TESTER

LH 20S

(RESISTANCE ALARM SYSTEM)

OPERATING MANUAL

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Ver. 17.12

A pre-insulated heating pipelines with a resistance alarm system as a tested system.

From a measuring point of view, a pre-insulated heating pipelines with a resistance alarm system is a tested system consisting of the following elements: carrier pipe (steel), polyurethane insulation, alarm loop, casing pipe. The alarm loop consists of: a non-insulated resistance wire or with perforated resistance (e.g. NiCr8020) and an insulated copper wire. The resistance wire has a characteristic resistance stated in Ω/m. Whereas, the copper wire acting as a return route for electrical measurement signals, is characterized by such a low characteristic resistance that its impact on the test results is often ignored. Also due to its complete electrical insulation from other elements of the alarm system. Both wires are placed in polyurethane insulation filling the space between the carrier pipe and casing pipe. Leakage in at least one of the pipes makes the insulation soaked with water. As a result, its electrical resistance changes. Galvanic voltage between the resistance wire and carrier pipe (steel) also appears. These changes may be observed through periodic resistance and voltage measurements between the resistance wire and steel pipe. The measurement results show the water saturation degree of the polyurethane insulation. An alarm loop resistance wire enables the determination of a leak (moisture) location.

1. Types of measurement information and their presentation by an LH-20S device.

An LH-20S instrument may be used to measure the resistance and voltage (e.g. galvanic) of polyurethane insulation, and the resistance of an alarm loop. The resistance value is automatically converted into the length of the tested district heating pipelines section. Whereas based on the measured polyurethane insulation resistance value, it is possible to calculate the MH degree of humidity or C direct short-circuit of an alarm cable with a steel pipe. The relationships between the insulation resistance value and the MH or C parameter are shown in table no. 1.

Polyurethane insulation degree of humidity (MH)	Direct shorting of an alarm wire and a steel pipe	Polyurethane resistance value range
1	1	100Ω÷500Ω
2	2	500Ω÷1.2kΩ
3	3	1.2kΩ÷5kΩ
4	4	5kΩ÷20kΩ
5	5	20kΩ÷65kΩ
6	6	65kΩ÷200kΩ
7	7	200kΩ÷300kΩ
8	8	300kΩ÷450kΩ
9	---	450kΩ÷1MΩ
10	---	1MΩ÷3MΩ
11	---	3MΩ÷10MΩ
12	---	10MΩ÷20MΩ
13	---	20MΩ÷30MΩ
14	---	30MΩ÷50MΩ
0	---	>50MΩ

table 1

In a resistive system, the length of an alarm loop and a heating pipelines section is calculated from a measured resistance wire value. The technical conditions stipulate that the maximum length of a resistive alarm loop is 1000 m. For this length, the polyurethane insulation degree of humidity should satisfy the condition: MH≥12. The minimum polyurethane insulation resistance value for sections shorter than 1km are calculated based on the formula:

$$R = \frac{R_{min}}{L / L_{max}}$$

R [MΩ] – minimum value of polyurethane insulation resistance for a heating pipelines section shorter than 1km.

Rmin [MΩ] – minimum value of polyurethane insulation resistance for a heating pipelines with a length of Lmax = 1km;
Rmin = 10MΩ (MH=12)

L [km] - tested heating pipelines section length; L ≤ Lmax

Lmax[km] – maximum lengths of a heating pipelines section with a resistance alarm system; Lmax = 1km.

A leak (moisture) in operated heating pipelines is localized mainly when the moisture degree of polyurethane insulation satisfies the condition MH ≤ 10.

In an LH-20S instrument, measurement results and calculation values are presented on a backlit, alphanumeric LCD. The backlit meter indication field consists of two rows containing 16 character fields each. The first row displays:

- voltage between a resistance wire and a carrier pipe (steel);
- polyurethane insulation MH moisture degree value;
- polyurethane insulation resistance value [kΩ, MΩ];
  or
- direct shorting C value of an alarm wire and a steel pipe
- direct shorting resistance value [kΩ, MΩ];
- steel pipe magnetic connection contact resistance value.

