Halton District School Board

Request for Tender
RFT 22-132

Renovations at Gladys Speers Public School

Closing Date: May 19, 2022

Closing Time: 2:00 p.m.

Sealed RFTs will be received **via email to chatelaina@hdsb.ca**
on or before 2:00 p.m., Eastern Daylight Time

Late or Facsimile Bids will not be considered

May 3, 2022

Amanda Chatelain, CPPB
Senior Officer – Purchasing

Communications Notice

To obtain documents online please visit: https://hdsb.bidsandtenders.ca

If you subscribe to bids & tenders you can login to your account to download the document(s) without the preview watermark. You may also opt to purchase a one-time download for this opportunity. Documents are not provided in any other manner.

All proponents shall be registered as a Plan Taker for this opportunity, which will enable the proponent to download the Request for Proposal (RFP) without the watermark preview, to receive addenda email notifications, and to download addenda.

Should the HDSB receive a proposal that is subsequently found to be from a bidder that is not registered with bids & tenders and the bidder did not obtain the proposal document from https://hdsb.bidsandtenders.ca the HDSB reserves the right to remove the proposal from further consideration.

To ensure receipt of the latest information and updates via email regarding this opportunity, the onus is on the proponent to register as a Plan Taker for this opportunity at https://hdsb.bidsandtenders.ca.

The following documents form part of all HDSB competitive proposal documents:

HDSB Procurement Administrative Procedure:

https://www.hdsb.ca/our-board/Policy/Procurement.pdf

HDSB Asbestos Management in Facilities Administrative Procedure:

https://www.hdsb.ca/our-board/Policy/AsbestosManagementInFacilities.pdf

HDSB Vendor Performance Management Administrative Procedure:

https://www.hdsb.ca/our-board/Policy/VendorPerformanceManagement.pdf

Broader Public Sector Procurement Directive

https://www.doingbusiness.mgs.gov.on.ca/mbs/psb/psb.nsf/Attachments/001-BPS_Procurement_Directive/$FILE/BPS_Procurement_Directive.pdf

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Part A – Outline and Instructions

1. Introduction and Board Profile

The Halton District School Board is composed of approximately 104 school locations (86 elementary and 18 secondary schools). These locations service approximately 65,000 regular day school students (Junior Kindergarten to Grade 12). The Board employs approximately 10,860 employees. Please visit our website **http://www.hdsb.ca** for additional information.

2. General Terms of the RFT

The Halton District School Board, hereinafter referred to as HDSB, is seeking qualified Contractors to complete renovations at Gladys Speers Public School located at 2150 Samway Rd, Oakville, ON L6L 2P6, as outlined herein. Specific details of the RFT are to be found in the attached scope of work, specifications and drawings.

3. Bid Security and Bonding Requirements

Any bid submission equal to or greater than $500,000, must be submitted with a Bid Bond in the value of ten percent (10%) of the Total Cost and a Surety Consent in favour of the Halton District School Board. The Surety Consent shall cover a Performance Bond and a Labour & Materials Payment bond, each in the amount of fifty percent (50%) of the contract price as a guarantee that the Bidder shall execute the contract upon award.

The Bid Security so submitted shall be irrevocable and valid for 90 from closing date set for the submission of tender.

In order to be considered for award of a contract equal to or over $500,000, the Bidder shall submit as part of their Submission, a Surety Consent, completed by a Bonding Company. Any others will not be accepted.

Upon receipt of written notice from the Halton District School Board that it has been awarded the Contract, the successful Bidder shall provide, within five (5) working days of such notice, an original Performance Bond and a Labour and Material Payment Bond, each for the amount of fifty per cent (50%) of the total lump sum price, to guarantee the performance of all obligations of the Contract.

4. RFT Closing Information

Bidders must submit their Submission **via email** on or before 2:00 p.m., Eastern Daylight Time on **May 19, 2022** (the “Closing Time”) to the following address:

chatelaina@hdsb.ca
Attention: Amanda Chatelain

Submissions will be deemed to be officially received by the time stamp issued by the HDSB’s email server. Submissions received after the official closing time will be declared non-compliant and shall not be considered during the selection process. Electronic

submission shall be no larger than 25MB. Proponents are responsible for confirming that their submission has been successfully received.

5. Accuracy of Information/Liability for Errors or Omissions

While the HDSB has used considerable efforts to ensure an accurate representation of information in this document, the information contained in it is supplied solely as a guideline for Bidders. Any data contained in this RFT or provided by way of Addenda are estimates only and are for the sole purpose of indicating to the Bidder the general size of what is being requested hereunder. The information is not guaranteed or warranted to be accurate by the HDSB, nor is it necessarily comprehensive or exhaustive. Nothing in this document is intended to relieve Bidders from forming their own opinions and conclusions with respect to the matters addressed in this RFT. It is the Bidder's responsibility to avail itself of all the necessary information to prepare a Submission in response to this RFT.

6. Communication After RFT Issuance

All Communications regarding any aspect of this RFT must be submitted via Bids and Tenders.

Bidders that fail to comply with the requirement to direct all communications to the RFT Authority via Bids and Tenders may be disqualified from this RFT process. Without limiting the generality of this provision, Bidders shall not communicate with or attempt to communicate with the following as it relates to this RFT:

- any employee or agent of the HDSB, other than the RFT Purchasing contact;
- any member of the HDSB governing body including, without limitation, the director, officers, trustees, superintendents, and any advisors thereto;

Bidders shall promptly examine this RFT and all Appendices, including the Form of Tender, and:

- shall report any errors, omissions or ambiguities; and
- may direct questions or seek additional information on or before the Deadline for Questions to the RFT Purchasing contact.

It is the responsibility of the Bidder to seek clarification, by submitting questions to the RFT Authority via Bids and Tenders, on any matter it considers to be unclear. The HDSB shall not be responsible for any misunderstanding on the part of the Bidder concerning this RFT or its process.

In the event a Bidder has any reason to believe that an error, omission or ambiguity exists, the Bidder must notify the RFT Authority via Bids and Tenders prior to submitting a Proposal.

If appropriate, the RFT Authority will then clarify the matter for the benefit of all Bidders by publication on the same public platform, its website or by notice to Bidders who have requested a copy of this RFT in the same manner as set out in section 6 below.

In answering a Bidder's questions, the HDSB will set out the question, without identifying the Bidder that submitted the question, and the HDSB may in its sole discretion:

- edit the question for clarity;
- answer similar questions from various Bidders only once.

Where an answer results in any change to the RFT, such answer will be formally evidenced through the issue of a separate addendum for this purpose.

7. Addenda

If the HDSB for any reason, determines that it is necessary to provide additional information relating to this RFT, such information will be communicated to all Bidders by addendum in the same manner the RFT was communicated. Each Addendum shall form an integral part of this RFT. This RFT may only be amended in accordance with this section.

All questions related to this Tender must be submitted in writing via bids and tenders prior to 2 p.m. on May 10, 2022. Any addendum will be posted no later than May 12, 2022.

Any amendment or supplement to this RFT made in any other manner will not be binding on the HDSB. All Addenda shall become an integral part of this RFT and shall be incorporated into any content. Each Bidder shall be responsible for verifying before depositing its Proposal that it has received all Addenda that have been issued.

8. Planned Schedule of Events – Project Schedule

Event	**Date**
Release of RFT	May 2, 2022
Non-Mandatory Site Meeting	May 5, 2022
Question Deadline	May 10, 2022
Issuance of Final Addendum	May 12, 2022
RFT Closing	May 19, 2022
Project Timelines	June 29, 2022 – December 30, 2022

9. Bidder's Costs

Bidders shall bear all costs and expenses incurred relating to any aspect of its participation in this RFT process, including all costs and expenses relating to the Bidder's participation in:

- the preparation, presentation and receipt of its Submission;
- the Bidders attendance at any meeting in relation to the RFT process, including any presentation or interview;
- the conduct of any due diligence on its part, including any information-gathering activity;
- the preparation of the Bidder's own questions prior to the Deadline for Questions; and
- any discussion and/or finalization, if any, in respect of the Form of Agreement.

10. Bidding Format

Unless otherwise specified in these RFT documents or the final contract entered into between the HDSB and the successful Bidder, responses shall be for a stipulated sum without escalator clauses or other qualifications (when applicable). Bidders submitting a bid with escalator clauses or other qualifications that are not in accordance with the terms and conditions of this RFT may have their bid rejected.

All information entered on this RFT document must be type written or entered in ink. No pencil entries will be accepted.

Erasure(s), overwriting or strike-out(s) must be initialed in ink by the person signing this Submission.

Respondents will use the following format for their submission:

- Form of Tender (complete form must be included with your submission, including bonds and any other information as may be required herein)
- Appendix A - Signed Declaration Sheet (must be included with your submission)
- Bid Security and Bonding Requirements as required

11. Pricing

Please do not add tax to base (unit) price. (when applicable). Early payment discounts may be considered part of the Submission. Credit Card payment acceptance may be considered part of the Submission.

12. Subcontractors

The General Contractor must select a subcontractor from the HDSB pre-qualified list of sub-contractors attached in Appendix B.

The Contractor agrees to preserve and protect the rights of the parties under the contract with respect to work performed under subcontract, and shall:

- enter into contracts or written agreements with their subcontractors to require them to perform their work in accordance with and subject to the terms and conditions of the contract. Further, the Contractor shall be fully responsible to the Owner for acts and omissions of their subcontractors and of any persons directly or indirectly employed by them as for acts and omissions of persons directly employed by them.

- therefore, agree that they will incorporate the terms and conditions of the Contract Documents into all Subcontractor Agreements they enter into with their subcontractors.

The HDSB reserves the right, at its discretion to waive the requirement to utilized the mandatory list of pre-qualified sub-trades at any time during the tendering process based on market conditions.

13. Non-Mandatory Site Meeting

There will be a Non-Mandatory Site Meeting on May 5, 2022 at the main office of Gladys Speers Public School located at 2150 Samway Rd, Oakville, ON L6L 2P6. The Non-Mandatory Site Meeting will start at 10:00 a.m. Bidders shall follow Public Health and HDSB Covid-19 protocols while on site.

Part B – Standard Terms and Conditions

14. Scope

Unless otherwise expressly stated these Standard Terms and Conditions form a part of this document and apply in like force to contracts for the purchase of commodities as stated in this document. All Bidders will be bound by the terms and conditions set forth, except as specifically qualified in Special Terms and Conditions issued in connection with this document or any Addenda issued relating to this document.

15. Definitions

As used herein as well as in all RFSQ, RFQ, RFP, RFI, Tender or contract documents issued by the Halton District School Board, the following definitions will apply.

Addenda/Addendum	an addition/change made to this document, subsequent to its printing or publication.
Applicable Law and Applicable Laws	means any common law requirement and all applicable and enforceable statutes, regulations, directives, policies, administrative interpretations, orders, by-laws, rules, guidelines, approvals and other legal requirements of any government and/or regulatory authority in effect from time to time.
Bid/Submission/Proposal	an offer from a Bidder in response to a Proposal/Tender which is subject to acceptance or rejection.
Proponent	a legal entity, being a company, partnership or individual who submits a Bid, Proposal, or Submission in response to a formal request for Bid, Proposal, or Submission.
Board/HDSB	means the Halton District School Board.
Contract	means the agreement, in writing, governing the performance of the Work and/or the purchase and sale of commodities and includes, without limitation, the document (including standard terms and conditions), Bidder Submission and the written document accepting the Bidder Submission (including any notice of acceptance or award).
Document	means the document describing the Goods and/or Services to be purchased and the terms upon which the Goods and/or Services are to be purchased and

	includes, without limitation, those documents referenced on the index of the document and such Addenda as may be issued by the HDSB.
Goods *or* **Services**	product and/or any and all labour, vehicles or equipment used by a Bidder in fulfilling a Contract.
HST	means Harmonized Sales Tax.
Intellectual Property	means any trademark, copyright, moral right, patent, industrial design, trade name, domain name, trade secret, know how, integrated circuit topography or other intellectual property, industrial property or proprietary right owned by, licensed to, or used by any third person.
Mandatory Requirement	a minimum requirement – where the words “mandatory”, “must”, “required”, “shall” and/or “will” are referenced in this document and such requirement is identified as a Mandatory Requirement. Failure to comply will deem the submission non-compliant and the bid/submission will be disqualified.
Proposal/RFP	a sealed written offer to supply Goods and/or Services of any value, acceptance of which may be subject to negotiation.
Quotation/RFQ	a written offer to supply Goods and/or Services with a value that is less than $100,000.
Response	the package submitted by a Bidder in response to an RFP or RFT.
Specifications	those stated requirements for the Goods and/or Services set out in the document.
Subcontractor	a person, firm or corporation having a direct contract with the contractor to perform a part or parts of the Work, or to supply Goods worked to a special design according to the contract documents, but does not include one who merely supplies Goods not so worked.
Tender/RFT	a sealed written offer to supply Goods and/or Services with a value that is greater than $100,000.
Bidder Submission	means the document as completed by the Bidder for the purpose of offering to sell to the HDSB the services

	and/or goods specified in the document, and includes but is not limited to Quotations, Tenders and Proposals.
Work	means the Work to be undertaken by the Bidder pursuant to the provisions of the Contract.

16. Reserved Rights of the HDSB

The HDSB reserves the right to:

(a) make public the names of any or all Bidders;

(b) request written clarification or the submission of supplementary written information in relation to the clarification request from any Bidder and incorporate a Bidder's response to that request for clarification into the Bidder's Submission;

(c) assess a Bidder's Submission on the basis of:

(i) a financial analysis determining the actual cost of the Submission when considering factors including quality, service, price and transition costs arising from the replacement of existing goods, services, practices, methodologies and infrastructure (howsoever originally established);

(ii) information provided by references;

(iii) the Bidder's past performance on previous contracts awarded by the HDSB;

(iv) the information provided by a Bidder pursuant to the HDSB exercising its clarification rights under this RFT process; or

(v) other relevant information that arises during this RFT process;

(d) waive formalities and accept Submissions that substantially comply with the requirements of this RFT;

(e) verify with any Bidder or with a third party any information set out in a Submission;

(f) check references other than those provided by any Bidder;

(g) disqualify any Bidder whose Submission contains misrepresentations or any other inaccurate or misleading information;

(h) disqualify any Bidder or the Submission of any Bidder who has engaged in conduct prohibited by this RFT;

(i) disqualify a Bidder for any conduct, situation or circumstance that constitutes a Conflict of Interest, as solely determined by the HDSB and at any time.

(j) make changes, including substantial changes, to this RFT, provided that those changes are issued by way of addenda in the manner set out in this RFT;

(k) select any Bidder other than the Bidder whose bid reflects the lowest cost to the HDSB;

(l) review all Bidders utilizing the HDSB Vendor Performance Management Administrative Procedure, which can include suspension of Bidders who fail the meet the HDSB's expectations or who are involved in litigation or threatened litigation against HDSB. The HDSB Vendor Performance Management Administrative Procedure is found at the attached link

(www.hdsb.ca/our-board/Policy/VendorPerformanceManagement.pdf)

(m) award to one or more bidders according to their requirements;

(n) cancel this RFT process at any time and for any or no reason;

(o) cancel this RFT process at any stage and issue a new RFT for the same or similar deliverables;

(p) accept any Submission in whole or in part; or

(q) award to multiple bidders if circumstances are warranted;

(r) reject any or all Submissions;

(s) to limit the number of pre-qualified Bidders eligible to submit proposals for any future projects. HDSB shall not be obligated to provide all pre-qualified Bidders with the same opportunity to bid on all future projects within each stated category. By participating in this RFT, Bidders acknowledge that there is no guarantee that a Bidder will receive any assignments, work or projects and that there is no expectation that any specified number of projects will be made available during the pre-qualification term;

and these reserved rights are in addition to any other express rights or any other rights that may be implied in the circumstances.

In addition, the HDSB reserves the right at any time during normal business hours, and as often as the HDSB may deem necessary, to examine, the successful Bidder's records with respect to the successful Bidder's services under the Bidder's purchase order and/or Submission and any Contract. The successful Bidder shall permit the HDSB to audit, examine, and make copies, excerpts or transcripts from such records, and to make audits

of data relating to matters covered by a Submission, any purchase order and/or any Contract. The successful Bidder shall maintain and retain all records and other documents related to a Submission, any purchase order, and/or any Contract for a period of seven (7) years from the date of final payment, except in cases where unresolved audit questions require a longer period of time for resolution, as determined by the HDSB.

17. Litigation with the HDSB

The HDSB may, in its absolute discretion, reject a Submission submitted by a Bidder **prior to or after a Submission opening, if the Bidder:**

(a) is or has in the past 10 years been a party to litigation with the HDSB; or

(b) directly or indirectly, including by common ownership or control or otherwise, is related to a party currently in litigation with the HDSB or a party that has in the past 10 years been in litigation with the HDSB; or

(c) intends to use a subcontractor in respect of a specific project who is, or has in the past 10 years been a party to litigation with the HDSB, or who is related to a party currently in litigation with the HDSB or a party that has in the past 10 years been in litigation with the HDSB.

For the purposes hereof, the phrase “litigation with the HDSB” includes cases in which the Bidder or prospective Bidder or any of the parties named above, has advised the HDSB in writing of their intention to commence litigation, or have commenced or have advised the HDSB of their intention to commence an arbitral proceeding against the HDSB (excepting only construction lien demands, notices or proceedings or arbitrations under O. Reg 444/98 of the Education Act).

In determining whether or not to exercise its discretion as set out herein, the HDSB will consider whether the litigation (past or current) is likely to affect a Bidder’s ability to work with the HDSB, its consultants and representatives, and whether the HDSB’s experience with the Bidder, the related party or subcontractor, as the case may be, in the matter giving rise to the litigation, indicates that the HDSB is likely to incur increased staff and legal costs in the administration of the Contract if it is awarded to the Bidder.

18. Accessibility for Ontarians with Disabilities (AODA)

The HDSB is committed to accessibility and preventing and removing barriers for persons with disabilities. Where practicable, the HDSB will incorporate accessibility features and criteria when procuring or acquiring goods, services and facilities, in which case, a Bidder must be capable of recommending and delivering same in an inclusive and accessible manner, consistent with the Ontario Human Rights Code (“OHRC”), the Ontarians with Disabilities Act, 2005 (“AODA”) and its Regulations, in order to achieve accessibility for Ontarians with disabilities. If the HDSB determines that it is impractical to do so an explanation will be provided upon request.

In accordance with Ontario Regulation 429-07 made under the AODA, the HDSB has established policies, practices and procedures governing the provisions of its services to persons with disabilities, which may be found at:

https://www.hdsb.ca/our-board/Pages/Accessibility.aspx

19. Ability to Negotiate/Contract Negotiations

The HDSB reserves the right to enter into negotiations with any Bidder as it sees fit, or with another Bidder concurrently. The HDSB will not incur liability to any Bidder as a result of these negotiations.

The HDSB may, prior to and after Contract award, negotiate changes to the specifications, the type of materials or any conditions with the successful or preferred Bidder or one or more of the Bidders without having any duty or obligation to advise any other Bidder or to allow them to vary their bid prices as a result of such changes, and the HDSB shall have no liability to any other Bidder as a result of such negotiations or modifications.

20. Agree to Abide by the Established Process

It is vital to the HDSB that the process leading to the recommendation of a bidder(s) and the conclusion of an agreement for the provision of these services be, and be seen to be, open and fair and that each of the respondents is treated equally.

No respondent can be seen to be deriving, intentionally or otherwise, an advantage or information, which is not equally available to all other respondents. Nor is it acceptable that any advantage or information be sought or obtained from any unauthorized staff or representative of the HDSB, or any benefit derived from any special or personal relationships or contacts.

All communications, including requests for information, between respondents to this RFT and the HDSB should be between only the representative(s) of the HDSB who has been authorized and designated for that particular purpose. Bidders must not rely on information from any other source.

21. Assignment

Unless otherwise stated in this document, it is mutually agreed and understood that the successful Bidder will not assign, transfer, convey, sublet or otherwise dispose of the Contract (in whole or in part) or the right, title or interest therein, or the Bidder's power to execute such contract to any other person, firm, company or corporation without the previous written consent of the HDSB. Any act in derogation of the foregoing shall be null and void. For the purposes hereof, the transfer or issuance of shares by a Bidder of more than fifty (50%) percent of the voting securities of a Bidder to any third party other than to an affiliate (as such term is defined in the Business Corporations Act (Ontario)) or the

shareholder or shareholders of the Bidder as of the Closing Date, whether or not such transfer or issuance of voting securities takes place in one or more transactions, shall, for the purposes of this Agreement, be deemed to be an assignment of the Contract requiring the consent of the HDSB, unless such transfer or issuance of shares is made pursuant to an initial public offering of common shares under the Securities Act (Ontario).

22. Award

The final award will be based on (but not limited to) the best value for money and quality service delivery from a Bidder who complies with the provisions of this Submission solicitation, including specifications, contractual terms and conditions, who can reasonably be expected to provide satisfactory performance on the proposed Contract based on reputation, references, performance on previous contracts, and sufficiency of financial and other resources, and provides a solution that is a fit with the HDSB's requirements. The lowest price or bid shall not be the sole, determinative factor.

23. Breaking a Tie

In the event of a tie score, the HDSB will resolve same based on the earlier date/time stamp of when the bid was received by HDSB in accordance with this RFT.

24. Change Orders

A change order results when unforeseen conditions are identified from the original scope of work (Contract or Purchase Order) and is inextricably tied to the original scope.

The following steps should occur prior to issuance of a change order that does not originate from HDSB senior management:

- appropriate HDSB approval must be acquired prior to modifying any Contract or Purchase Order

- appropriate written HDSB approval must be obtained prior to commencing the work.

All requests or recommendations for Change Orders shall include the impact to both price and schedule for the work to be performed. HDSB shall have the right to retain consultants or experts to help identify the need or to verify the impact of the change order on the project.

No change in the work shall proceed without the written approval of the Owner. Any change shall be initiated by Owners "WORK ORDERS" which shall bear the change cost and the Contractor's and Owner's representative's signatures as an instruction to proceed. All changes shall be restricted to five percent (5%) overhead and five percent (5%) profit applied to the labour and material cost.

25. Conflict of Interest

For the purposes hereof, “Conflict of Interest” includes:

(a) in relation to the Submission process, the Bidder has an unfair advantage or engaged in conduct, directly or indirectly, that may give the Bidder an unfair advantage, including:

(i) having or having access to information in the preparation of the Submission that is confidential to the HDSB and not available to other Bidders;

(ii) communicating with any person with a view to influencing preferred treatment in the Submission process; or

(iii) engaging in conduct that compromises or could be seen to compromise the integrity of the open and competitive process and render that process non-competitive and unfair; or

(b) in relation to the performance of the Work, services or contractual obligations, the Bidder’s other commitments, relationships or financial interests:

(i) could or could be perceived to exercise an improper influence over the objective, unbiased and impartial exercise of the Bidder’s independent judgments; or

(ii) could or could be perceived to compromise or impair or be incompatible with the effective performance of the Bidder’s work, services or contractual obligations.

The Bidder shall:

(a) avoid any Conflict of Interest in the Submission process and in the performance of its contractual obligations;

(b) disclose to the HDSB without delay any actual or potential Conflict of Interest that arises during the Submission process or during the performance of its contractual obligations; and

(c) comply with any requirements prescribed by the HDSB to resolve any Conflict of Interest.

In addition to all other contractual rights or rights available at law or in equity, the HDSB may immediately disqualify a Submission or terminate the Contract upon giving notice to the Bidder where:

i. the Bidder fails to disclose an actual or potential Conflict of Interest;

ii. the Bidder fails to comply with any requirements prescribed by the HDSB to resolve a Conflict of Interest; or

iii. the Bidder's Conflict of Interest cannot be resolved.

This paragraph shall survive any termination or expiry of the Contract.

26. HDSB Confidential Information

For the purposes hereof, "HDSB Confidential Information" means all information of the HDSB that is of a confidential nature, including all confidential information in the custody or control of the HDSB, regardless of whether it is identified as confidential or not, and whether recorded or not, and however fixed, stored, expressed or embodied, which comes into the knowledge, possession or control of the Bidder in connection with the Contract. For greater certainty, HDSB Confidential Information shall:

(a) include:

(i) all new information derived at any time from any such information whether created by the HDSB, the Bidder or any third party;

(ii) all information (including Personal Information) that the HDSB is obliged or has the discretion not to disclose under provincial or federal legislation or otherwise at law; but

(b) not include information that:

(i) is or becomes generally available to the public without fault or breach on the part of the Bidder of any duty of confidentiality owed by the Bidder to the HDSB or to any third party;

(ii) the Bidder can demonstrate to have been rightfully obtained by Bidder without any obligation of confidence, from a third party who had the right to transfer or disclose it to the Bidder free of any obligation of confidence;

(iii) the Bidder can demonstrate to have been rightfully known to or in the possession of the Bidder at the time of disclosure, free of any obligation of confidence when disclosed; or

(iv) is independently developed by the Bidder;

but the exclusions in this subparagraph shall in no way limit the meaning of Personal Information or the obligations attaching thereto under the Contract or at law.

During and following the term of the Contract, the Bidder shall:

(a) keep all HDSB Confidential Information confidential and secure;

(b) limit the disclosure of HDSB Confidential Information to only those of its directors, officer, employees, agents, partners, affiliates, volunteers or subcontractors who have a need to know it for the purpose of carrying out its obligations under the Contract and who have been specifically authorized to have such disclosure;

(c) not directly or indirectly disclose, destroy, exploit or use any HDSB Confidential Information (except for the purpose of carrying out its obligations under the Contract or except if required by order of a court or tribunal), without first obtaining:

    (i) the written consent of the HDSB; and

    (ii) in respect of any HDSB Confidential Information about any third party, the written consent of such third party;

(d) provide HDSB Confidential Information to the HDSB on demand; and

(e) return all HDSB Confidential Information to the HDSB before the end of the Term, with no copy or portion kept by the Bidder.

27. Criminal Background Checks

The Bidder acknowledges that the HDSB must be in compliance with Regulation 521/01 of the Education Act (Ontario) - Collection of Personal Information with respect to criminal background checks and offence declarations. The Bidder covenants and agrees to assist the HDSB in complying with same by providing the HDSB, or such other entity as the HDSB may designate, with a criminal background check covering offences under the Criminal Code, the Narcotics Control Act, and any other offences which would be revealed by a search of the automated Criminal Records Retrieval System maintained by the RCMP or, in instances where the Bidder will have access to or is responsible for minors or vulnerable persons, a Vulnerable Persons Clearance certificate in addition to the above ("Criminal Background Check"), together with an Offence Declaration in HDSB approved form, for every individual or employee of the Bidder who may come into direct contact with students on a regular basis at a school site of the HDSB, or who may have access to student information.

For the purposes of this document, the HDSB shall determine in its sole and unfettered discretion whether an individual or employee of the Bidder may come into direct contact with students on a regular basis or may have access to student information. The Bidder agrees to indemnify and save harmless the HDSB from all claims, liabilities, expenses, and penalties to which it may be subjected on account of the Bidder's failure to provide a Criminal Background Check and an Offence Declaration, as aforesaid. This indemnity shall survive the expiration or sooner termination of the Contract. In addition, and

notwithstanding anything else herein contained, if the Bidder fails to provide a Criminal Background Check and an Offence Declaration for an individual or employee of the Bidder who may come into direct contact with students on a regular basis at a school site of the HDSB or who may have access to student information, then the HDSB shall have the right to forthwith terminate the Contract without prejudice to any other rights which it may have in the Contract, in law or in equity.

28. Debrief

The HDSB, at the written request of a Bidder will conduct a debriefing. Bidders must submit their request within sixty (60) days of Contract award notification. The HDSB will only identify any weaknesses or strengths in the Bidder's submission. No information regarding other Bidders' submissions will be disclosed. The intent of the debriefing information session is to assist a Bidder in presenting a better Submission in subsequent procurement opportunities. Any debriefing provided is not for the purpose of providing any opportunity to challenge the procurement process.

29. Dispute Resolution

In the event that a Bidder wishes to review the decision of the HDSB in respect of any material aspect of the RFT process, and subject to having attended a debriefing, the Bidder shall submit a protest in writing to the RFT Authority within ten (10) days from such a debriefing.

Any request that is not received in a timely manner will not be considered, and the Bidder will be notified in writing.

A protest in writing shall include the following:

(a) a specific identification of the provision and/or procurement procedure that is alleged to have been breached;

(b) a specific description of each act alleged to have breached the procurement process;

(c) a precise statement of the relevant facts;

(d) an identification of the issues to be resolved; and

(e) the Bidder's requested remedy.

For the purpose of a protest, the HDSB will review and address any protest in a timely and appropriate manner. HDSB's decision in this regard is final.

30. Environmental Statement

The HDSB, when practically and financially feasible, will consider the acquisition of goods and services that will reduce the environmental footprint of the Board.

31. Force Majeure

Delays in or failure of performance by either party under the Contract shall not constitute default thereunder or give rise to any claim for damages if caused by occurrences beyond the control of the party affected, including but not limited to, decrees of Governments, acts of God, fires, floods, riots, wars, rebellion, sabotage, and atomic or nuclear incidents. Lack of finances, strikes, lockouts or other concerted acts by workers shall not be deemed to be a cause beyond a party's control.

In the event that performance of the Contract in the reasonable opinion of either party is made impossible by an occurrence beyond the control of the party affected, then either party shall notify the other in writing. The HDSB shall either terminate the Contract forthwith and without any further payments being made, or authorize the Bidder to continue the performance of the Contract with such adjustments as may be required by the occurrence in question and agreed upon by both parties. In the event that the parties cannot agree upon the aforementioned adjustment, it is agreed by the parties that the Contract shall be terminated.

32. Guarantees and Warranties

All Work shall be done in a good and workmanship like manner. All materials, goods and services must meet the applicable specifications, either by the HDSB, its consultant on the project or the manufacturer. The Bidder warrants and guarantees that all materials, Goods; Services and workmanship will be free from defects and fit for the purpose intended by the HDSB. All Goods delivered by the Bidder must be new, in good working order and of the latest model possessing all accessories standard to the manufacturer's stock model. The Goods and/or Services must be covered by written guarantees and warranties acceptable to the HDSB.

33. Health & Safety / WHMIS

Bidders and/or contractors must comply with the Occupational Health and Safety Act and its regulations. All Bidder's contractors and sub-contractors and their respective employees will have received health and safety training appropriate to their trade, and will be able to provide proof thereof to the HDSB upon request. Contractors shall be held responsible for any sub-contractors where such are permissible by the HDSB. The HDSB may request and suppliers/contractors/sub-contractors will provide evidence of such training at any time.

Suppliers/contractors/sub-contractors shall comply with the HDSB policies, programs and procedures at all times while on site. All suppliers/contractors/sub-contractors are

required to sign in upon arrival/exit at a HDSB location prior to beginning and at completion of Work.

Suppliers and/or contractors/sub-contractors shall be held responsible for all fines and/or contraventions of legislation which have been incurred by the HDSB.

As per Ontario regulation 278/05 section 10 (5) the HDSB will provide contractors/sub-contractors performing work in HDSB buildings access to the site-specific asbestos inventory. Site specific asbestos inventories are available at each HDSB site. Contractors/sub-contractors shall review the site-specific asbestos inventory in relation to the scope of work they are undertaking, prior to the commencement of work. The requirements of the HDSB's Asbestos Management Administrative Procedure are to be adhered to at all times. A copy of the HDSB's Asbestos Management Administrative Procedure can be found at:

http://www.hdsb.ca/our-board/Policy/AsbestosManagementInFacilities.pdf.

All Work is subject to prior approval by the appropriate HDSB department.

Contractors shall examine carefully the HDSB's Asbestos Register for the Work site, in addition to examining existing conditions for suspected Asbestos Containing Materials (ACM), on which completion of Work is dependent.

Upon discovery of unforeseen suspected ACM affecting completion of the Work, the Contractor shall cease any operations that may disturb said materials and notify the Owner immediately.

The Contractor shall arrange for removal of ACM affecting completion of Work through a HDSB-approved ACM abatement contractor, and arrange for coordination of testing through HDSB Facility Services, if required.

Contractors shall be responsible for any sub-contractors in their employ with respect to the aforementioned requirements.

34. Indemnification and Liability

The Bidder hereby agrees to indemnify and hold harmless the HDSB, its directors, officers, trustees, employees and agents from and against all liability, loss, costs, damages and expenses (including legal, expert and consultant fees), causes of actions, actions, claims, demands, lawsuits or other proceedings, by whomever made, sustained, incurred, brought or prosecuted if:

(a) resulting from the Bidder's failure to observe and conform to the standards established by law or by any other association which has established standards recognized by the Province of Ontario;

(b) relating to labour and equipment furnished for the Work; and

(c) involving inventions, copyrights, trademarks or patents, and rights thereto, used in doing the Work and in the subsequent use and operation of the Work or any part thereof upon completion.

35. Insurance and Liability

The successful bidder must indemnify the HDSB from any and all manner of damage or injury, risk, claims, demands, actions, penalties, causes of action, damages and any and all costs arising out of, or incurred by reason of provision of goods and/or services by the bidder. The cost of such insurance will be the responsibility of the Bidder.

The successful bidder(s) will obtain and provide current proof of insurance upon the award, that the successful Bidder will be covered by:

at least Two Million Canadian Dollars (C$2,000,000.00) of comprehensive commercial general liability insurance for bodily injury, property damage, operations liability, contractual liability and tenant's legal liability, including umbrella liability insurance covering liability arising from premises, operations, independent contractors, products-completed operations, personal injury and liability assumed under the Contract;

at least One Million Canadian Dollars (C$1,000,000.00) of business automobile liability insurance and, if necessary, umbrella liability insurance for owned, hired and non-owned vehicles covering bodily injury and property damage: and with an insurer licensed to carry on business in the Province of Ontario.

In the case of multi-year contracts, a copy of a valid certificate must be provided to the Halton District School HDSB annually thereafter, at least thirty (30) days prior to the anniversary date of the contract commencement date. At commencement of the Contract and throughout the Contract duration, certification shall be submitted on a Certificate of Insurance form with the above-mentioned coverage, thereby protecting the Halton District School Board against claims for property damage and bodily injuries, including accidental death, caused by the successful Bidder(s) or its employees and/or Sub-contractors during the performance of its obligations under the Contract.

The Halton District School Board must be named as additional insured, and the policy must contain a cross liability clause, and thirty (30) day prior notice clause of any cancellation, non-renewal or product change in coverage, terms or conditions.

As a condition precedent to contract award, Certificates of all such insurance policies shall be filed with the HDSB by the successful Bidder and shall be subject to the HDSB's approval as to the adequacy of protection.

All the above-mentioned insurance shall be maintained until the HDSB certifies that the work is complete.

36. Invoicing/Payment/EFT

To ensure that payment is not deferred, the following information shall be on all invoices:

- Bidder's Name or Business Number, Address, Telephone Number and HST registration number
- Invoice Date
- Invoice Number
- Purchase Order Number, Name of Requester, Shipment Destination
- Name of Halton District School Board staff that issued this order
- Complete Good/Service Description (including hourly rates, service/delivery dates, service location)
- Attach Copy of Service Report/Work Order Completed
- Terms of payment
- Total of HST where applicable
- Total Amount Payable

The HDSB's method of payment is by Electronic Funds Transfer (EFT). If the Bidder is a new vendor or current vendor who has not previously utilized the EFT payment service or has banking information which has changed, then an "Application of Vendor Direct Deposit" form is required to be completed, which is available through the Purchasing contact for this document. This form along with a voided cheque or letter from the Bidder's bank should be sent to:

Halton District School Board
Attention: Accounts Payable Department
J.W. Singleton Centre,
PO Box 5005 Stn LCD 1,
Burlington ON L7R 3Z2 or

electronically to: apeft@hdsb.ca before any invoices are submitted to the HDSB for payment. Payment terms are Net 28. Early payment discounts may be considered.

37. Irrevocability

The Submission will be open for acceptance by the HDSB and irrevocable by the Bidder for a period of ninety (90) calendar days from the Closing Date.

38. Municipal Freedom of Information and Protection of Privacy Act ("MFIPPA")

(a) The Bidder acknowledges and agrees that the HDSB is subject to MFIPPA. The Bidder further expressly acknowledges and agrees that, upon the acceptance of a successful Submission and conclusion of this process (including execution and delivery of the Contract between the HDSB and the successful Bidder), subject to subsection (b) below, the Submission shall not be considered confidential for the

purposes of Section 10 of MFIPPA and, in the event of an access request or at the discretion of HDSB, shall be subject to release in its entirety without redaction.

(b) Notwithstanding paragraph (a) above, the Bidder and the HDSB acknowledge and agree that the information listed below is considered to be supplied by the Bidder to the HDSB in confidence:

1. For Services: Hourly rates/fees and information from which such rates/fees could be reasonably deduced.

2. For Goods: Unit costs and information from which such unit costs could be reasonably deduced.

(c) Notwithstanding the foregoing, the Bidder acknowledges and agrees that, because the HDSB is subject to MFIPPA, all or part of any Submission, including information supplied in confidence, may be subject to release in response to an access request submitted pursuant to MFIPPA. In the event that the HDSB receives a request for access to all or part of a Submission supplied in confidence, the HDSB shall deliver the relevant notice to the Bidder, who shall bare all costs, legal or otherwise, with respect to any objection the Bidder may have in respect of the release of any or all parts of the Submission pursuant to MFIPPA.

39. No Guarantee of Work or Exclusivity of Contract

The HDSB makes no guarantee of the value or quality of goods or services or volume of work to be assigned to the successful Bidder. Any Contract executed with a successful Bidder may not be an exclusive Contract for the provision of the requested Goods or Services. Quantity where specified more or less, are estimates of previous consumption and are furnished without liability to the HDSB.

40. Non-Performance/Termination of Contract

If the Bidder delivers substandard, unapproved or defective items, which are rejected by the HDSB, the Bidder agrees to replace these items at the Bidder's expense with items of a quality deemed acceptable to the HDSB within a 48-hour period of the mutual satisfactory agreement being reached. If the Bidder fails to replace the items within this 48-hour period, the parties agree that the HDSB may purchase substitutes for the rejected items in the open market at no additional cost or liability to the HDSB.

Where at any time the quality of the Goods or Service supplied by the successful Bidder is not of a satisfactory standard, the HDSB may issue a verbal warning outlining the deficiency in supply or other aspects of performance and requiring the successful Bidder to correct those deficiencies within such period of time as stated. If the deficiency is not corrected within the time specified, or having been corrected, there is a further instance of deficient performance, the HDSB may issue a written notice to the successful Bidder, identifying the deficiency in performance and setting a final date or time period for its

correction, and advising that if corrective steps are not taken by that date or within that time, the HDSB may terminate the Contract and take corrective action itself.

Until the HDSB is satisfied that the unsatisfactory performance has been corrected, the HDSB may hold back from any payment an amount sufficient to rectify the unsatisfactory performance until its requirements have been met.

The HDSB reserves the right, in its absolute discretion, to terminate a Contract immediately without penalty, costs or damages of any kind whatsoever, where the Bidder has violated any laws or performed any of the following acts while performing work with the HDSB and further reserves the right to take that failure into account with respect to the award of any future contract.

a) over-billing or duplicate billing;

b) splitting of invoices;

c) charging for items not supplied;

d) charging for items not approved prior to invoicing;

e) charging for items of one grade, while supplying items of an inferior grade;

f) Misrepresentation as to the quality or origin of goods, their functionality or suitability for a purpose, or their performance characteristics;

g) not responding to the HDSB or, failure to complete contract.

41. Ownership

The Submission, along with all correspondence, documentation and information provided to the HDSB by any Bidder in connection with or arising out of the Submission, once received by the HDSB, shall become the property of the HDSB and may be appended to any Contract and/or purchase order with the successful Bidder.

42. Permits, Licenses and Approvals

Bidders shall obtain all permits, licences and approvals required in connection with the supply of the Goods and/or Services. The costs of obtaining such permits, licences and approvals shall be the responsibility of, and shall be paid for by the Bidder.

Where a Bidder is required by any Applicable Law to hold or obtain any such licence, permit, or approval to carry on an activity contemplated in its Submission or in the Contract, neither the acceptance of the Submission nor the execution of the Contract by the HDSB shall be considered an approval by the HDSB for the Bidder to carry on such activity without the requite licence, permit, consent or authorization.

Without in any way limiting the generality of the foregoing, any electrical Goods being proposed for consideration pursuant to this RFT must be authorized or approved in accordance with the Electrical Safety Code or by a certification organization accredited with the Standards Council of Canada Act (Canada), and shall bear the certification organization's mark identifying the Goods certified for use in Canada. Certification shall be to the standard that is appropriate for the intended use of the electrical Goods at any of the HDSB's schools or facilities.

43. Co-operative Purchasing Provisions

This document is being issued by the HDSB to meet the HDSB's requirements. The successful Bidder acknowledges that the Provincial Government encourages cooperative procurement initiatives by School HDSBs. Bidders shall indicate on the Form of Quotation if they are willing to extend pricing and submission terms to other District School Boards in the province of Ontario where the scope of work is deemed similar or the same and where both parties are in agreement, in which case they shall be deemed to have granted consent to the HDSB to share the Submission with such HDSBs, subject to such HDSBs agreeing to receive the Submission in confidence on the understanding that the Submission contains financial, commercial, technical and other sensitive information of the Bidder. The Bidder will not be penalized if it does not agree to this provision. The HDSB will not incur any financial responsibility in connection with any purchase by another School Board. Each School Board shall accept sole responsibility for its own contract management such as placing orders and making payments to the successful Bidder.

44. Proof of WSIB Coverage

If the Bidder is subject to the Workplace Safety and Insurance Act ("WSIA") or the Workplace Safety and Insurance Amendment Act, 2008 ("WSIAA"), the Bidder shall submit a valid clearance certificate of Workplace Safety and Insurance Board ("WSIB") coverage to the HDSB before commencing the performance of any work or services. In addition, the Bidder shall, from time to time during the term of the Contract and at the request of the HDSB, provide additional WSIB clearance certificates. The Bidder covenants and agrees to pay when due, and to ensure that each of its subcontractors pays when due, all amounts required to be paid by it or its subcontractors, from time to time during the term of the Contract, under the WSIA and/or the WSIAA, failing which the HDSB shall have the right, in addition to and not in substitution for any other right it may have pursuant to the Contract or otherwise at law or in equity, to pay to the WSIB any amount due pursuant to the WSIA or the WSIAA unpaid by the Bidder or its subcontractors and to deduct such amount from any amount due and owing from time to time to the Bidder pursuant to the Contract together with all costs incurred by the HDSB in connection therewith.

45. Right to Withdraw

Submissions may be withdrawn prior to the Closing Time. Following Closing, no Submission may be withdrawn. Any Bidder who attempts to do so may have a negative Performance Evaluation placed on record with the HDSB in accordance with the Vendor Performance Management Administrative Procedure

(www.hdsb.ca/our-board/Policy/VendorPerformanceManagement.pdf)

46. Smoking on HDSB Property

Smoking of any substance and in any manner is prohibited in all HDSB buildings and on all HDSB property. This includes, without limitation, tobacco, cannabis in any form and vaping.

47. Vehicle Operation on HDSB Property

The successful Bidder shall use due care and caution when motorized vehicles are in operation on school property while students are expected to enter or exit the school building and/or are visible outside the school building on school property or adjacent property, particularly during recess, lunch period and preceding and following the end of the school day. Vehicles operated in parking lot and driveway areas shall not be driven at a speed in excess of 8-kilometers/per hour.

Further, on school property drivers must turn off vehicles and remove the keys during any stop. At no time are vehicles to be left running while unattended. It is recommended that the vehicle be locked when left unsupervised. The HDSB will not be responsible for any theft of, or any theft from, vehicles operated by the successful Bidder.

Asphalt play areas around the exterior of the school building are not constructed to handle heavy vehicles. Bidders will be held responsible for any damage to HDSB property including but not limited to asphalt or natural surfaces as a result of using them for access of heavy vehicles. Making good of natural surfaces or asphalt areas that are damaged in the course of the work shall be to the original (new) condition irrespective of their condition prior to commencement of the work, or the condition of the adjacent unaffected areas. Vehicles are only permitted to access, stand or be parked in areas designated by administrative staff of HDSB, which for the purposes of this provision does not include principals of schools.

48. Bidder Conduct

When on HDSB property, the Bidder and its employees must:

- have proper identification (name badge, uniform with logo, photo I.D. etc.).
- be dressed appropriately (the following are not appropriate: clothing that fails to contain the anatomy when the person is carrying out normal duties; clothing with

printed slogans, advertising or designs that are obscene or could have a double meaning).

- use appropriate language.
- refrain from wearing scented products or fragrances such as perfume, cologne, after shave, shampoos (as required).
- work with dignity, courtesy and respect for self and others.
- not make noise or move in corridors during morning announcements, and playing of the national anthem.
- observe procedures during fire evacuation and lockdowns, whether they are actual or test (drills).
- park in spots designated by the Principal.

The Bidder must observe all HDSB policies and procedures including but not limited to: Smoke-Free Environment; Sexual, Racial and Ethno Cultural Harassment, etc.

The Bidder will ensure that the education program is not interrupted and that the health and safety of the students and staff is not compromised.

No person who is impaired by alcohol or drugs will enter and/or remain on HDSB property.

The Bidder agrees that its employees and sub-contractors will observe and comply with all standards, procedures, policies, rules and regulations of the HDSB, including but not limited to privacy, use of facilities, equipment, building security and computer technology.

Halton District School Board

FORM OF TENDER

Project: Renovations – Gladys Speers Public School
Project Reference #: RFT 22-132

From (Bidder):_____
Company Name

Street Address

City, Province and postal code

Phone Number Email Address

To (Owner): Halton District School Board
2050 Guelph Line
Burlington, Ontario L7P 5A8

We, the undersigned, having examined the Tender Documents for the above-named Project, including Addenda, hereby offer to perform the Work in accordance with the Tender Documents, for the Stipulated Price of:

Base Bid Amount	$
Cash Allowance	$ 170,000
Contingency Allowance	$ 80,000
Total Amount (Excluding HST)	**$**
Project Timelines	June 29, 2022 – December 30, 2022

Proposed HDSB Pre-Qualified Sub-Contractors

Electrical	
Mechanical	
Roofing	

Form of Tender Continued
RFT 22-132 Gladys Speers Public School
Page 2 of 2

We, the undersigned, declare that:

a. We agree to perform the Work within the required completion time specified in the Tender Documents,
b. We have arrived at the Tender without collusion with any competitor,
c. This Tender is open to acceptance by the Owner for a period of 90 days from the date of Tender Closing,
d. All Form of Tender supplements called for by the Tender Documents from an integral part of this Tender.

Signature: _____ _____
LEGAL NAME OF BIDDER DATE

_____ _____ _____
AUTHORIZED SIGNATURE OF BIDDER & TITLE PRINTED NAME
I have the authority to bind the Bidder

Halton District School Board

APPENDIX A - DECLARATION SIGNATURE SHEET

1. I/WE DECLARE that this Submission is made without collusion, knowledge, and comparison of figures or arrangement with any other company, firm or person submitting a Submission for the same work.

2. I/WE DECLARE that to our knowledge no member of Halton District School Board is, will be or has become financially interested, directly or indirectly, in any aspect of the Contract other than in the appropriate discharge of his/her obligations as an employee/officer of Halton District School Board.

3. I/WE HAVE READ, Understood and agree to abide by the Agreement to Abide by the Established Process.

4. I/WE HAVE CAREFULLY examined the RFT documents, and have a clear and comprehensive knowledge of what is being requested hereunder. By submitting the Submission, the Bidder agrees and consents to the administrative procedures of the Board, as well as the procedures, terms, conditions and provisions of the RFT, including the Form of Tender.

5. I/WE have carefully examined all of the Proposal Documents, and that we have thoroughly reviewed all proposal documentation and addenda number _____to_____, and hereby accept and agree to same as forming part and parcel of the proposed Contract.

6. I/WE ARE AUTHORIZED BY and have the authority to bind the Bidder.

DATE:_____

NAME:_____
Please Print

SIGNATURE:_____

TITLE:_____

COMPANY NAME:_____

ADDRESS:_____

PHONE NUMBER: _____

E-MAIL ADDRESS:_____

E-MAIL to Send PO: _____

Halton District School Board

APPENDIX B – HDSB PRE-QUALIFIED SUB-CONTRACTOR

ELECTRICAL

Vendor Name	Contact Name	Email Address	Telephone Number
B-Safe Electric	Dan More	dan@b-safe.cabrian@b-safe.ca	905-872-7233
Best Electric Co.	Gurmukh Sehmbi	gsehmbi@bestelectric.ca	416-677-3851
Black & McDonald Limited	Brian Mino	swatson@blackandmcdonald.c	905-560-3100
Cahill Electric Inc.	Chris Cahill	chris@cahillelectric.ca	905-388-0515
CEC Services Ltd.	Kyle Feinstein	estimating@beswickgroup.com	905-716-3711
EEL Line Corporation	Majeed Wraich	majeed@eelline.ca	416-540-8894
Electrobauer Systems Limited	Michael Bauer	michaelbauer@rogers.com	416-389-6804
Elite Electrical Solutions Ltd.	Amar Taneja	estimate@eliteelectrical.ca	905-789-5511
Gremar Electric Ltd.	Gennaro Di Gregor	gennaro@gremar.ca	905-652-2641
Indcon Inc.	Nitesh Patel	indcon74@gmail.com	416-677-3303
LJ Barton Mechanical Inc.	Mike Van den Heu	estimating@ljbarton.com	905-304-1976
North Star Electric	Greg Harris	gharris@northstarelectric.ca	905-845-9063
Ozz Electric	Dave Burlo	estimating@ozzelectric.com	416-637-7237
Star Electrical Services	Harvinder Kahlon	info@starelectrical.ca	905-799-3883

MECHANICAL

Vendor Name	Contact Name	Email Address	Telephone Number
Ainsworth Inc.	Michael Karmazyn	Kari.Cordeau@ainsworth.com	416-751-4420
BAS Mechanical Inc.	Riaz Ahmad	estimator@basmechanical.ca	905-669-1126
Black & McDonald Limited	Jordan Anderson	swatson@blackandmcdonald.com	289-919-1166
Black Creek Mechanical Ltd.	Nelson Pedreira	estimating@blackcreekmechanical.c	416-604-7558
Brenner Mechanical Inc.	Michael Brenner	mbrenner@brenner.ca	519-746-0439
Canadian Air Tech Systems Inc.	Joan Blakeley	mail@ctas.ca	416-291-1296
CEC Mechanical Ltd.	Devin Brown	dbrown@beswickgroup.com	905-266-1500
Kirk Mechanical Limited	Robert Kirk	kirkmech@bellnet.ca	905-681-0140
LJ Barton Mechanical Inc.	Bruce Hunter	estimating@ljbarton.com	905-304-1976
Mattina Mechanical Limited	Domenic Mattina	dmattina@mattina.ca	905-544-6380
Mechfield Canada Inc.	Kaleem Ahmad Bhatti	salman@mechfield.com	289-597-7555
Mekcon Ltd.	Inaam Cheema	info@mekcon.ca	905-918-1899
Modern Niagara Southwestern Ontario Inc.	Rachel McGowan	rmcgowan@modernniagara.comrfqs	289-768-1951
Superior Boiler Works & Welding Ltd.	Domenic Settimi	info@sbww.com	(905) 643-6628
VCI Controls Inc.	Jeff Morneau	jmorneau@vcicontrols.ca	905-850-4464
Velocity Mechanical Inc.	Peter Linseman	quotes@velocitymechanical.com	519-896-1119

ROOFING

Vendor Name	Contact Name	Email Address	Telephone Number
Atlantic Roofers Ontario Ltd.	Tony Pocobene	tpocobene@on.aibn.com	905-573-6202
Atlas-Apex Roofing	John McDowell	inquiries@atlas-apex.com	416 421 6244
Bothwell Accurate	Lenny Baptista	LBaptista@bothwell-accurate.com	905-673-0615
Crawford Roofing Corporation	Nelson Rites	nelson.rites@crawfordroofing.ca	416.787.0649
Dean-Chandler Roofin Limited	Ken Goodale	kengoodale@deanchandler.ca	416.751.7840
Eileen Roofing Inc.	Dianne Cabral	dianne@eileenroofing.com	416-762-1819
Flynn Canada Ltd.	Joseph Raposo	Joseph.Raposo@flynncompanies.c	905-643-9515
GRRC Roofing	George Roque	george@grrc.ca	905-393-7989
Nortex Roofing Ltd.	Sandra Furtado	sandra@notexroofing.com	416-236-6090
Semple Gooder Roofin Corporation	Mark Baxter	rcapretta@semplegooder.com	416-743-5370
Solar Roofing & Sheet Metal Ltd.	Sonia Gaio-Francisc	sonia@solarroofing.casolarroofing@	(416) 658 6045
Top-Line Roofing & Sheet Metal	Jason Bras	jason.bras@top-lineroofing.coma.ku	905.602.0760
Trio Roofing Systems Inc.	Paulo Vieira	paulo@trioroofing.ca	905.456.1688
Triumph Roofing	Marco Peneda	info@triumphinc.ca	416-534-8877

GLADYS SPEERS PUBLIC SCHOOL RENOVATIONS

2150 SAMWAY RD, OAKVILLE, ON L6L 2P6

Halton District School Board

Unit 100 – 706 Euclid Avenue
Toronto, Ontario, Canada M6G 2T9
Telephone: (416) 591-6575 Fax: (416) 591-1010

Project No.: 21153
Date: February, 2022
Set No.:
Issued:

Specifications

Section	Title	Pages
00001	List of Drawings	2
00002	Room Finish Schedule	1
00003	Door Frame Schedule	3
00004	Window Schedule	1
00005	List of Consultants	1
	Division 00 - Procurement and Contracting Requirements	
00226	Designated Substances Report	1
00710	General Conditions	1
00830	Supplementary Conditions	33
	Division 01 - General Requirements	
01011	Summary of Work Single Contract	3
01021	Allowances	2
01040	Coordination	4
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List of Drawings

Architectural Drawings
WK Lim & MP Liu Architects Inc.
Unit 100 – 706 Euclid Avenue
Toronto, Ontario M6G 2T9
Tel: (416) 591- 6575
Fax: (416)591- 1010

No.	Title	Date	Revision
A0	Title Sheet	December 2021	May 2, 2022
SP1	Site Plan	December 2021	May 2, 2022
A1	Key Plan, Wall Type Legend	December 2021	May 2, 2022
A2	Enlarged Plans	December 2021	May 2, 2022
A3	Enlarged Plans	December 2021	May 2, 2022
A4	Sections and Details	December 2021	May 2, 2022
A5	Sections and Details	December 2021	May 2, 2022
A6	Millwork Details and Interior Elevations	December 2021	May 2, 2022

Structural Drawings
IRC Building Sciences Group
2121 Argentia Road
Toronto, Ontario
Tel: (905) 607-7244
Fax: (905) 607-7288

No.	Title	Date	Revision
S01	Notes, Partial Plan, Sections and Details	April 18, 2022	April 26, 2022
S02	Main Roof Framing Plan	April 18, 2022	April 26, 2022

Mechanical Drawings
SAB Engineering Ltd.
1 588 Edward Ave., Unit # 25
Richmond Hill, ON L4C 9Y6
Tel: 905-787-8885
Fax: 905-787-8771

No.	Title	Date	Revision
M-1.1	Symbol List, Equipment Schedules, Key Plans & Notes – Mechanical	December 2021	April 26, 2022
M-1.2	Plumbing Fixture Services Schedule & Details – Mechanical	December 2021	April 26, 2022
M-2.1	Part of Ground Floor (North) – Existing & Demolition Work – Mechanical	December 2021	April 26, 2022
M-2.2	Part of Ground Floor (South) – Existing & Demolition Work – Mechanical	December 2021	April 26, 2022
M-2.3	Roof – Equipment & Gas Piping Layout – Existing & Demolition Work – Mechanical	December 2021	April 26, 2022
M-3.1	Part of Ground Floor (North) – Existing & New Work – Mechanical	December 2021	April 26, 2022

M-3.2	Part of Ground Floor (South) – Existing & New Work - Mechanical	December 2021	April 26, 2022
M-3.3	Roof – Equipment, Ductwork & Gas Piping Layout – Existing & New Work - Mechanical	December 2021	April 26, 2022
M-4.1	Control Schematics – Mechanical	December 2021	April 26, 2022
M-4.2	Gas Piping Schematic – Existing, Demolition & New Work – Mechanical	December 2021	April 26, 2022

Electrical Drawings
SAB Engineering Ltd.
1 588 Edward Ave., Unit # 25
Richmond Hill, ON L4C 9Y6
Tel: 905-787-8885
Fax: 905-787-8771

No.	**Title**	**Date**	**Revision**
E-1.1	Key Plans, Symbol List, Notes & Equipment Wiring – Electrical	December 2021	April 26, 2022
E-2.1	Ground Floor – Equipment & Lighting Layout – Existing & Demolition Work – Electrical	December 2021	April 26, 2022
E-2.2	Roof – Equipment Layout – Existing & Demolition Work – Electrical	December 2021	April 26, 2022
E-3.1	Ground Floor – Equipment & Lighting Layout – New Work - Electrical	December 2021	April 26, 2022
E-3.2	Roof – Equipment Layout – New Work – Electrical	December 2021	April 26, 2022
E-200	Electrical Services Site Plan – Electrical	December 2021	April 26, 2022
E-201	Electrical Services Details – Electrical	December 2021	April 26, 2022
E-300	Electrical Services Floor Plan & Single Line Diagram – Electrical	December 2021	April 26, 2022

END OF SECTION

Liu Lim Architects inc.	**PROJECT NAME**	Gladys Speers Public School Renovations	**PROJECT NO:** 21153
	PROJECT ADDRESS	Halton District School Board	**SHEET:** 1 of 1
	CITY,	2150 Samway Rd, Oakville, Ontario	**DATE:** February 2022

ROOM FINISH SCHEDULE

ROOM NO.	ROOM NAME	FLOOR FINISH	WALL BASE	WALL MATERIAL	WALL FINISH	CEILING MATERIAL	CEILING FINISH	CEILING HEIGHT	F.R.R.	REMARK
20	STAFF ROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	-	
21	GYM	EXIST.	EXIST.	EXIST.	PAINT	-	-	-	-	PREPARE, PRIME AND PAINT EXPOSED DUCTWORKS, EXISTING STEEL STRUCTURE AND METAL DECK.
21A	STORAGE	L.V.T.	RUBBER	EXIST. /CONC. BLOCK	PAINT/ PAINT	EXIST.	EXIST.	EXIST.	-	
1	CLASSROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	-	PREPARE, PRIME AND PAINT EXPOSED DUCTWORK.
2	CLASSROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	-	PREPARE, PRIME AND PAINT EXPOSED DUCTWORK.
3	CLASSROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	-	PREPARE, PRIME AND PAINT EXPOSED DUCTWORK.
4	CLASSROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	-	PREPARE, PRIME AND PAINT EXPOSED DUCTWORK.
5	CLASSROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	-	PREPARE, PRIME AND PAINT EXPOSED DUCTWORK.
6	CLASSROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	-	PREPARE, PRIME AND PAINT EXPOSED DUCTWORK.
12	CLASSROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	-	PREPARE, PRIME AND PAINT EXPOSED DUCTWORK.
13	CLASSROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	-	PREPARE, PRIME AND PAINT EXPOSED DUCTWORK.
14	CLASSROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	-	PREPARE, PRIME AND PAINT EXPOSED DUCTWORK.
15	CLASSROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	-	PREPARE, PRIME AND PAINT EXPOSED DUCTWORK.
16	CLASSROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	-	PREPARE, PRIME AND PAINT EXPOSED DUCTWORK.
17	CLASSROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	-	PREPARE, PRIME AND PAINT EXPOSED DUCTWORK.
18	CLASSROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	-	PREPARE, PRIME AND PAINT EXPOSED DUCTWORK.
19	CLASSROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	-	PREPARE, PRIME AND PAINT EXPOSED DUCTWORK.
22	LIBRARY	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	-	PREPARE, PRIME AND PAINT EXPOSED DUCTWORK.

Liu Lim Architects inc.	**PROJECT NAME**	Gladys Speers Public School Renovations	**PROJECT NO:** 21153
	PROJECT ADDRESS	Halton District School Board	**SHEET:** 1 of 1
	CITY	2150 Samway Rd, Oakville, Ontario	**DATE:** February 2022

DOOR AND FRAME SCHEDULE

DOOR NO.	SIZE	DOOR TYPE	DOOR MATERIAL	DOOR FINISH	DOOR GRILLE	GLAZING	FRAME TYPE	FRAME MATERIAL	FRAME FINISH	LABEL	REMARK
V-1	2 - 979 x 2150 x 45	B	ALUM.	-	-	LAM I.G.	2	ALUM.	-	-	LEVERSET + PANIC DEVICE, CLOSER WITH STOP, KICKPLATE, PERIMETER WEATHERSTRIPPING AND BOTTOM SWEEP
V-2	2 - 979 x 2150 x 45	B	ALUM.	-	-	LAM I.G.	2	ALUM.	-	-	LEVERSET + PANIC DEVICE, CLOSER WITH STOP, KICKPLATE, PERIMETER WEATHERSTRIPPING AND BOTTOM SWEEP
21A	2 - 950 x 2150 x 45	A	H.M.	PAINT	-	-	1	P.S.	PAINT		LEVERSET, OVERHEAD STOP, KICKPLATE

DOOR AND FRAME SCHEDULE

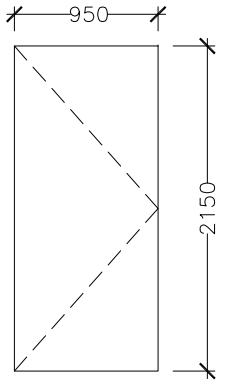
HALTON DISTRICT SCHOOL BOARD
GLADYS SPEERS PS RENOVATIONS
2150 SAMWAY RD, OAKVILLE ON

OAKVILLE ONTARIO

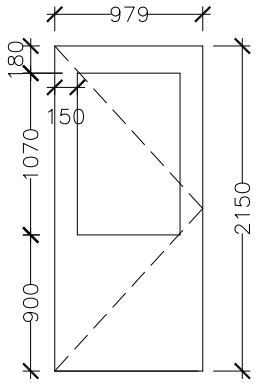
PROJECT NO.: 21153
DATE: FEBRUARY 2022
REVISED:

DOOR TYPES

A



B



TYPICAL NOTES:

1. AT 140 CONCRETE BLOCK WALLS PROVIDE DOOR FRAMES WITH THROAT SIZE 146 TO WRAP AROUND CONCRETE BLOCK.

2. AT 190 CONCRETE BLOCK WALLS PROVIDE DOOR FRAMES WITH THROAT SIZE 197 TO WRAP AROUND CONCRETE BLOCK.

3. AT GYPSUM BOARD PARTITIONS PROVIDE DOOR FRAMES WITH THROAT SIZE 124 TO WRAP AROUND PARTITIONS.

DOOR AND FRAME SCHEDULE

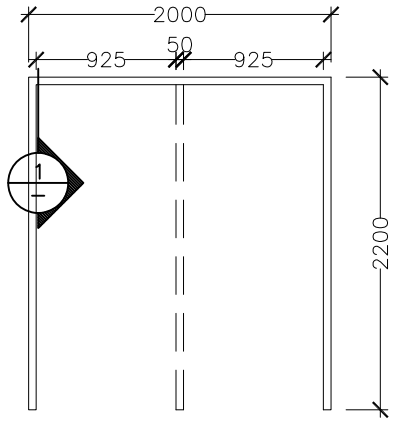
HALTON DISTRICT SCHOOL BOARD
GLADYS SPEERS PS RENOVATIONS
2150 SAMWAY RD, OAKVILLE ON

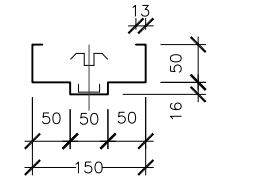
OAKVILLE ONTARIO

PROJECT NO.: 21153
DATE: FEBRUARY 2022
REVISED:

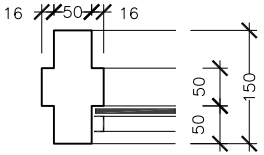
FRAME TYPES

1



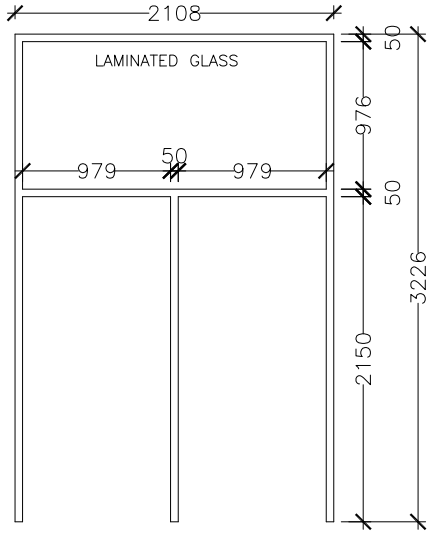


1 — TYPICAL FRAME DETAIL



2 — TYPICAL MULLION DETAIL

2



WINDOW SCHEDULE

HALTON DISTRICT SCHOOL BOARD
GLADYS SPEERS PS RENOVATIONS
2150 SAMWAY RD, OAKVILLE ON

OAKVILLE ONTARIO

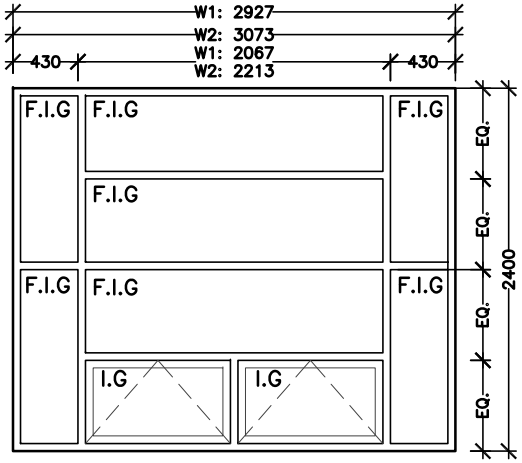
PROJECT NO.: 21153

DATE: FEBRUARY 2022

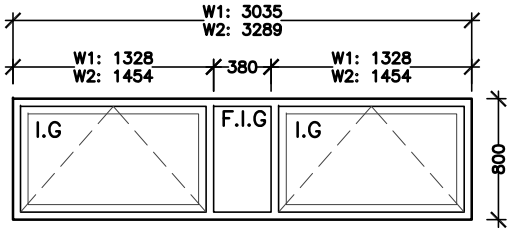
SHEET 1 OF 1

NOTE:

1. DIMENSIONS INDICATE APPROXIMATE ROUGH OPENING SIZES. VERIFY ON SITE.
2. FILL FRAME JOINT TO R.O. W/ COMPRESSIBLE FOAM INSULATION.
3. PROVIDE INTERIOR AND EXTERIOR PERIMETER CAULKING ON BACKER ROD.
4. PROVIDE CONTINUOUS SEAL AT JUNCTION TO AIR AND VAPOUR BARRIERS.
5. SEAL FRAME PERIMETER TO BUILDING ENVELOPE AIR/VAPOUR BARRIER WITH SELF-ADHESIVE SHEET MEMBRANE



WINDOW TYPE W1:
ALUMINUM THERMALLY BROKEN SASH AND FRAME
PRE-FINISHED CLEAR ANODIZED INSULATING GLASS
3 UPPER FIXED PANES
4 SIDE FIXED PANES
2 LOWER THPO AWNING SASHES
W/ FRAMED REMOVABLE INSECT SCREENS
W/ ROTARY GEAR FOLDING OR LOW-PROFILE HANDLE OPERATOR
EXTRUDED ALUMINUM SILL ON DAMPPROOF COURSE MEMBRANE
SLOPED MIN. 5 DEG. WITH DRIP AND JAMB DEFLECTORS
REMOTE TELEFLEX OPERATOR
LOCATE CRANK HANDLE ON SITE AS DETERMINED BY CONSULTANT
MAX 1100 AFF



WINDOW TYPE W2:
ALUMINUM THERMALLY BROKEN SASH AND FRAME
PRE-FINISHED CLEAR ANODIZED INSULATING GLASS
1 CENTRE FIXED PANE
2 FLANKING THPO AWNING SASHES
W/ FRAMED REMOVABLE INSECT SCREENS
W/ ROTARY GEAR FOLDING OR LOW-PROFILE HANDLE OPERATOR
EXTRUDED ALUMINUM SILL ON DAMPPROOF COURSE MEMBRANE
SLOPED MIN. 5 DEG. WITH DRIP AND JAMB DEFLECTORS
REMOTE TELEFLEX OPERATOR
LOCATE CRANK HANDLE ON SITE AS DETERMINED BY CONSULTANT
MAX 1100 AFF

PART 1 GENERAL

1.1 THE CONSULTANT (ARCHITECT)

WK Lim & MP Liu Architects Inc.
Unit 100-706 Euclid Avenue
Toronto, Ontario M6G 2T9
Tel: (416) 591-6575
Fax: (416) 591-1010

1.2 THE SUBCONSULTANTS

1. The Structural Engineer for this Project is:
   IRC Building Sciences Group
   2121 Argentia Road
   Toronto, Ontario
   Tel: (905) 607-7244
   Fax: (905) 607-7288

2. The Mechanical Consultant for this Project is:
   SAB Engineering Inc.
   588 Edward Avenue, Unit 25
   Richmond Hill, Ontario
   Tel: (905) 787-8885
   Fax: (905) 787-8771

3. The Electrical Consultant for this Project is:
   SAB Engineering Inc.
   588 Edward Avenue, Unit 25
   Richmond Hill, Ontario
   Tel: (905) 787-8885
   Fax: (905) 787-8771

END OF SECTION

1.1 Hazardous Material Report

.1 A copy of a detailed Designated Substances Report is included herein, titled as: "Survey of Asbestos-Containing Materials" for Glady Speers Public School, 2150 Samway Rd, Oakville Ontario, dated December 13, 2018 prepared for the Halton District School Board by Arcadis Canada Inc. and The Halton District School Board List of Pre-approved Contractors

.2 This report identifies existing building components which contain designated substances and asbestos products. The recommendations given in the report shall not be construed as a requirement of this Contract unless Work under the Contract results in disturbance to identified asbestos products. The Contractor is to review the contents of the report and exercise means as required to conform to Ontario Regulation 654/85.

.3 The report, by its nature, cannot reveal all conditions that exist or can occur on the site. Should subsurface conditions be found to vary substantially from the report, changes in the Work will be made, with resulting credits or expenditures to the contract Price accruing to the Owner.

.4 The Contractor is to note that subsequent to the preparation of this Report, some corrective work has been undertaken.

.5 Asbestos removal/containment Work is to be performed only during the Christmas Break, Spring Break, or Summer Break, with exact dates as defined by the Board. If phasing is required, Work area is to be isolated from the remainder of the school and phased Work is to be commenced and completed within each break period.

.6 As the investigation for asbestos was not intrusive, should the Work uncover a material that is suspected to contain asbestos, then with notification to and the authorization by the Board, Norrox is to be engaged by the Board and co-ordinated by the Contractor for sample collection and analysis. If required, further instruction will be forwarded where materials are confirmed to contain asbestos and will impact on the construction work.

1.1 GENERAL CONDITIONS

1.1.1 CCDC 2 - 2008 The General Conditions of the Stipulated Price Contract is the General Conditions between the Owner and the Contractor.

1.2 SUPPLEMENTARY CONDITION

1.2.1 Refer to Document 00830 for amendments to these General Conditions.

END OF DOCUMENT

SUPPLEMENTARY GENERAL CONDITIONS
to CCDC 2, 2008 Stipulated Price Contract for Gladys Speers Public School Renovations.

SC1 GENERAL

1.0 Where a General Condition or paragraph of the General Conditions of the Contract is deleted by the Supplementary General Conditions, the numbering of the remaining General Conditions or paragraph shall remain unchanged, unless stated otherwise herein, and the numbering of the deleted item will be retained, unused.

1.1 The General Conditions for Canadian Standard Construction Document, CCDC No. 2, 2008 edition for the construction of the GLADYS SPEERS PUBLIC SCHOOL RENOVATIONS project, in Oakville, Ontario are hereby amended, including Articles A-1 through A-8, the Definitions and the General Conditions GC 1.1 to GC 12.3 inclusive. These Supplementary General Conditions supersede, replace or amend the *Contract Document* clauses, as noted in each item. Supplementary General Conditions are indicated in this Document 00810 as "SC 1" (for Supplementary Condition No. 1), "SC 2", etc. General Conditions stated in the *Contract Document* are referred to in this Document 00810 as "GC 1.1" (for General Condition No. 1.1 of CCDC No. 2, 2008), "GC 2.1", etc.

1.2 Throughout the *Contract Documents* references to the "General Conditions of the *Contract*" or "General Conditions" shall include the Supplementary General Conditions listed in this Document 00810.

1.3 These Supplementary General Conditions shall apply to all work.

1.4 Where any article, paragraph or sub-paragraph in the General Conditions is supplemented by one of the following paragraphs, the provisions of such article, paragraph or sub-paragraph shall remain in effect and the supplemental provisions shall be considered as added thereto.

1.5 Where any article, paragraph, or sub-paragraph in the General Conditions is amended, voided, or superseded by any of the following paragraphs, the provisions of such article, paragraph, or sub-paragraph not so amended, voided or superseded shall remain in effect.

AGREEMENT BETWEEN OWNER AND CONTRACTOR

SC2 ARTICLE A-3 – CONTRACT DOCUMENTS

3.1 Add the following to the list of *Contract Documents* in paragraph 3.1:
- Supplementary General Conditions to CCDC 2 – 2008 (this Document)
- Drawings and Specifications
- Bid Documents, including Instructions to Bidders, Form of Tender, and Tender addenda, if applicable
- Performance Bond
- Labour and Material Payment Bond

SC3 ARTICLE A-5 – PAYMENT

5.1 Amend the first sentence of paragraph 5.1, to read:
"Subject to the provisions of the contract documents and in accordance with legislation and statutory regulations respecting holdback percentages and, where such legislation does not exist or apply, subject to a lien holdback of Ten percent (10%) PLUS a Reserve Fund of One percent (1%), the Board shall:"

5.3.1 Delete paragraph 5.3.1 in its entirety and replace it with the following:

5.3.1 "Interest

.1 Should either party fail to make payments as they become due under the terms of the Contract or in an award by arbitration or court, interest shall also become due and payable on such unpaid amounts at 2% above the prime rate. Such interest shall be compounded on a monthly basis. The prime rate shall be the rate of interest quoted by the Bank of Canada for prime business loans, as it may change from time to time."

SC4 ARTICLE A-9 – CONFLICT OF INTEREST

Add new Article A-9 – CONFLICT OF INTEREST as follows:

9.1 "The *Contractor*, all of the *Subcontractors* and *Suppliers* and any of their respective advisors, partners, directors, officers, employees, agents, and volunteers shall not engage in any activity or provide any services where such activity or the provision of such services creates a conflict of interest (actually or potentially, in the sole opinion of the *Owner*) with the provision of the *Work* pursuant to the *Contract*. The *Contractor* acknowledges and agrees that a conflict of interest, as described in this Article A-9, includes, but is not limited to, the use of *Confidential Information* where the *Owner* has not specifically authorized such use."

9.2 "The *Contractor* shall disclose to the *Owner*, in writing, without delay, any actual or potential situation that may be reasonably interpreted as either a conflict of interest or a potential conflict of interest, including the retention of any *Subcontractor* or *Supplier* that is directly or indirectly affiliated with or related to the *Contractor*."

9.3 "The *Contractor* covenants and agrees that it will not hire or retain the services of any employee or previous employee of the *Owner* where to do so constitutes a breach by such employee or previous employee of the *Owner's* conflict of interest policy, as it may be amended from time to time, until after completion of the *Work* under the *Contract*."

9.4 "It is of the essence of the *Contract* that the *Owner* shall not have direct or indirect liability to any *Subcontractor* or *Supplier*, and that the *Owner* relies on the maintenance of an arm's-length relationship between the *Contractor* and its *Subcontractors* and *Suppliers*. Consistent with this fundamental term of the *Contract*, the *Contractor* will not enter into any agreement or understanding with any *Subcontractor* or *Supplier*, whether as part of any contract or any written or oral collateral agreement, pursuant to which the parties thereto agree to cooperate in the presentation of a claim for payment against the *Owner*, directly or through the *Contractor*, where such claim is, in whole or in part, in respect of a disputed claim by

the *Subcontractor* or *Supplier* against the *Contractor*, where the payment to the *Subcontractor* or *Supplier* by the *Contractor* is agreed to be conditional or contingent on the ability to recover those amounts or a portion thereof from the *Owner*, failing which the *Contractor* shall be saved harmless from all or a portion of those claims. The *Contractor* acknowledges that any such agreement would undermine the required arm's-length relationship and constitute a conflict of interest. For greater certainty, the *Contractor* shall only be entitled to advance claims against the *Owner* for amounts pertaining to *Subcontractor* or *Supplier* claims where the *Contractor* has actually paid or unconditionally acknowledged liability for those claims or where those claims are the subject of litigation or binding arbitration between the *Subcontractor* or *Supplier* and the *Contractor* has been found liable for those claims.

9.5 "Notwithstanding paragraph 7.1.2 of GC 7.1 - OWNER'S RIGHT TO PERFORM THE WORK, TERMINATE THE CONTRACTOR'S RIGHT TO CONTINUE WITH THE WORK, SUSPEND THE WORK OR TERMINATE THE CONTRACT, a breach of this Article by the *Contractor*, any of the *Subcontractors,* or any of their respective advisors, partners, directors, officers, employees, agents, and volunteers shall entitle the *Owner* to terminate the *Contract*, in addition to any other rights and remedies that the *Owner* has in the *Contract*, in law, or in equity."

SC5 ARTICLE A-10 CONSTRUCTION SAFETY

SC5.1 Add new Article A-10 – CONSTRUCTION SAFETY as follows:

10.1 "The *Contractor* represents and warrants that in tendering for the *Work*, and in entering into a *Contract* with the *Owner* for the performance of the *Work* that the Contractor will comply with all applicable statutory obligations, including without limitation, the obligations imposed by the Occupational Health and Safety Act (Ontario) and all Regulations thereto, and all amending and successor legislation, including without limitation, Bill 208 (the "Act"), in connection with all Work performed by either the Contractor, Sub-Contractors, or any other contractor on, or in connection with the Project."

10.2 "The *Contractor* further declares and agrees that if awarded the *Contract,* the undersigned shall abide by all of the items identified under Construction Safety in the General Instructions of the *Contract Documents* and, for the purposes of the *Project*, the undersigned specifically agrees to be the "constructor" of the *Project* within the meaning of the Act, and as such, shall assume all the obligations and responsibilities, and observe all construction safety requirements and procedures and duties of inspection imposed by the Act on the "constructor", as defined in the General Instructions of the *Contract Documents*, for all work and services performed by the undersigned, the *Sub-Contractors* or other *Contractors* on or in connection with the Project."

SC6 ARTICLE A-11 DECLARATION OF NO CONFLICT

SC6.1 Add new Article A-11 – DECLARATION OF NO CONFLICT as follows:

11.1 "The *Contractor* represents and warrants that in tendering for the *Work*, and in entering into a *Contract* with the *Owner* for the performance of the *Work* that the Contractor's Tender submission was made in good faith and without any connection, knowledge, comparison of figures, or arrangements with any other company, firm, or person making a Tender for the same work and is, in all respects, fair and without collusion with any other bidder for this Contract, and without fraud. The undersigned also represents and warrants that, to the best of the undersigned's knowledge and belief, no actual or potential conflict of interest exists with respect to the submission of the Tender or performance of the Contract other than those disclosed hereunder. The undersigned confirms that, where the Board discovers that the undersigned has failed to disclose all actual or potential conflicts of interest, the Board may disqualify the undersigned or terminate any Contract awarded to the undersigned pursuant to this Tender process. The undersigned understands that, for the purposes hereof, "conflict of interest" also includes:

.1 in relation to the Tender process, the undersigned has an unfair advantage or engages in conduct, directly or indirectly, that may give the undersigned an unfair advantage, including:
- .1 having or having access to information in the preparation of the undersigned's proposal that is confidential to the Board and not available to other bidders;
- .2 communicating with any person with a view to influencing preferred treatment in the Tender process; or,
- .3 engaging in conduct that compromises or could be seen to compromise the integrity of the open and competitive process and render that process non-competitive and unfair; or,

.2 in relation to the performance of its contractual obligations in a Board contract, the undersigned's other commitments, relationships or financial interests:
- .1 could or could be perceived to exercise an improper influence over the objective, unbiased and impartial exercise of the Board's independent judgment; or,
- .2 could or could be perceived to compromise, impair or be incompatible with the effective performance of the undersigned's contractual obligations."

SC7 DEFINITIONS

4. Amend Definition 4 (Consultant) by adding the following to the end of the Definition:
"For the purposes of the *Contract*, the terms "*Consultant"*, "Architect" and "Engineer" shall be considered synonymous."

12. Amend Definition 12 (Owner) by adding the following to the end of the Definition:
"The words "Owner" and "Board" shall be considered synonymous."

16. Amend Definition 16 (Provide) by adding the following to the end of the Definition:
"The word "Provide" has this meaning whether or not the first letter is capitalized."

Add the following **new** definitions:

27. Confidential Information

Confidential Information means all the information or material of the *Owner* that is of a proprietary or confidential nature, whether it is identified as proprietary or confidential or not, including but not limited to information and material of every kind and description (such as drawings and move-lists) which is communicated to or comes into the possession or control of the *Contractor* at any time, but *Confidential Information* shall not include information that:

1) is or becomes generally available to the public without fault or breach on the part of the *Contractor*, including without limitation breach of any duty of confidentiality owed by the *Contractor* to the *Owner* or to any third party, but only after that information becomes generally available to the public;

2) the *Contractor* can demonstrate to have been rightfully obtained by the *Contractor* from a third party who had the right to transfer or disclose it to the *Contractor* free of any obligation of confidence;

3) the *Contractor* can demonstrate to have been rightfully known to or in the possession of the *Contractor* at the time of disclosure, free of any obligation of confidence; or

4) is independently developed by the *Contractor* without use of any *Confidential Information*.

28. Construction Schedule

Construction Schedule means the schedule for the performance of the *Work* provided by the *Contractor* pursuant to GC 3.5, including any amendments to the *Construction Schedule* made pursuant to the *Contract Documents*.

29. Force Majeure

Force Majeure means any cause, beyond the *Contractor's* control, other than a lack of funds, which prevents the performance by the *Contractor* of any of its obligations under the *Contract* and the event of *Force Majeure* was not caused by the *Contractor's* default or active commission or omission and could not be avoided or mitigated by the exercise of reasonable effort or foresight by the *Contractor*. *Force Majeure* includes *Labour Disputes*, fire, unusual delay by common carriers or unavoidable casualties, civil disturbance, acts, orders, legislation, regulations or directives of any government or other public authority, acts of a public enemy, war, riot, sabotage, blockage, embargo, lightning, earthquake, or acts of God.

30. Install

Install means install and connect. *Install* has this meaning whether or not the first letter is capitalized.

31. Labour Dispute

Labour Dispute means any lawful or unlawful labour problems, work stoppage, labour disruption, strike, job action, slow down, lock-outs, picketing, refusal to work or continue to work, refusal to supply materials, cessation of work or other labour controversy which does, or might, affect the *Work*.

32. Overhead

Overhead means all site and head office operations and facilities, all site and head office administration and supervision; all duties and taxes for permits and licenses required by the authorities having jurisdiction at the *Place of the Work*; all requirements of Division 1, including but not limited to submittals, warranty, quality control, insurance and bonding; calculations, testing and inspections; meals and accommodations; and, tools, expendables and clean-up costs.

33. Request for Information (RFI)

Request for Information or *RFI* means written documentation sent by the *Contractor* to the *Owner* or to the *Owner's* representative or the *Consultant* requesting written clarification(s) and/or interpretation(s) of the *Drawings* and/or *Specifications*, *Contract* requirements and/or other pertinent information required to complete the *Work* of the *Contract* without applying for a change or changes to the *Work*.

SC8 GC 1.1 CONTRACT DOCUMENTS

SC8.1 Add the following sub-paragraphs to the end of paragraph 1.1.6:

.1 "The *Specifications* are divided into divisions and sections for convenience but shall be read as a whole and neither such division nor anything else contained in the *Contract Documents* will be construed to place responsibility on the *Owner* or the *Consultant* to settle disputes among the *Sub-Contractors* and *Suppliers* with respect to such divisions."

.2 "The *Drawings* are divided into groups, types and sets for convenience but shall be read as a whole and neither such grouping, nor separation of information from drawing to drawing nor anything else contained in the *Contract Documents* will be construed to place responsibility on the *Owner* or the *Consultant* to divide or control the *Work*, nor to settle disputes among the *Sub-Contractors* and *Suppliers* with respect to such divisions."

.3 "The *Drawings* are, in part, diagrammatic and are intended to convey the scope of the *Work* and indicate general and appropriate locations, arrangements and sizes of fixtures, equipment and outlets. The *Contractor* shall obtain more accurate information about the locations, arrangements and sizes from study and coordination of the *Drawings*, including *Shop Drawings,* and shall become familiar with conditions and spaces affecting those matters before proceeding with the *Work*."

.4 "Where site conditions require reasonable minor changes in indicated locations and arrangements, the *Contractor* shall make such changes at no additional cost to the *Owner*. Similarly, where known conditions or existing conditions interfere with new installation and require relocation, the *Contractor* shall include such relocation in the *Work*."

.5 "The *Contractor* shall arrange and install fixtures and equipment in such a way as to conserve as much headroom and space as possible."

.6 "The Schedules are those portions of the *Contract Documents*, wherever located and whenever issued, which compile information of similar content and may consist of drawings, tables, charts and/or lists."

SC8.2 Add new paragraphs 1.1.7.5, 1.1.7.6, 1.1.7.7, 1.1.7.8 and 1.1.7.9 as follows**:**

1.1.7.5 "Noted materials and annotations on the *Drawings* shall govern over the graphic representation of the *Drawings."*

1.1.7.6 "Finishes in the Room Finish Schedules shall govern over those shown on the *Drawings."*

1.1.7.7 "Items, Procedures and Requirements as specified in the Sections of Division 01 – General Requirements of the *Specifications* shall form part of and be read in conjunction with the technical specification Sections found elsewhere in the (overall) *Specifications."*

1.1.7.8 "Architectural drawings shall have precedence over structural, plumbing, mechanical, electrical and landscape drawings insofar as outlining, determining and interpreting conflicts over the required design intent of all architectural layouts and architectural elements of construction, it being understood that the integrity and installation of the systems designed by the *Consultant* or its *Sub-Consultants* are to remain with each of the applicable drawing disciplines."

1.1.7.9 "Should reference standards and *Specifications* conflict with each other or if certain requirements of the *Specifications* conflict with other requirements of the *Specifications*, the more stringent requirements shall govern."

SC9 GC 1.4 ASSIGNMENT

SC9.1 Delete paragraph 1.4.1 in its entirety and replace with the following:

1.4.1 "The Contractor shall not assign the Contract or any portion thereof, without the prior written consent of the Owner, which consent may be unreasonably withheld. The Owner shall be entitled to assign the Contract to a corporation, partnership or other entity (the "Assignee"). Upon the assumption by the Assignee of the Owner's obligations under the Contract, the Owner shall be released from its obligations under the Contract ".

SC10 GC 1.5 EXAMINATION OF DOCUMENTS AND SITE

SC10.1 Add new GC 1.5 – EXAMINATION OF DOCUMENTS AND SITE as follows:

1.5.1 "The *Contractor* declares and represents that in tendering for the *Work*, and in entering into a *Contract* with the *Owner* for the performance of the *Work*, it has either investigated for itself the character of the *Work* to be done and all local conditions, including the location of any utility which can be determined from the records or other information available at the offices of any person, partnership,

corporation, including a municipal corporation and any board or commission thereof having jurisdiction or control over the utility that might affect its tender or its acceptance of the *Work*, or that, not having so investigated, the *Contractor* has assumed and does hereby assume all risk of conditions now existing or arising in the course of the *Work* which might or could make the *Work*, or any items thereof more expensive in character, or more onerous to fulfil, than was contemplated or known when the tender was made or the *Contract* signed."

1.5.2 "The *Contractor* also declares that in tendering for the *Work* and in entering into this *Contract,* the *Contractor* did not and does not rely upon information furnished by the *Owner* or any of its agents or servants respecting the nature or confirmation of the ground at the site of the *Work*, or the location, character, quality or quantity of the materials to be removed or to be employed in the construction of *Work*, or the character of the construction machinery and equipment or facilities needed to perform the *Work*, or the general and local performance of the work under the *Contract* and expressly waives and releases the *Owner* from all claims with respect to the said information with respect to the *Work*."

SC11 GC 2.2 ROLE OF THE CONSULTANT

SC11.1 In paragraph 2.2.7, delete the words "Except with respect to GC 5.1 – FINANCING INFORMATION REQUIRED OF THE OWNER".

SC11.2 Amend paragraph 2.2.13 by adding the following to the end of that paragraph:

"If, in the opinion of the *Contractor*, the *Supplemental Instruction* involves an adjustment in the *Contract Price* or in the *Contract Time*, it shall, within ten (10) *Working Days* of receipt of a *Supplemental Instruction*, provide the *Consultant* with a notice in writing to that effect. Failure to provide written notification within the time stipulated in this paragraph 2.2.13 shall be deemed an acceptance of the *Supplemental Instruction* by the *Contractor*, without any adjustment in the *Contract Price* or *Contract Time*."

SC11.3 Add new paragraph 2.2.19 as follows:

"The *Consultant* or the *Owner*, acting reasonably, may from time to time require the *Contractor* to remove from the *Project* any personnel of the *Contractor*, including project managers, superintendents or *Subcontractors*. Such persons shall be replaced by the *Contractor* in a timely fashion to the satisfaction of the *Consultant* and the *Owner*, at no cost to the *Owner*."

SC12 GC 2.3 REVIEW AND INSPECTION OF THE WORK

SC12.1 Amend paragraph 2.3.2 by adding the words "and *Owner*" after the words "*Consultant*" in the second and third lines.

SC12.2 In the first and second lines of paragraph 2.3.4. insert the word "review" after the word "inspections".

SC12.3 Paragraph 2.3.5: In the first line after *"Consultant"*, add "or the *Owner".*

SC12.4 Add a new paragraph 2.3.8 as follows:

2.3.8 "The *Owner* shall have access to the Work at all times. The *Contractor* shall provide sufficient, safe, and proper facilities at all time for the review of the *Work* by the *Owner* and the inspection of the *Work* by authorized agencies."

SC13 GC 2.4 DEFECTIVE WORK

SC13.1 Amend GC 2.4.1 by inserting "or the *Owner*" in the first sentence following "rejected by the *Consultant*".

SC13.2 Add new paragraphs 2.4.1.1 and 2.4.1.2 as follows:

2.4.1.1 "The *Contractor* shall rectify, in a manner acceptable to the *Owner* and the *Consultant*, all defective work and deficiencies discovered throughout the *Work*, whether or not they are specifically identified by the *Consultant*."

2.4.1.2 "The *Contractor* shall prioritize the correction of any defective work, which, in the sole discretion of the *Owner*, adversely affects the day to day operations of the *Owner* or which, in the sole discretion of the *Consultant*, adversely affects the progress of the *Work*."

SC13.3 Add new paragraph 2.4.4 as follows:

2.4.4 "Neither acceptance of the *Work* by the *Consultant* or the *Owner*, nor any failure by the *Consultant* or the *Owner* to identify, observe or warn of defective *Work* or any deficiency in the *Work* shall relieve the *Contractor* from the Contractor's responsibility for rectifying such defects or deficiencies at the *Contractor's* sole cost."

SC14 GC 3.1 CONTROL OF THE WORK

SC14.1 Add a new paragraph 3.1.3 as follows:

3.1.3 "Prior to or concurrent with individual procurement, fabrication and construction activities, the *Contractor* shall verify at the *Place of the Work*, all relevant measurements and levels necessary for proper and complete fabrication, assembly and installation of the *Work* and shall carefully compare such field measurements and conditions with the requirements of the *Contract Documents*. Where dimensions are not included or exact locations are not apparent, and the *Contractor* requires additional information in order to proceed with *Work*, the *Contractor* shall immediately notify the *Consultant* in writing and obtain written instructions from the *Consultant* before proceeding with the affected *Work*."

SC15 GC 3.2 CONSTRUCTION BY OWNER OR OTHER CONTRACTORS

SC15.1 Delete paragraphs 3.2.2.1, 3.2.2.2 and 3.3.2.4 in their entirety.

SC15.2 Add new paragraph 3.2.3.4 as follows:

3.2.3.4 "Subject to GC 9.4 CONSTRUCTION SAFETY, for the *Owner's* own forces and for other contractors, assume overall responsibility for compliance with all aspects of the applicable health and safety legislation in force at the *Place of the Work*, including all of the responsibilities of the "Constructor", pursuant to the *Occupational Health and Safety Act* (Ontario)."

SC16 GC 3.5 CONSTRUCTION SCHEDULE

SC16.1 Delete paragraph 3.5.1 in its entirety and replace with the following:

"The *Contractor* shall:

.1 Within five (5) calendar days of receiving written confirmation of the award of the Contract, prepare and submit to the *Owner* and the *Consultant* for their review and acceptance, a construction schedule in the format indicated below that indicates the timing of the activities of the *Work* and provides sufficient detail of the critical events and their inter-relationship to demonstrate the *Work* will be performed in conformity with the *Contract Time* and in accordance with the *Contract Documents.*

.1 Such schedule is to include a delivery schedule for *Products* whose delivery is critical to the schedule for the *Work* or are required by the *Contract* to be included in a *Products* delivery schedule; and,

.2 The *Contractor* shall employ construction scheduling software, being the latest version of "Microsoft Project"*,* that permits the progress of the *Work* to be monitored in relation to the critical path established in the schedule; and,

.3 The *Contractor* shall provide the schedule and any successor or revised schedules in both electronic format and hard copy; and,

.4 Once accepted by the *Owner* and the *Consultant*, the construction schedule submitted by the *Contractor* shall become the baseline construction schedule; and,

.2 Monitor the progress of the *Work* and report to the *Consultant* and *Owner* in writing on a weekly basis relative to the baseline construction schedule, or any revised schedule previously accepted by the *Owner*. Report on any variation from the baseline or slippage in the schedule.

.3 Update and submit to the *Consultant* and *Owner* the electronic and hard copy schedule on a monthly basis, at a minimum, or as required by the *Consultant*.

SC16.2 Add new paragraphs 3.5.2 and 3.5.3 as follows:

3.5.2 "If, at any time, it should appear to the *Owner* or the *Consultant* that the actual progress of the *Work* is behind schedule or is likely to become behind schedule, or if the *Contractor* has given notice of such to the *Owner* or the

Consultant pursuant to subparagraph 3.5.1.3, the *Contractor* shall, either at the request of the *Owner* or the *Consultant*, or following giving notice pursuant to subparagraph 3.5.1.3, take appropriate steps to cause the actual progress of the *Work* to conform to the schedule or minimize the resulting delay. Within five (5) calendar days of the request by the *Owner* or the *Consultant* or the notice being given pursuant to subparagraph 3.5.1.3, the *Contractor* shall produce and present to the *Owner* and the *Consultant* a plan demonstrating how the *Contractor* will achieve the recovery of the last accepted schedule."

3.5.3 "The *Contractor* is responsible for performing the *Work* within the *Contract Time*. Any schedule submissions revised from the accepted baseline construction schedule or revised schedule accepted by the *Owner* pursuant to GC 3.5 CONSTRUCTION SCHEDULE, during construction are not deemed to be approved extensions to the *Contract Time.* All extensions to the *Contract Time* must be made in accordance with the *Contract Documents*."

SC17 GC 3.6 SUPERVISION

SC17.1 In paragraphs 3.6.1 and 3.6.2 replace the word "representative" with "superintendent".

SC17.2 Add new paragraph 3.6.3 , 3.6.4, 3.6.5 and 3.6.6 as follows:

3.6.3 "The superintendent for the project shall be acceptable to the *Owner* and *Consultant*, and shall be in full time attendance at the *Place of Work* while the *Work* is being performed. The *Contractor* shall provide the *Owner* and the *Consultant* with the names, addresses and telephone numbers of the superintendent referred to in this paragraph 3.6.1 and other responsible persons who may be contacted for emergency and other reasons during non-working hours."

3.6.4 "The superintendent shall not be changed by the *Contractor* without valid reason, which reason shall be provided in writing. The superintendent shall not be changed without prior consultation with and agreement by the *Owner* and the *Consultant*."

3.6.5 "The *Contractor* shall replace the superintendent within 7 *Working Days* of the *Owner's* written notification, if the superintendent's performance is not acceptable to the *Owner*."

3.6.6 "The superintendent must remain assigned to the project and present on the project worksite from the start of the Work, through the lien period, and shall remain on the project worksite until all deficiencies are completed and accepted, unless otherwise authorized by the Consultant or the Owner."

SC18 GC 3.7 SUBCONTRACTORS AND SUPPLIERS

SC18.1 In paragraph 3.7.1.1 add to the end of the second line "including any warranties and service agreements which extend beyond the term of the *Contract*."

SC18.2 In subparagraph 3.7.1.2 after the words "the *Contract Documents*" insert the words "including any required surety bonding".

SC18.3 Add to the end of paragraph 3.7.2 the following sentences:

"Substitution of any *Subcontractor* and/or *Suppliers* after submission of the *Contractor's* bid will not be accepted unless a valid reason is given in writing to and approved by the *Owner*, whose approval may be arbitrarily withheld. The reason for substitution must be provided to the *Owner* and to the original *Subcontractor* and/or *Supplier* and the *Subcontractor* and/or *Supplier* shall be given the opportunity to reply to the *Contractor* and *Owner.* The *Contractor* shall be fully aware of the capability of each *Subcontractor* and/or *Supplier* included in its bid, including but not limited to technical ability, financial stability and ability to maintain the proposed construction schedule."

SC18.4 In paragraph 3.7.4, change the word "shall" to "may" in the second line.

SC18.5 Add new paragraphs 3.7.7 and 3.7.8 as follows:

3.7.7 "Where provided in the *Contract*, the *Owner* may assign to the *Contractor*, and the *Contractor* agrees to accept, any *Contract* procured by the *Owner* for *Work* or services required on the *Project* that has been pre-tendered or pre-negotiated by the *Owner*."

3.7.8 "The *Contractor* covenants that each subcontract or supply contract which the *Contractor* enters into for the purpose of performing the *Work* shall expressly provide for the assignment thereof to the *Owner* (at the option of the *Owner*) and the assumption by the *Owner* of the obligations of the *Contractor* thereunder, upon the termination of the *Contract* and upon written notice by the *Owner* to the other parties to such subcontracts or supply contracts, without the imposition of further terms or conditions; provided, however, that until the *Owner* has given such notice, nothing herein contained shall be deemed to create any contractual or other liability upon the *Owner* for the performance of obligations under such subcontracts or supply contracts."

SC19 GC 3.8 LABOUR AND PRODUCTS

SC19.1 Add new paragraphs 3.8.4 and 3.8.5 as follows:

3.8.4 "All manufactured *Products* which are identified by their proprietary names or by part or catalogue number in the *Specifications* shall be used by the *Contractor.* No substitutes for such specified *Products* shall be used without the written approval of the *Owner* and the *Consultant*. Substitutes will only be considered by the *Consultant* when submitted in sufficient time to permit proper review and investigation. When requesting approval for the use of substitutes, the *Contractor* shall include in its submission any proposed change in the *Contract Price*. The *Contractor* shall use all proprietary *Products* in strict accordance with the manufacturer's directions."

3.8.5 "Materials, appliances, equipment and other *Products* are sometimes specified by reference to brand names, proprietary names, trademarks or symbols. In such cases, the name of a manufacturer, distributor, *Supplier* or dealer is sometimes given to assist the *Contractor* to find a source *Supplier*. This shall not relieve the *Contractor* from its responsibility from finding its own source of supply even if the source names no longer supplies the *Product* specified. If the *Contractor* is unable to obtain the specified *Product*, the *Contractor* shall supply a substitute product equal to or better than the specified *Product,* as approved by the *Consultant,* with no extra compensation. Should the *Contractor* be unable to obtain a substitute *Product* equal to or superior to the specified *Product* and the *Owner* accepts a different Product, the *Contract Price* shall be adjusted accordingly, as approved by the *Consultant*."

SC20 GC 3.10 SHOP DRAWINGS

SC20.1 Add new paragraph 3.10.13 as follows:

3.10.13 "Reviewed *Shop Drawings*, including comments and/or instructions marked thereon, shall not authorize a change in the *Contract Price* and/or the *Contract Time*."

SC21 GC 3.13 CLEAN UP

SC21.1 Add new paragraph 3.13.4 as follows:

3.13.4 "In the event that the *Contractor* fails to remove waste and debris as provided in this GC 3.13, then the *Owner* or the *Consultant* may give the *Contractor* twenty-four (24) hours written notice to meet its obligations respecting clean up. Should the *Contractor* fail to meet its obligations pursuant to this GC 3.13 within the twenty-four (24) hour period next following delivery of the notice, the *Owner* may remove such waste and debris and deduct from payments otherwise due to the *Contractor*, the *Owner's* costs for such clean up, including a reasonable mark-up for administration costs."

SC22 GC 3.14 BOARD OCCUPANCY

SC22.1 Add a new General Condition 3.14 – BOARD OCCUPANCY as follows:

3.14.1 "The *Board* and other *Contractors* as assigned by the *Board* shall have the right to enter, use and occupy the *Work* site, in whole or in part, and place fittings and equipment at or within the *Work* before completion of the Contract. The *Contractor* shall observe and protect the right of other *Contractors* and persons authorized by the *Board* or *Consultant* to use the *Work* site."

3.14.2 "The *Contractor* shall provide free and safe access to the building should the *Board* require occupation prior to completion of the *Contract*. The *Contractor* shall not be entitled to an indemnity for any interference with the Contractor's operations and any *Work* still to be performed by the *Contractor* shall be

performed at times other than when the building is occupied. *Board* costs for *Board* staff required to be present during *Work* being carried out by the *Contractor* and/or by any of the *Sub-Contractors* on weekends and after hours shall be paid by the *Contractor*."

3.14.3 "Such entry and occupancy by the *Board* shall not be considered as acceptance of the *Work* or relieve the *Contractor* of the Contractor's responsibility to complete the project in an acceptable manner, to an acceptable level of quality, within the agreed *Project Schedule.*"

SC23 GC 4.1 CASH ALLOWANCES

SC23.1 Delete and replace the last sentence in paragraph 4.1.4 with the following sentence:

"Multiple cash allowances, if more than one exists, may be combined for the purpose of calculating the foregoing.

SC23.2 Delete and replace paragraph 4.1.5 with the following sentence:

"Where costs exceed the total amount of all Cash Allowances, the Contract Price shall be adjusted by Change Order. Overhead and Profit charges may only be charged to overruns on the sum total of the Cash Allowances. The maximum mark up on the authorized overrun on Cash Allowances shall be 5%."

SC23.3 Add new paragraphs 4.1.8 and 4.1.9 as follows:

4.1.8 "The *Owner* reserves the right to call, or to have the *Contractor* call, for competitive bids for portions of the *Work*, which are to be paid for from cash allowances."

4.1.9 "Cash allowances cover the net cost to the *Contractor* of services, *Products*, *Construction Equipment*, freight, unloading, handling, storage, installation, provincial sales tax, and other authorized expenses incurred in performing any *Work* stipulated under the cash allowances but does not include any *Value Added Taxes* payable by the *Owner* and the *Contractor."*

SC24 GC 4.2 CONTINGENCY ALLOWANCE

SC24.1 Delete existing paragraph 4.2.1 and replace with the following:
"No contingency allowance is included in the Contract.

SC24.2 Delete existing paragraph 4.2.2 in its entirety.

SC24.3 Delete existing paragraph 4.2.3 in its entirety.

SC25 GC 5.1 FINANCING INFORMATION REQUIRED OF THE OWNER

SC25.1 Delete GC 5.1, including paragraphs 5.1.1 and 5.1.2 in their entirety.

SC26 GC 5.2 APPLICATIONS FOR PROGRESS PAYMENT

SC26.1 Delete and replace paragraph 5.2.3 with the following:

"The amount claimed shall be for the value, proportionate to the amount of the *Contract*, of *Work* performed and *Products* delivered and incorporated into the *Work* as of the last day of the payment period. No amount claimed shall include *Products* not incorporated into the Work (whether delivered to the site or not) except when prior financial and/or security arrangements are made and agreed to by the *Contractor*, *Owner* and *Consultant*."

SC26.2 Add the following additional sentence to the end of paragraph 5.2.7:

"Such *Products* not incorporated shall, prior to any such consideration for payment, be free and clear of all security interests, liens and other claims of third parties."

SC26.3 Add new paragraph 5.2.8 as follows:

5.2.8 "Each application for payment, except the first, shall include a statutory declaration, in the CCDC 9A – 2001 form, up to the date of the application for payment, in a form approved by the Consultant. Each application for payment (including the first), shall also include:

.1 A certificate, issued by an agency or firm providing workers' compensation insurance to the *Contractor*, verifying that coverage is in force at the time of making the application for payment, and that coverage will remain in force for at least sixty (60) days thereafter.

.2 A declaration by the *Contractor*, in a form approved by the *Consultant*, verifying that the performance of the *Work* is in compliance with all applicable regulatory requirements respecting environmental protection, fire safety, public safety and occupational health and safety.

.3 A pre-approved schedule of values, supplied by the *Contractor*, for Divisions 1 through 14 of the *Work*, aggregating the total amount of the *Contract Price.*

.4 A separate pre-approved schedule of values, supplied by each *Subcontractor*, for each of Division 15 (Mechanical) and 16 (Electrical) of the *Work*, aggregating the total amount of the *Contract Price* for those divisions of work.

.5 Invoices to support all claims against the cash allowance.

.6 An acceptable construction schedule pursuant to GC 3.5."

SC27 GC 5.3 PROGRESS PAYMENT

SC27.1 In the first sentence, after the words "after the receipt by the Consultant" add the word "complete".

SC27.2 Delete subparagraph 5.3.1.3 in its entirety and substitute as follows:

"The *Owner* shall make payment to the *Contractor* on account as provided in Article A-5 of the Agreement – PAYMENT no later than 30 calendar days after the date of a complete certificate of payment is issued by the *Consultant"*

SC27.3 Add new paragraphs 5.3.4 and 5.3.5 as follows:

5.3.4 "The schedule of values required by paragraph 5.2.4, shall provide for the establishment of a Reserve Fund equivalent to the value of One percent (1%) of the Work performed, which fund shall be held in an interest-bearing trust account in the name of the *Owner* and paid to the Contractor at the time of final completion of the Work. This Reserve Fund shall be in addition to any required Construction Lien Holdback. The funds shall be subject to claims by the *Owner* and others as provided for under the terms of the *Contract Documents.*"

5.3.5 "In the event of construction lien action affecting the Project, the Contractor agrees to indemnify and compensate the *Owner* for any expenses incurred. The *Owner* reserves the right to secure the possible cost of construction liens by retaining from the amount of the next payment certificate a sum equal to the amount of any lien claim plus an additional amount of 25% of any such lien amount. Funds so retained and not so expended, shall be released to the Contractor upon the full discharge of all liens and dismissal of all actions against the Owner".

SC28 GC 5.4 SUBSTANTIAL PERFORMANCE OF THE WORK

SC28.1 Add new paragraphs 5.4.4, 5.4.5 and 5.4.6 as follows:

5.4.4 Following the issuance of a certificate of *Substantial Performance of the Work*, the *Consultant* will review the *Work* and prepare a list of deficiencies and incomplete *Work* items.

.1 The Consultant will assign a monetary value to each item.

.2 Values assigned shall be those estimated to be required to have deficiencies corrected by an outside Contractor, not currently engaged in the Work of the Contract.

.3 The total of such amounts will be withheld from payments form a portion of the Deficiency Holdback, conditions for which are listed in GC 5.10 – DEFICIENCY HOLDBACK.

.4 Re-review of deficiencies and incomplete *Work* items shall be in accordance with provisions and procedures as detailed in the Specifications, including payment and/or withholding of payment provisions and procedures.

5.4.5 "Within the time prescribed by the construction/builder's lien legislation in force at the *Place of the Work*, or where there is no legislation or no time prescribed, within a reasonable time of receiving a copy of the certificate of *Substantial Performance of the Work* signed by the *Consultant*, the *Contractor* shall take whatever steps are required to publish or post a signed copy of the certificate, as is required by such legislation. If the *Contractor* fails to comply with this provision,

the *Owner* may take the required steps pursuant to the legislation and charge the *Contractor* for any costs so incurred."

5.4.6 Following the issuance of the certificate of *Substantial Performance of the Work*, the following shall apply to completing the *Work*:

.1 *Contractor* is to complete the *Work* within sixty (60) calendar days, or such shorter time period as is established under paragraph 5.4.3.

.2 No payments will be processed following *Substantial Performance of the Work* and prior to Total Performance of the *Work*.

.3 The *Owner* reserves the right to contract out any or all unfinished *Work* if it has not been completed within sixty (60) days of *Substantial Performance of the Work* without prejudice to any other right or remedy and without affecting the warranty period. The cost of completing the *Work* shall be deducted from the *Contract Price.*

SC29 GC 5.5 PAYMENT OF HOLDBACK UPON SUBSTANTIAL PERFORMANCE OF THE WORK

SC29.1 Amend paragraph 5.5.2 by adding the following sentence to the end of that paragraph:

"In addition to a Reserve Fund noted in SC27.3, paragraph 5.3.4, a Deficiency Holdback may also be retained by the *Owner* to secure the correction of deficiencies and/or warranty claims. Included in these amounts would be all *Consultant* and *Owner* costs related to the correction of deficiencies and/or warranty claims."

SC29.2 Delete paragraphs 5.5.3 and 5.5.5 in their entirety.

SC29.3 Add new replacement subparagraph 5.5.3 as follows:

5.5.3 "Failure by the *Contractor* to publish the Substantial Performance Certificate places no onus on the *Consultant* or *Owner* to do so. If the Certificate is not published, the *Owner* shall release the holdback to the *Contractor* 45 days after the contract is deemed complete, again having satisfied themselves as above."

SC30 GC 5.6 PROGRESSIVE RELEASE OF HOLDBACK

SC30.1 Delete GC 5.6 in its entirety and replace with the following paragraph 5.6.1:

5.6.1 "No progressive release of holdback on separate sub-contracts will be made. After *Substantial Performance of the Work* and until *Total Performance of the Work*, no payments will be made on the *Contract* with the exception of release of holdback."

SC31 GC 5.7 FINAL PAYMENT

SC31.1 Add to the end of paragraph 5.7.2 the following:

"The *Work* shall be deemed not to be completed until all of the documents listed in the Contract Documents have been delivered and confirmed as being satisfactory. The *Owner* may withhold payment in respect of the delivery of any documents in an amount determined by the *Consultant* in accordance with the provisions of GC 5.8 - WITHHOLDING OF PAYMENT."

SC31.2 Delete from the second line of paragraph 5.7.4 the words, " 5 calendar days after the issuance" and substitute the words "30 calendar days after receipt of".

SC32 GC 5.10 DEFICIENCY HOLDBACK

SC32.1 Add a new General Condition 5.10 – DEFICIENCY HOLDBACK as follows:

5.10.1 "Notwithstanding any provisions contained in the *Contract Documents* concerning certification and release of monies to the *Contractor*, the *Owner* reserves the right to establish a Deficiency Holdback, in addition to a Reserve Fund, at the time of the review for *Substantial Performance."*

5.10.2 "Amount of the Deficiency Holdback shall be based upon one or more of the following:

.1 The total of the values assigned to Deficiency List items, as described in GC 5.4, Item 5.4.4.1;

.2 A premium to be determined, based upon individual *Project* completion circumstances present at the time of the deficiency review, up to a total of 100% of the dollar value of the deficiencies listed by the *Consultant.*"

5.10.3 "The *Owner* shall retain the entire deficiency holdback amount until completion of all of the deficiencies listed by the *Consultant* to the satisfaction of the *Consultant and Owner*."

SC33 GC 6.1 OWNER'S RIGHT TO MAKE CHANGES

SC33.1 Add new paragraphs 6.1.3 and 6.1.4 as follows:

6.1.3 "The *Contractor* agrees that changes resulting from construction coordination, including but not limited to, site surface conditions, site coordination, and *Sub-Contractor and Supplier* coordination are included in the *Contract Price* and the *Contractor* shall be precluded from making any claim for a change in the *Contract Price* as a result of such changes."

6.1.4 "Labour costs shall be actual, prevailing rates at the *Place of the Work* paid to workers, plus statutory charges on labour including WSIB, unemployment insurance, Canada pension, vacation pay, hospitalization and medical insurance. The *Contractor* shall provide proof of these rates, when requested by the *Consultant*, for review and/or agreement."

SC34 GC 6.2 CHANGE ORDER

SC34.1 Add new paragraph 6.2.3 as follows:

6.2.3 "The value of a change shall be determined in one or more of the following methods as directed by the *Consultant*:

.1 by estimate and acceptance of a lump sum, such estimate including a detailed breakdown of all labour and materials involved in executing the change to the *Work*;

.2 by negotiated unit prices which include the *Contractor's* overhead and profit, as noted in paragraph 6.2.4, or;

.3 by negotiated and accepted lump sum amount, including the *Contractor's* overhead and profit, *as noted in paragraph 6.2.4."*

SC34.2 Add new paragraph 6.2.4 as follows:

6.2.4 "Overhead and profit charged on Changes, resulting in extra costs, shall be calculated as follows:

.1 Combined overhead and profit mark up on *Work* performed by the General *Contractor's* own forces shall not exceed 10%.

.2 Overhead and profit shall not be charged on credits to the *Contract*. Where a change includes both credits and extras, overhead and profit shall apply only to the net extra amount.

.3 General *Contractor's* combined overhead and profit mark up on subcontract work shall not exceed 5%.

.4 Combined overhead and profit mark up charged by *Subcontractors* on their own *Work*, shall not exceed 10%."

.5 Subcontractor's combined overhead and profit mark up on subcontract work shall not exceed 5%".

SC34.3 Add new paragraph 6.2.5 as follows:

6.2.5 "All quotations will be submitted in a complete manner listing:

.1 quantity of each material,

.2 unit cost of each material,

.3 man hours involved for each type of labour,

.4 cost per hour for each type of labour,

.5 overhead and profit (markup),

.6 *Subcontractor* quotations submitted listing items .1 to .5 above."

SC34.4 Add new paragraph 6.2.6 as follows:

"Allowances for overhead and profit shall cover all of the General Contractor's and Subcontractor's administrative and incidental costs relating to a change including, without limitation, costs relating to project managers, superintendents, assistants, watchpersons and administrative personnel, shop drawing production, head office and site office expenses, worker tools, temporary facilities, bonds, insurance, transportation, record drawings, cleanup and disposal of waste materials".

SC35 GC 6.3 CHANGE DIRECTIVE

SC35.1 Delete and replace paragraph 6.3.6.1 with the following:

6.2.4 "Overhead and profit charged on Change Directive items shall be calculated as follows:

.1 Combined overhead and profit mark up on *Work* performed by the General *Contractor's* own forces shall not exceed 10%.

.2 Overhead and profit shall not be charged on credits to the *Contract*. Where a change includes both credits and extras, overhead and profit shall apply only to the net extra amount.

.3 General *Contractor's* combined overhead and profit mark up on subcontract work shall not exceed 5%.

.4 Combined overhead and profit mark up charged by *Subcontractors* on their own *Work*, shall not exceed 10%."

.5 Subcontractor's combined overhead and profit mark up on subcontract work shall not exceed 5%.

SC35.2 In subparagraph 6.3.7.1 insert "while directly engaged in the work attributable to the change" after the words "in the direct employ of the *Contractor*".

SC36 GC 6.4 CONCEALED OR UNKNOWN CONDITIONS

SC36.1 Add new paragraph 6.4.5 as follows:

6.4.5 "Prior to the submission of the bid on which the *Contract* was awarded, the *Contractor* confirms that it carefully investigated the *Place of the Work* and carried out such tests as it deemed appropriate and, in doing so, applied to that investigation an appropriate degree of care and skill.

The *Contractor* is deemed to assume all risk of conditions or circumstances now existing or arising in the course of the *Work* which could make the Work more expensive or more difficult to perform than was contemplated at the time the *Contract* was executed. No claim by the *Contractor* will be considered by the *Owner* or the *Consultant* in connection with conditions which could reasonably have been ascertained by such investigation or other due diligence undertaken prior to the execution of the *Contract*."

SC36.2 Add new paragraph 6.4.6 as follows:

6.4.6 "Having regard to paragraph 6.4.5, if the *Contractor* believes that the conditions of the *Place of the Work* differ materially from those indicated in the *Contract Documents,* from those reasonably anticipated, or conditions which were reasonably concealed from discovery notwithstanding the conduct of the investigation described in paragraph 6.4.5, it shall provide the *Owner* and the *Consultant* with *Notice in Writing* no later than five (5) *Working Days* after the first observation of such conditions." If contractor does not provide notice in writing within five working days, it will be understood by the Owner and Contractor that the conditions of the site are as per Contract Drawings and Specifications.

SC37 GC 6.5 DELAYS

SC37.1 Delete paragraph 6.5.3 in its entirety and replace with the following:

"If the *Contractor* is delayed in the performance of the *Work* by *Force Majeure*, then the *Contract Time* shall be extended for such reasonable time as the *Consultant* may recommend in consultation with the *Contractor*. The extension of time shall not be less than the time lost as a result of the event causing the delay, unless the *Contractor* agrees to a shorter extension. The *Contractor* shall not be entitled to payment for costs incurred by such delays unless such delays result from the actions of the *Owner."*

SC37.2 Add new paragraphs 6.5.6, 6.5.7 and 6.5.8 as follows:

6.5.6 "If the *Contractor* is delayed in the performance of the *Work* by an act or omission of the *Contractor* or anyone directly or indirectly employed or engaged by the *Contractor,* or by any cause within the *Contractor's* control, then the *Contract Time* may be extended for such reasonable time as the *Owner* may decide in consultation with the *Consultant* and the *Contractor*. The *Owner* shall be reimbursed by the *Contractor* for all reasonable costs incurred by the *Owner* as the result of such delay, including, but not limited to, the cost of all additional services required by the *Owner* from the *Consultant* or any sub-consultants, project managers, or others employed or engaged by the *Owner*, and in particular, the costs of the *Consultant's* services during the period between the date of *Substantial Performance of the Work* stated in Article A-1 herein, as the same may be extended through the provision of these General Conditions, and any later or actual date of *Substantial Performance of the Work* achieved by the *Contractor*."

6.5.7 "No claim for delay shall be made and the *Contract Time* shall not be extended due to climatic conditions which are within normal or expected statistical maximums and minimums, within a ten year time period, or arising from the *Contractor's* efforts to maintain the *Contract* schedule."

6.5.8 "The parties acknowledge the construction of the *Work* is designed to accommodate the requirements of the *Owner* and failure to attain *Substantial Performance* by the date stipulated in the Agreement shall result in inconvenience and expense to the *Owner* and its teachers, students, and others – the exact extent of which is virtually impossible to calculate. Consequently, the parties agree that their best estimate of costs involved in delay beyond the stipulated date for *Substantial Performance* is $ 1000.00 (**One Thousand Dollars) per day** and said sum shall be paid by the *Contractor* to the *Owner* for each Working Day of the delay, and shall be deemed for all purposes as reasonable compensation to the *Owner* for delay costs only. This amount is not, and shall not be deemed to be a penalty, but is a fair estimate of the actual costs resulting from the delay, and shall be charged in addition to all other cost provided for in the contract documents".

SC38 GC 6.6 CLAIMS FOR A CHANGE IN THE CONTRACT PRICE

SC38.1 Delete GC 6.6 in its entirety.

SC39 GC 7.1 OWNER'S RIGHT TO PERFORM THE WORK, TERMINATE THE CONTRACTOR'S RIGHT TO CONTINUE WITH THE WORK OR TERMINATE THE CONTRACT

SC39.1 Add a new subparagraph 7.1.3.4 as follows:

7.1.3.4 "An "acceptable schedule" as referred to in subparagraph 7.1.3.2. means a schedule approved by the *Consultant* and the *Owner* wherein the default can be corrected within the balance of the *Contract Time* and shall not cause delay to any other aspect of the *Work* or the *Work* of other *Contractors*, and in no event shall it be deemed to give a right to extend the *Contract Time*."

SC39.2 Add new paragraph 7.1.7 as follows:

7.1.7 "In addition to any changes certified by the *Consultant,* pursuant to the provisions of item 7.1.5.3 of the General Conditions, the *Contractor* shall:

.1 pay an allowance for the additional time and services required by the *Board's* representative and other employees equivalent to the relevant payroll costs, plus 150%.

.2 be responsible for all legal costs incurred by the *Board* with respect to liens arising out of this *Contract*. This includes all costs to perform more than one search per payment such that it includes the costs of all searches discovering liens registered against the *Board's* property, arising out of the *Contract*."

SC40 GC 7.2 CONTRACTOR'S RIGHT TO SUSPEND THE WORK OR TERMINATE THE CONTRACT

SC40.1 Delete paragraph 7.2.2, in its entirety.

SC40.2 Delete subparagraph 7.2.3.1, 7.2.3.2 and 7.2.3.3 in their entirety.

SC40.3 In subparagraph 7.2.3.4, delete the words "except for GC 5.1 - FINANCING INFORMATION REQUIRED OF THE OWNER".

SC40.4 Renumber paragraph 7.2.5 as paragraph 7.2.6. Add a new paragraph 7.2.5 as follows:

7.2.5 "If the default cannot be corrected within the 5 *Working Days* specified in paragraph 7.2.4, the *Owner* shall be deemed to have cured the default if it:

.1 commences correction of the default within the specified time;

.2 provides the *Contractor* with an acceptable schedule for such correction; and,

.3 completes the correction in accordance with such schedule."

SC40.5 Delete paragraph 7.2.6 (previous 7.2.5) entirely and replace with the following:

7.2.6 "If the *Contractor* terminates the *Contract* under the conditions described in GC 7.2 – CONTRACTOR'S RIGHT TO SUSPEND THE WORK OR TERMINATE THE CONTRACT, the *Contractor* shall be entitled to be paid for

all *Work* performed to the date of termination, as determined by the *Consultant*. The *Contractor* shall also be entitled to recover the direct costs associated with termination, including the costs of demobilization and losses sustained on *Products* and *Construction Equipment*. The *Contractor* shall not be entitled to any recovery for any special, indirect or consequential losses, including loss of profit."

SC40.6 Add new paragraphs 7.2.7, 7.2.8 and 7.2.9 as follows:

7.2.7 "The *Contractor* shall not be entitled to give notice of the *Owner's* default or terminate the *Contract* in the event the *Owner* withholds certificates or payment or both in accordance with the *Contract* because of:

.1 the *Contractor's* failure to pay all legitimate claims promptly, or

.2 the *Contractor's* failure to correct deficiencies and incomplete Work in accordance with timelines set out elsewhere in the Contract Documents, or

.3 the failure of the *Contractor* to discharge construction liens which are registered against the title to the *Place of the Work."*

SC41 GC 8.2 NEGOTIATION, MEDIATION AND ARBITRATION

SC41.1 Delete paragraph 8.2.1 and substitute the following therefore:

"Subject to the consent of each of the Owner and Contractor, the parties may appoint a Project Mediator in accordance with the Rules for Mediation of Construction Disputes as provided in CCDC 40 in effect at the time of bid closing, within 20 Working Days after Notice in Writing is given by one party to another of a dispute which the parties have been unable to resolve amicably with the assistance of the Consultant".

SC41.2 Amend paragraph 8.2.4 by changing part of the second line from "the parties shall request the Project Mediator" to "and subject to paragraph 8.2.1 the parties may request the Project Mediator".

SC41.3 Delete paragraphs 8.2.6, 8.2.7 and 8.2.8 in their entirety.

SC41.4 Add new paragraph as follows:
The dispute may be finally resolved by arbitration under the Rules of Arbitration of Construction Disputes, as provided in CCDC 40 in effect at the time of bid closing, provided that both the Contractor and the Owner agree. If the Contractor and the Owner agree to resolve the dispute by arbitration, the arbitration shall be conducted in the jurisdiction of the Place of Work.

SC42 GC 9.1 PROTECTION OF WORK AND PROPERTY

SC42.1 Delete subparagraph 9.1.1.1 in its entirety and substitute the following:

"Errors in the *Contract Documents* which the *Contractor* could not reasonably have discovered applying the proper level of care and diligence;"

SC43 GC 9.2 TOXIC AND HAZARDOUS SUBSTANCES

SC43.1 Add a new subparagraph 9.2.5.5 as follows:

9.2.5.5 "In addition to the steps described in subparagraph 9.2.5.3, take any further steps it deems necessary to mitigate or stabilize any conditions resulting from encountering toxic or hazardous substances or materials."

SC43.2 Add new paragraphs 9.2.10, 9.2.11 and 9.2.12 as follows:

9.2.10 "The *Contractor*, *Sub-Contractors* and *Suppliers* shall not bring on to the *Place of the Work* any toxic or hazardous substances and materials except as required in order to perform the *Work*. If such toxic or hazardous substances or materials are required, storage in quantities sufficient to allow Work to proceed to the end of any current Work week only shall be permitted. All such toxic and hazardous materials and substances shall be handled and disposed of only in accordance with all laws and regulations that are applicable at the *Place of the Work*."

9.2.11 "The *Contractor* shall indemnify and hold harmless the *Owner*, the *Consultant* and their respective directors, officers, trustees, agents and employees, from and against any and all liabilities, costs, expenses, and claims resulting from bodily injury, including death, and damage to property of any person, corporation or other body politic, that arises from the use by the *Contractor*, *Sub-Contractors* and *Suppliers* of any toxic or hazardous substances or materials at the *Place of the Work*."

9.2.12 "Renovation and/or Alterations Projects: Asbestos containing materials may have been used during the original construction or previous alteration of School Board facilities. If asbestos containing materials are discovered during the course of the *Project*, stop Work and immediately notify the *Owner* and the *Consultant*. Do not remove existing material containing asbestos fibres."

SC44 GC 9.4 CONSTRUCTION HEALTH AND SAFETY

SC44.1 Rename General Condition 9.4 to read: CONSTRUCTION HEALTH AND SAFETY

SC44.2 Delete paragraph 9.4.1 in its entirety and substitute as follows:

9.4.1 "The *Contractor* shall be solely responsible for construction safety at the *Place of the Work* and for compliance with the rules, regulations, and practices required by the applicable construction health and safety legislation and shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the performance of the *Work."*

SC44.3 Add new paragraphs 9.4.2 to 9.4.10 as follows:

9.4.2 "Observe and enforce construction safety measures required by the National Building Code (1990) Part 8; the Provincial Government; Workers' Compensation Board; and, Municipal authorities. In particular, the Occupational Health and Safety Act (Ont. Reg. 213/91), the Ontario Construction Safety Act, WHMIS, the regulations of the Ontario Ministry of Labour and Ontario Hydro Safety Requirements shall be strictly enforced."

9.4.3 "The *Board* reserves the right to engage in separate contracts, beyond those of the General *Contractor,* as part of the total construction of the Project. These separate contracts shall include, but need not be limited to, the supply and installation of plug-in/plug-out units; supply and installation of draperies, stage equipment, projection equipment and storage shelving units; the supply and installation of telephone, communication, computer and surveillance systems, equipment, wiring and components; the supply and placement of furnishings; and graphic art services."

9.4.4 "The General *Contractor,* hereafter called the "*Constructor*" as defined by the Occupational Health and Safety Act of Ontario, shall be responsible for supervising and directing any such contractors as the Board may choose to perform Work on the site. The *Constructor* shall ensure that all contractors conform to the requirements of Health and Safety legislation and site policies while on the contract site."

9.4.5 "*Constructor* shall ensure that copies of all applicable construction safety regulations, codes and standards are available on the job-site throughout the period of construction. All workers are to be informed that these documents are available for reference at any time."

9.4.6 "The *Constructor* shall ensure that all supervisory personnel on the job-site are fully aware of the contents of the Occupational Health and Safety Act (Ontario Regulation 213/91 - Construction Projects), as amended, and the "Workers' Compensation Act" and that they comply with all requirements and procedures prescribed therein including, but not limited to, the following construction safety requirements:

.1 *Constructor* to register with the Director of the Occupational Health and Safety Division prior to commencement of *Work* on the Project, and (O. Reg. 213/91, sec 5).

.2 File a notice of Project and commencement of the Project, (O. Reg. 213/91, sec 6).

.3 Notification prior to trenching deeper than 1.2 m, (O. Reg. 213/91, sec 7).

.4 Establish a Joint Health and Safety and/or Worker Trades Committee, as required.

.5 Ensure that all activities arising out of the above are recorded and that minutes are available to an inspector of the Ontario Ministry of Labour.

.6 The *Contractor* shall be considered as the "Constructor" in consideration of the rights and responsibilities for all construction safety requirements, procedures, facilities and inspection of all Work

performed by the *Contractor*, *Sub-Contractors*/Sub-trades and other *Contractors* engaged on this Project.

.7 In the event of a conflict between any of the provisions of the above authorities, **the most stringent provisions are to be applied**."

9.4.7 "Material Safety Data Sheets (MSDS) must be available at the Project site for any product **designated hazardous** or containing **hazardous ingredients** prior to being used, installed or applied inside the building."

9.4.8 "The *Constructor* must provide a job introduction or safety indoctrination session for all personnel and trades Working, inspecting and/or supervision the site."

9.4.9 "The *Constructor* will be responsible for taking all necessary steps to protect personnel (Workers, visitors, general public, etc.) and property from any harm throughout the duration of the Contract."

9.4.10 "The *Constructor* shall supply **competent personnel** to implement the Health and Safety program and ensure compliance with the company's standards and those of the Occupational Health and Safety Act of Ontario."

9.4.11 "The *Constructor* will include these provisions in any agreement with sub-contractors or trades and shall monitor compliance."

9.4.12 "The *Constructor* is responsible for any delays in the progress of Work due to an infraction of legislated or site Health and Safety requirements.

.1 If, in the opinion of the consultant, additional Work and steps to recover such delays are necessary to meet dates set in the Contract, the Constructor shall provide all such services without any additional cost to the Board."

9.4.13 "During the course of the Project, if the Health and Safety policies of the Constructor are found to be deficient and/or the CAD-7 rating by the WCB has changed adversely, additional full-time **accredited safety personnel** must be appointed without extra cost to the *Board*."

9.4.14 "The *Contractor* shall promptly report in writing to the *Owner* and the *Consultant* all accidents of any sort arising out of or in connection with the performance of the *Work*, whether on or adjacent to the job site, giving full details and statement of witnesses. If death or serious injuries or damages are caused, the accident shall be promptly reported by the *Contractor* to the *Owner* and the *Consultant* by telephone or messenger in addition to any reporting required under the applicable safety regulations."

SC45 GC 10.2 LAWS, NOTICES, PERMITS, AND FEES

SC45.1 Amend paragraph 10.2.2 by deleting the words "building permit".

SC45.2 Delete and replace paragraph 10.2.3 to read:

10.2.3 "The Contractor shall be responsible for the procurement of permits, licenses, inspections, and certificates, which are necessary for the performance of the Work, except those as noted in paragraph 10.2.2 and as described in the Specifications, Section 01001 – *Summary of Work and Special Conditions*, Item 1.14.3 – *Construction Related Fees, Permits, Building Permit*."

SC45.3 Add new paragraph 10.2.8 as follows:

10.2.8 "The *Contractor* shall furnish all certificates that are required or given by the appropriate governmental authorities as evidence that the *Work* as installed conforms with the laws and regulations of authorities having jurisdiction, including certificates of compliance for the *Owner's* occupancy or partial occupancy. The certificates are to be final certificates giving complete clearance of the *Work*, in the event that such governmental authorities furnish such certificates."

SC45.4 Add new GC 10.2.9 – NOTIFICATIONS TO CHIEF BUILDING OFFICIAL, as follows:

10.2.9 "The contractor shall notify the Chief Building Official or the registered code agency where applicable, of the readiness, substantial completion and completion of the stages of construction set out in Division C - Part 1 1.3.5.1 of the Building Code, O. Reg. 332/12 as amended. The contractor shall be present at each site inspection by an inspector or registered code agency as applicable under Division C - Part 1 1.3.5.1 of the Building Code."

SC46 GC 10.4 WORKERS' COMPENSATION

SC46.1 Revise paragraph 10.4.1 to read as follows:

"Prior to commencing the *Work*, and with each and every application for payment thereafter, including the *Contractor's* application for payment of the holdback amount following *Substantial Performance of the Work* and again with the *Contractor's* application for final payment, the *Contractor* shall provide evidence of compliance with workers' compensation legislation in force at the *Place of the Work*, including payments due thereunder."

SC47 GC 12.1 INDEMNIFICATION

SC47.1 Inclusion of indemnification of *Consultant* by other parties:

Replace the words "*Owner* and the *Contractor*" with the words "*Owner,* the *Contractor* and the *Consultant"* in paragraphs 12.1.1, 12.1.2.1, 12.1.2.2, 12.1.4, 12.1.6

SC47.2 The provisions of GC 12.1 - INDEMNIFICATION shall survive the termination of the *Contract,* howsoever caused and no payment or partial payment, no issuance of a final

certificate of payment and no occupancy in whole or in part of the *Work* shall constitute a waiver or release of any of the provisions of GC 12.1.

SC48 GC 12.2 WAIVER OF CLAIMS

SC48.1 Delete GC 12.2 – WAIVER OF CLAIMS, in its entirety.

SC49 GC 12.3 WARRANTY

SC49.1 Add new paragraphs 12.3.7 to 12.3.12 as follows:

12..3.7 "Where required by the *Contract Documents*, the *Contractor* shall provide a maintenance bond as security for the performance of the *Contractor's* obligations as set out in GC 12.3 WARRANTY."

12.3.8 "The *Contractor* shall provide fully and properly completed and signed copies of all warranties and guarantees required by the *Contract Documents*, containing:

.1 the proper name of the *Owner*;
.2 the proper name and address of the *Project*;
.3 the date the warranty commences, which shall be at the "date of *Substantial Performance of the Work*" unless otherwise directed by the *Consultant* in writing.
.4 a clear definition of what is being warranted and/or guaranteed as required by the *Contract Documents*; and
.5 the signature and seal (if required by the governing law of the *Contract*) of the company issuing the warranty, countersigned by the *Contractor*."

12.3.9 "Should any *Work* be repaired or replaced during the time period for which it is covered by the specified warranty, a new warranty shall be provided under the same conditions and for the same period as specified herein before. The new warranty shall commence at the completion of the repair or replacement."

12.3.10 "The *Contractor* shall ensure that its *Subcontractors* are bound to the requirements of GC 12.3 – WARRANTY for the *Subcontractor's* portion of the *Work."*

SC50 PART 13 OTHER PROVISIONS

SC50.1 Add new Part 13 OTHER PROVISIONS, including GC13.1 as follows:

SC51 GC 13.1 CONSTRUCTION LIENS

SC51.1 Add new GC 13.1 – CONSTRUCTION LIENS, as follows:

13.1.1 "In the event that a claim for lien is registered against the *Project* by a *Sub-Contractor, Sub-Sub-Contractor* or *Supplier*, and provided the *Owner* has paid

all amounts properly owing under the *Contract*, the *Contractor* shall, at its own expense:

.1 within 10 calendar days, ensure that any and all claims for lien and certificates of action are discharged, released, or vacated by the posting of security or otherwise; and

.2 in the case of written notices of lien, ensure that such notices are withdrawn, in writing.

13.1.2 In the event that the *Contractor* fails to conform with the requirements of paragraph 13.1.1, the *Owner* may fulfil those requirements and set off and deduct from any amount owing to the *Contractor*, all costs and associated expenses, including the costs of posting security and all legal fees and disbursements associated with discharging or vacating the claim for lien or certificate of action and defending the action. If there is no amount owing by the *Owner* to the *Contractor*, then the *Contractor* shall reimburse the *Owner* for all of the said costs and associated expenses.

SC52 Add new GC 1.5 – CONTRACT DOCUMENTS, as follows:

1.5.1. Abbreviations may be used in the contract documents and are to be governed by the following clauses.

.1 Abbreviations may or may not be punctuated by periods

.2 Tense, singularity or plurality is to be read in context of note

.3 All notes are to be read in demonstrative syntax

.4 The Contractor is to advise of undefined abbreviations and be responsible for unverifiable assumptions.

.5 Only the Architect has the authority to define abbreviations – clarification will be provided upon request.

.6 The following table (Table 1.5.1) contains abbreviations which may be used in the contract documents:

TABLE 1.5.1:

&	AND
@	AT
+	PLUS
+/-	PLUS OR MINUS, APPROXIMATE SUBJECT TO VERIFICATION
ACT, AC. TILE	ACOUSTIC TILE
AD, A.D.	AREA DRAIN
AD, A.D.	AREA DRAIN
ADJ	ADJUSTABLE
AFF	ABOVE FINISHED FLOOR

ALT	ALTERNATE
ALUM	ALUMINUM
ARCH	ARCHITECTURAL
AVG	AVERAGE
B/F, BF	BARRIER FREE
BR	BRICK
C.T., CT	CERAMIC TILE
C/B	CHALKBOARD
C/C	CENTRE TO CENTRE
C/L	CENTER LINE
C/W	COMPLETE WITH
CAR	CARPET
CB	CHALK BOARD
CCM	CONVEX CEILING MIRROR
CCTV	CLOSED CIRCUIT TV
CH	COAT HOOKS
CH	COAT HOOKS
CLG	CEILING
CON	CONSULTANT
CONC	CONCRETE
CONC BL	CONCRETE BLOCK
CR	COAT RACK
CS	CONVENIENCE SHELF
DEMO	DEMOLITION, DEMOLISH
DET	DETAIL
DF	DRINKING FOUNTAIN
DIA.	DIAMETER
DIM	DIMENSION
DIV	DIVISION
DIV	DIVISION
DO, DITTO	SAME, TYPICAL, REPEAT
DP. C	DAMPPROOF COURSE
DR	DOOR
DR	DOOR
ELEC	ELECTRICAL
ELEV	ELEVATION
EXIST	EXISTING
EXT	EXTERIOR
FB	FIRE BLANKET
FD, F.D.	FLOOR DRAIN

FE	FIRE EXTINGUISHER
FEC	FIRE EXTINGUISHER CABINET
FHC	FIRE HOSE CABINET
FH	FIRE HYDRANT
FIN	FINISH, FINISHED
FIN. FL.	FINISHED FLOOR
FIN. GR	FINISHED GRADE
FRR	FIRE RESISTANCE RATED
FSS	FOLDING SHOWER SEAT
FSS	FOLDING SHOWER SEAT
GALV.	GALVANIZED
GB	GRAB BAR
GBF	FOLDING GRAB BAR
GBL	GRAB BAR L-SHAPE
GBR	GRAB BAR
GBS	SHOWER GRAB BAR
GC	GENERAL CONTRACTOR
GEN	GENERAL
GFA	GROSS FLOOR AREA
GFI	GROUND FAULT INTERRUPTOR
GL	GLAZING
GR	GRADE
GYP BD, G.B.	GYPSUM BOARD
HD	HAND DRYER
HD	HEAVY DUTY
HDF	HIGH DENSITY FIBRE BOARD
HOR	HORIZONTAL
HVAC	HEATING VENTILATION AND AIR CONDITIONING
INT	INTERIOR
LAP	LAY-IN ACCOUSTIC PANEL
M	MIRROR
MAS	MASTIC
MAS	MASONRY
MAX	MAXIMUM
MDF	MEDIUM DENSITY FIBRE BOARD
MECH	MECHANICAL
MET	METAL
MG, M.G.	MAKE GOOD
MH	MAN HOLE
MIN	MINIMUM

MIR	MIRROR
MISC.	MISCELLANEOUS
MOD. BIT	MODIFIED BITUMEN
N.I.C./NIC	NOT IN CONTRACT
N.T.S	NOT TO SCALE
N/A	NOT APPLICABLE
O.C	ON CENTER
OBC	ONTARIO BUILDING CODE
OWSJ	OPEN WEB STEEL JOIST
P.T.	PORCELAIN TILE
PA	PUBLIC ADDRESS SYSTEM
PCT	PRIVACY CURTAIN TRACK INCLUDING CURTAIN
PEO	PROFESSIONAL ENGINEERS OF ONTARIO
PLAM	PLASTIC LAMINATE
PLY	PLY WOOD
POLY	POLYETHYLENE
PREF	PREFFERED
PRE-FIN	PRE-FINISHED
PRE-MAN	PRE-MANUFACTURED
PS	PRESSED STEEL
PTD	PAPER TOWEL DISPENSER
PTD	PAINTED
PVC	POLYVINYL CHLORIDE
R+S	ROD AND SHELF
RD, R.D.	ROOF DRAIN
RE-BAR	REINFORCING BAR
REIN.	REINFORCED
RENO	RENOVATION
REQ'D	REQUIRED
RM	ROOM
RT/SRT/IT	
RWL	RAINWATER LEADER - SEE MECHANICAL OR SITE SERVICING
S.S, SS	STAINLESS STEEL
SCB	SLIDING CHALK BOARD
SD	SOAP DISPENSER
SEC, SECT	SECTION
SEP	SEPARATE
SIM	SIMILAR
SMT	SCIENCE MATH & TECHNOLOGY

SND	SANITARY NAPKIN DISPOSAL
SNDISP	SANITARY NAPKIN DISPENSER
SPEC	SPECIFICATION
SPEC. ED.	SPECIAL EDUCATION
SPMDD	STANDARD PROCTOR MAXIMUM DRY DENSITY
SR+C	SHOWER ROD + CURTAIN
SSD	SHOWER SOAP DISH
STO / STOR	STORAGE
STOR	STORAGE
STRUC	STRUCTURAL
STRUC	STRUCTURAL
SUP	SUPPORT, SUPPORTED
SW/B, SWB	SLIDING WHITE BOARD
T/B	TACKBOARD
T/O	TOP OF
TB	TACK BOARD
TD	TOILET TISSUE DISPENSER
TDD	PAPER TOWEL DISPENSER AND DISPOSAL
TLB	TOWEL BAR
TM T/M	TILTED MIRROR
TYP.	TYPICAL
U/N	UNLESS NOTED OTHERWISE
U/S	UNDERSIDE
V.B	VAPOUR BARRIER
VCT	VINYL COMPOSITE TILE
VCT	VINYL COMPOSITION TILE
VERT, VER	VERTICAL
VEST	VESTIBULE
W/	WITH
W/B	WHITEBOARD
W/D	WASHER DRYER
WC	WATER CLOSET
WD	WOOD
WIN	WINDOW

PART 1 - GENERAL

1.1 Work Covered by Contract Documents

.1 Work of this Contract comprises general construction and renovations to the Gladys Speers Public School located at 2150 Samway Rd, Oakville ON, identified as Project No. 21153.

1.2 Contract Method

.1 Construct the Work under a single fixed price contract.

1.3 Work Sequence

.1 Construct Work in stages to accommodate Owner's continued use of premises during construction and as follows:

.1 Commence Work after July 02, 2022, or as instructed by the Owner. Work to include:

.1 Provision of construction hoarding and isolation as required of Work Areas and staging areas.

.2 Establishment of temporary exits during construction if required, reviewed and approved by local authorities having jurisdiction.

.2 Complete all Work, ready for Occupancy on or before August xx, 2022.

.3 Coordinate Progress Schedule and coordinate with Owner Occupancy during construction.

.4 Required stages:

.1 Mobilization including preparation of Shop Drawings and ordering of materials and equipment are to commence immediately upon the award of Contract.

.2 Contractor to co-ordinate parts of the Work to expedite the required stages.

1.4 Progress Draw Breakdown

.1 Submit proposed breakdown to Consultant for review following award of Contract. Itemized in detail indicating proportions of work of each subtrade in accordance with Sections of this specification, and in further detail as required by the Consultant to accurately assess the progress of Work.

1.5 Contractor Use of Premises

.1 Contractor has unrestricted use of the Work Area until Substantial Performance as scheduled and co-ordinated with the Board.

.2 Contractor shall limit use of premises for Work, for storage, and for access, to allow;
- .1 Owner occupancy.
- .2 Work by other contractors.
- .3 Public usage.

.3 Coordinate use of premises under direction of Owner and Consultant.

.4 Assume full responsibility for protection and safekeeping of products under this Contract.

.5 Obtain and pay for use of additional storage or work areas needed for operations under this Contract.

1.6 Owner Occupancy

.1 Owner will occupy premises during entire construction period for execution of normal operations.

.2 Cooperate with Owner in scheduling operations to minimize conflict and to facilitate Owner usage.

1.7 No Smoking Policy

.1 No person is allowed to smoke at any time on the property. It is the Contractor's responsibility to ensure that his employees and Sub-Contractors, if any, comply with this policy.

1.8 Vehicle and Operation

.1 Conform to regulation of Municipality regarding cleanup of tracking on streets and protection of sidewalks and curbs and other applicable Laws, By-laws and Regulations.

.2 Make arrangements with Owner for suitable access for the site. Pay all charges in connection therewith.

.3 Drivers of motor vehicles shall not operate their vehicles beyond the parking area. Such vehicles shall be operated with due caution at all times while on school property. Speed limits shall not exceed 8 kilometers (5 miles) per hour at any time.

PART 2 - PRODUCTS Not Used.

PART 3 - EXECUTION Not Used.

1 Requirements Included

.1 Cash allowances

2 Cash Allowances

.1 Refer to GC 4.1.

.2 Include in the Contract Price, cash allowances stated herein.

.3 Cash allowances, unless otherwise specified, cover the net cost to the Contractor of services, products, construction machinery and equipment, freight, handling, unloading, storage and other authorized expenses incurred in performing the Work.

.4 The Contract Price, and not the cash allowance, includes the Contractor's overhead and profit in connection with such cash allowance.

.5 The Contract Price will be adjusted by written order to provide for an excess or deficit to each cash allowance.

.6 Where costs under a cash allowance exceed the amount of the allowance, the Contractor will be compensated for any excess incurred and substantiated plus an allowance for overhead and profit as set out in the Contract Documents.

.7 Progress payments on accounts of work authorized under cash allowances shall be included in the Consultant's monthly certificate for payment.

.8 A schedule shall be prepared jointly by the Consultant and Contractor to show when items called for under cash allowances must be authorized by the Consultant for ordering purposes so that the progress of the Work will not be delayed.

.9 The amount of each allowance, for work specified in the respective specificaitons Sections:

.1 Oakville Hydro Charges: $100,000.00
.2 Structural Steel Inspection: $3,000.00
.3 Roofing Inspection: $3,000.00
.4 Subgrade Compaction: $3,000.00
.5 Window Testing: $4,000.00
.6 General: $37,000.00
.7 Projector Supply at Gym: $20,000.00
.8 The total value of above allowances $170,000.00.

3 Contingency Allowances

.1 Refer to GC 4.2.

.2 Include in the Contract Price a stipulated sum contingency allowance in the amount of $80,000.00.

.3 Do not include in the Contract Price, additional sums for products, installation, overhead or profit.

.4 Expenditures under the contingency allowance will be authorized in accordance with the procedures provided in Part 6 - Changes in the Work, and evaluated under GC 6.3.

PART 1 - GENERAL

1.1 Section Includes

.1 Project meetings.

.2 Project coordination.

.3 Cutting and patching.

.4 Field engineering.

.5 Identification systems.

1.2 Related Sections

.1 Section 01601 - Material and Equipment.

.2 Individual Product Sections: Cutting and patching incidental to work of the section. Advance notification to other sections required.

1.3 Meetings

.1 Schedule and administer project meetings throughout the progress of the work at the call of the Consultant.

.2 Provide physical space and make arrangements for meetings.

.3 Record the minutes. Reproduce and distribute copies of minutes within three days after each meeting and transmit to meeting participants.

.4 Within 15 days after award of Contract, request a meeting of parties in contract to discuss and resolve administrative procedures and responsibilities.

.5 Incorporate mutually agreed variations to Contract Documents into Agreement, prior to signing.

.6 During the course of Work schedule progress meetings monthly.

.7 Contractor, major Subcontractors involved in Work and Consultants and Owner are to be in attendance.

1.4 Coordination

.1 Allocate of mobilization areas of site; for field offices and sheds, access, traffic, and parking facilities.

.2 During construction coordinate use of site and facilities through procedures for submittals, reports and records, schedules, coordination of drawings, recommendations, and resolution of ambiguities and conflicts.

.3 Provide information required for preparation of coordination drawings. Review and approve revised drawings for submission to Consultant.

.4 Mechanical and Electrical Coordinator: Employ and pay for services of a person or firm technically qualified and experienced in field coordination for the type of mechanical and electrical work required for this Project, for duration of construction work.

1.5 Cutting and Patching

.1 Execute cutting, fitting, and patching including excavation and fill, to complete the Work.

.2 Remove and replace defective and non-conforming work.

.3 Restore work with new products in accordance with requirements of Contract Documents.

.4 Provide openings in non-structural elements of Work for penetrations of mechanical and electrical work.

.5 Execute work by methods to avoid damage to other work, and which will provide proper surfaces to receive patching and finishing.

.6 Employ original installer to perform cutting and patching for exposed to view materials.

.7 Cut rigid materials using masonry saw or core drill. Pneumatic or impact tools not allowed with masonry materials without prior approval.

.8 Refinish surfaces to match adjacent finishes: For continuous surfaces refinish to nearest intersection; for an assembly, refinish entire unit.

1.6 Field Engineering

.1 Qualified registered land surveyor, acceptable to Owner.

.2 Locate, confirm and protect control points prior to starting site work. Preserve permanent reference points during construction.

.3 Report to Consultant when a reference point is lost or destroyed, or requires relocation because of necessary changes in grades or location.

.4 Establish two permanent bench marks on site, referenced to established bench marks by survey control points. Record locations, with horizontal and vertical data in Project Record Documents.

.5 Establish lines and levels, locate and lay out, by instrumentation.

.6 On completion of foundation, prepare a certified survey showing dimensions, locations, angles and elevations of Work.

1.7 Identification Systems

.1 Submit 2 typed copies of schedules for nameplates and valve tags 15 days prior to inspection for Substantial Performance or 5 days prior to date scheduled for instruction of Owner's personnel.

.2 Nameplate schedules shall list: Pump, control, valves and electrical equipment nameplates.

.3 Include nameplate designation, manufacturer's nameplate data, equipment and component parts; numbers, location of equipment, and switch location and normal operating position of switch.

.4 Valve tag schedules shall list each tag by system. Include reference

number, valve location and usage, system identification, colour code, and function, size and valve manufacturer with model number, and normal operating position of valve.

PART 2 - PRODUCTS Not Used

PART 3 - EXECUTION Not Used

1 Section Includes

.1 Shop drawings and product data

.2 Samples

.3 Certificates and transcripts

2 Related Sections

.1 Section 01310 - Construction Schedule: Submissions of schedules

.2 Section 01400 - Quality Control: Submission of test and mix design mill tests.

.3 Section 01601 - Material and Equipment: Submission of manufacturer's instructions.

.4 Section 01655 - Facility Start-Up: Submission of system and equipment documents.

.5 Section 01721 - Project Record Documents: Operating and maintenance manuals, and record drawings.

3 Administrative

.1 Submit to Consultant submittals listed for review. Submit with reasonable promptness and in orderly sequence so as to not cause delay in the Work. Failure to submit in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.

.2 Work affected by the submittal shall not proceed until review is complete.

.3 Review submittals prior to submission to the Consultant. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and

co-ordinated with the requirements of the Work and the Contract Documents. Submittals not stamped, signed, dated and identified as to the specific project will be returned without being examined and shall be considered rejected.

.4 Verify field measurements and affected adjacent Work are coordinated.

.5 Contractor's responsibility for errors and omissions in submission is not relieved by Consultant's review of submittals.

.6 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Consultant review.

.7 Keep one reviewed copy of each submission on site.

4 Shop Drawings and Product Data

.1 Refer to G.C 3.10.

.2 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by the Contractor to illustrate details of a portion of the Work.

.3 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been coordinated, regardless of the Section under which the adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.

.4 Adjustments made on shop drawings by the Consultant are not intended to change the Contract Price. If adjustments affect the value of Work, state such in writing to the Consultant prior to proceeding with the Work.

.5 Make changes in shop drawings as the Consultant may require, consistent with Contract Documents. When resubmitting, notify the Consultant in writing of any revisions other than those requested.

.6 Submit one transparency and six (6) prints of shop drawings for each requirement requested in specification Sections and as the consultant may reasonably request.

.7 Submit six (6) copies of product data sheets or brochures for requirements requested in specification Sections and as the Consultant may reasonably request where shop drawings will not be prepared due to standardized manufacture of product.

.8 If upon review by the Consultant, no errors or omissions are discovered or if only minor corrections are made, the transparency will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through the same procedure indicated above, shall be performed before fabrication and installation of Work may proceed.

5 Samples

.1 Submit for review samples in duplicate as requested in respective specification Sections. Label samples as to origin and intended use in the Work.

.2 Deliver samples prepaid to Consultant's business address.

.3 Notify the Consultant in writing, at the time of submission of deviations in samples from requirements of Contract Documents.

.4 Adjustments made on samples by the Consultant are not intended to change the Contract Price. If adjustments affect the value of Work, state such in writing to the Consultant prior to proceeding with the Work.

.5 Make changes in samples which the Consultant may require, consistent with Contract Documents.

6 Certificates and Transcripts

.1 Immediately after award of Contract, submit Workers' Compensation Board status transcription of insurances.

1 Section Includes

.1 Schedule, form, content

.2 Scheduled revisions

.3 Critical path scheduling

2 Related Sections

.1 Section 01770 - Take-Over Procedures: Project closeout requirements.

3 Schedules Required

.1 Submit the following schedules:
- .1 Construction Progress Schedule
- .2 Submittal Schedule for Shop Drawings and Product Data
- .3 Submittal Schedule for Samples
- .4 Submittal Schedule for timeliness of Owner furnished Products
- .5 Product Delivery Schedule
- .6 Cash Allowance Schedule for purchasing Products

4 Format

.1 Prepare schedule in the form of a horizontal bar chart.

.2 Provide a separate bar for each trade or operation.

.3 Provide horizontal time scale identifying the first work day of each week.

.4 Format for listings: The chronological order of trades for the Work.

.5 Identification of listings: By specification Section numbers and

Specification subjects .

5 Submission

.1 Submit initial schedules within 15 days after award of Contract.

.2 Submit one opaque reproduction, plus 2 copies to be retained by the Consultant.

.3 Consultant will review schedule and return review copy within 10 days after receipt.

.4 Resubmit finalized schedule within 7 days after return of review copy.

.5 Submit revised progress schedule with each application for payment.

.6 Distribute copies of the revised schedule to:
- .1 Job site office.
- .2 Subcontractors.
- .3 Other concerned parties.

.7 Instruct recipients to report to the Contractor within 10 days, any problems anticipated by the timetable shown in the schedule.

6 Construction Progress Schedule

.1 Include the complete sequence of construction activities.

.2 Include the dates for the commencement and completion of each major elements of construction including the following.
- .1 Site clearing.
- .2 Site utilities.
- .3 Foundation Work.
- .4 Structural framing.
- .5 Special Subcontractor work.
- .6 Equipment Installations.
- .7 Finishes.

.3 Show projected percentage of completion of each item as of the first day of the month.

.4 Indicate progress of each activity to date of submission schedule.

.5 Show changes occurring since previous submission of schedule:
.1 Major changes in scope.
.2 Activities modified since previous submission.
.3 Revised projections of progress and completion.
.4 Other identifiable changes.

.6 Provide a narrative report to define:
.1 Problem areas, anticipated delays, and the impact on the schedule.
.2 Corrective action recommended and its effect.
.3 The effect of changes on schedules of other prime contractors.

7 Submittals Schedule

.1 Include schedule for submitting shop drawings, product data, samples .

.2 Indicate dates for submitting, review time, resubmission time, float time, last date for meeting fabrication schedule.

.3 Include dates when reviewed submittals will be required from the Consultant.

1 Section Includes

.1 Inspection and testing, administrative and enforcement requirements.

.2 Tests and mix designs.

.3 Mock-ups.

.4 Mill tests.

.5 Equipment and system adjust and balance.

2 Related Sections

.1 Section 01300 - Submittals: Submission of samples to confirm product quality.

.2 Section 01601 - Material and Equipment: Material and workmanship quality, reference standards.

3 Inspection

.1 Refer to GC 2.3.

.2 The Owner and the Consultant shall have access to the Work. If part of the Work is in preparation at locations other than the Place of the Work, access shall be given to such work whenever it is in progress.

.3 Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by Consultant instructions, or the law of the Place of the Work.

.4 If the Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have the inspections or tests satisfactorily completed and make good such Work.

.5 The Consultant may order any part of the Work to be examined if the

Work is suspected to be not in accordance with the Contract Documents. If, upon examination such work is found not in accordance with the Contract Documents, correct such work and pay the cost of examination and correction. If such Work is found in accordance with the Contract Documents, the Owner shall pay the cost of examination and replacement.

4 Independent Inspection Agencies

.1 Independent Inspection/Testing Agencies will be engaged by the Owner for the purpose of inspecting and/or testing portions of Work.

.2 Costs shall be allocated as set out in Section 01021 - Allowances.

.3 Provide equipment required for executing inspection and testing by the appointed agencies.

.4 Employment of inspection/testing agencies does not relax the responsibility to perform Work in accordance with the Contract Documents.

.5 If defects are revealed during inspection and/or testing, the appointed agency will request additional inspection and/or testing to ascertain full degree of defect. Correct defect and irregularities as advised by Consultant at no cost to the Owner. Pay costs for retesting and reinspection.

5 Access to Work

.1 Allow inspection/testing agencies access to the Work, off site manufacturing and fabrication plants.

.2 Co-operate to provide reasonable facilities for such access.

6 Procedures

.1 Notify the appropriate agency and Consultant in advance of the requirement for tests, in order that attendance arrangements can be made.

.2 Submit samples and/or materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in an orderly sequence so as not to cause delay in the Work.

.3 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples.

7 Rejected Work

.1 Refer to GC 2.4.

.2 Remove defective Work, whether the result of poor workmanship, use of defective products or damage and whether incorporated in the Work or not, which has been rejected by the Consultant as failing to conform to the Contract Documents. Replace or re-execute in accordance with the Contracts Documents.

.3 Make good other Contractor's work damaged by such removals or replacements promptly.

.4 If in the opinion of the Consultant it is not expedient to correct defective Work or Work not performed in accordance with the Contract Documents, the Owner may deduct from the Contract Price the difference in value between the Work performed and that called for by the Contract Documents, the amount of which shall be determined by the Consultant.

8 Reports

.1 Submit 4 copies of inspection and test reports to the Consultant.

.2 Provide copies to Subcontractor of work being inspected or tested and manufacturer or fabricator of material being inspected or tested .

9 Tests and Mix Designs

.1 Furnish test results and mix designs as may be requested.

.2 The cost of tests and mix designs beyond those called for in the Contract Documents or beyond those required by the law of the Place of Work shall

be appraised by the Consultant and may be authorized as recoverable.

10 Mockup

.1 Prepare mock-up for Work specifically requested in the specifications. Include for Work of all Sections required to provide mock-ups.

.2 Construct in all locations acceptable to the Consultant.

.3 Prepare mock-up for Consultant review with reasonable promptness and in an orderly sequence, so as not to cause any delay in the Work.

.4 Failure to prepare mock-up in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.

.5 If requested, the Consultant will assist in preparing a schedule fixing the dates for preparation.

.6 Mock-up may remain as part of the Work.

11 Mill Tests

.1 Submit mill test certificates as may be requested.

12 Equipment and Systems

.1 Submit adjustment and balancing reports for mechanical, electrical and building equipment systems.

PART 1 - GENERAL

1.1 Section Includes

.1 Temporary utilities.

1.2 Related Sections

.1 Construction Section 01535 Temporary facilities: Construction Facilities

.2 Temporary Section 01560 Temporary controls

1.3 Installation and Removal

.1 Provide temporary utilities controls in order to execute work expeditiously.

.2 Remove from site all such work after use.

1.4 Dewatering

.1 Provide temporary drainage and pumping facilities to keep excavations and site free from standing water.

1.5 Sanitary Facilities

.1 Provide sufficient sanitary facilities for workers in accordance with

local health authorities.

.2 Maintain in clean condition.

1.6 Water Supply

.1 The Owner will provide a continuous supply of potable water for construction use.

.2 Arrange for connection with appropriate utility company and pay all costs for installation, maintenance and removal.

.3 Pay for utility charges at prevailing rates.

1.7 Temporary Heating

.1 Provide temporary heating required during construction period, including attendance, maintenance and fuel.

.2 Construction heaters used inside building must be vented to outside or be non-flameless type. Solid fuel salamanders not permitted.

.3 Maintain temperatures of minimum 10 degrees C in areas where construction is in progress, unless indicated otherwise in specifications.

.4 Ventilate heated areas and keep building free of exhaust or combustion gases.

.5 The use of the permanent heating system of building, or portions thereof, may not be used.

.6 Date of Substantial Performance and Warranties for heating system do not commence until entire system is in as near original condition as possible and is so certified by Consultant.

.7 Be responsible for damage to work due to failure in providing adequate heat and protection during construction.

1.8 Temporary Power and Light

.1 Provide and pay for temporary power during construction for temporary lighting and operating of power tools, to a maximum supply of 230 volts 30 amps.

.2 Arrange for connection with appropriate utility company. Pay all costs for installation, maintenance and removal.

.3 Temporary power for electric cranes and other equipment requiring in access of above is responsibility of Contractor.

.4 Provide and maintain temporary lighting throughout project. Level of illumination on all floors and stairs shall not be less than 15 foot candles 162 Lx.

1.9 Temporary Telephone

.1 Provide and pay for temporary telephones necessary for own use and use of Consultant and Owner.

1.10 Fire Protection

.1 Provide and maintain temporary fire protection equipment during performance of work required by insurance companies having jurisdiction and governing codes, regulations and bylaws.

.2 Open and burning rubbish are not permitted on site.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

PART 1 - GENERAL

1.1 Section Includes

.1 Construction aids.

.2 Traffic controls.

.3 Office and sheds.

.4 Project identification.

1.2 Related Sections

.1 Temporary Section 01510 utilities: Temporary Utilities

.2 Temporary Section 01560 controls: Temporary Controls

1.3 Installation and Removal

.1 Provide construction facilities in order to execute work expeditiously.

.2 Remove from site all such work after use.

1.4 Scaffolding

.1 Provide and maintain scaffolding, ramps, ladders, swing staging, platforms and temporary stairs.

1.5 Hoisting

.1 Provide, operate and maintain hoists required for moving of workers, materials and equipment. Make financial arrangements with Subcontractors for use thereof.

.2 Hoists shall be operated by qualified operator.

1.6 Site Storage/ Loading

.1 Refer to GC 3.3.

.2 Confine work and operations of employees by Contract documents. Do not unreasonably encumber premises with products.

.3 Do not load or permit to load any part of work with a weight or force that will endanger the work.

1.7 Security

.1 Provide and pay for responsible security personnel to guard site and contents of site after working hours and during holidays.

1.8 Offices

.1 Provide and maintain in clean condition during progress of work, adequately lighted, heated and ventilated Consultant's temporary office and Contractor's office with space for filing and layout of Contract Documents and Contractor's normal site office staff.

.2 Provide adequate required first aid facilities.

.3 Subcontractors may provide their own offices as necessary. Direct location of these offices.

1.9 Equipment, Tool and Materials Storage

.1 Provide and maintain, in a clean and orderly condition, lockable weatherproof sheds for storage of tools, equipment and materials.

.2 Locate materials not required to be stored in weatherproof sheds on site in a manner to cause least interference with work activities.

PART 2 - PRODUCTS Not used.

PART 3 - EXECUTION Not used.

PART 1 - GENERAL

1.1 Section Includes

.1 Barriers.

.2 Environmental Controls.

.3 Traffic Controls.

1.2 Related Sections

.1 Temporary Section 01510 Temporary Utilities

.2 Construction Section 01535 Temporary Facilities: Construction Facilities

1.3 Installation and Removal

.1 Provide temporary controls in order to execute work expeditiously.

.2 Remove from site all such work after use.

.3 Conform to requirements of authorities having jurisdiction.

1.4 Hoarding

.1 Erect hoarding where indicated on drawings to protect the public, workers, public and private property from injury or damage.

.2 Provide hoarding with solid 16mm plywood barricade painted to Owner's

approval 2.4 m high, protecting public and private property from injury or damage. Provide lockable gates within hoarding for access to site by workers and vehicles.

.3 Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to building.

.4 Provide barriers around trees and plants designated to remain. Protect from damage.

1.5 Guard Rails and Barricades

.1 Provide secure, rigid guard rails and barricades around deep excavations, open shafts, open stair wells, open edges of floors and roofs.

.2 Provide as required by governing authorities.

1.6 Weather Enclosures

.1 Provide weather tight closures to unfinished door and window openings, tops of shafts and other openings in floors and roofs.

.2 Close off floor areas where walls are not finished; seal off other openings; enclose building interior work for temporary heat.

.3 Design enclosures to withstand wind pressure and snow loading.

1.7 Dust Tight Screens

.1 Provide dust tight screens or partitions to localize dust generating activities, and for the protection of workers, finished areas of work and the public.

.2 Maintain and relocate protection until such work is complete.

1.8 Access to Site

.1 Provide and maintain access roads, sidewalk crossings, ramps and construction runways as may be required for access to the work.

1.9 Public Traffic Flow

.1 Provide and maintain flagpersons, traffic signals, barricades and flares, lights, or lanterns as required to perform the work and protect the public.

1.10 Protection for Off-Site and Public Property

.1 Protect surrounding private and public property from damage during performance work.

.2 Be responsible for damage incurred.

1.11 Protection of Building Finishes and Equipment

.1 Provide protection for finished and partially finished building finishes and equipment during performance of work.

.2 Provide necessary screens, covers, and hoardings as required.

.3 Be responsible for damage incurred due to lack of or improper protection.

1.12 Maintainance of Existing Building Exits

.1 Maintain and protect existing building exits during Contruction. Provide temporary exits through the work area as required.

.2 Review temporary exits with Consultant and local Building Officials and provide as required.

1.13 Fire Routes

.1 Maintain access to property including overhead clearance for use by emergency response vehicles.

PART 2 - PRODUCTS Not Used

PART 3 - EXECUTION Not Used

PART 1 - GENERAL

1.1 Section Includes

.1 Reference standards.

.2 Product quality, availability, storage, handling, protection, transportation.

.3 Manufacturer's instructions.

.4 Workmanship, coordination and fastenings.

.5 Existing facilities.

1.2 Related Sections

.1 Section 01400 - Quality Control: Quality control and inspection of Work.

1.3 Reference Standards

.1 Within the text of the specifications, reference may be made to the following standards: ACI - American Concrete Institute AISC - American Institute of Steel Construction ANSI - American National Standards Institute ASTM - American Society of Testing and Materials CEC - Canadian Electrical Code (published by CSA) CEMA - Canadian Electrical Manufacturer's Association CGSB - Canadian General Standards Board CISC - Canadian Institute of Steel Construction CLA - Canadian Lumberman's Association CPCA - Canadian Painting Contractors' Association CPCI - Canadian Prestressed Concrete Institute CRCA - Canadian Roofing Construction Association CSA - Canadian Standards Association FM - Factory Mutual Engineering Corporation IEEE - Institute of Electrical and Electronic Engineers IPCEA - Insulated Power Cable Engineers Association NAAMM - National Association of Architectural Metal Manufacturers NBC - National Building Code NEMA - National Electrical

Manufacturers' Association TTMAC - Terrazzo, Tile and Marble Association of Canada ULC - Underwriters' Laboratories of Canada

.2 Conform to these standards, in whole or in part as specifically requested in the specifications.

.3 If there is question as to whether any product or system is in conformance with applicable standards, the Consultant reserves the right to have such products or systems tested to prove or disprove conformance.

.4 The cost for such testing will be born by the Owner in the event of conformance with Contract Documents or by the Contractor in the event of non-conformance.

.5 Conform to latest date of issue of referenced standards in effect on date of submission of bids, except where a specific date or issue is specifically noted.

1.4 Associations

.1 AA - Aluminum Association, 900 19th Street N.W., Washington, D.C., U.S.A. 20006 http://www.aluminum.org

.2 AASHTO - American Association of State Highway and Transportation Officials, 444 N Capitol Street N.W., Suite 249, Washington, D.C., U.S.A. 20001 http://www.aashto.org

.3 ACI - American Concrete Institute, P.O. Box 9094, Farmington Hills, Michigan U.S.A. 48333 http://www.aci-int.org

.4 AHA - American Hardboard Association, 887-B Wilmette Road, Palatine, Illinois, U.S.A. 60067

.5 AITC - American Institute of Timber Construction, 7012 S. Revere Parkway, Suite 140, Englewood, Colorado, U.S.A. 80112 http://www.aitc-glulam.org

.6 AMCA - Air Movement and Control Association Inc., 30 West University Drive, Arlington Heights, Illinois, U.S.A. 60004-1893 http://www.amca.org

.7 ANSI - American National Standards Institute, 11 West 42nd Street, New York, New York, U.S.A. 10036 http://www.ansi.org

.8 API - American Petroleum Institute,1220 L St. Northwest, Washington,

D.C., U.S.A. 20005-4070 http://www.api.org

.9 ARI - Air Conditioning and Refrigeration Institute, 1815 North Fort Myer Drive, Arlington, Virginia, U.S.A. 22209 http://www.ari.org

.10 ASHRAE - American Society of Heating, Refrigeration and Air-Conditioning Engineers, 1791 Tullie Circle NE, Atlanta, Georgia, U.S.A. 30329 http://www.ashrae.org

.11 ASME - American Society of Mechanical Engineers, United Engineering Centre, 345 East 47th Street, New York, New York, U.S.A. 10017-2392 http://www.asme.org

.12 ASTM - American Society for Testing and Materials, 100 Barr Harbor Drive West, Conshohocken, Pennsylvania 19428-2959 http://www.astm.org

.13 AWCI - Association of the Wall and Ceiling Industries, 1711 Connecticut Avenue N.W., Washington, D.C. U.S.A. 20009 http://www.awci.org

.14 AWMAC - Architectural Woodwork Manufacturers Association of Canada, 516 4 Street West, High River, Alberta T1V 1B6 http://www.awmac.com

.15 AWS - American Welding Society, 550 N.W. LeJeune Road, Miami, Florida U.S.A. 33126 http://www.amweld.org

.16 AWWA - American Water Works Association, 6666 W. Quincy Avenue, Denver, Colorado, U.S.A. 80235 http://www.awwa.org

.17 CFFM - Canadian Forces Fire Marshal, 101 Colonel By Drive, 8NT MGen George R. Pearkes Bldg., Ottawa, Ontario K1A 0K2

.18 CGA - Canadian Gas Association, 243 Consumers Road, Suite 1200, North York, Ontario M2J 5E3 http://www.cga.ca

.19 CGSB - Canadian General Standards Board, Place du Portage, Phase III, 6B1, 11 Laurier Street, Hull, Quebec K1A 1G6 http://w3.pwgsc.gc.ca/cgsb

.20 CISC - Canadian Institute of Steel Construction, 201 Consumers Road, Suite 300, Willowdale, Ontario M2J 4G8

.21 CITC - Canadian Institute of Timber Construction, 200 Cooper Street, Ottawa, Ontario K2P 0G1

.22 CMB - Construction Materials Board, 101 Colonel By Drive, 8NT MGen George R. Pearkes Bldg., Ottawa, Ontario K1A 0K2

.23 COFI - Council of Forest Industries, 555 Burrard, Suite 1200, Vancouver, B.C. V7X 1S7 http://www.cofi.org

.24 CRCA - Canadian Roofing Contractors Association, 151 Slater Street, Suite 606, Ottawa, Ontario K1P 5H3

.25 CSA - Canadian Standards Association, 178 Rexdale Blvd., Etobicoke, Ontario M9W 1R3 http://www.csa.ca

.26 CSC - Construction Specifications Canada, 100 Lombard Street, Suite 200, Toronto, Ontario M5C 1M3 http://www.csc-dcc.ca

.27 CSDFMA - Canadian Steel Door and Frame Manufacturing Association One Yonge Street, Suite 1400, Toronto, Ontario M5E 1J9

.28 CSPI - Corrugated Steel Pipe Institute, 201 Consumers Road, Suite 306, Willowdale, Ontario M2J 4G8

.29 CSSBI - Canadian Sheet Steel Building Institute, 201 Consumers Road, Suite 305, Willowdale, Ontario M2J 4G8 http://www.cssbi.ca

.30 CWC - Canadian Wood Council, 1400 Blair Place, Suite 210, Ottawa, Ontario K1J 9B8 http://www.cwc.ca

.31 EEMAC - Electrical and Electronic Manufacturers' Association of Canada, 1 Yonge Street, Suite 1608, Toronto, Ontario M5E 1R1 http://www.electro.ca

.32 FCC - Fire Commissioner of Canada, Place du Portage, Phase II, 165 rue Hotel de Ville, Hull Quebec K1A 0J2

.33 ICPI - Interlocking Concrete Pavement Institute, P.O. Box 23053, Milton, Ontario L9T 2M0 http://www.icpi.org/icpi

.34 IEEE - Institute of Electrical and Electronics Engineers, 345 East 47th Street, New York, New York U.S.A. 10017 http://www.ieee.org

.35 MSS - Manufacturers Standardization Society of the Valve and Fittings Industry, 127 Park Street, N.E., Vienna, Virginia U.S.A.22180

.36 NAAMM - National Association of Architectural Metal Manufacturers, 8 South Michigan Avenue, Suite 1000, Chicago, Illinois U.S.A. 60603 http://www.naamm.org

.37 NEMA - National Electrical Manufacturers Association,1300 N. 17th Street, Suite 1847, Rosslyn, Virginia 22209 http://www.nema.org

.38 NFPA - National Fire Protection Association, 1 Batterymarch Park, Quincy, Massachusetts, U.S.A. 02269-9101 http://www.nfpa.org

.39 NFSA - National Fire Sprinkler Association, P.O. Box 1000, Patterson,

New York, U.S.A. 12563 http://www.nfsa.org

.40 NHLA - National Hardwood Lumber Association, P.O. Box 34518, Memphis, Tennessee, U.S.A 38184-0518 http://www.natlhardwood.org

.41 NLGA - National Lumber Grades Authority, 260-1055 West Hastings, Vancouver, B.C. V6E 2E9

.42 NRC - National Research Council, Montreal Road, Ottawa, Ontario K1A 0S2

.43 PCI - Prestressed Concrete Institute, 175 W. Jackson Blvd., Suite 1859, Chicago, Illinois, U.S.A. 60604 http://www.pci.org

.44 QPL - Qualification Program List, c/o Canadian General Standards Board, Place du Portage, Phase III, 6B1, 11 Laurier Street, Hull, Quebec K1A 1G6 http://w3.pwgsc.gc.ca/cgsb

.45 SAE - Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, Pennsylvania 15096-0001 http://www.sae.org

.46 SCC - Standards Council of Canada, 1200-45 O'Connor Street, Ottawa, Ontario K1P 6N7 http://www.scc.ca

.47 SMACNA - Sheet Metal and Air Conditioning Contractors' National Association, 4201 Lafayette Center Drive, Chantilly, Virginia 20151-1209 http://www.smacna.org

.48 SSPC - Steel Structures Painting Council, 40 24th Street, Pittsburgh, Pennsylvania 15222-4656 http://www.sspc.org

.49 TTMAC - Terrazzo, Tile and Marble Association of Canada, 30 Capston Gate, Unit 5 Concord, Ontario L4K 3E8 http://www.ttmac.com

.50 UL - Underwriters' Laboratories, 333 Pfingsten Road, Northbrook, Illinois, U.S.A. 60062 http://www.ul.com

.51 ULC - Underwriters' Laboratories of Canada, 7 Crouse Road, Scarborough, Ontario M1R 3A9 http://www.ulc.ca

.52 USACE - United States Army Corps Engineers, Huntsville, Alabama http://www.hnd.usace.army.mil

1.5 Quality

.1 Refer to GC 3.8.

.2 Products, materials, equipment and articles (referred to as Products throughout the specifications) incorporated in the Work shall be new, not damaged or defective, and of the best quality (compatible with specifications) for the purpose intended. If requested, furnish evidence as to type, source and quality of Products provided.

.3 Defective Products, whenever identified prior to the completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is a precaution against oversight or error. Remove and replace defective Products at own expense and be responsible for delays and expenses caused by rejection.

.4 Should any dispute arise as to the quality or fitness of Products, the decision rests strictly with the Consultant based upon the requirements of the Contract Documents.

.5 Unless otherwise indicated in the specifications, maintain uniformity of manufacture for any particular or like item throughout the building.

.6 Permanent labels, trademarks and nameplates on Products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

1.6 Availability

.1 Immediately upon signing Contract, review Product delivery requirements and anticipate foreseeable supply delays for any items. If delays in supply of Products are foreseeable, notify the Consultant of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of Work.

.2 In the event of failure to notify the Consultant at commencement of Work and should it subsequently appear that Work may be delayed for such reason, the Consultant reserves the right to substitute more readily available products of similar character, at no increase in Contract Price.

1.7 Storage, Handling and Protection

.1 Handle and store Products in a manner to prevent damage, adulteration,

deterioration and soiling and in accordance with manufacturer's instructions when applicable.

.2 Store packaged or bundled Products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in the Work.

.3 Store products subject to damage from weather in weatherproof enclosures.

.4 Store cementitious products clear of earth or concrete floors, and away from walls.

.5 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.

.6 Store sheet materials, lumber on flat, solid supports and keep clear of ground. Slope to shed moisture.

.7 Store and mix paints in a heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.

.8 Remove and replace damaged Products at own expense and to the satisfaction of the Consultant.

1.8 Transportation

.1 Pay costs of transportation of Products required in the performance of Work.

.2 Transportation cost of Products supplied by the Owner will be paid for by the Owner. Unload, handle and store such Products.

1.9 Manufacturer's Instructions

.1 Unless otherwise indicated in the specifications, install or erect Products in accordance with manufacturer's instructions. Do not rely on labels or enclosures provided with Products. Obtain written instructions directly from manufacturers.

.2 Notify the Consultant in writing, of conflicts between the specifications and manufacturer's instructions, so that the Consultant may establish the course of action.

.3 Improper installation or erection of Products, due to failure in complying with these requirements, authorizes the Consultant to require removal and re-installation at no increase in Contract Price.

1.10 Workmanship

.1 Workmanship shall be the best quality, executed by workers experienced and skilled in the respective duties for which they are employed. Immediately notify the Consultant if required Work is such as to make it impractical to produce required results.

.2 Do not employ any unfit person or anyone unskilled in their required duties. The Consultant reserves the right to require the dismissal from the site, workers deemed incompetent, careless, insubordinate or otherwise objectionable.

.3 Decisions as to the quality or fitness of workmanship in cases of dispute rest solely with the Consultant, whose decision is final.

1.11 Co-Ordination

.1 Insure cooperation of workers in laying out Work. Maintain efficient and continuous supervision.

.2 Be responsible for coordination and placement of openings, sleeves and accessories.

1.12 Concealment

.1 In finished areas, conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.

.2 Before installation, inform the Consultant if there is a contradictory situation. Install as directed by Consultant.

1.13 Remedial Work

.1 Refer to GC 2.4 and Section 01040.

.2 Perform remedial work required to repair or replace the parts or portions of the Work identified as defective or unacceptable. Coordinate adjacent affected Work as required.

.3 Perform remedial work by specialists familiar with the materials affected. Perform in a manner to neither damage nor endanger any portion of Work.

1.14 Location of Fixtures

.1 Consider the location of fixtures, outlets, and mechanical and electrical items indicated as approximate.

.2 Inform the Consultant of a conflicting installation. Install as directed.

1.15 Fastenings

.1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless indicated otherwise.

.2 Prevent electrolytic action between dissimilar metals and materials.

.3 Use noncorrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in the affected specification Section.

.4 Space anchors within their load limit or shear capacity and ensure they provide positive permanent anchorage. Wood, or any other organic material plugs are not acceptable.

.5 Keep exposed fastenings to a minimum, space evenly and install neatly.

.6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

1.16 Protection of Work in Progress

.1 Adequately protect Work completed or in progress. Work damaged or defaced due to failure in providing such protection is to be removed and replaced, or repaired, as directed by the Consultant, at no increase in Contract Price.

.2 Prevent overloading of any part of the building. Do not cut, drill or sleeve any load bearing structural member, unless specifically indicated without written approval of Consultant.

1.17 Existing Utilities

.1 When breaking into or connecting to existing services or utilities, execute Work at times directed by local governing authorities, with a minimum of disturbance to Work, and/or building occupants and pedestrian and vehicular traffic.

.2 Protect, relocate or maintain existing active services. When services are encountered, cap off in a manner approved by authority having jurisdiction, stake and record location of capped service.

PART 2 - PRODUCTS Not Used

PART 3 - EXECUTION Not Used

PART 1 - GENERAL

1.1 Section Includes

.1 Testing, adjusting and balancing of building equipment and systems.

.2 Procedures for demonstration and instruction of equipment and systems to Owner's personnel.

1.2 Related Section

.1 Section 01400 - Quality Control: Employment of testing agency and payment for services.

.2 Individual Sections: Demonstrating systems and equipment.

1.3 References

.1 Associated Air Balance Council (AABC): National Standards For Field Measurements and Instrumentation, Total Systems Balance, Air Distribution Hydronics Systems.

1.4 Quality Assurance

.1 Testing organization: Current member in good standing of AABC certified to perform specified services.

.2 Comply with applicable procedures and standards of the certification sponsoring association.

.3 Perform services under direction of supervisor qualified under certification requirements of sponsoring association.

1.5 Submittals

.1 Prior to start of Work, submit name of organization proposed to perform services and names of specialty personnel proposed to perform services. Designate who has managerial responsibilities for coordination of entire testing, adjusting and balancing.

.2 Submit documentation to confirm organization compliance with quality assurance provision.

.3 Submit 3 preliminary specimen copies of each of report forms proposed for use.

.4 Fifteen days prior to Substantial Performance, submit 3 copies of final reports on applicable forms.

.5 Submit reports of testing, adjusting, and balancing postponed due to seasonal, climatic, occupancy, or other reasons beyond Contractor's control, promptly after execution of those services.

1.6 Procedures

.1 Comply with procedural standards of certifying association under whose standard services will be performed.

.2 Report to Consultant any deficiencies or defects noted during performance of services.

.3 Prepare each system for testing and balancing.

.4 Cooperate with testing organization, provide access to equipment and systems.

.5 Notify testing organization 7 days prior to time project will be ready for testing, adjusting, and balancing.

1.7 Final Reports

.1 Organization having managerial responsibility shall make reports.

.2 Ensure each form bears signature of recorder, and that of supervisor of reporting organization.

.3 Identify each instrument used, and latest date of calibration of each.

.4 Submit 3 copies of final reports on applicable forms.

1.8 Contractor Responsibilities

.1 Prepare each system for testing and balancing.

.2 Cooperate with testing organization and provide access to equipment and systems.

.3 Provide personnel and operate systems at designated times, and under conditions required for proper testing, adjusting, and balancing.

.4 Notify testing organization 7 days prior to time project will be ready for testing, adjusting, and balancing.

1.9 Preparation

.1 Provide instruments required for test, adjust, and balance operations.

.2 Verify systems installation is complete and in continuous operation.

.3 Verify lighting is turned on when lighting is included in cooling load.

.4 Verify equipment such as computers, laboratory and electronic equipment are in full operation.

.5 Test equipment, balance distribution systems, and adjust devices for HVAC systems.

1.10 Systems Demonstration

.1 Demonstrate start-up, operation, control, adjustment,

trouble-shooting, servicing, and maintenance of each item of equipment at agreed upon times, at the equipment designated location.

.2 Owner will provide list of personnel to receive instructions, and will coordinate their attendance at agreed-upon times.

.3 Instruct personnel in all phases of operation and maintenance using operation and maintenance manuals as the basis of instruction.

.4 Review contents of manual in detail to explain all aspects of operation and maintenance.

.5 Prepare and insert additional data in operations and maintenance manuals when the need for additional data becomes apparent during instructions.

PART 2 - PRODUCTS Not Used.

PART 3 - EXECUTION Not Used.

PART 1 - GENERAL

1.1 Section Includes

.1 Progressive cleaning.

.2 Final cleaning.

1.2 Related Section

.1 Section 01770 - Take-Over Procedures.

1.3 Project Cleanliness

.1 Maintain the Work in tidy condition, free from accumulation of waste products and debris, other than that caused by the Owner or other Contractors.

.2 Remove waste material and debris from the site and deposit in waste container at the end of each working day. Do not burn waste materials on site.

.3 Clean interior areas prior to start of finish work, maintain areas free of dust and other contaminants during finishing operations.

.4 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.

.5 Provide on-site containers for collection of waste materials and debris.

.6 Dispose of waste materials and debris off site .

.7 Store volatile waste in covered metal containers, and remove from premises at end of each working day.

.8 Provide adequate ventilation during use of volatile or noxious

substances. Use of building ventilation systems is not permitted for this purpose.

.9 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.

.10 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

1.4 Final Cleaning

.1 Refer to GC 3.13.

.2 When the Work is Substantially Performed, remove surplus products, tools, construction machinery and equipment not required for the performance of the remaining Work.

.3 Remove waste products and debris other than that caused by the Owner, other contractors or their employees, and leave the Work clean and suitable for the occupancy by Owner.

.4 Prior to final review, remove surplus products, tools, construction machinery and equipment. Remove waste products and debris other than that caused by the Owner or other Contractors.

.5 Remove waste materials and the site at regularly scheduled times or dispose of as directed by the consultant. Do not burn waste materials on site, unless approved by the Consultant.

.6 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.

.7 Leave the work broom clean before the inspection process commences.

.8 Clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, mechanical and electrical fixtures. Replace broken, scratched or disfigured glass.

.9 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls, and floors.

.10 Vacuum clean and dust building interiors, behind grilles, louvres and screens.

.11 Wax, seal, shampoo or prepare floor finishes, as recommended by the manufacturer.

.12 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.

.13 Broom clean and wash exterior walks, steps and surfaces.

.14 Remove dirt and other disfiguration from exterior surfaces.

.15 Clean and sweep roofs, gutters, areaways, sunken wells.

.16 Sweep and wash clean paved areas.

.17 Clean equipment and fixtures to a sanitary condition, clean or replace filters of mechanical equipment.

.18 Clean roofs, downspouts, and drainage systems.

.19 Clean lighting reflectors, lenses and other lighting surfaces.

.20 Remove debris and surplus materials from crawl areas and other accessible concealed spaces.

.21 Remove snow and ice from access to building.

PART 2 - PRODUCTS Not Used.

PART 3 - EXECUTION Not Used.

PART 1 - GENERAL

1.1 Section Includes

.1 Record documents, samples, specifications.

