

Carl Hamm

Pipesystems



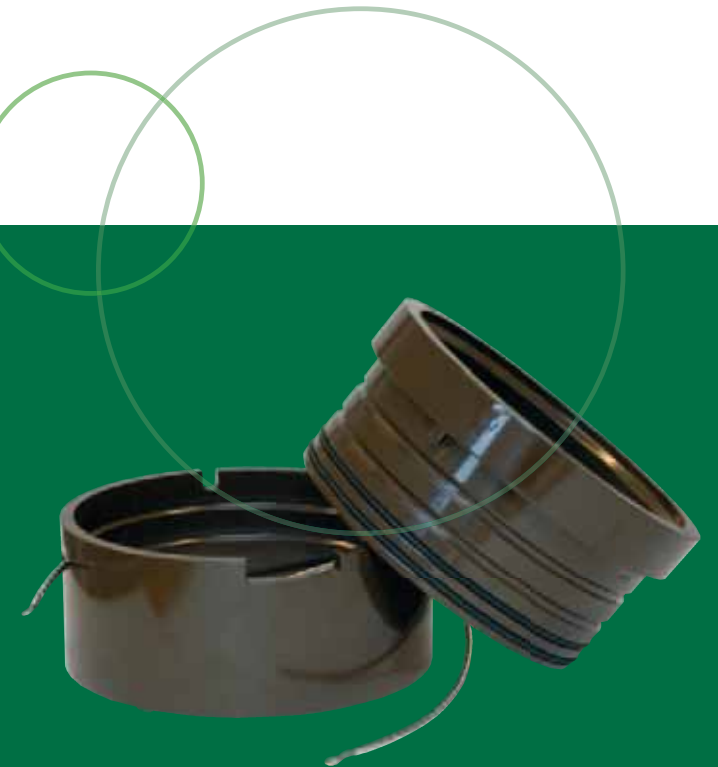
ZSM Connection



ZSM Connections

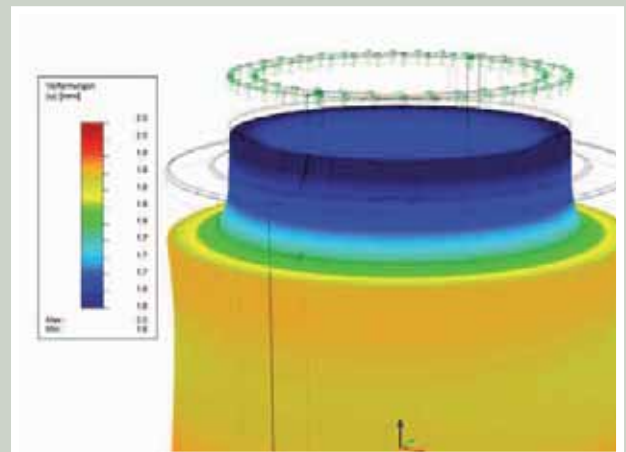
The tight sleeve connection – in short ZSM – is an axial non-positive and detachable pipe connection. It is used as a pit pipeline in underground mining and in deep-well sinking.

Our patent-protected tight sleeve system is an interesting alternative to other conventional connection systems thanks to its quick and easy assembly/disassembly, space-saving design and favourable price.



ZSM Connection with corrosion-proof coating

- **Small installation dimensions.**
- **Quick, easy and safe to assemble and disassemble.**
- **No special tools.**
- **The ZSM Connection permits low deflections.**