The second row of the alphanumeric display shows:

- length value [m] of the tested heating pipelines section;
- alarm loop resistance value [Ω].

Apart from the information of numerical nature, text messages are also displayed. The first row of the display states reasons preventing the measurement of polyurethane insulation resistance:

- **Brak kontaktu (*No contact*) -** bad quality of the magnetic connector with a steel pipe;
- **Kontakt (*Contact*)? 0.1÷3kΩ -** too high contact resistance of the magnetic connector with a steel pipe;
- **Zwarcie (*Shorting*)** - metallic contact between a steel pipe and alarm loop.

The second row of the alphanumeric display shows causes preventing the alarm loop resistance measurement:

- **Przerwana pętla (*Interrupted loop*) -** electric gap in an alarm loop circuit.
- **HI -** alarm loop resistance (length) measurement range exceeded.

Please note that there is logical consistency between the type and the display location of measurement results and text messages.

In addition, LH-20S displays information on own power supplies running flat. Since the meter is supplied from two batteries placed one over the other, the message text is as follows:

- **Górna bateria (Upper battery)** - replace the upper battery;
- **Górna bateria (Bottom battery) -** replace the bottom battery.

Used batteries shall be stored in containers for used batteries.

Practical advice.

The “upper battery” in the LHS20S has very low power load. After the “Dolna bateria” (*Bottom battery*) message is displayed, swap the batteries and continue the measurement for some time more.

2. Types of measurement information and their execution methods.

3.1 Basic measurement execution.

The basic measurement provides the most information about the condition of a tested pre-insulated heating pipelines with a resistance alarm loop. In certain cases, usually emergency, this information suggests the execution of additional measurements, aimed at detailed determination of the cause and location of a damage. The method of connecting the LH-20S during a basic measurement is shown in fig. 1. Make sure that the alarm loop wires are shorted on one end of the tested heating pipelines. The shorting may be executed in a junction or measurement box, etc.

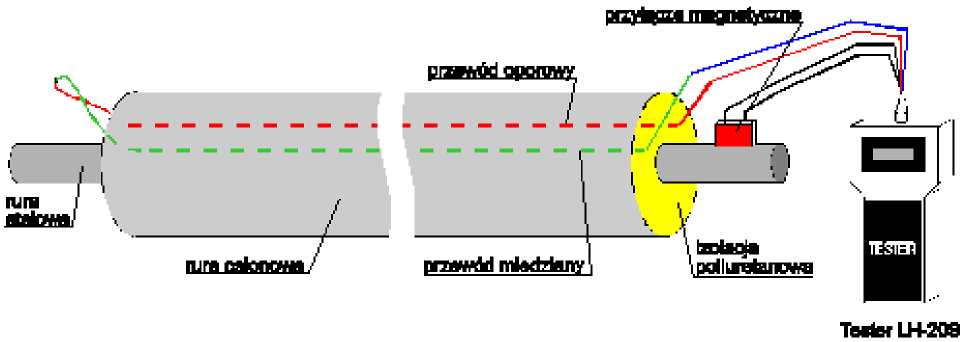

Fig. 1. Basic measurement.

After careful execution of the connection, in a manner shown in fig. 1., press and hold the START switch of an LH-20S meter. First, the display will show information regarding the device (type, serial no.), and then the values of the measurements and calculations. An indication example is shown below.

MH=0Ω	90MΩ
1000m	5736

The first row of the display provides: the calculated polyurethane insulation MH moisture degree value, measured polyurethane insulation resistance value. While the second row of the alphanumeric display shows: the calculated length of the tested heating pipelines section in [m], measured alarm loop resistance value [Ω].

Practical advice.

When conducting work associated with installing an alarm system, carry out the basic measurements as often as possible. The used instruments shall provide accurate information on the quality of the performed work. The correctness of these statements can be demonstrated by using the example shown in figure 2. It shows, in a schematic manner, three fragments of a heating pipelines, which are to be interconnected. The obtained values of MH moisture degree and polyurethane insulation resistance measurement results are given next to each of them. Let us now consider two cases.

