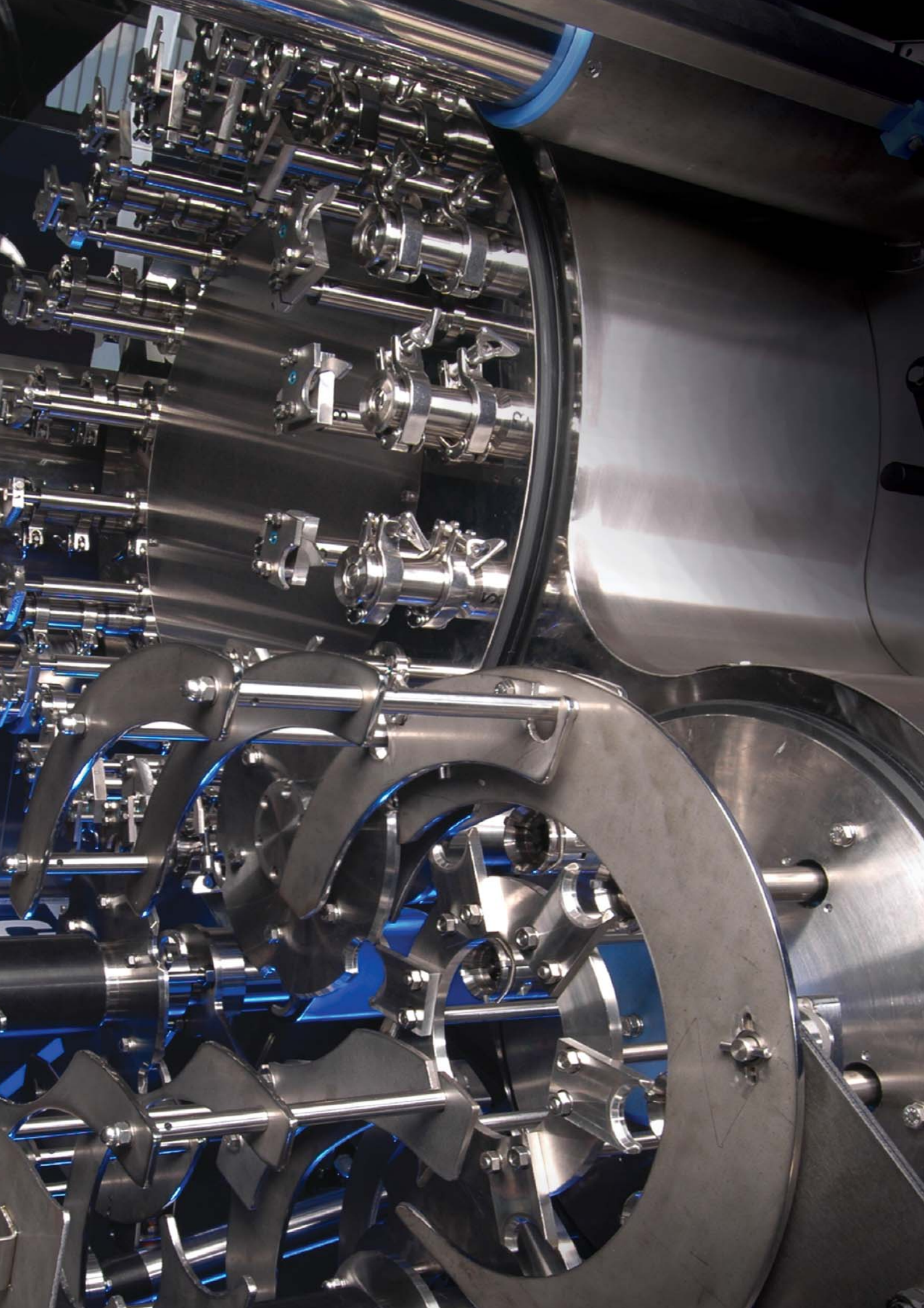
Industrial Components and Application Guide

Tyco Electronics

Our commitment. Your advantage.



Tyco Electronics Can Help You To Become A Leading Force In The Industrial Sector

With improved technical developments and longer product lifetimes, plus an ever-increasing pressure to reduce costs, the industrial sector faces many challenges. Whether it's machine and equipment building, factory automation, process control, motion control and drives, robotics, electrical or any other related areas, the same challenges are being faced throughout this complex market. For over 50-plus years, Tyco Electronics has worked with industry leaders to lower costs, to increase reliability, and to devise new and innovative ways to implement industrial products.

Early Involvement Pays Off in Competitive Advantage

With over 8,000 engineers and 12 design centres, plus manufacturing facilities in 25 countries globally, we put a premium on innovation when it comes to helping companies solve tough design problems. Talking to us early on in your design cycle will give you the full benefit of our expertise to help you:

- Shorten the design cycle
- Reduce costs
- Increase reliability
- Design for manufacturability

In short, we can help you achieve a sustainable competitive advantage.

Our commitment to advanced engineering and world-class manufacturing delivers innovation that can advance any project - from showing you the best existing products to offering a value-added solution, or even designing a new product.

Tyco Electronics is the world's largest supplier of passive electronic components, including connectors and interconnect systems, relays, switches, circuit protection devices, touchscreens, sensors, filters and wire and cable.

Tyco Electronics' ability to serve your present and future requirements is realised through the synergies of a strong R&D programme and our expertise in materials science, product design and process engineering, all supported by our network of knowledgeable application engineers, sales representatives and customer service personnel.

Engineering Centres
1. Bangkok
2. Bensheim
3. Greensboro NC
4. Harrisburg PA
5. Kawasaki
6. Kyungsan
7. Menlo Park CA
8. St. Augustin
9. Shanghai
10. Shenzhen
11. Sydney
12. Turin

GIC Manufacturing North America
1. East Providence RI
2. Guaymas MX
3. Hermosillo MX
4. Juarez MX
5. Lancaster PA
6. Lickdale PA
7. Menlo Park CA
8. Portland OR
9. PTP/Reidsville Rd NC

EMEA
1. Bideford
2. Collegno
3. Doncaster
4. Grenoble
5. L'viv
6. Roedermark
7. Swindon
8. Trutnov
9. Waidhofen

Asia Pacific
1. Auckland
2. Christchurch
3. Kingsgrove
4. Qingdao
5. Shanghai
6. Shenzhen

* GIC = Global Industrial & Commercial

Leading Industrial Solutions - Just A Simple Mouse-Click Away

Fast Access To Information 24/7

We make it quick and easy for you to find the information you need and to order samples and production parts, as well as to obtain documentation and CAD models.

Find Our Web Site

tycoelectronics.com is your single location for comprehensive product information, including CAD models, product and application specifications, drawings and competitive cross references. Our advanced parametric search engine allows you to find the exact part you need and all the documentation that goes with it. E-commerce gives you access to order tracking, distributor inventories, samples and much more.

Visit Our Industrial Portal

To make things easy, we have created an industry-specific site that focuses exclusively on industrial. Here you can find our extensive line of products and solutions for industrial: **tycoelectronics.com/industrial**

tycoelectronics.com/industrial

Sales Support

Management, Engineering, Purchasing, R&D, Production, Maintenance, - what ever your job is within a company, Tyco Electronics has an extensive team of customer services and sales engineers dedicated to supporting you. Sales engineers are available to visit your site to discuss the technical and commercial issues appropriate to your project or requirement. This support covers both existing products within our diverse portfolio and those which need to be tailored to your needs. Customer service can initiate new orders, change orders, request air shipments or drop shipments and generally support your business on a day to day basis.

Please see page 38 for contact details of your local Tyco Electronics organisation.

Product Information Centre

Our Product Information Centre works closely with our sales support and sales engineer teams to ensure continuity of support. Whether you need an exact part or an alternative product, if you are looking for documentation or the right technical solution to resolve a problem, our experienced specialists are waiting to assist you across new and established products. They are committed:

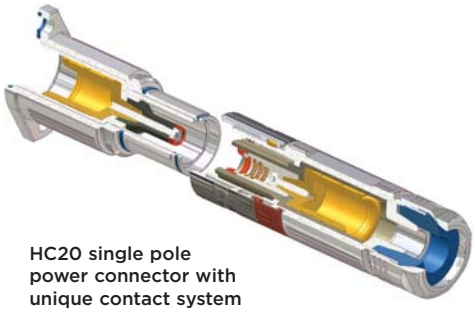
- To provide customers with dedicated technical support, product samples and literature across the Tyco Electronics product portfolio
- To assist in identifying the right solution for the customers application
- To advise customers on the available sales channels
- To support customers using our internet based system
- To develop strong customer relationships by being professional, efficient and friendly

Please see page 38 for contact details of your local Product Information Centre.

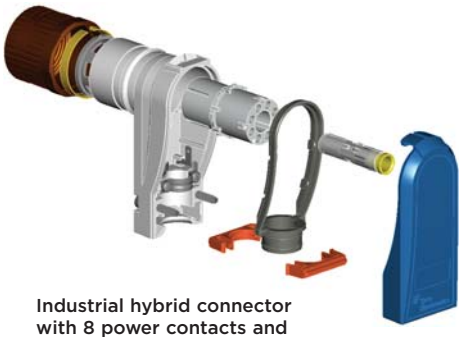
Distribution Network

We manufacture nearly 500,000 products, backed up by approximately 94,000 employees who all have a singular commitment to bringing performance advantage to every technology, product and service we provide. We serve customers in more than 150 countries, working closely with selected wholesalers, distributors and authorised dealers in order to improve our product availability and our service. Our global coverage places us near our customers and allows us to assist them in consolidating their supply base and lowering their production costs.

Please see tycoelectronics.com for further details on the distribution network.



HC20 single pole power connector with unique contact system



Industrial hybrid connector with 8 power contacts and Fast Ethernet interface

Within our development teams, we have the knowledge and the skills which are required to meet all of your needs. Our global presence means we operate wherever you do, and we can support you worldwide through a single account management programme, to simplify design and sourcing. Our focus on industrial gives you access to the widest selection of standard and semi-custom products, including:

- Connectors and terminal blocks
- Sensors and relays
- Switches and filters
- Wire and cable
- Identification
- Tooling

and many others from such well respected brands as AMP, HTS, OEG, Potter & Brumfield, Schrack, Corcom and Raychem.

Faster Front-End Design

With market dynamics forcing ever-shortening design cycles, our ability to quick-turn product concepts will keep your projects on schedule and shorten the time to market. Our capabilities include:

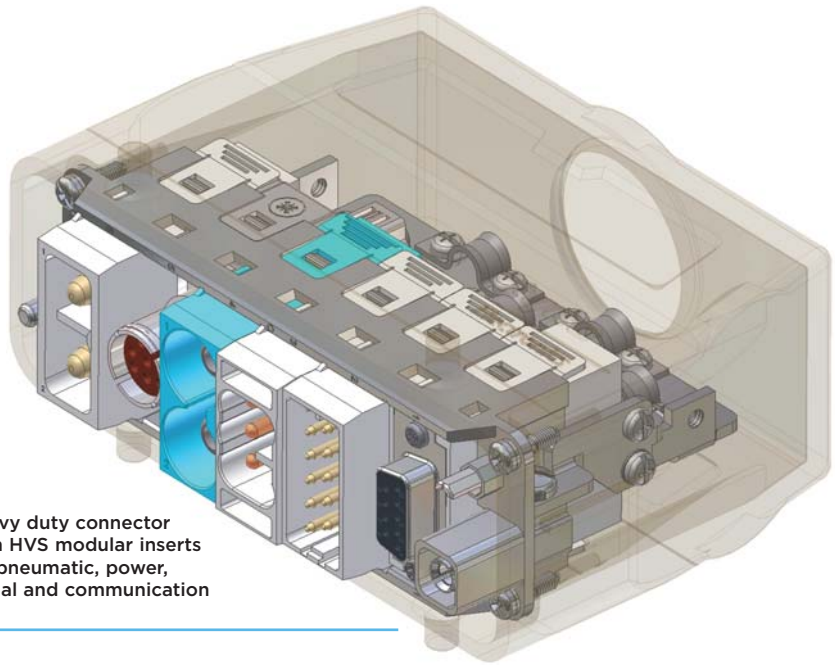
- **Computer-aided engineering -** giving some of the most sophisticated modelling and simulation capabilities in the industry to validate a design before prototyping.
- **Rapid prototyping -** from stereolithography for rough 'form and fit' evaluation in minutes, to model shops that turn prototypes in days, providing you with product samples quickly and conveniently.
- **CAD model interchange -** allowing us to import your CAD files into our system for custom application development. Alternately, we provide our CAD files in a wide range of formats for maximum compatibility, to ease integration of our products into yours. Sharing files is simple, fast and seamless.

Innovative Engineering For Mechanical, Electrical & Thermal Performance

From extensive research in materials, contact physics and signal transmission - to advanced tools which can model, simulate and validate a design, we understand the requirements of the industrial sector. Every product we design considers the mechanical, electrical and thermal parameters – and their interactions.

Every design is subject to solid modelling, finite-element analysis (FEA), root-cause failure analysis (RCFA) and failure-mode and effects analysis (FMEA) – all supported by extensive design reviews and documentation, so that the design is optimised for its application.

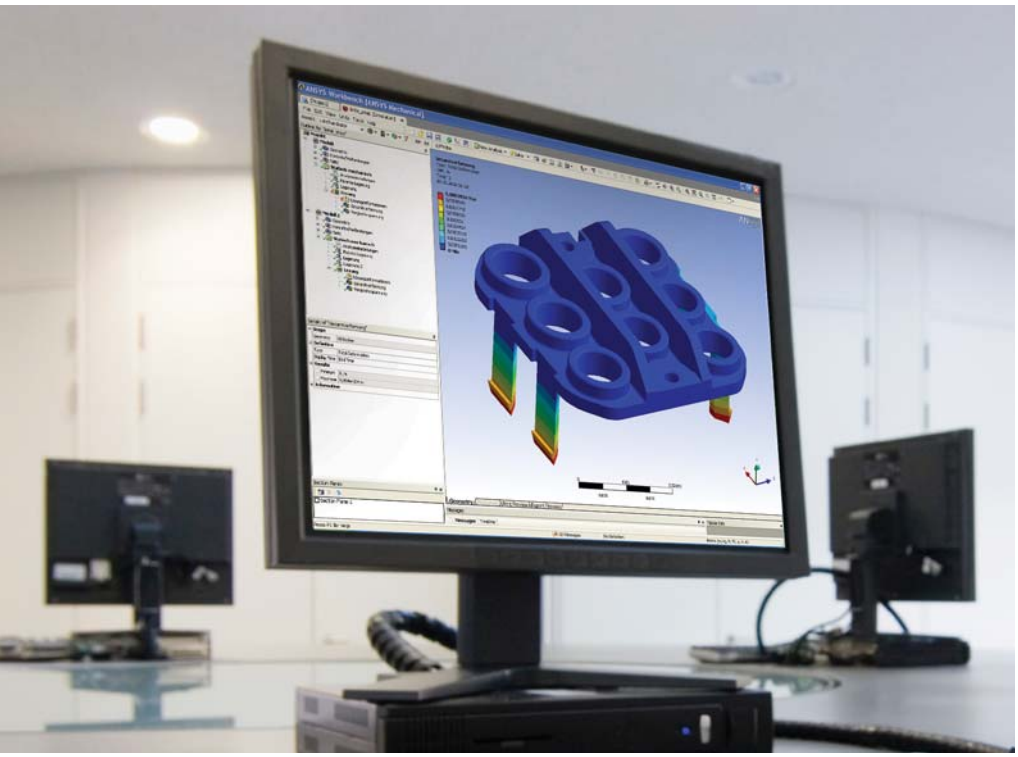
As a company focussing on Six Sigma and Lean Manufacturing, we are continually improving our processes by reducing variation and eliminating waste. Six Sigma methodologies are part of our culture, which is one that puts design excellence and product quality at the forefront of everything we do.



