

**Town Of Sterling, CT
Cable Infrastructure Project**

Acronyms

AHJ	Authority having jurisdiction	m	Meter(s)
ANEXT	Alien near-end crosstalk	MHz	Megahertz
ANSI	American National Standards Institute	mm	Millimeter(s)
ASTM	American Society for Testing and Materials	N	Newton(s)
AWG	American wire gauge	NEXT	Near-end crosstalk
BICSI	Building Industry Consulting Service International	nF	Nanofarad(s)
C	Celsius	ns	Nanosecond(s)
CDT	Cable Design Technologies	NVP	Nominal velocity of propagation
CMP	Communications plenum	OD	Outside diameter
CMR	Communications riser	PCB	Printed circuit board
CP	Consolidation point	PE	Professional Engineer
CSC	Construction Specifications Canada	pF	Picofarad(s)
CSI	The Construction Specifications Institute	PSACRF	Power-sum attenuation-to-crosstalk ratio far-end
dB	Decibel(s)	PSAACRF	Power-sum attenuation-to-alien crosstalk ratio far-end
DC	Direct current	PSANEXT	Power-sum alien near-end crosstalk
EF	Entrance facility	PSELFEXT	Power-sum equal level far-end crosstalk
EIA	Electronic Industries Alliance	PSNEXT	Power-sum near-end crosstalk
ELFEXT	Equal level far-end crosstalk	RU	Rack unit [45 mm (1.75 in)]
ER	Equipment room	RFQ	Request for quote
F	Fahrenheit	TBB	Telecommunications bonding backbone
ft	Foot/feet	TDR	Time domain reflectometer
Gb/s	Gigabits per second	TE	Telecommunications enclosure
IDC	Insulation displacement contact	TGB	Telecommunications grounding busbar
IEC	International Electrotechnical Commission	TIA	Telecommunications Industry Association
IEEE	Institute of Electrical and Electronics Engineers	TMGB	Telecommunications main grounding busbar
in	Inch(es)	TO	Telecommunications outlet/connector
ISO	International Organization for Standardization	TR	Telecommunications room
kg	Kilogram(s)	U	Rack unit [45 mm (1.75 in)]
lb	Pound(s)	UL	Underwriters Laboratories
lbf	Pound-force	WA	Work area
LC	Limited combustible		
LSOH	Low smoke zero halogen		
LSZH	Low smoke zero halogen		

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Division 27 – Communications

27 00 00 Communications

27 05 00 Common Work Results for Communications

27 05 26 Grounding and Bonding for Communications Systems

27 05 26.01 General

27 05 26.01.A The facility shall be equipped with a telecommunications bonding backbone (TBB). This backbone shall be used to ground all telecommunications cable shields, racks, cabinets, raceways, and other associated hardware that has the potential to act as a current-carrying conductor. The TBB shall be installed independent of the building's electrical and building ground and shall be designed in accordance with the recommendations found in TIA-607-C, *Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications*.

27 05 26.01.B The main entrance facility/equipment room (EF/ER) in each building shall be equipped with a telecommunications main grounding busbar (TMGB). Each telecommunications enclosure (TE) and/or telecommunications room (TR) shall be provided with a telecommunications grounding busbar (TGB). The TMGB shall be connected to the building electrical entrance grounding facility. The intent is to provide a telecommunications grounding system that is equal in potential to the building electrical grounding system. This will minimize ground loop current potential between telecommunications equipment and the electrical system that supplies power to the equipment.

27 05 26.01.C All metal equipment racks, cabinets, backboards, cable shields, strength members, splice cases, cable trays, and the like entering or residing in TEs/TRs/ERs/EFs shall be grounded to the appropriate TGB/TMGB using a minimum 6 AWG stranded copper bonding conductor and compression connectors.

27 05 26.01.D All wires used for telecommunications grounding purposes shall be identified with green insulation or green tape. Non-insulated wires shall be identified at each termination point using green tape. All cables and busbars shall be identified and labeled in accordance with TIA-607-C.

27 05 26.02 grounding and bonding system installation

27 05 26.02.A The TBB shall be designed and/or approved by a qualified Professional Engineer (PE), licensed in the jurisdiction where the work is to be performed. The TBB shall adhere to the recommendations found in TIA-607-C and shall be installed in accordance with industry best practices.

27 05 26.02.B A licensed electrical contractor shall perform the installation and termination of the main bonding conductor to the building service entrance ground.

27 05 28 Pathways for Communications Systems

27 05 53 Identification for Communications Systems

- 27 05 53.01 General
- 27 05 53.01.A Labeling shall be in accordance with the recommendations found in TIA/-606-B, the manufacturer's recommendations/installation guides, and industry best practices.
- 27 05 53.01.B Label stock shall be polyester-base material self-laminating for cables (wrap-around), wall outlets, terminal blocks and patch panels. It shall be durable and must be smudge and smear resistant as soon as they are made, will not fade over time or rub off, will not peel or loosen and will withstand specific component temperature and humidity requirements.
- 27 05 53.01.X Ordering information for Belden labels can be found in ANNEX B

27 08 00 Commissioning of Communications

27 08 01 System Documentation

- 27 08 01.01 General
- 27 08 01.01.A Upon completion of the installation, the successful bidder shall provide three comprehensive sets of documentation to the owner of the Belden System 2400 for approval. Documentation shall include the items detailed below.
- 27 08 01.01.B Documentation shall be submitted within 10 working days of the completion of each testing phase (e.g., subsystem, area, floor). This includes all test results and draft as-built drawings. Draft drawings may include hand-written annotations. Printer-generated (final) copies of all drawings shall be submitted within 30 working days of the completion of each testing phase. At the request of the owner of the Belden System 2400, the successful bidder shall provide copies of the original test results in electronic format, for example a Fluke Networks (*.flw) Linkware file or a Microsoft Excel (*.xls) file.
- 27 08 01.01.C The owner of the Belden System 2400 may request a 10% random field re-test of the installed cabling system (at no additional cost) to verify documented findings. If the re-test findings contradict the documentation submitted by the successful bidder, additional testing can be requested to the extent deemed necessary by the owner of the Belden System 2400, including a 100% re-test. This testing shall be at no additional cost to the owner of the Belden System 2400.

27 08 02 Test Results Documentation

- 27 08 02.01 General
- 27 08 02.01.A The test equipment shall meet the requirements found in the TIA-568-C series of standards.

- 27 08 02.01.B Test documentation shall be provided on permanent media within three weeks after the completion of the project. The media shall be clearly marked on the outside front cover with the words "Project Test Documentation", the project name, and the date of completion (month and year). The results shall include a record of test frequencies, cable type, conductor pair and cable (or connector) ID, measurement direction, reference setup, and technician name(s). The test equipment name, manufacturer, model number, serial number, software version, and last calibration date will also be provided. Unless the manufacturer specifies a more frequent calibration cycle, proof of annual calibration must be documented for all test equipment used in this installation.
- 27 08 02.01.C Printouts generated for each cable by the test equipment shall be submitted as part of the documentation package. Alternately, the successful bidder may furnish this information in electronic format on permanent media. The media shall contain the electronic equivalent of the test results as defined by the bid specification, in a file format such as Fluke (*.flw) Linkware file format or compatible with Microsoft Word or Microsoft Excel.
- 27 08 02.01.D When repairs and re-tests are performed, the problem(s) found and the corrective action(s) taken shall be noted. Both the failed and passed test results shall be documented.
- 27 08 03 As-Built Drawings
- 27 08 03.01 general
- 27 08 03.01.A Drawings must include cable routes and telecommunications outlet/connector (TO) locations. Each TO location shall be referenced by its unique identifier. Numbering, icons, and drawing conventions used shall be consistent throughout all documentation provided. The owner of the Belden System 2400 will provide floor plans in paper and electronic (DWG, AutoCAD Release 14) formats, to which as-built construction information can be added. These documents will be modified accordingly by the successful bidder to denote as-built information as defined above and returned to the owner of the Belden System 2400.
- 27 08 03.01.B The successful bidder shall annotate the base drawings and provide both print (same plot size as originals) and electronic (AutoCAD Release 14) versions of the modified files.

