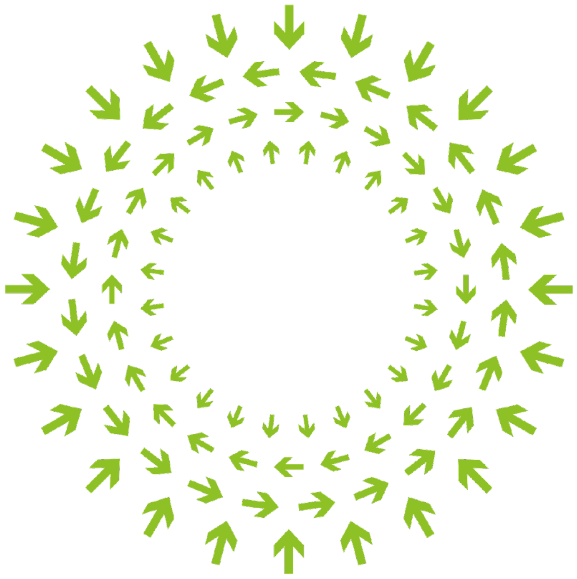

OPEN

Compute Project

Open Rack V3 Base Specification

Revision 1.0

Authors: Glenn Charest, Steve Mills, Loren Vorreiter

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1.2 Acknowledgements

The Contributors of this Specification would like to acknowledge the following people for their feedback:

Paul Clements - Rittal
Darryl Daniel - Meta
Dmitriy Shapiro - Meta

2. OCP Tenets Compliance

2.1. Openness

The Open Rack specification was developed in concert with the Rack and Power community to provide a flexible and extensible solution that many companies can use to build open products. All of the components needed to build an entire rack system are incorporated into the base specification.

2.2. Efficiency

Ideally, the V3 specification will be in use for many years which will allow the IT systems that are designed for use with V3 to be re-used multiple times and encourage re-use.

2.3. Impact

Open Rack is used as a fundamental basis for many OCP contributions that will be built on top of the specification.

2.4. Scale

The ORv3 base specification is designed to provide a base frame for large scale deployment of racks. By sharing common and interchangeable parts, the community can build at Scale while leveraging components from each other.

3. Revision Table

Date	Revision	Author	Description
6 JUN 2022	0.1	Glenn Charest	Initial Release
24AUG22	0.2	GC, SM, LV	Major updates
22SEP22	1.0	SM	Released to the community

4. Scope

This document defines technical specifications for all components within the Open Rack Frame V3 family used in the Open Compute Project. This document is intended to define all of the requirements needed to ensure intermateability of IT Gear across different racks and power systems developed by the community. Compliance with this specification is required for any products intended to operate with Open Rack V3.

5. Overview

Open Rack is a fundamental building block for the Open Compute ecosystem. It provides the structure and power for interoperability of Open Rack based IT Systems that are contributed to the Open Compute Foundation.

Any statements using:

SHALL must meet this requirement to comply with the specification

SHOULD are recommended to meet this requirement but are not required

MAY are suggested if the rack supplier is interested in meeting for interoperability between solutions

6. Mechanical

There are 2 different mechanical versions of the Open Rack Frame. Both versions are acceptable alternatives. There are no formal requirements for external dimensions such as depth, height, & width of the frame. These dimensions may vary per rack developer's requirements. Consideration needs to be given to shipping constraints including packaging (truck height) and doorway access limitations within data centers and lab spaces.

6.1 Rack Geometry Option 1

6.1.1 Frame Dimensions

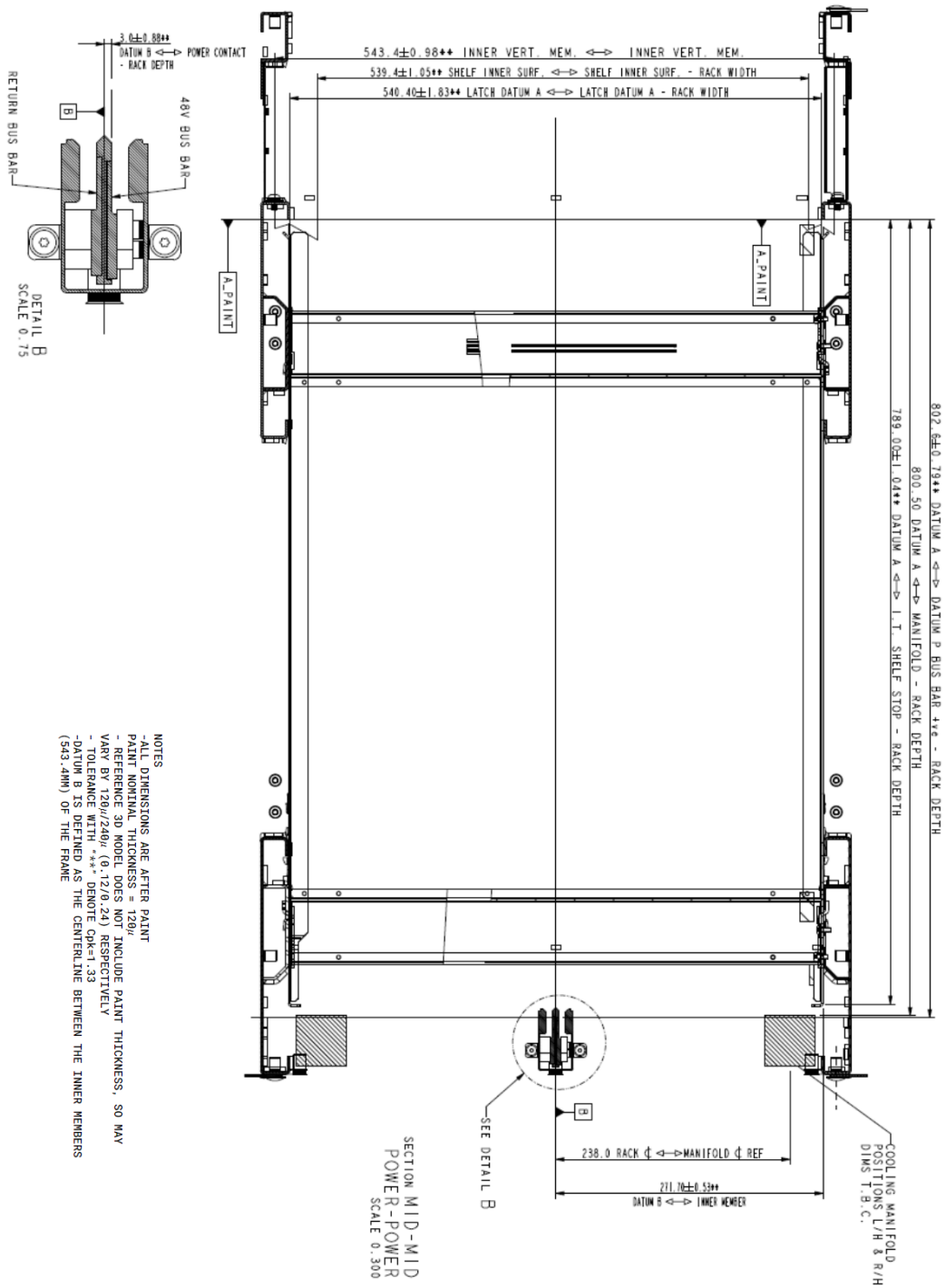
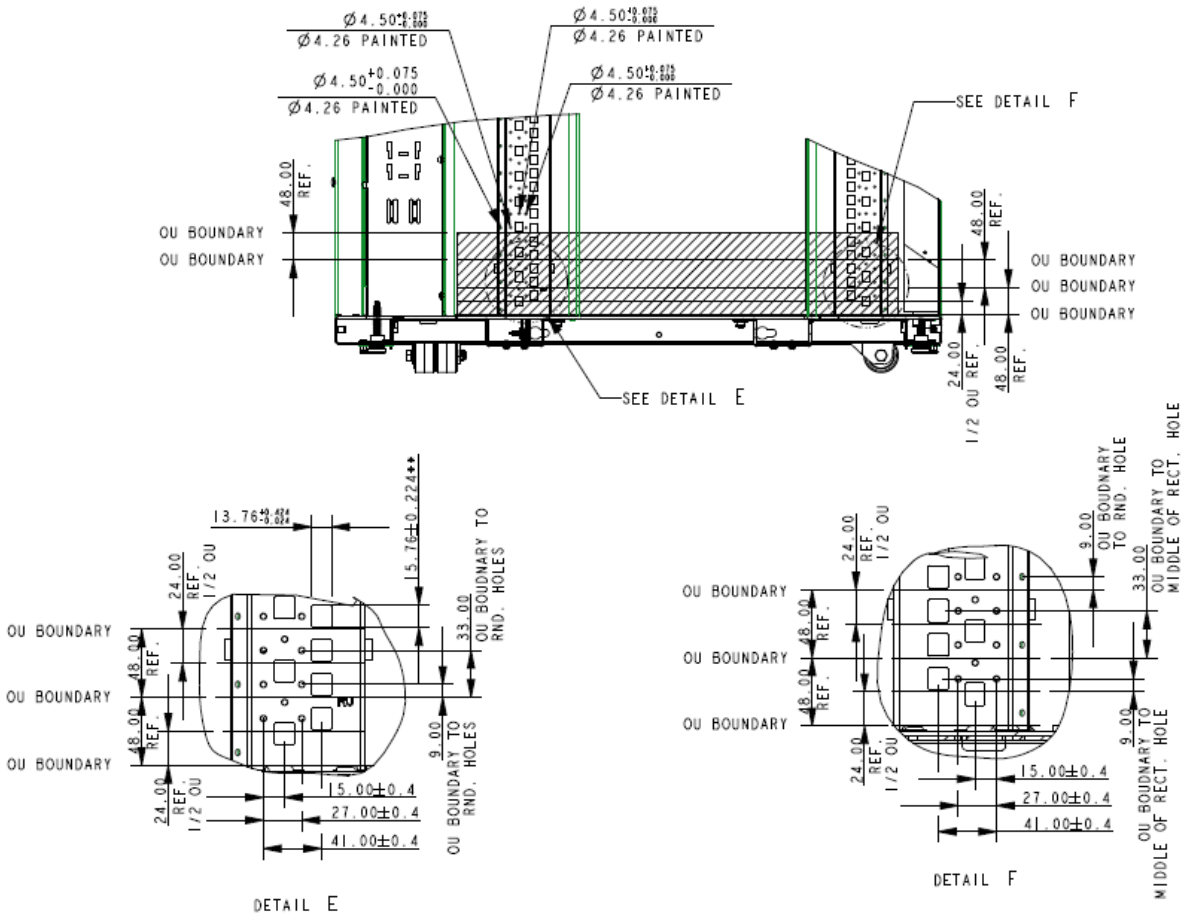