FEM calculation

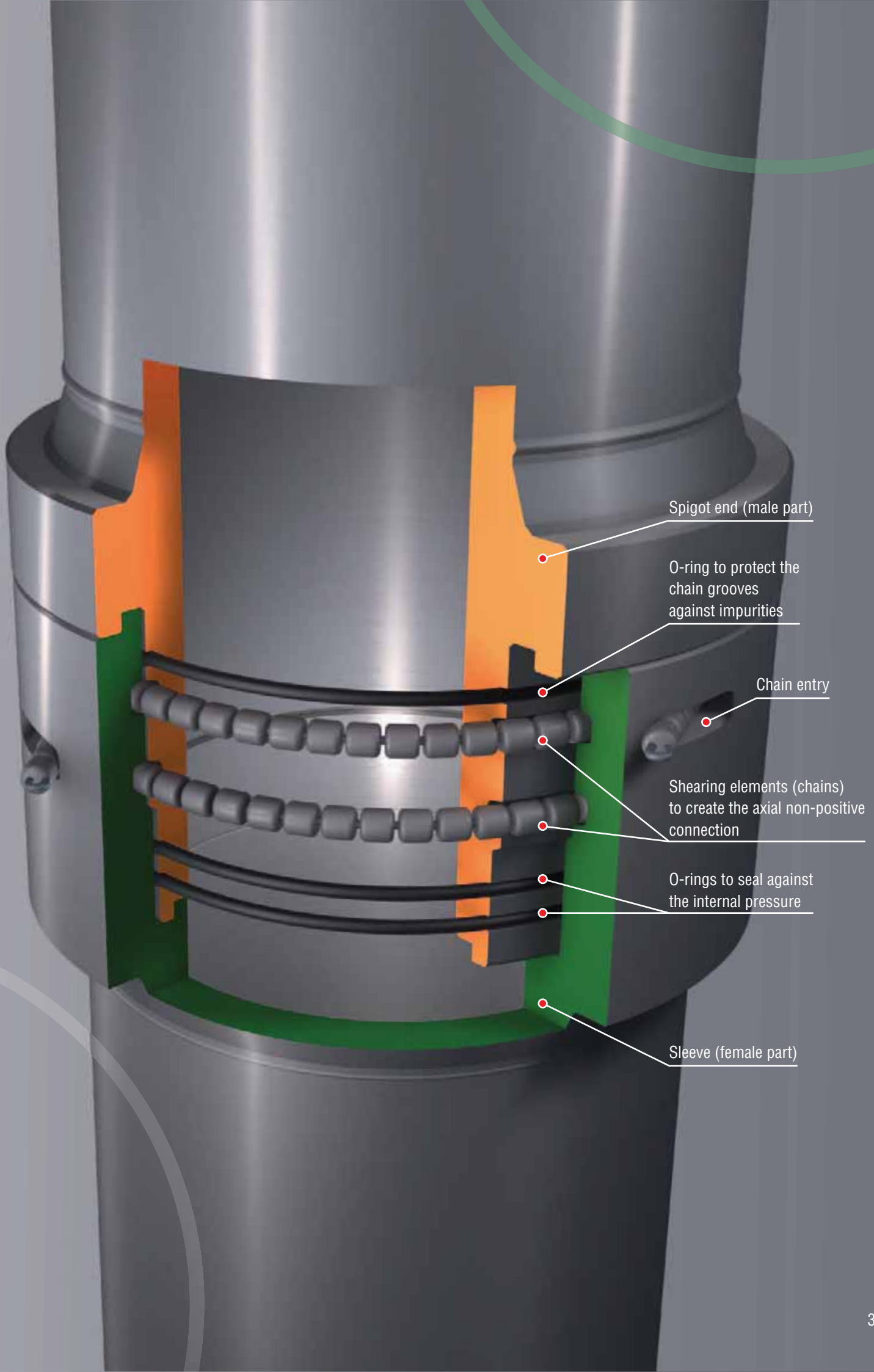
Technical Data

(standard range)

| | |
|------------------|-----------------------------------|
| Dimensions | DN 50-DN 1400 |
| Nominal pressure | up to PN 400 |
| Axial forces | up to 1600 tonnes (rupture loads) |

The ZSM Connections were examined at the DMT Rope Testing Centre in various tensile tests for the maximum rupture loads.

The development of the ZSM Connections was flanked by FEM calculations.



Spigot end (male part)

O-ring to protect the chain grooves against impurities

Chain entry

Shearing elements (chains) to create the axial non-positive connection

O-rings to seal against the internal pressure

Sleeve (female part)

The success story of the Carl Hamm ZSM Connection

The ZSM Connection was launched on the market in 1992 as a simple, quick, tight connection – initially as a casing (lost form-work) in well sinking.

The potential of this connection was recognised in the mid-1990s. The ZSM Connection was further developed in cooperation with Rheinbraun (now called RWE Power). The objective was a medium-carrying, axially load-bearing, quick-to-install and detachable connection. The results revolutionised the well operations of Rheinbraun. As a consequence, all wells were operated with ZSM pipelines.

