Welding Pre-Heating and Demagnetization Equipment

Ring Coils - Clamp Coils - Blankets
**INTRODUCTION**

Weldings are the biggest unknown in steel assembled products. In order to increase the reliability of welded structures, the American Welding Society (AWS), issued the Welding Procedure Specifications (WPS).

According to WPS, welding pre-heat is one of the most important processes influencing the quality and reliability of weldings. Cold weldings or joints welded without uniform temperature through the wall thickness create weak and porous structures, with high internal stresses.

TESI welding pre-heating equipment are designed to contain the heat within the areas to be welded with high efficiency, extremely short heating time, and perfectly clear and dry surfaces.

Conventional systems, such as open flame or electrical resistances, cannot guarantee any of these advantages. High frequency induction systems, although effective, can only generate SKIN EFFECT, and are not able to completely match welding pre-heat requirements.

TESI provides a series of Welding Pre-Heat equipment for any kind of application:

- **Internal (IRC) and external (ERC) Ring coils**
- **Clamp coils (IWC and AIC series)**
- **Flexible and semi-rigid coils (Blankets)**

Guarantee uniform heat not only on the surface but completely penetrating through the steel, with very limited tolerance range.

**WELDING PRE-HEATING RING COILS**

One set is composed of two rings, usually connected in parallel, installed externally (ERC) or internally (IRC) of each pipe’s terminal and connected with the generator through connection cables.

Welding pre-heating ring coils guarantee uniform heating through the wall thickness of pipes, with extremely limited tolerance range.

After the heating process is completed, coils are removed, pipes aligned and welded. These operations require quite some time, and with any other conventional system the pipes cool down. With Tesi induction heating equipment, pipes remain hot for a longer time, allowing operators to perform perfect weldings.

Tesi developed an innovative thermodynamic software, Tesisoft, which allows to simulate the required temperature profile for a perfect tuning of coils and generators.

**HEAT DISTRIBUTION ON PIPE AS OF TESISOFT SOFTWARE SIMULATION**

![Heat distribution graph](image-url)

**Legend**

- **Pipe Ø56”**
- **WT 12.7**
- **P=100 kW**
- **Time 200 sec**

Graph showing temperature distribution along the pipe with real log and distance in mm.
WELDING PRE-HEATING CLAMP COILS - IWC

One set is composed by one clamp installed across the joint area. By using these clamps, pipes to be welded can be aligned before the heating process because the clamp will heat simultaneously 100 mm of one end and 100 mm of the other end.

The coil is connected with the generator by connection cables. Welding pre-heating clamp coils, as well as ring coils, guarantee uniform heating through the wall thickness of pipes, with limited tolerance range.

In very cold environments, where the pipe temperature drops down quickly, this solution allows to start the welding process immediately after the heating cycle because the pipes are already aligned.

In some cases, when the welding process is handled in different steps (root weld + interpass fillings + cap weld), the clamp coil is used also to maintain the temperature during intervals.

**Heat distribution on Pipe - Foreseen Profile**

![Heat distribution on Pipe - Foreseen Profile](image)

**Legend**
- Pipe Ø56" WT 12.7
- P=100 kW - Time 420 sec
- Temperature after 10 sec
- " " 20 sec
- " " 60 sec
- " " 2 min
- " " 3 min
- " " 4 min
- " " 5 min
- " " 6 min
- " " 7 min
- " " 8 min
**AUTOMATIC WELDING PRE-HEATING CLAMP COILS - AIC SERIES**

Tesi AIC (Automatic Induction Coils) series is designed for Welding Pre-Heating process and is available for S-Lay and J-Lay projects.

The coil is composed by a stainless steel frame that holds all the pneumatic components, cylinders, valves, connections and dampers. The induction coil is assembled into the frame and connected to cylinders that open and close it.

Stainless steel and fiberglass guards guarantee complete protection of the parts in motion and total safety for operators. AIC clamp coils are interfaced with induction generators and controlled by a wireless remote.

The coil can be handled by simple overhead cranes on which is connected by lifting chains or, in case the welding platform has manipulators, an interface structure can be built.

