OPEN

Compute Project

Open Rack Standard V1.0

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Contents

1 Introduction

1.1 Purpose

By adhering to the following principles, the Open Rack fulfills the Open Compute Project goal of maximizing operational efficiency of large-scale deployments:

- Installation and service operations are located in the cold aisle
- Data cables are located on the front of the rack
- Component faults are identifiable from the front of the rack
- Routine service procedures do not require tools
- Non-recyclable components are minimized
- Designs are vanity-free
- Racks are integrated directly into data center air containment solutions

This standard defines the required interfaces between the Open Rack and the equipment it supports. **NOTE**: The standard does not include all of the information necessary to completely define an entire rack.

1.2 Reference Documents

A 3D CAD file of the standard cross-section is provided on GitHub (www.github.com) as a reference to help with the design of the rack: LINK TBD

There is also a Chassis design guide on GIT HUB

1.3 Compliance

In order for any product to state compliance with this standard, the product must meet all of the requirements stated with the term SHALL. Any statements using the term SHOULD are recommendations for the design, but are NOT required features to show compliance.

2 Overview of Facebook's Open Rack Implementation

The Open Rack is divided into three zones as shown in Figure 1:

- A Cable zone facing the cold-aisle side of the data center
- An Equipment Bay in the middle for all of the equipment
- A Power and Cooling zone on the hot-aisle side of the data center

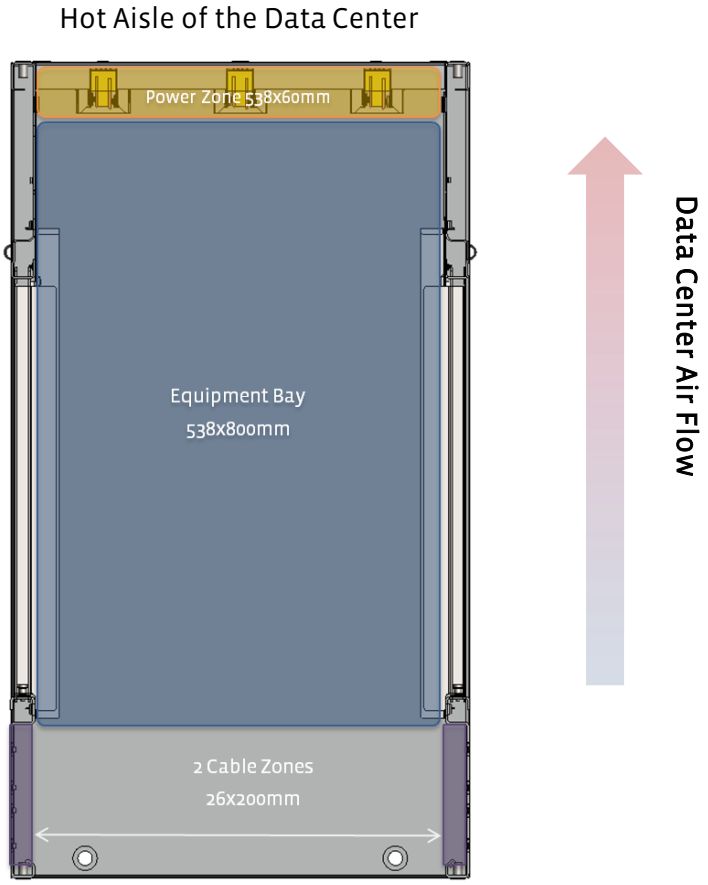

Figure 1: Top View of the Open Rack

The Cable zone, located at the front of the rack, manages and protects the data cables connected to the IT equipment. Technicians can add and remove equipment from the rack without standing in the hot-aisle to perform routine service.

The Equipment Bay is approximately 538mm wide by 800 mm deep. This is the area in which equipment sits (e.g., servers, storage, switches and rack level power shelves). During installation, the equipment slides past the cable zone and rests on a series of horizontal support shelves within the rack. Once on the support shelves, a DC connector in the equipment blind-mates into the 12V bus bars in the Power/Cooling zone.

