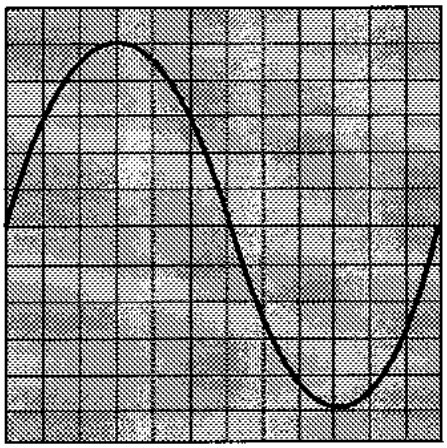

Test Report

PPR 1160

Extended design tests of Termination Type GUST 12, 150 - 240 and Joint Type GUSJ 12, 150 - 240 for impregnated paper insulated cables

Pages:	5 (series E, 6 pages)
Appendices:	4
Date:	12.10.1995 (for series A, B, C and D) 15.02.1996 (for series E)

Tested by:	Manfred Spiss Manfred Spiss	Signature: M. Spiss M. Spiss	Date: 12.10.95 10.02.96
Prepared by:	Manfred Wilck Bodo Böttcher	Signature: M. Wilck B. Böttcher	Date: 12.10.95 15.02.96
Released by:	Manfred Wilck Manfred Wilck	Signature: M. Wilck M. Wilck	Date: 12.10.95 15.02.96

Raychem

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I. OBJECTIVE

To qualify the Raychem terminations GUST and joints GUSJ for the use on impregnated paper insulated power cables 6/10 (12) kV.

II. SPECIFICATION

In order to achieve a broad user coverage, a specification was formed comprising requirements of the following national and international standards:

GOST 13781.0.86
VDE 0278
CENELEC HD628, HD629.2 (draft)
IEC S02-3, 502-2 (draft)

III. TEST SPECIMEN

Cables:	Impregnated paper insulated cable, type NAKBA, 6/12 kV, 3 x 150 mm², Al sm and 3 x 240 mm², Al sm
	Manufacturer: Siemens AG
Joints:	GUSJ 12, 150 - 240
	Manufacturer: Raychem GmbH
Terminations:	GUST 12, 150 - 240
	Manufacturer: Raychem GmbH

IV. INSTALLATION

The installations were carried out in accordance with

EPP 1085, 4/92 terminations
EPP 1084, 10/94 joints

(**Attachment 1 and 2**)

V. TESTING

A. Series 1; two loops terminated with GUST 12, 150 - 240 and one joint GUSJ 12, 150 - 240 in each cable loop.
Cable length between terminations and joint: 2.5 m.

A.1 AC Voltage Withstand Test

4.5 U_0 (27 kV) 5 minutes

Method: IEC 60-1

Result: Passed

A.2 DC Withstand Test

8 x U_0 (48 kV) 15 minutes, each phase in turn with the other phases and the lead jacket grounded.

Method: IEC 1442

Result: Passed

A.3 Impulse Voltage Withstand Test

10 times ± 80 kV (Diagram see **Attachment 3**)

Method: IEC 230

Result: Passed

A.4 Thermal Cycling In Air

5 h on, 3 h off, 80°C conductor temperature, 2,5 x U_0 (15 kV) applied continuously, 63 cycles. 3-phase current and voltage sources were used.

Method: VDE 0273

Result: Passed

A.5 Thermal Cycling In Water

as described under A.4.

Method: VDE 0273

Result: Passed

A.6 AC Voltage Test (3-Phase)

3 U_0 (18 kV phase to ground) 4 h

Method: IEC 60-1

Result: Passed

B. Series 2; one sample 150 mm² Al sm terminated with GUST 12, 150 - 240 and one joint GUSJ 12, 150 - 240 installed in the middle of the cable. Cable length between termination and joint: 1 m.

B.1 Thermal Short Circuit Test

200°C conductor temperature. Each conductor was subjected to two current pulses of 18.8 KA for 1 sec.
(Diagram see **Attachment 4**)

Method: IEC 1442

Result: Passed

B.2 Thermal Cycling In Air

as described under A.4. , 9 cycles

Method: VDE 0273

Result: Passed

B.3 DC Withstand Test

as described under A.2.

Method: IEC 1442

Result: Passed

C. Series 3; one sample 150 mm² Al sm terminated with GUST 12, 150 - 240, cable length between terminations: 2.5 m

C.1 Salt Fog Test

1.25 U_0 (7.5 kV) 3-phase

Spray rate: 0.4 l/m³/h
Conductivity: 1600 mS/m
Duration: 1000 h

Method: IEC 1442

Result: Passed. No tracking, no erosion.

D. Series 4; long term test.
Two loops 150 mm² Al sm terminated with GUST 12, 150 - 240.
Two loops 240 mm² Al sm terminated with GUST 12, 150 - 240.
Length between terminations: 8 m. The test loops were suspended vertically, outdoor.

Two loops 150 mm² Al sm terminated with GUST 12, 150 - 240. Joints GUSJ 12, 150 - 240 installed in the middle of the cable. Cable length between the accessories: 2.5 m.

D.1 Thermal Cycling In Air

5 h on, 3 h off, 80°C conductor temperature, 3-phase AC voltage, 2 x U_0 applied continuously.

Result: All samples passed 2400 cycles (19.200 hr).
Tests are continuing.

Test Arrangements Test D.1: Thermal Cycling in Air

E. Series 5; one loop terminated with GUST 12, 150 - 240 and one joint GUSJ 12, 150 - 240 installed in the loop.
Cable length between terminations and joint: 1,5 m

E.1 Low Temperature Application

The sample was placed in a fridge and stored at - 50°C for 24 h. Afterwards the sample was removed and stored at ambient temperature for 24 hr.

E.2 AC Voltage Withstand Test

40 kV AC, 4 h, each phase in turn with the remaining phases and the metal sheath grounded.

Method: IEC 60-1

Result: Passed

E.3 DC Withstand Test

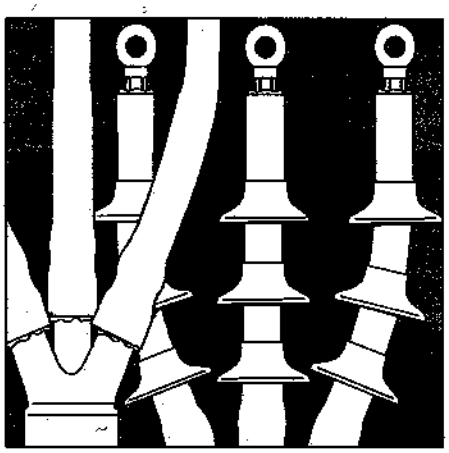
10 x U_0 (60 kV) 10 minutes, each phase in turn with the remaining phases and the metal sheath grounded.

Method: IEC 1442

Result: Passed

Attachement 1
(PPR 1160)

E L E C T R I C A L
P R O D U C T S · D I V I S I O N



Installation Instruction ESD 1085 4/92

Terminations for MI-Paper Insulated Cable 6/10 kV

Raychem

Before Starting

Check to ensure that the kit you are going to use fits the cable.

Refer to the kit label and the title of the installation instruction.

Components or work steps may have been improved since you last installed this product.

Carefully read and follow the steps in the installation instruction.

General Instructions

Use a propane (preferred) or butane gas torch.

Adjust the torch to obtain a soft blue flame with a yellow tip.

Pencil-like blue flames should be avoided.

Keep the torch aimed in the shrink direction to preheat the material.

Keep the flame moving continuously to avoid scorching the material.

Clean and degrease all parts that will come into contact with adhesive.

If a solvent is used follow the manufacturer's handling instructions.

