

**CARP**  
**HANGAR DOOR**  
**REPLACEMENT**  
Ontario

ARCHITECTURAL SPECIFICATIONS  
**Woodman Architect & Associates Ltd.**

**Project No.: PTS 3447**

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**PART 1 GENERAL**

**1.1 Time of Completion**

- .1 Commence work in accordance with notification of acceptance of your offer and complete the work by March 28, 2016.
- .2 Contractors are advised that the Client will be implementing a series of projects at the above project location. Though each of these projects are independent from the other, cooperation and coordination is required in common service areas including, but not limited to the security check points, load dock facilities, site access and parking. No contractor will have exclusive use of any of these common services areas. The successful bidder for this project will be further briefed and provided with information on all other active projects at the project start-up meeting.
- .3 All correspondence shall include the project number, be in electronic format (signed documents and 3 copies of O & M manual excluded). Hard copies and faxes will not be accepted.

**1.2 Minimum Standards**

- .1 All materials shall be new and work shall conform to the minimum applicable standards of the Canadian General Standards Board, the Canadian Standards Association, the National Building Code of Canada 2010 (NBC) and all applicable Provincial and Municipal codes. In the case of conflict or discrepancy the most stringent requirement shall apply.

**1.3 Shop Drawings**

- .1 Submit for the Departmental Representative's review, five (5) copies of each shop drawing or a clear precise electronic copy.
- .2 The review is for the sole purpose of ascertaining conformance with the general design concept, and does not mean approval of the design details inherent in the shop drawings, responsibility for which shall remain with the Contractor. Such review shall not relieve the Contractor of responsibility for errors or omissions in the shop drawings or of this responsibility for meeting all requirements of the Contract Documents.
- .3 Do not commence manufacture or order materials before shop drawings are reviewed.

**1.4 Samples**

- .1 Samples: examples of materials, equipment, quality, finishes, workmanship.
- .2 Where colour, pattern or texture is criterion, submit full range of samples.
- .3 Reviewed and accepted samples will become standard of workmanship and material against which installed work will be verified.

**1.5 Product Data**

- .1 Product data: manufacturers catalogue sheets, brochures, literature, performance charts and diagrams, used to illustrate standard manufactured products.

- .2 Submit five (5) copies of product data or a clear precise electronic copy.
- .3 Delete information not applicable to project.
- .4 Cross-reference product data information to applicable portions of Contract Documents.

**1.6 Taxes**

- .1 Pay all taxes properly levied by law (including Federal, Provincial and Municipal).

**1.7 Fees, Permits, and Certificates**

- .1 Pay all fees and obtain all permits. Provide authorities with plans and information for acceptance certificates. Provide inspection certificates as evidence that work conforms to requirements of Authority having jurisdiction.

**1.8 Fire Safety Requirements**

- .1 Comply with the National Building Code of Canada 2010 (NBC) for fire safety in construction and the National Fire Code of Canada 2010 (NFC) for fire prevention, fire fighting and life safety in building in use.
- .2 Comply with Human Resources Skills Development Canada (HRSDC), Fire Commissioner of Canada (FCC) standards:
  - .1 No. 301: Standard for Construction Operations.
  - .2 No. 302: Standard for Welding and Cutting
  - .3 No. 374: Fire Protection Standard for General Storage (Indoor and Outdoor)
  - .4 Available from Fire Protection Engineering Services, Labour Program, HRSDC or following internet site:  
<http://esdc.gc.ca>
  - .5 Retain all fire safety documents and standards on site.
- .3 Welding and cutting:
  - .1 At least 48 hours prior to commencing cutting, welding or soldering procedure, provide to Departmental Representative:
  - .2 Notice of intent, indicating devices affected, time and duration of isolation or bypass.
  - .3 Completed welding permit as defined in FC 302.
  - .4 Return welding permit to Departmental Representative immediately upon completion of procedures for which permit was issued.
  - .5 A fire watcher as described in FC 302 shall be assigned when welding or cutting operations are carried out in areas where combustible materials within 10m may be ignited by conduction or radiation.

- .4 Where work required interruption of fire alarms or fire suppression, extinguishing or protection systems:
  - .1 Provide watchman service as described in FC 301: In general, watchman service is defined as an individual conversant with Fire Emergency Procedures, performing fire picket duty within an unprotected and unoccupied (no workers) area once per hour.
  - .2 Retain services of manufacturer for fire protection systems on daily basis or as approved by FCC, to isolate and protect all devices relating to:
    - .1 Modification of fire alarms, fire suppression, extinguishing or protection systems; and/or,
    - .2 Cutting, welding, soldering or other construction activities, which might activate fire protection systems.
- .5 Immediately upon completion of work, restore fire protection systems to normal operation and verify that all devices are fully operational.
- .6 Inform fire alarm system monitoring agency and local Fire Department immediately prior to isolation and immediately upon restoration of normal operation.

#### **1.9 Field Quality Control**

- .1 Carry out work using qualified licensed workers or apprentices in accordance with Provincial Act respecting manpower vocational training and qualification.
- .2 Permit employees registered in Provincial apprenticeship program to perform specific tasks only if under direct supervision of qualified licensed workers.
- .3 Determine permitted activities and tasks by apprentices, based on level of training attended and demonstration of ability to perform specific duties.

#### **1.10 Hazardous Materials**

- .1 Comply with the requirements of the Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials; and regarding labeling and the provision of Material Safety Data Sheets (MSDS) acceptable to Human Resources Development Canada, Labour Program.
- .2 For work in occupied buildings give the Departmental Representative 48 hours notice for work involving [designated substances (Ontario Bill 208)], hazardous substances (Canada Labour Code Part II Section 10), and before painting, caulking, installing carpet or using adhesives.

#### **1.11 Temporary Utilities**

- .1 Existing services required for the work, [excluding power required for space heating], may be used by the Contractor without charge. Ensure capacity is adequate prior to imposing additional loads. Connect and disconnect at own expense and responsibility.
- .2 Notify the Departmental Representative and utility companies of intended interruption of services, obtain requisite permission.

- .3 Give the Departmental Representative 48 hours notice related to each necessary interruption of any mechanical or electrical service throughout the course of the work.

Keep duration of these interruptions to a minimum. Carry out all interruptions after normal working hours of the occupants, preferably on weekends.

#### **1.12 Removed Materials**

- .1 Unless otherwise specified, materials for removal become the Contractor's property and shall be taken from site.

#### **1.13 Protection**

- .1 Protect finished work against damage until take-over.
- .2 Protect adjacent work against the spread of dust and dirt beyond the work areas.
- .3 Protect operatives and other users of site from all hazards.

#### **1.14 Use of Site and Facilities**

- .1 Execute work with least possible interference or disturbance to the normal use of premises. Make arrangements with Departmental Representative to facilitate work as slated. Refer to article 1.34 Scheduling below for work that must be done during "off hours".
- .2 Maintain existing services to building and provide for personnel and vehicle access.
- .3 Where security is reduced by work provide temporary means to maintain security.
- .4 Where elevators, dumbwaiters, conveyors or escalators exist, Contractor may use these at Departmental Representative's discretion. Protect from damage, safety hazards and overloading of existing equipment.
- .5 Sanitary facilities will be assigned for Contractor's personnel. Others shall not be used. Keep facilities clean.
- .6 Closures: Protect work temporarily until permanent enclosures completed.

#### **1.15 Site Storage**

- .1 Do not unreasonably encumber site with materials or equipment.
- .2 Move stored products or equipment that interferes with operations of Departmental Representative or other contractors.
- .3 Obtain and pay for use of additional storage or work areas needed for operations.

#### **1.16 Cut, Patch and Make Good**

- .1 Cut existing surfaces as required to accommodate new work.
- .2 Remove all items so shown or specified.
- .3 Patch and make good surfaces cut, damaged or disturbed, to Departmental Representative's approval. Match existing material, colour, finish and texture.

- .4 Install fire stops and smoke seals in accordance with ULC-S115 [1995(R2001)], around pipe, ductwork, cables, and other objects penetrating fire separations to provide fire resistance not less than the fire resistance rating of surrounding floor, ceiling, and wall assembly. Provide proof of manufacturers training for installation of fire stop materials.

**1.17 Sleeves, Hangers and Inserts**

- .1 Co-ordinate setting and packing of sleeves and supply and installation of hangers and inserts. Obtain Departmental Representative's approval before cutting into structure.

**1.18 Examination**

- .1 Examine site and conditions likely to affect work and be familiar and conversant with existing conditions.
- .2 Provide photographs of surrounding properties, objects and structures liable to be damaged or be the subject of subsequent claims or you may be held responsible.

**1.19 Signs**

- .1 Provide common-use signs related to traffic control, information, instruction use of equipment, public safety devices, etcetera, in both official languages or by the use of commonly understood graphic symbols to the Departmental Representative's approval.
- .2 No advertising will be permitted on this project.

**1.20 Access and Egress**

- .1 Design, construct and maintain temporary "access to" and "egress from" work areas, including stairs, runways, ramps or ladders and scaffolding, independent of finished surfaces and in accordance with relevant municipal, provincial and other regulations.

**1.21 Scaffolds and Work Platforms**

- .1 Design, install, and inspect scaffolds and work platforms required for work in accordance with relevant municipal, provincial and other regulations.
- .2 Provide design drawings, signed and sealed by qualified Professional Engineer licensed in the Province of Ontario where prescribed.
- .3 Additions or modifications to scaffolding must be approved by Professional Engineer in writing.

**1.22 Public Way Protection**

- .1 Design, erect and maintain hoarding and covered pedestrian walkways to support all loads including wind loads and provide protection, complete with signs and electrical lighting as required by authority having jurisdiction.

**1.23 Waste Management**

- .1 Submit complete records of all removals from site for both "materials designated for alternative disposal" and "general waste" including:

- .1 Time and date of removal.
- .2 Description of material and quantities.
- .3 Proof that materials have been received at an Approved Waster Processing Site or certified Waste Disposal Site as required.

#### **1.24 Operations and Maintenance Manuals**

- .1 Two (2) weeks prior to any scheduled training, submit to Departmental Representative three (3) hard copies and 1 electronic of approved Operations Data and Maintenance Manual, compiled as follows:
  - .1 Bind data in vinyl hard cover 3 "d" ring type loose leaf binders for 212 x 275 mm size paper. Binders must not exceed 75 mm thick or be more than 2/3 full.
  - .2 Enclose title sheet labeled "Operation Data and Maintenance Manual" project name, date and list of contents. Project name must appear on binder face and spine.
  - .3 Organize contents into applicable sections of work to parallel project specifications breakdown. Mark each section by labeled tabs protected with celluloid covers fastened to hard paper dividing sheets.
- .2 Include following information plus data specified:
  - .1 Maintenance instruction for finished surface and materials.
  - .2 Copy of hardware and paint scheduled.
  - .3 Description: Operation of the equipment and systems defining start-up, shut-down and emergency procedures, and any fixed or adjustable set points that affect the efficiency of the operation. Include nameplate information such as make, size, capacity and serial number.
  - .4 Maintenance: Use clear drawings, diagrams or manufacturers' literature that specifically apply and detail the following:
    - .1 lubrication products and schedules
    - .2 trouble shooting procedures
    - .3 adjustment techniques
    - .4 operational checks
    - .5 Suppliers names, addresses and telephone numbers and components supplied by them must be included in this section. Components must be identified by a description and manufacturers part number.
  - .5 Guarantees showing:
    - .1 Name and address of projects.
    - .2 Guarantee commencement date (date of Interim Certificate of Completion).

- .3 Duration of guarantee.
  - .4 Clear indication of what is being guaranteed and what remedial action will be taken under guarantee.
  - .5 Signature and seal of Guarantor.
  - .6 Additional material used in project listed under various Sections showing name of manufacturer and source of supply.
- .3 Spare parts: List all recommended spares to be maintained on site to ensure optimum efficiency. List all special tools appropriate to unique application. All parts/tools detailed must be identified as to manufacturer, manufacturer part number and supplier (including address).
  - .4 Include one complete set of final shop drawings (bound separately) indicating corrections and changes made during fabrication and installation.
  - .5 Client will withhold at their discretion a minimum of \$5,000.00 until approved O & M manuals are received. Substantial completion will not be obtained if the O & M manuals have not been submitted for approval.

**1.25 Records**

- .1 As work progresses, maintain accurate records to show deviations from contract drawings. Just prior to Departmental Representative's inspection for issuance of substantial certification of completion, supply to the Departmental Representative one (1) set of white prints with all deviations neatly inked in. The Departmental Representative will provide two sets of clean white prints for this purpose.
- .2 Client will withhold at their discretion a minimum of \$ 5,000.00 until as- build drawings are received and approved by the Departmental Representative. Substantial completion will not be obtained if the as-built drawings have not been submitted for approval.

**1.26 Guarantees and Warranties**

- .1 Before completion of work collect all manufacturer's guarantees and warranties and deposit with Departmental Representative.

**1.27 Clean Up**

- .1 Clean up work area as work progresses. At the end of each work period and more often if ordered by the Departmental Representative, remove debris from site, neatly stack material for use, and clean up generally.
- .2 Upon completion, remove scaffolding, temporary protection and surplus materials. Make good defects noted at this stage.
- .3 Wash and polish glass, mirrors, ceramic tile, aluminum, chrome, stainless steel, baked or porcelain enamel, plastic laminate and other plastic surfaces, floors, hardware and washroom fixtures. Clean manufactured articles in accordance with manufacturer's directions.
- .4 Clean areas under contract to a condition at least equal to that previously existing and to approval of Departmental Representative.

