®TRACEADO eléctrico AKO-TRACE
Installation, testing and maintenance of Electrical Heat Tracing with constant wattage parallel heating cables

0- Introduction
An electrical heat tracing system is designed to meet the process requirements and the plant conditions. It consists of the design documentation, instructions and some components that must be installed on site, where pipe, heating cables, heat insulation and power supply installers normally work. For the correct and fully warranted functioning of a ®TRACEADO eléctrico AKO-TRACE system, the documentation and instructions must be respected. The Site Manager should co-ordinate the different phases and tests, in order to ensure that the parameters planned in the design are achieved. Maintenance with the appropriate tests is essential for the safety and continuity of the system features. The electrical standards, regulations, local codes and practices should also be observed.

Use of these instructions
These instructions are only conceived to install, test and maintain, electrical heat tracing ®TRACEADO eléctrico AKO-TRACE systems, with constant wattage parallel heating cables on pipes, tanks and surfaces that are usually thermal insulated. Please ask for any information about other applications.

5- Lagging and its marking
6- Start-up testing and documentation
7- Use
8- Modifications, repairs and maintenance
9- Instructions for hazardous areas classified as potentially explosives
10- Troubleshooting and repair guide

FIGURE 1
1- Material reception and testing before installation

1.1 Reception

Make sure that you have the latest version of the instructions and the project documentation and that you have received the materials you had ordered. Check the cables, the components, the thermostats and the accessories in order to make sure that their voltages, power and features are appropriate.

Check the aspect of the material you have received to detect any possible damage caused by transport. It is advisable to check the cable resistance or power and the insulation resistance of every cable reel. The minimum resistance should be 20 MΩ and it should be measured with an insulation resistance tester “Wegger” at 1000 Vcc. Do not connect the heating cable while it is wound around the reel.

1.2 Storage

Keep the materials in a clean and dry place until you need to install them on site, in order to minimise any possible mechanic damage. Storage temperature ranges from -15ºC up to +60ºC are accepted.

1.3 Tests before installation

Before starting the installation and in order to check that the design matches the construction conditions, it is essential to check and test each one of the following items.

1.3.1 Piping and fittings to be head traced

Make sure that the pipes and/or fittings installation is completed, the provisional supports has been removed after installing the definitive ones, the covering or painting is completely dry, and the pressure tests has been satisfactorily passed. Carrying out this type of works after installing the cable can damage it. Follow and check the planned heating cable routing, find the points where the power supply, the thermostats, the junction boxes and the components will be placed. Check that the pipes and/or fittings material, the diameters, the lengths and the general work, match with the drawings and the design documentation. Make sure that they do not have any burrs, rough surfaces or sharp edges that could damage the cable. In that case, debur or cover them with AKO-717441 fibreglass adhesive tape or with AKO 717440 aluminium adhesive tape. Special design should be used for plastic pipe and surfaces. If there are differences between the design and the work site, ask the Project Manager.

1.3.2 Thermal insulation

Check if any pipe section is suspended. In that case, warn the lagging installer to seal the penetration in the bar hanger with a sealing compound (see figure 9). In any case, remember that the maintenance of the temperature requires the thermal insulation dry and correctly installed.

1.3.3 Process and design

Make sure that usual process temperature in pipes and/or fittings, or unusual temperatures (e.g. when steam cleanings are carried out) not exceed the indicated in the design specifications nor the maximum temperatures that the cables and the components withstand. This would cause to deteriorate the cable features and its life would be shortened.

Check whether the design specifies to apply or not, a covering with AKO-717440 aluminium adhesive tape before and/or after installing the heating cable in order to improve its conductivity and to obtain a good heat distribution.

Check design and process and make sure that the situation planned for the thermostat sensors in each control area (set of heating cables circuits controlled by a thermostat) does not receive any influence, which is not planned in the design.

2- Heating cable installation, components and accessories

2.1 Heating cable description

AKO parallel heating cables, have a per-meter constant wattage regardless of their length. These cables can be therefore supplied in reels, so that they can be cut-to-length and finished on site.

Its feature is that the heating conductor element it’s coiled to form a spiral round the two insulated conductors that it contact with, alternatively, at given regular interval points. Internally, the cable forms a system of many resistances in parallel. The two conductors supply power to these resistances. When cutting the cable between two contact points, will have two non-heating cold leads. Each one of these leads is placed at the ends of heating cable length, between the cut point and the first contact point at each end. The longest cold lead will be the end connection. The shortest cold lead will be the end seal. The minimum lengths of each cold lead are established in the data sheet of corresponding kits. The data sheet instructions must be followed to insure that the cable it is correctly installed.

When voltage is applied to the conductors, the heating conductor element receives the same voltage between the contact points A-B, B-C, C-D, etc. This ensures that the wattage power output per linear metre of cable it’s constant and independent of its length (See fig. 2).
2.2 General installations details

The heating cable should be fixed in contact with the pipe or the surface to be heated. The connection cold lead should be the only part that passes through the lagging. Its function is supply power from the junction box to the heating zones of the cable. The connection cold lead should pass through the bottom part of the lagging to avoid the penetration of water or moisture in the lagging. It should be avoided that the lead is tense. Make sure that it allows any movement caused by vibrations or expansions.

