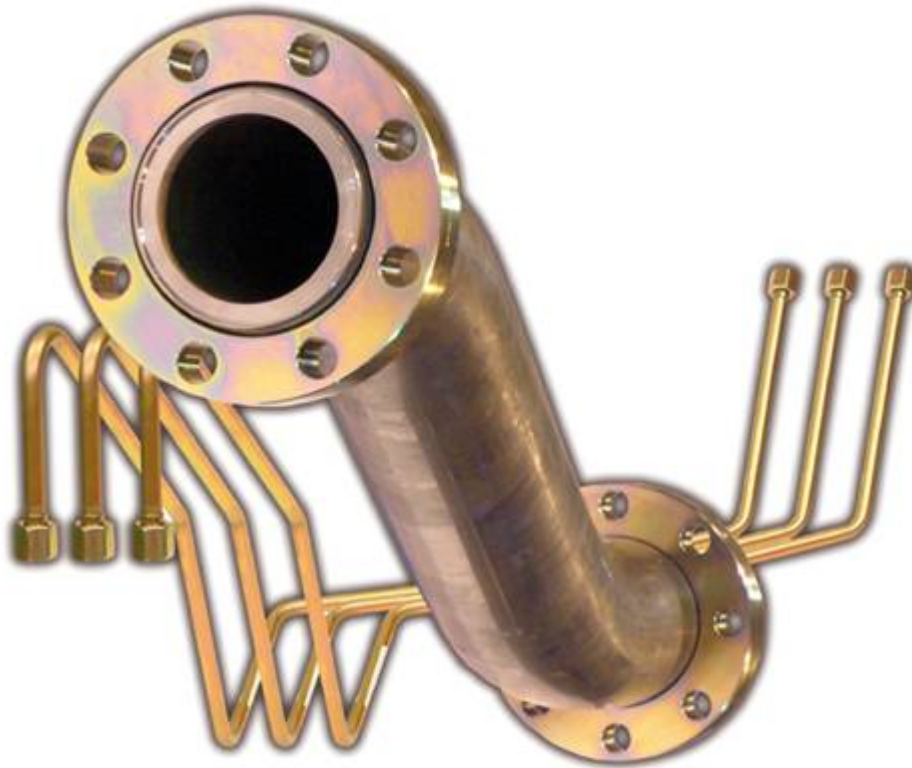


Prefabricated Piping Systems



Prefabricated Piping Systems Introduction

GS-Hydro's *Prefabricated Piping System*-solutions covers the full range of *materials, components and services from engineering to installation, testing and flushing* of complete piping systems.



Prefabricated Piping Systems Introduction - *Technology*

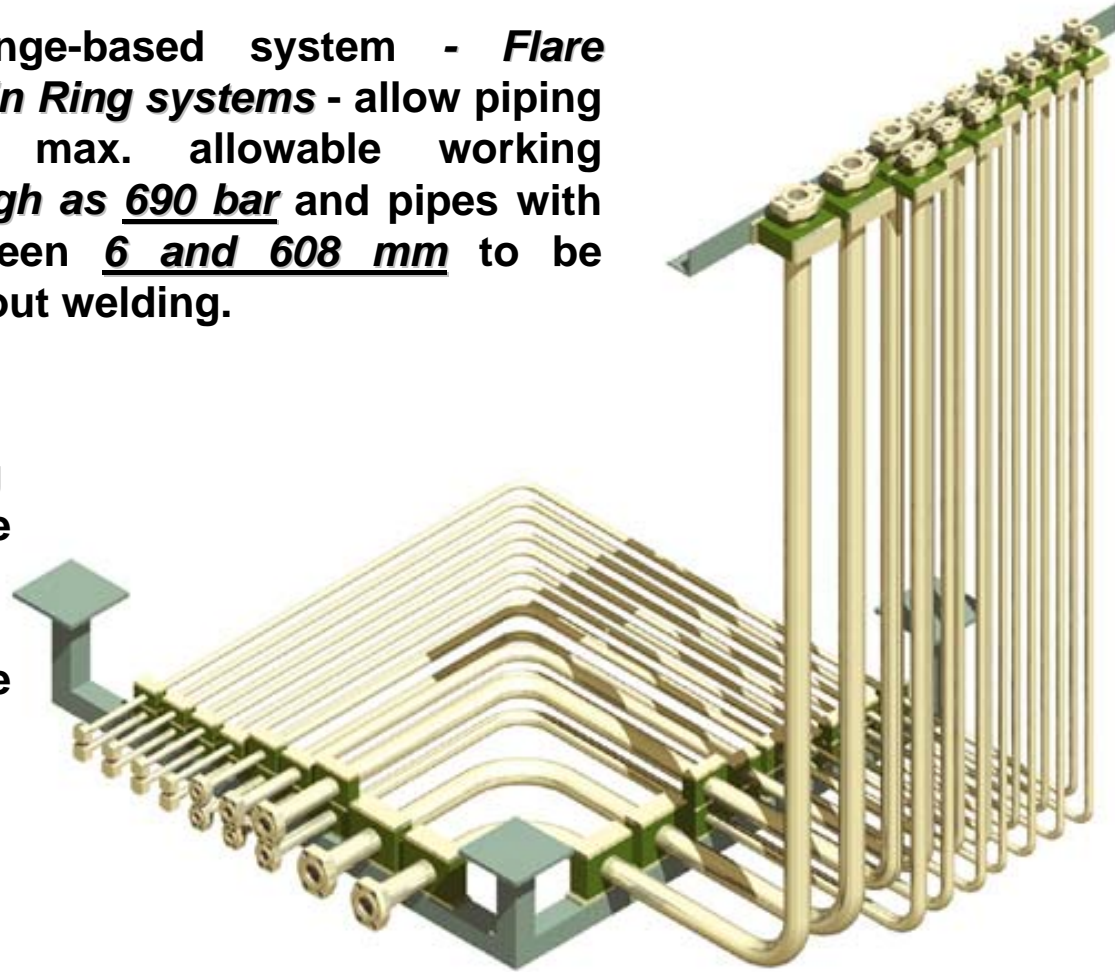
GS-Hydro's flange-based system - *Flare flange and Retain Ring systems* - allow piping systems with max. allowable working pressures as high as 690 bar and pipes with diameters between 6 and 608 mm to be assembled without welding.

High pressure

- **GS Retain ring**
- **37° flare flange**

Low pressure

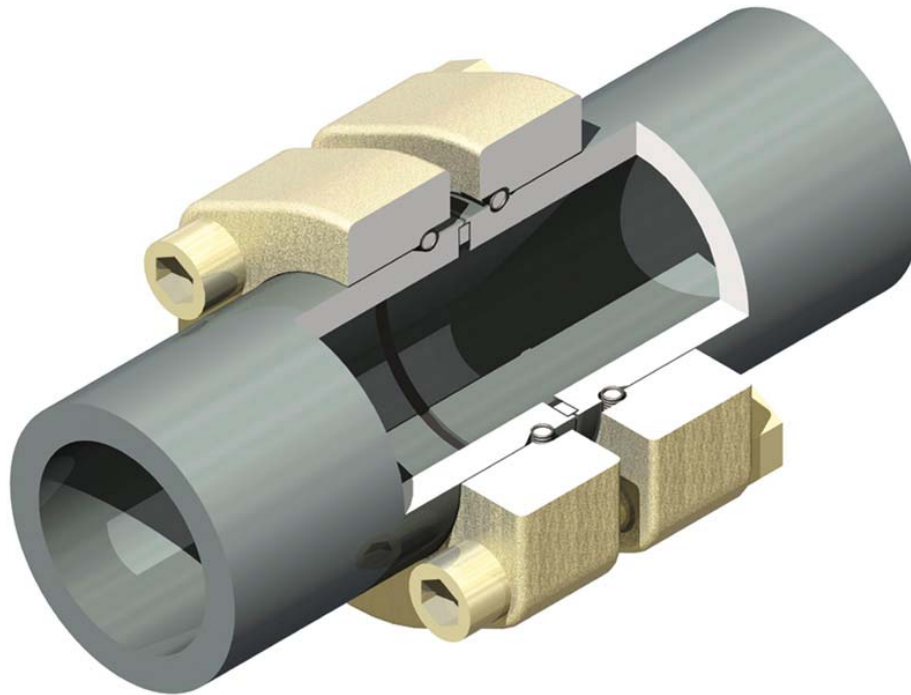
- **90° flare flange**



Prefabricated Piping Systems Introduction - *Technology*

GS Retain Ring System

	SAE 3000	SAE 6000	ISO 6164
pressure, bar	210 - 350	420	210 - 690
size, pipe	26x6 - 97x12	26x6 - 66x8.5	60.3x11,04 - 355.6x41,4
size. flange	1/2" - 3"	1/2" - 2"	2" - 14"



