

Information and Products for use in
Wind Power Generation



TOP TO BOTTOM

Thomas & Betts

Wind Power is Building

Wind farms produce electricity directly from a natural, clean and sustainable energy resource, and this technology is now the world's fastest growing electrical generation source. The U. S. is beginning to see more wind farms proposed due to their environmental benefits and the passage of advantageous legislation, making wind energy one of present day's lower cost renewable energy sources.

Wind turbines are becoming a common sight in many locations throughout the U. S., with a number of turbines and large wind farms already planned for installation in the near future. Utility-scale wind turbines in service in the U.S. commonly range between 1.5 and 3.0 megawatts (MW) in size. The cumulative installed capacity in the U.S. by 2009 is expected to reach 18,850 MW, representing nearly 70 billion dollars in anticipated construction.

Every wind generation site has a degree of specific issues that influence the design and construction of that site. Wind turbines generate power independently, distributing electricity through shared cabling out into the grid. Turbines are arranged to maximize the flow of wind while not interfering with each other or creating a dramatic environmental impact.

To generate enough electricity for a power distribution network, the larger wind turbines are more often installed in modern wind farms. Each structure consists of a steel tower on which a nacelle, or machine room, rests. The blades, made of fiberglass and carbon fiber, are attached to the hub of the generator and rotate in the wind. Each blade is between 65 and 100 feet long. The entire structure, nearly 170 feet high, is anchored to a concrete base constructed of over 400 tons of cement and iron reinforcing rods.

Construction requirements and specifications for wind turbine installations are established by the turbine manufacturer and the specification engineers of the wind farm project, which may include engineering consulting firms. However, every site has a degree of specific issues that influence the design and construction of the project. As in any other industrial plant or power generation facility, installers need advanced components to accommodate very specific tolerances and provide predictable, reliable performance and control. The right installation will improve process control, increase operational performance and provide preventive maintenance.

The added cost of increasing tower height is often justified by the increase in power generated from stronger winds. Larger wind turbines are usually mounted on towers ranging from 130 to 170 feet tall.



At the end of 2006, 11,603 MW of power is produced in the U.S. by installed wind projects (DOE). The greatest number are in California and Texas, although the midwest and southeast are a largely untapped source for new construction with high potential for energy generation.



T&B can make it a breeze

At Thomas & Betts, we understand the ups and downs of the wind power business and the challenges faced by its electricians. We're focusing on products designed to address issues in every phase of your installation so you can focus on cost, quality, flexibility and regulatory challenges you face from the beginning to the end of the project.

Our expertise in inventive engineering and manufacturing new products will help you make the best use of your time, materials and help lower your overall cost for installation and maintenance of your next wind farm project. Best of all, our ISO and industry-specific adherence to specification standards provides consistent quality and safety in our products.



Designing products with a variety of materials offers the largest range of choices for multiple installations and environments. T&B's QTP program provides fast, reliable made-to-order products that meet your unique specifications.

T&B's family of compression, mechanical and exothermic products match specific applications from top to bottom. Of equal importance is the challenge to select the best tools and systems that provide reliable installations during both construction and routine maintenance activities without sacrificing the quality and integrity of the installation or extending labor costs. T&B offers a full complement of tools and accessories for the most demanding applications, while incorporating state-of-the-art design for optimal performance and handling.

Backed by the largest single source of electrical products in the industry, T&B will work in partnership with your electrical staff to provide the best solutions for your wind power generation project while satisfying financial and technical demands.



T&B's local and technical support will offer clear, consistent information regarding training, codes and standards, and product recommendations.



Engineering labor saving products that perform consistently means fewer call-backs and reduces trips up the tower.



Whether the work is in a cabinet below or up on "high wire", the reliability of Thomas & Betts products helps things run smoothly.

