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Kimball International is a recognized industry leader in the design, engineering, and production of responsive furniture solutions for today’s dynamic workplace environments. The Kimball Cetra® panel system — a carefully conceived balance of aesthetics and technical innovation — is a perfect reflection of our commitment to total customer support and satisfaction.

The breadth of Cetra panel system’s product selection is remarkable. Equally impressive is Cetra’s ability to accommodate the power and communications requirements of any office environment. Cetra offers 8- or 10-wire electrical configurations, ample space for communications cable routing and storage, and floor or worksurface access to electrical, voice, and data connections. These features enhance the functionality and versatility of Cetra systems furniture.

At Kimball, we understand that Cetra’s power and communications capabilities become fully leveraged only through careful planning and application of its components. To that end, we have developed the Electrical/Communications Planning Guide for Panel Based Systems, which contains information that is both comprehensive and easily understandable.

The planning guide is organized in three major sections: the first section contains a glossary of terms and Kimball product code compliance and certification information; the second section encompasses electrical planning; and the third section covers communications planning.

With this information, Kimball product specifiers — whether facility planners, architects, or interior designers — and their designated electrical and communications contractors/installers will be well-equipped to correctly, safely plan and apply the Cetra system to suit their customers’ specific, unique workplace requirements.
**Ampere (Amp)**
The volume of electrical current drawn from a circuit.

**Base Wireway**
The enclosed channel, located at the base of all Cetra panels, through which electrical wiring and communications cabling are routed.

**Bend Radius**
The measurement of how closely a communications cable can turn a corner without being damaged or degrading the voice/data signal.

**BNC Coax Connector**
A bayonet-style termination used on standard coaxial cable.

**BNC Coax Receptacle**
A receptacle that accepts BNC coax connectors.

**Branch Circuit**
A single circuit consisting of circuit conductors (wires) connected between the electrical service (circuit breakers) and the circuit outlets (receptacles). A branch circuit includes all devices and loads connected to it.

**CSA Listed**
Refers to equipment or materials tested and published by the Canadian Standards Association (CSA) to ensure the safety of users. The CSA is one of Canada’s largest product-certification and standard-development organizations.

**Cable Termination**
See Termination Ports.

**Category 5**
The performance and construction standard for the cables and fittings used for data transmission.

**Ceiling Power Entry**
A component that transfers electrical power from the facility ceiling to Cetra panels.

**Choke Point**
The smallest available space in a wireway through which wires and cables may be routed.

**Circuit**
A complete path of electrical current. When receptacles are attached to this path, the circuit can power electrical devices.

**Circuit Breaker**
A device designed to open and close a circuit by non-automatic means and to open the circuit automatically on a predetermined over-current.

**Coaxial Cable**
A data cable consisting of a core conductor surrounded by a layer of insulation, a metal sheath, and an insulated outer coating. The sheath serves as a second conductor and as a shield. “Coaxial” refers to the manner in which all layers share the same central axis.

**Coaxial Termination**
The barrel-shaped connector used as termination points and as in-line connectors for coaxial cable.

**Common Ground**
An electrical circuit that uses a variety of conductors for a ground path. Ground conductors include wire, conduit, the metal of a building, or water pipes.

**Conductor**
Any material that can be used to carry electrical power, usually copper wire and terminals.

**Conduit**
Metal or non-metallic rigid or flexible tubing used to route and protect electrical or communication wires.
Glossary of Terms

Continuous Load
A circuit in which the maximum current is expected to continue for three hours or more.

Current
The quantity of the electrical charge flowing in a circuit. Current is measured in amps.

Dedicated Circuit
A single circuit, consisting of separate hot, neutral, and ground wire that is dedicated to power a specific electrical load.

Designated Circuit
A single circuit, consisting of a hot, neutral, and ground wire. Either the neutral and ground wire—or both—may be shared with other circuits. The circuit is designated, by the user, to power specific electrical loads.

Duplex Receptacle
An outlet in an electrical distribution system that provides two positions for accessing an electrical circuit.

Electrical Distribution Assembly
An assembly that distributes power to receptacles, via the base wireway or mid-wireway. Kimball uses the term “AED” to describe its electrical distribution assemblies.

Electrical Noise
Unwanted electrical signals that produce undesirable effects in circuits.

Electromagnetic Interference (EMI)
An electrical or electromagnetic interference that causes undesirable response, degradation, or failure in electronic equipment.

Extender Ring
A device used to increase wire or cable termination clearance for voice and data ports.

Fiber-Optic Cable
A data cable consisting of thin filaments that transmit light signals. Fiber optic cables offer high-speed, high-volume transmission that is free from the electronic interference and distortion often found in copper cables.

50-Position Connector
A connector used for terminating 50 copper conductors (25-pair cable).

Flat Conductor Cable
A cable that consists of three or more flat copper conductors placed edge-to-edge, separated and enclosed within an insulating assembly.

Floor Monument
An electrical outlet, located on the floor, that is attached to a duct or cell beneath the floor.

Floor Power Entry
A component that transfers electrical power from the facility floor, wall, or column to Cetra panels.

Four-Pair Cable
A type of twisted pair cable consisting of four sets of two twisted copper strands. 4-pair cable is a popular way to accommodate voice and data. Also known as “twisted 4-pair,” “4-pair UTP,” or “4-pair STP.”
**Ground**  
A wire that is directly or indirectly attached to the earth.

**Hot Wire**  
The conductor that carries current from the power source to the equipment. For a complete circuit, the hot wire requires a neutral wire to carry the unused current back to the power source.

**IBM Type 1 Cable**
A type of cable used for high-speed data transmission. Consists of 2-pair twisted, shielded cable appropriately sheathed.

**IBM Type 1 Receptacle**
A receptacle used when terminating Type 1 cable.

**IBM Type 2 Cable**
A type of cable. Consists of 2-pair twisted, shielded cable for data, and 4-pair twisted cable for telephone communications.

**IBM 4-Position Data Connector**
A connector that functions as a connector or a receptacle, depending on its orientation.

**Impedance**  
The resistance to flow of alternating current through a conductor. Generally expressed in ohms.

**In-Line Devices**  
Pieces of communications-related equipment located on cable routes. Examples of in-line devices include amplifiers, multiplexers, splitters, junction boxes, and transition boxes.

**Isolated Ground**  
A ground conductor that is electrically and mechanically separated from other circuits or conductors.

**Jumper Cable**
A cable used to route power between Cetra panels, through directional connector posts, curved panels, and from the base wireway to the mid-wireway. Jumper cables may be used within the base wireway or mid-wireway.

**Junction Box**
A box with a blank cover that joins different runs of wires or cables, and provides a space for the connection and branching of the enclosed conductors.

**LAN Termination**
A termination port for a Local Area Network (LAN). LAN termination types vary widely among LAN equipment manufacturers.

**Light-Emitting Diode (LED)**
A semiconductor device that emits light.

**Mid-Wireway**
The enclosed channel, located at worksurface height of certain Cetra panels, through which electrical wiring and communications cabling is routed. Access to the mid-wireway is provided just above the worksurface level.

**National Electric Code (NEC)**
A set of regulations that governs planning, construction, and installation of electrical conductors and equipment. The NEC is the basis for all electrical codes used in the United States.

**Neutral Wire**
The conductor that carries current back to the power source. It is always used with a hot wire to complete a circuit.
Glossary of Terms

Ohm
The measure of electrical resistance in a circuit.

Open Circuit
A condition where the current flow through a conductor is interrupted by a missing or damaged component.

Outlet
A point in the wiring system at which electrical current is accessed to supply electricity to equipment.

Pass-Thru Cable
A cable used to route power through non-powered panels and directional connector posts, via the base wireway. Pass-thru cables must be connected to a distribution assembly at each end.

Phase
The location of a position of an alternating current in a waveform. Measured in degrees, with 360° corresponding to one complete cycle.

Plenum
This term may refer either to an air chamber in an HVAC system or to the space between a dropped ceiling and the floor above.

Plenum-Rated Cable
Wire or cable rated for use in a plenum.

Polarized Plug
A plug designed to be inserted into a receptacle in one position only.

Power Zone
A function of circuit planning which defines each office area that is supplied by specific circuit breakers.

RJ-Type Connector
A connector commonly used to terminate twisted pair cables. RJ-45 and RJ-11 connectors are the industry standards. “RJ” is an acronym for “registered jack.”

RJ-Type Receptacle
A receptacle that receives RJ-type connectors. RJ-45 receptacles are larger and will receive more conductors than RJ-11 receptacles.

Receptacle
A contact device installed at the outlet for the connection of a single contact device.

Riser
The conduit or path, placed between floors of a building, into which cables are placed to bring service from one floor to another.

Shielded Conductor Cable
A cable in which the insulated conductors are enclosed in a conducting envelope to minimize the effects of electromagnetic fields.

Short Circuit
A condition where the current flow of one circuit comes in contact with a ground.

Siamese Cable
A cable that combines two cables within single or separate (yet attached) jackets.

