OFFICE OF
INFORMATION
AND TECHNOLOGY

VA Enterprise Facility IT Support Infrastructure Standards

Version 2.0

February 5, 2018 | Solution Delivery
Data Center Engineering

Table 1: Version Changes

Date	Reason for Changes	Version	Author
2007	Original	0.0	Michael Julian, RCDD
2009	Revision	0.1	Michael Julian, RCDD
2012	Revision	1.0	Michael Julian, RCDD
12/07/2016	EDICT Revision	1.1	EDICT Team
05/09/2017	Expanded revision including addition of Administrative and Operations Standard. Name changed to include IT Support Infrastructure to reflect broader scope.	1.2	EDICT Team
1/31/2018	Ratified by SEDR	2.0	SEG
2/05/2018	SD Change Order Approval	2.0	CAB

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1 Introduction

1.1 Authority of This Standard

The Office of Information and Technology (OIT) VA Enterprise Facility IT Support Infrastructure Standard defines the technical requirements necessary to maintain optimum reliability and efficiency within Department of Veterans Affairs (VA) facilities and computing centers. Primary considerations for the standards are to balance economy, reliability, capacity, sustainability, and redundancy against supported system availability requirements and available resources.

The purpose of this document is to serve as the master reference document for planning and design of facility IT support infrastructure throughout the Department of Veterans Affairs (VA) facilities. IT Support Infrastructure is defined as all passive telecommunications and information technology equipment and supporting rooms and spaces including information transport systems, power distribution, HVAC, grounding, monitoring and metering equipment required to support active IT and telecommunications equipment in data centers/computer rooms, telecommunication rooms, entrance facilities and the necessary pathways, risers and conduits interconnecting them. Specifications and design criteria in this manual are expected to be followed in planning of VA facilities. This standard establishes the common architecture and baseline standards for physical design and engineering for the IT support infrastructure throughout the VA enterprise. The topologies and specifications documented in this standard are to be implemented without modification, except when required by outside Authority Having Jurisdiction (AHJ), in which case, those requirements shall be communicated to the Enterprise Data Center Infrastructure Collaboration Team (EDICT) for consideration of inclusion in a future version of the standard. The authority of this standard derives from approved technical standards and enterprise baselines. Within IT Operations and Services (ITOPS), Solution Delivery (SD) is responsible for the enterprise-wide technical framework and IT architecture services for OIT, VHA, VBA, and NCA systems and projects. SD determines technical standards, also known as configuration baselines, for infrastructure technologies deployed promoting one technology vision across VA, which supports system optimization, integration, and interoperability throughout the enterprise. SD owns the enterprise configuration baselines for the technologies they manage and baselines for infrastructure technologies and architecture for the projects they support.

Approved technical standards and enterprise baselines are communicated through ITOPS bulletins and published to the Security Management and Analytics (SMA) portal under the Baseline and Configuration Management Library.

Requests for variances or changes to this standard are to be submitted to the VA IT EDICT distribution list for consideration. If approved by the committee then the standard will be updated, socialized through the Systems Engineering Design Review (SEDR) process, and submitted to the Enterprise Change Management Datacenter Change Advisory Board for ratification.

1.2 Scope

IT Support Infrastructure is defined as all passive telecommunications and information technology equipment and supporting rooms and spaces including information transport systems, power distribution, HVAC, grounding, monitoring and metering equipment required to support active IT and telecommunications equipment in facility data centers/computer rooms, telecommunication rooms, entrance facilities and the necessary pathways, risers and conduits interconnecting them. The scope of this document includes design, construction, sustainment, maintenance, repair, upgrade, modernization, administration, and operations of the IT support infrastructure.

The Infrastructure and Administration sections of this standard defines the topologies and specifications for facilities and systems in the VA enterprise, and the Operations section defines the how those facilities and systems shall be operated. The Administration section lists the acceptable and recommended specifications for cable plant and data center naming conventions.

Engineering and Operations are distinct functions that inform and rely on one another to provide a complete solution.

IT Support infrastructure that doesn't conform to this standard is considered to have a one-time initial variance. However, non-conforming infrastructure will be brought into compliance during routine tech refresh, lifecycle replacement, upgrades, or new installations. Facility managers shall also implement incremental changes to bring telecommunications spaces up to VA sanctioned standards to gain associated efficiencies and cost savings without waiting for required tech refresh periods.

All related projects entering or in the design and implementation phases shall contact EDICT at VAEDICT@va.gov for assistance in ITS, data center, and telecommunications space design and standard compliance.

1.3 Purpose

A standard is a set of rules or requirements that are determined by a consensus opinion of subject matter experts and prescribe criteria for a product, process, test, or procedure. The general benefits of a standard are quality, interchangeability of parts or systems, consistency, and reduction of lifecycle costs. Information Technology (IT) standards are based on business needs provided through or supported by IT Services. IT Services are designed to support business processes and are constructed from software, hardware and infrastructure components. Establishing and enforcing standards for the selection and configuration of these supporting components improves the maintainability, reliability, and availability of IT Services within projected economic constraints in alignment with business needs.

The IT Support Infrastructure standard section describes VA's facility IT support infrastructure and contain sections necessary to support their standardization. Sections include standard specifications for subject components, decisions supporting the standard specifications, guidelines or recommendations for implementing the standard specifications, and supplemental factors to consider when evaluating subject components. Additionally, it provides guidance on procuring components that meet the standard specifications, guidance on integrating them with existing components, and explanation of how the subject components fit into the VA Architecture.

The Facility IT Support Administration standard section lists the acceptable and recommended specifications for Inside Plant naming conventions, including racks, equipment enclosures, fiber and Unshielded Twisted Pair (UTP) transport media, as well as active and passive elements concerning power distribution. Sections include standard specifications for components, decisions supporting the standard specifications, guidelines or recommendations for implementing the standard specifications, and supplemental factors to consider when evaluating subject components. Other supplementary documents will provide guidance on procuring components that meet the standard specifications, guidance on integrating them with existing components, and explanation of how the components fit into the VA architecture.

The Operations standard describes VA's facility operations and contains sections necessary to support the standardization of those operations. Sections include standard specifications for operations and maintenance work and work results, decisions supporting the standard specifications, guidelines or recommendations for implementing the standard specifications, and supplemental factors to consider when evaluating subject components. Additionally, it provides guidance on procuring services that meet the standard specifications, guidance on integrating them with existing services and organizational responsibilities, and explanation of how the subject components fit into the VA architecture.

1.4 Objectives

This standard provides recommended specifications across all VA facilities to support:

- Solution evaluation
- Requirement evaluation
- Solution design
- Solution procurement and bid evaluation
- Evaluation of architectural specifications
- Standardization of passive Inside Plant infrastructure
- Standardization of design criteria for telecommunications spaces, facilities physical infrastructure systems, and operation and maintenance of systems supporting VA services
- Standardization of naming and identification conventions for VA data centers
- Standardization of Inside Plant and rack power infrastructure naming conventions
- Standardization of labeling and identification conventions for physical plant systems and components
- Standardization of operations
- Operational solution procurement and bid evaluation
- Evaluation of maintenance, repair, and replacement specifications
- Standardization of lifecycle sustainment activities across all VA data centers

- Standardization of the operational, organizational, and aesthetic results of Sustainment, Maintenance, and Repair (SM&R) activities

1.5 Theory of Operation

These standards are applicable to the planning, designing, and use of telecommunications spaces across all Department components within VA. This includes physical spaces used for operation of IT equipment and systems (servers, storage, network switching and distribution, et cetera), telecommunications equipment and systems (local and wide area network, telephone, cable television, physical security IT systems, et cetera), and the physical infrastructure equipment (power conditioning and distribution, heat rejection and air conditioning, et cetera) necessary to operate the supported IT equipment and systems at the availability and sustainability levels described. Telecommunications spaces include telecommunications rooms, entrance facilities, data centers, horizontal pathways, vertical pathways, etc.

2 Data Center Classification

VA has four segregated data center types to support the enterprise distributed computing environment.

- Core Data Centers (CDC) provide enterprise-level support services for VA-wide and cross-component systems and applications.
- Mission Support Centers (MSC) are highly specialized data centers that provide unique, focused services that are best provided from smaller, mission-focused facilities that cannot or should not be supported by CDCs or CSCs due to MSCs' association with mission specific infrastructure or equipment.
- Campus Support Centers (CSC) operate local data centers to support VA tenants located on a VA campus and within geographically supported areas. CSCs provide services that cannot be provided (technically or economically) from a CDC. Only one CSC is authorized per VA campus.
- Network Support Centers (NSC) provide lower-level application and IT services distribution across the geographic breadth of the VA's computing enterprise, enabling special functions and distributed users to satisfy the Agency Department mission.

2.1 Core Data Centers (CDC)

CDCs are facilities that provide shared and distributed enterprise services to supported sites. CDCs host cloud services (IaaS, PaaS, SaaS) to provide complete end-to-end IT services (including but not limited to application, backup, and storage) to the supported VA sites.

The CDC architecture is considered mission-essential and is designed, operated, and maintained to provide availability consistent with current VA national data center standards for supported IT applications. CDCs are the target architecture component for IT services that span multiple Department components and user groups (services and applications used by many or all users, such as messaging, productivity, and collaboration).

CDCs may be VA-owned, leased, or government or commercial outsourced (external cloud) data centers. CDCs meet (or are planned to meet) all published CDC physical infrastructure requirements to ensure enterprise reliability, redundancy, High Availability (HA), and Disaster Recovery (DR) requirements.

CDCs may also provide services designated to be provided by NSC, if no local NSC to provide those services is available. CDCs may also provide MSC-type application support.

2.2 Mission Support Centers (MSC)

MSCs provide element-specific and single-instance special enterprise services that may be inappropriate for consolidation to CDC facilities. MSCs are the target architecture for specialized-function systems and applications, particularly those that support a specific but limited and distributed user group (services allowing the Department to function but with a limited user base such as internal financial management, or applications requiring centralized processing for a small number of user facilities, such as consolidated pharmacies).

MSC physical requirements supporting the computing environment may be more lenient than those for CDCs. Specific requirements will vary based on the supported functions, criticality of the mission, and similar criteria. For example, MSCs designated as enterprise Test/Development (Test/Dev) environments will not require the same level of high-availability physical and network redundancy as a mission-critical production environment that directly supports patient care.

MSCs may also provide services designated to be provided by an NSC, if no local NSC to provide those services is available.

2.3 Campus Support Centers (CSC)

CSCs provide geographically-specific, operational IT services in support of campus services to Veterans and VA employees that cannot be effectively consolidated or provided over cloud architectures to the campus. CSCs may also provide services designated to be provided by an NSC, if no local NSC to provide those services is available.

IT services at CSCs are provided by multiple organizations, including Clinical Engineering (CE a.k.a. biomed), health informatics, Veterans Affairs Medical Centers (VAMC), Veterans Benefits Administration (VBA) Regional Offices, Office of Information Field Office (OIFO), and Research & Development (R&D), etc.

Future data center architecture models for CSCs are intended to provide for collocation of IT equipment and systems from all provider organizations into the minimum number of operational spaces on a campus; that is, consolidated data centers providing environmental and area network support appropriate to all IT equipment needed by tenant organizations on a particular campus to perform their missions.

2.4 Network Support Center (NSC)

NSCs provide local IT services that cannot be effectively consolidated or provided over a network-supported distributed architecture to the local operational site. Local means to the immediate facility and to facilities within the local commuting/networking area for the purposes of this architecture; NSCs may provide application support for all VA facilities in a metropolitan area, for example.

Where application architecture and network requirements require a closer data center point of presence to enable end users effective, efficient system access, an NSC is the appropriate target environment.

Table 2: Data Center Classification Standard

ID	Primary Attribute	Secondary Attribute	Specification
1	Core Data Center (CDC)	Description	CDCs are centralized data centers that provide enterprise-level services to geographically-distributed VA organizations to support business functions. CDCs maintain complete High Availability (HA) and Disaster Recovery (DR)
		Planned ANSI/TIA 942 Rating	3
		Examples	Information Technology Center (ITC) Regional Data Center (RDC)
2	Mission Support Center (MSC)	Description	MSCs are stand-alone data centers that provide specific enterprise IT functionality to VA organizations and business functions
		Planned ANSI/TIA 942 Rating	2 or 3
		Examples	• Test/Dev data centers at Rating 2 • Financial Services Center (FSC) • Centralized Mail Outpatient Pharmacy (CMOP) • Consolidated Patient Account Center (CPAC) • Health Administration Center (HAC)
3	Campus Support Center (CSC)	Description	CSCs are stand-alone data centers that provide specific IT functionality to a VA campus supporting all VA tenants on that campus and in the geographically supported area
		Planned ANSI/TIA 942 Rating	3
		Examples	VA Medical Center (VAMC)
4	Network Support Center (NSC)	Description	NSCs are local data centers that provide local IT application and network support to local operating locations
		Planned ANSI/TIA 942 Rating	1
		Examples	• Enterprise Test/Development data center • Telecommunications Room (TR) • Other small server rooms (not "*shallow rooms*")

Evaluation Factors

- Data center facility appropriately and centrally categorized by function and usage.
- Capability gaps between existing and planned EIA/TIA 942 Rating requirements identified.

3 Standards

3.1 Facility IT Support Infrastructure Standard

3.1.1 Structured Cabling

This standard supports structured cabling as a vendor-neutral, extensible approach to information transport system design in VA facilities, *not limited to data center applications*. The specifications for horizontal cabling for LAN applications and vertical cabling for intra and inter building backbone are laser-enhanced fiber optics and high-bandwidth Unshielded Twisted Pair (UTP). The minimum bandwidth requirement for fiber is 40 Gbe and 10 Gbe on UTP. All local and campus area networks shall be installed in a structured topology with patch panels serving transition points. Individual “home run” cables are not permitted in this standard for LAN applications, including data centers.

The Horizontal and Main Distribution Areas should be located adjacent to switching components within the rack to minimize patch cord length and cable management requirements. This approach is consistent with ITS industry standards, and it supports the SD LAN and data center network design baselines.

Work-area outlets and Equipment Distributions shall support the minimum performance and capacity requirements of this standard.

This standard has been harmonized with OIT LAN Baselines.

3.1.1.1 Unshielded Twisted Pair (UTP)

This standard specifies pre-terminated Category 6A UTP for horizontal distribution. This performance category is applicable to field-terminated or factory pre-terminated applications. The preferred termination method is factory pre-terminated cabling for UTP with each cable terminating in an individual connector. While pre-terminated cables require that distances between termination points are known this approach results in the rapid installation of horizontal cabling without risks associated with field termination including wire fragments, impaired cabling performance due to poor installation techniques, faulty terminations, etc. Spiral wrapping pre-terminated bundles is an effective way to maintain the bundle of six cables without impacting ease of installation.

Factory pre-termination is the preferred termination method but field-termination is acceptable for work-area distribution applications and where pre-termination is impractical.

Category 6A cabling is specified in standard ANSI/TIA-1179 Healthcare Facility Telecommunications Infrastructure for new installations. Where Category 6A cannot be justified on technical requirements, the minimum acceptable UTP performance category is Category 6.

Table 3: UTP Standard

ID	Primary Attribute	Secondary Attribute	Specification
1	Performance Characteristics (Horizontal and First Level Backbone)	Performance Category	Category 6A (10 GbE) Category 6 (grandfathered and exceptions only)
		Performance Specifications	Meets or exceeds TIA-EIA-568-C.2-10, TSB-155
		Wire Size	26 AWG Maximum
		Smoke Rating	• Riser cable for vertical runs through floors • Plenum rated for plenum spaces • Not rated for other applications • Or as per AHJ requirement
		Jacket Color	Blue (to match 606C HC patching field designation)
		Termination Method	• Pre-terminated, 8P8C termination method preferred OR • Field-terminated to work area outlets only where distances cannot be precisely calculated
		Media Connector	Pre-terminated with split 8P8C preferred
		Bundling	Multiple cable harness

Evaluation Factors

- Performance characteristics
- Termination (factory or field)
- Power over Ethernet (PoE)
- Compatibility with specified patch panels
- Smoke rating

Implementation Guidance

Horizontal cabling, including fiber and UTP, shall be installed in a structured topology with patch panels serving as at all vertical and horizontal transition points including Equipment Distributors (EDs), Horizontal Distributors (HDs), and throughout the Main Distribution Area (MDA) for all backbone levels. The patch panels at the HC and MDA shall be located adjacent to switching components to minimize patch cord length and cable management requirements.

Where installed, the ED patch panels will be installed in the top five (5) RUs of each enclosure or within small (five (5) RUs or less) racks mounted on cable tray above the associated equipment cabinet.

See Section 3.3 on cable routing and implementation.

Pre-termination requires that distances between termination points are known; however, it assures maximum performance and rapid installation. Only use field-terminations to work area outlets as required where distances can't be precisely calculated.

3.1.1.2 UTP Patch Panel Standards

This standard anticipates the bandwidth demands of virtualization by specifying Category 6A UTP in production and test facilities. This standard can be applied to field-terminated or factory pre-terminated applications. The preferred termination method is factory pre-terminated cabling for UTP. Category 6A cabling is specified in standard ANSI/TIA-1179 Healthcare Facility Telecommunications Infrastructure for new installations.

Modularity of structured cabling components in the telecommunications rooms, entrance facilities, and data centers improves capacity planning and move/add/change outcomes. This standard specifies a one (1) rack-unit high, 24 position patch panel that is performance tuned to the UTP. Angled panels eliminate the need for horizontal cable management in the rack and are the typical configuration. No horizontal cable management is required when specifying angled panels.

Table 4: UTP Patch Panel Standards

ID	Primary Attribute	Secondary Attribute	Specification
1	Performance Characteristics	Performance Category	Category 6A (10 Gigabit Ethernet (GbE)) Category 6 (variance)
		Position Count	24 (4 six-port modules)
		Form Factor	• One (1) RU • MDA- angled • HDA- angled (end of row or TR) • ED ▪ Flat in cabinet ▪ or angled overhead
		Color Coding	Black

Evaluation Factors

- Performance category
- Form factor
- Compatibility with pre-terminated cable interfaces

Implementation Guidance

See Operational Standards section on cable routing and implementation.

Horizontal cabling, including fiber and UTP, shall be installed in a structured topology with patch panels serving as at all vertical and horizontal transition points including Equipment Distributors (EDs), Horizontal Distributors (HDs), and throughout the Main Distribution Area

(MDA) for all backbone levels. The HC shall be located adjacent to switching components to minimize patch cord length and cable management requirements.

Where installed, the ED patch panels will be installed in the top five (5) RUs of each enclosure or within small (five (5) RUs or less) racks mounted on cable tray above the associated equipment cabinet.

3.1.1.3 UTP Patch Cord

This standard specifies center-tuned Category 6a or Category 6 patch cords. This standard does not specify color-coding for patch cable jackets. Based on the observations of hundreds of VA facilities, color-coded patch cables provide little or no utility and create inventory management issues. Effective color coding has been observed for in-rack, dual-homed server/appliance applications using a simple white/black scheme. Patch cables shall be factory pre-terminated and shall match the category of the associated patch panel and connected UTP.

Table 5: UTP Patch Cord Standards

ID	Primary Attribute	Secondary Attribute	Specification
1	Performance Characteristics	Performance Category	• Category 6A (Cat 6 variance) • Stranded • 26-gauge
		Performance Specifications	Center tuned to horizontal media
		Jacket Color	Not specified
		Termination Method	Factory pre-terminated

Evaluation Factors

- Performance characteristics
- Center-tuned to installed patch panels

Implementation Guidance

See Operational Standards section on cable routing and implementation.

Use most appropriate length to meet cable management standards.

Inside Plant Design best practices dictate that component-level compliance to a performance standard must be maintained across the entire horizontal link. The quality of patch cords and adherence to performance standards is critical to the reliable operation of a high-speed LAN.

3.1.1.4 Fiber Optic Cable

This standard specifies laser-enhanced 50/125 OM4-rated multimode fiber-optic cable.

Pre-termination requires that distances between termination points are known; however, it assures maximum performance and rapid installation. In backbone and data center applications, a 12-strand, loose tube cable assembly using a Multi-pair Push On (MPO) connector is specified.

If fiber media is required for horizontal distribution to work area outlets, a structured approach is required. A stated need for fiber to work area outlets (WAO) should be scrutinized by the planner and justified by sound technical requirements.

Table 6: Fiber Optic Cable Standards

ID	Primary Attribute	Secondary Attribute	Specification
1	Fiber (Horizontal and First Level Backbone)	Performance Category	OM4 Laser Enhanced to 40 GbE
		Performance Specifications	Laser Optimized 50/125 µm fibers with effective modal bandwidth of at least 4,700 MHz·km at 850 nm
		Mode	Multimode
		Smoke Rating	• Riser cable for vertical runs through floors • Plenum rated for plenum spaces • Not rated for other applications • Or as per AHJ requirement
		Jacket Color	Aqua
		Termination Method	Factory pre-terminated
		Media Connector	Pre-terminated with MPO
		Strand Count	12 per assembly
		Bundling	Loose Tube
		Polarity	Straight (or Type A)

Evaluation Factors

- Warranty
- OM4 performance characteristics for 40 GbE
- Smoke rating requirements
- Technical requirements for inclusion in horizontal distribution to the WAO.

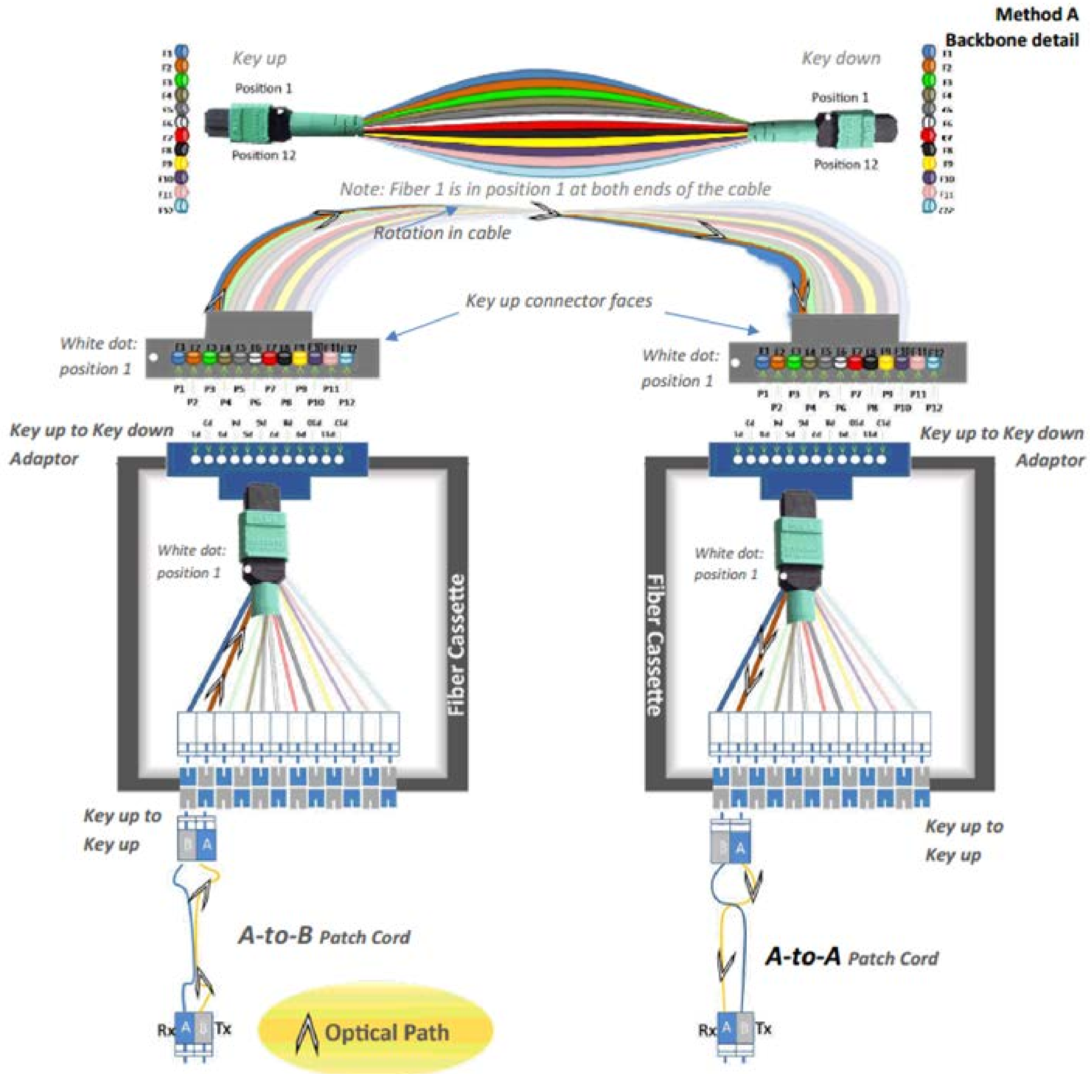
Implementation Guidance

See Section 3.3 on cable routing and implementation

Pre-termination requires that distances between termination points are known; however, it assures maximum performance and rapid installation.

This standard specifies the polarity of horizontal pre-terminated MPO-based fiber optic cabling as Type A or “straight-through.” This will ensure that position one (1) will correspond to position one on both ends of the cable. If a polarity flip for the channel is necessary use a Type A/A patch cable on one end and a Type A/B patch cable on the other end. In some cases, an A/B cord can be converted to an A/A by switching the connector position on one end of the patch cord.

Figure 1: Method A Polarity of Horizontal Pre-terminated MPO-based Fiber Optic Cabling



3.1.1.5 Fiber Distribution Cassettes

This standard specifies the transition component of the structured cabling system for fiber optic cabling in telecommunication spaces. It is the fiber equivalent to UTP patch panels. This standard specifies 24-strand, 12-position OM4-rated cassettes with duplex LC interfaces. The cassette will be equipped with dual, 12-strand MPO interfaces as the backbone or horizontal interface.

Table 7: Fiber Distribution Cassettes

ID	Primary Attribute	Secondary Attribute	Specification
1	Performance Characteristics	Form Factor	One (1) RU
		Capacity	3 cassettes minimum
		User Interfaces	LC connectors (12 duplex per cassette)
		Backbone Interfaces	24 strand (two 12-strand Multi-Fiber Push On (MPO)) per cassette (50 micron)
		Type	OM4 Laser Enhanced 40 GbE 50/125 Multimode

Evaluation Factors

- Performance characteristics
- Form factor
- Interfaces

Implementation Guidance

This standard specifies Optical Multimode-4 (OM4)-rated (40 GbE) 850 nm laser-enhanced multi-cable fiber cable assemblies (specified elsewhere in this document) pre-terminated with MPO connectors. One cassette will be used to provide LC interfaces at both ends of the horizontal or backbone link and will support two 12-strand cable assemblies for a total capacity of 12 duplex LC interfaces. Three of these cassettes can be installed horizontally in the specified fiber distribution panel.

