

Innovative Piping Solutions



INTRODUCTION...

From Innovator to Global Provider of Complete Piping Systems

GS-Hydro has developed an innovation in non-welded piping technology into a truly global piping business. From a manufacturer of flanges the company has evolved into the world's leading supplier of "Piping without Welding". Today GS-Hydro supplies complete, non-welded piping systems, piping modules and piping components to customers world-wide. The innovative GS Piping System is primarily used in hydraulic applications, but it is also ideal for other, both low and high pressure, applications with high demands on quality, reliability and cleanliness.

GS-Hydro was founded in Finland in 1978. The first foreign subsidiary was established in Norway in 1982 and the business was primarily directed towards the Marine industry in which the reliability and cleanliness of the non-welded piping system combined with the flexible engineering and the fast and cost efficient installation were quickly seen as major benefits when constructing hydraulic and other high pressure piping systems. The oil industry in the North Sea expanded during the 1980's and the Offshore industry - which is one of the many industries for which the GS-Piping System is the optimum piping solution - became an

World's leading supplier of Piping without Welding

GS-Hydro's non-welded piping system is utilised by customers in different industry segments for a wide range of demanding applications: aluminum presses and harbour cranes, steel production machinery, aerospace and automotive test equipment, scrap cutters, shredders, pulpers and paper machines are among the equipment and machinery which have been fitted with the GS Piping System along with more than 6000 ships, 90 drilling rigs and numerous oil and gas platforms.

*The core of GS-Hydro's technology consists of two innovative flange systems, the **Flare Flange and Retain Ring** systems, which allow piping systems with working pressures from 10 to 690 bar and pipe diameters between 16 and 608 mm to be assembled without welding.*

The inherently clean and fast-and-easy-to-install GS Piping System provides a higher quality and a more cost efficient alternative to conventional, welded piping systems.

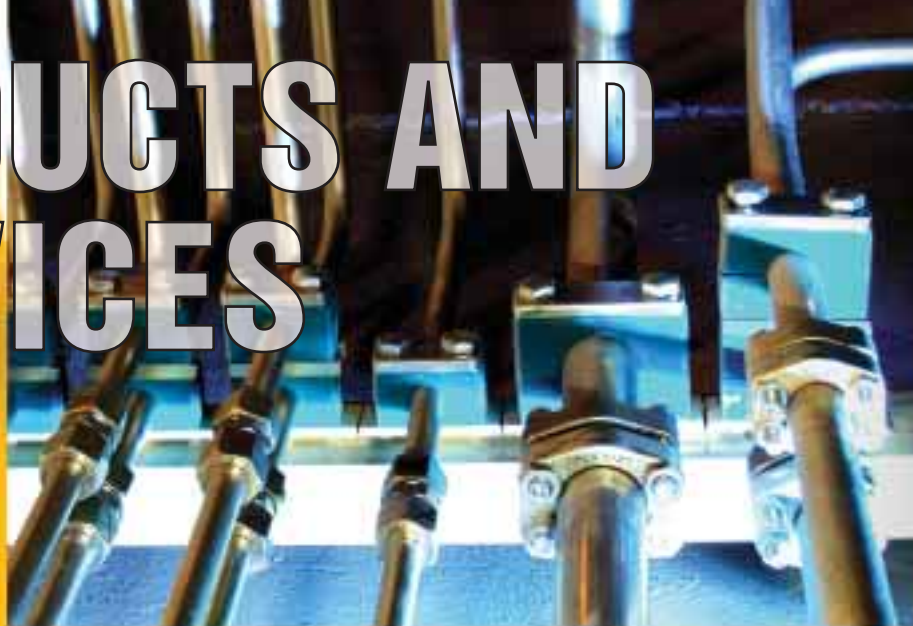




increasingly important customer segment. Subsidiaries were established during the 1980's in Sweden, Denmark, the Netherlands, and Germany. Sales to land-based industries such as Construction & Mobile Equipment, Aerospace & Defence and Pulp & Paper subsequently increased. During the 1990's, growth continued with new subsidiaries being established in Spain, the UK, Poland, Russia, the USA and Korea. The first subsidiary of the new millennium was established in Shanghai, China.

