LOUISIANA DEPARTMENT OF TRANSPORTATION & DEVELOPMENT

Office of the Secretary
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John Bel Edwards, Governor
Shawn D. Wilson, Ph.D., Secretary

April 10, 2018

Mr. Charles W. Bolinger
Division Administrator
Federal Highway Administration
5304 Flanders Drive, Suite A Baton Rouge, LA 70808

Subject: Light Pole Breakaway Cable System Certification

Dear Mr. Bolinger:

In accordance with the provisions of 23 CFR 635.411(a), the Louisiana Department of Transportation and Development has determined that on the basis of safety, performance, and extended service life, the Pole Cable Distribution System (PCDS) developed by MG²/Duraline and marketed under the name DOT-PLUG® Breakaway Cable System is a necessary proprietary product.

For safety, the product performs a reliable electrical disconnect upon pole knockdown such that motorist are not exposed to any live conductors. Because underground junction boxes in Louisiana frequently fill with water, required performance dictates that the components be submersible. The MG² device is submersible and IP68 rated. The use of non-submersible components results in light outages and increased maintenance. For performance reliability the MG² device is designed for a 25 lb disengagement force. The system electrically disconnects at the designated connectors and leaves the remaining components intact. After knockdown the device components can be reconnected within a new pole thus providing an extended service life and reduced maintenance costs.

The Department knows of no other system that provides these functions.

In accordance with 23 CFR 635.411(a), the Department is authorized to certify this decision with the following statement:

I, Christopher P Knotts, DOTD Chief Engineer of the Louisiana Department of Transportation and Development, do hereby certify that in accordance with the requirements of 23 CFR 635.411(a)(2), that the Pole Cable Distribution System (PCDS) developed by MG²/Duraline and marketed under the name DOT-PLUG® Breakaway Cable System is a necessary proprietary product that is essential for safety, performance, and extended service life.

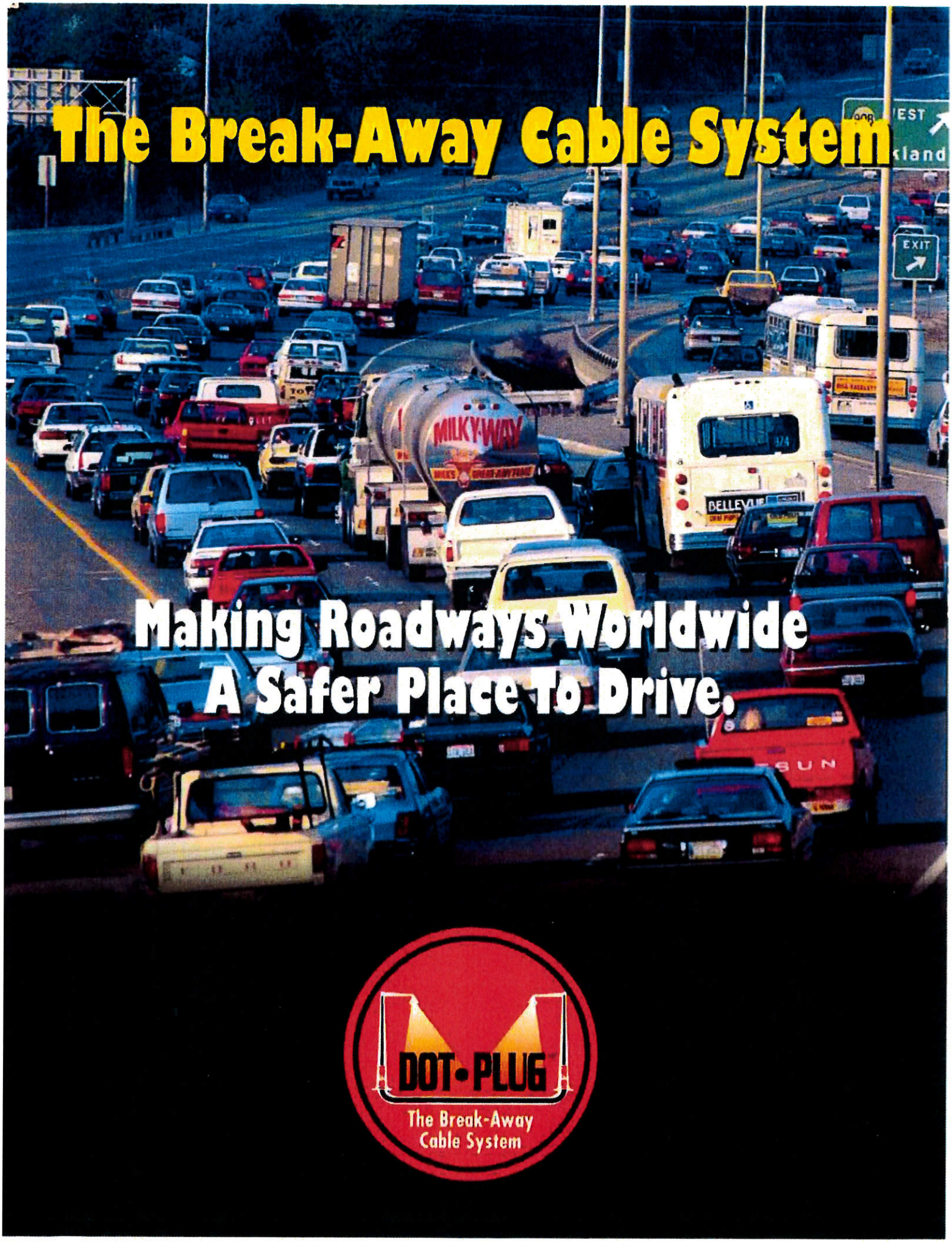
This certification is statewide and will sunset in three years unless action is taken by the department to extend it. This certification will be posted on the Department's website.

Sincerely,

Christopher P Knotts, P.E.
DOTD Chief Engineer

Attachment:
Product Brochure.

cc: Hector W. Santiago, P.E., FHWA


The Break-Away Cable System
EXIT
MILKY WAY
Making Roadways Worldwide
A Safer Place To Drive.
DOT-PLUG
The Break-Away
Cable System

The Break-Away Cable System

The safest and easiest-to-maintain wiring system for roadway poles.

The DOT•PLUG™ Break-Away Cable System is the preferred system for safety, durability and less "***down-time***."