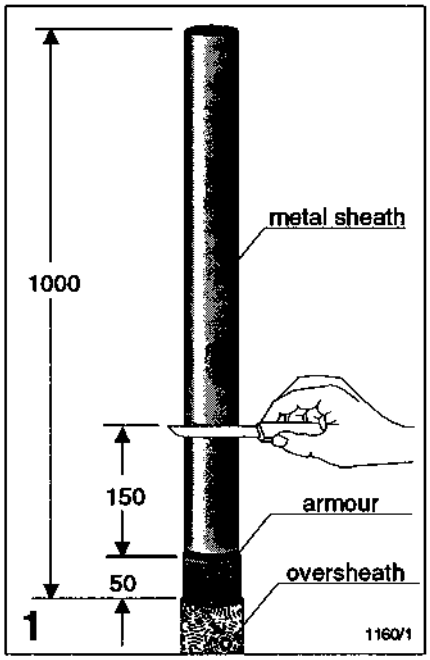
Tubing should be cut smoothly with a sharp knife leaving no jagged edges.

Start shrinking the tubing at the position recommended in the instruction.

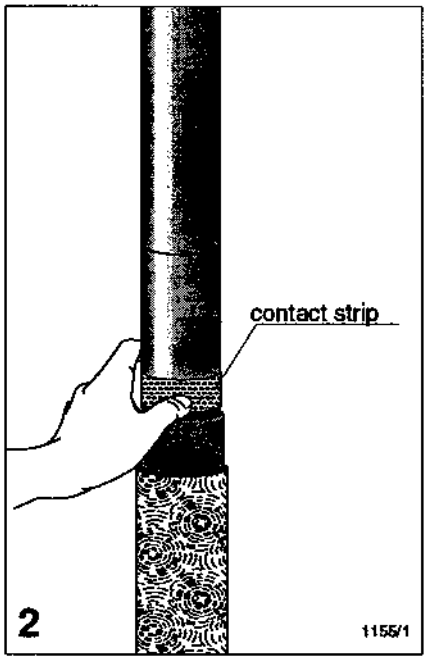
Ensure that the tubing is shrunk smoothly all round before continuing along the cable.

Tubing should be smooth and wrinkle free with inner components clearly defined.

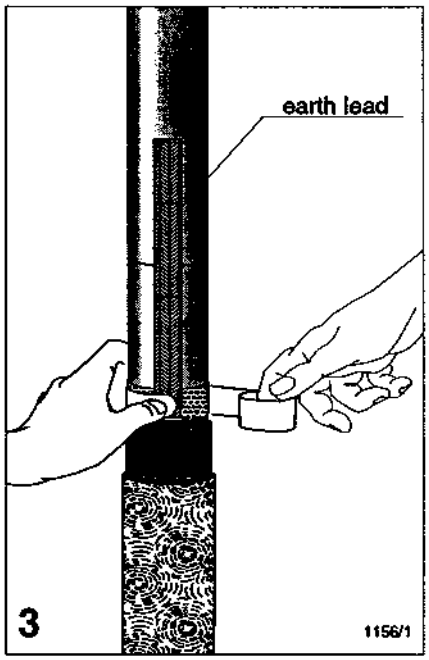
Cable Preparation



Cut the cable to the required length. Remove the oversheath and armour according to the dimensions as given in the drawing. Cut the metal sheath 150 mm above the armour cut.



Position the perforated contact strip around the metal sheath next to the armour cut.

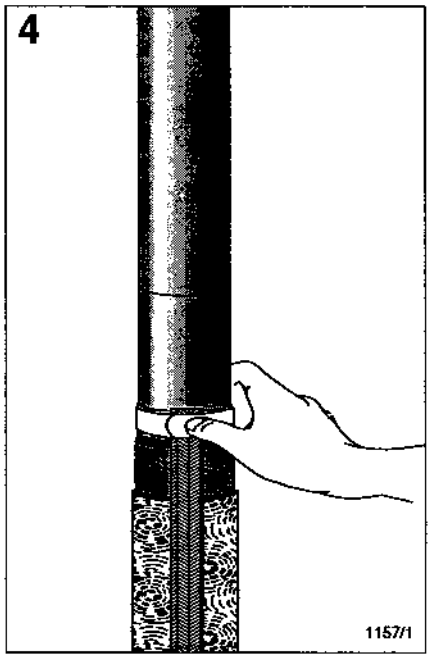


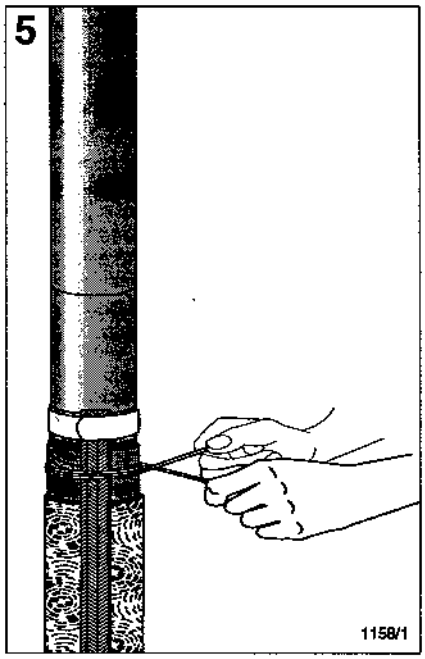
Position the end of the earth lead on top of the cheese grater. Wrap one layer of the roll spring around it to keep it in place.

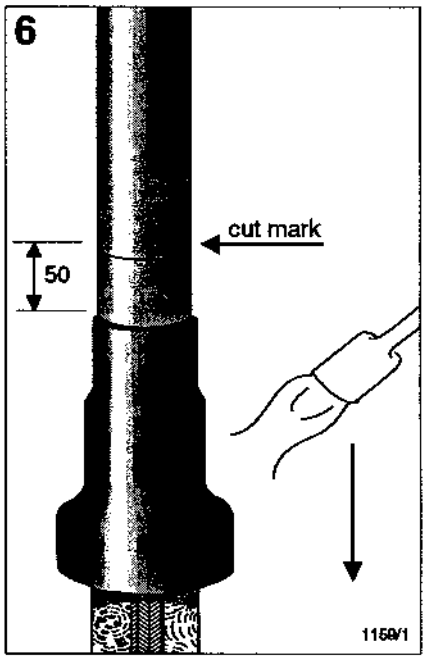
Fold back the earth lead and wrap the roll spring around it. Fix it into place with a twisting action.

Tie the earth lead to the armour with a wire binder.

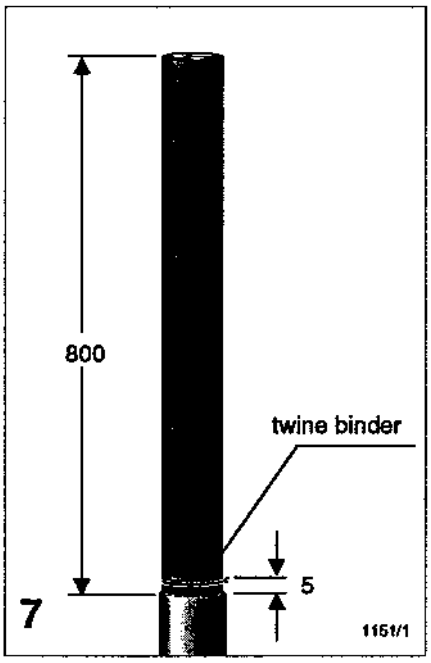
Place the short insulation tubing over the earth connection. Position the end of the tubing 50 mm away from the metal sheath cut. Shrink down starting from the metal sheath end and work towards the oversheath.