Figure 6.1.1. Frame Cross-section

6.1.2 Vertical OpenU Details for Rack Option 1

The rack supports IT Gear spacing for both 48mm vertical OpenU systems or 44.45mm EIA310-D rack units (RU). This section provides details for OpenU features in the rack frame.



NOTE:

1. ALL HOLES AND FEATURES HAVE POSITIONAL TOLERANCE AS FOLLOWS FROM THE OU BOUNDARY VERTICALLY:
   A. <=150mm ± 0.1mm
   B. >150mm VARIATIONS VARIES PROPORTIONAL ALONG THE LENGTH AT 0.6M/M BETWEEN FEATURES AND THEORETICAL OU BOUDNARIES SHOWN
2. VERTICAL DIMS VARY ACCORDING TO 44.45mm PITCH
3. PAINT INCLUDED @120µ±10% PER LAYER
4. PAINT TOLERANCE ±0.012 CONSIDERED FOR REF.
   IF DIM CONTAINS TWO LAYERS OF PAINT, ±0.024 ADDED TO EXISTING TOLERANCE
5. TOLERANCES WITH "**" DENOTE Cpk=1.33, OTHERWISE Cpk=1.0

Figure 6.1.2.1 Vertical OpenU definition (Rack Option 1)

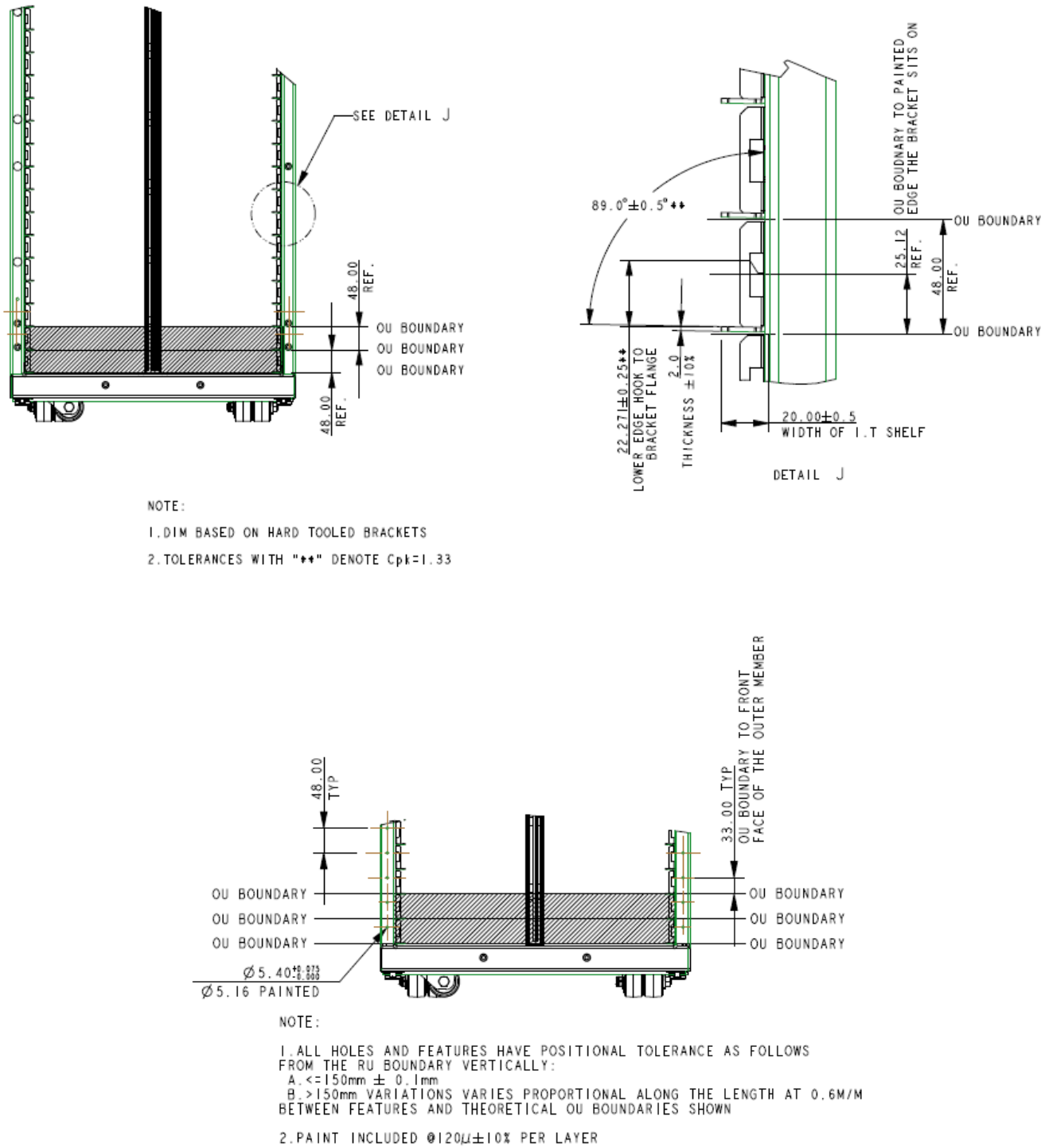
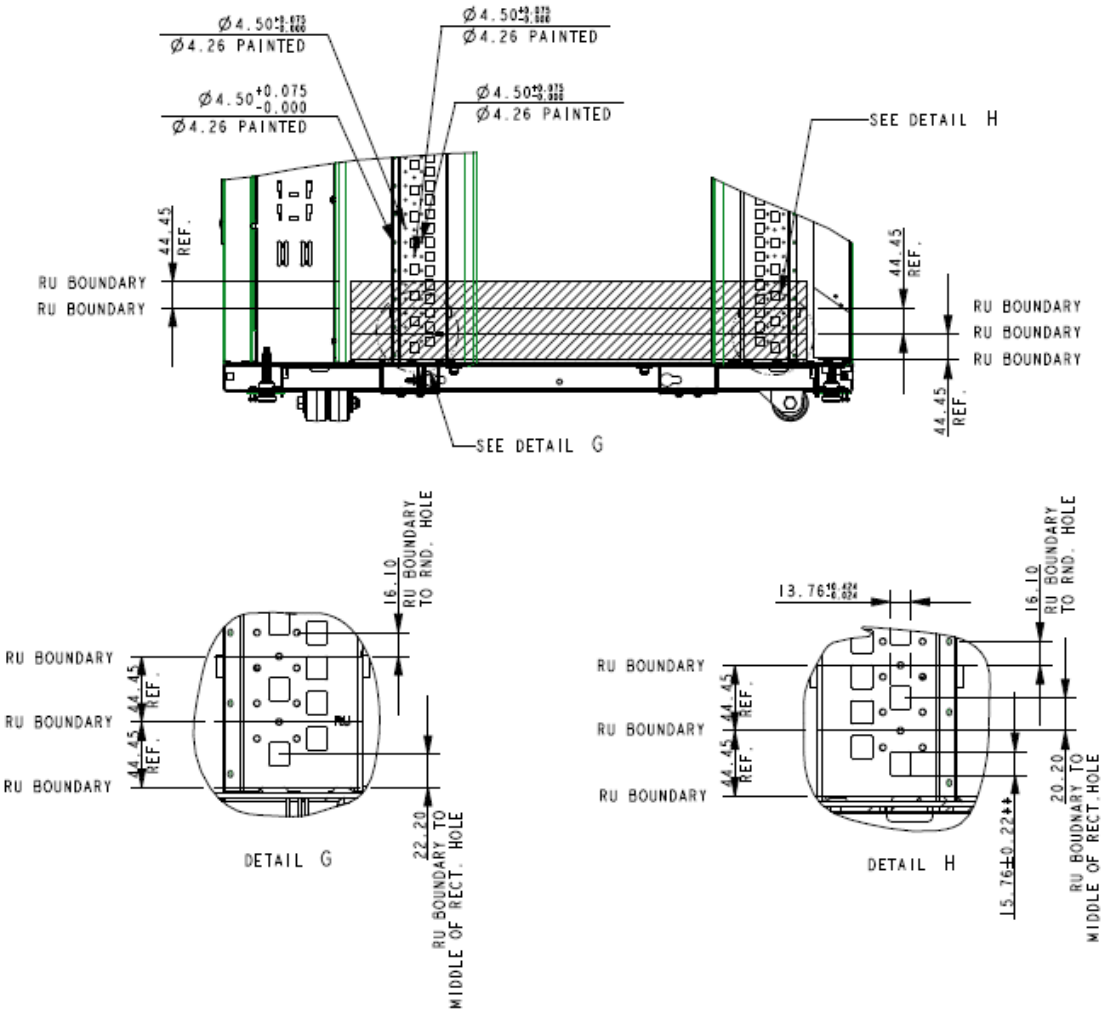