On unwinding and installing the cable, we recommend:
AVOID any sharp edge, excessive mechanical efforts and do not twist, squash it, step on the cable, or put any load on it.
WE ADVISE to put the reel on a support in order to reduce the strength of unwinding the cable. Unwind the cable and extend it near the pipe avoiding any interference with supports or fittings. Do it in lengths and fix the cable on the pipe.

Add 1 m of cable length to each power end, splice, branch pipe or termination. Plan the supplementary lengths to compensate for any higher heat losses in the supports, valves and flanges or for spiralling as required by the system design documentation.

The cut cable ends on which the connection kit and end-seal have not been immediately installed should be protected from moisture, corrosion or any possible mechanical damage until the installation is completed (i.e., liquid silicone).

2.3 Cable installation on pipes

Make sure that the catalogue num. and features of the cable to be applied on each pipe length or equipment, match with the ones established by the design documentation.

Enough length of cold lead should be left in the power supply point for the connection to the box. Make sure that the heating length of the cable comes into contact with the pipe or surface to be heated. Fix the cable with AKO-717441 fibre glass adhesive tape AKO-717440 aluminium adhesive tape if a better heat transferance were needed and if it were so specified. Do not use metallic fixing elements that could damage the cable or vinyl tapes or other kinds that could cause corrosion on the cables or the pipes.

Cable installation should be planned in order to facilitate any subsequent intervention, assembly and disassembly on the pipe and equipment (repair, valves exchange, etc.). Once the installation is completed and tested, the lagging and protection of pipe and/or equipment should be started following the design specifications as well as the item 5 of these instructions.
Cables should be uniformly distributed on the surface to be heated. Cables should not intersect or make contact. The distance between cables should be of at least 10 mm. The bend radius shall be of at least 20 mm. If these instructions are not observed, points and areas with higher temperatures will exist.

The heating cable should be applied straight along the pipe (one or more cables) or in spiral on the pipe only if it is specified in the TRACEADO eléctrico AKO-TRACE system documentation or as a result of the calculations.

2.3.1 Straight tracing

Cables should be installed according to figure 4 and avoiding the lower generatrix on the horizontal pipe. On vertical pipes, cables should be distributed equidistantly.

Install the heating cable in its position and fix it with AKO-717441 fibreglass adhesive tape rings every 300 mm or less if necessary. See figure 5.

2.3.2 Spiral tracing

The cable should be spiralled only on the pipes specified in the project documentation. According to the pipe diameter and the ratio indicated in the design, the approximate pitch between turns shall be that specified in the following table.

<table>
<thead>
<tr>
<th>DN (mm)</th>
<th>DN (inches)</th>
<th>Spiral Ratio (meters of cable per meter of pipe)</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>1</td>
<td>250   170  140  110  100</td>
</tr>
<tr>
<td>32</td>
<td>1 ¼</td>
<td>310   210  170  140  130</td>
</tr>
<tr>
<td>40</td>
<td>1 ½</td>
<td>350   240  190  160  140</td>
</tr>
<tr>
<td>50</td>
<td>2</td>
<td>430   300  240  200  180</td>
</tr>
<tr>
<td>65</td>
<td>2 ½</td>
<td>520   360  290  240  210</td>
</tr>
<tr>
<td>80</td>
<td>3</td>
<td>630   430  350  290  260</td>
</tr>
<tr>
<td>90</td>
<td>3 ½</td>
<td>720   490  390  330  290</td>
</tr>
<tr>
<td>100</td>
<td>4</td>
<td>800   560  440  370  330</td>
</tr>
<tr>
<td>125</td>
<td>5</td>
<td>990   680  550  460  400</td>
</tr>
<tr>
<td>150</td>
<td>6</td>
<td>1180  810  650  550  480</td>
</tr>
<tr>
<td>200</td>
<td>8</td>
<td>1520  1050  840  710  620</td>
</tr>
</tbody>
</table>

Example: For a DN 50 (2") pipe requiring a ratio of 1.2 metres of cable per metre of pipe, the pitch shall be 300 mm.

Mark on the pipe the pitch between turns or use a tape measure and fix the cable while installing it. If you use rings of AKO-717441 fibreglass adhesive tape, the maximum distance between rings is 2 m.

Two different spiral-tracing methods are shown in figures 7 and 8.
Step 1. Make the first loop as shown
Step 2. Fix the loop and wind around the pipe
Step 3. Space uniformly and fix on the pipe

Heating cable length = Pipe length x Spiral ratio

2.3.3 Heating cable cut at the end lead

The constant wattage parallel heating cable can be cut at any length and this does not affect the per-meter wattage output. Nevertheless, the maximum cable circuit length must not exceed the length indicated in its data sheet. This would cause an excessive voltage drop at the end length.

At the end of the pipe to be heated, fix the heating cable on the pipe and make sure that supplementary lengths indicated in item 2.2 have been observed.

Cut the cable of the reel at least at 160 mm from the last contact point of the installed cable. Leave at least 500 mm of free cable so that the kit end seal can be applied. Apply the end-seal kit and fix again the 500 mm of cable on the pipe. Leave a mark allowing the kit to be located so that when the lagging is applied the corresponding marking may be placed on its outer cladding.

2.4 Installation details on supports, valves, etc.

There are usually protuberances along the pipe due to elements and fittings of the pipe work such as supports, flanges, valves, etc. At these points, the heat losses are higher due to their larger surface area or to the supports conduction. Therefore more heating cable should be applied on them to compensate this losses increase.

