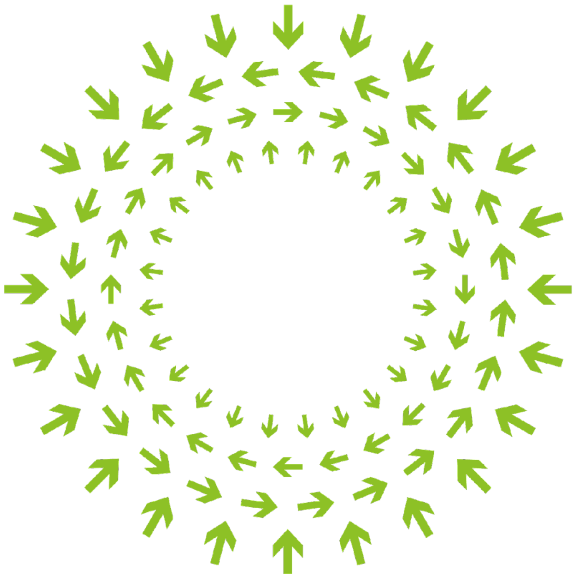

OPEN

Compute Project

Google Implementation of the Open Rack Frame V3 Specification

Revision 0.2

Authors: Loren Vorreiter, Johnny Yau

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2) The above license does not apply to the Appendix or Appendices. The information in the Appendix or Appendices is for reference only and non-normative in nature.

2. Revision Table

Date	Revision	Author	Description
28 July 2022	0.1	Loren Vorreiter	Initial draft
24 Sept 2022	0.2	Loren Vorreiter	Update images and content details

3. Scope

This document provides technical specifications for the Google Implementation of the Open Rack Frame V3 Specification used by the Open Compute Project. The intent is to detail the intermateability of IT gear across different racks and power systems that may be developed by the community. Compliance with this specification is required for products intended to operate with Open Rack V3 (ORv3).

4. Overview

This document includes the key specifications that compatible racks must meet to support both 19 in. (482 mm) EIA and 21 in. (533 mm) ORv3 compatible payloads. Additional rack design features and details are not included in the scope of this document.

5. Mechanical

The base rack includes features in order to mount accessories that change the overall depth and height. Precise mounting points are listed and illustrated in this specification—only the base height, width, and depth are detailed in Table 1.

5.1 External Dimensions

5.1.1 Table 1. Physical Dimensions

Dimension	Rack Dimensions
Base rack height	80.9 in. (2054.2 mm)
Minimum Clearance to Floor	1.78 in. (45.2mm)
Width	27.8 in. (706.2 mm)
Base rack physical envelope depth (option 1)	31.7 in. (805.2mm)
Base rack physical envelope depth (option 2)	48 in. (1219 mm)
Min weight	646 lbs. (293 kg)
Max weight	1800 lbs. (816.5 kg)

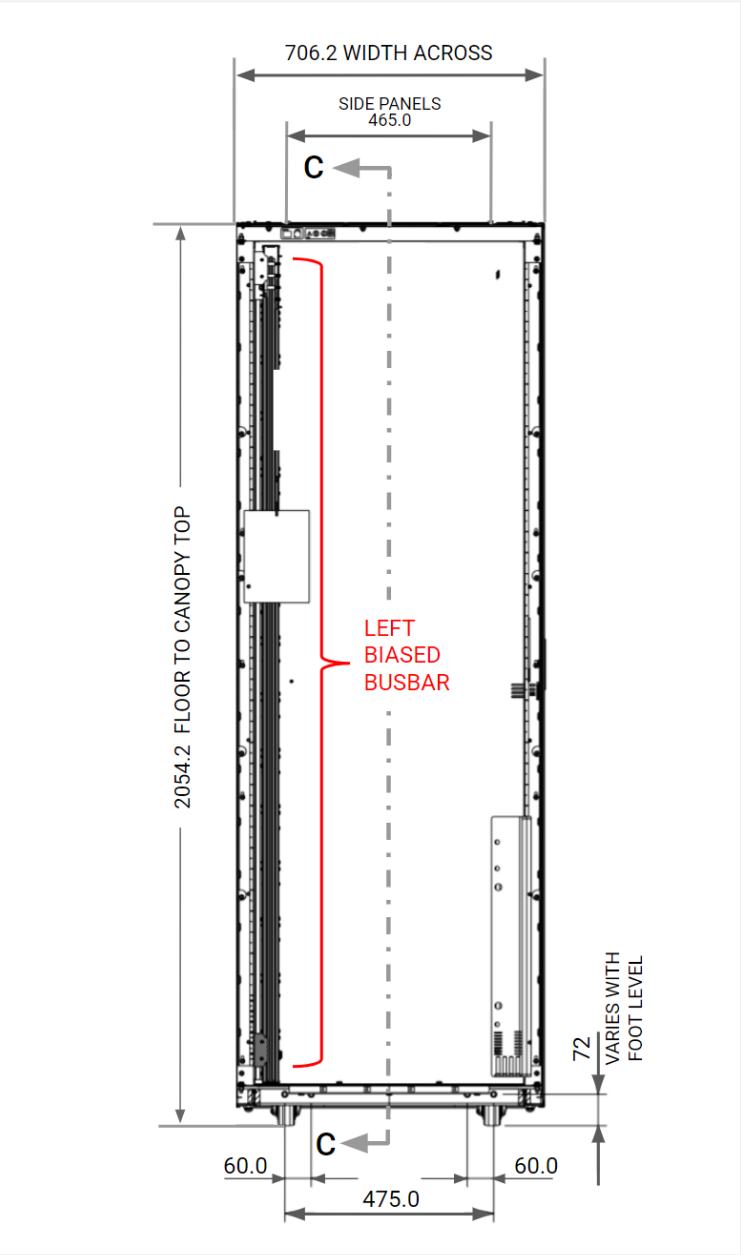

Figure 1. Front facing rack with left biased busbar (dimensions in mm)

5.2 Busbar Location

The rack must support the left biased busbar location (shown at the front of the rack) so that, when accessing the rear of the rack, it is situated in a manner that doesn't interfere with the rail placement. The precise busbar location is illustrated in Figures 1 and 2.