Today, GS-Hydro is a global provider of complete, non-welded piping solutions with operations in more than twenty-five (25) countries. GS-Hydro operates through fifteen (15) subsidiaries, as well as through agents and representatives. The company delivers non-welded piping solutions covering complete piping systems (including design & engineering, materials & components, prefabrication and on-site services), customised, prefabricated piping modules, and separate piping components and materials. The GS Piping System is used in a wide variety of applications by customers in different industries ranging from the Marine and Offshore industries to the Aerospace & Defence, Automotive, Construction & Mobile Equipment, Metals & Mining, Pulp & Paper, Wood & Forestry, Plastics & Rubber, Recycling, Power and Sugar industries.

PRODUCTS AND SERVICES



Complete, Non-welded Piping Solutions

GS-Hydro's full range of products and services covers complete, non-welded Piping Systems, customised, prefabricated Piping Modules and separate Piping Components, as well as the machines needed for the fabrication and preparation of a non-welded piping system.

from complete Piping Systems...

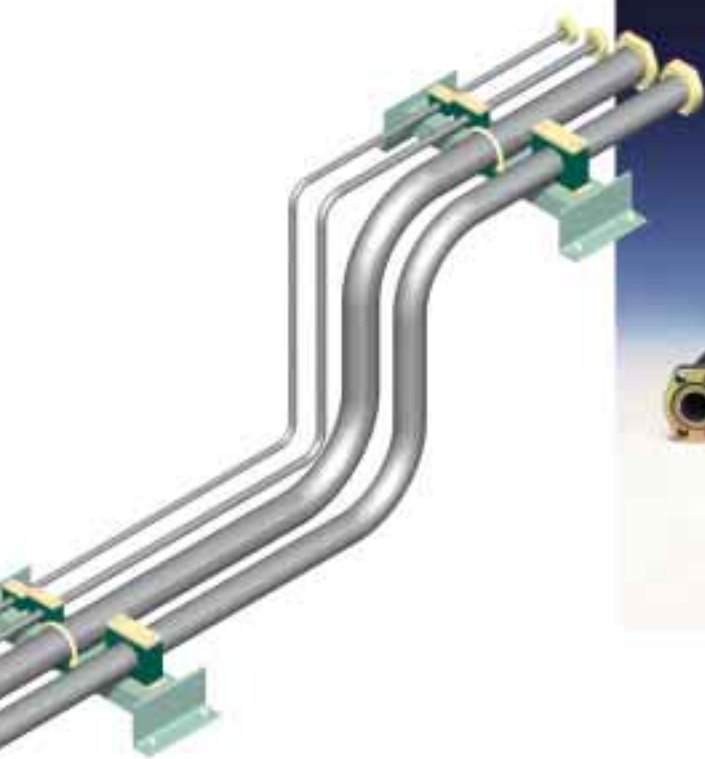
GS-Hydro's state-of-the-art **Engineering** forms the basis for the precise prefabrication of the piping modules that are used to construct the non-welded piping system. By creating a 3D model of the piping, it is possible to ensure correct routing and optimum layout, and also to evaluate the ease of installation. If necessary, a computer-based FEM-analysis can be performed to determine stresses in the piping system. GS-Hydro's complete engineering services cover essentially everything from creating the specification for the piping to layout design, parts lists, and the necessary documentation.

GS-Hydro keeps a large stock of **Piping and Piping Components** to ensure that deliveries are carried out on time - even in large, demanding projects. One of the reasons why the GS piping system is so flexible and quick to install is the availability of a wide range of flanged elbows, tees, reducers and adaptors. A comprehensive range of high-pressure hose assemblies is also available, as well as a full range of valves, couplings and clamps. The large stock also covers cold-drawn, high tensile precision carbon steel and stainless steel piping. In addition, GS-Hydro delivers copper-nickel, titanium and duplex steel piping according to customers' requirements.

