Raychem
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Gel Inline Splice
Type GILS 4/0 to
ANSI C119.1-1986

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Gel Inline Splice Type GILS 4/0 to
ANSI C119.1-1986

Enclosures:

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I. OBJECTIVE

To evaluate the mechanical, electrical, and environmental sealing integrity of the gel inline splice closure type GILS-4/0 when used over inline mechanical connector type RYC-4/0. The samples were subjected to the test sequence specified in American National Standard ANSI C119.1-1986, "Sealed Insulated Underground Connector Systems Rated 600 Volts."

II. SUMMARY

A total of twelve test assemblies, six #2 AWG and six 4/0 AWG were evaluated for thermal, electrical, environmental and mechanical performance. Each sample was subjected to water immersion, oven heat conditioning, cold temperature conditioning, followed by twist and flex, then current load cycling and voltage withstand tests.

All samples passed the design test specification requirements.

III. CONCLUSION

By passing the ANSI C119.1-1986 (Part 4.3) test specification requirements, the Raychem GILS product (GILS-4/0) has demonstrated the ability to withstand the mechanical, electrical and sealing requirements for underground cable splices when used on solid dielectric cables rated up to 600 volts.

IV. SAMPLE PREPARATION

The construction of the test assemblies consisted of stripping the insulation from the cables for a specified length and installing the RYC 4/0 mechanical inline connector. The GILS 4/0 gel closures were centered over the RYC-4/0 connector and compressed until the locking snaps engaged.

IV. SAMPLE PREPARATION (continued)

The sample matrix was as follows:

Cable	Connector Type	Closure type	Sample Number
4/0	RYC-4/0	GILS-4/0	1-6
#2	RYC-4/0	GILS-4/0	7-12

V. TESTING

Each test assembly was subjected to the sequence of tests described in this report, as specified in ANSI C119.1-1986, Part 4.3 entitled "Integrity of Seal Connector Insulation."

Test Sequence

1. Immersion

The test samples were immersed for 24 hours in a water bath containing tap water having a temperature of 25°C ± 5°C. The assemblies were positioned so that the entire cable assembly was submerged under a minimum one foot head of water.

2. Insulation Resistance

After the 24 hour immersion, the insulation resistance was measured by applying 500 volts DC between the conductor of each individual sample and the grounded water bath for 1 minute.

Requirement: > 6.0×10^6 ohms

Results: All samples passed. Values reported in section A of Appendix I.

3. AC Voltage Withstand - Initial

Immediately following the insulation resistance measurements, each sample was subjected to an AC voltage of 2200 volts rms for a period of 1 minute. The voltage was applied between the conductor of the cable and the grounded water bath.

Requirement: No breakdown or flashover.

Results: All samples passed.

4. Heat Conditioning

The test samples were removed from the water bath, allowed to dry and placed in an air circulating oven at a temperature of 90°C ± 5°C for 72 hours. After the heat conditioning the samples were removed from the oven and allowed to cool to room temperature.

5. Flexing

Each sample was subjected to a flexing test consisting of securely clamping the cable insulation at a distance of 15 times the cable diameter for cables above #4 AWG, from the bottom edge of the closure. While clamped, the cable sample was bent through an arc of 90° in both directions from the vertical degree base position. This cycle was repeated ten times.

6. Twisting

While still clamped in accordance with the flexing test, the samples were twisted around the conductor axis 15° clockwise, returned to the starting position, twisted 15° counterclockwise, and returned to the starting position. This cycle was repeated five times.

7. Immersion

After the twisting and flexing tests the samples were immersed for 24 hours.

8. Insulation Resistance

Following twenty-four hours immersion, the insulation resistance was measured according to Test 2.

Requirement: > 1.0 x 10^9 ohms or ≥ 90% of the initial recorded value.

Results: All samples passed. Values reported in Section B of Appendix I.

9. Cold Conditioning

The samples were removed from the water bath, allowed to dry and placed in a freezer at a temperature of -18°C ± 5°C for 4-hours.

10. Flexing

Immediately following the cold conditioning, while still within 5°C of the -18°C temperature, the test samples were subjected to 10 flexing cycles, as described in Test 5.

11. Twisting

Five twisting cycles were performed on the samples, as described in Test 6, while the samples were within 5°C of the -18°C cold conditioning temperature.

12. Water Immersion

The samples were immersed for 24 hours, according to Test 1, following the cold twist test.

13. Insulation Resistance

Insulation resistance was measured after the 24 hour immersion, as described in Test 2.