.2 Equipment and systems.

.3 Product data, materials and finishes, and related information.

.4 Operation and maintenance data.

.5 Warranties and bonds.

1.2 Related Sections

.1 Section 01040 - Coordination

.2 Section 01300 - Submittals: Shop drawings, samples, manufacturers instructions, photographs.

.3 Section 01310 - Construction Schedule: Total project Schedule.

.4 Section 01400 - Quality Control: Test and inspect reports.

.5 Section 01655 - Facility Start-up: Test and balance, system performance verification and takeover procedures.

.6 Individual Specifications Sections: Specific requirements for operation and maintenance data.

1.3 Submission

.1 Prepare instructions and data by personnel experienced in maintenance and operation of described products.

.2 Submit one copy of completed volumes in final form 15 days prior to substantial performance.

.3 Copy will be returned after final inspection, with Consultant comments.

.4 Revise content of documents as required prior to final submittal.

.5 Two weeks prior to Substantial Performance of the work, submit to the Consultant, two final copies of operating and maintenance manuals.

1.4 Format

.1 Organize data in the form of an instructional manual.

.2 Binders: commercial quality, 8 1/2 x 11 inch maximum ring size.

.3 When multiple binders are used, correlate data into related consistent groupings.

.4 Cover: Identify each binder with type or printed title "Project Record Documents"; list title of Project, identify subject matter of contents.

.5 Arrange content by systems, under Section numbers and sequence of Table of Contents.

.6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.

.7 Test: Manufacturer's printed data, or typewritten data on 20 pound paper.

.8 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

1.5 Contents, Each Volume

.1 Table of Contents: provide title of project; names, addresses, and telephone numbers of Consultant and Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.

.2 For Each Product or System: list names, addresses and telephone numbers

of subcontractors and suppliers, including local source of supplies and replacement parts.

.3 Product Data: mark each sheet to clearly identify specific products and component parts, and data applicable to installation; delete inapplicable information.

.4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.

.5 Typewritten Text: as required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01400.

1.6 Record Documents and Samples

.1 In addition to requirements in General Conditions, Maintain at the site for Owner one record copy of:
- .1 Contract Drawings.
- .2 Specifications.
- .3 Addenda.
- .4 Change Orders and other modifications to the Contract.
- .5 Reviewed shop drawings, product data, and samples.
- .6 Field test records.
- .7 Inspection certificates.
- .8 Manufacturer's certificates.

.2 Store Record Documents and Samples in Field Office apart from documents used for construction. Provide files, racks, and secure storage.

.3 Label and file in accordance with Section number listings in List of Contents of this Project Manual. Label each document "PROJECT RECORD" in neat, large, printed letters.

.4 Maintain Record Documents in a clean, dry and legible condition. Do not use Record Documents for construction purposes.

.5 Keep Record Documents and samples available for inspection by Consultant.

.6 Consolidate, index, bind and submit record documents in accordance with Section 1780 Closeout Submittals.

1.7 Recording Actual Site Conditions

.1 Record information on a full set of black line opaque As-Built drawings provided by Owner, and in a copy of a Project Manual.

.2 Provide felt tip marking pens, maintaining separate colours for each major system, for recording information.

.3 Record information concurrently with construction progress. Do not conceal work until required information is recorded.

.4 Contract Drawings and shop drawings: legibly mark each item to record actual construction, including:

.1 Measure depths of elements of foundation in relation to finish first floor datum.

.2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.

.3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.

.4 Field changes of dimension and detail.

.5 Changes made by change orders.

.6 Details not on original Contract Drawings.

.7 References to related shop drawings and modifications.

.5 Specifications: legibly mark each item to record actual construction, including:

.1 Manufacturer, trade name, and catalog number of each project actually installed, particularly optional items and substitute items.

.2 Changes made by Addenda and change orders.

.6 Other Documents: maintain manufacturer's certifications, inspection certifications, field test records, required by individual specifications sections.

1.8 Record Drawings

.1 Contruction drawings for this project have been prepared on a CAD system. The software used is AutoCAD 2010.

.2 Submit As-Built drawings to Consultant for preparation of Record Drawings.

.3 Submit As-Built drawings to the Consultant for review prior to Application for Certificate for Substantial Performance of the work.

.4 The Consultant will update computer drawings and submit computer disk copies and print copies directly to the Owner. Cost for preparation of Record Drawings is included in Section 01021. Consultant will submit invoices directly to Contractor for direct payment. Invoice is due and payable upon receipt.

1.9 Equipment and Systems

.1 Each Item of Equipment and Each System: include description of unit or system, and component parts. Give function, normal operation characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.

.2 Panelboard Circuit Directories: provide electrical service characteristics, controls, and communications.

.3 Include installed colour coded wiring diagrams.

.4 Operating Procedures: include start-up, break- in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.

.5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

.6 Provide servicing and lubrication schedule, and list of lubricants required.

.7 Include manufacturer's printed operation and maintenance instructions.

.8 Include sequence of operation by controls manufacturer.

.9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

.10 Provide installed control diagrams by controls manufacturer.

.11 Provide Contractor's coordination drawings, with installed colour coded piping diagrams.

.12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

.13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

.14 Include test and balancing reports as specified in Section 01400 and 01655.

.15 Additional Requirements: As specified in individual specification sections.

1.10 Materials and Finishes

.1 Building Products, Applied Materials, and Finishes: include product data, with catalog number, size, composition, and colour and texture designations. Provide information for re-ordering custom manufactured products.

.2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

.3 Moisture-protection and Weather-exposed Products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommend schedule for cleaning and maintenance.

.4 Additional Requirements: as specified in individual specifications sections.

1.11 Warranties and Bonds

.1 Separate each warranty or bond with index tab sheets keyed to the List of Contents listing.

.2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

.3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers, within ten days after completion of the applicable item of work.

.4 Except for items put into use with Owner's permission, leave date of beginning of time of warranty until the Date of Substantial Performance is determined.

.5 Verify that documents are in proper form, contain full information, and are notarized.

.6 Co-execute submittals when required.

.7 Retain warranties and bonds until time specified for submittal.

1 Manual

.1 An organized compilation of operating and maintenance data including detailed technical information, documents and records describing operation and maintenance of individual products or systems as specified in individual sections of Divisions 02 - 16.

2 General

.1 Assemble, coordinate, bind and index required data into Operation and Maintenance Manual.

.2 Submit complete operation and maintenance manual to Consultant 2 weeks prior to application for Substantial Performance.

.3 Submit 4 bond hard copies and one USB flash drive with each page coverted .pdf file format matching order of hard copy submission.

.4 Organize data into same numerical order as contract specifications.

.5 Material: label each section with tabs protected with celluloid covers fastened to hard paper dividing sheets.

.6 Type lists and notes.

.7 Drawings, diagrams and manufacturers literature must be legible.

3 Binders

.1 Binders: vinyl, hard covered, 3 "D" ring, loose leaf, sized for 215 x 280 mm paper, with spine pocket.

.2 Identify contents of each binder on spline.

4 Contents

.1 Binder 1:

.1 Cover sheet containing:

.1 Date submitted.

.2 Project title, location and project number.

.3 Names and addresses of Contractor, and all Sub-contractors.

.2 Table of Contents of all binders.

.3 List of maintenance materials as specified in Section 01750 - Maintenance Materials, Special Tools and Spare Parts.

.4 List of special tools as specified in Section 01750 - Maintenance Materials, Special Tools and Spare Parts.

.5 List of spare parts as specified in Section 01750 - Maintenance Materials, Special Tools and Spare Parts.

.6 Warranties, guarantees.

.7 Copies of approvals, and certificates.

.2 Remaining binders:

.1 Cover sheet containing:

.1 Date submitted.

.2 Project title, location and project number.

.2 Table of Contents of individual binder.

.3 Provide data as specified in individual sections of Divisions 02 to 16.

.1 List of equipment including service depot.

.2 Nameplate information including equipment number, make, size, capacity, model number and serial number.

.3 Parts list.

.4 Installation details.

.5 Operating instructions.

.6 Maintenance instructions for equipment.

.7 Maintenance instructions for finishes.

.3 Shop drawings:

.1 Bind separately one complete set of reviewed final shop drawings and product data.

PART 1 - GENERAL

1.1 Section includes

.1 Section includes:
- .1 Spare parts.
- .2 Maintenance materials.
- .3 Special tools.

1.2 Related Sections

.1 Delivery Section 01655 and receipt of Testing, Adjusting spare parts and Balancing of associated with Systems testing, adjusting and balancing:

.2 Systems Section 01655 Facility Start-up

.3 Take-over procedures: Section 01770 Take-Over Procedures

.4 Project record Section 01721 Project Record Documents

.5 Individual Specifications Sections: Specific requirements for operation and maintenance data.

1.3 Quality

.1 Spare parts, maintenance materials and special tools provided shall be new, not damaged or defective, and of the same quality and manufacture as Products provided in the Work.

.2 If requested, furnish evidence as to type, source and quality of Products provided.

.3 Defective products will be rejected, regardless of previous inspections. Replace products at own expense.

1.4 Transportation

.1 Pay costs of transportation.

1.5 Storage, handling and protection

.1 Store spare parts, maintenance materials and special tools in a manner to prevent damage, or deterioration.

.2 Store in original and undamaged condition with manufacturer's seal and labels intact.

.3 Store components subject to damage from weather in weatherproof enclosures.

.4 Store paints and freezable materials in a heated and ventilated room.

.5 Remove and replace damaged products at own expense and to satisfaction of Consultant.

1.6 Spare Parts

.1 Provide spare parts in quantities specified in individual specification sections.

.2 Provide items of same manufacture and quality as items in the Work.

.3 Deliver to Project site or location as directed; place and store.

.4 Receive and catalogue all items. Submit inventory listing to Consultant. Include approved listings in Maintenance Manual specified in Section 01300.

.5 Obtain receipt for delivered products and submit prior to final payment.

1.7 Maintenance Materials

.1 Provide maintenance and extra materials in quantities specified in individual specification sections.

.2 Provide items of same manufacture and quality as items in the Work.

.3 Deliver to Project site or location as directed; place and store.

.4 Receive and catalogue all items. Submit inventory listing to Consultant. Include approved listings in Maintenance Manual specified in Section 01300.

.5 Obtain receipt for delivered products and submit prior to final payment.

1.8 Special Tools

.1 Provide special tools in quantities specified in individual specification Sections.

.2 Provide items with tags identifying their function and equipment to which they are associated.

.3 Deliver to Project site or location as directed; place and store.

.4 Receive and catalogue all items. Include listings in Maintenance Manual specified in Section 01300.

PART 2 - PRODUCTS Not used

PART 3 - EXECUTION Not used

PART 1 - GENERAL

1.1 Section Includes

.1 Administrative procedures preceding preliminary and final inspections of the Work.

1.2 Related Sections

.1 Testing, adjusting Section 01655 and balancing: Testing, Adjusting and Balancing of Systems

.2 Conform to OAA/OGCA Take-Over Procedures Document No. 100 dated November 1983.

1.3 Inspection and Declaration Procedures

.1 Contractor's Inspection: Contractor and all Subcontractors shall conduct an inspection of the Work, identify deficiencies and defects; repair as required to conform to Contract Documents. Notify Consultant in writing of satisfactory completion of Contractor's Inspection and that corrections have been made. Request a Consultant's Inspection.

.2 Consultant's Inspection: Consultants and Contractor will perform an inspection of the Work to identify obvious defects or deficiencies. Contractor shall correct Work accordingly.

.3 Completion: submit a written certificate that following have been performed:

.1 Work has been completed and inspected for compliance with Contract Documents,

.2 Defects have been corrected and deficiencies have been completed,

.3 Equipment and systems have been tested, adjusted and balanced and are fully operational,

.4 Certificates required by authorities having jurisdiction have

been submitted,

.5 Operation of systems have been demonstrated to Owner's personnel, and

.6 Work is complete and ready for Final Inspection.

.4 Final Inspection: when items noted above are completed, request a final inspection of the Work by Owner, Consultants, and Contractor. If Work is deemed incomplete by Owner and Consultant, complete outstanding items and request a reinspection.

.5 Declaration of Substantial Performance: when Owner and Consultants consider deficiencies and defects have been corrected and it appears requirements of Contract have been substantially performed, make application for certificate of Substantial Performance. Refer to General Conditions Article GC 5.4 Substantial Performance of the Work. Submission of Project Record Documents in accordance with Section 01721 and Operation and Maintenance Manual in accordance with Section 01730 is a requirement for Substantial Performance.

.6 Commencement of Lien and Warranty Periods: date of Owner's acceptance of submitted declaration of Substantial Performance shall be date for commencement for warranty period and commencement of lien period unless required otherwise by lien statute of the Place of the Work.

.7 Final Payment: When Owner and Consultant consider final deficiencies and defects have been corrected and it appears requirements of Contract have been totally performed, make application for final payment. Refer to CCDC 2, General Conditions Article GC 5.7 for specifics to application. If Work is deemed incomplete by Owner and Consultant , complete outstanding items and request reinspection.

.8 Payment of Holdback: After issuance of certificate of Substantial Performance of Work, submit an application for payment of holdback amount in accordance with CCDC 2, General Conditions Article 5.5.

1.4 Reinspection

.1 Should status of the Work require reinspection by Consultant due to failure of Work to comply with Contractor's claims for inspection, Owner will deduct amount of Consultant's compensation for reinspection services from payment to Contractor.

PART 2 - PRODUCTS Not Used.

PART 3 - EXECUTION Not Used.

PART 1 - GENERAL

1.1 Section Includes

.1 As-built, samples, and specifications.

.2 Equipment and systems.

.3 Product data, materials and finishes, and related information.

.4 Operation and maintenance data.

.5 Spare parts, special tools and maintenance materials.

.6 Warranties and bonds.

.7 Final site survey.

1.2 Related Sections

.1 Section 01300 - Submittals.

.2 Section 01400 - Quality Control.

.3 Section 01770 - Closeout Procedures.

1.3 Submission

.1 Prepare instructions and data by personnel experienced in maintenance and operation of described products.

.2 Copy will be returned after final inspection, with Consultant's comments.

.3 Revise content of documents as required prior to final submittal.

.4 Two weeks prior to Substantial Performance of the Work, submit to the Consultant, four final copies of operating and maintenance manuals in English.

.5 Ensure spare parts, maintenance materials and special tools provided are new, undamaged or defective, and of same quality and manufacture as products provided in Work.

.6 If requested, furnish evidence as to type, source and quality of products provided.

.7 Defective products will be rejected, regardless of previous inspections. Replace products at own expense.

.8 Pay costs of transportation.

1.4 Format

.1 Organize data in the form of an instructional manual.

.2 Binders: vinyl, hard covered, 3 'D' ring, loose leaf 219 x 279 mm with spine and face pockets.

.3 When multiple binders are used, correlate data into related consistent groupings. Identify contents of each binder on spine.

.4 Cover: Identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.

.5 Arrange content by systems, under Section numbers and sequence of Table of Contents.

.6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.

.7 Text: Manufacturer's printed data, or typewritten data.

.8 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

.9 USB flash drive with each page coverted .pdf file format matching order of hard copy submission.

1.5 Contents - Each Volume

.1 Table of Contents: provide title of project;
  .1 date of submission; names,
  .2 addresses, and telephone numbers of Consultant and Contractor with name of responsible parties;
  .3 schedule of products and systems, indexed to content of volume.

.2 For each product or system:
  .1 list names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.

.3 Product Data: mark each sheet to clearly identify specific products and component parts, and data applicable to installation; delete inapplicable information.

.4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.

.5 Typewritten Text: as required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01450 - Quality Control .

.6 Training: Co-ordinate with Owner and submit schedule for demonstrations and training.

1.6 As-builts and Samples

.1 In addition to requirements in General Conditions, maintain at the site for ConsultantOwner one record copy of:
  .1 Contract Drawings.
  .2 Specifications.
  .3 Addenda.
  .4 Change Orders and other modifications to the Contract.
  .5 Reviewed shop drawings, product data, and samples.
  .6 Field test records.
  .7 Inspection certificates.
  .8 Manufacturer's certificates.

.2 Store record documents and samples in field office apart from documents

used for construction. Provide files, racks, and secure storage.

.3 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual. Label each document "PROJECT RECORD" in neat, large, printed letters.

.4 Maintain record documents in clean, dry and legible condition. Do not use record documents for construction purposes.

.5 Keep record documents and samples available for inspection by Consultant .

1.7 Recording Actual Site Conditions

.1 Record information on set of black line opaque drawings, and in copy of Project Manual, provided by Consultant .

.2 Provide felt tip marking pens, maintaining separate colours for each major system, for recording information.

.3 Record information concurrently with construction progress. Do not conceal Work until required information is recorded.

.4 Contract Drawings and shop drawings: legibly mark each item to record actual construction, including:

.1 Measured depths of elements of foundation in relation to finish first floor datum.

.2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.

.3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.

.4 Field changes of dimension and detail.

.5 Changes made by change orders.

.6 Details not on original Contract Drawings.

.7 References to related shop drawings and modifications.

.5 Specifications: legibly mark each item to record actual construction, including:

.1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.

.2 Changes made by Addenda and change orders.

.6 Other Documents: maintain manufacturer's certifications, inspection certifications, field test records, required by individual

specifications sections.

1.8 Final Survey

.1 Submit final site survey certificate certifying that elevations and locations of completed Work are in conformance, or non-conformance with Contract Documents.

1.9 Equipment and Systems

.1 Each Item of Equipment and Each System: include description of unit or system, and component parts. Give function, normal operation characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.

.2 Panel board circuit directories: provide electrical service characteristics, controls, and communications.

.3 Include installed colour coded wiring diagrams.

.4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.

.5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

.6 Provide servicing and lubrication schedule, and list of lubricants required.

.7 Include manufacturer's printed operation and maintenance instructions.

.8 Include sequence of operation by controls manufacturer.

.9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

.10 Provide installed control diagrams by controls manufacturer.

.11 Provide Contractor's coordination drawings, with installed colour coded piping diagrams.

.12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

.13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

.14 Include test and balancing reports as specified in Section 01450 - Quality Control and 01810 - Commissioning .

.15 Additional requirements: As specified in individual specification sections.

1.10 Materials and Finishes

.1 Building Products, Applied Materials, and Finishes: include product data, with catalogue number, size, composition, and colour and texture designations. Provide information for re-ordering custom manufactured products.

.2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

.3 Moisture-protection and Weather-exposed Products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

.4 Additional Requirements: as specified in individual specifications sections.

1.11 Spare Parts

.1 Provide spare parts, in quantities specified in individual specification sections.

.2 Provide items of same manufacture and quality as items in Work.

.3 Deliver to site location as directed; place and store.

.4 Receive and catalogue all items. Submit inventory listing to Engineer Consultant . Include approved listings in Maintenance Manual.

.5 Obtain receipt for delivered products and submit prior to final payment.

1.12 Maintenance Materials

.1 Provide maintenance and extra materials, in quantities specified in individual specification sections.

.2 Provide items of same manufacture and quality as items in Work.

.3 Deliver to location as directed ; place and store.

.4 Receive and catalogue all items. Submit inventory listing to Consultant.

Include approved listings in Maintenance Manual.

.5 Obtain receipt for delivered products and submit prior to final payment.

1.13 Special Tools

.1 Provide special tools, in quantities specified in individual specification section.

.2 Provide items with tags identifying their associated function and equipment.

.3 Deliver to location as directed; place and store.

.4 Receive and catalogue all items. Submit inventory listing to Consultant. Include approved listings in Maintenance Manual.

1.14 Storage, Handling and Protection

.1 Store spare parts, maintenance materials, and special tools in manner

to prevent damage or deterioration.

.2 Store in original and undamaged condition with manufacturer's seal and labels intact.

.3 Store components subject to damage from weather in weatherproof enclosures.

.4 Store paints and freezable materials in a heated and ventilated room.

.5 Remove and replace damaged products at own expense and to satisfaction of Consultant.

1.15 Warranties and Bonds

.1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.

.2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

.3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers, within ten days after completion of the applicable item of work.

.4 Except for items put into use with Owner's permission, leave date of beginning of time of warranty until the Date of Substantial Performance is determined.

.5 Verify that documents are in proper form, contain full information, and are notarized.

.6 Co-execute submittals when required.

.7 Retain warranties and bonds until time specified for submittal.

PART 2 - PRODUCTS

PART 3 - EXECUTION

PART 1 - GENERAL

1.1 Protection

.1 Protect existing items designated to remain and materials designated for salvage. In event of damage to such items, immediately replace or make repairs to approval of Consultant and at no cost to Owner.

PART 2 - PRODUCTS Not Used.

PART 3 - EXECUTION

3.1 Preparation

.1 Inspect site and verify with Consultant items designated for removal and items to remain.

.2 Locate and protect utility lines. Preserve in operating condition active utilities traversing site.

.3 Notify utility companies before starting demolition.

3.2 Removal

.1 Remove items as indicated.

.2 Do not disturb adjacent items designated to remain in place.

3.3 Salvage

.1 Carefully dismantle items containing materials for salvage and stockpile salvaged materials at locations as indicated or as directed by Consultant.

3.4 Disposal of Material

.1 Dispose of materials not designated for salvage or re-use in work, off-site.

3.5 Restoration

.1 Upon completion of work, remove debris, trim surfaces and leave work site clean.

.2 Reinstate areas and existing works outside areas of demolition to match condition of adjacent, undisturbed areas.

PART 1 - GENERAL

1.1 References

.1 CSA A179-M76 Mortar and Grout for Unit Masonry.

.2 A371-94 Masonry Construction for Buildings.

1.2 Source Quality Control

.1 Submit laboratory test reports in accordance with Section 01300 - Submittals.

.2 Submit laboratory test reports certifying compliance of masonry units and mortar ingredients with specification requirements.

.3 For clay units, in addition to requirements set out in referenced CSA and ASTM Standards include data indicating initial rate of absorption for units proposed for use.

1.3 Samples

.1 Submit samples in accordance with Section 01300 - Submittals.

.2 Submit samples:
.1 Two of each type of masonry unit specified.
.2 One of each type of masonry accessory specified.
.3 One of each type of masonry reinforcement and tie proposed for use.
.4 As required for testing purposes.

1.4 Product Delivery, Storage and Handling

.1 Deliver materials to job site in dry condition.

.2 Keep materials dry until use, except where wetting of bricks is specified.

.3 Store under waterproof cover on pallets or plank platforms held off ground by means of plank or timber skids.

1.5 Cold Weather Requirements

.1 Supplement Clause 5.15.2 of A371-94 with following requirements:
.1 Maintain temperature of mortar between 5°C and 50°C until used.

1.6 Hot Weather Requirements

.1 Protect freshly laid masonry from drying too rapidly, by means of waterproof, non-staining coverings.

1.7 Protection

.1 Keep masonry dry using waterproof, non-staining coverings that extend over walls and down sides sufficient to protect walls from wind driven rain, until masonry work is completed and protected by flashings or other permanent construction.

.2 Protect masonry and other work from marking and other damage. Protect completed work from mortar droppings. Use non-staining coverings.

.3 Provide temporary bracing of masonry work during and after erection until permanent lateral support is in place.

PART 2 - PRODUCTS

2.1 Materials

.1 Masonry materials are specified in other sections.

PART 3 - EXECUTION

3.1 Workmanship

.1 Do masonry work in accordance with A371-94 except where specified otherwise.

.2 Build masonry plumb, level, and true to line, with vertical joints in alignment.

.3 Layout coursing and bond to achieve correct coursing heights, and continuity of bond above and below openings, with minimum of cutting.

3.2 Tolerances

.1 Tolerances in notes to Clause 5.3 of A371-94 apply.

3.3 Exposed Masonry

.1 Remove chipped, cracked, and otherwise damaged units in exposed masonry and replace with undamaged units.

3.4 Jointing

.1 Allow joints to set just enough to remove excess water, then tool with round jointer to provide smooth, compressed, uniformly concave joints where concave joints are indicated.

.2 Allow joints to set just enough to remove excess water, then rake joints uniformly to 6 mm depth and compress with square tool to provide smooth, compressed, raked joints of uniform depth where raked joints are indicated.

.3 At all exposed horizontal masonry, strike mortar across exposed masonry to drain water and prevent accumulation of snow. Apply clear waterproof sealer.

.4 Strike flush all joints concealed in walls and joints in walls to receive plaster, tile, insulation, or other applied material except paint or similar thin finish coating.

3.5 Cutting

.1 Cut out neatly for electrical switches, outlet boxes, and other recessed or built-in objects.

.2 Make cuts straight, clean, and free from uneven edges.

3.6 Building-In

.1 Build in items required to be built into masonry.

.2 Prevent displacement of built-in items during construction. Check plumb, location and alignment frequently, as work progresses.

.3 Brace door jambs to maintain plumb. Fill spaces between jambs and masonry with mortar.

3.7 Wetting of Bricks

.1 Except in cold weather, wet clay bricks having an initial rate of absorption exceeding 1 g/minute/1000 mm^2: wet to uniform degree of saturation, 3 to 24 hours before laying, and do not lay until surface

dry.

.2 Wet tops of walls built of bricks qualifying for wetting, when recommencing work on such walls.

3.8 Parging

.1 Use parging mortar specified in Section 04100 - Mortar and Grout for Masonry.

.2 Apply parging in uniform coating not less than 10 mm thick, where indicated.

3.9 Support of Loads

.1 Use 25 MPa concrete to Section 03300 - Cast-in-Place Concrete, where concrete fill is used in lieu of solid units.

.2 Use grout to CSA A179-94(R1999) where grout is used in lieu of solid units.

.3 Install building paper below voids to be filled with concrete grout; keep paper 25 mm back from faces of units.

3.10 Provision for Movement

.1 Leave 3 mm space below shelf angles.

.2 Leave 6 mm space or space as required to accommodate anticipated deflection between top of non-load bearing walls and partitions and structural elements. Do not use wedges. Pack joint with mineral wool batts, and caulk with fire stop material. Provide lateral support at 1200 o.c. as required, unless otherwise specified.

.3 Build masonry to tie in with stabilizers, with provision for vertical movement.

3.11 Loose Steel Lintels

.1 Install loose steel lintels. Centre over opening width.

3.12 Control Joints

.1 Provide continuous control joints at 6.0 m o.c. maximum or as indicated.

3.13 Existing Work

.1 Make good existing work. Use materials to match existing.

3.14 Recessed Devices

.1 Recess wall mounted electrical devices in Gymnasium and any other wall mounted equipment which may be prone to damage. Recess concrete block face panel minimum 50mm, size to suit but not smaller than 200mm x 200mm. Provide bullnose blocks at exposed vertical corners. Submit summary of equipment to be recessed and review with Consultant prior to commencement of work.

3.15 Testing

.1 Inspection and testing will be carried out by Testing Laboratory designated by Consultant.

.2 Cost of testing will be paid from cash allowance specified in Section 01021 - Allowances.

PART 1 - GENERAL

1.1 Related Work

.1 Masonry procedures: Section 04050 Masonry Procedures

1.2 References

.1 CSA A179-94(R1999) Mortar and Grout for Unit Masonry.

1.3 Samples

.1 Submit samples in accordance with Section 01300 - Submittals.

.2 Submit two samples of coloured mortar.

PART 2 - PRODUCTS

2.1 Materials

.1 Mortar and grout: CSA A179-94(R1999).

.2 Lime Mortars:
.1 Portland cement type 10, in accordance with CAN/CSA-A5-93.
.2 Hydrated lime type 'S', in accordance with C207-91 (1992).
.3 Colouring pigments: pigments constituted of ground coloured natural aggregates or mettalic oxide pigments, colour as selected by

consultant from manufacturer's available range. The ratio of colouring agent/density of cementitious material shall not exceed 10%.

.4 Do not use admixtures.

.3 Water: potable, clean exempt from ice, oils, acids, alkalis, organic matter, sediments or any other harmful matter.

.4 Sand: fine grain aggregates, grading in accordance with A179-94.

.5 Use aggregate passing 1.18 mm sieve where 6 mm thick joints are indicated.

.6 Colour: ground coloured natural aggregates or metallic oxide pigments to Consultants selection from manufacturer's standard range, one colour for each masonry type.

.7 Provide materials in strict accordance with mortar and masonry manufacturers' specifications.

2.2 Material Source

.1 Use same brands of materials and source of aggregate for entire project.

2.3 Mortar Types

.1 Mortar for exterior masonry above grade:

.1 Loadbearing: Type S based on Property specifications.

.2 Non-loadbearing: Type S based on Property specifications.

.3 Parapet walls, chimneys, unprotected walls: Type S based on Proportion specifications.

.2 Mortar for foundation walls, manholes, sewers, pavements, walks, patios and other exterior masonry at or below grade: Type M based on Property specifications.

.3 Mortar for interior masonry:

.1 Loadbearing: Type S based on Property specifications.

.2 Non-loadbearing: Type N based on Property specifications.

.4 Following applies regardless of mortar types and uses specified above:

.1 Mortar for calcium silicate brick and concrete brick: Type O based

on Proportion specifications.

.2 Mortar for grouted reinforced masonry: Type S based on Proportion specifications.

.3 Mortar for pointing: Type O based on Proportion specifications.

.4 Mortar for glass block: 1 part white portland cement, 1 part hydrated lime, 6 parts white sand aggregate by volume.

2.4 Coloured Mortar

.1 Coloured mortar: use colouring admixture not exceeding 10% of cement content by mass, or integrally coloured masonry cement, or portland/lime to produce coloured mortar to match approved sample.

.2 Use coloured mortar for brick, one colour for each brick type..

2.5 Grout

.1 Grout: to CSA A179-94(R1999) Table 3.

2.6 Parging

.1 Parging mortar: Type N to CSA A179-94(R1999).

PART 3 - EXECUTION

3.1 Mixing

.1 Do masonry mortar and grout work in accordance with CSA A179-94(R1999) except where specified otherwise.

.2 Mix grout to semi-fluid consistency.

.3 Incorporate colour and admixtures into mixes in accordance with manufacturer's instructions.

.4 Use clean mixer for coloured mortar.

.5 Prehydrate pointing mortar by mixing ingredients dry, then mix again adding just enough water to produce damp unworkable mix that will retain its form when pressed into ball. Allow to stand for not less than 1 hour nor more than 2 hours then remix with sufficient water to produce mortar of proper consistency for pointing.

3.2 Parging

.1 Apply parging in uniform coating not less than 10mm thick, where indicated.

PART 1 - GENERAL

1.1 References

.1 ASTM D 2240-02b Test Method for Rubber Property - Durometer Hardness.

.2 A371-94 Masonry Construction for Buildings.

1.2 Samples

.1 Submit samples in accordance with Section 01300.

PART 2 - PRODUCTS

2.1 Materials

.1 Control joint filler: purpose-made elastomer 90 durometer hardness to ASTM D 2240-02b of size and shape indicated.

.2 Nailing inserts: 0.6 mm thick purpose-made galvanized steel inserts for setting in mortar joints.

.3 Masonry flashing:

.1 Membrane masonry flashing and through-wall dampproof course: Blue Skin TWF as manufactured by Bakor Inc. or Colphene 3000 as manufactured by Soprema Inc.

.2 Lap adhesive: recommended by manufacturer of flashing material.

.4 Weep hole vents: purpose-made PVC designed to drain cavities to exterior, complete with insect screens and mortar guards.

.5 Cavity spacers: purpose made to prevent accumulation of mortar droppings from obstructing cavity. Submit samples and technical information for review.

PART 3 - EXECUTION

3.1 Control Joints

.1 Install continuous control joint fillers in control joints at locations indicated.

3.2 Weep Hole Vents

.1 Install weep hole vents in vertical joints immediately over flashings, sills and at top of cavities, in exterior wythes of cavity wall and masonry veneer wall construction, at maximum horizontal spacing of 600 mm oc.

3.3 Nailing Inserts

.1 Install nailing inserts in mortar joints at 400 mm oc each way, for attachment of wall strapping.

3.4 Masonry Flashing

.1 Install flashings in masonry in accordance with A371-M94 as follows:

.1 Install flashings under exterior masonry bearing on foundation walls, slabs, shelf angles, and steel angles over openings. Install flashings under weep hole courses and as indicated.

.2 In double wythe walls and veneered walls, carry flashings from front edge of masonry, under outer wythe, then up backing not less than 150 mm, and as follows:

.1 For masonry backing embed flashing 25 mm in joint.

.2 For concrete backing, insert flashing into reglets.

.3 For wood frame backing, staple flashing to walls behind sheathing paper.

.4 For gypsum board backing, bond to wall using manufacturer's recommended adhesive.

.3 Lap joints 150 mm and seal with adhesive.

.4 Lap and seal through-wall dampproof course flashings to air and vapour barrier membranes.

.5 Lap and seal minimum 150 through-wall dampproof course flashings to adjacent roof flashing membranes. Extend with backing film intact surplus dampproof course membrane for this purpose.

.6 Provide masonry flashing membrane where continuity of trowelled air/vapour barriers may be compromised.

3.5 Cavity Spacers

.1 Provide in accordance with manufacturer's specifications cavity spacers minimum 150mm at bottom of cavities above throughwall dampproof courses/masonry flashings.

PART 1 - GENERAL

1.1 References

.1 CAN/CSA-A23.1-00, Concrete Materials and Methods of Concrete Construction.

.2 A370-94, Connectors for Masonry.

.3 A371-94, Masonry Construction for Buildings.

.4 CSA G30.3-M1983 (R1998) (R1998), Cold-Drawn Steel Wire for Concrete Reinforcement.

.5 CSA G30.12-M1977, Billet-Steel Bars for Concrete Reinforcement.

.6 CAN3-S304-M84 (R1997) (R1997), Masonry Design for Buildings.

.7 CSA W186-M1990 (R1998) (R1998), Welding of Reinforcing Bars in Reinforced Concrete Construction.

1.2 Source Quality Control

.1 Upon request, provide Consultant with certified copy of mill test report of reinforcement steel and connectors, showing physical and chemical analysis, minimum 5 weeks prior to commencing reinforcement work.

.2 Upon request inform Consultant of proposed source of material to be supplied.

1.3 Shop Drawings

.1 Submit shop drawings in accordance with Section 01300.

.2 Shop drawings consist of bar bending details, lists and placing

drawings.

.3 On placing drawings, indicate sizes, spacing, location and quantities of reinforcement and connectors.

PART 2 - PRODUCTS

2.1 Materials

.1 Bar reinforcement: to A371-M94 and CSA G30.12.

.2 Wire reinforcement: to A371-M94 and CSA G30.3-M1983 (R1998) (R1998), truss type.

.3 Connectors: to A370-M94 and CAN3-S304-M84 (R1997) (R1997).
.1 Interior walls: corrosion resistant or non corroding connectors.
.2 Exterior walls: Adjustable hot-dipped galvanized DW130 as manufactured by Dur-O-Wall Limited or approved equal as recommended by manufacturer for intended use.

.4 Corrosion protection: to CAN3-S304-M84 (R1997) (R1997), galvanized.

2.2 Fabrication

.1 Fabricate reinforcing in accordance with CAN/CSA-A23.1-00 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Ontario.

.2 Fabricate connectors in accordance with A370-M94.

.3 Obtain Consultant's approval for locations of reinforcement splices other than shown on placing drawings.

.4 Upon approval of Consultant, weld reinforcement in accordance with CSA W186-M1990 (R1998) (R1998).

.5 Ship reinforcement and connectors, clearly identified in accordance with drawings.

PART 3 - EXECUTION

3.1 Installation

.1 Install masonry connectors and reinforcement in accordance with A370-M94, A371-M94 and CAN3-S304-M84 (R1997) (R1997), unless indicated otherwise.

.2 Prior to placing concrete mortar grout, obtain Consultant's approval of placement of reinforcement and connectors.

.3 Do additional reinforcement of masonry as indicated.

3.2 Bonding and Tying

.1 Bond walls of two or more wythes using metal connectors in accordance with NBC, CAN3-S304-M84 (R1997) (R1997), A371-94 and as indicated.

.2 Tie masonry veneer to backing in accordance with NBC, CAN3-S304-M84 (R1997) (R1997), A371-94 and as indicated.

3.3 Reinforced Lintels and Bond Beams

.1 Reinforce masonry lintels and bond beams as indicated.

.2 Place and grout reinforcement in accordance with CAN3-S304-M84 (R1997) (R1997).

3.4 Grouting

.1 Grout masonry in accordance with CAN3-S304-M84 (R1997) (R1997) and as indicated.

3.5 Metal Anchors

.1 Do metal anchors as indicated.

3.6 Lateral Support and Anchorage

.1 Do lateral support and anchorage in accordance with CAN3-S304-M84 (R1997) (R1997) and as indicated.

3.7 Control Joints

.1 Terminate reinforcement 25 mm short of each side of control joints unless otherwise indicated.

3.8 Field Bending

.1 Do not field bend reinforcement and connectors except where indicated or authorized by Consultant.

.2 When field bending is authorized, bend without heat, applying a slow and steady pressure.

.3 Replace bars and connectors which develop cracks or splits.

3.9 Field Touch-up

.1 Touch up damaged and cut ends of epoxy coated or galvanized reinforcement steel and connectors with compatible finish to provide continuous coating.

PART 1 - GENERAL

1.1 References

.1 A165 Series-94 Series (CAN3-A165.1)-M85 CSA Standards on Concrete Masonry Units.

PART 2 - PRODUCTS

2.1 Materials

.1 Standard concrete masonry units: to A165 Series-94 Series (CAN3-A165.1).

.1 Classification: H/15/A /M.

.2 Size: modular.

.3 Special shapes: provide bull- nosed units for exposed corners. Provide purpose-made shapes for lintels and bond beams. At window openings, provide solid bull-nose sill blocks laid on side. Provide additional special shapes as indicated. Provide solid blocks at first course above foundation and as indicated on structural drawings.

.4 Colour: standard grey.

PART 3 - EXECUTION

3.1 Laying Concrete Masonry Units

.1 Bond: running bond for interior units.

.2 Coursing height: 200 mm for one block and one joint.

.3 Jointing: concave where exposed or where paint or other finish coating is specified.

3.2 Laying Pre-faced Concrete Masonry Units

.1 Bond: running.

.1 Coursing height: 200 mm for one block and one joint.

.2 Jointing: provide concave joints.

.3 Clean block faces using soft cloths before mortar hardens rake to 10 mm depth. After completion of block laying fill joints with pointing mortar then point to provide concave joints. Repeat cleaning of faces.

3.3 Concrete Masonry Lintels

.1 Install reinforced concrete block lintels over openings in masonry where steel or reinforced concrete lintels are not indicated.

.2 End bearing: not less than 200 mm as indicated on drawings.

3.4 Corridor Bullnose Blocks With Ceramic Tile Base

.1 At exterior concrete block corners with ceramic tile base, at first course provide square block with upper corner ground to single facet at 45 degree chamfer at corner.

3.5 Cleaning

.1 Allow mortar droppings on unglazed concrete masonry to partially dry then remove by means of trowel, followed by rubbing lightly with small piece of block and finally by brushing.

PART 1 - GENERAL

1.1 Related Work

.1 Installation of Section 03300 anchors: Cast-in-Place Concrete

.2 Installation of steel Section 04050 angle lintels: Masonry Procedures

.3 Structural steel: Section 05120 Structural Steel

.4 Metal joists: Section 05210 Steel Joists

.5 Finish painting: Section 09900 Painting

1.2 Reference Standards

.1 ASTM A 53/A 53M-02 53M-02, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Steamless.

.2 ASTM A 269-02a, Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.

.3 ASTM A 307-02, Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile.

.4 CAN/CGSB-1.40-M89, Primer, Structural Steel, Oil Alkyd Type.

.5 CAN/CGSB-1.108-M89, Bituminous Solvent Type Paint.

.6 CAN/CGSB-1.181-99, Ready-Mixed, Organic Zinc-Rich Coating.

.7 CSA G40.21-98, Structural Quality Steels.

.8 CAN/CSA-G164-M92 (R1998) (R1998), Hot Dip Galvanizing of Irregularly Shaped Articles.

.9 CSA S16.01, Limit States Design of Steel Structures.

.10 CSA W59-1989 (R2001) (R2001), Welded Steel Construction (Metal Arc Welding).

1.3 Shop Drawings

.1 Submit shop drawings in accordance with Section 01300 - Submittals.

.2 Indicate materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.

PART 2 - PRODUCTS

2.1 Materials

.1 Steel sections and plates: to CSA G40.21-98, Grade 300W 350W.

.2 Steel pipe: to ASTM A 53/A 53M-02 53M-02 extra strong, black finish.

.3 Welding materials: to CSA W59-1989 (R2001) (R2001).

.4 Welding electrodes: to CSA W48-01 Series.

.5 Bolts and anchorbolts: to ASTM A 307-02.

.6 Grout: non-shrink, non-metallic, flowable, 24h, MPa 15, pull-out strength 7.9 MPa.

2.2 Fabrication

.1 Fabricate work square, true, straight and accurate to required size, with joints closely fitted and properly secured.

.2 Use self-tapping shake-proof oval headed screws on items requiring assembly by screws or as indicated.

.3 Where possible, fit and shop assemble work, ready for erection.

.4 Ensure exposed welds are continuous for length of each joint. File or grind exposed welds smooth and flush.

2.3 Finishes

.1 Galvanizing: hot dipped galvanizing with zinc coating 600 g/m² to CAN/CSA-G164-M92 (R1998)(R1998).

.2 Chromium plating: chrome on steel with plating sequence of 0.009 mm thickness of copper 0.010 mm thickness of nickel and 0.0025 mm thickness of chromium.

.3 Shop coat primer: to CAN/CGSB-1.40-M89.

.4 Zinc primer: zinc rich, ready mix to CAN/CGSB-1.181-99.

.5 Bituminous paint: to CAN/CGSB-1.108-M89.

2.4 Isolation Coating

.1 Isolate aluminum from following components, by means of bituminous paint:
.1 Dissimilar metals except stainless steel, zinc, or white bronze of small area.
.2 Concrete, mortar and masonry.
.3 Wood.

2.5 Shop Painting

.1 Apply one shop coat of primer to metal items, with exception of galvanized or concrete encased items.

.2 Use primer unadulterated, as prepared by manufacturer. Paint on dry surfaces, free from rust, scale, grease. Do not paint when temperature is lower than 7°C.

.3 Clean surfaces to be field welded; do not paint.

2.6 Angle Lintels

.1 Steel angles: galvanized at exterior locations, prime painted at interior locations, sizes indicated for openings. Provide 150 mm minimum bearing at ends.

.2 Weld or bolt back-to-back angles to profiles as indicated.

.3 Finish: shop painted.

2.7 Pipe Balustrades

.1 Construct balusters and handrails from steel pipe.

.2 Cap and weld exposed ends of balusters and handrails.

.3 Terminate at abutting wall with end flange.

2.8 Bar Balustrades

.1 Construct bar balustrades as follows except as indicated otherwise on drawings:
- .1 Balusters: 25 x 25 mm bar.
- .2 Top rail: 2" dia. pipe.
- .3 Bottom rail: 25 x 10 mm bar.
- .4 Pickets: 1/2" dia. bar at 100 mm oc.

.2 Fabricate supports for wood balustrade from 38 x 38 mm steel tubing with both ends capped and welded.

.3 Weld balustrades to stringers as indicated.

2.9 Guards

.1 Construct guards in accordance with drawings. Provide plates, anchors, brackets as required. Weld components.

2.10 Access Ladders

.1 Stringers: 90 x 8mm thick, steel.

.2 Steel Rungs: 20 mm diameter, welded to stringers at both sides each rung.

.3 Brackets: sizes and shapes as indicated and as required, weld to stringers at 800 mm c.c., complete with fixing anchors.

.4 Prime paint for interior.

PART 3 - EXECUTION

3.1 Erection

.1 Do welding work in accordance with CSA W59-1989 (R2001) (R2001) unless specified otherwise.

.2 Erect metalwork square, plumb, straight, and true, accurately fitted, with tight joints and intersections.

.3 Provide suitable means of anchorage acceptable to Consultant such as dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles.

.4 Exposed fastening devices to match finish and be compatible with material through which they pass.

.5 Provide components for building by other sections in accordance with shop drawings and schedule.

.6 Make field connections with bolts to CSA S16.01, or weld.

.7 Hand items over for casting into concrete or building into masonry to

appropriate trades together with setting templates.

.8 Touch-up rivets, field welds, bolts and burnt or scratched surfaces after completion of erection with primer.

.9 Touch-up galvanized surfaces with zinc rich primer where burned by field welding.

PART 1 - GENERAL

1.1 References

.1 Canadian Standards Association (CSA)
- .1 CSA B111-1974 (R1998) (R1998), Wire Nails, Spikes and Staples.
- .2 CAN/CSA-G164-M92 (R1998) (R1998), Hot Dip Galvanizing of Irregularly Shaped Articles.
- .3 CSA O121-M1978 (R1998) (R1998), Douglas Fir Plywood.
- .4 CAN/CSA-O141-91 (R1999) (R1999), Softwood Lumber.
- .5 CSA O151-M1978 (R1998) (R1998), Canadian Softwood Plywood.
- .6 CAN/CSA-O325.0-92 (R1998) (R1998), Construction Sheathing.

.2 National Lumber Grades Authority (NLGA)
- .1 Standard Grading Rules for Canadian Lumber 1991.

1.2 Quality Assurance

.1 Lumber identification: by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.

.2 Plywood identification: by grade mark in accordance with applicable CSA standards.

.3 Plywood, OSB and wood based composite panel construction sheathing identification: by grademark in accordance with applicable CSA standards.

1.3 Waste Management and Disposal

.1 Do not burn scrap at the project site.

.2 Fold up metal banding, flatten, and place in designated area for recycling.

1.4 Source Quality

.1 Lumber identification: by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.

.2 Plywood identification: by grade mark in accordance with applicable CSA standards.

PART 2 - PRODUCTS

2.1 Lumber Material

.1 Lumber: unless specified otherwise, softwood, S4S, moisture content 19% or less in accordance with following standards:
- .1 CAN/CSA-O141-91 (R1999) (R1999).
- .2 NLGA Standard Grading Rules for Canadian Lumber, latest edition.

.2 Machine stress-rated lumber is acceptable for all purposes.

.3 Glued end-jointed (finger-jointed) lumber is not acceptable.

.4 Framing and board lumber: in accordance with NBC 1985 Subsection 9.3.2.

.5 Furring, blocking, nailing strips, grounds, rough bucks, cants, curbs, fascia backing and sleepers:
- .1 Board sizes: "Standard" or better grade.
- .2 Dimension sizes: "Standard" light framing or better grade.
- .3 Post and timbers sizes: "Standard" or better grade.

2.2 Panel Standards

.1 Panel standards: type, grade and thickness as indicated, in accordance with following standards:

.1 Douglas fir plywood (DFP): to CSA O121-M1978 (R1998) (R1998), standard construction.
.2 Canadian softwood plywood (CSP): to CSA O151-M1978 (R1998) (R1998), standard construction.
.3 Poplar plywood (PP): to CAN/CSA-O15-90 (R1999) (R1999), standard construction.
.4 Interior mat-formed wood particleboard: to CAN3-0188.1.
.5 Waferboard: to CAN3-0188.2.
.6 Hardboard: to CAN/CGSB-11.3-M87.
.7 Insulating fiberboard sheathing: to CAN/CSA-A247-M86 (R1996) (R1996).
.8 Glass fibre board sheathing: non- structural, rigid, faced, fiberglass, insulating exterior sheathing board.
.9 Poly-isocyanurate sheathing: to CGSB 51- GP-21M.
.10 Expanded polystyrene sheathing: to CAN/CGSB-51.20-M87.
.11 Gypsum sheathing: to CAN/CSA-A82.27-M91.

2.3 Panel Materials End Uses

.1 Roof sheathing:
.1 Plywood, DFP or CSP sheathing grade or PP standard sheathing grade, T&G square edge, 16 mm thick.

.2 Exterior wall sheathing:
.1 Plywood, DFP or CSP sheathing grade or PP standard sheathing grade, square edge, 16 mm thick.

2.4 Sheathing Paper

.1 Exterior wall sheathing paper: to CAN/CGSB-51.32-M77 laminated type impregnated .

2.5 Dampproof Membrane

.1 Polyethylene film: to CAN/CGSB-51.33-M89, Type 1, 0.15 mm thick.

.2 Roll roofing: to CSA A123.2-M1979 (R2001) (R2001), Type S.

2.6 Adhesives

.1 Subflooring adhesive: to CAN/CGSB-71.26-M88, cartridge loaded.

2.7 Fasteners

.1 Nails, spikes and staples: to CSA B111-1974 (R1998) (R1998).

.2 Bolts: 12.5 mm diameter unless indicated otherwise, complete with nuts and washers.

.3 Proprietary fasteners: toggle bolts, expansion shields and lag bolts, screws and lead or inorganic fibre plugs, explosive actuated fastening devices, recommended for purpose by manufacturer.

.4 Galvanizing: to CAN/CSA-G164-M92 (R1998) (R1998), use galvanized fasteners for exterior work, interior highly humid areas, pressure-preservative, fire-retardant treated lumber.

.5 Joist hangers: minimum 1 mm thick sheet steel, galvanized ZF001 coating designation.

.6 Nailing discs: flat caps, minimum 25 mm diameter, minimum 0.4 mm thick, sheet metal, fibre, formed to prevent dishing. Bell or cup shapes not acceptable.

2.8 Wood Preservative

.1 Surface-applied wood preservative: clear, copper napthenate or 5% pentachlorophenol solution, water repellant preservative. All lumber utilized at roof and exterior applications to be treated with wood preservative.

.2 Pentachlorophenol use is restricted to building components that are in ground contact and subject to decay or insect attack only. Where used, pentachlorophenol-treated wood must be covered with two coats of an appropriate sealer.

.3 Structures built with wood treated with pentachlorophenol and inorganic

arsenicals must not be used for storing food nor should the wood come in contact with drinking water.

PART 3 - EXECUTION

3.1 Construction

.1 Comply with requirements of the Ontario Building Code NBC 1985 Part 9 supplemented by following paragraphs.

3.2 Erection of Framing Members

.1 Install members true to line, levels and elevations.

.2 Construct continuous members from pieces of longest practical length.

.3 Install spanning members with "crown-edge" up.

.4 Use caution when working with particle board. Use dust collectors and high quality respirator masks.

3.3 Erection

.1 Frame, anchor, fasten, tie and brace members to provide necessary strength and rigidity.

3.4 Defacement Marks

.1 Install lumber and panel materials so that grade-marks and other defacing marks are not visible or are removed by sanding.

3.5 Wall Sheathing

.1 Install wall sheathing in accordance with manufacturer's printed instructions.

3.6 Furring and Blocking

.1 Install furring and blocking as required to space-out and support casework, cabinets, wall and ceiling finishes, facings, fascia, soffit, siding and other work as required.

.2 Install furring to support siding applied vertically where there is no blocking and where sheathing is not suitable for direct nailing.

.3 Align and plumb faces of furring and blocking to tolerance of 1:600.

3.7 Nailing Strips, Grounds and Rough Bucks

.1 Install rough bucks, nailers and linings to rough openings as required to provide backing for frames and other work.

3.8 Cants, Curbs, Fascia Backing

.1 Install wood cants, fascia backing, nailers, curbs and other wood supports as required and secure using galvanized steel fasteners.

.2 Install wood backing, dressed, tapered and recessed slightly below top surface of roof insulation for roof hopper.

3.9 Sleepers

.1 Install sleepers as indicated.

3.10 Fasteners

.1 Countersink bolts where necessary to provide clearance for other work.

.2 Use nailing disks for soft sheathing as recommended by sheathing manufacturer.

3.11 Surface- Applied Wood Preservative

.1 Treat surfaces of material with wood preservative, before installation.

.2 Apply preservative by dipping, or by brush to completely saturate and maintain wet film on surface for minimum 3 minute soak on lumber and one minute soak on plywood.

.3 Re-treat surfaces exposed by cutting, trimming or boring with liberal brush application of preservative before installation.

.4 Treat all material as follows:

.1 Wood cants, fascia backing, curbs, nailers, sleepers on roof deck.

.2 Wood furring for outside surface of exterior masonry concrete walls.

.3 Wood sleepers supporting wood subflooring over concrete slabs in contact with ground or fill.

3.12 Electrical Equipment Backboard

.1 Provide backboards for mounting electrical equipment as indicated. Use 19 mm thick plywood on 19 x 38 mm furring around perimeter and at maximum 300 mm intermediate spacing.

PART 1 - GENERAL

1.1 Related Work

.1 Laminated plastic Section 06240 work: Laminated plastic

.2 Architectural Section 06400 woodwork: Architectural Woodwork

.3 Supply of finishing Section 08710 hardware: Finish Hardware

.4 Painting and Section 09900 finishing: Painting

1.2 References

.1 CSA B111-1974 (R1998) (R1998) (R1998) Wire Nails, Spikes and Staples.

.2 CAN/CSA-G164-M92 (R1998) (R1998) (R1998) Hot Dip Galvanizing of Irregularly Shaped Articles.

.3 CSA O115-M1982(R2001) Hardwood and Decorative Plywood.

.4 CSA O121-M1978 (R1998) (R1998) (R1998) Douglas Fir Plywood.

.5 CAN/CSA-O141-91 (R1999) (R1999) (R1999) Softwood Lumber.

.6 CSA O151-M1978 (R1998) (R1998) (R1998) Canadian Softwood Plywood.

.7 CSA O153-M1980 (R1998) (R1998) (R1998) Poplar Plywood.

.8 CAN3-O188.1-M78 Interior Mat-Formed Wood Particleboard.

.9 CAN4-S104-M80(R1985) Fire Tests of Door Assemblies.

.10 CAN4-S105-M85(R1992) Fire Door Frames.

.11 CAN/CGSB-11.3-M87 Hardboard.

.12 ANSI A208.1-1999 Particleboard, Matformed Wood.

.13 AWMAC Quality Standards for Architectural Woodwork 1991.

.14 National Lumber Grades Authority (NLGA) Standard Grading Rules for Canadian Lumber 1987.

.15 National Hardwood Lumber Association (NHLA) Rules for the Measurement and Inspection of Hardwood and Cypress January 1986.

1.3 Reference Standards

.1 Do finish carpentry to Millwork Standards of the Architectural Woodwork Manufacturers Association of Canada (AWMAC) 1998, except where specified otherwise.

1.4 Requirements of Regulatory Agencies

.1 Wood fire rated frames and panels: listed and labelled by an organization accredited by Standards Council of Canada in conformance with CAN4-S104-M80(R1985) and CAN4-S105-M85(R1992) for ratings specified or indicated.

1.5 Samples

.1 Submit samples in accordance with Section 01300 - Submittals.

.2 Submit duplicate samples: sample size 300 x 300 mm or 400 mm long unless specified otherwise.

1.6 Shop Drawings

.1 Submit shop drawings in accordance with Section 01300 - Submittals.

.2 Indicate details of construction, profiles, jointing, fastening and other related details.

.3 Indicate all materials, thicknesses, finishes and hardware.

1.7 Product Delivery, Storage and Handling

.1 Protect materials against dampness during and after delivery.

.2 Store materials in ventilated areas, protected from extreme changes of temperature or humidity.

PART 2 - PRODUCTS

2.1 Lumber Material

.1 Softwood lumber: unless specified otherwise, S4S, moisture content 19% or less in accordance with following standards:
- .1 CAN/CSA-O141-91 (R1999) (R1999) (R1999).
- .2 NLGA Standard Grading Rules for Canadian Lumber.
- .3 AWMAC premium grade, moisture content as specified.

.2 Machine stress-rated lumber is acceptable for all purposes.

.3 Hardwood lumber: moisture content 7% or less in accordance with following standards:
- .1 National Hardwood Lumber Association (NHLA).
- .2 AWMAC premium grade, moisture content as specified.

2.2 Panel Materials

.1 Douglas fir plywood (DFP): to CSA O121-M1978 (R1998) (R1998) (R1998), standard construction.

.2 Canadian softwood plywood (CSP): to CSA O151-M1978 (R1998) (R1998) (R1998), standard construction.

.3 Hardwood plywood: to CSA O115-M1982(R2001).

.4 Poplar plywood (PP): to CSA O153-M1980 (R1998) (R1998) (R1998), standard construction.

.5 Interior mat-formed wood particleboard: to CAN3-0188.1.

.6 Hardboard: to CAN/CGSB-11.3-M87.

.7 Medium density fibreboard (MDF): to ANSI A208.2-1994, density 769 kg/m 3.

.8 Melamine overlaid panelboards:

.1 Melamine overlay, heat and pressure laminated with phenolic resin to thickness indicated mm thick particleboard core.

.2 Overlay bonded to both faces where exposed two sides, and when panel material require surface on one side only, reverse side to be overlaid with a plain (buff) balancing sheet.

.3 Furniture finish: matched wood grain pattern selected by Consultant.

.4 Edge finishing: matching melamine and polyester overlay edge strip with self-adhesive.

2.3 Fasteners

.1 Nails and staples: to CSA B111-1974 (R1998) (R1998) (R1998); galvanized to CAN/CSA-G164-M92 (R1998) for exterior work, interior humid areas and for treated lumber; plain finish elsewhere.

.2 Wood screws: to CSA B35.4-72 electroplated steel, size and type to suit application.

.3 Splines: metal.

.4 Adhesive: as recommended by manufacturer.

2.4 Standing and Running Trim

.1 Interior:

.1 Grade: Clear select.

.2 Solid stock: Maple species.

.3 Veneered stock: Maple veneer, clear select grade, quarter cut.

2.5 Shelving

.1 Hardwood plywood:
- .1 Thickness: 16mm.
- .2 Number of plies: 5.
- .3 Face veneer: Maple species, clear select grade, rotary cut.
- .4 Back veneer: Maple species, clear select grade, rotary cut.
- .5 Core: veneer.
- .6 Bond: Type II.
- .7 Sanding: regular sanding.
- .8 Grain direction longitudinal.

.2 Edge banding: provide 10mm thick solid matching wood strip on plywood edges 12 mm or thicker, exposed in final assembly. Strips same width as plywood .

PART 3 - EXECUTION

3.1 Workmanship

.1 Do finish carpentry to Quality Standards of the Architectural Woodwork Manufacturers Association of Canada (AWMAC), except where specified otherwise.

.2 Scribe and cut as required to fit abutting walls, and surfaces, to fit properly into recesses and to accommodate piping, columns, fixtures, outlets, or other projecting, intersecting or penetrating objects.

.3 Form joints to conceal shrinkage.

3.2 Fastening

.1 Position items of finished carpentry work accurately, level, plumb, true and fasten or anchor securely.

.2 Design and select fasteners to suit size and nature of components being joined. Use proprietary devices as recommended by manufacturer.

.3 Set finishing nails to receive filler. Where screws are used to secure members countersink screw in round cleanly cut hole and plug with wood plug to match material being secured.

.4 Replace items of finish carpentry with damage to wood surfaces including hammer and other bruises.

3.3 Standing and Running Trim

.1 Butt and cope internal joints of baseboards to make snug, tight, joint. Cut right angle joints of casing and base with mitred joints.

.2 Fit backs of baseboards and casing snugly to wall surfaces to eliminate cracks at junction of base and casing with walls.

.3 Make joints in baseboard, where necessary using a 45° scarfe type joint.

.4 Install door and window trim in single lengths without splicing.

3.4 Shelving

.1 Install shelving on adjustable shelf brackets with recessed steel pilasters.

3.5 Hardware

.1 Install hardware supplied under Section 08710 - Finish Hardware, coat hooks and closet rod brackets.

PART 1 - GENERAL

1.1 Samples

.1 Submit samples in accordance with Section 01300 - Submittals.

.2 Submit duplicate samples: sample size 600 x 600 mm or 600 mm long unless specified otherwise.

.3 Submit duplicate colour samples of laminated plastic for colour selection.

.4 Submit duplicate samples of laminated plastic joints, edging, cutouts and postformed profiles.

.5 Submit samples of all casework hardware for approval.

1.2 Reference Standards

.1 American National Standards Institute (ANSI)
.1 ANSI A208.2-1994 1986 , Medium Density Fiberboard for Interior Use.

.2 American Society for Testing and Materials (ASTM)
.1 ASTM E 1333-96(2002) 90 , Standard Test Method for Determining Formaldehyde Levels From Wood Products Under Defined Test Conditions Using a Large Chamber.

.3 Architectural Woodwork Manufacturers Association of Canada (AWMAC)
.1 AWMAC Architectural Woodwork Standards, latest edition and updates.

.4 Canadian Standards Association (CSA)
.1 CAN3-A172-M79 (R1999) (R1999) M79 , High Pressure Paper Base, Decorative Laminates.
.2 CSA B111-1974 (R1998) (R1998) 1974 , Wire Nails, Spikes and

Staples.

.3 CSA O115-M1982(R2001) M1982 , Hardwood and Decorative Plywood.

.4 CSA O121-M1978 (R1998) (R1998) M1978 , Douglas Fir Plywood.

.5 CAN/CSA-O141-91 (R1999) (R1999) 91 , Softwood Lumber.

.6 CSA O151-M1978 (R1998) (R1998) M1978 , Canadian Softwood Plywood.

.7 CSA O153-M1980 (R1998) (R1998) M1980 , Poplar Plywood.

.8 CAN3-O188.1-M78 M78 , Interior Mat-Formed Wood Particleboard.

.9 CAN/CGSB-11.3-M87 M87 , Hardboard.

.5 National Hardwood Lumber Association (NHLA)

.1 Rules for the Measurement and Inspection of Hardwood and Cypress January 1996 .

.6 National Lumber Grades Authority (NLGA)

.1 Standard Grading Rules for Canadian Lumber 1991 .

1.3 Shop Drawings

.1 Submit shop drawings in accordance with Section 01300 - Submittals.

.2 Indicate details of construction, profiles, jointing, fastening and other related details.

.1 Scale: profiles full size, details 1/2 full size.

.3 Indicate all materials, thicknesses, finishes and hardware.

.4 Indicate locations of all service outlets in casework, typical and special installation conditions, and all connections, attachments, anchorage and location of exposed fastenings.

1.4 Product Delivery, Storage and Handling

.1 Protect millwork against dampness during and after delivery.

.2 Store millwork in ventilated areas, protected from extreme changes of temperature or humidity.

1.5 Guarantee

.1 This architectural woodworker shall furnish the owner with a two (2) year AWMAC Guarantee Certificate, or an equivalent maintenance bond, to the full value of the architectural woodwork sub-contract, certifying that the architectural woodwork has been manufactured and/or installed in accordance with the standards incorporated in the AWMAC Quality Standards manual (edition in effect at time of tender). Those providing the maintenance bond, instead of the Guarantee Certificate, to submit a letter from their insurer stating that they will provide the bond. A copy of this letter to be attached to their tenders. The Guarantee shall cover replacing and/or refinishing to make good any defects in architectural woodwork due to faulty workmanship or defective materials supplied by this architectural woodworker, which appear during a two (2) year period following the date of substantial completion of the project.

.2 Recognized qualifications and/or Membership in AWMAC may be a requirement of the Guarantee and Inspection service. These costs, if any, shall be borne by the contractor or carried in his tender price.

PART 2 - PRODUCTS

2.1 Lumber Material

.1 Softwood lumber: unless specified otherwise, S4S, moisture content 15% or less in accordance with following standards:
- .1 CAN/CSA-O141-91 (R1999) (R1999).
- .2 NLGA Standard Grading Rules for Canadian Lumber.
- .3 AWMAC premium grade, moisture content as specified.

.2 Machine stress-rated lumber is acceptable for all purposes.

.3 Hardwood lumber: moisture content 7% or less in accordance with following standards:
- .1 National Hardwood Lumber Association (NHLA).
- .2 AWMAC premium grade, moisture content as specified.

2.2 Panel Materials

.1 Douglas fir plywood (DFP): to CSA O121-M1978 (R1998) (R1998), standard construction.

.2 Canadian softwood plywood (CSP): to CSA O151-M1978 (R1998) (R1998), standard construction.

.3 Hardwood plywood: to CSA O115-M1982(R2001).

.4 Poplar plywood (PP): to CSA O153-M1980 (R1998) (R1998), standard construction.

.5 Interior mat-formed wood particleboard: to CAN3-0188.1.

.6 Birch plywood: to AWMAC Natural.

.7 Fibreboard must contain less than 10 % roundwood by weight, using a weighted average over a three month period at each manufacturing location. (Roundwood refers to logs, with bark, delivered to a pulp mill, cut in lengths up to 3 m).

.8 Hardboard

.1 to CAN/CGSB-11.3-M87.

.2 manufactured such that formaldehyde emissions do not exceed 0.15 ppm (180 µg/m ^{3}) when tested in accordance with ASTM E 1333-96(2002).

.3 if manufactured using a wet process:

.1 be made by a process that does not release matter in the undiluted product plant effluent generating a BOD ¥ in excess of 50 mg/L to a natural watercourse or a sewage treatment facility lacking secondary treatment;

.2 be made by a process that does not release TSS in excess of 60 mg/L to a natural watercourse or a sewage treatment facility lacking secondary treatment;

.4 contain at least 50 % recycled materials.

.9 Medium density fibreboard (MDF): to ANSI A208.2-1994, density 769 kg/m ^{3} .

.10 Medium density fibreboard must:

.1 meet the performance requirements of ANSI A208.2-1994.

.2 be manufactured such that formaldehyde emissions do not exceed 0.15 ppm (180 µg/m ^{3}) when tested in accordance with ASTM E 1333-96(2002).

.3 contain at least 15 % recycled materials by weight.

.11 Melamine Panels: Pre-fabricated melamine faced particle board panels to ANSI A208.1-1999 Standards and ALA 1992, "Panval" by Uniboard Canada Inc., "Panolam" by Panolam Industries or "Flakeboard" by Flakeboard Company Ltd. as distributed by Wandarosa or McFaddens. Hardrock maple

melamine finish. At exposed edges provide 3mm polyvinylchloride in colour to match melamine face. Colours as selected by Consultant from manufacturer's complete range.

2.3 Fasteners

.1 Nails and staples: to CSA B111-1974 (R1998) (R1998).

.2 Wood screws: steel, type and size to suit application to CSA B35.4-72.

2.4 Sealants

.1 Sealant: to Section 07900.

2.5 Casework

.1 Fabricate caseworks to AWMAC premium quality grade.

.2 Furring, blocking, nailing strips, grounds and rough bucks and sleepers.
.1 S2S is acceptable for non-visible locations.
.2 Board sizes: "Standard" or better grade.
.3 Dimension sizes: "Standard" light framing or better grade.

.3 Framing spruce species, NLGA Clear select grade.

.4 Case bodies (ends, divisions and bottoms).
.1 19mm melamine panels with continuous 3mm PVC strip at exposed edges.

.5 Backs.
.1 6mm white hardboard except where visible ie. without doors or with glass panels in doors, 6mm melamine parnels.

.6 Shelving.
.1 19mm melamine panels with continuous 3mm PVC strip at exposed edges.

2.6 Drawers

.1 Fabricate drawers to AWMAC premium grade supplemented as follows:

.2 Sides and Backs.
.1 Softwood and poplar plywood DFP or CSP or PP G2S grade, square edge, 13 mm thick.

.3 Bottoms.
.1 Softwood and poplar plywood DFP or CSP or PP G2S grade, square edge, 6 mm thick.

.4 Fronts.
.1 19mm melamine panels with continuous 3mm PVC strips at exposed edges. Softwood plywood:

2.7 Casework Doors and Cupboard and Closet Gables

.1 Fabricate doors to AWMAC premium grade supplemented as follows:

.2 19mm melamine panels with continuous 3mm PVC strips at exposed edges.

.3 At teacher's closets, 38mm melamine panels solid core: to CAN/CSA-O132.2.1 with continuous 3mm PVC strips at exposed edges.

2.8 Laminated Plastic Counter Tops and Splashbacks

.1 Countertops and splashbacks and visible counter gables: one piece, factory laminated, self-edge type.
.1 Laminated plastic: General Purpose, Colour as selected by Consultant.
.2 Core: 19 Particle Board.
.3 Adhesive: waterproof as recommended by manufacturer.
.4 Draw bolts: nickel plated.

2.9 Hardware

.1 Hinges: 91.275 x 195.710, 2 per door leaf minimum, spaced at 800mm maximum.

.2 Door and drawer pulls: Stainless Steel "D" pulls, 220 x 3 1/2 - 32D. One per door and drawer.

.3 Catches: Magnetic, 323A, one per door leaf.

.4 Drawer slide: two-piece pre-painted steel with neoprene bearing rollers, each side, 230 x length to suit.

.5 Drawer or door lock: Stainless steel, cylinder type with latch and receiving plate, key operated, 8138-26D-MK, one per drawer and door. Locks to be keyed alike per room and master keyed.

.6 Adjustable shelving standards: recessed pilaster KV255 2 per side adjustable clips Richelieu Hardware Cat. No. 2432G, 4 per shelf. www.richelieu.com, tel#1-800-361-6000.

.7 Closet rod: KV770 x 1 5/16" complete with flange KV764, one set per closet.

.8 Coat Hooks: Canadian Builders Hardware CBH 61 brushed aluminum screwed to min. 2mm x 130mm steel plate with ground corners anchored to wall assembly.

.9 Automatic door bolt: Richelieu LOCDL200 or LOCDL300 to suit.

2.10 Edge Banding

.1 3mm solid PVC to match melamine panels. Strips same width as finished panel.

2.11 Fabrication

.1 Set nails and countersink screws, apply stained wood filler to indentations, sand smooth and leave ready to receive finish.

.2 Shop install cabinet hardware for doors, shelves and drawers. Recess shelf standards unless noted otherwise.

.3 Shelving to cabinetwork to be adjustable unless otherwise noted.

.4 Provide cutouts for plumbing fixtures, inserts, appliances, outlet boxes and other fixtures.

.5 Shop assemble work for delivery to site in size easily handled and to ensure passage through building openings.

2.12 Finishing

.1 Factory stain finish according to AWMAC Part 5 Article 8.5.3.

2.13 Change Table

.1 Kool and Galt model 077-G268 with panelled doors with pinch-free hing es, castors, and two adjustable shelves 0077-G245 ,15cm deep padded p an of seamless medical-grade vinyl covering foam cushion, automatical ly retracting steps, tilt-out diaper hamper, accessories shelf. 112cm x 57cm x 95cm H.

PART 3 - EXECUTION

3.1 Installation

.1 Install prefinished millwork at locations shown on drawings. Position accurately, level, plumb straight.

.2 Fasten and anchor millwork securely. Provide heavy duty fixture attachments for wall mounted cabinets.

.3 Use draw bolts in countertop joints.

.4 Scribe and cut as required to fit abuting walls and to fit properly into recesses and to accommodate piping, columns, fixtures, outlets or other projecting, intersecting or penetrating objects.

.5 At junction of plastic laminate counter back splash and adjacent wall finish, apply small bead of sealant.

.6 Apply water resistant building paper or bituminous coating over wood

framing members in contact with masonry or cementitious construction.

.7 Fit hardware accurately and securely in accordance with manufacturer's directions.

.8 Seal cut-outs at all penetrations through countertops.

.9 Install chnage table in accordance with manufacturer's specifications.

3.2 Cleaning

.1 Clean millwork and cabinet work inside cupboards and drawers andoutside surfaces.

3.3 Protection

.1 Protect millwork and cabinet work from damage until final inspection .

PART 1 - GENERAL

1.1 Related Work

.1 Fire stopping and smoke seals within mechanical assemblies (i.e inside ducts, dampers) and electrical assemblies (i.e. inside cable trays) are specified in Divisions 15 and 16 respectively.

1.2 References

.1 ULC-S115-M95, Standard Method of Fire Tests of Firestop Systems.

1.3 Samples

.1 Submit samples in accordance with Section 01300 Submittals.

1.4 Shop Drawings

.1 Submit shop drawings and product data in accordance with Section 01300 - Submittals.

.2 Submit shop drawings to show proposed material, reinforcement, anchorage, fastenings and method of installation. Construction details should accurately reflect actual job conditions.

.3 Submit manufacturer's product data for materials and prefabricated devices, providing descriptions are sufficient for identification at job site. Include manufacturer's printed instructions for installation.

PART 2 - PRODUCTS

1.5 Materials

.1 Fire stopping and smoke seal systems: in accordance with ULC-S115-M95.
.1 Asbestos-free materials and systems capable of maintaining an effective barrier against flame, smoke and gases in compliance with requirements of ULC-S115-M95 and not to exceed opening sizes for which they are intended.
.2 Firestop system rating: to suit rating of penetrated assembly, minimum 1 hr.

.2 Service penetration assemblies: certified by ULC in accordance with ULC-S115-M95 and listed in ULC Guide No. 40 U19.

.3 Service penetration firestop components: certified by ULC in accordance with ULC-S115-M95 and listed in ULC Guide No. 40 U19.13 and ULC Guide No. 40 U19.15 under the Label Service of ULC.

.4 Fire-resistance rating of installed fire stopping assembly not less than the fire- resistance rating of surrounding floor and wall assembly.

.5 Fire stopping and smoke seals at openings intended for ease of re-entry such as cables: elastomeric seal.

.6 Fire stopping and smoke seals at openings around penetrations for pipes, ductwork and other mechanical items requiring sound and vibration control: elastomeric seal.

.7 Primers: to manufacturer's recommendation for specific material, substrate, and end use.

.8 Water (if applicable): potable, clean and free from injurious amounts of deleterious substances.

.9 Damming and backup materials, supports and anchoring devices: to manufacturer's recommendations, and in accordance with tested assembly being installed as acceptable to authorities having jurisdiction.

.10 Sealants for vertical joints: non-sagging.

1.6 Acceptable Manufacturers

.1 Products in accordance with this specification by only the following manufacturers will be accepted.
.1 3M

.2 AD Fire Protection
.3 Hilti
.4 Nuco
.5 Tremco
.6 Rectorseal

PART 3 - EXECUTION

3.1 Preparation

.1 Examine sizes and conditions of voids to be filled to establish correct thicknesses and installation of materials. Ensure that substrates and surfaces are clean, dry and frost free.

.2 Prepare surfaces in contact with fire stopping materials and smoke seals to manufacturer's instructions.

.3 Maintain insulation around pipes and ducts penetrating fire separation without interuption to vapour barrier.

.4 Mask where necessary to avoid spillage and over coating onto adjoining surfaces; remove stains on adjacent surfaces.

3.2 Installation

.1 Install fire stopping and smoke seal material and components in accordance with ULC certification and manufacturer's instructions.

.2 Seal holes or voids made by through penetrations, poke-through termination devices, and unpenetrated openings or joints to ensure continuity and integrity of fire separation are maintained.

.3 Provide temporary forming as required and remove forming only after materials have gained sufficient strength and after initial curing.

.4 Tool or trowel exposed surfaces to a neat finish.

.5 Remove excess compound promptly as work progresses and upon completion.

3.3 Inspection

.1 Notify Consultant when ready for inspection and prior to concealing or enclosing firestopping materials and service penetration assemblies.

3.4 Schedule

.1 Firestop and smoke seal at:

.1 Penetrations through fire separations and fire-resistance rated masonry, concrete, and gypsum board partitions and walls.

.2 Top of fire separations and fire-resistance rated masonry and gypsum board partitions.

.3 Intersection of fire separations and fire-resistance rated masonry and gypsum board partitions.

.4 Control and sway joints in fire separations and fire-resistance rated masonry and gypsum board partitions and walls.

.5 Penetrations through fire separations and fire-resistance rated floor slabs, ceilings and roofs.

.6 Openings and sleeves installed for future use through fire separations.

.7 Around mechanical and electrical assemblies penetrating fire separations.

.8 Rigid ducts: greater than 129 cm^2: fire stopping to consist of bead of fire stopping material between retaining angle and fire separation and between retaining angle and duct, on each side of fire separation.

3.5 Clean Up

.1 Remove excess materials and debris and clean adjacent surfaces immediately after application.

.2 Remove temporary dams after initial set of fire stopping and smoke seal materials.

PART 1 - GENERAL

1.1 References

.1 Aluminum Association
- .1 Aluminum Sheet Metal Work in Building Construction- 1980.
- .2 Designation System for Aluminum Finishes- 1980.

.2 American Society for Testing and Materials (ASTM)
- .1 ASTM A 167-99 94a , Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- .2 ASTM A 591/A 591M-98 591M-98 591M-98 591M-96 591M-96 591M-96 591M-96 591 M- 89(1994) , Specification for Steel Sheet, Electrolytic Zinc-Coated, for Light Coating Mass Applications.
- .3 ASTM A 606-01 91a(1993) , Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance.
- .4 ASTM A 653/A 653M-02a 653M-02a 653M-02a 653 M- 95 , Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .5 ASTM A 792/A 792M-02 792M-02 792M-02 792M- 95 , Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
- .6 ASTM B 32-00e1 95b , Specification for Solder Metal.
- .7 ASTM B 370-98 92 , Specification for Copper Sheet and Strip for Building Construction.
- .8 ASTM D 523-89(1999) 89(1994) , Test Method for Specular Gloss.
- .9 ASTM D 822-01 89 , Practice for Conducting Tests on Paint and Related Coatings and Materials Using Filtered Open-Flame Carbon Arc Light and Water Exposure Apparatus.

.3 Canadian Roofing Contractors Association (CRCA).
- .1 Roofing Specifications Manual.

.4 Canadian Standards Association (CSA)
- .1 CSA A123.3-98 M1979 , Asphalt or Tar Saturated Roofing Felt.
- .2 CSA PKG.A440-00 Series-98 Series-98 Series-98 Series-98 M90 , Windows.
- .3 CSA B111-1974 (R1998) (R1998) (R1998) 1974 , Wire Nails, Spikes and Staples.

.5 Canadian General Standards Board (CGSB)
.1 CAN/CGSB-37.5-M89 M89 , Cutback Asphalt Plastic Cement.
.2 CAN/CGSB-51.32-M77 M77 , Sheathing, Membrane, Breather Type.
.3 CAN/CGSB-93.1-M85 M85 , Sheet, Aluminum Alloy, Prefinished, Residential.

1.2 Samples

.1 Submit shop drawings in accordance with Section 01300.

.2 Submit duplicate 50 x 50 mm samples of each type of sheet metal material, colour and finish.

PART 2 - PRODUCTS

2.1 Prefinished Steel Sheet

.1 Prefinished steel with factory applied silicone modified polyester.
.1 Class F2S.
.2 Premium colour selected by Consultant to match existing.
.3 Specular gloss: 30 units +/- 5 in accordance with ASTM D 523-89(1999).
.4 Coating thickness: not less than 25 micrometres.
.5 Resistance to accelerated weathering for chalk rating of 8, colour fade 5 units or less and erosion rate less than 20% to ASTM D 822-01 as follows:
.1 Outdoor exposure period 10000 hours.
.2 Humidity resistance exposure period 10000 hours.

2.2 Accessories

.1 Isolation coating: alkali resistant bituminous paint.

.2 Plastic cement: to CAN/CGSB-37.5-M89.

.3 Underlay for metal flashing: No. 15 perforated asphalt felt to CSA A123.3-98.

.4 Sealants: according to Section 07900. Ensure compatibility of materials.

.5 Cleats: of same material, and temper as sheet metal, minimum 50 mm wide. Thickness same as sheet metal being secured.

.6 Fasteners: of same material as sheet metal, to CSA B111-1974 (R1998) (R1998) (R1998), ring thread flat head roofing nails of length and thickness suitable for metal flashing application.

.7 Washers: of same material as sheet metal, 1 mm thick with rubber packings.

.8 Touch-up paint: as recommended by prefinished material manufacturer.

2.3 Fabrication

.1 Fabricate metal flashings and other sheet metal work in accordance with applicable CRCA 'FL' series details and as indicated.

.2 Fabricate aluminum flashings and other sheet aluminum work in accordance with Aluminum Association Aluminum Sheet Metal Work in Building Construction.

.3 Form pieces in 2400 mm maximum lengths. Make allowance for expansion at joints.

.4 Hem exposed edges on underside 12 mm. Miter and seal corners with sealant.

.5 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.

.6 Apply isolation coating to metal surfaces to be embedded in concrete or mortar.

2.4 Metal Flashings

.1 Form flashings, copings and fascias to profiles indicated of 22ga

prefinished steel .

2.5 Pans

.1 Form pans to receive roofing plastic from 22ga thick prefinished steel sheet metal with minimum 75 mm upstand above finished roof and 100 mm continuous flanges with no open corners. Rivet joints. Make pans minimum 50 mm wider than member passing through roof membrane.

2.6 Reglets and Cap Flashings

.1 Form recessed reglets and metal cap flashing of 1 mm thick sheet metal to be built-in masonry work for base flashings as detailed and in accordance with CRCA FL series details. Provide slotted fixing holes and steel/plastic washer fasteners. Cover face and ends with plastic tape.

2.7 Gutters and Rainwater Leaders (RWL)

.1 Brake form gutters to profile as shown on drawings including hemmed edges and S-lock seams.

.2 Brake form minimum 130mm x 130mm rainwater leaders as shown on drawings including S-lock seams.

.3 Provide watertight transitions and conncetions as required.

.4 Submit shop drawings indicating mounting details and co-ordination with linear trench drain assembly.

PART 3 - EXECUTION

3.1 Installation

.1 Install sheet metal work in accordance with CRCA FL series details and as detailed.

.2 Use concealed fastenings except where approved before installation.

.3 Provide underlay under sheet metal. Secure in place and lap joints 100 mm.

.4 Counterflash bituminous flashings at intersections of roof with vertical surfaces and curbs. Flash joints using S-lock forming tight fit over hook strips, as detailed.

.5 Lock end joints and caulk with sealant.

.6 Install surface mounted reglets true and level, and caulk top of reglet with sealant.

.7 Insert metal flashing into reglets and under cap flashing to form weathertight junction.

.8 Turn top edge of flashing into recessed reglet or mortar joint minimum of 25 mm. Lead wedge flashing securely into joint.

.9 Caulk flashing at reglet and cap flashing with sealant.

.10 Install pans, where shown and as required around items projecting through roof membrane.

PART 1 - GENERAL

1.1 Summary

.1 This Section specifies caulking and sealants not specified in other Sections.

.2 Refer to other sections for other caulking and sealants.

1.2 References

.1 CAN/CGSB-19.1-M87, Putty, Linseed Oil Type.

.2 CAN/CGSB-19.2-M87, Glazing Compound, Nonhardening, Modified Oil Type.

.3 CGSB 19-GP-5M, Sealing Compound, One Component, Acrylic Base, Solvent Curing.

.4 CAN/CGSB-19.6-M87, Caulking Compound, Oil Base.

.5 CAN/CGSB-19.13-M87, Sealing Compound, One-component, Elastomeric, Chemical Curing.

.6 CGSB 19-GP-14M, Sealing Compound, One Component, Butyl-polyisobutylene Polymer Base, Solvent Curing.

.7 CAN/CGSB-19.17-M90, One-Component Acrylic Emulsion Base Sealing Compound.

.8 CAN/CGSB-19.18-M87, Sealing Compound, One Component, Silicone Base, Solvent Curing.

.9 CAN/CGSB-19.20-M87, Cold-applied Sealing Compound, Aviation Fuel-resistant.

.10 CAN/CGSB-19.21-M87, Sealing and Bedding Compound Acoustical.

.11 CAN/CGSB-19.22-M89, Mildew Resistant, Sealing Compound for Tubs and

Tiles.

.12 CAN/CGSB-19.24-M90, Multi-component, Chemical Curing Sealing Compound.

1.3 Samples

.1 Submit samples in accordance with Section 01300 - Submittals.

.2 Submit duplicate samples of each type of material and colour. Colours to be as selected by Consultant from manufacturer's standard and premium colour range.

1.4 Delivery, Storage, and Handling

.1 Deliver and store materials in original wrappings and containers with manufacturer's seals and labels, intact. Protect from freezing, moisture and water.

1.5 Environmental and Safety Requirements

.1 Conform to manufacturer's recommended temperatures, relative humidity, and substrate moisture content for application and curing of sealants including special conditions governing use.

.2 For interior caulking work, ventilate areas as directed by Consultant.

1.6 Compatibility

.1 Contractor together with manufacturer to recommend materials most appropriate for use intended and to assure compatibility of caulking materials with adjacent materials. Commencement of Work shall be deemed comformance with this Article.

.2 Examine sustrates prior to commencing work and report to Consultant deficiencies which may impede the work of this Section. Commencement of Work shall be deemed acceptance of substrate.

PART 2 - PRODUCTS

2.1 Sealant Materials

.1 Sealants and caulking compounds must:

.1 meet or exceed all applicable governmental and industrial safety and performance standards; and

.2 be manufactured and transported in such a manner that all steps of the process, including the disposal of waste products arising therefrom, will meet the requirements of all applicable governmental acts, by laws and regulations including, for facilities located in Canada, the fisheries Act and the Canadian Environmental Protection Act (CEPA).

.2 Sealant and caulking compounds must not be formulated or manufactured with: aromatic solvents, fibrous talc or asbestos, formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavalent chromium, barium or their compounds, except barium sulfate.

.3 Sealant and caulking compounds must not contain a total of volatile organic compounds (VOCs) in excess of 5% by weight as calculated from records of the amounts of constituents used to make the product;

.4 Sealant and caulking compounds must be accompanied by detailed instructions for proper application so as to minimize health concerns and maximize performance, and information describing proper disposal methods.

.5 Caulking that emits strong odours, contains toxic chemicals or is not certified as mould resistant shall not be used in air handling units.

.6 When low toxicity caulks are not possible, confine usage to areas which offgas to the exterior, are contained behind air barriers, or are applied several months before occupancy to maximize off-gas time.

.7 In the selection of the products and materials of this section preference will be given to those with the following characteristics: Water based, water soluble, water clean-up, non-flammable, Biodegradable , low Volatile Organic Compound (VOC) content, manufactured without compounds which contribute to ozone depletion in the upper atmosphere,

manufactured without compounds which contribute to smog in the lower atmosphere, does not contain methylene chloride, does not contain chlorinated hydrocarbons.

.8 The manufacturing process must adhere to Lifecycle Assessment Standards as per CSA Z760-94 LCA Standards .

.9 Sealants acceptable for use on this project except CAN/CGSB-19.1-M87 and CAN/CGSB-19.18-M87 must be listed on CGSB Qualified Products List issued by CGSB Qualification Board for Joint Sealants. Where sealants are qualified with primers use only these primers.

2.2 Sealant Material Designations

.1 Sealants for vertical and horizontal non-traffic bearing joints, to Table 1, CGSB 19-GP-23:

.1 Normal temperature range, dry conditions, movement range to 25%: CGSB 19-GP-9Ma+Amd- Oct-80, CAN/CGSB-19.13-M87, CAN/CGSB-19.18-M87, Can2-19.24-M80.

.2 Normal temperature range, wet conditions, movement range to 25%: CAN/CGSB-19.13-M87, Can2-19.24-M80.

.3 Low temperature range, dry conditions, movement range to 25%: CGSB 19-GP-9Ma+Amd- Oct-80, CAN/CGSB-19.13-M87, CAN/CGSB-19.18-M87, Can2-19.24-M80.

.4 Low temperature range, wet conditions, movement range to 25%: CAN/CGSB-19.13-M87, Can2-19.24-M80.

.2 Sealants in interior applications subject to high humidity and dampness to be silicone type with integral fungiside.

2.3 Back-up Materials

.1 Polyethylene, Urethane, Neoprene or Vinyl Foam

.1 Extruded closed cell foam backer rod.

.2 Size: oversize 30 to 50%.

.2 Neoprene or Butyl Rubber

.1 Round solid rod, Shore A hardness 70.

.3 High Density Foam.

.1 Extruded closed cell polyvinyl chloride (PVC), extruded

polyethylene, closed cell, Shore A hardness 20, tensile strength 140 to 200 kPa, extruded polyolefin foam, 32 kg/m³ density, or neoprene foam backer, size as recommended by manufacturer.

.2 Bond Breaker Tape.

.1 Polyethylene bond breaker tape which will not bond to sealant.

.3 Ensure compatibility with sealants.

2.4 Sealant Selection

.1 Use sealant as recommended by manufacturer for use intended. Submit sealant schedule to Consultant for review prior to commencement of work.

2.5 Joint Cleaner

.1 Non-corrosive and non-staining type, compatible with joint forming materials and sealant recommended by sealant manufacturer.

.2 Primer: as recommended by manufacturer.

PART 3 - EXECUTION

3.1 Protection

.1 Protect installed work of other trades from staining or contamination.

3.2 Preparation of Joint Surfaces

.1 Examine joint sizes and conditions to establish correct depth to width relationship for installation of backup materials and sealants.

.2 Clean bonding joint surfaces of harmful matter substances including dust, rust, oil grease, and other matter which may impair work.

.3 Do not apply sealants to joint surfaces treated with sealer, curing compound, water repellent, or other coatings unless tests have been performed to ensure compatibility of materials. Remove coatings as required.

.4 Ensure joint surfaces are dry and frost free.

.5 Prepare surfaces in accordance with manufacturer's directions.

3.3 Priming

.1 Where necessary to prevent staining, mask adjacent surfaces prior to priming and caulking.

.2 Prime sides of joints in accordance with sealant manufacturer's instructions immediately prior to caulking.

3.4 Backup Material

.1 Apply bond breaker tape where required to manufacturer's instructions.

.2 Install joint filler to achieve correct joint depth and shape.

3.5 Mixing

.1 Mix materials in strict accordance with sealant manufacturer's instructions.

3.6 Application

.1 Sealant.

.1 Apply sealant in accordance with manufacturer's instructions at

all joints between dissimilar materials.

.2 Apply sealant in continuous beads.

.3 Apply sealant using gun with proper size nozzle.

.4 Use sufficient pressure to fill voids and joints solid.

.5 Form surface of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities.

.6 Tool exposed surfaces to give slightly concave shape.

.7 Remove excess compound promptly as work progresses and upon completion.

.2 Curing.

.1 Cure sealants in accordance with sealant manufacturer's instructions.

.2 Do not cover up sealants until proper curing has taken place.

.3 Cleanup.

.1 Clean adjacent surfaces immediately and leave work neat and clean.

.2 Remove excess and droppings, using recommended cleaners as work progresses.

.3 Remove masking tape after initial set of sealant.

PART 1 - GENERAL

1.1 Related Work

.1 Building-in and Section 04050 grouting frames Masonry Procedures in masonry:

.2 Building-in frames Section 06100 into wood stud 06101 walls: Rough Carpentry.

.3 Caulking of joints Section 07900 between frames and sealants other building components:

.4 Supply of finish Section 08710 hardware, including Finish Hardware weatherstripping and mounting heights:

.5 Glazing: Section 08800 Glazing

.6 Building-in frames Section 09111 into steel stud Metal Stud System walls:

.7 Painting: Section 09900

1.2 References

.1 American Society for Testing and Materials (ASTM).
.1 ASTM A 653/A 653M-02a 653M-02a, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
.2 ASTM B 29-92(1997), Specification for Pig Lead.
.3 ASTM B 749-97, Specification for Lead and Lead Alloy Strip, Sheet and Plate Products.

.2 Canadian General Standards Board (CGSB).
.1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
.2 CGSB 41-GP-19Ma, Rigid Vinyl Extrusions for Windows and Doors.
.3 CAN/CGSB-51.20-M87, Thermal Insulation, Polystyrene, Boards and

Pipe Covering.
.4 CGSB 51-GP-21M, Thermal Insulation, Urethane and Isocyanurate, Unfaced.

.3 Canadian Standards Association (CSA).
.1 CSA A101-M1983, Thermal Insulation, Mineral Fibre, for Buildings.
.2 CSA G40.21-98, Structural Quality Steels.
.3 CSA W59-M1989 (R2001) (R2001), Welded Steel Construction (Metal Arc Welding).

.4 Canadian Steel Door and Frame Manufacturers' Association, (CSDFMA).
.1 CSDFMA, Specifications for Commercial Steel Doors and Frames, 1990.
.2 CSDFMA, Recommended Selection and Usage Guide for Commercial Steel Doors, 1990.

.5 National Fire Protection Association (NFPA).
.1 ANSI/NFPA 80-1998, Fire Doors and Windows.
.2 ANSI/NFPA 252-1999, Door Assemblies, Fire Tests of.

.6 Underwriters' Laboratories of Canada (ULC).
.1 CAN4-S104-M80(R1985) M80(R1985), Fire Tests of Door Assemblies.
.2 CAN4-S105-M85(R1992), Fire Door Frames.

1.3 Design Requirements

.1 Design exterior frame assembly to accommodate to expansion and contraction when subjected to minimum and maximum surface temperature of -35°C to 35°C.

.2 Maximum deflection for exterior steel entrance screens under wind load of 1.2 kPa not to exceed 1/175th of span.

1.4 Requirements of Regulatory Agencies

.1 Steel fire rated doors and frames: labelled and listed by an organization accredited by Standards Council of Canada in conformance with CAN4-S104-M80(R1985) revised 1985 and CAN4-S105-M85(R1992) for ratings specified or indicated.

.2 Install labelled steel fire rated doors and frames to ANSI/NFPA 80-1998

except where specified otherwise.

1.5 Shop Drawings

.1 Submit shop drawings in accordance with Section 01300 - Submittals.

.2 Indicate each type of door, material, steel core thicknesses, mortises, reinforcements, location of exposed fasteners, openings, glazed louvred, arrangement of hardware and fire rating.

.3 Indicate each type frame material, core thickness, reinforcements, glazing stops, location of anchors and exposed fastenings and finishes.

PART 2 - PRODUCTS

2.1 Materials

.1 Hot dipped galvanized steel sheet: to ASTM A 653/A 653M-02a 653M-02a, ZF75, minimum base steel thickness in accordance with CSDFMA Table 1 - Thickness for Component Parts.

.2 Reinforcement channel: to CSA G40.21-98, Type 44W, coating designation to ASTM A 653/A 653M-02a 653M-02a, ZF75.

.3 Composites: balance of core materials used in conjuction with lead: in accordance with manufacturers' proprietary design.

2.2 Door Core Materials

.1 Stiffened: face sheets welded, vertically stiffened, uninsulated core.
.1 Polyurethane: to CGSB 51-GP-21M rigid, modified poly/isocyanurate, closed cell board. Density 32 kg/m^3.

.2 Temperature rise rated (TRR): core composition to limit temperature rise on unexposed side of door to 250°C at 30 60minutes. Core to be tested as part of a complete door assembly, in accordance with

CAN4-S104-M80(R1985), ASTM E 152-81a or ANSI/NFPA 252-1999, covering Standard Method of Tests of Door Assemblies and listed by nationally recognized testing agency having factory inspection service.

.3 Thermal insulation material must:

.1 not require being labelled as poisonous, corrosive, flammable or explosive under the Consumer Chemical and Container Regulations of the Hazardous Products Act;

.2 be manufactured using a process that uses chemical compounds with the minimum ozone depletion potential (ODP) available.

.4 Board-type thermal insulation materials must:

.1 contain, when calculated on a 12-month rolling basis:

.1 over 35 % recycled material by weight of the finished product if made from glass fibre,

.2 over 45 % recycled material by weight of the finished product if made from mineral composition,

.3 over 10 % recycled material by weight of the finished product, if made from plastic.

2.3 Adhesives

.1 Select Adhesives which:

.1 do not contain volatile organic compounds in excess of 5 % by weight as measured by EPA Method 24-24A, 40 C.F.R., Part 60, Appendix A (1991), Method 18,48 Federal Register 48, no. 202, October 18, 1983 Method 1400 NIOSH Manual of Analytical Methods, Volume 1, February 1984, Environmental Protection Agency Method 8240 GC/MS Method for Volatile Organics, September 1986, as demonstrated through calculation from records of the amounts of constituents used to make the product;

.2 are accompanied by detailed instructions for proper application so as to minimize health concerns and maximize performance;

.3 are accompanied by information describing proper disposal methods for containers.

.2 Steel components: heat resistant, spray grade, resin reinforced neoprene/rubber (polychloroprene) based, low viscosity, contact cement.

.3 Polystyrene and polyurethane cores: heat resistant, epoxy resin based, low viscosity, contact cement.

.4 Lock-seam doors: fire resistant, resin reinforced polychloroprene, high viscosity, sealant/adhesive.

2.4 Primers

.1 Touch-up prime CAN/CGSB-1.181-99.

2.5 Accessories

.1 Door silencers: single stud rubber/neoprene type GJ-64.

.2 Exterior and interior top and bottom caps: rigid polyvinylchloride extrusion conforming to CGSB 41-GP-19Ma steel.

.3 Fabricate glazing stops as formed channel, minimum 16 mm height, accurately fitted, butted at corners and fastened to frame sections with counter-sunk oval head sheet metal screws.

.4 Door bottom seal.

.5 Metallic paste filler: to manufacturer's standard.

.6 Fire labels: metal riveted.

.7 Sealant: in accordance with Section 07900.

.8 Glazing: in accordance with Section 08800.

.9 Make provisions for glazing as indicated and provide necessary glazing stops.

.1 Provide removable stainless steel glazing beads for use with glazing tapes and compounds and secured with countersunk stainless steel screws or dry glazing of snap-on type.

.2 Design exterior glazing stops to be tamperproof. Provide non-removeable stainless steel screws.

2.6 Frames Fabrication General

.1 Fabricate frames in accordance with CSDFMA specifications.

.2 Fabricate frames to profiles and maximum face sizes as indicated and to suit wall conditions. Frame depths to cover masonry cavities where applicable. All exposed corner blocks are bullnosed. Generally, for

150 concrete block walls, throat size to cap block. For cavity walls, frame depth to be minimum 178mm with fasteners to suit anchorage into masonry veneer and back-up block.

.3 Exterior frames: 1.6 mm welded thermally broken type construction.

.4 Interior frames: 1.6 mm welded knocked-down type construction.

.5 Blank, reinforce, drill and tap frames for mortised, templated hardware, andelectronic hardware using templates provided by finish hardware supplier. Reinforce frames for surface mounted hardware.

.6 Protect mortised cutouts with steel guard boxes except for gypsum board installations.

.7 Prepare frame for door silencers, 3 for single door, 2 at head for double door.

.8 Manufacturer's nameplates on frames and screens are not permitted.

.9 Conceal fastenings except where exposed fastenings are indicated.

.10 Provide factory-applied touch up primer at areas where zinc coating has been removed during fabrication.

.11 Insulate exterior frame components with polyurethane insulation.

.12 Steel frames to exterior and interior openings 1200 mm or less in unsupported width 1.52 mm base thickness.

.1 Steel frames exterior and interior openings over 1200 mm in unsupported width 1.52 mm base thickness. Reinforce head with framed steel reinforcing channel for full width. Reinforce for all hardware.

2.7 Frame Anchorage

.1 Provide appropriate anchorage to floor and wall construction.

.2 Locate each wall anchor immediately above or below each hinge reinforecement on hinge jamb and directly opposite on strike jamb.

.3 Provide 2 anchors for rebate opening heights up to 1520 mm and 1 additional anchor for each additional 760 mm of height or fraction thereof.

.4 Locate anchors for frames in existing openings not more than 150 mm

from top and bottom of each jambs and intermediate at 660 mm o.c. maximum.

.5 At masonry cavity walls, use galvanized offset T-anchors set into concrete block wythe.

2.8 Frames: Welded Type

.1 Welding in accordance with CSA W59-1989 (R2001) (R2001).

.2 Accurately mitre or mechanically joint frame product and securely weld on inside of profile.

.3 Cope accurately and securely weld butt joints of mullions, transom bars, centre rails and sills.

.4 Grind welded joints and corners to a flat plane, fill with metalic paste and sane to uniform smooth finish.

.5 Securely attach floor anchors to inside of each jamb profile.

.6 Weld in 2 temporary jamb spreaders per frame to maintain proper alignment during shipment.

.7 Securely attach lead to inside of frame profile from return to jamb soffit (inclusive) on door side of frame only.

2.9 Door Fabrication General

.1 Doors: swing type, vertically stiffened, flush, with provision for glass and/or louvre openings as indicated.

.2 Exterior doors: hollow steel construction. Interior doors: hollow steel construction.

.3 Fabricate doors with longitudinal edges fully welded. Seams: grind welded joints to a flat plane, fill with metallic paste filler and sand to a uniform smooth finish.

.4 Doors: manufacturers' proprietary construction, tested and/or engineered as part of a fully operable assembly, including door, frame, gasketing and hardware in accordance with ASTM E 330-02.

.5 Blank, reinforce, drill doors and tap for mortised, templated hardware andelectronic hardware.

.6 Factory prepare holes 12.7 mm diameter and larger except mounting and through-bolt holes, on site, at time of hardware installation.

.7 Reinforce doors where required, for surface mounted hardware.

.8 Provide flush steel top caps to exterior doors. Provide inverted, recessed, spot welded channels to top and bottom of interior doors.

.9 Provide factory-applied touch-up primer at areas where zinc coating has been removed during fabrication.

.10 Provide fire labelled doors for those openings requiring fire protection ratings, as scheduled. Test such products in strict conformance with CAN4-S104-M80(R1985), ASTM E 152-81a or ANSI/NFPA 252-1999 and list by nationally recognized agency having factory inspection service and construct as detailed in Follow-Up Service Procedures/Factory Inspection Manuals issued by listing agency to individual manufacturers.

.11 Manufacturer's nameplates on doors are not permitted.

.12 Bevel lock and hinge edges 3mm in 50mm unless builder's hardware or door swing dictates otherwise.

.13 Fabricate door faces without visible seams, free of scale, pitting, coil brakes, buckles and waves. Formed edges shall be true and straight with a minimum radius for the thickness of steel used.

.14 Top and bottom of doors shall be provided with inverted, recessed, 16 ga. steel end channels, welded to each face sheet at 150mm o.c. minimum.

.15 Hollow metal doors to be Fleming H series or equal.

2.10 Hollow Steel Construction

.1 Form each face sheet for exterior doors from 1.6 mm sheet steel.

.2 Form each face sheet for interior doors from 1.2 sheet steel.

.3 Reinforce doors with vertical stiffeners, securely welded to each face sheet at 150 mm on centre maximum.

.4 Fill voids between stiffeners of exterior doors with polyurethane core.

.5 Fill voids between stiffeners of interior doors with temperature rise rated core.

2.11 Thermally Broken Doors and Frames

.1 Fabricate thermally broken doors by using insulated core and separating exterior parts from interior parts with continuous interlocking thermal break.

.2 Thermal break: rigid polyvinylchloride extrusion conforming to CGSB 41-GP-19Ma.

.3 Fabricate thermally broken frames separating exterior parts form interior parts with continuous interlocking thermal break.

.4 Apply insulation.

PART 3 - EXECUTION

3.1 Installation General

.1 Install in accordance with National Fire Codes, Volume 4, produced by National Fire Protection Association (ANSI/NFPA 80-1998.

.2 Install doors and frames to CSDFMA Installation Guide.

3.2 Door Installation

.1 Install doors and hardware in accordance with hardware templates and manufacturer's instructions and Section 08710 - Finish Hardware.

.2 Provide even margins between doors and jambs and doors and finished floor and thresholds as follows.

.1 Hinge side: 1.0 mm.

.2 Latchside and head: 1.5 mm.

.3 Finished floor, top of carpet noncombustible sill and thresholds: 13 mm.

.3 Adjust operable parts for correct function.

.4 Install louvres.

3.3 Frame Installation

.1 Set frames plumb, square, level and at correct elevation.

.2 Secure anchorages and connections to adjacent construction.

.3 Brace frames rigidly in position while building-in. Install temporary horizontal wood spreader at third points of door opening to maintain frame width. Provide vertical support at centre of head for openings over 1200 mm wide. Remove temporary spreaders after frames are built-in.

.4 Make allowances for deflection of structure to ensure structural loads are not transmitted to frames.

.5 Caulk perimeter of frames between frame and adjacent material.

.6 Maintain continunity of air barrier and vapour retarder.

3.4 Finish Repairs

.1 Touch up with primer galvanized finish damaged during installation.

.2 Fill exposed frame anchors and surfaces with imperfections with metallic paste filler and sand to a uniform smooth finish.

3.5 Glazing

.1 Install glazing for doors and frames in accordance with Section 08800 - Glazing.

PART 1 - GENERAL

1.1 Related Work

.1 Caulking of joints between Section 07900 frames and other building Sealants components:

.2 Supply of finish Section 08710 hardware: Door Hardware

.3 Wiring and conduit Division 16 for electronic hardware.

1.2 References

.1 Aluminum Association Designation System for Aluminum Finishes-1980.

.2 ASTM E 330-02 Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.

.3 CSA G40.21-98 Structural Quality Steels.

.4 CAN/CSA-G164-M92 (R1998) Hot Dip Galvanizing of Irregularly Shaped Articles.

.5 CAN/CGSB-1.40-M89 Primer, Structural Steel, Oil Alkyd Type.

.6 CAN/CGSB-12.1-M90 Tempered or Laminated Safety Glass.

1.3 Design Criteria

.1 Design frames and doors in exterior walls to:
.1 Accommodate expansion and contraction within service temperature range of -35 to 35°C.
.2 Limit deflection of mullions to maximum 1/175th of clear span

when tested to ASTM E 330-02 under wind load of 1.2 kpa. Submit certificate of tests performed.

1.4 Samples

.1 Submit samples in accordance with Section 01300.

.2 Submit one 300 x 300 mm corner sample of each type door and frame.

.3 Submit sample showing glazing detail, reinforcement, finish and location of manufacturer's nameplates.

.4 Frame sample to show glazing stop, door stop, jointing detail, finish, wall trim, and removable mullion.

1.5 Shop Drawings

.1 Submit shop drawings in accordance with Section 01305.

.2 Indicate each type of door and frame, extrusion profiles, method of assembly, section and hardware reinforcement, locations of exposed fasteners, finishes and location of manufacturer's nameplates.

.3 Submit detail drawings indicating connections, lateral bracing of system and anchorage to base building.

.4 Submit catalogue details for each type of door and frame illustrating profiles, dimensions and methods of assembly.

.5 Shop drawings to be signed and sealed by member of the Professional Engineers of Ontario (P.E.O.).

1.6 Maintenance Data

.1 Provide operation and maintenance data for cleaning and maintenance of aluminum finishes for incorporation into manual specified in Section 01730.

1.7 Protection

.1 Apply temporary protective coating to finished surfaces. Remove coating after erection. Do not use coatings that will become hard to remove or leave residue.

.2 Leave protective covering in place until final cleaning of building.

PART 2 - PRODUCTS

2.1 Materials

.1 Aluminum extrusions: Aluminum Association alloy AA6063-T5 or T6 anodizing quality.

.2 Sheet aluminum: Aluminum Association alloy AA1100-H14 or AA5005-H32 or H34 anodizing quality.

.3 Steel reinforcement: to CSA G40.21-98, grade 300W.

.4 Fasteners:stainless steel.

.5 Door bumpers: black neoprene.

.6 Isolation coating: bituminous paint.

.7 Glass: laminated security glass to CAN/CGSB-12.1-M90, Type 1, Class A.

.8 Glazing materials: in accordance with Section 08800.

.9 Sealants: in accordance with Section 07900 colour selected by Consultant.

2.2 Aluminum Doors

.1 Aluminum doors to be wide stile type constructed of porthole extrusions minimum 50mm thick with minimum wall thickness of 3 mm. Alumicor Series 800A, Kawneer 500, Sherwood Windows Limited W-2000 wide-style or other approved equal. Provide doors to dimensions and configurations as shown on drawings.

.2 Door stiles minimum nominal 89 mm wide or as shown on drawings.

.3 Top rail minimum nominal 89 mm wide or as shown on drawings.

.4 Bottom rail minimum nominal 300 mm wide or as shown on drawings and to match glazing sill extrusion.

.5 Mid rail minimum nominal 200mm or as shown on drawings.

.6 Reinforce mechanically-joined corners of doors to produce sturdy door unit.

.7 Glazing stops: interlocking snap-in type for single dry glazing. Exterior stops: tamperproof type.

.8 Hardware: Prepare doors for hardware specified in Section 08710.

.9 Supply and install aluminum doors in thermally broken aluminum frames and screens.

.10 Corner construction shall be butt joined with two hidden welds. At each corner, welds shall be of the inert gas process with maximum penetration and without heat discolouration on exposed surfaces.

.11 Prepare for and install finishing hardware on aluminum doors. Provide cutouts, recesses, mortising required for finish and operating hardware. Coordinate with Section 08710.

.12 Provide rails and transoms to sizes and profiles shown in these Specifications or as shown on drawings.

.13 Make provision for concealed magnetic door switches as specified.

2.3 Aluminum Frames

.1 Construct heavy duty frames of aluminum extrusions with minimum wall thickness of 3 mm.

.2 Framing System: complete framing system including dry glazing splines,

removable horizontal member stops, connecting brackets, sloped framing and single glazing, door stops, fasteners, extruded aluminum adapters for single glazing, removable centre mullions, etc. for complete installation.

.3 Prepare exterior frames for door jamb contacts and security wiring to Owner's requirements.

.4 Supply and install aluminum doors in thermally broken aluminum frames and screens.

.5 Prepare for and install finishing hardware on aluminum frames. Provide cutouts, recesses, mortising required for finish and operating hardware. Coordinate with supply by Section 08710.

.6 Provide sidelights, rails and transoms to sizes and profiles shown in these Specifications or as shown on drawings.

.7 Make provision for concealed magnetic door switches as specified.

2.4 Finishes

.1 Finish exposed surfaces of aluminum components in accordance with Aluminum Association Designation System for Aluminum Finishes.

.1 Bronze or brown anodized to match existing. Verify on site.

.2 Appearance and properties of anodized finishes designated by the Aluminum Association as Architectural Class 1, Architectural Class 2, and Protective and Decorative.

2.5 Steel Finishes

.1 Finish steel clips and reinforcing steel with steel primer to CAN/CGSB-1.40-M89 zinc coating to CAN/CSA-G164-M92 (R1998) (R1998) (R1998) (R1998).

2.6 Fabrication

.1 Doors and framing to be by same manufacturer.

.2 Fabricate doors and frames to profiles and maximum face sizes as shown.

.3 Provide structural steel reinforcement as required.

.4 Fit joints tightly and secure mechanically.

.5 Conceal fastenings.

.6 Mortise, reinforce, drill and tap doors, frames and reinforcements to receive hardware using templates provided under Section 08710 - Finish Hardware.

.7 Isolate aluminum from direct contact with dissimilar metals, concrete and masonry.

2.7 Acceptable Manufacturers

.1 Products in accordance with this specification by only the following manufactuers will be accepted.
- .1 Alumicor
- .2 Sherwood
- .3 Kawneer

PART 3 - EXECUTION

3.1 Installation

.1 Set frames plumb, square, level at correct elevation in alignment with adjacent work.

.2 Anchor securely.

.3 Install doors and hardware in accordance with hardware templates and manufacturer's instructions.

.4 Adjust operable parts for correct function.

.5 Make allowances for deflection of structure to ensure that structural

loads are not transmitted to frames.

3.2 Glazing

.1 Glaze aluminum doors and frames in accordance with Section 08800 - Glazing. All glazing in doors, sidelights and transoms to be insulated units, tempered glass exterior and laminated security glass at interior.

3.3 Caulking

.1 Seal joints to provide weathertight seal at outside and air, vapour seal at inside.

.2 Apply sealant in accordance with Section 07900 - Sealant. Conceal sealant within the aluminum work except where exposed use is permitted by Consultant.

PART 1 - GENERAL

1.1 Reference

.1 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB-1.40-M89, Primer, Structural Steel, Oil Alkyd Type.
- .2 CAN/CGSB-79.1-M91, Insect Screens.

.2 Canadian Standards Association (CSA)
- .1 CSA PKG.A440-00, Windows.
- .2 CAN/CSA-G164-M92 (R1998) (R1998), Hot Dip Galvanizing of Irregularly Shaped Articles.
- .3 CAN/CSA-Z91-M90, Safety Code for Window Cleaning Operations.
- .4 CSA Z760-94, Life Cycle Assessment.
- .5 CAN/CSA IS0 14040- 97, Environmental Management - Life Cycle Cost Assessment - Principle and Framework.

1.2 Samples

.1 Submit samples in accordance with Section 01300 - Submittals.

.2 Submit one representative model of each window type.

.3 Include frame, sash, sill, glazing and weatherproofing method, insect screens, surface finish and hardware. Show location of manufacturer's nameplates.

.4 Include 150 mm long samples of head, jamb, sill, meeting rail mullions to indicate profile.

1.3 Shop Drawings

.1 Submit shop drawings in accordance with Section 01300.

.2 Indicate materials and details in scale full size for head, jamb and

sill, profiles of components, interior and exterior trim junction between combination units elevations of unit, anchorage details, location of isolation coating, blocking, glazing, description of related components and exposed finishes fasteners, and caulking. Indicate location of manufacturer's nameplates.

1.4 Test Reports

.1 Submit test reports from approved independent testing laboratories, certifying compliance with specifications, for:
- .1 Windows
- .2 Enamelled finish, weathering characteristics.
- .3 Insect screens.
- .4 Air tightness.
- .5 Water tightness.
- .6 Wind load resistance.
- .7 Condensation resistance.
- .8 Safety drop - vertical sliding windows only.
- .9 Block operation - sliding windows only.
- .10 Sash strength and stiffness - Hinged.
- .11 Ease of operation - windows with operable lights.
- .12 Sash pull-off - vinyl windows.
- .13 Forced entry resistance.
- .14 Mullion deflection - combination and composite windows.

1.5 Maintenance Data

.1 Provide operation and maintenance data for windows.

1.6 Affidavits

.1 Submit manufacturer's name, catalogue and proof that the windows to be supplied meet all the standards specified herein.

1.7 Quality Assurance

.1 Aluminum manufacturer shall be responsible for design and fabrication of all system components to ensure they meet loads imposed and allow for expansion/contraction of materials without failure of joint seals, visible distortion in glazing panels, or undue stress on fastening mechanisms.

.2 Doors and windows shall be designed to meet or exceed air and water infiltration performance criteria of applicable standards and shall safely withstand local wind and snow loadings acting on plane of unit per latest codes.

.3 Contractors Qualifications: Work of this trade shall be executed by a company with a minimum of ten years proven first class experience in this type of work having adequate equipment and skilled personnel to expedite completion of the work in an efficient and very best workmanlike manner.

.4 Source Quality Control: Windows supplied under this specification shall have been tested by an independent testing agency indicating compliance with the performance requirements of A440 Series-98. This qualification shall be prerequisite for tendering.

.5 Field Testing: Provide frames on site for inspection prior to their installation. Upon receiving approval of the frame install one in the presence of the Owner complete with glass, panels, operating units and all sealants.

.6 Two windows will be selected by the Consultant at random and be tested as complete and installed assemblies after all windows have been installed including air barrier and perimeter sealants, according to ASTM 283.73 and ASTM E 547-00. Assemblies that do not conform to specified standards and tests under test conditions shall be resealed, and other units shall be installed in a manner that will avoid the leakage. Cost of this test will be borne by the Owner.

.7 Should the installed windows fail this test, costs of subsequent tests of corrected installations will be borne by the Contractor.

.8 Caulking work of this section shall be performed by skilled experienced personnel in strict accordance with methods and procedures outlined in Section 07900. Submit proof of such experience if requested by Consultant.

1.8 Performance Criteria

.1 Operating vents must meet CSA PKG.A440-00, Air Tightness - A3 (leakage-0.00 cfm/ft), Water Tightness - B5, Wind Load Resistance - C5, and Condensation Resistance Index (I) of 50.

.2 Fixed framing must meet CSA PKG.A440-00, Air Tightness - Fixed (leakage - 0.004 cfm/ft), Water Tightness - B7, Wind Resistance - C4, and Condensation Resistance Index (I) of 58.

.3 Wind Load Resistance: Windows must resist deflection greater than L/125 for sash and greater than L/175 for mullions when tested to CSA PKG.A440-00 Level C3.

.4 Thermal Resistance: Window must have an "I" value of 50 as determined in accordance with CSA PKG.A440-00 in order to resist condensation at -18 deg. C (Toronto 2.5% January mean) at 35% Relative Humidity.

.5 At the conclusion of these tests there shall be no glass breakage, permanent damage of fasteners, hardware parts, or any other damage causing the window to be inoperable. There shall be no permanent deformation of any frame or sash member in excess of 0.4% of its span.

.6 No escape of moisture into the wall cavity due to the failure of the window installation will be tolerated.

.7 Test results determined by the testing agent will be prima facie evidence relied upon by the Owner to determine compliance to these requirements. The bidder agrees to accept said determination and will not contest same.

1.9 Warranty

.1 All work of this section shall be warranted against leaks, irregularities, faulty material, faulty workmanship or poor installation of same. Corrective work performed under warranty shall be to Consultant's approval and at no additional cost to Owner. Warranty shall be effective for period of two (2) years from date of Substantial Performance of entire project. Also submit following extended warranties:

.1 Ten (10) year warranty on all windows

.2 Ten (10) year warranty on all caulking

.3 Ten (10) year warranty on hermetically sealed units

PART 2 - PRODUCTS

2.1 Manufacturers

.1 Frames, sidelights, transoms, screens and windows shall be as manufactured and assembled in plant and must be installed by the selected manufacturer. No exceptions will be permitted.

.2 Manufacturers of aluminum windows having Product considered acceptable for use are:

.1 Aerloc
.2 Windspec
.3 Alwind Industries Ltd.
.4 Sherwood Windows Limited.
.5 Alumicor Limited.

.3 Unless noted otherwise, aluminum window profiles as described in this section are based on the products of Alumicor Limited. Similar profiles by Windspec or Sherwood will be acceptable but it is the responsibility of the Bidder to ensure that they meet the intent of the design noted on the tender drawings.

2.2 Materials

.1 Aluminum frames, sash, frames for flyscreens, etc. shall be extruded from 6063-T5 alloy, shall be mechanically straightened and free from hammer marks, etc. Extrusions shall adhere closely to profile and dimension as detailed on manufacturer's drawings and shall be 2.6 mm thick, minimum.

.2 Materials: to CSA PKG.A440-00.

.3 All windows by same manufacturer.

.4 All windows shall be fabricated to sizes shown and be Alumicor ShadowLine 970 4" series finished and glazed as stated below, and which, when erected, shall provide completely watertight enclosures. All windows to be provided with fiberglass pressure plate.

.5 All operable windows shown on elevations shall open out. Operable windows shall be Alumicor Univent 1350 Series projecting ventilators. As inserts to the fixed window framing Alumicor ShadowLine 970 4" series frame complete with top-hung open-out vents at locations shown on

drawings. Operable windows are to have roto-operator and claw handles, and fly screens fitted with tamperproof fasteners. Sash openings to be restricted to maximum 100 mm. Submit sample.

.6 Glass:

.1 Float glass: to CAN/CGSB-12.3-M91, glazing quality.

.2 Tempered safety glass to CAN/CGSB-12.1-M90, Type 2, Class A of thickness indicated minimum 6mm.

.3 Laminated safety glass to CAN/CGSB-12.1-M90, Type 1, Class A minimum 6mm or thickness as indicated.

.4 Insulating glass units: to CAN/CGSB-12.8-M97, with outer pane of 6mm glass and inner pane of 6mm glass with 25 mm total thickness.

.7 Thermal Break: Extruded virgin polyvinylchloride Thermo-Barrier. Conform to CSA PKG.A440-00.

.8 Screens: at each operating unit to CAN/CGSB-79.1-M91 and CSA PKG.A440-00.

.1 Class: Heavy Duty with rigidly joined corners.

.2 Insect screening mesh: count 18 x 14 black fibreglass secured by continuous spline.

.3 Fasteners: tamper proof.

.4 Screen frames: colour to match window frames.

.5 Mount screen frames for interior replacement. Insect screens installed on the exterior shall be mechanically fastened to the window frame in a vandal-proof manner.

.9 Weatherstipping: E.P.D.M. gaskets as shown on drawings.

.10 Aluminum Sills/Expansion Covers: To be extruded aluminum shapes 2.6 mm minimum thick, reinforced, as shown on the drawings with cover plates and drip deflectors. Finish to match framing.

.11 Aluminum Interior Stools and Trim: Column covers, trim and aluminum flashing, etc. to be 1.5 mm (.062") finish to match framing.

.12 Aluminum Exterior Trim/Panning: Extruded aluminum allow 6063-T5 be 2.0 mm (.078") thick minimum, to match frame finish and colour.

.13 Anchor Brackets: Extruded aluminum angles, 90mm x 140mm x 100mm long x 3mm thick, bitumastic painted.

.14 Anchors: Non-magnetic, stain and corrosion resistant stainless steel to ASTM E-149. Exposed fasteners are not acceptable.

.15 Exterior metal sills and aluminum facings: extruded aluminum of type and size to suit job conditions; minimum 3 mm thick, complete with joint covers, jamb drip deflectors, chairs, anchors and anchoring devices.

.16 Isolation coating: alkali resistant bituminous paint.

.17 Insulated Aluminum Panels: Panel Construction:

Exterior Composite Panel:
Duranar Finish
1.5 mm Aluminum fully adhesive bonded
12 mm Plywood
Min. 25 mm Rigid Polyisocyranurate Insulation Board

All of the above components to be under heat and pressure with top quality permanently elastic neoprene contact adhesive. Submit sample of panel to Consultant for approval before fabrication.

2.3 Window Type and Classification

.1 Types:
- .1 Hopper Sash: Bottom Hinged Projecting In with insulating glass.
- .2 Awning Sash: Top Hinged Projecting out with insulating glass.
- .3 Fixed: with insulating glass.
- .4 Screens: on ventilating portion of windows.

.2 Classification rating: to CSA PKG.A440-00.
- .1 Air leakage: A3
- .2 Water leakage: B3
- .3 Wind load resistance: C3
- .4 Condensation resistance: Temperature Index, I D2
- .5 Forced Entry: F2
- .6 Insect Screens: S2
- .7 Glazing: G2

.3 Ventilator frames shall consist of inner and outer aluminum frame sections joined by means of an interlocking thermal barrier. Thermal barrier shall completely prevent metal to metal contact in any form. Vent corner shall be cut at 45 degrees, swaged with 3 heavy duty reinforcing angles per corner. Screwed corners on vents will not be permitted.

2.4 Fabrication

.1 Fabricate in accordance with CSA PKG.A440-00 supplemented as follows:

.2 Cope and butt join all joints in main frame and sash, neatly, in weathertight manner and secure by means of screws anchored into integral screw ports with stainless steel screws 8-#8 screws per corner.

.3 Internally seal all sash corners at time of assembly with polyurethane caulking.

.4 Deburr and make smooth all sharp milled edges and corners of sash and screen frames.

.5 Framing shall consist of closed tubular aluminum sections reinforced as required and thermally broken. Open channel profiles are not acceptable.

.6 Design coupling mullions to eliminate "seam joint" on weathered side while providing functional split to permit unit module construction and to provide for thermal expansion.

.7 Make allowances for deflection of structure to ensure that structural loads are not transmitted to aluminium framing.

.8 Provide mullion wall thicknesses, internal reinforcement and mullion extensions necessary to provide adequate strength, stiffness and connections that suit overall loads imposed on configurations indicated on drawings.

.9 Provide all vertical and horizontal mullions, corner and column covers, trim, insulated bases and panels, accessories, fasteners, integral wood blocking, etc. necessary for total aluminium assemblies indicated on drawings. Unless otherwise shown, aluminium to be minimum 2 mm thick.

.10 Provide sill members with minimum 5 deg. slope away from the frame. Fabricate extruded aluminium sills with profiles indicated and to suit wall condition. Provide drip deflectors at sill ends and at abutting vertical surfaces. Open ends of sills shall be fitted with neatly applied closure plates. Anchors shall be designed not to work loose after installation. Unless otherwise detailed, provide flush slip joint at intermediate sill joints.

.11 Provide sill weep system which will facilitate drainage of water accumulating in sill area while preventing passage of air, dirt and insects to interior.

.12 Fabricate and anchor both inner and outer frames using specified screw fasteners without violating the Thermo-Barrier. Exposed fasteners or the use of pop revets is not acceptable.

.13 Fabricate entire window in a manner that will allow easy replacement of any defective, damaged or worn components, hardware or weatherstripping.

.14 Thermo-Barrier: Provide completely metal to metal separation between the two main frame members. Do not use connecting screws, clips or other members or restrict in any manner the expansion and contraction of the individual separate frame member. Factory seal between Thermo-Barrier and frame around entire perimeter to ensure weathertight assembly.

.15 Glazing: Provide sash frames which will permit glass replacement without the use of special tools.

.16 Weatherstripping: Double weatherstrip window units at all sash perimeters. Conceal weatherstripping to prevent accumulation of foreign matter or matting due to cleaning, operation or handling which would reduce effectiveness or life of seal. Install all weatherstripping in specially extruded ports and secure to prevent shrinkage, movement or loss when removing sash for cleaning or glass replacement.

.17 Fabricate units square and true with maximum tolerance of plus or minus 1.5 mm for units with a diagonal measurement of 1800 mm or less and plus or minus 3 mm for units with a diagonal measurement over 1800 mm.

.18 Face dimensions detailed are maximum permissible sizes.

.19 Brace frames to maintain squareness and rigidity during shipment and installation.

.20 Finish steel clips and reinforcement with shop coat primer to CAN/CGSB-1.40-M89.

2.5 Aluminum Finishes

.1 Finish exposed surfaces of aluminum components in accordance with Aluminum Association Designation System for Aluminum Finishes - 1980.

.1 Clear anodized to match existing: AA-M10C21A41.

2.6 Isolation Coating

.1 Isolate aluminum from following components, by means of isolation coating:

.1 Dissimilar metals except stainless steel, zinc, or white bronze of small area.
.2 Concrete, mortar and masonry.
.3 Wood.

2.7 Glazing

.1 Glaze windows in accordance with CSA PKG.A440-00.

.2 Refer to Section 08800 for products supplied and installed under this Section.

2.8 Hardware

.1 Operable Venting Hardware: Each hinged vent to have extruded aluminum hinges with stainless steel pins, and two solid white bronze cam handles and two stainless steel friction side arms and two solid white metal allen key locks.

.2 Provide special keyed opening device for windows normally locked.

.3 Window latching devices:
.1 Submit samples to Consultant for approval.
.2 Where sash is located 1900mm or more above finished floor, provide roto operator to permit opening and closing from remote location 1200mm above finished floor. Teleflex or equal. Submit sample and shop drawings.

2.9 Air Barrier and Vapour Retarder

.1 Equip window frames with site installed air barrier and vapour retarder material for sealing to building air barrier and vapour retarder as follows:
.1 Material: identical to, or compatible with, building air barrier and vapour retarder materials to provide required air tightness and vapour diffusion control throughout exterior envelope assembly.
.2 Material width: adequate to provide required air tightness and vapour diffusion control to building air barrier and vapour retarder

from interior.

2.10 Acceptable Manufacturers

.1 Products in accordance with this specification by only the following manufacturers will be accepted.
- .1 Aerloc
- .2 Windspec
- .3 Alwind Industries Ltd.
- .4 Sherwood Windows Ltd.
- .5 Alumicor Ltd.

PART 3 - EXECUTION

3.1 Window Installation

.1 Install in accordance with CSA PKG.A440-00 and manufacturer's instructions.

.2 Prior to installation of face masonry, install anchor brackets in masonry cavity as required to back-up concrete block. Ensure continuity of air/vapour barrier and insulation.

.3 Install windows and doors plumb, level and true relative to building structure. Do not exceed 3mm in 3050mm (1/8" in 10'-0") variation from plumb and level.

.4 Fill void between exterior aluminum frame and window opening with single component polyurethane foam as detailed to form a complete air seal to wall vapour retarder.

.5 Arrange components to prevent abrupt variation in colour.

3.2 Sill Installation

.1 Install metal sills with uniform wash to exterior, level in length, straight in alignment with plumb upstands and faces. Use one piece lengths at each location.

.2 Cut sills to fit window opening.

.3 Secure sills in place with anchoring devices located at ends joints of continuous sills and evenly spaced 600 mm oc in between.

.4 Fasten expansion joint cover plates and drip deflectors with self tapping stainless steel screws.

.5 Maintain 6 to 9 mm space between butt ends of continuous sills. For sills over 1200 mm in length, maintain 3 to 6 mm space at each end.

3.3 Caulking

.1 Seal joints between windows and window sills with sealant. Bed sill expansion joint cover plates and drip deflectors in bedding compound. Caulk between sill upstand and window-frame. Caulk butt joints in continuous sills.

.2 Foam Sealant: All voids between aluminium frames and masonry openings shall be completely filled with Polycel sealant.

.3 Apply sealant in accordance with Section 07900 - Sealants. Conceal sealant within window units except where exposed use is permitted by Consultant.

3.4 Protection

.1 Protect pre-finished surfaces of metal work with protective coatings or wrappings to remain in place until construction completion. Use materials recommended by finishers or manufacturers of metals to ensure that method is sufficiently protective, easily removed and harmless to finish.

.2 Remove protection from metal glazing surfaces before installation of glass.

.3 Maintain protection from time of installation to final cleanup in accordance with Section 01700.

PART 1 - GENERAL

1.1 General Requirements

.1 Comply with requirements listed in Division 1

1.2 Work Included

.1 Supply finishing hardware as listed in the hardware schedule. Refer to Door Hardware list prepared by Commercial Doors and Hardware Ltd.

1.3 Quality Assurance

.1 Meet all requirements of the local building code and all other applicable regulations.

.2 Products listed in Part 2 of this specification establish the minimum requirements for this project. Alternate products must be applied for and approved in writing prior to tender closing. Deviation from specified products will require the supply and installation of correct products, any/all associated costs.

.3 Qualified suppliers must have in their employ a Certified A.H.C. (Architectural Hardware Consultant), licensed by the Door and Hardware Institute. The supplier must have a minimum of five (5) years experience furnishing hardware for similar projects. It is the responsibility of the successful bidder to review the hardware schedule, the door and frame schedule and details, both to familiarize themselves with the scope of work and ensure product compatibility. Failure to report discrepancies, prior to tender closing, assures the owners/architect and consultant that these documents have been reviewed and are satisfactory to the bidder.

.4 Inspection of supplied Finishing Hardware will be done by a Certified A.H.C. A complete Site Inspection Report will be issued to the Architect.

.5 Acceptable bidders
Commercial doors and Hardware Ltd.
Upper Canada Hardware
Trillium Architectural Hardware.
Great lakes Door and Hardware.

1.4 Submittals

.1 Upon request provide mounted samples of hardware items to be supplied.

.2 Prepare and submit two (3) copies of a detailed hardware schedule listing product Numbers, size and finishes. Include two (2) sets of catalog cuts.

.3 Furnish other sections with two (2) complete sets of hardware templates for Related fabricating and installation.

.4 Submit for owner review and comments two (2) key schedules listing the door number, hardware heading or item, and the key group.

.5 Where electrical hardware is supplied, provide wiring diagrams showing all wire termination points. Where electrical hardware is supplied and installed provide the contractor with riser diagrams listing the correct wire runs and back box sizes as well as 115 VAC requirements.

.6 Where required in Division 1, provide two (2) operating manuals for the owners use. Include copies of the hardware schedule, templates, installation instructions and all maintenance data.

1.5 Product Delivery, Handling, and Storage

.1 Deliver each hardware item in its original package complete with all fasteners, keys, templates, and installation instructions required for installation.

.2 Clearly mark each container with the door opening number and the hardware schedule item or heading number.

.3 The contractor must store hardware delivered in a secure area. The storage area must contain adequate shelf space to hold all the hardware off the floor. Ensure the area is kept dry and clean.

.4 When requested, package items of hardware separately for delivery to other Fabricators for their installation.

1.6 Warranty

.1 Provide a written warranty for a period as follows:
Five (5) years on Cylindrical Lever sets.
Five (5) years on Exit Devices.
Twenty (20) years on Door Closers.
One (2) year on Electronic Products.
One (1) year on balance of products.

.2 When requested provide extended warranties listed in Division 1.

PART 2 – PRODUCTS

2.1 Butt Hinges

.1 All butt type hinges will be Ball bearing type.
.2 Exterior out swing door hinges must be non-ferrous and have non-removable pins
(NRP).
.3 Where the door width exceeds 3'0" (950mm) supply 5" (127) high hinges.
.4 Supply two (2) hinges for doors up to 5'0" (1525 mm) high and an additional hinge for each 2'5" (760 mm) or fraction thereof in door height.
.5 Approved products:

ACCEPTABLE MANUFACTURERS	ITEM	ITEM	ITEM
MCKINNEY	T4A 3786	T4A 3386	TA 2714
STANLEY	FBB168	FBB199	FBB179

2.1.1.8 Continuous Hinges:

ACCEPTABLE MANUFACTURERS	ITEM	ITEM
MARKAR	FM100 SERIES	
MCKINNEY	MCK12-HD	
IVES	112HD	

.1 Interior: 628 finish.2 Exterior: 628 finish

2.2 Lock and Latchsets

.1 Locks and latch sets are to be cylindrical, full feature, freewheeling, and ANSI Grade 1 lever sets.
.2 Lever trim must have concealed through bolt mounting. The lever is to be solid cast with a return to the door face. The back plates (rosettes) are to be cold forged brass or bronze in the finish listed.
.3 Provide ¾" latch throw for pairs of labeled doors.

.4 Approved products:

ACCEPTABLE MANUFACTURERS	ITEM	ITEM	ITEM	ITEM	ITEM
SARGENT	8204 LNL	8237 LNL	8238 LNL	8215 LNL	8265 LNL

2.3 Cylinders and Keying

.1 Exterior locks and cylinders shall be keyed to a new LFIC Sargent GMK system , to the owners requirements.
.2 All Interior locks and cylinders shall be GMK to a new factory registered system.
.3 Cylinders supplied to site must have a construction core cylinder. Permanent Master keyed cores keyed to owners requirements are to be shipped to site as directed by the owner.
.4 All locks and cylinders shall be keyed to the owners requirements. Provide a Keying schedule for approval.
.5 Include the following with the key system:
-All keys should be stamped with key code

2.4 Exit Devices

.1 All exit devices will be low profile push pad style devices. Outside trim will have the same trim design as the locksets. Exit hardware must have the correct life safety or fire rated labels attached to the active case. Ensure that the actuating push pad covers 1/2 of the door opening.
.2 Interior doors requiring exit devices are to be equipped with standard Pullman deadlatching latchbolts, accident hazard or fire labeled as necessary.
.3 Provide alarm exit devices where noted at exterior doors. Alarm exit devices are to be supplied with a cylinder operated on/off switch and decal warning of alarmed door.
.4 Equip exterior aluminum door exit devices with necessary fasteners and features included where thermally broken doors are specified.
.5 Approve products:

ACCEPTABLE MANUFACTURERS	ITEM	ITEM	ITEM
SARGENT	8800 SERIES 630	8843 ETL 630	8515 ETL 630
VON DUPRIN	98 SERIES 630	98L 630	98L-BE 630

2.5 Electric Strikes

.1 Furnish Electric Strikes to exceed ANSI/BHMA A156.5, and listed by Underwriters Laboratories where required. Electric Strikes are to be manufactured from investment casting and stainless steel for durability and corrosion resistance. Furnish strikes with appropriate latch bolt keepers, monitors as listed in the schedule.
.2 It is the responsibility of the finishing hardware supplier to provide Riser Diagrams, Point-to-Point Diagrams and method of

operation notes for each of the openings utilizing these products.

.3 Approved products:

ACCEPTABLE MANUFACTURERS	ITEM	ITEM	ITEM
HES	9500 SERIES LBM 630	9600 SEIES 630	1006 SERIES 630
VON DUPRIN	6300 SERIES LBM 630	6300 SERIES 630	6200 SERIES 630

2.6 Door Closer

.1 Door closers will all have full adjustment features including back check, general speed, and latch speed control.

.2 All interior door closers will have reduced opening force spring power to meet the barrier free codes of 22N (5 lbs.)

.3 Surface mounted door closers are to be located on the room side of the door whenever possible or as directed by the architect.

.4 Where listed, door closers are to have full body covers to match the project finishes. Installation instructions must be inside all door closer covers.

.5 Template closers to permit full shock absorber action.

.6 Approved products.

ACCEPTABLE MANUFACTURER	ITEM	ITEM	ITEM
NORTON	R8501 689	7500 SERIES	CLP 7500
SARGENT	1430 SERIES 689	350 SERIES 689	350 PS

.1 Where required, out swinging doors and interior doors shall have closers with parallel arms.

.2 Back-checking feature shall be of a proper size to operate the door efficiently.

.3 All closers shall be complete with full cover of same design and manufacturer.

.4 All interior closers shall be reduced-force type.

.5 All interior doors for barrier-free use shall be delayed action and reduced-force type, meeting OBC requirements.

.6 Mount closers on interior room side of doors.

.7 All door closers shall be mounted with through-bolts.

2.7 Door Operators

.1 Electro-mechanical operator, powered by 1/4 hp motor. Completely assembled and sealed unit which includes helical gear drive transmission and interconnected rack and gear system for

compression of exterior replaceable heavy duty spiral spring, all contained within a die cast aluminum housing and filled with special lubricant for extreme temperature conditions.

.2 Drive shaft is minimum 15/16" (24mm) thick containing 14 tooth splines to maximize bearing surface contact with drive arm assembly to eliminate slippage.

.3 Interfaced with the transmission system is a DC shunt-wound permanent magnet motor with sealed ball bearings. System operates from 120 VAC-60 cycle-1 phase power supply. Operator is mounted in the header case housing using vibration isolators to maintain quiet operation.

.4 Approved product.

ACCEPTABLE MANUFACTURERS	ITEM	ITEM
GYRO-TECH or approved equal	8700 CLEAR ALUM	HD GT 8500

-All Actuators/ visual indicators supplied in French Language.
-Operators Supplied and installed by this section Finishing Hardware 08710.

2.8 Pulls and Plates

.1 Supply door trim as listed in the hardware schedule. Pulls are supplied with back to back (BTB) or through bolt mounting as required. When push plates are listed with door pulls, install the push plate to conceal the through bolt. Verify all heights of full length door pulls prior to ordering. Co-ordinate heights with related door hardware products.

.2 All kickplates, push plates, and bumper plates must have beveled sides and corners rounded to ensure there are no sharp edges. Supply plates with counter sunk screw holes. The plates will be .050 gauge. Size to suit door width. Supply stainless steel type 315 as listed.

.3 All exterior door pulls shall be specified as the hospital pull type.

ACCEPTABLE MANUFACTURERS	ITEM	ITEM	ITEM
CBH	7109-1	CBH 353 TB	7130-1
GALLERY	1181-2	2616H MOD TB	4212-2
STANDARD METAL	3112-2	H12 TB	2112-2

2.9 Door Stops and Holders

.1 Wall stops are only to be used on proper wall conditions such as block or masonry. Supply floor stops with sufficient height to suite the floor condition or undercut of doors.

.2 Overhead stops and holders will be surface mounted unless there is a conflict with door closers or other hardware. Provide door stays with friction action in locations that do not have door closers. Install all overhead stops and holders for 90 DEG stop unless otherwise specified.

.3 Electronic door holder will be supplied to suit the specified voltage and be connected to the fire alarm system to release the door when signaled.

.4 Approved Manufacturers:

ACCEPTABLE MANUFACTURERS	ITEM	ITEM	ITEM
RIXSON	1 SERIES	9 SERIES	FM 998 TRIVOLT
GLYN JOHNSON	100 SERIES	90 SERIES	SEM7830
DORMA	1020 SERIES	9020 SERIES	2100 TRIVOLT

2.10 Door Seals

.1 Perimeter seals must be supplied to fully cover all gaps between the door, frame, and floor condition to seal against weather, sound, or smoke.

.2 Frame gasketing must be closed cell neoprene. Extruded housing must have a rib to prevent distortion during installation. Aluminum frames will be equipped with felt inserts by the frame supplier.

.3 Door bottoms will be heavy duty and have an adjustment screw to ensure proper contact with the floor. Supply the correct drop insert for carpet where required.

.4 Thresholds must be installed to ensure the door bottom makes full contact. Supply thermally broken thresholds for all exterior door openings.

.5 Approved products:

1. KN CROWDER MFTG.
2. PEMKO MFTG.
3. ZERO MFTG .

2.11 Fastening

.1 Supply screws, bolts, expansion shields and other fastening devices required for the Satisfactory installation and operation of hardware, and as recommended by the Hardware manufacturers for long life under hard use.

.2 Exposed screws for installing hardware shall have Phillips or Robertson heads.

.3 Where a door pull is scheduled on one side of door and a push plate on the other side, fastening devices, and install so the pull can be secured through the door from the reverse side. Install push plate to cover fasteners.

.4 Exposed fastening devices shall match the finish and material of hardware.

PART 3 – EXECUTION

3.1 Inspection

.1 The hardware supplier must inspect all the door openings to ensure that installation is complete and that all items are operating as intended. When requested, provide a written report on all site inspections made.

3.2 Installation

.1 The installer shall obtain a copy of ANSI/DHI A115.1G-94, **"Installation Guide for Doors and Hardware".** It is the intent of this document to be used as a reference guide in the proper handling, storage, and installation of finishing hardware, and doors and frames. This document can be obtained through the Door and Hardware Institute.

.2 Installers of hardware must follow all manufacturer's instructions including door closer adjustment, handing of locksets as required, and degree of door swing. Advise the consultants if door frames are not square and plumb and prevent proper door installation.

.3 All finishing hardware and electronic hardware are to be bid as a supply and install package.
Testing and verification of all electronic products and systems is the responsibility of this division.

.4 Mount hardware to suit door elevations. Unless otherwise directed by the consultant, install hardware at the following mounting heights:

Locksets	40"	(1015mm)
Exit device	40"	(1015mm)
Push/Pull	42"	(1065mm)
Deadlock	48"	(1200mm)

.5 When requested, the hardware supplier will instruct the installer on installation of newer or unusual.

3.3 Hardware Schedule

.1 See attached hardware list.

END OF SECTION

FINISHING HARDWARE SCHEDULE

Gladys Speers P.S. Reno 2022, HDSB
2150 Samway Rd Oakville

Architect
WK Lim Architect Inc.

Detailer: **RYAN RUPRECHT**
Consultant: **ROSS RUPRECHT B.A., A.H.C.**

Submittal Date: **Apr 25/22**

Manufacturers & Finishes

Manufacturers

CBH
Fleming Door Products Ltd.
Glynn-Johnson
Ives
LCN
Schlage
Schlage E.S.
UNK
Von Duprin
Zero

Finishes

625 - Bright chromium plated over nickel
626 - Satin chromium plated over nickel
652 - Satin chromium plated over nickel
689 - Aluminum painted
US28 - Satin aluminum, clear anodized
US32D - Satin stainless steel

Openings Schedule

Opening Number(s)	Qty	Location 1	To/ From	Location 2	Door Catalog	Nominal Width	Nominal Height	Door Thickness	Type	Hand	Label	Degree of Opening	Hardware Group	Heading Num.	Remarks
V-1	1	EXTERIOR			<Aluminum>	979, 979	2150	45	Pair	LHRA/RHRA		90°	EXT PR AL	1	
V-2	1	EXTERIOR			<Aluminum>	979, 979	2150	45	Pair	LHRA/RHRA		90°	EXT PR AL NL	2	
21A	1	STORAGE				950, 950	2150	45	Pair	RHRA		110°	04	3	

CDH
COMMERCIAL DOORS & HARDWARE LTD.
2150 WINSTON PARK DR
OAKVILLE , ON., ross@cdh.ca

Gladys Speers P.S. Reno 2022, HDSB
2150 Samway Rd Oakville

Submittal Date: Apr 25/22

Hardware Schedule

Heading #1 (Group: EXT PR AL)

Item #1 — 1 Pair of doors V-1, EXTERIOR — 90° LHRA/RHRA

979, 979 x 2150 x 45 - AL DR x AL FR

1		UNK MULLION BY FRAME SUPPLIER	
1		UNK WEATHER STRP BY DOOR AND FRAME SUPPLIER	
2	Continuous Hinge	Ives 112XY-83" US28	US28
2	Exit Device	Von Duprin CD-98-DT-4' -57MM AL DR THK	626
2	Cylinder	Schlage 20-001 114 XQ11-949 36-083	626
2	Surface Closer	LCN 4040XP EDA 689 45	689
2	Kick Plate	CBH CBH 903 200 X 50MM LDW C32D	US32D
2	Overhead Door Stop	Glynn-Johnson 104S US32D	US32D
2	Threshold	Zero 625A 48	A
2	Gasketing	Zero SWEEP 8192AA 48	AA
2	Miscellaneous Item	LCN 4040XP-18PA 689	689
2	Miscellaneous Item	Schlage E.S. 679-05HM	BLK

Heading #2 (Group: EXT PR AL NL)

Item #2 — 1 Pair of doors V-2, EXTERIOR — 90° LHRA/RHRA

979, 979 x 2150 x 45 - AL DR x AL FR

1		UNK MULLION BY FRAME SUPPLIER	
1		UNK WEATHER STRP BY DOOR AND FRAME SUPPLIER	
2	Continuous Hinge	Ives 112XY-83" US28	US28
1	Exit Device	Von Duprin CD-98-DT-4' -57MM AL DR THK	626
1	Exit Device	Von Duprin CD-98-NL-4' -57MM AL DR THK.	626
2	Cylinder	Schlage 20-001 114 XQ11-949 36-083	626
1	Cylinder	Schlage 20-021 Open 625	625
2	Surface Closer	LCN 4040XP EDA 689 45	689
2	Kick Plate	CBH CBH 903 200 X 50MM LDW C32D	US32D
2	Overhead Door Stop	Glynn-Johnson 104S US32D	US32D
2	Threshold	Zero 625A 48	A
2	Gasketing	Zero SWEEP 8192AA 48	AA
2	Miscellaneous Item	LCN 4040XP-18PA 689	689
2	Miscellaneous Item	Schlage E.S. 679-05HM	BLK

Heading #3 (Group: 04)

Item #3 — 1 Pair of doors 21A, STORAGE — 110° RHRA

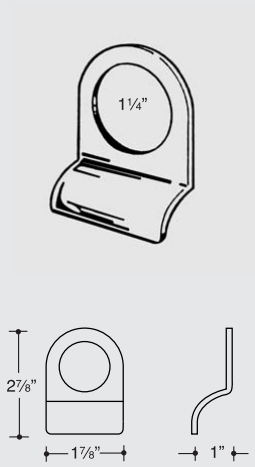
950, 950 x 2150 x 45 - HM DR x HM FR

6	Standard Hinge	Ives 5BB1 4.5 X 4 NRP 652	652
2	Flush Bolt	Ives FB458	626
1	Lockset	Schlage ND80 P6 RHO 626	626
		ACT LEAF	
1	Cylinder	CBH CBH 353 C32D 45	US32D
1	Pair Accessory	Ives DP2	626
1	Surface Closer	LCN 4040XP SHCUSH	689
		ACT LEAF	
1	Overhead Door Stop	Glynn-Johnson 904S US32D	US32D
1	Gasketing	Zero ASTRAGAL 328AA 2PC X 84	AA

Cylinder Pulls

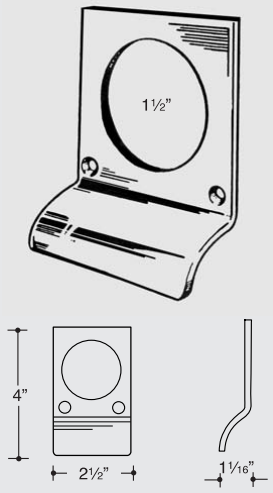
CBH 350 CYLINDER PULL

MATERIAL: CAST BRASS, BRONZE AND ALUMINUM (.125)
FINISHES: ALL STANDARD



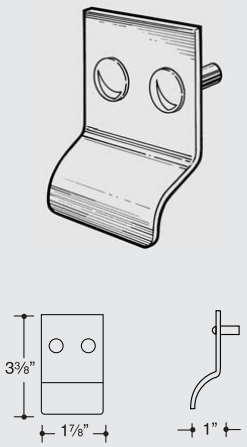
CBH 351 CYLINDER PULL

MATERIAL: BRASS, BRONZE AND STAINLESS STEEL (.125)
FINISHES: ALL STANDARD



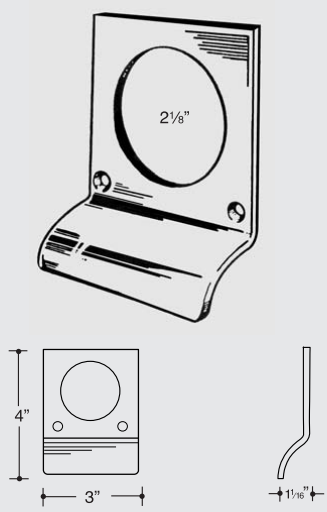
CBH 351-1 BLANK CYLINDER PULL C/W SEX NUTS

MATERIAL: STAINLESS STEEL (.125)
FINISHES: C32D



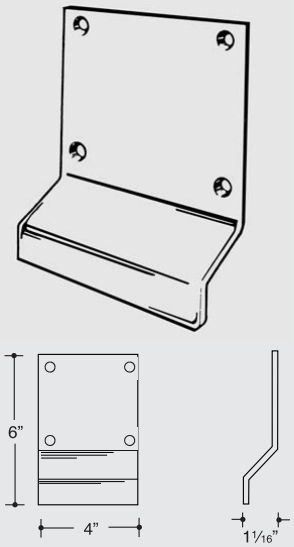
CBH 352 CYLINDER PULL

MATERIAL: BRASS, BRONZE AND STAINLESS STEEL (.125)
FINISHES: ALL STANDARD



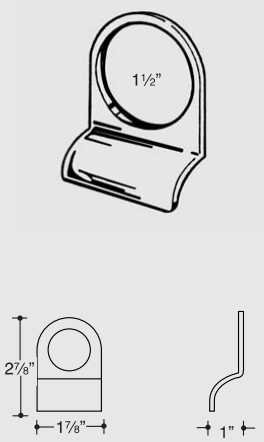
CBH 353 BLANK PULL

MATERIAL: BRASS, BRONZE, ALUMINUM AND STAINLESS STEEL (.125)
FINISHES: ALL STANDARD



CBH 354 CYLINDER PULL

MATERIAL: CAST BRASS, BRONZE AND ALUMINUM (.125)
FINISHES: ALL STANDARD



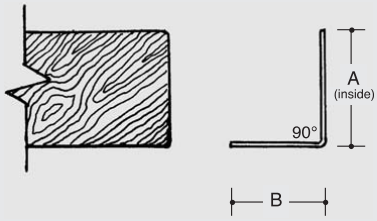
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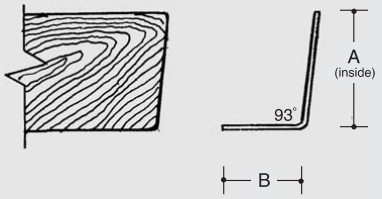
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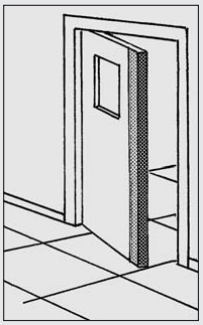
Kick Plates
Edge Guards/Corner Guards
Astragals

CBH 410 DOOR EDGE

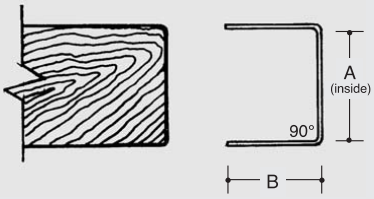


CBH 420 DOOR EDGE (WITH BEVEL)

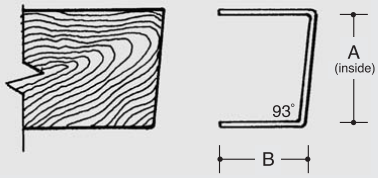




CBH 430 DOOR CHANNEL



CBH 440 DOOR CHANNEL (WITH BEVEL)
LH SHOWN



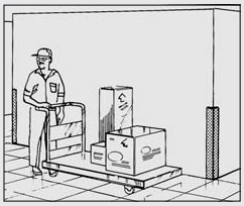
MATERIAL: BRASS, BRONZE AND STAINLESS STEEL
FINISHES: ALL STANDARD

When ordering please specify A & B dimensions and location of screw holes

Note: A dimension equals door thickness

CBH 450 CORNER GUARD

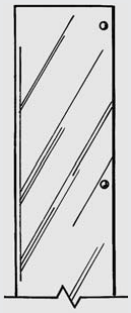


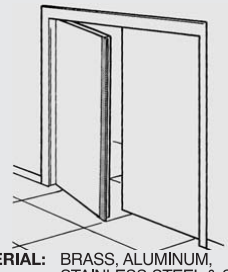


MATERIAL: BRASS, BRONZE AND STAINLESS STEEL
FINISHES: ALL STANDARD
When ordering please specify all dimensions and fastening.
Example: CBH 450 2" X 2" X48" X C32D

CBH 498
CBH 499

⅛" x 1½" x LENGTH ASTRAGAL
⅛" x 2" x LENGTH ASTRAGAL

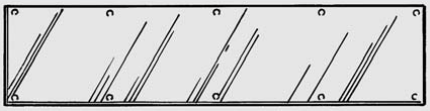




MATERIAL: BRASS, ALUMINUM, STAINLESS STEEL & STEEL PRIME COATED
OTHER FINISHES: P.O.A.

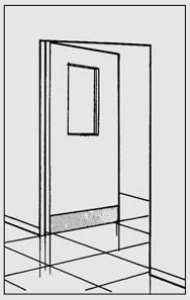
CBH 900
CBH 901
CBH 902
CBH 903

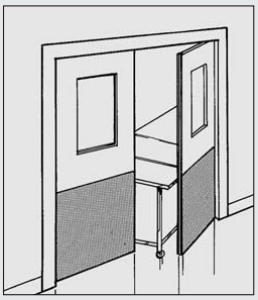
ALUMINUM KICKPLATE
BRASS KICKPLATE
BRONZE KICKPLATE
STAINLESS STEEL KICKPLATE



All kickplates are drilled, countersunk and supplied standard with #6 x 5/8 oval head socket wood screws. Machine screws or tape fastening is available upon request.

Kickplates available with bevelled edges at extra cost.
All tape Kickplates are bevelled edge.





.050 GAUGE PLATES WILL BE SUPPLIED STANDARD. FOR THICKER GAUGE PLATES USE SUFFIX **A. 062 B .125**

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Submittal Date: Apr 25/22

90 Series surface overhead door holders/stops



90 Series heavy-duty

Glynn-Johnson 90 Series holders and stops are the most rugged models available for heavy-duty applications. The channel is surface-mounted to the door, most often with sex bolts, and the jamb bracket is surface mounted to the jamb, requiring minimal door and frame preparation.

These versatile units can be used in conjunction with most surface-applied door closers. The provided templates allow for variable mounting positions, ranging from 85° to 110° hold-open/stop angle. These templates are designed for installation in almost all types of doors, including doors with conventional butt-type hinges or specialty hinges.

Four models:

- 90H Series hold-open model
- 90S Series stop-only model
- 90F Series friction hold-open model
- 90SE Series special stop-only model

Five sizes:

- Simple
- Standardized
- Each model is available in five sizes

Three options:

- J—Angle jamb bracket
- SHIM—Blade stop shim kits
- SOC—Pin-in-socket security screw package

Unmatched convenience:

- Non-handed
- Improved compatibility with door closers
- Single-acting doors
- Interior/exterior applications
- Durable
- Easy to install
- Improved corrosion resistance
- Function conversion kits available

Materials and finishes

In 300 Series stainless steel, brass and steel substrates, these models are available in the largest selection of finishes in the industry. Stainless steel models offer the highest resistance to corrosion. Available in the following finishes:

Finish	Description
US3	Polished brass
US4	Satin brass
US10	Satin bronze
US10B	Oil rubbed bronze
US32	Polished stainless steel
US32D	Satin stainless steel
SP4	Powder coat brass
SP10	Powder coat bronze
SP28	Powder coat aluminum
SP313	Powder coat dark bronze
SPBLK	Powder coat black
652	Chrome-like coating

Models

Glynn-Johnson 90 Series door holders and stops provide long-lasting protection for doors, frames and hardware. All models incorporate a heavy-duty channel/slide-arm design and offset jamb bracket. This unique design allows for simple field modification of functions, should user requirements change.

90H Series hold-open

(Suffix H) Hold-open models provide a convenient method of holding the door open at a predetermined position for short or long periods of time, permitting an unobstructed traffic flow through the opening. The hold-open function can easily be turned on or off by simply rotating the serrated knob on the bottom of the channel. This knob engages the hold-open mechanism, allowing the door to be held open at a predetermined position ranging from 85° to 110°. When the knob is flipped over, it acts as a stop and shock absorber.

The tension on the hold-open mechanism can be adjusted using a phillips screwdriver to offset air currents or other exterior conditions. The hold-open tension adjustment is located on the top of the slider in the channel.

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100 Series concealed overhead door holders/stops



100 Series heavy-duty

Glynn-Johnson offers a complete line of overhead door holders and stops, accommodating virtually all openings with solutions for even the most complex door control problems. These concealed holders and stops provide the most attractive and reliable heavy-duty door control available.

Glynn-Johnson 100 Series holders and stops provide the most reliable and versatile concealed overhead door control. They are designed for installation on virtually all types of doors mounted on conventional type butt hinges, pivots, continuous hinges, swing clear hinges and numerous other specialty hinges. When used in conjunction with many surface-applied door closers, 100 Series holders and stops provide the most effective control for entrance doors and vestibule doors of all types, as well as heavy or often used interior doors. Templates provided allow for variable mounting positions, ranging from 85° - 110° of opening.

Five models:

- 100H Series hold-open model
- 100HP Series internal hold-open model
- 100F Series friction hold-open model
- 100S Series stop-only model
- 100SE Series special stop-only model

Six sizes:

- Each model comes in six sizes.
- Simple
- Standardized

Three options:

- ADJ—Adjustable jamb bracket
- CJ—Jamb Bracket for use with LCN 5030 closer
- SOC—Pin-in-socket security screw package

Unmatched convenience:

- Non-handed
- Improved compatibility with door closers
- Single/double-acting doors
- Interior/exterior applications
- Reduced door prep
- Durable
- Improved corrosion resistance
- Function conversion kits are available

Materials and finishes

In heavy gauge brass or 300 Series stainless steel, these models offer the broadest range of finishes in the industry, complementing any design and offering the highest resistance to corrosion. Available in the following finishes:

Finishes	Description
US3	Polished brass
US4	Satin brass
US10	Satin bronze
US10B	Oil rubbed bronze
US32	Polished stainless steel
US32D	Satin stainless steel
SP4	Powder coat brass
SP10	Powder coat bronze
SP28	Powder coat aluminum
SP313	Powder coat dark bronze
SPBLK	Powder coat black

Models

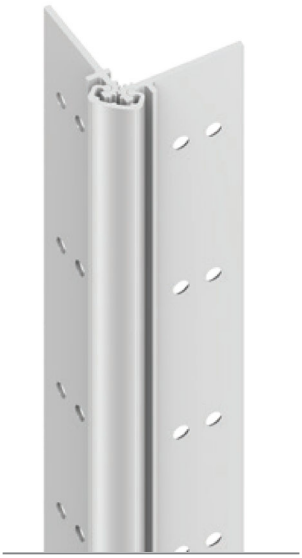
These models provide a wide range of optional features, and are ideal for use on entrance and vestibule doors, large doors, doors opened frequently, or doors subject to abuse. These models are also furnished with an offset-style jamb bracket.

Designed for heavy-duty applications, 100 Series models will provide long-lasting protection to doors, frames, hinges, related hardware and surrounding walls or obstructions.

100H Series hold-open

(Suffix H) The hold-open function should be used where it is desired to hold a door open at a predetermined position for short or long periods of time, permitting an unobstructed traffic flow through the opening.

These models are both selective and adjustable, featuring the most reliable hold-open mechanism available. They feature a control knob which protrudes from the face of the door and turns the hold-open function on or off. Set in the inactive position, the unit acts as a stop and shock absorber. The tension on the hold-open mechanism can be adjusted using an allen wrench to offset air currents or other exterior conditions. The hold-open tension adjustment is located in the bottom of the track in the top of the door.



112XY Full mortise - narrow frame and door leaf

- For 1 3/4" doors
- Patented center loaded, interlocking bearing design
- Non Handed for custom cut lengths
- Flush mounted, no inset
- 48" Maximum door width
- Beveled or square edge doors
- Frame guidance lip is extended further for retrofit applications to cover existing heavy weight architectural hinge preps
- For doors weighing up to 450 pounds without reinforcing, 600 pounds with reinforcing
- For lead-lined application consult factory for engineering specials

Certifications
- Meets ANSI 156.26 for 150lbs and 300lbs
- UL10C certified

Standard lengths
- 83", 85", 95", 119"

Standard mounting hardware
- 12-24 x 3/4" Steel self drilling / self tapping phillips head screw

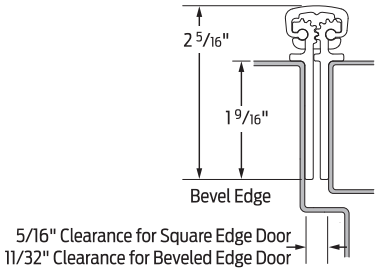
Finishes
- Clear Anodized (US28), Dark Bronze Anodized (313AN), Black Anodized (315AN)

Custom anodizing and painting are available, consult factory.

Options:
- HT.....Hospital tip
- EPT .....Electric power transfer
- TWP CON.....Electrical through wire panel with Allegion Connect

Optional mounting hardware:
- SECHM.....Security screws - hollow metal door and frame
- SECWDHM.....Security screws - 1/2 wood, 1/2 hollow metal
- SECWDWD .....Security screws - wood door and frame
- TEKWD .....1/2 self drill, self tap 1/2 wood
- WD.....Wood door and frame

For single door applications:
For pairs of doors see chart and general information



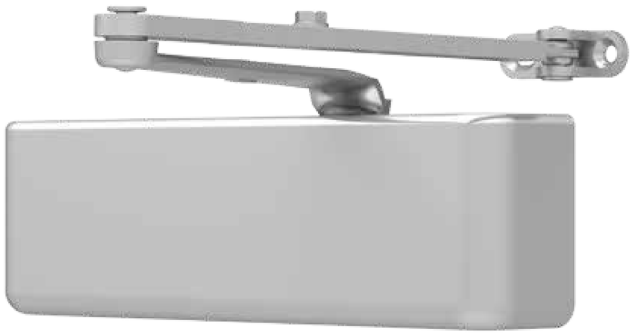
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4040XP Series

Features

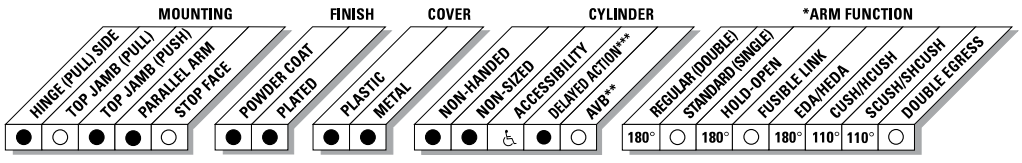


The 4040XP is LCN's most durable and flexible heavy duty closer designed for institutional and other demanding high traffic applications.

Certifications	Grade 1 - ANSI A156.4, UL 10C, ADA, 100 Hour Salt Spray, Meets BAA - Buy American Act
Body Construction	■ Cast Iron Body ■ Full Complement Bearings ■ 1-1/2″ Diameter Piston ■ 3/4″ Diameter Double Heat Treated Pinion Journal
Fluid	All Weather Liquid X Fluid
Handing	Non-Handed
Templating	Peel-n-Stick templates - 2-1/4″ x 5″ Mounting Hole Pattern
Size	Adjustable Spring Size 1-6, includes Patented Green Dial
Warranty	30 years

Cover	■ Plastic, Standard ■ Metal, Optional
Fasteners	Self Reaming and Tapping Screws (SRT)
Mounting	Hinge (Pull Side), Top Jamb (Push Side), Parallel Arm (Push Side)
Arms	Regular Arm
Finishes/Colors/ Powder Coat	■ Aluminum (689) ■ Statuary Bronze (690) ■ Light Bronze (691) ■ Black (693) ■ Dark Bronze (695) ■ Brass (696) ■ Custom colors optional
	■ Optional SRI primer - powder coat only ■ Optional plated finishes

Special Templates | Customized installation templates or products may be available to solve unusual applications. Contact LCN Product Support for assistance.



● AVAILABLE
○ NOT AVAILABLE

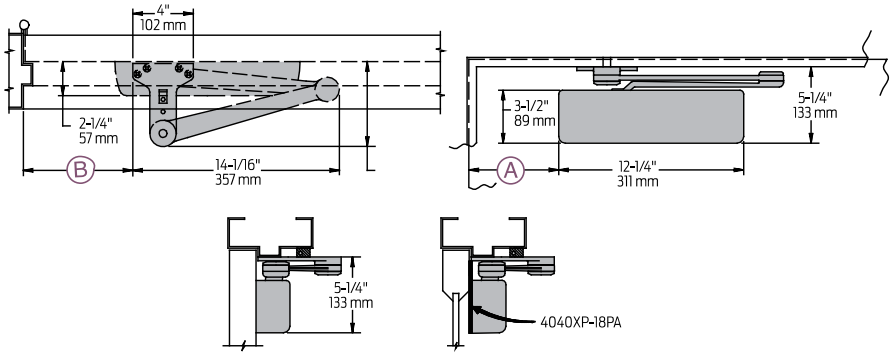
Closer available with less than 5.0 lbs. opening force on 36″ door.
* *Maximum opening/hold-open point with standard template.*
** *Advanced Variable Backcheck.*
*** *Delay feature incorporates standard 4040 cylinder (not XP).*

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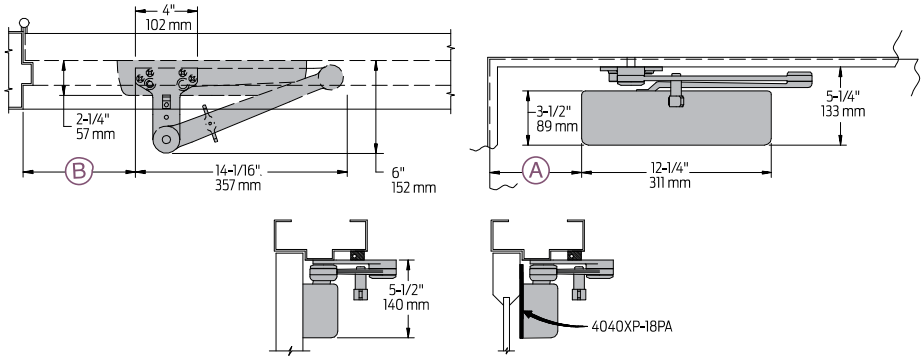
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EDA mount



CUSH mount



Clearance	4040XP-62EDA is 5-1/2″ (140 mm) from door face. 6″ (152 mm) for CUSH
Head Frame	Flush or rabetted requires CUSH FLUSH PANEL ADAPTER, 4040XP-419
CUSH ARM	Requires SHOE SUPPORT, 4040XP-30 for fifth screw anchorage for narrow frames
Delayed Action	■ Incorporates standard 4041 cylinder, without XP cylinder. ■ Delays closing from maximum opening to ; 115˚ with 180˚ template, 95˚ with 110˚ template, 85˚ with 100˚ template, 75˚ with 90˚ template. Delay time adjustable up to approximately 1 minute.

Maximum Opening

EDA arm can be templated for points at:	CUSH arms can be templated for opening/hold-open point at:
110º: A = 6-3/8″ (162 mm) B = 7-3/4″ (197 mm)	85º: A = 7-15/16″ (202 mm) B = 9-1/8″ (232 mm)
or 180º: A = 2-7/8″ (73 mm) B = 4-1/4″ (108 mm)	90º: A = 7-3/16″ (183 mm) B = 8-1/2″ (216 mm)
Hold-open points up to maximum opening with HEDA arm	100º: A = 6-1/16″ (154 mm) B = 7-1/4″ (184 mm)
	or 110º: A = 5-1/16″ (129 mm) B = 6-3/8″ (162 mm)

Notes:

· 4040XP Series closers ordered with EDA or CUSH arms include 4040XP-201 FIFTH HOLE SPACER to support the shoe

· Spring Cush stop points are approximately 5˚ more than templated stop point

· Hold open at templated stop points

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Arms



4040XP-3077
Regular Arm

- Non-handed
- Mounts pull side or top jamb with shallow reveal P4041 closer includes PA SHOE, 4040XP-62PA required for parallel arm mounting



4040XP-3077L
Long Arm

- Non-handed
- Includes LONG ROD AND SHOE, 4040XP-79LR for top jamb mount
- Optional



4040XP-3077ELR
Extra Long Arm

- Non-handed
- Includes EXTRA LONG ROD AND SHOE, 4040XP-79ELR for top jamb mount with deep reveal
- Optional



4040XP-3049
Hold-Open Arm

- Non-handed
- Mounts pull side or top jamb with shallow reveal, hold-open adjustable shoe
- 4040XP closer includes 4040XP-62PA shoe required for parallel arm mounting
- Optional



4040XP-3049L
Long Hold-Open Arm

- Non-handed
- Includes LONG HEAD AND TUBE, 4040XP-3048L for top jamb mount
- Optional



4040XP-3077EDA
Extra Duty Arm

- Non-handed
- Features forged, solid steel main and forearm for potentially abusive installations
- Optional



4040XP-3049EDA
Hold-Open Extra Duty Arm

- Handed
- Parallel arm features forged, solid steel main and forearm for potentially abusive installations
- Hold-open function is adjusted at the shoe
- Optional



4040XP-3077EDA/62G
Extra Duty Arm with 62G

- Non-handed
- Features forged, solid steel main and forearm for potentially abusive installations
- 62G shoe provides additional blade stop clearance
- Optional



4040XP-3049EDA/62G
Hold-Open Extra Duty Arm with 62G

- Handed
- Features forged, solid steel main and forearm for potentially abusive installations
- 62G shoe provides additional blade stop clearance. Hold-open function is adjusted at the shoe
- Optional



4040XP-3077CNS
Cush-N-Stop® Arm

- Non-handed
- Features solid forged steel main arm and forearm with stop in soffit shoe.
- Optional



4040XP-3049CNS
HCUSH Arm

- Non-handed
- Hold-open function with templated stop/hold-open points
- Handle controls hold-open function
- Optional



4040XP-3077SCNS
Spring CUSH Arm

- Non-handed
- For abusive applications features solid forged steel main arm and forearm with spring loaded stop in the soffit shoe
- Optional



4040XP-3049SCNS
Spring HCUSH Arm

- Non-handed
- For abusive applications features solid forged steel main arm and forearm with spring loaded stop in the soffit shoe
- Handle controls hold-open function
- Optional

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ND mechanical



Applications

The Schlage ND is extremely versatile and is regularly used in healthcare, education, government, office, retail and other commercial applications.

With 31 mechanical functions, the ND's range spans from the simple (non-locking passage) to complex (double-cylinder security) to specialized (school time-out lock).

Because the ND uses an ANSI 161 door prep, commonly used across cylindrical locks, it is ideal for both new construction and retrofit applications.

Key features

- Significantly exceeds ANSI/BHMA A156.2 requirements for Grade 1 cylindrical locks
- 31 mechanical functions (see adjacent columns for wired electrified and electronic options)
- Nine lever designs, two rose designs
- 10 available finishes
- Supports standard, SFIC and FSIC cylinder formats
- Multiple key systems available – open, patented, restricted, geographic exclusive, UL437
- Support for 10 non-Schlage cores (see cylinder section)

ND wired electrified



Applications

Wired electrified locks complement the mechanical offering and are typically incorporated into a wired access control system or used independently with a remote access switch (e.g. switch behind a receptionist desk).

The electrified ND is ideally used in:

- high traffic areas, where line power ensures continuous operation
- new construction, where electrified door prep, hinges and wiring can easily be incorporated into the building

Key features

All mechanical features plus:

- auto-detecting 12-24VDC input
- selectable EL/EU operation
- low 0.23 amp max current draw that allows multiple locks on a single power supply
- low 0.010 amp holding current that eliminates "hot levers" in electrically locked applications
- modular Request to Exit (RX) that can be added at any time
- inventory friendly–one lock supports 12-24V, EL or EU, with or without RX
- six electrified functions for application flexibility

NDE wireless electronic



Applications

Wireless electronic locks complete the offering by delivering all of the access control system hardware components required at the door in a single integrated design.

NDE wireless lock applications include:

- retrofit applications where electronic credentials can be used for improved visibility and control
- new construction to expand the scope of access control to interior openings
- low to medium traffic areas, where battery power delivers long life

Key features

All mechanical features[1] plus:

- Fits standard ANSI 161L mechanical door prep
- Installs in minutes with only a Phillips screwdriver
- Integrated card reader, door position sensor and Request to Exit (RX) switch
- Built-in Bluetooth® enables wireless configuration from smart phones and tablets
- Built-in Wi-Fi enables automatic updates to access rights
- Capable of networked real-time communication[2]
- Up to 2 years of battery life (4 AA)

1 NDE wireless electronic lock available in seven lever designs, one rose design, and nine finishes only.
2 Requires ENGAGE™ Gateway and alliance access control software.

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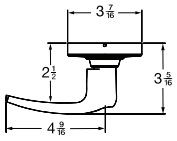
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Lever designs and finishes

Athens (ATH)[2]

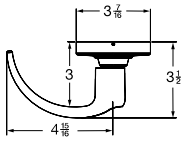




Mechanical | Wired electrified | Wireless electronic

Sparta (SPA)[1, 2]

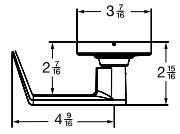




Mechanical | Wired electrified | Wireless electronic

Rhodes (RHO)[1, 2]

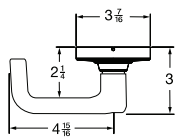




Mechanical | Wired electrified | NDE wireless electronic

Tubular (TLR)[1, 2]

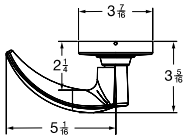




Mechanical | Wired electrified | Wireless electronic

Omega (OME)[1]

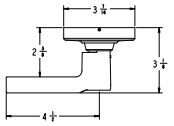




Mechanical | Wired electrified | Wireless electronic

Latitude (LAT)

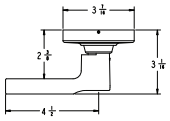




Mechanical | Wired electrified | Wireless electronic

Broadway (BRW)

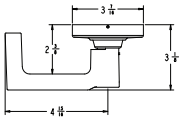




Mechanical | Wired electrified | Wireless electronic

Longitude (LON)

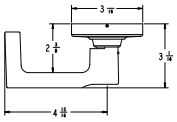




Mechanical | Wired electrified | Wireless electronic

Boardwalk (BWK)





Mechanical | Wired electrified | Wireless electronic

All levers comply with the Americans with Disabilities Act (ADA).

1 Boardwalk, Longitude, Omega, Rhodes, Sparta and Tubular levers comply with California State code for return within 1/2" of door face.

2 Athens, Rhodes, Sparta and Tubular levers support cylinders from other manufacturers, see cylinder section on page 24 for details.

Finish options									
Color	Bright brass	Satin brass	Satin bronze	Oil rubbed bronze	Satin nickel	Matte black	Bright chrome	Satin chrome	Aged bronze
ANSI/BHMA number	605	606	612	613	619	622	625	626/626AM	643e
US number	US3	US4	US10	US10B	US15	US19	US26	US26D	US11
Mechanical	■	■	■	■	■	■	■	■	■
Wired electrified	■	■	■	■	■	■	■	■	■
Wireless electronic	■	■	■	—	■	■	■	■	■

Product information and specifications contained in this catalog are subject to change without notice. Please consult the factory.

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ND Series mechanical lock

The ND mechanical lock, along with being Schlage's best selling mechanical lock, is the foundation for both the wired electrified and NDE wireless electronic lock. Not only did Schlage invent the cylindrical lock, but we continue to make it better with capabilities such as:

- Unparalleled strength - the lock prevents access even when subjected to torque loads up to 3,100 in-lbs (2.6x BHMA[1]), withstands pry bar attacks of 1,600 lbs (8x BHMA requirements[1]), and withstands 100 hammer blows (20x BHMA requirements[1,2])
- Exceptional durability - cycle tested to over 16M cycles (16x BHMA requirements[1]) with near zero droop or wobble - without the use of set screws or O-rings
- Improved feel - improved strength and durability are more than numbers, you can actually feel it in the lock
- Improved installation - installation is even easier than before (and withoutany set screws or O-rings)

All this is in addition to what you know and expect with the Schlage ND: 31 mechanical functions (plus wired electrified and wireless electronic) to meet the needs of any application; nine lever designs that suite with otherSchlage locks and Von Duprin exit devices; renowned sales, customer and technical support.





1 Beyond grade 1 performance for ND locks with Schlage cylinders only (standard, FSIC & SFIC). Performance with non-Schlage cylinders will exceed BHMA grade 1 requirements but may be less than the performance of products with Schlage cylinders.

2 Vertical impact testing stopped after 100 blows with no sign of failure or stress.

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ND Series mechanical lock
Keyed function list

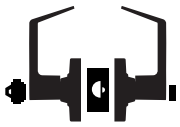
Schlage ANSI

ND50PD F82

Entrance/office lock

- Push-button locking.
- Push-button locks outside lever until it is unlocked with key or by turning inside lever.
- Inside lever always free for immediate egress.

Outside Inside



Schlage ANSI

ND53PD F109

Entrance lock

- Turn/push-button locking: Pushing and turning the button locks the outside lever, requiring use of a key until the button is manually unlocked.
- Push-button locking: Pushing button locks outside lever until unlocked by key or by turning the inside lever.
- Inside lever always free for immediate egress.

Outside Inside



Schlage ANSI

ND60PD F88

Vestibule lock

- Latch retracted by key from outside when outside lever is locked by key in inside lever.
- Inside lever always free for immediate egress.

Outside Inside



Schlage ANSI

ND66PD F91

Store lock†

- Key in either lever locks or unlocks both levers.

Outside Inside



Schlage ANSI

ND70PD F84

Classroom lock

- Outside lever locked and unlocked by key.
- Inside lever always free for immediate egress.

Outside Inside



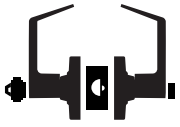
Schlage ANSI

ND73PD F90

Corridor lock

- Locked or unlocked by key from outside.
- Push-button locking from inside.
- Turn inside lever or close door to release button.
- When outside lever is locked by key it can only be unlocked by key.
- Inside lever always free for immediate egress.

Outside Inside



Schlage ANSI

ND75PD -

Classroom security lock

- Key in either lever locks or unlocks outside lever.
- Inside lever always free for immediate egress.

Outside Inside



Schlage ANSI

ND80PD F86

Storeroom lock

- Outside lever is fixed.
- Entrance by key only.
- Inside lever always free for immediate egress.

Outside Inside



Available with RX

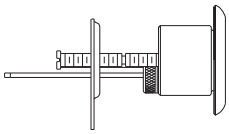
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Cylinders for exit devices, aluminum door, etc.





Rim cylinders			
Number	Tailpiece	Pins	Cylinder mechanism
20-021 20-022	Vertical Horizontal	6	Standard pin and tumbler
91-074 91-075	Vertical Horizontal	7	SL cylinder (restricted Everest 29 R and Everest B only)
20-709 20-710	Vertical Horizontal	6	Primus
20-716	Horizontal	6	Primus lockout
20-509 20-510	Vertical Horizontal	6	Primus UL 437 listed high security
20-516	Horizontal	6	Primus UL 437 listed lockout
20-709-XP 20-710-XP	Vertical Horizontal	6	Primus XP
91-774-XP 91-775-XP	Vertical Horizontal	7	Primus XP SL cylinder (restricted Everest 29 R and Everest B only)
20-716-XP	Horizontal	6	Primus XP lockout
20-509-XP 20-510-XP	Vertical Horizontal	6	Primus XP UL 437 listed high security
20-516-XP	Horizontal	6	Primus XP UL 437 listed lockout

Notes
- 1 1/8" length standard. Optional lengths available in 1/8" (4mm) increments up to 1 3/4" (44mm).
- Lockout keys must be ordered separately and lockout cylinders will not be master keyed by Schlage.

Mortise and rim cylinder finish options



Bright brass (605)	Satin brass (606)	Antique brass (609)	Satin bronze (612)	Oil rubbed bronze (613)	Satin nickel (619)	Matte black (622)	Bright chrome (625)	Satin chrome (626)	Bright stainless steel (629)	Satin stainless steel (630)	Aged bronze (643e)
Faceplate	Faceplate and plug	Faceplate	Faceplate	Faceplate	Faceplate	Faceplate and plug	Faceplate	Faceplate and plug	Faceplate	Faceplate	Faceplate and plug

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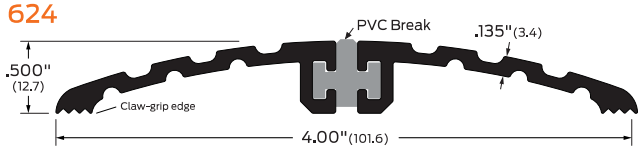
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Thresholds

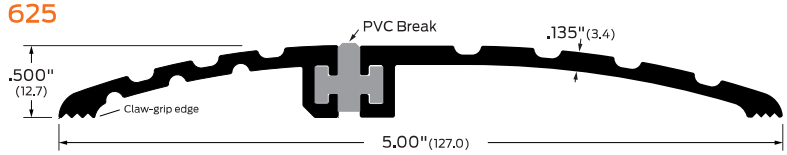
Thermal break thresholds

624



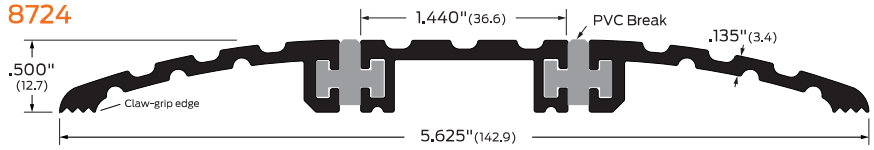
Finishes: A, BK, D, G
Options: E, EL, V3, EV3, ELV3
BHMA CERTIFIED
ANSI/BHMA:
624A, 624D, 624G, 624BK J32139
624A-E, 624D-E, 624G-D, 624BK-E J32239

625



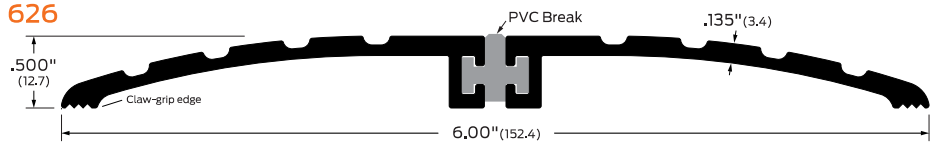
Finishes: A, BK, D, G
Options: E, EL, V3, EV3, ELV3
BHMA CERTIFIED
ANSI/BHMA:
625A, 625BK, 625D, 625G J32139
625A-E, 625BK-E, 625D-E, 625G-E J32239

8724



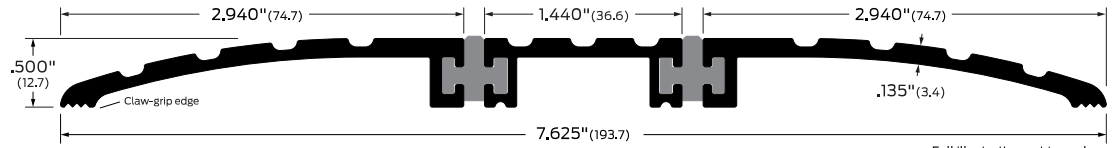
Finishes: A, BK, D, G
Options: E, EL, V3, EV3, ELV3
BHMA CERTIFIED
ANSI/BHMA:
8724A, 8724D, 8724G, 8724BK J32139
8724A-E, 8724D-E, 8724G-E, 8724BK-E J32239

626



Finishes: A, BK, D, G
Options: E, EL, V3, EV3, ELV3
BHMA CERTIFIED
ANSI/BHMA:
626A, 626D, 626G, 626BK J32139
626A-E, 626D-E, 626G-D, 626BK-E J32239

8726



Full illustration not to scale

Finishes: A, BK, D, G
Options: E, EL, V3, EV3, ELV3
BHMA CERTIFIED
ANSI/BHMA:
8726A, 8726D, 8726G, 8726BK J32139
8726A-E, 8726D-E, 8726G-E, 8726BK-E J32239

See Thresholds Accessories & options page for details.

Finishes:

A	Aluminum mill finish
BK	Aluminum black anodized
D	Aluminum dark bronze anodized
G	Aluminum gold anodized
B	Bronze, architectural mill finish
B-ORB	Oil-rubbed bronze

Options:

E	Epoxy abrasive tread
EL	Photoluminescent and abrasive epoxy tread
V3	Full body strength fill
EV3	Epoxy and full body strength fill
ELV3	Photoluminescent and abrasive epoxy tread, full body strength fill

Note:

Special anchors available for mounting most thresholds on concrete surfaces.

Width dimensions for thresholds on this page are nominal. Slight variations may result from thermal break manufacturing.

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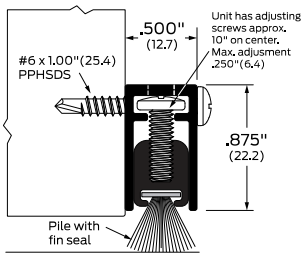
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Perimeter seals

Door sweeps

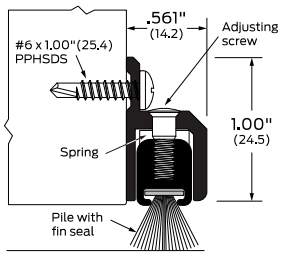
871



Finishes: AA, BK, D, G
Options: S, SEC
ANSI/BHMA: 871AA, 871BK, 871D, 871G R3F434

Adjustable

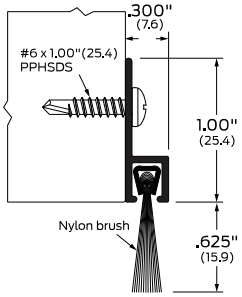
255



Finishes: AA, BK, D, G
Options: SEC
ANSI/BHMA: 255AA, 255BK, 255D, 255G R3F434

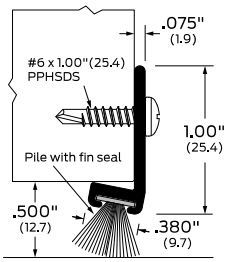
Adjustable

8192



Finishes: AA, BK, D, G
Options: PSA, SEC
ANSI/BHMA: 8192AA, 8192BK, 8192D, 8192G R3A436

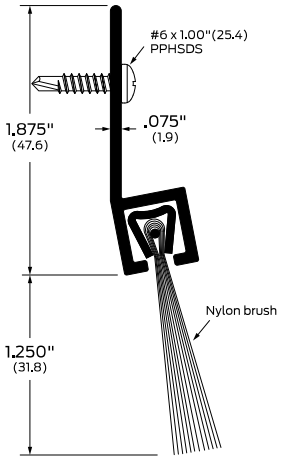
98





Finishes: A, BK, D, G
Options: PSA, S, SEC
ANSI/BHMA: 98A, 98BK, 98D, 98G R3F436

96



Finishes: A, BK, D, G
Options: SEC
ANSI/BHMA: 96A, 96BK, 96D, 96G R3A436

Suitable for mixed-use commercial, hospitality, multi-family, as well as sliding barn doors.

See Perimeter seals Accessories & options page for details.