Heavy duty connector with HVS modular inserts for pneumatic, power, signal and communication

Our in-house test capabilities include mechanical, electrical, environmental testing and ANSYS analysis to qualify and validate that our products meet your specifications. Our test labs are approved by Underwriters Laboratories for testing Tyco Electronics' passive components, which is your sign that they meet stringent requirements for rigorous and reliable analysis. Routine capabilities include:

- **Environmental Testing**
  - Temperature and humidity
  - Temperature cycling
  - Thermal shock
  - Heat aging
- **Electrical**
  - Contact resistance
  - Dielectric withstanding voltage
  - Temperature rise versus current
  - EMI
- **Mechanical**
  - Vibration
  - Shock
  - Tension/compression
  - Mating cycles
  - Mating/unmating forces
  - Normal force
  - Flex life
  - Crush resistance
- **Product Simulation**



Your Standards Are Our Standards

Our engineering teams have a thorough knowledge of agency standards and regulations. We design and test our products to allow you to satisfy these requirements, through qualification testing, periodic retesting, labelling and marking. We comply with standards from ANSI/AAMI, IEC, UL/CSA, CE, VDE and other international agencies. We comply so you can comply.

Customer Confidentiality

All customer and project-related information will be handled securely and with extreme care. In order to guarantee complete confidentiality and peace of mind, Tyco Electronics provides secure data exchange services for all documentation and CAD models via IFX (Internet File Exchange) and Odette servers.

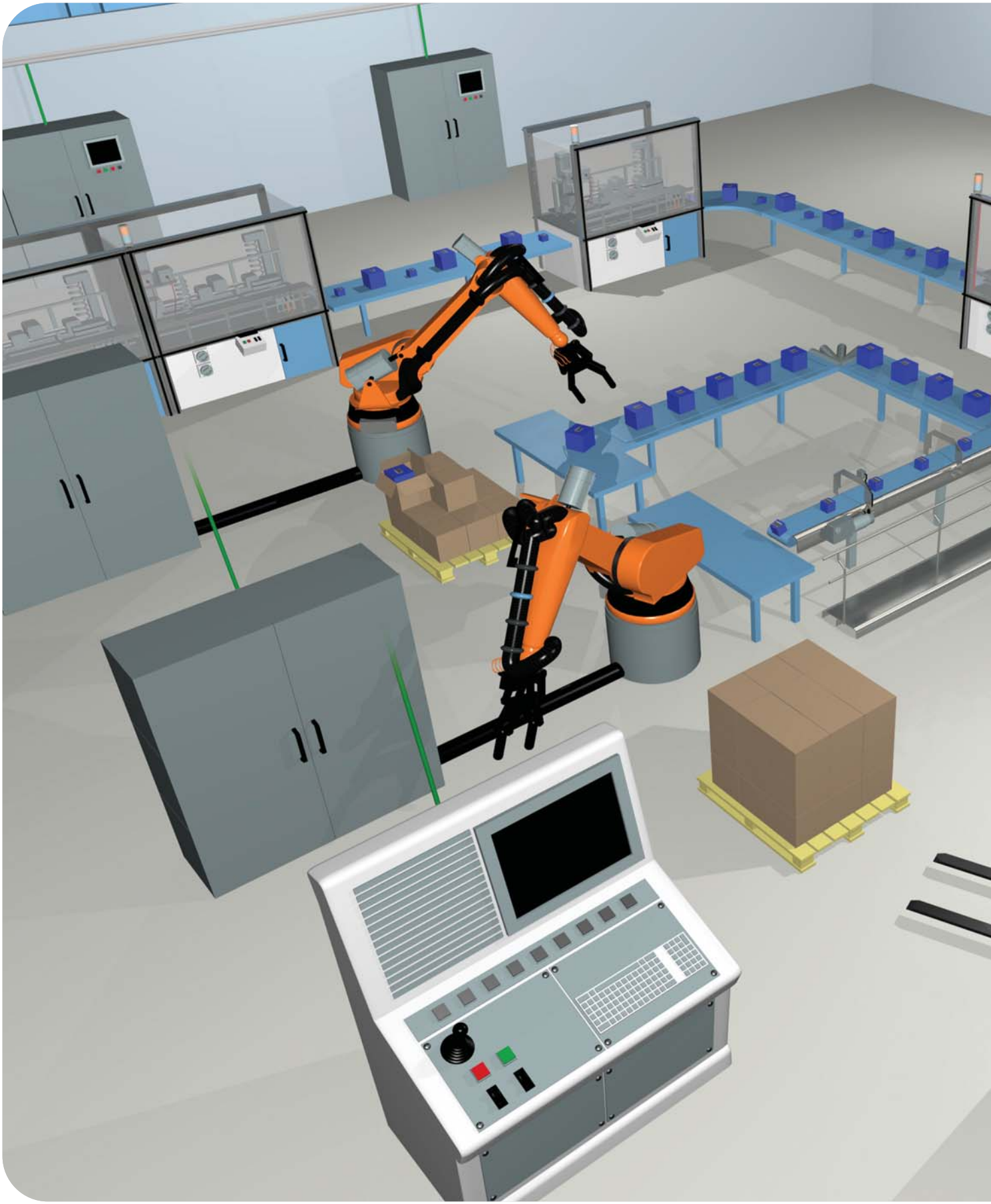
Product And Application Specifications

Tyco Electronics provides a full range of documentation which contains all of the product specifications you may require. Application Specifications are also available, in order to ensure that all components and products are professionally implemented.

Product Literature And Online Support

In addition to product and application specifications, Tyco Electronics offers a range of detailed product catalogues and brochures which you can also benefit from. And in order to assist you even further, all documents are available online, so that you can access the information you require 24 hours a day, 7 days a week.

Please see tycoelectronics.com and tycoelectronics.com/industrial for further details.



Production Equipment

Production equipment is becoming increasingly more sophisticated. Plug and play capabilities are important to get the equipment up and running as fast as possible. **Please see Page 10**

Material Handling

A material handling system is often at the centre of every manufacturing facility. Today's material handling systems are a complex network of motors, drives, belt systems, controls, and sensors all working together on a seamless platform.
Please see Page 11

Forklifts

The forklift has become an indispensable piece of equipment in manufacturing and warehousing operations. Using the most reliable components will ensure highest level of productivity and lowest cost of ownership. **Please see Page 12**

Robots

Manufacturing companies throughout the world are demanding more productivity. To meet these demands, companies are implementing more sophisticated industrial robots to help achieve production and profitability targets. **Please see Page 13**

Motors

Motors are the engines which keep the factory floor equipment moving. It is critical to monitor and control motor performance. Integration into the control system is important to successful implementation.
Please see Page 13

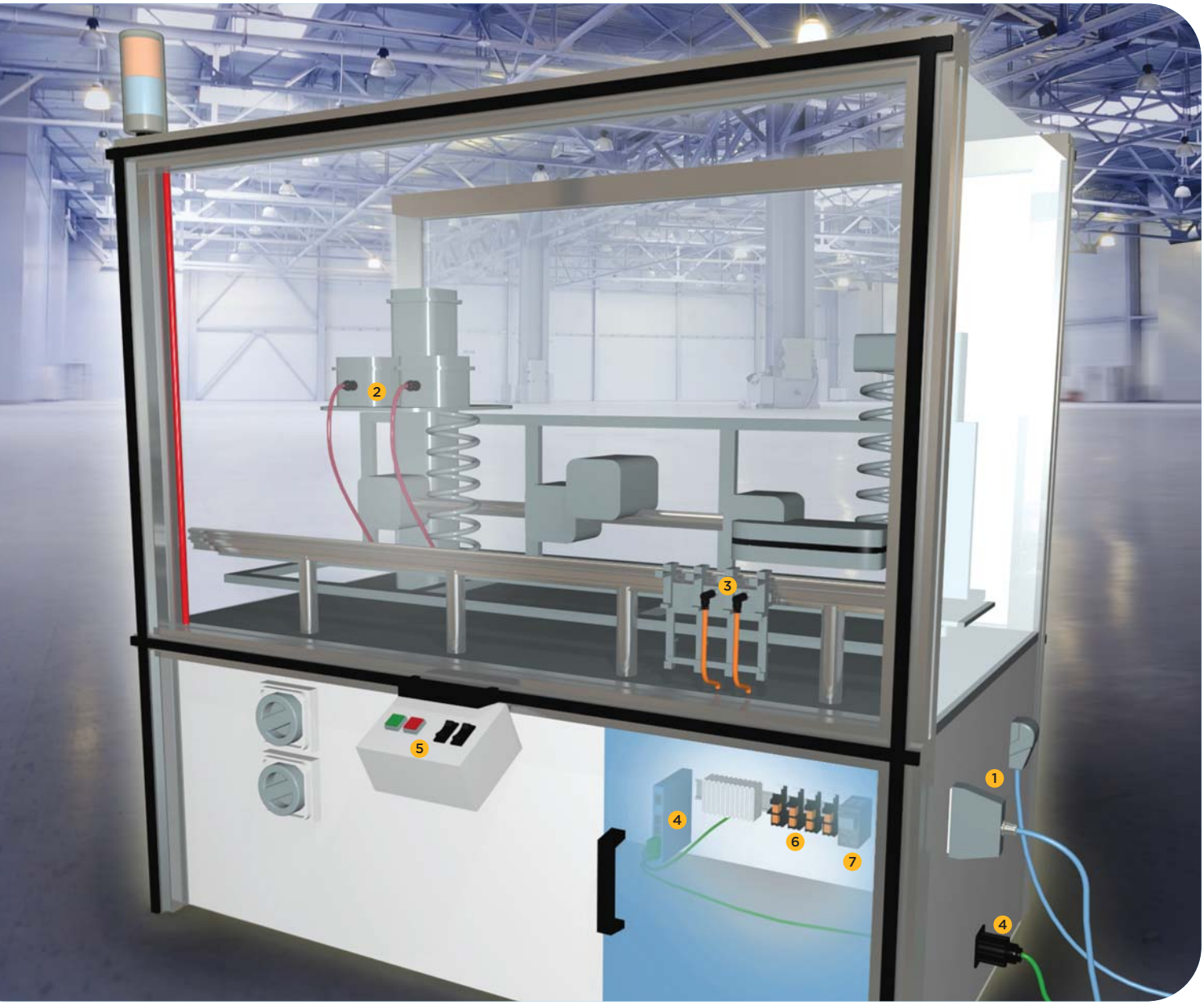
Control Cabinets

Inside of a control cabinet, you will find various electric and electronic components including the power supply, inverter, sequencer, drive, PLC, and relays. Having the ability to communicate between equipment and device is essential for efficient production. **Please see also Page 14**

Monitoring (HMI)

The Human Machine Interface is the communication device between the machine and the user. It is the centre of all monitoring and control operations. **Please see Page 15**

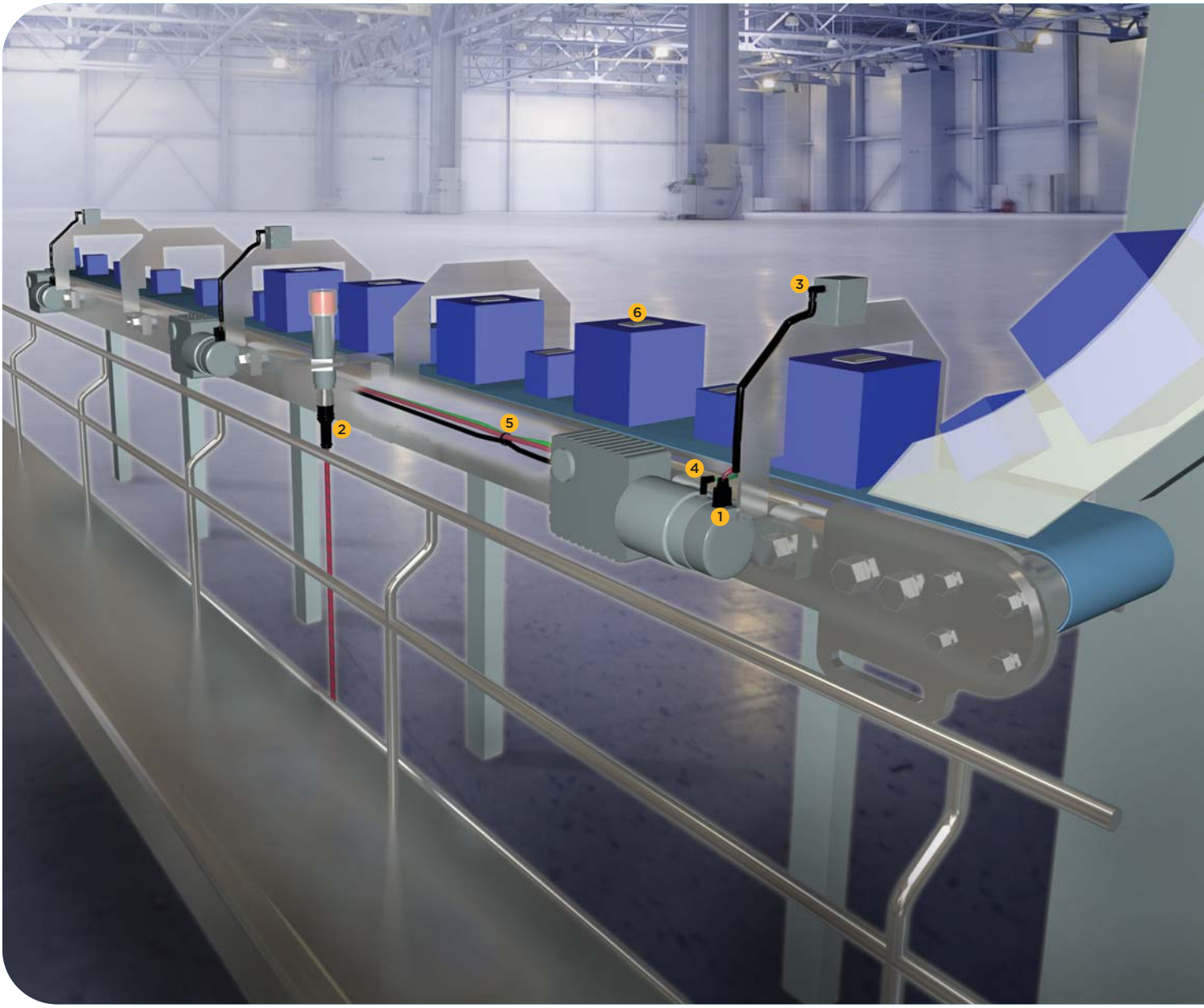
Please also see tycoelectronics.com/industrial for further details.



Production Equipment

In today's competitive environment, production equipment is becoming increasingly more sophisticated based on the demands of the market. Maximising up-time and reducing down-time are primary goals for machine builders. Plug and Play capability to insure quick integration will help companies get on-line faster to meet their Return On Invested Capital objectives. Electrical components which are built with increased ruggedness and reliability while designed for quick installation are critical factors for successful implementation.

Tyco Electronics offers the following key products which address this market:



Material Handling

A material handling system is often at the center of every manufacturing facility. Whether moving boxes in a distribution center or components off an assembly line, keeping the products moving is the key to efficiency and profitability. Today's material handling systems are a complex network of motors, drives, belt systems, controls, and sensors all working together on a seamless platform. Ethernet based controls systems are becoming the preferred choice, even down to the device level.