Note - The Open Rack V2 (ORv2) busbar is shown in these illustrations (*dimensions depicted in mm*); the rack structure can accommodate an **ORv2** or **ORv3** busbar.

5.2.1 Rack Depth (Option 1)

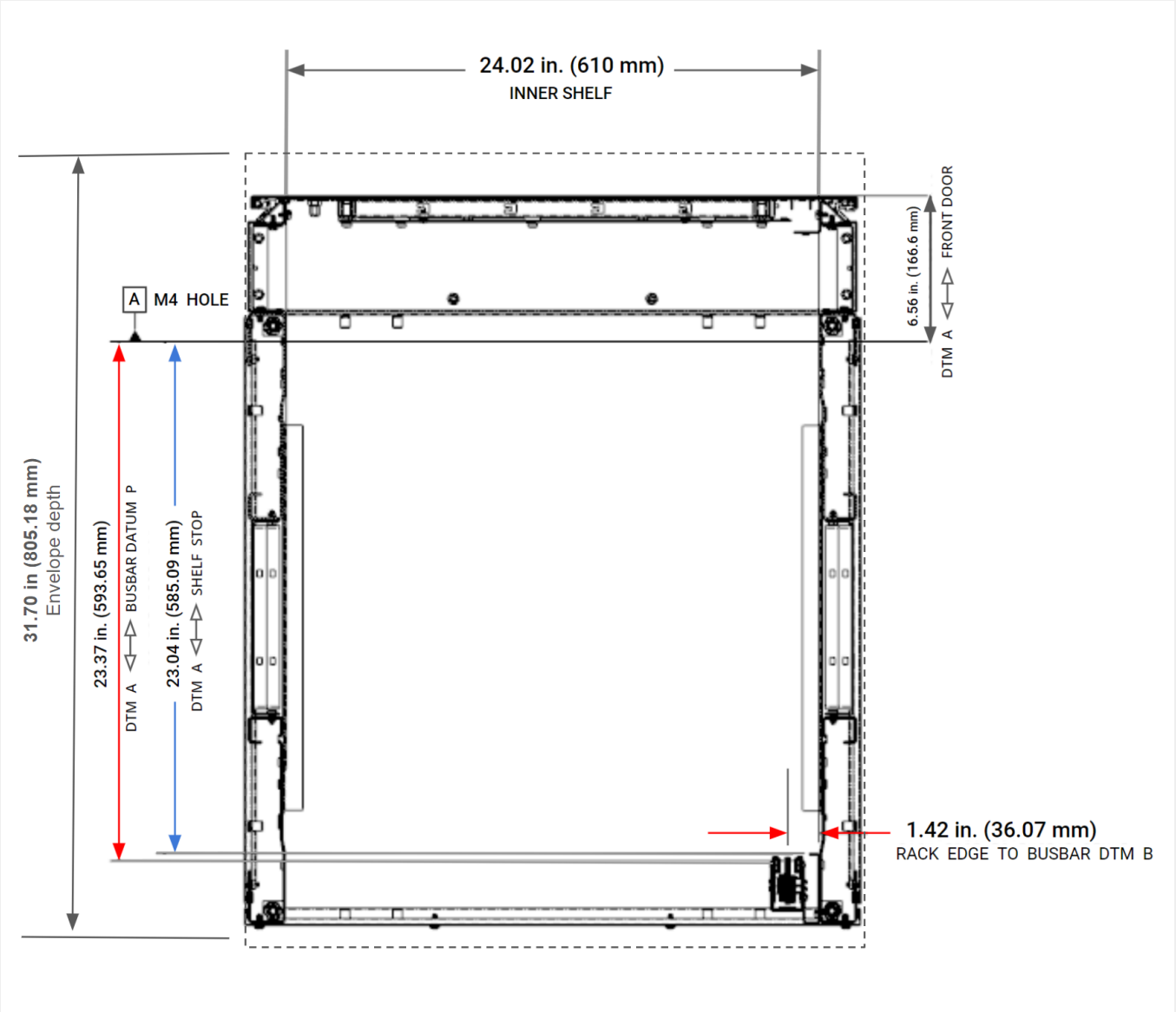

Figure 2. Option 1 - Top view of rack (ORv2) with busbar depth

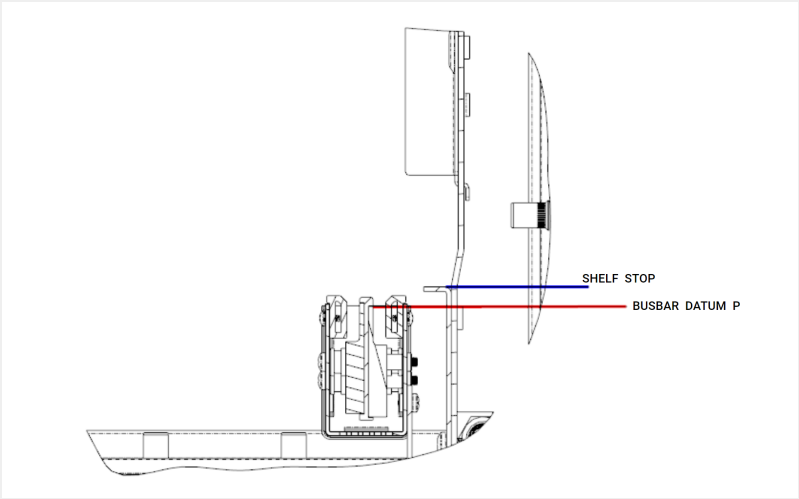

Figure 2. Option 1 - Closeup of busbar relative to shelf stop

5.2.2 Rack Depth (Option 2)

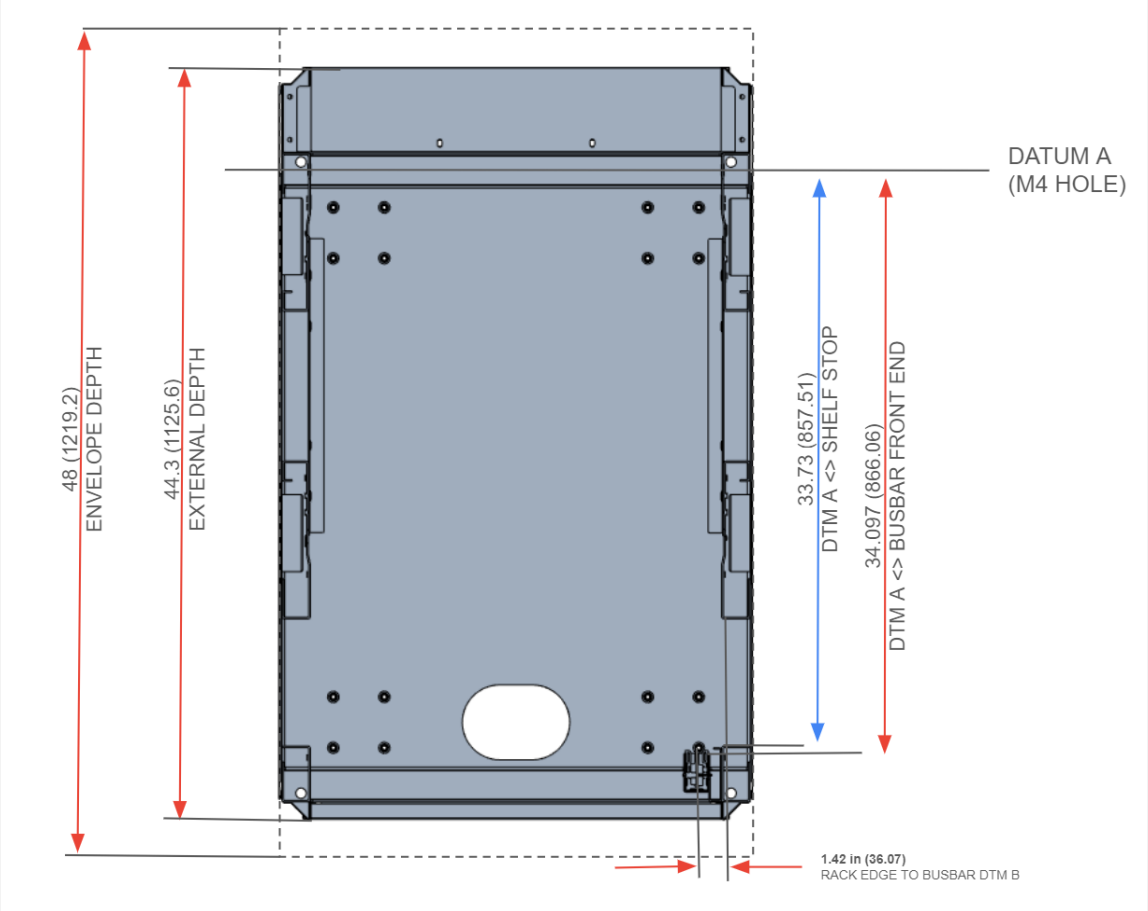

Figure 2. Option 2 - Top view of rack with busbar depth

5.3 Payload Combinations

The internal rack configuration must be flexible enough to meet the two standards specified in sections 5.3.1 and 5.3.2 below. The ability to support a 21 in. (533 mm) wide payload (OCP) is generally suitable to support the remaining standards with the exception of the busbar placement. The support combination should be provided in the form of add-on kits.

5.3.1 OCP (Open Rack V3)

The rack must have suitable features to support mounting hardware for payloads that meet the Open Compute Form Factor. Specifications are defined in Open Rack V3.

The rack vertical pitch in this case should be in OUs.

5.3.2 19 in. (483 mm) EIA

The rack's features must be able to support mounting hardware to incorporate 19 in.-EIA payloads.

5.3.3 Payload Details

Dimension	Specification
Total payload usable height	74.65 in. (1896 mm)
Shelves	39.5 OU (1 OU = 1.89 in. (48 mm))
Standard shelf thickness	0.12 in. (3 mm)
Rack unit pitch	1 OU = 1.89 in. (48 mm)
Tray depth to front panel	24.15 in. (613 mm)
Tray depth to handle	25.0 in. (635 mm)
EIA rail depth	23.07 in (586.15 mm) Std Depth 29.25 in (742.95 mm) Extended Depth

The internal rack opening must be at least 24 in. (610 mm) wide and 77 in. (1956 mm) tall. The available depth is dependent on whether or not a door is present.

These are overall form factors specified for the rack. Cases where design details violate these dimensions should be resolved, through discussion, to determine the benefits of going beyond these standards.