27 10 00 **Structured Cabling**

- 27 10 01 Scope
- 27 10 01.01 General
- 27 10 01.01.A This document describes the requirements for furnishing and installing a telecommunications cabling infrastructure at *Town of Sterling*. A balanced twisted-pair cabling system capable of supporting Gigabit Ethernet networking is described.
- 27 10 01.01.B All cables and related support, termination, and grounding hardware shall be furnished, installed, tested, labeled, and documented by the successful bidder as detailed in this document.
- 27 10 01.01.C General product specifications, design considerations, and installation guidelines are provided in this document. Specific site-related requirements are provided as an attachment to this document. In case of conflict, this document shall take precedence. The successful bidder shall meet or exceed all requirements for the cabling system described in this document.
- 27 10 02 Regulatory References
- 27 10 02.01 General
- 27 10 02.01.A All workmanship and materials shall be in full conformance with applicable building, electrical, and other codes, as determined by the authority having jurisdiction (AHJ).
- 27 10 02.01.B All cabling system components shall be Underwriters Laboratories (UL) or ETL Listed and shall be marked as such.
- 27 10 02.02 Reference list
- 27 10 02.02.A The product specifications, design considerations, and installation guidelines provided in this document are in part derived from recommendations found in recognized telecommunications industry standards. The following are used as reference:
- | | |
|-----------------------|--|
| ANSI/TIA-568-D.0-2015 | Generic Telecommunications Cabling for Customer Premises |
| ANSI/TIA-568-D.1-2015 | Commercial Building Telecommunications Cabling Standard |
| ANSI/TIA-568-C.3-2008 | Optical Fiber Cabling Components Standard |
| ANSI/TIA-568-C.4-2011 | Broadband Coaxial Cabling And Components Standard |
| ANSI/TIA-569-D-2015 | Telecommunications Pathways and Spaces |
| ANSI/TIA-570-C-2012 | Residential Telecommunications Infrastructure Standard |

ANSI/TIA-606-B-2011	Administration Standard for Commercial Telecommunications Infrastructure
ANSI/TIA-607-C-2016	Generic Telecommunications Bonding And Grounding (Earthing) For Customer Premises
ANSI/TIA-758-B-2012	Customer-Owned Outside Plant Telecommunications Infrastructure Standard
ANSI/TIA-862-B-2015	Intelligent Building Systems Cabling Standard
ANSI/TIA-942-A-2012	Telecommunications Infrastructure Standard for Data Centers
ANSI/TIA-1005-A-2012	Telecommunications Infrastructure Standard for Industrial Premises
ANSI/TIA-1152-2009	Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling
ANSI/TIA-1179-2010	Healthcare Facility Telecommunications Cabling Standard
ANSI/TIA-4966-2014	Telecommunications Infrastructure Standard for Educational Facilities
ANSI/TIA-4994-2015	Standard for Sustainable Information Communications Technology
ANSI/TIA-5017-2016	Telecommunications Physical Network Security Standard
TIA TSB-155-A-2010	Guidelines for the Assessment and Mitigation of Installed Category 6 Cabling to Support 10GBASE-T
TIA TSB-162-A-2013	Telecommunications Cabling Guidelines for Wireless Access Points
TIA TSB-184-2009	Guidelines for Supporting Power Delivery Over Balanced Twisted-Pair Cabling
TIA TSB-185-R2015	Environmental Classification (MICE) Tutorial
TIA TSB-190-2011	Guidelines on Shared Pathways and Shared Sheaths

TIA TSB-5018	Structured Cabling Infrastructure Guidelines to support Distributed Antenna Systems
ANSI/BICSI 001-2009	Information Transport Systems Design Standard for K-12 Educational Institutions
ANSI/BICSI 002-2014	Data Center Design and Implementation Best Practices
ANSI/BICSI 003-2014	Building Information Modeling (BIM) Practices for Information Technology Systems
ANSI/BICSI 004-2012	Information Technology Systems Design and Implementation Best Practices for Healthcare Institutions and Facilities
ANSI/BICSI 005-2013	Electronic Safety and Security (ESS) System Design and Implementation Best Practices
ANSI/BICSI 006-2015	Distributed Antenna System (DAS) Design and Implementation Best Practices
ANSI/NECA/BICSI 568-2006	Standard for Installing Commercial Building Telecommunications Cabling
NECA/BICSI 607-2011	Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings

27 10 02.02.B In cases where product specifications, design considerations, and installation guidelines provided in this document are in conflict with the references listed above, the more stringent requirements shall apply. All references listed above were current during development of this publication. The bidder is responsible for referencing to the most recent releases when developing bid proposals.

27 10 02.02.C This document does not take precedence over any code, either partially or wholly.

27 10 03 General Condition – Approved Vendor

27 10 03.01 General

27 10 03.01.A The bidder must be an authorized Belden Alliance Partner Networking Installer. The bidder must have successfully completed all design and installation training provided by Belden .

27 10 03.01.B The bidder shall demonstrate proven expertise in the implementation of network cabling. Expertise can be illustrated through the inclusion of details of at least three projects involving the design and installation of a Category 5e, Category 6, or Augmented Category 6 (Category 6A) balanced twisted-pair cabling system within the past two-year period. Names and contact information for each of the three projects shall be included.

- 27 10 03.01.C The successful bidder shall hereinafter be referred to as the Vendor.
- 27 10 03.01.D The Vendor shall accept complete responsibility for the design, installation, acceptance testing, and certification of the Belden System 2400.
- 27 10 03.01.E The Vendor shall provide proof of its current Alliance Partner status and shall deliver Belden System Certification for the installed Belden System 2400.

27 10 04 General Condition – Approved Installer

- 27 10 04.01 General
- 27 10 04.01.A The installation of the Belden System 2400 shall be performed by employees of the Vendor.
- 27 10 04.01.B All installation and testing shall be performed by a Belden Alliance Partner Networking Installer and supervised by individuals qualified to install and test the Belden System 2400, in accordance with Belden requirements. The supervisor(s) shall have successfully completed Belden installation training provided by Belden.

27 10 05 General Condition – Approved Products

- 27 10 05.01.A Approved balanced twisted-pair cable:
UTP Bonded-Pair: [MediaTwist Cable Series](#)
UTP non-bonded: [2400 Cable Series](#)
STP non-bonded: [2400F Cable Series](#)
- 27 10 05.01.B Approved connectors:
REVConnect CAT6+ UTP Jack
REVConnect CAT6+ UTP Plug
REVConnect CAT6+ STP Jack
REVConnect CAT6+ STP Plug
[KeyConnect CAT6+ UTP Jacks](#)
[KeyConnect CAT6+ STP Jacks](#)
- 27 10 05.01.C Approved patch panels:
[KeyConnect Patch Panels \(flat\)](#)
[KeyConnect Patch Panels \(angled\)](#)
[AngleFlex Patch Panels](#)
[CAT6+ 110-inline Patch Panels](#)
- 27 10 05.01.D Approved patch cordage:
[CAT6+ Bonded-Pair Modular Cords](#)
[CAT6+ Bonded-Pair Pigtails](#)
[CAT6+ Traceable Bonded-Pair Modular Cords](#)
- 27 10 05.01.E Approved Cross-Connect System:
[GigaBIX IDC System](#)
- 27 10 05.01.F Approved workstation outlets: Belden Inc.

[KeyConnect Faceplates](#)

[KeyConnect Adapters and Boxes](#)

27 10 05.02 Equivalent products

27 10 05.02.A To qualify for System Certification, only products made or approved by Belden shall be used to ensure the end-to-end performance of the Belden System 2400.

27 10 07 Work Included

27 10 07.01 General

27 10 07.01.A The work included consists of all labor, equipment, products, and supplies required to design, install, test, and certify the Belden System 2400 in compliance with project specifications.

27 10 07.01.B The work included consists of (but is not limited to) the following:

1. Pre-registration of project with Belden as a Belden Certified Project.
2. Furnishing and installation of a complete balanced twisted-pair telecommunications cabling infrastructure capable of supporting Gigabit networking.
3. Furnishing, installation of, and termination of all cabling runs.
4. Furnishing and installation of all TOs, patch panels, and cordage.
5. Furnishing and installation of all required cabinets and/or racks in TEs, TRs, and/or ERs.
6. Furnishing of any other material required to implement a complete system.
7. Testing all installed cabling runs and furnishing a summary report confirming the Pass status of each run.
8. Furnishing all test and labeling information in both electronic and paper formats.
9. Providing training and complete documentation, including the Belden End-User Guide, Application Guidelines, and as-built drawings.