3.1.1.6 Fiber Patch Cords

This standard specifies high-bandwidth, factory pre-terminated fiber patch cords. The standard media interface for fiber patch cords is duplex LC. Patch cord polarity requirements can be accommodated by specifying a polarity-reversible duplex interface. When polarity requirements are not known, the polarity-reversible duplex LC interface should be specified.

Table 8: Fiber Patch Cord Standards

ID	Primary Attribute	Secondary Attribute	Specification
1	Performance Characteristics	Performance Category	40 Gigabit OM4
		Performance Specifications	Laser enhanced, 50/125 multimode fiber, Duplex LC
		Jacket Color	Aqua
		Termination Method	Factory pre-terminated
		Polarity	• Type A to B (Crossover)– ED • Type A to A (Straight) – HDA and MDA

Evaluation Factors

- Polarity reversibility

- Performance specifications

Implementation Guidance

Inside Plant design best practices dictate that component-level compliance to a performance standard must be maintained across the entire horizontal link. The quality of patch cords and adherence to performance standards is critical to the reliable operation of a high-speed LAN or SAN.

Polarity of the fiber optic channel may need to be flipped depending on the application. This will ensure that the equipment sending or transmitting will be connected to the receiving port of the equipment at the other end. If typical A/B fiber patch cords are used on both sides of the channel, continuity may be lost. As shown in Figure 5, this is corrected by either switching the connector position of both strands at one end of the patch cord or by using a Type A/A patch cable on only one end of the channel.

Pre-termination requires that distances between termination points are known; however, it assures maximum performance and rapid installation.

See Section 3.3 on cable routing and implementation.

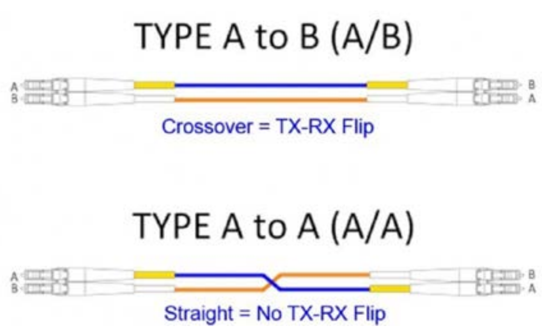


Figure 2: Polarity of Fiber Optic Patch Cable

3.1.1.7 Fiber Distribution Panel/Cabinet

This standard specifies a one (1) RU panel for mounting fiber cassettes. The smallest form-factor has been selected for application flexibility.

Table 9: Fiber Distribution Panel/Cabinet Standards

ID	Primary Attribute	Secondary Attribute	Specification
1	Performance Characteristics	Form Factor	One (1) RU
		Cassette Capacity	3 cassettes (minimum/maximum)
		Type	• Cabinet (network rack installation or lock requirements) • Panel (server cabinet with vertical exhaust, no security requirement for lock)

Evaluation Factors

- Form factor
- Cassette capacity
- Locking requirements

Implementation Guidance

ED Fiber Distribution Panels will be installed in RU 45 of each vertical exhaust duct cabinet where required. Fiber distribution panels shall be used in all other type implementations.

3.1.1.8 Cable Support Infrastructure

This standard creates uniform high-capacity horizontal and vertical cable management for Category 6A patch cords.

Table 10: Cable Support Infrastructure Standards

ID	Primary Attribute	Secondary Attribute	Specification
1	Horizontal Cable Management Panels	Form Factor	• One (1) RU (up to 50 Cat 6a patch cords) • Two (2) RU (up to 100 Cat 6a patch cords)
		Cover	Double-hinged
		Finger Spacing	To meet requirement; typically 6-port spacing (five fingers)
		Dimensions	6 in. to 16 in.
2	Vertical Cable Management Panels	Door	Double-hinged

Evaluation Factors

- RU Finger spacing

- Double-hinged cover capacity

Implementation Guidance

Vertical cable management will be utilized for the horizontal distribution area and the main distribution area. Horizontal cable management within the rack will be utilized as necessary to encourage defined and traceable routing of individual patch cords from switches to the vertical cable managers.

3.1.1.9 Work Area Outlets (WAOs)

Work Area Outlets are user interfaces to the cabling system within a work space, floor, or building. This standard specifies the *typical* quantity and type of faceplate, wall box, conduit, and outlets for *typical* administrative work areas. However, this guidance does not preclude variations based on atypical capacity requirements nor does it supersede guidance or requirements set forth by CFM concerning Work Area Outlet specifications for specialized spaces.

Typical in-wall workboxes shall be a double-gang telecommunications-rated work box with rigid conduit extending to the horizontal pathway.

Floor boxes shall be dual-gang or “poke-thru” type. Cable that extends through a slab penetration shall terminate in the nearest practicable TR on the same serving floor.

The typical (standard density) WAO will consist of two RJ45 interfaces. This provides connectivity for one (1) IP telephone and one (1) workstation. Some IP phone base units have a data port. This allows the workstation to interface with the network via the phone base unit to leave one (1) RJ45 at the faceplate available for future use.

WAO media interfaces shall be tuned to the horizontal media, specified to the same performance rating, and installed according to best practices.

No “phone outlets” are specified in this standard. Legacy equipment, such as fax machines and analog phones, will require a variance from this standard via the variance request process.

Single-outlet, posted faceplates shall be configured with one (1) RJ45 interface.

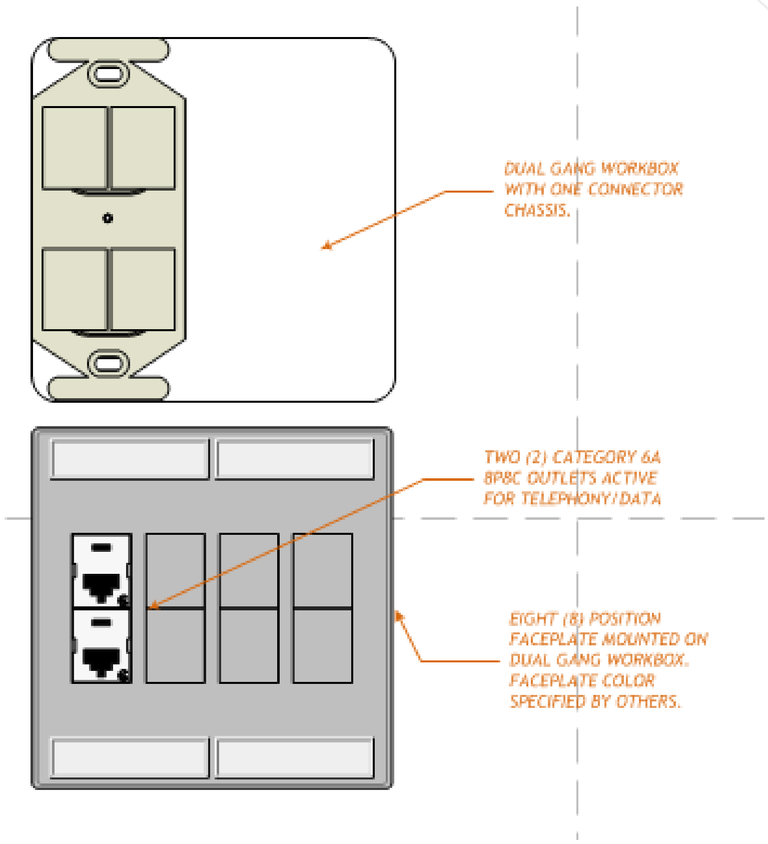


Figure 3: Typical Standard-Density WAO

The high density WAO configuration consists of four (4) RJ45 interfaces. This configuration is typically used for desktop support and other technical staff or in cases where multiple devices need network access from the same WAO.

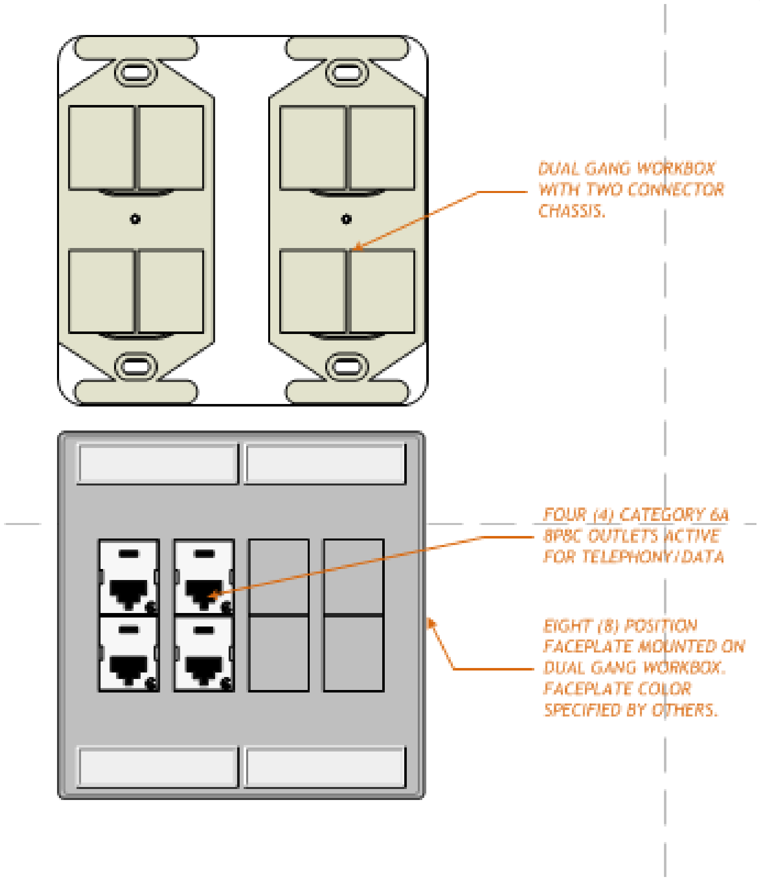


Figure 4: Typical High Density WAO

Evaluation Factors

- Serving zone capacity requirements
- Special safety or medical device requirements

3.1.1.10 Horizontal Distribution

Horizontal distribution is defined as structured cabling that connects the Work Area Outlet or the Equipment Distributor to a Horizontal Distributor (HD). The HD will be located in the end of row Horizontal Distribution Area (HDA) or in the Telecommunications Room (TR) depending on the application.

Horizontal media shall be specified per section 3.1.1.1 Unshielded Twisted Pair. If the application, such as a Data Center, requires 40 GbE fiber, specify the media per section 3.1.1.4 Fiber Optic Cable.

3.1.1.11 Vertical (Backbone) Distribution

Vertical Distribution is defined as structured cabling that connects the Horizontal Distributor to the Main Distributor (MD). The Main Distribution Area (MDA) will be located in a centralized location within the building, data center, or LAN serving area. Typically, this will be a Campus Support Center or a Data Center.

The MDA shall be a separate and distinct telecommunications space within the LAN serving area. The MDA shall not be located in a Telecommunications Room.

This standard only recognizes 50/125 Laser-Enhanced Multimode (OM4) as an acceptable backbone media (see 3.1.1.4). UTP shall be utilized only if fiber media cannot serve specialized applications such as legacy phones, fax machines, or security panels. Where copper backbone is required, this standard specifies quantity two (2) riser-rated Category 6, 25-pair cables to be installed between the Telecommunications Room HDA and the Campus Support Center MDA. This approach will support twelve (12) patch panel positions. One 12-position Category 6 patch panel shall be installed in the HDA and the MDA. Individual 4-pair Category 6 UTP riser-rated cables may be used, but this approach is not recommended and will require technical review by OIT.

3.1.2 Telecommunications Space Design

VA telecommunications spaces, including entrance facility, telecommunications rooms, and data center facilities shall be designed and operated in accordance with the EIA/TIA-942 Ratings for each data center classification, except as detailed specifications are provided in this and other VA data center facilities standards.

3.1.2.1 Building Specifications for Common Telecommunications Spaces

Table 11: Building Specifications

ID	Primary Attribute	Secondary Attribute	Specification
1	Shell	Security	Via combination of manual and electronic control or minimum electronic control
		Access Route	Lead to location outside computer room for access control
		Egress	Observes life safety code
		Door Height (Computer Room)	8 ft. minimum
		Door Height (Mechanical Room)	9 ft. minimum
		Door Width	• CSC, CDC, MSCs- 6 Ft. • NSC- 3 ft.
		Slab to Floor Above	16 ft. minimum
		Raised Floor to Ceiling	12 ft. minimum
		Raised Floor in new data center construction (used only if CFD analysis determines raised floor is the best cooling solution)	• 18 in. minimum above slab • 24 in. fully loaded racks • 36 in. high density
2	Floor Height	Slab to Floor Above	16 ft. minimum
		Raised Floor to Ceiling	12 ft. minimum
		Raised Floor in new data center construction (used only if CFD analysis determines raised floor is the best cooling solution)	• 18 in. minimum above slab • 24 in. fully loaded racks • 36 in. high density

ID	Primary Attribute	Secondary Attribute	Specification
3	Floor Tile	Perforated Tile	• Only positioned at the base of the cold aisle racks • Positioned so that they can be removed without interference from racks
		Dimensions	24 in. by 24 in.

3.1.2.2 Data Center Layout Standard

Data centers will be designed in accordance with the specifications below, VA standards, and industry best practices referenced in Appendix B.

Computational Fluid Dynamics (CFD) modeling shall be used to determine the most effective and cost-effective layout and containment solution for a given space (including new design/build, capability expansion, and lifecycle replacement). All data center design for new data centers, expansion, or significant modification of existing data centers will be approved through OIT Solution Delivery Data Center and Cloud Engineering (VAITESEDatacenterEngineering2@va.gov).

Airflow direction shall be a prime consideration when designing the floor layout and when selecting and procuring IT equipment. Equipment shall be specified, procured, configured, and installed so that the equipment draws cool air from the front face of the rack and flows from the front of the rack to the rear and the hot exhaust exiting the chassis at the rear face of the rack. Do not create conditions for exhaust to be recirculated back into cold air supply spaces.

Table 12: Data Center Floor Layout Standard

ID	Primary Attribute	Secondary Attribute	Specification
1	Aisles	Orientation	• Front of racks will be oriented toward cold aisle as in Figure 2 • Front of racks will be aligned with each other to create a continuous linear aisle • If a raised access floor is utilized, front of racks will be flush with edge of floor tiles
		Width	• 4 ft. minimum in cold aisles • 3 ft. minimum in hot aisles (4 ft. recommended)
		Cold Aisle	Power cables if run in an access floor will be placed in cable trays in cold aisles

ID	Primary Attribute	Secondary Attribute	Specification
		Hot Aisle	Data cables if run in an access floor will be placed in cable trays in hot aisles
		Containment	Hot or cold aisle containment will be determined based on data center layout, HVAC configuration, and analysis
2	Support Equipment	Computer Room Air Condition (CRAC)	• Placed along the perimeter of the data center or in a dedicated mechanical room • Centered on Hot aisles • Exact placement determined using CFD analysis
		PDUs	• Not to be placed within cold aisles • "A" side PDU and "B" side PDU will be aligned in a regular order to indicate power source.
		Remote Power Panels (RPP)	• Not to be placed within cold aisles • "A" side RPPs aligned in a row • "B" side RPPs aligned in a row
		UPSs	• CDCs and MSCs UPSs shall be in separate dedicated spaces • For CSCs placed along the perimeter of the data center in accordance with CFD analysis or dedicated space
3	Equipment Rows	Length	No more than 14 racks/cabinets per pod
		Orientation	No rows that terminate along a wall
		Cabinet/Rack Placement	• End of row racks shall be used for the Horizontal Distribution Area (HDA) to accommodate structured cabling • Gaps between adjacent cabinets within each rack are closed to eliminate internal paths of bypass and recirculation of air flows • Equipment cabinets will be used within the rows as specified in corresponding tables below
		Clearance	• 3 ft. minimum distance from walls • 4 ft. minimum distance from air

ID	Primary Attribute	Secondary Attribute	Specification
			conditioning and power distribution equipment (6 ft. recommended)

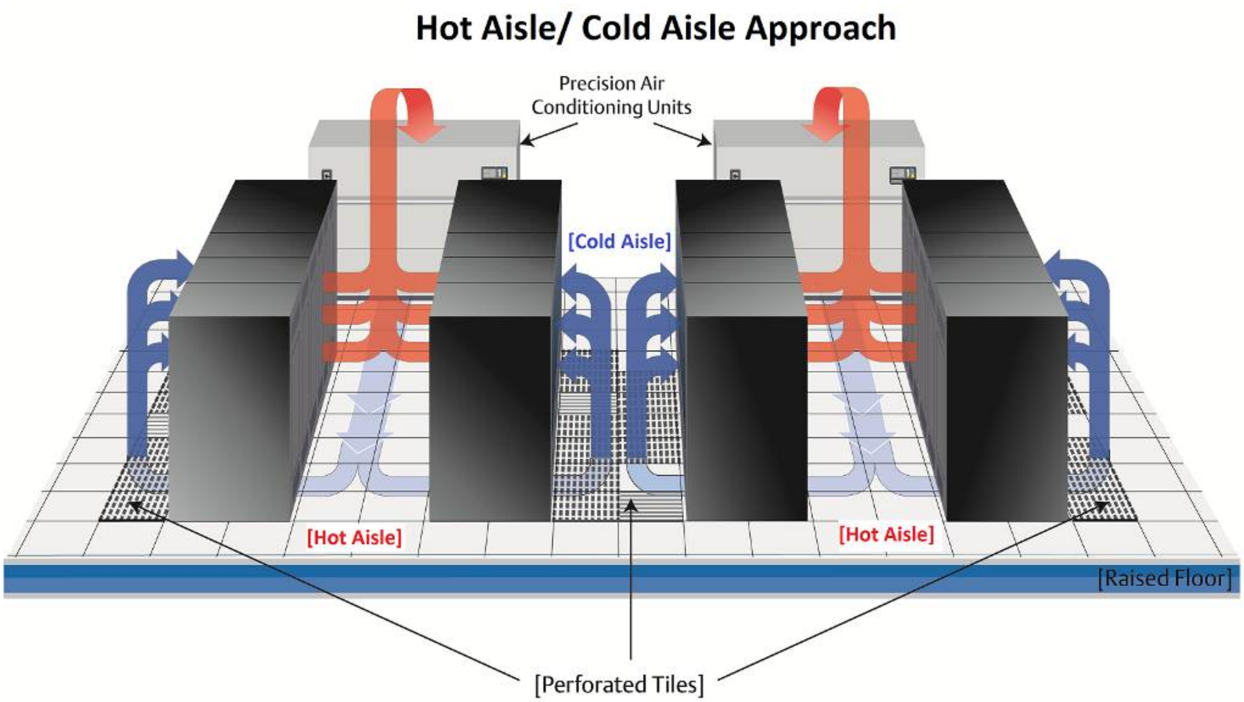


Figure 5: Hot Aisle/Cold Aisle Approach

Implementation Guidance

Determination and maintenance of categorization of enterprise data center facilities shall be conducted by NDCOL, in alignment with their mission to report Department data center information to the OMB.

These standards apply to new data center and telecommunications space construction as well as expansion, modification, and operation of existing facilities.

Note: VA shall not design or build "*shallow rooms*" or similar closets. Shallow rooms are intended for access to vertical chases and riser cables installed there only. Where a distribution TR is necessary in a location (i.e. the third floor of the west wing of a hospital), VA shall construct and operate out of a standardized TR.

3.1.2.3 Data Center Planned Redundancy Levels

VA data center facilities shall be designed and operated in accordance with the EIA/TIA-942 Ratings for each data center type, except as detailed specifications are provided in this and other VA data center facilities standards.

These specifications define the minimum system redundancy levels for the physical plants and facilities physical infrastructure systems (“system”) that support VA enterprise data centers. This standard shall be used to quantify and qualify designs of physical infrastructure supporting data center facilities and spaces when those spaces are being designed, built, retrofitted, refreshed, and updated.

The minimum design redundancy levels for new and replacement systems in VA data centers are detailed above. These designs balance system implementation and operation cost against availability needs for each type of VA data center facility. In planning physical infrastructure system projects, reduction of potential single points of failure is generally considered more critical than increasing the redundancy level of a system.

From a design perspective on a system+system (2N) design, the smaller capacity of the two individual systems is considered the overall system capacity. For instance, a 2N system with a 500K side and a 750K side has a maximum capacity of 500K.

Redundancy is represented relating to the need (N). If no redundancy is required the system simply has a redundancy level of N. To gain the simplest form of redundancy one additional system is added represented by N+1. For example, if you need two CRACs to meet the cooling need of the data center, then to obtain an N+1 redundancy level a third CRAC must be added. To provide further redundancy a 2N system could be put in place. In the CRAC example four CRACs would create a 2N system. Furthermore, for a 2N+1 system five CRACs would be required to meet this level of redundancy. Finally, for a 2(N+1) system six CRACs would be required. See Figure 6: Generic Redundancy Level Standards for Physical Plants, Facilities, and Infrastructure Systems.

*Circled loads are active

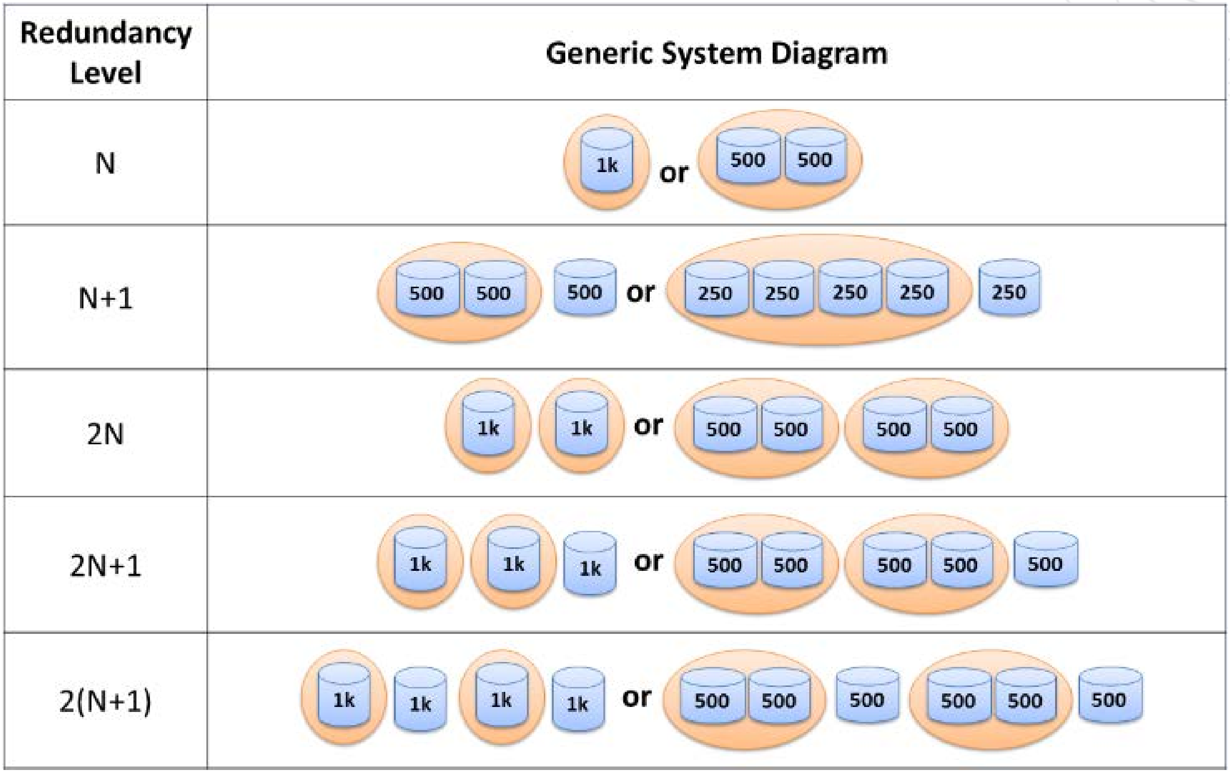


Figure 6: Generic Redundancy Level Standards for Physical Plants, Facilities, and Infrastructure Systems

Table 13: Data Center Planned Redundancy Levels

ID	Primary Attribute	Secondary Attribute	Specification
1	Facility Power Input Sources	Core Data Center (CDC)	N+1 redundant feed (one commercial, one generated)
		Mission Support Center (MSC)	N+1 redundant feed (one commercial, one generated) for an ANSI/TIA Rating 3 facility or single feed (N) for an ANSI/TIA Rating 2 facility
		Campus Support Center (CSC)	N+1 redundant feed (one commercial, one generated)
		Network Support Center (NSC)	N (one commercial)
2	Emergency Power Generation Source	Core Data Center (CDC)	N+1
		Mission Support Center (MSC)	N for rating 2 facility and N + 1 for rating 3 facility.
		Campus Support Center (CSC)	N+1
		Network Support Center	None required

ID	Primary Attribute	Secondary Attribute	Specification
		(NSC)	
3	Uninterruptible Power System (UPS) Technical Power Systems	Core Data Center (CDC)	2N
		Mission Support Center (MSC)	N+1 (distributed redundant modules or block redundant system with dedicated battery string for each module)
		Campus Support Centers (CSC)	2N
		Network Support Center (NSC)	N (single UPS system, single battery string)
4	Electrical Distribution (ED) (UPS to IT equipment)	Core Data Center (CDC)	2N (mirrored A/B distribution from UPS to rack in support of all IT systems)
		Mission Support Center (MSC)	2N (mirrored A/B distribution from UPS to rack in support of all IT systems)
		Campus Support Center (CSC)	2N (A/B distribution from UPSs to rack in support of all IT systems)
		Network Support Center (NSC)	N
5	Environmental Support (HVAC)	Core Data Center (CDC)	N+1 redundancy for mechanical equipment. Temporary loss of electrical power will not cause loss of cooling but may cause temperature to elevate within operational range of critical equipment
		Mission Support Center (MSC)	N+1 redundancy for mechanical equipment. Temporary loss of electrical power will not cause loss of cooling but may cause temperature to elevate within operational range of critical equipment
		Campus Support Center (CSC)	N+1 redundancy for mechanical equipment. Temporary loss of electrical power will not cause loss of cooling but may cause temperature to elevate within operational range of critical equipment
		Network Support Center (NSC)	N

Core Data Center (CDC) and Campus Support Center (CSC) Redundancy Levels

Table 14: Core Data Center (CDC) and Campus Support Center (CSC) Planned Redundancy Levels

