BRANDES

Installation instructions for plastic jacket pipes

Pipe engineering part

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1 Introduction

The present "Installation instruction for plastic jacktet pipes" applies to all plastic jacket pipe systems as compound systems or sliding systems.
It contains the whole "Pipe engineering part" (refer to Fig. 1.1) of the BRANDES monitoring system and discribes the following

- installation / connection of the monitoring wires,
- validation measurements after installation,
- leading out the loop ends in buildings and soil,
- installation and wiring of pipe-sensor connectors
- installation and wiring of junction boxes,
- filling in the loop test-record template
- etc.

Before installing the devices, the pipe engineering part has to be finished by closing the sensor loop ends in all junction boxes, in order to prevent seeking an open end later. After finishing the pipe engineering part, the loop test-record template has to be prepared immediately and shall be signed by the client or his representative (refer to section 9, final measurement with preparation of a loop test report template).

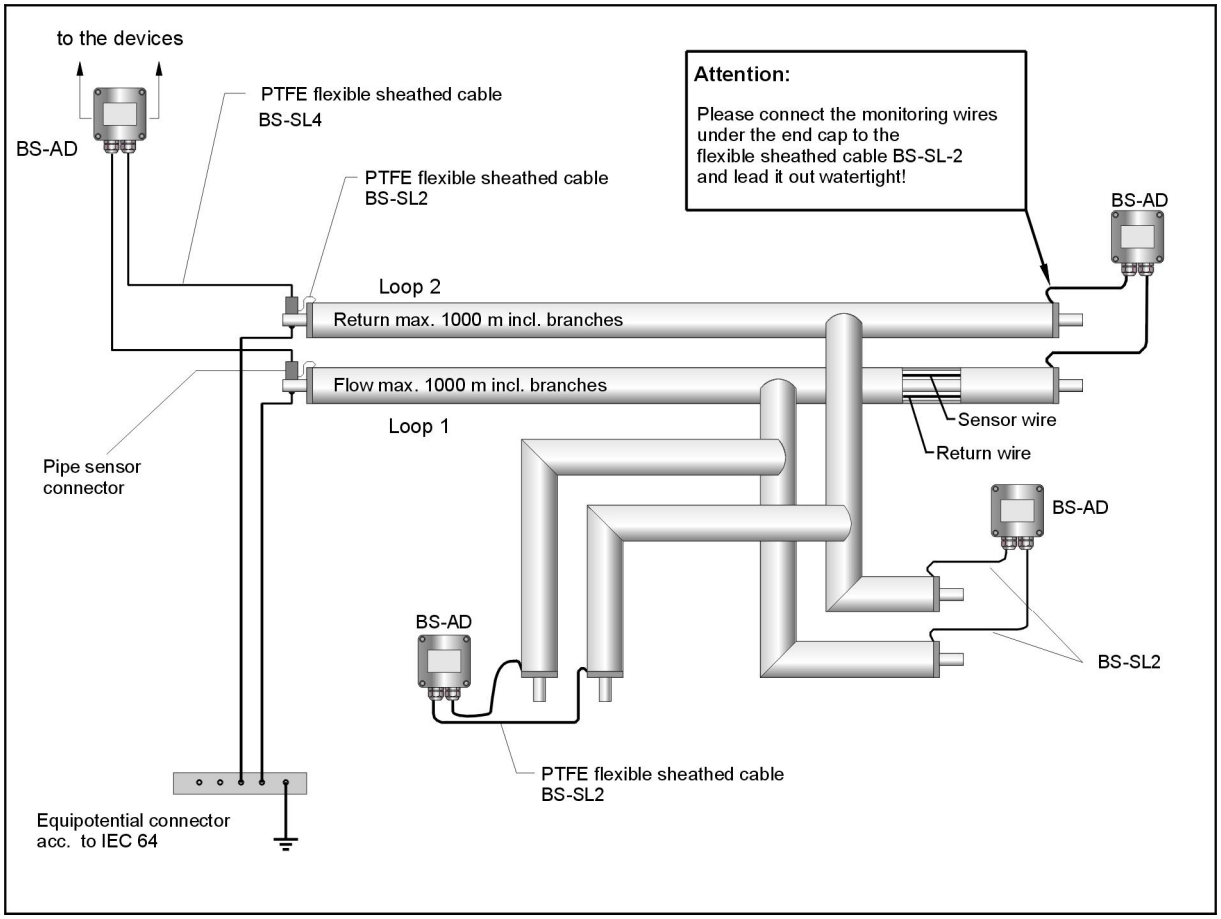
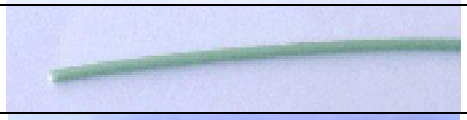
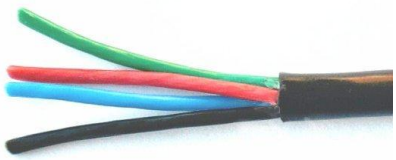
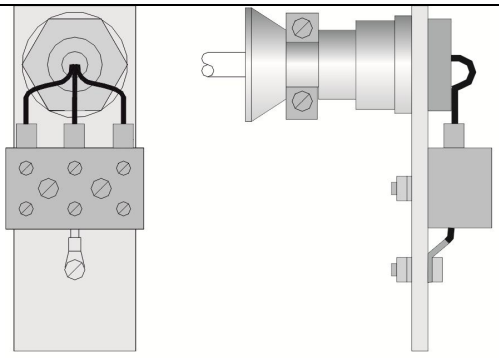
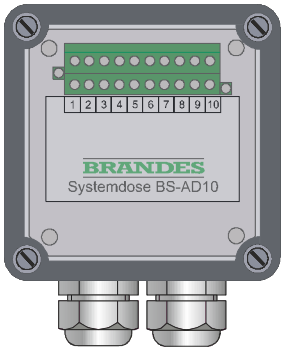
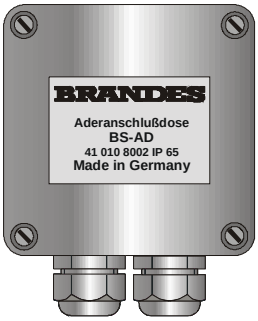


Fig. 1.1 General view on the pipe engineering part of the BRANDES monitoring system.

2 Required system components

2.1 Connecting devices and accessories

Sensor wire, red, BS-FA (in reserve)	
Return wire, green, BS-RA (in reserve)	
Crimp connector BS-QU22	
Heat-shrinkable sleeve, BS-SRA	
Spacer, BS-AH	
Fixing tape for spacer (e.g. Scotch tape, no PVC material!)	
Plug connectors, BS-STK	
Flexible PTFE sheathed cable, BS-SL2	
Flexible PTFE sheathed cable, BS-SL4	
Pipe/Sensor connector	

Junction box, BS-AD10	
Junction box, BS-AD	

2.2 Tools

Crimping pliers BS-QZ22

Wire stripper BS-AZ

Side cutters

Screwdrivers 4,5 mm and 2,5 mm

Hot air blower DT70, make Camping Gaz or similar

2.3 Measuring instruments

Hand-held installtion tester, BS-MH4
Digital ohmmeter

The use of any other than special BRANDES system components automatically renders the warranty null and void.

3 Connecting the monitoring wires

3.1 Red sensor wire to red sensor wire

3.1.1 Shortening the sensor wire

Pull the sensor wires straight from the front ends of a pipe (avoid making loops!) and remove the PU foam from the front ends in accordance with the relevant regulations. Prepare the remaining area for subsequent insulation and sealing, in accordance with the manufacturer's regulations (Fig. 3.1).

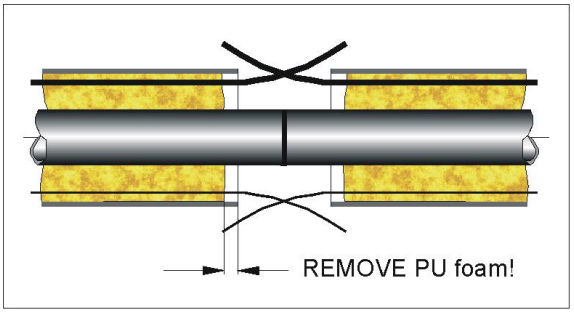


Fig. 3.1 Removal of the PU foam

Shorten the sensor wires in such way that the stripped ends can be inserted loosely in eiher side of the uninsulated crimp connnector BS-QU22.
Therefore hold the wires next to each other and shorten them at the perforations so that the wires have a fourfold excessive length of the perforation spacing (Fig. 3.2).

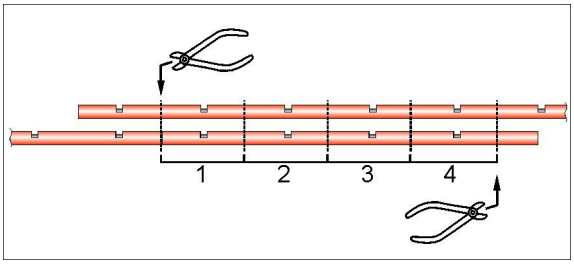


Fig. 3.2 Shortening the sensor wire

3.1.2 Stripping

Strip the wire ends starting from the perforation (Fig. 3.3).

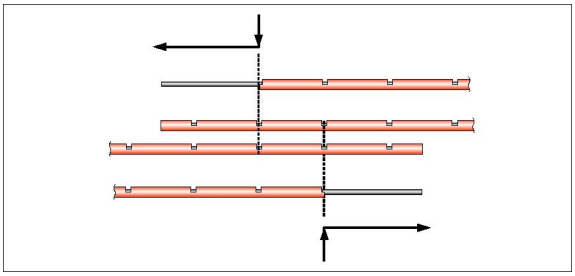


Fig. 3.3 Stripping the sensor wire

>> Conduct loop validation measurement with the BS-MH! << (refer to chapter 8)

Connect sensor wire to return wire at the beginning of the loop before starting validation measurements.

3.1.3 Connecting

Slide a heat-shrinkable sleeve BS-SRA over one end of the wire.
Insert the stripped wire ends on each side of the uninsulated crimp connector BS-QU22 (Fig. 3.4).

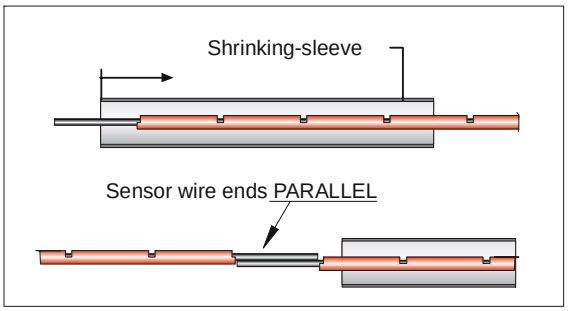


Fig. 3.4 Connecting the sensor wires

>>The wire ends must be located parallel to each other!<<

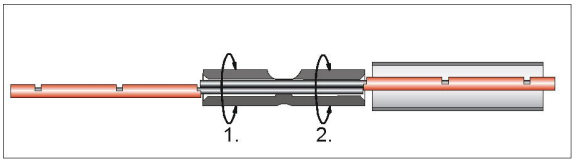


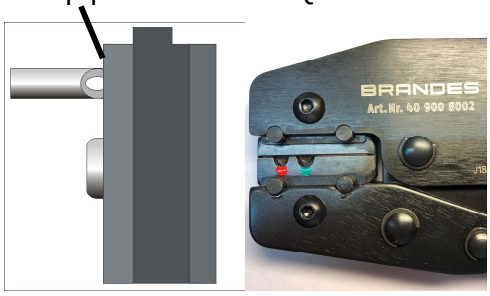
Fig. 3.5 Crimping the crimp connector

Crimp the connector twice using crimping pliers BS-QZ22 (Fig. 3.5).

For compressing the connectors for sensor wire
use the first groove (= red marking)

Information:
Position the connector in the crimping plier in such way that the view hole can still be seen halfwise at the side.

Crimp position for BS-QU22



Then conduct a pull test opposite the connector; pull towards the pipe; **not to the side away from the pipe!**
(Fig. 3.6).

If the connection becomes undone, repeat the procedure with a new crimp connector!

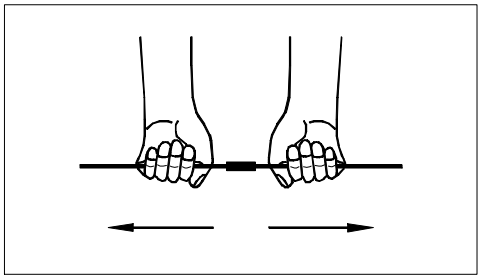


Fig. 3.6 Pull test

3.1.4 Insulation / heat-shrinking the junction

Center the heat-shrinkable sleeve over the junction and, using the hot-air blower, shrink-fit evenly from the middle outwards, until melted adhesive emerges from the ends (Fig. 3.7).

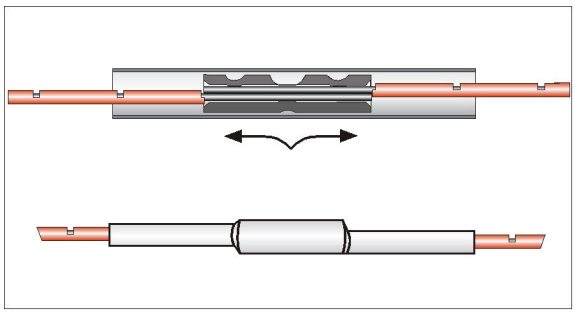


Fig. 3.7 Heat-shrinking the junction

Note:

The heat-shrinkable sleeve is not self-extinguishing. Therefore do not overheat as it may "start burning"!