The ZSM Connection was further developed for use underground on the basis of this technical success.

In 2003, the first pit pipeline was equipped with ZSM Technology in German hard-coal mining – Heinrich colliery, Essen. In such cases the higher tensile and compressive loads as well as the high safety requirements in a shaft used for descent were taken into account.

The ZSM Connection was continuously further developed and also successfully used in a wide range of installation situations in German mining and more recently internationally as well.



Installation of a ZSM Pipeline



Easy operation of the shearing elements

Easy installation

- The spigot end (male part) has three sealing grooves and two chain grooves on the outside.
- The sleeve (female part) has two chain grooves on the inside.
- O-rings are inserted into the sealing grooves of the spigot end.

- The spigot end and sleeve are pushed together without any additional aids.
- The seal is created in this way.

- The chain grooves form two annular cavities.
- Shearing elements (chains) are inserted manually through openings in the sleeve. Tools are not required.
- The spigot end and sleeve therefore have an axial non-positive connection.

- The chains can be simply withdrawn again for disassembly. The pipeline can be separated.

ZSM vs. flange

| | ZSM | Flange |
|--------------------|------------------------|--|
| Hydrostatic forces | O-ring (gasket) | Screws, nuts, gaskets with a defined tightening torque |
| Axial forces | Shearing chain | |
| Torsion forces | Torsion safety element | |
| Tools | – | Impact wrench |

ZSM in underground mining

The ZSM Connection excels owing to its cost-effectiveness, especially when used with high-performance immersion pumps.

Here it shows off its system advantages of time-saving assembly and disassembly.

In confined installation situations the low installation dimensions of the ZSM Technology permit optimised pipeline cross-sections.

The uncomplicated disassembly of the pipe section guarantees shorter times required to change a pump. Downtimes due to maintenance and repairs are reduced to a minimum.