ID	Primary Attribute	Secondary Attribute	Specification
1	Facility Power Input Sources	System Redundancy Components	N+1 redundant feed (one commercial, one generated)
		Distribution Paths	One active, one standby (one commercial utility feed, one standby generation, automatic transfer switch)
		System (N) Capacity	Total facility design capacity (either commercial feed or generator can provide 100 percent of the facility's design load)
2	Emergency Power Generation Source	System Redundancy Components	N+1
		Distribution Paths	Single path (automatic transfer switch)
		System (N) Capacity	Total facility design capacity (generator source can provide all critical mechanical and electrical support for the facility)
3	UPS Technical Power Systems	System Redundancy Components	2N
		Distribution Paths	Two simultaneously active (A/B configuration)
		System (N) Capacity	Each UPS system (A/B) rated for 100 percent of data center design load
		UPS Technology	Two delta conversion or double conversion UPS systems
4	Electrical Distribution (UPS to IT equipment)	System Redundancy Components	2N (mirrored A/B distribution from UPS to rack in support of all IT systems)
		Distribution Paths	Two simultaneously active (A/B distribution from UPSs to Power Distribution Units (PDU) to rack PDUs
		System (N) Capacity	Maximum design loading of all components with one distribution path offline at 80 percent per NEC
5	Environmental Support (HVAC)	System Redundancy Components	N+1 redundancy for mechanical equipment. Temporary loss of electrical power will not cause loss of cooling but may cause temperature to elevate within operational range of critical equipment
		Redundancy Configuration	One normal, one alternate (systems in automatically controlled lead-lag configuration)
		System (N) Capacity	Total facility design capacity (each side of cooling system designed to ultimate data center load)

Mission Support Center (MSC) Planned Redundancy Levels

Table 15: Mission Support Center (MSC) Planned Redundancy Levels

ID	Primary Attribute	Secondary Attribute	Specification
1	Facility Power Input Sources	System Redundancy Components	N+1 Redundant Feed (one commercial, one generated) for an ANSI/TIA-912 rated 3 facility or Single feed (N) for an ANSI/TIA-942 rated 2 facility
		Distribution Paths	One active, one standby (one commercial utility feed, one standby generation, automatic transfer switch)
		System (N) Capacity	Total facility design capacity (either source can provide 100 percent of the facility's design load)
2	Emergency Power Generation Source	System Redundancy Components	• N+1 for an ANSI/TIA-942 rated 3 facility • N for an ANSI/TIA-942 rated 2 facility
		Distribution Paths	Single path (automatic transfer switch)
		System (N) Capacity	Total facility design capacity (generator source can provide all critical mechanical and electrical support for the facility) for an ANSI/TIA-942-rated 3 facility or sized for UPS and mechanical system without redundancy for a Rated 2 facility
3	UPS Technical Power Systems	System Redundancy Components	N+1 (distributed redundant modules or block redundant system with dedicated battery string for each module)
		Distribution Paths	Two simultaneously active (A/B configuration)
		System (N) Capacity	Each UPS system (A/B) rated for 100 percent of data center design load
		UPS Technology	Delta conversion or double conversion UPS systems
4	Electrical Distribution (UPS to IT equipment)	System Redundancy Components	2N (mirrored A/B distribution from UPS to rack in support of all IT systems) in an ANSI/TIA-942 rated 3 facility or single cord feed in an ANSI/TIA-942 rated 2 facility
		Distribution Paths	Two simultaneously active (A/B distribution from UPSs to PDUs to MPDUs)
		System (N) Capacity	Maximum design loading of all components with one system offline at 80 percent per NEC

ID	Primary Attribute	Secondary Attribute	Specification
5	Environmental Support (HVAC)	System Redundancy Components	N+1 redundancy for mechanical equipment • Temporary loss of electrical power will not cause loss of cooling, but may cause temperature to elevate within operational range of critical equipment for an ANSI/TIA-942 rated 3 facility or N+1 redundancy for mechanical equipment) • Loss of electrical power can cause loss of cooling in an ANSI/TIA-942 rated 2 facility
		Redundancy Configuration	One normal, one alternate (systems in automatically controlled lead-lag configuration)
		System (N) Capacity	Total facility design capacity (cooling system designed to ultimate data center load)

3.1.2.3.1 Network Support Center (NSC) Planned Redundancy Levels

Table 16: Network Support Center (NSC) Planned Redundancy Levels

ID	Primary Attribute	Secondary Attribute	Specification
1	Facility Power Input Sources	System Redundancy Components	N (one commercial)
		Distribution Paths	One path
		System (N) Capacity	Total facility design capacity (commercial feed can provide 100 percent of the facility’s design load)
2	Emergency Power Generation Source	System Redundancy Components	None required
		Distribution Paths	None required
		System (N) Capacity	None required
3	UPS Technical Power Systems	System Redundancy Components	N (single UPS system, single battery string; may be individual rack-mount UPS systems for each rack)
		Distribution Paths	One path
		System (N) Capacity	UPS system(s) rated for 100 percent of critical IT system design load
		UPS Technology	Rack-mounted line interactive UPS systems (mechanical automatic transfer switches

ID	Primary Attribute	Secondary Attribute	Specification
			optional)
4	Electrical Distribution (UPS to IT equipment)	System Redundancy Components	N
		Distribution Paths	One path
		System (N) Capacity	Maximum design loading of all components with one system offline at 80 percent per NEC
5	Environmental Support (HVAC)	System Redundancy Components	N
		Redundancy Configuration	One system
		System (N) Capacity	Total facility design capacity (cooling system designed to ultimate data center load)

3.1.2.4 Telecommunications Room Layout

The Telecommunications Room (TR) serves as the transition point between the Horizontal and Backbone cabling systems. This room will contain all LAN, security, video distribution, paging, and any other system that serves the TR zone.

Few TRs are exactly alike. OIT shall design or conduct design reviews of all projects involving new or renovated Telecommunications Rooms to assure that the power, cooling, and room layout are consistent with VA and industry standards.

3.1.2.5 Entrance Facility

Entrance facilities are the building entrance point for incoming circuits and represent the transition point from Inside Plant to Outside Plant.

Entrance Facilities will have similar features as the Telecommunications Room, including backboard, racks, power, and cable management. OIT shall design or conduct design reviews of all projects involving new or renovated Entrance Facilities to assure that the power, cooling, and room layout are consistent with VA and industry standards.

3.1.2.6 Network Equipment Racks

Table 17: Network Equipment Racks

ID	Primary Attribute	Secondary Attribute	Specification
1	Dimensions	Height	8 ft. maximum
		Width	24 in.
		Depth	30 in.
		Rail Style (Front/Rear)	• EIA threaded or • Square punched
		Rack Units (RU)	45
2	Design	Style	Channel rack
		Static Capacity	2,000 lbs. minimum
		Cable Management	Built in overhead waterfall and channel cable management strap attachment points
		Rail Marking	Present on front and rear rails graduated starting one RU from the bottom in RUs

ID	Primary Attribute	Secondary Attribute	Specification
		Color	White or existing match
3	Required Accessories	Air Dam and Sealing Kit	Required under each cabinet and between rails and cabinet sides
		Grounding Strap	• 6 in. • Bonded in accordance with ANSI/TIA-607-C Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises • Tagged with “Do Not Disconnect”
		Rack PDU Brackets	Rack PDU brackets

Evaluation Factors

- Dimensions
- Cable management capacities
- Available accessories for horizontal and vertical cable management
- Static capacity
- Locking front or rear doors
- Side-to-side airflow dams

Implementation Guidance

Racks shall have proper seismic rating when deployed in areas prone to earthquakes or as required by Federal regulation or other AHJs and best practices.

Racks shall be used for all networking gear to include the Main Distribution Area (MDA) and the Horizontal Distribution Area (HDA). This standard specifies a deep channel open rack to accommodate the depth and weight of most data networking equipment while providing high capacities for horizontal cable and large diameter Category 6a patch cords.

White racks are specified for two reasons. First, typically servers, switches, patch panels, blanking panels, KVMs and other rack equipment are all black. This makes it difficult for technicians to work within a rack due to the low light levels. A white rack shall be used for reduced energy absorption and increased reflectivity.

Server cabinets shall not be used in place of network racks due to inherent cable management limitations even within cabinets that have been designed for network elements.

3.1.2.7 Equipment Cabinets

These specifications define a standardized server enclosure with sufficient depth to accommodate active hardware and cable management.

Table 18: IT Equipment Cabinet Standards

ID	Primary Attribute	Secondary Attribute	Specification
1	Dimensions	Height	8 ft. maximum
		Width	• 24 in. • 30 in. permitted in groups of four to maintain alignment with floor tiles
		Depth	48 in. maximum with all doors and accessories installed
		RU	45
2	Design	Rails	• Square-punched (2 pair = front + rear) • Toolless adjustable
		Rack Marking	Present on front and rear rails graduated starting one RU from the bottom
		Static Capacity	2,500 lbs. minimum
		Color	White or existing match
		Bonding Connection	Doors and frame
		Green Technology	Heat containment per data center cooling architecture
3	Panels	Front Door	Single perforated (minimum 63 percent open)
		Rear Door	• Single Solid OR • Split, perforated where vertical exhaust ducts cannot be implemented
		Latches	Keyed lock upgradable to keyless system compression latch
		Top	• Vertical exhaust duct (heat containment) • High capacity cable access w/brushes

ID	Primary Attribute	Secondary Attribute	Specification
		Side	• Solid • Locking
		Bottom	• Solid • With high capacity cable access w/ brush grommets or air dam foam
4	Required Accessories	Air Dam and Sealing Kit	Required under each cabinet and between rails and cabinet sides
		Castors	Required for safe cabinet movement
		Leveling Legs	Required
		Grounding Strap	• 6 in. • Bonded in accordance with ANSI/TIA-607-C Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises • Tagged with “Do Not Disconnect”
		RPDU brackets	Zero U vertical single mount brackets for standard density cabinets

Evaluation Factors

- Dimensions
- Vertical exhaust duct/heat containment
- Available RUs

Implementation Guidance

This standard specifies green technology in the form of heat containment. This approach to thermal management does have corresponding data center design requirements and, therefore, should be selected based on the cooling architecture of the target data center.

Enclosures shall be equipped with seismic bracing when deployed in areas prone to earthquakes or as required by Federal regulation or other AHJs and best practices.

White channel racks are specified in this standard for reduced energy absorption and increased reflectivity. White server cabinets are specified because they improve the technician’s ability to work within a cabinet due to the improved light levels. Second, a white cabinet reduces energy absorption and increases overall reflectivity within the space.

3.1.3 Telecommunications Space Environment Conditioning

These specifications define the environmental operating envelope conditions and provide design and operations guidance for how to achieve and maintain those conditions in VA enterprise data centers. This standard shall be used to specify and design computer room spaces and the environmental control systems and equipment to be operated therein.

VA data center environmental requirements are classified as Environmental Class A1 per American Society of Heating and Air-Conditioning Engineers (ASHRAE) TC9.9, requiring "tightly controlled environmental parameters (dew point, temperature, and relative humidity)" to support mission critical operations.

IT equipment load shall not exceed the overall cooling capacity of the data center (1 Watt of power consumed requires 1 Watt of cooling). Excess demand requires re-engineering or self-contained high-density cooling solutions. In general, 1 refrigeration ton = ~3.517 kW = 12,000 BTUs.

The ASHRAE-recommended environmental envelope allows an IT equipment inlet temperature range of 64°F to 81°F. VA data center facilities (with the exception of NSCs and TRs) shall maintain an average rack-face inlet temperature range of 72°F to 81°F (see Data center Monitoring standard). In summary, the 'average rack-face inlet temperature' will be determined as the average of a standard three-sensor temperature measurement at the bottom, mid, and top height levels as measured 2 in. distance from the IT equipment inlets. For implementations that do not yet have the standard three-sensor installation shall be measured at 48 in. height above the floor at 2 in. distance in the interim. Data center temperature and humidity conditions shall be measured at the air intake to the IT equipment as described, rather than measuring the ambient or average condition(s) throughout the data center.

Cooling equipment set points will vary depending on equipment, set point thermocouple location, equipment location with respect to the IT equipment, and other factors. Establish and modulate the cooling equipment set point(s) to achieve the 72°F to 81°F IT equipment inlet temperature range, while staying within the other (humidity, dew point) specifications. IT equipment exhaust temperatures shall not be used for determination of cooling equipment set points.

High-density racks shall be distributed across the entire data center floor to keep cooling systems from becoming ineffective (unless when employed with cold isle containment). This allows high-density racks to pull additional cool air from perforated tiles feeding the adjacent low-density racks that require less cooling.

Alternatively, dedicated high-density areas may be employed with cold isle containment to provide additional capability to power and cool to an average value below the peak enclosure value for high-density equipment. Typically this includes shortening the airflow path between the cooling system and the rack.

In response to the fourth edition of ASHRAE's Thermal Guidelines for Data Processing Environments, the Telecommunications Industry Association (TIA) has published ANSI/TIA-569-D-1-2016, Telecommunications Pathways and Spaces: Addendum 1- Revised Temperature and Humidity Requirements for Telecommunications Spaces. This standard addresses ASHRAE Class B Spaces. The temperature and humidity requirements for these telecommunications spaces are as follows:

Table 19: ASHRAE Class B Environmental Requirements

ID	Primary Attribute	Secondary Attribute	Specification
1	Class B Space • Distributor room/ enclosure • Entrance room or space • Access provider space • Service provider space	Temperature	41 ºF - 95 ºF dry bulb
		Humidity Range, Non-Condensing	8% RH - 80% RH
		Dew Point	≤ 82.4°F

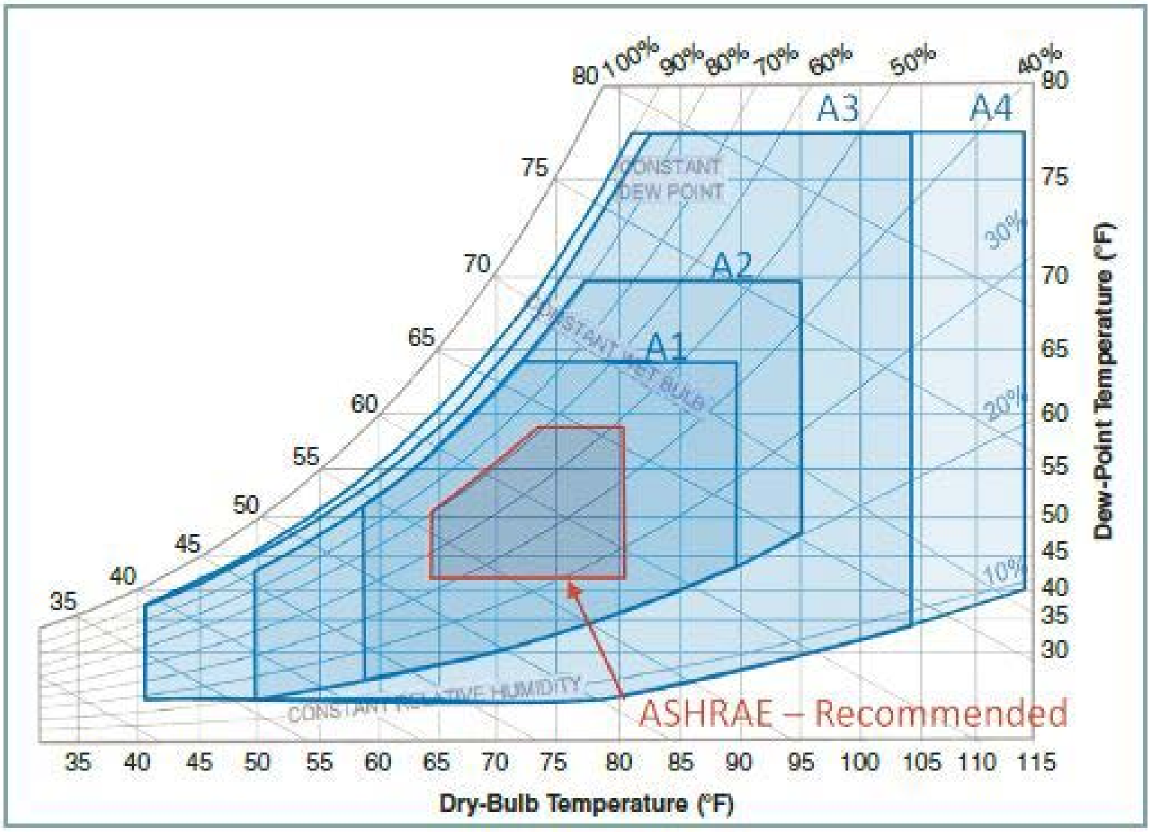


Figure 7: 2011 ASHRAE Environmental Classes for Data Center Applications

Note: Envelopes Represent Conditions at IT Equipment Inlet

3.1.3.1 Data Center Facility Environment Conditioning Standards (CDC, MSC, and CSC)

Table 20: Data Center Facility Environment Conditioning Standards (CDC, MSC, and CSC)

ID	Primary Attribute	Secondary Attribute	Specification
1	Environmental Envelope	Temperature (at IT equipment inlet)	72°F - 81°F
		Humidity (at IT equipment inlet)	≤ 60 percent
		Dew Point (at IT equipment inlet)	≤ 59°F
		Rate of Temperature Change	≤ 9°F per hour
		Room Height (Vertical Dimension)	16 ft. height (12 ft. legacy) from finished floor level, with larger heights preferable
2	Environmental Control Equipment	Primary Air Conditioning Type	Computer Room Air Conditioning (CRAC)
		Humidity Control Equipment	Dedicated, low-pressure dry fog humidification systems (only as necessary)

ID	Primary Attribute	Secondary Attribute	Specification
		Airflow Plenum	Underfloor or above ceiling is not used for open airflow distribution
		Static Pressure (Raised Floor)	0.15 in. of H20 water column (WC), Design distribution shall be not less than 5kW (1.422 ton) of cooling per each 25 percent perforated tile
		Airflow Tile (Raised Floor)	• 25 percent open for SD racks • 50 percent open for HD racks • ARU/active tiles per CFD analysis
		Airflow Control Equipment (Raised Floor)	Fill in all floor penetrations to eliminate leakage to minimize cooling plenum static pressure loss
		High Capacity Grate Tiles (Raised Floor)	May be used in the floor near high-density areas (over 5 kW per rack) to eliminate hot-spots and air shortages
		Overhead Supply Air Ducts	• Vents directly placed over cold aisle • Placed as closely as possible to equipment intake • No lateral diffusing vents
		Ducted Systems Hot Air Return Vents	When used, placed as closely as possible to equipment exhausts or directly connected via flexible piping
		Blanking Panels	Required in every RU where no equipment resides on the front (cold aisle) of each cabinet
		Computational Fluid Dynamics (CFD)	Required for all new or significantly modified data centers (except NSCs)
		Containment Systems	• Must be considered for all new or significantly modified data centers • Required where close-coupled air conditioning is employed
		Rules-based Borrowed Cooling (Existing data centers)	• Utilized for high- density deployment to borrow adjacent underutilized cooling capacity • Racks separated to prevent exceeding peak enclosure power and cooling values
		Close-Coupled Air Conditioning Systems	Used only with a containment system and when shown to be effective in CFD modeling

Evaluation Factors

- Temperature and humidity controlled within designated parameters
- Temperature and humidity measured at appropriate locations
- Bypass and recirculation air measures implemented
- CFD modeling used for data center design

Implementation Guidance

Identify an environmental control window that is compatible with all of the different thermal specifications, types of equipment, and equipment vintages in the data center for optimal energy saving.

Blanking panels and air dams shall be installed in all positions within the rack that do not contain equipment. Failure to do so causes hot exhaust air to mix with the cool supply air (see example A) and does not allow for an adequate amount of cool air to reach the intake of all the equipment present in the rack. With blanking panels installed (see example B) the hot air does not have a path back to recirculate so only cold air is provided to the equipment intake.

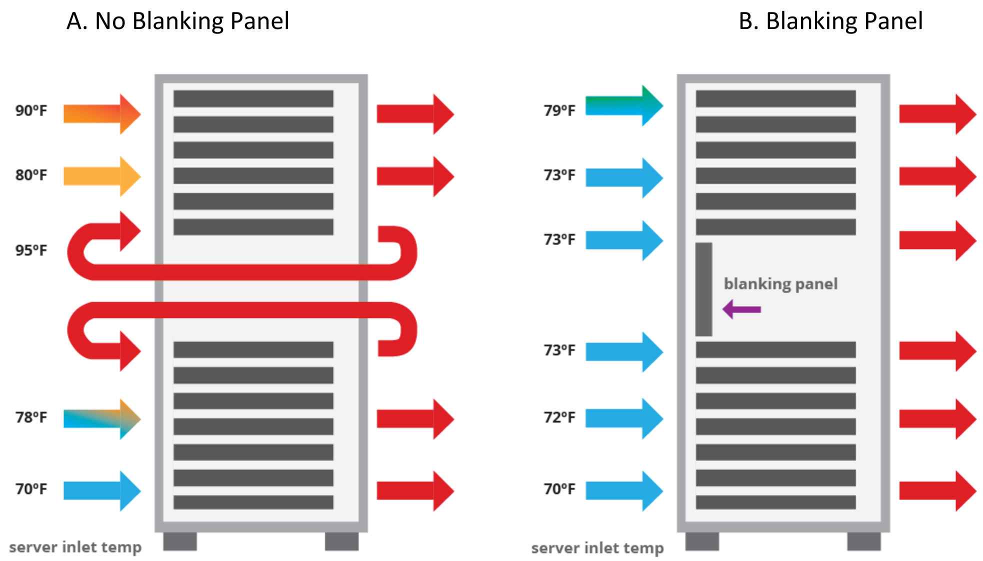


Figure 8: Blanking Panel Application

3.1.3.2 Data Center Facility Environmental Standards – Exceptions

Exceptions to these attributes are listed in tables below for each class of data center to include NSC standards which are not covered above.

Table 21: CDC Facility Environmental Requirements (Exceptions)

ID	Primary Attribute	Secondary Attribute	Specification
1	Environmental Envelope	Alarming	• Automatic alarming when parameters are exceeded is recommended where automated systems are available • Monitoring integrated into Building Automation System (BAS) with automatic alarming when conditions exceed prescribed limits

Table 22: MSC Facility Environmental Requirements (Exceptions)

ID	Primary Attribute	Secondary Attribute	Specification
1	Environmental Envelope	Monitoring	Monitored by automatic system(s) in multiple locations, with indicators allowing operators to determine the general condition of the data center

Table 23: CSC Facility Environmental Requirements (Exceptions)

ID	Primary Attribute	Secondary Attribute	Specification
1	Environmental Envelope	Room Height	Vertical dimension of new data centers shall be not less than 12 ft. height (legacy facilities are encouraged to maximize room height through removal of aesthetic suspended ceilings to maximize cooling efficiency)

Table 24: NSC Facility Environmental Requirements (Exceptions)

ID	Primary Attribute	Secondary Attribute	Specification
1	Environmental Envelope	Temperature (at IT equipment inlet)	72°F - 89°F
		Room Height	Not less than 8' from finished floor level to ceiling
		Monitoring	Monitored with indicators allowing operators to determine the general condition of the data center
2	Environmental Control Equipment	Primary Air Conditioning Type	Split System Air Conditioners in any NSC with active IT server and storage components
		Humidity Control Equipment	No dedicated humidity control equipment required
		Airflow Plenum	Not applicable
		Airflow Control Equipment	Not applicable
		Computational Fluid Dynamics (CFD) Modeling	Not required
		Containment Systems	Not specified

3.1.3.3 Environmental Control Equipment Requirements

Table 25: Environmental Control Equipment

ID	Primary Attribute	Secondary Attribute	Specification
1	Computer Room Air Conditioner (CRAC) Equipment	Total Cooling Capacity	Not less than 10 tons per unit
		Placement	CRAC units employed with raised access floors should be placed perpendicular to hot isles for effective air distribution supply to the cold isles.

ID	Primary Attribute	Secondary Attribute	Specification
			Applies to all configs that use CRACs
		Fan Type	• New and replacement units shall utilize electrically commuted (EC) fan technology • Upgrade centrifugal fan units with EC plug fans where feasible
		Variable Speed Drive (VSD)	• Shall be used in all possible applications • Fan(s) should be controlled by an automated VSD system provided internally to the CRAC or as supplementary external equipment powering the fans • Older CRAC units shall be retrofitted with VSDs
		Intake Chimneys	• Utilize CRAC intake hoods or chimneys on downdraft models to draw in heated air from the highest, warmest part of the room when possible to maximize ΔT across the cooling coils • Do not extend hoods into a void ceiling space • Retrofit existing CRAC units with hoods where feasible
		Floor Stand	Where CRAC units are used in computer spaces with a raised access floor, they shall be mounted level with the finished floor level on an adjustable, seismic-rated floor stand designed for the equipment
		Service Clearance	Provide clear 36 in. on the front and both ends of each unit, unless manufacturer guidance requires more for servicing
		Control System	• Install a management control system for all computer rooms with three (3) or more CRAC units. • The control system shall operate the system(s) in the most energy efficient manner possible maintaining planned system redundancy levels, specified IT equipment inlet conditions, and maximizing the ΔT between the CRAC supply and return
		Local Monitoring	• Each CRAC shall have a local monitoring panel affixed to the unit accessing the following information: • System automatic restart with

ID	Primary Attribute	Secondary Attribute	Specification
			programmable delay • Sequential load activation • Sensor calibration • Current temperature set point and location of that set point • Current supply and return temperature and humidity • Unit diagnostics (fan, valve, alarm) • Alarm log history • Run time log • Audible and visual alarm
2	Split System Air Conditioner Equipment	Operation	Automatic operation to maintain set point temperature in the computer space for >99 percent exterior environmental conditions
3	Self-Contained or Portable Air Conditioner Equipment	General Usage	Shall not be used as part of a planned cooling system in VA data centers
		Emergency Usage	May be used for supplemental emergency cooling for short durations when primary equipment is unable to support the design load (e.g. until repaired)

3.1.3.4 Airflow Control

3.1.3.4.1 Room Height

Legacy facilities are encouraged to maximize room height (vertical dimension) through the removal of aesthetic suspended ceilings to maximize cooling efficiency.

3.1.3.4.2 Air-Distribution Ceiling Plenums

In new designs, ceiling void spaces (above a suspended ceiling) shall not be used as plenum spaces for air distribution (return) except when fully ducted above a suspended ceiling (legacy facilities may continue to use down flow CRAC units with in-room and above-ceiling return designs). The use of grate ceiling tiles to allow hot air into a non-return ceiling void (not plenum) space is acceptable. When used as a plenum (without ducting), the horizontal surfaces of the plenum must be periodically cleaned (vacuumed). Taking the friability of typical suspended ceiling acoustic tiles, their location above IT equipment, and the interface of other infrastructure equipment (lighting, fire suppression, structured cabling systems, et cetera) into account, the maintenance requirement is not offset by the additional risks and costs incurred.