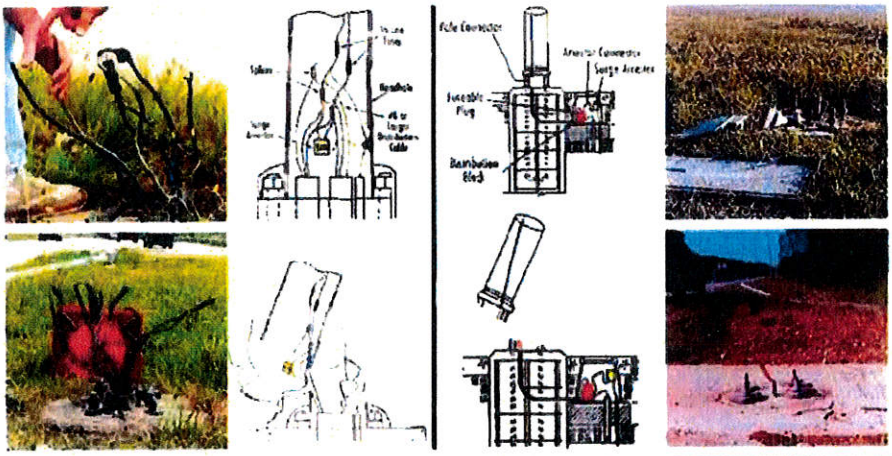
All Duraline/[MG]² connectors have undergone rigorous testing and have achieved certification from Factory Mutual [FM] (Test Report #J.I. X9A7.AE), a recognized independent laboratory for multiple performance criteria including but not limited to:

- **Flame Retardant** - Flammability tests were conducted on the cable, the molded body of the connectors and the molded protective caps. These materials were subjected to five flame applications on for 15 seconds and off for 15 seconds. After all applications, the materials self-extinguished before one minue upon removal of the flame and did not burn through.
- **Crushing Test** - No breakage or deformation resulted when the mated and unmated connectors were subjected to a crushing force of 500 pounds for one minute. Following the crush test, satisfactory dielectric tests were performed.
- **Submersible Test** - The mated and capped connectors were immersed in water for a prolonged period of time. Immediately following the immersion, satisfactory dielectric and leakage current tests were performed. The connectors were unmated and caps were removed and were found to have successfully prevented water from reaching the contact areas of the connectors.

"Due to this system, which was designed so that when an errant vehicle knocks down the pole, the structure would electronically disconnect at the foundation, leaving no more than a few inches of wires, cables, or connectors protruding from the electrical conduit, the amount of time to repair the electrical system of the pole and reset it has drastically reduced. This is a safer disconnect system where as emergency personnel and accident victims are not exposed to live wires. We have had much success with the components disconnecting as designed. This has saved us time and money. The wires no longer required splicing and repair, the circuit does not have to be reset and the time to reset this pole has almost nearly been cut in half."

– Benton G. Payne, P.E., Division Mgr.
State of North Carolina
Dept. of Transportation

Conventional Wiring vs. DOT•PLUG™ Break-Away Cable System



The System That's Been Featured In...

- McGraw Hills Highway Engineering Handbook
- FHWA Publication FHWA-HI-97-026
- National Highway Institute Course #38034

DOT•PLUG™

The Field Proven Wiring System within the Many Department's of Transportation Since 1992.

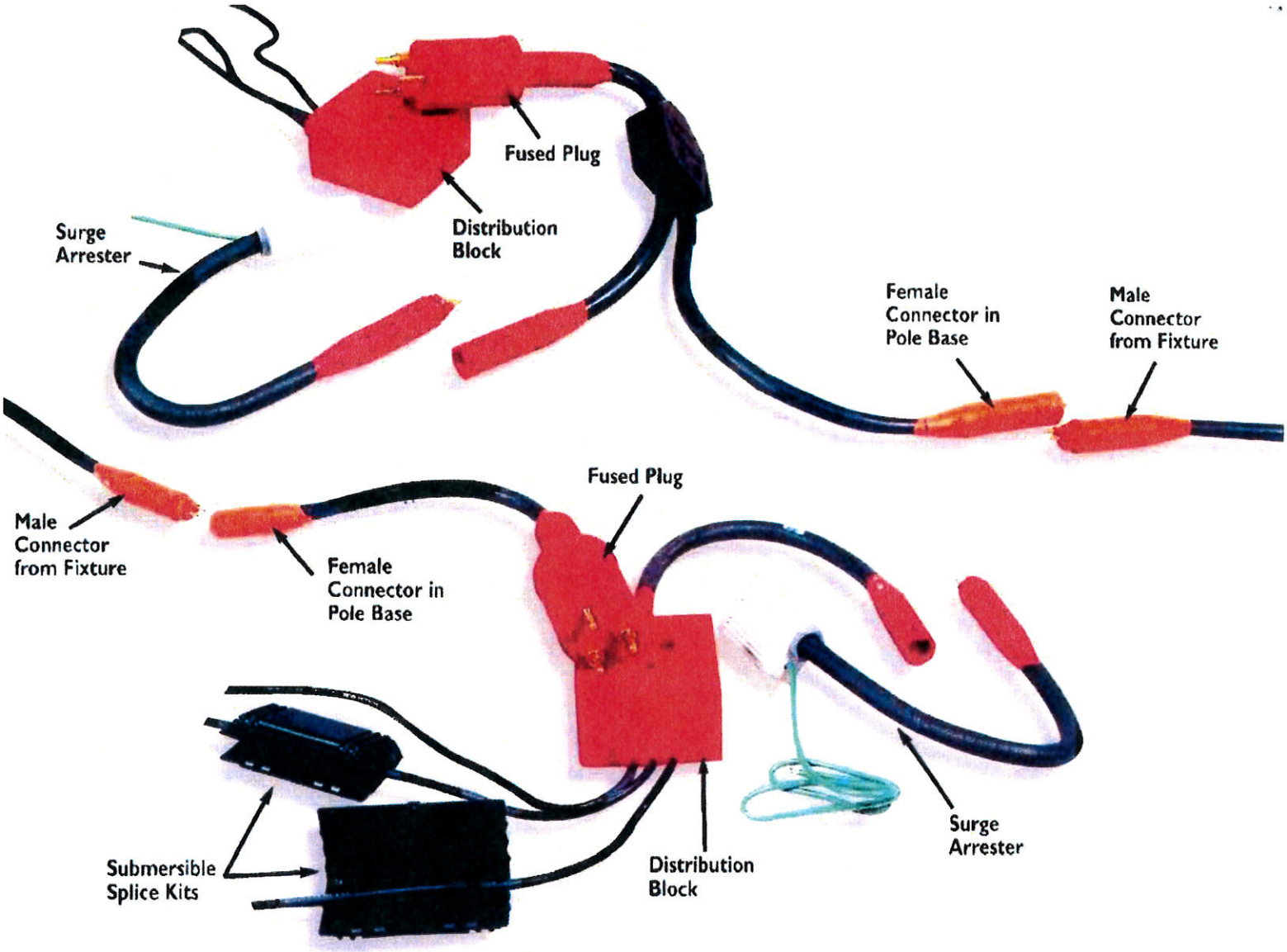
Features & Benefits of DOT•PLUG™

- Eliminates specifying, design engineer(s), and contactors liability due to injury or death attributed to preventable fire or electrocution.
- Eliminates possibility of fire after accident due to sparking wires.
- Eliminates possibility of electrocution to accident victims, rescue personnel and pedestrians.
- Eliminates damaged splices in adjoining poles.
- Eliminates fuseholder & surge arrester replacement after knockdown.
- Eliminates delayed rescue efforts attributed to exposed wire.
- Eliminates repeated splicing and wire damage after knockdown.
- Allows remaining poles on circuit to continue illumination.
- Meets the new break-away wiring requirements of AASHTO.
- System maintenance quick and simple.
- Dot Plug™ allows proper pole trajection during knockdown.

DOT•PLUG™
The Break-Away Cable System

[MG]² INC.

Innovative Technology For a Safer Roadway



DOT•PLUG
The Break-Away Cable System

[MG]² INC.