Check if the design documentation specifies the cable lengths to be installed on supports, valves or other fittings. If not, follow the specifications of these instructions. The general criterion is to apply the cable proportionally to the surface of the fitting, taking as a reference the metres of cable applied on the pipe per surface unit.

Remember that, especially on the fittings, cable installation should be planned in order to facilitate any intervention, disassembly and subsequent assembly on the pipe (repair, valves exchange, etc.).

The most usual examples in a pipe work system are the following:

2.4.1 Pipe bar hanger (Fig.9)

The supports used to suspend the pipe usually do not need supplementary heating cable. If you find them on site, ignore the cable provision if it is specified in the design documentation.

2.4.2 Pipe supports shoe (Fig.10)

In straight cable tracing, the planned support length should be applied Z-shaped and be three times longer than the base shoe. In spiral tracing, it should be installed reducing the pitch between turns at both sides of the support. Different solutions can be adopted according to the type of support.

2.4.3 Elbows and bends (Fig.11)

In straight cable tracing, apply it on the outer generatrix of the elbow or bend. In spiral tracing, watch that the turns do not make contact itself in the interior side of the bend.
2.4.4 T-branches in the pipe (Fig.12)

In pipe T-branches, attention should be paid on whether the diameter is equal to or below the main pipe diameter. Generally, a branch junction box is installed and then the ratio specified according to the diameter is applied.

In very short branch pipes, a double tracing can be applied, only if there is a good heat transfer and there is no thermal imbalance. It would be a problem to apply this tracing on stainless steel or plastic pipe unless the application ratio on this pipe was 2.

2.4.5 Flanges (Fig.13)

The heating cable supplementary length when normal flanges are used should be 4 times the pipe diameter. The cable is applied either turning or reducing its pitch before and after the flange. The flange should not be passed through its bottom in order to avoid the cable damage due to a liquid leak.

Make sure that the cable makes a good contact with the flange and the pipe. Avoid any burrs and sharp edges, especially at the screws, which could damage it. Use preferably aluminium adhesive tape.

2.4.6 Valves (Fig.14)

The cable additional length planned in the design should be applied on every valve. This will be done according to the type, the size and the shape of the valve (see figure 14 for some examples). The cable should be applied on the valve’s body, as uniformly as possible, without crossing it and observing the minimum distances. If, due to the type of valve, the planned length cannot be applied, spiral the excess cable in the opposite direction before and after the valve to facilitate its maintenance.

If there is an important part of the valve that has not been insulated (control box, wheel, etc.), apply cable near this part to compensate its losses.

Some valves or complex fittings in line with the pipe can have very irregular shapes and surfaces that may require the fixing and covering of the cable with aluminium tape in order to improve the heat transfer and to have a uniform temperature.

2.5 Components and accessories installation (Fig.15)

Appropriate components and accessories should be used to observe the electric standards and the current codes and practices.

Appropriate components to be used are specified in the data sheet corresponding to every type of cable. These include instructions to be followed to connect and install the cable correctly.

Our constant wattage heating cables are parallel circuit types. Therefore the two conductors should not be interconnected. This would cause a short-circuit.

2.5.1 Components needed

Every heating cable length needs:
- One end-seal and connection kit

In some cases, either in line splicing kits or splicing through a box and 2 end-seal and connection kits will be needed. A box and 3 end-seal and connection kits should be used to install T-branches.

2.5.2 Components installation method

Instructions for every kit as well as indications in items 2.2 and 2.3.3 should be observed. The leads should be applied as follows:

At the connection cold lead, cable should be fixed to the pipe with adhesive tape at 50 mm from the last contact point of the installed cable to ensure that the heating length makes contact with the surface to be heated.

The connection lead should be cut at the appropriate length to connect the cable to the junction box. The protection kit should be installed in order to protect heating cable passing through the lagging and cladding. Then the connection end kit should be installed.
Once end-seal kit has been installed at the cable end lead, it should be fixed with adhesive tape to the pipe in order for it to be subsequently covered by the lagging.

2.5.3 Junction boxes and other accessories

In a TRACEADO eléctrico AKO-TRACE system, junction boxes, supports to fix boxes to pipe, heating cables protection kits to passing through the lagging and cladding, adhesive tapes, and signalling and warning labels are usually used.

The box protection type or degree must be suitable for the environment where they are to be installed. On horizontal pipes and whenever possible, place the connection boxes below the pipe so that they are easily accessible and protected from possible hit, and where access is not normally necessary. Try not to place cable entries on top of the box and make sure that the glands are appropriate and have been correctly fixed. Unused entries shall be blanked off with suitable plugs. Close the junction boxes with their lids whenever access to them is not necessary.

Fixing supports to pipes can be used for junction boxes as well as for temperature controllers. Whenever it is possible, they should be installed so that the lagging can be passed through its lower part in order to avoid the penetration of moisture. If it is not possible, remember to seal this point of the lagging.

Protection kits to pass through the lagging, mentioned in item 2.5.2, are used to protect the cable during the installation of the lagging. They should be placed under the pipe to avoid the penetration of water, moisture or corrosion in the lagging.

The silicon protectors are used to protect the heating cables at sharp edges such as endplates of insulation cladding in flanges, valves, pumps, etc.

