

Duplex is a very versatile material for chemical tankers

## Selection of materials

The choice of the optimum material depends on its later use and the requirements associated with this. Corrosion resisting materials have become widely accepted for chemical and gas tankers. The following materials are especially used in the shipbuilding industry:

### Gas tankers

For gas tankers, 1.4541 and 1.4571 or TP 321, TP 304L and TP 316L are mainly used.

Here, temperature resistance is a crucial criterion for the choice of material. Possible exposure of the outer surfaces to corrosion damage from the sea air also needs to be considered, although the medium itself does not generally impose any special corrosion requirements. The advantages of corrosion resisting steels against low-temperature steel are:

- Availability
- Weight savings on deck
- Avoidance of contamination of the media

### Chemical tankers

For chemical tankers, 1.4462 (duplex) or TP 316L with 2.5% molybdenum content, or 1.4432 are used.

The choice of material is then mainly governed by the cargo list specified by the shipbuilder. Exposure to corrosion from the medium is the major decision criterion here, whereby the following types of corrosion in particular need to be prevented:

- Pitting corrosion  
This arises from the partial destruction of the passivation layer by chloride ions. Pin-prick blemishes form on the surface, which can then lead to the destruction of the component in just a few weeks. The risk of pitting corrosion increases with the concentration of chloride ions and with increasing temperature.

Resistance to pitting corrosion can be estimated using the pitting resistance equivalent (PRE) formula:

$$PRE = \% Cr + 3.3 \times \% Mo + 16 \times \% N$$

- Stress corrosion  
Stress corrosion is also caused by chloride ions in conjunction with stresses (internal or external). Austenitic steels are susceptible to this type of corrosion from approx. 60°C. This susceptibility can be reduced by increasing the molybdenum and nickel content. Austenitic-ferritic steels (e.g. duplex), on the other hand, are comparatively insensitive.

When components are exposed to dynamic stresses – as caused by vibration – fatigue corrosion may set in a similar fashion.

### Sea water pipes in general shipbuilding

For cooling water, heat exchanger pipes with sea water and for steam pipes on deck, copper-nickel, nickel or titanium alloys are often used.

The pipe components are produced by BUTTING in any shape technically possible in accordance with the customer's specifications or CAD isometric drawings.

#### Prefabricated duplex pipes for the shipbuilding industry



## Surface treatment

The corrosion resistance of stainless steels is based on their ability to form a passive layer in most media known. This dense, impenetrable protective layer is only a few atom layers thick (2–4 nm) and mainly consists of chromium oxide. It prevents the stainless steel from corroding if it is not destroyed and free from defects.

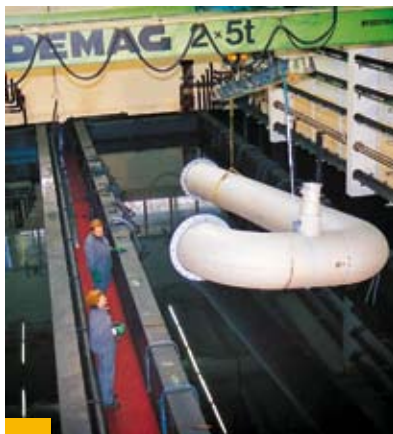
It is therefore very important to provide a bright metallic surface, which must be completely free from tinting, scale and ferrite contamination.

After their fabrication, high alloy special steels must have the same corrosion resistance – especially when used as welded



**Mufflers for HDW Kiel after cleaning in the pickling bath**

joints – as the parent metal. During the pipe production or subsequent processing of the pipes into prefabricated compo-



**Prefabricated pipework component undergoing full-body pickling**

nents, various production steps have to be carried out which may however affect the corrosion behaviour of the material concerned. This requires further finishing of the surface to guarantee a complete protective passive layer.

## Ideal pickling facilities

BUTTING has a number of ways of producing a corrosion-resisting surface on components. Chemical full body pickling is still considered to be the most reliable method to remove ferritic contamination and annealing colours. BUTTING subjects all stainless steel pipes, fittings and components to this kind of full-body pickling.



**Glass marble peening improves the surface properties**

This ensures that the part is clean and that the necessary corrosion-resisting passive layer is formed even in otherwise inaccessible places. We have a number of 20.0 × 4.0 × 2.0 m pickling baths, plus 16 pipe pickling baths up to 27 m long. For large fittings or vessels, spray pickling is also used to treat the surface.

## Alternative surface treatments

In addition to the chemical surface treatment, customer-specific requirements are met by means of mechanical processes, in particular grinding inside and outside surfaces. BUTTING has radial grinding equipment for outside surfaces. Pipes with dimensions from DN 20 to DN 350 can be ground with grit 180 up to 400 under optimum conditions. Both radial and axial grinding machines are available for grinding the inside surfaces.

Our products can also be treated by shot-blasting with different grades of grit. Our centrifugal machine is designed for components from 4 m to 12 m in length and 114 mm to 762 mm in diameter. Glass marble peening is another type of surface treatment you can choose from.

We have sufficient capacity for surface engineering to ensure that we can carry out all these services for you even on your own material.

## BUTTING's outdoor blasting plant for the surface treatment of pipes





**Radioscopic examination (real time radiography) – Jörg Müller**



**Top-quality ship-building technology**

BUTTING's high quality standard is reflected in the large number of approvals issued to the company by renowned certification bodies.