6. Structural Specifications

Specification	Measurement
Maximum average floor loading pressure	6.1 kPa (127 lbs/sq ft)
Maximum average tile load	817 kg/tile (1800 lbs/tile)[1] 408 kg/tile (900 lbs/tile)[2] 204 kg/tile (450 lbs/tile)[3] Casters distribute load on: 1. 1 standard 24 in. [60 cm] raised floor tile 2. 2 standard 24 in. [60 cm] raised floor tiles 3. 4 standard 24 in. [60 cm] raised floor tiles
Maximum concentrated static load at single caster	252 kg (555 lbs) If floor tile rating is unknown: 1. Floor protection must be used when rolling populated racks. ***or*** 2. Empty racks should be populated after they have been rolled into position.

7. Seismic Specifications

Note - Values in this table assume worst case rack configurations. If exceptions have been granted, see separate documentation that references deviating configurations for actual configuration weights.

Description	Measurement
Seismic fasteners	**Qty 4** - M12 threaded fasteners provided at the top of the rack for bracing or ganging (see 7.5.1 Top of Rack Fasteners). **Qty 8** - Bottom of rack fasteners for a 12 mm through hole. The fasteners used to anchor the bracket to the floor are to be provided by the local site team.

7.1 Dynamic Loading

Loading is dependent on rack height. Racks under 82 in. tall should be capable of shipping with a maximum of 2200 lbs (997.9 kg) of IT gear.

Dynamic conditions include the following:

1. Shipping (packaged product) under ASTMD4169-09, Assurance Level II, Handling, Truck/air (Level II).
2. Dynamic threshold test is specified in the 11. Testing section.
3. Seismic loading per the parameters in the table below. (ASCE7-16 is applicable. Test parameters and response spectrum are specified in AC156).

Shake Table Test Parameters for Required Response Spectrum (5% Critical Damping)							
Building Code	Test Criteria	SDS (g)	z/h	Horizontal		Vertical	
				A_FLX-H	A_RIG-H	A_FLX-V	A_RIG-V
IBC 20**	AS156	2.237	0.74	3.58	2.22	1.50	0.60

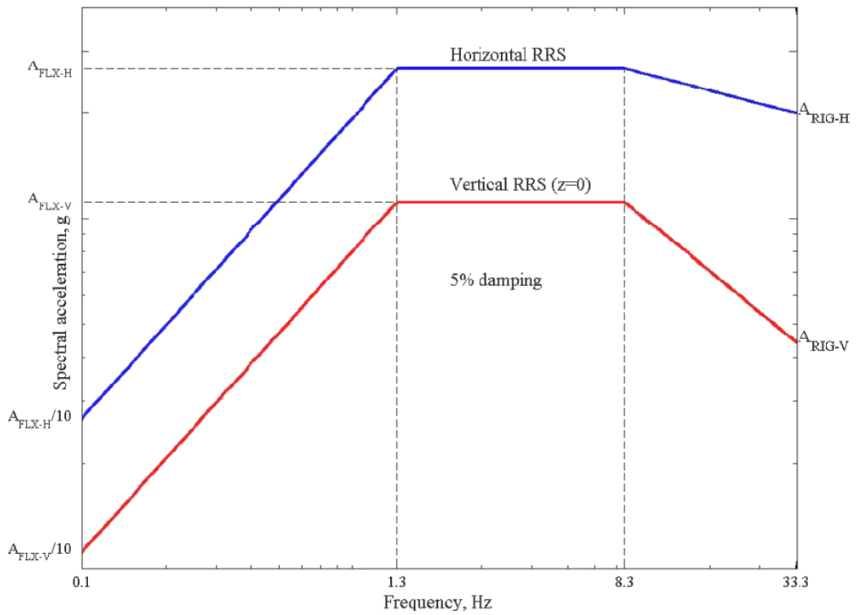

Figure 3. Spectral acceleration and Frequency measurement (5% critical damping)

7.2 Seismic Mounting Points

Racks must provide restraining locations in order to attach optional seismic brackets. The specific bracket design is dependent on seismic zone level and interface connection details to floor/air containment structures.

7.2.1 Rear Restraint Locations

The rack must provide **four** restraining locations (M8 threaded inserts) at the **rear** of the rack.

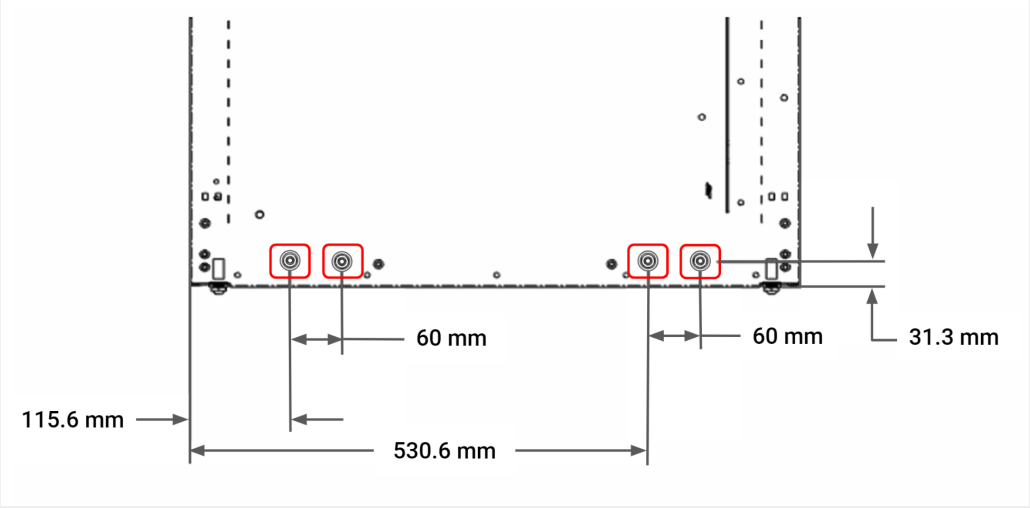

Figure 4. Restraint Configuration 1 (RC1)

7.2.2 Front Restraint Locations

The rack must provide **four** restraining locations (M8 threaded inserts) at the **front** of the rack.