Clamps for fixing on pipes are included in the supports for fixing to pipes and in the protection kits to pass through the lagging. Clamps should not nip the heating cable because they would damage it.

Fixing adhesive tapes should be appropriate to withstand any temperature and not to cause corrosion in cables or in pipe and/or surfaces.

Warning labels are supplied. Attach them on the cladding to indicate that there is an electric tracing system under the lagging.

It is advisable that the installer marks with indelible identifying labels the heating cable length, junction boxes and thermostats. They should be labelled according to the nomenclature or code used in the design documentation. In heating cable lengths, labels should be placed in the connection lead next to the junction box. They should be applied according to instructions in item 5.

2.5.4 Typical system

See a detail of the typical installation with the most usual components and accessories in figure 15.
3- Power supply, protections and temperature control

Electric installation for the power supply of heating circuits should respect all standards, regulations and current codes of practice related to the environment and the facility features. Every heating circuit should be supplied by a power line with its corresponding protections, that should be identified according to the nomenclature or code used in the design documentation. If the heating cable has a protection metal braid, this braid shall be connected to the protective conductor (PE) of the plant installation.

3.1 Overcurrent protection

Electric protection should be in accordance with the project documentation and appropriate for the planned current in every circuit. It can be done either with circuit breaker switches or with fuses.

3.2 Residual current protection

In installations with heating cable without metal braid protection, a residual current device with a sensitivity of 30 mA should be used.

In installations with heating cable with metal braid protection, a residual current device with a sensitivity of 30 mA should be used in the following cases:
- In hazardous areas with a potentially explosive atmosphere
- In places with a risk of mechanical damages
- In environments with moisture or with a risk or corrosion
- Whenever frequent repairs or modifications are predicted

Other sensitivities may also be used, all standards, regulations and current codes of practice should be observed.

3.3 Protective earth

To obtain an efficient earth connection (with PE protection conductor element), use cable with a metal braid covering in installations with:
- Plastic pipes
- Stainless steel pipes
- Painted pipes with bad electric conductivity

3.4 Temperature control

Temperature control allows us to save energy and makes the system work within its process and security limits.

3.4.0 General considerations

During the design process and according to temperatures given to carry out the project, normal working temperatures and maximum temperatures that the system could reach should have been planned so that they are within the security levels. Temperature limits that should have been taken into consideration are due to fluids, heating cables and their components, plastic pipe, thermal insulation, classified hazardous areas, etc. It should be also planned how to control and ensure this temperature.

The two usual methods to do so are:

3.4.1 Ambient temperature detection

During the design process, this method is usually specified for frost protection systems and/or to maintain temperature levels near to ambient or non-critical temperatures.

The maximum point temperature, with the system being stabilised at the sensor detection maximum ambient temperature, should not exceed the maximum temperature allowed in any point of the system.

The temperature sensor should be installed in a place where minimum ambient temperatures can be predicted. It cannot be directly exposed either to the sunlight or to the influence of any thermal process or other plant temperatures.

3.4.2 Surface temperature detection

It is very usual that, due to process conditions, controlling pipe surface temperature is specified. In this case, the design documentation should define the control zones (group of heating cables circuits controlled by a thermostat) and the position of sensors on pipe.

The temperature sensor should be fixed parallel to the pipe and with a good thermal contact with it using binding clamps. Watch not to nip the heating cable. The maximum distance between the sensor and the heating cable, should be 80 mm for steel pipe, 30 mm for stainless steel pipe, and in contact with the heating cable for plastic pipe. Different conditions specified in the design documentation should have priority over these general instructions.

If the thermostat’s function is to protect from maximum exposure temperature disconnecting the cable (e.g. steam cleaning), the sensor should be fixed in the place where the highest temperatures are foreseen, taking into consideration that regulation should not exceed maximum working temperatures established for each cable.

When the sensor is installed on the pipe, it should be taken into consideration that it cannot receive any influence from heat bridges, such as supports, valves, pumps, etc., or from areas with temperatures different from the temperature to be maintained. The distance between these areas should not be less than 1 m. If there exists more than one control zone, place the sensor on the correct pipe.

When the capillary or the cable of the thermostat sensor is installed, to pass through the lagging, precautions should be taken to avoid any damage. See picture 16.
4- Testing after cable installation and before lagging

Once the heating cable and its components and accessories have been installed, in order to avoid any subsequent disassembling of the lagging, and before its installation, the following tests and checks should be carried out:

4.1 Checking list

- Supply voltage should match cables and thermostats voltage.
- It is advisable to identify heating cables, boxes and thermostats according to the nomenclature or code used in the design documentation.
- Heating cables and thermostat sensors should be correctly placed on the pipes and/or work pieces according to the design documentation.
- Heating cables, components, accessories and thermostats should be installed following the installation instructions.
- Thermostat sensors should be fixed making a good contact with pipe and/or work pieces.
- The lids of junction boxes should be correctly placed and cable entries that are not being used should be closed.
- The connection leads to the junction boxes should have the correct lengths and pass through the lagging by the protection kits.
- Cables should be fixed to pipes and/or work pieces using the appropriate materials.
- Heating cable should make a good contact with the pipe and/or work piece without gaps between them.
- Cable should be uniformly distributed on the pipe and/or fittings.
- Heating cables should neither intersect nor be twisted.