Prefabricated Piping Systems Introduction - *Technology*

GS Retain Ring System - Construction and Assembly

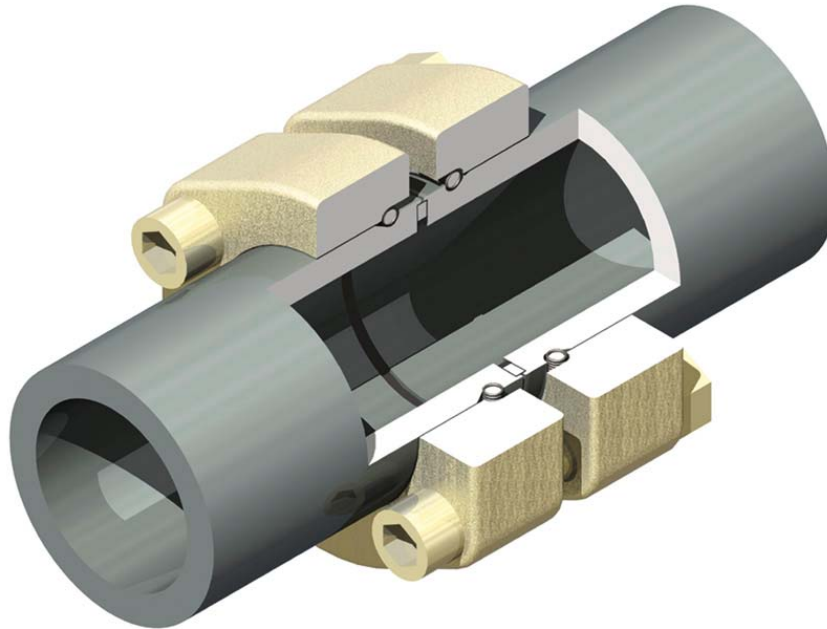
- Pipe ends are preworked (grooved)
- GS flange is fitted onto the pipe end
- A flexible retain ring is stretched by hand over the groove at the end of the pipe
- A seal is placed between the pipe ends
- The flange screws are tightened



Prefabricated Piping Systems Introduction - *Technology*

GS Retain Ring System - Operating principle

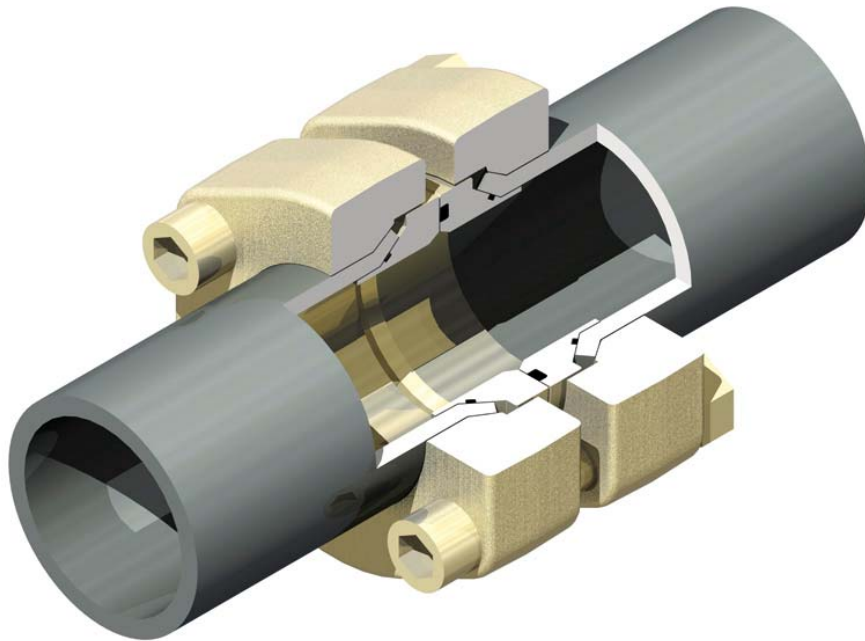
- Screws and flanges press against seal
- Pressure acts against bonded seal lips increasing tightness of connection
- Retain ring, flanges and screws absorb normal axial forces and shocks



Prefabricated Piping Systems Introduction - *Technology*

37° Flare Flange System

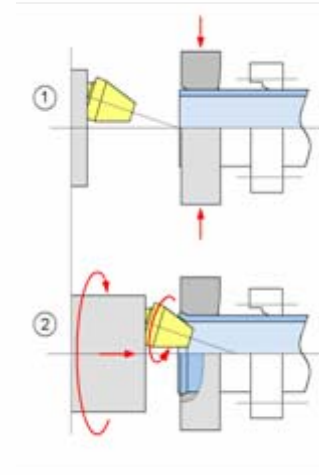
	SAE 50	SAE 3000	SAE 6000
pressure, bar	< 50	210 - 350	420
size, pipe	50x3 - 273x6	16x2 - 90x5	16x2 - 60x5
size, flange	1 1/2" - 10"	1/2" - 3"	1/2"-2"



Prefabricated Piping Systems Introduction - *Technology*

37° Flare Flange System - Construction and Assembly

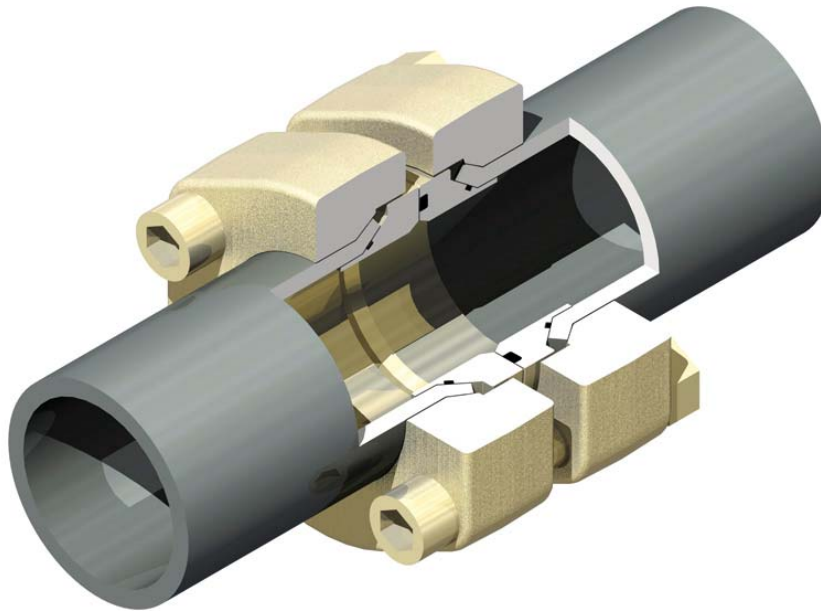
- Consisting of three parts: flange, sleeve and cone
- GS flange is fitted onto the pipe
- Pipe end is flared
- Insert cone is pressed into the pipe end
- Seal is placed between pipe ends
- Flange screws are tightened



Prefabricated Piping Systems Introduction - *Technology*

37° Flare Flange System - Operating principle

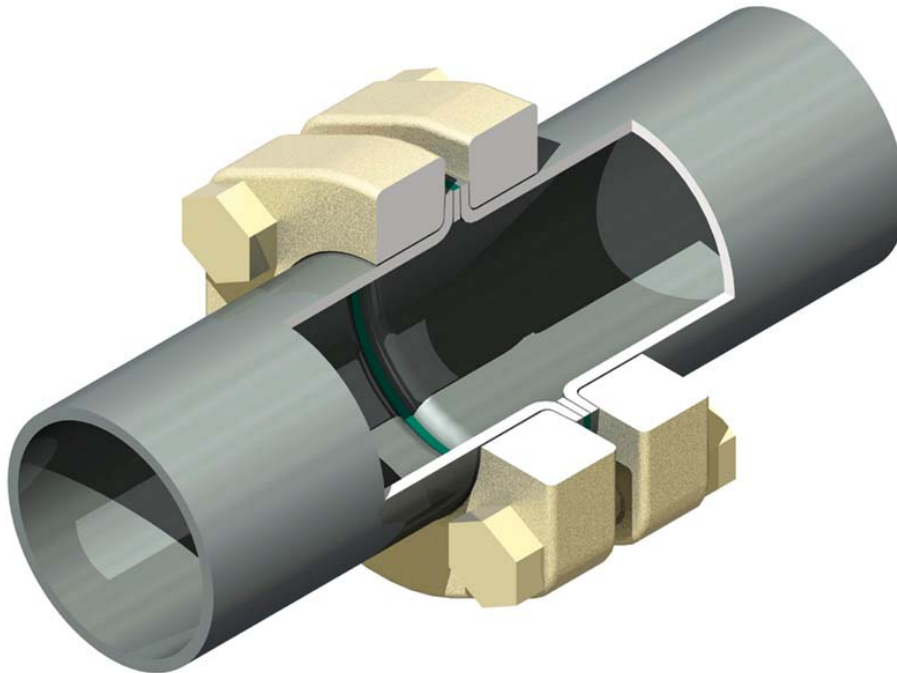
- Screws and flanges press against seal
- The flared end is clamped between two surfaces: cone and sleeve. The sealing effect is maintained without any deformation