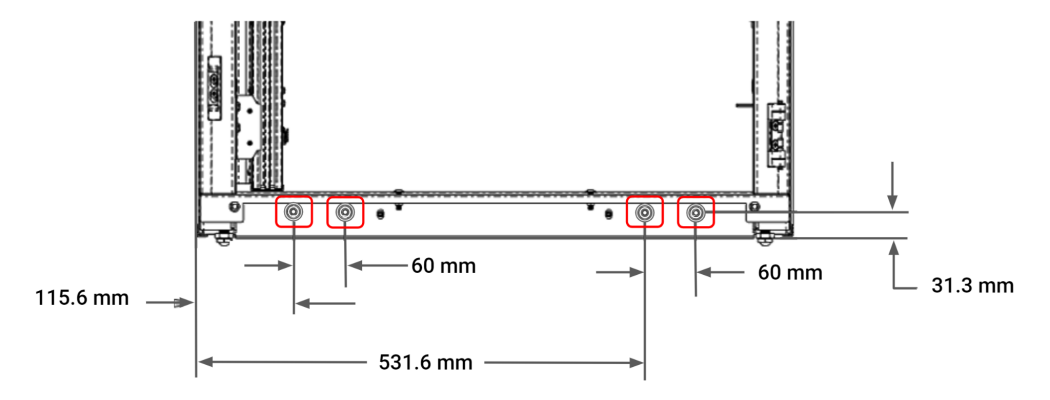

Figure 5. Restraint Configuration 2 (RC2)

7.2.3 Rear of Rack Mounting Points

To install optional accessories, such as a rear door, a perforated panel, or seismic brackets, the rear of the rack must include the mounting locations illustrated in Figure 6.

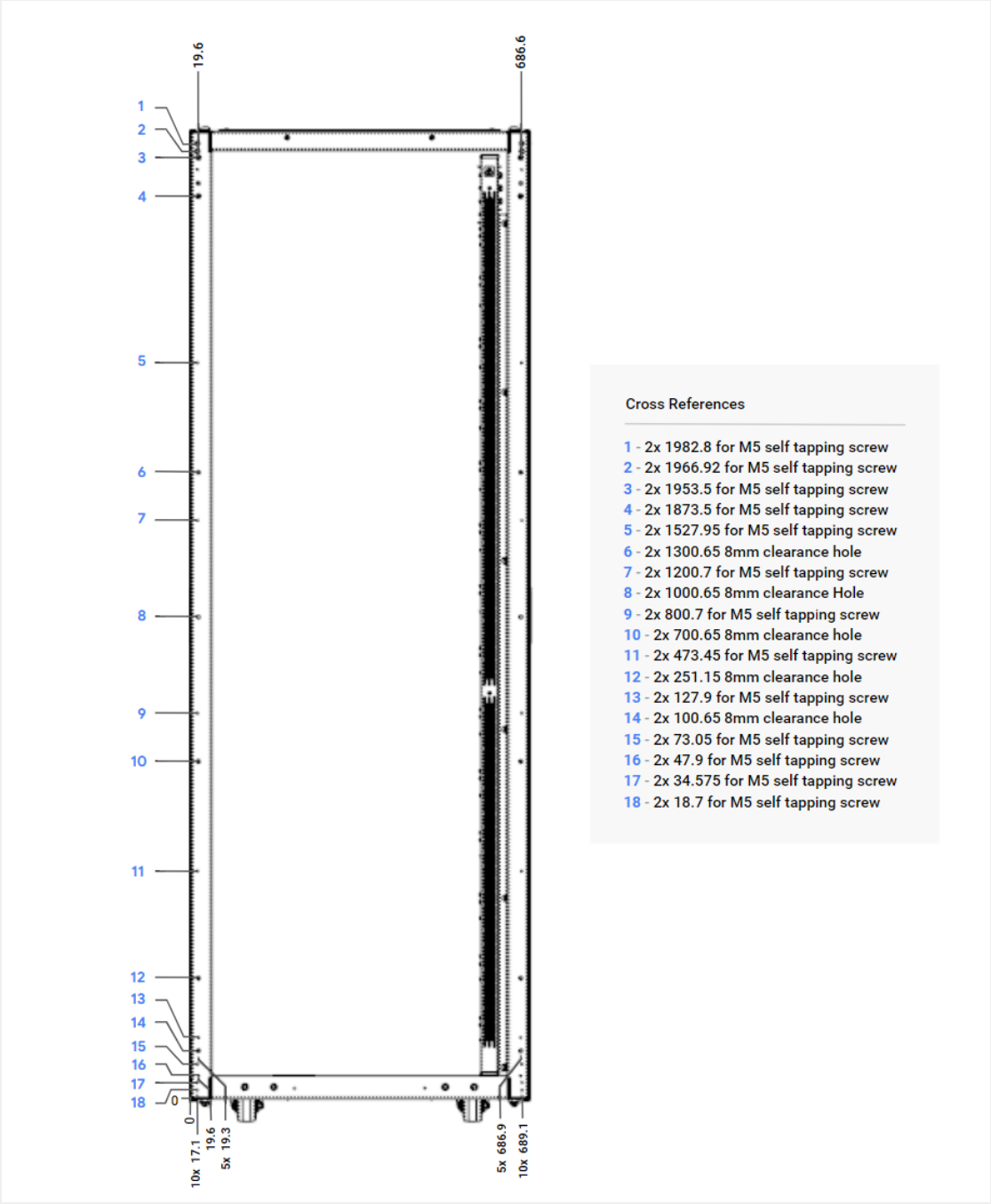

Figure 6. Rear rack mounting points (in mm)

7.2.4 Front of Rack Mounting Points

To install optional accessories, such as a front door, secure door, and cable managers, the front of the rack must include the mounting locations illustrated in Figure 7.