Figure 6.1.2.2 Front Orientation of OpenU (Rack Option 1)

6.1.3 Vertical RU (Optional)

This section provides support for EIA 310-D IT Gear Pitch of 44.45mm. Rac



NOTE:

1.ALL HOLES AND FEATURES HAVE POSITIONAL TOLERANCE AS FOLLOWS FROM THE RU BOUNDARY VERTICALLY:
A.<=150mm ± 0.1mm
B.>150mm VARIATIONS VARIES PROPORTIONAL ALONG THE LENGTH AT 0.6M/M BETWEEN FEATURES AND THEORETICAL RU BOUNDARIES SHOWN

2.VERTICAL DIMS VARY ACCORDING TO 44.45mm PITCH

3.PAINT INCLUDED @120µ±10% PER LAYER

4.PAINT TOLERANCE ±0.012 CONSIDERED FOR REF.
IF DIM CONTAINS TWO LAYERS OF PAINT, ±0.024 ADDED TO EXISTING TOLERANCE

5.TOLERANCE WITH "++" DENOTE Cpk=1.33

6.SEE FIGURE 6.1.2.1 FOR LATERAL HOLE DIMENSIONS

Figure 6.1.3 Side View of Rack Unit (RU) Detail (Rack Option 1)

6.2 Rack Geometry Option 2

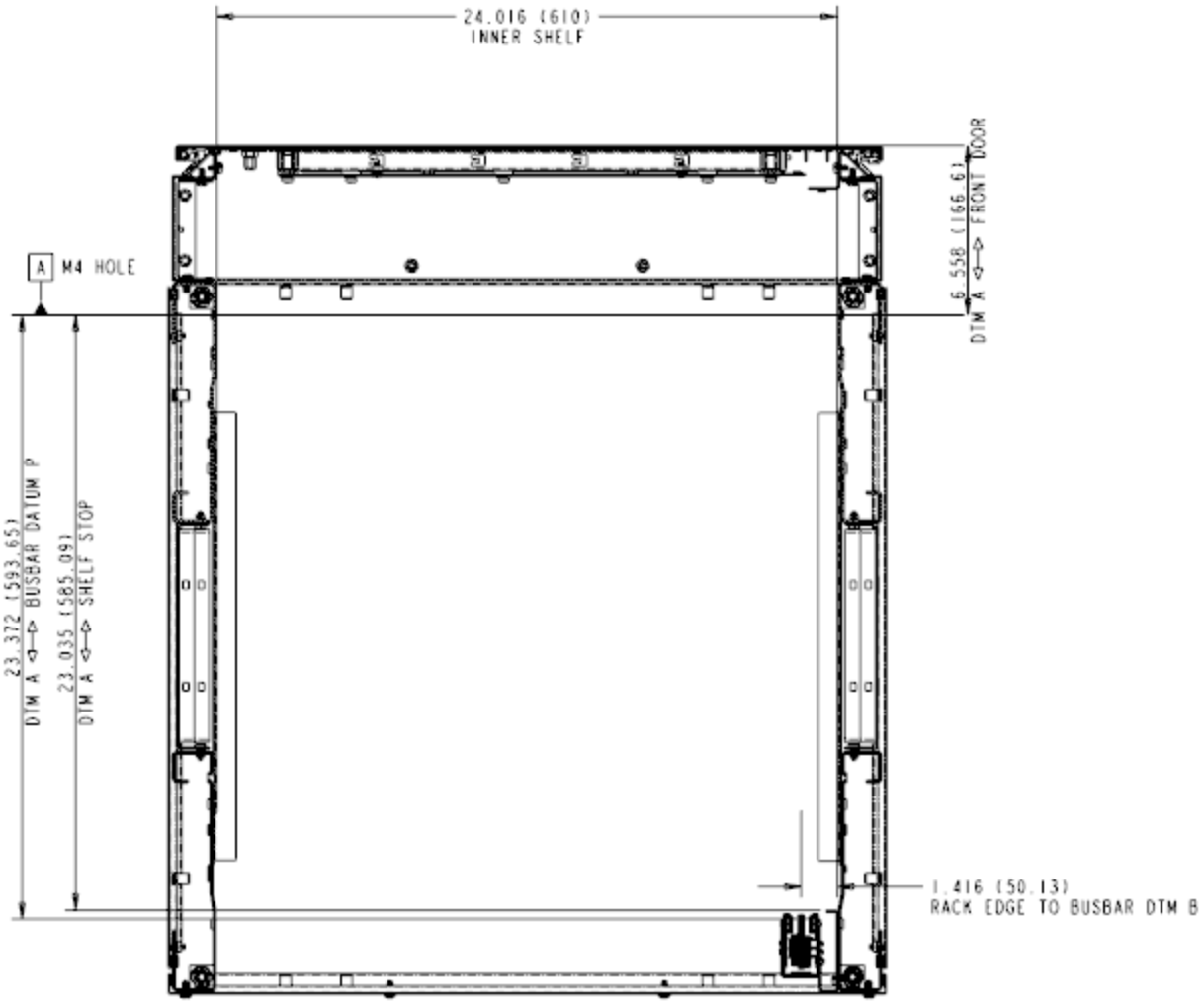


Figure 6.2.1 Top View Rack Frame Option2

