GLOSSARY OF TERMS

10 BaseT – 10Mbit/s transfer rate.

100 Base TX – 100 Mbit/s transfer rate.

1000 BaseT – 1000 Mbits/sec transfer rate.

ACCELERATED AGING – A connector test in which temperature, voltage, current, or other parameters are increased beyond the normal operating values to observe deterioration in a relatively short period of time.

ACCESSORIES – Auxiliary devices such as cable clamps, endbells, gaskets, or any number of mechanical hardware devices that can be added to a connector.

ADAPTER – A device which enables the interconnection of two dissimilar connectors and/or mechanically allows the connection of unique accessories. Some adapters are actually connectors in themselves and allow the user to mate the adapter with one half of a connector and then mate a different type of connector to the adapter effecting a transition. These types of adapters are common in RF and audio connectors. Other adapters are purely mechanical and allow the use of unique accessories or allow for special mounting configurations.

AEM – A connector insulating material which will not emit halogen (toxic) gases when exposed to flame. Referred to as a ZERO HALOGEN insulator. See HALOGEN.

AEX – Marking that states the equipment is approved and conforms to NEC standards.

ALLOY – A composition of two or more elements, of which at least one is a metal. In connector applications it is usually a combination of metals which is used to create an alloy superior in performance to any of its individual components.

ALTERNATE INSERT POSITION – See ROTATION.

ALTERNATING CURRENT – A flow of electricity which reaches a maximum in one direction, decreases to zero, then reverses itself and reaches maximum in the opposite direction. This cycle is repeated continuously. The number of such cycles per second is the frequency. The average value of the voltage during any cycle is zero. Abbreviated ac.

AMBIENT TEMPERATURE – The temperature of the environment surrounding the connector. Usually the air. Normally used as the reference when specifying the **OPERATING TEMPERATURE** range of the connector.

AMP – Abbreviation for ampere.

AMPERE – A unit of electrical current or rate of flow of electrons. One volt across one ohm of resistance causes a current of 1 ampere.

ANODIZE – A protective, insulating oxide layer formed on a metal by electrolytic action. Occasionally used as the outer most layer in connector plating, anodize is a very tough, non-conductive plating.

APIN CONTACT – (See Pizza Bone)

ARC – A luminous discharge of electricity through a gas. In connector usage, this is an extremely undesirable discharge through the air across two or more contacts or the contacts and the shell. This is usually the result of operating the connector beyond it's capabilities. Arc discharge is characterized by a relatively low voltage drop, a high current density, and the high probability that the connector and related circuitry will be damaged as a result.

ASTM B211 – Specification standard for Aluminum and Aluminum-Alloy Rods, Bars, and Wires.

ATMOSPHERE – The unit of pressure defined as the pressure of 760 mm mercury at 0o C. Approximately 14.7 pounds per square inch.

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AWG – American Wire Gauge. A standard for wire diameters based on the approximate circular mil area of the wire. As numbers get larger, wire diameters decrease in size (a size 16 AWG wire has a larger diameter than a size 22 AWG).

B22 6061-T6 Aluminum – Precipitation hardening aluminum alloy.

BACK MOUNTING – See REAR MOUNTING.

BACK-END TERMINATION – See ENDBELL.

BACKSHELL MOLD – See POTTING CUP.

BANDING – Visual stripes of color used for distinguishing different parts.

BAR – A centimeter-gram-second unit of pressure (force exerted on a unit of area) equal to 1,000,00 dynes per square centimeter. Formerly known as microbar. Its symbol is b.

BASE METAL – The metal which the connector or connector component is made and over which various platings will be deposited.

BAYONET COUPLING – A quick coupling mechanism for mechanically mating and unmating connector halves. The plug half has a coupling nut with internal ramps and the receptacle has three "bayonet" pins. The two halves are mated and unmated by rotating the coupling nut. A REVERSE BAYONET COUPLING reverses this arrangement, with the ramps on the receptacle and the bayonet pins or roller bolts under the coupling nut.

BERYLLIUM COPPER – An alloy of copper used to make contacts. It is relatively expensive, but has superior spring quantities, is resistant to fatigue, and can operate at higher temperatures than other materials such as phosphor bronze. It is used when numerous insertion and extraction cycles are required.

BEZEL – A holder or flange designed to receive and position a lens or window in an electronic component such as an indicator assembly.

BIFURCATED CONTACT – A contact design in which the metal of the mating tube is slotted lengthwise to create two independent spring elements.

BODY – The main portion of the connector made of the shell, insulator, and contacts.

BOOT – A rear accessory, usually made of a resilient material, which is used around a multiconductor cable to add additional insulation, strength, abrasion resistance, or sealing. Also see SHRINK BOOT.

BRAID – A woven metal tube used as shielding around a wire or a group of wires. In a flattened form, it is used as a grounding strap.

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BREAKDOWN – An electrical discharge through a connector insulator or insulation on a wire. A catastrophic failure mode.

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CABLE CONNECTING RECEPTACLE – Unlike most receptacles which are designed for panel mounting, a cable connecting receptacle is for in-line use. It does not have a flange or jam nut for panel mounting, but does have rear threads to accept an endbell.

CABLE RECEPTACLE – See CABLE CONNECTING RECEPTACLE.

CABLE SEAL – An endbell or cable clamp that is used to seal a round jacketed cable as it enters the rear of the connector. Examples would be a Gland Seal Endbell or an MS3057-C cable clamp.

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insulator into which the contacts fit. The cavities are generally marked with a unique designation or number for ease of identification.

CONTACT INSPECTION HOLE – See INSPECTION HOLE.

CONTACT RESISTANCE – The maximum amount of resistance which a contact introduces into the connection when carrying a specified current (usually stated in milliohms). When not stated, values are typically given for "Initial" or new contacts. Most specifications also limit the maximum resistance during or after each of a series of extreme tests, such as "Contact Resistance After Corrosion Test". These figures are typically slightly higher than "Initial". Also see POTENTIAL DROP.

CONTACT RETENTION – The maximum allowable axial load which can be applied to a contact from either direction without it being dislodged from the insulator. Usually stated in Newtons or pounds of force.

CONTACT SEPARATION FORCE – The force required to separate a pair of mated contacts. Usually stated in Newtons or pounds of force.

CONTACT SIZE – This usually relates to the maximum size wire this contact can nominally accommodate. It is based on that AWG size most closely corresponding to the circular mil area of the engaging end of a pin contact. For example, a size 16 contact can accommodate a size 16 AWG wire maximum and the pin corresponds to the CMA of a size 16 AWG. Note, however, that oversized crimp pots are available for some crimp contacts which will allow, for example, a size 16 contact to accommodate a size 14 AWG wire.

CONTACT SPACING – The distance between two centers of adjacent contacts.

CONTINUITY – An unbroken conductive path for electrical energy.

COUPLING – There are three common methods of mechanically coupling circular connectors, all three are represented in this catalog. Coupling can be made with threads (as in the CT series), three pin bayonet (as in TRIDENT and KPT/ KPSE) or ramps (as in the CB and CR series).

COUPLING NUT – The rotating ring on plug style connectors which mechanically locks the two connector halves together. Coupling nuts may function by means of internal threads, roller wheels, pins, or internal bayonet ramps. Also known as a coupling ring.

COUPLING RING – See COUPLING NUT.

COUPLING TORQUE – Torque is rotational force, usually stated in Newton-meters or Foot-pounds. In the coupling of connectors it is normally used to give the maximum or minimum force which should be applied to the coupling nut when mating and unmating the two connector halves.

CPS – Cycles per second.

CREEPAGE – The conduction of electricity across the surface of an insulator.

CREEPAGE DISTANCE – The shortest distance between contacts of opposite polarities, or between a live contact and ground, measured over the surface of the insulator.

CREEPAGE PATH – A path across the surface of the insulator between two conductors. Lengthening the path reduces the possibility of arc damage.

CRIMP – A method of attaching a contact to a wire through the application of pressure.

CRIMP CONTACT – A contact which is terminated to a wire by means of crimping with an appropriate die and tool. After termination, an insertion tool is normally used to insert the crimped contact into the connector. Removable crimp contacts can be FRONT RELEASE or REAR RELEASE. A removal tool is usually required to remove the contact.

CSA – Abbreviation for Canadian Standards Association.

CURRENT – The movement of electrons through a conductor. Current is measured in amperes. It's symbol is I.

CURRENT RATING – The maximum current that a particular wire, contact, or connector can accommodate. NOTE: When several wires are used in a single connector or elevated temperature or altitude is involved, derating curves must be applied to these ratings. A typical derating system is MIL-W-5088 which allows the user to calculate the derating effects of current, ambient temperature, number of wires in the bundle, and altitude.

DB – Abbreviation for DECIBEL.

DEAD FACE - See DEAD FRONT.

DEAD FRONT – The mating surface of a connector which is designed so that the conductive elements, such as the contacts, are physically recessed in the insulator to avoid shorting or shock hazard.

DECIBEL – A standard unit of measure for transmission gain or loss. It expresses the ratio of power input to power output. Abbreviated DB. The term DBm is used when 1 milliwatt is the reference level.

DERATING – To reduce the voltage, current, or power rating of a connector to improve its reliability or to permit operation at high ambient temperatures or altitudes.

DERATING CURVE – A graph of the change in power handling capability of a connector as a function of ambient temperature or altitude. Typically the graphed function is curved, hence the name.

DIALLYL PHTHALATE – A thermosetting plastic used for insulators and some types of connector housings. It has outstanding resistance to chemicals, excellent dimensional stability, and superior electrical insulating properties.