Prefabricated Piping Systems Introduction - *Technology*

90° Flare Flange System

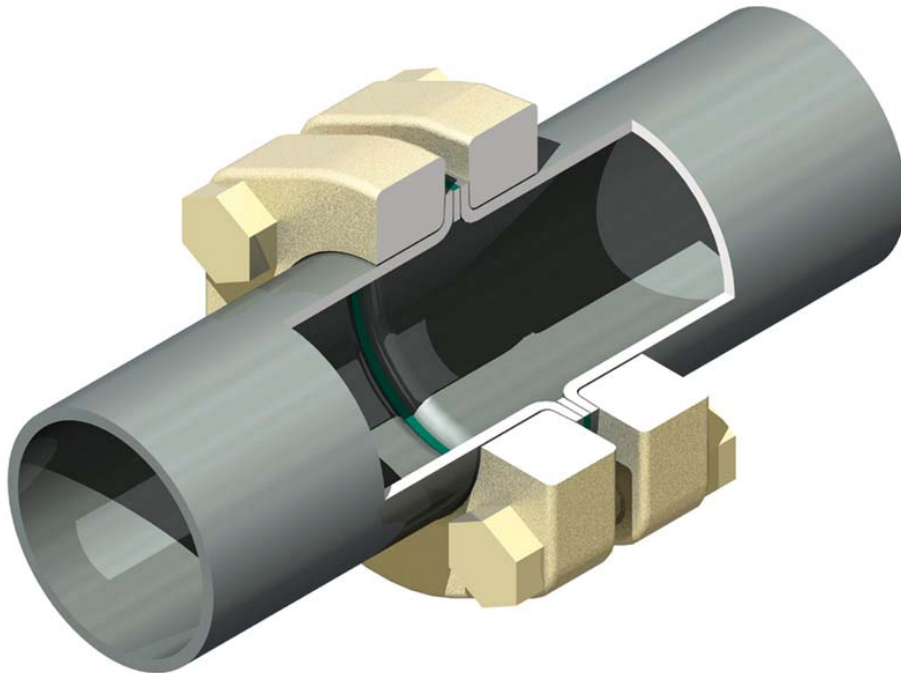
	SAE	DIN/BS
pressure, bar	10 - 40	10 - 40
size, pipe	16x1.5 - 220x6	21.3x2.1- 406.4x8.8 (608x12.5)
size, flange	1/2" - 8"	1/2" - 16 (24")



Prefabricated Piping Systems Introduction - *Technology*

90° Flare Flange System - Construction and Assembly

- Consisting of flange alone
- GS flange is fitted onto the pipe
- Pipe end is flared
- Seal is placed between pipe ends



Prefabricated Piping Systems Introduction - *Technology*

90° Flare Flange System - Operating principle

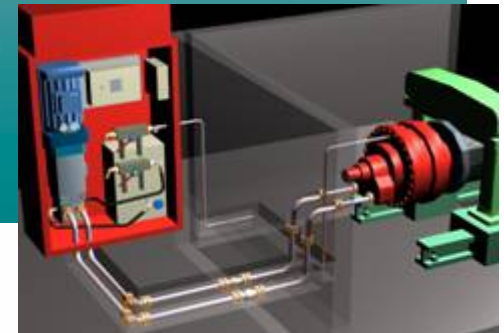
- Screws and flanges press against seal
- The flared ends is clamped against each other with seal in-between



Prefabricated Piping Systems Introduction

Engineering

- Process design
- Mechanical design
- Layout design
(*in 2D or 3D*)
- Prefabrication design
- Installation design
- Documentation



Prefabricated Piping Systems Introduction

Material and component supply

- Piping (material)
- Piping components
 - flanges, elbows, tees, adaptors etc.
 - couplings
 - clamps
 - valves
 - hoses etc.



Prefabricated Piping Systems Introduction

Prefabrication

- Cold and induction bending
- 37° and 90° flaring
- Retain ring machining
- Welding / X-ray / pressure testing
- Cleaning – painting
- Packing – transportation



Prefabricated Piping Systems Introduction

On-site Services

- Supervision
- Installation
- Start-up and commissioning
- Testing
- Flushing



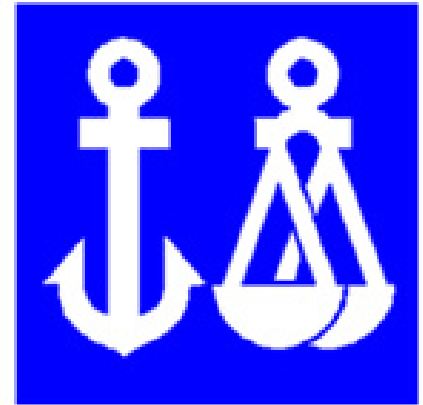
Prefabricated Piping Systems Introduction

Documentation

- [Hydraulic Circuits]
- Layout drawings (piping)
- Part lists (material take-off)
- Material certificates
- Test reports
- Approvals from agencies

- ↓ DNV
- ↓ Lloyd's Register of shipping
- ↓ Germanischer Lloyd'
- ↓ American Bureau of Shipping
- ↓ Bureau Veritas
- ↓ Registro Italiano Navale
- ↓ Maritimo Register of Shipping
- ↓ Nippon Kajii Kyokai
- ↓ etc.

ISO 9001

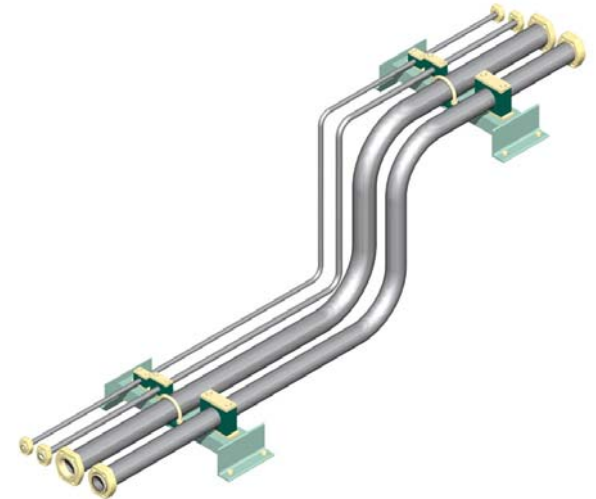


**CERTIFICATED
FIRM**

Prefabricated Piping Systems Engineering

Engineering

- Process design
 - pipe sizing
 - pressure drop calculations etc.
- Mechanical design
 - connection technology
 - material selection
 - pipe class selection
 - stress analysis for piping / supports
 - stress analysis for flanges
- Layout design (in 2D or 3D)
 - layout drawings (pipe routing)
- Prefabrication design
 - workshop (piece/spool) drawings
 - piping support drawings
- Installation design
 - assembly and installation drawings
 - assembly and installation manuals



Prefabricated Piping Systems Engineering - *Process Design*

Basic Design Data

- Hydraulic circuits* (P&ID's) with process design data (m, p, T), **and either...**
 - a) including pipe sizes **or**
 - b) with sufficient information for pipe size selection
 - * pump capacities, design/max.**
 - * flow rates for equipment and machinery (e.g. hydraulic motors, cylinders); design/max.**
 - * operating pressure(s)
 - * operating temperature
 - + piping specification (*design requirements incl. max. velocity/pressure drop etc.*)

NOTE!

* for complete process, including Hydraulic Power Units

** pump design flow is not necessarily = Σ flow to equipment, as all equipment might not be in operation simultaneously

Prefabricated Piping Systems Engineering - *Process Design*

If pipe sizes are provided on the Hydraulic Circuits, the closest GS-Piping System size is selected *with matching ID & required wall thk.*

Pipe Sizing

- initial design based on velocity (*max. v [m/s]*)
- sizing checked by pressure drop calculation (*based on acceptable Δp [bar]*) after layout design (pipe routing) and mechanical design (wall thk) completed

Prefabricated Piping Systems Engineering - *Mechanical Design*

Basic Design Data

- Piping specification, *including*
 - * *material specifications*
 - * *jointing/connection technology*
 - * *other requirements*
- Max. allowable working pressure / design pressure
- Design temperature
- Application (*especially in case of Marine and Off-shore!*)
- Classification requirements
- Other requirements (stress analysis etc.)



Prefabricated Piping Systems Engineering - *Mechanical Design*

Selection of connection / jointing technology

- 37° flare flange, Retain ring, Walforn, JIC etc.
- Based on pipe size (OD x wall thickness) and max. working pressure