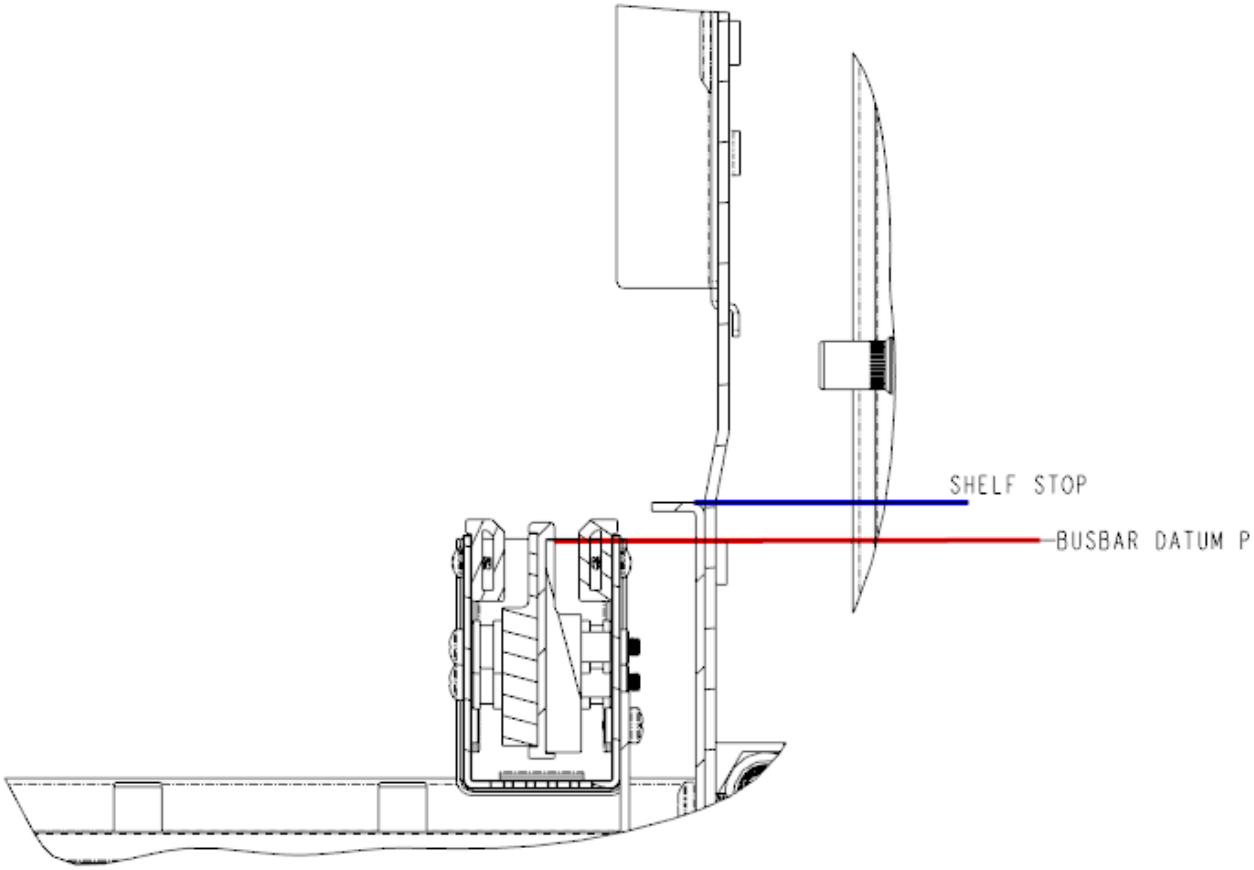


Figure 6.2.2 Top View Busbar Location Option2

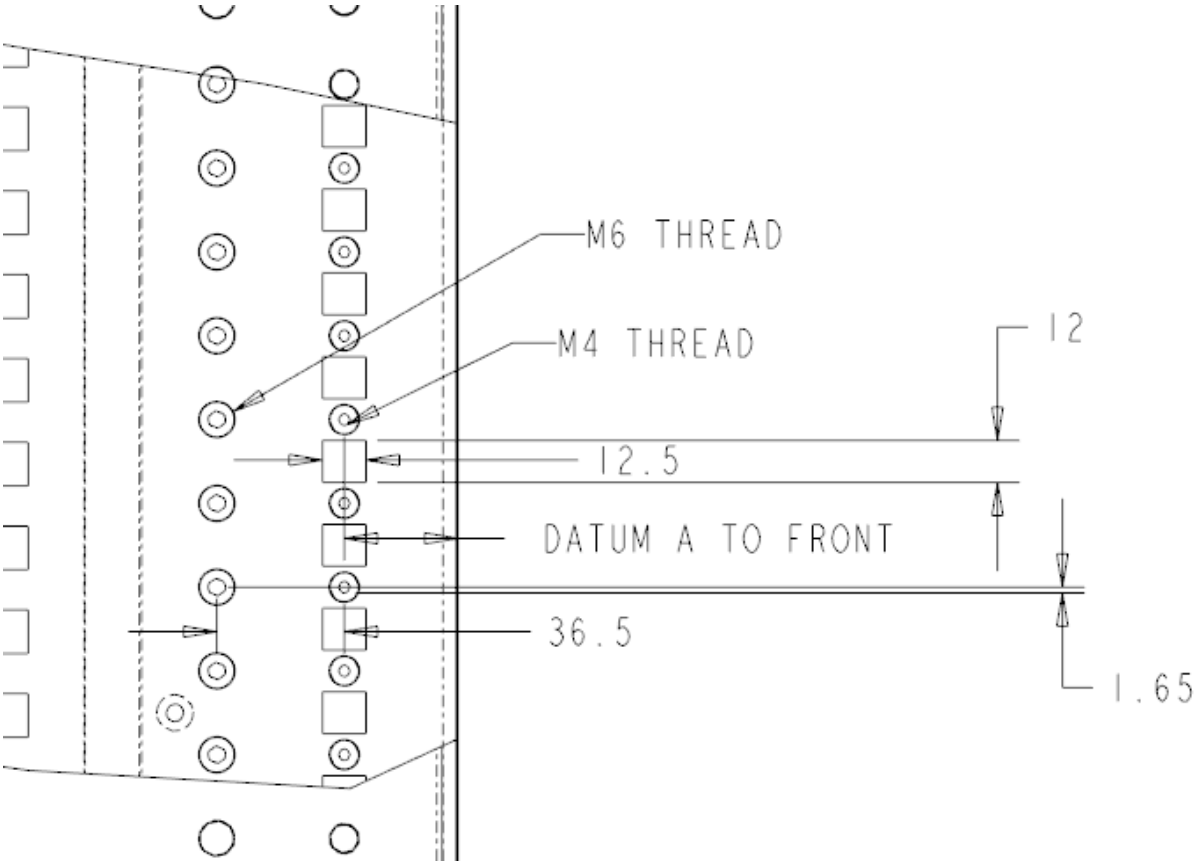


Figure 6.2.3 Side View Rack Vertical Locations Option2

6.3 Busbar

6.3.1 48V Busbar Geometry

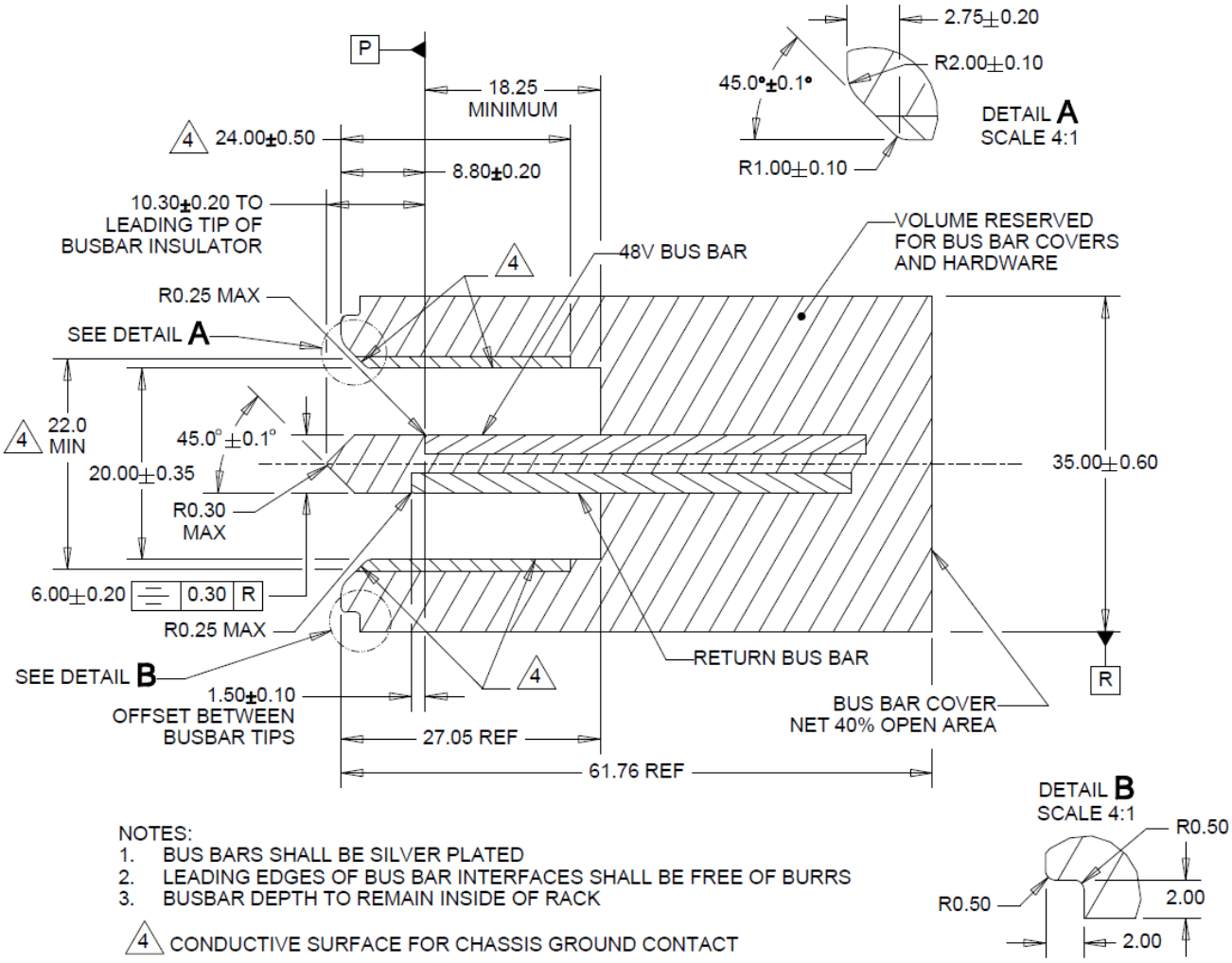


Figure 6.3.1 48V Busbar Cross-section

6.3.2 Ground Path

The electrically conductive surface of the busbar (note 4) as defined in Figure 6.3.1 above SHALL have a continuous electrically conductive path to the frame of the rack. The ground path SHALL pass rust grade 6 per ASTM D610-01 after 48 hours of salt spray per ASTMB117-07.

6.3.3 Center Busbar Interfaces to the Rack Frame (Optional)

The geometry of the 48V busbar that provides power to the IT Gear has standardized interfaces between the rack and the busbar to allow for interoperability between the components. The rack MAY incorporate these features at the rack builders discretion.