Thomas & Betts

Special Considerations for Wind Power Generation

The Environment

Outdoor settings demand the highest performance electrical components for power distribution to equipment, devices, switchgear and lighting systems. Extreme weather conditions demand connections capable of resistance to corrosion or rust in both salt spray areas and inland facilities. Both icy and high-heat settings demand optimum performance throughout cyclical weather conditions and extreme seasonal shifts. Environments high in moisture or dry conditions are factors addressed specifically in the design and testing of T&B products. Best performance in coastal or inland settings is a priority.

Water and corrosion from water are some of the highest threats to safe and reliable connections in wind powered generators. Additionally, because of the remote setting for most wind farms, long response times can result in further damage and losses from problems needing immediate attention.

Thomas & Betts electrical products are designed, manufactured and tested to function fully in a broad range of NEMA requirements, giving you time and cost-saving options and materials to address your specific needs.

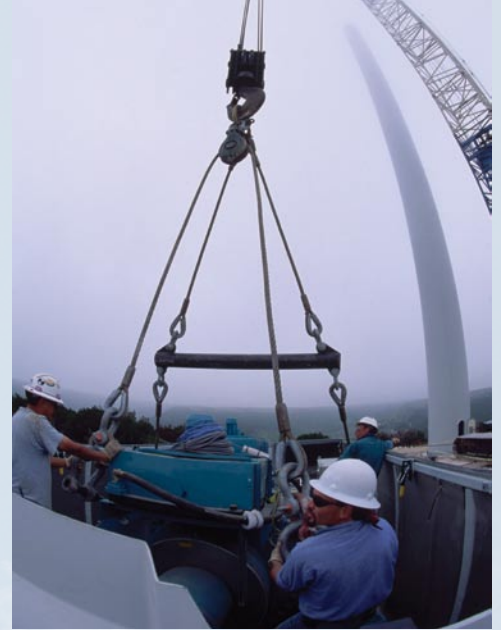
Environment	Concerns
Outdoor	Cyclical Weather Conditions: Moisture/Dry; Corrosion – Galvanic Salt Fog / Coastal Areas; Corrosion - Galvanic · Extreme Temperatures
Indoor	Humidity / Moisture; Corrosion – Galvanic Salt Fog / Coastal Areas; Corrosion – Galvanic · Extreme Temperatures

T&B designs and tests products for best performance in extreme high and low operating temperatures.

Grounding

T&B offers a complete family of compression, mechanical and exothermic products for above ground and direct burial grounding applications. The large variety of connectors provide electrical continuity for the integrity of the grounding circuit and can be installed in all climate conditions. These full range products will reduce the number of connectors and dies needed for your installation and meet all applicable standards (UL467, CSA 22.2) and both compression and exothermic products are tested according to and meet IEEE 837 requirements. They satisfy the recommended practice for the selection of grounding connector joints described in IEEE 837 guidelines for qualifying permanent connections used in substation grounding. Choosing the right product will prevent costly job interruptions and ensure timely completion of the installation and project.

With the broadest family of electrical products, T&B can provide the right product at the right time for your need. Overall, no other manufacturer can bring as many products and years of experience to grounding as Thomas & Betts.



From salt water settings to the top of a mountain wind farm, the environmental challenges to wind turbines are in the extreme ranges.



With over 2,000 thunderstorms active throughout the world at any given moment, creating approximately 100 flashes of lightning per second, wind turbines are subject to the most demanding forces of nature. Currents of up to 200,000 amps within an extremely short period of time test the strength of the system's grounding capability.



Proper grounding of the tower during construction is essential for preparing the wind turbine for lightning strikes.

Special Considerations for Wind Power Generation

Vibration and Structural Movement

With any electrical equipment or wiring installation operating at line voltages in continuous operation, cable and component damage or incorrect installation that permits moisture or contamination can lead to equipment failure, arcing and potential fire hazard. In your wind turbine installation, the quality of the electrical system may be compromised by materials inferior for the application or components poorly designed to match the performance of the generator machinery. Additionally, it's important to provide your maintenance team the information and training necessary to correctly install critical structural systems for safe and reliable operation. Reducing space is a premium consideration in wind generation structures and Elastimold® products offer the greatest compact solutions inside the tower. Using environmentally-friendly insulation technology with **no green gasses** makes Elastimold® a primary contributor to the wind generation mission.