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**1.28 Hours of Work**

- .1 Immediately upon award of the contract, the Contractor shall prepare and submit the requisite forms, provided by the Client, for each employee and sub-contractor employee to be engaged in the work in an occupied building. The Contractor shall mobilize on site, only once the Facility Access has been granted.
- .2 The Contractor should batch the fully completed submissions, based on priority work on site and allow for an 8 working day processing time in the project schedule for the review to occur. The inability to submit the fully completed requisite forms will not be reason for an extension to the project schedule or additional compensation.
- .3 Contractor's personnel engaged in the work outside the normal working hours of Monday to Friday, from 06:00 to 16:00 must be escorted by a designate of the Departmental Representative. This designate will be at no cost to the Contractor.
- .4 The contractor shall give the Client 72 hours notice for work to be carried out during periods outside of the above normal working hours.

**1.29 Contract Documents**

- .1 Drawings and specifications are complementary, items shown or mentioned in one and not in the other are deemed to be included in the contract work.

**1.30 Security Escort**

- .1 All personnel employed on this project shall be escorted, paid for by the Client.
- .2 Submit an escort request to Departmental Representative at least 48 hours before the service is needed. For requests submitted within the time mentioned above, the Departmental Representative will pay for the costs of the security escort. The cost incurred by a late request will be charged to the Contractor.
- .3 Any escort request may be cancelled free of charge if notification of cancellation is given at least 24 hours before the scheduled time of the escort. The cost incurred by a late cancellation will be charged to the Contractor.
- .4 The calculation of costs will be based on the average hourly rate of a security officer for a minimum of eight hours per day for a later service request and of four hours for late cancellations.

**1.31 Building Smoking Environment**

- .1 Smoking is not permitted in the Building. Obey smoking restrictions on building property.

**1.32 Dust Control**

- .1 Provide dust tight screens or partitions to localize dust generating activities, and for protection of workers, finished areas of work and public.
- .2 Maintain and relocate protection until such work is complete.

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**1.33 Testing Laboratory Service**

- .1 Where tests indicate non-compliance with specifications, Contractor to pay for initial test and all subsequent testing of work to verify acceptability of corrected work.

**1.34 Scheduling**

- .1 On award of contract submit bar chart construction schedule for work, indicating anticipated progress stages within time of completion. When schedule has been reviewed by the Departmental Representative, take necessary measures to complete work within scheduled time. Do not change schedule without notifying Departmental Representative.
- .2 Carry out work during "regular hours" Monday to Friday from 06:00 to 16:00 hours [and on Saturdays, Sundays and statutory holidays.
- .3 Carry out work of any power interruptions, noise generating activities or odorous work during "off hours" Monday to Friday from 16:00 to 06:00 hours and on Saturdays, Sundays, and statutory holidays.
- .4 Give the Departmental Representative 48 hours notice for work to be carried out during "off hours".
- .5 The substantial completion date is set for 30 calendar days after award of contract. The awarded contractor is to adhere to this date.
- .6 The Client has the right to postpone the working schedule of the contractor due to operational requirements of the Client for up to 3 days, upon the Client giving the contractor 24 hours notice, with no charge to the Client.

**1.35 Cost Breakdown**

- .1 Before submitting first progress claim submit breakdown of Contract Amount in detail as directed by Departmental Representative and aggregating the Contract Amount. After approval by Departmental Representative cost breakdown will be used as the basis of progress payments. All invoicing must be verified by the Departmental Representative and a certificate of payment will be issued to the contractor. The contractor will send invoice to the Client:

**"Accounts Payable"**

**73 Leikin Drive, Mail Stop #1**

**Ottawa, Ontario K1A 0R2**

**Project #: PTS 3447**

**Project Name: Carp Hangar Door Replacement**

**Project Manager: A. Chow**

Invoice must include certificate of payment, current WSIB and Insurance. Include Statutory Declaration after first progress payment and subsequent invoices. Any information missing on invoices will be returned.

**1.36 Administration**

- .1 All correspondence shall be electronic PDF format and include the Client's project number in the subject line.

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**1.37 Items required at Start-up Meeting**

- .1 Detailed construction schedule (preferably bar chart). Indicate construction time (day-time or after-hours) to allow the Client to request escorts for indoor and week-end work. The contractor must include a schedule including the following milestones: testing, delivery of O & M Manual, sequencing of commissioning, acceptance and occupancy. Allow for 10 working days of processing time in the project schedule for the review of clearances to occur. The inability to submit the fully completed requisite forms will not be a reason for an extension to the project schedule or additional compensation. Contact Departmental Representative to receive the required forms. Identify all building system's shutdown or bypasses on the schedule.
- .2 List of employees (including sub-trades) who will be working on the site. The Client can verify if employees require an extension on their security clearances or need a new clearance.
- .3 Notice of Project form if construction costs exceed \$50,000.00
- .4 Sub-contractor(s) permits as required.
- .5 List of shop drawings/samples/product data. Three (3) copies.
- .6 List of Health and Safety related documents:
  - Site-specific hazard assessment report
  - Site-specific Health & Safety plan with emergency procedures
  - Emergency action plan
  - Site-specific emergency medical plan
  - Accident report
  - Emergency numbers
  - Nearest medical emergency centre – directions
  - Worker, emergency-response team members
  - Map
- .7 Proof of training as required by legislative jurisdiction.
- .8 If you plan on taking pictures on the Carp Hangar site, proper authorization is required before and after the pictures are taken.

**1.38 Cranes**

- .1 A 24-hour notice must be given to the Departmental Representative prior to using a crane on site. The crane must be certified within the last year. The operator must be certified to operate the crane. The area around the crane must be cautioned off. The crane must be stabilized on solid ground. The loading area must be able to support all craning loads. The load must not be lifted overtop any workers or public.

1.39 **Training**

- .1 Training will have to be performed for the Client and/or Departmental Representative.

**END OF SECTION**

## **PART 1 - GENERAL**

### **1.1 References**

- .1 Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations.
- .2 Health Canada/ Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS)
- .3 Province of Ontario
  - .1 Occupational Health and Safety Act and Regulations for Construction Projects, R.S.O. 1990 June 2002.

### **1.2 Submittals**

- .1 Make submittals in accordance with Section 01 01 00 - General Instructions.
- .2 Submit site-specific Health and Safety Plan: Within 7 days after date of Notice to Proceed and prior to commencement of Work. Health and Safety Plan must include:
  - .1 Site specific safety hazard assessment.
  - .2 Safety and health risk or hazard analysis for site tasks and operation found in work plan.
  - .3 All applicable Material Safety Data Sheets (MSDS).
  - .4 Other safe-work procedures such as:
    - .1 Communication plan.
    - .2 Communication numbers.
    - .3 Emergency Procedures.
    - .4 Public Protection.
    - .5 Use of personal protective equipment.
    - .6 Name of employees and supervisor(s) on-site and
    - .7 Any required proof (copy) of training for all workers on the project.
- .3 Submit 3 copies of Contractor's authorized representative's work site health and safety inspection reports to the Departmental Representative, weekly.
- .4 Submit copies of reports or directions issued by Federal and Provincial health and safety inspector.
- .5 Submit construction safety checklist after completion.

- .6 Personal training requirements including as follows:
  - .1 Names of personnel and alternates responsible for site safety and health, hazards present on site, and use of personal protective equipment.
- .7 Submit copies of reports or directions issued by Federal, and Provincial health and safety inspectors.
- .8 Submit copies of incident and accident reports.
- .9 Submit WHMIS Material Safety Data Sheets (MSDS) to the Client's Representative.
- .10 The Departmental Representative will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within 7 days after receipt of plan. Revise plan as appropriate and resubmit plan to Consultant within 7 days after receipt of comments from the Departmental Representative.
- .11 The Departmental Representative's review of Contractor's final Health and Safety plan should not be construed as approval and does not reduce the Contractor's overall responsibility for construction Health and Safety.
- .12 Medical Surveillance: Where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel, and submit additional certifications as personnel are sent to site.
- .13 On-site Contingency and Emergency Response Plan: Address standard operating procedures to be implemented during emergency situations.

**1.3 Filing of Notice**

- .1 File Notice with Provincial authorities prior to commencement of Work

**1.4 Work Permit**

- .1 Obtain building permit related to project prior to commencement of Work.

**1.5 Safety Assessment**

- .1 Perform site specific safety hazard assessments related to project.

**1.6 Meetings**

- .1 Schedule and administer Health and Safety meeting with the Departmental Representative prior to commencement of Work.

**1.7 Regulatory Requirements**

- .1 Comply with specified standards and regulations to ensure safe operations at site containing hazardous or toxic materials.

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**1.8 General Requirements**

- .1 Develop written site-specific Health and Safety Plan based on hazard assessment prior to commencing any site Work and continue to implement, maintain, and enforce plan until final demobilization from site. Health and Safety Plan must address project specifications.
- .2 The Departmental Representative may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns.

**1.9 Responsibility**

- .1 Be responsible for safety of persons and property on site and for protection of persons off site and environment to extent that they may be affected by conduct of Work.
- .2 Comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial, and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

**1.10 Compliance Requirements**

- .1 Comply with Ontario Health and Safety Act and Regulations for Construction Projects (R.S.O.).
- .2 Comply with Canada Labour Code, Canada Occupational Safety and Health Regulations.

**1.11 Unforeseen Hazards**

- .1 When unforeseen or peculiar safety-related factor, hazard, or condition occurs during performance of Work, follow procedures in place for Employee's Right to Refuse Work in accordance with Acts and Regulations of Province having jurisdiction and advise the Departmental Representative verbally and in writing.

**1.12 Health and Safety Coordinator**

- .1 Employ and assign to Work, competent and authorized representative as Health and Safety Coordinator. Health and Safety Coordinator must:
  - .1 Have minimum 2 years' site-related working experience specific to activities.
  - .2 Have working knowledge of occupational safety and health regulations.
  - .3 Be responsible for completing Contractor's Health and Safety Training Sessions and ensuring that personnel not successfully completing required training are not permitted to enter site to perform Work.
  - .4 Be responsible for implementing, enforcing daily and monitoring site-specific Contractor's Health and Safety Plan.
  - .5 Be on site during execution of Work and report directly to and be under direction of site supervisor.

### 1.13 Posting of Documents

- .1 Ensure applicable items, articles, notices and orders are posted in conspicuous location on site in accordance with Acts and Regulations of Province having jurisdiction, and in consultation with the Departmental Representative.
- .2 Construction employers and required by law to have certain items posted/available in the workplace. (If workplace is portable and no where to post information, then info could be put into a 3 ring binder, or similar, that is available at the site).

- .3 Required to be posted on site or available on site:

Construction employers are required either by law or by policy to have certain items posted/available in the workplace. (If workplace is portable and no where to post information, then info could be put into a 3 ring binder, or similar, that is available at the site).

- Occupational Health and Safety Act and Regulations for Construction Projects (Act S. 25(2)(I).
- Company Occupational Health and Safety Policy & Program to implement their policy (Act S. 25(2)(J), (K).
- Ministry of Labour (MOL) inspector's orders (if any) (Act S. 59(3).
- Emergency procedures (Reg. 213.91 S. 17).
- Access to phone in case of an emergency (Reg. 213/91 S. 18).
- Address and phone number of nearest MOL office (Reg. 213/91 S. 17).
- Danger signs in hazardous areas (Reg. 213/91 S. 17).
- Location of toilet facilities (Reg. 213/91 S. 17).
- Name, trade, and employer of Health and Safety Rep., JHSC, Trades Committee (if applicable) (Reg. 213/91 S. 17).
- A copy of the employer's completed and approved registration form 1000 (Reg. 213/91 S.5).
- In case of injury poster supplied by the WSIB (Workplace Safety and Insurance Board) (Form 82, WSIB Reg. 1101 S. 1(b)(i).
- First Aid Box containing items as per (WSIB Reg. 1101 S. 1 (1)(a), 8,9,10, and 11)(1).
- Valid first aid certificates of qualification of the trained workers on duty and who is in charge of the First Aid Station (WSIB Reg. 1101 S 1(1)(b)(ii).
- Inspection records documenting the date of the most recent inspection of the First Aid Stations and the signature of the worker performing the inspection (WSIB Reg. 1101 S 1(1)(b)(ii)(iii).

- Investigation Reports respecting an Accident/Incident describing all activities. The report must contain "who" was involved (Including Witnesses), Time, Date, Location, and so on. A competent person must lead the investigation. Report all property damage.
- Site Specific Safety Plan including the Hazard Analysis for the entire project including safety plans from sub-contractors.
- Name of Supervisor on site for five workers or more, and or name of competent worker when under five workers on site.
- All applicable Federal, Provincial, and Municipal permit applications and or permits must be obtained and posted for the duration of the project.
- Where applicable, upon request the names and trade licenses of the workers on site to be submitted prior to the start of the project.
- Posting of the buildings protocol given to the awarded contractor at the start up meeting by the Departmental Representative.

**1.14 Construction Safety Checklists**

- .1 Obtain Construction Safety checklist from the Departmental Representative.
- .2 Review and implement out applicable health and safety checklists provided by the Departmental Representative in collaboration with Engineer.

**1.15 Correction of Non-Compliance**

- .1 Immediately address health and safety non-compliance issues identified by authority having jurisdiction or by the Departmental Representative.
- .2 Provide the Departmental Representative with written report of action taken to correct non-compliance of health and safety issues identified.
- .3 The Departmental Representative may stop Work if non-compliance of health and safety regulations is not corrected.