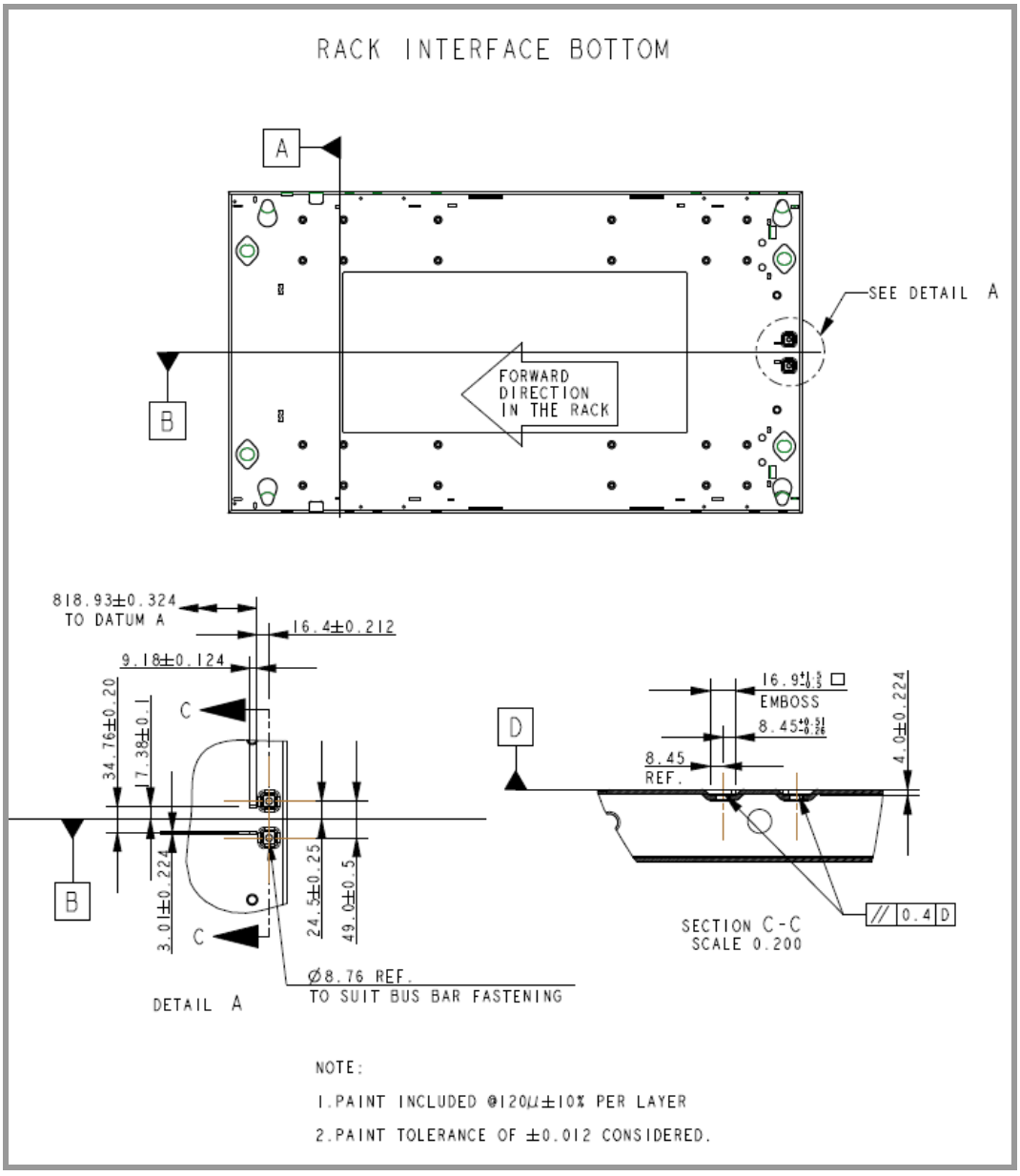


Figure 6.3.3.1 Rack/busbar interfaces in the rack bottom plate

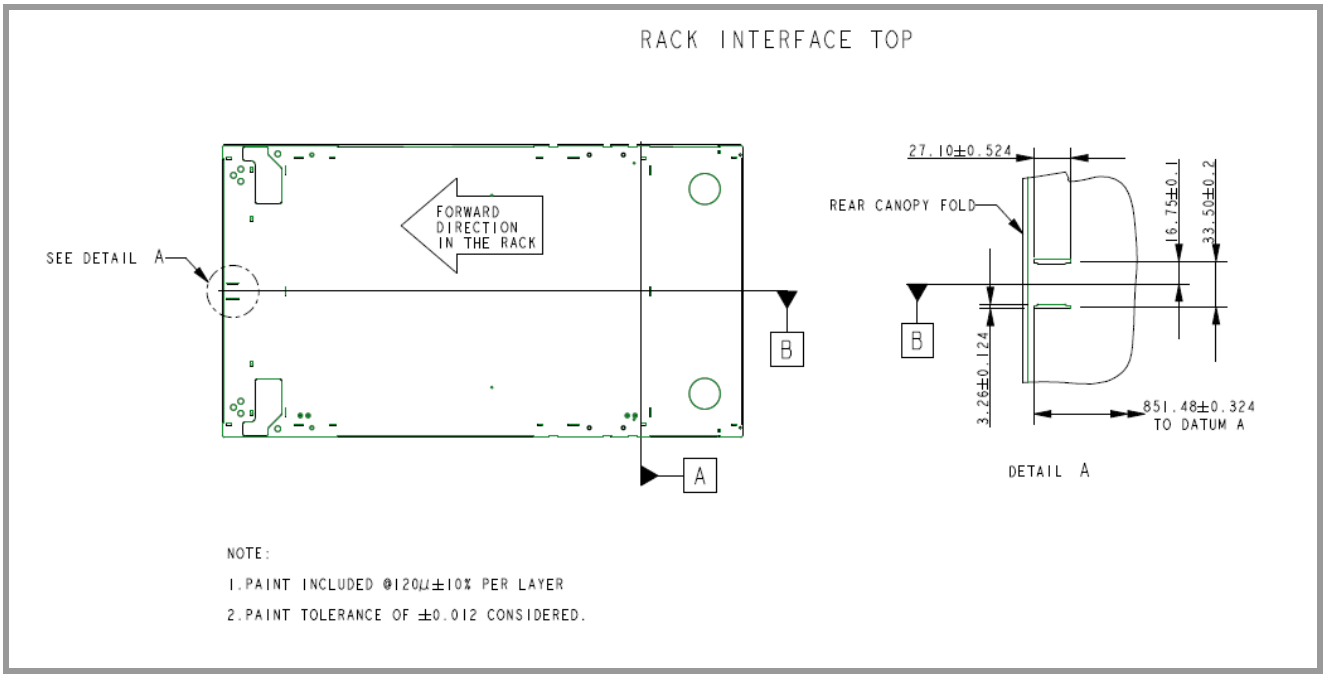


Figure 6.3.3.2 Rack/busbar interfaces in the rack top canopy (Top View, Rack Option 1)

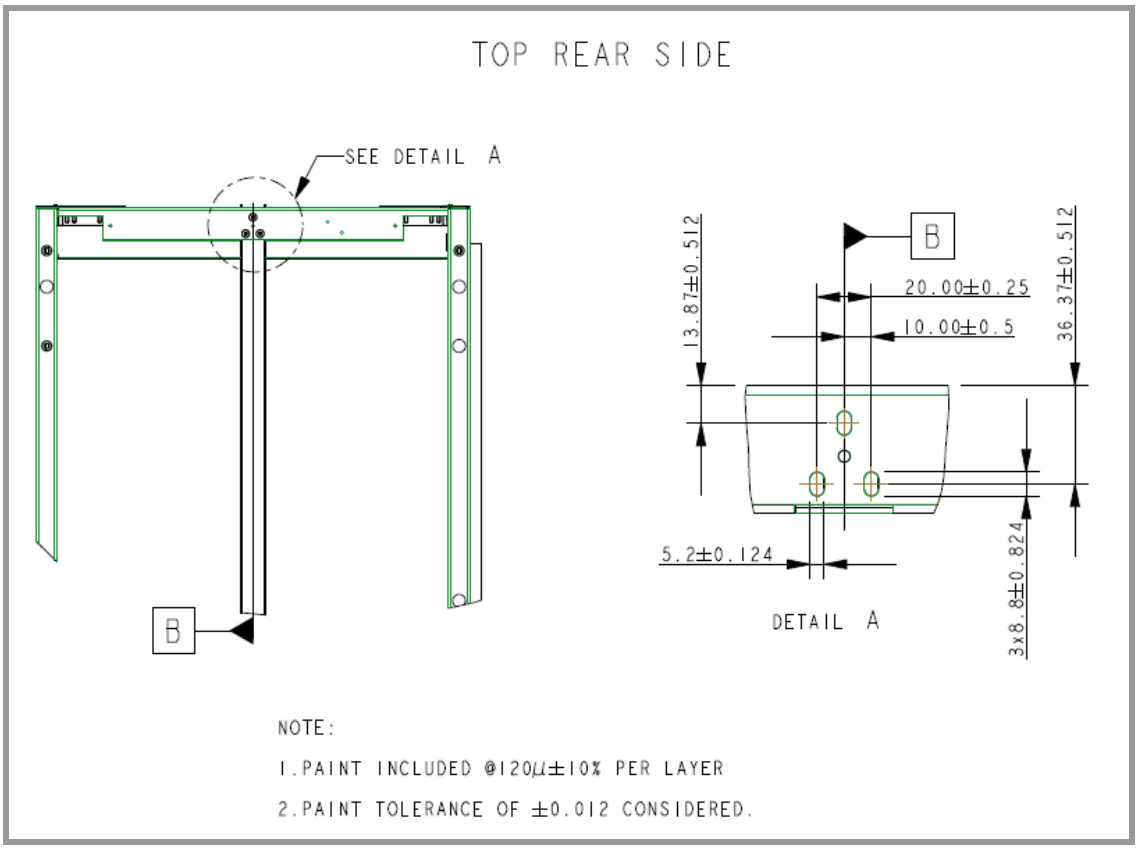


Figure 6.3.3.3 Rack/busbar interfaces in the rack top canopy (Rear View,

Rack Option 1)

6.4 Stabilizer Interfaces (Optional)