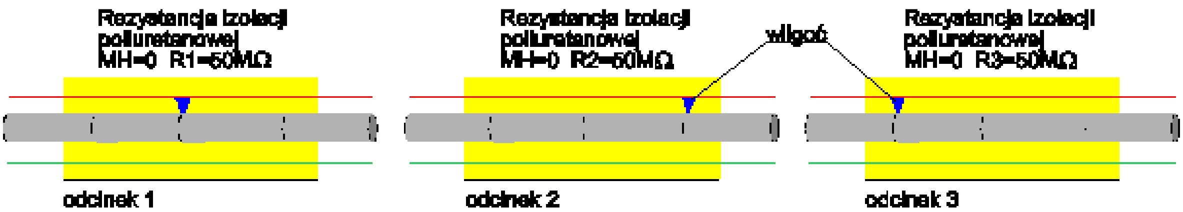

Fig. 2.

<u>*CASE 1.*</u> *A fitter performs the measurements with an instrument, which measures the MH parameter and the polyurethane insulation resistance.*

Preliminary moisture measurements, performed separately for each network section, indicate poor alarm system. MH=0 indications are not satisfactory, if the polyurethane insulation resistance values at each pipeline section are equal to 50MΩ. The connection effect may be forecast even before they are executed. The resultant polyurethane insulation resistance value of two connected sections shall be:

$$Rz = \frac{R1 \cdot R2}{R1 + R2} = \frac{50 \cdot 50}{50 + 50}[M\Omega] = 25M\Omega \rightarrow MH = 13$$

and after adding section 3:

$$Rc = \frac{Rz \cdot R3}{Rz + R3} = \frac{25 \cdot 50}{25 + 50}[M\Omega] \approx 16{,}8M\Omega \rightarrow MH = 12$$

The fitter shall not give in to the suggestions and will not be attempting to correct the previously executed connections between three network sections. If he/she performed the work on his/her own, he/she will regret not having conducted check measurements of polyurethane insulation resistance. In consequence, he allowed moisture to be closed in a cable joint (joints) of each of the executed network sections.

<u>*CASE 2.*</u> *A fitter performs the measurements with the use of an instrument allowing the measurements of* ***only*** *the MH moisture degree of polyurethane insulation.*

Measurement performed separately for sections 1 and 2 of the heating pipelines indicated very good alarm system condition (MH=0). However, after executing a connection between these two sections, the moisture degree value is MH=13. It is not yet a critical situation. Such will be caused by adding section 3. The indication will then decrease to MH=12.

Three, apparently very well executed sections(MH=0) of an alarm system, after being interconnected, barely meet the technical conditions regarding the moisture degree (MH≥12).

An inexperienced fitter will succumb to the suggestions and will look for mistakes in the recently executed connections between three pipeline sections.

3.2 Auxiliary measurement method if MH≤11 or in the case of a ZWARCIE (*SHORTING*) or C message.

Indication examples of an LH-20S:

MH=9 0.8MΩ	Shorting	C =7 0.2MΩ
1000m 5736	1000m 5736Ω	1000m 5736Ω

Each of the discussed emergency cases should be located and removed. The selection of the mode of action depends on the alarm loop copper wire insulation conditions. If, as per the assumptions, a copper wire is not in direct electrical contact (shorting) or through moisture with a carrier pipe, then the localization is performed using a typical method and typical instruments (e.g. LP-10S). A copper wire insulation conditions is checked by performing an auxiliary measurement with an LH-20S device. A measurement system concept is stated in figure 2. It should be noted that a resistive alarm loop is open on both ends of a tested heating pipelines, and a blue measuring lead of an LH-20S instrument does not participate in the measurement.

