



Intertek Testing Services

ETL SEMKO

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ITS Job No. 3031601

ITS Report No. 3031601-001

Date: September 17, 2002

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REPORT OF TESTING

Rendered To:
Jinro Industries Company LTD
569 Bosong-Ri, Pungse-myon
Chonan-Si, Chungnam
Republic of Korea

Product Identification:

Power & Distribution Cables:

2kV SP 2/0AWG x 1C with cross-linked polyolefin (Type P) insulation.

2kV SPBS 2/0AWG x 1C with cross-linked polyolefin (Type P) insulation, aluminum, tinned copper or bronze armor, and a neoprene (Type N) sheath.

600V TPN 6AWG x 3C with cross-linked polyolefin (Type (P) insulation and a neoprene (Type N) sheath.

600V TPNBS 6AWG x 3C with cross-linked polyolefin (Type (P) insulation, aluminum, tinned copper or bronze armor, and a neoprene (Type N) sheath.

Control Cables:

600V CPN 14AWG x 7C with cross-linked polyolefin (Type (P) insulation and a neoprene (Type N) sheath.

600V CPNBS 14AWG x 7C with cross-linked polyolefin (Type (P) insulation, aluminum, tinned copper or bronze armor, and a neoprene (Type N) sheath.

Signal Cables:

600V TP(I/S-OS)PN 18AWG x 7P with cross-linked polyolefin (Type (P) insulation and a neoprene (Type N) sheath.

600V TP(I/S-OS)PNBS 18AWG x 7P with cross-linked polyolefin (Type (P) insulation, aluminum, tinned copper or bronze armor, and a neoprene (Type N) sheath.

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Specifications

IEEE-45, 1998: IEEE Recommended Practice for Electric Installations on Shipboard.

UL 1309: Standard for Marine Shipboard Cable.

IEEE-1580-2001: IEEE Recommended Practice for Marine Cable for Use on Shipboard and Fixed or Floating Platforms.

IEC 60332-3-22, First Edition 2000-10: Tests on electric cables under fire conditions – Part 3-22: Test for vertical flame spread of vertically-mounted bunched wires or cables – Category A

Tests Procedures & Results: The following table identifies all testing required by the specification identified above. The table identifies the test, the procedure, requirements, results, and conclusion.

Sample Identification:

Sample	Description
A	2kV SP 2/0AWG x 1C with cross-linked polyolefin (Type P) insulation.
B	2kV SPBS 2/0AWG x 1C with cross-linked polyolefin (Type P) insulation, aluminum, tinned copper or bronze armor, and a neoprene (Type N) sheath.
C	600V TPN 6AWG x 3C with cross-linked polyolefin (Type P) insulation and a neoprene (Type N) sheath.
D	600V TPNBS 6AWG x 3C with cross-linked polyolefin (Type P) insulation, aluminum, tinned copper or bronze armor, and a neoprene (Type N) sheath.
E	600V CPN 14AWG x 7C with cross-linked polyolefin (Type P) insulation and a neoprene (Type N) sheath.
F	600V CPNBS 14AWG x 7C with cross-linked polyolefin (Type P) insulation, aluminum, tinned copper or bronze armor, and a neoprene (Type N) sheath.
G	600V TP(I/S-OS)PN 18AWG x 7P with cross-linked polyolefin (Type P) insulation and a neoprene (Type N) sheath.
H	600V TP(I/S-OS)PNBS 18AWG x 7P with cross-linked polyolefin (Type P) insulation, aluminum, tinned copper or bronze armor, and a neoprene (Type N) sheath.