Tyco Electronics offers the following key products which address this market:

Forklift

The logistical chain in today's competitive environment is important in providing on time delivery and great service. Whether it is an electric, gas, or diesel driven forklift, the technology which drives the equipment and improves the user interface is becoming more sophisticated. Having the right balance between controller, sensors, drive units and motors is important to long term reliability. Using the most reliable components will ensure highest level of productivity and lowest cost of ownership.

Tyco Electronics offers the following key products which address this market:

Robots & Motors

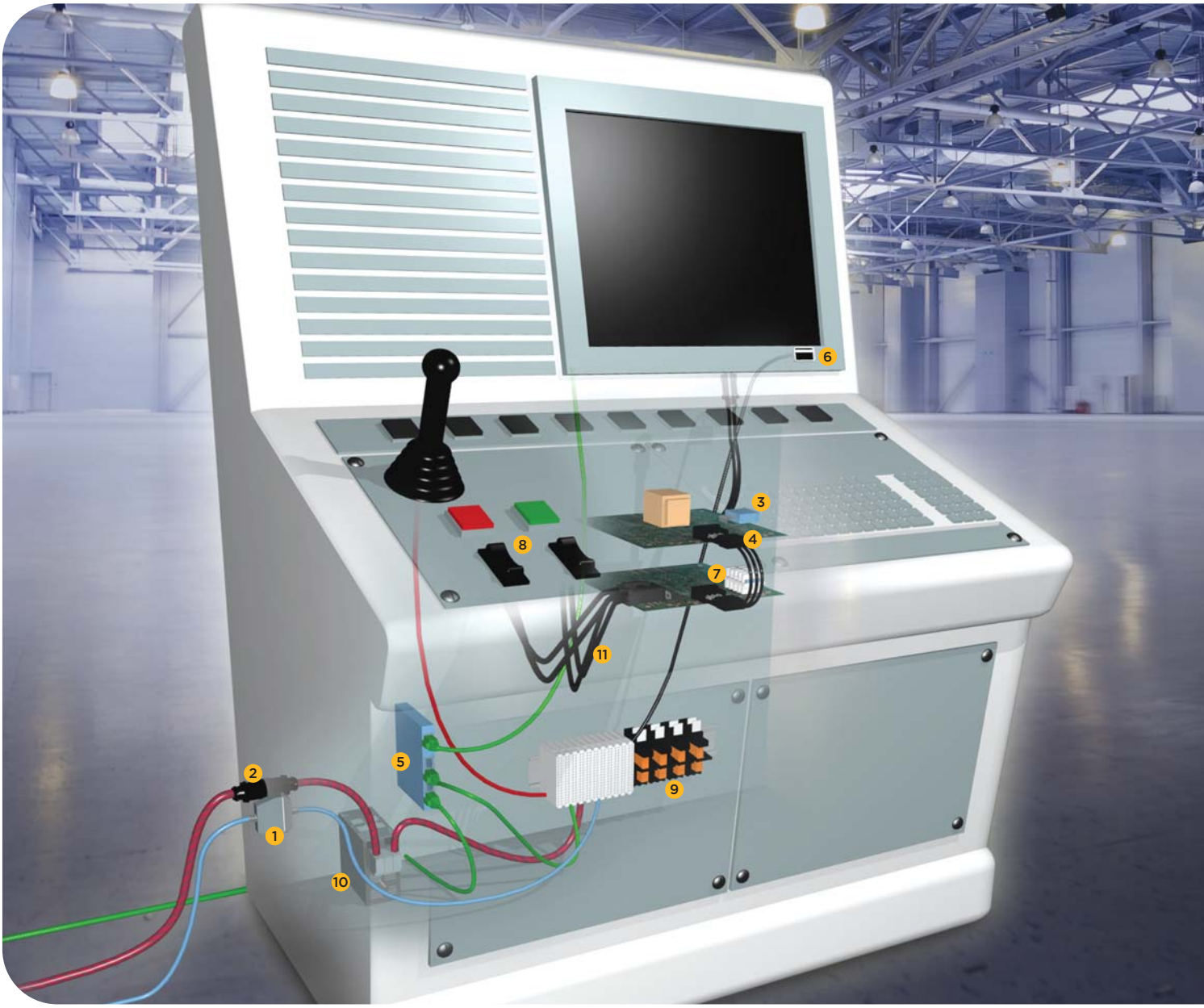
Manufacturing companies throughout the world are demanding more productivity, efficiency, and accuracy from their operations. To meet these demands, companies are implementing more sophisticated Industrial robots and motors. On board intelligence, PC based, or PLC driven, these systems are networked together to provide a high degree of interoperability while maintaining consistent predictability. Due to the wide range of operating environments, IP65 – IP69 protection class components can be crucial for a robust and reliable system.

Tyco Electronics offers the following key products which address this market:

Control Cabinet

Inside of a control cabinet, you will find various electric and electronic components including the power supply, inverter, sequencer, drive and PLC. These units are required to supply electric power, drive, control, and monitor different equipment in the plant. Having the ability to communicate and network all this information between the factory and the companies' Enterprise Resource Planning system is essential.

Tyco Electronics offers the following key products which address this market:



Monitoring (HMI Interface)

HMI (Human Machine Interface) is the communication device between the machine and the user. It is the centre of all monitoring and control operations. With an increased demand for Web-based HMIs, applications have become more complex. Manufacturers are challenged with providing a user-friendly interface while meeting the required system features, environmental conditions, and high speed connectivity. The ability to easily upgrade system components, system software, and transfer or collect data is necessary to maintain technology leadership.

Tyco Electronics offers the following key products which address this market:

HTS Heavy Duty Connectors

Tyco Electronics offers a range of heavy duty connectors which serve a wide range of industries, including industrial. This range includes inserts for signal and power applications as well as combination inserts for signal and power in the same insert. Modular inserts are also available, which allow the end user to create unrestricted combinations of different inserts.

HTS connectors will accommodate up to 5000V, 420A and 216 contacts. The inserts are available in RJ45, USB, FireWire, Fibre Optics, D-sub, Coax, Pneumatic, Power and Signal. The connector housings are made from die-cast aluminum and are classified IP65 to IP68. EMI/EMC and corrosion protection is also possible which is essential in Industrial environments.

Typical applications include:

- Machinery
- Manufacturing equipment
- Factory automation
- Field instrumentation

Product Features

- Impact resistant die-cast aluminum
- Powder coated surface for corrosion resistance
- EMI protection
- IP68 classification for submersion in water
- Protection against shock and vibration
- Inserts accommodate up to 5000V, 420A and 216 contacts
- Silver and gold plated contacts
- Crimp, screw and spring clamp style wire termination
- Laser-marked inserts provide permanent product identification

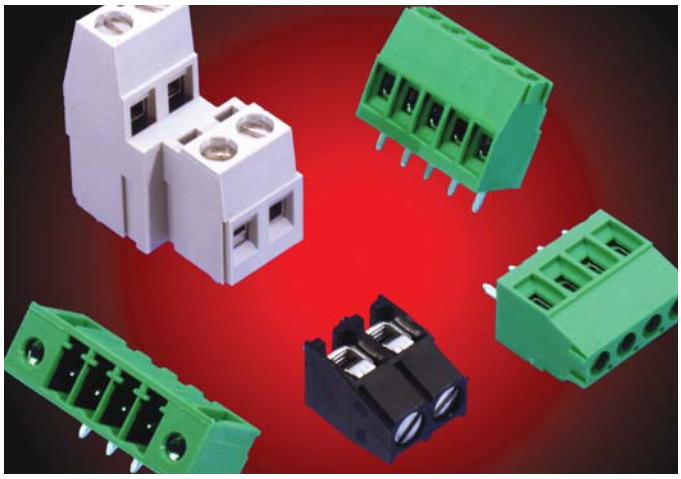
Circular Plastic Connectors CPC

The CPC (Circular Plastic Connector) family consists of four sizes of pin and socket connectors arranged in six different series, which permit a wide range of different contact types. These connectors are used as a rugged power input/output connector solution in commercial applications such as automotive, aviation, measurement and control technology, pharmaceuticals, mechanical engineering and machine controls. Rapid connect and disconnect is achieved with the use of a coupling ring which is optional in the metal version). As an extension of the standard CPC ranges, splash-proof connectors classified as IP65 and IP67 are also available, as are connectors with metal housings.

Product Features

- Lightweight, all-plastic circular connectors with quick connect/disconnect coupling
- Offered in six connector series comprising signal, power and combination signal/power configurations
- Overall position range of 3 to 63 and current capacity up to 50A
- Available in panel or chassis mount and free-hanging configurations
- Some versions sealable to IEC IP65 or IP67
- The metal-shell version (CMC – Circular Metal-Shell connector) has a thermoplastic insert in a nickel-plated, zinc alloy shell. An optional TETRASEALS interface seal provides splash-proof sealing between connector metal shells.

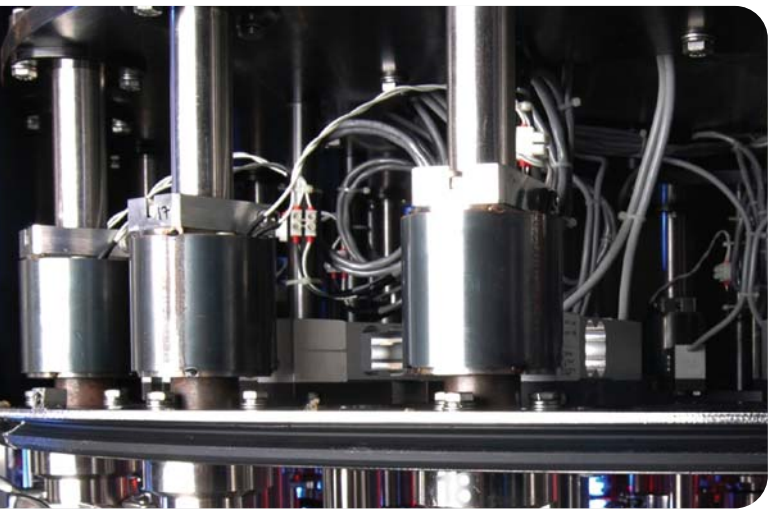
Terminal Block Connectors



Tyco Electronics offers an extremely wide range of terminal blocks for all customer requirements in an industrial environment. The portfolio also features the special rising cage clamp design. The modular design of Terminal Block connectors consists of one-piece board-mount terminal blocks and plug connectors, with mating straight and right angle shrouded headers. A special version - which can be mated either 90° or 180° - completes the product line.

Product Features

- IR reflow compatible
- Rising cage clamp with open screws to simplify handling in the field and to minimise installation effort
- Captive screws
- Non-magnetic metal parts
- Halogen-free Polyamide 6.6 housings according to UL 94V-0
- Operating temperature -40°C to +105°C
- End-to-end stackable without loss of centreline space



Dynamic Series Connectors

Dynamic Series Connectors are the perfect solution for wire-to-wire, wire-to-panel and wire-to-board applications. The Dynamic Series family of products offers solutions for both signal and power, and is further segmented by current rating. The D-1000 series offers the smallest centreline spacing of 2mm (0.078") and 3 to 5A per line whilst the D-5000 series offers the largest centreline spacing of 10.16mm (0.400") and 12.5 to 48A per line.

The Dynamic Series family of products has a connector solution for almost all applications, and new additions to this series are constantly being made.

Product Features

- Audible click during mate cycle
- Polarised and Latching housings
- Various keying options to prevent mis-mating of connectors
- "Lance-less" contact design prevents back-out issues
- Visual markings identify housing cavities
- Visual markings identify housing cavities and contact size
- Accommodates 120VAC, 3A to 630VAC, 48A
- Wire range AWG 30 (0.5mm^2) to AWG 8 (8mm^2)
- PCB connectors in 90° and 180°

M8/M12 Connectors & Cords Sets

Tyco Electronics offers a line of M8/M12 products for use in the industrial and factory automation markets. This connector system follows the established industry standards and consists of single-ended cable assemblies in lengths of two to ten metres. The cable assemblies are available with both PVC and PUR jacketed cables for indoor and outdoor use. They also include options for straight or right angle over-molded connector ends, shielding and LEDs. Panel mount products are offered for both PCB mount or solder cup. Field terminable products are available in both screw-type or solder cup termination style. Y-adapters are available for splitting of control signals and double-ended cord-sets are available upon request.

Product Features

- IP67 rated product for cable assemblies and panel mount product
- IP68 rated product for field terminable products
- M8 product family
  - 3 and 4 position product
- M12 product family
  - 3, 4, 5 and 8 position product
- PVC and PUR jacketed cable available
- Single and double ended cable assemblies
- Shielded and un-shielded product
- Panel and PCB mount product
- Field terminable product

Industrial Ethernet Products

Tyco Electronics offers a variety of connectors and active products for Industrial Ethernet applications. These will accommodate all of your connection needs, from ruggedised RJ45 connectors to Ethernet switches. Solutions for both IP20 and IP67 applications are available.

Passive Products

IP20 field-installable RJ45 plugs, IP67 plug and receptacle kits, IP20 and IP67 cable assemblies and Industrial Ethernet cable.

Active Products

Industrial Ethernet switches, media converters and device servers.

Product Features

- Tool-less, field terminable, IP20 RJ45 plug
  - 4 and 8 position
- IP67 plug and receptacle connectors meet the Ethernet/IP and Open DeviceNet Vendor Association

Interoperability Interface Specification

- 10/100MB Ethernet switches
  - 4 port RJ45 with 1 port fibre optic
  - 5 position RJ45
  - 8 position RJ45
- 10/100/1000MB Ethernet switch
  - 4 port with 1 port Small Form-Factor Pluggable transceiver
- Media converter
  - 1 port RJ45 to 1 port fibre optic
- Device Server
  - 2 ports RJ45 to 1 port 9 pin D-Sub
- Cat 5e Industrial Ethernet cable
  - 2 twisted pair solid
  - 2 twisted pair stranded
  - 4 twisted pair stranded

Industrial Mini I/O Connector

Ethernet connectivity at 1/4 the size. Tyco Electronics Industrial Mini I/O connector is 1/4 the size of standard RJ45 connectors. At 1Gbit per second speed, it can be used in a variety of applications. Two points of contact and a metallic latch make this ideal for high vibration industrial applications.

Product Features

- Two points of contact
- 0.5A per contact
- Latching
- Utilises standard Cat 5e industrial cable
- Two keying options prevent miss-mating
- Cable assemblies available upon request

Coax Connectors

The RF coax connectors range comprises a variety of styles and configurations to suit almost all design requirements and production needs. The combination of connectors and associated tooling ensures trouble free termination at the lowest applied cost.

Product Features

- Designed and manufactured to meet customer requirements in industrial atmosphere
- Wide range of connectors available in 50 and 75 Ohm impedance
- The range offers connectors to suit from DC to high frequency operation
- Mounting style of PCB, panel and bulkhead available
- Multiple plating options
- Cable termination can be crimp, solder clamp or pressure sleeve methods
- Full range of connector crimp dies and hand tools

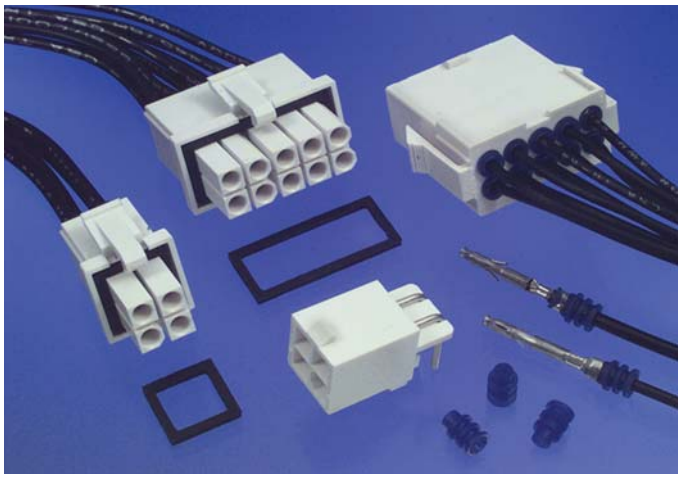
MATE-N-LOK Connectors

A reliable, versatile and environmentally-friendly connector system with crimp poke contacts, available in strip or loose piece. Efficient polarisation and connector latching are features of this economical connector range.