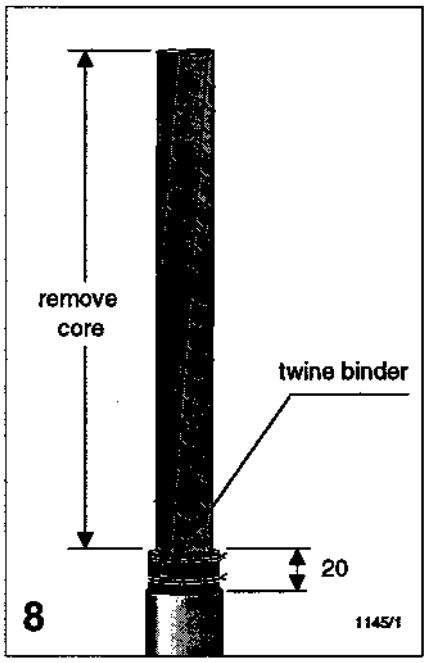




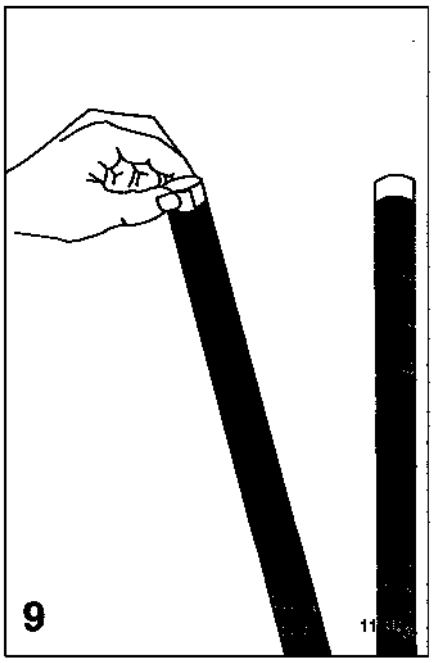
Core Preparation



Cut the cable and remove metal sheath according to the dimension in drawing
Tie a twine binder 5 mm above the metal sheath around the cores. Peel off the carbon paper down to the twine binder.

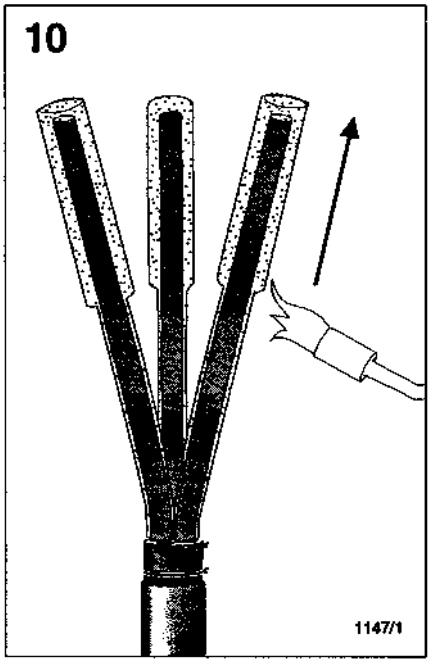


Wrap the twine binder 20 mm from the metal sheath around the cores. Peel of the paper layer down to the twine binder.
Separate the cores and pull out the bedding. Cut it as close as possible down into the crutch region.

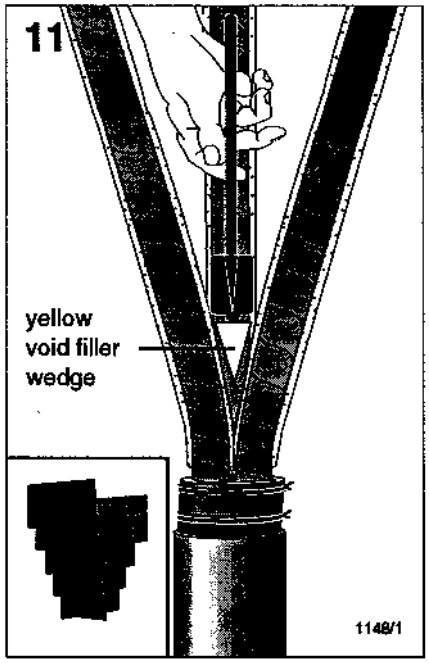


Keep the insulation papers at the core ends in place with a layer of tape.

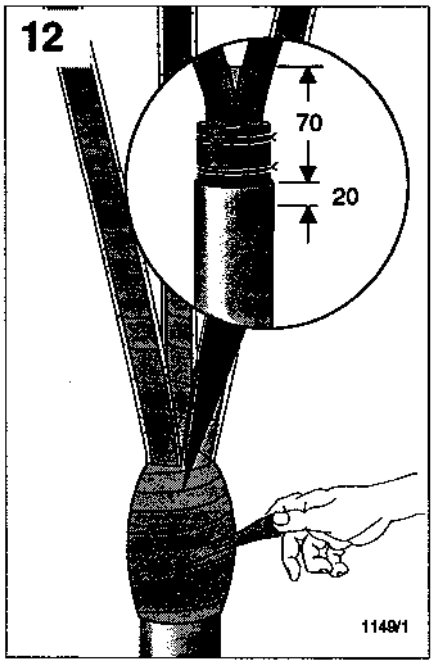
Place the transparent tubings over each core pushing them well down into the crutch. Shrink them into place starting at the crutch end and working towards each end.
Ensure that the tubing is shrunk down evenly and is free from air and grease pockets.



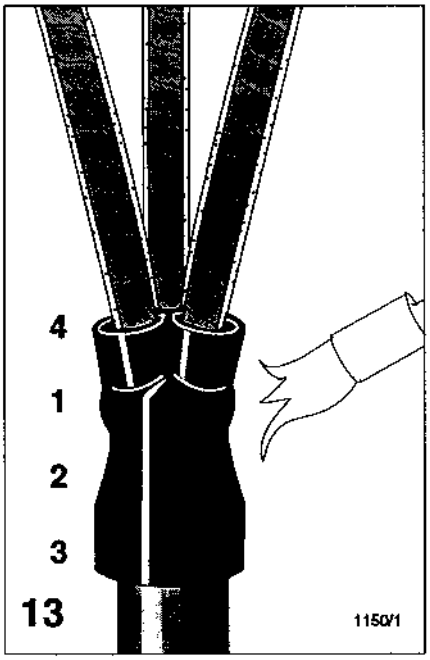
Roll up the medium length void filling tape (yellow) to a wedge shape. Push well down into the crutch.



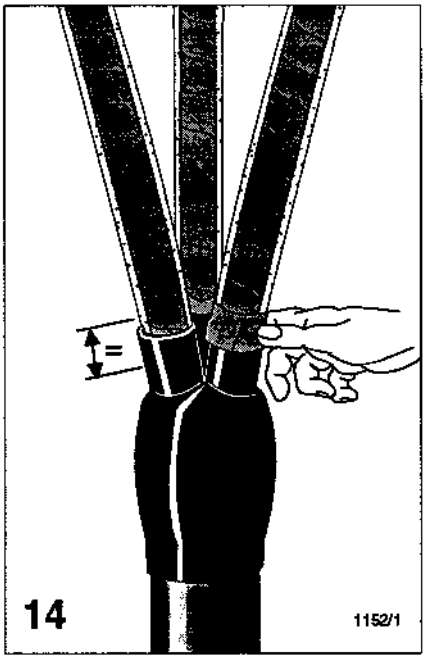
Wrap the long void filling tape (yellow) around the metal sheath for 20 mm and up to70 mm on to the cores. Repeat with another layer, or more, overlapping thickly at the centre until an ovel shape is formed.
Note:
For cross sections from 35 to 70 mm^2, cover 40mm instead of 70mm only .



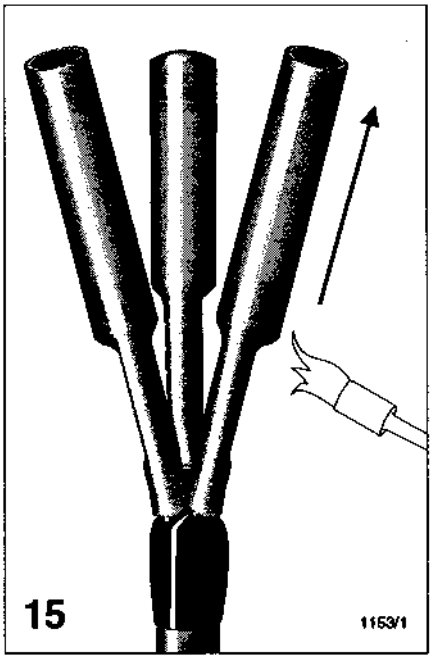
Completion of Termination



Slide the conductive breakout over the cores pushing it well down into the crutch. Shrink it into place according to the sequence as shown in the drawing.