Finishes:

A	Aluminum mill finish
AA	Aluminum clear anodized
BK	Aluminum black anodized
D	Aluminum dark bronze anodized
G	Aluminum gold anodized
B	Bronze, architectural mill finish
B-ORB	Oil-rubbed aged bronze

Options:

FLO	Air flow/ sound block
PSA	Pressure-sensitive adhesive
ZAG	Ligature resistant gasketing
S	Order as a set
SEC	Security screws

Note:

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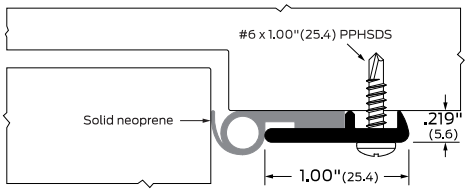
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Perimeter seals

Head and jamb gasketing

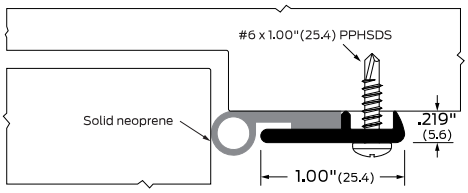
326



Finishes:	Options:	ANSI/BHMA:	
AA, BK, D, G, B, B-ORB	ZAG, S, SEC	326AA, 326BK, 326D, 326G 326B	R3B164 R1B164

Extruded Bulb/Finger for double-sealing protection.

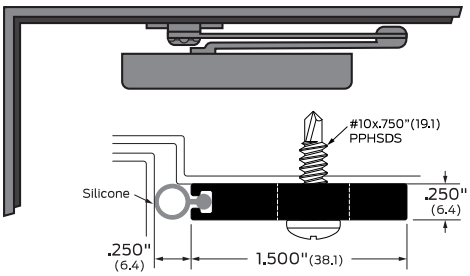
328



Finishes:	Options:	ANSI/BHMA:	
AA, BK, D, G, B, B-ORB	ZAG, S, SEC	328AA, 328BK, 328D, 328G 328B	R3B164 R1B164

ZAG option for mental health applications includes security screws

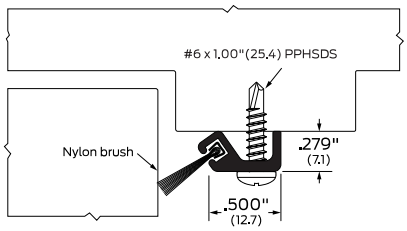
429



Finishes:	Options:	ANSI/BHMA:	
AA, BK, D, G	S, SEC	429AA, 429BK, 429D, 429G	R3E164

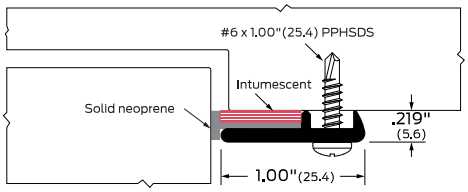
Gasketing protection for closer bracket or door coordinator.

8305



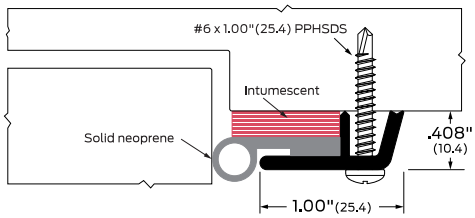
Finishes:	Options:	ANSI/BHMA:	
AA, BK, D, G	S, SEC	8305AA, 8305BK, 8305D, 8306G	R3A166

302FS



Finishes:	Options:	ANSI/BHMA:	
AA, BK, D, G B, B-ORB	S, SEC	302FS-AA, 302FS-BK, 302FS-D, 302FS-G 302FS-B	R3R164 R1R164

328FS



Finishes:	Options:	ANSI/BHMA:	
AA, BK, D, G	S, SEC	328FS-AA, 328FS-BK, 328FS-D, 328FS-G	R3R164

See Perimeter seals Accessories & options page for details.

Finishes:

A	Aluminum mill finish
AA	Aluminum clear anodized
BK	Aluminum black anodized
D	Aluminum dark bronze anodized
G	Aluminum gold anodized
B	Bronze, architectural mill finish
B-ORB	Oil-rubbed aged bronze

Options:

FLO	Air flow/ sound block
PSA	Pressure-sensitive adhesive
ZAG	Ligature resistant gasketing
S	Order as a set
SEC	Security screws

Note:

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Submittal Date: Apr 25/22

PART 1 - GENERAL

1.1 References

.1 ASTM E 330-02 Test Method for Structural Performance of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference.

.2 ASTM C 542-94(1999) Specification for Lock-Strip Gaskets.

.3 ASTM D 790-02 Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

.4 ASTM D 1003-00 Test Method for Haze and Luminous Transmittance of Plastics.

.5 ASTM D 1929-96(2001)e1e1 Test Method for Ignition Properties of Plastics.

.6 ASTM D 2240-02b Test Method for Rubber Property - Durometer Hardness.

.7 ASTM E 84-01 Test Method for Surface Burning Characteristics of Building Materials.

.8 ASTM F 1233-98 Test Method for Security Glazing Materials and Systems.

.9 CAN/CGSB-12.1-M90 Tempered or Laminated Safety Glass.

.10 CAN/CGSB-12.2-M91 Flat, Clear Sheet Glass.

.11 CAN/CGSB-12.3-M91 Flat, Clear Float Glass.

.12 CAN/CGSB-12.4-M91 Heat Absorbing Glass.

.13 CAN/CGSB-12.5-M86 Mirrors, Silvered.

.14 CAN/CGSB-12.8-M97 Insulating Glass Units.

.15 CAN/CGSB-12.10-M76 Glass, Light and Heat Reflecting.

.16 CAN/CGSB-12.11-M90 Wired Safety Glass.

.17 CAN/CGSB-12.12-M90 Plastic Safety Glazing.

.18 Flat Glass Manufacturers Association (FGMA) Glazing Manual.

.19 Laminators Safety Glass Association Standards Manual.

1.2 Performance Requirements

.1 Provide continuity of building enclosure vapour and air barrier using glass and glazing materials as follow:
.1 Utilize inner light of multiple light sealed units for continuity of air and vapour seal.

.2 Size glass to withstand wind loads, dead loads and positive and negative live loads acting normal to plane of glass to a design pressure applicable to locale as measured in accordance with ASTM E 330-02.

.3 Limit glass deflection to lesser of 1/200 or flexural limit of glass with full recovery of glazing materials.

.4 Provide fire rated labelled glass in accordance with tested assemblies recognized by authorities having jurisdiction to achieve specified fire resistance ratings for intended application.

1.3 Samples

.1 Submit samples in accordance with Section 01300.

.2 Submit duplicate 12" size samples of mullions and sealant material.

1.4 Closeout Submittals

.1 Provide maintenance data including cleaning instructions for incorporation into manual specified in Section 01730.

1.5 Quality Assurance

.1 Perform work in accordance with FGMA Glazing Manual IGMAC and Laminators Safety Glass Association - Standards Manual for glazing installation methods.

.2 Maintain one copy of each standard document on site.

.3 Provide testing and analysis of glass under provisions of Section 01450.

.4 Provide shop inspection and testing for glass.

1.6 Environmental Requirements

.1 Install glazing when ambient temperature is 10°C minimum. Maintain ventilated environment for 24 hours after application.

.2 Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

PART 2 - PRODUCTS

2.1 Glass Materials

.1 Tempered safety glass to CAN/CGSB-12.1-M90, Type 2, Class A of thickness indicated.

.2 Laminated safety glass to CAN/CGSB-12.1-M90, Type 1, Class A minimum 6mm or thickness as indicated.

.3 Float glass: to CAN/CGSB-12.3-M91, glazing quality.

.4 Mirrors silvered, glass: to CAN/CGSB-12.5-M86, silvered, Type 1A 6 mm thick, ground and polished edges framed with stainless steel edging and supported with concealed tamperproof fasteners and adhesive of sizes indicated.

.5 Insulating glass units:

.1 CAN/CGSB-12.8-M97, with outer pane of 6 mm thick tempered safety glass and inner pane of 6 mm thick clear float glass with 25 mm total thickness, Low E coating on #2 surface.

.1 Outerboard Lite: Guardian CrystalGray Glass or equal. a) Coating on Surface No.2: SN 68 #2 Clear 1" IGU.

.2 Air Space: 12 mm (1/2 inch) wide, hermetically sealed, dehydrated air space.

.3 Inboard Lite: Guardian Clear Glass or equal.

.4 Glass Unit Performance Characeristics: a) Visible Light Transmittance: 68 percent b) Visible Light Reflectance Outdoors: 11 percent c) Ultraviolet Transmittance: 30 percent d) Winter U-Value Nightime: 0.245 e) Summer U-Value Daytime: 0.22 f) Solar Heat Gain Coefficient: 0.34 g) Light to Solar Gain: 1.82

.5 Edge Seals: ASTM E 2188, with aluminum spacers, dual-sealed with a primary seal of polyisobutylene and a secondary seal of silicone sealant for glass-to-spacer seals.

.6 Sealant: Approved by glass manufacturer.

.6 Wired glass: to CAN/CGSB-12.11-M90, type 1 clear Georgian Polished Plate, wire mesh style 3, 6 mm thick.

.7 Obscure patterned glass: to CAN/CGSB-12.13-M91, 6mm thick, inside pane of insulating glass units where shown. Submit samples to Consultant for approval.

.8 Fire rated glass: glass material labelled by accredited testing organization recognized by authorities having juridiction. Firelite Plus 8mm non-wired ceramic glazing or equal as approved by Consultant.

.9 At all glass in exterior doors and exterior sidelights, CAN/CGSB-12.8-M97, with outer pane of 6mm thick laminated safety glass and inner pane of 6mm thick laminated safety glass with 25mm total thickness, capillary tubes. Match Tint and Low E to window glass.

2.2 Glazing and Sealing Compound Materials

.1 Glazing compound:

.1 Oil base, to CAN/CGSB-19.6-M87, Type 1, black colour.

.2 Non-hardening, modified oil type to CAN/CGSB-19.2-M87, black colour.

.2 Sealant compound: one component acrylic base, to CGSB 19-GP-5M, gun grade, black colour.

.3 Sealant compound: one component compound, to CAN/CGSB-19.13-M87, Class A, gun grade, black colour.

.4 Sealant compound: one component, silicone base, solvent curing to CAN/CGSB-19.18-M87, black colour.

.5 Sealant compound: multi-component, chemical curing to CAN/CGSB-19.24-M90, type 2, class A, black colour.

.6 Sealing and Bedding Compound, Acoustical: to CAN/CGSB-19.21-M87.

.7 Putty Linseed Oil: to CAN/CGSB-19.1-M87.

2.3 Accessories

.1 Glazing tape: pre-shimmed preformed butyl tape, 10-15 durometer hardness, paper release, black colour, to suit.

.2 Setting blocks: neoprene, Shore "A" durometer hardness Shore "A" 80-90, 100 mm long x 6 mm high x width to suit glass thickness.

.3 Spacer shims: neoprene, Shore "A" durometer hardness 80, 75 mm long x 2.4 mm thick x 9 mm high.

.4 Glazing splines: neoprene manufacturer's standard dry glazing splines to suit aluminum extrusions, grey colour.

.5 Glazing points and wire spring clips: corrosion resistant, manufacturer's standard.

.6 Lock-strip gaskets: black neoprene to ASTM C 542-94(1999), H type U type for cavities spline type for recessed reglets type. Provide internal drainage channel with drainage holes in sill section. Injection mould one-piece corner sections and heat-seal to main gasket.

.7 Primer-sealers and cleaners: to glass manufacturer's standard.

.8 Breather tubes: to manufacturer's standard.

.9 Mirror attachment accessories:
.1 Stainless steel clips.
.2 Plastic rosettes.
.3 Mirror adhesive, chemically compatible with mirror coating and wall substrate.
.4 Mirror frames: Stainless steel.

PART 3 - EXECUTION

3.1 Examination

.1 Verify that openings for glazing are correctly sized and within tolerance.

.2 Verify that surfaces of glazing channels or recesses are clean, free of obstructions, and ready to receive glazing.

3.2 Preparation

.1 Clean contact surfaces with solvent and wipe dry.

.2 Seal porous glazing channels or recesses with substrate compatible primer or sealer.

.3 Prime surfaces scheduled to receive sealant.

3.3 Workmanship

.1 Remove protective coatings and clean contact surfaces with solvent and wipe dry.

.2 Apply primer-sealer to contact surfaces.

.3 Place setting blocks as per manufacturer's instructions.

.4 Install glass, rest on setting blocks, ensure full contact and adhesion at perimeter.

.5 Install removable stops, without displacing tape or sealant.

.6 Provide edge clearance of 3 mm minimum.

.7 Insert spacer shims to center glass in space. Place shims at 600 mm oc and keep 6 mm below sight line.

.8 Apply cap bead of sealant at exterior void.

.9 Apply sealant to uniform and level line, flush with sightline and tooled or wiped with solvent to smooth appearance.

.10 Do not cut or abrade tempered, heat treated, or coated glass.

3.4 Exterior Glazing

.1 Dry method - tape/tape and sealant:
.1 Cut glazing tape to proper length and set against permanent stops 5 mm below sightline. Install horizontal strips first, extend over entire width of opening before applying vertical strips. Weld corners together by butting tape and dabbing with sealant.
.2 Place glazing tape on glass in manner described above.

.2 Combination method - tape/sealant:
.1 Cut glazing tape to proper length and set against permanent stops, 5 mm below sightline. Install horizontal strips first, extend over entire width of opening before applying vertical strips. Weld corners together by butting tape and dabbing with sealant.
.2 Fill gap between glass and applied stop with sealant to depth equal to bite of frame on glass but not more than 10 mm below sightline.

.3 Wet method - sealant/sealant:
.1 Apply sealant to back and bottom of rabbet.
.2 Bed glass in position with sealant.
.3 Fill gap between glass and stops with sealant to depth equal to bite of frame on glass but not more than 10 mm below sightline.

.4 Lock strip gasket method:
.1 Unpack and lay out gaskets on flat warm area to permit recovery of shape.
.2 Install gaskets under compression from corners inward.
.3 Drain infiltrated moisture to exterior through drain holes in sill.
.4 Install locking strip and gasket assembly to manufacturer's instructions.

3.5 Interior Glazing

.1 Dry method - tape/tape:
.1 Cut glazing tape to length and install against permanent stop, project 1.5 mm above sightline.
.2 Place glazing tape on free perimeter of glass in same manner described above.

.2 Combination method - tape/sealant:
.1 Cut glazing tape to proper length and install against permanent stop, projecting 1.5 mm above sightline.
.2 Fill gap between glass and applied stop with sealant to depth equal to bite of frame on glass to uniform and level line.
.3 Trim off excess tape to sightline.

.3 Wet method - compound/compound:
.1 Apply sealant to back and bottom of rabbet.
.2 Bed glass in position with sealant.
.3 Locate and secure glass using glaziers' clips.
.4 Fill gaps between glass and stops with compound until flush with sightline and tool to smooth straight line.

.4 Gasket method:
.1 Install gasket to permanent stop and install glass.
.2 Apply removable stops. Install gaskets in frame channels.

3.6 Fire Rated Glass

.1 Install fire rated glass in accordance with manufacturer's specifications.

3.7 Mirror Installation

.1 Install mirrors where indicated using full adhesive bed and clips.

3.8 Cleaning

.1 Remove glazing materials from finish surfaces.

.2 Remove labels after work is complete.

.3 Clean glass and mirrors.

3.9 Protection of Finished Work

.1 After installation, mark light with an "X" by using removable plastic tape or paste. Do not mark heat absorbing or reflective glass units.

PART 1 - GENERAL

1.1 References

.1 CAN/CGSB-1.40-M89, Primer, Structural Steel, Oil Alkyd Type.

.2 CAN/CGSB-19.21-M87, Sealing and Bedding Compound Acoustical.

.3 ASTM C 645-00, Specification for Non-Load (Axial) Bearing Steel Studs, Runners (Track), and Rigid Furring Channels for Screw Application of Gypsum Board.

PART 2 - PRODUCTS

2.1 Materials

.1 Non-loadbearing channel stud framing: to ASTM C 645-00, 92 mm stud size, roll formed from 0.91 mm thickness hot dipped galvanized steel sheet, for screw attachment of gypsum board. Knock-out service holes at 460 mm centres.

.2 Floor and ceiling tracks: to ASTM C 645-00, in widths to suit stud sizes, 32 mm flange height.

.3 Metal channel stiffener: 38 x 19 mm size, 1.4 mm thick cold rolled steel, coated with rust inhibitive coating.

.4 Acoustical sealant: to CAN/CGSB-19.21-M87.

.5 Insulating strip: rubberized, moisture resistant 3 mm thick foam strip, 12 mm wide, with self sticking adhesive on one face, lengths as required.

PART 3 - EXECUTION

3.1 Erection

.1 Align partition tracks at floor and ceiling and secure at 600 mm o.c. maximum.

.2 Install dampproof course under stud shoe tracks of partitions on slabs on grade.

.3 Place studs vertically at 400 mm oc and not more than 50 mm from abutting walls, and at each side of openings and corners. Position studs in tracks at floor and ceiling. Cross brace steel studs as required to provide rigid installation to manufacturer's instructions.

.4 Erect metal studding to tolerance of 1:1000.

.5 Attach studs to bottom track using screws .

.6 Co-ordinate simultaneous erection of studs with installation of service lines. When erecting studs ensure web openings are aligned.

.7 Co-ordinate erection of studs with installation of door/window frames and special supports or anchorage for work specified in other Sections.

.8 Provide two studs extending from floor to ceiling at each side of openings wider than stud centres specified. Secure studs together, 50 mm apart using column clips or other approved means of fastening placed alongside frame anchor clips.

.9 Install heavy gauge single jamb studs at openings.

.10 Erect track at head of door/window openings and sills of sidelight/window openings to accommodate intermediate studs. Secure track to studs at each end, in accordance with manufacturer's instructions. Install intermediate studs above and below openings in same manner and spacing as wall studs.

.11 Frame openings and around built-in equipment, cabinets, access panels, on four sides. Extend framing into reveals. Check clearances with equipment suppliers.

.12 Provide 40 mm stud or furring channel secured between studs for attachment of millwork and fixtures behind lavatory basins, toilet and bathroom accessories, and other fixtures including coat and boot racks, grab bars and towel rails, attached to steel stud partitions. Provide double studs as required and as directed by Consultant.

.13 Install steel studs or furring channel between studs for attaching electrical and other boxes.

.14 Extend partitions to underside of structure except where noted otherwise on drawings.

.15 At suspended bulkheads and partitions, brace back to structure as required at 1200mm o.c. Suspend bulkheads and partitions in strict accordance with manufacturer's instructions. Review method of suspension with Consultant prior to commencement of Work. Failure to do so will result in immediate rejection of Work.

.16 Maintain clearance under beams and structural slabs to avoid transmission of structural loads to studs. Use 50 mm leg ceiling tracks to form double track slip joint.

.17 Install continuous insulating strips to isolate studs from uninsulated surfaces.

.18 Install two continuous beads of acoustical sealant or insulating strip under studs and tracks around perimeter of sound control partitions.

PART 1 - GENERAL

1.1 References

.1 ASTM C 635-00 Specifications for Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings.

.2 ASTM C 636-96 Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.

1.2 Design Criteria

.1 Maximum deflection: 1/360th of span to ASTM C 635-00 deflection test.

1.3 Samples

.1 Submit samples in accordance with Section 01300 - Submittals.

.2 Submit one representative model of each type ceiling suspension system.

.3 Ceiling system to show basic construction and assembly, treatment at walls, recessed fixtures, splicing, interlocking, finishes, acoustical unit installation.

PART 2 - PRODUCTS

2.1 Materials

.1 Intermediate duty system to ASTM C 635-00.

.2 Basic materials for suspension system: commercial quality cold rolled steel zinc coated or aluminum sheet mill finished.

.3 Exposed tee bar grid components: shop painted satin sheen white colour . Components die cut. Main tee with double web, rectangular bulb and 25 mm rolled cap on exposed face. Cross tee with rectangular bulb; web extended to form positive interlock with main tee webs; lower flange extended and offset to provide flush intersection.

.4 Hanger wire: galvanized soft annealed steel wire.
- .1 3.6 mm diameter for access tile ceilings.
- .2 to ULC design requirements for fire rated assemblies.
- .3 2.6 mm diameter for other ceilings.

.5 Hanger inserts: purpose made.

.6 Carrying channels: 38 x 19 mm channel, of 1.2 mm thick galvanized steel.

.7 Accessories: splices, clips, wire ties, retainers and wall moulding flush, to complement suspension system components, as recommended by system manufacturer.

.8 Secondary Support System: Unistrut or equal complete with purpose made clamps and fastening systems as required, spanning between structural members. Submit shop drawings signed and sealed by member of Professional Engineers of Ontario (P.E.O.).

PART 3 - EXECUTION

3.1 Installation

.1 Installation: in accordance with ASTM C 636-96 except where specified otherwise.

.2 Install suspension system to manufacturer's instructions and Certification Organizations tested design requirements.

.3 Do not erect ceiling suspension system until work above ceiling has been inspected by Consultant. Remove existing suspension system leaving

existing hangers and anchorage to structure intact and serviceable for re-use. Re-use existing hangers and anchorage wherever possible after verifying condition capable of supporting suspension system. Where existing hangers and/or anchors are not capable of supporting suspension system replace hangers and/or anchors to match existing or as specified herein.

.4 Secure hangers to overhead structure using attachment methods acceptable to Consultant. DO NOT SUSPEND FROM METAL DECK. Suspend from open web steel joists, beams or channels or provide secondary support systems spanning between structural members. Where secondary support systems are utilized, submit shop drawings signed and sealed by member of Professional Engineers of Ontario (PEO).

.5 Secure hangers to overhead structure using attachment methods acceptable to Consultant. DO NOT SUSPEND FROM METAL OR PRE-CAST CONCRETE DECK. Suspend from open web steel joists, beams or channels or provide secondary support systems spanning between structural members. Where secondary support systems are utilized, submit shop drawings signed and sealed by member of Professional Engineers of Ontario (PEO).

.6 Lay out center line of ceiling both ways, to provide balanced borders at room perimeter with border units not less than 50% of standard unit width and according to reflected ceiling plan.

.7 Lay out center line of ceiling both ways, to provide balanced borders at room perimeter with border units not less than 50% of standard unit width and according to reflected ceiling plan. Match location of existing suspension system wherever possible.

.8 Install wall mould to provide correct ceiling height.

.9 Completed suspension system to support super- imposed loads, such as lighting fixtures diffusers grilles and speakers.

.10 Support at light fixtures and diffusers with additional ceiling suspension hangers within 150mm of each corner and at maximum 600mm around perimeter of fixture.

.11 Interlock cross member to main runner to provide rigid assembly.

.12 Frame at openings for light fixtures, air diffusers, speakers and at changes in ceiling heights.

.13 Install access splines to provide 10 percent ceiling access.

.14 Finished ceiling system to be square with adjoining walls and level within 1:1000.

3.2 Cleaning

.1 Touch up scratches, abrasions, voids and other defects in painted surfaces.

PART 1 - GENERAL

1.1 References

.1 Canadian Standards Association (CSA)
.1 CSA B111-1974, Wire Nails, Spikes and Staples.

.2 Canadian General Standards Board (CGSB)
.1 CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet, for Use in Building Construction.
.2 CAN/CGSB-92.1-M89, Sound Absorptive Prefabricated Acoustical Units.

.3 Underwriters Laboratories of Canada (ULC)
.1 CAN/ULC-S102-M88, Surface Burning Characteristics of Building Materials.

1.2 Environmental Conditions

.1 Permit wet work to dry before commencement of installation.

.2 Maintain uniform minimum temperature of 15°C and humidity of 20 - 40% before and during installation.

.3 Store materials in work area 48 hours prior to installation.

1.3 Maintenance Materials

.4 Provide maintenance materials in accordance with Section 01001.

.5 Provide acoustical units amounting to 2% of gross ceiling area for each pattern and type required for project.

.6 Materials to be same production run as installed materials.

PART 2 - PRODUCTS

2.1 Materials

.1 Acoustic units for suspended ceiling system as manufacturered by Armstrong World Industries Canada Ltd.: to CAN/CGSB-92.1-M89.
- .1 Type Minaboard/Fireguard or approved equal.
- .2 Pattern Cortega.
- .3 Flame spread rating of 25 or less.
- .4 Noise reduction coefficient (NRC) designation of -.65.
- .5 Light reflectance range of min.75.
- .6 Edge type square.
- .7 Colour white.
- .8 Size 610 x 1220 x 16 mm thick.
- .9 Shape flat.

.2 Adhesive: type recommended by acoustic unit manufacturer.

.3 Staples, nails and screws: to CSA B111-1974 non-corrosive finish as recommended by acoustic unit manufacturer.

.4 Polyethylene: to CAN/CGSB-51.33-M89, Type 2, 0.15 mm thick.

.5 Hold down clips: purpose made clips to secure tile to suspension system, approved for use in fire-rated systems.

PART 3 - EXECUTION

3.1 Installation

.1 Do not install acoustical panels and tiles until work above ceiling has been inspected by Consultant.

.2 Co-ordinate ceiling work to accommodate components of other sections, such as light fixtures, diffusers, speakers, sprinkler heads, to be built into acoustical ceiling components.

.3 Provide light fixture protection boxes in accordance with applicable ULC Design.

3.2 Suspension System

.1 Install acoustical panels and tiles in ceiling suspension system.

3.3 Interface With Other Work

.1 Co-ordinate ceiling work to accommodate components of other sections, such as light fixtures, diffusers, speakers, sprinkler heads, to be built into acoustical ceiling components.

PART 1 - GENERAL

1.1 References

.1 CSA A126.3-M84 Sheet Vinyl Flooring Products.

.2 CAN/CSA-A126.5-M87 Resilient Wall Base.

1.2 Samples

.1 Submit samples in accordance with Section 01300 - Submittals.

.2 Submit duplicate 300 x 300 mm sample pieces of sheet material, 300 mm long base, feature strips, edge strips.

1.3 Maintenance Data

.1 Provide maintenance data for resilient flooring for incorporation into manual.

1.4 Maintenance Materials

.1 Provide maintenance materials in accordance with Section 01750 - Spare Parts and Maintenance Materials.

.2 Deliver 10 m^2 of each colour, pattern and type flooring material required for project for maintenance use. Identify each roll. Store where directed.

.3 Maintenance materials to be in one piece and same production run as installed materials.

1.5 Environmental Requirements

.1 Maintain air temperature and structural base temperature at flooring installation area above 20°C for 48 hours before, during and 48 hours after installation.

PART 2 - PRODUCTS

2.1 Materials

.1 Vinyl composition tile: to CSA A126.1-M84 Type A plain, 3.0 mm thick, 300 x 300 mm size selected by Consultant from manufacturer's standard and premium range.

.2 Accent vinyl composition tile: to CSA A126.1-M84 Type A plain, 3.0 mm thick, 300 x 300 mm size in colour selected by Consultant from manufacturer's standard and premium range. Accent tile to be provided in pattern of one tile every fourth tile both ways centred on room or in alternate pattern to be provided by Consultant at a later date.

.3 Commercial luxury vinyl tile: to CSA A126.1-M84 Type A plain, 4.5 mm thick, with attached sound choice accoustical backing, level set colloection, 500mm x 500mm size or 250mm x 1000mm or approved equal in colour selected by Consultant from manufacturer's standard and premium range.

.4 Resilient base: CAN/CSA-A126.5-M87, continuous, top set, complete with premoulded end stops and external corners, Johnsonite, Amtico or approved equal:

.1 Type: 3-vinyl

.2 Style: A-straight B-cove.

.3 Thickness: 3.17 mm.

.4 Height: 101.6 mm.

.5 Lengths: coils 3650 mm.

.6 Colour: as selected by Consultant from manufacturer's standard and premium range.

.5 Primers and adhesives: waterproof, of types recommended by resilient flooring manufacturer for specific material on applicable substrate, above, on or below grade.

.6 Sub-floor filler and leveller: white premix latex requiring water only to produce cementitious paste or 2 part latex-type filler requiring

no water as recommended by flooring manufacturer for use with their product.

.7 Metal edge strips: aluminum extruded, smooth, mill finish with lip to extend under floor finish, shoulder flush with top of adjacent floor finish.

.8 Sealer and wax: sealing and waxing of floors in accordance with Section 017700 Article 1.8.

2.2 Acceptable Manufacturers

.1 VCT products in accordance with this specification by only the following manufacturers will be accepted.
- .1 Armstrong
- .2 Mannington
- .3 Flextile

.2 Safety sheet flooring products in accordance with this specification by only the following manufacturers will be accepted.
- .1 Altro
- .2 Polyflor
- .3 Gerflor
- .4 Johnsonite
- .5 Armstrong
- .6 Amtico

.3 LVT products in accordance with this specification by only the following manufacturers will be accepted.
- .1 Interface Inc.
- .2 Armstrong
- .3 Mannington.

PART 3 - EXECUTION

3.1 Inspection

.1 Ensure concrete floors are dry by using test methods recommended by flooring manufacturer.

.2 Testing for concrete moisture content paid for by the Owner in accordance with Section 01 45 00 Quality Control.

3.2 Sub-floor Treatment

.1 Remove sub-floor ridges and bumps. Fill low spots, cracks, joints, holes and other defects with sub-floor filler.

.2 Clean floor and apply filler; trowel and float to leave smooth, flat hard surface. Prohibit traffic until filler cured and dry.

.3 Seal concrete slab to resilient flooring manufacturer's printed instructions.

3.3 Tile Application

.1 Apply adhesive uniformly using recommended trowel in accordance with flooring manufacturer's instructions. Do not spread more adhesive than can be covered by flooring before initial set takes place.

.2 Lay flooring with joints parallel to building lines to produce symmetrical tile pattern. Border tiles minimum half tile width.

.3 Install flooring to ashlar pattern with all joints aligned.

.4 Lay-out patterns as applicable for review and approval of Consultant. Submit layout drawing indicating patterns.

.5 As installation progresses, and after installation, roll flooring in 2 directions with 45 kg minimum roller to ensure full adhesion.

.6 Cut tile and fit neatly around fixed objects.

.7 Install feature strips and floor markings where indicated. Fit joints tightly.

.8 Install flooring in pan type floor access covers. Maintain floor pattern.

.9 Continue flooring through areas to receive movable type partitions without interrupting floor pattern.

.10 Terminate flooring at centerline of door in openings where adjacent floor finish or colour is dissimilar.

.11 Install metal edge strips at unprotected or exposed edges where flooring terminates.

3.4 Sheet Flooring Application

.1 Apply adhesive uniformly using recommended trowel. Do not spread more adhesive than can be covered by flooring before initial set takes place.

.2 Lay flooring with seams parallel to building lines to produce a minimum number of seams. Border widths minimum 1/3 width of full material.

.3 Run sheets in direction of traffic. Double cut sheet joints and continuously seal according to manufacturer's printed instructions.

.4 As installation progresses, and after installation roll flooring with roller of weight to manufacturer's recoomendations to ensure full adhesion.

.5 Cut flooring neatly around fixed objects.

.6 Install feature strips and floor markings where indicated. Fit joints tightly.

.7 Install flooring in pan type floor access covers. Maintain floor pattern.

.8 Continue flooring over areas which will be under built-in furniture.

.9 Continue flooring thorugh areas to receive movable type partitions without interrupting floor pattern

.10 Terminate flooring at centreline of door in openings where adjacent floor finish or colour is dissimilar.

.11 Install metal edge strips at unprotected or exposed edges where flooring terminates.

3.5 Base Application

.1 Lay out base to keep number of joints at minimum.

.2 Set base in adhesive tightly by using 3 kg hand roller, against wall and floor surfaces.

.3 Install straight and level to variation of 1:1000.

.4 Scribe and fit to door frames and other obstructions. Use premoulded end pieces at flush door frames.

.5 Cope internal corners. Use premoulded corner units for right angle external corners. Use formed straight base material for external corners of other angles.

.6 Use toeless type base where floor finish will be carpet, coved type elsewhere.

.7 Install toeless type base before installation of carpet on floors.

.8 Heat weld linoleum base in accordance with manufacturer's printed instructions.

3.6 Initial Cleaning and Waxing

.1 Remove excess adhesive from floor, base and wall surfaces without damage.

.2 Broom clean completed work. Wet mopping, sealing and waxing to be performed in accordance with Section 01700 Article 1.8.

3.7 Protection of Finished Work

.1 Protect new floors from time of final set of adhesive until final inspection.

.2 Prohibit traffic on floor for 48 hours after installation.

PART 1 - GENERAL

1.1 References

.1 American Society for Testing and Materials (ASTM)
- .1 ASTM D 3960-02 93 , Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings.

.2 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB-1.36-M97 97 , General Purpose Interior Varnish.
- .2 CAN/CGSB-1.38-2000 M91 , Interior Enamel Undercoater.
- .3 CGSB 1-GP-48M 78 , Primer, Marine, for Steel.
- .4 CAN/CGSB-1.57-96 96 , Alkyd, Interior, Semigloss, Enamel.
- .5 CAN/CGSB-1.60-97 97 , Interior Alkyd Gloss Enamel.
- .6 CAN/CGSB-1.68-M91 M91 , Solvent Type Primer-Sealer for Interior Walls.
- .7 CAN/CGSB-1.73-97 97 , Exterior and Interior Enamel for Floors.
- .8 CAN/CGSB-1.100-99 95 , Interior Latex Type, Flat Paint.
- .9 CAN/CGSB-1.102-M89 M89 , Clear Alkyd Type Sealer.
- .10 CAN/CGSB-1.118-95 95 , Interior Alkyd, Flat Finish.
- .11 CAN/CGSB-1.119-2000 95 , Primer-Sealer, Wall, Interior Latex Type.
- .12 CAN/CGSB-1.121-93 93 , Vinyl Pretreatment Coating for Metals (Vinyl Wash Primer).
- .13 CAN/CGSB-1.126-M91 M91 , Vinyl Sealer for Wood.
- .14 CAN/CGSB-1.143-98 M90 , Heat Resistant Aluminum Enamel, Silicone Alkyd.
- .15 CAN/CGSB-1.145-97 97 , Solvent-Based Pigmented Stain.
- .16 CAN/CGSB-1.146-99 92 , Cold Curing, Gloss Epoxy Coating.
- .17 CAN/CGSB-1.150-M91 M91 , Clear Lacquer for Wood Furniture.
- .18 CAN/CGSB-1.153-2000 M90 , High Build, Gloss, Epoxy Coating.
- .19 CAN/CGSB-1.165-M89 M89 , Cold Curing Epoxy Primer.
- .20 CAN/CGSB-1.175-97 97 , Polyurethane Interior Coating, Oil Modified, Clear, Gloss and Satin.
- .21 CGSB 1-GP-180Ma 96 , Coating, Polyurethane, Two-Package, General Purpose.
- .22 CAN/CGSB-1.188-96 96 , Emulsion Type Filler Masonry Block.
- .23 CGSB 1-GP-193Ma 83 , Coating, High-Build Epoxy, Marine.
- .24 CAN/CGSB-1.195-99 95 , Interior Semigloss Latex Paint.
- .25 CAN/CGSB-1.198-2001 95 , Cementitious Primer (for Galvanized Surfaces).
- .26 CAN/CGSB-1.202-96 96 , Interior Low Gloss Alkyd Enamel.
- .27 CAN/CGSB-1.209-93 93 , Low Sheen Latex Interior Paint.
- .28 CGSB 85-GP-1M 78 , Painting (New) Exterior Wooden Surfaces.
- .29 CGSB 85-GP-2M 78 , Painting (Maintenance) of Exterior Painted Wooden Surfaces.
- .30 CGSB 85-GP-10M 79 , Shop Painting Structural Steel.

.31 CGSB 85-GP-11M 80 , Painting Steel for Protection Against Continuous Wetting.
.32 CGSB 85-GP-13M 80 , Painting Structural Steel for Protection Against Heavy Industrial Atmospheres.
.33 CGSB 85-GP-14M 78 , Painting Steel Surfaces Exposed to Normally Dry Weather.
.34 CGSB 85-GP-15M 78 , Painting, Maintenance, Exterior Steel Exposed to Normally Dry Weather.
.35 CGSB 85-GP-16M 79 , Painting Galvanized Steel.
.36 CGSB 85-GP-18M 80 , Painting, Maintenance, Exterior, Steel, for Protection Against Continuous Wetting.
.37 CGSB 85-GP-20M 79 , Painting copper and Copper Alloys.
.38 CGSB 85-GP-31M 79 , Painting Stucco, Masonry and Brick Surfaces.
.39 CGSB 85-GP-32M 79 , Painting Concrete Floors.
.40 CGSB 85-GP-33M 79 , Painting Interior Plaster and Wallboard.
.41 CAN/CGSB-85.100-93 93 , Painting.

.3 Canadian Painting Contractors' Association (CPCA).
.1 Painting Specifications Manual 1993 .

.4 Canadian Standards Association (CSA)
.1 CSA Z760-94 94 , Life Cycle Assessment.

.5 Environmental Choice Program (ECP)
.1 ECP-67- 95 , Recycled Water-Borne Surface Coatings.
.2 ECP-76- 98 , Surface Coatings.

.6 Environmental Protection Agency (EPA)
.1 EPA-SW-846, Test Methods for Evaluating Solid Wastes.

.7 International Organization for Standardization (ISO)
.1 ISO 14040/14041- 1997 , Environmental Management - Life Cycle Assessment.

.8 National Fire Code of Canada 1995 .

.9 Steel Structures Painting Council (SSPC).
.1 Systems and Specifications Manual 1989

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1.2 Product Data

.1 Submit product data in accordance with Section 01340.

.2 Submit full records of all products used. List each product in relation to finish formula and include the following:
.1 Finish formula designation.
.2 Product type and use.
.3 CGSB number.

.4 Manufacturer's product number.
.5 Colour number s .
.6 Manufacturer's Material Safety Data Sheets (MSDS).
.7 Maximum VOC classification.
.8 Eco-Logo certification.

.3 Submit manufacturer's installation and application instructions for each product specified.

1.3 Samples

.1 Submit samples in accordance with Section 01340.

.2 Submit duplicate 300 x 200 mm sample panels of each paint.

.3 Submit full range of available colours where colour availability is restricted.

.4 Use 3 mm plate steel for finishes over metal surfaces. Use 12.5 mm birchplywood for finishes over wood surfaces. Use 50 mm concrete block for finishes over concrete or concrete masonry surfaces. Use 12.5 mm gypsum board for finishes over gypsum board and other smooth surfaces.

1.4 Submittals

.1 Within a period of 30 days after award of Contract, and before any paint materials are delivered to the job site, submit to the Owner a complete list of all materials proposed to be furnished and installed under this portion of the work including a letter as to the name of the paint manufacturer proposed for the work.

.2 This shall in no way be construed as permitting substitution of materials for those specified or approved for this work by the Consultant.

.3 Accompanying the materials' list, submit to the Consultant two copies of the full range of colours available in each of the proposed products.

.4 After the award of Contract, the Consultant will prepare and issue a Colour Schedule. This Schedule is guidance for the painter in the preparation of samples of colour and finish. The Painter shall not purchase materials on the basis of the Colour Schedule.

.5 Upon receipt of the Colour Schedule, provide materials and prepare samples indicating colours and degree of gloss. The samples shall be submitted on gypsum board, 600 mm square for those areas where the paint is to be applied to a smooth

finished surface and on Celotex board, 600 mm square where paint is to be applied on finished masonry.

.6 Meet with the Consultant to consider the samples which will be inspected under the conditions and in the areas to which the colours and finishes are to be applied. Modify the colours as often as may be required for the Consultant's final approval. Upon final approval, the Painter will be authorized to proceed with the purchase of the materials.

.7 The samples shall be clearly identified and will be maintained clean and in good condition at the site. Upon receipt of such factory pre-mixed paints as purchased by the Painter, he will satisfy himself that the materials in sealed containers matches precisely the samples which have been approved before applying same to the appropriate surfaces.

.8 Upon commencement of the Work, sample rooms shall be prepared with base and finish coats as specified. This Work shall be executed in the presence of the paint manufacturer's representative to ensure that the materials are applied at the proper coverages. It shall be the responsibility of this trade contractor to advise the paint manufacturer and the Consultant in writing as to time and date which this work will be performed. Sample rooms and finishes when approved shall be a standard for comparison for the remainder of the work. Work subsequently executed which in the Consultant's or paint manufacturer's opinion does not equal the sample finishes, shall be corrected as may be necessary by the painter without additional charge.

.9 Maintenance Materials: Provide 2% additional matching paint of each type and colour used on project for maintenance purposes. Turn over to General Contractor and obtain receipt.

1.5 Quality Assurance

.1 Use only qualified painters for the mixing and application of paint on exposed surfaces. In the acceptance or rejection painting work, no allowance will be made for lack of skill on the part of painters.

.2 Retain purchase orders, invoices and other documents to prove that all materials utilized in this contract meet requirements of the specifications. Produce documents when requested by Consultant.

.3 Standard of Acceptance:

.1 Walls: No defects visible from a distance of 1000 mm at 90 degrees to surface.

.2 Ceilings: No defects visible from floor at 45 degrees to surface when viewed using final lighting source.

.3 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.

1.6 Delivery, Storage and Handling

.1 Deliver and store materials in original containers, sealed, with labels intact.

.2 Indicate on containers or wrappings:
- .1 Manufacturer's name and address.
- .2 Type of paint.
- .3 Compliance with applicable standard.
- .4 Colour number in accordance with established colour schedule.

.3 Remove damaged, opened and rejected materials from site.

.4 Provide and maintain dry, temperature controlled, secure storage.

.5 Observe manufacturer's recommendations for storage and handling.

.6 Store materials and supplies away from heat generating devices. Use all means necessary to ensure the safe storage and use of paint materials and the prompt and safe disposal of waste. Safeguards to be taken at all times to prevent fire from improperly stored rags, thinners and paints.

.7 Use all means necessary to protect materials before, during and after application to protect the installed work and materials of all other trades.

.8 Store materials and equipment in a well ventilated area with temperature range 7 to 30 °C.

.9 Store temperature sensitive products above minimum temperature as recommended by manufacturer.

.10 Keep areas used for storage, cleaning and preparation, clean and orderly to approval of Consultant. After completion of operations, return areas to clean condition to approval of Consultant.

.11 Store only the approved materials at the job site, and store only in a suitable and designated area restricted to the storage of paint materials and related equipment. Provide adequate protection to walls and floors. In the event of damage, immediately make all repairs and replacements necessary to the approval of the Owner and at no additional cost to the Owner.

.12 Provide minimum one 9 kg Type ABC dry chemical fire extinguisher adjacent to storage area.

.13 Remove only in quantities required for same day use.

.14 Fire Safety Requirements:

.1 Store oily rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.

.2 Handle, store, use and dispose of flammable and combustible materials in accordance with the National Fire Code of Canada.

1.7 Environmental Requirements

.1 Ventilation:

.1 Provide continuous ventilation during and after application of paint. Run ventilation system 24 hours per day during installation; provide continuous ventilation for 7 days after completion of application of paint.

.2 Apply paint finishes only when temperature at location of installation can be satisfactorily maintained within manufacturer's recommendations.

.3 Substrate and ambient temperature must be within limits prescribed in paint standard and by manufacturer to approval of Consultant.

.4 Maintain minimum substrate and ambient air temperature of 5°C for Alkyd and 7°C for latex paints. Maximum relative humidity 85%. Maintain supplemental heating until paint has cured sufficiently.

.5 Moisture Content:

.1 Check moisture content of substrates to be painted using electronic moisture meter or other approved method. Maximum moisture content shall be:

.1 Concrete and Concrete Masonry: Maximum 12% for solvent coatings and as recommended by manufacturer for water based coatings.

.2 Gypsum Board and Plaster: Maximum 12%.

.3 Wood: Maximum 15%.

.6 Provide temporary heating where permanent facilities are not available to maintain minimum recommended temperatures.

.7 Apply paint finish only in areas where dust is no longer being generated by related construction operations such that airborne particles will not affect the quality of the finished surface.

.8 Apply paint only when surface to be painted is dry, properly cured and adequately prepared.

.9 Painting in occupied facilities to be carried out during silent hours only. Schedule operations to approval of Consultant such that painted surfaces will have dried and cured sufficiently before occupants are affected.

.10 Provide minimum 270 lx on surfaces to be painted.

1.8 Scheduling

.1 Submit work schedule for various stages of painting to Consultant for approval. Submit schedule minimum of 48 hours in advance of proposed operations.

.2 Obtain written authorization from Consultant for any changes in work schedule.

.3 Schedule painting operations to prevent disruption of occupants in and about the building.

1.9 Extra Materials

.1 Submit maintenance materials.

.2 Submit one - four litre can of each type and colour of primer finish coating . Identify colour and paint type in relation to established colour schedule and finish formula.

.3 Deliver to Owner and store where directed.

1.10 Waste Management

.1 Place materials defined as hazardous or toxic waste, including used sealant and adhesive tubes and containers, in containers or areas designated for hazardous waste.

.2 Return solvent and oil soaked rags for contaminant recovery and laundering or for proper disposal.

.3 Close and seal tightly all partly used sealant and adhesive containers and store protected in well ventilated fire-safe area at moderate temperature.

.4 Do not dispose of paints or solvents by pouring on the ground. Place in designated containers and ensure proper disposal.

.5 Solvent based paints, wood preservatives, stains and finishes which cannot be reused must be treated as hazardous waste and

disposed of in an appropriate manner in accordance with hazardous waste regulations. Empty paint cans are to be dry prior to disposal or recycling (where available).

.6 Where paint recycling is available, collect all waste paint by type and provide for delivery to recycling or collection facility.

.7 Paints, stains, and finishes are regarded as hazardous products and are subject to regulations for disposal. Information on these controls can be obtained from the Provincial Ministries of Environment and Regional levels of Government.

PART 2 - PRODUCTS

2.1 Materials

.1 Qualified products: only paint materials listed on the CGSB Qualified Products List are acceptable for use on this project.

.2 Top line paints, or approved equal, of each of the individual companies listed below may be used:
- .1 Benjamin Moore Paints
- .2 Para Paints
- .3 Crown Diamond Company
- .4 Pratt and Lambert Inc.
- .5 Sherwin-Williams Company of Canada Limited
- .6 Colour Your World
- .7 The Glidden Company (Canada)
- .8 PPG Canada Inc.

.3 All products shall be applied to minimum thickness as recommended by the manufacturer and C.G.S.B. Where exact finish coat is not listed, consult supplier's specification sheet.

.4 Paint materials for each coating formula to be products of a single manufacturer.

.5 Low odour products: Whenever possible, select products exhibiting low odour characteristics. If two products are otherwise equivalent, select the product with the lowest odour.

.6 Water-borne surface coatings must:
- .1 Meet or exceed all applicable governmental and/or industrial safety and performance standards.
- .2 Manufactured and transported in such a manner that all steps of the process, including the disposal of waste products arising therefrom, will meet the requirements of all applicable governmental acts, by-laws and regulations including, for

facilities located in Canada, the Fisheries Act and the Canadian Environmental Protection Act (CEPA).

.7 Water-borne surface coatings must not be formulated or manufactured with: aromatic solvents, formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavelant chromium or their compounds.

.8 Water-borne surface coatings and recycled water-borne surface coatings must have a flash point of 61.0 °C or greater.

.9 Both water-borne surface coatings and recycled water-borne surface coatings must be made by a process that does not release:
.1 Matter in the undiluted production plant effluent generating a 'Biochemical Oxygen Demand' (BOD) in excess of 15 mg/L to a natural watercourse or a sewage treatment facility lacking secondary treatment.
.2 Total Suspended Solids (TSS) in the undiluted production plant effluent in excess of 15 mg/L to a natural watercourse or

a
sewage treatment facility lacking secondary treatment.

.10 Water-borne surface coatings and recycled water-borne surface coatings must contain information describing proper disposal methods within their packaging.

.11 Water-borne paints and stains and recycled water-borne surface coatings must not contain VOCs in excess of 250 g/L as determined by ASTM D 3960-02.

.12 Water-borne varnishes must not contain VOCs in excess of 300 g/L.

.13 Recycled water-borne surface coatings must contain 50 % post-consumer material by volume.

.14 Recycled water-borne surface coatings must not contain:
.1 Lead in excess of 600.0 ppm weight/weight total solids.
.2 Mercury in excess of 50.0 ppm weight/weight total product.
.3 Cadmium in excess of 1.0 ppm weight/weight total product.
.4 Hexavelant chromium in excess of 3.0 ppm weight/weight total product.
.5 Organochlorines or polychlorinated biphenyls (PCBS) in excess of 1.0 ppm weight/weight total product.

.15 The following must be performed on each batch of consolidated post-consumer material before the surface coating is reformulated and canned. These tests must be performed at a

laboratory or facility which has been accredited by the Standards Council of Canada.
.1 Lead, cadmium and chromium are to be determined using ICP-AES (Inductively Coupled Plasma - Atomic Emission Spectroscopy) technique no. 6010 as defined in EPA SW-846.
.2 Mercury is to be determined by Cold Vapour Atomic Absorption Spectroscopy using Technique no. 7471 as defined in EPA SW-846.
.3 Organochlorines and PCBs are to be determined by Gas Chromatography using Technique no. 8081 as defined in EPA SW-846.

.16 The manufacturing process must adhere to Lifecycle Assessment Standards as per ISO 14040/14041 , CSA Z760-94 .

2.2 Colours

.1 Consultant will provide Colour Schedule after contract award.

.2 Colour schedule will be based upon the selection of five base colours and three accent colours. No more than eight colours will be selected for the entire project and no more than three colours will be selected in each area.

.3 Selection of colours will be from manufacturers full range of colours.

.4 Where specific products are available in a restricted range of colours, selection will be based on the limited range.

.5 Perform all colour tinting operations prior to delivery of paint to site. On-site tinting of painting materials allowed only with Consultant's written permission.

.6 Second coat in a three coat system to be tinted slightly lighter colour than top coat to show visible difference between coats.

2.3 Paint Finishes

.1 Exterior Metal:
- .1 Galvanized:
  - .1 1 coat Galvanized Metal Primer
  - .2 2 coats acrylic latex enamel
- .2 Structural Iron and Steel:
  - .1 1 coat Rust Inhibitive Paint
  - .2 2 coats acrylic latex enamel
- .3 Aluminum:
  - .1 1 coat Rust Inhibitive Paint
  - .2 2 coats acrylic Latex enamel

.2 Interior Metal:
.1 Galvanized:
.1 1 coat Galvanized Metal Primer
.2 2 coats alkyd enamel
.2 Structural Iron and Steel:
.1 1 coat Rust Inhibitive Paint
.2 2 coats alkyd enamel

.3 Wood:
.1 Paint:
.1 1 coat Latex Enamel Underbody
.2 2 coats acrylic latex enamel
.2 Natural - Opened Grained Woods
.1 1 coat Paste Wood Filler
.2 2 coats Urethane Satin Finish
.3 Natural - Close Grained Woods
.1 3 coats Urethane Satin Finish
.4 Stained - Open Grained Woods
.1 1 coat Paste Wood Filler Tinted with Stain
.2 2 coats Urethane Satin Finish
.5 Stained - Close Grained Woods
.1 1 coat Interior Stain
.2 2 coats Urethane Satin Finish

.4 Interior Gypsum Board:
.1 Primer:
.1 1 coat latex primer
.2 Paint:
.1 1 coat latex primer
.2 2 coats acrylic latex
.3 Epoxy:
.1 1 coat latex primer
.2 2 coats 2-component Waterborne Acrylic Epoxy Enamel

.5 Interior Masonry:
.1 Primer:
.1 1 coat block Filler and primer
.2 Paint:
.1 1 coat block Filler and primer
.2 2 coats alkyd enamel
.3 Epoxy:
.1 2 coats Block Filler and primer
.2 2 coats 2-component Waterborne Acrylic Epoxy Enamel

.6 Interior Concrete:
.1 Paint (Floors):
.1 1 coat concrete floor enamel, thinner as recommended by manufacturer
.2 2 coats floor enamel

2.4 Substitution of Materials

.1 The Consultant reserves the right to interchange finishes called for in regard to Sealer, Primer, Stain, Paint, etc. without an additional labour cost for application of the item. An extra charge for the difference in material cost would be considered.

PART 3 - EXECUTION

3.1 General

.1 Perform all painting operations in accordance with CAN/CGSB-85.100-93 except where specified otherwise.

.2 Apply all paint materials in accordance with paint manufacturer's written application instructions.

.3 Paint or otherwise finish surfaces of building materials, building services and building accessories not otherwise protected or covered, as shown on Room Finish and Door Schedules, Drawings and as specified herein.

.4 In addition, and unless otherwise specified, all work which is exposed to view and which is not prefinished shall be finished by this Section.

.5 In areas specifically designated as "unfinished", painting is not required except for bare, primed and zinc coated metal surfaces and insulated ductwork and pipes.

.6 Where exposed to view paint bare metals, previously primed metals and zinc coated metals unless specified otherwise.

.7 Paint behind surface mounted fixtures on walls and ceilings with full coats of paint.

.8 Paint walls behind wall mounted heating units with full coats of paint.

.9 Paint inside surfaces of light coves white.

.10 Finish tops of doors, trim, projections and other work as specified for surrounding work whether above sight lines or not.

.11 Paint piping, ducts and conduit in colours matching background wall or ceiling colours, unless otherwise directed by Consultant. Ducts in mechanical rooms require only one finish coat in addition to primer. Other exposed ductwork to receive two finish coats.

.12 Unless specifically indicated on Drawings to be painted, all finish carpentry work shall receive transparent finish.

.13 Paint shall be applied by means of brushes except for wall and ceiling surfaces on which the paint shall be applied by rollers. Spray painting will be permitted for ceilings only and must be done outside normal working hours.

.14 Paint shall not be applied in rooms or areas where dust, dirt and debris are present. Cleaning is to be carried out by others to the approval of this trade before the work is commenced.

.15 Regardless of the number of coats specified for any surface, apply sufficient paint to completely cover and hide substrate and to produce solid, uniform appearance.

.16 Where two or more coats of the same paint are to be applied, undercoats shall be tinted in lighter shades of final coat to differentiate from final coat.

.17 Following completion of painting in each area, promptly reinstall all items removed for painting, using only workmen skilled in the particular trade.

.18 Previously Painted Items: When items to receive paint have been previously painted, lightly sand surface and touch up any defective areas with primer. Apply two coats of finish
compatible with existing paint. Paint surfaces to be touched up 'break to break'.

3.2 Inspection

.1 Condition of Surfaces:

.1 Check all surfaces with electric moisture meter and do not proceed if reading is higher than 12-15 without written permission of the Consultant.

.2 Proceed with work only when surfaces and conditions are satisfactory for production of a first class job.

.3 Remove dust, grease, rust and extraneous matter from all surfaces (except that rust occurring on items specified to be primed under other Sections shall be removed and work reprimed under those Sections).

.4 Fine sand all surfaces before starting work of this trade, after filler or primer is applied and between finish coats, where required, so as to eliminate all roughness.
Previously painted surfaces to be fine sanded.

.5 Painting shall not be undertaken at temperatures under 10 degrees C, or on surfaces where condensation has or will form due to presence of high humidity and lack of proper ventilation, or under dusty conditions.

3.3 Preparation

.1 Remove electrical cover plates, light fixtures, surface hardware on doors, door stops, bath accessories and all other surface mounted fittings and fastenings prior to undertaking any painting operations. Store for re-installation after painting is completed.

.2 Move and cover furniture and portable equipment as necessary to carry out painting operations. Replace as painting operations progress.

.3 As painting operations progress, place "WET PAINT" signs in occupied areas to approval of Consultant.

.4 Prime all caulked areas before painting.

3.4 Protection

.1 Provide metal pans or adequate tarpaulin to protect floors in areas assigned for the storage and mixing of paints.

.2 Use sufficient drop cloths and protective coverings for the full protection of floors, furnishings and work not being painted.

.3 Leave above areas clean and free from evidence of occupancy upon completion of painting.

.4 Protect paint materials from fire and freezing.

.5 Keep waste rags in metal drums containing water and remove from building at end of each working shift.

.6 Protect existing building surfaces not to be painted from paint spatters, markings and other damage. If damaged, clean and restore such surfaces as directed by Consultant.

.7 Cover or mask floors, windows and other ornamental hardware adjacent to areas being painted to prevent damage and to protect from paint drops and splatters. Use non-staining coverings.

.8 Protect items that are permanently attached such as Fire Labels on doors and frames.

.9 Protect factory finished products and equipment.

.10 Protect passing pedestrians, building occupants and the general public in and about the building.

3.5 Existing Conditions

.1 Investigate existing substrates for problems related to proper and complete preparation of surfaces to be painted. Report to Engineer all damage, defects, unsatisfactory or unfavourable conditions before proceeding with work.

.2 Investigate moisture content of surfaces to be painted and report findings to Engineer. Do not proceed with work until conditions fall within acceptable range as recommended by manufacturer.

.3 Maximum moisture content as follows:
- .1 Plaster and wallboard: 12%.
- .2 Masonry/Concrete: 12%.
- .3 Concrete Block/Brick: 12%.
- .4 Wood: 15%.

3.6 Cleaning

.1 Clean all surfaces to be painted as follows:
- .1 Remove all dust, dirt, and other surface debris by vacuuming, wiping with dry, clean cloths or compressed air .
- .2 Wash surfaces with solution of T.S.P. bleachand clean warm water using a stiff bristle brush to remove dirt, oil and other surface contaminants.
- .3 Rinse scrubbed surfaces with clean water until foreign matter is flushed from surface.
- .4 Allow surfaces to drain completely and allow to dry thoroughly.
- .5 To prepare surfaces for water-based painting, water-based cleaners should be used in place of organic solvents.
- .6 Use trigger operated spray nozzles for water hoses.
- .7 Many water-based paints cannot be removed with water once dried. However, minimize the use of kerosene or any such organic solvents to clean up water-based paints.

.2 Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before prime coat is applied and between applications of remaining coats. Apply primer, paint, or pretreatment as soon as possible after cleaning and before deterioration occurs.

.3 Sand existing surfaces with intact, smooth, high gloss coatings to provide adequate adhesion for new finishes.

3.7 Surface Preparation

.1 Prepare new wood surfaces to CGSB 85-GP-1M.

.2 Where possible, prime all surfaces of new wood surfaces before installation. Use same primers as specified for exposed surfaces.

.3 Prepare previously painted wood surfaces to CGSB 85-GP-2M.
.1 Apply vinyl sealer to CAN/CGSB-1.126-M91 over knots, pitch, sap and resinous areas.
.2 Apply wood filler to nail holes and cracks.
.3 Tint filler to match stains for stained woodwork.

.4 Prepare stucco, brick, concrete masonry and concrete surfaces to CGSB 85-GP-31M.

.5 Prepare concrete floors to CGSB 85-GP-32M. Prepare new concrete floor by acid etching. Rinse with clean water and thoroughly dry.

.6 Prepare plaster and wallboard surfaces to CGSB 85-GP-33M.

3.8 Surface Preparation -Concrete

.1 Test surfaces for alkalinity with pink litmus paper or other recognized methods.

.2 Where extreme alkalinity occurs, wash surfaces with 4% solution tetrapotassium pyrophosphate (5 oz. per gallon of water) where latex base paint is to be used, and with zinc sulphate solution (3 lbs. per gallon water) where other paint bases are to be used.

.3 Etch normal concrete surfaces to receive alkyd paint with muriatic acid solution (1 part commercial 31.45% to 3 parts water).

3.9 Surface Preparation -Gypsum Board

.1 Gypsum board shall be bone-dry and all patching complete before the first coat of paint is applied. Surfaces shall be inspected, all "hot spots" properly treated and all rough areas sanded smooth.

3.10 Surface Preparation - Woodwork

.1 Sand smooth all woodwork to be finished and clean surfaces free of dust before applying first coat. With painted woodwork, fill nail holes, splits and scratches with non-shrinking filler after first coat is dry. When these blemishes occur on woodwork surface to receive transparent finish, use putty tinted to match local grain condition. Between coats, sand lightly with No. 00 sandpaper and remove dust.

3.11 Surface Preparation -Metal

.1 Clean new metal surfaces to be painted by: removing rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with the following:
.1 Solvent cleaning: SSPC-SP-1.
.2 Hand tool cleaning: SSPC-SP-2.
.3 Power tool cleaning: SSPC-SP-3.
.4 Commercial blast cleaning: SSPC-SP-6.
.5 Brush-off blast cleaning: SSPC-SP-7.

.2 Clean existing metal surfaces to be repainted by: removing loose, cracked, brittle or non-adherent paint, rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with following:
.1 Scrape edges of old paint back to sound material. Where remaining paint is thick and sound, feather exposed edges.
.2 Commercial blast clean rusted and bare metal surfaces where existing paint system has failed.
.3 Solvent cleaning: SSPC-SP-1.
.4 Hand tool cleaning: SSPC-SP-2.
.5 Power tool cleaning: SSPC-SP-3.
.6 Commercial blast cleaning: SSPC-SP-6.
.7 Brush-off blast cleaning: SSPC-SP-7.

.3 Remove traces of blast products from surfaces, pockets and corners to be painted by brushing with clean brushes blowing with clean dry compressed air , or vacuum cleaning .

.4 Touch up shop primer to CGSB 85-GP-10M with primer as specified in applicable section. Touch-up to include cleaning and painting of field connections, welds, rivets, nuts, washers, bolts, and damaged or defective paint and rusted areas.

.5 Prepare galvanized steel and zinc coated steel surfaces to CGSB 85-GP-16M.

.6 Prepare copper and copper alloys surfaces to CGSB 85-GP-20M.

.7 Prepare new steel surfaces exposed normally to dry conditions to CGSB 85-GP-14M.

.8 Prepare previously painted steel surfaces exposed normally to dry conditions to CGSB 85-GP-15M.

.9 Prepare steel surfaces exposed to industrial environments to CGSB 85-GP-13M.

.10 Prepare steel surfaces exposed to water or high humidity levels to CGSB 85-GP-11M CGSB 85-GP-18M .

.11 Do not apply paint until prepared surfaces have been accepted by Consultant .

3.12 Mixing Paint

.1 Mix ingredients in container before and during use and ensure breaking up of lumps, complete dispersion of settled pigment, and uniform composition.

.2 Thin paint for spraying according to manufacturer's instructions. If directions are not on container, obtain instructions in writing from manufacturer and provide copy of instructions to Engineer.

.3 Do not use kerosene or any such organic solvents to thin water-based paints.

3.13 Application

.1 Method of application to be as approved by Consultant. Apply paint by brushroller air sprayer or airless sprayer . Conform to manufacturer's application instructions unless specified otherwise.

.2 Brush application.
.1 Work paint into cracks, crevices and corners. Paint surfaces not accessible to brushes by spray, daubers or sheepskins.
.2 Brush out runs and sags.
.3 Remove runs, sags and brush marks from finished work and repaint.

.3 Spray application.
.1 Provide and maintain equipment that is suitable for intended purpose, capable of properly atomizing paint to be applied, and equipped with suitable pressure regulators and gauges.
.2 Keep paint ingredients properly mixed in containers during paint application either by continuous mechanical agitation or by intermittent agitation as frequently as necessary.

.3 Apply paint in a uniform layer, with overlapping at edges of spray pattern.
.4 Brush out immediately all runs and sags.
.5 Use brushes to work paint into cracks, crevices and places which are not adequately painted by spray.

.4 Use dipping, sheepskins or daubers only when no other method is practical in places of difficult access and only when specifically authorized by Engineer.

.5 Apply each coat of paint as a continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied.

.6 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.

.7 Sand and dust between each coat to remove visible defects.

.8 Finish tops of cupboards, cabinets and projecting ledges, both above and below sight lines as specified for surrounding surfaces.

.9 Finish inside of cupboards and cabinets as specified for outside surfaces.

.10 Finish closets and alcoves as specified for adjoining rooms.

.11 Finish top, bottom, edges and cutouts of doors after fitting as specified for door surfaces.

3.14 Mechanical Electrical Equipment

.1 In finished areas: paint exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment. Colour and texture to match adjacent surfaces, except as noted otherwise.

.2 In boiler room, mechanical and electrical rooms: paint exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment.

.3 In other unfinished areas: leave exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment in original finish and touch up scratches and marks.

.4 Touch up scratches and marks on factory painted finishes and equipment with paint as supplied by manufacturer of equipment.

.5 Do not paint over nameplates.

.6 Keep sprinkler heads free of paint.

.7 Paint inside of ductwork where visible behind grilles, registers and diffusers with primer and one coat of matt black paint.

.8 Paint disconnect switches for fire alarm system and exit light systems in red enamel.

.9 Paint all fire protection piping red .

.10 Paint all natural gas piping yellow .

.11 Paint both sides and edges of backboards for telephone and electrical equipment before installation. Leave equipment in original finish except for touch-up as required, and paint conduits, mounting accessories and other unfinished items.

3.15 Restoration

.1 Clean and re-install all hardware items that were removed before undertaken painting operations.

.2 Remove protective coverings and warning signs as soon as practical after operations cease.

.3 Remove paint splashings on exposed surfaces that were not painted. Remove smears and spatter immediately as operations progress, using compatible solvent.

.4 Protect freshly completed surfaces from paint droppings and dust to approval of Consultant. Avoid scuffing newly applied paint.

.5 Restore areas used for storage, cleaning, mixing and handling of paint to clean condition as approved by Consultant.

3.16 Adjusting and Cleaning

.1 During progress of the work, do not allow the accumulation of empty containers or other excess items except in areas specifically set aside for that purpose.

.2 Prevent accidental spilling of paint materials and, in event of such spill, immediately remove all spilled material and the waste of other equipment used to clean up the spill. Wash the surfaces to their original undamaged condition, all at no additional cost to the Owner.

.3 Prior to takeover of the project by Owner, inspect work of this Section and touch-up or refinish damaged finishes and finishes unsatisfactory to Consultant.

.4 Upon completion of this portion of the work, visually inspect all surfaces and removal all paint and traces of paint from surfaces not scheduled to be painted.

END

PART 1 - GENERAL

1.1 References

.1 Aluminum Association Designation System for Aluminum Finishes - 1980.

.2 ASTM A 526/A 526M-90 526M-90 526M-90 Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Commercial Quality.

.3 CAN/CGSB-1.81-M90 Primer, Alkyd, Air Drying for Vehicles and Equipment.

.4 CAN/CGSB-1.88-92 Enamel, Alkyd, Air Drying and Baking, Gloss.

.5 CAN/CGSB-1.104-M91 Enamel, Alkyd, Air Drying and Baking, Exterior and Interior, Semigloss.

1.2 Shop Drawings

.1 Submit shop drawings in accordance with Section 01300 - Submittals.

.2 Indicate location, type, size, arrangement, hardware, anchor or mounting details, and accessories.

1.3 Maintenance Data

.1 Provide operation and maintenance data for incorporation into manual specified in Section 01730 - Operation and Maintenance Manual.

.2 Affix maintenance instruction labels to chalkboards.

PART 2 - PRODUCTS

2.1 Coat Rack

.1 Coat rack system Student Line Series 1000 Model STL 1001 as manufactured by ASI Virtural Display Products.

.1 Shelf: coat rack to consist of four 19mm O.D. square 18 guage steel tubes closed and protected with form fitting black plastic end caps.

.2 Brackets: two-piece heavy duty die cast aluminum designed with an integral backplate that provides a sure grip fastening. All screw fastenings shall colour match bracket finish.

.3 Dovetail: mounting shall be heavy gauge extruded aluminum engineered for a slide fitting vertical adjustment of one full shelf with length to suit applicable model. Spacing as per manufacturer's standard but shall not exceed 1000mm.

.4 Finish: for shelf tubes, brackets and dovetail is durable electorstatically applied Duracron in manufacturer's standard colour green.

.5 Coat Hooks: Manufacturer's standard double prong molded ABS high-impact plastic formed to be non-turning, positive gripping and adjustable. Colour to be grey. Hooks to be arranged on second and fourth t ubes of coat rack spaced 200mm and staggered.

.2 Anchor clips, brackets and fasteners: concealed type recommended by manufacturer for fixed mounting.

PART 3 - EXECUTION

3.1 Installation

.1 Install coat rack system in accordance with manufacturer's instructions, plumb and level.

3.2 Cleaning

.2 Clean surfaces after installation using manufacturer's recommended

cleaning procedures.

PART 1 - GENERAL

1.1 Design Criteria

.1 Design gymnasium equipment to comply with applicable by-laws and requirements and for applications as intended.

.2 Equipment assemblies to be structurally sound and of compatible components and capable of supporting superimposed loads without deflection detrimental to function, safety and appearance.

.3 Electrical equipment to bear certification of CSA.

.4 Basketball backstops to O.A.S.B.O. Health and Safety Committee recommendations.

1.2 Acceptable Manufacturers and Installers

.1 Products provided by Apple Athletic Products Inc. are specified, or equal.

.2 Only installers licensed and authorized by the manufacturer will be accepted.

1.3 Shop Drawings

.1 Submit shop drawings in accordance with Section 01300.

.2 Indicate size, location and description of components, materials, attachment devices and details, description of frame and finish, and construction and mounting details.

1.4 Maintenance Data

.1 Provide maintenance data complete with pertinent details, special tools, spare parts lists and warnings against harmful maintenance materials for incorporation into manual specified in Section 01730.

1.5 Systems Demonstration

.1 Upon acceptance by Owner, co-ordinate and conduct systems demonstration of Gymnasium Equipment to school staff in accordance with Section 01655.

PART 2 - PRODUCTS

2.1 Materials

.1 Gymnasium Protective Padding:

.1 Removable Wall Padding: 2'x4'x2" vertical foldable, 2" thick high density polyethylene foam core, color selected by consultant at later date, manufactured by Apple Athletic Products Inc. or equal.

PART 3 - EXECUTION

3.1 Installation

.1 Erect components plumb, level and in proper alignment.

.2 Install in accordance with manufacturer's specifications.

PART 1 GENERAL

1.1 SECTION INCLUDES

A. SS Fascia or Pocket Shade System

1.2 RELATED SECTIONS

A. Section 06100 [06 10 00] – Rough Carpentry: Blocking for support of window shade hardware.

B. Section 07900 [07 90 00] - Joint Sealers: Sealants for perimeter of shade system.

C. Section 09260 [09 21 23] - Gypsum Board Assemblies: Suspended gypsum board ceilings to contain recessed window shade pockets.

D. Section 09510 [09 51 23] - Acoustical Tile Ceilings: Suspended acoustical panel ceilings to contain recessed window shade pockets.

E. Section 09900 [09 90 00] - Painting

F. Section 15900 [23 09 00] – HVAC Instrumentation and Controls.

G. Section 16050 [26 05 19] - Low-Voltage Electrical Power Conductors and Cables" for power cables.

H. Section 16570 [26 09 33] - Architectural Lighting Controls" for lighting integration into digital shading systems.

I. Section 16575 [26 09 43] - Distributed Digital Lighting Controls" for lighting integration into digital shading systems.

1.3 REFERENCES

A. NFPA 70 - National Electrical Code; National Fire Protection Association.

B. NEMA - National Electrical Manufacturers Association

C. FCC emission standards

D. UL - Underwriters Laboratories, Inc. Listings

E. UL 2043 - Standard for Fire Test for Heat and Visible Smoke Release for Discrete Products Installed in Air-Handling Spaces.

F. UL 20 – General Use Switches, Plug Load Controls

G. UL 924 – Standard for Emergency Lighting and Power Equipment

H. ULC - Underwriter Laboratories of Canada Listings

I. UL GREENGUARD Certification Program (GreenGuard Gold).

J. LEED –Leadership in Energy and Environment Design is an internationally recognized third-party green building certification program.

1.4 SUBMITTALS

A. Submit under provisions of Section 01330 [01 33 26] - Submittal Procedures:

B. Product Data: Manufacturer's data sheets on each product specified, including:
1. Preparation instructions and recommendations.
2. Installation and maintenance instructions.
3. Styles, material descriptions, dimensions of individual components, profiles, features, finishes and operating instructions.
4. Storage and handling requirements and recommendations.
5. Mounting details and installation methods.
6. Typical wiring diagrams including integration of motor controllers with building management system, audiovisual and lighting control systems as applicable.

C. Shop Drawings: Plans, elevations, sections, product details, installation details, operational clearances, wiring diagrams and relationship to adjacent work.

D. LEED Submittals: Provide documentation of how the requirements of Credit will be met.

E. Window Treatment Schedule: For all roller shades. Use same room designations as indicated on the Drawings, field verified window dimensions, quantities, type of shade, controls, shadeband material, and color, and include opening sizes and key to typical mounting details.

F. Selection Samples: For each finish product specified, two complete sets of shadeband material options and aluminum finish color samples representing manufacturer's full range of available colors and patterns.

G. Verification Samples: For each finish product specified, two complete sets of shade components demonstrating compliance with specified requirements. Shadeband material sample and aluminum finish sample as selected, representing actual product, color, and patterns. Mark face of material to indicate interior faces.

H. Maintenance Data: Methods for maintaining roller shades, precautions regarding cleaning materials and methods, instructions for operating hardware and controls.

I. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

J. Closeout Submittals Operation and Maintenance Data: For roller shades, motor operators, and control systems.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in design and manufacturing of manual and motorized shading systems and distributed lighting control systems with a minimum of 25 years documented experience.

B. Installer Qualifications: Company certified by the Legrand and specializing in installation of networked lighting control products with minimum 3 years documented experience.

C. System Components: Demonstrate that individual components have undergone quality control and testing prior to shipping.

D. NFPA Flame-Test: Passes NFPA 701. Materials tested shall be identical to products proposed for use.

E. Motor operators, controls, and controllers shall be certified by a Nationally Recognized Testing laboratory (NRTL) to provide UL or ETL recognized or listed wired AC and DC powered motors and components.

F. Demonstrate that motors operators, controls, and controllers provided can connect to the internet with an acceptable level of security and ensure that that devices that allow for communication between the controls system hierarchy or the internet is certified by ioXt Alliance and listed on the ioXt website's current Certified Product Page (under Ecosystem - Network Lighting Controls. (https://compliance.ioxtalliance.org/products.

G. Mock-Up: Provide a mock-up of one of each type roller shade assembly specified for evaluation of mounting, appearance and accessories.
   1. Locate mock-up in window(s) designated by Architect.
   2. Do not proceed with remaining work until mock-up is accepted by Architect.
   3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 PRE-INSTALLATION MEETINGS

A. Convene minimum two weeks prior to commencing Work of this section. Meeting to be attended by Contractor, Architect, system installer, factory authorized manufacturer's representative, and representative of all trades related to the system installation.
   1. Review installation procedures and coordination required with related Work and the following:
   2. Inspect and make notes of job conditions prior to installation:

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

B. Store fabric, tube and motor units flat, on a flat horizontal surface to prevent sagging and deformation/twisting of contents, until ready for installation.

C. Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

1.8 SEQUENCING

A. Ensure that locating templates and other information required for installation of products of this section are furnished to affected trades in time to prevent interruption of construction progress.

B. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.9 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

B. Do not install shade units until interior painting, wet work, ceilings, window pockets, and mechanical/electrical work above window site is complete before installation.

1.10 WARRANTY

A. For all hardware including shade brackets, metal extrusions, and manual clutches: twenty-five (25) years.

B. For all shade motors, controls, and power supplies manufactured by Others: eight (8) years.

C. For fabrics used as part of the shade system (for interior use only, regardless of whether fabrics are rated for outdoor/exterior use):
   1. Mermet Fabrics:
      a. Mermet GreenScreen fabric: five (5) years
      b. All other Mermet fabrics: ten (10) years
   2. Phifer Fabrics - twenty-five (25) years
   3. All Others - five (5) years

1.11 MAINTENANCE AND OPERATIONAL SERVICES

A. Remote Access and Enhanced Warranty for Networked Lighting Controls: Provide Manufacturer's Remote Access and Enhanced Warranty for Networked Lighting and Shading Controls as follows:
   1. Configure to allow the manufacturer remote access to the lighting and shading control system. Configuration includes at a minimum: cellular modem, antenna for the modem, cellular service contract and any connections required to enable communication to the specified Network Lighting and Shading Control system.
   2. Remote Access program will automatically trigger a First Year Enhanced Warranty Agreement that will start once lighting and shading control system startup is complete and accepted by the Owner. During this one year period, the Owners authorized site contact can request the manufacturer to check the system for proper operation, and make any programmable changes desired. Manufacturer shall provide a phone number dedicated to customer calls concerning Remote Accessible systems, and a support organization capable of enabling cellular communication to the system for troubleshooting and making requested changes to the system. Any user attempting to request remote support on the system shall be fully verified by the Remote Operations

Center (ROC) before providing remote support or making any changes to the system. Systems that allow the modem to be always accessible will not be acceptable. Access must be by a secured VPN connection to the private lighting control network that is completely isolated from the Owner's internal network. Remote access that requires a connection through the Owner's internal network is not acceptable.

3. Remote Access Program may be continued by the Owner after the first year. However, If the Owner does not continue the enhanced warranty the cellular contract will lapse, and all hardware components, while still remaining property of the Owner, will remain in situ so that they can be re-activated at a later time should the Owner desire.
4. Manufacturer's Remote Access capability shall provide at a minimum the following features:
   a. Ability to provide initial system diagnostics through LMCS Software to detect fault conditions in hardware or connected devices.
   b. Access to all devices via LMCS Software allowing for programmability of device features. This will include all scheduling of Time of Day Events and programming of individual device parameters to meet Sequence of Operation requirements.
   c. Access to the LMSM Segment Manager browser-based interface (if included on project) to verify it is setup per project documentation, and all functional operations are working properly.
   d. On demand access to manufacturer technical support via a Remote Operations Center (ROC) that will provide remote troubleshooting, diagnostics, and configuration/programming assistance.
   e. Additional client training and tuning on the Lighting and Shading Control System after building occupancy can be performed while remotely connected to the site.
   f. Remote Site Readiness Check (SRC) which allows the Remote Operations Center to perform a remote discovery of all devices connected to the lighting and shading control network during installation. DLM Networked projects that have a RACCESS cellular modem and have successfully completed the Site Readiness Check (SRC) process will receive priority scheduling (a SRC is considered successful if 80% or more of the networked devices are found on the network during discovery). After the scheduled on-site startup, all manufacturer provided startup work for a site with a successful SRC will be done remotely, or via later complimentary return trips.

B. Technology-Enabled Service Contract: The manufacturer of the Lighting and Shading Control System shall provide a service contract for continued support of the system post installation that combines secure yet immediately accessible remote support with the backup assurance of onsite support when necessary. The coverage levels and features of the selected service contract would apply immediately upon completion of startup and supersede any enhanced remote support offered by the manufacturer during the first year after startup.
   1. Technology-enabled service contract requires a RACCESS (Remote Access) secure cellular connection that allows the manufacturer remote access to the lighting control system to provide remote troubleshooting, diagnostics, and configuration/programming assistance. Manufacturer shall ensure provision of a cellular service plan that keeps the modem active through the chosen Technology-Enabled Service Contract's duration.

2. If the customer does not renew the Service Contract at the end of the contract term, the cellular service plan will lapse, and all hardware components will remain in situ so that they can be re-activated later should the customer desire.
3. Technology-Enabled Service Contract Specifics
   a. Provide a complete "Connect Plus" Service Contract that includes the following features:
      1) Priority access to manufacturer technical support via a Remote Operations Center
      2) A complete system backup of LMCS and Segment Manager software files semi-annually
      3) Semi-annual Device Health Checks to identify any devices that have been bypassed, disconnected, or not functioning with recommendations for resolution
      4) An annual onsite training session by a certified factory-trained technician
      5) Semi-annual system tuning visits to optimize the lighting and shading configuration, fine tune the Sequence of Operations or make programming changes to the system
      6) A 3 day onsite response time for unscheduled emergency visits provided by factory-trained technicians
   b. Provide a complete "Connect Prime" Service Contract that includes the following:
      1) 24/7 priority access to manufacturer technical support via a Remote Operations Center
      2) A complete system backup of LMCS and Segment Manager software files quarterly
      3) Quarterly Device Health Checks to identify any devices that have been bypassed, disconnected, or not functioning with recommendations for resolution
      4) Semi-annual onsite training sessions by a certified factory-trained technician
      5) Quarterly system tuning visits to optimize the lighting configuration, fine tune the Sequence of Operations or make programming changes to the system
      6) A next day onsite response time for unscheduled emergency visits provided by factory-trained technicians
4. Length of Technology-Enabled Service Contract:
   a. 1 Year
   b. 2 Year
   c. 3 Year
   d. 4 Year
   e. 5 Year

1.12 EXTRA MATERIALS

A. See Section 01600 [01 65 00] - Product Requirements, for additional provisions.

B. Furnish extra maintenance materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: Legrand: Wattstopper/Legrand, which is located at: 2700 Zanker Rd. Suite 168; San Jose, CA 95134; Tel: 408-988-5331; Fax: 408-988-5373; Email: request info (jon.null@legrand.us); Web: https://www.legrand.us/wattstopper.aspx.

B. Substitutions: Not permitted.

C. Requests for substitutions will be considered in accordance with provisions of Section 01600 [01 62 00].

D. All products specified in this section shall be provided by a single manufacturer.

2.2 SS SERIES FASCIA SHADE SYSTEM

A. Legrand SS Specification Series fascia, shade system. System shall be a fascia roll roller shade bracket system with motor operated shades. Provide the following System(s) in the locations indicated on the Drawings.
1. Operation:
a. Low Voltage Motorized Shading System with DLM Motors and Controls.
1) Motorized brackets
2) banded 4 panels per side, adjust roller shade width for duct penetrations

B. Base Shade Configurations with Fascia
1. RLR-SS-3-MO-D-C-S-F: 4.3 Roll Up Diameter (RUD) Motorized Inside Top Mount Standard Roll. Bracket Dimensions 4 inches Deep, 1-1/8 inches Wide, 4-1/8 inches High

C. Shade Fabric:

1. Room Darkening Fabrics
a. As selected by Architect from manufacturer’s standard range
2. Color and pattern: As indicated in Color Schedule on Drawings.
3. Color and pattern: As selected by Architect from manufacturer's standard range.

D. Shade Options
1. Hembar: Extruded T6 6360 aluminum with plastic end finials,
a. Round: Round Hembar used for Coupled and Larger shades
1) Exposed.
2. Exterior Hembar Colors: Extruded aluminum with plastic end finials.
a. Finish: Silver.
3. Fabric Drop:
a. Standard Roll
4. Drive Side:
a. Right

5. Fascia:
   a. Standard Fascia
      1) 4.3 inch
6. Channel and Sill Rail: Provided with wool pile for room darkening. Works with any hembar.
   a. Side Channel
   b. Sill Rail

E. Mounting Bracket and Coupler Versions
1. Provide brackets versions and couplers to suit shade layout indicated on the Drawings

F. DLM Motors
1. Description: DLM motors are self-configuring digital devices incorporating both a wired connection and wireless Bluetooth low energy technology built-in for a variety of control options. The DLM shade motors have a unique counter-balance spring design that allows shade to use less energy and for extremely quiet operation. This patented design also allows the shades to be manually pulled into position using the hembar. The low motors are powered by 24-36VDC coming from the DLM room controller power supply and there a number of wired switch options for control of the shades.
2. Operation: DLM shades motors have two different gear ratios to support shades of different sizes. The 40:1 gear ratio motor (LMSH-MCA140) are used on smaller shades and the 73:1 gear ratio motors (LMSH-MCA173) are required for larger and coupled shades. Each shade motor uses a counter-balance spring designed specifically for the weight of the shade and motor type. The motor and spring assembly shall be specified and tested by the factory. When using Plug n' Go (PnG) operation the MCA (motor control assemblies) will automatically join the network, set a default upper and lower shade limit, and be assigned to any shade switches on the project. These settings can be customized later by using the Push n' Learn (PnL) and Pull n' Save (PnS) procedures found in shade controller power supply or shade switch installation instructions. The automated start up procedures are designed to save installation and startup time by defaulting to a default initial system configuration based on installed components.
3. Technical Specifications:
   a. Input voltage: 24/36VDC, Connect to LMSH-PS602 or LMSH-PS610 Power Supply
   b. Current Consumption: 250mA, 6W
   c. Speed/Torque
      1) – LMSH-MCA140: 38 RPM/10 N-cm
      2) – LMSH-MCA173: 29 RPM/15 N-cm
   d. Connection to Shade Bus: 4-Conductor wire whip with female terminal (power and data over four wires)
   e. Cable Whip Length: 13 inches
   f. Motors Status LED: Tri-color (RGB)
   g. Minimum Shade Size: 16 inches wide
   h. Maximum Shade Size: 15 foot wide by 20 foot tall
   i. Operating Temperature: 32° to 120°F (0° to 50°C)
   j. Storage Temperature: -20° to 180°F (-28° to 82°C)
   k. Relative Humidity: 5 to 95% (non condensing)
   l. IP Rating: IP44
   m. UL and cUL listed; UL/C-UL Ratings: 36 VDC, 0.12 A, Class 2 Supply
4. Controls

a. LMSH-MCA140: DLM Motor Control Assembly, 24V, 40:1 Gear Ratio, 13" wire whip
b. LMSH-MCA173: DLM Motor Control Assembly, 36V, 73:1 Gear Ratio, 13" wire whip
c. Motors shall be able to be installed left or right drive, inside shade tube.
d. Motors are not damaged when a user "pulls down" on shade hembar when power or control is not engaged.
e. Shade cassette system shall enable the user to send shade all the way open, all the way down, or to stop at a fixed position via a prescribed sequence of "tugs" or pulling on the hembar without damaging the motor, drive, brackets or roller shade.

5. DLM-Based Low Voltage Wall Switches:
   a. Description: LMSH Series Wall Switches arelself configuring digital low voltage devices for manual control of DLM based shades from one or more locations. They are part of a Digital Lighting Management (DLM) system and can control any shade motors connected to DLM shade room controllers. Motors and power supplies are connected using a four-wire shade bus with pre-configured cables and simple to configure bus system. The switches are connect using standard DLM in-room-bus (IRB) RJ45 cables for foolproof installation.
   b. Operation: Switches operate on Class 2 power supplied to a DLM local network by one or more shade room controllers. The switches send a digital signal for shade control whenever a pushbutton is pressed by a user. Plug n' Go (PnG) automatic configuration assigns all shade to the switch buttons upon system startup. In addition, shade default upper and lower limits are assigned during PnG. There are two additional programming procedures that allow for customization of the motorized shade system – Press n' Learn allows for switch button assignments and functions to be reconfigured and Press n' Save allows the installer to change the shade upper and lower limits.
   c. Specifications:
      1) Input voltage: 24VDC from DLM local network
      2) Current consumption: 5mA
      3) DLM local network connection: 2 RJ45 ports
      4) 1, 2, 4, or 5 control buttons, each with LED status indicator
      5) Hidden configuration button to access Push n' Learn and Pull n' Save configurations
      6) Infrared (IR) transceiver
      7) Operating conditions: for indoor use only; 32-131°F (0-55°C); 5-95% RH, non-condensing UL and cUL listed
      8) FCC part 15 compliant
      9) Programmable top and bottom shade limits
      10) Wired Switches
      11) 1-Rocker Wall Switch
      12) 2-Button Wall Switch
      13) 4-Button Wall Switch
      14) 4-Button Plus Rocker Wall Switch
      15) Colors: White, Black, Gray, Ivory, Light Almond
6. DLM Shade System Wiring Components: Provide wiring components required including preconfigured shade bus connections, customized wiring, shade bus extenders and testers, non-plenum and plenum rated local network cables as required. The shade bus shade supports an open topology wiring structure using passive shade bus connectors, extenders and cables.
7. DLM Shade Room Controllers

a. Description: DLM-based shade room controllers, are self-configuring digital devices that provide low voltage power and control for up to two or ten motorized shades. The controllers accept 120/277VAC input line voltage and are typically mounted in the ceiling to a four-square junction box. Controllers provide power and control for shades on the shade bus and integrate switches on the shade In-Room-Bus (IRB).

b. Features:
   1) Distributed shade control system reduces lengthy homerun wiring.
   2) Two different shade room controller options, LMSH-PS610 for up to 10 shades and LMSH-PS602 for up to two shades, allows for system flexibility when setting up a shade room network
   3) Shade room controllers provide buttons for shade control and system configuration to allow testing and control of the system while installing the shades
   4) Plug n' Go automatic configuration along with Push n' Save and Push n' Learn for system personalization
   5) Plug to other components (switches) using Cat 5e cables with RJ45 connectors eliminating wiring errors
   6) Four wire shade bus with preconfigured wires simplifies wiring to shade motors. The wiring system is plug and play
   7) Controller shall provide the option for creating groups and astronomic schedules independent of integration with other systems or lighting controls.
   8) Component of Digital Lighting Management integrated shade and lighting control system.

c. Specifications
   1) Input voltage: 120/277VAC, 50/60Hz
   2) Shade Bus Ports: 1 (LMSH-PS602), 2 (LMSH-PS610)
   3) Shade Bus Voltage: 24V (LMSH-PS602), 36V (LMSH-PS610)
   4) Shade Capacity: up to 2 (LMSH-PS602) or 10 (LMSH-PS610) DLM-based shade motors
   5) Connection to the DLM Local Network: 2 RJ-45 ports
   6) Local Network Characteristics when using shade controller:
      (a) Shade Network provides low voltage power to shade motors over Shade Bus cables, up to 1,000' (or 2 x 500') max
      (b) DLM Local Network In-Room Bus (IRB) provides low voltage power to switches over Cat 5e cable LMRJ;
   7) Class 2 output to DLM local network: 24VDC, 150mA
   8) DLM local network parameters
      (c) Maximum current: 800mA
      (d) Cat 5e cable: 150' per device to 1,000' max – Up to 64 loads and communicating devices
   9) Operating conditions: for indoor use only; 32-131°F (0-55°C); 5-95% RH, non-condensing
   10) UL and cUL listed

G. Connection When Using A DLM Shade Control System
   1. The LMSH-PS6xx shade controllers use a 4-wire shade bus for power and control of shades and a DLM IRB network using Cat5e for connection to wall switches and other shade power supplies. Legrand offers preterminated cable assemblies for both the shade bus and local IRB network for plug and play in a single room or area.

2. Install room controllers so that switch and shade bus wire bus limits are not exceeded. The shade bus limit is 1000 ft. (no motor should be more than 500 ft. from shade controller and the DLM bus limit is 1000 ft.
3. If connected to an LMSH-PS602 shade room controller, a single shade can connect directly to the controller. To connect a second shade, use the LMSH-SBE4 Shade Bus Extender or splitter.
4. If connected to an LMSH-PS610 shade room controller, two shades can connect directly to the controller. To connect additional shades (up to 10 total), use the LMSH-SBE4 Shade Bus Extender or splitter.

2.3 SOURCE QUALITY CONTROL

A. Motor Manufacturer Factory Quality Control Process:
1. Testing and approval of motors shall be completed by one or more global safety testing laboratories including, but not limited to: UL, CUL, TUV, ETL, CE, and VDE.
2. Prior to being shipped, each motor to pass testing for having no defects in wiring and operation including:
a. Assembled motor test design specifications when installed in various end products.
b. Product installation testing.
c. Product safety tests.
d. Product performance tests.
e. Life cycle testing for endurance and reliability.
f. Embedded software tests.
g. Heat and fire resistance tests.
h. Water and oxidation resistance tests.
i. Climate tests, temperature and humidity.
j. Acoustic tests, sound level and quality.
k. Radio frequency tests, transmission and reception.
l. Electromechanical capability, CEM.

PART 3 EXECUTION

A. Do not begin installation until substrates have been properly prepared.

B. Examine areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, blocking.

C. Identify locations of connections to building electrical system, and other conditions affecting performance of the Work.

D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Coordinate requirements for blocking and structural supports to ensure adequate means for installation of window shades.

B. Coordinate requirements for blocking, construction of shade pockets, and structural supports to ensure adequate means for installation of window shades.

C. Coordinate installation of recessed shade pockets with construction of suspended acoustical panel ceilings specified in Section 09510.

D. Coordinate installation of recessed shade pockets with construction of suspended gypsum board ceilings specified in Section 09260.

E. Coordinate requirements of Section 16050 [26 05 19] for power supply conduit, and wiring required for window shade motors and controls.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install roller shades level, plumb, square, and true. Allow proper clearances for window operation hardware.

C. Coordinate the work with Section 16050 [26 05 19] - Low-Voltage Electrical Power Conductors and Cables for power cables, Section 16570 [26 09 33] - Architectural Lighting Controls" for lighting integration into digital shading systems and Section 16575 [26 09 43] - Distributed Digital Lighting Controls" for lighting integration into digital shading systems to ensure the systems will be integrated using a Hardwired or Wireless communication network.

D. Install the following items to conceal roller and operating mechanism. Do not use exposed fasteners.
1. Fascia.
2. Closure panels.
3. Endcaps.

E. Install headbox, side channels, and sill channel with sealant specified in Section 07900 - Joint Sealers to eliminate light leaks at perimeter of shade system.

F. Position shades level, plumb, and at proper height relative to adjacent construction. Secure with fasteners recommended by manufacturer.

G. Comply with NECA 1 and NECA 130.

H. Comply with FCC guidelines.

I. Electrical Connections: Connect each roller shade motor operator and stationary control system to building electrical system.
1. Grounding: Provide electrical grounding in accordance with NFPA 70.

3.4 ADJUSTING

A. Adjust and balance roller shades and motorized equipment to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

1. Program each motor-operator control system to Owner-provided program settings.

B. Commissioning Control Systems: Perform commissioning of integrated automation control systems performed by Legrand/WattStopper Factory Authorized Tech.

3.5 TESTING

A. Test motorized window shades to verify that controls, limit switches, interface to other building systems, and other operating components are functional. Correct deficiencies.

B. Test window shades to verify that operating mechanism, fabric retainer, and other operating components are functional. Correct deficiencies.
1. Motorized operating mechanism.

C. During daylight hours, lower shades and turn off interior lights. Verify that there are no light leaks at perimeter or within shade assembly. Correct deficiencies.

D. Demonstrate operation of shades to Owner's designated representatives.

3.6 CLEANING AND PROTECTION

A. Clean roller shade surfaces, after installation, according to manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure that roller shades are without damage or deterioration at time of Substantial Completion.

C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

3.7 SCHEDULES

A. Shade Type S-3 Blackout Shades With Blackout Channels, Single Roller
1. SF-RD6 ES Shade 6 With Ceiling Mount Fascia, Side and Bottom Channels
a. Mounting Type: Inside the window top mounted.
b. Extruded Aluminum 6 inch Fascia
c. 4 inch Extruded Aluminum Closure
d. Mounting Angle
e. End Bracket
f. Extruded Aluminum Exterior Hembar
g. 2-1/2 inch or 3-1/2 inch Extruded Aluminum Tube
h. Fabric: Blackout
i. Motorized Blackout Side Channel
j. Manual Blackout Bottom Channel
k. Hembar: Exterior
l. Fabric Drop: Standard Roll
m. Manual Bypass: Left.

n. Fascia/Hembar Color: Silver

END OF SECTION

GLADYS SPEER PUBLIC SCHOOL
RENOVATIONS

MECHANICAL/ELECTRICAL SPECIFICATIONS

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PART 1 - GENERAL

1.1. GENERAL

1.1.1 This specification defines the general requirements and procedures for submittals. A submittal is information submitted for the Consultant's review to establish compliance with the contract documents.

1.1.2 Detailed submittal requirements are found in the technical sections of the contract specifications. The Consultant may request submittals in addition to those specified when deemed necessary to adequately describe the work covered in the respective technical specifications at no additional cost to the Client

1.1.3 Consultant review of a submittal does not relieve the Contractor of the responsibility for compliance with the contract documents or any error which may exist. The Contractor is responsible for fully complying with all contract requirements and the satisfactory construction of all work, including the need to check, confirm, and coordinate the work of all subcontractors for the project. Non-compliant material incorporated in the work will be removed and replaced at the Contractor's expense.

1.2 DEFINITIONS

1.2.1 Shop Drawings: Drawings, diagrams, and schedules specifically prepared to illustrate some portion of the work. Drawings prepared by or for the Contractor to show how multiple systems and interdisciplinary work will be integrated and coordinated.

1.2.2 Product Data: Catalog cuts, illustrations, schedules, diagrams, performance charts, instructions, and brochures, which describe and illustrate size, physical appearance, and other characteristics of materials, systems, or equipment for some portion of the work. Samples of warranty language when the contract requires extended product warranties.

1.2.3 Samples: Physical examples of materials, equipment, or workmanship that illustrate functional and aesthetic characteristics of a material or product and establish standards by which the work can be judged. Color samples from the manufacturer's standard line (or custom color samples if specified) to be used in selecting or approving colors for the project. Field samples and mock-ups constructed to establish standards by which the ensuing work can be judged.

1.2.4 Design Data: Calculations, mix designs, analyses, or other data pertaining to a part of work.

1.2.5 Test Reports: Report which includes findings of a test required to be performed by the Contractor on an actual portion of the work. Report which includes finding of a test made at the job site or on sample taken from the job site, on portion of work during or after installation.

1.2.6 Certificates: Document required of Contractor, or of a manufacturer, supplier, installer, or subcontractor through Contractor. The purpose is to document procedures, acceptability of methods, or personnel qualifications for a portion of the work.

1.2.7 Manufacturer's Instructions: Pre-printed material describing installation of a product, system, or material, including special notices and MSDS concerning impedances, hazards, and safety precautions.

1.2.8 Manufacturer's Field Reports: Documentation of the testing and verification actions taken by manufacturer's representative at the job site on a portion of the work, during or after installation, to confirm compliance with manufacturer's standards or instructions. The documentation must indicate whether the material, product, or system has passed or failed the test.

1.2.9 Operation and Maintenance Data: Manufacturer data that is required to operate, maintain, troubleshoot, and repair equipment, including manufacturer's help, parts list, and product line documentation. This data shall be incorporated in an operations and maintenance manual.

1.2.10 Closeout Submittals: Documentation necessary to properly close out a construction contract. For example, Operation and Maintenance manuals, as-built drawings. Also, submittal requirements necessary to properly close out a phase of construction on a multi-phase contract.

1.3 SUBMITTAL REGISTER

1.3.1 The submittal register prepared by the Contractor will list items of equipment and materials for which submittals are required by the specifications. This list may not be all inclusive and additional submittals may be required by the specifications. The Contractor is not relieved from supplying submittals required by the contract documents but which have been omitted from the submittal register.

1.3.2 The submittal register will serve as a scheduling document for submittals and will be used to control submittal actions throughout the contract period.

1.3.3 The Contractor shall provide the initial submittal register in electronic format. Thereafter, the Contractor shall track all submittals by maintaining a complete list, including completion of all data columns, including dates on which submittals are received and returned by the Consultant.

1.3.4 The Contractor shall update the submittal register as submittal actions occur and maintain the submittal register at the project site until final acceptance of all work by Client representative.

1.3.5 The Contractor shall submit formal monthly updates to the submittal register in electronic format. Each monthly update shall document actual submission and approval dates for each submittal.

1.4 SUBMISSION PROCEDURES – SHOP DRAWINGS

1.4.1. The contractor shall review all shop drawings before submittal to the Consultant. This review implies that the Contractor has determined or will determine measurements and has verified or will verify on the site, the construction criteria, materials, catalog

numbers and similar data, and that he has reviewed and coordinated each shop drawing with the Contractual Documents and Specifications.

1.4.2. Submit shop drawings to the Consultant within reasonable delays and in a logical sequence in compliance with the construction schedule.

1.4.3. Submit for approval, all of the items specifically mentioned under the separate sections of the specification, with information sufficient to evidence full compliance with contract requirements. Materials, fabricated articles and the like to be installed in permanent work shall equal those of approved submittals.

1.4.4. Submission Preparation

1.4.4.1. Each submittal is to be complete and in sufficient detail to allow ready determination of compliance with contract requirements.

1.4.4.2. Collect required data for each specific material, product, unit of work, or system into a single submittal. Prominently mark choices, options, and portions applicable to the submittal. Partial submittals will not be accepted for expedition of construction effort. Submittal will be returned without review if incomplete.

1.4.4.3. All irrelevant or unnecessary data shall be removed from the submittal to facilitate accuracy and timely processing. Submittals that contain the excessive amount of irrelevant or unnecessary data will be returned with review.

1.4.4.4. Forward submittals in sufficient time to permit proper consideration and approval action by the Consultant; minimum time required for Consultant's review shall be 10 business days or longer, if the submitted equipment does not match the standard of acceptance and additional time is required for the evaluation.

1.4.4.5. Schedule submission to assure adequate lead time for procurement of contract required items. Delays attributable to untimely and rejected submittals will not serve as a basis for extending contract time for completion.

1.4.4.6. The Consultant's review consists in reviewing the conformity of shop drawings with the contract documents for recommendation to the Client or Owner. The Consultant is not liable for any responsibility for dimensions, details nor quantities.

1.4.4.7. After an item has been reviewed by the Consultant no change in brand or make will be permitted unless:

1.4.4.7.1. Satisfactory written evidence is presented to, and positively reviewed by the Consultant, that manufacturer cannot make scheduled delivery of approved item or;

1.4.4.7.2. Item delivered has been rejected and substitution of a suitable item is an urgent necessity or;
1.4.4.7.3. Other conditions become apparent which indicates approval of such substitute item to be in best interest of the Client.

1.4.5. If the Contractor installs equipment or material for which he has not submitted shop drawings for verification, the Consultant may, if the equipment or material is not installed in accordance with plans and specifications, require the equipment or material to be removed and replaced by a compliant product at no additional cost to the Client

1.4.6. Shop drawings relating to products, special design systems or installations, custom equipment or similar to, all of which are not standard or catalogued products, will be considered engineering documents and as such, shall be authenticated by their author engineer. Authentication shall be in conformity with current Province of Ontario Laws and By-Laws. As an example, not limited to, shop drawings of a custom air-handling unit are covered by the present article and as such, constitute engineering documents that will require an authentication by their author engineer.

1.4.7. When shop drawings are resubmitted, indicate in writing all revisions other than those required by the Consultant.

1.4.8. Submit for review by the Consultant, within reasonable delays of the contract award, the complete set of shop drawings required. Faxed shop drawings are not accepted.

1.4.9. Shop drawings shall be submitted in electronic format. The following rules must be followed entirely:

1.4.9.1. The identification form must be included;
1.4.9.2. A shop drawing identification sheet hereby mentioned shall be included;
1.4.9.3. A single file in PDF format for each shop drawing shall be submitted. In the case where more than one document constitute the drawing, they must all be incorporated into a single file;
1.4.9.4. Printing parameters of the drawings must be incorporated in the file to assure a scaled printing on a commercial printer;
1.4.9.5. The file must be of an excellent graphical quality;
1.4.9.6. Transmission of the shop drawings must follow the path of communication established for the project;
1.4.9.7. A transmittal sheet shall be attached to submitted drawings.

1.4.10. Shop drawings not following these directives will be returned to the contractor with a "Rejected" recommendation.

1.4.11. Each shop drawing shall be presented with an identification form. The shop drawing identification sheet shall include as a minimum the following information:

1.4.11.1. Owner's name
1.4.11.2. Project's name

1.4.11.3. Consultant's name
1.4.11.4. Contractor's name
1.4.11.5. Name of sender
1.4.11.6. Sub contractor's name
1.4.11.7. Supplier's name
1.4.11.8. Specialty
1.4.11.9. Description
1.4.11.10. Specifications section number and article number
1.4.11.11. Revision number
1.4.11.12. Blank space for stamp of Conformity Review.

1.4.12. Submit all shop drawings in English, certified for construction by the manufacturer.

1.4.13. Drawings for non-standard articles or materials shall be produced, especially for the project.

1.4.14. Shop drawings shall include:

1.4.14.1. Construction details, dimensions, weights and equipment or material characteristics together with supplementary information such as bulletins, illustrations and exploded views of constituting parts.
1.4.14.2. Graphs, curves, capacities, efficiency and other technical data submitted by the manufacturer or requested by the Engineer concerning the operation of the equipment.
1.4.14.3. Wiring diagrams, single line diagrams, principle diagrams, control diagrams, operating sequences and all interconnections with other systems when required.
1.4.14.4. Flow diagrams for air, water, oil, fuel, etc. if applicable.
1.4.14.5. Marketing folders or publicity brochures will not be accepted.

1.4.15. Shop drawings will be returned with one or two of the following mentions: "Reviewed", "Modify and resubmit", "Modify as noted", "Rejected".

1.4.16. Drawings stamped "Reviewed" will not be further commented. Drawings comply with contractual documents.

1.4.17. Drawings stamped "Rejected" shall be done over again and resubmitted for approval. Drawings do not comply with contractual documents.

1.4.18. Drawings stamped "Modify as noted" shall not be resubmitted. Conditionally to the corrections indicated, drawings comply with contractual documents.

1.4.19. Drawings stamped "Modify and resubmit" shall be resubmitted, in part or in whole, as indicated for further examination. Drawings do not comply with contractual documents.

1.4.20. Drawings stamped "Modify as noted" and "Modify and resubmit" shall be resubmitted in part or in whole, as indicated, for further examination. Conditionally to the corrections indicated, drawings comply with contractual documents.

1.4.21. The Consultant's examination of the shop drawings does not relieve the Contractor from supplying equipment conforming to current standards and bylaws and to the requirements of this specification.

1.4.22. Any equipment, which is manufactured without the Engineer's prior examination, may be rejected. Assume all costs inherent to such a rejection.

1.5. **SUBMISSION SCHEDULING**

1.5.1. Submittals are to be scheduled, submitted, reviewed, and returned to the Contractor prior to the acquisition of the material or equipment. All comments marked by the Consultant shall be incorporated in the item for which a submission was made. No material or equipment shall be acquisitioned if the respective submissions was reviewed and rejected by the Consultant

1.5.2. Coordinate scheduling, sequencing, preparing, and processing of submittals with performance of work so that work will not be delayed by submittal processing. Allow time for potential re-submittal.

1.5.3. No delay costs or time extensions will be allowed for time lost in late submittals or re-submittals.

1.5.4. All submittals are required to be reviewed prior to the start of the specified work activity.

1.5 AS BUILT DOCUMENTATION

1.5.5. During progress of the Work, Contractor shall maintain a set of Record Documents and Shop Drawings at the Site. Contractor must update these documents weekly, at a minimum, with mark-ups of actual installations that vary from the Work as originally shown. Contractor shall include all Drawings issued as addenda, clarifications, or Change Orders.

1.5.6. Contractor shall maintain and have available for review in conjunction with project progress meetings, a current set of the marked-up Record Documents and Shop Drawings. Availability for review and acceptability of both the format and content are prerequisites for certification and acceptance of the Application for Payment by the Client and Consultant.

1.5.7. Contractor must protect marked-up Record Documents from deterioration and loss in a secure location.

1.6 RECORD DOCUMENTS EDIT LOG

1.5.8. During progress of the Work, Contractor shall update the Record Documents Edit Log each time updates or edits are made, or information is added. The Record Documents Edit Log shall be submitted to the Consultant and Client prior to submitting each monthly Application for Payment.

1.5.9. The Record Documents Edit Log shall include the following information as a minimum:

1.5.9.1. Date Edited.

1.5.9.2. Name and Company of Person Making Edit.

1.5.9.3. Edit Type: RFI, Change Order/Request for Proposal, Field Change, Red Line,

1.5.9.4. Supplemental Document, and Revision/ASI.

1.5.9.5. Reference: name and number of the source document if applicable, such as Change Order

1.5.9.6. or RFI number.

1.5.9.7. Sheet(s) Edited.

1.7 AS-BUILT DRAWINGS

1.5.10. Contractor must mark-up Drawings that are most compatible for showing actual physical condition, fully and accurately and must reference all other appearances of this Work to the updated sheet. Contractor must include cross-references to the Change Order number on the updated Drawing sheet and all additional sheets where the Work is shown.

1.5.11. Contractor must mark-up with erasable colored pencil, in a legible and professional manner using separate colors where feasible, to distinguish between changes for different categories of Work at the same general location.

1.5.12. Contractor must mark-up important additional information, which was either shown schematically only or omitted from the Construction Documents. Contractor must give particular attention to information on concealed work that would be difficult to identify or measure and record at a later date.

1.5.13. The contractor shall receive from the Consultant a set of electronic files of the project, with the engineering seal, stamp, signature and Consultant's logo removed.

1.5.14. The contractor shall use the files as backgrounds on which all the changes recorded during the construction phase shall be transcribed electronically.

1.5.15. Once all the changes have been transcribed on the backgrounds, the drawings shall be electronically stamped "AS BUILT DRAWINGS" and shall be converted to pdf format and submitted to the Consultant for review. The Contractor remains responsible for the accuracy of the recorded information.

1.5.16. In association with Contractor's request for Substantial Completion inspection, Contractor must submit one (1) electronic copy of the marked-up as-built drawings to Client's representative.

1.8 RECORD SPECIFICATIONS

1.8.1. It is mandatory that all changes to specified materials, installation, warranty, etc. be clearly and fully marked within the applicable Specification section in a manner acceptable to the Consultant and Client. Contractor shall review with the Owner and document an acceptable procedure early in the construction phase.

1.8.2. Contractor must give particular attention to substitutions, selection of options, and similar information on work where the exact products used are not clearly identified or readily discernible in the original Specifications. When applicable, Contractor must cross-reference related Record Drawing information and product data.

1.8.3. Contractor must neatly transcribe and post all marked-up information to a "clean" copy of the Specifications, ensuring that similar types of information are annotated in like fashion throughout the Specifications. The Record Specifications shall then be converted to pdf format and submitted to the Consultant for review. The Contractor remains responsible for the accuracy of Record Specifications content. .

1.8.4. In association with Contractor's request for Substantial Completion inspection, Contractor must submit the electronic version (pdf) of the Record Specifications to the Client representative.

1.9. **OPERATION AND MAINTENANCE MANUALS**

1.9.1. Submit operations and maintenance and operation data for all required equipment min. 15 days before application for Substantial Completion of the work. Substantial Completion status for the work will not be granted in the absence of full Operations and maintenance Information.

1.9.2. Contractor shall furnish the following equipment data content to be Included in Operating and Maintenance Manuals:

1.9.2.1. *Description of Equipment*.

1.9.2.2. *Record Product Submittals*. Clearly identify all options and accessories of actual installed product and variations in the actual Work in comparison with submitted information.

1.9.2.3. *Parts List.* Clearly identify every part in the item of equipment with the proper manufacturer's name, part nomenclature and number, local source, and list price.

1.9.2.4. *Recommended Spare Parts List*. For each equipment item that Owner will likely need within a 12-month period to support and operate that item of equipment. The quantities of spare parts recommended must be based upon the quantity of like equipment items installed under the Contract Documents.

1.9.2.5. *Normal Operating Instructions*. Detailed information to permit a journeyman mechanic to adjust, start-up, operate, and shut down the equipment. Special

start-up precautions shall be noted as well as other action items required before the equipment is put into service.

1.9.2.6. Emergency Operating Procedures. Detailed description of the sequence of action to be taken in the event of a malfunction of the unit, either to permit a short period of continued operation or emergency shutdown to prevent further damage to the unit and to the system in which it is installed.

1.9.2.7. *Preventive Maintenance*. Detailed information to cover routine and special inspection requirements, including but not limited to, field adjustments, inspections for wear, adjustment changes, packing wear, lubrication points, frequency and specific lubrication type required, cleaning of the unit and type solvent to use, and such other measures as are applicable to preventive maintenance program.

1.9.2.8. *Calibration.* Detailed data on what to calibrate, how to calibrate, when to calibrate and procedures to enable checking the equipment for reliability or indications as well as data for test equipment, special tools and the location of test points.

1.9.2.9. *Scale and Corrosion Control*. Detailed information covering the prevention of and removal of scale and corrosion.

1.9.2.10. *Trouble Shooting Procedures*. Detailed information and procedures for detecting and isolating malfunctions and detailed information concerning probable causes and applicable remedies.

1.9.2.11. *Removal and Installation Instructions.* Detailed information concerning the logical sequence of steps required to remove and install the item including instructions for the use of special tools and equipment.

1.9.2.12. *Disassembly and Assembly Instructions*. Detailed illustrations and text to show the logical procedure and provide the instructions necessary to disassemble and assemble the unit properly. The text shall include all checks and special precautions as well as the use of special tools and equipment required to perform the assembly or disassembly.

1.9.2.13. *Repair Instructions*. Detailed repair procedures to bring the equipment up to the required operating standard including instruction for examining equipment and parts for needed repairs and adjustments, and tests or inspections required to determine whether old parts may be reused or must be replaced.

1.9.2.14. *Special Tools and Test Equipment*. Detailed list of the special tools and test equipment needed to perform repair and maintenance for each equipment item. The list shall contain the special tool and test equipment part number, size, quantity, price, manufacturer’s name and address, and local supplier’s name and address.

1.9.2.15. *System Drawings*. Contractor shall furnish detailed drawings, where applicable, that clearly show wiring diagrams, utility service diagrams, control diagrams, system schematics, pneumatic and fluid flow diagrams, etc., which pertain to the unit function. System drawings must show major pieces of equipment, such as chillers, boilers, heat exchangers, pumps, air handlers, tanks, switchgear, etc., as meaningful to the Project. Fluid flow and direction and valves with their valve tag identification numbers must be clearly noted on drawings. Drawings must show modifications to another manufacturer's standard unit when it is incorporated into the assembly or package unit.

1.9.3. Warranties And Guarantees

1.9.3.1. Contractor shall include, within the Operating and Maintenance Manual organizational structure for each system, equipment item, or material, an executed copy of the specified warranty/guarantee with warranty effective dates covering that particular system, equipment item, or material. Contractor shall include the manufacturer's warranty as specified and the installing subcontractor's and supplier's guarantee for workmanship and system operation.

1.9.4. Requirements For Close-Out Manual

1.9.4.1. The Commissioning and Close-Out Manual shall include, but is not limited to, the following:

1.9.4.1.1. Commissioning documentation, pre-functional and functional check lists and forms.

1.9.4.1.2. Final air balance reports produced by the Test, Adjust, and Balance Firm.

1.9.4.1.3. Completed Valve Schedule and Fire, Fire/Smoke and Smoke Damper Schedule

1.9.4.1.4. Owner Demonstration / Training Reports: Contractor shall furnish Training Plan and

1.9.4.1.5. Documentation of Owner's personnel training regarding operation of systems. Contractor shall include identification of parties receiving training and date(s) of such training.

1.9.4.1.6. Electrical Test Reports (including factory tests and settings).

1.9.4.1.7. Miscellaneous Equipment Test Reports (including factory tests and settings).

1.9.4.1.8. HVAC Calibration Reports (including duct testing reports).

1.9.4.1.9. Fire Alarm Test Reports.
1.9.4.1.10. Piping Test Reports.
1.9.4.1.11. Sewer Video Log.
1.9.4.1.12. Code-required Certifications as described within Technical Specifications.
1.9.4.1.13. Material Safety Data Sheets (MSDS) for any and all products incorporated into the Project.

1.9.5. Miscellaneous Close-out Documents.

1.9.5.1. Contractor shall provide categories of requirements resulting in miscellaneous work records including, but not be limited to, the following:

1.9.5.1.1. Required field records on excavations, foundations, underground construction, wells and similar work.
1.9.5.1.2. Accurate survey showing locations and elevations of underground lines, including invert elevations of drainage piping. Surveys establishing lines and levels of building.

1.9.5.1.3. Certifications received in lieu of labels on products and similar record documentation.

1.9.5.1.4. Testing and qualification of tradesmen.

1.9.5.1.5. Documented qualification of installation firms.

1.9.5.1.6. Materials testing reports.

1.9.5.1.7. Final inspection Punch-list and deficiency corrections.

1.9.5.1.8. All original, signed Project warranties and guarantees.

1.10. **MAINTENANCE AND OPERATIONS MANUAL FORMATTING**

1.10.1. Provide minimum of two (2) hard copies and one electronic copy of Mechanical Maintenance Manuals, in accordance to the following:

1.10.2. Manuals to be bound in a hard cover neatly labeled: "OPERATING AND MAINTENANCE INSTRUCTIONS".

1.10.3. The Maintenance and Operations Manuals shall be divided into sections with neatly labeled and tabbed dividers between each section. The sections to be included in the manual are:

1.10.3.1. Section I General.
1.10.3.2. Section II Piping and Pump Systems, Ductwork and Accessories.
1.10.3.3. Section III – HVAC Equipment/Electrical Equipment
1.10.3.4. Section IV Automatic Controls
1.10.3.5. Section V - Air and Water Balancing

1.10.4. The following information shall be contained within the sections:

1.10.4.1. SECTION I: A list giving name, address and telephone number of the Consultant, Engineers, General Contractor, Mechanical Trade and Controls Trade. Written warranties for the Mechanical Systems. A copy of the Valve directory giving number, valve location, normal valve position, and purpose of valve. Equipment lists and certificates shall be provided - certificates shall be signed and sealed by the appropriate suppliers.

1.10.4.2. SECTION II, III: A copy of all pressure tests and operational tests. A copy of Gas Operational Tests for gas fired equipment. A list giving name, address and telephone number of all suppliers. Details of chemical treatment equipment and substances. A copy of all reviewed Shop Drawings for all mechanical equipment and ancillary devices (valves, expansion tanks, pumps, strainers, plumbing, etc). Copies of warranties.

1.10.4.3. SECTION IV: Complete Control Diagrams, Wiring Diagrams and description of Control system and the functioning sequence of the system.

1.10.4.4. SECTION V: Complete air and hydronic balancing reports.

1.11. **WITHHOLDING OF PAYMENT**

1.11.1 Payment for materials incorporated in the work will not be made if required approvals have not been obtained.

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PART 1 - GENERAL

1.1. **DESCRIPTION:**

1.1.1. This section specifies demolition and removal of utilities, services and equipment, as noted on the drawings and as required for the completion of the new work

1.2. **DEFINITIONS**

1.2.1. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.

1.2.2. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse or store as noted on Drawings.

1.2.3. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.

1.2.4. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

1.2.5. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.3. **WARRANTY**

1.3.1. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during demolition, by methods and with materials and using approved contractors so as not to void existing warranties. Notify warrantor before proceeding. Existing warranties include the following:

1.3.1.1. Roof system

Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

1.4. **PROTECTION:**

1.4.1. Perform demolition in such manner as to eliminate hazards to persons and property; to minimize interference with use of adjacent areas, utilities and structures or interruption of use of such utilities; and to provide free passage to and from such adjacent areas of structures.

1.4.2. Carry out all demolition work in a neat and orderly manner. Keep noise, dust, and similar nuisances to a minimum. Do not collapse walls. Do not throw or drop materials.

1.4.3. Provide safeguards, including warning signs, barricades, temporary fences, warning lights, and other similar items that are required for protection of all personnel during demolition and removal operations.

1.4.4. Where material indicated to be removed is suspected of containing asbestos, inform Client's Representative immediately. Do not disturb materials suspected of containing asbestos until asbestos content has been verified by Client.

1.4.5. Use extreme caution when cutting into shafts and chases. Shafts and chases may end above occupied areas within building. Take all necessary precautions to prevent debris from falling through openings between floors during demolition operations.

1.4.6. Maintain fences, barricades, lights, and other similar items around exposed excavations until such excavations have been completely filled.

1.4.7. Prevent debris from blocking drainage systems (floor drains) or affecting other mechanical and electrical systems that must remain in operation.

1.4.8. Protect building floors against damage from demolition work. Use ½" plywood covers over floor where lifting, moving, rolling of removed equipment is anticipated. Be responsible for repairing any damage to flooring caused by the work defined in this section. Execute repairs to the satisfaction of the Board at no cost to the Board.

1.4.9. Provide enclosed dust chutes with control gates from each floor to carry debris to truck beds and govern flow of material into truck. Provide overhead bridges of tight board or prefabricated metal construction at dust chutes to protect persons and property from falling debris.

1.4.10. Prevent spread of flying particles and dust. Sprinkle rubbish and debris with water to keep dust to a minimum. Do not use water if it results in hazardous or objectionable

condition such as, but not limited to; ice, flooding, or pollution. Vacuum and dust the work area daily.

1.4.11. Maintain at least one stairway in each structure in usable condition to highest remaining floor. Keep stairway free of obstructions and debris until that level of structure has been removed.

1.4.12. Wherever a cutting torch or other equipment that might cause a fire is used, provide and maintain fire extinguishers nearby ready for immediate use. Instruct all possible users in use of fire extinguishers.

1.4.13. Keep hydrants clear and accessible at all times. Prohibit debris from accumulating within a radius of 4500 mm (15 feet) of fire hydrants.

1.4.14. Before beginning any demolition work, the Contractor shall survey the site and examine the drawings and specifications to determine the extent of the work. The contractor shall take necessary precautions to avoid damages to existing items to remain in place, to be reused, or to remain the property of the Client.

1.4.15. Any damaged items shall be repaired or replaced as approved by the Consultant. The Contractor shall coordinate the work of this section with all other work and shall construct and maintain shoring, bracing, and supports as required.

1.4.16. The Contractor shall ensure that structural elements are not overloaded and shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract. Do not overload structural elements. Provide new supports and reinforcement for existing construction weakened by demolition or removal works. Repairs, reinforcement, or structural replacement must have Resident Engineer's approval.

1.5. **QUALIFICATIONS**

1.5.1. Work of this section shall be executed by trades personnel having a minimum of five years experience in the demolition field and capable to deploy adequate equipment as required to complete the work in an efficient and orderly manner.

1.6. **EXAMINATION**

1.6.1. Examine existing property. Determine the nature of materials to be removed.

1.6.2. When utilities or building services are encountered that are not indicated on the drawings, the Consultant shall be notified prior to further work in that area.

1.7. **SCHEDULING**

1.7.1. Coordinate the timing and duration of DCW, DHW and power shut-down with the Board representatives.

1.8. **MAINTAINING TRAFFIC**

1.8.1. Maintain and preserve Board's access requirements within, to and from existing building in areas where demolition and removal work is being carried out.

1.8.2. Do not close, obstruct, place or store material in the building driveways and passageways. Conduct operations with minimum interference with roads, streets, driveways, user traffic and passageways.

1.9. **HAULING OPERATIONS**

1.9.1. Maintain roadways and paving in the hauling areas clean on a daily basis and as required by Municipal Authorities.

1.9.2. Parking is not ample or readily available in the area where the building is located. Coordinate delivery of equipment with the Board representatives.

1.10. **INTERRUPTIONS TO CLIENT'S OPERATIONS**

1.10.1. There will be absolutely no interruptions to the building schedule during demolition work. Therefore, it is imperative that operations and machine and equipment movements, deliveries and removals are executed at time or times that will permit uninterrupted Board's operations in and around the building, including parking, receiving areas, deliveries and site and means of access and egress.

1.10.2. Where interruptions of domestic cold and hot water are necessary, coordinate with the School Representatives the timing and duration of such interruptions.

1.11. **SAFETY REQUIREMENTS**

1.11.1. Coordinate posting of danger signs conspicuously around property. Close doorways and thoroughfares giving access to area of demolition with barricades.

1.11.2. Provide a competent, experienced supervisor in charge of the Work and on Site while Work is in progress.

1.11.3. Should any suspect designated substance not already identified, be encountered, cease work in the immediate area and immediately report, to the Board. Board is responsible for removal of designated substances.

1.12. **WORK INCLUDED IN THIS SECTION**

1.12.1. Removal of existing horizontal unit ventilators throughout the classrooms noted on the drawings. Unit ventilator to be disconnected from hot water supply & return piping c/w all piping accessories. Disconnect each unit ventilator from existing power and controls. Remove all redundant wiring.

1.12.2. Remove the existing thermostats in the spaces noted on the drawings. Remove all associated control wiring.

1.12.3. Remove the outdoor louver associated with each demolished unit ventilator. Repair exterior brick wall and seal to match existing wall. Insulate and finish inside wall to match existing conditions.

1.12.4. Remove hydronic control valves throughout the school in the spaces noted on the drawings. Cut piping locally and remove valve and all associated control wiring.

1.12.5. Remove existing rooftop mounted exhaust fans, as noted on the drawings. Curbs and openings that will become redundant shall be sealed, weatherproofed, and integrated into the roofing assembly. Curbs and openings that will be re-used shall be temporarily sealed to ensure no leaks occur during construction.

1.12.6. Removal and demolition of the existing kitchen in the school's staff room. Disconnect, the sink, dishwasher from existing DCW & DHW connections. Remove existing kitchen exhaust fan and associated ductwork. Remove oven and stove assembly.

1.12.7. Removal of existing fan and associated ductwork installed in the office space ceiling, as noted on the drawings. Remove all accessories and supports. Remove outdoor louver associated with the demolished fan. Replace curtain wall with new panel, to match existing. Insulate and finish the wall inside to match existing conditions.

1.12.8. Remove the existing exhaust duct serving the gymnasium. Duct to be removed all the way from roof exhaust fan to below the existing stage. Cap opening in stage floor, and make safe.

1.12.9. Demolish existing gas meter serving the school and prepare to upgrade service to the new load noted on the drawings. Remove portions of gas piping on the roof as noted on the drawings. Exact cutting locations to be determined on site.

1.12.10. Remove existing lights in the gymnasium as noted on the drawings.

1.12.11. Removal of existing electrical equipment as per the electrical power upgrade drawings. Refer to these drawings for detailed electrical demolition scope.

PART 2 - PRODUCTS

2.1. Not applicable

PART 3 - EXECUTION

3.1. **GENERAL**

3.1.1. At the end of each day's work, leave site in a safe condition and erect safety barriers and lights as required. Ensure that no parts of the existing building are in danger of collapsing.

3.1.2. Review the requirements of new equipment to be installed. Perform all demolition work required to allow for the new equipment to be installed, whether shown on the drawings or not.

3.1.3. Provide any additional labour, materials and services not specifically indicated on the drawings but required to complete the demolition work.

3.1.4. Do not disturb adjacent structures or equipment designated to remain in place.

3.1.5. Confine operations and workers to those parts of the building which are defined on the drawings and exercise great care not to damage existing construction beyond that necessary for the carrying out of new work. Make good any such damage in every respect, to the satisfaction of the Client.

3.2. **DUST CONTROL**

3.2.1. Prevent spread of flying particles and dust. Sprinkle rubbish and debris with water to keep dust to a minimum. Do not use water if it results in hazardous or objectionable condition such as, but not limited to; ice, flooding, or pollution. Vacuum and dust the work area daily

3.3. **DISPOSAL**

3.3.1. <u>Removed Items</u>

3.3.1.1. Unless otherwise instructed by the Client's representative, all materials from demolition including brick, concrete, stone, metals, insulation, wiring, tubing and similar materials shall be removed

3.3.1.2. Removed items become property of Contractor and shall be disposed of by him daily, off the site to avoid accumulation at the demolition site. Materials that cannot be removed daily shall be stored in areas specified by the Consultant. Contractor shall dispose debris in compliance with applicable federal, provincial or local permits, rules and/or regulations.

3.3.1.3. Dispose of demolished materials in accordance with the requirements of Authorities Having Jurisdiction. At the end of demolition work, leave site in broom-clean condition. Clean existing surfaces specified to receive new applied finishes to ensure proper adherence.

3.3.2. Removed and Salvaged Items:

3.3.2.1. The Board Representative will review the Site prior to commencement of demolition and instruct the Contractor, in writing, as to the items to be Removed and Salvaged. Perform the following:

3.3.2.1.1. Clean salvaged items.
3.3.2.1.2. Pack or crate items after cleaning. Identify contents of containers.
3.3.2.1.3. Store items in a secure area until delivery to Owner.
3.3.2.1.4. Transport items to Owner's storage area location in building.
3.3.2.1.5. Protect items from damage during transport and storage.

3.3.3. Removed and Reinstalled Items:

3.3.3.1. Clean and repair items to functional condition adequate for intended reuse.
3.3.3.2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3.3.3.3. Protect items from damage during transport and storage.
3.3.3.4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

3.3.4. Existing Items to Remain:

3.3.4.1. Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Owner's Representative, items may be

removed to a suitable, protected storage location off-site during selective demolition and reinstalled in their original locations after selective demolition operations are complete.

3.4. **REFRIGERANTS**

3.4.1. Refrigerant handling requirements are specified in Section 23 23 00.

3.5. **DEMOLITION OF ARCHITECTURAL FINISHES**

3.5.1. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

3.5.1.1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.

3.5.1.2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.

3.5.1.3. Do not use cutting torches without written permission from Client's Representative. Comply with Owner's rules and procedures.

3.5.1.4. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loading on supporting walls, floors, or framing.

3.5.1.5. Dispose of demolished items and materials promptly.

3.5.1.6. Remove all loose material from partially demolished work leaving only sound and secure construction.

3.5.2. Plaster:

3.5.2.1. Remove loose plaster that will be exposed in finished construction. Loose plaster is defined as plaster material of at least 2 inches by 4 inches in size that can be moved by touch or that sounds hollow when lightly tapped with a hammer.

3.5.3. Flooring:

3.5.3.1. Where shown, scheduled or otherwise required for application or installation of new floor finishes or coverings, remove existing flooring tile, resilient sheet flooring as follows:

3.5.3.1.1. Remove all traces of existing flooring materials. Remove resilient sheet and tile flooring products

3.5.3.1.2. Remove adhesives, except those containing asbestos. Use chemical strippers approved by manufacturer of new flooring materials, or grind concrete floor surfaces to completely remove adhesive. Obtain Client's Representative's approval of removal method prior to beginning removal work.

3.5.3.1.3. Do not remove vinyl composition tile or adhesives suspected of containing asbestos. Client will verify asbestos content of questionable materials. Removal of asbestos-containing adhesives (if any) shall be undertaken separately by the Client

3.5.3.1.4. Clean floor slabs of dust and adhesive residue.

3.6. **DEMOLITION OF CONCRETE OR ASPHALT**

3.6.1. Water used during concrete and asphalt work (including sweeping and saw-cutting) must be contained and collected for proper disposal. Do not discharge water containing dust or debris from concrete or asphalt work into storm drains, catch basins or to the sanitary sewer system.

PART 1 - GENERAL

1.1. DESCRIPTION

1.1.1. The requirements of this Section shall apply to all sections of Division 22.

1.2. DEFINITIONS:

1.2.1. Exposed: Piping and equipment exposed to view in finished rooms.

1.3. RELATED WORK

1.3.1. Section 01 33 23, SHOP DRAWINGS,
1.3.2. Section 07 84 00, FIRESTOPPING.
1.3.3. Section 07 92 00, JOINT SEALANTS.
1.3.4. Section 22 05 53. IDENTIFICATION FOR PLUMBING SYSTEMS
1.3.5. Section 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT.
1.3.6. Section 22 07 11, PLUMBING INSULATION.
1.3.7. Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS
1.3.8. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
1.3.9. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES.
1.3.10. Section 26 29 11, MOTOR CONTROLLERS.

1.4. APPLICABLE PUBLICATIONS

1.4.1. The publications listed below shall form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
1.4.2. Ontario Building Code – Part 7 latest edition
1.4.3. Ontario Standard CSA-B149.1 latest edition
1.4.4. American Society for Testing and Materials (ASTM):
- 1.4.4.1. A36/A36M-2012 Standard Specification for Carbon Structural Steel
- 1.4.4.2. F1760-01(R2011) Standard Specification for Coextruded Poly(Vinyl Chloride) (PVC) Non-Pressure Plastic Pipe Having Reprocessed-Recycled Content

1.4.5. Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry, Inc:
- 1.4.5.1. SP-58-2009 Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application and Installation
- 1.4.5.2. SP-69-2003 Pipe Hangers and Supports - Selection and Application

1.4.6. National Fire Protection Association (NFPA):
- 1.4.6.1. 51B-2014 Standard for Fire Prevention During Welding, Cutting and Other Hot Work
- 1.4.6.2. 70-2011 National Electrical Code (NEC)

1.5. **SUBMITTALS**

1.5.1. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS,

1.5.2. Manufacturer's Literature and Data: submit all equipment and material performance and characteristics, operational curves, diagrams and schematic, power wiring schematics and all other pertinent operational information. Submit all equipment physical sizes, weights, methods of lifting and installation, support requirements.

1.5.3. Electric motor data and variable speed drive data shall be submitted with the driven equipment.

1.5.4. Equipment and materials identification.

1.5.5. Fire stopping materials.

1.5.6. Hangers, inserts, supports and bracing. Provide load calculations for variable spring and constant support hangers.

1.5.7. Wall, floor, and ceiling plates.

1.5.8. Submittals and shop drawings for interdependent items, containing applicable descriptive information, shall be furnished together and complete in a group. Coordinate and properly integrate materials and equipment in each group to provide a completely compatible and efficient installation. Final review and approvals will be made only by groups.

1.6. **DUTIES OF MECHANICAL CONTRACTOR**

1.6.1. The mechanical contractor shall assume the responsibilities and duties including but not limited to the ones described below:

1.6.2. Superintendence

1.6.2.1. Provide full time on-site superintendent personnel and supporting staff with proven experience in project of similar value and complexity.

1.6.2.2. Site superintendent shall have over-all authority to speak for and represent the mechanical contractor.

1.6.3. Coordination

1.6.3.1. Coordinate the work with all the sub-trades involved to ensure that the work will be carried out on schedule and in proper sequence.

1.6.3.2. Take complete responsibility for all remedial work that results from failure to coordinate any aspect of the mechanical work prior to its fabrication and/or installation.

1.6.3.3. Take responsibility for the delivery of equipment necessary to complete the work in accordance with the approved schedule.

1.6.4. Staffing and Scheduling

1.6.4.1. Within seven days after the award of the contract, the Mechanical Contractor shall provide to the Client representative the following information:

1.6.4.1.1. Appointment of official representatives in the project.
1.6.4.1.2. Schedule of work.
1.6.4.1.3. Delivery schedule for specified equipment.
1.6.4.1.4. Requirements for temporary facilities, site signs, storage, etc.

1.6.5. Work Completion Meeting

1.6.5.1. Prior to application for Substantial Performance of the Work, the mechanical contractor shall participate in the take-over meeting. Agenda to include the following:

1.6.5.1.1. Review of outstanding deficiencies.
1.6.5.1.2. Submission of maintenance manuals, warranties and as-built drawings.
1.6.5.1.3. Results of performance tests and described further in this section.
1.6.5.1.4. Scheduling of training to Board's personnel.

1.7. **SCHEDULING OF WORK**

1.7.1. For all work to be performed under this contract, adhere to Construction Schedule agreed upon with the Client.

1.8. **INTENT**

1.8.1. Bidders for this work shall include for all labor, material, equipment and all other related cost including all applicable taxes (except GST) and fees to provide the work as indicated on the drawings and as described below:

1.8.1.1. Provide new kitchen sink and dishwasher as noted on the mechanical and architectural drawings.

1.8.1.2. Provide new DCW & DHW to new plumbing fixtures and connect to existing risers as noted on the drawings. Exact tie-in point to be confirmed on site.

1.8.1.3. Provide new sanitary connections for the new plumbing fixtures. Connect new sanitary to existing sanitary riser as noted on the drawings. Exact tie-in point to be confirmed on site. Provide all necessary venting connections as required by OBC.

1.8.1.4. Provide new pumped condensate from the new air conditioning unit to be installed in the staff room. Provide new funnel floor drain for indirect condensate connection. Tie-in new funnel floor drain into the new sanitary piping, upstream of the new trap.

1.8.2. Misinterpretation of any requirement of the drawings and specifications will not relieve the Mechanical Contractor of responsibility. If in any doubt, the Mechanical Contractor shall contact the Consultant for written clarification prior to submitting a bid for the Work.

1.9. **INTERFERENCES**

1.9.1. The mechanical drawings do not show all the architectural and structural details, and any information involving accurate measuring of the building shall be taken from the building drawings or at the building. Make without additional change, any necessary changes or additions to the runs of drains, pipes, ducts, etc., to accommodate the above conditions. The location of equipment may be altered without charge providing the change is made before installation and does not necessitate major additional material.

1.9.2. Wherever differences occur between specifications, riser diagrams or schematics and drawings, the maximum conditions shall govern and the bid shall be based on whichever information indicates the greater cost.

1.9.3. Field verifications of dimensions on plans shall be made since actual locations, distances, and levels will be governed by actual field conditions.

1.9.4. Discrepancies between different plans, or between plans and actual field conditions, or between plans and specifications shall promptly be brought to the attention of the Consultant for a decision.

1.9.5. Install all mechanical services including but not exclusive to drains, pipes, and ducts, to conserve headroom and interfere as little as possible with the free use of the space through which they pass. All drains, pipes, ducts, etc., particularly those which may interfere with the inside treatment of the building, or conflicting with other trades, shall be installed only after the locations have been approved by the Consultant. Special care shall be taken in the installation of all mechanical services including, but not exclusive to drains, pipes, and ducts, which are to be concealed, to see that they come within the finished lines of floors, walls, and ceilings. Where such drains, pipes, ducts, etc., have been installed in such a manner as to cause interference, they shall be removed and re installed in suitable locations without extra cost to the Board.

1.9.6. Before commencing work, check and verify all grade and invert elevations, stacks, levels, and dimensions, to ensure proper and correct installation of the work.

1.9.7. In every place where there is space indicated as reserved for future or other equipment, leave such space clear, install blank offs, shut off valves with blind flanges and other work so that the necessary connections can be made without any stoppages to the system. Consult with the consultant whenever necessary for this purpose.

1.9.8. In addition to the work specifically mentioned in the Specifications and shown on the drawings, provide all other items that are obviously necessary to make a complete working installation, including those required by the Authorities Having Jurisdiction over the work.

1.9.9. The mechanical plans show approximate locations for wall mounted devices. Obtain Consultant's approval of mounting heights and locations before commencement of work.

1.10. **EXAMINE SITE**

1.10.1. Examine the site and the local conditions affecting the work. Examine carefully all drawings and the complete specifications to ensure that the work can be satisfactorily carried out as shown. No allowance will be made later for any expenses incurred through the failure to make these examinations or to report any such discrepancies in writing to the Consultant.

1.11. **INTERFERENCE DRAWINGS:**

1.11.1. Complete consolidated and coordinated interference drawings shall be submitted for all new systems, and for existing systems that are in the same areas. The drawings shall include plan views, elevations and sections of all systems and shall be on a scale of not less than 1:200. Clearly identify and dimension the proposed locations of the principal items of equipment. The drawings shall clearly show the proposed location and adequate clearance for all equipment, controls, piping, pumps, valves and other items. All valves, trap primer valves, water hammer arrestors, strainers, and equipment requiring service shall be provided with an access door sized for the complete removal of plumbing device, component, or equipment. Equipment foundations shall not be installed until equipment or piping layout drawings have been approved. Detailed layout drawings shall be provided for all piping systems. In addition, details of the following shall be provided.

1.11.2. Mechanical equipment rooms.

1.11.3. Interstitial space.

1.11.4. Pipe sleeves.

1.11.5. Equipment penetrations of floors, walls, ceilings, or roofs.

1.12. **MAINTENANCE DATA AND OPERATING INSTRUCTIONS:**

1.12.1. Maintenance and operating manuals, for systems and equipment. Include complete list indicating all components of the systems with diagrams of the internal wiring for each item of equipment.

1.12.2. Include listing of recommended replacement parts for keeping in stock supply, including sources of supply, for equipment shall be provided. The listing shall include belts for equipment: Belt manufacturer, model number, size and style, and distinguished whether of multiple belt sets.

1.13. **MATERIALS AND STANDARDS OF ACCEPTANCE**

1.13.1. Where materials, equipment, apparatus, or other products are specified by the manufacturer, brand name, type or catalogue number, such designation is to establish standards of desired quality style or dimensions and shall be the basis of the Bid. Materials so specified shall be furnished under this Contract.

1.13.2. Where two or more designations are listed, the contractor shall choose one of those listed and state the choice made on the Bid Form (where applicable). *First choice shall be given to the equipment selected as the basis of design; equipment listed as equal shall be considered only if it suits the local conditions in terms of clearances, power supply availability and weight restrictions.*

1.14. **MATERIAL SUBSTITUTIONS**

1.14.1. After execution of the Contract, requests for substitution of materials or makes other than those specifically named in the Contract Documents may be reviewed and approved by the Consultant, subject to Client's review and acceptance of the financial credits involved.

1.14.2. In the absence of such express approval by the Consultant, the Mechanical Contractor will be held to furnish specified items under the base bid as the standard of acceptance.

1.14.3. If equipment is submitted which differs in arrangement from that specified/shown on the documents, provide drawings that show the rearrangement of all associated systems. Approval will be given only if all features of the equipment and associated systems, including accessibility, are equivalent to that required by the contract.

1.15. **CODES, PERMITS, FEES AND CONNECTIONS**

1.15.1. Conform to Federal, Provincial and Municipal regulations and perform work in accordance with requirements of By Laws and Regulations in force in area where the building is to be erected.

1.15.2. Apply for, obtain, and pay for all permits, fees and service connections for the work and the inspections required by Authorities Having Jurisdiction in the area where the building is to be erected.

1.15.3. For information, a specific code or standard might be mentioned. This information must not be taken as the only code or standard applicable.

1.15.4. When part of equipment does not bear the required CSA label, the contractor shall obtain from CSA or Hydro Electric Power Commission, when that part of the equipment is an electric component, a special approval and pay the applicable fees.

1.15.5. Furnish necessary certificates as evidence that the work installed conforms with laws and regulations of Authorities having jurisdiction. Changes in work requested by an Authority having jurisdiction shall be carried out without charge.

1.16. **CONSULTANT'S INSTRUCTIONS**

1.16.1. During construction the Consultant will issue such instructions as may be necessary for verification and correction of the work. These instructions shall be binding as part of the specification.

1.17. **ADDITIONAL WORK AND CHANGES**

1.17.1. Unless a written order, reviewed by the Consultant and countersigned or otherwise approved by the Client Representative, no additional work shall be undertaken by the Contractor.

1.18. **QUALITY ASSURANCE**

1.18.1. Products Criteria:

1.18.1.1. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture, supply and servicing of the specified products for at least 5 years. However, digital electronics devices, software and systems such as controls, instruments, computer work station, shall be the current generation of technology and basic design that has a proven satisfactory service record of at least 5 years.

1.18.1.2. Equipment Service: There shall be permanent service organizations, authorized and trained by manufacturers of the equipment supplied, located within 160 km (100 miles) of the project. These organizations shall come to the site and provide acceptable service to restore operations within four hours of receipt of notification by phone, e-mail or fax in event of an emergency, such as the shut-down of equipment; or within 24 hours in a non-emergency. Names, mail and e-mail addresses and phone numbers of service organizations providing service under these conditions for (as applicable to the project): pumps, compressors, water heaters, critical instrumentation, computer workstation and programming shall be submitted for project record and inserted into the operations and maintenance manual.

1.18.1.3. All items furnished shall be free from defects that would adversely affect the performance, maintainability and appearance of individual components and overall assembly.

1.18.1.4. The products and execution of work specified in Division 22 shall conform to the referenced codes and standards as required by the specifications. Local codes and amendments enforced by the local code official shall be enforced, if required by local authorities such as the natural gas supplier. If the local codes

are more stringent, then the local code shall apply. Any conflicts shall be brought to the attention of the Consultant.

1.18.1.5. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.

1.18.1.6. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.

1.18.1.7. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.

1.18.2. Welding: Before any welding is performed, contractor shall submit a certificate certifying that welders comply with the following requirements:

1.18.2.1. Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code", Section IX, "Welding and Brazing Qualifications".

1.18.2.2. Comply with provisions of ASME B31 series "Code for Pressure Piping".

1.18.3. Manufacturer's Recommendations: Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished to the Consultant and then incorporated in the Operations and Maintenance Manuals prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.

1.19. **EXECUTION (INSTALLATION, CONSTRUCTION) QUALITY:**

1.19.1. All items shall be applied and installed in accordance with manufacturer's written instructions. Conflicts between the manufacturer's instructions and the contract documents shall be referred to the Consultant for resolution at least 10 working days prior to commencing installation of any item.

1.19.2. All items that require access, such as for operating, cleaning, servicing, maintenance, and calibration, shall be easily and safely accessible by persons standing at floor level, or standing on permanent platforms, without the use of portable ladders. Examples of these items include, but are not limited to: all types of valves, filters and strainers,

transmitters, and control devices. Prior to commencing installation work, refer conflicts between this requirement and contract documents to COR for resolution.

1.19.3. Plumbing Systems: Unless otherwise required herein, perform plumbing work in accordance with the latest version of OBC section 7 and other applicable by-laws by the Authorities Having Jurisdiction.

1.20. **CLEANLINESS OF PIPING AND EQUIPMENT SYSTEMS:**

1.20.1. Care shall be exercised in the storage and handling of equipment and piping material to be incorporated in the work. Debris arising from cutting, threading and welding of piping shall be removed.

1.20.2. Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.

1.20.3. The interior of all tanks shall be cleaned prior to delivery and beneficial use by the Client. All piping shall be tested in accordance with the specifications and OBC requirements. All filters, strainers, fixture faucets shall be flushed of debris prior to final acceptance.

1.20.4. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.

1.21. **DELIVERY, STORAGE AND HANDLING**

1.21.1. Protection of Equipment:

1.21.1.1. Equipment and material placed on the job site shall remain in the custody of the Contractor until phased acceptance, whether or not the Government has reimbursed the Contractor for the equipment and material. The Contractor is solely responsible for the protection of such equipment and material against any damage.

1.21.1.2. Damaged equipment shall be replaced with an identical unit as determined and directed by the COR. Such replacement shall be at no additional cost or additional time to the Client.

1.21.1.3. Interiors of new equipment and piping systems shall be protected against entry of foreign matter. Both inside and outside shall be cleaned before painting or placing equipment in operation.

1.21.1.4. Existing equipment and piping being worked on by the Contractor shall be under the custody and responsibility of the Contractor and shall be protected as required for new work.

1.22. **AS-BUILT DOCUMENTATION**

1.22.1. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.

1.22.2. Submit operation and maintenance data updated to include submittal review comments, substitutions and construction revisions shall be inserted into a three ring binder. All aspects of system operation and maintenance procedures, including piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices such as damper and door closure interlocks shall be included. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.

1.22.3. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. As-built drawings are to be provided, and a copy of them on Auto-Cad version 2007 or higher provided on compact disk or DVD. Should the installing contractor engage the consulting company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party company' requirement.

1.22.4. Certification documentation shall be provided prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and a certification that all results of tests were within limits specified.

PART 2 - PRODUCTS

2.1. **MATERIALS FOR VARIOUS SERVICES**

2.1.1. Plastic pipe, fittings and solvent cement shall meet C-NSF/ANSI 14 and C-NSF/ANSI 61. Solder or flux containing lead shall not be used with copper pipe.

2.1.2. n-line devices such as water meters, building valves, check valves, stops, valves, fittings, tanks and backflow preventers shall comply with C-NSF/ANSI 61 and C-NSF/ANSI 372.

2.1.3. End point devices such as drinking fountains, lavatory faucets, kitchen and bar faucets, ice makers supply stops, and end-point control valves used to dispense drinking water must meet requirements of C-NSF/ANSI 61 and C-NSF/ANSI 372.

2.2. **FACTORY-ASSEMBLED PRODUCTS**

2.2.1. Standardization of components shall be maximized to reduce spare part requirements.

2.2.2. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for final assembled unit.

2.2.3. All components of an assembled unit need not be products of same manufacturer.

2.2.4. Constituent parts that are alike shall be products of a single manufacturer.

2.2.5. Components shall be compatible with each other and with the total assembly for intended service.

2.2.6. Contractor shall guarantee performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly at no additional cost or time to the Government.

2.2.7. Components of equipment shall bear manufacturer's name and trademark, model number, serial number and performance data on a name plate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.

2.2.8. Major items of equipment, which serve the same function, shall be the same make and model.

2.3. **COMPATIBILITY OF RELATED EQUIPMENT**

2.3.1. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that the result will be a complete and fully operational system that conforms to contract requirements.

2.4. **SAFETY GUARDS**

2.4.1. Pump shafts and couplings shall be fully guarded by a sheet steel guard, covering coupling and shaft but not bearings. Material shall be minimum 16-gage sheet steel; ends shall be braked and drilled and attached to pump base with minimum of four 8 mm

(¼ inch) bolts. Reinforce guard as necessary to prevent side play forcing guard onto couplings.

2.4.2. All Equipment shall have moving parts protected from personal injury.

2.5. **LIFTING ATTACHMENTS**

2.5.1. Equipment shall be provided with suitable lifting attachments to enable equipment to be lifted in its normal position. Lifting attachments shall withstand any handling conditions that might be encountered, without bending or distortion of shape, such as rapid lowering and braking of load.

2.6. **ELECTRIC MOTORS, MOTOR CONTROL, CONTROL WIRING**

2.6.1. N/A

2.7. **VARIABLE SPEED MOTOR CONTROLLERS**

2.7.1. N/A

2.8. **EQUIPMENT AND MATERIALS IDENTIFICATION**

2.8.1. Use symbols, nomenclature and equipment numbers specified, shown on the drawings, or shown in the maintenance manuals. Coordinate equipment and valve identification with facility maintenance staff. In addition, provide bar code identification nameplate for all equipment which will allow the equipment identification code to be scanned into the system for maintenance and inventory tracking. Identification for piping is specified in Section 22 05 53. IDENTIFICATION FOR PLUMBING SYSTEMS

2.8.2. Interior (Indoor) Equipment: Engraved nameplates, with letters not less than 7 mm (3/16 inch) high of brass with black filled letters, or rigid black plastic with white letters specified in Section 22 05 53. IDENTIFICATION FOR PLUMBING SYSTEMS shall be permanently fastened to the equipment. Unit components such as water heaters, tanks, coils, filters, etc. shall be identified.

2.8.3. Exterior (Outdoor) Equipment: Brass nameplates, with engraved black filled letters, not less than 7 mm (3/16 inch) high riveted or bolted to the equipment.

2.8.4. Control Items: All temperature, pressure, and controllers shall be labeled and the component's function identified. Identify and label each item as they appear on the control diagrams.

2.8.5. Valve Tags and Lists:

2.8.5.1. Plumbing: All valves shall be provided with valve tags and listed on a valve list (Fixture stops not included).

2.8.5.2. Valve tags: Engraved black filled numbers and letters not less than 15 mm (1/2 inch) high for number designation, and not less than 8 mm (1/4 inch) for service designation on 19 gage, 40 mm (1 1/2 inches) round brass disc, attached with brass "S" hook or brass chain.

2.8.5.3. Valve lists: Valve lists shall be created using a word processing program and printed on plastic coated cards. The plastic coated valve list card(s), sized 215 mm (8 1/2 inches) by 275 mm (11 inches) shall show valve tag number, valve function and area of control for each service or system. The valve list shall be in a punched 3 ring binder notebook. An additional copy of the valve list shall be mounted in picture frames for mounting to a wall. COR shall instruct contractor where frames shall be mounted.

2.8.5.4. A detailed plan for each floor of the building indicating the location and valve number for each valve shall be provided in the 3-ring binder notebook. Each valve location shall be identified with a color coded sticker or thumb tack in ceiling or access door.

2.9. **FIRESTOPPING**

2.9.1. N/A

2.10. **GALVANIZED REPAIR COMPOUND**

2.10.1. Mil. Spec. DOD P 21035B, paint.

2.11. **PIPE AND EQUIPMENT SUPPORTS AND RESTRAINTS**

2.11.1. Type Numbers Specified: For materials, design, manufacture, selection, application, and installation refer to MSS SP 58. For selection and application refer to MSS SP 69.

2.11.2. For Attachment to Concrete Construction:

2.11.2.1. Concrete insert: Type 18, MSS SP 58.

2.11.2.2. Self drilling expansion shields and machine bolt expansion anchors: Permitted in concrete not less than 100 mm (4 inches) thick when approved by the COR for each job condition.

2.11.2.3. Power driven fasteners: Permitted in existing concrete or masonry not less than 100 mm (4 inches) thick when approved by the COR for each job condition.

2.11.3. For Attachment to Steel Construction: MSS SP 58.

2.11.3.1. Welded attachment: Type 22.
2.11.3.2. Beam clamps: Types 20, 21, 28 or 29. Type 23 C clamp may be used for individual copper tubing up to 23 mm (7/8 inch) outside diameter.

2.11.4. Attachment to Metal Pan or Deck: As required for materials specified

2.11.5. For Attachment to Wood Construction: Wood screws or lag bolts.

2.11.6. Hanger Rods: Hot rolled steel, ASTM A36/A36M or ASTM A575 for allowable load listed in MSS SP 58. For piping, provide adjustment means for controlling level or slope. Types 13 or 15 turn buckles shall provide 40 mm (1 1/2 inches) minimum of adjustment and incorporate locknuts. All thread rods are acceptable.

2.11.7. Multiple (Trapeze) Hangers: Galvanized, cold formed, lipped steel channel horizontal member, not less than 43 mm by 43 mm (1 5/8 inches by 1 5/8 inches), 2.7 mm (No. 12 gage), designed to accept special spring held, hardened steel nuts.

2.11.8. Guide individual pipes on the horizontal member of every other trapeze hanger with 8 mm (1/4 inch) U bolt fabricated from steel rod. Provide Type 40 insulation shield, secured by two 15 mm (1/2 inch) galvanized steel bands, or insulated calcium silicate shield for insulated piping at each hanger.

2.11.9. Pipe Hangers and Supports: (MSS SP 58), use hangers sized to encircle insulation on insulated piping. Refer to Section 22 07 11, PLUMBING INSULATION for insulation thickness. To protect insulation, provide Type 39 saddles for roller type supports or insulated calcium silicate shields. Provide Type 40 insulation shield or insulated calcium silicate shield at all other types of supports and hangers including those for insulated piping.

2.11.10. General Types (MSS SP 58):

2.11.10.1. Standard clevis hanger: Type 1; provide locknut.
2.11.10.2. Riser clamps: Type 8.
2.11.10.3. Wall brackets: Types 31, 32 or 33.
2.11.10.4. Roller supports: Type 41, 43, 44 and 46.
2.11.10.5. Saddle support: Type 36, 37 or 38.

2.11.10.6. Turnbuckle: Types 13 or 15.
2.11.10.7. U-bolt clamp: Type 24.

2.11.11. Copper Tube:

2.11.11.1. Hangers, clamps and other support material in contact with tubing shall be painted with copper colored epoxy paint, copper-coated, plastic coated or taped with isolation tape to prevent electrolysis.
2.11.11.2. For vertical runs use epoxy painted, copper-coated or plastic coated riser clamps.
2.11.11.3. For supporting tube to strut: Provide epoxy painted pipe straps for copper tube or plastic inserted vibration isolation clamps.
2.11.11.4. Insulated Lines: Provide pre-insulated calcium silicate shields sized for copper tube.

2.11.12. Supports for plastic or glass piping: As recommended by the pipe manufacturer with black rubber tape extending one inch beyond steel support or clamp.

2.11.13. Spring Supports (Expansion and contraction of vertical piping):

2.11.13.1. Movement up to 20 mm (3/4 inch): Type 51 or 52 variable spring unit with integral turn buckle and load indicator.
2.11.13.2. Movement more than 20 mm (3/4 inch): Type 54 or 55 constant support unit with integral adjusting nut, turn buckle and travel position indicator.
2.11.13.3. Spring hangers are required on all plumbing system pumps one horsepower and greater.

2.11.14. Plumbing Piping (Other Than General Types):

2.11.14.1. Horizontal piping: Type 1, 5, 7, 9, and 10.
2.11.14.2. Chrome plated piping: Chrome plated supports.
2.11.14.3. Hangers and supports in pipe chase: Prefabricated system ABS self-extinguishing material, not subject to electrolytic action, to hold piping, prevent vibration and compensate for all static and operational conditions.
2.11.15. Blocking, stays and bracing: Angle iron or preformed metal channel shapes, 1.3 mm (18 gage) minimum.

2.11.16. Pre-insulated Calcium Silicate Shields:

2.11.16.1. Provide 360 degree water resistant high density 965 kPa (140 psig) compressive strength calcium silicate shields encased in galvanized metal.

2.11.16.2. Pre-insulated calcium silicate shields to be installed at the point of support during erection.

2.11.16.3. Shield thickness shall match the pipe insulation.

2.11.16.4. The type of shield is selected by the temperature of the pipe, the load it must carry, and the type of support it will be used with.

2.11.16.5. Shields for supporting cold water shall have insulation that extends a minimum of 25 mm (1 inch) past the sheet metal.

2.11.16.6. The insulated calcium silicate shield shall support the maximum allowable water filled span as indicated in MSS SP-69. To support the load, the shields shall have one or more of the following features: structural inserts 4138 kPa (600 psig) compressive strength, an extra bottom metal shield, or formed structural steel (ASTM A36/A36M) wear plates welded to the bottom sheet metal jacket.

2.11.16.7. Shields may be used on steel clevis hanger type supports, trapeze hangers, roller supports or flat surfaces.

2.12. **PIPE PENETRATIONS**

2.12.1. Pipe penetration sleeves shall be installed for all pipe other than rectangular blocked out floor openings for risers in mechanical bays.

2.12.2. Pipe penetration sleeve materials shall comply with all firestopping requirements for each penetration.

2.12.3. To prevent accidental liquid spills from passing to a lower level, provide the following:

2.12.3.1. For sleeves: Extend sleeve 50 mm (2 inch) above finished floor and provide sealant for watertight joint.

2.12.3.2. For blocked out floor openings: Provide 40 mm (1 1/2 inch) angle set in silicone adhesive around opening.

2.12.3.3. For drilled penetrations: Provide 40 mm (1 1/2 inch) angle ring or square set in silicone adhesive around penetration.

2.12.3.4. Penetrations are not allowed through beams or ribs, but may be installed in concrete beam flanges, with structural engineer prior approval. Any deviation from these requirements must receive prior approval of the Consultant.

2.12.4. Sheet metal, plastic, or moisture resistant fiber sleeves shall be provided for pipe passing through floors, interior walls, and partitions, unless brass or steel pipe sleeves are specifically called for below.

2.12.5. Cast iron or zinc coated pipe sleeves shall be provided for pipe passing through exterior walls below grade. The space between the sleeve and pipe shall be made watertight with a modular or link rubber seal. The link seal shall be applied at both ends of the sleeve.

2.12.6. Galvanized steel or an alternate black iron pipe sleeve with asphalt coating sleeves shall be used for pipe passing through concrete beam flanges, except where brass pipe sleeves are called for. A galvanized steel sleeve shall be provided for pipe passing through floor of mechanical rooms, laundry work rooms, and animal rooms above basement. Except in mechanical rooms, sleeves shall be connected with a floor plate.

2.12.7. Brass Pipe Sleeves shall be provided for pipe passing through quarry tile, terrazzo or ceramic tile floors. The sleeve shall be connected with a floor plate.

2.12.8. Sleeve clearance through floors, walls, partitions, and beam flanges shall be 25 mm (1 inch) greater in diameter than external diameter of pipe. Sleeve for pipe with insulation shall be large enough to accommodate the insulation plus 25 mm (1 inch) in diameter. Interior openings shall be caulked tight with firestopping material and sealant to prevent the spread of fire, smoke, water and gases.

2.12.9. Pipe passing through roof shall be installed through a 4.9 kg per square meter copper flashing with an integral skirt or flange. Skirt or flange shall extend not less than 200 mm (8 inches) from the pipe and set in a solid coating of bituminous cement. Extend flashing a minimum of 250 mm (10 inches) up the pipe. Pipe passing through a waterproofing membrane shall be provided with a clamping flange. The annular space between the sleeve and pipe shall be sealed water

2.13. **TOOLS AND LUBRICANTS**

2.13.1. Furnish, and turn over to the Client, special tools not readily available commercially, that are required for disassembly or adjustment of equipment and machinery furnished.

2.13.2. Grease Guns with Attachments for Applicable Fittings: One for each type of grease required for each motor or other equipment.

2.13.3. Tool Containers: metal, permanently identified for intended service and mounted, or located, where directed by the Client.

2.13.4. Lubricants: A minimum of 0.95 L (1 quart) of oil, and 0.45 kg (1 pound) of grease, of equipment manufacturer's recommended grade and type, in unopened containers and

properly identified as to use for each different application. Bio-based materials shall be utilized when possible.

2.14. **WALL, FLOOR AND CEILING PLATES**

2.14.1. Material and Type: Chrome plated brass or chrome plated steel, one piece or split type with concealed hinge, with set screw for fastening to pipe, or sleeve. Use plates that fit tight around pipes, cover openings around pipes and cover the entire pipe sleeve projection.

2.14.2. Thickness: Not less than 2.4 mm (3/32 inch) for floor plates. For wall and ceiling plates, not less than 0.64 mm (0.025 inch) for up to 75 mm (3 inch) pipe, 0.89 mm (0.035 inch) for larger pipe.

2.14.3. Locations: Use where pipe penetrates floors, walls and ceilings in exposed locations, in finished areas only. Wall plates shall be used where insulation ends on exposed water supply pipe drop from overhead. A watertight joint shall be provided in spaces where brass or steel pipe sleeves are specified.

PART 3 - EXECUTION

3.1. **ARRANGEMENT AND INSTALLATION OF EQUIPMENT AND PIPING**

3.1.1. Location of piping, sleeves, inserts, hangers, and equipment, access provisions shall be coordinated with the work of all trades. Piping, sleeves, inserts, hangers, and equipment shall be located clear of windows, doors, openings, light outlets, and other services and utilities. Equipment layout drawings shall be prepared to coordinate proper location and personnel access of all facilities. The drawings shall be submitted for review.

3.1.2. Manufacturer's published recommendations shall be followed for installation methods not otherwise specified.

3.1.3. Operating Personnel Access and Observation Provisions: All equipment and systems shall be arranged to provide clear view and easy access, without use of portable ladders, for maintenance, testing and operation of all devices including, but not limited to: all equipment items, valves, backflow preventers, filters, strainers, transmitters, sensors, meters and control devices. All gages and indicators shall be clearly visible by personnel standing on the floor or on permanent platforms. Maintenance and operating space and access provisions that are shown on the drawings shall not be changed nor reduced.

3.1.4. Structural systems necessary for pipe and equipment support shall be coordinated to permit proper installation.

3.1.5. Location of pipe sleeves, trenches and chases shall be accurately coordinated with equipment and piping locations.

3.1.6. Cutting Holes:

3.1.6.1. Holes shall be located to avoid interference with structural members such as beams or grade beams. Holes shall be laid out in advance and drilling done only after approval by COR. If the Contractor considers it necessary to drill through structural members, this matter shall be referred to COR for approval.

3.1.6.2. Waterproof membrane shall not be penetrated. Pipe floor penetration block outs shall be provided outside the extents of the waterproof membrane.

3.1.6.3. Holes through concrete and masonry shall be cut by rotary core drill. Pneumatic hammer, impact electric, and hand or manual hammer type drill will not be allowed, except as permitted by the Consultant where working area space is limited.

3.1.7. Minor Piping: Generally, small diameter pipe runs from drips and drains, water cooling, trap priming and other service are not shown but must be provided.

3.2. **PROTECTION AND CLEANING:**

3.2.1. Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations. Damaged or defective items in the opinion of the Consultant, shall be replaced at no additional cost or time to the Client.

3.2.2. Protect all finished parts of equipment, such as shafts and bearings where accessible, from rust prior to operation by means of protective grease coating and wrapping. Close pipe openings with caps or plugs during installation. Pipe openings, equipment, and plumbing fixtures shall be tightly covered against dirt or mechanical injury. At completion of all work thoroughly clean fixtures, exposed materials and equipment.

3.2.3. Concrete and Grout: Concrete and shrink compensating grout 25 MPa (3000 psig) minimum, shall be used for all pad or floor mounted equipment.

3.2.4. Gages, thermometers, valves and other devices shall be installed with due regard for ease in reading or operating and maintaining said devices. Thermometers and gages shall be located and positioned to be easily read by operator or staff standing on floor or

walkway provided. Servicing shall not require dismantling adjacent equipment or pipe work.

3.2.5. Interconnection of Electrical Instrumentation and Controls: Electrical interconnection is generally not shown but shall be provided as specified. This includes interconnections of sensors, transmitters, transducers, control devices, control and instrumentation panels, alarms, instruments and computer workstations. Comply with NFPA 70.

3.3. **WORK IN EXISTING BUILDING:**

3.3.1. Make alterations to existing service piping at times that will cause the least interfere with normal operation of the facility.

3.3.2. Work in bathrooms, restrooms, housekeeping closets: All pipe penetrations behind escutcheons shall be sealed with plumbers putty.

3.3.3. Switchgear Drip Protection: Every effort shall be made to eliminate the installation of pipe above data equipment, and electrical and telephone switchgear. If this is not possible, encase pipe in a second pipe with a minimum of joints. Drain valve shall be provided in low point of casement pipe.

3.3.4. Inaccessible Equipment:

3.3.4.1. Where the Client determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled or remedial action performed as directed at no additional cost or additional time to the Client.

3.3.4.2. The term "conveniently accessible" is defined as capable of being reached without climbing or crawling under or over obstacles such as electrical conduit, motors, fans, pumps, belt guards, transformers, high voltage lines, piping, and ductwork.

3.4. **TEMPORARY PIPING AND EQUIPMENT**

3.4.1. Continuity of operation of existing facilities may require temporary installation or relocation of equipment and piping. Temporary equipment or pipe installation or relocation shall be provided to maintain continuity of operation of existing facilities.

3.4.2. The Contractor shall provide all required facilities in accordance with the requirements of phased construction and maintenance of service. All piping and equipment shall be

properly supported, sloped to drain, operate without excessive stress, and shall be insulated where injury can occur to personnel by contact with operating facilities.

3.4.3. Temporary facilities and piping shall be completely removed back to the nearest active distribution branch or main pipe line and any openings in structures sealed. Dead legs are not allowed in potable water systems. Necessary blind flanges and caps shall be provided to seal open piping remaining in service.

3.5. **RIGGING**

3.5.1. Openings in building structures shall be planned to accommodate design scheme.

3.5.2. Alternative methods of equipment delivery may be offered and will be considered by Government under specified restrictions of phasing and service requirements as well as structural integrity of the building.

3.5.3. All openings in the building shall be closed when not required for rigging operations to maintain proper environment in the facility for Government operation and maintenance of service.

3.5.4. Contractor shall provide all facilities required to deliver specified equipment and place on foundations. Attachments to structures for rigging purposes and support of equipment on structures shall be Contractor's full responsibility.

3.5.5. Contractor shall check all clearances, weight limitations and shall prepare a rigging plan; All modifications to structures, including reinforcement thereof, shall be at Contractor's cost, time and responsibility.

3.6. **THERMOMETERS AND PRESSURE GAUGES**

3.6.1. General:

3.6.1.1. Locate direct reading thermometers and gauges for reading from floor or platform.

3.6.1.2. Provide remote reading thermometers and gauges where direct reading instruments cannot be satisfactorily located.

3.6.1.3. Locate engraved lamacoid nameplate as specified in Section Identification, identifying medium adjacent to thermometers and gauges.

3.6.2. Thermometers:

3.6.2.1. Industrial, 9" adjustable angle cast aluminum case, CGSB standard CAN/CGSB-14.4-M88 red reading mercury, lens front tube, white scale black embossed figures, clear glass or acrylic window, tapered aluminum stem.

3.6.2.2. Scale shall be suitable for 2 times the temperature range of service. Scale shall be combined Celsius and Fahrenheit.

3.6.2.3. Standard of Acceptance: Weiss, Ashcroft, Trerice.

3.6.3. Pressure Gauges:

3.6.3.1. 5" dial, solid front blow out back, fibreglass reinforced polypropylene case, phosphor bronze bourdon tube and brass 1/4" N.P.T. socket, bottom connection, stainless steel rotary type movement, gauge to be registered with the Provincial Boiler and Pressure Vessel Safety Branch with a registration number and conform to ANSI B40.1. Accuracy to be grade "A".

3.6.3.2. On pumps liquid filled gauges shall be utilized.

3.6.3.3. Standard of Acceptance: Weiss, Ashcroft, Trerice.

3.6.3.4. Provide bronze stop cock, bronze bar stock ¼" N.P.T. bronze porous core pressure snubber for pulsating operation and diaphragm for corrosive service.

3.6.3.5. Use materials compatible with system requirements.

3.6.4. Gauges shall have combined kilopascal and psi scales.

3.7. **PIPE AND EQUIPMENT SUPPORTS**

3.7.1. Where hanger spacing does not correspond with joist or rib spacing, use structural steel channels secured directly to joist and rib structure that will correspond to the required hanger spacing, and then suspend the equipment and piping from the channels. Holes shall be drilled or burned in structural steel ONLY with the prior written approval of the Consultant

3.7.2. The use of chain pipe supports, wire or strap hangers; wood for blocking, stays and bracing, or hangers suspended from piping above shall not be permitted. Rusty products shall be replaced.

3.7.3. Hanger rods shall be used that are straight and vertical. Turnbuckles for vertical adjustments may be omitted where limited space prevents use. A minimum of 15 mm (1/2 inch) clearance between pipe or piping covering and adjacent work shall be provided.

3.7.4. Overhead Supports:

3.7.4.1. The basic structural system of the building is designed to sustain the loads imposed by equipment and piping to be supported overhead.

3.7.4.2. Provide steel structural members, in addition to those shown, of adequate capability to support the imposed loads, located in accordance with the final approved layout of equipment and piping.

3.7.5. Tubing and capillary systems shall be supported in channel troughs.

3.7.6. Floor Supports:

3.7.6.1. Provide concrete bases, concrete anchor blocks and pedestals, and structural steel systems for support of equipment and piping. Concrete bases and structural systems shall be anchored and doweled to resist forces under operating and seismic conditions (if applicable) without excessive displacement or structural failure.

3.7.6.2. Bases and supports shall not be located and installed until equipment mounted thereon has been approved. Bases shall be sized to match equipment mounted thereon plus 50 mm (2 inch) excess on all edges. Structural drawings shall be reviewed for additional requirements. Bases shall be neatly finished and smoothed, shall have chamfered edges at the top, and shall be suitable for painting.

3.7.6.3. All equipment shall be shimmed, leveled, firmly anchored, and grouted with epoxy grout. Anchor bolts shall be placed in sleeves, anchored to the bases. Fill the annular space between sleeves and bolts with a grout material to permit alignment and realignment.

3.8. **LUBRICATION**

3.8.1. All equipment and devices requiring lubrication shall be lubricated prior to initial operation. All devices and equipment shall be field checked for proper lubrication.

3.8.2. All devices and equipment shall be equipped with required lubrication fittings. A minimum of one liter (one quart) of oil and 0.45 kg (1 pound) of grease of manufacturer's recommended grade and type for each different application shall be provided. All materials shall be delivered to COR in unopened containers that are properly identified as to application.

3.8.3. A separate grease gun with attachments for applicable fittings shall be provided for each type of grease applied.

3.8.4. All lubrication points shall be accessible without disassembling equipment, except to remove access plates.

3.8.5. All lubrication points shall be extended to one side of the equipment.

3.9. PLUMBING SYSTEMS DEMOLITION

3.9.1. In an operating plant, cleanliness and safety shall be maintained. The plant shall be kept in an operating condition. Client's personnel will be carrying on their normal duties of operating, cleaning and maintaining equipment and plant operation. Work shall be confined to the immediate area concerned; maintain cleanliness and wet down demolished materials to eliminate dust. Dust and debris shall not be permitted to accumulate in the area to the detriment of plant operation. All flame cutting shall be performed to maintain the fire safety integrity of this plant. Adequate fire extinguishing facilities shall be available at all times. All work shall be performed in accordance with recognized fire protection standards.

3.9.2. Unless specified otherwise, all piping, wiring, conduit, and other devices associated with the equipment not re-used in the new work shall be completely removed from Client's property. This includes all concrete equipment pads, pipe, valves, fittings, insulation, and all hangers including the top connection and any fastenings to building structural systems. All openings shall be sealed after removal of equipment, pipes, ducts, and other penetrations in roof, walls, floors, in an approved manner and in accordance with plans and specifications where specifically covered. Structural integrity of the building system shall be maintained. Reference shall also be made to the drawings and specifications of the other disciplines in the project for additional facilities to be demolished or handled.

3.9.3. All valves including gate, globe, ball, butterfly and check, all pressure gages and thermometers with wells shall remain Client property and shall be removed and delivered to Client and stored as directed. The Contractor shall remove all other material and equipment, devices and demolition debris under these plans and specifications. Such material shall be removed from Client's property expeditiously and shall not be allowed to accumulate.

3.10. CLEANING AND PAINTING

3.10.1. Prior to final inspection and acceptance of the plant and facilities for beneficial use by the Client, the plant facilities, equipment and systems shall be thoroughly cleaned and painted.

3.10.2. In addition, the following special conditions apply:

3.10.2.1. Cleaning shall be thorough. Solvents, cleaning materials and methods recommended by the manufacturers shall be used for the specific tasks. All rust shall be removed prior to painting and from surfaces to remain unpainted. Scratches, scuffs, and abrasions shall be repaired prior to applying prime and finish coats.

3.10.3. The following Material and Equipment shall NOT be painted:

3.10.3.1. Motors, controllers, control switches, and safety switches.
3.10.3.2. Control and interlock devices.
3.10.3.3. Regulators.
3.10.3.4. Pressure reducing valves.
3.10.3.5. Control valves and thermostatic elements.
3.10.3.6. Lubrication devices and grease fittings.
3.10.3.7. Copper, brass, aluminum, stainless steel and bronze surfaces.
3.10.3.8. Valve stems and rotating shafts.
3.10.3.9. Pressure gages and thermometers.
3.10.3.10. Glass.
3.10.3.11. Name plates.

3.10.4. Control and instrument panels shall be cleaned and damaged surfaces repaired. Touch-up painting shall be made with matching paint type and color obtained from manufacturer or computer matched.

3.10.5. Pumps, motors, steel and cast iron bases, and coupling guards shall be cleaned, and shall be touched-up with the same paint type and color as utilized by the pump manufacturer.

3.10.6. The final result shall be a smooth, even-colored, even-textured factory finish on all items. The entire piece of equipment shall be repainted, if necessary, to achieve this. Lead based paints shall not be used.

3.11. **IDENTIFICATION SIGNS**

3.11.1. Laminated plastic signs, with engraved lettering not less than 7 mm (3/16 inch) high, shall be provided that designates equipment function, for all equipment, switches, motor controllers, relays, meters, control devices, including automatic control valves.

Nomenclature and identification symbols shall correspond to that used in maintenance manual, and in diagrams specified elsewhere. Attach by chain, adhesive, or screws.

3.11.2. Factory Built Equipment: Metal plate, securely attached, with name and address of manufacturer, serial number, model number, size, and performance data shall be placed on factory built equipment.

3.11.3. Pipe Identification: Refer to Section 22 05 53. IDENTIFICATION FOR PLUMBING SYSTEMS

3.12. **STARTUP AND TEMPORARY OPERATION**

3.12.1. Startup of equipment shall be performed as described in the equipment specifications. Vibration within specified tolerance shall be verified prior to extended operation.

3.12.2. Where commission is applicable, the commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the Commissioning Agent. Provide a minimum of 1 week weeks prior notice.

3.13. **OPERATING AND PERFORMANCE TESTS**

3.13.1. Prior to the final inspection, all required tests shall be performed. Submit the test reports and records to the Consultant.

3.13.2. Should evidence of malfunction in any tested system, or piece of equipment or component part thereof, occur during or as a result of tests, make proper corrections, repairs or replacements, and repeat tests at no additional cost to the Client.

3.13.3. When completion of certain work or systems occurs at a time when final control settings and adjustments cannot be properly made to make performance tests, then conduct such performance tests and finalize control settings during the first actual seasonal use of the respective systems following completion of work. Rescheduling of these tests shall be requested in writing to the Consultant for approval.

3.14. **OPERATION AND MAINTENANCE MANUALS**

3.14.1. All new and temporary equipment and all elements of each assembly shall be included.

3.14.2. Data sheet on each device listing model, size, capacity, pressure, speed, horsepower, impeller size, and other information shall be included.

3.14.3. Manufacturer's installation, maintenance, repair, and operation instructions for each device shall be included. Assembly drawings and parts lists shall also be included. A summary of operating precautions and reasons for precautions shall be included in the Operations and Maintenance Manual.

3.14.4. Lubrication instructions, type and quantity of lubricant shall be included.

3.14.5. Schematic diagrams and wiring diagrams of all control systems corrected to include all field modifications shall be included.

3.14.6. Set points of all interlock devices shall be listed.

3.14.7. Trouble-shooting guide for the control system troubleshooting shall be inserted into the Operations and Maintenance Manual.

3.14.8. The control system sequence of operation corrected with submittal review comments shall be inserted into the Operations and Maintenance Manual.

3.14.9. Emergency procedures for shutdown and startup of equipment and systems.

3.15. **CLOSE-OUT DOCUMENTATION**

3.15.1. 10 (ten) days prior to substantial performance of work obtain documentation and/or prepare certification of the following items and submit them to the Client representative:

3.15.1.1. All inspection certificates.
3.15.1.2. Guarantee certificates as called for under "Warranty".
3.15.1.3. Record drawings.
3.15.1.4. Operating and Maintenance Manuals.
3.15.1.5. Test certifications as called for under "Testing".
3.15.1.6. Provide a signed statement to the effect that all tests for mechanical systems and equipment have been completely carried out in the Trade Sections of these Specifications and to the manufacturer's recommendations, and in accordance with the requirements of all authorities having jurisdiction.

3.16. **COMMISSIONING**

3.16.1. Where applicable, provide commissioning documentation in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

3.17. **OPERATING AND PERFORMANCE TESTS**

3.17.1. Prior to the final inspection, perform required tests as specified and submit the test reports and records to the Consultant. The timing of the tests shall be arranged to suit the convenience of the Consultant, and the manner and duration shall be as the Consultant deems necessary. Record the daily start and stop times, operating hours and functions performed. Ensure that the performance tests are witnessed by the Consultant.

3.17.2. Should evidence of malfunction in any tested system, or piece of equipment or component part thereof, occur during or as a result of tests, make proper corrections, repairs or replacements, and repeat tests at no additional cost to the Client.

3.17.3. At the successful completion of Performance Tests and all testing and balancing, make the systems ready for final inspection and subsequent acceptance of the Client. Replace and clean filters, flush out lines and equipment, remove and clean strainers, fill liquid systems and purge air. Provide water treatment to pipes and report in accordance to current by-laws. Disinfect all domestic water as required by current by-laws and Authorities Having Jurisdiction.

3.17.4. When completion of certain work or system occurs at a time when final control settings and adjustments cannot be properly made to make performance tests, then make performance tests for heating systems and for cooling systems respectively during first actual seasonal use of respective systems following completion of work.

3.18. **DEMONSTRATION AND TRAINING**

3.18.1. Provide services of manufacturer’s technical representative for four hours to instruct Client’s personnel in operation and maintenance of the system.

PART 1 - GENERAL

1.1. DESCRIPTION

1.1.1. This section describes the requirements for general-duty valves for domestic water and sewer systems.

1.2. RELATED WORK

1.2.1. Section 01 33 23, SHOP DRAWINGS.
1.2.2. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

1.3. APPLICABLE PUBLICATIONS

1.3.1. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

1.3.2. American Society of Mechanical Engineers (ASME):

1.3.2.1. A112.14.1-2003 Backwater Valves

1.3.3. American Society of Sanitary Engineering (ASSE):

1.3.3.1. 1001-2008 Performance Requirements for Atmospheric Type Vacuum Breakers
1.3.3.2. 1003-2009 Performance Requirements for Water Pressure Reducing Valves for Domestic Water Distribution Systems
1.3.3.3. 1017-2009 Performance Requirements for Temperature Actuated Mixing Valves for Hot Water Distribution Systems
1.3.3.4. 1069-2005 Performance Requirements for Automatic Temperature Control Mixing Valves
1.3.3.5. 1070-2004 Performance Requirements for Water Temperature Limiting Devices
1.3.3.6. 1071-2012 Performance Requirements for Temperature Actuated Mixing Valves for Plumbed Emergency Equipment

1.3.4. American Society for Testing and Materials (ASTM):

1.3.4.1. A126-2004(R2009) Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
1.3.4.2. A276-2013a Standard Specification for Stainless Steel Bars and Shapes

1.3.4.3. A536-1984(R2009) Standard Specification for Ductile Iron Castings

1.3.5. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS):

1.3.5.1. SP-25-2008 Standard Marking Systems for Valves, Fittings, Flanges and Unions
1.3.5.2. SP-67-2011 Butterfly Valves
1.3.5.3. SP-70-2011 Gray Iron Gate Valves, Flanged and Threaded Ends
1.3.5.4. SP-71-2011 Gray Iron Swing Check Valves, Flanged and Threaded Ends
1.3.5.5. SP-80-2013 Bronze Gate, Globe, Angle, and Check Valves
1.3.5.6. SP-85-2011 Gray Iron Globe & Angle Valves, Flanged and Threaded Ends
1.3.5.7. SP-110-2010 Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

1.3.6. NSF International (NSF):

1.3.6.1. 61-2012 Drinking Water System Components – Health Effects
1.3.6.2. 372-2011 Drinking Water System Components – Lead Content

1.4. **SUBMITTALS**

1.4.1. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS

1.4.2. Manufacturer's Literature and Data Including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.

1.4.2.1. Ball Valves.
1.4.2.2. Gate Valves.
1.4.2.3. Butterfly Valves.
1.4.2.4. Balancing Valves.
1.4.2.5. Check Valves.
1.4.2.6. Globe Valves.
1.4.2.7. Water Pressure Reducing Valves and Connections.
1.4.2.8. Backwater Valves.
1.4.2.9. Backflow Preventers.
1.4.2.10. Vacuum Breakers
1.4.2.11. Chainwheels.
1.4.2.12. Thermostatic Mixing Valves.
1.4.2.13. Trap primer devices

1.4.2.14. Strainers
1.4.2.15. Non-freezing wall hydrants

1.4.3. Test and Balance reports for balancing valves.

1.4.4. Piping diagrams of thermostatic mixing valves to be installed.

1.5. **DELIVERY, STORAGE, AND HANDLING**

1.5.1. Valves shall be prepared for shipping as follows:

1.5.1.1. Protect internal parts against rust and corrosion.
1.5.1.2. Protect threads, flange faces, grooves, and weld ends.
1.5.1.3. Set angle, gate, and globe valves closed to prevent rattling.
1.5.1.4. Set ball and plug valves open to minimize exposure of functional surfaces.
1.5.1.5. Set butterfly valves closed or slightly open.
1.5.1.6. Block check valves in either closed or open position.

1.5.2. Valves shall be prepared for storage as follows:

1.5.2.1. Maintain valve end protection.
1.5.2.2. Store valves indoors and maintain at higher than ambient dew point temperature.

PART 2 - PRODUCTS

2.1. **VALVES, GENERAL**

2.1.1. Asbestos packing and gaskets are prohibited.

2.1.2. All valves shall have seats, stem seals and disc materials compatible with intended fluid, temperature, pressure and service.

2.1.3. Bronze valves shall be made with dezincification resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc shall not be permitted.

2.1.4. Valves in insulated piping shall have 50 mm or DN50 (2 inch) stem extensions and extended handles of non-thermal conductive material that allows operating the valve without breaking the vapor seal or disturbing the insulation. Memory stops shall be fully adjustable after insulation is applied.

2.1.5. Exposed Valves over 65 mm or DN65 (2-1/2 inches) installed at an elevation over 3.6 m (12 feet) shall have a chain-wheel attachment to valve hand-wheel, stem, or other actuator.

2.1.6. All valves used to supply potable water shall meet the requirements of NSF 61 and NSF 372.

2.1.7. Unless noted otherwise, valves shall be same size as piping.

2.1.8. Standards of acceptance: Jenkins, Crane, Toyo, Kitz

2.2. **SHUT-OFF VALVES**

2.2.1. Cold, Hot and Re-circulating Hot Water:

2.2.1.1. 50 mm or DN50 (2 inches) and smaller: Ball, MSS SP-110, Ball valve shall be full port three piece or two piece with a union design with adjustable stem package. Threaded stem designs are not allowed. The ball valve shall have a SWP rating of 1035 kPa (150 psig) and a CWP rating of 4138 kPa (600 psig). The body material shall be Bronze ASTM B584, Alloy C844. The ends shall be non-lead solder.

2.2.1.2. Less than 100 mm DN100 (4 inches): Butterfly shall have an iron body with EPDM seal and aluminum bronze disc. The butterfly valve shall meet MSS SP-67, type I standard. The butterfly valve shall have a SWP rating of 1380 kPa (200 psig). The valve design shall be lug type suitable for bidirectional dead-end service at rated pressure. The body material shall meet ASTM A536, ductile iron.

2.2.1.3. 100 mm DN100 (4 inches) and larger:

1

2.2.1.3.1. Class 125, OS&Y, Cast Iron Gate Valve. The gate valve shall meet MSS SP-70 type I standard. The gate valve shall have a CWP rating of 1380 kPa (200 psig). The valve materials shall meet ASTM A126, grey iron with bolted bonnet, flanged ends, bronze trim, and positive-seal resilient solid wedge disc. The gate valve shall be gear operated for sizes under 200 mm or DN200 (8 inches) and crank operated for sizes 200 mm or DN200 (8 inches) and above.

2.2.1.3.2. Single flange, ductile iron butterfly valves: The single flanged butterfly valve shall meet the MSS SP-67 standard. The butterfly valve shall have a CWP rating of 1380 kPa (200 psig). The butterfly valve shall be lug type, suitable for bidirectional dead-end service at rated pressure without use of

downstream flange. The body material shall comply with ASTM A536 ductile iron. The seat shall be EPDM with stainless steel disc and stem.

2.3. **BALANCING VALVES**

2.3.1. Hot Water Re-circulating, 75 mm or DN75 (3 inches) and smaller: manual balancing valve shall be of bronze body, brass ball construction with glass and carbon filled TFE seat rings and designed for positive shutoff. The manual balancing valve shall have differential pressure read-out ports across the valve seat area. The read out ports shall be fitting with internal EPT inserts and check valves. The valve body shall have 8 mm or DN8 NPT (1/4 inch NPT) tapped drain and purge port. The valves shall have memory stops that allow the valve to close for service and then reopened to set point without disturbing the balance position. All valves shall have calibrated nameplates to assure specific valve settings.

2.3.2. Larger than 75 mm or DN75 (3 inches): Manual balancing valves shall be of heavy duty cast iron flanged construction with 861 kPa (125 psig) flange connections. The flanged manual balancing valves shall have either a brass ball with glass and carbon filled TFE seal rings or fitted with a bronze seat, replaceable bronze disc with EPDM seal insert and stainless steel stem. The design pressure shall be 1200 kPa (175 psig) at 121 degrees C (250 degrees F).

2.3.3. Standard of Acceptance: Armstrong, Bell&Gossett, T&A suitable for potable water.

2.4. **CHECK VALVES**

2.4.1. 75 mm or DN75 (3 inches) and smaller shall be Class 125, bronze swing check valves with non-metallic disc suitable for type of service. The check valve shall meet MSS SP-80 Type 4 standard. The check valve shall have a CWP rating of 1380 kPa (200 psig). The check valve shall have a Y pattern horizontal body design with bronze body material conforming to ASTM B62, solder joints, and PTFE or TFE disc.