DIE CAST – Process to shape molten metal in a mold cavity under high pressure.

DIELECTRIC – An insulator used to isolate two conductors.

DIN - Abbreviation for Deutsche Industrie Norm, a German standards organization.

DIN 5510-2 – German Approval for non-metallic materials to be used in rail vehicles in, with respect to smoke gas emissions from burning.

DIN EN 60526 – A standard used on high voltage connectors being used in medical X-ray equipment.

DIRECT CURRENT – An essentially constant value of current that flows in only one direction. Abbreviated dc.

DRAIN WIRE – In a foil shielded cable, the drain wire is an uninsulated wire which runs the length of the cable making intimate electrical contact with the inside of the foil. Since it would be difficult to directly terminate the fragile foil shield, the drain wire is used to terminate the shield by either soldering or crimping the drain wire to a ground termination.

DUMMY RECEPTACLE – A receptacle shell which takes the place of a working receptacle and is used to fill an empty connector mounting hole or to provide a location to mate an unused connector. A dummy receptacle has no contacts and no insulator and thus provides no electrical function.

DUST CAP – A cover used in place of a mating connector to seal it against dirt and moisture. Usually secured to the connector by a captive chain, wire, or rope.

DYNE – The standard centimeter-gram-second unit of force, equal to the force that produces an acceleration of one centimeter per second per second on a mass of one gram. Its abbreviation is dyn.

EEX – Marking that states the equipment is approved and conforms to Cenelec standards.

ELECTROPLATNG – To deposit a metal on the surface of a conductor using electrolysis.

EMC SHEILDING – Electromagnetic Compatibility shielding. Shielding from electromagnetic disturbances.

EMI/RFI – Electro-Magnetic Interference and Radio Frequency Interference. This is unwanted stray electronic radiation which may enter, and/or be emitted by a electronic system. The most common method of shielding interconnections against this radiation is to use wires with a metallic braided shield and a connector system which will extend the shield through the interconnection. This type of design will keep radiation from entering, or being emitted by the system. Endbells for shielded cable and connectors with threads or grounding fingers are typically used for this purpose. Call for the specific EMI/RFI accommodations of the connectors in this catalog.

EN – Abbreviation for Euro Norm. A European market-wide product standard.

ENDBELL (also known as BACKSHELL) – The outer rear end of the connector which is attached by means of internal threads or screws. It adapts the connector to its wire connections in a variety of ways. Typical endbells might have cable clamps to secure a wire bundle, ridges for heat shrink tubing, pipe threads, or shield termination mechanisms. Endbells may be straight, right angle, or 45 degree.

ENVIRONMENTALLY SEALED – A connector which uses seals, gaskets, O-rings, potting, or other devices to prevent moisture, dirt, air, or other contaminants from entering and degrading its performance.

ERGONOMIC – Maximum comfort without injury or stress.

ETHERNET – A system used to connect multiple computer systems on a local area network

ETSI – Abbreviation for European Telecommunications Standards Institute. A group which deals with telecommunications standards at the European level, corresponding to the ITU at the international level.

EU – Abbreviation for European Union. A group of European community nations. In practice, they typically adopt standards set by the ISO, IEC, and ITU.

EX APPROVAL – Symbol to identify approval by the ATEX directive.

EXTRACTION TOOL – A device used to remove a (removable) contact from a connector insulator. The extraction tool may be inserted into the mating face of the insulator (FRONT RELEASE) or the wire side (REAR RELEASE). In either case, the contact comes out the rear, or wire side, of the connector.

F – Abbreviation for Fahrenheit.

FAHRENHEIT – A temperature scale in which the freezing point of water is defined as 32 degrees and the boiling point is 212 degrees at normal atmospheric pressure. See the conversion tables for converting Fahrenheit to Celsius.

FAILURE MODE – The manner in which a failure occurs, including the operating conditions of the connector at the time of failure.

FEMALE CONTACT – See SOCKET CONTACT.

FERRULE – A bell shaped ring which is placed over a WIRE SEALING GROMMET to provide uniform axial compression of the grommet and to minimize the transmission of torque to the grommet when the endbell is screwed on to the rear of the connector. Ferrules are a part of the sealing mechanism at the rear of a connector. Ferrules are normally a separate component part of the connector although some endbells have integrated ferrules. Ferrules are usually made from a thermoplastic material, but occasionally ferrules are made of metal.

FINISH – See PLATING.

FIREWALL – A wall or separation used to prevent fire from spreading. Also part of a computer network security system that blocks unauthorized users.

FIREWIRE – High speed serial bus communication interface. Also known as an IEEE 1394 interface.

FIRST-MAKE LAST-BREAK CONTACT – A contact which is longer than a standard contact or which sits in the insulator in such a way that it mates with the opposing connector half before any of the other contacts. Used to insure that a ground connection between the connector halves mates before, and breaks after, any of the other contacts.

FLAMEPROOF – Flame-retardant, resistant to catching fire.

FLANGE – A square mounting flange with four mounting holes for bolting the connector to a panel. The mounting holes may be clearance holes or threaded.

FLANGED RECEPTACLE – The shell of this connector has a square flange with mounting holes at each corner. Mounting holes are usually clearance holes, but may be threaded. Flanged receptacles can usually be front or rear panel mounted depending upon panel thickness. Some connectors have two different versions, one for front mounting, and one for rear panel mounting. As known as a Box Mount or Wall Mount.

FLASH – 1. As commonly used in connector terminology, flash refers to extremely thin platings of metal, for example: gold flash is a very thin plating of gold. So thin, that the thickness is generally not specified. 2. A defect in the molding process or omission of a secondary operation such that undesirable rough edges remain on the connector from the mold gate or seam.

FLASH PLATING – See FLASH (1).

FOLLOWER – See FERRULE.

FOOT-POUND – A unit of measurement equivalent to the work of raising one pound vertically a distance of one foot.

FRONT MOUNTING – A receptacle that can only be mounted to the front of a panel with it's mounting FLANGE outside the equipment.

FRONT RELEASE - For crimp type removable contacts, front release means that the appropriate extraction tool is inserted from the front, or mating face, of the connector. The contact is then pushed out the rear (wire side) of the connector.

g – The international unit for the acceleration of a falling body in the earth's gravitational field, inversely proportional to the square of the distance from the body to the center of the earth. 1g = 32.17 feet per second per second. Connectors are frequently tested by subjecting them to very short duration shocks which are several times the force of gravity while simultaneously confirming electrical continuity.

GAS TIGHT – The mating of two contact surfaces which are so tight that corrosive gasses can not enter the joint.

GEESC – General Electrotechnical Engineering Standards Committee. A European organization which sets standards for electrical devices.

GERMAN LLOYD – Germanischer Lloyd, German electrical safety standards.

GLAND SEAL – Usually part of an endbell, a gland seal is a resilient element which is compressed around a cable jacket by means of a compression ring. When the proper diameter wire is used and the compression ring is tightened to specifications, the gland creates an air and moisture tight seal around the cable jacket.

GOLD – A precious metal which is more conductive than silver or copper. Because it does not corrode and is highly conductive, it is used as a plating for contacts. It's chemical symbol is Au.

GROMMET – See WIRE SEALING GROMMET.

GROMMET CAVITY – A defined hole in the WIRE SEALING GROMMET through which the wires are passed. The cavities are generally marked with a unique designation or number for ease of use.

GROMMET SEAL – See WIRE SEALING GROMMET.

GUIDE PIN – A special pin which is inserted into a socket contact before the contact can be inserted into the connector insulator. Guide pins provide a rounded surface at the front of the socket and greatly aid in pushing the contact into the insulator thus avoiding damage to both the insulator and the contact. Typically, small size socket contacts require the use of guide pins while larger sizes can be inserted without them.

HALOGEN – A general name applied to four chemical elements, fluorine, chlorine, bromine, and iodine, that have similar chemical properties. As it applies to connector insulating materials, these elements are all high toxic to humans when burned.

HARNESS – A group of wires or cables bundled together with attached connectors and/or components in a preshaped assembly.

HEAT SHRINK ENDBELL – An endbell specifically designed to allow heat shrink boots or heat shrink tubing to be applied over it and insure a good bond.

HE308 – a European Specification used for the D38999 Series I type connector and inserts.

HEAT SHRINK BOOT – A plastic made of nylon or polyolefin which shrinks when heated to provide insulation and environmental protection from wires.

HERTZ – International unit of frequency equal to one cycle per second. That is, 20,000 Hz is 20,000 cycles per second.

HIGH VOLTAGE – A voltage that could cause damage or injury.

HYSOL – An Epoxy Resin used as a potting compound.

Hz – Symbol for Hertz, an International unit of frequency equal to one cycle per second. That is, 20,000 Hz is 20,000 cycles per second.

I.D. – Abbreviation for inside diameter.

IDC RECEPTACLE – A receptacle that has been approved with an Industrial Development Certificate.

IEC – Abbreviation for the International Electrotechnical Commission. An international organization that develops standards exclusively for electrical engineering. CENELEC is the equivalent organization at the European level.

IEC ZONE – International Electrotechnical Commision which sets standards for zones in which gas leak and/or explosions could occur.

INITIAL – A test result taken prior to any other environmental testing. For example, contact resistance is frequently specified "Initial" , that is, with "new" contacts. Most specifications also limit the maximum resistance during or after each of a series of extreme tests, such as "Contact Resistance After Corrosion Test". These figures are typically slightly higher than "Initial".