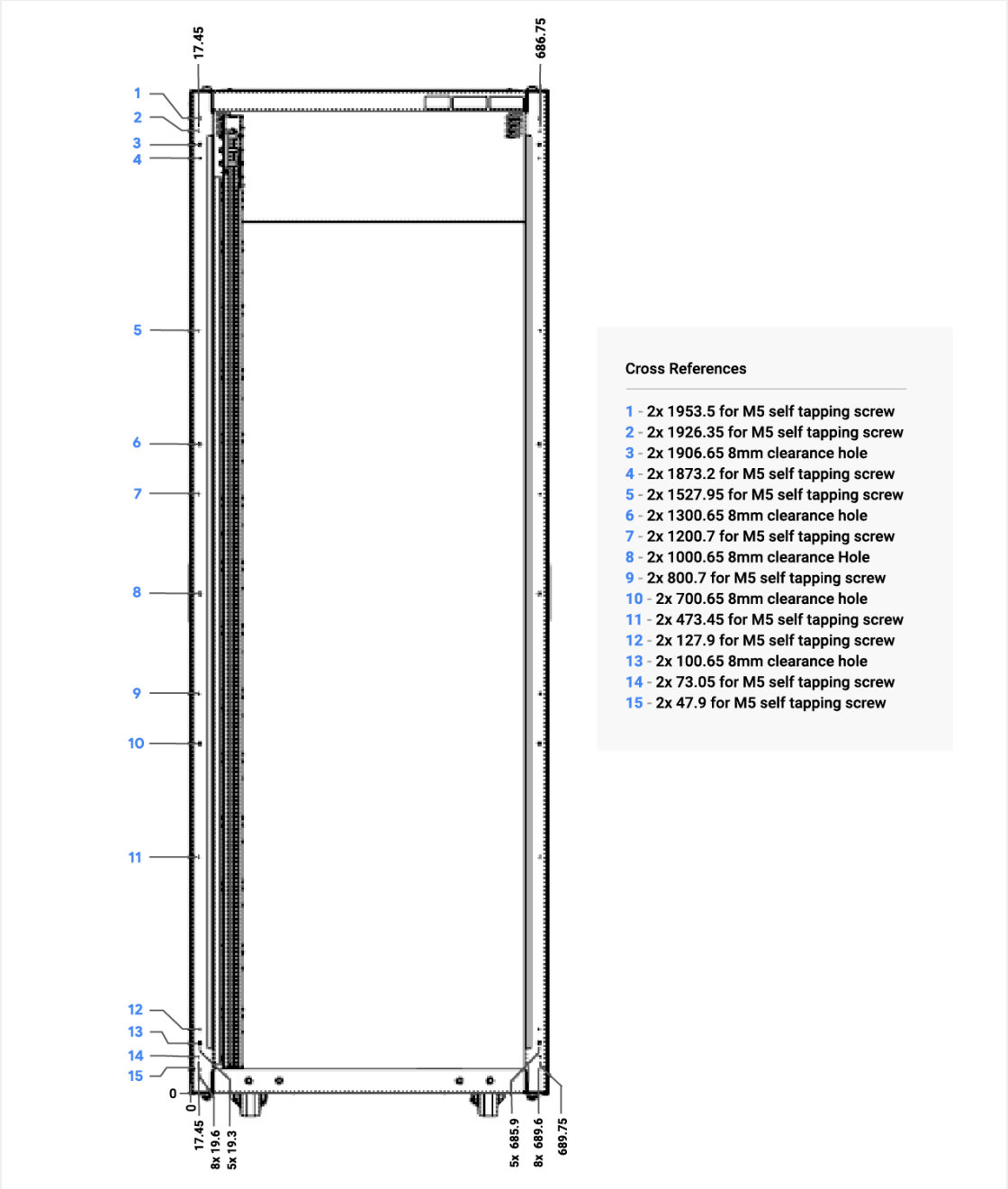

Figure 7. Front rack mounting points (in mm)

7.2.5 Payload Mounting Points

The following **three** features are located on the inside walls at every ½ OU (24 mm):

1. M4 Thread (locating dimension for payload). Datum A
2. M6 Thread
3. Rectangular Cutout

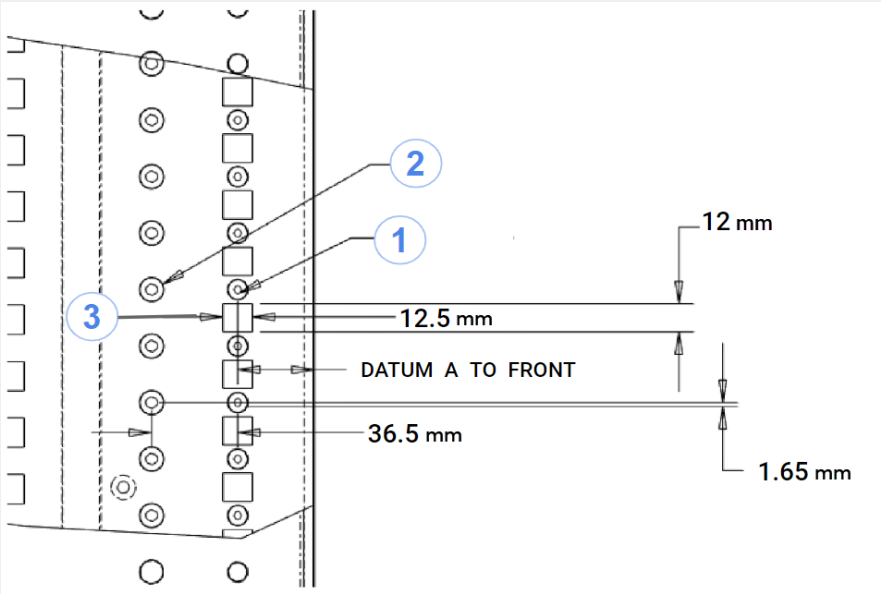

Figure 8. Inside rack wall - payload mounting points

7.3 Casters

- The rack casters must be able to support the specified loading capacity.
- Casters must be able to swivel 360 degrees.
- The location and placement of the swivel casters is installed, as needed, to support the dynamic loading of the rack.
- Casters must always remain within the rack envelope.