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**LEGENDA**

- Pipe Ø12" WT 12.7 P=100 kW
- Pipe Ø18" WT 12.7 P=100 kW
- Pipe Ø24" WT 12.7 P=100 kW
- Pipe Ø36" WT 12.7 P=100 kW
- Pipe Ø56" WT 12.7 P=100 kW

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**THERMAL GRADIENT - FORESEEN PROFILE**

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**WELDING PRE-HEATING RING AND CLAMP COILS GENERAL FEATURES**

<table>
<thead>
<tr>
<th>DIMENSIONS</th>
<th>INCHES</th>
<th>8 ÷ 56</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating Width</td>
<td>mm</td>
<td>100 + 200 (each pipe’s ends)</td>
</tr>
<tr>
<td>Power Supply</td>
<td>kW</td>
<td>120 ÷ 350</td>
</tr>
<tr>
<td>MAX Input Voltage</td>
<td>V</td>
<td>Depending on the generator used, coils are provided with specific Voltage (Max 500 V), Current (Max 750 A) and Frequency (Max 400/600 Hz)</td>
</tr>
<tr>
<td>MAX Input Current</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>Frequency</td>
<td>Hz</td>
<td></td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>°C</td>
<td>-40 ÷ +45 / -40 ÷ +113</td>
</tr>
<tr>
<td>(°F)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IP PROTECTION</td>
<td></td>
<td>IP22 / IP66 (depending on the connection used)</td>
</tr>
<tr>
<td>Standards</td>
<td></td>
<td>2006/42/CE</td>
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<tr>
<td>Certifications</td>
<td></td>
<td>CE</td>
</tr>
<tr>
<td>Output Connectors</td>
<td></td>
<td>PowerLOCK / Lugs</td>
</tr>
</tbody>
</table>

**NOTE:**

Tesi coils are designed to be powered by generators made by Tesi.
FLEXIBLE AND SEMI-RIGID COILS (BLANKETS)

TESI Induction Blanket is another solution in pre-heat technology. The flexible, lightweight induction heating blankets come in a variety of sizes and are capable of pre-heat temperatures up to 200°C (392° F). The blankets easily conform to circular and flat parts and install in a matter of seconds.

Manufactured with durable high-temperature materials, Tesi flexible induction blankets are designed to withstand the tough conditions in both industrial and construction applications.

Each blanket is supplied with two spare securing straps and one replaceable Kevlar sleeve which provides added protection against abrasion, cuts and tears, extending blanket life. Electrical connection to output extension cables is made through the use of durable twistlock connectors.

DEMMAGNETIZATION

Residual magnetism on pipes can be a serious problem. In worst cases it may cause arc deflection during welding and inhibit welding processes completely.

The vast majority of traditional demag systems on the market can only remove homogeneous and superficial magnetism because they are based on alternating currents that do not penetrate into the wall thickness.

For example, with a sinusoidal current at 10Hz the flux of B (magnetic field) is confined in few millimeters on the pipe surface, for any current values.

Another method is to heat the material above its Curie temperature, which is the critical point where a material’s intrinsic magnetic moments change direction, resulting in the loss of its ferromagnetic properties. The Curie temperature for a low carbon steel is 770°C or 1390°F. Although effective, this demagnetization system is often inconvenient, especially in pipeline constructions, since it damages the main coating permanently.

TESI DEMAGNETIZER UNIT doesn’t work like conventional systems.

Our system is based on a special DC current (around 1000A at a very low voltage) able to avoid any skin effect and penetrate to the whole pipe wall thickness. Tests have been carried out on pipes diameters from 6” to 56” and very big wall thickness using our standard Welding Pre-Heating RING COILS, that allow to performed both processes with the same equipment.

Magnetism values can be detected by using the same remote control provided with the generator. The remote control transmits the information to the generator’s main board, which calculates the required DC current and activates the DEMAG routine, providing operators with the necessary information on the remote display.

First, the current uniforms the magnetic field detected through the magnetization of the end of the pipe in the same direction.

Secondly, our automatic feedback system - based on a Hall effect probe - reads the magnetic field and removes it by magnetizing the end of the pipe in the opposite direction. The operation takes just few minutes according to pipe diameter, but in any case less than 5 min and keeps the magnetic field values below 10Gauss for some hours.

TS DEMAG ® can be integrated in every series of Tesi generators or supplied as stand-alone package.
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