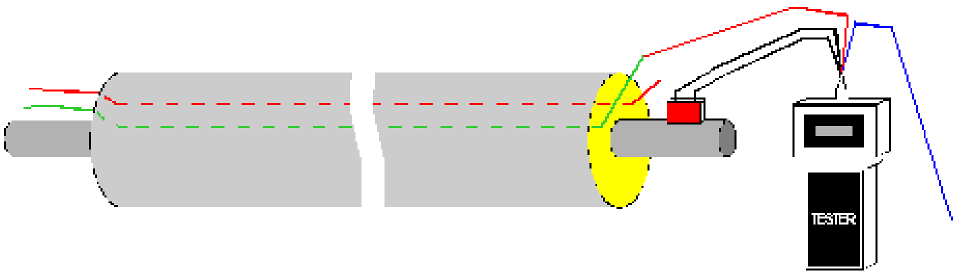

Fig. 3. Checking the condition of a copper wire insulation.

Only an LH-20S indication shown below is a confirmation of a good condition of copper wire teflon insulation.

MH=0Ω >99MΩ
Interrupted loop

A **Przerwana pętla** (*Interrupted loop*) message arises from the selected measurement method (no blue lead) and does not have any significance in this case. After obtaining measurement results other than the ones stated, make sure that a leak localization measurement is not burdened with a very large error. It may even turn out that determining a moisture location is impossible. Such is the case when the MH parameter reaches low values or instead of the measurement results regarding the resistance of insulation between a copper wire and a steel pipe, a Zwarcie (*Shorting*) message appears.

Practical advice.

*One, very important conclusions, stems from these discussions: **prior to locating a leak (moisture) or a shorting in a pre-insulated heating pipelines, we must always first check the current condition of alarm loop copper wire insulation.***
A typical symptom of the impact of copper wire insulation damage occurring during an attempt to locate a leak or shorting are results indicating that a failure occurs on a heating pipelines end exactly opposite relative to the measurement position. After moving to the indicated location and reattempting the localization, it turns out that the determined failure location is at the end of the heating pipelines, where we performed the first measurement.
And so on.
Accidental shorting between a copper wire and a steel pipe or insulation damage at a moisture location, virtually excludes it from the measurements. The shorting location may be determined only with a reflectometer. Similar to the case of a location with very high moisture between a copper wire and a carrier pipe.
When measuring a heating pipelines, we need to remember that it is formed by two twin pipelines: supply and return. Therefore, when locating moisture occurring simultaneously between a resistance and copper wires and a steel pipe, it is possible to replace a damaged copper wire with a good wire "borrowed" from a twin alarm loop. If this helps us find the failure location relative to the resistance wire, it will be highly likely that it is also a damage location (does not rather concern a shorting location) of the copper wire insulation.
A damaged copper wire may be, when locating moisture, replaced by a resistance wire "borrowed" from a twin loop of the other pipeline. Of course, provided there is no electric contact with a steel pipe (MH=0; >99MΩ). However, in the described case, the manner of calculating a leak (moisture) location will change. The tested heating pipelines fragment, with such formed alarm loop is twice as long as stated on the assembly diagram. (Heating pipelines and alarm loop lengths are measured along the resistance wire.)
In a similar manner, but for a completely different purpose, the aforementioned auxiliary measurement for an alarm loop resistance wire is conducted. A measurement system concept is stated in figure 4.

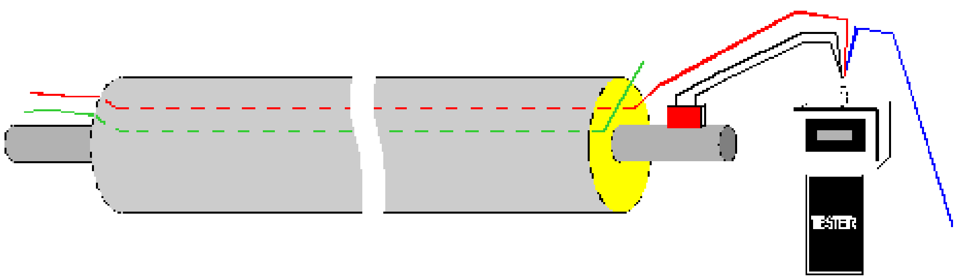

Fig. 4. Checking the degree of moisture between a resistance wire and a steel pipe. Shorting detection