Material selection

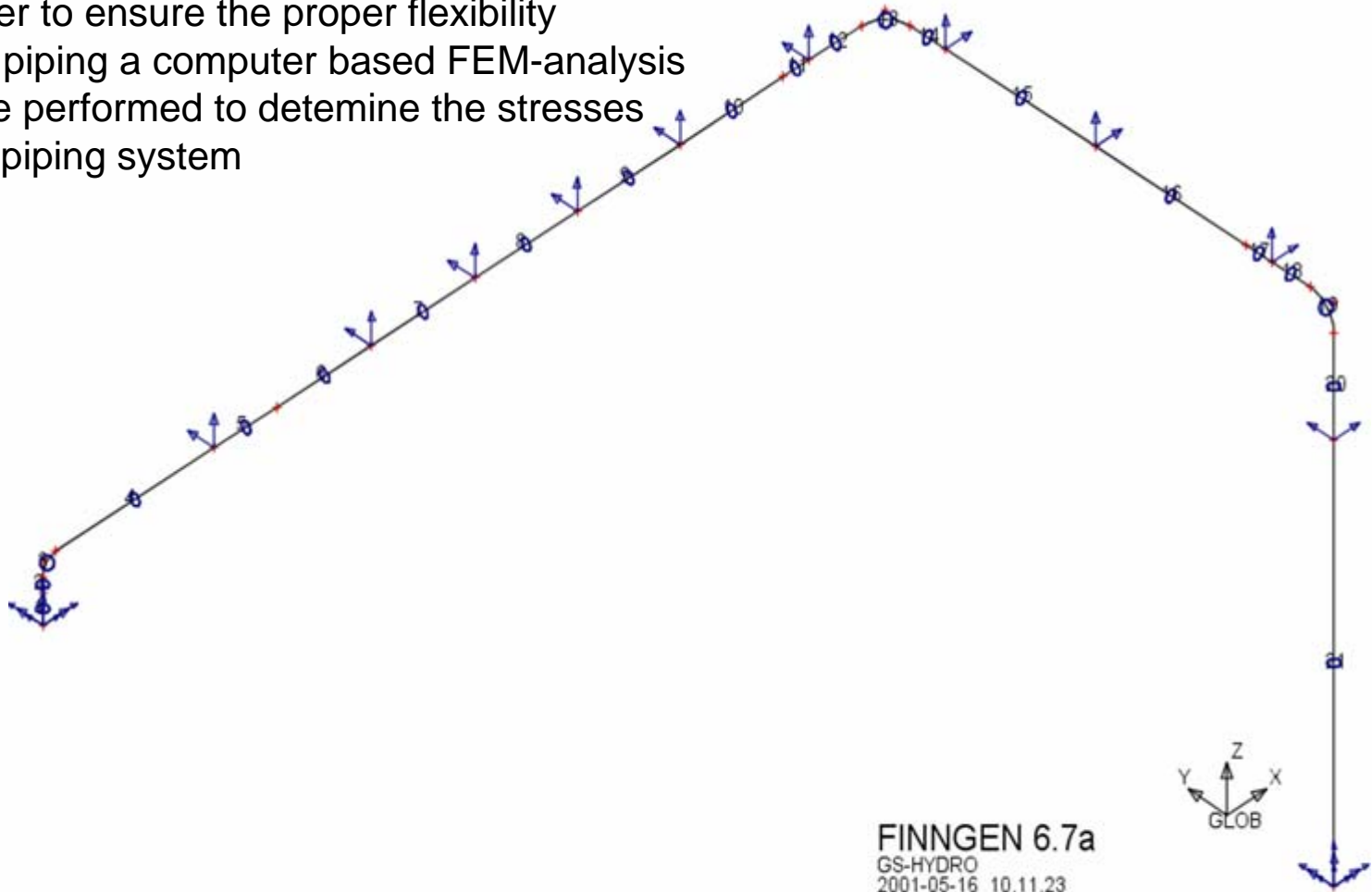
- St 37.4, St 52.4, AISI316L, CuNi, Titanium etc.
- Based on environmental conditions (corrosion etc.)

Pipe class

- Determination of wall thickness (pipe size e.g. 60x5)
- Based on code, working pressure, pipe OD

Prefabricated Piping Systems Engineering - *Mechanical Design*

In order to ensure the proper flexibility of the piping a computer based FEM-analysis can be performed to determine the stresses in the piping system

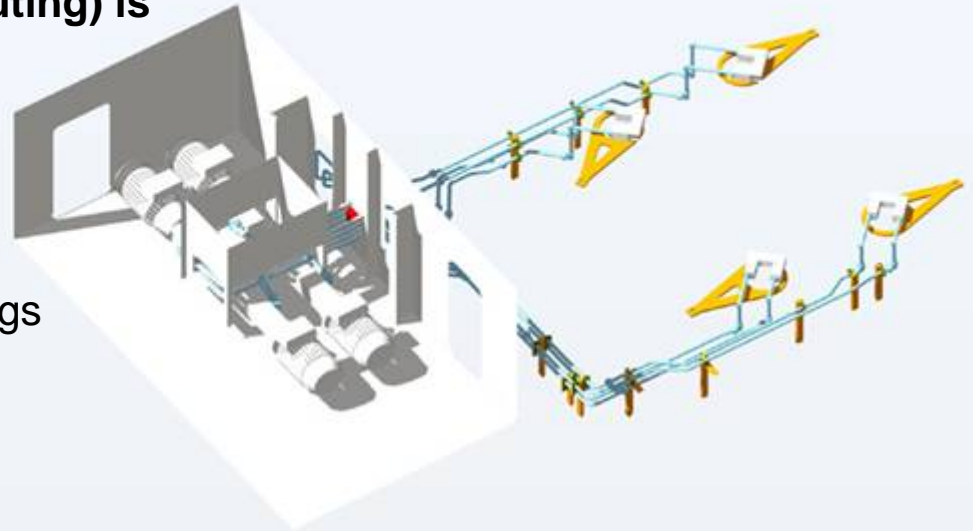
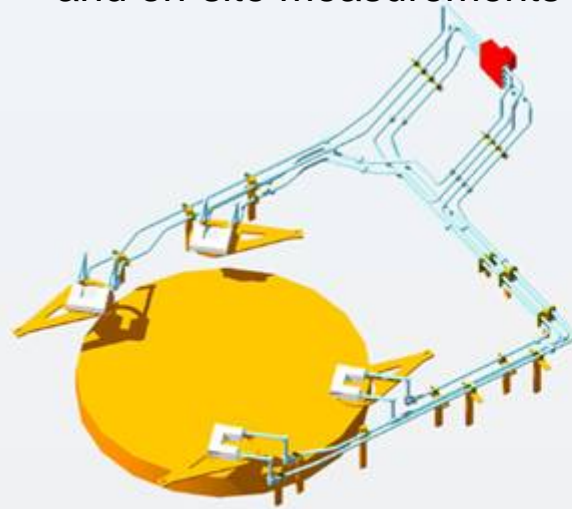


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GS-HYDRO
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Prefabricated Piping Systems Engineering - *Layout Design*

Piping layout design (pipe routing) is done either in 2D or 3D based on...

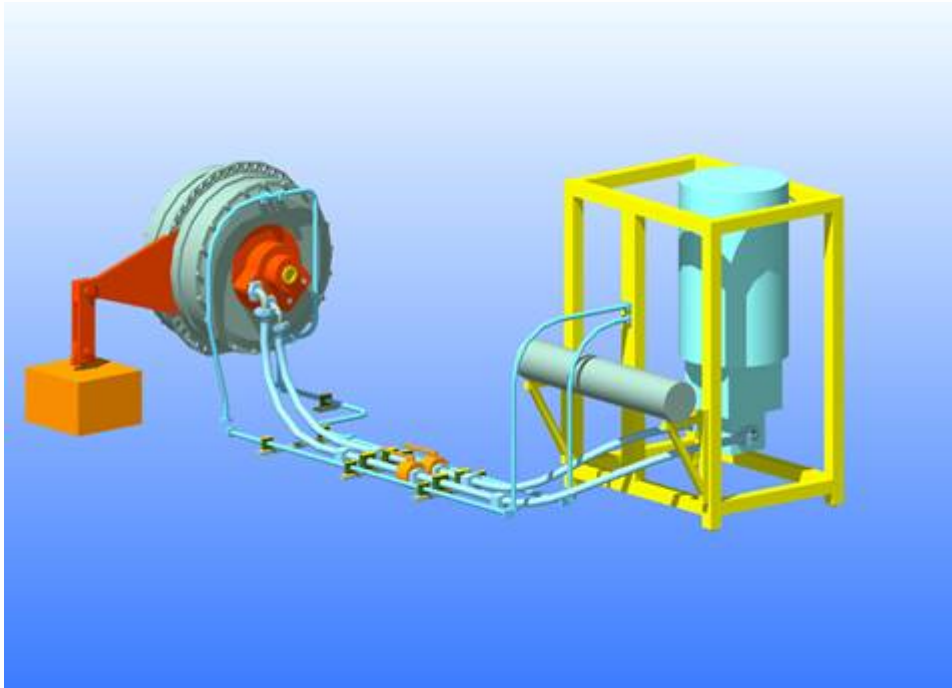
- a) layout/sectional/dimensional drawings,
- b) on-site measurements **or**
- c) with a combination of drawings and on-site measurements



Prefabricated Piping Systems Engineering - *Layout Design*

General Piping Layout (*in 2D or 3D*) is prepared to show how the piping will be routed, either for

- a) informative purposes only (to show principally the intended pipe routing **or**
- b) as the basis for the drawings needed for (pre)fabrication.



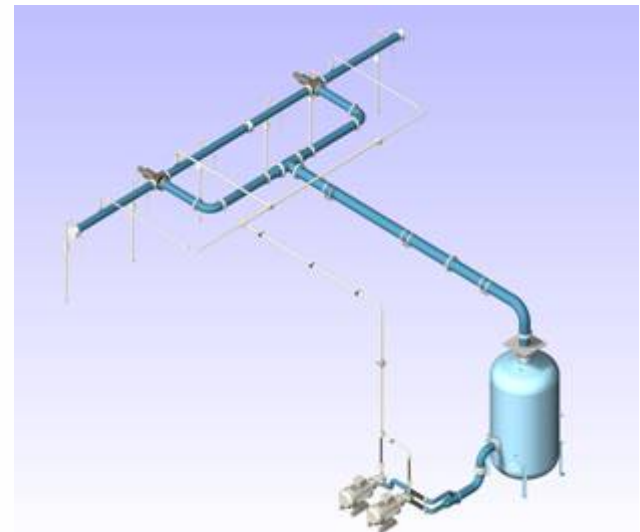
Prefabricated Piping Systems Engineering - *Layout Design*

Basic Design Data

- Layout drawings and/or sectional drawings
 - * showing (exact) location of equipment/machinery
 - * showing restrictions (walls, steel structures etc.) to be taken into account when selecting pipe routing (piping layout)
 - * providing exact dimensions*
 - Dimensional drawings of equipment/machinery showing tie-in points:
 - * exact location (of tie-in point)
 - * type of connection
 - * size
 - * pressure rating
 - * type of seal
- (• Hydraulic circuit)

***NOTE!**

If exact dimensions are not provided (drawings), site measurements have to be made to ensure correct dimensions for prefabrication.