The Power/Cooling zone in the rack consists of one or more pairs of 12V bus bars that transmit power from a rack level power shelf to the equipment. The vertical bus bars connect the equipment with the rack-level power sub-system located either above or below the Equipment Bay. The system is designed so that equipment in the Equipment Bay can attach to the bus bar continuously along its entire length to accommodate chassis of different sizes over multiple generations. Optionally, this zone could also include rack-level cooling fans, a rack level management system, data fabrics, and PDUs.

Integrated together, these components combine to create a self-contained eco-system optimized for hyper-scale computing.

Figure 2: Open Rack Assembly Example

The rack retention features incorporated into the vertical posts repeat every 48mm. This 48mm increment is defined as OpenU.

3 Mechanical Requirements

3.1 Rack Columns

The vertical columns in the rack help retain equipment and also limit its horizontal movement. This enables the chassis to align the bus bar clip to the bus bars.

As the equipment is installed into the rack, it will stop against a series of lances in on the hot-aisle side of the rack frame. The lances keep the equipment from falling out the back of the rack when moving the rack or servicing equipment. The lances also provide several millimeters of air gap between the back of the equipment and the bus bars. This air gap prevents shock loads from damaging the bus bars.

Once the equipment is installed, the rack frame equipment has a series of rectangles along the front vertical frame that can be used to prevent the equipment from moving forward. Equipment designers can use these rectangles when designing retention schemes that help technicians quickly remove equipment. For example, equipment that does not weigh much could use simple metal spring latches to grab into the rectangle. Heavier equipment might use a thick cam lever with a positive latch for retention.

In order to comply with this standard, the vertical columns of the rack SHALL contain the features defined below and displayed in Figure 3 and Figure 4 and Figure 5:

- A series of 14x18mm rectangles on the front column for the equipment in the Equipment Bay. The rectangles must appear at least 15mm deep into the frame.
- A series of lances in the rear column to act as hard stops for the equipment in the Equipment Bay.
- Rectangles and lances SHALL repeat every 48mm along the length of the vertical columns. They may repeat every 24mm (support for 1/2OpenU) if desired.