A recommended best practice is to remove suspended ceiling systems in data center facilities altogether, to allow exhausted hot air to rise. Because cooling equipment efficiency is directly proportional to the change in temperature, extending CRAC intake ducts to the hottest exhaust air (at the ceiling) presents the greatest opportunity for efficiency.

The use of 'egg-crate' grate ceiling tiles to allow hot air into a non-return ceiling void space is acceptable. Unless directly ducted to the IT equipment rack discharges, do not extend CRAC intakes through a suspended ceiling, as this makes the space a plenum.

Where the ceiling void space is used as a plenum return in existing (legacy) facilities, future physical infrastructure technical refresh projects shall change the air path to eliminate this usage.

3.1.3.4.3 Air-Distribution Floor Plenums

Basically the goal of using air-distribution floor plenums is to provide uniform tile air velocity cooling effect across all perforated tiles or grilles.

Overhead cabling is used whenever possible to eliminate possible airflow restriction. Under-floor obstructions such as network and power cables are minimized to prevent obstruct of airflow and cooling supply to the racks. Excess unused cables and equipment cables shall be reclaimed to minimize blockage of air flow. Floor vents are not placed too close to CRAC units to avoid producing negative pressure which causes room air to be drawn back under the floor.

CFD analysis is required before selecting raised-floor solutions.

3.1.3.4.4 Perforated Tiles and High Capacity Grate Tiles

Perforated tiles or grates are used to introduce cold air directly into the equipment intake in the cold aisle. An appropriate number of tiles or grates are used to match the load that is calculated in the cold aisle. Improperly placed tiles increase non-functional air flow and reduce the pressure of cold air flow where it is required. Placing too few in the cold aisle will cause recirculation and too many will increase the amount of bypass. If we can't completely maximize air flow efficiency, then bypass is preferred over recirculation issues.

High capacity grate tiles may be used in the floor near high-density areas (over 5 kW per rack) to eliminate hot-spots and air shortages. These should not be automatically addressed by installing high-capacity grates without considering the complications that may be introduced:

- High-capacity grates pass three times more air than normal capacity tiles and may alter the fixed pressure that is required to feed cold air to other servers
- Additional forced air may bypass the intended target equipment and flow right past the faces to the top of the aisle providing no benefit
- Creates large airflow variations
- Dramatically alters under-floor pressure gradients, making cooling non-uniform and unpredictable
- Impacts airflow in neighboring areas. Some locations will NOT receive enough cooling
- Air Removal Units (ARU) or active floor tiles are used to improve targeted air flow for higher density racks

A recalculation of CFD modeling is required when high-capacity grates or active floor tiles are added or relocated.

3.1.3.4.5 Air Containment Devices

Where an underfloor plenum is used for cooling air distribution, grommets, or air dam foam sheets shall be used at all access floor penetrations to minimize cooling plenum static pressure loss.

Seal other cabinet holes that traditional blanking panels do not fit with manufacturer sealing kits. Other air containment solutions include expanding foam pillows, fire-stop caulking, temporary metal or fiberboard cover plates, and commercial expanding foam are not acceptable for use in VA data centers; they are either temporary, are not flexible enough to allow for re-cabling, require replacement during any changes, or may present fire and safety hazards.

3.1.3.4.5.1 Brushed Floor Grommets

Figure 9: Brushed Floor Grommet

3.1.3.4.5.2 Air Dam Foam Sheets

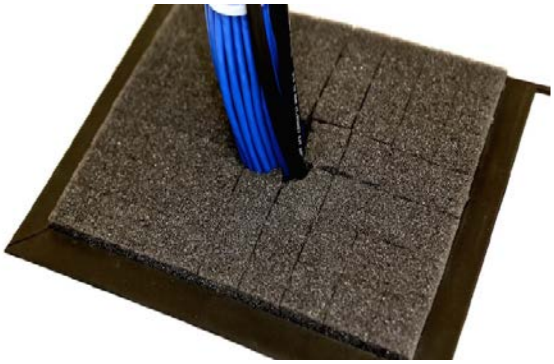


Figure 10: Air Dam Foam

3.1.3.4.5.3 Blanking Panels

Blanking panels reduce hotspots and bypass airflow by preventing equipment exhaust air or hot-aisle air from migrating to the conditioned air-intake stream at the front of the IT equipment rack. All IT equipment racks shall have blanking panels installed between IT equipment in order to prevent recirculation of cooling airflow.

3.1.3.4.5.4 Blocking Other Recirculation Paths

Ensure that IT equipment racks are installed flush to one another without air gaps between the racks. Use appropriate materials to fill gaps between racks to prevent recirculation of exhaust air to the cold aisle.

Recirculation air under racks has been shown to be a significant contributor to cooling inefficiency in VA data centers. Install blanking materials under IT equipment racks in the same plane as blanking panels.

3.1.3.4.5.5 Air Distribution Containment Systems

Legacy VA data centers typically use the entire room volume as a heat sink, the least efficient and least effective manner of controlling temperatures and humidity.

Air containment systems may increase the efficiency of data center HVAC systems by separating cold (supply) and hot (exhaust) air streams, allowing hotter and drier air to be introduced to the CRAC unit or close-coupled cooling system. The efficiency of these systems is directly proportional to the ΔT between the air streams.

Containment systems may be installed in any VA data center to improve the efficiency and/or effectiveness of the HVAC system. Containment systems are required to be installed in all VA data centers where close-coupled cooling systems are employed. Both hot and cold containment system designs are acceptable and may be appropriate for use in VA data center facilities. Use CFD modeling to determine which design solution(s) will be most effective and cost-effective prior to implementation.

Local AHJ fire and safety standards may supersede this standard or make containment solutions cost prohibitive.

3.1.3.4.5.6 Containment Equipment

Use the most cost-effective containment solution available that will satisfy the efficiency design criteria for a given implementation. Hard walls, sliding doors, and hard roofing containment are not required. Vinyl sheeting (“meat locker door”) solutions are acceptable. When containment is used, consideration must be given to fire alarm and suppression systems to ensure containment systems do not interfere.

3.1.3.4.5.7 Cold Containment

Cold containment solutions are intended to collect and contain cold (supply) air from cooling units (CRACs) at the inlets of the IT equipment. Design and operate cold containment solutions such that appropriate volumes of air are presented to the cold containment zone to avoid inefficiencies with bypass airflow (either excess air being forced through IT equipment or leakage due to over-pressurization). Cold containment retrofits will generally require the least amount of equipment to implement.

Cold containment may be used in conjunction with heat containment solutions to achieve air stream separation goals. Partial cold containment solutions, when used with proper airflow management equipment, can provide significant efficiency returns with minimal amounts of investment. For example, the addition of end-of-row containment doors, with no other containment, may improve airflow efficiency up to 15 percent in some data centers.

3.1.3.4.5.8 Heat Containment

Heat containment solutions are intended to direct hot (exhaust) air from IT equipment racks upwards and away from areas that it can mix with cold (supply) air entering the IT equipment rack face. Heat containment may be used in conjunction with cold containment solutions to achieve air stream separation goals.

Chimney Return Systems - A subset of heat containment, chimney return systems direct the exhaust from IT equipment racks vertically to a ducting system that returns the hot air stream directly to the CRAC unit intakes without mixing. This variant on heat containment can be very effective but requires extensive installation work, limiting its ability to be implemented in operational data centers.

Do not employ chimney systems without ducted returns unless the open ceiling and chimney heights exceed twelve ft.

3.1.3.5 HVAC Environmental Control Equipment

In general, legacy VA data centers use a pressurized subfloor air distribution plenum for cooling air distribution to IT equipment. It is not necessary for future VA data centers to use this model if other, more efficient and effective environmental control models can be used.

Alternative air conditioning types are allowable provided they increase the efficiency of the HVAC system and do not provide more cooling than the ultimate design load of the data center (for example, do not install a 5-ton CRAC unit in a Network Support Center designed to contain 1 ton of IT equipment).

3.1.3.6 Computer Room Air Conditioners (CRAC) Units

Self-contained CRACs are generally used in conjunction with raised access floor distribution plenums in legacy VA data center facilities. Where used with a raised access floor, CRACs shall be supported by manufacturer-specified, seismic-rated floor stands independent of the access floor.

Utilize high-efficiency electrically commutated (EC) plug fans in CRAC units. Retrofit legacy CRAC units with plug fans for increased operational efficiency where feasible.

An automated control system shall be provided to coordinate CRAC unit settings in all VA data centers with three (3) or more CRAC units.

3.1.3.7 Split System Air Conditioners

Split system air conditioners are self-contained systems with a ductless connection between the heat pump (cooling) component in the interior space and a condenser (heat rejection) component external to the controlled environment that is either wall mounted or is mounted within a suspended ceiling system. These units are only appropriate for use in small, non-critical, distributed VA data centers and other small IT-related spaces. The typical configuration of these rooms is a local server/telecommunications room. Size these systems to match the ultimate design load of the space. Due to the non-critical nature of IT equipment operating in these facilities, redundant equipment is not required.

3.1.3.8 Self-Contained Air Conditioners

Self-contained air conditioning units are considered portable or temporary units. These systems are inappropriate for long-term use in VA data center spaces, and shall only be used for temporary spot cooling purposes in the event a primary system is inoperative. Self-contained units shall not be used to increase the cooling capacity of a VA data center in order to increase the amount of IT equipment that can be installed.

3.1.3.9 Close-Coupled Air-Conditioners

The use of close-coupled air conditioning systems is permitted in VA data centers when the systems are specifically designed into the support model. In general, use close-coupled systems in portions of the data center designed for high density (>5kW per IT equipment rack). When close-coupled systems are used, containment must be implemented in the zone(s) where the systems are installed.

Close-coupled systems shall not be used to increase the amount of cooling available within a data center unless the power being supplied to the data center is simultaneously being increased (increased design capacity in both power and cooling must match).

3.1.3.10 Humidity Control Equipment

Humidity control equipment shall be used in VA data center facilities to allow operators to maintain the computing environment within the allowable operating parameters and to minimize the energy required to provide a stable and efficient environment for IT equipment.

The introduction of additional humidification in VA data centers should be conducted using dedicated, low-pressure dry fog humidification systems. Acceptable systems to support VA IT equipment produce uniform, non-wetting dry fog with a mean droplet diameter not to exceed 10.0 µm. Provide compressed air, humidity sensors, an automatic control system, and appropriate water strainer, filter, purifier, and deionizer equipment for the humidification system.

System design shall comply with ASHRAE Standard 188-2015 and VHA Directive 1061 (2014) for Legionella control.

Steam humidification systems introduce additional heat into the data center that must be removed, using additional energy; ultrasonic humidification systems are effective but require significant maintenance. Both types are designated as inappropriate for use in VA data centers due to identified resource capabilities.

Evaluation Factors

- CFD Analysis
- IT equipment inlet environmental conditions
- CRAC set points
- CRAC fan speed control
- CRAC intake chimneys
- Floor to ceiling height
- Design redundancy levels maintained

Implementation Guidance

Environmental control of VA data center spaces shall be based on the IT equipment requirements and not cooled for human comfort. Significant energy intensity reductions can be made by modifying these environmental control parameters and ensuring appropriate airflow paths and systems are designed, operated, and maintained. Retrofit all VA data center spaces for maximal energy savings as rapidly as feasible. Operate CRAC units only as required to maintain prescribed operational parameters.

3.1.3.11 Monitoring

Table 26: Monitored Conditions

Primary Attribute	Secondary Attribute	Specification
Monitored Conditions	Fire and Smoke Detection	• All VA Data centers shall have a Fire and Smoke Detection system in all data and infrastructure spaces as prescribed by NFPA standards, Local Fire Codes, the Authority Having Jurisdiction (AHJ), and/or VA CFM • The Fire and Smoke Detection system may be incorporated into an automatic fire suppression system • Where allowed by the AHJ, Fire and Smoke Detection shall use an early-warning Aspirated Smoke Detection (ASD) system such as VESDA
	Water Detection	All CDCs, CSCs, and MSC shall install a liquid water detection system in all data and infrastructure spaces (not required for NSCs). Required in: • Raised floor spaces • IT spaces where water sources exist in or above electronic equipment • HVAC chiller rooms • Fire suppression system areas (pumps and controls)
	Power	All VA data centers shall monitor continuity and quality of: • Utility Power delivery • UPS Power output • Auxiliary Generator power output • Branch Circuit Power output
	Temperature – Equipment Cabinets	All VA data centers shall monitor air temperatures at multiple points in IT equipment cabinets. Exact quantity and placement of sensors shall be determined according to the design and implementation of airflow management measures
	Temperature - Infrastructure Equipment	All VA data centers shall monitor Supply Air and Return Air temperatures: • Supply Air Temperature shall be monitored at the output of each physical infrastructure device supplying cold air, whether the device is active or not • Return Air Temperature shall be monitored at the intake of each physical infrastructure device supplying cold air, whether the device is active or not

Primary Attribute	Secondary Attribute	Specification
	Humidity - Infrastructure Equipment	All VA data centers shall monitor Supply Air and Return Air Relative Humidity: • Supply Air Humidity shall be monitored at the output of each physical infrastructure device supplying cold air, whether the device is active or not • Return Air Humidity shall be monitored at the intake of each physical infrastructure device supplying cold air, whether the device is active or not
IT Equipment Cabinets	Temperature and Humidity Sensors	To ensure an adequate supply of cooling air, all IT cabinets in facilities lacking best-practice airflow management shall have at least four sensors per cabinet: • Temperature sensors in Front Top (FT), Front Middle (FM), Front Bottom (FB), and Rear Top (RT) locations • Humidity sensor in FM location
		IT Cabinets in facilities WITH best-practice airflow management may use fewer sensors, meeting the following minimum criteria: • Sensors in cabinets at the ends of a contiguous row/string • Sensors in every third cabinet in the middle of a contiguous row/string • At least two sensors per monitored cabinet • Temperature sensors in the FM and RT locations • Humidity sensor in the FM location
	Sensor Locations	IT Equipment Cabinet sensor locations shall correspond to the ASHRAE-recommended monitoring locations: • Front Top (FT): Centered horizontally, inside the front door, no more than 1 foot from the top of the cabinet • Front Middle (FM): Centered horizontally, inside the front door, 4 ft. +/- 6 in. from the finished floor surface • Front Bottom (FB): Centered horizontally, inside the front door, no more than 1 foot from the finished floor surface • Rear Top (RT): Centered horizontally, inside the rear door, no more than 1 ft. from the top of

Primary Attribute	Secondary Attribute	Specification
		the cabinet • Rear Middle (RM): Centered horizontally, inside the rear door, 4 ft. +/- 6 in. from the finished floor surface • Rear Bottom (RB): Centered horizontally, inside the rear door, no more than 1 foot from the finished floor surface
Communication Protocols	IT Devices	Monitored IT Devices shall use the Simple Network Communication Protocol (SNMP), configured in a secure mode as required by the TRM. Implementations shall adhere to the VA LAN Security Standard: • SNMPv3 secured using SSL • SSL using Secure Hash Algorithm (SHA-1) authentication • Advanced Encryption Standard (AES) Encryption, at 128-bit or the highest level supported by the attached hardware
	Monitoring Systems	To support data stream integration, monitoring systems shall support Secured SNMP v3.0 for upstream communication and **at least two** of the following industrial communication protocols to receive sensor data: • BACnet or BACnetIP • Modbus or Modbus IP • CAN bus or CAN bus IP • FieldBus or FieldBus-IP
	Monitoring Devices	Monitoring devices and systems shall be capable of communication using **at least two** of the following protocols: • Secured SNMP v3.0 • BACnet or BACnetIP • Modbus or Modbus IP • CAN bus or CAN bus IP • Fieldbus or Fieldbus-IP
	Physical Infrastructure Devices	Infrastructure device communication modules shall support **at least two** of the following protocols: • Secured SNMP v3.0 • BACnet or BACnet IP • Modbus or Modbus IP • CAN bus or CAN bus IP • Fieldbus or Fieldbus-IP

Evaluation Factors

- Facility actively monitors all required monitoring points
- IT equipment rack temperature/humidity sensors installed as described in standard
- Water detection system design
  - Point leak detection units
  - Zone leak detection panels
  - Linear detection systems
  - Wire-free sensors
  - DCIM integration
- Monitoring systems and equipment comply with communications protocol requirements

Implementation Guidance

- Monitoring shall be defined as continual real-time observation of a condition or set of conditions affecting computing spaces
- Functional definitions of Monitoring and Metering shall not be interpreted to require separate systems; a single sensor, device, or system may support multiple monitoring and metering functions
- Detection, alerting, and alarming functions, as well as automatic triggering of interventions, shall be considered to be part of a monitoring system
- Monitoring systems alone shall not be expected to continuously gather data in the way that a metering system does, but a monitoring system may collect forensic data during a period when a detection threshold has been exceeded
- Alerts are communicated when a condition threshold has been reached or exceeded. Alert triggers shall be set to provide sufficient reaction time to respond to, investigate, and correct the underlying cause of the condition
- Alarming systems shall communicate when an absolute limit has been exceeded
- Eliminate risk from water damage and mold
  - Avoid introducing water sources in or above IT areas
  - Separate HVAC condensers and fire suppression system from computing space IT areas where feasible
  - Consider drip trays or similar protection with point leak detection units where water lines exist
  - Employ manual shut-offs and valves
  - Ensure onsite personnel know location of system shut-offs and valves and how to operate them

3.1.4 Facility IT Support Power Distribution

These specifications define a standardized power distribution from data center PDUs or Power Panel to the active equipment enclosure with sufficient power to energize up to 10 kW redundantly in a high power density configuration or 5 kW redundantly in a standard density configuration. This approach allows the facility engineer to provide a standardized branch circuit (3-phase 30 Amp) and receptacle type (L21-30R) through the facility for the majority of server, LAN, and SAN stacks. Proprietary and equipment specific power requirements shall be avoided where possible. This standardized approach creates consistency throughout the data center and reduces overall power complexity. Ultimately, this approach will reduce the capital costs of installing new equipment and the operation costs by reducing or eliminating the need to change branch circuits with each equipment refresh.

3.1.4.1 Topology for Power Distribution Standard (CDC, CSC, MSC)

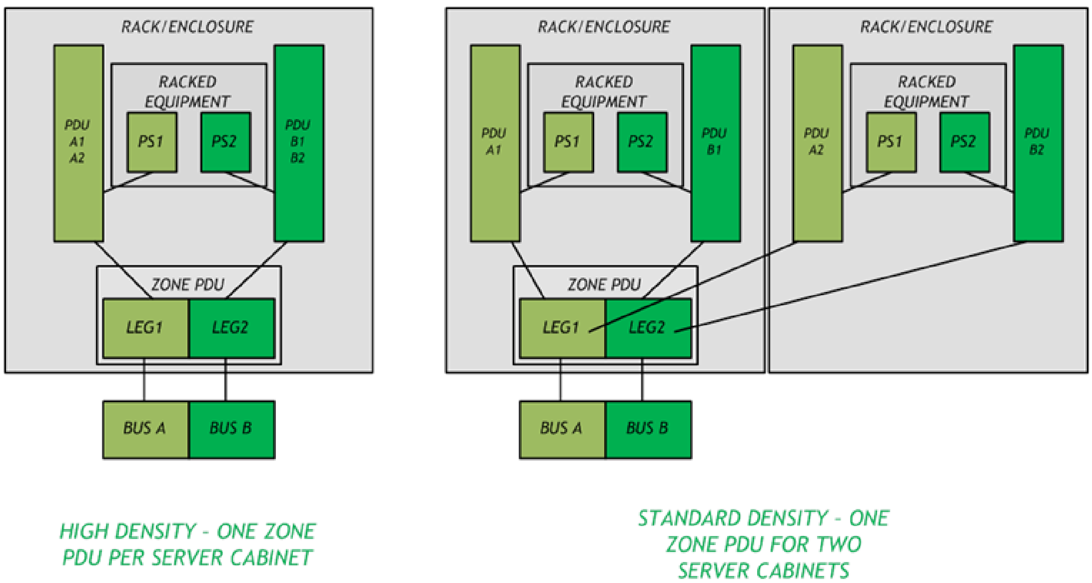


Figure 11: Topology with Site UPS Backup (CDC, CSC, MSC)

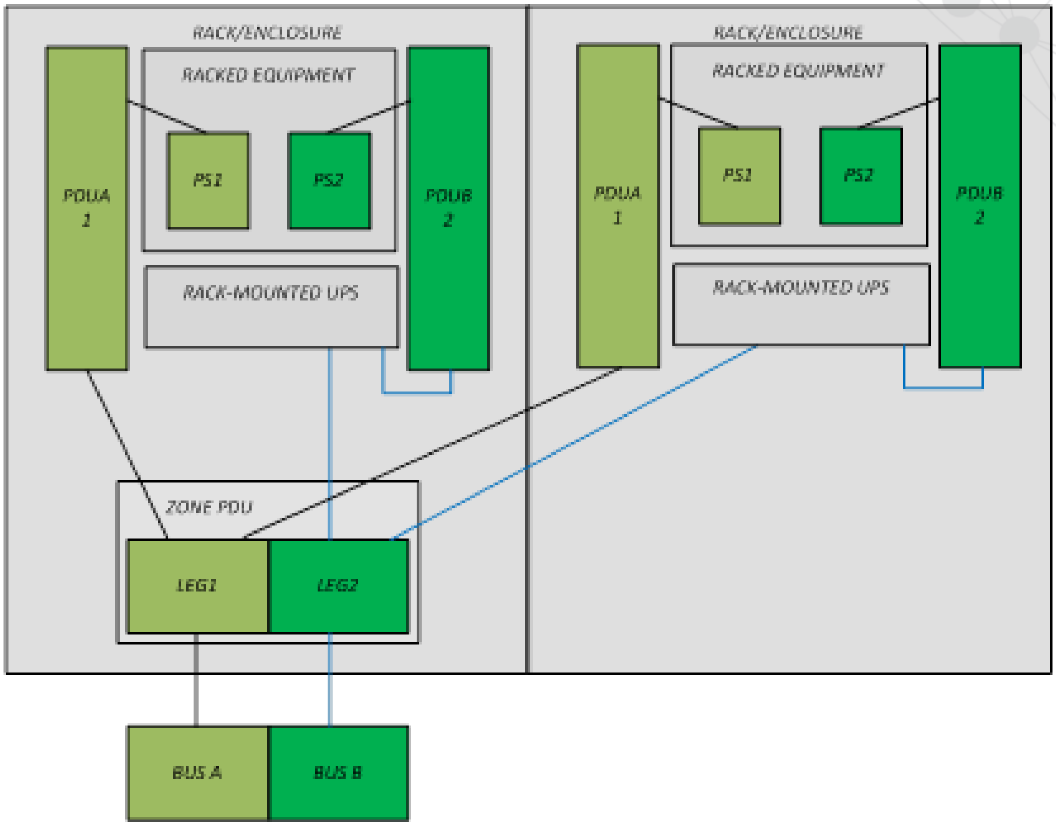


Figure 4: TR Topology with In-rack UPS Backup (NSC)

3.1.4.2 Branch Power Circuit to Rack/Cabinet

This section describes the power circuit characteristics from data center PDUs or Power Panel to the rack or cabinet. The per-rack power density of approximately five kilowatts (5 kW) redundant shall be used except when a specific IT system requires something special that cannot be supported by it. High-density rack power is ten kilowatts (10 kW) redundant.

Table 27: Branch Power Circuit to Rack/Cabinet Standard

ID	Primary Attribute	Secondary Attribute	Specification
1	Branch Circuit	Voltage	208
		Phase	3-Phase WYE
		Amp	30
		Neutral Conductor	One gauge larger

		Receptacle	• L21-30R for Zone PDUs
			• L21-20R
			  • Bus bar implementations directly feeding rack PDUs
			  • Single rack TRs to power rack PDUs

ID	Primary Attribute	Secondary Attribute	Specification
		Color	Jacket color differentiated by source bus
		Pathway	Rectilinear with respect to the isles with no diagonal runs
		Length	Following rectilinear path and no longer than 4 ft. of slack

3.1.4.3 Zone PDUs

This section describes the characteristics of the zone PDU. The zone PDU allows the implementation engineer to specify a typical branch circuit while providing enough 10 amp and 16 amp outlets to support standard power density (5 kW) redundant and high power density (10 kW) redundant configurations.

Table 28: Zone PDU Standard

ID	Primary Attribute	Secondary Attribute	Specification
1	Zone PDU	Mounting	Standard 19 in. rack mount
		Agency Approval	• UL Listed • UL Listed 60950 • UL Recognized Component Mark
		Form Factor	2 RU
		AC Voltage Input	208V WYE (3-Phase)
		Current Input	30 Amp
		Current Output	30 Amp
		Full Load	• 21,600 Watts • 180 Amps (90 redundant)
		National Electrical Manufacturers Association (NEMA) Convenience Outlets	Six (6), 5-20R
		NEMA Outlets for Vertical Power Strips	Four (4), L21-20R
		NEMA Plugs	Two (2), L21-30P
		Cord Length	10 ft.
		Breaker Group	• 30 Amp A Side and B Side • 20 Amp Secondary (branch) A and B side

Evaluation Factors

- Power efficiency to reduce electricity losses for lowest overall lifecycle cost
- Number and type of receptacles provided

Implementation Guidance

- One Zone PDU for every two racks or cabinets
- One Zone PDU for every one high density rack or cabinet

3.1.4.4 Rack Mounted UPS

This section describes the UPSs that are mounted in racks located in TRs where no facility UPS is available. The rack mounted UPS will provide 5-6 kW to the vertical PDU on the B Side.

Table 29: Rack Mounted UPS Standard

ID	Primary Attribute	Secondary Attribute	Specification
1	UPS (in rack/ enclosure)	Mounting	19 in. rack mount
		AC Voltage Input	208V 3-phase
		Current Input	20A
		Current Output	20A
		Output Receptacle	L21-20R
		Input Plug	L21-20P
		Phase Type	Three-phase
		Battery Capacity	10 mins. on full load
		kW Rating	5-6 kW

Evaluation Factors

- Power efficiency to reduce electricity losses for lowest overall lifecycle cost
- Battery Capacity
- kW Rating

Implementation Guidance

Rack mounted UPS shall be mounted starting in RU 1 at the bottom of the rack due to excess weight to ensure stability.

A test plan is required to ensure that each bus is represented in a rack or cabinet. If four (4) vertical PDUs are installed in a single rack or cabinet, then represent A bus and B bus on both sides of the cabinet. The correct specification for the Zone PDU is to feed it with two power sources. Power inputs should originate from two independent power sources. Each input will use identical specs: WYE (5-wire) configured, 208V, 30A, three-phase, terminating in a NEMA L21-30R locking receptacle. The neutral conductor should be upsized one gauge to match the upsized neutral conductors in the PDU units. The neutral "upsizing" should ideally be continued in the power distribution system back to the UPS or transformer winding pole. This increases the efficiency of the power distribution system and suppresses harmonics in the system.