The primary reason for taking this measurement shall be further explained in the Practical advice chapter. At this point, it should be added that it is sometime performed somewhat spontaneously, after detecting moisture between a copper wire and a steel pipe within a tested heating pipelines. The confirmation of the detected state for both wire types is sought after at that

point. Usually, also after detecting moisture, the obtained results are compared. Conclusions may be drawn from that very rarely. However, we cannot waste such an opportunity.
Cases, in which after detecting moisture in a branched heating pipelines one can immediately proceed with locating a moisture position are rare. Even when an auxiliary measurement showed a good condition of copper wire insulation. It may happen that there are a few leak (moisture) locations, and acting without proper discernment, we will not be able to find any of those for a long time. First, one should divide a moist alarm loop into sections, opening the connections in junction boxes (BS-AD; PPA) or at any other possible location. Next, using the auxiliary measurement (fig. 4) described above, the moisture level for each section is measured. Next, when moisture is present at two or more sections, alarm loops are formed by connecting (e.g. in a junction box) the end of the "moist" wire (MH≤11) of one pipe with the end of a twin section of a "dry" wire (MH=0; >99MΩ) of the second pipe. Only for alarm loops constructed in such a way, are the leaks (moisture) localized. Note that an alarm loop formed of two resistance wires in different pipes, has a length twice as big as the value stated on the assembly diagram for a tested heating pipelines fragment. In addition, if a network is branched, an extension of a resistance wire in a branch may be a copper wire. Therefore, when forming substitute loops, the alarm system diagram shall be used.
It sometimes happens that both parallel (from two pipes) wire sections, which we want to use to form a substitute loop, indicate moisture. Then, for the purposes of localization, we use an additional copper wire lead outside of the tested sections of a heating pipelines.

3.3 Method for conducting an auxiliary measurement after displayed Przerwana Pętla (*Interrupted Loop*) or HI message, or changing values of alarm loop length and resistance measurement results.

Auxiliary measurements are performed when the measurement information referred to in the title occur during the basic measurement. The first reaction to a **Przerwana Pętla** (*Interrupted Loop*) message should be checking all measuring leads of an LH-20S instrument and all available alarm loop connections (junction boxes, connectors of joints welded to steel pipes). A confirmation of a good condition of measuring leads (red and blue) is obtaining the indications of 0m and 0÷4Ω in the second row of the display after shorting them.
Examples of possible indications of an LH-20S meter signalling a gap in a resistive alarm loop are shown below.

1) MH=0 >99MΩ
Interrupted loop

2) MH=10 2.2MΩ
Interrupted loop

3) MH=0 >99MΩ
HI

4) MH=6 0.2M Ω
HI

5) MH=4 12k Ω | *changing over a wide range*
653m 3745 Ω | *measurement result values*

For typical alarm loop damage, induced by typical causes, these indications are interpreted as follows

Indication 1.

Moisture (MH=0; >99MΩ) between an alarm loop and a steel pipe does not appear at the gap location. Impossible to determine the number of defects. At least one of the two types of wires forming an alarm loop was damaged.

Indication 2.

Moisture is present (MH=10) at the alarm loop gap location. Impossible to determine the number of defects. At least one of the two types of wires forming an alarm loop was damaged. The damage is of external nature: local casing pipe damage, external moisture source (groundwater).

Indication 3.

Alarm loop broken at one location. Caused by incorrect crimping of a bushing connecting alarm loop wire section terminals in a cable joint. It is impossible to specify, on which of the two types of the wires forming an alarm loop a mistake was made.

Indication 4.

It is impossible to specify the number of ruptures in an alarm loop, although most probably only one exists. The ends of the broken signalling loop wire are in electrical contact due to moisture. The resistance of this connection is added to the resistance of the wires and is large enough, for the alarm loop resistance (length) measurement range to be exceeded. Simultaneous indication of moisture (MH=6) and displaying of the **HI** message indicates external damage causes: local damage of the casing pipe, external moisture source (groundwater).

Indication 5.