4.2 Tests to be carried out in each circuit

Once checks specified in item 4.1 have been carried out, electric resistance and insulation resistance of each circuit should be tested. The values obtained shall be recorded in a test and check on site sheet as indicated in page 14.

Tests should be carried out in the boxes, before connecting or disconnecting the power supply lines.

Electric resistance should be measured between the conductors of the heating cable. To test the insulation resistance the following processes should be observed according to the type of cable.

Insulation resistance should be tested with a megger at 1000 Vcc. The obtained values should be over 20 MΩ for cables shorter than 75 m, or [(1500 MΩ.m) / length in m] for longer cables.

4.2.1 Cables with metal braid covering

Insulation resistance between the conductors and the earth connection metal braid must be carried out. See figure 17.

4.2.2 Cables with metal braid covering and outer jacket protection

Insulation resistance between the conductors and the earth connection metal braid must be carried out. See figure 18.

5- Thermal insulation and marking on it

Once tests and checks specified in section 4 have been satisfactorily passed, lagging should be installed as soon as possible to avoid any mechanical damage and to protect the electric tracing. Remember that the correct temperature maintenance requires the lagging to be correctly installed and dry. It is therefore advisable to take into consideration the following recommendations and tests:

It is absolutely necessary to use the type, the thickness of the insulation and the “k” conductivity factor specified in the design documentation. If there were any modification, thermal losses should be calculated again and the project should be analysed again.

Protect the thermal insulation from the penetration of water and moisture during storage, manipulation and installation. If the outer protection cladding is not immediately installed, use temporary protections.

There should not be insulation material from the lagging between the heating cable and the pipe or fittings. This would harm the heat transfer. On valves or on very irregular surfaces, using aluminium adhesive tape on the cable is a good barrier to prevent this.

In using two pre-formed half-cane-shaped sections on horizontal pipe, the junction plan of both sections should be in horizontal position.

If rigid lagging is used, take into consideration its inside diameter that should be the appropriate one, including cable dimensions.

No heating cable can be damaged or nipped by the binding clamps or for any other reason.

All cable entry and exit points that pass through the lagging must be carried out in the bottom and sealed. If this is not possible, special care shall be taken to seal them appropriately to protect them from rain penetration.

Isolate and lag all heat sinks such as supports, valves, pumps, etc. Seal them to protect them from rain. If leaks may appear at these points, make drainage drills at the bottom part.

When a protective metal clad covering is used with fixing screws, their length shall be short enough not to penetrate the isolation and damage the heating cable. When installing the cladding, take care not to damage the cable with burrs and sharp edges.

Fix on the protective cladding during lagging installation, the kit end seals position marking adhesive labels. This will facilitate the localisation of failures.

Once the lagging has been installed, fix AKO-717445 warning adhesive labels on the cladding to indicate that there are electric circuits under the insulation. Labels should be placed where they are very visible from the normal crossing place and at a maximum distance between them of 6 meters.
6- Start up testing and documentation

In this item the tests to be carried out in the start-up until closing the construction site with its corresponding as built documentation are indicated.

6.1 Tests to be carried out

A visual inspection should be carried out to check that recommendations in item 5 have been observed. It should be specially observed that cables have not been damaged and that any possible rain penetration in the lagging has been sealed.

The tests indicated in item 4.2 shall be repeated for each circuit, following the same procedures. The values obtained must not be substantially different from the values recorded on testing this point and they shall also be recorded on the same on site test and check sheet. If any anomaly is detected, it shall be revised and modified if appropriate before start-up.

6.2 Start-up

1- Observations indicated in previous tests should be taken into consideration for the start-up.

2- Before start-up, make sure that the installation of the power supply observes all electric standards, regulations and current codes of practice.

3- Check identification or identify the circuit protections.

4- Set thermostats to around 5ºC above ambient temperature or pipe temperature at the moment of checking. Remember that once the circuits have been tested, thermostats shall be set to design temperature.

5- Switch on the general circuit breaker with individual circuit breakers off.

6.3 Documentation

The data obtained in items 4.2, 6.1 and 6.2 should be recorded in test and check on site sheets as indicated in page 14. These sheets can be included with the as built documentation of the construction site closing. This documentation should be given to the user, who should have it for any possible modification, repair and maintenance in pipe, or any subsequent incident.

Data or values in units demanded should be recorded in test and check on site sheets.

7- Use

Any modification in the installation and/or process implies the review of the design documentation (project) associated to this facility, since its security can be affected by the modification.

8- Modifications, repairs and maintenance

It is important to apply the appropriate processes and to respect intervals, tests and checks when pipes, cables, lagging and other system components are modified, repaired or maintained so that a ®TRACEADO eléctrico AKO-TRACE system maintains long-lasting functional and safety characteristics.

8.1 Modifications

Any modification in the system, either of its dimensions or of its process conditions, implies that design of the modified part should be tested, checked and, if necessary, modified. To carry out the modification, indications and tests included in these instructions should be observed. All data should be recorded and modified in the system documentation.

8.2 Repairs

Pipe, work pieces and lagging as well as heating cables and accessories may need some repairs:

8.2.1 Pipes, work pieces and lagging

Disconnect the heating cable and protect it from any possible mechanical or thermal damage during the pipe, work pieces and lagging repair works. Check that it has been correctly installed according to these instructions at the end of the repair and fit the lagging again according to indications in item 5. When modification, repair or maintenance work is carried out, an inspection sheet like the one in page 14 should be filled in (use only the appropriate part of the sheet).