2.4.2. 100 mm or DN100 (4 inches) and larger: Check valves shall be Class 125, iron swing check valve with lever and weight closure control. The check valve shall meet MSS SP-71 Type I standard. The check valve shall have a CWP rating of 1380 kPa (200 psig). The check valve shall have a clear or full waterway body design with gray iron body material conforming to ASTM A126, bolted bonnet, flanged ends, bronze trim.

2.4.3. All check valves on the discharge side of submersible sump pumps shall have factory installed exterior level and weight with sufficient weight to prevent the check valve from hammering against the seat when the sump pump stops.

2.5. **GLOBE VALVES**

2.5.1. 75 mm or DN75 (3 inches) or smaller: Class 150, bronze globe valve with non-metallic disc. The globe valve shall meet MSS SP-80, Type 2 standard. The globe valve shall have a CWP rating of 2070 kPa (300 psig). The valve material shall be bronze with integral seal and union ring bonnet conforming to ASTM B62 with solder ends, copper-silicon bronze stem, PTFE or TFE disc, and malleable iron hand wheel.

2.5.2. Larger than 75 mm or DN75 (3 inches): Similar to above, except with cast iron body and bronze trim, Class 125, iron globe valve. The globe valve shall meet MSS SP-85, Type 1 standard. The globe valve shall have a CWP rating of 1380 kPa (200 psig). The valve material shall be gray iron with bolted bonnet conforming to ASTM A126 with flanged ends, bronze trim, and malleable iron handwheel.

2.6. **WATER PRESSURE REDUCING VALVE AND CONNECTIONS**

2.6.1. 75 mm or DN75 (3 inches) or smaller: The pressure reducing valve shall consist of a bronze body and bell housing, a separate access cover for the plunger, and a bolt to adjust the downstream pressure. The pressure reducing valve shall meet ASSE 1003. The bronze bell housing and access cap shall be threaded to the body and shall not require the use of ferrous screws. The assembly shall be of the balanced piston design and shall reduce pressure in both flow and no flow conditions. The assembly shall be accessible for maintenance without having to remove the body from the line.

2.6.2. 100 mm or DN100 (4 inches) and larger: The pressure reducing valve shall consist of a flanged cast iron body and rated to 1380 kPa (200 psig). The valve shall have a large elastomer diaphragm for sensitive response. The pressure reducing valve shall meet ASSE 1003.

2.6.3. The regulator shall have a tap for pressure gauge.

2.6.4. The regulator shall have a temperature rating of 100 degrees C (212 degrees F) for hot water or hot water return service. Pressure regulators shall have accurate pressure regulation to 6.9 kPa (+/- 1 psig).

2.6.5. Setting: Entering water pressure, discharge pressure, capacity, size, and related measurements shall be as shown on the drawings.

2.6.6. Connections Valves and Strainers: Shut off valves shall be installed on each side of reducing valve and a bypass line equal in size to the regulator inlet pipe shall be installed

with a normally closed globe valve. A strainer shall be installed on inlet side of, and same size as pressure reducing valve. A pressure gage shall be installed on the inlet and outlet of the valve.

2.6.7. Standard of Acceptance: Watts, Zurn, Powers

2.7. **BACKWATER VALVE**

2.7.1. The backwater valve shall have a cast iron body, automatic thermoplastic type valve seat and flapper suited for water service. The flapper shall be slightly open during periods of non operation. The pressure reducing valve shall meet ASME A112.14.1. The cleanout shall be extended to the finish floor and fit with a threaded countersunk plug. A clamping device shall be included when the cleanout extends through the waterproofing membrane.

2.7.2. When the backwater valve is installed greater than 600 mm (24 inches) below the finish floor elevation, a pit or manhole large enough for a repair person can enter to service the backwater valve shall be installed.

2.8. **BACKFLOW PREVENTERS**

2.8.1. A backflow prevention assembly shall be installed at any point in the plumbing system where the potable water supply comes in contact with a potential source of contamination.

2.8.2. Premises isolation Backflow Preventers

2.8.2.1. *50 mm (2 inches) and smaller*

2.8.2.1.1. Double Check Valve Assembly shall be installed at each noted location.
2.8.2.1.2. The assembly shall consist of two positive seating check modules with captured springs and rubber seat discs. The check module seats and seat discs shall be replaceable. Service ofall internal components shall be through a single access cover secured with stainless steel bolts.
2.8.2.1.3. The Double Check Valve Assemblies shall be constructed using Lead Free* cast copper silicon alloy.
2.8.2.1.4. The assembly shall also include two resilient seated isolation valves; four top mounted, resilient seated test cocks.
2.8.2.1.5. The assembly shall meet the requirements of ASSE Std. 1015 and AWWA Std. C510.
2.8.2.1.6. Standard of Acceptance: Watts Series LF007.

2.8.2.2. *65 mm (2½ inches) and larger*

2.8.2.2.1. Double Check Valve Assembly shall consist of two independent tri-link check modules within a single housing, sleeve access port, four test cocks and two drip tight OS&Y gate-type shut-off valves.

2.8.2.2.2. Tri-link checks shall be removable and serviceable, without the use of special tools. The housing shall be constructed of 304 Schedule 40 stainless steel pipe with groove end connections.

2.8.2.2.3. Tri-link checks shall have reversible elastomer discs and in operation shall produce drip tight closure against reverse flow caused by backpressure or back siphonage.

2.8.2.2.4. Standard of acceptance: Watts Series 757, 757N.

2.8.3. Fire protection backflow preventers

2.8.3.1. *65 mm (2½ inches) and larger*

2.8.3.1.1. Lead Free* Double Check Detector Assembly shall consist of two independent tri-link check modules within a single housing, sleeve access port, four test cocks and two drip tight OS&Y gate shutoff valves.

2.8.3.1.2. Tri-link checks shall be removable and serviceable, without the use of special tools. The housing shall be constructed of 304 Schedule 40 stainless steel pipe with groove end connections.

2.8.3.1.3. Tri-link checks shall have reversible elastomer discs and in operation shall produce drip tight closure against reverse flow caused by backpressure or backsiphonage.

2.8.3.1.4. The bypass assembly shall consist of a meter, which registers in either gallon or cubic measurement, a double check backflow assembly and required test cocks.

2.8.3.1.5. Standard of Acceptance: Watts Series LF757DCDA, LF757NDCDA.

2.8.4. Connections between domestic water and HVAC make-up water systems

2.8.4.1. Application: make-up water connections to heating systems, chilled water systems, glycol systems, cooling tower systems, irrigation systems, hose bibbs.

2.8.4.2. 6 mm to 75 mm (¼ to 3 inches)

2.8.4.3. Reduced Pressure Zone Assembly shall be installed at each potential health hazard location to prevent backflow due to backsiphonage and/or backpressure.

2.8.4.4. The assembly shall consist of an internal pressure differential relief valve located in a zone between two positive seating check modules with captured springs

and silicone seat discs. Seats and seat discs shall be replaceable in both check modules and the relief valve. There shall be no threads or screws in the waterway exposed to line fluids. Service of all internal components shall be through a single access cover secured with stainless steel bolts. Body and shutoffs shall be constructed using Lead Free* cast copper silicon alloy materials.

2.8.4.5. The assembly shall also include two resilient seated isolation valves, four resilient seated test cocks and an air gap drain fitting. The assembly shall meet the requirements of: USC; ASSE Std. 1013; AWWA Std. C511; CSA B64.4.

2.8.4.6. Standard of Acceptance: Watts Series LF009.

2.8.5. Vacuum Breakers

2.8.5.1. Atmospheric vacuum breakers shall be installed in the following applications.

2.8.5.1.1. Hose bibs.
2.8.5.1.2. Wall hydrants
2.8.5.1.3. Irrigation systems
2.8.5.1.4. All kitchen equipment, if not protected by air gap.

2.8.5.2. A spill-resistant atmospheric vacuum breaker shall be installed, in accordance with the manufacturer's instructions, as noted on the plans and specified herein.

2.8.5.3. The Lead Free* Atmospheric Vacuum Breaker shall be constructed using Lead Free* materials. Lead Free atmospheric vacuum breaker shall comply with provincial codes and standards where applicable, requiring reduced lead content.

2.8.5.4. The valve shall consist of a one piece modular check and float assembly made of engineered thermoplastic and housed in a Lead Free cast copper silicon alloy body. Springs shall be stainless steel. The valve shall be constructed with a molded diaphragm separating the air inlet from the potable water supply to prevent spillage.

2.8.5.5. Standard of Acceptance: Watts Series LF289.

2.9. **STRAINERS**

2.9.1. Minimum service rating of 860 kPa (125 psi) gauge pressure or 1½ times system pressure whichever is greater.

2.9.2. Cast iron body, cleanable Y pattern, Wye-pattern, removable stainless steel 20 (standard) mesh screen.

2.9.3. NSF 61/ANSI 372 compliant.

2.9.4. NPS 50 mm (2") nominal and under, screwed with brass cap.

2.9.5. NPS 65 mm (2½") and over flanged with bolted cap. Threaded screwed off center opening; blow down valve same diameter as threaded opening.

2.9.6. Standard of Acceptance; Zurn, Watts, Apollo

2.10. **TRAP PRIMERS**

2.10.1. Pressure operated (max. 4 traps)

2.10.1.1. Diaphragm operated primer with 13 mm (½") NPT connection, automatically activated when the pressure drops. Operating range of 138 to 552 kPa (20 to 80 psig) for a maximum of four (4) drain traps. To be installed on a cold fresh water line of 38 mm (1½") or less. Max. distance between trap primer and most remote trap: as per manufacturer's instruction

2.10.1.2. Provide ½" Type K hard copper tubing connection between trap primer valve and floor drain.

2.10.1.3. Acceptable product: PPP Oregon series.

2.10.2. Electronic trap primer (max. 12 traps)

2.10.2.1. With 13 mm (½") NPT connection, for a maximum of twelve (12) drain traps.

2.10.2.2. Supplied in a NEMA 1 box, power supply 115V. To be installed on a cold fresh water line of 38 mm (1½") or less. The prime-time priming assembly will supply a minimum of 600 ml (1 oz.) of potable water at 20 PSIG at a preset factory setting of 6 seconds every 24 hours.

2.10.2.3. The entire unit is pre-assembled in a steel cabinet ready to be either surface or flush wall mounted. The Priming assembly must be mounted above the finished floor.

2.10.2.4. Factory assembled with a bronze body ball valve, water hammer arrestor, solenoid valve, atmospheric vaccuum breaker, 24 hour timer, 3/4" NPT

connection, and a type L copper manifold. Electronic single point power connection 120V/1 amp draw and manual override switch

2.10.2.5. Provide ½" Type K hard copper tubing connection between trap primer valve and floor drain.

2.10.2.6. Acceptable product: PPP PTS series.

2.11. **WATER HAMMER ARRESTORS (SHOCK ABSORBERS)**

2.11.1. Closed copper tube chamber with permanently sealed 410 kPa (60 psig) air charge above a Double O-ring piston. Two high heat Buna-N 0-rings pressure packed and lubricated with FDA approved Dow Corning No. 11 silicone compound. All units shall be designed in accordance with ASSE 1010 for sealed wall installations without an access panel.

2.11.2. Provide arrestors at all solenoid valves and on branch supplies to each fixture or group of fixtures and where indicated. Conform to ASSE-1010. Stainless steel or copper construction.

2.11.3. Water-hammer arrestors dimension must be conform to ASSE-1010. Water inlet maximum pressure is 468.8 kPa (68 psi). NSF 61/ANSI 372 compliant.

2.11.4. Standard of Acceptable: Watts, Zurn, PPP

2.12. **NON FREEZING WALL HYDRANTS**

2.12.1. Wall type, recessed 177 x 177 (7" x 7") box, bronze or stainless steel; nickel finish, polished face brass valve with vacuum breaker, copper casing and key NPS 18 mm (¾").

2.12.2. Standards of Acceptance: Jay-R. Smith, Zurn, Watts.

2.12.3. Hose bib for garbage room: Recessed valve with 75 mm (3") center to center, screwdriver operated integral stops, C & F indexed cross handle, vacuum breaker for hose, spring loaded, lever operated self closing stop and check, 1500 mm (5') long flexible hose and spray. Mounted 1200 mm (4') above floor.

2.12.4. Acceptable product: Cambridge Brass 53T4543, 53T5547.

2.13. **CHAINWHEELS**

2.13.1. Valve chain wheel assembly with sprocket rim brackets and chain shall be constructed according to the following:

2.13.1.1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
2.13.1.2. Attachment: For connection to butterfly or valve stem.
2.13.1.3. Sprocket rim with chain guides: Ductile or cast iron of type and size required for valve with zinc coating.
2.13.1.4. Chain: hot dipped galvanized steel of size required to fit sprocket rim.

2.14. **THERMOSTATIC MIXING VALVES**

2.14.1. Thermostatic Thermostatic Mixing Valves shall comply with the following general performance requirements:

2.14.1.1. Shall meet ASSE requirements for water temperature control.
2.14.1.2. The body shall be cast bronze or brass with corrosion resistant internal parts preventing scale and biofilm build-up. Provide chrome-plated finish in exposed areas.
2.14.1.3. No special tool shall be required for temperature adjustment, maintenance, replacing parts and disinfecting operations.
2.14.1.4. Valve shall be able to be placed in various positions without making temperature adjustment or reading difficult.
2.14.1.5. Valve shall allow easy temperature adjustments to allow hot water circulation. Internal parts shall be able to withstand disinfecting operations of chemical and thermal treatment of water temperatures up to 82°C (180°F) for 30 minutes or 50 mg/L (50 ppm) chlorine residual concentration for 24 hours.
2.14.1.6. Parts shall be easily removed or replaced without dismantling the valves, for easy scale removal and disinfecting of parts.
2.14.1.7. Valve shall have a manual adjustable temperature control with locking mechanism to prevent tampering by end user. Outlet temperature shall be visible to ensure outlet temperature does not exceed specified limits, particularly after thermal eradication procedures.
2.14.1.8. Standards of Acceptance: Powers, Leonard.

2.14.2. Master Thermostatic Water Mixing Valves:

2.14.2.1. Application: Tempered water distribution from central hot water source at relatively constant flow.
2.14.2.2. Connections: Flanged or threaded union inlets and outlet.
2.14.2.3. Standard: ASSE 1017.
2.14.2.4. Pressure Rating: 861 kPa (125 psig).
2.14.2.5. Suitable for flows between 3 gpm and 200 gpm (0.2 l/s to 12.6 l/s)
2.14.2.6. Valves feature advanced paraffin actuation technology for dynamic response
2.14.2.7. Valves feature a single-seat design for virtual shut down in the event of cold-water failure, triple-duty check stops with screens, and a 5°F (3°C) approach temperature for low temperature hot water supply.
2.14.2.8. Construction: rough Lead-Free* bronze.
2.14.2.9. Dirt and lime resistant poppet and seat design.
2.14.2.10. Vandal-resistant locking mechanism to secure temperature setting
2.14.2.11. Rotatable union triple-duty checkstops
2.14.2.12. Standard of Acceptance: Powers Hydroguard LFMM 430 series, max pressure drop 5 psi (34.5 kPa).

2.14.3. Hi-Lo Water-Mixing-Valve Assemblies:

2.14.3.1. Application: Tempered water distribution from hot water source covering a wide range of flow.
2.14.3.2. Multi-valve Hi/Lo tempering valves are fully assembled, factory tested
2.14.3.3. Each system is equipped with highly-responsive thermostatic tempering valves listed to ASSE 1017 and CSA B125
2.14.3.4. Each system includes a PRV, ball valves, pressure/temperature gauges aand triple-duty check stops.
2.14.3.5. Dirt and lime resistant poppet and seat design
2.14.3.6. The valves shall be constructed using Lead Free* brass.
2.14.3.7. Valves assembly shall also include copper piping, ball valve(s) and temperature/pressure gauge for diagnostics. The tempering valve shall have union checkstops, an outlet temperature range of 90 – 160°F (32 – 71°C) (with lockable means), and a single seat design for positive shutoff.
2.14.3.8. Tempering valves are listed to ASSE 1017 and CSA B125.
2.14.3.9. Minimum flow: 0.5 gpm (1.9 l/min)
2.14.3.10. Minimum approach temperature: 5 deg.F (3 deg.C) above setpoint.
2.14.3.11. Standard of Acceptance: Powers LFSH 1430 series; max. pressure drop: 5 psi (34.5 kPa).

2.14.4. Water Temperature Limiting Devices(point of use tempering valves)

2.14.4.1. Application: Single plumbing fixture point-of-use such as sinks or lavatories.
2.14.4.2. Standard: ASSE 1070.
2.14.4.3. Pressure Rating: 861 kPa (125 psig).
2.14.4.4. Thermostatic tempering valve shall be constructed using lead free* cast copper silicon alloy material.
2.14.4.5. The valve shall feature advanced paraffin-based actuation technology and union connections for ease of maintenance. All internal components shall be corrosion-resistant. Valve shall feature integral checks to prevent crossflow and inlet screens to filter out debris. The valve shall be asse 1069, ASSE 1070, ASSE 1017 and IAPMO CUPC listed.
2.14.4.6. Capacity of the valve shall be up to 12.0 gpm (45.0 lpm) at 45psi (310 kpa) differential. Valve shall perform to a minimum flow of 0.5 gpm (2 lpm) to ASSE 1070.
2.14.4.7. Control temperature shall be adjustable between 80°F - 120°F (27 - 49°C). The valve shall feature a vandal-resistant lockable handle to prevent tampering.
2.14.4.8. Standard of acceptance: Powers Hydroguard LFLM 495. Max. Pressure drop: 5 psi (34.5 kPa).

PART 3 - EXECUTION

3.1. EXAMINATION

3.1.1. Valve interior shall be examined for cleanliness, freedom from foreign matter, and corrosion. Special packing materials shall be removed, such as blocks, used to prevent disc movement during shipping and handling.

3.1.2. Valves shall be operated in positions from fully open to fully closed. Guides and seats shall be examined and made accessible by such operations.

3.1.3. Threads on valve and mating pipe shall be examined for form and cleanliness.

3.1.4. Mating flange faces shall be examined for conditions that might cause leakage. Bolting shall be checked for proper size, length, and material. Gaskets shall be verified for proper size and that its material composition is suitable for service and free from defects and damage.

3.1.5. Do not attempt to repair defective valves; replace with new valves.

3.2. **INSTALLATION**

3.2.1. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

3.2.2. Valves Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

3.2.3. Valves shall be located for easy access and shall be provide with separate support.

3.2.4. Valves shall be accessible with access doors when installed inside partitions or above hard ceilings.

3.2.5. Valves shall be installed in horizontal piping with stem at or above center of pipe.

3.2.6. Valves shall be installed in a position to allow full stem movement.

3.2.7. Install chain wheels on operators for all valves 100 mm (4 inches) and larger and more than 3.6 m (12 feet) above floor. Chains shall be extended to 1524 mm (60 inches) above finished floor.

3.2.8. Check valves shall be installed for proper direction of flow and as follows:

3.2.8.1. Swing Check Valves: In horizontal position with hinge pin level and on top of valve.

3.2.8.2. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction. Locate backflow preventers in same room as connected equipment or system.

3.2.8.3. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.

3.2.8.4. Install pressure gages on outlet of backflow preventers.

3.2.8.5. Do not install bypass piping around backflow preventers.

3.2.9. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets.

3.2.10. Install cabinet-type units recessed in or surface mounted on wall as specified.

3.3. **STRAINERS**

3.3.1. Install upstream of all:

3.3.1.1. Solenoid valves
3.3.1.2. Pressure reducing valves

3.4. **WATER HAMMER ARRESTORS**

3.4.1. Arrestors should always be installed so that there is an unobstructed shock path to the arrestor. Doing otherwise could result in shake and rattle of the pipes when the valve is closed.

3.4.2. Arrestors should always be placed as near to the source of shock as possible (shower valves, dishwashers, laundry machines, flush valves) - one each on the hot and cold water lines.

3.4. **ELECTRONIC TRAP PRIMING**

3.4.1. Make all wiring and power supply connections in accordance with the manufacturer's instructions.

3.5. **THERMOSTATIC MIXING VALVES**

3.5.1. Install and pipe in strict accordance with the manufacturer's instructions

3.5.2. Provide all accessories required by the manufacturer's instructions (balancing valves, check valves, etc)

3.5.3. Start-up and adjustment: by manufacturer's representative

3.6. **LABELING AND IDENTIFYING**

3.6.1. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

3.6.2. Calibrated balancing valves.

3.6.3. Master, thermostatic, water mixing valves.

3.6.4. Manifold, thermostatic, water-mixing-valve assemblies.

3.6.5. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.

3.7. **ADJUSTING**

3.7.1. Valve packing shall be adjusted or replaced after piping systems have been tested and put into service but before final adjusting and balancing. Valves shall be replaced if persistent leaking occurs.

3.7.2. Set field-adjustable flow set points of balancing valves and record data. Ensure recorded data represents actual measured or observed conditions. Permanently mark settings of valves and other adjustment devices allowing settings to be restored. Set and lock memory stops. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

3.7.3. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

3.7.4. Testing and adjusting of balancing valves shall be performed by an independent NEBB Accredited Test and Balance Contractor. A final settings and flow report shall be submitted to the Client.

3.8. **COMMISSIONING**

3.8.1. Provide commissioning documentation in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

3.8.2. Components provided under this section of the specification will be tested as part of a larger system.

3.9. **DEMONSTRATION AND TRAINING**

3.9.1. Provide services of manufacturer's technical representative for fourhours to instruct Client's Personnel in operation and maintenance of the system.

3.9.2. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

1.1.1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2. SUMMARY

1.2.1. Section Includes:

1.2.1.1. Equipment labels.
1.2.1.2. Pipe labels.
1.2.1.3. Valve tags.
1.2.1.4. Warning tags.

1.3. ACTION SUBMITTALS

1.3.1. Product Data: For each type of product indicated.

1.3.2. Samples: For color, letter style, and graphic representation required for each identification material and device.

1.3.3. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

1.3.4. Valve numbering scheme.

1.3.5. Valve Schedules: For each piping system to include in maintenance manuals.

1.4. COORDINATION

1.4.1. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

1.4.2. Coordinate installation of identifying devices with locations of access panels and doors.

1.4.3. Install identifying devices before installing acoustical ceilings and similar concealment.

1.5. **WORK INCLUDED**

1.5.1. Furnish and install nameplates, valve tags, valve charts, and pipe markers on all Plumbing equipment, and piping.

1.5.2. Provide nameplates with the unit number and service designation on all plumbing equipment.

1.5.3. Indicate all valve tag numbers on Record Drawings and submit framed under glass valve tag charts including valve service and location.

1.5.4. Install color coded ceiling tacks in acoustical tile ceilings or color coded tape on ceiling grid to identify location of equipment, valves and dampers that require regular maintenance or are part of a life safety system (fire dampers, smoke dampers, sprinkler valves or main isolation valves).

1.5.5. Concealed fire protection valves shall be marked by red label triangles (3" equilateral) and circle dots (1" diameter). Triangles shall be placed on the wall nearest the valve with the apex pointing toward the ceiling tile. Dots shall be placed on border of ceiling tile.

1.5.6. Provide underground plastic pipe markers 6 to 8 inches below finish grade, directly above buried pipes.

1.5.7. Prepare valve charts and frame under glass. All valves and the tag numbers shall be shown on the Record As-Built Drawings.

1.5.8. Provide valve computer data base to match chart.

1.5.9. Prepare and install exterior protected brass plaques indicating underground service entrances.

PART 2 - PRODUCTS

2.1. **GENERAL**

2.1.1. Acceptable manufactures contingent on compliance with the specification.

2.1.1.1. Seton
2.1.1.2. Brady Corporation
2.1.1.3. Marking Services Incorporated

2.2. **EQUIPMENT NAMEPLATES**

2.2.1. Equipment nameplates shall be 3" x 6" long, 0.02" aluminum with a black enamel background with engraved natural aluminum letters similar to Seton Style 2065-20. Nameplate shall have pressure sensitive taped backing.

2.2.2. The nameplate shall contain the unit or equipment designation ("AHU" for air handling unit, "P" for circulating pump, etc.), unit number and area or system served.

2.2.3. Nameplates for exterior equipment shall be applied with waterproof adhesive.

2.3. **PIPE IDENTIFICATION AND VALVE TAGS**

2.3.1. General Requirements for Manufactured Pipe Labels:

2.3.1.1. Preprinted, color-coded, with lettering indicating service, showing flow direction, and area served (i.e. "domestic cold water").

2.3.1.2. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

2.3.1.3. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

2.3.1.4. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction, and visible all around pipe.

2.3.1.5. Lettering Size: At least 1-1/2 inches high.

2.3.2. All piping, except that piping which is within inaccessible chases, shall be identified.

2.3.3. Each marker background shall be appropriately color coded with a clearly printed legend to identify the contents of the pipe in conformance with the "Scheme for the Identification of Piping Systems" (ASME A13.1-1981).

2.3.4. Setmark snap-around markers shall be used for overall diameters up to 6" and straparound markers shall be used above 6" overall diameters.

2.3.5. Markers shall be located:

2.3.5.1. Adjacent to each valve
2.3.5.2. At each branch
2.3.5.3. At each cap for future
2.3.5.4. At each riser takeoff,
2.3.5.5. At each pipe passage through wall (each side)
2.3.5.6. At each pipe passage at 20’ – 0” intervals maximum.
2.3.5.7. At each piece of equipment.
2.3.5.8. At all access doors.
2.3.5.9. A minimum of one (1) marker shall be provided at each room.

2.3.6. Under ground pipe markers:

2.3.6.1. Provide detectable tape on all underground piping:
2.3.6.2. Labels shall be color coded and labeled the same as indoors.

2.3.7. Valve tags

2.3.7.1. All valves shall be designated by distinguishing numbers and letters carefully coordinated with a valve chart. Valve tags shall include what room(s) the valve serves and piece of equipment served.
2.3.7.2. Valve tags shall be color coded 0.032” anodized aluminum tags, with engraved letters similar to Seton S Type 250-BL or approved equal.

2.3.8. HVAC tags shall be round 2” diameter, similar to Seton 15426.

2.3.9. Plumbing tags shall be square 2” x 2” similar to Seton 42769.

2.3.10. Fire Protection tags shall be square 2” x 2” similar to Seton 42769 RED.

2.3.11. Lettering shall be ¼” high for type service and ½” for valve number. Tag shall indicate service and valve number.

2.3.12. Each service shall be a different color.

2.3.13. Tag shall be attached to valves with chain similar to Seton No 16 stainless steel jack chain.

2.3.14. Whenever a valve is above a hung ceiling, the valve tag shall be located immediately above the hung ceiling.

2.3.15. Provide a tag for every valve except:

2.3.15.1. Perimeter radiation shut-off valves that are located at the finned tube radiation element within the accessible (from the space) heating enclosure

2.3.16. Furnish a minimum of two (2) typed valve lists

2.3.17. Each framed under glass or Plexiglas. Each chart shall be enclosed in an approved 0.015" thick plastic closure for permanent protection.

2.3.18. Valve numbers shall correspond to those indicated on the Record Drawings and on the printed valve lists.

2.3.19. The printed list shall include the valve number, location and purpose of each valve. It shall state other necessary information such as the required opening or closing of another valve when one valve is to be opened or closed.

2.3.20. Printed framed valve lists shall be displayed in each Mechanical Room or in a location designated by the Client.

2.4. **VALVE DATA BASE.**

2.4.1. Provide a valve data base for all valves to operate on the building computer.

2.4.2. Every valve shall include:

2.4.2.1. Tag Number
2.4.2.2. Service (Hot water, Chilled water, Sprinkler, etc.)
2.4.2.3. Size
2.4.2.4. Operation
2.4.2.5. Location
2.4.2.6. Manufacture
2.4.2.7. Model number
2.4.2.8. Submittal reference

2.5. **UTILITY ENTRANCE DESIGNATIONS**

2.5.1. Provide a brass wall plaque, minimum 0.020" thickness, secured to the exterior wall just above the grade line for all buried service entrances or exits. Samples are: Water Service Below; Gas Service Below; Sanitary Sewer Below; Storm Sewer Below; Irrigation Water Below; etc.

2.5.2. Ceiling Tacks or Tape.

2.5.2.1. Provide steel color coded 3/4 inch diameter ceiling tacks in acoustical tile ceilings or color coded tape applied to ceiling grid to locate equipment, valves or dampers that require regular maintenance or are part of a Life Safety System.

2.5.2.2. The tacks or tapes shall be color codes as follows:

2.5.2.2.1. Yellow – HVAC
2.5.2.2.2. Red – Life Safety (fire dampers, sprinkler valves, etc.)
2.5.2.2.3. Green - Plumbing Valves.
2.5.2.2.4. Blue – Heating/Cooling Valves.

PART 3 - EXECUTION

3.1. **PREPARATION**

3.1.1. All surfaces shall be cleaned and insulated (if applicable) prior to installing any identification.

3.1.2. Exterior surfaces of outdoor equipment shall be dry and prepared to accept the specified identification.

3.2. **INSTALLATION**

3.2.1. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion. Seal with clear lacquer.

3.2.2. Install valve tags with chain.

3.2.3. Install plastic pipe markers in accordance with manufacturer’s Instructions.

3.2.4. Install plastic tape markers complete around pipe in accordance with manufacturer’s instructions.

3.2.5. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

3.2.6. Identify air handling units, pumps, domestic hot water heaters, fire pumps, heat transfer equipment tanks, water treatment devices, etc. with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.

3.2.7. Identify control panels and major control components outside panels with plastic nameplates.

3.2.8. Install detector tape on all under ground services in accordance with the manufactures recommendations.

3.2.9. Identify thermostats relating to air handling equipment serving multiple spaces.

3.2.10. Identify valves in main and branch piping with valve tags.

3.2.11. Tag automatic controls, instruments and relays. Key to control schematic.

3.2.12. Identify piping, concealed or exposed, with pipe markers or where buried using plastic tape pipe markers. Use tags on piping ¾ inch diameter and smaller. Identify service, flow direction and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 7 m (20 feet) on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

PART 1 - GENERAL

1.1. DESCRIPTION

1.1.1. Field applied insulation for thermal efficiency and condensation control for Plumbing piping and equipment.

1.1.2. Re-insulation of plumbing piping and equipment after asbestos abatement.

1.1.3. Definitions

1.1.3.1. ASJ: All service jacket, white finish facing or jacket.

1.1.3.2. Air conditioned space: Space having air temperature and/or humidity controlled by mechanical equipment.

1.1.3.3. Cold: Equipment or piping handling media at design temperature of 16 degrees C (60 degrees F) or below.

1.1.3.4. Concealed: Piping above ceilings and in chases, interstitial space, and pipe chases.

1.1.3.5. Exposed: Piping and equipment exposed to view in finished areas including mechanical equipment rooms or exposed to outdoor weather. Shafts, chases, interstitial spaces, unfinished attics, crawl spaces and pipe basements are not considered finished areas.

1.1.3.6. Hot: Plumbing equipment or piping handling media above 41 degrees C (105 degrees F).

1.1.3.7. Thermal conductance: Heat flow rate through materials.

1.1.3.8. Flat surface: Watts per square meter (BTU per hour per square foot).

1.1.3.9. Pipe or Cylinder: Watts per square meter (BTU per hour per linear foot).

1.1.3.10. Thermal Conductivity (k): Watt per meter, per degree C (BTU per inch thickness, per hour, per square foot, per degree F temperature difference).

1.1.3.11. Vapor Retarder (Vapor Barrier): A material which retards the transmission (migration) of water vapor. Performance of the vapor retarder is rated in terms of permeance (perms). or the purpose of this specification, vapor retarders shall have a maximum published permeance of 0.1 perms and vapor barriers shall have a maximum published permeance of 0.001 perms.

1.2. RELATED WORK

1.2.1. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING: General mechanical requirements and items, which are common to more than one section of Division 22.

1.3. **QUALITY ASSURANCE**

1.3.1. Criteria:

1.3.2. Comply with NFPA 90A, particularly paragraphs 4.3.3.1 through 4.3.3.6, 4.3.10.2.6, and 5.4.6.4,

1.3.3. Specified k factors are at 24 degrees C (75 degrees F) mean temperature unless stated otherwise. For pipe, use insulation manufacturer's published heat flow tables. For domestic hot water supply and return, run out insulation and condensation control insulation, no thickness adjustment need be made.

1.3.4. All materials shall be compatible and suitable for service temperature, and shall not contribute to corrosion or otherwise attack surface to which applied in either the wet or dry state.

1.3.5. Every package or standard container of insulation or accessories delivered to the job site for use must have a manufacturer's stamp or label giving the name of the manufacturer and description of the material

1.4. **SUBMITTALS**

1.4.1. Submit in accordance with Section 01 33 23, SHOP DRAWINGS

1.4.2. Shop Drawings:

1.4.2.1. All information, clearly presented, shall be included to determine compliance with drawings and specifications and ASTM, federal and military specifications.

1.4.2.2. Insulation materials: Specify each type used and state surface burning characteristics.

1.4.2.3. Insulation facings and jackets: Each type used.

1.4.2.4. Insulation accessory materials: Each type used.

1.4.2.5. Manufacturer's installation and fitting fabrication instructions for flexible unicellular insulation.

1.4.2.6. Make reference to applicable specification paragraph numbers for coordination.

1.5. **STORAGE AND HANDLING OF MATERIAL**

1.5.1. Store materials in clean and dry environment, pipe covering jackets shall be clean and unmarred. Place adhesives in original containers. Maintain ambient temperatures and conditions as required by printed instructions of manufacturers of adhesives, mastics and finishing cements.

1.6. **APPLICABLE PUBLICATIONS**

1.6.1. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.

1.6.2. National Fire Protection Association (NFPA):

1.6.2.1. 101-09 Life Safety Code

1.6.2.2. 251-06 Standard methods of Tests of Fire Endurance of Building Construction Materials

1.6.2.3. 255-06 Standard Method of tests of Surface Burning Characteristics of Building Materials

1.6.3. Underwriters Laboratories, Inc (UL):

1.6.3.1. 723 UL Standard for Safety Test for Surface Burning Characteristics of Building Materials with Revision of 08/03

1.6.4. Manufacturer's Standardization Society of the Valve and Fitting Industry (MSS):

1.6.4.1. SP58-2002 Pipe Hangers and Supports Materials, Design, and Manufacture

1.7. **STANDARDS OF ACCEPTANCE**

1.7.1. Owens/Corning, Knauf, Johns Mansville

PART 2 - PRODUCTS

2.1. **MINERAL FIBER OR FIBER GLASS**

2.1.1. ASTM C547 (Pipe Fitting Insulation and Preformed Pipe Insulation), class 1, k = 0.037 (0.26) at 24 degrees C (75 deg. F), for use at temperatures from -20 deg. C (-4 deg.F) and up to 230 deg.C (450 deg. F)with an all service vapor retarder jacket with polyvinyl chloride premolded fitting covering.

2.1.2. Application: all domestic water supply piping (hot, cold, recirculation), all horizontal sections of storm drains.

2.1.3. Thickness:

2.1.3.1. Piping larger than 75mm (3”): 38 mm thickness
2.1.3.2. Piping nominal 25mm-75mm (1-3”): 25 mm thickness
2.1.3.3. Piping nominal 19mm (3/4”) and less: 12 mm thickness
2.1.3.4. Outdoor insulation (any size): increase insulation thickness by 12 mm (1/2”)

2.1.4. At fittings and flanges (including water meter and body of roof drains), insulate with wrapped fiberglass insulation of same thickness as adjacent pipe, and cover with pre-molded PVC jackets. Seal edge of jacket with self-sealing vapor barrier tape.

Elbows, flanges and other fittings shall be insulated with the same material as is used on the pipe straights.

2.2. **INSULATION FACINGS AND JACKETS**

2.2.1. Vapor Retarder, higher strength with low water permeance = 0.02 or less perm rating, Beach puncture 50 units for insulation facing on pipe insulation jackets.

2.2.2. Facings and jackets

2.2.2.1. Concealed indoor areas:

2.2.2.1.1. Shall be all service type (ASJ) in concealed spaces and PVC Vapor Retarder jacketing in all exposed areas, including mechanical rooms and service areas.
2.2.2.1.2. All service Jacket (ASJ) shall be white kraft bonded to 0.025 mm (1 mil) thick aluminum foil, fiberglass reinforced, with pressure sensitive adhesive closure. Comply with ASTM C1136. Beach puncture 50 units, Suitable for painting without sizing. Jackets shall have minimum 40 mm (1-1/2 inch) lap on longitudinal joints and minimum 75mm (3 inch) butt strip on end joints. Butt strip material shall be same as the jacket. Lap and butt strips shall be self-sealing type with factory-applied pressure sensitive adhesive.
2.2.2.1.3. Standard of Acceptance: Zeston, Ceeco, Proto

2.2.2.2. Exposed indoor areas:

2.2.2.2.1. Shall be heavy PVC fitting covers (0.75 mm thickness. Overlap PVC covers on pipe insulation jackets as least 1 inch (25 mm) at each end. Secure fitting

covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.

2.2.2.3. Indoor Fittings Jackets

2.2.2.3.1. Pipe fitting insulation covering (jackets): Fitting covering shall be premolded to match shape of fitting and shall be polyvinyl chloride (PVC) minimum thickness 0.7 mm (0.03 inches). Provide color matching vapor retarder pressure sensitive tape.

2.2.2.3.2. Adhesive: Compatible with PVC jacket, and recommended by insulation material manufacturer.

2.2.2.3.3. Standard of Acceptance: Zeston, Ceeco, Proto

2.2.2.4. Aluminum Jackets – Outdoor Piping and Fittings

2.2.2.4.1. Aluminum Jacket-Piping systems: ASTM B209, 3003 alloy, H-14 temper, 0.6 mm (0.023 inch) minimum thickness with locking longitudinal joints. Jackets for elbows, tees and other fittings shall be factory-fabricated to match shape of fitting and of 0.6 mm (0.024) inch minimum thickness aluminum. Fittings shall be of same construction as straight run jackets but need not be of the same alloy. Factory-fabricated stainless steel bands shall be installed on all circumferential joints. Bands shall be 13 mm (0.5 inch) wide on 450 mm (18 inch) centers. System shall be weatherproof if utilized for outside service.

2.2.2.4.2. Field applied vapor barrier jackets shall be provided, in addition to the specified facings and jackets, on all exterior piping as well as on interior piping exposed to outdoor air (i.e.; in ventilated attics, piping in ventilated (not air conditioned) spaces, etc.) The vapor barrier jacket shall consist of a multi-layer laminated cladding with a maximum water vapor permeance of 0.001 perms. The minimum puncture resistance shall be 35 cm-kg (30 inch-pounds) for interior locations and 92 cm-kg (80 inch-pounds) for exterior or exposed locations or where the insulation is subject to damage.

2.2.2.4.3. Neither rivets, screws, staples nor any other fastener capable of penetrating the underlying vapor retarder shall be used to secure the aluminum jacketing.

2.2.2.4.4. Standards of Acceptance: Childers-Lock-on and Pabco-Surfeit.

2.3. **PIPE COVERING PROTECTION SADDLES**

2.3.1. Cold pipe support - indoors: Premolded pipe insulation 180 degrees (half-shells) on bottom half of pipe at supports. Material shall be cellular glass or high density Polyisocyanurate insulation of the same thickness as adjacent insulation. Density of Polyisocyanurate insulation shall be a minimum of 48 kg/m3 (3.0 pcf).

2.3.2. Warm or hot pipe supports - indoors: Premolded pipe insulation (180 degree half-shells) on bottom half of pipe at supports. Material shall be high density Polyisocyanurate (for temperatures up to 149 degrees C [300 degrees F]), cellular glass or calcium silicate. Insulation at supports shall have same thickness as adjacent insulation. Density of Polyisocyanurate insulation shall be a minimum of 48 kg/m^3 (3.0 pcf).

2.3.3. All piping – outdoors: Metallic shield shall be made of galvanized steel painted on both sides with a minimum two coats of aluminum paint. 180 degree for clevises and roller type hangers and 360 degree for clamp type hangers and supports. Shield and insert length and gauge shall be 400 mm (16") long and min. 2.75 mm (12ga) thickness.

2.4. **ADHESIVE, MASTIC, CEMENT**

2.4.1. Insulation manufacturers' published recommendations.

2.5. **MECHANICAL FASTENERS**

2.5.1. Wire: 1.3 mm thick (18 gage) soft annealed galvanized or 1.9 mm (14 gage) copper clad steel or nickel copper alloy.

2.5.2. Bands: 13 mm (1/2 inch) nominal width, brass, galvanized steel, aluminum or stainless steel.

2.6. **FIRESTOPPING MATERIAL**

2.6.1. N/A

2.7. **FLAME AND SMOKE**

2.7.1. Unless shown otherwise all assembled systems shall meet flame spread 25 and smoke developed 50 rating as developed under ASTM, NFPA and UL standards and specifications. See paragraph 1.3 "Quality Assurance".

PART 3 - EXECUTION

3.1. **GENERAL REQUIREMENTS**

3.1.1. Required pressure tests of piping joints and connections shall be completed and the work approved by the Consultant for application of insulation. Surface shall be clean and dry with all foreign materials, such as dirt, oil, loose scale and rust removed.

3.1.2. Except for specific exceptions, insulate all specified equipment, and piping (pipe, fittings, valves, accessories). Insulate each pipe individually. Do not use scrap pieces of insulation where a full length section will fit.

3.1.3. Insulation materials shall be installed in a first class manner with smooth and even surfaces, with jackets and facings drawn tight and smoothly cemented down at all laps. Insulation shall be continuous through all sleeves and openings, except at fire dampers and duct heaters (NFPA 90A). Vapor retarders shall be continuous and uninterrupted throughout systems with operating temperature 16 degrees C (60 degrees F) and below. Lap and seal vapor barrier over ends and exposed edges of insulation. Anchors, supports and other metal projections through insulation on cold surfaces shall be insulated and vapor sealed for a minimum length of 150 mm (6 inches).

3.1.4. Install vapor stops at all insulation terminations on either side of valves, pumps and equipment and particularly in straight lengths of pipe insulation.

3.1.5. Construct insulation on parts of equipment such as cold water pumps and heat exchangers that must be opened periodically for maintenance or repair, so insulation can be removed and replaced without damage. Install insulation with bolted 1 mm thick (20 gage) galvanized steel or aluminum covers as complete units, or in sections, with all necessary supports, and split to coincide with flange/split of the equipment.

3.1.6. Insulation on hot piping and equipment shall be terminated square at items not to be insulated, access openings and nameplates. Cover all exposed raw insulation with white sealer or jacket material.

3.1.7. Protect all insulations outside of buildings with aluminum jacket using lock joint or other approved system for a continuous weather tight system. Access doors and other items requiring maintenance or access shall be removable and sealable.

3.1.8. Plumbing work not to be insulated:

3.1.8.1. Piping and valves of fire protection system.

3.1.8.2. Factory pre-insulated components.
3.1.8.3. Over equipment nameplates.
3.1.8.4. Chromium plated brass piping.
3.1.8.5. Water piping in contact with earth.
3.1.8.6. Vibration control devices
3.1.8.7. Air chambers, unions, strainers, check valves, flow regulators.
3.1.8.8. Small horizontal cold water branch runs in partitions to individual fixtures may be without insulation for maximum distance of 900 mm (3 feet).

3.1.9. Apply insulation materials subject to the manufacturer's recommended temperature limits. Apply adhesives, mastic and coatings at the manufacturer's recommended minimum coverage.

3.1.10. Firestop Pipe insulation:

3.1.10.1. Provide firestopping insulation at fire and smoke barriers through penetrations. Fire stopping insulation shall be UL listed.

3.1.10.2. Pipe penetrations requiring fire stop insulation including, but not limited to the following:

3.1.10.2.1. Pipe risers through floors
3.1.10.2.2. Pipe chase walls and floors
3.1.10.2.3. Smoke partitions
3.1.10.2.4. Fire partitions
3.1.10.2.5. Freeze protection of above grade outdoor piping (over heat tracing tape): 20 mm (0.75) thick insulation, for all pipe sizes 75 mm(3 inches) and smaller and 25 mm(1inch) thick insulation for larger pipes. Provide metal jackets for all pipes. Provide where indicated on the drawings

3.1.11. Provide vapor barrier jackets over insulation as follows:

3.1.11.1. All piping exposed to outdoor weather.
3.1.11.2. All interior piping conveying fluids exposed to outdoor air (i.e. in attics, ventilated (not air conditioned) spaces, etc.

3.1.12. Provide metal jackets over insulation as follows:

3.1.12.1. All plumbing piping exposed to outdoor weather.

3.2. **INSULATION INSTALLATION**

3.2.1. Molded Mineral Fiber Pipe and Tubing Covering:

3.2.1.1. Fit insulation to pipe, aligning longitudinal joints. Seal longitudinal joint laps and circumferential butt strips by rubbing hard with a nylon sealing tool to assure a positive seal. Staples may be used to assist in securing insulation. Seal all vapor retarder penetrations on cold piping with a generous application of vapor barrier mastic. Provide inserts and install with metal insulation shields at outside pipe supports. Install freeze protection insulation over heating cable.

3.2.2. Contractor's options for fitting, flange and valve insulation:

3.2.2.1. Factory molded, ASTM C547 or field mitered sections, joined with adhesive or wired in place. For hot piping finish with a smoothing coat of finishing cement. For cold fittings, 16 degrees C (60 degrees F) or less, vapor seal with a layer of glass fitting tape imbedded between two 2 mm (1/16 inch) coats of vapor barrier mastic.

3.2.2.2. Fitting tape shall extend over the adjacent pipe insulation and overlap on itself at least 50 mm (2 inches).

3.2.2.3. Nominal thickness in millimeters and inches specified in the schedule at the end of this section.

3.3. **FIELD-APPLIED JACKET APPLICATION**

3.3.1. Apply PVC jacket where indicated, with 1 inch (25 mm) overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

3.3.2. Apply metal jacket where indicated, with 2-inch (50 mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel band 12 inches (300 mm) o.c. and at end joints. Provide vapor-barrier jackets. Aluminum jackets shall have seams located below the horizontal plane of the horizontal piping route. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and cover with aluminum jackets.

3.4. **COMMISSIONING**

3.4.1. N/A

PART 1 - GENERAL

1.1. DESCRIPTION

1.1.1. Domestic water systems, including piping, equipment and all necessary accessories as designated in this section.

1.2. RELATED WORK

1.2.1. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
1.2.2. Section 22 07 11, INSULATION - PLUMBING.

1.3. SUBMITTALS

1.3.1. Submit in accordance with Section 01 33 23, SHOP DRAWINGS

1.3.2. Manufacturer's Literature and Data: All items listed in Part 2 - Products.

1.4. APPLICABLE PUBLICATIONS

1.4.1. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

1.4.2. Ontario Building Code – Part 7

1.4.3. American National Standards Institute (ANSI):

1.4.3.1.	A13.1	Scheme for Identification of Piping Systems
1.4.3.2.	B16.3-2011	Malleable Iron Threaded Fittings Classes 150 and 300
1.4.3.3.	B16.9-2007	Factory-Made Wrought Butt Welding Fittings
1.4.3.4.	B16.11-2011	Forged Fittings, Socket-Welding and Threaded
1.4.3.5.	B16.15-2006	Cast Copper Alloy Threaded Fittings Classes 125 and 250
1.4.3.6.	B16.18-2001	Cast Copper Alloy Solder-Joint Pressure Fittings
1.4.3.7.	B16.22-2012	Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
1.4.3.8.	NSF/ANSI 61-2012	Drinking Water System Components - Health Effects

1.4.4. American Society for Testing and Materials (ASTM):

1.4.4.1.	A183-03(2009)	Carbon Steel Track Bolts and Nuts
1.4.4.2.	B32-08	Solder Metal
1.4.4.3.	B61-08	Steam or Valve Bronze Castings

1.4.4.4. B75/B75M-11 Seamless Copper Tube
1.4.4.5. B88-09 Seamless Copper Water Tube
1.4.4.6. B584-12a Copper Alloy Sand Castings for General Applications
1.4.4.7. B687-99(2011) Brass, Copper, and Chromium-Plated Pipe Nipples
1.4.4.8. E1120-08 Liquid Chlorine
1.4.4.9. E1229-08 Calcium Hypochlorite

1.4.5. American Water Works Association (AWWA):

1.4.5.1. C110/A21.10-12 Ductile Iron and Gray Iron
1.4.5.2. C151/A21.51-09 Ductile-Iron Pipe, Centrifugally Cast
1.4.5.3. C153/A21.53-11 Ductile-Iron Compact Fittings
1.4.5.4. C651-05 Disinfecting Water Mains

1.4.6. NSF International (NSF)

1.4.6.1. NSF/ANSI 61 (2012) Drinking Water System Components – Health Effects
1.4.6.2. NSF/ANSI 372 (2011) Drinking Water System Components – Lead Content

1.5. **QUALITY ASSURANCE**

1.5.1. All piping materials shall be compatible for temperature, pressure and service.

1.5.2. All piping materials of a given type shall be manufactured by a single source, and supplied by a single supplier.

1.5.3. All wetted seals shall be made from materials that are immune from chloramine degradation.

1.5.4. All joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer.

1.5.5. All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability.

PART 2 - PRODUCTS

2.1. **MATERIALS**

2.1.1. Material or equipment containing a weighted average of greater than 0.25 percent lead shall not be used in any potable water system intended for human consumption, and

shall be certified in accordance with NSF/ANSI 61 or NSF 372. Endpoint devices used to dispense water for drinking must meet the requirements of NSF/ANSI 61, Section 9.

2.2. **UNDERGROUND WATER SERVICE CONNECTIONS TO BUILDINGS**

2.2.1. N/A

2.3. **ABOVE GROUND (INTERIOR) WATER PIPING**

2.3.1. Pipe: Copper tube, ASTM B88, Type K or L, drawn.

2.3.2. Fittings for Copper Tube:

2.3.2.1. Wrought copper or bronze castings conforming to ANSI B16.18 and B16.22. Unions shall be bronze, MSS SP72 & SP 110, Solder or braze joints. Use 95/5 tin and antimony for all soldered joints.

2.3.2.2. Adapters: Provide adapters for joining screwed pipe to copper tubing.

2.3.3. Unions And Flanges

2.3.3.1. Unions, flanges and gasket materials to have a pressure rating of not less than 150 psig at 180 degrees. Gasket material for flanges and flanged fittings shall be teflon type. Treated paper gaskets are not acceptable.

2.3.3.2. 50 mm (2") and smaller copper unions:

2.3.3.2.1. ANSI B16.18 cast bronze union coupling or ANSI B15.24 Class 150 cast bronze flanges.

2.3.3.3. 65 mm (2½ ") and larger flanges:

2.3.3.3.1. ANSI B15.24 Class 150 cast bronze flanges with full face teflon gaskets.

2.3.4. Solder: For installation of the potable water systems, only lead free solder shall be used, as required by the Ontario Act. Regulation 815/84 of the Ontario Water Resources.

2.4. **EXPOSED WATER PIPING**

2.4.1. Finished Room: Use full iron pipe size chrome plated brass piping for exposed water piping connecting fixtures, casework, cabinets, equipment when not concealed.

2.4.2. Fittings: ANSI B16.15 cast bronze threaded fittings with chrome finish.

2.4.3. Nipples: ASTM B 687, Chromium-plated.

2.4.4. Unions: Mss SP-72, SP-110, Brass or Bronze with chrome finish. Unions 2-1/2 inches (65 mm) and larger shall be flange type with approved gaskets.

2.5. Unfinished Rooms, Mechanical Rooms and Kitchens: Chrome plated brass piping is not required.

2.6. **TRAP PRIMER WATER PIPING:**

2.6.1. Pipe: Copper tube, ASTM B88, type K, hard drawn.

2.6.2. Fittings: Bronze castings conforming to ANSI B16.18 Solder joints.

2.6.3. Solder: ASTM B32 composition Sb5. Provide non-corrosive flux.

2.7. **STRAINERS**

2.7.1. Provide on high pressure side of pressure reducing valves, upstream of solenoid valves, on suction side of pumps, on inlet side of indicating and control instruments and equipment subject to sediment damage and where shown on drawings. Strainer element shall be removable without disconnection of piping.

2.7.2. Water: Basket or "Y" type with easily removable cover and brass strainer basket.

2.7.3. Body: Smaller than 3 inches (80 mm), brass or bronze; 3 inches (80 mm) and larger, cast iron or semi-steel.

2.8. **DIELECTRIC FITTINGS**

2.8.1. Provide dielectric couplings or unions between ferrous and non-ferrous pipe.

2.9. **STERILIZATION CHEMICALS**

2.9.1. Hypochlorite: ASTM E1120-08
2.9.2. Liquid Chlorine: ASTM E1229-08

PART 3 - EXECUTION

3.1. **INSTALLATION**

3.1.1. Install branch piping for water from the piping system and connect to all fixtures, valves, cocks, outlets, casework, cabinets and equipment.

3.1.2. Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe, except for plastic and glass, shall be reamed to full size after cutting.

3.1.3. Install union and shut-off valve on pressure piping at connections to equipment.

3.1.4. Lay out pipe lines straight, plumb and in true alignment. Offset as required to avoid interference with other work, to conceal piping, to allow maximum headroom and to avoid interference with windows and doors. Lay out all pipes and establish their levels from bench marks, existing floors or finished grades.

3.1.5. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment

3.1.6. Piping shall be concealed unless indicated otherwise on drawings. Do not conceal piping until it has been inspected, tested, flushed and approved.

3.1.7. Use eccentric reducing fittings to increase or decrease pipe sizes. Bushings are not acceptable. Orient reducers to prevent trapping of water.

3.1.8. Locate groups of pipe parallel to each other, spaced to permit applying insulation and servicing of valves. Install hot and cold water lines at least 6 inches apart. Install piping at least 3 inches clear of electrical conduit and avoid running pipe within 3’-6” of electrical equipment, from floor to ceiling.

3.1.9. Grade all lines to facilitate drainage. Provide drain valves at bottom of risers and all low points in system. Design domestic hot water circulating lines with no traps.

3.1.10. All domestic water piping shall be insulated throughout. For cold water, use vapor barrier.

3.1.11. Connect branch lines at bottom of main serving fixtures below and pitch down so that main may be drained through fixture. Connect branch lines to top of main serving only fixtures located on floor above.

3.2. **COPPER PIPE JOINTS**

3.2.1. Remove all slivers and burrs remaining from the cutting operation by reaming and filing both pipe surfaces. Clean fitting and tube with metal brush, emery cloth or sandpaper. Remove residue from the cleaning operation, apply flux and assemble joint to socket stop. Apply flame to fitting until solder melts when placed at joint. Remove flame and feed solder into joint until full penetration of cup and ring of solder appears. Wipe excess solder and flux from joint.

3.3. **THREADED PIPE JOINTS**

3.3.1. Use a thread lubricant or teflon tape when making joints; no hard setting pipe thread cement or caulking will be allowed.

3.4. **PIPE HANGERS, SUPPORTS AND ACCESSORIES:**

3.4.1. All piping shall be supported per the requirements of the Ontario Building Code part 7

3.4.2. Shop Painting and Plating: Hangers, supports, rods, inserts and accessories used for pipe supports shall be shop coated with red lead or zinc chromate primer paint. Electroplated copper hanger rods, hangers and accessories may be used with copper tubing.

3.4.3. Floor, Wall and Ceiling Plates, Supports, Hangers:

3.4.3.1. Solid or split un-plated cast iron.
3.4.3.2. All plates shall be provided with set screws.
3.4.3.3. Pipe Hangers: Height adjustable clevis type.
3.4.3.4. Adjustable Floor Rests and Base Flanges: Steel.
3.4.3.5. Concrete Inserts: "Universal" or continuous slotted type.
3.4.3.6. Hanger Rods: Mild, low carbon steel, fully threaded or Threaded at each end with two removable nuts at each end for positioning rod and hanger and locking each in place.
3.4.3.7. Riser Clamps: Malleable iron or steel.
3.4.3.8. Rollers: Cast iron.
3.4.3.9. Self-drilling type expansion shields shall be "Phillips" type, with case hardened steel expander plugs.
3.4.3.10. Hangers and supports utilized with insulated pipe and tubing shall have 180 degree metal protection shield Centered on and welded to the hanger and support. The shield shall be 4 inches in length and be 16 gauge steel. The shield shall be sized for the insulation.

3.4.4. For cold piping, install hangers and supports to maintain an effective continuous thermal and vapor barrier between cold piping and hangers and supports.

3.4.5. Miscellaneous Materials: As specified, required, directed or as noted on the drawings for proper installation of hangers, supports and accessories.

3.4.6. With the installation of each flexible expansion joint, provide piping restraints for the upstream and downstream section of the piping at the flexible expansion joint. Provide calculations supporting the restraint length design and type of selected restraints.

3.4.7. Install chrome plated cast brass escutcheon with set screw at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.

3.5. **PENETRATIONS:**

3.5.1. Install pipe sleeves where piping passes through building construction including all walls, floors and ceilings.

3.5.2. For new wall construction, promptly and accurately locate and securely set sleeves in forms before concrete is poured. For masonry construction, set the sleeves over the piping for Masonry Contractor to build around.

3.5.3. Fire Stopping: Where pipes pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00. Completely fill and seal clearances between raceways and openings with the fire stopping materials.

3.5.4. Waterproofing: At floor penetrations, completely seal clearances around the pipe and make watertight with sealant

3.6. **TESTS**

3.6.1. General: Test system either in its entirety or in sections.

3.6.2. Potable Water System: Test after installation of piping and domestic water heaters, but before piping is concealed, before covering is applied, and before plumbing fixtures are connected. Fill systems with water and maintain hydrostatic pressure of 150 psi (1040 kPa) gage for two hours. No decrease in pressure is allowed. Provide a pressure gage with a shutoff and bleeder valve at the highest point of the piping being tested.

3.6.3. All Other Piping Tests: Test new installed piping under 1-1/2 times actual operating conditions and prove tight.

3.7. **VALVES INSTALLATION**

3.7.1. Install valves with stem in horizontal position whenever possible. All valves shall be easily accessible. Install valve in each water connection to fixture.

3.7.2. Install union and shut off valve on piping at connections to equipment and at all other locations indicated on the drawings.

3.7.3. Provide isolation valves on all main branch feeds to washroom fixture groups. Where possible, locate all valves in accessible ceilings. In hard ceiling areas, group valves to be accessed from one access door.

3.7.4. Backflow prevention device shall be installed in an accessible location, 5 (five) feet above finish floor.

3.7.5. Connect to fixtures and equipment in accordance with manufacturer's instructions.

3.8. **STERILIZATION**

3.8.1. After tests have been successfully completed, thoroughly flush and sterilize the interior domestic water distribution system in accordance with the Ontario Building Code part 7, the requirements of Authorities Having Jurisdiction and AWWA C651.

3.8.2. Use liquid chlorine or hypochlorite for sterilization.

PART 1 - GENERAL

1.1. DESCRIPTION

1.1.1. This section pertains to storm and sanitary sewer and sanitary vent systems, including piping, equipment and all necessary accessories as designated in this section.

1.2. RELATED WORK

1.2.1. Section 01 33 23, SHOP DRAWINGS.
1.2.2. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING
1.2.3. Section 22 07 11, PLUMBING INSULATION.

1.3. APPLICABLE PUBLICATIONS

1.3.1. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

1.3.1.1. Ontario Building Code – Part 7

1.4. SUBMITTALS

1.4.1. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS.

1.4.2. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.

1.4.2.1. Piping.
1.4.2.2. Penetration Sleeves.
1.4.2.3. Pipe Fittings.
1.4.2.4. Exposed Piping and Fittings.

1.4.3. Detailed shop drawing of clamping device and extensions when required in connection with the waterproofing membrane or the floor drain.

1.5. AS-BUILT DOCUMENTATION

1.5.1. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification

testing. As-built drawings are to be provided, and a copy of them on Auto-Cad version 2007 or higher provided on compact disk or DVD. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement.

1.5.2. Certification documentation shall be provided prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and a certification that all results of tests were within limits specified.

PART 2 - PRODUCTS

2.1. **UNDERGROUND STORM AND SANITARY DRAINS – GRAVITY FLOW**

2.1.1. Main line sewers will be PVC SDR35 sewer pipe and shall be in compliance with ASTM D3040 or ASTM F1760 and third party certified to CSA B182.2.

2.1.2. Sewer laterals will be PVC SDR28 sewer pipe and shall be third party certified by CSA as above.

2.1.3. Joints

2.1.3.1. Sealing gaskets must meet the requirements of ASTM D3034 or ASTM F1760, CSA B182.2.

2.1.3.2. In addition, the pipe joints must be able to withstand a minimum hydrostatic pressure of 345 kPa (50 psi) without leakage.

2.1.4. Pipe Stiffness

2.1.4.1. The minimum ring stiffness shall be 320 kPa (46 psi) for SDR35 pipe and 625 kPa (90 psi) for SDR 28.

2.1.4.2. This stiffness will be determined using the test methods prescribed by ASTM D3034 and ASTM F1760.

2.1.5. Fittings

2.1.5.1. Injection-molded gasketed PVC fittings shall meet the requirements of ASTM 3034 and ASTM F1336 and shall be certified to CSA B182.1 or CSA B182.2.

2.1.5.2. Fabricated fittings must conform to ASTM F1336 and CSA B182.2

2.1.6. Standard of Acceptance: IPEX Ring-Tite

2.2. **ABOVE GROUND STORM AND SANITARY DRAINS/VENTS - GRAVITY FLOW**

2.2.1. Smaller than 75 mm (3") diam.

2.2.1.1. Copper DWV tube sanitary waste, drain and vent drawn temper conforming to ASTM B306.

2.2.1.2. The copper drainage fittings shall be cast copper or wrought copper conforming to CSA B158.1, ASME B16.23 or ASME B16.29.

2.2.1.3. The joints shall be lead free, using a water flushable flux, and conforming to ASTM B32

2.2.2. Larger than 100 mm (4") diam

2.2.2.1. Cast iron Pipe shall be bell and spigot or hubless (plain end or no-hub or hubless).

2.2.2.2. The material for all pipe and fittings shall be cast iron soil pipe and fittings and shall conform to the requirements of CSA B70, ASTM A888, or ASTM A74.

2.2.2.3. Cast iron pipe and fittings shall be made from a minimum of 95 percent post-consumer recycled material.

2.2.2.4. Joints for hubless pipe and fittings shall conform to the manufacturer's installation instructions. Couplings for hubless joints shall conform to CISPI 310. Joints for hub and spigot pipe shall be installed with compression gaskets conforming to the requirements of ASTM C564.

2.3. **ACID RESISTANT PIPING**

2.3.1. General

2.3.1.1. Acid waste drain and vent system, as shown on drawings, shall be NSF listed, Schedule 40, polypropylene as manufactured by IPEX to include pipe supplied in

10 ft. lengths (or 20 ft lengths if NFRPP is specified), and matched fittings, traps and neutralization tanks from the same manufacturer.

2.3.1.2. It shall also include recommended adapters to connect to other piping materials, where applicable.

2.3.2. Material

2.3.2.1. Pipe shall be made from NSF listed Type 110 or 210, flame retardant polypropylene conforming to ASTM D4101, with a maximum average flame spread of zero seconds and a maximum extent of burning of 13 mm, in accordance with ASTM D635.

2.3.2.2. Matched fittings shall be made from NSF listed flame retardant polypropylene with average maximum burn time of 80 seconds and maximum extent of burning of 20 mm in accordance with ASTM D635.

2.3.2.3. If NFRPP pipe is specified, it shall be made from NSF 14 listed and CSA certified Schedule 40 PP as manufactured by IPEX. Pipe shall comply with ASTM F1412 and material used shall comply with the material requirements of ASTM D4101.

2.3.3. Fittings

2.3.3.1. Fittings shall be NSF listed, be of all plastic construction and be designed to lock into a machined groove on the mating piping. All fittings shall have integrally molded union connections. No metallic grab rings or clamps shall be allowed.

2.3.3.2. Fittings containing EVA (ethylene vinyl acetate) are strictly prohibited. Couplings shall not be added to make mechanical joint fittings. Fittings shall be Labline or approved equivalent.

2.3.4. Joints

2.3.4.1. Connections between polypropylene pipe and matched fittings shall be made using the Labline Joint.

2.3.5. Installation And Testing

2.3.5.1. Installation and testing shall be in accordance with the contract drawings, the manufacturer’s recommendations and the local plumbing codes. Testing with

compressed air is prohibited. The entire system shall be installed free of stress and in proper alignment.

2.3.5.2. Horizontal supports shall provide a wide bearing area and be free of burrs or sharp edges. Support spacings shall be in accordance with the manufacturer's recommendations and local plumbing codes.

2.3.5.3. Vertical piping shall have riser clamps at each floor. Pipe supports shall be installed so that horizontal piping is in uniform alignment and with a uniform slope of at least 1/8" per foot, or in accordance with the local plumbing codes.

2.3.6. Standard of Acceptance: IPEX Labline

2.3.7. **STORM AND SANITARY DRAINS – PUMPED FLOW**

2.3.7.1. Smaller than 75 mm (3") diam above ground:

2.3.7.1.1. Copper pump discharge pipe and fittings:

- Copper tube shall be hard drawn Type K or L conforming to ASTM B88.
- Fittings shall be cast copper alloy conforming to ASME B16.18 or wrought copper conforming to ASME B16.22 with solder joint ends.
- Unions shall be copper alloy, hexagonal stock body with ball and socket, metal to metal seating surface conforming to MSS SP-123 with female solder-jointor threaded ends.
- Flanges shall be Class 150, cast copper conforming to ASME B16.24 with solder-joint end.
- Flange gaskets shall be full face, flat nonmetallic, asbestos free conforming to ASME B16.21.
- Flange nuts and bolts shall be carbon steel conforming to ASME B18.2.1.
- Solder shall be lead free, water flushable flux conforming to ASTM B32 and ASTM B813.

2.3.7.2. Larger than 100 mm (4") diam) above ground

2.3.7.2.1. Galvanized steel pump discharge pipe and fittings:

- Galvanized steel pipe shall be Schedule 40 weight class conforming to ASTM A53/A53M, with square cut grooved or threaded ends to match joining method.

- Fittings shall be Class 125, gray-iron threaded fittings conforming to ASME B16.4.
- Unions shall be Class 150 hexagonal-stock body with ball and socket, metal to metal, bronze seating surface, malleable iron conforming to ASME B16.39 with female threaded ends.
- Flanges shall be Class 125 cast iron conforming to ASME B16.1.
- Flange gaskets shall be full face, flat nonmetallic, asbestos free conforming to ASME B16.21.
- Flange nuts and bolts shall be carbon steel conforming to ASME B18.2.1.

2.3.7.3. All sizes, buried pumped sanitary pipe:

2.3.7.3.1. Polyethylene piping, Series 160 or higher of CAN/CSA-B137.1

2.4. **EXPOSED SANITARY PIPING**

2.4.1. Chrome plated brass piping of full iron pipe size shall be used in finished rooms for exposed waste piping connecting fixtures, casework, cabinets, equipment awhen not concealed by apron.

2.4.1.1. The Pipe shall meet ASTM B43, regular weight.
2.4.1.2. The Fittings shall conform to ASME B16.15 and ASTM D2665.
2.4.1.3. Nipples shall conform to ASTM B687, Chromium-plated.
2.4.1.4. Unions shall be brass or bronze with chrome finish. Unions 65 mm (2 1/2 inches) and larger shall be flange type with approved gaskets.

2.4.2. The finished room classification does not include mechanical Rooms, service rooms. .

2.5. **SPECIALTY PIPE FITTINGS**

2.5.1. Transition pipe couplings shall join piping with small differences in outside diameters or different materials. End connections shall be of the same size and compatible with the pipes being joined. The transition coupling shall be elastomeric, sleeve type reducing or transition pattern and include shear and corrosion resistant metal, tension band and tightening mechanism on each end. The transition coupling sleeve coupling shall be of the following material:

2.5.1.1. For cast iron drain pipes, the sleeve material shall be rubber conforming to ASTM C564.
2.5.1.2. For PVC drain pipes, the sleeve material shall be elastomeric seal or PVC, conforming to ASTM F477 or ASTM D5926.

2.5.1.3. For dissimilar pipes, the sleeve material shall be PVC conforming to ASTM D5926, or other material compatible with the pipe materials being joined.

2.5.2. The dielectric fittings shall conform to ASSE 1079 with a pressure rating of 861 kPa (125 psig) at a minimum temperature of 82 degrees C (180 degrees F). The end connection shall be solder joint copper alloy and threaded ferrous.

2.5.3. Dielectric flange insulating kits shall be of non-conducting materials for field assembly of companion flanges with a pressure rating of 1035 kPa (150 psig). The gasket shall be neoprene or phenolic. The bolt sleeves shall be phenolic or polyethylene. The washers shall be phenolic with steel backing washers.

2.5.4. The di-electric nipples shall be electroplated steel nipple complying with ASTM F1545 with a pressure rating of 2070 kPa (300 psig) at 107 degrees C (225 degrees F). The end connection shall be male threaded. The lining shall be inert and noncorrosive propylene.

2.6. **PENETRATION SLEEVES**

2.6.1. A sleeve flashing device shall be provided at points where pipes pass through membrane waterproofed floors or walls. The sleeve flashing device shall be manufactured, cast iron fitting with clamping device that forms a sleeve for the pipe floor penetration of the floor membrane. A galvanized steel pipe extension shall be included in the top of the fitting that will extend 50 mm (2 inches) above finished floor and galvanized steel pipe extension in the bottom of the fitting that will extend through the floor slab. A waterproof caulked joint shall be provided at the top hub.

PART 3 - EXECUTION

3.1. **PIPE INSTALLATION**

3.1.1. The pipe installation shall comply with the requirements of the Ontario Building Code part 7 and these specifications.

3.1.2. Branch piping shall be installed for waste from the respective piping systems and connect to all fixtures, valves, cocks, outlets, casework, cabinets and equipment.

3.1.3. Provide and size venting to all plumbing fixtures and fixture groups in accordance to Ontario Water Resources Act, Plumbing Code most recent edition, and local authorities having jurisdiction.

3.1.4. Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe shall be reamed to full size after cutting.

3.1.5. All pipe runs shall be laid out to avoid interference with other work.

3.1.6. The piping shall be installed above accessible ceilings where possible.

3.1.7. The piping shall be installed to permit valve servicing or operation.

3.1.8. The piping shall be installed free of sags and bends.

3.1.9. Seismic restraint shall be installed where required by code.

3.1.10. Changes in direction for soil and waste drainage and vent piping shall be made using appropriate branches, bends and long sweep bends. Sanitary tees and short sweep quarter bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Long turn double wye branch and eighth bend fittings shall be used if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Proper size of standard increaser and reducers shall be used if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

3.1.11. Provide minimum slope of 1% for all horizontal sections larger than 100 mm (4”) diam and 2% for all horizontal sections of 75 mm (3”) or less. Buried drain lines and vent piping shall be laid beginning at the low point of each system. Piping shall be installed true to grades and alignment indicated with unbroken continuity of invert. Hub ends shall be placed upstream. Required gaskets shall be installed according to manufacturer’s written instruction for use of lubricants, cements, and other installation requirements.

3.1.12. Except for where a single sink is served, no buried sanitary line shall be less than 100 mm (4”) diam. Run buried piping min 200 mm (8”) below the bottom of concrete slabs.

3.2. **JOINT CONSTRUCTION**

3.2.1. Hub and spigot, cast iron piping with gasket joints shall be joined in accordance with CISPI’s “Cast Iron Soil Pipe and Fittings Handbook” for compression joints.

3.2.2. Hub and spigot, cast iron piping with calked joints shall be joined in accordance with CISPI’s “Cast Iron Soil Pipe and Fittings Handbook” for lead and oakum calked joints.

3.2.3. Hubless or No-hub, cast iron piping shall be joined in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless piping coupling joints.

3.2.4. For threaded joints, thread pipe with tapered pipe threads according to ASME B1.20.1. The threads shall be cut full and clean using sharp disc cutters. Threaded pipe ends shall be reamed to remove burrs and restored to full pipe inside diameter. Pipe fittings and valves shall be joined as follows:

3.2.4.1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is required by the pipe service.

3.2.4.2. Pipe sections with damaged threads shall be replaced with new sections of pipe.

3.2.5. Copper tube and fittings with soldered joints shall be joined according to ASTM B828. A water flushable, lead free flux conforming to ASTM B813 and a lead free alloy solder conforming to ASTM B32 shall be used.

3.2.6. For PVC piping, solvent cement joints shall be used for joints. All surfaces shall be cleaned and dry prior to applying the primer and solvent cement. Installation practices shall comply with ASTM F402. The joint shall conform to ASTM D2855 and ASTM D2665 appendixes.

3.3. **SPECIALTY PIPE FITTINGS**

3.3.1. Transition coupling shall be installed at pipe joints with small differences in pipe outside diameters.

3.3.2. Dielectric fittings shall be installed at connections of dissimilar metal piping and tubing.

3.4. **PIPE HANGERS, SUPPORTS AND ACCESSORIES**

3.4.1. All piping shall be supported according to the requirement of Ontario Building Code and these specifications. Where conflicts arise between the code, these specifications and Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING the most restrictive or the requirement that specifies supports with highest loading or shortest spacing shall apply.

3.4.2. Hangers, supports, rods, inserts and accessories used for pipe supports shall be painted. Electroplated copper hanger rods, hangers and accessories may be used with copper tubing.

3.4.3. Horizontal piping and tubing shall be supported within 300 mm (12 inches) of each fitting or coupling.

3.4.4. Horizontal cast iron piping shall be supported with the following maximum horizontal spacing and minimum hanger rod diameters:

3.4.4.1. 40 mm or DN40 to 50 mm or DN50 (NPS 1-1/2 inch to NPS 2 inch): 1500 mm (60 inches) with 10 mm (3/8 inch) rod.
3.4.4.2. 75 mm or DN75 (NPS 3 inch): 1500 mm (60 inches) with 15 mm (1/2 inch) rod.
3.4.4.3. 100 mm or DN100 to 125 mm or DN125 (NPS 4 inch to NPS 5 inch): 1500 mm (60 inches) with 18 mm (5/8 inch) rod.
3.4.4.4. 150 mm or DN150 to 200 mm or DN200 (NPS 6 inch to NPS 8 inch): 1500 mm (60 inches) with 20 mm (3/4 inch) rod.
3.4.4.5. 250 mm or DN250 to 300 mm or DN300 (NPS 10 inch to NPS 12 inch): 1500 mm (60 inch) with 23 mm (7/8 inch) rod.

3.4.5. Vertical piping and tubing shall be supported at the base, at each floor, and at intervals no greater than 4.6 m (15 feet).

3.4.6. In addition to the requirements in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, Floor, Wall and Ceiling Plates, Supports, Hangers shall have the following characteristics:

3.4.6.1. Solid or split unplated cast iron.
3.4.6.2. All plates shall be provided with set screws.
3.4.6.3. Height adjustable clevis type pipe hangers.
3.4.6.4. Adjustable floor rests and base flanges shall be steel.
3.4.6.5. Hanger rods shall be low carbon steel, fully threaded or threaded at each end with two removable nuts at each end for positioning rod and hanger and locking each in place.
3.4.6.6. Riser clamps shall be malleable iron or steel.
3.4.6.7. Rollers shall be cast iron.
3.4.6.8. See Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING SYSTEMS, for requirements on insulated pipe protective shields at hanger supports.
3.4.6.9. Miscellaneous materials shall be provided as specified, required, directed or as noted on the drawings for proper installation of hangers, supports and accessories. If the vertical distance exceeds 6.1 m (20 feet) for cast iron pipe additional support shall be provided in the center of that span. All necessary auxiliary steel shall be provided to provide that support.
3.4.6.10. Cast escutcheon with set screw shall be provided at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.

3.4.7. Penetrations:

3.4.7.1. Fire Stopping: Where pipes pass through fire partitions, fire walls, smoke partitions, or floors, a fire stop shall be installed that provides an effective barrier against the spread of fire, smoke and gases. Clearances between raceways and openings shall be completely filled and sealed with the fire stopping materials.

3.4.7.2. Water proofing: At floor penetrations, clearances shall be completely sealed around the pipe and make watertight with sealant

3.4.8. Sanitary vents shall be extended separately through roof.

3.5. **TESTS**

3.5.1. Storm and sanitary waste and drain systems shall be tested either in third entirety or in sections.

3.5.2. If tests are required by an Authority Having Jurisdiction, perform tests in the presence of each governing authority and obtain certification. Repeat tests as often as necessary to obtain certification.

3.5.3. Tests shall be conducted before trenches are backfilled or fixtures are connected. A water test or air test shall be conducted, as directed.

3.5.4. If entire system is tested for a water test, tightly close all openings in pipes except highest opening, and fill system with water to point of overflow. If the waste system is tested in sections, tightly plug each opening except highest opening of section under test, fill each section with water and test with at least a 3 m (10 foot) head of water. In testing successive sections, test at least upper 3 m (10 feet) of next preceding section so that each joint or pipe except upper most 3 m (10 feet) of system has been submitted to a test of at least a 3 m (10 foot) head of water. Water shall be kept in the system, or in portion under test, for at least 15 minutes before inspection starts. System shall then be tight at all joints.

3.5.5. For an air test, an air pressure of 34 kPa (5 psig) gage shall be maintained for at least 15 minutes without leakage. A force pump and mercury column gage shall be used for the air test.

3.5.6. After installing all fixtures and equipment, open water supply so that all p-traps can be observed. For 15 minutes of operation, all p-traps shall be inspected for leaks and any leaks found shall be corrected.

PART 1 - GENERAL

1.1. DESCRIPTION

1.1.1. This section specifies materials and installation for the following specialties:

1.1.1.1. Clean-outs
1.1.1.2. Access Doors
1.1.1.3. Floor Drains
1.1.1.4. Trench Drains
1.1.1.5. Roof Drains
1.1.1.6. Plumbing Fixture Carriers
1.1.1.7. Grease Intrerceptors
1.1.1.8. Oil Interceptors
1.1.1.9. Acid neutralizers

1.2. RELATED WORK

1.2.1. Section 01 00 00, GENERAL REQUIREMENTS.
1.2.2. Section 01 33 23, SHOP DRAWINGS.
1.2.3. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
1.2.4. Section 22 13 00, FACILITY SANITARY AND VENT PIPING.

1.3. APPLICABLE PUBLICATIONS

1.3.1. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

1.3.2. American Society for Testing and Materials (ASTM):
1.3.2.1. C891-2011 Standard Practice for Installation of Underground Precast Concrete Utility Structures

1.3.3. Ontario Building Code (OBC)
1.3.3.1. Part 7 Plumbing

1.4. SUBMITTALS

1.4.1. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS.

1.4.2. Manufacturer's Literature and Data: For each type of plumbing specialty indicated, the submittal shall include materials of fabrication, dimensions, rated capacities, retention capacities, operating characteristics, size and location of each pipe connection, furnished specialties, and accessories.

1.4.3. Detailed shop drawing of clamping device and extensions when required in connection with the waterproofing membrane or the floor or roof drain shall be submitted.

1.4.4. Complete operating and maintenance manuals including wiring diagrams, technical data sheets and information for ordering replaceable parts:

1.4.5. Include complete list indicating all components of the systems.

1.4.6. Include complete diagrams of the internal wiring for each item of equipment.

1.4.7. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

PART 2 - PRODUCTS

2.1. **FLOOR CLEAN-OUTS**

2.1.1. Standards of Acceptance:

2.1.1.1. J R Smith, Zurn, Watts

2.1.2. Finished Floor Clean-outs Round Top for Carpeted Areas

2.1.2.1. Description: Duco cast iron floor level cleanout assembly with round, adjustable, scoriated, nickel bronze top, and no-hub outlet. Bronze top shape to be as paer acrictectural schedules.

2.1.2.2. Outlet size: 2" (50 mm) to 8" (200mm) diam.

2.1.2.3. Application: pedestrian and medium load wheeled traffic

2.1.3. Finished Floor Clean-outs Square Top for Tiled Areas

2.1.3.1. Description: Duco cast iron floor level cleanout assembly with square, adjustable, scoriated, nickel bronze top, and no-hub outlet. Bronze top shape to

be as per architectural schedules. Where square tops are selected, align sides with adjacent tiles patterns or walls.

2.1.3.2. Outlet size: 2" (50 mm) to 8" (200mm) diam.

2.1.3.3. Application: pedestrian and medium load wheeled traffic

2.1.4. Finished Floor Clean-Out Square Top for Vynil Tiles

2.1.4.1. Description: Duco Cast Iron Cleanout with Taper Thread Bronze Plug and Square Adjustable Secured Nickel Bronze Top with 1/8 (3 mm) seep Tile Recess. The square top is particularly adaptable to the straight line patterns of tile designs. Allows for easy floor level adjustment.

2.1.4.2. Outlet size: 2" (50 mm) to 8" (200mm) diam.

2.1.4.3. Application: pedestrian and medium load wheeled traffic

2.2. Finished Floor Clean-Out Square Top for Terrazzo Floors

2.2.1.1. Description: Duco Cast Iron Cleanout with Square Adjustable Secured Nickel Bronze Top with 1/2"(13) Terrazzo Recess. The recess is filled with the floor material, presenting an unobtrusive appearance. Lock-in design firmly holds floor material in recess. The square top is particularly adaptable to the straight line patterns of tile designs. Allows for easy floor level adjustment.

2.2.1.2. Outlet size: 2" (50 mm) to 8" (200mm) diam.

2.2.1.3. Application: pedestrian and medium load wheeled traffic

2.2.2. Unfinished Floor Clean-Outs with Adjustable Round Cast Iron Cover

2.2.2.1. Description: Duco Cast Iron Cleanout with Round Adjustable Scoriated Cast Iron Top with Non-Tilt Tractor Cover.

2.2.2.2. Spigot outlet

2.2.2.3. Outlet size: 2" (50 mm) to 8" (200mm) diam.

2.2.2.4. Application: pedestrian up to heavy load wheeled traffic

2.3. **VERTICAL RISERS CLEAN-OUTS**

2.3.1. Taper Thread Plug with Round Access Cover

2.3.1.1. Description: Duco Cast Iron Caulk Ferrule with Cast Bronze Taper Thread Plug. Cover: chrome plated deep cover or stainless steel shallow cover; refer to architectural finishes schedule.

2.3.1.2. Outlet size: 2" (50 mm) to 8" (200mm) diam.

2.3.1.3. Applications: Used in hub openings in drainage piping where a cleanout is required. Ribbing on outside of ferrule prevents turning of ferrule in the caulking lead. Face-of-wall cover on finished walls.

2.3.2. Taper Thread Plug with Square Frame and Cover

2.3.2.1. Description: Duco Cast Iron Caulk Ferrule with Cast Bronze Taper Thread Plug, Chrome Plated Bronze Square Frame and Secured Cover.

2.3.2.2. Outlet Size: 2" (50 mm) to 8" (200mm) diam.

2.3.2.3. Applications: Used to cover cleanout plugs concealed in walls. The square design shall be used to adjacent walls, floors, ceilings, etc., that are finished of material in straight line patterns. The anchoring lugs provide easy means for securing the frame to the wall construction. The face-of-wall cover is for tile, masonry, or dry wall construction and shall be installed on an opening provided in the finished wall. The flush-with-wall cover shall be used for plaster or wet wall construction and is installed during the wall construction.

2.3.3. Cleanout Tee with Countersunk Plug and Round Access Cover

2.3.3.1. Description: Duco Cast Iron Cleanout Tee and Countersunk Plug with Stainless Steel Round Cover and Screw

2.3.3.2. Outlet Size: 2" (50 mm) to 6" (150mm) diam.

2.3.3.3. Applications: Used in concealed drainage lines where a cleanout is desired. Removable face-of-wall cover allows access to closure plug.

2.3.4. Cleanout Tee with Square Frame and Cover

2.3.4.1. Description: Duco Cast Iron Cleanout Tee and Countersunk Plug with Chrome Plated Bronze Square Frame and Secured Cover.

2.3.4.2. Outlet size: 2" (50 mm) to 6" (150mm) diam.

2.3.4.3. Application: Used in concealed drainage lines where a cleanout is desired. Face-of-Wall Cover shall be used for tile, masonry or drywall construction. The Flush-with-Wall cover shall be used for plaster or wet wall construction.

2.4. **ACCESS DOORS**

2.4.1. Face-of-Wall Type Access Door with Frame

2.4.1.1. 16 gauge steel door and frame with concealed hinge and screwdriver operated latch which holds the door securely closed. Nailer slots are provided for attaching to studs. When the door opening height is 24 inches (61 cm) or over, a continuous piano hinge and additional latches are provided at the top and bottom of door. When specified with allen latch or cylinder lock, matching latches/locks are furnished.

2.4.1.2. Finish: Prime coat - white

2.4.1.3. Sizes: 6"x6" (150mmx150mm) to 18"x36" (450mmx900mm)

2.4.1.4. Applications: Used to cover cleanout plugs, valves, controls or equipment concealed in walls and ceilings. Larger sizes are used to provide man access to utility and attic spaces. The face-of-the-wall type is for tile, masonry or dry wall construction, and is usually installed in an opening provided in the finished wall. The anchor holes provide a means of securely anchoring so that the face of the cover will be flush with the finished wall.

2.4.1.5. Standard of Acceptance: J R Smith, Zurn

2.4.2. Fire Rated Wall Access Door

2.4.2.1. Access door and frame shall be fabricated from 16 gage, galvannealed steel with a prime coat finish suitable for painting. Hinge shall be concealed type. Door shall have a heavy duty spring to provide positive latching when closed, and an

interior latch release slide enabling door to be opened from the inside. Exterior latch shall be recessed and operated using ring attached to the sliding bolt.

2.4.2.2. Finish: Prime coat - white

2.4.2.3. Sizes: 8"x8" (200mmx200mm) to 36"x48" (900mmx1,200mm)

2.4.2.4. Applications: Used to cover cleanout plugs, valves, controls or equipment concealed in walls. Larger sizes are used to provide man access to utility spaces.

2.4.2.5. Standard of Acceptance: J R Smith, Zurn

2.4.3. Fire Rated Ceiling Access Door

2.4.3.1. Access door frame shall be fabricated from 16 gage galvannealed steel with a prime coat finish and provided with masonry anchors and bolt holes. Access door panel shall be fabricated from 20 gage, galvannealed steel with a prime coat finish. Door shall be filled with 2" thick, fire rated insulation, and be welded pan type. Access door shall have automatic closer, be self-latching and contain interior latch release. Exterior latching shall be recessed and universal self-latching bolt, operated by either a knurled knob or flush key.

2.4.3.2. Finish shall be a prime coat suitable for painting.

2.4.3.3. Access door and fire door assembly rated at 1 1/2 hours.

2.4.3.4. Sizes: 8"x8" (200mmx200mm) to 24"x36" (600mmx900mm)

2.4.3.5. Standard of Acceptance: J R Smith, Zurn

2.5. **FLOOR DRAINS**

2.5.1. Standard of Acceptance:

2.5.1.1. J R Smith, Zurn, Watts.

2.5.2. Floor Drains with Adjustable Strainer Round Heads

2.5.2.1. Duco Cast Iron Body, Adjustable Strainer. Selected with 4"(100) Wide Flange and Secondary Flashing Flange.

2.5.2.2. Applications: General service floor drain for use in showers, toilets, kitchens, and other finished areas where foot traffic is expected. The round top strainer head is used for all types of poured finished floors. General service floor drain for use in showers, toilets, kitchens, and other finished areas where foot traffic is expected. The round top strainer head is used for all types of poured finished floors.

2.5.2.3. ½" (13) Trap Primer connection

2.5.3. Floor Drain with Adjustable Square Strainer Head

2.5.3.1. Duco Cast Iron Body with Flashing Collar and Adjustable Strainer Square Head

2.5.3.2. Applications: General service floor drain for use in showers, toilets, kitchens and other finished areas where foot traffic is expected. The square top strainer head is used for all types of poured finished floors. The square top is particularly adaptable to floors that are finished in material of square or straight line pattern. Reversible flashing collar permits adjustment of the strainer to meet finished floor level.

2.5.3.3. ½"(13) Trap Primer connection

2.5.4. Funnel Floor Drain

2.5.4.1. Epoxy coated cast iron floor drain with anchor flange, reversible membrane clamp with primary and secondary weepholes, 5 in. (127mm) diameter 1/4 in. (6mm) thick adjustable nickel bronze strainer, 4 in. (102mm) x9 in. (229mm) oval cast iron (standard) funnel, and no hub (standard) outlet.

2.5.4.2. The funnel prevents splashing and directs the waste into the drain. The exposed portion of grate serves as drain for any other waste on the floor. The funnel is attached to the grate by means of concealed screws and it may be moved to any grate location desired.

2.5.4.3. Applications: mechanical rooms

2.5.5. Heavy Duty Floor Drains with 12" Top Solid Free Standing Sediment Bucket

2.5.5.1. Duco Cast Iron Body and Flashing Collar with Cast Iron Tractor Grate and Solid Free Standing Sediment Bucket.

2.5.5.2. Application: Used in heavy trucking or traffic areas where waste water contains sand, sediment and other debris. Drain has solid free standing bucket to intercept this type of debris.

2.5.5.3. ½"(13) Trap Primer connection

2.5.6. Modular Cast Iron Trench Drains

2.5.6.1. Duco Cast Iron Flanged Body Outlet Section A and Flanged End Plate with Cast Iron Anti-Shift Loose Set Square Hole Grate.

2.5.6.2. Applications: Used as a ramp drain in loading or parking areas where a wide continuous trench drain is required to handle moderate traffic loads and serve as a reservoir for large water runoff. Can also be used individually as an area drain.

2.5.7. Planting Area Drains

2.5.7.1. Duco Cast Iron Body and Flashing Clamp with Polyethylene Dome and Stainless Steel Mesh Screen.

2.5.7.2. Applications: Used to drain excess moisture which builds up in large planting or flower boxes. Extra large mesh covered dome insures greater drainage area and prevents soil or stones from entering the drain line.

2.6. **ROOF DRAINS**

2.6.1. Standard of Acceptance:

2.6.1.1. J R Smith, Zurn, Watts

2.6.2. General Purpose Roof Drains with Adjustable Extension

2.6.2.1. Duco Cast Iron Body with Adjustable Extension Sleeve, Reversible Collar, Combined Flashing Clamp and Gravel Stop, with Aluminium Dome.

2.6.2.2. Applications: Used in flat roofs of any construction. The adjustable extension sleeve permits adjustment from a minimum of 1 1/4" (32) to a maximum of 4" (100), easily accommodating up to 2 3/4"(70) of varying insulation thicknesses.

2.6.3. Flow Regulating Roof Drain

2.6.3.1. Dura-Coated cast iron body, controlled flow weir shall be linear functioning with integral membrane flashing clamp/gravel guard and aluminium dome. All data shall be verified proportional to flow rates. Each notch will allow 10 GPM [38 LPM] of flow per 1" [25mm] of rain water build.

2.6.3.2. Outlet: 2" (50 mm) to 4" (100 mm)

2.6.3.3. Flow rate information and max water build-up on roof: as noted on the drawings

2.6.4. Cast Iron Body Scupper Drains

2.6.4.1. Duco Cast Iron Body, Flashing Clamp and Loose Set Grate.

2.6.4.2. Applications: Used at junction of roof and parapet. Side outlet (90°) drains may be connected to outside downspout by using drain in conjunction downspout adaptor. When connecting to an inside leader, the 45° outlet drains may be offset into the wall. The flush grate prevents obstruction to traffic. The angle grate prevents debris from blocking drainage.

2.6.4.3. Outlet size: 2" (50 mm) to 6" (150 mm)

2.7. **PLUMBING FIXTURES CARRIERS**

2.7.1. Standard of Acceptance:

2.7.1.1. J R Smith, Zurn, Watts

2.7.2. Wall -Mounted Urinal Carrier

2.7.2.1. Wall urinal support system complete with Dura-Coated carbon structural steel rectangular tubing uprights, conforming to ASTM A500 Grade C, with welded base feet having slotted floor anchor holes.

2.7.2.2. Lower bearing plate is vertically adjustable with slot to accommodate bearing jack placement. Upper universal hanger plate is pre-notched for back spud inlet and is designed for various hardware positions and fixtures. Includes mounting fasteners and hardware. Carrier system exceeds load and deflection requirements as outlined in ASME Standard A112.6.1M.

2.7.3. Wall Mounted Toilet Carrier - Single Side Arrangement

2.7.3.1. Horizontal siphon jet water closet carrier system, with high performance Dura-Coated cast iron main fitting with hydro-mechanically optimized sweep, 4" [102 mm] no-hub connections, and extended 2" [51 mm] vent.

2.7.3.2. Corrosion resistant, adjustable 3" [76 mm] dia. X 6" [152 mm] coupling with integral test cap, designed to increase flow velocity and line carry, and bonded gasket optimizes flow performance while reducing installation steps.

2.7.3.3. Complete system includes an adjustable, gasketed faceplate; floor mounted foot supports; fixture bolts, trim, and stud protectors. Carrier complies with all applicable requirements of ASME A112.6.1M up to a 500 lbs [227 kg] maximum static load.

2.7.4. Wall Mounted Toilet Carrier - Back to Back Arrangement

2.7.4.1. Horizontal siphon jet water closet carrier system, with high performance Dura-Coated cast iron main fitting with hydro-mechanically optimized sweep, 4" [102 mm] hub & spigot connections, and extended 2" [51 mm] vent. Corrosion resistant, adjustable 3" [76 mm] dia. X 6" [152 mm] couplings with integral test caps, designed to increase flow velocity and line carry, and bonded gaskets optimize flow performance while reducing installation steps. Complete system includes adjustable, gasketed faceplates; floor mounted foot supports; fixture bolts, trim, and stud protectors.

2.7.4.2. Carrier system complies with all applicable requirements of ASME A112.6.1M up to a 500 lbs [227 kg] maximum static load.

2.7.5. Concealed Arm System - Wall Lavatories

2.7.5.1. Wall Hung Lavatory Support System complete with Dura-Coated upright supports made from structural carbon-steel square tubing, conforming to ASTM A500 Grade C standards, with welded steel plate mounting feet featuring separate bolt patterns for using either 3/8" [10mm] or 1/2" [13mm] anchors, both meeting OSHPD spacing requirements. Includes lower and upper plates, marked with an indexed ruler guide for accurate adjustability of upright spacing, from 15" [381mm] to 22" [560mm].

2.7.5.2. Individual slotted header plates with integral welded arm sleeves provide 2" [51mm] of additional horizontal adjustment per plate allowing for a total horizontal adjustment range of 11" [279mm] to 26" [660mm]. Arms are Dura-Coated cast iron and include leveling screws and soft-set elastomeric locking devices. Uprights, plates, and header plates are all factory assembled for easy installation. Carrier system exceeds load and deflection requirements when tested in accordance to ASME Standard A112.6.1M at any adjustment position.

2.8. **TRAPS**

2.8.1. Cast iron body deep seal traps, threaded, hub, or spigot on inlet.

2.9. **ACID NEUTRALIZER**

2.9.1. Contractor shall furnish and install HDPE or Polypropylene Neutralization Tank. Tank shall be rotationally molded, seamless construction with flanged top and welded or bolt down cover, as supplied by IPEX. Tank shall be Neutratank, having 100-gallon capacity complete with 3" inlet and outlet, and 1-1/2" vent connection. Tank to be 32" diameter x 42" high.

2.9.2. Tank shall be installed in accordance with manufacturer’s recommendations.

2.9.3. Contractor shall furnish and fill the tank prior to installation with limestone chips, to a level just below the tank outlet. Water should be added to the tank prior to placement of the limestone chips.

2.9.4. Standard of Acceptance: IPEX Neutratank

2.9.5. Monitoring and alarm:

2.9.5.1. NEMA 4X rated, PH monitoring system ULC 508 listed monitoring and alarm panel, chemically resistant PH probe for the continuous sampling of the downstream flow, while keeping an accurate, permanent record of PH discharge levels and, visual and audible alarms which are triggered if the system senses that concentrations have drifted outside pre-set parameters.

2.9.6. Standard of Acceptance: IPEX Neutrasystem 2

2.10. **GREASE INTERCEPTORS**

2.10.1. Low profile

2.10.1.1. Low profile to fit under sink or counters

2.10.1.2. Interceptor is all type 304 stainless stel fabricated grease interceptor, with stainless steel cover, with internal air relief by-pass. This interceptor also comes standard with bronze cleanout plug, removable pressure equalizing/flow diffusing inlet baffle, fixed bottom outlet baffle and visible double wall trap seal. Gasketed non-skid secured cover complete with tie down assembly, and Z1108 flow control fitting. Regularly furnished with 3" (inch) low inlet and outlet.

2.10.1.3. Standard of Acceptace; Zurn Z1171

2.11. Pit-Recessed Grease Interceptor

2.11.1. Large capacity acid resistant all type 304 stainless steel fabricated grease interceptor, with stainless steel cover, internal air relief by-pass, bronze cleanout plug (which can be used as a sampling port), and visible double wall trap seal that comes standard with pressure equalizing/flow diffusing baffle. The gasketed non-skid secured cover with removable lift handles, and flow control fitting. Regularly furnished with inlet and outlet in high position.

2.11.2. Standard of Acceptance: Zurn Z1172 series.

2.12. **OIL INTERCEPTOR**

2.12.1. Pit-recessed installation

2.12.1.1. All type 304 stainless seel fabricated oil interceptor, with stainless steel cover, with bronze cleanout plug and visible double wall trap seal, removable combination pressure equalizing/flow diffusing baffle and sediment bucket, oil drawoff, vent connections, secured gasketed non-skid cover and left hand integral storage tank.

2.12.1.2. Regularly furnished with inlet and outlet in high position.

2.12.1.3. Standard of acceptance; Zurn Z1186 series

2.13. **SOLIDS INTERCEPTOR**

2.13.1. Exposed Installation

2.13.1.1. Acid Resistant Composite Interceptor, in lieu of fixture 'P' trap, for exposed installation, with removable PVC sediment bucket having a removable 3/32 [2] dia. perforated flow defusing/intercepting PVC screen, with top access gasketed secured cover, stainless steel draw latches and hardware with an ABS handle for easy removal of sediment bucket and screen. Regularly furnished with 2 [51] threaded low inlet and high outlet.

2.13.2. Standard of Acceptance: Zurn Z1180 series

2.13.3. Recessed Installation

2.13.3.1. Dura Coated interior and exterior fabricated steel sand interceptor with No-Hub inlet and outlet, complete with removable heavy duty grates

2.13.3.2. Standard of Acceptance: Zurn Z1187 series

PART 3 - INSTALLATION

3.1. **EXAMINATION AND PREPARATION**

3.1.1. Verify existing grades, inverts, utilities, obstacles, and topographical conditions prior to installations.

3.1.2. Examine rough-in requirements for plumbing fixtures and other equipment having drain connections to verify actual locations of piping connections prior to installation.

3.1.3. Examine walls, floors, roof, and plumbing chases for suitable conditions where piping and specialties are to be installed.

3.2. **INSTALLATION OF PIPING**

3.2.1. Refer to Related Section 221113 for additional requirements

3.3. **INSTALLATION OF CLEANOUTS**

3.3.1. Cleanout locations should be indicated on drawings.

3.3.2. Provide cleanouts at each change in direction of piping greater than 45 degrees, where indicated on drawings and where required by code. Clean-outs shall be same size as pipe served through 4". Above ground cleanouts: install cleanouts at base of each vertical soil or waste stack.

3.3.3. Encase exterior cleanouts in concrete flush with grade.

3.3.4. Cleanouts shall be aesthetically located with respect to tile patterns, masonry bond and alignment. Coordinate installation with masonry and concrete work.

3.3.5. Prior to acceptance of the system, demonstrate that cleanout plugs are easily removable and can be easily rodded.

3.3.6. When cleanouts are required in above grade floors, flash and clamp cleanouts in floors provided with membrane waterproofing as specified for floor drains.

3.4. **INSTALLATION OF FLOOR DRAINS**

3.4.1. Install floor drains as indicated on drawings, at low points of surface areas to be drained.

3.4.2. Provide trap for all floor drains, minimum 3" trap and waste.

3.4.3. Check drainage of surfaces by flooding with the hose.

3.4.4. Provide vent for floor drain piping per code, minimum 1 1/2".

3.5. **INSTALLATION OF ROOF DRAINS**

3.5.1. Install drain flashing collar or flange so that no leakage occurs between roof drain and adjoining roofing. Maintain integrity of waterproof membranes, where penetrated.

3.5.2. Check drainage of surfaces by flooding with hose.

3.6. **PLUMBING CARRIERS**

3.6.1. Install in accordance with the manufacturer's instructions

3.6.2. Coordinate with the architectural division the width of the sanitary chases to ensure adequate access for maintenance and replacement

3.7. **INTERCEPTORS**

3.7.1. Interceptors shall be set level and plumb.

3.7.2. Metal interceptors covers shall be set flush with finished surface in pavements and the tops shall be traffic-rated. Set tops 75 mm (3 inches) above finished surface elsewhere unless otherwise indicated.

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PART 1 - GENERAL

1.1. **DESCRIPTION**

1.1.1. Plumbing fixtures, associated trim and fittings necessary to make a complete installation from wall or floor connections to rough piping, and certain accessories

1.2. **RELATED WORK**

1.2.1. Section 01 23 33, SHOP DRAWINGS.

1.2.2. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

1.3. **APPLICABLE PUBLICATIONS**

1.3.1. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

1.3.2. American Society for Testing and Materials (ASTM):

1.3.2.1. C891-2011Standard Practice for Installation of Underground Precast Concrete Utility Structures

1.3.3. Ontario Building Code (OBC)

1.3.3.1. Part 7 Plumbing

1.3.4. Do the work in accordance with CAN 3-B45 Series-M81 and CSA B125-1975 except where specified otherwise.

1.4. **SUBMITTALS**

1.4.1. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS.

1.4.2. Manufacturer's Literature and Data: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, connections, and capacity.

1.4.3. Detailed shop drawing of clamping device and extensions when required in connection with the waterproofing membrane or the floor or roof drain shall be submitted.

1.4.4. Complete operating and maintenance manuals including wiring diagrams, technical data sheets and information for ordering replaceable parts:

1.4.5. Include complete list indicating all components of the systems.

1.4.6. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

PART 2 - PRODUCTS

2.1. MATERIALS

2.1.1. Material or equipment containing a weighted average of greater than 0.25 percent lead is prohibited in any potable water system intended for human consumption, and shall be certified in accordance with NSF 61 or NSF 372. Endpoint devices used to dispense water for drinking shall meet the requirements of NSF 61.

2.1.2. Plastic pipe, fittings, and solvent cement shall meet NSF 14 and shall be NSF listed for the service intended.

2.2. STAINLESS STEEL

2.2.1. Corrosion-resistant Steel (CRS):

2.2.2. Plate, Sheet and Strip: CRS flat products shall conform to chemical composition requirements of any 300 series steel specified in ASTM A276.

2.2.3. Finish: Exposed surfaces shall have standard polish (ground and polished) equal to NAAMM finish Number 4.

2.2.4. Die-cast zinc alloy products are prohibited.

2.3. STOPS

Provide lock-shield loose key or screw driver pattern angle stops, straight stops or stops integral with faucet, with each compression type faucet whether specifically called for or not, including sinks in solid-surface, wood and metal casework, laboratory furniture and pharmacy furniture. Locate stops centrally above or below fixture in accessible location.

2.3.1. Furnish keys for lock shield stops to the Client**.**

2.3.2. Supply from stops not integral with faucet shall be chrome plated copper flexible tubing or flexible stainless steel with inner core of non-toxic polymer.

2.3.3. Supply pipe from wall to valve stop shall be rigid threaded IPS copper alloy pipe, i.e. red brass pipe nipple, chrome plated where exposed.

2.4. ESCUTCHEONS

2.4.1. Heavy type, chrome plated, with set screws. Provide for piping serving plumbing fixtures and at each wall, ceiling and floor penetrations in exposed finished locations and within cabinets and millwork.

2.5. **FIXTURES AND TRIM**

2.5.1. Architectural drawings to govern in determination of number and location of fixtures.
2.5.2. Fixtures to be product of one manufacturer.
2.5.3. Unless specified otherwise, trim to be product of one manufacturer.

2.6. **GENERAL**

2.6.1. Plumbing fixtures shall be as indicated and specified with all required supports, accessories, wastes, vent and water connections as required to make the fixture complete and operational.
2.6.2. Unless specified otherwise, fixtures shall be in accordance with the Architect's color schedule.
2.6.3. Unless specified otherwise, all exposed valves, pipe, escutcheon, etc., shall be polished chrome finish.
2.6.4. Fixtures and trim shall be new and free of all defects or blemishes. Finished surfaces shall be clean, smooth, and bright guaranteed not to craze, change colour or scale. Imperfections of any kind shall be sufficient reason for rejection and the item shall be removed and an acceptable replacement installed at no additional cost.
2.6.5. Protect fixtures with enamel or glazed surface from damage by covering or coating as recommended in the Bulletin "Handling & Care of Enameled C.I. Plumbing Fixtures".
2.6.6. Fixture type is specified below. Refer to plumbing drawings for fixture quantity.

2.7. **[S-1] Stainless Steel Sink (Double Compartments):**

2.7.1. Sink: Kindred Model QDL2031-8-1. Double compartment sink with faucet ledge.20 gauge, type 302, 18-8 stainless steel. Self rimming. 1 faucet hole. Exposed surfaces are satin finished. Undercoated to reduce condensation and resonance. Complete with factory applied rim seal, Universal Installation System hardware, cutout template and 3-1/2" crumb cup waste assembly, location center back. Compartment Size: Overall Size: 20 1/8" x 31 1/4" x 8" deep (51cm x 79cm x 20cm deep).
2.7.2. Faucet Moen 87603, single handle deck faucet for exposed mounting sink. All metal fabricated body, 9-1/8"" (231 mm) long spout swings 180 deg., 1.5 gpm (5.7 l/min) vandal resistant aerator, vandal resistant lever handle, lever handle shall return to neutral position when faucet is turned off, red and blue on handle to indicate hot/cold temperature. Control mechanism shall be the diamond coated ceramic cartridge,

adjustable handle limit stop, 3/8" O.D. straight, staggered copper supply tubes with 3/8" fittings.

2.7.3. Accessories: 'P' trap 17 gauge (1.5 mm) clean-out and escutcheon, basin supplies with offset flex, risers, stops and escutcheons, sediment interceptor, offset open grid strainer, cast brass, 1-1/4" (32 mm).

PART 3 - INSTALLATION

3.1. Connect fixtures complete with supplies and drains, traps and cleanouts, supported level and square, such as to make them completely functional.

3.2. Hot water faucets shall be on left. Where indicated and applicable, supply and install the tempering valves in accordance with the manufacturer's instructions.

3.3. Provide venting for all plumbing fixtures as required by codes.

3.4. All barrier-free fixtures to be mounted at heights to be in accordance with all codes and local Authorities Having Jurisdiction.

3.5. Provide chrome plated flexible supplies to fixtures with screw driver stops, reducers and escutcheons.

3.6. All piping shall be recessed unless otherwise approved. Piping to be installed in recessed areas (such as under cabinetry, counters and other millwork or ceiling spaces) shall be run in neat parallel lines as tight as possible to walls and ceilings.

3.7. Provide ball isolation valves for connections to all fixtures.

3.8. All angle valves for fixtures shall be chrome plated.

3.9. All sanitary drains visible under the counter shall be either chromed or painted to match the color of the wall

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PART 1 - GENERAL

1.1. DESCRIPTION

1.1.1. The requirements of this Section apply to all sections of Division 23.

1.2. DEFINITIONS:

1.2.1. Exposed: Piping, ductwork, and equipment exposed to view in finished rooms.
1.2.2. Option or optional: Contractor's choice of an alternate material or method.

1.3. RELATED WORK

1.3.1. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA
1.3.2. Section 23 05 53, IDENTIFICATION – HVAC SYSTEMS
1.3.3. Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC
1.3.4. Section 23 05 41, NOISE AND VIBRATION CONTROL
1.3.5. Section 23 05 93, TESTING, ADJUSTING, and BALANCING FOR HVAC
1.3.6. Section 23 07 11, HVAC INSULATION.

1.4. QUALITY ASSURANCE

1.4.1. Mechanical, electrical and associated systems shall be safe, reliable, efficient, durable, easily and safely operable and maintainable, easily and safely accessible, and in compliance with applicable codes as specified. The systems shall be comprised of high quality institutional-class and industrial-class products of manufacturers that are experienced specialists in the required product lines. All construction firms and personnel shall be experienced and qualified specialists in industrial and institutional HVAC

1.5. PRODUCTS CRITERIA:

1.5.1. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 3 years (or longer as specified elsewhere). The design, model and size of each item shall have been in satisfactory and efficient operation on at least three installations for approximately three years. However, digital electronics devices, software and systems such as controls, instruments, computer work station, shall be the current generation of technology and basic design that has a proven satisfactory service record of at least three years. See other specification sections for any exceptions and/or additional requirements.

1.5.2. All items furnished shall be free from defects that would adversely affect the performance, maintainability and appearance of individual components and overall assembly.

1.5.3. Conform to codes and standards as required by the specifications. Conform to local codes, if required by local authorities such as the natural gas supplier, if the local codes are more stringent than those specified. Refer any conflicts to the Consultant.

1.5.4. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.

1.5.5. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.

1.5.6. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.

1.5.7. Asbestos products or equipment or materials containing asbestos shall not be used.

1.6. **EQUIPMENT SERVICE ORGANIZATIONS:**

1.6.1. HVAC: Products and systems shall be supported by service organizations that maintain a complete inventory of repair parts and are located within 50 miles to the site.

1.6.2. HVAC Mechanical Systems Welding: Before any welding is performed, contractor shall submit a certificate certifying that welders comply with the following requirements:

1.6.3. Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code", Section IX, "Welding and Brazing Qualifications".

1.6.4. Comply with provisions of ASME B31 series "Code for Pressure Piping".

1.7. **EXECUTION (INSTALLATION, CONSTRUCTION) QUALITY:**

1.7.1. Apply and install all items in accordance with manufacturer's written instructions. Refer conflicts between the manufacturer's instructions and the contract drawings and specifications to the Consultant for resolution.

1.7.2. Provide complete layout drawings, schematics, diagrams, sections, notes and specifications as required to allow for competitive bidding and construction. Do not commence construction work on any system until the layout drawings have been approved.

1.8. DUTIES OF MECHANICAL CONTRACTOR

1.8.1. The mechanical contractor shall assume the responsibilities and duties of a general contractor including but not limited to the ones described below:

1.8.2. Superintendence

1.8.2.1. Provide full time on-site superintendent personnel and supporting staff with proven experience in project of similar value and complexity.

1.8.2.2. Site superintendent shall have over-all authority to speak for and represent the mechanical contractor.

1.8.3. Coordination

1.8.3.1. Coordinate the work with all the sub-trades involved to ensure that the work will be carried out on schedule and in proper sequence.

1.8.3.2. Take complete responsibility for all remedial work that results from failure to coordinate any aspect of the mechanical work prior to its fabrication and/or installation.

1.8.3.3. Take responsibility for the delivery of equipment necessary to complete the work in accordance with the approved schedule.

1.8.4. Staffing and Scheduling

1.8.4.1. Within seven days after the award of the contract, the Mechanical Contractor shall provide to the Board representative the following information:

1.8.4.1.1. Appointment of official representatives in the project.
1.8.4.1.2. Schedule of work.
1.8.4.1.3. Delivery schedule for specified equipment.
1.8.4.1.4. Requirements for temporary facilities, site signs, storage, etc.

1.8.5. Work Completion Meeting

1.8.5.1. Prior to application for Substantial Performance of the Work, the mechanical contractor shall participate in the take-over meeting. Agenda to include the following:

1.8.5.1.1. Review of outstanding deficiencies.
1.8.5.1.2. Submission of maintenance manuals, warranties and as-built drawings.
1.8.5.1.3. Results of performance tests and described further in this section.
1.8.5.1.4. Scheduling of training to Board's personnel.

1.9. **COMMISSIONING**

1.9.1. The Board may at its discretion use a third party as a commissioning agent for the construction portion of the work. The requirement for commissioning shall be included in the front-end documents of the bidders' package.

1.9.2. If commissioning is included, the contractor shall provide all manpower and will take into account all the hours required to participate in the commissioning process including meetings with the commissioning agent, completion of forms and check-lists, verifications, simulations, rectifications of deficiencies and other activities associated with the commissioning process.

1.10. **SCHEDULING OF WORK**

1.10.1. For all work to be performed under this contract, adhere to Construction Schedule agreed upon with the Board.

1.11. **INTENT**

1.11.1. Bidders for this work shall include for all labor, material, equipment and all other related cost including all applicable taxes (except HST) and fees to provide the work as indicated on the drawings.

1.11.2. Scope of work is as indicated on the drawings and includes but is not limited to, the following:

1.11.2.1. Provide new rooftop units as noted on the mechanical equipment schedule and as shown on the layout drawings. New rooftop unit locations to be confirmed on site and coordinated with the new structural framing. Refer to structural drawings for more information.

1.11.2.2. Provide new supply and return ductwork on the roof and connect to each new rooftop unit as shown on the layout drawings. Provide adequate duct supports throughout. Insulate all outdoor ductwork.

1.11.2.3. Provide new supply air ductwork throughout the classroom spaces approximately as shown on the layout drawings. Exact routing through the school to be determined on site by the contractor. Provide adequate supports and hangers as required.

1.11.2.4. Coordinate ductwork runs through each classroom with existing services in the ceiling space. Run the ducts as high as possible and as tight to the walls as possible. Re-locate any devices in the ceiling as required to run the new ductwork.

1.11.2.5. Connect new supply ductwork up through the roof to the roof mounted ductwork. Provide new roof openings as required. Refer to structural drawings for opening details.

1.11.2.6. Provide new return air ductwork in the ceiling space above the drywall ceiling. Terminate as an open-ended duct. Connect new return ductwork up through the roof to the roof mounted ductwork. Provide new roof openings as required. Refer to structural drawings for opening details.

1.11.2.7. Provide new variable-air-volume (VAV) boxes throughout the classroom spaces as shown on the layout drawings. Exact tie-in location of VAV boxes to be determined on site by the contractor. Each VAV box is to have a minimum 900MM sound attenuator downstream. Provide adequate supports for each new VAV box as required. Provide new BAS controller for each VAV box and provide all control wiring necessary to integrate each VAV box into the school's BAS system.

1.11.2.8. Provide visual cover for each VAV box. Refer to architectural drawings for more details.

1.11.2.9. Provide new supply & return grilles as noted on the layout and grille schedule. Exact locations of all grilles/diffusers to be determined on site by the contractor.

1.11.2.10. Provide new return air ducts from each return grille in the classrooms and terminate above the drywall ceiling with an open-ended duct.

1.11.2.11. Provide new fire dampers for all ductwork penetrating the fire-rated drywall ceiling assembly.

1.11.2.12. Create new air transfer openings between the classrooms as noted on the layout drawings. Openings to be cut above the drywall ceiling assembly. Exact cutting location through the walls to be determined on site by the contractor. Refer to layout drawings for size of each new opening.

1.11.2.13. Repair all locations where the fire-rated drywall ceiling was damaged or removed during construction. New fire-rated drywall to have the same fire rating as the existing ceiling. Finish to match existing conditions.

1.11.2.14. Insulate all supply ductwork passing through all unconditioned spaces. Unconditioned spaces include but are not limited to, the T-bar ceiling space.

1.11.2.15. Provide new supply and return ductwork in the office space approximately as noted on the layout drawings. Provide all transfer ducts between the office spaces as shown. Exact duct routing to be determined on site by the contractor.

1.11.2.16. Provide supply & return grilles/diffusers throughout the office space approximately as shown on the layout drawings.

1.11.2.17. Provide new supply and return ductwork to serve the school's gymnasium space. New ducts will penetrate through the side wall, each taking up a window opening. Exact penetration location to be confirmed on site by the contractor. Run new main supply ductwork at high level, in-between the existing OWSJ. Run new side branches through the openings of the OWSJ. Provide all hangers and supports as required. Provide new diffusers and return grilles as shown.

1.11.2.18. Provide new kitchen assembly for the school's staff room. Provide new plumbing fixtures as noted on the schedule and the specifications. Provide new dishwasher and oven/stove assemblies. Dishwasher and oven/stove to be selected by the architect/client.

1.11.2.19. Provide new kitchen hood assembly as shown on the layout drawings and as indicated in the equipment schedule. Provide new kitchen exhaust duct from hood up to the roof approximately as shown. Exact routing to be determined on site by the contractor. Re-use the existing roof opening and terminate duct with a goose-neck and bird screen. Seal and weatherproof existing opening around new exhaust duct. Provide power for the hood from the nearest electrical panel.

1.11.2.20. Provide all new plumbing domestic water and sanitary connections for the new kitchen equipment. Cut open block wall in the staff room as required to connect back to existing piping. Extend existing piping as required to make the new connections. Provide new P-trap for the sink fixture.

1.11.2.21. Provide new split air condition system of the school's staff room. Provide wall-mounted indoor evaporator complete with pumped condensate, as noted in the mechanical equipment schedule. Provide new roof-mounted condensing unit complete with non-penetrating roof supports, as noted in the equipment schedule.

1.11.2.22. Provide new insulated refrigerant lines between indoor evaporator and outdoor condenser. Provide hangers and supports as required. Run new pipes through the exterior wall and up along the wall to the roof. Provide sheet metal exterior cover for the pipes as they run up along the wall. Coordinate with the equipment manufacturer to ensure that adequate amounts of refrigerant and oil are supplied to make the systems fully operational.

1.11.2.23. Provide new wall-fin convectors as shown on the layout drawings and as indicated in the mechanical equipment schedule. Connect new convectors to existing HWS & HWR piping approximately as shown. Refer to details on M-1 for

more information. Provide new pencil-proof linear bar grille for all new wall fin radiators. Exact length to be confirmed on site, width to match existing. Coordinate installation with new millwork enclosures for the wall fins, refer to architectural drawings for more details.

1.11.2.24. Provide new control valves and thermostats as indicated on the layout drawings. Provide all new control wiring and controllers as required to connect new valves and thermostats.

1.11.2.25. Provide all new power supply wiring, conduits, disconnects, breakers, fuses and other devices required to feed power to the new equipment as noted on the electrical drawings and to make the new equipment fully functional.

1.11.2.26. Supply and install all new BAS sensors, relays and other devices as noted on the BAS diagrams and as required to have the new systems operate in accordance with the specified sequences. Provide all new BAS wiring between all field devices and the BAS controllers. Update the existing BAS system as specified, including software and graphical interface.

1.11.2.27. All new refrigerant lines and conduits on the roof shall be supported by non-penetrating roof supports; refer to details on the drawings.

1.11.2.28. All cutting and patching required for the installation of refrigerant lines and power supply conduits to the new equipment (indoor and outdoor) shall be included.

1.11.2.29. Upon conclusion of the work, provide start-up by equipment manufacturer representatives and balancing/adjustments by the TAB specialist. Coordinate commissioning of the upgraded BAS system with the Board's representatives.

1.11.3. Misinterpretation of any requirement of the drawings and specifications will not relieve the Mechanical Contractor of responsibility. If in any doubt, the Mechanical Contractor shall contact the Consultant for written clarification prior to submitting a bid for the Work.

1.12. **INTERFERENCES**

1.12.1. The mechanical drawings do not show all the architectural and structural details, and any information involving accurate measuring of the building shall be taken from the building drawings or at the building. Make without additional change, any necessary changes or additions to the runs of drains, pipes, ducts, etc., to accommodate the above conditions. The location of equipment may be altered without charge providing the change is made before installation and does not necessitate major additional material.

1.12.2. Wherever differences occur between specifications, riser diagrams or schematics and drawings, the maximum conditions shall govern and the bid shall be based on whichever information indicates the greater cost.

1.12.3. Field verifications of dimensions on plans shall be made since actual locations, distances, and levels will be governed by actual field conditions.

1.12.4. Discrepancies between different plans, or between plans and actual field conditions, or between plans and specifications shall promptly be brought to the attention of the Consultant for a decision.

1.12.5. Install all mechanical services including but not exclusive to drains, pipes, and ducts, to conserve headroom and interfere as little as possible with the free use of the space through which they pass. All drains, pipes, ducts, etc., particularly those which may interfere with the inside treatment of the building, or conflicting with other trades, shall be installed only after the locations have been approved by the Consultant. Special care shall be taken in the installation of all mechanical services including, but not exclusive to drains, pipes, and ducts, which are to be concealed, to see that they come within the finished lines of floors, walls, and ceilings. Where such drains, pipes, ducts, etc., have been installed in such a manner as to cause interference, they shall be removed and re installed in suitable locations without extra cost to the Board.

1.12.6. Before commencing work, check and verify all grade and invert elevations, stacks, levels, and dimensions, to ensure proper and correct installation of the work.

1.12.7. In every place where there is space indicated as reserved for future or other equipment, leave such space clear, install blank offs, shut off valves with blind flanges and other work so that the necessary connections can be made without any stoppages to the system. Consult with the consultant whenever necessary for this purpose.

1.12.8. In addition to the work specifically mentioned in the Specifications and shown on the drawings, provide all other items that are obviously necessary to make a complete working installation, including those required by the Authorities Having Jurisdiction over the work.

1.12.9. The mechanical plans show approximate locations for wall mounted devices. Obtain Consultant's approval of mounting heights and locations before commencement of work.

1.13. **EXAMINE SITE**

1.13.1. Examine the site and the local conditions affecting the work prior to submission of the tender price. Examine carefully all drawings and the complete specifications to ensure that the work can be satisfactorily carried out as shown. No allowance will be made later for any expenses incurred through the failure to make these examinations or to report any such discrepancies in writing to the Consultant.

1.14. **INTERFERENCE AND SLEEVING DRAWINGS:**

1.14.1. Submit complete consolidated and coordinated interference drawings for all new air handling systems, and for existing systems that are in the same areas.

1.14.2. The drawings shall include plan views, elevations and sections of all systems and shall be on a scale of not less than 1:200. Clearly identify and dimension the proposed locations of the principal items of equipment. The drawings shall clearly show locations and adequate clearance for all equipment, ductwork, piping, valves, control panels and other items. Show the access means for all items requiring access for operations and maintenance. Provide detailed layout drawings of all piping and duct systems.

1.14.3. Do not install equipment foundations, equipment, ductwork or piping until interference drawings have been approved.

1.15. **SUBMITTALS**

1.15.1. Submit documentation in accordance with Section 01 33 23, and with requirements in the individual specification sections.

1.15.2. Contractor shall make all necessary field measurements and investigations to assure that the equipment and assemblies will meet contract requirements.

1.15.3. If equipment is submitted which differs in arrangement from that shown, provide drawings that show the rearrangement of all associated systems. Approval will be given only if all features of the equipment and associated systems, including accessibility, are equivalent to that required by the contract.

1.15.4. Prior to submitting shop drawings for approval, contractor shall certify in writing that manufacturers of all major items of equipment have each reviewed drawings and specifications, and have jointly coordinated and properly integrated their equipment and controls to provide a complete and efficient installation.

1.15.5. Submittals and shop drawings for interdependent items, containing applicable descriptive information, shall be furnished together and complete in a group. Coordinate and properly integrate materials and equipment in each group to provide a completely compatible and efficient.

1.15.6. Manufacturer's Literature and Data:

1.15.6.1. Submit all information pertaining to the performance and capacity of the equipment.
1.15.6.2. Submit all information pertaining to methods of connection to piping and ductwork, electrical wiring, controls and noise generated by the equipment (as applicable to the project).
1.15.6.3. Submit belt drive with the driven equipment. Submit selection data for specific drives when requested by the Consultant.
1.15.6.4. Submit electric motor data and variable speed drive data with the driven equipment.
1.15.6.5. Equipment and materials identification.
1.15.6.6. Fire-stopping materials.
1.15.6.7. Hangers, inserts, supports and bracing, for both indoor and outdoor installations. Where applicable, provide load ratings and deflection for spring supports and hangers.
1.15.6.8. Wall, floor, and ceiling plates.

1.15.7. HVAC Maintenance Data and Operating Instructions:

1.15.7.1. Provide a listing of recommended replacement parts for keeping in stock supply, including sources of supply, for equipment. Include in the listing belts for equipment: Belt manufacturer, model number, size and style, and distinguished whether of multiple belt sets.
1.15.7.2. Provide copies of approved HVAC equipment submittals to the Testing, Adjusting and Balancing Subcontractor.

1.16. **MATERIALS AND STANDARDS OF ACCEPTANCE**

1.16.1. Where materials, equipment, apparatus, or other products are specified by the manufacturer, brand name, type or catalogue number, such designation is to establish standards of desired quality style or dimensions and shall be the basis of the Bid. Materials so specified shall be furnished under this Contract.

1.16.2. Where two or more designations are listed, the contractor shall choose one of those listed and state the choice made on the Bid Form (where applicable). *Note that the basis of design equipment has specific physical characteristics in terms of footprint and clearances requirements. Inclusion of a manufacturer other than the one for the Basis of Design in the Standard of Acceptance is not an automatic approval for submission of equipment which cannot be installed due to specific site conditions.*

1.17. **MATERIAL SUBSTITUTIONS**

1.17.1. After execution of the Contract, requests for substitution of materials or makes other than those specifically named in the Contract Documents may be reviewed and approved by the Consultant, subject to Board's review and acceptance of the financial credits involved.

1.17.2. In the absence of such express approval by the Consultant, the Mechanical Contractor will be held to furnish specified items under the base bid as the standard of acceptance.

1.17.3. If equipment is submitted which differs in arrangement from that specified/shown on the documents, provide drawings that show the rearrangement of all associated systems. Approval will be given only if all features of the equipment and associated systems, including accessibility, are equivalent to that required by the contract.

1.18. **CODES, PERMITS, FEES AND CONNECTIONS**

1.18.1. Conform to Federal, Provincial and Municipal regulations and perform work in accordance with requirements of By Laws and Regulations in force in area where the building is to be erected.

1.18.2. Apply for, obtain, and pay for all permits, fees and service connections for the work and the inspections required by Authorities Having Jurisdiction in the area where the work will take place

1.18.3. Where applicable, apply for, obtain, and pay for all permits, fees and service connections for the work and the inspections required by Authorities Having Jurisdiction in the area where the work will take place, including TSSA and ESA. Where applicable, have the work inspected and certified by PV [Boilers and Pressure Vessels Reg], OE [Operating Engineers Reg.] and FS [Fuel Safety Reg.] branches of TSSA. At the end of the work, the new plant shall be fully TSSA certified.

1.18.4. For information, a specific code or standard might be mentioned. This information must not be taken as the only code or standard applicable.

1.18.5. When part of equipment does not bear the required CSA label, the contractor shall obtain from CSA or Hydro Electric Power Commission, when that part of the equipment is an electric component, a special approval and pay the applicable fees.

1.18.6. Furnish necessary certificates as evidence that the work installed conforms with laws and regulations of Authorities having jurisdiction. Changes in work requested by an Authority having jurisdiction shall be carried out without charge.

1.19. **CONSULTANT'S INSTRUCTIONS**

1.19.1. During construction the Consultant will issue such instructions as may be necessary for verification and correction of the work. These instructions shall be binding as part of the specification.

1.20. **ADDITIONAL WORK AND CHANGES**

1.20.1. Unless a written order, reviewed by the Consultant and countersigned or otherwise approved by the Board Representative, no additional work shall be undertaken by the Contractor.

1.21. **DELIVERY, STORAGE AND HANDLING**

1.21.1. Protection of Equipment:

1.21.1.1. Equipment and material placed on the job site shall remain in the custody of the Contractor until phased acceptance, whether or not the Board has reimbursed the Contractor for the equipment and material. The Contractor is solely responsible for the protection of such equipment and material against any damage.

1.21.1.2. Place damaged equipment in first class, new operating condition; or, replace same as determined and directed by the Consultant. Such repair or replacement shall be at no additional cost to the Board.

1.21.1.3. Protect interiors of new equipment and piping systems against entry of foreign matter. Clean both inside and outside before painting or placing equipment in operation.

1.21.1.4. Existing equipment and piping being worked on by the Contractor shall be under the custody and responsibility of the Contractor and shall be protected as required for new work.

1.21.2. Cleanliness of Piping and Equipment Systems:

1.21.2.1. Exercise care in storage and handling of equipment and piping material to be incorporated in the work. Remove debris arising from cutting, threading and welding of piping.

1.21.2.2. Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.

1.21.2.3. Clean interior of all tanks prior to delivery for beneficial use by the Board.

1.21.2.4. Boilers shall be left clean following final internal inspection by Board insurance representative or inspector.

1.21.2.5. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.

1.22. **JOB CONDITIONS – WORK IN EXISTING BUILDING**

1.22.1. Building Operation: Board employees will be continuously operating and managing all facilities, including temporary facilities, that serve the building.

1.22.2. Maintenance of Service: Schedule all work to permit continuous service as required by the Board.

1.22.3. Services Interruptions: Limited service interruptions, as required for interconnections of new and existing systems, will be coordinated with the Board and permitted by the Board during the agreed-upon schedule of interruption. Provide at least one week advance notice to the Board representatives.

1.22.4. Phasing of Work: Comply with all requirements shown on drawings or specified.

1.22.5. Building Working Environment: Maintain the architectural and structural integrity of the building and the working environment at all times. Maintain the interior of building at 18 degrees C (65 degrees F) minimum. Limit the opening of doors, windows or other access openings to brief periods as necessary for rigging purposes. No storm water or ground water leakage permitted. Provide daily clean up of construction and demolition debris on all floor surfaces and on all equipment being operated by the Board.

1.22.6. Acceptance of Work for Board Operation: As new facilities are made available for operation and these facilities are of beneficial use to the Board, inspections will be made and tests will be performed. Based on the inspections, a list of contract deficiencies will be issued to the Contractor. After correction of deficiencies as

necessary for beneficial use, the Consultant will process necessary acceptance and the equipment will then be under the control and operation of Board personnel.

PART 2 - PRODUCTS

2.1. FACTORY-ASSEMBLED PRODUCTS

2.1.1. Provide maximum standardization of components to reduce spare part requirements.

2.1.2. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for final assembled unit.

2.1.3. All components of an assembled unit need not be products of same manufacturer.

2.1.4. Constituent parts that are alike shall be products of a single manufacturer.

2.1.5. Components shall be compatible with each other and with the total assembly for intended service.

2.1.6. Contractor shall guarantee performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.

2.1.7. Components of equipment shall bear manufacturer's name and trademark, model number, serial number and performance data on a name plate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.

2.1.8. Major items of equipment, which serve the same function, must be the same make and model. Exceptions will be permitted if performance requirements cannot be met.

2.2. COMPATIBILITY OF RELATED EQUIPMENT

2.2.1. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that the result will be a complete and fully operational plant that conforms to contract requirements.

2.3. BELT DRIVES

2.3.1. Type: ANSI/RMA standard V belts with proper motor pulley and driven sheave. Belts shall be constructed of reinforced cord and rubber.

2.3.2. Dimensions, rating and selection standards: ANSI/RMA IP 20 and IP 21.

2.3.3. Minimum Horsepower Rating: Motor horsepower plus recommended ANSI/RMA service factor (not less than 20 percent) in addition to the ANSI/RMA allowances for pitch diameter, center distance, and arc of contact.

2.3.4. Maximum Speed: 25 m/s (5000 feet per minute).

2.3.5. Adjustment Provisions: For alignment and ANSI/RMA standard allowances for installation and take up.

2.3.6. Drives may utilize a single V Belt (any cross section) when it is the manufacturer's standard.

2.3.7. Multiple Belts: Matched to ANSI/RMA specified limits by measurement on a belt measuring fixture. Seal matched sets together to prevent mixing or partial loss of sets. Replacement, when necessary, shall be an entire set of new matched belts.

2.3.8. Sheaves and Pulleys:

2.3.8.1. Material: Pressed steel, or close grained cast iron.
2.3.8.2. Bore: Fixed or bushing type for securing to shaft with keys.
2.3.8.3. Balanced: Statically and dynamically.
2.3.8.4. roove spacing for driving and driven pulleys shall be the same.
2.3.8.5. Drive Types, Based on ARI 435:

2.3.9. Provide adjustable pitch or fixed pitch drive as follows:

2.3.9.1. Fan speeds up to 1800 RPM: 7.5 kW (10 horsepower) and smaller.
2.3.9.2. Fan speeds over 1800 RPM: 2.2 kW (3 horsepower) and smaller.
2.3.9.3. Provide fixed pitch drives for drives larger than those listed above.

2.3.10. The final fan speeds required to just meet the system CFM and pressure requirements, without throttling, shall be determined by adjustment of a temporary adjustable pitch motor sheave or by fan law calculation if a fixed pitch drive is used initially.

2.4. **DRIVE GUARDS**

2.4.1. For machinery and equipment, provide guards as shown in AMCA 410 for belts, chains, couplings, pulleys, sheaves, shafts, gears and other moving parts regardless of height

above the floor to prevent damage to equipment and injury to personnel. Drive guards may be excluded where motors and drives are inside factory fabricated air handling unit casings.

2.4.2. Pump shafts and couplings shall be fully guarded by a sheet steel guard, covering coupling and shaft but not bearings. Material shall be minimum 16-gage sheet steel; ends shall be braked and drilled and attached to pump base with minimum of four 6 mm (1/4-inch) bolts. Reinforce guard as necessary to prevent side play forcing guard onto couplings.

2.4.3. V-belt and sheave assemblies shall be totally enclosed, firmly mounted, non-resonant. Guard shall be an assembly of minimum 22-gage sheet steel and expanded or perforated metal to permit observation of belts. 25 mm (one-inch) diameter hole shall be provided at each shaft centerline to permit speed measurement.

2.4.4. Materials: Sheet steel, cast iron, expanded metal or wire mesh rigidly secured so as to be removable without disassembling pipe, duct, or electrical connections to equipment.

2.4.5. Access for Speed Measurement: 25 mm (One inch) diameter hole at each shaft center.

2.5. **LIFTING ATTACHMENTS**

2.5.1. Provide equipment with suitable lifting attachments to enable equipment to be lifted in its normal position. Lifting attachments shall withstand any handling conditions that might be encountered, without bending or distortion of shape, such as rapid lowering and braking of load.

2.6. **EQUIPMENT REQUIREMENTS AND INSTALLATION**

2.6.1. Permit equipment maintenance and disassembly by use of unions or flanges to minimize disturbance to connecting piping and duct systems and without interference from building structure or other equipment.

2.6.2. Provide accessible means for lubricating equipment including permanent lubricated bearings.

2.6.3. For all base mounted boilers, pumps, compressors, air handling units, fans and other rotating equipment, provide chamfered edge housekeeping pads a minimum of 4" high and 4" larger than equipment dimensions all around. Work shall be performed by the trades specializing in this work.

2.6.4. Pipe drain lines, overflows and safety relief vents to drains. If the horizontal drains present a tripping hazard, use aluminum checkered plate covers.

2.6.5. Line up equipment, rectangular cleanouts and similar items with building walls wherever possible.

2.7. **ELECTRIC MOTORS**

2.7.1. All material and equipment furnished and installation methods shall conform to the requirements of Section 23 05 12,; and, Section 26 05 19, Provide all electrical wiring, conduit, and devices necessary for the proper connection, protection and operation of the systems. Provide special energy efficient premium efficiency type motors as scheduled.

2.8. **VARIABLE SPEED MOTOR CONTROLLERS**

2.8.1. Refer to Section 26 05 11, and Section 23 05 14 for specifications.

2.8.2. The combination of controller and motor shall be provided by the manufacturer of the driven equipment, such as pumps and fans, and shall be rated for 100 percent output performance. Multiple units of the same class of equipment, i.e. air handlers, fans, pumps, shall be product of a single manufacturer.

2.8.3. Motors shall be premium efficiency type and be approved by the motor controller manufacturer. The controller-motor combination shall be guaranteed to provide full motor nameplate horsepower in variable frequency operation. Both driving and driven motor/fan sheaves shall be fixed pitch.

2.8.4. Controller shall not add any current or voltage transients to the input AC power distribution system, DDC controls, sensitive medical equipment, etc., nor shall be affected from other devices on the AC power system.

2.8.5. Controller shall be provided with the following operating features and accessories:

2.8.5.1. Suitable for variable torque load.

2.8.5.2. Provide thermal magnetic circuit breaker or fused switch with external operator and incoming line fuses. Provide output line reactors on line between drive and motor for motors over 50 HP or where the distance between the breaker and motor exceeds 50 feet.

2.9. **EQUIPMENT AND MATERIALS IDENTIFICATION**

2.9.1.1. Refer to section 23 05 53

2.10. **FIRESTOPPING**

2.10.1. Provide either factory built (Firestop Devices) or field installed (through-Penetration Firestop Systems) to form a specific building system maintaining required integrity of the fire barrier and stop the passage of gases or smoke. Firestop systems to accommodate building movements without impairing their integrity.

2.10.2. Through-penetration firestop systems and firestop devices tested in accordance with ASTM E814 or UL 1479 using the "F" or "T" rating to maintain the same rating and integrity as the fire barrier being sealed. "T" ratings are not required for penetrations smaller than or equal to 101 mm (4 inches) nominal pipe or 0.01 square meter (16 square inches) in overall cross sectional area.

2.10.3. Firestop sealants used for firestopping or smoke sealing to have the following properties:

2.10.3.1. Contain no flammable or toxic solvents.
2.10.3.2. Release no dangerous or flammable out gassing during the drying or curing of products.
2.10.3.3. Water-resistant after drying or curing and unaffected by high humidity, condensation or transient water exposure.
2.10.3.4. When installed in exposed areas, capable of being sanded and finished with similar surface treatments as used on the surrounding wall or floor surface.

2.10.4. Firestopping system or devices used for penetrations by glass pipe, plastic pipe or conduits, unenclosed cables, or other non-metallic materials to have following properties:

2.10.4.1. Classified for use with the particular type of penetrating material used.
2.10.4.2. Penetrations containing loose electrical cables, computer data cables, and communications cables protected using firestopping systems that allow unrestricted cable changes without damage to the seal.

2.10.5. Maximum flame spread of 25 and smoke development of 50 when tested in accordance with ASTM E84 or UL 723. Material to be an approved firestopping material as listed in UL Fire Resistance Directory or by a nationally recognized testing laboratory.

2.10.6. FM, UL, or WH rated or tested by an approved laboratory in accordance with ASTM E814.

2.10.7. Materials to be nontoxic and noncarcinogen at all stages of application or during fire conditions and to not contain hazardous chemicals. Provide firestop material that is free from Ethylene Glycol, PCB, MEK, and asbestos.

2.10.8. For firestopping exposed to view, traffic, moisture, and physical damage, provide products that do not deteriorate when exposed to these conditions.

2.10.8.1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.

2.10.8.2. For floor penetrations with annular spaces exceeding 101 mm (4 inches) or more in width and exposed to possible loading and traffic, provide firestop systems capable of supporting the floor loads involved either by installing floor plates or by other means acceptable to the firestop manufacturer.

2.10.8.3. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.

2.11. **GALVANIZED REPAIR COMPOUND**

2.11.1. Mil. Spec. DOD P 21035B, paint form.

2.12. **HVAC PIPE AND EQUIPMENT SUPPORTS AND RESTRAINTS**

2.12.1. Vibration Isolators: Refer to Section 23 05 41

2.12.2. Supports for Roof Mounted Items:

2.12.2.1. Equipment: Refer to details on mechanical and structural drawings.

2.12.2.2. Pipe Supports: Refer to details on the drawings.

2.12.2.3. Supports for Indoor Mounted Items

2.12.2.3.1. Attachment to Concrete Building Construction:

- Concrete insert: MSS SP-58, Type 18.
- Self drilling expansion shields and machine bolt expansion anchors: Permitted in concrete not less than 102 mm (four inches) thick when approved by the Consultant for each job condition.

- Power driven fasteners: Permitted in existing concrete or masonry not less than 102 mm (four inches) thick when approved by the Consultant for each job condition.

2.12.2.3.2. Attachment to Steel Building Construction:

- Welded attachment: MSS SP 58, Type 22.
- Beam clamps: MSS SP-58, Types 20, 21, 28 or 29. Type 23 C clamp may be used for individual copper tubing up to 23mm (7/8 inch) outside diameter.

2.12.2.3.3. Attachment to existing structure: Support from existing floor/roof frame

- Attachment to Wood Construction: Wood screws or lag bolts.
- Hanger Rods: Hot rolled steel, ASTM A36 or A575 for allowable load listed in MSS SP 58. For piping, provide adjustment means for controlling level or slope. Types 13 or 15 turn buckles shall provide 38 mm (1 1/2 inches) minimum of adjustment and incorporate locknuts. All thread rods are acceptable.

2.12.2.3.4. Hangers Supporting Multiple Pipes (Trapeze Hangers): Galvanized, cold formed, lipped steel channel horizontal member, not less than 41 mm by 41 mm (1 5/8 inches by 1 5/8 inches), 2.7 mm (No. 12 gage), designed to accept special spring held, hardened steel nuts. Not permitted for steam supply and condensate piping.

2.12.2.3.5. Allowable hanger load: Manufacturers rating less 91kg (200 pounds).

2.12.2.3.6. Guide individual pipes on the horizontal member of every other trapeze hanger with 6 mm (1/4 inch) U bolt fabricated from steel rod. Provide Type 40 insulation shield, secured by two 13mm (1/2 inch) galvanized steel bands, or preinsulated calcium silicate shield for insulated piping at each hanger.

2.12.3. Supports for Piping Systems:

2.12.3.1. Select hangers sized to encircle insulation on insulated piping. Refer to Section 23 07 11 for insulation thickness. To protect insulation, provide Type 39 saddles for roller type supports or pre-insulated calcium silicate shields. Provide Type 40 insulation shield or pre-insulated calcium silicate shield at all other types of supports and hangers including those for pre-insulated piping.

2.12.4. Piping Systems (MSS SP 58):

2.12.4.1. Standard clevis hanger: Type 1; provide locknut.
2.12.4.2. Riser clamps: Type 8.
2.12.4.3. Wall brackets: Types 31, 32 or 33.
2.12.4.4. Roller supports: Type 41, 43, 44 and 46.
2.12.4.5. Saddle support: Type 36, 37 or 38.
2.12.4.6. Turnbuckle: Types 13 or 15. Preinsulate.
2.12.4.7. U bolt clamp: Type 24.

2.12.5. Copper Tube:

2.12.5.1. Hangers, clamps and other support material in contact with tubing shall be painted with copper colored epoxy paint, plastic coated or taped with non-adhesive isolation tape to prevent electrolysis.
2.12.5.2. For vertical runs use epoxy painted or plastic coated riser clamps.
2.12.5.3. For supporting tube to strut: Provide epoxy painted pipe straps for copper tube or plastic inserted vibration isolation clamps.

2.12.6. Insulated Lines: Provide pre-insulated calcium silicate shields sized for copper tube.

2.12.7. Supports for plastic or glass piping: As recommended by the pipe manufacturer with black rubber tape extending one inch beyond steel support or clamp.

2.12.8. Piping with Vertical Expansion and Contraction:

2.12.8.1. Movement up to 20 mm (3/4 inch): Type 51 or 52 variable spring unit with integral turn buckle and load indicator.
2.12.8.2. Movement more than 20 mm (3/4 inch): Type 54 or 55 constant support unit with integral adjusting nut, turn buckle and travel position indicator.
2.12.8.3. Convertor and Expansion Tank Hangers: May be Type 1 sized for the shell diameter. Insulation where required will cover the hangers.

2.12.9. For pipe sizes larger than (50 mm) 2-inches:

2.12.9.1. Pre-insulated Calcium Silicate Shields:

2.12.9.1.1. Provide 360 degree water resistant high density 965 kPa (140 psi) compressive strength calcium silicate shields encased in galvanized metal.
2.12.9.1.2. Pre-insulated calcium silicate shields to be installed at the point of support during erection.
2.12.9.1.3. Shield thickness shall match the pipe insulation.

2.12.9.1.4. The type of shield is selected by the temperature of the pipe, the load it must carry, and the type of support it will be used with.

2.12.9.1.5. Shields for supporting chilled or cold water shall have insulation that extends a minimum of 1 inch past the sheet metal. Provide for an adequate vapor barrier in chilled lines.

2.12.9.1.6. The pre-insulated calcium silicate shield shall support the maximum allowable water filled span as indicated in MSS-SP 69. To support the load, the shields may have one or more of the following features: structural inserts 4138 kPa (600 psi) compressive strength, an extra bottom metal shield, or formed structural steel (ASTM A36) wear plates welded to the bottom sheet metal jacket.

2.12.9.1.7. Shields may be used on steel clevis hanger type supports, roller supports or flat surfaces

2.13. **PIPE PENETRATIONS – ROOFS**

2.13.1. Refer to details on the drawings

2.14. **PIPE PENETRATIONS THROUGH INTERIOR BUILDING ELEMENTS**

2.14.1. Install sleeves during construction for other than blocked out floor openings for risers in mechanical bays.

2.14.2. To prevent accidental liquid spills from passing to a lower level, provide the following:

2.14.2.1. For sleeves: Extend sleeve 25 mm (one inch) above finished floor and provide sealant for watertight joint.

2.14.2.2. For blocked out floor openings: Provide 40 mm (1½ inch) angle set in silicone adhesive around opening.

2.14.2.3. For drilled penetrations: Provide 40 mm (1½ inch) angle ring or square set in silicone adhesive around penetration.

2.14.3. Penetrations are not allowed through beams or ribs, but may be installed in concrete beam flanges. Any deviation from these requirements must receive prior approval of Consultant.

2.14.4. Sheet Metal, Plastic, or Moisture resistant Fiber Sleeves: Provide for pipe passing through floors, interior walls, and partitions, unless brass or steel pipe sleeves are specifically called for below.

2.14.5. Cast Iron or Zinc Coated Pipe Sleeves: Provide for pipe passing through exterior walls below grade. Make space between sleeve and pipe watertight with a modular or link rubber seal. Seal shall be applied at both ends of sleeve.

2.14.6. Galvanized Steel or an alternate Black Iron Pipe with asphalt coating Sleeves: Provide for pipe passing through concrete beam flanges, except where brass pipe sleeves are called for. Provide sleeve for pipe passing through floor of mechanical rooms, laundry work rooms, and animal rooms above basement. Except in mechanical rooms, connect sleeve with floor plate.

2.14.7. Brass Pipe Sleeves: Provide for pipe passing through quarry tile, terrazzo or ceramic tile floors. Connect sleeve with floor plate.

2.14.8. Sleeves are not required for wall hydrants for fire department connections or in drywall construction.

2.14.9. Sleeve Clearance: Sleeve through floors, walls, partitions, and beam flanges shall be one inch greater in diameter than external diameter of pipe. Sleeve for pipe with insulation shall be large enough to accommodate the insulation. Interior openings shall be caulked tight with fire stopping material and sealant to prevent the spread of fire, smoke, and gases.

2.15. **DUCT PENETRATIONS - ROOFS**

2.15.1. Provide curbs for roof mounted piping, ductwork and equipment. Curbs shall be 18 inches high with continuously welded seams, built-in cant strip, interior baffle with acoustic insulation, curb bottom, hinged curb adapter.

2.15.2. Refer to details on mechanical and structural drawings

2.16. **DUCT PENETRATIONS – INTERIOR BUILDING ELEMENTS**

2.16.1. Provide sheet metal sleeves min 150 mm (6”) raised above the penetrated floors. Seal space between sleeves and ducts.

2.16.2. For penetrations through fire rated building elements, refer to details on the drawings.

2.16.3. Provide firestopping for openings through fire and smoke barriers, maintaining minimum required rating of floor, ceiling or wall assembly.

2.17. **SPECIAL TOOLS AND LUBRICANTS**

2.17.1. Furnish, and turn over to the Board, tools not readily available commercially, that are required for disassembly or adjustment of equipment and machinery furnished.

2.17.2. Grease Guns with Attachments for Applicable Fittings: One for each type of grease required for each motor or other equipment.

2.17.3. Refrigerant Tools: Provide system charging/Evacuation equipment, gauges, fittings, and tools required for maintenance of furnished equipment.

2.17.4. Tool Containers: Hardwood or metal, permanently identified for in tended service and mounted, or located, where directed by the Consultant.

2.17.5. Lubricants: A minimum of 0.95 L (one quart) of oil, and 0.45 kg (one pound) of grease, of equipment manufacturer's recommended grade and type, in unopened containers and properly identified as to use for each different application.

2.18. **WALL, FLOOR AND CEILING PLATES**

2.18.1. Material and Type: Chrome plated brass or chrome plated steel, one piece or split type with concealed hinge, with set screw for fastening to pipe, or sleeve. Use plates that fit tight around pipes, cover openings around pipes and cover the entire pipe sleeve projection.

2.18.2. Thickness: Not less than 2.4 mm (3/32 inch) for floor plates. For wall and ceiling plates, not less than 0.64 mm (0.025-inch) for up to 80 mm (3 inch pipe), 0.89 mm (0.035-inch) for larger pipe.

2.18.3. Locations: Use where pipe penetrates floors, walls and ceilings in exposed locations, in finished areas only. Provide a watertight joint in spaces where brass or steel pipe sleeves are specified.

PART 3 - EXECUTION

3.1. **ARRANGEMENT AND INSTALLATION OF EQUIPMENT AND PIPING**

3.1.1. Coordinate location of piping, sleeves, inserts, hangers, ductwork and equipment. Locate piping, sleeves, inserts, hangers, ductwork and equipment clear of windows, doors, openings, light outlets, and other services and utilities. Prepare equipment layout drawings to coordinate proper location and personnel access of all facilities.

Submit the interference drawings for review as required by Part 1. Follow manufacturer's published recommendations for installation methods not otherwise specified.

3.1.2. Operating Personnel Access and Observation Provisions: Select and arrange all equipment and systems to provide clear view and easy access, without use of portable ladders, for maintenance and operation of all devices including, btemperature but not limited to: all equipment items, valves, filters, strainers, transmitters, sensors, control devices. All gages and indicators shall be clearly visible by personnel standing on the floor or on permanent platforms. Do not reduce or change maintenance and operating space and access provisions that are shown on the drawings.

3.2. **THERMOMETERS AND PRESSURE GAUGES**

3.2.1. General:

3.2.1.1. Locate direct reading thermometers and gauges for reading from floor or platform.

3.2.1.2. Provide remote reading thermometers and gauges where direct reading instruments cannot be satisfactorily located.

3.2.1.3. Locate engraved lamacoid nameplate as specified in Section Identification, identifying medium adjacent to thermometers and gauges.

3.2.2. Thermometers:

3.2.2.1. Industrial, 9" adjustable angle cast aluminum case, CGSB standard CAN/CGSB-14.4-M88 red reading mercury, lens front tube, white scale black embossed figures, clear glass or acrylic window, tapered aluminum stem.

3.2.2.2. Scale shall be suitable for 2 times the temperature range of service. Scale shall be combined Celsius and Fahrenheit.

3.2.2.3. Standard of Acceptance: Weiss, Ashcroft, Trerice.

3.2.3. Pressure Gauges:

3.2.3.1. 5" dial, solid front blow out back, fibreglass reinforced polypropylene case, phosphor bronze bourdon tube and brass 1/4" N.P.T. socket, bottom connection, stainless steel rotary type movement, gauge to be registered with the Provincial Boiler and Pressure Vessel Safety Branch with a registration number and conform to ANSI B40.1. Accuracy to be grade "A".

3.2.3.2. On pumps liquid filled gauges shall be utilized.

3.2.3.3. Standard of Acceptance: Weiss, Ashcroft, Trerice.

3.2.3.4. Provide bronze stop cock, bronze bar stock ¼" N.P.T. bronze porous core pressure snubber for pulsating operation and diaphragm for corrosive service.

3.2.3.5. Use materials compatible with system requirements.

3.2.4. Gauges shall have combined kilopascal and psi scales.

3.3. EQUIPMENT AND PIPING SUPPORT

3.3.1. Coordinate structural systems necessary for pipe and equipment support with pipe and equipment locations to permit proper installation.

3.3.2. Location of pipe sleeves, trenches and chases shall be accurately coordinated with equipment and piping locations.

3.3.3. Cutting Holes:

3.3.3.1. Cut holes through concrete and masonry by rotary core drill. Pneumatic hammer, impact electric, and hand or manual hammer type drill will not be allowed, except as permitted by Consultant where working area space is limited.

3.3.3.2. Locate holes to avoid interference with structural members such as beams or grade beams. Holes shall be laid out in advance and drilling done only after approval by Consultant. If the Contractor considers it necessary to drill through structural members, this matter shall be referred to Consultant for approval.

3.3.3.3. Do not penetrate membrane waterproofing.

3.4. ITEMS NOT SHOWN BUT REQUIRED

3.4.1. Interconnection of Instrumentation or Control Devices: Generally, electrical and pneumatic interconnections are not shown but must be provided.

3.4.2. Minor Piping: Generally, small diameter pipe runs from drips and drains, water cooling, and other service are not shown but must be provided.

3.4.3. Electrical and Pneumatic Interconnection of Controls and Instruments: This generally not shown but must be provided. This includes interconnections of sensors, transmitters, transducers, control devices, control and instrumentation panels, instruments and computer workstations. Comply with NFPA-70.

3.5. PROTECTION AND CLEANING:

3.5.1. Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the

manufacturer's recommendations and as approved by the Consultant. Damaged or defective items in the opinion of the Consultant, shall be replaced.

3.5.2. Protect all finished parts of equipment, such as shafts and bearings where accessible, from rust prior to operation by means of protective grease coating and wrapping. Close pipe openings with caps or plugs during installation. Tightly cover and protect fixtures and equipment against dirt, water chemical, or mechanical injury. At completion of all work thoroughly clean fixtures, exposed materials and equipment.

3.6. **WORK IN EXISTING BUILDING:**

3.6.1. Make alterations to existing service piping at times that will least interfere with normal operation of the facility.

3.6.2. Cut required openings through existing masonry and reinforced concrete using diamond core drills. Use of pneumatic hammer type drills, impact type electric drills, and hand or manual hammer type drills, will be permitted only with approval of the Board. Locate openings that will least effect structural slabs, columns, ribs or beams. Refer to the Consultant for determination of proper design for openings through structural sections and opening layouts approval, prior to cutting or drilling into structure. After Consultant's approval, carefully cut opening through construction no larger than absolutely necessary for the required installation.

3.6.3. Switchgear/Electrical Equipment Drip Protection: Every effort shall be made to eliminate the installation of pipe above electrical and telephone switchgear. If this is not possible, encase pipe in a second pipe with a minimum of joints. Installation of piping, ductwork, leak protection apparatus or other installations foreign to the electrical installation shall be located in the space equal to the width and depth of the equipment and extending from to a height of 1.8 m (6 ft.) above the equipment to ceiling structure, whichever is lower (NFPA 70).

3.6.4. Inaccessible Equipment:

3.6.4.1. Where the Board determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled or remedial action performed as directed at no additional cost to the Board.

3.6.4.2. The term "conveniently accessible" is defined as capable of being reached without climbing or crawling under or over obstacles such as motors, fans, pumps, belt guards, transformers, high voltage lines, piping, and ductwork.

3.7. **TEMPORARY PIPING AND EQUIPMENT**

3.7.1. Continuity of operation of existing facilities will generally require temporary installation or relocation of equipment and piping.

3.7.2. The Contractor shall provide all required facilities in accordance with the requirements of phased construction and maintenance of service. All piping and equipment shall be properly supported, sloped to drain, operate without excessive stress, and shall be insulated where injury can occur to personnel by contact with operating facilities.

3.7.3. Temporary facilities and piping shall be completely removed and any openings in structures sealed. Provide necessary blind flanges and caps to seal open piping remaining in service.

3.8. **RIGGING**

3.8.1. Design is based on application of available equipment. Openings in building structures are planned to accommodate design scheme.

3.8.2. Alternative methods of equipment delivery may be offered by Contractor and will be considered by Board under specified restrictions of phasing and maintenance of service as well as structural integrity of the building.

3.8.3. Close all openings in the building when not required for rigging operations to maintain proper environment in the facility for Board operation and maintenance of service.

3.8.4. Contractor shall provide all facilities required to deliver specified equipment and place on foundations. Attachments to structures for rigging purposes and support of equipment on structures shall be Contractor's full responsibility. Upon request, the Board will check structure adequacy and advise Contractor of recommended restrictions.

3.8.5. Contractor shall check all clearances, weight limitations and shall offer a rigging plan designed by a Registered Professional Engineer. All modifications to structures, including reinforcement thereof, shall be at Contractor's cost, time and responsibility.

3.8.6. Rigging plan and methods shall be referred to Consultant for evaluation prior to actual work.

3.8.7. Restore building to original condition upon completion of rigging work.

3.9. **PIPE AND EQUIPMENT SUPPORTS**

3.9.1. Where hanger spacing does not correspond with joist or rib spacing, use structural steel channels secured directly to joist and rib structure that will correspond to the required hanger spacing, and then suspend the equipment and piping from the channels. Drill or burn holes in structural steel only with the prior approval of the Consultant.

3.9.2. Use of chain, wire or strap hangers; wood for blocking, stays and bracing; or, hangers suspended from piping above will not be permitted. Replace or thoroughly clean rusty products and paint with zinc primer.

3.9.3. Use hanger rods that are straight and vertical. Turnbuckles for vertical adjustments may be omitted where limited space prevents use. Provide a minimum of 15 mm (1/2 inch) clearance between pipe or piping covering and adjacent work.

3.9.4. HVAC Horizontal Pipe Support Spacing: Refer to MSS SP 69. Provide additional supports at valves, strainers, in line pumps and other heavy components. Provide a support within one foot of each elbow.

3.9.5. HVAC Vertical Pipe Supports:

3.9.5.1. Up to 150 mm (6 inch pipe), 9 m (30 feet) long, bolt riser clamps to the pipe below couplings, or welded to the pipe and rests supports securely on the building structure.

3.9.5.2. Vertical pipe larger than the foregoing, support on base elbows or tees, or substantial pipe legs extending to the building structure.

3.9.6. Overhead Supports:

3.9.6.1. The basic structural system of the building is designed to sustain the loads imposed by equipment and piping to be supported overhead.

3.9.6.2. Provide steel structural members, in addition to those shown, of adequate capability to support the imposed loads, located in accordance with the final approved layout of equipment and piping.

3.9.7. Tubing and capillary systems shall be supported in channel troughs.

3.9.8. Floor Supports:

3.9.8.1. Provide concrete bases, concrete anchor blocks and pedestals, and structural steel systems for support of equipment and piping. Anchor and dowel concrete

bases and structural systems to resist forces under operating and seismic conditions (if applicable) without excessive displacement or structural failure.

3.9.8.2. Do not locate or install bases and supports until equipment mounted thereon has been approved. Size bases to match equipment mounted thereon plus 50 mm (2 inch) excess on all edges. Boiler foundations shall have horizontal dimensions that exceed boiler base frame dimensions by at least 150 mm (6 inches) on all sides. Refer to structural drawings. Bases shall be neatly finished and smoothed, shall have chamfered edges at the top, and shall be suitable for painting.

3.9.9. All equipment shall be shimmed, leveled, firmly anchored, and grouted with epoxy grout. Anchor bolts shall be placed in sleeves, anchored to the bases. Fill the annular space between sleeves and bolts with a granular material to permit alignment and realignment.

3.10. **CLEANING AND PAINTING**

3.10.1. Prior to final inspection and acceptance of the plant and facilities for beneficial use by the Board, the plant facilities, equipment and systems shall be thoroughly cleaned and painted.

3.10.2. In addition, the following special conditions apply:

3.10.2.1. Cleaning shall be thorough. Use solvents, cleaning materials and methods recommended by the manufacturers for the specific tasks. Remove all rust prior to painting and from surfaces to remain unpainted. Repair scratches, scuffs, and abrasions prior to applying prime and finish coats.

3.10.3. Material And Equipment Not To Be Painted Includes:

3.10.3.1. Motors, controllers, control switches, and safety switches.
3.10.3.2. Control and interlock devices.
3.10.3.3. Regulators.
3.10.3.4. Pressure reducing valves.
3.10.3.5. Control valves and thermostatic elements.
3.10.3.6. Lubrication devices and grease fittings.
3.10.3.7. Copper, brass, aluminum, stainless steel and bronze surfaces.
3.10.3.8. Valve stems and rotating shafts.
3.10.3.9. Pressure gauges and thermometers.
3.10.3.10. Glass.
3.10.3.11. Name plates.

3.10.4. Control and instrument panels shall be cleaned, damaged surfaces repaired, and shall be touched-up with matching paint obtained from panel manufacturer.

3.10.5. Pumps, motors, steel and cast iron bases, and coupling guards shall be cleaned, and shall be touched-up with the same color as utilized by the pump manufacturer

3.10.6. Temporary Facilities: Apply paint to surfaces that do not have existing finish coats.

3.10.7. Final result shall be smooth, even-colored, even-textured factory finish on all items. Completely repaint the entire piece of equipment if necessary to achieve this.

3.11. **IDENTIFICATION SIGNS**

3.11.1. Refer to Section 23 05 53

3.12. **MOTOR AND DRIVE ALIGNMENT**

3.12.1. Belt Drive: Set driving and driven shafts parallel and align so that the corresponding grooves are in the same plane.

3.12.2. Direct connect Drive: Securely mount motor in accurate alignment so that shafts are free from both angular and parallel misalignment when both motor and driven machine are operating at normal temperatures.

3.13. **LUBRICATION**

3.13.1. Lubricate all devices requiring lubrication prior to initial operation. Field-check all devices for proper lubrication.

3.13.2. Equip all devices with required lubrication fittings or devices. Provide a minimum of one liter (one quart) of oil and 0.5 kg (one pound) of grease of manufacturer's recommended grade and type for each different application; also provide 12 grease sticks for lubricated plug valves. Deliver all materials to Consultant in unopened containers that are properly identified as to application.

3.13.3. Provide a separate grease gun with attachments for applicable fittings for each type of grease applied.

3.13.4. All lubrication points shall be accessible without disassembling equipment, except to remove access plates.

3.14. **CONCRETE**

3.14.1. All concrete work required to complete this project, whether shown on the drawings or not, shall be the Contractor's responsibility.

3.14.2. Refer to this specification section for requirements for housekeeping pad.

3.15. **METALS**

3.15.1. All steel construction required for the completion of this project, whether shown on the drawings or not, shall be the Contractor's responsibility.

3.16. **CUTTING, PATCHING, ROOFING AND X-RAY**

3.16.1. All cutting, patching, roofing and X-Rays required for the completion of this project whether shown on the drawings or not, shall be the Contractor's responsibility. The cutting and patching work shall be performed in accordance with the following:

3.16.1.1. All cutting and patching shall be done by the trades specializing in the materials to be cut.

3.16.1.2. All flashing and equipment supports on the roof shall be done in strict accordance with the Board standards by Board-approved roofing contractors only.

3.16.1.3. Should any cutting, roofing and/or repairing of finished surfaces be required, the Sub-trade contractor for the Contractor shall employ the particular trades engaged on the site for this type of work.

3.16.1.4. None of the roofing work shall affect any current roof warranty. Coordinate with the Board representative the status of the roof, and if under warranty, coordinate all the work with the warranty holder.

3.16.1.5. Supporting members of any floor, wall or the building structure shall be cut only in such a location and manner as approved by the Consultant.

3.16.1.6. Where slabs in the portions of the building which are existing must be saw-cut or core drilled, all locations shall be x-rayed prior to saw-cutting or core-drilling. All x-raying shall be done by personnel qualified in the use of the type of equipment required to x-ray the saw-cuts shall be permitted to perform this

work on the site. No allowance will be made later for expenses incurred through the failure of performing these x-rays.

3.17. **OPERATING AND MAINTENANCE MANUALS**

3.17.1. Refer to Section 01 23 33

3.18. **CLOSE-OUT DOCUMENTATION**

3.18.1. 10 (ten) days prior to substantial performance of work obtain documentation and/or prepare certification of the following items and submit them to the Board representative:

3.18.1.1. All inspection certificates.
3.18.1.2. Guarantee certificates as called for under "Warranty".
3.18.1.3. Record drawings.
3.18.1.4. Operating and Maintenance Manuals.
3.18.1.5. Test certifications as called for under "Testing".
3.18.1.6. Provide a signed statement to the effect that all tests for mechanical systems and equipment have been completely carried out in the Trade Sections of these Specifications and to the manufacturer's recommendations, and in accordance with the requirements of all authorities having jurisdiction.

3.19. **COMMISSIONING**

3.19.1. Where applicable and the commissioning process is part of the project, provide commissioning documentation and all the manpower required for all inspection, start up, and contractor testing required above and required by the Checklists provided by the Commissioning Agent.

3.19.2. Coordinate with the Commissioning Agent if the start up and operation of the installed equipment is part of larger systems which require additional testing and verification.

3.20. **STARTUP AND TEMPORARY OPERATION**

3.20.1. Startup equipment as described in equipment specifications. Verify that vibration is within specified tolerance prior to extended operation.

3.21. **OPERATING AND PERFORMANCE TESTS**

3.21.1. Prior to the final inspection, perform required tests as specified and submit the test reports and records to the Consultant. The timing of the tests shall be arranged to suit the convenience of the Consultant, and the manner and duration shall be as the Consultant deems necessary. Record the daily start and stop times, operating hours and functions performed. Ensure that the performance tests are witnessed by the Consultant.

3.21.2. Should evidence of malfunction in any tested system, or piece of equipment or component part thereof, occur during or as a result of tests, make proper corrections, repairs or replacements, and repeat tests at no additional cost to the Board.

3.21.3. At the successful completion of Performance Tests and all testing and balancing, make the systems ready for final inspection and subsequent acceptance of the Board. Replace and clean filters, flush out lines and equipment, remove and clean strainers, fill liquid systems and purge air. Provide water treatment to pipes and report in accordance to current by-laws. Disinfect all domestic water as required by current by-laws and Authorities Having Jurisdiction.

3.21.4. When completion of certain work or system occurs at a time when final control settings and adjustments cannot be properly made to make performance tests, then make performance tests for heating systems and for cooling systems respectively during first actual seasonal use of respective systems following completion of work.

3.22. **INSTRUCTIONS TO BOARD PERSONNEL**

3.22.1. Provide in accordance with Section 23 08 11

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PART 1 - GENERAL

1.1. **DESCRIPTION:**

1.1.1. This section specifies the furnishing, installation and connection of motors for HVAC equipment.

1.2. **RELATED WORK:**

1.2.1. Section 01 33 23, SHOP DRAWINGS AND PROJECT DOCUMENTATION.
1.2.2. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
1.2.3. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
1.2.4. Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS.

1.3. **SUBMITTALS:**

1.3.1. Submit in accordance with Section 01 33 23, SHOP DRAWINGS AND PROJECT DOCUMENTATION, and Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.3.2. Shop Drawings:

1.3.2.1. Provide documentation to demonstrate compliance with drawings and specifications.
1.3.2.2. Include electrical ratings, efficiency, bearing data, power factor, frame size, dimensions, mounting details, materials, horsepower, voltage, phase, speed (RPM), enclosure, starting characteristics, torque characteristics, code letter, full load and locked rotor current, service factor, and lubrication method.

1.3.3. Manuals:

1.3.3.1. Submit simultaneously with the shop drawings, companion copies of complete installation, maintenance and operating manuals, including technical data sheets and application data.
1.3.3.2. Certification: Two weeks prior to final inspection, unless otherwise noted, submit four copies of the following certification to the Resident Engineer:
1.3.3.3. Certification that the motors have been applied, installed, adjusted, lubricated, and tested according to manufacturer published recommendations.

1.4. **APPLICABLE PUBLICATIONS:**

1.4.1. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

1.4.2. National Electrical Manufacturers Association (NEMA):

1.4.2.1. MG 1-2006 Rev. 1 2009 Motors and Generators
1.4.2.2. MG 2–2001 Rev. 1 2007 Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators

1.4.3. National Fire Protection Association (NFPA):

1.4.3.1. 70-latest National Electrical Code (NEC)

1.4.4. Institute of Electrical and Electronics Engineers (IEEE):

1.4.4.1. 112-04 Standard Test Procedure for Polyphase Induction Motors and Generators

1.4.5. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):

1.4.5.1. 90.1-latest Energy Standard for Buildings Except Low-Rise Residential Buildings

1.5. **STANDARDS OF ACCEPTANCE**

1.5.1. Baldor Electric Company
1.5.2. Leeson Electric
1.5.3. General Electric
1.5.4. Dayton

PART 2 - PRODUCTS

2.1. **MOTORS:**

2.1.1. All material and equipment furnished and installation methods shall conform to the requirements of Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS; and Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW). Provide all electrical wiring, conduit, and devices necessary for the proper connection, protection and operation of the systems. Provide premium efficiency type

motors as scheduled. Unless otherwise specified for a particular application, use electric motors with the following requirements.

2.1.2. Single phase Motors: Motors for centrifugal fans and pumps may be split phase or permanent split capacitor (PSC) type. Provide capacitor-start type for hard starting applications.

2.1.3. Electrically Commutated motor (EC Type): Motor shall be brushless DC type specifically designed for applications with heavy duty ball bearings and electronic commutation. The motor shall be speed controllable down to 20% of full speed and 85% efficient at all speeds.

2.1.4. Poly-phase Motors: NEMA Design B, Squirrel cage, induction type.

2.1.5. Two Speed Motors: Each two-speed motor shall have two separate windings. Provide a time- delay (20 seconds minimum) relay for switching from high to low speed.

2.1.6. Number of phases shall be as follows:

2.1.6.1. Motors, less than 373 W (1/2 HP): Single phase.
2.1.6.2. Motors, 373 W (1/2 HP) and larger: 3 phase.
2.1.6.3. Exceptions:
2.1.6.3.1. Hermetically sealed motors.
2.1.6.3.2. Where specified otherwise on the equipment schedules
2.1.6.3.3. Motors for equipment assemblies, less than 746 W (one HP), may be single phase provided the manufacturer of the proposed assemblies cannot supply the assemblies with three phase motors.

2.1.7. Motors shall be designed for operating the connected loads continuously in a 40°C (104°F) environment, where the motors are installed, without exceeding the NEMA standard temperature rises for the motor insulation. If the motors exceed 40°C (104°F), the motors shall be rated for the actual ambient temperatures.

2.1.8. Motor designs, as indicated by the NEMA code letters, shall be coordinated with the connected loads to assure adequate starting and running torque.

2.2. **MOTOR ENCLOSURES:**

2.2.1. Shall be the NEMA types as specified and/or shown on the drawings.

2.2.2. Where the types of motor enclosures are not shown on the drawings, they shall be the NEMA types, which are most suitable for the environmental conditions where the motors are being installed.

2.2.3. Enclosure requirements for certain conditions are as follows:

2.2.3.1. Motors located outdoors, indoors in wet or high humidity locations, or in unfiltered airstreams shall be totally enclosed type.

2.2.3.2. Where motors are located in an NEC 511 classified area, provide TEFC explosion proof motor enclosures.

2.2.3.3. Where motors are located in a corrosive environment, provide TEFC enclosures with corrosion resistant finish.

2.2.3.4. Enclosures shall be primed and finish coated at the factory with manufacturer's prime coat and standard finish.

2.2.4. Special Requirements:

2.2.4.1. Where motor power requirements of equipment furnished deviate from power shown on plans, provide electrical service designed under the requirements of NFPA 70 without additional time or cost to the Client

2.2.4.2. Assemblies of motors, starters, controls and interlocks on factory assembled and wired devices shall be in accordance with the requirements of this specification.

2.2.5. Wire and cable materials specified in the electrical division of the specifications shall be modified as follows:

2.2.5.1. Wiring material located where temperatures can exceed 71 degrees C (160 degrees F) shall be stranded copper with Teflon FEP insulation with jacket. This includes wiring on the boilers.

2.2.5.2. Other wiring at boilers and to control panels shall be NFPA 70 designation THWN.

2.2.5.3. Provide shielded conductors or wiring in separate conduits for all instrumentation and control systems where recommended by manufacturer of equipment.

2.2.6. Select motor sizes so that the motors do not operate into the service factor at maximum required loads on the driven equipment. Motors on pumps shall be sized for non-overloading at all points on the pump performance curves.

2.2.7. Motors less than 3 HP:

2.2.7.1. Steel or cast iron motor frames, cast aluminum, cast iron, or steel end plates, steel or cast iron terminal box, copper windings. Motor nameplates shall be steel, engraved-type, riveted to motor.

2.2.7.2. Bearings: Regreasable with relief plugs, pre-lubricated ball bearings suitable for radial and thrust loading of the application, with grease fittings, selected for a minimum L-10bearing life of 26,280 hours, for belted and direct drive.

2.2.8. Motors 3 HP and above:

2.2.8.1. Cast iron motor frame and mounting feet, cast iron end plates (bells), steel or cast iron terminal box, copper windings. Motor nameplates shall be stainless steel engraved type, riveted to the motor.

2.2.8.2. Bearings shall be regreasable with relief plugs, pre-lubricated ball bearings suitable for radial and thrust loading of the application, with grease fittings. Rated for an L-10 life of 40,000 hours (belted) or 130,000 hours (direct connected).

2.2.9. Bearing life calculations shall be per ABMA 9, and for belted applications shall be based on the maximum external side load limits for belted applications per NEMA MG-1 Table 14-1A. L-10 life calculations for vertical motors and horizontal motors mounted in the vertical position shall consider the application's thrust loading.

2.2.10. TEFC motors shall also include an external shaft slinger on drive end.

2.2.11. Motors shall not exceed dBA levels listed in NEMA MG-1 54 PART 9 Tables 9-1 and 9-3, at all speeds.

2.2.12. Motors utilized with variable frequency drives shall be rated "inverter-duty" per NEMA Standard, MG1, Part 31.4.4.2. Provide motor shaft grounding apparatus that will protect bearings from damage from stray currents.

2.3. **ENERGY EFFICIENT MOTORS (MOTOR EFFICIENCIES):**

2.3.1. All permanently wired polyphase motors of 746 Watts (1 HP) or more shall meet the minimum full-load efficiencies as indicated in the following table.

2.3.2. Motors of 746 Watts or more with open, drip-proof or totally enclosed fan-cooled enclosures shall be NEMA premium efficiency type, unless otherwise indicated.

2.3.3. Motors provided as an integral part of motor driven equipment are excluded from this requirement if a minimum seasonal or overall efficiency requirement is indicated for that equipment by the provisions of another section.

Minimum Premium Efficiencies Open Drip-Proof				**Minimum Premium Efficiencies Totally Enclosed Fan-Cooled**			
Rating kW (HP)	**1200 RPM**	**1800 RPM**	**3600 RPM**	**Rating kW (HP)**	**1200 RPM**	**1800 RPM**	**3600 RPM**
0.746 (1)	82.5%	85.5%	77.0%	0.746 (1)	82.5%	85.5%	77.0%
1.12 (1.5)	86.5%	86.5%	84.0%	1.12 (1.5)	87.5%	86.5%	84.0%
1.49 (2)	87.5%	86.5%	85.5%	1.49 (2)	88.5%	86.5%	85.5%
2.24 (3)	88.5%	89.5%	85.5%	2.24 (3)	89.5%	89.5%	86.5%
3.73 (5)	89.5%	89.5%	86.5%	3.73 (5)	89.5%	89.5%	88.5%
5.60 (7.5)	90.2%	91.0%	88.5%	5.60 (7.5)	91.0%	91.7%	89.5%
7.46 (10)	91.7%	91.7%	89.5%	7.46 (10)	91.0%	91.7%	90.2%
11.2 (15)	91.7%	93.0%	90.2%	11.2 (15)	91.7%	92.4%	91.0%
14.9 (20)	92.4%	93.0%	91.0%	14.9 (20)	91.7%	93.0%	91.0%
18.7 (25)	93.0%	93.6%	91.7%	18.7 (25)	93.0%	93.6%	91.7%
22.4 (30)	93.6%	94.1%	91.7%	22.4 (30)	93.0%	93.6%	91.7%
29.8 (40)	94.1%	94.1%	92.4%	29.8 (40)	94.1%	94.1%	92.4%
37.3 (50)	94.1%	94.5%	93.0%	37.3 (50)	94.1%	94.5%	93.0%
44.8 (60)	94.5%	95.0%	93.6%	44.8 (60)	94.5%	95.0%	93.6%
56.9 (75)	94.5%	95.0%	93.6%	56.9 (75)	94.5%	95.4%	93.6%
74.6 (100)	95.0%	95.4%	93.6%	74.6 (100)	95.0%	95.4%	94.1%
93.3 (125)	95.0%	95.4%	94.1%	93.3 (125)	95.0%	95.4%	95.0%
112 (150)	95.4%	95.8%	94.1%	112 (150)	95.8%	95.8%	95.0%

2.3.4. Minimum Power Factor at Full Load and Rated Voltage: 90 percent at 1200 RPM, 1800 RPM and 3600 RPM.

PART 3 - EXECUTION

3.1. **INSTALLATION:**

3.1.1. Install motors in accordance with manufacturer's recommendations, the NEC, NEMA, as shown on the drawings and/or as required by other sections of these specifications.

3.2. **FIELD TESTS**

3.2.1. Perform an electric insulation resistance Test using a megohmmeter on all motors after installation, before start-up. All shall test free from grounds.

3.2.2. Perform Load test in accordance with ANSI/IEEE 112, Test Method B, to determine freedom from electrical or mechanical defects and compliance with performance data.

3.2.3. Insulation Resistance: Not less than one half meg-ohm between stator conductors and frame, to be determined at the time of final inspection.

3.2.4. All test data shall be complied into a report form for each motor and provided to the contracting officer or their representative.

3.3. **STARTUP AND TESTING**

3.3.1. The Commissioning Agent will observe startup and contractor testing of all equipment. Coordinate the startup and contractor testing schedules with Resident Engineer and Commissioning Agent. Provide a minimum of 7 days prior notice.

PART 1 - GENERAL

1.1. DESCRIPTION

1.1.1. This specification is to cover a complete Variable Frequency Drive (VFD aka: VSD, AFD, ASD, Inverter, AC Drive, et al) consisting of a pulse width modulated (PWM) inverter designed for use with a standard NEMA Design B induction motor.

1.1.2. The drive manufacturer shall supply the drive and all necessary options as herein specified. The manufacturer shall have been engaged in the production of this type of equipment for a minimum of twenty years. VFDs that are manufactured by a third party and "brand labeled" shall not be acceptable. Drive manufacturers who do not build their own power boards and assemblies, or do not have full control of the power board manufacturing and quality control, shall be considered as a "brand labeled" drive. All VFDs installed on this project shall be from the same manufacturer.

1.2. QUALITY ASSURANCE

1.2.1. Referenced Standards and Guidelines:

1.2.1.1. Institute of Electrical and Electronic Engineers (IEEE)
1.2.1.2. IEEE 519-1992, Guide for Harmonic Content and Control.
1.2.1.3. Underwriters Laboratories (as appropriate)

1.2.1.3.1. UL508
1.2.1.3.2. UL508A
1.2.1.3.3. UL508C

1.2.1.4. National Electrical Manufacturer's Association (NEMA)
1.2.1.5. ICS 7.0, AC Adjustable Speed Drives
1.2.1.6. International Electrotechnical Commission (IEC)
1.2.1.7. EN/IEC 61800-3
1.2.1.8. National Electric Code (NEC)
1.2.1.9. NEC 430.120, Adjustable-Speed Drive Systems

1.2.2. Qualifications:

1.2.2.1. VFDs and options shall be UL508 listed as a complete assembly. The base VFD shall be UL labeled 100 kA RMS Symmetrical, 600V max. C

1.2.2.2. CE Mark – The base VFD shall conform to the European Union Electromagnetic Compatibility directive, a requirement for CE marking. The VFD shall meet product standard EN 61800-3 for the First Environment restricted level (Category C2). Base drives that only meet the Second Environment (Category C3, C4) shall be supplied with filters to bring the drive in compliance with the First Environment levels.

1.2.2.3. The entire VFD assembly, including the bypass (if specified), shall be seismically certified and labeled as such in accordance with the 2012 International Building Code (IBC)

1.3. **STANDARD OF ACCEPTANCE:**

1.3.1.1. ABB ACH Series.
1.3.1.2. Danfoss

1.4. **SUBMITTALS**

1.4.1. Submittals shall include the following information:

1.4.1.1. Outline dimensions, conduit entry locations and weight.
1.4.1.2. Customer connection and power wiring diagrams.
1.4.1.3. Complete technical product description include a complete list of options provided.
1.4.1.4. Any portions of this specification not met must be clearly indicated or the supplier and contractor shall be liable to provide all additional components required to meet this specification.

PART 2 - PRODUCTS

2.1. **VARIABLE FREQUENCY DRIVES**

2.1.1.
2.1.2. The VFD package as specified herein and defined on the VFD schedule shall be enclosed in a UL Type enclosure (enclosures with only NEMA ratings are not acceptable), completely assembled and tested by the manufacturer in an ISO9001 facility.
2.1.3.
2.1.4. The VFD shall provide full rated output from a line of ±10% of nominal voltage. The VFD shall continue to operate without faulting from a line of +30% to -35% of nominal voltage.
2.1.5.
2.1.6. VFDs shall be capable of continuous full load operation under the following environmental operating conditions:

2.1.6.1. -15 to 40° C (5 to 104° F) ambient temperature. Operation to 50° C shall be allowed with a 10% reduction from VFD full load current.
2.1.6.2. Altitude 0 to 3300 feet above sea level. Operation to 6600 shall be allowed with a 10% reduction from VFD full load current.
2.1.6.3. Humidity less than 95%, non-condensing.

2.1.7. All VFDs shall have the following standard features:

2.1.7.1. All circuit boards shall be coated to protect against corrosion.
2.1.7.2. All VFDs shall have the same customer interface, including digital display, and keypad, regardless of horsepower rating. The keypad shall be removable,

capable of remote mounting and allow for uploading and downloading of parameter settings as an aid for start-up of multiple VFDs.

2.1.7.3. The keypad shall include Hand-Off-Auto selections and manual speed control. The drive shall incorporate "bumpless transfer" of speed reference when switching between "Hand" and "Auto" modes. There shall be fault reset and "Help" buttons on the keypad. The Help button shall include "on-line" assistance for programming and troubleshooting.

2.1.7.4. There shall be a built-in time clock in the VFD keypad. The clock shall have a battery backup with 10 years minimum life span. The clock shall be used to date and time stamp faults and record operating parameters at the time of fault. VFD programming shall be held in non-volatile memory and is not dependent on battery power

2.1.7.5. The VFD's shall utilize pre-programmed application macros specifically designed to facilitate start-up. The Application Macros shall provide one command to reprogram all parameters and customer interfaces for a particular application to reduce programming time. The VFD shall have two user macros to allow the end-user to create and save custom settings.

2.1.7.6. The VFD shall have cooling fans that are designed for easy replacement. The fans shall be designed for replacement without requiring removing the VFD from the wall or removal of circuit boards. The VFD cooling fans shall operate only when required, based on the temperature of and run command to the drive. VFD protection shall be based on thermal sensing and not cooling fan operation.

2.1.7.7. The VFD shall be capable of starting into a coasting load (forward or reverse) up to full speed and accelerate or decelerate to set point without tripping or component damage (flying start).

2.1.7.8. The VFD shall have the ability to automatically restart after an over-current, over-voltage, under-voltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between attempts shall be programmable.

2.1.7.9. The overload rating of the drive shall be 110% of its normal duty current rating for 1 minute every 10 minutes, 130% overload for 2 seconds every minute. The minimum FLA rating shall meet or exceed the values in the NEC/UL table 430.250 for 4-pole motors.

2.1.7.10. VFDs through 200 HP shall have internal swinging (non-linear) chokes providing impedance equivalent to 5% to reduce the harmonics to the power line. Swinging choke shall be required resulting in superior partial load harmonic reduction. Linear chokes are not acceptable. 5% impedance may be from dual (positive and negative DC bus) chokes, or 5% swinging AC line chokes. VFD's with only one DC choke shall add an AC line choke.

2.1.7.11. The input current rating of the VFD shall not be greater than the output current rating. VFD's with higher input current ratings require the upstream wiring, protection devices, and source transformers to be oversized per NEC 430.122. Input and output current ratings must be shown on the VFD nameplate.

2.1.7.12. The VFD shall include a coordinated AC transient surge protection system consisting of 4 MOVs (phase to phase and phase to ground), a capacitor clamp, 1600 PIV Diode Bridge and internal chokes. The MOV's shall have a minimum

125 joule rating per phase across the diode bridge. VFDs that do not include coordinated AC transient surge protection shall include an external TVSS (Transient Voltage Surge Suppressor).

2.1.7.13. The VFD shall provide a programmable loss-of-load (broken belt / broken coupling) Form-C relay output. The drive shall be programmable to signal the loss-of-load condition via a keypad warning, Form-C relay output, and / or over the serial communications bus. The loss-of-load condition sensing algorithm shall include a programmable time delay that will allow for motor acceleration from zero speed without signaling a false loss-of-load condition.

2.1.7.14. The VFD shall include multiple "two zone" PID algorithms that allow the VFD to maintain PID control from two separate feedback signals (4-20mA, 0-10V, and / or serial communications). The two zone control PID algorithm will control motor speed based on a minimum, maximum, or average of the two feedback signals. All of the VFD PID controllers shall include the ability for "two zone" control.

2.1.7.15. If the input reference is lost, the VFD shall give the user the option of either (1) stopping and displaying a fault, (2) running at a programmable preset speed, (3) hold the VFD speed based on the last good reference received, or (4) cause a warning to be issued, as selected by the user. The drive shall be programmable to signal this condition via a keypad warning, Form-C relay output and / or over the serial communication bus.

2.1.7.16. The VFD shall have programmable "Sleep" and "Wake up" functions to allow the drive to be started and stopped from the level of a process feedback signal.

2.1.8. All VFDs to have the following adjustments:

2.1.8.1. Three (3) programmable critical frequency lockout ranges to prevent the VFD from operating the load continuously at an unstable speed. The lockout range must be fully adjustable, from 0 to full speed.

2.1.8.2. Two (2) PID Set point controllers shall be standard in the drive, allowing pressure or flow signals to be connected to the VFD, using the microprocessor in the VFD for the closed-loop control. The VFD shall have 250 ma of 24 VDC auxiliary power and be capable of loop powering a transmitter supplied by others. The PID set point shall be adjustable from the VFD keypad, analog inputs, or over the communications bus. There shall be two independent parameter sets for the PID controller and the capability to switch between the parameter sets via a digital input, serial communications or from the keypad. The independent parameter sets are typically used for night setback, switching between summer and winter set points, etc.

2.1.8.3. There shall be an independent, second PID loop that can utilize the second analog input and modulate one of the analog outputs to maintain the set point of an independent process (i.e. valves, dampers, etc.). All set points, process variables, etc. to be accessible from the serial communication network.

2.1.8.4. Two (2) programmable analog inputs shall accept current or voltage signals.

2.1.8.5. Two (2) programmable analog outputs (0-20ma or 4-20 ma). The outputs may be programmed to output proportional to Frequency, Motor Speed, Output

Voltage, Output Current, Motor Torque, Motor Power (kW), DC Bus voltage, Active Reference, Active Feedback, and other data.

2.1.8.6. Six (6) programmable digital inputs for maximum flexibility in interfacing with external devices. All digital inputs shall be programmable to initiate upon an application or removal of 24VDC.