Simplex Surge-Protected Receptacle
An outlet in an electrical distribution system that provides one position for accessing an electrical circuit. The receptacle is designed to protect user equipment from voltage transients and surges.
**Single-Phase Power**
A type of electrical system or circuit that utilizes a single source of alternating current. A single-phase circuit may consist of two or three wires.

**Surge Protector**
A product that protects against transient voltage surges.

**TIA (Telecommunications Industry Association)**
An organization that establishes standards for the telecommunications industry.

**Terminal**
An electrical conductor, usually attached to a wire, that provides a connection point in an electrical distribution system.

**Termination Port**
A port, located at the end of a cable route, that allows user access to voice and/or data cables. Examples include coaxial, LAN, RJ-type, and ST-type.

**Thin Ethernet (“Thin Net”) Cable**
A coaxial cable that can be used instead of thick coaxial cable or twisted pair cable for computer network installations.

**Third Harmonic Currents**
A distortion in electrical current, caused by equipment (such as computers) that uses power in high-frequency pulses instead of in a linear pattern. Third harmonic currents can cause a neutral wire to overheat. Cetra’s 4-circuit, 8-wire electrical system is designed with an UL listed oversized neutral.

**Three-Phase Power**
A type of electrical system or circuit that utilizes three separate sources of alternating current. The three sources are electrically related to each other by a 120° phase separation. A 3-phase circuit may consist of four or more wires.

**3+1 Circuit Configuration**
The 3+1 configuration consists of three utility circuits plus one dedicated circuit.

**3+3 Circuit Configuration**
A 6-circuit application, for use with intensive computer and peripheral equipment applications. The 3+3 configuration consists of three designated utility circuits plus three designated computer circuits.

**25-Pair Cable**
A type of twisted pair cable consisting of 25 sets of two twisted copper strands. (Telephone cable is an example of 25-pair cable.)

**Twisted-Pair Cable**
A cable type in which two insulated wires (“pairs”) are wound together and covered with a protective coating/shield. Twisted-pair cable is available in five categories — most notably Category 3 and Category 5. Category 3 is most common for voice and data; Category 5 is for high-speed applications.

**2+2 Circuit Configuration**
A 4-circuit application, for use with intensive computer and peripheral equipment applications. The 2+2 configuration consists of two designated utility circuits plus two designated computer circuits.

**UL Listed**
Refers to equipment or materials tested and published by Underwriters’ Laboratories, Inc. (UL) to ensure the safety of users.

**Voice/Data Cable**
A common term for telephone and computer cables.

**Voltage (Volt)**
The measure of electrical pressure in a circuit. One volt of pressure is required to push one amp of current through a wire with one ohm of resistance.

**Wattage (Watt)**
The measure of power derived by multiplying volts and amps.

**Wireway**
The enclosed channel, located at the base and worksurface height of Cetra panels, through which electrical wiring and communications cabling are routed.
Kimball Product Code Compliance and Certification

National Code Compliance/Certification

Cetra panels and electrical components are listed by Underwriters’ Laboratories, Inc. (UL), the Canadian Standards Association (CSA), and other recognized authorities. Panels and electrical components can be installed to meet all major building codes as well as those of the National Electric Code (NEC).

Note: Any field modification of the electrical components, the panel, or glass (in a window panel) voids the UL and CSA listings and product warranties.

Kimball products have received the following certifications:

<table>
<thead>
<tr>
<th>Organization</th>
<th>Code Classification</th>
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<tbody>
<tr>
<td>UL Listing (United States)</td>
<td>#E77023 (in accordance with UL1286)</td>
</tr>
<tr>
<td>CSA Listing (Canada)</td>
<td>#LR53648</td>
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Electrical components for Cetra panels are recognized by UL under file number E30326.

Local Code Compliance/Certification

The NEC sets performance requirements for electrical systems on a national basis. However, the cities of Chicago, Los Angeles, and New York have issued local electrical codes that place additional requirements on power system performance. Kimball products have been certified to meet the following local codes:

<table>
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<th>City</th>
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<td>Los Angeles</td>
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<tr>
<td>New York</td>
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<tr>
<td>10-wire</td>
<td>#95A0393</td>
</tr>
<tr>
<td>8-wire</td>
<td>#88A0108</td>
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<td>Chicago</td>
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<td></td>
<td>#0901E</td>
</tr>
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<td></td>
<td>#2228E</td>
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Note: Specifiers/customers/end users must accept the responsibility for awareness of Local Code requirements (including the use of licensed personnel) and for compliance with local codes.

Special electrical components are available to meet hardwire code restrictions for Chicago. Please contact Kimball Customer Service or reference the Chicago Hardwire Planning Guide for information.
The Cetra panel system is capable of accommodating the power distribution requirements of virtually any office environment. With power access available at both panel base and mid-panel locations, there's no limit to the design complexity of Cetra panel configurations/layouts. With three, four-circuit wiring configuration options — as well as a six-circuit wiring configuration option — Cetra-based power can be customized for varied quantities and types of computers, computer peripheral equipment, and non-computer equipment within the entire work environment and individual workstations.

While Kimball’s Cetra panel system is easy to specify, the product specifier involved in developing the electrical plan must be knowledgeable in the use and application of Cetra product. The product specifier — or specifier’s/end user’s technical representative — must also be aware of all National and Local Electrical Codes that are applicable to the project’s installation site.

**Power Distribution**

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**Electrical Planning Guidelines**

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**Kimball Electrical Circuit Configuration Options**

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<td>10-wire, 3 and 3</td>
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**Electrical Wiring Diagrams**

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<tr>
<td>Connecting Building Power to Cetra 8-wire Configurations</td>
<td>29-30</td>
</tr>
<tr>
<td>Connecting Building Power to Cetra 10-wire Configurations</td>
<td>31-32</td>
</tr>
</tbody>
</table>
Cetra electrical components are UL and CSA Listed for use with multiple building power sources. Building power sources may be single-phase 120-volt, 3-phase 208Y/120 volt, 3-wire single phase, or a quality power system such as a UPS (uninterruptible power supply).

Individual building power sources must be grounded power sources. All sources must be connected to the same grounding electrode system. Ground continuity must be verified when using uninterruptible power supplies (UPS) and isolation transformers.

**Note:** All building-to-panel wiring connections must be performed and inspected by qualified, licensed electricians or electrical engineers in accordance with the National Electrical Code and appropriate Local Codes. Further, the product specifier — or specifier’s/end user’s technical representative — supervising the installation of Cetra electrical components is responsible for complying with all applicable National and Local Electrical Codes in effect at the designated site.

Refer to the Electrical Wiring Diagrams section (pages 29-32) for technical schematic diagrams showing how building power sources interface with the Cetra electrical distribution system.
The Power Distribution information contained in this planning guide is organized sequentially from pages 12-21. Here's a brief description of each major topic covered within the power distribution section:

**Wiring Configurations,**
**page 12**  
Details of Cetra’s 8- and 10-wire configurations, along with information concerning electrical circuit layouts, circuit capabilities, and code restrictions.

**Power Distribution: Building-to-Panel,**  
**pages 13-16**  
Explanation of how building power interfaces with Cetra panels via floor/column power entry components and the ceiling power entry assembly.

**Power Distribution: Within the Panel,**  
**page 17-20**  
Explanation of how electrical distribution assemblies (AEDs) route power within the panel base wireway and the panel mid-wireway, and how power is connected between the base wireway and mid-wireway; explanation of the manner in which power is routed between panels — via jumper cables — at both base wireway and mid-wireway levels.

**Power Distribution: Panel to Equipment,**  
**page 21**  
Explanation of how electrical distribution assemblies interface with power receptacles; description of 8- and 10-wire power receptacles; and depiction of power receptacle sites along the base wireway and mid-wireway.
The Cetra electrical system is available with an 8- or 10-wire configuration. For general information on electrical planning guidelines for all Cetra system furniture installations, please see pages 22 and 23.

**Figure A** 8-wire, 3 and 1 Configuration and 2 and 2 Configuration

- Ground
- Ground
- Neutral
- Neutral
- Hot
- Hot
- Hot
- Hot

The 8-wire configuration supports work environments having light to medium intensity computerized equipment needs. The 8-wire layout (Figure A) consists of four 12-gauge hot wires, two 10-gauge neutral wires, and two 12-gauge ground wires. For additional information on the two 4-circuit configuration options — 3 and 1, 2 and 2 — please see pages 25 and 26.

**Figure B** 10-wire, 2 and 2 Configuration

- Ground
- Ground
- Neutral
- Neutral
- Neutral
- Neutral
- Hot
- Hot
- Hot
- Hot

The 10-wire configuration supports work environments having heavy intensity, advanced computerized equipment requirements. One available 10-wire layout (Figure B) consists of four 12-gauge hot wires, four 12-gauge neutral wires, and two 12-gauge ground wires; a second layout (Figure C) has six 12-gauge hot wires, two 10-gauge neutral wires, and two 12-gauge ground wires. For additional information on the 4-circuit (2 and 2) configuration option, please see page 26; details on the 6-circuit (3 and 3) option can be found on page 27.