Make sure that electric protections work properly.

8.2.2 Heating cables

As in every electric installation, a damaged cable may facilitate the penetration of moisture or corrosion that may cause a short-circuit, with the resulting fire risk. The damaged cable should be immediately replaced. Before doing it, it is important to analyse the cause of the failure so that the fault may be corrected and avoided in the future.

A heating cable should be repaired with original AKO kits and components according to their included instructions. The damaged cable length should be cut and replaced with a new cable length using the splicing system specified for each type of cable.

8.3 Maintenance

It is advisable to carry out periodic inspections at not more than two years intervals. However, they should be carried out more frequently when working, safety, corrosion, moisture, etc., conditions require it. In frost protection installations and in those ones whose correct operation is closely related to weather conditions, it is recommended to carry out inspections every year, before these conditions take place. An inspection should be carried out after any repair or maintenance work in pipe, work piece or lagging.

Check regularly the correct operation of electric protections and thermostats, as well as the identification labels indicated in item 2.5.3. These labels should be legible, and replaced when necessary.

The inspection process should be the same as the one specified in item 6. It should be also recorded in inspection sheets as the one indicated in page 14, (use only the appropriate part of the sheet).
9-Instructions for hazardous areas classified as potentially explosive

If a \textcircled{1}TRACEADO eléctrico AKO-TRACE system, or a part of it, is installed or has to pass through a hazardous classified area as potentially explosive atmosphere, in addition previous items indications the instructions and tests specified in this item should be strictly ensured. Electric or tracing installers who take part in the work should be qualified, competent and fully conversant with safety standards to work in hazardous areas classified as potentially explosive atmospheres.

9.1 At the materials reception

Check that heating cables, their end seal and connection kits, boxes, thermostats, glands and other electric material are certified and approved to standards EN 60079-0 and EN 60079-7.

Check that heating cables, their end seal and connection kits, boxes, thermostats, glands and other electric material are certified and approved to standards EN 60079-0 and EN 60079-7.

9.2 Design

When the system is designed the appropriate heating cables are selected, the following should be taken into consideration:

- The location should be:
  - Y Class I and the Zones 1 or 2 (for gas or vapours)
  - Y Class II and the Zones 21 or 22 (for flammable dusts)
- AKO-701xx and AKO-711xx cables materials: Silicone insulation, with FEP fluoropolymer outer jacket.
- Maximum surface temperature (pipe, tank, etc.) on which heating cable will be applied.

The maximum surface temperature is defined as maximum working temperature (the cable being connected). Under these working conditions, the heating cable surface temperature shall never exceed the gas or vapour ignition temperature of the zone, or the maximum heating cable surface temperature for combustible dusts.

In the item 9.4 we define how to ensure that maximum working temperatures are not exceed.

Group, category and code of the cables:

- AKO-701xx: II 2 G Ex e IIC T3..T6 Gb -40°C ≤Ta≤ +60°C
- AKO-701xx: II 2 G Ex e IIC T3..T6 Gb -40°C ≤Ta≤ +60°C
- AKO-711xx: II 2 G Ex e IIC T2..T6 Gb -40°C ≤Ta≤ +60°C
- AKO-711xx: II 2 G Ex e IIC T210°C..T85°C Db -40°C ≤Ta≤ +60°C

Maximum exposure temperature:

- AKO-701xx: 180 °C (cable disconnected)
- AKO-711xx: 200 °C (cable disconnected)

Range ambient temperature for its use: -40 °C to +60 °C

9.3 Cables and components installation

To install the heating cable, only the end seal and connection kit certified along with the cable should be used. Its reference is specified in the cables data sheet. Included instructions for each kit should be observed.

It must be taken into consideration that any installation, repair or modification carried out without complying with these instructions and the specific instructions for each installation element would invalidate its certificate.

9.3.1 Heating length identification on site installation

Identification labels should be placed before installing the lagging and before filling in the installation sheet.

Each heating length of an installation must have an AKO-71751 identification label, filled in by pencil, with the following data indicated in bold type:

- Referencia del cable: AKO-As indicated in the reel. (Each cable reel indicates the cable reference).
- Número de fabricación: Number indicated in the reel. (Each cable reel indicates its manufacture number (Nº) that should appear in the label).
- Temperatura máxima de exposición: ____ °C indicated en the reel. (It is the maximum temperature allowed by the cable materials).
- Voltaje: 230 V or voltage specified in the project documentation.
- Potencia: Power indicated in the reel or in the project documentation in __ W/m ±7%. (Each cable reel indicates power in W/m at 230 V. It should appear in the label unless another power is specified in the project documentation).
- Proyecto: Project number or reference.
- Tramo calefactor: Heating length indicated in the project documentation.
- Temperatura de trabajo: Working temperature in the project documentation ____ °C.
ever the insulation resistance is not greater than 50

IT earth system:

An insulation control device should be used to disconnect the supply when-

operating current of 30 mA.

Preference should be given to protective devices with a rated residual

current not exceeding 100 mA should be used.