Allow the sleeve to cool down before continuing the work!

3.1.5 Fixing the sensor wire

(refer to item 3.2.5)

3.2 Green return wire to green return wire

3.2.1 Shortening the wires

Pull the return wires straight from the front ends of the pipe (avoid making loops!) and check the wire and its insulation for damage. Cut away damaged sections or replace the insulator with heat-shrinkable sleeve. The critical point is the wire outlet at the PU foam (Fig. 3.8)!

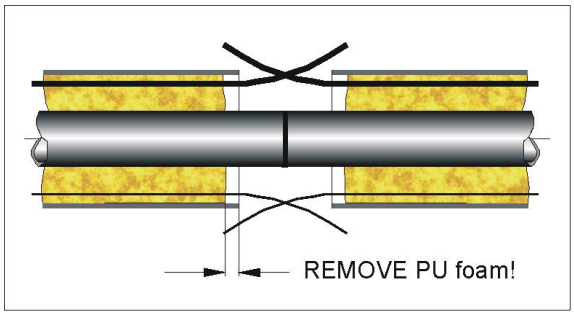


Fig. 3.8 Removal of PU foam

Shorten the sensor wire in such way that the stripped ends can be inserted on both sides and loose in the crimp connector BS-QU22.

3.2.2 Stripping the wire ends

Strip the wire ends to about half the length of the crimp connector (Fig. 3.9).

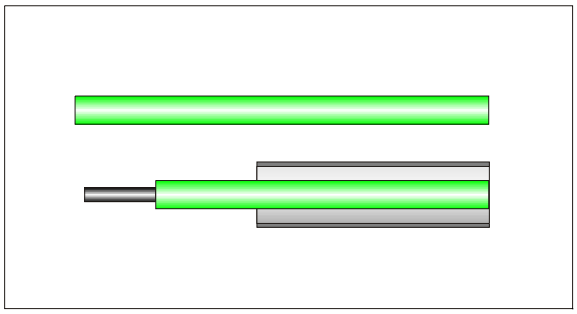


Fig. 3.9 Stripping the return wire

Caution:

Always use the self-adjusting BRANDES wire strippers to remove the insulation. Otherwise you will run the risk of breaking the wires!

Note:

Conduct loop validation measurement with the BS-MH!

3.2.3 Connecting the wires

Slide a heat-shrinkable sleeve BS-SRA over one end of the wire.

Insert the stripped end of the first wire into the uninsulated crimp connector BS-QU22 up to the middle stop and crimp once using crimping pliers BS-QZ22 (Fig. 3.10).

For compressing the connectors for return wire use the second groove (= green marking)

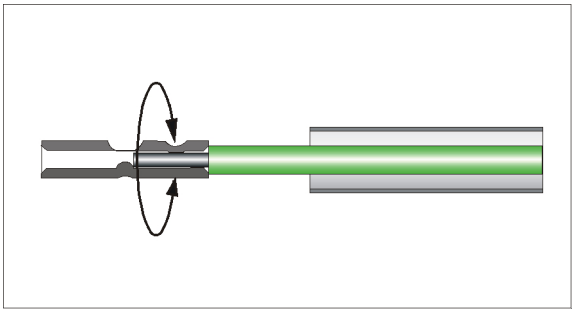
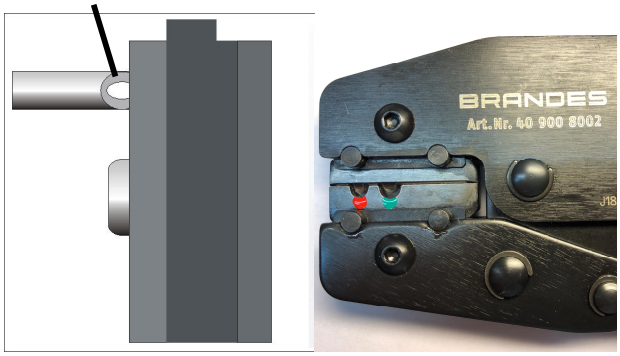


Fig. 3.10 Crimping of the connector

Information:
Position the connector in the crimping plier in such way that the view hole can still be seen halfwise at the side.



Attention:

Wire end shall not protrude out of the view hole.

Caution:

The end of the wire must not project out of the side hole.

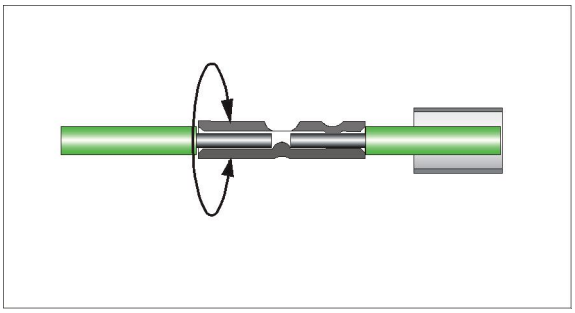


Fig. 3.11 Connecting the return wires

Then insert the second wire end into the other side of the connector and crimp it, too (Fig. 3.11).

Conduct the pull test opposite the connector; pull towards the pipe, **not to the side away** from the pipe! (Fig. 3.12)

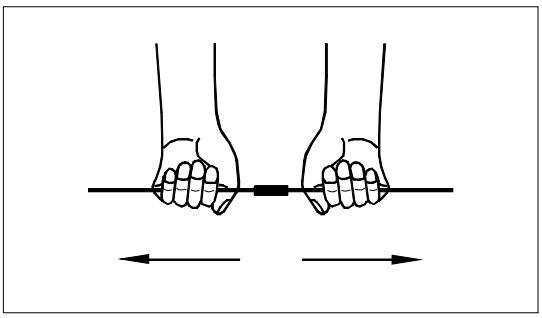


Fig. 3.12 Pull test

If the connection is destroyed after this test, repeat the procedure with a new crimp connector!

3.2.4 Insulation/ heat-shrinking the junction

Center the heat-shrinkable sleeve over the junction and, using the hot-air blower, shrink-fit evenly from the middle outwards until melted adhesive emerges from the ends (Fig. 3.13).

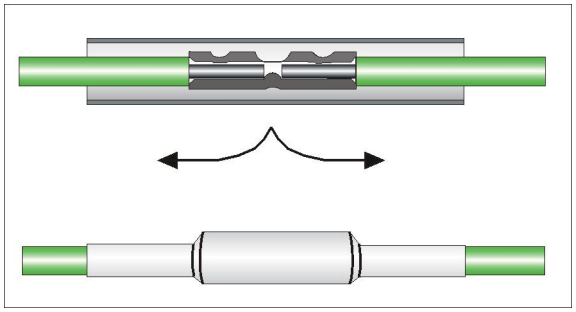


Fig. 3.13 Heat-shrinking the junction

Note:

The shrinking-sleeve is not self-extinguishing.
Therefore do not overheat it as it may "start burning"!

Allow the sleeve to cool down before continuing the work!

3.2.5 Fixing the sensor and return wire

Fix the spacer BS-AH to the inner pipe with fixing tape and insert each wire separately. Always position the spacers in such way that no contact between wires and pipe may occur. (Fig. 3.14)

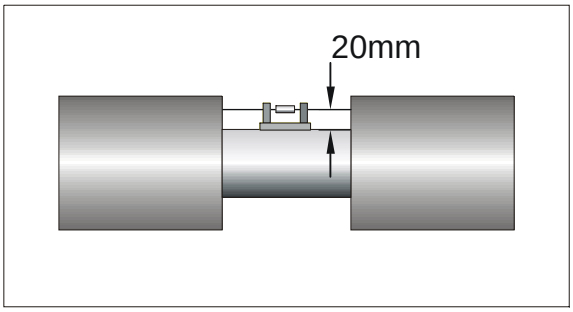


Fig. 3.14 Fixing the wires

>> Minimum distance between wire and pipe around 20 mm <<

3.3 Red sensor wire to green return wire

3.3.1 Shortening and stripping the wires

As described before.

3.3.2 Connecting the wires

Slide the heat-shrinkable sleeve BS-SRA over one end of the wire.
Bend the stripped sensor wire end back from the middle, insert it into one side of the uninsulated crimp connector BS-QU22 up to the middle and crimp once.

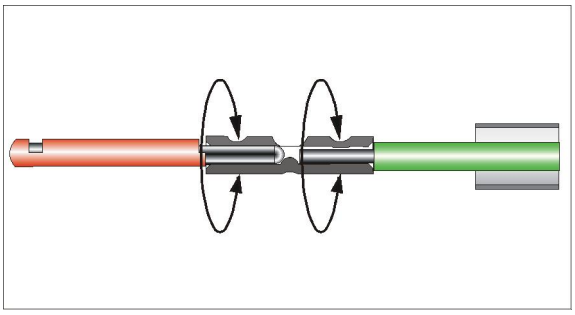
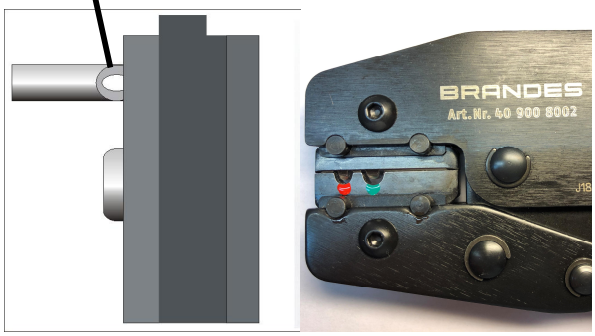


Fig. 3.15 Connecting sensor wire to return wire

Then insert the stripped end of the return wire into the other side of the connector and crimp it, too.(Fig. 3.15)

Information:
Position the connector in the crimping plier in such way that the view hole can still be seen halfwise at the side.



>> Conduct the pull test! <<

Heat-shrink the junction as described above (Fig. 3.16).

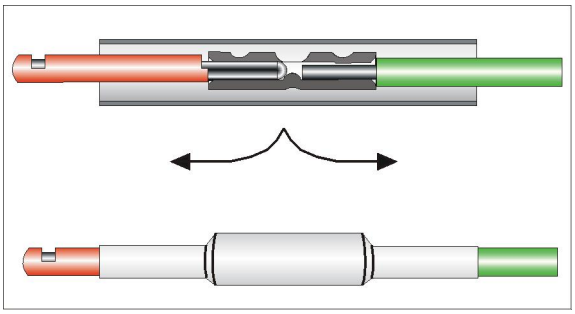


Fig. 3.16 Heat-shrinking the junction

3.3.3 Fixing the junction

Position a spacer on the inner pipe, fix it and insert the wires.
Refer to 3.2.5 and to Fig. 3.14.

3.4 Connecting sensor wire red and/or return wire green to on-going copper wires

3.4.1 Red sensor wire to on-going copper wire

As described under 3.3.

3.4.2 Green return wire to on-going copper wire

As described under 3.2.

4 Leading the loops out in buildings

4.1 General information

Flexible PTFE sheathed cable BS-SL2 must always be used to provide a **waterproof extension** to sensor wires and return wires where these are led out of the pipes ends to the junction boxes or pipe-sensor connectors in buildings, pits or other constructions(refer to 4.2 and 4.3).
The installation of unprotected sensor and return wires is **NOT PERMITTED**. They would certainly trigger false messages.
Connect the sensor wire to the red-insulated wire of the PTFE sheathed cable BS-SL2) as described under 3.3, and the return wire to the green-insulated wire as described under 3.2.
Lead the connected BS-SL2 cable out from under the end cap. Cover the flexible sheathed cable with Mastix or a similar filler in the area of the jacket pipe and the medium pipe of the end cap (which will subsequently be shrink-fitted), in order to avoid hollow spaces (gaps) between the shrink-fitted end cap and the jacket pipe.
If a pipe-sensor connector is to be installed, the PTFE flexible sheathed cable can be led out along the inner pipe, thanks to high temperature stability (< 200°C),(refer to 4.2).

