

## DIVISION 05 50 00

### METALS

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#### PART 1 - GENERAL

#### 1.1 Description of the Work:

##### 1.1.1 Fabrication, galvanizing and installation of:

##### 1.1.1.1 Ladders:

- .1 New ladders complete with all mounting hardware and related items for access, a ladder of 6" from face of the roof curb combined with a wide coping will require a small platform cantilevered from the top of the ladder to ensure safe access from the ladder to the roof. In such cases, a separate step is also required from the platform down to the roof. The step is generally bolted to the precast concrete patio slabs.
- .2 Include cages, spanning platforms, and steps as shown on the Drawings.

##### 1.1.1.2 Stairs:

- .1 Sets of new access stairs that are custom fabricated.
- .2 Pre-fabricated for use more simply as safe steps to get over pipes and similar items on roofs.

##### 1.1.1.3 Railings:

- .1 Sets of fixed safety railings that are custom fabricated and fixed to a roof structure.
- .2 Railings that are pre-fabricated for use as travel restraint barriers to keep service personal away from roof edges.

##### 1.1.2 All assemblies for placement at the exterior shall be hot dipped galvanized unless otherwise noted on the Drawings or specified herein.

1.1.2.1 Work shall be executed as generally shown on the Drawings and as specifically set out by the consultant in the applicable engineering details and specifications provided.

1.1.2.2 The consultant shall execute the required engineering and provide drawings and specifications as part of the tender.

1.1.2.3 The consultant will provide shop drawing review and site review.

##### 1.1.3 Coordinate with Section applicable to ensure that all aspects of the Work are allocated, to confirm finished heights affecting fabrication, to ensure all layout of the Work ensures proper setting and anchoring, and to identify the party providing hoisting.

##### 1.1.4 Heights are necessarily above finished roof surfaces and can only be estimated until the roofing is in place.

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- 1.1.5 Hoisting could be by the Metal Fabricator, Roofer or GC so it is merited to identify the need for coordination.
- 1.1.6 Items like precast concrete patio slabs needed to anchor the steps could be supplied by the Metal Fabricator, or by the Roofer so coordination becomes important in preventing project delays.
- 1.2 Reference Standards:
  - 1.2.1 Ministry of Labour “Fixed Access Ladders” Engineering Data Sheet 2-04 (revised January 1997).
  - 1.2.2 As noted on the consultants Engineering Drawings.
  - 1.2.3 The consultants engineer will place reference standards in specification notes on the engineered drawings.
- 1.3 Submittals:
  - 1.3.1 Division 1 Section for submittals notes that no shop drawings are to be submitted without engineering stamps where applicable.
  - 1.3.2 Trades must ensure that the submittals with stamps are to be submitted to ensure that the Consultant is not being asked to approve something that the engineer has not approved.
  - 1.3.3 Shop Drawings:
    - 1.3.3.1 Shop drawings shall show site-measured elevations, offsets and related dimensions.
    - 1.3.3.2 Anchorage shall be detailed.
    - 1.3.3.3 Anchorage details must provide for adjustment in level and plumb to accommodate the nature of the roofing that will commonly present slopes even in both directions.
      - .1 Adjustable bolted connections (such as angles with slotted holes) shall be used in lieu of shims where feasible.
    - 1.3.3.4 Do not submit shop drawings without an engineer’s stamp.
  - 1.3.4 Provide cut sheets for proposed stair and platform grates.
  - 1.3.5 Provide cut sheets for all pre-fabricated post bases, flashings, collars.

The following is only where applicable:

  - 1.3.6 Provide shop drawing layouts for portable guard rail system.
  - 1.3.7 Provide shop drawing layout for purpose-made “bridges” over rooftop equipment, curbs, etc.

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#### PART 2 - PRODUCTS

##### 2.1 Materials:

2.1.1 Refer to Consultants Engineering Drawings for details for all components, plates, anchors, complete.

2.1.2 Include also galvanized metal shapes to provide basic levelling, plumbing and solid fixing of the fabricated work given the roof slopes and associated site conditions.