A residual current protective device with a rated residual operating

TT and TN earth systems:

of its triggering and the appropriate correction has been made.

connected again until qualified personnel have investigated the cause

should indicate that if any one of them triggered, it should not be

installed in classified areas should be placed in the panel. A warning

instructions.

9.4 Protections and temperature control

9.4.1 Protections

Circuit-breakers and residual current devices protecting circuits in-

stalled in classified areas should be placed in the panel. A warning

should indicate that if any one of them triggered, it should not be

connected again until qualified personnel have investigated the cause

of its triggering and the appropriate correction has been made.

TT and TN earth systems:

A residual current protective device with a rated residual operating

current not exceeding 100 mA should be used.

Preference should be given to protective devices with a rated residual

operating current of 30 mA.

IT earth system:

An insulation control device should be used to disconnect the supply when-

ever the insulation resistance is not greater than 50 \( \Omega \)V of rated voltage.

9.4.2 Temperature control by a stabilised system

A non flowing system is stabilised at a specific ambient temperature

when the power output of the applied cable or heating cables, it is

exactly the same as the losses of the pipe or equipment through the

thermal insulation due to the difference between its temperature and

the ambient. In this situation of stabilisation, a pipe temperature

increase it is impossible, because this would cause an increase of its

losses and these would be higher than the power that can be supplied

by cables. This is absolutely impossible.

To use this maximum temperature control method, in the design should

have taken into consideration the stabilisation temperature of pipe or

equipment in an ambient at 40 °C (or at the maximum ambient that

could occur if it were higher). The stabilisation temperature should not

exceed the maximum working temperature of the selected cable for the

gas or vapour ignition temperature (see table in item 9.2)

If thermostat it is used to control the temperature to be maintained,
does not be used to control the safety maximum temperature. In this

case, the pipe or equipment stabilisation temperature calculated for the

worst conditions should not exceed the maximum working temperature

of the heating cable for the gas or vapour ignition temperature.

9.4.3 Temperature control with safety temperature limiter

thermostat

In this temperature control method, either a double thermostat or two

thermostats are used. One of them to control the temperature to be main-
tained and another security thermostat limits the pipe or equipment tem-

perature so that it does not exceed the maximum working temperature

of the heating cable for the gas or vapour ignition temperature.

Both thermostats should be independent.

The safety temperature limiter thermostat should only be manually reset

using a tool. In case of failure of this thermostat or its sensor, the contact

should cut off the heating cable power supply before it reaches the

maximum safety temperature.

Sensors should be tightly fitted on the surface to be heated (on pipe,

parallel to it). The limiter sensor should be placed where the maximum

process temperature is expected and its thermostat should be set at the

maximum working temperature of the heating cable for the gas or

vapour ignition temperature of the area, or at the temperature indicated

in the project documentation. The temperature regulation sensor

should be placed at the most appropriate point for the process and its

thermostat should be set at the temperature to be maintained.

After adjusting the limiter thermostat it should be blocked and sealed. It

should not be liable to suffer any subsequent modifications once it has

come into operation. If it is triggered after having been put into

operation, it is necessary to analyse the reason for this triggering and

carry out any necessary correction before setting it again.
9.5 Test and check on site sheet

In the test and check on site sheet at page 14, the location in item 1 and the identification labels in item 9 should be filled in.

9.6 Modifications and repairs

When in addition to indicated in items 8.1 and 8.2, there were modifications as, hazardous zone classification, dangerous materials that are being handled, process or dimensional conditions, design conditions should be checked. Carry out any necessary modifications and record all them in the project documentation with all new checking that have been carried out.

Any repair should be carried out according to these instructions and the specific instructions with which every component has been certified. When this is not possible, replace the damaged component with a new one.

When in the initial design and installation, cables have been covered and fitted on the valves and complex on line fittings, with aluminium adhesive tape to reduce surface temperatures and make them uniform, the same criteria should be followed whenever a repair is carried out. An inspection should be carried out so that the repair is correct and working conditions are the same as in the initial design.

Installation examples

**FIGURE 19**

<table>
<thead>
<tr>
<th>NON-HAZARDOUS AREA</th>
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**TRACEADO eléctrico AKO-TRACE, Electrical heat trace system**

**TEST AND CHECK ON SITE SHEET:** RV- ___________________ Hoja: _____________

If the measure result is not possible or not appropriate, indicate: / . Cross in the appropriate box: X

### BEFORE LAGGING

<table>
<thead>
<tr>
<th></th>
<th>Location heating cable: Group and category</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Hazardous area: Yes II 2 G No Zone 1 or 2 Gas or vapour ignition temp.: &gt; ºC (T) Flammable dust: TMin y TMic ºC Surface maximum temperature of the heating cable: °C °C</td>
</tr>
<tr>
<td>2</td>
<td>Heating cable length</td>
</tr>
<tr>
<td>3</td>
<td>Heating cable code or reference</td>
</tr>
<tr>
<td>4</td>
<td>Pipe or equipment</td>
</tr>
<tr>
<td>5</td>
<td>Applied ratio (cable m / pipe m)</td>
</tr>
<tr>
<td>6</td>
<td>Insulation resistance at 1000 Vcc Ω Ω Ω Ω</td>
</tr>
<tr>
<td>7</td>
<td>Heating cable length resistance Ω Ω Ω Ω</td>
</tr>
<tr>
<td>8</td>
<td>Correct sensor situation Yes No Yes No Yes No Yes No</td>
</tr>
</tbody>
</table>