27 10 08 Drawings Specifications

27 10 08.01 General

27 10 08.01.A All drawings and plans provided with this document are diagrammatic. They are included to show the scope of the project in order to assist in the development of bid documents. The Vendor shall make allowances in the bid proposals to cover the work required to comply with the intent of the drawings and plans.

27 10 08.01.B The Vendor shall verify all dimensions at the site and is responsible for their accuracy.

27 10 08.01.C Prior to submitting a bid, the Vendor shall indicate:

1. Any specified materials the Vendor believes to be inadequate.
2. Any necessary items of work omitted from the bid specification.

27 10 09 Pre-Project Submittals

27 10 09.01 General

27 10 09.01.A Under the provisions of this document and prior to the start of work, the Vendor shall:

1. Submit proof of Belden Alliance Partner Networking Installer status of their company and the names of all individuals that will be performing the installation and testing to the owner of the Belden System 2400.
2. Submit details of all cabling system products to be used to the owner of the Belden System 2400.

27 10 09.01.B Work shall not be performed without the written approval of the submitted items by the owner of the Belden System 2400.

27 10 09.01.C The Vendor must obtain approval from Belden and from the owner of the Belden System 2400 for any substitution of submitted products. No substituted items shall be installed without written approval.

27 10 10 Delivery, Storage, and Handling

27 10 10.01 General

27 10 10.01.A Delivery and receipt of project materials shall be at *Town of Sterling*.

27 10 10.01.B All cable to be used in the project shall be stored according to manufacturer's recommendations. In addition, all cable must be stored in a protected area. If cable is stored outside, it must be covered with opaque plastic or canvas for protection from the elements, with adequate ventilation to prevent condensation. If air temperature at the cable storage location will be below 4.4 °C (40 °F), the cable shall be moved to a heated location [minimum 10 °C (50 °F)]. If necessary, cable shall be stored off-site at the Vendor's expense.

27 10 10.01.C If the Vendor intends to provide a trailer on-site for the storage of project materials, prior approval must be obtained from the owner of the Belden System 2400.

27 10 11 Structured Cabling Overview

27 10 11.01 General

27 10 11.01.A The system chosen shall meet the following specifications:

1. The balanced twisted-pair cable shall be available in Bonded pair and non-Bonded pair configurations.
2. The balanced twisted-pair cabling system shall support Gigabit Ethernet networking and shall provide additional performance margin up to 250 MHz for a 4-connector, 100 m (328 ft) channel.

NOTE: 4-connector refers to one TO, one consolidation point (CP), and two cross-connect panels in a TE/TR/ER (one for horizontal cables and one for equipment pigtails).

27 10 11.01.B

At a minimum, the balanced twisted-pair cabling system shall exceed the key performance parameters for Cat 6 found in TIA -568-C.2 (2009) Category 6 standard over the specified frequency ranges by the values listed below. The balanced twisted-pair cabling system shall also meet all the requirements of ISO/IEC 11801 Edition 2.0 2002-09.

Parameter	Margin		
	100 MHz	200 MHz	250 MHz
Insertion loss	1.1 dB	1.5 dB	1.8 dB
Return loss ^(a)	4.0 dB	4.0 dB	4.0 dB
PSNEXT	4.0 dB	4.0 dB	4.0 dB
PSACR-N	5.1 dB	5.5 dB	5.8 dB
PSACR-F (formerly PSELFEXT)	5.5 dB	5.5 dB	5.5 dB

Values represent System 2400 channel margin against TIA -568-C.2 Category 6 standard. The margin is the additional headroom (in dB) compared to the minimum specified value for Category 6 at each frequency point over the specified frequency range.

The worst case margin is determined at the frequency where the measured data point is closest to the limit line. This margin applies for a worst-case, 4-connector, 100-meter channel configuration.

PSNEXT = Power-sum near-end crosstalk

PSACR-F = Power-sum attenuation-to-crosstalk ratio far-end

PSACRN = Power-sum attenuation-to-crosstalk ratio near-end

(a) = applies to bonded-pair cables and cords

(b) = extrapolated values using Category 6 limit line equations

27 10 12 Testing and Acceptance

27 10 12.01 GENERAL

27 10 12.01.A All terminated cabling runs shall be 100% tested for defects in installation and to verify cabling system performance under installed conditions according to the requirements found in the TIA -568-C series of standards. All pairs in each installed cable shall be verified prior to system acceptance. Any defect in the cabling system installation, including (but not limited to) cables, connectors, patch panels, and cordage shall be repaired or replaced in order to ensure 100% usability of all installed runs.

27 10 12.02 Copper channel testing

27 10 12.02.A All balanced twisted-pair cable links shall be tested for basic continuity and length, as indicated below. Additional testing shall be performed to verify compliance with Category 6 performance for the parameters listed in Section 27 10 11.01.B of this document. The extent of testing shall be in accordance with the end-customer's testing requirements. Belden recommends 100% testing of permanent links for Insertion Loss, Return Loss, NEXT, PSNEXT and PSACRF. These tests are performed at the same time as the Continuity test using an automated tester, such as the Fluke DTX1800.

- 27 10 12.02.B Continuity – Each pair in every installed cabling run shall be tested using a test set that detects and identifies opens, shorts, polarity and pair reversals, crossed pairs, and split pairs. The results shall be recorded as Pass/Fail (as indicated by the test set) and referenced to the appropriate cable identification number and circuit/pair number. Any fault shall be corrected and the run re-tested prior to final acceptance.
- 27 10 12.02.C Length – Every installed cabling run shall be tested for installed length using a time domain reflectometer (TDR) device. The cable length shall not exceed 90 m (295 ft). The cable length shall be recorded, referencing the cable identification number and circuit/pair number.
- 27 10 12.02.D Category 6 performance testing shall be done according to the published standards.

27 10 13 Warranty and Services

- 27 10 13.01 Qualification of system
 - 27 10 13.01.A The installed Belden System 2400 shall be covered by Belden System Certification, issued by Belden and delivered by the Belden Alliance Partner Networking Installer.
 - 27 10 13.01.B Telecommunications spaces and pathways in new buildings or in those buildings having undergone major renovations in the preceding three years should conform to the recommendations outlined in TIA-569-C. In cases of installation in restrictive spaces and pathways (where it is not possible to implement the standards-based recommendations), no cabling run shall exceed 90 m (295 ft) in length nor be installed in any manner that limits the performance of the Belden System 2400.
 - 27 10 13.01.C The installed Belden System 2400 shall conform to all applicable local building and electrical codes.
- 27 10 13.02 Certification
 - 27 10 13.02.A To qualify for System Certification, the Belden System 2400 shall be designed, installed, and tested by a Belden Alliance Partner Networking Installer .
 - 27 10 13.02.B To qualify for System Certification, the installed cabling system shall fully comply with all relevant Belden design and applications guidelines, including any pre-approved deviations as specified in the latest release of the Belden Certification Guide.
 - 27 10 13.02.C To qualify for System Certification, only products made or approved by Belden shall be used to ensure the end-to-end performance of the Belden System 2400. The Belden 25-Year Component Warranty and Lifetime Application Assurance can only be provided to installations consisting of products supplied by Belden for the Belden System 2400.
 - 27 10 13.02.D Belden will not provide certification or warranty coverage for products manufactured by other entities.
- 27 10 13.03 25-year Component Warranty
 - 27 10 13.03.A The Belden System Certification shall provide a twenty-five (25) year warranty for all Belden passive components used in the installed Belden System 2400. Defective and/or improperly installed products shall be replaced and/or reinstalled at no cost to the owner of the Belden System 2400.
- 27 10 13.04 Lifetime Application Assurance

- 27 10 13.04.A The Belden System Certification shall provide the assurance that all present and future commercially available applications engineered for the performance level of the installed cabling system in accordance published standards will work for the lifetime of the certified Belden System 2400.
- 27 10 13.04.B Should the certified Belden System 2400 fail to support the networking technologies designed to operate over it—at the time of cutover, during subsequent use, or after upgrading active network devices (e.g., migrating to Gigabit Ethernet switches from 100 Mb/s Ethernet switches)—Belden and the Vendor shall take prompt corrective action.
- 27 10 13.05 Owner responsibility
- 27 10 13.05.A The Vendor shall provide a Belden End-User Guide to the owner of the Belden System 2400. This document describes essential system elements and specifies the owner’s responsibilities for maintaining the integrity of the installed cabling system over time. The Belden End-User Guide contains guidelines for cabling system modifications (e.g., relocations, additions, changes to services), in addition to labeling and record-keeping maintenance requirements.
- 27 10 13.05.B The owner of the Belden System 2400 accepts that the benefits offered by System Certification are revoked if non-approved products are introduced to the installed Belden System 2400. To regain System Certification in such cases, a Belden Alliance Partner Networking Installer must apply and validate all corrective modifications deemed necessary by Belden.