**1.16 Powder Actuated Devices**

- .1 The use of powder-actuated devices is not allowed.

**1.17 Work Stoppage**

- .1 Give precedence to health and safety of public and site personnel, protection of environment over cost, and schedule considerations for work.

**PART 2 - PRODUCTS**

**2.1 Not Used**

.1 Not used.

**PART 3 - EXECUTION**

**3.1 Not Used**

.1 Not used

**END OF SECTION**

**PART 1            GENERAL**

**1.1    Section Includes**

- .1    The main objectives of the commissioning process can be classified as follows:
  - .1    To ensure installation of all new equipment conforms to the contract document.
  - .2    Performance verification that all components of the equipment actually perform as specified. This will be verified by measurements, visual inspection, equipment data sheets, manufacturer's representative assistance at start-up and integrated testing.
  - .3    Operation & Maintenance Personnel fully trained to operate and maintain the new equipment and systems.

**1.2    Related Sections**

- .1    All applicable Control, Fire Alarm, and Sprinkler.
- .2    All applicable Electrical Division 26 subsections.

**1.3    Scope of Commissioning**

- .1    The scope consists of:
  - .1    Testing of the 'new' components installed as defined in the tender document.
  - .2    Testing of system(s) including existing system(s) that has been modified or extended as part of the work as defined in the tender document.
  - .3    Integrated System Performance Testing and fine tuning as defined in the tender document.
  - .4    Seasonal testing as defined in the tender document.

**1.4    Commissioning Schedule**

- .1    Within 1 month of contract award, the contractor will be responsible for providing a detailed schedule for showing all commissioning activities. Schedule to include the following milestones as a minimum:
  - .1    Testing.
  - .2    Start-up.
  - .3    Delivery of O & M.
  - .4    Sequencing of commissioning.
  - .5    Acceptance and
  - .6    Occupancy

- .2 Contractor to provide Construction Project Schedule - Bar (Gantt) Charts.
- .3 Unless otherwise specified in writing by the Departmental Representative, all testing and related requirements specified herein will be successfully performed prior to the issuance of the Interim Certificate of Completion.

### **1.5 Submittal**

- .1 Prior to start of Work; submit one (1) set of shop drawings to the Departmental Representative for review and comments, from an O & M perspective. This shall include all components and systems delivered within the Controls/Fire Alarm/Sprinkler, Mechanical, and Electrical sub-sections.
- .2 Submit CMMS documentation for all components or systems to be removed as part of this project prior to removal.
- .3 Submit start-up report forms prior to scheduling commissioning activities.
- .4 Submit O & M Manual for review and comments prior to scheduling commissioning activities and training of O & M personnel.
- .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.
- .6 Documentation will be required from all equipment manufacturers outlining that their respective equipment is operational, has been installed to their requirements, started and commissioned successfully.
- .7 Submit not later than 2 weeks after award of contract. Request to make any changes to these commissioning specification, including; timing, procedures, tolerances and instruments. Request should be made in writing to the Departmental Representative, and approval obtained from the Departmental Representative not less than 3 weeks prior to start of commissioning.

### **1.6 Manufacturers Involvement**

- .1 Arrange for Manufacturer to submit copies of all production test records for production test required by these specifications prior to shipping.
- .2 Prior to start-up of equipment or systems, obtain manufacturer's installation, start-up and operation instructions and review with Departmental Representative.
- .3 Use manufacturer's trained start-up personnel to maintain integrity of warranty.
- .4 Verify with manufacturer that testing as specified will not void any warranties.
- .5 Manufacturer's personnel to be experienced in design, installation and operation of equipment and systems and be able to interpret test results in clear, concise, logical manner.
- .6 Report in writing to Departmental Representative and deficiencies or defects noted during performance of services.

### **1.7 Seasonal Testing**

- .1 Notwithstanding all inclusive requirements specified in this section, additional separate cycles of performance testing and verification will be required at later date for components and systems whose full operation is dependent on seasonal conditions.
- .2 Contractor's responsibilities with respect to such commissioning activities will be as specified in relevant sections.

### **1.8 Responsibilities**

- .1 Departmental Representative is responsible for the overall delivery of commissioning activities, review and approval of all documentation, overview of performance, verification of activities, and verification of accuracy of reported results.
- .2 Departmental Representative is responsible for the witnessing and certification of the performance verification results.
- .3 Contractor is responsible to perform all commissioning activities and record results.
- .4 Responsibility of the satisfactory completion of the project, and demonstration that the requirements of the commissioning are satisfied rest with the Contractor, who will employ and pay for Specialists, supervision, inspection and testing as required, to complete the work as described.
- .5 Coordinate all sub-trades, other divisions, manufacturers, suppliers, and other specialists as required to ensure all phases of work shall be properly organized prior to commencement of each particular testing procedure. Establish all necessary manpower requirements.
- .6 Coordinate the activities of this Section with the starting and testing of:
  - .1 Special components and systems specified in the Controls, Fire Alarm, & Sprinkler sub-sections.
  - .2 Mechanical components and systems specified in the Mechanical sub-sections.
  - .3 Electrical components and systems specified in the Electrical sub-sections.
- .7 Where any components or systems require testing prior to starting, ensure that such work has been completed and approved prior to starting of these components and systems.

### **1.9 Preparation**

- .1 The contractor shall have contract documents, shop drawings, product data, and operation and maintenance data in hand during equipment performance verification process.
- .2 Except when otherwise specified, complete all start-up and testing prior to acceptance test and hand-over of the project.
- .3 Co-ordinate work and manpower requirements of sub-trades, suppliers, manufacturers, specialists, disciplines as required ensuring that all work is properly organized prior to start-up and testing.

- .4 Where equipment or systems require testing prior to start-up, ensure that such work is completed and approved prior to delivery of equipment or systems.
- .5 Notify Departmental Representative seven (7) days prior to time project will be ready for testing, adjusting, and balancing.

#### **1.10 Computerized Maintenance Management System (CMMS)**

- .1 All contract work shall comply with the requirements of the Client's CMMS. It is required to provide CMMS inventory sheets. Inventory sheets will include all product data, serial and model numbers, equipment description, and location.
- .2 Collect and record all CMMS data for all new or relocated equipment being installed, replaced, removed from or taken out of service from existing inventory of equipment.
- .3 Submit to the Departmental Representative an inventory sheet identified with CMMS number only for each existing system or component being removed prior to removal.
- .4 Submit to the Departmental Representative a fully completed inventory data sheet for all new equipment two (2) weeks prior to seeking approval for proposed component identification. All CMMS inventory sheets are to be added to the O & M Manual.
- .5 CMMS applies to all major components or systems. Minor items are not to be inventoried under the CMMS. The Departmental Representative will provide clarification to the Contractors upon request.

#### **1.11 Start-up and Testing**

- .1 Before start-up, clean all newly installed equipment and or systems and verify same to be free from all contaminants.
- .2 After testing, protect equipment and systems from construction activities.
- .3 Conceal equipment and systems only after inspection and testing is completed and approved by the Departmental Representative.
- .4 Assume all liabilities and costs for inspections including disassembly and reassembly after approval, starting, testing, and adjusting, including supply of testing equipment.

#### **1.12 Witnessing of Starting and Testing**

- .1 Provide sufficient notice not less than seven (7) days prior to commencement.
- .2 The Departmental Representative may witness all or any portion of start-up and testing at their discretion.
- .3 General Contractor to be present at all tests performed by sub-trades, suppliers, and equipment manufacturers.

#### **1.13 Start-Up Activities**

- .1 Factory and on-site testing.
- .2 Pre-start-up, component by component inspections.

- .3 Check of all equipment, systems, installation, electrical connections, etc. for conformity to contract documents, equipment manufacturer's installation requirements, etc.
- .4 Check of location, installation, setting of controls, limit and safety devices and operate as designed.
- .5 Compilation of pre-start-up deficiency list and rectification of all deficiencies in writing to the Departmental Representative.
- .6 Start-up verification for proper and safe operation.
- .7 Identification and correction of start-up and pre-commissioning deficiencies.
- .8 Failure to follow specified start-up procedures shall result in a re-evaluation of equipment by independent testing agency selected by the Departmental Representative. Should results reveal that the equipment start-up was not in accordance with specified requirements, the contractor shall remove from site and replace with new, which will also be subject to specific start-up procedures.
- .9 TAB shall be as specified in relevant sections and shall verify the performance of all systems to ensure that they meet requirements of the contract document.

#### **1.14 Maintenance of Equipment and Systems**

- .1 After start-up maintain equipment and systems as directed by equipment/system manufacturer.
- .2 Maintain equipment and provide equipment service call-acksas described in section 01 01 00 - General Instructions.
- .3 In conjunction with the manufacturer develop written maintenance program. Submit to the Departmental Representative for approval before implementation.

#### **1.15 Start-Up Documentation**

- .1 Assemble and submit start-up reports to the Departmental Representative before commencement of commissioning.
- .2 Start-up documentation to include as a minimum, witness and certified by the Departmental Representative, factory and on-site test certificates, pre-start-up inspection reports, installation/start-up checklists signed, certified and witnessed.
- .3 Marked-up schematics of systems as actually installed.

#### **1.16 Commissioning Documentation**

- .1 All results of test, performance verification and commissioning procedures to be reported, documented, witnessed and certified by Departmental Representative using forms supplied by Departmental Representative and approved by the Departmental Representative.
- .2 All commissioning documentation to be reviewed and approved by the Departmental Representative.

- .3 The Departmental Representative will develop project specific verification forms for verification of components and systems, which will be provided to the Contractor. Fully completed forms with the exception of verification results data, are to be completed and submitted to the Departmental Representative within four (4) weeks of approval of shop drawings or as specified.
  - .1 Supplementing the above, the Contractor shall provide project specific verification forms for Electrical Mechanical Control Systems (EMCS). Submit sample verification forms with shop drawing submission. Update forms as required and resubmit to the Departmental Representative should there be changes to the initial scope of work. After contractor start-up and debugging of programming, complete verification process in the presence of the Departmental Representative.
  - .2 Component forms shall be completed as follows:
    - .1 The specified requirements shall be completed by Contractor and verified by the Departmental Representative.
    - .2 The shop drawing information shall be completed by hand and shall reflect APPROVED shop drawings.
    - .3 The installed information shall be completed by the Contractor from nameplates on installed equipment. This shall be completed by hand.
    - .4 The systems verification cannot take place before all related components have been verified as correct.
    - .5 Integrated systems verification cannot take place before all related systems have been verified as correct.
    - .6 Verification forms will be provided for information and convenience to the Contractor and will not relieve the Contractor of responsibility for verification of components, systems, or integrated systems not included on the verification forms. Refer to sample verification forms at the end of this Section.
    - .7 A verification form is to be completed for each integrated system in a category requiring verification.
    - .8 System and Integrated system verification forms are to be completed by the Contractor and verified by the Departmental Representative.

#### **1.18 Start of Commissioning**

- .1 Notify the Departmental Representative not less than seven (7) days prior to commencement of commissioning.
- .2 Commissioning to be in accordance with the completion schedule for the project and commissioning plan.
- .3 Start commissioning only after completion of start-up, TAB, and any elements of building affecting start-up and performance verification of systems have been rectified.

- .4 Contractor to provide sufficient 'qualified' personnel to Departmental Representative's satisfaction at field locations and at the central operation work (monitoring) station to successfully test and commission components, systems, and integrated systems.

#### **1.19 Commission General Requirements**

- .1 Carry out commission under actual or simulating operating range in all modes. (i.e.: regular, emergency, day, night, heating, and cooling).
- .2 Each system to be tested independently. If interlocked with or operation is affected by other systems, in unison with those systems.
- .3 Commissioning procedures to be repeatable and reported results are to be verifiable.
- .4 Follow equipment manufacturer's instructions re: operating and safety aspects.

#### **1.20 Conflicts**

- .1 If requirements of this or other sections of construction or commissioning specification conflict, report to the Departmental Representative before start-up and obtain clarification.
- .2 Failure to report conflicts and obtain clarification will result in application of most stringent requirement.

#### **1.21 Commissioning Meeting**

- .1 In accordance with requirements of project meeting supplemented as specified herein, commissioning meeting will be held at same time as, and form part of regular construction progress meetings, or can be separate.
- .2 Commissioning meetings will be held weekly during the construction phase. Meetings to continue on regular basis until issuance of Interim Certificate of Completion, after which meetings will occur as required to address operational and warranty issues.
- .3 Purpose of meetings shall be to resolve issues, monitor progress, identify deficiencies relating to commissioning.
- .4 To be present at the meetings, General Contractor and all his sub-contractors, Departmental Representative and Project Manager.
- .5 Departmental Representative to put forward agenda, chair meetings as well as record and distribute minutes.

#### **1.22 Records of Commissioning Activities**

- .1 Maintain accurate, detailed records of commissioning activities including; names of technicians, supervisors and dates of commissioning activities.

#### **1.23 Inter-Disciplinary Co-ordination**

- .1 Be present, assist and witness commissioning of all systems and equipment of other disciplines which impact upon, interface with, are interlocked or interconnected with system being commissioned.

### **1.24 Pre-Commissioning Review**

- .1 Review contract documents and confirm in writing to the Departmental Representative adequacy of provisions for commissioning and all other aspects of design pertinent to the success of commissioning.
- .2 Before starting commissioning, review:
  - .1 Installation.
  - .2 Documentation.
  - .3 Design Criteria and Intents.
  - .4 All Start-up Documentation.
  - .5 Commissioning Specifications, requirements and forms.
  - .6 Commissioning Schedules.
  - .7 Commissioning Standards and Procedures.
  - .8 Cleanliness of Systems.
  - .9 As-built drawings (marked-up).
  - .10 O & M Manual.
- .3 Report to the Departmental Representative in writing all discrepancies and deficiencies.