3.1.4.5 Vertical Rack PDUs

This section describes the PDUs that will energize the racked equipment. Each rack or cabinet will have one vertical PDU from Side A and Side B for a total of two vertical PDUs for standard density (5 kW redundant). If high-density power is required (10 kW redundant), each rack or cabinet will be equipped with two (2) vertical PDUs connected to bus A and two (2) vertical PDUs connected to bus B for a total of four (4) vertical PDUs.

Table 30: Vertical Rack PDU Standard

ID	Primary Attribute	Secondary Attribute	Specification
1	PDUs (in rack/ enclosure)	Receptacle Type(s)	• C-19 • C-13
		Power Cord Plug	L21-20P
		Power Cord Color Code	• A side black • B side a distinctly different color
		kW Rating	5 - 6 kW
		Volt Rating	208
		Monitoring	Power utilization per phase. LED display and SNMP v3 with Secure Sockets Layer (SSL) Encryption
		Mounting	Zero RU, toolless
		Phase Type	Three-phase

Evaluation Factors

- Power efficiency to reduce electricity losses for lowest overall lifecycle cost
- Number and type of receptacles provided

Implementation Guidance

All dual-corded equipment should connect to both A and B bus for power redundancy.

Order IEC C13/14 (10 amp) and IEC C19/20 (16 amp) cord sets with all equipment requiring 16 amps or less. Color coding of power cords is required to distinguish A and B sides for installation and troubleshooting.

A test plan is required to ensure that each bus is represented in a rack or cabinet. If four (4) vertical PDUs are installed in a single rack or cabinet, then represent A bus and B bus on both sides of the cabinet. The correct specification for the Zone PDU is to feed it with two power sources. Power inputs should originate from two independent power sources. Each input will use identical specs: WYE (5-wire) configured, 208V, 30A, three-phase, terminating in a NEMA 21-30R locking receptacle. The neutral conductor should be upsized one gauge to match the upsized neutral conductors in the PDU units. The neutral "upsizing" should ideally be continued in the power distribution system back to the UPS or transformer winding pole. This increases the efficiency of the power distribution system and suppresses harmonics in the system.

3.1.4.6 Cable Distribution

This standard offers consistency in the construction characteristics of overhead cable tray to achieve common mounting, hanging, support, bonding, and interconnecting features for the benefit of data center and ITS designers and end-users.

Network cable distribution shall be distributed in overhead cable trays in all new installations. Existing underfloor cable trays will be phased out during major upgrades to existing data centers and ITS.

Table 31: Cable Distribution Standards

ID	Primary Attribute	Secondary Attribute	Specification
1	Cable Tray	Design	Wire Basket
		Capacity	• Initial fill ratio not to exceed 25 percent • Maximum fill ratio not to exceed 50 percent • Depth of telecommunications cables not to exceed 6 in.
		Bonding Kit	Mechanically bond cable pathway sections and trays to one another and to the Signal Reference Grid (SRG) in accordance with ANSI/TIA-607-C Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
		Clearance	• 2 in. from top of cable tray to bottom of access floor in legacy underfloor installation • 6 in. clearance between cable trays in stacked overhead installations • Media types will be segregated
		Installation	• Per manufacturer’s recommendations

Evaluation Factors

- Wire-basket construction
- Toolless joining kits
- ASTM coating

Implementation Guidance

Cable pathways shall meet the clearance requirements of fire detection, suppression, and prevention systems, and these systems must be coordinated with other systems (e.g., electrical, mechanical, telecommunications) and meet the requirements of the manufacturer and the AHJ.

If both power and telecommunications cabling are distributed from below the access floor then:

- The power cabling should be routed either adjacent to or within the cold aisle
- The telecommunications cabling should be routed adjacent to or within the hot aisle
- Power and communication pathways should be positioned at different heights off the floor so that they can cross each other without interference. Alternatively, at every point where

the power and copper cabling cross the path of each other, the crossing should be at a right (90 degree) angle

3.1.4.7 Metering

Table 32: Metered Energy Consumption Data

Data	Units	Measured Location(s)	Period
Facility Total Electrical Consumption (FEC)	Kilowatt-hours (kWh)	Main building step-down transformer(s) and Generator plant	Monthly
Total Data Center Energy Consumption (TEC)	Kilowatt-hours (kWh)	• Utility Feed(s): Output to data center or • Automatic Transfer Switch (ATS): Output to data center or • Trunk Circuit(s): Output to data center	Monthly
Total Data Center Physical Infrastructure Energy Consumption (TPIEC)	Kilowatt-hours (kWh)	• Branch circuit(s) supporting physical infrastructure equipment: Output or • Physical infrastructure equipment: Input	Monthly
Total IT Equipment Energy Consumption (TITEC)	Kilowatt-hours (kWh)	• Rack-mounted PDU: Output or • Power Consumption data reported by IT system firmware: Input or • Branch Circuit Monitoring (BCM) of circuit(s) supporting IT equipment: Output	Monthly
Total UPS Load Energy Consumption (TUPSC)	Kilowatt-hours (kWh)	Uninterruptible Power Supply (UPS) System(s): Output	Monthly
Total Renewable Energy Usage by Data Center (RENEW)	Kilowatt-hours (kWh)	Utility billing detail and/or Facility Engineering staff	Monthly

Table 33: Energy Consumption Performance Metrics

Performance Metrics	Units	Performance Goal	Period
Power Utilization Effectiveness (PUE)	N/A	• New data centers < 1.4 with a goal of 1.2 • Existing data centers < 1.5	Monthly
Site Infrastructure Energy Efficiency Rating (SIEER)	N/A	N/A	Monthly

Evaluation Factors

- Data collection capabilities and intervals
- Data reporting capabilities and intervals

- Site-specific collection processes and engineering assumptions documented
- Performance metrics meet performance goals

Implementation Guidance

All VA data center facilities shall install and operate an Automated Energy Metering system meeting the requirements of the monitoring and metering standard. This system may combine elements of Building Automation Systems, Data Center Infrastructure Management (DCIM) systems, and Data Center Operations Systems, and other systems as needed to achieve the required outcomes. The absence of such a system does not exempt a facility from reporting requirements; until such an automatic system is operational in a facility, the relevant power and energy data shall be collected manually by qualified staff.

All VA data center facilities shall report the following energy consumption data within the period specified in the Performance Metrics:

3.1.4.7.1 Facility Total Electrical Consumption (FEC):

Total electrical energy from the local utility is metered by the local utility provider. This portion of the metric can be obtained from the utility electrical bill or can be calculated if local resources have capabilities to read the electrical meter(s) directly.

Generator energy may be estimated by the number of hours that the generator plant(s) run times the power capacity of those generators. The time that the generators run includes building (live) load tests where the building (or some portion thereof) is supported by the generator plant but does not include offline generator tests and maintenance.

3.1.4.7.2 Total Data Center Energy Consumption (TEC):

Total Data Center Energy Consumption (TEC) is the sum of Total Data Center Physical Infrastructure Energy Consumption (TPIEC) and Total IT Equipment Energy Consumption (TITEC).

3.1.4.7.3 Total Data Center Physical Infrastructure Energy Consumption (TPIEC):

The metric includes the amount of energy needed to operate power supply/distribution equipment (transformers, switchgear, meters, UPSs and PDUs, wiring to the IT devices), heating/cooling equipment (chillers, pumps, cooling towers, CRAC units), lighting in the datacenter, physical security systems in the datacenter (access control, intrusion detection, surveillance), fire protection and similar systems, and system electrical losses (through transmission, conversion, et cetera).

Explanation: VA facilities generally have shared/ integrated physical plants (mechanical and electrical rooms) that provide support to both data center and non-data center (administrative, patient care, et cetera) spaces. Separate metering of the portion(s) of physical plants that solely provide support to the data center should not be expected to be available because of the mixed use and legacy nature of VA facilities. There are no simple, standardized methods of obtaining this information in the shared/integrated physical infrastructure environments typical in VA facilities.

In order to obtain this information, VA uses a measure/estimate methodology. Estimate the fraction of the load of the device supporting the data center, and multiply this fraction by the monthly energy usage of the device. This fraction is an engineering estimate of what percentage of the device's load is used to support the data center (as opposed to supporting non-data center loads). For example, based on how much chilled water flow goes to administrative office spaces versus to the datacenter (perhaps based on water pipe size), the site estimates that 65 percent of the chilled water goes to the data center. The total energy consumed by the chillers is measured at 1,460 kWh. The energy consumed to support the data center for that chiller for the month is 1,460 kWh * 0.65 = 949 kWh.

Individual sites are responsible for documenting the assumptions that they use to calculate and summate physical infrastructure electrical consumption. There are no standard templates for collecting, aggregating, or estimating this information because of the unique configuration of physical infrastructure systems at each VA facility. Consult with local and enterprise facility and engineering staff as necessary and document the assumptions and process that will be used at the facility.

3.1.4.7.4 Total IT Equipment Energy Consumption (TITEC):

There are multiple ways to obtain this data, depending on the equipment that is installed in the data center. Use the most accurate method (methods are described from most to least accurate) to gather the metric information.

- If power distribution equipment (PDUs) in the data center have branch level metering, or if rack PDUs in the racks have rack-level power monitoring, whether this is connected to a facility building automation system (BAS)/energy management control system (EMCS) or not, collect actual energy use data at the level closest to the IT equipment. Use of a BAS/EMCS to automatically collect and calculate this information provides the most accurate measurement.

- If PDUs in the facility have the capability to record kWh that they supply (and most modern units do), perform a manual (or automated, if BAS/EMCS capabilities are available) recording of the kWh reading on the PDU at a specified time for each reporting period (e.g., calendar month). For example, collect kWh numbers for all PDUs supporting the data center at 9 am on the first calendar day of the month, and summate the change in kWh numbers from the previous period reading.

- Data centers generally have dedicated uninterruptible power supply (UPS) systems to ensure IT equipment power is continuously available. At a specified time for each reporting period (e.g., calendar month), collect kWh numbers for all UPS systems supporting the data center and summate the change in kWh numbers from the previous period reading.

- For non-dedicated data centers and facilities where UPS systems also support non-data center administrative functions, follow the guidance for UPS kWh reporting in (c) above, and use a documented, realistic engineering estimate of the percentage of the UPS system power that is supplied to the data center IT equipment. This engineering estimate could involve counting the approximate number of amp-hours used by IT equipment in the data center and the approximate number of amp-hours that are used in a UPS-backed administrative space, and determining the ratio (3:1, or 75 percent, for example). Use this estimated ratio (75 percent, in our example) times the change in kWh numbers from the previous period reading to report the metric.

- Where the data center does not have any of the previous metering equipment to assist in developing the metric, provide a realistic engineering estimate of IT equipment power use by another method. Consult with local and enterprise facility and engineering staff as necessary and document the assumptions and process that will be used at the facility. An example of how to estimate a monthly total IT electrical consumption is to use a clamp-on electrical meter on the input power cables to a dedicated electrical distribution circuit panel, determine the amperage being provided during an assumed representative time period, multiply the amperage by the panel voltage, divide by 1.73 for three-phase distribution, and convert from power basis to energy basis by multiplying by 730 (average hours per month). Other methods may be more appropriate given the equipment in and configuration of a particular data center facility.

3.1.4.7.5 Total UPS Load Energy Consumption (TUPSC):

Data centers generally have dedicated uninterruptible power supply (UPS) systems to ensure IT equipment power is continuously available. At a specified time for each reporting period (e.g., calendar month), collect kWh numbers for all UPS systems and summate the change in kWh numbers from the previous period reading. For example, last month's kWh reading on UPS 1 was 220,000 and this month's reading is 235,000. Last month's kWh reading on UPS 2 was 350,000 and this month's reading is 375,000. The UPS electrical consumption for the month is (235,000-220,000 + 375,000-350,000 =) 40,000 kWh.

Where UPS information is not available as kWh on the UPS, consult with local and enterprise facility and engineering staff as necessary and document the assumptions and process that will be used at the facility**.**

3.1.4.7.6 Total Renewable Energy Usage by Data Center (RENEW):

In accordance with Executive Order 13423, "Strengthening Federal Environmental, Energy, and Transportation Management" 2007, and National Energy Policy Act of 2005-SEC. 203. FEDERAL PURCHASE REQUIREMENT, 2005, VA has a current mandate of 7.5 percent (minimum) of consumed energy to be produced by renewable sources, and a future target of 20 percent (minimum) by 2020. Example: Facility X's total electrical consumption for August is 4,500,000 kWh, all from the electric company. Facility X pays for 250,000 kWh of electricity each month to be provided from wind farms. Facility X will report 250,000 kWh (5.56 percent) renewable energy usage for August.

3.1.4.7.7 Power Usage Effectiveness (PUE):

PUE is a dimensionless metric which describes how efficiently a data center is designed and operated to conserve power. PUE is defined as the ratio: (Total Data Center Energy Consumption) / (Total IT Equipment Energy Consumption) or (TEC / TITEC)

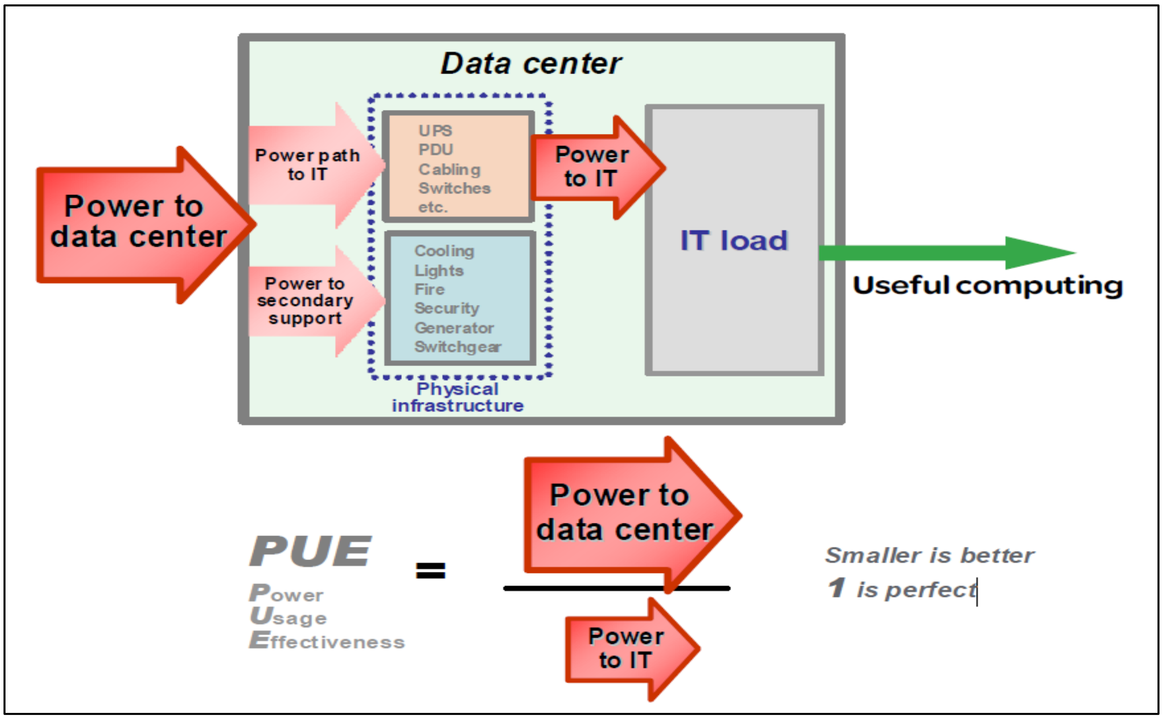


Figure 12: Power Utilization Effectiveness (PUE)

3.1.4.7.8 Site Infrastructure Energy Efficiency Rating (SIEER):

SIEER is a dimensionless metric which describes how efficiently a data center is designed and operated to conserve power. SIEER is defined as the ratio: *(Total Data Center Energy Consumption)/(Total UPS Load Energy Consumption)* or *(TEC/TUPSC)*

SIEER measures facility and data center efficiency differently than PUE, requires significantly less metering and monitoring equipment investment, allows VA flexibility in determining what is measured in shared-use (data center and administrative or hospital) facilities, and provides information that shows efficiency improvements over time between the data center and its host facility.

SIEER is defined as the total power coming into the facility divided by the total power being supported by the UPS system (technical power load, including the power necessary to operate the UPS and downstream power distribution equipment). While SIEER and PUE are similar efficiency metrics, they are not directly comparable.

3.2 Facility IT Support Administration Standard

These specifications are intended to allow complete and consistent identification and physical location information for VA data center and computing facilities, physical plant and distribution equipment supporting VA data center facilities, equipment located within the VA data center environment, and the component types and elements described for use in physical and logical information management systems describing the connectivity of physical elements present in the data center environment.

Identification specifications are based on the current version of ANSI/TIA-606-C, with modifications for the VA operating environment.

3.2.1 Data Center Position Identification

The purpose of this specification is to establish guidance for identifying physical locations for equipment and components in the VA data center environment. This specification contains instruction for uniform identification of equipment and component locations used at data processing facilities across the enterprise.

Specifically because of the legacy nature of VA facilities, no single facility location system is implemented enterprise-wide. Individual VA locations (i.e., VA Medical Centers) have developed and implemented individual location identification methodologies that are beyond the scope of this document. Data center facilities within VA facilities shall follow the location identification guidance herein.

Table 34: Data center Position Identification Conventions

ID	Primary Attribute	Secondary Attribute	Specification
1	Data Center Floor Grid Location Identification	Alignment	Aligned with plan North in building drawings
		Location Origin	Northwest corner
		Location Increments	• Two-foot increments with alphanumeric identification • Begin at the appropriate designator such as A1 for first full floor tile, depending on number of tiles in the data center* • Increase letters from left to right • Increase numbers from top to bottom
		Variances / Waivers	Required but granted automatically if existing (legacy) system is compatible

*See Implementation Guidance below for complete specifications.

Evaluation Factors

Each data center uses a compliant grid identification scheme allowing detailed location identification of physical equipment.

Implementation Guidance

Data center layouts shall be master-planned. Equipment layouts can be adequately defined by location in the data center master floor plan. This location identification scheme shall be applicable to all enterprise data centers, existing and new. Individual facilities shall apply for a variance if there is an existing location schema differing from the one stated; variances for compatible legacy systems will be approved automatically. (In the Data Center Infrastructure Management (DCIM) system of record for facilities with an approved variance, a characteristic, watermark, or similar shall be assigned to the plan view to indicate a non-standard layout.)

While some buildings are built to align with true north, many are not – but the architectural plans for all facilities will have a “Plan North,” aligned with the top of the drawing. This specification assumes that data center access floor grids will align with Plan North.

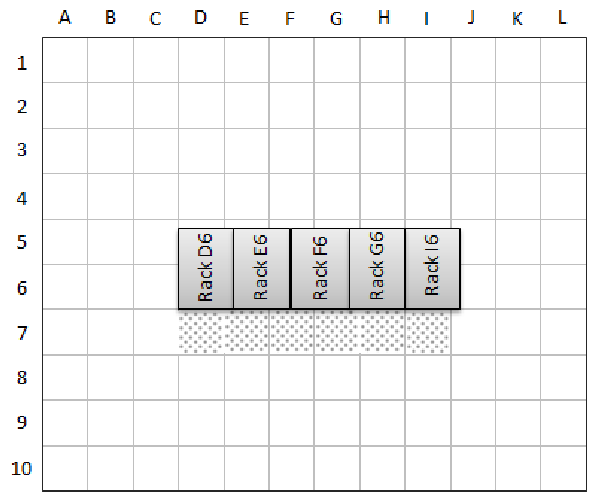
The ANSI/TIA-606-C standard initiates the computer room location system at the top left (plan NW) corner of the computing floor space. The access floor grid (where used) shall be alphanumeric with tile location A1 (*depending on data center size; see below*) denoting the (plan) northwestern-most full tile on the floor. For grid location identification purposes, beginning with alphanumeric tile location A01, letters shall increase across the X axis (left to right) from A to Z, then from AA to AZ, then BA to BZ, and so on. Numbers shall increase down the Y axis (top to bottom) from 1 onward (spreadsheet orientation). Representative examples of grid identification are shown below for reference.

If a facility has more than 26 tiles in the alpha direction, use AA as the starting location (rather than A) to allow sorting in database tools. For example, AA through AZ, then BA through BZ – do not start with A through Z in these larger facilities. If the data center has:

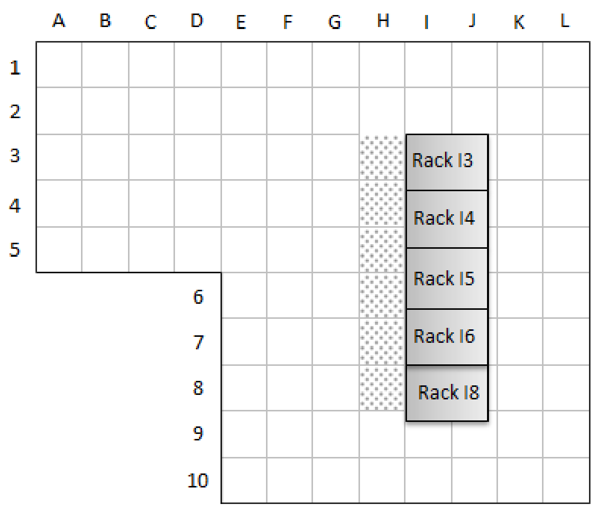
- Fewer than 10 tiles in the Y direction, then use “A1-A9”.
- 10 or more tiles in the Y direction, then use “A01-A99”.
- 100 or more tiles in the Y direction, then use “A001-A999”.
- The same follows for the X direction where “A1-Z1” are used for 26 tiles or fewer in the Y direction, and “AA01-ZZ01” are used for data centers with over 26 tiles in the Y direction.

Where an irregular arrangement of the facility means that there is no tile in what would be the A1 position, label floor tiles from this location using a 2’ increment. This system is of use in designating equipment locations for non-standard raised floor items, including CRAC units and larger storage or mainframe units. Note that there may be partial tiles around the first full tile(s) in any row or column that are not numbered in this system.

In data centers operated without an access floor grid, apply stenciled grid cross-hairs at 24” centers to the floor (where the cross-hair locations are accessible). The cross-hairs should extend at least 4” in each cardinal direction (4” in each axis). Note that the grid need not begin in the physical corner of the room and may be moved a simulated ‘partial tile’ in to better align with installed equipment.



Grid Identification – Typical Small Computer Room



Grid Identification – Offset Start Small Computer Room

Figure 13: Typical Position Identification Examples

Identification of individual computer spaces within a single building depends upon the configuration of those spaces. Where access floor spaces are adjacent and use the same grid (i.e., rooms separated by partition walls for security or other isolation purposes), both spaces shall use the same grid beginning with the A01 tile in the northwestern-most space. Where access floor spaces are separated and/or are based on separate grids (i.e., one room in one portion of a building and the other in a different portion), each space shall use individual grids, each starting with its own A01 tile.

Grid identification within each data center space shall be posted to allow occupants to understand their current location. Post location identifiers on walls, columns, and/or from hanging tags as necessary to allow occupants to reasonably determine all grid locations. Identifiers shall be (minimum) 4-inch height characters, semi-gloss black lettering, with top of character not more than 6 inches below ceiling, concrete slab, truss line or typically accepted physical divider between workspace and ceiling line.

Items on the floor shall be noted as being located at locations in accordance with ANSI/TIA-606-C , meaning the grid location of the tile containing the left front corner of the item (when facing the front of the item). If the item has no identifiable front, the first full tile covered closest to the grid origin shall be the location identifier.

3.2.2 Cross-Reference to Other Identification Systems

Nothing in the DCIM specification is designed or intended to conflict with any other mandatory standard(s) affecting the VA data center environment.

VA information management tools such as Data center Infrastructure Management (DCIM), Building Automation Systems (BAS), and Computerized Maintenance Management Systems (CMMS) shall include database fields (where applicable) to identify the standardized location identifier (and other location identifiers) as specified herein. These fields are not intended to supplant or replace other identification numbers already in use by other systems.

3.2.3 Standardized Data center Facility Type Identification

Data centers across VA generally support the local mission, and are tailored to the mission of the local office. This leads to multiple types of (and names for) the facilities, which must be standardized in order to ensure that the intent of using a facility's name is clearly understood.

The list of FACILITYTYPE attributes is intended to align with (but will not be replaced by) the data center classification schema described in section 2.1 of the VA Enterprise Data center Infrastructure Standard as VA undergoes further transformation and data center consolidation activities.

Evaluation Factors

- Each data center is classified as a single FACILITYTYPE.
- All data centers are classified as a FACILITYTYPE on the current FACILITYTYPE list.
- Use of FACILITYTYPE is consistent in OIT-standardized data structures.

Implementation Guidance

The FACILITYTYPE attribute describes at a high level what type of facility the data center supports, the specific mission of the facility, or what type of information is processed by the data center. As classes of facilities are simplified and collapsed through data center consolidation efforts, this list may be revised.

The FACILITYTYPE list is maintained by National Data Center Operations & Logistics (NDCOL), and is anticipated to be simplified as the enterprise completes transformative data center consolidation activities. Classify all data center facilities as exactly one of the facility types in the list below. Computer room facilities in VA medical centers, whether OIT, biomedical, facility management service, R&D, or otherwise, are classified as VAMCs in the FACILITYTYPE list.

FACILITYTYPE names shall only consist of three or four alpha characters and not contain ampersands, numbers, or other special characters to prevent issues with Data Center Infrastructure Management (DCIM) systems or other database queries.

Table 35: Standard FACILITYTYPE Naming Conventions

FACILITYTYPE	Description	Classification Archetype
VAMC	VA Medical Center	Campus Support Center (CSC)*
OPC	Outpatient Clinic or Community-Based Outpatient Clinic (CBOC)	
CMOP	Consolidated Mail Outpatient Pharmacy	Mission Support Center (MSC)
CPAC	Consolidated Patient Account Center	
HAC	Health Administration Center	
OIFO	Office of Information Field Office	
HEC	Health Eligibility Center	
FSC	Financial Services Center	
ARC	Allocation Resource Center	
NCPS	National Center for Patient Safety	
PBM	Pharmacy Benefits Management Office	
ALC	Acquisition Logistics Center	
CSP	Cooperative Studies Program	
HSRD	Health Services Research & Development Center	
NSC	Network Support Center (generic, if no other designation is appropriate)	Network Support Center (NSC)
VARO	VBA Regional Office	
VRE	Vocational Rehabilitation & Employment Center	
RMC	Records Management Center	

** There are some specific instances of overlap between the Core Data Center and VA Medical Center facilities (e.g. Cleveland, Temple) as the data centers in these locations operate both as Campus Support Centers and also provide or are designed and built to meet the intent of operation as a Core Data Center.*

3.2.4 Standardized Data Center Naming Convention

Facility legacy and common names are not standardized and do not yield sufficient clarity on where an OIT-operated or –supported computer or telecom space is located, what its function is, or what the intended mission supported by the facility or space is, in the context of the VA Data Center Strategy.

