

Scotchlok™ UY Connector Technical Report



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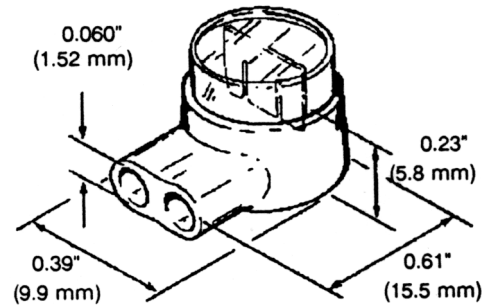
1.0 PRODUCT DESCRIPTION

The Scotchlok™ UY Connector is a butt-type, moisture resistant connector accepting two solid copper wires in the range of 22-26 AWG (0.65-0.4 mm) with a maximum insulation O.D. of 0.060 in. (1.52 mm). The UY Connector employs an insulation displacement contact (IDC) so that stripping of the conductor insulation prior to installation is not required. The UY Connector is easily installed and crimped using any of the approved Scotchlok Brand tools, such as the E-9C, E-9E, E9-Y or E9-BM.

SCOTCHLOK™ UY CONNECTOR BASIC PROPERTIES

PHYSICAL:

Width	0.39 in. (9.9 mm)
Length	0.61 in. (15.5 mm)
Crimped Height	0.23 in. (5.8 mm)



MATERIAL COMPOSITION:

Connector Body	Polycarbonate (Clear)
Connector Cap	Polycarbonate (Yellow)
Contact Element	Tin Plated Brass Alloy
Moisture Sealant	Petroleum Hydrocarbon Base

APPLICATION:

Wire Configuration	Two-Wire Butt
Wire Range	22-26 AWG (0.65-0.4 mm)
	Filled or Aircore PIC
Acceptable Conductors	Solid Copper Only
Max. Insulation O.D.	0.060 inches (1.52 mm)

2.0 TEST PROGRAM OVERVIEW

To predict the long-term performance reliability of the Scotchlok™ UY Connector in actual use, the connectors have been subjected to a number of tests which expose them to conditions more severe than anticipated to be encountered in actual use. The tests are based upon telephone industry performance specification and are believed to represent the most severe requirements from that industry.

The test conditions provide accelerated aging, allowing the prediction of the long-term performance within a relatively short time period. During the tests, such parameters as Connection Resistance, Insulation Resistance, Dielectric Strength and Physical Performance are monitored to determine the overall stability and reliability of the connectors.

3.0 CONNECTION STABILITY TESTS

Tests involving the measurement of connection resistance and connection resistance change, require that the samples be mounted on specially designed printed circuit (PC) boards which interface with 3M TelComm's computerized data acquisition system. All connection resistance measurements are made after the board mounted samples have reached thermal equilibrium in a regulated environmental chamber, controlled to $68 \pm 0.9^\circ\text{F}$ ($20 \pm 0.5^\circ\text{C}$.) With this system, connection resistances can be measured to better than 0.01 milliohm.

It should be noted that it is the connection resistance change which provides an indication of the reliability of an electrical joint. The resistance change of the connection must be small and randomly varied if the long-term reliability of the joint is to be assured. Random connection resistance changes remaining below 2.0 milliohms over the test period are generally considered acceptable as an indication of a stable electrical connection. Connection resistance changes greater than 2.0 milliohms are generally found to increase with time, eventually leading to service affecting instability, ultimately resulting in failure of the joint due to "high resistance opens".

3.01 Connection Resistance

Connection resistance measurements of Scotchlok™ UY connector are made by using the classical 4-wire method, employing a current of 100 milliamps D.C. It should be noted that the connection resistance is made up of the contact resistance of the joint PLUS the bulk resistance of the connector itself. The contact element bulk resistance is also measured by the 4-wire technique by joining two wires with the UY and dissolving away the plastic from around the metallic contact element. The contact resistance is thus calculated by subtracting the bulk resistance from the connection resistance.