A gap occurs at one location in the alarm system. The ends of the broken alarm loop wire are in electrical contact due to high moisture. Since the resistance of this connection does not have a fixed value, the alarm loop length and resistance measurement results change quite rapidly and over a broad range. It is impossible to specify, which of the two alarm loop wire was damaged. The damage is of external nature: local casing pipe damage, external moisture source (groundwater).

Gap/s in an alarm loop may be localized after proper discernment and preparation of measurement conditions. The testing should be commenced with checking the condition of a copper wire, since it is most vulnerable to this type of damage. Fig. 5 shows the concept of a proper measuring system.

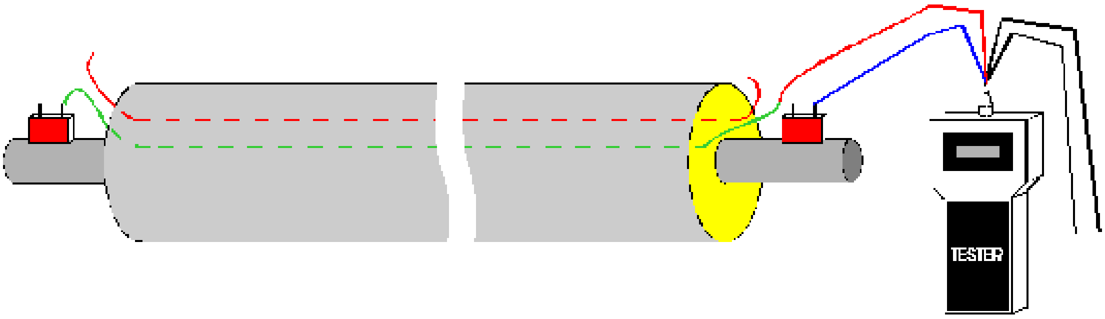

Fig. 5. Checking the copper wire condition in terms of mechanical damage.

As can be seen, with the help of a magnetic connector, one end of a copper wire is shorted with a steel pipe. The red and blue leads of an LH-20S meter are connected to the other end and the pipe. One can also use a magnetic connector to achieve a connection with the pipe. Next, the measurement is performed. If the second row displays a **Przerwana Pętla** (*Interrupted Loop*) or **HI** message or measurement result values changing over a broad range, it means that an alarm loop copper wire is damaged. The gap is localized with the use of a reflectometer. Whereas measurement results within a range of 0÷11m and, respectively, 0÷60Ω are a confirmation of a good condition of the copper wire. Results depend on the length of the tested wire (0.036 Ω/m) and the resistance of contacts between magnetic connectors and a steel pipe.

Practical advice.

Measuring systems designed for auxiliary measurements should be executed very carefully. The idea is for the connections present in them to not impact the test results. Figure 6 shows the method for checking the quality of a magnetic connector/steel pipe contact.

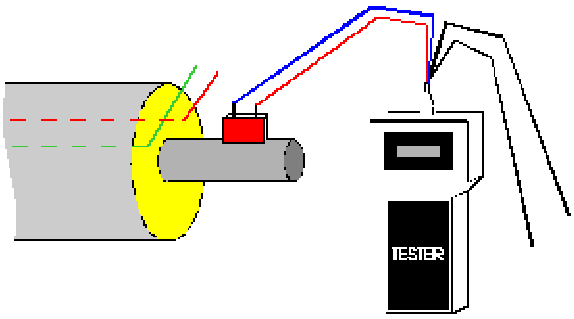

Fig. 6. Checking the quality of an electric contact between a magnetic connector and a carrier pipe.

A confirmation of a good contact is displaying the following measurement results: 0m, 0÷3 Ω. A resistance wire is checked regardless of the copper wire test result. Case of damaging (rupture) of both wire are not that rare. A relevant measurement system concept is stated in figure 7.