**Figure C** 10-wire, 3 and 3 Configuration

- Ground
- Ground
- Neutral
- Neutral
- Neutral
- Hot
- Hot
- Hot
- Hot
- Hot
- Hot

The 10-wire configuration supports work environments having heavy intensity, advanced computerized equipment requirements. One available 10-wire layout (Figure B) consists of four 12-gauge hot wires, four 12-gauge neutral wires, and two 12-gauge ground wires; a second layout (Figure C) has six 12-gauge hot wires, two 10-gauge neutral wires, and two 12-gauge ground wires. For additional information on the 4-circuit (2 and 2) configuration option, please see page 26; details on the 6-circuit (3 and 3) option can be found on page 27.
Kimball offers four methods for connecting a building’s power source to Cetra panels. The following pages provide information about these four applications: standard floor and wall/column power entry (this page), special floor power entry (pages 14 and 15), and standard ceiling power entry (page 16). For additional information on 8- and 10-wire electrical distribution assemblies (AEDs), please see page 17.

**Power Distribution**

**Building-to-Panel**

**Standard Floor and Wall/Column Applications**

**Figure A** Standard Floor Application

For standard floor applications, building power is delivered to the panel base via 8-wire or 10-wire floor power entry components. Figure A depicts a 10-wire floor power entry component attached to a 10-wire AED.

**Figure B** Wall/Column Application

For standard wall/column applications, building power is also delivered to the panel base via 8-wire or 10-wire floor power entry components. Figure B depicts an 8-wire floor power entry attached to an 8-wire AED.

**Figure C** 10-Wire Floor Power Entry Component – Left Application

For standard floor and wall/column applications, floor power entry components are compatible with the following Cetra panel widths: 24”, 30”, 36”, 42”, 48”, and 60”.

Ten-wire floor power entries are specified for left entry (Figure C) or right entry into the AED. The 10-wire component’s cable direction swivels 180°.

The 8-wire floor power entry is specified as “universal” only. The component is field-changeable for right (Figure D) or left entry into the AED. When installing, the 8-wire component’s cable direction must first be determined; then, the outer housing/cover is placed over the cable and attached with four screws.

**Power Entry Products**

- **10-Wire (Figure C)**
  - Model # AEF14L/R & AEF16L/R
  - Left/Right AED Entry
  - 3/4” trade size Conduit
  - 60” Conduit Length

- **8-Wire (Figure D)**
  - Model # AEF1U
  - Universal AED Entry
  - 1/2” trade size Conduit
  - 66” Conduit Length
Kimball manufactures several special floor power entry components designed to comply with certain hardwire code restrictions. Since local building and electrical codes prevail over National Electrical Codes, the product specifier — or specifier’s/end user’s technical representative — is responsible for complying with all applicable hardwire codes in effect at the designated installation site, and for specifying the proper Kimball product for the intended application.

**Special Floor Power Entry Applications**

**Chicago**

Hardwiring of a Cetra furniture installation may be required by certain Chicago codes that do not accept modular electrical plug-in components. Careful planning of the electrical layout, circuit requirements, location of power entries, and receptacle locations is extremely important.

For Chicago installations, panels, junction boxes, wireway covers, and branching conduit can be ordered from Kimball. Other items such as receptacles, wiring, conduit, junction boxes, and connectors can be provided by Midwest Interstate, 1355 West North Avenue, Chicago, Illinois, 60622; telephone (312) 342-2600. Please reference the Chicago Hardwire Planning Guide for additional information.

**New York City**

Kimball manufactures several floor power entry components designed to comply specifically with the hardwire code restrictions of New York City. These components are field-installed. The specifier/end user or electrical contractor must furnish box fittings, conduit, and wiring from the systems junction box to the building power source connection.

Figure A depicts the power entry component that must be specified for 36"- to 60"-wide panels equipped with an 8-wire electrical configuration. The chart on page 15 provides the complete listing of power entry components for New York City’s hardwire code restrictions.
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<thead>
<tr>
<th>Model Number</th>
<th>Kimball Product Application: Panel Width and Wiring Configuration</th>
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<tr>
<td>AEF2</td>
<td>36&quot;- to 60&quot;-wide panels, 8-wire configuration (attaches to distribution assembly, not included; eliminates two receptacles in 36&quot;-wide panel; eliminates one receptacle in 42&quot;, 48&quot;, and 60&quot;-wide panels).</td>
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<tr>
<td>AEF3</td>
<td>24&quot;-wide panel, 8-wire configuration (replaces distribution assembly; eliminates all receptacles; passes power one direction only per code).</td>
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<td>AEF34</td>
<td>24&quot;-wide panel, 10-wire/four-circuit configuration (replaces distribution assembly; eliminates all receptacles; passes power one direction only per code).</td>
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<td>AEF36</td>
<td>24&quot;-wide panel, 10-wire/six-circuit configuration (replaces distribution assembly; eliminates all receptacles; passes power one direction only per code).</td>
</tr>
<tr>
<td>AEF5</td>
<td>30&quot;-wide panel, 8-wire configuration (replaces distribution assembly; eliminates all receptacles; passes power one direction; additional conduit jumper can be specified separately to pass power bi-directionally).</td>
</tr>
<tr>
<td>AEF54</td>
<td>30&quot;-wide panel, 10-wire/four-circuit configuration (replaces distribution assembly; eliminates all receptacles; passes power one direction; additional conduit jumper can be specified separately to pass power bi-directionally).</td>
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<td>AEF56</td>
<td>30&quot;-wide panel, 10-wire/six-circuit configuration (replaces distribution assembly; eliminates all receptacles; passes power one direction; additional conduit jumper can be specified separately to pass power bi-directionally).</td>
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<td>AEF64</td>
<td>36&quot;-wide panel, 10-wire/four-circuit configuration (replaces distribution assembly; eliminates two receptacles; passes power one direction, and accepts jumper cable on opposite end).</td>
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<td>AEF66</td>
<td>36&quot;-wide panel, 10-wire/six-circuit configuration (replaces distribution assembly; eliminates two receptacles; passes power one direction, and accepts jumper cable on opposite end).</td>
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<td>AEF74</td>
<td>42&quot;- to 60&quot;-wide panels, 10-wire/four-circuit configuration (replaces distribution assembly).</td>
</tr>
<tr>
<td>AEF76</td>
<td>42&quot;- to 60&quot;-wide panels, 10-wire/six-circuit configuration (replaces distribution assembly).</td>
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</tbody>
</table>
For standard ceiling applications, building power is delivered from the plenum to the panel base using Kimball's ceiling power entry assembly (Figure A). The ceiling power entry assembly is used in conjunction with the ceiling power entry acoustical panel; both items are specified separately. The power pole is included with the ceiling power entry acoustical panel.

The ceiling power entry assembly includes the junction box and flexible conduit. One end of the conduit has a pigtail for hardwiring to the building power source (Figure B); the opposite end of the conduit has a connector that plugs into the electrical distribution assembly (AED) in the panel base wireway (Figure C). Figure D shows how the power pole attaches to the top of the panel.

**Note:** Access to a ceiling power source is regulated by the National Electric Code to a maximum conduit length of 12 feet.

### Ceiling Power Entry Assembly Product:

#### Package Contents

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<th>Qty</th>
<th>Description</th>
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<tbody>
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<td>1</td>
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</tr>
<tr>
<td>1</td>
<td>RACO 257 4 11/16&quot; square x 2 1/8&quot; box or equal</td>
</tr>
<tr>
<td>1</td>
<td>RACO 257 4 11/16&quot; square box cover or equal</td>
</tr>
<tr>
<td>1</td>
<td>RACO 2202 1/2-90 degree connector or equal</td>
</tr>
<tr>
<td>2</td>
<td>Phillips head #8 x 1/2&quot; thread forming screws</td>
</tr>
<tr>
<td>2</td>
<td>Hex head 1/4&quot; self tapping screws</td>
</tr>
</tbody>
</table>
Kimball provides several means for delivering and routing power through Cetra panel configurations. This page contains information about electrical distribution assemblies (AEDs), which are used to deliver power to the base wireway and mid-wireway. Pages 18-20 offer details on jumper cables, which route power between adjacent powered panels, between the panel base wireway to mid-wireway, and from powered-to-non-powered-to-powered panels.

**Electrical Distribution Assemblies (AEDs)**

The electrical distribution assembly (AED) is a component located inside the 4 1/2” x 2 1/2” opening of the base wireway or mid-wireway (Figure A). The AED’s length corresponds to the panel’s width.

Cetra panels can be specified with or without power distribution capabilities. Panels specified with power (P, P4, and P6 suffixes) feature factory-installed AEDs in the base wireway only. Panels specified without power (N suffix) can provide power at a later time; to add power to a non-powered panel, the AED is specified separately and field-installed.