7.4 Leveling Feet

- The rack must have leveling feet that can be lowered once the rack is placed in its final location.
- The leveling feet must be capable of being cycled—designed for more than one-time use.
- The leveling feet must be able to lift the rack at least 6 mm off the casters.
- The feet must support the fully loaded rack during seismic testing.
- The feet must stay within the rack footprint when deployed.

7.5 Fastener Requirements

The frame must have holes in various areas for thread forming and standard machine thread fasteners.

7.5.1 Top of Rack Fasteners

Figure 9 illustrates the **four** 0.5 in. threaded fasteners provided at the top of the rack for bracing or ganging.

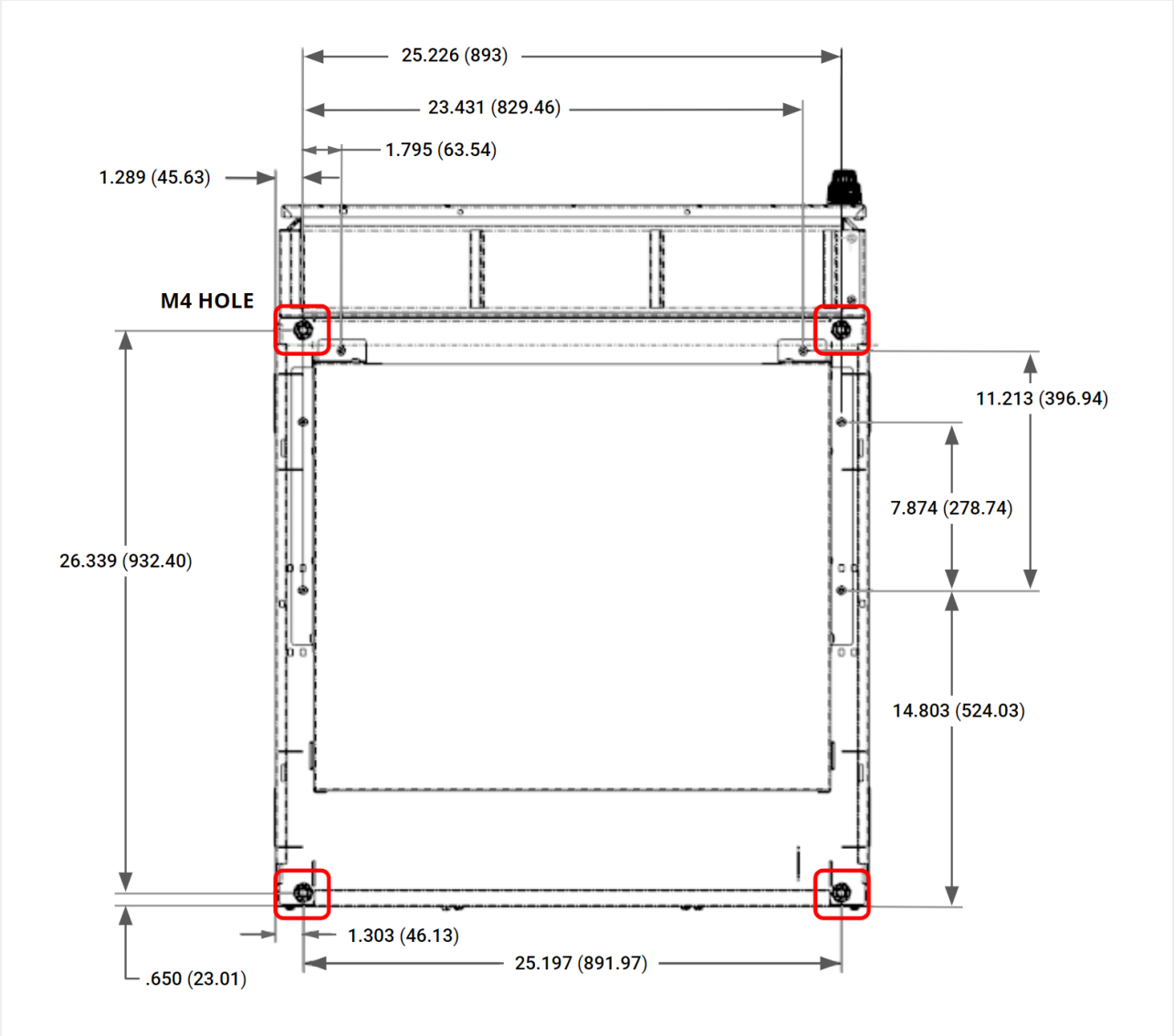

Figure 9. Top rack view

7.6 Side Panel

All rack configurations must include a side panel which is secured at all times to prevent air recirculation. The side panel design must also meet security requirements.