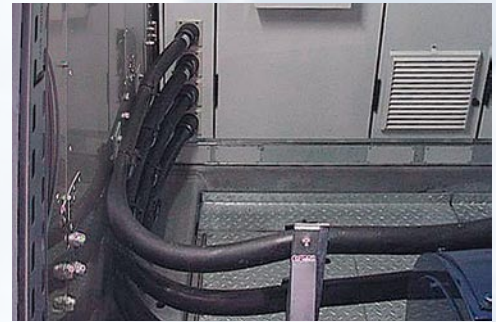
Wind farms are seeking increased return from invested capital and drive for greatest efficiency, operating round-the-clock for maximum output and ROI. To preclude the loss of an asset during normal operations, maintenance programs depend on fine-tuning information about performance changes and rely on the integrity of the initial installation. For this reason, it is important to choose the best products for your installation and partner with a resource that supports your maintenance needs.

Thomas & Betts offers several unique labor and time-saving products for quick change-out of vital connections to motors and power-generating machinery. Using a fast, press-together assembly, there's no risk of cutting wire insulation, less motor downtime, and eliminates installation errors that commonly result in additional costs and loss of time.

Power equipment also depends on liquidtight fittings designed to handle the unique connection demands of flexible cords and power cable applications. Exceptional mechanical strain relief against vibration and movement is needed in addition to a dependable seal against dust, oil, and other liquids. Where flexible cord or cable is exposed to intermittent or constant moisture and subjected to mechanical strain, choosing a watertight strain relief type electrical connector can make the difference between planning your next maintenance schedule or revenue loss due to equipment failure in the nacelle or base of the tower. Trust only liquidtight fittings by Thomas & Betts in your next installation.