Corrosion-protected ZSM Sleeves



Assembly flap during the functional check



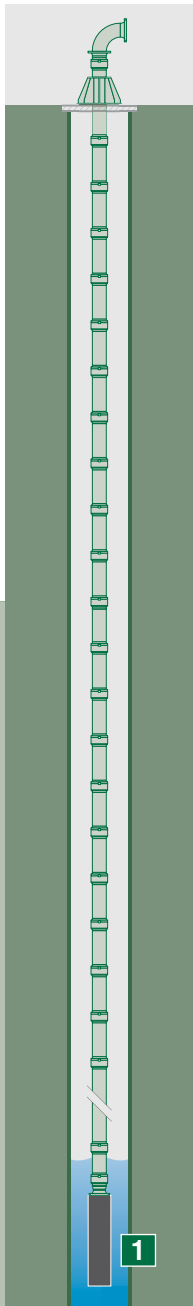
Prosper Haniel colliery, Germany

German mining

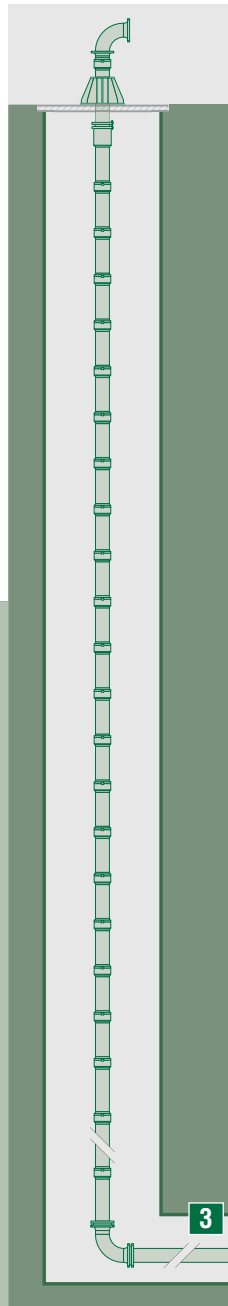
Major projects implemented

| Year | Customer/Plant | Dimensions | Total length |
|------|----------------------------|------------|-----------------|
| 2012 | RAG/Rob. Müser | DN 350 | 600 m |
| | RAG/Walsum | DN 300 | 3 x 830 m each |
| 2011 | RAG/Heinrich | DN 500 | 485 m |
| | RAG/DSK Ibbenbüren | DN 500 | 600 m |
| | RAG/Amalie | DN 350 | 900 m |
| | RAG/Concordia | DN 300 | 1050 m |
| 2010 | RAG/Carolinenglück | DN 500 | 950 m |
| | RAG/Heinrich | DN 500 | 485 m |
| | K+S/Esco Werk Braunschweig | DN 200 | 480 m |
| 2009 | RAG/Heinrich | DN 500 | 485 m |
| | RAG/Amalie | DN 350 | 900 m |
| | RAG/Prosper | DN 350 | 800 m |
| | RAG/Camphausen | DN 250 | 800 m |
| 2008 | RAG/Carolinenglück | DN 500 | 950 m |
| | EON/Huntorf power station | DN 500 | 700 m |
| | RAG/Saar | DN 400 | 1000 m |
| 2007 | RAG/Rossenray | DN 400 | 1050 m |
| | RAG/Amalie | DN 350 | 900 m |
| | RAG/Rob. Müser | DN 350 | 600 m |
| | RAG/Auguste Victoria | DN 350 | 800 m |
| 2005 | RAG/Prosper | DN 350 | 800 m |
| | RAG/Concordia | DN 300 | 1050 m |
| | RAG/Zollverein | DN 500 | 2 x 1050 m each |
| 2003 | RAG/Concordia | DN 300 | 1050 m |
| | RAG/Heinrich | DN 500 | 485 m |
| 2002 | EON/Huntorf power station | DN 500 | 2 x 700 m each |

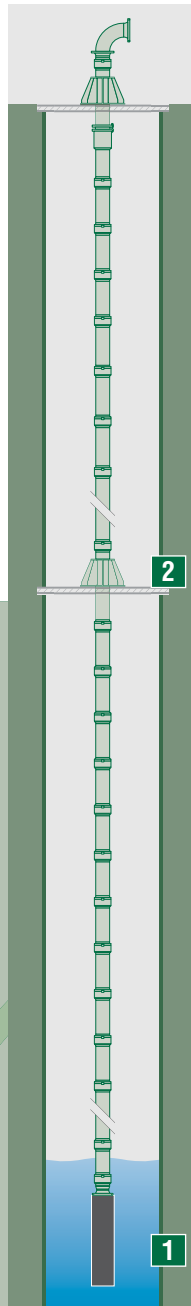
Freely suspended



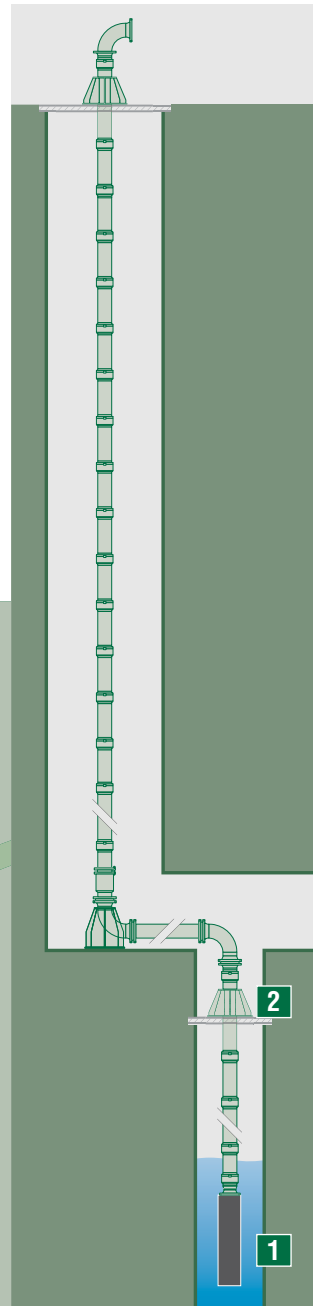
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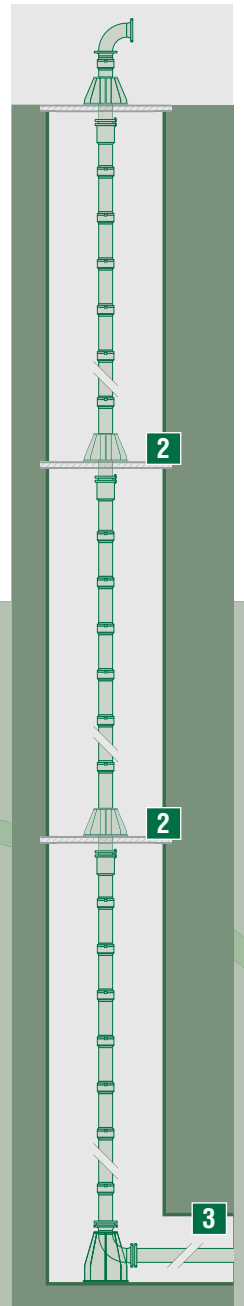
Partially suspended