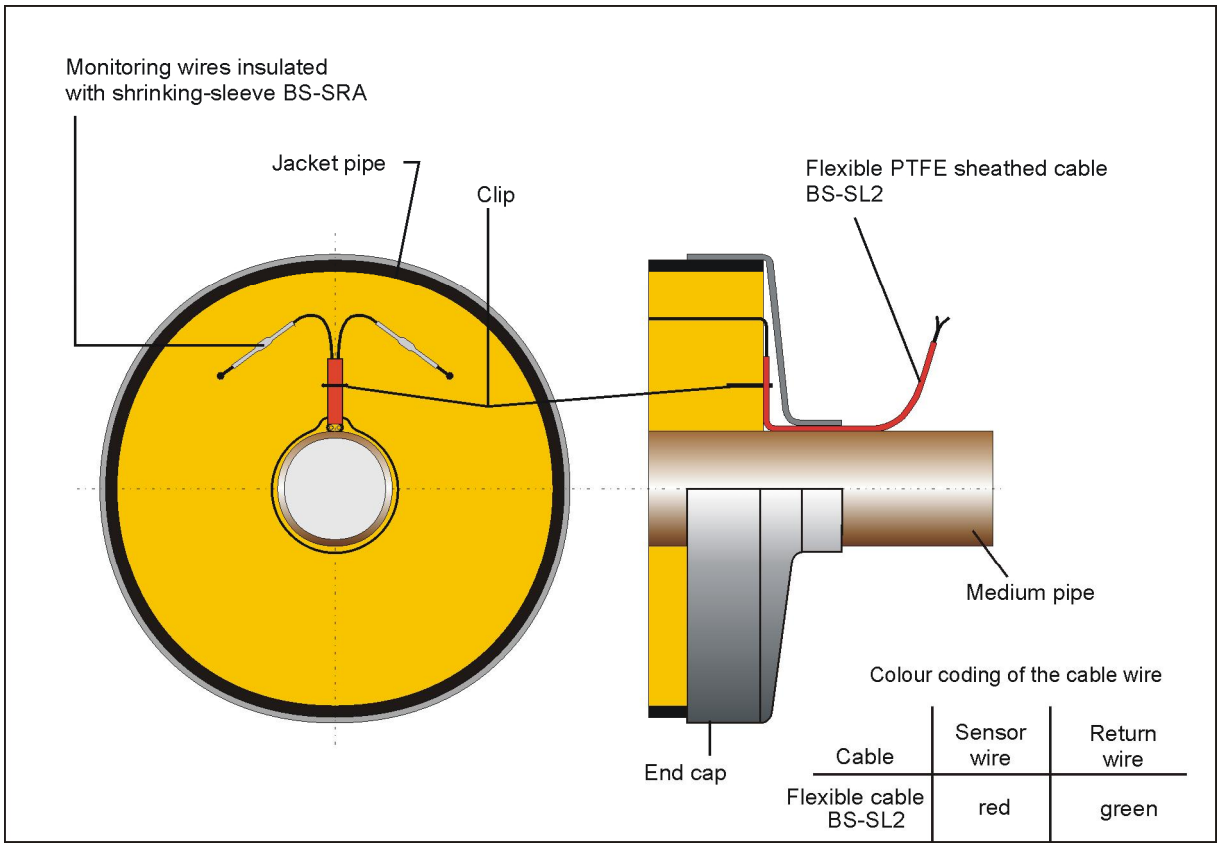


Fig. 4.1 Example 1: Connecting the monitoring wires to flexible sheathed cable BS-SL2 and leading the wires out(Th0081 EN.jpg)

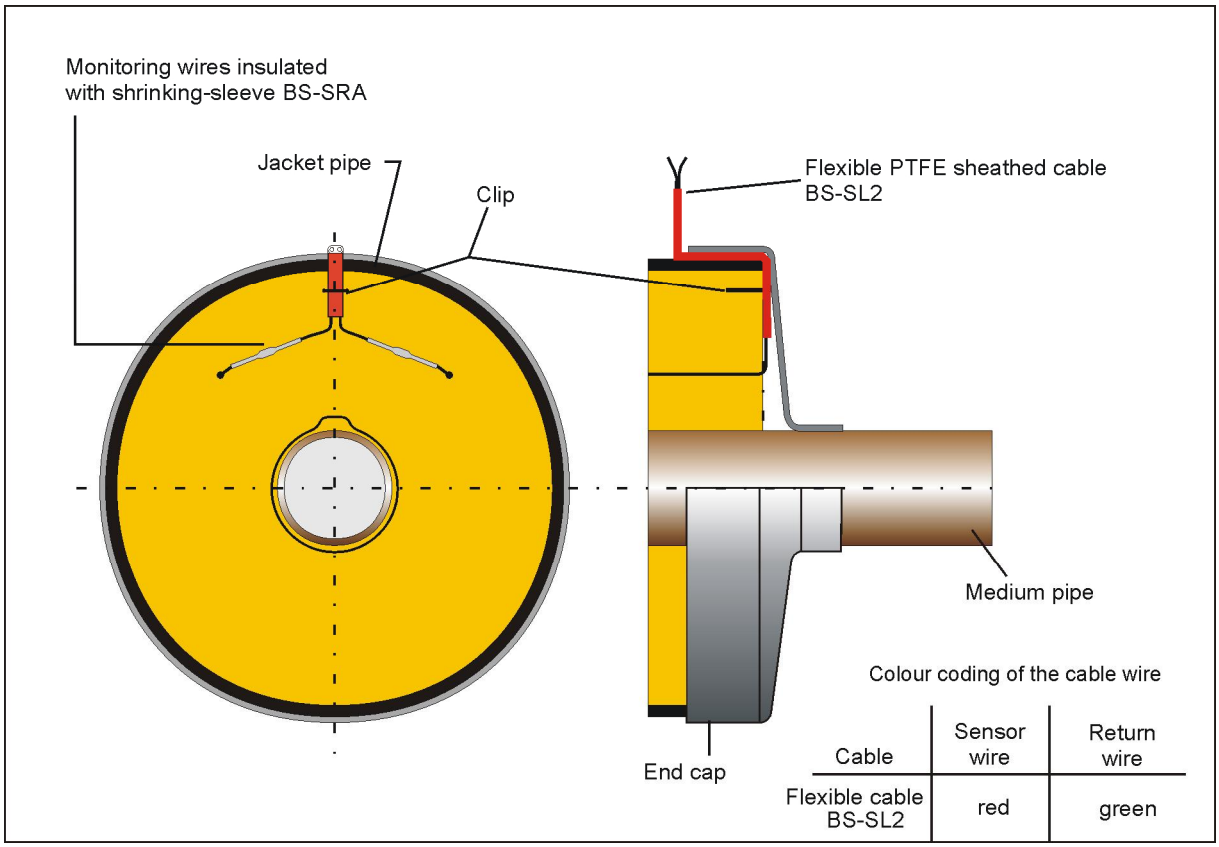
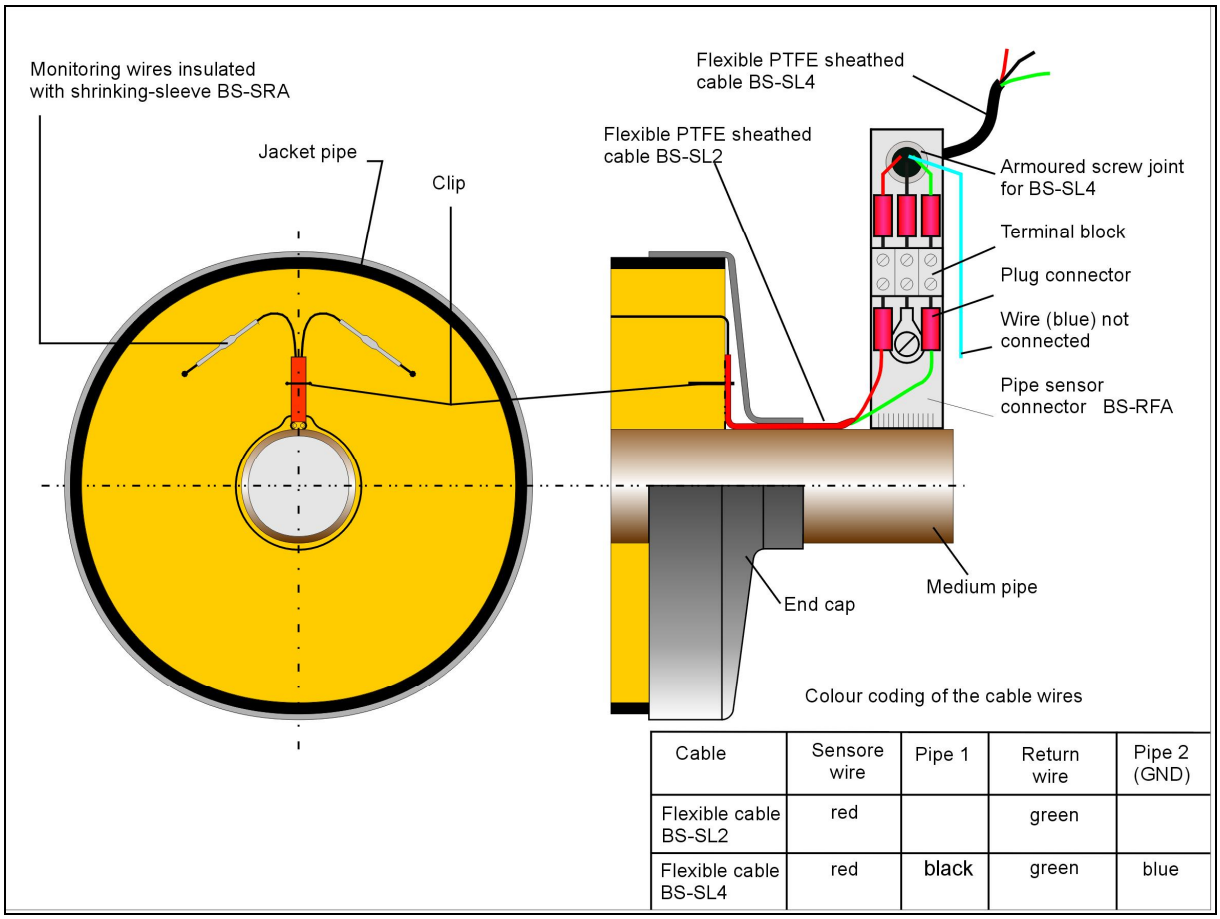


Fig. 4.1.1 Example 2: Connecting the monitoring wires to flexible sheathed cable BS-SL2 and leading the wires out

4.2 Leading the loop out with a pipe-sensor connector BS-RFA (for system connection)

Perfect function of the monitoring system requires a direct pipe contact at each monitoring device's location. This can only be achieved by using the welded-on pipe-sensor connector BS-RFA. As shown below, the plumber must weld the pipe-sensor connector onto the medium pipe at each pipe end (flow and return) at the device's location.
The pipe-sensor connector RFA 1 should be used for heat insulation up to 60 mm and RFA 2 should be used if the insulation is thicker than this.
Sensor wire and return wire must be connected to heat-resistant flexible PTFE sheathed cable BS-SL2 which provides a waterproof extension to the pipe-sensor connector. For the connections use plug connectors (!). The sheathed cable BS-SL2 can be installed directly on the medium pipe under the end cap. The flexible sheathed cable must be sealed additionally at the end caps using Mastix (make Raychem, 3M or similar).
Only the heat-resistant flexible PTFE sheathed cable BS-SL4 shall be used from the pipe-sensor connector into the junction box. The cable has to be fixed to the pipe-sensor connector by using armoured screw joints. For this purpose, the rubber seal rings have to be adapted to the cable.
"Normal" cable, e.g. NYY or similar, is not admitted as it shows no temperature stability.
The terminal block of the pipe-sensor connector must remain accessible; therefore shape the heat insulation jacket accordingly (e.g. fit rosette in/on lead jacket).
The pipe-sensor connector must be protected against dripping or trickling water!



Colour coding of the cable wires

Cable	Sensore wire	Pipe 1	Return wire	Pipe 2 (GND)
Flexible cable BS-SL2	red		green	
Flexible cable BS-SL4	red	black	green	blue

Fig. 4.2 Example 1: Leading the loop out with pipe-sensor connector

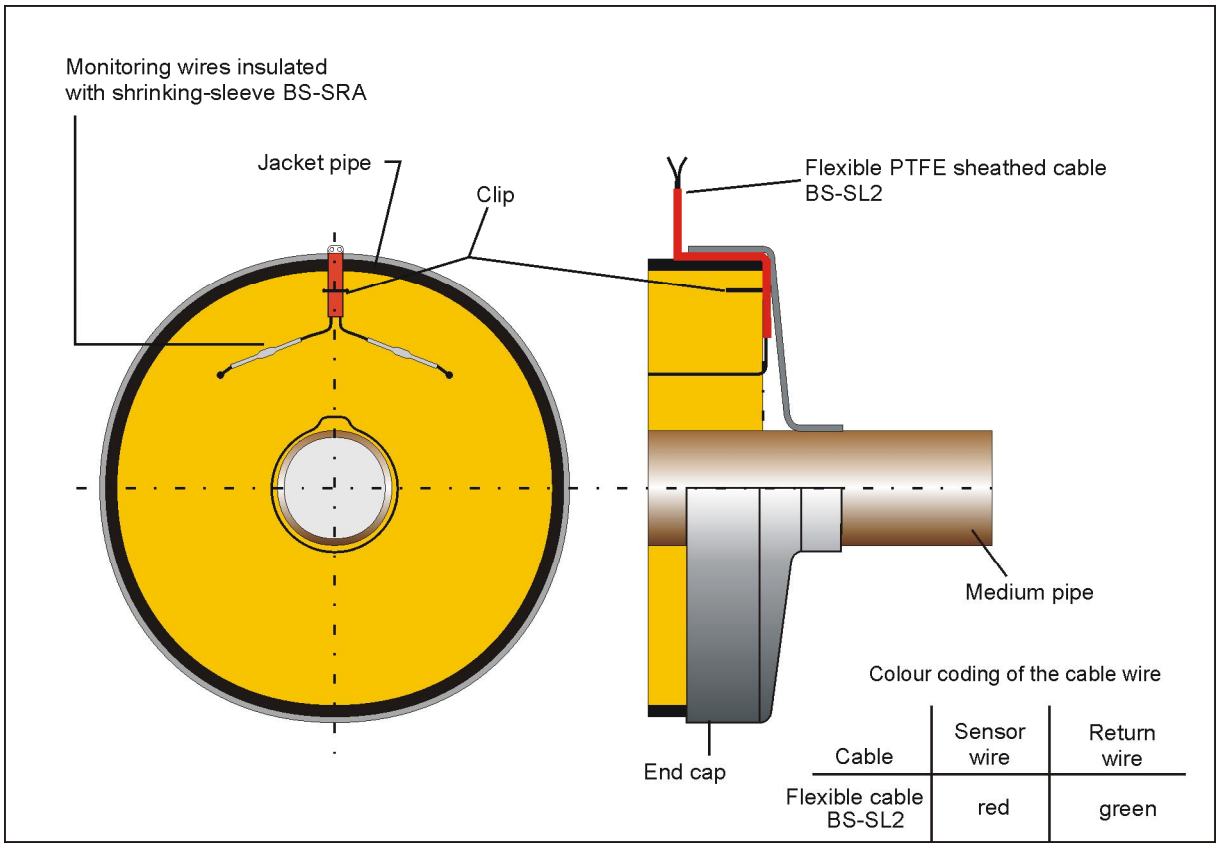


Fig. 4.2.1 Example 2: Leading the loop out with pipe-sensor connector

4.3 Leading the loop out <u>without</u> a pipe-sensor connector (only applied for closing of loops)

In this case, both monitoring wires are connected (refer to 3.4) to flexible sheathed cable BS-SL2 as described under 4.2, providing a **waterproof extension**, and are led between the end cap and the jacket pipe directly into the junction box, where they are connected using plug connectors (Fig. 4.3).