Product Features

- Standard density, wire-to-wire and wire-to-board connectors
- 5.08mm [0.200"] centreline
- 1-16 positions
- Panel mount or free hanging
- Ratings: 19A, 250VAC
- Hot side is egg-crated for safety
- Fully polarised nylon housings
- Easy cavity identification
- Locking devices are integral part of design. Connector halves will hold together under severe conditions of vibration and shock
- Wire-to-board capability using pin or socket headers

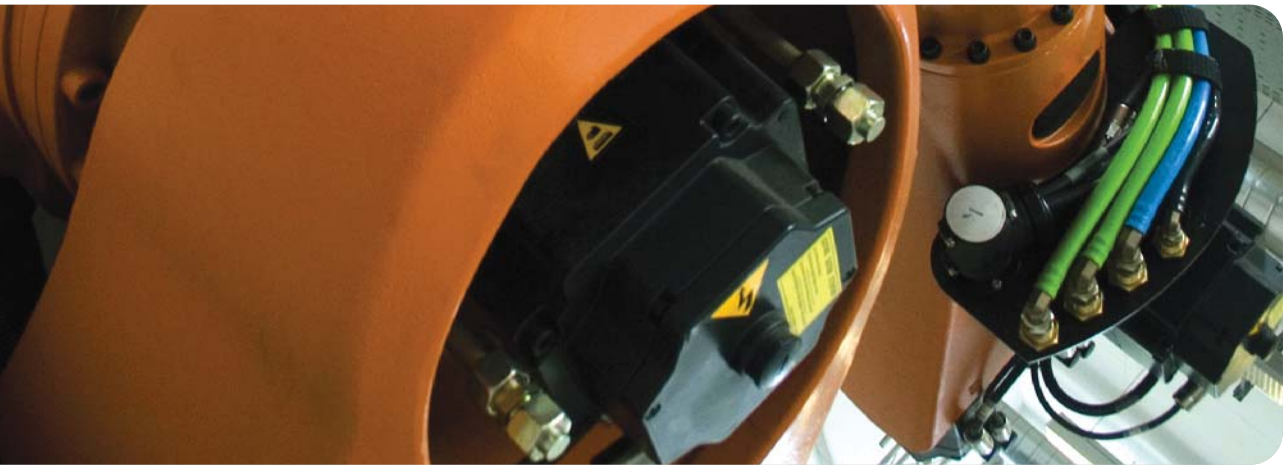
Mini-Universal MATE-N-LOK Connectors



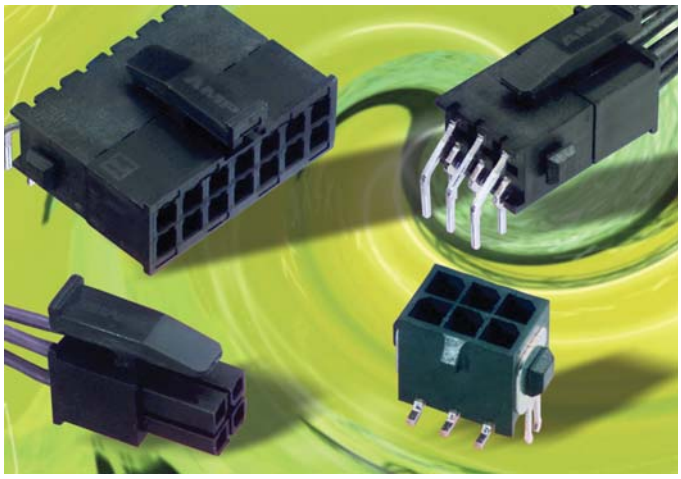
The Mini-Universal MATE-N-LOK connector was developed for low voltage halogen lamp termination, offering ease of use and low assembly cost with high operating reliability. The compact design can be easily used for installation in narrow spaces. Integrated strain relief assures a reliable connection.

Product Features

- High density, 4,14mm [0.163"] centreline plus 1-24 and 2-24 positions respectively
- Wire-to-wire and wire-to-board capability
- Ratings: 600VAC or VDC, 9.5A and 10.5A respectively
- Contacts are protected in the housings
- Seals available for splash protection



Micro MATE-N-LOK Connectors

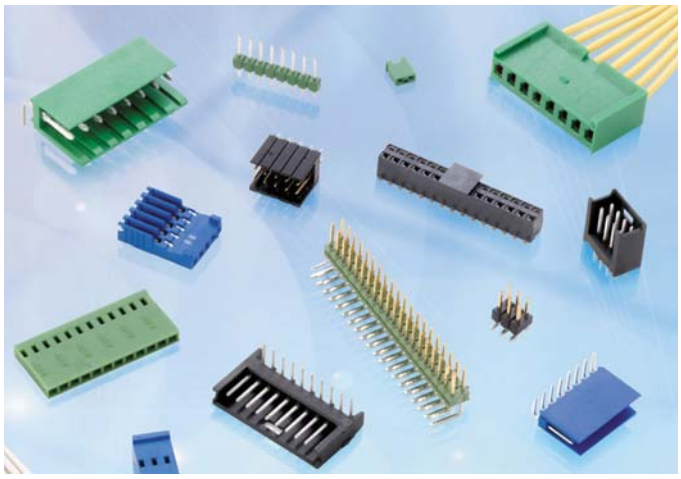


The Micro MATE-N-LOK 3mm connector system is a wire-to-wire and wire-to-board connector system with contacts on a 3mm [0.118"] centreline. Both single-row and dual-row configurations are available. Crimp, snap-in pin and receptacle contacts are used to terminate AWG 24-20 [0.2-0.6mm^2] and AWG 30-26 [0.05-0.15mm^2] wire. Plug and receptacle housings allow wire-to-wire and wire-to-panel configurations. Header assemblies for wire-to-board interconnections include vertical and right angle components. These IR reflow process compatible headers are available in through-hole and surface-mount configurations.

Product Features

- Wire-to-wire and wire-to-board pin and receptacle connector system
- Contacts are on 3mm [0.118"] centreline spacing
- 2 to 12 contact positions – single row
- 2 to 24 contact positions – dual row
- Panel mount or free-hanging wire-to-wire configurations
- Dual beam contact design for reliable interconnection
- Contacts accept AWG 24-20 and AWG 30-26 wire with an insulation diameter of 1.52mm [0.060"] maximum
- Contacts available in strip form or loose piece
- PCB-mount pin header assemblies in both vertical and right-angle styles
- Surface-mount or through-hole PCB pin header attachment
- PCB headers are IR reflow process compatible

AMPMODU Connectors

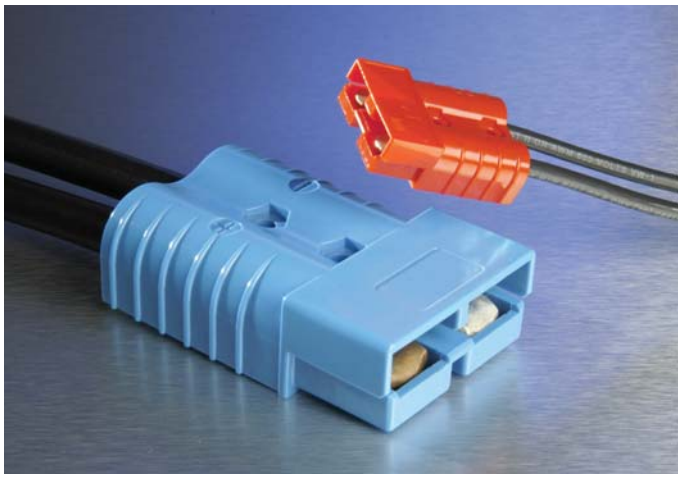


From fine-pitch signal to power connection, the AMPMODU system provides innovative solutions for all type of industries. Wire-to-board and wire-to-wire applications are reliably made possible through a comprehensive family of interconnect components in a choice of packaging densities. Fully compliant with recent RoHS 2002/95/EC directives, AMPMODU products feature a range of termination options for discrete wire or ribbon cable, as well as PCB mount variants for through-hole solder - including wave, pin in paste and press fit - plus surface-mount styles.

Product Features

- Available for board-to-board, wire-to-board and wire-to-wire applications
- Shrouded pin headers feature polarisation and detent latching
- Flame-retardant thermoplastic housings - UL 94V-1 and UL 94V-0 rated
- Contacts available in both tin and gold plating
- Pitches available 0.8mm [0.031"], 1.27mm [0.050"], 2mm [0.078"], 2.54mm [0.100"], 3.96mm [0.156"]
- PC/104 and PC/104 plus connectors
- Special contact locking clip

AMP Power Series Connectors

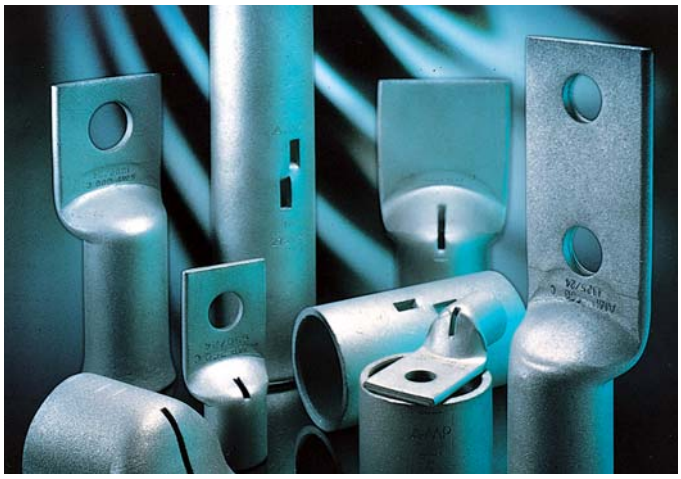


AMP Power Series Connectors provide a durable, quick connect/disconnect means of transmitting 'power' levels of current and voltage (15-275A, 600VAC/DC). This product family includes single-pole and two-pole (battery) connector housings, crimp snap-in contacts and accessories. Housings are offered in various colours and two-pole housings have different polarisation configurations. With the exception of black housings, each colour identifies a different keying configuration. In general, only same-colour housings will mate. Contacts are either cold-headed or stamped and formed, depending upon the connector series. AMP Power Series connectors are divided into eight series, based on approximate current-carrying capability.

Product Features

- Single-pole and 2-pole (battery) quick connect/disconnect connectors
- Eight series, based on approximate current–carrying capability
- Voltage rating: 600VAC/DC
- Colour-coded housings: UL 94V-0
- Modular single-pole housings are stackable in four directions
- Stainless steel retaining springs secure contacts in housings
- Stamped and formed, open barrel contacts (AWG 6-20) on reels for automatic and semi-automatic machine termination
- Connectors are inter-mateable with similar connectors from other manufacturers
- Hermaphroditic

AMPOWER Terminals & Splices



The AMPOWER terminal and splice product line is available in a variety of styles to suit your individual design requirements. AMPOWER terminals and splices are ideally suited for power generation and distribution. This makes electrical equipment such as generators, motors and welders (which are subject to continuous operation) a perfect application for AMPOWER products.

Product Features

- Designed for large cables and leads
- Ideally suited for power generation and distribution
- Accepts a wide range of stranded copper wires (AWG 6 to 1,000 MCM [13-507mm^2] for terminals and up to 1500 MCM [760mm^2] for splices)
- Available in a variety of terminal and splice styles
- High-quality, seamless tubular copper for maximum conductivity

PLASTI-GRIP Insulated Terminals & Splices

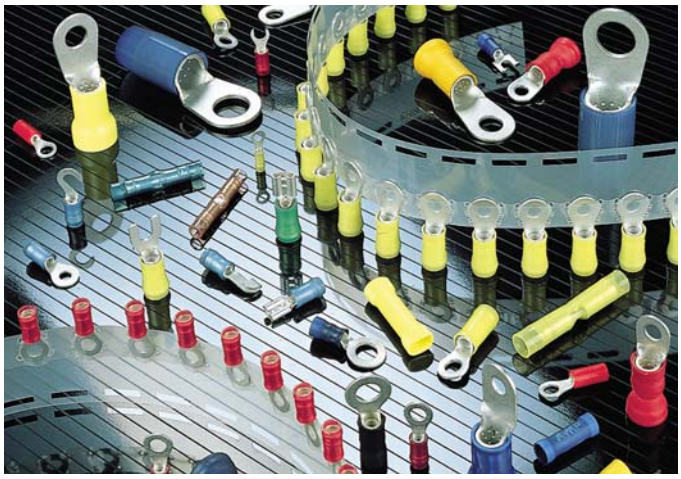
Pre-insulated PLASTI-GRIP solderless terminals and splices have been designed specifically to meet the need for inexpensive, insulated electrical terminations. The appeal of PLASTI-GRIP product lies in their broad range of wire sizes, built-in pre-insulation, ease and speed of application, uniform reliability and low installed cost. This enables them to be used in almost every type of industrial or commercial application.

As is true of all Tyco Electronics terminals and splices, carefully-engineered application tooling has been developed for the PLASTI-GRIP range, to ensure uniform, high-quality terminations.

Product Features

- Terminal is made of high conductivity copper, electro tin plated for improved corrosion resistance
- Serrated inner wire barrel provides maximum electrical contact and tensile strength after crimping
- Conical entry of the wire barrel allows easier insertion of the stripped wire
- Expanded vinyl insulation sleeve to accept a wide range of wire insulation diameters
- Insulation sleeves and corresponding tooling are colour-coded by wire range for easier identification

PIDG Terminals & Splices



PIDG pre-insulated diamond grip terminals and splices are designed for complete and uniform reliability. The pre-insulated termination ensures a vibration-safe connection with maximum conductivity, and its tensile strength approaches that of the wire itself. Each PIDG terminal consists of a tin-plated copper body, with a specially designed copper sleeve and insulation sleeve fitted over the terminal barrel.

Product Features

- Made of high conductivity copper
- Electro tin-plated for improved corrosion resistance
- Applicable wire size is marked on the tongue
- Inner serrations on the wire barrel give maximum electrical contact and tensile strength with the conductor
- Copper sleeve provides circumferential insulation support to the wire, and allows it to be bent in any direction without damaging the insulation or conductors
- Insulation sleeves and corresponding tooling are colour coded by wire size for easier identification
- A variety of PIDG terminals and splices are UL listed file E 13288 and certified by CSA file LR 7189

FASTON Terminals & Connectors

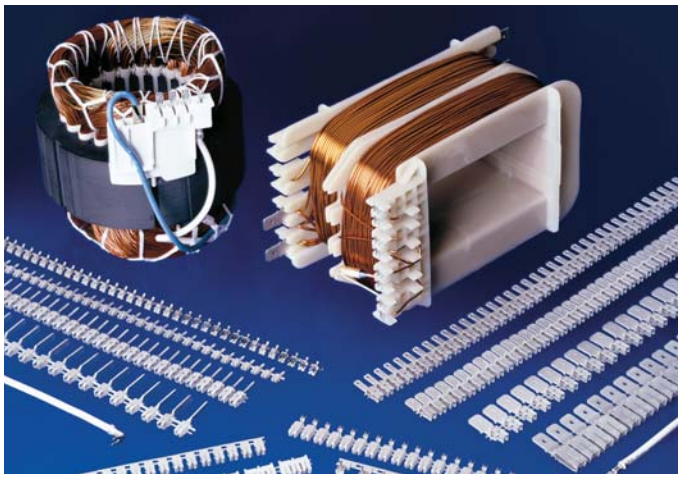
Tyco Electronics' FASTON product line consists of receptacles, tabs and splices specifically designed for quick connections, with a large variety of sizes and types available. Receptacles are available in straight and flag type, come in a variety of sizes and are designated numerically by a series number which corresponds to the width of the mating tab. Straight receptacles are available with or without insulation support. Insulation diameters of 1.2mm [0.047"] to 6.7mm [0.263"] are accommodated by the insulation support receptacle.