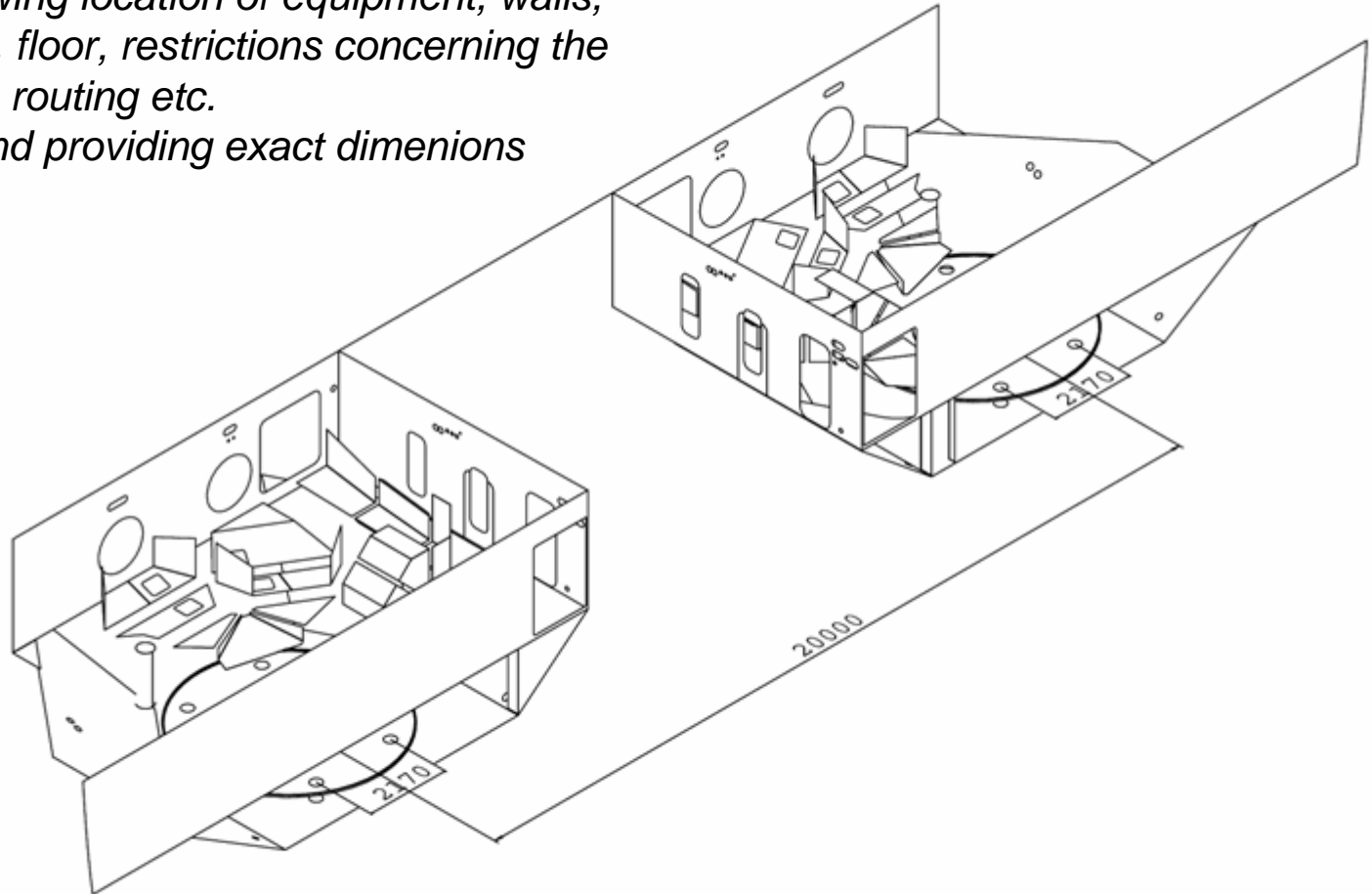


Prefabricated Piping Systems Engineering - *Layout Design*

Layout design based on drawings

*...showing location of equipment, walls,
roof, floor, restrictions concerning the
pipe routing etc.*

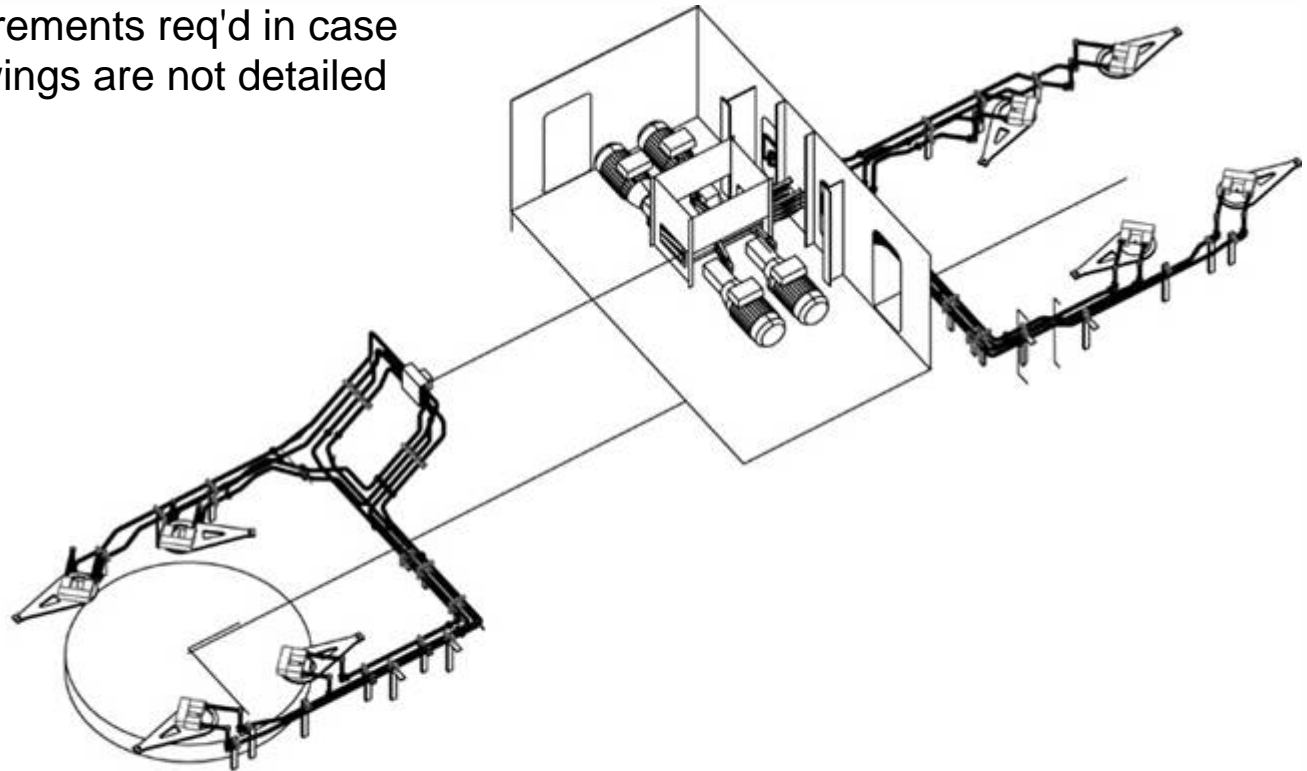
...and providing exact dimensions



Prefabricated Piping Systems Engineering - *Layout Design (Pipe Routing - general)*