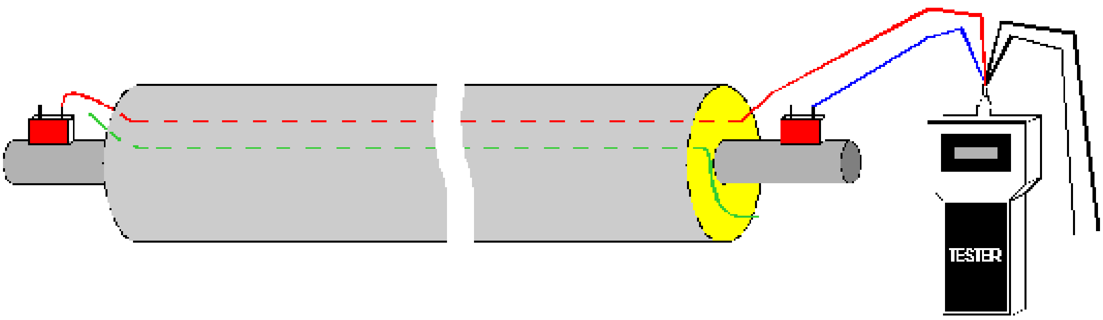

Fig. 7. Checking the resistance wire condition in terms of mechanical damage.

In the first search phase, a resistance wire is shorted with a steel pipe at one end of an alarm loop. It can be done, for example, in a junction box or as shown in figure 7. Next, the blue and red leads of the LH-20S meter are connected with the second end of the wire and the magnetic connector shorted with a steel pipe. The measurement result values confirming a good condition *of the resistance wire depend on its length (5.7Ω/m) and the resistance of contacts between magnetic connectors and the steel pipe. If the connections are executed carefully, just the length and resistance values of the tested wire are displayed. Whereas the appearance of the* ***Przerwana Pętla*** *(Interrupted Loop) or* ***HI*** *or measurement results values changing over a broad range mean that an alarm loop resistance wire is damaged. The type of the displayed message or the measurement result presentation manner define the type of the damage. (See examples of indications with comments). If a gap is detected, further actions depend on the structure of the tested heating pipelines. If it does not have any branches - a reflectometer is used to locate failures. In the case of branches, the damaged wire section shall be separated. For this purpose, the alarm loop connections in all junction boxes are opened. Next, the condition of each section is checked, almost directly following the description above and figure 7. The difference is that in the case of branches, an extension of a resistance wire cannot be a copper wire. In such a case, the end of this wire contacts the pipe.*

The gaps (ruptures) in selected sections of the alarm loop wire are usually located with a reflectometer. The capacitive method may be used to determine the wire rupture location only when the damage location does not exhibit moisture (indication 1).

Note. *In each of the auxiliary measurements described in this section of the manual, the information appearing in the first row of an LH-20S display do not have any significance. This may be an indication like MH=0 ; >99MΩ, if the black measuring leads are shorted together or a* ***Brak kontaktu*** *(No contact) message, if there is no contact between them.*

Shorting one on the alarm loop wires to with a steel pipe, results in the creation of a sort of a substitute loop. In such a case, the pipe acts as a reference wire, which we are sure does not have a gap, and its resistance is almost equal to 0Ω. The trouble spot in the creation of such substitute loops is obtaining almost zero values of magnetic connection contact resistance (fig. 5; 7). Sometimes, when executing connections, the distance between the end of the tested wire and the access point to the steel pipe, we want to set the connection at, creates a problem. The task can be made easier by creating substitute loops consisting of wires from two parallel sections of a heating pipelines. Of course, first we need to check for any gaps in the loop we "borrow" from. Connections between alarm loop sections are usually executed in junction boxes. For non-damaged sections, length indications have a value two times higher than the one stated on the diagram of a tested heating pipelines fragment.

3.4 The method of determining the causes for the Kontakt (*Contact*)? or Brak kontaktu (*No contact*) messages.

The **Kontakt** (*Contact*)**?** message appears in the first row of the display, simultaneously with the magnetic connector/steel pipe contact resistance value. Contact resistance measurement range is 100Ω ÷ 3000Ω (3kΩ). The message disappears, when the contact resistance value is lower than 100Ω. Whereas, if the resistance of the described connection is higher than 3kΩ, the **Brak kontaktu** (*No contact*) message appears on the display. After each of these messages appears, rub the magnetic connector against the steel pipe, until they disappear. If the actions do not provide the expected result, check the condition of two "black" measuring leads of the LH-20S. For this purpose, they are shorted together and the device is turned on. A confirmation of damage to the leads is a displayed **Brak kontaktu** (*No contact*) message. Of course, they should be repaired or replaced.