2.1.8.7. Three (3) programmable, digital Form-C relay outputs. The relay outputs shall include programmable on and off delay times and adjustable hysteresis. The relays shall be rated for maximum switching current 8 amps at 24 VDC and 0.4 A at 250 VAC; Maximum voltage 300 VDC and 250 VAC; continuous current rating of 2 amps RMS. Outputs shall be true Form-C type contacts; open collector outputs are not acceptable. Drives that have only two (2) relay outputs must provide an option card that provides additional relay outputs.

2.1.8.8. Run permissive circuit - There shall be a run permissive circuit for damper or valve control. Regardless of the source of a run command (keypad, input contact closure, time-clock control, or serial communications), the VFD shall provide a dry contact closure that will signal the damper to open (VFD motor does not operate). When the damper is fully open, a normally open dry contact (end-switch) shall close. The closed end-switch is wired to a VFD digital input and allows VFD motor operation. Two separate safety interlock inputs shall be provided. When either safety is opened, the motor shall be commanded to coast to stop and the damper shall be commanded to close. The keypad shall display “start enable 1 (or 2) missing”. The safety input status shall also be transmitted over the serial communications bus.

2.1.8.9. The VFD control shall include a programmable time delay for VFD start and a keypad indication that this time delay is active. A Form C relay output provides a contact closure to signal the VAV boxes open. This will allow VAV boxes to be driven open before the motor operates. The time delay shall be field programmable from 0 – 120 seconds. Start delay shall be active regardless of the start command source (keypad command, input contact closure, time-clock control, or serial communications), and when switching from drive to bypass.

2.1.8.10. Seven (7) programmable preset speeds.

2.1.8.11. Two independently adjustable accel and decel ramps with 1 – 1800 seconds adjustable time ramps.

2.1.8.12. The VFD shall include a motor flux optimization circuit that will automatically reduce applied motor voltage to the motor to optimize energy consumption and reduce audible motor noise. The VFD shall have selectable software for optimization of motor noise, energy consumption, and motor speed control.

2.1.8.13. The VFD shall include a carrier frequency control circuit that reduces the carrier frequency based on actual VFD temperature that allows higher carrier frequency settings without derating the VFD.

2.1.8.14. The VFD shall include password protection against parameter changes.

2.1.8.15. The Keypad shall include a backlit LCD display. The display shall be in complete English words for programming and fault diagnostics (alpha-numeric codes are not acceptable). All VFD faults shall be displayed in English words. The keypad shall include a minimum of 14 assistants including:

2.1.8.15.1. Start-up assistant

2.1.8.15.2. Parameter assistants
2.1.8.15.3. PID assistant
2.1.8.15.4. Reference assistant
2.1.8.15.5. I/O assistant
2.1.8.15.6. Serial communications assistant
2.1.8.15.7. Option module assistant
2.1.8.15.8. Panel display assistant
2.1.8.15.9. Low noise set-up assistant
2.1.8.15.10. Maintenance assistant
2.1.8.15.11. Troubleshooting assistant
2.1.8.15.12. Drive optimizer assistants

2.1.9. All applicable operating values shall be capable of being displayed in engineering (user) units. A minimum of three operating values from the list below shall be capable of being displayed at all times. The display shall be in complete English words (alpha-numeric codes are not acceptable):

2.1.9.1. Output Frequency
2.1.9.2. Motor Speed (RPM, %, or Engineering units)
2.1.9.3. Motor Current
2.1.9.4. Motor Torque
2.1.9.5. Motor Power (kW)
2.1.9.6. DC Bus Voltage
2.1.9.7. Output Voltage

2.1.10. The VFD shall include a fireman's override input. Upon receipt of a contact closure from the fire / smoke control station, the VFD shall operate in one of two modes: 1) Operate at a programmed predetermined fixed speed ranging from -500Hz (reverse) to 500Hz (forward). 2) Operate in a specific fireman's override PID algorithm that automatically adjusts motor speed based on override set point and feedback. The mode shall override all other inputs (analog/digital, serial communication, and all keypad commands), except customer defined safety run interlocks, and force the motor to run in one of the two modes above. "Override Mode" shall be displayed on the keypad. Upon removal of the override signal, the VFD shall resume normal operation, without the need to cycle the normal digital input run command.

2.2. **SERIAL COMMUNICATIONS**

2.2.1. The VFD shall have an EIA-485 port as standard. The standard protocols shall be Modbus, Johnson Controls N2, Siemens Building Technologies FLN, and BACnet. [Optional protocols for LonWorks, Profibus, EtherNet, BACnet IP, and DeviceNet shall be available.] Each individual drive shall have the protocol in the base VFD. The use of third party gateways and multiplexers is not acceptable. All protocols shall be "certified" by the governing authority (i.e. BTL Listing for BACnet). Use of non-certified protocols is not allowed.

2.2.2. The BACnet connection shall be an EIA-485, MS/TP interface operating at 9.6, 19.2, 38.4, or 76.8 Kbps. The connection shall be tested by the BACnet Testing Labs (BTL) and be BTL Listed. The BACnet interface shall conform to the BACnet standard device type of an Applications Specific Controller (B-ASC). The interface shall support all BIBBs defined by the BACnet standard profile for a B-ASC including, but not limited to:

2.2.2.1. Data Sharing – Read Property – B.
2.2.2.2. Data Sharing – Write Property – B.
2.2.2.3. Device Management – Dynamic Device Binding (Who-Is; I-Am).
2.2.2.4. Device Management – Dynamic Object Binding (Who-Has; I-Have).
2.2.2.5. Device Management – Communication Control – B.

2.2.3. Serial communication capabilities shall include, but not be limited to; run-stop controls, speed set adjustment, and lock and unlock the keypad. The drive shall have the capability of allowing the BAS to monitor feedback such as process variable feedback, output speed / frequency, current (in amps), % torque, power (kW), kilowatt hours (resettable), operating hours (resettable), and drive temperature. The BAS shall also be capable of monitoring the VFD relay output status, digital input status, and all analog input and analog output values. All diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote VFD fault reset shall be possible.

2.2.4. Serial communication in bypass (if bypass is specified) shall include, but not be limited to; bypass run-stop control, the ability to force the unit to bypass, and the ability to lock and unlock the keypad. The bypass shall have the capability of allowing the BAS to monitor feedback such as, current (in amps), kilowatt hours (resettable), operating hours (resettable), and bypass logic board temperature. The BAS shall also be capable of monitoring the bypass relay output status, and all digital input status. All bypass diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote bypass fault reset shall be possible.

2.2.5. The VFD / bypass shall allow the BAS to control the drive and bypass digital and analog outputs via the serial interface. This control shall be independent of any VFD function. The analog outputs may be used for modulating chilled water valves or cooling tower bypass valves. The drive and bypass' digital (Form-C relay) outputs may be used to actuate a damper, open a valve or control any other device that requires a maintained contact for operation. In addition, all of the drive and bypass' digital inputs shall be capable of being monitored by the BAS system. This allows for remote monitoring of which (of up to 4) safeties are open.

2.2.6. The VFD shall include an independent PID loop for customer use. The independent PID loop may be used for cooling tower bypass value control, chilled water value / hot water valve control, etc. Both the VFD PID control loop and the independent PID control loop shall continue functioning even if the serial communications connection is lost. As default, the VFD shall keep the last good set point command and last good DO & AO commands in memory in the event the serial communications connection is lost and continue controlling the process.

2.2.7. EMI / RFI filters. All VFD's shall include EMI/RFI filters. The onboard filters shall allow the VFD assembly to be CE Marked and the VFD shall meet product standard EN 61800-3 for the First Environment restricted level (Category C2) with up to 100 feet of motor cable. Second environment (Category C3, C4) is not acceptable, no Exceptions. Certified test reports shall be provided with the submittals confirming compliance to EN 61800-3, First Environment (C2).

2.3. **DRIVE OPTIONS**

2.3.1. Options shall be furnished and mounted by the drive manufacturer as defined on the VFD schedule. All optional features shall be UL Listed by the drive manufacturer as a complete assembly and carry a UL508 label.

2.3.2. Circuit Breaker - Door interlocked padlockable circuit breaker that will disconnect all input power from the drive and all internally mounted options. Circuit breaker option shall be available with or without systems requiring bypass.

2.3.3. Disconnect Switch with Fuses - Door interlocked, padlockable disconnect switch that will disconnect all input power from the drive and all internally mounted options. Drive input fusing is included.

2.3.4. Fieldbus adapters – The following optional fieldbus adapters shall be available as a plug in modules.

2.3.4.1. LonWorks
2.3.4.2. DeviceNet
2.3.4.3. Ethernet IP
2.3.4.4. ControlNet over Ethernet & ModBus TCP
2.3.4.5. BACnet IP
2.3.4.6. Profibus

2.4. **BYPASS**

2.4.1. Bypasses shall be furnished and mounted by the drive manufacturer as defined on the VFD schedule. All VFD with bypass configurations shall be UL Listed by the drive manufacturer as a complete assembly and carry a UL508 label.

2.4.2. A complete factory wired and tested bypass system consisting of a door interlocked, padlockable circuit breaker, output contactor, bypass contactor, and fast acting VFD input fuses. UL Listed motor overload protection shall be provided in both drive and bypass modes.

2.4.3. The bypass enclosure door and VFD enclosure must be mechanically interlocked such that the disconnecting device must be in the "Off" position before either enclosure may be accessed.

2.4.4. The VFD and bypass package shall have a UL listed short circuit current rating (SCCR) of 100,000 Amps and this rating shall be indicated on the UL data label.

2.4.5. Drive Isolation Fuses - To ensure maximum availability of bypass operation, fast acting fuses, exclusive to the VFD, shall be provided to allow the VFD to disconnect from the line prior to clearing upstream branch circuit protection. This maintains bypass operation capability in the event of a VFD failure. Bypass designs which have no such fuses, or that incorporate fuses common to both the VFD and the bypass, will not be accepted. Third contactor "isolation contactors" are not an acceptable alternative to fuses, as contactors could weld closed and are not an NEC recognized disconnecting device.

2.4.6. The bypass shall maintain positive contactor control through the voltage tolerance window of nominal voltage +30%, -35%. This feature is designed to avoid contactor coil failure during brown out / low line conditions and allow for input single phase operation when in the VFD mode. Designs that will not allow input single phase operation in the VFD mode are not acceptable.

2.4.7. Motor protection from single phase power conditions - the bypass system must be able to detect a single phase input power condition while running in bypass, disengage the motor in a controlled fashion, and give a single phase input power indication. Bypass systems not incorporating single phase protection in bypass mode are not acceptable.

2.4.8. The bypass system shall be designed for stand-alone operation and shall be completely functional in both Hand and Automatic modes even if the VFD has been removed from the system for repair / replacement. Serial communications shall remain functional even with the VFD removed. Bypass systems that do not maintain full functionality with the drive removed are not acceptable.

2.4.9. Serial communications – the bypass shall be capable of being monitored and / or controlled via serial communications. On-board communications protocols shall include ModBus RTU; Johnson Controls N2; Siemens Building Technologies FLN (P1); and BACnet MS/TP.

2.4.10. Serial communication capabilities shall include, but not be limited to: bypass run-stop control, the ability to force the unit to bypass, and the ability to lock and unlock the keypad. The bypass shall have the capability of allowing the BAS to monitor feedback such as, current (Amps), kilowatt hours (resettable), operating hours (resettable), and bypass logic board temperature. The BAS shall also be capable of monitoring the bypass relay output status, and all digital input status. All bypass diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote bypass fault reset shall be possible. The following additional status indications and settings shall be transmitted over the serial communications bus and / or via a Form-C relay output – keypad "Hand" or "Auto" selected, bypass selected, and broken belt indication. The BAS system shall also be able to monitor if the motor is running in the VFD mode or bypass mode over serial communications. A minimum of 50 field serial communications points shall be capable of being monitored in the bypass mode.

2.4.11. The bypass serial communications shall allow control of the drive/bypass (system) digital outputs via the serial interface. This control shall be independent of any bypass function or operating state. The system digital (relay) outputs may be used to actuate a damper, open a valve or control any other device that requires a maintained contact for operation. All system analog and digital I/O shall be capable of being monitored by the BAS system.

2.4.12. There shall be an adjustable motor current sensing circuit for the bypass and VFD modes to provide proof of flow (broken belt) indication. The condition shall be indicated on the keypad display, transmitted over the BAS and / or via a Form-C relay output contact closure. The broken belt indication shall be programmable to be a system (drive and bypass) indication. The broken belt condition sensing algorithm shall be programmable to cause a warning or system shutdown.

2.4.13. The digital inputs for the system shall accept 24VDC. The bypass shall incorporate an internally sourced power supply and not require an external control power source. The bypass power board shall supply 250 mA of 24 VDC for use by others to power external devices.

2.4.14. There shall be a coordinated run permissive circuit for damper or valve control. Regardless of the source of a run command (keypad command, time-clock control, digital input, or serial communications) the bypass shall provide a dry contact closure that will signal the damper to open before the motor can run. When the damper is fully open, a normally open dry contact (end-switch) shall close. The closed end-switch is wired to a bypass system input and allows motor operation. Up to four separate safety interlock inputs shall be provided. When any safety is opened, the motor shall be commanded to coast to stop, and the damper shall be commanded to close. This feature will also operate in Fireman's override / smoke control mode.

2.4.15. The bypass control shall monitor the status of the VFD and bypass contactors and indicate when there is a welded contactor contact or open contactor coil. This failed contactor condition shall be indicated on the bypass LCD display, programmed to activate a Form-C relay output, and / or over the serial communications protocol.

2.4.16. The bypass control shall include a programmable time delay bypass start including keypad indication of the time delay. A Form C relay output commands the VAV boxes open. This will allow VAV boxes to be driven open before the motor operates at full speed in the bypass mode. The time delay shall be field programmable from 0 – 120 seconds.

2.4.17. There shall be a keypad adjustment to select manual or automatic transfer to bypass. The user shall be able to select via keypad programming which drive faults will result in an automatic transfer to bypass mode and which faults require a manual transfer to bypass. The user may select whether the system shall automatically transfer from drive to bypass mode on the following drive fault conditions:

2.4.17.1. Over current

2.4.17.2. Over voltage
2.4.17.3. Under voltage
2.4.17.4. Loss of analog input
2.4.17.5. The following operators shall be provided:
2.4.17.6. Bypass Hand-Off-Auto
2.4.17.7. Drive mode selector
2.4.17.8. Bypass mode selector
2.4.17.9. Bypass fault reset
2.4.17.10. The bypass shall include the ability to select the operating mode of the system (VFD/Bypass) from either the bypass keypad or digital input.
2.4.17.11. The bypass shall include a two line, 20 character LCD display. The display shall allow the user to access and view:
2.4.17.12. Energy savings – in US dollars
2.4.17.13. Bypass motor amps
2.4.17.14. Bypass input voltage– average and individual phase voltage
2.4.17.15. Bypass power (kW)
2.4.17.16. Bypass faults and fault logs
2.4.17.17. Bypass warnings
2.4.17.18. Bypass operating time (resettable)
2.4.17.19. Bypass energy (kilowatt hours – resettable)
2.4.17.20. I/O status
2.4.17.21. Parameter settings / programming
2.4.17.22. Printed circuit board temperature
2.4.17.23. The following indicating lights (LED type) or keypad display indications shall be provided. A test mode or push to test feature shall be provided.
2.4.17.24. Power-on (Ready)
2.4.17.25. Run enable
2.4.17.26. Drive mode selected
2.4.17.27. Bypass mode selected
2.4.17.28. Drive running
2.4.17.29. Bypass running
2.4.17.30. Drive fault
2.4.17.31. Bypass fault
2.4.17.32. Bypass H-O-A mode
2.4.17.33. Automatic transfer to bypass selected
2.4.17.34. Safety open
2.4.17.35. Damper opening
2.4.17.36. Damper end-switch made

2.4.18. The Bypass controller shall have six programmable digital inputs, and five programmable Form-C relay outputs. This I/O allows for a total System (VFD and Bypass) I/O count of 24 points as standard. The bypass I/O shall be available to the BAS system even with the VFD removed.

2.4.19. The on-board Form-C relay outputs in the bypass shall programmable for any of the following indications.

2.4.19.1. System started
2.4.19.2. System running
2.4.19.3. Bypass override enabled
2.4.19.4. Drive fault
2.4.19.5. Bypass fault
2.4.19.6. Bypass H-O-A position
2.4.19.7. Motor proof-of-flow (broken belt)
2.4.19.8. Overload
2.4.19.9. Bypass selected
2.4.19.10. Bypass run
2.4.19.11. System started (damper opening)
2.4.19.12. Bypass alarm
2.4.19.13. Over temperature

2.4.20. The bypass shall provide a separate terminal strip for connection of freeze, fire, smoke contacts, and external start command. All external safety interlocks shall remain fully functional whether the system is in VFD or Bypass mode. The remote start/stop contact shall operate in VFD and bypass modes. The terminal strip shall allow for independent connection of up to four (4) unique safety inputs.

2.4.21. The bypass shall include a supervisory control mode. In this bypass mode, the bypass shall monitor the value of the VFD's analog input (feedback). This feedback value is used to control the bypass contactor on and off state. The supervisory mode shall allow the user to maintain hysteresis control over applications such as cooling towers and booster pumps.

2.4.22. The user shall be able to select the text to be displayed on the keypad when an external safety opens. Example text display indications include "FireStat", "FreezStat", "Over pressure" and "Low suction". The user shall also be able to determine which of the four (4) safety contacts is open over the serial communications connection.

2.4.23. Smoke Control Override Mode (Override 1) – The bypass shall include a dedicated digital input that will transfer the motor from VFD mode to Bypass mode upon receipt of a dry contact closure from the Fire / Smoke Control System. The Smoke Control Override Mode action is not programmable and will always function as described in the bypass User's Manual documentation. In this mode, the system will ignore low priority safeties and acknowledge high priority safeties. All keypad control, serial communications control, and normal customer start / stop control inputs will be disregarded. This Smoke Control Mode shall be designed to meet the intent of UL864/UUKL.

2.4.24. Fireman's Override Mode (Override 2) – the bypass shall include a second, programmable override input which will allow the user to configure the unit to acknowledge some digital inputs, all digital inputs, ignore digital inputs or any combination of the above. This programmability allows the user to program the bypass unit to react in whatever manner the local Authority Having Jurisdiction (AHJ) requires. The Override 2 action may be programmed for "Run-to-Destruction". The user may also force the unit into Override 2 via the serial communications link.

2.4.25. Class 10, 20, or 30 (programmable) electronic motor overload protection shall be included.

2.4.26. Drive Service Switch – Drive service switches shall be furnished and mounted by the drive manufacturer as defined on the VFD schedule. VFD/Bypass configurations that utilize contactors as a means to remove VFD input power for the purpose of VFD servicing are not acceptable. NEC Code does not recognize a contactor as a means of disconnect in a motor control circuit.

PART 3 - EXECUTION

3.1. INSTALLATION

3.1.1. Installation shall be the responsibility of the mechanical contractor. The contractor shall install the drive in accordance with the recommendations of the VFD manufacturer as outlined in the VFD installation manual.

3.1.2. Power wiring shall be completed by the electrical contractor, to NEC code 430.122 wiring requirements based on the VFD input current. The contractor shall complete all wiring in accordance with the recommendations of the VFD manufacturer as outlined in the installation manual.

3.2. START-UP

3.2.1. Factory start-up shall be provided for each drive by a factory authorized service center. A start-up form shall be filled out for each drive with a copy provided to the owner, and a copy kept on file at the manufacturer.

3.3. PRODUCT SUPPORT

3.3.1. Factory trained application engineering and service personnel that are thoroughly familiar with the VFD products offered shall be locally available at both the specifying and installation locations. A toll free 24/365 technical support line connected to factory support personnel located in the US shall be available. Technical support offered only through the local sales office is not acceptable.

3.3.2. Training shall include installation, programming and operation of the VFD, bypass and serial communication. Factory authorized start up and owner training to be provided locally upon request.

3.4. WARRANTY

3.4.1. The VFD Product Warranty shall be 36 months from the date of factory shipment. The warranty shall include all parts, labor, travel time and expenses. A toll free 24/365 technical support line shall be available.

1GENERAL

1.1. DESCRIPTION

1.1.1. This section specifies the application of noise and vibration control techniques to boiler plant rotating equipment including pumps, fans, compressors and motors.

1.2. RELATED WORK

1.2.1. Section 01 33 23, SHOP DRAWINGS.

1.3. SUBMITTALS

1.3.1. Submit in accordance with Section 01 33 23, SHOP DRAWINGS

1.3.1.1. Noise and Vibration Control Devices; include with the equipment submittals.

1.3.1.2. Provide separate shop drawings for each isolated system complete with performance and product data.

1.3.1.3. Submit type of isolator, size, height when uncompressed and maximum allowable static deflection weight of all isolated equipment, loads on each isolator and static deflection of each isolator under the specific design load.

1.3.1.4. Submit marked up plans indicating all locations where pipes are to be isolated in mechanical rooms and as specified.

1.4. APPLICABLE PUBLICATIONS

1.4.1. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.

1.4.2. ASHRAE - 1995 - HVAC Applications, Chapter 43 - “Sound and Vibration Control”.

1.5. SCOPE OF WORK:

1.5.1. Provide vibration control items for isolating vibration of mechanical equipment, piping and ductwork.

1.5.2. Provide all hangers, isolators, bases, pads, sleeves and other devices specified, required, or detailed for the project. Include all vibration isolation system elements as recommended by the equipment manufacturer’s representative to make a complete, correct and safe installation. Supply and install all incidental materials needed.

1.6. **QUALITY ASSURANCE**

1.6.1. Work of this section shall be performed by skilled workers who are experienced in the necessary crafts to meet the requirements of this Section.

1.6.2. Provide field supervision and inspection to assure proper installation, adjustment and performance. Replace any isolators that are found to resonate with the supported equipment.

1.6.3. As a minimum provide vibration control per ASHRAE - 1995 - HVAC Applications, Chapter 43 - “Sound and Vibration Control”.

1.6.4. Isolators shall be selected, installed and adjusted to prevent the transmission of objectionable vibration and noise to the building structure.

1.6.5. The size and number of mounts and hangers shall be chosen to meet these specifications, even if not specifically shown on the plans. Brackets, rails, bases, braces, etc., shall be provided as needed for a complete and correct installation.

1.7. **ACCEPTABLE MANUFACTURERS**

1.7.1. Subject to compliance with the Contract Documents, manufacturers for products specified in this Section shall be one of the following:

1.7.1.1. Kinetics Noise Controls.
1.7.1.2. Mason Industries, Inc.
1.7.1.3. Vibron Ltd.

PART 2 - PRODUCTS

2.1. **SUSPENDED VIBRATION ISOLATION**

2.1.1. <u>Combination isolation hanger assembly with neoprene insert</u>

2.1.1.1. Vibration isolators for suspended equipment with minimum static deflection requirement exceeding 0.4" (10 mm), and where both high and low frequency vibrations are to be isolated, shall be hangers consisting of a laterally stable spring in series with an elastomer-in-shear insert complete with load transfer plates and assembled in a stamped or welded steel bracket.

2.1.1.2. The bracket shall be finished with an polyester powder coating. The manufacturer shall provide independent laboratory testing showing that the bracket with this finish has endured a minimum of 1,000 hours of exposure to salt spray fog testing per ASTM B117 without signs of corrosion.

2.1.1.3. The elastomer insert shall be molded from oil-resistant compounds and shall be color coded to indicate load capacity and selected to operate within its published load range.

2.1.1.4. The spring element shall have a minimum lateral stiffness of 1.0 times the rated vertical stiffness.

2.1.1.5. Springs shall be color coded or otherwise identified to indicate load capacity.

2.1.1.6. The hanger bracket shall be designed to carry a 500% overload without failure and to allow a support rod misalignment through a 30° arc without metal-to-metal contact or other short circuit.

2.1.1.7. The 1" and 2" hanger brackets shall incorporate spring caps with indexed steps which correspond to the washer diameter of appropriately sized hanger rod to keep the rod centered in the spring cap and reduce rod misalignment. The spring caps are protected under U.S. patent number 5,653,426.

2.1.1.8. Isolation hangers shall be selected by the manufacturer for each specific application to comply with deflection requirements as shown on the Vibration Isolation Schedule or as indicated on the project documents.

2.1.1.9. *Applications: Suspended mechanical equipment such as in-line fans, cabinet fans, and piping and ductwork in close proximity to mechanical equipment.*

2.1.1.10. Standard of Acceptance: Kinetics Noise Control SRH series.

2.1.2. Neoprene Isolation Hangers

2.1.2.1. Vibration isolators with maximum static deflection requirements under operating load conditions not exceeding 0.57" (15 mm) shall be hangers consisting of an elastomer-in-shear insert encased in a welded steel bracket and provided with a stamped load transfer cap.

2.1.2.2. The elastomer insert shall be molded from oil resistant compounds, shall be color coded to indicate load capacity and selected to operate within its published load range.

2.1.2.3. The hanger bracket shall be designed to carry a 500% overload without failure and to allow support rod misalignment through a 30° arc without metal-to-metal contact or other short circuit.

2.1.2.4. Isolation hangers shall be selected by the manufacturer for each specific application to comply with deflection requirements as shown on the Vibration Isolation Schedule or as indicated on the project documents.

2.1.2.5. *Applications: isolation of vibration produced by suspended mechanical equipment, in-line and exhaust fans, ductwork, piping.*

2.1.2.6. Standard of Acceptance: Kinetics Noise Control SRH series.

2.1.3. Piping Hangers Spring Vibration isolators

2.1.3.1. Vibration isolators for suspended equipment with minimum static deflection requirement exceeding 0.4" (10 mm), and where both high and low frequency vibrations are to be isolated, shall be hangers consisting of a laterally stable spring in series with an elastomer-in-shear insert complete with load transfer plates and assembled in a stamped or welded steel bracket.

2.1.3.2. The bracket shall be finished with an polyester powder coating. The manufacturer shall provide independent laboratory testing showing that the bracket with this finish has endured a minimum of 1,000 hours of exposure to salt spray fog testing per ASTM B117 without signs of corrosion.

2.1.3.3. The elastomer insert shall be molded from oil-resistant compounds and shall be color coded to indicate load capacity and selected to operate within its published load range.

2.1.3.4. The spring element shall have a minimum lateral stiffness of 1.0 times the rated vertical stiffness.

2.1.3.5. Springs shall be color coded or otherwise identified to indicate load capacity.

2.1.3.6. The hanger bracket shall be designed to carry a 500% overload without failure and to allow a support rod misalignment through a 30° arc without metal-to-metal contact or other short circuit.

2.1.3.7. The 1" and 2" hanger brackets shall incorporate spring caps with indexed steps which correspond to the washer diameter of appropriately sized hanger rod to keep the rod centered in the spring cap and reduce rod misalignment. The spring caps are protected under U.S. patent number 5,653,426.

2.1.3.8. Isolation hangers shall be selected by the manufacturer for each specific application to comply with deflection requirements as shown on the Vibration Isolation Schedule or as indicated on the project documents.

2.1.3.9. *Application: first three pipe hangers upstream/downstream of pumping equipment.*

2.1.3.10. The combination isolation hanger assembly with neoprene insert shall be Model SRH, as manufactured by Kinetics Noise Control, Inc.

2.2. **FLOOR MOUNTED VIBRATION ISOLATION**

2.2.1. Restrained Spring Isolators

2.2.1.1. Vibration isolators for equipment which is subject to load variations and large external or torquing forces shall consist of large diameter laterally stabile steel springs assembled into welded steel housing assemblies designed to limit vertical movement of the supported equipment.

2.2.1.2. Housing assemblies shall be fabricated steel members and shall consist of a top load plate complete with adjusting and leveling bolts, vertical restraints, isolation washers and a bottom plate with internal non-skid noise isolation pads. Housing shall be electrozinc plated or hot dip galvanized for corrosion resistance. Housing should be designed to provide a constant free and operating height within 1/8" (0.06 mm).

2.2.1.3. Spring elements shall have a lateral stiffness greater than 1.2 times the rated vertical stiffness and shall be designed to provide a minimum of 50% overload capacity. Non-welded spring elements shall be polyester powder coated, and shall have a 1000 hr rating when tested in accordance with ASTM B-117.

2.2.1.4. All springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. All springs except internal nested springs shall have an outside diameter not less than 0.8 of the compressed height of the spring. Ends of springs shall be square and ground for stability. Laterally stable springs shall have kx/ky ratios of at least 0.9. All springs shall be fully color-coded to indicate capacity – color striping is not considered adequate.

2.2.1.5. Corrosion Protection: All springs shall be powder-coated enamel. Housings shall be galvanized, powder-coated enamel, or painted with rust-resistant paint. Hot-dipped galvanized housings shall be provided as indicated on the Schedule

2.2.1.6. Operating static deflections are available up to 4" (102 mm) to compensate for long span flexible floor structures and maintain a high degree of noise and vibration isolation.

2.2.1.7. Springs shall be selected to provide maximum deflections; select from manufacturer's literature based on supported equipment weight. Springs shall be color coded or otherwise identified to indicate load capacity.

2.2.1.8. *Vertically restrained spring isolation mounts are recommended as a noise and vibration isolator for heavy mechanical equipment, or when the equipment to be isolated has significant changes of weight during maintenance operations, and for equipment subjected to moderate external forces or wind loads, such as such as chillers, cooling towers, condensing units larger than 50 ton capacity, air handlers and utility type exhaust fans larger than 10,000 cfm capacity, and similar.*

2.2.1.9. Standards of Acceptance: Kinetics Nose Controls FRS (supported weight up to 1,500 kg) or FLS series (supported equipment weight above 1,500 kg).

2.2.2. Neoprene Isolation Pads

2.2.2.1. Isolation pads shall be single ribbed or crossed, double ribbed elastomer-in-shear pads, in combination with steel shims when required, having maximum deflections between 0.08" to 0.14"

2.2.2.2. All pads shall be true elastomer-in-shear using alternately higher and lower ribs to provide effective vibration isolation, and shall be molded using 2500 PSI (176 kg/cm2) tensile strength, oil resistant compounds with no color additives.

2.2.2.3. Pads shall be 45 to 65 durometer and designed to permit 60 or 120 PSI (4.2 or 8.4 kg/cm2) loading at maximum rated deflections.

2.2.2.4. When two isolation pads are laminated, they shall be separated by, and bonded to, a galvanized steel shim plate.

2.2.2.5. *Application: floor/concrete curb/sleeper mounted equipment such as boilers pumps, utility type exhaust fans of less than 10,000 cfm capacity, condensing units of less than 50 ton capacity, condensers/fluid coolers, and similar*

2.2.2.6. Standard of Acceptance: Kinetics Noise Control models NPS, NPD, NGS or NGD to suit weight of equipment and max. deflection rates.

2.2.3. Elastomeric Isolation Mounts

2.2.3.1. One-piece molded neoprene mounts with encapsulated metal inserts, color coded to identify capacity, with non-skid ribs on the bottom load surfaces. Each isolator incorporates two bolt-down holes on the bottom load surface and a tapped steel load top plate for attachment to the supported equipment. The neoprene is highly oil resistant and has been designed to operate within the strain limits of the isolator to provide maximum isolation and longest life expectancy possible using neoprene compounds.

2.2.3.2. *Isolation mounts are designed for up to 0.5" (13 mm) deflection, available in four sizes and eleven capacities from 55 lbs. to 4,000 lbs. (25 kg to 1814 kg).*

2.2.3.3. Standard of Acceptance: Kinetics Noise Control model RDS.

2.2.4. Inertia Base Pads

2.2.4.1. Isolation bases shall be constructed of concrete cast into fabricated inertia base frames, the steel members of which are designed and supplied by the isolator manufacturer. The concrete shall be poured into a welded steel frame, incorporating prelocated equipment anchor bolts, 1/2-in (13 mm) diameter reinforcing bars on nominal 8-in (203 mm) centers each way, and recessed isolator mounting brackets to reduce the mounting height of the equipment, and reduce the footprint of the base. The thickness of the base shall be a minimum of 8% of the longest span between isolators, at least 6 in (152 mm), or as indicated on the drawings. Where inertia bases are used to mount pumps, the bases shall be sized to support piping elbows.

2.2.4.2. Applications: Support of heavy equipment where preventing noise transmission to adjacent spaces is critical. Inertia bases are used to support mechanical equipment, reduce equipment vibration, provide for attachment of vibration isolators, prevent differential movement between driving and driven members, reduce rocking by lowering equipment center of gravity, reduce motion of equipment during start-up and shut-down, act to reduce reaction movement due to operating loads on equipment, and act as a noise barrier.

2.2.4.3. *Typical uses for inertia base frames, with poured concrete and supported by noise and vibration isolators, include use with open-type centrifugal chillers, reciprocating air and refrigeration compressors, chillers, and heat pumps, close-coupled and base-mounted pumps, centrifugal fans, internal combustion engines, and similar types of equipment.*

2.2.4.4. Standard of Acceptance: Kinetics Noise Control model CIB-L

2.2.5. Vibration isolator Rails

2.2.5.1. Spring components shall be 1"/25 mm for air handling equipment/condensing units and 2"/50 mm deflection for cooling towers/chillers, free-standing, un-housed, laterally stable steel springs. Springs shall have a lateral stiffness greater than 1.0 times the rated vertical stiffness and shall be designed for 50% overload to solid.

2.2.5.2. Springs shall be color coded to indicate load capacity.

2.2.5.3. Rails shall provide continuous support for the rooftop equipment and shall be designed to provide isolation against casing-radiated vibration in the rooftop equipment housing and structure borne vibration from rotating and mechanical equipment in the rooftop package.

2.2.5.4. Rail assembly shall consist of extruded aluminum top and bottom members connected by spring isolators and a continuous air- and water-tight seal. The seal shall be a beaded elastomeric material retained in a keyway along the top extrusion. The weather strip shall be sealed along the bottom with an aluminum fascia strip.

2.2.5.5. Rail assemblies shall incorporate means for attachment to the building and the supported equipment and shall incorporate additional stiffening members if necessary to assure stability.

2.2.5.6. Vibration isolators shall be selected by the manufacturer for each specific application to comply with deflection requirements as shown on the Vibration Isolation Schedule or as indicated on the project documents.

2.2.5.7. *Application: designed and engineered to isolate packaged roof mounted equipment from the roof structure. Typical applications: cooling tower, condensing units, roof mounted air handling equipment and similar*

2.2.5.8. Where specified, the vibration isolation rails shall have a positive elastomeric air and weather seal permitting the inside of the unit to be used as a return air plenum. The KSR mates with the inside of the manufacturers' curb eliminating any internal interference.

2.2.5.9. Standard of Acceptance: Kinetics Noise Control Model KSR

2.3. **PIPING CONNECTIONS**

2.3.1. Flexible Piping Connectors

2.3.1.1. Flexible Braided Hose Connectors – HVAC Systems

2.3.1.1.1. Type 321 Stainless Steel Hose with type 304 Stainless Steel Outer Braid and 150# Carbon Steel Flat Faced Drilled Bolting Flanges

2.3.1.1.2. Length: 229 mm (9") to 356" (14") depending on diameter. max. lateral offset: 10 mm (0.125")

2.3.1.1.3.

2.3.1.1.4. Application: piping connected to rotating equipment to reduce the transmission of noise and vibration, and to eliminate stresses in piping systems due to misalignment and thermal movement of the piping, where fluid temperature may exceed 90^{O}C.

2.3.1.1.5. Standard of Acceptance: Kinetics Noise Control model BFMC-FFF

2.3.1.2. Refrigerant Piping Flexible Hose Connectors

2.3.1.2.1. Bronze flexible bellows with bronze braided outer cover and shall have bronze female copper sweat ends.

2.3.1.2.2. Standards of Acceptance: Kinetics Nose Control model BFMC-CFE

2.3.2. Twin Sphere Neoprene Connector

2.3.2.1. Made of molded EPDM reinforced with nylon tire cord and shall have mild steel floating flanges. Use control rods to limit deflections and movements to within the prescribed values indicated by the manufacturer.

2.3.2.2. Axial compression: 50 mm (2"). Axial elongation: 30 mm (1.25"). Transverse movement: 40 mm (1.5")

2.3.2.3. Application: piping connected to rotating equipment piping connected to rotating equipment to reduce the transmission of noise and vibration, and to eliminate stresses in piping systems due to misalignment and thermal movement of the piping, where fluid temperatures remain in the -10 deg.C to 90 deg. C (14 deg.F to 190 deg.F).

2.3.2.4. Standard of Acceptance: Kinetics Noise Control model FTC

2.4. **DUCTWORK CONNECTIONS**

2.4.1. Ductwork Flexible Connector

2.4.1.1. Fully welded match drilled carbon steel flanges equipped with backing bars fastened in place with zinc plated hardward and EPDM flex membrane material. Acoustically rated design shall be used where called for on the design documentation, with an absorptive acoustic fill and EPDM outer barrier.

2.4.1.2. EPDM Flexible material: 1/8" thick layered EPDM flex membrane with internal nylon scrim for superior tear strength. Resistant to ozone and UV exposure and cold cracking (suitable for outdoor use).

2.4.1.3. Aerodynamic protective metal flow liner for air streams in excess of 6,000 cfm.

2.4.1.4. Construction: flange to flange distance: 200 mm (8") static mode. Lateral and axial movement: +/- 12.5 mm (1/2 inch). Operating temperature: up to 100 deg.C (212 deg.F)

2.4.1.5. Application: between fans (intake and discharge) and ductwork.

2.4.1.6. *Exception: not required for air handling units where fans are internally isolated*

2.4.1.7. Standard of Acceptance: Kinetics Noise Control model Kineflex

PART 3 - EXECUTION

3.1. GENERAL

3.1.1. Statically and dynamically balance all pumps, fans, compressors and drivers. Align shafts of pumps, fans, and drivers to limit noise and vibration to specified values. Level and anchor equipment as necessary to achieve and maintain alignment.

3.1.2. All equipment mounted on vibration isolators springs shall have a minimum operating clearance of 2 inches between the bottom of the equipment or inertia base (and height saving bracket) and the concrete housekeeping pad (or bolt heads) beneath the equipment.

3.1.3. Check the clearance to ensure that no scraps have been left to short circuit the vibration isolators.

3.1.4. Provide a minimum of 4 inches between isolated equipment and the walls, ceiling, floors, columns and any other equipment not installed on vibration isolators.

3.1.5. Piping, ductwork, conduit or mechanical equipment shall not be hung from or supported on other equipment, pipes, or ductwork installed on vibration isolators.

3.1.6. Equipment connected to water or other fluid piping shall be erected on isolators or isolated foundations at correct operating heights prior to connection of piping. Equipment should be blocked-up with temporary shims to final operating height. When the system is assembled and fluid is added, the isolators shall be adjusted to allow removal of the shims.

3.1.7. All mechanical equipment not specifically identified in this specification that contains rotating or vibration elements shall be installed on neoprene isolators as appropriate. Provide supporting steel structure between isolators and equipment if isolator does not readily connect to equipment.

3.2. FLOOR MOUNTED PUMPS

3.2.1. Neoprene Isolation pads with or without inertia concrete pads – as specified or shown on the drawings

3.3. FLOOR MOUNTED BOILERS

3.3.1. Neoprene isolation pads – select to suit equipment weight

3.4. **FLOOR MOUNTED FANS AND AIR HANDLING EQUIPMENT**

3.4.1. Neoprene isolation pads (less than 10,000 cfm), restrained springs (above 10,000 cfm) with or without inertia concrete pads, as specified or shown on the drawings. Secure springs to equipment and pads.

3.5. **FLOOR OR ROOF MOUNTED CHILLERS/COOLING TOWERS**

3.5.1. Restrained springs or vibration isolation rails, number and location of springs coordinated with the equipment manufacturer and selected to suit equipment weight. For indoor equipment, use inertia isolation pads where shown on the drawings. Secure springs or rails to equipment and support structure (outdoors) or pads (indoors)

3.6. **PIPING ISOLATION**

3.6.1. Use flexible hoses or neoprene vibration isolators at all connections between piping and equipment containing rotating parts (pumps, air handlers, chillers, cooling towers, etc). Applicable to refrigerant piping as well. Do not use neoprene isolators outdoors or where fluid temperatures temperature not suitable

3.6.2. Use restrained spring isolators for the first three piping supports upstream and downstream of each pump.

3.7. **CEILING SUSPENDED EQUIPMENT**

3.7.1. Restrained spring isolators or neoprene isolation pads, as indicated on the drawings

3.8. **AIR COOLED CONDENSING UNITS**

3.8.1. Neoprene pad or elastomeric mounts secured to the support structure and equipment base rails (less than 50 ton capacity). Select based on equipment weight.

3.8.2. Restrained springs or vibration isolator rails secured to the support structure and equipment base rails (over 50 ton capacity). Select based on equipment weight.

3.9. **AIR COOLED CONDENSING UNITS**

3.9.1. Neoprene pad or elastomeric mounts secured to the support structure and equipment base rails

3.10. **ROOFTOP AIR HANDLING UNITS AND UTILITY TYPE EXHAUST FANS**

3.10.1. Vibration isolation rails (where specified)

3.11. **DUCT CONNECTORS**

3.11.1. At all connections between fans and ductwork, where not provided by thr manufacturer.

3.11.2. Exception: kitchen grease exhaust ductwork connection to exhaust fan.

3.12. **ELECTRICAL CONNECTIONS**

3.12.1. All wiring connections to mechanical equipment on vibration isolators (either spring or neoprene type) shall be made with a minimum 36 inch long flexible liquid-tight conduit in a 360^{o} loop. Coordinate wiring connections with the electrical sub-trade.

3.13. **INSPECTION**

3.13.1. Supplier shall inspect and approve the installation of the vibration isolators and shall submit a report to the Client which verifies that all of the isolation equipment has been properly installed and that the installation is in full conformance with the specification. The report shall record the vibration isolator identification and model or type.

3.13.2. For isolators containing steel springs the report shall also record the size and uncompressed height, design static deflection and measured static deflection of the isolators provided.

3.14. **COMMISSIONING**

3.14.1. N/A

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PART 1 - GENERAL

1.1. **DESCRIPTION**

1.1.1. Testing, adjusting, and balancing (TAB) of heating, ventilating and air conditioning (HVAC) systems. TAB includes the following:

1.1.1.1. Planning systematic TAB procedures.
1.1.1.2. Design Review Report.
1.1.1.3. Systems Inspection report.
1.1.1.4. Duct Air Leakage test report.
1.1.1.5. Systems Readiness Report.
1.1.1.6. Balancing air and water distribution systems; adjustment of total system to provide design performance; and testing performance of equipment and automatic controls.
1.1.1.7. Recording and reporting results.

1.1.2. Definitions:

1.1.2.1. TAB: Testing, Adjusting and Balancing; the process of checking and adjusting HVAC systems to meet design objectives.
1.1.2.2. AABC: Associated Air Balance Council.
1.1.2.3. NEBB: National Environmental Balancing Bureau.

1.1.3. Hydronic Systems: Includes chilled water, condenser water, heating hot water and glycol water systems as applicable to the project.

1.1.4. Air Systems: Includes all outside air, supply air, return air, exhaust air and relief air systems, as applicable to the project.

1.1.5. Flow rate tolerance: The allowable percentage variation, minus to plus, of actual flow rate from values (design) in the contract documents.

1.2. **RELATED WORK**

1.2.1. Section 23 05 11, COMMON WORK RESULTS FOR HVAC SYSTEMS.
1.2.2. Section 23 37 00, AIR DISTRIBUTION
1.2.3. Section 23 21 13, HYDRONIC PIPING
1.2.4. Section 23 74 15, PACKAGED ROOFTOP UNITS

1.3. **QUALITY ASSURANCE**

1.3.1. Qualifications:

1.3.1.1. TAB Agency: The TAB agency shall be a subcontractor of the General Contractor and shall report to and be paid by the General Contractor.

1.3.1.2. The TAB agency shall be either a certified member of AABC or certified by the NEBB to perform TAB service for HVAC, water balancing and vibrations and sound testing of equipment. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the agency loses subject certification during this period, the General Contractor shall immediately notify the Consultant and submit another TAB firm for approval.

1.3.2. TAB Specialist: The TAB specialist shall be either a member of AABC or an experienced technician of the Agency certified by NEBB. The certification shall be maintained for the entire duration of duties specified herein.

1.3.3. TAB Specialist shall be identified by the General Contractor within 10 days after the notice to proceed. The TAB specialist will be coordinating, scheduling and reporting all TAB work and related activities and will provide necessary information as required by the Consultant. The responsibilities would specifically include:

1.3.3.1. Shall directly supervise all TAB work.

1.3.3.2. Shall sign the TAB reports that bear the seal of the TAB standard. The reports shall be accompanied by report forms and schematic drawings required by the TAB standard, AABC or NEBB.

1.3.3.3. Would follow all TAB work through its satisfactory completion.

1.3.3.4. Shall provide final markings of settings of all HVAC adjustment devices.

1.3.3.5. Permanently mark location of duct test ports.

1.3.4. All TAB technicians performing actual TAB work shall be experienced and must have done satisfactory work on a minimum of 3 projects comparable in size and complexity to this project. The lead technician shall be certified by AABC or NEBB

1.3.5. Test Equipment Criteria: The instrumentation shall meet the accuracy/calibration requirements established by AABC National Standards or by NEBB Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems and instrument manufacturer. Provide calibration history of the instruments to be used for test and balance purpose.

1.3.6. Tab Criteria:

1.3.6.1. Flow rate tolerance: Following tolerances are allowed. For tolerances not mentioned herein follow ASHRAE Handbook "HVAC Applications", Chapter 36, as a guideline. Air Filter resistance during tests, artificially imposed if necessary, shall be at least 100 percent of manufacturer recommended change over pressure drop values for pre-filters and after-filters.

1.3.6.2. Tolerances:

1.3.6.2.1. Air handling unit and all other fans, cubic meters/min (cubic feet per minute): +/-5% of design values noted in the equipment schedules.
1.3.6.2.2. Air terminal units (maximum values): +/-5% of the design values noted on the equipment schedules.
1.3.6.2.3. Exhaust hoods/cabinets: 0% to +10% of the design values noted on the equipment schedules
1.3.6.2.4. Minimum outside air: 0% to +10% of the design values noted on the equipment schedules
1.3.6.2.5. Individual room air outlets and inlets, and air flow rates not mentioned above: +/-5% of the design values noted on the equipment schedules.
1.3.6.2.6. Heating hot water pumps and hot water coils: +/-5% of the design values noted on the equipment schedules.
1.3.6.2.7. Chilled water and condenser water pumps: 0% to +5% of the design values noted on the equipment schedules
1.3.6.2.8. Chilled water coils: 0% to +5% of the design values noted on the equipment schedules.
1.3.6.2.9. Heat output capacities: 0% to +10% of the design values noted on the equipment schedules
1.3.6.2.10. Cooling output capacities: +/-5% of the design values noted on the equipment schedules

1.3.7. Typical TAB procedures and results shall be demonstrated to the Consultant for one air distribution system (including all fans, three terminal units, three rooms randomly selected by the Consultant) and one hydronic system (pumps and three coils) as follows:

1.3.7.1. When field TAB work begins.
1.3.7.2. During each partial final inspection and the final inspection for the project if requested by the Board

1.4. **SUBMITTALS**

1.4.1. Submit in accordance with Section 01 23 33, SHOP DRAWINGS AND PROJECT DOCUMENTATION.

1.4.2. Submit names and qualifications of TAB agency and TAB specialists within 10 days after the notice to proceed. Submit information on three recently completed projects and a list of proposed test equipment.

1.4.3. Submit Following for Review and Approval:

1.4.3.1. Design Review Report within 10 days after the award of contract from the General Contractor.
1.4.3.2. Systems inspection report on equipment and installation for conformance with design.
1.4.3.3. Duct Air Leakage Test Report.
1.4.3.4. Systems Readiness Report.

1.4.4. Intermediate and Final TAB reports covering flow balance and adjustments, performance tests, vibration tests and sound tests.

1.4.5. Include in final reports uncorrected installation deficiencies noted during TAB and applicable explanatory comments on test results that differ from design requirements.

1.4.6. Prior to request for Final or Partial Final inspection, submit completed Test and Balance report for the area.

1.5. **APPLICABLE PUBLICATIONS**

1.5.1. The following publications form a part of this specification to the extent indicated by the reference thereto. In text the publications are referenced to by the acronym of the organization.

1.5.1.1. American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE):
1.5.1.2. 2007 HVAC Applications ASHRAE Handbook, Chapter 37, Testing, Adjusting, and Balancing and Chapter 47, Sound and Vibration Control
1.5.1.3. Associated Air Balance Council (AABC):
1.5.1.3.1. AABC National Standards for Total System Balance
1.5.1.3.2. National Environmental Balancing Bureau (NEBB):

1.5.1.3.3. 7th Edition 2005 Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems

1.5.1.3.4. 2nd Edition 2006 Procedural Standards for the Measurement of Sound and Vibration

1.5.1.3.5. 3rd Edition 2009 .....Procedural Standards for Whole Building Systems Commissioning of New Construction

1.5.1.4. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):

1.5.1.4.1. 3rd Edition 2002 HVAC SYSTEMS Testing, Adjusting and Balancing

PART 2 - PRODUCTS

2.1. **PLUGS**

2.1.1. Provide plastic plugs to seal holes drilled in ductwork for test purposes.

2.2. **INSULATION REPAIR MATERIAL**

2.2.1. See Section 23 07 11, HVAC INSULATION.

2.2.2. Provide for repair of insulation removed or damaged for TAB work.

PART 3 - EXECUTION

3.1. **GENERAL**

3.1.1. Obtain applicable contract documents and copies of approved submittals for HVAC equipment and automatic control systems.

3.1.2. *Coordinate all balancing work with the BAS vendor. Where balancing variable flow systems, fine tune the pressure differential sensor settings to ensure that all end users receive adequate water and air flows.*

3.2. **DESIGN REVIEW REPORT**

3.2.1. The TAB Specialist shall review the Contract Plans and specifications and advise the Consultant of any design deficiencies that would prevent the HVAC systems from effectively operating in accordance with the sequence of operation specified or prevent the effective and accurate TAB of the system. The TAB Specialist shall provide a report individually listing each deficiency and the corresponding proposed corrective action necessary for proper system operation.

3.3. **SYSTEMS INSPECTION REPORT**

3.3.1. Inspect equipment and installation for conformance with design.

3.3.2. The inspection and report is to be done after piping and air distribution equipment is on site and piping/duct installation has begun, but well in advance of performance testing and balancing work. The purpose of the inspection is to identify and report deviations from design and ensure that systems will be ready for TAB at the appropriate time.

3.3.3. Reports: Follow check list format developed by AABC, NEBB or SMACNA, supplemented by narrative comments, with emphasis on air handling units and fans. Check for conformance with submittals. Verify that diffuser and register sizes are correct. Check air terminal unit installation including their duct sizes and routing.

3.4. **DUCT AIR LEAKAGE TEST REPORT**

3.4.1. TAB Agency shall perform the leakage test as outlined in "Duct leakage Tests and Repairs" in Section 23 31 00, HVAC DUCTS.

3.5. **SYSTEM READINESS REPORT**

3.5.1. The TAB Contractor shall measure existing air and water flow rates associated with existing systems utilized to serve renovated areas as indicated on drawings. Submit report of findings to Consultant.

3.5.2. Inspect each System to ensure that it is complete including installation and operation of controls. Submit report to Consultant in standard format and forms prepared and or approved by the Commissioning Agent, as applicable to the project.

3.5.3. Verify that all items such as ductwork piping, ports, terminals, connectors, etc., that is required for TAB are installed. Provide a report to the Consultant.

3.6. **TAB REPORTS**

3.6.1. The TAB contractor shall provide raw data immediately in writing to the Consultant if there is a problem in achieving intended results before submitting a formal report.

3.6.2. If over 20 percent of readings in the intermediate report fall outside the acceptable range, the TAB report shall be considered invalid and all contract TAB work shall be repeated and re-submitted for approval at no additional cost to the Board.

3.6.3. Do not proceed with the remaining systems until intermediate reports are reviewed by the Consultant.

3.7. **TAB PROCEDURES**

3.7.1. Tab shall be performed in accordance with the requirement of the Standard under which TAB agency is certified by either AABC or NEBB.

3.7.2. General: During TAB all related system components shall be in full operation. Fan and pump rotation, motor loads and equipment vibration shall be checked and corrected as necessary before proceeding with TAB. Set controls and/or block off parts of distribution systems to simulate design operation of variable volume air or water systems for test and balance work.

3.7.3. For air handling systems, perform balancing work when the building envelope is substantially completed (windows and doors installed, ceilings completed, transfer grilles installed)

3.7.4. For air handling systems equipped with hydronic components, make air and hydronic balancing at the same time.

3.7.5. Air Balance and Equipment Test: Include air handling units, fans, terminal units, fan coil units, room diffusers/outlets/inlets, computer room AC units, and laboratory fume hoods and biological safety cabinets.

3.7.6. Artificially load air filters by partial blanking to produce air pressure drop of manufacturer's recommended pressure drop.

3.7.7. Adjust fan speeds to provide design air flow.

3.7.8. Test and balance systems in all specified modes of operation, including variable volume, economizer, and fire emergency modes. Verify that dampers and other controls function properly.

3.7.9. Variable air volume (VAV) systems:

3.7.9.1. Not applicable to this project

3.7.10. Water Balance and Equipment Test: Include circulating pumps, convertors, heat exchangers, boilers, coils, coolers and condensers

3.7.10.1. Adjust flow rates for equipment.

3.7.10.2. Primary secondary (variable volume) systems: Balance systems at design water flow and then verify that variable flow controls function as designed.

3.7.10.3. Record final measurements for hydronic equipment on performance data sheets. Include entering and leaving water temperatures for heating and cooling coils, and for convertors. Include entering and leaving air temperatures (DB/WB for cooling coils) for air handling units and reheat coils. Make air and water temperature measurements at the same time.

3.8. **LOCATION OF MEASUREMENTS AND MEASURED PARAMETERS**

3.8.1. Perform hydronic measurements at each:

3.8.1.1. Boiler
3.8.1.2. Coil
3.8.1.3. Heat Exchanger
3.8.1.4. Control Valve
3.8.1.5. Balancing Valve

3.8.2. Perform air measurements at each:

3.8.2.1. Fan/Air Handling System discharge
3.8.2.2. Exhaust fan
3.8.2.3. Coil
3.8.2.4. Fresh air/Exhaust damper
3.8.2.5. Terminal unit
3.8.2.6. Air distribution equipment

3.8.3. Measured parameters

3.8.3.1. Air flows
3.8.3.2. Hydronic flows
3.8.3.3. Temperatures entering/leaving coils (hydronic and air)
3.8.3.4. Pressure drops at each measured equipment/device (hydronic and air)
3.8.3.5. Electric Power drawn by electrical equipment

3.9. **MARKING OF SETTINGS**

3.9.1. Following approval of Tab final Report, the setting of all HVAC adjustment devices including valves, splitters and dampers shall be permanently marked by the TAB

Specialist so that adjustment can be restored if disturbed at any time. Style and colors used for markings shall be coordinated with the Consultant.

3.10. IDENTIFICATION OF TEST PORTS

3.10.1. The TAB Specialist shall permanently and legibly identify the location points of duct test ports. If the ductwork has exterior insulation, the identification shall be made on the exterior side of the insulation. All penetrations through ductwork and ductwork insulation shall be sealed to prevent air leaks and maintain integrity of vapor barrier.

3.11. COMMISSIONING

3.11.1. N/A

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PART 1 - GENERAL

1.1. DESCRIPTION

1.1.1. Field applied insulation for thermal efficiency and condensation control for HVAC piping, ductwork and equipment.

1.1.2. Re-insulation of HVAC piping, ductwork and equipment after asbestos abatement.

1.1.3. Definitions

1.1.3.1. ASJ: All service jacket, white finish facing or jacket.

1.1.3.2. Air conditioned space: Space having air temperature and/or humidity controlled by mechanical equipment.

1.1.3.3. Cold: Equipment or piping handling media at design temperature of 16 degrees C (60 degrees F) or below.

1.1.3.4. Concealed: Piping above ceilings and in chases, interstitial space, and pipe chases.

1.1.3.5. Exposed: Piping and equipment exposed to view in finished areas including mechanical equipment rooms or exposed to outdoor weather. Shafts, chases, interstitial spaces, unfinished attics, crawl spaces and pipe basements are not considered finished areas.

1.1.3.6. Hot: Hot water equipment or piping handling media above 41 degrees C (105 degrees F).

1.1.3.7. Thermal conductance: Heat flow rate through materials.

1.1.3.8. Thermal Conductivity (k): Watt per meter, per degree C (BTU per inch thickness, per hour, per square foot, per degree F temperature difference).

1.1.3.9. Vapor Retarder (Vapor Barrier): A material which retards the transmission (migration) of water vapor. Performance of the vapor retarder is rated in terms of permeance (perms). or the purpose of this specification, vapor retarders shall have a maximum published permeance of 0.1 perms and vapor barriers shall have a maximum published permeance of 0.001 perms.

1.2. **RELATED WORK**

1.2.1. Section 23 05 11, COMMON WORK RESULTS FOR HVAC SYSTEMS.
1.2.2. Section 23 31 00, HVAC DUCTS AND CASINGS.
1.2.3. Section 23 21 13, HYDRONIC PIPING

1.3. **QUALITY ASSURANCE**

1.3.1. Comply with OBC requirements for flame spread and smoke development rates.

1.3.2. Specified k factors are at 24 degrees C (75 degrees F) mean temperature unless stated otherwise. For pipe, use insulation manufacturer's published heat flow tables. For domestic hot water supply and return, run out insulation and condensation control insulation, no thickness adjustment need be made.

1.3.3. All materials shall be compatible and suitable for service temperature, and shall not contribute to corrosion or otherwise attack surface to which applied in either the wet or dry state.

1.3.4. Every package or standard container of insulation or accessories delivered to the job site for use must have a manufacturer's stamp or label giving the name of the manufacturer and description of the material

1.4. **SUBMITTALS**

1.4.1. Submit in accordance with Section 01 33 23, SHOP DRAWINGS AND PROJECT DOCUMENTATION

1.4.2. Shop Drawings:

1.4.2.1. All information, clearly presented, shall be included to determine compliance with drawings and specifications and ASTM, federal and military specifications.

1.4.2.2. Insulation materials: Specify each type used and state surface burning characteristics.

1.4.2.3. Insulation facings and jackets: Each type used.

1.4.2.4. Insulation accessory materials: Each type used.

1.4.2.5. Manufacturer's installation and fitting fabrication instructions for flexible unicellular insulation.

1.4.2.6. Make reference to applicable specification paragraph numbers for coordination.

1.5. **STORAGE AND HANDLING OF MATERIAL**

1.5.1. Store materials in clean and dry environment, pipe covering jackets shall be clean and unmarred. Place adhesives in original containers. Maintain ambient temperatures and conditions as required by printed instructions of manufacturers of adhesives, mastics and finishing cements.

1.6. **APPLICABLE PUBLICATIONS**

1.6.1. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.

1.6.2. National Fire Protection Association (NFPA):

1.6.2.1. 101-09 Life Safety Code

1.6.2.2. 251-06 Standard methods of Tests of Fire Endurance of Building Construction Materials

1.6.2.3. 255-06 Standard Method of tests of Surface Burning Characteristics of Building Materials

1.6.3. Underwriters Laboratories, Inc (UL):

1.6.3.1. 723 UL Standard for Safety Test for Surface Burning Characteristics of Building Materials with Revision of 08/03

1.6.4. Manufacturer’s Standardization Society of the Valve and Fitting Industry (MSS):

1.6.4.1. SP58-2002 Pipe Hangers and Supports Materials, Design, and Manufacture

1.7. **STANDARDS OF ACCEPTANCE**

1.7.1. Owens/Corning, Knauf, Johns Mansville

PART 2 - PRODUCTS

2.1. **HVAC PIPING INSULATION**

2.1.1. Application (as applicable to the project)

2.1.1.1. All hot water heating/glycol
2.1.1.2. All chilled water/glycol
2.1.1.3. All steam piping
2.1.1.4. All condensate piping
2.1.1.5. All piping conveying water and located in spaces where the temperature can drop below freezing. Also refer to heat tracing specifications
2.1.1.6. All other piping conveying fluids warmer than 30^{O}C or colder than 18^{O}C

2.1.2. Mineral Fiber Or Fiber Glass

2.1.2.1. ASTM C547 (Pipe Fitting Insulation and Preformed Pipe Insulation), class 1, k = 0.037 (0.26) at 24 degrees C (75 deg. F), for use at temperatures from -20 deg. C (-4 deg.F) and up to 230 deg.C (450 deg. F)with an all service vapor retarder jacket with polyvinyl chloride premolded fitting covering.

2.1.2.2. Thickness:

2.1.2.2.1. Piping larger than 75mm (3”): 38 mm thickness
2.1.2.2.2. Piping nominal 25mm-75mm (1-3”): 25 mm thickness
2.1.2.2.3. Piping nominal 19mm (3/4”) and less: 12 mm thickness
2.1.2.2.4. Outdoor insulation (any size): increase insulation thickness by 12 mm (½”)

2.1.2.3. At fittings and flanges (including water meter and body of roof drains), insulate with wrapped fiberglass insulation of same thickness as adjacent pipe, and cover with pre-molded PVC jackets. Seal edge of jacket with self-sealing vapor barrier tape.

2.1.3. Insulation Facings And Jackets

2.1.3.1. Vapor Retarder, higher strength with low water permeance = 0.02 or less perm rating, Beach puncture 50 units for insulation facing on pipe insulation jackets.

2.1.3.2. Facings and jackets

2.1.3.2.1. Concealed indoor areas:

- Shall be all service type (ASJ) in concealed spaces and PVC Vapor Retarder jacketing in all exposed areas, including mechanical rooms and service areas.
- All service Jacket (ASJ) shall be white kraft bonded to 0.025 mm (1 mil) thick aluminum foil, fiberglass reinforced, with pressure sensitive adhesive closure. Comply with ASTM C1136. Beach puncture 50 units, Suitable for painting without sizing. Jackets shall have minimum 40 mm (1-1/2 inch) lap on longitudinal joints and minimum 75mm (3 inch) butt strip on end joints. Butt strip material shall be same as the jacket. Lap and butt strips shall be self-sealing type with factory-applied pressure sensitive adhesive.
- Standard of Acceptance: Zeston, Ceeco, Proto

2.1.3.2.2. Exposed indoor areas:

- Shall be heavy PVC fitting covers (0.75 mm thickness. Overlap PVC covers on pipe insulation jackets as least 1 inch (25 mm) at each end. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.

2.1.3.2.3. Indoor Fittings Jackets

- Pipe fitting insulation covering (jackets): Fitting covering shall be premolded to match shape of fitting and shall be polyvinyl chloride (PVC) minimum thickness 0.7 mm (0.03 inches). Provide color matching vapor retarder pressure sensitive tape.

- Adhesive: Compatible with PVC jacket, and recommended by insulation material manufacturer.

- Standard of Acceptance: Zeston, Ceeco, Proto

2.1.3.2.4. Aluminum Jackets – Outdoor Piping and Fittings

- Aluminum Jacket-Piping systems: ASTM B209, 3003 alloy, H-14 temper, 0.6 mm (0.023 inch) minimum thickness with locking longitudinal joints. Jackets for elbows, tees and other fittings shall be factory-fabricated to match shape of fitting and of 0.6 mm (0.024) inch minimum thickness aluminum. Fittings shall be of same construction as straight run jackets but need not be of the same alloy. Factory-fabricated stainless steel bands shall be installed on all circumferential joints. Bands shall be 13 mm (0.5 inch) wide on 450 mm (18 inch) centers. System shall be weatherproof if utilized for outside service.

- Field applied vapor barrier jackets shall be provided, in addition to the specified facings and jackets, on all exterior piping as well as on interior piping exposed to outdoor air (i.e.; in ventilated attics, piping in ventilated (not air conditioned) spaces, etc.) The vapor barrier jacket shall consist of a multi-layer laminated cladding with a maximum water vapor permeance of 0.001 perms. The minimum puncture resistance shall be 35 cm-kg (30 inch-pounds) for interior locations and 92 cm-kg (80 inch-pounds) for exterior or exposed locations or where the insulation is subject to damage.

- Neither rivets, screws, staples nor any other fastener capable of penetrating the underlying vapor retarder shall be used to secure the aluminum jacketing.

- Standards of Acceptance: Childers-Lock-on and Pabco-Surfeit.

2.1.4. Pipe Covering Protection Saddles

2.1.4.1. Cold pipe support - indoors: Premolded pipe insulation 180 degrees (half-shells) on bottom half of pipe at supports. Material shall be cellular glass or high density Polyisocyanurate insulation of the same thickness as adjacent insulation. Density of Polyisocyanurate insulation shall be a minimum of 48 kg/m3 (3.0 pcf).

2.1.4.2. Warm or hot pipe supports - indoors: Premolded pipe insulation (180 degree half-shells) on bottom half of pipe at supports. Material shall be high density Polyisocyanurate (for temperatures up to 149 degrees C [300 degrees F]), cellular glass or calcium silicate. Insulation at supports shall have same thickness as adjacent insulation. Density of Polyisocyanurate insulation shall be a minimum of 48 kg/m^3 (3.0 pcf).

2.1.4.3. All piping – outdoors: Metallic shield shall be made of galvanized steel painted on both sides with a minimum two coats of aluminum paint. 180 degree for clevises and roller type hangers and 360 degree for clamp type hangers and supports. Shield and insert length and gauge shall be 400 mm (16") long and min. 2.75 mm (12ga) thickness.

2.1.5. Adhesive, Mastic, Cement

2.1.5.1. Insulation manufacturers' published recommendations.

2.1.6. Mechanical Fasteners

2.1.6.1. Wire: 1.3 mm thick (18 gage) soft annealed galvanized or 1.9 mm (14 gage) copper clad steel or nickel copper alloy.

2.1.6.2. Bands: 13 mm (1/2 inch) nominal width, brass, galvanized steel, aluminum or stainless steel.

2.1.7. Flame And Smoke

2.1.7.1. Unless shown otherwise all assembled systems shall meet flame spread 25 and smoke developed 50 rating as developed under ASTM, NFPA and UL standards and specifications. See paragraph 1.3 "Quality Assurance".

2.2. **FITTINGS, FLANGE AND VALVE INSULATION – HOT AND COLD PIPING:**

2.2.1. Factory molded, ASTM C547 or field mitered sections, joined with adhesive or wired in place.

2.2.2. For hot piping finish with a smoothing coat of finishing cement.

2.2.3. For cold fittings, 16 degrees C (60 degrees F) or less, vapor seal with a layer of glass fitting tape imbedded between two 2 mm (1/16 inch) coats of vapor barrier mastic.

2.2.4. Fitting tape shall extend over the adjacent pipe insulation and overlap on itself at least 50 mm (2 inches).

2.2.5. Nominal thickness: same as piping of same size.

2.3. **EQUIPMENT INSULATION**

2.3.1. Applications: all heat exchangers, chilled water pumps, chilled water expansion tanks, chiller headers or evaporator vessels

2.3.2. Flexible Elastomeric Cellular Thermal insulation, ASTM C177, C518, k = 0.039 (0.27) at 24 degrees C (75 degrees F), flame spread not over 25, smoke developed not over 50, for temperatures from minus 4 degrees C (40 degrees F) to 93 degrees C (200 degrees F). No jacket required.

2.4. **DUCTWORK INSULATION**

2.4.1. Application

2.4.1.1. All concealed ductwork, or exposed in mechanical rooms conveying air at temperatures above 30^{O}C or below 18^{O}C and running through heated spaces.
2.4.1.2. All ductwork running through unheated spaces (attics)
2.4.1.3. All exhaust air ductwork 3m upstream of the point of discharge to the outdoors
2.4.1.4. All fresh air supply ductwork
2.4.1.5. All ductwork mounted outdoors
2.4.1.6. All combustion air ductwork

2.4.2. <u>Round Ductwork or Rectangular Ductwork Concealed – any side less than 750 mm (30”)</u>

2.4.2.1. Insulate ductwork with 40 mm (1½") thick, blanket-type, fiberglass insulation with factory-applied vapor barrier, and 2" stapling and taping flange along one edge. Insulation: ASTM C553, density of 0.75, conductivity of 0.32. Vapor barrier: aluminum foil, permeance of 0.02, and puncture resistance of 50 units. Composite flame spread/ smoke density of 25/50.

2.4.2.2. Apply insulation from outlet of air handling equipment to air distribution equipment

2.4.2.3. Jacket

2.4.2.3.1. A zero permeability, all weather, multi-layered laminate coated with a cold weather acrylic adhesive, superior resistance to weathering, mold, UV and extreme environmental conditions. Designed for use as a vapour barrier for insulation cladding and jacketing applications.
2.4.2.3.2. Zero permeability vapour barrier for insulation cladding and jacketing applications

2.4.2.3.3. Cold weather acrylic adhesive applies easily at temperatures as cold as -23°C (-10°F)
2.4.2.3.4. Puncture and Tear resistant
2.4.2.3.5. Self Adhesive material installs easily with no offsite fabrication required
2.4.2.3.6. Cuts and installs easily on-site, no special tools required
2.4.2.3.7. Flexible, strong, reinforced insulation cladding
2.4.2.3.8. Standard Acceptance: 3M™ VentureClad™ Insulation Jacketing

2.4.3. Round Ductwork - Outdoor

2.4.3.1. Insulate ductwork with 50 mm (2") thick, blanket-type, fiberglass insulation with factory-applied vapor barrier, and 2" stapling and taping flange along one edge. Insulation: ASTM C553, density of 0.75, conductivity of 0.32. Vapor barrier: aluminum foil, permeance of 0.02, and puncture resistance of 50 units. Composite flame spread/ smoke density of 25/50.

2.4.3.2. Jacket

2.4.3.2.1. A zero permeability, all weather, multi-layered laminate coated with a cold weather acrylic adhesive, superior resistance to weathering, mold, UV and extreme environmental conditions. Designed for use as a vapour barrier for insulation cladding and jacketing applications.
2.4.3.2.2. Zero permeability vapour barrier for insulation cladding and jacketing applications
2.4.3.2.3. Cold weather acrylic adhesive applies easily at temperatures as cold as -23°C (-10°F)
2.4.3.2.4. Puncture and Tear resistant
2.4.3.2.5. Self Adhesive material installs easily with no offsite fabrication required
2.4.3.2.6. Cuts and installs easily on-site, no special tools required
2.4.3.2.7. Flexible, strong, reinforced insulation cladding
2.4.3.2.8. Standard Acceptance: 3M™ VentureClad™ Insulation Jacketing

2.4.4. Rectangular Ductwork Concealed – any side larger than 750 mm (30”)

In mechanical equipment rooms and all other areas where visible without removing ceilings or opening access panels, insulate ductwork with 40 mm (1 ½” thick) rigid, fiberglass insulation board ASTM C612 Class 2, conductivity of 0.26, density of 3.0. with factory-applied vapor barrier. Vapor barrier: laminated white kraft paper, aluminum foil, glass fiber reinforcement, permeance of 0.02, and puncture resistance of 50 units. Composite flame spread/ smoke density of 25/50.

2.4.4.1. In ceiling spaces, building shafts, and other locations where not visible, insulate ductwork with 1-1/2" thick, blanket-type, fiberglass insulation with factory-applied vapor barrier, and 2" stapling and taping flange along one edge. Insulation: ASTM C553, density of 0.75, conductivity of 0.23 @75F. Vapor barrier: laminated white kraft paper, aluminum foil, glass fiber reinforcement, permeance of 0.02, and puncture resistance of 50 units. Composite flame spread/ smoke density of 25/50.

2.4.4.2. Jacket

2.4.4.2.1. A zero permeability, all weather, multi-layered laminate coated with a cold weather acrylic adhesive, superior resistance to weathering, mold, UV and extreme environmental conditions. Designed for use as a vapour barrier for insulation cladding and jacketing applications.
2.4.4.2.2. Zero permeability vapour barrier for insulation cladding and jacketing applications
2.4.4.2.3. Cold weather acrylic adhesive applies easily at temperatures as cold as -23°C (-10°F)
2.4.4.2.4. Puncture and Tear resistant
2.4.4.2.5. Self Adhesive material installs easily with no offsite fabrication required
2.4.4.2.6. Cuts and installs easily on-site, no special tools required
2.4.4.2.7. Flexible, strong, reinforced insulation cladding
2.4.4.2.8. Standard Acceptance: 3M™ VentureClad™ Insulation Jacketing

2.4.5. <u>Outdoor Rectangular Ductwork – any size</u>

2.4.5.1. Insulate ductwork with 50 mm (2” thick) rigid, fiberglass insulation board with factory-applied vapor barrier. Insulation: ASTM C612 Class 2, conductivity of 0.26, density of 3.0.

2.4.5.2. Vapor barrier: laminated white kraft paper, aluminum foil, glass fiber reinforcement, permeance of 0.02, and puncture resistance of 50 units. Composite flame spread/ smoke density of 25/50.

2.4.5.3. Jacket

2.4.5.3.1. A zero permeability, all weather, multi-layered laminate coated with a cold weather acrylic adhesive, superior resistance to weathering, mold, UV and extreme environmental conditions. Designed for use as a vapour barrier for insulation cladding and jacketing applications.

2.4.5.3.2. Zero permeability vapour barrier for insulation cladding and jacketing applications
2.4.5.3.3. Cold weather acrylic adhesive applies easily at temperatures as cold as -23°C (-10°F)
2.4.5.3.4. Puncture and Tear resistant
2.4.5.3.5. Self Adhesive material installs easily with no offsite fabrication required
2.4.5.3.6. Cuts and installs easily on-site, no special tools required
2.4.5.3.7. Flexible, strong, reinforced insulation cladding
2.4.5.3.8. Standard Acceptance: 3M™ VentureClad™ Insulation Jacketing

2.4.6. Kitchen Exhaust Ductwork listed under NFPA-96

2.4.6.1. Not applicable

2.4.7. Accessories

2.4.7.1. Closure Materials: Butt strips, bands, wires, staples, mastics, adhesives; pressure-sensitive tapes.
2.4.7.2. Support Materials: Hanger straps, hanger rods, saddles, support rings.
2.4.7.3. Contact adhesive: quick-setting, non-flammable fire resistive adhesive to adhere fibrous glass to ducts. Flame spread 15 smoke development 0.

PART 3 - EXECUTION

3.1. GENERAL REQUIREMENTS

3.1.1. Required pressure tests of piping and ductwork joints and connections shall be completed and the work approved by the Consultant for application of insulation. Surface shall be clean and dry with all foreign materials, such as dirt, oil, loose scale and rust removed.

3.1.2. Except for specific exceptions, insulate all specified equipment, and piping (pipe, fittings, valves, accessories). Insulate each pipe individually. Do not use scrap pieces of insulation where a full length section will fit.

3.1.3. Insulation materials shall be installed in a first class manner with smooth and even surfaces, with jackets and facings drawn tight and smoothly cemented down at all laps. Insulation shall be continuous through all sleeves and openings, except at fire dampers and duct heaters (NFPA 90A). Vapor retarders shall be continuous and uninterrupted throughout systems with operating temperature 16 degrees C (60 degrees F) and below. Lap and seal vapor barrier over ends and exposed edges of insulation. Anchors, supports

and other metal projections through insulation on cold surfaces shall be insulated and vapor sealed for a minimum length of 150 mm (6 inches).

3.1.4. Install vapor stops at all insulation terminations on either side of valves, pumps and equipment and particularly in straight lengths of pipe insulation.

3.1.5. Construct insulation on parts of equipment such as chilled water pumps and heads of chillers, convertors and heat exchangers that must be opened periodically for maintenance or repair, so insulation can be removed and replaced without damage. Install insulation with bolted 1 mm thick (20 gage) galvanized steel or aluminum covers as complete units, or in sections, with all necessary supports, and split to coincide with flange/split of the equipment.

3.1.6. Insulation on hot piping and equipment shall be terminated square at items not to be insulated, access openings and nameplates. Cover all exposed raw insulation with white sealer or jacket material.

3.1.7. Protect all insulations outside of buildings with aluminum jacket using lock joint or other approved system for a continuous weather tight system. Access doors and other items requiring maintenance or access shall be removable and sealable.

3.1.8. Elbows, flanges and other fittings shall be insulated with the same material as is used on the pipe straights.

3.1.9. Hot piping work not to be insulated:

3.1.9.1. Factory pre-insulated components.
3.1.9.2. Over equipment nameplates.
3.1.9.3. Vibration control devices
3.1.9.4. Air chambers, unions, strainers, check valves, flow regulators.
3.1.9.5. Pot feeders, filtration cartridges

3.1.10. Ductwork not to be insulated:

3.1.10.1. Indoor return ductwork
3.1.10.2. Exhaust air ductwork up to 3 m (10 ft) prior to existing the building

3.1.11. Firestop Pipe insulation:

3.1.11.1. Provide firestopping insulation at fire and smoke barriers through penetrations. Fire stopping insulation shall be UL listed.

3.1.11.2. Pipe penetrations requiring fire stop insulation including, but not limited to the following:

3.1.11.2.1. Pipe risers through floors
3.1.11.2.2. Pipe chase walls and floors
3.1.11.2.3. Smoke partitions
3.1.11.2.4. Fire partitions
3.1.11.2.5. Freeze protection of above grade outdoor piping (over heat tracing tape): 20 mm (0.75) thick insulation, for all pipe sizes 75 mm(3 inches) and smaller and 25 mm(1inch) thick insulation for larger pipes. Provide metal jackets for all pipes. Provide where indicated on the drawings

3.1.12. Provide vapor barrier jackets over insulation as follows:

3.1.12.1. All piping and ductwork exposed to outdoor weather.
3.1.12.2. All interior piping and ductwork conveying fluids exposed to outdoor air (i.e. in attics, ventilated (not air conditioned) spaces, etc.

3.1.13. Provide metal jackets over insulation as follows:

3.1.13.1. All HVAC piping and ductwork exposed to outdoor weather.

3.2. **INSULATION INSTALLATION**

3.2.1. Molded Mineral Fiber Pipe and Tubing Covering:

3.2.1.1. Fit insulation to pipe, aligning longitudinal joints. Seal longitudinal joint laps and circumferential butt strips by rubbing hard with a nylon sealing tool to assure a positive seal. Staples may be used to assist in securing insulation. Seal all vapor retarder penetrations on cold piping with a generous application of vapor barrier mastic. Provide inserts and install with metal insulation shields at outside pipe supports. Install freeze protection insulation over heating cable.

3.2.2. Flexible Mineral Fiber Blanket - Ductwork:

3.2.2.1. Adhere insulation to metal with 75 mm (3 inch) wide strips of insulation bonding adhesive at 200 mm (8 inches) on center all around duct. Additionally secure insulation to bottom of ducts exceeding 600 mm (24 inches) in width with pins welded or adhered on 450 mm (18 inch) centers. Secure washers on pins. Butt insulation edges and seal joints with laps and butt strips. Staples may be used to

assist in securing insulation. Seal all vapor retarder penetrations with mastic. Sagging duct insulation will not be acceptable. Install firestop duct insulation where required.

3.2.2.2. Blanket insulation shall be tightly sealed at all joints and seams. Insulation shall be cut longer than ductwork perimeter to allow maximum thickness on all areas and avoid excessive compression. All joints shall be over lapped at least 2" and stapled in place. The stapled seams shall be sealed with a minimum 3" wide pressure sensitive tape designed for use with the duct insulation. All breaks in the vapor barrier facing shall also be sealed with the tape. The underside of ductwork 18" or greater in width, and vertical surfaces 48" or greater shall have the insulation additionally secured with mechanical fasteners and speed clips spaced approximately 12" on center. The protruding ends of the fasteners shall be cut off flush after the speed clips are installed, and then sealed with the same tape as specified above.

3.2.2.3. Finished installation shall provide a continuous and effective vapor barrier.

3.2.2.4. Supply air ductwork to be insulated includes main and branch ducts from AHU discharge to room supply outlets, and the bodies of ceiling outlets to prevent condensation. Insulate sound attenuator units, coil casings and damper frames. To prevent condensation insulate trapeze type supports and angle iron hangers for flat oval ducts that are in direct contact with metal duct.

3.2.3. Rigid Board Mineral Fiber Insulation - Ductwork

3.2.3.1. Apply board on pins spaced not more than 300 mm (12 inches) on center each way, and not less than 75 mm (3 inches) from each edge of board. In addition to pins, apply insulation bonding adhesive to entire underside of horizontal metal surfaces. Butt insulation edges tightly and seal all joints with laps and butt strips. After applying speed clips cut pins off flush and apply vapor seal patches over clips.

3.2.3.2. Insulation shall be scored, beveled or mitered to provide tight joints and be secured to equipment with bands spaced 225 mm (9 inches) on center for irregular surfaces or with pins and clips on flat surfaces. Use corner beads to protect edges of insulation.

3.2.3.3. For hot equipment: Stretch 25 mm (1 inch) mesh wire, with edges wire laced together, over insulation and finish with insulating and finishing cement applied in one coat, 6 mm (1/4 inch) thick, trowel led to a smooth finish.

3.2.3.4. For cold equipment: Apply meshed glass fabric in a tack coat 1.5 to 1.7 square meter per liter (60 to 70 square feet per gallon) of vapor mastic and finish with mastic at 0.3 to 0.4 square meter per liter (12 to 15 square feet per gallon) over the entire fabric surface.

3.2.4. Duct Wrap for Kitchen Hood Grease Ducts:

3.2.4.1. Not Applicable.

3.2.5. Flexible Elastomeric Cellular Thermal Insulation:

3.2.5.1.1. Not applicable

3.3. **INSULATION JOINTS**

3.3.1. All insulation joints should be sealed with pressure-sensitive joint sealing tape to match the insulation facing. Rub hard with a plastic sealing tool to effect a tight bond.

3.3.2. Recommended practice: 3" (76mm) wide tape on flat surfaces or where edges are ship-lapped and stapled. Use 5" (102mm) wide tape in lieu of ship-lapping.

3.3.3. All sheet metal joints must be sealed prior to insulating.

3.4. **INSULATION AT DUCT SUPPORTS**

3.4.1. Refer to and conform strictly to insulation and protection jacket manufacturers' instructions.

3.4.2. To properly insulate through a roof top duct support; lift duct off of support, insulate duct through the support, install protection jacket through the support and add an additional layer of protection jacket 6" wide on the bottom and both sides at the point of contact with the support system.

3.4.3. When it is not possible to lift a duct off the rooftop supports, it is necessary to incorporate the support system into the insulation system by encapsulating the supports with insulation. This same system must be used if duct supports are screwed onto the ductwork

3.5. **FIELD-APPLIED JACKET APPLICATION**

3.5.1. Apply PVC jacket on piping insulation where indicated, with 1 inch (25 mm) overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

3.5.2. Apply aluminum jacket where indicated (piping and ductwork) and on all piping/ductwork located outdoors, with 2-inch (50 mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel band 12 inches (300 mm) o.c. and at end joints. Provide vapor-barrier jackets. Aluminum jackets shall have seams located below the horizontal plane of the horizontal piping route. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and cover with aluminum jackets.

3.6. **OUTDOOR DUCTWORK – RECTANGULAR**

3.6.1. All roof-top ductwork to must be designed and built with adequate slope (watershed) to prevent ponding water. Ponding water is defined as water that stays in place for greater than 24 hours.

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PART 1 - GENERAL

1.1. **REQUIREMENTS INCLUDED**

1.2. Procedures for on-site demonstration and testing of equipment and systems, including temporary facilities.

1.3. **INSTRUCTION OF BOARD'S OPERATING PERSONNEL.**

1.3.1. All demonstrations, instructions and testing must be completed prior to Board acceptance for beneficial use. All safety devices most pass 100 percent before the mechanical systems can be accepted for beneficial use.

1.3.2. Plumbing and emergency power systems are not included.

1.4. **DEFINITIONS**

1.4.1. Start Up: Initial inspection, cleaning, lubrication, adjustment, and operation of equipment and systems by the contractor with the assistance of the representatives of the equipment manufacturers.

1.4.2. Pre Tests: The final stage of the startup procedure. This occurs after all adjustments have been made except for minor fine-tuning that can be done during the pre test. Serves as verification that the systems are ready for the final test. Witnessing of pre test by the Consultant is not required.

1.4.3. Final Tests: Tests, witnessed by the Commissioning Agent or their representative, which demonstrate that all equipment and systems are in compliance with requirements.

1.5. **QUALITY ASSURANCE**

1.5.1. Experienced, trained technical service personnel who are representatives of the equipment manufacturers and system designers shall demonstrate, provide instructions, pre test and final test, as specified, the following equipment:

1.5.1.1. Boilers and Economizers
1.5.1.2. Burners
1.5.1.3. Air Handling Equipment and VFDs
1.5.1.4. Air Conditioning/Refrigeration Equipment
1.5.1.5. Control systems and Instrumentation.
1.5.1.6. Pumps and VFDs

1.5.1.7. Safety valves
1.5.1.8. Plumbing Specialties (requiring adjustment and set-up)

1.5.2. The person responsible for programming the BAS shall demonstrate and provide instructions on hardware, software and programming.

1.5.3. The Board will provide a list of personnel to receive instructions and will coordinate their attendance at agreed upon times.

1.5.4. All safety devices shall comply with the TSSA requirements.

1.6. **SUBMITTALS**

1.6.1. Names and qualifications of personnel performing demonstrations, instructions and tests.

1.6.2. Certification that pre testing is complete.

1.6.3. Preliminary schedule of all demonstrations, instructions and final tests two weeks prior to proposed dates.

1.6.4. Provide reports within three weeks after satisfactory completion of demonstrations, instructions, and tests. List date, type of work, persons participating, amount of time, test results, calculations of test results, test data.

1.6.5. Completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion,

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1. **PREPARATION FOR FINAL TESTS, DEMONSTRATIONS, AND INSTRUCTIONS**

3.1.1. Verify that equipment and systems are fully operational. Complete all start up and pre test activities for all equipment and systems. Complete all construction and finish work.

3.1.2. Arrange for all test personnel for all equipment to be continuously present during one period of time so that all equipment and systems can be tested in their interrelated functions. For instance, the burner in a heating system shall be tested during the boiler

testing, and instrumentation performance will be evaluated in conjunction with boiler testing.

3.1.3. Deliver maintenance and operating manuals four weeks prior to instruction period.

3.1.4. Furnish all special tools.

3.2. **FINAL TESTS**

3.2.1. Demonstrate proper operation of each equipment and system.

3.2.2. Provide tests on equipment as specified in the individual specification sections.

3.3. **STARTUP AND TESTING**

3.3.1. The Consultant will observe startup and contractor testing of selected equipment. Coordinate the startup and contactor testing schedules with the Consultant. Provide a minimum of 7 days prior notice.

3.4. **DEMONSTRATIONS AND TRAINING**

3.4.1. Demonstrate operation and maintenance of equipment and systems to Board personnel no more than two weeks prior to scheduled Board operation of the equipment.

3.4.2. Use operation and maintenance manuals as basis of instruction. Review contents of manuals with personnel in detail to explain all aspects of operation and maintenance.

3.4.3. Demonstrate start up, operation, control, adjustment, trouble shooting, servicing, maintenance, and shut down of each item of equipment. Allow Government personnel to practice operating the equipment under supervision of instructors.

3.4.4. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instructions.

3.4.5. Submit training plans and instructor qualifications

3.5. **TIME ALLOCATED FOR DEMONSTRATIONS AND INSTRUCTIONS**

3.5.1. At least 16 total instructor hours to include all new building services installed under this project.

3.5.2. At least 4 total instructor hours to include BAS and computer workstation and programs.

PART 4 - Do not exceed three trainees per session, one four hour session, per day, per trainee. **GENERAL**

4.1. **REQUIREMENTS INCLUDED**

4.2. Procedures for on site demonstration and testing of equipment and systems, including temporary facilities.

4.3. **INSTRUCTION OF CLIENT'S OPERATING PERSONNEL.**

4.3.1. All demonstrations, instructions and testing must be completed prior to Client acceptance for beneficial use. All safety devices most pass 100 percent before the mechanical systems can be accepted for beneficial use.

4.3.2. Plumbing and emergency power systems are not included.

4.4. **DEFINITIONS**

4.4.1. Start Up: Initial inspection, cleaning, lubrication, adjustment, and operation of equipment and systems by the contractor with the assistance of the representatives of the equipment manufacturers.

4.4.2. Pre Tests: The final stage of the start up procedure. This occurs after all adjustments have been made except for minor fine-tuning that can be done during the pre test. Serves as verification that the systems are ready for the final test. Witnessing of pre test by the Consultant is not required.

4.4.3. Final Tests: Tests, witnessed by the Commissioning Agent or their representative, which demonstrate that all equipment and systems are in compliance with requirements.

4.5. **QUALITY ASSURANCE**

4.5.1. Experienced, trained technical service personnel who are representatives of the equipment manufacturers and system designers shall demonstrate, provide instructions, pre test and final test, as specified, the following equipment:

4.5.1.1. Boilers and economizers
4.5.1.2. Burners
4.5.1.3. Control systems.
4.5.1.4. Instrumentation.

4.5.2. Experienced technicians shall demonstrate and provide instructions on the following equipment:

4.5.2.1. Pumps and piping systems
4.5.2.2. Ventilation, air conditioning/cooling and heating systems
4.5.2.3. Control and safety valves

4.5.3. The person responsible for programming the BAS shall demonstrate and provide instructions on hardware, software and programming.

4.5.4. The Client will provide a list of personnel to receive instructions and will coordinate their attendance at agreed upon times.

4.5.5. All safety devices shall comply with the TSSA requirements.

4.6. **SUBMITTALS**

4.6.1. Names and qualifications of personnel performing demonstrations, instructions and tests.

4.6.2. Certification that pre testing is complete.

4.6.3. Preliminary schedule of all demonstrations, instructions and final tests two weeks prior to proposed dates.

4.6.4. Provide reports within three weeks after satisfactory completion of demonstrations, instructions, and tests. List date, type of work, persons participating, amount of time, test results, calculations of test results, test data.

4.6.5. Completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion,

PART 5 - PRODUCTS (NOT USED)

PART 6 - EXECUTION

6.1. **PREPARATION FOR FINAL TESTS, DEMONSTRATIONS, AND INSTRUCTIONS**

6.1.1. Verify that equipment and systems are fully operational. Complete all start up and pre test activities for all equipment and systems. Complete all construction and finish work.

6.1.2. Arrange for all test personnel for all equipment to be continuously present during one period of time so that all equipment and systems can be tested in their interrelated functions. For instance, the burner in a heating system shall be tested during the boiler testing, and instrumentation performance will be evaluated in conjunction with boiler testing.

6.1.3. Deliver maintenance and operating manuals four weeks prior to instruction period.

6.1.4. Furnish all special tools.

6.2. **FINAL TESTS**

6.2.1. Demonstrate proper operation of each equipment and system.

6.2.2. Provide tests on equipment as specified in the individual specification sections.

6.3. **STARTUP AND TESTING**

6.3.1. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contactor testing schedules with the Resident Engineer and Commissioning Agent. Provide a minimum of 7 days prior notice.

6.4. **COMMISSIONING**

6.4.1. Provide commissioning documentation in accordance with the requirements of the Commissioning Agency for all inspection, start up, and contractor testing required above and required by the Systems Readiness Checklist.

6.5. **DEMONSTRATIONS AND TRAINING**

6.5.1. Demonstrate operation and maintenance of equipment and systems to Client personnel no more than two weeks prior to scheduled Client operation of the plant.

6.5.2. Use operation and maintenance manuals as basis of instruction. Review contents of manuals with personnel in detail to explain all aspects of operation and maintenance.

6.5.3. Demonstrate start up, operation, control, adjustment, trouble shooting, servicing, maintenance, and shut down of each item of equipment. Allow Government personnel to practice operating the equipment under supervision of instructors.

6.5.4. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instructions.

6.5.5. Submit training plans and instructor qualifications

6.6. **TIME ALLOCATED FOR DEMONSTRATIONS AND INSTRUCTIONS**

6.6.1. At least 8 total instructor hours to include all new building services installed under this project.

6.6.2. At least 4 total instructor hours to include BAS and computer workstation and programs.

6.6.3. Do not exceed three trainees per session, one four hour session, per day, per trainee.

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

1.1.1. Drawings and general provisions of the Contract, including General Conditions apply to this Section.

1.1.2. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.2. SUMMARY

1.2.1. This section covers the complete natural gas system installation, within and to five (5) feet beyond building perimeter unless noted otherwise on Contract Drawings, including but not limited to piping, regulators, unions, valves, installation, testing and other normal parts that make the systems complete, operable, code compliant and acceptable to the authorities having jurisdiction.

1.3. REFERENCE STANDARDS

1.3.1. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

1.3.2. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

1.3.3. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1.3.3.1. CSA B-149.1 Latest Edition

1.3.3.2. NFPA 54, National Fuel Gas Code, Latest Edition.

1.3.3.3. American Society of Mechanical Engineers (ASME): (Copyrighted Society)

1.3.3.3.1. A13.1-96 Scheme for Identification of Piping Systems
1.3.3.3.2. B16.3 98 Malleable Iron Threaded Fittings ANSI/ASME
1.3.3.3.3. B16.9 01 Factory-Made Wrought Steel Buttwelding Fittings
1.3.3.3.4. B16.11 01 Forged Steel Fittings, Socket-Welding and Threaded ANSI/ASME
1.3.3.3.5. B16.15-85(R 1994) Cast Bronze Threaded Fittings ANSI/ASME
1.3.3.3.6. B31.8-01 Gas Transmission and Distribution Piping Systems ANSI/ASME

1.3.3.4. American Society for Testing and Materials (ASTM):

1.3.3.4.1. A47-99 Ferritic Malleable Iron Castings Revision 1989
1.3.3.4.2. A53-02 Pipe, Steel, Black And Hot-Dipped, Zinc-coated Welded and Seamless
1.3.3.4.3. A183-83(R1998) Carbon Steel Track Bolts and Nuts
1.3.3.4.4. A536-84(R1999) E1 Ductile Iron Castings
1.3.3.4.5. A733-03 Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
1.3.3.4.6. B687-99 Brass, Copper, and Chromium-Plated Pipe Nipples

1.4. **QUALITY ASSURANCE**

1.4.1. All materials, equipment and Work shall meet or exceed all applicable federal, state and local requirements and conform to codes and ordinances of authorities having jurisdiction.

1.4.2. Valves: Manufacturer’s name, size, standards compliance and pressure rating clearly marked on outside of valve body.

1.4.3. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.

1.4.4. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience.

1.5. **SUBMITTALS**

1.5.1. Product Data:

1.5.1.1. Provide code and standards compliance verification, manufacturer's product data and ratings on pipe materials, pipe fittings, regulators, valves and accessories.

1.5.1.2. Manufacturer's Literature and Data:

1.5.1.2.1. Pipe & Fittings.
1.5.1.2.2. Valves.
1.5.1.2.3. Strainers.
1.5.1.2.4. All items listed in Part 2 - Products.

1.5.2. Record Documents:

1.5.2.1. Submit test reports and inspection certification for all natural gas systems installed under this Contract.

1.5.2.2. Submit manufacturer's data reports for all material used in coating and wrapping.

1.5.2.3. Submit welder's certifications prior to any shop or field fabrication. Welder's certifications shall be current within six (6) months of submission.

1.5.2.4. Record actual locations of valves, regulators, etc. and prepare valve charts.

1.5.2.5. Provide full written description of manufacturer's warranty.

1.5.3. Operation and Maintenance Data:

1.5.3.1. Include installation instructions, spare parts lists, exploded assembly views manufacturer's recommended maintenance.

1.6. **DELIVERY, STORAGE AND HANDLING**

1.6.1. Accept valves on site in shipping containers with labeling in place, inspect for damage and store with a minimum of handling. Store plastic piping under cover out of direct sunlight. Do not store materials directly on the ground.

1.6.2. Provide temporary protective coating on cast iron and steel valves.

1.6.3. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

1.6.4. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work and isolating parts of completed system.

1.7. **EXTRA MATERIALS**

1.7.1. Provide one (1) plug valve wrench for every ten (10) plug valves sized 50 mm (2 inches) and smaller, minimum of one. Provide each plug valve sized 65 mm (2½ inches) and larger with a wrench incorporating a setscrew.

PART 2 - PRODUCTS

2.1. GENERAL

2.1.1. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.1.2. Natural gas pressures shall not exceed 34.5 kPa (5 psi) gauge on customer side of the meter.

2.1.3. Pipe joint compound shall be lead-free, non-toxic, non-hardening, insoluble in the presence of natural gas and compliant with ANSI/NSF 61. Temperature service range of -15 degrees F to +400 degrees F.

2.2. PIPING

2.2.1. Above Ground Piping Outside of Building (Including roof):

2.2.1.1. Piping 50 mm (2 inches) and smaller shall be seamless Schedule 40 black steel, ASTM A106 or ASTM A53 Type "S", Grade A or B, with Class 150 black malleable iron threaded fittings conforming to ASME B16.3.

2.2.1.2. Piping 65 mm (2½ inches) and larger shall be Type "S" seamless or Type "E" electric resistance welded Schedule 40 black steel, ASTM A53, Grade A or B, with Schedule 40 wrought carbon steel fittings, ASTM A 234 and butt weld joints.

2.2.1.3. Provide field applied primer and outdoor-grade yellow epoxy paint coating on all pipe and fittings. Galvanizing shall not be considered adequate protection.

2.2.2. Above Ground Piping Exposed Inside of Building:

2.2.2.1. Piping 50 mm (2 inches) and smaller shall be seamless Schedule 40 black steel, ASTM A106 or ASTM A53 Type "S", Grade A or B, with Class 150 black malleable iron threaded fittings conforming to ASME B16.3.

2.2.2.2. Piping 65 mm (2½ inches)and larger shall be Type "S" seamless or Type "E" electric resistance welded Schedule 40 black steel, ASTM A53, Grade A or B, with Schedule 40 wrought carbon steel fittings, ASTM A 234 and butt weld joints.

2.2.2.3. Provide field applied primer and yellow epoxy paint coating on all pipe and fittings. Galvanizing shall not be considered adequate protection.

2.3. **EXCEPTIONS:**

2.3.1. All exposed piping 50 mm (2 inches) and smaller located within areas utilized as return air plenums shall have welded joints with Schedule 40 socket welded forged steel fittings conforming to ASME B16.11.

2.3.2. All exposed piping 50 mm (2 inches) and smaller serving laboratories from main natural gas riser to each emergency shut-off valve shall have welded joints with Schedule 40 socket welded forged steel fittings conforming to ASME B16.11.

2.3.3. Above Ground Piping Concealed Inside of Building (Includes above all ceilings, within partitions, within chases, and all non-accessible locations):

2.3.3.1. Piping 50 mm (2 inches) and smaller shall be seamless Schedule 40 black steel, ASTM A106 or ASTM A53 Type "S", Grade A or B, with welded joints with Schedule 40 socket welded forged steel fittings conforming to ASME B16.11.

2.3.3.2. Piping 65 mm (2½ inches)and larger shall be Type "S" seamless or Type "E" electric resistance welded Schedule 40 black steel, ASTM A53, Grade A or B, with Schedule 40 wrought carbon steel fittings, ASTM A 234 and butt weld joints.

2.4. **VALVES**

2.4.1. All valves shall be designed, manufactured and approved for natural gas service.

2.4.2. Standards of Acceptance: Nibco, Magnatrol, Emerson

2.4.3. Line Shut-off Valves sizes 50 mm (2 inches) and smaller shall be iron body lubricated plug valve conforming to ASTM-A-126, U.L. Listed and A.G.A. Approved for natural gas service with threaded ends, wrench operation, rated for 200 WOG service pressure and –20 to 200 degrees F.

2.4.4. Line Shut-off Valves sizes 65 mm (2½ inches)and larger shall be iron body lubricated plug valve conforming to ASTM-A-126, U.L. Listed and A.G.A. Approved for natural gas service with flanged ends, wrench operation, rated for 200 WOG service pressure and –20 to 200 degrees F.

2.4.5. Appliance/Equipment Shut-off Valves at local connections sizes 2 inches and smaller shall be bronze body, full port ball or butterfly type, U.L. Listed and A.G.A. Approved for natural gas service with threaded ends, quarter turn lever handle operation, rated for 175 W.O.G. service pressure and 30 to 275 degrees F.

2.4.6. Manual Emergency Shut-off Valves sizes 2 inches and smaller shall be bronze body, full port ball or butterfly type, U.L. Listed and A.G.A. Approved for natural gas service with threaded ends, quarter turn lever handle operation, rated for 175 W.O.G. service pressure and 30 to 275 degrees F.

2.4.7. Automatic Emergency Shut-off Valves shall be U.L. Listed F.M. Approved for natural gas service, 2-way electrically tripped solenoid type; fail safe closed; manual reset; Type 1 solenoid enclosure; NBR seals and disc; stainless steel core tube and springs; copper coil.

2.5. **STRAINERS**

2.5.1. Provide on high pressure side of pressure reducing valves, on inlet side of indicating and control instruments and equipment subject to sediment damage and where shown on drawings. Strainer element shall be removable without disconnection of piping.

2.5.2. Gas Lines: "Y" type with removable mesh lined brass strainer sleeve.

2.5.3. Body: Smaller than 80 mm (3 inches), brass or bronze; 80 mm (3 inches) and larger, cast iron or semi steel.

2.6. **PRESSURE REGULATORS**

2.6.1. All pressure regulators shall be designed, manufactured and approved for natural gas service.

2.6.2. Vent all pressure regulators to the outdoors, in accordance with TSSA and CSA-B-149.1 requirements. Terminate vents with approved caps and insect screens as per TSSA requirements and CSA B-149.1 provisions.

2.6.3. Segregate regulators vents by pressure levels; do not gang-vent vents from regulators serving different pressure gas piping. Size common vents as per CSA B-149.1 provisions.

2.6.4. Pressure regulators for individual service lines shall be capable of reducing distribution line pressure to pressures required for users. Pressure relief shall be set at a lower pressure than would cause unsafe operation of any connected user. Regulator shall

have a single port with orifice diameter no greater than that recommended by manufacturer for the maximum gas pressure at the regulator inlet. Regulator vent valve shall be of resilient materials designed to withstand flow conditions when pressed against valve port. Regulator shall be capable of limiting build-up of pressure under no-flow conditions to 50 percent or less of the discharge pressure maintained under flow conditions. Commercial grade diaphragm type with internal relief valve, vent valve, cast iron body, Buna-N diaphragm.

2.6.5. Install pressure gauge adjacent to and downstream of each line pressure regulator.

2.6.6. Standard of Acceptance: Rockwell, Fisher.

2.7. **UNIONS**

2.7.1. Unions in 2 inches and smaller in ferrous lines shall be right and left hand nipple/coupling assembly, or ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends, 2-1/2 inches and larger shall be ground flange unions. Companion flanges on lines at various items of equipment, machines and pieces of apparatus may serve as unions to permit disconnection of piping.

2.7.2. Unions connecting ferrous pipe to copper or brass pipe shall be dielectric type.

2.7.3. Above grade flexible stainless steel appliance/equipment connectors shall conform with AGA under the ANSI Z21.69 Standard. Hose shall be braided stainless steel with a polyolefin heat-shrink tubing with high flame-retardant qualities. Hose shall be equipped with malleable iron unions and spring loaded brass quick-link couplings. An easily accessible manual shut-off valve shall be installed ahead of all hose connections. Specify T&S Brass "Safe-T-Link" or approved equal.

2.8. **FLANGES**

2.8.1. All 150 lb. and 300 lb. ANSI flanges shall be domestically manufactured, weld neck forged carbon steel, conforming to ANSI B16.5 and ASTM A 181 Grade I or II or A 105 71. Slip on flanges shall not be used. Each fitting shall be stamped as specified by ANSI B16.9 and, in addition, shall have the laboratory control number stenciled on each fitting for ready reference as to physical properties and chemical composition of the material. Complete test reports may be required for any fitting selected at random.

2.8.2. Flanges which have been machined, remarked, painted or otherwise produced domestically from imported forges will not be acceptable. Flanges shall have the

manufacturer's trademark permanently identified in accordance with MSS SP 25. Contractor shall submit data for firm certifying compliance with these Specifications.

2.8.3. Bolts used shall be carbon steel bolts with semi finished hexagon nuts of American Standard Heavy dimensions. All thread rods will not be an acceptable for flange bolts. Bolts shall have a tensile strength of 60,000 psi and an elastic limit of 30,000 psi. Flat-faced flanges shall be required to match flanges on pumps, check valves, strainers, etc. Only one manufacturer of weld flanges will be approved for each project.

2.8.4. All flanges shall be gasketed. Contractor shall place gasket between flanges of flanged joints. Gaskets shall fit within the bolt circle on raised face flanges and shall be full face on flat face flanges. Gaskets shall be cut from 1/16 inch thick, non metallic, non asbestos gasket material suitable for operating temperatures from 150 degrees F to +75 degrees F, Klingersil C-4400, Manville Style 60 service sheet packing, or approved equal.

2.9. **LABORATORY NATURAL GAS PIPING**

2.9.1. All natural gas piping serving labs from main natural gas riser shall be routed exposed to view below ceiling and painted yellow.

2.9.2. Install emergency gas shut-off valve in each line serving individual laboratory rooms. Locate shut-off actuator within lab area adjacent to each room exit at 1,500 mm (60 inches) above finished floor. Location of emergency shut-off shall be accessible to occupants for shutting off the natural gas supply under emergency conditions.

2.9.3. Gas piping joints shall be welded from main natural gas riser to each emergency shut-off valve. Piping from the emergency shutoff valve to the outlets shall be assembled with threaded fittings provided all joints are exposed to view or within the confines of laboratory furniture.

2.9.4. Install flexible stainless steel appliance/equipment connector at each fume hood and biological safety cabinet requiring natural gas service. Connectors shall not be concealed within or extended through wall, floor or partition and shall be located entirely in the same room as the connected equipment. Provide an accessible shut-off valve not less than the nominal size of the equipment connector, immediately ahead of the connector.

2.10. **EXPANSION COMPENSATORS**

2.10.1. For piping 50 mm (2") and less: refer to details shown in CSA-B149.1

2.10.2. For Piping 65 mm (2½") and larger:

2.10.2.1. CGA-Approved Flexible Hose Expansion Loops for Fuel Applications

2.10.2.1.1. Provide flexible hose expansion loop(s) as required to accommodate any thermal expansion, contraction, building settlement, or seismic movement of the piping system.

2.10.2.1.2. Flexible hose expansion loops shall be manufactured complete with two parallel sections of corrugated metal house, compatible braid, 180 deg return bend, with inlet and outlet connections. Field fabricated loops shall not be acceptable.

2.10.2.1.3. Flexible loops shall be capable of movement in the ±X, ±Y, and ±Z planes.

2.10.2.1.4. Flexible hose expansion loops shall impart no thrust loads to system support, anchors or building structure.

2.10.2.1.5. Materials

- Fittings shall be standard weight, Carbon Steel conforming to ASTM A234 / ASME B16.9
- Corrugated Hose; Stainless Steel, Type 321
- Braid; 304 Stainless Steel.
- End fittings shall carbon steel plate flanges with 150 lb. drilling.
- Flexible hose expansion loops for gas service up to 4" shall be CSA / AGA listed and be in conformance with UL-536.

2.10.2.1.6. Standard of Acceptance: Metraflex, Flexonics

PART 3 - EXECUTION

3.1. **PREPARATION**

3.1.1. Ream pipe ends and remove cutting burrs. Bevel plain end ferrous pipe.

3.1.2. Remove cutting oil, scale and dirt, on inside and outside of piping, before assembly.

3.2. **EQUIPMENT CONNECTIONS**

3.2.1. Provide specified connections, shutoff valves, regulators and unions at each and every appliance and piece of equipment requiring natural gas.

3.2.2. Provide and install union type connections at all equipment to permit removal of service piping.

3.2.3. Gas service connections shall have a diameter at least one pipe size larger than that of the inlet connection to the equipment as provided by the manufacturer and be of adequate size to provide the total input demand of the connected equipment.

3.2.4. Provide listed and labeled appliance connectors complying with ANSI Z21.69 and listed for use with food service equipment having casters, or that is otherwise subject to movement for cleaning, and other large movable equipment. Connectors shall have listed and labeled quick-disconnect devices and shall have retaining cables attached to structures and equipment. Connectors shall not be concealed within or extended through wall, floor or partition and shall be located entirely in the same room as the connected equipment. Provide an accessible shut-off valve not less than the nominal size of the equipment connector, immediately ahead of the connector.

3.2.5. Rigid metallic pipe and fittings shall be used at service connections to all stationary equipment.

3.3. **FLEXIBLE HOSE EXPANSION LOOPS**

3.3.1. Install and guide per manufacturers' installation instructions.

3.3.2. Flexible hose expansion loop return fitting shall be supported to allow movement

3.4. **PIPING INSTALLATION**

3.4.1. Installation shall meet or exceed all applicable provincial and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

3.4.2. All installation shall be in accordance with manufacturer's published recommendations.

3.4.3. Provide support for and connections to natural gas service meter in accordance with requirements of the CSA B-149.1 Latest Edition and utility company recommendations, whichever is stricter.

3.4.4. Slope piping down in direction of flow to low points.

3.4.5. Use eccentric reducers at pipe size change installed to provide positive drainage.

3.4.6. Provide clearance for access for maintenance of equipment, valves and fitting

3.4.7. Distribution piping shall be as short and as direct as practicable between the point of delivery and the outlets.

3.4.8. All above ground gas piping shall be electrically continuous and bonded to electrical system ground conductor in accordance with NFPA 70.

3.4.9. Provide and install union type fittings at proper points to permit dismantling or removal of pipe. No unions will be required in welded lines except at equipment connections. Where union type fittings are necessary for piping dismantling purposes, right and left nipples and couplings shall be used. Flanges, ground-joint unions or approved flexible appliance connectors may be used at exposed fixture, appliance or equipment connections.

3.4.10. Provide dielectric isolation device where copper lines connect to ferrous lines or equipment, such as dielectric coupling or dielectric flange fitting.

3.4.11. Valves, regulators, flanges, union type fittings and similar appurtenances shall be accessible for operation and servicing and shall not be located above ceilings, within chases, walls/partitions, spaces utilized as return air plenums or non-accessible locations.

3.4.12. Route piping in orderly manner and maintain gradient. Install piping to conserve building space. Group piping whenever practical at common elevations.

3.4.13. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to TSSA requirements at CSA-B149.1 provisions for distance between expansion joints.

3.4.14. Make service connections at the top of the main, whenever the depth of the main is sufficient to allow top connections. When service connections cannot be made at the top of the main, they shall be made on the side of the main no lower than the horizontal midpoint of the gas main.

3.4.15. Close nipples, bushing and cross type fittings shall not be installed in any gas piping system.

3.4.16. Slope piping and arrange to drain at low points. Install drip/sediment traps at points where condensate and debris may collect. Locate drip/sediment traps where readily accessible for cleaning and emptying. Do not install where condensate would be subject to freezing. Construct drip/sediment traps using tee fitting with capped nipple connected to bottom outlet. Use minimum-length nipple of 3 pipe diameters, but not

less than 4 inches long, and same size as connected pipe. Cap shall be screwed pattern, black, standard weight, malleable iron. Install with adequate space for removal of cap.

3.4.17. Install valves for shut off and to isolate equipment, parts of systems, or vertical risers. All valves shall be located such that servicing and operation is possible. All flanged valves shown in horizontal lines with the valve stem shall be positioned so that the valve stem is inclined one bolt hole above the horizontal position. Screw pattern valves placed in horizontal lines shall be installed with their valve stems inclined at an angle of a minimum of 30 degrees above the horizontal position. All valves must be true and straight at the time the system is tested and inspected for final acceptance. Valves shall be installed as nearly as possible to the locations indicated in the Contract Drawings. Any change in valve location must be so indicated on the Record Drawings.

3.4.18. Install line shut-off valve at each branch connection to riser. Branch line shut-off valves shall be automatic type where indicated on Drawings.

3.4.19. Provide adequate clearance for access to and operation of all valves.

3.4.20. Install valves with stems upright or horizontal, not inverted unless required otherwise by the valve manufacturer.

3.4.21. Pipe vents from gas pressure reducing valves and pipe casing sleeves to the exterior of the building and terminated with outlet turned down and capped with corrosion resistant insect screen. Vent terminations shall be at least seven feet above grade or pedestrian traffic and a minimum three (3) feet above or twenty five (25) feet horizontally from all air intakes or building openings.

3.5. **GAS PRESSURE**

3.5.1. Coordinate and review with the local gas supplier the existing meter and main gas regulator. Confirm with the local gas supplier that the current meter and regulator are suitable for the equipment installed under this project, taking into account all other existing gas-fired appliances.

3.5.2. Where applicable to the project, the new gas burners require a min. of 7” w.g. (1.74 kPa) gas pressure when firing at maximum rate. Ensure that the existing gas metering station is adjusted so that all burners receive this pressure when firting at maximum rate and the other gas fired appliances are operational.

3.5.3. Refer to the cash allowance section of these specifications

3.6. **PIPE HANGERS, SUPPORTS AND ACCESSORIES**

3.6.1. All piping shall be supported as Ontario Gas Code recommendations (CSA B-149.1) or the following (whichever is more restrictive):

3.6.1.1. Above ground horizontal natural gas and encasement piping shall be supported at intervals of no greater than 1,800 mm (6 ft) for ½ inch piping, 2,400 mm (8 ft) for 3/4 inch and 1 inch piping and 3,000 mm (10 ft) for 1¼ inches and larger piping. Vertical piping shall be supported at each floor level and at intervals as specified for horizontal piping. Provide additional supports at fittings as required by TSSA and CSA B-149.1 latest edition.

3.6.2. Indoor Pipe Supports

3.6.2.1. Shop Painting and Plating: Hangers, supports, rods, inserts and accessories used for pipe supports shall be shop coated with red lead or zinc chromate primer paint. Electroplated copper hanger rods, hangers and accessories may be used with copper tubing.

3.6.2.2. Floor, Wall and Ceiling Plates, Supports, Hangers:

3.6.2.2.1. Solid or split unplated cast iron.
3.6.2.2.2. All plates shall be provided with set screws.
3.6.2.2.3. Pipe Hangers: Height adjustable clevis type.
3.6.2.2.4. Adjustable Floor Rests and Base Flanges:Steel.
3.6.2.2.5. Concrete Inserts: "Universal" or continuous slotted type.
3.6.2.2.6. Hanger Rods: Mild, low carbon steel, fully threaded or Threaded at each end with two removable nuts at each end for positioning rod and hanger and locking each in place.
3.6.2.2.7. Riser Clamps: Malleable iron or steel.
3.6.2.2.8. Rollers: Cast iron.
3.6.2.2.9. Self-drilling type expansion shields shall be "Phillips" type, with case hardened steel expander plugs.

3.6.2.3. Hangers and supports utilized with insulated pipe and tubing shall have 180 degree (min.) metal protection shield centered on and welded to the hanger and support. The shield shall be 4 inches in length and be 16 gauge steel. The shield shall be sized for the insulation.

3.6.2.4. Miscellaneous Materials: As specified and/or required for proper installation of hangers, supports and accessories. Provide all necessary auxiliary steel to provide that support.

3.6.2.5. Install cast escutcheon with set screw at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.

3.6.2.6. Extension bars shall not be used for supporting gas or encasement piping. Gas or encasement piping shall not be used to support any other piping or component.

3.6.3. Outdoor Pipe Supports (Roof)

3.6.3.1. The roof block is an assembled product comprised of two major components including the support shell which is an one piece, UV resistent, thermoplastic injection molded Polypropylene Impact Copolymer and the Type 3, 20 psi extruded polystyrene non-marring base.

3.6.3.2. The support shell (shown left, inverted without base) is designed with an interior web creating eight symmetrical cavities. Design maximizes support strength while substantially reducing the overall weight.

3.6.3.3. Interior cavities allow for expansion and contraction under extreme temperature conditions over its lifetime. The lower portion of the onepiece support shell incorporates a ¾" high wall which reduces UV exposure to the extruded polystyrene base.

3.6.3.4. Min. mounting height above the roof: 300 mm (12"). Use two 12.7 mm electro-zinc all threaded rod risers and 25 mm galvanized slotted channel to achieve required pipe mounting height.

3.6.3.5. Supply metallic galvanized straps to secure pipe to supports and screw on both sides into the support blocks. Use a coarse screw with a large head diameter to maximize retention.

3.6.3.6. Standard of Acceptance: , Dura-Block DBE Series, Quick-Block

3.7. **WALLS AND FLOOR PENETRATIONS**

3.7.1. Provide metallic sleeves at all locations where the gas line passes through floor or wall.

3.7.2. Provide fire stopping material in the annular space between the gas line and the sleeve.

3.7.3. Waterproofing: At floor penetrations, completely seal clearances around the pipe and make watertight with sealant

3.8. **IDENTIFICATION**

3.8.1. All gas piping shall be primed and painted yellow. For outdoors, use outdoor grade paint.

3.8.2. Piping conveying gas at pressures above 6.9 kPa (1 psi) shall be identified as per the TSSA requirements.

3.9. **INSTALLATION OF WELDED PIPING**

3.9.1. Piping and fittings shall be welded and fabricated in accordance with ASME/ANSI the latest editions of Standard B32.1 for all systems. Machine beveling in shop is preferred. Field beveling may be done by flame cutting to recognized standards.

3.9.2. Ensure complete penetration of deposited metal with base metal. Provide filler metal suitable for use with base metal. Maintain inside of fittings free from globules of weld metal. All welded pipe joints shall be made by the fusion welding process, employing a metallic arc or gas welding process. All pipes shall have the ends beveled 37-½ inch degrees and all joints shall be aligned true before welding. Except as specified otherwise, all changes in direction, intersection of lines, reduction in pipe size and the like shall be made with factory-fabricated welding fittings. Mitering of pipe to form elbows, notching of straight runs to form tees, or any similar construction will not be permitted.

3.9.3. Align piping and equipment so that no part is offset more than 1/16 inch. Set all fittings and joints square and true and preserve alignment during welding operation. Use of alignment rods inside pipe is prohibited.

3.9.4. Contractor shall not permit any weld to project within the pipe so as to restrict it. Tack welds, if used, must be of the same material and made by the same procedure as the completed weld. Otherwise, remove tack welded during welding operation.

3.9.5. Do not split, bend, flatten or otherwise damage piping before, during or after installation.

3.9.6. Remove dirt, scale and other foreign matter from the inside of piping, by swabbing or flushing, prior to the connection of other piping sections, fittings, valves or equipment.

3.9.7. In no cases shall Schedule 40 pipe be welded with less than three passes including one stringer/root, one filler and one lacer. Schedule 80 pipe shall be welded with not less than four passes including one stringer/root, two filler and one lacer. In all cases, however, the weld must be filled before the cap weld is added.

3.9.8. Weld Testing:

3.9.8.1. At the Client's request, all welds may be subject to inspection, visual and/or x-ray, for compliance with Specifications. The Client will employ a testing laboratory for the purposes of performing said inspections and/or x-ray testing. Initial visual and x-ray inspections will be provided by the Client. The Contractor shall be responsible for all labor, material and travel expenses involved in the re-inspection and retesting of any welds found to be unacceptable. In addition, the Contractor shall be responsible for the costs involved in any and all additional testing required or recommended by ASME/ANSI Standards B31.1 and B31.3 due to the discovery of poor, unacceptable or rejected welds.

3.9.8.2. Welds lacking penetration, containing excessive porosity or cracks, or are found to be unacceptable for any reason, must be removed and replaced with an original quality weld as specified herein.

3.10. **TESTING**

3.10.1. All natural gas systems shall be inspected, tested, purged and placed into operation in accordance with NFPA 54 and as required herein.

3.10.2. All necessary apparatus for conducting tests shall be furnished by the Contractor and comply with the requirements of NFPA 54.

3.10.3. All new rough-in distribution piping and affected portions of existing systems connected to, shall be subjected to a pneumatic test pressure utilizing clean, dry air and must be demonstrated to be absolutely tight when subjected to the pressures and time durations listed herein. All equipment and components designed for operating pressures of less than the test pressure shall not be connected to the piping system during test.

3.10.4. Systems on which the normal operating pressure is less than 3.45 kPa (0.5 psi) gauge (psig), the test pressure shall be 34.5 kPa (5.0 psig) and the time interval shall be 30 minutes.

3.10.5. Systems on which the normal operating pressure is between 3.45 kPa (0.5 psig) and 34.5 kPa (5.0 psig), the test pressure shall be 1.5 times the normal operating pressure or 34.5 kPa (5.0 psig), whichever is greater, and the time interval shall be 30 minutes.

3.10.6. Systems on which the normal operating pressure is 34.5 kPa (5.0 psig) or greater, the test pressure shall be 1.5 times the normal operating pressure, and the time interval shall be one (1) hour.

3.10.7. After testing is complete, the entire gas system shall be purged with dry nitrogen to eliminate all air, debris and moisture from the piping before natural gas is introduced into the system.

3.10.8. After successful results of pressure test and purging have been completed, a leakage test shall be performed in accordance with NFPA 54 Appendix D.

3.10.9. Connect, inspect and purge gas utilization equipment, lab hook-ups, outlets, etc., and place into operation only after successful results of pressure test, leakage test and purging have been completed and accepted.

3.10.10. In all instances in which leaks are then found, they shall be eliminated in the manner designated by the Client's duly authorized representative. Testing operations shall be repeated until gas-piping systems are absolutely tight at the pneumatic test pressures indicated above.

3.10.11. The Contractor shall make all arrangements to assure the Consultant and/or Commissioning Agent view the final test and that a certificate is provided from the Inspectors verifying that the installation meets requirements.

3.10.12. Pressure test gas piping sleeve system with clean, dry compressed air at 15 psig by temporarily sealing all openings between gas carrier pipe and sleeve and vent openings. Sleeve systems must be demonstrated to be absolutely tight when subjected to this pressure for a period of four hours.

PART 1 - GENERAL

1.1. DESCRIPTION

1.1.1. Water piping to connect HVAC equipment, including the following:

1.1.1.1. Chilled water, condenser water, heating hot water and drain piping.
1.1.1.2. Extension of domestic water make up piping.
1.1.1.3. Glycol water piping.

1.2. RELATED WORK

1.2.1. Section 01 23 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
1.2.2. Section 33 10 00, WATER UTILITIES: Underground piping.
1.2.3. Section 23 05 11, COMMON WORK RESULTS FOR HVAC:
1.2.4. Section 23 21 23, HYDRONIC PUMPS

1.3. QUALITY ASSURANCE

1.3.1. Section 23 05 11, COMMON WORK RESULTS FOR HVAC, which includes welding qualifications.
1.3.2. Submit prior to welding of steel piping a certificate of Welder’s certification. The certificate shall be current and not more than one year old.
1.3.3. All joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer.
1.3.4. All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability.

1.4. SUBMITTALS

1.4.1. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

1.4.2. Manufacturer's Literature and Data:

1.4.2.1. Pipe and equipment supports.
1.4.2.2. Pipe and tubing, with specification, class or type, and schedule.
1.4.2.3. Pipe fittings, including miscellaneous adapters and special fittings.
1.4.2.4. Flanges, gaskets and bolting.
1.4.2.5. Valves of all types.
1.4.2.6. Heat Exchnagers

1.4.2.7. Strainers.
1.4.2.8. Flexible connectors for water service.
1.4.2.9. Pipe alignment guides.
1.4.2.10. Expansion joints.
1.4.2.11. Expansion compensators.
1.4.2.12. All specified hydronic system components.
1.4.2.13. Water flow measuring devices.
1.4.2.14. Gages.
1.4.2.15. Thermometers and test wells.
1.4.2.16. Electric heat tracing systems.
1.4.2.17. Air separators.
1.4.2.18. Expansion tanks.
1.4.2.19. Submit the welder's qualifications in the form of a current (less than one year old) and formal certificate.
1.4.2.20. As Built Piping Diagrams: Provide drawing as follows for chilled water/glycol, condenser water, and heating hot water/glycol system and other piping systems and equipment in electronic Autocad and pdf format.

1.5. **APPLICABLE PUBLICATIONS**

1.5.1. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. American National Standards Institute, Inc.

1.5.2. American Society of Mechanical Engineers/American National Standards Institute, Inc. (ASME/ANSI):

1.5.2.1. B1.20.1-83(R2006) Pipe Threads, General Purpose (Inch)
1.5.2.2. B16.4 06 Gray Iron Threaded FittingsB16.18-01 Cast Copper Alloy Solder joint Pressure fittings
1.5.2.3. B16.23-02 Cast Copper Alloy Solder joint Drainage fittings
1.5.2.4. B40.100-05 Pressure Gauges and Gauge Attachments

1.5.3. American National Standards Institute, Inc./Fluid Controls Institute (ANSI/FCI):

1.5.3.1. 70-2-2006 Control Valve Seat Leakage
1.5.3.2. American Society of Mechanical Engineers (ASME):
1.5.3.3. B16.1-98 Cast Iron Pipe Flanges and Flanged Fittings
1.5.3.4. B16.3-2006 Malleable Iron Threaded Fittings: Class 150 and 300
1.5.3.5. B16.4 2006 Gray Iron Threaded Fittings: (Class 125 and 250)

1.5.3.6. B16.5-2003 Pipe Flanges and Flanged Fittings: NPS ½ through NPS 24 Metric/Inch Standard
1.5.3.7. B16.9-07 Factory Made Wrought Butt Welding Fittings
1.5.3.8. B16.11-05 Forged Fittings, Socket Welding and Threaded
1.5.3.9. B16.18-01 Cast Copper Alloy Solder Joint Pressure Fittings
1.5.3.10. B16.22-01 Wrought Copper and Bronze Solder Joint Pressure Fittings.
1.5.3.11. B16.24 06 Cast Copper Alloy Pipe Flanges and Flanged Fittings
1.5.3.12. B16.39 06 Malleable Iron Threaded Pipe Unions
1.5.3.13. B16.42-06 Ductile Iron Pipe Flanges and Flanged Fittings
1.5.3.14. B31.1 08 Power Piping

1.5.4. American Society for Testing and Materials (ASTM):

1.5.4.1. A47/A47M-99 (2004) Ferritic Malleable Iron Castings
1.5.4.2. A53/A53M-07 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
1.5.4.3. A106/A106M-08 Standard Specification for Seamless Carbon Steel Pipe for High Temperature Service
1.5.4.4. A126 04 Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
1.5.4.5. A183 03 Standard Specification for Carbon Steel Track Bolts and Nuts
1.5.4.6. A216/A216M-08 Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High Temperature Service
1.5.4.7. A234/A234M-07 Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
1.5.4.8. A307 07 Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
1.5.4.9. A536 84 (2004) Standard Specification for Ductile Iron Castings
1.5.4.10. A615/A615M-08 Deformed and Plain Carbon Steel Bars for Concrete Reinforcement
1.5.4.11. B32 08 Standard Specification for Solder Metal
1.5.4.12. B62 02 Standard Specification for Composition Bronze or Ounce Metal Castings
1.5.4.13. B88 03 Standard Specification for Seamless Copper Water Tube
1.5.4.14. American Water Works Association (AWWA):
1.5.4.15. C110-08 Ductile Iron and Grey Iron Fittings for Water
1.5.4.16. C203-02 Coal Tar Protective Coatings and Linings for Steel Water Pipe Lines Enamel and Tape Hot Applied

1.6. **SPARE PARTS**

1.6.1. For mechanical pressed sealed fittings provide tools required for each pipe size used at the facility.

PART 2 - PRODUCTS

2.1. **PIPE AND TUBING**

2.1.1. Chilled Water/Glycol Piping, Condenser Water Piping, Heating Hot Water/Glycol Piping as applicable to the project:

2.1.1.1. 50 mm (2") diam and smaller:

2.1.1.1.1. Schedule 40 continuous weld or electric resistance welded black carbon steel conforming to ASTM A53 84a Grade B, with threaded ends.

2.1.1.1.2. Type “L” hard drawn copper tubing conforming to ASTM B88. Type “L” soft annealed copper tubing may be used within convector enclosures.

2.1.1.2. 65 mm (2½“) diam and larger

2.1.1.2.1. Schedule 40 continuous weld or electric resistance welded black carbon steel conforming to ASTM A53 84a Grade B, with bevelled ends.

2.1.1.2.2. Schedule 40 continuous weld or electric resistance welded black carbon steel conforming to ASTM A53 84a Grade B, with grooved ends conforming to CSA B242-M.

2.1.2. Cooling Coil Condensate Drain Piping:

2.1.2.1. From air handling units: Copper water tube, ASTM B88, Type M

2.1.2.2. From fan coil or other terminal units: Copper water tube, ASTM B88, Type L for runouts and Type M for mains.

2.1.3. Chemical Feed Piping for Cooling Tower Water Treatment: Chlorinated polyvinyl chloride (CPVC), Schedule 80, ASTM F441.

2.1.4. Pipe supports, including insulation shields, for above ground piping: Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

2.2. **FITTINGS FOR COPPER TUBING**

2.2.1. Joints 50 mm (2”) and smaller:

2.2.1.1. *Solder Joints:* Joints shall be made up in accordance with recommended practices of the materials applied. Apply 95/5 tin and antimony on all copper piping.

2.2.1.2. *Screwed Joints:* Pipe Thread: ANSI B1.20. Lubricant or Sealant: Oil and graphite or other compound approved for the intended service.

2.2.2. Joints 65 mm (2½“) and larger:

2.2.2.1. Bronze Flanges and Flanged Fittings: ASME B16.24.

2.2.2.2. Fittings: ASME B16.18 cast copper or ASME B16.22 solder wrought copper.

2.3. **FITTINGS FOR STEEL PIPE**

2.3.1. 50 mm (2 inches) and Smaller: Screwed or welded joints.

2.3.1.1. Butt welding: ASME B16.9 with same wall thickness as connecting piping.

2.3.1.2. Forged steel, socket welding or threaded: ASME B16.11.

2.3.1.3. Screwed: 150 pound malleable iron, ASME B16.3. 125 pound cast iron, ASME B16.4, may be used in lieu of malleable iron. Bushing reduction of a single pipe size, or use of close nipples, is not acceptable.

2.3.2. 65 mm (2 1/2 inches) and Larger: Welded or flanged joints.

2.3.2.1. Butt welding fittings: ASME B16.9 with same wall thickness as connecting piping. Elbows shall be long radius type, unless otherwise noted.

2.3.2.2. Welding flanges and bolting: ASME B16.5:

2.3.2.3. Weld neck or slip on, plain face, with 6 mm (1/8 inch) thick full face neoprene gasket suitable for 104 degrees C (220 degrees F).

2.3.2.4. Flange bolting: Carbon steel machine bolts or studs and nuts, ASTM A307, Grade B.

2.4. **FITTINGS FOR PLASTIC PIPING**

2.4.1. Chemical feed piping for condenser water treatment: Chlorinated polyvinyl chloride (CPVC), Schedule 80, ASTM F439.

2.5. **DIELECTRIC FITTINGS**

2.5.1. Provide where copper tubing and ferrous metal pipe are joined.
2.5.2. 50 mm (2 inches) and Smaller: Threaded dielectric union, ASME B16.39.
2.5.3. 65 mm (2 1/2 inches) and Larger: Flange union with dielectric gasket and bolt sleeves, ASME B16.42.
2.5.4. Temperature Rating, 99 degrees C (210 degrees F).

2.6. **UNION**

2.6.1. 50 mm (2") diam and smaller:

2.6.1.1. All brass construction with ground joint and either solder joint or screwed ends as required.

2.6.1.2. Class 150 black malleable iron construction with brass to iron ground joint and screwed ends, conforming to ASTM A197 and ANSI/ASME B1.20.1.

2.6.1.3. Provide dielectric unions or couplings at all connections between copper tubing and ferrous piping or equipment.

2.7. **FLANGES**

2.7.1. Class 150 forged steel slip-on or weld-neck raised face type conforming to ASTM A181 Grade 1 and ANSI/ASME B16.5. Remove raised face where flanges connect to Class 125 cast iron valves.

2.7.2. Hinged, two piece, shouldered or keyed cast malleable iron

2.7.3. Conforming to ASTM A47 Grade 32510 with elastomeric gasket suitable for service and lock bolt.

2.8. **GASKETS AND BOLTS**

2.8.1. Gaskets
2.8.1.1. 1.6 mm (1/16") Garlock 3200 with SBR binder or equivalent asbestos free material.
2.8.2. Bolts

2.8.2.1. Semi finishedhex head machine bolts and semi finished hex nuts, both of carbon steel conforming. to ASTM A307 Class A.

2.9. **PLUGS**

2.9.1. 50 mm (2") diam and smaller

2.9.2. Class 3000 screwed, square head, machined from solid steel or forging to ASTM A105 Grade 2.

2.10. **SCREWED JOINTS**

2.10.1. Pipe Thread: ANSI B1.20.

2.10.2. Lubricant or Sealant: Oil and graphite or other compound approved for the intended service.

2.11. **VALVES**

2.11.1. Asbestos packing is not acceptable.

2.11.2. All valves of the same type shall be products of a single manufacturer.

2.11.3. Provide chain operators for valves 150 mm (6 inches) and larger when the centerline is located 2400 mm (8 feet) or more above the floor or operating platform.

2.11.4. Standard of Acceptance: Crane, Toyo, Kitz, RWV

2.11.5. Shut-Off Valves

2.11.5.1. Ball Valves (Pipe sizes 50 mm [2”] and smaller): MSS-SP 110, screwed or solder connections, brass or bronze body with chrome-plated ball with full port and Teflon seat at 2760 kPa (400 psig) working pressure rating. Provide stem extension to allow operation without interfering with pipe insulation.

2.11.5.2. Butterfly Valves (Pipe Sizes 65 mm [2-1/2”] and larger): Provide stem extension to allow 50 mm (2 inches) of pipe insulation without interfering with valve operation. MSS SP 67, flange lug type or grooved end rated 1205 kPa (175 psig) working pressure at 93 degrees C (200 degrees F). Valves shall be ANSI Leakage Class VI and rated for bubble tight shut-off to full valve pressure rating. Valve shall be rated for dead end service and bi-directional flow capability to full rated pressure. Not permitted for direct buried pipe applications.

2.11.5.2.1. Body: Cast iron, ASTM A126, Class B. Malleable iron, ASTM A47 electro-plated, or ductile iron, ASTM A536, Grade 65 45 12 electro-plated.

2.11.5.2.2. Trim: Bronze, aluminum bronze, or 300 series stainless steel disc, bronze bearings, 316 stainless steel shaft and manufacturer's recommended resilient seat. Resilient seat shall be field replaceable, and fully line the body to completely isolate the body from the product. A phosphate coated steel

shaft or stem is acceptable, if the stem is completely isolated from the product.

2.11.5.2.3. Actuators: Field interchangeable. Valves for balancing service shall have adjustable memory stop to limit open position.

2.11.5.2.4. Valves 150 mm (6 inches) and smaller: Lever actuator with minimum of seven locking positions, except where chain wheel is required.

2.11.5.2.5. Valves 200 mm (8 inches) and larger: Enclosed worm gear with handwheel, and where required, chain wheel operator.

2.11.5.3. Gate Valves (Contractor's Option in lieu of Ball or Butterfly Valves):

2.11.5.3.1. 50 mm (2 inches) and smaller: MSS SP 80, Bronze, 1034 kPa (150 psig), wedge disc, rising stem, union bonnet.

2.11.5.3.2. 65 mm (2 1/2 inches) and larger: Flanged, outside screw and yoke. MSS SP 70, iron body, bronze mounted, 861 kPa (125 psig) wedge disc.

2.11.5.4. Globe and Angle Valves

2.11.5.4.1. Globe Valves

- 50 mm (2 inches) and smaller: MSS SP 80, bronze, 1034 kPa (150 lb.) Globe valves shall be union bonnet with metal plug type disc.
- 65 mm (2 1/2 inches) and larger: 861 kPa (125 psig), flanged, iron body, bronze trim, MSS SP 85 for globe valves.

2.11.5.4.2. Angle Valves:

- 50 mm (2 inches) and smaller: MSS SP 80, bronze, 1034 kPa (150 lb.) Angle valves shall be union bonnet with metal plug type disc.
- 65 mm (2 1/2 inches) and larger: 861 kPa (125 psig), flanged, iron body, bronze trim, MSS SP 85 for angle.

2.11.5.4.3. Check Valves

- Swing Check Valves:
- 50 mm (2 inches) and smaller: MSS SP 80, bronze, 1034 kPa (150 lb.), 45 degree swing disc.
- 65 mm (2 1/2 inches) and larger: 861 kPa (125 psig), flanged, iron body, bronze trim, MSS SP 71 for check valves.
- Non Slam or Silent Check Valve: Spring loaded double disc swing check or internally guided flat disc lift type check for bubble tight shut off. Provide where check valves are shown in chilled water and hot water piping. Check valves incorporating a balancing feature may be used.

- Body: MSS-SP 125 cast iron, ASTM A126, Class B, or steel, ASTM A216, Class WCB, or ductile iron, ASTM 536, flanged, grooved, or wafer type.
- Seat, disc and spring: 18 8 stainless steel, or bronze, ASTM B62. Seats may be elastomer material.

2.11.5.4.4. Water Flow Balancing Valves: For flow regulation and shut off. Valves shall be line size rather than reduced to control valve size.

- Standard of Acceptance: Crane, Toyo, Kitz, RWV, Amstrong
-

- *General*

  Globe style valve.
  Provide a readout kit including flow meter, readout probes, hoses, flow charts or calculator, and carrying case.
  Standard of Acceptance: Armstrong CBV series, Taco, Tour and Anderson

- *Valves ½" to 2" diam*:

  Valves are to be of the 'Y' pattern, equal percentage globe-style and provide three functions: 1) Precise flow measurement, 2) Precision flow balancing, 3) Positive drip-tight shut-off.
  Valve shall provide multi-turn, 360° adjustment with micrometer type indicators located on the valve handwheel. Valves shall have a minimum of five full 360° handwheel turns. 90° 'circuit-setter' style ball valves are not acceptable. Valve handle shall have hidden memory feature, which will provide a means for locking the valve position after the system is balanced.
  Valves shall be furnished with precision machined venturi built into the valve body to provide highly accurate flow measurement and flow balancing. The venturi shall have two, ¼" threaded brass metering ports with check valves and gasketted caps located on the inlet side of the valve. Valves shall be furnished with flow smoothing fins downstream of the valve seat and integral to the forged valve body to make the flow more laminar. The valve body, stem and plug shall be brass. The handwheel shall be high-strength resin.

- *Valves 2-1/2" to 12" diam*:

Valves are to be of the 'Y' pattern, equal percentage globe-style and provide three functions: 1) Precise flow measurement, 2) Precision flow balancing, 3) Positive drip-tight shut-off.

Valve shall provide multi-turn, 360° adjustment with micrometer type indicators located on the valve handwheel. Valves shall have a minimum of five full 360° handwheel turns. 90° 'circuit-setter' style ball valves are not acceptable. Valve handle shall have hidden memory feature, which will provide a means for locking the valve position after the system is balanced.

Valves shall be furnished with precision machined venturi built into the valve body to provide highly accurate flow measurement and flow balancing. The venturi shall have two, ¼" threaded brass metering ports with check valves and gasketted caps located on the inlet side of the valve. Valves shall be furnished with flow smoothing fins downstream of the valve seat and integral to the forged valve body to make the flow more laminar. The valve body, stem and plug shall be brass. The handwheel shall be high-strength resin.

2.11.5.4.5. Automatic Balancing Control Valves:

- Use only where specifically approved by the consultant
- Factory calibrated to maintain constant flow (plus or minus five percent) over system pressure fluctuations of at least 10 times the minimum required for control. Provide standard pressure taps and four sets of capacity charts. Valves shall be line size and be one of the following designs:
- Gray iron (ASTM A126) or brass body rated 1205 kPa (175 psig) at 93 degrees C (200 degrees F), with stainless steel piston and spring.
- Brass or ferrous body designed for 2067 kPa (300 psig) service at 121 degrees C (250 degrees F), with corrosion resistant, tamper proof, self cleaning piston/spring assembly that is easily removable for inspection or replacement.
- Provide a readout kit including flow meter, probes, hoses, flow charts and carrying case.
- Standard of Acceptance: Kitz, RWV

2.11.5.4.6. Manual Radiator/Convector Valves: Brass, packless, with position indicator.

2.12. **WATER FLOW MEASURING DEVICES**

2.12.1. Minimum overall accuracy plus or minus three percent over a range of 70 to 110 percent of design flow. Select devices for not less than 110 percent of design flow rate.

2.12.2. Venturi Type: Bronze, steel, or cast iron with bronze throat, with valved pressure sensing taps upstream and at the throat.

2.12.3. Wafer Type Circuit Sensor: Cast iron wafer type flow meter equipped with readout valves to facilitate the connecting of a differential pressure meter. Each readout valve shall be fitted with an integral check valve designed to minimize system fluid loss during the monitoring process.

2.12.4. Self Averaging Annular Sensor Type: Brass or stainless steel metering tube, shutoff valves and quick coupling pressure connections. Metering tube shall be rotatable so all sensing ports may be pointed down stream when unit is not in use.

2.12.5. Flow Measuring Device Identification:

2.12.5.1. Metal tag attached by chain to the device.

2.12.5.2. Include meter or equipment number, manufacturer's name, meter model, flow rate factor and design flow rate in l/m (gpm).

2.12.5.3. Permanently Mounted Water Flow Indicating Meters: Minimum 150 mm (6 inch) diameter, or 450 mm (18 inch) long scale, for 120 percent of design flow rate, direct reading in lps (gpm), with three valve manifold and two shut off valves.

2.13. **STRAINERS**

2.13.1. Basket or Y Type.

2.13.1.1. Screens: Bronze, monel metal or 18 8 stainless steel, free area not less than 2 1/2 times pipe area, with perforations as follows: 1.1 mm (0.045 inch) diameter perforations for 100 mm (4 inches) and larger: 3.2 mm (0.125 inch) diameter perforations.

2.13.1.2. Suction Diffusers: Specified in Section 23 21 23, HYDRONIC PUMPS.

2.14. **FLEXIBLE CONNECTORS FOR WATER SERVICE**

2.15. Refer to section 23 05 51

2.16. EXPANSION JOINTS

2.16.1. Factory built devices, inserted in the pipe lines, designed to absorb axial cyclical pipe movement which results from thermal expansion and contraction. This includes factory-built or field-fabricated guides located along the pipe lines to restrain lateral pipe motion and direct the axial pipe movement into the expansion joints.

2.16.2. Manufacturing Quality Assurance: Conform to Expansion Joints Manufacturers Association Standards.

2.16.3. Bellows Internally Pressurized Type:

2.16.3.1. Multiple corrugations of Type 304 or Type A240-321 stainless steel.
2.16.3.2. Internal stainless steel sleeve entire length of bellows.
2.16.3.3. External cast iron equalizing rings for services exceeding 340 kPa (50 psig).
2.16.3.4. Welded ends.
2.16.3.5. Design shall conform to standards of EJMA and ASME B31.1.
2.16.3.6. External tie rods designed to withstand pressure thrust force upon anchor failure if one or both anchors for the joint are at change in direction of pipeline.
2.16.3.7. Integral external cover.

2.16.4. Bellows Externally Pressurized Type:

2.16.4.1. Multiple corrugations of Type 304 stainless steel.
2.16.4.2. Internal and external guide integral with joint.
2.16.4.3. Design for external pressurization of bellows to eliminate squirm.
2.16.4.4. Welded ends.
2.16.4.5. Conform to the standards of EJMA and ASME B31.1.
2.16.4.6. Threaded connection at bottom, 25 mm (one inch) minimum, for drain or drip point.
2.16.4.7. Integral external cover and internal sleeve.

2.16.5. Expansion Compensators:

2.16.5.1. Corrugated bellows, externally pressurized, stainless steel or bronze.
2.16.5.2. Internal guides and anti torque devices.
2.16.5.3. Threaded ends.
2.16.5.4. External shroud.
2.16.5.5. Conform to standards of EJMA.

2.16.6. Expansion Joint Identification: Provide stamped brass or stainless steel nameplate on each expansion joint listing the manufacturer, the allowable movement, flow direction, design pressure and temperature, date of manufacture, and identifying the expansion joint by the identification number on the contract drawings.

2.16.7. Guides: Provide factory-built guides along the pipe line to permit axial movement only and to restrain lateral and angular movement. Guides must be designed to withstand a minimum of 15 percent of the axial force which will be imposed on the expansion joints and anchors. Field-built guides may be used if detailed on the contract drawings.

2.16.8. Supports: Provide saddle supports and frame or hangers for heat exchanger. Mounting height shall be adjusted to facilitate gravity return of steam condensate. Construct supports from steel, weld joints.

2.17. **HEAT EXCHANGER FOR HVAC SERVICE (FLUID TO FLUID OR STEAM TO FLUID):**

2.17.1. General

2.17.1.1. Performance: As scheduled on drawings.
2.17.1.2. Provide thermometers, wells and temperature and pressure indicating gauges in supply and return piping at the hot and cold side connections of the exchanger.
2.17.1.3. Piping connections 2” and smaller to be carbon steel NPT tappings. Piping connections 4” and larger to be studded port design to accept ANSI flange connections. Connection ports to be integral to the frame or pressure plate.
2.17.1.4. Insulate the heat exchanger frame and plate shroud as required to prevent condensation on cold surfaces.
2.17.1.5. Mount on concrete pads min 100 mm (4”) high.
2.17.1.6. Pipe relief valves to nearest floor drains.
2.17.1.7. Pipe drain and vent valves to nearest floor drain.
2.17.1.8. Standard of Acceptance: Armstrong, Alfa Laval
2.17.1.9. Nameplates

2.17.1.9.1. Each exchanger shall have a stainless steel nameplate permanently attached to the frame. The nameplate shall be mounted off the surface of the heat exchanger to permit the application of 2-inch thick insulation.
2.17.1.9.2. Nameplate brackets shall be fabricated from thermally nonconductive materials to eliminate sweating.
2.17.1.9.3. The nameplate shall include as a minimum, the following data stamped on the face of the nameplate

- Project name.
- Equipment designation.

- Year manufactured.
- Hot and cold side design.
- Temperatures.
- Working pressures.
- Design flow rates.
- Pressure differentials at design flow rates.

2.17.2. Shell And Tube Type Heat Exchnager

2.17.2.1. Conform to ANSI/ASME Boilers and Pressure Vessels Code Section VIII, Division 1 for design and fabrication of pressure vessels for manufacture of tubular heat exchangers and heat exchanger shells.

2.17.2.2. U-bend removable tube bundle, heating fluid in shell, heated fluid in tubes, equipped with support cradles.

2.17.2.3. Maximum tube velocity: 2.3 m/s (7.5 feet per second).

2.17.2.4. Tube fouling factor: TEMA Standards, but not less than 0.001.

2.17.2.5. Materials:

2.17.2.5.1. Shell: Steel.
2.17.2.5.2. Tube sheet and tube supports: Steel or brass.
2.17.2.5.3. Tubes: 20 mm (3/4 inch) OD copper.
2.17.2.5.4. Head or bonnet: Cast iron or steel.

2.17.2.6. Construction: In accordance with ASME Pressure Vessel Code for 861 kPa (125 psig) working pressure for shell and tubes. Provide manufacturer's certified data report,

2.17.3. Plate and Frame Heat Exchanger

2.17.3.1. ASME Certification: The complete assembly shall be factory assembled and tested in accordance with ASME Code, Section VIII, Division I, and furnished with ASME Code Certification (VI Form) for design pressures as specified in this Section.

2.17.3.2. Fixed frame with bolted removable corrugated channel plate assembly, ASME code stamped for 150 psig working pressure.

2.17.3.3. Provide Type 316 stainless steel heat transfer plates with herringbone corrugations designed to provide support to adjacent plates to allow pressurization of each circuit to a full differential with no pressure on the adjacent plate channels without deformation of the heat transfer plates.

2.17.3.4. Channel plate ports to be double gasketed to prevent mixing or cross-contamination of hot side and cold side fluids.

2.17.3.5. Gaskets

2.17.3.5.1. Gaskets shall be one piece molded nitrile (NRB) rubber compatible with the fluid shown on the plan and schedule and suitable for working temperature up to 250 degrees F. Gaskets shall fit around the heat transfer area and the port holes without the need for glue or adhesive.

2.17.3.5.2. Gasket shall be permanently marked to indentify quality and material.

2.17.3.5.3. Gasket to have reliving grooves in the double gasketed areas to prevent any cross-contamination between the hot and cold fluids and cause leak to flow outside of unit.

2.17.3.5.4. Channel plate carrying bars to be carbon steel with zinc yellow chromate finish.

2.17.3.6. Fixed frame plates and moveable pressure plates to be corrosion resistant epoxy painted carbon steel.

2.17.3.7. Bolts

2.17.3.7.1. Compression bolts shall not require the special tools and shall be equipped with lock washers at the movable cover to facilitate opening and closing of a unit from the fixed cover.

2.17.3.7.2. Compression bolts shall be equipped with captive nuts at the fixed cover and threaded nuts at the removable cover. Welding of the nuts to the closure bolt is prohibited.

2.17.3.7.3. Compression bolts shall be high tensile strength carbon steel. Both the fixed and free nuts shall be heavy duty carbon steel. The nuts and washers shall be cadmium plated and the bolts shall be coated with molybdenum grease for rust protection. Provide plastic sleeve to protect bolts.

2.17.3.7.4. Bolts shall be provided with rolled threads to reduce galling and double-width hex nuts to distribute the load, plus ball bearing box washers at all critical closing bolts on all units greater than 50” in height.

2.17.3.8. Finished units to be provided with OSHA required, formed aluminum splash guards to enclose exterior channel plate and gasket surfaces

2.17.3.9. Provide two sets of replacement gaskets and provide one set of wrenches for disassembly of plate type heat exchangers.

2.18. HYDRONIC SYSTEM COMPONENTS

2.18.1. Air Purger: Cast iron or fabricated steel, 861 kPa (125 psig) water working pressure, for in line installation.

2.18.2. Tangential Air Separator: ASME Pressure Vessel Code construction for 861 kPa (125 psig) working pressure, flanged tangential inlet and outlet connection, internal perforated stainless steel air collector tube designed to direct released air into expansion tank, bottom blowdown connection. Provide a removable stainless steel strainer element having 5 mm (3/16 inch) perforations and free area of not less than five times the cross sectional area of connecting piping.

2.18.3. Diaphragm Type Expansion Tank: Full acceptance type, ASME Pressure Vessel Code construction for 861 kPa (125 psig) working pressure, welded steel shell, rust proof coated, with a flexible elastomeric diaphragm suitable for a maximum operating temperature of 116 degrees C (240 degrees F). Tank shall be equipped with system connection, drain connection, standard air fill valve and be factory pre charged to a minimum of 83 kPa (12 psig).

2.18.4. Pressure Reducing Valve (Water): Diaphragm or bellows operated, spring loaded type, with minimum adjustable range of 28 kPa (4 psig) above and below set point. Bronze, brass or iron body and bronze, brass or stainless steel trim, rated 861 kPa (125 psig) working pressure at 107 degrees C (225 degrees F).

2.18.5. Pressure Relief Valve: Bronze or iron body and bronze or stainless steel trim, with testing lever. Comply with ASME Code for Pressure Vessels, Section 8, and bear ASME stamp.

2.18.6. Automatic Air Vent Valves: Automatic air vent should be used only on air separators and similar applications in mechanical rooms. When used, pipe outlet to floor drain to prevent damage from leaks. Cast iron or semi steel body, 1034 kPa (150 psig) working pressure, stainless steel float, valve, valve seat and mechanism, minimum 15 mm (1/2 inch) water connection and 6 mm (1/4 inch) air outlet. Air outlet shall be piped to the nearest floor drain.

2.18.7. Radiator/Convector Automatic Air Vent: provide automatic air venting for hot or cold water distribution systems at terminal equipment (convectors/radiators). The vent valve

utilizes a float to actuate the valve plug which is located at the top of the valve. Once the air is displaced and the system pressure is sustained, the valve plug seals and prevents any water from escaping from the system. The float vent can also operate as an anti-vacuum device since it will permit air to enter the system when it must be drained. It can also be installed to permit the separation and dispersal of air while fluid is actually circulating in the system.

2.18.7.1. Features

2.18.7.1.1. Body and cover are brass construction
2.18.7.1.2. Air vent with silicone rubber seal
2.18.7.1.3. Impurities do not usually affect function as maximum float line of water is always lower than the valve seal
2.18.7.1.4. Float is high temperature resistant polyethylene
2.18.7.1.5. Suitable for use with glycol systems
2.18.7.1.6. Can be disassembled for inspection and cleaning

2.18.7.2. Pressure – Temperature
2.18.7.2.1. Minimum working pressure: 1.45psi (10 kPa)
2.18.7.2.2. Maximum working pressure: 150psi (10 bar)
2.18.7.2.3. Temperature Range: 33˚F – 240˚F (5˚C – 116˚C)

2.18.7.3. Standard of Acceptance: Watts Series FV-4M1

2.19. GLYCOL FILL TANK

2.19.1. Glycol auto fill unit complete with expansion tank to control and provide expansion and maintain the glycol system pressure by providing glycol make-up automatically upon a drop in system pressure

2.19.2. Construction

2.19.2.1. Polypropylene Tank 200 liter (53 gallon) capacity
2.19.2.2. Pump construction: all bronze
2.19.2.3. Water fill connection: ball valve - 304 SS ball, brass body
2.19.2.4. Glycol fill connection: ball valve - 304 SS ball, brass body
2.19.2.5. Contacts for BAS remote indication for: high level/low level/pump run

2.19.3. The glycol autofill shall be provided with the following standard features:

2.19.3.1. The unit shall monitor and maintain the minimum system pressure at all times
2.19.3.2. Low mixture cut-out level switches shall monitor the status of the mixing tank

2.19.3.3. Level switches shall be 24 volt maximum to ensure intrinsic electrical safety
2.19.3.4. Pump suction isolation valve
2.19.3.5. Pump suction strainer
2.19.3.6. Single phase power connection
2.19.3.7. 45 psi (300 kPa) fill pressure

2.19.4. Standard of Acceptance: Armstrong GLA Series

2.20. WATER FILTERS AND POT CHEMICAL FEEDERS

2.20.1. See section 23 25 00, HVAC WATER TREATMENT

2.21. GAGES, TEMPERATURE, PRESSURE AND COMPOUND

2.21.1. See section 23 05 11 COMMON WORK RESULTS FOR HVAC

2.21.2. Provide brass lever handle union cock. Provide brass/bronze pressure snubber for gages in water service.

2.21.3. Range of Gages: Provide range equal to at least 150 percent of normal operating range.

2.22. PRESSURE/TEMPERATURE TEST PROVISIONS

2.22.1. Pete's Plug: 6 mm (1/4 inch) MPT by 75 mm (3 inches) long, brass body and cap, with retained safety cap, nordelself closing valve cores, permanently installed in piping where shown, or in lieu of pressure gage test connections shown on the drawings.

2.23. FIRESTOPPING MATERIAL

2.23.1. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC

2.24. ELECTRICAL HEAT TRACING SYSTEMS

2.24.1. Systems shall meet requirements of the National Electrical Code (NEC), Section 427.
2.24.2. Provide tracing for outdoor piping subject to freezing temperatures (Below 38 degrees F) as follows:

2.24.2.1. Heat tracing shall be provided to the extent shown on the drawings (Floor plans and Elevations). Heat tracing shall extend below grade to below the defined frost line.

2.24.2.2. Heating Cable: Flexible, parallel circuit construction consisting of a continuous self-limiting resistance, conductive inner core material between two parallel copper bus wires, designed for cut to length at the job site and for wrapping around valves and complex fittings. Self-regulation shall prevent overheating and burnouts even where the cable overlaps itself.

2.24.2.3. Provide end seals at ends of circuits. Wire at the ends of the circuits is not to be tied together.

2.24.2.4. Provide sufficient cable, as recommended by the manufacturer, to keep the pipe surface at 2.2 degrees C (36 degrees F) minimum during winter outdoor design temperature, but not less than the following:

2.24.2.5. 75 mm (3 inch) pipe and smaller with 25 mm (1 inch) thick insulation: 4 watts per foot of pipe.

2.24.2.6. 100 mm (4 inch)pipe and larger 38 mm (1 1/2 inch) thick insulation: 8 watts per feet of pipe.

2.24.3. Electrical Heating Tracing Accessories:

2.24.3.1. Power supply connection fitting and stainless steel mounting brackets. Provide stainless steel worm gear clamp to fasten bracket to pipe.

2.24.3.2. 13 mm (1/2 inch) wide fiberglass reinforced pressure sensitive cloth tape to fasten cable to pipe at 300 mm (12 inch) intervals.

2.24.3.3. Pipe surface temperature control thermostat: Cast aluminum, NEMA 4 (watertight) enclosure, 13 mm (1/2 inch) NPT conduit hub, SPST switch rated 20 amps at 480 volts AC, with capillary and copper bulb sensor. Set thermostat to maintain pipe surface temperature at not less than 1.1 degrees C (34 degrees F).

2.24.3.4. Signs: Manufacturer's standard (NEC Code), stamped "ELECTRIC TRACED" located on the insulation jacket at 3000 mm (10 feet) intervals along the pipe on alternating sides.

PART 3 - EXECUTION

3.1. GENERAL

3.1.1. The drawings show the general arrangement of pipe and equipment but do not show all required fittings and offsets that may be necessary to connect pipes to equipment, fan-coils, coils, radiators, etc., and to coordinate with other trades. Provide all necessary fittings, offsets and pipe runs based on field measurements and at no additional cost to the government. Coordinate with other trades for space available and relative location of HVAC equipment and accessories to be connected on ceiling grid. Pipe location on the drawings shall be altered by contractor where necessary to avoid interferences and clearance difficulties.

3.1.2. Store materials to avoid excessive exposure to weather or foreign materials. Keep inside of piping relatively clean during installation and protect open ends when work is not in progress.

3.1.3. Support piping securely. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

3.1.4. Install piping generally parallel to walls and column center lines, unless shown otherwise on the drawings. Space piping, including insulation, to provide 25 mm (one inch) minimum clearance between adjacent piping or other surface. Unless shown otherwise, slope drain piping down in the direction of flow not less than 25 mm (one inch) in 12 m (40 feet). Provide eccentric reducers to keep bottom of sloped piping flat.

3.1.5. Locate and orient valves to permit proper operation and access for maintenance of packing, seat and disc. Generally locate valve stems in overhead piping in horizontal position. Provide a union adjacent to one end of all threaded end valves. Control valves usually require reducers to connect to pipe sizes shown on the drawing. Install butterfly valves with the valve open as recommended by the manufacturer to prevent binding of the disc in the seat.

3.1.6. Offset equipment connections to allow valving off for maintenance and repair with minimal removal of piping. Provide flexibility in equipment connections and branch line take offs with 3 elbow swing joints where noted on the drawings.

3.1.7. Tee water piping runouts or branches into the side of mains or other branches. Avoid bull-head tees, which are two return lines entering opposite ends of a tee and exiting out the common side.

3.1.8. Provide manual or automatic air vent at all piping system high points and drain valves at all low points. Install piping to floor drains from all automatic air vents.

3.1.9. Connect piping to equipment as shown on the drawings and as recommended by the manufacturer.

3.1.10. . Install components furnished by others such as:

3.1.10.1. Water treatment pot feeders and condenser water treatment systems.

3.1.10.2. Flow elements (orifice unions), control valve bodies, flow switches, pressure taps with valve, and wells for sensors.

3.1.10.3. Thermometer Wells: In pipes 65 mm (2 1/2 inches) and smaller increase the pipe size to provide free area equal to the upstream pipe area.

3.1.11. Firestopping: Fill openings around uninsulated piping penetrating floors or fire walls, with firestop material. For firestopping insulated piping refer to Section 23 07 11, INSULATION – HVAC SYSTEMS.

3.1.12. Where copper piping is connected to steel piping, provide dielectric connections.

3.2. **PIPE JOINTS**

3.2.1. Welded: Beveling, spacing and other details shall conform to ASME B31.1 and AWS B2.1. See Welder's qualification requirements under "Quality Assurance" in Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM GENERATION.

3.2.2. Screwed: Threads shall conform to ASME B1.20; joint compound shall be applied to male threads only and joints made up so no more than three threads show. Coat exposed threads on steel pipe with joint compound, or red lead paint for corrosion protection.

3.2.3. 125 Pound Cast Iron Flange (Plain Face): Mating flange shall have raised face, if any, removed to avoid overstressing the cast iron flange.

3.2.4. Solvent Welded Joints: As recommended by the manufacturer.

3.3. **EXPANSION JOINTS (BELLOWS AND SLIP TYPE)**

3.3.1. Anchors and Guides: Provide type, quantity and spacing as recommended by manufacturer of expansion joint and as shown. A professional engineer shall verify in writing that anchors and guides are properly designed for forces and moments which will be imposed.

3.3.2. Cold Set: Provide setting of joint travel at installation as recommended by the manufacturer for the ambient temperature during the installation.

3.3.3. Preparation for Service: Remove all apparatus provided to restrain joint during shipping or installation. Representative of manufacturer shall visit the site and verify that installation is proper.

3.3.4. Access: Expansion joints must be located in readily accessible space. Locate joints to permit access without removing piping or other devices. Allow clear space to permit replacement of joints and to permit access to devices for inspection of all surfaces and for adding.

3.4. **BRAZING**

3.4.1. Flux shall not be allowed to penetrate to the inside of the pipe. The outside of the tube and fittings shall be cleaned by washing with hot water in order to remove any residual flux.

3.4.2. During the brazing of the pipe connections, except when performing final connections and emergency repairs, the interior of the pipe shall be maintained with a nitrogen atmosphere. This shall be done by purging the pipe a sufficient number of times to remove all air and oxygen and by maintaining a small purge flow to prevent reentry of

3.5. **LEAK TESTING ABOVEGROUND PIPING**

3.5.1. Inspect all joints and connections for leaks and workmanship and make corrections as necessary, to the satisfaction of the Resident Engineer. Tests may be either of those below, or a combination, as approved by the Resident Engineer.

3.5.2. An operating test at design pressure, and for hot systems, design maximum temperature.

3.5.3. A hydrostatic test at 1.5 times design pressure. For water systems the design maximum pressure would usually be the static head, or expansion tank maximum pressure, plus pump head. Factory tested equipment (convertors, exchangers, coils, etc.) need not be field tested. Isolate equipment where necessary to avoid excessive pressure on mechanical seals and safety devices.

3.6. **FLUSHING AND CLEANING PIPING SYSTEMS**

3.6.1. Water Piping: Clean systems as recommended by the suppliers of chemicals specified in Section 23 25 00, HVAC WATER TREATMENT.

3.6.2. Initial flushing: Remove loose dirt, mill scale, metal chips, weld beads, rust, and like deleterious substances without damage to any system component. Provide temporary piping or hose to bypass coils, control valves, exchangers and other factory cleaned equipment unless acceptable means of protection are provided and subsequent inspection of hide out areas takes place. Isolate or protect clean system components, including pumps and pressure vessels, and remove any component which may be

damaged. Open all valves, drains, vents and strainers at all system levels. Remove plugs, caps, spool pieces, and components to facilitate early debris discharge from system. Sectionalize system to obtain debris carrying velocity of 1.8 m/S (6 feet per second), if possible. Connect dead end supply and return headers as necessary. Flush bottoms of risers. Install temporary strainers where necessary to protect down stream equipment. Supply and remove flushing water and drainage by various type hose, temporary and permanent piping and Contractor's booster pumps. Flush until clean as approved by the Resident Engineer.

3.6.3. Cleaning: Using products supplied in Section 23 25 00, HVAC WATER TREATMENT, circulate systems at normal temperature to remove adherent organic soil, hydrocarbons, flux, pipe mill varnish, pipe joint compounds, iron oxide, and like deleterious substances not removed by flushing, without chemical or mechanical damage to any system component. Removal of tightly adherent mill scale is not required. Keep isolated equipment which is "clean" and where dead end debris accumulation cannot occur. Sectionalize system if possible, to circulate at velocities not less than 1.8 m/S (6 feet per second). Circulate each section for not less than four hours. Blow down all strainers, or remove and clean as frequently as necessary. Drain and prepare for final flushing.

3.6.4. Final Flushing: Return systems to conditions required by initial flushing after all cleaning solution has been displaced by clean make up. Flush all dead ends and isolated clean equipment. Gently operate all valves to dislodge any debris in valve body by throttling velocity. Flush for not less than one hour.

3.7. **WATER TREATMENT**

3.7.1. Install water treatment equipment and provide water treatment system piping.

3.7.2. Close and fill system as soon as possible after final flushing to minimize corrosion.

3.7.3. Charge systems with chemicals specified in Section 23 25 00, HVAC WATER TREATMENT.

3.7.4. Utilize this activity, by arrangement with the Resident Engineer, for instructing VA operating personnel.

3.8. **ELECTRIC HEAT TRACING**

3.8.1. Install tracing as recommended by the manufacturer.

3.8.2. Coordinate electrical connections.

3.9. **OPERATING AND PERFORMANCE TEST AND INSTRUCTION**

3.9.1. Refer to PART 3, Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

3.9.2. Adjust red set hand on pressure gages to normal working pressure.

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PART 1 - GENERAL

1.1. DESCRIPTION

1.1.1. Refrigerating system: Combination of interconnected refrigerant containing parts constituting one closed refrigeration circuit in which a refrigerant is circulated for the purpose of extracting heat.

1.1.2. Low side means the parts of a refrigerating system subjected to evaporator pressure.

1.1.3. High side means the parts of a refrigerating system subjected to condenser pressure.

1.1.4. Brazed joint: A gas tight joint obtained by the joining of metal parts with alloys which melt at temperatures higher than 449 degrees C (840 degrees F) but less than the melting temperatures of the joined parts.

1.2. RELATED WORK

1.2.1. Section 01 33 23, SHOP DRAWINGS.
1.2.2. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

1.3. QUALITY ASSURANCE

1.3.1. Refer to specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

1.3.2. Comply with ASHRAE Standard 15, Safety Code for Mechanical Refrigeration. The application of this Code is intended to assure the safe design, construction, installation, operation, and inspection of every refrigerating system employing a fluid which normally is vaporized and liquefied in its refrigerating cycle.

1.3.3. Comply with ASME B31.5: Refrigerant Piping and Heat Transfer Components.

1.3.4. Products shall comply with UL 207 "Refrigerant–Containing Components and Accessories, "Nonelectrical"; or UL 429 "Electrical Operated Valves."

1.4. SUBMITTALS

1.4.1. Submit in accordance with specification Section 01 33 23, SHOP DRAWINGS.

1.4.2. Shop Drawings:

1.4.2.1. Complete information for components noted, including valves and refrigerant piping accessories, clearly presented, shall be included to determine compliance with drawings and specifications for components noted below:

1.4.2.1.1. Tubing and fittings
1.4.2.1.2. Valves
1.4.2.1.3. Strainers
1.4.2.1.4. Moisture liquid indicators
1.4.2.1.5. Filter driers
1.4.2.1.6. Flexible metal hose
1.4.2.1.7. Liquid suction interchanges
1.4.2.1.8. Oil separators (when specified)
1.4.2.1.9. Gages
1.4.2.1.10. Pipe and equipment supports
1.4.2.1.11. Refrigerant and oil
1.4.2.1.12. Pipe/conduit roof penetration cover
1.4.2.1.13. Soldering and brazing materials

1.4.2.2. Layout of refrigerant piping and accessories, including flow capacities, valves locations, and oil traps slopes of horizontal runs, floor/wall penetrations, and equipment connection details.

1.4.2.3. Refrigerant piping shall be sized, selected, and designed either by the equipment manufacturer or in strict accordance with the manufacturer's published instructions. The schematic piping diagram shall show all accessories such as, stop valves, level indicators, liquid receivers, oil separator, gauges, thermostatic expansion valves, solenoid valves, moisture separators and driers to make a complete installation.

1.4.2.4. Design Manual: Furnish two copies of design manual of refrigerant valves and accessories.

1.5. **APPLICABLE PUBLICATIONS**

1.5.1. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

1.5.2. Air Conditioning, Heating, and Refrigeration Institute (ARI/AHRI):

1.5.2.1. 495-1999 (R2002) Standard for Refrigerant Liquid Receivers
1.5.2.2. 730-2005 Flow Capacity Rating of Suction-Line Filters and Suction-Line Filter-Driers
1.5.2.3. 750-2007 Thermostatic Refrigerant Expansion Valves
1.5.2.4. 760 2007 Performance Rating of Solenoid Valves for Use with Volatile Refrigerants

1.5.3. American Society of Heating Refrigerating and Air Conditioning Engineers (ASHRAE):

1.5.3.1. ANSI/ASHRAE 15 2007 Safety Standard for Refrigeration Systems (ANSI)
1.5.3.2. ANSI/ASHRAE 17 2008 Method of Testing Capacity of Thermostatic Refrigerant Expansion Valves (ANSI)
1.5.3.3. 63.1-95 (RA 01) Method of Testing Liquid Line Refrigerant Driers (ANSI)

1.5.4. American National Standards Institute (ANSI):

1.5.4.1. ASME (ANSI)A13.1-2007 Scheme for Identification of Piping Systems
1.5.4.2. Z535.1-2006 Safety Color Code

1.5.5. American Society of Mechanical Engineers (ASME):

1.5.5.1. ANSI/ASME B16.22 2001 (R2005)
1.5.5.2. Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings (ANSI)
1.5.5.3. ANSI/ASME B16.24 2006 Cast Copper Alloy Pipe Flanges and Flanged Fittings, Class 150, 300, 400, 600, 900, 1500 and 2500 (ANSI)
1.5.5.4. ANSI/ASME B31.5-2006 Refrigeration Piping and Heat Transfer Components (ANSI)
1.5.5.5. ANSI/ASME B40.100-2005 Pressure Gauges and Gauge Attachments
1.5.5.6. ANSI/ASME B40.200-2008 Thermometers, Direct Reading and Remote Reading

1.5.6. American Society for Testing and Materials (ASTM)

1.5.6.1. B88 03 Standard Specification for Seamless Copper Water Tube
1.5.6.2. B88M-05 Standard Specification for Seamless Copper Water Tube (Metric)
1.5.6.3. B280 08 Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service

1.5.7. Underwriters Laboratories (U.L.):

1.5.7.1. U.L.207-2009 Standard for Refrigerant-Containing Components and Accessories, Nonelectrical

1.5.7.2. U.L.429-99 (Rev.2006) Standard for Electrically Operated Valves

PART 2 - PRODUCTS

2.1. **PIPING AND FITTINGS**

2.1.1. Refrigerant Piping: For piping up to 100 mm (4 inch) use Copper refrigerant tube, ASTM B280, cleaned, dehydrated and sealed, marked ACR on hard temper straight lengths. Coils shall be tagged ASTM B280 by the manufacturer. For piping over 100 mm (4 inch) use A53 Black SML steel.

2.1.2. Fittings, Valves and Accessories:

2.1.2.1. Copper fittings: Wrought copper fittings, ASME B16.22.

2.1.2.2. Brazed Joints, refrigerant tubing: Cadmium free, AWS A5.8/A5.8M, 45 percent silver brazing alloy, Class BAg-5.

2.1.2.3. Solder Joints, water and drain: 95 5 tin antimony, ASTM B32 (95TA).

2.1.2.4. Refrigerant piping – Welded Joints.

2.1.2.5. Flanges and flanged fittings: ASME B16.24.

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2.1.3. Flexible connectors

2.1.3.1. Install at all locations where refrigerant piping is connected to equipment containing moving or rotating parts (compressors, supply fans, condenser fans, etc)

2.1.3.2. Also refer to section 23 05 51

2.2. **REFRIGERATION VALVES:**

2.2.1. Stop Valves:

2.2.1.1. Brass or bronze alloy, packless, or packed type with gas tight cap, frost proof, back seating.

2.2.2. Pressure Relief Valves:

2.2.2.1. Comply with ASME Boiler and Pressure Vessel Code; UL listed. Forged brass with nonferrous, corrosion resistant internal working parts of high strength, cast iron bodies conforming to ASTM A126, Grade B. Set valves in accordance with ASHRAE Standard 15.

2.2.3. Solenoid Valves:

2.2.3.1. UL-listed, 250 deg. F temperature rating, 400 psig working pressure; forged brass, with Teflon valve seat, two-way straight through pattern, and solder end connections. Provide manual operator to open valve. Furnish complete with NEMA 1 solenoid enclosure with ½ inch conduit adapter, holding coil, voltage to meet controls requirements.

2.2.3.2. Comply with ARI 760 and UL 429, UL-listed, two-position, direct acting or pilot-operated, moisture and vapor proof type of corrosion resisting materials, designed for intended service, and solder-end connections. Fitted with suitable NEMA 250 enclosure of type required by location and normally open or closed holding coil (as specified)

2.2.4. Thermostatic Expansion Valves:

2.2.4.1. Comply with ARI 750. Brass body with stainless-steel or non-corrosive non ferrous internal parts, diaphragm and spring-loaded (direct-operated) type with sensing bulb and distributor having side connection for hot-gas bypass and external equalizer. Size and operating characteristics as recommended by manufacturer of evaporator and factory set for superheat requirements. Solder-end connections. Testing and rating in accordance with ASHRAE Standard 17.

2.2.5. Check Valves:

2.2.5.1. Brass or bronze alloy with swing or lift type, with tight closing resilient seals for silent operation; designed for low pressure drop, and with solder-end

connections. Direction of flow shall be legibly and permanently indicated on the valve body.

2.2.6. Strainers:

2.2.6.1. Designed to permit removing screen without removing strainer from piping system, and provided with screens 80 to 100 mesh in liquid lines DN 25 (NPS 1) and smaller, 60 mesh in liquid lines larger than DN 25 (NPS 1), and 40 mesh in suction lines. Provide strainers in liquid line serving each thermostatic expansion valve, and in suction line serving each refrigerant compressor not equipped with integral strainer.

2.2.7. Refrigerant Moisture/Liquid Indicators:

2.2.7.1. Double ported type having heavy sight glasses sealed into forged bronze body and incorporating means of indicating refrigerant charge and moisture indication. Provide screwed brass seal caps.

2.2.8. Refrigerant Filter Dryers:

2.2.8.1. UL listed, angle or in line type, as shown on drawings. Conform to ARI Standard 730 and ASHRAE Standard 63.1. Heavy gage steel shell protected with corrosion-resistant paint; perforated baffle plates to prevent desiccant bypass. Size as recommended by manufacturer for service and capacity of system with connection not less than the line size in which installed. Filter driers with replaceable filters shall be furnished with one spare element of each type and size.

2.2.9. Flexible Metal Hose:

2.2.9.1. Seamless bronze corrugated hose, covered with bronze wire braid, with standard copper tube ends. Provide in suction and discharge piping of each compressor and connections to air handling equipment. As manufactured by Anaconda or equal

2.2.10. Oil Separators:

2.2.10.1. Provide for condensing units, as shown. All welded steel construction with capacity to eliminate a minimum of 95 percent of the oil from the hot gas flowing through it. Provide manufacturer's published ratings for minimum and maximum refrigeration tonnage corresponding to this oil separating efficiency.

Separator shall be equipped with a float valve to prevent return of the hot gas to crankcase, and shall have isolating stop valves so it can be opened and services without pumping out any other part of the system. ASME construction or UL listed.

2.2.11. Receivers:

2.2.11.1. Conform to AHRI 495, steel construction, equipped with tappings for liquid inlet and outlet valves, pressure relief valve and liquid level indicator.

2.2.12. Standards of Acceptance for Refrigerant Valves and Specialties:

2.2.12.1. Emerson Electric, Danfoss, Henry Industries

2.3. **GAGES**

2.3.1. Temperature Gages: Comply with ASME B40.200. Industrial duty type and in required temperature range for service in which installed. Gages shall have Celsius scale in 1-degree (Fahrenheit scale in 2-degree) graduations and with black number on a white face. The pointer shall be adjustable. Rigid stem type temperature gages shall be provided in thermal wells located within 1525 mm (5 feet) of the finished floor. Universal adjustable angle type or remote element type temperature gages shall be provided in thermal wells located 1525 to 2135 mm (5 to 7 feet) above the finished floor. Remote element type temperature gages shall be provided in thermal wells located 2135 mm (7 feet) above the finished floor.

2.3.2. Vacuum and Pressure Gages: Comply with ASME B40.100 and provide with throttling type needle valve or a pulsation dampener and shut-off valve. Gage shall be a minimum of 90 mm (3-1/2 inches) in diameter with a range from 0 kPa (0 psig) to approximately 1.5 times the maximum system working pressure. Each gage range shall be selected so that at normal operating pressure, the needle is within the middle-third of the range.

2.3.3. Suction: 101 kPa (30 inches Hg) vacuum to 1723 kPa (gage) (250 psig).

2.3.4. Discharge: 0 to 3445 kPa (gage) (0 to 500 psig).

2.4. **PIPE SUPPORTS**

2.4.1. <u>Indoor supports</u>

2.4.1.1. Refer to specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

2.4.2. Outdoor supports

2.4.2.1. The roof block is an assembled product comprised of two major components including the support shell which is an one piece, UV resistant, thermoplastic injection molded Polypropylene Impact Copolymer and the Type 3, 20 psi extruded polystyrene non-marring base. The support shell is designed with an interior web creating eight symmetrical cavities. Design maximizes support strength while substantially reducing the overall weight. Interior cavities allow for expansion and contraction under extreme temperature conditions over its lifetime. The lower portion of the one piece support shell incorporates a ¾" high wall which reduces UV exposure to the extruded polystyrene base.

2.4.2.2. Straps: install 2-hole galvanized pipe straps, mounted to the roof block using fasteners available locally. Ensure that there is no direct contact between the copper refrigerant piping and the galvanized straps.

2.4.2.3. Standard of Acceptance: Miro Industries, Block-Ease, Portable Pipe Hangers. Min. height above roof: 150 mm.

2.5. **REFRIGERANTS AND OIL**

2.5.1. Provide EPA approved refrigerant and oil for proper system operation.

2.6. **PIPE INSULATION FOR DX HVAC SYSTEMS**

2.6.1. Application: all refrigerant suction lines, all hot gas discharge lines.

2.6.2. Insulation materials shall have a closed cell structure to prevent moisture from wicking which makes it an efficient insulation.

2.6.3. Insulation materials shall be manufactured without the use of CFC's, HFC's or HCFC's. It is also formaldehyde free, low VOCs, fiber free, dust free and resists mold and mildew.

2.6.4. Insulation materials shall have a flame-spread index of less than 25 and a smoke-developed index of less than 50 as tested in accordance with ASTM E 84. In addition, the products, when tested, shall not melt or drip flaming particles, and the flame shall not be progressive.

2.6.5. Insulation materials shall have a maximum thermal conductivity of 0.27 Btu-in./h-ft2-°F at a 75°F mean temperature as tested in accordance with ASTM C 177 or ASTM C 518.

2.6.6. Insulation materials shall have a maximum water vapor transmission of 0.08 perm-inches when tested in accordance with ASTM E 96, Procedure A.

2.6.7. Standard of Acceptance: Armaflex

2.6.8. Insulation shall be a flexible, closed-cell elastomeric pipe insulation: AP Armaflex, AC Accoflex. Adhesive shall be Armaflex 520, 520 Black or 520 BLV Adhesive. The insulation must conform to ASTM C534 Grade 1, Type I.

2.6.9. Sizes

2.6.9.1. Wall Thickness (nominal): 3/8”, 1/2”, 3/4”, 1”, 1-1/2”, 2” (10, 13, 19, 25, 38, 50mm)

2.6.9.2. Inside Diameter, Tubular: 3/8” ID to 10”ID (10mm ID to 250mm)

2.6.10. Specifications Compliance:

2.6.10.1. ASTM C 534, Type I — Grade 1
2.6.10.2. ASTM D 1056, 2B1
2.6.10.3. ASTM E 84, NFPA 255, UL723
2.6.10.4. ASTM G21/C1338
2.6.10.5. ASTM G22
2.6.10.6. CAN/ULC S102

2.6.11. Outdoor protection: ArmaFlex WB Finish – Latex-based, UV resistant protective coating for outdoor applications

2.6.12. Accessories

2.6.12.1. ArmaFlex 520 and 520 Black Adhesive – Air-drying, solvent-based contact adhesive for strong bonds and tight seams.
2.6.12.2. ArmaFlex BLV – Black Low VOC Air-drying, solvent-based contact adhesive
2.6.12.3. ArmaFlex Insulation Tape – black foam, pressure-sensitive seam tape
2.6.12.4. Armacell Fabricated Fittings – Made to order pre-fabricated fittings in Tees, Elbows, P-Traps and more
2.6.12.5. ArmaFix Insulation Pipe Hangers – Easy-to-use insulated pipe hanger supports that protect against compression, up to 1” wall thickness.

PART 3 - EXECUTION

3.1. **INSTALLATION**

3.1.1. Install refrigerant piping and refrigerant containing parts in accordance with ASHRAE Standard 15 and ASME B31.5

3.2. Install piping as short as possible, with a minimum number of joints, elbow and fittings.

3.2.1. Install piping with adequate clearance between pipe and adjacent walls and hangers to allow for service and inspection. Space piping, including insulation, to provide 25 mm (1 inch) minimum clearance between adjacent piping or other surface. Use pipe sleeves through walls, floors, and ceilings, sized to permit installation of pipes with full thickness insulation.

3.2.2. Locate and orient valves to permit proper operation and access for maintenance of packing, seat and disc. Generally locate valve stems in overhead piping in horizontal position. Provide a union adjacent to one end of all threaded end valves. Control valves usually require reducers to connect to pipe sizes shown on the drawing.

3.2.3. Install hangers and supports per ASME B31.5 and the refrigerant piping manufacturer's recommendations.

3.2.4. Slope refrigerant piping as follows:

3.3. Install horizontal hot gas discharge piping with 1/2" per 10 feet downward slope away from the compressor.

3.4. Install horizontal suction lines with 1/2 inch per 10 feet downward slope to the compressor, with no long traps or dead ends which may cause oil to separate from the suction gas and return to the compressor in damaging slugs.

3.5. Install traps and double risers where indicated, and where required to entrain oil in vertical runs.

3.6. Liquid lines may be installed level.

3.6.1. Install strainers immediately ahead of each expansion valve, solenoid valve, hot gas bypass valve, compressor suction valve, and as required to protect refrigerant piping system components.

3.6.2. Install moisture/liquid indicators in liquid lines between filter/driers and thermostatic expansion valves and in liquid line to receiver (where applicable).

3.6.3. Install unions to allow removal of solenoid valves, pressure regulating valves, expansion valves, and at connections to compressors and evaporators.

3.6.4. Joint Construction:

3.6.4.1. Brazed Joints: Comply with AWS "Brazing Handbook" and with filler materials complying with AWS A5.8/A5.8M.

3.6.4.2. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper tubing.

3.6.4.3. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.

3.6.4.4. Swab fittings and valves with manufacturer's recommended cleaning fluid to remove oil and other compounds prior to installation.

3.6.4.5. Pass nitrogen gas through the pipe or tubing to prevent oxidation as each joint is brazed. Cap the system with a reusable plug after each brazing operation to retain the nitrogen and prevent entrance of air and moisture.

3.6.4.6. Protect refrigerant system during construction against entrance of foreign matter, dirt and moisture; have open ends of piping and connections to compressors, condensers, evaporators and other equipment tightly capped until assembly.

3.6.4.7. Pipe relief valve discharge to outdoors for systems containing more than 45 kg (100 lbs) of refrigerant.

3.6.5. Firestopping: Fill openings around uninsulated piping penetrating floors or fire walls, with firestop material.

3.7. **PIPE AND TUBING INSULATION**

3.7.1. Insulate all suction piping, including traps

3.7.2. Outdoors: Apply two coats of weather resistant finish as recommended by the manufacturer to insulation exposed to outdoor weather.

3.7.3. Protect insulation at all support points; use galvanized metallic saddles.

3.8. **SIGNS AND IDENTIFICATION**

3.8.1. Each refrigerating system erected on the premises shall be provided with an easily legible permanent sign securely attached and easily accessible, indicating thereon the name and address of the installer, the kind and total number of pounds of refrigerant required in the system for normal operations, and the field test pressure applied.

3.8.2. Systems containing more than 50 kg (110 lb) of refrigerant shall be provided with durable signs, in accordance with ANSI A13.1 and ANSI Z535.1, having letters not less than 13 mm (1/2 inch) in height designating:

3.8.3. Valves and switches for controlling refrigerant flow, the ventilation and the refrigerant compressor(s).

3.8.4. Signs on all exposed high pressure and low pressure piping installed outside the machinery room, with name of the refrigerant and the letters "HP" or "LP."

3.9. **VALVE INSTALLATION**

3.9.1. General: Install refrigerant valves where indicated, and in accordance with manufacturer's instructions.

3.9.2. Install globe valves on each side of strainers and driers, in liquid and suction lines at evaporators, and elsewhere as indicated.

3.9.3. Install a full sized, 3-valve bypass around each drier.

3.9.4. Install solenoid valves ahead of each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at the top.

3.9.5. Coordinate electrical requirements and connections.

3.9.6. Thermostatic expansion valves may be mounted in any position, as close as possible to the evaporator.

3.9.7. Where refrigerant distributors are used, mount the distributor directly on the expansion valve outlet.

3.9.8. Install the valve in such a location so that the diaphragm case is warmer than the bulb. Verify proper location for bulb with valve manufacturer.

3.9.9. Secure the bulb to a clean, straight, horizontal section of the suction line using two bulb straps. Do not mount bulb in a trap or at the bottom of the line.

3.9.10. Where external equalizer lines are required make the connection where it will clearly reflect the pressure existing in the suction line at the bulb location.

3.9.11. Install pressure regulating and relieving valves as required by ASHRAE Standard 15.

3.10. **FIELD QUALITY CONTROL**

3.10.1. Prior to initial operation examine and inspect piping system for conformance to plans and specifications and ASME B31.5. Correct equipment, material, or work rejected because of defects or nonconformance with plans and specifications, and ANSI codes for pressure piping.

3.10.2. After completion of piping installation and prior to initial operation, conduct test on piping system according to ASME B31.5. Furnish materials and equipment required for tests. Perform tests in the presence of Resident Engineer. If the test fails, correct defects and perform the test again until it is satisfactorily done and all joints are proved tight.

3.10.3. Every refrigerant-containing parts of the system that is erected on the premises, except compressors, condensers, evaporators, safety devices, pressure gages, control mechanisms and systems that are factory tested, shall be tested and proved tight after complete installation, and before operation.

3.10.4. The high and low side of each system shall be tested and proved tight at not less than the lower of the design pressure or the setting of the pressure relief device protecting the high or low side of the system, respectively, except systems erected on the premises using non-toxic and non-flammable Group A1 refrigerants with copper tubing not exceeding DN 18 (NPS 5/8). This may be tested by means of the refrigerant charged into the system at the saturated vapor pressure of the refrigerant at 20 degrees C (68 degrees F) minimum.

3.10.5. Test Medium: A suitable dry gas such as nitrogen or shall be used for pressure testing. The means used to build up test pressure shall have either a pressure limiting device or pressure-reducing device with a pressure-relief device and a gage on the outlet side. The pressure relief device shall be set above the test pressure but low enough to prevent permanent deformation of the system components.