All mid-wireway panels are shipped with or without AEDs in the base wireway. For the mid-wireway, the AED must be specified separately and field-installed. A single electrical jumper cable must be specified to pass power from the base wireway AED to the mid-wireway AED. See page 20 for more information on this type of jumper cable.

**Note:** The product specifier — or specifier’s/end user’s technical representative — should consult all applicable National and Local Electrical Codes prior to specification of AEDs.

**Figure A** Electrical Distribution Assembly (AED)

![Electrical Distribution Assembly (AED)](image)

### Electrical Distribution Assembly Products

**Note:** All five-digit model numbers apply to 8-wire configurations; six-digit model numbers ending in 4 (AED184) apply to 10-wire, 2 and 2 configurations; six-digit model numbers ending in 6 (AED186) apply to 10-wire, 3 and 3 configurations.

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Kimball Product Application: Cetra Panel Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>AED18, 184, 186</td>
<td>For 18”-wide panels</td>
</tr>
<tr>
<td>AED24, 244, 246</td>
<td>For 24”-wide panels</td>
</tr>
<tr>
<td>AED30, 304, 306</td>
<td>For 30”-wide panels</td>
</tr>
<tr>
<td>AED36, 364, 366</td>
<td>For 36”-wide panels</td>
</tr>
<tr>
<td>AED42, 424, 426</td>
<td>For 42”-wide panels</td>
</tr>
<tr>
<td>AED48, 484, 486</td>
<td>For 48”-wide panels</td>
</tr>
<tr>
<td>AED60, 604, 606</td>
<td>For 60”-wide panels</td>
</tr>
</tbody>
</table>

**Note:** 18” electrical distribution assemblies (AEDs) accept one jumper cable per end. Therefore, when three or four 18” powered panels intersect at a “T” or “X” connector, an additional AED and jumper cables may be required to distribute power.
Jumper Cables

Jumper cable components featured on this page and page 19 provide power connections between adjacent powered panels. These components’ model numbers have an AEJ prefix.

The jumper cables described on page 20 route power from powered to non-powered to powered panels, and from the base wireway to mid-wireway. These components’ model numbers have an AET prefix.

All types of jumper cables — AEJ or AET — attach to the ends of 8- or 10-wire electrical distribution assemblies (AEDs); the only exception is the AET2 cable when it’s used in a base wireway-to-mid-wireway application. Charts on pages 19 and 20 provide the specific jumper cable model numbers applicable to 8- and 10-wire configurations.

Note: The product specifier — or specifier’s/end user’s technical representative — should consult all applicable National and Local Electrical Codes prior to specification of jumper cables.

AEJ Jumper Cable

Panel-to-Panel Connection

Figure A  Panel-to-Panel Jumper Cable

The panel-to-panel jumper cable (AEJ1, AEJ14, AEJ16) routes power along a straight panel run. The cable can be installed within the base wireway or mid-wireway (Figure A).

AEJ Jumper Cable

90° Corner Panel Connection

Figure B  90° Corner Jumper Cable

The 90° corner jumper cable (AEJ2, AEJ24, AEJ26) routes power from a straight panel run to a panel installed perpendicular to the straight run. The cable can be installed within the base wireway or mid-wireway (Figure B).
Power Distribution

Within the Panel

120° and 135° Corner Panel Connections

AEJ Jumper Cables

120° and 135° Corner Panel Connections

The 120° corner jumper cable (AEJ3, AEJ34, AEJ36) and 135° corner jumper cable (AEJ4, AEJ44, AEJ46) route power along an angled panel run. Both the 120° (Figure C) and 135° (Figure D) cables can be installed within the base wireway only.

Figure C 120° Corner Jumper Cable

Figure D 135° Corner Jumper Cable

The panel-to-post-to-panel jumper cable (AEJ5, AEJ54, AEJ56) also routes power along a straight panel run, but it provides added length to bypass a panel post. The cable can be installed within the base wireway only (Figure E).

Figure E Panel-to-Post-to-Panel Jumper Cable

AEJ Jumper Cable Products

Note: All four-digit model numbers apply to 8-wire configurations; five-digit model numbers ending in 4 (AEJ14) apply to 10-wire, 2 and 2 configurations; five-digit model numbers ending in 6 (AEJ16) apply to 10-wire, 3 and 3 configurations.

10-wire AEJ Jumper Cable

8-wire AEJ Jumper Cable

Model Number

AEJ1, 14, 16 . . . . . . . . . . . . Panel-to-panel
AEJ2, 24, 26 . . . . . . . . . . . . 90° corner
AEJ3, 34, 36 . . . . . . . . . . . . 120° corner
AEJ4, 44, 46 . . . . . . . . . . . . 135° corner
AEJ5, 54, 56 . . . . . . . . . . . . Panel-to-post-to-panel

Panel-to-Post-to-Panel Connection

Kimball Product Application: Cetra Panel Connection
AET Jumper Cables

AET jumper cables are used to connect power between a powered panel that is separated from another powered panel by one or more non-powered panels. The cables can be used in the base wireway only.

AET jumper cables support the following applications: panel-to-panel (Figure A), panel-to-panel-to-post-to-panel (Figure B), and panel-to-curved panel-to-panel (Figure C).

The AET1 through AET7 jumper cables represent the seven different lengths required to span a single non-powered Cetra panel. AET8 through AET12 are longer cables designed to span multiple panel widths. Figure D shows how to calculate the cable length requirements on multiple-panel spans.

**Figure D** Cable Length Calculation for Multiple Panel Spans

**Formula:**
- Panel Width(s)
- + 2 1/2" Per Connector
- = Panel/Connector Width
- + 14" AED-to-Panel Reveal
- = Total AET Cable Length Required

**Example:**
- 96" Panel Width (36" + 30" + 30")
- + 7 1/2" Per Connector (3 @ 2 1/2" each)
- = 103 1/2" Panel Connector Width
- + 14" AED-to-Panel Reveal
- = 117 1/2" Total AET Cable Length Required
  (specify AET11)

**AET Jumper Cable Products**

**Note:** All four-digit model numbers apply to 8-wire configurations; five-digit model numbers ending in 4 (AET14) apply to 10-wire, 2 and 2 configurations; five-digit model numbers ending in 6 (AET16) apply to 10-wire, 3 and 3 configurations.

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Kimball Product Application: Cetra Panel Span</th>
</tr>
</thead>
<tbody>
<tr>
<td>AET1, 14, 16</td>
<td>Spanning a single 18&quot;-wide panel (37&quot; long)</td>
</tr>
<tr>
<td>AET2, 24, 26</td>
<td>Spanning a single 24&quot;-wide panel, or providing the base wireway-to-mid-wireway connection (43&quot; long)</td>
</tr>
<tr>
<td>AET3, 34, 36</td>
<td>Spanning a single 48&quot;-wide or curved panel (67&quot; long)</td>
</tr>
<tr>
<td>AET4, 44, 46</td>
<td>Spanning a single 30&quot;-wide panel (49&quot; long)</td>
</tr>
<tr>
<td>AET5, 54, 56</td>
<td>Spanning a single 36&quot;-wide panel (55&quot; long)</td>
</tr>
<tr>
<td>AET6, 64, 66</td>
<td>Spanning a single 42&quot;-wide panel (61&quot; long)</td>
</tr>
<tr>
<td>AET7, 74, 76</td>
<td>Spanning a single 60&quot;-wide panel (80&quot; long)</td>
</tr>
<tr>
<td>AET8, 84, 86</td>
<td>Spanning multiple panels; refer to figure D formula (92&quot; long)</td>
</tr>
<tr>
<td>AET9, 94, 96</td>
<td>Spanning multiple panels; refer to figure D formula (104&quot; long)</td>
</tr>
<tr>
<td>AET10, 104, 106</td>
<td>Spanning multiple panels; refer to figure D formula (116&quot; long)</td>
</tr>
<tr>
<td>AET11, 114, 116</td>
<td>Spanning multiple panels; refer to figure D formula (128&quot; long)</td>
</tr>
<tr>
<td>AET12, 124, 126</td>
<td>Spanning multiple panels; refer to figure D formula (144&quot; long)</td>
</tr>
</tbody>
</table>

**Figure E** Base-to-Mid-Wireway Jumper Cable

The 43"-long AET jumper cable (AET2, AET24, AET26) also serves as the power connection between the base wireway and mid-wireway. The jumper cable is positioned within the vertical channel located inside the mid-wireway panel (Figure E).
Cetra panels deliver power from electrical distribution assemblies (AEDs) to equipment via receptacles. Receptacles connect to the AED, providing power access points along the base wireway and the mid-panel wireway.

**Receptacles**

Receptacle sites are located nine inches inside of the panel’s reveal (Figure A). A simplex receptacle (Figure B) — featuring integral surge suppression — is available for 8-wire configurations only. Duplex receptacles are available for both 8-wire (Figure C) or 10-wire (Figure D) configurations.