### **1.25 Operation of System During Commissioning**

- .1 Operate and maintain for the length of time required as determined by the Departmental Representative for commissioning to be completed, and as required for verification of reported results.

### **1.26 Commissioning Tolerances**

- .1 Definitions:
  - .1 Application tolerances: Specified range of acceptable deviations of measured values from specified values or specified design criteria.
  - .2 Measurement tolerances: Unless specified otherwise, all measured and reported values to be within  $\pm 2\%$  of actual values.
  - .3 Instrument accuracy tolerances: Accuracy of measured value as percentage of actual value. Refer to relevant sections of these commissioning specifications.
  - .4 Values measured during verification of reported results to be within  $\pm 5\%$  of reported results.

### **1.27 Results**

- .1 If start-up, testing and or PV produce unacceptable results; repair, replace or repeat specified starting and or PV procedures until acceptable results are achieved.
- .2 Provide manpower and materials bear cost for re-commissioning.

### **1.28 Instruments**

- .1 Submit list of all instruments proposed to be used, listing all data including serial number, current calibration certificate date, calibration expiry date for review and approval by the Departmental Representative.
- .2 Provide safety equipment required for personnel involved in the starting testing and commissioning program.
- .3 In addition to instruments listed in the specification document, provide the following:
  - .1 Two-way radio.
  - .2 Ladders
  - .3 Other equipment
  - .4 Safety equipment for start-up and testing personnel.
  - .5 Provide list of equipment and instruments to be used in the start-up, TAB testing for review and approval by the Departmental Representative.

### **1.29 Installed Instrumentation**

- .1 Instruments installed under Contract may be used for TAB and PV if:
  - .1 Accuracy complies with these specifications.
  - .2 Calibration certificates have been deposited with the Departmental Representative.
  - .3 Calibrated EMCS sensors may be used to obtain performance data provided that sensor calibration has been completed and accepted.

### **1.30 Witnessing Commissioning**

- .1 The Departmental Representative will witness all activities. The Departmental Representative may witness some activities to satisfy the design intent has been met.
- .2 The Departmental Representative will certify all the results.
- .3 Contractor to be present at all tests.

### **1.31 Authorities Having Jurisdiction**

- .1 The contractor will complete initial start-up successfully prior to performance verifications and certification by presiding authorities having jurisdiction.

- .2 To facilitate the turnover of the project, call and arrange for authorities to witness procedures in a manner that avoids unnecessary duplication of tests. It shall be the responsibility of the Contractor to confirm which tests the presiding authorities having jurisdiction, are required to attend. Confirm that the presiding authorities will be present for each test, as required.
- .3 Any cost associated with presiding authorities attending testing during the daytime and during off-hours shall be the responsibility of the Contractor. Include all such cost in your tender.
- .4 Obtain Certificates of Approval, acceptance and compliance with the rules and regulations of authority having jurisdiction. Provide copies to the Departmental Representative within five (5) days of tests with the commissioning report.
- .5 Submit reports generated by special testing agencies to the Departmental Representative prior to the issuance of the Interim Certificate of Completion.
- .6 Special Testing agencies shall be approved by the Departmental Representative with acceptable facilities and qualifications.

### **1.32 Deficiencies, Faults, Defects, Repetition**

- .1 Correct all deficiencies found during start-up and commissioning to satisfaction of the Departmental Representative.
- .2 Report faults, defects affecting commissioning to the Departmental Representative in writing as they become apparent. Unless instructed otherwise, halt commissioning until same is rectified.
- .3 Where verification of reported results fail to receive the Departmental Representative's approval, and where repetition of verification again fails to receive approval, and where the Departmental Representative deems Contractor's request for 2<sup>nd</sup> verification was premature, then all costs incurred by Departmental Representative for 3<sup>rd</sup> and subsequent verifications to be borne by the contractor.

### **1.33 Activities Upon Completion of Commissioning**

- .1 After commissioning is completed to satisfaction of the Departmental Representative, replace drive guards, close access doors, lock devices in set positions, and ensure sensors are at required settings.
- .2 Permanently and indelibly mark all settings to allow restoration at any time during life of facility. Markings to be eradicated or covered in any way.
- .3 Record 'as commissioned' settings in commissioning report.

### **1.34 Completion of Commissioning**

- .1 Co-operate fully with Departmental Representative during all stages of acceptance and occupancy of the facility.
- .2 Upon completion of commissioning, leave all systems in normal operating mode.

- .3 Except for warranty and seasonal verification activities specified in these commissioning specifications, commissioning to be completed prior to issuance of Interim Certificate of Completion.
- .4 Compile test reports, verification forms, and certificates, by Division, by specification Section, into one Commissioning Manual.
- .5 Submit draft manual for review and approval to the Departmental Representative, two (2) weeks prior to application for Interim Certificate of Completion for the project.
- .6 Submit six (6) copies of the approved manual prior to Interim Certificate of Completion.

**PART 2 PRODUCTS**

**2.1 Not Applicable**

**PART 3 EXECUTION**

**3.1 Not Applicable**

**END OF SECTION**

**PART 1 GENERAL**

**1.1 Related Work**

- .1 Section: Instructions to Bidders
- .2 Section: 01 01 00 General Instructions

**1.2 Standards**

- .1 Comply with National Building Code, Part 8, Construction Safety Measures at Construction and Demolition Sites, and Provincial requirements.

**1.3 References**

- .1 Canadian Standards Association (CSA International)
  - .1 CSA S350-M1980 (R1998), Code of Practice for Safety in Demolition of Structures.

**1.4 Asbestos**

- .1 Demolition of spray or trowel applied asbestos can be hazardous to health. Should material resembling spray or trowel-applied asbestos be encountered, stop work and notify Departmental Representative immediately. Do not proceed until written instructions have been received from the Departmental Representative.

**PART 2 PRODUCTS - Not used.**

**PART 3 EXECUTION**

**3.1 Protection**

- .1 Keep noise, dust and inconvenience to occupants to minimum.
- .2 Protect building systems, services and equipment.
- .3 Provide temporary dust screens, weather covers, railings, supports and other protection as required.

**3.2 Installation**

- .1 Remove parts of existing building walls, to permit new construction as indicated.
- .2 Inspect and verify with the Departmental Representative items designated for removal and items to be preserved.
- .3 Dispose of removed materials, to the appropriate recycling facilities where required, except where specified otherwise, in accordance with authority having jurisdiction.

**DEMOLITION**

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- .4 Protect existing and adjacent items designated to remain. In event of damage, immediately replace such items or make repairs to approval of the Departmental Representative.
- .5 Trim edges of partially demolished building elements to tolerances as defined by Departmental Representative to suit future use.
- .6 Dispose of removed materials, to appropriate recycling facilities except where specified otherwise, in accordance with authority having jurisdiction.

**3.3 Notice**

- .1 Notify the Departmental Representative before disrupting building/floor access or services.

**END OF SECTION**

## **PART 1 GENERAL**

### **1.1 References**

- .1 Canadian Standards Association (CSA)
  - .1 CAN/CSA A23.1-09/A23.2-09, Concrete Materials and Methods of Concrete Construction.
  - .2 CAN/CSA O86-08, Engineering Design in Wood (Limit States Design).
  - .3 CSA O121-08), Douglas Fir Plywood.
  - .4 CSA O151-09, Canadian Softwood Plywood.
  - .5 CSA O153-M1980 (R2008), Poplar Plywood.
  - .6 CSA O437 Series-93 (R2001), Standards for OSB and Waferboard.
  - .7 CSA S269.1-1975 (R2003), Falsework for Construction Purposes.
  - .8 CAN/CSA S269.3-M92 (R2008), Concrete Formwork.
- .2 Council of Forest Industries of British Columbia (COFI)
  - .1 COFI Exterior Plywood for Concrete Formwork.

### **1.2 Shop drawings**

- .1 Submit shop drawings for formwork and falsework in accordance with Section 01 01 00 - General Instructions.
- .2 Indicate method and schedule of construction, shoring, stripping and re-shoring procedures, materials, arrangement of joints, special architectural exposed finishes, ties, liners, and locations of temporary embedded parts. Comply with CSA S269.1, for falsework drawings .Comply with CAN/CSA-S269.3 for formwork drawings.
- .3 Indicate formwork design data, such as permissible rate of concrete placement, and temperature of concrete, in forms.

### **1.3 Waste management and disposal**

- .1 Separate and recycle waste materials in accordance with the Waste Reduction Workplan.
- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Ensure emptied containers are sealed and stored safely for disposal away from children.
- .4 Use sealers, form release and stripping agents that are non-toxic, biodegradable and have zero or low VOC's.

## **PART 2 PRODUCTS**

### **2.1 Materials**

- .1 Formwork materials:
  - .1 For concrete without special architectural features, use wood and wood product formwork materials to CSA-O121, CAN/CSA-O86, CSA O437 Series and CSA-O153.
  - .2 For concrete with special architectural features, use formwork materials to CAN/CSA-A23.1.
- .2 Form ties:
  - .1 For concrete not designated 'Architectural', use removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25 mm dia. in concrete surface.
  - .2 For Architectural concrete, use snap ties complete with plastic cones and light grey concrete plugs.
- .3 Form liner:
  - .1 Plywood: medium density overlay Canadian Softwood Plywood to CSA O151 T and G, 19mm thick.
- .4 Form release agent: non-toxic, biodegradable, and low VOC.
- .5 Form stripping agent: colourless mineral oil, non-toxic, biodegradable, low VOC, free of kerosene, with viscosity between 15 to 24 mm<sup>2</sup>/s at 40°C, flashpoint minimum 150°C, open cup.
- .6 Falsework materials: to CSA-S269.1.

## **PART 3 Execution**

### **3.1 Fabrication and erection**

- .1 Verify lines, levels and centres before proceeding with formwork/falsework and ensure dimensions agree with drawings.
- .2 Obtain Consultant's approval for use of earth forms framing openings not indicated on drawings.
- .3 Hand trim sides and bottoms and remove loose earth from earth forms before placing concrete.
- .4 Fabricate and erect falsework in accordance with CSA S269.1 and COFI Exterior Plywood for Concrete Formwork.
- .5 Refer to architectural drawings for concrete members requiring architectural exposed finishes.
- .6 Do not place shores and mud sills on frozen ground.
- .7 Provide site drainage to prevent washout of soil supporting mud sills and shores.

- .8 Fabricate and erect formwork in accordance with CAN/CSA-S269.3 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CAN/CSA-A23.1.
- .9 Align form joints and make watertight. Keep form joints to minimum.
- .10 Locate horizontal form joints for exposed columns 2400 mm above finished floor elevation.
- .11 Use 25 mm chamfer strips on external corners and/or 25 mm fillets at interior corners , joints, unless specified otherwise.
- .12 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.
- .13 Construct forms for architectural concrete, and place ties as indicated and/or as directed. Joint pattern not necessarily based on using standard size panels or maximum permissible spacing of ties.
- .14 Build in anchors, sleeves, and other inserts required to accommodate Work specified in other sections. Assure that all anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.
- .15 Line forms for following surfaces:
  - .1 Exposed faces of abutments, wingwalls, piers and pylons. Do not stagger joints of form lining material. Align joints to obtain uniform pattern.
- .16 Clean formwork in accordance with CAN/CSA-A23.1, before placing concrete.

### **3.2 Removal and reshoring**

- .1 Leave formwork in place for following minimum periods of time after placing concrete.
  - .1 3 days for walls and sides of beams.
  - .2 3 days for footings and abutments.
- .2 Remove formwork when concrete has reached 70% of its design strength or minimum period noted above, whichever comes later, and replace immediately with adequate reshoring.
- .3 Re-use formwork and falsework subject to requirements of CAN/CSA-A23.1.

**END OF SECTION**

## **PART 1 GENERAL**

### **1.1 Related sections**

- .1 Section 03 30 00 - Cast-in-Place Concrete.

### **1.2 References**

- .1 American Society for Testing and Materials (ASTM)
  - .1 ASTM A82/A82M-07, Specification for Steel Wire, Plain for Concrete Reinforcement.
  - .2 ASTM A185/A185M-07, Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
  - .3 ASTM A 775/A 775M-07b, Specification for Epoxy-Coated Reinforcing Steel Bars.
- .2 Canadian Standards Association (CSA)
  - .1 CAN/CSA A23.1-09/A23.2-09, Concrete Materials and Methods of Concrete Construction.
  - .2 CAN3-A23.3-04, Design of Concrete Structures for Buildings.
  - .3 CAN/CSA-G30.18-M92 (R2007), Billet-Steel Bars for Concrete Reinforcement.
  - .4 CAN/CSA-G40.20/G40.21-04, Structural Quality Steels.
  - .5 CSA W186-M1990 (R2007), Welding of Reinforcing Bars in Reinforced Concrete Construction.

### **1.3 Shop drawings**

- .1 Submit shop drawings including placing of reinforcement in accordance with Section 01 01 00- General Instructions.
- .2 Indicate on shop drawings, bar bending details, lists, quantities of reinforcement, sizes, spacings, locations of reinforcement and mechanical splices if approved by Departmental Representative , with identifying code marks to permit correct placement without reference to structural drawings. Indicate sizes, spacings and locations of chairs, spacers and hangers. Prepare reinforcement drawings in accordance with Reinforcing Steel Manual of Standard Practice - by Reinforcing Steel Institute of Canada.
- .3 Detail lap lengths and bar development lengths to CAN3-A23.3, unless otherwise indicated. Provide type B tension lap splices unless otherwise indicated.