IN-LINE RECEPTACLE – See CABLE CONNECTING RECEPTACLE.

INDENTOR – The part of a crimping die which indents the contact barrel to form the actual crimp. Indentors normally make six or eight multiple indention's for each crimp.

INDIVIDUAL WIRE SEALING GROMMET – See WIRE SEALING GROMMET.

INSERT – See INSULATOR.

INSERT ARRANGEMENT – See LAYOUT.

INSERT RETENTION FORCE – The maximum allowable force which should be applied to the face of the insulator without dislodging it from the shell or causing any change in connector performance specifications. Usually stated in Newtons or pounds of force.

INSERTION FORCE – The effort, usually stated ounces or Newtons, required to engage two contacts or connector halves.

INSERTION TOOL – A device used to insert a contact into a connector insulator.

INSPECTION HOLE – A small hole in a crimp contact barrel. A properly crimped contact will allow the user to see the bare wire through the inspection hole. This is verification that the wire is fully seated in the crimp barrel.

INSULATION – A material which has high electrical resistance and is suitable for covering or encasing electrical components to prevent a short circuit.

INSULATION DISPLACEMENT CONNECTOR (IDC) – A connector contact with sharp tines which pierce and displace the wire insulation and make direct electrical connection with the conductor. Normally used with multipin connectors which must be terminated to flat cable. This is a fast, low cost method to terminate many conductors simultaneously.

INSULATION GRIP – See INSULATION SUPPORT.

INSULATION RESISTANCE – The minimum resistance (usually stated in Megohms) between adjacent contacts and between the contacts and the shell at a specific voltage. When not stated, values are typically given for new insulators. Most specifications also specify minimum resistance figures during or after each of a series of extreme tests, such as "Insulation Resistance During Dry Heat".

INSULATION SUPPORT – An extended portion at the rear of a crimp contact that is crimped around the wire insulation to provide extra strain relief. This crimp is in addition to the crimp over the conductor which provides the actual electrical termination.

INSULATOR – The insulating element into which the contacts are mounted in a connector. This can be a resilient material, thermoplastic, or a thermoset compound, among other materials.

INSULATOR POLARIZATION – See INSULATOR ROTATION.

INSULATOR ROTATION – A method of differentiating a circular connector if more than one connector with the same sex and layout is to be used in a system. The insulator is permanently positioned in the shell so that only a connector with the same degree of rotation can be mated with it. Possible rotations are specific to each layout with some layouts having many possible rotations and others having none. A chart of valid rotations is listed by layout for connectors capable of being rotated. Most connector series use the military convention of assigning letter designations for specific degrees of rotation (for example: W, X, Y, Z). Also see KEYING.

INTERCHANGEABLE – The characteristic of connectors in which a connector half of one manufacturer or series will directly replace that of another manufacturer and provide the same electrical and mechanical function.

INTERFACIAL SEAL – The sealing of mated connectors over the entire face of the mating insulators when the two connector halves are mated. Usually done by employing resilient insulators.

INTERMATEABLE – The characteristic of connectors in which a connector half of one manufacturer or series will mate directly with the connector half of another manufacturer.

INTERMITTENT – Occurring at intervals. A connection which passes electrical current only in random or undesirable intervals.

INTERMOUNTABLE – The characteristic of connectors in which one manufacturer's connector or series will mount in exactly the same panel space and mounting holes as another manufacturer's.

INTRINSIC – A natural or essential property of a system that occurs within.

IP40 – Protect against granular foreign objects.

IP54 – Protected from dust and splashing water.

IP65 – One classification from a rating system used in Europe covering the environmental sealing capability of a connector or enclosure. The system uses two digits, the first digit relates to the degrees of protection the connector has from dirt and dust under the conditions defined in the specification. The second digit relates to the degrees of protection it has against moisture. The degree of protection against dirt ranges from 1 (no protection), to 6 (dust tight). Moisture sealing in the specification ranges from 1 (no protection), to 8 (protected against continuous submersion). The classification IP65 states that the connector is "dust-tight" (6), allowing no ingress of dust what-so-ever, and "protected against water jets" (5), water projected by a nozzle against the connector from any direction shall have no harmful effect.

IP67 – One classification from a rating system used in Europe covering the environmental sealing capability of a connector or enclosure. The system uses two digits, the first digit relates to the degrees of protection the connector has from dirt and dust under the conditions defined in the specification. The second digit relates to the degrees of protection it has against moisture. The degree of protection against dirt ranges from 1 (no protection), to 6 (dust tight). Moisture sealing in the specification ranges from 1 (no protection), to 8 (protected against continuous submersion). The classification IP67 states that the connector is "dust-tight" (6), allowing no ingress of dust what-so-ever, and "protected against the effects of immersion" (7), the ingress of water in harmful quantity shall not be possible when the connector is immersed in water under defined conditions of pressure and time.

IP68 – complete protection from dust, and immersible beyond 1m.

IP69 – One classification from a rating system used in Europe covering the environmental sealing capability of a connector or enclosure. The system uses two digits, the first digit relates to the degrees of protection the connector has from dirt and dust under the conditions defined in the specification. The second digit relates to the degree of protection it has against moisture. The degree of protection against dirt ranges from 1 (no protection), to 6 (dust tight). Moisture sealing in the specification ranges from 1 (no protection), to 8 (protected against continuous submersion). The classification IP69 states that the connector is "dust-tight" (6), allowing no ingress of dust whatsoever, and "protected against the effects of high pressure steam washing" (9), the ingress of water in harmful quantity shall not be possible when the connector is subjected to high pressure steam washing under defined conditions of pressure and time.

IP RATING – Ingress Protection Rating, describes degrees of protection from objects and water. Used for electrical and mechanical enclosures.

ISO – Abbreviation for the International Organization for Standards. A group that operates at the international level and sets most standards for industry, with the exception of electrical engineering and telecommunications which are set by the IEC and ITU respectively. CEN is the equivalent organization at the European level.

ITU – Abbreviation for International Telecommunications Union. A group which sets international standards for telecommunications. ETSI is the equivalent organization at the European level.

JACKET – The outermost layer of insulation in a cable composed of several wires.

JACKSCREW – A screw attached to one half of a connector pair used to mechanically align, draw them together, and lock them in place.

JAM NUT – See JAM NUT RECEPTACLE.

JAM NUT RECEPTACLE – A top-hat shaped connector (the top of the hat being the mating surface). It is mounted into a round panel hole from the rear. The "brim of the hat" prevents the connector from falling through the hole. A large hex nut (jam nut) is screwed on to the front of the connector to secure it to the panel. Typically, the upper "brim" of the hat contains an O-ring which seals the connector to the panel.

JN1003 – Circular multi-pin connectors to use on Eurofighter Typhoon Aircrafts.

KEY – A mechanism used to polarize connectors by the user. See KEYING.

GLOSSARY OF TERMS

KEYING – A method of differentiating a connector if more than one connector with the same sex and layout is to be used in a system. The key is usually a pin or other projection which can be located in a contact cavity or slot. The key will prevent a connector without a matching orifice from mating. Keying and POLARIZATION serve the same function, but keying can be done by the user, while polarization is manufactured into the connector and normally can not be altered by the user.

LACING CORD – Several types of cord or ribbon which can be used to tie a group of wires into a bundle or harness.

LAMBDA – Greek letter used to designate wavelength measured in meters.

LANYARD RELEASE – A plug connector with a wire or cable handle (lanyard). The plug can be separated from the receptacle by an axial pull on the lanyard.

LAYOUT – The number, size, and geometric arrangement of the contacts in a connector. When a connector is said to have a certain "layout" it refers to a specific contact configuration. For example, the KPT/KPSE series has a page of drawings showing the arrangement of the contacts in the insulator. Each of these arrangements can be referred to as a layout.

L.E.D. – Abbreviation for light emitting diode. A solid state light source which may emit visible light or light of a higher or lower frequency. One application is for very long life, shock resistant lighted indicators.

LEVELS OF INTERCONNECTION – A system of classifying interconnection devices into one of six categories. Level 1 is chip to lead. It covers interconnections used inside of integrated circuits and passive devices to connect the internal elements to the leads on the device package. Level 2 is device to board. It covers the interconnection of PC mounted parts to the printed circuit board. Level 3 is Board to Backplane. It covers the direct interconnection of PC boards. Level 4 is Board to board. It covers interconnections between circuit boards within the same enclosure. Level 5 is board to box. It covers interconnection of circuit board to the I/O of the equipment. It forms the system interconnection to the outside world. Level 6 is System to System. It covers external connections of one system to another, for example an interconnection of a computer to it's CRT terminal would be a Level 6 interconnect.

LOCATOR – A part of a crimping tool TURRET. Rotation of the locator sets the tool for a particular size or sex contact. Also see TURRET.

LOCK WIRE – A mechanical means of securing a mated pair of threaded connectors. A wire is passed through a hole in the coupling nut and then secured to the shell, endbell, or other surface. Using this technique, the coupling nut can not be removed without cutting the lock wire. Lock wires are used to provide additional vibration resistance or to minimize the possibility of tampering with the connector. Lock wires are unnecessary with bayonet style connectors.

LOW SMOKE ZERO HALOGEN – Cable jacketing that produces small amounts of smoke and no halogen when in environments of high heat or flames.

MALE CONTACT – See PIN CONTACT.

MARINE BRONZE – Designed for marine applications due to its antimicrobial and algaecidal properties, as well as being corrosion resistant.

MATING LIFE – The minimum number of times a connector can be mated and unmated and still meet all of its design specifications. The maximum life may be much higher than this figure.