##### 2.1.3 Fasteners:

2.1.3.1 All fasteners and anchors to be stainless steel.

2.1.3.2 Refer to Consultants Engineering Drawing details and specifications will accompany this tender.

##### 2.1.4 Precast Concrete Patio Slabs (\_\_\_\_ required):

In most cases, the roofing specifications will carry a product specification for wet-cast, fibre reinforced and air entrained precast concrete pavers.

Do NOT use dry-pack products – which is how most slabs are now made. Include 1” pads and metal edge protection for use on conventional roof systems.

2.1.4.1 Coordinate with the roofing Section \_\_\_\_ for the specific product to be utilized.

These are sample guideline specifications only and actual products best suited to each project will vary.

Under the O.B.C. there are loadings applicable to railings that depend on whether they are subject to, for example, light conditions of roof access by service people, or heavier access by the public – such as larger groups.

Additionally, railings can require pickets at 4” centres if there is public access even if the occupancy load is light – there is real risk of students with family having access onto roofs.

If railings fully enclose a roof, the merit to include gates should be considered. If railings fully or substantially enclose roofs, consider placing same 8’ inward of roof edges. This leaves a walkable space (exceeding 2.0 m or 6’-6” away from the roof edge) for safe access for service and maintenance purposes.

##### 2.1.5 Railing Post Bases (\_\_\_\_ required)

This post base noted below is well suited to locations needing railings for roof service access. This post base is NOT well suited to cases where there is

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public access to the roof and pickets of 4" centres are required – see ARS-115 below.

The default finish is a red epoxy primer coating. Below, the "-G" suffix designates a galvanized finish that is preferred but can delay delivery. If finish painting is required due to visibility, Queen's has a designated colour for this – currently being RAL 7024 Graphite grey Semi-Gloss (effective 2018).

#### 2.1.5.1 Thaler ARS-400-G Rail Support, or approved equal.

- .1 Urethane insulated
- .2 Galvanized finish
- .3 ¼" wall thickness, 3½" diameter, 14" high HSS base
- .4 ⅝" thick 12" x 12" base plate
- .5 Thaler SJ-155A stack jack flashing of spun aluminum to fit the ARS-400, or approved equal.

The item below is needed for inverted roofs to prevent ballast punching holes in the stack jack flashing.

- .6 Thaler T12 ballast collar to fit the SJ-155A stack jack and of custom height should be specified to achieve 2" clearance above the ballast, or approved equal and is thus often dependent upon insulation and ballast.

Below item is needed in most cases for metal decks, although welded connections to OWSJ are a feasible alternative. Welded gusset plates are likely required also.

- .7 ⅝" thick 12" x 12" under-deck plate with ⅝" stainless steel bolts of length to suit with nuts and washers.
- .8 As an example for concrete decks, anchorage might be by 4-Hilti ⅝"∅ x 4¾" KB3 anchors
- .9 Anchor bolts and/or underdeck plates for the ARS-400 (or approved equal) base plate to be per Consultants Engineering Drawings.

This item below is best suited to cases where a railing with pickets at approximately 4" centres is required. In this case, the railing can sit to the inside of the post base and the post base itself does not create a "step" that would require an even higher top rail to be provided.

If pickets are needed, it is probable that the bottom rail should be located nominally less than 4" above the insulation, not 4" above the ballast of an inverted roof, or nominally 4" above the pea stone of a conventional roof.

#### 2.1.5.2 Thaler ARS-115-G Rail Support, or approved equal.

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- .1 Urethane insulated
- .2 Galvanized finish
- .3 Schedule 40, 4½" diameter, 14" high HSS base
- .4 ⅝" thick 12" x 12" base plate  
Thaler by default makes the back bracket 1/8" thick but prior engineering suggests an increase of 3/8", especially for public access loading. This will impact Thaler executed welding sizes at the triangular gusset also.  
Similar detailed review is needed for all other manufacturers pre-engineered products.
- .5 ⅜" thick x 4" x 18" back bracket
- .6 Thaler SJ-155A stack jack flashing of spun aluminum to fit the ARS-115, or approved equal.  
The item below I needed for inverted roofs to prevent ballast punching holes in the stack jack flashing.
- .7 Thaler T12 ballast collar to fit the SJ-155A stack jack and of custom height should be specified to achieve 2" clearance above the ballast, or approved equal.

Below item is needed for in most cases for metal decks, although welded connections to OWSJ are a feasible alternative. Welded gusset plates are likely required also.