27 11 00 **Communications Equipment Room Fittings**

27 11 16 **Communications Cabinets, Racks, Frames, and Enclosures**

NOTE: If cabinets, racks, frames, and enclosures do not need to be specified, remove Section 27 11 16.

- 27 11 16.01 Racks
- 27 11 16.01.A All racks shall provide cable management and support elements for cordage at the front of the rack. They shall also provide cable management, support, and protection elements for the cables and/or equipment pigtailed placed along the legs of the rack.
- 27 11 16.01.B Any free-standing rack shall be a knock-down rack assembly equipped with two vertical and two universal channels.
- 27 11 16.02 Rack installation
- 27 11 16.02.A Racks shall be securely attached to the concrete floor using a minimum 9.5 mm (0.375 in) hardware or as required by local codes.
- 27 11 16.02.B Racks shall be placed with a minimum of 914 mm (36 in) clearance from the walls on all sides of the rack. When mounted in a row, there shall be a minimum of 914 mm (36 in) clearance from the wall behind the racks, in front of the row of racks, and from the walls at the ends of the row.
- 27 11 16.02.C All racks shall be grounded to the TGB in accordance with Section 27 05 26 of this document.

NOTE: If grounding and bonding does not need to be specified, remove Section 27 11 16.02.C.

- 27 11 16.02.D Rack-mount fasteners not used for installing patch panels and other hardware shall be bagged and left with the rack upon completion of the installation.
- 27 11 16.02.E Rack-mount termination equipment shall be installed in accordance with the manufacturer's recommendations and installation guides.
- 27 11 16.02.F Wall-mount termination equipment shall be installed on 1.2 m x 2.4 m x 19 mm (4 ft x 8 ft x 0.75 in) void-free plywood. The plywood shall be mounted 0.3 m (1 ft) above the finished floor. The plywood shall be painted with two coats of white, fire-retardant paint.
- 27 11 16.02.G Wall-mount termination equipment shall be installed in accordance with the manufacturer's recommendations and installation guides.
- 27 11 16.02.Z Ordering information for racks can be found in [Annex B](#)

27 11 19 **Communications Termination Blocks and Patch Panels**

- 27 11 19.01 Termination blocks
- 27 11 19.01.A The termination block system shall provide a centralized termination, identification, and service assignment point for Cat 6 cabling and cordage in TEs/TRs/ERs.

- 27 11 19.01.B The termination blocks used to terminate the 4-pair balanced twisted-pair cable shall have the following characteristics:
1. Utilizes an extremely compact connector equipped with double-sided Insulation Displacement Connection (IDC) clips in a symmetrical construction which allows termination of high-performance cables on one side and cross-connect wires or patch cords on the other.
 2. Possesses mounting positions for 72 station cables (or 48 station cables with rack mounted option)
 3. Provides space behind connector to maintain the correct bend radii of terminated cables.
 4. Have accommodations for either patch cords or jumper wire for service assignments.
 5. Have the possibility of mounting the connectors on the wall or in a cross-connect frame for front-to-back cross-connect arrangement.
 6. Exceeds Category 6 performance as defined in TIA-568-C.2 (2009).
- 27 11 19.01.Z Ordering information for Belden IDC system can be found in [ANNEX B](#)
- 27 11 19.03 Patch panels
- 27 11 19.03.A The patch panel system shall provide a centralized termination, identification, and service assignment point for Cat 6 cabling and cordage in TEs/TRs/ERs.
- 27 11 19.03.B The patch panels used to terminate the 4-pair balanced twisted-pair cable shall have the following characteristics:
1. The patch panel offering shall be available in 24-port 1U, 48-port 1U, 48-port 2U, and 72-port 2U in flat and angled configurations to address various density and cable management needs.
- The patch panels shall offer angled entry to the patch cords and the possibility to change the configuration of the angled modules to split patch cord 12 per side or 24 to one side. The patch panel should have a low profile (max. 2 inches) to fit in shallow enclosures. The patch panels shall allow termination of the modules from the front to facilitate installation in crowded cabinets. [NOTE: Use this requirement only if specifying AngleFlex Patch Panels]*
2. The patch panel offering shall include a front accessible panel with 1-port modularity to facilitate installation in tight spaces. [NOTE: Use this requirement only if specifying KeyConnect Front Access Patch Panels]
 3. The rear cable management for the patch panels shall be integrated in the design of the panel and require no additional accessories to dress terminated cables.
 4. The patch panels shall be equipped with 24, 48, or 72 connectors. The connectors shall have the characteristics described in Section 27 15 43.03 of this document.
 5. The transmission characteristics of the patch panels shall be guaranteed to 250 MHz for all ports.
- 27 11 19.03.Z Ordering information for copper patch panels can be found in [Annex B](#)
- 27 11 19.05 Copper termination hardware installation

- 27 11 19.05.A Cables shall be dressed and terminated in accordance with standards-based recommendations, the manufacturer's recommendations/installation guides, and industry best practices.
- 27 11 19.05.B The twisted pairs shall be guided, positioned and secured at the connector termination point using a termination bar that locks the pairs in place to prevent untwisting of pairs into the cable when terminating the conductors.
- 27 11 19.05.C The termination bar holding the wires in place at the IDC termination shall withstand a tensile force of 15 lbs minimum applied to the cable without dislodging the IDC connection
- 27 11 19.05.D Cables shall be neatly bundled, dressed, and routed to their respective termination connectors. Each patch panel shall terminate a cable bundle separated and dressed back to the point of cable entrance into the equipment cabinet or rack.
- 27 11 19.05.E Each cable shall be clearly labeled on the cable jacket behind the patch panel at a location that can be viewed without removing the bundle support element(s). Labels obscured from view shall not be acceptable.

27 13 13 Communications Copper Backbone Cabling

- 27 13 13.01 Backbone cables
- 27 13 13.01.A The backbone cabling is the portion of the cabling system that links the termination fields in different TEs/TRs/ERs within a building (and between buildings in a campus environment). It is commonly installed between floors in a vertical orientation.
- 27 13 13.02 Backbone cable installation
- 27 13 13.02.A Backbone cables shall be installed in accordance with standards-based recommendations, the manufacturer's recommendations/installation guides, and industry best practices.
- 27 13 13.02.B A plastic or nylon pull cord with a minimum test rating of 90 kg (200 lb) shall be co-installed with the cable in any conduit.
- 27 13 13.02.C Where cables are routed using conduits, the backbone and horizontal cables shall be installed in separate conduits.
- 27 13 13.02.D Where cables are installed in an air return plenum, any non-plenum cable shall be installed in metallic conduit.
- 27 13 13.02.E Where backbone cables and horizontal cables are installed in a cable tray or wireway, backbone cables shall be installed first and segregated from the horizontal cables.
- 27 13 13.02.F All backbone cables shall be securely fastened to a wall of the TE/TR/ER served.
- 27 13 13.02.G Backbone cables spanning more than three floors shall be securely attached at the top of the cable run with a wire mesh grip as well as on alternating floors or as required by local codes.
- 27 13 13.02.H Vertical cable runs shall be supported by messenger strand, cable ladder, or any other method that provides adequate support for the weight of the cable.
- 27 13 13.02.I Large bundles of backbone cables and/or heavy cables shall be attached to support elements using metal clamps and/or metal banding.

27 15 13 Communications Copper Horizontal Cabling

27 15 13.01 Topology

27 15 13.01.A The horizontal cabling shall be installed using a star topology, typically extending from centralized TRs to individual TOs in work areas (WAs).

