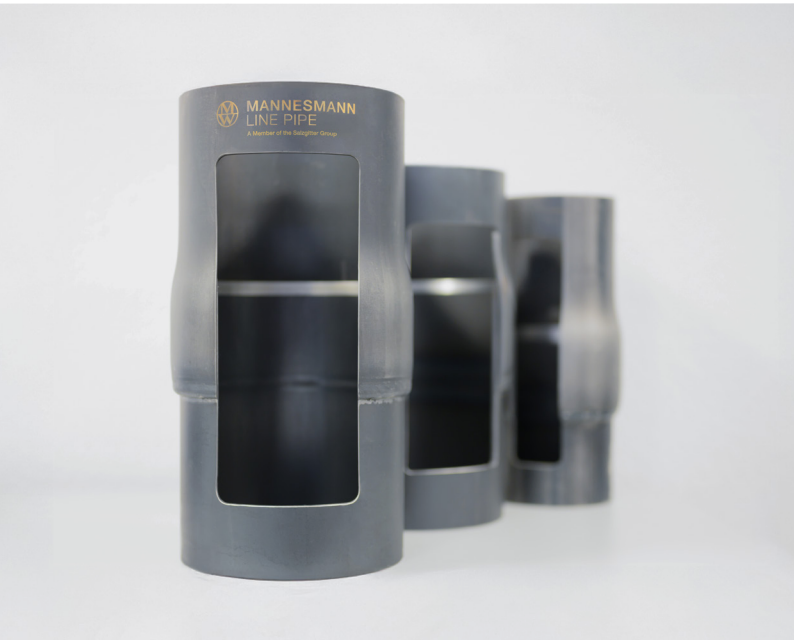

Cable conduits

HFI-welded steel pipes for the protection of underground power cables

MANNESMANN
LINE PIPE
A Member of the Salzgitter Group

Steel cable conduits

The ongoing conversion of the energy supply to renewable sources and the growing demand for energy, e.g. due to the substitution of natural gas with hydrogen and the electrification of production processes and mobility solutions, require a reliable and secure infrastructure. Power grids, and in particular the extra-high voltage grid (>220 kV), therefore have to be adapted and expanded in line with the changes in generation and consumption patterns.

Underground power cables are therefore becoming increasingly important. This type of installation offers advantages not only in terms of aesthetics and minimizing disruption in the public sphere, but also in terms of the safety and durability of the cable systems. However, it should be borne in mind that the growing number of underground cables is also expected to lead to an increase in situations requiring special cable protection. Unlike with overhead cables, particular challenges arise, for example, when traversing rivers, roads and railroad lines.

In these situations in particular, HFI-welded steel pipes are a simple, durable and tried-and-tested solution for trenchless installation with a variety of possible coatings.

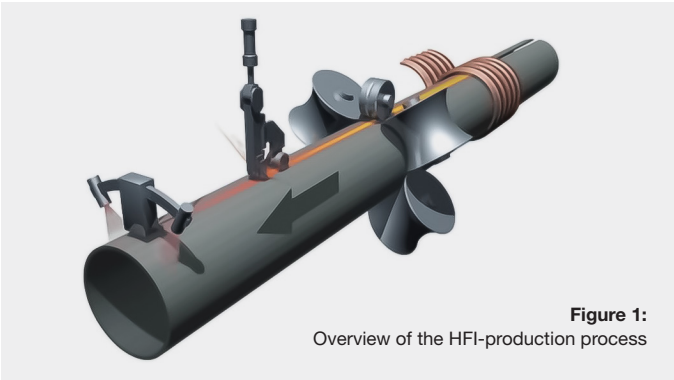

Figure 1:
Overview of the HFI-production process

HFI-welded steel pipes

The high-frequency induction welding process is a proven method for the production of longitudinally welded pipes. The starting material for this process is hot strip, which is continuously formed into a tube. For joining, the strip edges are inductively heated to welding temperature and pressed together. The resultant welding beads on the outside and inside of the pipe are leveled by scraping tools down to the pipe contour. The result is a product that meets the highest standards of pipe geometry over the entire pipe length and circumference. **Figure 1** illustrates the production process.

The seam joint is created without filler metal. After welding, the seam and the heat-affected zone undergo a normalizing heat treatment.

In addition, the weld is tested ultrasonically over its entire length and the mechanical and technological properties are verified by destructive testing in each production batch. The product is shipped with a 3.1 certificate.

The key advantages of steel cable conduits over other materials include:

- Great variety of designs due to different grades/wall thickness combinations, thus enabling high tensile forces to be realized when pulled into the HDD drill hole
- Better mechanical protection (safety) in applications with higher loads, e.g. road and river crossings, slopes, etc.
- Shielding of the magnetic field around the conductor cable, reducing the risk of interference with other infrastructure

Steel cable conduits

- Better dissipation of any short-circuit current compared to using the ground or additionally laid conductors and therefore better short circuit detectability
- High-performance joining technologies available, e.g. where space is limited during installation (ESM push-in welded socket, ZSM tension-resistant push-in socket joint)
- Use of alternative installation techniques (e.g. trenchless installation possible over several kilometers)
- Coating options for the conduit's outer surface: PE or PP plastic coatings, fiber cement coatings or GRP to enhance resistance to soil conditions
- Good heat dissipation
- Pipe can be given cathodic protection, making it possible to detect external influences
- Non-destructive testing (NDT) of the joint possible as required
- Metallic properties allow the position of the steel conduit to be measured as it is pulled in
- Rugged pipe material to prevent internal damage when pulling in the cable using a steel rope, especially when passing unavoidable radii in the pipeline
- Different coating colors possible
- Pressure-tight system: pressure measurement can be used for defect detection.