- .8 ⅝" thick 12" x 12" under-deck plate with ⅝" stainless steel bolts of length to suit with nuts and washers
- .9 Example: anchorage might be 4-Hilti ⅝"Ø x 4¾" KB3 anchors
- .10 Anchor bolts and/or underdeck plates for the ARS-115 Base Plate to be per Consultants Engineering Drawings

### 2.1.5.3 Posts, Rails:

All below is subject to engineering undertaken by the Consultant;

- .1 1½" x 1½" x ⅛" HSS hot dipped galvanized.

### 2.1.5.4 Pickets:

- .1 ½" x ½" solid hot dipped galvanized.

### 2.1.6 Stair Tread Grates:

2.1.6.1 Fully checker plate treads are often not suited to snow covered roof conditions.

2.1.6.2 1" x 3/16" galvanized grating with checker plate nosings.

Alternative;

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- 2.1.6.3 11<sup>3</sup>/<sub>4</sub>" x 1<sup>3</sup>/<sub>4</sub>" Grip Span 14 GA galvanized panels, or approved equal.
- 2.1.7 Ladders:
- 2.1.7.1 Rungs: <sup>3</sup>/<sub>4</sub>" Ø smooth or deformed rebar hot dipped galvanized.
- 2.1.7.2 Side rails are suited to the splay of the rails needed at the top and the connection to guard rails on the sides of the platform (if needed) crossing the parapet coping atop the ladder.
- 2.1.7.3 Rails: 3" x 2" x <sup>1</sup>/<sub>8</sub>" HSS hot dipped galvanized.
- 2.1.7.4 Cage:
- .1 Hoops: 2" x <sup>1</sup>/<sub>4</sub>" hot dipped galvanized.
- .2 Vertical Slats (5): 1<sup>3</sup>/<sub>4</sub>" x 3/16" hot dipped galvanized.
- 2.1.7.5 Platform:
- .1 <sup>3</sup>/<sub>4</sub>" x 3/16" grating  
Alternative;
- .2 11<sup>3</sup>/<sub>4</sub>" x 1<sup>3</sup>/<sub>4</sub>" Grip Span 14 GA galvanized panels, or approved equal.
- 2.1.8 Pre-Fabricated Options:
- Note that there are many suppliers of prefabricated kits for railings, ladders and stairs used on roofs. Some of these offerings are believed to fail to fully satisfy specific requirements and performance levels of the O.B.C. or OSHA, etc., despite claims to the contrary. Engineering assessment in numerous cases suggests that the products do not satisfy requirements. In some cases, the supplier notes that testing was conducted to verify conformance where analysis might suggest otherwise. Such testing should be obtained for review by the Consultant. Similarly, some portable railing systems offer optional rubber base pads that would enhance grip on a granulated surface of a modified bitumen roof, as compared to a smooth steel plate on the same surface. Some tests might be done on roofs affording friction, but the subject roof might have pea stone cover that acts more like ball bearings, or on a ballasted inverted roof that allows several inches of "tipping" of the base plates into the ballast thickness. As for using "kits", this risks leaving a non-experienced installer trying to determine how to assemble components in less than ideal circumstances and leaving to the Owner a potential need for annual inspections – these are safety components.
- In the case of aluminum components, these are often found to have been damaged over their life by abuse in moving equipment on roofs.

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Accordingly, use of prefabricated assemblies are best left to cases where opportunities for preferred custom fixed assemblies, such as anchorage to/through roof decks, are limited.

Prefabricated and aluminum ladders are NOT deemed to be ideal.

Note that where prefabricated components are specified, the Consultant shall be responsible for verifying that the engineering certifications are sound and that they are directly applicable to the project.