Wrap the short void filling tape (yellow) individually around each turret overlapping equally onto the cores.



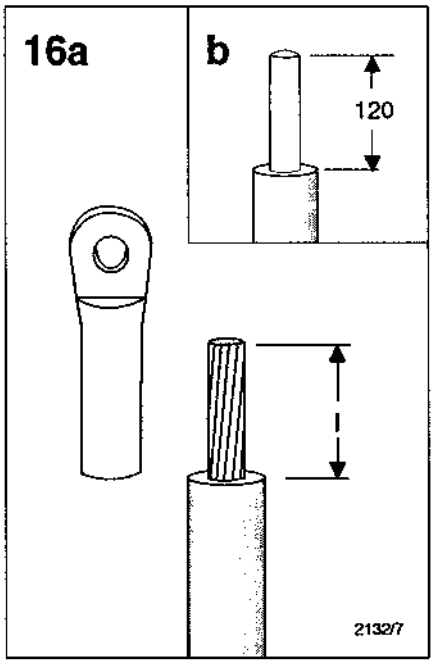
Slide the sealing sleeves over each core pushing them well down into the crutch. Shrink them individually into place starting at the crutch and working towards each end.

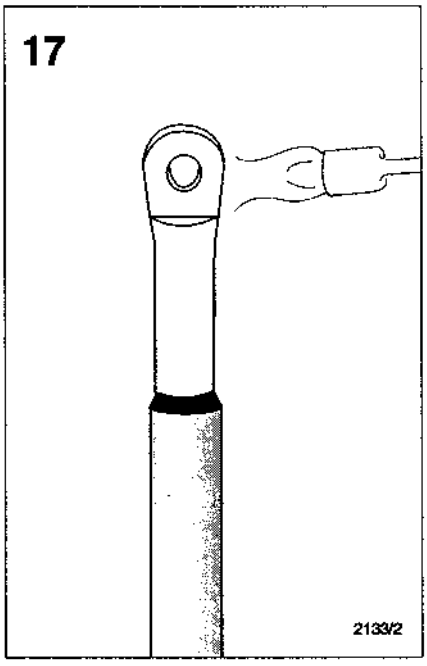
a. with Lug connection
Cut back the insulaton according to the depth of lug hole, **l = lug barrel hole + 5 mm.** Install the cable lug. Clean and degrease the lug and sealing sleeve.

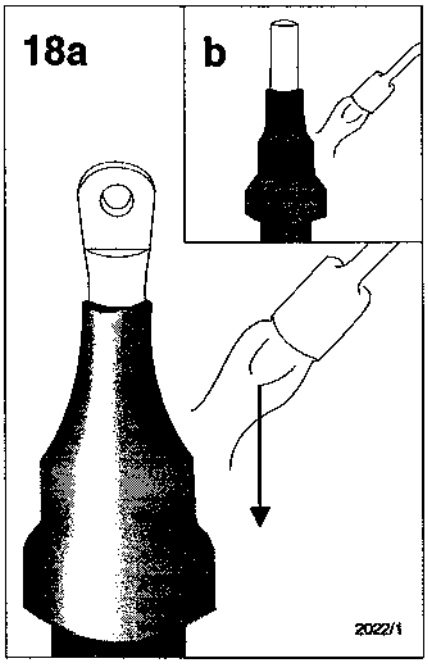
b. Non lug connection
(for solid Al. only)
Cut back the insulation according to the dimension given in drawing b.

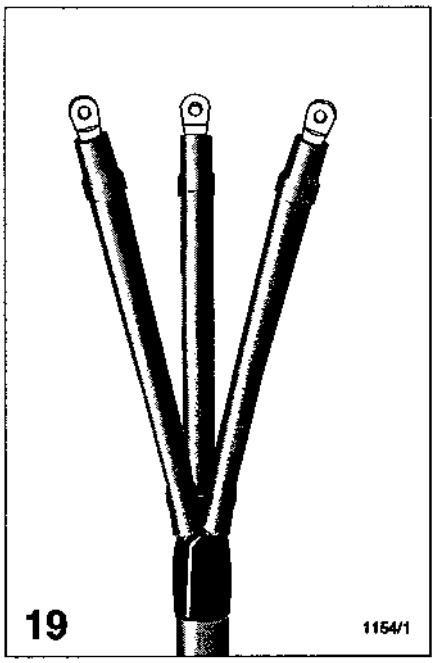
Preheat the lug.

Slide the boots over the cores equally covering the lug/core and the insulation. Shrink them into place starting from the connecting end.

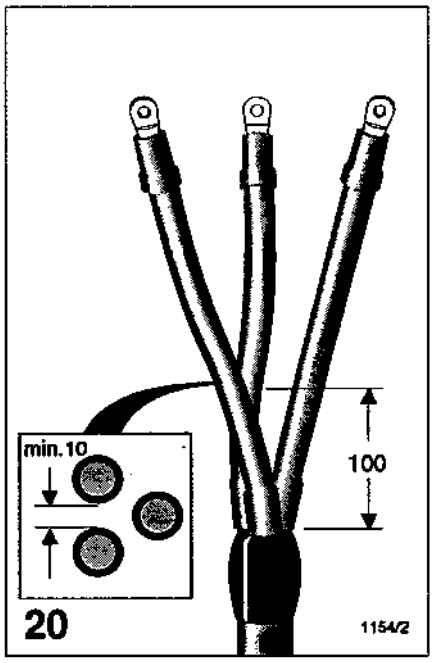








Termination completed.
Allow the termination to cool before applying any mechanical strain.



For crossed connections make sure a minimum clearance of 10 mm is kept between the cores.

Please dispose of all waste according to environmental regulations.

At Raychem we are committed to continuous quality improvement in every aspect of our business.
If you have comments on the installation instruction please contact your local Raychem office.

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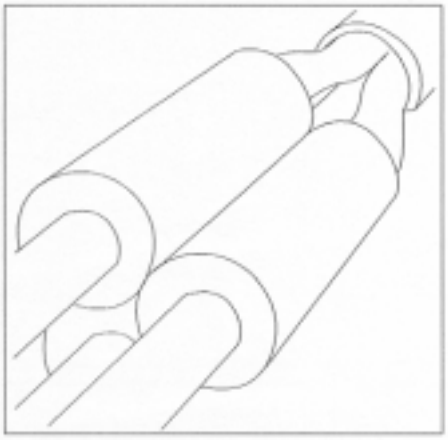
Attachement 2
(PPR 1160)

E L E C T R I C A L
P R O D U C T S · D I V I S I O N



Installation Instruction
ESD 1084 10/94

Joints for 3-Core
MI - Paper Insulated
Cables 6/10 kV

Raychem

Before Starting

Check to ensure that the kit you are going to use fits the cable.

Refer to the kit label and the title of the installation instruction.

It is possible that components or work steps have been improved since you last installed this product.

Carefully read and follow the steps in the installation instruction.

General Instructions

Use a propane (preferred) or butane gas torch.

Adjust the torch to obtain a soft blue flame with a yellow tip. Pencil-like blue flames should be avoided.

Keep the torch aimed in the shrink direction to preheat the material.

Keep the flame moving continuously to avoid scorching the material.

Clean and degrease all parts that will come into contact with adhesive.

If a solvent is used follow the manufacturer's handling instructions.

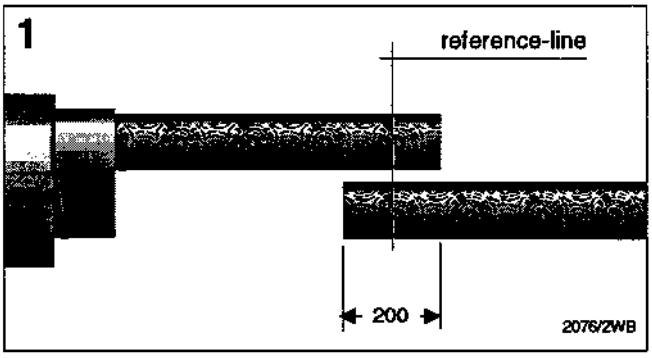
Start shrinking the tubing at the position recommended in the instruction.