3.11. **SYSTEM TEST AND CHARGING**

3.11.1. Provide a full charge of refrigerant and oil, to suit the capacity of the system, including lengths of refrigerant piping and receivers. System Test and Charging: As recommended by the equipment manufacturer or as follows:

3.11.2. Connect a drum of refrigerant to charging connection and introduce enough refrigerant into system to raise the pressure to 70 kPa (10 psi) gage. Close valves and disconnect refrigerant drum. Test system for leaks with halide test torch or other approved method suitable for the test gas used. Repair all leaking joints and retest.

3.11.3. Connect a drum of dry nitrogen to charging valve and bring test pressure to design pressure for low side and for high side. Test entire system again for leaks.

3.11.4. Evacuate the entire refrigerant system by the triplicate evacuation method with a vacuum pump equipped with an electronic gage reading in mPa (microns). Pull the system down to 665 mPa (500 microns) 665 mPa (2245.6 inches of mercury at 60 degrees F) and hold for four hours then break the vacuum with dry nitrogen (or refrigerant). Repeat the evacuation two more times breaking the third vacuum with the refrigeration to be charged and charge with the proper volume of refrigerant.

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

1.1.1. Drawings and general provisions of the Contract, Standard General and Supplementary General Conditions, and other applicable Specification Sections.

1.2. SUMMARY

1.2.1. Products specified in this section include the following:

1.2.1.1. Chemical Inhibitors for Water and Glycol
1.2.1.2. Chemicals for Inhibitors and cleaning
1.2.1.3. Pot Feeder and Accessories
1.2.1.4. Filtration cartridge housing
1.2.1.5. Piping, fittings and Accessories
1.2.1.6. Glycol Feed System (where applicable to the project)

1.2.2. Provide a Chemical Services Provider (CSP) to perform the services described below.

1.2.3. Provide water treatment products and services including:

1.2.3.1. Chemicals for cleaning, passivation, and treatment of each system.
1.2.3.2. On-going treatment, chemicals, testing, certification, and reports to demonstrate effective water treatment is maintained at all times.
1.2.3.3. Start-up and operation of chemical treatment equipment.

1.2.4. Provide a complete chemical water treatment program during construction for all new and reused piping networks. This program shall begin from the point each system is filled during construction and extend until Substantial Completion or final Client acceptance of each system, whichever occurs later. The program shall include water analysis chemicals, testing equipment, consulting and service for the following systems:

1.2.4.1. Heating Hot Water System
1.2.4.2. Chilled Water System
1.2.4.3. Dual Temperature Water System
1.2.4.4. Glycol System
1.2.4.5. All other closed loop systems

1.2.5. Attend project meetings as required to plan, schedule and coordinate above activities with other project contractors and the Client.

1.2.6. Provide recommended testing procedures and chemical treatment schedule for Client's personnel. This information shall be submitted to the Client in a Program Administration Manual.

1.3. **SUBMITTALS**

1.3.1. Product Data:

1.3.1.1. Include rated capacities; water-pressure drops; shipping, installed, and operating weights; and complete data on furnished products listed below:

1.3.1.1.1. Pot Feeders
1.3.1.1.2. Filtration cartridges and housing
1.3.1.1.3. Glycol Feed System
1.3.1.1.4. Flow Indicators
1.3.1.1.5. Valves
1.3.1.1.6. Product specifications and MSDS's for each chemical used
1.3.1.1.7. Cleaning Procedures
1.3.1.1.8. Passivation Procedures
1.3.1.1.9. Chemical Treatment Procedures

1.3.2. Shop Drawings

1.3.2.1. Shop Drawings to include detailed equipment assemblies indicating dimensions, weights, loads, required clearances, method of field assembly, components, and the location and size of each field connection as necessary to assist the mechanical contractor with proper system installations
1.3.2.2. Service Reports as indicated under Part 2 below.

1.4. **QUALITY ASSURANCE**

1.4.1. Manufacturers and Products: The products and manufacturers specified in this Section establish the standard of quality for the Work.

1.4.2. Subject to compliance with all requirements, provide specified products from the manufacturers indicated in the Standard of Acceptance

1.4.3. Products in this section shall be built, tested, and installed in compliance with the specified quality assurance standards; latest editions, unless noted otherwise.

1.4.4. American Society for Testing and Materials (ASTM)

1.4.4.1. D859 – Test Method for Silica in Water
1.4.4.2. D1067 – Test Methods for Acidity/Alkalinity in Water
1.4.4.3. D1068 – Test Methods for Iron in Water
1.4.4.4. D1126 – Test Method for Hardness in Water
1.4.4.5. D3370 – Practices for Sampling Water from Closed Conduits
1.4.4.6. D4012 - Test Method for Adenosine Triphosphate (ATP)
1.4.4.7. Content of Microorganisms in Water
1.4.4.8. D5465 - Practice for Determining Microbial Colony Countsfrom Waters Analyzed by Plating Methods

1.4.5. Conform to all applicable Codes, Regulations, and Municipal requirements for the use and disposal of chemicals (including cleaning compounds) and waste to public sewer systems.

1.4.6. Wastewater shall be discharged to the sanitary sewer only if it has a pH between 5.0 and 10.0 and meets the requirements of the locality where the work takes place. Glycols (of any type) shall not be discharged to the sanitary sewer.

1.4.7. Wastewater containing any chemical or sediment is prohibited from discharge to the storm water system. No chemical shall contain Chromates or Inorganic Phosphates.

1.5. **DELIVERY, STORAGE, AND HANDLING**

1.5.1. Package for delivery to best protect finished surfaces while using the least amount of single-use packaging as possible. Deliver equipment and components adequately packaged for lifting, skidding, or rolling into final position, according to manufacturer's instructions. If possible, package and ship products using reusable blankets and fabrics, or reusable cardboard and crate systems.

1.5.2. Store materials and equipment raised off the floor on pallets and protected with coverings to prevent damage due to weather and construction activities. Store in areas that prevent damage due to freezing and extreme temperatures or sunlight. Arrange coverings to provide air circulation to avoid damage from condensation or chemical build-up. Protect from damage, dirt and debris at all times.

1.5.3. Store chemicals in curb protected area. Such secondary containment areas must have the capacity to hold the volume of the largest container or 10% of the combined containers, whichever larger. If room has no floor drains, then the room itself may be considered sufficient secondary containment. If the room is considered the secondary

containment ensure there is a lip at the door so no liquids can exit the room in the event of a leak. Verify field conditions before storing any chemicals

1.5.4. Provide temporary containment areas when permanent containment areas do not exist. Remove temporary containment at the end of construction.

1.6. **WARRANTY**

1.6.1. Provide a complete warranty for parts and labor for a minimum of one year from the date of Substantial Completion. This warranty does not include ongoing chemical treatment or monitoring.

1.7. **STANDARDS OF ACCEPTANCE - CHEMICAL SERVICE PROVIDERS (CSPS)**

1.7.1. Control-Chem
1.7.2. Klenzoid

1.8. **STANDARDS OF ACCEPTANCE - CHEMCIAL TREATMENT HARDWARE**

1.8.1. Neptune
1.8.2. Axiom
1.8.3. Griswald

PART 2 - PRODUCTS

2.1. **CHEMICAL TREATMENT EQUIPMENT**

2.1.1. Piping

2.1.1.1. Chemical feed piping, schedule 80 black steel, crosses at all changes in direction with unconnected ports plugged.

2.1.2. Chemical By-Pass Feeder - Domed Bottom

2.1.2.1. The feeder shall be constructed of min 10 ga carbon steel with interior and exterior epoxy coating.

2.1.2.2. Capacity 17.5 liter (5 gallon) for heating systems smaller than 5,000 gallon water content, 45 liter (12 gallon) for heating systems larger than 5,000 gallon water content.

2.1.2.3. The feeder will be rated for a minimum of 350 psig at 250 degrees F.

2.1.2.4. Tank shall be provided with a wide mouth of not less than 100 mm (4”) inside diameter so that chemicals can be introduced without the need of a funnel.

2.1.2.5. Four ¾” access ports for flow, vent, and drain.

2.1.2.6. The enclosure shall be a grooved end cap. The retaining bolts are removable by a small adjustable wrench. Rotating cap closures or closures requiring special wrenches shall not be considered equal.

2.1.2.7. The feeder will include heavy legs, minimum 3/16” thick, welded to the sides of the vessel, with holes in the feet to allow floor mounting with anchor bolts.

2.1.2.8. Options

2.1.2.8.1. Stainless steel basket with 1/8” perforations to hold solid chemicals
2.1.2.8.2. Isolation valve kit includes two ¾” ball valves with integral ¼” drain/vent valves and an integral vent valve to bleed off air or release pressure.
2.1.2.8.3. 250 mm x 250 mm (10"x10" funnel package c/w ball valve

2.1.2.9. Standard of Acceptance: Neptune, Griswold

2.1.3. <u>Filtration Cartridges and Housing</u>

2.1.3.1. Side stream type, complete with necessary shut off valves, drain and air release valves, and system connections. Include one borosilicate sight glass window downstream of the filter to provide flow visibility.

2.1.3.2. All 304 stainless steel filter housing with a mounting bracket, including brass head and two EPDM O rings, brass drain valve with barb fitting and cap

2.1.3.3. The housing is rated for a max pressure of 300 psi and a water temperature of 93 deg C. Size capacity at 5% of total system flow.

2.1.3.4. It also features a corrosion resistant brass sight flow indicator that indicates water flow through the hydronic water filter. Sight flow indicator shall include EPDM O-rings, two tempered borosilicate glass windows, 304SS cage, TPX ball, and cork washers (non-wetted part).

2.1.3.5. The hydronic heating water filter also features 3/4" female NPT ports and brass inlet and outlet ball valves.

2.1.3.6. Manual balancing valve shall be of brass construction and shall include an integral air vent, memory stop, shall be able to provide flow metering, flow balancing, and filter cartridge isolation. Three brass nipples shall each be 3" in length.

2.1.3.7. Filter cartridge shall be a cotton wound filter cartridge with tin core (5 micron).

2.1.3.8. Standard of Acceptance; Neptune, Griswald, Axiom, RainFresh

2.1.4. Pulse Water Meter

2.1.4.1. Multi-jet principle, suitable for cold or hot water models.Wertted materials: brass; couplings: brass.

2.1.4.2. The impeller is centered in a ring of jets, with inlet jets on one level and outlet jets on another. A gear train drives the register totalizer dials. For pulse output, one of the pointers is replaced by a magnet, which is detected by an encapsulated sensor attached to the outside of the lens. Pulse rate is determined by the dial on which the magnet is placed, and by the number of sensors (single or double).

2.1.4.3. Changing the pulse rate requires no special tools and can be done in the field.

2.1.4.4. Accuracy: +/-2% of nominal flow

2.1.4.5. Electrical rating: 0.01A @ 24VAC/DC

2.1.4.6. Select meter size to suit anticipated flow. 20 mm (3/4") for 20 gpm or less, 25 mm (1") for flows up to 50 gpm.

2.1.4.7. Standard of Acceptance: Neptune, Dwyer

2.1.5. Automatic Glycol Fill Tank

2.1.5.1. Applications: HVAC systems using bladder and compression tanks up to 90 psi (621 kPa) cold-fill pressure

2.1.5.2. Role: providing glycol make-up automatically upon a drop in system pressure

2.1.5.3. Description: The Glycol Auto-Fill Units provides automatic glycol make-up for HVAC systems. The specially molded mixing tank offers a compact package with built-in housing for controls and make-up pump

2.1.5.4. Materials: Polypropylene (holding tank), bronze (pump, isolation and check valves), stainless steel/brass (fill ball valves)

2.1.5.5. Performance range

2.1.5.5.1. Suitable for all bladder and compression tanks up to 90 psi (621 kPa) cold-fill pressure
2.1.5.5.2. Higher cold-fill pressures available
2.1.5.5.3. Temperature: Max fluid temp 140°F (60°C); max ambient temp 104°F (40°C)

2.1.5.6. The unit shall monitor and maintain the minimum system pressure at all times.

2.1.5.7. Low mixture cut-out level switches shall monitor the status of the mixing tank

2.1.5.8. Level switches shall be 24 volt maximum to ensure intrinsic electrical safety

2.1.5.9. Fill pressure: 45 psi (300 kPa)

2.1.5.10. Standard of Acceptance: Armstrong GLA series.

2.1.6. Glycol Fluid

2.1.6.1. Fluid: 40% food-grade polypropylene glycol, pre-mixed.

2.1.6.2. Standard of Acceptance: DOW PuraGuard™ Propylene Glycol USP/EP, with a suitable inhibitor package

2.1.6.3. Unless noted otherwise by the consultant or noted otherwise on the drawings, carry the cost to supply 500 gallons (1,750 liters) of pre-mixed polypropylene fluid.

2.2. **CLEANING COMPOUNDS**

2.2.1. Alkaline phosphate or non-phosphate detergent/surfactant/specific to remove organic soil, hydrocarbons, flux, pipe mill varnish, pipe compounds, iron oxide, and like

deleterious substances, with or without inhibitor, suitable for system wetted metals without deleterious effects.

2.2.2. All chemicals to be acceptable for discharge to sanitary sewer. Provide chemicals that comply with provincial regulations.

2.2.3. Chemical inhibitor shall be polymer based and contain azole in an amount appropriate for the percentage of internal copper surface area of the system piping. Provide products with PTSA (pToluenesulfonic acid) florescent tracer dyes. Molybdenum shall not be used as a tracer. Optionally, for hot water heating systems only, nitrite/azole based inhibitors may be used. Inhibitor will not cause or enhance bacteria/corrosion problems or mechanical seal failure due to excessive total dissolved solids. Shot feed manually. Maintain inhibitor residual as determined by water treatment laboratory, taking into consideration residual and temperature effect on pump mechanical seals.

2.2.4. PH Control: Inhibitor formulation shall include adequate buffer to maintain pH in the range recommended by the boiler manufacturer.

2.2.5. No chemicals shall contain chromates or inorganic phosphates.

2.2.6. Utilize non-oxidizing biocides in the event sterilization is required.

2.2.7. Adjust chemical concentrations as required to achieve the required performance

2.3. **PERFORMANCE REQUIREMENTS**

2.3.1. Cleaning activities shall remove oil, grease, silt, and rust from system. Cleaned metal surfaces shall be well passivated.

2.3.2. The water treatment programs proposed by the CSP shall maintain corrosion rates below 0.5 mils per year for mild steel and 0.1 mils per year for copper and/or brass, with no pitting allowed.

2.3.3. Suspended solids: Nil. Total Iron Concentration: 0.5 mg/L Fe maximum. Total Copper Concentration: 0.2 mg/L Cu maximum.

2.3.4. Heat exchanger fouling and capacity reduction shall not exceed that allowed by fouling factor 0.0005

2.3.5. These rates shall be verified with corrosion coupons provided by the CSP Coupons shall be analyzed in the CSP's analytical laboratory every three months, more often if required, to assure these levels are not exceeded.

2.3.6. Microbiological growth levels shall be maintained below 10,000 cfu's aerobic bacteria and 10 cfu's anaerobic bacteria. The CSP shall perform detailed microbiological culturing at the CSP's company's analytical laboratory monthly, more often if required, to assure these levels are not exceeded

2.3.7. Inhibitor shall be stable at equipment skin surface temperatures and bulk water temperatures of not less than 121 degrees C (250 degrees F) and 52 degrees C (125 degrees Fahrenheit) respectively.

2.4. **FLUSHING OF NEW AND REUSED PIPING**

2.4.1. Flush and clean all new and reused piping.

2.4.2. Before adding cleaning chemicals to the closed system and subsequent flushing, all air handling coils and fan coil units should be isolated by closing the inlet and outlet valves and opening the bypass valves. This is done to prevent dirt and solids from lodging the coils.

2.4.3. System is operated with a minimum pressure of 35 kPa at highest point and expansion tank level is maintained at 1/3 to ½ full.

2.4.4. Do not valve in or operate system pumps until after system has been cleaned.

2.4.5. Provide a copy of recommended cleaning procedures and chemicals for review by Consultant.

2.4.6. Prior to chemical cleaning, the systems shall be inspected to ensure removal of heavy debris and excessive dirt and oil. Temporary strainers shall be installed on the suction side of each pump.

2.4.7. Provisions shall be made for temporary connections between the supply and return mains in the system to permit circulation of the cleaner. A 1" pipe connection shall be provided on the suction side of the circulating pumps for introduction of the cleaning solution.

2.4.8. Each system shall be flushed to remove loose dirt and shall be hydrostatically tested to ensure that there are no leaks. Rotation of pumps shall be checked.

2.4.9. The contractor shall introduce a neutral pH cleaner and rust remover into each system at a dosage recommended by the water treatment supplier. The cleaner shall not attack carbon steel, copper, stainless steel, bronze, brass, aluminum, plastics or natural and synthetic rubbers. "Flash rusting" shall not occur after cleaning.

2.4.10. The cleaner shall be circulated at a temperature of 20^{O}C to 80^{O}C for a period of not less than 72 hours. PH adjustment shall be carried out by the water treatment supplier's representative.

2.4.11. Each system shall be drained, refilled with fresh water, recirculated for a period of 12 hours, drained a second time, and immediately refilled and treated with the recommended corrosion inhibitor.

2.4.12. The water treatment company shall provide the loan of a drum pump and dolly to facilitate the introduction of the cleaner into the system.

2.4.13. After chemical cleaning is satisfactorily completed, open the inlet and outlet valves to each coil and close the by-pass valves. Also, clean all strainers.

2.4.14. Provide and later remove all temporary bypasses, drains, vents, etc. required to flush and clean the system. Temporary components for flushing and cleaning are not indicated on the drawings.

2.5. **TREATMENT PROGRAM – CHEMICAL TREATMENT AND PASSIVATION**

2.5.1. Provide passivation and chemical treatment per the approved chemical treatment procedures. Chemically treat new and reused piping networks using chemicals and treatment procedures compatible with the system being cleaned and the chemical treatment chemicals in existing piping systems being connected to. Test existing piping systems or otherwise determine chemical treatment in existing piping and validate compatibility. Note that existing systems may be silica based, adjust water treatment program accordingly.

2.5.2. When connecting into active existing systems, treat piping networks installed or reused by the project and verify by lab analysis that the treatment levels per the treatment plan have been attained prior to connecting into the existing active system. Submit validating report for approval.

2.5.3. Do not connect into existing active system until report is approved by Client.

2.5.4. Provide temporary valves, piping, and accessories as required to treat the project's piping prior to connection to the active system.

2.5.5. Provide passivation/chemical treatment at system startup or immediately upon operation of a system for temporary cooling and heating, whichever comes first.

2.5.6. Provide chemical treatment immediately after each system has been cleaned and flushed. Thereafter immediately begin the approved water treatment maintenance program to passivate and prevent corrosion, scale, and organic growth and to maintain treatment chemical levels. Note that systems or parts of systems will not typically be started at the same time; adjust treatment strategy accordingly.

PART 3 - EXECUTION

3.1. **CHEMICAL SERVICE PROVIDER (CSP) SERVICES**

3.1.1. The CSP shall provide all cleaning and treatment chemicals, basic services, testing, equipment and materials necessary for a complete water treatment program.

3.1.2. The CSP shall perform an analysis of the supply water to determine the type and quantities of chemical treatment needed to maintain the required water quality to prevent corrosion, scaling, and biological growth. The CSP will at minimum provide weekly site visits to verify proper water treatment for the first month after any system or part of a system is treated. Provide monthly visits thereafter, or more often if required to assure performance requirements are being met, to analyze water samples, inspect equipment, and add additional chemicals as required to maintain proper water treatment, until final written Client acceptance of the respective system.

3.1.3. At each site visit CSP shall analyze each system for corrosion inhibitors, pH, total iron, total copper, bacteria levels (provide monthly analytical laboratory analysis), and conductivity; inspect loss from corrosion (provide analytical laboratory analysis every three months), record make-up meter readings, and perform any other tests necessary to validate that corrosion, scale, and organic growth is being prevented.

3.1.4. <u>Reports:</u>

3.1.4.1. Submit a written startup test report for each system placed into service. A service report shall be prepared on site by the CSP, submitted at the time of each service visit (with copies immediately provided to the Client), which shall include all required test results and recommendations.

3.1.4.2. Additionally, provide final reports for approval to the Client regarding each site service visit, certified by a representative of the CSP, within one week of any water treatment activity. Such reports shall include the results of any field or lab tests. Reports shall clearly state if the required water quality and maximum corrosion rates are being achieved.

3.1.4.3. At a minimum, each report shall include the following information:

3.1.4.3.1. System Treated
3.1.4.3.2. Date
3.1.4.3.3. Conductivity
3.1.4.3.4. pH
3.1.4.3.5. Total Iron
3.1.4.3.6. Total Copper
3.1.4.3.7. Bacteria(cfu) (monthly analytical laboratory analysis)
3.1.4.3.8. Corrosion Rates (three month analytical laboratory analysis)
3.1.4.3.9. Make-up Water Quantity since Last Visit
3.1.4.3.10. Corrosion Inhibitor level (ppm)
3.1.4.3.11. Silica level (ppm)

3.1.5. Conduct final on-site system turn over meeting with Client and Consultant or Commissioning Agent (as applicable to the project). Present final validation report demonstrating that performance requirements have been achieved and that each system is currently properly treated.

3.1.6. Train Owner's maintenance personnel in water treatment procedures.

3.1.7. <u>Program Administration Manual:</u>

3.1.7.1. The CSP shall provide the Owner with two (2) Program Administration Manuals including sections covering program control, testing requirements, in plant logs, safety data and system information. Each section shall include the following:

3.1.7.1.1. *Program Control*: Include a complete program outline with chemical descriptions, control ranges, and required action for “out of range” situations. Also include complete ordering instructions with applicable account numbers and phone numbers.

3.1.7.1.2. *Testing Requirements*: This section will include basic testing practices as well as detailed test instructions for each test to be performed.

3.1.7.1.3. *In-Plant Logs*: Include detailed testing log sheets for each system to be tested including room to record one (1) month's data on one (1) sheet and a section to log chemical inventory.

3.1.7.1.4. *Safety Data*: Include the CSP's 24-hour toll free safety hotline number as well as MSDS sheets for each chemical used.

3.1.7.1.5. *System Information*: Include any equipment manuals and related information.

3.2. **INSTALLATION AND TREATMENT**

3.2.1. Install all required components, and chemically passivate/treat and maintain the system as described in Part 2.

3.2.2. Use and dispose of chemicals and wastewater (including from existing piping networks) per the Quality Assurance section of this specification. All costs of disposal shall be borne by the contractor.

3.2.3. Provide and install all chemicals and all incidental components.

3.2.4. Install equipment at locations shown on the Drawings. Follow the manufacturer's installation and startup instructions.

3.2.5. Passivate and chemically treat each system immediately after it has been cleaned and flushed.

3.2.6. Install pot feeders and filtration cartridges with openings no higher than 1,200 mm (4 ft) above finished floor. Pipe pot feeder drain to nearest floor drain (where glycol is not present).

3.2.7. The treatment program shall begin at system start-up or immediately upon first operation of the system by the contractor for temporary heating and cooling, whichever comes first. Continue the program until Substantial Completion.

3.3. **INSTALLATION OF PREMIXED INHIBITED GLYCOL SYSTEM**

3.3.1. Following system flushing and cleaning, drain the entire piping system. Add premixed glycol/inhibitor solution into the system. Circulate system fluid, adding additional pre-mixed glycol/inhibitor as required until all air is purged from the system.

3.3.2. Sample fluid, measure concentration of glycol and inhibitor. Drain system fluid as required and add additional pre-mixed solution to achieve the design concentration of glycol and the manufacturer's recommended concentration of inhibitor. Submit report of activities, including volumes of all fluids used.

3.4. **INSTALLATION OF GLYCOL FEED SYSTEM**

3.4.1. Level and bolt Glycol Feed System to the floor within the containment area. Support all piping and conduits independent of the Glycol Feed Unit.

3.4.2. Make all connections to power supply and BAS.

3.4.3. Ensure that the discharge of all PRVs, vents and reliefs from systems containing glycol are returned to the glycol feed tank and not drained to the sanitary system.

3.4.4. Start-up and adjustments: by the equipment manufacturer.

3.5. **GLYCOL TREATMENT CONTROL LIMITS**

3.5.1. Maintain control limits specified in following schedule:

3.5.1.1. Propylene Glycol concentration, % vol: 40 ±2
3.5.1.2. pH at 25°C: 8.5 minimum
3.5.1.3. reserve alkalinity based on 100% glycol: 9.0 minimum
3.5.1.4. Provide basic water test equipment complete with reagents for chemicals supplied and specific test for determination of pH and treatment residual. Include required specialized or supplementary equipment.

3.6. **FIELD QUALITY CONTROL:**

3.6.1. The CSP shall:

3.6.1.1. Verify that systems and equipment have been properly cleaned, flushed, and filled with water, and are fully operational before introducing operational chemicals for water-treatment systems.

3.6.1.2. Introduce and maintain chemical treatment to achieve the specified performance requirements.

3.6.1.3. Submit a written startup test report for each system placed into service.

3.6.1.4. Provide validation testing and required reports.

3.6.1.5. Attend final on-site system turn over meeting with Client and Consultant or Commissioning agent (as applicable to the project). Present final validation report demonstrating that performance requirements have been achieved and that each system is currently properly treated.

PART 1 - GENERAL

1.1. DESCRIPTION

1.1.1. Ductwork and accessories for HVAC including the following:

1.1.1.1. Supply air, return air, outside air, exhaust, make-up air, and relief systems.
1.1.1.2. Exhaust duct for chemical fume hoods, kitchen hood exhaust (grease) and “wet exhaust” ducts.

1.1.2. Section Includes:

1.1.2.1. Ductwork materials, plenums, construction, , fabrication, and support
1.1.2.2. Galvanized steel ductwork (rectangular, round)
1.1.2.3. Stainless steel ductwork.
1.1.2.4. Aluminum ductwork
1.1.2.5. Grease exhaust ductwork.
1.1.2.6. Leak-proof ductwork
1.1.2.7. Reinforcing and supports.
1.1.2.8. Flexible duct.
1.1.2.9. Special ductwork construction including exhaust plenums;
1.1.2.10. Duct sealants.
1.1.2.11. Ductwork sealing, inspection, and leakage testing.
1.1.2.12. Ductwork accessories

1.1.3. *Section does not include:*

1.1.3.1. *Dust or particle collection ductwork*

1.1.4. Definitions:

1.1.4.1. SMACNA standards as used in this specification means the HVAC Duct Construction Standards, Metal And Flexible.
1.1.4.2. Seal or sealing: use of liquid or mastic sealant, with or without compatible tape overlay, or gasketing of flanged joints, to keep air leakage at duct joints, seams and connections to an acceptable minimum.
1.1.4.3. Duct pressure classification: SMACNA HVAC Duct Construction Standards, Metal and Flexible.
1.1.4.4. Exposed duct: exposed to view in a finished room
1.1.4.5. Outdoor duct: exposed to weather.

1.2. QUALITY ASSURANCE

1.2.1. Reference Standards: Products in this section shall be built, tested, and installed in compliance with the following quality assurance standards; latest editions, unless noted otherwise.

1.2.2. Duct system construction and installation: referenced SMACNA standards are the minimum acceptable quality.

1.2.3. Duct sealing, air leakage criteria, and air leakage tests: ducts shall be sealed as per duct sealing requirements of SMACNA HVAC air duct leakage test manual for duct pressure classes shown on the drawings.

1.2.4. Duct accessories exposed to the air stream, such as dampers of all types (except smoke dampers) and access openings, shall be of the same material as the duct or provide at least the same level of corrosion resistance.

1.3. SUBMITTALS

1.3.1. Provide the following information and product data:

1.3.1.1. Sealants and gaskets
1.3.1.2. Access doors
1.3.1.3. Hangers and supports
1.3.1.4. Duct fittings
1.3.1.5. Turning vanes
1.3.1.6. Flexible duct
1.3.1.7. Volume control dampers
1.3.1.8. Fire and smoke dampers

1.3.2. Applicable Publications

1.3.2.1. American Society for Testing and Materials (ASTM):

1.3.2.1.1. A167 99(2009) Standard Specification for Stainless and Heat Resisting Chromium Nickel Steel Plate, Sheet, and Strip
1.3.2.1.2. A653-09 Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy coated (Galvannealed) by the Hot-Dip process
1.3.2.1.3. A1011-09a Standard Specification for Steel, Sheet and Strip, Hot rolled, Carbon, structural, High-Strength Low-Alloy, High Strength Low-Alloy with Improved Formability, and Ultra-High Strength
1.3.2.1.4. B209 07 Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate

1.3.2.1.5. C1071-05e1Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)

1.3.2.1.6. E84-09a Standard Test Method for Surface Burning Characteristics of Building Materials

1.3.2.2. National Fire Protection Association (NFPA):

1.3.2.2.1. 90A-09 Standard for the Installation of Air Conditioning and Ventilating Systems

1.3.2.2.2. 96-08 Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations

1.3.2.2.3. E. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):

1.3.2.2.4. 2nd Edition – 2005 HVAC Duct Construction Standards, Metal and Flexible

1.3.2.2.5. 1st Edition - 1985 HVAC Air Duct Leakage Test Manual

1.3.2.2.6. 6th Edition – 2003 Fibrous Glass Duct Construction Standards

1.3.2.3. Underwriters Laboratories, Inc. (UL):

1.3.2.3.1. 181 08 Factory Made Air Ducts and Air Connectors

1.3.2.3.2. 555 06 Standard for Fire Dampers

1.3.2.3.3. 555S 06 Standard for Smoke Dampers

1.4. **WARRANTY**

1.4.1. Provide a complete parts and labor warranty for a minimum of one year from the date of Substantial Completion.

PART 2 - PRODUCTS

2.1. **GENERAL USE DUCTWORK**

2.1.1. General: Except for systems specified otherwise, construct ducts, casings, and accessories of galvanized sheet steel of lock-forming quality to ASTM A653, coating G90; or, aluminum sheet, ASTM B209, alloy 1100, 3003 or 5052.

2.1.2. Specified Corrosion Resistant Systems: Stainless steel sheet, ASTM A167, Class 302 or 304, Condition A (annealed) Finish No. 4 for exposed ducts and Finish No. 2B for concealed duct or ducts located in mechanical rooms.

2.1.3. Approved factory made joints may be used.

2.1.4. Provide fittings, branches, inlets and outlets in such a manner that air turbulence is reduced to a minimum.

2.1.5. Rectangular Duct Construction

2.1.5.1. Rectangular duct longitudinal seams shall be Pittsburgh lock 3/8 in. minimum pocket. Crossbreak or bead rectangular ductwork

2.1.5.2. Thickness shall be the more restrictive between the SMACANA Standards and the following:

2.1.5.2.1. Ducts through 12 in. wide: 24 Gage
2.1.5.2.2. Ducts 13 in. through 30 in. wide: 22 Gage.
2.1.5.2.3. Ducts 31 in. through 84 in. wide: 20 Gage.
2.1.5.2.4. Ducts 84 in. and larger: 18 Gage

2.1.5.3. Elbows

2.1.5.3.1. Unless shown otherwise on the drawings, install a 1.5 times width to centerline radius elbow (full radius elbow). Where not possible, use lesser radii configurations, with 'radius-proportional' splitter vanes permanently installed within.
2.1.5.3.2. Only where shown specifically on the drawings, provide square elbows with double thickness vanes.

2.1.5.4. Transitions

2.1.5.4.1. Limit transition angles (for each side) to 15 degrees diverging and 30 degrees converging.

2.1.5.5. Offsets:

2.1.5.5.1. Radiused elbows, as indicated.

2.1.5.6. Take-Off Fittings:

2.1.5.6.1. For take-offs carrying more than 25 percent of duct main, provide an increasing branch elbow with an inside radius equal to branch duct width. Size branch and main at elbow for equal velocity.

2.1.5.6.2. For take-offs carrying 25 percent or less of duct main, provide flanged increased area branch take-off (45 degree entry, "shoe" type) or 45 degree lateral wye takeoffs. Conical fittings shall be used for spiral, round, and oval ductwork.

2.1.5.6.3. For take-offs directly to side outlet for register or grille, provide an increased area tap. For take-offs directly to diffusers see appropriate SMACNA figures.

2.1.5.7. Turning vanes

2.1.5.7.1. Install double wall, airfoil, 2 inch radius vanes in ducts with vane runner length 18" or greater and air velocity less than 2000 fpm. Install double wall, airfoil, 4-1/2 inch radius vanes in ducts with vane runner length 18" or greater and air velocity 2000 fpm or greater.

2.1.5.8.

2.1.5.8.1. If duct size changes in a mitered elbow, use single wall type vanes with a trailing edge extension. If duct size changes in a radius elbow or if short radius elbows must be used, install sheet metal turning vanes in accordance with SMACNA Chart 4-1 and Figure 4-9.

2.1.6. Round Duct Construction

2.1.6.1. All round and oval duct shall be manufactured of spiral lock seams. Ductwork up to 12 in. diameter and 2 in. w.g. can be manufactured with longitudinal lock seams.

2.1.6.2. Minimum galvanized rectangular duct gage shall be the more restrictive between the SMACANA Standards and the following:

2.1.6.2.1. Ducts less than 10" diam: 26 ga spiro duct without ribs
2.1.6.2.2. Ducts 12" to 16" in. diam: 24 Gage
2.1.6.2.3. Ducts 18" through 24" diam: 22 Gage.
2.1.6.2.4. Ducts 26 in. through 30" diam: 20 Gage.
2.1.6.2.5. Ducts 32" diam and larger: 18 Gage

2.1.6.3. Tees shall be conical. Laterals shall be straight. Taps through 10 in. diameter in size shall have a machine drawn entrance and fittings shall have longitudinal seams, continuously welded. Both sides of welds shall be primed with zinc chromate. Tap entrances shall be free of weld build-up.

2.1.6.4. Elbows in diameters 2 in. through 10 in. shall be stamped or pleated. Elbows shall be 5 gore for 90 degrees and 3 gore for 45 degrees. Elbows shall have 1.5 times width to centerline radius (full radius elbow).

2.1.6.5. Flanges, access doors and taps into spiral ducts shall be factory fabricated.

2.1.6.6. Field joints in diameters through 48 in. shall be made with 2 in. long slip-fit, sleeve coupling, or flanges. Duct sealer to be applied on male end connectors before insertion and afterwards to cover the entire joint and sheet metal screws. Sheet metal screws shall be installed at a maximum 300 mm spacing, with a minimum of 3 screws per joint.

2.1.6.7. Ductwork 48 in. diameter and over, and for all sizes where disassembly or removal is required, shall be joined with flanges.

2.2. **SEALING CLASSIFICATION**

2.2.1. Sealant: Elastomeric compound, gun or brush grade, maximum 25 flame spread and 50 smoke developed (dry state) compounded specifically for sealing ductwork as recommended by the manufacturer. Generally provide liquid sealant, with or without compatible tape, for low clearance slip joints and heavy, permanently elastic, mastic type where clearances are larger. Oil base caulking and glazing compounds are not acceptable because they do not retain elasticity and bond.

2.2.2. Tape: Use only tape specifically designated by the sealant manufacturer and apply only over wet sealant. Pressure sensitive tape shall not be used on bare metal or on dry sealant.

2.2.3. Gaskets in Flanged Joints: Soft neoprene.

2.2.4. Sealing classification as per the following table

SEAL CLASS	SEALING REQUIREMENTS	STATIC PRESSURE	ALLOWABLE LEAKAGE RATE
A	All traverse duct joints, all longitudinal duct seams and all duct wall penetrations	-4” to +4” w.g. (1,000 to +1,000 Pa)	1% of total design air flow at 4” w.g. (+1,000 Pa) operating pressure
B	All traverse duct joints, all longitudinal duct seams	-3” to +3” w.g. (-750 to +750 Pa)	1% of total design air flow at 3” w.g. (+750 Pa) operating pressure
C	All traverse duct joints	-2” to +2” w.g. (-500 to +500 Pa)	1.5% of total design air flow at 2” w.g. (+500 Pa) operating pressure

D	Not sealed	-1” to +1” w.g. (-250 to +250 Pa)	5% of total design air flow at 1” w.g. (+250 Pa) operating pressure

Note: Dust collection exhaust ductwork not included.

2.3. PRESSURE CLASSIFICATIONS

2.3.1. Ductwork material shall be constructed in accordance with SMACNA ratings for the following pressure classifications. Seal classifications shall be in accordance with the following table:

DUCTWORK	OPERATING PRESSURE	SEAL CLASS	REMARKS
All supply ductwork	-3” to +3” w.g. (-750 to +750 Pa)	B	
All return ductwork	-2” to +2” w.g. (-500 to +500 Pa)	C	
All exhaust ductwork	-2” to +2” w.g. (-500 to +500 Pa)	C	
All other ductwork not listed herein	-1” to +1” w.g. (-250 to +250 Pa)	D	

2.4. LIQUID TIGHT DUCTWORK

2.4.1. Applications

2.4.1.1. Exhaust from showers, kitchen dishwashers
2.4.1.2. All outdoor mounted ductwork
2.4.1.3. All swimming pool supply and return/exhaust ductwork

2.4.2. Duct construction:

2.4.2.1. Outdoor ductwork: Min. 18 ga carbon steel continuous external weld for all seams and joints. Provide neoprene gaskets at flanged connections. Where ducts are not self draining back to the equipment, provide low point drain pocket with copper drain pipe to sanitary sewer. Provide access door in side of duct at drain pockets.

2.4.2.2. Indoor ductwork: Min. thickness of 0.040 in. aluminum alloy 3003H-14 capable of double seaming without fracture, or 316L stainless steel. Ductwork shall be continuously welded and watertight. Pitch duct to low point drains. Pipe drains to floor drains or utility sinks.

2.5. KITCHEN GREASE EXHAUST DUCTWORK

2.5.1. Exhaust Ducts: Construct in compliance with NFPA 96, including supports, insulation, clearance from combustible materials, location of access doors and grease collection.

2.5.2. Material: 1.6 mm (16 gage) steel sheet (black iron), ASTM A1011, or 1.3 mm (18 gage) stainless steel. Use stainless steel for exposed duct in occupied areas. See Optional Duct Materials.

2.5.3. Construction: Liquid tight with continuous external weld for all seams and joints. Where ducts are not self draining back to the equipment, provide low point drain pocket with copper drain pipe to sanitary sewer. Provide access doors or panels for duct cleaning inside of horizontal duct at drain pockets, at 6 m (20 feet) intervals, and at each change of direction.

2.5.4. Refer to SMACNA "Guidelines for Welding Sheet Metal" for applicable requirements.

2.5.5. Access doors or panels shall be of the same material and thickness of the duct with gaskets and sealants that are rated 815 degrees C (1500 degrees F) and shall be grease-tight.

2.5.6. Locate access doors at 6 m (20 feet) intervals and at each change in duct direction.

2.5.7. Stainless Steel Ductwork

2.5.7.1. Min 18 ga thickness

2.5.7.2. Concealed stainless steel ductwork shall have an ASTM mill rolled No.1 or No.2 D finish.

2.5.7.3. Exposed stainless steel ductwork shall have an ASTM mill rolled No.2 B finish, or as indicated. Welds shall be ground smooth and final brushed with stainless steel wire brushes. Welds on exposed stainless steel ductwork shall be free of stain, burn-through, or discoloration.

2.5.8. Optional duct construction:

2.5.8.1. Double-wall factory-built grease duct, UL labeled and complying with NFPA 96 may be furnished in lieu of specified materials for kitchen and grill hood exhaust. Installation and accessories shall comply with the manufacturers catalog data. Outer jacket of exposed ductwork shall be stainless steel. Square and rectangular duct shown in the drawings will have to be converted to equivalent round size.

2.5.8.2. Complete with all pre-manufactured accessories to meet NFPA-96 requirements. Each section shall bear the UL(C) label.

2.5.8.3. Standard of Acceptance: CaptiveAir, Duravent

2.6. **LABORATORY HOOD DUCTWORK**

2.6.1. Laboratory Hood, Exhaust and Associated Ductwork: 1.3 mm (18 gage) all welded Stainless steel.

2.6.2. Stainless Steel Ductwork

2.6.2.1. Minimum stainless steel rectangular duct gauge shall be 18 gauge, for welding.

2.6.2.2. ASTM A167, type 316L.

2.6.2.3. Concealed stainless steel ductwork shall have an ASTM mill rolled No.1 or No.2 D finish.

2.6.2.4. Exposed stainless steel ductwork shall have an ASTM mill rolled No.2 B finish, or as indicated. Welds shall be ground smooth and final brushed with stainless steel wire brushes. Welds on exposed stainless steel ductwork shall be free of stain, burn-through, or discoloration to the satisfaction of the University's Representative/Project Design Engineer.

2.6.2.5. Screws and rivets shall be stainless steel.

2.7. **PLENUMS**

2.7.1. Intake and Exhaust plenums shall be double wall with 2 in. thick duct liner, G-90 galvanized steel solid inner wall (gauge per specified duct minimum standards) and minimum 18 gauge, G-90 galvanized steel outer wall.

2.8. **FLEXIBLE AIR DUCT**

2.8.1. General: Factory fabricated, complying with NFPA 90A for connectors not passing through floors of buildings. Flexible ducts shall not penetrate any fire or smoke barrier which is required to have a fire resistance rating of one hour or more. Flexible duct length shall not exceed 1.5 m (5 feet). Provide insulated acoustical air duct connectors in supply air duct systems and elsewhere as shown.

2.8.2. Flexible ducts shall be listed by Underwriters Laboratories, Inc., complying with UL 181. Ducts larger than 200 mm (8 inches) in diameter shall be Class 1. Ducts 200 mm (8 inches) in diameter and smaller may be Class 1 or Class 2.

2.8.3. Insulated Flexible Air Duct: Factory made including mineral fiber insulation with maximum C factor of 0.25 at 24 degrees C (75 degrees F) mean temperature, encased with a low permeability moisture barrier outer jacket, having a puncture resistance of not less than 50 Beach Units. Acoustic insertion loss shall not be less than 3 dB per 300 mm (foot) of straight duct, at 500 Hz, based on 150 mm (6 inch) duct, of 750 m/min (2500 fpm).

2.8.4. Application Criteria:

2.8.4.1. Temperature range: -18 to 93 degrees C (0 to 200 degrees F) internal.
2.8.4.2. Maximum working velocity: 1200 m/min (4000 feet per minute).
2.8.4.3. Minimum working pressure, inches of water gage: 2500 Pa (10 inches) positive, 500 Pa (2 inches) negative.

2.8.5. Duct Clamps: 100 percent nylon strap, 80 kg (175 pounds) minimum loop tensile strength manufactured for this purpose or stainless steel strap with cadmium plated worm gear tightening device. Apply clamps with sealant and as approved for UL 181, Class 1 installation.

2.9. **DUCT ACCESS DOORS**

2.9.1. Provide access doors, sized and located for maintenance work, upstream, in the following locations:

2.9.1.1. Each in-duct coil (hydronic or DX)
2.9.1.2. Each duct mounted coil and humidifier.
2.9.1.3. Each fire damper (for link service), smoke damper and automatic control damper.
2.9.1.4. Each duct mounted smoke detector.

2.9.2. Openings shall be as large as feasible in small ducts, 300 mm by 300 mm (12 inch by 12 inch) minimum where possible. Access sections in insulated ducts shall be double wall, insulated. Transparent shatterproof covers are preferred for uninsulated ducts.

2.9.3. For rectangular ducts: Refer to SMACNA HVAC Duct Construction Standards (Figure 2 12).

2.9.4. For round and flat oval duct: Refer to SMACNA HVAC duct Construction Standards (Figure 2-11).

2.9.5. Access doors to be designed and constructed for the pressure class of the duct in which the door is to be installed. Doors in exposed areas shall be hinged type with cam

sash lock. Hinges shall be aluminum or steel full length continuous piano type. Doors in concealed spaces shall be secured in place with cam sash latches.

2.9.6. For both hinged and non-hinged doors provide sufficient number of camp sash latches to provide air tight seal when door is closed. Do not use hinged doors in concealed spaces if this will restrict access.

2.9.7. Use minimum 1" deep 24 gauge galvanized steel double wall access doors with minimum 24 gauge galvanized steel frames. For non-galvanized ductwork, use minimum 1" deep double wall access door with frame that shall use materials of construction identical to adjacent ductwork.

2.9.8. Provide double neoprene gasket that shall provide seals from the frame to the door and frame to the duct. When access doors are installed in insulated ductwork or equipment provide insulated doors with insulation equivalent to what is provided for adjacent ductwork or equipment. Access doors constructed with sheet metal screw fasteners will not be accepted.

2.10. **VOLUME CONTROL DAMPERS (MANUAL ADJUSTMENT)**

2.10.1. Single or multi-blade in opposed arrangement, as detailed in SMACNA Standards. Refer to SMACNA Detail Figure 2-12 for Single Blade and Figure 2.13 for Multi-blade Volume Dampers.

2.11. **INSTRUMENT TEST FITTINGS**

2.11.1. Manufactured type with a minimum 50 mm (two inch) length for insulated duct, and a minimum 25 mm (one inch) length for duct not insulated. Test hole shall have a flat gasket for rectangular ducts and a concave gasket for round ducts at the base, and a screw cap to prevent air leakage.

2.11.2. Provide instrument test holes at each duct or casing mounted temperature sensor or transmitter, and at entering and leaving side of each heating coil, cooling coil, and heat recovery unit.

2.12. **DUCTWORK HANGERS AND SUPPORTS**

2.12.1. Generally, hang and support ductwork per the latest edition of SMACNA. Additionally, adhere to the more specific requirements found in this specification section, the Related Sections, and as indicated on the project drawings.

2.12.2. Hanging duct, equipment, or accessories with cables or wires is prohibited.

2.12.3. Provide vibration isolation as specified in Related Section.

2.12.4. Ductwork shall be supported and anchored to structure so that horizontal ducts are without sag or sway, vertical ducts without buckle and all ducts are free from deformation, collapse or vibration

2.12.5. Upper hanger attachments:

2.12.5.1. For concrete: manufactured concrete inserts.

2.12.5.1.1. Standard of Acceptance: Myatt fig 485.

2.12.5.2. For concrete after concrete pour:

2.12.5.2.1. Expanded concrete anchors shall be made of steel.

2.12.5.3. Powder actuated fasteners shall only be utilized for slabs that are thicker than 100 mm (4'') and shall not be utilized in lightweight aggregate concretes.

2.12.5.4. Holes for expanding fasteners shall be drilled either by a carbide bit or by the teeth on the fastener itself. Expansion shield shall be “set'' by driving it into the hole and expanding it with a conical plug.

2.12.5.5. For steel joist: manufactured joist clamp or steel plate washer.

2.12.5.5.1. Standard of Acceptance: Grinnell fig 61 or 86 for joist clamps.

2.12.5.6. For steel beams: manufactured beam clamps:

2.12.5.6.1. Standard of Acceptance: Grinnell fig. 60

2.12.6. Support un-insulated rectangular ducts in sizes up to 600 mm (24 in.) by non-perforated galvanized steel strap or by trapeze hangers. Support insulated rectangular ducts and ducts larger than 36 in. with trapeze hangers. Straps shall be one gauge thicker that the duct material being supported.

2.12.7. Support rectangular ducts in sizes 350 mm (26 in) and larger by galvanized steel angle with black galvanized steel rods to ASHRAE and SMACNA. Space the angle supports in accordance with the following table:

DUCT SIZE	ANGLE SIZE (mm)	ROD SIZE (mm)
Up to 750 mm (30”)	25 x 25 x 3	6
800-1500 mm (32”-60”)	40 x 40 x 3	10
1500-2400 mm (60”-96”)	50 x 50 x 5	10
> 2400 mm (96”)	50 x 50 x 6	10

2.12.8. For round ductwork the duct shall be supported as follows:

2.12.8.1.1. For duct dimensions 900 mm (36'') single strap hangers are acceptable.

2.12.8.1.2. For duct dimensions over 900 mm (36") use trapeze hangers with rods provided on both sides of the duct.

2.12.8.2. Minimum hanger sizes shall be in accordance with table 4-2 of SMACNA.

2.12.8.3. Loading on trapeze bars shall be in accordance with Table 4-3 of SMACNA

2.12.9. Install supports on both ends of duct turns, branch fittings and transitions.

2.12.10. Do not hang ductwork from piping, ducts, other trades hangers, existing hangers, or equipment.

2.12.11. Provide supports on each side of any duct mounted equipment or device, including fans, coils, dampers, etc, to permit removal of item without removal of adjacent duct sections.

2.12.12. Provide supplemental steel required to support ductwork in shafts, mechanical rooms or on the floor where structural steel is not properly positioned.

2.12.13. Beam clamps shall be double sided on ducts over 36 in. by 36 in. Use double sided or single sided beam clamps with retaining clips on all other sizes.

2.12.14. Do not modify existing structural steel without approval and a structural engineer’s review.

2.12.15. Provide clamping systems that are compatible with the structural steel system of the building.

2.12.16. Use angle iron "V" construction supports or similarly rigid construction for vertical ducting that requires lateral support.

2.12.17. Ductwork mounted on roof or otherwise exposed to elements shall be supported with non-penetrating supports constructed of galvanized steel angles and channels, regardless of duct size. Standard of Acceptance: Portable Pipe Hangers (Canada)

2.12.18. Provide angle sway bracing and diagonal cross bracing to the structure to provide support against maximum lateral loads that may be imposed on the ductwork installed downstream of fan discharges and ductwork exposed to wind loads, and any other locations exposed to lateral loads.

PART 3 - EXECUTION

3.1. **INSTALLATION**

3.1.1. Comply with provisions of Section 23 05 11, COMMON WORK RESULTS FOR HVAC, particularly regarding coordination with other trades and work in existing buildings.

3.1.2. Comply with the provisions of section 23 07 11 INSULATION FOR HVAC

3.1.3. Drawings show the general layout of ductwork and accessories but do not show all required fittings and offsets that may be necessary to connect ducts to equipment, boxes, diffusers, grilles, etc., and to coordinate with other trades. Fabricate ductwork based on field measurements. Provide all necessary fittings and offsets at no additional cost to the government. Coordinate with other trades for space available and relative location of HVAC equipment and accessories on ceiling grid. Duct sizes on the drawings are inside dimensions which shall be altered by Contractor to other dimensions with the same air handling characteristics where necessary to avoid interferences and clearance difficulties.

3.1.4. Ductwork shall be installed to true alignment, parallel or perpendicular to adjacent building walls, floors and ceilings, to present a neat and workmanlike appearance.

3.1.5. Provide duct transitions, offsets and connections to dampers, coils, and other equipment in accordance with SMACNA Standards, Section II. Provide streamliner, when an obstruction cannot be avoided and must be taken in by a duct. Repair galvanized areas with galvanizing repair compound.

3.1.6. Provide bolted construction and tie rod reinforcement in accordance with SMACNA Standards.

3.1.7. Construct casings, eliminators, and pipe penetrations in accordance with SMACNA Standards, Chapter 6. Design casing access doors to swing against air pressure so that pressure helps to maintain a tight seal.

3.1.8. Install duct hangers and supports in accordance with SMACNA Standards, Chapter 4.

3.1.9. For ductwork mounted outdoors, install duct with slight lateral pitch to prevent water ponding on top of duct.

3.1.10. Install special equipment items in ductwork systems including, but not limited to: control dampers, thermometers, airflow measuring devices and other related items, according to manufacturer's recommendations.

3.1.11. Seal openings around duct penetrations of floors and fire rated partitions with fire stop material as required by NFPA 90A.

3.1.12. Flexible duct installation: Refer to SMACNA Standards, Chapter 3. Ducts shall be continuous, single pieces not over 1.5 m (5 feet) long (NFPA 90A), as straight and short as feasible, adequately supported. Centerline radius of bends shall be not less than two duct diameters. Make connections with clamps as recommended by SMACNA. Clamp per SMACNA with one clamp on the core duct and one on the insulation jacket. Flexible ducts shall not penetrate floors, or any chase or partition designated as a fire or smoke barrier, including corridor partitions fire rated one hour or two hour. Support ducts SMACNA Standards.

3.1.13. Where diffusers, registers and grilles cannot be installed to avoid seeing inside the duct, paint the inside of the duct with flat black paint to reduce visibility.

3.1.14. Protection and Cleaning:

3.1.14.1. Adequately protect equipment and materials against physical damage. Place equipment in first class operating condition, or return to source of supply for repair or replacement, as determined by the Consultant. Protect equipment and ducts during construction against entry of foreign matter to the inside and clean both inside and outside before operation and painting. When new ducts are connected to existing ductwork, clean both new and existing ductwork by mopping and vacuum cleaning inside and outside before operation.

3.2. **DUCT LEAKAGE TESTS AND REPAIR**

3.2.1. Ductwork leakage testing shall be performed by the Testing and Balancing Contractor. For maximum leakage rates, refer to pressure classifications and sealing classifications included in part 2 of these specifications

3.2.2. Ductwork leakage testing shall be performed for the entire air distribution system (including all supply, return, exhaust and relief ductwork), section by section, including fans, coils and filter sections.

3.2.3. All ductwork shall be leak tested first before enclosed in a shaft or covered in other inaccessible areas.

3.2.4. If any portion of the duct system tested fails to meet the permissible leakage level, the Contractor shall rectify sealing of ductwork to bring it into compliance and shall retest it until acceptable leakage is demonstrated to the Resident Engineer.

3.2.5. All tests and necessary repairs shall be completed prior to insulation or concealment of ductwork.

3.2.6. Duct Leakage Testing Procedures:

3.2.6.1. Prior to fabrication and installation, develop and submit for approval a ductwork testing plan, indicating locations of temporary caps, surface area of ductwork test sections, test pressure, leakage class and allowable leakage in cubic feet per minute.

3.2.6.2. Notify the Client's Representative at least 2 days prior to each test.

3.2.6.3. Provide all blank-off plates, flanges, and safing required to isolate each section of duct to be tested.

3.2.6.4. Provide necessary testing apparatus.

3.2.6.5. For all ducts, pressurize ductwork to the specified pressure class and inspect ductwork for visual and audible leaks, and leaks perceptible to a hand 2 in. from duct. Reseal all perceptible leaks until acceptable to Client's Representative.

3.2.6.6. After completing visual and audible inspection, conduct measured ductwork leakage tests at the specified pressure class for the duct. Reseal and retest as required until successfully achieving the specified leakage class.

3.2.6.7. Submit leakage test report for approval, using SMACNA or other approved form.

3.2.6.8. Make sure all openings used for testing flow and temperatures by TAB Contractor are sealed properly.

3.3. **DUCT PAINTING**

3.3.1. Where the interior of duct is visible through grilles, registers, diffusers or other air diffusion devices, paint the interior flat black. Coordinate work with Architectural Trade.

3.3.2. For plenum returns, where equipment and structure above ceiling is visible through return air grilles, provide black sheet metal baffle with turned edges suspended from building construction. Size and position the baffle to prevent restriction of air flow. Where space above ceiling precludes use of a baffle, paint visible building surfaces flat black.

3.4. **DUCTWORK EXPOSED TO WIND VELOCITY**

3.4.1. Provide additional support and bracing to all exposed ductwork installed on the roof or outside the building to withstand wind velocity of145 km/h (90 mph).

3.4.2. All bracing to be to be stamped and sealed by a licensed Structural Professional Engineer and submitted for review. All engineering services required for additional strapping to be provided by the roof duct support manufacturer and paid for by the Contractor.

PART 1 - GENERAL

1.1. DESCRIPTION

1.1.1. Air terminal units, air flow control valves.

1.2. RELATED WORK

1.2.1. Section 01 33 23, SHOP DRAWINGS.
1.2.2. Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM GENERATION.
1.2.3. Section 23 05 41, NOISE and VIBRATION CONTROL
1.2.4. Section 23 05 93, TESTING, ADJUSTING, and BALANCING FOR HVAC.
1.2.5. Section 23 31 00, METALLIC DUCTWORK.

1.3. SUBMITTALS

1.3.1. Product Data shall be provided with data indicating configuration, general assembly, and materials used in fabrication, including catalog performance ratings that indicate air flow, static pressure, NC designation, electrical characteristics, and connection requirements.

1.3.2. Shop Drawings shall indicate configuration, general assembly, and materials used in fabrication, and electrical characteristics and connection requirements.

1.3.3. Manufacturer shall include schedules listing discharge and radiated sound power level for each of the second through seventh octave bands (125 – 4000 Hertz) at specified differential static pressures.

1.3.4. Manufacturer shall include schedules listing discharge and radiated sound power level for each of second through sixth octave bands at inlet static pressures from 1 to 4 inch water gauge.

1.3.5. Certificates shall be issued to certify that the air coil capacities, pressure drops, and selection procedures meet or exceed specified requirements or coils are tested and rated in accordance with AHRI 410.

1.3.6. Manufacturer's Installation Instructions shall indicate support and hanging details, installation instructions, recommendations, and service clearances required.

1.3.7. Project Record Documents shall record actual locations of units and controls components and locations of access doors.

1.3.8. Operation and Maintenance Data shall include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists. Include directions for resetting constant-volume regulators.

1.3.9. Manufacturer's warranty shall be submitted and ensure forms have been completed in Owner's name and registered with manufacturer.

1.3.10. Maintenance Materials shall be furnished for the Owner's use in maintenance of the project.

1.4. **QUALITY ASSURANCE**

1.4.1. Manufacturer Qualifications shall be specified in this section, with minimum ten years of documented experience.

1.4.2. Product Listing Organization Qualifications: The manufacturer shall be listed with an organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.5. **WARRANTY**

1.5.1. Provide 18 month manufacturer warranty from date of shipment for air terminal units, integral sound attenuators, integral heating coils, and integral controls.

1.6. **APPLICABLE PUBLICATIONS**

1.6.1. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

1.6.2. National Fire Protection Association (NFPA):

1.6.2.1. 90A-09 Standard for the Installation of Air Conditioning and Ventilating Systems

1.6.3. Underwriters Laboratories, Inc. (UL):

1.6.3.1. 181 08 Standard for Factory-Made Air Ducts and Air Connectors

1.6.4. American Society for Testing and Materials (ASTM):

1.6.4.1. C 665-06 Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing

1.7. **DELIVERY, STORAGE, AND HANDLING**

1.7.1. Mark each terminal unit before shipment to the job site with a unique identifier corresponding to its location and function in the building. Identifier nomenclature shall correspond to the Terminal Airflow Unit Detail.

PART 2 - PRODUCTS

2.1. **GENERAL**

2.1.1. Factory built, pressure independent units, factory set field adjustable air flow rate, suitable for single duct applications.

2.1.2. Clearly show on each unit the unit number and on the equipment schedules, factory set air volumes corresponding to the contract drawings.

2.1.3. Capacity and Performance: as noted in the equipment schedules. If not otherwise noted, the maximum capacity of a single terminal unit shall not exceed 566 Liters/second (1,200 CFM)

2.2. **ADMINISTRATIVE REQUIREMENTS**

2.2.1. Controls Contractor shall coordinate with the terminal airflow unit manufacturer to provide a complete operating system.

2.3. **SINGLE-DUCT TERMINAL VAV UNITS WITH DIRECT DIGITAL CONTROLS.**

2.3.1. Standard of Acceptance

2.3.1.1. Price Industries, Inc.
2.3.1.2. Trane
2.3.1.3. Titus

2.3.2. Performance Requirements:

2.3.2.1. The assemblies shall be pressure independent and shall reset to any air flow between zero and the maximum cataloged air volume.
2.3.2.2. For performance details, refer to the equipment schedules

2.3.2.3. Sound attenuation: Use attenuation values found in AHRI 885 Appendix E.

2.3.3. General:

2.3.3.1. The terminal units shall be factory-assembled, AHRI 880 rated and bearing the AHRI seal for an air volume control terminal with damper assembly and flow sensor.

2.3.4. Description:

2.3.4.1. Furnish and install single duct terminal units in the sizes and configurations as indicated on the plans.

2.3.5. Unit Casing:

2.3.5.1. The unit casing shall be constructed of a minimum 22 gauge, 0.032 inch galvanized steel.
2.3.5.2. The casing shall be assembled with longitudinal lock seam construction.
2.3.5.3. Casing leakage shall be tested in accordance with ASHRAE 130.
2.3.5.4. Casing leakage for the basic assembly shall not exceed 1.0 percent of the maximum rated airflow at 1.0 inches of water gauge.
2.3.5.5. Casing leakage for the basic assembly shall not exceed 2.0 percent of the maximum rated airflow at 3.0 inches of water gauge.

2.3.6. Unit Discharge:

2.3.6.1. Manufacturer shall provide rectangular unit discharges with slip-and-drive connections.

2.3.7. Liners:

2.3.7.1.1. Fiber-Free Foam Insulation

- Insulation shall comply with the requirements of UL 181 (erosion, mold growth and humidity) and ASHRAE 62.1, and shall have a maximum flame/smoke spread of 25/50 for both the insulation and the adhesive when tested in accordance with ASTM E84.
- The insulation shall be secured with adhesive.
- Insulation thickness shall be (select one): 1/2 inch thick, R-value of 2.0.

2.3.8. Primary Air Damper Assembly:

2.3.8.1. The damper assembly shall be heavy-gauge, galvanized steel with a solid shaft rotating in bearings.

2.3.8.2. The damper shaft shall incorporate a visual position indicator etched into the end of the damper shaft to clearly indicate damper position over the full range of 90 degrees.

2.3.8.3. The damper shaft shall be mounted on the left, right, top, or bottom of the damper when looking in the direction of airflow, as warranted by the site conditions.

2.3.8.4. The 18 gauge damper assembly shall incorporate a peripheral gasket on the damper blades for tight airflow shutoff.

2.3.8.5. Air leakage past the closed damper shall not exceed 2 percent of the unit maximum rated airflow at 3.0 inch water gauge inlet static pressure, tested in accordance with ASHRAE 130.

2.3.8.6. The damper, seal, and bearing system shall be tested to 1.25 million cycles, or the equivalent of 100 full open/closures per day for 35 years, with no visible signs of wear, tear, or failure of the damper assembly after such testing.

2.3.9. Airflow Sensor:

2.3.9.1. The airflow sensor shall be a differential pressure airflow device measuring total and static pressures, and mounted to the inlet valve.

2.3.9.2. Plastic parts shall be fire-resistant, complying with UL 94.

2.3.9.3. The airflow sensor shall be RoHS (Restriction of Hazardous Substances) compliant. Material containing polybrominated compounds shall not be acceptable.

2.3.9.4. Control tubing shall be protected by grommets at the wall of the airflow sensor's housing.

2.3.9.5. The airflow sensor shall be furnished with twelve total pressure sensing ports and four static pressure sensing ports, and shall include a center averaging chamber that amplifies the sensed airflow signal.

2.3.9.6. After balancing, the airflow sensor signal accuracy shall be plus or minus five percent throughout terminal operating range.

2.3.10. Inlet Valve - Standard:

2.3.10.1. The inlet valve shall be a consistent diameter to retain flex duct and provide a stop for hard duct.

2.3.10.2. The inlet valve shall include a 1/8 inch raised single bead weld for added strength.

2.3.10.3. The gasket seal shall be a low leakage continuous piece with a peripheral gasket for tight airflow shutoff.

2.3.10.4. The inlet valve shall include two heavy duty stop pins to accurately position the damper in the closed and open positions.

2.3.11. Options:

2.3.11.1. Bottom Access Door:

2.3.11.1.1. The unit shall be supplied with a 4 inch x 6-3/4 inch bottom access door, secured to the casing with quarter turn sash latches.

2.3.11.2. Hot Water Heating Coil:

2.3.11.2.1. N/A

2.3.11.3. Sound Attenuator:

2.3.11.3.1. The manufacturer shall supply sound attenuators to meet scheduled acoustical performance requirements. The attenuators shall be supplied in the following configuration (refer to drawings):

2.3.11.3.2. Three foot integral discharge attenuator.

2.3.11.3.3. Three foot discharge attenuator supplied as a separate piece.

2.3.11.4. Control Transformers:

2.3.11.4.1. The terminal unit shall be supplied with a factory mounted 50 VA control transformer.

2.3.11.5. Low Leakage Construction:

2.3.11.5.1. The terminals shall be provided with factory certified low leakage construction up to [three], [four], or [six] inches water gauge internal pressure.

2.3.11.5.2. Inlet dampers shall exhibit leakage rates of less than 0.5% of maximum nominal catalog airflow

2.3.11.5.3. Single duct casings shall exhibit external leakage rates of less than 1% of maximum nominal catalog airflow

2.3.11.5.4. Terminals with low leakage construction shall include the following design features:

- The access door shall be supplied with compression style gasketing and quarter turn latches.
- The unit casing shall be flanged and gasketed at all external casing seams.
- All production units shall be individually factory tested to ensure compliance with project specific leakage requirements.
- Leakage test results shall be documented on a label affixed to each certified low leakage unit.

2.3.12. Electrical Requirements:

2.3.12.1. Single duct terminal units shall be provided with single-point power connection.
2.3.12.2. The terminal unit equipment wiring shall comply with the requirements of CESC and NFPA 70.

2.3.13. Controls:

2.3.13.1. Equipment shall be equipped with a dedicated controller supplied by the BAS vendor.
2.3.13.2. The control installation can take place at the factory (pre-wired) or field provided by the BAS installer.
2.3.13.3. The temperature sensor shall be supplied and installed by the BAS vendor

2.3.13.4. Controls Sequence:

2.3.13.4.1. Refer to sequences noted on the drawings.

2.4. **SINGLE DUCT BYPASS TERMINAL UNITS WITH DIGITAL CONTROLS**

2.4.1.1. N/A

2.5. **AIR VOLUME CONTROL VALVE**

2.5.1. Standards of Acceptance

2.5.1.1. Price Industries, Inc.
2.5.1.2. Phoenix Controls
2.5.1.3. Trane

2.5.2. Construction:

2.5.2.1. The unit casing shall be constructed from a minimum 22 gauge, 0.032 inch zinc-coated steel.

2.5.2.2. The damper assembly shall be heavy-gauge, galvanized steel with a solid shaft rotating in bearings.

2.5.2.3. The damper shaft shall incorporate a visual position indicator etched into the end of the damper shaft to clearly indicate damper position over the full range of 90 degrees.

2.5.2.4. The 18 gauge damper assembly shall incorporate a peripheral gasket on the damper blades for tight airflow shutoff.

2.5.2.5. Air leakage past the closed damper shall not exceed two percent of the unit maximum airflow at three inches water gauge inlet static pressure, tested in accordance with ASHRAE 130.

2.5.2.6. The damper, seal and bearing system shall be tested to 1.25 million cycles, or the equivalent of 100 full open/closures per day for 35 years, with no visible signs of wear, tear, or failure of the damper assembly after such testing.

2.5.2.7. The controls enclosure shall be constructed from minimum 22 gauge, 0.032 inch zinc-coated steel.

2.5.2.8. The controls enclosure mounting bracket shall be zinc-coated steel.

2.5.3. Airflow Sensor

2.5.3.1. The airflow sensor shall be a differential pressure airflow device measuring total, static, and velocity pressures, mounted to the inlet valve.

2.5.3.2. Plastic parts shall be fire-resistant, complying with UL 94.

2.5.3.3. The airflow sensor shall be RoHS (Restriction of Hazardous Substances) compliant. Materials containing polybrominated compounds shall not be acceptable.

2.5.3.4. Control tubing shall be protected by grommets at the wall of the airflow sensor's housing.

2.5.3.5. The airflow sensor shall be furnished with twelve total pressure sensing ports, and include a center averaging chamber that amplifies the sensed airflow signal.

2.5.3.6. The airflow sensor signal accuracy shall be plus or minus five percent throughout terminal operating range.

2.5.4. Controls:

2.5.4.1. Equipment shall be equipped with a dedicated controller supplied by the BAS vendor.

2.5.4.2. The controller installation can take place at the factory (pre-wired) or field provided by the BAS installer.

2.5.5. Controls Sequence:

2.5.5.1. Refer to sequences noted on the drawings.

PART 3 - EXECUTION

3.1. **EXAMINATION AND PREPARATION**

3.1.1. Review and examine conditions affecting work. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2. **HANGER AND SUPPORT INSTALLATION**

3.2.1. Comply with applicable SMACNA HVAC Duct Construction Standards and Hanger and Support construction standards, and applicable Division 23 Sections.

3.2.2. Support terminal air units independently from adjacent ductwork. Ensure supports do not interfere with accessibility of other equipment, e.g., access to terminal air units BAS control enclosure. Do not hang terminal air units from piping, other ducts or equipment.

3.3. **INSTALLATION**

3.3.1. Work shall be installed as shown and according to the manufacturer’s diagrams and recommendations.

3.3.2. Handle and install units in accordance with manufacturer's written instructions.

3.3.3. Support units rigidly so they remain stationary at all times. Cross bracing or other means of stiffening shall be provided as necessary. Method of support shall be such that distortion and malfunction of units cannot occur.

3.3.4. Locate air terminal units to provide a straight section of inlet duct for proper functioning of volume controls.

3.4. **CLEANING AND PROTECTION**

3.4.1. Protect open end of terminal boxes, flow sensors and controllers throughout the entire construction period, until Substantial Completion.

PART 1 - GENERAL

1.1. DESCRIPTION

1.1.1. Air Outlets and Inlets: Diffusers, Registers, and Grilles.

1.2. RELATED WORK

1.2.1. Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM GENERATION.
1.2.2. Section 23 05 93, TESTING, ADJUSTING, and BALANCING FOR HVAC.

1.3. REFERENCE STANDARDS

1.3.1. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

1.3.2. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

1.3.3. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1.3.3.1. AMCA 500 Test Method for Louvers, Dampers and Shutters.
1.3.3.2. ANSI/NFPA 90A Installation of Air Conditioning and Ventilating Systems.
1.3.3.3. ARI 890 – Rating of Air Diffusers and Air Diffuser Assemblies.
1.3.3.4. ASHRAE 70 Method of Testing for Rating the Air Flow Performance of Outlets and Inlets.
1.3.3.5. SMACNA 1035 - HVAC Duct Construction Standards - Metal and Flexible.

1.4. QUALITY ASSURANCE

1.4.1. Test and rate performance of air outlets and inlets in accordance with ASHRAE 70.
1.4.2. Test and rate performance of louvers in accordance with AMCA 500.
1.4.3. Fire Safety Code: Comply with NFPA 90A.

1.5. SUBMITTALS

1.5.1. All air distribution equipment to be the product of the same manufacturer.

1.5.2. Submit in accordance with Section 01 33 23, SHOP DRAWINGS the following:

1.5.2.1. Manufacturer's name and model number
1.5.2.2. Identification as referenced in the documents
1.5.2.3. Capacities/ratings
1.5.2.4. Materials of construction
1.5.2.5. Sound ratings
1.5.2.6. Dimensions
1.5.2.7. Finish
1.5.2.8. Color selection charts where applicable
1.5.2.9. Manufacturer's installation instructions
1.5.2.10. Mounting methods and frames

PART 2 - PRODUCTS

2.1. SQUARE PLAQUE DIFFUSER

2.1.1. N/A

2.2. SQUARE PLAQUE DIFFUSER - FIRE RATED

2.2.1. N/A

2.3. ADJUSTABLE SQUARE CONE DIFFUSERS

2.3.1. General

2.3.1.1. The square cone diffuser shall be supplied to deliver a 360 degree radial, horizontal airflow pattern. The cones and backpan shall be one-piece die-formed with smooth, aerodynamically designed surfaces and no corner joints. This contoured design shall protect the ceiling and help to prevent smudging and streaking.

2.3.2. Construction:

2.3.2.1. Diffusers shall be aluminum construction, and shall consist of a seamless, one-piece, precision formed backpan that incorporates a round inlet collar of sufficient length for connecting rigid or flexible duct and an outer frame which is recessed from the ceiling plane to allow for field adjustment of the airflow discharge from fully horizontal to fully vertical.

2.3.2.2. An inner cone assembly shall consist of 3 cones (300x300 size) or 4 cones (600x600 size) which drop below the ceiling plane to assure optimal VAV air diffusion performance. The inner cone assembly shall be completely removable from the diffuser face to allow for full access to any dampers or other ductwork components located near the diffuser neck.

2.3.2.3. Non-protrusive airflow directional tabs shall be provided on the back of the inner cones which may be positioned for either horizontal or vertical discharge.

2.3.2.4. The diffuser ceiling module size and neck size shall be as noted on the drawings and equipment schedules.

2.3.3. Paint Specification:

2.3.3.1. Paint finish shall be as per the architectural finishing schedule. All components shall have a baked-on powder coat finish.

2.3.3.2. The paint finish must demonstrate no degradation when tested in accordance with ASTM D1308 (covered and spot immersion) and ASTM D4752 (MEK double rub) paint durability tests.

2.3.3.3. The paint film thickness shall be a minimum of 2.0 mils.

2.3.3.4. The finish shall have a hardness of 2H.

2.3.3.5. The finish shall withstand a minimum salt spray exposure of 500 hours with no measurable creep in accordance with ASTM D1654, and 1000 hours of exposure with no rusting or blistering as per ASTM D610 and ASTM D714.

2.3.3.6. The finish shall have an impact resistance of 80 inch-pounds.

2.3.3.7. All components shall have a custom finish in a color to match a customer supplied sample.

2.3.4. Mounting Frame:

2.3.4.1. The diffuser mounting frame shall be suitable for lay-in or surface mount applications. Refer to architectural reflected ceiling plan and architectural ceiling construction details.

2.3.5. Volume Control Damper:

2.3.5.1. The diffuser shall be supplied with a steel radial damper, diffuser mounted

2.3.6. Beaded Extended Neck:

2.3.6.1. The diffuser shall be supplied with a beaded neck extended to a depth of 2-1/2 inches.

2.4. **ADJUSTABLE SQUARE CONE DIFFUSERS - FIRE RATED**

2.4.1. N/A

2.5. **ROUND CONE DIFFUSER - ADJUSTABLE DISCHARGE PATTERN**

2.5.1. Round ceiling diffusers aluminum with steel screws, adjustable. The diffusers shall have four cones and round neck inlets of the sizes and mounting types shown on the plans and outlet schedule.

2.5.2. Round diffusers shall be constructed of 0.051 aluminum. The airflow discharge pattern shall be field adjustable from horizontal to vertical by extending or retracting the inner three cones.

2.5.3. These three cones shall be constructed as a single inner assembly and must be easily removable using a spring lock mechanism.

2.5.4. Vertical to horizontal discharge pattern must be achieved by one of three adjustment methods as follows:

2.5.4.1. Type 1. The inner cone assembly can be removed and repositioned by means of adjusting screws.
2.5.4.2. Type 2. The inner cone assembly can be adjusted by sliding the cones up or down.
2.5.4.3. Type 3. The center cone can be rotated clockwise or counterclockwise to move the cones up or down.

2.5.5. Volume Control

2.5.5.1. Round damper shall be constructed of heavy gauge steel. Damper must be operable from the face of the diffuser. A retainer cable shall be provided to allow the inner core assembly to hang during maintenance of diffusers with a neck size of 12 inches or greater.

2.5.6. Finish

2.5.6.1. The finish shall be as per the architectural finishing schedule.
2.5.6.2. The finish shall be an anodic acrylic paint, baked at 315°F for 30 minutes. The pencil hardness must be HB to H.
2.5.6.3. The paint must pass a 100-hour ASTM B117 Corrosive Environments Salt Spray Test without creepage, blistering or deterioration of film. The paint must pass a

250-hour ASTM D870 Water Immersion Test. The paint must also pass the ASTM D2794 Reverse Impact Cracking Test with a 50-inch pound force applied.

2.5.7. Standard of Acceptance: E.h.Price model ARCD, Titus, Ruskin

2.6. **ROUND PLAQUE DIFFUSER – ADJUSTABLE DISCHARGE PATTERN**

2.6.1. N/A

2.7. **T-BAR DIFFUSER - SLOPED PLENUM**

2.7.1. N/A

2.8. **T-BAR DIFFUSER - SLOPED PLENUM - FIRE RATED**

2.8.1. N/A

2.9. **ALUMINUM LOUVERED SUPPLY GRILLE**

2.9.1.1. N/A

2.10. **LINER BAR SUPPLY GRILLE**

2.10.1. Construction:

2.10.1.1. The grilles shall have fixed 0, 15, or 30 degree deflection blades spaced 1/4 inch, 1/2 inch, or 7/16 inch on center. Refer to drawings and equipment schedules. The blades shall run parallel to the long dimension of the grille.

2.10.1.2. The grille blades, border, and mullions material shall be heavy extruded aluminum construction.

2.10.1.3. Units wider than 18 inches shall be supplied in multiple sections with mounting channels. The maximum section length shall be 1,800 mm (72 inches).

2.10.1.4. The core shall be supplied with 3/32 inch, 1/8 inch, or 3/16 inch bars - refer to drawings and equipment schedules.

2.10.2. Paint Specification:

2.10.2.1. All components shall have a baked-on powder coat finish.

2.10.2.2. The paint finish must demonstrate no degradation when tested in accordance with ASTM D1308 (covered and spot immersion) and ASTM D4752 (MEK double rub) paint durability tests.

2.10.2.3. The paint film thickness shall be a minimum of 2.0 mils.

2.10.2.4. The finish shall have a hardness of 2H.

2.10.2.5. The finish shall withstand a minimum salt spray exposure of 1000 hours with no measurable creep in accordance with ASTM D1654, and 1000 hours of exposure with no rusting or blistering as per ASTM D610 and ASTM D714.

2.10.2.6. The finish shall have an impact resistance of 80 inch-pounds.

2.10.2.7. The frame shall have a brushed finish and clear-coated, and the core bars shall be clear-coated only.

2.10.3. End Conditions:

2.10.3.1. The grille shall be supplied with the following end conditions, as noted on the drawings and architectural details:

2.10.3.1.1. Both ends mitred.

2.10.3.1.2. One end mitred, one end open

2.10.3.1.3. Both ends open

2.10.4. Opposed Blade Damper:

2.10.4.1. The grille shall be supplied with an opposed blade damper and shall be operable from the grille face.

2.10.4.2. The damper shall be coated heavy duty 18 gauge cold rolled steel construction, and shall be supplied with a face accessible screw type blade locking mechanism.

2.10.5. Border Style:

2.10.5.1. The grille shall be suitable for surface mounting (not acceptable for floor mounting), complete with a border in the following style - refer to drawings, schedules and architectural details:

2.10.5.1.1. Core only.

2.10.5.1.2. 1/2 inch border.

2.10.5.1.3. 3/4 inch border.

2.10.5.1.4. 3/4 inch border with mounting frame.

2.10.5.1.5. 1 inch border.

2.10.5.1.6. 1 inch border with mounting frame.

2.10.6. Fastening:

2.10.6.1. The grille shall be supplied with the following fastening method: countersunk screw holes with factory-supplied screws.

2.10.7. Mitered Corner Module:

2.10.7.1. The grille shall be supplied with a mitered corner module fixed at 90 or 135 degrees. Refer to layout drawings

2.10.8. Sidewall Mitered Corner:

2.10.8.1. The grille shall be supplied with a sidewall type mitered corner for an inside or outside corner installation. Refer to drawing layouts.

2.10.9. Standard of Acceptance: E.H.Price LBP serires, Titus, Ruskin

2.11. **EGG-CRATE RETURN GRILLE**

2.11.1. Construction:

2.11.1.1. Grilles shall be aluminum construction, consisting of an extruded aluminum border and an aluminum ½ x ½ x ½ inch grid egg crate core.

2.11.1.2. The minimum grille size shall be 150x100 mm (6x4 inches). The maximum one-piece grille size without a mullion shall be 1,200x600 mm (48 inches x 24 inches). The maximum size grille size with a mullion is 2,400x1,200 mm (96 x 48 inches).

2.11.2. Paint Specification:

2.11.2.1. All components shall have a baked-on powder coat finish. Finish color as per the architectural schedules.

2.11.2.2. The paint finish must demonstrate no degradation when tested in accordance with ASTM D1308 (covered and spot immersion) and ASTM D4752 (MEK double rub) paint durability tests.

2.11.2.3. The paint film thickness shall be a minimum of 2.0 mils.

2.11.2.4. The finish shall have a hardness of 2H.

2.11.2.5. The finish shall withstand a minimum salt spray exposure of 500 hours with no measurable creep in accordance with ASTM D1654, and 1000 hours of exposure with no rusting or blistering as per ASTM D610 and ASTM D714.

2.11.2.6. The finish shall have an impact resistance of 80 inch-pounds.

2.11.3. Volume control

2.11.3.1. The grille shall be supplied with an aluminum with mill finish opposed blade damper.

2.11.4. Border Style:

2.11.4.1. The grille shall be suitable for sidewall, exposed duct, or T-bar lay-in mounting, complete with a border in the following styles - refer to layouts and equipment schedules:

2.11.4.1.1. 1-1/4 inch flat face border for surface mount applications.
2.11.4.1.2. Narrow flat face border for 15/16 inch T-bar lay-in.
2.11.4.1.3. Exposed duct border for mounting directly to exposed ducts.
2.11.4.1.4. Core only (no border) for 15/16 inch T-bar applications.

2.11.5. Mounting Frames:

2.11.5.1. The grille shall be supplied with a 3/8 inch flat border mounting frame.

2.11.6. Fastening:

2.11.6.1. The grille shall be supplied with

2.11.6.1.1. Countersunk screw holes complete with oval-head screws where surface mounted.
2.11.6.1.2. No screw holes (default for T-Bar frames).

2.11.7. Standard of Acceptance:

2.11.7.1. E.H.Price series 80, Titus, Ruskin

2.12. **ALUMINUM LOUVERED RETURN GRILLE**

2.12.1.1. N/A

2.13. **HEAVY DUTY GYM RETURN GRILLE**

2.13.1. Construction:

2.13.1.1. The grille blades and border shall be aluminum construction. The heavy duty extruded aluminum blades shall be held by mandrel tubes with spacing no greater than 12 inches on center.

2.13.1.2. The 14 gauge steel border shall have smooth contours to reduce the possibility of injury to occupants when installed in a gymnasium.

2.13.1.3. Grilles shall be fixed louver type, and shall have - see drawings and equipment schedules:

2.13.1.3.1. Zero (0) degree deflection, 1/2 inch on center blade spacing.

2.13.1.3.2. Forty-five (45) degree deflection, 1/2 inch on center blade spacing.

2.13.1.3.3. Thirty (30) degree deflection, 1/2 inch on center blade spacing.

2.13.1.4. The grille blade orientation shall be front blades parallel to the long dimension.

2.13.1.5. The grille shall be suitable for surface mounting with 1-1/4 inch flat border.

2.13.2. Paint Specification:

2.13.2.1. All components shall have a baked-on powder coat finish. See architectural finishing schedules

2.13.2.2. The paint finish must demonstrate no degradation when tested in accordance with ASTM D1308 (covered and spot immersion) and ASTM D4752 (MEK double rub) paint durability tests.

2.13.2.3. The paint film thickness shall be a minimum of 2.0 mils.

2.13.2.4. The finish shall have a hardness of 2H.

2.13.2.5. The finish shall withstand a minimum salt spray exposure of 1000 hours with no measurable creep in accordance with ASTM D1654, and 1000 hours of exposure with no rusting or blistering as per ASTM D610 and ASTM D714.

2.13.2.6. The finish shall have an impact resistance of 80 inch-pounds.

2.13.3. Volume Control

2.13.3.1. The register shall be supplied with a mill finish aluminum opposed blade damper. The damper shall be operable from the register face.

2.13.4. Fastening:

2.13.4.1. The grille shall be supplied with the following fastening method

2.13.4.1.1. Countersunk screw holes complete with screws.

2.13.4.1.2. Concealed fastening (only applicable to Models 98 or 99).

2.13.5. Standard of Acceptance:

2.13.5.1. E.H.Price 97/98/99 series, Titus, Ruskin

2.14. **HIGH-CAPACITY DRUM LOUVER/DIFFUSER**

2.14.1.1. N/A

2.15.

2.16. **OUTDOOR LOUVER 4" DEEP, 39° EXTRUDED DRAINABLE BLADE**

2.16.1.1. N/A

2.17. **OUTDOOR STATIONARY LOUVER 2” DEEP J-BLADE**

2.17.1. N/A

2.18. **DRAINABLE LOUVERED PENTHOUSE, 39° BLADE 4” DEEP**

2.18.1.1. N/A

PART 3 - EXECUTION

3.1. **GENERAL**

3.1.1. All installation shall be in accordance with manufacturer’s published recommendations.

3.1.2. Check location of air outlets and inlets and make necessary adjustments in position to conform to architectural features, reflected ceiling plans, symmetry, and lighting arrangement. Coordinate location of air distribution equipment with lighting fixtures, fire alarm and PA devices.

3.1.3. Install air outlets and inlets to ductwork with airtight connection.

3.1.4. Provide balancing dampers on duct take off to diffusers, grilles and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

3.1.5. Provide all specialties and frames for air distribution devices as required for proper installation in ceiling type as indicated on Architectural Drawings. Provide all cutting and patching of T-bars, gypsum board, and other ceiling systems as required for installation of air devices.

3.1.6. Where diffusers, registers and grilles cannot be installed to avoid seeing inside duct, paint inside of duct with flat black paint to reduce visibility.

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PART 1 - GENERAL

1.1. DESCRIPTION

1.1.1. Motorized dampers not included as part of pre-manufactured air handling equipment
1.1.2. Fire dampers
1.1.3. Smoke Dampers
1.1.4. Combination Fire/Smoke Dampers

1.2. MOTORIZED DAMPERS TYPE

1.2.1. All modulating motorized dampers shall be opposed-blades type
1.2.2. All two-position motorized dampers shall be parallel type

1.3. SUBMITTALS

1.3.1. Product Data: Submit performance data, rated capacities, furnished specialties, sound-power ratings, and accessories for each type of product.

1.3.2. Damper manufacturer's installation instructions.

1.3.3. Product Data for each type of product.

1.3.4. Shop Drawings:

1.3.4.1. Indicate the location and rating of all dampers on shop drawings and submittals.
1.3.4.2. Operation and maintenance data.

1.3.5. Damper Operators

1.3.5.1. Refer to section 23 09 23 DIGITAL CONTROLS

1.3.6. Record Documents:

1.3.6.1. Fire Dampers: The damper manufacturer’s literature submitted for approval prior to the installation shall include performance data developed from testing in accordance with AMCA 500D standards and shall show the pressure drops for all sizes of dampers required at anticipated air flow rates. Maximum pressure drop through fire damper shall not exceed 0.05-inch water gauge.

1.3.6.2. Combination Fire/Smoke Dampers: Assign identification numbers for each damper with corresponding number noted on Drawings. Provide air quantity, size, free area of damper, pressure drop and proposed velocity through each damper. Provide manufacturer's data of damper and its accessories or options. At Owner's request, provide two (2) dampers (18-inch x 12 inch) for the purpose of illustrating damper operation to Owner's operating and maintenance personnel.

1.3.7. Access Doors. Include type of material, installation guidelines, leakage rates and maximum pressure data.

1.3.8. Volume Control Dampers. Include type of material, installation guidelines, pressure drop and maximum pressure data.

1.4. **APPLICABLE PUBLICATIONS**

1.4.1. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

1.4.2. American Society for Testing and Materials (ASTM):

1.4.2.1. A167 99 (2004) Standard Specification for Stainless and Heat Resisting Chromium Nickel Steel Plate, Sheet and Strip

1.4.2.2. B209 07 Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate

1.4.3. National Fire Protection Association (NFPA):

1.4.3.1. 90A-09 Standard for the Installation of Air Conditioning and Ventilating Systems

1.4.4. Underwriters Laboratories, Inc. (UL):

1.4.4.1. 181 08 UL Standard for Safety Factory Made Air Ducts and Connectors

PART 2 - PRODUCTS

2.1. **THERMALLY INSULATED DAMPER**

2.1.1. Extruded aluminum (6063-T5) damper frame shall not be less than 0.080" (2.03 mm) in thickness. Damper frame shall be 4" (101.6 mm) deep x 1" (25.4 mm), with duct mounting flanges on both sides of frame. Damper frame shall have a 2" (50.8 mm)

mounting flange on the rear of the damper, when installed as Extended Rear Flange install type. Frame to be assembled using zinc-plated steel mounting fasteners. Welded frames shall not be acceptable.

2.1.2. Blades shall be maximum 6" (152.4 mm) deep extruded aluminum (6063-T5) air-foil profiles with a minimum wall thickness of 0.06” (1.52mm). Blades shall be internally insulated with expanded polyurethane foam and shall be thermally broken. Complete blade shall have an insulating factor of R-2.29. All blades shall be symmetrically pivoted.

2.1.3. Blade seals shall be extruded EPDM, secured in an integral slot within the aluminum blade extrusions and shall be mechanically fastened to prevent shrinkage and movement over the life of the damper. Adhesive or clip-on type blade seals will not be approved.

2.1.4. Frame seals shall be extruded silicone, secured in an integral slot within the aluminum frame extrusions and shall be mechanically fastened to prevent shrinkage and movement over the life of the damper. Metallic compression type jamb seals will not be approved.

2.1.5. Bearings shall be a dual bearing system composed of a Celcon inner bearing (fixed around a 7/16" (11.11 mm) aluminum hexagon blade pivot pin), rotating within a polycarbonate outer bearing inserted in the frame. Single axle bearing, rotating in an extruded or punched hole shall not be acceptable.

2.1.6. Hexagonal control shaft shall be 7/16" (11.11 mm). It shall have an adjustable length and shall be an integral part of the blade axle. A field-applied control shaft shall not be acceptable. All parts shall be zinc-plated steel.

2.1.7. Linkage hardware shall be aluminum and corrosion-resistant zinc-plated steel, installed in the frame side, out of the airstream, and accessible after installation. Linkage hardware shall be complete with cup-point trunnion screws to prevent linkage slippage and a Celcon bearing between moving parts to reduce wear and increase longevity. Linkage that consists of metal rubbing metal will not be approved.

2.1.8. Dampers shall be designed for operation in temperatures ranging from -40°F (-40°C) to 212°F (100°C).

2.1.9. Dampers shall be AMCA rated for Leakage Class 1A at 1 in w.g. (0.25 kPa) static pressure differential. Standard air leakage data to be certified under the AMCA Certified Ratings Program.

2.1.10. Dampers shall be custom made to required size, with blade stops not exceeding 1¼" (31.7 mm) in height. The blade stop shall be a continuous and integral part of the head/sill. Welded and caulked blade stops shall not be acceptable.

2.1.11. Dampers shall be opposed blade action or parallel blade action as indicated on the plans or specified herein.

2.1.12. Dampers shall be installed in the following manner: Flanged to Duct, Installed in Duct, Extended Rear Flange, or Square to Round Transition. (Specify one.)

2.1.13. Installation of dampers must be in accordance with TAMCO's current installation guidelines, provided with each damper shipment.

2.1.14. Field supplied intermediate structural support is required to resist applied pressure loads for dampers that consist of two or more sections in both height and width. (See TAMCO Aluminum Damper Installation Guidelines.)

2.1.15. SC - Severe Cold Temperature Option:

2.1.15.1. Blade seals shall be extruded silicone, secured in an integral slot within the aluminum blade extrusions and shall be mechanically fastened to prevent shrinkage and movement over the life of the damper. Adhesive or clip-on type blade seals will not be approved.

2.1.16. MR - Moisture Resistance Option:

2.1.16.1. Extruded aluminum (6063-T5) damper frame shall not be less than 0.080" (2.03 mm) in thickness. Damper frame shall be 4" (101.6 mm) deep x 1" (25.4 mm), with duct mounting flanges on both sides of frame. Damper frame shall have a 2" (50.8 mm) mounting flange on the rear of the damper, when installed as Extended Rear Flange install type. Frame shall be assembled using stainless steel screws. Welded frames shall not be acceptable.

2.1.16.2. Hexagonal control shaft shall be 7/16" (11.11 mm). It shall have an adjustable length and shall be an integral part of the blade axle. A field-applied control shaft shall not be acceptable. All parts shall be stainless steel.

2.1.16.3. Linkage hardware shall be aluminum and stainless steel, installed in the frame side, out of the airstream, and accessible after installation. Linkage hardware shall be complete with stainless steel cup-point trunnion screws to prevent linkage slippage and a Celcon bearing between moving parts to reduce wear and

increase longevity. Linkage that consists of metal rubbing metal will not be approved.

2.1.17. Standard of Acceptance: Taco 9000 series, Ruskin

2.2. **ENHANCED AIR-FOIL CONTROL DAMPER**

2.2.1. Extruded aluminum (6063-T5) damper frame shall not be less than 0.080” (2.03 mm) in thickness. Damper frame shall be 4” (101.6 mm) deep x 1" (25.4 mm), with duct mounting flanges on both sides of frame. Damper frame shall have a 2" (50.8 mm) mounting flange on the rear of the damper, when installed as Extended Rear Flange install type. Frame to be assembled using zinc-plated steel mounting fasteners. Welded frames shall not be acceptable.

2.2.2. Blades shall be maximum 6" (152.4 mm) deep extruded aluminum (6063-T5) air-foil profiles with a minimum wall thickness of 0.06” (1.52mm). Aluminum end caps shall be press fitted to blade ends, in order to seal hollow interior and reduce air leakage rates. All blades shall be symmetrically pivoted.

2.2.3. Blade seals shall be extruded silicone, secured in an integral slot within the aluminum blade extrusions and shall be mechanically fastened to prevent shrinkage and movement over the life of the damper. Adhesive or clip-on type blade seals will not be approved.

2.2.4. Frame seals shall be extruded silicone, secured in an integral slot within the aluminum frame extrusions and shall be mechanically fastened to prevent shrinkage and movement over the life of the damper. Metallic compression type jamb seals will not be approved.

2.2.5. Bearings shall be a dual bearing system composed of a Celcon inner bearing (fixed around a 7/16" (11.11 mm) aluminum hexagon blade pivot pin), rotating within a polycarbonate outer bearing inserted in the frame. Single axle bearing, rotating in an extruded or punched hole shall not be acceptable.

2.2.6. Hexagonal control shaft shall be 7/16" (11.11 mm). It shall have an adjustable length and shall be an integral part of the blade axle. A field-applied control shaft shall not be acceptable. All parts shall be zinc-plated steel.

2.2.7. Linkage hardware shall be aluminum and corrosion-resistant zinc-plated steel, installed in the frame side, out of the airstream, and accessible after installation. Linkage hardware shall be complete with cup-point trunnion screws to prevent linkage slippage

and a Celcon bearing between moving parts to reduce wear and increase longevity. Linkage that consists of metal rubbing metal will not be approved.

2.2.8. Dampers shall be designed for operation in temperatures ranging from -40°F (-40°C) to 212°F (100°C).

2.2.9. Dampers shall be AMCA rated for Leakage Class 1A at 1 in. w.g. (0.25 kPa) static pressure differential. Standard air leakage data to be certified under the AMCA Certified Ratings Program.

2.2.10. Dampers shall be custom made to required size, with blade stops not exceeding 1¼" (31.7 mm) in height. Welded and caulked blade stops shall not be acceptable.

2.2.11. Dampers shall be opposed blade or parallel blade action, as indicated on the plans and specified herein.

2.2.12. Dampers shall be installed in the following manner: Flanged to Duct, Installed in Duct, Extended Rear Flange, or Square to Round Transition. (Specify one.)

2.2.13. Installation of dampers must be in accordance with TAMCO's current installation guidelines, provided with each damper shipment.

2.2.14. Field-supplied intermediate structural support is required to resist applied pressure loads for dampers that consist of two or more sections in both height and width. (See TAMCO Aluminum Damper Installation Guidelines.)

2.2.15. ET - Elevated Temperature Option (Up To 300°F (149°C):

2.2.15.1. Bearings shall be a dual bearing system composed of a bronze oilite inner bearing (fixed around a 7/16" (11.11 mm) aluminum hexagon blade pivot pin), rotating within a bronze oilite outer bearing inserted in the frame. Single axle bearing, rotating in an extruded or punched hole shall not be acceptable

2.2.15.2. Linkage hardware shall be aluminum and corrosion-resistant zinc-plated steel, installed in the frame side, out of the airstream, and accessible after installation. Linkage hardware shall be complete with cup-point trunnion screws to prevent linkage slippage. Trunnion bearings shall be bronze oilite. Linkage that consists of steel rubbing steel will not be approved.

2.2.15.3. Dampers shall be designed for operation in temperatures ranging from -40°F (-40°C) to 300°F (149°C).

2.2.16. MR - Moisture Resistance Option:

2.2.16.1. Extruded aluminum (6063-T5) damper frame shall not be less than 0.080” (2.03 mm) in thickness. Damper frame shall be 4” (101.6 mm) deep x 1" (25.4 mm), with duct mounting flanges on both sides of frame. Damper frame shall have a 2" (50.8 mm) mounting flange on the rear of the damper, when installed as Extended Rear Flange install type. Frame shall be assembled using stainless steel screws. Welded frames shall not be acceptable.

2.2.16.2. Hexagonal control shaft shall be 7/16" (11.11 mm). It shall have an adjustable length and shall be an integral part of the blade axle. A field-applied control shaft shall not be acceptable. All parts shall be stainless steel.

2.2.16.3. Linkage hardware shall be aluminum and stainless steel, installed in the frame side, out of the airstream, and accessible after installation. Linkage hardware shall be complete with stainless steel cup-point trunnion screws to prevent linkage slippage and a Celcon bearing between moving parts to reduce wear and increase longevity. Linkage that consists of metal rubbing metal will not be approved.

2.2.17. Standard of Acceptance: Tamco 1500 series, Ruskin

2.3. **FIRE DAMPERS**

2.3.1. Each fire damper shall be constructed and tested in accordance with Underwriters Laboratories Safety Standard 555, latest edition. Dampers shall possess a 1 1/2 hour or 3 hour (as appropriate for the construction shown in the architectural Drawings) protection rating, 165 degrees F fusible link, and shall bear a U.L. label in accordance with Underwriters' Laboratories labeling procedures. Construct fire dampers such that damper frame material and curtain material are galvanized [and 304 stainless steel for dampers serving untreated outside air].

2.3.2. Fire dampers shall be curtain blade type and damper shall be constructed so that the blades are out of the air stream to provide 100 percent free area of duct in which the damper is housed (Type B).

2.3.3. Use Curtain Type Fire Dampers for fire dampers where possible. Use Multiple Blade Fire Dampers for fire damper sizes that exceed manufacturer’s allowable Curtain Type Fire Damper sizes, or where velocities or pressures exceed Curtain Type Fire Dampers.

2.3.4. Equip fire dampers for vertical or horizontal installation as required by location shown on Drawings. Install fire dampers in wall and floor openings utilizing steel sleeves, angles and other material and practices as required to provide an installation equivalent to that utilized by the manufacturer when the respective dampers were tested by Underwriters Laboratories. Mounting angles shall be provided and installed per manufacturer's instructions. Damper shall have 5" frame constructed of minimum 20 gauge galvanized steel. Blades shall be minimum 24 gauge galvanized steel. Closure spring shall be Type 301 stainless steel, constant force or spring clip type. Damper shall be classified for dynamic closure to 2000 fpm and 4 inches w.g. static pressure.

2.3.5. Completely seal the damper assembly to the building components using manufacturer recommended material(s).

2.3.6. Standard of Acceptance: Ruskin, Greenheck, Nailor

2.4. **COMBINATION FIRE/SMOKE DAMPERS**

2.4.1. Each combination fire/smoke damper shall be 1½ hour or 3 hour (as appropriate for the construction shown in the architectural drawings) fire rated under UL Standard 555, Current Edition, and shall be further classified by Underwriters Laboratories as a Leakage Rated Damper for use in smoke control systems under the latest version of UL555S, and bear a UL label attesting to same. Damper manufacturer shall have tested and qualified with UL, a complete range of damper sizes covering all dampers required by this Specification. Testing and UL qualifying a single damper size is not acceptable. The leakage rating under UL555S shall be no higher than Leakage Class I (4 CFM per square foot at one-inch water gauge pressure and 8 CFM per square foot at 4 inches water gauge pressure). Maximum air pressure drop through each combination fire/smoke damper shall not exceed 0.10-inch water gauge at 2,000 feet per minute through a 24 x 24 inch damper. All ratings shall be dynamic.

2.4.2. Damper frame shall be minimum 16-gage galvanized steel formed into a structural hat channel shape with tabbed corners for reinforcement, as approved in testing by Underwriters Laboratories. Bearings shall be integral high surface area non electrolytic materials construction to incorporate a friction free frame blade lap seal, or molybdenum disulfide impregnated stainless steel or bronze oilite sleeve type turning in an extruded hole in the frame or an extruded frame raceway. Dampers may be either parallel or opposed blade type. Blades shall be airfoil type and constructed with a minimum of 14-gage equivalent thickness. Blade edge seal material shall be able to withstand 450 degrees F. Jamb seals shall be flexible stainless steel compression type or lap seal type.

2.4.3. In addition to the leakage ratings specified herein, combination fire/smoke dampers and their operators shall be qualified under UL555S to an elevated temperature of 350 degrees F. Electric operators shall be installed by the damper manufacturer at the time of damper fabrication. Damper and operator shall be supplied as a single entity that meets all applicable UL555 and UL555S qualifications for both dampers and operators. Manufacturer shall provide a factory-assembled sleeve.

2.4.4. As part of the UL qualification, dampers shall have demonstrated a capacity to operate (open and close) under HVAC system operation conditions, with pressures at least 6 inches water gauge in the closed position, and 3000 fpm air velocity in the open position for damper sizes up to a 120”x96” for vertical installation and 144”x96” for horizontal installation.

2.4.5. Each combination fire/smoke damper, except as noted hereinafter, shall be equipped with a UL Classified firestat/releasing device. The firestat/releasing device shall electrically lock the damper in a closed position when the duct temperatures exceed 165 degrees F and still allow the appropriate authority to operate the damper as may be required for smoke control functions. Damper must be operable while the temperature is above 350 degrees F. Actuator/operator package shall include two damper position indicator switches linked directly to damper blade to provide capability of remotely indicating damper position. One switch shall close when the damper is fully open, and the other switch shall close when the damper is fully closed. The firestat/releasing device and position indicator switches shall be capable of interfacing electrically with the smoke detectors, building fire alarm system, and remote indicating/control stations or building automation system (BAS).

2.4.6. Temperature Release Device. Close in a controlled manner and lock damper during test, smoke detection, power failure, or fire conditions through actuator closure spring. At no time shall actuator disengage from damper blades. Allow damper to be automatically and remotely reset after test or power failure conditions. After exposure to high temperature or fire, inspect damper before reset to ensure proper operation. Controlled closing and locking of damper in 7 to 15 seconds to allow duct pressure to equalize. Instantaneous closure is not acceptable.

2.4.7. Actuators for operation of smoke dampers shall be smoke system fail safe, spring return normally open supplies and normally closed returns, or as indicated on the Drawings, and shall be furnished and installed by the damper manufacturer as required by the U.L. rating mentioned above. Actuators shall be electric[120V] [24V], 60 Hz to match the type of temperature control system specified elsewhere in this Specification. Furnish all required relays, EP switches, wiring and other labor and material necessary to completely interconnect the smoke detector system.

2.4.8. Furnish each damper in a square or rectangular configuration. Furnish and install sleeves manufactured by the approved damper manufacturer for each damper. Construct sleeves with square or rectangular to square, rectangular, round, or oval adapters as required. Dampers shall be installed in the sleeves in accordance with manufacturer's U.L. installation instructions. The entire assembly, following installation, shall operate smoothly.

2.4.9. Each combination fire/smoke damper shall be equipped with a Damper Test Switch. The damper test switch will have the ability to "cycle test" the fire/smoke damper by pushing and holding the test button until the damper has cycled.

2.4.10. Dampers shall have a minimum 5-year warranty.

2.4.11. Completely seal the damper assembly to the building components using manufacturer recommended material(s).

2.4.12. Standard of Acceptance: Ruskin, Greenheck, Nailor

2.5. **SMOKE DAMPERS**

2.5.1. Each smoke damper shall be dynamic rated type and shall be further classified by Underwriters Laboratories as a Leakage Rated Damper for use in smoke control systems under the latest version of UL555S, and bear a UL label attesting to same. Damper manufacturer shall have tested, and qualified with UL, a complete range of damper sizes covering all dampers required by this Specification. Testing and UL qualifying a single damper size is not acceptable. Leakage rating under UL555S shall be no higher than Leakage Class I (4 CFM per square foot at one-inch water gauge pressure and 8 CFM per square foot at 4 inches water gauge pressure). Maximum air pressure drop through each smoke damper shall not exceed 0.10-inch water gauge at 2,000 feet per minute through a 24 x 24 inch damper. All ratings shall be dynamic.

2.5.2. Damper frame shall be minimum 16-gauge galvanized formed into a structural hat channel shape with corner braces for reinforcement, as approved in testing by Underwriters Laboratories. Bearings shall be stainless steel sleeve type turning in an extruded hole in the frame or an extruded frame raceway. Dampers shall be opposed blade type. Blades shall be constructed from minimum 14 gauge equivalent galvanized steel. Blades shall be airfoil shaped double skin construction. Blade edge seal material shall be silicone rubber designed to withstand 450 degrees F. Jamb seals shall be aluminum flexible metal compression type.

2.5.3. In addition to the leakage ratings specified herein, smoke dampers and their operators shall be qualified under UL555S to an elevated temperature of 350 degrees F. Two position [120V][24V], 60 Hz electric operators shall be installed by the damper manufacturer at the time of damper fabrication. Damper and operator shall be supplied as a single entity that meets all applicable UL555 and UL555S qualifications for both dampers and operators.

2.5.4. As part of the UL qualification, dampers shall have demonstrated a capacity to operate (open and close) under HVAC system operation conditions, with pressures of at least 6 inches water gauge in the closed position, and 3000 fpm air velocity in the open position for damper sizes up to a 120”x96” for vertical installation and 144”x96” for horizontal installation.

2.5.5. The damper must be operable while the temperature is above 350 degrees F. The actuator/operator package shall include two damper position indicator switches linked directly to damper blade to provide capability of remotely indicating damper position. One switch shall close when the damper is fully open, and the other switch shall close when the damper is fully closed. Position indicator switches shall be capable of interfacing electrically with the smoke detectors, building fire alarm systems, and remote indicating/control stations (BAS).

2.5.6. Actuators for operation of smoke dampers shall be smoke system fail safe, spring return or as indicated on the Drawings, and shall be furnished and installed by the damper manufacturer as required by the UL rating mentioned above. Actuators shall be electric to match the type of temperature control system specified elsewhere in this Specification. Furnish all required relays, EP switches, wiring and other labor and material necessary to completely interconnect the smoke detector system.

2.5.7. Furnish each damper in a square or rectangular configuration. Furnish and install sleeves manufactured by the approved damper manufacturer for each damper. Construct sleeves with square or rectangular to square, rectangular, round, or oval adapters as required. Install dampers in the sleeves in accordance with manufacturer’s UL installation instructions. Entire assembly, following installation, shall operate smoothly.

2.5.8. Each smoke damper shall be equipped with a Damper Test Switch. The damper test switch will have the ability to “cycle test” the smoke damper by pushing and holding the test button until the damper has cycled.

2.5.9. Completely seal the damper assembly to the building components.

2.5.10. Standard of Acceptance: Ruskin, Greenheck, Nailor

PART 3 - INSTALLATION

3.1. GENERAL

3.1.1. Installation shall meet or exceed all applicable requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

3.1.2. All installation shall be in accordance with manufacturer's published recommendations.

3.1.3. Provide motorized dampers where indicated on the drawings and control schematics.

3.1.4. Provide all motorized dampers furnished by the BAS Provider in strict accordance with manufacturer's written installation instruction and requirements of these Specifications.

3.1.5. Provide fire dampers, and combination fire and smoke dampers at locations indicated, where ducts and outlets pass through fire rated components. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.

3.2. MOTORIZED DAMPERS

3.2.1. Dampers shall be installed square and plumb to casing, duct, wall, etc. without racking. Align and adjust dampers to ensure proper opening and closing without binding or hesitation.

3.2.2. Seal completely around frame. Provide necessary blank off plates required to install dampers that are smaller than duct size. Provide necessary transitions required to install dampers larger than duct size.

3.2.3. Assemble multiple sections dampers with required interconnecting linkage and extend required number of shafts through duct for external mounting of damper motors.

3.2.4. Provide necessary sheet metal baffle plates to eliminate stratification and provide air volumes specified. Locate baffles by experimentation, and affix and seal permanently in place, only after stratification problem has been eliminated.

3.2.5. Install all damper control/adjustment devices on stand-offs to allow complete coverage of insulation.

3.2.6. Install dampers designed for horizontal mounting in horizontal orientation, and dampers designed for vertical mounting in vertical orientation.

3.2.7. Adequately reinforce multiple section dampers per manufacturer's recommendations.

3.2.8. Coordinate access through ceilings or walls to ensure each damper is accessible.

3.3. **FIRE AND SMOKE DAMPERS**

3.3.1. Fire dampers, smoke dampers and combination fire smoke dampers should not be installed where ducts pass through non fire/smoke rated architectural or structural components. Remove all existing or new fire and smoke dampers and combination fire smoke dampers from non-fire rated architectural or structural constructions.

3.3.2. Provide duct access doors for inspection and cleaning before and after duct mounted filters, coils, fans, automatic dampers, at fire dampers, smoke dampers, fire/smoke dampers, upstream of air flow measuring stations, downstream from manual dampers (not spin-in fittings) and elsewhere as indicated on Drawings. Provide minimum 8 x 8 inch (200 x 200 mm) size for hand access, 18 x 18 inch (450 x 450 mm) size for shoulder access, and as indicated.

3.3.3. Provide duct test holes where indicated and where required for testing and balancing purposes.

3.3.4. Access doors as specified elsewhere shall be provided for access to all parts of the fire and combination fire and smoke dampers. Doors shall open not less than 90 degrees following installation and shall be insulated type where installed in insulated ducts.

3.3.5. Label access doors according to Section 20 05 53 to indicate the purpose of access door.

3.3.6. Install each fire and combination fire and smoke damper square and true to the building. The installation shall not place pressure on the damper frame but shall enclose the damper as required by UL555 and UL555S. Handle damper using sleeve or frame. Do not lift damper using blades, actuator, or jackshaft.

3.4. **TESTING**

3.4.1. After each fire damper, smoke damper and combination fire and smoke damper has been installed and sealed in their prescribed openings and prior to installation of ceilings, Contractor shall, as directed by Owner, activate part or all dampers as required

to verify “first-time” closure. The activation must be scheduled as part of the commissioning and witnessed by an institutional representative.

3.4.2. Activation of damper shall be accomplished by manually operating the resettable link, disconnecting the linkage at the fire damper fusible link, and manually operating the fire/smoke damper through electronic controls.

3.4.3. Failure of damper to close properly and smoothly on the first attempt will be cause to replace the entire damper assembly.

3.4.4. Coordinate smoke damper system interlock requirements with the fire alarm system.

PART 1 - GENERAL

1.1. DESCRIPTION

1.1.1. Roof top air handling units including integral components specified herein.

1.1.2. Definitions:

1.1.2.1. Packaged Roof Mounted Air handler: A factory fabricated assembly consisting of fan, coils, filters, and other necessary equipment to perform one or more of the following functions of circulating, cleaning, heating, cooling, humidifying, dehumidifying, and mixing of air. Design capacities of units shall be as scheduled on the drawings.

1.2. RELATED WORK

1.2.1. Section 23 05 11, COMMON WORK RESULTS FOR HVAC:
1.2.2. Section 23 05 51, NOISE and VIBRATION ISOLATION
1.2.3. Section 23 31 00, METALLIC DUCTWORK
1.2.4. Section 23 05 93, TESTING, ADJUSTING, and BALANCING.
1.2.5. Section 26 29 11, MOTOR CONTROLLERS

1.3. QUALITY ASSURANCE

1.3.1. Air Handling Units Certification

1.3.1.1. The air handling units shall be certified in accordance with AHRI 430 and tested/rated in accordance with AHRI 260.
1.3.1.2. Heating, Cooling, and Air Handling Capacity and Performance Standards: AHRI 430, AHRI 410, ASHRAE 51, and AMCA 210.

1.3.2. Performance Criteria:

1.3.2.1. The fan BHP shall include all system effects for all fans
1.3.2.2. The fan motor shall be selected within the rated nameplate capacity, without relying upon NEMA Standard Service Factor.
1.3.2.3. Units shall be factory-fabricated, assembled, and tested by a manufacturer, in business of manufacturing similar air-handling units for at least five (5) years.

1.4. **SUBMITTALS:**

1.4.1. The contractor shall, in accordance with Section 01 33 23, SHOP DRAWINGS furnish a complete submission for all roof top units covered in the project. The submission shall include all information listed below. Partial and incomplete submissions shall be rejected without reviews.

1.4.2. Manufacturer's Literature and Data:

1.4.2.1. Submittals for RTUs shall include, as applicable to the project,all fans, drives, motors, coils, humidifiers, sound attenuators, mixing box with outside/return air dampers, filter housings, economizers and all related acces¬sories. The contractor shall provide custom drawings showing total air handling unit assembly including dimensions, operating weight, access sections, flexible connections, door swings, controls penetrations, electrical disconnect, lights, duplex receptacles, switches, wiring, utility connection points, unit support system, vibration isolators, drain pan, pressure drops through each component (filter, coil etc) and rigging points.

1.4.2.2. Submittal drawings of section or component only, will not be acceptable. Contractor shall also submit performance data including performance test results, charts, curves or certified computer selection data; data sheets; fabrication and insulation details; if the unit cannot be shipped in one piece, the contractor shall indicate the number of pieces that each unit will have to be broken into to meet shipping and job site rigging requirements. This data shall be submitted in hard copies and in electronic version.

1.4.2.3. Submit sound power levels in each octave band for fan and at entrance and discharge of RTUs at scheduled conditions. Include sound attenuator capacities and itemized internal component attenuation. Internal lining of supply air ductwork with sound absorbing material is not permitted.

1.4.2.4. Provide fan curves showing Liters/Second (cubic feet per minute), static pressure, efficiency, and horsepower for design point of operation and at maximum design Liters/Second (cubic feet per minute) and 110 percent of design static pressure.

1.4.2.5. Submit total fan static pressure, external static pressure, for RTU including total, inlet and discharge pressures, and itemized specified internal losses and unspecified internal losses. Refer to air handling unit schedule on drawings.

1.4.3. Maintenance and operating manuals. Include instructions for lubrication, filter replacement, motor and drive replacement, spare part lists, and wiring diagrams.

1.4.4. Submit written results of factory tests for approval prior to shipping.

1.4.5. Submit shipping information that clearly indicates how the units will be shipped in compliance with the descriptions below.

1.4.6. Units shall be shipped in one (1) piece where possible and in shrink wrapping to protect the unit from dirt, moisture and/or road salt.

1.4.7. If not shipped in one (1) piece, provide manufacturer approved shipping splits where required for installation or to meet shipping and/or job site rigging requirements in modular sections. Indicate clearly that the shipping splits shown in the submittals have been verified to accommodate the construction constraints for rigging as required to complete installation and removal of any section for replacement through available access without adversely affecting other sections.

1.4.8. If shipping splits are provided, each component shall be individually shrink wrapped to protect the unit and all necessary hardware (e.g. bolts, gaskets etc.) will be included to assemble unit on site.

1.4.9. Lifting lugs will be provided to facilitate rigging on shipping splits and joining of segments. If the unit cannot be shipped in one piece, the contractor shall indicate the number of pieces that each unit will have to be broken into to meet shipping and job site rigging requirements.

1.5. **APPLICABLE PUBLICATIONS**

1.5.1. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

1.5.2. Air Conditioning, Heating, and Refrigeration Institute (AHRI):

1.5.2.1. 260-01 Sound Rating of Ducted Air Moving and Conditioning Equipment
1.5.2.2. 410 01 Standard for Forced-Circulation Air-Heating and Air-Cooling Coils
1.5.2.3. 430 09 Standard for Central Station Air Handling Units

1.5.3. Air Moving and Conditioning Association (AMCA):

1.5.3.1. 210 07 Laboratory Methods of Testing Fans for Rating

1.5.4. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE):

1.5.4.1. 51 2007Laboratory Methods of Testing Fans for Rating

1.5.5. American Society for Testing and Materials (ASTM):

1.5.5.1. B117 07a Salt Spray (Fog) Testing

1.5.5.2. C1071 05e1 Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)

1.6. **WARRANTY**

1.6.1. If any part of your Air Conditioner fails because of a manufacturing defect within one year from the date of the original purchase, Warrantor will furnish without charge the required replacement part.

1.6.2. If factory installed, stainless steel heat exchanger fails because of a manufacturing defect within ten years from the date of start-up, Warrantor will furnish without charge a replacement heat exchanger. Any local transportation, related service labor and diagnosis calls are not included.

1.6.3. If the sealed motor-compressor fails because of a manufacturing defect within the second through fifth year from the date of original purchase, Warrantor will furnish without charge the required replacement compressor

1.7. **STANDARD OF ACCEPTANCE**

1.7.1. Carrier, Trane

PART 2 - P**RODUCTS**

2.1. **PACKAGED ELECTRIC COOLING OR ELECTRIC COOLING/GAS HEATING ROOF MOUNTED UNITS 3-5 TON CAPACITY**

2.1.1. General:

2.1.1.1. Outdoor, rooftop mounted, electrically controlled, heating and cooling unit utilizing a fully hermetic scroll compressor(s) for cooling duty and gas combustion for heating duty.

2.1.1.2. Factory assembled, single-piece heating and cooling rooftop unit. Contained within the unit enclosure shall be all factory wiring, piping, controls, and special features required prior to field start-up.

2.1.1.3. Unit shall use R-410A refrigerant.

2.1.1.4. Unit shall be installed in accordance with the manufacturer's instructions.

2.1.1.5. Unit must be selected and installed in compliance with local, provincial, and federal codes.

2.1.2. Quality Assurance:

2.1.2.1. Unit meets and exceeds ASHRAE 90.1 minimum efficiency requirements.
2.1.2.2. Unit shall be rated in accordance with AHRI Standards 210/240.
2.1.2.3. Unit shall be designed to conform to ASHRAE 15.
2.1.2.4. Unit shall be UL-tested and certified in accordance with ANSI Z21.47 Standards and UL listed and certified under Canadian standards as a total package for safety requirements.
2.1.2.5. Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.
2.1.2.6. Unit casing shall be capable of withstanding 500-hour salt spray exposure per ASTM B117 (scribed specimen).
2.1.2.7. Unit shall be designed in accordance with ISO 9001, and shall be manufactured in a facility registered by ISO 9001:2015.
2.1.2.8. Roof curb shall be designed to conform to NRCA Standards.
2.1.2.9. Unit shall be subjected to a completely automated run test on the assembly line. The data for each unit will be stored at the factory, and must be available upon request.
2.1.2.10. Unit shall be designed in accordance with UL Standard 1995, including tested to withstand rain.
2.1.2.11. Unit shall be constructed to prevent intrusion of snow and tested to prevent snow intrusion into the control box up to 40 mph.

2.1.3. Delivery, Storage, and Handling:

2.1.3.1. Unit shall be stored and handled per manufacturer's recommendations.
2.1.3.2. Lifted by crane requires either shipping top panel or spreader bars.
2.1.3.3. Unit shall only be stored or positioned in the upright position.

2.1.4. Operating Characteristics:

2.1.4.1. Performance: as noted in the equipment schedules

2.1.4.2. Unit shall be capable of starting and running at 125°F (52°C) ambient outdoor temperature, meeting maximum load criteria of AHRI Standard 210/240 at ±10% voltage.

2.1.4.3. Compressor with standard controls shall be capable of operation down to 35°F (2°C), ambient outdoor temperatures. Accessory winter start kit is necessary if mechanically cooling at ambient temperatures down to 25°F (–4°C).

2.1.4.4. Unit shall discharge supply air vertically or horizontally as shown on contract drawings.

2.1.4.5. Unit shall be factory configured for vertical supply and return configurations.

2.1.4.6. Unit shall be field convertible from vertical to horizontal airflow on all models. No special kit required.

2.1.4.7. Unit shall be capable of mixed operation: vertical supply with horizontal return or horizontal supply with vertical return.

2.1.5. Electrical Requirements:

2.1.5.1. Main power supply voltage, phase, and frequency must match those noted in the equipment schedule and match the manufacturer's instructions.

2.1.6. Safeties:

2.1.6.1. Compressor over-temperature, over-current. High internal pressure differential.

2.1.6.1.1. Low pressure switch.

2.1.6.1.2. Low pressure switch shall use different color wire than the high pressure switch. The purpose is to assist the installer and service technician to correctly wire and or troubleshoot the rooftop unit.

2.1.6.1.3. High pressure switch.

2.1.6.1.4. High pressure switch shall use different color wire than the low pressure switch. The purpose is to assist the installer and service technician to correctly wire and or troubleshoot the rooftop unit.

2.1.6.1.5. Automatic reset, motor thermal overload protector.

2.1.7. Heating section shall be provided with the following minimum protections (where heating is specified in equipment schedules):

2.1.7.1. High temperature limit switches.

2.1.7.2. Induced draft motor speed sensor.

2.1.7.3. Flame rollout switch.

2.1.7.4. Flame proving controls.

2.1.8. Unit Cabinet:

2.1.8.1. Unit cabinet shall be constructed of galvanized steel, and shall be bonderized and coated with a pre-painted baked enamel finish on all externally exposed surfaces.

2.1.8.2. Unit cabinet exterior paint shall be: film thickness, (dry) 0.003 inches minimum, gloss (per ASTM D523, 60°F/16°C): 60, Hardness: H-2H Pencil hardness.

2.1.8.3. Evaporator fan compartment interior cabinet insulation shall conform to AHRI Standards 210/240 minimum exterior sweat criteria. Interior surfaces shall be insulated with a minimum 1/2-in. thick, 1 lb density, flexible fiberglass insulation, neoprene coated on the air side.

2.1.8.4. Foil Faced Insulation: Throughout unit cabinet air stream, nonfibrous and cleanable foil faced insulation is used.

2.1.8.5. Base of unit shall have a minimum of four locations for thru-the-base gas and electrical connections (factory-installed or field-installed), standard.

2.1.9. Base Rail:

2.1.9.1. Unit shall have base rails on a minimum of 2 sides.

2.1.9.2. Holes shall be provided in the base rails for rigging shackles to facilitate maneuvering and overhead rigging.

2.1.9.3. Holes shall be provided in the base rail for moving the rooftop by fork truck.

2.1.9.4. Base rail shall be a minimum of 16 gage thickness.

2.1.10. Condensate pan and connections:

2.1.10.1. Shall be a sloped condensate drain pan made of a corrosion resistant material.

2.1.10.2. Shall comply with ASHRAE Standard 62.

2.1.10.3. Shall use a 3/4-in. 14 NPT drain connection, possible either through the bottom or side of the drain pan. Connection shall be made per manufacturer's recommendations.

2.1.11. Top panel:

2.1.11.1. Shall be a single piece top panel on all sizes.

2.1.12. Gas Connections (where applicable to the project):

2.1.12.1. All gas piping connecting to unit gas valve shall enter the unit cabinet at a single location on side of unit (horizontal plane).

2.1.13. Thru-the-base capability

2.1.13.1. Standard unit shall have a thru-the-base gas-line location using a raised, embossed portion of the unit basepan.
2.1.13.2. Where specified, factory approved, water-tight connection method must be used for thru-the-base gas connections.
2.1.13.3. No basepan penetration, other than those authorized by the manufacturer, is permitted.

2.1.14. Electrical Connections:

2.1.14.1. All unit power wiring shall enter unit cabinet at a single, factory prepared, knockout location.

2.1.15. Thru-the-base capability.

2.1.15.1. Standard unit shall have a thru-the-base electrical location(s) using a raised, embossed portion of the unit basepan.
2.1.15.2. Where specified, factory approved, water-tight connection method must be used for thru-the-base electrical connections.
2.1.15.3. No basepan penetration, other than those authorized by the manufacturer, is permitted.

2.1.16. Hinged Access Panels:

2.1.16.1. Shall provide easy access through integrated quarter turn latches.
2.1.16.2. Shall be on major panels of: filter, control box, fan motor, and compressor.
2.1.16.3. Unit shall have one factory installed, toolless, removable, filter access panel.
2.1.16.4. Panels covering control box, indoor fan, indoor fan motor, gas components (where applicable), and compressors shall have molded composite handles.
2.1.16.5. Handles shall be UV modified, composite. They shall be permanently attached, and recessed into the panel.

2.1.17. Gas Heat (where noted in the equipment schedules):

2.1.17.1. General

2.1.17.1.1. Heat exchanger shall be an induced draft design. Positive pressure heat exchanger designs shall not be allowed.
2.1.17.1.2. Shall incorporate a direct-spark ignition system and redundant main gas valve.

2.1.17.1.3. Gas supply pressure at the inlet to the rooftop unit gas valve must match that required by the manufacturer.
2.1.17.1.4. The heat exchanger shall be controlled by an integrated gas controller (IGC) microprocessor.
2.1.17.1.5. IGC board shall notify users of fault using an LED (light-emitting diode).
2.1.17.1.6. The LED shall be visible without removing the control box access panel.
2.1.17.1.7. IGC board shall contain algorithms that modify evaporator fan operation to prevent future cycling on high temperature limit switch.
2.1.17.1.8. Unit shall be equipped with anti-cycle protection with one short cycle on unit flame rollout switch or 4 continuous short cycles on the high temperature limit switch. Fault indication shall be made using an LED.

2.1.17.2. Stainless Steel Heat Exchanger construction

2.1.17.2.1. Use energy saving, direct-spark ignition system.
2.1.17.2.2. Use a redundant main gas valve.
2.1.17.2.3. The stainless steel heat exchanger shall be of the tubular-section type, constructed of a minimum of 20-gage type 409 stainless steel.
2.1.17.3. Type 409 stainless steel shall be used in heat exchanger tubes and vestibule plate.
2.1.17.4. Complete stainless steel heat exchanger allows for greater application flexibility.

2.1.18. Coils

2.1.18.1. Aluminum Fin-Copper Tube Coils:

2.1.18.1.1. Standard evaporator and condenser coils shall have aluminum lanced plate fins mechanically bonded to seamless internally grooved copper tubes with all joints brazed.
2.1.18.2. Evaporator coils shall be leak tested to 150 psig, pressure tested to 450 psig, and qualified to UL 1995 burst test at 1775 psig.
2.1.18.3. Condenser coils shall be leak tested to 150 psig, pressure tested to 650 psig, and qualified to UL 1995 burst test at 1980 psig.

2.1.19. Refrigerant Components

2.1.19.1. Refrigerant circuit shall include the following control, safety, and maintenance features:

2.1.19.1.1. TXV metering system on all models shall include a multiple feed distribution system that optimizes coil performance.

2.1.19.1.2. Refrigerant filter drier - Solid core design.
2.1.19.1.3. Service gage connections on suction and discharge lines.
2.1.19.1.4. Pressure gage access through a specially designed access port in the top panel of the unit.

2.1.19.2. There shall be gage line access port in the skin of the rooftop, covered by a black, removable plug. The plug shall be easy to remove and replace. When the plug is removed, the gage access port shall enable maintenance personnel to route their pressure gage lines.

2.1.19.3. The plug shall be made of a leak proof, UV-resistant, composite material.

2.1.20. Compressors

2.1.20.1. Unit shall use fully hermetic, two stage scroll compressor on a single refrigeration circuit.
2.1.20.2. Compressor motors shall be cooled by refrigerant gas passing through motor windings.
2.1.20.3. Compressors shall be internally protected from high discharge temperature conditions.

2.1.20.4. Compressors shall be protected from an over-temperature and over-amperage conditions by an internal, motor overload device.
2.1.20.5. Compressor shall be factory mounted on rubber grommets.
2.1.20.6. Compressor motors shall have internal line break thermal, current overload and high pressure differential protection.
2.1.20.7. Crankcase heaters shall not be required for normal operating range, unless required by compressor manufacturer due to refrigerant charge limits.

2.1.21. Filter Section

2.1.21.1. Filters shall be held in place by a pivoting filter tray, facilitating easy removal and installation.
2.1.21.2. Shall consist of factory installed, low velocity, throw-away 2-in. thick fiberglass filters.
2.1.21.3. Filters shall be standard, commercially available sizes.
2.1.21.4. Only one size filter per unit is allowed.

2.1.22. Evaporator Fan and Motor

2.1.22.1. Direct Drive Evaporator fan motor:

2.1.22.1.1. Shall be a ECM motor design.
2.1.22.1.2. Shall have permanently lubricated bearings.
2.1.22.1.3. Shall have inherent automatic-reset thermal overload protection.
2.1.22.1.4. Shall have slow ramp up to speed capabilities.

2.1.22.2. Evaporator Fan:

2.1.22.2.1. Shall be easily set with selection switch and adjustment pot on unit control board.
2.1.22.2.2. Blower fan shall be a Vane Axial fan design with 75% less moving parts than a conventional belt drive system.
2.1.22.2.3. Shall be constructed of a cast aluminum stator and high impact composite material on rotor and air inlet casing.
2.1.22.2.4. Shall be a patented pending design with a corrosion resistant material and dynamically balanced.

2.1.23. Condenser Fans and Motors

2.1.23.1. Condenser fan motors:

2.1.23.1.1. Shall be a totally enclosed motor.
2.1.23.1.2. Shall use permanently lubricated bearings.
2.1.23.1.3. Shall have inherent thermal overload protection with an automatic reset feature.
2.1.23.1.4. Shall use a shaft-down design on all sizes.

2.1.23.2. Condenser Fans:

2.1.23.2.1. Shall be a direct-driven propeller type fan constructed of high impact composite material.
2.1.23.2.2. Shall have high impact composite blades completely formed into one piece without blade fasteners or connectors and shall be dynamically balanced.

2.1.24. Economizer

2.1.24.1. Integrated, gear driven opposing modulating blade design type capable of simultaneous economizer and compressor operation.

2.1.24.2. Independent modules for vertical or horizontal return configuration shall be available. Vertical return modules shall be available where noted on thr drawings and equipment schedules as a factory installed option.

2.1.24.3. amper blades shall be galvanized steel with composite gears. Plastic or composite blades on intake or return shall not be acceptable.

2.1.24.4. hall include all hardware and controls to provide free cooling with outdoor air when temperature and/or humidity are below setpoints.

2.1.24.5. Shall be equipped with gear driven dampers for both the outdoor ventilation air and the return air for positive air stream control.

2.1.24.6. Standard leak rate shall be equipped with dampers not to exceed 2% leakage at 1 in. wg pressure differential.

2.1.24.7. Functions with solid-state analog enthalpy or dry bulb changeover control sensing.

2.1.24.8. Contain LED indicates for: when free cooling is available, when module is in DCV mode, when exhaust fan contact is closed.

2.1.24.9. Dry bulb outdoor air temperature sensor shall be provided as standard. Outdoor air sensor setpoint shall be adjustable and shall range from 40 to 100°F (4 to 38°C). Additional sensor options shall be available as accessories.

2.1.24.10. The economizer controller shall also provide control of an accessory power exhaust unit function. Factory set at 100%, with a range of 0% to 100%.

2.1.24.11. The economizer shall maintain minimum airflow into the building during occupied period and provide design ventilation rate for full occupancy.

2.1.24.12. Dampers shall be completely closed when the unit is in the unoccupied mode.

2.1.24.13. Economizer controller shall accept a 2-10 Vdc CO2 sensor input for IAQ/DCV control. In this mode, dampers shall modulate the outdoor air damper to provide ventilation based on the sensor input.

2.1.24.14. Compressor lockout temperature control is adjustable from –45°F to 80°F, set at a factory default of 32°F.

2.1.24.15. Actuator shall be direct coupled to economizer gear. No linkage arms or control rods shall be acceptable.

2.1.24.16. Economizer controller shall provide indications when in free cooling mode, in the DCV mode, or the exhaust fan contact is closed.

2.1.25. Controls

2.1.25.1. Shall be ASHRAE 62 compliant.

2.1.25.2. Shall accept 18-30VAC, 50-60Hz, and consume 15VA or less power.

2.1.25.3. Shall have an operating temperature range from –40°F (–40°C) to 130°F (54°C), 10% to 90% RH (non-condensing).

2.1.25.4. Shall include built-in protocol for BACnet (MS/TP and PTP modes), Modbus (RTU and ASCII), Johnson N2 and LonWorks. LonWorks Echelon processor required for all Lon applications shall be contained in separate com-munication board.

2.1.25.5. Shall have an LED display independently showing the status of serial communication, running, errors, power, all digital outputs, and all analog inputs.

2.1.25.6. Shall accept the following inputs: space temperature, setpoint adjustment, outdoor air temperature, indoor air quality, outdoor air quality, compressor lock-out, fire shutdown, enthalpy switch, and fan status / filter status / humidity / remote occupancy.

Shall provide the following outputs: economizer, variable frequency drive, fan, cooling stage 1, cooling stage 2, heat stage 1, heat stage 2, exhaust reversing valve/high fan speed.

2.1.25.7. Shall have built-in surge protection circuitry through solid-state poly-switches. Poly-switches shall be used on incoming power and network connections. Poly-switches will return to normal when the “trip” condition clears.

2.1.25.8. Shall have a battery backup capable of a minimum of 10,000 hours of data and time clock retention during power outages.

2.1.25.9. Shall include an RS-485 protocol communication port, an access port for connection of a computer, an RS-485 port for network communication to space sensors and displays, and a port to connect an optional LonWorks communications card.

2.1.25.10. Interface with building automation system (BAS)

2.1.25.10.1. The unit shall be compatible with the building automation system.

2.1.25.10.2. At the very minimum, the unit controls shall be capable of interfacing with the building automation system as follows:

- Allow building automation control to enable/disable the unit based on a pre-determined schedule
- Allow the building automation to enable the cooling or the heating sections (where heating is specified in the equipment schedules)
- Set the operating parameters for economizer operation.
- Allow the building automation to provide a cooling setpoint and a heating setoint (where heating is specified in the equipment schedules).
- Provide feedback to the building automation in regards to:
- Fan status
- Economizer status
- Return air temperature
- Mized air temperature
- Discharged air temperature

- Cooling section status and each cooling stage status
- Heating section status (where heating is specified in the equipment schedules) and each heating stage status
- Malfunctioning alarms

2.1.26. Low Ambient Control Package:

2.1.26.1. Where noted on the equipment schedules, controller shall control coil head pressure by condenser fan speed modulation or condenser fan cycling and wind baffles.

2.1.26.2. Shall consist of solid-state control and condenser coil temperature sensor to maintain condensing temperature between 90°F (32°C) and 110°F (43°C) at outdoor ambient temperatures down to –20°F (–29°C).

2.1.27. Flue Shield (where gas heat is noted in the equipment schedules).

2.1.27.1. Flue shield shall provide protection from the hot sides of the gas flue hood.

2.1.28. Condenser Coil Hail Guard Assembly (Factoryinstalled on 3 Phase Models Only. Fieldinstalled on all 3 and 1 Phase Models.)

2.1.28.1. Shall protect against damage from hail.

2.1.28.2. Shall be either hood style or louvered.

2.1.29. Unit-Mounted, Non-Fused Disconnect Switch

2.1.29.1. Switch shall be factory installed, internally mounted.

2.1.29.2. Shall be accessible from outside the unit.

2.1.29.3. Shall provide local shutdown and lockout capability.

2.1.30. Convenience Outlet:

2.1.30.1. Factory-Installed Non-Powered convenience outlet.

2.1.30.2. Outlet shall be powered from a separate 115/120v power source. Refer to electrical drawings.

2.1.30.3. A transformer shall not be included.

2.1.30.4. Outlet shall be factory-installed and internally mounted with easily accessible 115-v female receptacle.

2.1.30.5. Outlet shall include 15 amp GFI receptacles with independent fuse protection.

2.1.30.5.1. Outlet shall be accessible from outside the unit.

2.1.31. Thru-the-Base Connectors (where noted on equipment schedules and shown on the drawings):

2.1.31.1. Kits shall provide connectors to permit gas and electrical connections to be brought to the unit through the unit basepan.
2.1.31.2. Minimum of four connection locations per unit.

2.1.32. Propeller Power Exhaust:

2.1.32.1. Power exhaust shall be used in conjunction with an integrated economizer.
2.1.32.2. Independent modules for vertical or horizontal return configurations shall be available.
2.1.32.3. Horizontal power exhaust is shall be mounted in return ductwork.
2.1.32.4. Power exhaust shall be controlled by economizer controller operation. Exhaust fans shall be energized when dampers open past the 0 to 100% adjustable setpoint on the economizer control.

2.1.33. Roof Curbs (Vertical Air Discharge):

2.1.33.1. Full perimeter roof curb with exhaust capability providing separate air streams for energy recovery from the exhaust air without supply air contamination.
2.1.33.2. Formed galvanized steel with wood nailer strip and shall be capable of supporting entire unit weight.
2.1.33.3. Permits installation and securing of ductwork to curb prior to mounting unit on the curb.

2.1.34. Indoor Air Quality (CO2) Sensor:

2.1.34.1. Shall be able to provide demand ventilation indoor air quality (IAQ) control.
2.1.34.2. The IAQ sensor shall be available in duct mount, wall mount, or wall mount with LED display. The setpoint shall have adjustment capability.

2.1.35. Smoke detectors - where noted on the drawings (factory-installed only):

2.1.35.1. Shall be a Four-Wire Controller and Detector.
2.1.35.2. Shall be environmental compensated with differential sensing for reliable, stable, and drift-free sensitivity.
2.1.35.3. Shall use magnet-activated test/reset sensor switches.
2.1.35.4. Shall have tool-less connection terminal access.
2.1.35.5. Shall have a recessed momentary switch for testing and resetting the detector.

2.1.36. Condensate overflow switch:

2.1.36.1. This sensor and related controller monitors the condensate level in the drain pan and shuts down compression operation when overflow conditions occur. It includes:

2.1.36.1.1. Indicator light — solid red (more than
2.1.36.1.2. 10 seconds on water contact – compressors disabled), blinking red (sensor disconnected).
2.1.36.1.3. 10 second delay to break — eliminates nuisance trips from splashing or waves in pan (sensor needs 10 seconds of constant water contact before tripping).
2.1.36.1.4. Disables the compressor(s) operation when condensate plug is detected, but still allows fans to run for Economizer.

2.2. PACKAGED ELECTRIC COOLING OR ELECTRIC COOLING/GAS HEATING ROOF MOUNTED UNITS 5-25 TON CAPACITY

2.2.1. General

2.2.1.1. Outdoor, rooftop mounted, electrically controlled, heating and cooling unit utilizing hermetic scroll compressor(s) for cooling duty and gas combustion for heating duty.
2.2.1.2. Factory assembled, single piece heating and cooling rooftop unit. Contained within the unit enclosure shall be all facto-ry wiring, piping, controls, and special features required prior to field start-up.
2.2.1.3. Unit shall use R-410A refrigerant.
2.2.1.4. Unit shall be installed in accordance with the manufacturer's instructions.
2.2.1.5. Unit must be selected and installed in compliance with local, provincial, and federal codes.

2.2.2. Quality Assurance

2.2.2.1. Unit meets ASHRAE 90.1-2016 and minimum efficiency requirements.
2.2.2.2. Units are ENERGY STAR certified where sizes are required.
2.2.2.3. Unit shall be rated in accordance with AHRI Standard 340/360.
2.2.2.4. Unit shall be designed to conform to ASHRAE 15.
2.2.2.5. Unit shall be C-ETL-tested and certified in accordance with ANSI Z21.47 Standards and CETL-listed and certified un-der Canadian standards as a total package for safety requirements. Unit shall be CSA listed and approved.

2.2.2.6. Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.

2.2.2.7. Unit internal insulation linings shall be resistant to mold growth in accordance with “mold growth and humidity” test in ASTM C1338, G21, and UL 181 or comparable test method. Air stream surfaces shall be evaluated in accordance with the “Erosion Test” in UL 181, as part of ASTM C1071.

2.2.2.8. Unit casing shall be capable of withstanding 500-hour salt spray exposure per ASTM B117 (scribed specimen).

2.2.2.9. Roof curb shall be designed to conform to NRCA Standards.

2.2.2.10. Unit shall be subjected to a completely automated run test on the assembly line. The data for each unit will be stored at the factory, and must be available upon request.

2.2.2.11. Unit shall be designed in accordance with UL Standard 1995, ETL listed including tested to withstand rain.

2.2.2.12. Unit shall be constructed to prevent intrusion of snow and tested to prevent snow intrusion into the control box up to 40 mph.

2.2.2.13. Unit shake tested to assurance level 1, ASTM D4169 to ensure shipping reliability.

2.2.2.14. High-Efficiency Motors listed shall meet section 313 of the Energy Independence and Security Act of 2007 (EISA 2007).

2.2.3. Delivery, storage, and handling

2.2.3.1. Unit shall be stored and handled per manufacturer’s recommendations.

2.2.3.2. Lifted by crane requires either shipping top panel or spreader bars.

2.2.3.3. Unit shall only be stored or positioned in the upright position.

2.2.4. Operating characteristics

2.2.4.1. As noted on the equipment schedules and drawings

2.2.4.2. Unit shall be capable of starting and running at 125°F (52°C) ambient outdoor temperature, meeting maximum load criteria of AHRI Standard 340/360 at ± 10% voltage.

2.2.4.3. Compressor with standard controls shall be capable of operation from 35°F (2°C), ambient outdoor temperatures. Ac-cessory kits are necessary if mechanically cooling at ambient temperatures below 35°F (2°C).

2.2.4.4. Unit shall be factory furnished for either vertical or horizontal configuration without the use of special conversion kits. No field conversion is possible.

2.2.5. Electrical Requirements

2.2.5.1. Main power supply voltage, phase, and frequency must match those noted on the equipment schedules and required by the manufacturer.

2.2.6. Safeties:

2.2.6.1. Compressor over-temperature, over-current.
2.2.6.2. Low-pressure switch.
2.2.6.3. Units with 2 compressors shall have different sized connectors for the circuit 1 and circuit 2 loss of charge switches. They shall physically prevent the cross-wiring of the safety switches between circuits 1 and 2.
2.2.6.4. Loss of charge switch shall use different color wire than the high pressure switch. The purpose is to assist the installer and service technician to correctly wire and/or troubleshoot the rooftop unit.
2.2.6.5. High-pressure switch.

2.2.6.6. Units with 2 compressors shall have different sized connectors for the circuit 1 and circuit 2 high pressure switches. They shall physically prevent the cross-wiring of the safety switches between circuits 1 and 2.
2.2.6.7. High-pressure switch shall use different color wire than the low-pressure switch. The purpose is to assist the installer and service technician to correctly wire and/or troubleshoot the rooftop unit.
2.2.6.8. Automatic reset, motor thermal overload protector.
2.2.6.9. Heating section (where indicated in the equipment schedules) shall be provided with the following minimum protections.
2.2.6.10. High-temperature limit switches.
2.2.6.11. Induced draft motor speed sensor.
2.2.6.12. Flame rollout switch.
2.2.6.13. Flame proving controls.

2.2.7. Unit Cabinet

2.2.7.1. Unit cabinet shall be constructed of galvanized steel, and shall be bonderized and coated with a pre-painted baked ena-mel finish on all externally exposed surfaces.
2.2.7.2. Unit cabinet exterior paint shall be: film thickness, (dry) 0.003 inches minimum, gloss (per ASTM D523, 60°F): 60, Hardness: H-2H Pencil hardness.
2.2.7.3. Evaporator fan compartment interior cabinet insulation shall conform to AHRI Standards 340/360 minimum exterior sweat criteria. Interior surfaces shall be insulated with a minimum 1/2-in. thick, 1 lb density, flexible fiberglass

insulation, neoprene coated on the air side. Aluminum foil-faced fiberglass insulation shall be used in the heat compartment.

2.2.7.4. Unit internal insulation linings shall be resistant to mold growth in accordance with "mold growth and humidity" test in ASTM C1338, G21, and UL 181 or comparable test method. Air stream surfaces shall be evaluated in accordance with the "Erosion Test" in UL 181, as part of ASTM C1071.

2.2.7.5. Base of unit shall have a minimum of four locations for factory thru-the-base gas and electrical connections (factory-installed or field-installed) standard. Connections shall be internal to the cabinet to protect from environmental issues.

2.2.7.6. Hinged Access Panels

2.2.7.6.1. Shall provide easy access through integrated quarter turn latches.

2.2.7.6.2. Shall be on major panels of – filter, control box, fan motor and compressor.

2.2.7.7. Foil faced insulation

2.2.7.7.1. Throughout unit cabinet air stream, non-fibrous and cleanable foil faced insulation is used.

2.2.7.8. Base Rail

2.2.7.8.1. Unit shall have base rails on a minimum of 2 sides.

2.2.7.8.2. Holes shall be provided in the base rails for rigging shackles to facilitate maneuvering and overhead rigging.

2.2.7.8.3. Holes shall be provided in the base rail for moving the rooftop by fork truck.

2.2.7.8.4. Base rail shall be a minimum of 16 gauge thickness.

2.2.7.9. Condensate pan and connections:

2.2.7.9.1. Shall be a sloped condensate drain pan made of a non-corrosive material.

2.2.7.9.2. Shall comply with ASHRAE Standard 62.

2.2.7.9.3. Shall use a 3/4-in. 14 NPT drain connection at the end of the drain pan. Connection shall be made per manufacturer's recommendations.

2.2.7.10. Top panel:

2.2.7.10.1. Shall be a multi-piece top panel linked with water tight flanges and interlocking systems.

2.2.8. Gas Connections (where applicable)

2.2.8.1. All gas piping connecting to unit gas valve shall enter the unit cabinet at a single location on side of unit (horizontal plane).

2.2.9. Thru-the-base capability

2.2.9.1. Standard unit shall have a thru-the-base gas-line location using a raised, embossed portion of the unit basepan.
2.2.9.2. Where noted on the drawings and equipment schedules, factory-approved, water-tight connection method must be used for thru-the-base gas connections.
2.2.9.3. No basepan penetration, other than those authorized by the manufacturer, is permitted.

2.2.10. Electrical Connections

2.2.10.1. All unit power wiring shall enter unit cabinet at a single, factory-prepared, knockout location.
2.2.10.2. Thru-the-base capability where noted on the drawings and equipment schedules
2.2.10.3. Thru-the-base provisions/connections are available as standard with every unit. When bottom connections are required, field furnished couplings are required.
2.2.10.4. No basepan penetration, other than those authorized by the manufacturer, is permitted.

2.2.11. Gas Heat – where noted on the equipment schedules

2.2.11.1. General

2.2.11.1.1. Heat exchanger shall be an induced draft design. Positive pressure heat exchanger designs shall not be allowed.
2.2.11.1.2. All units shall have 3 stages of heating (low-med-high)
2.2.11.1.3. Shall incorporate a direct-spark ignition system and redundant main gas valve.
2.2.11.1.4. Gas supply pressure at the inlet to the rooftop unit gas valve must match that required by the manufacturer.
2.2.11.1.5. The heat exchanger shall be controlled by an integrated gas controller (IGC) microprocessor.
2.2.11.1.6. IGC board shall notify users of fault using an LED (light-emitting diode).

2.2.11.1.7. IGC board shall contain algorithms that modify evaporator-fan operation to prevent future cycling on high temperature limit switch.

2.2.11.1.8. Unit shall be equipped with anti-cycle protection with one short cycle on unit flame rollout switch or 4 continuous short cycles on the high temperature limit switch. Fault indication shall be made using an LED.

2.2.11.2. Stainless Steel Heat Exchanger construction

2.2.11.2.1. Use energy saving, direct-spark ignition system.

2.2.11.2.2. Use a redundant main gas valve.

2.2.11.2.3. Burners shall be of the in-shot type constructed of aluminum-coated steel.

2.2.11.2.4. All gas piping shall enter the unit cabinet at a single location on side of unit (horizontal plane).

2.2.11.2.5. The stainless steel heat exchanger shall be of the tubular-section type, constructed of a minimum of 20-gauge type 409 stainless steel.

2.2.11.2.6. Type 409 stainless steel shall be used in heat exchanger tubes and vestibule plate.

2.2.11.2.7. Complete stainless steel heat exchanger allows for greater application flexibility.

2.2.11.2.8. Induced draft combustion motor and blower

2.2.11.2.9. Shall be a direct-drive, single inlet, forward-curved centrifugal type.

2.2.11.2.10. Shall be made from steel with a corrosion-resistant finish.

2.2.11.2.11. Shall have permanently lubricated sealed bearings.

2.2.11.2.12. Shall have inherent thermal overload protection.

2.2.11.2.13. Shall have an automatic reset feature.

2.2.12. Coils

2.2.12.1. Standard Aluminum Fin/Copper Tube Coils:

2.2.12.2. Standard evaporator and condenser coils shall have aluminum lanced plate fins mechanically bonded to seamless internally grooved copper tubes with all joints brazed.

2.2.12.3. Evaporator coils shall be leak tested to 150 psig, pressure tested to 450 psig, and qualified to UL 1995 burst test at 1775 psig.

2.2.12.4. Condenser coils shall be leak tested to 150 psig, pressure tested to 650 psig, and qualified to UL 1995 burst test at 1980 psig.

2.2.13. Refrigerant components

2.2.13.1. Refrigerant circuit shall include the following control, safety, and maintenance features:
2.2.13.2. Thermostatic Expansion Valve (TXV) shall help provide optimum performance across the entire operating range. Shall contain removable power element to allow change out of power element and bulb without removing the valve body.
2.2.13.3. Refrigerant filter drier.
2.2.13.4. Service gauge connections on suction and discharge lines.
2.2.13.5. Pressure gauge access through a specially designed access screen on the side of the unit.

2.2.14. Compressors

2.2.14.1. Unit shall use fully hermetic, scroll compressor for each independent refrigeration circuit.
2.2.14.2. Cooling Stages
2.2.14.2.1. single compressor/single stage cooling designs (up to 6 ton cooling)
2.2.14.2.2. single compressor/2-stage cooling (7.5 to 15 ton cooling)
2.2.14.2.3. 2 compressor/2-stage cooling. (15 ton to 25 ton cooling)

2.2.14.3. Compressor motors shall be cooled by refrigerant gas passing through motor windings.
2.2.14.4. Compressors shall be internally protected from high discharge temperature conditions.
2.2.14.5. Compressors shall be protected from an over-temperature and over-amperage conditions by an internal, motor overload device.
2.2.14.6. Compressor shall be factory mounted on rubber grommets.
2.2.14.7. Compressor motors shall have internal line break thermal, current overload and high pressure differential protection.
2.2.14.8. Crankcase heaters shall not be required for normal operating range, unless provided by the factory.

2.2.15. Filter section

2.2.15.1. Filters access is specified in the unit cabinet section of this specification.
2.2.15.2. Filters shall be held in place by a preformed slide out filter tray, facilitating easy removal and installation.
2.2.15.3. Shall consist of factory-installed, low velocity, throw-away 2-in. thick fiberglass filters.
2.2.15.4. Filters shall be standard, commercially available sizes.
2.2.15.5. Only one size filter per unit is allowed.

2.2.16. Evaporator fan and motor

2.2.16.1. Evaporator fan motor:

2.2.16.1.1. Shall have inherent automatic-reset thermal overload protection or circuit breaker.

2.2.16.1.2. Shall have a maximum continuous bhp rating for continuous duty operation; no safety factors above that rating shall be required.

2.2.16.2. Belt-driven evaporator fan:

2.2.16.2.1. Belt drive shall include an adjustable-pitch motor pulley and belt break protection system.
2.2.16.2.2. Shall use rigid pillow block bearing system with lubricate fittings at are accessible or lubrication line.
2.2.16.2.3. Blower fan shall be double-inlet type with forward-curved blades.
2.2.16.2.4. Shall be constructed from steel with a corrosion resistant finish and dynamically balanced.

2.2.17. Condenser Fans and Motors

2.2.17.1. Condenser fan motors:

2.2.17.1.1. Shall be a totally enclosed motor.
2.2.17.1.2. Shall use permanently lubricated bearings.
2.2.17.1.3. Shall have inherent thermal overload protection with an automatic reset feature.

2.2.17.2. Shall use a shaft down design on all sizes.

2.2.17.3. Condenser fans:

2.2.17.3.1. Shall be a direct driven propeller type fan.
2.2.17.3.2. Shall have aluminum blades riveted to corrosion resistant steel spiders and shall be dynamically balanced.

2.2.18. Controls

2.2.18.1. Shall be ASHRAE 62 compliant.
2.2.18.2. Shall accept 18-30VAC, 50-60Hz, and consume 15VA or less power.

2.2.18.3. Shall have an operating temperature range from –40°F (–40°C) to 130°F (54°C), 10% to 90% RH (non-condensing).

2.2.18.4. Shall include a wiring terminal strip for connections to the school's BAS system. Terminal strip to have minimum all connections in order to achieve the sequence of operations as outlined on the control drawings.

2.2.18.5. Shall have a controller with LED display independently showing the status of serial communication, running, errors, power, all digital outputs, and all analog inputs.

2.2.18.6. Shall accept the following inputs: space temperature, setpoint adjustment, outdoor air temperature, indoor air quality, outdoor air quality, compressor lock-out, fire shutdown, enthalpy switch, and fan status / filter status / humidity / remote occupancy.

2.2.18.7. Shall provide the following outputs: economizer, variable frequency drive, fan, cooling stage 1, cooling stage 2, heat stage 1, heat stage 2, exhaust reversing valve/high fan speed.

2.2.18.8. Shall have built-in surge protection circuitry through solid-state poly-switches. Poly-switches shall be used on incoming power and network connections. Poly-switches will return to normal when the "trip" condition clears.

2.2.18.9. Shall have a battery backup capable of a minimum of 10,000 hours of data and time clock retention during power outages.

2.2.18.10. Shall include an RS-485 protocol communication port, an access port for connection of a computer, an RS-485 port for network communication to space sensors and displays, and a port to connect an optional LonWorks communications card.

2.2.18.11. Interface with building automation system (BAS)

2.2.18.12. The unit shall be compatible with the building automation system.

2.2.18.13. At the very minimum, the unit controls shall be capable of interfacing with the building automation system as follows:

2.2.18.13.1. Allow building automation control to enable/disable the unit based on a pre-determined schedule

2.2.18.13.2. Allow the building automation to enable the cooling or the heating sections (where heating is specified in the equipment schedules)

2.2.18.13.3. Set the operating parameters for economizer operation.

2.2.18.13.4. Allow the building automation to provide a cooling setpoint and a heating setpoint (where heating is specified in the equipment schedules).

2.2.18.13.5. Provide feedback to the building automation in regards to:

- Fan status
- Economizer status
- Return air temperature

- Mixed air temperature
- Discharged air temperature
- Cooling section status and each cooling stage status
- Heating section status (where heating is specified in the equipment schedules) and each heating stage status
- Malfunctioning alarms

2.2.19. Special Features and Accessories

2.2.19.1. Economizer

2.2.19.1.1. Integrated, gear driven opposing modulating blade design type capable of simultaneous economizer and compressor operation.

2.2.19.1.2. Independent modules for vertical or horizontal return configuration shall be available. Vertical return modules shall be available as a factory-installed option.

2.2.19.1.3. Damper blades shall be galvanized steel with composite gears. Plastic or composite blades on intake or return shall not be acceptable.

2.2.19.1.4. Shall include all hardware and controls to provide free cooling with outdoor air when temperature and/or humidity are below setpoints.

2.2.19.1.5. Shall be equipped with gear driven dampers for both the outdoor ventilation air and the return air for positive air stream control.

2.2.19.1.6. Low leak rate models shall be equipped with dampers not to exceed 2% leakage at 1 in. wg pressure differential.

2.2.19.1.7. Shall be capable of introducing up to 100% outdoor air.

2.2.19.2. Centrifugal Propeller Power Exhaust:

2.2.19.2.1. Power exhaust shall be used in conjunction with an integrated economizer.

2.2.19.2.2. Independent modules for vertical or horizontal return configurations shall be available.

2.2.19.2.3. Horizontal power exhaust is shall be mounted in return ductwork.

2.2.19.2.4. Power exhaust shall be controlled by economizer controller operation. Exhaust fans shall be energized when dampers open past the 0-100% adjustable setpoint on the economizer control.

2.2.19.2.5. Shall be designed to close damper(s) during loss-of-power situations with spring return built into motor.

2.2.19.3. Dry bulb outdoor air temperature sensor shall be provided as standard..

2.2.19.4. The economizer controller shall also provide control of an accessory power exhaust unit function. Factory set at 100%, with a range of 0% to 100%.
2.2.19.5. The economizer shall maintain minimum airflow into the building during occupied period and provide design ventilation rate for full occupancy.
2.2.19.6. Dampers shall be completely closed when the unit is in the unoccupied mode.
2.2.19.7. Economizer controller shall accept a 2-10 Vdc CO2 sensor input for IAQ/DCV control. In this mode, dampers shall modulate the outdoor air damper to provide ventilation based on the sensor input.
2.2.19.8. Compressor lockout temperature on is adjustable from –45°F to 80°F, set at a factory default of 32°F. Others shall open at 35°F (2°C) and close at 50°F (10°C).
2.2.19.9. Actuator shall be direct coupled to economizer gear. No linkage arms or control rods shall be acceptable.
2.2.19.10. Economizer controller shall provide indications when in free cooling mode, in the DCV mode, or the exhaust fan con-tact is closed.

2.2.20. Low Ambient Controller (where specified in the equipment schedules)

2.2.20.1. Controller shall control coil head pressure by condenser-fan speed modulation or condenser-fan cycling and wind baf-fles.
2.2.20.2. Shall consist of solid-state control and condenser-coil temperature sensor to maintain condensing temperature between 90°F (32°C) and 110°F (43°C) at outdoor ambient temperatures down to 0°F (–18°C).

2.2.21. Condenser Coil Hail Guard Assembly:

2.2.21.1. Shall protect against damage from hail.
2.2.21.2. Shall be of louvered style.

2.2.22. Unit-Mounted, Non-Fused Disconnect Switch:

2.2.22.1. Switch shall be factory-installed, internally mounted.
2.2.22.2. National Electric Code (NEC) and UL or ETL approved non-fused switch shall provide unit power shutoff.
2.2.22.3. Shall be accessible from outside the unit.
2.2.22.4. Shall provide local shutdown and lockout capability.
2.2.22.5. Sized only for the unit as ordered from the factory. Does not accommodate field-installed devices.

2.2.23. Convenience outlet:

2.2.23.1. Non-powered convenience outlet.

2.2.23.2. Outlet shall be powered from a separate 115-120v power source.
2.2.23.3. A transformer shall not be included.
2.2.23.4. Outlet shall be factory-installed and internally mounted with easily accessible 115-v female receptacle.
2.2.23.5. Outlet shall include 15 amp GFI receptacles.
2.2.23.6. Outlet shall be accessible from outside the unit.
2.2.23.7. Outlet shall include a field-installed “Wet in Use” cover.

2.2.24. Flue Discharge Deflector (where gas heat is shown on the equipment schedules):

2.2.24.1. Flue discharge deflector shall direct unit exhaust vertically instead of horizontally.

2.2.25. Fan/Filter Status Switch:

2.2.25.1. Switch shall provide status of indoor evaporator fan (ON/OFF) or filter (CLEAN/DIRTY).
2.2.25.2. Status shall be displayed either over communication bus (when used with direct digital controls) or with an indicator light at the thermostat.

2.2.26. Roof Curbs (Vertical air discharge):

2.2.26.1. Full perimeter roof curb with exhaust capability providing separate air streams for energy recovery from the exhaust air without supply air contamination.
2.2.26.2. Formed galvanized steel with wood nailer strip and shall be capable of supporting entire unit weight.
2.2.26.3. Permits installation and securing of ductwork to curb prior to mounting unit on the curb.

2.2.27. Indoor Air Quality (CO2) Sensor:

2.2.27.1. Shall be able to provide demand ventilation indoor air quality (IAQ) control.
2.2.27.2. The IAQ sensor shall be available in duct mount, wall mount, or wall mount with LED display. The setpoint shall have adjustment capability.

2.2.28. Smoke detectors:

2.2.28.1. Shall be a Four-Wire Controller and Detector.
2.2.28.2. Shall be environmental compensated with differential sensing for reliable, stable, and drift-free sensitivity.
2.2.28.3. Shall use magnet-activated test/reset sensor switches.

2.2.28.4. Shall have tool-less connection terminal access.

2.2.29. Condensate Overflow Switch:

2.2.29.1. This sensor and related controller monitors the condensate level in the drain pan and shuts down compression operation when overflow conditions occur. It includes:

2.2.29.1.1. Indicator light - solid red (more than 10 seconds on water contact - compressors disabled), blinking red (sensor dis-connected).
2.2.29.1.2. 10 second delay to break - eliminates nuisance trips from splashing or waves in pan (sensor needs 10 seconds of constant water contact before tripping).

2.2.29.1.3. Disables the compressor(s) operation when condensate plug is detected, but still allows fans to run for Economizer.

PART 3 - EXECUTION

3.1. **INSTALLATION**

3.1.1. Install roof top units in conformance with ARI 435.

3.1.2. Make all connections to power, automation and gas (where applicable). Connect unit to ductwork.

3.1.3. Assemble and install roof top unit components in strict accordance with manufacturer's instructions. Unit to be completely level.

3.1.4. Repair painted units by touch up of all scratches with finish paint material. Vacuum the interior of air-handling units clean prior to operation.

3.1.5. Leakage and test requirements for roof top units shall be the same as specified for ductwork in Specification Section 23 31 00, METALLIC DUCTRWORK except leakage shall not exceed Leakage Class (CL) 12 listed in SMACNA HVAC Air Duct Leakage Test Manual when tested at 1.5 times the design static pressure. Repair casing air leaks that can be heard or felt during normal operation and to meet test requirements.

3.1.6. Seal and/or fill all openings between the casing and RTU components and utility connections to prevent air leakage or bypass.

3.2. **STARTUP SERVICES**

3.2.1. The air handling unit shall not be operated for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings are lubricated and fan has been test run under observation.

3.2.2. An authorized factory representative should start up, test and certify the final installation and application specific calibration of control components. Items to be verified include fan performance over entire operating range, noise and vibration testing, verification of proper alignment, overall inspection of the installation, Client's staff training, etc.

PART 1 - GENERAL

1.1. GENERAL

1.1.1. System Description

1.1.1.1. The air conditioning system shall be a split system with Variable Compressor Speed Inverter Technology (VCSI), charged with R410A refrigerant.

1.1.1.2. The system shall consist of up to four indoor wall mounted evaporator section(s) with wireless controller and an outdoor unit configured as a horizontal discharge single phase unit.

1.2. DEFINITIONS:

1.2.1. Energy Efficiency Ratio (EER): The ratio of net cooling capacity is Btu/h to total rate of electricity input in watts under designated operating conditions (Btu hour/Watt).

1.2.2. Seasonal Energy Efficiency Ratio (EER): The ratio of the total cooling output of an air conditioner during its normal annual usage period for cooling in Btu/h divided by total electric energy input in watts during the same period (Btu hour/Watt).

1.3. RELATED WORK

1.3.1. Section 23 05 11, COMMON WORK RESULTS FOR HVAC
1.3.2. Section 23 23 00, REFRIGERANT PIPING.

1.4. SUBMITTALS

1.4.1. Submit in accordance with specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES

1.4.2. Manufacturer’s literature and data:

1.4.2.1. Sufficient information, including capacities, pressure drops and piping connections clearly presented, shall be included to determine compliance with drawings and specifications
1.4.2.2. Unit Dimensions required clearances, operating weights accessories and start-up instructions.
1.4.2.3. Electrical requirements, wiring diagrams, interlocking and control wiring showing factory installed and portions to be field installed.

1.4.2.4. Mounting and flashing of the roof curb to the roofing structure with coordinating requirements for the roof membrane system.

1.4.3. Certification: Submit proof of specified ARI Certification.

1.4.4. Performance Rating: Submit catalog selection data showing equipment ratings and compliance with required sensible-to-heat-ratio, energy efficiency ratio (EER), and coefficient of performance (COP).

1.4.5. Operating and Maintenance Manual: Submit three copies of Operating and Maintenance manual to Consultant two weeks prior to final inspection.

1.4.6. Completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion

1.5. **QUALITY ASSURANCE**

1.5.1. The units shall be listed by Electrical Testing Laboratories (ETL) and bear the ETL label.

1.5.2. All wiring shall be in accordance with the Canadian Electrical Code.

1.5.3. The units shall be rated in accordance with ARI Standard 210 and bear the ARI label.

1.5.4. The units shall be manufactured in a facility registered to ISO 9001 and ISO14001 which are a set of standards applying to environmental protection set by the International Standard Organization (ISO).

1.5.5. A full charge of R410A for 131 feet of refrigerant tubing shall be provided in the condensing unit.

1.5.6. A dry air holding charge shall be provided in the evaporator.

1.5.7. System efficiency shall meet or exceed 19.0 SEER and 10.6 HSPF.

1.6. **DELIVERY, STORAGE AND HANDLING**

1.6.1. Unit shall be stored and handled according to the manufacturer’s recommendation.

1.6.2. The wireless controller shall be shipped inside the carton with the indoor unit and able to withstand 40.5°C (105°F) storage temperatures and 95% relative humidity.

1.7. **WARRANTY**

1.7.1. The units shall have a manufacturer's warranty for a period of five (5) years from date of installation.

1.7.2. The compressor shall have a warranty of seven (7) years from date of installation. If, during this period, any part should fail to function properly due to defects in workmanship or material, it shall be replaced or repaired at the discretion of the manufacturer.

1.7.3. This warranty does not include labour. Manufacturer shall have twenty years experience in the Canadian market.

1.8. **PERFORMANCE**

1.8.1. Each system shall perform in accordance to the ratings shown in the equipment schedules.

1.8.2. Performance shall be based on 26.7°CDB, 19.4°CWB (80°FDB, 67°FWB) for the indoor unit and 35°C DB, 23.9°C WB (95°FDB, 75°FWB) for the outdoor unit.

1.9. **STANDARD OF ACCEPTANCE**

1.9.1. Indoor units: Mitsubishi MSY - M series, wall mounted, capacity as noted on the equipment schedules

1.9.2. Outdoor units: Mitsubishi MUY – M series, capacity as noted on the equipment schedules

PART 2 - PRODUCTS

2.1. **INDOOR UNIT**

2.1.1. General

2.1.1.1. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, internal piping, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism an auto restart function, an emergency operation function

and a test run switch. Indoor unit and refrigerant pipes shall be charged with dry air before shipment from the factory.

2.1.2. Unit Cabinet

2.1.2.1. The casing shall have a white finish. Multi directional drain and refrigerant piping offering four (4) directions for refrigerant piping and two (2) directions for draining shall be standard. There shall be a separate back plate which secures the unit firmly to the wall.

2.1.3. Fan

2.1.3.1. The indoor unit fan shall be an assembly with a line-flow fan direct driven by a single motor. The fan shall be statically and dynamically balanced and run on a motor with permanently lubricated bearings. A manual adjustable guide vane shall be provided with the ability to change the airflow from side to side (left to right). A motorized air sweep flow louver shall provide an automatic change in airflow by directing the air up and down to provide for uniform air distribution. The indoor unit fan shall consist of three (3) speeds, High, Medium and Low.

2.1.4. Filter

2.1.4.1. Return air shall be filtered by means of easily removed catechin and enzyme filters.

2.1.5. Coil

2.1.5.1. The evaporator coil shall be of nonferrous construction with pre-coated aluminum strake fins on copper tubing. All tube joints shall be brazed with PhosCopper or silver alloy. The coil shall be pressure tested at the factory. A condensate pan and drain shall be provided under the coil.

2.1.6. Electrical

2.1.6.1. The electrical power of the unit, supplied from the outdoor unit shall be 208 volts or 230 volts, 1 phase, 60 hertz. The system shall be capable of satisfactory operation within voltage limits of 198 volts to 253 volts. The indoor unit shall not have any supplemental electrical heat elements.

2.1.7. Control

2.1.7.1. Each system shall be operated by a wall-mounted space sensor coupled with a key switch operated by the head caretaker.

2.1.7.2. For details, refer to the sequences of operation on the drawings.

2.1.7.3. The control voltage between the indoor unit and the outdoor unit shall be 208 volts or 230 volts AC. The system shall be capable of automatic restart when power is restored after power interruption.

2.1.7.4. The heat pump mode of operation of the system shall be disabled.

2.2. **OUTDOOR UNIT**

2.2.1. General

2.2.1.1. The outdoor unit is designed specifically for use with indoor evaporator units.

2.2.1.2. These units are equipped with a circuit board that interfaces to the evaporator indoor units.

2.2.1.3. The outdoor unit shall be completely factory assembled, internally piped and wired.

2.2.1.4. Each unit must be run tested at the factory.

2.2.2. Unit Cabinet

2.2.2.1. The casing shall be zinc coated steel with acrylic or polyester coating for corrosion protection.

2.2.3. Fan

2.2.3.1. The unit shall be furnished with a direct drive propeller type fan. The fan motor shall have inherent protection, be permanently lubricated bearings. The fan motor shall be mounted for quiet operation. The fan shall be provided with a raised guard to prevent contact with moving parts. The outdoor unit shall have horizontal discharge airflow.

2.2.4. Coil

2.2.4.1. The condenser coil shall be of nonferrous construction with pre-coated aluminum strake fins on copper tubing. The coil shall be protected with an integral metal guard. Refrigerant flow from the condenser shall be controlled by means of a linear expansion valve (LEV) metering orifice. The linear expansion valve shall be controlled by a microprocessor controlled step motor.

2.2.5. Compressor

2.2.5.1. The compressor shall have variable compressor speed inverter technology (VCSI).

2.2.5.2. The outdoor unit shall have an accumulator. The compressor shall be equipped with an internal thermal overload. The outdoor unit must have the ability to operate with a maximum height difference of 49 feet in case all indoor unit(s) is(are) installed higher than the outdoor unit or 49 ft between the highest and lowest indoor units if some indoor units are above and below outdoor unit and 33 feet between outdoor and lowest indoor unit if all indoor units all below outdoor unit.

2.2.5.3. The unit shall have a maximum refrigerant tubing length of 82 feet per indoor unit and a total of 230 feet between all indoor and outdoor units without the need for line size changes, traps or additional oil. The unit shall be pre-charged for a maximum of 131 feet of refrigerant tubing. The compressor shall be mounted to avoid the transmission of vibration.

2.2.6. Electrical

2.2.6.1. The electrical power of the unit shall be 208 volts or 230 volts, 1 phase, 60 hertz.

2.2.6.2. The unit shall be capable of satisfactory operation within voltage limits of 198 volts to 253 volts. Pulse Amplitude Modulation shall be incorporated into electrical circuit The outdoor unit shall be controlled by the microprocessor located in the indoor unit.

2.2.6.3. The control voltage between the indoor unit and the outdoor unit shall be 208 volts or 230 volts AC.

PART 3 - INSTALLATION

3.1. OUTDOOR UNIT

3.1.1. Install outdoor in strict accordance with the manufacturer's instructions; adhere strictly to all manufacturer's instructions pertaining to clearances around the equipment and between the adjacent condensing units.

3.1.2. Secure outdoor equipment to the roof supports; for roof supports, refer to details on the drawings.

3.1.3. Connect equipment to power supply and refrigerant piping. All refrigerant piping final sizing to be calculated by the manufacturer and submitted at shop drawings stage. Calculation shall be based on the total developed length of the lines.

3.1.4. Connect equipment to the BAS and make all connections between the outdoor equipment and the indoor evaporator. Supply and install all wiring and controllers furnished by the manufacturer.

3.2. INDOOR UNITS

3.2.1. Install indoor units where noted on the drawings and conform strictly to the manufacturer's instructions.

3.2.2. Connect all refrigerant lines in accordance with the manufacturer's instructions.

3.2.3. A full load of refrigerant shall be supplied for each system, adequate tfor the system capacity and refrigerant lines lengths.

3.2.4. Make connections to power supply in accordance to the manufacturer's instructions.

3.2.5. Make connections to the BAS in accordance with the sequences of operations and BAS specifications.

3.2.6. Connect all evaporators to a condensate drainage loop, discharging onto the janitorial sink, as noted. Slope the drain lines as specified.

3.2.7. Coordinate the layout of the drainage with the existing radiators, heating pipes and other services. Cut out round sections through the radiator covers where required and pass in between finned elements.

3.3. **CONNECTIONS**

3.3.1. Verify condensate drainage requirements.

3.3.2. Install condensate drain, minimum connection size, with trap and indirect connection to noted discharge point.

3.3.3. Install piping adjacent to units to allow service and maintenance.

3.3.4. Ground equipment and install power wiring, switches, and controls for self contained and split systems.

3.3.5. Connect refrigerant piping to coils with shutoff valves on the suction and liquid lines at the coil and a union or flange at each connection at the coil and condenser.

3.4. **FIELD QUALITY CONTROL**

3.4.1. Perform tests and inspections and prepare test reports.

3.4.2. Tests and Inspections: After installing units and after electrical circuitry has been energized, test units for compliance with requirements. Inspect for and remove shipping bolts, blocks, and tie-down straps. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment. Remove and replace malfunctioning units and retest as specified above.

3.5. **INSTRUCTIONS**

3.5.1. Provide services of manufacturer's technical representative for four hours to instruct Board personnel in operation and maintenance of units.

3.6. **STARTUP AND TESTING**

3.6.1. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the Board project Supervisor and Commissioning Agent. Provide a minimum of 7 days prior notice.

3.7. **DEMONSTRATION AND TRAINING**

3.7.1. Provide services of manufacturer's technical representative for four hours to instruct VA personnel in operation and maintenance of units.

3.7.2. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00 – COMMISSIONING OF HVAC SYSTEMS.

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PART 1 - GENERAL

1.1. DESCRIPTION

1.1.1. Perimeter convectors, heaters, finned elements. .

1.2. RELATED WORK

1.2.1. Section 01 33 23, SHOP DRAWINGS.
1.2.2. Section 23 05 93, TESTING, ADJUSTING, and BALANCING FOR HVAC.

1.3. SUBMITTALS

1.3.1. Product Data shall be provided with data indicating configuration, general assembly, and materials used in fabrication, including catalog performance ratings that indicate heating outputs, correction factors, support details and connection requirements.

1.3.2. Shop Drawings shall indicate configuration, general assembly, and materials used in fabrication, and electrical characteristics and connection requirements.

1.3.3. Manufacturer's Installation Instructions shall indicate support and hanging details, installation instructions, recommendations, and service clearances required.

1.3.4. Project Record Documents shall record actual locations of units and controls components and locations of access doors.

1.3.5. Operation and Maintenance Data shall include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists. Include directions for resetting constant-volume regulators.

1.3.6. Manufacturer’s warranty shall be submitted and ensure forms have been completed in Owner's name and registered with manufacturer.

1.3.7. Maintenance Materials shall be furnished for the Board’s use in maintenance of the project.

1.4. QUALITY ASSURANCE

1.4.1. Manufacturer Qualifications shall be specified in this section, with minimum ten years of documented experience.

1.4.2. Product Listing Organization Qualifications: The manufacturer shall be listed with an organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.5. **WARRANTY**

1.5.1. Provide 18 month manufacturer warranty from date of shipment for air terminal units, integral sound attenuators, integral heating coils, and integral controls.

1.6. **APPLICABLE PUBLICATIONS**

1.6.1. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

1.6.2. American National Standards Institute / Air Conditioning, Heating and Refrigeration Institute (ANSI/AHRI):

1.6.2.1. 440 08 Performance Rating of Room Fan Coils

1.6.3. Underwriters Laboratories, Inc. (UL):

1.6.3.1. 1995 05Heating and Cooling Equipment

1.7. **DELIVERY, STORAGE, AND HANDLING**

1.7.1. Mark each terminal unit before shipment to the job site with a unique identifier corresponding to its location and function in the building. Identifier nomenclature shall correspond to the Terminal Airflow Unit Detail.

PART 2 - PRODUCTS

2.1. **GENERAL**

2.1.1. Factory built.

2.1.2. Clearly show on each unit the unit number and on the equipment schedules, heating output corresponding to the contract drawings.

2.1.3. Capacity and Performance: as noted in the equipment schedules.

2.2. **ADMINISTRATIVE REQUIREMENTS**

2.2.1. Controls Contractor shall coordinate with the terminal heating equipment manufacturer to provide a complete operating system.

2.3. **FINNED ELEMENTS IN EXISTING MILLWORK**

2.3.1. Elements are non-ferrous - seamless copper tube with aluminum fins)

2.3.2. The tubes are expanded within the fins to obtain a permanent thermal bond between the two. These are manufactured in lengths of 1’0” to 10’0” by 6” increments. Both elements can be used on either steam or hot water systems.

2.3.3. Number of stacked finned elements and length/heating output: as per equipment schedules and drawings.

2.3.4. Standard of Acceptance: Rosemex RAF series, Engineered Air.

2.4. **SLOPED TOP CONVECTORS**

2.4.1. General

2.4.1.1. Most models consist of element and cabinet supports hung from a continuous hanging strip. Enclosure lengths are assembled together using concealed joiner strips to give a single unit look in every room. The cabinet support design enables the installer to simply clip the bottom of the enclosure to the support.

2.4.2. Enclosures

2.4.2.1. Enclosures are made of quality cold rolled steel, 18, 16 or 14 gauge, formed and reinforced with top supports, degreased, phosphatized and coated inside and out with a corrosion resistant tan primer. Panels are manufactured in lengths of 2’0” to 8’0” by 6” increments.

2.4.2.2. Enclosure height: as noted on the drawings. Coordinate with the window sill height, where applicable

2.4.3. Finned Elements

2.4.3.1. Elements are non-ferrous - seamless copper tube with aluminum fins)

2.4.3.2. The tubes are expanded within the fins to obtain a permanent thermal bond between the two. These are manufactured in lengths of 1’0” to 10’0” by 6” increments. Both elements can be used on either steam or hot water systems.

2.4.4. Accessories

2.4.4.1. End Piece

2.4.4.1.1. End pieces are used to close off enclosure ends when cabinets do not terminate on an adjacent wall. The end piece is manufactured with rounded corners and protrudes 1” beyond enclosure to give a neat finished appearance.

2.4.4.2. Wall Trim

2.4.4.2.1. Joiners are manufactured to overlap enclosures and cover the gap between cabinet end and adjacent wall or columns. These are usually supplied in 4”, 5”, 6” or 8” lengths.

2.4.4.3. Concealed Joiner (butt joint)

2.4.4.3.1. Otherwise known as “butt joint connector”, this piece fits between two enclosure lengths to give a clean hairline joint appearance to the installation.

2.4.4.4. Inside Corner

2.4.4.4.1. Inside corners are manufactured to overlap enclosures and are used when piping runs on two or more inside walls to meet heating requirements. These are usually supplied at 90° angles, however may be modified to meet project conditions.

2.4.4.5. Outside Corner

2.4.4.5.1. Outside corners are manufactured to overlap enclosures and are used when piping runs on two or more outside walls to meet heating requirements. These are usually supplied at 90° angles, however may be modified to meet project conditions.

2.4.4.6. Access Doors

2.4.4.6.1. Access doors are manufactured to permit access to valves or other controls located inside enclosure. Two types are available, factory installed 5” x 7” or field mounted 5” x 7” with frame. They are supplied as standard with a screw lock, however a camlock type is also available.

2.4.4.6.2. For field mounted access doors, the contractor is required to perforate the enclosure.

2.4.4.7. Pipe Covers

2.4.4.7.1. Pipe covers are used to hide pipes that run around a column. These are supplied in 5”, 11” or 17” heights and are 3 3/4” deep.

2.4.4.8. Dampers

2.4.4.8.1. Dampers are knob operated hinged type and are available for use on most convector models. The screw type mechanism is corrosion proof and sets the damper in any position.

2.4.5. Standard of Acceptance: Rosemex RVS Series, Engineered Air

2.5. **WALL-HUNG CONVECTOR-RADIATOR**

2.5.1. The cabinet is screwed or bolted to wall, depending on its construction, at approximately 5 1/4” from floor.

2.5.2. Cabinet construction: 20ga steel back, 16 ga steel top, 18 ga steel sides and front.

2.5.3. The front panel is easily removable.

2.5.4. The element is adjustable to pipe line position and may be slightly pitched at one end or the other to facilitate proper air venting.

2.5.5. Access door for access to BAS components and isolation valves: by the manufacturer, factory installed.

2.5.6. Optional manual damper.

2.5.7. Standard of Acceptance: Rosemex WF series, Engineered Air

PART 3 - EXECUTION

3.1. EXAMINATION AND PREPARATION

3.1.1. Review and examine conditions affecting work. Proceed with installation only after unsatisfactory conditions have been corrected.

3.1.2. Where applicable, take apart carefully existing millwork and store in a safe space, to be re-assembled after the finned elements are installed.

3.1.3. Prior to submission of shop drawings, the equipment manufacturer shall inspect the site and make final measurements to ensure that the new equipment and covers fit as specified.

3.2. INSTALLATION

3.2.1. Work shall be installed as shown and according to the manufacturer’s diagrams and recommendations.

3.2.2. Provide minimum clearances from the finished floor as per the manufacturer’s recommendations.

3.2.3. Handle and install units in accordance with manufacturer's written instructions.

3.2.4. Support units rigidly so they remain stationary at all times. Cross bracing or other means of stiffening shall be provided as necessary. Method of support shall be such that distortion and malfunction of units cannot occur.

3.2.5. Work shall be installed as shown and according to the manufacturer’s diagrams and recommendations.

3.2.6. Where continuous wall to wall installations are shown on the drawings provide all fillers, corner fittings, sleeves, end caps and other accessories, which shall have the same profile as the basic unit. Provide access panels or extensions where required for access to valves, or traps shown on the drawings.

3.2.7. Handle and install units in accordance with manufacturer's written instructions.

3.3. **ACCESS TO BAS DEVICES AND ISOLATION VALVES**

3.3.1. Ensure that adequate means are provided to allow access to the BAS components and isolation valves, strainers and balancing valves.

3.3.2. Where possible, use hinged access door, pre-manufactured by the covers manufacturer. Where not possible, mount BAS components and valve fittings in other accessible areas such as ceiling spaces or vertical chases. Where located in ceiling spaces, identify location at the nearest tile or ceiling grid intersection.

3.4. **CLEANING AND PROTECTION**

3.4.1. Protect casing and covers throughout the entire construction period, until Substantial Completion.

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PART 1 - GENERAL

1.1. DESCRIPTION

1.1.1. This section applies to all sections of Division 26.

1.1.2. Furnish and install electrical systems, materials, equipment, and accessories in accordance with the specifications and drawings. Capacities and ratings of motors, transformers, conductors and cable, switchboards, switchgear, panelboards, motor control centers, generators, automatic transfer switches, and other items and arrangements for the specified items are shown on the drawings.

1.1.3. Electrical service entrance equipment and arrangements for temporary and permanent connections to the electric utility company's system shall conform to the electric utility company's requirements. Coordinate fuses, circuit breakers and relays with the electric utility company's system, and obtain electric utility company approval for sizes and settings of these devices.

1.1.4. Conductor ampacities specified or shown on the drawings are based on copper conductors, with the conduit and raceways sized per NEC. Aluminum conductors are prohibited.

1.2. MINIMUM REQUIREMENTS

1.2.1. Canadian Electrical Safety Code, (CESC), National Electrical Code (NEC), Underwriters Laboratories, Inc. (UL), and National Fire Protection Association (NFPA) codes and standards are the minimum requirements for materials and installation.

1.2.2. The drawings and specifications shall govern in those instances where requirements are greater than those stated in the above codes and standards.

1.3. TEST STANDARDS

1.3.1. All materials and equipment shall be listed, labeled, or certified by a Nationally Recognized Testing Laboratory (NRTL) to meet Underwriters Laboratories, Inc. (UL), standards where test standards have been established. Materials and equipment which are not covered by UL standards will be accepted, providing that materials and equipment are listed, labeled, certified or otherwise determined to meet the safety requirements of a NRTL. Materials and equipment which no NRTL accepts, certifies, lists, labels, or determines to be safe, will be considered if inspected or tested in accordance with national industrial standards, such as ANSI, NEMA, and NETA. Evidence of compliance shall include certified test reports and definitive shop drawings.

1.4. DEFINITIONS:

1.4.1. Listed: Materials and equipment included in a list published by an organization that is acceptable to the Authority Having Jurisdiction and concerned with evaluation of

products or services, that maintains periodic inspection of production or listed materials and equipment or periodic evaluation of services, and whose listing states that the materials and equipment either meets appropriate designated standards or has been tested and found suitable for a specified purpose.

1.4.2. Labeled: Materials and equipment to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the Authority Having Jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled materials and equipment, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

1.4.3. Certified: Materials and equipment which:

1.4.4. Have been tested and found to meet nationally recognized standards or to be safe for use in a specified manner.

1.4.5. Bear a label, tag, or other record of certification.

1.5. **QUALIFICATIONS (PRODUCTS AND SERVICES)**

1.5.1. Manufacturer’s Qualifications: The manufacturer shall regularly and currently produce, as one of the manufacturer's principal products, the materials and equipment specified for this project, and shall have manufactured the materials and equipment for at least three years.

1.5.2. Product Qualification:

1.5.2.1. Manufacturer's materials and equipment shall have been in satisfactory operation, on three installations of similar size and type as this project, for at least three years.

1.5.2.2. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within eight hours of receipt of notification that service is needed. Submit name and address of service organizations.

1.6. **APPLICABLE PUBLICATIONS, CODES AND STANDARDS**

1.6.1. Applicable publications listed in all Sections of Division 26 are the latest issue, unless otherwise noted.

1.6.2. Products specified in all sections of Division 26 shall comply with the applicable publications listed in each section.

1.6.3. Publications:

1.6.3.1. CAN/CSA C22.1-015, Canadian Electrical Code Part 1 (23nd Edition), Safety Standard for Electrical Installations.

1.6.3.2. Ontario Electrical Safety Code 26th Edition / 2015 or later.
1.6.3.3. CAN3-C235-83 (R2010), Preferred Voltage Levels for AC Systems, 0 to 50,000V.
1.6.3.4. National Building Code of Canada.
1.6.3.5. National Fire Code of Canada.
1.6.3.6. Ontario Building Code 2012.
1.6.3.7. National Fire Protection Code NFPA-70

1.7. MANUFACTURED PRODUCTS

1.7.1. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, and for which replacement parts shall be available.

1.7.2. When more than one unit of the same class or type of materials and equipment is required, such units shall be the product of a single manufacturer.

1.7.3. Equipment Assemblies and Components:

1.7.3.1. Components of an assembled unit need not be products of the same manufacturer.
1.7.3.2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.

1.7.4. Components shall be compatible with each other and with the total assembly for the intended service.

1.7.5. Constituent parts which are similar shall be the product of a single manufacturer.
1.7.6. Factory wiring and terminals shall be identified on the equipment being furnished and on all wiring diagrams.

1.7.7. When Factory Testing Is Specified:
1.7.7.1.
1.7.7.2. The Board shall have the option of witnessing factory tests. The Contractor shall notify the Board a minimum of 15 working days prior to the manufacturer's performing the factory tests.
1.7.7.3. When materials and equipment fail factory tests, and re-testing and re-inspection is required, the Contractor shall be liable for all additional expenses for the Board to witness re-testing.