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IEEE-45, 1998 UL 1309 IEEE-1580-2001				
Complete Cable				
Test	Procedure	Requirements	Results	Conclusion
High Voltage	IEEE-45, 1998: Section 8.13.1 UL 1309: Section 4.2.2 IEEE-1580- 2001: Section 5.17.1	Sample A: Withstand 8.0kV for 5 minutes without breakdown. Sample B: Withstand 8.0kV for 5 minutes without breakdown. Sample C: Withstand 5.5kV for 5 minutes without breakdown. Sample D: Withstand 5.5kV for 5 minutes without breakdown. Sample E: Withstand 3.5kV for 5 minutes without breakdown. Sample F: Withstand 3.5 kV for 5 minutes without breakdown. Sample G: Withstand 1.5 kV for 5 minutes without breakdown. Sample H: Withstand 1.5 kV for 5 minutes without breakdown.	Sample A: No Breakdown Sample B: No Breakdown Sample C: No Breakdown Sample D: No Breakdown Sample E: No Breakdown Sample F: No Breakdown Sample G: No Breakdown Sample H: No Breakdown	PASS PASS PASS PASS PASS PASS
Conductor Resistance	IEEE-45, 1998: Section 8.13.2 UL 1309: Section 3.1.1 IEEE-1580- 2001: Section 5.17.3	Sample A: 0.94Ω/1000 ft. max. Sample B: 0.94Ω/1000 ft. max. Sample C: 0.483Ω/1000 ft. max. Sample D: 0.483Ω/1000 ft. max. Sample E: 3.11Ω/1000 ft. max. Sample F: 3.11Ω/1000 ft. max. Sample G: 6.34Ω/1000 ft. max. Sample H: 6.34Ω/1000 ft. max.	Sample A: 0.74 Sample B: 0.737 Sample C: 0.438 Sample D: 0.434 Sample E: 2.824 Sample F: 2.762 Sample G: 5.375 Sample H: 5.375	PASS PASS PASS PASS PASS PASS PASS PASS
Insulation Resistance	IEEE-45, 1998: Section 8.13.3 UL 1309: Section 4.2.3 IEEE-1580- 2001: Section 5.17.4	Samples A & B: 800 MΩ/1000ft. minimum. Samples C & D: 1200 MΩ/1000ft. minimum. Sample E & F: 1600 MΩ/1000ft. minimum. Sample G & H: 3000 MΩ/1000ft. minimum.	Samples A & B: 2472 Samples C & D: 5885 Samples E & F: 13376 Samples G & H: 6130	PASS PASS PASS PASS
Low Temperature Bend	UL 1309: Section 4.3.1 IEEE-1580- 2001: Section 5.17.11	No cracks or ruptures in the insulation or jacket	Sample B: No Cracks or Ruptures. Sample D: No Cracks or Ruptures. Sample F: No Cracks or Ruptures. Sample H: No Cracks or Ruptures.	PASS PASS PASS PASS
Low Temperature Impact	UL 1309: Section 4.3.2 IEEE-1580- 2001: Section 5.17.12	8 out of 10 specimens shall not exhibit cracks in the jacket	Sample B: No Cracks. Sample D: No Cracks. Sample F: No Cracks. Sample H: No Cracks.	PASS PASS PASS PASS

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IEEE-45, 1998 UL 1309 IEEE-1580-2001	Continued			
Complete Cable	Continued			
Test	Procedure	Requirements	Results	Conclusion
Salt Water Immersion	IEEE-45, 1998: Section 8.13.6 UL 1309: Section 4.3.6 IEEE-1580-2001: Section 5.17.7	Sample A: Withstand 8.0kV for 5 minutes without breakdown & jacket and insulation shall not crack. Sample B: Withstand 8.0kV for 5 minutes without breakdown & jacket and insulation shall not crack. Sample C: Withstand 5.5kV for 5 minutes without breakdown & jacket and insulation shall not crack. Sample D: Withstand 5.5kV for 5 minutes without breakdown & jacket and insulation shall not crack. Sample E: Withstand 3.5kV for 5 minutes without breakdown & jacket and insulation shall not crack. Sample F: Withstand 3.5 kV for 5 minutes without breakdown & jacket and insulation shall not crack. Sample G: Withstand 1.5 kV for 5 minutes without breakdown & jacket and insulation shall not crack. Sample H: Withstand 1.5 kV for 5 minutes without breakdown & jacket and insulation shall not crack.	Sample A: No Breakdown & No Cracks Sample B: No Breakdown & No Cracks Sample C: No Breakdown & No Cracks Sample D: No Breakdown & No Cracks Sample E: No Breakdown & No Cracks Sample F: No Breakdown & No Cracks Sample G: No Breakdown & No Cracks Sample H: No Breakdown & No Cracks	PASS PASS PASS PASS PASS PASS
Oil Immersion	IEEE-45, 1998: Section 8.13.7 UL 1309: Section 4.3.7 IEEE-1580-2001: Section 5.17.8	Sample C: Withstand 5.5kV for 5 minutes without breakdown & jacket and insulation shall not crack. Sample E: Withstand 3.5kV for 5 minutes without breakdown & jacket and insulation shall not crack. Sample G: Withstand 1.5 kV for 5 minutes without breakdown & jacket and insulation shall not crack.	Sample C: No Breakdown & No Cracks Sample E: No Breakdowns & No Cracks Sample G: No Breakdown & No Cracks	PASS PASS PASS

