



PPR 694

Qualification of  
Inline Joint type EPKJ  
for Plastic Insulated  
Cables 4x150mm<sup>2</sup>  
1 kV

Tested by: **EPM** -Test Institute Munich  
Date: 19th January 1984

Pages: 8  
Appendix: --

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(Translation from German to English by Tyco Electronics Raychem GmbH)

TEST REPORT NO.4020 of 19<sup>th</sup> January 1984

TEST OBJECT Inline Joint type EPKJ for plastic insulated cables  
4x150 mm<sup>2</sup> 1 kV

MANUFACTURER Raychem GmbH, Wernher-von-Braun-Strasse 11  
D-8011 Putzbrunn near Munich

REQUESTOR The manufacturer

TEST REQUIREMENTS Test according to VDE 0278 part 1/6.80  
VDE requirements "Power cable accessories with  
rated voltages U up to 30 kV, general" and part 3/6.80  
VDE requirements "Power cable accessories with  
rated voltages U up to 30 kV, joints  $U_0/U = 0.6/1$  kV"  
Additional tests which were not required by VDE were  
carried out as specified by the requestor.

This report contains 8 pages

## **Test sample**

|             |  |
|-------------|--|
| Quantity:   | 5 test loops   |
| Connectors: | Hexagonal crimp connectors   |
| Cable:      | NA2XY 4x150mm <sup>2</sup> se 0.6/1 kV<br>(4-core sector shaped solid aluminium conductor 150mm <sup>2</sup> ,<br>XLPE insulated, PVC sheathed)<br>Manufacturer Kabelmetal, 1981 |
| Joint:      | 4 heat-shrinkable inner tubing<br>WCSM 28/9-250/172<br>1 heat-shrinkable outer tubing<br>WCSM 90/30-800/172  |

## **Preparation**

5 test loops were installed in accordance with Raychem Installation Instruction EPP 0081 10/82 and in accordance with VDE 0278 by members of Raychem GmbH at the premises of Elektrisches Pruefamt Muenchen.

## Test Sequence

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## Tests

### 1. Temperature Control inside the joint

In accordance with part 1 section 5.12 Of VDE 0278, a thermocouple was installed on the conductor 10mm next to the connector on one of the test loops before shrinking the tubing (see fig. 2 of original report).

Following the complete installation of the test loop a current in accordance with VDE 0298 part 2 table 5 was applied.

The current was calculated to an ambient temperature of 20°C, at 333A. After 15 hours, the temperature inside the joint was measured at 84°C.

In accordance with VDE 0278 90°C + 5K are sufficient.

Fig. 2 of original report

Test sample with partially pushed on heat-shrinkable tubing, upper left is the thermocouple to measure the temperature

## 2. **Insulation Resistance in water**

On 4 test loops, 50 mm away from the end of the joint the oversheath was removed for a distance of 50mm. The joints were then arranged in a water bath in such a way that there was a distance of at least 1000 mm between the top of the cable and the water level, whereby the cores were at least 100 mm above the water level (see fig.3 of original report).

In this configuration, the insulation resistance was measured with a test voltage of 5000 V. Each conductor was tested to all other cores in turn and afterwards all cores together to the water bath (**not necessary** in accordance with VDE).

Results, see page 9.

**3. AC Voltage Withstand 4 kV 15 minutes in water**

The test was performed in accordance with VDE 0472 §508 2.1

A sinusoidal voltage of 4 kV eff. 50Hz was applied in turns between every single conductor and all other cores grounded for a period of 15 minutes (requirement according to VDE 0278 1 minute in air).

Result: No breakdown or flashover.

**4. Impulse Voltage test 8 kV in air**

The test was performed with an impulse voltage which had a rise time of 1.2µs and a decay of about 50µs. The test loops were subjected to 10 impulses of 8 kV positive and 10 impulses of 8 kV negative polarity in turn between one conductor and the grounded other conductors (**not required** by VDE 0278).