The flexible sheathed cable must be additionally sealed at the end caps using Mastix (make Raychem, 3M or similar).

Important!

Sensor wire and return wire are not allowed to be led out of the end cap directly. They could cause false messages originated by moisture located outside the monitored pipe, e.g. in pits.

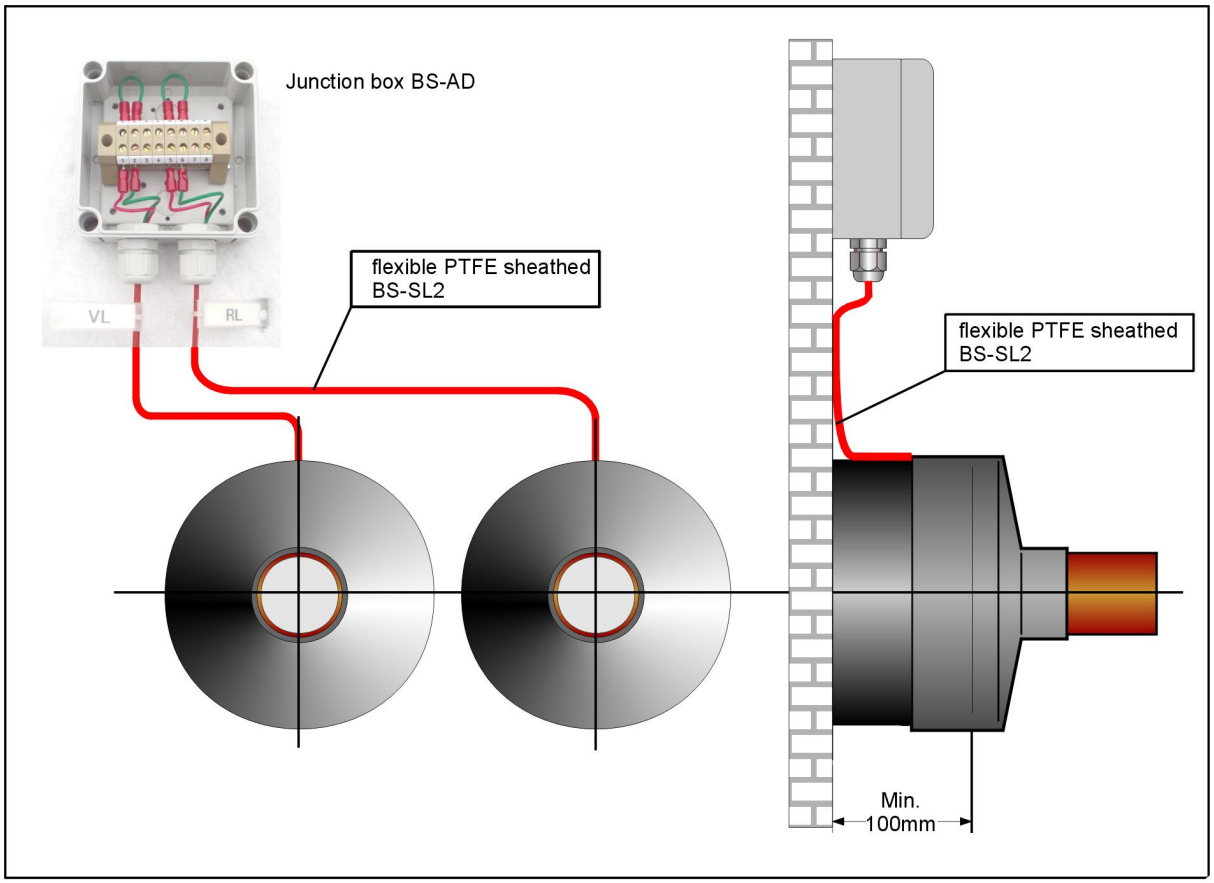


Fig. 4.3 Leading the loop out without pipe-sensor connector (only applied for closing of loops)

5 Wiring to the junction box

5.1 General information

Flexible PTFE sheathed cable must be used at all accessible end points located in buildings or pits, to extend the monitoring wires up to the junction boxes (refer to items 4.1 and 4.2) where they are connected (Fig.s 5.1 and 5.2) to the terminals.

For this connection always use the plug connectors supplied with the junction boxes!

If no monitoring unit is connected immediately, the loops must always be closed in all junction boxes, so that a closed sensor loop can be measured from any junction box!

5.2 Connection diagrams

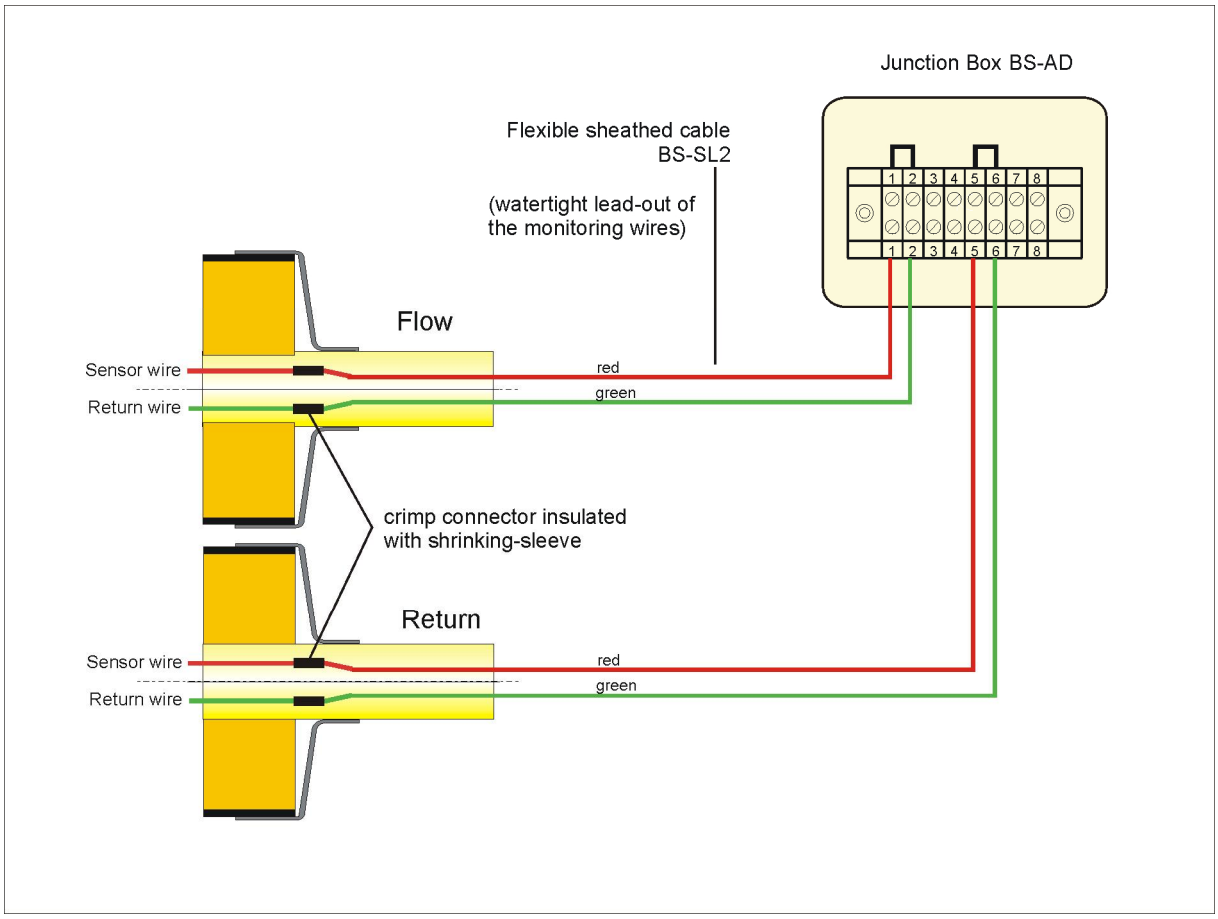


Fig. 5.1 Connection diagram of the junction box without pipe-sensor connector (end of the loop)

Note:
In order to ensurre the proper functionality of the system, each monitoring unit has to have a double pipe connection. The first pipe connection is carried out with the inner of the three connectors at the terminal of the pipe-sensor connector BS-RFA. The second pipe connection is made by welding the hexagon bolt (which is enclosed with the pipe-sensor connector) and its connection components. This pipe junction is connected to the blue wire of the flexible sheathed cable BS-SL4 and then wired through to the junction box (Fig. 5.2).
If there are at least two pipes with one pipe-sensor connector each at the connection point for the monitoring unit (e.g. supply and return), the first pipe connection can be made on the supply, the second one on the return pipe.
The wiring and continuation of each of both pipe connection points to the devices must in any case be carried out separately (refer to Fig. 5.3).
The pipe connection point 1 (supply) for the device 1 has to be bridged inside the junction box BS-AD to the connection point 1 for the device 2. The pipe connection point 2, however, has to be bridged inside the junction box BS-AD to the connection point 2 for device 1
(= bridges 4 > 8 and 7 > 3). The pipe connection points which are directly at the pipe always have to be separated mechanically. The electrical connection is made by the equipotential bonding, which always has to be provided. If no equipotential bonding between both pipes (check by measuring!) is provided, the devices have to be connected in accordance with Fig. 5.2.

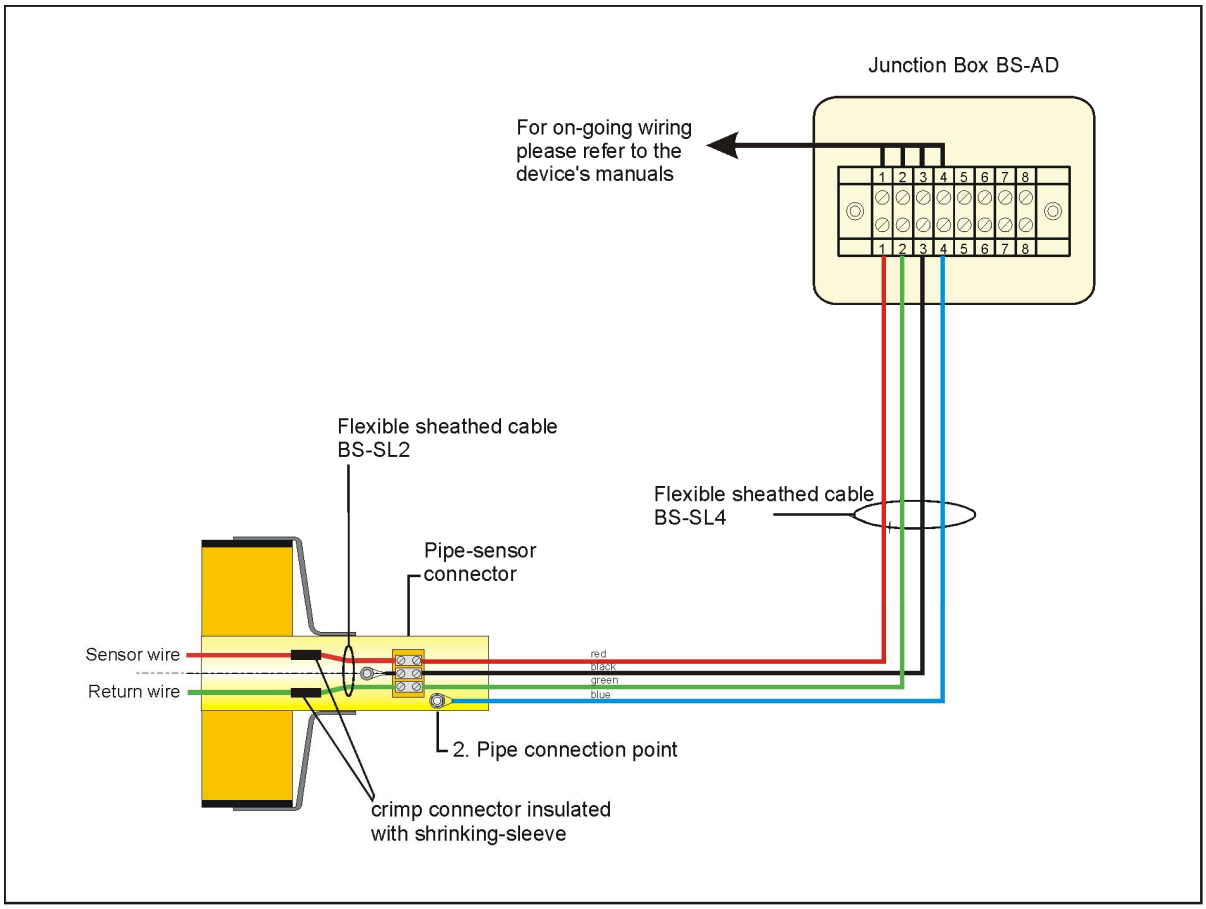


Fig. 5.2 Connection diagram of the junction box with pipe-sensor connector for one monitoring device (connection point) and one pipe