1.8. VARIATIONS FROM CONTRACT REQUIREMENTS

1.8.1. Where the Board or the Contractor requests variations from the contract requirements, the connecting work and related components shall include, but not be limited to additions or changes to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels and installation methods.

1.9. MATERIALS AND EQUIPMENT PROTECTION

1.9.1. Materials and equipment shall be protected during shipment and storage against physical damage, vermin, dirt, corrosive substances, fumes, moisture, cold and rain.

1.9.2. Store materials and equipment indoors in clean dry space with uniform temperature to prevent condensation.

1.9.3. During installation, equipment shall be protected against entry of foreign matter, and be vacuum-cleaned both inside and outside before testing and operating. Compressed air shall not be used to clean equipment. Remove loose packing and flammable materials from inside equipment.

1.9.4. Damaged equipment shall be repaired or replaced, as determined by the Consultant.

1.9.5. Painted surfaces shall be protected with factory installed removable heavy kraft paper, sheet vinyl or equal.

1.9.6. Damaged paint on equipment shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.

1.10. WORK PERFORMANCE

1.10.1. All electrical work shall comply with the requirements of CESC, NFPA 70 (NEC), NFPA 70B, NFPA 70E, OSHA Part 1910 subpart J – General Environmental Controls, OSHA Part 1910 subpart K – Medical and First Aid, and OSHA Part 1910 subpart S – Electrical, in addition to other references required by contract.

1.10.2. Job site safety and worker safety is the responsibility of the Contractor.

1.10.3. Electrical work shall be accomplished with all affected circuits or equipment de-energized. When an electrical outage cannot be accomplished in this manner for the required work, the following requirements are mandatory:

1.10.4. Electricians must use full protective equipment (i.e., certified and tested insulating material to cover exposed energized electrical components, certified and tested insulated tools, etc.) while working on energized systems in accordance with NFPA 70E.

1.10.5. Work on energized circuits or equipment cannot begin until prior written approval is obtained from the Consultant

1.10.6. For work that affects existing electrical systems, arrange, phase and perform work to assure minimal interference with normal functioning of the facility.

1.10.7. New work shall be installed and connected to existing work neatly, safely and professionally. Disturbed or damaged work shall be replaced or repaired to its prior conditions.

1.10.8. Coordinate location of equipment and conduit with other trades to minimize interference.

1.11. **COORDINATION AND INTERFERENCE DRAWINGS**

1.11.1. Provide information and cooperate with the General/Mechanical Contractor for the preparation of interference and coordination drawings.

1.11.2. Interference and coordination drawings to be provided in order to make clear the Work intended or to show how it affects other trades.

1.11.3. interference and coordination drawings to be provided for:

1.11.3.1. Mechanical, Electrical, Communications Rooms

1.11.3.2. Service corridors and tunnels

1.11.3.3. Corridor, lobbies and all public spaces

1.11.3.4. Crawl spaces

1.11.3.5. Attic spaces

1.11.3.6. Underground Trenches

1.11.3.7. Raised floor spaces

1.12. **EQUIPMENT INSTALLATION AND REQUIREMENTS**

1.12.1. Equipment location shall be as close as practical to locations shown on the drawings.

1.12.2. Working clearances shall not be less than specified in the CEC.

1.12.3. Inaccessible Equipment:

1.12.3.1. Where the Consultant determines that the Contractor has installed equipment not readily accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the Board.

1.12.3.2. "Readily accessible" is defined as being capable of being reached quickly for operation, maintenance, or inspections without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.

1.12.4. Electrical service entrance equipment and arrangements for temporary and permanent connections to the electric utility company’s system shall conform to the electric utility company's requirements. Coordinate fuses, circuit breakers and relays with the electric utility company’s system, and obtain electric utility company approval for sizes and settings of these devices.

1.13. **EQUIPMENT IDENTIFICATION**

1.13.1. In addition to the requirements of the CEC, install an identification sign which clearly indicates information required for use and maintenance of items such as switchboards and switchgear, panelboards, cabinets, motor controllers, fused and non-fused safety switches, generators, automatic transfer switches, separately enclosed circuit breakers, individual breakers and controllers in switchboards, switchgear and motor control assemblies, control devices and other significant equipment.

1.13.2. Identification signs for Normal Power System equipment shall be laminated black phenolic resin with a white core with engraved lettering. Identification signs for Essential Electrical System (EES) equipment, as defined in the NEC, shall be laminated red phenolic resin with a white core with engraved lettering. Lettering shall be a minimum of 12 mm (1/2 inch) high. Identification signs shall indicate equipment designation, rated bus amperage, voltage, number of phases, number of wires, and type of EES power branch as applicable. Secure nameplates with screws.

1.13.3. Install adhesive arc flash warning labels on all equipment as required by NFPA 70E. Label shall indicate the arc hazard boundary (inches), working distance (inches), arc flash incident energy at the working distance (calories/cm2), required PPE category and description including the glove rating, voltage rating of the equipment, limited approach distance (inches), restricted approach distance (inches), prohibited approach distance (inches), equipment/bus name, date prepared, and manufacturer name and address.

1.14. **SUBMITTALS**

1.14.1. All submittals shall include copies of adequate descriptive literature, catalog cuts, shop drawings, test reports, certifications, samples, and other data necessary for the Board to ascertain that the proposed materials and equipment comply with drawing and specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify specific materials and equipment being submitted.

1.14.2. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval.

1.14.3. The Consultant's approval shall be obtained for all materials and equipment before delivery to the job site. Delivery, storage or installation of materials and equipment which has not had prior approval will not be permitted.

1.14.4. The submittals shall include the following:

1.14.4.1. Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical

data sheets, shop drawings, manuals, pictures, nameplate data, and test reports as required.

1.14.4.2. Elementary and interconnection wiring diagrams for communication and signal systems, control systems, and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.

1.14.4.3. Parts list which shall include information for replacement parts and ordering instructions, as recommended by the equipment manufacturer.

1.14.5. Maintenance and Operation Manuals:

1.14.5.1. Submit as required for systems and equipment specified in the technical sections. Furnish in hardcover binders or an approved equivalent.

1.14.5.2. Inscribe the following identification on the cover: the words "MAINTENANCE AND OPERATION MANUAL," the name and location of the system, material, equipment, building, name of Contractor, and contract name and number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the material or equipment.

1.14.5.3. Provide a table of contents and assemble the manual to conform to the table of contents, with tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in.

1.14.6. The manuals shall include:

1.14.6.1. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.

1.14.6.2. A control sequence describing start-up, operation, and shutdown.

1.14.6.3. Description of the function of each principal item of equipment.

1.14.6.4. Installation instructions.

1.14.6.5. Safety precautions for operation and maintenance.

1.14.6.6. Diagrams and illustrations.

1.14.6.7. Periodic maintenance and testing procedures and frequencies, including replacement parts numbers.

1.14.6.8. Performance data.

1.14.6.9. Pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare and replacement parts, and name of servicing organization.

1.14.6.10. List of factory approved or qualified permanent servicing organizations for equipment repair and periodic testing and maintenance, including addresses and factory certification qualifications.

1.14.6.11. Approvals will be based on complete submission of shop drawings, manuals, test reports, certifications, and samples as applicable.

1.15. **RECORD DRAWINGS**

1.15.1. The Consultant will provide to the Electrical Contractor one set of AutoCad computer files and one set of white prints of all drawings relating to the work of this contract, for the purpose of preparing record drawings. As the job progresses, mark up the white prints to accurately indicate installed work, i.e. location and elevations, etc. On completion of the work, the Electrical Contractor to transfer the information neatly onto the computer files based on AutoCad 2007 or higher, and submit the electronic files and one set of prints for review and comment. Correct the files as directed by the Consultant and hand these over to the Board, together with a set of white prints, on completion.

1.15.2. Record, as the job progresses, all approved changes and deviations made to any work shown on the original contract drawings whether by addenda, requested changes, job instructions, and changes due to job conditions.

1.15.3. Indicate on the drawings all conduits, pull boxes, junction boxes, empty conduits, concealed main and sub-feeder conduits and any other equipment not clearly in view, with exact dimensions for future reference. Tie dimensions by measurement to existing topographical features, and include changes in directions as well as at least three points on straight runs of conduits on raceways.

1.15.4. All conduits in slabs, under slab and direct buried are to be shown on the Record drawings.

1.15.5. Record drawings to be kept up to date and be available for checking at any time by Boards and Consultant. Progress draws will not be reviewed unless the record drawing set is up to date.

1.15.6. All equipment schedules, panel schedules, system schedules, riser diagrams, details, etc. to be updated to reflect the as installed condition and included as part of the record drawing submission.

1.15.7. Provide a schedule indicating the protective device trip setting of all Air Circuit Breakers and Electronic Solid State Circuit Breakers which are reflected on each of the Power Distribution Single Line Riser Diagram drawings. The protective device trip settings that are to be listed in the schedule are to be those which are based upon the final reviewed and accepted version of the short circuit and protection and coordination as well as the arc flash study.

1.15.8. Branch circuiting, lighting zoning, switching, etc. methodology to be the same as that indicated on the electrical contract documents that are issued for construction.

1.15.9. Electrical record drawings to be submitted in both AutoCad and PDF format.

1.15.10. Record drawings will not be reviewed for acceptance until project substantial completion has been issued.

1.16. **ACCEPTANCE CHECKS AND TESTS**

1.16.1. The Contractor shall furnish the instruments, materials, and labor for tests.

1.16.2. Where systems are comprised of components specified in more than one section of Division 26, the Contractor shall coordinate the installation, testing, and adjustment of all components between various manufacturer's representatives and technicians so that a complete, functional, and operational system is delivered to the Board.

1.16.3. When test results indicate any defects, the Contractor shall repair or replace the defective materials or equipment, and repeat the tests. Repair, replacement, and retesting shall be accomplished at no additional cost to the Board.

1.17. **CODES, PERMITS AND INSPECTIONS**

1.17.1. All work to meet or exceed the latest requirements of the Codes and Standards as listed in PART 1 of these specifications, supplements, local inspection bulletins and all Authorities Having Jurisdiction.

1.17.2. Arrange for inspection of all work and pay all fees in this regard. On completion of the work, deliver the final unconditional certificate of approval of the Electrical Safety Authority (ESA).

1.17.3. It is hereby agreed that all requirements meet CAN/CSA requirements and a complete installation in accordance with these requirements to be provided.

1.17.4. Keep a permanent record of each inspection made by the Electrical Safety Authority showing the date, inspector's name, scope of the inspection and statement of special decisions or permissions granted. Make these records available to the Consultant at any time, and turn them over at completion of the work.

1.18. **WARRANTY**

1.18.1. All work performed and all equipment and material furnished under this Division shall be free from defects and shall remain so for a period of one year from the date of acceptance of the entire installation by the Board's representative.

1.19. **INSTRUCTION**

1.19.1. Instruction to designated Board personnel shall be provided for the particular equipment or system as required in each associated technical specification section.

1.19.2. Furnish the services of competent instructors to give full instruction in the adjustment, operation, and maintenance of the specified equipment and system, including pertinent safety requirements. Instructors shall be thoroughly familiar with all aspects

of the installation, and shall be trained in operating theory as well as practical operation and maintenance procedures.

1.19.3. A training schedule shall be developed and submitted by the Contractor and approved by the Consultant at least 15 days prior to the planned training.

PART 2 - PRODUCTS

2.1. **MATERIALS AND EQUIPMENT**

2.1.1. All materials and equipment to be new and free from defects.

2.1.2. All material and equipment to be CAN/CSA certified. Where CAN/CSA certified material and equipment is not available, obtain special approval from authority having jurisdiction before delivery to site and submit such approval as described in PART 1 - SUBMITTALS.

2.1.3. Where materials, equipment, apparatus, or other products are specified by the manufacturer, brand name, type or catalogue number, such designation is to establish the standards of desired quality, style or dimensions and to be the basis of the Bid. Furnish materials so specified under this Contract unless changed by mutual agreement. Where two or more designations are listed, the Electrical Contractor to choose one of those listed.

2.1.4. Where the use of equivalent, alternate or substitute equipment alters the design or space requirements indicated on the plans, the Electrical Contractor for this contract to include all items of cost for the revised design and construction, including the cost of all the other trades involved.

2.1.5. Acceptance of the proposed equivalents, alternates or substitutions to be subject to the review by the Consultant, and if requested, the Electrical Contractor to submit for inspection, samples of both the specified and the proposed alternate items.

2.1.6. In all cases where the use of equivalents, alternates or substitutions is permitted, the Electrical Contractor to bear any extra costs of evaluating the quality of materials and the equipment to be installed.

2.2. **EQUIVALENTS AND ALTERNATES**

2.2.1. Should the Electrical Contractor propose to furnish material and equipment other than those specified, he is to apply in writing to the Consultant for approval of equivalents at least ten working days prior to the closing of Bids, submitting with his request for approval, complete descriptive and technical data on the item or items he proposes to furnish. Approval for changes in the base bid specifications will be considered only upon the individual requests of the Electrical Contractor. No blanket approval for equipment will be given to suppliers, distributors or contractors.

2.2.2. Unless requests for changes in base bid specifications are received and approved prior to the opening of the bids, as defined above, the Electrical Contractor will be held to furnish all specified items under his base bid. After the Contract is awarded, changes in specifications will be made only as defined in the Article dealing with Material Substitution.

2.2.3. Replace unspecified materials or rejected equivalents and alternates built into the work with specified or accepted materials at no additional cost to the Owner.

2.2.4. If any material or equipment being considered for substitution involves additional design, architectural or engineering fees or other costs in checking whether or not the substitute material or equipment is suitable for the project, such fees or costs to be paid for by the Electrical Contractor. A minimum of five hundred dollars ($500.00) to be applied to each piece of device or equipment requested for review. There is no guarantee that the reviewed product will be accepted by the Board or the reviewing Consultant.

2.3. **MATERIAL SUBSTITUTION**

2.3.1. After award of the Contract, requests for substitution of materials of makes other than those specifically named in the Contract Documents may be considered by the Consultant subject to the following:

2.3.1.1. The specified material cannot be delivered to the job in time to complete the work in proper sequence to work of other trades, due to conditions beyond the control of the Electrical Contractor.

2.3.1.2. Requests for substitutions to be accompanied by documentary proof of equality, difference in price and delivery, if any, in the form of certified quotations from suppliers of both specified and proposed equipment.

2.3.1.3. In case of difference in price, the Owner is to receive all benefit of the difference in cost involved in any substitution and the Contract altered by change order to credit the Owner with any savings so obtained.

2.3.1.4. Materials and equipment substituted or offered as alternatives to have spare parts and servicing available and to fit into the space allocation shown on the drawings.

2.3.1.5. If any material or equipment being considered for substitution involves additional design, architectural or engineering fees or other costs in checking whether or not the substitute material or equipment is suitable for the project, such fees or costs to be paid for by the Electrical Contractor. A minimum of five hundred dollars ($500.00) to be applied to each piece of device or equipment requested for review. There is no guarantee that the reviewed product will be accepted by the Board or the reviewing Consultant.

2.4. **WARNING SIGNS**

2.4.1. Warning Signs: in accordance with requirements of Authority Having Jurisdiction and Consultants.
2.4.2. Comply with Health Canada/Workplace Hazardous Materials Information System (WHMIS).
2.4.3. Provide warning labels in both English and French where project requires.

2.5. **FINISHES**

2.5.1. Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and two coats of finish enamel.
2.5.2. Paint outdoor electrical distribution equipment green finish to EEMAC Y1-2.
2.5.3. Paint indoor normal power distribution equipment enclosures light grey to EEMAC 2Y-1.
2.5.4. Paint indoor emergency power “Life Safety” distribution equipment enclosures Red.
2.5.5. Paint indoor emergency power “Non-life Safety” distribution equipment enclosures International Orange, RAL #2009.
2.5.6. Paint indoor UPS power distribution equipment enclosures Blue, RAL #5017.

2.6. **CAN/CSA/NEMA RATING**

2.6.1. All electrical equipment provided for this project to be CAN/CSA/NEMA Rated only. IEC Rated equipment is not acceptable and will not be accepted.

PART 3 - EXECUTION

3.1. **INSTALLATION**

3.1.1. Comply with all Codes and Standards listed in PART 1 – GENERAL.
3.1.2. Comply with manufacturer's written data, including product technical bulletins, product catalog installation instructions, product carton installation instructions, MSDS, and product datasheets.
3.1.3. Protect electrical equipment from dust and dirt. Plug or cap openings of conduits, fixtures and equipment during construction with approved materials for such use.
3.1.4. The Electrical Contractor to be responsible for the layout of the work of this contract, and for any damage caused to site or existing building, or other Contracts by improper location or carrying out of this work.
3.1.5. Ensure the prompt installation of the work of this contract in advance of concrete pouring or similar work.
3.1.6. No conduits for any power or systems to be permitted to be installed within the concrete slabs or concrete walls for this project except in select identified areas as per the drawings and specifications.
3.1.7. Furnish items to be "built-in" in ample time and give any necessary information and assistance in connection with the building-in of the same.
3.1.8. Manufactured products supplied with instructions for their use to be used in strict accordance with those instructions.

3.1.9. Ensure that all equipment and material is ordered in time to meet the building schedule. Provide a schedule of equipment deliveries to the Construction Manager within the time limit stipulated.

3.2. **SITE SERVICES**

3.2.1. Site services: acquire a full working knowledge of the building site, services and any existing conditions thereon that may impact the project implementation. Review and examine the contract drawings and schedules of all trades prior to bid submittal to ensure full knowledge of the contract scope of work is ascertained.

3.2.2. The location of equipment indicated or specified is considered approximate. Review proposed locations with Consultant prior to installation.

3.2.3. Locate equipment, piping, duct and/or conduit to provide minimum interference and maximum usable space and in accordance with manufacturer's recommendations for safety, access and maintenance.

3.3. **CONTRACTOR'S SHOP**

3.3.1. Provide job site office, workshop, tools, scaffolds, material storage, etc., as required to complete the work of this contract and as directed by the Consultant.

3.3.2. The electrical contractor’s office should as a minimum have the following capabilities, Phone, fax, email, High speed internet connection, router with a spare port and patch cable in order that the consultant can access the internet to deal with project related issues, copier and printer.

3.4. **TEMPORARY SERVICES**

3.4.1. Provide temporary electrical services with all poles, transformer and protection equipment from the locations as coordinated with the Owner. Provide all power panels at various locations on the site required to perform the work and as specified by the Consultant. All temporary services must be coordinated with the Owner. Do not use the permanent service of new or existing building for temporary power for construction unless specific written approval is obtained from the Consultant and coordinated with the Board

3.5. **ACCESS TO ELECTRICAL EQUIPMENT, JUNCTION BOXES AND PULL BOXES**

3.5.1. Clear access of a minimum of 1 meter must be provided for all electrical equipment, junction boxes and pull boxes.

3.5.2. All junction boxes and pull boxes to be within 600mm of an access panel or access luminaire and be easily accessed.

3.5.3. All electrical boxes that have free sides (IE: no conduits entering or leaving a side) to be kept clear in order to permit installation of conduits at a later date. Hence free sides of all electrical boxes to be clear of other conduits and services.

3.6. **NAMEPLATES**

3.6.1. Ensure manufacturer's nameplates, CAN/CSA labels and identification nameplates are visible and legible after equipment is installed.

3.7. **LOCK OFF TABS**

3.7.1. Provide lock off tabs on all panel boards for circuits that serve:

3.7.1.1. Emergency lighting;
3.7.1.2. Exit lighting;
3.7.1.3. Fire alarm equipment
3.7.1.4. Security equipment.

3.8. **FIRESTOPPING**

3.8.1. Where cables, sleeves or conduits, pass through floors and fire rated walls pack space between wiring and sleeve or opening and seal with Hilti fire stopping system that is appropriate. The fire stopping installation must meet one of the approved details as required to meet the rating of the assembly. Contact the Hilti representative to ensure that the installation meet Hilti requirements.

3.8.2. Care must be taken to keep integrity of all assemblies and maintain good finishes of surrounding areas, use tape for finish at edges when apply fire stopping materials. Provide at the end of the project a letter from Hilti indicating that the installation meets all requirements.

3.8.3. Meet all requirements of the Codes and fire proofing requirements as specified within the Contract Documents.

3.8.4. Provide Shop drawings for the various Fire stopping assemblies that will be utilized on the project to achieve the fire rating for construction assemblies or methods.

3.8.5. *Refer (where applicable) to architectural drawings for fire separation diagrams. Such drawings may not be issued as part of the electrical documents; it is the electrical contractor's obligation to review all contract documentation of all involved disciplines (drawings and specifications).*

3.9. **BASES AND SUPPORTS**

3.9.1. Where conduit and equipment is located on walls or slabs which will not permit the support of equipment, provide suitable supports to the building structure. Supports to

be constructed of steel members or of steel pipe and fittings designed to safely support the equipment.

3.9.2. All equipment bases to be set on pads of kinetic pre-compressed fiberglass or vibration isolators sized to suit the equipment which they ought to support.

3.10. **INSERTS, SLEEVES AND CURBS**

3.10.1. Provide all inserts, sleeves and curbs required for the work of this contract.

3.10.2. Use only factory made threaded or toggle type inserts as required for support and anchors, properly sized for the load to be carried. Place inserts only in portions of the main structure and not in any finishing material.

3.10.3. Use factory made expansion shields where inserts cannot be placed, but only where approved by the Structural Engineer and only for loads of 50 kg or less.

3.10.4. Do not use powder activated tools unless with written permission of the Board's Representative.

3.10.5. Supply and locate all inserts, holes, anchor bolts and sleeves in time when walls, floors and roof are erected.

3.10.6. Size sleeves to provide 25 mm clearance all around.

3.10.7. Pack all sleeves between the conduit or cable passing through the sleeve and the sleeve and all spare sleeves with loose fiberglass insulation. Seal the annular space both sides as follows:

3.10.7.1. For all horizontal sleeves in exposed areas, use a seal of equal or better fire rating than the wall to be sealed.

3.10.7.2. For all horizontal concealed sleeves through fire walls and through walls separating areas of different air pressure, use a permanently resilient silicone base or equal sealing compound.

3.10.7.3. For all vertical sleeves through roofs, washrooms, janitor closets, equipment rooms, use permanently resilient silicone base or equal compound, non-flammable and waterproof. Ensure that the seal is compatible with floor and ceiling finishes. Check the room finishes schedules for further information.

3.11. **CUT PATCH AND MAKE GOOD**

3.11.1. All drilling, cutting, patching, concrete curbs, housekeeping pads and similar work required for installation of the specified systems shall be done under this contract.

3.11.2. Do not use powder actuated tools using explosives, unless permitted expressly by the Board in writing.

3.11.3. All cutting of steel shall be by mechanical cutters or saws. Torches and abrasives will only be permitted if there is no alternative. Prior to using torches or abrasives obtain Hot Work Permit in accordance with the Board's hot work procedure.

3.11.4. Scan the walls/floor slabs using ground penetrating radar (GPR) technology prior to making openings to determine the presence and location of embedded conduits or rebar. Clean the floors/walls immediately after core drilling/saw cutting is complete. All core drilling and loud and/or prolonged drilling shall be done after normal working hours (during silent hours) or as permitted by the "hammer drilling" schedule and 48 hour lead notice is to be provided to the building Owner to confirm contractor has met all mandatory conditions.

3.11.5. Core drilling through floors and walls shall be done with diamond drills only. The use of pneumatic hammers will not be permitted.

3.11.6. Patch and make good all surfaces cut, damaged or disturbed to the Board 's approval. Match existing material, colour, finish and texture.

3.11.7. Welding and cutting: conform to Ontario Health and Safety Act O.Reg. 213/91 amended to O.Reg. 628/05 Construction Projects. Obtain a Hot Work Permit from the PM prior to welding and cutting operations. Follow the PM's hot work procedures.

3.11.8. Do not dispose of cement, mortar, plaster or other similar materials into drainage system. Contractor shall be liable for all costs associated with cleanup and reinstatement to original condition after doing so.

3.11.9. Dispose of sediment-containing liquids such as those resulting from core drilling or concrete cutting into designated drains. Flush drain with sufficient quantity of clean water to ensure that drain is free-flowing and unobstructed. Be liable for all costs associated with cleanup and reinstatement of drain and piping to original condition if found to be blocked by sediment.

3.11.10. Firestop all penetrations through wall and floor assemblies with Hilti Firestop solutions having a fire resistance rating not less than the assembly penetrated, colour: red. Unless otherwise noted, use the following assembly ratings: floors 2-hours; walls except around stairways – 1½ hours; walls around stairways: 2 – hours. Submit to Consultant for approval the proposed system detail sheets bearing the UL/CUL system number. Provide specified firestopping compound on both sides of assembly penetrated regardless of UL/CUL detail requirements.

3.12. **REMOVALS AND DEMOLITION**

3.12.1. The drawings indicate the general scope of electrical removals. Verify on site the exact requirements and extent of removals.

3.12.2. Visit the site to determine the extent of all removals.

3.12.3. Maintain, retain and make good as required all existing systems, branch wiring and feeders intended to remain operational in areas which are affected by these renovations.

3.12.4. Schedule all demolition work with project manager prior to any service interruption in occupied building area.

3.12.5. All shutdowns of existing base building systems shall be coordinated with the Board's representative. Pay for any cost incurred. All building services to remain fully operational during construction. Include in tender for off hours to install new breaker in existing panels and connection for feeders.

3.12.6. Remove electrical equipment as required complete with wiring up to associated panel. Remove all electrical components to be demolished or to be relocated and make safe all wiring. Hand over removed items to owner if requested. Dispose of the equipment properly which Owner does not wish to retain. Update existing panel directory which is affected.

3.12.7. Inform the Consultant and the Board immediately if any contaminated materials are found on site. Remove the items so that they can be packed and removed from the site. Provide assistance and cooperation for the complete removal.

3.12.8. The contractor shall be responsible to relocate any existing electrical equipment and/or wiring that will interfere with new construction.

3.12.9. The contractor shall be responsible for reconnection of any services that are to remain and have been disconnected during the course of demolition or construction.

3.12.10. All systems and components which are affected by the renovation shall remain operational subsequent to project completion. Reinstate immediately any services disrupted during demolition not intended to be removed as part of this contract at no extra cost.

3.12.11. Retain continuity of service of the fire alarm system to all occupied areas of the building.

3.12.12. The contractor shall advise security in the event that fire alarm system continuity is disrupted such that a fire watch can commence immediately.

3.12.13. Repair all damages inside and outside of the renovated areas caused by the demolition/construction without extra cost to the Owner.

3.13. **REMOVED MATERIAL**

3.13.1. All material removed during demolition shall become the property of the Contractor. The contractor shall remove material from the site and dispose of in accordance with provincial regulations. Under no circumstances is the contractor to use the building Owner's refuse containers for disposal.

3.14. **NUMBER AND LOCATION OF OUTLETS**

3.14.1. Provide outlets for power and systems of the number and in the locations shown on the drawings. Locate all outlets accurately with respect to building lines and in centering outlets due allowance to be made for overhead pipes, ducts, equipment and for variations in wall or ceiling finishes, window trim, paneling, etc. When necessary, make adjustments to ensure that all outlets are properly centered.

3.14.2. The location of any outlet may be changed without extra cost or credit providing that the new location is within 6 metres (20 feet) of that originally shown on the drawings and that instructions for the change are issued before installation of the outlet.

3.14.3. Do not mount outlet boxes in walls and partitions back-to-back and provide a minimum of 150 mm (6 inch) between boxes. Provide acoustic insulating medium in conduits which join boxes on opposite sides of same wall or partition. Acoustic properties of the wall to be matched or exceeded. Where applicable, for acoustically sensitive/critical rooms, more spacing separation and acoustic box seal is required. Refer to acoustic specifications and electrical drawings for detailed requirements.

3.15. **MOUNTING HEIGHTS**

3.15.1. The mounting height of equipment is measured from the finished floor to the centerline of the equipment unless specified or otherwise indicated.

3.15.2. If the mounting height of any equipment is not indicated, verify the mounting height before proceeding with the installation.

3.15.3. Install electrical equipment at the following mounting heights unless otherwise detailed or indicated. Refer to Architectural reflected ceiling plans, elevations, sections and details for final device location and to confirm all mounting heights.

3.15.4. All device mounting heights and orientation to be coordinated and confirmed by the Prime Consultant prior to installation.

3.15.4.1. Local switches and control devices: 1100 mm (42 inch)

3.15.4.2. Wall receptacles:

3.15.4.2.1. General: 400 mm (15 inch)
3.15.4.2.2. Above top of counters or backsplash: 175 mm (7 inch)

3.15.4.2.3. In mechanical rooms: 1400 mm (55 inch)

3.15.5. Panelboards:

3.15.5.1. 1800 mm (70 inch) to the top except that the panelboard not to be lower than 150 mm (6 inch) above the floor.
3.15.5.2. Where multiple panelboards are mounted together, align the tops of all the panelboards or trims with the highest panelboard determining the height.

3.15.6. Fire alarm system pull stations: 1200 mm (48 inch)

3.15.6.1. Fire alarm system speakers/strobes: 2300 mm (90 inch) and at least 150 mm (6 inch) below the ceiling measured to the top of device, or on ceiling.
3.15.6.2. Fire Alarm System end of line resistors as per code requirements. EOL resistors to be grouped in service spaces.
3.15.6.3. Fire fighter's phone: 1400 mm (55 inch) measured to the centerline of the enclosure.

3.15.7. Individual starters:

3.15.7.1. 1500 mm (60 inch) to the top.
3.15.7.2. Where multiple starters are mounted together, align the tops of all the starters or trims with the highest starter determining the height.

3.15.8. Splitters: 100 mm (4 inch) below the lowest equipment connected to the splitter.

3.16. MECHANICAL AND ELECTRICAL CO-ORDINATION OF RESPONSIBILITIES

3.16.1. The following is a list of mechanical and electrical responsibilities for the above mentioned project:

3.16.1.1. The Electrical Contractor to provide all starters or combinations starters/disconnects (fused or non-fused, as specified) for Mechanical Motors along with Line and Load side power wiring with the exception of Packaged Mechanical Equipment or Units.
3.16.1.2. Where so specified, Packaged Mechanical Equipment to be provided with its own integral disconnect(s), starters(s) or unit mounted VFD(s). With respect to Packaged Mechanical Equipment or Units the Electrical Contractor to provide the Line Side power wiring and connection(s) to the equipment connection point(s).
3.16.1.3. The Electrical Contractor to provide equipment isolation disconnect switches for all *remote* mechanical equipment unless otherwise indicated within the Mechanical Contract Documents or unless equipment is already furnished with a local disconnect. Where applicable, weather-proof enclosures shall be used. *Remote definition: not in sight, as per NFPA-70 article 430.102*
3.16.1.4. All BAS equipment and devices, to be supplied by the BAS vendor and installed by the mechanical Contractor.

3.16.1.5. The Mechanical Contractor to provide all control wiring, BAS wiring, and 120 volt control wiring for Mechanical Equipment or Units.

3.16.1.6. The Mechanical Contractor to provide all motors.

3.16.1.7. The Electrical Contractor to provide all fire alarm interface wiring to the Mechanical Equipment or Units for fire alarm Fan Shut Down, Fan Start-up as and for fire alarm Smoke Control.

3.16.1.8. The Electrical Contractor to provide all fire alarm wiring.

3.16.1.9. The Electrical Contractor to provide all relays for interface to control wiring for fan shutdown and fan start up for air handling units used as part of the smoke control system(s).

3.16.1.10. The Mechanical Contractor to provide all relays as required by the Mechanical Equipment or Units to connect to the various building systems.

3.16.1.11. The Mechanical Contractor to provide electric pipe heat tracing which to be based upon the self-limited type and be at 208 volts 1 Phase. The Electrical Contractor to provide 208 volts 1 Phase power connection(s) for the electric pipe heat tracing system(s). The Mechanical Contractor to provide loads requirements of the heat tracing to the Electrical Contractor prior to final power connection.

3.16.1.12. The Mechanical Contractor to provide electric heating, associated controls and control wiring. The Electrical Contractor to provide the Line Side power connection to the electric heating. The Mechanical Contractor to provide any framing required for recessed electric heating.

3.16.1.13. Separate Variable Frequency Drives (VFDs) to be provided by the Mechanical Contractor. Should the Mechanical Contractor change or modify motor sizes from what is specified within the Bid Documents during any stage of this project the Mechanical Contractor will be responsible to cover all associated electrical costs such as revised motor starter and feeds, etc.

3.17. **FLASHING**

3.17.1. Coordinate with requirements for roofing, waterproofing and flashing with the Roofing Contractor.

3.17.2. Flash electrical parts passing through or built into a roof, an outside wall or a waterproof floor.

3.17.3.

3.17.4. Provide 8-pound sheet lead flashing for cast iron or wrought iron sleeves passing through roof.

3.17.5. Flashing shall suit roof angle and shall extend minimum 450 mm (18 inch) on all sides. Leave flashing as directed by the Roofing Contractor for him to build into roofing, rendering a watertight connection.

3.17.6. Provide counter flashing on stacks, ducts and pipes passing through roof to fit over flashing or curb.

3.17.7. Provide sleeves passing through outside walls with lead or copper flashing as directed.

3.18. **SYSTEM STARTUP**

3.18.1. Inform Consultant and operating personnel in operation, care and maintenance of systems, system equipment and components.

3.18.2. Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.

3.18.3. Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant will aspects of its care and operation.

3.19. **CLEANING**

3.19.1. Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

3.19.2. Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

3.19.3. During the performance of the work and on the completion, remove from the site and premises all debris, rubbish and waste materials caused by the performance of the work for this contract. Remove all tools and surplus materials after completion and acceptance of the work.

3.19.4. Vacuum all equipment thoroughly at the time of final acceptance of the work. Clean plastic components and exposed components of luminaires in accordance with the manufacturer's recommendation.

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PART 1 - GENERAL

1.1. DESCRIPTION

1.1.1. This section specifies the furnishing, installation, connection, and testing of the electrical conductors and cables for use in electrical systems rated 600 V and below, indicated as cable(s), conductor(s), wire, or wiring in this section.

1.2. RELATED WORK

1.2.1. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
1.2.2. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
1.2.3. Section 26 05 33, CONDUITS AND BOXES FOR ELECTRICAL SYSTEMS.

1.3. FACTORY TESTS

1.3.1. Conductors and cables shall be thoroughly tested at the factory per NEMA to ensure that there are no electrical defects. Factory tests shall be certified.

1.4. SUBMITTALS

1.4.1. Shop Drawings:

1.4.1.1. Submit sufficient information to demonstrate compliance with drawings and specifications.
1.4.1.2. Submit the following data for approval:
1.4.1.3. Electrical ratings and insulation type for each conductor and cable.
1.4.1.4. Splicing materials and pulling lubricant.

1.4.2. Certifications: Two weeks prior to final inspection, submit the following.

1.4.2.1. Certification by the manufacturer that the conductors and cables conform to the requirements of the drawings and specifications.
1.4.2.2. Certification by the Contractor that the conductors and cables have been properly installed, adjusted, and tested.

1.5. **APPLICABLE PUBLICATIONS**

1.5.1. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are reference in the text by designation only.

1.5.1.1. CAN/CSA-C22.2 NO.38-10, Thermoset-Insulated Wire and Cables (Tri-national
1.5.1.2. standard, with UL 44 and ANCE NMX-J-451).
1.5.1.3. CAN/CSA C22.2 NO.51-09, Armored Cables.
1.5.1.4. CAN/CSA C22.2 NO.75-08, Thermoplastic-Insulated Wires and Cables (Trinational
1.5.1.5. standard, with UL 83 and NMX-J-010-ANCE-2008).
1.5.1.6. CAN/CSA C22.2 NO.124-04 (R2009), Mineral-Insulated Cable.
1.5.1.7. CAN/CSA C22.2 NO.131-07, Type TECK 90 Cable.
1.5.1.8. CAN/CSA C22.2 NO. 239-09, Control and Instrumentation Cables.

1.5.1.9. American Society of Testing Material (ASTM):

1.5.1.9.1. D2301-10 Standard Specification for Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape
1.5.1.9.2. D2304-10 Test Method for Thermal Endurance of Rigid Electrical Insulating Materials
1.5.1.9.3. D3005-10 Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape

1.5.1.10. National Electrical Manufacturers Association (NEMA):

1.5.1.10.1. WC 70-09 Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy

1.5.1.11. National Fire Protection Association (NFPA):

1.5.1.11.1. 70-11 National Electrical Code (NEC)

1.5.1.12. Underwriters Laboratories, Inc. (UL):

1.5.1.12.1. 44-10 Thermoset-Insulated Wires and Cables
1.5.1.12.2. 83-08 Thermoplastic-Insulated Wires and Cables
1.5.1.12.3. 467-07 Grounding and Bonding Equipment
1.5.1.12.4. 486A-486B-03 Wire Connectors
1.5.1.12.5. 486C-04 Splicing Wire Connectors

1.5.1.12.6. 486D-05 Sealed Wire Connector Systems
1.5.1.12.7. 486E-09 Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
1.5.1.12.8. 514B-04 Conduit, Tubing, and Cable Fittings

PART 2 - PRODUCTS

2.1. CONDUCTORS AND CABLES

2.1.1. Conductors and cables shall be in accordance with NEMA, UL, as specified herein, and as shown on the drawings.

2.1.2. All conductors shall be copper.

2.1.3. Single Conductor and Cable:

2.1.3.1. No. 12 AWG: Minimum size, except where smaller sizes are specified herein or shown on the drawings.
2.1.3.2. No. 8 AWG and larger: Stranded.
2.1.3.3. No. 10 AWG and smaller: Solid; except shall be stranded for final connection to motors, transformers, and vibrating equipment.

2.1.4. Insulation: THHN-THWN and XHHW-2. XHHW-2 shall be used for isolated power systems.

2.2. SPLICES

2.2.1. Splices shall be in accordance with NEC and UL.

2.2.2. Above Ground Splices for No. 10 AWG and Smaller:

2.2.2.1. Solderless, screw on, reusable pressure cable type, with integral insulation, approved for copper and aluminum conductors.
2.2.2.2. The integral insulator shall have a skirt to completely cover the stripped conductors.
2.2.2.3. The number, size, and combination of conductors used with the connector, as listed on the manufacturer's packaging, shall be strictly followed.

2.2.3. Above Ground Splices for No. 8 AWG to No. 4/0 AWG:

2.2.3.1. Compression, hex screw, or bolt clamp type of high conductivity and corrosion resistant material, listed for use with copper and aluminum conductors.

2.2.3.2. Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.

2.2.3.3. Splice and insulation shall be product of the same manufacturer.

2.2.3.4. All bolts, nuts, and washers used with splices shall be cadmium-plated.

2.2.4. Above Ground Splices for 250 kcmil and Larger:

2.2.4.1. Long barrel “butt-splice” or “sleeve” type compression connectors, with minimum of two compression indents per wire, listed for use with copper and aluminum conductors.

2.2.4.2. Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.

2.2.4.3. Splice and insulation shall be product of the same manufacturer.

2.3. **CONNECTORS AND TERMINATIONS**

2.3.1. Mechanical type of high conductivity and corrosion resistant material, listed for use with copper and aluminum conductors.

2.3.2. Long barrel compression type of high conductivity and corrosion resistant material, with minimum of two compression indents per wire, listed for use with copper and aluminum conductors.

2.3.3. All bolts, nuts, and washers used to connect connections and terminations to bus bars or other termination points shall be cadmium-plated.

2.4. **CONTROL WIRING**

2.4.1. Unless otherwise specified elsewhere in these specifications, control wiring shall be as specified herein, except that the minimum size shall be not less than No. 14 AWG.

2.4.2. Control wiring shall be sized such that the voltage drop under in-rush conditions does not adversely affect operation of the controls.

2.5. **WIRE LUBRICATING COMPOUND**

2.5.1. Lubricating compound shall be suitable for the wire insulation and conduit, and shall not harden or become adhesive.

2.5.2. Shall not be used on conductors for isolated power systems.

PART 3 - EXECUTION

3.1. **GENERAL**

3.1.1. Install conductors in accordance with the CSEC, NEC, as specified, and as shown on the drawings.

3.1.2. Install all conductors in metallic conduits, unless specified otherwise. Where multiple conduits follow the same routing, provide raceway systems.

3.1.3. Splice conductors only in outlet boxes, junction boxes, pullboxes, manholes, or handholes.

3.1.4. Conductors of different systems (e.g., 120 V and 347 V) shall not be installed in the same raceway.

3.1.5. Install conduit supports for all vertical feeders in accordance with the NEC. Provide split wedge type which firmly clamps each individual cable and tightens due to cable weight.

3.1.6. In panelboards, cabinets, wireways, switches, enclosures, and equipment assemblies, neatly form, train, and tie the conductors with non-metallic ties.

3.1.7. For connections to motors, transformers, and vibrating equipment, stranded conductors shall be used only from the last fixed point of connection to the motors, transformers, or vibrating equipment.

3.1.8. Use expanding foam or non-hardening duct-seal to seal conduits entering a building or where penetrating building walls/floors, after installation of conduits.

3.1.9. Conductor and Cable Pulling:

3.1.9.1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling. Use lubricants approved for the cable.

3.1.9.2. Use nonmetallic pull ropes.

3.1.9.3. Attach pull ropes by means of either woven basket grips or pulling eyes attached directly to the conductors.

3.1.9.4. All conductors in a single conduit shall be pulled simultaneously.

3.1.9.5. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

3.1.9.6. No more than three branch circuits shall be installed in any one conduit.

3.1.9.7. When stripping stranded conductors, use a tool that does not damage the conductor or remove conductor strands.

3.2. **SPLICE AND TERMINATION INSTALLATION**

3.2.1. Splices and terminations shall be mechanically and electrically secure, and tightened to manufacturer's published torque values using a torque screwdriver or wrench.

3.2.2. Where the Consultant determines that unsatisfactory splices or terminations have been installed, replace the splices or terminations at no additional cost to the Board.

3.3. **CONDUCTOR IDENTIFICATION**

3.3.1. When using colored tape to identify phase, neutral, and ground conductors larger than No. 8 AWG, apply tape in half-overlapping turns for a minimum of 75 mm (3 inches) from terminal points, and in junction boxes, pullboxes, and manholes. Apply the last two laps of tape with no tension to prevent possible unwinding. Where cable markings are covered by tape, apply tags to cable, stating size and insulation type.

3.4. **FEEDER CONDUCTOR IDENTIFICATION**

3.4.1. In each interior pullbox, install brass tags on all feeder conductors to clearly designate their circuit identification and voltage. The tags shall be the embossed type, 40 mm (1-1/2 inches) in diameter and 40 mils thick. Attach tags with plastic ties.

3.5. **EXISTING CONDUCTORS**

3.5.1. Unless specifically indicated on the plans, existing conductors shall not be reused.

3.6. **CONTROL WIRING INSTALLATION**

3.6.1. Unless otherwise specified in other sections, install control wiring and connect to equipment to perform the required functions as specified or as shown on the drawings.

3.6.2. Install a separate power supply circuit for each system, except where otherwise shown on the drawings.

3.7. **CONTROL WIRING IDENTIFICATION**

3.7.1. Install a permanent wire marker on each wire at each termination.

3.7.2. Identifying numbers and letters on the wire markers shall correspond to those on the wiring diagrams used for installing the systems.

3.7.3. Wire markers shall retain their markings after cleaning.

3.8. **ACCEPTANCE CHECKS AND TESTS**

3.8.1. Perform in accordance with the manufacturer's recommendations. In addition, include the following:

3.8.1.1. Visual Inspection and Tests: Inspect physical condition.

3.8.2. Electrical tests:

3.8.2.1. After installation but before connection to utilization devices, such as fixtures, motors, or appliances, test conductors phase-to-phase and phase-to-ground resistance with an insulation resistance tester. Existing conductors to be reused shall also be tested.

3.8.2.2. Applied voltage shall be 500 V DC for 300 V rated cable, and 1000 V DC for 600 V rated cable. Apply test for one minute or until reading is constant for 15 seconds, whichever is longer. Minimum insulation resistance values shall not be less than 25 megohms for 300 V rated cable and 100 megohms for 600 V rated cable.

3.8.2.3. Perform phase rotation test on all three-phase circuits

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PART 1 - GENERAL

1.1. DESCRIPTION

1.1.1. This section specifies the furnishing, installation, connection, and testing of grounding and bonding equipment, indicated as grounding equipment in this section.

1.1.2. “Grounding electrode system” refers to grounding electrode conductors and all electrodes required or allowed by CESC and NEC, as well as made, supplementary, and lightning protection system grounding electrodes.

1.1.3. The terms “connect” and “bond” are used interchangeably in this section and have the same meaning.

1.2. RELATED WORK

1.2.1. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS
1.2.2. Section 26 05 19, ELECTRICAL WIRING AND CABLES:
1.2.3. Section 26 05 33, CONDUITS AND BOXES FOR ELECTRICAL SYSTEMS
1.2.4. Section 26 24 19, MOTOR STARTERS AND CONTROLLERS

1.3. QUALITY ASSURANCE

1.3.1. Quality Assurance shall be in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4. SUBMITTALS

1.4.1. Submit in accordance with requirements of Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:

1.4.2. Shop Drawings:

1.4.2.1. Submit sufficient information to demonstrate compliance with drawings and specifications.
1.4.2.2. Submit plans showing the location of system grounding electrodes and connections, and the routing of aboveground and underground grounding electrode conductors.

1.4.3. Test Reports:

1.4.3.1. Two weeks prior to the final inspection, submit ground resistance field test reports to the Consultant

1.4.4. Certifications:

1.4.4.1. Certification by the Contractor that the grounding equipment has been properly installed and tested.

1.5. **APPLICABLE PUBLICATIONS**

1.5.1. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

1.5.2. Canadian Standards Association (CSA)

1.5.2.1. CAN/CSA Standard C22.2 No.0.4-04(R2009) - Bonding of Electrical Equipment.
1.5.2.2. CAN/CSA Standard C22.2 No.41-07 - Grounding and Bonding Equipment (Bi-national standard, with UL 467).
1.5.2.3. Canadian and Ontario Electrical Safety Codes. (Latest Edition).

1.5.3. ANSI/TIA/EIA-607.

1.5.4. (CAN/CSA TS27) Best Practices for Ground and Bonding of Devices in Telecommunication Spaces.

1.5.5. Latest edition of IEEE Standard No. 80.

1.5.6. American Society for Testing and Materials (ASTM):

1.5.6.1. B1-13 Standard Specification for Hard-Drawn Copper Wire
1.5.6.2. B3-13 Standard Specification for Soft or Annealed Copper Wire
1.5.6.3. B8-11 Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

1.5.7. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

1.5.7.1. 81-12 IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System Part 1: Normal Measurements

1.5.8. National Fire Protection Association (NFPA):

1.5.8.1. 70-17 National Electrical Code (NEC)
1.5.8.2. 70E-15 National Electrical Safety Code

1.5.9. Underwriters Laboratories, Inc. (UL):

1.5.9.1. 44-14 Thermoset Insulated Wires and Cables
1.5.9.2. 83-14 Thermoplastic Insulated Wires and Cables
1.5.9.3. 467-13 Grounding and Bonding Equipment

PART 2 - PRODUCTS

2.1. GROUNDING AND BONDING CONDUCTORS

2.1.1. Install a complete, permanent and continuous system for earthling and grounding of networks, circuits and apparatus. The system shall include electrodes, conductor, connectors and required accessories on drawings to satisfy local authorities.

2.1.2. Install bonding/grounding connections from exposed non-current carrying metal parts of equipment including, but not necessarily limited to the following:

2.1.2.1. Frames of all motors.
2.1.2.2. All Starters.
2.1.2.3. Main Electrical Switchboards.
2.1.2.4. Medium Voltage Load Interrupter Switches.
2.1.2.5. Panelboards and Distribution Panels.
2.1.2.6. Isolations Switch(es).
2.1.2.7. Exterior mounted cable trays.
2.1.2.8. Raised floor pedestals.
2.1.2.9. Conductive Flooring.
2.1.2.10. Communication Rooms.
2.1.2.11. Transformers.
2.1.2.12. Transfer Switches.
2.1.2.13. Power Raceway System.
2.1.2.14. Generating equipment.

2.1.3. Install connectors according to manufacturer's recommendations.

2.1.4. Equipment grounding conductors shall be insulated stranded copper, except that sizes No. 10 AWG and smaller shall be solid copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes No. 4 AWG and larger shall be identified per NEC.

2.1.5. Bonding conductors shall be bare stranded copper, except that sizes No. 10 AWG and smaller shall be bare solid copper. Bonding conductors shall be stranded for final connection to motors, transformers, and vibrating equipment.

2.1.6. Conductor sizes shall not be less than shown on the drawings, or not less than required by the NEC, whichever is greater.

2.1.7. Insulation: THHN-THWN and XHHW-2. XHHW-2 shall be used for isolated power systems.

2.2. **GROUND RODS**

2.2.1. Copper clad steel, 19 mm (0.75 inch) diameter by 3m (10 feet) long.

2.2.2. Quantity of rods shall be as required to obtain the specified ground resistance.

2.3. **CONCRETE ENCASED ELECTRODE**

2.3.1. Concrete encased electrode shall be No. 4 AWG bare copper wire, installed per NEC.

2.4. **GROUND CONNECTIONS**

2.4.1. Below Grade and Inaccessible Locations: Exothermic-welded type connectors.

2.4.2. Above Grade:

2.4.2.1. Bonding Jumpers: Listed for use with copper conductors. For wire sizes No. 8 AWG and larger, use compression-type connectors. For wire sizes smaller than No. 8 AWG, use mechanical type lugs. Connectors or lugs shall use zinc-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.

2.4.2.2. Connection to Building Steel: Exothermic-welded type connectors.

2.4.2.3. Connection to Grounding Bus Bars: Listed for use with aluminum and copper conductors. Use mechanical type lugs, with zinc-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.

2.4.2.4. Connection to Equipment Rack and Cabinet Ground Bars: Listed for use with aluminum and copper conductors. Use mechanical type lugs, with zinc-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.

2.5. **EQUIPMENT RACK AND CABINET GROUND BARS**

2.5.1. Provide solid copper ground bars designed for mounting on the framework of open or cabinet-enclosed equipment racks. Ground bars shall have minimum dimensions of 6.3 mm (0.25 inch) thick x 19 mm (0.75 inch) wide, with length as required or as shown on the drawings. Provide insulators and mounting brackets.

2.6. **GROUND TERMINAL BLOCKS**

2.6.1. At any equipment mounting location (e.g., backboards and hinged cover enclosures) where rack-type ground bars cannot be mounted, provide mechanical type lugs, with zinc-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.

2.7. **GROUNDING BUS BAR**

2.7.1. Pre-drilled rectangular copper bar with stand-off insulators,minimum 6.3 mm (0.25 inch) thick x100 mm (4 inches) high in cross-section, length as shown on the drawings, with hole size, quantity, and spacing per detail shown on the drawings. Provide insulators and mounting brackets.

PART 3 - EXECUTION

3.1. **GENERAL**

3.1.1. Installation shall be in accordance with the CEC, NEC, and manufacturer's instructions.

3.1.2. System Grounding:

3.1.2.1. Secondary service neutrals: Ground at the supply side of the secondary disconnecting means and at the related transformer.

3.1.2.2. Separately derived systems (transformers downstream from the service entrance): Ground the secondary neutral.

3.1.2.3. Equipment Grounding: Metallic piping, building structural steel, electrical enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames,

and other conductive items in close proximity with electrical circuits, shall be bonded and grounded.

3.2. **INACCESSIBLE GROUNDING CONNECTIONS**

3.2.1. Make grounding connections, which are normally buried or otherwise inaccessible, by exothermic weld.

3.3. **SECONDARY VOLTAGE EQUIPMENT AND CIRCUITS**

3.3.1. Main Bonding Jumper: Bond the secondary service neutral to the ground bus in the service equipment.

3.3.2. Metallic Piping, Building Structural Steel, and Supplemental Electrode(s):

3.3.2.1. Provide a grounding electrode conductor sized per CESC and NEC between the service equipment ground bus and all metallic water pipe systems, building structural steel, and supplemental or made electrodes. Provide jumpers across insulating joints in the metallic piping.

3.3.2.2. Provide a supplemental ground electrode to bond to the grounding electrode system.

3.3.3. Switchgear, Switchboards, Unit Substations, Panelboards, Motor Control Centers, Engine-Generators, Automatic Transfer Switches, and other electrical equipment:

3.3.3.1. Connect the equipment grounding conductors to the ground bus.

3.3.3.2. Connect metallic conduits by grounding bushings and equipment grounding conductor to the equipment ground bus.

3.3.4. Transformers:

3.3.4.1. Exterior: Exterior transformers supplying interior service equipment shall have the neutral grounded at the transformer secondary. Provide a grounding electrode at the transformer.

3.3.4.2. Separately derived systems (transformers downstream from service equipment): Ground the secondary neutral at the transformer. Provide a grounding electrode conductor from the transformer to the nearest suitable component of the grounding electrode system

3.4. **RACEWAY**

3.4.1. Conduit Systems:

3.4.1.1. Ground all metallic conduit systems. All metallic conduit systems shall contain an equipment grounding conductor.

3.4.1.2. Non metallic conduit systems, except non-metallic feeder conduits that carry a grounded conductor from exterior transformers to interior or building-mounted service entrance equipment, shall contain an equipment grounding conductor.

3.4.1.3. Metallic conduit that only contains a grounding conductor, and is provided for its mechanical protection, shall be bonded to that conductor at the entrance and exit from the conduit.

3.4.1.4. Metallic conduits which terminate without mechanical connection to an electrical equipment housing by means of locknut and bushings or adapters, shall be provided with grounding bushings. Connect bushings with a equipment grounding conductor to the equipment ground bus.

3.4.2. Feeders and Branch Circuits: Install equipment grounding conductors with all feeders, and power and lighting branch circuits.

3.4.3. Boxes, Cabinets, Enclosures, and Panelboards:

3.4.3.1. Bond the equipment grounding conductor to each pullbox, junction box, outlet box, device box, cabinets, and other enclosures through which the conductor passes (except for special grounding systems for intensive care units and other critical units shown).

3.4.3.2. Provide lugs in each box and enclosure for equipment grounding conductor termination.

3.4.4. Wireway Systems:

3.4.4.1. Bond the metallic structures of wireway to provide electrical continuity throughout the wireway system, by connecting a No. 6 AWG bonding jumper at all intermediate metallic enclosures and across all section junctions.

3.4.4.2. Install insulated No. 6 AWG bonding jumpers between the wireway system, bonded as required above, and the closest building ground at each end and approximately every 16 M (50 feet).

3.4.4.3. Use insulated No. 6 AWG bonding jumpers to ground or bond metallic wireway at each end for all intermediate metallic enclosures and across all section junctions.

3.4.4.4. Use insulated No. 6 AWG bonding jumpers to ground cable tray to column-mounted building ground plates (pads) at each end and approximately every 15 M (49 feet).

3.4.4.5. Receptacles shall not be grounded through their mounting screws. Ground receptacles with a jumper from the receptacle green ground terminal to the device box ground screw and a jumper to the branch circuit equipment grounding conductor.

3.4.5. Ground lighting fixtures to the equipment grounding conductor of the wiring system. Fixtures connected with flexible conduit shall have a green ground wire included with the power wires from the fixture through the flexible conduit to the first outlet box.

3.4.6. Fixed electrical appliances and equipment shall be provided with a ground lug for termination of the equipment grounding conductor.

3.5. **OUTDOOR METALLIC FENCES AROUND ELECTRICAL EQUIPMENT**

3.5.1. Fences shall be grounded with a ground rod at each fixed gate post and at each corner post.

3.5.2. Drive ground rods until the top is 300 mm (12 inches) below grade. Attach a No. 4 AWG copper conductor by exothermic weld to the ground rods, and extend underground to the immediate vicinity of fence post. Lace the conductor vertically into 300 mm (12 inches) of fence mesh and fasten by two approved bronze compression fittings, one to bond the wire to post and the other to bond the wire to fence. Each gate section shall be bonded to its gatepost by a 3 mm x 25 mm (0.375 inch x 1 inch) flexible, braided copper strap and ground post clamps. Clamps shall be of the anti-electrolysis type.

3.6. **CORROSION INHIBITORS**

3.6.1. When making grounding and bonding connections, apply a corrosion inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.

3.7. **CONDUCTIVE PIPING**

3.7.1. Bond all conductive piping systems, interior and exterior, to the grounding electrode system. Bonding connections shall be made as close as practical to the equipment ground bus.

3.7.2. In operating rooms and at intensive care and coronary care type beds, bond the medical gas piping and medical vacuum piping at the outlets directly to the patient ground bus.

3.8. **MAIN ELECTRICAL ROOM GROUNDING**

3.8.1. Provide ground bus bar and mounting hardware at each main electrical room where incoming feeders are terminated, as shown on the drawings. Connect to pigtail extensions of the building grounding ring, as shown on the drawings.

3.9. **GROUND RESISTANCE**

3.9.1. Grounding system resistance to ground shall not exceed 5 ohms. Make any modifications or additions to the grounding electrode system necessary for compliance without additional cost to the Government. Final tests shall ensure that this requirement is met.

3.9.2. Grounding system resistance shall comply with the electric utility company ground resistance requirements.

3.10. **GROUND ROD INSTALLATION**

3.10.1. For outdoor installations, drive each rod vertically in the earth, until top of rod is 610 mm (24 inches) below final grade.

3.10.2. For indoor installations, leave 100 mm (4 inches) of each rod exposed.

3.10.3. Where buried or permanently concealed ground connections are required, make the connections by the exothermic process, to form solid metal joints. Make accessible ground connections with mechanical pressure-type ground connectors.

3.10.4. Where rock or impenetrable soil prevents the driving of vertical ground rods, install angled ground rods or grounding electrodes in horizontal trenches to achieve the specified ground resistance.

3.11. **ACCEPTANCE CHECKS AND TESTS**

3.11.1. Resistance of the grounding electrode system shall be measured using a four-terminal fall-of-potential method as defined in IEEE 81. Ground resistance measurements shall be made before the electrical distribution system is energized or connected to the electric utility company ground system, and shall be made in normally dry conditions not fewer than 48 hours after the last rainfall.

3.11.2. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

3.11.3. Below-grade connections shall be visually inspected by the Consultant prior to backfilling. The Contractor shall notify the Consultant 24 hours before the connections are ready for inspection

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PART 1 - GENERAL

1.1. DESCRIPTION

1.1.1. This section specifies the furnishing, installation, and connection of conduit, fittings, and boxes, to form complete, coordinated, grounded raceway systems. Raceways are required for all wiring unless shown or specified otherwise.

1.1.2. Definitions: The term conduit, as used in this specification, shall mean any or all of the raceway types specified.

1.2. RELATED WORK

1.2.1. Section 26 05 11 GENERAL REQUIREMENTS – ELECTRICAL INSTALLATIONS

1.3. QUALITY ASSURANCE

1.3.1. Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, GENERAL REQUIREMENTS – ELECTRICAL INSTALLATIONS.

1.4. SUBMITTALS

1.4.1. Submit in accordance with Section 26 05 11, GENERAL REQUIREMENTS – ELECTRICAL INSTALLATIONS.

1.4.2. Shop Drawings:

1.4.2.1. Size and location of main feeders.
1.4.2.2. Size and location of panels and pull-boxes.
1.4.2.3. Layout of required conduit penetrations through structural elements.
1.4.2.4. Submit the following data for approval:
1.4.2.5. Raceway types and sizes.
1.4.2.6. Conduit bodies, connectors and fittings.
1.4.2.7. Splitter troughs
1.4.2.8. Junction and pull boxes, types and sizes.

1.4.3. Certifications: Two weeks prior to final inspection, submit the following:

1.4.3.1. Certification by the manufacturer that raceways, conduits, conduit bodies, connectors, fittings, junction and pull boxes, and all related equipment conform to the requirements of the drawings and specifications.

1.4.3.2. Certification by the Contractor that raceways, conduits, conduit bodies, connectors, fittings, junction and pull boxes, and all related equipment have been properly installed.

1.5. **APPLICABLE PUBLICATIONS**

1.5.1. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

1.5.2. Canadian Standards Association (CSA International)

1.5.2.1. CAN/CSA C22.2 No. 18.3-12, Conduit, Tubing, and Cable Fittings (Tri-National standard, with ANCE NMX-J-017 and UL 514B).

1.5.2.2. CAN/CSA C22.2 No. 18.4-04 (R2009), Hardware for the Support of Conduit, Tubing, and Cable (Bi-National standard, with UL 2239).

1.5.2.3. CAN/CSA C22.2 No. 18.5-02 (R2012), Positioning Devices (Bi-National standard, with UL 1565).

1.5.2.4. C22.2 NO.45.1-07, Electrical Rigid Metal Conduit – Steel (Tri-national standard, with UL 6 and NMX-J-534-ANCE-2007).

1.5.2.5. C22.2 No.56-04 (R2009) Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.

1.5.2.6. C22.2 NO.83-M1985 (R2008), Electrical Metallic Tubing.

1.5.2.7. C22.2 No.211.2-06 (R2011) Rigid PVC (Unplasticized) Conduit.

1.5.2.8. CAN/CSA C22.2 NO.227.1-06 (R2011), Electrical Nonmetallic Tubing (Bi-National standard, with UL 1653).

1.5.2.9. CAN/CSA C22.2 NO.227.2.1-04 (R2009), Liquid-Tight Flexible Nonmetallic Conduit (Bi-National standard, with UL 1660).

1.5.2.10. CAN/CSA C22.2 No. 227.3-05 (R2010), Nonmetallic Mechanical Protection Tubing (NMPT), (Bi-national standard, with UL 1696).

1.5.3. American National Standards Institute (ANSI):

1.5.3.1. C80.1-05 Electrical Rigid Steel Conduit

1.5.3.2. C80.3-05 Steel Electrical Metal Tubing

1.5.3.3. C80.6-05 Electrical Intermediate Metal Conduit

1.5.4. National Fire Protection Association (NFPA):

1.5.5. 70-11 National Electrical Code (NEC)

1.5.6. Underwriters Laboratories, Inc. (UL):

1.5.6.1.	1-05	Flexible Metal Conduit
1.5.6.2.	5-11	Surface Metal Raceway and Fittings
1.5.6.3.	6-07	Electrical Rigid Metal Conduit - Steel
1.5.6.4.	50-95	Enclosures for Electrical Equipment
1.5.6.5.	360-13	Liquid-Tight Flexible Steel Conduit
1.5.6.6.	467-13	Grounding and Bonding Equipment
1.5.6.7.	514A-13	Metallic Outlet Boxes
1.5.6.8.	514B-12	Conduit, Tubing, and Cable Fittings
1.5.6.9.	514C-07	Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers
1.5.6.10.	797-07	Electrical Metallic Tubing
1.5.6.11.	1242-06	Electrical Intermediate Metal Conduit - Steel

1.5.7. National Electrical Manufacturers Association (NEMA):

1.5.7.1. FB1-12 Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable

1.5.7.2. FB2.10-13 Selection and Installation Guidelines for Fittings for use with Non-Flexible Conduit or Tubing (Rigid Metal Conduit, Intermediate Metallic Conduit, and Electrical Metallic Tubing)

1.5.7.3. FB2.20-12 Selection and Installation Guidelines for Fittings for use with Flexible Electrical Conduit and Cable

PART 2 - PRODUCTS

2.1. **MATERIAL**

2.1.1. Conduit Size: In accordance with the CEC/NFPA-70, but not less than 13 mm (0.5-inch) unless otherwise shown.

2.1.2. Rigid Steel Conduit (RMC): Shall conform to CAN/CSA C22.2 NO.45.1, UL 6 and ANSI C80.1. *Application: for all outdoor installations and other locations where specified or shown on the drawings*.

2.1.3. Rigid Intermediate Steel Conduit (IMC): Shall conform to CAN/CSA C22.2 NO.18.3, UL 1242 and ANSI C80.6. *Application: for all outdoor installations and other locations where specified or shown on the drawings*.

2.1.4. Electrical Metallic Tubing (EMT): Shall conform to CAN/CSA C22.2 NO.83, UL 797 and ANSI C80.3. Maximum size not to exceed 105 mm (4 inches) and shall be permitted only with cable rated 600 V or less. *Application: for all indoor installations and other locations where specified or shown on the drawings.*

2.1.5. Flexible Metal Conduit: Shall conform to CAN/CSA C22.2 NO.56, UL 1. *Application: last 1000 mm (40") before final connections to burners and other locations where specified or shown on the drawings*.

2.1.6. Liquid-tight Flexible Metal Conduit: Shall conform to CAN/CSA C22.2 NO.227.2.1, UL 360. *Applications: last 1000 mm (40") before connecting to motors and other vibrating equipment and other locations where specified or shown on the drawings*.

2.2. **CONDUIT FITTINGS:**

2.2.1. Rigid Steel and Intermediate Metallic Conduit Fittings:

2.2.1.1. Fittings shall meet the requirements of UL 514B and NEMA FB1.

2.2.1.2. Standard threaded couplings, locknuts, bushings, conduit bodies, and elbows: Only steel or malleable iron materials are acceptable. Integral retractable type IMC couplings are also acceptable.

2.2.1.3. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure.

2.2.1.4. Bushings: Metallic insulating type, consisting of an insulating insert, molded or locked into the metallic body of the fitting. Bushings made entirely of metal or nonmetallic material are not permitted.

2.2.1.5. Erickson (Union Type) and Set Screw Type Couplings: Approved for use in concrete is permitted for use to complete a conduit run where conduit is installed in concrete. Use set screws of case-hardened steel with hex head and cup point to firmly seat in conduit wall for positive ground. Tightening of set screws with pliers is prohibited.

2.2.1.6. Sealing Fittings: Threaded cast iron type. Use continuous drain-type sealing fittings to prevent passage of water vapor. In concealed work, install fittings in flush steel boxes with blank cover plates having the same finishes as that of other electrical plates in the room.

2.2.2. Electrical Metallic Tubing Fittings:

2.2.2.1. Fittings and conduit bodies shall meet the requirements of UL 514B, ANSI C80.3, and NEMA FB1.

2.2.2.2. Only steel or malleable iron materials are acceptable.

2.2.2.3. Both compression and setscrew fittings are allowed, but one choice is to be made for a project. Fittings are to be of uniform type throughout the project.

2.2.2.4. Compression Couplings and Connectors: Concrete-tight and rain-tight, with connectors having insulated throats

2.2.2.5. Setscrew Couplings and Connectors: Use setscrews of case-hardened steel with hex head and cup point, to firmly seat in wall of conduit for positive grounding

2.2.2.6. Indent-type connectors or couplings are prohibited.

2.2.2.7. Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal" are prohibited.

2.2.3. Flexible Metal Conduit Fittings:

2.2.3.1. Conform to UL 514B. Only steel or malleable iron materials are acceptable.

2.2.3.2. Clamp-type, with insulated throat.

2.2.3.3. Liquid tight Flexible Metal Conduit Fittings:

2.2.3.4. Fittings shall meet the requirements of UL 514B and NEMA FB1.

2.2.3.5. Only steel or malleable iron materials are acceptable.

2.2.3.6. Fittings must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening. Connectors shall have insulated throats.

2.2.4. Surface Metal Raceway Fittings:

2.2.4.1. As recommended by the raceway manufacturer. Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, conduit entry fittings, accessories, and other fittings as required for complete system.

2.2.5. Expansion and Deflection Couplings:

2.2.5.1. Conform to UL 467 and UL 514B.

2.2.5.2. Accommodate a 19 mm (0.75-inch) deflection, expansion, or contraction in any direction, and allow 30 degree angular deflections.

2.2.5.3. Include internal flexible metal braid, sized to guarantee conduit ground continuity and a low-impedance path for fault currents, in accordance with UL 467 and the CEC tables for equipment grounding conductors.

2.2.6. Jacket: Flexible, corrosion resistant, watertight, moisture and heat-resistant molded rubber material with stainless steel jacket clamps.

2.2.7. Conduit Supports:

2.2.7.1. Parts and Hardware: Zinc coat or provide equivalent corrosion protection.
2.2.7.2. Individual Conduit Hangers: Designed for the purpose, having a pre assembled closure bolt and nut, and provisions for receiving a hanger rod.
2.2.7.3. Multiple Conduit (Trapeze) Hangers: Not less than 38 mm x 38 mm (1.5 x 1.5 inches), 12-gauge steel, cold-formed, lipped channels; with not less than 9 mm (0.375-inch) diameter steel hanger rods.
2.2.7.4. Solid Masonry and Concrete Anchors: Self drilling expansion shields, or machine bolt expansion.

2.2.8. Outlet, Junction, and Pull Boxes:

2.2.8.1. Applicable Publications

2.2.8.1.1. CAN/CSA C22.2 NO.18.1-04 (R2009), Metallic Outlet Boxes (Tri-National standard with ANCE NMX-J-023/1 and UL 514A).
2.2.8.1.2. C22.2 NO.18.2-06, Nonmetallic Outlet Boxes.
2.2.8.1.3. CAN/CSA C22.2 NO.18.3-12, Conduit, Tubing and Cable Fittings (Tri-national standard, with ANCE NMX-J-017 and UL 514B).
2.2.8.1.4. UL-50 and UL-514A.

2.2.8.2. Rustproof cast metal where required by the NEC or shown on drawings.

2.2.8.3. Sheet Metal Boxes: Galvanized steel, except where shown on drawings.

2.2.9. Metal Wireways: Equip with hinged covers, except as shown on drawings. Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for a complete system.

2.2.10. Splitter troughs

2.2.10.1. Sheet metal enclosure with welded edges and hinged shaped cover with locking facility when closed.
2.2.10.2. Copper bus bars c/w terminals corresponding to the number and size of the incoming and outgoing conductors as shown.

2.2.10.3. Unless otherwise indicated the splitters shall have sufficient length to accommodate the layout of the secondary equipment.

2.2.10.4. Supply at least three space terminals for each terminal size in 400 A and less splitters.

PART 3 - EXECUTION

3.1. PENETRATIONS

3.1.1. Cutting or Holes:

3.1.1.1. Cut holes in advance where they should be placed in the structural elements, such as ribs or beams.

3.1.1.2. Cut holes through concrete and masonry in new and existing structures with a diamond core drill or concrete saw.

3.1.1.3. Firestop: Where conduits, wireways, and other electrical raceways pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases.

3.1.1.4. Verify that roof penetration details are shown on drawings.

3.1.1.5. Waterproofing: At floor, exterior wall, and roof conduit penetrations, completely seal the gap around conduit to render it watertight.

3.2. INSTALLATION, GENERAL

3.2.1. In accordance with ULC, OESC, CEC, NEC, NEMA, as shown on drawings, and as specified herein.

3.2.2. Raceway systems used for Essential Electrical Systems (EES) shall be entirely independent of other raceway systems.

3.2.3. Install conduit as follows:

3.2.3.1. In fully completed mechanically and electrically continuous runs before pulling in cables or wires.

3.2.3.2. Unless otherwise indicated on the drawings or specified herein, installation of all conduits shall be concealed within finished walls, floors, and ceilings.

3.2.3.3. Flattened, dented, or deformed conduit is not permitted. Remove and replace the damaged conduits with new conduits.

3.2.3.4. Assure conduit installation does not encroach into the ceiling height head room, walkways, or doorways.

3.2.3.5. Cut conduits square, ream, remove burrs, and draw up tight.

3.2.3.6. Independently support conduit at 2.4 M (8 feet) on centers with specified materials or as shown on drawings.

3.2.3.7. Do not use suspended ceilings, suspended ceiling supporting members, lighting fixtures, other conduits, cable tray, boxes, piping, or ducts to support conduits and conduit runs.

3.2.3.8. Support within 300 mm (12 inches) of changes of direction, and within 300 mm (12 inches) of each enclosure to which connected.

3.2.3.9. Close ends of empty conduits with plugs or caps at the rough in stage until wires are pulled in, to prevent entry of debris.

3.2.3.10. Conduit installations under fume and vent hoods are prohibited.

3.2.3.11. Secure conduits to cabinets, junction boxes, pull-boxes, and outlet boxes with bonding type locknuts. For rigid steel and IMC conduit installations, provide a locknut on the inside of the enclosure, made up wrench tight. Do not make conduit connections to junction box covers.

3.2.3.12. Flashing of penetrations of the roof membrane is shown on the drawing details.

3.2.3.13. Conduit bodies shall only be used for changes in direction, and shall not contain splices.

3.2.4. Conduit Bends:

3.2.4.1. Make bends with standard conduit bending machines.

3.2.4.2. Conduit hickey may be used for slight offsets and for straightening stubbed out conduits.

3.2.4.3. Bending of conduits with a pipe tee or vise is prohibited.

3.2.5. Layout and Homeruns:

3.2.5.1. Install conduit with wiring, including homeruns, as shown on drawings.

3.2.5.2. Deviations: Make only where necessary to avoid interferences.

3.3. **CONCEALED WORK INSTALLATION**

3.3.1. In Concrete:

3.3.1.1. Conduit: Rigid steel, IMC, or EMT. Do not install EMT in concrete slabs that are in contact with soil, gravel, or vapor barriers.

3.3.1.2. Align and run conduit in direct lines.

3.3.1.3. Install conduit through concrete beams only:

3.3.1.4. Where shown on the structural drawings.

3.3.1.5. Installation of conduit in concrete that is less than 75 mm (3 inches) thick is prohibited.

3.3.1.6. Conduit outside diameter larger than one-third of the slab thickness is prohibited.

3.3.1.7. Space between conduits in slabs: Approximately six conduit diameters apart, and one conduit diameter at conduit crossings.

3.3.1.8. Install conduits approximately in the center of the slab so that there will be a minimum of 19 mm (0.75-inch) of concrete around the conduits.

3.3.1.9. Make couplings and connections watertight. Use thread compounds that are UL approved conductive type to ensure low resistance ground continuity through the conduits. Tightening setscrews with pliers is prohibited.

3.3.2. Above Furred or Suspended Ceilings and in Walls:

3.3.2.1. Conduit for Conductors 600 V and Below: EMT.

3.3.2.2. Align and run conduit parallel or perpendicular to the building lines.

3.3.2.3. Connect recessed lighting fixtures to conduit runs with maximum 1.8 M (6 feet) of flexible metal conduit extending from a junction box to the fixture.

3.3.2.4. Tightening set screws with pliers is prohibited.

3.3.2.5. For conduits running through metal studs, limit field cut holes to no more than 70% of web depth. Spacing between holes shall be at least 457 mm (18 inches). Cuts or notches in flanges or return lips shall not be permitted.

3.4. **EXPOSED WORK INSTALLATION**

3.4.1. Unless otherwise indicated on drawings, exposed conduit is only permitted in mechanical and electrical rooms.

3.4.2. Conduit for Conductors 600 V and Below: Rigid steel or IMC (outdoors), EMT (indoors). Mixing different types of conduits in the system is prohibited.

3.4.3. Align and run conduit parallel or perpendicular to the building lines.

3.4.4. Install horizontal runs close to the ceiling or beams and secure with conduit straps.

3.4.5. Support horizontal or vertical runs at not over 2.4 M (8 feet) intervals.

3.4.6. Surface Metal Raceways: Use only where shown on drawings.

3.4.7. Painting:

3.4.7.1. Paint exposed conduit as specified

3.5. **HAZARDOUS LOCATIONS**

3.5.1. Use rigid steel conduit only.

3.5.2. Install UL approved sealing fittings that prevent passage of explosive vapors in hazardous areas equipped with explosion-proof lighting fixtures, switches, and receptacles, as required by the NEC.

3.6. **WET OR DAMP LOCATIONS**

3.6.1. Use rigid steel or IMC conduits unless as shown on drawings.

3.6.2. Provide sealing fittings to prevent passage of water vapor where conduits pass from warm to cold locations, i.e., refrigerated spaces, constant-temperature rooms, air-conditioned spaces, building exterior walls, roofs, or similar spaces.

3.6.3. Use rigid steel or IMC conduit within 1.5 M (5 feet) of the exterior and below concrete building slabs in contact with soil, gravel, or vapor barriers, unless as shown on drawings. Conduit shall be half-lapped with 10 mil PVC tape before installation. After installation, completely recoat or retape any damaged areas of coating.

3.6.4. Conduits run on roof shall be supported with integral galvanized lipped steel channel, attached to UV-inhibited polycarbonate or polypropylene blocks every 2.4 M (8 feet) with 9 mm (3/8-inch) galvanized threaded rods, square washer and locknut. Conduits shall be attached to steel channel with conduit clamps.

3.7. **MOTORS AND VIBRATING EQUIPMENT**

3.7.1. Use flexible metal conduit for connections to motors and other electrical equipment subject to movement, vibration, misalignment, cramped quarters, or noise transmission.

3.7.2. Use liquid tight flexible metal conduit for installation in exterior locations, moisture or humidity laden atmosphere, corrosive atmosphere, water or spray wash down operations, inside airstream of HVAC units, and locations subject to seepage or dripping of oil, grease, or water.

3.7.3. Provide a green equipment grounding conductor with flexible and liquid-tight flexible metal conduit.

3.8. **EXPANSION JOINTS**

3.8.1. Conduits 75 mm (3 inch) and larger that are secured to the building structure on opposite sides of a building expansion joint require expansion and deflection couplings. Install the couplings in accordance with the manufacturer's recommendations.

3.8.2. Provide conduits smaller than 75 mm (3 inch) with junction boxes on both sides of the expansion joint. Connect flexible metal conduits to junction boxes with sufficient slack to produce a 125 mm (5 inch) vertical drop midway between the ends of the flexible metal conduit. Flexible metal conduit shall have a green insulated copper bonding jumper installed. In lieu of this flexible metal conduit, expansion and deflection couplings as specified above are acceptable.

3.8.3. Install expansion and deflection couplings where shown.

3.9. **CONDUIT SUPPORTS**

3.9.1. Safe working load shall not exceed one-quarter of proof test load of fastening devices.

3.9.2. Use pipe straps or individual conduit hangers for supporting individual conduits.

3.9.3. Support multiple conduit runs with trapeze hangers. Use trapeze hangers that are designed to support a load equal to or greater than the sum of the weights of the conduits, wires, hanger itself, and an additional 90 kg (200 lbs). Attach each conduit with U bolts or other approved fasteners.

3.9.4. Support conduit independently of junction boxes, pull-boxes, fixtures, suspended ceiling T bars, angle supports, and similar items.

3.9.5. Fasteners and Supports in Solid Masonry and Concrete:

3.9.5.1. New Construction: Use steel or malleable iron concrete inserts set in place prior to placing the concrete.

3.9.6. Existing Construction:

3.9.6.1. Steel expansion anchors not less than 6 mm (0.25-inch) bolt size and not less than 28 mm (1.125 inch) in embedment.

3.9.6.2. Power set fasteners not less than 6 mm (0.25-inch) diameter with depth of penetration not less than 75 mm (3 inch).

3.9.6.3. Use vibration and shock-resistant anchors and fasteners for attaching to concrete ceilings.

3.9.6.4. Hollow Masonry: Toggle bolts.

3.9.6.5. Bolts supported only by plaster or gypsum wallboard are not acceptable.

3.9.6.6. Metal Structures: Use machine screw fasteners or other devices specifically designed and approved for the application.

3.9.6.7. Attachment by wood plugs, raw plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.

3.9.6.8. Chain, wire, or perforated strap shall not be used to support or fasten conduit.

3.9.6.9. Spring steel type supports or fasteners are prohibited for all uses except horizontal and vertical supports/fasteners within walls.

3.9.6.10. Vertical Supports: Vertical conduit runs shall have riser clamps and supports in accordance with the NEC and as shown. Provide supports for cable and wire with fittings that include internal wedges and retaining collars.

3.10. BOX INSTALLATION

3.10.1. Boxes for Concealed Conduits:

3.10.1.1. Flush-mounted.

3.10.1.1.1. Provide raised covers for boxes to suit the wall or ceiling, construction, and finish.

3.10.1.1.2. In addition to boxes shown, install additional boxes where needed to prevent damage to cables and wires during pulling-in operations or where more than the equivalent of 4-90 degree bends are necessary.

3.10.1.1.3. Locate pullboxes so that covers are accessible and easily removed. Coordinate locations with piping and ductwork where installed above ceilings.

3.10.1.1.4. Remove only knockouts as required. Plug unused openings. Use threaded plugs for cast metal boxes and snap in metal covers for sheet metal boxes.

3.10.1.1.5. Outlet boxes mounted back to back in the same wall are prohibited. A minimum 600 mm (24 inch) center-to-center lateral spacing shall be maintained between boxes.

3.10.1.2. Flush-mounted wall or ceiling boxes shall be installed with raised covers so that the front face of raised cover is flush with the wall. Surface-mounted wall or ceiling boxes shall be installed with surface-style flat or raised covers.

3.10.1.3. Minimum size of outlet boxes for ground fault circuit interrupter (GFCI) receptacles is 100 mm (4 inches) square x 55 mm (2.125 inches) deep, with device covers for the wall material and thickness involved.

3.10.1.4. Stencil or install phenolic nameplates on covers of the boxes identified on riser diagrams; for example "SIG FA JB No. 1."

3.10.1.5. On all branch circuit junction box covers, identify the circuits with black marker.

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PART 1 - GENERAL

1.1. DESCRIPTION

1.1.1. This section specifies the furnishing, installation, connection, and testing of low-voltage dry-type general-purpose transformers, indicated as transformers in this section.

1.2. RELATED WORK

1.2.1. Section 26 05 11
1.2.2. Section 26 05 19
1.2.3. Section 26 05 33

1.3. QUALITY ASSURANCE

1.3.1. Quality Assurance shall be in accordance with Section 26 05 11, COMMON RESULTS – ELECTRICAL WORK.

1.4. SUBMITTALS

1.4.1. Shop Drawings:

1.4.1.1. Include electrical ratings, dimensions, mounting details, materials, required clearances, terminations, weight, temperature rise, wiring and connection diagrams, plan, front, side, and rear elevations, accessories, and device nameplate data.

1.4.2. Manuals:

1.4.2.1. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals including technical data sheets and wiring diagrams.
1.4.2.2. Schematic signal and control diagrams, with all terminals identified, matching terminal identification in the transformers.
1.4.2.3. Include information for testing, repair, troubleshooting, assembly, disassembly, and factory recommended/required periodic maintenance procedures and frequency.
1.4.2.4. Certifications: Two weeks prior to final inspection, submit the following.
1.4.2.5. Certification by the manufacturer that the transformers conform to the requirements of the drawings and specifications.

1.4.2.6. Certification by the Contractor that the transformers have been properly installed, adjusted, and tested.

PART 2 - PRODUCTS

2.1. TRANSFORMERS

2.1.1. Unless otherwise specified, transformers shall be in accordance with CESC, NEMA, NFPA, UL and as shown on the drawings.

2.1.2. Transformers shall have the following features:

2.1.2.1. Self-cooled by natural convection, isolating windings, dry-type. Rating and winding connections shall be as shown on the drawings.
2.1.2.2. Ratings shown on the drawings are for continuous duty without the use of cooling fans.
2.1.2.3. Copper windings.

2.1.3. Insulation systems:

2.1.3.1. Transformers 30 kVA and larger: UL rated 220 °C (428 °F) system with an average maximum rise by resistance of 150 °C (302 °F) in a maximum ambient of 40 °C (104 °F).

2.1.3.2. Transformers below 30 kVA: Same as for 30 kVA and larger or UL rated 185 °C (365 °F) system with an average maximum rise by resistance of 115 °C (239 °F) in a maximum ambient of 40 °C (104 °F).

2.1.4. Core and coil assemblies:

2.1.4.1. Rigidly braced to withstand the stresses caused by short-circuit currents and rough handling during shipment.
2.1.4.2. Cores shall be grain-oriented, non-aging, and silicon steel.
2.1.4.3. Coils shall be continuous windings without splices except for taps.
2.1.4.4. Coil loss and core loss shall be minimized for efficient operation.
2.1.4.5. Primary and secondary tap connections shall be brazed or pressure type.
2.1.4.6. Coil windings shall have end filters or tie-downs for maximum strength.
2.1.4.7. Average audible sound levels shall comply with NEMA.
2.1.4.8. If not shown on drawings, nominal impedance shall be as permitted by NEMA.

2.1.4.9. Single phase transformers rated 15 kVA through 25 kVA shall have two 5% full capacity taps below normal rated primary voltage. All transformers rated 30 kVA and larger shall have two 2.5% full capacity taps above, and four 2.5% full capacity taps below normal rated primary voltage.

2.1.4.10. Core assemblies shall be grounded to their enclosures with adequate flexible ground straps.

2.1.5. Enclosures:

2.1.5.1. Comprised of not less than code gauge steel.
2.1.5.2. Outdoor enclosures shall be NEMA 3R.
2.1.5.3. Temperature rise at hottest spot shall conform to NEMA Standards, and shall not bake and peel off the enclosure paint after the transformer has been placed in service.
2.1.5.4. Ventilation openings shall prevent accidental access to live components.
2.1.5.5. The enclosure at the factory shall be thoroughly cleaned and painted with manufacturer's prime coat and standard finish.
2.1.5.6. Standard NEMA features and accessories, including ground pad, lifting provisions, and nameplate with the wiring diagram and sound level indicated.
2.1.5.7. Dimensions and configurations shall conform to the spaces designated for their installations.

2.1.6. Standard of Acceptance:

2.1.6.1. Eaton
2.1.6.2. Cutler Hammer
2.1.6.3. General Electric

PART 3 - EXECUTION

3.1. **INSTALLATION**

3.1.1. Installation of transformers shall be in accordance with the CEC, NEC, as recommended by the equipment manufacturer and as shown on the drawings.

3.1.2. Anchor transformers with rustproof bolts, nuts, and washers, in accordance with manufacturer’s instructions, and as shown on drawings.

3.1.3. Exterior Location: Mount transformers on concrete slab. Unless otherwise indicated, the slab shall be at least 200 mm (8 inches) thick, reinforced with a 150 by 150 mm (6 by

6 inches) No. 6 mesh placed uniformly 100 mm (4 inches) from the top of the slab. Slab shall be placed on a 150 mm (6 inches) thick, well-compacted gravel base. The top of the concrete slab shall be approximately 100 mm (4 inches) above the finished grade. Edges above grade shall have 15 mm (1/2 inch) chamfer. The slab shall be of adequate size to project at least 200 mm (8 inches) beyond the equipment. Provide conduit turn-ups and cable entrance space required by the equipment to be mounted. Seal voids around conduit openings in slab with water- and oil-resistant caulking or sealant. Cut off and bush conduits 75 mm (3 inches) above slab surface.

3.1.4. Install transformers with manufacturer's recommended clearance from wall and adjacent equipment for air circulation. Minimum clearance shall be 150 mm (6 inches).

3.1.5. Install transformers on vibration pads designed to suppress transformer noise and vibrations.

3.2. **ACCEPTANCE CHECKS AND TESTS**

3.2.1. Perform tests in accordance with the manufacturer's recommendations. In addition, include the following:

3.2.1.1. Visual Inspection and Tests:
3.2.1.2. Compare equipment nameplate data with specifications and approved shop drawings.
3.2.1.3. Inspect physical and mechanical condition.
3.2.1.4. Inspect all field-installed bolted electrical connections, using the calibrated torque-wrench method to verify tightness of accessible bolted electrical connections.
3.2.1.5. Perform specific inspections and mechanical tests as recommended by manufacturer.
3.2.1.6. Verify correct equipment grounding.
3.2.1.7. Verify proper secondary phase-to-phase and phase-to-neutral voltage after energization and prior to connection to loads.

3.3. **FOLLOW-UP VERIFICATION**

3.3.1. Upon completion of acceptance checks, settings, and tests, the contractor shall demonstrate that the transformers are in good operating condition, and properly performing the intended function.

PART 1 - GENERAL

1.1. RELATED SECTIONS

1.1.1. Section 26 24 16.01 – Panelboards Breaker Type.
1.1.2. Section 26 45 00 - Overcurrent Protective Device Coordination And Arc Flash Hazard Studies.

1.2. REFERENCES

1.2.1. CAN/CSA-C22.2 No. 5-09, Moulded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard, with UL 489 and NMX-J-266-ANCE-2010).
1.2.2. AN/CSA-C22.2 No. 144-M91 (R2011): Ground Fault Circuit Interrupters.
1.2.3. CAN/CSA-C22.2 No. 144.1- 06 (R2011): Ground-Fault Circuit-Interrupters (Tri-National standard, with UL 943 and NMX-J-520-ANCE).

1.3. SUBMITTALS

1.3.1. Submit product data in accordance with Section 01 33 00 - Submittals.

1.3.2. Include time-current characteristic curves for breakers with ampacity of 200A and over or with interrupting capacity of 22,000A symmetrical (rms) and over at system voltage.

1.3.3. Acceptable Materials

1.3.3.1. Schneider Electric Canada;
1.3.3.2. Siemens Canada;
1.3.3.3. Eaton Electric.

PART 2 - PRODUCTS

2.1. BREAKERS GENERAL

2.1.1. Molded case circuit breakers and Ground-fault circuit interrupters: to C22.2 NO. 5.

2.1.2. Comply with UL 489, NEMA AB 1, and NEMA AB 3, fully rated with interrupting capacity to comply with available fault currents.

2.1.3. Bolt-on moulded case circuit breakers: quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.

2.1.4. Common-trip breakers: with single handle for multi-pole applications.

2.1.5. Magnetic instantaneous trip elements in circuit breakers to operate only when the value of the current reaches the setting.

2.1.6. Trip settings on breakers with adjustable trips to range of 3 to 8 times the rated current.

2.1.7. Provide pad locking devices where indicated on breakers to lock the handle of a breaker in the "on" or "off" position with the trip units to remain free to function and protect the circuit from both overload and short circuit conditions.

2.2. **GENERAL REQUIREMENTS:**

2.2.1. Circuit breakers 250 Amps and larger shall be rated to carry 100% of their current rating continuously.

2.2.2. Thermal-Magnetic Circuit Breakers:

2.2.2.1. Molded case circuit breakers to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

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2.2.2.2. Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A up to 400 A.

2.2.2.3. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

2.2.3. Solid State Trip Breakers (LSI)

2.2.3.1. Moulded case circuit breakers to operate by means of solid-state trip unit with associated current monitors and self-powered shunt trip to provide inverse time current trip under overload condition, and long time, short time, instantaneous tripping for circuit protection.

2.2.3.2. Electronic Trip Circuit Breakers: 400 A and larger. Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

2.2.3.3. Instantaneous trip.
2.2.3.4. Long- and short-time pickup levels.
2.2.3.5. Long- and short-time time adjustments.
2.2.3.6. Ground-fault pickup level, time delay, and I^2t response

2.2.4. Each adjustment shall have discrete settings (fully adjustable) and shall be independent of all other adjustments.

2.2.5. Long Time Pickup indication to signal when loading approaches or exceeds the adjustable ampere rating of the circuit breaker shall be provided.

PART 3 - EXECUTION

3.1. **INSTALLATION**

3.1.1. Circuit breakers in panelboards shall be factory installed.

3.1.2. Install individual breakers where indicated.

3.1.3. New Circuit Breakers in Existing Panelboards:

3.1.3.1. Circuit breakers shall be of standard manufacture and match existing devices.
3.1.3.2. Circuit breakers shall be “bolt-on” type.
3.1.3.3. Circuit breakers shall have an AIC rating compatible with the Building’s short circuit analysis report.

3.2. **FIELD QUALITY CONTROL**

3.2.1. Perform tests and inspections.

3.2.2. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

3.2.3. Acceptance Testing Preparation:

3.2.3.1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
3.2.3.2. Test continuity of each circuit.

3.2.4. Tests and Inspections:

3.2.4.1. Perform each visual and mechanical inspection and electrical test stated in Acceptance Testing Specification. Certify compliance with test parameters.

3.2.4.2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.2.4.3. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

3.2.4.4. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

3.2.4.5. Prepare test and inspection report, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken and observations after remedial action.

3.3. **ADJUSTING**

3.3.1. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

3.3.2. Set field-adjustable circuit-breaker trip ranges. Provide list of “as left” settings and submit to Client

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PART 1 - GENERAL

1.1. **DESCRIPTION**

1.1.1. This section specifies the furnishing, installation, and connection of fused and unfused disconnect switches (indicated as switches in this section), circuit breaker distribution panels and separately-enclosed circuit breakers for use in electrical systems rated 600 V and below.

1.2. **RELATED WORK**

1.2.1. Section 26 05 11, ELECTRICAL GENERAL REQUIREMENTS:
1.2.2. Section 26 05 19, CONDUCTORS AND CABLES:
1.2.3. Section 26 05 33, CONDUITS AND BOXES FOR ELECTRICAL SYSTEMS.

1.3. **SUBMITTALS**

1.3.1. Submit the following.

1.3.1.1. Shop Drawings:

1.3.1.1.1. Submit sufficient information to demonstrate compliance with drawings and specifications.
1.3.1.1.2. Submit the following data for approval:
1.3.1.1.3. Electrical ratings, dimensions, mounting details, materials, required clearances, terminations, weight, fuses, circuit breakers, wiring and connection diagrams, accessories, and device nameplate data.

1.3.1.2. Manuals:

1.3.1.2.1. Submit complete maintenance and operating manuals including technical data sheets, wiring diagrams, and information for ordering fuses, circuit breakers, and replacement parts.
1.3.1.2.2. Include schematic diagrams, with all terminals identified, matching terminal identification in the enclosed switches and circuit breakers.
1.3.1.2.3. Include information for testing, repair, troubleshooting, assembly, and disassembly.
1.3.1.2.4. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
1.3.1.2.5. Certifications: Two weeks prior to final inspection, submit the following.

1.3.1.2.6. Certification by the manufacturer that the enclosed switches and circuit breakers conform to the requirements of the drawings and specifications.

1.3.1.2.7. Certification by the Contractor that the enclosed switches and circuit breakers have been properly installed, adjusted, and tested.

1.4. **APPLICABLE PUBLICATIONS**

1.4.1. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

1.4.2. CAN/CSA-22.2

1.4.2.1. CAN/CSA-C22.2 No. 4-04 (R2009), Enclosed Switches.

1.4.2.2. CAN/CSA C22.2 NO.39-M1987 (R2007) Fuseholder Assemblies).

1.4.3. National Electrical Manufacturers Association (NEMA):

1.4.3.1. Low Voltage Cartridge Fuses

1.4.3.2. Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)

1.4.4. National Fire Protection Association (NFPA):

1.4.4.1. 70-11 National Electrical Code (NEC)

1.4.5. Underwriters Laboratories, Inc. (UL):

1.4.5.1. 98-07 Enclosed and Dead-Front Switches

1.4.5.2. 248-00 Low Voltage Fuses

1.4.5.3. 489-09 Molded Case Circuit Breakers and Circuit Breaker Enclosures

PART 2 - PRODUCTS

2.1. **PANELBOARD-MOUNTED FUSED DISCONNECTS**

2.1.1. Circuit breakers shall be per CAN/CSA22.2 #4, UL, NEC, as shown on the drawings, and as specified.

2.1.2. For circuit breakers being added to existing panelboards, coordinate the breaker type with existing panelboards. Modify the panel directory accordingly.

2.1.3. Circuit breakers shall be bolt-on type.

2.1.4. Circuit breakers shall have minimum interrupting rating as required to withstand the vailable fault current, but not less than:

2.1.4.1. 120/208 V Panelboard: 10,000 A symmetrical.
2.1.4.2. 120/240 V Panelboard: 10,000 A symmetrical.
2.1.4.3. 347/575 V Panelboard: 14,000 A symmetrical.

Circuit breakers shall have automatic, trip free, non-adjustable, inverse time, and instantaneous magnetic trips for less than 400 A frame. Circuit breakers with 400 A frames and above shall have magnetic trip, adjustable from 5x to 10x.

2.1.5. Circuit breaker features shall be as follows:

2.1.5.1. A rugged, integral housing of molded insulating material.
2.1.5.2. Silver alloy contacts.
2.1.5.3. Arc quenchers and phase barriers for each pole.
2.1.5.4. Quick-make, quick-break, operating mechanisms.
2.1.5.5. A trip element for each pole, thermal magnetic type with long time delay and instantaneous characteristics, a common trip bar for all poles and a single operator.
2.1.5.6. Electrically and mechanically trip free.
2.1.5.7. An operating handle which indicates closed, tripped, and open positions.
2.1.5.8. An overload on one pole of a multi-pole breaker shall automatically cause all the poles of the breaker to open.
2.1.5.9. Ground fault current interrupting breakers, shunt trip breakers, lighting control breakers (including accessories to switch line currents), or other accessory devices or functions shall be provided where shown on the drawings.

2.2. **FUSED DISCONNECT SWITCHES RATED 600 AMPERES AND LESS**

2.2.1. Switches shall be in accordance with CAN/CSA22.2 #4, NEMA, NEC, UL, as specified, and as shown on the drawings.

2.2.2. Shall be NEMA classified General Duty (GD) for 240 V switches, and NEMA classified Heavy Duty (HD) for 575 V switches.

2.2.3. Shall be horsepower (HP) rated.

2.2.4. NEMA 1 (indoor applications), NEMA 3R (outdoor or wet environment))

2.2.5. Shall have the following features:

2.2.5.1. Switch mechanism shall be the quick-make, quick-break type.
2.2.5.2. Copper blades, visible in the open position.
2.2.5.3. An arc chute for each pole.
2.2.5.4. External operating handle shall indicate open and closed positions, and have lock open padlocking provisions.
2.2.5.5. Mechanical interlock shall permit opening of the door only when the switch is in the open position, defeatable to permit inspection.
2.2.5.6. Fuse holders for the sizes and types of fuses specified.
2.2.5.7. Solid neutral for each switch being installed in a circuit which includes a neutral conductor.
2.2.5.8. Ground lugs for each ground conductor.

2.2.6. Enclosures:

2.2.6.1. Shall be the NEMA types shown on the drawings.
2.2.6.2. Where the types of switch enclosures are not shown, they shall be the NEMA types most suitable for the ambient environmental conditions.
2.2.6.3. Shall be finished with manufacturer's standard gray baked enamel paint over pretreated steel.

2.2.7. Standards of Acceptance: Eaton, Cutler Hammer, Siemens, Square D

2.3. **UNFUSED DISCONNECT SWITCHES RATED 600 AMPERES AND LESS**

2.3.1. Shall be the same as fused switches, but without provisions for fuses.

2.3.2. Standards of acceptance: same as fused disconnects

2.4. **CIRCUIT BREAKER TYPE DISTRIBUTION PANELS**

2.4.1. Distribution panels conforming to CSA C22.2 no. 29 standard.

2.4.2. Supplied by the same and only manufacturer.

2.4.3. As specified on the drawings

2.4.4. Arrange bus bars per phase order. All circuits shall be identified by a letter, as shown on drawings.

2.4.5. Panels shall have bus bars, and number of branch circuits and circuit breakers as shown.

2.4.6. Panels to be complete with door, lock and two keys, locks and keys to be interchangeable for all panels of the same type.

2.4.7. Bus bars shall be copper as the supports and circuit breakers material have the same expansion coefficients, with full capacity neutral.

2.4.8. For surface or flush mounting as shown on drawings.

2.4.9. Panel bus bars to be compatible with bolted-on circuit breakers.

2.4.10. Standard finish: ASA 61 grey baked enamel.

2.4.11. Circuit breakers: conforming to article “Molded Case Circuit Breakers” described herein.

2.5. The grounding bus bar shall conform to article Grounding and Bonding.

2.6. Acceptable manufacturers:

2.6.1. Eaton, Siemens, GE.

2.7. **MOTOR RATED TOGGLE SWITCHES**

2.7.1. Not applicable

2.8. **CARTRIDGE FUSES**

2.8.1. Shall be in accordance with CSA C22.2 no. 106 and C22.2 no. 248 standards.

2.8.2. High rupturing capacity (HRC) fuses 200kA RMS symmetrical and current limiting fuses.

2.8.3. Supplied by the same and only manufacturer.

2.8.4. Service Entrance: Class L, fast acting.

2.8.5. Feeders: Class L, fast acting

2.8.6. Motor and Transformer Branch Circuits: Class RK1 time delay.

2.8.7. Other Branch Circuits: Class J (less than 600A) or Class L (over 600A), fast acting.

2.8.8. Control Circuits: Class CC fast acting

2.8.9. Standard of Acceptance: Cooper Busman, Eaton

2.9. **MOLDED CASE CIRCUIT BREAKERS**

2.9.1. Molded case circuit breakers conforming to CSA C22.2 no. 5 standard.
2.9.2. Circuit protection devices contained in plastic insulated enclosures.
2.9.3. Bolted to the panel bus bars.
2.9.4. Quick make quick break mechanism.
2.9.5. Manually operated.
2.9.6. Complete with thermal and magnetic trip unit compensated for an ambient temperature of 40 °C (104 °F).
2.9.7. Multi-pole breakers to have a common trip device and operating lever.
2.9.8. In 120 or 208 Volts circuits use, unless otherwise noted on the distribution diagram or on the panel description sheets, single, two or three pole circuit breakers having the ratings as shown and with a 10 kA minimum RMS, symmetrical rupturing capacity.
2.9.9. Authentication of new breakers (not counterfeited)

2.9.9.1. Except otherwise noted, all breakers installed in panels (new or existing) shall be new and obtained exclusively from a distributor authorized by manufacturer.
2.9.9.2. Submit with breaker shop drawings, a copy of the purchase order to the distributor. Quantities, models and sizes shown on the purchase order shall correspond to those indicated on the shop drawings.

PART 3 - EXECUTION

3.1. INSTALLATION

3.1.1. Installation shall be in accordance with the manufacturer's instructions, the CEC, as shown on the drawings, and as specified.

3.1.2. Fused switches shall be furnished complete with fuses. Arrange fuses such that rating information is readable without removing the fuses.

3.1.3. All disconnect switches and fuses supplied by the same manufacturer.

3.1.4. Safety switches in the circuit between a motor and a variable frequency drive shall be fitted with one type C auxiliary contact. Connect this contact to the variable frequency drive with two (2) # 14 AWG conductors inside a 12 mm (½") conduit.

3.2. MOLDED CASE CIRCUIT BREAKER

3.2.1. Install circuit breakers and connect as shown.

3.2.2. When a panel is replaced with a new one, the contractor shall verify the compatibility of the existing breakers with the new panel type. New breakers shall be supplied if the existing breakers are not compatible with the new panel and cannot be relocated.

3.3. FUSES

3.3.1. Install fuses in fuse holders just before energizing.

3.3.2. Insure that fuses and holders are perfectly matched.

3.3.3. Insure that the right fuse is used to protect the corresponding circuit.

3.3.4. Store the spare fuses in an orderly manner

3.4. IDENTIFICATION

3.4.1. Identify switches, as to equipment served, with engraved laminated phenolic name plates.

3.5. ACCEPTANCE CHECKS AND TESTS

3.5.1. Perform in accordance with the manufacturer's recommendations. In addition, include the following:

3.5.2. Visual Inspection and Tests:

3.5.2.1. Compare equipment nameplate data with specifications and approved shop drawings.
3.5.2.2. Inspect physical, electrical, and mechanical condition.
3.5.2.3. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method.

3.5.3. Vacuum-clean enclosure interior. Clean enclosure exterior.

3.6. **SPARE PARTS**

3.6.1. Two weeks prior to the final inspection, furnish one complete set of spare fuses for each fused disconnect switch installed on the project. Deliver to the Board representative.

GLADYS SPEERS PS RENOVATIONS

2150 SAMWAY RD,

OAKVILLE, ONTARIO L6L 2P6

Halton District School Board

1. VERIFY ALL DIMENSIONS AND EXISTING SITE CONDITIONS. REPORT ANY DISCREPANCIES TO ARCHITECT BEFORE PROCEEDING WITH THE WORK
2. REPORT TO ARCHITECT AT LEAST THREE WORKING DAYS PRIOR TO CONSTRUCTION ALL DISCREPANCIES, OMISSIONS, ERRORS, DEPARTURES FROM BUILDING BY-LAWS, O.B.C., OR GOOD PRACTICE AND POINTS CONSIDERED TO BE OF AMBIGUOUS INTENT, SO THAT THE ARCHITECT MAY, IF NECESSARY, ISSUE INSTRUCTIONS BY ADDENDA. THE ARCHITECT WILL NOT BE RESPONSIBLE FOR ORAL INSTRUCTIONS.
3. DO NOT SCALE DRAWINGS.
4. EXTEND, MAKE GOOD, REPAIR AND CLEAN EXISTING SUBSTRATES, FINISHES, AND COMPONENTS AS REQUIRED TO MATCH EXISTING. PROVIDE ADDITIONAL MATERIALS AND COMPONENTS AS REQUIRED. MAINTAIN CONTINUITY TO EXISTING WORK, FLUSH, PLUMB AND IN ALIGNMENT, AND WITHOUT DETRIMENTS TO VISUAL APPEARANCE. MATCH EXISTING MATERIALS AND METHODS. VARIATIONS WILL BE ACCEPTED BY ARCHITECT'S WRITTEN AUTHORIZATION ONLY, AND WHERE AUTHORIZED MUST MEET OR EXCEED QUALITY AND PERFORMANCE OF EXISTING.
5. PROTECT EXISTING WORK TO REMAIN AS REQUIRED. BE RESPONSIBLE FOR REPAIRS, MAKING GOOD AND CLEANING IN EVENT PROTECTION IS NOT ADEQUATE.
6. PROTECT PUBLIC AND OTHER PRIVATE PROPERTY BEYOND IMMEDIATE WORK AREA. CONTRACTOR TO HOLD OWNER HARMLESS AGAINST ALL CLAIMS ASSOCIATED WITH THIS WORK.
7. MAINTAIN CONTINUITY OF ALL EXISTING FIRE SEPARATIONS, ASSEMBLIES, AND PROTECTIVE CLADDING.
8. ALL WORK IS TO BE PROVIDED AS COMPLETE, OPERATING SYSTEMS EXCEPT AS NOTED.
9. PREPARE ALL EXISTING SUBSTRATES TO RECEIVE NEW FINISHES AS REQUIRED ACCORDING TO RECOMMENDATIONS OF MANUFACTURER OF NEW FINISH MATERIALS.
10. PROVIDE PURPOSE-MADE ALUMINUM REDUCING STRIPS AT ALL DISSIMILAR FLOOR FINISH MATERIALS, INCLUDING JUNCTION OF EXISTING MATERIALS TO NEW MATERIALS. SUBMIT SAMPLES TO ARCHITECT FOR APPROVAL.
11. MOVE MATERIALS AND DEBRIS FROM IMMEDIATE WORK AREA TO EXTERIOR RUBBISH BINS IN CLOSED DUST-TIGHT CONTAINERS. LOCATE BINS TO APPROVAL OF OWNER AND LANDLORD.
12. CO-ORDINATE AND PAY FOR ALL CHARGES AND FEES ASSOCIATED WITH THE WORK TO BE PERFORMED AS LEVIED BY THE AUTHORITIES HAVING JURISDICTION. PROCURE ALL ENCROACHMENT AGREEMENTS AS REQUIRED TO PERMIT WORK TO BE PERFORMED.
13. PROVIDE DUSTTIGHT CONSTRUCTION HOARDING. SUBMIT SHOP DRAWINGS.
14. PERFORM ALL SITE PREPARATIONS AND DEMOLITIONS AS REQUIRED TO PERMIT NEW WORK TO COMMENCE AND BE ACCOMMODATED.
15. THE SCHEDULE AND SEQUENCE OF THE WORK WILL BE SUBJECT TO THE APPROVAL OF THE OWNER. THE OWNER INTENDS TO OCCUPY AND OPERATE IN THE PREMISES DURING CONSTRUCTION.
16. PROVIDE ACCESS TO ALL CONTROL DEVICES AND MAINTAIN ACCESS TO ALL EXISTING CONTROL DEVICES WHICH ARE COVERED BY FINISHES. PROVIDE PRE-MANUFACTURED ACCESS PANELS TO SUIT. SUBMIT SAMPLES TO ARCHITECT FOR APPROVAL.
17. REMOVE ALL EXISTING INACTIVE AND ABANDONED MECHANICAL AND ELECTRICAL SERVICE LINES. MAKE GOOD.
18. CONFORM TO MANUFACTURER'S SPECIFICATIONS AND RECOMMENDATIONS.
19. MAINTAIN ACCESS TO EXITS AT ALL TIMES. PROVIDE ALTERNATE EXITS IN CONSULTATION WITH AND AT APPROVAL OF BUILDING OFFICIAL. PROVIDE TEMPORARY EXIT SIGNS AND ADJUST EXISTING EXIT SIGNS AS REQUIRED. AT COMPLETION OF WORK, REMOVE TEMPORARY SIGNS AND RESTORE SIGNAGE. MAKE GOOD.

INFORMATION FOR THIS SITE PLAN TAKEN FROM DOCUMENTS PROVIDED BY THE HALTON DISTRICT SCHOOL BOARD

1 — RENOVATION NOTES

— N.T.S.

Revisions

Ref.	No.	Description	Date	Initial
△		CONSULTANTS COORDINATION	2022/01/31	
△		CONSULTANTS COORDINATION	2022/02/07	
△		CLIENTS REVIEW	2022/02/18	
△		CONSULTANTS COORDINATION	2022/02/24	
△		CONSULTANTS COORDINATION	2022/04/14	
△		CONSULTANTS COORDINATION	2022/04/19	
△		PRE-TENDER SUBMISSION	2022/04/27	
△		ISSUED FOR PERMIT AND TENDER	2022/05/02	

Project:

GLADYS SPEERS PS RENOVATIONS
2150 SAMWAY RD, OAKVILLE, ON L6L 2P6

liu lim Architects inc.

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ONTARIO ASSOCIATION OF ARCHITECTS
K. LIM
LICENCE
3660

Consultant:

Title:

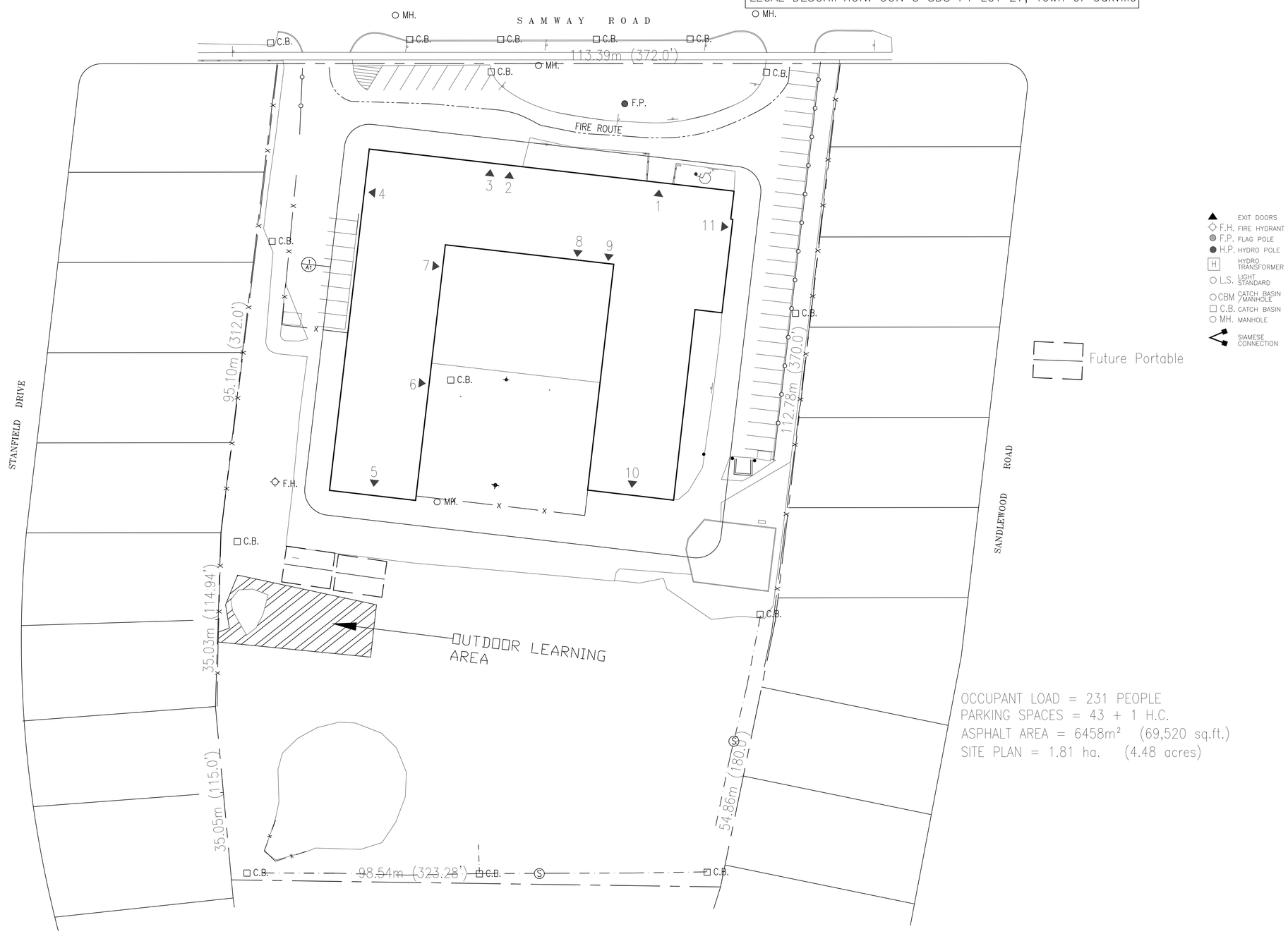
TITLE SHEET

Drawn by: M.L.	Date: DECEMBER 2021
Checked by: W.L.	Plotted:
Scale: AS SHOWN	Issued:
Job No.: 21153	Drawing No.: A0
Set No.:	of:

NOTE: PLAN ROTATED

SAWCUT AND MAKE GOOD EXISTING FINISHES–SEE ELECTRICAL

LEGAL DESCRIPTION: CON 3 SDS PT LOT 27, Town of Oakville



OCCUPANT LOAD = 231 PEOPLE
PARKING SPACES = 43 + 1 H.C.
ASPHALT AREA = 6458m² (69,520 sq.ft.)
SITE PLAN = 1.81 ha. (4.48 acres)

1 SITE PLAN

1:400

Revisions

Ref.	No.	Description	Date	Initial
△		CONSULTANTS COORDINATION	2022/01/31	
△		CONSULTANTS COORDINATION	2022/02/07	
△		CLIENTS REVIEW	2022/02/18	
△		CONSULTANTS COORDINATION	2022/02/24	
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△		ISSUED FOR PERMIT AND TENDER	2022/05/02	

Project:

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RENOVATIONS
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ONTARIO ASSOCIATION OF ARCHITECTS
W.K. LIM
LICENCE
3060

Consultant:

Title:

SITE PLAN

Drawn by:	Date:
M.L.	DECEMBER 2021
Checked by: W.L.	Plotted:
Scale: 1:400	Issued:
Job No.: 21153	Drawing No.: SP1
Set No.:	of:

WALL TYPES:

EXISTING TO REMAIN

REMOVE EXISTING WALL, PARTITIONS, PLUMBING FIXTURES AS SHOWN DOTTED. MAKE GOOD.
RELOCATE EXISTING SERVICES AS REQUIRED.
CAP AND MAKE SAFE ALL SERVICE LINES.
SEE MECHANICAL AND ELECTRICAL.

FIRE SEPARATIONS:

SEE REFLECTED CEILING PLAN FOR FIRE RATED SEPARATIONS

TEMPORARY CONSTRUCTION EXITS:

BARRICADE AND PROVIDE DUST TIGHT HOARDING TO EXISTING BUILDING. ESTABLISH ALTERNATE EXITS DURING CONSTRUCTION THROUGH EXISTING DOORS TO EXTERIOR. PROVIDE EXIT SIGNS AS REQUIRED AND REMOVE AND MAKE GOOD AT COMPLETION OF WORK. MASK EXISTING SIGNS AS REQUIRED FOR TEMPORARY EXITS. REVIEW EXITING DURING CONSTRUCTION WITH LOCAL BUILDING DEPARTMENT PRIOR TO COMMENCEMENT OF CONSTRUCTION.

AT EXISTING PARTITIONS TO BE DEMOLISHED:

SAWCUT AND MAKE GOOD AT TERMINATIONS WITH MIN. 200 CAP OF SIMILAR MATERIAL TO MATCH EXISTING
MAKE GOOD EXISTING CEILING, FLOOR AND WALL BASE TO MATCH EXISTING

AT PERPENDICULAR WALL JUNCTIONS, GRIND SMOOTH AS REQUIRED
REMOVE METAL TIES AS REQUIRED AND MAKE GOOD
PAINT ENTIRE AFFECTED WALL PLANES

REMOVE EXISTING WALL MOUNTED EQUIPMENT
RELOCATE AS DIRECTED ON SITE OR TURN OVER TO SCHOOL

LEGEND:

XX — MILLWORK TYPE XX

XXX — DOOR NO. XXX

XXX — ROOM NO. XXX

XX — PARTITION TYPE XXX

ELEV. — ELEVATION A, ELEVATION B, ELEVATION C, ELEVATION D, DETAIL NO. XX, DRAWING NO. YYY

DETAIL — XXX / YYY — DETAIL NO. XXX/REFERENCE DRAWING YYY

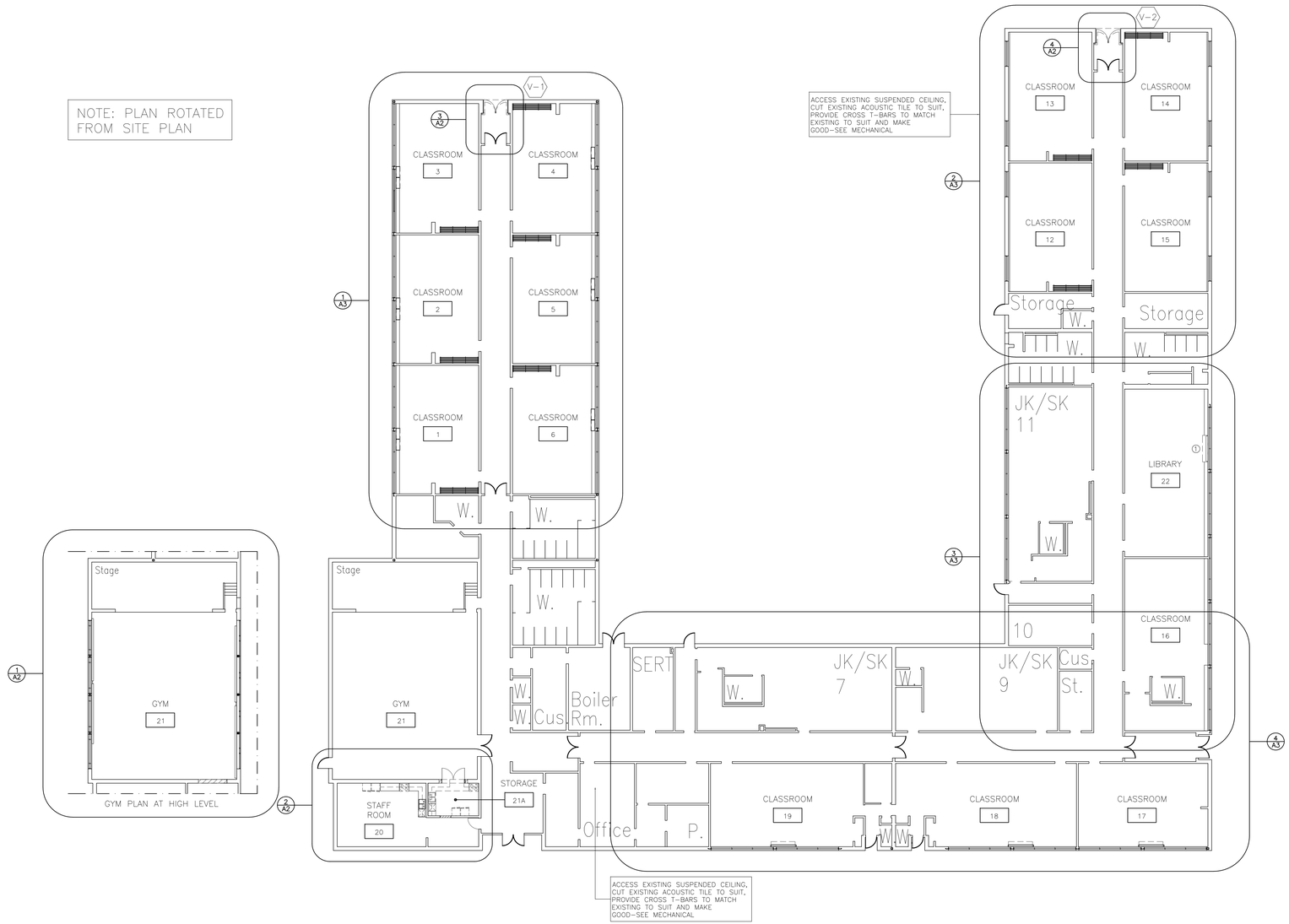
SECTION — XX / YYY — SECTION NO. XX/REFERENCE DRAWING YYY

LIMIT OF FLOOR FINISH
PROVIDE PURPOSE MADE
PRE-FINISHED METAL TRANSITION STRIP
TO PROFILE AS SELECTED BY CONSULTANT
SUBMIT SAMPLES

REMOVE EXISTING FLOORING AND WALL BASE
CLEAN & STRIP SUBSTRATE OF RESIDUAL SEALANT

2 — WALL TYPE LEGEND DETAIL — NTS

NOTE: PLAN ROTATED FROM SITE PLAN



1 — KEY PLAN — 1:200

Revisions

Ref.	No.	Description	Date	Initial
1		CONSULTANTS COORDINATION	2022/01/31	
2		CONSULTANTS COORDINATION	2022/02/07	
3		CLIENTS REVIEW	2022/02/18	
4		CONSULTANTS COORDINATION	2022/02/24	
5		CONSULTANTS COORDINATION	2022/04/14	
6		CONSULTANTS COORDINATION	2022/04/19	
7		PRE-TENDER SUBMISSION	2022/04/27	
8		ISSUED FOR PERMIT AND TENDER	2022/05/02	

Project:

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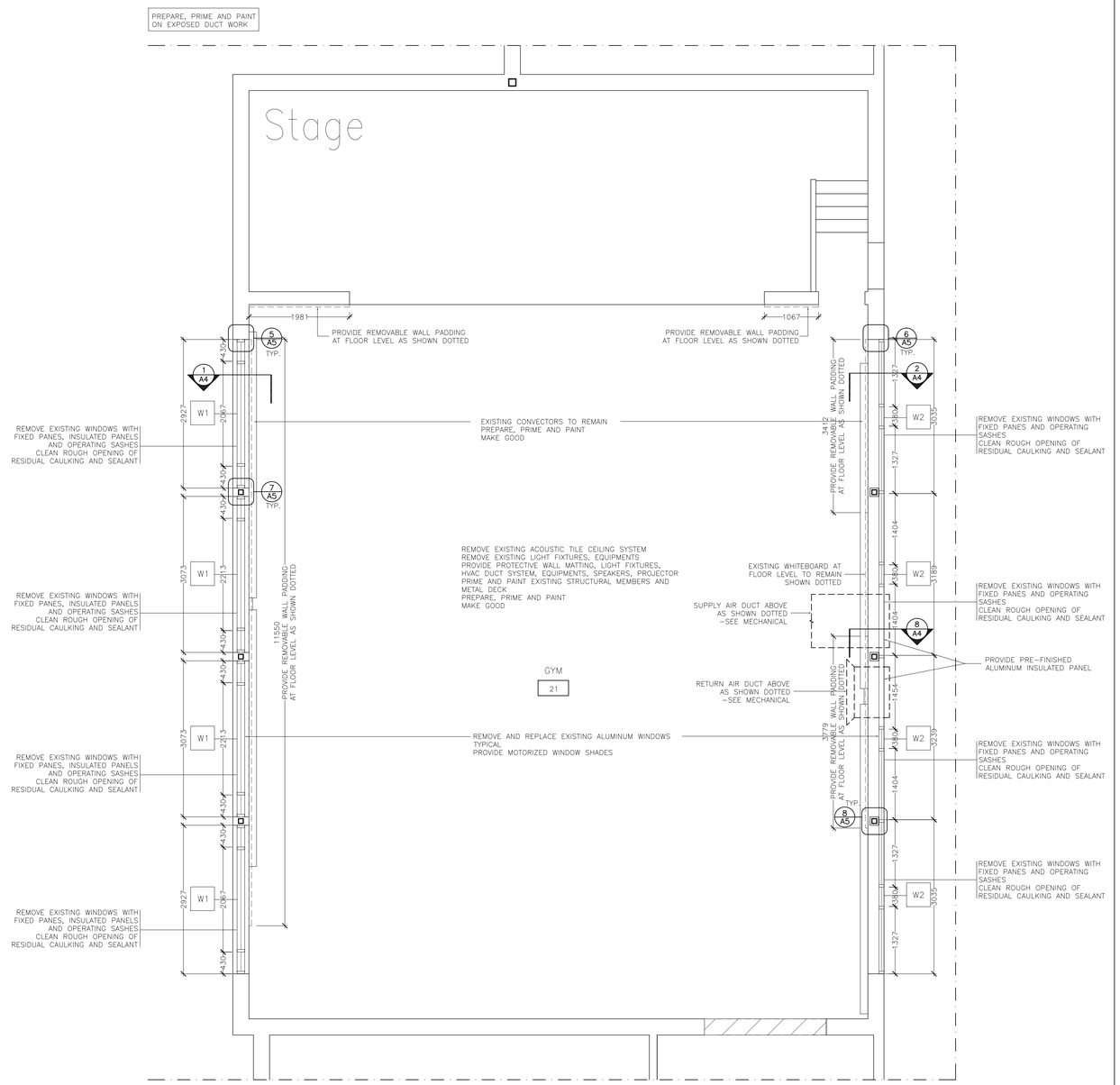
ONTARIO ASSOCIATION OF ARCHITECTS
W. K. LIM
LICENCE 3660

Consultant:

Title:

KEY PLAN, WALL TYPE LEGEND

Drawn by: M.L.	Date: DECEMBER 2021
Checked by: W.L.	Plotted:
Scale: AS SHOWN	Issued:
Job No.: 21153	Drawing No.: A1
Set No.:	of:



1 A1 ENLARGED GYM PLAN — 1:50

NOTE (1):

SHORE AND BRACE WALL AS REQUIRED
SAWCUT OPENING 200 WIDER AT EACH JAMB AND ONE BLOCK COURSE ABOVE HEAD – PROVIDE LINTEL REFER TO DRAWING A4 DETAIL 3

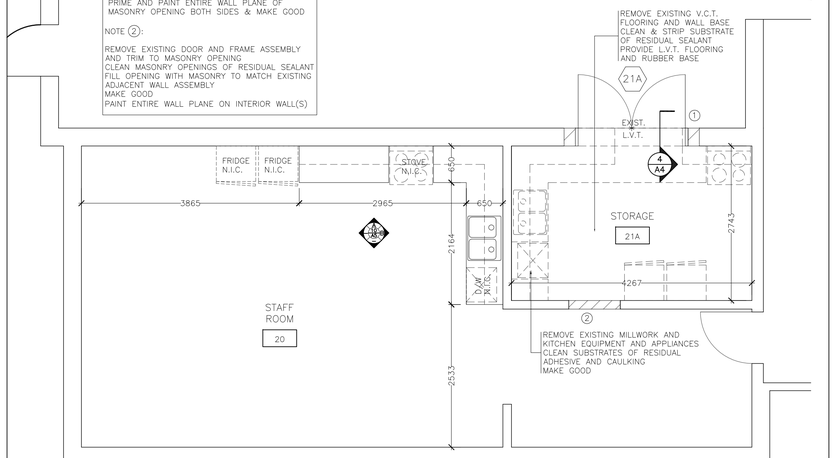
GRIND SUBFLOOR SMOOTH AND FLUSH TO ADJACENT SUBFLOOR
CHIP FOUNDATION 50 BELOW SUBFLOOR
PROVIDE FLUSH CONCRETE TOPPING – FINISH TO MATCH EXISTING SUBSTRATE

REMOVE AS REQUIRED AND EXTEND FINISH FLOORING IN FULL UNITS TO MATCH EXISTING FOR FULL WIDTH OF OPENING
PROVIDE BULLNOSE CONCRETE BLOCK AT JAMBS TO MATCH WIDTH OF EXISTING MASONRY OR PROVIDE METAL FRAME OF THROAT DEPTH TO CAP BLOCK
SET FRAME ANCHORS INTO MASONRY COURSING

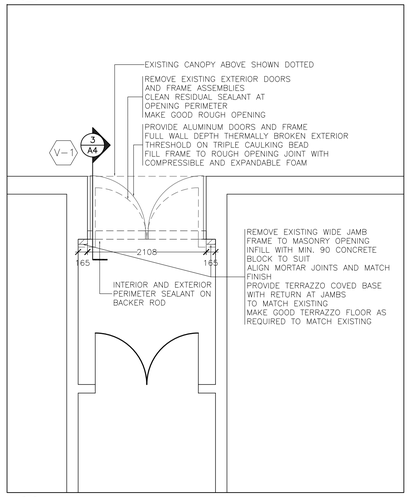
PRIME AND PAINT ENTIRE WALL PLANE OF MASONRY OPENING BOTH SIDES & MAKE GOOD

NOTE (2):

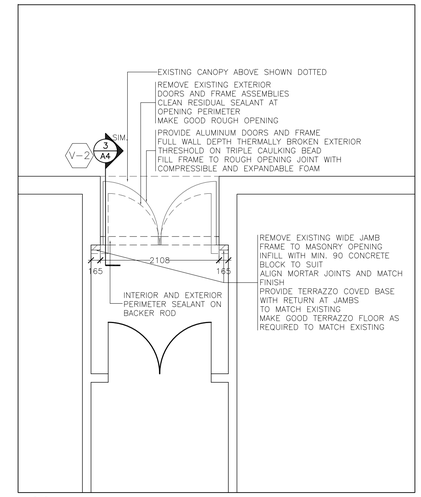
REMOVE EXISTING DOOR AND FRAME ASSEMBLY AND TRIM TO MASONRY OPENING
CLEAN MASONRY OPENINGS OF RESIDUAL SEALANT
FILL OPENING WITH MASONRY TO MATCH EXISTING ADJACENT WALL ASSEMBLY
MAKE GOOD
PAINT ENTIRE WALL PLANE ON INTERIOR WALL(S)



2 A1 ENLARGED STAFF ROOM 20 PLAN — 1:50



3 – ENLARGED DOOR V-1 PLAN — 1:50



4 – ENLARGED DOOR V-2 PLAN — 1:50

Revisions

Ref.	No.	Description	Date	Initial
△		CONSULTANTS COORDINATION	2022/01/31	
△		CONSULTANTS COORDINATION	2022/02/07	
△		CLIENTS REVIEW	2022/02/18	
△		CONSULTANTS COORDINATION	2022/02/24	
△		CONSULTANTS COORDINATION	2022/04/14	
△		CONSULTANTS COORDINATION	2022/04/19	
△		PRE-TENDER SUBMISSION	2022/04/27	
△		ISSUED FOR PERMIT AND TENDER	2022/05/02	

Project:

GLADYS SPEERS PS RENOVATIONS
2150 SAMWAY RD, OAKVILLE, ON L6L 2P6

Liu + Lim Architects inc.
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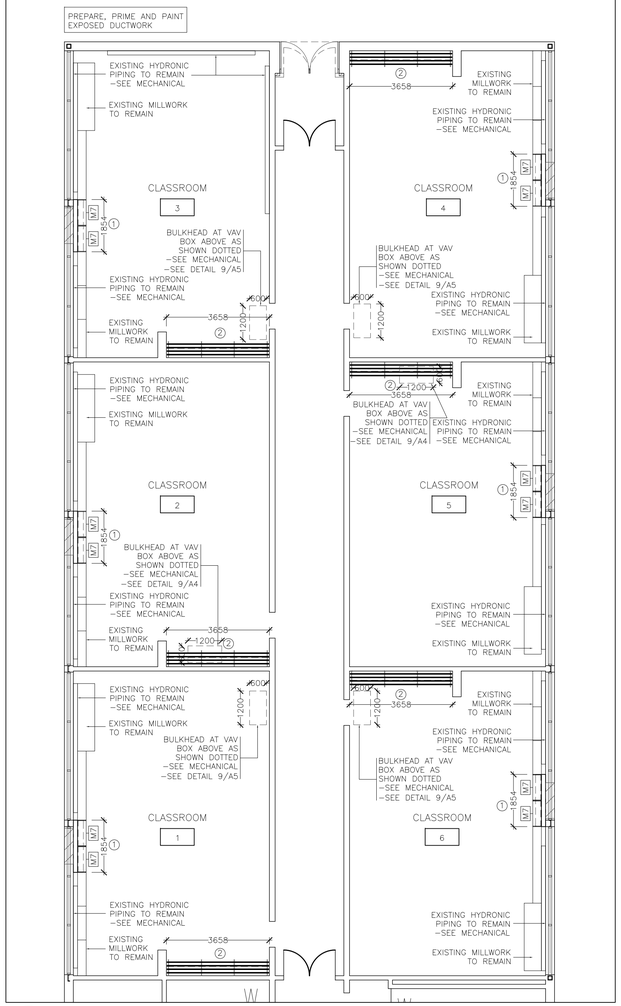
ONTARIO ASSOCIATION OF ARCHITECTS
ANDREW K. LIM
LICENCE 3660

Consultant:

Title:

ENLARGED PLANS

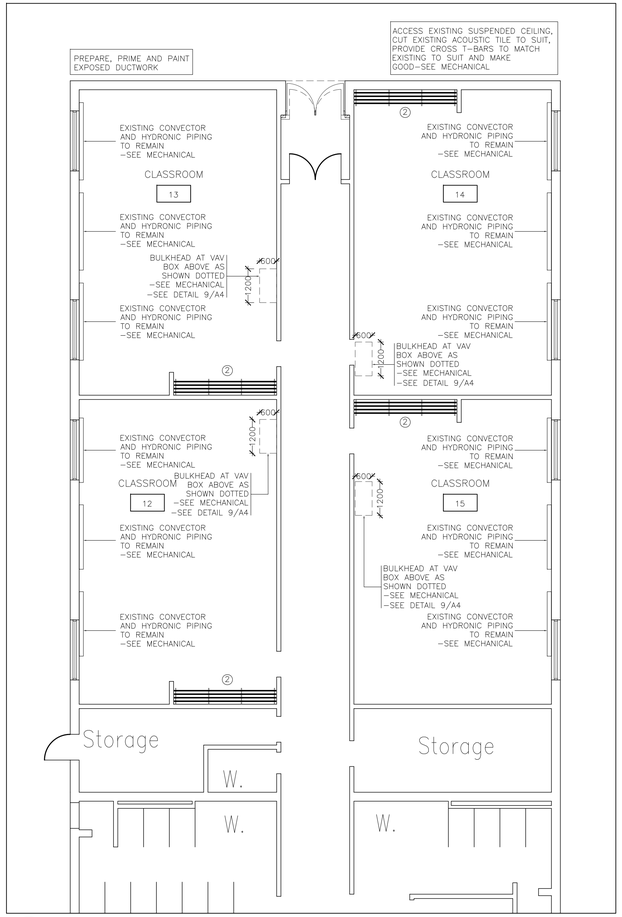
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Checked by: W.L.	Plotted:
Scale: 1:50	Issued:
Job No.: 21153	Drawing No.: A2
Set No.:	of:



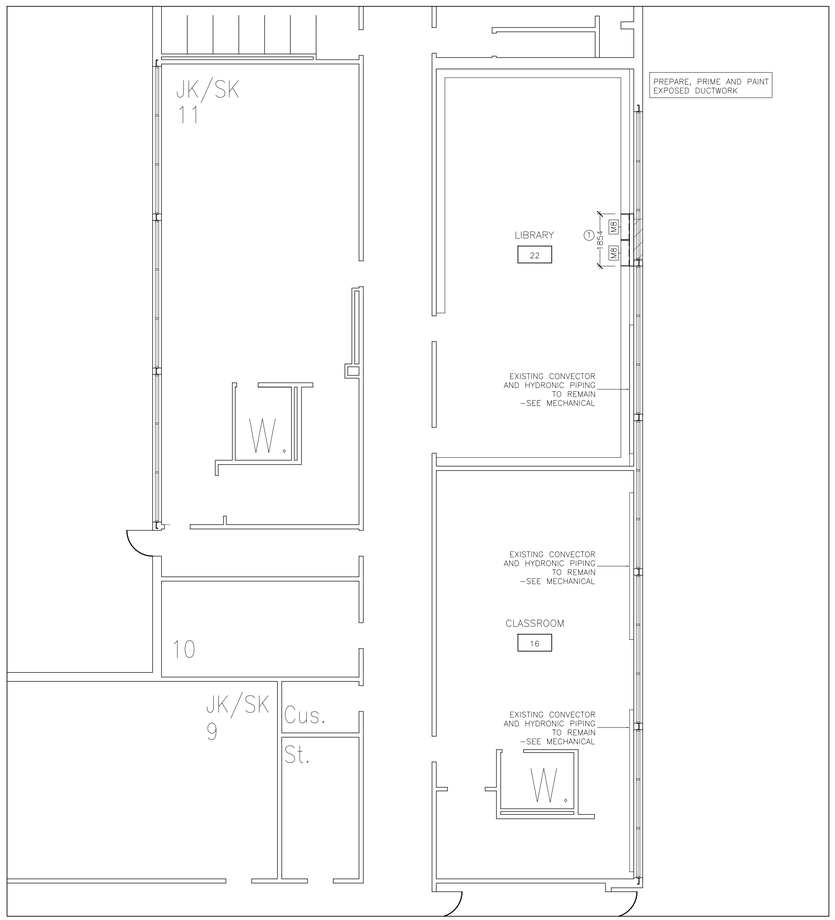
1 A1 ENLARGED CLASSROOM 1–6 PLAN 1:100

NOTE ① :
REMOVE EXISTING UNIT VENTILATOR ASSEMBLY –SEE MECHANICAL
STRIP WALL TO EXISTING CONCRETE BLOCK SUBSTRATE
CLEAN, AND PREPARE SUBSTRATE
PROVIDE BLOCK FILLER
REMOVE EXISTING LOUVRE
INFILL OPENING TO MATCH EXISTING WALL ASSEMBLY
PROVIDE RADIATOR–SEE MECHANICAL
PROVIDE MILLWORK TO SUIT
MAKE GOOD

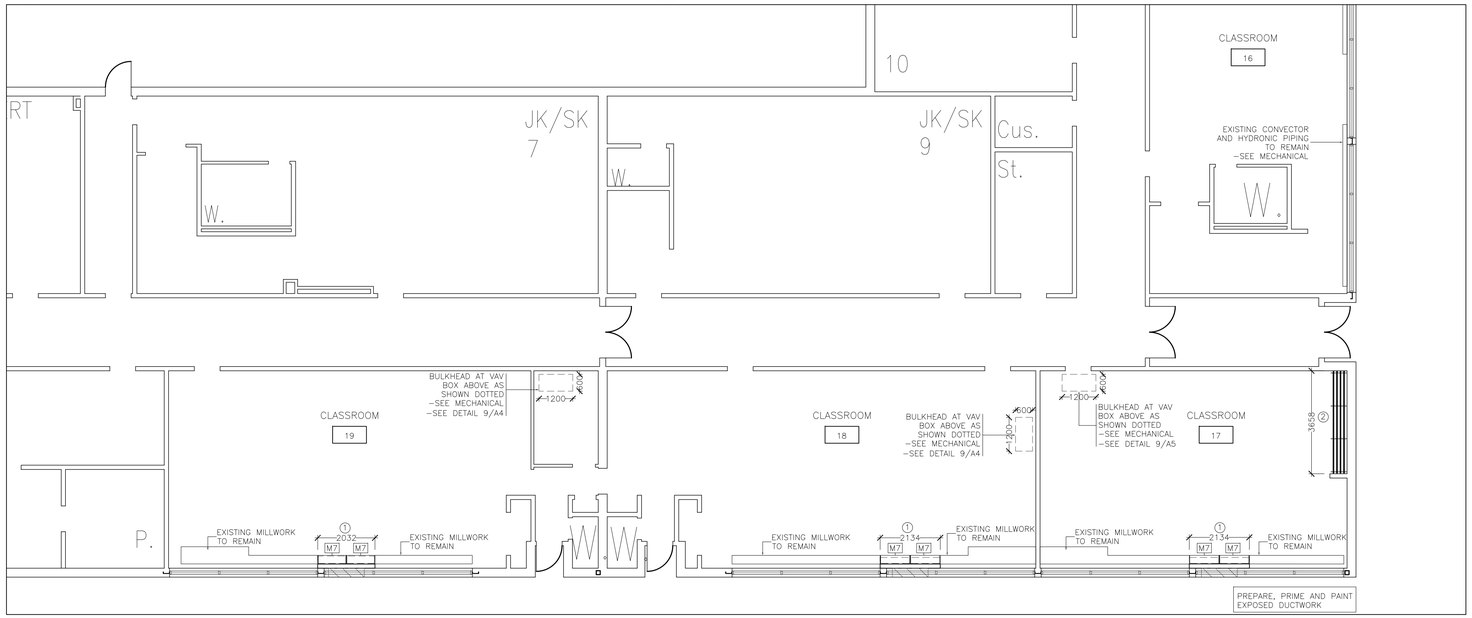
NOTE ② :
REMOVE EXISTING SHELF AND BREAKAWAY HOOKS
PROVIDE COAT RACK SYSTEM WITH BREAKAWAY HOOKS
MATCH EXISTING SHELF LENGTH



2 A1 ENLARGED CLASSROOM 12–15 PLAN 1:100



3 A1 ENLARGED LIBRARY 22 AND CLASSROOM 16 PLAN 1:100



4 A1 ENLARGED CLASSROOM 17–19 PLAN 1:100

Revisions

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△		CONSULTANTS COORDINATION	2022/04/19	
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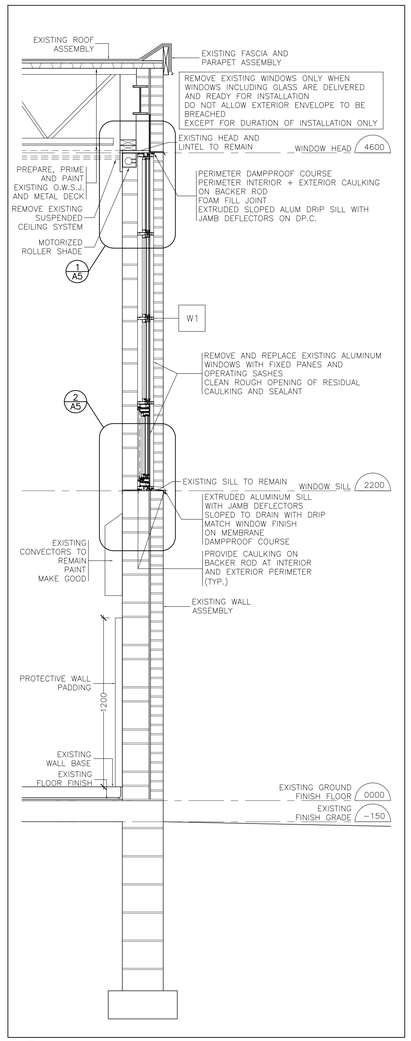
ONTARIO ASSOCIATION OF ARCHITECTS
WILLIAM K. LIM
LICENCE 3660

Consultant:

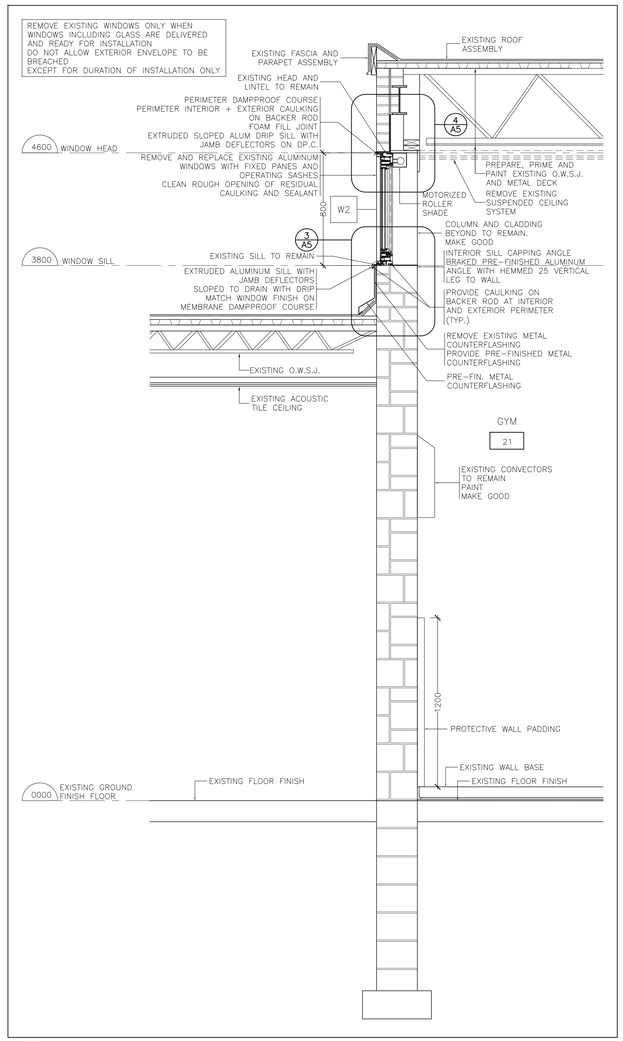
Title:

ENLARGED PLANS

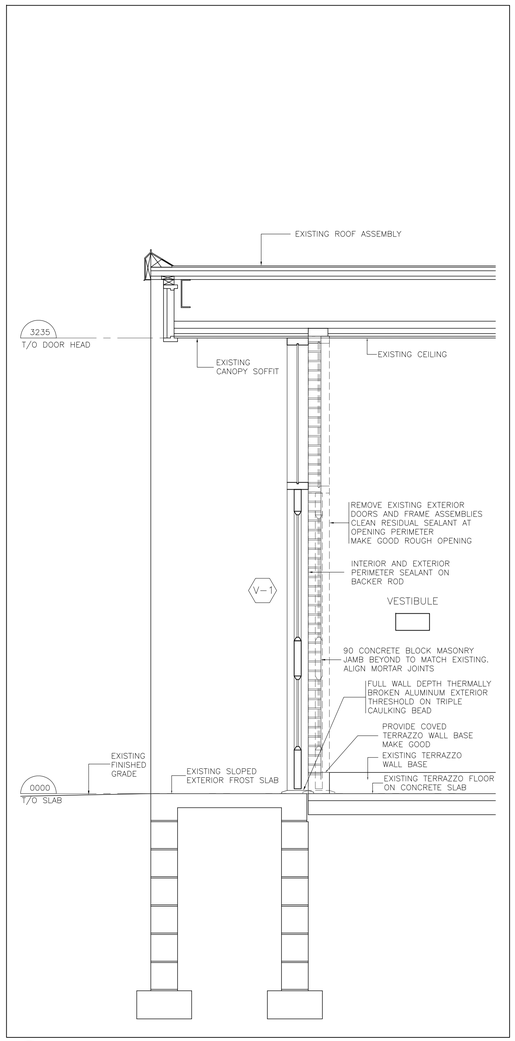
Drawn by:	Date:
M.L.	DECEMBER 2021
Checked by:	Plotted:
W.L.	
Scale:	Issued:
1:100	
Job No.:	Drawing No.:
21153	A3
Set No.:	of:



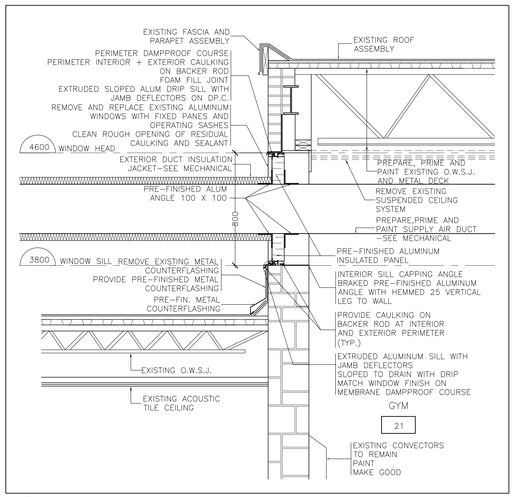
1 A2 TYPICAL WINDOW W1 SECTION 1:20



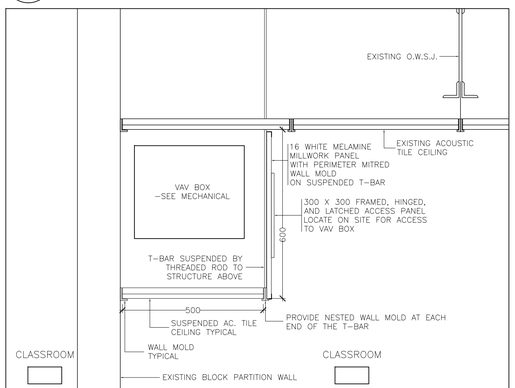
2 A2 TYPICAL WINDOW W2 SECTION 1:20



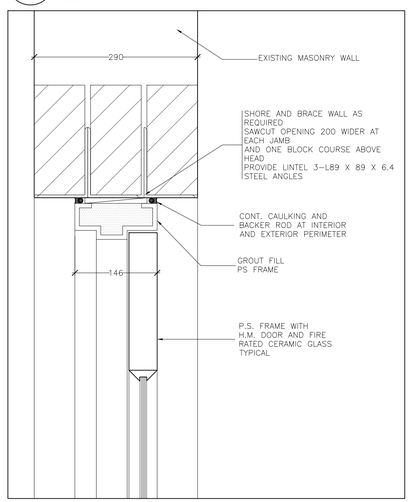
3 A2 DOOR V-1 SECTION 1:20



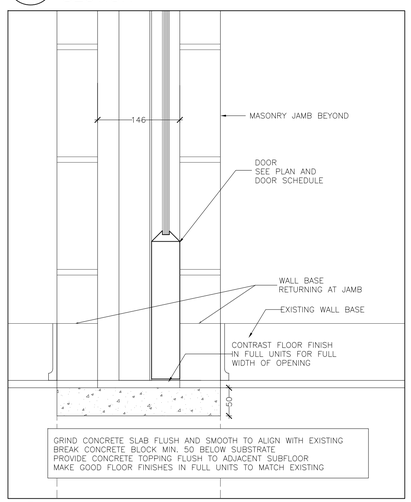
8 A2 SUPPLY AIR DUCT AT GYM HIGH WINDOW SECTION 1:20



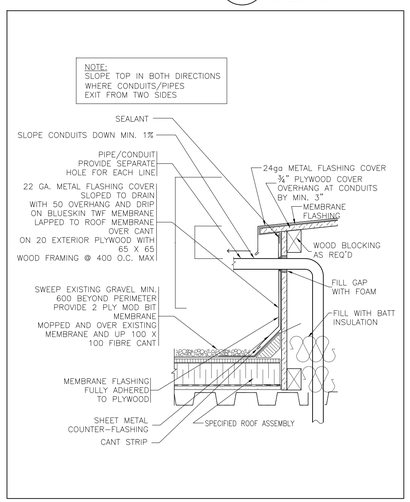
9 A2 BULKHEAD AT VAV BOX BETWEEN CLASSROOMS SECTION 1:10



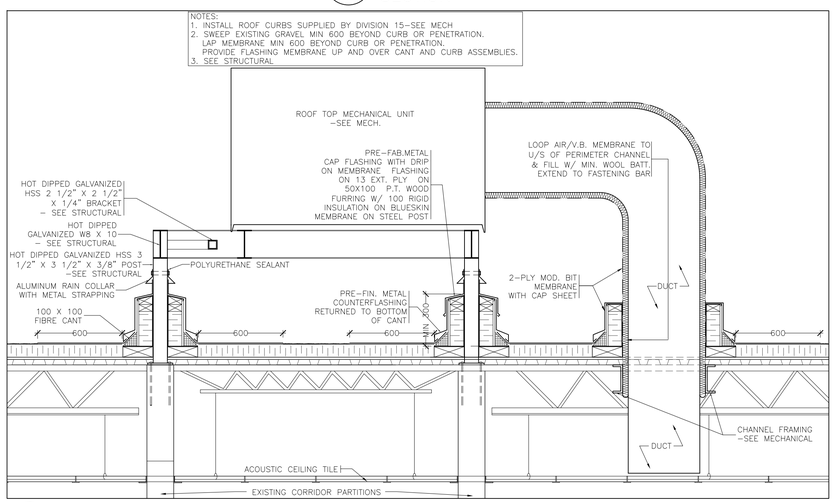
4 – MASONRY OPENING DOOR THRESHOLD SECTION 1:5



5 – MASONRY OPENING DOOR THRESHOLD SECTION 1:5



6 – DOG HOUSE DETAIL 1:10



7 – MECHANICAL UNIT ROOF PENETRATION DETAIL 1:20

Revisions

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△		CLIENTS REVIEW	2022/02/18	
△		CONSULTANTS COORDINATION	2022/02/24	
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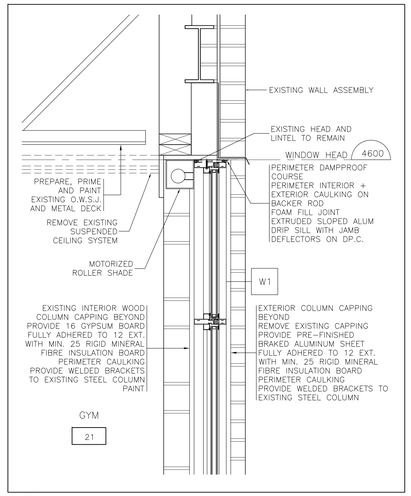
ONTARIO ASSOCIATION OF ARCHITECTS
M. K. LIM
LICENCE 3660

Consultant:

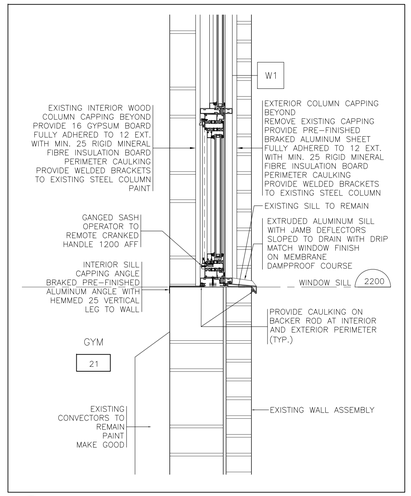
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SECTIONS AND DETAILS

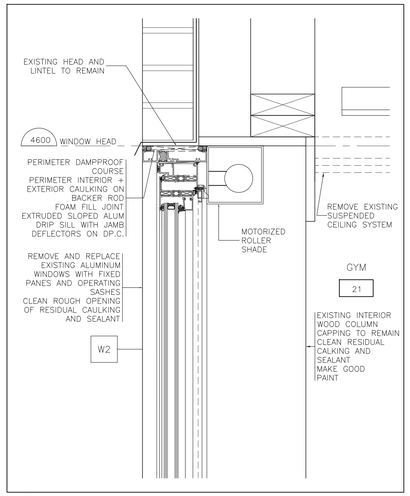
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M.L.	DECEMBER 2021
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Job No.: 21153	Drawing No.: A4
Set No.:	of:



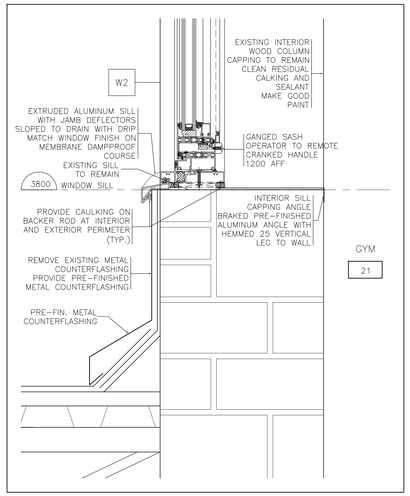
1 / A4 WINDOW HEAD AT TYPICAL WINDOW W1 DETAIL 1:10



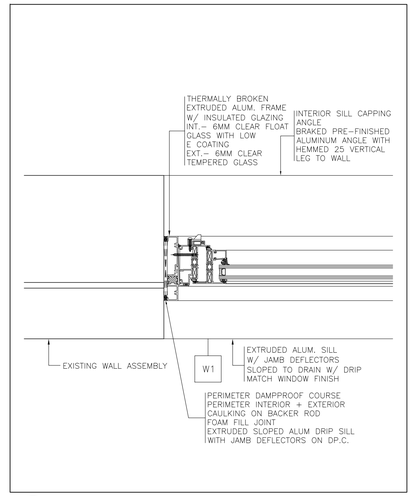
1 / A4 WINDOW SILL AT TYPICAL WINDOW W1 DETAIL 1:10



3 / A4 WINDOW HEAD AT TYPICAL WINDOW W2 DETAIL 1:5



4 / A4 WINDOW SILL AT TYPICAL WINDOW W2 DETAIL 1:5



5 / A2 WINDOW JAMB AT TYPICAL WINDOW W1 PLAN 1:5

6 / A2 WINDOW JAMB AT TYPICAL WINDOW W2 PLAN 1:5

7 / A2 WINDOW W1 JAMB AT EXISTING COLUMN PLAN 1:5

8 / A2 WINDOW W2 JAMB AT EXISTING COLUMN PLAN 1:5

9 / A2 BULKHEAD AT VAV BOX AT CORRIDOR WALL SECTION 1:10

Revisions

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△		PRE–TENDER SUBMISSION	2022/04/27	
△		ISSUED FOR PERMIT AND TENDER	2022/05/02	

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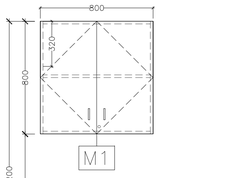
ONTARIO ASSOCIATION OF ARCHITECTS
W.K. LIM
LICENCE
3660

Consultant:

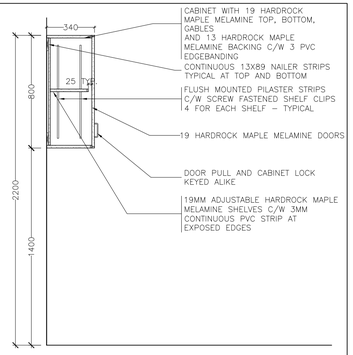
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Job No.: 21153	Drawing No.: A5
Set No.:	of:

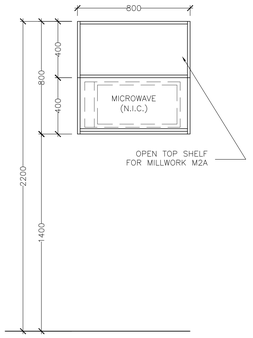


A — MILLWORK M1 ELEVATION 1:20

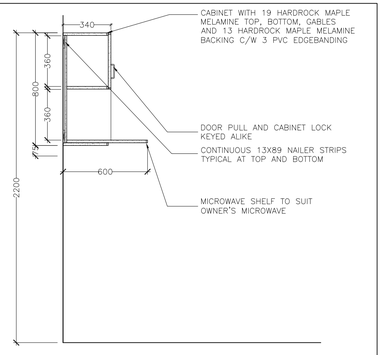


B — MILLWORK M1 SECTION 1:20

1 / A2 MILLWORK M1 DETAILS 1:20

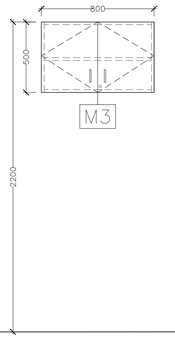


A — MILLWORK M2 ELEVATION 1:20

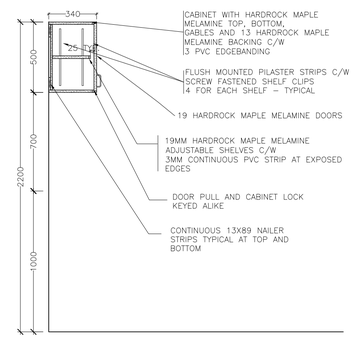


B — MILLWORK M2 SECTION 1:20

2 / A2 MILLWORK M2 DETAILS 1:20

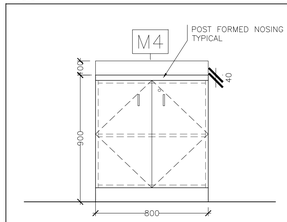


A — MILLWORK M3 ELEVATION 1:20

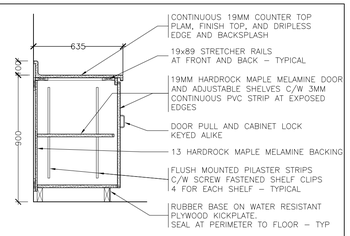


B — MILLWORK M3 SECTION 1:20

3 / A10 MILLWORK M3 DETAILS 1:20

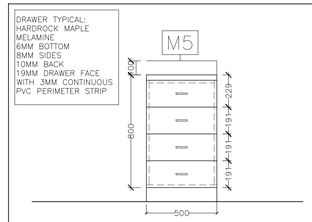


A — MILLWORK M4 ELEVATION 1:20

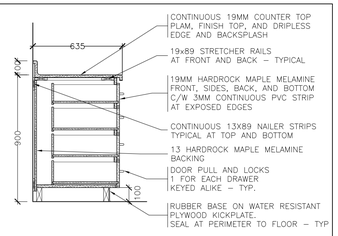


B — MILLWORK M4 SECTION 1:20

4 / A2 MILLWORK M4 DETAILS 1:20

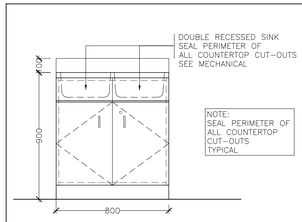


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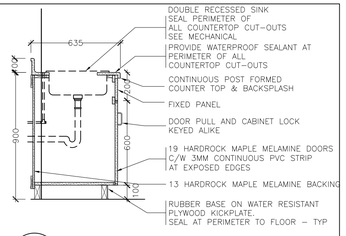


B — MILLWORK M5 SECTION 1:20

5 / A2 MILLWORK M5 DETAILS 1:20

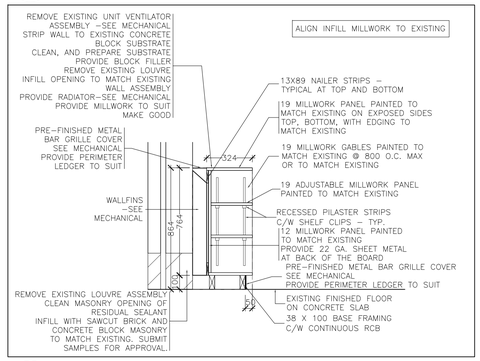


A — MILLWORK M6 ELEVATION 1:20

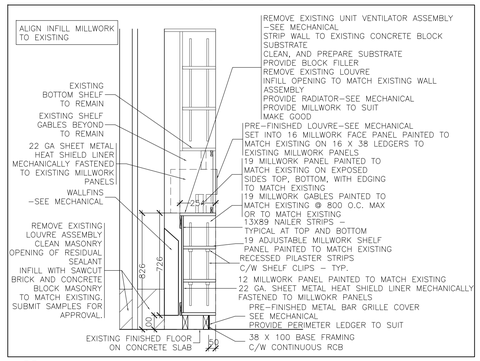


B — MILLWORK M6 SECTION 1:20

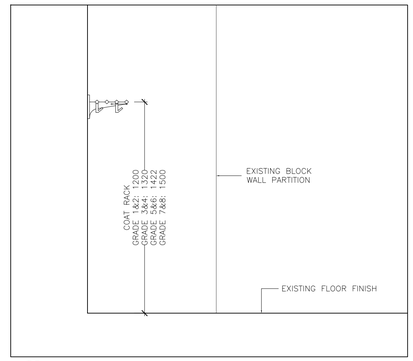
6 / A2 MILLWORK M6 DETAILS 1:20



7 / A2 M7 SHELVES SECTION 1:20

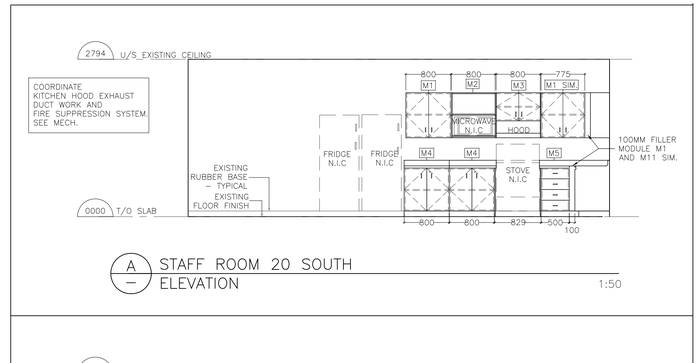


8 / A2 M8 SHELVES SECTION 1:20

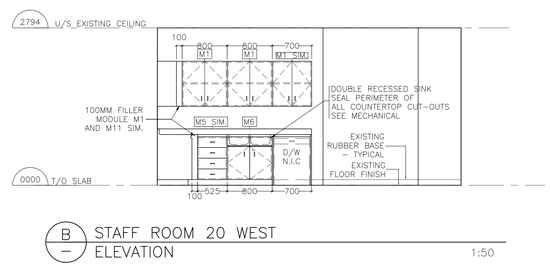


9 / A3 COAT RACK ELEVATION 1:20

NOTE:
CAULK ALL JOINTS OF MILLWORK TO FLOOR.
PROVIDE RUBBER BASE AT ALL MILLWORK KICKS AND GABLES ADJACENT TO FLOOR.



A — STAFF ROOM 20 SOUTH ELEVATION 1:50



B — STAFF ROOM 20 WEST ELEVATION 1:50

10 / A2 STAFF ROOM 20 INTERIOR ELEVATIONS 1:50

Revisions

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ONTARIO ASSOCIATION OF ARCHITECTS
LICENCE 3660
W.K. LIM

Consultant:

Title:

MILLWORK DETAILS AND INTERIOR ELEVATIONS

Drawn by:	Date:
M.L.	DECEMBER 2021
Checked by: W.L.	Plotted:
Scale: AS SHOWN	Issued:
Job No.: 21153	Drawing No.: A6
Set No.:	of:

GENERAL NOTES

1. THE NEW RTU SUPPORT FRAMING AND EXISTING ROOF FRAMING HAS BEEN DESIGNED AND REVIEWED IN ACCORDANCE WITH THE ONTARIO BUILDING CODE 2012. AMENDED BY RESOLUTION 88/19, EFFECTIVE JANUARY 1, 2020.
2. THE CONTRACTOR SHALL CHECK ALL DIMENSIONS WITH THE SITE CONDITIONS AND THE LATEST ISSUE OF ARCHITECTURAL, MECHANICAL AND ELECTRICAL DRAWINGS. REPORT ANY DISCREPANCIES BEFORE PROCEEDING WITH THE WORK.
3. READ STRUCTURAL DRAWINGS IN CONJUNCTION WITH SPECIFICATIONS AND OTHER CONTRACT DOCUMENTS.
4. SEE ARCHITECTURAL, MECHANICAL AND ELECTRICAL DRAWINGS FOR LOCATION OF OPENINGS, EQUIPMENT BASES, SUMP PITS, AND TRENCHES NOT INDICATED ON STRUCTURAL DRAWINGS.
5. SEE DRAWINGS FOR DESIGN LOADS. DO NOT EXCEED DURING CONSTRUCTION.
6. ALL REFERENCES TO CODES & STANDARDS ARE TO THE LATEST ISSUE.

SITE INSPECTION REPORTS & TESTING

1. THE ONTARIO BUILDING CODE 2012 SPECIFIES THAT GENERAL FIELD REVIEWS OF THE BUILDING BE CARRIED OUT DURING THE COURSE OF CONSTRUCTION. THE CONTRACTOR SHALL NOTIFY THE ENGINEER OF THE START OF CONSTRUCTION TO FACILITATE SUCH REVIEWS BY THE STRUCTURAL ENGINEER.

SHOP DRAWINGS

1. THE CONTRACTOR SHALL FURNISH SHOP DRAWINGS TO THE STRUCTURAL ENGINEER, A MINIMUM OF ONE REPRODUCIBLE AND TWO PRINTS STAMPED BY A PROFESSIONAL ENGINEER LICENSED IN THE PROVINCE OF ONTARIO.
   A) STRUCTURAL STEEL ERECTION DRAWINGS.
   B) STEEL MOMENT CONNECTIONS.

STRUCTURAL METAL

1. CONFORM TO CSA STANDARD CAN/CSA S16 LIMIT STATES DESIGN OF STEEL STRUCTURES.
2. CONFORM TO CSA STANDARD W55.3, RESISTANCE WELDING QUALIFICATIONS CODE FOR FABRICATORS OF STRUCTURAL MEMBERS USED IN BUILDINGS.
3. CONFORM TO CSA STANDARD W59, WELDED STEEL CONSTRUCTION (METAL ARC WELDING).
4. WELDING ELECTRODES – CSA STANDARD W48, FILLER METALS AND ALLIED MATERIALS FOR METAL ARC WELDING.
5. STRUCTURAL STEEL – CSA STANDARD G40.20/G40.21, GENERAL REQUIREMENTS FOR ROLLED OR WELDED STRUCTURAL QUALITY STEEL/STRUCTURAL QUALITY STEELS. GRADE 350W FOR GENERAL PURPOSE STRUCTURAL STEEL SHAPES, 300W FOR ANGLES, CHANNELS, RODS AND PLATES. HOLLOW STRUCTURAL SECTIONS SHALL CONFORM TO CSA STANDARD G40.20 GRADE 350W, HOT FORM WELDED OR HOLLOW STRUCTURAL SECTION, CLASS H.
6. HIGH STRENGTH BOLTS, NUTS AND WASHERS A.S.T.M. STANDARD A325, STANDARD SPECIFICATION FOR STRUCTURAL BOLTS, STEEL, HEAT TREATED 120/105 ksi MINIMUM TENSILE STRENGTH OR A325M, STANDARD SPECIFICATION FOR HIGH STRENGTH BOLTS FOR STRUCTURAL STEEL JOINTS (METRIC).
7. ANCHOR RODS – A.S.T.M. F1554 GRADE 36
8. PRIMER:
   A) HOT DIPPED GALVANIZED AS PER CAN/CSA–G164 HOT DIP GALVANIZING OF IRREGULARLY SHAPED ARTICLES.

DESIGN LOADS

BUILDING IMPORTANCE: HIGH

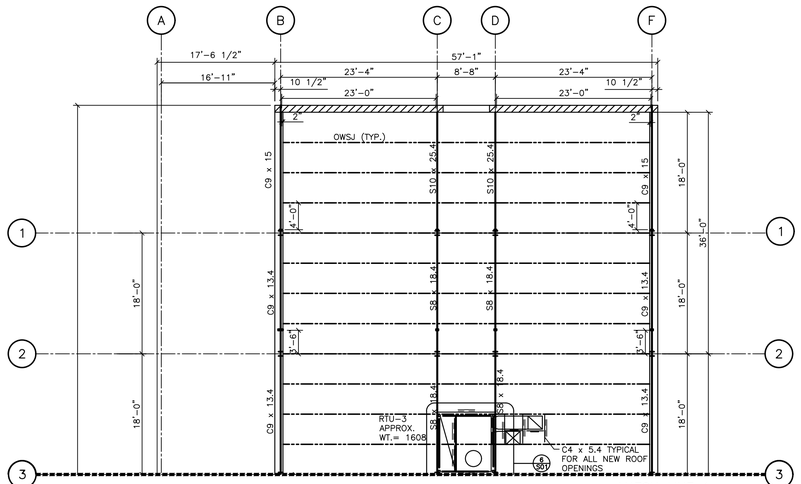
ROOF

SNOW LOAD: 30.71 PSF

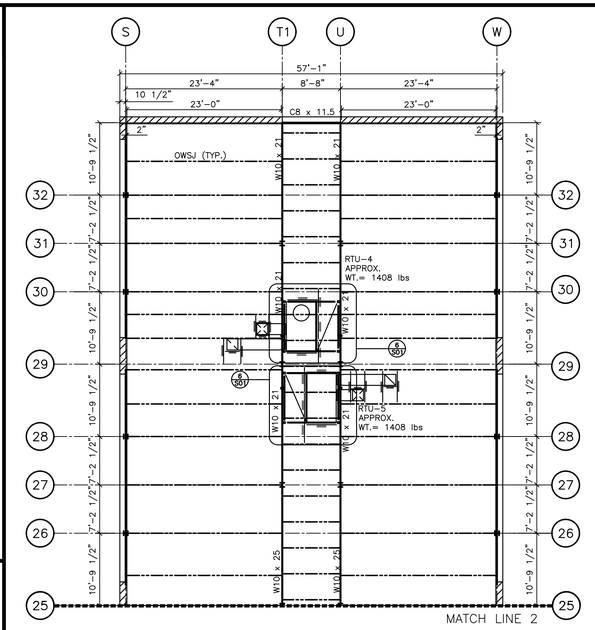
DEAD LOAD: 22.0 PSF

WIND LOAD

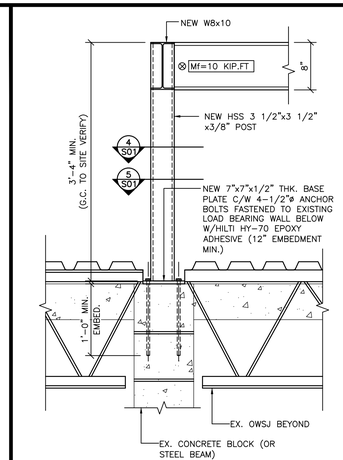
q 1/50= 9.82 PSF



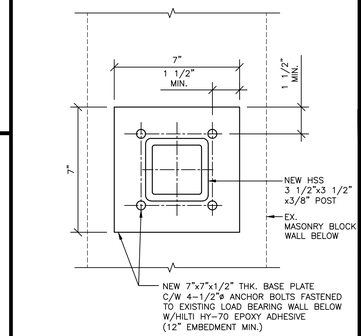
1 S01 MAIN ROOF FRAMING PLAN
SCALE 3/32" = 1'–0"



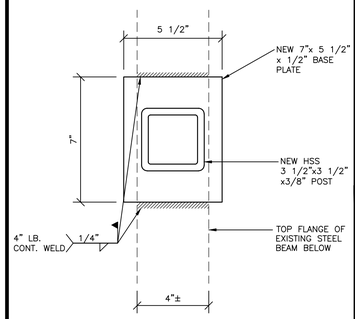
2 S01 MAIN ROOF FRAMING PLAN
SCALE 3/32" = 1'–0"



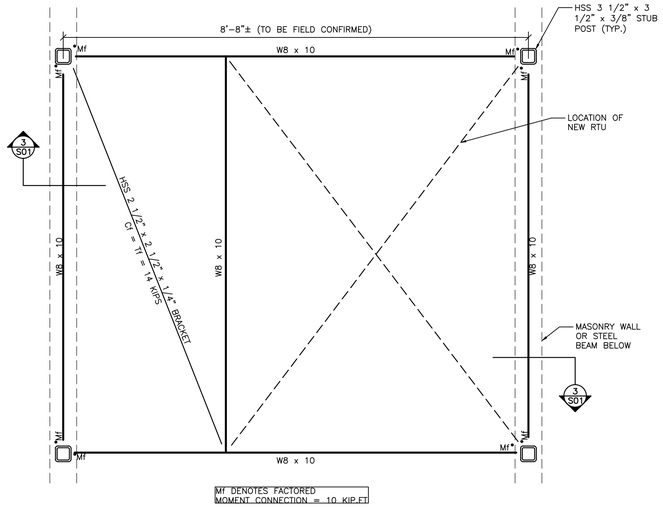
3 S01 TYPICAL CONNECTION DETAIL NEW POST TO EX. MASONRY BLOCK WALL (OR STEEL BEAM) CONNECTION
SCALE 1" = 1'–0"



4 S01 TYPICAL BASE PLATE DETAIL (AT MASONRY BLOCK WALL)
SCALE 3" = 1'–0"



5 S01 TYPICAL BASE PLATE DETAIL (AT EXISTING STEEL BEAM LOCATIONS)
SCALE 3" = 1'–0"



6 S01 TYPICAL NEW RTU SUPPORT FRAMING PLAN
SCALE 3/4" = 1'–0"

Revisions

NO.	DESCRIPTION	DATE

Issue Table

ISSUE DESCRIPTION	DATE
ISSUED FOR CLIENT REVIEW	04/18/22
ISSUED FOR TENDER	04/26/22

CONTRACTOR MUST CHECK AND VERIFY ALL DIMENSIONS AND BE RESPONSIBLE FOR SAME. REPORT ANY DISCREPANCIES TO THE ENGINEER BEFORE COMMENCING WORK.

DRAWINGS ARE NOT TO BE SCALED.

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SEAL:

IRC Building Sciences Group
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1.888.607.5245 WWW.IRCGROUP.COM

PROJECT:

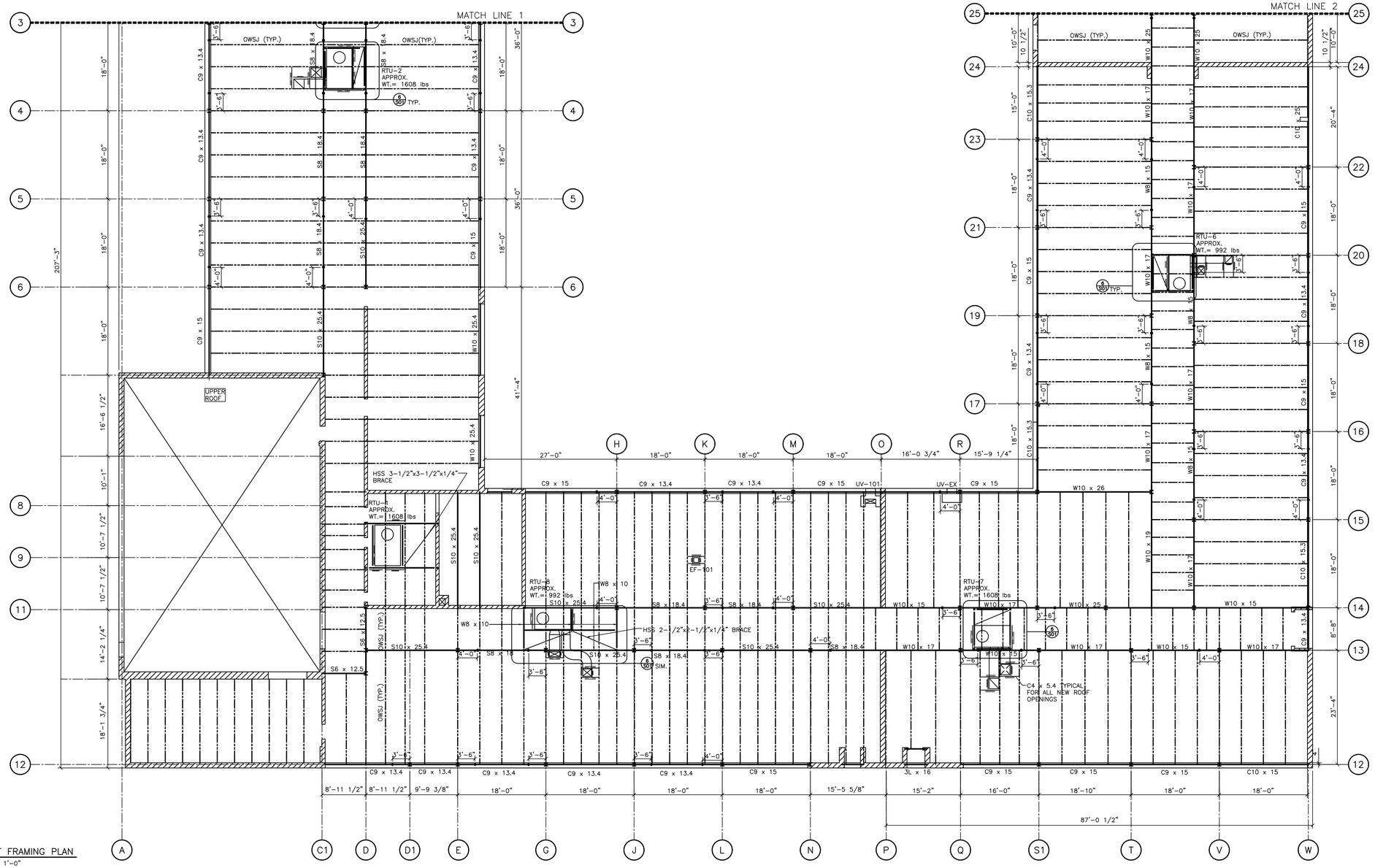
GLADYS SPEERS PUBLIC SCHOOL HVAC UPGRADES

2150 SAMWAY ROAD
OAKVILLE, ON

DESCRIPTION:

NOTES, PARTIAL PLAN, SECTIONS AND DETAILS

WORK NO.:	100156847	CADD NO.:	DS001
DESIGNED BY:	G.T.	DRAWN BY:	A.T.
SCALE:	AS NOTED	DRAWING NO.:	S01
DATE:	04/18/22		



1 S02 MAIN ROOF FRAMING PLAN
SCALE 3/32" = 1'-0"

Revisions

NO.	DESCRIPTION	DATE

Issue Table

ISSUE DESCRIPTION	DATE
ISSUED FOR CLIENT REVIEW	04/18/22
ISSUED FOR TENDER	04/26/22

CONTRACTOR MUST CHECK AND VERIFY ALL DIMENSIONS AND BE RESPONSIBLE FOR SAME. REPORT ANY DISCREPANCIES TO THE ENGINEER BEFORE COMMENCING WORK.

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PROJECT:

GLADYS SPEERS PUBLIC SCHOOL HVAC UPGRADES

2150 SAMWAY ROAD
OAKVILLE, ON

DESCRIPTION:

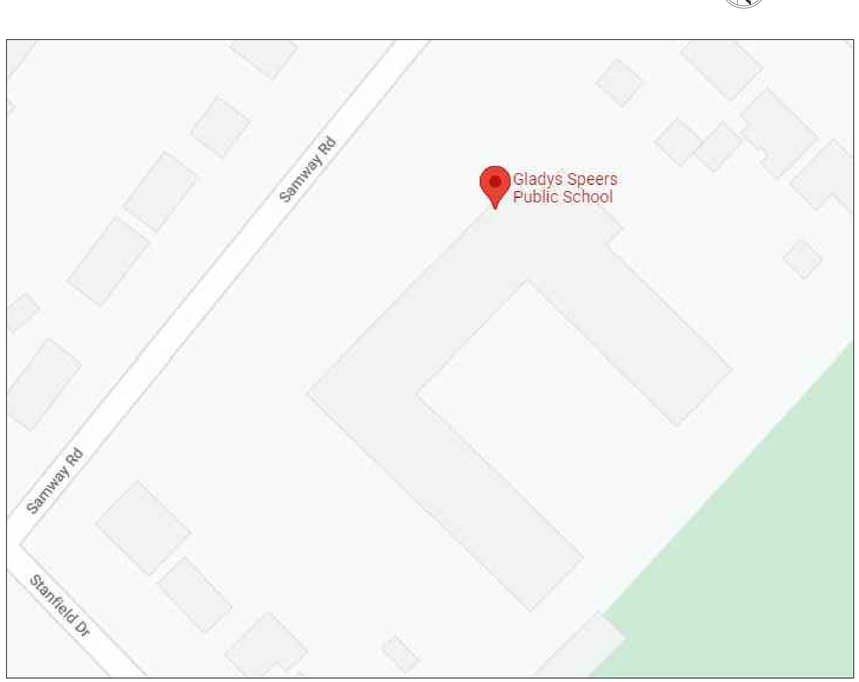
MAIN ROOF FRAMING PLAN

WORK NO.:	100156847	CADD NO.:	DS002
DESIGNED BY:	G.T.	DRAWN BY:	A.T.
SCALE:	AS NOTED	DRAWING NO.:	S02
DATE:	04/18/22		

HDSB
GLADYS SPEERS PUBLIC SCHOOL
RENOVATIONS

2150 SAMWAY RD.
OAKVILLE ON. L6L 2P6

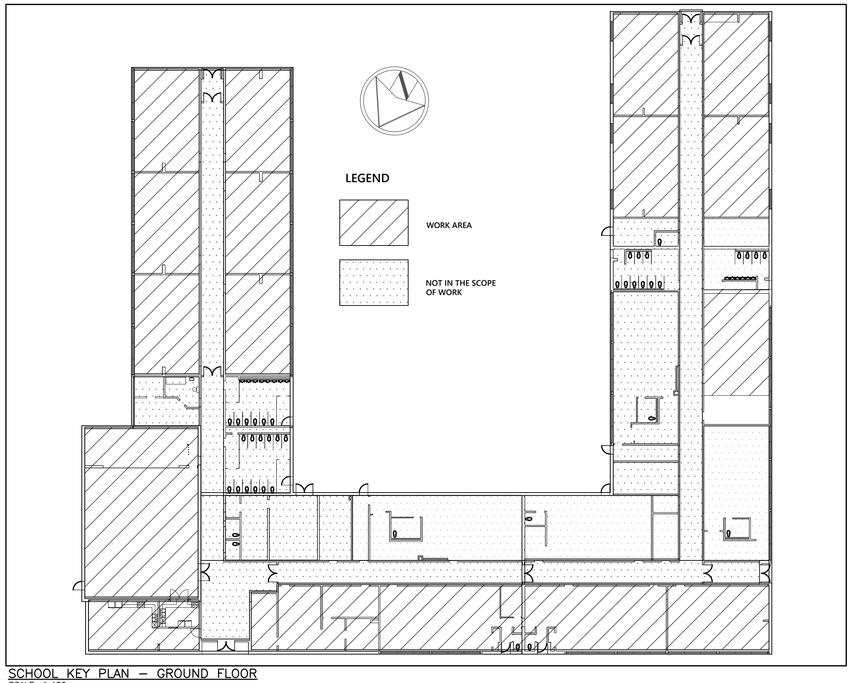
ISSUED FOR TENDER
APRIL 2022



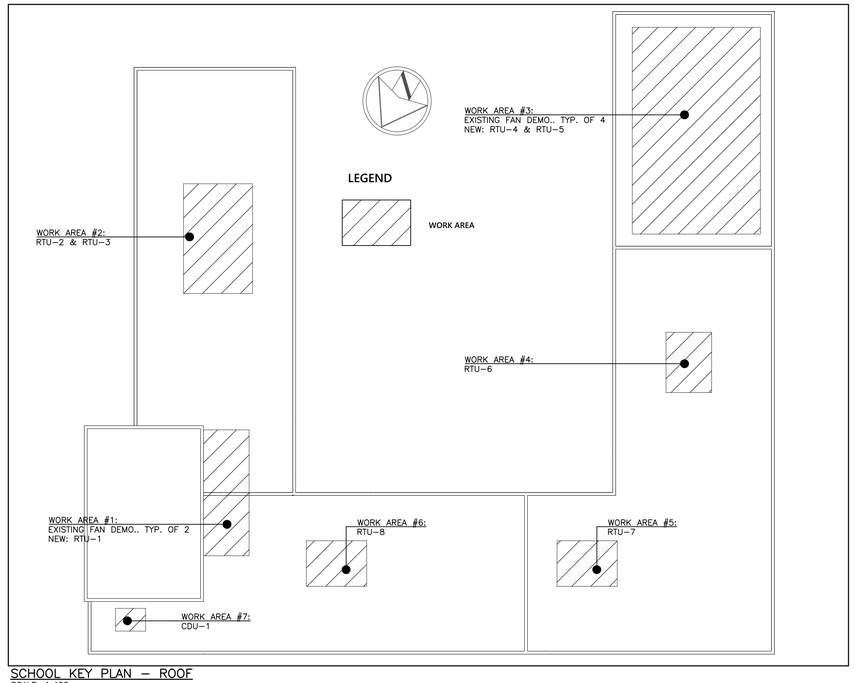


NO.	DRAWING LIST
M–1.1	SYMBOL LIST, EQUIPMENT SCHEDULES, KEY PLANS & NOTES – MECHANICAL
M–1.2	PLUMBING FIXTURE SERVICES SCHEDULE & DETAILS – MECHANICAL
M–2.1	PART OF GROUND FLOOR (NORTH) – EXISTING & DEMOLITION WORK – MECHANICAL
M–2.2	PART OF GROUND FLOOR (SOUTH) – EXISTING & DEMOLITION WORK – MECHANICAL
M–2.3	ROOF – EQUIPMENT & GAS PIPING LAYOUT – EXISTING & DEMOLITION WORK – MECHANICAL
M–3.1	PART OF GROUND FLOOR (NORTH) – EXISTING & NEW WORK – MECHANICAL
M–3.2	PART OF GROUND FLOOR (SOUTH) – EXISTING & NEW WORK – MECHANICAL
M–3.3	ROOF – EQUIPMENT, DUCTWORK & GAS PIPING LAYOUT – EXISTING & NEW WORK – MECHANICAL
M–4.1	CONTROL SCHEMATICS – MECHANICAL
M–4.2	GAS PIPING SCHEMATIC – EXISTING, DEMOLITION & NEW WORK – MECHANICAL
E–1.1	KEY PLANS, SYMBOL LIST, NOTES & EQUIPMENT WIRING – ELECTRICAL
E–2.1	GROUND FLOOR – EQUIPMENT & LIGHTING LAYOUT – EXISTING & DEMOLITION WORK – ELECTRICAL
E–2.2	ROOF – EQUIPMENT LAYOUT – EXISTING & DEMOLITION WORK – ELECTRICAL
E–3.1	GROUND FLOOR – EQUIPMENT & LIGHTING LAYOUT – NEW WORK – ELELCTRICAL
E–3.2	ROOF – EQUIPMENT LAYOUT – NEW WORK – ELELCTRICAL
E–200	ELECTRICAL SERVICES SITE PLAN – ELECTRICAL
E–201	ELECTRICAL SERVICES DETAILS – ELECTRICAL
E–300	ELECTRICAL SERVICES FLOOR PLAN & SINGLE LINE DIAGRAM – ELECTRICAL

SAB ENGINEERING Inc.