Result: No breakdown or flashover

**5. Insulation Resistance in water**

Repeat of test 2., (**not required** by VDE 0278).

Result: See page 9

**6. Load Cycling test**

In accordance with part 1 §4.4 the conductors of the test loops were connected in series and subjected to 63 cycles free in air. Each load cycle consisted of a 5 hour heating period and a 3 hour cooling period. The current was calculated with a factor of 1.09 (in accordance with VDE 0278 part 1 table 1) to be 336 A in accordance with VDE 0298, part 2 table 5. This current was controlled at the end of the first load cycle and not changed afterwards.

**7. Thermal Short Circuit test**

At 20°C room temperature, each core was exposed to 17.5 kA for 1s which increased the conductor temperature to approx. 250°C. Each core was exposed twice, before the second short circuit current the test loops were cooled down to room temperature (**not required** in accordance to VDE 0278).

**8. Load Cycling test in water**

Repeat of test 6. with an additional 63 cycles, but in water to test the sealing. The test set up was as described in test 2. The water temperature was during the whole test less than 40°C.

**9. Insulation Resistance in water**

Repeat of test 2.

Result: See page 9

**10. AC Voltage Withstand 4 kV 15 minutes in water**

Repeat of test 3. (in accordance with VDE 0278 only 1 minute **necessary**)

Result: No breakdown or flashover on any of the test loops

**11. Impulse Voltage test 8 kV in water**

As per test 4., but in water and the bunched cores grounded to water (**not required** by VDE 0278).

Result: No breakdown or flashover on any of the test loops

**12. DC Voltage test in water**

As per test 3., but with a DC Voltage of 15 kV each for 5 minutes (**not required** by VDE 0278).

Result: No breakdown or flashover on any of the test loops



### Results of the Insulation Resistance tests in water

| Loop No. | Measure of the Insulation Resistance |             | with sample No. 2, MW | with sample No. 5, MW | with sample No. 9, MW |
|----------|--------------------------------------|-------------|-----------------------|-----------------------|-----------------------|
| 1        | Blue phase                           |             | >100                  | >100                  | >100                  |
|          | Brown phase                          | /all others | >100                  | >100                  | >100                  |
|          | Black phase                          | bunched     | >100                  | >100                  | >100                  |
|          | Yellow/green phase                   |             | >100                  | >100                  | >100                  |
|          | All phases bunched                   | /water      | >100                  | >100                  | >100                  |
| 2        | Blue phase                           |             | >100                  | >100                  | >100                  |
|          | Brown phase                          | /all others | >100                  | >100                  | >100                  |
|          | Black phase                          | bunched     | >100                  | >100                  | >100                  |
|          | Yellow/green phase                   |             | >100                  | >100                  | >100                  |
|          | All phases bunched                   | /water      | >100                  | >100                  | >100                  |
| 3        | Blue phase                           |             | >100                  | >100                  | >100                  |
|          | Brown phase                          | /all others | >100                  | >100                  | >100                  |
|          | Black phase                          | bunched     | >100                  | >100                  | >100                  |
|          | Yellow/green phase                   |             | >100                  | >100                  | >100                  |
|          | All phases bunched                   | /water      | >100                  | >100                  | >100                  |
| 4        | Blue phase                           |             | >100                  | >100                  | >100                  |
|          | Brown phase                          | /all others | >100                  | >100                  | >100                  |
|          | Black phase                          | bunched     | >100                  | >100                  | >100                  |
|          | Yellow/green phase                   |             | >100                  | >100                  | >100                  |
|          | All phases bunched                   | /water      | >100                  | >100                  | >100                  |

Test requirements: Insulation resistance must be >1 MΩ in accordance with VDE 0278

**Result:** Despite the additional tests of the thermal short circuit, all increased requirements of VDE 0278 part 1/6.80 and part 3/6.80 were fully met.