*Innovative Technology For a Safer Roadway

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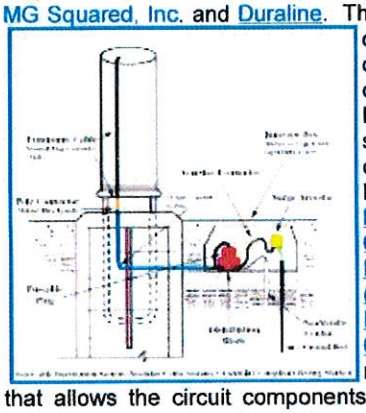
Tel: 205/823-6688 • Fax: 205/823-6615
www.mgsquared.com • email: martin@mgsquared.com

AASHTO SAFE

Knowledge for a Safer, more Cost effective, and Easily Maintained Lighting System

Pole Cable Distribution System (PCDS)

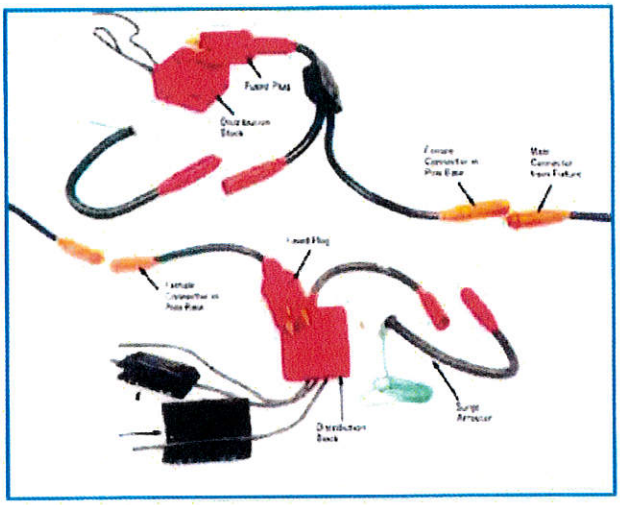
Also known as a Modular Cable System (MCDS) or marketed under the name "DOTPLUG", the PCDS was initially developed by MG Squared, Inc. and Duraline. This system eliminates a number of problems presented with current non-AASHTO compliant wiring methods. Details on the use of this system in lighting applications can be found in the Federal Highway Administration Publication No. FHWA-HI-97-026 as well as the Highway Engineering Handbook (McGraw-Hill 1st & 2nd Editions). This PCDS is an IP-68 submersible (6 ft water), modular plug and cable system that allows the circuit components (i.e., the low-amperage, fast-acting, current-limiting fuses; the surge arrester where desired; and the conductor splices) to be placed in an underground junction box adjacent to the pole foundation. The circuit breakaway connector can be positively positioned at the top edge of the conduit inside the pole base. Since the stiff, typically no. 4 or no. 6 copper, conduction cables never enter the pole, the system unplugs at ground level when properly installed. The impact that knocks down the pole will not put stress on the electrical cables and will not weaken splices in adjacent poles. Most important, with the PCDS, there is no exposed electrical hazard upon knockdown as exist with non-AASHTO compliant conventional wiring methods. When this system is combined with a properly installed foundation, the possibility of fire and explosion or electrical shock is significantly reduced if not eliminated.



According to the Highway Engineering Handbook: recent developments have shown that the splices, the surge arresters, the fuse holders, and the ground rod must be placed underground in a junction box adjacent to the pole base to provide the greatest possible degree of safety. This requires all components to be submersible. This design will positively place a breakaway connector in the wiring system at the top edge of the foundation; the fuses are underground, where no damage can occur on the supply side. The PCDS developed by MG²/Duraline and marketed under the name DOTPLUG®, was the first of these submersible wiring systems on the market and has proven to be very reliable. The AASHTO *Standard Specification for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, 4th ed. (2001)* has included some positive statements strongly encouraging the use of this submersible-type wiring system for all breakaway poles.

Maintenance Time and Cost Reduced

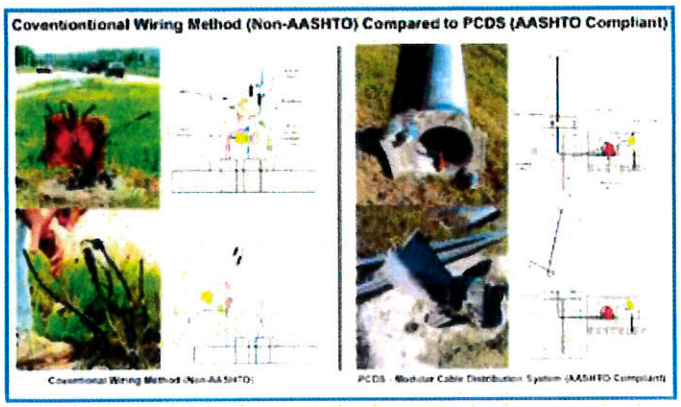
The Design of the PCDS allows quick access to fuses and splices. Splicing is done with a re-enterable IP68 submersible splice kit. The no. 4 or no. 6 is typically tapped onto the leads from the PCDS distribution block with a simple split bolt. The tool-less splice kit is a great alternative to splicing compounds and does not require sacrificing the valuable copper when remaking a splice.



Fuses are easily accessed inside the fused plug that is fed by the distribution block. Surge arrestors have been incorporated into the design of the PCDS and are simply plug and play. The major time and cost savings is seen quickly when resetting a pole after a knockdown. According to Benton G. Payne (Division Mgr.- State of North Carolina Department of Transportation) *"the amount of time to repair the electrical system of a pole knock down and reset it has drastically been reduced. This has saved us time and money. The wires no longer required splicing and repair, the circuit does not have to be reset and the time to reset this pole has almost been cut in half"*. Because of the modular design, components of the system are easily replaced if needed.

Avoiding Electrical Hazards

In the 1990's AASHTO recognized a hazard with the current wiring methods of the time. Those conventional wiring methods, **still used today**, were identified to pose a potential deadly threat by the electric circuits that are exposed after impact by an errant vehicle. There are documented cases of motorists who survived the impact with a luminaire pole, only to be subsequently killed from the resulting explosion, fire, or electrocuted from exposed conductors on, near or under a



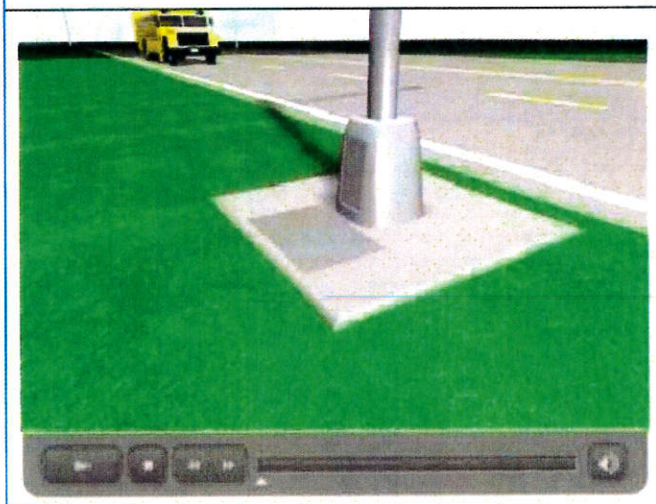
vehicle. [Learn More Here]

PCDS versus Conventional Wiring Method:

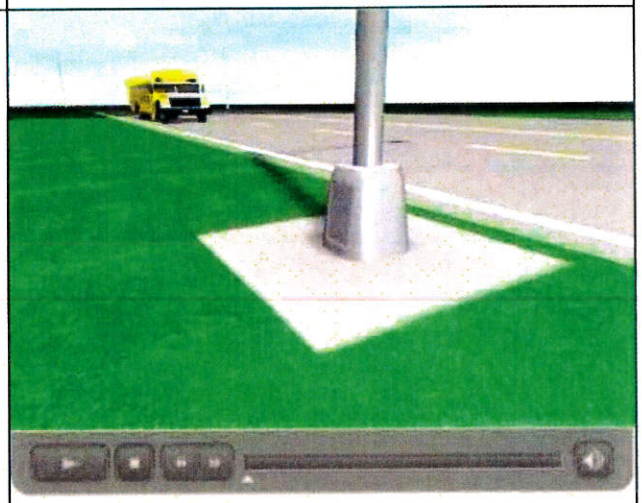
Animation Comparison of AASHTO Compliant PCDS wiring method as opposed to a Conventional Non-AASHTO Compliant wiring method. Please note the concrete pad is not a requirement, and is used in this animation as a tool to help illustrate the two wiring methods. *Animation courtesy of MG Squared, Inc.*

PCDS Wiring Method (Pole Cable Distribution System)
MEETS current AASHTO

Conventional Wiring Method
DOES NOT MEET current AASHTO



Click ► on the video player above to view the animation



Click ► on the video player above to view the animation

To learn more about the American Association of State Highway and Transportation Officials and/or their Highway Standards, please visit the official website www.aashto.org

AASHTO SAFE

Knowledge for a Safer, more Cost effective, and Easily Maintained Lighting System

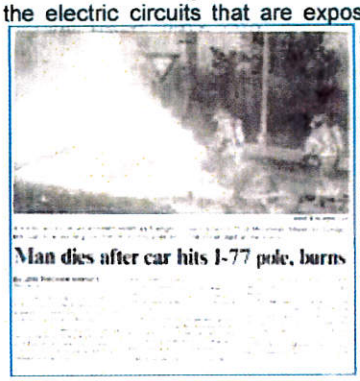
PCDS- a Solution to Electrical Hazards and Copper theft:

Some States are finding that the use of an AASHTO compliant Pole Cable Distribution System (PCDS) not only reduces the risk of electrical shock to maintenance crews, rescue personnel, and the public; but is thwarting highway copper thieves after the precious metal inside their lighting systems.

Figure 1: Conventional Wiring Method (NOT AASHTO Compliant) Click to enlarge

•Part 1: Avoiding Electrical Hazards

In the 1990's AASHTO recognized a hazard with the current wiring methods of the time. Those conventional wiring methods, **still used today**, were identified to pose a potential deadly threat by the electric circuits that are exposed after impact by an errant vehicle. There are documented cases of motorists who survived the impact with a luminaire pole, only to be subsequently killed from the resulting explosion, fire, or electrocuted from exposed conductors on, near or under a vehicle. The explosion and fire are usually caused when the fuel tank ruptures, the vehicle having been caught on an improperly constructed foundation, and the electrical system sparks repeatedly until the fuel explodes. In other incidences, medical personnel have been delayed from attending to victims because of the risk of electrical shock from exposed conductors near or under a vehicle (*Highway Engineering Handbook, 2 ed.*).



Man dies after car hits I-77 pole, burns

Although AASHTO had set standards for breakaway poles and foundations, it was also realized that the pole wiring system must also be capable of properly separating (AASHTO *Standard Specification for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, 4th ed. (2001).* One reason is that the tensile strength and wire size of conventional systems directly affects the trajectory of the falling pole. Another reason is that improper separation of the electrical cabling can result in bare conductors that are still energized, posing an electrical and possible fire hazard at the accident site.

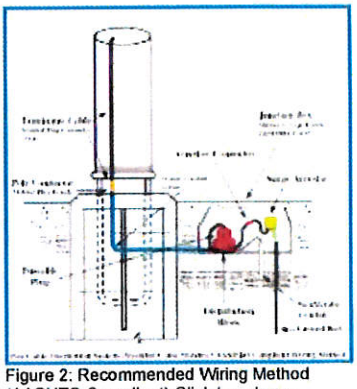


Figure 2: Recommended Wiring Method (AASHTO Compliant) Click to enlarge

Prior experiences show "Breakaway fuse holders", which have been used as an alternate to an AASHTO compliant PCDS, frequently perform improperly during an accident situation. Rather than properly separating, the device frequently pulls off the wire, leaving an exposed end that is potentially deadly. These widely used "breakaway fuse holders" have not been certified by testing, nor do the systems they are installed in meet the latest AASHTO standards (***see figure 1***).

The MG²/Duraline PCDS (DOTPLUG®) is a great example of a current product that meets current AASHTO standards and avoids the hazards mentioned above (***see figure 2***). Avoiding these hazards also greatly reduces the liability of the DOT, Utility Companies, design engineers, and others in relation to the electrical wiring system. Another benefit from the use of this type system is the reduction of maintenance/repair cost and time. Further advances like the incorporation of a "ground fault circuit interrupter" (GFCI/ELCI) into the wiring systems is helping avoid fatal and costly accidents resulting from worn or poorly maintained Municipal lighting systems (see electrical injury/death media). It is essential that as a DOT, Municipality, Utility Compnay or as a electrical engineer; that they be educated to avoid these hazards and to abide by all current AASHTO and/or Electrical Standards.

Figure 3: Breakaway fuse holders frequently perform improperly during an accident situation. Click to enlarge

•Part 2: PCDS - Thwarts Copper Thieves Targeting Highway Lighting Systems

In our Media section, you can see that Thieves across the Nation and Canada are targeting Interstate/Highway lighting systems. They are after the valuable copper which is fetching over $3 a pound at recycling facilities. The Hawaii DOT has spent about $300,000 to replace wiring stolen from overhead lights, and experts say that figure could top $1 million once the wiring is replaced. This problem is not isolated to any specific region. Reports range from San Francisco, California to Charlotte, North Carolina. According to California Highway Patrol Officer Jennifer Hink, she says freeway wire theft is occurring an average of once a week. She says those stranded in conked out vehicles at night are facing dangers in Los Angeles, Orange and Riverside counties.

Thieves will simply pull a vehicle up to a lighting pole and tie off the #4 or #6 copper to a trailer hitch and take off, stripping the pole and pulling hundreds of feet of copper from the ground. Besides

costing the tax payers millions of dollars in stolen copper, these thieves are leaving drivers in the dark. So how can a PCDS stop thieves wanting the copper and save valuable tax dollars in replacing wire?

Figure 4: Example of a pole knockdown using an AASHTO Compliant PCDS. Click to enlarge

The Design of a PCDS like the MG² DOTPLUG® is modular. There are three main components: a luminaire cable to the fixture, a fused plug that runs to the base of the pole, and a distribution block. Thieves tying off to the luminaire cable will find a 14-3 SOWA cord. Thieves tying off to the cord in the base of the pole won't get too far trying to pull the molded fused plug through a narrow conduit. At worst, the 6 to 11 ft piece of SOWA cord that feeds the pole base would either be ripped, or unplugged. What they end up at best with is 14-3 SOWA cord that went to the fixture and possibly a 6 to 11 foot piece of cord that went to the distribution block. The valuable #4 or #6 is left untouched in a protected junction box. In this scenario, the design of the MG² PCDS would keep other lights on the system burning. Plus each of the "plug-in" type components of the MG² PCDS is easily replaceable. This dramatically reduces replacement and repair cost and time to the lighting system.