27 15 13.01.B The cabling system shall provide (*A MINIMUM OF TWO*) cabling runs to the TO in each WA. All runs will terminate in designated TEs/TRs/ERs. No run shall exceed 90 m (295 ft), as measured from the cable termination point at each end. An additional 10 m (33 ft) is allowed for cordage at both ends, for a maximum allowable end-to-end or channel length of 100 m (328 ft).

27 15 13.02 Horizontal cables

27 15 13.02.A The 4-pair balanced twisted-pair cables shall be available in Bonded pair and non-Bonded pair configurations. The characteristics listed below shall apply to both configurations.

27 15 13.02.B The cables will be available in plenum (CMP), non-plenum (CMR), low smoke zero halogen (LSOH/LSZH), and limited combustible (LC) versions. The minimum recommended installation temperature shall be 5 °C (40 °F). The temperature rating shall be 60 °C (140 °F).

27 15 13.02.C The cable conductors shall be 23 AWG solid copper.

27 15 13.02.D The effective cable OD shall be 0.225 in. The effective cable OD is the diameter of a six-around-one cable bundle divided by 3.

27 15 13.02.E The minimum bend radius shall be 25 mm (1 in) for CMR-rated cable and CMP-rated cable.

27 15 13.02.F The guaranteed values for the primary transmission characteristics of the cable are as follows:

Maximum DC resistance (at 20 °C)	9.38 ohms/100 m (328 ft)
Maximum DC resistance unbalance	5 %
Maximum mutual capacitance	5.6 nF/100 m (328 ft)
Maximum capacitance unbalance (pair to ground)	330 pF/100 m (328 ft)
Maximum propagation delay skew	25 ns/100 m (328 ft)
NVP – plenum	72% @ 10 MHz
NVP – non-plenum	68% @ 10 MHz

DC = Direct current

NVP = Nominal velocity of propagation

27 15 13.02.Z Ordering information for Belden cables can be found in [ANNEX B](#)

- 27 15 13.03 Horizontal cable installation
- 27 15 13.03.A Horizontal cables shall be installed in accordance with TIA standards-based recommendations, the manufacturer's recommendations/installation guides, and industry best practices.
- 27 15 13.03.B A plastic or nylon pull cord with a minimum test rating of 90 kg (200 lb) shall be co-installed with the cable in any conduit.
- 27 15 13.03.C Cable raceways shall not be filled greater than the TIA-569-C recommended maximum fill for the particular raceway type, or 40%.
- 27 15 13.03.D Cables shall be installed in continuous lengths from origin to destination. An exception is made for one CP in any cabling run.
- 27 15 13.03.E Where cables are installed in an air return plenum, any non-plenum cable shall be installed in metallic conduit.
- 27 15 13.03.F If CPs are used, they shall be placed in accessible locations and housed in suitable enclosures intended for that purpose.
- 27 15 13.03.G If a J-hook or trapeze system is used to support cable bundles, all horizontal cables shall be supported at every 1.2 m to 1.5 m (48 in to 60 in) intervals. It is recommended that the support surface is rounded without any sharp edges and at least 2 inches wide. At no point shall cable(s) rest on acoustic ceiling grids or panels.
- 27 15 13.03.H Horizontal cables shall be bundled in groups of no more than 50 cables. Cable bundle quantities in excess of 50 cables may cause deformation of the bottom cables within the bundles, which will degrade the performance of those cables.
- 27 15 13.03.I Cable shall be installed above fire-sprinkler systems and shall not be attached to such systems or any associated ancillary equipment or hardware. The cabling system and its associated pathways shall be installed so that they do not obscure any valves, fire alarm conduit(s), boxes, or other control devices.
- 27 15 13.03.J Cables shall not be attached to ceiling grid or lighting fixture wires. Where support for horizontal cable is required, the Vendor shall install appropriate carriers to support the cabling.
- 27 15 13.03.K Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the Vendor prior to final acceptance at no cost to the owner of the Belden System 2400.
- 27 15 13.03.L Cables shall be identified by a self-adhesive label in accordance with Section 27 05 53 of this document and TIA -606-B. The cable label shall be applied to the cable behind the faceplate, on a section of cable that can be accessed by removing the cover plate.
- 27 15 13.03.M Balanced twisted-pair cable shall be installed so that there are no bends smaller than 4 times the OD of the cable at any point in the run or at the termination points.
- 27 15 13.03.N The pulling tension on any 4-pair balanced twisted-pair cable shall not exceed 110 N (25 lbf).

27 15 43 Communications Faceplates and Connectors

- 27 15 43.01 General

- 27 15 43.01.A Each horizontal cable shall be terminated at its designated WA in a modular connector assembly using a KeyConnect module designed to snap into a faceplate.
- 27 15 43.01.B The WA modular connector assembly/faceplate shall accommodate:
1. A minimum of two cabling runs.
 2. Blank fillers, to be installed in any outlet port in the faceplate that is not occupied by a modular connector assembly.
- 27 15 43.01.C Multiple WA outlets that are in close proximity on drawings (and not separated by physical barriers) may be combined in a single faceplate. The Vendor shall be responsible for determining the optimum compliant configuration.
- 27 15 43.01.D The same orientation and positioning of modular connector assemblies on faceplates shall be used throughout the project. Prior to installation, the Vendor shall submit the proposed configuration(s) for WA modular connector assemblies/faceplates for approval by the owner of the Belden System 2400.
- 27 15 43.01.E All WA outlets shall accommodate printed label strips for outlet identification purposes. Printed labels shall be permanent and shall comply with TIA -606-B. Handwritten labels shall not be accepted.
- 27 15 43.02 FACEPLATES
- 27 15 43.02.A The faceplate housing the modular connector assemblies shall provide a symmetrically centered appearance for the modules.
- 27 15 43.02.B The faceplate housing the modular connector assemblies shall have no visible mounting screws.
- 27 15 43.02.C The faceplate housing the modular connector assemblies shall have built-in labeling windows to facilitate outlet identification.
- 27 15 43.02.D The faceplates shall be available in 2 different styles: fixed-port design faceplate (wall-mounting) and adapters (modular furniture, surface-mount) as well as modular design (field-configurable).
- 27 15 43.02.E All faceplates designs shall be compatible with UTP, F/UTP and multimedia modules.
- 27 15 43.02.F All plastic faceplates shall be made of UV-stable fire-retardant UL 94V-0 material.
- 27 15 43.02.G All plastic faceplates shall have the option of being mounted on adapter boxes for surface mount installation.
- 27 15 43.02.G The stainless steel faceplates shall be made of brushed stainless steel and shall have a fire-retardant plastic insert UL94V-0 to snap connector.
- 27 15 43.02.G The field-configurable faceplate shall have a modular design that allows connectors to be inserted and removed from the frame without unscrewing it from the wall. *[NOTE: Use this requirement only if specifying MediaFlex Outlets]*
- 27 15 43.02.G The field-configurable faceplates shall be compatible with both keystone-style and Belden Proprietary MDVO-style module footprint for optimal flexibility in the design of the workstation outlet. *[NOTE: Use this requirement only if specifying MediaFlex Outlets]*
- 27 15 43.02.X Ordering information for Belden Faceplates can be found in [Annex B](#)

- 27 15 43.03 Connectors
- 27 15 43.03.A The modular jack assemblies used to terminate the 4-pair balanced twisted-pair cable shall have the characteristics listed below.
- 27 15 43.03.B The connectors shall be modular in form, with available mounting options for TOs, CPs, rack-mount panels, and wall-mount panels.
- 27 15 43.03.C The connector termination method shall involve no pair separation making bonded-pair cable quick and easy to terminate. *[NOTE: Use this requirement only if specifying REVConnect connectors]*
- 27 15 43.03.D The connector termination method shall offer the possibility to change the connector interface without having to re-terminated the cable (ex.: Change jack color or replace a jack by a plug interface) *[NOTE: Use this requirement only if specifying REVConnect connectors]*
- 27 15 43.03.E The connectors shall use an encapsulated lead frame technology ensuring long-term reliability as well as stable transmission performance.
- 27 15 43.03.F The connectors shall use a plastic element to position and hold each cable pair at a right angle to its corresponding IDC termination point.
- 27 15 43.03.G The connectors shall incorporate crosstalk compensation and impedance matching circuitry ensuring additional NEXT, FEXT, insertion loss and return loss margin beyond minimum Category 6 requirements to guarantee transmission performance up to 300 MHz.
- 27 15 43.03.H The transmission characteristics of a mated connection when measured at 100 MHz with Belden CAT6+ plugs shall be as follows:

Parameter	Minimum Average
NEXT	55.1 dB
PSNEXT	52.0 dB
FEXT	49.8 dB
PSFEXT	46.9 dB
Insertion Loss	0.10 dB
Return loss	27.0 dB

NEXT = Near-end crosstalk

PSANEXT = Power-sum alien near-end crosstalk

- 27 15 43.03.Z Ordering information for connectors can be found in [Annex B](#)
- 27 15 43.04 Work area installation

- 27 15 43.04.A Work area TOs shall be installed in accordance with standards-based recommendations, the manufacturer's recommendations/installation guides, and industry best practices.
- 27 15 43.04.B Cables shall be dressed and terminated in accordance with standards-based recommendations, the manufacturer's recommendations/installation guides, and industry best practices.
- 27 15 43.04.C Slack cable shall be coiled in flush or surface-mount TOs if adequate space is provided to house the cable coil without exceeding the manufacturer's bend radius limitations. In hollow-wall installations where box eliminators are used, cable slack can be stored in the wall. No more than 300 mm (12 in) of slack shall be stored in a TO, modular furniture raceway, or insulated wall. Excess slack may be loosely coiled and stored in the ceiling above each WA.
- 27 15 43.04.D The twisted pairs shall be guided, positioned and secured at the connector termination point using a termination bar that locks the pairs in place to prevent untwisting of pairs into the cable when terminating the conductors.
- 27 15 43.04.E Bend radius of the cable in the termination area shall not be less than 4 times the OD of the cable.
- 27 15 43.04.F Data outlets (unless otherwise noted in drawings) shall occupy the bottom positions on faceplates. Data outlets in horizontally oriented faceplates shall occupy the right-most positions.
- 27 15 43.04.G Voice outlets (unless otherwise noted in drawings) shall occupy the top positions on faceplates. Voice outlets in horizontally oriented faceplates shall occupy the left-most positions.

27 16 00 Communications Connecting Cords, Devices, and Adapters

27 16 19 Communications Patch Cords, Station Cords, and Cross-Connect Wire

27 16 19.01 Cordage

27 16 19.01.A The work area cords, patch cords, and equipment cords/pigtails shall meet TIA-568-C.2 Category 6 standard and ISO/IEC 11801 Class E standard for component compliance. The modular cords shall also meet reliability requirements of TIA/EIA-568-B.2, Normative Annex F.4.3.1 with a minimum Return Loss margin of 3 dB throughout each step of the mechanical stress test procedure.

27 16 19.01.B The modular cord shall use minimum 24 AWG solid copper conductors and shall be made with bonded-pair cable to provide structural integrity and stable transmission performance in environments where frequent moves, adds, and changes are routine. A crossweb element shall be used for consistent pair separation and minimal NEXT coupling. The nominal cable diameter of the modular cord shall be 6.0 mm (0.24 in).

27 16 19.01.D The modular cords shall be available in standard colors (Brown, Red, Orange, Yellow, Green, Blue, Purple, Gray, White, Black) and also TIA 606-A Pantone colors (Red, Orange, Yellow, Green, Blue, Purple).

27 16 19.01.E The management bar technology of the modular cord shall have tightly controlled and centered plug NEXT performance. The tolerance on de-embedded plug NEXT shall be within half the range specified in the TIA Category 6 standard for the 3-6 / 4-5 pair combination.

27 16 19.01.F The modular cords shall be available in standard or traceable versions. Traceable versions shall include a button-activated LED light within the plug head, such that activation of which will cause LEDs to flash on both ends of patch cord for easy tracing and identification.

27 16 19.01.Z Ordering information for modular cords can be found in [Annex B](#)

ANNEX A: ADDITIONAL INFORMATION

NOTE: Firestop installation is a critical safety element. If penetrations must be introduced to one or more fire-rated barriers for the purpose of installing pathways or cabling, include this section.

Division 07 – THERMAL AND MOISTURE PROTECTION

07 80 00 Fire and Smoke Protection

07 84 00 Firestopping

07 84 13 Penetration Firestopping

07 84 13.01 firestop system

07 84 13.01.A A firestop system consists of the item or items penetrating the fire-rated barrier, the opening in the barrier, and the materials used to seal and restore the fire integrity of the penetrated barrier. Firestop systems serve as an effective block against fire, smoke, heat, vapor, and pressurized water streams.

07 84 13.01.B All penetrations through fire-rated building structures (e.g., walls, floors) shall be sealed with an appropriate firestop system. This requirement applies to “through” penetrations (complete penetration) as well as “membrane” penetrations (through one side of a hollow structure). Any penetrating items (e.g., riser slots and sleeves, cables, conduits, cable trays, raceways) shall be properly firestopped.

07 84 13.01.C Firestop systems shall be UL Classified to ASTM E814 – *Standard Test Method for Fire Tests of Through-Penetration Fire Stops* (UL 1479) and shall be approved by a qualified PE licensed in the jurisdiction where the work is to be performed. One or more drawings illustrating the deployment of the proposed firestop system(s), stamped or embossed by the PE, shall be provided to the owner of the Belden System 2400 prior to installing the firestop system(s).

07 84 13.02 Firestop system installation

07 84 13.02.A All firestop systems shall be installed in accordance with the manufacturer’s recommendations/installation guides and shall be available for inspection by the local AHJ prior to acceptance.

ANNEX B: PRODUCT ORDERING INFORMATION

27 05 53.01.Z LabelFlex Labeling Solution

LabelFlex Labeling Solution

LabelFlex for KeyConnect Patch Panel, White, 5 Sheets, 24 labels/sh	AX102299
LabelFlex for Ultra-High Density Patch Panel, White, 5 Sheets, 24 labels/sh	AX103275
LabelFlex for AngleFlex Patch Panel, White, 5 Sheets, 180 labels/sh	AX103257
LabelFlex for MediaFlex Outlets, White, 10 Sheets, 30 labels/sh	AX101821
LabelFlex for KeyConnect Faceplates White, 5 Sheets, 80 labels/sh	AX101552

27 11 16.01.Z High-density Racking System

High-density Racking System	Part No.
Steel relay rack, 19" W x 84" H, #12-24 tapped holes, Black, Knock Down	XDR8419-312N
Steel relay rack, 19" W x 84" H, #12-24 tapped hole, Black, Welded	XDR8419-312W
Single-sided High-density Vertical Manager	
High-density with doors, 3-5/8" W x 84" H, Black	BHVH003
High-density with doors, 6" W x 84" H, Black	BHVH006
High-density with doors, 10" W x 84" H, Black	BHVH010
High-density with doors, 12" W x 84" H, Black	BHVH012
Double-sided High-density Vertical Manager	
High-density with doors, 3-5/8" W x 84" H, Black	BHVHH03
High-density with doors, 6" W x 84" H, Black	BHVHH06
High-density with doors, 10" W x 84" H, Black	BHVHH10
High-density with doors, 12" W x 84" H, Black	BHVHH12
Vertical Manager Backcover	
3-5/8" W, Black	BHBC03X
6" W, Black	BHBC06X
10" W, Black	BHBC10X
12" W, Black	BHBC12X
Vertical Manager Doors (1 Pair)	
3-5/8" W, Black	BHDK03X
6" W, Black	BHDK06X
10" W, Black	BHDK10X
12" W, Black	BHDK12X
Horizontal Manager with Cover	
19" W x 1U, Black	BHH191U
19" W x 2U, Black	BHH192U
19" W x 3U, Black	BHH193U

27 11 19.01.Z GigaBIX System

GigaBIX System	Part No.
GigaBIX Connector, 6 port	AX101447
GigaBIX Mount	AX101472
GigaBIX Designation Strip	AX101483
GigaBIX Wire Guard	AX101486
GigaBIX Termination Bar	AX101719
GigaBIX Frame Distribution Frame 1152 ports	AX102073
GigaBIX Frame End Kit	AX102082
GigaBIX Cross Connect Wire	XCGB4