Prefabrication begins with the accurate cutting of the pipes to the required length. The pipes are then bent with GS-Hydro's cold bending machines. Non-standard and large diameter pipes are bent using induction bending. After bending, the pipe ends are prepared for flare flanges (flared) or retain rings (grooved). The use of prefabricated piping modules ensures a high quality and fast installation. Using portable machines,



Quality is a key element at GS-Hydro. The company's QA system complies with ISO 9001. In addition to receiving approvals from the world's leading classification societies, GS piping products have undergone rigorous test programmes on behalf of, for instance, several major oil companies.



pipe spools can also be fabricated at the site to allow for adjustments. GS-Hydro's total **On-Site** support and **Services** include supervision and installation services as well as flushing and testing of the non-welded piping system.

To complete the total piping system delivery, GS-Hydro provides a **Documentation** package to suit the customer's demands. The documentation covers installation and assembly manuals and all necessary test reports and material certificates such as 2.2, 3.1.B and 3.1.C, as well as approvals from classification agencies including DNV, ABS, Lloyds, GL, etc.

...to customised Piping Modules...

Customised, prefabricated piping modules consisting of piping and components are delivered to customers ready to be installed. The precise dimensioning and fabrication of the piping modules, which include even pre-engineered supports, ensure high quality as well as fast and easy installation. The serially produced piping modules can either be fabricated on the basis of the customer's drawings or based on engineering and modeling done by GS-Hydro.

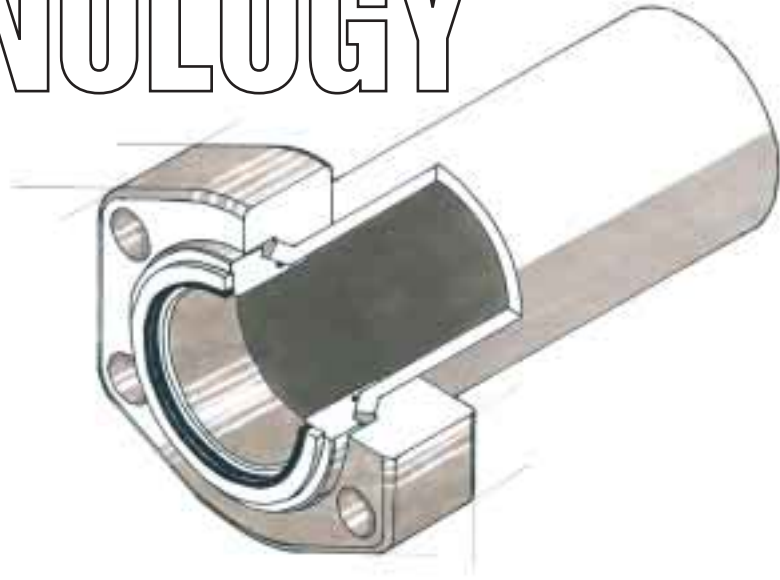
...and separate Piping Components...

In order to guarantee the highest possible level of service and short delivery times - for both repair work and major projects - GS-Hydro maintains a large stock of pipes and a wide variety of separate piping components. These include all necessary parts for a complete hydraulic piping system: piping (material), valves, couplings, fittings, connectors, clamps, hoses, etc. GS-Hydro uses only high-quality subcontractors and partners to complete its piping component orders.

...as well as Machines.

GS-Hydro also supplies or rents a wide variety of machines specifically designed for bending, cutting, end-preparation, and cleaning. For larger projects a complete mobile workshop with all the necessary machines is available.

TECHNOLOGY



Innovative Piping without Welding-technology

GS-Hydro's technology for connecting pipes is based on flanges and pipe-end preparation machines, designed and developed in-house. GS-Hydro manufactures a wide range of flanges, which are used to create extremely tight joints, which can withstand the high pressures encountered in hydraulic and other high pressure piping systems. The flanges have been adapted to fit pipes from 16 to 608 mm in diameter and working pressures as high as 690 bar.