MEAN TIME BETWEEN FAILURES – The limit of the ratio of operating time of a connector to the number of observed failures as the failures approach infinity. Abbreviated MTBF.

MICRON – A unit of length equal to 10-6 meters (.001 millimeters).

MIL – One thousandth of an inch (.001). Used in the United States as unit of length in wire diameters and linear dimensions.

MIL-SPEC – Abbreviation for Military Specification.

MILLI – Prefix meaning one-thousandth (1/1000, .001, or 10-3) Abbreviated m.

MILLIAMP – Abbreviation for milliampere.

MILLIAMPERE – One one-thousandth (.001) of an ampere. Abbreviated mA.

MILLIMETER – Metric unit of linear measure. 1 millimeter = .03937 inches.

MILLIOHM – One one-thousandth (.001) of an ohm.

MILLISECOND – One thousandth of a second (.001). Abbreviated ms.

MILLIVOLT – One thousandth of a volt (.001). Abbreviated mV.

mm – millimeter. See MILLIMETER.

mm^2 – Millimeters squared. A standard for wire diameters used in Europe instead of AWG. As numbers get larger, wire diameters increase in size. The relationship between mm2 and AWG is reverse logarithmic. 1 mm2 = 1973 circular mils. A conversion graph is needed to make accurate comparisons between AWG and mm2. Call for assistance.

MOUNTING CLIP – Any of a variety of mounting accessories used to secure a connector or connector pair to a rigid surface.

MOUNTING FLANGE – See FLANGE and FLANGED RECEPTACLE.

MS – 1. Abbreviation for Millisecond. 2. Abbreviation for Military Specification.

MTBF – Abbreviation for mean time between failures.

MULTI-CONDUCTOR CABLE – Two or more individual wires surrounded by a jacketing material.

N – See NEWTON.

NANO – One billionth (10-9). Abbreviated n.

NAPKIN RING – One of several designs used for screw machine socket contacts. A band of plated conductive metal is formed around a circumferential cut or opening in the mating portion of contact. This creates a zone of mechanical and electrical continuity between the mated contacts.

NEC – National Electrical Code which contains regulations governing construction and installation of electrical wiring apparatus in the United States.

NEC DIVISION – National Electric Code sets national standards for areas where hazardous gases and/or explosions could occur.

NEMA – Abbreviation for National Electrical Manufacturer's Association. An organization of manufacturers of electrical products that sets various standards for electrical devices. NEMA ratings for degrees of protection against environmental contamination for electrical devices is roughly equivalent to the IP rating system in Europe.

NEMA 4X – U.S. specification in the protection of light splashing liquids, dripping, dirt, dust, lint, and fibers.

NEST – The portion of a crimping die that supports the contact barrel during crimping.

NEWTON – A unit of acceleration. One Newton is the force capable of accelerating 1 kilogram to one meter per second per second. 1 pound force = 4.448221 Newtons.

NEWTON-METERS – A unit of measure for rotational acceleration. 1 Nm = .7376 Foot Pounds.

NF22Q100 – A type of Quadrax Cable.

NF24Q100 – A type of Quadrax Cable.

NF26Q100 – A type of Quadrax Cable.

NFF 16-101 – French Approval for non-metallic materials to be used in rail vehicles in, with respect to smoke gas emissions from burning.

Nm – See NEWTON-METERS.

NPT – National Pipe Thread. A standard system of threads used for pipe.

O.D. – Abbreviation for outside diameter.

OHM – The unit of electrical resistance. One ohm is the value of resistance through which a potential difference of one volt will maintain a current of one ampere. Its symbol is the Greek letter omega.

O-RING – A donut shaped ring of rubber used as a seal around the periphery of connectors and connector accessories to form an air, dirt, and moisture tight seal.

OPEN CRIMP CONTACT – Contact which has an opening that remains open untill crimped to the wire.

OPERATING TEMPERATURE – The range of AMBIENT TEMPERATURES over which the connector can operate and still meet all of it's design specifications.

OPERATING VOLTAGE – The range of voltages over which the connector can be operated. Safety precautions must be taken anytime a voltage in excess of 50V is to be used in a circuit. Check your local and national codes for guidelines.

OUTGASSING – The circumstance in which an insulator releases gasses trapped within it under a vacuum or conditions of decreased pressure, high heat, or both.

PANEL – The outside surface of a piece of equipment on to which connectors are mounted. The panel is usually made of metal.

PANEL MOUNT – A connector designed to be mounted on a panel by means of screws or jam nut.

PAIRED CABLE – A cable in which all of the conductors are arranged in the form of twisted pairs.

PASSIVATED – Plating that allows the surface to be "passive" or unreactive.

PC CONNECTOR – A connector with PC contacts.

PC CONTACT – A pin or socket contact that has a post opposite the mating end which is intended to be soldered directly to a printed circuit (PC) board instead of being terminated to a wire. The solder post may come in a variety of diameters and lengths.

PC PIN – See PC CONTACT.

PERIPHERAL SEAL – A resilient seal used to keep moisture from entering the connector at the point where the plug and receptacle shells meet. A common method is to use flat gaskets on receptacles and O-rings on plugs.

PHOSPHOR BRONZE – An alloy of copper, tin, and phosphorus used to make spring contacts. It typically used in lower cost contacts where frequent insertions and withdrawals and high temperatures are not a factor.

PIGGY BACK GROMMET – A sealing component which captures a smaller cable OD, an addition to Twinax or Quadrax contacts.

PIN – A male contact. See PIN CONTACT.

PIN CONTACT – The contact which has a long shaft at the engagement end which enters the socket contact.

PIZZA BONE – The uneaten, discarded pieces of crust from the outside edge of a slice of pizza.

PLATING – The metallic coatings used on contacts and metal connectors. These are thin layers of metal designed to improve conductivity, solderability, or to resist corrosion. Typical contact finishes are gold or silver. Typical shell finishes are olive drab over cadmium, electroless nickel, or black anodize.

PLUG – The male portion of the connector pair usually employing a coupling nut to secure it to the receptacle half. A Plug may have either pin or socket contacts.

POLARIZATION – A mechanical mechanism that allows connector halves to intermate in only one specific orientation. This can be accomplished by asymmetrical shapes of the two halves as in a D-Subminiature connector, insulator rotation, keys, keyways, ramps, or other means. Polarization prevents connectors of the same size and/or same layout from intermating when this is undesirable, such as when two otherwise identical connectors are used on the same panel. Polarization is typically done by the assembler and can not be changed by the user, while keying is typically done by the user with an auxiliary keying device.

POLARIZING PIN – See KEY.

POLARIZED BACKSHELL – An ENDBELL with "TEETH" for positioning the endbell.

POSITION – See INSULATOR ROTATION.

POTENTIAL – The difference in voltage between two points in a circuit. Frequently one point is assumed to be ground, which has zero potential.

POTENTIAL DROP – The difference in potential between two ends of a resistance with a current flowing through it. In connector specifications it is the maximum amount of voltage drop in millivolts (or resistance in milliohms) which a contact introduces into the connection. When not stated, values are typically given for "Initial" or new contacts. Most specifications also limit maximum voltage drop (or resistance) during or after each of a series of extreme tests. These figures are typically slightly higher than "Initial".

POT LIFE – The period after the addition of a catalyst during which the compound can be used.

POTTING – The permanent sealing of a cable to a connector using an insulating material such as potting compound to exclude moisture or provide stain relief. See POTTING CUP.

POTTING COMPOUND – A sealing material used in potting to fill a potting cup.

POTTING CUP – A bell-shaped (plastic) endbell with an enlarged opening for the wires. After the connector is loaded with wired contacts, the potting cup is attached to the rear of the connector. The inside of the cup is then filled with a potting compound. When the compound hardens, it forms a solid, permanent, watertight mass around the wires.

POTTING RING – A portion of the POTTING CUP which secures the bell shaped cup to the rear of the connector, usually by means of internal threads.

PRESS AND ROLLED – Contact metal is flattened and then shaped into the contact form by rolling the metal into shape.

PRE-TIN – To apply tin-lead solder to contact solder cup and/or conductor prior to soldering the two together.

PULSE-LOK – Plastic, circular, lightweight, ergonomic, water proof, Quick-Release connectors.

QPL'D – High density, glass sealed hermetic subminature connector series.

QUADRAX – High Speed Data contacts which contain an outer contact and four inner contacts.

RACK & PANEL CONNECTOR – A connector made to mount inside a cabinet (rack) which contains electronic modules. These modules have a mating connector half mounted on their rear panels. The modules slide into and out of the rack like a drawer. When fully pushed into the rack, the connector halves self align and mate, connecting the module to the rack system. This arrangement of rack mounted modules makes it easy to quickly interchange modules.

RAMP – A sloped channel that accepts the bayonet pins or roller wheels in a bayonet or reverse bayonet connector. The ramp is part of the mechanism which mechanically locks the two connector halves together.

RANGE – See SEALING RANGE and WIRE RANGE.

RATCHET CRIMP TOOL – A crimping tool with a ratchet mechanism in the handle which will not allow the jaws to open until the crimp dies have closed completely insuring a complete crimp.

REAR MOUNTING – A receptacle that mounts through the panel from the rear, with it's mounting flange inside the equipment. Typically, rear mount receptacles are slightly longer than front mount types to allow for the thickness of the panel. Flange mount receptacles usually come in front and rear mount versions. All Jam nut receptacles are rear mount.

REAR RELEASE – Device in the insulator allowing only the removal of contacts from the rear by an extraction tool.