CONNECTION RESISTANCE (Data in Milliohms)

WIRE SIZE AWG (mm)	CONNECTION RESISTANCE	BULK RESISTANCE	CONTACT RESISTANCE	
22 (0.65)	0.28	0.10	0.18	max.
to	0.20	0.10	0.10	min.
22 (0.65)	0.25	0.10	0.15	ave.
26 (0.4)	0.57	0.10	0.47	max.
to	0.26	0.10	0.16	min.
26 (0.4)	0.48	0.10	0.38	ave.

3.02 Heat/Cold Cycle

The Heat/Cold Cycle test subjects the UY connector to 100 continuous cycles of exposure to 20 seconds in liquid nitrogen at -320°F (-195°C) followed by 240 seconds in forced air at 180°F (82°C). This very extreme thermal cycle subjects the connections to severe stresses caused by the different thermal expansions and contractions. Connectors which can pass this test with connection resistance changes under 2.0 milliohms are considered to be acceptable.

HEAT/COLD PERFORMANCE DATA (Data in Milliohms)

WIRE SIZE AWG (mm)	CONNECTION RESISTANCE CHANGE		
	MINIMUM	MAXIMUM	AVERAGE
22 (0.65) to 22 (0.65)	-0.016	0.018	-0.002
22 (0.65) to 26 (0.4)	-0.024	0.970	0.064
26 (0.4) to 26 (0.4)	-0.007	1.542	0.144

3.03 Stress Relaxation

The Stress Relaxation test subjects the UY Connector to an ambient temperature of 244°F (118°C) for a period of 33 days. Following days 1, 2, 4, 8, 16 and 33, each sample is pulled momentarily with a 0.5 lb. (2.2 N) force. This mechanical disturbance is followed with connection resistance measurements.

This Stress Relaxation environment is intended to simulate the amount of relaxation which would occur at room temperature over the projected life of 40 years. Connection resistance changes less than 2.0 milliohms are considered acceptable.

STRESS RELAXATION PERFORMANCE DATA
(Data in Milliohms)

WIRE SIZE AWG (mm)	CONNECTION RESISTANCE CHANGE		
	MINIMUM	MAXIMUM	AVERAGE
22 (0.65) to 22 (0.65)	-0.003	0.028	0.010
22 (0.65) to 26 (0.4)	-0.012	0.164	0.024
26 (0.4) to 26 (0.4)	-0.005	0.404	0.072

3.04 Temperature Cycle

The Temperature Cycle test subjects the UY Connector to 512 eight-hour temperature cycles from -40°F to 140°F (-40°C to 60°C) with one hour dwells at the end point temperatures. The temperature cycles shall have an average rate of change of 60°F (33°C) per hour between temperature extremes. At designated intervals, connection resistance measurements are taken and compared with the initial connection resistance values, allowing determination of connection resistance change.

TEMPERATURE CYCLE PERFORMANCE DATA
(Data in Milliohms)

WIRE SIZE AWG (mm)	CONNECTION RESISTANCE CHANGE		
	MINIMUM	MAXIMUM	AVERAGE
22 (0.65) to 22 (0.65)	0.003	0.015	0.008
26 (0.4) to 26 (0.4)	0.020	0.397	0.090

3.05 Vibration

The Vibration test subjects the UY Connector to vibration for 20 minutes in each of three mutually perpendicular planes. The vibration ranges from 10 to 55 to 10 Hz in one minute cycles. The amplitude of the vibration is 0.060 in. (1.6 mm).

VIBRATION PERFORMANCE DATA (Data in Milliohms)

WIRE SIZE AWG (mm)	CONNECTION RESISTANCE CHANGE		
	MINIMUM	MAXIMUM	AVERAGE
22 (0.65) to 22 (0.65)	0.020	0.062	0.033
22 (0.65) to 26 (0.4)	0.003	0.060	0.034
26 (0.4) to 26 (0.4)	0.001	0.257	0.093

3.06 Current Cycle

The Current Cycle test subjects the UY Connector to the overload currents listed in the table below:

CURRENT CYCLE TEST

WIRE SIZE AWG (mm)	"INITIAL" AND "FINAL" CURRENT (Amperes)	"TEST" CURRENT (Amperes)
22 (0.65)	9.0	11.0
26 (0.4)	3.0	3.8

The current is increased to the "Initial" value for 15 minutes to establish thermal equilibrium. After this time, the voltage drop across each sample is recorded and noted as the "Initial" reading. The current is then increased to the "Test" value and maintained for 45 minutes. At the end of this time the current is reduced to zero for 15 minutes. This cycle is repeated 50 times.