GS Retain Ring Flanges



are compact, high-pressure joints, in which the flanges are held to the pipe by a "retain ring", a stainless steel ring/spring that sits in a machined groove on the pipe-end. The wide range of flanged fittings includes tees, elbows and threaded adaptors. For hydraulic applications, a standard, bonded seal is used whereas a fire-safe seal is used for process piping. The retain ring system is the ideal solution for connecting high-pressure piping with thick walls (> 6 mm). The retain ring system covers all sizes from (26) 46-350 mm and with special arrangements it is possible to reach a working pressure as high as 690 bar.

	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"

GS 37° Flare Flanges

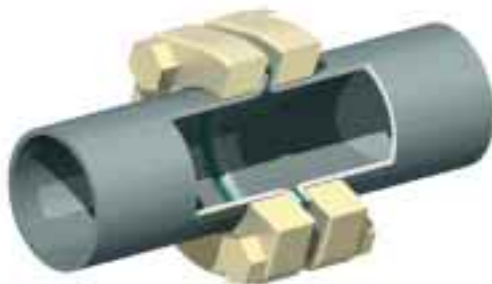


provide a non-welded high-pressure joint, as an alternative to compression fittings or welding. After cutting and deburring, the end of the tube is clamped into a flaring machine where a conical rotating tool flares the pipe end into a dye. An insert is placed in each pipe end with a seal in-between, and the flanges are then tightened together. Flaring typically takes 25% less time (or more) than welding. The joint is extremely clean and there is therefore no need to X-ray. Installation at the site is very quick and costs less due to the flexibility of the flare flange system. The GS 37° flare flange system provides a non-welded high-pressure joint for mild and stainless steel tubes up to a diameter of 90 mm. For small pipe sizes, the flare flange system is essentially safer than “bite” type fittings, particularly under heavy vibration, and when stainless steel piping is used.

	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"

The 37° flare flange system can also be utilised for low pressure (< 50 bar) piping systems for pipe sizes from 25 mm to 273 mm.

GS 90° Flare Flanges



were developed to provide a non-welded, low pressure flanged joint. Flaring of the tube end is carried out in the same way as in the 37° flange system, with an additional rotating tool used to produce the 90° flare. Extensive testing programs have shown the suitability of this jointing method for low pressure piping in mild steel, stainless steel, copper-nickel and titanium. The 90° flare flange system can be utilised for low pressure piping systems (10-40 bar) and for pipes with a maximum diameter of 608 mm. The 90° flare flange system is suitable for hydraulic return lines, but also for other applications such as water, drainage, seawater and other process piping systems. The 90° flare flange system is easy and fast to install. Due to the compact design, the flanges require little space and the pipes can thus be installed very close to each other.

	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")