In each panel base wireway, up to four duplex receptacles can be specified. Each mid-wireway panel can accommodate up to eight duplex receptacles. Curved and 18”-wide panels do not accept receptacles.

There are two conditions that reduce the number of available receptacle sites in a single panel. First, a power entry component will use one receptacle location. Second, a base wireway-to-mid-panel wireway jumper cable will use two receptacle locations.

**Note:** The product specifier — or specifier’s/end user’s technical representative — should consult all applicable National and Local Electrical Codes prior to specification of receptacles.

---

**Receptacle Products**

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Kimball Product Application: Receptacle Type, Function, and Wiring Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>AER4S, AERSS</td>
<td>Simplex surge receptacle; delivers power from circuits 4 and 5 only with a shared neutral and ground or dedicated neutral and isolated ground; 8-wire, 3 and 1 configuration or 8-wire, 2 and 2 configuration</td>
</tr>
<tr>
<td>AER1, AER2, AER3</td>
<td>Duplex receptacle; delivers power from circuits 1, 2, and 3 with a shared neutral and a shared ground; 8-wire, 3 and 1 configuration</td>
</tr>
<tr>
<td>AER4</td>
<td>Duplex receptacle; delivers power from circuit 4, which is a dedicated circuit for computer application with a dedicated neutral and an isolated ground; 8-wire, 3 and 1 configuration</td>
</tr>
<tr>
<td>AER1, AER2</td>
<td>Duplex receptacle; delivers power from designated circuits 1 and 2 with a shared neutral and a shared ground; 8-wire, 2 and 2 configuration</td>
</tr>
<tr>
<td>AER4, AER5</td>
<td>Duplex receptacle; delivers power from designated circuits 4 and 5 with a shared neutral and a shared isolated ground; 8-wire, 2 and 2 configuration</td>
</tr>
<tr>
<td>AER14, AER24</td>
<td>Duplex receptacle; delivers power from designated circuits 1 and 2 with an independent neutral and a shared ground; 10-wire, 2 and 2 configuration</td>
</tr>
<tr>
<td>AER34, AER44</td>
<td>Duplex receptacle; delivers power from designated circuits 3 and 4 with an independent neutral and a shared isolated ground; 10-wire, 2 and 2 configuration</td>
</tr>
<tr>
<td>AER16, AER26, AER36</td>
<td>Duplex receptacle; delivers power from designated circuits 1, 2, and 3 with a shared neutral and a shared ground; 10-wire, 3 and 3 configuration</td>
</tr>
<tr>
<td>AER46, AER56, AER66</td>
<td>Duplex receptacle; delivers power from designated circuits 4, 5, and 6 with a shared neutral and a shared isolated ground; 10-wire, 3 and 3 configuration</td>
</tr>
</tbody>
</table>
Proper electrical planning is critically important in any panel system furniture installation. The product specifier’s knowledge base must encompass three major areas of emphasis. First, the specifier should possess a clear understanding of the capabilities of the Cetra electrical system. Second, the specifier should know what type of computerized and non-computerized equipment must be accommodated — for both present needs and for any enhancements or changes that may be required in the future. Third, the specifier should be knowledgeable of all electrical and building codes in effect at the installation site.

The information below and on page 23 provides the basic electrical planning guidelines for a Cetra system installation. Page 24 is a discussion of harmonics and Kimball’s response to this electrical phenomenon.

Effective electrical planning begins with a layout of the systems furniture installation. Using the planned office layout, the product specifier should take these steps:

- Designate each panel through which power will be routed. Each run must be continuous, but it may branch, follow corners, or provide a power supply to the mid-wireway.

- Note the width of each panel and determine where receptacles will be located. Make sure they are accessible and note if they are located at the base wireway or mid-wireway.

- For each panel, list either the pre-wired number, its distribution assembly number, or pass-thru cable number. Define and list the interconnecting jumper assemblies that are required to complete the system.

- Determine which electrical circuit each receptacle will use. Also determine the location of the power entry components that will connect to the building’s power source. (For more specific guidelines on electrical circuit planning and equipment amperages, see page 23.)

The National Electrical Code (NEC) restricts the maximum number of receptacles to 13 on a 20-amp rated circuit (in USA) and 10 receptacles on a 15-amp rated circuit (in Canada). These limits apply to all power systems. (Local Codes may also further restrict current loading, or the number or type of circuits, or the number of receptacles.)

The Cetra four-circuit system can therefore accommodate up to 52 receptacles (4 x 13) per power entry; the six-circuit system allows for up to 78 receptacles (6 x 13) per power entry. However, Kimball recommends using only 10 receptacles per circuit; even though this is 25 percent below the maximum, it allows for future expansion. Kimball also recommends balancing the electrical load and number of receptacles on each circuit to ensure that the amperage requirements of the equipment do not exceed stated limitations.

When planning an electrical layout, it is also advisable to route electricity only to areas where it is presently needed, or where the need for power is anticipated in the near future. Furthermore, receptacle installation should be limited to the number necessary to power the equipment in the furniture installation. Excess receptacles may encourage use of unauthorized equipment and lead to circuit overloads.

Some furniture installations will require multiple building power entry points. Separate building power sources must never be connected to the same segment of cabling, during either initial installation or future panel reconfiguration.

A panel circuit should be connected to one — and only one — source of building power. Otherwise, a significant risk of fire or electrical shock will be present.
Each Cetra system electrical circuit has the potential to carry a maximum rated load of 20 amps of electrical service (15 amps in Canada). However, applicable National and Local Building and Electrical Codes may further restrict the current usage of the Cetra system. For example, the National Electrical Code (NEC) derates the load capacity to no more than 80% (NEC 384-16-C) capacity for continuous load situations.

Continuous load is defined as a circuit that is in constant use for a period of three or more hours. Examples of continuous loading include circuits that power lighting, computers, computer data storage devices, and printers that remain activated throughout the day. In most workplace environments, most of the circuits are subjected to continuous load.

All electrical circuit planning should be based on the anticipated equipment load, and not on the maximum number of receptacles allowed. In fact, considering the loads of many types of equipment, the amperage capacity of a circuit will be exhausted with less than the 13 receptacles allowed by the NEC in United States-based installations.

Based on the capacity of 16 usableamps per continuous-use circuit, Kimball recommends that the initial loading on each circuit be approximately 10 amps. This initial planning limitation permits the end user to add or change electrical equipment within the guidelines of amperage limits; this may also prevent premature redesigns of the electrical layout.

The amperage rating of equipment is displayed on the manufacturer’s nameplate or product literature. If the equipment power consumption is listed as watts, convert watts to amps using the following formula: watts divided by volts equals amps. For example, 120 watts divided by 120 volts equals 1 amp.

When calculating lighting amperage loads for Kimball task lighting units, apply the amperage figures provided in the chart below.

**Task Lighting Products**

<table>
<thead>
<tr>
<th>Lamp Type</th>
<th>Lamp Length</th>
<th>Basic Task Light Amperage Load</th>
<th>Premium Task Light Amperage Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>17W-T8</td>
<td>24”</td>
<td>620</td>
<td>.145</td>
</tr>
<tr>
<td>25W-T8</td>
<td>36”</td>
<td>622</td>
<td>.200</td>
</tr>
<tr>
<td>32W-T8</td>
<td>48”</td>
<td>650</td>
<td>.277</td>
</tr>
</tbody>
</table>
The issue of harmonics is a potentially serious concern in today's workplace, an issue created by the increased use of computers and computer peripheral equipment.

Harmonic (or non-linear) electrical currents are caused primarily by personal computers. Other sources of harmonic currents are: the electric discharge lighting from magnetic or solid-state ballasts; electric drive systems; welders; solid-state heating controls; or any other types of electrical equipment that draw current in abrupt, non-continuous pulses.

The effects of non-linear, non-continuous electrical loads — and their resulting harmonic currents — can become manifested in several areas of a power system, most commonly in building transformers (which can fail) and neutral conductors (which can become overheated).

The major problem with harmonics will reside in the building supply (transformer) side of the electrical system. To combat the effects of harmonics, from a building/transformer perspective, an additional isolated transformer with oversized neutral conductors can be installed in a location close to the installation's computer areas.

The Cetra system diminishes the impact of harmonics in two primary ways.

- First, the Cetra system utilizes UL-listed, 10-gauge increased size neutral conductors. These conductors are capable of handling a theoretical 173% potential neutral overloading caused by additive harmonic currents (i.e., a multiple-computer work environment).

- Second, the Cetra system offers 8-wire and 10-wire electrical configurations that divide the 3-phase harmonic currents between two increased size neutrals, increased size shared neutrals or independent neutrals. See pages 25-27 for more information on these configurations: 8- or 10-wire 2 and 2, and 10-wire 3 and 3.