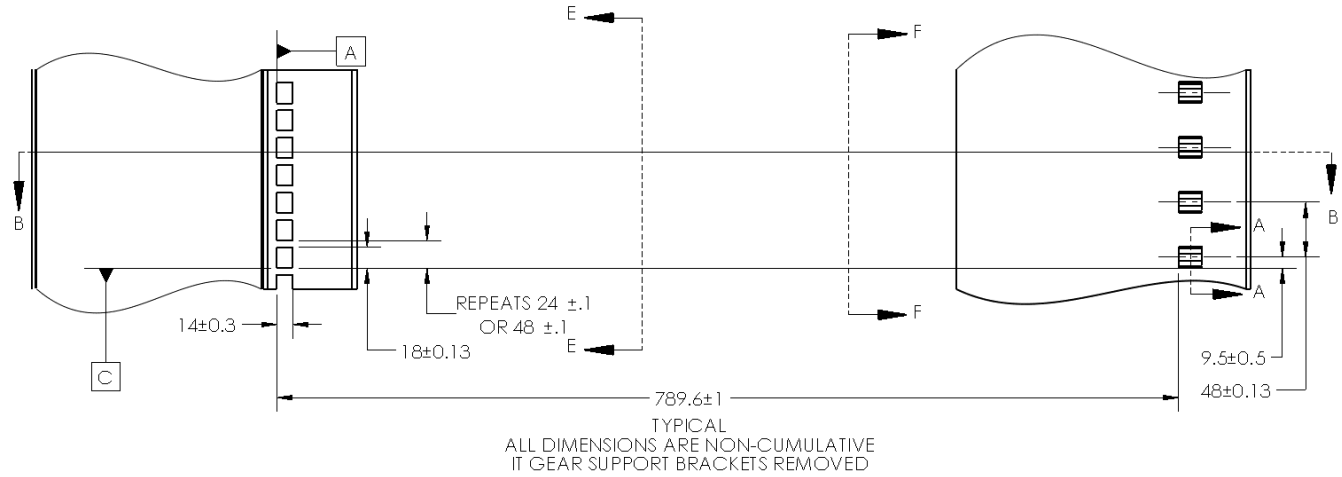

Figure 3: Open Rack Front Detail

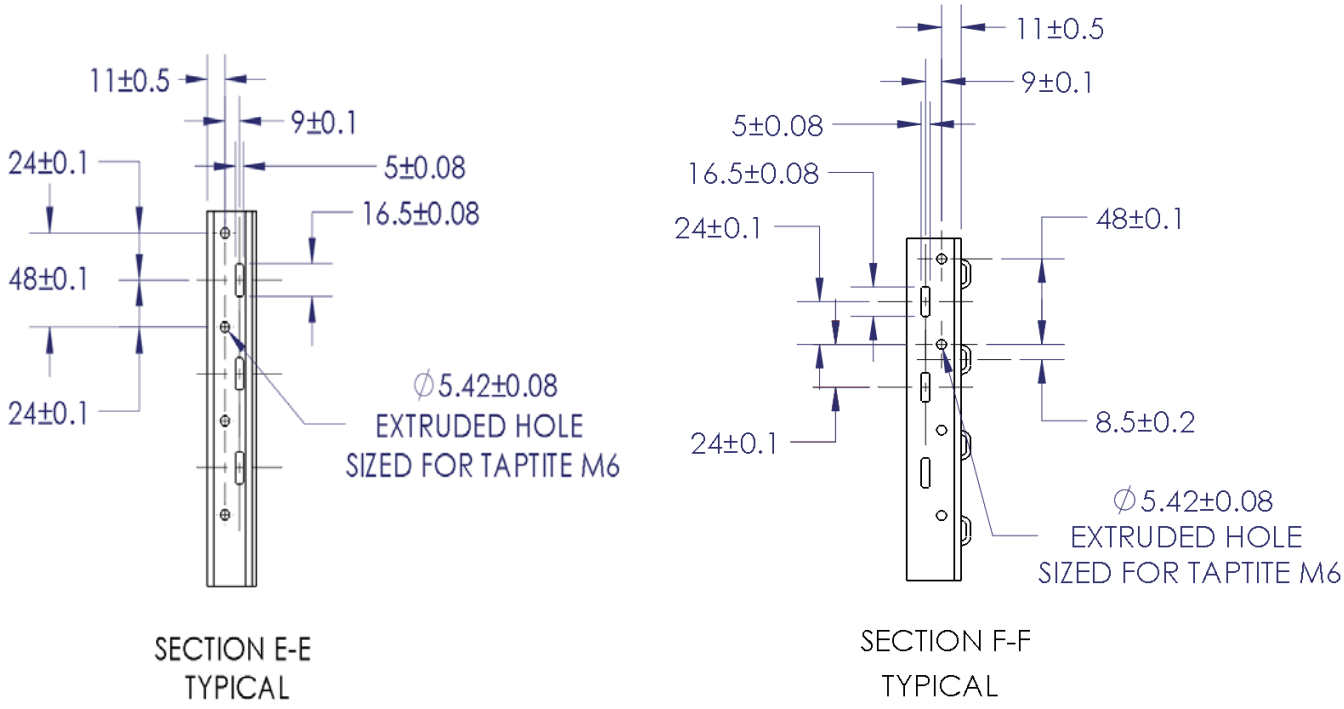

Figure 4. Front and rear Vertical Post Detail

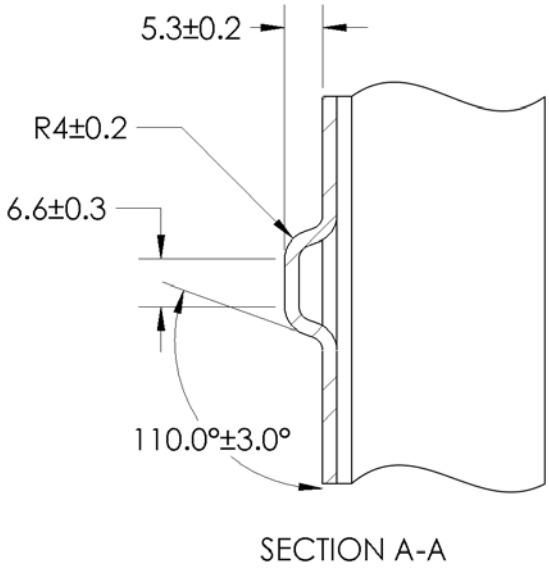

Figure 5: Open Rack Rear Stop Detail

The rack SHALL also provide the following features (Figure 6):