### **1.4 Waste management and disposal**

- .1 Separate and recycle waste materials in accordance with the Waste Reduction Workplan.

## **PART 2 PRODUCTS**

### **2.1 Materials**

- .1 Substitute different size bars only if permitted in writing by Departmental Representative.
- .2 Reinforcing steel: billet steel, grade 400, deformed bars to CAN/CSA-G30.18, unless indicated otherwise.
- .3 Reinforcing steel: weldable low alloy steel deformed bars to CAN/CSA-30.18.
- .4 Cold-drawn annealed steel wire ties: to ASTM A82.
- .5 Deformed steel wire for concrete reinforcement: to ASTM A496.
- .6 Welded steel wire fabric: to ASTM A185. Provide in flat sheets only.
- .7 Epoxy coating of non-prestressed reinforcement: to ASTM A 775/A 775M.
- .8 Chairs, bolsters, bar supports, spacers: to CAN/CSA-A23.1.
- .9 Mechanical splices: subject to approval of Departmental Representative.
- .10 Plain round bars: to CAN/CSA-G40.21.

### **2.2 Fabrication**

- .1 Fabricate reinforcing steel in accordance with CAN/CSA-A23.1 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada, unless indicated otherwise.
- .2 Obtain Departmental Representative 's approval for locations of reinforcement splices other than those shown on placing drawings.
- .3 Upon approval of Departmental Representative, weld reinforcement in accordance with CSA W186.
- .4 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.

### **2.3 Source quality control**

- .1 Upon request, provide by Departmental Representative with certified copy of mill test report of reinforcing steel, showing physical and chemical analysis, minimum 2 weeks prior to commencing reinforcing work.
- .2 Upon request inform Departmental Representative of proposed source of material to be supplied.

**PART 3 EXECUTION**

**3.1 Field bending**

- .1 Do not field bend or field weld reinforcement except where indicated or authorized by Departmental Representative.
- .2 When field bending is authorized, bend without heat, applying a slow and steady pressure.
- .3 Replace bars which develop cracks or splits.

**3.2 Placing of reinforcement**

- .1 Place reinforcing steel as indicated on reviewed placing drawings and in accordance with CAN/CSA-A23.1.
- .2 Use plain round bars as slip dowels in concrete. Paint portion of dowel intended to move within hardened concrete with one coat of asphalt paint. When paint is dry, apply a thick even film of mineral lubricating grease.
- .3 Prior to placing concrete, obtain Departmental Representative's approval of reinforcing material and placement.
- .4 Ensure cover to reinforcement is maintained during concrete pour.
- .5 Protect epoxy coated portions of bars with covering during transportation and handling.

**3.3 Field touch-up**

- .1 Touch up damaged and cut ends of epoxy coated with compatible finish to provide continuous coating.

**END OF SECTION**

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**PART 1 GENERAL**

**1.1 Related sections**

- .1 Section 03 10 00 - Concrete Forming and Accessories.
- .2 Section 03 20 00 - Concrete Reinforcing.

**1.2 Measurement procedures**

- .1 Cast-in-place concrete will not be measured but will be paid for as a fixed price item.
- .2 Heating of water and aggregates and providing cold weather protection will not be measured but considered incidental to work.
- .3 Cooling of concrete and providing hot weather protection will not be measured but considered incidental to work.
- .4 Supply and installation of anchor bolts, nuts and washers and bolt grouting will not be measured but considered incidental to work.

**1.3 References**

- .1 American Society for Testing and Materials (ASTM)
  - .1 ASTM C309-07, Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
  - .2 ASTM C494-08a, Specification for Chemical Admixtures for Concrete.
- .2 Canadian General Standards Board (CGSB)
  - .1 CGSB 81-GP-1M-77, Flooring, Conductive and Spark Resistant.
- .3 Canadian Standards Association (CSA)
  - .1 CAN/CSA A23.1-09/A23.2-09, Concrete Materials and Methods of Concrete Construction.
  - .2 CAN/CSA-A23.2-04, Methods of Test for Concrete.
  - .3 CAN/CSA-A3000-08 - Cementitious materials compendium.

**1.4 Samples**

- .1 Submit samples in accordance with Section 01 01 00 - General Instructions.
- .2 At least 4 weeks prior to commencing work, inform Departmental Representative of proposed source of aggregates and provide access for sampling.

**1.5 Certificates**

- .1 Submit certificates in accordance with 01 01 00 - General Instructions.
- .2 Minimum 4 weeks prior to starting concrete work submit to Departmental Representative manufacturer's test data and certification by qualified independent

inspection and testing laboratory that following materials will meet specified requirements:

- .1 Portland cement.
  - .2 Supplementary cementing materials.
  - .3 Grout.
  - .4 Admixtures.
  - .5 Aggregates.
  - .6 Water.
- 
- .3 Provide certification that mix proportions selected will produce concrete of quality, yield and strength as specified in concrete mixes, and will comply with CAN/CSA-A23.1.
  - .4 Provide certification that plant, equipment, and materials to be used in concrete comply with requirements of CAN/CSA-A23.1.

#### **1.6 Quality assurance**

- .1 Minimum 4 weeks prior to starting concrete work, submit proposed quality control procedures for Departmental Representative's approval for following items:
  - .1 Falsework erection.
  - .2 Hot weather concrete.
  - .3 Cold weather concrete.
  - .4 Curing.
  - .5 Finishes.
  - .6 Formwork removal.
  - .7 Joints.

#### **1.7 Waste management and disposal**

- .1 Separate and recycle waste materials in accordance with the Waste Reduction Workplan.
- .2 Use trigger operated spray nozzles for water hoses.
- .3 Designate a cleaning area for tools to limit water use and runoff.
- .4 Carefully coordinate the specified concrete work with weather conditions.
- .5 Ensure emptied containers are sealed and stored safely for disposal away from children.
- .6 Prevent plasticizers, water-reducing agents and air-entraining agents from entering drinking water supplies or streams. Using appropriate safety precautions, collect liquid or solidify liquid with an inert, noncombustible material and remove for disposal. Dispose of all waste in accordance with applicable local, provincial and national regulations.
- .7 Choose least harmful, appropriate cleaning method which will perform adequately.

## **PART 2 PRODUCTS**

### **2.1 Materials**

- .1 Portland cement Normal (type GU): to CSA-A3000.
- .2 Supplementary cementing materials: to CSA-A3000.
- .3 Water: to CAN/CSA-A23.1.
- .4 Aggregates: to CAN/CSA-A23.1. Coarse aggregates to be normal density.
- .5 Air entraining admixture: to CAN/CSA-A23.1.
- .6 Chemical admixtures: to ASTM C494. Departmental Representative to approve accelerating or set retarding admixtures during cold and hot weather placing.
- .7 Concrete retarders: to ASTM C494 water based, low VOC, solvent free. Do not allow moisture of any kind to come in contact with the retarder film.
- .8 Curing compound: to CAN/CSA-A23.1 and to ASTM C309, Type 1-chlorinated rubber.
- .9 Cushion pads: tough, resilient, weather, moisture, and oil resistant material that will not corrode or cause corrosion, consisting of either layers of approved cotton duck saturated and bound together by approved rubber or synthetic compounds, or made from specially compounded synthetic materials.

### **2.2 Mixes**

- .1 Proportion normal density concrete in accordance with CAN/CSA-A23.1, Alternative 1 to give following properties for all concrete
- .2 Concrete Class/properties:
  - .1 As noted on drawings.

## **PART 3 EXECUTION**

### **3.1 Preparation**

- .1 Obtain Departmental Representative's approval before placing concrete. Provide 24 hours notice prior to placing of concrete.
- .2 Pumping of concrete is permitted only after approval of equipment and mix.
- .3 Ensure reinforcement and inserts are not disturbed during concrete placement.
- .4 Prior to placing of concrete obtain Departmental Representative's approval of proposed method for protection of concrete during placing and curing in adverse weather. This includes protection to prevent soil and concrete from freezing in

cold weather. Heat and/insulated tarps are required in temperatures below freezing.

- .5 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.
- .6 In locations where new concrete is dowelled to existing work, drill holes in existing concrete. Place steel dowels of deformed steel reinforcing bars and pack solidly with epoxy grout to anchor and hold dowels in positions as indicated.
- .7 Do not place load upon new concrete until authorized by Departmental Representative.

### **3.2 Protection**

- .1 Protect soil and concrete from freezing for at least 3 days after the concrete pour. Provide heat and/or insulated tarps to maintain temperature above freezing.

### **3.3 Construction**

- .1 Do cast-in-place concrete work in accordance with CAN/CSA-A23.1.
- .2 Sleeves and inserts.
  - .1 No sleeves, ducts, pipes or other openings shall pass through joists, beams, column capitals or columns, except where indicated or approved by Departmental Representative.
  - .2 Where approved by Departmental Representative, set sleeves, ties, pipe hangers and other inserts and openings as indicated or specified elsewhere. Sleeves and openings greater than 100 x 100 mm not indicated, must be approved by Departmental Representative.
  - .3 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain approval of modifications from Departmental Representative before placing of concrete.
  - .4 Check locations and sizes of sleeves and openings shown on drawings.
  - .5 Set special inserts for strength testing as indicated and as required by non-destructive method of testing concrete.
- .3 Anchor bolts.
  - .1 Set anchor bolts to templates under supervision of appropriate trade prior to placing concrete.
- .4 Grout under base plates using procedures in accordance with manufacturer's recommendations which result in 100 % contact over grouted area.
- .5 Finishing.
  - .1 Finish concrete in accordance with CAN/CSA-A23.1.
  - .2 Use procedures acceptable to Departmental Representative or those noted in CAN/CSA-A23.1 to remove excess bleed water. Ensure surface is not damaged.
  - .3 Use curing compounds compatible with applied finish on concrete surfaces. Applied finish on concrete. Provide written declaration that compounds used are compatible.

- .4 Finish concrete floor to meet requirements of CGSB 81-GP-1M.
- .5 Provide swirl-trowelled finish unless otherwise indicated.
- .6 Rub exposed sharp edges of concrete with carborundum to produce 3 mm radius edges unless otherwise indicated.

### **3.4 Field quality control**

- .1 Inspection and testing of concrete and concrete materials will be carried out by a Testing Laboratory designated by Departmental Representative in accordance with CAN/CSA-A23.1.
- .2 Owner will pay for costs of tests.
- .3 Departmental Representative will take additional test cylinders during cold weather concreting. Cure cylinders on job site under same conditions as concrete which they represent.
- .4 Non-destructive Methods for Testing Concrete shall be in accordance with CAN/CSA-A23.2.
- .5 Inspection or testing by Departmental Representative will not augment or replace Contractor quality control nor relieve him of his contractual responsibility.

**END OF SECTION**

## **PART 1 GENERAL**

### **1.1 References**

- .1 American Society for Testing and Materials International, (ASTM)
  - .1 ASTM A325-02, Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-85.10-99, Protective Coatings for Metals.
  - .2 CAN/CGSB-1.40-97, Anticorrosive Structural Steel Alkyd Primer.
  - .3 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc - Rich Coating.
  - .4 CAN/CGSB-85.100-93, Painting.
- .3 Canadian Standards Association (CSA International)
  - .1 CAN/CSA G40.20/G40.21-04, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
  - .2 CAN/CSA-S16-01, Limit States Design of Steel Structures.
  - .3 CAN/CSA-S136-07), Cold Formed Steel Structural Members.
  - .4 CSA W47.1-03 (R2008), Certification of Companies for Fusion Welding of Steel Structures.
  - .5 CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding.
  - .6 CSA W55.3-08, Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings.
  - .7 CSA W59-03 (R2008), Welded Steel Construction (Metal Arc Welding).
- .4 The Society for Protective Coatings (SSPC)
  - .1 SSPC SP-6/NACE No. 3-00, Commercial Blast Cleaning.

### **1.2 Design requirements**

- .1 Design details and connections in accordance with requirements of CAN/CSA-S16 and CAN/CSA-S136 to resist forces, moments, shears and allow for movements indicated.
- .2 Shear connections:
  - .1 Select framed beam shear connections from an industry accepted publication such as "Handbook of the Canadian Institute of Steel Construction" when connection for shear only (standard connection) is required.
  - .2 Select or design connections to support reaction from maximum uniformly distributed load that can be safely supported by beam in bending, provided no point loads act on beam, when shears are not indicated.
- .3 Submit sketches and design calculations stamped and signed by qualified professional engineer licensed in Provinces of Ontario, Canada for non standard connections.

### **1.3 Shop drawings**

- .1 Submit shop drawings including fabrication and erection documents and materials list in accordance with Section 01 01 00 - General Instructions.
- .2 Erection drawings: indicate details and information necessary for assembly and erection purposes including:
  - .1 Description of methods.
  - .2 Sequence of erection.
  - .3 Type of equipment used in erection.
  - .4 Temporary bracings.
- .3 Ensure Fabricator drawings showing designed assemblies, components and connections are stamped and signed by qualified professional engineer licensed in the province of Ontario, Canada.

### **1.4 Quality assurance**

- .1 Submit 2 copies of mill test reports 2 weeks prior to fabrication of structural steel.
  - .1 Mill test reports to show chemical and physical properties and other details of steel to be incorporated in project.
  - .2 Provide mill test reports certified by metallurgists qualified to practice in province of Ontario, Canada.
- .2 Provide structural steel Fabricator's affidavit stating that materials and products used in fabrication conform to applicable material and products standards specified and indicated.