Racks SHOULD require an optional stabilizer for stability. The geometry dimensions below are recommended for mounting/attaching the stabilizers to the frame on both sides. See Section 10 for additional requirements

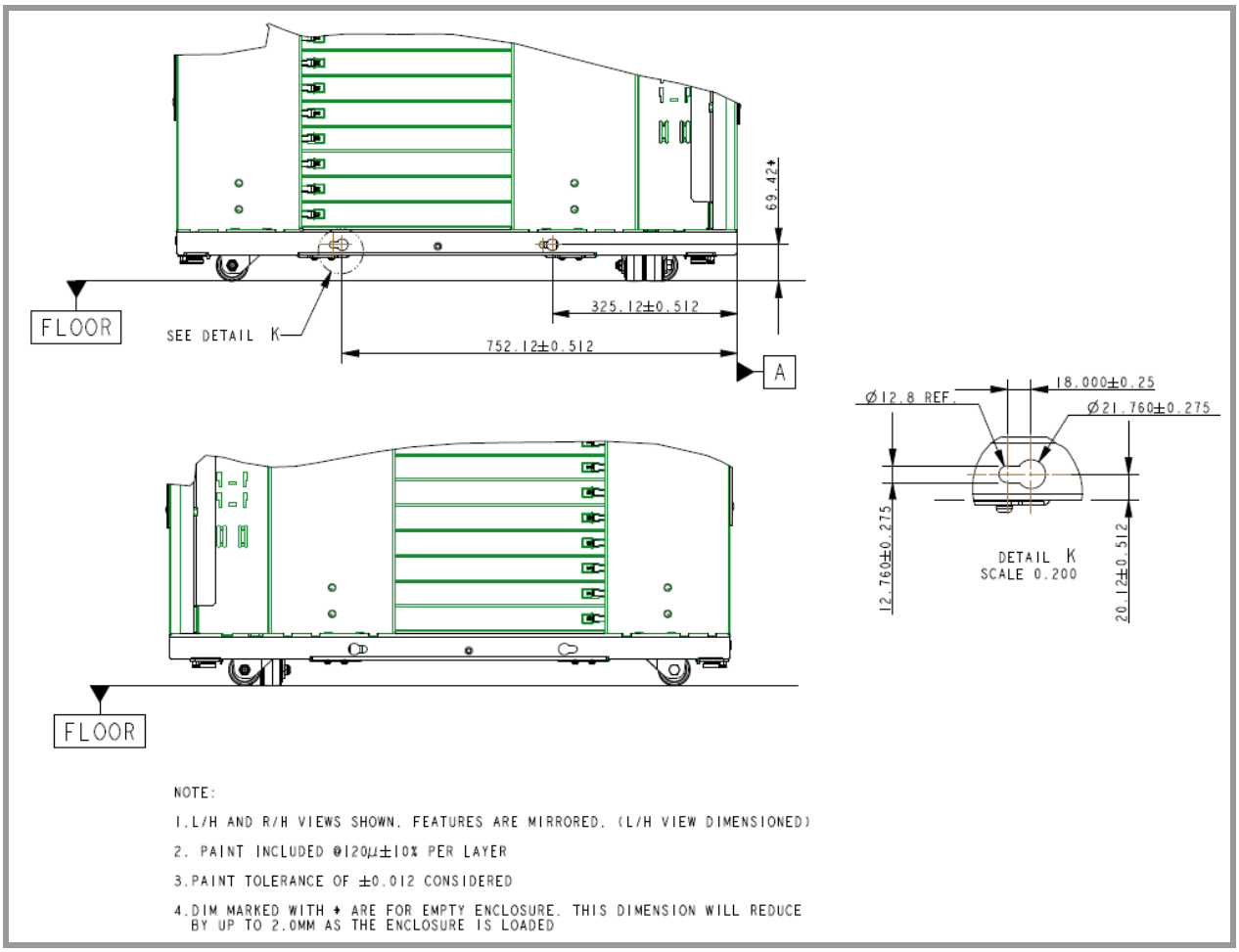


Figure 6.4. Stabilizer Details

6.5 Side Panel

The rack SHALL provide supporting features for side panels on the rack that must remain in place while moving the rack.