The product line offers speed application, uniform reliability and low per-line cost. Speed application is achieved through the use of application tools, for which a complete line has been developed specifically for these terminals. This product line has a long history with proven reliability.

Product Features

- Straight right-angle and receptacle-tab combinations available
- Receptacles available for 6.3 - 4.8 - 2.8mm tab size (.250- .187- .110 Series)
- Receptacles mate with 0.5mm [0.019"] and 0.8mm [0.031"] thick tabs
- Low insertion force (LIF) receptacles available
- IEC 60335-1, Glow Wire 750° NO FLAME housings available
- RoHS compliant

MAG-MATE Terminals



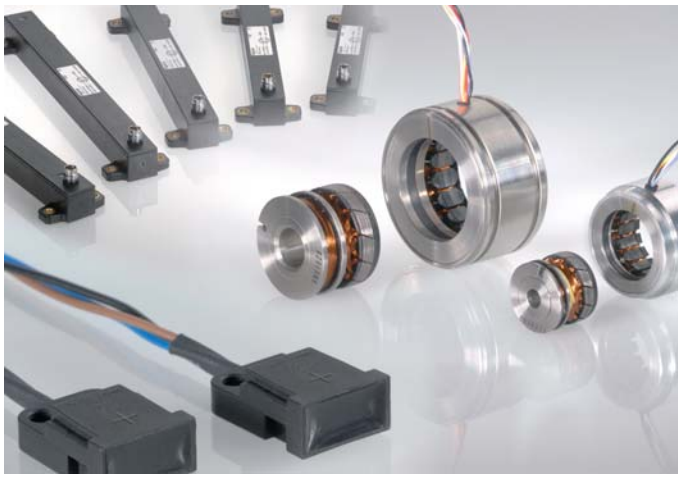
The MAG-MATE terminal provides a durable, gas-tight electrical connection without the need to pre-strip the wire. The system uses insulation displacement technology in conjunction with a pre-determined design of plastic terminal pocket, which is moulded into the bobbin frame.

High speed coiling machines utilise MAG-MATE products, to achieve significant applied-cost savings due to quick and efficient application, especially when compared with soldered assembly. AMP semi-automatic application tooling machines are available for this low cost product.

Product Features

- Terminates all magnet wire film insulations
- Eliminates need for pre-stripping conductors
- Eliminates need to post-insulate termination
- Excess magnet wire automatically trimmed during termination process
- Simultaneously terminates two magnet wires
- Various lead wire attachment options available
- Available in reels, strip form and loose piece
- Varnish-resist tab terminals are available for special applications
- High-speed, fully automated integrated systems provide uniform termination reliability at the lowest possible applied cost
- Stable, gas-tight and free of oxides or other contaminants
- Wire sizes for standard products AWG 52 – 12 (0,02 – 2,06mm^2)

Sensors



Tyco Electronics offers a wide range of sensors for the contactless detection of diverse mechanical parameters such as switching, position, distance, angle, engine speed and rotation. All these sensors operate on the basis of the magnetic induction principle.

Thanks to their compact size and multiple control options, these electromagnetic sensors can be matched to almost all requirements. The selection and dimensioning of the magnetic circuit is oriented exactly to the relevant application.

A comprehensive service and a customised package is also offered in addition to standard elements. This covers the entire range from selection of the sensor technology via dimensioning, simulation, qualification and prototyping to the series manufacture of customised solutions.
A distinction is made between three types of binary sensors:

- Hall-effect proximity switches
- Pulse-wire sensors
- Position and compensation sensors

Product Features

- Contactless and no friction
- High level of innovation
- Wide range of proven sensor modules for position detection
- Customised solutions
- Selection of optimum sensor principle
- Application-specific design of sensor system
- Customised solutions which consider specific applications needs
- In-house prototyping and mass production facilities

Switches

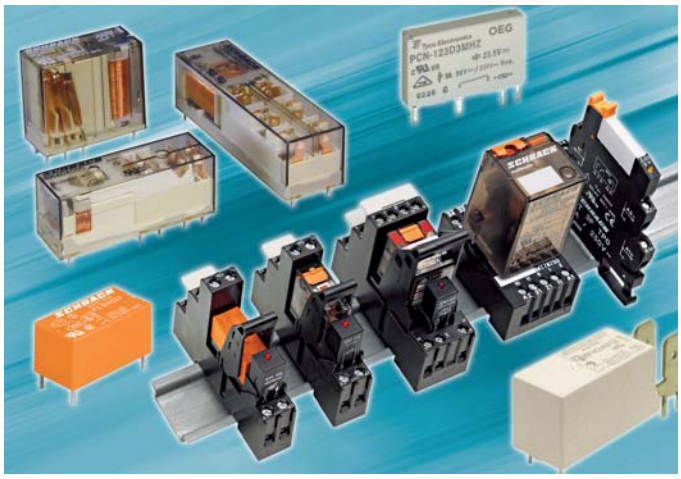
The Tyco Electronics range of switches is designed to be cost-effective, reliable and to enhance productivity. Delivering a broad range of switch products, the range covers rotary, panel mount Power Rocker, micro switches, toggle, DIP switches, slide switches. In addition, customised switching solutions for customer applications from the mA-range up to 25A are also offered. Rotary knobs, caps, boot seals and other accessories complete the extensive range.

Covering the widest possible variety of industrial applications, Tyco Electronics' switches can be used anywhere including production lines, robotics, lifts, conveyers, control panels, vending machines cash dispensers and motion control systems.

Product Features

- Customised versions
- Process-sealed and environmental-sealed versions
- Wide range of contact configurations, from 1 pol up to 30 pol
- Various mounting/terminal options - THT, SMT, wire lug, solder lug, quick connect and different bushing styles

Relays

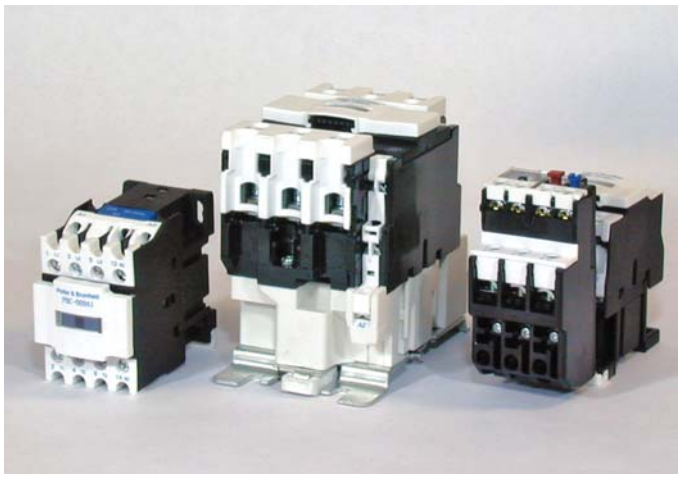


The Tyco Electronics' range of Power Relays provides a cost effective solution for almost all main switching requirements. Incorporating the SCHRACK, POTTER & BRUMFIELD and OEG brands, these relays are for PCB, socket, surface or rail mounting with up to 30A capability. Products cover industrial, safety and many other applications - with solutions for high inrush, high temperature, energy saving and high reliability applications. All products meet the relevant international standards.

Product Features

- PCB, Plug-In, Solder/Faston, THR terminals
- DC-, AC-, bi-stable coils
- Up to 4 C/O contacts
- Up to 60A switching current
- Relays for high inrush currents
- Safety relays
- Relays for solar applications
- Relays for high ambient temperatures
- RoHs compliant
- Many approvals available (e.g. VDE, TÜV, cULus, etc.)

IEC-Type Contactors



Compact AC coil contactors in three frame widths offer ratings from 9A to 80A (AC-3 per IEC 947-4). Available accessories include auxiliary contact blocks for side or front mounting, thermal overload relays, timer blocks for front mounting, mechanical interlocks and more.

Product Features

- Contactors offer three pole switching (main contacts) plus integral auxiliary contacts
- Designed to snap onto DIN rail (35mm or 75mm) or mount directly to a panel with screws
- Efficient 50/60Hz coils (50 or 60 Hz coils optional) Finger-safe (IP20) terminals
- Modular design allows accessories and contactors to snap together
- Bimetallic thermal overload relay can be added to create a starter
- Coil termination permits either same side or diagonal wiring

Filters

Tyco Electronics' CORCOM brand is one of the worldwide market leaders in the field of EMC filter technologies. The range offers filter solutions based on more than 50 years experience for clients in industrial applications. A large selection of off-the-shelf filters and already-proven special filters are available, in order to provide an optimal solution for noise reduction problems. Tyco Electronics also offers the possibility of developing a custom-designed filter specially tailored to customers' requirements. Three main categories of filter are available:

1. IEC Plug Filters - Power Entry Modules (PEM) & IEC Plugs

The key ranges in this category are the P Series (PEM), EJ Series and the SRB Series. These filters cover a wide range of applications and connection/assembly requirements, making them suitable for a diverse range of electrical and electronic devices.

2. Single-Phase Filters For Industrial Applications

The key ranges in this category are the EMC and B Series. These include an extensive selection of filter ranges for use in single-phase industrial applications, and include a wide range of connection and attenuation properties. Application examples include consumer electronics, Industrial applications, motors drives, inverters and switching power supplies.

3. Three-Phase Filters For Industrial Applications

The key ranges in this category are the BCF and FCD series. Typical application areas here are machine tools and control cabinet, plus all types of power converter applications. The product spectrum comprises 3 and also 4-wire filters for a range of 3 to 900A.

Passives

As a leading manufacturer of passive components, Tyco Electronics serves a wide range of sectors, offering both standard and custom-designed solutions. Key resistor technologies are thick film, thin film, wire-wound and foil technology. These core processes can be adapted to achieve solutions both as standard components or specific to a customers design requirements. In addition Tyco Electronics is offering market leading range of inductors and capacitors to satisfy all customer requirements and to minimise their purchasing efforts.

With our in-house design and engineering capabilities and our test lab, we can offer customised solutions for your application.

Precision Resistors

- SMD and leaded high reliability and stability products
- Thin film and wire-wound technologies
- Accuracy to +/- 0.01% and 5ppm

Power Resistors

- Power ratings from 1W to > 1KW
- Wire-wound, thick and thin film, foil, carbon and ceramic composition
- Current-sensing capabilities
- Current sense resistors from 0.5 milliohm, TCRs and tolerances of 50ppm and 1%
- SMD series (TLR) offer power ratings to 3W

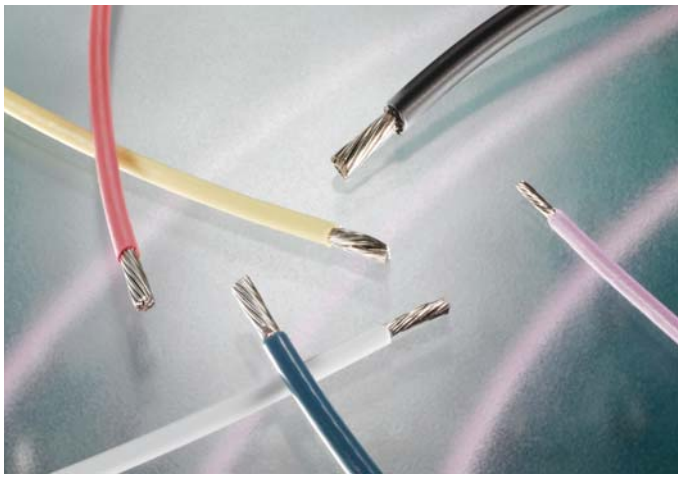
Customised Cables & Cable Assemblies

Tyco Electronics produces a wide range of standard and custom Cable Assemblies and value added products for use in an endless list of applications across every industry. Value Added Cable Assemblies can be custom-designed to meet individual requirements, and global manufacturing capabilities are also available for demand fulfilment based on customers needs.

Comprehensive Engineering Design and Support Teams can provide solutions for even the most demanding applications, from harsh environmental and industrial applications. Solutions can be developed to meet individual needs and the entire project can be managed for the customer from conception through project launch - meeting quality, cost and timescale objectives.

Tyco Electronics' Value Added Products business development team can create comprehensive cost reduction roadmaps that provide a structured and systematic approach to achieving long-term cost targets. The overall aim is to create sustainable lowest-cost solutions through the use of proven cost-reduction techniques, combined with comprehensive design and manufacturing capabilities.

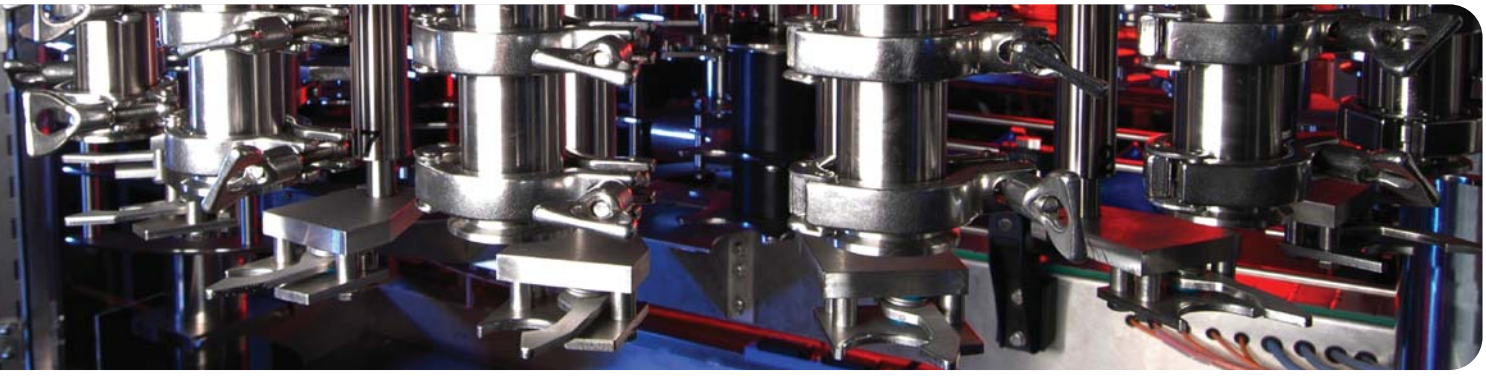
Wire & Cable



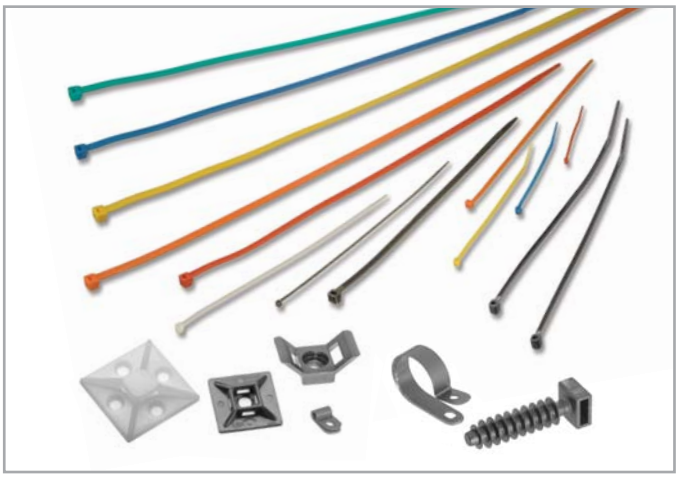
These products utilise Tyco Electronics' knowledge of materials and radiation chemistry to maximise the performance of materials which are used in exacting environments. By using precision extrusion, our wire and cable product range is smaller and lighter when compared to other wires and cables that have a similar electrical performance. This then allows for a reduction in the size of cable accessories and connectors. The product range includes high performance insulated wires, coaxial and data bus cables, power cables, electronics wire and multi-core cables.