### **1.5 Waste management and disposal**

- .1 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .2 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard packaging material for recycling in accordance with Waste Management Plan.
- .3 Divert unused metal materials from landfill to metal recycling facility approved by Departmental Representative.
- .4 Divert unused paint material from landfill to official hazardous material collections site approved by Departmental Representative.
- .5 Do not dispose of unused paint materials into sewer systems, into lakes, streams, onto ground or in other location where it will pose health or environmental hazard.

## **PART 2 Products**

### **2.1 Materials**

- .1 Structural steel: to CAN/CSA-G40.20/G40.21 Grade as indicated on drawings.
- .2 Anchor bolts: to CAN/CSA-G40.20/G40.21, Grade 262W.
- .3 Bolts, nuts and washers: to ASTM A325.
- .4 Welding materials: to CSA W48 Series, CSA W59 and certified by Canadian Welding Bureau.
- .5 Shop paint primer: to CAN/CGBS-1.40 and SSPC SP-6.
- .6 Zinc-rich primer paint: to CAN/CGSB-1.181.
- .7 Roof steel deck: 76mm deep by 0.91mm thick galvanized steel deck with Z275 finish.

### **2.2 Fabrication**

- .1 Fabricate structural steel in accordance with CAN/CSA-S16, CAN/CSA-S136 and in accordance with reviewed shop drawings.
- .2 Continuously seal members by continuous welds.
- .3 Provide effective drainage holes to prevent accumulation of water in hollow section members.

### **2.3 Shop painting**

- .1 Clean, prepare surfaces and shop prime structural steel in accordance with CAN/CSA-S16, CAN/CSA-S136, and CAN/CGSB-85.100, except where members to be encased in concrete.
- .2 Clean members, remove loose mill scale, rust, oil, dirt and other foreign matter. Prepare surface according to SSPC-SP-6.
- .3 Apply one coat of primer in shop to steel surfaces to achieve minimum dry film thickness of 1.5 to 2 mils, except:
  - .1 Surfaces to be encased in concrete.
  - .2 Surfaces and edges to be field welded.
  - .3 Faying surfaces of friction-type connections.
  - .4 Below grade surfaces in contact with soil.
- .4 Apply paint under cover, on dry surfaces when surface and air temperatures are above 5 degrees C.
- .5 Maintain dry condition and 5 degrees C minimum temperature until paint is thoroughly dry.

- .6 Strip paint from bolts, nuts, sharp edges and corners before prime coat is dry.
- .7 Paint all exterior steel with corrosion resistant primer and paint. Submit paint system datasheet to Departmental Representative prior to use.

### **PART 3 EXECUTION**

#### **3.1 General**

- .1 Structural steel work: in accordance with CAN/CSA-S16 and CAN/CSA-S136.
- .2 Welding: in accordance with CSA W59.
- .3 Companies to be certified under Division 1 or 2.1 of CSA W47.1 for fusion welding of steel structures and/or CSA W55.3 for resistance welding of structural components.

#### **3.2 Connection to existing work**

- .1 Verify dimensions and condition of existing work, report discrepancies and potential problem areas to Departmental Representative for direction before commencing fabrication.

#### **3.3 Marking**

- .1 Mark materials in accordance with CAN/CSA G40.20/G40.21. Do not use dye stamping. If steel is to be left in unpainted condition, place marking at locations not visible from exterior after erection.
- .2 Match marking: shop mark bearing assemblies and splices for fit and match.

#### **3.4 Erection**

- .1 Erect structural steel, as indicated and in accordance with CAN/CSA-S16 and CAN/CSA-S136 and in accordance with reviewed erection drawings.
- .2 Field cutting or altering structural members: to approval of Departmental Representative.
- .3 Clean with mechanical brush and touch up shop primer to bolts, rivets, welds and burned or scratched surfaces at completion of erection.
- .4 Continuously seal members by continuous welds where indicated. Grind smooth.

#### **3.5 Field Quality Control**

- .1 Inspection and testing of materials and workmanship will be carried out by testing laboratory designated by Departmental Representative.
- .2 Provide safe access and working areas for testing on site, as required by testing agency and as authorized by Departmental Representative.

- .3 Submit test reports to Departmental Representative within 2 weeks of completion of inspection.
- .4 Owner will pay costs of tests.

**3.6 Field painting**

- .1 Touch up damaged surfaces and surfaces without shop coat with primer to SSPC-SP-6 except as specified otherwise. Apply in accordance with CAN/CGSB 85.10.

**END OF SECTION**

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**PART 1 GENERAL**

**1.1 Related Work**

- .1 Section: Instructions to Bidders
- .2 Section: 01 01 00 General Instructions

**1.2 Qualifications of Manufacturer**

- .1 The manufacturer supplying the door shall have at least ten years experience in the design or manufacture of Aircraft Hangar Doors. All design drawings shall be stamped by a Professional Engineer registered in the Province of Ontario who is familiar with the design of hangar doors. The company or engineer shall have a Certificate of Authorization to practice Professional Engineering in the Province.

**1.3 Submittals**

- .1 The door manufacturer shall submit a complete set of approval drawings prior to the manufacture of the door. Drawings shall indicate typical elevations, sections and plans of the door as well as details on connections to the building, track layout, girt spacings/locations, weathering details, operator layout, motor size, and complete electrical wiring schematics. Drawings shall also indicate the wheel loads and locations on the tracks, the dead loads of the top guides to be carried by the building structure, the loads due to wind on the top guides and the amount and method in which vertical building deflections are handled.

Upon completion, the manufacturer shall provide three (3) sets of maintenance manuals to the owner which shall indicate door function, general arrangement and electrical schematics as well as the type and part number of replacement components used in the door system.

**1.4 Door Description**

- .1 Demolition of spray or trowel applied asbestos can be hazardous to health. Should material resembling spray or trowel-applied asbestos be encountered, stop work and notify Departmental Representative immediately. Do not proceed until written instructions have been received from the Departmental Representative.

**PART 2 PRODUCTS**

**2.2 Door Description**

- .1 There shall be one door designed to cover the opening as follows:
  - .1 Service Hangar: 35.5 m wide x 15.5 m high x 6 leaves (bi-parting).
  - .2 The door shall have 3 leaves running on separate rails. Leaves shall be set in echelon formation running on steel tracks and top guided. The leading leaf shall be electrically operated and shall pick up the adjacent leave(s) in both the opening and closing modes of operation. Doors shall be electrically operated with provision for emergency opening (towing).

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- .2 Design:
- .1 The doors shall be designed for the design loads as specified in the National Building Code of Canada. The net design wind pressure or suction shall not be less than the (1/50) average wind pressure applied as specified in the NBC with additional internal pressure or suction for a Category II building, and deflections of members shall not exceed 1/180 of their span at SLS=0.75.
  - .2 The doors shall be designed to accommodate vertical building deflections of 1/480 of the opening width downward and an upward deflection of 1/720 of the width of the door opening without transferring any vertical loads to the building support structure or (Optional: deflections as provided by the building supplier, please advise).
  - .3 Steel design to
    - .1 CSA S-16 or S-16-09
    - .2 CSA S-136 or S-136-07
  - .4 Welding to:
    - .1 CSA W59-03
- .3 Structural Steel:
- .1 Structural steel shall be all bolted construction designed for easy field erection. Girt spacing shall be coordinated with the cladding to accommodate the permissible span of the exterior cladding. Girts shall also be located above and below window openings (where applicable) to provide framed openings. Sag rods shall be provided where the girt span exceeds 20' 0" (6096mm) or where required by design.
  - .2 Each door panel shall be fitted with diagonal bracing to maintain the squareness of the frames. The bracing shall be designed to resist the maximum impact load plus 25% as calculated in the design of the bumper pickup system of the door leaves.
- .4 Ground Rails:
- .1 The ground rail system shall consist of hot rolled ASCE rail shapes having a minimum weight of 30 lbs per yard (or heavier if required by design) factory mounted to hot rolled channel (angle sleepers and fitted with leveling bolts. Rail spacing shall be accurately maintained during installation to the design spacing  $\pm 2$  mm and be designed for field bolting using standard ASCE rail splices. Sleeper spacing shall not exceed 5'-0" (1524mm) on centre and shall extend at least 6" (150 mm) either side of the rail assembly. Leveling devices shall permit the vertical adjustment of  $\pm 1$ " (25 mm) from the design position.

- .5 Bogies:
- .1 Bogies shall be designed to transfer all vertical dead loads and horizontal live loads to the wheels. The vertical deflection of the bogey shall not exceed 1/360 of the span and the horizontal deflection shall not exceed 1/240 of the span. Bogeys shall be drilled to accept vertical structural members and shall be fitted with a continuous mounting angle on the exterior face on which the exterior cladding and bottom door weather stripping can be mounted. Reinforced wheel boxes shall be accurately located in the bogey and designed for the easy insertion and removal of the wheels without the need to remove the door structure from the track.
- .6 Wheels:
- .1 Wheels shall be minimum 305 mm dia (larger if required by design) and made from C1045 steel and machined to properly fit the rail profile and fitted with heavy duty ball or spherical roller bearings designed to accommodate the vertical dead loads combined with the horizontal live loads due to wind. Bearings shall be designed for a minimum life of 25 years assuming the door fully opens and closes once per day with 100% dead load and wind loads at SLS-0.75. Wheel treads shall be heat treated to a hardness of Brinell 350. The Axle shall be designed to be removable and fitted with grease fittings to allow for bearing lubrication for easy maintenance.
- .7 Top Roller Assemblies:
- .1 Top rollers shall be affixed to the top of the door structure and be designed to resist the horizontal wind loads and accommodate the vertical deflection of the building. Top rollers shall slide effortlessly over the top guide members. Top rollers shall be fitted with sealed ball bearings and designed to last a minimum of 25 years (SLS-0.75). Provision shall be made to allow top rollers to be removed from above to allow for future maintenance.
- .8 Top Guides:
- .1 Top guides shall be designed to resist the applied live wind loads from the door structure and transfer them to the building structure at maximum 20' - 0" (6096 mm) intervals across the opening width. The top guides shall be supported vertically at a maximum 10' - 0" (3048 mm) and horizontally by the building structure at maximum 20' - 0" (6096 mm) intervals and shall be adjustable to allow for leveling the top guides to the neutral dead load position. In no event shall the top guide fall below the design door opening height in this position. The top guides shall be designed to accommodate vertical building deflections of 1/480 of the opening width downward and an upward deflection of 1/720 of the width of the door opening without transferring any vertical loads to the building support structure or (Optional: deflections as provided by the building supplier, please advise). In any case the vertical live load deflections of the building shall be verified by the building designer. Where required for proper weathering of the building vertical surfaces of the top guide shall be fitted with minimum 16ga (1.6 mm) thick steel plates to close the top guides to air infiltration and allow for the installation of fibre insulation (by others).

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- .9 Safety Bumpers:
- .1 Door leaves shall be fitted with shock absorbing pickup bumpers arranged as required for proper door operation and positioned for both the opening and closing modes of operation. Bumpers shall be designed for the maximum mass of the door including cladding and insulation travelling at the design door speed 12 inches/second (300 mm/sec) impacting with adjacent leaves as per door operation. Bumpers shall be designed for the most critical of these conditions. End stop bumpers shall be located on both sides of the opening to prevent the possibility of doors running off the end of the track. Bumpers shall be designed for the maximum door mass travelling at door speed striking a fixed object. Weldment and bracing design shall incorporate the maximum calculated bumper force plus an additional 25% in their design.
- .10 Weatherstripping:
- .1 The perimeter of each door leaf shall be fitted with polypropylene brush fastened to the door in aluminum extrusions. Weatherstripping shall be so arranged so as to be adjustable and easily removable for replacement and maintenance. Top panel weatherstripping shall brush against a continuous vertical surface and be arranged so that contact with the weathering surface is maintained throughout the complete range of the calculated building vertical deflection. Weathering against a horizontal surface at the top guide shall not be permitted. Vertical weathering shall be brush seals so arranged that it will not rub the front surface of the door or cladding system when the doors pass each other and comes in contact with the weathering surface only when the door is in the fully closed position.
- .11 Prime Paint:
- .1 All structural steel, top guides, bogeys and other non mechanical parts shall be given 1 coat of red oxide shop primer conforming to MPI 79 prior to shipment with the exception of bottom rails. All steel shall be prepared in accordance with SSPC-SP2 prior to painting.
- .12 Warning Horn:
- .1 Each leaf of each half of the door shall be fitted with a warning horn which shall be activated on the operation of the door and shall remain on so long as the door is in operation.
- .13 Safety Edge:
- .1 Each leading edge of each operated door (i.e. both the opening and closing sides of the door) shall be fitted with a Miller safety edge that shall stop the door in the event an obstruction is met.
- .14 Man Doors:
- .1 All man doors shall be provided by the general contractor and shall be located in the leading leaf of the opening. A framed opening c/w electrical interlock with the operator shall be provided to prevent hangar door motion if the man door is open.