Ensure that the tubing is shrunk smoothly all round before continuing along the cable.

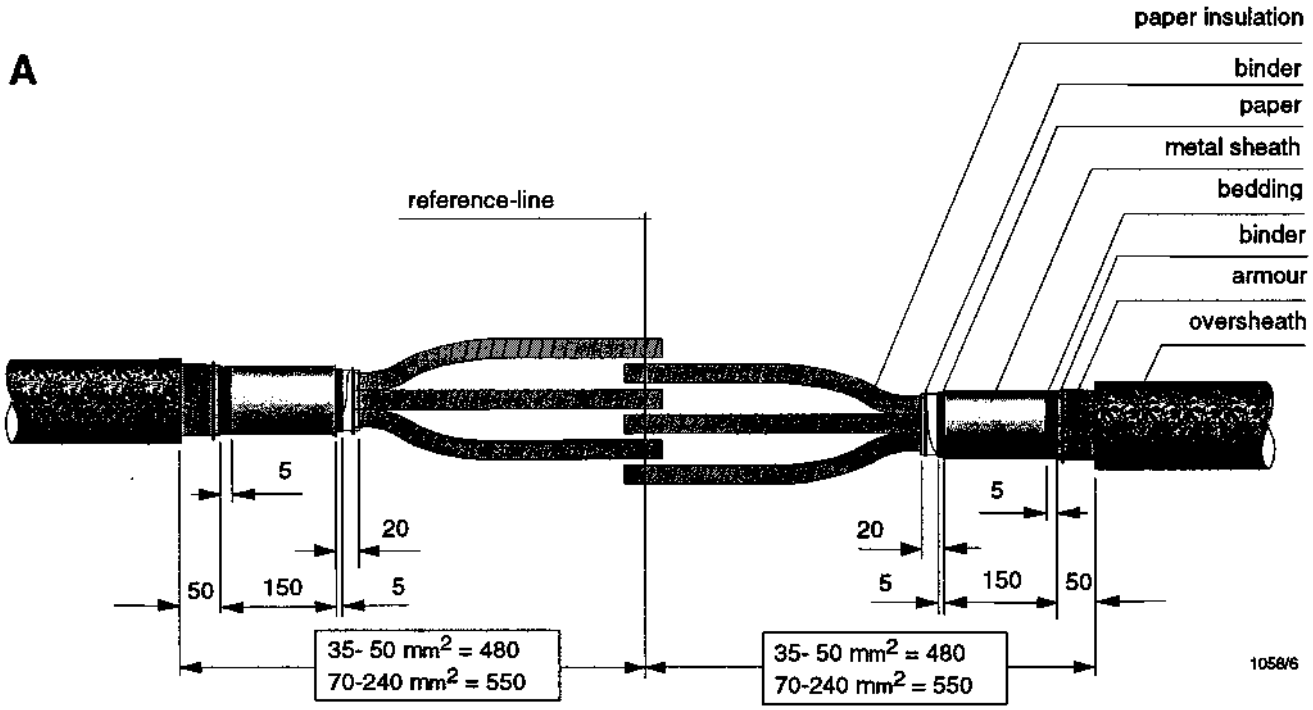
Tubing should be smooth and wrinkle free with inner components clearly defined.

Preparation of Cables

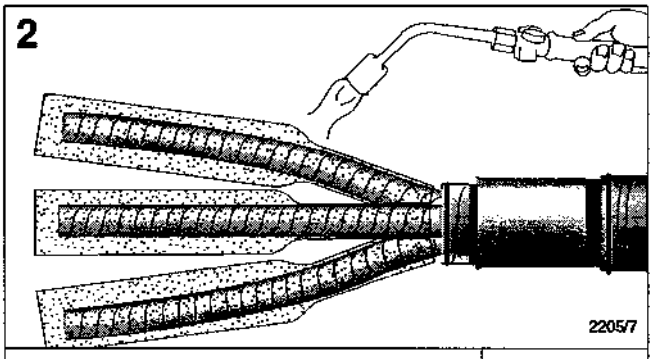
Overlap the cables to be jointed by about 200 mm.
Mark the reference-line (middle of overlap) as shown.
Slide the inner and outer sealing sleeves over one cable end
Remove the oversheath, armour, bedding, metal sheath and belt papers according to drawing **A**.
Clean, degrease and abrade the metal sheaths before exposing the cores.



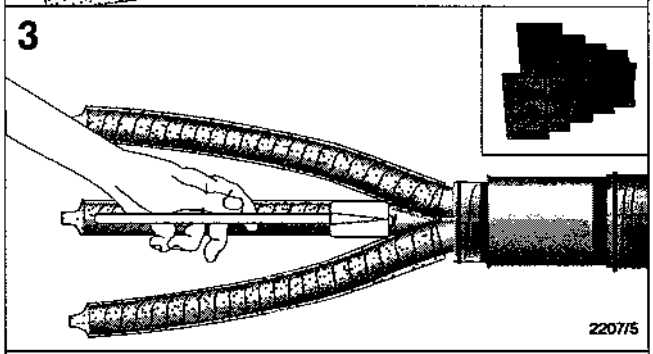
A



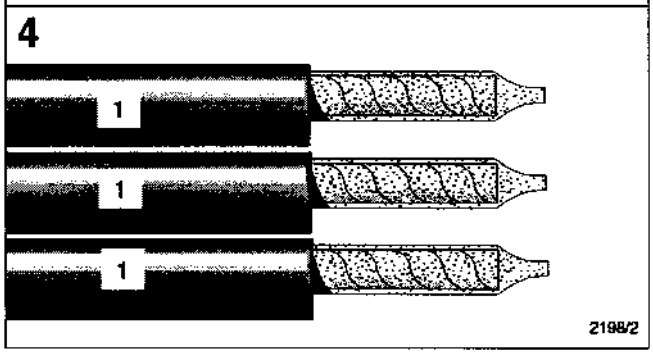
Place the transparent tubings over each core pushing them well down into the crutch. Shrink them into place starting at the crutch end and working towards each end. Ensure that the tubing is shrunk down evenly and is free from air and grease pockets.



Roll up the medium length void filling tape (yellow) to form a wedge shape. Push it well down into the crutch.

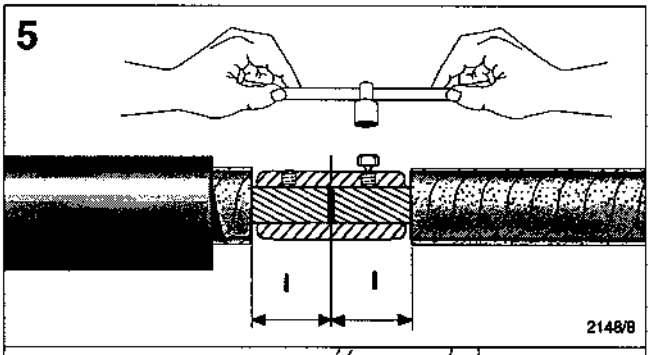


Slide an insulating tubing over each core.