At the end of the 50th cycle, the "Final" current is maintained for 15 minutes after which time the voltage drop across each sample is again noted. From these data the change in connection resistance between the initial and final values is determined.

CURRENT CYCLE PERFORMANCE DATA
(Data in Milliohms)

WIRE SIZE AWG (mm)	CONNECTION RESISTANCE CHANGE		
	MINIMUM	MAXIMUM	AVERAGE
22 (0.65) to 22 (0.65)	0.188	1.177	0.443
22 (0.65) to 26 (0.4)	0.400	7.033	2.306
26 (0.4) to 26 (0.4)	-0.866	5.966	2.440

Conclusions: The measurements of connection resistance for this test are not made through the use of the 3M TelComm computerized data acquisition system. Industry requirements for this test specify resistance changes shall not exceed 5% of the initial values.

All samples exhibited resistance changes less than the required 5% specification.

4.0 DIELECTRIC STRENGTH TESTS

4.01 Wet & Dry Dielectric Strength

The dielectric strength or voltage withstand of the UY Connector is determined by two methods: "Dry" or "Wet". The Dry Dielectric Strength test is conducted by immersing the test samples in conductive lead shot (#2 size). An A.C. voltage is established between the lead shot and the sample and increased at the rate of 500 volts per second until breakdown occurs.

The Wet Dielectric Strength test is conducted by immersing the test samples in 5% salt water (by weight). A copper electrode is placed in the salt water and an A.C. voltage established between the water and the sample. The voltage is increased at the rate of 500 volts per second until breakdown occurs.

Dielectric Strength values which exceed 2.5 KV AC are considered acceptable for both the Wet and Dry tests.

DIELECTRIC STRENGTH PERFORMANCE DATA (Kilovolts rms)

WIRE SIZE AWG (mm)	DRY TEST DIELECTRIC STRENGTH	WET TEST DIELECTRIC STRENGTH
22 (0.65) to 22 (0.65)	8.0 MIN. 16.4 MAX.	6.6 MIN. 15.1 MAX.
22 (0.65) to 26 (0.4)	8.2 MIN. 16.0 MAX.	4.8 MIN. 15.8 MAX.
26 (0.4) to 26 (0.4)	13.1 MIN. 17.5 MAX.	7.8 MIN. 15.2 MAX.

5.0 INSULATION RESISTANCE

5.01 Water Immersion

The UY connectors were immersed in a 5% salt water solution to a depth of 6 in. (152 mm) for a period of 30 days. At the end of the 30 day period insulation resistance measurements were made (at 250 VDC) between each connector and the water.

Industry requirements for insulation resistance typically require values to exceed 100 Megohms. The results listed for both the water immersion test and the high humidity test following easily exceed the industry requirements.

Data Following 30 Days Water Immersion

Wire Size AWG (mm)	Maximum (Ohms)	Minimum (Ohms)	% < 100 Megohms
22 (0.65) to 22 (0.65)	1.01×10^{12}	6.71×10^{11}	0
22 (0.65) to 26 (0.4)	1.29×10^{12}	7.91×10^{11}	0
26 (0.4) to 26 (0.4)	1.96×10^{12}	1.38×10^{12}	0

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5.02 High Humidity

The UY connectors were tightly bundled together and placed in a high humidity chamber capable of operating from 40°F to 140°F (4°C to 60°C) in 12 hour cycles. Stabilization at the end point temperatures was maintained for 4-3/4 hours with the relative humidity at 95%. Throughout the test, 48 volts D.C. was maintained between the tip and ring connectors. Insulation resistance measurements between each connector and all remaining connectors in the bundle were made (at 250 VDC) initially and after 37, 75 and 150 cycles at both dwell temperatures.