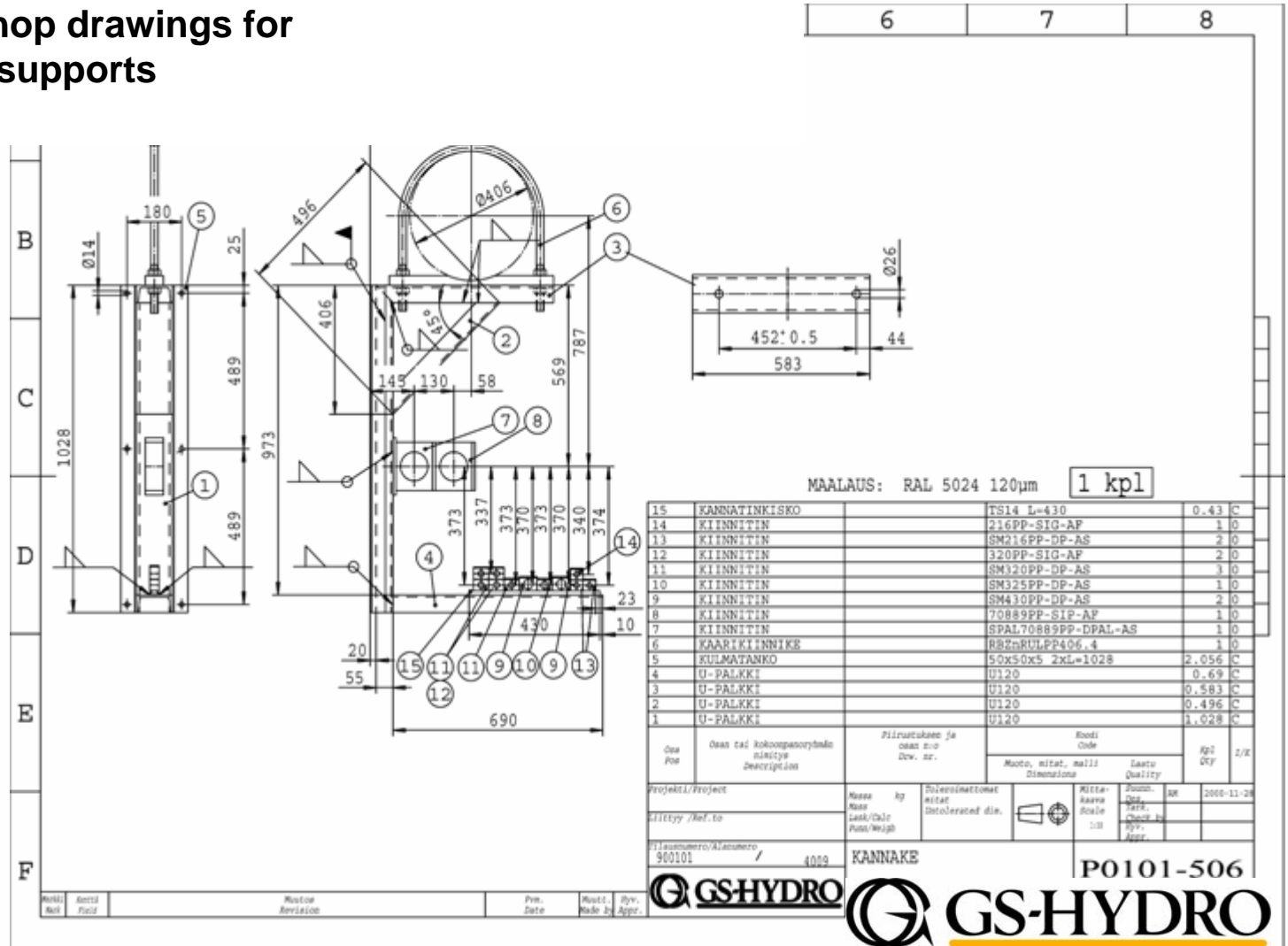
General Piping Layout is prepared to show how the piping will be routed

- ⇒ customer approval needed prior to detailed design
- ⇒ site measurements req'd in case layout drawings are not detailed enough



Prefabricated Piping Systems Engineering - Prefabrication Design

Workshop drawings for
piping supports



Prefabricated Piping Systems Engineering - Installation Design

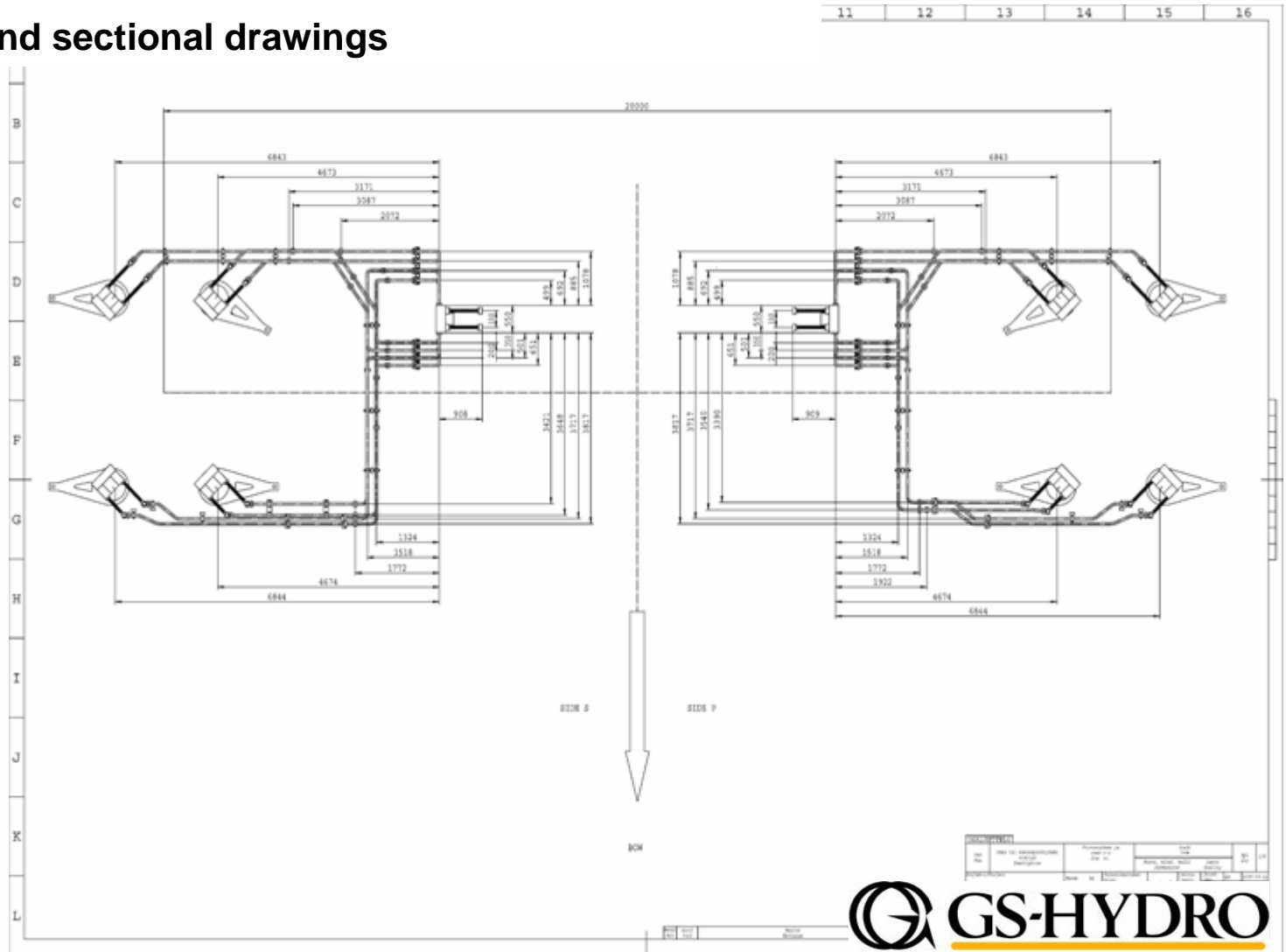
Assembly drawing(s), incl. parts lists

The drawing shows a complex piping system with various components labeled with callouts. The system is oriented with 'SIDE P' and 'SIDE S' indicated. A grid system is used for reference, with letters B through L on the left and numbers 8 through 16 at the top.

QTY	DESCRIPTION	REF.	UNIT
1	FLANGE	10000-1	FL
1	FLANGE	10000-2	FL
1	FLANGE	10000-3	FL
1	FLANGE	10000-4	FL
1	FLANGE	10000-5	FL
1	FLANGE	10000-6	FL
1	FLANGE	10000-7	FL
1	FLANGE	10000-8	FL
1	FLANGE	10000-9	FL
1	FLANGE	10000-10	FL
1	FLANGE	10000-11	FL
1	FLANGE	10000-12	FL
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1	FLANGE	10000-98	FL
1	FLANGE	10000-99	FL
1	FLANGE	10000-100	FL

Prefabricated Piping Systems Engineering - Installation Design

Plan and sectional drawings



Prefabricated Piping Systems Engineering - *Installation Design*

**Installation and Assembly Manuals
provide the necessary instructions
for installation and assembly.**



Prefabricated Piping Systems Material and Component Supply

Availability of all necessary materials and components for a complete piping system

- * piping
- * valves
- * flanges, fittings, couplings
- * clamps
- * hoses etc.

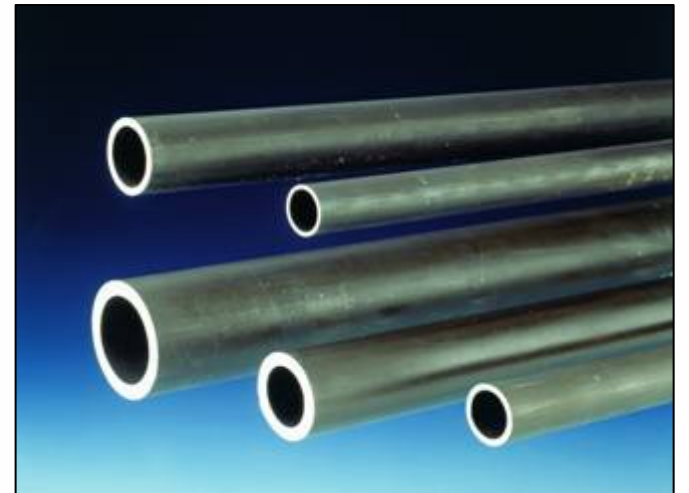
+ availability of flanged elbows, tees, reducers adaptors etc.