RECEPTACLE – The connector half that mates with the plug. The receptacle has threads, pins or ramps which engage the coupling nut on the plug, locking the two halves together. A receptacle may have either pin or socket contacts.

REDUCTION SLEEVE – A method of crimping a wire on to a crimp contact when the wire diameter is smaller than that accommodated by contact. The sleeve is inserted into the contact crimp barrel and then the wire is inserted into the sleeve. The contact is then crimped. The sleeve increases the diameter of the wire such that standard crimping tools and contacts can be used.

REMOVABLE CONTACT – A contact which can be inserted and removed from the insulator by the user. Insertion tool and extraction tool are normally required to insert and remove the contact.

REMOVAL TOOL – See EXTRACTION TOOL.

RESISTANCE - That property of a substance which impedes current and results in the dissipation of power in the form of heat. The unit of resistance is the ohm.

REVERSE BAYONET COUPLING – A quick coupling mechanism for mechanically mating and unmating connector halves. The plug half has internal roller bolts or pins and the receptacle has ramps. The two halves are mated and unmated by rotating the coupling nut.

RFI – See EMI/RFI.

RING – See COUPLING NUT.

RJ11 – Registered Jack 11. A cable used for one telephone line.

RMS – Abbreviation for root-mean-squared.

RoHS – ARestriction of Hazardous Substances Directive, Retricts the use of hazardous materials in electrical components. Helps reduce the amount of toxic waste.

ROOT MEAN SQUARE – The square root, of the average of the squares, of the values of a periodic quantity (like alternating current), taken through one complete period. It is the effective quantity of a periodic quantity. Abbreviated rms.

ROTATION – See INSULATOR ROTATION.

SAFETY WIRE – See LOCK WIRE.

SALT SPRAY TEST – A test, or series of tests, in which mated and/or unmated connectors are subjected to salt water under specified conditions. Used to test the connector's resistance to corrosion and any associated degradation in electrical function.

SASH CHAIN – A style of metal chain used to secure a DUST CAP to a connector or panel.

SCOOP PROOF – A connector design which includes an elongated shell to prevent the pin contacts from contacting the mating connector face before they are properly aligned for mating. This eliminates the possibility of damaged pins during mating.

SCREW MACHINE CONTACT – A contact made from a solid bar or rod using screw machine operations. Some screw machine contacts include secondary elements which are welded, crimped, or formed around the basic screw machined part to complete the contact.

SCREW TERMINATION – Connection type where a wire is clamed down to the metal by a screw.

SEAL – There are generally four types of seals associated with connectors. See PERIPHERAL SEAL, INTERFACIAL SEAL, WIRE SEALING GROMMET, and CABLE SEAL.

SEAL PLUG – See WIRE HOLE FILLER.

SEALING RANGE – The sizes of wire insulation diameter accommodated by a connector's individual wire sealing grommet. Also the diameter of a cable jacket accommodated by a gland seal endbell.

SELECTIVE PLATING – The application of metal PLATING to selective areas of the contact, particularly those areas subject to wear. Precious metal platings may be applied selectively to those contact surfaces responsible for the electrical connection, reducing the contact cost without sacrificing electrical performance.

SELF LOCKING PLUG – A plug that automatically locks when closed.

SERIAL FPDP – Serial Front Panel Data Port, is a high speed data protocol.

SERRATIONS – See TEETH.

SERVICE RATING – The service rating is determined by the amount of insulation or creepage distance between contacts. Each layout has a service rating associated with it based upon the operating voltages which can be safely handled by that specific arrangement of contacts.

SEV – Schweizerischer Electrotechnischer Verein, Electrical standards for Switzerland.

SHELL – The outside case of a connector into which the insulator and contacts are situated.

SHELL SIZE – A standard system developed for military circular connectors for indicating the diameter of the shell. The system is based upon 1/16" increments, that is, a size 16 shell is one inch in diameter.

SHIELDED CABLE – A cable or group of wires enclosed within a conductive shield. The shield is normally terminated to ground and minimizes the effects of unwanted electrical energy entering or leaving the cable. Shields are made of braided copper, copper foil, or other conductive overlays. The shield is usually enclosed in an insulating jacket. Also See EMI/RFI. Some connector and connector endbells allow the termination and continuation of the shielding effect through the connector. See SHIELDED CABLE ENDBELL.

SHIELDED CABLE ENDBELL – Endbell with a threaded rear ring designed to captivate the braid of a shielded cable and continue the shielding through the connector.

SHIELDED INTERCONNECT – conductive material in between the cable conductor and the outer jacket. Also could be used to cover the individual conductors.

SHOCK – An abrupt impact applied to a stationary object. It is usually expressed in gravities (g).

SHRINK BOOT – A rear accessory made from various types of insulating materials which shrink when specific temperatures are applied to them. Shrink boots are used to add additional insulation, strength, abrasion resistance, or sealing properties to the connector. Boots are supplied to the user in an expanded form, but return to a predefined shape and size when the appropriate amount of heat is applied to them. Various materials and options are available to meet specific user requirements, such as boots with meltable inner adhesive liners which form a moisture tight mass inside the boot after it has been shrunk.

SILICONE – A group of polymers which are rubbery and extremely stable in high temperatures. silicone is an insulator and is water repellent by nature.

SILVER – A precious metal which is more conductive than copper. Because it does not readily corrode, it is used for contact plating. It's chemical symbol is Ag.

SIRA – Connectors used in Antennas and can be foam filled.

SKID WASHER – A smooth flat washer used to protect the WAVE SPRING from damage.

SLEEVE – A bell-shaped ring that is placed over a WIRE SEALING GROMMET to provide uniform axial compression of the grommet and to minimize the transmission of torque to the grommet when the endbell is screwed onto the rear of the connector. Sleeves are a part of the sealing mechanism at the rear of a connector. Sleeves are normally a separate part of the connector although some endbells have integrated ferrules. Sleeves are usually made from a thermoplastic material but are occasionally made of metal.

SOCKET – A female contact. See SOCKET CONTACT.

SOCKET CONTACT – The contact which has a opening at the engagement end to accept the pin contact.

SOLDER – A melting alloy based of lead, tin, brass, or silver for joining metals together.

SOLDER CONTACT – A contact which is terminated to the wire with solder. Solder contacts are normally bonded into the insulator and can not be removed by the user. The alternative is crimp contacts to which a wire is attached by crimping. Crimp contacts can usually be inserted and removed by the user.

SOLDER CUP – The end of a SOLDER CONTACT designed to accept a wire which will be then soldered to the contact.

STAMPED AND FORMED CONTACT – Contacts made by stamping and forming a sheet of metal rather than by machining metal stock. Also see SCREW MACHINE CONTACTS.

STAR CLIP - One of several designs used for screw machine socket contacts. A tiny plated star shaped clip is captivated inside a solid barrel into which the pin contact fits. The clip creates a multi-point area of mechanical and electrical continuity between the mated contacts.

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STEAM, ETO, & GAMMA STERILIZATION – Cleansed of germs and other microorganisms by Steam under pressure, Ethylene Oxide, or by penetrating Gamma rays.

STERILIZATION – The act of making something free from germs or other microorganisms.

STRANDED CONDUCTOR – A conductor composed of several smaller independent strands.

STRIP – To remove insulation from a conductor.

STRIP FORM CONTACTS – Stamped and formed crimp contacts supplied on a continuous metal strip for use in automated or semi-automated crimping machines.

STRIP LENGTH – The length of conductor which should be exposed from the insulation at the end of the wire prior to terminating to a contact. Using the appropriate strip length guarantees a connection with maximum mechanical strength and a minimum of exposed conductor. NOTE: Correct strip lengths are typically quite short. Care should be taken to use the strip length data in this catalog to prepare wires for termination.

STRIPPER – A tool to remove insulation from a wire.

TEETH – A serrated edge on the rear of a connector shell and/or front of an endbell which allows the endbell to be positioned at a specific angle before tightening on to the connector. Used particularly with right angle endbells to position them at a specific angle.

GLOSSARY OF TERMS

TEST PROD – A sharp metal point with an insulated handle used with various types of test equipment for making an electrical connection between the circuit and the test gear.

TEST VOLTAGE - The range of voltages over which the connector has been tested per the parameters in the applicable specification.

THERMOCOUPLE CONTACT – A contact made of a special material for use with thermocouple probes. Typical contact materials are Alumel, chromel, constantan, or iron.

THERMOPLASTIC – A plastic material that can be softened by heat and rehardened into a solid state by cooling. This process can be accomplished using a variety of techniques.

THERMOSET – A plastic material which hardens when heat and pressure are applied. Unlike thermoplastic, it cannot be remelted or remolded.

THREADED COUPLING – A method of mechanically coupling connector halves which makes use of a threaded coupling nut on the plug which threads into a mating thread on the receptacle.

THRU-BULKHEAD RECEPTACLE – Flange mounted on a panel, the TBR connector has a mating end on each side of the panel, one with pin contacts, and the other with socket contacts. This provides a transition through a panel (or bulkhead). Standard plug style connectors can be mated with the TBR from each side of the panel. TBR's are used when a disconnect is needed from each side of the panel. They are particularly useful when air leakage through the panel must be eliminated.

THROUGH HOLE – See CLEARANCE HOLE.

TORQUE – A force which produces rotation. See ROTATIONAL TORQUE.

TORQUE WRENCH – A device which makes use of an integrated gauge which allows you to tighten coupling nuts, endbells, and bolts to a specific force.