27 11 19.01.Z GigaBIX Patch Cords

GigaBIX CAT6+ Patch Cord, 4-Pair, 24 AWG Solid, BIX-BIX, CMR	Black
4 ft (1.2 m)	AX101945
8 ft (2.4 m)	AX101947
10 ft (3.0 m)	AX101948
15 ft (4.6 m)	AX101949
25 ft (7.6 m)	AX101950
GigaBIX CAT6+ Patch Cord, 4-Pair, 24 AWG Solid, T568A-BIX, CMR	Black
4 ft (1.2 m)	AX101951
8 ft (2.4 m)	AX101953
10 ft (3.0 m)	AX101954
15 ft (4.6 m)	AX101955
25 ft (7.6 m)	AX101956
CAT6+ Patch Cord, 4-Pair, 24 AWG Solid, T568B-BIX, CMR	Black
4 ft (1.2 m)	AX101957
8 ft (2.4 m)	AX101959
10 ft (3.0 m)	AX101960
15 ft (4.6 m)	AX101961
25 ft (7.6 m)	AX101962

27 11 19.03.Z KeyConnect Patch Panels

CAT6+ HD Patch Panels (Preloaded, inline 110 punch)	Part No.
CAT6+ HD-110 Patch Panel, 24-port, 1U, Black (Preloaded)	AX105520
CAT6+ HD-110 Patch Panel, 48-port, 2U, Black (Preloaded)	AX105521
CAT6+ KeyConnect Patch Panels (Preloaded)	
CAT6+ KeyConnect Patch Panel, 24-port, 1U, Black, Preloaded	AX103253
CAT6+ KeyConnect Patch Panel, 24-port, 1U, Black, Short Cable Management, Preloaded	AX103253-SCM
CAT6+ KeyConnect Patch Panel, 48-port, 2U, Black, Preloaded	AX103255
CAT6+ KeyConnect Patch Panel, 48-port, 2U, Black, Short Cable Management, Preloaded	AX103255-SCM
CAT6+ Ultra High Density Patch Panel (Preloaded)	
CAT6+ Ultra High-Density Patch Panel, 48-port, 1U, Black (Preloaded)	AX103263
CAT6+ KeyConnect Angled Patch Panel (Preloaded)	
CAT6+ KeyConnect Angled Patch Panel, 24-port, 1U, Black (Preloaded)	AX105360
CAT6+ KeyConnect Angled Patch Panel, 48-port, 2U, Black (Preloaded)	AX105361
CAT6+ KeyConnect Angled Patch Panel, 48-port, 1U, Black (Preloaded)	AX105362
KeyConnect Modular Patch Panels (Empty)	
KeyConnect Modular Patch Panel, 24-port, 1U, Black (Empty)	AX103114
KeyConnect Modular Patch Panel, 48-port, 1U, Black (Empty)	AX103121
KeyConnect Modular Patch Panel, 48-port, 2U, Black (Empty)	AX103115
KeyConnect Modular Patch Panel, 72-port, 2U, Black (Empty)	AX103116
KeyConnect Modular Patch Panel, 96-port, 3U, Black (Empty)	AX105371
KeyConnect AngleFlex Patch Panels (Empty)	
KeyConnect AngleFlex Patch Panel, 24-port, 1U, Black (Empty)	AX103248
KeyConnect AngleFlex Patch Panel, 48-port, 2U, Black (Empty)	AX103249
KeyConnect Angled Patch Panels (Empty)	
KeyConnect Angled Patch Panel, 24-port, 1U, Black (Empty)	AX104599
KeyConnect Angled Patch Panel, 48-port, 2U, Black (Empty)	AX104601
KeyConnect Angled Patch Panel, 48-port, 1U, Black (Empty)	AX104600
KeyConnect Front Access Patch Panels	
KeyConnect Front Access Patch Panel, 24-port, 1U, Black	AX106288
KeyConnect Front Access Patch Panel, 48-port, 2U, Black	AX106289
KeyConnect Front Access Patch Panel, 72-port, 2U, Black	AX106290
Labeling Kit (12 strips and LabelFlex sheets for 96 ports)	AX106291
Spare Bezel Kit for Front Access Patch Panel, 24-Pack	AX106292-B24

27 15 13.02.Z CAT6+ Cables

Data Twist 2412 Nonbonded-Pair, 4-pair, 23 AWG, CMR, Category 6

Belden Part Number	Color	Length	Packaging
2412 0021000	Red	305 m (1000 ft)	Spool
2412 0031000	Orange	305 m (1000 ft)	Spool
2412 0041000	Yellow	305 m (1000 ft)	Spool
2412 0051000	Green	305 m (1000 ft)	Spool
2412 0061000	Blue	305 m (1000 ft)	Spool
2412 0071000	Purple	305 m (1000 ft)	Spool
2412 0081000	Gray	305 m (1000 ft)	Spool
2412 0091000	White	305 m (1000 ft)	Spool
2412 0101000	Black	305 m (1000 ft)	Spool
2412 0041500	Yellow	458 m (1500 ft)	Spool
2412 0091500	White	458 m (1500 ft)	Spool
2412 0101500	Black	458 m (1500 ft)	Spool
2412 0062500	Blue	762 m (2500 ft)	Spool

Data Twist 2413 Nonbonded-Pair, 4-pair, 23 AWG, CMP, Category 6

Belden Part Number	Color	Length	Packaging
2413 0041000	Yellow	305 m (1000 ft)	Spool
2413 0051000	Green	305 m (1000 ft)	Spool
2413 D151000	Blue	305 m (1000 ft)	Spool
2413 0071000	Purple	305 m (1000 ft)	Spool
2413 0081000	Gray	305 m (1000 ft)	Spool
2413 0091000	White	305 m (1000 ft)	Spool
2413 0101000	Black	305 m (1000 ft)	Spool
2413 0101500	Black	458 m (1500 ft)	Spool
2413 0042500	Yellow	762 m (2500 ft)	Spool
2413 D152500	Blue	762 m (2500 ft)	Spool

MediaTwist Bonded-Pair, 4-pair, 23 AWG, CMR, Category 6

Belden Part Number	Color	Length	Packaging
1872A F6H1000	Dk. Pearl	305 m (1000 ft)	Spool
1872A X6G1000	Gold	305 m (1000 ft)	Spool
1872A 0021000	Red	305 m (1000 ft)	Spool
1872A 0031000	Orange	305 m (1000 ft)	Spool
1872A 0041000	Yellow	305 m (1000 ft)	Spool
1872A 0051000	Green	305 m (1000 ft)	Spool
1872A 0061000	Lt. Blue	305 m (1000 ft)	Spool
1872A 0071000	Violet	305 m (1000 ft)	Spool
1872A 0091000	White	305 m (1000 ft)	Spool

MediaTwist Bonded-Pair, 4-pair, 23 AWG, CMP, Category 6

Belden Part Number	Color	Length	Packaging
1874A D151000	Blue	305 m (1000 ft)	Spool
1874A F6H1000	Dk. Pearl	305 m (1000 ft)	Spool
1874A 0021000	Red	305 m (1000 ft)	Spool
1874A 0031000	Orange	305 m (1000 ft)	Spool
1874A 0041000	Yellow	305 m (1000 ft)	Spool
1874A 0051000	Dk. Green	305 m (1000 ft)	Spool
1874A 0071000	Violet	305 m (1000 ft)	Spool
1874A 0091000	White	458 m (1500 ft)	Spool
1874A 0101000	Black	762 m (2500 ft)	Spool

27 15 43.02.Z Workstation Outlet System

KeyConnect Faceplates	Almond	Elec. White
KeyConnect Faceplate 1-Port, w/ ID Windows, Single-gang	AX103922	AX102660
KeyConnect Faceplate 2-Port, w/ ID Windows, Single-gang	AX103923	AX102655
KeyConnect Faceplate 4-Port, w/ ID Windows, Single-gang	AX102248	AX102249
KeyConnect Faceplate 6-Port, w/ ID Windows, Single-gang	AX102250	AX102251
KeyConnect Faceplate 12-Port, w/ ID Windows, Double-gang	AX102256	AX102257
KeyConnect Single-gang Back Box, 1.89 in.	AX104127	AX102657
KeyConnect Double-gang Back Box, 1.89 in.	AX104130	AX104131

KeyConnect Stainless Steel Faceplates	No Window	With ID Window
KeyConnect Stainless Steel Faceplate 1-Port, Single-gang	AX102006	AX104230
KeyConnect Stainless Steel Faceplate 2-Port, Single-gang	AX102007	AX104231
KeyConnect Stainless Steel Faceplate 4-Port, Single-gang	AX102009	AX104232
KeyConnect Stainless Steel Faceplate 6-Port, Single-gang	AX102010	AX104233
KeyConnect Stainless Steel Faceplate 12-Port, Double-gang	AX102013	AX104234