Data Following 150 High Humidity Cycles

Wire Size AWG (mm)	Maximum (Ohms)	Minimum (Ohms)	% < 100 Megohms
22 (0.65) to 22 (0.65)	1.0×10^{13}	7.6×10^{12}	0
22 (0.65) to 26 (0.4)	1.2×10^{13}	8.6×10^{12}	0
26 (0.4) to 26 (0.4)	1.3×10^{13}	7.0×10^{12}	0

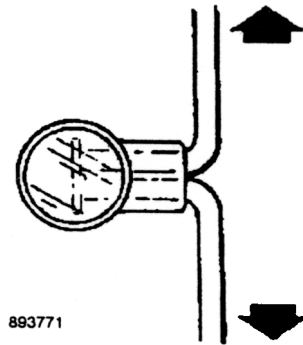
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6.0 PHYSICAL TESTS

6.01 Tensile Strength

The Tensile Strength test determines the mechanical strength of the joint made with the UY Connector. To perform the test, each wire is pulled with a tensile machine operated at a head speed of 2.4 in/min. (1 mm/sec.) until failure.

Tensile strengths which exceed 85% of the strength of the original unspliced wire are considered acceptable.



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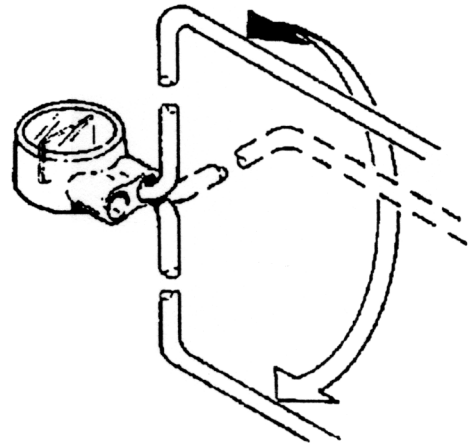
TENSILE STRENGTH PERFORMANCE DATA

WIRE SIZE AWG (mm)	WIRE BREAKING STRENGTH		AVERAGE PERCENT OF WIRE STRENGTH
	MAXIMUM	MINIMUM	
22 (0.65) to 22 (0.65)	18.8 lb. 84.0 Newtons	16.8 lb. 75.0 Newtons	86.9
22 (0.65) to 26 (0.4)	8.0 lb. 36.0 Newtons	7.8 lb. 35.0 Newtons	94.6
26 (0.4) to 26 (0.4)	7.8 lb. 35.0 Newtons	7.6 lb. 34.0 Newtons	92.8

6.02 Torsion

For this test, the wires from each sample were bent 90 degrees against the connector body (in the plane of the wire port axes). From this position, using a conductor crank arm of 2 in. (50.8 mm), the conductor was rotated 10 times to each side.

Connectors which can survive 10 torsional cranks as described above, are expected to survive normal field abuse.



TORSION TEST PERFORMANCE DATA

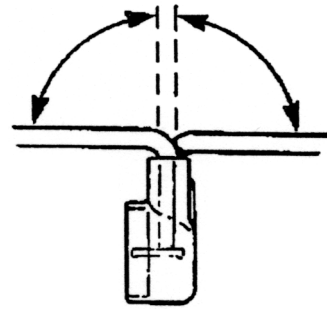
Wire Size AWG (mm)	No. Rotations to Each Side	Comments
22 (0.65) to 22 (0.65)	10	No wire breakage or slipping in contact
22 (0.65) to 26 (0.4)	10	No wire breakage or slipping in contact
26 (0.4) to 26 (0.4)	10	No wire breakage or slipping in contact

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6.03 Bending

Using a conductor bending arm of 2 in. (50.8 mm), the conductors were bent 90 degrees toward each side 10 times with all motion remaining in the same plane (no torsional rotation).

Connectors which can survive 10 bends as described above, are expected to survive normal field abuse.



BENDING TEST PERFORMANCE DATA

Wire Size AWG (mm)	No. Bends to Each Side	Comments
22 (0.65) to 22 (0.65)	10	No wire breakage or slipping in contact
22 (0.65) to 26 (0.4)	10	No wire breakage or slipping in contact
26 (0.4) to 26 (0.4)	10	No wire breakage or slipping in contact

7.0 CONCLUSION

The Scotchlok™ UY Connector successfully met or exceeded all the test requirements. It has been used for over 25 years in actual service around the world. For information concerning specific agency approvals please contact your 3M representative.

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