Evaluation Factors

- Each data center is assigned a single standardized data center name.
- Use of CITYNAME is consistent in OIT-standardized data structures for all data center facilities.
- Use of FACILITYTYPE is consistent in OIT-standardized data structures for all data center facilities.

Implementation Guidance

The basic Standardized Data Center Name is formatted as [CITYNAME FACILITYTYPE]. The master naming list for Standardized Data Center Names shall be maintained by NDCOL.

The CITYNAME attribute is intended to be the physical municipality in which the site or facility is primarily located which is unique from other municipality names in use, and is the most discrete and descriptive. This field is qualitative depending on the mission and function of the type of VA facility; for example, the new VA medical center supporting the Denver, CO metropolitan area is actually located in Aurora, CO, but the CITYNAME will be Denver. The VA medical center supporting Augusta, ME, is located in Togus, ME; because Augusta, GA is a more significant metropolitan area, the Georgia facility will be assigned CITYNAME Augusta, while the Maine facility will be assigned CITYNAME Togus.

The FACILITYTYPE attribute describes at a high level what type of facility the data center supports, the specific mission of the facility, or what type of information is processed by the data center. The available types align with the data center classification archetypes. As classes of facilities are simplified and collapsed through data center consolidation efforts, this list may be revised.

A site or facility will be referred to by its “standard name” where possible. Where there is more than one reportable computer room at a single site or facility, both computer rooms share the same “standard name” and are differentiated using its DCOI-assigned facility ID number. This naming convention includes the ability to identify all OIT computer support spaces (computer rooms, telecom rooms, non-OIT computer rooms, IDFs, and similar) uniquely, drilling down from the site or facility ‘standard name’ with additional record fields as described. Due to the wide variety of legacy configurations at individual facilities, additional detailed guidance on how to linguistically identify these individual spaces is not provided.

Example: The fictional VA medical center in Timbuktu is classified as a Campus Support Center for the hospital campus; its standardized data center name is Timbuktu CSC. There are other IT support spaces on the campus supported by this CSC, including a biomed server room that is determined to not be able to be consolidated to the main data center, two main telecommunications rooms servicing remote buildings on campus, auxiliary telecommunications rooms servicing other floors in the remote buildings, and auxiliary telecommunications rooms servicing different wings and floors of the main hospital building. All of these spaces are considered hierarchically under (attached to) the Timbuktu CSC. They are specifically identified by building number and room number; for example, Timbuktu CSC, Bldg 3, Rm 3-102.

Not all computing support spaces will be assigned a Standardized Data Center Name. All computing support spaces, from data centers to telecommunications rooms to non-reportable rooms containing IT equipment that requires IT or physical environment management, shall be assigned an NDCOL facility ID number, separate from the DCOI-assigned facility ID number. The NDCOL facility ID numbers shall be of the format “NDCOL-XXXXX,” where XXXXX is a unique five-digit number. NDCOL facility ID numbers are not intended to be sequential, either at time of assignment or in the future. ID numbers are assigned at the enterprise data warehouse level by NDCOL and distributed by the NDCOL DCIM team.

Example: Timbuktu CSC is assigned DCOI facility ID number DCOI-99999. The NDCOL facility ID number for the reportable data center is NDCOL-12345, and the telecommunications rooms supporting two-story remote building 3 are NDCOL-34201 and NDCOL-58456. -34201 and -58456 are supported by the reportable data center, but are not assigned a DCOI facility ID number.

Example: A fictional National Cemetery has a computing support space, operating a router connecting the facility with the VA wide area network. NCA spaces do not operate data centers. This facility will not be assigned a Standardized Data Center Name or DCOI facility ID number, but will be assigned an NDCOL facility ID number, NDCOL-56789.

Where a computing support space is directly supported by a data center with a DCOI facility ID number, include record field information that the space is supported by that data center, indicating the hierarchical arrangement. Not all computing support spaces are located in facilities with a data center, or directly supported by a facility subject to the standardized naming convention. Assign these spaces an NDCOL facility ID number; they will be further identified by their physical address and having blank record field information where the standard name and DCOI facility ID number of the supporting facility would otherwise be recorded.

The legacy (or official) site or facility name shall be retained and record fields available in all databases and systems to cross-reference the standardized name with the legacy name. An example of a legacy name that may not be sufficiently descriptive is “John J Pershing VAMC.” Without additional information, the location of this facility could be in doubt.

3.2.5 Color Coded Identification

Table 36: Color Identification Conventions

ID	Primary Attribute	Secondary Attribute	Specification
1	Color Identification	Backbone Telecommunications Cabling	See *Table 3: UTP Standard* and *Table 6: Fiber Optic Cable Standards*
		Telecommunications Patch Cabling	Not specified, follow local site schema
		Power Distribution	Colors shall be used to differentiate electrical bus power sources. No enterprise specification is prescribed.

3.2.5.1 Data Communication Cabling Color Coding

The standard does not specify an enterprise color scheme for UTP patch cables. Color coding scheme for patch cables should be avoided, however; individual site schemas are acceptable if consistent and documented. Horizontal and backbone cabling is color coded per Table 3: UTP Standard and Table 6: Fiber Optic Cable Standards.

3.2.5.2 Power Distribution Color Coding

All redundant power distribution within the computing spaces shall incorporate specific color identification to differentiate between different electrical bus power types. Use of specific color identification for each electrical bus shall stay consistent throughout building distribution. No enterprise color specification is prescribed. A suggested strategy is to use blue LFMC conduit for A-bus circuits and grey LFMC conduit for B-bus circuits. Use of different label colors to differentiate electrical bus power is an acceptable solution.

Within IT equipment racks/cabinets, separate A- and B-side power and segregate equipment power cords (between vertical rack power distribution units and IT equipment) by color for identification of A/B power to each piece of IT equipment (see example below). Follow best practices for managing the power cords similarly to other cabling.

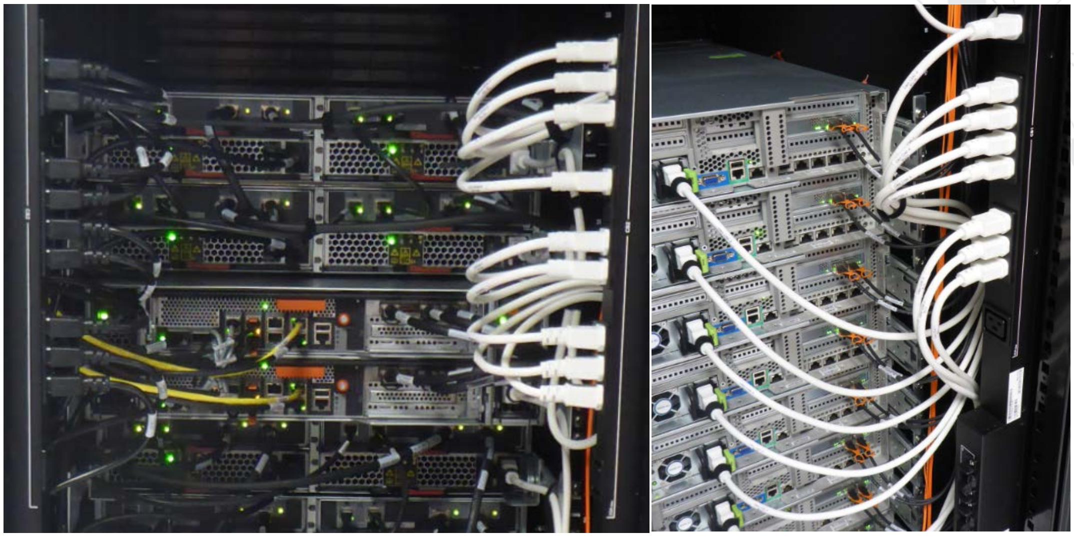


Figure 14: Example of Best-Practice Differentiated Power Cord Coloration Implementation

3.2.6 ITS Equipment, & Component Labeling

The purpose of this specification is to establish guidance for labeling physical locations, equipment, and components in the VA data center environment congruent with the identification specifications in this standard.

This specification contains instruction for uniform and appropriate labeling of data center and ITS equipment at VA data center facilities. Applications include:

- Identifying and labeling new systems when installed.
- Re-labeling existing systems as field verification documentation is generated.
- Uniform labeling of equipment and components used at data processing facilities across the enterprise.

3.2.6.1 Label Materials

Materials for labeling purposes are not specifically defined in these standards. Use materials appropriate to the purpose, intent, environment, and equipment being labeled.

Approved Materials

Labels should be resistant to the environmental conditions at the point of installation (such as moisture, heat, or ultraviolet light), and should have a design life equal to or greater than that of the labeled component.

Unapproved Materials

Materials which can be lost, damaged, rendered unreadable, easily removed, soiled or degraded by operating environment, or which are of a non-permanent nature shall not be used for labeling or identification purposes. This includes (but is not limited to) paper, paper in clear plastic protectors, and direct labeling of equipment and components with markers or paint.

Table 38: ITS Equipment, & Component Labeling Conventions

ID	Primary Attribute	Secondary Attribute	Specification
1	Equipment Labeling	Attachment	Permanently attached
		Position	• Readily visible • Horizontal orientation where feasible • Top right corner of equipment faceplate where feasible • Shall not interfere with operation of labeled equipment
		Materials	• Appropriate for the installation environment • Durable and permanent • Heat resistant in high temperature areas
		Coloration	Not specified
3	IT Equipment Rack/Cabinet Labeling	Governing Industry Standard	ANSI/TIA 606-C, NFPA 70
		Labeling Requirements	• Floor Grid Location • Power Source(s)
4	Data Communications Cabling Labeling	Governing Industry Standard	ANSI/TIA 606-C
		Label Location	Both ends of all installed cables
		Coloration	Following local site schema
5	Power Distribution Labeling	Governing Industry Standard	ANSI/TIA 606-C, NFPA 70
		Label Location	• Both ends of all installed cables • Within 36" of leaving distribution panel enclosure • Within 12" of the point-of-use end of conduit
		Coloration	Colors shall be used to differentiate electrical bus power sources. No enterprise specification is prescribed

Evaluation Factors

- All equipment and components are labeled as specified.
- Labeling is done in a legible, professional manner.
- Facility location systems are in place in the data center environment.
- Power distribution is labeled appropriately from end-to-end and uses bus color scheme allowing rapid visual identification.

Implementation Guidance

Data center equipment and components shall be labeled per operational requirements before being designated operable or in service.

Labels shall be permanently attached and designed to withstand wear, erosion and corrosion.

Position labels so they are readily visible and, where feasible, oriented in a horizontal position. Where feasible, labels should be placed near the top right corner of permanently installed equipment faceplates. Labels shall be legible without manipulation by site personnel. Although not recommended, vertical orientation may be used only where space is limited. Vertical orientation shall be read from top to bottom.

Labels or tags installed under this specification shall not interfere or alter existing manufacturer's nameplate or code information. Labels described in this specification are intended for identification within the local facility, and are not expected to support or substitute for asset management labeling.

Labels shall be located to eliminate any possible confusion as to the item being identified and shall not obscure other items nearby.

Labels shall not interfere with an operator's ability to read the instrument, display, or gauge, or to operate the equipment.

Labels shall be mounted in such a way as to preclude accidental removal.

Labels shall be mounted on a flat surface, if possible.

Use ANSI/TIA-607-C identifier scheme for telecommunications bonding and grounding system elements to use compatible terms in ISO/IEC 30129. Legacy terms used in earlier revisions of TIA-607 may also be used.

3.2.6.2 Support Infrastructure Identification

This section identifies equipment support elements covered under this standard. Equipment support elements are passive components such as racks and cabinets that serve to house or mount both passive and active components such as patch panels or servers.

Table 37: Support Infrastructure Identification Convention

ID	Primary Attribute	Secondary Attribute	Specification
1	Equipment Support	Row	**ROW-xxx** • **ROW** designates row • **xxx** is a sequential number (pad number of digits in designator (x, xx, xxx) to match the total number) • Example: Row 01
		Rack/Cabinet	**RK-aann** • **RK** designates rack (or cabinet) labeled left to

ID	Primary Attribute	Secondary Attribute	Specification
			right when looking at the front of the rack • **aa** is the alphabetic portion of the floor grid location (pad number of digits in designator (a, aa) to align with the number of floor location tiles in the plan E-W axis) • **nn** is the numeric portion of the floor grid location (pad number of digits in designator (n, nn, nnn) to match the total number) • Example: RK-AM45 • For DESIGN PURPOSES ONLY, racks may be identified by row designation and sequential numbers. These will be converted to alphanumeric locations upon physical installation for sustainment. • **n** is the numeric row designator (pad number of digits in designator (n, nn) to match the total number of rows) • **xxx** is a sequential number (pad number of digits in designator (x, xx, xxx) to match the total number) • Example: RK-101
		Pathway Rack	• PRK-aann • PRK designates pathway rack, which is a small enclosure (typically 5RU) that is generally attached to an overhead cable tray assembly above an IT equipment rack or cabinet for the purposes of terminating structured cabling to a patch panel in the pathway rack • aa is the alphabetic portion of the floor grid location (pad number of digits in designator (a, aa) to align with the number of floor location tiles in the plan E-W axis) • nn is the numeric portion of the floor grid location (pad number of digits in designator (n, nn, nnn) to match the total number) • Example: PRK-AM45 • For DESIGN PURPOSES ONLY, racks may be identified by row designation and sequential numbers. These will be converted to alphanumeric locations upon physical installation for sustainment • n is the numeric row designator (pad number of digits in designator (n, nn) to match the total number of rows) • xxx is a sequential number (pad number of

ID	Primary Attribute	Secondary Attribute	Specification
			digits in designator (x, xx, xxx) to match the total number) • Example: PRK-101
		Rack Units	**ru** • **ru** is the rack unit number present (stamped or painted) on front and rear rails corresponding to the bottom left corner of the item in the rack or server • Example: SERVER AD02-35 with 35 indicating the RU
2	Cable Tray	Not Defined	Not Defined
3	Cable Management Panels	Horizontal	**CMH-aann-ru** • **CMH** designates cable management panel • **aann** designates installed location by rack or cabinet identifier • **ru** is the rack unit in which the panel is installed Example: CMH-AM45-30 (cable management panel at position RU30 in rack or cabinet AM45)
		Vertical	**CMV-aann-aann; CMV-aann-L; CMV-aann-R** • **CMV** designates cable management panel • **aann-aann** designates rack or cabinet identifiers, left-to-right, viewed from front, between which panel is installed • **L or R** designates on which side of rack panel is installed, as viewed from front of rack, if not installed between racks Example: CMV-AM45-AM46 (cable management panel is between racks or cabinets AM45 and AM46)

3.2.6.3 IT Equipment Cabinet/Rack Location Identification

Use the modified ANSI/TIA-606-C compatible labeling format with cabinet/rack grid location and cabinet/rack RU position (format xy-ru) to identify IT equipment, switch, patch panel, and similar equipment locations. Equipment location in IT equipment racks shall be identified by the bottom rack unit (RU) that the equipment occupies (e.g., a 4RU height server position occupying positions 36-39 is located at RU position 36). VA-standard IT equipment racks have 45RU of spaces for racked equipment. RU numbering shall begin at the bottom-most mounting space and increase upwards (one RU is 1.75” height, and the numbering is typically printed on the mounting rails).

In the example shown, the server in IT equipment rack AD02 that occupies spaces 27 and 28 RU from the bottom of the rack would be identified with location AD02-27.

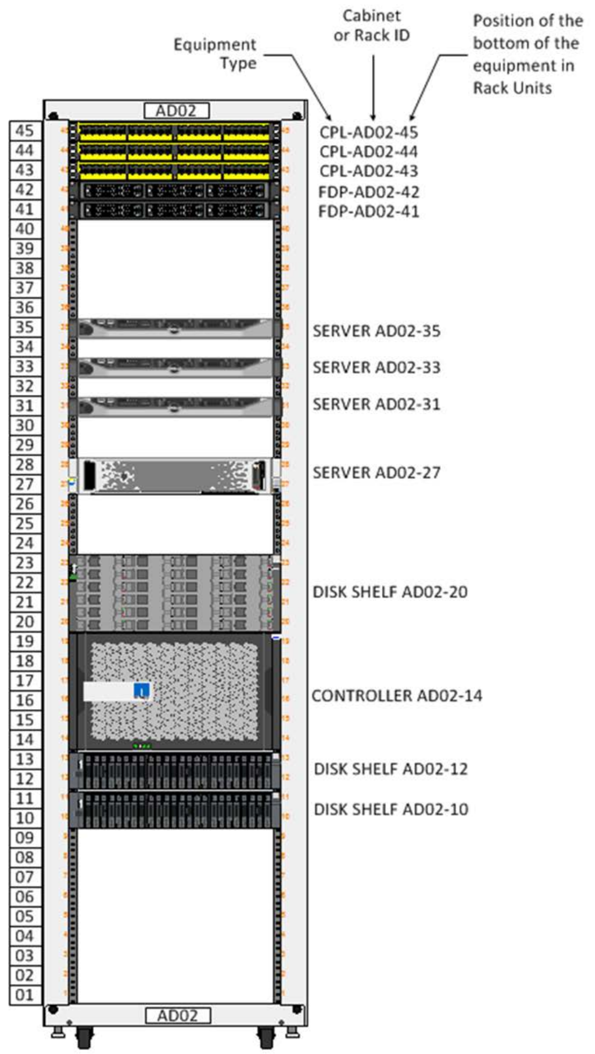


Figure 15: Rack Unit (RU) Identification Example

3.2.6.4 Transport Media and Interface Identification

This section identifies transport media and associated elements covered under this standard. Transport media includes, but may not be limited to, all horizontal and vertical (backbone) cabling and patch cords. Associated elements includes, but may not be limited to, patch panels and fiber termination elements.

Table 40: Transport Media and Interface Identification Conventions

ID	Primary Attribute	Secondary Attribute	Specification
1	Patch Panel	UTP	**CPL-aann-ru** • **CPL** designates UTP patch panel • **aann** designates installed location by rack or cabinet identifier • **ru** is the rack unit in which installed

ID	Primary Attribute	Secondary Attribute	Specification
			• Example: CPL-AM45-40 (patch panel installed in RU40 in rack, cabinet, or pathway rack AM45) • Note: **aann-ru** may be utilized as the sole label designator (without CPL). The fully qualified name is intended to support reporting activities through a physical layer asset management system
		UTP Patch Panel Position	**CPL-aann-ru.xx** • **CPL** designates UTP patch panel • **aann** designates installed location by rack or cabinet identifier • **ru** is the rack unit the panel is installed • **xx** is the position number as identified by the patch panel stamped label • Example: CPL-AM45-AA.24 (position 24 in the patch panel designated as AA in rack, cabinet, or pathway rack AM45) • Note: **aann-ru.xx** may be utilized as the sole label designator. The fully qualified name is intended to support reporting activities through a physical layer asset management system
2	Fiber Distribution Termination Hardware	Fiber Distribution Panel/Cabinets	**FPL-aann-ru** • **FPL** designates fiber distribution panel • **aann** designates installed location by rack or cabinet identifier • **ru** is the rack unit the distribution panel is installed • Example: FPL-AM45-30 (fiber cabinet at position RU30 in rack or cabinet AM45)
		Fiber Distribution	**FCS-aann-ru.L**

ID	Primary Attribute	Secondary Attribute	Specification
		Cassette	• **FCS** designates fiber distribution panel cassette • **aann** designates installed location by rack or cabinet identifier • **ru** is the rack unit in which the FCS is installed • **L** designates the fiber distribution cabinet/panel slot location ID numbered from left to right starting at 1 • Example: FCS-AM45-40.2 (the cassette in slot location two of FCS in RU 40 in rack or cabinet AM45)
		Fiber Distribution Cassette Interface Position	**FCS-aann-ru.L.xx** • **FCS** designates fiber distribution cassette interface position • **aann** designates installed location by rack or cabinet identifier • **ru** is the rack unit in which the FDC is installed • **L** designates the fiber distribution cabinet/panel slot ID • **xx** is the position identifier as labeled on the cassette. If a label is not available then use (L) for the left Multi-fiber Push On (MPO) and (R) for the right MPO • Example: FCS-AM45-40.2.05 (position five in the cassette in slot two of FCS installed in RU 40 in rack or cabinet AM45), alternately FCS-101-40.2.L
3	Cable (Data Communications)	Bulk Unshielded Twisted Pair (UTP)	**UTP[aann-ru.yy]/[aann-ru.yy]** • **UTP** designates unshielded twisted pair • **aann** designates terminal locations by rack or cabinet identifier • **ru** is the patch panel rack unit (RU) designator • **yy** is a two digit number corresponding to the patch panel position • Example: UTP[AM45-42.24]/[AAR15-03.24] UTP connecting position 24 in patch panel located at RU42 in rack AM45 to position 24

ID	Primary Attribute	Secondary Attribute	Specification
			in patch panel located at RU03 in pathway rack AR15
		Pre-terminated Cable Assemblies (UTP)	**UTP[aann-ru]/[aann-ru]. nn-mm** • **UTP** designates unshielded twisted pair • **aann** designates terminal locations by rack or cabinet identifier • **ru** designates rack RU in which installed • **nn-mm** are two numbers that identify the start and end ports to be connected by the bundle • Example: UTP[AM45-AA]/[AR15-AB].01-06 UTP bundle connecting patch panel AA located in rack AM45 to patch panel AB in rack AR15 port 01 to port 06 (inclusive)
4	Fiber Cable (Data Communications) Fiber Cable (Data Communications)	Pre-terminated Cable Assemblies (Multi-mode)	**FMM[aann-yy.L]/[aann-yy.L]** • **FMM** designates fiber optic cabling, multi-mode • **aann** designates terminal locations by rack or cabinet identifier • **yy** is a numeric fiber distribution cabinet/panel identifier per rack or cabinet • **L** designates the fiber distribution cabinet/panel cassette or slot ID and the left or right MPO connector • Example: FMM[AM45-03.2L]/[AR15-03.2L] Multi-mode cable assembly connecting cassette two, left MPO in FCS 03 located in rack AM45 to cassette two, left MPO in FCS 03 located in rack AR15
		Pre-terminated Cable Assemblies (Single-mode)	**FSM[aann-yy.L]/[aann-yy.L]** • **FSM** designates fiber optic cabling, single-mode • **aann** designates terminal locations by rack or cabinet identifier • **yy** is a numeric fiber distribution cabinet/panel identifier per rack or cabinet • **L** designates the fiber distribution cabinet/panel cassette or slot ID and the left or right MPO connector

ID	Primary Attribute	Secondary Attribute	Specification
			• Example: FMM[AM45-03.2R]/[AR15-03.2R] Multi-mode cable assembly one connecting cassette two, right MPO in FCS 03 located in rack AM45 to cassette two, right MPO in FCS 03 located in rack AR15
5	Patch Cords	UTP	**CCA[aann-ru.xx]/[aann-ru.xx]** • **CCA** designates UTP patch cable • **aann** designates terminal locations by rack or cabinet identifier • **ru** is the RU location of the patch panel or device • **xx** is the port or visually identifiable NIC ID to which the end of the patch cord is connected • Example: CCA[AM45-44.12]/[AR15-30.2] UTP patch cable connecting patch panel 44 position 12, located in rack AM45 to IT equipment NIC port 2, located in rack unit position 30, rack AR15
		Fiber Optic	**FCA[aann-ru.xx]/[aann-ru.xx]** • **FCA** designates fiber patch cable • **aann** designates terminal locations by rack or cabinet identifier • **ru** is the RU location of the patch panel or device • **xx** is the port or visually identifiable NIC ID to which the end of the patch cord is connected • Example: FCA[AM45-44.06]/[AR15-24.2] Fiber patch cable connecting patch panel in RU44, position 06, located in rack AM45 to IT equipment NIC port 2, located in rack unit position 24, rack AR15

3.2.6.5 Power Distribution Identification

This section identifies power distribution components and associated elements covered under this standard. Power distribution includes, but may not be limited to, active and passive facilities equipment that transfers electricity from source equipment and panels to the terminal receptacles on rack-mounted power distribution assemblies. Associated elements include, but may not be limited to, PDUs, distribution panels, power whips, and in-rack power distribution systems.

Identification of power distribution is limited to physical location of the equipment and not to power chain relationships. Power chain relationships will be elaborated upon in a future standard revision.