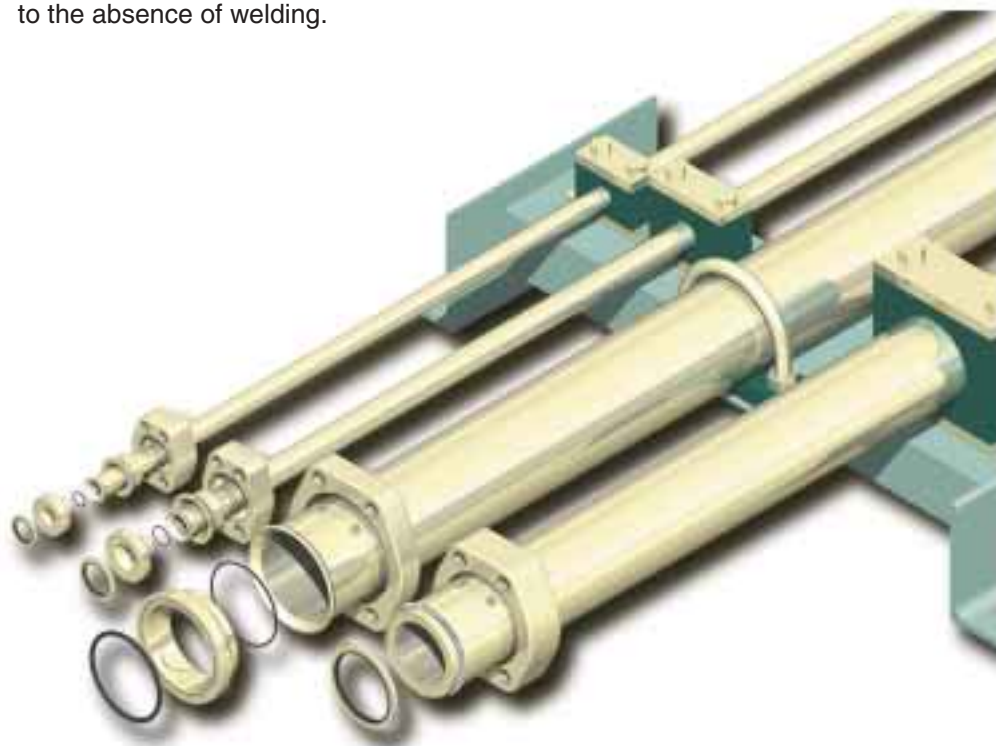
ADVANTAGES

High Quality, Inherently Clean and Cost-Efficient Technology...

GS-Hydro's Piping without Welding-technology provides major cost savings and substantial technical benefits to customers around the world: the GS Piping System - approved by numerous classification agencies - is highly reliable, inherently clean as well as flexible, fast and easy to prefabricate, assemble and install. All-in-all, GS-Hydro's non-welded piping technology offers a higher quality and, overall, a more cost efficient alternative to conventional, welded piping systems.

GS-Hydro's innovative pipe jointing technology allows piping systems - with working pressure as high as 690 bar and pipes with diameters up to 600 mm - to be assembled without any welding, with high integrity, leak-free joints. The highly reliable, non-welded GS piping system offers a number of benefits compared to conventional, welded piping systems. The non-welded technology produces an inherently clean piping system, which requires significantly less cleaning/flushing prior to start-up and which has a clearly lower risk of any (cleanliness-related) operational problems. The jointing technology combined with the possibility of optimising the degree of prefabrication prior to installation ensures fast, flexible and easy installation. The installation time and costs are further reduced because no X-raying or post-weld cleaning is needed. The fast and easy installation of GS-Hydro's non-welded piping system combined with the minimised need for flushing/cleaning leads to greatly reduced overall costs compared to conventional, welded piping systems.

The non-welded piping system, which does not require any "hot work" permits, can also be installed in environments with high fire safety requirements without any interruptions in operation or production, thanks to the absence of welding.





...for Total Piping Solutions

GS-Hydro's expertise covers the delivery of complete, non-welded piping systems from design & engineering, materials & components and prefabrication to on-site work, including supervision, installation, flushing, testing, and documentation. Taking complete responsibility for the piping system, allows GS-Hydro to optimise every phase of the piping project ensuring a high quality, cost-efficient and on-time delivery of the entire system.

The piping system projects are coordinated by GS-Hydro's experienced project management. By working together with the customer's engineers, GS-Hydro is able ensure the best possible piping layout and piping support arrangement - even in large, complex projects - as well as the optimum selection of both materials and components. The large stocks kept by GS-Hydro companies combined with the availability of a wide range of materials and piping components including flanges, tees, elbows etc., ensure that on-time deliveries can be guaranteed even in the most demanding projects. The use of accurately prefabricated piping modules forms the basis for a high quality piping system as well as the fast and easy installation. If necessary, pipe spools can also be fabricated (bent, grooved, and/or flared) on-site to allow for adjustments. Because all piping is intrinsically clean and pre-washed, flushing/cleaning times, and costs, are greatly reduced lowering the total cost of the piping system. The successful completion of the entire piping system project is ensured by GS-Hydro's experienced site supervisors.

EXPERIENCE

Wide Application Expertise...