TURRET – An interchangeable device which is attached to a CRIMP TOOL that allows the tool to crimp a range of contacts. Each turret is made to crimp a specific style contact or a range of contacts and/or wire gauges. Also see LOCATOR.

TWISTED PAIR – A cable in which the two insulated conductors are twisted together beneath the jacket. A group of wires in a jacket may also be twisted together in pairs.

UL – Abbreviation for Underwriter's Laboratories, a corporation supported by a group of underwriters for the purpose of establishing safety standards covering certain types of equipment and components in the United States.

UL94 V0 – Plastics burning global standard, VO means burning will stop within 10 seconds.

USB-A/B – Universal Serial Bus connector with 4 pins. Comes in two styles, A, and B.

V – Symbol for volt.

VAC – Volts, alternating current.

VDC – Volts, direct current.

VDE – A German rating covering performance specifications of a device.

VIBRATION – A continuously reversing change in the magnitude of a given force.

VG 95 234 – European Specification for Reverse Bayonet coupling connectors

VOLT – The unit of measurement of electromotive force. It is equivalent to the force required to produce a current of 1 ampere through a resistance of one ohm.

VOLTAGE – The force which causes current to flow through an electrical conductor. Its symbol is E. The greatest effective difference in potential between and two conductors of a circuit.

VOLTAGE DROP – The difference in voltage between two points in a circuit due to the loss of electrical pressure as a current flows through an impedance.

VOLTAGE RATING – The maximum voltage which a connector can sustain without breaking down or varying from design specifications.

W – 1. In circular connectors, a degree of INSULATOR ROTATION. 2. Symbol for watt, work, or energy.

WASH OUT – A defect in the mold used to make molded connector components that manifests itself as a blurred or deformed surface around the area on the component where the mold is gated. It is the result of mold age and wear. It is typically a cosmetic issue that rarely results in any decreased connector performance.

WAVE SPRING – A wavy metal washer mounted inside a coupling nut. When the connector halves are mated, the wavespring applies a reverse pressure on the two mated halves. This is intended to improve vibration performance or peripheral sealing.

WAVE WASHER – See WAVE SPRING.

WIRE BUNDLE – A group of individual wires held together by a wire accessory such as cable ties, lacing cord, tubing, or clamps.

WIRE INSULATION DIAMETER – The outside diameter of the insulation on an insulated wire.

WIRE RANGE – The sizes of wire conductors accommodated by a particular contact.

WIRE HOLE FILLER (also know as a seal plug) – A plug which is inserted into an unused GROMMET CAVITY in a connector to retain the sealing capability of the connector. They can be inserted into unused cavities in the grommet, insulator, or both, however, contacts are always recommended for filling unused insulator cavities. Fillers are usually made of plastic and are commonly found in two shapes, one which resembles a blunt nail and the other shaped like a barbell.

WIRE SEALING GROMMET – A resilient disc with holes in it to accommodate the individual wires entering the rear of the connector. Each cavity forms a tight seal against the wire insulation (as long as wires within the specified diameter are used). The grommet seals the back of the connector against moisture, dirt, and air. The grommet is normally held in place and compressed by an endbell and/or ferrule. It is usually a separate component, but may be part of the insulator itself. Also see GROMMET CAVITY.

WIRE SIZE – A numerical designation for conductor diameter. This catalog uses American Wire Gauge (AWG) which is based on the approximate circular mil area of the wire. Also see AWG and mm2.

WIRE STRIP LENGTH – See STRIP LENGTH.

WIRE WRAP CONTACT – A type of contact which is terminated by wrapping wire around a post in a manner that deforms the wire and creates a gas tight connection between the wire and the post. This method is slow and labor intensive. If used at all, it is employed in prototype work.

WORK – The magnitude of a force times the distance through which that force is applied.

X – 1. In circular connectors, a degree of INSULATOR ROTATION. 2. Symbol for reactance.

Y – 1. In circular connectors, a degree of INSULATOR ROTATION. 2. Symbol for admittance.

Z – 1. In circular connectors, a degree of INSULATOR ROTATION. 2. Symbol for impedance.

ZERO HALOGEN – In connector terminology, an insulating material that will not emit halogen gasses when burned. See HALOGEN and AEM.

ZERO INSERTION FORCE CONNECTOR (ZIF) – A connector designed in such a way that the contacts do not mechanically touch until the two connector halves have been jointed and a compression mechanism has forced the contacts together. A ZIF connector has extremely low insertion and removal forces making it possible to easily mate very large numbers of contacts with virtually no wear.

TEMPERATURE CONVERSION TABLE

If center column value is ˚F, the ˚C equivalent is to the left. If center column value is ˚C, the ˚F equivalent is to the right.

˚C		˚F	˚C		˚F	˚C		˚F	˚C		˚F	˚C		˚F
-40.00	-40	-40.0	-2.22	28	82.4	35.56	96	204.8	73.33	164	327.2	111.11	232	449.6
-39.44	-39	-38.2	-1.67	29	84.2	36.11	97	206.6	73.89	165	329.0	111.67	233	451.4
-38.89	-38	-36.4	-1.11	30	86.0	36.67	98	208.4	74.44	166	330.8	112.22	234	453.2
-38.33	-37	-34.6	-0.56	31	87.8	37.22	99	210.2	75.00	167	332.6	112.78	235	455.0
-37.78	-36	-32.8	0.00	32	89.6	37.78	100	212.0	75.56	168	334.4	113.33	236	456.8
-37.22	-35	-31.0	0.56	33	91.4	38.33	101	213.8	76.11	169	336.2	113.89	237	458.6
-36.67	-34	-29.2	1.11	34	93.2	38.89	102	215.6	76.67	170	338.0	114.44	238	460.4
-36.11	-33	-27.4	1.67	35	95.0	39.44	103	217.4	77.22	171	339.8	115.00	239	462.2
-35.56	-32	-25.6	2.22	36	96.8	40.00	104	219.2	77.78	172	341.6	115.56	240	464.0
-35.00	-31	-23.8	2.78	37	98.6	40.56	105	221.0	78.33	173	343.4	116.11	241	465.8
-34.44	-30	-22.0	3.33	38	100.4	41.11	106	222.8	78.89	174	345.2	116.67	242	467.6
-33.89	-29	-20.2	3.89	39	102.2	41.67	107	224.6	79.44	175	347.0	117.22	243	469.4
-33.33	-28	-18.4	4.44	40	104.0	42.22	108	226.4	80.00	176	348.8	117.78	244	471.2
-32.78	-27	-16.6	5.00	41	105.8	42.78	109	228.2	80.56	177	350.6	118.33	245	473.0
-32.22	-26	-14.8	5.56	42	107.6	43.33	110	230.0	81.11	178	352.4	118.89	246	474.8
-31.67	-25	-13.0	6.11	43	109.4	43.89	111	231.8	81.67	179	354.2	119.44	247	476.6
-31.11	-24	-11.2	6.67	44	111.2	44.44	112	233.6	82.22	180	356.0	120.00	248	478.4
-30.56	-23	-9.4	7.22	45	113.0	45.00	113	235.4	82.78	181	357.8	120.56	249	480.2
-30.00	-22	-7.6	7.78	46	114.8	45.56	114	237.2	83.33	182	359.6	121.11	250	482.0
-29.44	-21	-5.8	8.33	47	116.6	46.11	115	239.0	83.89	183	361.4	121.67	251	483.8
-28.89	-20	-4.0	8.89	48	118.4	46.67	116	240.8	84.44	184	363.2	122.22	252	485.6
-28.33	-19	-2.2	9.44	49	120.2	47.22	117	242.6	85.00	185	365.0	122.78	253	487.4
-27.78	-18	-0.4	10.00	50	122.0	47.78	118	244.4	85.56	186	366.8	123.33	254	489.2
-27.22	-17	1.4	10.56	51	123.8	48.33	119	246.2	86.11	187	368.6	123.89	255	491.0
-26.67	-16	3.2	11.11	52	125.6	48.89	120	248.0	86.67	188	370.4	124.44	256	492.8
-26.11	-15	5.0	11.67	53	127.4	49.44	121	249.8	87.22	189	372.2	125.00	257	494.6
-25.56	-14	6.8	12.22	54	129.2	50.00	122	251.6	87.78	190	374.0	125.56	258	496.4
-25.00	-13	8.6	12.78	55	131.0	50.56	123	253.4	88.33	191	375.8	126.11	259	498.2
-24.44	-12	10.4	13.33	56	132.8	51.11	124	255.2	88.89	192	377.6	126.67	260	500.0
-23.89	-11	12.2	13.89	57	134.6	51.67	125	257.0	89.44	193	379.4	127.22	261	501.8
-23.33	-10	14.0	14.44	58	136.4	52.22	126	258.8	90.00	194	381.2	127.78	262	503.6
-22.78	-9	15.8	15.00	59	138.2	52.78	127	260.6	90.56	195	383.0	128.33	263	505.4
-22.22	-8	17.6	15.56	60	140.0	53.33	128	262.4	91.11	196	384.8	128.89	264	507.2
-21.67	-7	19.4	16.11	61	141.8	53.89	129	264.2	91.67	197	386.6	129.44	265	509.0
-21.11	-6	21.2	16.67	62	143.6	54.44	130	266.0	92.22	198	388.4	130.00	266	510.8
-20.56	-5	23.0	17.22	63	145.4	55.00	131	267.8	92.78	199	390.2	130.56	267	512.6
-20.00	-4	24.8	17.78	64	147.2	55.56	132	269.6	93.33	200	392.0	131.11	268	514.4
-19.44	-3	26.6	18.33	65	149.0	56.11	133	271.4	93.89	201	393.8	131.67	269	516.2
-18.89	-2	28.4	18.89	66	150.8	56.67	134	273.2	94.44	202	395.6	132.22	270	518.0
-18.33	-1	30.2	19.44	67	152.6	57.22	135	275.0	95.00	203	397.4	132.78	271	519.8
-17.78	0	32.0	20.00	68	154.4	57.78	136	276.8	95.56	204	399.2	133.33	272	521.6
-17.22	1	33.8	20.56	69	156.2	58.33	137	278.6	96.11	205	401.0	133.89	273	523.4
-16.67	2	35.6	21.11	70	158.0	58.89	138	280.4	96.67	206	402.8	134.44	274	525.2
-16.11	3	37.4	21.67	71	159.8	59.44	139	282.2	97.22	207	404.6	135.00	275	527.0
-15.56	4	39.2	22.22	72	161.6	60.00	140	284.0	97.78	208	406.4	135.56	276	528.8
-15.00	5	41.0	22.78	73	163.4	60.56	141	285.8	98.33	209	408.2	136.11	277	530.6
-14.44	6	42.8	23.33	74	165.2	61.11	142	287.6	98.89	210	410.0	136.67	278	532.4
-13.89	7	44.6	23.89	75	167.0	61.67	143	289.4	99.44	211	411.8	137.22	279	534.2
-13.33	8	46.4	24.44	76	168.8	62.22	144	291.2	100.00	212	413.6	137.78	280	536.0
-12.78	9	48.2	25.00	77	170.6	62.78	145	293.0	100.56	213	415.4	138.33	281	537.8
-12.22	10	50.0	25.56	78	172.4	63.33	146	294.8	101.11	214	417.2	138.89	282	539.6
-11.67	11	51.8	26.11	79	174.2	63.89	147	296.6	101.67	215	419.0	139.44	283	541.4
-11.11	12	53.6	26.67	80	176.0	64.44	148	298.4	102.22	216	420.8	140.00	284	543.2
-10.56	13	55.4	27.22	81	177.8	65.00	149	300.2	102.78	217	422.6	140.56	285	545.0
-10.00	14	57.2	27.78	82	179.6	65.56	150	302.0	103.33	218	424.4	141.11	286	546.8
-9.44	15	59.0	28.33	83	181.4	66.11	151	303.8	103.89	219	426.2	141.67	287	548.6
-8.89	16	60.8	28.89	84	183.2	66.67	152	305.6	104.44	220	428.0	142.22	288	550.4
-8.33	17	62.6	29.44	85	185.0	67.22	153	307.4	105.00	221	429.8	142.78	289	552.2
-7.78	18	64.4	30.00	86	186.8	67.78	154	309.2	105.56	222	431.6	143.33	290	554.0
-7.22	19	66.2	30.56	87	188.6	68.33	155	311.0	106.11	223	433.4	143.89	291	555.8
-6.67	20	68.0	31.11	88	190.4	68.89	156	312.8	106.67	224	435.2	144.44	292	557.6
-6.11	21	69.8	31.67	89	192.2	69.44	157	314.6	107.22	225	437.0	145.00	293	559.4
-5.56	22	71.6	32.22	90	194.0	70.00	158	316.4	107.78	226	438.8	145.56	294	561.2
-5.00	23	73.4	32.78	91	195.8	70.56	159	318.2	108.33	227	440.6	146.11	295	563.0
-4.44	24	75.2	33.33	92	197.6	71.11	160	320.0	108.89	228	442.4	146.67	296	564.8
-3.89	25	77.0	33.89	93	199.4	71.67	161	321.8	109.44	229	444.2	147.22	297	566.6
-3.33	26	78.8	34.44	94	201.2	72.22	162	323.6	110.00	230	446.0	147.78	298	568.4
-2.78	27	80.6	35.00	95	203.0	72.78	163	325.4	110.56	231	447.8	148.33	299	570.2
												148.89	300	572.0
												149.44	301	573.8
												150.00	302	575.6