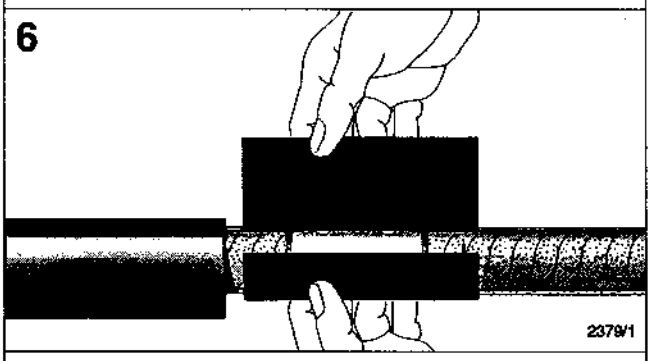


Completion of Joint

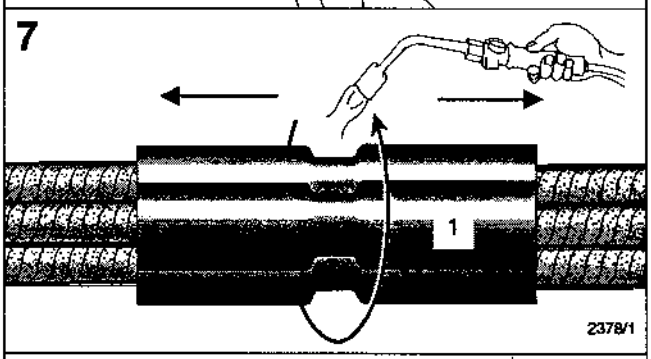
Cut the cores at the reference line.
Remove the insulation on all cores according to dimension **l = half the connector length + 5 mm.**
Fit the conductors into the connector so that the connector end lines up with the insulation. Take up the tension equally on the bolts. Tighten the bolts until the heads shear off.
Note: No gap should be left between the connector and the insulation.



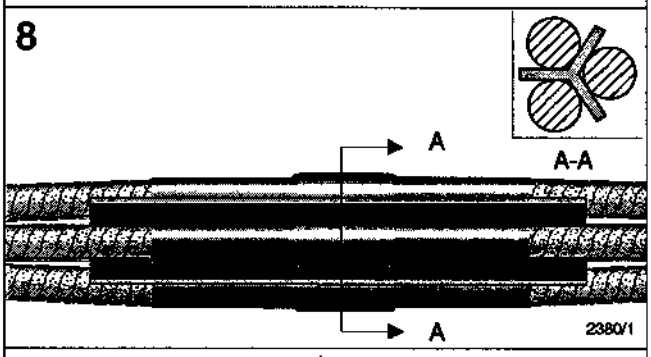
Wrap the stress grading patch centrally over the connector area.



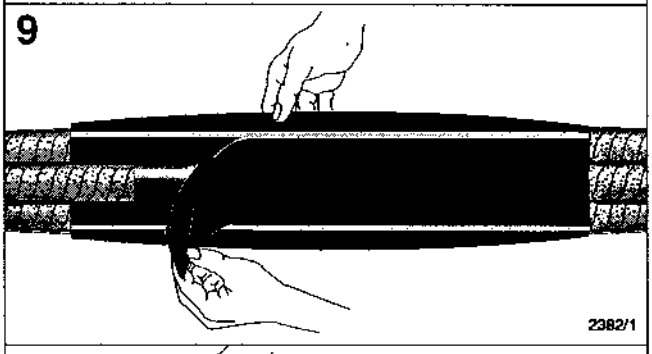
Position the insulating tubing (1) centrally over the connectors. Start shrinking in the centre working towards the ends. The tubing should be fully shrunk and wrinkle free.



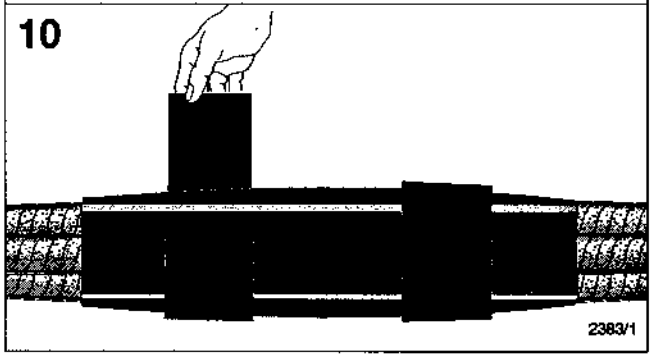
Remove the release foil from the core separator. Insert the core separator profile between the cores in the centre of the joint. Relay the cores as far as possible.



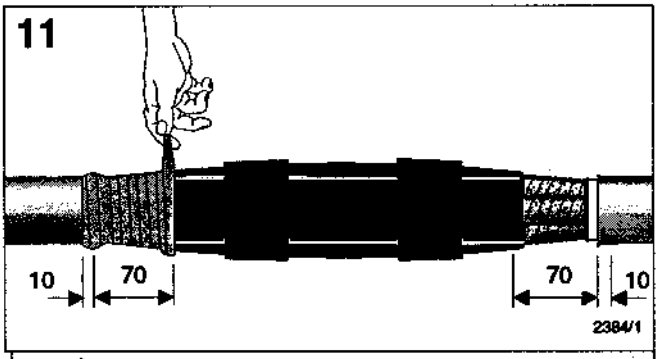
Remove the release foil from the filler pieces. Fill up the gaps between the cores with the filler pieces so that the flat side faces outwards.
Sqeeze the fillers into the space between cores and separators.



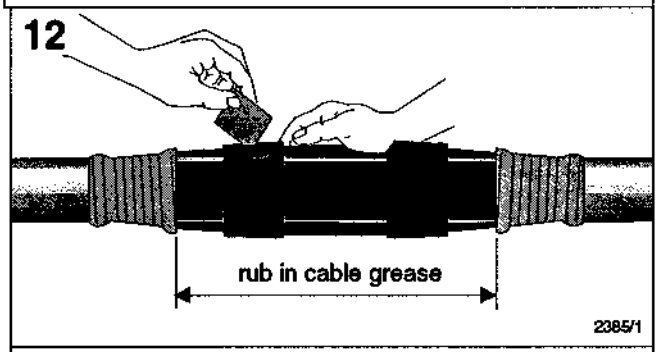
Wrap two pieces of mastic around the joint in the region of the insulating tubing ends.



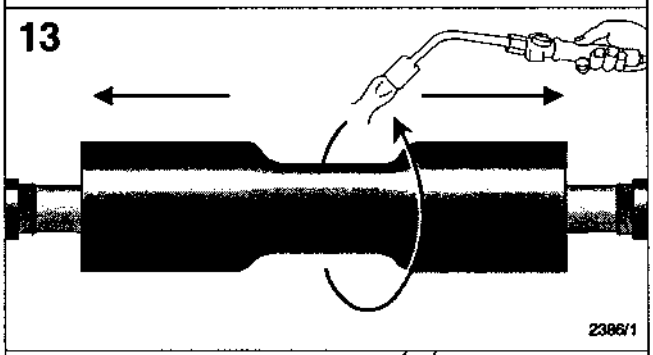
Remove one release paper from the long void filling tape (yellow). Roll up the tape and apply it with a 50% overlap, stretching it to about half of its original width. Starting from a point 10 mm along the metal sheath, continue for 70 mm overlapping onto the filler pieces. Use two lengths of tape per side.



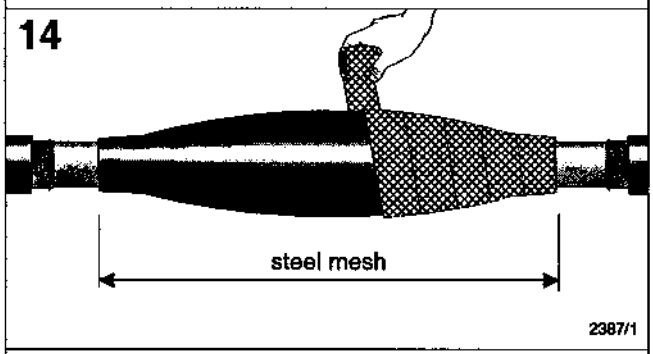
Cover the joint area between the void fillers with cable grease.