Requirement: > 1.0 x 10^9 ohms or > 90% of the initial recorded value.

Results: All samples passed. Values shown in Section C of Appendix I.

14. Current Cycling and Water Immersion

The test samples were series connected and subjected to 50 cycles of current heating each followed by water immersion. One cycle is defined as applying sufficient current for 1 hour to the cables to achieve a conductor temperature of 90°C in air, then de-energizing the cables. Within 3 minutes of de-energizing, the samples were immersed under a minimum of 1 foot head of tap water (25°C + 5°C) for 30 minutes.

15. Insulation Resistance

Insulation resistance was measured on each sample, per Test 2, after the 25th and 50th thermal cycles following a 24 hour immersion period.

Requirement: >1.0 x 10^9 ohms or > 90% of the initial recorded value.

Results: All samples passed. Values reported in Section A of Appendix II.

16. AC Voltage Withstand after 50th Current Cycle

An AC voltage of 2200V rms was applied for 1 minute between each sample conductor and the grounded water bath while the sample remained immersed in the water.

Requirement: No breakdown or flashover.

Results: All samples passed.

17. AC Leakage Current after 50th Current Cycle.

The leakage current was measured on each sample when subjected to an AC voltage of 600V applied between each conductor and the grounded water bath.

Requirement: 1000 μA maximum.

Results: All samples passed. Values reported in section A of Appendix 11.

APPENDIX I

A. Insulation Resistance After Initial Immersion

Requirement: > 6.0×10^6 ohms

Sample #	**IR (ohms)**	**Sample #**	**IR (ohms)**
1	1.7×10^{12}	7	4.0×10^{12}
2	3.0×10^{12}	8	3.0×10^{12}
3	5.0×10^{12}	9	1.0×10^{12}
4	7.0×10^{12}	10	2.0×10^{12}
5	6.0×10^{12}	11	2.0×10^{12}
6	2.5×10^{12}	12	3.0×10^{12}

APPENDIX I (continued)

B. Insulation Resistance After Heat Aging and Flexing and Twisting

Requirement: > 1.0×10^9 ohms or $\geq$ 90% of the initial recorded value.

Sample #	**IR (ohms)**	**Sample #**	**IR (ohms)**
1	3.0×10^{12}	7	3.0×10^{12}
2	3.0×10^{12}	8	5.0×10^{12}
3	2.5×10^{12}	9	2.0×10^{12}
4	5.0×10^{12}	10	5.0×10^{12}
5	5.0×10^{12}	11	3.0×10^{12}
6	5.0×10^{12}	12	4.0×10^{12}

APPENDIX I (continued)

C. Insulation Resistance After Cold Conditioning and Flexing and Twisting

Requirement: > 1.0 x 10^9 ohms or ≥ 90% of the initial recorded value.

Sample #	**IR (ohms)**	**Sample #**	**IR (ohms)**
1	3.0 x 10^{12}	7	4.0 x 10^{12}
2	3.0 x 10^{12}	8	6.0 x 10^{12}
3	3.0 x 10^{12}	9	2.0 x 10^{12}
4	4.0 x 10^{12}	10	5.0 x 10^{12}
5	5.0 x 10^{12}	11	3.0 x 10^{12}
6	2.5 x 10^{12}	12	4.0 x 10^{12}

APPENDIX II

A. Insulation Resistance / Leakage Current After Load Cycling

Requirement: > 1.0 x 10^9 ohms or ≥ 90% of the initial recorded value

< 1000 µA at 600V Ac

Sample #	**IR 25th Cycle (ohms)**	**IR 50th Cycle (ohms)**	**Leakage Current (µA)**
1	1.8 x 10^{12}	1.2 x 10^{12}	230
2	8.0 x 10^{11}	1.5 x 10^{12}	200
3	2.5 x 10^{12}	1.5 x 10^{12}	230
4	2.0 x 10^{12}	1.4 x 10^{12}	225
5	8.0 x 10^{12}	1.5 x 10^{12}	260
6	2.0 x 10^{12}	1.5 x 10^{12}	240
7	2.0 x 10^{12}	1.5 x 10^{12}	170
8	1.0 x 10^{12}	1.1 x 10^{12}	165
9	9.0 x 10^{11}	1.2 x 10^{12}	169
10	1.5 x 10^{12}	1.4 x 10^{12}	170
11	9.0 x 10^{11}	1.2 x 10^{12}	170
12	1.4 x 10^{12}	1.3 x 10^{12}	165