- 2.1.8.1 “Bridges” over low ducting, piping, cable trays, etc.
  - .1 Dura-Blok GRATEWALK systems, complete with support blocks, rails, etc.;
  - .2 Or approved equal.
  - .3 Include precast concrete patio slabs at each landing.
- 2.1.8.2 Travel restraint barriers/guards:
  - .1 W.S. Safety (BlueWater Mfg., Inc.) “SafetyRail 2000” system, or approved equal. This item is intended primarily herein to safeguard service personnel accessing doors and/or equipment near roof edges and needing to be safeguarded from accidentally coming within 2m from the roof edge, therefore supplemental bracing could be merited/necessary.
  - .2 Include:
    - .1 Roof Guard bases, yellow;
    - .2 Roof Guard rails, yellow;
      - .1 Lengths as shown on the Drawings.
    - .3 LP Outrigger kits, yellow;
    - .4 All accessories and adjunct components including securing pins with lanyard; and,
    - .5 Include also supplemental braces to adjacent walls/curbs as merited by engineering review undertaken by the supplier and/or as shown on the Drawings.
  - .3 Submittal for possible approval of other systems must include detailed testing and certified engineering reports.
    - .1 Statements such as “satisfies all OSHA requirements” or similar without defining the performance level and applicable requirements of the OBC cannot be accepted.

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- .2 Testing, certifications and review of alternates must be clear to dissipate back and forth debate and ensure the required level of safety is met.
- .3 If the Consultant's engineer is not satisfied with the received testing and certified engineering reports for the proposed alternate products, then further satisfactory information could be requested in follow-up, or the proposed alternate will be rejected at the discretion of the Consultant's engineer.
- .4 The Consultant and/or the Consultant's engineer reserves the right and discretion to accept or reject alternative systems based on review of submitted materials and will not be bound to seek out any more detailed or more conclusive information than that which is at first submitted.

#### 2.2 Warranty:

- 2.2.1 Provide full 2-year warranty on the Work of this Section barring only damage caused by physical abuse.

#### 2.3 Shop Fabrication:

- 2.3.1 Undertake detailed site review and measurement and provide shop drawings showing revisions required, if any, to the layout of the Work.
- 2.3.2 Execute the layout of the fabrications as set out on the Consultants Engineering Drawings and as per the approved shop drawings
- 2.3.3 Fabrications to be neatly fitted, welded and ground.
  - 2.3.3.1 All fabrications to be true and square except as required.
  - 2.3.3.2 All fabrications to be free of sharp edges, burrs, rough welds, etc.
- 2.3.4 Hot dip galvanize all exterior stairs, ladders, brackets, railings and related items of the Work.
  - 2.3.4.1 Hot dipped galvanizing shall conform to ASTM A-123.

## PART 3 - EXECUTION

#### 3.1 Preparation:

- 3.1.1 Make detailed site review of the existing conditions.



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- 3.1.1.1 Coordinate with roofing Section \_\_\_\_\_ as to the finished height of the roofing assemblies so as to set the height and the spacing of rungs/treads of the ladders, stairs.
- 3.1.1.2 Make site measurement of elevations, dimensions and angles.
- 3.1.1.3 Coordinate with roofing Section \_\_\_\_\_ to confirm the party responsible for hoisting and setting.
- 3.1.2 Take all precautions needed for safety of all parties involved in and affected by the Work of this Section.
  - 3.1.2.1 Conform with Ministry of Labour requirements except where more stringent requirements are set out for this project.
  - 3.1.2.2 Safety on the roof shall be by approved roof edge fixed barriers, or by fall arrest equipment.
    - .1 Workers being tied off with safety lines and working right at roof edges require fall arrest measures to dissipate issues with having enough slack in safety lines/lanyards.
    - .2 Many fall arrest tie-off carts are not suitable for use on inverted roofs in some cases. Care is needed in setting out site safety requirements.
    - .3 Simple travel restraint of ropes and lanyards will not be permitted for work at roof edges.
    - .4 Fall arrest equipment must be certified for use on the specific subject roof types.
- 3.1.3 Any on-site welding must be undertaken only with all required safety and fire protections in place and only with prior written approval from the Owner.
  - 3.1.3.1 In advance of commencing Work, secure a Hot Work Permit from the Owner.
  - 3.1.3.2 Coordinate with the Owner in advance of any Work that could trigger false fire alarms due to fumes, smoke, debris, dust, etc.
    - .1 Contractor shall be responsible for any "false alarm" fees caused by the Work.
    - .2 Coordinate with the Owner to have fire detection covered or removed for the duration of the Work.
    - .3 Note that drilling through masonry/concrete can cause dust spread that also impacts fire detection sensors.
    - .4 Ensure that windows, doors and grilles are closed as needed.
  - 3.1.3.3 Execute Work under a fire-watch plan if risk of fire is inherent to the Work process.