Prefabricated Piping Systems Material and Component Supply

GS-Hydro Products

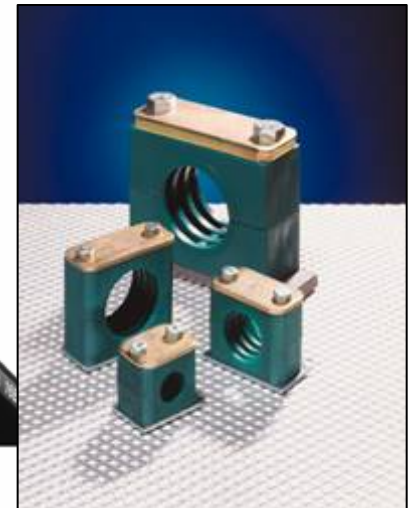
- Pipes and tubes
 - Cold drawn St 37.4 and St 52.4
 - AISI 316L - Duplex
 - Copper-Nickel and Titanium
 - Size range: 12-600 mm
- Flanges (for 37° and 90°) and retain ring



Prefabricated Piping Systems Material and Component Supply

GS-Hydro Trading Products

- Couplings / Connectors / Fittings
- Flared couplings
- DIN 2353 couplings
- Clamps
- Valves
- Hoses and couplings
- Plugs



Prefabricated Piping Systems Prefabrication

Prefabrication is done in workshop to ensure optimum fabrication conditions and a flexible, fast and easy installation.

On-site (pre)fabrication - cutting, bending, flaring and grooving - is done, as needed, with portable machines.



Prefabricated Piping Systems Prefabrication



Cutting
prefabrication starts with
accurate cutting to length...

Prefabricated Piping Systems Prefabrication

Bending

...followed by cold or induction bending to a radius of typically 2-3 times the OD of the pipe



Prefabricated Piping Systems Prefabrication



Flaring

...after which the pipe is either flared...



Prefabricated Piping Systems Prefabrication



Grooving

...or grooved to complete
the prefabrication



Prefabricated Piping Systems Prefabrication

**Cleaning, painting,
pressure testing etc.**
...is done in accordance with the
customer's requirements.



Prefabricated Piping Systems On-site Services

On-site services include

- supervision
- assembly and installation
- flushing
- testing

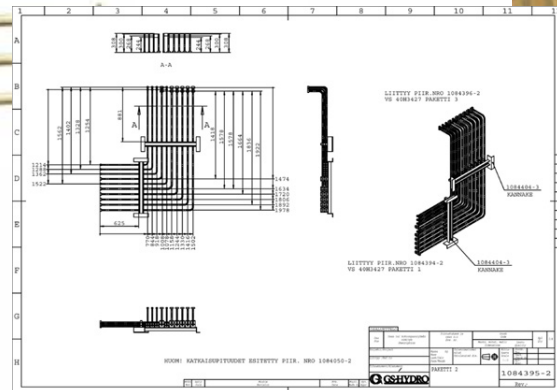
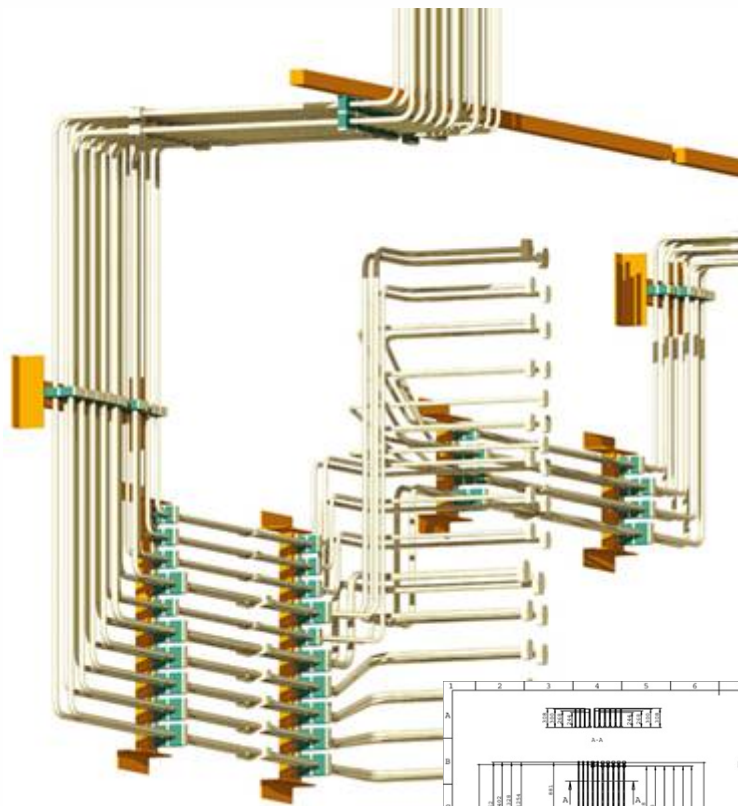
On-site Installation



Flushing

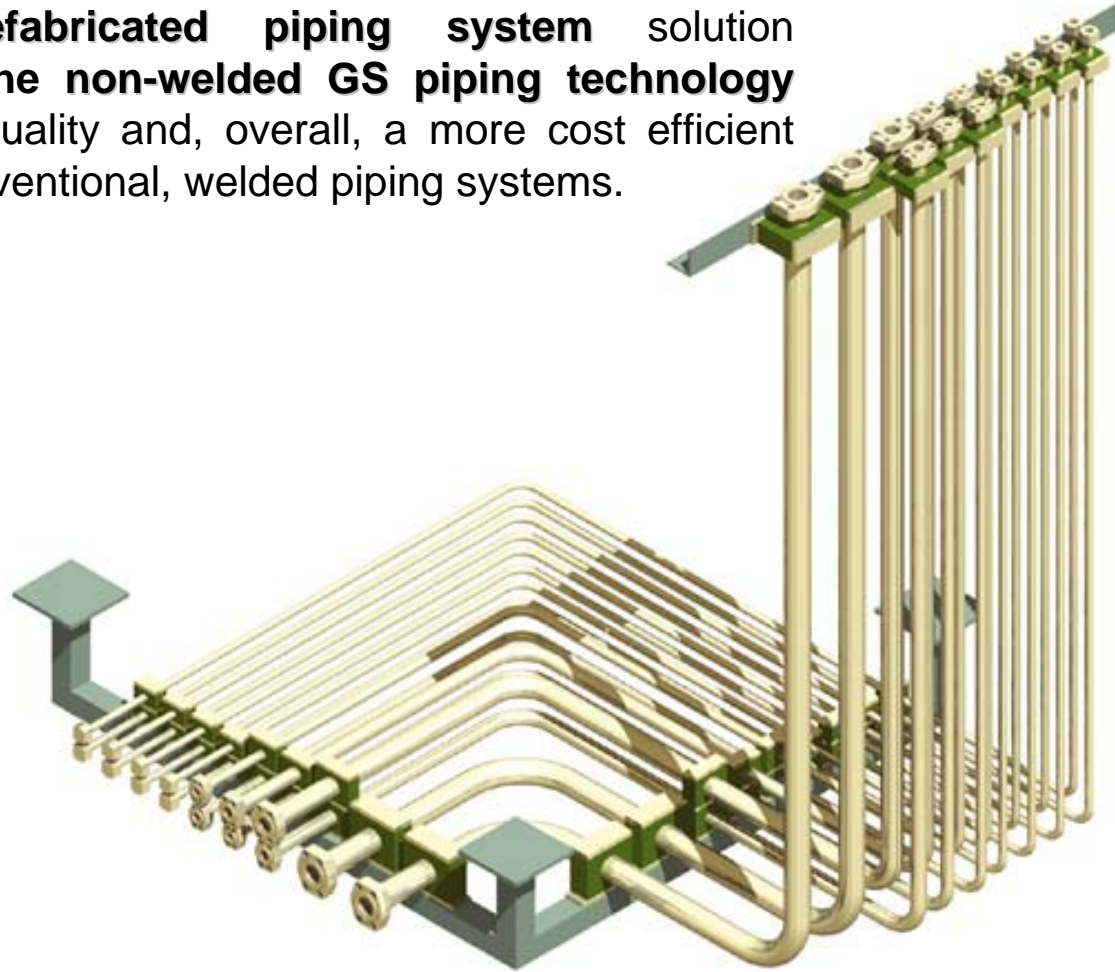
PIPING WITHOUT WELDING

Prefabricated Piping Systems Complete Prefabricated Piping Systems



Prefabricated Piping Systems Advantages

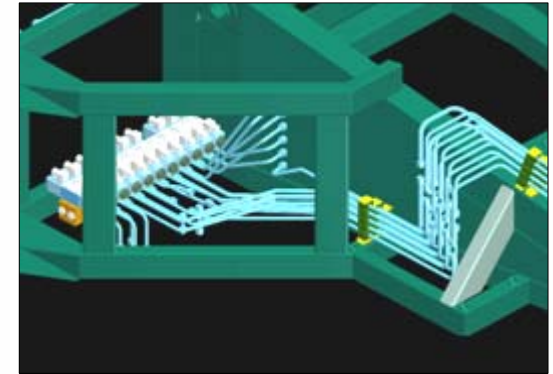
GS-Hydro's **prefabricated piping system** solution combined with **the non-welded GS piping technology** offers a higher quality and, overall, a more cost efficient alternative to conventional, welded piping systems.