- Vertical columns 538-540mm apart
- Support for three-bus bar cage assemblies

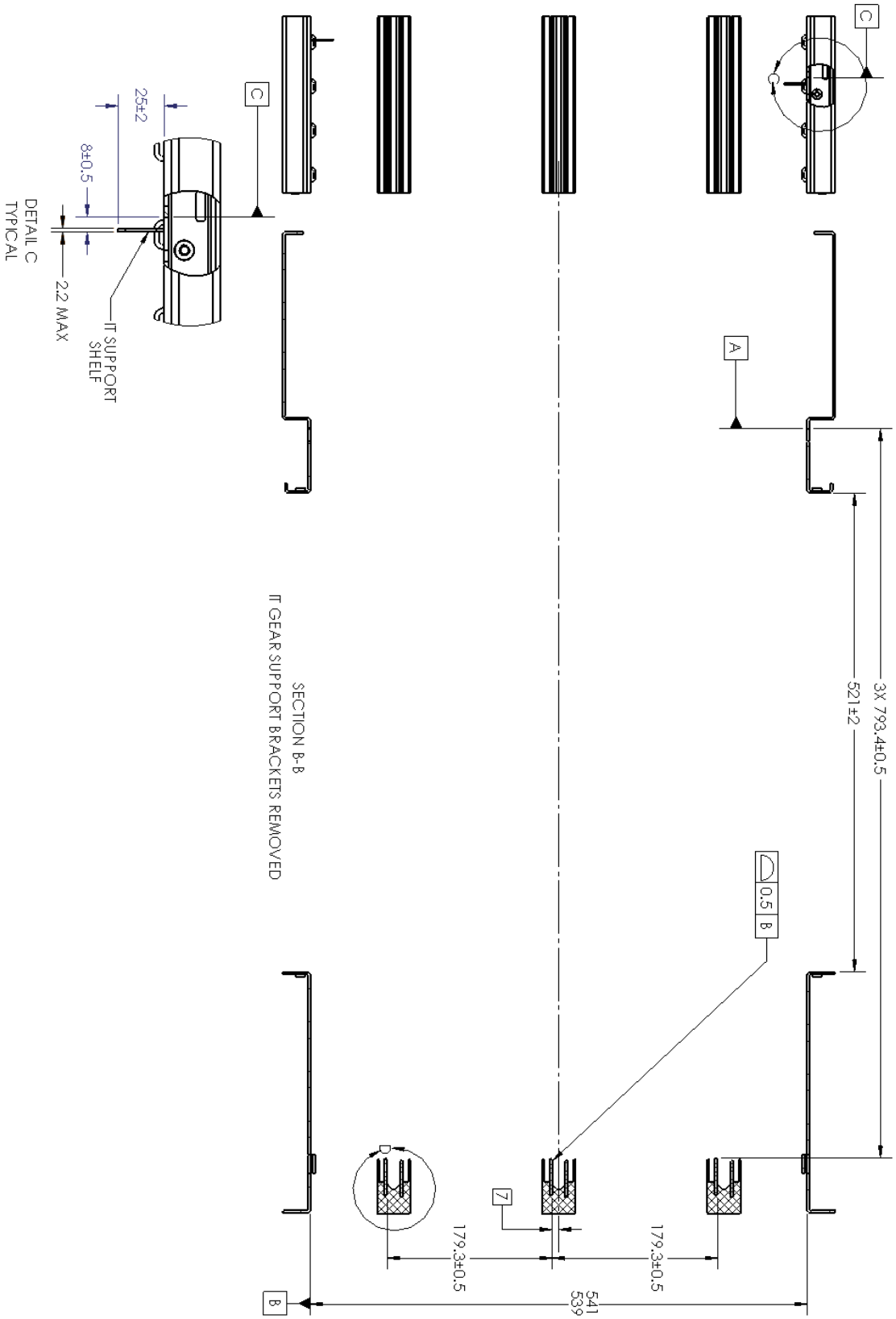

Figure 6: Open Rack Cross-Section

3.2 IT Support Shelves

The IT equipment sits on a series of horizontal support shelves. These shelves could be constructed as individual brackets that are assembled into the rack, or incorporated into the rack structure itself by creating them out of the sides of the rack. The quantity (which may be zero) and vertical locations of the shelves are left to the customer to specify.