6.6 Caster Requirements

If the frame has casters, they SHALL comply with the following requirements in this section.

6.6.1 Rotation

All 4 casters SHALL swivel 360°and always remain within the rack envelope

6.6.2 Rack Approach Angle

Rack SHALL have a ramp entry angle of 10 degrees minimum when pushed from either the front or rear direction. This requirement is optional for add-on kits, but SHOULD meet this requirement to prevent movement issues during installation and decommissioning.

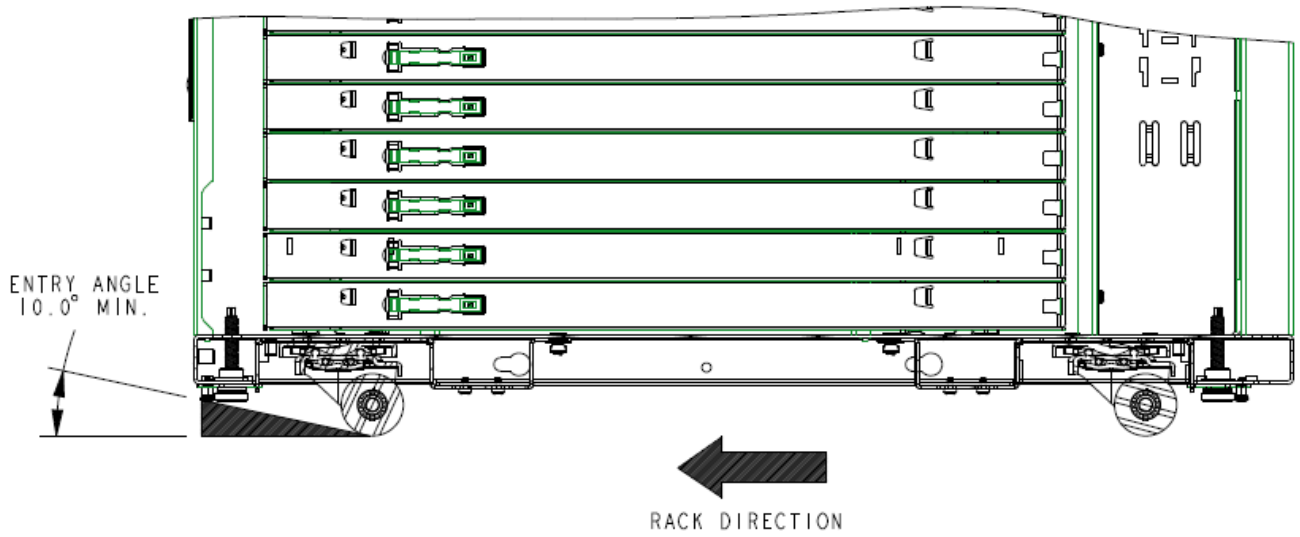


Figure 6.6.2. Rack Entry Angle Details

6.6.3 Rack Exit Angle

Rack SHALL have a ramp exit angle of 15 degrees minimum when pushed from either the front or rear direction. Add on kits are not required to meet this requirement.

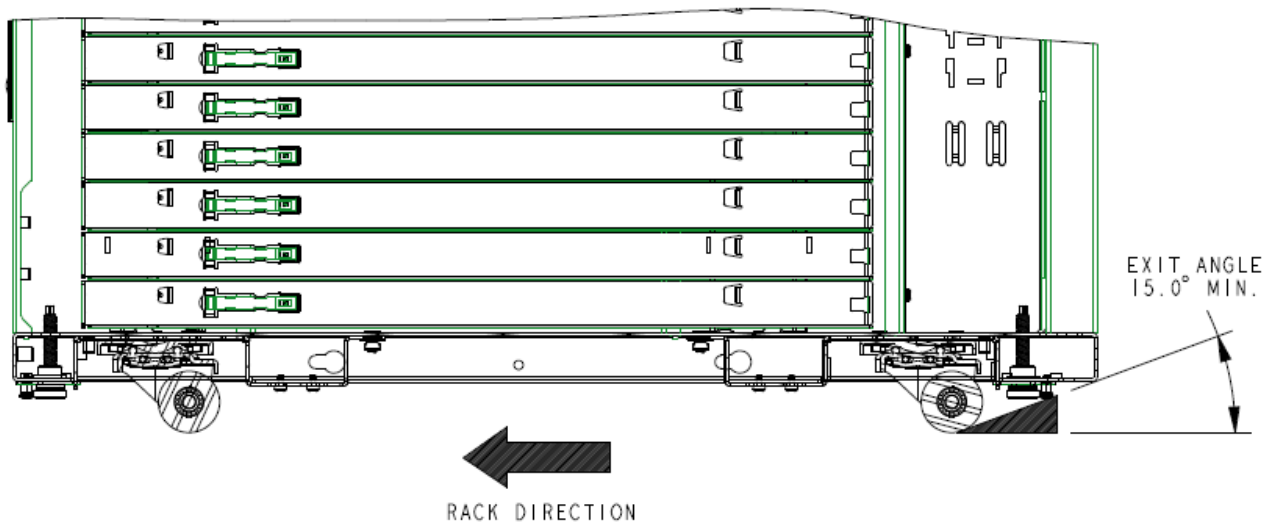


Figure 6.6.3. Rack Exit Angle Details

6.6.4 Caster Tests (Optional)

Frames with casters SHOULD comply with the test plan below:

Test Name	Test Description	Samples	Pass/Fail Criteria
Creep test	Test wheel with 700 lbs. (317.5 kg) compression load in a chamber at 90° C (194° F) for up to 10 days.	4	*Visual Inspection*: No visible defects *Diameter*: No deformation or flat at contact point *Hardness*: Measure hardness of wheel in multiple locations
Compression test	Test wheel under increased compression load till deformation is seen.	4	Compression load for deformation SHOULD exceed 1400 lbs. (635 kg) for all samples.
Impact test	Test wheel SHOULD be dropped from a height of 2 in. (51 mm) loaded with 605 lbs. (274.4 kg).	2	No visible deformation or flat points SHOULD be noted. Two to five impacts SHALL be done on each caster sample.

Accelerated life testing	Test wheel loaded to 700 lbs. (317.5 kg) over 4 miles (6.4 km), with 1 min run and 2 min rest.	4	No visible deformation or flat points SHOULD be noted.
Dynamic Test per ANSI ICWM Section 6.8	Dynamic capacity of the test done at 4 kph (2.5 mph).	4	As per the standard.

6.7 Leveling Feet

Rack leveling feet SHALL comply with all of the following:

6.7.1 a swivel foot at least 30 mm in diameter to prevent the rack from walking when the feet are deployed
6.7.2 lift the rack casters a minimum of 15mm off the floor
6.7.3 support the fully loaded rack under seismic test conditions as defined by the rack manufacturer or end user
6.7.4 be operable with an 8mm hex driver either electric or by hand wrench
6.7.5 have a max torque of 25N-m to raise or lower while fully loaded
6.7.6 stay within the rack footprint when deployed
6.7.7 ship and remain in the raised condition during all non-seismic tests
6.7.8 be replaceable without requiring equipment to lift the rack off the floor. Tools MAY be used for service.
6.7.9 be able to be raised or lowered from the front or rear of the rack.

For these requirements, a fully loaded rack (with total supported IT mass defined by the user or the rack manufacturer) will have the mass evenly distributed throughout the rack frame during the test.

6.8 Fastener Requirements

The frame will have holes in various areas for thread forming & standard machine thread fasteners. To standardize the tools used to build Open Rack, the holes/inserts SHALL meet the following durability using the hardware listed as appropriate:

6.8.1 All Ø4.5mm holes (before paint) in the rack are designed for steel M5 thread-forming screws per DIN 7500. Holes to have minimum strip out torque of 6.25 N-m. Nominal torque required is 5 N-m and supports a minimum of 5 cycles of tightening & untightening.

6.8.2 All Ø5.4mm holes (before paint) in the rack are designed for M6 thread-forming screws per DIN 7500. Holes to have minimum strip out torque of 6.25 N-m. Nominal torque required is 5 N-m and supports a minimum of 5 cycles of tightening & untightening.