Table 41: Power Distribution Identification Conventions

ID	Primary Attribute	Secondary Attribute	Specification
1	Power Distribution Source (data center level)	Power Distribution Unit (PDU)	**PDU-xxxx** • **PDU** designates Power Distribution Unit • **xxxx** is the host name matching the VA naming convention for networked PDUs within the facility or local naming convention for non-networked PDUs • In facilities with multiple (A/B) bus distribution to the IT equipment, local naming conventions should indicate which bus the power is supplied from • Example: PDU-3A
		Remote Distribution Cabinet (RDC)	**RDC-xxxx** • **RDC** designates a Remote Distribution Cabinet, which is a stand-alone expansion distribution panel unit fed from a sub feed breaker in a PDU • **xxxx** is the local naming convention for the RDC within the facility. The typical RDC designator will be a sub designation of the parent PDU, i.e., RDC3A-1 indicates an RDC fed from sub feed breaker 1 on PDU3A. • Example: RDC-3A-1
		Distribution Panel (DP)	**DP-xxxx** • **DP** designates a wall-mounted distribution panel fed from an upstream DP, sub feed breaker in a PDU, or other similar source • **xxxx** is the local naming convention for the DP within the facility • Naming conventions for DPs at the facility or data center level are not specified Example: DP-CR3A
		Busway	**BUS-xxxx** • BUS designates an overhead power distribution busway, which is a ceiling-mounted conductor enclosure fed from an upstream distribution

ID	Primary Attribute	Secondary Attribute	Specification
			panel, sub feed breaker in a PDU, or other similar source, to which individual 'taps' with integral power whips are attached • **xxxx** is the local naming convention for the busway within the facility • Busways are typically associated with rows of IT equipment. Example: BUS-ROW3
		Power Tap	**TP [ELEMENT1]/[ELEMENT2]** • Example: TP[BUS-xxxx]/[RPDU-aann.gl.zn] • **TP** designates a power tap off a power busway system • The ELEMENT components select the source (ELEMENT1) and powered item (ELEMENT2) using nomenclature described elsewhere in this specification. Many combinations of taps are possible using this designation depending upon the specific power distribution schema used in individual data center facilities
2	Power Distribution Source (rack/enclosure level)	Zone Power Distribution Unit (PDU)	• **ZPDU-aann.ru** • **ZPDU** designates a Zone Power Distribution Unit, which is a rack-mounted unit allowing A/B distribution to standard and high-density power distribution topologies • **aann** designates terminal locations by rack or cabinet identifier • **ru** is the rack unit where a horizontal ZPDU is installed in the rack or cabinets viewed from the rear of the rack Example: ZPDU-AM45. 03 is a horizontal ZPDU installed in rack AM45 at RU position 03.
		Subzone Vertical Rack Power Distribution Unit (RPDU)	**RPDU-aann.gl.zn** or **RPDU-aann.aann.gl.zn** • **RPDU** designates Rack Power Distribution Unit, which is a distribution power strip that power cords from terminal IT equipment plug into • **aann** designates terminal locations by rack or cabinet identifier • **gl** is the group and leg designation as labeled on the zone PDU outlet connected to the rack-mounted PDU • **z** designates left or right (L or R) mounting of the PDU

ID	Primary Attribute	Secondary Attribute	Specification
			• **n** is the number of the PDU starting at the rear of the rack • Example: RPDU-AR16.A2.L2 is the second power strip mounted on the left of the rack connecting to the zone PDU's A bus in rack AR16. • Alternative: If no zone PDU is present (direct connection from the RPDU to a power whip from a DP, RDC, or PDU): • Where there is a single bus supporting a space, the bus is denoted as A. The first RPDU on each bus is number 1, the second 2, and so on. Example: RPDU-AR16.A2 is the second power strip on the A bus in rack AR16. RPDU-AR18.B1 is the first power strip in the B bus in rack AR18
3	Power Distribution (conductors)	Power Whips	**WHIP[ELEMENT1]/[ELEMENT2]** • Examples: WHIP[PDU-xxx.aa,bb,cc]/[ZPDU-aann. ru] • **WHIP** designates a set of electrical conductors in a conduit or other flexible power cord assembly intended to move electricity from a distribution point to a point-of-use component • The ELEMENT components select the source (ELEMENT1) and powered item (ELEMENT2) using nomenclature described elsewhere in this specification. Many combinations of whips are possible using this designation depending upon the specific power distribution schema used in individual data center facilities • **aa,bb,cc** is the set of circuit breaker positions used at the source end corresponding to the positions in the breaker panel, if applicable. For whips beginning at a busway tap, do not use the .aa,bb,cc portion of the designator Example: WHIP[PDU-3A.13,15,17]/[ZPDU-AR14-03] Power whip connecting three-pole circuit breaker in positions 13,15,17 in PDU-3A to zone PDU in rack AR14 located at position RU03
		Power Cords (from Rack PDUs to IT Equipment)	Not Defined

3.2.6.6 Data Communications Cabling Labeling

The VA Administration Standard specifies use of ANSI/TIA 606-C compatible formats for identifying data communications cabling. (More complicated installations may require reference to that document.) Data communications cabling (UTP, fiber, and other) shall be labeled on both ends with information about the network port that it connects to on each end. Machine-printed paper tags secured with clear plastic or acetate adhesive tape are the minimum standard for these tags as in *Figure 16* below. Hand written labels of any type are not permitted.

	
"Flag" labels – not preferred	Parallel (in-line) labels - preferred

Figure 16: Example of Communications Cable Labeling

Equipment ports and the cables in each (if any) are denoted by the equipment position with the additional identifier PN. Thus, a cable end will be labeled in ANSI/TIA 606-C compliant format fs.xy-r:PN.

IT equipment (including switch and patch panel) network ports shall be individually identified from manufacturer information, typically provided in equipment drawings available for integration with rack elevation drawings and a Data Center Infrastructure Management (DCIM) tool. Where not otherwise provided, cardinally number ports along the top row from left-to-right, then along the next row down from left-to-right, and so forth.

In order to identify the connected path of each data communications cable, the physical position identifiers at both ends are needed. The label for each cable shall identify the near side location (NS) and the far side (FS) location in VA-modified ANSI/TIA 606-C compatible format (e.g. "NS / FS"). Therefore, a patch cable going from 1DC.AD02-35:10 to patch panel BD12-19 port 04 would be identified (on the near end) as 1DC.AD02-35:10 / 1DC.BD12-19:04, and labeled (on the near end) as AD02-35:10 / BD12-19:04. On the far end, the cable would be labeled as BD12-19:04 / AD02-35:10. Automated systems adopted within VA shall understand the reciprocal relationship in these identifiers as representing a single connection.

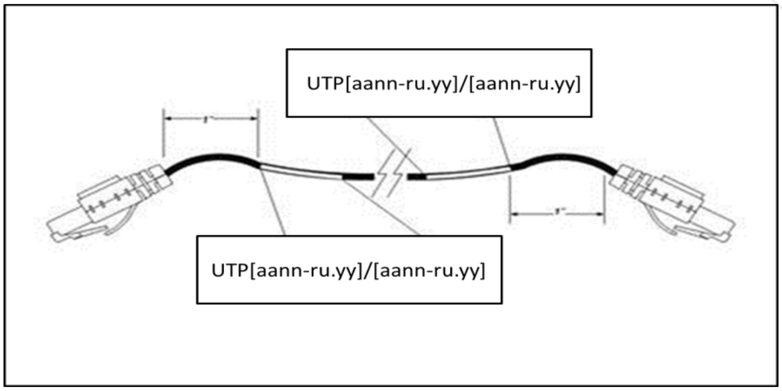


Figure 17: Detailed Example of Communications Cable Labeling

3.2.6.7 IT Equipment Rack/Cabinet Labeling

In order to cross-identify network racks and server cabinets (hereafter, generically referred to as ‘racks’) located on the floor with critical safety information (including power sources), each rack shall be labeled with its physical location (grid identification) and power distribution sources. Rack identifying physical location shall be posted on both the front and rear of each rack, on the frame above or at the top of the door (as applicable).

3.2.6.8 IT Equipment In-Rack/In-Cabinet Power Distribution Labeling

Rack power information shall be labeled on each individual vertical rack PDU, not on the exterior of the rack. Machine-printed paper tags secured with clear plastic or acetate adhesive tape are the minimum standard for these tags. Hand written labels of any type are not permitted.

Alternative IT equipment (non-rack based) shall be labeled with physical location (grid identification) and power distribution sources, and with any additional identifying information needed to identify that specific piece of equipment. Install power designator labels near or on the power cord leaving the equipment. Place equipment location tags on the front top, or at location associated with the first full tile closest to the origin.

3.2.6.9 Power Distribution to Information Technology Labeling

Data center power distribution components such as breakers, switches, receptacle junction boxes, and IT equipment power circuits (“whips”) shall be labeled with approved machine generated adhesive tape, cable tags or other approved method. Hand written labels of any type are not permitted.

All non-IT power distribution in the data center space should be labeled in the same manner to ensure a safe environment. All electrical equipment which is served by or which contains multiple sources of power shall comply with NFPA 70 standards to identify both disconnecting means.

The source end of each whip shall be labeled within 36” of the conduit leaving the distribution panel enclosure. The point-of-use end of each whip shall be labeled on the junction box, on the connector, or within 12” of the end of the conduit.

Labels installed internal to electrical or electronic components shall not provide a ground or short circuit path or interfere with the operation of components.

3.2.6.10 Physical Label Format

Labels on power whips shall contain the following information:

- PDU/Panel Source
- Circuit Number
- Whip Length
- Equipment Location
- Receptacle Type

The figure below shows an example of a self-adhesive label for use on a whip. There is no prescribed format for these labels.

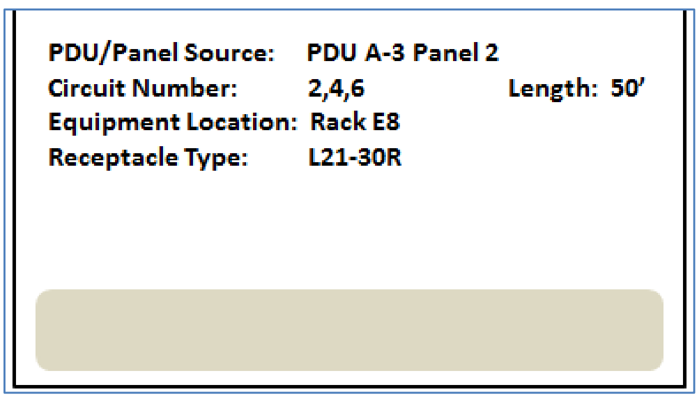


Figure 18: Power Whip Label Example

3.3 Facility IT Support Operations Standard

3.3.1 Facilities Physical Support Equipment Sustainment

Data center Facilities Physical Support Equipment Sustainment is a specialized subset of data center Operations concerned specifically with the lifecycle replacement of the physical facilities support equipment that provides an appropriate operating environment for IT systems in VA data centers. Equipment Sustainment standards are intended to allow appropriate programming, budgeting, and project implementation for lifecycle replacements of critical systems supporting VA data center facilities, providing an optimal balance between operational risk and cost.

These specifications define when and how VA will update physical facilities equipment and systems to provide the intended electrical and environmental reliability and redundancy levels defined in this standard.

VA data center facilities shall be designed and operated in accordance with the specified EIA/TIA-942 Ratings for each data center classification, except as detailed specifications are provided in this and other VA data center facilities standards.

3.3.2 Facilities Physical Support Equipment Maintenance & Repair

Data center Facilities Physical Support Equipment Maintenance & Repair is a specialized subset of Data center Operations concerned specifically with the operation, maintenance, and repair of the physical facilities support equipment that provides an appropriate operating environment for IT systems in VA data centers. Equipment Maintenance & Repair standards are intended to allow correct and appropriate implementation of high-level guidance from this standard through development of appropriate SOPs and MOPs, decision-making for outsourcing of services, requirements definition, procurement of outsourced services, and SM&R activities on physical facilities support equipment in the electrical and environmental support chains.

These specifications define how VA will operate and maintain physical facilities equipment and systems to provide the intended electrical and environmental reliability and redundancy levels defined in this standard.

VA data center facilities shall be designed and operated in accordance with the specified EIA/TIA-942 Ratings and Tiered Infrastructure Maintenance Standards (TIMS) levels for each data center classification, except as detailed specifications are provided in this and other VA data center facilities standards.

3.3.3 Data Center IT Support Operations Standard

Data center IT Support Operations is a specialized subset of data center Operations concerned specifically with the implementation, management, operation, and maintenance of infrastructure systems enabling physical hosting, power distribution, and telecommunications to the IT equipment point of use.

These specifications define how VA will operate and maintain systems such as structured cabling and 'last-mile' power distribution to IT equipment racks/cabinets, and how the configuration management of these systems will interact with IT management systems of record. Operational "rack-and-stack" functions are in the scope of this standard.

3.3.3.1 Telecommunications Rooms (TRs)

Design of Telecommunications Rooms is addressed in detail in the PG 18-12 OIT Design Guide.

Evaluation Factors

Not applicable.

Implementation Guidance

Where a distribution TR is necessary in a location (i.e. the third floor of the west wing of a hospital), VA shall construct and operate out of a standardized TR.

VA shall not design, build, or use "shallow rooms" or similar closets spaces.

Where existing shallow rooms are used for telecommunications cabling, they shall only be used for access to vertical chases and riser cabling pass-through installed there. No active or passive network equipment, power requirements, or environmental considerations are required.

3.3.3.2 IT Equipment

IT equipment shall be installed into and operated in environments intended, designed, and suitable for the equipment. This guidance applies irrespective of the ownership, purpose, or operational support for the IT equipment, or whether it is located in a designated VA data center.

Evaluation Factors

- Airflow direction shall be a consideration when selecting and procuring IT equipment. Equipment shall be specified, procured, configured, and installed to facilitate movement of air from cold aisle (supply) to hot aisle (return) and to ensure hot exhaust is not introduced into cold air supply spaces.
- Server cabinets are not suitable for use in place of network racks.

Implementation Guidance

Mount all active equipment to the front rails of the IT equipment cabinets, with front faces vertically aligned as closely as possible.

IT equipment airflow shall be oriented so that intakes draw from designated cold aisle areas and exhausts shall be directed into designated hot aisle areas.

3.3.3.3 Management of Telecommunications Cabling

Cable management is largely qualitative in nature, requiring the exercise of judgement by IT staff. Proper cable management is necessary in order to enable optimal airflow through IT equipment (minimizing energy usage), to allow identification and management of cabling throughout the IT equipment lifecycle, and to minimize risks of damage to the networking system by minimizing opportunities for damage to cables, connectors, and conveyances. Aesthetically, proper cable management reflects the professional approach expected and necessary to support the mission of providing the best possible IT support to the Veteran.

Evaluation Factors

- Cable management allows appropriate airflow
- Cables properly labeled to allow easy identification
- Cable management is organized, logical, systematic, and aesthetic

Implementation Guidance

Cabling plants shall be planned to enable the installation of IT equipment. Install and utilize cable conveyances (cable trays, cable managers, and similar) in all IT installations. Free-run telecommunications cabling is not maintainable or sustainable, and has a higher lifecycle cost than properly designed and installed cabling plant systems.

- Cabling shall be run in horizontal, vertical, or overhead cable management systems where available. Procure and install cable management equipment when cabling installations need such to enable aesthetic, managed cabling outcomes.
- Always plan the cabling path and manage the cabling installation, down to the level of the patch cable to the individual piece of IT equipment. Individual cables shall not be free-run.
- Individual cable lengths shall be selected appropriate to their purpose. Cable slack shall be managed with attention to installation criteria such as bend radius. Excessive slack indicates a poor choice of cable length.
- Patch cables and power cords between Rack PDUs and IT equipment shall not be run from one IT equipment rack to another. (Power distribution detailed in the Infrastructure section specifically calls out zone PDUs that supply power to multiple racks to obtain maximum power densities. These devices and their power supplies are not affected by this guidance.)
- Patch and power cables shall not be left unmanaged where they may interfere with exhaust airflow or have the potential to catch or snag on people or equipment.
- Document all cabling components and their linkage between components and make sure that this information is updated on a regular basis. The installation, labeling, and documentation should always match. Maintain cabling documentation, labeling, and logical/physical cabling diagrams.
- No enterprise color scheme is specified for UTP patch cables. Where a local or organizational color scheme for cabling exists, it shall be followed. Color schemes should be avoided.
- Consider vendor-specific IT equipment requirements for cabling so as not to impede intended operation of that equipment, such as blocking exhaust ports. For example, cabling management in the picture below is appropriate except for the aqua-colored cables

entering from the left, which cover the fan module on the left of the switch. This keeps the fan module from being replaced without disconnecting the network.

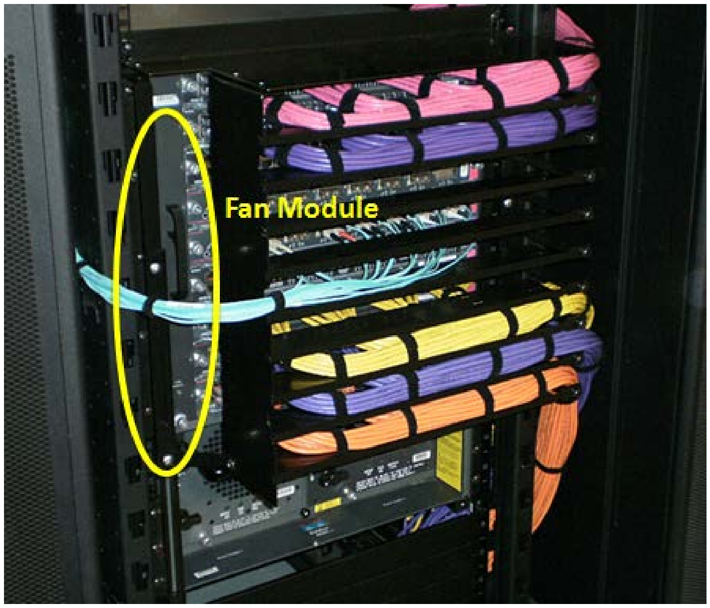


Figure 19: Equipment-Specific Cable Management Requirements

Below are examples of acceptable cabling management implementations. No installation is ever optimal for all considerations, but these represent the level of workmanship expected in the VA computer room environment.

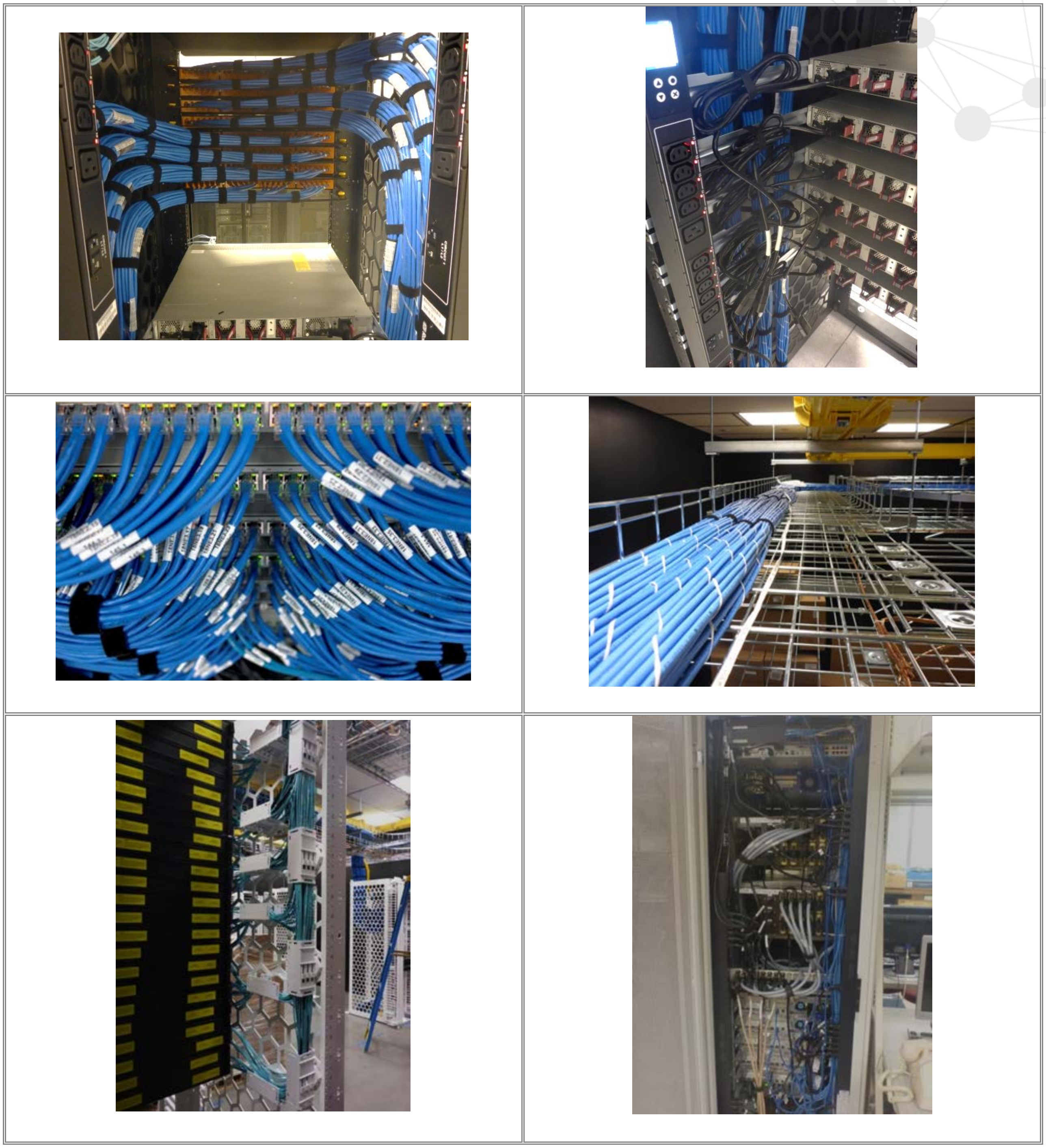


Figure 20: Acceptable Cable Management Results

Aesthetic requirements shall be implemented to the 'common man' standard. Below are examples of unacceptable cabling management implementations that will require remediation.

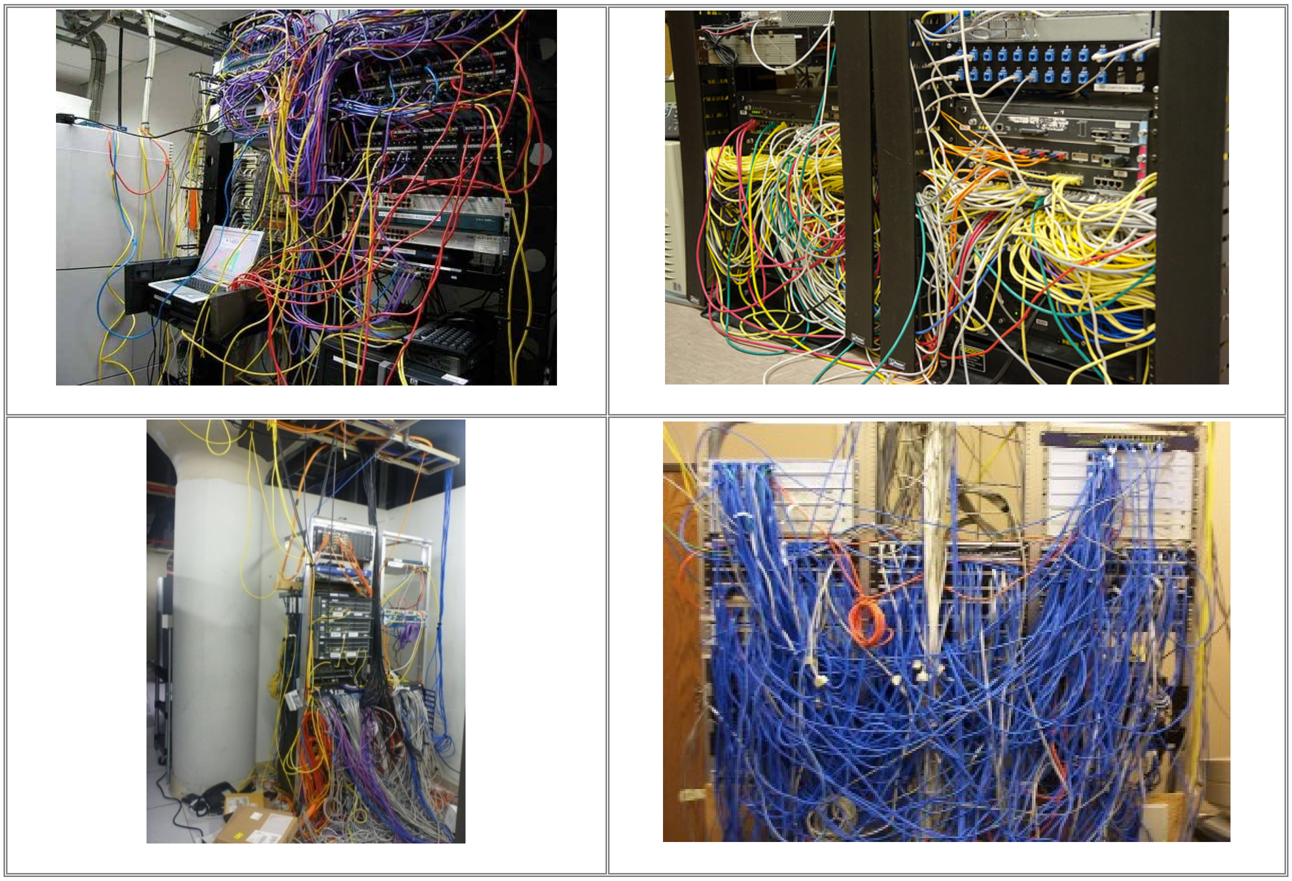


Figure 21: Unacceptable Cable Management Results

3.3.3.4 Installation Guidance

- All cabling shall be installed in a neat, workmanlike manner without twists, kinks, and unnecessary crossovers.
- Cables should not be in contact with the ground. Use cable management components and techniques to maintain a clean, clear, and safe work environment.
- Do not mount cabling in locations that block access to other equipment (e.g. power strip or fans) inside and outside the racks.
- Patch cables should follow the side of the IT equipment rack closest to the assigned NIC.
- Cables should not be looped around themselves or other objects.
- Route cables with gentle loops to avoid damage due to exceeding bend radius limitations. Glass fiber can be easily broken with rough handling or overly tight bends.
- Cables should be tight enough to maintain position but not tight enough to deform the jacket or put tension on the connectors.

- Based on heat exhaust (airflow), serviceability, and excess cable lengths, do not install folding/retractable cable management arms for IT equipment in VA computer spaces. Arms currently installed on existing equipment may be used until the equipment is refreshed and removed.
- All cable slack should be concealed within the rack either vertically or within cable managers. Slack should not be looped. With use of the correct length cables, there should not be sufficient slack to enable looping.
- Use the correct length patch cables.
- Cables should not be twisted or wrapped around other cables, including when bundled.

3.3.3.5 Cable Bundling Guidance

- Bundle cables together in groups of relevance (for example, cables to a single equipment distributor or uplinks to core devices), as this will ease management and troubleshooting.
- Bundles of cables, when necessary, should be built from sub-bundles of no more than 6-8 individual cables. The larger bundles should not exceed 4 sub-bundles of like quantity.
- When bundling or securing cables, use Velcro-based ties not more than every 1 to 2 meters, and more frequently as needed to maintain a clean installation. Do not use zip ties or twist ties for cable bundling or securing, as these apply pressure on the cables.
- Only bundle like cable types. Do not bundle fiber, power, and UTP together.
- Cable labels shall be visually accessible to local personnel following installation, for future identification and troubleshooting purposes. Rather than bundling groups of cabling in a manner that prevents identification of individual cables, bundle in a different manner and/or relocate the cabling to locations where they will not be obscured. Consider bundling so all cables are on the exterior of the bundle, as shown in Figure 21. The exception to this is when factory pre-bundled cabling is used.