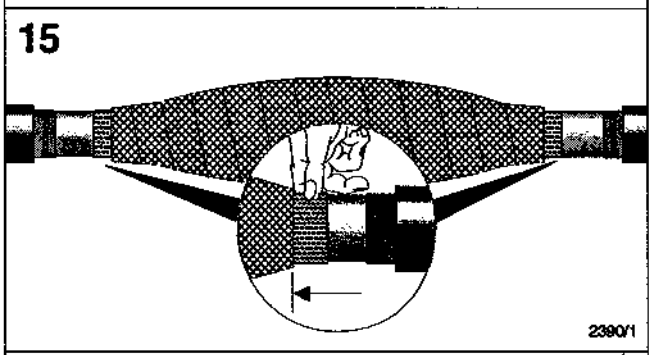
Position the inner sealing sleeve centrally over the joint. Start shrinking in the centre working towards the ends.



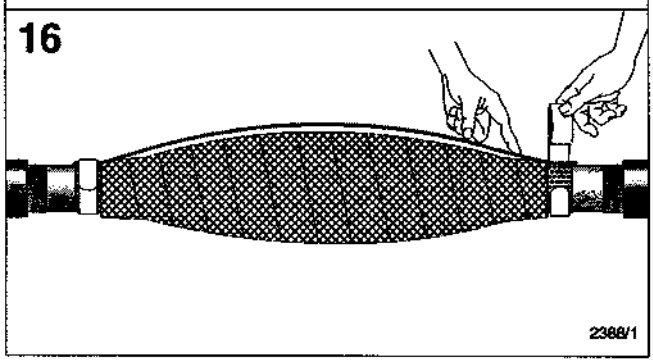
Wrap a layer of steel mesh with a 50% overlap around the sealing sleeve.



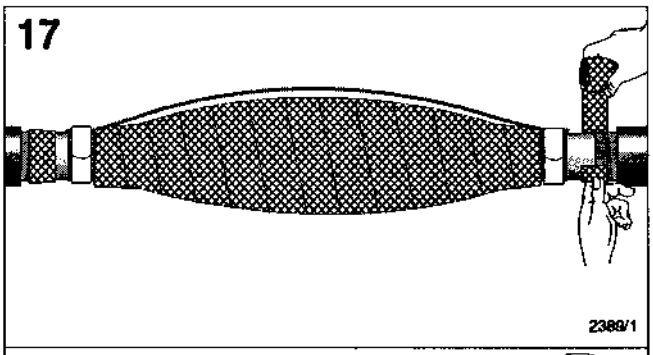
Position the cheese grater next to the steel mesh.



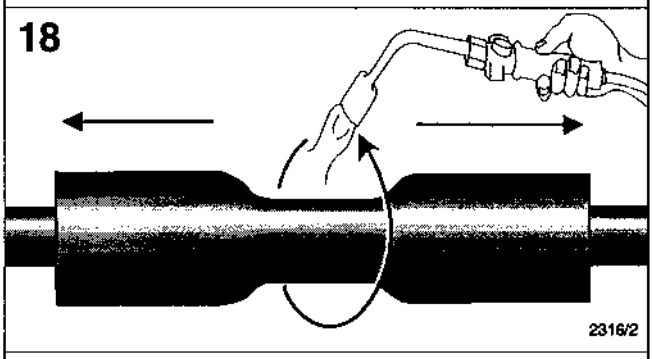
Lay the earth lead across the joint and fix the ends to the cheese grater with the roll springs.



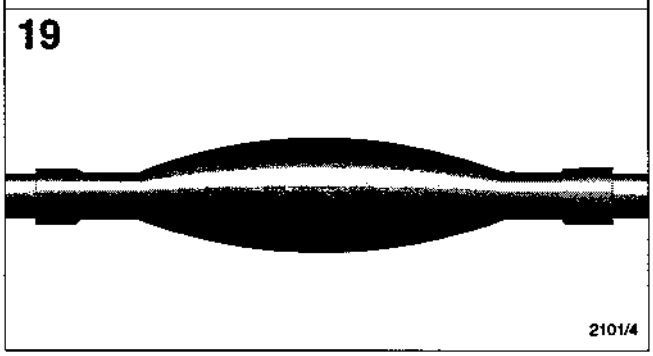
Wrap a short layer of copper braid around the metal sheath and armour so that both are equally overlapped.



Position the outer sleeve centrally over the joint. Start shrinking in the centre working towards the ends.



Joint completed. Allow the joint to cool down before applying any mechanical strain.



Please dispose of all waste according to environmental regulations.

At Raychem we are committed to continuous quality improvement in every aspect of our business.
If you have comments on the installation instruction please contact your local Raychem office.