The IT Support Shelves SHALL:

- Support equipment as small as 1 OpenU tall (48mm)
- Conform to the shape shown in Detail B (Figure 6)
- Provide a continuous ground path from the equipment to the Open Rack frame
- Have a finish that does not encourage the growth of metal whiskers
- Be recessed between the vertical posts so that the 538mm equipment bay width is not reduced
- Support an evenly distributed load of at least 7kN load per pair without taking a permanent set.

The pair of IT Support brackets SHOULD:

- Have a hot-dip zinc coating conforming to ASTM A653 or JIS 3302 SGOC

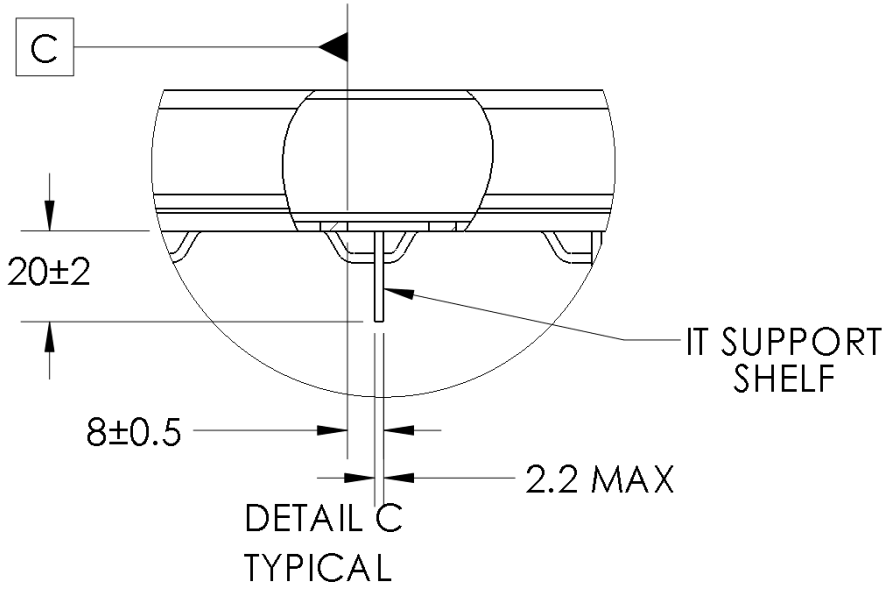

Figure 4: IT Support Bracket Detail

3.3 Bus bar

The bus bars are located in the back of the rack and transmit the 12V power from the rack-level power sub-system to the equipment in the rack. The bars allow the equipment to plug directly into the power so the technician does not need to go to the back of the rack to disconnect power cords prior to servicing equipment.

The bus bar cover protects the user from the positive 12V bus bar when the rack is powered-up. Access to the front of the bus bar should be limited by the design of the equipment and/or a blank to fill any empty equipment location in the rack.

The Bus bars SHALL:

- Be populated with either one or three bus bars per power zone

- Be located in the center position in the rack if only a single bus bar pair is populated
- Be located in the rack per Figure 6 and comply with Detail D in Figure 7
- Be plated with nickel at minimum of 10 microns thick. The nickel plating may be over-plated with silver or gold

The Bus bars SHOULD be designed so that they can be removed and re-installed by a trained service technician in the field.

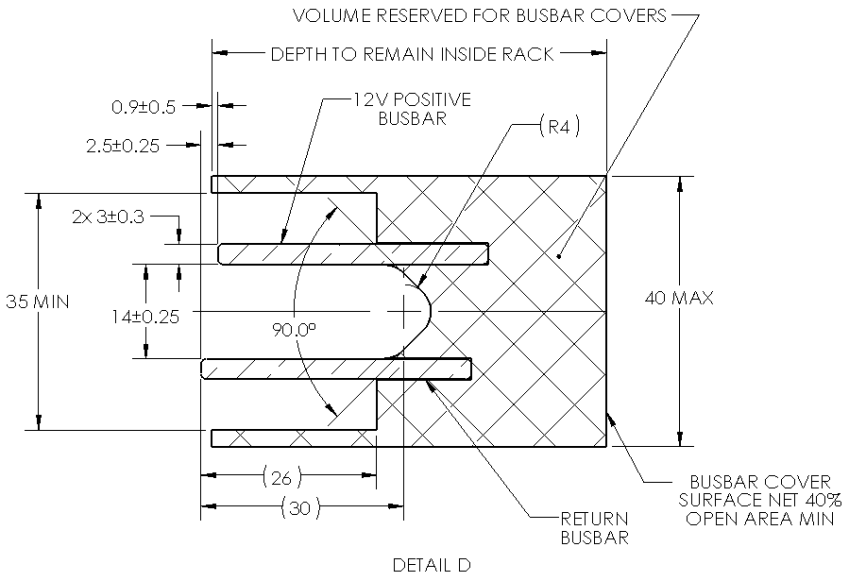

Figure 5: Bus bar Detail

A volume around each bus bar is reserved for an optional bus bar cover to protect the user. While protecting the user is not optional, the methodology is. For example, a single hinged panel could cover the entire back of the rack rather than using individual covers around each bus bar set.

The bus bars SHALL:

- Have user access limited by a method that conforms to UL60950
- Be made of copper with an IACS near 100%

If individual bus bar covers are used, the bus bar covers SHALL:

- Stay within the zone defined in Figure 7
- Have a perforated surface behind the bus bars that has a minimum of 40% opening after any support, insulators, or labels are included (Figure 7)
- Have perforations and limited access to service panels that conform to UL 60950

3.4 OpenU Marking

Each OpenU on the rack should be numbered so technicians can easily identify the exact location of the equipment.

Each OpenU on the rack SHALL be sequentially numbered in a permanent and legible manner starting with the number one (1) in the bottom of the rack.

Each OpenU number SHOULD be located so that cable bundles and equipment will not hinder its visibility.

3.5 Marking for Re-Use

The lifecycle of the rack is normally significantly longer than the equipment inside it. Ideally the rack would be used for multiple generations of equipment. The max load rating of the rack frame and the IT Shelves, however, is not controlled by this standard. Thus, when it is time to re-purpose the rack for future equipment, it is necessary to know the limits of the rack.

The load rating SHOULD be located so it is visible from the cold-aisle of the rack.

The rack SHALL be marked:

- In a permanent and legible manner with the maximum load (in kilograms) that the IT Support shelves and the rack frame are capable of supporting (whichever is less) under Telcordia GR63 Zone2
- With the latest revision number of the standard for which the rack is compliant in either of the following formats:
    - OPEN RACK SPECIFICATION REVXX.X
    - ORS REVXX.X

  Where "XXX" is the alphanumeric version of the specification such as: V1.0 or V2.2
- In a location that is visible to the user without removing equipment
- In a location that will not be damaged by equipment sliding in and out of the rack during routine service

4 Electrical Requirements

4.1 Bus bar Power Connection

The bus bar connector provides the electrical path from the 12V and ground bus bars in the back of Open Rack to the IT equipment in the Equipment Bay.

If the busbar connection is designed to be inserted while the busbar has a voltage, the design SHALL ensure that the ground busbar makes electrical connection prior to the 12V busbar.

For any IT Gear connected to the busbar, the In-rush current SHALL be less than 100% of the max IT Gear load.

4.2 Bus bar

The bus bar SHALL:

- Have a voltage of 12.2+/- 0.4V of average DC (0 Hz bandwidth) at any point along the entire length of the bus
- Voltage Ripple less than 120mV peak-to-peak, with 20MHz bandwidth per a (TBD) pre-defined chassis load

The bus bar SHOULD:

- Be plated with either nickel or silver to protect the surface of the bus bar during repeated cycling of the bus bar power connector

The rack-level power system SHOULD provide 12.5 +/-0.1V at the connection to the bus bar.

The current density of the bus bar SHOULD be less than 6amp/mm^2.

5 Revision History

Revision	Release Date	Change Description
Steve Mills	0.1	Initial release
Steve Mills	0.9	Release for OCP review
Jay Hauser	0.9.1	General edit
Steve Mills	0.92	Finalize EE portion and Add updates from OCP Summit
Steve Mills	1.0	Update per Aug OCP Summit; add Figure 4; 4.2 add predefined load (TBD)