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- .15 Electric Operation:
- .1 The two centre leaves of the door system shall be fitted with (1 or 2 as required by design) - 600 V-3ph TEFC electric operator complete with brake and (Optional: initial start up shall be controlled using electronic soft start design) shall move the doors without spinning the driven wheel in normal dry conditions. The operator shall consist of a high quality double or triple reduction helical bevel gears running in an oil bath (Nord Gear) and fitted with an electric motor complete with disc brake. The gear box, brake, and motor shall be designed to be back driven by releasing the brake disconnect lever which is interlocked with the control panel to prevent electric operation while in manual mode. Each operator shall drive one of the machined steel wheels by means of sprockets a suitable designed roller chain (min FS = 7:1). The motor shall be designed to move the door at about 60 feet per minute (18 metres per minute). All electrical equipment located below 18" (460 mm) of the floor level shall be explosion proof.
- .16 Controls:
- .1 Electrical door controls shall be mounted on the leading leaf of each drive door in NEMA 12 (Dust tight) enclosures. All control components and control panels shall be CSA certified and control panels shall be CSA inspected. The control panel shall contain all necessary starters, timers, transformers, thermal overloads and relays pre-wired to a numbered terminal board for easy connection and maintenance. Starters shall be oversized, and all components shall be of the highest quality. The control voltage shall be 120 v/1ph/60hz and the operator and main supply voltage shall be 600 v/3ph/60hz.
- .17 Conductors:
- .1 Power supply to the door system shall be through a festooning power supply system (Optional: Pow-R-Feed system as manufactured by Aero-Motive). Conductors shall be copper and continuous throughout the length of the system (Optional: and housed in a weather tight sealed housing). The system shall be designed to accommodate the expansion contraction of the top guide system.
- .18 Door Operation:
- .1 Opening:
- .1 Open push buttons shall be located on the leading (opening) edge of each leaf. The push button shall be depressed and held which activates the door in motion warning horn; the door starts to travel in the opening mode until the door reaches the fully open position at which time the door stops. At any time during this process should the push button be released, the door shall stop.
- .2 Closing:
- .1 The closing operation of the door is identical to the opening mode except the door can be jogged to the fully closed position.

**PART 3 EXECUTION**

**3.1 Installation**

- .1 Ground rails shall be installed  $\pm 3$  mm in 6 M and  $\pm 6$  mm overall in both alignment and top of track elevation as shown on the manufacturer's drawings. The ground rail system shall be securely fastened to reinforcing bar or other means of attachment so the possibility of movement during concrete backfilling is impossible.
- .2 Top Guides shall be installed  $\pm 6$  mm in 6 M and  $\pm 10$  mm overall for both alignment and elevation as shown on the manufacturers drawing.
- .3 All other components shall be installed as required by the manufacturer's drawings and in good workmanship fashion.
- .4 The door installer shall supervise the electrical wiring of the door system. Wiring shall be performed by the project electrical subcontractor.
- .5 Proper function of the door shall be demonstrated to the Departmental Representative to show substantial completion of the door system.

**END OF SECTION**

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- 1 General**
- 1.1 GENERAL**
- .1 This Section covers items common to Sections of Division 26. This section supplements requirements of Division 01.
- 1.2 CODES AND STANDARDS**
- .1 Do complete all new installation in the accordance with CSA C22.1HB-02 except where specified otherwise.
- 1.3 CARE, OPERATION AND START-UP**
- .1 Instruct Departmental Representative and operating personnel in the operation, care and maintenance of equipment.
- .2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components.
- .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 with all aspects of its care and operation.
- 1.4 VOLTAGE RATINGS**
- .1 Operating voltages: to CAN3-C235-83 (R2000).
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- 1.5 PERMITS, FEES AND INSPECTION**
- .1 Submit to Electrical Safety Authority and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.
- .2 Pay associated fees in accordance with Section 01 00 00 – General Instructions.
- .3 The Engineer will provide drawings and specifications required by Electrical Safety Authority and Supply Authority at no cost.
- .4 Notify the Departmental Representative of changes required by Electrical Safety Authority prior to making changes.
- .5 Furnish Certificates of Acceptance from Electrical Safety Authority or authorities having jurisdiction on completion of work to Departmental Representative.
- 1.6 MATERIALS AND EQUIPMENT**
- .1 Provide materials and equipment in accordance with this Section Item 1.23.
- .2 Equipment and material to be CSA certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Departmental Representative.
- .3 Factory assemble control panels and component assemblies.

**1.7 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS**

- .1 Supplier and installer responsibility is indicated in Motor, Control and Equipment Schedule on electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings.
- .2 Control wiring and conduit is specified in Division 26 except for conduit, wiring and connections below 50 V which are related to control systems.

**1.8 FINISHES**

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
  - .1 Paint outdoor electrical equipment "equipment green" finish to EEMAC Y1-1-1955.
  - .2 Paint indoor switchgear and distribution enclosures light grey to EEMAC 2Y-1-1958.
- .2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .3 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

**1.9 EQUIPMENT IDENTIFICATION**

- .1 Identify electrical equipment with nameplates and/or labels as follows:
- .2 Nameplates:
  - .1 Lamicoid 3 mm thick plastic engraving sheet, black face, white core, mechanically attached with self tapping screws.

NAMEPLATE SIZES			
Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters
- .3 Labels:
  - .1 Embossed plastic labels with 6 mm high letters unless specified otherwise.
- .4 Wording on nameplates and labels to be approved by Departmental Representative prior to manufacture.
- .5 Allow for average of twenty-five (25) letters per nameplate and label.
- .6 Identification to be English.
- .7 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .8 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .9 Terminal cabinets and pull boxes: indicate system and voltage.
- .10 Transformers: indicate capacity, primary and secondary voltages.

**1.10 WIRING IDENTIFICATION**

- .1 Identify wiring with permanent indelible identifying markings either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.

- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour code: to CSA C22.1-1986.
- .4 Use colour coded wires in communication cables, matched throughout system.

#### 1.11 CONDUIT AND CABLE IDENTIFICATION

- .1 Colour code conduits, boxes and metallic sheathed cables.
- .2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.
- .3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.
 

	<u>Prime</u>	<u>Auxiliary</u>
up to 250 V	yellow	
up to 600 V	yellow	green
Telephone	green	
Other communication systems	green	blue
Fire alarm	red	
Emergency voice	red	blue
Other security systems	red	yellow

#### 1.12 WIRING TERMINATIONS

- .1 Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminum conductors.

#### 1.13 MANUFACTURERS AND CSA LABELS

- .1 Visible and legible after equipment is installed.

#### 1.15 SINGLE LINE ELECTRICAL DIAGRAMS

- .1 Update existing fire alarm riser diagram, plan and zoning of building at fire alarm control panel and annunciator related to work done.

#### 1.16 LOCATION OF OUTLETS

- .1 Locate outlets in accordance with Section 01 00 00 - General Instructions.
- .2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.
- .3 Change the location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.
- .4 Locate light switches on latch side of doors. Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.

#### 1.17 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .3 Install electrical equipment at following heights unless indicated otherwise.
  - .1 Local switches: 1400 mm.

- .2 Wall receptacles:
  - .1 General: 300 mm.
  - .2 Above top of continuous baseboard heater: 200 mm.
  - .3 Above top of counters or counter splash backs: 175 mm.
  - .4 In mechanical rooms: 1400 mm.
- .3 Panelboards: as required by Code or as indicated.
- .4 Telephone and interphone outlets: 300 mm.
- .5 Wall mounted telephone and interphone outlets: 1500 mm.
- .6 Fire alarm stations: 1500 mm.
- .7 Fire alarm bells: 2100 mm.
- .8 Television outlets: 300 mm.
- .9 Door bell pushbuttons: 1500 mm.

### 1.18 LOAD BALANCE

- .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance. Adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
- .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
- .3 Submit, at completion of work, report listing phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load. State hour and date on which each load was measured, and voltage at time of test.

### 1.19 CONDUIT AND CABLE INSTALLATION

- .1 Install conduit and sleeves prior to pouring of concrete. Sleeves through concrete: schedule 40 steel pipe, sized for free passage of conduit, and protruding 50 mm.
- .2 Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.

### 1.20 FIELD QUALITY CONTROL

- .1 Conduct and pay for following tests:
  - .1 Power generation and distribution system including phasing, voltage, grounding and load balancing.
  - .2 Circuits originating from branch distribution panels.
  - .3 Lighting and its control.
  - .4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
  - .5 Systems: fire alarm system, communications.
- .2 Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.
- .3 Insulation resistance testing.
  - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
  - .2 Check resistance to ground before energizing.
  - .3 Carry out tests in presence of Departmental Representative .
  - .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
  - .5 Submit test results for Departmental Representative review.

**1.21 CO-ORDINATION OF PROTECTIVE DEVICES**

- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

**1.22 DEMOLITION AND REMOVAL**

- .1 Separate and recycle waste materials in accordance with Waste Management and Disposal section.
- .2 Divert unused metal and wiring materials from landfill to metal recycling facility.
- .3 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .4 Dispose of corrugated cardboard polystyrene plastic packaging material in appropriate on-site bin for recycling in accordance with site waste management program.

**1.23 SUBMITAL PROCEDURE FOR SHOP DRAWINGS AND PRODUCT DATA**

- .1 CCDC 2 GC 3.11.
- .2 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of 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 Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.
- .4 Allow 7days for Departmental Representative review of each submission.
- .5 Adjustments made on shop drawings by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental Representative prior to proceeding with Work.
- .6 Make changes in shop drawings as Departmental Representative may require, consistent with Contract Documents. When resubmitting, notify Departmental Representative in writing of any revisions other than those requested.
- .7 Accompany submissions with transmittal letter, containing:
  - .1 Date.
  - .2 Project title and number.
  - .3 Contractor's name and address.
  - .4 Identification and quantity of each shop drawing, product data and sample.
  - .5 Other pertinent data.
- .8 Submissions shall include:
  - .1 Date and revision dates.
  - .2 Project title and number.
  - .3 Name and address of:
    - .1 Subcontractor.
    - .2 Supplier.
    - .3 Manufacturer.
  - .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
  - .5 Details of appropriate portions of Work as applicable:

- .1 Fabrication.
- .2 Layout, showing dimensions, including identified field dimensions, and clearances.
- .3 Setting or erection details.
- .4 Capacities.
- .5 Performance characteristics.
- .6 Standards.
- .7 Operating weight.
- .8 Wiring diagrams.
- .9 Single line and schematic diagrams.
- .10 Relationship to adjacent work.

- .9 After Departmental Representative review, distribute copies.
- .10 Submit one electronic copy of shop drawings for each requirement requested in specification Sections and as consultant may reasonably request.
- .11 Delete information not applicable to project.
- .12 Supplement standard information to provide details applicable to project.
- .14 If upon review by Departmental Representative, no errors or omissions are discovered or if only minor corrections are made 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 same procedure indicated above, must be performed before fabrication and installation of Work may proceed.

**2 Products (not applicable)**

**3 Execution (not applicable)**

**END OF SECTION**

**1 General****1.1 REFERENCES**

- .1 CSA C22.2 No. 65-93 (R1999) Wire Connectors.
- .2 EEMAC 1Y-2, 1961 Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).

**2 Products****2.1 MATERIALS**

- .1 Pressure type wire connectors: with current carrying parts of copper, copper alloy, aluminum, aluminum alloy sized to fit copper, aluminum conductors as required.
- .2 Fixture type splicing connectors: with current carrying parts of copper, copper alloy sized to fit copper conductors 10 AWG or less.
- .3 Bushing stud connectors: to EEMAC 1Y-2 to consist of:
  - .1 Connector body and stud clamp for stranded, round, copper, aluminum conductors, tube, bar.
  - .2 Clamp for stranded, round copper conductors, bar.
  - .3 Clamp for stranded aluminum, ACSR conductors, round aluminum bar.
  - .4 Stud clamp bolts.
  - .5 Bolts for copper conductors, bar.
  - .6 Bolts for aluminum conductors, bar.
  - .7 Sized for conductors, tubes, bars as indicated.
- .4 Clamps or connectors for armoured cable, aluminum sheathed cable, mineral insulated cable, flexible conduit, non-metallic sheathed cable as required.

**3 Execution****3.1 INSTALLATION**

- .1 Remove insulation carefully from ends of conductors and:
  - .1 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.
  - .2 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No.65.
  - .3 Install fixture type connectors and tighten. Replace insulating cap.
  - .4 Install bushing stud connectors in accordance with EEMAC 1Y-2.

**END OF SECTION**

**1 General****1.1 RELATED SECTIONS**

- .1 Section 26 05 20 - Wire and Box Connectors - 0 - 1000 V.

**1.2 REFERENCES**

- .1 CSA C22.2-94 .0.3-96, Test Methods for Electrical Wires and Cables.
- .2 CSA C22.2-94. 131-M89(R1994), Type TECK 90 Cable.

**1.3 PRODUCT DATA**

- .1 Submit product data in accordance with Section 01 33 00 – Submittal Procedures.

**2 Products****2.1 BUILDING WIRES**

- .1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .2 Copper conductors: size as indicated, with 600 V insulation of chemically cross-linked thermosetting polyethylene material rated RW90 and RWU90.
- .3 Copper conductors: size as indicated, with thermoplastic insulation type TWU TWH rated at 600 V.

**2.2 TECK CABLE**

- .1 Cable: to CAN/CSA-C22.2 No.131.
- .2 Conductors:
  - .1 Grounding conductor: copper.
  - .2 Circuit conductors: copper, size as indicated.
- .3 Insulation:
  - .1 Type: ethylene propylene rubber.
  - .2 Chemically cross-linked thermosetting polyethylene rated type RW90, 600 V.
- .4 Inner jacket: polyvinyl chloride material.
- .5 Armour: flat, interlocking galvanized steel or aluminum.
- .6 Overall covering: thermoplastic polyvinyl chloride material.
- .7 Connectors:
  - .1 Watertight, approved for TECK cable.