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IEEE-45, 1998 UL 1309 IEEE-1580-2001	Continued			
Complete Cable	Continued			
Test	Procedure	Requirement	Results	Conclusion
Pull-Through Metal Plates	IEEE-45, 1998: Section 8.13.8 UL 1309: Section 4.3.8 IEEE-1580-2001: Section 5.17.9	No parts of the cable under the jacket shall be exposed.	Sample A: No Exposure Sample B: No Exposure Sample C: No Exposure Sample D: No Exposure Sample E: No Exposure Sample F: No Exposure Sample G: No Exposure Sample H: No Exposure	PASS PASS PASS PASS PASS PASS PASS PASS
Bending Endurance	IEEE-45, 1998: Section 8.13.9 UL 1309: Section 4.3.9 IEEE-1580-2001: Section 5.17.10	Sample A: Withstand 8.0kV for 5 minutes without breakdown & jacket and insulation shall not crack. Sample B: Withstand 8.0kV for 5 minutes without breakdown & jacket and insulation shall not crack. Sample C: Withstand 5.5kV for 5 minutes without breakdown & jacket and insulation shall not crack. Sample D: Withstand 5.5kV for 5 minutes without breakdown & jacket and insulation shall not crack. Sample E: Withstand 3.5kV for 5 minutes without breakdown & jacket and insulation shall not crack. Sample F: Withstand 3.5 kV for 5 minutes without breakdown & jacket and insulation shall not crack. Sample G: Withstand 1.5 kV for 5 minutes without breakdown & jacket and insulation shall not crack. Sample H: Withstand 1.5 kV for 5 minutes without breakdown & jacket and insulation shall not crack.	Sample A: No Breakdown & No Cracks Sample B: No Breakdown & No Cracks Sample C: No Breakdown & No Cracks Sample D: No Breakdown & No Cracks Sample E: No Breakdown & No Cracks Sample F: No Breakdown & No Cracks Sample G: No Breakdown & No Cracks Sample H: No Breakdown & No Cracks	PASS PASS PASS PASS PASS PASS PASS PASS

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IEEE-45, 1998 UL 1309 IEEE-1580-2001	Continued			
Insulation	Continued			
Test	Procedure	Requirements	Results	Conclusion
Accelerated Water Absorption (Gravimetical Method)	IEEE-45, 1998: Table 8-5 UL 1309: Table 3	Maximum: 13.0 mg/in ²	Water Absorption: 2.3	PASS
Physical Requirements	IEEE-45, 1998: Table 8-5 UL 1309: Table 3 IEEE-1580-2001: Table 14	UNAGED: Tensile Strength: 1800 PSI minimum. Elongation: 250% minimum. OVEN AGED: Tensile Strength: 90% of unaged minimum. Elongation: 50% of unaged minimum.	UNAGED: Tensile Strength: 1806.9 Elongation: 436 OVEN AGED: Tensile Strength: 109.3 Elongation: 97.2	PASS PASS PASS PASS
Heat Distortion	IEEE-45, 1998: Table 8-5 UL 1309: Table 3 IEEE-1580-2001: Table 14	Maximum change in Thickness: 20%	Change: 5%	PASS
Cold Bend	IEEE-45, 1998: Table 8-5 UL 1309: Table 3	Sample B: Withstand 8.0kV for 5 minutes without breakdown & and insulation shall not crack. Sample D: Withstand 5.5kV for 5 minutes without breakdown & and insulation shall not crack. Sample F: Withstand 3.5kV for 5 minutes without breakdown & and insulation shall not crack. Sample H: Withstand 1.5 kV for 5 minutes without breakdown & and insulation shall not crack.	Sample B: No Breakdown & No Cracks. Sample D: No Breakdown & No Cracks. Sample F: No Breakdown & No Cracks. Sample H: No Breakdown & No Cracks.	PASS PASS PASS PASS
Cold Impact	IEEE-45, 1998: Table 8-5 UL 1309: Table 3	8 out of 10 specimens shall not exhibit cracks in the jacket	Sample A: No Cracks Sample C: No Cracks Sample E: No Cracks Sample G: No Cracks	PASS PASS PASS PASS
Ozone Resistance	IEEE-45, 1998: Table 8-5 IEEE-1580-2001: Table 14	No Cracks	Sample A: No Cracks Sample C: No Cracks Sample E: No Cracks Sample G: No Cracks	PASS PASS PASS PASS
Tension Set	IEEE-45, 1998: Table 8-5	Set shall not exceed 30%	Set: 4.75%	PASS