Product Features

- Small size
- Lightweight
- 600, 1000 and 2500V rating
- Good chemical resistance
- Available in both wire and multi-cable formats
- Low smoke and low corrosive gas generation
- Resists notch propagation



Cable Ties, Mounts & Accessories



There is a need for cable ties in order to bundle and fasten wires and cables quickly and economically, in various application areas. Tyco Electronics has extended the existing AMP-TY cable tie range to satisfy present and future market requirements. The range consists of the most commonly-used sizes, materials and colours with customer-friendly packaging, and now offers an almost unlimited number of possibilities.

Product Features

- Self-locking head ensures stable binding power even under extreme conditions - e.g. temperature and vibration
- Interior serrations help to hold individual wires or bundles firmly in place through friction
- The tapered tip, often with a 'bent tail' facility for easy insertion, speeds up threading and reduces applied cost
- Tough, smooth polyamide may be used for indoor and outdoor applications
- The all synthetic one-piece design eliminates metal parts
- AMP-TY cable ties can be applied by hand or by using application tools

Heat Shrink Tubing

With today's installation techniques, heat shrinkable products simply cannot be ignored. Due to easy processing and shrinking at relatively low temperatures, these products can be used in many applications. With a top performance at a low price, shrink products make it possible to accomplish lasting and safe mechanical and electrical protection of various parts. They also allow repairing of cables and cable connections. For the development of prototypes or small production runs, Tyco Electronics offers kits with several different types of shrink tubing, or for other applications an extensive range of heat shrinkable tubing is also offered.

Product Features

- Flame retardant, standard-grade polyolefin
- Thin wall heat shrink with a 2:1 shrink ratio
- Wide range of different colours
- Supplied in dispenser packs, multi packs and bulk reels
- Insulation – thermal and electrical
- Protection – chemical and mechanical abrasion
- Strain relief – connectors and splices
- Sealing – moisture, water and fuels
- Identification - earth/grounding colour
- Cosmetic – improves appearance

Identification

Tyco Electronics offers a wide range of custom and pre-print adhesive-backed labels as well as dashboards and membrane keyboards all of which are made from high quality materials and adhesives. We also offer a comprehensive after-sales and technical support service, including full hardware and software installation and training.

Product Features

- Custom and pre-print labels to meet specific customer application requirements, including custom designs and logos
- UL-certified label materials, marking and labelling systems (PGDQ2 and PGJI2)
- Printer, ribbon and label material solutions
- Custom-designed membrane keyboards and dashboards for industrial control and HMI
- Colour-matching to customer specifications: PMS, RAL and BSI standards
- Scratch-resistant and anti-graffiti over-laminating technology
- Multiple types of adhesives to suit most surfaces

Cable Identification

Tyco Electronics is a world-class supplier of industrial identification products which deliver the latest in wire and cable identification. We offer product lines in a wide range of materials and ink technologies, to suit a range of demanding environments.

Product Features

- Heat-shrinkable tubing sleeves provide permanent wire identification, strain relief and insulation
- Tie-on cable markers provide identification solutions for large cables and wire bundles
- Available in a multitude of sizes, materials and colours for diverse applications
- Outstanding print quality and mark permanence
- Meets industry and customer-specific standards
- Products will perform in harsh industrial environments and are abrasion resistant and fluid-resistant (oils, greases and fuels) as well as being suitable for high or low temperature applications
- Complete printing system available including software, printers and ribbons

Tyco Electronics Application Tooling Division can provide you with the best and most economical system solutions, including:

- Hand tools
- Semi-automatic bench machines
- Magnet wire terminating equipment
- Advanced wire processing machines
- High-speed blockloaders
- Lead makers
- Harness makers
- Mass termination machines
- Insertion and seating machines
- Crimping machines
- IDC/ribbon cable assembly machines
- Wire seal applicators
- Precision applicators
- PC Board assembly equipment
- Press-fit assembly equipment
- De-panelling equipment

MAG-MATE Insertion Machine

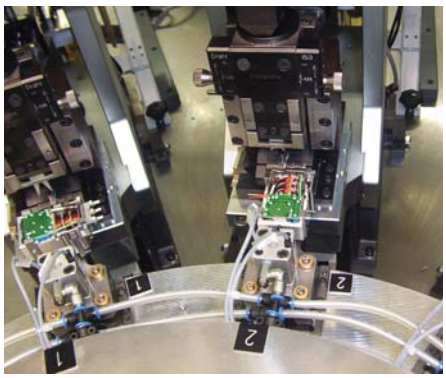
MAG-MATE Applications

Magnet Wire Tooling

Our Global Application Tooling Division also offers a broad selection of tooling to support the application of terminals. We have further developed existing technology for the application of various AMPLIVAR and MAG-MATE terminals, according to customer specific requirements.

With special MAG-MATE tooling, electrical connections between magnet wire and MAG-MATE terminals can be made. During this termination the small stripping devices penetrate the film insulation on the magnet wire. Residual spring energy in the terminal causes the side walls of the IDC slot to function as opposing cantilever beams. This constant pressure results in an intimate metal-to-metal interface, providing a reliable long term connection.

Based on the well known crimp technique, the AMPLIVAR technology is another method by which to apply magnet wire. Various AMPLIVAR termination machines are available to terminate AMPLIVAR splices. The splices have machined sharp-edged serrations inside the crimp barrels and these serrations pierce the insulating layer of the magnet wire in a manner that provides a large contact area. This application technology also ensures reliable electrical connections.



AMPLIVAR Round Table Machine

Hand Tool

Tyco Electronics

A

abrasion-resistance A measure of the ability of a wire or wire covering to resist damage by mechanical means.

accelerated aging A test in which voltage, temperature, or other test parameters are increased above normal operating values to obtain observable deterioration in a relatively short time. The plotted results give service life within the context of the test.

adapter A device usually attached to the rear of connectors that provides for the attachment of harnessing components, such as strain-relief clamps, heat-shrinkable boots, and braid.

adhesive liner Lining that melts and flows inside a sleeve or molded part, filling any voids in between the substrate and the sleeve or molded part. DuraSeal has an adhesive liner.

ampacity See current-carrying capacity.

amplitude The magnitude of variation in a changing quantity from its zero value. The word requires modification — as with adjectives such as peak, maximum, rms, etc. — to designate the specific amplitude in question.

arc voltage Voltage that continues to pass through a surge protector during activation of GDT (approx. 20 volts).

ASTM (American Society for Testing and Materials) A nonprofit industry-wide organisation that formulates test methods and material specifications, and publishes standards, testing methods, recommended practices, definitions and other materials.

AWG (American Wire Gauge) The recognised method (in the United States) of specifying conductor size. The higher the gauge number, the smaller the conductor size.

B

back mounted A connector attached to the inside of a panel or box with its mounting flanges inside the equipment.

bare conductor A conductor not covered with insulating material.

barrel ***1.) Connector barrel:*** The section of the terminal, splice, or contact that accommodates the stripped conductor. ***2.) Insulation barrel:*** The section of the terminal, splice, or contact that accommodates the conductor insulation. ***3.) Open barrel:*** The section of a cap that accommodates the conductor.

bayonet coupling A quick-coupling device for plug and receptacle connectors. Mating is accomplished by rotation of the two parts under pressure.

bellmouth Flared at the mouth. The rear of a properly crimped wire barrel will have a slight flare (bellmouth) to relieve the strain on the wire strands as they leave the area of high compression and take their natural "lay". A bellmouth condition may also be present in front of the wire barrel.

binder A spiral wrapping of a thread to hold together the members of a cable.

blocking The sticking together of insulated wires; usually caused by heat.

body Main or largest portion of a connector to which other portions are attached.

bonding temperature Temperature above which adhesive melts and flows sufficiently to form an adhesive bond between substrates.

braid A weave of metal fibres used as a shield covering for an insulated conductor or group of insulated conductors. When flattened it may be used as a grounding strap.

braid angle The angle between the braid strands and the axis of the cable.

breakdown voltage The voltage at which an insulator or dielectric fails to maintain the applied voltage.

breakout A region in a harness assembly where a wire or a group of wires is detached to form a separate, terminated branch. Also known as a transition.

bulkhead A term used to define a mounting style of connectors. Bulkhead connectors are designed to be inserted into a panel cutout from the rear (component side) of the panel.

bunch stranding A method of twisting individual strands to form a finished stranded conductor. Specifically, a number of strands twisted together in a common direction and with a uniform pitch (or twist) per inch.

bus A communal circuit over which data or power is transmitted.

C

cable Two or more wires in a twisted or parallel configuration. Also, a shielded wire.

cable clamp A mechanical clamp attached to the cable side of a termination assembly to support the cable or wire bundle. It provides strain relief and absorbs vibration and shock that would otherwise be transmitted by the cable terminations.

cable clamp adapter A mechanical adapter that attaches to the rear of a termination assembly to allow the attachment of a cable clamp.

cable sealing clamp A device consisting of a gland nut designed to seal around the jacket of a cable.

cabler A machine that mechanically assembles a group of insulated wires.

cabling The act of twisting together two or more insulated components to form a cable.

capacitance The property of an electrical conductor (dielectric in a capacitor) that permits the storage of energy as a result of electrical displacement. The basic unit of capacitance is the farad, however, measurement is more commonly in microfarads or picofarads.

carrier A group of strands or ends used to form a finished braid.

chemical resistance The ability of an insulation to withstand the presence of materials – such as acids, bases, water, salt water, and fuels – that can deteriorate the insulation, or that, if penetrable to the conductor, can cause dielectric loss of insulating qualities.

circuit The interconnection of a number of electrical elements or parts to accomplish a desired function.

Circular Mil Area (CMA) A unit of area equal to the area of a circle whose diameter is 1 mil (0.001 inch). Used chiefly in specifying cross-sectional areas of conductors. (See AMP Brochure No. 4402-8, Computing Circular Mil Area for AMP Terminals and Splices).

clocking The arrangement of connector inserts, jackscrews, polarising pins, sockets, keys/keyways, or housing configurations to prevent the mismating or cross-mating of connectors. See also polarisation.

closed entry contact A female contact designed to prevent the entry of a pin or probing device having a cross-sectional dimension (diameter) greater than the mating pin.

cold impact A test performed by subjecting a component to a specified impact during exposure to low temperature. It measures the brittleness of the material.

cold joint A soldered joint made with insufficient heat. (Solder hasn't completely flowed and wet the substrate).

colour code A means of identifying cable components using solid colours or stripes. Also, the scheme that assigns a number from 0 to 9 for each of 10 colours.

component A wire or cable that is combined with other wires or cables to make a multicomponent cable.

compound An insulating or jacketing material made by formulating polymeric materials and additives.

Compound Under Strands (CUS) A problem that occurs when loose stranding, or overheating during extrusion, allows compounds to get under individual strands of conductor.

concentric stranding A method of stranding conductor. Specifically, the final conductor is built up in layers so that the inner diameter of a succeeding layer is always equal to the outer diameter of the underlying layer.

conductivity The capability of a material to carry electrical current, usually expressed as a percentage of copper conductivity (copper being 100%). Specifically, the ratio of the current flow to the potential difference causing the flow. The reciprocal of resistance.

conductor The metallic strand or strands used to carry an electric current.

conductor resistance The resistance to flow of the electrical current along a conductor. Expressed in ohms/1,000 feet. (Usually referenced to 20°C).

conduit A tubular raceway for holding wires or cables.

configuration Arrangement of contacts in a multiple-contact connector.

connector A device used to physically and electrically connect two or more conductors.

connector classes Categories based on shape, function and smallest size contact in a series.

connector insert In connectors with metal shells, the part that holds contacts in proper arrangement while electrically insulating them from each other and from the shell.

contact The element in a connector that makes the actual electrical connection. Also the parts of a connector that actually carry the electrical current, and are touched together or separated to control the flow.

contact crimp A contact whose rear portion is a hollow cylinder that accepts the conductor. A crimping tool is applied to swage or form the contact metal firmly against the conductor. Sometimes referred to as a solderless contact.

contact durability The number of insertion and withdrawal cycles that a connector must be capable of withstanding while remaining within the performance levels of the applicable specification.

contact engaging and separating force Force required to either engage or separate contacts. Values are generally established for maximum and minimum forces.

contact inspection hole A hole, perpendicular to the cylindrical rear portion of screw machined contacts, used to check the depth to which wire has been inserted into the barrel.

contact resistance Measurement of electrical resistance of mated contacts when assembled in a connector under typical service use. Electrical resistance is determined by measuring from the rear of the electrical area of one contact to the rear of the contact area of the mating contact (excluding both crimps) while carrying a specified test current.

contact size The diameter of the engagement end of a pin contact; also related to the current-carrying capacity of a contact.

contact, two-piece A contact made of two separate parts joined by swedging, brazing or other means of fastening to form a single contact. While this provides the mechanical advantages of two metals, it also has the inherent electrical disadvantage of difference in conductivity.

continuity A continuous path for the flow of current in an electrical circuit.

continuous operating temperature Maximum temperature at which a component will maintain an acceptable lifetime performance, based on accelerated aging prediction.

core 1.) In cables, a component or assembly of components over which additional components, such as a shield or a sheath, are applied. 2.) Inner wall of dual-wall heat-shrinkable tubing.

coupling ring The portion of a plug that aids in the mating and demating of a plug and receptacle and holds the plug to the receptacle.

cover, electrical connector An item specifically designed to cover the mating end of a connector for mechanical and/or environmental protection. Also known as a dust cover.

coverage A calculated percentage that defines the completeness with which a braid or shield covers the surface of the underlying insulated conductor or conductors.

crimp The final configuration of a terminal barrel after the necessary compression forces have been applied to cause a functional union between the terminal barrel and the wire.

crimp height A top to bottom measurement of the crimped barrel, using a crimp height comparator in the prescribed manner. (Refer to AMP Instruction Sheet 7424).

crimping dies A term used to identify the shaping tools that, when moved toward each other, produce a certain desirable shape to the barrel of the terminal or contact that has been placed between them. Crimping dies are often referred to as die sets or as die inserts.

crimping head Tooling containing jaws and linkage for use in pneumatic or hydraulic powered units to crimp loose-piece contacts/terminals that may be too large for hand tool applications.

crimping tool A term commonly used to identify a hand held mechanical device that is used to crimp a contact, terminal or splice.

crosslinking The formation of bonds between molecular chains in a polymer by means of chemical catalysation or electron bombardment. The properties of the resulting thermosetting material are usually improved.

crosslinking by irradiation A method of crosslinking polymers that makes a nonflowing material. This generally improves the properties of the polymer.