**2.4 ARMoured CABLES**

- .1 Conductors: insulated, copper, size as indicated.
- .2 Type: AC90 ACL90 - lead sheath over cable assembly and under armour.
- .3 Armour: interlocking type fabricated from galvanized steel, aluminum strip.

- .4 Type: ACWU90 - PVC flame retardant jacket over thermoplastic armour meeting requirements of Vertical Tray Fire Test of CSA C22.2 No.0.3 with maximum flame travel of 1.2 m.

**2.6 CONTROL CABLES**

- .1 Type LVT: 2 soft annealed copper conductors, sized as indicated, with thermoplastic insulation, outer covering of thermoplastic jacket, and armour of closely wound aluminum wire.
- .2 Low energy 300 V control cable: solid stranded annealed copper conductors sized as indicated, with PVC insulation type TW TW -40°C TWH polyethylene insulation with shielding of tape coated with paramagnetic material tape coated with diamagnetic material wire braid metallized tapes over each conductor pair group over all conductors and overall covering of PVC jackets polyethylene jackets lead sheath aluminum sheath interlocked armour of flat galvanized steel aluminum strip copper strip.

**3 Execution**

**3.1 INSTALLATION OF BUILDING WIRES**

- .1 Install wiring as follows:
  - .1 In conduit systems in accordance with Section 26 05 34.

**3.2 INSTALLATION OF TECK CABLE 0 - 1000 V**

- .1 Install cables.
- .2 Group cables wherever possible on channels.
- .3 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - 0 - 1000 V.

**3.4 INSTALLATION OF ARMOURED CABLES**

- .1 Group cables wherever possible.
- .2 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - 0 - 1000 V.

**3.6 INSTALLATION OF CONTROL CABLES**

- .1 Install control cables in conduit.
- .2 Ground control cable shield.

**END OF SECTION**

- 
- 1 General**
- 2 PRODUCT**
- 2.1 SUPPORT CHANNELS**
- .1 U shape channels, size 41 x 41 mm, 2.5 mm thick, surface mounted and suspended.
- 3 Execution**
- 3.1 INSTALLATION**
- .1 Secure equipment to hollow and solid masonry, tile and plaster surfaces with lead anchors.
- .2 Secure equipment to poured concrete with expandable inserts.
- .3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .4 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.
- .5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .6 Fasten exposed conduit or cables to building construction or support system using straps.
- .1 One-hole malleable iron or steel straps to secure surface conduits and cables 50 mm and smaller.
- .2 Two-hole steel straps for conduits and cables larger than 50 mm.
- .3 Beam clamps to secure conduit to exposed steel work.
- .7 Suspended support systems.
- .1 Support individual cable or conduit runs with 6 mm dia threaded rods and spring clips.
- .2 Support 2 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.
- .8 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .9 Ensure adequate supports for raceways and cables dropped vertically to equipment where there is no wall support.
- .10 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .11 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Engineer.
- .12 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

**END OF SECTION**

- 
- 1 General**
- 1.1 SHOP DRAWINGS AND PRODUCT DATA**
- .1 Submit shop drawings and product data for cabinets in accordance with Section 26 05 01 Item 1.23.
- 2 Products**
- 2.1 JUNCTION AND PULL BOXES**
- .1 Welded steel construction with screw-on flat covers for surface mounting.
- .2 Covers with 25 mm minimum extension all around, for flush-mounted pull and junction boxes.
- 2.2 CABINETS**
- .1 Type E: sheet steel, hinged door and return flange overlapping sides, handle, lock and catch, for surface mounting.
- .2 Type T: sheet steel cabinet, with hinged door, latch, lock, 2 keys, containing 19 mm G1S fir plywood sheet steel backboard for surface mounting.
- 3 Execution**
- 3.1 JUNCTION, PULL BOXES AND CABINETS INSTALLATION**
- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Mount cabinets with top not higher than 2 m above finished floor.
- .3 Install terminal block as indicated in Type T cabinets.
- .4 Only main junction and pull boxes are indicated. Install pull boxes so as not to exceed 30 m of conduit run between pull boxes.
- 3.2 IDENTIFICATION**
- .1 Provide equipment identification in accordance with Section 26 05 01 - Electrical General Requirements.
- .2 Install size 2 identification labels indicating system name voltage and phase.

**END OF SECTION**

**1 General****1.1 REFERENCES**

- .1 CSA C22.1HB-02 Canadian Electrical Code, Part 1.

**2 Products****2.1 OUTLET AND CONDUIT BOXES GENERAL**

- .1 Size boxes in accordance with CSA C22.1HB-02.
- .2 102mm square or larger outlet boxes as required for special devices.
- .3 Gang boxes where wiring devices are grouped.
- .4 Blank cover plates for boxes without wiring devices.
- .5 Combination boxes with barriers where outlets for more than one system are grouped.

**2.2 SHEET STEEL OUTLET BOXES**

- .1 Electro-galvanized steel single and multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
- .2 Electro-galvanized steel utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 x 54 x 48 mm.
- .3 102mm square or octagonal outlet boxes for lighting fixture outlets.
- .4 102mm square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster tile walls.

**2.3 MASONRY BOXES**

- .1 Electro-galvanized steel masonry single and multi gang boxes for devices flush mounted in exposed block walls.

**2.4 CONCRETE BOXES**

- .1 Electro-Galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

**2.5 CONDUIT BOXES**

- .1 Cast FS or FD aluminum or fe-raloy boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle.

**2.6 OUTLET BOXES FOR NON-METALLIC SHEATHED CABLE**

- .1 Electro-galvanized, sectional, screw ganging steel boxes, minimum size 76 x 50 x 63 mm with two double clamps to take non-metallic sheathed cables.

**2.7 FITTINGS - GENERAL**

- .1 Bushing and connectors with nylon insulated throats.

- .2 Knock-out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

**3 Execution**

**3.1 INSTALLATION**

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.

**END OF SECTION**

**1 General****1.1 REFERENCES**

- .1 Canadian Standards Association (CSA)
  - .1 CSA C22.2-94. 18-98, Outlet Boxes, Conduit Boxes, and Fittings.
  - .2 CSA C22.2-94. 56-1977(R1999), Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
  - .3 CSA C22.2-94. 83-M1985(R1999), Electrical Metallic Tubing.

**2 Products****2.1 CONDUITS**

- .1 Electrical metallic tubing (EMT): to CSA C22.2 No.83, with couplings with expanded ends.
- .2 Flexible metal conduit: to CSA C22.2 No.56, steel aluminum liquid-tight flexible metal.

**2.2 CONDUIT FASTENINGS**

- .1 One hole steel straps to secure surface conduits NPS 2 and smaller. Two hole steel straps for conduits larger than NPS 2.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at 1.5 m oc.
- .4 Threaded rods, 6 mm dia., to support suspended channels.

**2.3 CONDUIT FITTINGS**

- .1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.
- .2 Factory "ells" where 90° bends are required for NPS 1 and larger conduits.
- .3 Watertight connectors and couplings for EMT. Set-screws are not acceptable.

**2.5 FISH CORD**

- .1 Polypropylene.

**3 Execution****3.1 INSTALLATION**

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conceal conduits except in mechanical and electrical service rooms in unfinished areas.
- .3 Use electrical metallic tubing (EMT) except in cast concrete above 2.4 m not subject to mechanical injury.
- .4 Use flexible metal conduit for connection to motors in dry areas connection to recessed incandescent fixtures without a prewired outlet box connection to surface or recessed fluorescent fixtures work in movable metal partitions.

- .5 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.
- .6 Minimum conduit size for lighting and power circuits: NPS 3/4.
- .7 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .8 Mechanically bend steel conduit over 19 mm dia.
- .9 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .10 Install fish cord in empty conduits.
- .11 Run 2-NPS 1 spare conduits up to ceiling space and 2-NPS 1 spare conduits down to ceiling space from each flush panel. Terminate these conduits in 152 x 152 x 102 mm junction boxes in ceiling space or in case of an exposed concrete slab, terminate each conduit in surface type box.
- .12 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.
- .13 Dry conduits out before installing wire.

### **3.2 SURFACE CONDUITS**

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on suspended surface channels.
- .5 Do not pass conduits through structural members except as indicated.
- .6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

### **3.3 CONCEALED CONDUITS**

- .1 Run parallel or perpendicular to building lines.
- .2 Do not install horizontal runs in masonry walls.
- .3 Do not install conduits in terrazzo or concrete toppings.

**END OF SECTION**

**1 General**

**1.1 PRODUCT DATA**

- .1 Submit shop drawings and product data in accordance with Section 26 05 01 Item 1.23.

**2 Products**

**2.1 DISCONNECT SWITCHES**

- .1 Fusible, horsepower rated disconnect switch in CSA Enclosure, size as indicated.
- .2 Provision for padlocking in on-off switch position by locks.
- .3 Mechanically interlocked door to prevent opening when handle in ON position.
- .4 Fuse holders: to be re-locatable and suitable without adaptors, for type and size of fuse indicated.
- .5 Quick-make, quick-break action.
- .6 ON-OFF switch position indication on switch enclosure cover.
- .7 Weatherproof for all outdoor installations.

**2.2 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 01 - Electrical General Requirements
- .2 Indicate name of load controlled on size 4 nameplate.

**3 Execution**

**3.1 INSTALLATION**

- .1 Install disconnect switches complete with fuses if applicable.
- .2 Install weatherproof NEMA 4 enclosure for all rooftop installations.

**END OF SECTION**

**1 General****1.1 RELATED SECTIONS**

- .1 Section 26 05 01 - Electrical General Requirements.

**1.2 REFERENCES**

- .1 International Electrotechnical Commission (IEC)
  - .1 IEC 947-4-1-1990, Part 4: Contactors and motor-starters.

**1.3 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings in accordance with Section 26 05 01 Item 1.23.
- .2 Indicate:
  - .1 Mounting method and dimensions.
  - .2 Starter size and type.
  - .3 Layout of identified internal and front panel components.
  - .4 Enclosure types.
  - .5 Wiring diagram for each type of starter.
  - .6 Interconnection diagrams.

**1.4 OPERATION AND MAINTENANCE DATA**

- .1 Provide operation and maintenance data for motor starters for incorporation into manual.
- .2 Include operation and maintenance data for each type and style of starter.

**1.5 MAINTENANCE MATERIALS**

- .1 Provide listed spare parts for each different size and type of starter:
  - .1 3 contacts, stationary.
  - .2 3 contacts, movable.
  - .3 1 contacts, auxiliary.
  - .4 1 control transformers.
  - .5 1 operating coil.
  - .6 2 fuses.
  - .7 10% indicating lamp bulbs used.

**1.6 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Section 01 35 31 – Health and Safety Requirements, and with the Waste Reduction of Work plan.
- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Ensure emptied containers are sealed and stored safely for disposal away from children.

**2 Products****2.1 MATERIALS**

- .1 Starters: to IEC 947-4 with AC4 utilization category.

**2.3 FULL VOLTAGE MAGNETIC STARTERS**

- .1 Magnetic and combination magnetic starters of size, type, rating and enclosure type as indicated with components as follows:
  - .1 Contactor solenoid operated, rapid action type.
  - .2 Motor overload protective device in each phase, manually reset from outside enclosure.
  - .3 Wiring and schematic diagram inside starter enclosure in visible location.
  - .4 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.
- .2 Combination type starters to include fused disconnect switch motor circuit interrupter circuit breaker with operating lever on outside of enclosure to control disconnect motor circuit interrupter circuit breaker, and provision for:
  - .1 Locking in "OFF" position with up to 3 padlocks.
  - .2 Independent locking of enclosure door.
  - .3 Provision for preventing switching to "ON" position while enclosure door open.
- .3 Accessories:
  - .1 Pushbuttons Selector switches: standard heavy duty oil tight labelled as indicated.
  - .2 Indicating lights: standard heavy duty oil tight type and color as indicated.
  - .3 1-N/O and 1-N/C spare auxiliary contacts unless otherwise indicated.

**2.5 MULTI-SPEED STARTERS**

- .1 2 speed starters of size, type, rating and enclosure type as indicated. Starter suitable for constant torque variable torque constant kW type motor and with components as follows:
  - .1 One-3 pole contactor for each winding for separate winding motors.
  - .2 One-3 pole and one-5 pole contactor for each reconnectable winding for consequent pole type motors.
  - .3 Three overload relays with 3 heater elements and manual reset for each speed.
- .2 Accessories:
  - .1 Pushbuttons Selector switches: standard heavy duty oil tight labelled as indicated.
  - .2 Indicating lights: standard heavy duty oil tight, type and color as indicated.
  - .3 Auxiliary control devices as indicated.
  - .4 Low speed compelling relay automatic sequence accelerating decelerating relays for each speed.

**2.14 FINISHES**

- .1 Apply finishes to enclosure in accordance with Section 26 05 01 - Electrical General Requirements.

**2.15 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 01 - Electrical General Requirements.
- .2 Manual starter designation label, white plate, black letters, size 1, engraved as indicated.
- .3 Magnetic starter designation label, white plate, black letters, engraved as indicated.

**3 Execution****3.1 INSTALLATION**

- .1 Install starters, connect power and control as indicated.
- .2 Ensure correct fuses and overload devices elements installed.

**3.2 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 01 - Electrical General Requirements and manufacturer's instructions.
- .2 Operate switches, contactors to verify correct functioning.
- .3 Perform starting and stopping sequences of contactors and relays.
- .4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

**END OF SECTION**