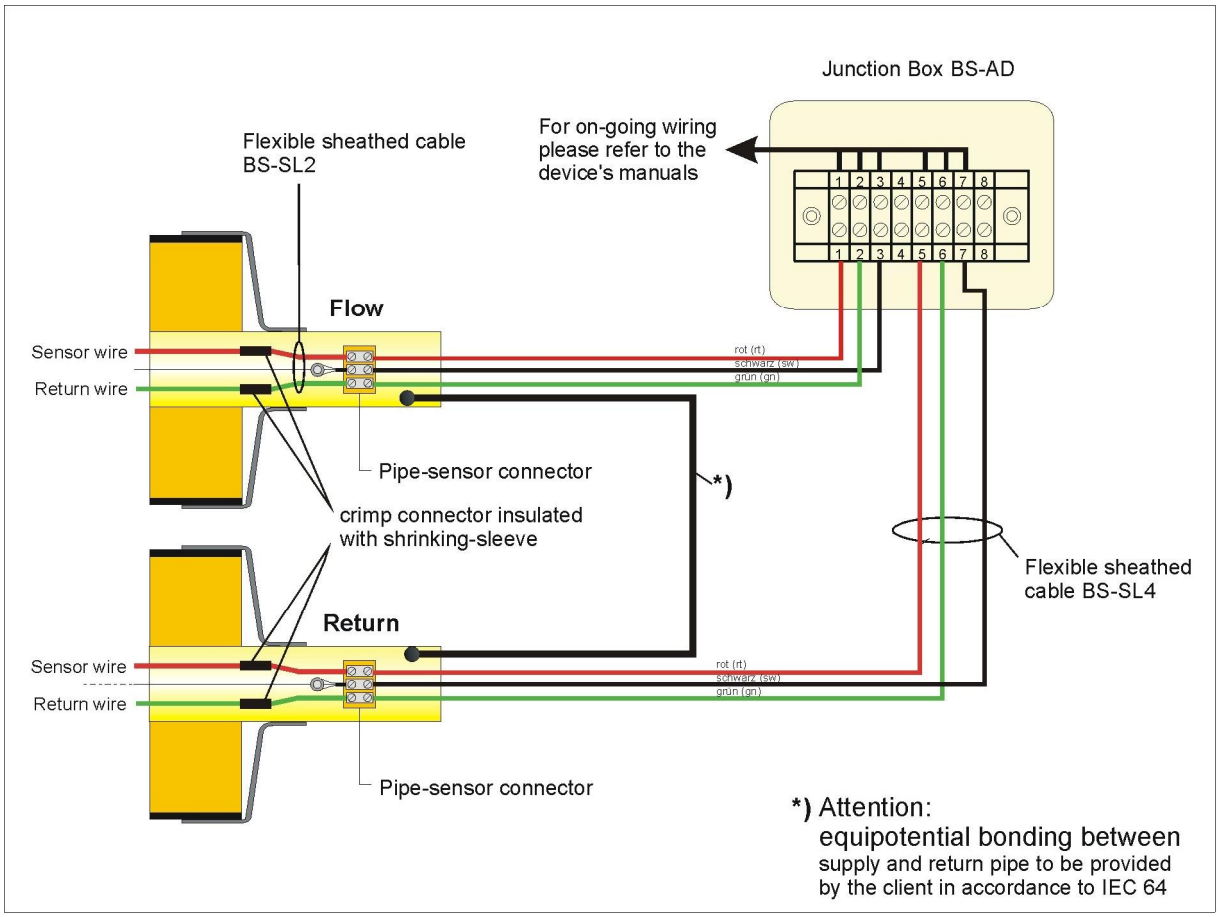


Fig. 5.3 Connection diagram of the junction box with pipe-sensor connector for 2 pipes

For the connection diagrams from the junction box to the monitoring units, please refer to the document "Planning of BRANDES monitoring systems", to the corresponding technical manuals for the monitoring units or to the project's specific connection scheme.

5.3 Junction box BS-AD

The junction box must be installed on a plane surface and must be accessible at any time. It must therefore always be fitted next to the pipes on the accessible side and **never** between the pipes (Fig. 5.4).

Additional spacers must be used for mounting on wet or uneven walls.

Cables must always be led into the junction box from the side or from the bottom, never from the top!

Seal the cables with the armoured screw joints which you will find enclosed with each junction box. For this purpose adapt the rubber gasket of the armoured screw joints to the outer cable diameters.

Use screw joints PG 16 for installation cables and screw joints PG 11 for the flexible sheathed cables BS-SL2 and BS-SL4.

Next to the rubber gaskets of the armoured screw joints, the flexible sheathed cable BS-SL2 (two-wire!) must be aditionally taped with a self-welding customary insulating tape.

Sequence for the cable lead-in into the junction box:

1. Slide the armoured screw joints on the cable ends.
2. Prepare the cable ends and fit plug connectors or wire end covers on the wire ends.
3. Remove the fixing nut and introduce the cable with the armoured screw joint into the prepared hole of the junction box. Do not forget the gasket!
4. Tighten up the armoured screw joint using the fixing nut.
5. Tape the flexible sheathed cable BS-SL2 with insulation tape (see above).
6. Pinch the wires in accordance with the connection scheme.
7. Tighten up the armoured screw joints in order to fix the cables.

Put marked labels on each wire end.

Note: Record the terminal assignment in a drawing!

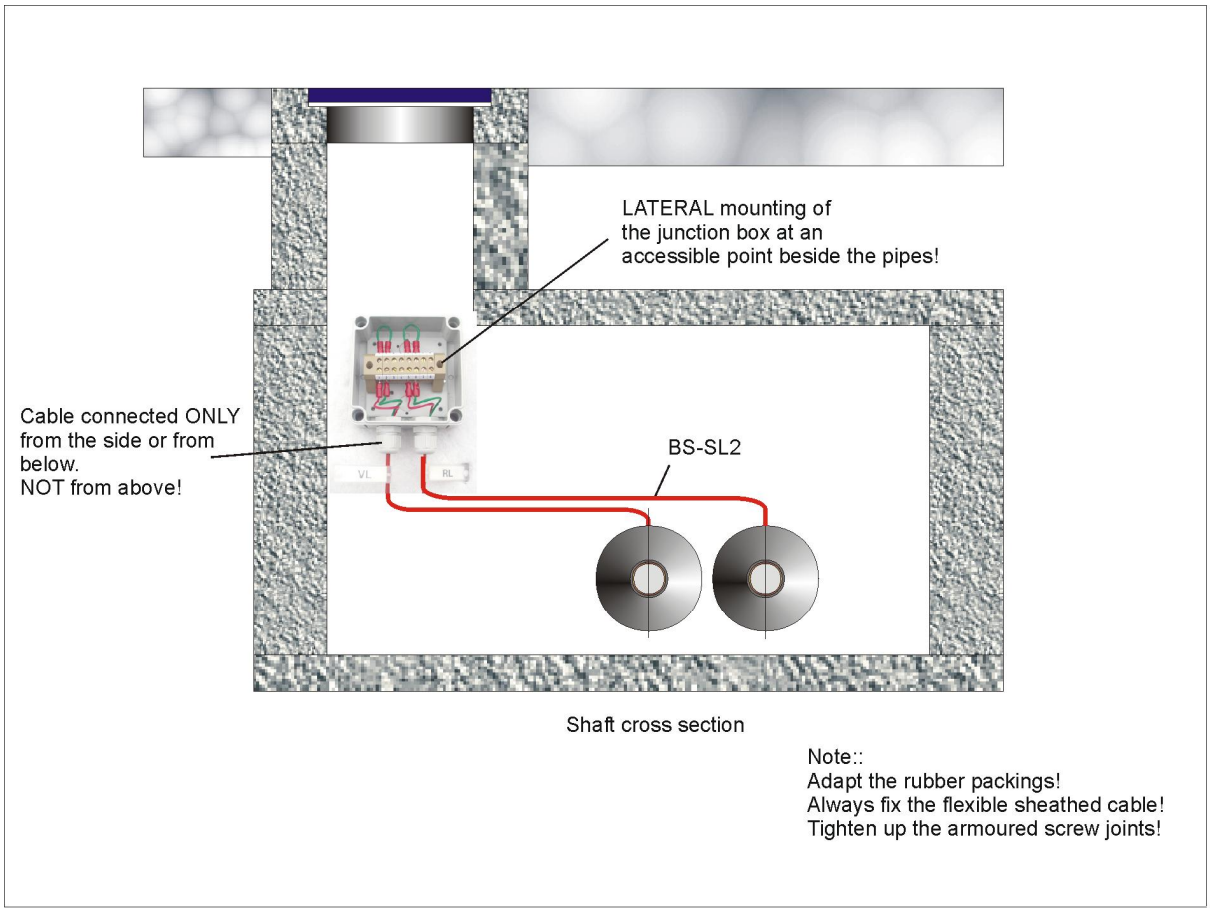


Fig. 5.4 Installation of the junction box

6 Separation of loops and leading cables out at sleeves

6.1 General information on loop separation

Loop separation or loop closing within a section, i.e. outside buildings, should not be realized in junction sleeves or end caps which will not be accessible any more. These points have to be accessible at any time.

Therefore the loop has to be extended and lead out as it is done inside buildings, but this time using an underground cable, e.g. NYY 7 x 1.5 mm^2.

Realize the connection between the monitoring wires and the wires of the underground cable as described under 3.4.

The junction points have to be kept at distance from the medium pipe using spacers of PU foam. Then they have to be fixed.

Mark all cables and wire ends:

- cable: which pipe; flow/return, etc.
- wires: from/to which direction/loop;
  to sensor wire/to return wire?

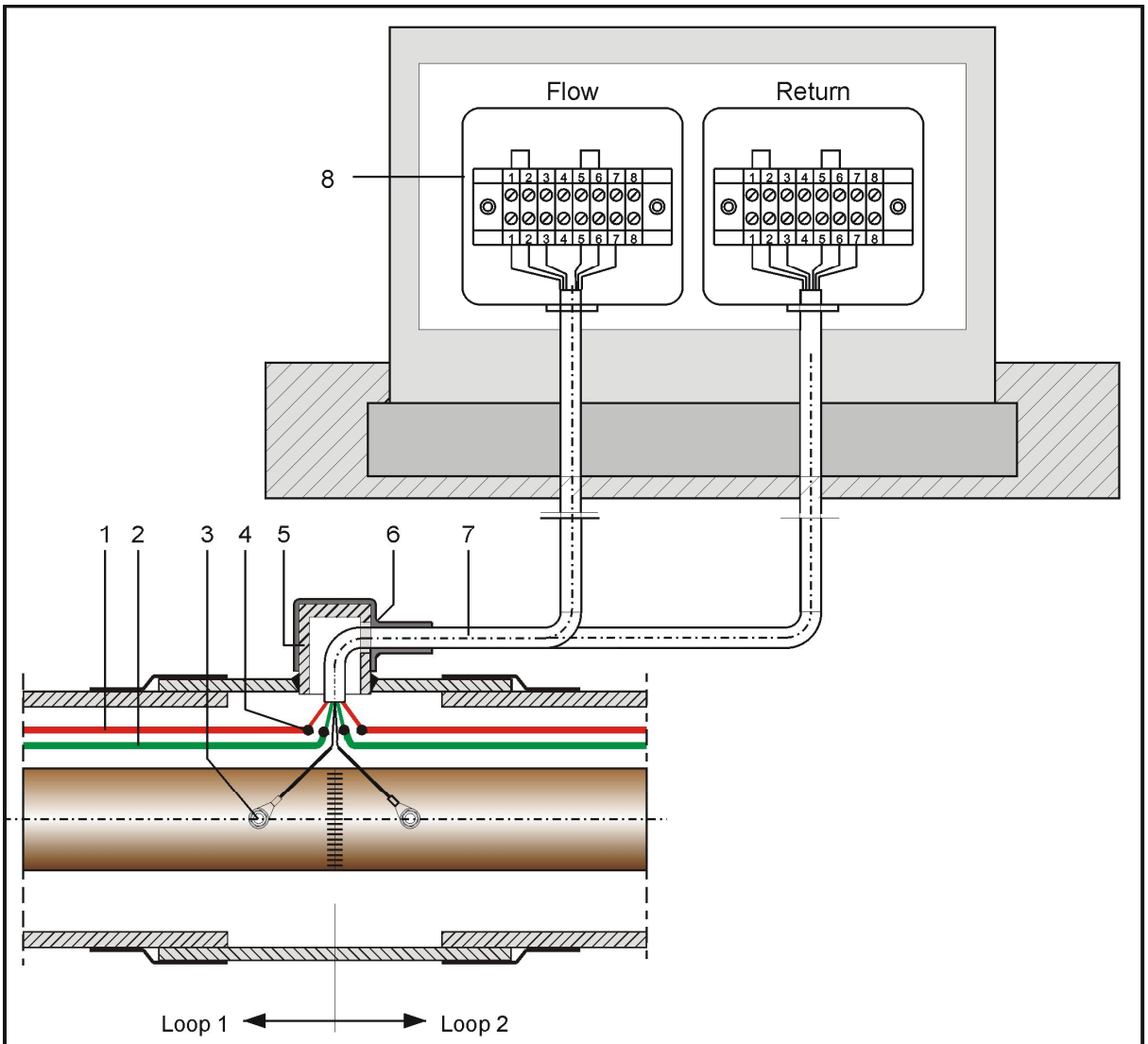
Note: Always use the same wire colour for the same application!

6.2 Leading cables out of sleeves

The cables have to be lead out of the pipe sleeves and have to be sealed using the suitable system components of the resepective pipe system manufacturer in order to be permanently waterproof (refer to the example of Fig. 6.1).