GS-Hydro's piping solutions are extensively used in the **Marine** (shipbuilding) industry for hydraulic, seawater and other piping systems, where high integrity and cleanliness requirements, fast installation times and flexible engineering bring major time and cost benefits for ship yards, ship owners, and marine equipment suppliers. The hydraulic applications for vessels include winches, hatch covers, ramps, thrusters and steering gear.

For the **Offshore** industry, GS-Hydro supplies piping for hydraulic systems, air tensioning systems, mud and cement lines, water injection and process lines, as well as for seawater, cooling water and fire mains systems. The hydraulic applications on oil drilling rigs and production platforms include drilling equipment, winches and cranes as well as mooring systems. High quality, quick assembly, and no "hot work" allow for safe and cost effective installation compared to conventional welding. The GS Piping System is also ideal for repair and maintenance work on oil and gas platforms.

In the **Aerospace & Defence** industries, GS piping modules are utilised in defence vehicles where precision-made modules guarantee both the quality and reliability of the piping, and ensure a quick and easy installation. GS-Hydro's non-welded piping system is used extensively by manufacturers of airplane test equipment - mainly due to the typically large pipe sizes, high pressures and strict cleanliness requirements encountered in this type of equipment.

GS-Hydro's piping solutions are optimal for high-performance servo-hydraulic testing systems used in the **Automotive** industry. "Piping without Welding" is also utilised for various types of presses and transfer lines used in car factories.

Many **Construction & Mobile Equipment** suppliers utilise the flare flange-based piping system because of its flexibility and precision. Leak-free GS piping modules are utilised for the hydraulics in, for example, large harbour cranes, tilt trucks, excavators, service vehicles, loaders, landfill compactors, tunnel boring machines and fork lifts.

GS-Hydro's non-welded piping system is used in machinery hydraulics for steel production, in aluminium presses, and in drive systems for crushers, transporting and loading equipment. High quality and reliability,





in addition to the fast and easy installation, have traditionally been the reasons why customers in the **Metals & Mining** industry choose the GS piping system.

Non-welded piping technology is used extensively in bale presses and pulpers as well as in paper machines. In the **Pulp & Paper** industry, GS-Hydro is typically involved in the early stages of projects, working in close co-operation with the equipment manufacturers to ensure optimum layouts, pipe sizing and the selection of materials and components, which results in major cost savings.