6.8.3 Busbar Top Screws: The M5 threaded holes for mounting the busbar at the top are designed to utilize M5 x 8mm (Min) pan head machine screws. Holes to have minimum strip out torque of 6.8 N-m. Nominal torque required is 5 N-m.

6.8.4 Busbar Bottom Screws: The two M6 threaded holes for mounting the busbar at the bottom are designed to take M6 x 10mm (Min) ultra low head machines screws. Holes to have minimum strip out torque of 5 N-m. Nominal torque required is 4 N-m.

7.0 Environmental Requirements

7.1 Operating Temperature: 10°C to 60°C
7.2 Long-term Storage: -40°C to 50°C and 5-95% RH
7.3 Short-term Storage: -20°C to 65°C and 10-80% RH
7.4 Operating Humidity: 85%max, 5°C dew point minimum

8.0 Color and Marking

8.1 Text & Font

Any Text on the frame SHALL use the font MS Reference with a minimum size of 4mm

8.2 U Markings

All “U” markings (both OpenU and RU) SHALL be marked in a permanent and legible manner using a high contrast color with the lowest location marked as “1” and incrementing up the rack frame.

9.0 Electrical Grounding

9.1 Telco Ground Lug

9.2 Provide M5X0.8 nut features as an electrical ground to mate with Data Center Telco Ground Lug as defined in FB PN: 18-000233.

9.3 Conductivity of the ground path SHALL be protected from rust and corrosion over the life of the product. All ground points SHALL pass rust grade 6 per ASTM D610-01 after 48 hours of salt spray per ASTMB117-07.

9.4 Green ground screws SHALL be provided with the rack and have a hex head 8mm across the flats.

9.5 Ground points SHALL be located per 3D CAD on the top surface of the rack for overhead grounding and the rear base surface to support underfloor grounding

9.6 IT Gear Ground Path

9.6.1 Rack SHALL provide a supplemental electrically conductive path from the IT equipment in the rack to the rack grounding lug on the top of the rack.

9.6.2 This path SHALL not pass through any surfaces that are not protected from rust and corrosion such as un-plated surfaces.

10. Environmental and Regulations

10.1 CB Certification with country deviations in accordance with IEC62368-1

10.2 UL62368-1:2019, EN/IEC 62368-1:2020+ A11/2020: Hazard-based performance standard for Audio video, IT & Communication Technology Equipment.

10.3 CE Mark

10.4 RoHS Directive (2015/863/EU); aims to reduce the environmental impact of EEE by restricting the use of certain substances during manufacture.

10.5 Substances of Concern In articles as such or in complex objects (Products)The vendor SHALL provide the declaration of compliance document stating that a product doesn't contain any substances regulated by EPA 40 CFR751

10.6 REACH Regulation (EC) No 1907/2006; registration with the European Chemicals Agency (ECHA), evaluation, authorization and restriction of chemicals.

10.7 All plastic materials will be rated UL94V-0 or better from UL recognized suppliers

11. Testing

Unless otherwise stated, all tests are required to be performed in a fully-loaded configuration SHALL assume that the mass is evenly distributed throughout the volume of the rack. The mass used will match the IT Gear mass rating specified by the rack manufacturer or the end customer. The frame SHALL comply with all the tests in section 11.

11.1 Rolling Movement

11.1.1 **Obstacle Test:** Roll over a 4mm vertical step with each caster independently at 0.8m/s, 5 times each

11.1.2 **Gap Test:** Traverse 25.4mm wide gap in the floor at 0.5m/s , 5 times

11.1.3 **Ramp Test:** Transition a 5-degree ramp both up and down. From a flat surface, traverse a 5 degree ramp up to an elevated flat surface . From an elevated flat surface, traverse down a 5 degree ramp down to a flat surface. Each surface SHALL be large enough for the entire rack (the full frame depth & width) to roll onto prior to transitioning to the next surface

11.1.4 **Roll Off Test**: 19mm, 5 times per direction (with front leading and then with rear leading)

11.1.5 **Rack Distance Rolling Test:** Roll 800m on a concrete floor at 0.8m/s, without stopping for prescribed distance. After completing the four tests above, the force (kgw) required to push the rack from a non-moving position along a smooth, flat cement floor SHALL be less than 5% the total combined weight (kgw) of the rack and IT Gear.

11.2 Unpackaged Tests

11.2.1 The enclosure system SHALL be tilted to an angle of 10 degrees from its normal upright position and held in this position for a period of 1 minute. The test SHALL be repeated for all four sides (front, back, left, right).

(1) Test with maximum payload, evenly distributed in rack. Add-on stabilizers MAY be used to meet this requirement for rack at max payload. Stabilizer SHALL pass the test at maximum payload, evenly distributed in rack.

(2) base rack with no payload SHALL also pass with no stabilizer

11.2.2 Leveling feet SHALL be raised and lowered 3 cycles individually to raise rack to 15mm off the floor until all 4 are raised. Start with front left , then rear right, then rear left, & finally front left. Lower in reverse order. Repeat for 3 cycles.

11.2.3 While in its normal position on a flat surface, with casters rotated towards the surface, a force equal to 20 percent of the weight of the fully loaded enclosure system, but not more than 250 N (56.2 lbf), is applied in any direction except upwards, at a height not exceeding 2 m (78.74 in) from the floor. The force is applied to the front, back and each side of the system, each for a period of 1 minute.

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12.0 Electrical Requirements for IT Gear

12.1 Input Voltage Specification

Option 1: The expected nominal input voltage delivered by the Open Rack V3 Power Shelf is 51VDC. The IT gear power delivery subsystem SHALL accept and operate normally with an input voltage tolerance range between 46V and 52V.

Option 2: The expected nominal input voltage delivered by the Open Rack V3 Power Shelf is 54VDC. The IT gear power delivery subsystem SHALL accept and operate normally with an input voltage tolerance range between 52V and 56V.

12.2 Input Power Delivery Power Sequence Requirements

As part of the Open Rack V3 architecture, a new bus bar connector has been designed to improve upon last generation challenges and incorporate new features such as the ability to monitor voltage drop of the input power cable assembly.

The Open Rack V3 IT Gear Input Connector has total of 4 connections which SHALL have the following minimum ratings:

* Power Path (required), 100A continuous
* Ground Path (required), 100A continuous
* Chassis Ground (required), 65A for 2 minutes
* Power Sense (required), 1.5A continuous

There is a fifth connection that MAY be populated:
* Ground Return Sense (optional) 1.5A continuous

12.3 Voltage sense signals (optional)

One important differentiation between Open Rack V2 and V3 is that the new connector requires IT gear designs to make use of the power sense line to control the on & off behavior of power entry circuitry such as hot swap and/or load switches. This implementation ensures that the IT gear does not attempt to begin powering on until the input connector is fully asserted into the bus bar and is powered off before removal to prevent arcing events.

With the addition of the power and ground return sense lines, it SHALL be possible to implement a differential voltage sensing scheme to monitor the voltage drop of the input power cable assembly (e.g. from bus bar to IT gear connector). Additional circuitry such as differential voltage sensors and remote telemetry reporting capability SHALL be required to realize this monitoring implementation. This is an optional feature for Open Rack V3, but it is highly recommended to enhance the platform's health monitoring and thermal event mitigation capability.

13. References

[1] OCP Open Rack Specification 2.1
[2] OCP Profiles - https://github.com/opencomputeproject/OCP-Profiles
[3] Redfish Interop Validator - https://github.com/DMTF/Redfish-Interop-Validator
[4] Redfish Service Validator - https://github.com/DMTF/Redfish-Service-Validator

[5] Redfish Service Conformance Check -
https://github.com/DMTF/Redfish-Service-Conformance-Check

Appendix A - Requirements for IC Approval

Requirements	Details	Link to which Section in Spec
Contribution License Agreement	Which one?	Link to Sec 1
Are All Contributors listed in Sec 1: License?	Yes	
Did All the Contributors sign the appropriate license for this spec? Final Spec Agreement/HW License?	Yes	
Which 3 of the 4 OCP Tenets are supported by this Spec?	Openness Efficiency Impact Scale	List reasons here. Link to presentation if separate.
Is there a Supplier(s) that is building a product based on this Spec? (Supplier must be an OCP Solution Provider)	Yes	Rittal
Will Supplier(s) have the product available for GENERAL AVAILABILITY within 120 days?	Yes	Please have each Supplier fill out Appendix B.