A dilatation loop must be laid where the cable is led out, in order to protect the cable against shearing and rupture caused by sliding movements of the pipe.

Note: Measure the point/sleeve where the cable is led out and note the results in the corresponding loop record templates and pipe revision plans.



LEGEND:

1 Red sensor wire
2 Green return wire
3 Pipe connector (welded-on) 1)
4 Uninsulated crimp connector, shrink-fitted, waterproof
5 PE sleeve,welded-in
6 Heat-shrinkable sleeve 2)
7 Underground cable,7x1.5mm^2
8 Junction box,above ground (!) (e.g. in the measuring post;drawn)

1) e.g. M6 screw,DIN 558 with nut and serrated lock washer DIN 6798 and cable connector

2) e.g. Raychem preform 222D263-3-22

Terminal assignment of the junction box

Terminal 1: Sensor wire loop 1
Terminal 2: Return wire loop 1
Terminal 3: Pipe connection
Terminal 4: unassigned/reserve
Terminal 5: Sensor wire loop 2
Terminal 6: Return wire loop 2
Terminal 7: Pipe connection
Terminal 8: unassigned/reserve

Fig. 6.1 Example of how to lead cables out of junction sleeves

7 Wiring of sensor loops

7.1 Wiring in builidings or pits

7.1.1 Through-wiring in a building or pit

If the pipes are led through buildings or pits, then the accompanying sensor loop must also be led through the building.

The associated cabling/wiring must be waterproof and must lead from one junction box to the next one.

Flexible PTFE sheathed cable must be used to lead the monitoring wires into the junction boxes, as described in section 4.

No other solutions are permitted, as there is no ensurance that they would be waterproof and heat-resistant on a long-term basis, and this may result in undefinable false messages from the connected monitoring system!

Separate sensor loops must be made for each pipe and they are to be wired in buildings separately in accordance with Fig. 7.1.

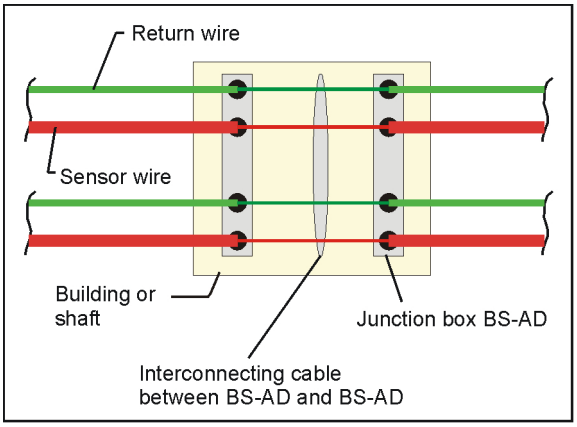


Fig. 7.1 Through-wiring in buildings or pits

7.1.2 Branch wiring in buildings or pits

For the looping-in of branch lines originating in buildings, proceed according to section 7.1.1.

The wiring must comply with Fig. 7.2, if appropirate in accordance with the "right-hand rule" (refer to 7.3).

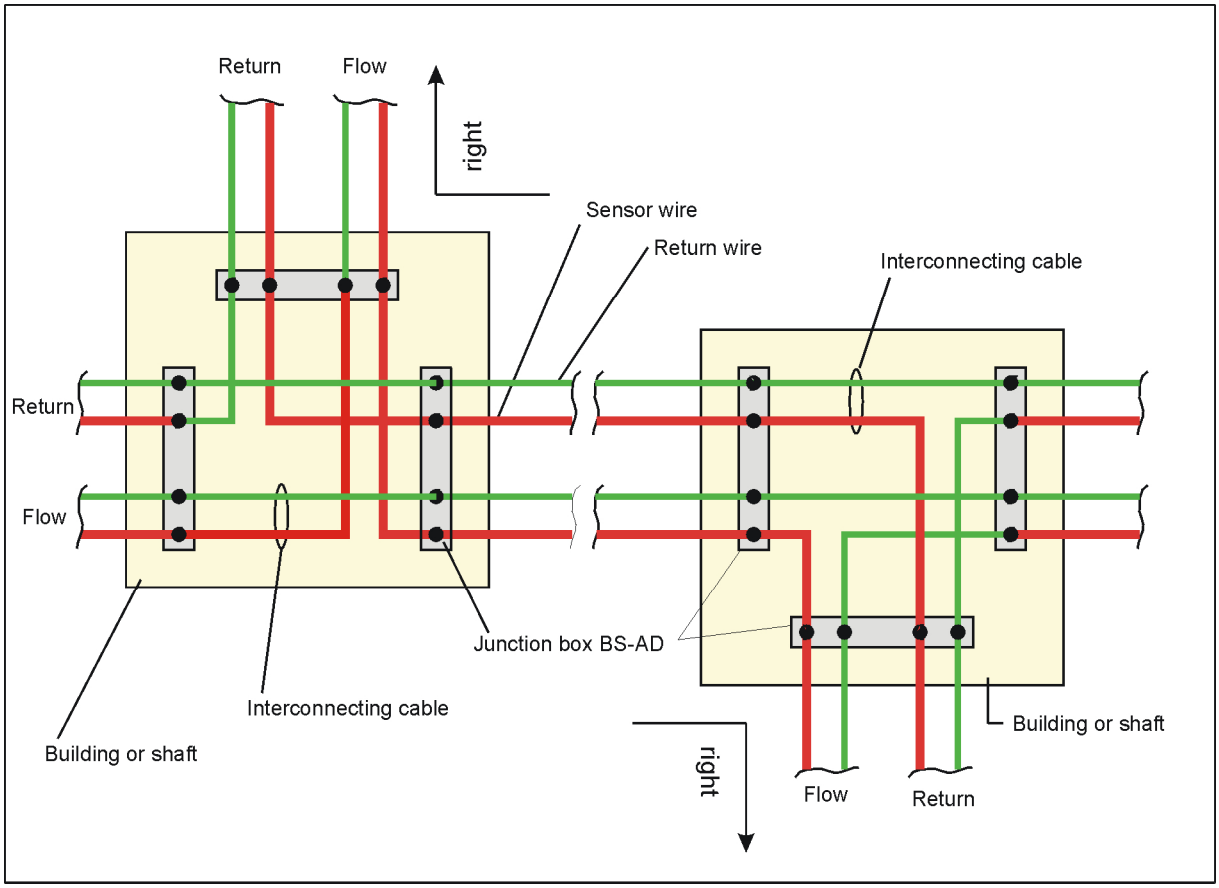


Fig. 7.2 Branch wiring in buildings

7.2 Wiring of T-parts

7.2.1 T-parts preinsulated in factory

The preinsulated T-parts, which have been produced in accordance with the BRANDES specifications, only have one sensor wire and one return wire, i.e. one pair of wires projecting out of each pipe end. "Red" must then be connected to "red" and "green" to "green" on the building site.
The monitoring wires of the T-parts supplied from the factory are arranged in accordance with the right-hand rule (refer to 7.3) when installed pointing **upwards** (Fig. 7.3).If the branch line is pointing **downwards** (Fig. 7.3), the sensor wire/return wire order is different and must be noted for subsequent fault locating measurements.

Important:

All branch lines pointing downwards must be recorded in the drawing / test report template!

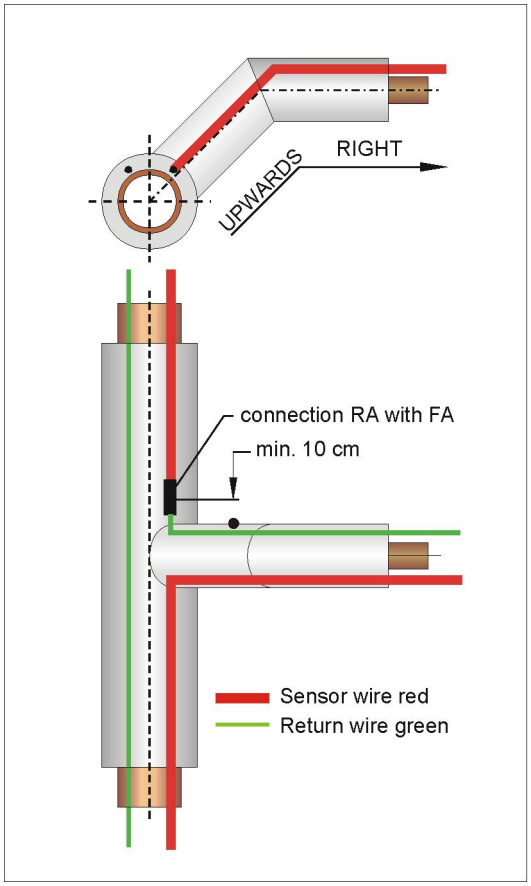


Fig. 7.3 Position of sensor wire and return wire with installation pointing upwards

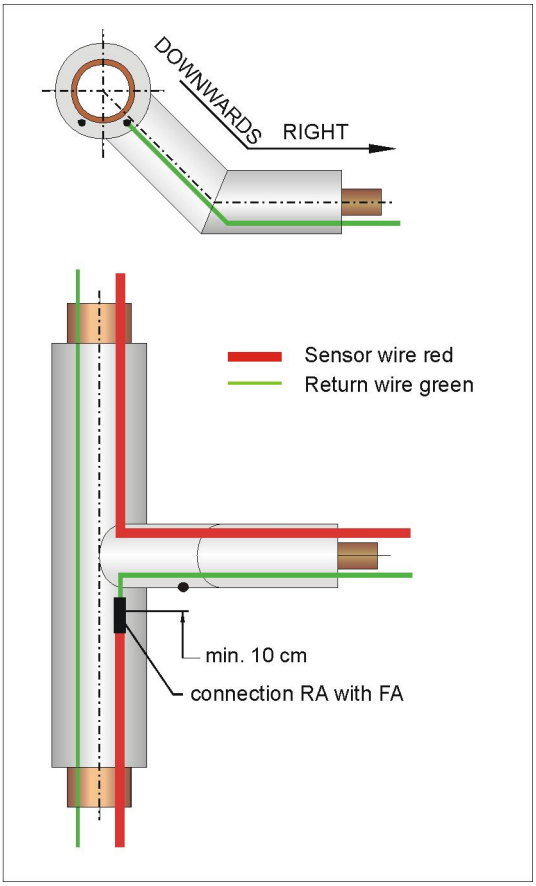


Fig. 7.4 Position of sensor wire and return wire with installation pointing downwards!

7.2.2 Parallel T-branches preinsulated in factory

These are also factory-equipped with the corresponding wires in accordance with the BRANDES specification (Fig. 7.5). The content of 7.1 also applies here accordingly.

Attention:

Directly after installing the T-parts and connecting the wires, you must record (e.g. in the loop test report template) the position of the T-parts and - above all - the direction of the branches which are in parallel to the main pipe!

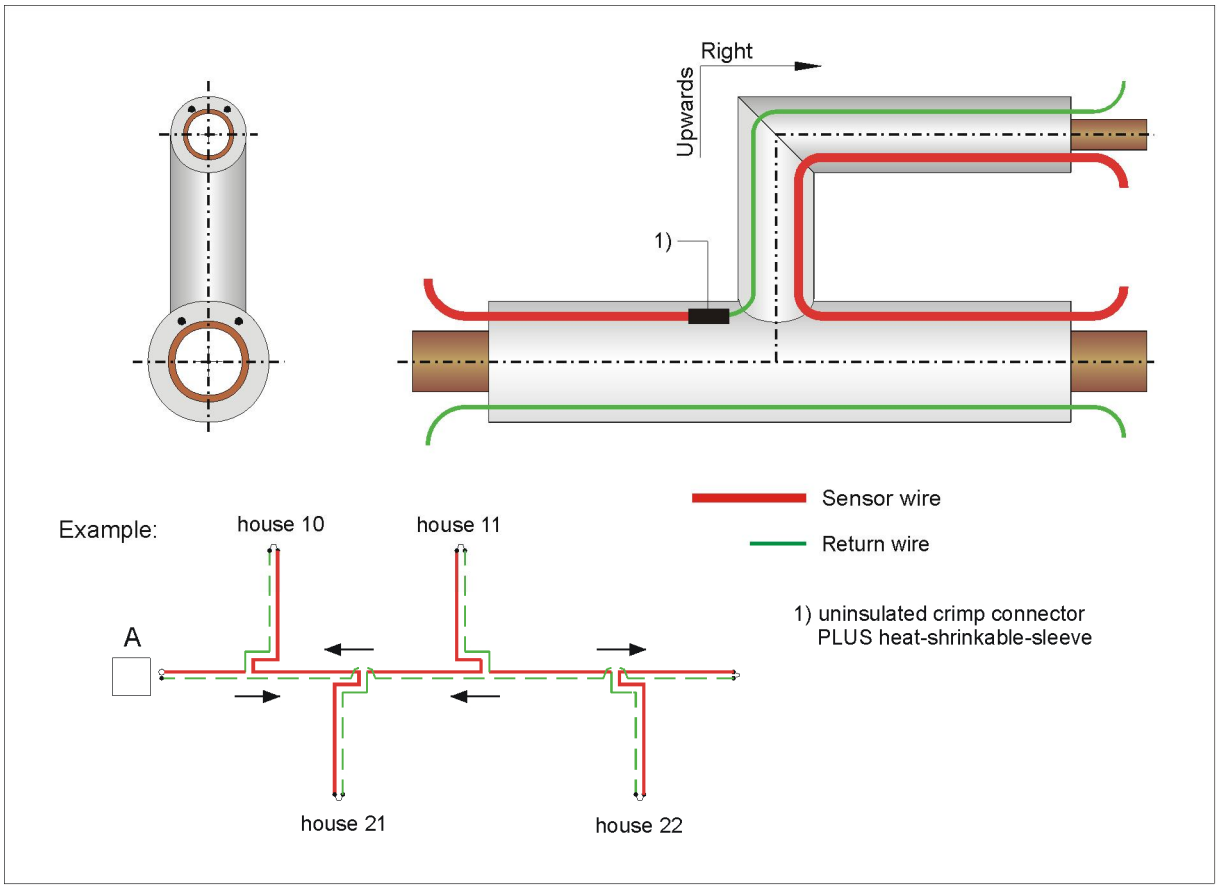


Fig. 7.5 Position of the sensor wire and return wire in parallel T-parts

7.2.3 Installation of T-parts

The branch line has to be regarded from main line in that way that it only branches off to te right.. Independent from the branch line, whether branching off upwards or downwards, at this the sensor wire coming from the main line has to be looped-in to the right into the branch. The wiring is then done according to pic. 7.6.