If it is Zone 1, 2, 21 or 22 it is absolutely necessary:

- 9 Completed identification label Yes No Yes No Yes No Yes No

Before start-up if it apply: Electrical board and wiring system testing and checking on site. Yes No

### START-UP

**Warning!** Each circuit should be individually tested (switch off the other circuits) verifying that the associated thermostat operate correctly

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<tr>
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<th>Insulation resistance at 1000 Vcc Ω Ω Ω Ω</th>
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<tbody>
<tr>
<td>10</td>
<td>Heating cable length resistance Ω Ω Ω Ω</td>
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<tr>
<td>11</td>
<td>Signalling labels in place Yes No Yes No Yes No Yes No</td>
</tr>
<tr>
<td>12</td>
<td>Appropriate kits, glands and boxes Yes No Yes No Yes No Yes No</td>
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<tr>
<td>13</td>
<td>Control thermostat set point °C °C °C °C</td>
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<tr>
<td>14</td>
<td>Safety thermostat (manual resetting) °C °C °C °C</td>
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<tr>
<td>15</td>
<td>Circuit number or circuit-breaker ref</td>
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<tr>
<td>16</td>
<td>Appropriate circuit-breaker rating Yes No Yes No Yes No Yes No</td>
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<tr>
<td>17</td>
<td>Voltage in electric board V V V V</td>
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<tr>
<td>18</td>
<td>RCD residual current device: Sensitivity mA mA mA mA</td>
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<tr>
<td>19</td>
<td>RCD residual current device tested Yes No Yes No Yes No Yes No</td>
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<tr>
<td>20</td>
<td>Voltage in connection terminals V V V V</td>
</tr>
<tr>
<td>21</td>
<td>Normal working current A A A A</td>
</tr>
</tbody>
</table>

MEGGERS AT 1000 Vcc USED: AKO Company: Sheet:

MULTIMETERS USED: AKO Company: Sheet:

AMMETERS USED: AKO Company: Sheet:

<table>
<thead>
<tr>
<th>Name</th>
<th>Number</th>
<th>Calibration: Expiry date</th>
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Notes and remarks: ____________________________________________

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Inspector
Project manager
Client
10- Guide to detect and repair failures

Any anomaly that could occur is stated below. It is advisable to ask our technical service if the problem persists although procedures in this guide have been followed.

10.1 Electric protection trips or blows (Circuit-breaker or fuse)

It could be due to:

10.1.1 Electrical fault at:
   a - damaged heating cable
   b - faulty tees or splices
   c - faulty end seal
   d - faulty connection to box

Corrective action: Locate and repair (see remark at the end)

10.1.2 Circuit oversized

Corrective action: Resize or redefine the circuit (if more powerful protections are required, ensure supply cable is well dimensioned).

10.1.3 Defective electric protection

Corrective action: Replace it

10.2 RCD Residual current device trips

It could be due to:

10.2.1 Earth fault at:
   a - damaged heating cable
   b - faulty tees or splices
   c - faulty end seal
   d - faulty connection to box

Corrective action: Locate and repair (see remark at the end).

10.2.2 Excessive moisture in:
   a - junction box
   b - tees or splices
   c - end-seals

Corrective action: Dry out and reseal immediately against moisture. Perform insulation resistance test.

10.2.3 High capacitance leakage currents due to excessive power cable and heating lengths

Corrective action: Redesign without surpassing the maximum lengths of cable and adapting protections and power.

10.2.4 Main terminals disturbances

Corrective action: Check if it matches the documentation.

10.2.5 Defective RCD residual current device

Corrective action: Replace it

10.3 Weak or null cable power output

It could be due to:

10.3.1 Loss of supply voltage due to:
   a - Overcurrent or residual current protection triggered
   b - Loose terminals in junction box
   c - Power supply failure

Corrective action: Restore supply voltage
   a - Follow procedures specified in items 10.1 and 10.2
   b - Re-tighten terminals in junction boxes (if overheating has occurred, replace it)
   c - Locate damage and repair

10.3.2 Control thermostat is connected in the normally open position

Corrective action: Reconnect to normally closed position.

10.3.3 High electric resistance at:
   a - junction box
   b - tees or splices

Corrective action: Locate and repair. Re-tighten terminals or if overheating has occurred, replace it.

10.4 Low pipe temperature

It could be due to:

10.4.1 Wet thermal insulation

Corrective action: Remove and replace with dry insulation of correct specification and ensure complete weatherproofing.

10.4.2 Incorrect operation or setting of controls

Corrective action: Check that the temperature sensor location is correct, reset or repair.

10.4.3 Design error

Corrective action: Check with competent authority for design parameters and modify to meet AKO recommendations.

REMARK:
Locate faults by the following steps:
1. Visually inspect the power connections, splices and end seals for correct installation.
2. Look for signs of damage at:
   a) Valves, pumps, flanges and supports
   b) Areas where repairs or maintenance work have been carried out
3. Look for crushed or damaged insulation and cladding along the pipe.
4. If after 1, 2 and 3 above the fault has not been located, then either:
   a) Consult our technical service
   b) Where local practices and conditions allow (e.g. non hazardous areas), cut the circuit in two halves and test each length to locate the damaged area. Remove lagging to locate the fault