CSA (Canadian Standards Association) An agency that has developed standard specifications for products with particular emphasis on safety in the end use.

current A movement or flow of electrons. Also, the measure of this flow, expressed in amperes.

current-carrying capacity The maximum current an insulated conductor is capable of carrying without exceeding its insulation- and/or jacket temperature limitations under specified ambient conditions. Also known as ampacity.

current rating The maximum continuous electrical flow of current recommended for a given situation. It is expressed in amperes.

cutout The hole, usually round or rectangular, cut into a metal panel in order to mount a connector. The cutout may also include holes for mounting screws or bolts.

cut-through resistance Resistance of solid material to penetration by an object (typically a closely controlled knife edge) under conditions of pressure, temperature, and other elements.

cycle One complete sequence of values of an alternating quantity, including a rise to maximum in one direction and return to zero; a rise to maximum in the opposite direction and return to zero. The number of cycles occurring in one second is called the frequency.

D

die closure Term used to designate a crimping area (crimping chamber) when the dies are fully closed or bottomed. Die closure is checked with go/no go plug guage to insure that the crimp produced by the tooling satisfies the crimp height specification.

dielectric A material that serves as an insulator. The amount of resistance to voltage in a given insulation.

dielectric breakdown The voltage required to cause an electrical failure or breakthrough of the insulation. Determined by a destructive test. See also breakdown voltage.

dielectric constant (also K) The ratio of the capacitance between two electrodes with a solid, liquid, or gaseous dielectric, to the capacitance with air between the electrodes. Also called permittivity and specific inductive capacity. Generally low values are desirable for insulation.

dielectric strength The maximum voltage a dielectric can withstand without rupture. Usually expressed as volts per mil.

dielectric withstanding voltage The maximum potential gradient that a dielectric material can withstand without failure.

Direct Current Resistance (DCR) The resistance offered by any circuit to the flow of direct current.

direction of lay The lateral direction in which the strands or elements of a cable run over the top of the cable as they recede from the observer. Expressed as right-hand or left-hand lay.

discontinuity Rated interconnection: a broken connection (open circuit) or the loss of a specified connection characteristic. Transient phenomena: Short term (temporary) interruption or unacceptable variation in current or voltage.

drain wire In a cable, an un-insulated conductor laid over the component, or components, in a foil-shield cable. Used as a ground connection.

dust cover See cover, electrical connector.

E

elastic memory The ability of a crosslinked polymer to be deformed to some predetermined shape, hold that shape for a period, and then return to its original shape upon the application of heat.

elastomer A material that exhibits very low or zero crystallinity and a high degree of flexibility (rubber is a synonym).

electromagnetic compatibility (EMC) The ability of an electronic device to operate in its intended environment without its performance being affected by EMI and without generating EMI that will affect other equipment.

electromagnetic interference (EMI) Unwanted electrical or electromagnetic energy that causes undesirable responses, degrading performance or complete malfunctions in electronic equipment. See also: noise.

electromotive force (emf) See voltage.

elongation The ultimate elongation, or elongation at rupture. Expressed as a percentage of original length.

EMI Abbreviation for electromagnetic interference.

encapsulant Description related to the way dual-wall tubing products and precoated molded parts melt and flow when heated, filling any void in the area being covered. Unlike an adhesive, an encapsulant does not form a mechanical bond to the substrate.

encapsulation Covering and sealing.

environmentally sealed A unit is provided with gaskets, seals, grommets, potting or other means to keep out moisture, dust, air or dirt which might reduce or impair its performance.

epoxy A family of thermosetting resins usually used as adhesives or encapsulants.

Expanded ID (EID) The specified minimum (as supplied) internal diameter of tubing.

expansion ratio An expression of how much larger the inside diameter of a tubing is before shrinking. Specifically, the relationship of the minimum (expanded) inside diameter of tubing to the maximum (recovered) inside diameter, expressed as a ratio. See also shrink ratio.

extraction tool A tool used for removing contacts from a connector body.

F

feedthrough A connector or terminal block, usually having double-ended terminals, which permits distribution and bussing of electrical circuits. Also used to describe a bushing in a wall or bulkhead, separating compartments at different pressure levels, with terminations on both sides.

ferrule A short tube used to make solderless connections to shielded or coaxial cable. Also molded into the plastic inserts of multiple contact connectors to provide strong, wear-resistant shoulders on which contact retaining springs can bear.

filler A material used in a cable construction to fill large interstices, thus providing a round construction; can be shaped, round, or in mastic forms. A nonfunctional member used in a cable to provide a more circular cross section.

flame-resistant A descriptor applied to a material that is inherently resistant to burning.

flame retardant A descriptor applied to a material that has been made or treated so as to resist burning.

flat braid A braided shield composed of flat strands.

flat cable A cable with each component in a single, flat plane.

flat conductor A conductor having a rectangular cross section, as opposed to a round or square cross section.

flex life A measure of the susceptibility of a conductor or other device to failure due to fatigue from repeated bending.

flux A liquid or solid that, when heated, exercises a cleaning and protective action upon surfaces. Used to promote or facilitate fusion during soldering or welding.

fretting corrosion A form of excellerated oxidation that appears at the interface of contacting materials undergoing slight cyclic relative motion. All non-nobel metals (tin) are susceptible to some degree of fretting corrosion and will suffer contact resistance increases.

front mounted A connector is said to be front mounted when it is attached to the outside of the mating side of a panel. A front mounted connector can only be installed or removed from the outside of the equipment.

front release contacts Connector contacts that are released from the front side of the connector and then removed from the back, wire side of the connector.

full recovery temperature, minimum See recovery temperature.

G

gauge A term used to denote the physical size of a wire. See also AWG.

ground A connection, intentional or accidental, between an electrical circuit and the earth or some conducting body (e.g. chassis) serving in place of earth.

grounding conductor A conductor that provides a current return path from an electrical device to ground.

H

hardness A general term that correlates with strength, rigidity, and resistance to abrasion or penetration. Measured on Shore or Rockwell scales. See also Shore.

harness A system providing electrical connection between two or more points.

heat aging A test that subjects components or materials to temperatures above normal operating values to evaluate changes in performance in order to predict service life. See also accelerated aging.

heat shock A test to determine the stability of a material by continuously exposing it to an extremely high temperature for a short period of time. The test was developed both to demonstrate that the material is crosslinked and to observe any problems in dripping, cracking or flowing.

heat-shrinkable A type of plastic material that has been cross-linked. A term describing tubes, sleeves, caps, boots, films or other forms of plastic which shrink to encapsulate, protect or insulate connections, splices, terminations and other configurations.

hermetic Airtight, impervious to external influence, as in a hermetic package. Often used to describe metal-to-metal solder or weld-sealed packages.

hermetic seal Hermetically sealed connectors are usually multiple contact connectors where the contacts are bonded to the connector by glass or other materials and permits maximum leakage rate of gas through the connector of 1.0 micron ft./hr. at one atmosphere pressure for special applications.

hertz (Hz) International standard term for cycles per second. Named after the German physicist Heinrich R. Hertz (e.g., 60 cycles per second is equal to 60 hertz or 60 Hz).

hookup wire and cable Wiring used to connect various points in electronic assemblies.

hot-melt adhesive An adhesive that becomes activated by heating. When heated, it melts, flows over the substrate surface, and forms an adhesive bond. Reheating causes the adhesive to remelt.

I

ID (Internal Diameter) The inside or internal diameter of a tubing.

impulse test A high voltage test designed to locate pinholes in the insulation of a wire or cable by applying a voltage while the wire or cable is being drawn through an electrode.

inductance One cause of reactance. An electromagnetic phenomenon in which the expanding and collapsing of a magnetic field surrounding a conductor or device tends to impede changes in current. The effects of inductance become greater as frequencies increase. The basic unit for inductance is the henry.

insert Meltable thermoplastic ring placed within a SolderSleeve device. Aids in encapsulation and sealing.

insert (connector) Part that holds the contacts in their proper arrangement and electrically insulates them from each other and from the shell.

insert arrangement (connector) The number, spacing and arrangement of contacts in a termination assembly.

insert cavity (connector) A defined hole in the connector insert into which the contacts are inserted.

insertion tool (connector) A tool used to insert removable contacts into a connector.

inspection hole A hole placed at one end of a contact barrel to permit visual inspection, to ensure that the conductor has been inserted to the proper depth in the barrel prior to crimping or soldering.

insulated terminal A solderless terminal with an insulated sleeve over the barrel to prevent a short circuit in certain installations.

insulation crimp The area of a terminal splice or contact that has been formed around the insulation of a wire.

insulation, electrical A nonconductive material usually surrounding or separating two conductive materials. Often called the dielectric in cables designed for high-frequency use.

insulation grip The ability of certain crimped terminals to hold firmly in place both the conductor and a small portion of insulation. This prevents the conductor from being exposed due to insulation receding away from the terminal.

insulation resistance The electrical resistance between two conductors separated by an insulating material.

insulation, thermal A nonconductive material that prevents the passage of heat.

interconnection The joining of one individual device with another.

interface The two surfaces of a multiple-contact connector that face each other when the connector is assembled.

interference An electrical or electromagnetic disturbance that causes undesirable response in electronic equipment.

interstice In a cable construction, the space or void left between or around the cabled components.

irradiation In insulations, the exposure of the material to high-energy emissions for the purpose of favorably altering the molecular structure via crosslinking.

J

jack A connecting device into which a plug can be inserted to make circuit connections. The jack may also have contacts which open or close to perform switching functions when the plug is inserted or removed. See also: receptacle.

jacket 1.) A material covering over a wire or cable assembly. 2.) Outer covering of a dual-wall heat-shrinkable tubing.

jackscrew A screw attached to one half of a two-piece, multiple-contact connector and used to draw both halves together and to separate them.

K

key (connector) A short pin or other projection that slides into a mating slot or groove to guide two parts being assembled.

keying (connector) Mechanical arrangement of guide pins and sockets, keying plugs, contacts, bosses, slots, keyways, inserts, or grooves in a connector housing, shell or insert that allows connectors of the same size and type to be lined up; used in situations where there is danger of making a wrong connection.

keyway The slot or groove in which a key slides.

kV (kilovolt) A unit equal to 1,000 volts.

L

lacing cord or twine Used for lacing and tying cable forms, hookup wires, cable ends, cable bundles and wire harness assemblies. Available in various materials and impregnants.

lanyard A device, attached to certain quick-disconnect connectors, that permits uncoupling and separation of connector halves by a pull on a wire or cable.

lay Refers to direction or sometimes the ratio of lay length to core diameter.

lay length A term used in cable manufacturing to denote the distance of advance of one member, or a group of spirally twisted members in one turn, measured axially. The lay of any helical element of a cable or conductor is the axial length of a turn of the helix of that element.

life cycle A test to determine the length of time before failure in a controlled, usually accelerated environment.

liner See core.

longitudinal change (shrink tubing) The change in length of tubing when recovered. Expressed in the percent of change from the original length.

lug A termination, usually crimped or soldered to a conductor, that allows connection to be made with a retaining screw.

M

marking A printed identification number or symbol applied to the surface of a wire or cable.

matched impedance The coupling of two circuits in such a way that the impedance of one circuit equals the impedance of the other.

mate To join two connectors in a normal engaging mode.

maximum discharge current defined as the peak current of an impulse which the device can withstand once without substantially affecting device performance.

mega (M) A prefix meaning one million (106).

melt/flow index Measurement of the flow of thermoplastic material under given conditions of temperature and pressure. Expressed as grams per unit of time.

melting point The temperature at which crystallinity disappears when crystalline material is heated.

MIL A unit equal to one one-thousandth of an inch (.001"); used in measuring the diameter of a conductor or thickness of insulation over a conductor.

minimum full recovery temperature See recovery temperature.

multiconductor More than one component within a single-cable complex.

multiple-conductor cable A combination of two or more components cabled together.

N

nick A small cut or notch in conductor strands or insulation.

noise An extraneous signal in an electrical circuit, capable of interfering with the desired signal. Classes of noise include burst of popcorn noise, intermediate frequency noise at low audio frequencies, white (thermal) noise, etc. Signals from power supply or ground line coupled into an amplifier output may be considered noise.

nominal A descriptor applied to a dimension representing the centre of the range of tolerance or a value if no tolerance is applied.

O

"O" crimp An insulation support crimp for open barrel terminals and contacts. In its crimped form it resembles an "O" and conforms to the shape of the round wire insulation. "O" crimp is also used to describe the circumferential crimps used on COAXICON ferrules.

OFT (Optional Flame Test) Canadian Standards Association's test for flame-retardance. Tubing with an OFT rating is highly flame-retardant.

operating temperature The maximum internal temperature at which a system, harness, or connector may operate in continuous service; generally expressed as a time and temperature.

operating temperature range The range between the maximum and the minimum internal temperature of insulation in a system, harness, or connector in continuous service. The lower limit is determined by low temperature flex test.

Optional Flame Test See OFT.

P

packaging The process of physically locating, connecting, and protecting devices or components.

panel The side or front (usually metal) of a piece of equipment on which connectors are mounted.

panel mount A method of fixing a connector to a board, panel or frame. The mounted connector is usually the receptacle or female connector. The plug or male connector is usually the removable portion.

peripheral seal A seal provided around the periphery of connector inserts to prevent the ingress of fluids or contaminants at the perimeter of mated connectors.

pigtail A short conductor or wire extending from an electrical or electronic device to serve as a jumper or ground connection.

pin contact An electrical terminal, usually in a connector. Normally a smaller termination than a lug.

plastic deformation Change in dimensions under a load that does not recover when the load is removed.

plating The overlaying of a thin coating of metal on metallic components to improve conductivity, facilitate soldering, or prevent corrosion.

plug The part of a connector that is normally "removable" from the other, permanently mounted part; usually that half of a two-piece connector that contains the pin contacts.

plug connector An electrical connector that is intended to be attached to the free end of a conductor, wire, cable, or bundle, and that couples or mates to a receptacle connector.

poke through A term describing stray wires in a solder joint that poke through the insulation.

polarisation (connectors) A mechanical arrangement of inserts or the shell configuration (referred to as clocking in some instances) that prohibits the mating of mismatched plugs and receptacles. See also clocking.

polyamide A polymer formed by the reaction of a diamine and a diacid. Nylons are commercial polyamides characterised by toughness, solvent resistance, and sharp melting point.

polymer A material of high molecular weight formed by the chemical union of monomers.

polyolefin A family of polymers (such as polyethylene and polypropylene) made from olefin monomers.

potting The permanent sealing of the cable end of a connector with a compound or material that thermosets into an elastomer, to exclude moisture and/or to provide strain relief.

pretinned Description of an electrical component to which solder has been applied prior to soldering.

primary insulation The inner member of a dual-wall wire insulation. The insulation applied directly on the conductor. Also referred to as the core. See also core.

printed circuit board (pcb) An insulating board serving as a base for a printed circuit. When the printing process is completed, the board may include printed components, as well as printed wiring.

PVC (Polyvinyl chloride) A polymer compound used as wire insulation.

Q

quality assurance Systematic, planned, and documented activities designed to provide confidence that a product will meet specifications.

quality control Activities that monitor, measure, and control the characteristics of a material, component, or product to documented specifications.

quick disconnect A type of connector shell that permits rapid locking and unlocking of two connector halves.

R

radiation crosslinking The act of crosslinking a material with ionising radiation. (Most Raychem products are radiation crosslinked, with an electron beam as the form of ionising radiation.) See also crosslinking by irradiation.

rated temperature The maximum temperature at which a component can operate for extended periods with acceptable changes in its basic properties.

rated voltage The maximum voltage at which an electric component can operate for extended periods without undue degradation.

receptacle Usually the fixed or stationary half of a two-piece multiple contact connector. Also the connector half usually mounted on a panel and containing socket contacts.

removable contact A contact that can be mechanically joined to or removed from an insert. Usually special tools are required to lock the contact in place or remove it for repair or replacement.

residual impulse Defined as the voltage that will pass through the device prior to activation of the GDT.

residual voltage Defined as the small amount of voltage left on the line after an impulse passes.

resistance A measure of the difficulty in moving electrical current through a conductor or insulation when a voltage is applied. It is measured in ohms.

resonance A frequency at which captive reactance and inductive reactance.

ribbon cable Flat cable with conductors that have been individually insulated together. Its structure is usually characterised by individual colours of insulation for each conductor, although a single colour may be used for all conductors.

root mean square (rms) The effective value of an alternating current, corresponding to the direct current value that will produce the same heating effect.

rope lay A type of conductor lay that uses stranded conductors as components to build a larger conductor.