Duraline
75 Hoffman Lane, Islandia, NY 11749

IP68 Rated Modular Distribution for
Highway Lighting Systems
Revised: 6/19/03
Identification No. ESN-0154

Scope

This specification describes DURALINE's IP68 rated model 3B30-1 and 3B30-2 distribution blocks, 3MFP-10, 3MFP-30 male fused connectors, FTP-2 and FTP-3 female connectors, MTP-2 and MTP-3 male connectors and molded junctions.

3B30-1 Distribution Block

DURALINE's IP68 rated 3B30-1 distribution block is integrally molded to (3) pieces of #10/1 DLO, 1KV cable, and measures 2.25" high, 3.75" wide and 3.75" long. The cable strain relief extends 1.00" from the end of the block, providing a means of leverage to disengage the mated connector from the block. It is equipped with one outlet to accept DURALINE's 3-wire model 3MFP type male fused connector. The block incorporates chambers to accept interference "O" rings integrally molded to the pins of the mating connectors which create a watertight seal when mated and fully seated. The block is molded in red compound.

3B30-2 Distribution Block

DURALINE's IP68 rated 3B30-2 distribution block is integrally molded to a minimum of 1' of 10/2 SOOW, 600V cable, and (3) pieces of #10/1 DLO, 1KV cable on the opposing side. The block measures 2.25" high, 3.75" wide and 3.75" long. The cable strain relief extends 1.00" from the #10/1 DLO side and 1.50" from the 10/2 side, providing a means of leverage to disengage the mated connector from the block. It is equipped with one outlet to accept DURALINE's 3-wire model 3MFP type male fused connector. The block incorporates chambers to accept interference "O" rings integrally molded to the pins of the mating connectors which create a watertight seal when mated and fully seated. The block is molded in red compound.

The 10/2 cable terminates with DURALINE's IP68 rated model FTP-2 female connector, integrally molded to the other end. The FTP-2 connector body measures 1.00" at its maximum cross sectional diameter, and is 3.25" long. The cable strain relief extends approximately 1.00" from the rear of the connector. The face of the connector contains a molded shroud measuring .37" deep, having an inside diameter of .75", concentric to the outside diameter of the connector. A .06" wide "O" ring seal along the I.D. of the shroud provides a watertight seal when mated and fully seated with DURALINE's IP68 rated MTP-2 male connector. The FTP-2 is a two pole, two wire connector which contains one .125" (nom) diameter barrel, and one .156" (nom) dia. barrel. The connector is molded in red compound.

Duraline
75 Hoffman Lane, Islandia, NY 11749

MTP-2 Male Connector

DURALINE's IP68 rated MTP-2 connector body measures 1.00" at its maximum cross sectional diameter and is 2.87" long. It is integrally molded to a minimum of 1' of 10/2 SOOW, 600V cable. The cable strain relief extends approximately 1.00" from the rear of the connector.

A .37" long section of the face of the connector steps down in diameter to .75", concentric to the outside diameter of the connector. A .06" wide "O" ring surrounds this section and provides a watertight seal when mated and fully seated with DURALINE's IP68 rated FTP-2 female connector. This two-pole connector contains one .125" diameter (nom.) pin, and one .156" diameter (nom.) pin which extend .62" from the face of the connector.

The MTP-2 connector requires an engagement force of 25 lbs. and a disengagement force of 25 lbs. when mated with the FTP-2 connector. The connector is molded in red compound.

3MFP-5/FTP-3 Adapter

DURALINE's IP68 rated 3MFP-5 measures 2.31" at its maximum cross sectional diameter. The body of the connector measures 3.18" long and is integrally molded to 14/3 SOOW, 600V cable. The cable strain relief measures 1.25" at its maximum diameter and extends approximately 3.18" from the rear of the connector body.

This two-pole, three wire grounded, fused connector contains two .250" dia. (nom.) replaceable molded pins which provide access to two Bussman KTK 5 amp, 600V fuses (13/32" Dia., 1 1/2" long), or equal. These two pins extend 1.31" from the face of the connector and include integrally molded "O" rings which provide a watertight seal when mated and fully seated to DURALINE's IP68 rated 3B30 type distribution block. A .250" (nom.) diameter ground pin projects from the face of the connector .87". The 3MFP-10 and 3MFP30 connectors are identical except they are supplied on 10/3 SOOW cable and are equipped with either two Bussman KTK 10 amp, 600V fuses or two Bussman KTK 30 amp, 600V fuses (13/32" Dia., 1 1/2" long), or equivalents.

The 3MFP connectors require an engagement force of 25 lbs. and a disengagement force of 25 lbs. when mated with the 3B30 type distribution block. It is molded in red compound.

The 14/3 cable terminates with DURALINE's IP68 rated model FTP-3 female connector, integrally molded to the other end. The FTP-3 connector body measures 1.00" at its maximum cross sectional diameter, and is 3.25" long. The cable strain relief extends

approximately 1.00" from the rear of the connector. The face of the connector contains a molded shroud measuring .37" deep, having an inside diameter of .75", concentric to the

outside diameter of the connector. A .06" wide "O" ring seal along the I.D. of the shroud provides a watertight seal when mated and fully seated with DURALINE's MTP-3 male connector.

The FTP-3 is a two pole, three wire, grounded connector which contains one .125" (nom.) diameter barrel, one .156" (nom.) diameter barrel, and one reversed sex .125" (nom.) diameter male ground pin which extends from the face of the connector at the base of the shroud and projects .25" from the face of the connector. The FTP-3 is molded in orange compound.

A nylon cable tie plate measuring 1.98" long, .50" wide and .125" thick is secured to the 14/3 cable after installation on the FTP-3 end of the adapter to prevent unintentional movement of cable assembly back into conduit.

MTP-3 Male Connector

DURALINE's IP68 rated MTP-3 connector body measures 1.00" at its maximum cross sectional diameter and is 3.25" long. It is integrally molded to 14/3 SOOW, 600V cable. The cable strain relief extends approximately 1.00" from the rear of the connector.

A .37" long section of the face of the connector steps down in diameter to .75", concentric to the outside diameter of the connector. A .06" wide "O" ring surrounds this section and provides a watertight seal when mated and fully seated with DURALINE's FTP-3 female connector. The MTP-3 is a two-pole, three wire, grounded connector which contains one .125" diameter (nom.) pin, and one .156" diameter (nom.) pin, which extend .62" from the face of the connector, and one .125" diameter (nom.) reversed sex ground barrel.

The MTP-3 connector requires an engagement force of 25 lbs. and a disengagement force of 25 lbs. when mated with the FTP-3 connector. It is molded in orange compound.

The molded elastomer bodies of the distribution blocks and each connector is a thermosetting synthetic polymer which is non-flame supporting and which remains flexible over the temperature range of -40° F to 190° F (-40° C to 90° C). Hardness of the molded rubber is 65 durometer (nom.).