KeyConnect Wall Mount Phone Plates	
KeyConnect Wall Mount Phone Plates, Stainless Steel	AX102005
KeyConnect Wall Mount Phone Plates, Recessed, Elec. White	AX102902

KeyConnect Adapters	Almond	Elec. White	Black
KeyConnect Modular Furniture Adapter, 3-Port	AX103925	AX102291	AX102292
KeyConnect Modular Furniture Adapter, 4-Port	AX103926	AX102900	AX102901
KeyConnect Decora Adapter, 2-Port	AX106573-AL	AX106573-EW	AX106573-BK
KeyConnect Decora Adapter, 3-Port	AX106574-AL	AX106574-EW	AX106574-BK
KeyConnect Decora Adapter, 4-Port	AX106575-AL	AX106575-EW	AX106575-BK
KeyConnect Decora Adapter, 6-Port	AX106576-AL	AX106576-EW	AX106576-BK
KeyConnect 106 Adapter, 2-Port	AX104120	AX104121	AX104122
KeyConnect 106 Adapter, 4-Port	AX104123	AX104124	AX104125

KeyConnect Side-Entry Boxes	Almond	Elec. White	Black
KeyConnect Side-Entry Box, 1-Port	AX104132	AX102651	
KeyConnect Side-Entry Box, 2-Port	AX104133	AX102652	
KeyConnect Side-Entry Box, 4-Port	AX104134	AX102653	
KeyConnect Side-Entry Box, 6-Port	AX104135	AX102654	
KeyConnect Side-Entry Box, w/o Shutter, 1-Port	AX105352-AL	AX105352-EW	AX105352-BK
KeyConnect Side-Entry Box, w/o Shutter, 2-Port	AX105353-AL	AX105353-EW	AX105353-BK
KeyConnect Side-Entry Box, w/o Shutter, 4-Port	AX105354-AL	AX105354-EW	AX105354-BK
KeyConnect Side-Entry Box, w/o Shutter, 6-Port	AX105355-AL	AX105355-EW	AX105355-BK

MediaFlex Angled Edge Faceplate Kit, KeyConnect-Style	Gray	Almond	Elec.	Black

	White			
2-port, Flush, Single-gang	AX106617	AX106618	AX106619	AX106620
4-port, Flush, Single-gang	AX106621	AX106622	AX106623	AX106624
6-port, Flush, Single-gang	AX106625	AX106626	AX106627	AX106628
2-port, Angled, Single-gang	AX106629	AX106630	AX106631	AX106632
4-port, Angled, Single-gang	AX106633	AX106634	AX106635	AX106636
6-port, Flush, Double-gang	AX106637	AX106638	AX106639	AX106640
8-port, Flush, Double-gang	AX106641	AX106642	AX106643	AX106644
12-port, Flush, Double-gang	AX106645	AX106646	AX106647	AX106648
6-port, Angled, Double-gang	AX106649	AX106650	AX106651	AX106652
8-port, Angled, Double-gang	AX106653	AX106654	AX106655	AX106656
MediaFlex Plates and Adapter Boxes	Gray	Almond	Elec. White	Black
Single-gang Plate	AX101745	AX101746	AX101747	AX101748
Double-gang Plate	AX101869	AX101870	AX101871	AX101872
MediaFlex Surface Adapter Box, Single-gang	AX102480	AX102481	AX102482	AX102483
MediaFlex Adapter Box, Double-gang	AX101873	AX101874	AX101875	AX101876
MediaFlex Insert for KeyConnect and MDVO-style Modules	Gray	Almond	Elec. White	Black
KeyConnect 2-Port, Flush	AX104482	AX102410	AX102411	AX102737
KeyConnect 2-Port, Angled	AX104483	AX102412	AX102413	AX102738
MDVO-style 2-Port, Flush	AX101749	AX101750	AX101751	AX101752
MDVO-style 2-Port, Angled	AX101753	AX101754	AX101755	AX101756
MediaFlex Filler Insert	Gray	Almond	Elec. White	Black
1U Filler Insert	AX101757	AX101758	AX101759	AX101760
2U Filler Insert	AX101761	AX101762	AX101763	AX101764

27 15 43.03.Z CAT6+ Modular Jacks

Modular Jacks - UTP	REVConnect	KeyConnect
Gray	RV6MJKUGY-S1	AX101318
Almond	RV6MJKUAL-S1	AX101319
White	RV6MJKUEW-S1	AX101320
Black	RV6MJKUBK-S1	AX101321
Ivory	RV6MJKUIV-S1	AX103076
Orange	RV6MJKUOR-S1	AX104189
Red	RV6MJKURD-S1	AX104190
Yellow	RV6MJKUYL-S1	AX104191
Green	RV6MJKUGN-S1	AX104192
Blue	RV6MJKUBL-S1	AX104193
Purple	RV6MJKUPR-S1	AX104194

Modular Shielded Jacks

RV6MJKSME-S1 AX104596

Modular Plugs

Field Mount Plugs, UTP

Field Mount Plugs, FTP

REVConnect

Plugs

CAT6A Plugs

RVAFPUBK-S1

CAPFMUL-S1

RVAFPSME-S1

CAPFMFL-S1

27 16 19.01.Z CAT6+ Patch cords

CAT6+ UTP Patch Cord, Bonded-Pair, 4-Pair, 24 AWG Solid, T568A/B-T568A/B, CMR	Yellow	Green	Blue	Gray	White	Black
2 ft (0.6 m)	C601104002	C601105002	C601106002	C601108002	C601109002	C601100002
4 ft (1.2 m)	C601104004	C601105004	C601106004	C601108004	C601109004	C601100004
7 ft (2.1 m)	C601104007	C601105007	C601106007	C601108007	C601109007	C601100007
10 ft (3.0 m)	C601104010	C601105010	C601106010	C601108010	C601109010	C601100010
15 ft (4.6 m)	C601104015	C601105015	C601106015	C601108015	C601109015	C601100015
25 ft (7.6 m)	C601104025	C601105025	C601106025	C601108025	C601109025	C601100025

CAT6+ Shielded Patch Cords, 4-pair, 24 AWG Solid, T568A/B-T568A/B, CMR	Yellow	Green	Blue	Gray	White	Black
2 ft (0.6 m)	—	—	C6F1106002	C6F1108002	C6F1109002	C6F1100002
4 ft (1.2 m)	—	—	C6F1106004	C6F1108004	C6F1109004	C6F1100004
7 ft (2.1 m)	—	—	C6F1106007	C6F1108007	C6F1109007	C6F1100007
10 ft (3.0 m)	—	—	C6F1106010	C6F1108010	C6F1109010	C6F1100010
15 ft (4.6 m)	—	—	C6F1106015	C6F1108015	C6F1109015	C6F1100015
25 ft (7.6 m)	—	—	C6F1106025	C6F1108025	C6F1109025	C6F1100025

CAT6+ Traceable Patch cords

CAT6+ UTP Patch Cord, Bonded-Pair, 4-Pair, 24 AWG Solid, T568A/B-T568A/B, CMR	Red	Orange	Yellow	Green	Blue	Gray	White	Black
2 ft (0.6 m)	C6T1102002	C6T1103002	C6T1104002	C6T1105002	C6T1106002	C6T1108002	C6T1109002	C6T1100002
4 ft (1.2 m)	C6T1102004	C6T1103004	C6T1104004	C6T1105004	C6T1106004	C6T1108004	C6T1109004	C6T1100004
7 ft (2.1 m)	C6T1102007	C6T1103007	C6T1104007	C6T1105007	C6T1106007	C6T1108007	C6T1109007	C6T1100007
10 ft (3.0 m)	C6T1102010	C6T1103010	C6T1104010	C6T1105010	C6T1106010	C6T1108010	C6T1109010	C6T1100010
15 ft (4.6 m)	C6T1102015	C6T1103015	C6T1104015	C6T1105015	C6T1106015	C6T1108015	C6T1109015	C6T1100015
25 ft (7.6 m)	C6T1102025	C6T1103025	C6T1104025	C6T1105025	C6T1106025	C6T1108025	C6T1109025	C6T1100025