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- .1 In such case, coordinate also in advance with the Owner's Fire Safety Coordinator.
  - 3.1.4 If installing equipment to elevator or mechanical penthouses, coordinate with the Owner as to the potential need to disable the elevator during the Work to guard against damage/debris and dust entry to cabs and mechanical/electrical/electronic equipment.
- 3.2 Installation:
  - 3.2.1 Execute all Work as set-out on the Consultants Engineering Drawings, as shown on Contract Drawings, and as reasonably foreseen to be required to achieve the intended results so as to provide solid, rigid anchorage.
  - 3.2.2 Provide protection to guard against damage, dents, scratches, epoxy spills on the finishes, etc.
  - 3.2.3 Roofing must be protected from loading, welding, debris.
  - 3.2.4 Place precast concrete patio slabs to the layout shown on the Drawings and as needed to support steps, stairs, and providing "landing" at the top and base of ladders.
    - 3.2.4.1 On inverted roofing, the ballast must first be moved back to allow the patio slabs to site atop the filter fabric and insulation.
  - 3.2.5 Stairs must be level and plumb.
    - 3.2.5.1 Adjustable bolted clip angles with slotted holes, or similar, are to be used in lieu of shims.
      - .1 If shims are required, same must be of hot dipped galvanized metal or stainless steel and same must be set so as to be permanent and not subject to being displaced.
  - 3.2.6 Ensure that all roofing work (Section \_\_\_\_ ) around post bases has been completed.
  - 3.2.7 Verify height of railings above the finished roofing (nominally 42" in most cases).
  - 3.2.8 For roofs with public access, ensure nominal 4" wide gaps at all locations.
  - 3.2.9 Make thorough review of all hot dipped galvanized surfaces for burrs and drips, wires and other sharp conditions.
    - 3.2.9.1 File smooth and touch-up with Galvafroid paint, or equal, if bare metal is exposed.
- 3.3 Pre-Fabricated Assemblies:

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- 3.3.1 Install all pre-fabricated assemblies in strict accordance with the manufacturer's specifications, augmented by project and site specific requirements and opportunities, and as set out on approved shop drawings.
- 3.3.2 Ensure that stainless steel fasteners are utilized and secure to prevent tipping or displacement of components of the assembly.
- 3.4 Completion:
  - 3.4.1 Ensure that all equipment is level, secure and functioning properly.
  - 3.4.2 Remove any sharp barbs of galvanizing or sharp edges of metal.
    - 3.4.2.1 Apply Galvalume, or equal, paint (2 coats) to affected areas of hot dipped galvanizing.
  - 3.4.3 Clean-up all traces of the Work of this Section.
  - 3.4.4 Complete and submit warranties of the supplier and fabricator for the Work of this Section.

#### Additional Notes:

All roof areas are to be made safely accessible by ladders and stairs. Where piping, ducting, cable trays or structural elements impeded service traffic, provide stairs and "bridges" to ensure safe access.

Specify additional roof-top lighting where needed in cases where night-time emergency service could reasonably be required.

Consider TSSA requirements for safe access.

Wide curbs or other obstacles should have hand rails and/or anti-slip surfaces.

Stairs can often be mounted directly on precast concrete pavers, sometimes augmented by anchorage to a parapet between roofs, or a wall under an access window or door.

Railings should be mounted to Thaler (or equal) post bases and flashed with spun aluminum collars to suit the base plate. Provide ballast collars around the spun flashings if used on inverted/ballasted roofs.

Generally, custom-made hot dipped galvanized products will be preferred and should be engineered by the Consultant. Pre-fabricated "kits" of bolted assemblies are NOT deemed to be well suited to long-term durable safe use. The use of such kits also increases the obligations of the Owner for annual inspection and maintenance – not being required for welded hot dipped galvanized assemblies.

Aluminum stairs and railings are not preferred as they risk increased maintenance costs in the event of abuse such as in moving equipment

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around on the roofs leading to dents and damage. Nonetheless, aluminum is not prohibited.

Stainless steel is acceptable except where the Owner could require a painted finish – preparation for painting of stainless steel is unduly costly and generally of limited durability, and thus of higher maintenance cost.

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***END THIS SECTION***

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