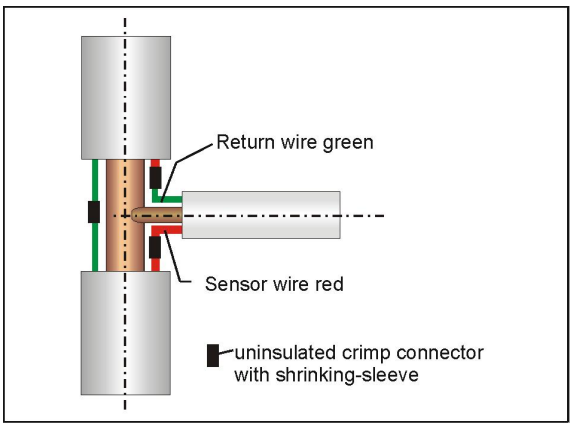


Fig. 7.6 Wiring of T-parts

7.3 Right-hand rule

1. The right-hand rule has priority when the wires are fitted into a T-part which is preinsulated in the manufacturer's factory.

2. The T-parts is positioned in such way that the branch is pointing **UPWARDS** and to the **RIGHT** from the observer's point of view (Fig. 7.3).

3. Assuming the same viewpoint, the **SENSOR WIRE** is led into the main line and then to the **RIGHT**, straight into the branch line; the main line's **RETURN WIRE** is passing through uninterrupted.

4. The return wire of the **BRANCH LINE** is led from the branch to the main line, where it is connected to the on-going sensor wire.

As far as installation T-parts and preinsulated T-parts with double wire complement on the building site are concerned, "RIGHT-HAND WIRING" means that, regardless of the flow direction or the location of the heating station, each branch line is pointing to the RIGHT; i.e. the observer always positions himself in such a way that the branch in front of him points to the right.

The sensor wire from the branch lines is then connected to the sensor wire from the observer's location, and the return wire from the branch lines are connected to the on-going sensor wire in the main line as viewed by the observer.

The return wire in the main line is always passing the branch uninterrupted.

Note: Branch lines are always looped-in from the main line's sensor wire. They are never looped in from the return wire!

8 Validation measurements

Continuous validating measurements with the BRANDES hand-held installation tester BS-MH must be conducted to ensure that the sensor loop and the monitoring system to be connected will work properly.

These measurements have to be carried out **from one sleeve to the next** during the supplementary insulation work. Therefore close the loop at the beginning of the pipe section by connecting sensor wire and return wire (Crimp connector and heat-shrinkable sleeve!). Also refer to Fig. 8.1.

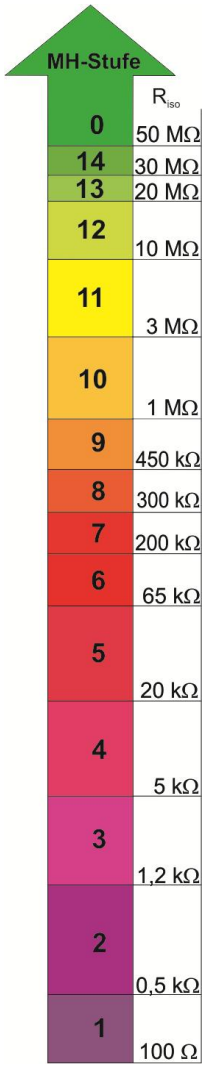
These are the results to be obtained by carrying out verification measurements with the installation tester BS-MH:

- is the loop closed or is it interrupted?
- how long is the sensor loop approximately (pipe length)?
- what is the measured resistance value for the sensor loop?
- what is the insulation value for the heat insulation?

(For more details concerning the measurements with the installation tester BS-MH please refer to the device's manual.)

The presence of humidity (construction humidity) is indicated by so-called MH-levels.

BS-MH-level	Insulation resistance
0	> 50 MΩ
14	30 - 50 MΩ
13	20 - 30 MΩ
12	10 - 20 MΩ
11	3 - 10 MΩ
10	1 - 3 MΩ
9	0,45 - 1 MΩ
8	300 - 450 kΩ
7	200 - 300 kΩ
6	65 - 200 kΩ
5	20 - 65 kΩ
4	5 - 20 kΩ
3	1,2 - 5 kΩ
2	0,5 - 1,2 kΩ
1	< 0,5 kΩ



Note: Devices of the former generation don't show level 13 and 14.

Evaluation:

Level 0 (ZERO) refers to the dry range and you should always try to achieve this level when conducting the continuous verification measurements during installation procedure.

The level 14 and all lower levels indicate the presence of humidity already during installation. This bears the risk of locking up the humidity and deteriorating the quality of the heat insulation.

Should you determine a change from ZERO to 14 when conducting the verification measurements from sleeve to sleeve, it is recommended to rework the corresponding sleeve area.

In case of level 11 or lower it is absolutely necessary to rework the concerned sleeves.

Note: Should the control measurements not be conducted continuously from sleeve to sleeve, humidity may be locked up at serveral points/sleeves without being detected. The associated repairs will cost a lot of time and money if they are carried out later.

If sensor loops are built up by different specific loop resistance values (e.g. with Flexwell district heat cable), the individual partial resistance values of the loop must be measured with a digital ohmmeter (multi-meter) and are then to be entered in the test report templates. The same applies to the position and values of the corresponding transition points.

Note: A digital multi-meter is not able to give clear statements about possible humidity concentration and is therefore not permitted for the conduction of verification measurements!

Adherence to the pipe-system manufacturer's processing guidelines and the relevant regulations, e.g. of the AGI, the BFW, etc. are fundamental prerequisites for high-quality workmanship.

The continuous verification measurements are only supportive on the way to achieve the quality which is to be expected by the finished pipe system.

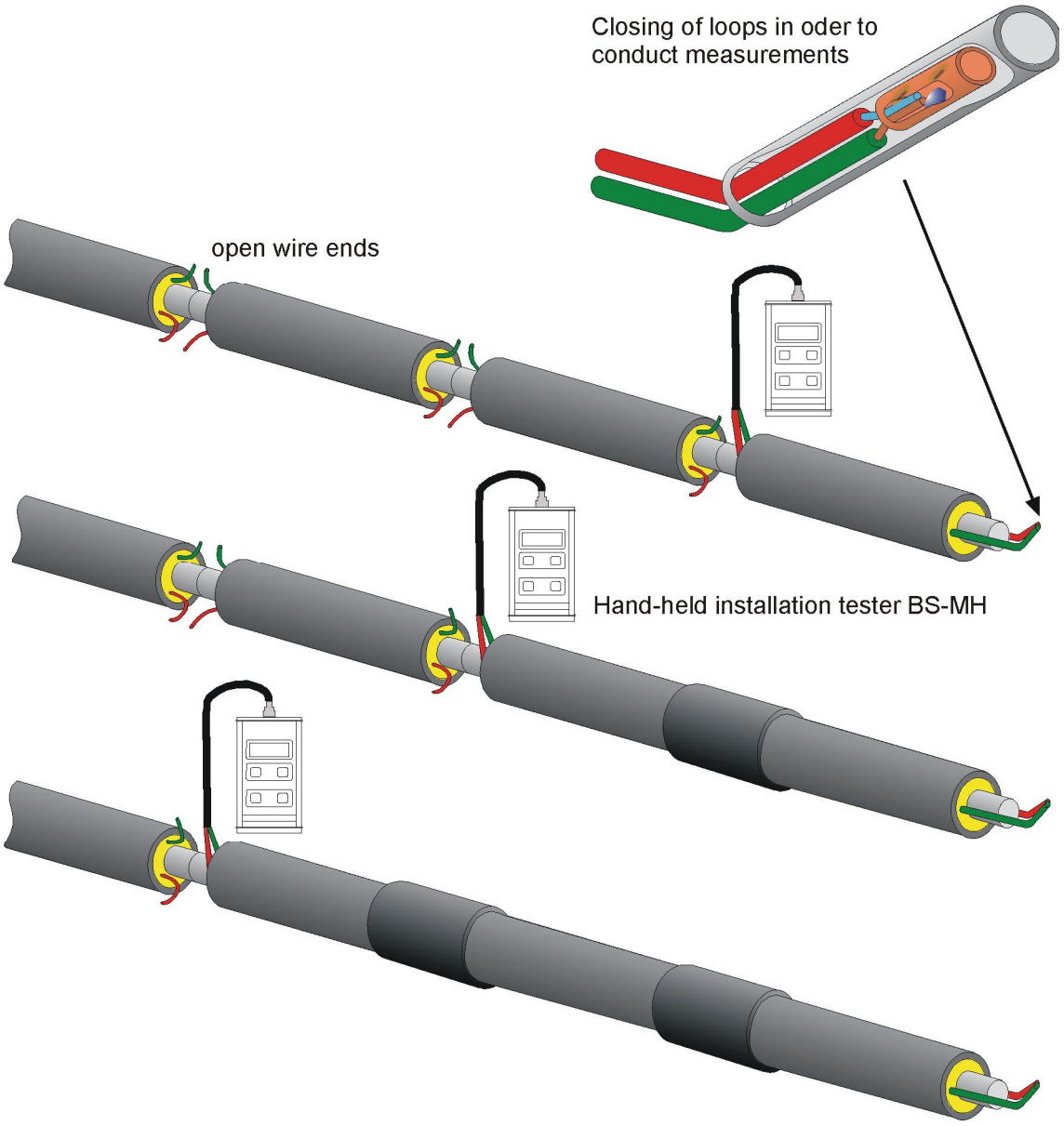


Fig. 8.1 Proceeding for validating measurements in the phase of post-insulation

9 Final measurement

Once the pipe engineering part of the monitoring system has been successfully installed, the plumber must conduct final measurement to register the ACTUAL status:

1. Insulation resistance measurement / BS-MH-stages

   To be carried out using the BS-MH or BS-MH hand-held installation tester.
   Other instruments (e.g. digital multimeters) cannot supply comparable and thus useful results.

2. Loop status measurement

   2.1 Using the hand-held tester BS-MH;
   has already been carried out by point 1.
   2.2 Using a digital ohmmeter
   to measure the resistance of the loop in Ohm or kOhm.
   Reverse the polarity of the terminals after the first measurement and repeat the measuring procedure.

Note: **Should the control measurements not be conducted continuously from sleeve to sleeve, humidity may be locked up at serveral points/sleeves without being detected. The corresponding repairs will cost a lot of time and money if they are carried out later.**

All measuring values must be entered in the loop test report (= acceptance report). (Please refer to the example Fig. 9.1).

The record must contain a drawing of the final sensor-loop wiring, to record the wiring and for subsequent preparation of the sensor loop diagram. There is no need to enter partial sections of the district heating lines in the drawing, but it must include the length of pipe which has been installed and connected, as well as the designations of buildings or other designations which allow a posterior identification of the pipe section (refer to the example).

The loop test report (acceptance report) is part of the order. Acceptance will not be granted without this!