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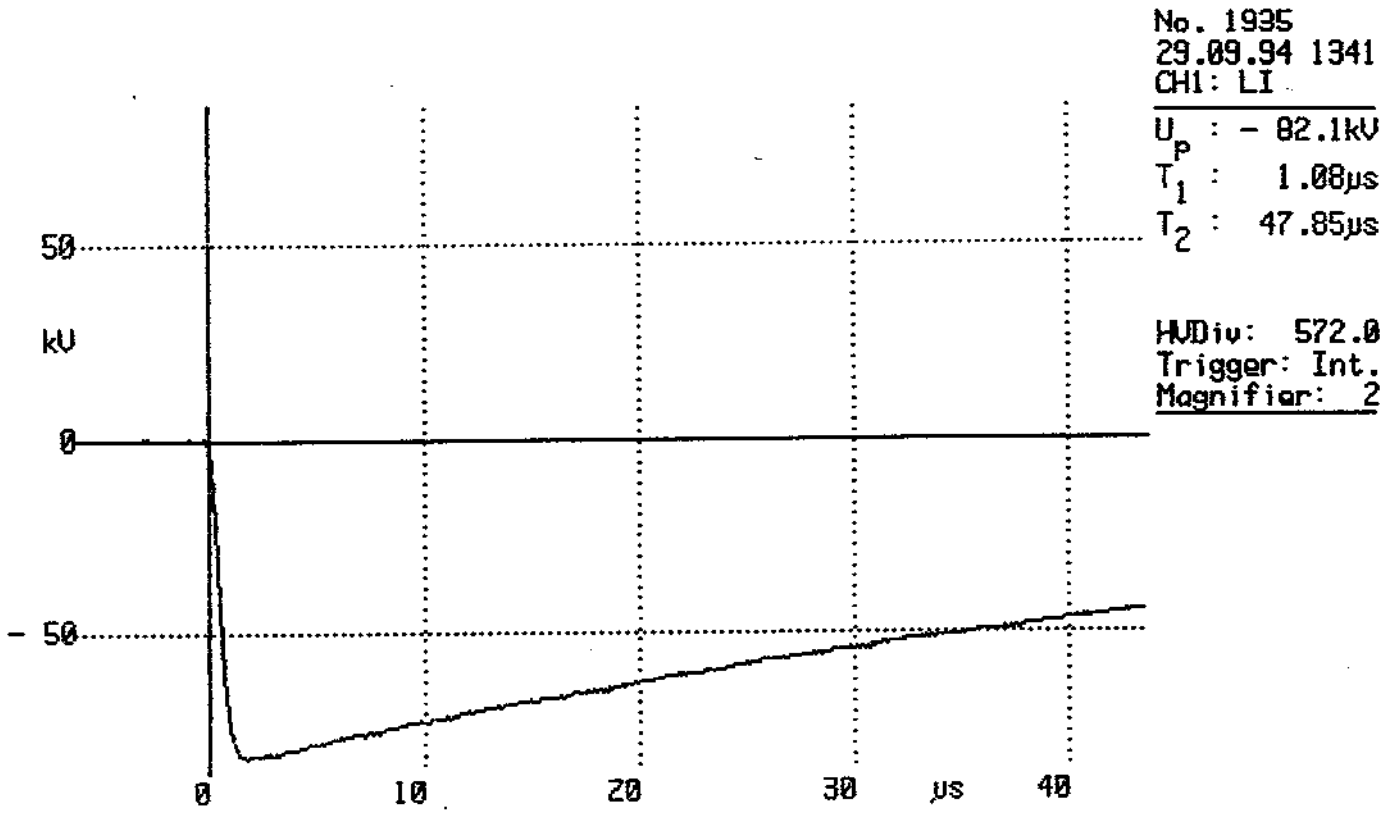
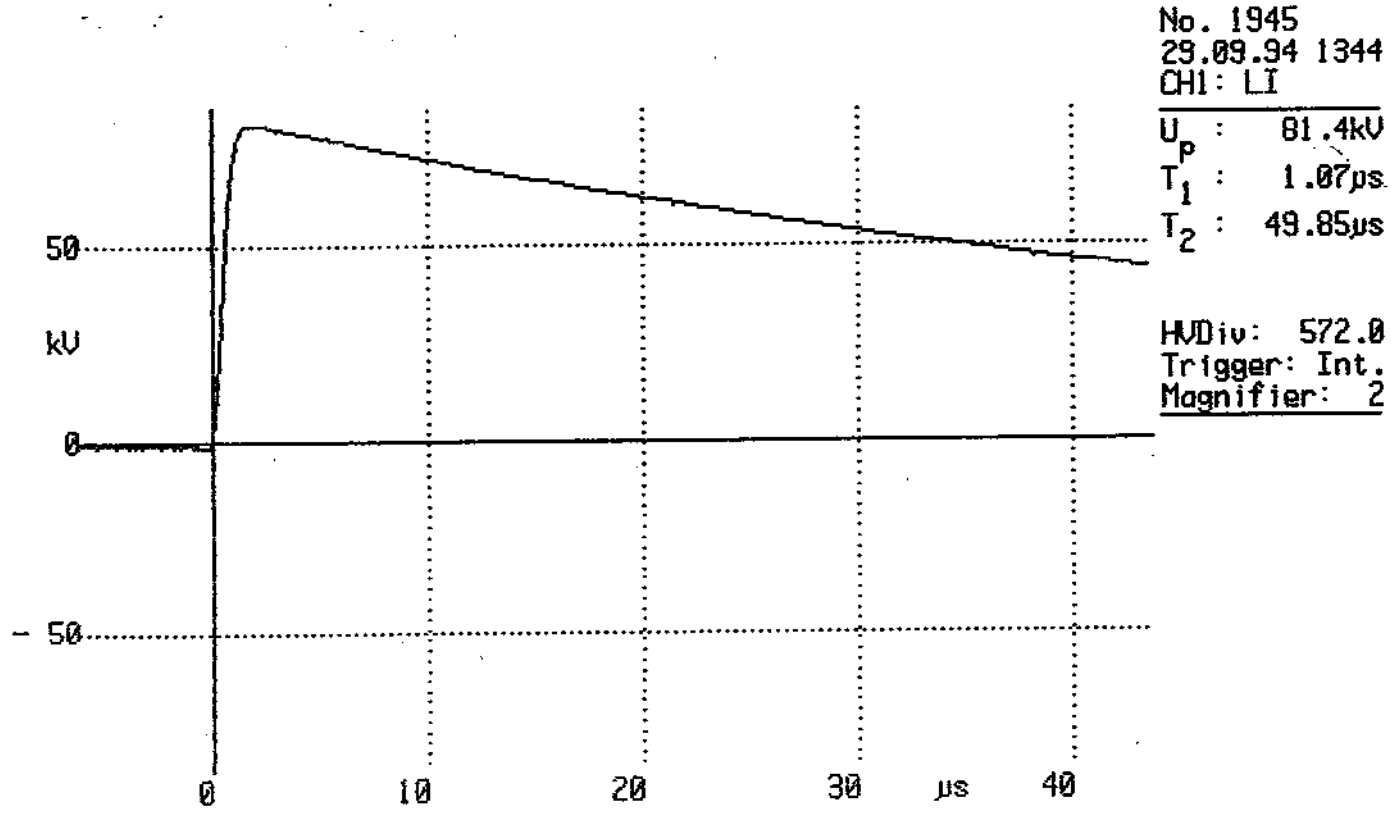
IMPULSE

GUST - Termination
GUSJ - Joint

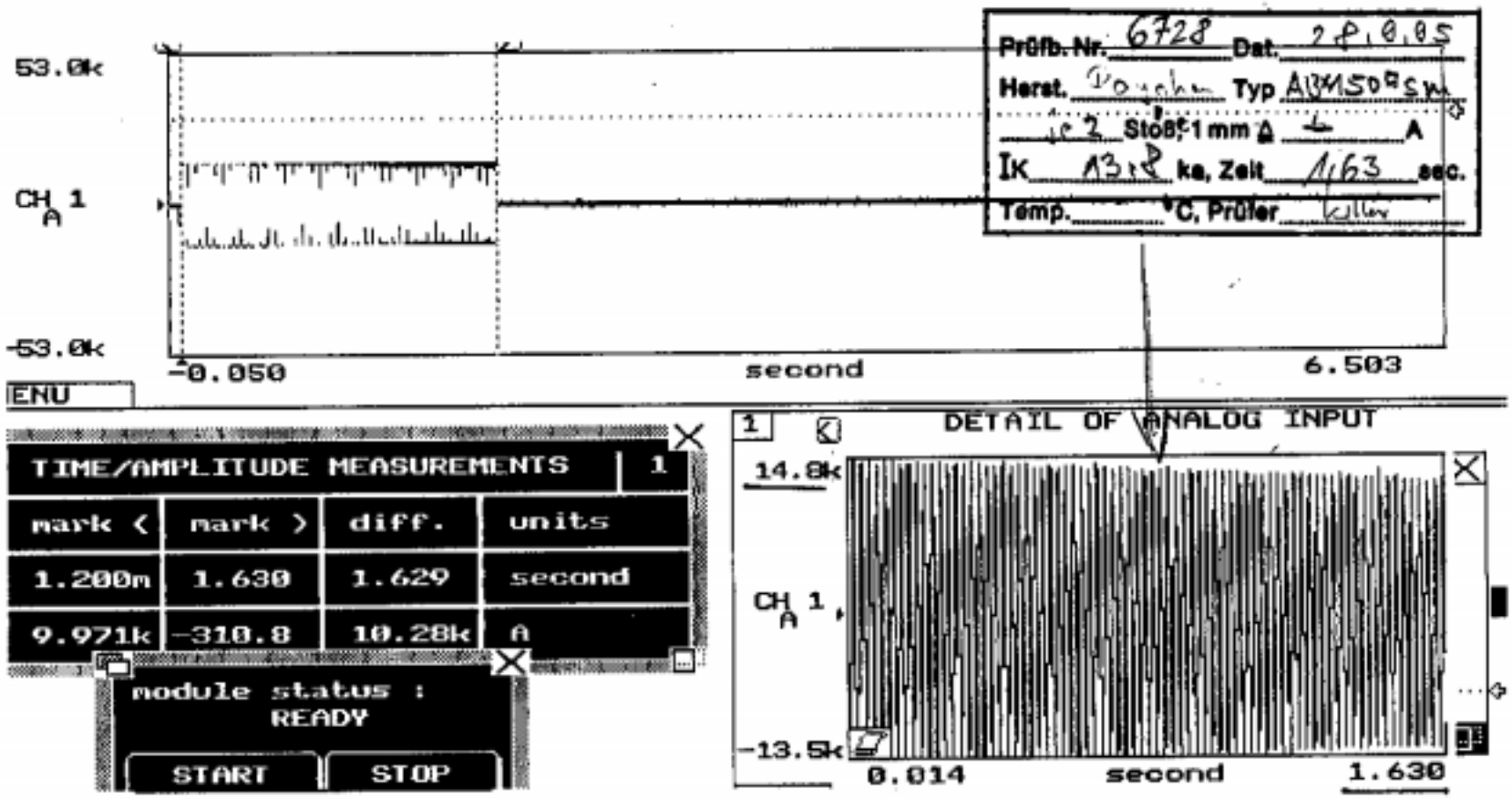


Tenth shot - negative - phase 1



Tenth shot - positive - phase 1

Attachment 4
(PPR 1160)



Test B.1: Thermal Short Circuit Test