8. Environmental Requirements

Non-Operational Conditions (Packaged)

- Temperature range: -40° to 70° C (-40° to 158° F)
- Humidity: 5 to 93% RH, non-condensing (typical)
- Altitude: 1200 m (3937 ft.) (typical)

Operational Conditions (Unpackaged)

- Temperature range: 10° to 45° C (50 to 113° F) (typical)
- Humidity: 10 to 90% RH, non-condensing (typical)
- Altitude: 1600 m (5249 ft.) (typical)
- Required air flow: 125 CFM per 1.0 kW of power deployed

Packaging

- Rack Weight 268 kg (598.8 lbs)
- Rack Weight (Maximum, FullyLoaded) 1000 kg (2200 lbs)
- Must support shipping of fully loaded rack

9. Color and Marking

9.1 Text and Font

Any text on the frame must use a minimum font size of four millimeters.

9.2 U Markings

All “U” markings should be marked in a permanent and legible manner using a high contrast color.

10. Electrical Grounding

The rack must provide a dedicated and discrete grounding path for all mounted panels. The ground point should be plated and protected from rust or corrosion. The rack must also provide a ground path for the IT equipment to the rack frame. The rack is capable of being ground bonded with up to a 6 AWG/ 16 mm^2 cable. The studs defined in 10.1 and 10.2 are installed with the rack and available for ground bonding.

10.1 Frame Grounding (Rear-Top)

Four M5 x 13 (spaced 5/8 in. (15.9 mm) apart) T30 self tapping screws are installed with the rack and are located on the back at the top right and left sides (see Figure 10). The grounding cable lug must be compatible with the screw provided.

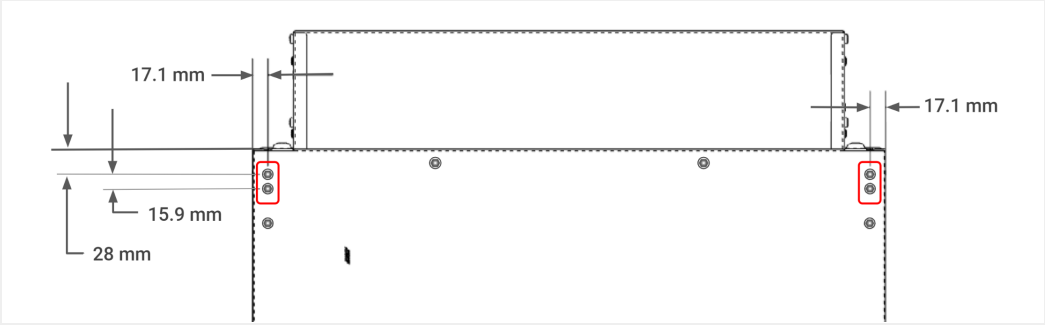

Figure 10. Rack from back top view - self tapping screws on left and right side

10.2 Frame Grounding (Rear-Bottom)

Four M5 x 13 (spaced 5/8 in. (15.9 mm) apart) T30 self tapping screws are installed with the rack and are located on the back at the bottom right and left sides (see Figure 11). The grounding cable lug must be compatible with the screw provided.

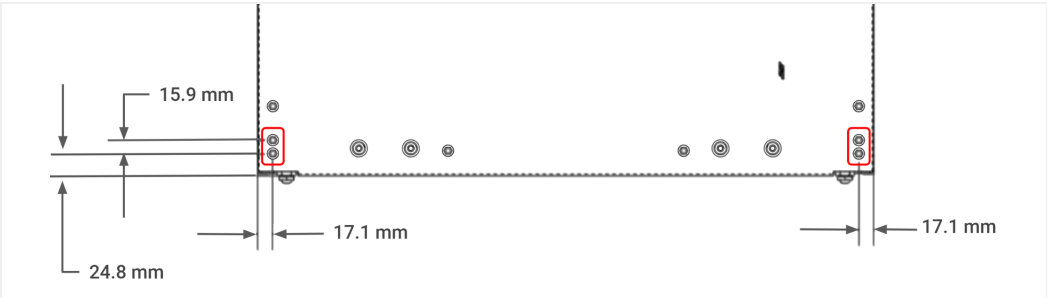

Figure 11. Rack from back bottom view - self tapping screws on left and right side

11. Testing

The rack must be tested to determine if it meets the requirements specified in this document. A rack test plan should include all requirements specified in this document and any testing needed for additional design features.

The test configuration should be developed in collaboration to ensure that the worst case is tested. The test data should be reviewed and design changes should be documented.

All seismic testing must follow AC156 seismic testing guidelines according to the seismic parameters specified in section 7.1 Dynamic Loading. A test configuration load will be defined for this test.

11.1 Dynamic Threshold Test

The fully loaded rack should be able to safely roll down from the pallet. Handles should be included in the packaging to allow for the rack to roll down in a safe manner.

The rack must be able to withstand a 0.75 in. (19 mm) drop at 2.8 ft/s (0.8 m/s) without damage to the wheels or the rack frame.

The required force to push the rack from a stationary position along a smooth cement floor must be less than five percent of the combined rack weight and IT gear.

The rack's center of gravity (CG) must be within less than 45% of the total rack height.

11.2 Caster Evaluation

Caster evaluation should follow 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 until deformation is visible.	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 should 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.

12. Compliance

Should be designed and tested to meet the following standards:

Specification	**Requirement**
EMC	FCC Part 15 Class A CISPR 32 / EN 55032 Class A EN 61000-3-2 EN 61000-3-3 CISPR 35 / EN 55035
Safety	EN 62368-1 IEC 60950-1/62368-1 CB Certification UL62368-1:2019, EN/IEC 62368-1:2020+ A11/2020 All plastic materials will be rated UL94V-0
Environmental	CE RoHS Directive (2015/863/EU) REACH Regulation (EC) No 1907/2006