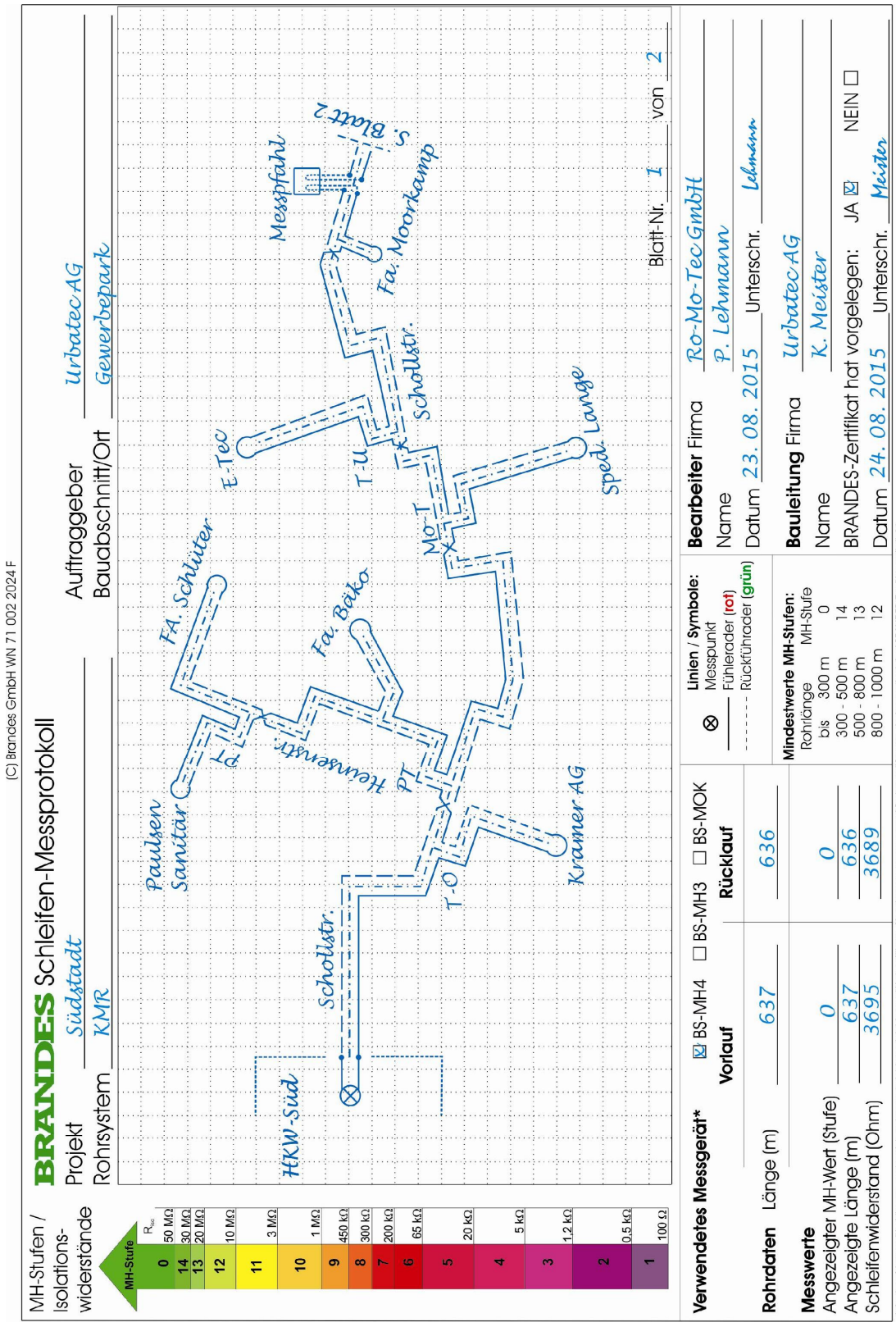


Fig. 9.1 Example "Loop test report template"

10 General information

The sensor wire and the return wire have to be cleaned **totally** off remaining separation medium and other soiling before connection.

Protective colouring, grease and other soiling have to be removed completely from the pipe ends (corresponding to the rules of the AGFW, BFW - *German District Heating Organizations* - and EN 489), so that a perfect metallic surface is provided.

Special care must be taken when separating the jacket pipes, in order not to damage the monitoring wires enclosed in the foam.

When welding the medium pipe, protect the front ends of the preinsulated units, and the monitoring wires in particular, from heat and sparks generated by the welding process.

When foaming in the sleeves and their seals, the preparative work prescibed by the relevant technical regulations *) must be performed in order to achieve the desired quality standard, e.g.:

- Protect the area around the sleeve from environmental influences.
- Clean and dry the area around the sleeve.
- Remove the PU-foam from the front end of each preinsulated unit to a depth of at least 2 cm.
- Heat up the contact surfaces for the reactive foam if their temperature is less than approx. 20°C.
- Heat the surfaces of the jacket pipe and sleeve up to approx. 65°C, if heat-shrinkable sleeve is to be used to seal the sleeve.

*) Refer to the processing guidelines issued by the manufacturers of the PU foam and of the heat-shrinkable sleeve, as well as to those issued by the AGFW, the BFW, *(German District Heating Organizations)* etc.

11 Safety regulations

Observe the relevant safety regulations covering equipotential bonding of the pipes and the corresponding IEC guidelines when welding steel pipes; particularily the accident prevention regulation concerning welding, cutting and related working processes.

As a measure of precaution, monititoring devices which are already connected should be separated (disconnected) from the pipe during welding works.

12 Annex

12.1 Instructions on handling the crimping pliers

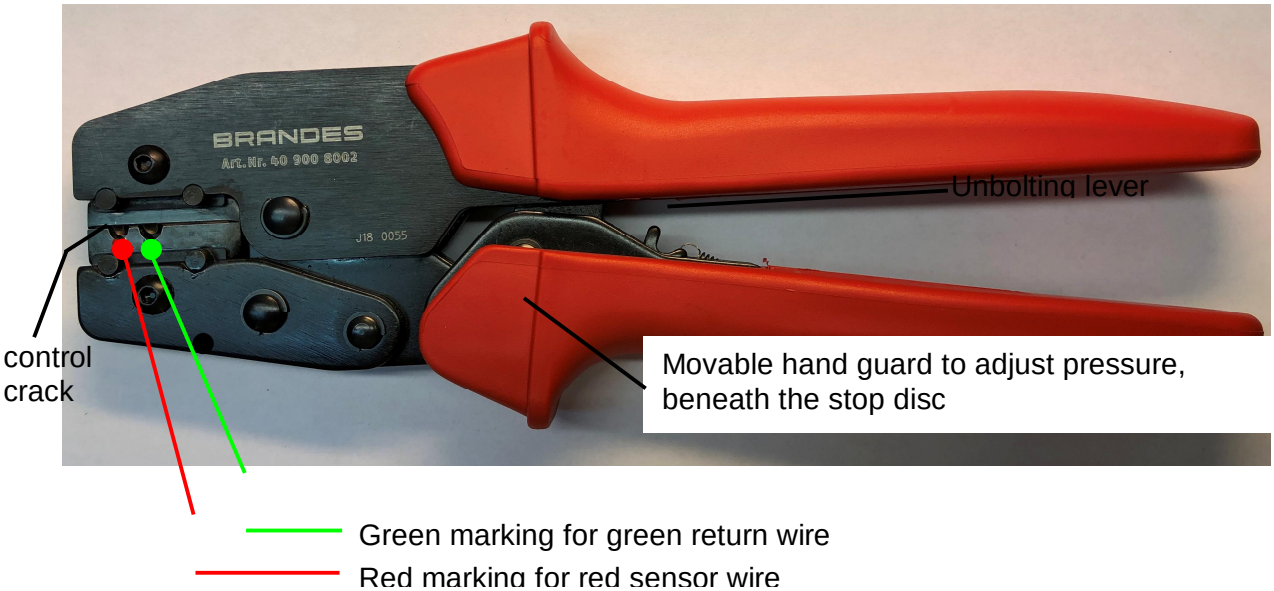


Fig. 12.1 Crimping plier BS-QZ22

For compressing the connectors for sensor and return wire please do exclusively use the specially designed crimping plier as shown above.

For compressing the connectors for sensor wire (with uninsulated crimp connectors BS-QU22):
Please use the first groove (= red marking)

For compressing the connectors for return wire (with uninsulated crimp connectors BS-QU22):
Please use the second groove (= greenmarking)

Working manual:

1. Open the tool by pressing the grips together and place the connector in the marked groove.
2. Press the grips together until the safety lock releases.
3. Take off the crimped connector.
4. Should there be an extraordinary heavy crimping process because of having placed the connector in the wrong groove please do not open the plier with power. In this case open the safety locking device by using the unbolting lever.

   Attention:
   A crimping that has been executed as described above may lead to a break off of the wire connection.

Consequence: Interruption

Maintenance

Please use a brush or a soft cotton-free cloth for clearing the tool from dust, humidity and other contaminants. Do not use anything that may damage the tool.

Make sure that all bolts, movable parts and the surface of the tool are covered with a thin film of a high-quality oil. Do not waste the oil, a thin film is enough for full function. Keep the tool in a dry and clean environment.

Adjusting the pressure

Each tool has been set optimal at works but the variance of usage will inevitably change the pressure point of the plier.

The crimping pressure can be set as follows:

1. Push the hand guard at the moving grip aside.

2. Note in which position the stop disc has been mounted.

3. The locking screw can now be removed with an allen key. To increase the pressure, the stop disc has to be turned anticlockwise. Often you will only need to set it to the next tooth.

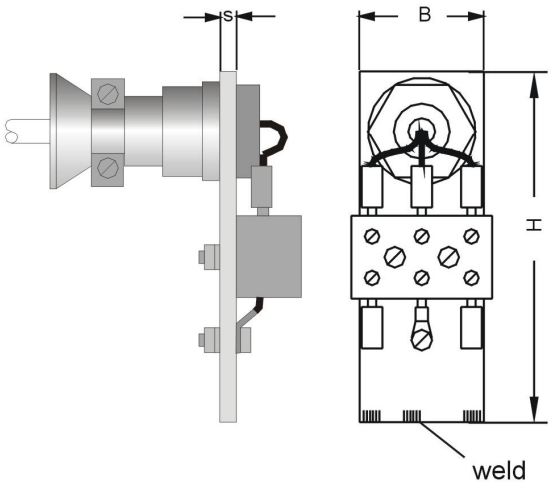
4. Place the stop disc in that way that the locking screw in the handle will lock the stop disc. Finally check the pressure by doing a test run and then try to distract the crimped parts.

5. Control of the pressure point:
   Hold the plier against light. The control crack shall only correspond to a hair-line crack, this means that you shall not be able to push a paper with normal thickness between without problems.

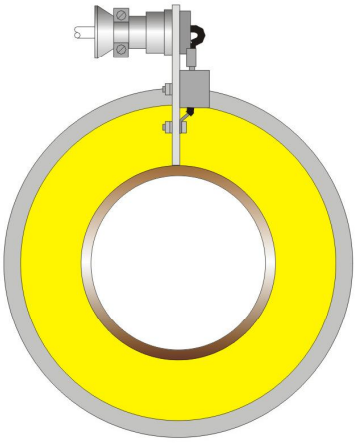
In the end please proof the pressure by a test pressure with following extraction of the connected wires.

12.2 Fig. Pipe Sensor Connector

BS-RFA1/-RFA2



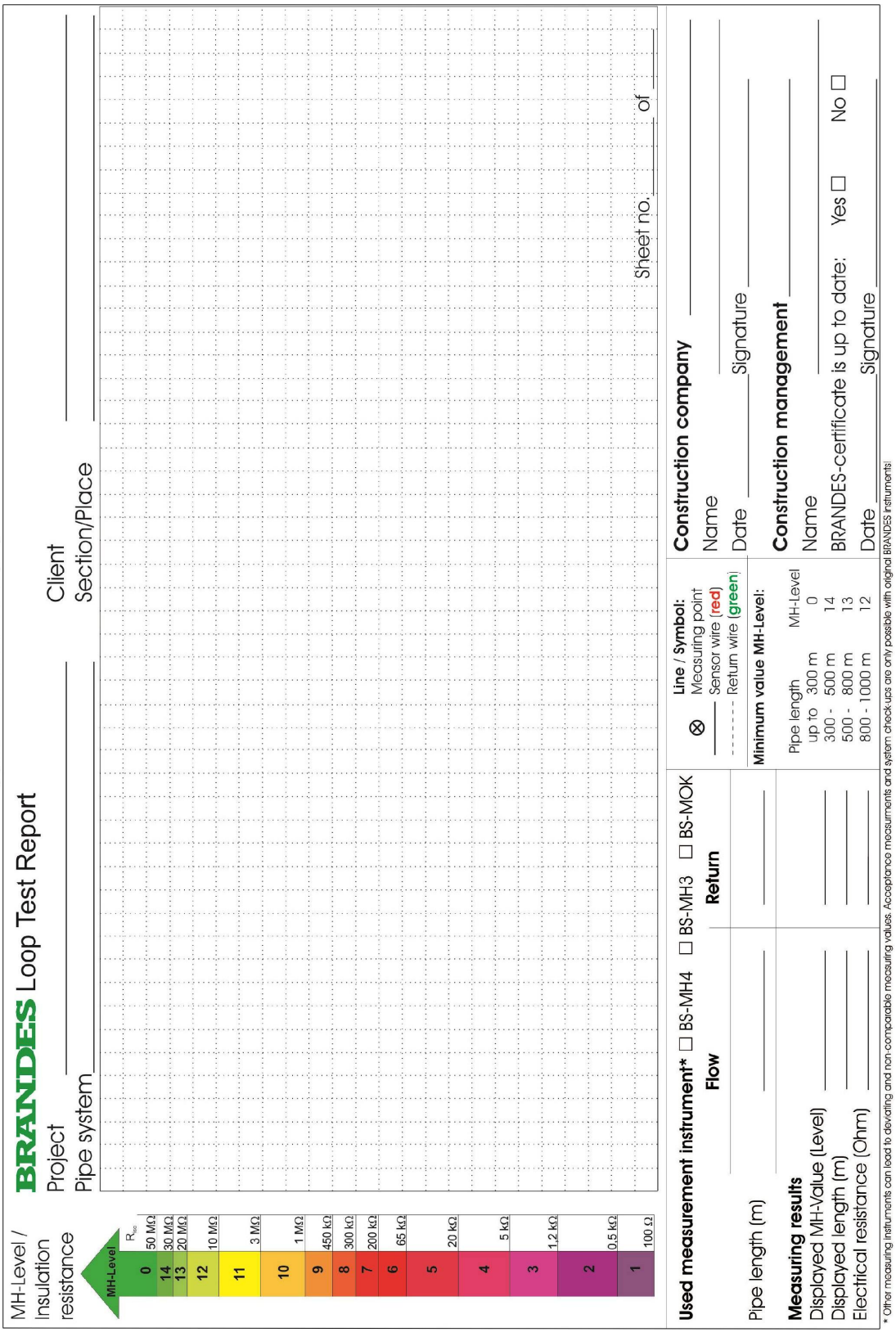
Proposal for the installation



Dimen. (mm)	Pipe sensor connector BS-RFA	
	BS-RFA 1	BS-RFA 2
H	85	155
B	30	30
s	4	4

Fig. 12.2 Pipe sensor connectors BS-RFA1 and RFA 2

12.3 Loop test report template



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