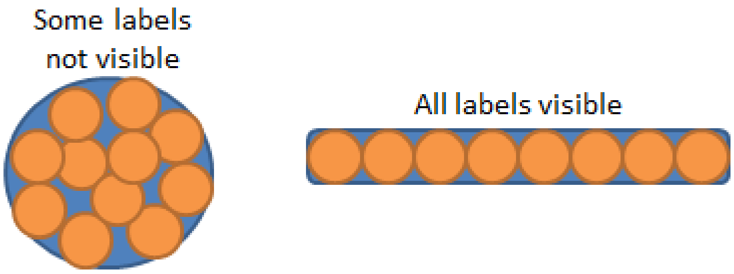


Figure 22: Cable Labels in Bundles

3.3.3.6 UTP, Fiber, & Power Cabling Guidance

- Segregate power and telecommunications cabling in separate cable tray systems; use different conveyance systems located not less than 12” apart when these two systems are run in parallel.
- Where possible, run power and telecommunications in separate paths to reduce risks of EMI/RFI and data transmission losses.
- Do not install UTP cabling on top of fiber cabling to prevent damage to the fiber transmission medium.
- Segregate UTP and fiber telecommunications cabling, using different conveyances where possible. Where not possible or provided, ensure fiber cable is protected from damage. Use fiber innerduct where necessary within the same cabling conveyance.
- Use properly-sized equipment power cords; use of 6’ length power cords where 2’ cords are needed is not considered a best practice.
- Separate A- and B-side power and segregate equipment power cords (between vertical rack power distribution units and IT equipment) by color for identification of A/B power to each piece of IT equipment. Follow best practices for managing the power cords similarly to other cabling.

3.3.4 Data Center Facility Management Standard

Data Center Facility Management is a specialized subset of Data Center Operations concerned specifically with the operation, maintenance, and organization of computing spaces and the physical facilities support equipment that provides the appropriate operating environment for IT systems in VA data centers. Data Center Facility Management standards are intended to allow correct and appropriate implementation (the “how”) of high-level guidance from this standard through configuration management, operational monitoring and management of power and environmental conditions, and ongoing SM&R activities in the physical computing space environment in VA data centers. These specifications define how VA will manage space, power, and cooling resources supporting the physical computing space environment and operate physical facilities equipment and other systems to provide the intended electrical and environmental reliability and redundancy levels defined in this standard.

3.3.4.1 Computer Room Operation Specifications

VA computing facilities shall utilize engineered, verified layout designs to optimize energy usage in the environmental control systems supporting the facilities.

Evaluation Factors

Designated hot and cold aisles are utilized in facilities with more than eight (8) IT equipment rack/cabinet equivalents.

Supply cooling air is not directly mixed with return air through placement of perforated floor tiles and similar vents.

Blanking panels and air dams are deployed in all IT equipment cabinets to minimize bypass air across the surface area of the cabinets.

Implementation Guidance

Unless otherwise designated through validated engineering design, utilize a hot/cold aisle arrangement for equipment located in VA data centers. This applies to both facilities that use a raised access floor plenum for cooling distribution and those that do not.

3.3.4.2 Recommended Tools & Bench Stock for Data Centers

A variety of tools and an appropriate quantity of bench stock are necessary for an operational data center to function properly. These include basic hand tools, cable management tools, facility management tools, and components routinely needed to manage the operating environment as well as moves, adds, and changes in the IT environment. Each VA data center shall obtain and maintain a basic tool inventory necessary to implement the VA ITS Standards. Each VA data center shall maintain a minimum bench stock level for components necessary to operate their facility.

Evaluation Factors

- Tool kits at each enterprise data center shall follow the general implementation guidance, without exceeding rational and realistic needs.
- Tool kits shall be inventoried, maintained, and stored in an appropriate, organized manner at each facility. (Methods of storage/maintenance are not specified.)
- Consumables for specific tools, as applicable, shall be maintained at appropriate levels.

Implementation Guidance

Tool requirements are described from simple to complex, aligned with the classification of the facility as described in section 2.

Network Support Centers (NSCs) will stock minimal tool requirements, primarily due to their low expected rate of change in the IT environment.

Table 38: NSC Tool List

Tool Description	Quantity
MRO Field Technician tool kit (SPC66C or equivalent) – screwdrivers, nut drivers, hex blades, crimp tools, pliers, cutters, et cetera	1
Cordless Drill w/ battery & charger	1
Lineman scissors	1
Leatherman multi-tool /w sheath	1
Socket Set Standard/Metric 1/4",3/8", 1/2"drive	1
Long Handle Crimper	1
Ratcheting Modular Crimp Tool (RJ-45)	1
Ratcheting Crimp tool	1
Cable Cutter, 9” minimum	1
Hack Saw	1

Screw driver, multiple standard/Phillips bits & torx bits	1
Basic First Aid Kit	1
Ear Muff, 27DB, Over-The-Head	1
Laser Safety Glasses Fit Over Frame Glass Lens Blue 50% VLT	1
Laser Safety Glasses Sport Wrap Frame Glass Lens Blue 50% VLT	1
Laser Safety Glasses Spectacle Frame Polycarb Lens, Green 24% VLT	1
Laser Safety Glasses Sport Wrap Frame Polycarb Lens, Green 24% VLT	1
Professional Quad-Tap Extension Cord - 50' 12/3 on Retractable Reel	1
Handheld LED Flashlight	1
Headlamp, LED	1
50W DC-AC Power Inverter	1
General Utility Gloves, multiple sizes	6
Latex Gloves, Medium	4
Latex Gloves, Large	4
Solid Floor Tile Lifter	1 per 500sf, min. 2
Perforated Floor Tile Lifter	1
Fiber Optic Cleaning Kit	1
Ladder, 6’	1
Ladder, 10’	1
Fish Tape, 50’	1
Tool Cart	1
Bolt Cutters	1
RJ45 Crimping Tool	1
Punch Down Tool	1

Campus Support Centers (CSCs) will stock a broad variety of tool requirements, sufficient to support a variety of commonly anticipated change work.

Table 39: CSC Tool List

Tool Description	Quantity
Complete Tool Set from NSC Requirements	1
Fluke 87 Multimeter, or equivalent	1
Thermo- Anemometer, or equivalent	1
DYMO Rhino 6000 Label Maker Kit, or equivalent	1
Lift-4 Model 480 IT Equipment Lifter, or equivalent	1
Ratcheting Cable Cutter	1

Mission Support Centers (MSCs) have specific missions and will stock tool requirements aligning with one of the previous three classification categories, primarily based on the amount of IT equipment and rate of change expected in the IT environment at each MSC. Small MSC facilities

(<10 IT equipment cabinets) should align with the NSC requirements. Larger MSC environments should align with the CSC requirements.

Core Data Centers (CDCs) will have the most complex and complete tool requirements. If specialized tools are needed at less complex sites, they shall be borrowed from (and returned to) the CDCs for the duration of the specific project work.

Table 40: CDC Tool List

Tool Description	Quantity
Complete Tool Set from CSC Requirements	1
Fluke Networks OneTouch, or equivalent	1
Fluke OptiFiber Pro Multimode OTDR kit, or equivalent	1
Thermal Imaging Camera, FLIR E6 or equivalent	1
Portable Band Saw	1
Reciprocating Saw or Jigsaw	1
Metal File	1
Manometer/Differential Pressure Meter	1

When specific tools may no longer be required (not used for 12 months or longer), notify the EDICT team. When other tools not on the general lists are identified as necessary, notify the EDICT team of the perceived requirement.

Bench stock items shall be maintained at all VA data center facilities commensurate with the operational level of need for that facility. Suggested bench stock items are listed below; specific quantities will be determined for individual locations.

Table 41: Bench Stock

Bench Stock Description	Quantity
Disposable Ear Plugs	Site Specific
Cage Nuts	Site Specific
Blanking Panels	Site Specific
Air Dam Material	Site Specific
Fiber Optic Conduit (innerduct)	Site Specific
Cat6A UTP, bulk	Site Specific
8P8C Connectors (RJ45)	Site Specific

3.3.5 Data Center Facility Engineering Standard

Data Center Facility Engineering is a specialized subset of Data Center Operations concerned specifically with the engineering, design, and implementation of physical facilities support equipment that provides an appropriate operating environment for IT systems in VA data centers. Data Center Facility Engineering standards are intended to allow correct and appropriate implementation of high-level guidance from the VA Enterprise ITS Standard through selection, procurement, installation, maintenance, and recoverability activities on physical facilities support equipment in the electrical and environmental support chains.

These specifications define how VA will select, procure, install, and operate physical facilities equipment and systems to provide the intended electrical and environmental reliability and redundancy levels defined in the VA Enterprise ITS Standard. These will be expanded upon in the next update of this standard.

Appendix A: Definitions

Alarming: Communicating when an absolute limit has been exceeded.

Alerting: Communicating when a condition threshold has been reached or exceeded.

Facility Total Electrical Consumption (FEC): Total of ALL energy used from all sourced by the building housing the data center. This metric requires totaling the (a) amount of electrical energy going into the building through the building's main step-down transformer(s) and (b) the amount of electrical energy generated through running any facility or data center generator equipment.

ASHRAE-recommended monitoring locations:

- Front Top (FT): Centered horizontally, inside the front door, no more than 1 ft. from the top of the cabinet
- Front Middle (FM): Centered horizontally, inside the front door, 4 ft. +/- 6 in. from the finished floor surface
- Front Bottom (FB): Centered horizontally, inside the front door, no more than 1 ft. from the finished floor surface
- Rear Top (RT): Centered horizontally, inside the rear door, no more than 1 ft. from the top of the cabinet
- Rear Middle (RM): Centered horizontally, inside the rear door, 4 ft. +/- 6 in. from the finished floor surface
- Rear Bottom (RB): Centered horizontally, inside the rear door, no more than 1 ft. from the finished floor surface

Metering: Measurement of a condition or set of conditions over a period of time. Metering is primarily a data collection function, intended to support analysis of operational characteristics of a data center.

Monitoring: Continual real-time observation of a condition or set of conditions affecting a data center.

Power Usage Effectiveness (PUE): PUE is a dimensionless metric which describes how efficiently a data center is designed and operated to conserve power. PUE is defined as the ratio: Total Data Center Energy Consumption (TEC) / Total IT Equipment Energy Consumption (TITEC) or TEC/TITEC.

Site Infrastructure Energy Efficiency Rating (SIEER): SIEER is a dimensionless metric which describes how efficiently a data center is designed and operated to conserve power. SIEER is defined as the ratio: Total Data Center Energy Consumption (TEC) / Total UPS Load Energy Consumption TUPEC or TEC/TUPSC.

Total Renewable Energy Usage by Data Center (RENEW): All electricity consumed by the facility housing the VA computer facility generated from renewable resources (solar, wind, hydro, wave, and similar) locally or through the supplying utility. Hydrocarbon and nuclear utility sources are not considered renewable for the purposes of this value.

TEC: Total of ALL energy used from all sources required to power all infrastructure and equipment within the confines of a data center.

TITEC: Summation of ALL energy directly consumed by IT equipment in the Data Center. IT equipment includes, but is not limited to, computers, storage systems, and networking gear.

TPIEC: Summation of ALL energy used by facilities physical infrastructure equipment that supports the computer space. This is the total amount of electricity necessary to run all mechanical and electrical equipment providing support to the computer space, but does not include the IT Equipment Load Electrical Consumption.

TUPSC: Summation of all energy used on the load (not source) side(s) of all UPS system(s) supporting the critical load in the computer space.

Appendix B: References

Documents listed herein may impact scope, design, and/or schedule and are listed for reference. All references herein are mandatory unless otherwise stated. The current version of all references is implied. Editions should be verified to ensure the latest is used, as should AHJ amendments incorporated during adoption. Superseding documents not listed herein are considered mandatory from their date of publication. Inadvertent omission of applicable documents referenced here does not waive necessity for compliance with requirements of those documents.

The use of nationally recognized commercial and industry standards, specifications, and codes is encouraged. This will simplify contract preparation and execution, and facilitate understanding and compliance with contract requirements, increase competition, reduce time requirements, and lower costs.

ANSI/ASHRAE Addendum15c, Safety Code for Mechanical Refrigeration

ANSI/ASHRAE Addendum15d, Safety Code for Mechanical Refrigeration

ANSI/ASHRAE Standard 90.4, Energy Standard for Data Centers

ANSI/TIA -455-C, General requirements for standard test procedures for optical fibers, cables, transducers, sensors, connecting and terminating devices, and other fiber optic components

ANSI/TIA-455-78B, FOTP-78 IEC 60793-1-40 Optical Fibres - Part 1-40: Measurement Methods and Test Procedures Attenuation

ANSI/TIA-470.110-D, Telecommunications Telephone Terminal Equipment - Transmission Requirements for Analog Telephones with Handsets

ANSI/TIA-492AAAA-B, Detail Specification for 62.5-Î¼m Core Diameter/125-Î¼m Cladding Diameter Class Ia Graded-Index Multimode Optical Fibers

ANSI/TIA-492AAAB-A, Detail Specification for 50-Î¼m Core Diameter/125-Î¼m Cladding Diameter Class Ia Graded-Index Multimode Optical Fibers

ANSI/TIA-492AAAC-B, Detail Specification for 850-nm Laser- Optimized, 50-Î¼m Core Diameter/125-Î¼m Cladding Diameter Class Ia Graded-Index Multimode Optical Fibers

ANSI/TIA-526-7-A, Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant, Adoption of IEC 61280-4-2 edition 2: Fibre-Optic Communications Subsystem Test Procedures; Part 4-2: Installed Cable Plant Single-Mode Attenuation and Optical Return Loss Measurement

ANSI/TIA-526-14-C, Optical Power Loss Measurement of Installed Multimode Fiber Cable Plant; Modification of IEC 61280-4-1 edition 2, Fiber-Optic Communications Subsystem Test Procedures- Part 4-1: Installed Cable Plant-Multimode Attenuation Measurement

ANSI/TIA-568.0-D, Generic Telecommunications Cabling for Customer Premises

ANSI/TIA-568.1-D, Commercial Building Telecommunications Infrastructure Standard

ANSI/TIA-568.3-D, Optical Fiber Cabling and Components Standard

ANSI/TIA-568-C.2, Balanced Twisted-Pair Telecommunications Cabling and Components Standards

ANSI/TIA-568-C.2 ERTA, Balanced Twisted-Pair Telecommunications Cabling and Components Standards

ANSI/TIA-568-C.2-1, Balanced Twisted-Pair Telecommunications Cabling and Components Standard, Addendum 1: Specifications for 100 Ω Category 8 Cabling

ANSI/TIA-568-C.2-2, Balanced Twisted-Pair Telecommunications Cabling and Components Standard, Addendum 2: Alternative Test Methodology for Category 6A Patch Cords - Addendum to TIA-568-C

ANSI/TIA-568-C.4, Broadband Coaxial Cabling and Components Standard

ANSI/TIA-569-D, Telecommunications Pathways and Spaces

ANSI/TIA-569-D-1, Telecommunications Pathways and Spaces: Addendum 1- Revised Temperature and Humidity Requirements for Telecommunications Spaces - Addendum to TIA-569-D

ANSI/TIA-598-D, Optical Fiber Cable Color Coding

ANSI/TIA-606-C, Administration Standard for Telecommunications Infrastructure

ANSI/TIA-607-C, Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises

ANSI/TIA-607-C-1, Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises - Addendum to TIA-607-C

ANSI/TIA-758-B, Customer-Owned Outside Plant Telecommunications Infrastructure Standard

ANSI/TIA-810-B, Telecommunications Telephone Terminal Equipment Transmission Requirements for Narrowband Digital Telephones

ANSI/TIA-862-B, Structured Cabling Infrastructure Standard for Intelligent Building Systems

ANSI/TIA-942-B, Telecommunications Infrastructure Standard for Data Centers

ANSI/TIA-968-B, Telecommunications Telephone Terminal Equipment Technical Requirements for Connection of Terminal Equipment to the Telephone Network

ANSI/TIA-968-B-1, Telecommunications Telephone Terminal Equipment Technical Requirements for Connection of Terminal Equipment to the Telephone Network-Addendum 1 - Addendum to TIA-968-B

ANSI/TIA-968-B-2, Telecommunications Telephone Terminal Equipment Technical Requirements for Connection of Terminal Equipment to the Telephone Network- Addendum 2 - Addendum to TIA-968-B

ANSI/TIA-968-B-3, Telecommunications Telephone Terminal Equipment Technical Requirements for Connection of Terminal Equipment to the Telephone Network- Addendum 3 - Addendum to TIA-968-B

ANSI/TIA-1005-A, Telecommunications Infrastructure Standard for Industrial Premises

ANSI/TIA-1005-A-1, Telecommunications Infrastructure Standard for Industrial Premises

Addendum 1- M12-8 X-Coding Connector (Addendum to TIA-1005-A)

ANSI/TIA-1152-A, Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling

ANSI/TIA-1179, Healthcare Facility Telecommunications Infrastructure

ANSI/TIA/EIA-455-1-B, Cable Flexing for Fiber Optic Interconnecting Devices

ANSI/TIA/EIA -455-2C, Impact Test Measurements for Fiber Optic Devices

ANSI/TIA/EIA-455-5C, FOTP-5 Humidity Test Procedure for Fiber Optic Components

ANSI/TIA/EIA-455-8, FOTP-8 Measurement of Splice or Connector Loss and Reflectance Using an OTDR

ANSI/TIA/EIA-455-34A, FOTP-34 Interconnection Device Insertion Loss Test

ANSI/TIA/EIA-455-171A, FOTP-171 Attenuation by Substitution Measurement for Short-Length Multimode Graded-Index and Single Mode Optical Fiber Cable Assemblies

ANSI/TIA/EIA-455-185, FOTP-185 Strength of Coupling Mechanism For Fiber Optic Interconnecting Devices

ANSI/TIA/EIA-455-188, FOTP-188 Low Temperature Testing of Fiber Optic Components

ANSI/TIA/EIA-492CAAB, Detail Specification for Class IVa Dispersion-Unshifted Single-Mode Optical Fibers with Low Water Peak

ANSI/TIA/EIA-568-Set, Commercial Building Telecommunications Cabling Standard ASHRAE Standard 52.2, Method of Testing General Ventilation Air-Cleaning Devices Removal by Particle Size (ANSI approved)

ASHRAE Standard 62.1-2007, Ventilation for Acceptable Indoor Air Quality

ASHRAE 135, BACnet - A Data Communication Protocol for Building Automation and Control Networks

ASHRAE 135 ERTA, BACnet - A Data Communication Protocol for Building Automation and Control Network

ASHRAE 135 INT 1, BACnet - A Data Communication Protocol for Building Automation and Control Network

ASHRAE 135 INT 2, BACnet - A Data Communication Protocol for Building Automation and Control Network

ASTM B258, Standard Specification for Standard Nominal Diameters and Cross-Sectional Areas of AWG Sizes of Solid Round Wires Used as Electrical Conductors

ASTM B539, Standard Test Methods for Measuring Resistance of Electrical Connections (Static Contacts)

ASTM D4565, Standard Test Methods for Physical and Environmental Performance Properties of Insulations and Jackets for Telecommunications Wire and Cable

ASTM D4566, Standard Test Methods for Electrical Performance Properties of Insulations and Jackets for Telecommunications Wire and Cable

ATIS 0600311, DC Power Systems Telecommunications Environment Protection

ATIS 0600336, Design Requirements for Universal Cabinets and Framework

BICSI 002, Data Center Design and Implementation Best Practices

BICSI ITSIMM, Information Technology Systems Installation Methods Manual (ITSIMM) - 7th Edition

BICSI OSPDRM, Outside Plant Design Reference Manual (OSPDRM) - Fifth Edition

BICSI TDMM, Telecommunications Distribution Methods Manual - 13th Edition; Volumes I & II

BICSI/NECA 568, Standard for Installing Commercial Building Telecommunications Cabling

BICSI/NECA 607 Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings 2011

CSI MASTERFORMAT ™ 2004 EDITION NUMBERS & TITLES Construction Specifications Institute (CSI)

ECIA EIA/ECA-310-E, Cabinets, Racks, Panels, and Associated Equipment

Executive Order 13693, "Planning for Federal Sustainability in the Next Decade"

Federal Information Processing Standard (FIPS) 200, Minimum Security Requirements for Federal Information and Information Systems

IEEE STD 446, Emergency and Standby Power Systems for Industrial and Commercial Applications (Orange Book)

MIL-STD-188-124B, Grounding, Shielding, and Bonding

National Energy Policy Act of 2005-SEC. 203. FEDERAL PURCHASE REQUIREMENT

NEMA FG 1, Fiberglass Cable Tray Systems - Revision No.1

NEMA VE 1, METAL CABLE TRAY SYSTEMS

NEMA VE 2, Cable Tray Installation Guidelines - Incorporates Errata 2016

NFPA 70, National Electrical Code

NFPA 72, National Fire Alarm and Signaling Code

NFPA 75, Standard for the Fire Protection of Information Technology Equipment

NFPA 101, Life Safety Code

NFPA 2001, Standard on Clean Agent Fire Extinguishing Systems

PG 18-12 OIT Design Guide, Office of Construction and Facilities Management Design Guide

Presidential Memorandum 131205, “Federal Leadership on Energy Management”

TIA-232-F, Interface Between Data Terminal Equipment and Data Circuit- Terminating Equipment Employing Serial Binary Data Interchange

TIA-455-6-B, FOTP-6 Cable Retention Test Procedure for Fiber Optic Cable Interconnecting Devices

TIA-455-13-A, FOTP-13 Visual and Mechanical Inspection of Fiber Optic Components, Devices, and Assemblies

TIA-455-21-A, FOTP-21 Mating Durability of Fiber Optic Interconnecting Devices

TIA-455-36-A, FOTP-36 Twist Test for Fiber Optic Connecting Devices

TIA-455-107-A, FOTP-107 Determination of Component Reflectance or Link/System Return Loss Using a Loss Test Set

TIA-470.000-E, Telecommunications Telephone Terminal Equipment Overview of Performance Standards for Analog Telephones

TIA-485-A, Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems

TIA-492CAAA, Detail Specification for Class IVa Dispersion-Unshifted Single-Mode Optical Fibers

TIA-561, Simple 8-Position Non-Synchronous Interface Between Data Terminal Equipment and Data Circuit- Terminating Equipment Employing Serial Binary Data Interchange

TIA-604-3-B, FOCIS 3 Fiber Optic Connector Intermateability Standard- Type SC and SC-APC

TIA-968-B ERTA, Telecommunications Telephone Terminal Equipment Technical Requirements for Connection of Terminal Equipment to the Telephone Network

TIA/EIA-455-4C, FOTP-4 Fiber Optic Component Temperature Life Test

TIA TSB-153, Static Discharge Between LAN and Data Terminal Equipment

TIA TSB-155-A, Guidelines for the Assessment and Mitigation of Installed Category 6 Cabling to Support 10GBASE-T

TIA TSB-184-A, Guidelines for Supporting Power Delivery Over Balanced Twisted-Pair Cabling

UL 444, UL Standard for Safety Communications Cables - Fifth Edition

UL 444 BULLETIN, UL Standard for Safety Communications Cables

VA DIRECTIVE 6500, INFORMATION SECURITY PROGRAM

Appendix C: Baseline and Configuration Management

VA standards are stored on the VA Baseline and Configuration Management SharePoint site .

Appendix E: Acronyms

For other acronyms, refer to the general VA Acronym Lookup.

Acronym	Definition
AES	Advanced Encryption Standard
AHJ	Authority Having Jurisdiction
ANSI	American National Standards Institute
ARU	Air Removal Units
ASD	Aspirated Smoke Detection
ASHRAE	American Society of Heating and Air-Conditioning Engineers
ATS	Automatic Transfer Switch
BACnet	Building Automation and Control Networking Protocol
BAS	Building Automation System
BCM	Branch Circuit Monitoring
C&A	Certification and Accreditation
CANBUS	Controller Area Network Bus
CDC	Core Data Center
CE	Clinical Engineering
CFD	Computational Fluid Dynamics
CFM	Cubic Ft. per Minute
CMOP	Consolidated Mail Outpatient Pharmacy
CPAC	Consolidated Patient Account Center
CRAC	Computer Room Air Conditioner
CRAH	Computer Room Air Handler
CDC	Campus Support Center
DCCI	Data Center Consolidation Initiative
DP	Dew Point
DR	Disaster Recovery
EC	Electrically Commuted
ED	Electrical Distribution

Acronym	Definition
EDICT	Data Center Infrastructure Collaboration Team
EIA	Electronic Industries Alliance
EMCS	Energy Management Control System
EO	Enterprise Operations
FB	Front Bottom
FEC	Facility Total Electrical Consumption
FDCCI	Federal Data Center Consolidation Initiative
FM	Front Middle
FSC	Financial Services Center
FT	Front Top
GbE	Gigabit Ethernet
HA	High Availability
IaaS	Infrastructure as a Service
IO	Infrastructure Operations (IO)
IT	Information Technology
ITOPS	IT Operations and Services
HAC	Health Administration Center
HC	Horizontal Cross Connect
HAD	Horizontal Distribution Area
HEC	Health Eligibility Center
HVAC	Heating, Ventilation, and Air Conditioning
kVA	Kilo-Volt/Amp
LAN	Local Area Network
MDA	Main Distribution Area
MODBUS	Modicon Communication Bus
MPDU	Modular Power Distribution Unit
MPO	Multi-Fiber Push On
MSC	Mission Support Center
NCCB	National Change Control Board

Acronym	Definition
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NDCOL	National Data Center Operations and Logistics
NSC	Network Support Center
OIT	Office of Information & Technology
OIFO	Office of Information Field Office
OM	Optical Multimode
OMB	Office of Management & Budget
PaaS	Platform as a Service
PDU	Power Distribution Unit
PUE	Power Usage Effectiveness
RB	Rear Bottom
RDC	Regional Data Center
RM	Rear Middle
RH	Relative Humidity
RPDU	Rack Power Distribution Unit
RT	Rear Top
RU	Rack Unit
SaaS	Software as a Service
SAN	Storage Area Network
SD	Solution Delivery
SEDR	Systems Engineering Design Review
SEG	Senior Engineering Group
SIEER	Site Infrastructure Energy Efficiency Rating
SRG	Signal Reference Grid
SHA	Secure Hash Algorithm
SSL	Secure Sockets Layer
TEC	Total Data Center Energy Consumption
TIA	Telecommunications Industry Association

Acronym	Definition
TITEC	Total IT Equipment Energy Consumption
TPIEC	Total Data Center Physical Infrastructure Energy Consumption
TUPSC	Total UPS Load Energy Consumption
TR	Telecommunications Room
UL	Underwriters Laboratories
UTP	Unshielded Twisted Pair
UPS	Uninterruptible Power System
VA	Department of Veterans Affairs
VAMC	Veterans Affairs Medical Center
VBA	Veterans Benefits Administration
VESDA	Very Early Smoke Detection Apparatus
VSD	Variable Speed Drive
WAN	Wide Area Network

Appendix F: Contributors

This standard is maintained by the Enterprise Data Center Infrastructure Collaboration Team (EDICT).

The following subject matter experts have contributed to the development of this document as indicated:

Table 42: Contributors

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