The contract furniture industry has been continually involved in developing solutions designed to handle harmonics in the office environment. The only truly effective method to determine if harmonic problems exist is to test the installation's electrical system. This requires that all electrical components be installed and operating in the office environment.
With careful planning and specification, Cetra furniture system electrical components can support virtually any workplace equipment requirement, for both present and anticipated future needs. The office layouts shown on this page and pages 26-27 illustrate usages of the four most common types of Cetra-based electrical circuit configurations.

This information is intended to assist specifiers in developing an approved electrical layout for their own unique, specific requirements. Please note that a single Cetra workstation cluster can accommodate two or more building power entry points, so long as the power entries are not interconnected.

The specifier — or specifier/end user’s representative — is responsible for obtaining the amperage draws of all non-Kimball electrical equipment, and for correctly allocating electrical circuits to power the installation’s equipment. (Refer to page 23 for the listing of Kimball task lighting products and their corresponding amperage draw.)

The planning of actual power supplies and branch circuits must be performed by qualified electricians or electrical engineers in accordance with the National Electrical Code (NEC) and appropriate Local Codes.

With the 8-wire, 3 and 1 configuration:

- Circuits 1, 2, and 3 share an increased size common neutral and ground wire. Circuits 1, 2, and 3 can be used for lighting and other general/utility equipment. Kimball receptacles used: AER1, AER2, AER3.
- Circuit 4 has a separate neutral and isolated ground wire, providing a clean source of power for computer applications. Kimball receptacle used: AER4.

8-Wire, 3 and 1 Configuration
**Kimball Electrical Circuit Configuration Options**

**8-Wire Electrical System**

**2 and 2 Circuit Configuration**

With the 8-wire, 2 and 2 configuration:

- Circuits 1 and 2 share an increased size common neutral and ground wire, providing a pair of designated circuits for lighting and other general/utility equipment. Kimball receptacles used: AER1, AER2.

- Circuits 4 and 5 share an increased size common neutral and an isolated ground wire, providing a pair of designated circuits — and a clean source of power — for computer applications. Kimball receptacles used: AER4, AER5.

**Note:** Receptacle 3 cannot be used in this configuration due to cross-talk or interference.

**10-Wire Electrical System**

**2 and 2 Circuit Configuration**

With the 10-wire, 2 and 2 configuration:

- Circuits 1 and 2 each have a neutral wire and share a common ground wire, providing a pair of designated circuits for lighting and other general/utility equipment. Kimball receptacles used: AER14, AER24.

- Circuits 3 and 4 each have a neutral wire and share an isolated ground wire, providing a pair of designated circuits — and a clean source of power — for computer applications. Kimball receptacles used: AER34, AER44.

**Note:** The additional two neutral wires featured in this 10-wire system configuration provide an enhanced level of clean power for installations having higher-intensity computer equipment levels.
With the 10-wire, 3 and 3 configuration:

- Circuits 1, 2, and 3 share a common increased size neutral and ground wire, providing three designated circuits for lighting and other general/utility equipment. Kimball receptacles used: AER16, AER26, AER36.

- Circuits 4, 5, and 6 share a common increased size neutral and isolated ground wire, providing three designated circuits — and a clean source of power — for computer applications. Kimball receptacles used: AER46, AER56, AER66.
The electrical wiring diagrams featured on this page show how Cetra 8- and 10-wire electrical systems can be interconnected within the same panel installation.

The electrical wiring diagrams featured on pages 29-32 are intended to show how Cetra 8- and 10-wire electrical systems connect to the building power source.

**Note:** Interconnection of 8- and 10-wire systems — as well as connections of Kimball power entry components to the building power source — must be made by a licensed electrician only. Installation must be in accordance with the National Electrical Code (NEC) and any applicable Local Codes.

Interconnecting Cetra 8-wire and 10-wire electrical systems within the same panel installation provides specifiers with additional product and planning flexibility. The wiring diagrams featured below indicate how the two systems interconnect according to specific wiring configurations.

### 8 to 10 Wire Jumper & Pass-thru Cable Products

**Model Number . . . . . . . . . . . . . . . . . . Kimball Product Application:**

- **AEJ14X83** . . . . . . . . . . . . Panel-to-panel jumper cable, 10-wire four circuit to 8-wire 3 and 1 or 2 and 2 configuration
- **AEJ16X83** . . . . . . . . . . . . Panel-to-panel jumper cable, 10-wire six circuit to 8-wire 3 and 1 configuration
- **AEJ16X82** . . . . . . . . . . . . Panel-to-panel jumper cable, 10-wire six circuit to 8-wire 2 and 2 configuration
- **AEJS4X83** . . . . . . . . . . . . Panel-post-panel jumper cable, 10-wire four circuit to 8-wire 3 and 1 or 2 and 2 configuration
- **AEJS6X83** . . . . . . . . . . . . Panel-post-panel jumper cable, 10-wire six circuit to 8-wire 3 and 1 configuration
- **AEJS6X82** . . . . . . . . . . . . Panel-post-panel jumper cable, 10-wire six circuit to 8-wire 2 and 2 configuration
- **AET2483** . . . . . . . . . . . . Base wireway-to-mid wireway pass-thru cable, 10-wire four circuit to 8-wire 3 and 1 or 2 and 2 configuration
- **AET2683** . . . . . . . . . . . . Base wireway-to-mid wireway pass-thru cable, 10-wire six circuit to 8-wire 3 and 1 configuration
- **AET2682** . . . . . . . . . . . . Base wireway-to-mid wireway pass-thru cable, 10-wire six circuit to 8-wire 2 and 2 configuration

**Note:** Panel-to-panel and panel-to-post jumper cables can only be used in the base wireway; not applicable at mid wireway.
3 & 1 Configuration
120/208V WYE 3 Phase 4 Wire

2 & 1 Configuration
120/240V Delta Single Phase

2 & 1 Configuration
120/240V Open Delta Single Phase

2 & 1 Configuration
120/240V Single Phase

8-Wire Schematic — 3 and 1 or 2 and 1 Configurations

The 3 and 1 configuration utilizes receptacles 1, 2, 3, and 4. The 2 and 1 configuration utilizes receptacles 1, 3, and 4.

Note: Receptacle 5 cannot be used in either of these configurations.

Ideally, a four-wire, WYE, 208 volt service provides the best utilization. Circuits 1, 2, and 3 can be wired for general use. Circuit 4, which has its own increased size neutral and an isolated ground, can be reserved for data and communications equipment.

Other power supplies such as 120/240 volt delta, 120/240 volt open delta, and 120/240 volt single phase will use circuits 1, 3, and 4 with L2 (red) circuit taped off.

Single phase 120 volt, two-wire systems will use L1 (black) paired with N1 (white/black), and L4 (pink) paired with N2 (white/red). L2 (red) and L3 (blue) should not be used.
Connecting Building Power to Cetra 8-Wire Configurations

2 & 2 Configuration
120/208V WYE 3 Phase 4 Wire

1 & 2 Configuration
120/240V Delta Single Phase

1 & 2 Configuration
120/240V Open Delta Single Phase

1 & 2 Configuration
120/240V Single Phase

8-Wire Schematic — 2 and 2 or 1 and 2 Configurations

The 2 and 2 configuration utilizes receptacles 1, 2, 4, and 5. The 1 and 2 configuration utilizes receptacles 1, 4, and 5.

Note: Receptacle 3 cannot be used in either of these configurations.

Ideally, a four-wire, WYE, 208 volt service provides the best utilization. Circuits 1 and 2 can be wired for general use. Circuits 4 and 5 can be reserved for data and communications equipment.

Other power supplies such as 120/240 volt delta, 120/240 volt open delta, and 120/240 volt single phase will use circuits 1, 4, and 5 with L2 (red) circuit taped off.

Single phase 120 volt, two-wire systems will use L1 (black) paired with N1 (white/black), and L4 (pink) paired with N2 (white/red). L2 (red) and L5 (blue) should not be used.
Connecting Building Power to Cetra 10-Wire Configurations

10-Wire Schematic — 2 and 2 Configuration

The 2 and 2 configuration utilizes receptacles 1, 2, 3, and 4.

Circuits 1 and 2 can be wired for general use, using separate neutrals and a common safety ground. Circuits 3 and 4 can be wired for computers, using separate neutrals and a shared isolated ground.
The 3 and 3 configuration utilizes receptacles 1, 2, 3, 4, 5, and 6.

Ideally, a four-wire, WYE, 208 volt service provides the best utilization. Circuits 1, 2, and 3 can be wired for general use. Circuits 4, 5, and 6 — which have their own increased size neutral and an isolated ground — can be reserved for data and communications requirements.
The Cetra panel system is capable of supporting the rapidly-changing, increasingly-complex communications requirements of today’s workplaces. Cetra panels offer efficient, convenient methods for routing and managing all types of voice and data cables. Access to communication ports and voice/data terminal connections is available at both the base wireway and mid-panel wireway locations of Cetra panels.

To ensure that both furniture and communications equipment fully meet the customer’s needs, the product specifier must be able to accurately convey the Cetra furniture product’s features and capabilities to the telecommunications contractors and specialists involved at the particular installation site.