A common cause of damage to black measuring leads is the manner of disconnecting a magnetic connector from a steel pipe. It involves pulling the black wire connecting it with the instrument.

4. Operating remarks.

A frequent cause of erroneous measurement results is a bad condition of electrotechnical grippers or measuring leads of a device. They should be checked from time to time. To do this:

- set the grippers on measuring leads, and then connect to the meter;
- couple the blue and red grippers together;
- turn on the LH-20S.

In the case of two good electrical connections, the following measurement results will appear in the second row of the display: 0m; 0Ω (not more than 3Ω). Other results will prove the presence of damage. In such a case, we have to check the condition of measuring leads:

- remove the grippers of measuring leads;
- short the red and blue measuring leads together;
- turn on the LH-20S.

Good condition of the measuring leads is confirmed by obtaining the following measurement results: 0m; 0Ω (not more than 3Ω). Other results prove the damage to one of the leads.
The described sequence of actions enables checking the quality of executed electrical connections between the device and the measured system and potentially determine, which of the connection elements (gripper, wire) is damaged.
Experience tells us that users most frequently check the measuring leads only. Cases of damage to the electrotechnical grippers are quite frequent. Whereas damage to a measuring socket of an LH-20S device
Check the “black” measuring leads is described above.

5. Decommissioning of an LH-20S device.

Pursuant to the provisions of the Act of 29 July 2005 on used electrical and electronic equipment (Journal of Laws, item 1495), the device bears a following symbol:

The symbol means that it is forbidden to place used equipment with any waste. A user of equipment marked in this manner is obliged to hand the equipment over to relevant companies dealing with collecting used equipment. The obligations arise from art. 35 and 36 of the aforementioned act.

6. TECHNICAL DATA:

1. Manner of presenting measurement informationalphanumeric LCD, 2x16 characters, backlit periodically
2. Measurement ranges:
measurement of voltage between a resistance wire and a carrier pipe .... 0 - 14V
polyurethane insulation MH moisture degree measurement..............................1 ÷ 14 and 0
polyurethane insulation resistance measurement ....0.1kΩ ÷ 99MΩ
metallic shorting of an alarm wire
with a carrier pipe ....0 ÷ 100Ω
measurement of the degree of direct shorting (C) of an alarm
wire and a carrier (steel) pipe ....1 ÷ 8MH
direct shorting resistance measurement...0.1kΩ÷0.45MΩ
alarm loop length measurement .... 1 ÷ 2000m
alarm loop resistance measurement .... 1 ÷ 12042Ω
magnetic connector/steel pipe contact resistance measurement .... 100Ω ÷ 3kΩ

3. Measurement errors:
accuracy of resistance measurement in terms of the MH degree....................±5%±2 digits
alarm loop resistance measurement accuracy .... ±0.2%
voltage measurement accuracy ....±1% of the measured value

4. Characteristics and meaning of text messages:
very bad quality of the magnetic connector with a steel pipe ...Brak kontaktu (*No contact*)
bad quality of the magnetic connector
with a carrier (steel) pipe; contact resistance value.............. Kontakt (*Contact*)? *XY* kΩ
electrical gap in an alarm loop .... Przerwana pętla (*Interrupted loop*)
direct shorting of an alarm wire and a carrier pipe C
metallic shorting of a sensor wire and a carrier pipe .... Zwarcie (*Shorting*)
alarm loop length measurement range exceeded ....---HI---
power supply batteries discharged... Górna bateria (*Top battery*)
Dolna bateria (*Bottom battery*)

5. Power supply .... 2 x 6F22 (2 x 9V)

6. Operating and storage temperature range... 5 ÷ 50°C

7. Relative humidity.. max. 80%

7. Casing tightness class IP65

8. Dimensions.. 223x105x40

9. Weight with batteries... 450g