Versions

- **Diameter**: from 114.3 mm to 610.0 mm
- **Wall thicknesses**: from 5-12 mm
- **Lengths**: up to 16 m
- **Production standard**: EN 10217-1 or -3
- **Grades**: P235TR1 – P355NH

Pipe end with modified push-in welding socket

The connection of pipes using push-in welding sockets is a technology that is already established in the water sector and in the urban installation of pressurized cable conduits (nitrogen-insulated cables). When this joining technology is used for power cable conduits, the question arises as to how the cable can be pulled into the socket without damaging the cable sheath. The socket conforming to DIN 2460 can be left unchanged, as the transition to the socket area from the socket geometry molded during the production process is designed without edges per se. For use as a cable conduit, the manufacturer modifies the final treatment of the push-in end. The ends of the conduit, which are normally smooth-edged, are given an internal beveled edge in the factory to suit the diameter and wall thickness **(Figure 2)**.

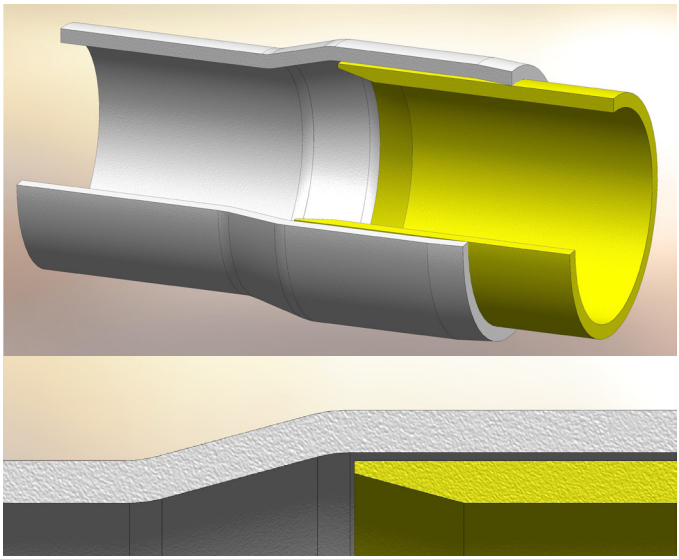

Figure 2:
Modified push-in welding socket for use on a cable conduit

This ensures that the cable insulation is not damaged when the cable is pulled in. During installation, the pipes are easy to join by welding, as only one fillet weld joint is required. The pipes are also suitable for trenchless applications. The weld seam factor for this joint is 0.7 in accordance with DIN EN 1993-1.

The advantages of connecting steel pipes using push-in welding sockets can be summarized as follows:

- Simple connection of the pipes on site
- No need to grind the root of the weld seam with an internal pipe manipulator
- No need to make geometric adjustments to the socket before welding
- No internal burrs due to socket welding
- No damage to the cable during insertion

Pipe end with prepared weld bevel

The pipes are supplied with a prepared weld bevel with a nominal bevel angle of 30°±5° and a web height of 1.6 mm ±0.8 mm. This design is suitable when high tensile forces are required or when a design without a socket is desired for insertion. When welding the pipe connection seam, MLP recommends grinding the weld root on the pipe inner wall flush with the pipe contour. Otherwise, the insulation of the inserted cable may be damaged when the pipe is pulled in.

ZSM joint

Another technology that can be used for connecting cable conduits is the ZSM socket from Carl Hamm **(Figure 3)**. The advantage of this connection is that it is detachable and no seams have to be welded in the field. In addition, high tensile forces can be absorbed. In the factory, a socket and a spigot end is welded to the steel pipe body for the ZSM connection. The roots of the resulting weld seams are ground down in the factory. In the field, the system is connected together in a form-fitting manner using shear element chains (no tools are required). The connection is gas-tight and detachable. The system is particularly recommended when the time available for connection on the construction site is limited or no skilled welders are available.

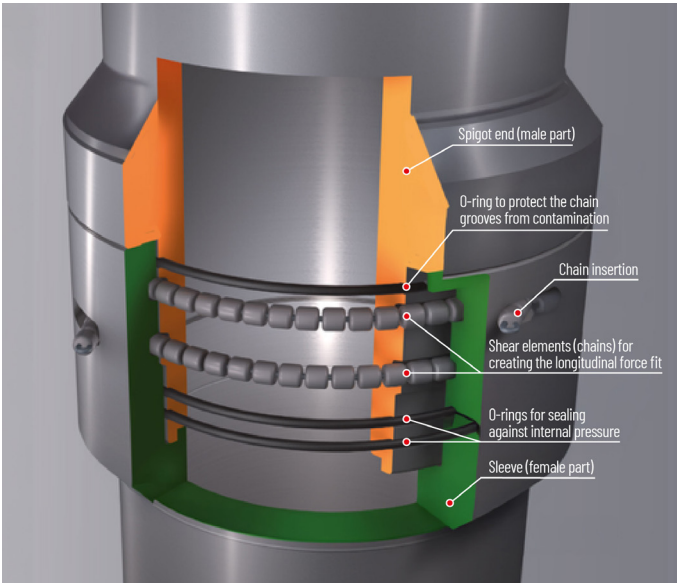

Figure 3:
Functional principle of the ZSM pipe joint in its fitted state

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