Partially suspended



Standing pipe column



1 Pump 2 Intermediate support point 3 To pump station

Installation situations of the Carl Hamm ZSM Connection

International mining

Major projects implemented

| Year | Customer/Plant | Dimensions | Total length |
|------|----------------------|------------|--------------|
| 2012 | Congo/Kipushi | DN 300 | 400 m |
| 2010 | Poland/Copper mining | DN 350 | 2 x 1000 m |

Major projects in the advanced planning phase

| Year | Customer/Plant | Dimensions | Total length |
|------|---------------------------|------------|-------------------|
| 2012 | South Africa/Evander 6 | DN 200 | 1300 m |
| | Zambia/Kanshansi | DN 400 | 400 m |
| | South Africa/Johannesburg | DN 400-500 | 7 x approx. 400 m |

ZSM in deep-well sinking

The ZSM Technology has been used for more than 15 years in German brown coal open-cast mining to regulate the groundwater level. The strengths of the ZSM Connection come to the fore in particular with interconnected wells, with several hundred individual wells.

The very frequent pump changes – due to the low pH of the water and the moving open-cast mining – can be performed much more economically thanks to the very short assembly and disassembly times.

The low installation dimensions of the connections permit higher pipeline cross-sections of the pipes used. As a result, lower flow rates can be achieved at the same pump capacity. This ensures a substantial extension of the service life of a pipeline and the pump used.

The ZSM Technology is also becoming interesting for applications in irrigation projects using deep wells, especially owing to the low installation dimensions and the resultant benefits.



Corrosion-protected
ZSM Pipes



Application possibilities for irrigation using deep wells



ZSM Connection, stainless steel



Welding of the spigot end and pipe



Use of the ZSM for groundwater management in brown coal mining

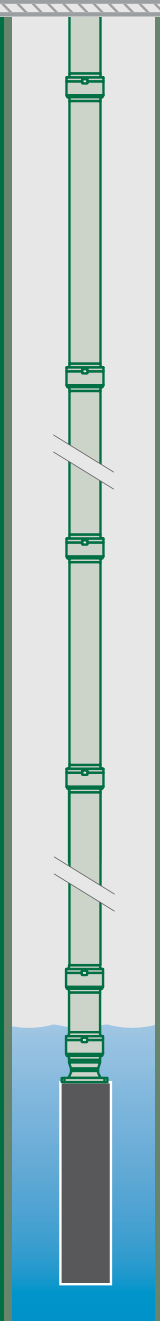
German brown coal mining

Projects implemented

| Year | Customer/Plant | Dimensions | Well | Total length |
|------------|----------------|-----------------|--------------|--------------|
| since 1998 | RWE Power | DN 50 to DN 400 | approx. 2000 | 250-500 m |



Brown coal open-cast mining



Everything from one source

We supply ready-to-install ZSM Pipelines.

In order to offer you optimum solutions, we apply our experience from over 80 years in mining and support you in all phases of your project.