CONDUIT CAPACITY*

Conduit Trade Size		1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	3 1/2	4
Internal Dia. Inches		0.622	0.824	1.047	1.388	1.610	2.067	2.469	3.068	3.548	4.026
Permissible Area		0.12	0.21	0.34	0.60	0.82	1.34	1.92	2.95	3.96	5.09
Cable O.D.	Cable Area Sq. In.										
0.125	0.0123	9	17	27	48	66	108	156	239	321	413
0.150	0.0177	6	11	19	33	46	75	108	166	223	287
0.175	0.0241	4	8	14	24	34	55	79	122	164	211
0.200	0.0315	3	6	10	19	26	42	61	93	126	162
0.225	0.0398	3	5	8	15	20	33	48	74	99	127
0.250	0.0491	2	4	6	12	16	27	39	60	89	103
0.275	0.0594	2	3	5	10	13	22	32	49	66	85
0.300	0.0707	1	2	4	8	11	18	27	41	56	71
0.325	0.0830	1	2	4	7	9	16	23	35	47	61
0.350	0.0963	1	2	3	6	8	13	19	30	41	52
0.375	0.1105	1	1	3	5	7	12	17	26	35	46
0.400	0.1257	-	1	2	4	6	10	15	23	31	40
0.425	0.1419	-	1	2	4	5	9	13	20	27	35
0.450	0.1591	-	1	2	3	5	8	12	18	24	32
0.475	0.1773	-	1	1	3	4	7	10	16	22	28
0.500	0.1964	-	1	1	3	4	6	9	15	20	25
0.525	0.2165	-	-	1	2	3	6	8	13	18	23
0.550	0.2376	-	-	1	2	3	5	8	12	16	21
0.575	0.2597	-	-	1	2	3	5	7	11	15	19
0.600	0.2828	-	-	1	2	2	4	6	10	14	18
0.625	0.3068	-	-	1	1	2	4	6	9	12	16
0.650	0.3319	-	-	-	1	2	4	5	8	11	15
0.675	0.3579	-	-	-	1	2	3	5	8	11	14
0.700	0.3849	-	-	-	1	2	3	4	7	10	13
0.725	0.4129	-	-	-	1	1	3	4	7	9	12
0.750	0.4418	-	-	-	1	1	3	4	6	8	11
0.775	0.4718	-	-	-	1	1	2	4	6	8	10
0.800	0.5027	-	-	-	1	1	2	3	5	7	10
0.825	0.5346	-	-	-	1	1	2	3	5	7	9
0.850	0.5675	-	-	-	1	1	2	3	5	6	8
0.875	0.6014	-	-	-	-	1	2	3	4	6	8
0.900	0.6362	-	-	-	-	1	2	3	4	6	8
0.925	0.6721	-	-	-	-	1	1	3	4	6	8
0.950	0.7089	-	-	-	-	1	1	2	4	5	7
0.975	0.7467	-	-	-	-	1	1	2	3	5	6
1.000	0.7854	-	-	-	-	1	1	2	3	5	6
1.025	0.8252	-	-	-	-	-	1	2	3	4	6
1.050	0.8660	-	-	-	-	-	1	2	3	4	5
1.075	0.9077	-	-	-	-	-	1	2	3	4	5
1.100	0.9504	-	-	-	-	-	1	2	3	4	5
1.125	0.9941	-	-	-	-	-	1	1	2	3	5
1.150	1.0387	-	-	-	-	-	1	1	2	3	4
1.175	1.0844	-	-	-	-	-	1	1	2	3	4
1.200	1.1310	-	-	-	-	-	1	1	2	3	4
1.225	1.1786	-	-	-	-	-	1	1	2	3	4
1.250	1.2272	-	-	-	-	-	1	1	2	3	4
1.275	1.2768	-	-	-	-	-	1	1	2	3	3
1.300	1.3274	-	-	-	-	-	1	1	2	2	3
1.325	1.3789	-	-	-	-	-	-	1	2	2	3
1.350	1.4314	-	-	-	-	-	-	1	2	2	3
1.375	1.4849	-	-	-	-	-	-	1	1	2	3
1.400	1.5394	-	-	-	-	-	-	1	1	2	3
1.425	1.5949	-	-	-	-	-	-	1	1	2	3
1.450	1.6513	-	-	-	-	-	-	1	1	2	2
1.475	1.7088	-	-	-	-	-	-	1	1	2	2
1.500	1.7672	-	-	-	-	-	-	1	1	2	2
1.525	1.8266	-	-	-	-	-	-	1	1	2	2
1.550	1.8870	-	-	-	-	-	-	1	1	2	2
1.575	1.9483	-	-	-	-	-	-	-	1	2	2
1.600	2.0107	-	-	-	-	-	-	-	1	1	2
1.625	2.0740	-	-	-	-	-	-	-	1	1	2
1.650	2.1383	-	-	-	-	-	-	-	1	1	2
1.675	2.2036	-	-	-	-	-	-	-	1	1	2
1.700	2.2699	-	-	-	-	-	-	-	1	1	2
1.725	2.3371	-	-	-	-	-	-	-	1	1	2
1.750	2.4053	-	-	-	-	-	-	-	1	1	2
1.775	2.4745	-	-	-	-	-	-	-	1	1	2
1.800	2.5447	-	-	-	-	-	-	-	1	1	2