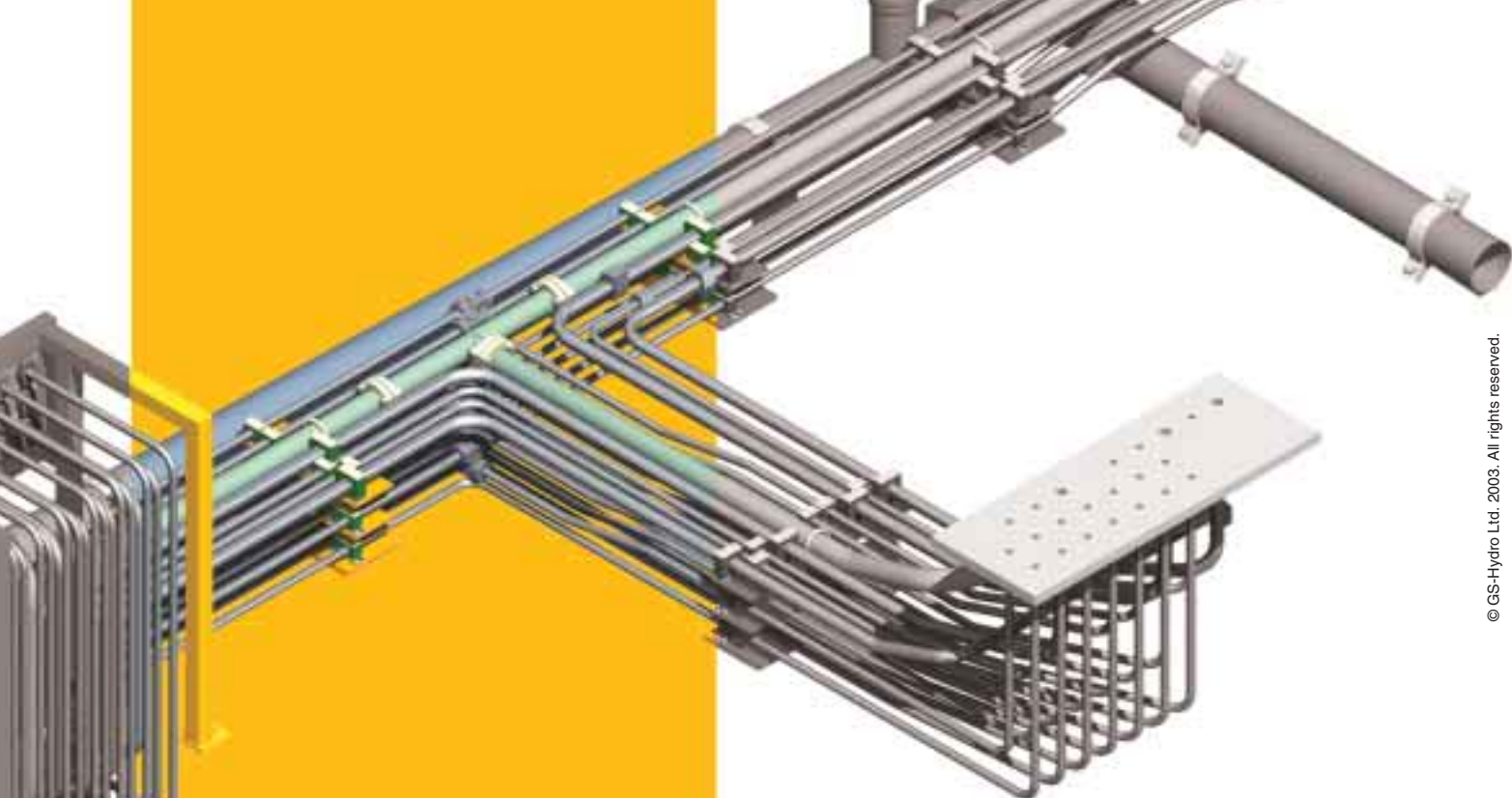
In the **Plastics & Rubber** industry GS-Hydro is recommended by numerous manufacturers of plastic molding injection machinery because of the inherent cleanliness and flexibility of the GS Piping System.

The **Recycling** industries use non-welded piping in shredders, scrap cutters, and presses for quick installations, optimised performance and reduced down time.

The GS piping systems is typically used for large, high-pressure hydraulic piping, as well as for low-pressure return lines in panel board, plywood, and particle board presses. These machines are usually fully assembled and tested at the manufacturer's facility before dispatch. Therefore, accurately prefabricated, clean piping that can be disassembled and reassembled quickly and easily is a major advantage for **Wood & Forestry** industry customers.

GS-Hydro's non-welded piping system is also used in numerous other applications: in the power industry, the GS Piping System is used in the hydraulics for water turbines and to reliably control fuel injection and exhaust valves in diesel engines. GS-Hydro has also developed the optimum piping solution which guarantees high cleanliness, quick installation and the highest possible reliability for hydraulic drives utilised in sugar mills. In addition, several civil/structural test facilities (earthquake simulators) and lift bridges have been fitted with the GS Piping System due to the forces encountered in this type of equipment as well as for reliability and cleanliness reasons.





High Quality, Clean and Reliable Piping without Welding

The innovative GS Piping System is used primarily in hydraulic applications, but it is also ideal for both low and high pressure applications with high demands on quality, reliability and cleanliness. In addition to being inherently clean, the GS Piping System is easy, fast and flexible to install.

Taking complete responsibility for the piping system allows GS-Hydro to optimise every phase of the delivery, thus ensuring a high quality, cost-efficient, on-time delivery of the entire piping system.



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