This section of the planning guide is designed to help product specifiers fulfill that objective. It provides basic information about communications technology and detailed explanations of how the Cetra system handles voice/data cable routing, access, and management.

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The technology used to transmit and receive information is becoming increasingly complex, particularly in terms of the voice (telephone) and data (computer) networks that are common in most of today’s workplaces. This increased level of voice/data network complexity is placing greater demands on furniture to physically support the communications process — particularly in the manner in which communications cables are routed and managed within the furniture system installation.

Within the context of cable routing, it’s important to address the issue of “cross-talk.” The term cross-talk is used to describe electromagnetic field interference with data signals.

Nobody can honestly guarantee a network to be error-free. Therefore, when a data package is received, it must pass several tests before it is accepted as valid data. When a receiver senses a corrupted data packet, it does one of two things. It corrects the packet or requests a retransmission. If the error is small, the Cycle Redundancy Check (CRC) code is used to correct the data string. If the error is too large, retransmission is requested. Data corruption occurs in all systems. An error transmission does not bring down the system.

Kimball’s panel system offers two ways to help reduce the likelihood of data corruption. All electrical components are either shielded or insulated, and mid-wireway panels are also available to allow for the physical separation of voice and data cables in their own wireway.

Data cables can also have an integral metallic or foil material that wraps around sensitive data wires to serve as a barrier.
Specific guidelines for planning voice/data communications systems within the Cetra panel system are provided on pages 36-47. Here’s a brief description of each major topic covered:

**Communications Cables,**
*pages 36-37*
Explanation of the different types of communications cables and their corresponding voice/data application; explanation of the cable “fill factor” calculation.

**Communications Cable Routing: Within the Panel Base Wireway,**
*pages 38-39*
Explanation of communications cable routes and pathways within Cetra powered and non-powered panel base wireways, including bend radius information for fiber optic cables; examples of various maximum cable capacities.

**Communications Cable Routing: Within the Panel Mid-Wireway,**
*pages 40-41*
Explanation of communications cable routes and pathways within Cetra powered and non-powered mid-wireways, including bend radius information for fiber optic cables; examples of various maximum cable capacities.

**Communications Cable Routing: Within the Ceiling Power Entry Panel,**
*pages 42-43*
Explanation of communications cable routes and pathways within the Cetra ceiling power entry panel, including bend radius information for fiber optic cables; examples of various maximum cable capacities.

**Communications Cable Access,**
*pages 44-46*
Explanation of standard and non-standard locations for voice/data ports along the Cetra panel base wireway and panel mid-wireway; description of various types of voice/data cable connections.

**Communications Cable Management,**
*page 47*
Description of Cetra cable management products.
Voice and data information is carried from transmitting to receiving equipment via low-voltage conductors (cables). To ensure correct specification of cable(s), the customer's voice/data communications needs must be fully researched by a telecommunications specialist; proper application of cabling within the furniture system is the product specifier's responsibility. This page lists several types of cables and their applications; the opposite page provides the formula for calculating how many cables can be stored inside the cavities of the Cetra panel system.

### Cable Types and Applications

<table>
<thead>
<tr>
<th>Cable Type</th>
<th>Diameter</th>
<th>Area (sq. inch)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>4-Fiber Optic Cable</strong></td>
<td>3/16”</td>
<td>.027</td>
<td>Fiber Optic</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Representing the newest generation of cable types, the fiber optic cable is comprised of a glass or plastic core surrounded by a protective cladding. Fiber optic cables use light — not low-voltage electricity — to transmit voice and data signals at significantly higher speeds and greater quantities than twisted pair cables.</td>
</tr>
<tr>
<td><strong>12-Fiber Optic Cable</strong></td>
<td>5/16”</td>
<td>.077</td>
<td></td>
</tr>
<tr>
<td><strong>IBM Type 1 Cable</strong></td>
<td>3/8”</td>
<td>.110</td>
<td>IBM Type 1 and Type 2</td>
</tr>
<tr>
<td><strong>IBM Type 2 Cable</strong></td>
<td>1/2”</td>
<td>.196</td>
<td>Primary used to connect equipment within a Local Area Network (LAN). IBM Type 1 and Type 2 cables are comprised of combinations of shielded and unshielded twisted pair cables insulated from each other, then bound or sheathed together in one bundle. These cables can be teflon coated to meet NEC regulations for ceiling plenum routing.</td>
</tr>
<tr>
<td><strong>12-Pair Twisted Pair</strong></td>
<td>3/16”</td>
<td>.027</td>
<td>Twisted Pair</td>
</tr>
<tr>
<td><strong>25-Pair Twisted Pair</strong></td>
<td>7/16”</td>
<td>.149</td>
<td>Currently the most common medium for voice/data transmission, twisted pair cable is comprised of two insulated low-voltage copper wires twisted together and covered with a protective plastic coating. Each copper wire pairing can carry a set of voice or data signals over long distances.</td>
</tr>
<tr>
<td><strong>Thin Ethernet</strong></td>
<td>1/4”</td>
<td>.049</td>
<td>Thin Ethernet</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Often used as a less-cumbersome alternative to thicker coaxial cable or twisted pair cable, thin ethernet cable is comprised of a metal core conductor surrounded by two insulated outer coverings. An ethernet cable is essentially a thin coaxial cable applied mostly in computer network installations.</td>
</tr>
</tbody>
</table>

---
Considering the wide variety of cable types being used in today’s systems furniture installations, Kimball recommends two methods for determining the quantity of cables that can be routed within the available openings/cavities of a Cetra panel.

The first method — “actual installation” — is the less-complicated alternative. With this method, there are no predeterminations of furniture cable capacities. The systems furniture workstation configuration is installed, and then this “actual installation” simply dictates the amount of cable — or combinations of cable — that can be accommodated.

The second method — “fill factor calculation” — is based on a mathematical equation. With this method, furniture cable capacities can be closely approximated and thereby pre-planned for the intended installation. The “fill factor” is the percentage of the total area of the panel’s interior cavity/opening that can be realistically used for cable storage. The “fill factor” figure assigned to a specific application is always arbitrary. However, smaller-diameter cables generate higher fill factors than larger-diameter cables.

**Fill Factor Formula**

\[ TA \times FF = UA \div CA = CQ \]

**Symbol Legend**

- **TA** = Total Area in square inches
- **FF** = Fill Factor in decimal of 1
- **UA** = Usable Area in square inches
- **CA** = Cable Area in square inches
- **CQ** = Cable Quantity

The following two examples show how cable storage capacities are determined using the "fill factor" calculation. Example 1 depicts an electrified panel base wireway cavity with 3/16" diameter cables (Figures A and B); the "fill factor" used in this application is 65 percent. Example 2 depicts an electrified panel mid-wireway cavity with 3/8" diameter cables (Figures C and D); the "fill factor" assigned to this application is 40 percent.

**Example 1: 3/16" (.027) diameter cable**

1 square inch x .65 = .65 ÷ .027 = 24 cables.

**Example 2: 3/8" (.110) diameter cable**

3.5 square inches x .40 = 1.4 ÷ .110 = 13 cables.
Communications Cable Routing

Voice/data communications cables can be routed along three separate areas of the Cetra panel: within the base wireway (as shown on this page and the opposite page), within the mid-wireway (pages 40-41), and within the ceiling power entry panel (pages 42-43). Each two-page spread provides a contextual view of a Cetra panel and the cable routing pathway being featured, specific bend radius information for fiber optic cable applications, the interior dimensions of openings/cavities, and actual examples of furniture cable capacities. All illustrations on pages 38-43 feature 10-wire electrical distribution assemblies (AEDs) where applicable.

**Note:** All communications cable infeeding and routing — and connections to voice/data termination points — must be performed and inspected by qualified, licensed telecommunications contractors in accordance with Telecommunications Industry Association (TIA) standards.

**Within the Panel Base Wireway**

Figure A depicts the position of communications cabling vis a vis the electrical distribution assembly (AED) within a Cetra panel base wireway.

**Bend Radius for Fiber Optic Cable**

Figure B depicts the top view of a base wireway, showing the bend radius of a fiber optic cable being routed into a 90° panel configuration.
Figure C depicts the cavity/opening of a Cetra panel base wireway; Figure D depicts the same cavity/opening with an electrified AED. For information on how to calculate “fill factors” for the panel base wireway, refer to the formula shown on page 37.

Figure E shows the cavity/opening filled with the maximum capacity of 26, 3/16” diameter Category 5 communications cables. Figure F shows the cavity filled with a combination of 9, 3/16” diameter Category 5 cables and 4, 3/8” diameter 25-pair twisted pair cables.