RT and RW specifications Specification that describes standard product properties. Qualification and acceptance inspection criteria are incorporated into RT and RW specifications. RT and RW specifications are issued and controlled by the Specifications Group.

S

sealant Soft, tacky, pliable material that seals where mechanical strength is not required.

sealed Environmentally protected by the thermoplastic inserts or core of encapsulant/adhesive that has melted down around the substrate.

sealing plug A plug that is inserted to fill an unoccupied contact aperture in a termination assembly.

semi-rigid A cable containing a flexible inner core and a relatively inflexible sheathing.

shelf life Generally, the length of time a product or material may be stored without deterioration. Specifically, the length of time during which shrink tubing will retain its expanded ID and return to its recovered ID. Usually not a concern—except for some "amnesic" materials. See amnesia.

shell (connector) The outside case, usually metallic, into which the insert (body) and contacts are assembled. Shells of mating connector halves usually provide for proper alignment and polarisation as well as for protection of projecting contacts.

shock (mechanical) (1) An abrupt impact applied to a stationary object. (2) An abrupt or nonperiodic change in position, characterised by suddenness, and by the development of substantial internal forces.

shore A scale for comparing hardness. Higher Shore values represent harder materials. The hardness of a polymer, for example, is usually represented as Shore A or Shore D, with D being harder.

shrink ratio An expression of how much the inside diameter of shrink tubing will reduce in size when recovered. The inverse of the expansion ratio. See also expansion ratio.

shrink temperature, minimum The minimum temperature at which a product begins to recover.

SHV Abbreviation for standard high voltage.

signal cable A cable designed to carry current of less than 12 amperes per conductor.

skew Any out-of-squareness of the cut end of a piece of tubing after shrinking.

skin effect The tendency of alternating currents to flow near the surface of the conductor, thus being restricted to a small part of the total cross-sectional area. This effect increases the resistance and becomes more marked as the frequency rises.

sleeve The insulated or metallic covering over the barrel of a terminal.

solder An alloy that melts at relatively low temperatures and is used to join metals with higher melt points.

solder contact A contact or terminal having a cup, hollow cylinder, eyelet or hook to accept a wire for a conventional soldered termination.

solder cup A tubular end of a terminal into which a wire conductor is inserted prior to being soldered.

solderability The property of a metal surface that allows it to be readily wetted by molten solder. See also wetting.

soldering A process of joining metallic surfaces with solder without melting the base metal.

SolderSleeve device A device of flux-coated solder preform encapsulated in a heat-recoverable plastic sleeve. Upon the application of heat, the flux and solder will melt and flow as the sleeve recovers, forcing the solder around and onto the metallic parts being joined, thus forming an electrically insulated and strain-relieved joint.

solid conductor A conductor composed of one single strand.

solvent resistance The ability of a material to retain physical and electrical properties after being immersed in specific solvents.

specific gravity The ratio of the density (mass per unit volume) of a material to that of water.

splice A joint connecting conductors with good mechanical strength and conductivity; a terminal that permanently joins two or more wires.

strain relief The technique for or act of removing or lessening the strain or stress on a joint, splice, or termination. SolderSleeve devices provide strain relief.

strain relief clamp See cable clamp.

strand A single unit of a conductor.

stranded conductor A conductor composed of more than one single strand. The strands in stranded conductors are usually twisted or braided together.

strip To remove insulation from a wire or cable.

stripe A continuous longitudinal or spiral colour strip applied on the surface of a wire, cable, or tubing for identification.

substrate The material – such as a wire, post, or tab – over which an interconnection device is used.

super high frequency (shf) The Federal Communications Commission designation for the band from 3,000 to 30,000 MHz in the radio spectrum.

surface resistance The ratio of the direct current applied to an insulation system to the current that passes across the surface of the system.

T

tape wrap A term denoting a spirally or longitudinally applied tape material wrapped around insulated or uninsulated wire and used as a mechanical barrier.

TC Tinned copper.

tear test A test to determine the tear strength of an insulating material. Usually includes exposure to given thermal conditions or a programmed series of conditions for prescribed periods of time.

temperature rating The maximum temperature at which the insulating material may be used in continuous operation without loss of its basic properties. Usually time dependent.

tensile The amount of axial load (longitudinal stress) required to break or pull the wire from the crimped barrel of the terminal, splice or contact.

tensile strength The greatest longitudinal stress that a substance or union can bear without tearing or pulling apart. In crimped terminations, it is the greatest longitudinal stress that a terminal can bear without the wire separating from the terminal.

thermal rating The effect of heat or cold applied at such a rate that nonuniform thermal expansion or contraction occurs within a given material or combination of materials. In electrical terminations, the effect can cause inserts and other insulation material to pull away from the metal parts.

thermal shock The effect of heat or cold applied at such a rate that nonuniform thermal expansion or contraction occurs within a given material or combination materials. The effect can cause inserts and other insulation materials to pull away from metal parts.

thermochromic indicator Special compound that changes colour when the proper wetting temperature has been reached in the solder joint.

thermoplastic A material that softens (melts and flows) when heated and becomes firm when cooled. A type of plastic that can be remelted a number of times without any important change in properties. Nylon, GE's Lexan, and PVC—examples of this type of plastic—are resilient after molding.

thermoset A material that hardens or sets when heated and, once set, cannot be resoftened by heating. This application of heat is called "curing."

thermosetting plastic A type of plastic in which an irreversible chemical reaction takes place while the plastic is being molded under heat and pressure.

thermosetting adhesive A curing adhesive that requires heat to promote curing. This type of plastic will not soften when reheated. See epoxy.

tolerance The total amount by which a quantity is allowed to vary from nominal; thus, the tolerance is half the algebraic difference between the maximum and minimum limits.

U

UL (Underwriters' Laboratories) A nonprofit independent testing organisation that operates a listing service for electrical and electronic materials and equipment.

ultraviolet degradation The degradation caused by long-time exposure of a material to sunlight or other ultraviolet rays.

V

volt (V) The unit of measurement for electromotive force (emf). It is equivalent to the force required to produce 1 ampere through a resistance of 1 ohm.

voltage (E) The term most often used to designate electrical pressure that exists between two points and is capable of producing a flow of current when a closed circuit is connected between the two points. Voltage is measured in volts, millivolts, microvolts and kilovolts. The terms electromotive force (emf), potential, potential difference and voltage drop are often referred to as voltage.

voltage breakdown The voltage necessary to cause insulation failure.

voltage drop The voltage developed across a component or conductor by the flow of current through the resistance or impedance of that component or conductor.

voltage rating The voltage that may be continuously applied to wire.

volume resistivity Reciprocal of conductivity; the resistance of a material to the flow of electrical current, usually expressed in ohm-cm.

VW-1 A rating determined by the Underwriters' Laboratories' (UL) optional Vertical Wire Flame Test – the most difficult flame test for tubing. Tubings with a VW-1 rating are highly flame-retardant.

W

wall thickness The thickness of the applied insulation or jacket.

water absorption test A method to determine the water uptake of a material. It is time and temperature dependent.

water blocking The sticking together of insulated wires; usually caused by heat.

wetting (solder) The formation of a relatively uniform, smooth, unbroken, and adherent film of solder to a base metal. Also, the free flow of solder alloy, with proper application of heat and flux, on a metallic surface to produce an adherent bond.

wicking The longitudinal flow of a liquid in a wire or cable construction due to capillary action. (This may also apply to solder).

wire A single conductor covered with insulation.

wire dress The orderly arrangement of wires and laced harnesses.

withstanding voltage The test voltage an electrical connector can withstand for one minute without showing evidence of electrical breakdown when the voltage is applied between conductors and grounding devices of the connectors in various combinations.

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Denmark – Glostrup
Phone: +45-43-48-04-00
Fax: +45-43-44-14-14

Egypt – Cairo
Phone: +202-419-2334
Fax: +202-417-7647

Estonia – Tartu
Phone: +372-5138-274
Fax: +372-7400-779

Finland – Helsinki
Phone: +358-95-12-34-20
Fax: +358-95-12-34-250

France – Cergy-Pontoise Cedex
Phone: +33-1-3420-8888
Fax: +33-1-3420-8600
Product Information centre:
Phone: +33-1-3420-8686
Fax: +33-1-3420-8623

France Export Divisions –
Cergy-Pontoise Cedex
Phone: +33-1-3420-8804
Fax: +33-1-3420-8699

Germany – Bensheim
Phone: +49-6251-133-0
Fax: +49-6251-133-1600
Product Information centre:
Phone: +49-6251-133-1999
Fax: +49-6251-133-1988

Greece – Athens
Phone: +30-210-9370-396/397
Fax: +30-210-9370-655

Hungary – Budapest
Phone: +36-1-289-1000
Fax: +36-1-289-1010
Product Information centre:
Phone: +36-1-289-1016
Fax: +36-1-289-1017

Ireland – Dublin
Phone: +353-1-866-5612
Fax: +353-1-866-5714

Israel – Petach-Tikva
Phone: +972-3-929-0999
Fax: +972-3-919-1088

Italy – Collegno (Torino)
Phone: +39-011-4012-111
Fax: +39-011-4031-116
Product Information centre:
Phone: +39-011-4012-428
Fax: +39-011-40-287-428

Lithuania and Latvia
Lithuania – Vilnius
Phone: +370-5-213-1402
Fax: +370-5-213-1403
Product Information centre:
Phone: +370-5-211-3016
Fax: +370-5-213-1403

Netherlands – 's-Hertogenbosch
Phone: +31-73-6246-246
Fax: +31-73-6212-365
Product Information centre:
Phone: +31-73-6246-999
Fax: +31-73-6246-998

Norway – Nesbru
Phone: +47-66-77-88-50
Fax: +47-66-77-88-55

Poland – Warsaw
Phone: +48-22-4576-700
Fax: +48-22-4576-720
Product Information centre:
Phone: +48-22-4576-704
Fax: +48-22-4576-720

Romania – Bucharest
Phone: +40-21-311-3479/3596
Fax: +40-21-312-0574

Russia – Moscow
Phone: +7-495-790-7902
Fax: +7-495-721-1893
Product Information centre:
Phone: +7-495-790-7902-404
Fax: +7-495-790-7902-401

Russia – St. Petersburg
Phone: +7-812-718-8192
Fax: +7-812-718-8193

Slovenia – Ljubljana
Phone: +386-1561-3270
Fax: +386-1561-3240

South Africa – Port Elizabeth
Phone: +27-41-503-4500
Fax: +27-41-581-0440

Spain – Barcelona
Phone: +34-93-291-0330
Fax: +34-93-201-7879

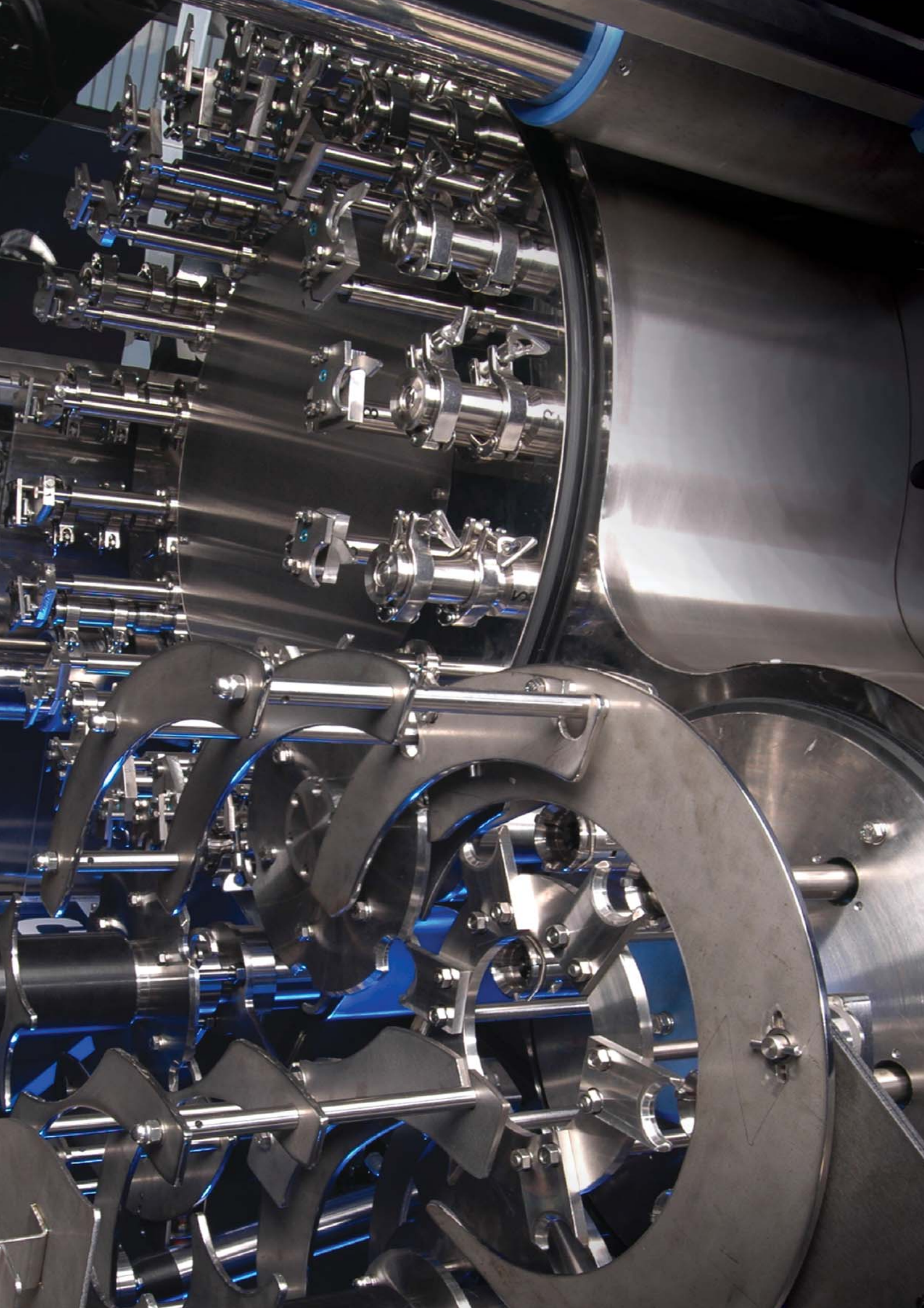
Sweden – Upplands Väsby
Phone: +46-8-50-72-50-00
Fax: +46-8-50-72-50-01

Switzerland – Steinach
Phone: +41-71-447-0447
Fax: +41-71-447-0444

Turkey – Istanbul
Phone: +90-212-281-8181/2/3
+90-212-282-5130/5430
Fax: +90-212-281-8184

Ukraine – Kiev
Phone: +380-44-206-2265
Fax: +380-44-206-2264
Product Information centre:
Phone: +380-44-206-2265
Fax: +380-44-206-2264

United Kingdom –
Stanmore, Middlesex
Phone: +44-8706-080208
Fax: +44-208-954-6234
Product Information centre:
Freephone (UK only):
0800-267-666
Phone: +44-8706-080208
Fax: +44-208-420-8095



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