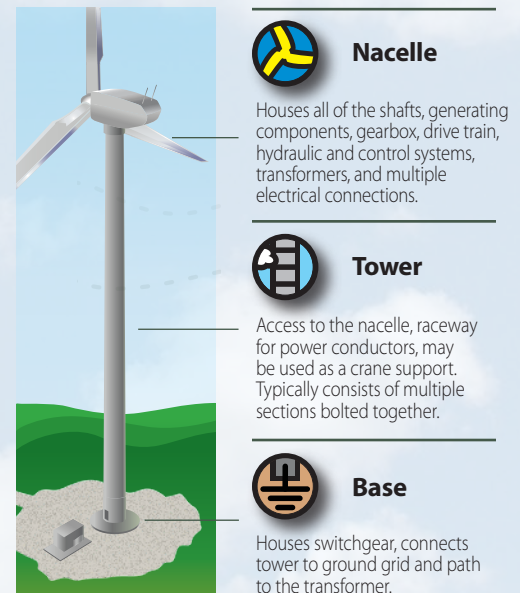


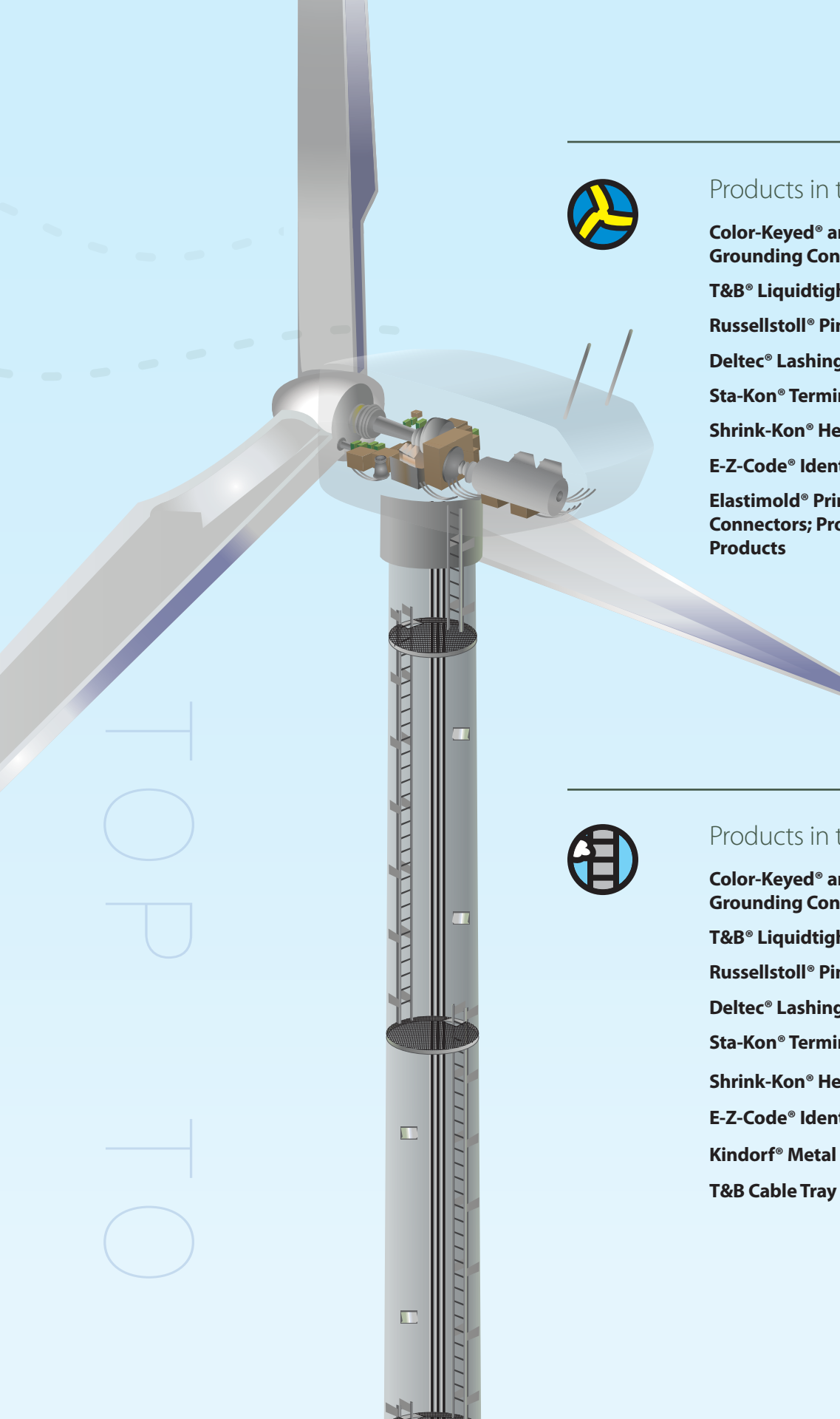
A modern wind turbine is designed to operate for more than 20 years, with an average 45–50 RPM. T&B designs its products to exceed this life expectancy.



Equipment and control systems for the turbine require reliable connections for prolonged exposure to vibration in the nacelle and tower structures.

T&B delivers solutions that make your job easier and offer the power to bring it all together in one package, top to bottom. Here's where we reach new heights in wind power construction:





Products in the **Nacelle**

Color-Keyed® and Blackburn® Power and Grounding Connectors

T&B® Liquidtight, Cord and Conduit Bodies

Russellstoll® Pin and Sleeve Receptacles

Deltec® Lashing Fasteners

Sta-Kon® Termination

Shrink-Kon® Heat Shrink

E-Z-Code® Identification

Elastimold® Primary and Secondary Connectors; Protection and Control Products



Products in the **Tower**

Color-Keyed® and Blackburn® Power and Grounding Connectors

T&B® Liquidtight, Cord and Conduit Bodies

Russellstoll® Pin and Sleeve Receptacles

Deltec® Lashing Fasteners

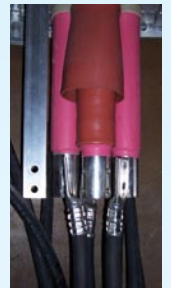
Sta-Kon® Termination

Shrink-Kon® Heat Shrink

E-Z-Code® Identification

Kindorf® Metal Framing

T&B Cable Tray



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Products in the **Base**

Color-Keyed® Power Connectors

T&B® Liquidtight Cord and Conduit Bodies

Russellstoll® Pin and Sleeve Receptacles

Deltec® Lashing Fasteners

Sta-Kon® Termination

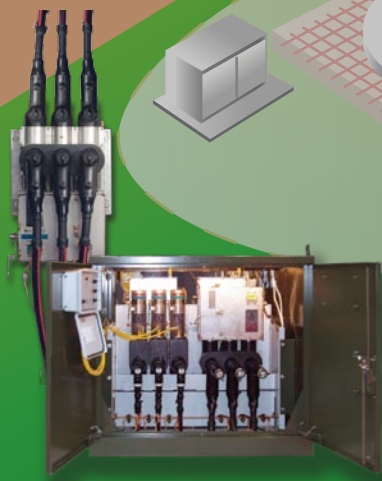
Shrink-Kon® Heat Shrink

E-Z-Code® Identification

Kindorf® Metal Framing

T&B Cable Tray

**Elastimold® Primary and Secondary
Connectors; Protection and
Control Products**



**Use T&B products,
and you're getting it right
from the ground up.**



Thomas & Betts

Products for installations in the **Nacelle**



Color-Keyed® Power Connectors

- Superior compression connections
- Broad range of tooling and dies, with hydraulic, pneumatic and manual tools
- Hydraulic tools produce the preferred hex-shaped circumferential crimp
- Custom modifications available
- Complete package of termination, splices and both C and H taps
- T&B color-code method ensures a superior crimp with die-code embossing
- UL listed and CSA certified

Blackburn® Grounding Products

- Compression, mechanical, exothermic
- Easy installation
- Corrosion-resistant alloys, provides low-resistance path
- UL listed and CSA certified, IEEE 837 tested (compression and exothermic)

T&B® Liquidtight, Cord and Conduit Bodies

- A complete line of Liquidtight, Cord and Rigid Fittings for every application
- Designed to stand up to demanding, wet or corrosive environments
- Safe Edge® ground cone design accepts variations in raceway convolutions (Liquidtight)
- Unique double bevel sealing ring (Liquidtight)
- Suitable for both grounding and bonding applications
- Provides exceptional mechanical strain relief (Cord)
- Dependable seal against dust, oil and other liquids (Cord)
- Rugged construction with zinc plating inside and out (Rigid)
- Threaded conduits also feature locknuts for secure connection to threadless openings (Rigid)
- UL listed and CSA certified

Sta-Kon® Termination

- Available in vinyl, nylon, uninsulated, heat shrinkable and tefzel materials
- Longer barrel offers a superior connection, selectively annealed
- Designs for most applications, including rings, locking forks and disconnects
- UL listed and CSA certified, all terminals meet military standards



Products for installations in the **Nacelle**



Shrink-Kon® Heat Shrinkable Tubing, Boots and Caps

- Heavy duty protection, field-proven reliability—rated 600V, 90°C
- A full range of sizes from #16 to 1000MCM, in colors, black and clear
- Made of thermally stabilized cross-linked polyolefin
- Improved protection against moisture provided by internal sealant

E-Z-Code® Identification

- Thermal printers with a wide variety of wire labeling material
- Complete labeling package, from self-laminating to heat-shrink markers
- Complete package of wire marker books and cards
- Signage for most requirements

Deltec® Lashing Fasteners

- Designed for outdoor applications that require strength, durability and ease of installation. Performs for years of service in field bench tests
- Traditional “smooth body” design, less stress sensitive than notched cable ties. Infinite strap lengths, fastening achieved through non-integral head
- Excellent resistance to ultraviolet light
- Made from low moisture-absorbing weatherable acetal

Elastimold® Primary and Secondary Connectors

- Surge arresters featuring “space saver” design and lower installed cost
- Voltage and fault indicators with AccQTrip™ “off the trip” logic circuitry
- Low voltage connectors, secondary and compression
- Modular system and standard interfaces, elbows, inserts, junctions and more

Ty-Rap® Cable Ties

- Rounded, low-profile head and smooth molded body
- Stainless steel barb – Infinitely adjustable design ensures the right fit
- Wide variety of materials for most environmental conditions
- Complete accessories for every application
- UL and Military (MS3367) listed



Products for installations in the Tower



Color-Keyed® Power Connectors

- Superior compression connections
- Broad range of tooling and dies, with hydraulic, pneumatic and manual tools
- Hydraulic tools produce the preferred hex-shaped circumferential crimp
- Custom modifications available
- Complete package of termination, splices and both C and H taps
- T&B color-code method ensures a superior crimp with die-code embossing
- UL listed and CSA certified

Blackburn® Grounding Products

- Compression, mechanical, exothermic
- Easy installation
- Corrosion-resistant alloys, provides low-resistance path
- UL listed and CSA certified, IEEE 837 tested (compression and exothermic)

T&B® Liquidtight, Cord and Conduit Bodies

- A complete line of Liquidtight, Cord and Rigid Fittings for every application
- Designed to stand up to demanding, wet or corrosive environments
- Safe Edge® ground cone design accepts variations in raceway convolutions (Liquidtight)
- Unique double bevel sealing ring (Liquidtight)
- Suitable for both grounding and bonding applications
- Provides exceptional mechanical strain relief (Cord)
- Dependable seal against dust, oil and other liquids (Cord)
- Rugged construction with zinc plating inside and out (Rigid)
- Threaded conduits also feature locknuts for secure connection to threadless openings (Rigid)
- UL listed and CSA certified

Russellstoll® Pin and Sleeve Receptacles

Complete line of electrical interconnection systems designed for specialized or harsh industrial environments in applications including:

- Heavy industrial/marine (outdoor, severe or high abuse environments)
- Washdown and light marine (watertight/waterproof)
- Industrial and commercial
- Control circuit and industrial/interlock



Products for installations in the Tower



Deltec® Lashing Fasteners

- Designed for outdoor applications that require strength, durability and ease of installation - performs for years of service in field bench tests
- Traditional "smooth body" design, less stress sensitive than notched cable ties. Infinite strap lengths, fastening achieved through non-integral head
- Excellent resistance to ultraviolet light
- Made from low moisture-absorbing weatherable acetal



Superstrut® Framing Channel and Accessories

Superstrut® Framing Channel is exceptionally tolerant to extreme temperature environments while offering superior corrosion resistance. The channel is roll formed when cold, enhancing its structural strength for demanding applications.

- 10' and 20' lengths in 14 gauge stainless steel
- Available in a wide variety of materials and finishes
- Threaded rod and an assortment of accessories to complete the installation



Sta-Kon® Termination

- Available in vinyl, nylon, uninsulated, heat shrinkable and tefzel materials
- Longer barrel offers a superior connection, selectively annealed
- Designs for most applications, including rings, locking forks and disconnects
- UL listed and CSA certified, all terminals meet Military standards



Shrink-Kon® Heat Shrinkable Tubing, Boots and Caps

- Heavy duty protection, field-proven reliability—rated 600V, 90°C
- A full range of sizes from #16 to 1000MCM, in colors, black and clear
- Made of thermally stabilized cross-linked polyolefin
- Improved protection against moisture provided by internal sealant



E-Z-Code® Identification

- Thermal printers with a wide variety of wire labeling material
- Complete labeling package, from self-laminating to heat-shrink markers
- Complete package of wire marker books and cards
- Signage for most requirements



Products for installations in the **Base**



Color-Keyed® Power Connectors

- Superior compression connections
- Broad range of tooling and dies, with hydraulic, pneumatic and manual tools
- Hydraulic tools produce the preferred hex-shaped circumferential crimp
- Custom modifications available
- Complete package of termination, splices and both C and H taps
- T&B color-code method ensures a superior crimp with die-code embossing
- UL listed and CSA certified

Blackburn® Grounding Products

- Compression, mechanical, exothermic
- Easy installation
- Corrosion-resistant alloys, provides low-resistance path
- UL listed and CSA certified, IEEE 837 tested (compression and exothermic)

T&B Cable Tray

- Complete line of products for all installation requirements
- All tray meets or exceeds all NEMA standards
- Ladder, ventilated and solid trough in 4", 5", 6", and 7" depths

Superstrut® Framing Channel and Accessories

Superstrut® Framing Channel is exceptionally tolerant to extreme temperature environments while offering superior corrosion resistance. The channel is roll formed when cold, enhancing its structural strength for demanding applications.

- 10' and 20' lengths in 14 gauge stainless steel
- Available in a wide variety of materials and finishes
- Threaded rod and an assortment of accessories to complete the installation

Ty-Rap® Cable Ties

- Rounded, low-profile head and smooth molded body
- Stainless steel barb – Infinitely adjustable design ensures the right fit
- Wide variety of materials for most environmental conditions
- Complete accessories for every application, UL and Military (MS3367) listed

Elastimold® Primary and Secondary Connectors; Protection and Control Products

- Compact, lightweight switchgear with modular construction
- Surge arresters featuring "space saver" design and lower installed cost
- Voltage and fault indicators with AccQTrip™ "off the trip" logic circuitry
- Highest current ratings available in a single fuse body, smaller design
- Modular system and standard interfaces, elbows, inserts, junctions and more



Products for installations in the **Base**



T&B® Liquidtight, Cord and Conduit Bodies

- A complete line of Liquidtight, Cord and Rigid Fittings for every application
- Designed to stand up to demanding, wet or corrosive environments
- Safe Edge® ground cone design accepts variations in raceway convolutions (Liquidtight)
- Unique double bevel sealing ring (Liquidtight)
- Suitable for both grounding and bonding applications
- Provides exceptional mechanical strain relief (Cord)
- Dependable seal against dust, oil and other liquids (Cord)
- Rugged construction with zinc plating inside and out (Rigid)
- Threaded conduits also feature locknuts for secure connection to threadless openings (Rigid)
- UL listed and CSA certified



Russellstoll® Pin and Sleeve Receptacles

Complete line of electrical interconnection systems designed for specialized or harsh industrial environments in applications including:

- Heavy industrial/marine (outdoor, severe or high abuse environments)
- Washdown and light marine (watertight/waterproof)
- Industrial and commercial
- Control circuit and industrial/interlock



Sta-Kon® Termination

- Available in vinyl, nylon, uninsulated, heat shrinkable and tefzel materials
- Longer barrel offers a superior connection, selectively annealed
- Designs for most applications, including rings, locking forks and disconnects
- UL listed and CSA certified, all terminals meet Military standards



Shrink-Kon® Heat Shrinkable Tubing, Boots and Caps

- Heavy duty protection, field-proven reliability—rated 600V, 90°C
- A full range of sizes from #16 to 1000MCM, in colors, black and clear
- Made of thermally stabilized cross-linked polyolefin
- Improved protection against moisture provided by internal sealant



E-Z-Code® Identification

- Thermal printers with a wide variety of wire labeling material
- Complete labeling package, from self-laminating to heat-shrink markers
- Complete package of wire marker books and cards
- Signage for most requirements

Connector Application Guide

	Mechanical Connections	Compression Connections	Exothermic Connections
Initial Cost			
Tooling Cost			
Additional Parts			
Installation			
Inspectable			
Flexibility			
Training			
Conductivity			
Environment - Corrosive			
Environment - Vibration			
Environment - Temperature			

Darker Color = More
 Lighter Color = Less

Tools for **Wind Power**



When the business is as up and down as wind farm construction, it's important to know you have a source for tooling that's designed for demanding use and still lightweight and portable. Contact your T&B representative for a complete catalog of the large array of industrial-strength tools for maximum performance of every connection in your installation.

Battpac® LT 14-Ton Battery-Powered Compression Tool

- Reduced weight and more ergonomic design
- New double-speed feature decreases crimp time by doubling jaw speed until it reaches load
- New more powerful Ni-MH battery has 50% more energy and less memory effect than old batteries
- Rotating head allows maximum flexibility for crimping
- Uses Standard T&B Color-Keyed® 15500 Series dies



Battpac® TBM54BSCT Battery-Powered Cutter

- Removable battery — simply change for continuous use
- One-handed control of blade advancement and retraction
- TBM54BSCTS cuts up to 750 kcmil copper, 21/8" O.D. aluminum and 636 kcmil ACSR
- TMB54BSCT cuts up to 1,500 kcmil copper and 21/8" O.D. aluminum (not for use on ACSR)



14-Ton Remote Hydraulic Crimping Head

- Rugged design, made to last in field or on bench
- C-yoke provides maximum flexibility for crimping
- Uses standard T&B Color-Keyed® 15500 Series dies
- Operates on 10,000 psi hydraulic pumps



Tool Services (1-800-284-TOOL)

Thomas & Betts Tool Services repairs all Thomas & Betts tools, from simple hand tools to hydraulic pumps and crimping heads. Tool Services performs all warranty repairs and can supply you with a temporary loaner tool when necessary. Tool Services can also perform non-warranty repairs, or, if you wish to repair your own tools, contact Tool Services to obtain any needed components, technical documentation and support.

For short-term installation projects, sometimes it makes more sense to rent than buy power tools. Renting T&B tools is easy. A rental agreement is available on our web site, and you can pay the rental fee by credit card. Call Tool Services at 1-800-284-TOOL (8665) for more details, including a list of Thomas & Betts tools available for rental.





TOP TO BOTTOM

Thomas & Betts service and support... what you need before your next high wire act.

Technical Services Support (1-888-862-3289)

Meeting and exceeding our customers' expectations is a fundamental goal of Thomas & Betts. Call our Technical Services Department and talk LIVE to a experienced technical representative who'll answer questions and concerns regarding all aspects of our products and services. We also offer a variety of on-line, self-service resources to make selecting and using our products as easy as possible.



Sales Support

Your Thomas & Betts sales team stands ready to offer a range of services to help you and your organization meet business, code and installation challenges. On the job site or on the plant floor, T&B sales associates offer a range of professional services including:

- Product Applications and Installations
- Technical Specifications
- Competitive Reviews
- Industry Trends and Code Changes



For more detailed information on the complete offering of Thomas & Betts' electrical products including competitive part number search, application and technical support, visit the "Electrical World" section of our web site at www.tnb.com.

For U.S. Customer Service and Order Inquiries,
Call **1-800-816-7809** or Fax **1-800-816-7810**.

For International Service and Order Inquiries,
Call (U.S.) **901-252-5400** or Fax **901-252-1330**.

For Canadian Customer Service and Order Inquiries,
Call **450-347-5318** or Fax **450-347-1976**.

For U.S. Technical Support,
Call **1-888-862-3289** or Fax **901-252-1321**.

For International Technical Support,
Call (U.S.) **901-252-5000**, Enter **1, 6672**.

For Tool Service and Repair,
Call **1-800-284-TOOL (8665)**.



Thomas & Betts

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