Prefabricated Piping Systems Advantages

Complete prefabricated piping systems

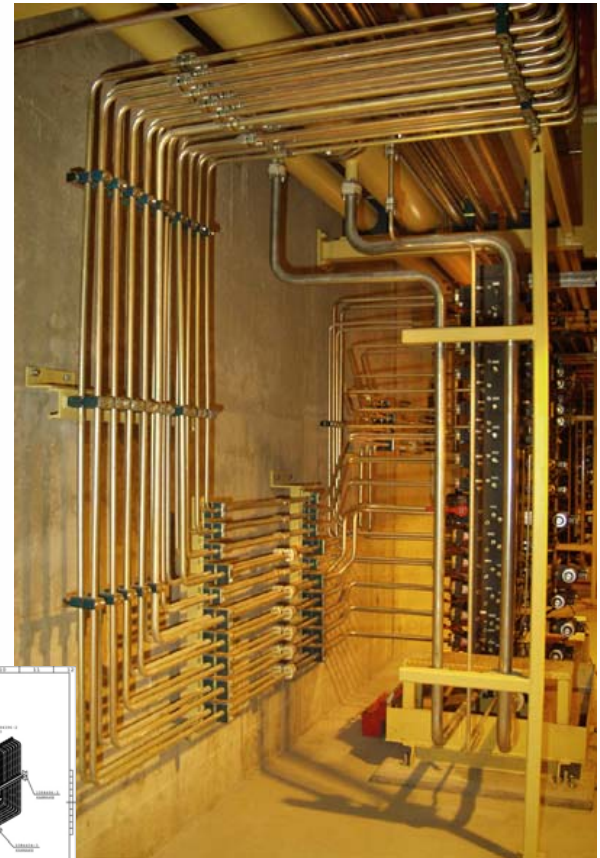
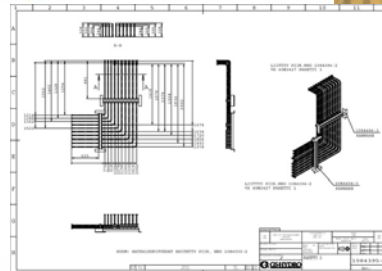
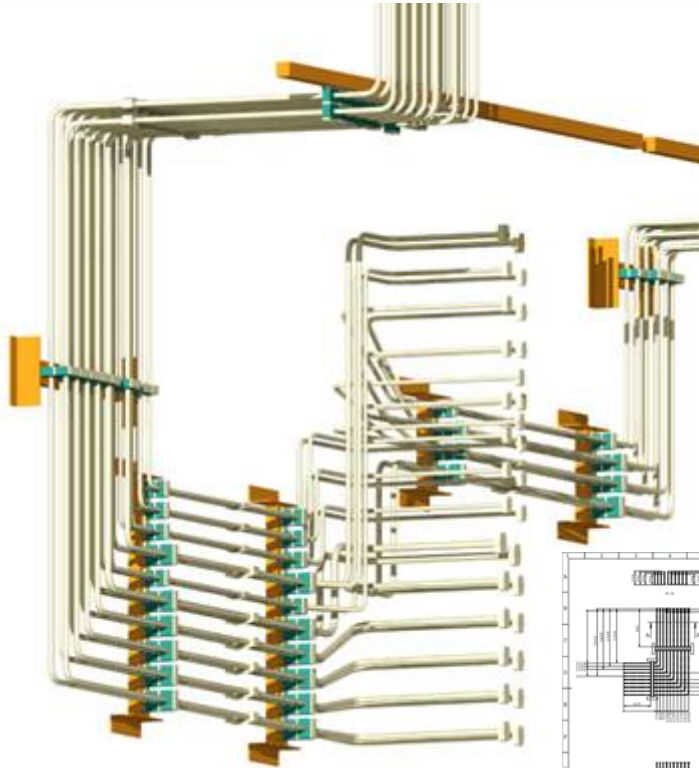
- Total responsibility gives possibility to optimise each phase of the delivery
 - Minimised amount of interfaces ensure efficient, fast and accurate project execution
- ⇒ **all benefits of a dedicated hydraulic piping engineering office, fabrication workshop and installation team without the continuous overhead costs**



Prefabricated Piping Systems Advantages

State-of-the-Art Engineering

- Complete engineering services from one, experienced source
- State-of-the-art design tools
- All necessary documentation incl. certificates



Prefabricated Piping Systems Advantages

Materials & Components for the Most Demanding Projects

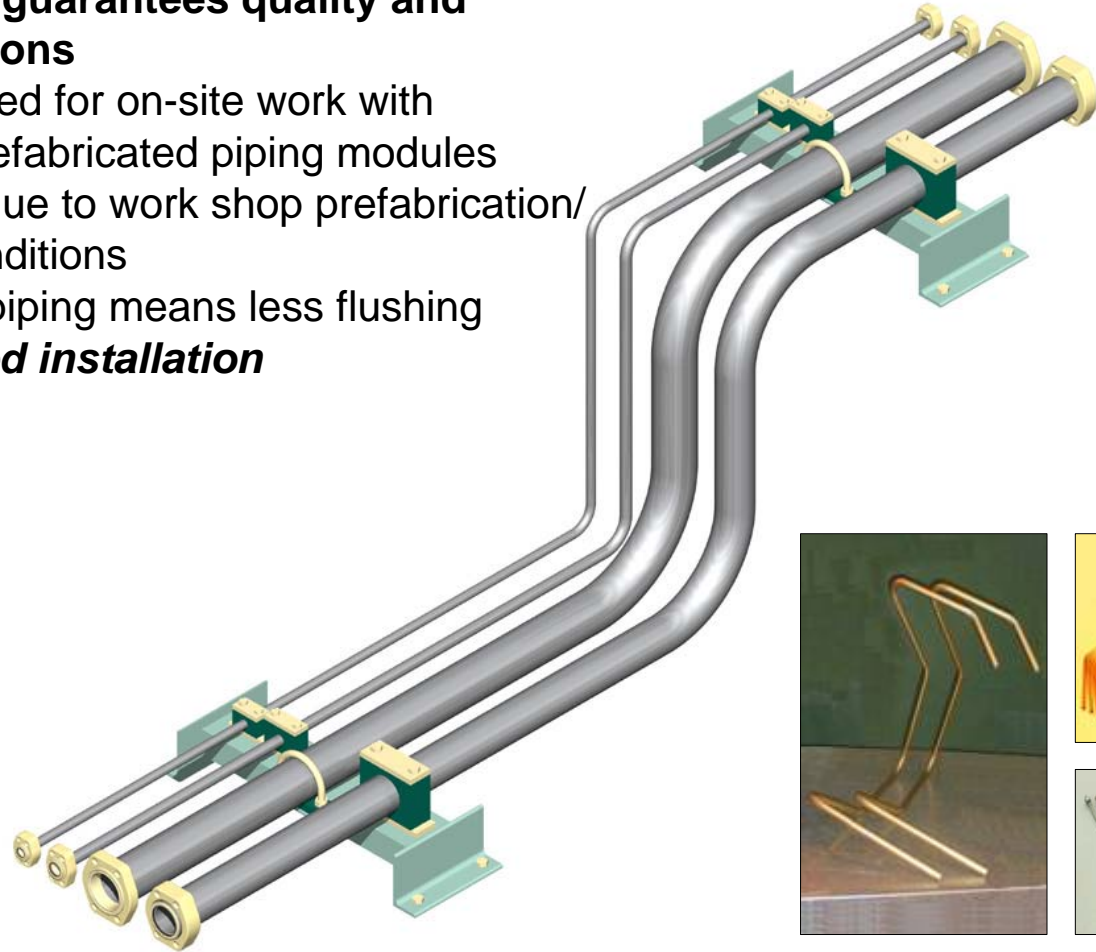
- Availability of all necessary materials and components
- High quality materials and components
- Large stock ensures quick, on-time deliveries



Prefabricated Piping Systems Advantages

Prefabrication guarantees quality and quick installations

- Minimised need for on-site work with accurately prefabricated piping modules
- High quality due to work shop prefabrication/assembly conditions
- Pre-washed piping means less flushing
⇒ ***optimised installation***



Prefabricated Piping Systems Advantages

On-site Services

- Easy, flexible and fast installation *due to...*
 - accurately prefabricated piping modules: single or multiple
 - full range of components (flanged elbows, tees, adaptors etc.)
 - GS flanges which can be rotated
 - absence of welding and associated x-raying,
 - post-weld cleaning
 - less flushing due to inherent cleanliness
- Efficient use of materials - minimised material wastage
- Accurate site-work costing already at design stage
- Greatly reduced site time and lower overall costs



Prefabricated Piping Systems Advantages of 'Piping without Welding'-technology

- ↓ Simple, reliable, flexible and safe
- ↓ Suitable for all different materials
- ↓ Proven, leak-free technology
- ↓ Highest level of cleanliness, intrinsically clean
- ↓ Fast, easy and flexible to install
- ↓ Easy and fast to use for repair and maintenance
- ↓ Small space requirement
- ↓ Leads to lower overall piping system cost
- ↓ Approved by numerous classification agencies