Figure C: 3.2 Square Inches
- Interior Dimension (total): 6.4 Square Inches
- Cavity/opening

Figure D: 1.75 Square Inches
- Interior Dimension (total): 3.5 Square Inches
- Electrified 10-wire AED
- Receptacle

Figure E: 3/16” Diameter Category 5 Cable
- Electrified 10-wire AED
- Receptacle

Figure F: 3/8” Diameter 25-pair Twisted Pair Cable
- Electrified 10-wire AED
- Receptacle
- 3/16” Diameter Category 5 Cable
- 3/8” Diameter 25-pair Twisted Pair Cable
Communications Cable Routing

Within the Panel Mid-Wireway

Cable Clearance for Panel-to-Panel Connection

Figure A depicts the position of communications cables being routed from the Cetra panel base wireway, through the panel vertical wireway, and into the panel mid-wireway. Inside the panel vertical wireway, the communications cables run alongside an AET jumper cable carrying power from the base wireway to mid-wireway.

Figure B depicts the interior of a panel-to-panel connection, showing the 1/2" clearance between the panel frame and wireway cover. The right side of the panel features an installed AEJ jumper cable; the cavity/opening below the cable is filled with 6, 3/16" diameter Category 5 cables and 3, 3/8" diameter 25-pair twisted pair cables. The cavity/opening on the left side of the panel is filled with a combination of 12, 3/16" diameter Category 5 cables and 9, 3/8" diameter 25-pair twisted pair cables.

Figure C depicts the top view of a 90° panel connection, showing the 1/2" clearance between the interior panel frame and the wireway cover.

Bend Radius for Fiber Optic Cable

Figure D depicts the side view of the mid-wireway panel, showing the bend radius of a fiber optic cable being routed from the base wireway into the mid-wireway.
Figure E depicts the cavity/opening of a Cetra panel mid-wireway; Figure F depicts the same cavity/opening with an electrified AED. For information on how to calculate “fill factors” for the panel mid-wireway, refer to the formula shown on page 37.

Figure G shows an electrified mid-wireway whose cavity is filled with 15, 3/16” diameter Category 5 cables and 13, 3/8” diameter 25-pair twisted pair cables in the center of the wireway.

Figure H depicts the top view of an empty panel vertical wireway channel. Figure I shows the same channel filled with an AET jumper cable. For information on how to calculate “fill factors” for the panel vertical wireway, refer to the formula shown on page 37.

Figure J shows the channel filled with the jumper cable: 14, 3/16” diameter Category 5 cables; and 11, 3/8” diameter 25-pair twisted pair cables.
Figure A depicts the position of communications cables being routed from the plenum to the base wireway of a Cetra ceiling power entry panel. There are two separate channels inside the power pole and within the internal panel wireway. One channel houses communications cables; the other channel houses the AEC conduit of the ceiling power entry assembly carrying power from the building power source to the base wireway.

Figure B is a detail view of the power pole, showing the metal septum that separates communications cables from the AEC conduit of the ceiling power entry assembly. The power pole fastens to the panel above the panel’s internal vertical wireway.
Communications
Cable Routing

Within the Ceiling Power Entry Panel

Figure D depicts the top view of the ceiling power entry panel's internal vertical wireway. The right-hand channel is empty; the left-hand channel contains the AEC conduit of the ceiling power entry assembly. For information on how to calculate "fill factors" for the ceiling power entry panel's internal vertical wireway, refer to the formula shown on page 37.

Figure E shows the same channels, with the right-hand channel filled with 11, 3/16" diameter Category 5 cables and 12, 3/8" diameter 25-pair twisted pair cables.

Figure C depicts the side view of the ceiling power entry acoustical panel, showing the bend radius of a fiber optic cable being routed from the plenum to the base wireway.

Cable Capacity Examples

Bend Radius for Fiber Optic Cable

Figure C

Figure D

Figure E
Communications Cable Access

Cetra panels provide access to communication cables along the base wireway and mid-wireway sites. Communication wireway covers are available with standard locations for access ports (see Figure A below). Wireway covers can also be field-modified to provide non-standard locations for access ports (see Figure D, page 45).

**Standard Locations for Voice/Data Cable Ports**

Factory-ordered standard communication wireway covers include one communication “punch” per wireway cover, in addition to the two standard punches for power receptacles (Figure B). The dimension of the communication opening is 1 3/8" high x 2 5/8" wide. The opening is located left of center.

**Communication Wireway Cover Products**

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Wireway Cover Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARPJ30</td>
<td>30” wide x 4 3/8” high x 1/2” deep</td>
</tr>
<tr>
<td>ARPJ36</td>
<td>36” wide x 4 3/8” high x 1/2” deep</td>
</tr>
<tr>
<td>ARPJ42</td>
<td>42” wide x 4 3/8” high x 1/2” deep</td>
</tr>
<tr>
<td>ARPJ48</td>
<td>48” wide x 4 3/8” high x 1/2” deep</td>
</tr>
<tr>
<td>ARPJ60</td>
<td>60” wide x 4 3/8” high x 1/2” deep</td>
</tr>
</tbody>
</table>

**Modified Power Receptacle Sites**

The Cetra panel wireway cover’s power receptacle sites (Figure C) can provide access for communications cable. The receptacle cover door is punched with a single cutout along one side (Figure D). Contact your Kimball Sales Representative for more information.
For a minimal charge, Cetra panel wireway covers — at the base wireway or mid-wireway locations — can be specially punched in non-standard locations or sizes (Figure D). This option is available on panels 30" wide or wider; the punch should be located off-center to allow clearance for deep-set access ports.

Access port cover sizes and depths need to be compared against the technical drawings shown below (Figures E-J) to verify that a particular port configuration can be fitted in a Cetra panel base wireway or panel mid-wireway. Figures E and F depict the clearance dimensions for non-electrified and electrified base wireways, respectively; Figure G shows an installed communications access port in context with an electrified base wireway. Figures H and I depict the clearance dimensions for non-electrified and electrified mid-wireways, respectively; Figure J shows an installed communications access port in context with an electrified base mid-wireway.
Communications Cable Access

Non-Standard Locations for Voice/Data Cable Ports

A wide variety of communications access ports are available on the market. It is the responsibility of the customer and/or customer’s telecommunications system contractor to determine precise parts needs and specifications that will support the work environment’s equipment requirements.

Extender Rings

The inside clearance within the Cetra panel base wireway and mid-wireway may be insufficient for some types of communications access ports. Extender rings — which fasten to access ports on the outside of the wireway cover — can be used to provide the necessary additional clearance (Figure A).

Voice/Data Cable Connections

The inside clearances and communications wireway cover openings of the Cetra panel system are designed to be compatible with AMP brand-name communications access ports. However, some AMP models can be attached to the wireway covers of non-electrified panels only.

Figure B depicts the access port for a fiber optic cable connection; Figure C depicts the access port for a configuration of two BNC coaxial cable connectors and one RJ-type connector.
Communications
Cable Management

The Cetra panel system provides three types of wire/cable management products that can be mounted vertically or horizontally. These wire/cable managers neatly store excess wires and cables, and they also offer additional wire/cable routing flexibility along the exterior of Cetra panel configurations.

**Vertical Wire/Cable Management Products**

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Finish</th>
<th>Length</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVCM165B</td>
<td>Black</td>
<td>16 1/2&quot;</td>
<td>Undersurface, or under an overhead</td>
</tr>
<tr>
<td>AVCM165</td>
<td>Fabric-covered</td>
<td>16 1/2&quot;</td>
<td>(when the overhead is mounted 2&quot; below the top of a 68&quot;-high panel).</td>
</tr>
<tr>
<td>AVCM185B</td>
<td>Black</td>
<td>18 1/2&quot;</td>
<td>Undersurface, or under an overhead</td>
</tr>
<tr>
<td>AVCM185</td>
<td>Fabric-covered</td>
<td>18 1/2&quot;</td>
<td>(when the overhead is mounted flush with the top of a 68&quot;-high panel).</td>
</tr>
</tbody>
</table>

The vertical wire/cable manager (Figure A) mounts in the Cetra panel’s reveal. It is used primarily for power cord management under the worksurface, or beneath an overhead to store task light power cords.

**Horizontal Wire/Cable Management Products**

There are two types of horizontal wire/cable managers: the undersurface wire manager and the worksurface wire manager. The trough-shaped undersurface wire manager (Figure B) mounts beneath worksurfaces to provide wire/cable storage. The worksurface wire manager (Figure C) is attached to the back edge of the worksurface; it features a flexible top edge and a rigid bottom edge with 3" cutouts spaced every six inches.

**Notes:** The worksurface wire manager is a component of a worksurface specification.
Showrooms:
Atlanta, Georgia
404.231.4950
Boston, Massachusetts
617.345.0606
Chicago, Illinois
312.644.8144
Dallas, Texas
214.969.9089
Denver, Colorado
303.722.0285
Jasper, Indiana
800.482.1616
Newport Beach, California
714.509.8600
New York, New York
212.753.6161
San Francisco, California
415.288.0640
Seattle, Washington
206.224.7474
West Hollywood, California
310.659.1543
London, England
171.224.3223
Dartmouth, Nova Scotia
902.468.6708
Toronto, Ontario
416.977.0987
Winnipeg, Manitoba
204.957.1676