



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.



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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



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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.).



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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.



75 Hoffman Lane, Islandia, NY 11749

IP68 Rated Modular Distribution for Highway Lighting Systems

Revised: 6/19/03

Identification No. ESN-0154

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:

<u>Plug Description</u>	<u>Straight Pull (lbs.)</u>	<u>Torque (ft. lbs.)</u>
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.



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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

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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.