Duraline
75 Hoffman Lane, Islandia, NY 11749

IP68 Rated Modular Distribution for
Highway Lighting Systems
Revised: 6/19/03
Identification No. ESN-0154

Independent Laboratory Testing by a Nationally Recognized Test Laboratory (NRTL)

Factory Mutual Approval # 3010147

DURALINE's 3B30-1, 3B30-2, 3MFP-5, 3MFP10, 3MFP30, FTP-2, MTP-2, FTP-3 and MTP-3 connectors have undergone rigorous testing for outside laboratory approval for use both indoors and outdoors and are rated IP68. In accordance with NEC Code 110-2 tests performed include test results summarized below from Factory Mutual approvals 3010147, OE4A5.AE, 1V8A0.AE, OV2A3.AE, OW1A6.AE, and 1X9A7.AE.

General – The industrial power equipment included in this document which are representative of production samples were examined, tested and compared to the manufacturer's drawings. All data is on file at Factory Mutual Research, along with other documents and correspondence applicable to this program.

As described by this document, the design and construction of the industrial power distribution equipment provide for the required degree of protection against electrical shock, fire, and injury required for temporary wiring installations in both indoor and outdoor locations. The use of the industrial power distribution for outdoors is a practical concern. The design is watertight when fully and properly mated to the rated plug, receptacle or protective cover when not mated. It is not intended that the actual mating be done in a driving rainstorm, but protection is provided against water entry when fully mated, including submersion.

Protection Against Electrical Shock

The Industrial power distribution equipment was examined and tested to verify that the required degree of protection against electrical shock is provided.

Accessibility – The live contact area on the female plugs and blocks are recessed so that no live parts are accessible when tested with rigid and articulated probes. No live parts are accessible when appropriate plugs and blocks are mated as the initial contact between male pins and female barrels is made within a concealed area of the plugs and blocks.

Protective Ground – There are no accessible non-current carrying conductive parts on the industrial power distribution equipment. When mating the equipment, connection between the male ground pin and the female barrel contact make first and break last as compared to the making and breaking of the live primary pin connections.

Spacing – Electrical spacing between uninsulated live parts and uninsulated grounded parts on the plugs and female blocks meet the 3/16" minimum requirement.

Leakage Current tests – With the male plugs mated with their intended female plugs, or female blocks, the leakage current measured between the primary conductors and the protective ground conductor when tested at the rated operating voltage did not exceed 0.5mA.

The mated plugs and female blocks were also wrapped in aluminum foil and a leakage current was then measured between the primary conductors and the foil wrap. Leakage current during these tests did not exceed 0.5 mA when tested at the rated operating voltage.

Dielectric - A test potential of 1960 volts was applied between each primary conductor and between the primary conductors tied together and the protective ground conductor for one minute with no occurrence of breakdown. Since the industrial power equipment has a protective insulation exterior material, the equipment was wrapped in aluminum foil and electrical tested between primary conductors tied together and the foil wrap. A test potential of 3950V, 60 Hz was applied to representative samples for 1 minute with no occurrence of breakdown.

Polarization – The male plugs are designed to mate with their intended female plugs and female blocks in only the correct polarized state.

Mechanical Requirements

The industrial power equipment was examined and tested to determine if sufficient mechanical strength and stability is provided to ensure protection from electrical shock and injury.

Drop test – The Industrial power equipment did not break, crack or damage when subjected to a drop test. The plug and female block cable ends were fixed to a wall 30 inches above the concrete floor. The plugs and female blocks were then held out horizontally and allowed to freely fall eight times onto the concrete floor, rotating the plugs 45 degrees after each drop.

Crushing test – No breakage or deformation resulted when the mated and unmated plugs and female blocks were subjected to a crushing force of 500 pounds for one minute.

Following the crush test, a satisfactory dielectric test was performed and the plugs and female blocks were checked for proper mating/unmating.

Security of Pins Test – The pins on the male plugs did not loosen or displace more than 3/32" when the pins were subjected to a pull force of 20 pounds for two minutes.

Impact Resistance Test – No breakage or deformation resulted when the plugs and female blocks were subjected to an impact caused by dropping a cylindrical 10-pound weight, having a flat face that is 2" in diameter, from a height of 18". The plugs and female blocks were then checked for proper mating/unmating.

Insertion and Withdrawal Forces – The appropriate plugs and female blocks could be mated manually as intended. The force required to disconnect the male plug from the female plug and the female block were measured and found to be greater than 20 pounds. This is satisfactory to ensure that the mated plugs and female blocks do not work themselves free.

Flex Test - No detachment or loosening resulted when each connector was subjected to a 5000 cycle flex test at the cable/bond area back and forth in a plane through an angle of 180 degrees. Following the flex test, a satisfactory dielectric test was performed.

Tensile Strength Tests – No breakage or loosening resulted when the plugs and female blocks were subjected to tensile strength tests, which consists of a straight pull and torque tests. The following straight pull and torque forces were each applied for one minute. With the plugs and female blocks firmly secured in place, the following forces were applied on the cable six inches from the plug/block mold area:

Plug Description	Straight Pull (lbs.)	Torque (ft. lbs.)
3B5/3B30	75	.5
3MFP plugs	75	.5
MTP/FTP plugs	30	.5

No-Load Endurance Tests – No-load endurance testing, consisting of 5000 cycles was performed on the FTP-3 and MTP-3 and 3FP30 and 3MFP/3MNFP plugs. A no-load endurance cycle consists of the male plug being completely inserted in the female plug and then completely withdrawn. No excessive wear resulted on the tested plugs which can occur during normal use or affect the watertight design for outdoor use.

Endurance testing was not considered necessary on the FTP-2 and MTP-2 plugs as the male and female pin/barrel design is identical to the tested FTP-3 and MTP-3 plugs. In addition, endurance testing was not considered necessary on the 3B5 and 3B30 female blocks as their female barrel design is identical to the 30FP3 female plug which is satisfactorily tested.

Extended Environmental Tests

IP68 Rating Tests – The following tests verify the industrial power equipment to be rated as IP68 (i.e., provides for a degree of protection defined as dust tight and rated for

continuous immersion). A Factory Mutual Research representative witnessed a continuous immersion and insulation resistance tests at the manufacturer's facility.

Dust Exclusion Test (IP6X) – The industrial power distribution equipment was suspended in a circulating dust atmosphere of 200-mesh talc. The test was carried out for eight hours. At the conclusion of the test, excess dust was removed from the sample's exterior and the samples were opened and evaluated. It was found that the industrial power equipment excluded the entry of dust on the electrical contacts.

Continuous Immersion Test (IPX8) – The industrial power distribution equipment connected to each of their respective connectors was suspended in a test tank. The tank was filled with water such that the highest point of the industrial connector was at least 6 feet (1.83 meters) below the surface of the water. The samples were removed from the tank after being submerged. The excess water was removed from the enclosure surfaces, and the enclosure was opened. Upon examination, it was found that the samples had excluded the entry of water on the electrical contacts.

Insulation Resistance Tests - The industrial power distribution equipment, connected to each of their respective connectors, was subjected to insulation resistance tests while immersed in water as described above. The insulation resistance measurements were conducted daily. Measurements between the following points on the test samples resulted in insulation resistance of greater than 200Mohms between each primary conductor and the surrounding water and between protective ground conductor and the surrounding water.

Corrosion Test – This test was waived as there are no accessible conductive metal parts on the industrial power equipment .

External Icing Test – Since the mated plugs and s and female blocks exclude the entrance of water, this test was waived as the plugs and female blocks do not contain areas that could accumulate ice or have external operators that could be damaged by ice.

Accelerated-Aging Test - This test was conducted on various colored HYPALON materials from which the connectors of the are molded. These materials were subjected to an oxygen atmosphere at 158 degrees F. at a pressure of 300 psi for 96 hours. As a result of this oxygen atmosphere exposure, the change in hardness on the samples was less than 10%.

Moisture Absorption Resistance Test – This test was conducted on samples of the SO type cable's outer jacket and on various colored HYPALON materials from which the

connectors are molded. These samples were immersed in distilled water for 48 hours. As a result of this immersion, the samples absorbed less than 2.7% of water by mass and no evidence of cracking or bubbling was evident.

Exposure to Deteriorating Liquids - The cable and connectors were dried at 212 degrees F (100 degrees C +/- 50 degrees C) for one hour. Following this, the samples were immersed in ASTM Reference Oil No. 1 and ASTM Reference Fuel C liquids for one hour. The samples showed no evidence of bubbling, cracking or corrosion. Within one hour after being removed from the fluids, the test samples satisfactorily passed the flammability test previously mentioned.

Comparative Tracking Index Tests – Black and red colored HYPALON samples were CTI tested per ASTM D3638-85. Electrodes, spaced 4mm (0.16") apart, were positioned on each test sample. The voltage to the electrodes was set up to 750 volts. Fifty drops of 0.1% ammonium chloride solution with an electrolyte resistivity of 385 ohm/cm (23 degree C) were then allowed to fall on each test sample between the electrodes from a height of not more than 40 mm (1.6") The solution drop size was 20 cubic mm (.0015 cu. in.) while the droppings occurred at a rate of 1 drop per 30 seconds. Test results were satisfactory as no tracking was evident on the HYPALON Test samples.

Hot Wire Ignition Tests – Black and red colored HYPALON samples were HWI tested per ASTM D3874-90. No. 24 AWG Nichrome heater wire, 10 inches in length, was wrapped five complete turns around each test sample. The heater wire was then energized to dissipate 6.5 W/in. for a duration time of not less than 60 seconds. Test results were satisfactory, as the HYPALON test samples did not ignite.

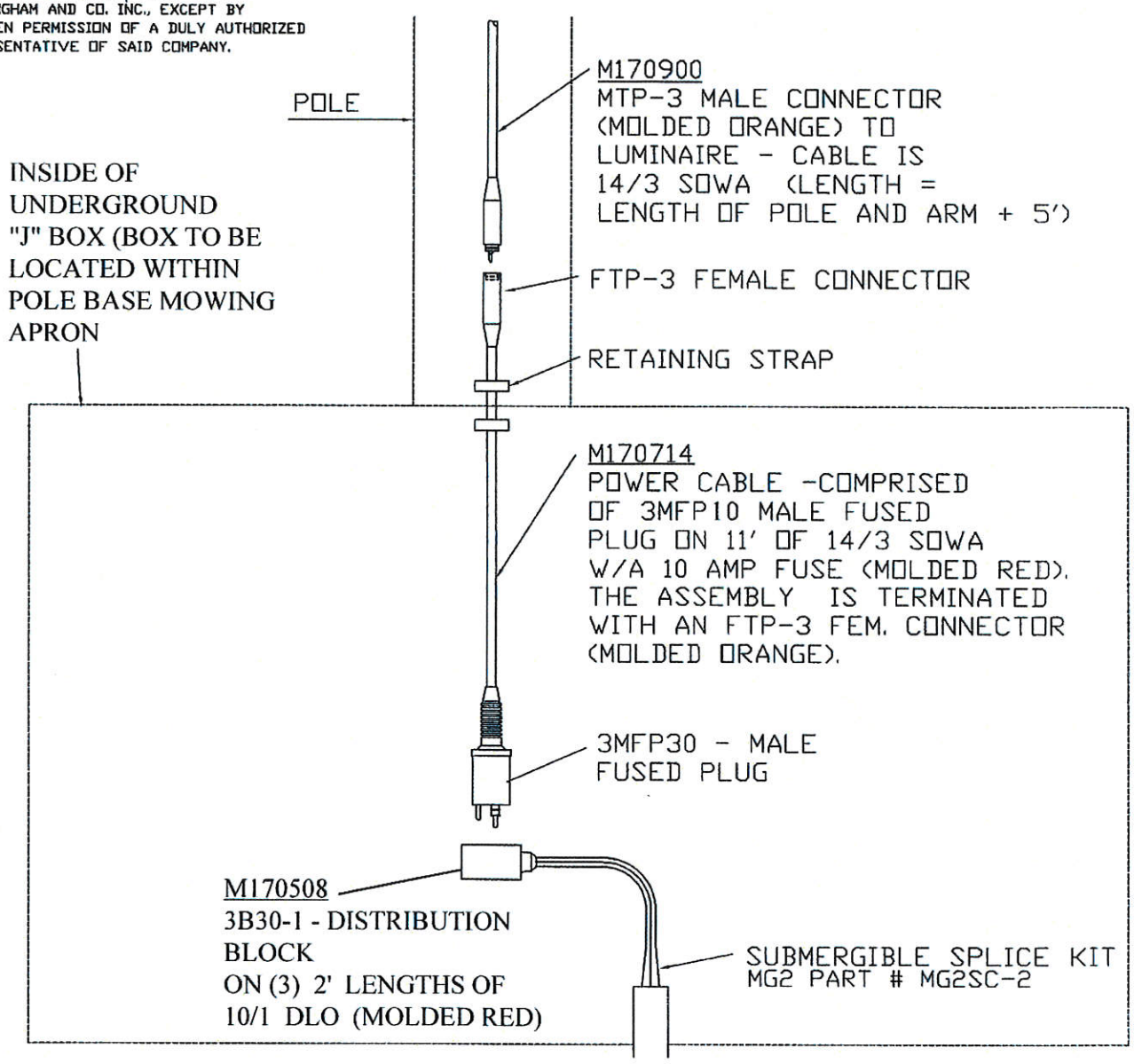
Internal Temperature Test - The internal temperature rise of the contact area of the mated connectors did not exceed a temperature rise of 54 degrees F (30 degrees C) referenced to 73 degrees F (23 degrees C) ambient temperature when operated at the maximum current rating.

External Temperature Test - The external temperature rise of the mated connectors and cable was not greater than 52 degreesF (29 degrees C) referenced to 73 degrees F (23 degrees C) ambient temperature when operated at the maximum current rating.

Flammability tests - Flammability tests were conducted on the cable, the molded body of the connectors and the molded protective caps. These materials were subjected to five flame applications on for 15 seconds and off for 15 seconds. After all applications, the materials self-extinguished before one minute upon removal of the flame and did not burn through.

REVISIONS

LTR	DESCRIPTION	DATE	APPROVED



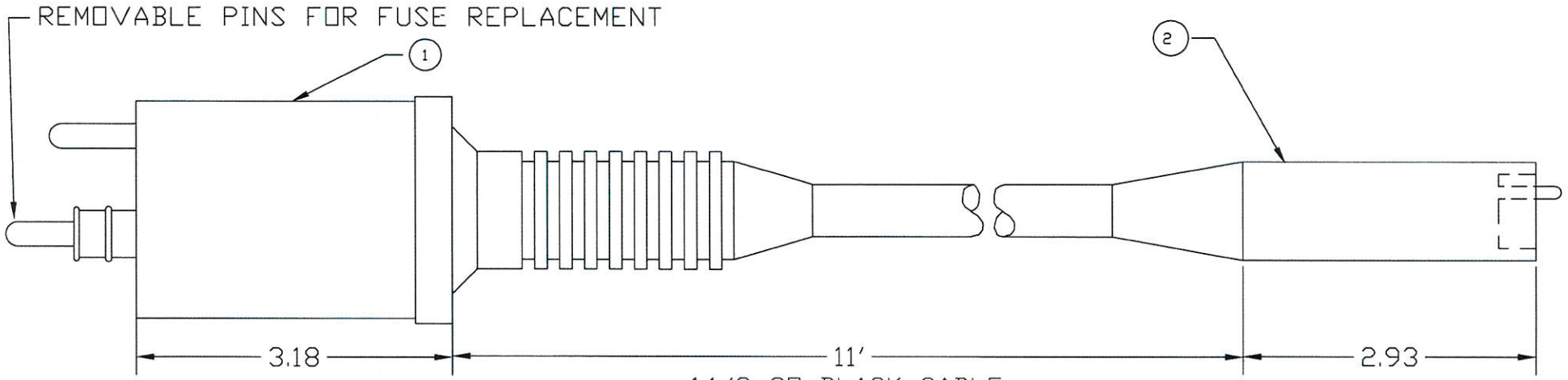
NOTE: 3MFP30 IS EQUIPPED WITH A 5 OR 10A, 500V FUSE, AND IS RATED FOR 10A

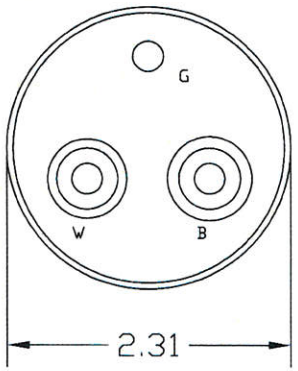
DIM'S IN INCHES UNLESS OTHERWISE NOTED. TOLERANCES: FRAC. DEC. ANGLE		MODULAR DISTRIBUTION SYSTEM, HIGHWAY LIGHTING (SINGLE LAMP), 10A (W/SURGE ARRESTOR)
	DRAWN:	
	CHECKED:	
MATERIAL:	APPROVED:	DURALINE DIV. OF J.B. NOTTINGHAM 75 HOFFMAN LANE ISLANDIA, NY 11749
	ENGR:	
FINISH:		

SIZE	CODE IDENT. NO.	DWG. NO.	REV.
A	16998	SK111698-1	

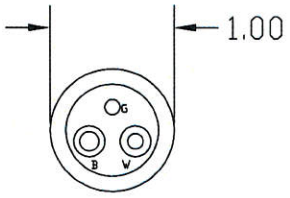
SCALE		SHEET

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED





3MFP5
FACE VIEW



FTP-3
FACE VIEW

QTY.	CODE	PART NUMBER	NOMENCLATURE OR DESCRIPTION	MATERIAL	ITEM
1		M170800	FTP-3 FEMALE CONNECTOR		2
1		M170700	3MFP5 MALE FUSED PLUG		1

PARTS LIST

DIMENSIONS IN INCHES UNLESS OTHERWISE NOTED. TOLERANCES: FRAC. DEC. ANG.

MATERIAL: BODY IS MOLDED HYPALON

FINISH:

DO NOT SCALE DRAWING

APPROVALS	DATE
DRAWN T.P.	11/15/95
CHECKED	
ISSUED	

3MFP5 ON 11' OF 14/3 SO W/FTP-3

DURALINE

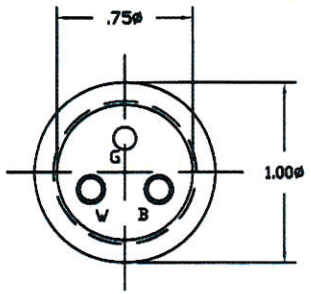
DIV. J.B. NOTTINGHAM
75 HOFFMAN LANE
ISLANDIA, NY 11749

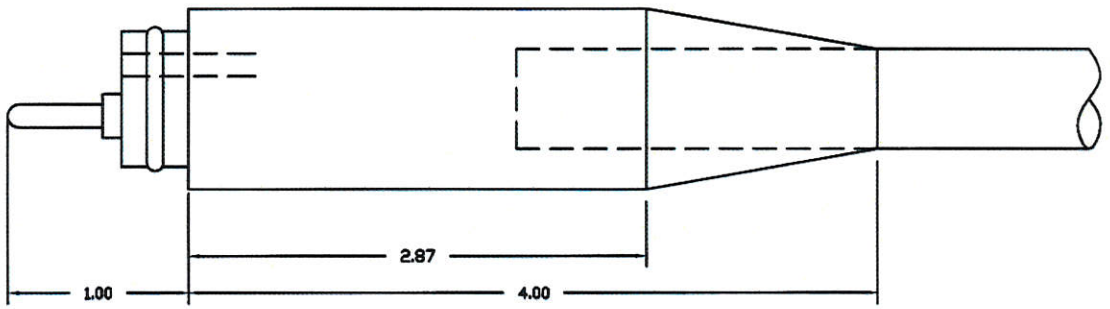
SIZE	FSCM NO.	DWG. NO.	REV.
A	16998	M170701	

SCALE

SHEET 1 OF 1

REVISIONS			
REV.	DESCRIPTION	DATE	





DIMENSIONS IN INCHES UNLESS OTHERWISE NOTED. TOLERANCES: FRAC. DEC. ANG.			MTP-3 MALE CONNECTOR
MATERIAL:	APPROVALS	DATE	Duraline / MG² INC. DIVISION OF J.B. NOTTINGHAM & CO., INC. 75 HOFFMAN LANE, ISLANDIA, NY 11749
	DRAWN EG	2/1/00	
FINISH:	CHECKED DR	4/9/02	SIZE A / FSCM NO. 16998 / DWG. NO. SM170900 / REV.
	ISSUED		
DO NOT SCALE DRAWING	DR	5/16/07	SCALE / SHEET

REVISIONS

LTR	DESCRIPTION	DATE	APPROVED
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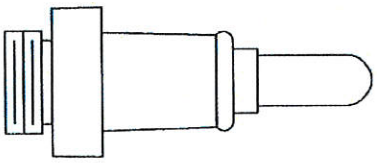

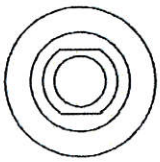

DIM'S IN INCHES UNLESS OTHERWISE NOTED.
TOLERANCES:
FRAC. DEC. ANGLE

DRAWN: T.P. 9/5/01
CHECKED:
APPROVED:
ENGR:

MATERIAL:
CONTACT IS 1/2 HARD BRASS
BODY IS MOLDED HYPALON

FINISH:

MOLDED PIN, 1/4" CONTACT

DURALINE
DIV. OF J.B. NOTTINGHAM
75 HOFFMAN LANE
ISLANDIA, NY 11749

SIZE	CODE IDENT. NO.	DWG. NO.	REV.
A	16998	A243100	D

SCALE | SHEET