Our services:

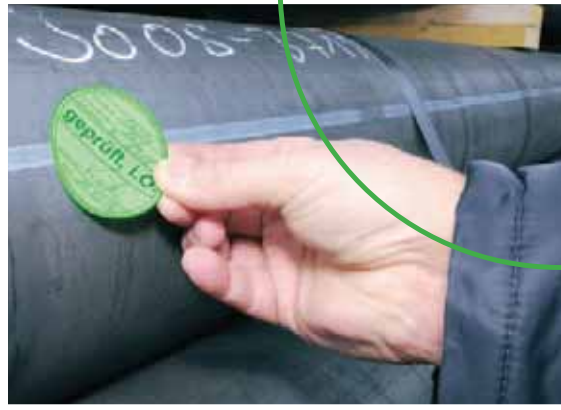
- **Budget planning on the basis of your information (see adjacent table).**
- **Planning of a pipeline including all components required.**
- **Static calculations.**
- **Preparation of the overview and detail drawings.**
- **Design of the ZSM Components on the basis of the specific requirements.**
- **Destructive tensile testing of the ZSM Components.**
- **Professional production of the complete pipeline using the in-house process – according to the specific manufacturing and test sequence plan.**
- **Depending on the requirement, we produce ZSM Pipelines made of:**
 - Carbon steels (e.g. P355 ff)
 - Stainless steels (e.g. 1.4571)
 - Duplex steels (e.g. 1.4462)
- **Inside and outside coating systems.**
- **Non-destructive testing of the welds.**
- **Worldwide shipment.**
- **Support during assembly.**



Planning and conceptual design



Mechanised welding line



Documented quality testing

Budget planning on the basis of your information (details required):

1. Installation situation (see page 7)
2. Pipeline length
3. Individual pipe length
4. Diameter/dimensions
5. Weight of pump/motor/cable
6. Pump feed pressure
7. Spacing of intermediate support points
8. Corrosion protection
9. Details of the safety concept (official specifications)

Quality management

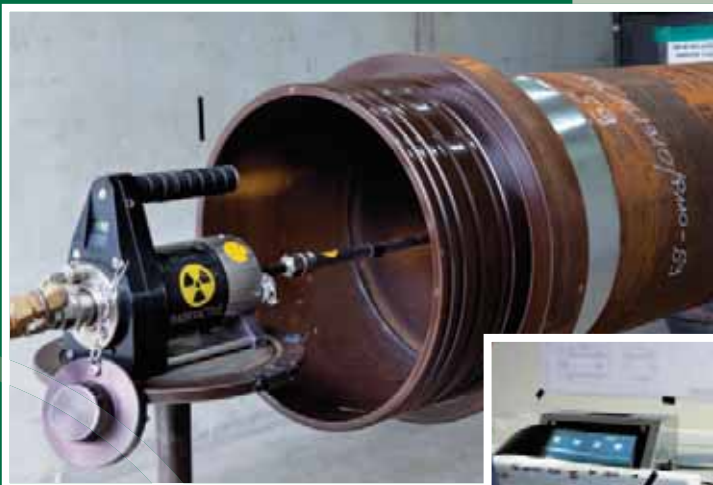
A certified quality management system was introduced in 1997. The development and design section was added in 2010.

As a certified specialised welding company, we satisfy national and international standards.

Certificates, permits (e.g. Germanischer Lloyd) and process inspections as well as the personal qualifications of our employees in the production and quality assurance departments guarantee a constantly high standard of quality.

Extract:

- | | |
|--------------------------------------|----------------------------------|
| • Quality management system | DIN EN ISO 9001:2008 |
| • Welding quality requirements | DIN EN ISO 3834-3 |
| • Inspection of the production shops | AD 2000 HPO |
| • Manufacture of steel structures | DIN 18800-7 |
| • EC Certificate of Conformity | CE marking of pressure equipment |
| • Process inspections | DIN EN ISO 15641-1 |
| • Welding staff | DIN EN 287-1 and DIN EN 1418 |
| • NDT (RT, PT, MT, VT) | DIN EN 473 – Level 2 |



Non-destructive testing



Worldwide shipment

Competence, experience, innovative thinking, modern production plans and motivated employees form the basis of our services.

With the flexibility of a modern, medium-sized company management and the experience of our over 80-year history, we are well equipped to meet the demands of the future.

Numerous certifications and permits give you the certainty that applicable rules and regulations are observed throughout the entire production process.

Our product range focuses on the water, waste water and power industries, tunnel construction and well sinking as well as open-cast and underground mining.

Profit from a strong partner who integrates itself with its skills into your specific requirements: from the conceptual planning to professional production and punctual delivery.



Carl Hamm

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