SCHOOL KEY PLAN – GROUND FLOOR
SCALE: 1:400



SCHOOL KEY PLAN – ROOF
SCALE: 1:400

SYMBOLS LIST

SYMBOL	DESCRIPTION
300x150	SHEET METAL DUCT – FIRST FIGURE INDICATES DIMENSION SHOWN
	SHEET METAL RISER UP – SUPPLY
	SHEET METAL RISER UP – RETURN AND EXHAUST
	SHEET METAL RISER DOWN – SUPPLY
	SHEET METAL RISER DOWN – RETURN AND EXHAUST
F/D	FUSIBLE LINK FIRE DAMPER WITH ACCESS DOOR IN DUCT
MD	MOTORIZED DAMPER
VD	VOLUME DAMPER
	SUPPLY AIR GRILLE
	EXHAUST OR RECIRC. GRILLE
	FLEXIBLE CONNECTION
O.E.D.	OPEN ENDED DUCT WITH BALANCING DAMPER AND BELLMOUTH INLET
A.D.	ACCESS DOOR
UH	UNIT HEATER
T	ROOM THERMOSTAT
	UNION
AV	MANUAL AIR VENT
	AUTOMATIC CONTROL VALVE – TWO WAY
	MIXING OR DIVERTER VALVE (3–WAY)
	VALVE
	BALANCING VALVE
	CHECK VALVE
	STRAINER – OVER 50mm PROVIDE WITH VALVED FLUSHING DRAIN
	PIPE TURNING DOWN
	PIPE TURNING UP
	PIPE REDUCER
	PLUMBING TRAP
TG	THERMOMETER
PG	PRESSURE GUAGE
S	SMOKE SENSOR
FD	FLOOR DRAIN
FFD	FUNNEL FLOOR DRAIN
RD	ROOF DRAIN
RWL	RAIN WATER LEADER
HB	HOSE BIBB
VTR	VENT THROUGH ROOF
HWS	HEATING WATER SUPPLY
HWR	HEATING WATER RETURN
	DOMESTIC COLD WATER PIPE
	DOMESTIC HOT WATER PIPE
CTE	CONNECT TO EXISTING
CUT	CUT POINT OF EXISTING SERVICE
C/W	COMPLETE WITH
EF	EXHAUST FAN
EX	EXISTING TO REMAIN
RL	TO BE RELOCATED
VFD	VARIABLE FREQUENCY DRIVE
	PERIMETER CONVECTOR
RAD–1 | 2,200 2,000 W	PERIMETER CONVECTOR TYPE CV–1, FINNED ELEMENT LENGTH 2,200 MM, HEATING OUTPUT 2,000 W.
S/A, R/A O/A, E/A	DENOTES: SUPPLY AIR, RETURN AIR, OUTSIDE AIR, EXHAUST AIR

SCHEDULE OF ROOFTOP UNIT

TAG	SUPPLY AIR FLOW CFM	SUPPLY E.S.P. Pa [in. wg]	SUPPLY FAN HP	HEATING CAPACITY INPUT kW [MBH]	HEATING CAPACITY OUTPUT kW [MBH]	MIN. OUTDOOR AIR (CFM)	DX COOLING PERFORMANCE TOTAL CAP. kW [MBH]	DX COOLING PERFORMANCE SENS. CAP. kW [MBH]	DX COOLING PERFORMANCE TEMP °C [°F] EDBT/EWBT	DX COOLING PERFORMANCE TEMP °C [°F] LDBT/LWBT	UNIT POWER VOLTAGE	UNIT POWER AMPS (MCA)	UNIT POWER MOCP (A)	UNIT WEIGHT KG [LBS]	REMARKS
RTU–1	4,000	249 [1.0]	2.75	73.3 [250]	58.6 [200]	1,500	33.4 [114]	27.5 [94]	26.7/19.4 [80/67]	14.5/14.2 [58.2/57.6]	208/3/60	48	60	730 [1,608]	
RTU–2	4,000	375 [1.5]	2.75	73.3 [250]	58.6 [200]	1,500	33.4 [114]	27.5 [94]	26.7/19.4 [80/67]	14.5/14.2 [58.2/57.6]	208/3/60	48	60	730 [1,608]	
RTU–3	4,000	375 [1.5]	2.75	73.3 [250]	58.6 [200]	1,500	33.4 [114]	27.5 [94]	26.7/19.4 [80/67]	14.5/14.2 [58.2/57.6]	208/3/60	48	60	730 [1,608]	
RTU–4	2,400	375 [1.5]	2.75	44.0 [150]	35.6 [122]	1,000	21.6 [74]	17.2 [59]	26.7/19.4 [80/67]	14.1/14.1 [57.3/57.1]	208/3/60	37	50	639 [1,408]	
RTU–5	2,400	375 [1.5]	2.75	44.0 [150]	35.6 [122]	1,000	21.6 [74]	17.2 [59]	26.7/19.4 [80/67]	14.1/14.1 [57.3/57.1]	208/3/60	37	50	639 [1,408]	
RTU–6	2,000	125 [0.5]	1.00	38.1 [130]	30.5 [104]	550	17.8 [61]	13.5 [46]	26.7/19.4 [80/67]	14.5/14.2 [58.2/57.6]	208/3/60	30.0	45	450 [992]	
RTU–7	4,000	375 [1.5]	2.75	73.3 [250]	58.6 [200]	1,500	33.4 [114]	27.5 [94]	26.7/19.4 [80/67]	14.5/14.2 [58.2/57.6]	208/3/60	48	60	730 [1,608]	
RTU–8	2,000	125 [0.5]	1.00	38.1 [130]	30.5 [104]	150	17.8 [61]	13.5 [46]	26.7/19.4 [80/67]	14.5/14.2 [58.2/57.6]	208/3/60	30.0	45	450 [992]	

NOTE: CLG: AIR EDBT/EWBT 78°F/66°F, LDBT/LWBT 55.9/55.2°F;

SCHEDULE OF VAV COILS

TAG	SERVING	MAX. AIR FLOW L/S (CFM)	MIN. AIR FLOW L/S (CFM)	MIN. PRES. DIFFERENT. (PA)	INLET SIZE DIA. (MM)	OUTLET SIZE (MM)	DIMENSIONS LxHxD MM[IN]	REMARKS
VAV–2–1	CLASSROOM 01	567 (1,200)	400 (850)	2.5	250	350x300	390x340x305 [15.5x13.5x12]	C/W MINIMUM 900MM SOUND ATTENUATOR
VAV–2–2	CLASSROOM 02	567 (1,200)	400 (850)	2.5	250	350x300	390x340x305 [15.5x13.5x12]	C/W MINIMUM 900MM SOUND ATTENUATOR
VAV–2–3	CLASSROOM 03	755 (1,600)	520 (1100)	2.5	300	425x350	470x390x330 [18.5x15.5x13]	C/W MINIMUM 900MM SOUND ATTENUATOR
VAV–3–1	CLASSROOM 04	755 (1,600)	520 (1100)	2.5	300	425x350	470x390x330 [18.5x15.5x13]	C/W MINIMUM 900MM SOUND ATTENUATOR
VAV–3–2	CLASSROOM 05	567 (1,200)	400 (850)	2.5	250	350x300	390x340x305 [15.5x13.5x12]	C/W MINIMUM 900MM SOUND ATTENUATOR
VAV–3–3	CLASSROOM 06	567 (1,200)	400 (850)	2.5	250	350x300	390x340x305 [15.5x13.5x12]	C/W MINIMUM 900MM SOUND ATTENUATOR
VAV–4–1	CLASSROOM 13	567 (1,200)	400 (850)	2.5	250	350x300	390x340x305 [15.5x13.5x12]	C/W MINIMUM 900MM SOUND ATTENUATOR
VAV–4–2	CLASSROOM 12	567 (1,200)	400 (850)	2.5	250	350x300	390x340x305 [15.5x13.5x12]	C/W MINIMUM 900MM SOUND ATTENUATOR
VAV–5–1	CLASSROOM 14	567 (1,200)	400 (850)	2.5	250	350x300	390x340x305 [15.5x13.5x12]	C/W MINIMUM 900MM SOUND ATTENUATOR
VAV–5–2	CLASSROOM 15	567 (1,200)	400 (850)	2.5	250	350x300	390x340x305 [15.5x13.5x12]	C/W MINIMUM 900MM SOUND ATTENUATOR
VAV–7–1	CLASSROOM 17	567 (1,200)	400 (850)	2.5	250	350x300	390x340x305 [15.5x13.5x12]	C/W MINIMUM 900MM SOUND ATTENUATOR
VAV–7–2	CLASSROOM 18	661 (1,400)	450 (950)	2.5	250	350x300	390x340x305 [15.5x13.5x12]	C/W MINIMUM 900MM SOUND ATTENUATOR
VAV–7–3	CLASSROOM 19	661 (1,400)	450 (950)	2.5	250	350x300	390x340x305 [15.5x13.5x12]	C/W MINIMUM 900MM SOUND ATTENUATOR

SCHEDULE OF OUTDOOR CONDENSERS

TAG	MANUFACTURER	MODEL	COOLING CAP. TONS [MBH]	REFRIGERANT	CONNECTION SIZES RL (MM/IN)	CONNECTION SIZES RG (MM/IN)	EQUIPMENT SIZE (HxLxW, MM)	POWER SUPPLY (V/PH/MCA)	MOCP	WEIGHT KG [LB]	REMARKS
CU–1	MITSUBISHI	MUY–GE24NA	2.0 [24]	R410A	9.5 [⅜]	18/[⅝]	875x840x330	230/1/60	20	54 [119]	C/W ECOFOOT SNOW STAND
NOTE:											

SCHEDULE OF INDOOR A/C UNITS

TAG	TYPE	MANUFACTURER	MODEL	CLG. CAP. (TONS/KW)	AIR FLOW (CFM)	POWER SUPPLY (V/PH/Hz)	MCA (A)	MOCP (A)	WEIGHT KG [LB]	EQUIPMENT SIZE (HxLxW, MM)	REFRIG. PIPE (MM) LIQUID	REFRIG. PIPE (MM) GAS	DRAIN (MM)	REMARKS
AC–1	WALL MOUNTED	MITSUBISHI	MSY–GE24NA	2.0/7.3	388–738	230/1ø/60	1.0	20	16.8 [37]	330x1,115x240	9.5	18	32	COOLING ONLY; C/W CONDENSATE PUMP
NOTE: COMPLETE WITH WIRED MA REMOTE CONTROLLERS, AND BACNET ADAPTER OR CENTRAL CONTROLLER FOR BACNET INTERFACE WITH EXISTING BUILDING AUTOMATION SYSTEM														

SCHEDULE OF GRILLES & DIFFUSERS

TYPE	SERVICE	MANUFACTURER	MODEL	VOLUME CONTROL	FINISH	REMARKS
A	SUPPLY	E.H. PRICE	SDG	YES	B12	SPIRAL DUCT GRILLES
B	RETURN	E.H. PRICE	80ECRG	NO	B12	EGG CRATE RETURN GRILLE
C	SUPPLY	E.H. PRICE	SCD	YES	B12	SQUARE CONE DIFFUSER
D	SUPPLY	E.H. PRICE	RCD	NO	B12	ROUND CONE DIFFUSER
E	RETURN	E.H. PRICE	95	NO	B12	LOUVERED RETURN GRILLE

SCHEDULE OF CONVECTOR

TAG	MANUFACTURER	MODEL	HEATING OUTPUT (BTU/FT)	HEATING AGENT SUPPLY (°F)	HEATING AGENT RETURN (°F)	TUBE DIAM (IN)	FIN SIZE (IN)	FIN SPACING (FINS/FT)	REMARKS
RAD–1	ENGINEERED AIR	3 ROWS (12" CENTERS)	3,010	82 [180]	71 [160]	1 ¼"	4" x 4"	50/FT	WALL MOUNTED/WITHOUT ENCLOSURE
RAD–2	ENGINEERED AIR	3 ROWS (12" CENTERS)	3,010	82 [180]	71 [160]	1 ¼"	4" x 4"	50/FT	WALL MOUNTED/WITHOUT ENCLOSURE
RAD–3	ENGINEERED AIR	3 ROWS (12" CENTERS)	3,010	82 [180]	71 [160]	1 ¼"	4" x 4"	50/FT	WALL MOUNTED/WITHOUT ENCLOSURE
RAD–4	ENGINEERED AIR	3 ROWS (12" CENTERS)	3,010	82 [180]	71 [160]	1 ¼"	4" x 4"	50/FT	WALL MOUNTED/WITHOUT ENCLOSURE
RAD–5	ENGINEERED AIR	3 ROWS (12" CENTERS)	3,010	82 [180]	71 [160]	1 ¼"	4" x 4"	50/FT	WALL MOUNTED/WITHOUT ENCLOSURE
RAD–6	ENGINEERED AIR	3 ROWS (12" CENTERS)	3,010	82 [180]	71 [160]	1 ¼"	4" x 4"	50/FT	WALL MOUNTED/WITHOUT ENCLOSURE
RAD–16A	ENGINEERED AIR	3 ROWS (12" CENTERS)	3,010	82 [180]	71 [160]	1 ¼"	4" x 4"	50/FT	WALL MOUNTED/WITHOUT ENCLOSURE
RAD–17	ENGINEERED AIR	1 ROW	1,060	82 [180]	71 [160]	1 ¼"	4" x 4"	50/FT	WALL MOUNTED/WITHOUT ENCLOSURE
RAD–18	ENGINEERED AIR	1 ROW	1,060	82 [180]	71 [160]	1 ¼"	4" x 4"	50/FT	WALL MOUNTED/WITHOUT ENCLOSURE
RAD–19	ENGINEERED AIR	3 ROWS (12" CENTERS)	3,010	82 [180]	71 [160]	1 ¼"	4" x 4"	50/FT	WALL MOUNTED/WITHOUT ENCLOSURE

Revisions

Ref.	No.	Description	Date	Initial
	1	50% REVIEW 0	2022/02/17	
	2	75% REVIEW	2022/03/09	
	3	100% REVIEW	2022/03/31	
	4	ISSUED FOR TENDER	2022/04/26	

Project:

GLADYS SPEERS PS RENOVATIONS
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LICENSED PROFESSIONAL ENGINEER
APRIL 2022
G. STRASHUN
PROVINCE OF ONTARIO

Consultant:

SAB ENGINEERING Inc.
588 EDWARD AVE., UNIT 25, RICHMOND HILL, ONT., L4C 9Y6
TEL. (905)-787 8885 FAX (905)-787 8771

Title:

SYMBOL LIST, EQUIPMENT SCHEDULE, KEY PLANS & NOTES – MECHANICAL

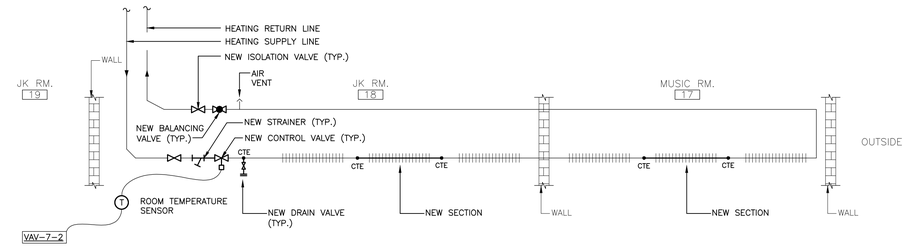
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Checked by: O.S.	Plotted:
Scale: AS SHOWN	Issued:
Job No.: 2022–01	Drawing No.: M-1.1
Set No.:	of: 10

PLUMBING FIXTURE SERVICES SCHEDULE

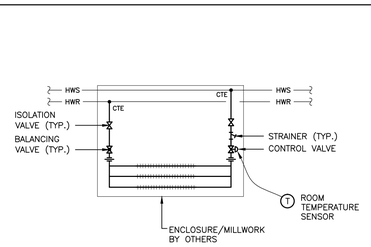
	FIXTURE NAME	TYPE	LOCATION	HOT	COLD	DRAIN	VENT
S-1	KITCHEN SINK	COUNTER MOUNTED, DOUBLE COMPARTMENT, STAINLESS STEEL SINK	STAFF ROOM	15	15	40	40

SCHEDULE OF KITCHEN HOOD

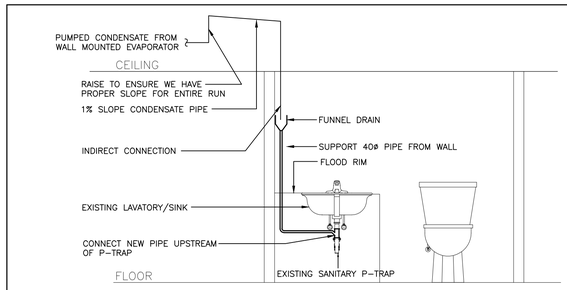
TAG	MANUFACTURER	MODEL	VOLTS	AMPS	REMARKS
H-1	ANCONA	SLIM-D	120	0.83	750MM (30IN) WIDE, STAINLESS STEEL, MIN 300 CFM



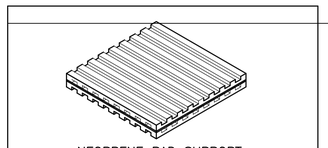
PERIMETER FINNED TUBE RADIATION CONNECTION FOR JK. ROOM-18 & MUSIC ROOM-17
N.T.S.



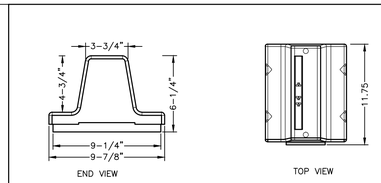
TYPICAL RADIATIOR CONNECTION (3-ROW)
N.T.S.



TYPICAL CONDENSATE DRAIN CONNECTION
N.T.S.

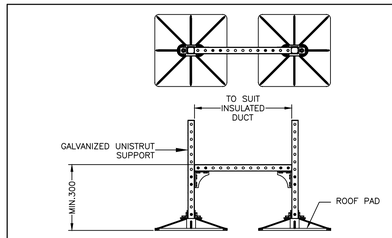


NEOPRENE PAD SUPPORT
N.T.S.



NOTES:
1. ROLLER EXTENSION KITS AVAILABLE FOR PIPE EXPANSION/CONTRACTION.
2. STRUT EXTENSION KITS AVAILABLE FOR ADJUSTABLE HEIGHT CONDUIT INSTALLATION.
3. CUSTOM SUPPORT SOLUTIONS AVAILABLE.
4. PROVIDE UNITSATRUT BASE OF THE PIPES SUPPORTED AND ASSOCIATED BRACKETS. AVOID DIRECT CONTACT BETWEEN DISSIMILAR METALS.

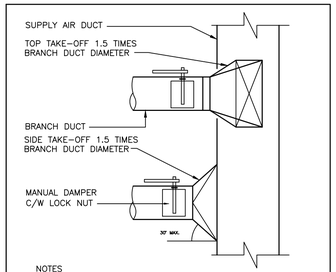
TYPICAL PIPE SUPPORT ON THE ROOF
N.T.S.



SUPPORT DUCTWORK ON ROOF WITH AN ENGINEERED PREFABRICATED DUCT SYSTEM DESIGNED FOR INSTALLATION WITHOUT ROOF PENETRATIONS, FLASHING OR DAMAGE TO THE ROOFING MATERIAL. THE SYSTEM SHALL CONSIST OF BASES, MADE OF HIGH DENSITY POLYPROPYLENE PLASTICS WITH UV PROTECTION, AND A HDG STRUCTURAL STEEL FRAME. NUTS, THREADED RODS AND WASHERS SHALL BE HDG, SPRING NUTS AND BOLTS FOR SPRING NUTS WILL BE ELECTRO-PLATED. SYSTEM SHALL BE CUSTOM DESIGNED TO FIT THE LOAD REQUIREMENTS THAT WILL BE REQUIRED. PROTECT DUCT INSULATION AS SPECIFIED AT POINTS OF SUPPORT.

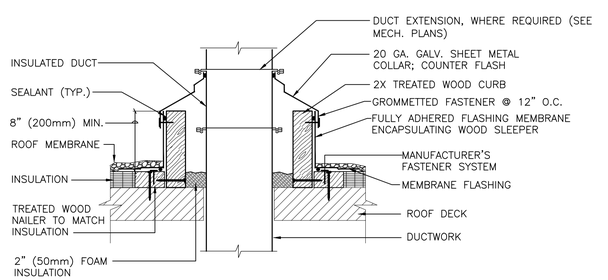
STANDARD OF ACCEPTANCE: PPH, MIRO INDUSTRIES OR EQUAL.

DUCT SUPPORT ON THE ROOF
N.T.S.

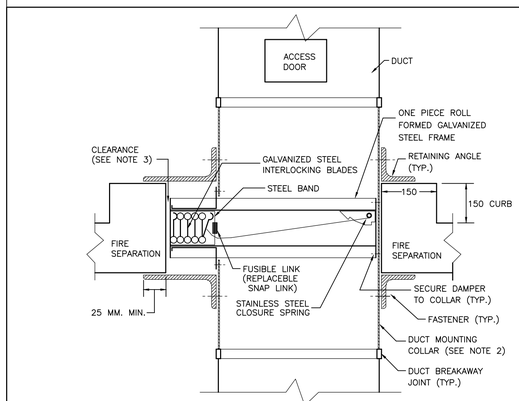


NOTES
1) REFER TO FLOOR PLANS FOR BRANCH DUCT ARRANGEMENT
2) THIS DETAIL ONLY APPLIED TO RECTANGLE TO ROUND DUCTS
3) BOTTOM TAKE-OFF IS SIMILAR TO TOP TAKE-OFF

DETAILS OF BRANCHE DUCT TAKE-OFF
N.T.S.

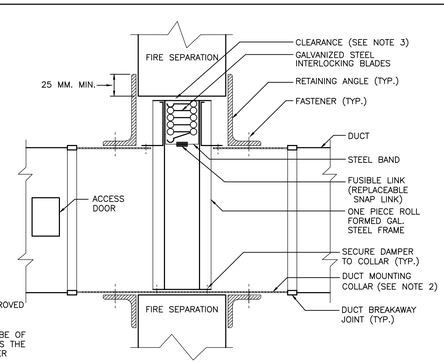


DUCT PENETRATION DETAIL
N.T.S.



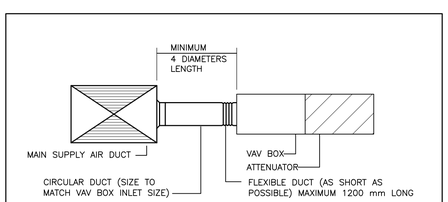
HORIZONTAL

NOTES:
1. ASSEMBLY SHALL BE U.L.C. APPROVED AND SHALL BE TYPE 'B'.
2. DUCT MOUNTING COLLAR SHALL BE OF THE SAME GAUGE OR HEAVIER AS THE DUCT BUT SHALL NOT BE LIGHTER THAN 20 GAUGE.
3. CLEARANCE SHALL BE 9 MM PER METER ON HEIGHT AND WIDTH OF DAMPER TO A MAXIMUM OF 12 MM.

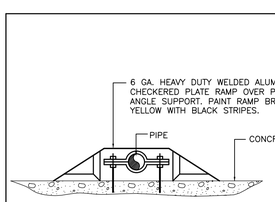


VERTICAL

TYPICAL FIRE DAMPER DETAIL
N.T.S.



TYPICAL VARIABLE AIR VOLUME (VAV) BOX DETAIL
N.T.S.



PIPE RAMP DETAIL
N.T.S.

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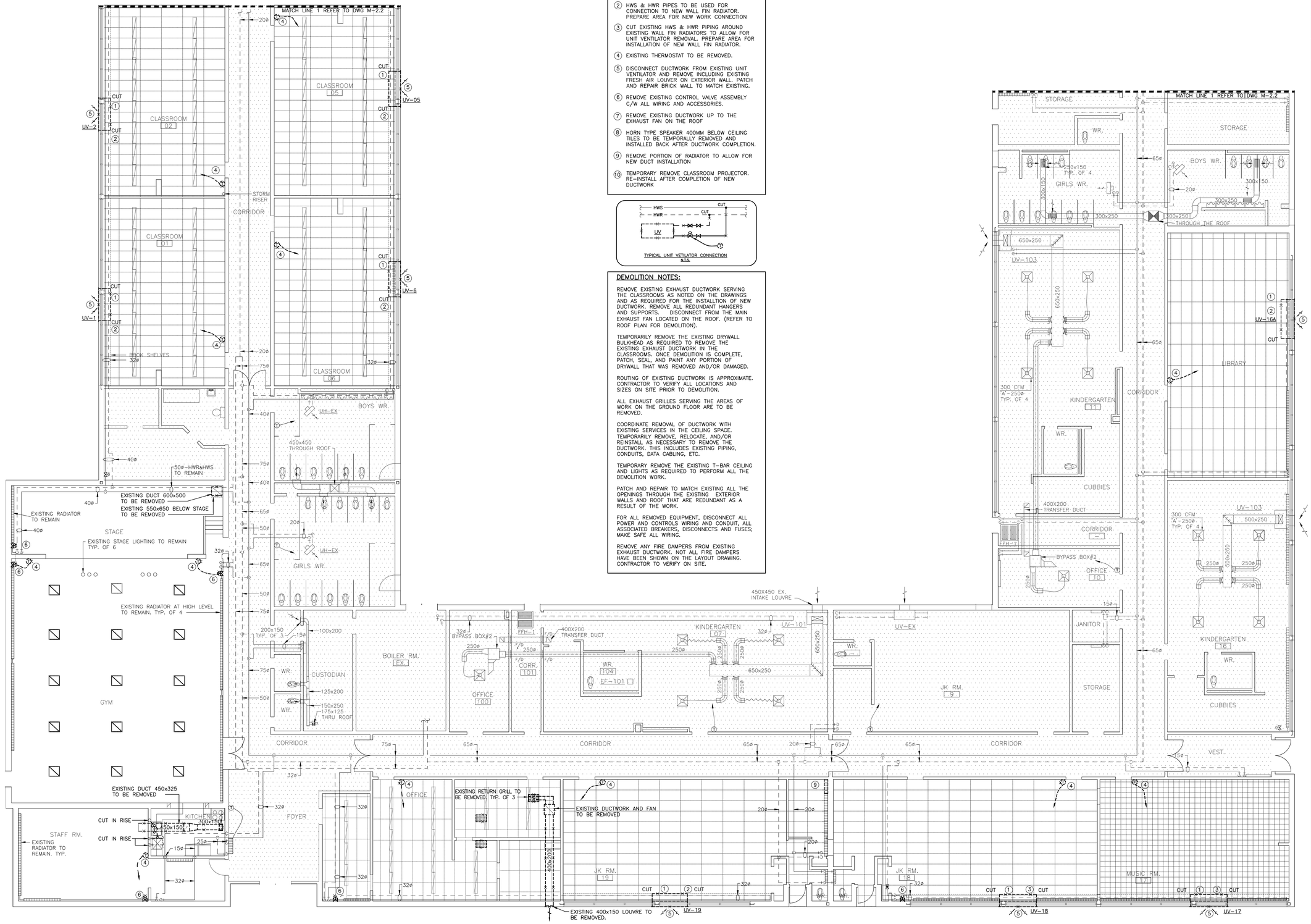
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TEL. (905)-787 8885 FAX (905)-787 8771

Title:

PLUMBING FIXTURE SERVICES SCHEDULE & DETAILS – MECHANICAL

Drawn by:	Date:
P.C.	DECEMBER 2021
Checked by:	**Plotted:**
O.S.	
Scale:	**Issued:**
AS SHOWN	
Job No.:	**Drawing No.:**
2022-01	M-1.2
Set No.:	of: 10

NOT IN THE SCOPE OF WORK



KEY NOTES

1. REMOVE EXISTING UNIT VENTILATOR. CUT LOCALLY AND DISCONNECT FROM EXISTING HWS & HWR PIPING C/W ALL ACCESSORIES. DISCONNECT FROM POWER AND CONTROLS AND REMOVE ALL REDUNDANT WIRING.
2. HWS & HWR PIPES TO BE USED FOR CONNECTION TO NEW WALL FIN RADIATOR. PREPARE AREA FOR NEW WORK CONNECTION
3. CUT EXISTING HWS & HWR PIPING AROUND EXISTING WALL FIN RADIATORS TO ALLOW FOR UNIT VENTILATOR REMOVAL. PREPARE AREA FOR INSTALLATION OF NEW WALL FIN RADIATOR.
4. EXISTING THERMOSTAT TO BE REMOVED.
5. DISCONNECT DUCTWORK FROM EXISTING UNIT VENTILATOR AND REMOVE INCLUDING EXISTING FRESH AIR LOUVER ON EXTERIOR WALL. PATCH AND REPAIR BRICK WALL TO MATCH EXISTING.
6. REMOVE EXISTING CONTROL VALVE ASSEMBLY C/W ALL WIRING AND ACCESSORIES.
7. REMOVE EXISTING DUCTWORK UP TO THE EXHAUST FAN ON THE ROOF
8. HORN TYPE SPEAKER 400MM BELOW CEILING TILES TO BE TEMPORALLY REMOVED AND INSTALLED BACK AFTER DUCTWORK COMPLETION.
9. REMOVE PORTION OF RADIATOR TO ALLOW FOR NEW DUCT INSTALLATION
10. TEMPORARY REMOVE CLASSROOM PROJECTOR. RE-INSTALL AFTER COMPLETION OF NEW DUCTWORK

TYPICAL UNIT VETILATOR CONNECTION
N.T.S.

DEMOLITION NOTES:

REMOVE EXISTING EXHAUST DUCTWORK SERVING THE CLASSROOMS AS NOTED ON THE DRAWINGS AND AS REQUIRED FOR THE INSTALLTION OF NEW DUCTWORK. REMOVE ALL REDUNDANT HANGERS AND SUPPORTS. DISCONNECT FROM THE MAIN EXHAUST FAN LOCATED ON THE ROOF. (REFER TO ROOF PLAN FOR DEMOLITION).

TEMPORARILY REMOVE THE EXISTING DRYWALL BULKHEAD AS REQUIRED TO REMOVE THE EXISTING EXHAUST DUCTWORK IN THE CLASSROOMS. ONCE DEMOLITION IS COMPLETE, PATCH, SEAL, AND PAINT ANY PORTION OF DRYWALL THAT WAS REMOVED AND/OR DAMAGED.

ROUTING OF EXISTING DUCTWORK IS APPROXIMATE. CONTRACTOR TO VERIFY ALL LOCATIONS AND SIZES ON SITE PRIOR TO DEMOLITION.

ALL EXHAUST GRILLES SERVING THE AREAS OF WORK ON THE GROUND FLOOR ARE TO BE REMOVED.

COORDINATE REMOVAL OF DUCTWORK WITH EXISTING SERVICES IN THE CEILING SPACE. TEMPORARILY REMOVE, RELOCATE, AND/OR REINSTALL AS NECESSARY TO REMOVE THE DUCTWORK. THIS INCLUDES EXISTING PIPING, CONDUITS, DATA CABLING, ETC.

TEMPORARY REMOVE THE EXISTING T-BAR CEILING AND LIGHTS AS REQUIRED TO PERFORM ALL THE DEMOLITION WORK.

PATCH AND REPAIR TO MATCH EXISTING ALL THE OPENINGS THROUGH THE EXISTING EXTERIOR WALLS AND ROOF THAT ARE REDUNDANT AS A RESULT OF THE WORK.

FOR ALL REMOVED EQUIPMENT, DISCONNECT ALL POWER AND CONTROLS WIRING AND CONDUIT, ALL ASSOCIATED BREAKERS, DISCONNECTS AND FUSES; MAKE SAFE ALL WIRING.

REMOVE ANY FIRE DAMPERS FROM EXISTING EXHAUST DUCTWORK. NOT ALL FIRE DAMPERS HAVE BEEN SHOWN ON THE LAYOUT DRAWING. CONTRACTOR TO VERIFY ON SITE.

PART OF GROUND FLOOR (NORTH) – EQUIPMENT, DUCTWORK & PIPING LAYOUT – EXISTING & DEMOLITION WORK – MECHANICAL
SCALE: 1:100

Revisions

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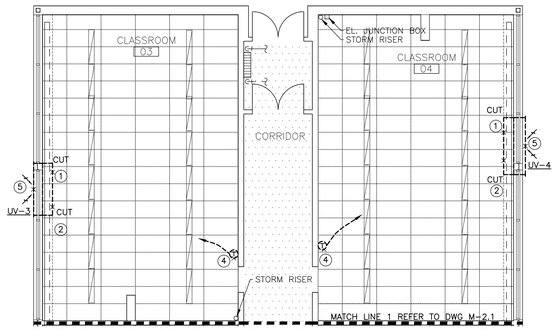
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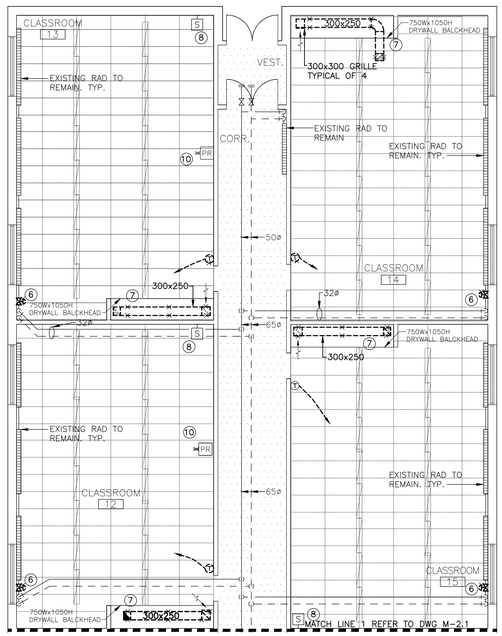
PART OF GROUND FLOOR (NORTH)
– EXISTING & DEMOLITION WORK
– MECHANICAL

Drawn by:	Date:
P.C.	DECEMBER 2021
Checked by:	Plotted:
O.S.	
Scale:	Issued:
AS SHOWN	
Job No.:	Drawing No.:
2022-01	M-2.1
Set No.:	of: 10

NOT IN THE SCOPE OF WORK



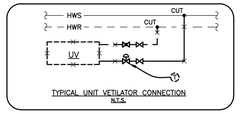
PART OF GROUND FLOOR PLAN (SOUTH-EAST) – EQUIPMENT LAYOUT – EXISTING & DEMOLITION WORK – MECHANICAL
SCALE: 1:100



PART OF GROUND FLOOR PLAN (SOUTH-WEST) – EQUIPMENT LAYOUT – EXISTING & DEMOLITION WORK – MECHANICAL
SCALE: 1:100

KEY NOTES

1. REMOVE EXISTING UNIT VENTILATOR. CUT LOCALLY AND DISCONNECT FROM EXISTING HWS & HWR PIPING C/W ALL ACCESSORIES. DISCONNECT FROM POWER AND CONTROLS AND REMOVE ALL REDUNDANT WIRING.
2. HWS & HWR PIPES TO BE USED FOR CONNECTION TO NEW WALL FIN RADIATOR. PREPARE AREA FOR NEW WORK CONNECTION
3. CUT EXISTING HWS & HWR PIPING AROUND EXISTING WALL FIN RADIATORS TO ALLOW FOR UNIT VENTILATOR REMOVAL. PREPARE AREA FOR INSTALLATION OF NEW WALL FIN RADIATOR.
4. EXISTING THERMOSTAT TO BE REMOVED.
5. DISCONNECT DUCTWORK FROM EXISTING UNIT VENTILATOR AND REMOVE INCLUDING EXISTING FRESH AIR LOUVER ON EXTERIOR WALL. PATCH AND REPAIR BRICK WALL TO MATCH EXISTING.
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8. HORN TYPE SPEAKER 400MM BELOW CEILING TILES TO BE TEMPORALLY REMOVED AND INSTALLED BACK AFTER DUCTWORK COMPLETION.
9. REMOVE PORTION OF RADIATOR TO ALLOW FOR NEW DUCT INSTALLATION
10. TEMPORARY REMOVE CLASSROOM PROJECTOR. RE-INSTALL AFTER COMPLETION OF NEW DUCTWORK



TYPICAL UNIT VETILATOR CONNECTION
N.T.S.

DEMOLITION NOTES:

REMOVE EXISTING EXHAUST DUCTWORK SERVING THE CLASSROOMS AS NOTED ON THE DRAWINGS AND AS REQUIRED FOR THE INSTALLTION OF NEW DUCTWORK. REMOVE ALL REDUNDANT HANGERS AND SUPPORTS. DISCONNECT FROM THE MAIN EXHAUST FAN LOCATED ON THE ROOF. (REFER TO ROOF PLAN FOR DEMOLITION).

TEMPORARILY REMOVE THE EXISTING DRYWALL BULKHEAD AS REQUIRED TO REMOVE THE EXISTING EXHAUST DUCTWORK IN THE CLASSROOMS. ONCE DEMOLITION IS COMPLETE, PATCH, SEAL, AND PAINT ANY PORTION OF DRYWALL THAT WAS REMOVED AND/OR DAMAGED.

ROUTING OF EXISTING DUCTWORK IS APPROXIMATE. CONTRACTOR TO VERIFY ALL LOCATIONS AND SIZES ON SITE PRIOR TO DEMOLITION.

ALL EXHAUST GRILLES SERVING THE AREAS OF WORK ON THE GROUND FLOOR ARE TO BE REMOVED.

COORDINATE REMOVAL OF DUCTWORK WITH EXISTING SERVICES IN THE CEILING SPACE. TEMPORARILY REMOVE, RELOCATE, AND/OR REINSTALL AS NECESSARY TO REMOVE THE DUCTWORK. THIS INCLUDES EXISTING PIPING, CONDUITS, DATA CABLING, ETC.

TEMPORARY REMOVE THE EXISTING T-BAR CEILING AND LIGHTS AS REQUIRED TO PERFORM ALL THE DEMOLITION WORK.

PATCH AND REPAIR TO MATCH EXISTING ALL THE OPENINGS THROUGH THE EXISTING EXTERIOR WALLS AND ROOF THAT ARE REDUNDANT AS A RESULT OF THE WORK.

FOR ALL REMOVED EQUIPMENT, DISCONNECT ALL POWER AND CONTROLS WIRING AND CONDUIT, ALL ASSOCIATED BREAKERS, DISCONNECTS AND FUSES; MAKE SAFE ALL WIRING.

REMOVE ANY FIRE DAMPERS FROM EXISTING EXHAUST DUCTWORK. NOT ALL FIRE DAMPERS HAVE BEEN SHOWN ON THE LAYOUT DRAWING. CONTRACTOR TO VERIFY ON SITE.

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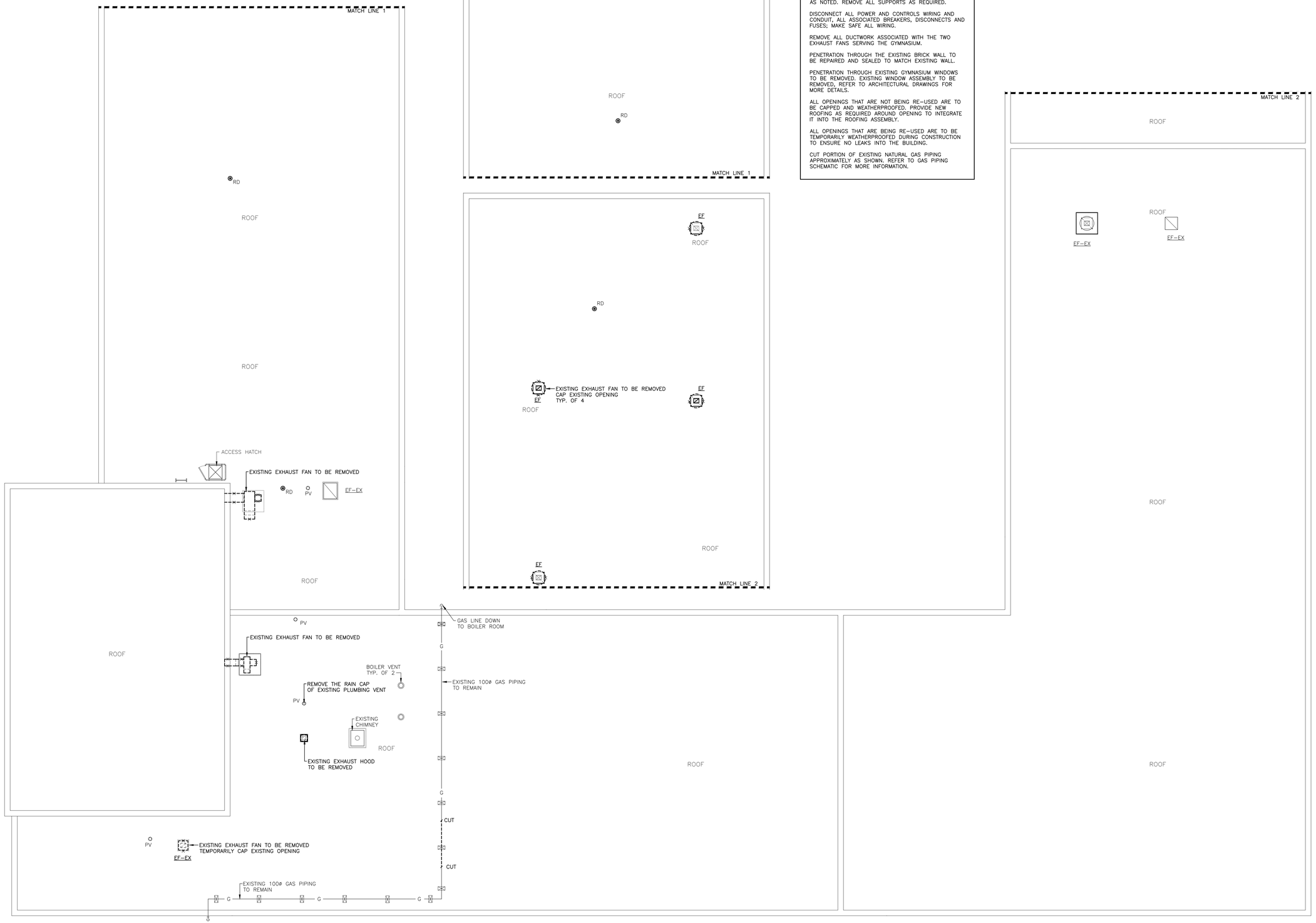
Consultant:

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Title:

PART OF GROUND FLOOR (SOUTH)
– EXISTING & DEMOLITION WORK
– MECHANICAL

Drawn by:	Date:
P.C.	DECEMBER 2021
Checked by: O.S.	Plotted:
Scale: AS SHOWN	Issued:
Job No.: 2022-01	Drawing No.: M-2.2
Set No.:	of: 10



ROOF PLAN – EQUIPMENT LAYOUT – EXISTING & DEMOLITION WORK – MECHANICAL
SCALE: 1:100

DEMOLITION NOTES:

REMOVE ALL ROOF MOUNTED EXISTING EXHAUST FANS AS NOTED. REMOVE ALL SUPPORTS AS REQUIRED.

DISCONNECT ALL POWER AND CONTROLS WIRING AND CONDUIT, ALL ASSOCIATED BREAKERS, DISCONNECTS AND FUSES; MAKE SAFE ALL WIRING.

REMOVE ALL DUCTWORK ASSOCIATED WITH THE TWO EXHAUST FANS SERVING THE GYMNASIUM.

PENETRATION THROUGH THE EXISTING BRICK WALL TO BE REPAIRED AND SEALED TO MATCH EXISTING WALL.

PENETRATION THROUGH EXISTING GYMNASIUM WINDOWS TO BE REMOVED. EXISTING WINDOW ASSEMBLY TO BE REMOVED, REFER TO ARCHITECTURAL DRAWINGS FOR MORE DETAILS.

ALL OPENINGS THAT ARE NOT BEING RE-USED ARE TO BE CAPPED AND WEATHERPROOFED. PROVIDE NEW ROOFING AS REQUIRED AROUND OPENING TO INTEGRATE IT INTO THE ROOFING ASSEMBLY.

ALL OPENINGS THAT ARE BEING RE-USED ARE TO BE TEMPORARILY WEATHERPROOFED DURING CONSTRUCTION TO ENSURE NO LEAKS INTO THE BUILDING.

CUT PORTION OF EXISTING NATURAL GAS PIPING APPROXIMATELY AS SHOWN. REFER TO GAS PIPING SCHEMATIC FOR MORE INFORMATION.

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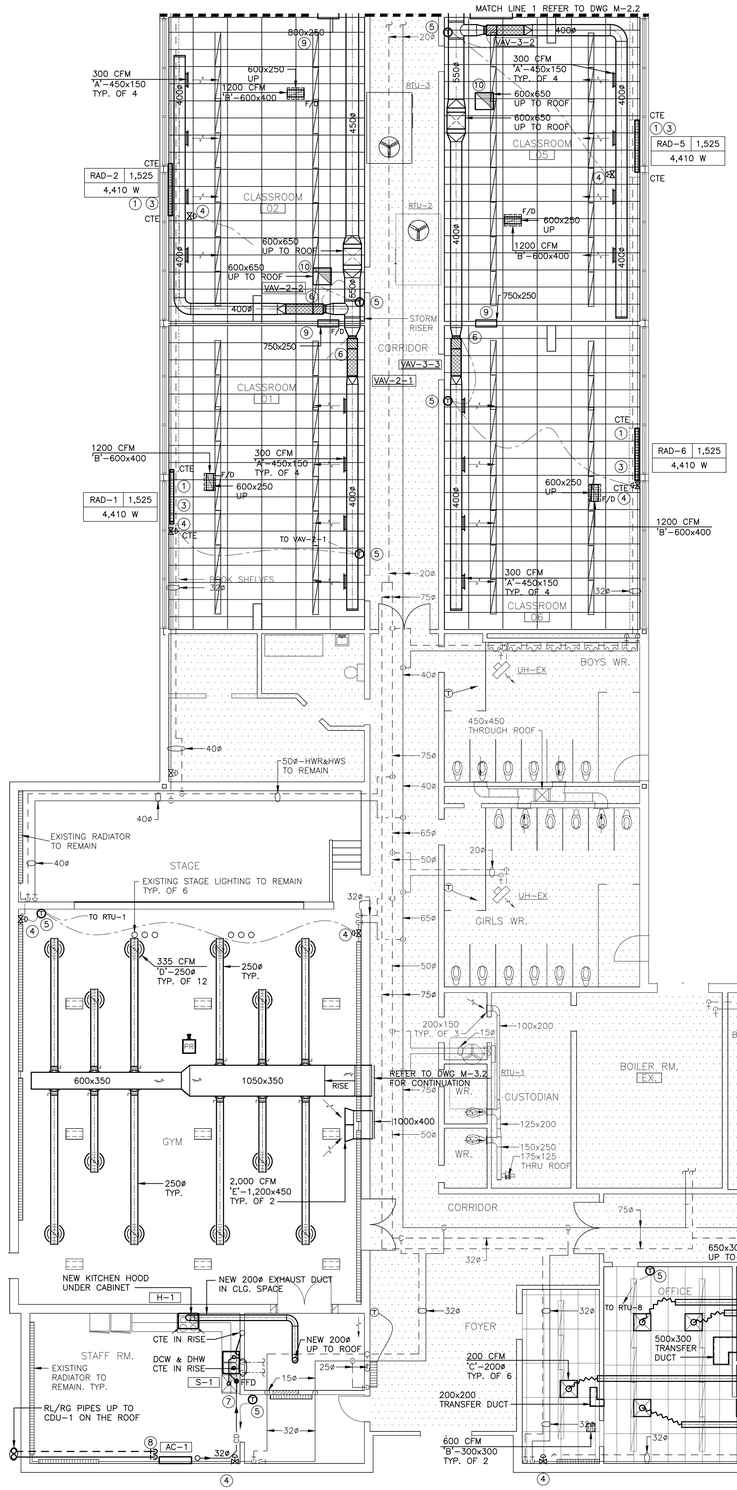
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Title:

ROOF – EQUIPMENT & GAS PIPING LAYOUT – EXISTING & DEMOLITION WORK – MECHANICAL

Drawn by:	Date:
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O.S.	
Scale:	**Issued:**
AS SHOWN	
Job No.:	**Drawing No.:**
2022-01	M-2.3
Set No.:	

NOT IN THE SCOPE OF WORK



KEY NOTES

1. INSTALL NEW 3-ROW BARE ELEMENT WALL FIN RADIATOR AS PER THE MECHANICAL EQUIPMENT SCHEDULE. CONNECT NEW WALLFIN TO EXISTING HWS & HWR MAINS RUNNING ALONG EXTERIOR WALL. REFER TO DETAIL ON M-1 FOR PIPING CONNECTION DETAIL.
2. INSTALL NEW 1-ROW BARE ELEMENT WALL FIN RADIATOR AS PER THE MECHANICAL EQUIPMENT SCHEDULE. CONNECT TO EXISTING TUBING FROM THE EXISTING WALL FIN RADIATORS IN THE SAME SPACE. REFER TO M-1 FOR PIPING CONNECTION DETAIL.
3. PROVIDE AND INSTALL NEW PENCIL-PROOF LINEAR BAR GRILLE FOR NEW WALL FIN RADIATORS (E.H. PRICE MODEL LBP ¼" BLADE SPACING). EXACT LENGTH TO BE CONFIRMED ON SITE, WIDTH TO MATCH EXISTING. COORDINATE INSTALLATION WITH NEW MILLWORK, REFER TO ARCHITECTURAL DRAWINGS FOR MORE DETAILS.
4. INSTALL NEW CONTROL VALVE APPROXIMATELY AS SHOWN. PROVIDE ALL NEW CONTROL WIRING AND CONNECT TO THE ASSOCIATED NEW THEMOSTAT.
5. INSTALL NEW THEMOSTAT ON THE WALL APPROXIMATELY AS SHOWN.
6. INSTALL NEW VAV BOX. PROVIDE ALL NEW CONTROL WIRING AND CONNECT TO THE ASSOCIATED NEW THERMOSTAT.
7. CONNECT NEW 32ø CONDENSATE DRAIN TO EXISTING SINK. REFER TO DETAIL ON M-1.
8. INSTALL NEW WALL-MOUNTED AC EVAPORATOR IN THE STAFF ROOM. FINAL LOCATION TO BE DETERMINED ON SITE. PROVIDE ADEQUATE SUPPORT. RUN NEW REFRIGERANT PIPING ABOVE T-BAR AND UP ALONG EXTERIOR WALL.
9. PROVIDE WALL OPENING ABOVE THE CEILING.
10. TERMINATED OPEN ENDED IN CEILING SPACE

NEW WORK NOTES:

PROVIDE FIRE DAMPERS AT ALL PENETRATIONS THROUGH FIRE-RATED WALLS, C/W ACCESS DOOR. NOT ALL REQUIRED FIRE DAMPERS MAY BE SHOWN ON THE LAYOUT DRAWING.

PROVIDE ALL HANGERS AND SUPPORTS FOR THE NEW EQUIPMENT, DUCTWORK AND PIPING.

PROVIDE NEW SUPPLY AND RETURN DUCTWORK THROUGHOUT THE SCHOOL APPROXIMATELY AS SHOWN. COORDINATE INSTALLATION OF ALL DUCTWORK WITH THE STRUCTURAL ELEMENTS

ALL NEW SUPPLY AIR DUCTWORK IS TO BE INSTALLED EXPOSED BELOW THE T-BAR CEILING, EXCEPT FOR TAKE-OFF BRANCHES IN ROOMS 12, 13, 14, & 15. INSTALL ALL DUCTWORK AS HIGH AS POSSIBLE. INSTALL DUCTS BETWEEN AND THROUGH OWSJ TO CONSERVE HEADROOM, WHERE POSSIBLE.

DUCTWORK ROUTING IS APPROXIMATE. CONTRACTOR TO MODIFY ROUTING BASED ON EXISTING CONDITIONS AS REQUIRED TO COMPLETE THE INSTALLATION. ALLOW FOR ADDITIONAL OFFSETS, ELBOWS, TRANSITIONS, AS REQUIRED TO COMPLETE THE INSTALLATION.

COORDINATE INSTALLATION OF THE DUCTWORK IN THE SCHOOL WITH EXISTING PIPING AND ELECTRICAL CONDUITS, LIGHTS HANGERS AND OTHER SERVICES. CONTRACTOR TO ALLOW FOR RELOCATION OF EXISTING ELECTRICAL CONDUITS IN ORDER TO COMPLETE THE INSTALLATION.

COORDINATE LOCATION OF GRILLES AND DIFFUSERS WITH THE EXISTING CEILING, LIGHTS AND STRUCTURAL ELEMENTS. MODIFY T-BAR CEILING AS REQUIRED TO INSTALL NEW GRILLES.

PROVIDE NEW VAV BOXES IN THE CLASSROOMS AS SHOWN ON THE DRAWINGS AND AS NOTED IN THE MECHANICAL EQUIPMENT SCHEDULE. PROVIDE ADEQUATE SUPPORT FOR ALL NEW VAV BOXES. INSTALL NEW SOUND ATTENUATOR DOWNSTREAM OF EACH NEW BOX. CONNECT EACH NEW VAV BOX TO SUPPLY AIR DUCTWORK AS SHOWN. REFER TO ARCHITECTURAL DRAWINGS FOR VAV BOX ENCLOSURE.

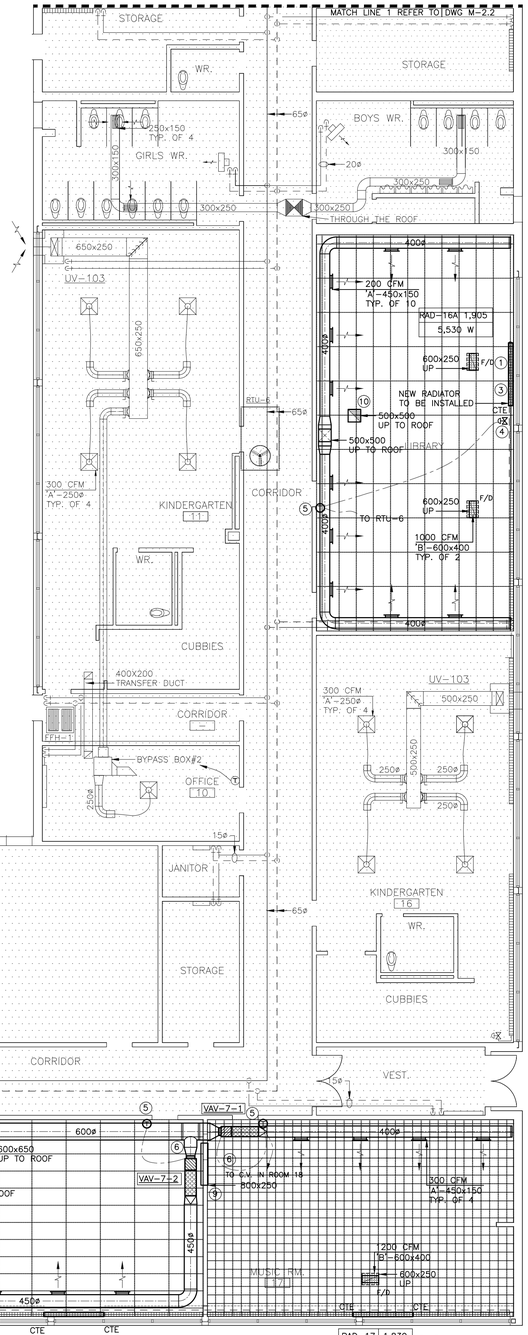
BALANCE AIR FLOWS FOR ALL SUPPLY AND RETURN DUCTWORK, VAV BOXES, GRILLES, AND DIFFUSERS. ADDITIONALLY, USE BALANCING DAMPERS TO ACHIEVE SPECIFIED AIR FLOWS AS SHOWN ON DRAWINGS.

CONTRACTOR TO ALLOW FOR THE COMPLETE REMOVAL OF THE T-BAR CEILING THROUGHOUT THE AREAS OF WORK. THIS INCLUDES THE REMOVAL OF EXISTING SERVICES INSTALLED IN THE T-BAR INCLUDING BUT NOT LIMITED TO: LIGHTS, SMOKE SENSORS, DATA DEVICES, ETC.

RE-INSTALL T-BAR CEILING AT THE COMPLETION OF THE NEW WORK INSTALLATION. REPLACE ALL DAMAGED CEILING TILES. RE-INSTALL ALL EXISTING SERVICES THAT WERE REMOVED AS PART OF THE T-BAR REMOVAL. RE-VERIFY ANY FIRE ALARM DEVICES THAT ARE RE-INSTALLED.

CONNECT ALL NEW ROOFTOP UNITS TO THE BUILDING'S EXISTING FIRE ALARM AND BAS.

IN AREAS OF STRUCTURAL REINFORCEMENT (REFER TO STRUCTURAL DRAWINGS), REMOVE CEILING, LIGHTS, ALL DEVICES ASSOCIATED WITH THE CEILING; TEMPORARY REMOVE ALL CONDUITS, WIRING AND OTHER SERVICES AS REQUIRED TO PERFORM THE STRUCTURAL WORK.



PART OF GROUND FLOOR (NORTH) - EQUIPMENT LAYOUT - NEW WORK - MECHANICAL
SCALE: 1:100

Revisions

Ref.	No.	Description	Date	Initial
△	1	50% REVIEW 0	2022/02/17	
△	2	75% REVIEW	2022/03/09	
△	3	100% REVIEW	2022/03/31	
△	4	ISSUED FOR TENDER	2022/04/26	

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LICENSED PROFESSIONAL ENGINEER APRIL 2022 G. STRASHUN PROVINCE OF ONTARIO

Consultant:

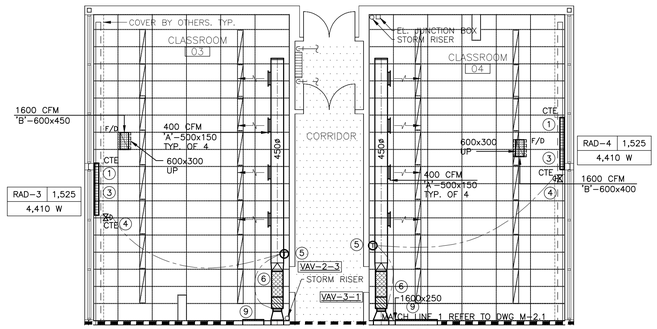
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Title:

PART OF GROUND FLOOR (NORTH)
- EXISTING & NEW WORK
- MECHANICAL

Drawn by: P.C.	Date: DECEMBER 2021
Checked by: O.S.	Plotted:
Scale: AS SHOWN	Issued:
Job No.: 2022-01	Drawing No.: M-3.1
Set No.:	of: 10

NOT IN THE SCOPE OF WORK

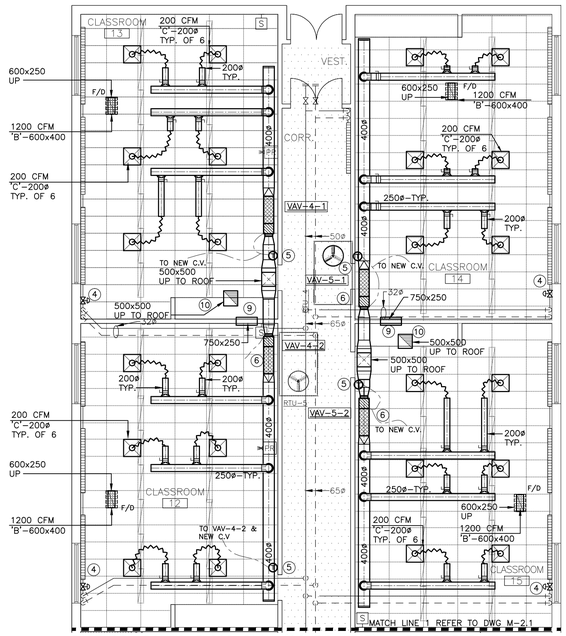


PART OF GROUND FLOOR PLAN (SOUTH-EAST) – EQUIPMENT LAYOUT – EXISTING & NEW WORK – MECHANICAL

SCALE: 1:100

KEY NOTES

1. INSTALL NEW 3-ROW BARE ELEMENT WALL FIN RADIATOR AS PER THE MECHANICAL EQUIPMENT SCHEDULE. CONNECT NEW WALLFIN TO EXISTING HWS & HWR MAINS RUNNING ALONG EXTERIOR WALL. REFER TO DETAIL ON M-1 FOR PIPING CONNECTION DETAIL.
2. INSTALL NEW 1-ROW BARE ELEMENT WALL FIN RADIATOR AS PER THE MECHANICAL EQUIPMENT SCHEDULE. CONNECT TO EXISTING TUBING FROM THE EXISTING WALL FIN RADIATORS IN THE SAME SPACE. REFER TO M-1 FOR PIPING CONNECTION DETAIL.
3. PROVIDE AND INSTALL NEW PENCIL-PROOF LINEAR BAR GRILLE FOR NEW WALL FIN RADIATORS (E.H. PRICE MODEL LBP ¼" BLADE SPACING). EXACT LENGTH TO BE CONFIRMED ON SITE, WIDTH TO MATCH EXISTING. COORDINATE INSTALLATION WITH NEW MILLWORK, REFER TO ARCHITECTURAL DRAWINGS FOR MORE DETAILS.
4. INSTALL NEW CONTROL VALVE APPROXIMATELY AS SHOWN. PROVIDE ALL NEW CONTROL WIRING AND CONNECT TO THE ASSOCIATED NEW THEMOSTAT.
5. INSTALL NEW THEMOSTAT ON THE WALL APPROXIMATELY AS SHOWN.
6. INSTALL NEW VAV BOX. PROVIDE ALL NEW CONTROL WIRING AND CONNECT TO THE ASSOCIATED NEW THERMOSTAT.
7. CONNECT NEW 32ø CONDENSATE DRAIN TO EXISTING SINK. REFER TO DETAIL ON M-1.
8. INSTALL NEW WALL-MOUNTED AC EVAPORATOR IN THE STAFF ROOM. FINAL LOCATION TO BE DETERMINED ON SITE. PROVIDE ADEQUATE SUPPORT. RUN NEW REFRIGERANT PIPING ABOVE T-BAR AND UP ALONG EXTERIOR WALL.
9. PROVIDE WALL OPENING ABOVE THE CEILING.
10. TERMINATED OPEN ENDED IN CEILING SPACE



PART OF GROUND FLOOR PLAN (SOUTH-WEST) – EQUIPMENT LAYOUT – EXISTING & NEW WORK – MECHANICAL

SCALE: 1:100

NEW WORK NOTES:

PROVIDE FIRE DAMPERS AT ALL PENETRATIONS THROUGH FIRE-RATED WALLS, C/W ACCESS DOOR. NOT ALL REQUIRED FIRE DAMPERS MAY BE SHOWN ON THE LAYOUT DRAWING.

PROVIDE ALL HANGERS AND SUPPORTS FOR THE NEW EQUIPMENT, DUCTWORK AND PIPING.

PROVIDE NEW SUPPLY AND RETURN DUCTWORK THROUGHOUT THE SCHOOL APPROXIMATELY AS SHOWN. COORDINATE INSTALLATION OF ALL DUCTWORK WITH THE STRUCTURAL ELEMENTS

ALL NEW SUPPLY AIR DUCTWORK IS TO BE INSTALLED EXPOSED BELOW THE T-BAR CEILING, EXCEPT FOR TAKE-OFF BRANCHES IN ROOMS 12, 13, 14, & 15. INSTALL ALL DUCTWORK AS HIGH AS POSSIBLE. INSTALL DUCTS BETWEEN AND THROUGH OWSJ TO CONSERVE HEADROOM, WHERE POSSIBLE.

DUCTWORK ROUTING IS APPROXIMATE. CONTRACTOR TO MODIFY ROUTING BASED ON EXISTING CONDITIONS AS REQUIRED TO COMPLETE THE INSTALLATION. ALLOW FOR ADDITIONAL OFFSETS, ELBOWS, TRANSITIONS, AS REQUIRED TO COMPLETE THE INSTALLATION.

COORDINATE INSTALLATION OF THE DUCTWORK IN THE SCHOOL WITH EXISTING PIPING AND ELECTRICAL CONDUITS, LIGHTS HANGERS AND OTHER SERVICES. CONTRACTOR TO ALLOW FOR RELOCATION OF EXISTING ELECTRICAL CONDUITS IN ORDER TO COMPLETE THE INSTALLATION.

COORDINATE LOCATION OF GRILLES AND DIFFUSERS WITH THE EXISTING CEILING, LIGHTS AND STRUCTURAL ELEMENTS. MODIFY T-BAR CEILING AS REQUIRED TO INSTALL NEW GRILLES.

PROVIDE NEW VAV BOXES IN THE CLASSROOMS AS SHOWN ON THE DRAWINGS AND AS NOTED IN THE MECHANICAL EQUIPMENT SCHEDULE. PROVIDE ADEQUATE SUPPORT FOR ALL NEW VAV BOXES. INSTALL NEW SOUND ATTENUATOR DOWNSTREAM OF EACH NEW BOX. CONNECT EACH NEW VAV BOX TO SUPPLY AIR DUCTWORK AS SHOWN. REFER TO ARCHITECTURAL DRAWINGS FOR VAV BOX ENCLOSURE.

BALANCE AIR FLOWS FOR ALL SUPPLY AND RETURN DUCTWORK, VAV BOXES, GRILLES, AND DIFFUSERS. ADDITIONALLY, USE BALANCING DAMPERS TO ACHIEVE SPECIFIED AIR FLOWS AS SHOWN ON DRAWINGS.

CONTRACTOR TO ALLOW FOR THE COMPLETE REMOVAL OF THE T-BAR CEILING THROUGHOUT THE AREAS OF WORK. THIS INCLUDES THE REMOVAL OF EXISTING SERVICES INSTALLED IN THE T-BAR INCLUDING BUT NOT LIMITED TO: LIGHTS, SMOKE SENSORS, DATA DEVICES, ETC.

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CONNECT ALL NEW ROOFTOP UNITS TO THE BUILDING'S EXISTING FIRE ALARM AND BAS.

IN AREAS OF STRUCTURAL REINFORCEMENT (REFER TO STRUCTURAL DRAWINGS), REMOVE CEILING, LIGHTS, ALL DEVICES ASSOCIATED WITH THE CEILING; TEMPORARY REMOVE ALL CONDUITS, WIRING AND OTHER SERVICES AS REQUIRED TO PERFORM THE STRUCTURAL WORK.

Revisions

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△	2	75% REVIEW	2022/03/09	
△	3	100% REVIEW	2022/03/31	
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LICENSED PROFESSIONAL ENGINEER
APRIL 2022
G. STRASHUN
PROVINCE OF ONTARIO

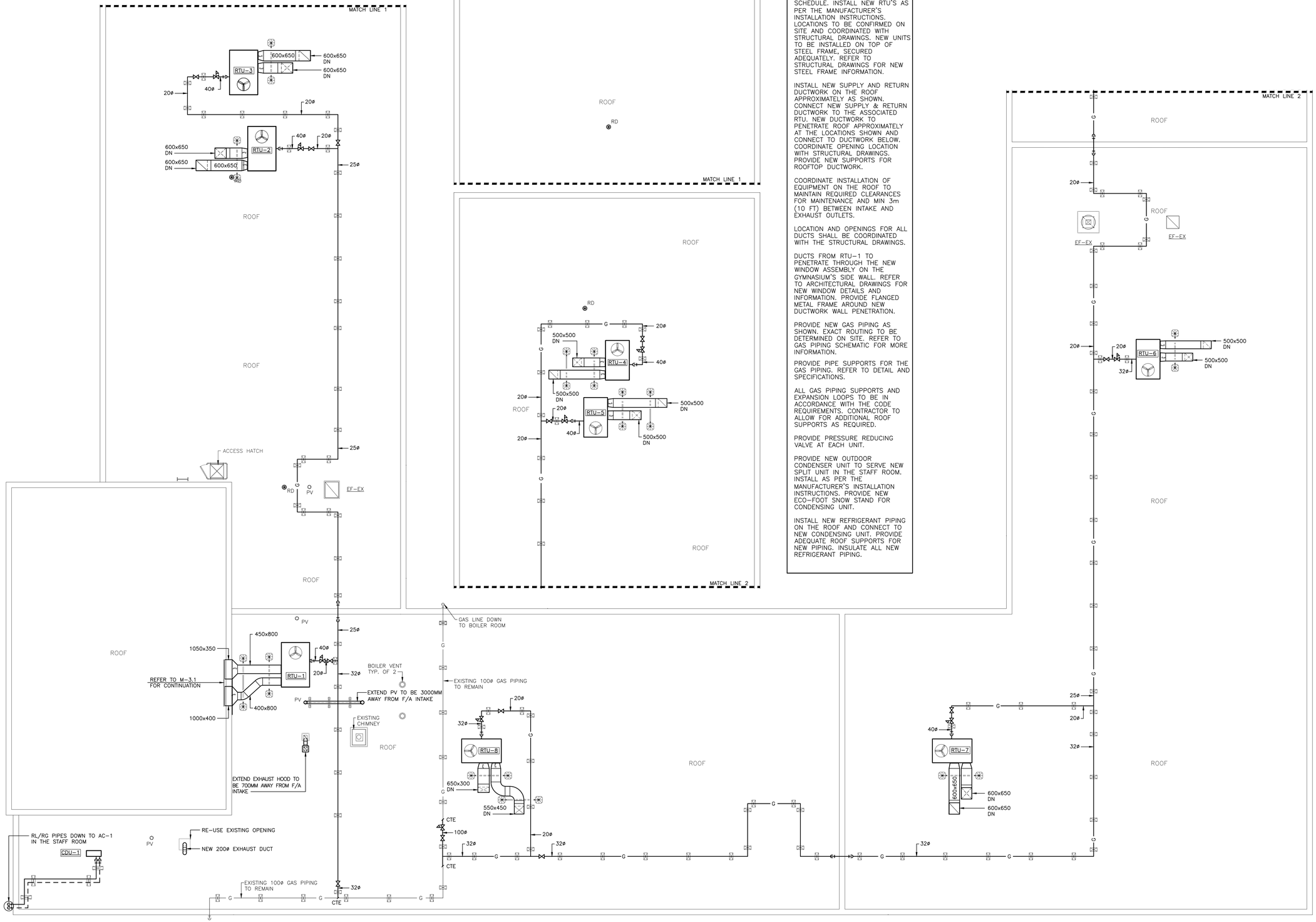
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TEL. (905)-787 8885 FAX (905)-787 8771

Title:

PART OF GROUND FLOOR (SOUTH)
– EXISTING & NEW WORK
– MECHANICAL

Drawn by:	Date:
P.C.	DECEMBER 2021
Checked by: O.S.	**Plotted:**
Scale: AS SHOWN	**Issued:**
Job No.: 2022-01	**Drawing No.:** M-3.2
Set No.:	of: 10



NEW WORK NOTES:

PROVIDE NEW ROOFTOP UNITS AS PER THE MECHANICAL EQUIPMENT SCHEDULE. INSTALL NEW RTU'S AS PER THE MANUFACTURER'S INSTALLATION INSTRUCTIONS. LOCATIONS TO BE CONFIRMED ON SITE AND COORDINATED WITH STRUCTURAL DRAWINGS. NEW UNITS TO BE INSTALLED ON TOP OF STEEL FRAME, SECURED ADEQUATELY. REFER TO STRUCTURAL DRAWINGS FOR NEW STEEL FRAME INFORMATION.

INSTALL NEW SUPPLY AND RETURN DUCTWORK ON THE ROOF APPROXIMATELY AS SHOWN. CONNECT NEW SUPPLY & RETURN DUCTWORK TO THE ASSOCIATED RTU. NEW DUCTWORK TO PENETRATE ROOF APPROXIMATELY AT THE LOCATIONS SHOWN AND CONNECT TO DUCTWORK BELOW. COORDINATE OPENING LOCATION WITH STRUCTURAL DRAWINGS. PROVIDE NEW SUPPORTS FOR ROOFTOP DUCTWORK.

COORDINATE INSTALLATION OF EQUIPMENT ON THE ROOF TO MAINTAIN REQUIRED CLEARANCES FOR MAINTENANCE AND MIN 3m (10 FT) BETWEEN INTAKE AND EXHAUST OUTLETS.

LOCATION AND OPENINGS FOR ALL DUCTS SHALL BE COORDINATED WITH THE STRUCTURAL DRAWINGS.

DUCTS FROM RTU-1 TO PENETRATE THROUGH THE NEW WINDOW ASSEMBLY ON THE GYMNASIUM'S SIDE WALL. REFER TO ARCHITECTURAL DRAWINGS FOR NEW WINDOW DETAILS AND INFORMATION. PROVIDE FLANGED METAL FRAME AROUND NEW DUCTWORK WALL PENETRATION.

PROVIDE NEW GAS PIPING AS SHOWN. EXACT ROUTING TO BE DETERMINED ON SITE. REFER TO GAS PIPING SCHEMATIC FOR MORE INFORMATION.

PROVIDE PIPE SUPPORTS FOR THE GAS PIPING. REFER TO DETAIL AND SPECIFICATIONS.

ALL GAS PIPING SUPPORTS AND EXPANSION LOOPS TO BE IN ACCORDANCE WITH THE CODE REQUIREMENTS. CONTRACTOR TO ALLOW FOR ADDITIONAL ROOF SUPPORTS AS REQUIRED.

PROVIDE PRESSURE REDUCING VALVE AT EACH UNIT.

PROVIDE NEW OUTDOOR CONDENSER UNIT TO SERVE NEW SPLIT UNIT IN THE STAFF ROOM. INSTALL AS PER THE MANUFACTURER'S INSTALLATION INSTRUCTIONS. PROVIDE NEW ECO-FOOT SNOW STAND FOR CONDENSING UNIT.

INSTALL NEW REFRIGERANT PIPING ON THE ROOF AND CONNECT TO NEW CONDENSING UNIT. PROVIDE ADEQUATE ROOF SUPPORTS FOR NEW PIPING. INSULATE ALL NEW REFRIGERANT PIPING.

ROOF PLAN – EQUIPMENT LAYOUT – NEW WORK – MECHANICAL
SCALE: 1:100

Revisions

Ref.	No.	Description	Date	Initial
△	1	50% REVIEW 0	2022/02/17	
△	2	75% REVIEW	2022/03/09	
△	3	100% REVIEW	2022/03/31	
△	4	ISSUED FOR TENDER	2022/04/26	

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LICENSED PROFESSIONAL ENGINEER
APRIL, 2022
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PROVINCE OF ONTARIO

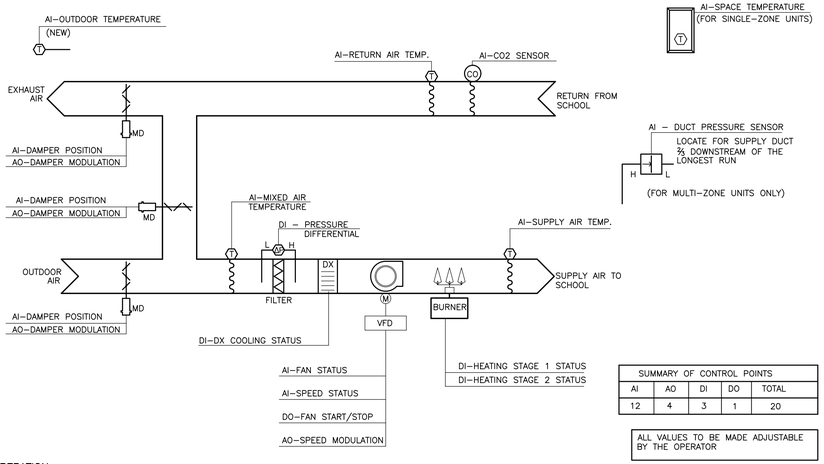
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Title:

ROOF – EQUIPMENT LAYOUT – EXISTING & NEW WORK – MECHANICAL

Drawn by: P.C.	Date: DECEMBER 2021
Checked by: O.S.	Plotted:
Scale: AS SHOWN	Issued:
Job No.: 2022-01	Drawing No.: M-3.3
Set No.:	of: 10



SUMMARY OF CONTROL POINTS				
AI	AO	DI	DO	TOTAL
12	4	3	1	20

ALL VALUES TO BE MADE ADJUSTABLE BY THE OPERATOR

SEQUENCE OF OPERATION

SOME ROOFTOP UNITS ARE SINGLE–ZONE, SOME ARE MULTI–ZONE UNITS WITH VAV BOXES. REFER TO EQUPIMENT SCHEDULE ON M–1 FOR MORE DETAILS.

HEATING AND COOLING MODES
THE ROOFTOP UNIT SHALL BE ENABLED/ DISABLED BY THE BAS IN ACCORDANCE WITH THE BOARD STRATEGY.

HEATING/COOLING MODES: THE ROOFTOP UNIT SHALL BE IN HEATING MODE WHEN THE SCHOOL'S HEATING PLANT IS ENERGIZED. THE ROOFTOP UNIT SHALL BE IN COOLING MODE AT ALL OTHER TIMES. HEATING/COOLING MODE TO BE DICTATED BY BAS.

UNIT SHALL BE CAPABLE OF PERFORMING MORNING WARM–UPS DURING HEATING SEASON AND MORNING COOLING DOWN DURING COOLING PERIOD.

EQUIPMENT ON/OFF

THE ROOFTOP UNIT SHALL BE ENABLED/DISABLED ON A SCHEDULE DETERMINED BY THE OWNER. WHEN DISABLED, THE SUPPLY FAN WILL STOP, THE FRESH AIR AND EXHAUST DAMPERS SHALL BE FULLY CLOSED, THE RETURN DAMPER SHALL BE FULLY OPEN.

EQUIPMENT ON, HEATING MODE, OCCUPIED HOURS

THE SUPPLY FAN SHALL RUN CONTINUOUSLY DURING ALL OCCUPIED HOURS.

SINGLE ZONE UNITS: THE SUPPLY FAN VFD SHALL BE USED FOR BALANCING PURPOSES ONLY. ONCE THE BALANCED FLOW IS REACHED, THE VFD SHALL BE LOCKED AT THIS VALUE DURING OCCUPIED HOURS. IT IS RESPONSIBILITY OF THE CONTRACTOR TO COORDINATE THIS BALANCED VALUE BETWEEN THE AIR BALANCER AND THE CONTROLS CONTRACTOR.

MULTI–ZONE UNITS: THE SUPPLY FAN VFD SHALL MODULATE AS REQUIRED TO MAINTAIN THE STATIC PRESSURE IN THE DISCHARGE DUCTWORK AT 375 PA (ADJUSTABLE AFTER BALANCING). THE CORRELATION BETWEEN THE VARIABLE AIR FLOW AND RPM FOR EACH FAN SHALL BE DERIVED FROM THE FAN LAWS AND FAN CURVES.

NOTE: AT THE BEGINNING OF EACH OCCUPIED PERIOD THE SUPPLY FAN SHALL START AT 20% OF NOMINAL RPM. AFTER THE BAS CONFIRMED THAT THE FAN IS RUNNING, THE FANS SHALL RAMP UP TO THEIR REQUIRED RPM OVER A PERIOD OF NO LESS THAN 2 MINUTES.

THE FRESH AIR DAMPER SHALL OPEN TO THE MINIMUM POSITION (MINIMUM POSITION SHALL BE SET DURING AIR BALANCING IN ORDER TO ACHIEVE MINIMUM OUTSIDE AIR FLOW AS SHOWN ON ROOF–TOP UNIT SCHEDULE ON M–1). ONCE BAS CONFIRMS THAT THE FRESH AIR DAMPER HAS OPENED TO THE MINIMUM POSITION, THE DAMPERS ARE TO COME UNDER THE CONTROL OF THE CO2 SENSOR. DAMPERS SHALL BE MODULATED BY THE BAS IN ORDER TO MAINTAIN THE CO2 CONCENTRATION SETPOINT IN RETURN AIR STREAM AT 800 PPM (ADJUSTABLE). THE OPENING OF THE FRESH AIR DAMPER SHALL BE LIMITED BY A MINIMUM MIXED AIR TEMPERATURE OF 5°C. IF MIXED AIR TEMPERATURE DROPS BELOW 5°C, THE FRESH AIR DAMPER SHALL RETURN TO ITS MINIMUM POSITION UNTIL THE MIXED AIR TEMPERATURE RISES BACK TO 10°C.

THE GAS FIRED HEAT EXCHANGER SHALL BE STAGED BY THE UNIT'S CONTROLLER AS REQUIRED TO MAINTAIN THE DISCHARGED AIR TEMPERATURE AT 28°C (ADJUSTABLE). EACH STAGE SHALL RUN FOR A MINIMUM OF 5 MIN. (ADJUSTABLE) AS TO AVOID CYCLING. THE SUPPLY AIR TEMPERATURE SET–POINT SHALL BE RESET BETWEEN 23°C AND 33°C BASED ON THE OUTDOOR AIR TEMPERATURE AS FOLLOWS:

IF THE OAT TEMPERATURE IS –14°C OR BELOW, THE SUPPLY AIR TEMPERATURE SETPOINT SHALL BE RESET TO 33°C.
IF THE OAT TEMPERATURE IS 10°C OR ABOVE, THE SUPPLY AIR TEMPERATURE SETPOINT SHALL BE RESET TO 23°C.
IF THE OAT TEMPERATURE IS BETWEEN –14°C AND 10°C, THE SUPPLY AIR TEMPERATURE SETPOINT SHALL BE VARY LINEARLY BETWEEN 33°C AND 23°C.

EQUIPMENT ON, HEATING MODE, UNOCCUPIED HOURS

AT THE BEGINNING OF THE UNOCCUPIED PERIOD, THE ROOFTOP UNIT BE DISABLED (FAN OFF, FRESH AIR AND EXHAUST DAMPERS CLOSED, RETURN DAMPER OPEN). THE GAS FIRED HEAT EXCHANGER SHALL BE OFF.

IF THE TEMPERATURE IN ANY OF THE SPACES SERVED BY THE UNIT DROPS 2°C BELOW THE UNOCCUPIED SETPOINT, THE SUPPLY FAN SHALL START AND RAMP UP UNDER VFD CONTROL. THE FAN SHALL RUN CONTINUOUSLY AND THE UNITS CONTROLLER SHALL STAGE THE GAS BURNER AS REQUIRED UNTIL ALL SPACES ARE SATISFIED; THE FRESH AIR AND EXHAUST DAMPERS SHALL REMAIN CLOSED, THE RETURN DAMPER SHALL STAY FULLY OPEN. THE RUN–TIME OF THE FANS SHALL NOT BE LESS THAN 10 MINUTES. ONCE ALL SPACES ARE SATISFIED, THE UNIT SHALL AGAIN BE DISABLED.

NOTE: ON A CALL TO RUN THE FANS THE SUPPLY FAN SHALL START AT 20% OF NOMINAL RPM. AFTER THE BAS CONFIRMED THAT THE FAN IS RUNNING, THE FAN SHALL RAMP UP TO THEIR REQUIRED RMP OVER A PERIOD OF NO LESS THAN 2 MINUTES.

EQUIPMENT ON, COOLING MODE, OCCUPIED HOURS,

THE SUPPLY FAN SHALL RUN CONTINUOUSLY.

SINGLE ZONE UNITS: THE SUPPLY FAN VFD SHALL BE USED FOR BALANCING PURPOSES ONLY. ONCE THE BALANCED FLOW IS REACHED, THE VFD SHALL BE LOCKED AT THIS VALUE DURING OCCUPIED HOURS. IT IS RESPONSIBILITY OF THE CONTRACTOR TO COORDINATE THIS BALANCED VALUE BETWEEN THE AIR BALANCER AND THE CONTROLS CONTRACTOR.

MULTI–ZONE UNITS: THE SUPPLY FAN VFD SHALL MODULATE AS REQUIRED TO MAINTAIN THE STATIC PRESSURE IN THE DISCHARGE DUCTWORK AT 375 PA (ADJUSTABLE AFTER BALANCING). THE CORRELATION BETWEEN THE VARIABLE AIR FLOW AND RPM FOR EACH FAN SHALL BE DERIVED FROM THE FAN LAWS AND FAN CURVES.

NOTE: AT THE BEGINNING OF EACH OCCUPIED PERIOD THE SUPPLY FAN SHALL START AT 20% OF NOMINAL RPM. AFTER THE BAS CONFIRMED THAT THE FAN IS RUNNING, THE FAN SHALL RAMP UP TO THEIR REQUIRED RPM OVER A PERIOD OF NO LESS THAN 2 MINUTES.

THE FRESH AIR DAMPER SHALL OPEN TO THE MINIMUM POSITION (MINIMUM POSITION SHALL BE SET DURING AIR BALANCING IN ORDER TO ACHIEVE MINIMUM OUTSIDE AIR FLOW AS SHOWN ON ROOF–TOP UNIT SCHEDULE ON M–1). ONCE BAS CONFIRMS THAT THE FRESH AIR DAMPER HAS OPENED TO THE MINIMUM POSITION, THE DAMPERS ARE TO COME UNDER THE CONTROL OF THE CO2 SENSOR. DAMPERS SHALL BE MODULATED BY THE BAS IN ORDER TO MAINTAIN THE CO2 CONCENTRATION SETPOINT IN RETURN AIR STREAM AT 800 PPM (ADJUSTABLE).

THE DX COOLING SECTION SHALL BE MODULATED BY UNIT CONTROLLER AS REQUIRED TO MAINTAIN THE DISCHARGED AIR TEMPERATURE AT 12°C (ADJUSTABLE). THE DX COOLING SECTION SHALL HAVE A MINIMUM RUN TIME OF 5 MINUTES (ADJUSTABLE).

DISCHARGE AIR TEMPERATURE SHALL BE RE–SET BY THE BAS IN ORDER TO MAINTAIN SPACE TEMPERATURE SETPOINT AT 24°C (ADJUSTABLE)

FREE COOLING SHALL BE PROVIDED BY THE UNIT'S ECONOMIZER BASED ON COMPARATIVE ENTHALPY CONTROL.

EQUIPMENT ON, COOLING MODE, UNOCCUPIED HOURS

DURING THE COOLING MODE UNOCCUPIED PERIODS, THE ROOFTOP UNIT SHALL BE DISABLED (FAN OFF, FRESH AIR AND EXHAUST DAMPERS CLOSED, RETURN DAMPER OPEN).

MORNING WARM UP/COOLDOWN

DURING HEATING MODE, AN OPTIMUM MORNING WARM–UP PROGRAM SHALL ENABLE THE ROOFTOP UNIT PRIOR TO THE SCHEDULED START OF THE OCCUPIED MODE. THE FRESH AIR AND EXHAUST AIR DAMPERS SHALL BE CLOSED. THE SUPPLY FAN SHALL START AND RAMP UP UNDER VFD CONTROL. THE FAN SHALL RUN CONTINUOUSLY AND THE UNITS CONTROLLER SHALL STAGE THE GAS BURNER AS REQUIRED TO BRING THE SPACE TEMPERATURES TO THE DESIRED OCCUPIED SETPOINT. THE START TIME FOR THE MORNING WARM UP SHALL BE A MAXIMUM OF 2 HOURS PRIOR TO NORMAL OCCUPANCY.

DURING COOLING MODE, AAN OPTIMUM MORNING COOL–DOWN PROGRAM SHALL ENABLE THE ROOFTOP UNIT PRIOR TO THE SCHEDULED START OF THE OCCUPIED MODE. THE FRESH AIR AND EXHAUST AIR DAMPERS SHALL BE CLOSED. THE SUPPLY FAN SHALL START AND RAMP UP UNDER VFD CONTROL. THE FAN SHALL RUN CONTINUOUSLY AND THE UNITS CONTROLLER SHALL STAGE THE DX SECTION AS REQUIRED TO BRING THE SPACE TEMPERATURES TO THE DESIRED OCCUPIED SETPOINT. THE START TIME FOR THE MORNING COOL DOWN SHALL BE A MAXIMUM OF 2 HOURS PRIOR TO NORMAL OCCUPANCY.

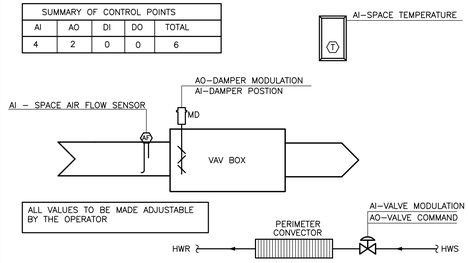
ALARMS

THE BAS SHALL GENERATE ALARMS IN CASE OF:

ANY FAN FAILURE;
ANY VFD FAILURE;
ANY DAMPER FAILURE;
DISCHARGE AIR PRESSURE RISES ABOVE 400 PA;
DISCHARGED AIR VARIANCE OF ±3°C FROM THE SETPOINT;
MIXED AIR TEMPERATURE LOWER THAN 4°C (IN ADDITION TO ALARM, THE FRESH AIR DAMPERS SHALL CLOSE);
DISCHARGED AIR LOWER THAN 8°C (IN ADDITION TO ALARM, THE FRESH AIR DAMPER SHALL CLOSE);
DISCHARGED AIR LOWER THAN 5°C (IN ADDITION TO ALARM, THE ENTIRE AIR HANDLER SHALL SHUT DOWN AND WILL REQUIRE MANUAL RE–START);
PRESSURE DIFFERENTIAL ACROSS THE FILTERS HIGHER THAN 254 PA.

CONTROL DIAGRAM FOR RTUs
N.T.S.

SUMMARY OF CONTROL POINTS				
AI	AO	DI	DO	TOTAL
4	2	0	0	6



SEQUENCE OF OPERATION

THE BAS CONTRACTOR SHALL PROVIDE A DEDICATED DDC CONTROLLER WITH INTEGRAL DAMPER ACTUATOR.

HEATING/COOLING MODES

THE VAV BOXES SHALL SELECT HEATING/COOLING MODE BASED ON THE HEATING/COOLING MODE OF ITS ASSOCIATED ROOFTOP UNIT.

HEATING MODE – OCCUPIED PERIODS

AT THE BEGINNING OF EACH OCCUPIED PERIOD, THE VAV BOXES SHALL OPEN TO ALLOW A MINIMUM OF THEIR AIR FLOW.

THE SPACE TEMPERATURE SENSOR SHALL MODULATE THE PERIMETER HEATING CONTROL VALVE AS REQUIRED TO MAINTAIN THE HEATING SPACE OCCUPIED SETPOINT.

IF THE PERIMETER HEATING VALVE IS OPEN 100% FOR MORE THAN 2 MINUTES, THE VAV BOXES SHALL INCREASE THE AIR SUPPLY BEYOND THE MINIMUM AS REQUIRED TO MAINTAIN THE OCCUPIED HEATING SETPOINT IN THE SPACE (21°C – ADJUSTABLE).

HEATING MODE – UNOCCUPIED PERIODS

THE VAV BOXES SHALL CLOSE TO MINIMUM AIR FLOW POSITION.

COOLING MODE – OCCUPIED PERIODS.

AT THE BEGINNING OF EACH OCCUPIED PERIOD, THE VAV BOXES SHALL OPEN TO ALLOW A MINIMUM OF THEIR AIR FLOW.

THE VAV BOXES SHALL INCREASE THE AIR SUPPLY BEYOND THE MINIMUM AS REQUIRED TO MAINTAIN THE OCCUPIED COOLING SETPOINT IN THE SPACE (24°C – ADJUSTABLE).

COOLING MODE – UNOCCUPIED PERIODS.

THE VAV BOXES SHALL CLOSE TO MINIMUM AIR FLOW POSITION

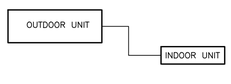
ALARMS

THE BAS SHALL GENERATE ALARMS IN CASE OF:

ANY SPACE TEMPERATURE VARIANCE OF ±3°C FROM THE SETPOINT;
ANY VAV BOX FAILURE.

NOTE: EXACT NUMBER OF VAVS TO BE DETERMINED BASED ON THE LAYOUT DRAWINGS.

TYPICAL VAV BOX – CONTROL DIAGRAM
N.T.S.



SUMMARY OF CONTROL POINTS				
AI	AO	DI	DO	TOTAL
1	0	0	0	1

ALL VALUES TO BE MADE ADJUSTABLE BY THE OPERATOR

SEQUENCE OF OPERATION

SPLIT AIR CONDITIONING SYSTEMS

THE SPLIT AIR CONDITIONING SYSTEMS SHALL BE ENERGIZED DURING THE COOLING OCCUPIED PERIODS ONLY.
WHEN THE SYSTEMS ARE ENERGIZED, THE INDOOR EVAPORATOR FANS SHALL RUN AS REQUIRED TO MAINTAIN THE COOLING/OCCUPIED SPACE SETPOINT (DEFAULT: 25°C, ADJUSTABLE.).

THE OUTDOOR CONDENSING UNIT SHALL OPERATE AS REQUIRED TO REJECT THE HEAT FROM THE BUILDING AND COLLECTED BY THE EVAPORATORS.
DURING UNOCCUPIED PERIODS, THE SPLIT AIR CONDITIONING SYSTEMS SHALL SHUT DOWN.

BAS TO ENSURE THAT HEATING AND COOLING SHALL NOT OPERATE AT THE SAME TIME.

BAS ALARMS

THE BAS SHALL GENERATE ALARMS IN ADDITION TO THOSE INCLUDED IN SECTION 23 09 23 AS FOLLOWS:

- SPACE TEMPERATURE IN ANY CONTROLLED AREA VARIES ±5°C FROM SETPOINT FOR MORE THAN 15 MINUTES.
- ANY SPLIT CONDENSING UNIT FAILURE

REFER TO SPECIFICATIONS SECTION FOR THE CONTROL OF THE A/C SYSTEM.

CONTROLS SUB–CONTRACTOR TO CONNECT TO THE AC SYSTEM VIA BACNET AND PROVIDE MINIMUM REQUIRED POINTS. PROVIDE ALL REQUIRED WIRING AND CONDUITS BETWEEN INDOOR AND OUTDOOR UNIT AND CONTROLLERS. COORDINATE WITH THE AC SYSTEM MANUFACTURER.

FOR EACH INDOOR UNIT PROVIDE AT LEAST:

- ROOM TEMPERATURE SETTING
- ROOM TEMPERATURE RESETTING
- ROOM TEMPERATURE
- INDOOR UNIT START/STOP
- OPERATING MODE
- INDOOR UNIT STATUS

FOR OUTDOOR UNIT PROVIDE:

- OUTDOOR UNIT START/STOP
- OUTDOOR UNIT STATUS

WALL MOUNTED CASSETTE – CONTROL DIAGRAM
N.T.S.

NOTES:

ALL VALUES TO BE MADE ADJUSTABLE BY THE OPERATOR.

ALL SENSORS AND DEVICES TO BE NEW.

PROVIDE NEW WIRING IN CONDUIT AS REQUIRED.

PROVIDE NEW DUCT–MOUNTED SMOKE SENSORS FOR EACH RTU. CONNECT THE SF TO FIRE ALARM SYSTEM. UNIT SHALL SHUT–DOWN IN CASE OF FIRE.

LOCATE PRESSURE DIFFERENTIAL SENSOR FOR SUPPLY DUCT ⅔ DOWNSTREAM OF THE LONGEST RUN.

Revisions

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△	2	75% REVIEW	2022/03/09	
△	3	100% REVIEW	2022/03/31	
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APRIL 2022
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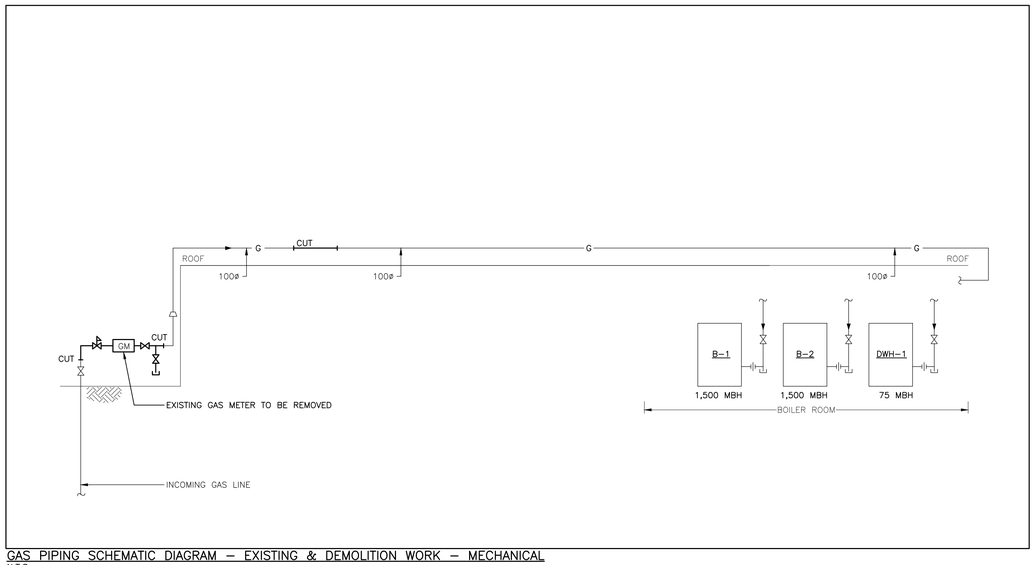
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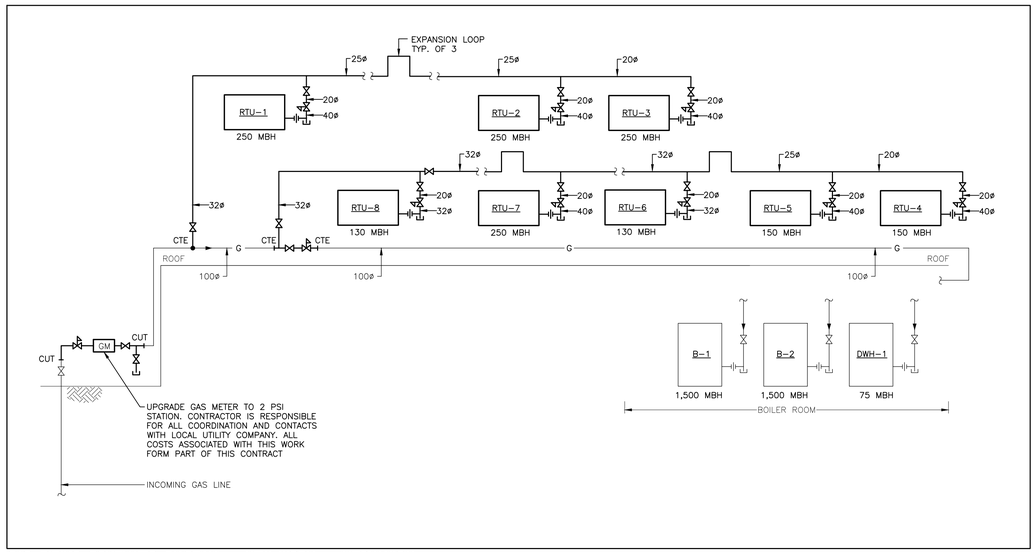
Title:

CONTROL SCHEMATICS – MECHANICAL

Drawn by:	Date:
P.C.	DECEMBER 2021
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Scale:	Issued:
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Job No.:	Drawing No.:
2022–01	M-4.1
Set No.:	of: 8



GAS PIPING SCHEMATIC DIAGRAM – EXISTING & DEMOLITION WORK – MECHANICAL
N.T.S.



GAS PIPING SCHEMATIC DIAGRAM – NEW WORK – MECHANICAL
N.T.S.

Revisions

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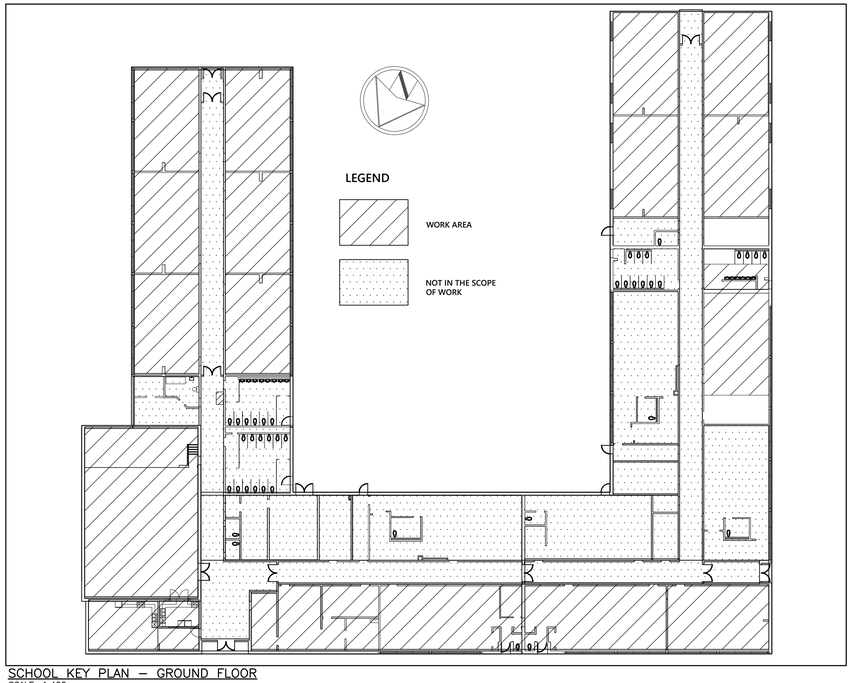
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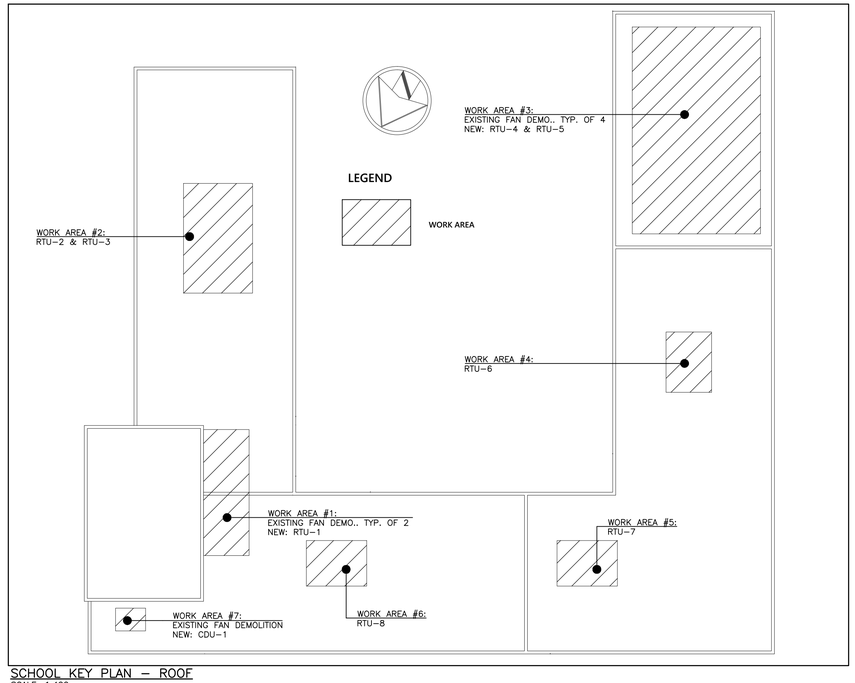
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GAS PIPING SCHEMATIC – EXISTING, DEMOLITION & NEW WORK – MECHANICAL

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Set No.:	of: 8



SCHOOL KEY PLAN – GROUND FLOOR
SCALE: 1:400



SCHOOL KEY PLAN – ROOF
SCALE: 1:400

ELECTRICAL LEGEND

	DIRECT POWER OUTLET FOR USE AS NOTED INCLUDING FINAL CONNECTION
	NON-FUSED DISCONNECT SWITCH
	FUSED DISCONNECT SWITCH
GFI	20A, 120V U-GROUND DUPLEX RECEPTACLE. GROUND FAULT INTERRUPTER
WP	WEATHERPROOF
EX	DENOTES: EXISTING TO REMAIN
R	DENOTES: EXISTING TO BE REMOVED
N	DENOTES: NEW
RE	DENOTES: EXISTING TO BE RELOCATED
	SINGLE POLE TOGGLE SWITCH WITH SINGLE GANG
	SINGLE POLE TOGGLE SWITCH WITH THREE GANG
	ELECTRICAL PANEL, SURFACE OR FLUSH RESPECTIVELY
	15A, 120V U-GROUND DUPLEX RECEPTACLE MOUNTED AT HIGH LEVEL
GFI	15A, 120V U-GROUND GROUND FAULT INTERRUPTER TYPE DUPLEX RECEPTACLE
	DATA OUTLET C/W 3/4"C WITH 90° BEND AT TOP AND PVC END BUSHING TO ACCESSIBLE CEILING SPACE.

MECHANICAL EQUIPMENT WIRING SCHEDULE

EQUIPMENT DESCRIPTION	POWER SOURCE	STARTER TYPE	MCA/BHP/ KW/AMP	VOLTS/PH./ FREQUENCY	BREAKER SIZE OR FUSE SIZE	FEEDER SIZE	REMARKS
RTU-1	BOILER RM DISTRIBUTION PANEL 'DP-1'	INTEGRAL	48.0 MCA	208/3/60	60A	3#AWG6+G IN 35mmC	PROVIDE NEW FUSED DISCONNECT AND CONNECT TO NEW DISTRIBUTION PANEL 'DP-1'. PROVIDE ALL WIRING BETWEEN THE PANEL 'DP-1', DISCONNECT, WEATHERPROOF DISCONNECT AND EQUIPMENT. ALL WIRING TO BE IN RIGID METAL CONDUIT. LAST 900 MM SHALL BE LIQUID-TIGHT FLEXIBLE FEEDERS.
RTU-2			48.0 MCA		60A	3#AWG6+G IN 35mmC	
RTU-3			48.0 MCA		60A	3#AWG6+G IN 35mmC	
RTU-4			37.0 MCA		50A	3#AWG2+G IN 41mmC	
RTU-5			37.0 MCA		50A	3#AWG2+G IN 41mmC	
RTU-6			30.0 MCA		45A	3#AWG4+G IN 35mmC	
RTU-7			48.0 MCA		60A	3#AWG6+G IN 35mmC	
RTU-8			30.0 MCA		45A	3#AWG8+G IN 27mmC	
CDU-1			17.1 MCA	208/1/60	20A	3#AWG12+G IN 21mmC	PROVIDE NEW FUSED DISCONNECT AND CONNECT ON NEW DISTRIBUTION PANEL 'DP-1'. PROVIDE ALL WIRING BETWEEN THE PANEL 'DP-1', DISCONNECT, WEATHERPROOF DISCONNECT AND EQUIPMENT. ALL WIRING TO BE IN RIGID METAL CONDUIT. LAST 900 MM SHALL BE LIQUID-TIGHT FLEXIBLE FEEDERS.
AC-1			1.0 MCA	208/1/60	20A	3#AWG12+G IN 21mmC	PROVIDE NEW FUSED DISCONNECT AND CONNECT ON NEW DISTRIBUTION PANEL 'DP-1'. PROVIDE ALL WIRING BETWEEN THE PANEL 'DP-1', DISCONNECT AND EQUIPMENT. ALL IN DOOR WIRING TO BE IN EMT CONDUIT, PROVIDE LOCAL DISCONNECT SWITCH.
BL-1	CORRIDOR PANEL 'A'		N/A	120/1/60	15A	3#AWG12+G IN 21mmC	PROVIDE NEW FUSED DISCONNECT AND CONNECT ON EXISTING DISTRIBUTION PANEL 'A'. PROVIDE ALL WIRING BETWEEN THE PANEL 'A', DISCONNECT AND MOTORIZED BLINDS. ALL IN DOOR WIRING TO BE IN EMT CONDUIT. PROVIDE LOCAL DISCONNECT SWITCH.
H-1	CORRIDOR PANEL 'A'		1.0 MCA	120/1/60	15A	3#AWG12+G IN 21mmC	PROVIDE NEW FUSED DISCONNECT AND CONNECT ON EXISTING DISTRIBUTION PANEL 'A'. PROVIDE ALL WIRING BETWEEN THE PANEL 'A', DISCONNECT AND MOTORIZED BLINDS. ALL IN DOOR WIRING TO BE IN EMT CONDUIT. PROVIDE LOCAL DISCONNECT SWITCH.

NOTES:

PROVIDE CONNECTION TO MECHANICAL EQUIPMENT TO ENSURE THAT FULL OPERATIONAL SYSTEMS ARE DELIVERED TO THE OWNER.

PROVIDE POWER CONNECTION TO ALL EQUIPMENT LISTED IN THE SCHEDULE. REFER ROOF LAYOUT FOR EXACT LOCATION OF EQUIPMENT.

PROVIDE SEPARATE DISCONNECTS FOR INDIVIDUAL MECHANICAL EQUIPMENT. SIZE AS INDICATED IN THE SCHEDULE.

DISCONNECTS LOCATIONS SHALL BE VERIFIED AND CO-COORDINATED ON SITE.

CONNECT NEW UNITS TO EXISTING FIRE ALARM SYSTEM. INCLUDE ALL REQUIRED WIRING AND DEVICES. PROVIDE VERIFICATION OF THE FIRE ALARM SYSTEM.

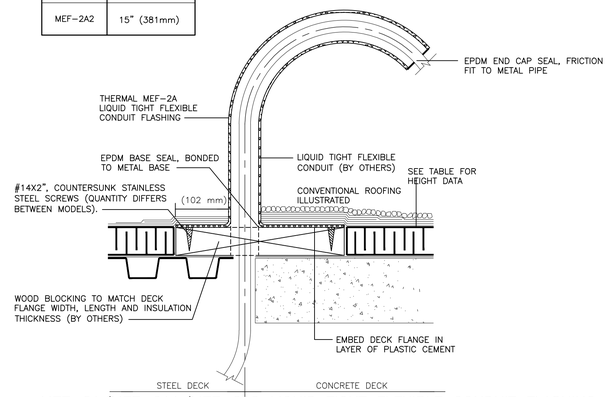
CONNECT NEW UNITS TO EXISTING BAS. INCLUDE ALL REQUIRED WIRING AND DEVICES. PROVIDE VERIFICATION OF THE BAS.

NEW LIGHTING FIXTURE SCHEDULE

TYPE	MANUFACTURER	CATALOGUE	DESCRIPTION
A	ORION	HHSL1-E1-120V-FD-840-06W	HARRIS LED HIGH BAY STAR LINE, GEN1, 120-277V, C/W WIREGUARD

TABLE

MODEL	HEIGHT
MEF-2A	12" (305mm)
MEF-2A1	12" (305mm)
MEF-2A2	15" (381mm)



MEF-2A/MEF-2A1/MEF-2A2 LIQUID TIGHT FLEXIBLE CONDUIT FLASHING
N.T.S.

GENERAL ELECTRICAL NOTES

1. IT IS MANDATORY FOR THE ELECTRICAL CONTRACTOR TO VISIT SITE AND REVIEW EXISTING CONDITIONS AND DEMOLITION SCOPE OF WORK TO SUIT EXISTING ARCHITECTURAL AND STRUCTURAL CONDITIONS AND MECHANICAL DRAWINGS.
2. CAREFULLY EXAMINE OTHER EXISTING UTILITY LINES SUCH AS GAS, WATER ETC. PRIOR TO START THE ELECTRICAL CONSTRICTION WORKS AND COORDINATE WITH OTHER TRADES AND REPORT OF ANY DISCREPANCY PRIOR TO PROCEEDING.
3. REFER TO ELECTRICAL AND MECHANICAL LAYOUTS FOR EXACT LOCATION OF ALL EQUIPMENT.
4. LOCATIONS OF ALL NEW DISCONNECT SWITCHES, VFDS AND STARTERS SHALL BE CONFIRMED WITH DIVISION 15 PRIOR TO INSTALLATION.

Revisions

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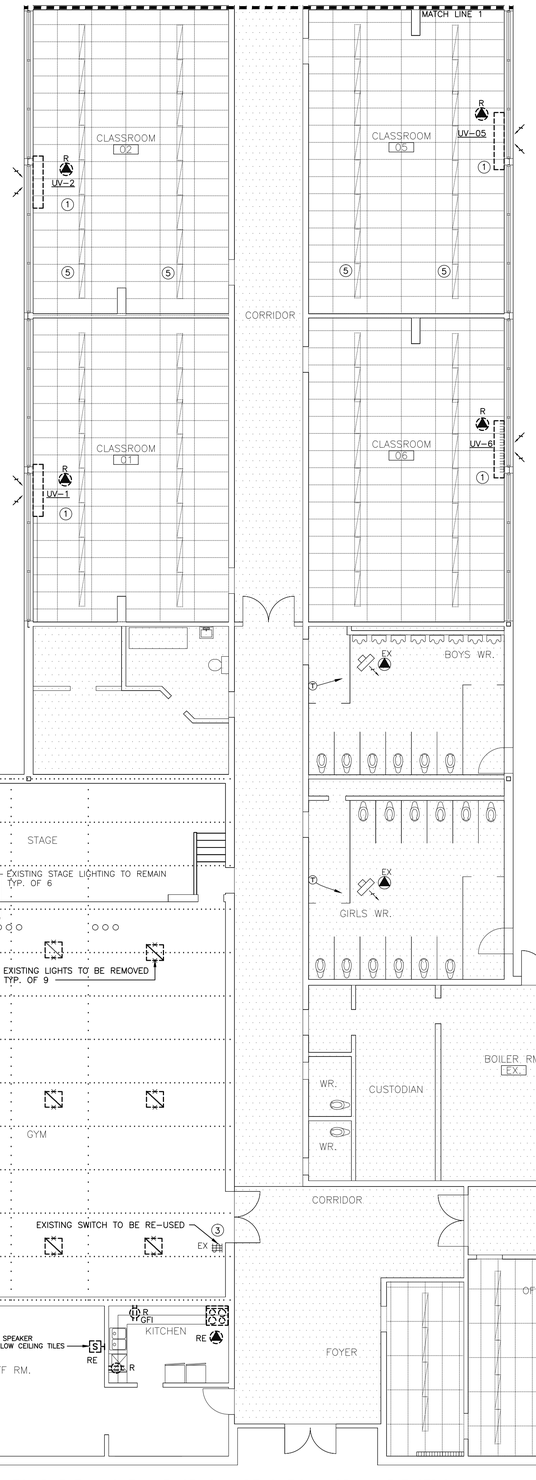
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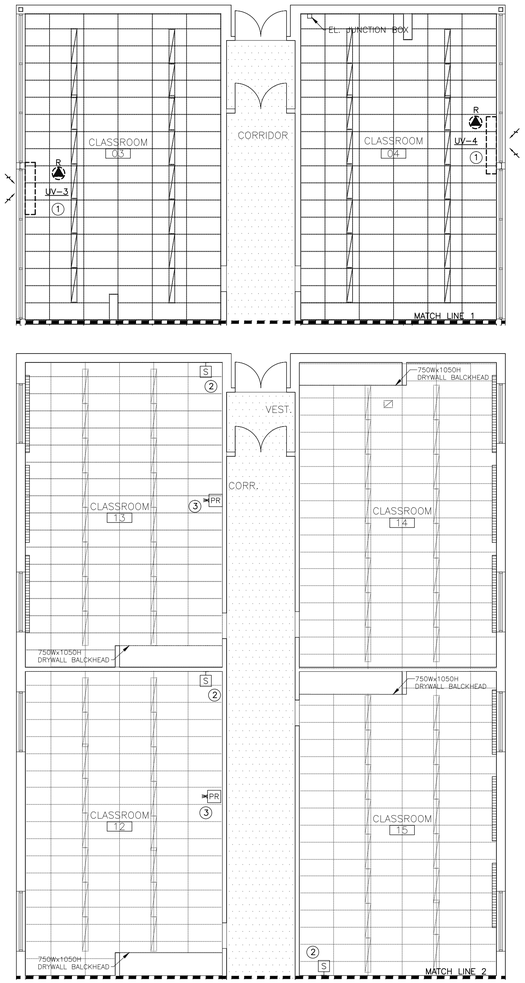
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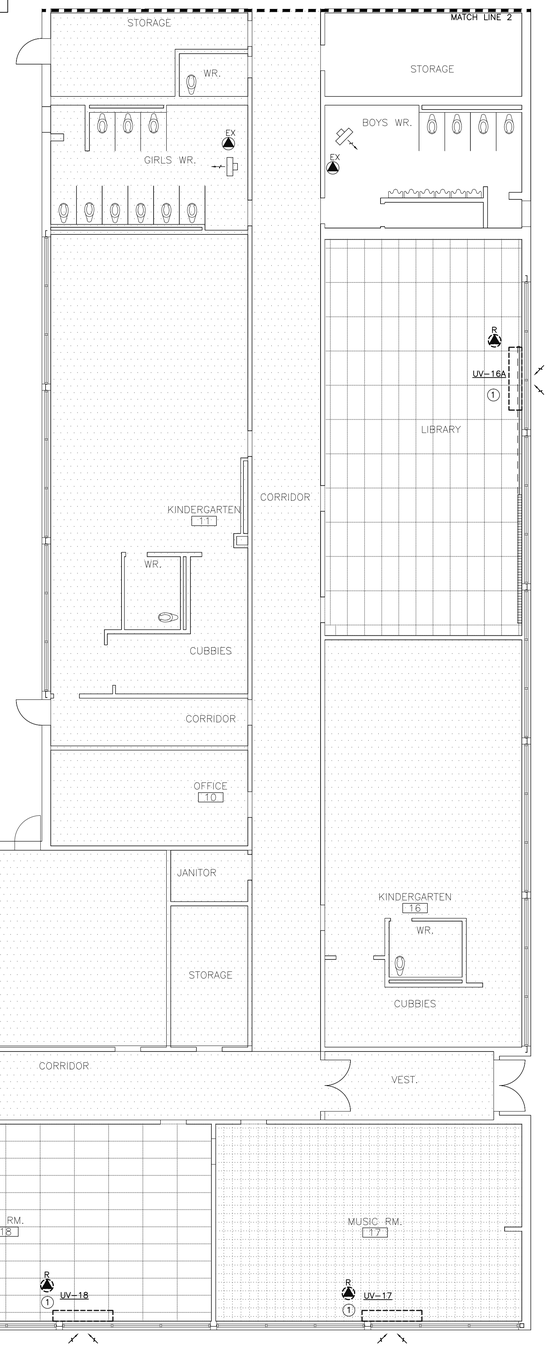
KEY PLANS, SYMBOL LIST, NOTES, EQUIPMENT WIRING DIAGRAM – ELELCTRICAL

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Set No.:	of: 5

NOT IN THE SCOPE OF WORK







KEY NOTES

1. REMOVE EXISTING UNIT VENTILATOR. CUT LOCALLY AND DISCONNECT FROM EXISTING CONTROLS AND POWER SUPPLY. REMOVE ALL REDUNDANT WIRING.
2. HORN TYPE SPEAKER 400MM BELOW CEILING TILES TO BE TEMPORALLY REMOVED AND INSTALLED BACK AFTER DUCTWORK COMPLETION.
3. REMOVE EXISTING WIRING FROM LIGHTS TO CONTROL PANEL. RE-USE EXISTING SWITCHES. REMOVE ALL REDUNDANT WIRING.
4. CLASSROOM PROJECTOR 600MM BELOW CEILING TILES TO BE TEMPORALLY REMOVED AND INSTALLED BACK AFTER DUCTWORK COMPLETION.
5. LOWER THE LIGHT FIXTURE AS REQUIRED IN ORDER TO ACCOMMODATE DUCTWORK.

GROUND FLOOR – EQUIPMENT LAYOUT – EXISTING & DEMOLITION WORK – ELELCTRICAL
SCALE: 1:100

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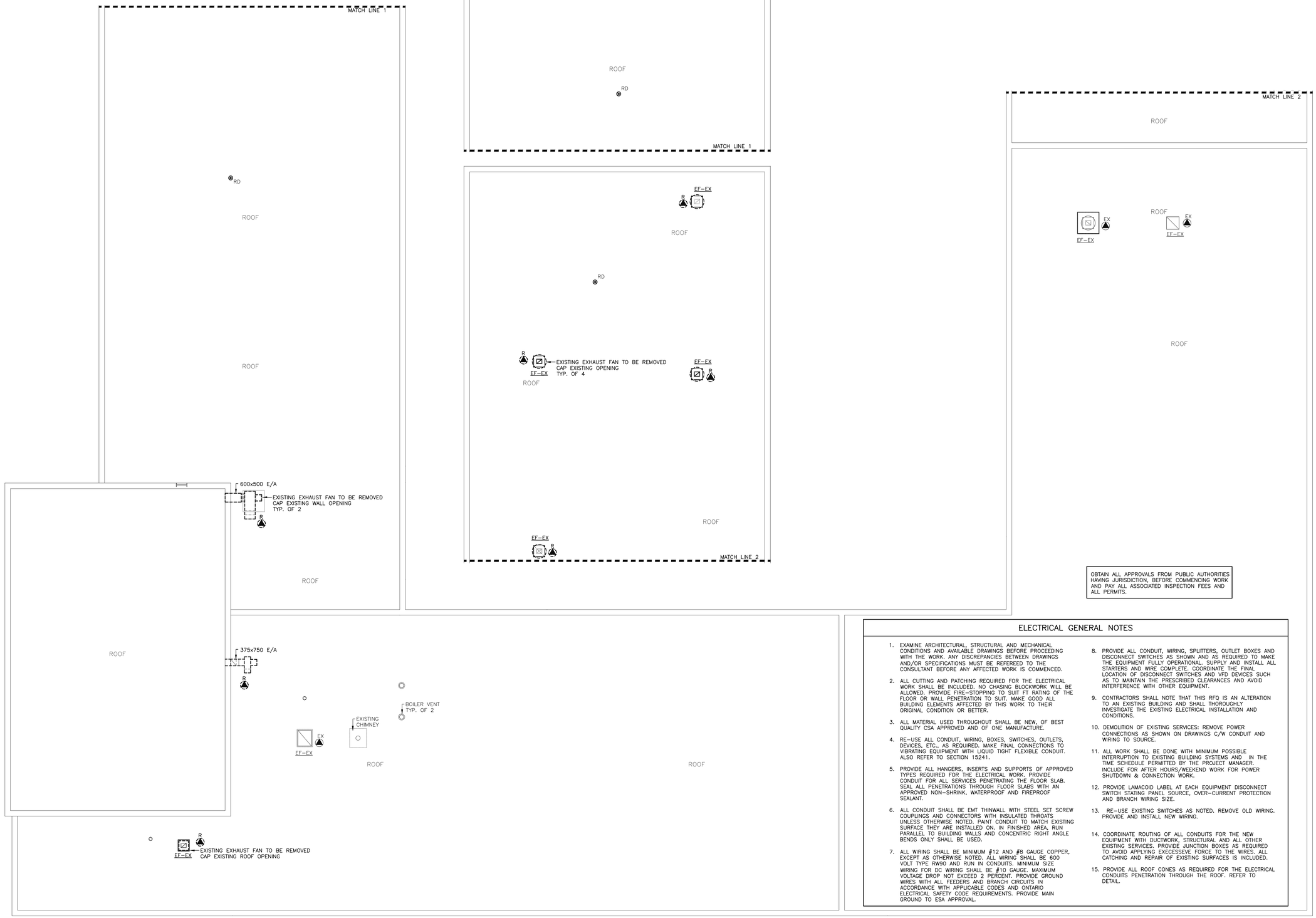
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Title:

GROUND FLOOR – EQUIPMENT & LIGHTING LAYOUT – EXISTING & DEMOLITION WORK – ELELCTRICAL

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2022-01	E-2.1
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ROOF PLAN – EQUIPMENT LAYOUT – EXISTING & DEMOLITION WORK – ELELCTRICAL
SCALE: 1:100

OBTAIN ALL APPROVALS FROM PUBLIC AUTHORITIES HAVING JURISDICTION, BEFORE COMMENCING WORK AND PAY ALL ASSOCIATED INSPECTION FEES AND ALL PERMITS.

ELECTRICAL GENERAL NOTES

1. EXAMINE ARCHITECTURAL, STRUCTURAL AND MECHANICAL CONDITIONS AND AVAILABLE DRAWINGS BEFORE PROCEEDING WITH THE WORK. ANY DISCREPANCIES BETWEEN DRAWINGS AND/OR SPECIFICATIONS MUST BE REFEREED TO THE CONSULTANT BEFORE ANY AFFECTED WORK IS COMMENCED.
2. ALL CUTTING AND PATCHING REQUIRED FOR THE ELECTRICAL WORK SHALL BE INCLUDED. NO CHASING BLOCKWORK WILL BE ALLOWED. PROVIDE FIRE-STOPPING TO SUIT FT RATING OF THE FLOOR OR WALL PENETRATION TO SUIT. MAKE GOOD ALL BUILDING ELEMENTS AFFECTED BY THIS WORK TO THEIR ORIGINAL CONDITION OR BETTER.
3. ALL MATERIAL USED THROUGHOUT SHALL BE NEW, OF BEST QUALITY CSA APPROVED AND OF ONE MANUFACTURE.
4. RE-USE ALL CONDUIT, WIRING, BOXES, SWITCHES, OUTLETS, DEVICES, ETC., AS REQUIRED. MAKE FINAL CONECTIONS TO VIBRATING EQUIPMENT WITH LIQUID TIGHT FLEXIBLE CONDUIT. ALSO REFER TO SECTION 15241.
5. PROVIDE ALL HANGERS, INSERTS AND SUPPORTS OF APPROVED TYPES REQUIRED FOR THE ELECTRICAL WORK. PROVIDE CONDUIT FOR ALL SERVICES PENETRATING THE FLOOR SLAB. SEAL ALL PENETRATIONS THROUGH FLOOR SLABS WITH AN APPROVED NON-SHRINK, WATERPROOF AND FIREPROOF SEALANT.
6. ALL CONDUIT SHALL BE EMT THINWALL WITH STEEL SET SCREW COUPLINGS AND CONNECTORS WITH INSULATED THROATS UNLESS OTHERWISE NOTED. PAINT CONDUIT TO MATCH EXISTING SURFACE THEY ARE INSTALLED ON. IN FINISHED AREA, RUN PARALLEL TO BUILDING WALLS AND CONCENTRIC RIGHT ANGLE BENDS ONLY SHALL BE USED.
7. ALL WIRING SHALL BE MINIMUM #12 AND #8 GAUGE COPPER, EXCEPT AS OTHERWISE NOTED. ALL WIRING SHALL BE 600 VOLT TYPE RW90 AND RUN IN CONDUITS. MINIMUM SIZE WIRING FOR DC WIRING SHALL BE #10 GAUGE. MAXIMUM VOLTAGE DROP NOT EXCEED 2 PERCENT. PROVIDE GROUND WIRES WITH ALL FEEDERS AND BRANCH CIRCUITS IN ACCORDANCE WITH APPLICABLE CODES AND ONTARIO ELECTRICAL SAFETY CODE REQUIREMENTS. PROVIDE MAIN GROUND TO ESA APPROVAL.
8. PROVIDE ALL CONDUIT, WIRING, SPLITTERS, OUTLET BOXES AND DISCONNECT SWITCHES AS SHOWN AND AS REQUIRED TO MAKE THE EQUIPMENT FULLY OPERATIONAL. SUPPLY AND INSTALL ALL STARTERS AND WIRE COMPLETE. COORDINATE THE FINAL LOCATION OF DISCONNECT SWITCHES AND VFD DEVICES SUCH AS TO MAINTAIN THE PRESCRIBED CLEARANCES AND AVOID INTERFERENCE WITH OTHER EQUIPMENT.
9. CONTRACTORS SHALL NOTE THAT THIS RFQ IS AN ALTERATION TO AN EXISTING BUILDING AND SHALL THOROUGHLY INVESTIGATE THE EXISTING ELECTRICAL INSTALLATION AND CONDITIONS.
10. DEMOLITION OF EXISTING SERVICES: REMOVE POWER CONNECTIONS AS SHOWN ON DRAWINGS C/W CONDUIT AND WIRING TO SOURCE.
11. ALL WORK SHALL BE DONE WITH MINIMUM POSSIBLE INTERRUPTION TO EXISTING BUILDING SYSTEMS AND IN THE TIME SCHEDULE PERMITTED BY THE PROJECT MANAGER. INCLUDE FOR AFTER HOURS/WEEKEND WORK FOR POWER SHUTDOWN & CONNECTION WORK.
12. PROVIDE LAMACOID LABEL AT EACH EQUIPMENT DISCONNECT SWITCH STATING PANEL SOURCE, OVER-CURRENT PROTECTION AND BRANCH WIRING SIZE.
13. RE-USE EXISTING SWITCHES AS NOTED. REMOVE OLD WIRING. PROVIDE AND INSTALL NEW WIRING.
14. COORDINATE ROUTING OF ALL CONDUITS FOR THE NEW EQUIPMENT WITH DUCTWORK, STRUCTURAL AND ALL OTHER EXISTING SERVICES. PROVIDE JUNCTION BOXES AS REQUIRED TO AVOID APPLYING EXCECSSEVE FORCE TO THE WIRES. ALL CATCHING AND REPAIR OF EXISTING SURFACES IS INCLUDED.
15. PROVIDE ALL ROOF CONES AS REQUIRED FOR THE ELECTRICAL CONDUITS PENETRATION THROUGH THE ROOF. REFER TO DETAIL.

Revisions

Ref.	No.	Description	Date	Initial
△	1	50% REVIEW 0	2022/02/17	
△	2	75% REVIEW	2022/03/09	
△	3	100% REVIEW	2022/03/31	
△	4	ISSUED FOR TENDER	2022/04/26	

Project:

GLADYS SPEERS PS
RENOVATIONS
2150 SAMWAY RD, OAKVILLE, ON L6L 2P6

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LICENSED PROFESSIONAL ENGINEER
APRIL, 2022
G. STRASHUN
PROVINCE OF ONTARIO

Consultant:

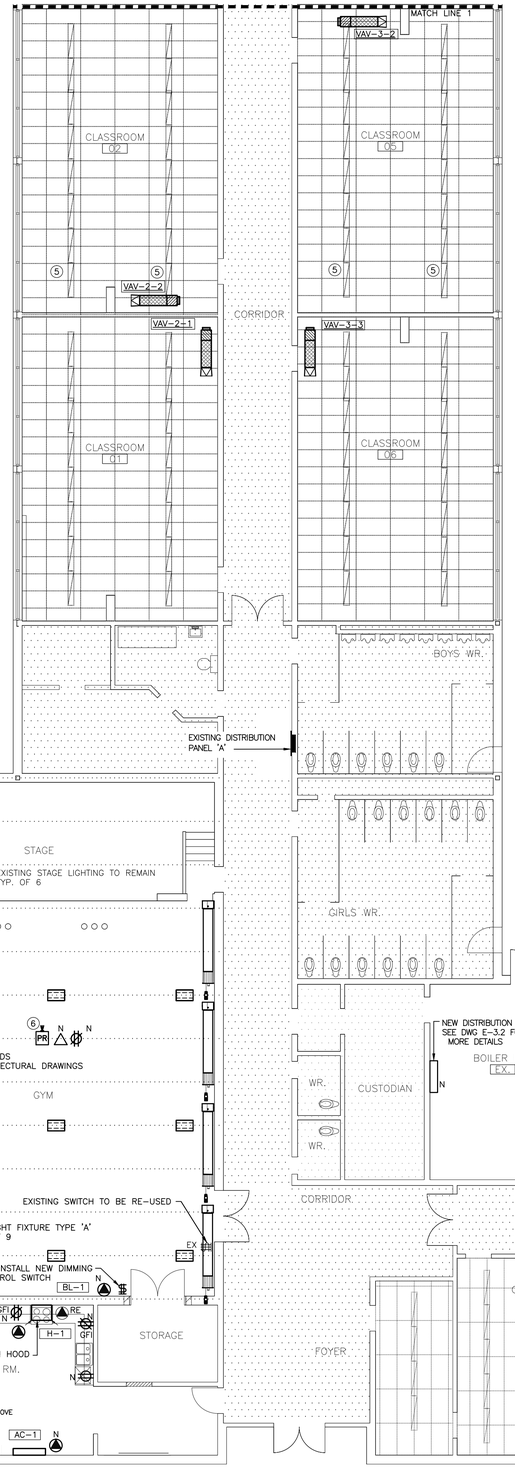
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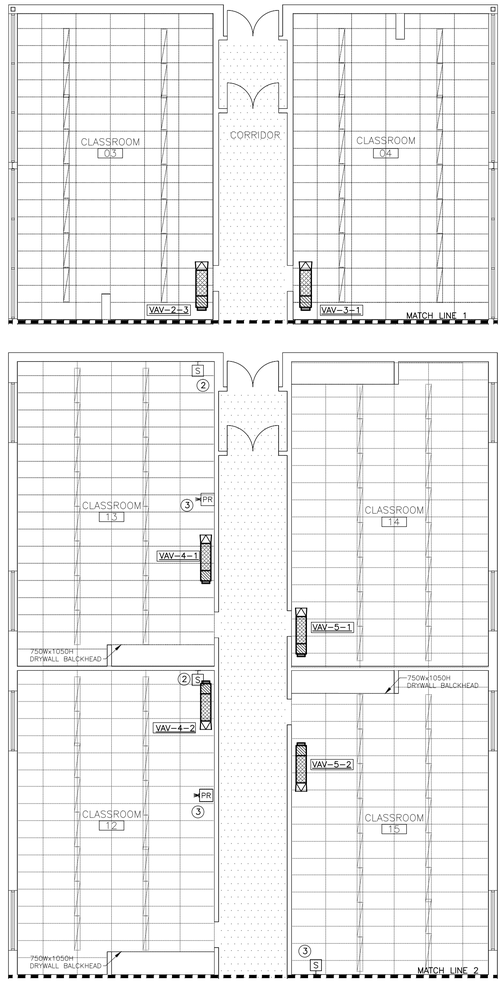
Title:

ROOF – EQUIPMENT LAYOUT
– EXISTING & DEMOLITION WORK
– ELECTRICAL

Drawn by: P.C.	Date: DECEMBER 2021
Checked by: O.S.	Plotted:
Scale: AS SHOWN	Issued:
Job No.: 2022-01	Drawing No.: E-2.2
Set No.:	of: 8

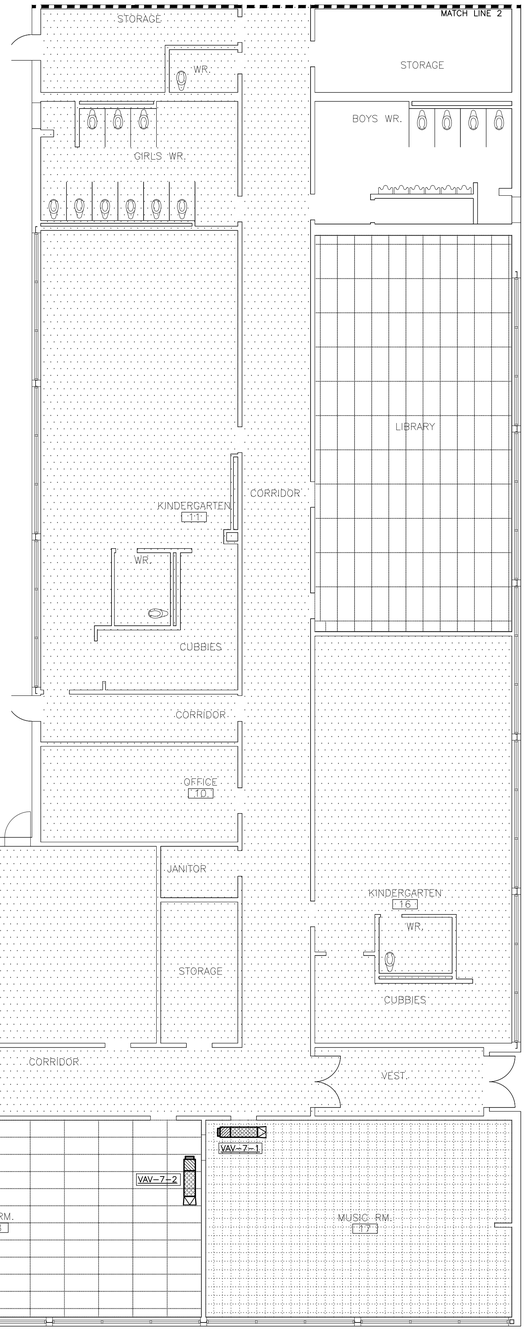
NOT IN THE SCOPE OF WORK


MATCH LINE 1
CLASSROOM 02
CLASSROOM 05
CLASSROOM 01
CLASSROOM 06
CORRIDOR
VAV-3-2
VAV-2-2
VAV-2-1
VAV-3-3
BOYS WR.
GIRLS WR.
EXISTING DISTRIBUTION PANEL 'A'
STAGE
EXISTING STAGE LIGHTING TO REMAIN TYP. OF 6
NEW POWER BLINDS REFER TO ARCHITECTURAL DRAWINGS FOR DETAILS
GYM
EXISTING SWITCH TO BE RE-USED
NEW LIGHT FIXTURE TYPE 'A' TYP. OF 9
PROVIDE & INSTALL NEW DIMMING SHADE CONTROL SWITCH
BL-1
H-1
NEW KITCHEN HOOD
STAFF RM.
STORAGE
LOCAL DISCONNECT ABOVE CEILING FOR AC-1
AC-1
NEW DISTRIBUTION PANEL 'DP-1' SEE DWG E-3.2 FOR MORE DETAILS
BOILER RM. EX.
CUSTODIAN
WR.
FOYER
OFFICE
CORRIDOR
KINDERGARTEN 07
CORR. 101
WR. 104
OFFICE 100
JK. RM. 9
JANITOR
STORAGE
KINDERGARTEN 16
CUBBIES
VEST.
JK. RM. 19
JK. RM. 18
MUSIC RM. 17
VAV-7-3
VAV-7-2
VAV-7-1


CLASSROOM 03
CORRIDOR
CLASSROOM 04
VAV-2-3
VAV-3-1
MATCH LINE 1
CLASSROOM 13
CLASSROOM 14
CLASSROOM 12
CLASSROOM 15
VAV-4-1
VAV-4-2
VAV-5-1
VAV-5-2
750Wx105DH DRYWALL BALCKHEAD
MATCH LINE 2

KEY NOTES

1. REMOVE EXISTING UNIT VENTILATOR. CUT LOCALLY AND DISCONNECT FROM EXISTING CONTROLS AND POWER SUPPLY. REMOVE ALL REDUNDANT WIRING.
2. HORN TYPE SPEAKER 400MM BELOW CEILING TILES TO BE TEMPORALLY REMOVED AND INSTALLED BACK AFTER DUCTWORK COMPLETION.
3. REMOVE EXISTING WIRING FROM LIGHTS TO CONTROL PANEL. RE-USE EXISTING SWITCHES. REMOVE ALL REDUNDANT WIRING.
4. CLASSROOM PROJECTOR 600MM BELOW CEILING TILES TO BE TEMPORALLY REMOVED AND INSTALLED BACK AFTER DUCTWORK COMPLETION.
5. LOWER THE LIGHT FIXTURE AS REQUIRED IN ORDER TO ACCOMMODATE DUCTWORK.
6. INSTALL NEW PROJECTOR IN THE GYMNASIUM AT HIGH LEVEL. FINAL LOCATION OF PROJECTOR TO BE DETERMINED ONCE PROJECTOR TYPE IS SELECTED. CONNECT NEW PROJECTOR TO DATA AND POWER CONNECTIONS AS SHOWN. COORDINATE INSTALLATION OF NEW PROJECTOR WITH NEW DUCTWORK AT HIGH LEVEL. PROVIDE ADEQUATE SUPPORTS. CONNECT NEW RECEPTACLE FOR PROJECTOR FROM THE NEAREST POWER SOURCE. ALL ROUGH-IN AND INSTALLATION COST FOR THE PROJECTOR SHALL BE INCLUDED IN THE BASE BID.



GROUND FLOOR – EQUIPMENT LAYOUT – NEW WORK – ELECTRICAL
SCALE: 1:100

Revisions

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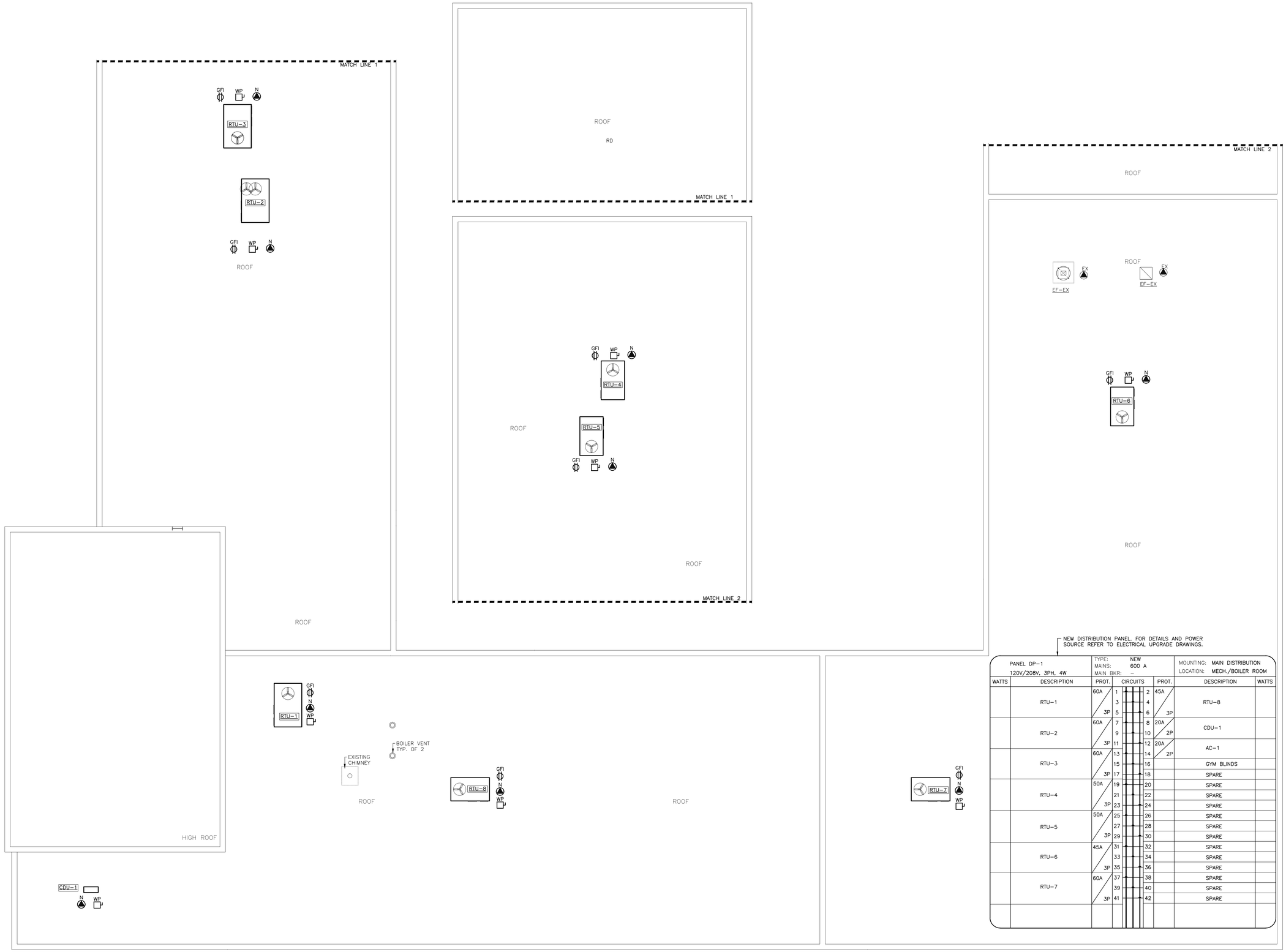
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Title:

GROUND FLOOR – EQUIPMENT & LIGHTING LAYOUT – NEW WORK – ELECTRICAL

Drawn by:	Date:
P.C.	DECEMBER 2021
Checked by:	**Plotted:**
O.S.	
Scale:	**Issued:**
AS SHOWN	
Job No.:	**Drawing No.:**
2022-01	E-3.1
Set No.:	of: 5



NEW DISTRIBUTION PANEL. FOR DETAILS AND POWER SOURCE REFER TO ELECTRICAL UPGRADE DRAWINGS.

PANEL DP-1
120V/208V, 3PH, 4W

TYPE: NEW
MAINS: 600 A
MAIN BKR: --

MOUNTING: MAIN DISTRIBUTION
LOCATION: MECH./BOILER ROOM

WATTS	DESCRIPTION	PROT.	CIRCUITS		PROT.	DESCRIPTION	WATTS
	RTU-1	60A 3P	1	2	45A 3P	RTU-8	
			3	4			
			5	6			
	RTU-2	60A 3P	7	8	20A 2P	CDU-1	
			9	10			
			11	12	20A 2P	AC-1	
	RTU-3	60A 3P	13	14			
			15	16		GYM BLINDS	
			17	18		SPARE	
	RTU-4	50A 3P	19	20		SPARE	
			21	22		SPARE	
			23	24		SPARE	
	RTU-5	50A 3P	25	26		SPARE	
			27	28		SPARE	
			29	30		SPARE	
	RTU-6	45A 3P	31	32		SPARE	
			33	34		SPARE	
			35	36		SPARE	
	RTU-7	60A 3P	37	38		SPARE	
			39	40		SPARE	
			41	42		SPARE	

ROOF PLAN – EQUIPMENT LAYOUT – NEW WORK – ELELCTRICAL
SCALE: 1:100

Revisions

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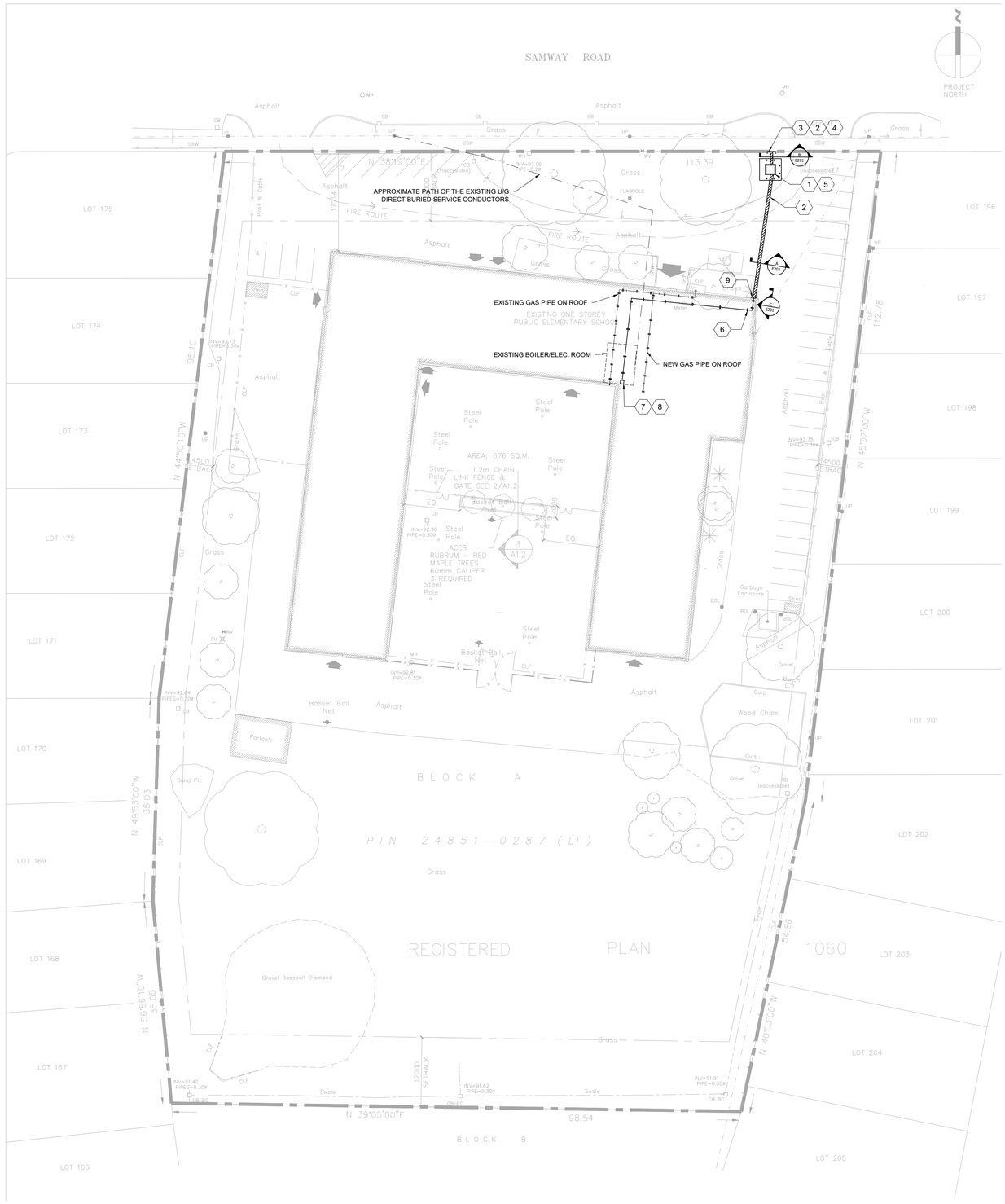
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Title:

ROOF – EQUIPMENT LAYOUT – NEW WORK – ELECTRICAL

Drawn by: P.C.	Date: DECEMBER 2021
Checked by: O.S.	Plotted:
Scale: AS SHOWN	Issued:
Job No.: 2022-01	Drawing No.: E-3.2
Set No.:	of: 5



GENERAL NOTES

1.1. PROVIDE ALL MATERIAL, EQUIPMENT AND LABOR REQUIRED TO CONSTRUCT, INSTALL, TEST AND COMPLETE A FULLY FUNCTIONING ELECTRICAL SYSTEM AS SHOWN ON THE DRAWINGS / SPECIFICATIONS. INCLUDE ALL ITEMS NECESSARY TO COMPLY WITH CODES AND AUTHORITIES HAVING JURISDICTION.

1.2. VISIT AND EXAMINE THE SITE CONDITIONS WHERE THE WORK IS TO BE DONE. REVIEW OTHER TRADES DRAWINGS AND SPECIFICATIONS AND INCLUDE THE COST ASSOCIATED WITH RELOCATING OR REROUTING OF THE ELECTRICAL EQUIPMENT. THERE WILL BE NO CONSIDERATION FOR EXTRAS FOR FAILURE TO COMPLY WITH THIS ITEM.

1.3. DEFINITIONS:
1.3.1. "PROVIDE": SUPPLY, INSTALL AND CONNECT
1.3.2. "INSTALL": INSTALL AND CONNECT

1.4. ALL WORK MUST BE PERFORMED IN ACCORDANCE WITH THE LATEST APPLICABLE ONTARIO BUILDING CODE AND CSA STANDARD C22.1—21 ONTARIO ELECTRICAL CODE, AND AHJ'S ADDITIONAL REQUIREMENTS OR INSTRUCTIONS.

1.5. THE CONTRACTOR IS RESPONSIBLE FOR OBTAINING AND PAYING FOR ALL PERMITS AND INSPECTIONS IN CONNECTION WITH THE WORK PRIOR TO STARTING THE WORK.

1.6. CARRY COSTS WITHIN BID FOR ALL BUILDING SHUTDOWNS TO BE DURING PREMIUM TIME. CONFIRM THE NORMAL OPERATION OF THE BUILDING AND OTHER EXISTING TENANTS WITH THE BUILDING OWNER. SHUTDOWN TIME AND DURATION SHALL BE CONFIRMED BY OWNER.

1.7. ALL CHANGE REQUESTS SHALL BE WITH ITEMIZED LABOUR AND MATERIAL BREAKDOWN.

1.8. ENSURE THAT ALL FLOOR PENETRATIONS AND SAW CUTTING IS APPROVED BY THE ARCHITECT, BUILDING OWNER AND STRUCTURAL ENGINEER PRIOR TO ANY CUTTING. PATCHING SHALL BY DONE BY THIS CONTRACTOR AND AS PER STRUCTURAL ENGINEER'S INSTRUCTIONS.

1.9. USE ONLY EXISTING T-BAR CEILING KNOCKOUTS FOR WIRE/CABLE OR CONDUIT. IF NEW HOLES ARE REQUIRED, THEY ARE TO BE DRILLED IN THE CENTRE OF THE T-BAR USING THE SAME DIAMETER HOLE AS THE EXISTING KNOCKOUT CAPS.

1.10. ALL MATERIALS AND EQUIPMENT SHALL BE NEW, C.S.A. CERTIFIED AND MANUFACTURED TO THE STANDARDS SPECIFIED.

1.11. WHERE THERE IS NO ALTERNATIVE TO SUPPLYING EQUIPMENT THAT IS NOT C.S.A. CERTIFIED, OBTAIN SPECIAL APPROVAL FROM THE LOCAL INSPECTION DEPARTMENT.

1.12. SUBMIT TO THE LOCAL ELECTRICAL INSPECTION DEPARTMENT, THE NECESSARY NUMBER OF DOCUMENTS FOR EXAMINATION, SPECIAL INSPECTION AND APPROVAL, PRIOR TO THE COMMENCEMENT OF THE WORK, AND PAY ALL COSTS AND ASSOCIATED FEES.

1.13. THE DRAWINGS FOR THE ELECTRICAL WORK ARE DIAGRAMMATIC PERFORMANCE DRAWINGS ONLY, INTENDED TO CONVEY THE SCOPE OF WORK AND INDICATE THE GENERAL ARRANGEMENT AND APPROXIMATE LOCATION OF ELECTRICAL EQUIPMENT. THE DRAWINGS DO NOT INTEND TO SHOW ARCHITECTURAL, INTERIOR DESIGN, MECHANICAL, STRUCTURAL OR BASE BUILDING DETAILS. CONTRACTOR SHALL BE RESPONSIBLE FOR A THOROUGH KNOWLEDGE OF SAME PRIOR TO PROCEEDING WITH THE WORK.

1.14. ANY DISCREPANCIES BETWEEN DRAWINGS AND/OR SPECIFICATIONS AND EXISTING CONDITIONS MUST BE REFERRED TO THE DESIGN CONSULTANT/ARCHITECT PRIOR TO ANY WORK.

1.15. MAKE, AT NO ADDITIONAL COST, ANY CHANGES OR ADDITIONS TO MATERIALS AND EQUIPMENT NECESSARY TO ACCOMMODATE STRUCTURAL CONDITIONS (OFFSETS AROUND BEAMS, COLUMNS, ETC.)

1.16. ACCESS PANELS MUST BE REVIEWED AND APPROVED BY OWNER PRIOR TO CLOSING CEILINGS.

2. BASE BUILDING REQUIREMENTS

2.0. ANY BASE BUILDING LIGHTING FIXTURES NOT BEING USED ARE TO BE RETURNED TO THE OWNER.

2.1. ALL RELOCATED BASE BUILDING LIGHTING FIXTURES MUST BE INDEPENDENTLY SUPPORTED FROM BUILDING STRUCTURE WITH TENSO CHAINS, MINIMUM OF TWO (2) POINTS.

2.2. CONTRACTOR MUST FOLLOW BASE BUILDING REQUIREMENTS AND TENANT IMPROVEMENT GUIDELINES PROVIDED DURING THE TENDER.

2.3. WHEN DELETING AND/OR MAKING SAFE EXISTING ELECTRICAL WORK, ENSURE THAT ALL DISCONNECTED WIRING IS CAPPED OFF.

2.4. EXISTING DEVICES DESIGNATED TO BE RELOCATED/REUSED SHALL BE INSPECTED AND REFURBISHED TO ENSURE CORRECT OPERATION WHEN PUT BACK INTO SERVICE AND MEETS ELECTRIC SAFETY INSPECTOR'S APPROVAL. OUTLET BOXES AND WIRING AND/OR CONDUITS THAT ARE CORRODED OR DAMAGED ARE TO BE REPLACED.

2.5. ALL EXISTING ELECTRICAL EQUIPMENT WHICH ARE NO LONGER REQUIRED SHALL BE REMOVED AND DISPOSED OF, OFF-SITE.

2.6. CONDUITS THAT ARE TO BE CUT BACK ARE TO TERMINATE IN A JUNCTION BOX.

2.7. CLEAN LUMINAIRE REFLECTORS AND LENSES, LAMPS, AND OTHER SURFACES THAT HAVE BEEN EXPOSED TO CONSTRUCTION DUST AND DIRT. CLEAN THE INSIDES AND OUTSIDES OF PANELBOARDS, SPLITTERS AND OTHER ELECTRICAL EQUIPMENT.

3. WORKMANSHIP

3.1. WORK SHALL BE PERFORMED BY LICENSED TRADESMEN SKILLED IN THE WORK TO BE PERFORMED. ONLY FIRST-CLASS WORKMANSHIP WILL BE ACCEPTED WITH RESPECT TO SAFETY, ACCESSIBILITY, DURABILITY, NEATNESS OF DETAIL, AND APPEARANCE.

3.2. ANY DAMAGE CAUSED TO THE PROPERTY OF THE OWNER THROUGH POOR WORKMANSHIP IS THE RESPONSIBILITY OF THE CONTRACTOR AND SHALL PAY FOR THE REPAIR OF SAME, WITHOUT EXPENSE TO THE OWNER.

4. CLEAN UP

4.1. CONSTRUCTION SITE SHALL BE KEPT CLEAN AND FREE FROM DEBRIS DURING THE DURATION OF THE PROJECT. CLEAN UP REFUSE, CAUSED BY ELECTRICAL WORK, DAILY FROM THE SITE, DISPOSE OF REFUSE AS DIRECTED BY THE GENERAL CONTRACTOR OR OWNER.

4.2. AFTER SUBSTANTIAL COMPLETION, REMOVE FROM THE PREMISES ALL SURPLUS AND WASTE MATERIAL AND DEBRIS. LEAVE THE SITE AND BUILDING IN CLEAN CONDITION.

5. TEMPORARY POWER

5.1. ELECTRICAL CONTRACTOR IS RESPONSIBLE TO CO-ORDINATE WITH OTHER TRADES AND OWNER TO PROVIDE TEMPORARY POWER C/W CORDS AND TEMP DISTRIBUTION SYSTEM AS REQUIRED DUE TO NEW CONSTRUCTION OR CONTINUITY OF SERVICE IN THE BASE BUILDING.

6. CUTTING AND PATCHING

6.1. ALL CUTTING AND PATCHING REQUIRED TO THE EXISTING BUILDING STRUCTURE FOR THE ELECTRICAL OPENING SHALL BE INCLUDED UNDER THIS CONTRACT AND BE ACCEPTABLE TO THE OWNER. OBTAIN WRITTEN APPROVAL FROM OWNER PRIOR TO ANY CUTTING IS CARRIED OUT.

6.2. ANY OPENING IN EXISTING STRUCTURE SHALL BE CO-ORDINATED, X-RAYED, CUT OR DRILLED AND PATCHED, AT THE EXPENSE OF THE ELECTRICAL CONTRACTOR, UNLESS OTHERWISE ADVISED BY THE GENERAL CONTRACTOR.

6.3. WHERE CONDUITS OR OTHER ELECTRICAL EQUIPMENT PASS THROUGH FIRE-RATED WALLS OR FLOORS, PROVIDE FIRE-STOPPING MATERIAL LISTED WITH, AND BEAR LABEL OF CSA AND ULC, AND MAINTAIN SAME FIRE RATING OF BUILDING COMPONENT PENETRATION.

7. SHOP DRAWINGS

7.1. SUBMIT SHOP DRAWINGS FOR LIGHTING FIXTURES, PANELBOARDS, TRANSFORMERS, AND OTHER MAJOR ELECTRICAL EQUIPMENT/SYSTEMS AS REQUESTED BY THE ELECTRICAL ENGINEER FOR APPROVAL.

8. WARRANTY

8.1. CONTRACTOR SHALL PROVIDE A WRITTEN WARRANTY OF ALL MATERIALS, EQUIPMENT AND WORKMANSHIP UNDER THIS DIVISION FOR A PERIOD OF ONE (1) YEAR, COMMENCING ON THE DATE OF SUBSTANTIAL PERFORMANCE OR ACCEPTANCE OF THE COMPLETED PORTION BY THE ARCHITECT/INTERIOR DESIGNER/ PROJECT MANAGER, WHICHEVER DATE IS LATER.

9. AS-BUILT DRAWINGS

- UPON COMPLETION OF WORK, ELECTRICAL CONTRACTOR SHALL PROVIDE THESE (3) SETS OF WHITE PRINTS TO REFLECT 'AS-BUILT' CONDITIONS. 'AS-BUILT' DRAWINGS SHALL INCORPORATE ANY CHANGES OR DEVIATIONS FROM THE TENDER DOCUMENTS.
- CONTRACTOR SHALL ALSO PROVIDE ELECTRONIC FILES IN AUTOCAD FORMAT IN A CD DISK TO REFLECT 'AS-BUILT' CONDITIONS.
- CONTRACTOR TO MARK THE DRAWINGS AS 'AS-BUILT' ALONG WITH ELECTRICAL CONTRACTORS COMPANY NAME.

10. CLOSE-OUT DOCUMENTS

SUBMIT 3 CDS OF ELECTRONIC COPY AND ONE 3-RING BINDER OF HARD COPY OF THE CLOSEOUT DOCUMENTS WHICH SHALL INCLUDE BUT NOT BE LIMITED TO:

- ESA INSPECTION REPORT AND FINAL CERTIFICATE
- STAMPED APPROVED SHOP DRAWINGS
- WARRANTY LETTER
- AS-BUILT DRAWING (CAD 2004 FILE AND PDF FORMAT)
- FIRE ALARM VERIFICATION REPORT

DESIGN NOTES:

1. PROPOSED LOCATION FOR NEW 225KVA PAD MOUNTED TRANSFORMER SUPPLIED AND INSTALLED BY UTILITY. EXACT LOCATION AND ORIENTATION TO BE CONFIRMED BY UTILITY PRIOR TO CONSTRUCTION.
2. ALL DUCT BANKS TO BE PROVIDED BY ELECTRICAL CONTRACTOR.
3. PRIMARY CABLES TERMINATION TO THE TRANSFORMER BY UTILITY.
4. COORDINATE WITH UTILITY TO PROVIDE NEW PRIMARY SERVICE FROM UTILITY POLE TO PRIMARY DUCT BANKS INSIDE THE SCHOOL PROPERTY ZONE.
5. ELECTRICAL CONTRACTOR TO PROVIDE CABLES, GROUNDING, GUARD POSTS AND FOUNDATION FOR THE NEW SERVICE AS PER UTILITY AND ESA REQUIREMENTS.
6. PROVIDE SUPPORT FOR SERVICE CONDUITS ON WALL AND ROOF. COORDINATE WITH MECHANICAL AND ROOF CONTRACTOR FOR THE EXACT CONDUIT PATH AND ELEVATION.
7. NEW DOGHOUSE ABOVE THE ELECTRICAL ROOM TO BE USED FOR TERMINATION OF CONDUCTORS TO NEW 600A/3P FUSED SERVICE DISCONNECT.
8. COORDINATE WITH THE ROOFING CONTRACTOR FOR THE EXACT LOCATION AND SIZE OF THE DOGHOUSE. REFER TO THE STRUCTURAL DRAWINGS FOR DOGHOUSE AND ROOFTOP CONDUIT SUPPORT DETAIL.
9. CONDUIT STUB UP POINT AND CONNECTION FROM RIGID PVC TO RIGID GALVANIZED STEEL FOR EXTERIOR RUN.
10. CONTRACTOR TO INFORM UTILITY WHEN DUCT INSTALLATION IS READY FOR INSPECTION. THIS SHALL BE DONE BEFORE ANY BACKFILL.
11. COORDINATE AND INFORM ESA FOR ALL REQUIRED INSPECTIONS DURING CONSTRUCTION.
12. THE EXACT DUCT BANK PATH SHALL BE DETERMINED IN COORDINATION WITH UTILITY AND EXISTING UNDERGROUND SERVICES. FOLLOW ALL REQUIRED CLEARANCE FROM OTHER UNDERGROUND SERVICES. ANY REQUIRED CROSSOVER WITH THE EXISTING SERVICES SHALL MEET OAKVILLE HYDRO AND CORRESPONDING SERVICE PROVIDER.
13. **RESTORE ALL SITE SURFACES TO THE PREVIOUS CONDITION. REINSTALL ASPHALT, LANDSCAPING, CONCRETE PAVEMENT, CURBS.**

BUILDING ELECTRICAL SERVICE SIZE CALCULATION BASED ON RULE 8-204 OF OESC.

1.	TOTAL AREA	3,000 m^2
2.	TOTAL CLASSROOM AREA	1,450 m^2
3.	BASIC LOAD (CLASSROOM @ 50W/m^2)	72,500 W
4.	BASIC LOAD @ 10W/m^2	15,500 W
5.	OTHER LOADS	115,425 W
6.	TOTAL (BY ADDING 3,4 & 5)	203,425 W
7.	LESS ELEC. HEATING	N/A
8.	LOAD PER SQUARE METER	67.81 W/m^2
9.	TOTAL LOAD WITH DEMAND FACTORS	116,969 W
10.	CONTINUOUS LOAD (X1.25)	146,212 W
11.	MINIMUM SERVICE SIZE @ 208V/3Ø	405.85 A (600A)

MAXIMUM SHORT CIRCUIT AT MAIN SERVICE DISCONNECT

1. INFINITE SHORT CIRCUIT ON PRIMARY
2. 225KVA TRANSFORMER WITH 2% IMPEDANCE
3. AVAILABLE SHORT CIRCUIT AT SECONDARY TERMINALS: 31,200KA
4. CONSIDERING 60m SECONDARY SERVICE LENGTH
5. MAXIMUM AVAILABLE SHORT CIRCUIT AT MAIN SERVICE DISCONNECT 14.5KA

ALL NEW EQUIPMENT TO BE RATED FOR MINIMUM 22KAIC.

Revisions

Ref.	No.	Description	Date	Initial
△	1	50% REVIEW	2022/02/17	
△	2	OAKVILLE HYDRO	2022/04/19	
△	3	ESA PLAN REVIEW	2022/04/20	
△	4	TENDER	2022/04/21	

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APR.21, 2022
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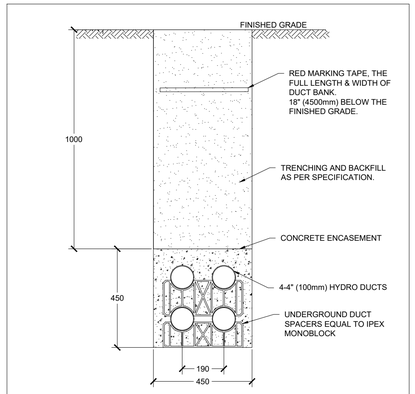
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Title:

ELECTRICAL SERVICES SITE PLAN

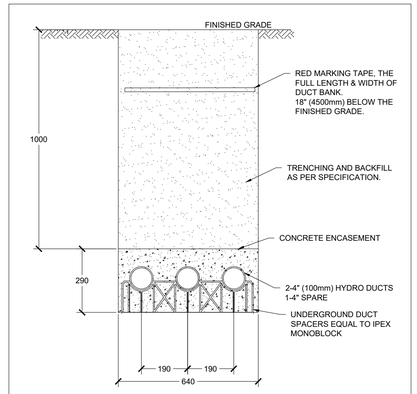
Drawn by: K.N.	Date: APRIL 2022
Checked by: K.N.	Plotted:
Scale: AS SHOWN	Issued:
Job No.: 2022–04	Drawing No.: **E-200**
Set No.:	of:



1. ENCASE DUCTS IN 20 MPa CONCRETE ON 1/2" (13mm) PEA GRAVEL.
2. SLOPE DUCT BANK A MINIMUM OF 3" (75mm) PER 100' (30.5M) (AWAY FROM BUILDING).
3. CONCRETE ENCASED DUCTS SHALL BE CSA APPROVED PVC TYPE II.
4. PROVIDE 1-3/16" (4.75mm) MIN. POLYPROPYLENE FISH ROPE IN EACH CONCRETE ENCASED OR DIRECT BURIED DUCT. SEAL DUCT ENDS WITH AN APPROVED DUCT PLUG.

EXACT CONSTRUCTION DETAILS SHALL CONFORM TO LOCAL UTILITY REQUIREMENTS AND DETAILS.

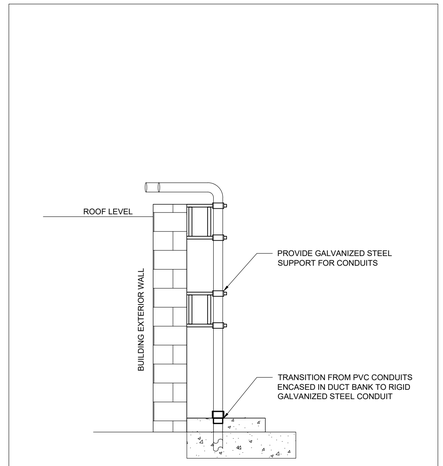
A / E-201 SECONDARY DUCT BANK
NTS



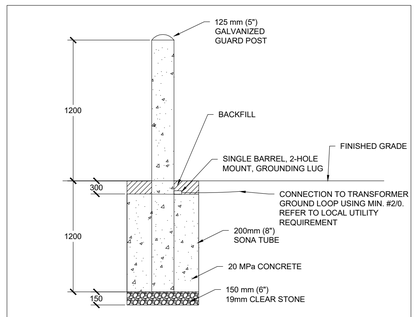
1. ENCASE DUCTS IN 20 MPa CONCRETE ON 1/2" (13mm) PEA GRAVEL.
2. SLOPE DUCT BANK A MINIMUM OF 3" (75mm) PER 100' (30.5M) (AWAY FROM BUILDING).
3. CONCRETE ENCASED DUCTS SHALL BE CSA APPROVED PVC TYPE II.
4. PROVIDE 1-3/16" (4.75mm) MIN. POLYPROPYLENE FISH ROPE IN EACH CONCRETE ENCASED OR DIRECT BURIED DUCT. SEAL DUCT ENDS WITH AN APPROVED DUCT PLUG.

EXACT CONSTRUCTION DETAILS SHALL CONFORM TO LOCAL UTILITY REQUIREMENTS AND DETAILS.

B / E-201 PRIMARY DUCT BANK
NTS



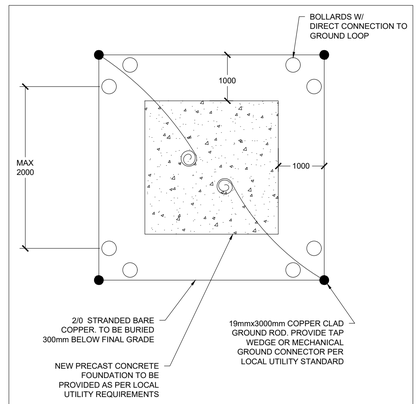
C / E-201 U/G TO OUTDOOR TRANSITION
NTS



1. NUMBER OF GUARD POSTS AND LOCATIONS SHOWN ARE TYPICAL ARRANGEMENTS. ACTUAL NUMBER OF GUARD POSTS AND LOCATION SHALL BE PROVIDED AS PER LOCAL UTILITY REQUIREMENT.
2. PAINT GUARD POST WITH SAFETY YELLOW PAINT. FOR PROPER ADHESION OF PAINT, GUARD POST SHALL BE CLEANED AND PRIMED PRIOR TO PAINTING. A REFLECTIVE STRIP IF REQUIRED SHALL BE PLACED AT EACH POST.
3. CONTRACTOR TO INSTALL A 300mm CONSTRUCTION JOINT AROUND THE GUARD POSTS EXCEPT IN GRASSY BOULEVARDS.

EXACT CONSTRUCTION DETAILS SHALL CONFORM TO LOCAL UTILITY REQUIREMENTS AND DETAILS.

D / E-201 BOLLARD MOUNTING DETAIL
NTS



1. LEAVE MIN. 3.0m COILED GROUND CONDUCTORS INSIDE FOUNDATION.
2. ALL POWER AND GROUND CONDUCTORS TO INSIDE FOUNDATION THROUGH DUCT FACE. SEAL ALL DUCT ENTRIES WITH FOAM OR APPROVED EQUIVALENT.
3. PROVIDE SOAK PIT AS PER LOCAL UTILITY REQUIREMENTS.

EXACT CONSTRUCTION DETAILS SHALL CONFORM TO LOCAL UTILITY REQUIREMENTS AND DETAILS.

E / E-201 PAD MOUNTED XFMR GROUNDING
NTS

Revisions

Ref.	No.	Description	Date	Initial
△	1	50% REVIEW	2022/02/17	
△	2	OAKVILLE HYDRO	2022/04/19	
△	3	ESA PLAN REVIEW	2022/04/20	
△	4	TENDER	2022/04/21	

Project:

GLADYS SPEERS PS
RENOVATIONS
2150 SAMWAY RD, OAKVILLE, ON L6L 2P6

iu im Architects inc.

Unit 100 – 706 Euclid Avenue
Toronto, Ontario, Canada M6G 2T9
Tel:(416)591–6575 Fax:(416)591–1010

LICENSED PROFESSIONAL ENGINEER
K. NAJAFZADEH
100510929
APR.21, 2022
PROVINCE OF ONTARIO

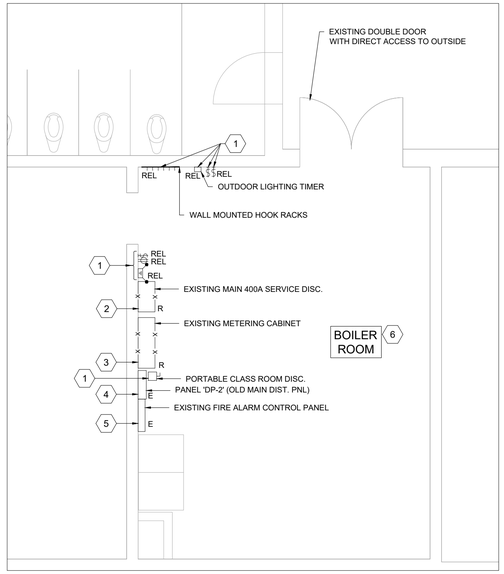
Consultant:

SAB ENGINEERING Inc.
588 EDWARD AVE., UNIT 25, RICHMOND HILL, ONT., L4C 9Y6
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Title:

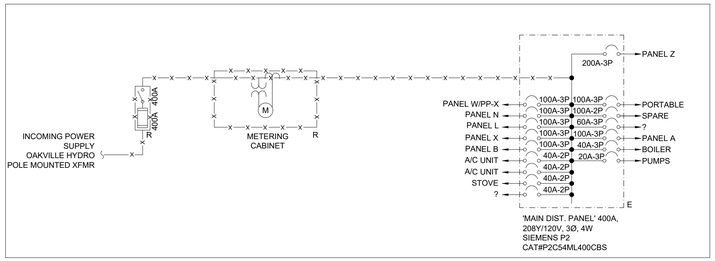
ELECTRICAL SERVICES DETAILS

Drawn by:	Date:
K.N.	APRIL 2022
Checked by: K.N.	Plotted:
Scale: AS SHOWN	Issued:
Job No.: 2022–04	Drawing No.: **E-201**
Set No.:	of:



1 BOILER ROOM - DEMO WORK

Scale: 1:50



2 SINGLE LINE DIAGRAM - DEMO WORK

NTS

DEMO NOTES:

1. ALLOW FOR RELOCATION OF THE EXISTING EQUIPMENT TO MAKE SPACE READY FOR NEW INSTALLATION.
2. REMOVE THE EXISTING 400A FUSED DISCONNECT SWITCH C/W WIRING AND CONDUIT. REMOVE THE SERVICE CONDUCTOR GUARDS. PATCH, REPAIR AND PAINT CONDUCTOR PENETRATION POINT ON BOILER ROOM FLOOR TO MATCH EXISTING.
3. EXISTING OAKVILLE HYDRO METERING TO BE REMOVED.
4. EXISTING MAIN PANEL TO REMAIN, RE-FED AND RENAME AS SHOWN IN THE NEW CONSTRUCTION NOTES.
5. EXISTING FIRE ALARM CONTROL PANEL TO REMAIN.
6. ALLOW FOR RELOCATION OF ANY WALL/CEILING MOUNTED EQUIPMENT AS REQUIRED FOR NEW SERVICE AND DOGHOUSE INSTALLATION.

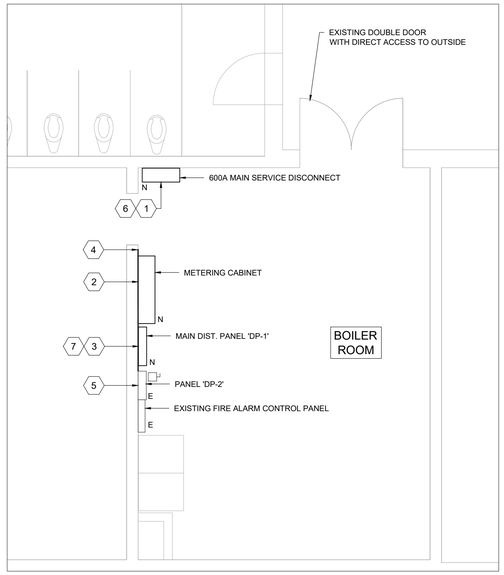
ELECTRICAL LEGEND	
ABBREVIATION	
E	EXISTING TO REMAIN
R	EXISTING TO BE DEMOLISHED/REMOVED
N	NEW MATERIAL/EQUIPMENT/SERVICES
REL	MATERIAL/EQUIPMENT/SERVICES TO BE RELOCATED.
ER	EXISTING IN RELOCATED POSITION
WP	WEATHER PROOF
NIC	NOT IN CONTRACT
SINGLE LINE DIAGRAM	
	CIRCUIT BREAKER
	DRAWOUT CIRCUIT BREAKER
	FUSED SWITCH
	POWER DISTRIBUTION TRANSFORMER
M M	METER - METERING CABINET
	AUTOMATIC TRANSFER SWITCH (CIRCUIT BREAKER TYPE)
	AUTOMATIC TRANSFER SWITCH (NON-CIRCUIT BREAKER TYPE)

Revisions

Ref.	No.	Description	Date	Initial
△	1	50% REVIEW	2022/02/17	
△	2	OAKVILLE HYDRO	2022/04/19	
△	3	ESA PLAN REVIEW	2022/04/20	
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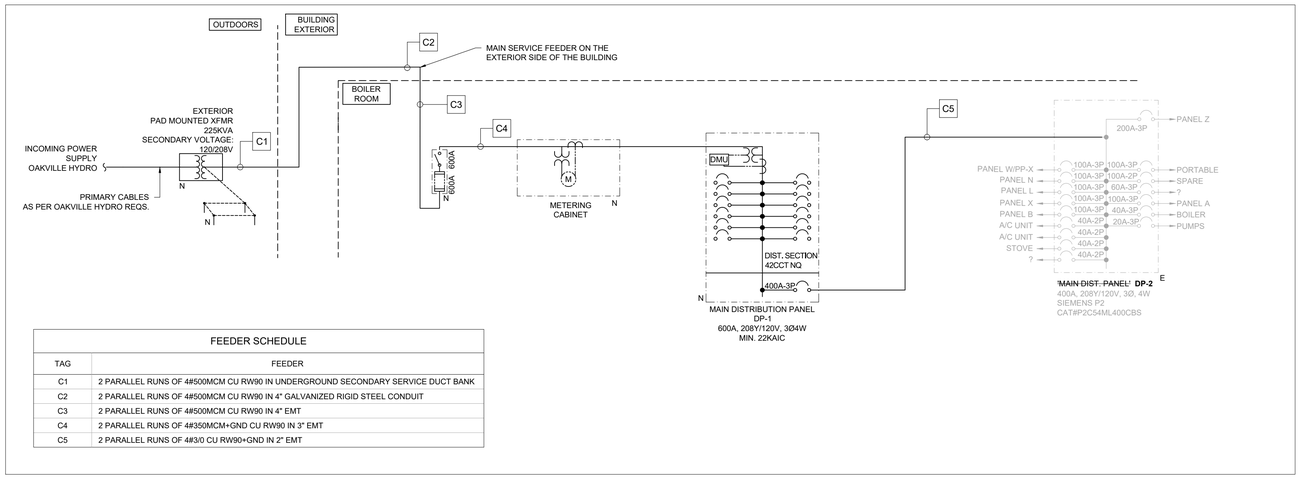
Project:

GLADYS SPEERS PS
RENOVATIONS
2150 SAMWAY RD, OAKVILLE,
ON L6L 2P6



3 BOILER ROOM - NEW WORK

Scale: 1:50



FEEDER SCHEDULE	
TAG	FEEDER
C1	2 PARALLEL RUNS OF 4#500MCM CU RW90 IN UNDERGROUND SECONDARY SERVICE DUCT BANK
C2	2 PARALLEL RUNS OF 4#500MCM CU RW90 IN 4" GALVANIZED RIGID STEEL CONDUIT
C3	2 PARALLEL RUNS OF 4#500MCM CU RW90 IN 4" EMT
C4	2 PARALLEL RUNS OF 4#350MCM+GND CU RW90 IN 3" EMT
C5	2 PARALLEL RUNS OF 4#3/0 CU RW90+GND IN 2" EMT

4 SINGLE LINE DIAGRAM - NEW WORK

NTS

DESIGN NOTES:

1. PROVIDE AND INSTALL NEW 600A FUSED DISCONNECT SWITCH, RATED FOR SERVICE ENTRANCE EQUIPMENT C/W SYSTEM BACKBOARD AND FEEDERS AS SHOWN IN THE SINGLE LINE DIAGRAM.
2. PROVIDE AND INSTALL NEW 1200mmX1200mmX300mm METERING CABINET C/W REMOVABLE 1100mmX1100mm BACK-PLATE AS PER OAKVILLE HYDRO REQUIREMENTS.
3. PROVIDE AND INSTALL NEW 600A, 120/208V, 3Ø4W MAIN DISTRIBUTION PANEL C/W A DIGITAL METERING UNIT AND BRANCH CIRCUITS AS SHOWN IN THE SLD. NEW MAIN DISTRIBUTION PANEL MUST COMPLETE WITH AT LEAST 42CCT NQ DISTRIBUTION TO BE USED FOR NEW HVAC EQUIPMENT INSTALLATION.
4. EXTEND THE EXISTING SYSTEM BACKBOARD TO SUITE NEW EQUIPMENT INSTALLATION.
5. RENAME THE OLD MAIN DISTRIBUTION PANEL TO PANEL 'DP-2'. PROVIDE AND INSTALL LAMACOID LABEL. PROVIDE AN UPDATE, TYPED, PRINTED PANEL SCHEDULE TO REPLACE THE EXISTING SCHEDULE.
6. COORDINATE WITH ROOFING CONTRACTOR FOR THE EXACT LOCATION AND SIZE OF THE NEW DOGHOUSE. ALLOW FOR RELOCATION OF THE EXISTING EQUIPMENT IN BOILER ROOM AS REQUIRED.
7. PANEL 'DP-1' SPECIFICATION & FEATURES
   - ENCLOSURE TYPE 2, WITH DOOR AND LOCK
   - BOX CAT# MH68HH
   - DIMENSIONS: 74"H x 27"W x 5.75"D
   - BUSSING: 600A RATED COPPER BUS, SILVER/TIN PLATED
   - DRIP HOOD
   - INCREASE TOP END GUTTER 6"
   - BRANCH USER PLACEMENT
   - SOLID NEUTRAL
   - INCREASE LEFT SIDE GUTTER 7"
   - GROUND BAR
   - PM5563 W/ DISPLAY
   - TOP FEED
   - 22KA SCCR
   - MAIN LUG 600A
   - APPROVED VENDOR: SQUARE D

GENERAL SERVICE UPGRADE NOTES:

1. CHECK THE SITE AND DO ALL REQUIRED MEASURING. CHECK THE REQUIRED BENDING RADIUS FOR ALL FEEDERS AND BRANCH CIRCUITS PRIOR ORDERING EQUIPMENT.
2. CHECK THE PHASE ROTATION BEFORE AND AFTER SERVICE CHANGE OVER.
3. REFER TO THE STRUCTURAL DRAWINGS FOR CONDUIT ROOF TOP SUPPORT AND DOGHOUSE DETAILS.
4. PROPERLY SEAL ALL CONDUITS TO AVOID ANY CONDENSATION BUILDUP AS PER OESC RULE 6-312.
5. MODIFY THE EXISTING BUILDING GROUNDING AS REQUIRED TO SUITE NEW WORK AND OESC REQUIREMENTS.

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Title:

ELECTRICAL SERVICES FLOOR PLAN & SINGLE LINE DIAGRAM

Drawn by: K.N.	Date: APRIL 2022
Checked by: K.N.	Plotted:
Scale: AS SHOWN	Issued:
Job No.: 2022–04	Drawing No.: **E-300**
Set No.:	of: