

Identification Solutions for Data Center Infrastructure

Properly identified Data Center infrastructure is easier to install, maintain, and repair.



Introduction

This guide provides insight and direction for the proper identification of data center infrastructure.

The identification requirements of specific data center applications are addressed through the implementation of industry recognized best practices with recommended Panduit solutions.



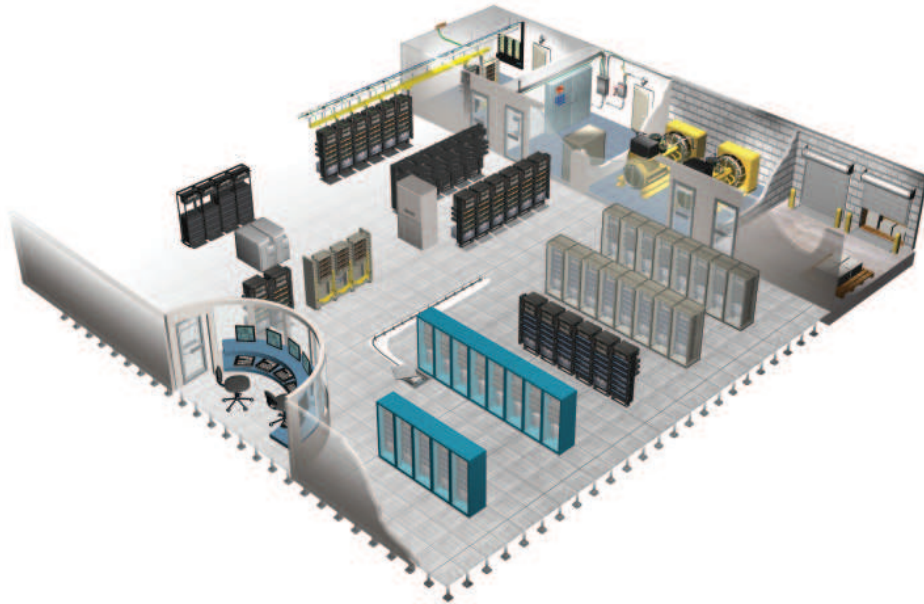
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Section 1 – Infrastructure Identification

Located throughout the data center are physical infrastructure components that support IT equipment providing essential services to critical business applications.

Any disruption of the physical infrastructure could cause interruption of business applications, resulting in lost revenue. Many of today's physical infrastructure disruptions are caused by moves, adds, or changes within the environment. The advantage of a properly identified infrastructure is that system components can be quickly and accurately identified so that the infrastructure and business services are immediately restored.



There are several industry standards that define the identification of the data center physical infrastructure:

TIA-942 – *Telecommunications Infrastructure Standard for Data Centers*

This standard covers the detailed design and installation requirements of data center infrastructure. Labeling and administration are not a part of the standard. The user of the standard is referred to TIA-606-B for guidance on this subject.

TIA-606-B –

Administration of Telecommunications Infrastructure

This standard specifies the administration for a generic cabling system to be deployed in data center computer rooms and equipment rooms by providing a scalable infrastructure identification scheme based on the grid coordinates of the computer room.

NFPA 70E-2012 –

Standard for Electrical Safety in the Workplace

This standard provides a guideline for establishing and maintaining a safe working area for employees relative to the hazards arising from the use of electricity.

The following sections of this application guide combine information from the above standards with industry best practices to provide specific guidance on the proper identification and labeling of critical data center infrastructure components.

Section 2 – Applications

2.1 – Data Center Computer and Equipment Rooms

Telecommunication Space Labeling

A telecommunication space (TS) identifier, unique within the building, shall be assigned to the space. The identifier consists of the floor and room or area designation on that floor. In this example, the telecommunication space is designated as Room A on the second floor of the building. Another example could be 1DC to represent the data center on floor 1.



Grid Labeling

Component locations are determined using an X-Y coordinate system based on the floor tile system in the data center space. Using alphabetic designations on one axis of the room and numerical designations on the other axis of the room create a series of alphanumeric designations that can be established for each floor tile in a data center space. These floor tile designations are the basis for determining the location of data center devices.

The standard also addresses situations where floor tiles are not in use. For these situations, rows and cabinet position in the row can be assigned in the data center. For example, row B cabinet 3.

In telecommunication rooms, floor-mounted racks and wall-mounted termination blocks can be assigned a sequential number instead of using a grid coordinate.

	AA	AB	AC	AD	AE	AF	AG	AH
01								
02								
03								
04								
05								
06								
07								
08								
09								

Cabinet/Rack Labeling

The floor tile designations are used to identify each cabinet or rack in the data center. The cabinet/rack location is based on which floor tile the right front corner of the cabinet/rack rests upon. Cabinets and racks should have location labels applied to the top and bottom of both the front and rear of the device. These labels should be visible whether or not doors are closed or opened on the cabinets.

A typical cabinet/rack label would have the following scheme:

AY15

This identifier would define that the cabinet/rack is located with its right front corner at the intersection of row AY and column 15.



Panel Labeling

Once the cabinet/rack identifiers are established, then the various panels in the cabinet/rack should be identified. The designation for the panel positions in a cabinet/rack can be either an alphabetic designation or a two-digit number that represents the rack unit number (RU) where the top-left mounting screw lands in the cabinet/rack. Using the RU method provides the data center manager with greater flexibility since it allows panels and equipment to be added or removed without disrupting the designation of panel identifiers.

A typical panel label would have the following scheme:

AR15-20

This identifier would define that the top mounting screw of the panel is located at rack position 20 in the cabinet/rack located in grid AR15 in the data center.



Port Labeling

Now that cabinets/racks and panels in each rack are identified, the next task is to establish identifiers for each port on a panel. Port identifiers are very important because they define the connectivity of cabling within the data center infrastructure. Many patch panels come from the factory with numbers already screen-printed above the ports. If this is the case, there is no need to re-label those patch panels. If the patch panels are not pre-printed with port numbers, labels will need to be created to identify the port numbers. The numbering sequence should proceed from left to right and top to bottom for all ports on a patch panel. The number of digits used for all numbers on a patch panel should be consistent with the total number of ports on that patch panel. For example, a 48-port patch panel should be labeled 01 through 48 and a 144-port patch panel should be labeled 001 through 144.

A typical port label would have the following scheme:

AB04-24:01

This identifier can be decoded to define that this is port 01 located on panel 24 in cabinet/rack AB04.

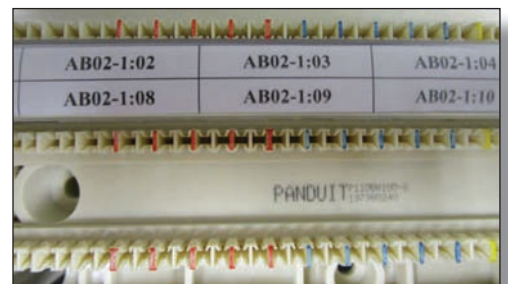
The cabinet/rack and panel identifiers are not usually necessary on the port label because the cabinet/rack and panel identification is obvious to the viewer who is standing at the location of the port. Therefore, a typical port label would have only the following scheme:

01

This identifier defines that this is port 01.

For the identification of fiber adapter panels, each adapter panel can be assigned a "letter" and the ports on each adapter sequentially numbered. For example, in the picture to the right, the label describes that ports 01 through 06 on adapter panel A in the fiber enclosure located at the 30 RU position in cabinet AC12 connect to ports 01 through 06 on the panel located at the 20 RU position in cabinet AC04.

For identification of pair groups on a punchdown block, the designation strip can be printed with identifiers for each group.



Structured Cabling Labels

Structured cabling labels are identified with information that defines the correlation between the near-end panel connection and the far-end panel connection. The near-end connection is the connection that is closest to the Main Distribution Area (MDA) in the network topology. A near-end connection identifier would consist of the cabinet/rack location, panel location, and port location. The far-end connection identifier would consist of the cabinet/rack location, panel location, and port location. A typical structured cabling label would have information in the following scheme:

AB04-24:01/AB07-36:13

This identifier would be decoded to define the cable connection between cabinet AB04 panel 24-port 01 going to cabinet AB07 panel 36-port 13. The far end of the cable would have a label that would have the same to/from information (**AB04-24:01/AB07-36:13**).



Patch Cord/Equipment Cord Labels

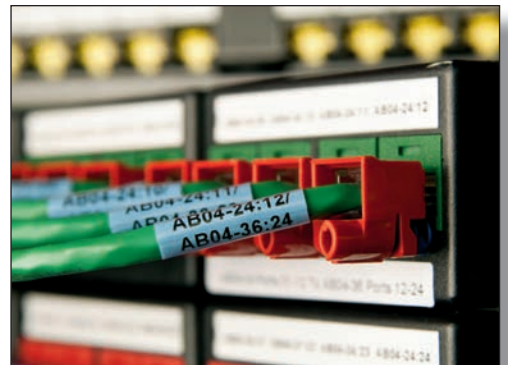
The administration and labeling of patch cords and equipment cords are optional in the standard but can be beneficial by improving the efficiency and lowering the cost of moves, adds, and changes to the system.

Patch cord/equipment cord labels are identified with information that defines the correlation between the near-end patch panel front connections and the far-end patch panel front connections or equipment connections. A near-end connection identifier would consist of the cabinet/rack location, panel location, and port location. The far-end connection identifier would consist of the cabinet/rack location, panel location, and port location. The rack unit location could be substituted for the equipment name, if necessary.

A typical patch cord label would have information in the following scheme:

AB04-24:01\AB04-36:13

This identifier would be decoded to define the patch cord connection between cabinet AB04 panel 24-port 01 going to the same cabinet panel 36-port 13. The far end of the cable would have a label that would have the same information in reverse order. (Notice the use of a backward slash as a separator in this identifier differs from the separator used in the identifier for structured cables.)



Continued on page 9

Patch Cord/Equipment Cord Labels (continued)

A typical equipment cord label would contain information in the following scheme:

AB04-24:01\AB04-Tinley2:A

This identifier would be decoded to define the equipment cord connection between cabinet AB04 panel 24-port 01 going to the same cabinet port A on equipment named Tinley2. The rack unit location is substituted here with the equipment name.

Patch Panel Connectivity

Patch panel connectivity is considered the most important area of infrastructure labeling because it defines the critical connections between ports on patch panels and equipment. This information defines the connections between the near-end ports and the far-end ports. This labeling can define the connection of a range of ports on a panel or only define the connection for two individual ports.

A typical patch panel connectivity label would have the following scheme:

AB04-24:ports 01-12/

AB04-36:ports 13-24

This identifier would be decoded to define the ports 01 through 12 on panel 24 of cabinet AB04 to connect to ports 13 through 24 on panel 36 in the same cabinet.



Grounding and Bonding

Labeling of the grounding and bonding system involves the identification of the main grounding busbar, grounding busbars, rack grounding busbars, mesh bonding network, bonding conductor for telecommunications, bonding backbone conductors, grounding equalizer conductors, and bonding conductors.

The typical scheme for the main grounding busbar would be:

1A-TMGB

This identifier can be decoded to define that this is the main telecommunications grounding busbar (TMGB) located on floor 1 in space A.

The typical scheme for a grounding busbar would be:

1A-TGB

This identifier can be decoded to define that this is the telecommunications grounding busbar (TGB) on floor 1 in space A.

The typical scheme for a rack grounding busbar would be:

3TRB.2=RGB

This identifier can be decoded to define that this is the rack grounding busbar (RGB) attached to rack #2 in the telecommunications room B on floor 3.

The typical scheme for a computer room mesh bonding network would be:

3DC1=MBN

This identifier can be decoded to define that this is the mesh bonding network (MBN) location in data center 1 on floor 3 of the building.

The typical scheme for the bonding conductors in the grounding and bonding system would include the device and the object to which it is connected.

For example:

1B301-TMGB/2R201-TGB

This bonding conductor identifier can be decoded to define that this is the conductor that connects the main telecommunications grounding busbar located on floor 1 in space B301 to the telecommunications grounding busbar on floor 2 in space R201.



2.2 Power Systems

The infrastructure to be identified in the data center power system would include the power equipment, power cabling, pathways, and computing equipment power cables.

Labels that identify power equipment should include information that indicates:

- The device name
- The device physical location

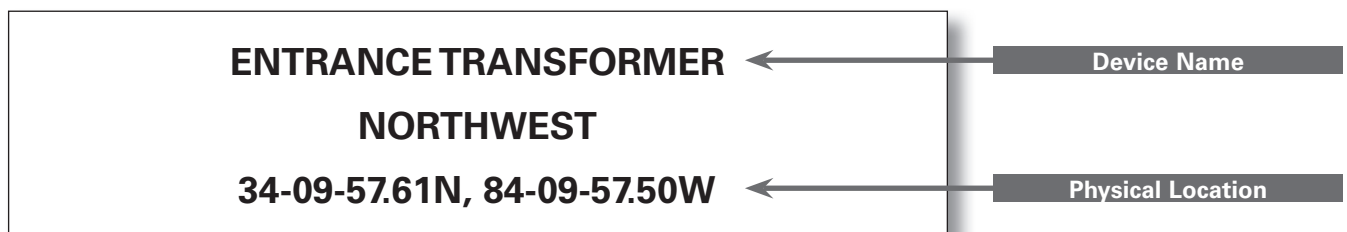
Labels that identify power cables and pathways should include:

- Information indicating the near-end and far-end connections
- Magnitude of the power such as voltage, amperage, and phase

Transformer Equipment Labeling

A label or placard with the transformer name and location should be attached to the device.

A typical transformer label would have the following scheme:

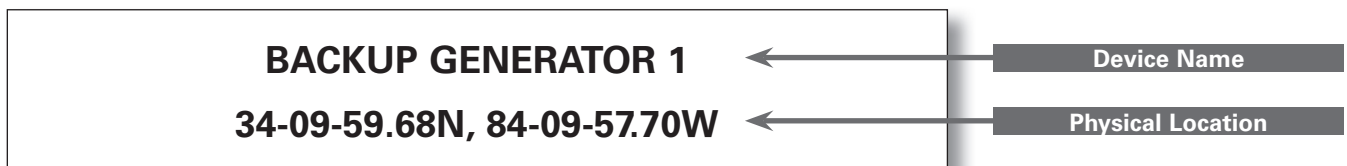


This identifier would define that the transformer is located at the Global Position Satellite (GPS) coordinates 34-09-57.61N, 84-09-57.50W and that it is the northwest entrance transformer.

Generator Equipment Labeling

A label or placard with the equipment name and location should be attached to the device.

A typical generator label would have the following scheme:

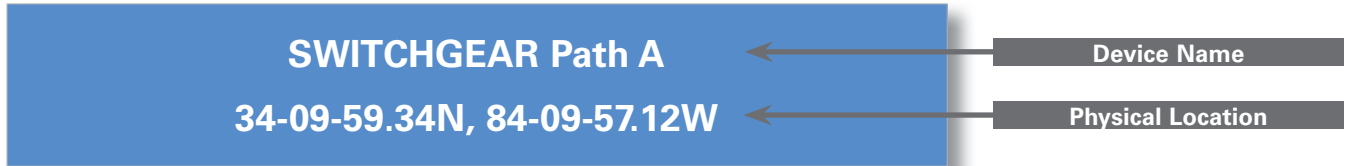


This identifier would define that the generator is located at the GPS coordinates 34-09-59.68N, 84-09-57.70W and that it is the backup generator #1.

Switchgear Equipment Labeling

A label or placard with the equipment name, location, and power path should be attached to the device.

A typical switchgear label would have the following scheme:



This identifier would define that the switchgear is located at the GPS coordinates 34-09-59.34N, 84-09-57.12W and that it is the switchgear for power path A. Color can be used to indicate the power path.

Uninterruptible Power Supply (UPS) Equipment Labeling

A label or placard with the equipment name, location, and power path should be attached to the device.

A typical UPS label would have the following scheme:



This identifier would define that the UPS is located at the GPS coordinates 34-09-58.94N, 84-09-56.70W and that it is the UPS for power path B. Color can be used to indicate the power path.

Power Distribution Unit (PDU) Equipment Labeling

A label or placard with the equipment name, location, and power path should be attached to the device.

A typical PDU label would have the following scheme:



This identifier would define that the PDU is located with its right front corner at the intersection of row AD and column 03 in the data center room and that it is the PDU #1 for power path A. Color can be used to indicate the power path.

Remote Power Panel (RPP) Labeling

A label with the equipment name, location, and power path should be attached to the device.

A typical RPP label would have the following scheme:



This identifier would define that the device RPP # 2 is located at the intersection of row AE and column 03 in the data center room and that it is the RPP for power path B. Color can be used to indicate the power path.

Rack Power Outlet Unit (POU) Equipment Labeling

A label with the equipment name, location, and power path should be attached to the device.

A typical POU label would have the following scheme:



This identifier would define that the device POU # 2 is located in cabinet AE03 in the data center room and that it is the POU for power path B. Color can be used to indicate the power path.

Computing Equipment Labeling

A label with the equipment name and grid location should be attached to the device.

A typical computing equipment label would have the following scheme:



This identifier would define that the device is server blueberry 1 located at rack unit 12 in cabinet AE03 in the data center room.

Transformer to Switchgear Power Path

Labels should be attached on each piece of equipment near the location where the power source enters the equipment. The label should have information that indicates the source or destination equipment name, location, and magnitude of the power.

The transformer label would have the following scheme:

Feed To
SWITCHGEAR A
(34-09-59.34N, 84-09-57.12W)
480 VAC 200A 3PH

This identifier would define that the device is feeding to switchgear A located at the GPS coordinates (34-09-59.34N, 84-09-57.12W) and that the magnitude of the power is 480 VAC, 200 Amps, and 3 phase.

The switchgear label would have the following scheme:

Feed From
NE Entrance Transformer
(34-09-57.61N, 84-09-57.50W)
480 VAC 200A 3PH

This identifier would define that the device is fed from the entrance transformer located in the northeast area of the site at the GPS coordinates (34-09-57.61N, 84-09-57.50W) and that the magnitude of the power is 480 VAC, 200 Amps, and 3 phase.

Generator to Switchgear Power Path

Labels should be attached on each piece of equipment near the location where the power source enters the equipment. The label should have information that indicates the source or destination equipment name, location, and magnitude of the power.

The generator label would have the following scheme:

Feed To
SWITCHGEAR A
(34-09-59.34N, 84-09-57.12W)
480 VAC 200A 3PH

This identifier would define that the device is feeding to switchgear A located at the GPS coordinates (34-09-59.34N, 84-09-57.12W) and that the magnitude of the power is 480 VAC, 200 Amps, and 3 phase.

The switchgear label would have the following scheme:

Feed From
Backup Generator #1
(34-09-59.68N, 84-09-57.70W)
480 VAC 200A 3PH

This identifier would define that the device is fed from backup generator #1 located at the GPS coordinates 34-09-59.68N, 84-09-57.70W and that the magnitude of the power is 480 VAC, 200 Amps, and 3 phase.

Switchgear to UPS Power Path

Labels should be attached on each piece of equipment near the location where the power source enters the equipment. The label should have information that indicates the source or destination equipment name, location, and magnitude of the power.

The switchgear label would have the following scheme:

Feed To
UPS B
(34-09-58.94N, 84-09-56.70W)
480 VAC 100A 3PH

This identifier would define that the device is feeding to UPS B located at the GPS coordinates (34-09-58.94N, 84-09-56.70W) and that the magnitude of the power is 480 VAC, 100 Amps, and 3 phase.

The UPS label would have the following scheme:

Feed From
SWITCHGEAR A
(34-09-59.34N, 84-09-57.12W)
480 VAC 100A 3PH

This identifier would define that the device is fed from switchgear A, the GPS location of the device is 34-09-59.34N, 84-09-57.12W and that the magnitude of the power is 480 VAC, 100 Amps, and 3 phase.

UPS to PDU Power Path

Labels should be attached to each end of the power cable that connects the two devices. The label should have information that indicates the source and destination equipment name, locations, and magnitude of the power. Color coding of labels can be used to indicate different power paths.

On the UPS side the label would have the following scheme:

UPS B / PDU A1
(34-09-58.94N, 84-09-56.70W)/AD03
208 VAC 100A 3PH

This identifier would define that the power cable connects devices UPS B and PDU A1, the locations of both devices, and the magnitude of power carried in the cable.

On the PDU side the label would have the following scheme:

PDU A1 / UPS B
AD03/(34-09-58.94N, 84-09-56.70W)
208 VAC 100A 3PH

This identifier would define that the power cable connects devices UPS B and PDU A1, the locations of both devices, and the magnitude of power carried in the cable.

PDU to RPP Power Path

Labels should be attached to each end of the power cable that connects the two devices. The label should have information that indicates the source and destination equipment name, locations, and magnitude of the power. Color coding of labels can be used to indicate different power paths.

On the PDU side the label would have the following scheme:

PDU A1 / RPP B2
AD03 / AE03
208 VAC 100A 3PH

This identifier would define that the power cable connects devices PDU A1 and RPP B2, the locations of both devices, and the magnitude of power carried in the cable.

On the RPP side the label would have the following scheme:

RPP B2 / PDU A1
AE03 / AD03
208 VAC 100A 3PH

This identifier would define that the power cable connects devices RPP B2 and PDU A1, the locations of both devices, and the magnitude of power carried in the cable.

RPP to POU Power Path

Labels should be attached to each end of the power cable that connects the two devices. The label should have information that indicates the source and destination equipment names, locations of the devices, circuit number and magnitude of the power. Color coding of labels can be used to indicate different power paths.

On the RPP side the label would have the following scheme:

RPP B2 / POU 2B
AE03 (Circuit 12) / AE05
208 VAC 50A 3PH

This identifier would define that the power cable connects devices RPP B2 and POU 2B, the locations of both devices, and the magnitude of power carried in the cable.

On the POU side the label would have the following scheme:

POU 2B / RPP B2
AE05 / AE03 (Circuit 12)
208 VAC 50A 3PH

This identifier would define that the power cable connects devices POU 2B and RPP B2, the locations of both devices, and the magnitude of power carried in the cable.

POU to Computing Equipment Power Path

Labels should be attached to each end of the power cable that connects the two devices. The label should have information that indicates the source and destination equipment names, device locations, power outlet numbers, and magnitude of the power. Color coding of labels can be used to indicate different power paths.

On the POU side the label would have the following scheme:

POU 2B / BLUEBERRY1
AE05 Outlet 2 / AE03-12 Outlet A
110 VAC 20A 2PH

This identifier would define that the power cable connects device POU 2B and device BLUEBERRY1, the locations of both devices, and the magnitude of power carried in the cable.

On the RPP side the label would have the following scheme:

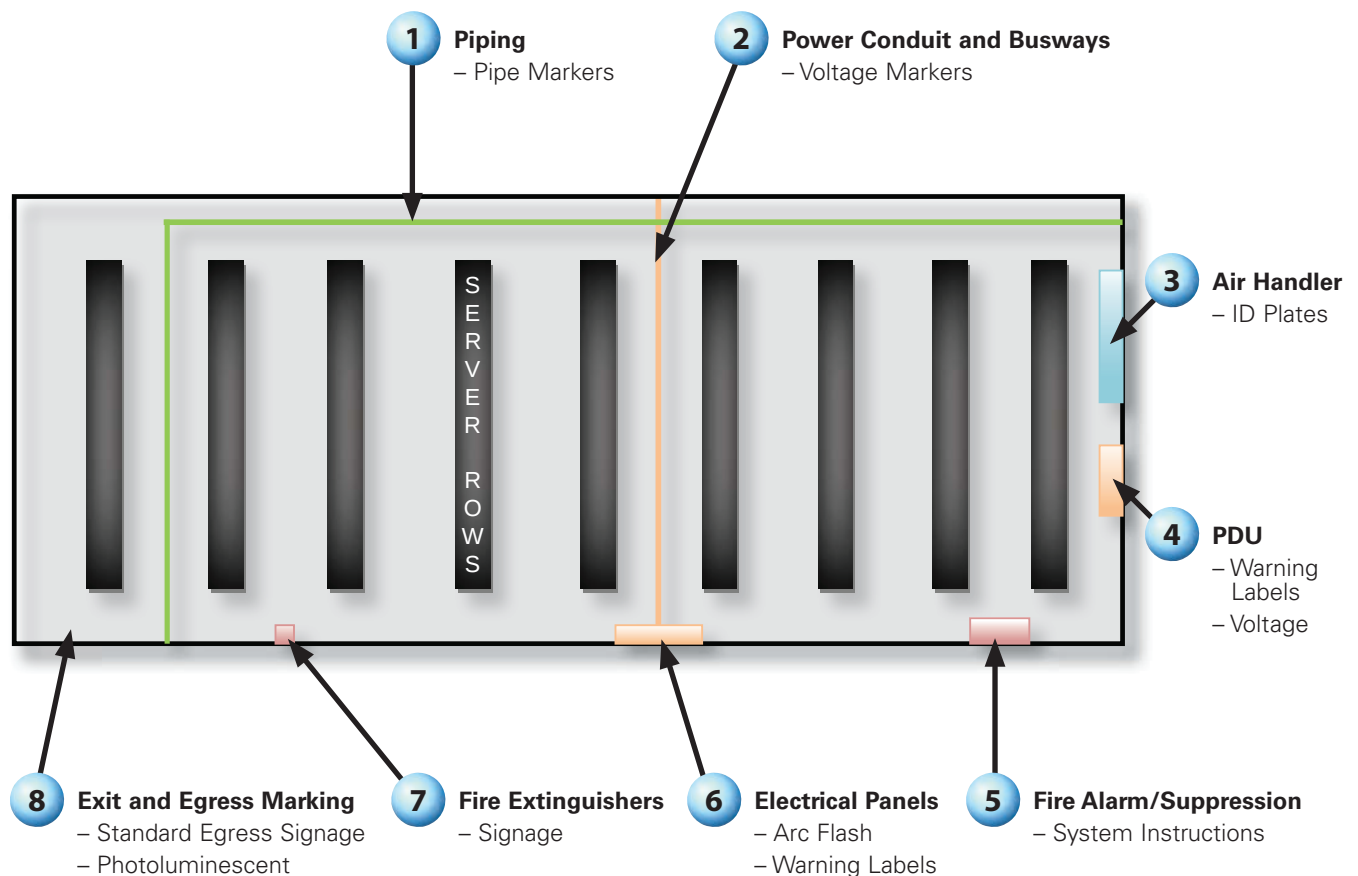
BLUEBERRY1 / POU 2B
AE03-12 Outlet A / AE05 Outlet 2
110 VAC 20A 2PH

This identifier would define that the power cable connects device BLUEBERRY1 and device POU 2B, the locations of both devices, and the magnitude of power carried in the cable.

2.3 Mechanical, Safety, and Facility Signage

Maintaining a safe workplace is essential to the proper operation of the data center. There are many systems present in the data center that can be potentially dangerous such as fire-suppressant systems, cooling systems, and power systems.

Below is a general layout of a data center specifying essential facility identification. This section discusses each type of facility identification including regulatory standards, specifications, and recommendations.



1 Piping – Pipe Marking

Pipes should be labeled to identify the contents (via text and color scheme), direction of flow, and the inherent hazard that the material poses to workers and the data center infrastructure. Water-bearing, fire-suppressant, and other liquids pose a potential risk. Clear identification/labeling of pipes alerts users or emergency personnel to a potential hazard (especially in high-traffic areas), and assists in troubleshooting/addressing a leak in the piping.

Pipe labels in the U.S. should conform to ANSI/ASME joint standard A13.1. The most recent update to this code was published in 2007, and introduced a new color scheme. In addition to specifying colors for pipe labels, the code specifies standards for label size and placement.

The current version of the ANSI/ASME code uses a **color scheme** with six standard color combinations, and four user-defined combinations. The colors are based on the contents of the pipe; in general, the most hazardous feature of the contents should determine the colors used.

Previous editions of the pipe-labeling code used a four-color scheme. The 2007 code applies only to new facilities; new labels in existing facilities should conform to the label scheme already in use to avoid confusion.

Also new to the 2007 edition is the specification of exact colors for pipe labels. Labels should use the safety colors listed in ANSI Z535.1.

PIPE CONTENTS	COLOR SCHEME
Fire-quenching fluids	WHITE text on SAFETY RED
Toxic and corrosive fluids	BLACK text on SAFETY ORANGE
Flammable fluids	BLACK text on SAFETY YELLOW
Combustible fluids	WHITE text on SAFETY BROWN
Potable, cooling, boiler feed, and other water	WHITE text on SAFETY GREEN
Compressed air	WHITE text on SAFETY BLUE
User defined	WHITE text on SAFETY PURPLE
User defined	BLACK text on SAFETY WHITE
User defined	WHITE text on SAFETY GREY
User defined	WHITE text on SAFETY BLACK

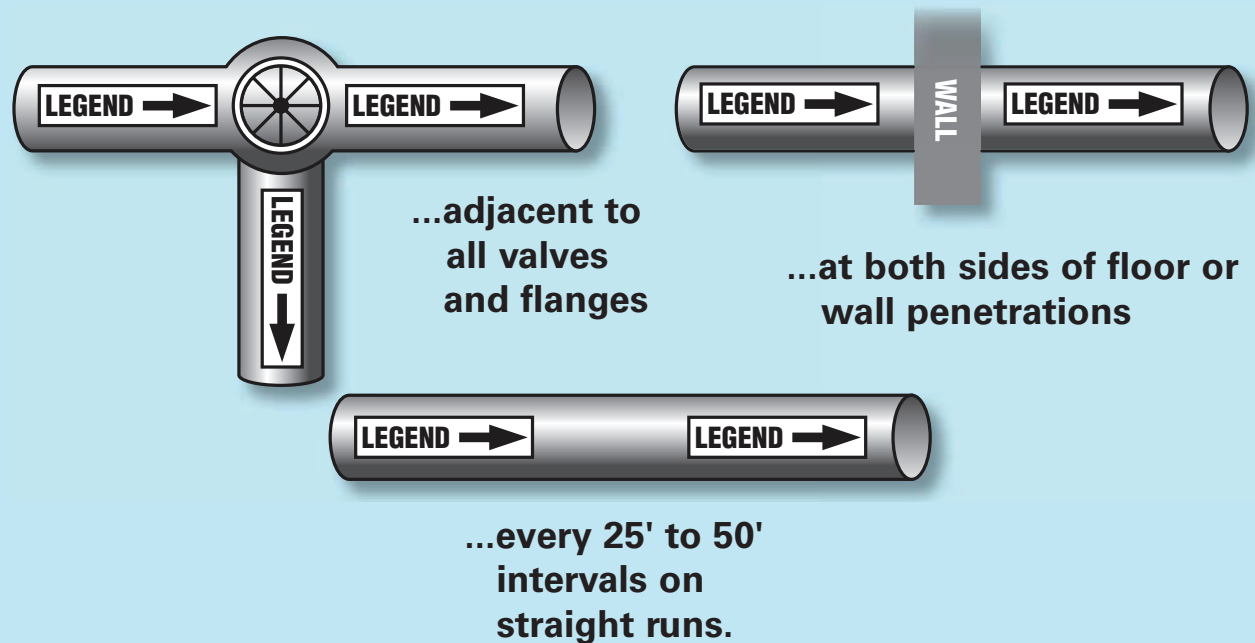
A **typical** pipe would have the following legend identifier and arrows to specify flow – see example below:



Pipe markers should be **positioned** according to the following criteria:

- Markers are easily seen from the normal angle of approach, for example, below the centerline of the pipe if the pipe is overhead, and above the centerline if the pipe is below eye level
- Labels are required at the following locations
 - Adjacent to all valves and flanges
 - Adjacent to all changes of direction
 - On both sides of wall or floor penetrations
 - At regular intervals on straight runs (50' is the acceptable maximum spacing, but closer spacing might be necessary for visibility)

Pipes shall be marked...



Pipe diameter determines the appropriate **label and text sizes** – see the following table:

Outside Pipe Diameter (Including Insulation)		Minimum Length of Label Color Field		Minimum Letter Height	
Inches	mm	Inches	mm	Inches	mm
0.75 – 1.25	19.0 – 32.0	8.00	203.0	0.50	13.0
1.50 – 2.00	38.0 – 51.0	8.00	203.0	0.75	19.0
2.50 – 6.00	64.0 – 152.0	12.00	305.0	1.25	32.0
8.00 – 10.00	203.0 – 254.0	24.00	610.0	2.50	64.0
>10.00	>254.0	32.00	813.0	3.50	89.0

Pipe markers are typically available in several types which are selected based on what type best suits the application. Types readily available are:

- 1) Pre-printed “**SNAP-ON**” pipe markers are in pre-curved configurations which are designed to mechanically snap onto the pipe. This type of marker also has an adhesive strip which may be used to set text orientation.



- 2) Pre-printed “**ADHESIVE**” pipe markers are flat with a pressure-sensitive adhesive designed to secure the marker onto the pipe.



- 3) Pre-printed “**TIE-ON**” pipe markers are made of semi-flexible material which enables conforming and securing to pipes utilizing cable tie fasteners.



- 4) “**DO-IT-YOURSELF**” continuous label stock pipe markers are available in compliant colors and with compatible hardware and software to quickly generate customized adhesive pipe markers.



2 Power Conduit and Busways – Voltage Markers

Power conduits, disconnects and other power system components should be labeled in accordance to applicable local regulations to insure compliance and protection of workers in the data center.

According to the following regulatory standard, supply conduits and industrial control panels should be labeled to identify the voltages.

NFPA 70 368.120 “Busways shall be marked with the voltage and current rating for which they are designed, and with the manufacturer’s name or trademark in such a manner as to be visible after installation.”

Voltage markers should meet ASME (ANSI) Standard Z535.1 (MARKING PHYSICAL HAZARDS SAFETY COLOR CODE).

A **typical** voltage marker will specify the voltage of the conductors within, and appear as follows:

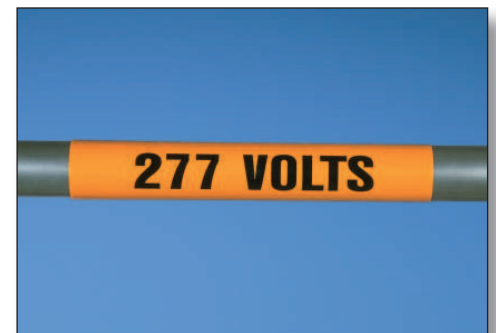


Voltage markers should be **positioned** according to the following criteria:

- Markers are easily seen from the normal angle of approach, for example, below the centerline of the conduit if positioned overhead, and above the centerline if the conduit is below eye level.
- Labels are recommended at the following locations
 - Beginning and termination point of the conduit
 - On both sides of wall or floor penetrations
 - At regular intervals on straight runs (50' is the acceptable maximum spacing, but closer spacing might be necessary for visibility)

Voltage markers are typically available in several types which are selected based on what type best suits the application. Marker types readily available are:

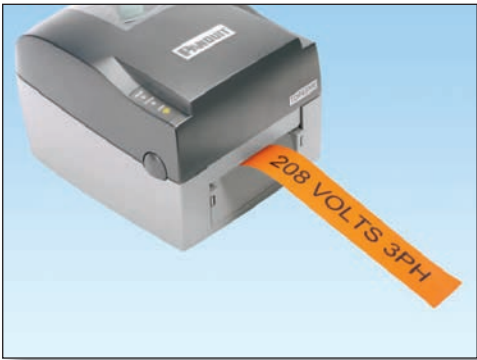
- 1) Pre-printed “**SNAP-ON**” voltage markers have conduit conforming memory for secure placement without the need for adhesive. This type of marker also has an adhesive strip which may be used to set text orientation.



Pre-printed “**ADHESIVE**” voltage markers are flat with a pressure-sensitive adhesive designed to secure the marker onto the conduit, busbar, etc.



2) “**DO-IT-YOURSELF**” continuous label stock voltage markers are available with compatible hardware and software to quickly generate customized adhesive voltage markers.



Vinyl material is typically used for both the conduit and pipe markers and is sufficient for data center applications with an indoor typically rated service temperature range of -40°F to 176°F [-40°C to 80°C].

3 Air Handler – ID Plates

The CRAH/CRAC units should be named and individually marked. The data center numbering grid may be used to identify each air-handling unit.

A recommended practice includes specifying the equipment name followed by the room location. See the example below.



ID plates are available in two basic configurations:

- 1) Custom **“ENGRAVED MARKER PLATES”** are commonly referred to as phenolic or acrylic plates with custom legends. They are available with adhesive and/or screw holes for mounting to the face of the equipment.
- 2) **“DO-IT-YOURSELF – RAISED PANEL LABELS”** are extremely durable component adhesive labels intended to be a lowest installed-cost alternative to engraved marker plates. Colors are available with compatible printer hardware and software to quickly generate customized ID “plates” onsite. See example below:



4 PDU (Power Distribution Units) – WARNING/Voltage Markers

VOLTAGE markers – include on label input power:

- 1) Voltage rating
- 2) WARNING or DANGER labeling providing specific or general identification of hazards.

NOTE: See Section 2.2 regarding the name plate for the PDU and the conductor identification.

5 Fire Alarm/Suppression – System Instructions

Fire-suppression systems within the data center are typically configured to either immediately initiate or delay their activation. Therefore, it is important that operation instructions are legible near the manual controls. Engraved plates or raised panel labels may be used to post these instructions (see Air Handler – ID Plates in this section for more information). See the example below:



6 Electrical Panels – Arc Flash/Warning Labels

Voltage markers and warning labels regarding the Arc Flash hazard for electrical equipment/enclosures/panelboards, etc. are identified within both the NEC and NFPA specifications.

For the Arc Flash hazard, calculations are required to determine the potential risks and label information for each relevant node (any electrical enclosure likely to be serviced by a worker) of the power system 50 volts or greater for AC system voltages, and 100 volts or greater for DC. These labels are required to be updated every five years or when any significant changes occur in the power system, whichever comes first (NFPA 70E 2012 130.5).

NEC 2011 (National Electric Code) 110.16 states, “Electrical equipment, such as switchboards, panelboards, industrial control, panels, meter socket enclosures, and motor control centers shall be field marked to warn qualified persons of potential electric Arc Flash hazards. The marking shall be located so as to be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of equipment.”

NFPA 70E 2012 130.5 [C] states, “**Equipment Labeling.** Electrical equipment such as switchboards, panel boards, industrial control panels, meter socket enclosures, and motor control centers that are in other than dwelling units, and are likely to require examination, adjustment, servicing, or maintenance while energized, shall be field marked with a label containing the available incident energy or required level of PPE.” Equipment labels applied September 30, 2011 to present contain the following information.

- 1) At least one of the following:
 - a. Calculated available incident energy and corresponding working distance
 - b. Minimum Arc rating of clothing
 - c. Required PPE (Personal Protective Equipment)
 - d. Highest Risk Category (HRC) for the equipment
- 2) Nominal system voltage
- 3) Arc Flash boundary

It is also good practice to include the date of analysis for determining when the next review is required.

Note: Labels applied prior to September 30, 2011 are acceptable if they contain the available incident energy or required level of PPE.

NFPA 70 409.110(2) states, “An industrial control panel shall be marked with the following information that is plainly visible after installation: supply voltage, number of phases, frequency, and full-load current for each incoming supply circuit.”

Warning labels should be positioned near the cover or access panel where maintenance personnel would typically enter the equipment for maintenance/repair activities. Label sizes are typically at least 4.50" x 2.25". Other common sizes are 3.5" x 5" and 5" X 7" for large enclosures. Smaller labels are available where space is limited. See images on the following page for recommended labels and application images for placement.

 DANGER	
No Safe PPE Exists Energized Work Prohibited	
ARC FLASH PROTECTION	SHOCK PROTECTION
Arc Flash Hazard Category _____	Voltage Shock Hazard _____
Incident Energy (cm/in ²) _____	Limited Approach Boundary _____
@ Working Distance _____	Restricted Approach Boundary _____
Arc Flash Boundary _____	Prohibited Approach Boundary _____
	Glove Class _____
Equipment ID: _____ Date Prepared: _____ By: _____	

 WARNING	
Arc Flash & Shock Hazard Appropriate PPE Required	
ARC FLASH PROTECTION	SHOCK PROTECTION
Arc Flash Hazard Category _____	Voltage Shock Hazard _____
Incident Energy (cal/cm ²) _____	Limited Approach Boundary _____
@ Working Distance _____	Restricted Approach Boundary _____
Arc Flash Boundary _____	Prohibited Approach Boundary _____
	Glove Class _____
Equipment ID: _____ Date Prepared: _____ By: _____	
PRODUCT P90007W2163Y	

Arc Flash and other hazard communication labels are available in a pre-printed version or are intended for desktop printing (i.e. , blank or header labels are loaded into a desktop printer to add specific data). Color coding according to the Arc Flash hazard category is also used for visual hazard communication.

Suggested standard:

Hazard risk category 0 to 1: Green

Hazard risk category 2 to 3: Yellow

Hazard risk category 4 to danger: Red



If space is available, positioning above the panel door is recommended since the label is visible when open.

2011 NEC NFPA 70 490.2 states that equipment exceeding a nominal voltage of 600V is considered HIGH VOLTAGE.

Additionally, according to 490.53, for equipment operating over 600V – all energized switching and control equipment are required to be enclosed in grounded metal cabinets and marked "DANGER – HIGH VOLTAGE – KEEP OUT."



Note: 600V and above is "high voltage" according to the NEC.



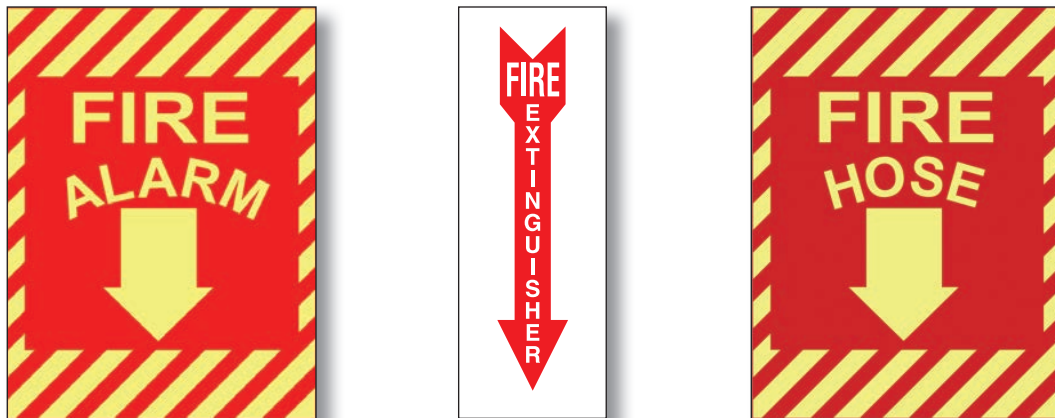
7 Fire Extinguishers – Signage

Regulatory standards require that fire extinguishers are clearly identified. Typically, fire extinguishers are placed so that employees have access to an extinguisher within every 50 – 75 feet (15.3 – 22.9 meters) of travel.

The identification sign should be placed above the fire extinguisher, pointing to the fire extinguisher location. The sign should be visible at 360 degrees of view at an optimum height where the extinguisher identification is visible at the maximum distance of 50 – 75 feet (15.3 – 22.9 meters).

Photoluminescent signs are typically used for this application because they are clearly visible when the power system is disabled. See the images below for examples of typical relevant signage.

OSHA 1910.157(C)(1) states, “The employer shall provide **portable fire extinguishers** and shall mount, locate and **identify them** so that they are readily accessible to employees without subjecting the employees to possible injury.”



8 Exit and Egress Marking – Standard and Photoluminescent

Egress routes and exits should be properly identified so that evacuation routes are clear and easily identifiable to all personnel in the data center.

Exit Signs:

Location – International Fire Code (IFC) 2009 states in section 1011.1, “Exits and exit access doors shall be marked by an approved exit sign **readily visible from any direction of egress travel**. The path of egress travel to exits and within exits shall be **marked by readily visible exit signs to clearly indicate the direction of egress travel** in cases where the exit or the path of egress travel is not immediately visible to the occupants. Intervening means of egress doors within exits shall be marked by exit signs. Exit sign placement shall be such that no point in an exit access corridor or exit passageway is more than 100 feet (30,480mm) or the listed viewing distance for the sign, whichever is less, from the nearest visible exit sign.”

Examples of Signs:



OSHA 1910.37(b)(4) states, "If the direction of travel to the exit or exit discharge is not immediately apparent, signs must be posted along the exit access indicating the direction of travel to the nearest exit and exit discharge. Additionally, the line-of-sight to an exit sign must clearly be visible at all times."

OSHA 1910.37(b)(5) states, "Each doorway or passage along an exit access that could be mistaken for an exit must be marked "Not an Exit" or similar designation, or be identified by a sign indicating its actual use (e.g., closet)."

Graphics – "IFC 2009 1011.5.1 shall have letters **no less than 6 inches** (152.4mm) – additional specifications identify the dimensions and spacing of lettering."

Illumination – "Signs must be illuminated (independent of an external power source) for duration of not less than 90 minutes in the event of power loss."

UL 924 qualifies exit signs for compliance to IBC (International Building Code), IFC, NFPA and NY local law 26-04.

- UL listed photoluminescent products meet all building codes and are tested and certified to meet the stringent guidelines set forth by the ICC. Many jurisdictions have adopted the 2009 International Building Code/Fire Code which outlines the requirements for photoluminescent exit path markings in high-rise buildings (75 feet).
- Photoluminescent products shall be listed to UL 924 (Standard for Safety of Emergency Lighting and Power Equipment) and UL 1994 (Standard for Safety of Low Level Path Marking and Lighting Systems) for compliance with IBC/IFC (2009) and building code requirements.
- 2009 IBC, IFC & 2009 Life Safety Code specify that exit signs used to mark exit doors must be approved. All approved exit signs must be tested and evaluated to the UL 924 performance standard-electric, photoluminescent and self-luminous signs. Exit signs must be so maintained that they will continue to operate for not less than 90 minutes after an electrical power failure.



Egress Marking

In commercial buildings **above 75 feet** (22.9m) for the lowest level of fire department vehicle access, the IBC and IFC (Section 1024 – LUMINOUS EGRESS PATH MARKINGS) specify that egress stairwells and passageways shall be marked with photoluminescent egress path markings. The scope of the egress path that requires marking by the IBC and IFC are handrails and handrail extensions, floor areas, stairs, landings, door areas, and obstacles. Photoluminescent materials shall comply with UL 1994 or ASTM E2072.

Requirements for Steps

A solid and continuous photoluminescent stripe extending the full width of the step and with a minimum width of 1 inch and no more than 2 inches wide is affixed to the horizontal leading edge of each step.

Requirements for Handrails and Handrail Extensions

Photoluminescent tape should be applied to the top surface of handrails and handrail extensions in a solid and continuous stripe of a minimum width of 1 inch and should extend the entire length of handrails and their extensions.

Requirements for Landings

The leading edge of the landing shall be marked with a photoluminescent stripe having a minimum width of 1 inch. The stripe shall not have a gap exceeding more than 4 inches where a corner or bend in the handrail occurs.

Examples of Photoluminescent Egress:



Section 3 – Selection Guide

3.1 – Data Cable Labels

Printer Type	Laser/Inkjet				
Cable Type	Copper	Copper	Fiber	Fiber	Fiber
Cable Diameter	Cat.5/5e/6	10G UTP/STP	2mm/3mm	Duplex 3mm	Dia 0.24" to 0.48" (6.1mm to 12.2mm)
Marker Type	Self-Laminating	Self-Laminating	Self-Laminating for Label-Core™	Self-Laminating for Label-Core™	Self-Laminating
Label P/N	S100X150YAJ	S100X225YAJ	S100X150YAJ	S100X225YAJ	S100X225YAJ

Printer Type	Laser/Inkjet		
Cable Type	Copper	Copper	Fiber
Cable Diameter	Cat5/5e/6	10G UTP/STP	Dia (0.24" to 0.48")
Marker Type	Turn-Tell®	Turn-Tell®	Turn-Tell®
Label P/N	R100X150X1J	R100X225X1J	R100X225X1J

Printer Type	Panduit LS8E				
Cable Type	Copper	Copper	Fiber	Fiber	Fiber
Cable Diameter	Cat.5/5e/6	10G UTP/STP	2mm/3mm	Duplex 3mm	Dia 0.24" to 0.48" (6.1mm to 12.2mm)
Marker Type	Self-Laminating	Self-Laminating	Self-Laminating for Label-Core™	Self-Laminating for Label-Core™	Self-Laminating
Label P/N	S100X150VAC	S100X225VAC	S100X160VAC	S100X220VAC	S100X225VAC

Printer Type	Panduit LS8E		
Cable Type	Copper	Copper	Fiber
Cable Diameter	Cat5/5e/6	10G UTP/STP	Dia (0.24" to 0.48")
Marker Type	Turn-Tell®	Turn-Tell®	Turn-Tell®
Label P/N	R100X150V1C	R100X225V1C	R100X225V1C

Printer Type	Desktop Thermal				
Cable Type	Copper	Copper	Fiber	Fiber	Fiber
Cable Diameter	Cat.5/5e/6	10G UTP/STP	2mm/3mm	Duplex 3mm	Dia 0.24" to 0.48" (6.1mm to 12.2mm)
Marker Type	Self-Laminating	Self-Laminating	Self-Laminating for Label-Core™	Self-Laminating for Label-Core™	Self-Laminating
Label P/N	S100X150VATY	S100X225VATY	S100X160VATY	S100X220VATY	S100X225VATY

Printer Type	Desktop Thermal		
Cable Type	Copper	Copper	Fiber
Cable Diameter	Cat5/5e/6	10G UTP/STP	Dia (0.24" to 0.48")
Marker Type	Turn-Tell®	Turn-Tell®	Turn-Tell®
Label P/N	R100X150V1T	R100X225V1T	R100X225V1T

3.2 – Power Cable Labels

Printer Type	Laser/Inkjet				
Cable Diameter	18 – 14 AWG	12 – 10 AWG	8 – 4 AWG	2 – 1 AWG	1/0 – 250 MCM
Marker Type	Self-Laminating	Self-Laminating	Self-Laminating	Self-Laminating	Self-Laminating
Label P/N	S100X075YAJ	S100X125YAJ	S100X225YAJ	S100X400YAJ	S100X650YAJ

Printer Type	Panduit LS8E				
Cable Diameter	18 – 14 AWG	12 – 10 AWG	8 – 4 AWG	2 – 1 AWG	1/0 – 250 MCM
Marker Type	Self-Laminating	Self-Laminating	Self-Laminating	Self-Laminating	Self-Laminating
Label P/N	S100X075VAC	S100X125VAC	S100X225VAC	S100X400VAC	S100X650VAC

Printer Type	Desktop Thermal				
Cable Diameter	18 – 14 AWG	12 – 10 AWG	8 – 4 AWG	2 – 1 AWG	1/0 – 250 MCM
Marker Type	Self-Laminating	Self-Laminating	Self-Laminating	Self-Laminating	Self-Laminating
Label P/N	S100X075VATY	S100X125VATY	S100X225VATY	S100X400VATY	S100X650VATY

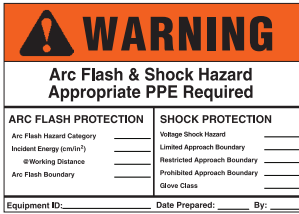
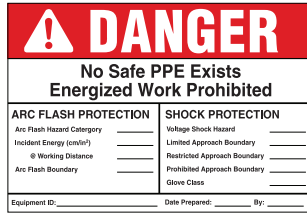
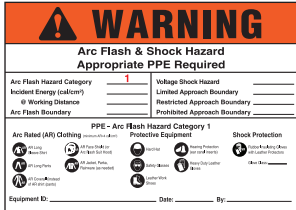
3.3 – Equipment Labels

Application	Laser/Inkjet	Panduit LS8E	Desktop Thermal
Printable Label for Grounding Busbar	C400X200YJJ	C200X100YPC	C400X200YJT
Printable Label for Rack Identification	C200X100YJJ	C200X100YPC	C200X100APT
Printable Label for Enclosure Identification	C200X100YJJ	C200X100YPC	C200X100APT
Printable Label for Fiber Port Identification	C350X100YJJ	T100X000VPC-BK	C400X100APT
Printable Label for Copper 4-port Identification	C261X030FJJ	C252X030FJC	C252X030APT
Printable Label for Copper 6-port Identification	C379X030FJJ	C379X030FJC	C379X030APT
Printable Label for Pathway Identification	C350X500FJJ	T100X000VUC-BK	T400X000VU1Y M300X100Y6T

3.4 – Facility Labels

Area	Part Number*	Examples
Electrical Hazards	Adhesive Backed PPS0710D72 PPS0710D73 PPS1014D73 PPS0710D28 Rigid Plastic PRS1014D70 PRS0710D72 PRS1014D72 PRS1420D75 PRS1014D73	 
Fire Safety/ Photoluminescent	PPS1209G010 PPS1209G011 PPS1209G012 PPS0710G001 PPS1014G002 PPS0710G020	 
Piping/ Conduit Markers	Adhesive Backed PCV-480-AY PCV-FOCBY GPMU-AG Snap-On PCV-480RY GPMSH-NG Strap-On GPMPC-SO GPMPC-SG Thermal Print T400X000VU1Y	   

*For the complete offering and specific part information on materials, sizes, and legends visit our website: www.panduit.com.

Area	Part Number*	Examples
Arc Flash Labels	Thermal Print PVS0507W2104Y-0 PVS0507W2104Y-1 PVS0507W2104Y-2 PVS0507W2104Y-3 PVS0507W2104Y-4 C400X400A51 C400X400YZ1	 
	Pre-Printed/Write-On PVS0305W2103Y PVS0305D2101Y PVS0507W2103Y PVS0507D2101Y	
	Raised Panel C400X400ANT C400X400YK	
Safety Signs	Thermal Print C400X600AX1 C400X600YZ1 C400X600YX1 T400X000YX1	 
	Laser Printable SEZ-1DLL SEZ-1CLL SEZ-1NLL SEZ-1WLL	
Photoluminescent Tapes	Pre-Printed PT2S-ARW PT2S-BLK PT2S-RED	 
	Thermal Print T200X000Y2T T400X000T2T	
Engraved Plates	GAP4010-A GAP4010 GAP85110-A GAP85110	
Raised Panel Labels	Thermal Print CX400X100APT CX400X100AWT C350X300A0T	 

*For the complete offering and specific part information on materials, sizes, and legends visit our website: www.panduit.com.

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