WIRE GAUGE

AWG	Diameter Inches	Diameter MM	CMA
4/0	0.460	(11.68)	212000
3/0	0.410	(10.41)	168000
2/0	0.365	(9.27)	133000
1/0	0.325	(8.26)	106000
1	0.289	(7.34)	83700
2	0.258	(6.55)	66400
3	0.229	(5.82)	52600
4	0.204	(5.18)	41700
5	0.182	(4.62)	33100
6	0.162	(4.11)	26300
7	0.144	(3.66)	20800
8	0.128	(3.25)	16500
9	0.114	(2.90)	13100
10	0.102	(2.59)	10400
11	0.091	(2.31)	8230
12	0.081	(2.06)	6530
13	0.072	(1.83)	5180
14	0.062	(1.57)	4110
15	0.057	(1.45)	3260
16	0.051	(1.30)	2580
17	0.045	(1.14)	2050
18	0.040	(1.02)	1620
19	0.036	(0.91)	1290
20	0.032	(0.81)	1020
21	0.0285	(0.72)	810
22	0.0253	(0.643)	642
23	0.0226	(0.574)	509
24	0.0201	(0.511)	404
25	0.0179	(0.45)	320
26	0.0159	(0.404)	254
27	0.0142	(0.361)	202
28	0.0126	(0.320)	106
29	0.0113	(0.29)	127
30	0.0100	(0.254)	101
31	0.0089	(0.23)	79.7
32	0.0080	(0.20)	63.2
33	0.0071	(0.18)	50.1
34	0.0063	(0.16)	39.8
35	0.0056	(0.14)	31.5
36	0.0050	(0.13)	25.0
37	0.0045	(0.114)	19.8
38	0.0040	(0.10)	15.7
39	0.0035	(0.09)	12.5
40	0.0031	(0.079)	9.9

Use to Convert American Wire Gauge to Diameter and Circular Mil Area.

Figures shown indicate number of cables of a given size O.D. that can be pulled through conduit size listed.

*Based on National Electrical Code for non-lead sheathed cables when 3 or more wires occupy the same conduit (40% fill).

CONVERSION FACTORS

MULTIPLY	BY	OBTAIN
acres	0.4047	hectares
atmospheres	1.10133	bars
atmospheres	0.0001033	kg per square meter
atmospheres	760	mm of mercury at 0°C
atmospheres	0.000010133	newtons per square meter
atmospheres	14.7	pounds per square inch
bars	0.9869	atmospheres
bars	100000	newtons per square meter
Btu	778.3	foot-pounds
Btu	0.000293	kilowatt-hours
Btu per hour	12.96	foot-pounds per minute
Btu per minute	17.58	watts
centimeters	0.03281	feet
centimeters	0.3937	inches
centimeters per second	1.969	feet per minute
centimeters per second	0.6	meters per minute
circular mils	0.000005067	square centimeters
circular mils	7.854E-07	square inches
circular mils	0.0005067	square millimeters
circular mils	0.7854	square mils
cubic centimeters	0.06102	cubic inches
cubic centimeters	0.001	liters
cubic feet	1728	cubic inches
cubic feet	0.02832	cubic meters
cubic feet	7.481	gallons (US liquid)
cubic feet	28.32	liters
cubic inches	16.393	cubic centimeters
cubic inches	0.0005787	cubic feet
cubic inches	0.00001639	cubic meters
cubic inches	0.01639	liters
cubic meters	35.31	cubic feet
cubic meters	1000	liters
dynes	0.00102	grams
dynes	0.00001	newtons
dynes	0.000002248	pounds
feet	30.48	centimeters
feet	12	inches
feet	0.0003048	kilometers
feet	0.06061	rods
feet of water (4°C)	0.8826	inches of mercury (0°C)
feet of water (4°C)	304.8	kg per square meter
feet of water (4°C)	62.43	pounds per square foot
feet per minute	0.508	centimeters per second
feet per minute	0.3048	meters per minute

MULTIPLY	BY	OBTAIN
feet per minute	0.01136	miles per hour
foot-pounds	0.001285	Btu
foot-pounds	1.356	joules
foot -pounds	0.1383	kilogram-meters
foot -pounds	3.766E-07	kilowatt-hours
foot-pounds	1.3557	newton-meters
foot-pounds per minute	0.07716	Btu per hour
foot-pounds per minute	0.0226	watts
gallons (US liquid)	0.1337	cubic feet
gallons (US liquid)	0.003785	cubic meters
gallons (US liquid)	4	quarts
grams	980.7	dynes
grams	0.03527	ounce
grams per cm	0.0056	pounds per inch
grams per cubic cm	0.03613	pounds per cubic inch
grams per sq cm	2.0481	pounds per square foot
hectares	2.471	acres
hectares	10000	square meters
horsepower	1.014	horsepower (metric)
horsepower (metric)	0.9863	horsepower
inches	2.54	centimeters
inches	0.08333	feet
inches	0.0254	meters
inches	25.4	millimeters
inches	1000	mils
inches	0.02778	yards
inches of mercury (0°C)	1.133	feet of water (4°C)
inches of mercury (0°C)	0.4912	pounds per square inch
inches of mercury (32°F)	33.86	millibars
inches of water (4°C)	0.07355	inches of mercury
inches of water (4°C)	25.4	kg per square meter
inches of water (4°C)	0.5782	ounces per square inch
inches of water (4°C)	5.202	pounds per square foot
joules	0.7376	foot-pounds
joules	9.81	kilogram-meters
kilograms	9.807	newtons
kilograms	2.2046	pounds
kilogram-calories per min.	69.77	watts
kilogram-force	9.81	newtons
kilogram-meters	7.233	foot -pounds
kilogram-meters	0.102	joules
kilograms per meter	0.672	pounds per foot
kilograms per meter	0.056	pounds per inch
kilograms per sq. meter	0.00009678	atmospheres

CONVERSION FACTORS

MULTIPLY	BY	OBTAIN
kilograms per sq. meter	0.003281	feet of water (4°C)
kilograms per sq. meter	0.2048	pounds per square foot
kilograms per sq. meter	0.001422	pounds per square inch
kilometers	3281	feet
kilometers	0.62137	miles
kilometers per hour	0.9113	feet per second
kilometers per hour	16.67	meters per minute
kilometers per minute	37.28	miles per hour
kilowatt-hours	3413	Btu
kilowatt-hours	0.000002655	foot -pounds
liters	1000	cubic centimeters
liters	0.03531	cubic feet
liters	61.02	cubic inches
liters	0.001	cubic meters
liters	0.908	quarts (dry)
liters	1.0567	quarts (US liquid)
meters	39.37	inches
meters	0.000394	mils
meters	1.0936	yards
meters per minute	1.667	centimeters per second
meters per minute	3.281	feet per minute
meters per minute	0.06	kilometers per hour
metric tons	0.9842	English long ton (2240 lbs)
metric tons	1.102	tons, short (2000 lbs)
miles (statute)	1.6094	kilometers
miles per hour	88	feet per minute
miles per hour	0.02682	kilometers per minute
millibars	0.02953	inches of mercury (32°F)
millibars	2.089	pounds per square foot
millimeters	0.03937	inches
millimeters	0.3937	mils
mm of mercury at 0°C	0.001316	atmospheres
mils	0.001	inches
mils	0.0000254	meters
mils	0.0254	millimeters
newtons	100000	dynes
newtons	0.102	kilograms
newtons	0.22481	pounds force
newton-meters	0.7376	foot-pounds
newton-meters	8.8512	inch-pounds
newtons per sq meter	0.00009678	atmospheres
newtons per sq meter	0.00001	bars
ounce	28.35	grams
ounces per square inch	1.729	inches of water (4°C)

MULTIPLY	BY	OBTAIN
pints	0.5	quarts
pounds	0.00004448	dynes
pounds	0.4536	kilogram
pounds force	4.44822	newtons
pounds per cubic foot	0.0005787	pounds per cubic inch
pounds per cubic inch	27.68	gram per cubic cm
pounds per cubic inch	1728	pounds per cubic foot
pounds per foot	1.488	kg per meter
pounds per inch	178.6	grams per cm
pounds per inch	17.86	kg per meter
pounds per square foot	0.01602	feet of water (4°C)
pounds per square foot	0.4883	grams per sq cm
pounds per square foot	0.1922	inches of water (4°C)
pounds per square foot	4.882	kg per square meter
pounds per square foot	4.882	kg per square meter
pounds per square foot	0.4788	millibars
pounds per square foot	0.006944	pounds per sq inch
pounds per square inch	0.06804	atmospheres
pounds per square inch	2.036	inches mercury (0°C)
pounds per square inch	703.1	kg per square meter
pounds per square inch	144	pounds per sq foot
quarts	0.25	gallons (US liquid)
quarts (dry)	1.1	liters
quarts (US liquid)	0.9463	liters
quarts	2	pints
rods	16.5	feet
square centimeters	0.00001973	circular mils
square centimeters	0.155	square inches
square feet	0.0929	square meters
square inches	0.000001273	circular mils
square inches	6.452	square centimeters
square kilometers	0.386	square miles
square meters	0.0001	hectares
square meters	10.76	square feet
square miles	2.59	square kilometers
square millimeters	1973	circular mils
square mils	1.273	circular mils
tons, English long (2240 lbs)	1.016	metric tons
tons, short (2000 lbs)	0.9072	metric tons
watts	0.05689	Btu per minute
watts	44.26	foot-pound per minute
watts	0.01433	kg-calories per minute
yards	0.02778	inches
yards	1.0936	meters

Corporate Headquarters, Philadelphia, PA

North American Production Facility, South Bend, IN

European Headquarters and Production Facility, Southampton, UK

Zhuhai, China Production Facility

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