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IEEE-45, 1998 UL 1309 IEEE-1580-2001	Continued			
Insulation	Continued			
Test	Procedure	Requirements	Results	Conclusion
Corrosivity	IEEE-45, 1998: Table 8-5	Not more than 5% removal of copper film.	0% of copper film was removed	PASS
Hot Oil resistance	IEEE-45, 1998: Table 8-5	Maximum Allowable Swell: ASTM #2 Oil: 60% Diesel (Fuel) Oil: 60%	ASTM #2 Oil: 28.2% Diesel (Fuel) Oil: 31.4%	PASS PASS
Hot Creep	IEEE-45, 1998: Table 8-5 UL 1309: Table 3 IEEE-1580- 2001: Table 14	Elongation: 25% maximum. Set: 2% Maximum.	Elongation: 12.5% Set: 0%	PASS
Flammability (VW-1)	IEEE-45, 1998: Table 8-5 IEEE-1580- 2001: Table 14	Specimen shall not flame longer than 60 seconds following any of the five 15 second flame applications, the cotton shall not ignite, & the flag shall not be damaged more than 25%	Sample A: Afterflame: None. No damage to flag. Cotton did not ignite. Sample C: Afterflame: 1 sec. No damage to flag. Cotton did not ignite. Sample E: Afterflame: 28 sec. No damage to flag. Cotton did not ignite. Sample G: Afterflame: 32 sec. No damage to flag. Cotton did not ignite.	PASS PASS PASS PASS

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Test	Procedure	Requirements	Results	Conclusion
IEEE-45, 1998 UL 1309 IEEE-1580-2001	Continued			
Jacket				
Physical Requirements	IEEE-45, 1998: Table 8-9 UL 1309: Table 5 IEEE-1580-2001: Table 16	UNAGED: Tensile Strength: 1800 PSI minimum. Elongation: 250% minimum. OVEN AGED: Tensile Strength: 80% of unaged minimum. Elongation: 60% of unaged minimum. OIL AGED: Tensile Strength: 80% of unaged minimum. Elongation: 80% of unaged minimum:	UNAGED: Tensile Strength: 2381 Elongation: 364 OVEN AGED: Tensile Strength: 91.6 Elongation: 97.8 OIL AGED: Tensile Strength: 89.6 Elongation: 87.4	PASS PASS PASS PASS PASS PASS
Cold Bend	IEEE-45, 1998: Table 8-9	Jacket shall exhibit no cracks.	Sample A: No Cracks Sample B: No Cracks Sample C: No Cracks Sample D: No Cracks Sample E: No Cracks Sample F: No Cracks Sample G: No Cracks Sample H: No Cracks	PASS
Cold Impact	IEEE-45, 1998: Table 8-9	8 out of 10 specimens shall not exhibit cracks in the jacket	Sample A: No Cracks Sample B: No Cracks Sample C: No Cracks Sample D: No Cracks Sample E: No Cracks Sample F: No Cracks Sample G: No Cracks Sample H: No Cracks	PASS
Mechanical Water Absorption	IEEE-45, 1998: Table 8-9 IEEE-1580-2001: Table 14	Maximum: 8.0 mg/in ²	Water Absorption: 6.9	PASS
Weatherometer	IEEE-45, 1998: Table 8-9 IEEE-1580-2001: Table 16	Tensile Strength: 80% of unaged Elongation: 80% of unaged.	Tensile Strength: 89.6% of unaged. Elongation: 87.4 % of unaged	PASS PASS
Tear Test	IEEE-45, 1998: Table 8-9 IEEE-1580-2001: Table 14	Average Force shall not be less than 35 lb/in thickness.	Average Force: 42.08	PASS

IEC 60332-3-22				
Complete Cable				
Test	Procedure	Requirements	Results	Conclusion
Test on Electric Cables Under Fire Conditions	Cat. A, Mounting Method F	Maximum Char not to exceed 2.5 meters above the bottom edge of the burner.	Sample A: Char: 1.14 meters Sample B: Char: 1.72 meters Sample G: Char: 1.87 meters Sample H: Char: 1.46 meters	PASS PASS PASS PASS

Conclusions

The samples, as described above, were tested at the Intertek Testing Services/ETL Semko laboratory located in Cortland, New York, and were found to be in compliance with the indicated applicable requirements.

Approved By:

Reviewed by:

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