We have already worked with the following companies in the shipbuilding field: Germanischer Lloyd (GL), Det Norske Veritas (DNV), Bureau Veritas (BV), Lloyd's Register (LR), American Bureau of Shipping (ABS), Registro Italiano Navale (RINA) and Howaldtswerke-Deutsche Werft AG (HDW).

BUTTING is allowed to carry out tests on behalf of DNV and GL and to issue the relevant test certificates (EN 10204/3.2). This procedure makes it possible to carry out the required tests during production without time delays. In our quality control department, our many staff track and document the challenging orders from the shipbuilding industry and other sectors.

**Approved worldwide**

The Quality Management System of BUTTING is approved by Germanischer Lloyd according to DIN EN ISO 9001. BUTTING also holds approvals from classification companies and third party inspectors, like Bureau Veritas and BDLI and renowned companies.



BUTTING also holds the following approvals:

- Weld procedure qualification acc. to AQUAP
- FRAMA TOM ANP-KTA 1401, IAEA 50-C-Q and AVS D 100/50
- Approval by Germanischer Lloyd for the welding of materials in defence engineering
- TÜV in accordance with the AD Merkblatt WO/HPO and TRD 100/201 EN 729-2
- Extensive verification of suitability acc. to DIN 18 800 part 7
- Approval acc. to HPO with DIN EN 729-2 and DGRL 97/23/EG
- Approval acc. to the water supply rules (WHG) § 19 I
- Statement of Assessment ASD-EASE acc. to EN 9100 (without design)
- Environmental Management System acc. to DIN EN ISO 14001
- Work Safety Management System acc. to OHSAS 18001

BUTTING complies with many testing and accreditation requirements:

- § 20 of the rules and regulations of radiation protection
- Accreditation of the laboratory acc. to DIN EN ISO/IEC 17025 : 2000 etc.

**A great number of testing installations**

As regards **non-destructive testing**, the following equipment is available at BUTTING:

- Radiography
- Radioscopy
- Radiology for pipes of up to 18 metres
- Eddy-current testing
- Ultrasonic testing
- Hydrostatic pressure testing
- Endoscope
- X-ray flash device
- Surface roughness measurements
- Dye-penetrant testing and Magnetic particle inspection

The following **destructive tests** are performed in the internal laboratory:

- Corrosion tests
- Hardness tests
- Ferrite determination
- Tensile tests
- Hot tensile tests
- Bend tests
- Charpy-impact tests, also at low temperatures
- Technological testing
- Metallographic examinations
- Spectroscopic analyses

## Duplex on board

Over the last few years, we have been engaged by our customers to supply pipe-work for more than 200 gas and chemical tankers.

For example, our long experience of processing duplex steels won us a contract to supply pipes, fittings and flanges in sizes from DN 25 to DN 400 to the New Stettin Shipyard in Poland. Among other items, we supplied around 19 km of 54.0 × 2.0 mm pipes in 12 m lengths for eight IMO Type I/II chemical tankers.

BUTTING was awarded a further order for pipework for two chemical tankers through Eucaro in Bremen for the same



**BUTTING pipes at sea**

shipyard. The pipes were produced in the Russian Sevmarsh yard. Delivery of the pipes in material 1.4462 with 2.7 % molybdenum content was completed in the spring of 2007, and the second ship followed in the autumn.



**Inspection of prefabricated products after installation**

BUTTING is also working on other interesting orders for gas and chemical tankers. On the one hand, we are furnishing ten chemical tankers for our Croatian customer 3. Maj with semi-finished products, pipes, tees, reducers and flanges in TP 316L with 2.5 % molybdenum content. At the same time, we were commissioned to supply pipework for five LNG tankers (pipes in TP 304L and TP 316L) for the Hudong shipyard in China.

## Close cooperation with BUTTING Shanghai

We have also worked closely with BUTTING (Shanghai) Co. Ltd., our subsidiary in China, on an order from TGE for the Sanoya shipyard in Japan. BUTTING Shanghai was awarded the contract to supply the pipes for a 6,000 m<sup>3</sup> ethylene tanker and an 8,600 m<sup>3</sup> LPG tanker, for which our Chinese colleagues handled the entire prefabrication process for the first time.



**Pipework components for a Polish shipyard**

First, the pipes were produced in Knesbeck in TP 316L to an order from MAN Ferrostaal for the end-customer TGE. The pipes were then prefabricated by BUTTING Shanghai using these pipes and fittings supplied by TGE. The high level of prefabrication meant that around 1,000 detailed isometric drawings had to be drawn up in Knesbeck. Our welding expertise was also called into play to meet the requirements of the pipe classes with pressure tests and 100 % radiographic examinations.



**H<sub>2</sub> reservoir pipe with welded on dished end for HDW**



The welds were carried out by BUTTING Knesebeck according to weld procedure specifications (WPS) and the relevant procedure qualification records (PQRs). Prefabrication and final inspection complied with the standards of Bureau Veritas.

BUTTING undertakes the prefabrication of pipes for deck systems in Knesebeck, according to drawings and isometrics supplied by the shipyard. The capacity for bending pipes, complying with the requirements of the certification companies in terms of weld quality and the use of full body pickling provide the ideal conditions for creating high-quality products.

### Welding O<sub>2</sub> tanks for submarines



Another advantage for this shipyard was the immediate installation of piping components after delivery. The certification company carries out the final inspections of all prefabricated piping components on BUTTING's premises. The relevant documentation is supplied with the products.

### Sophisticated products

BUTTING was also commissioned by Peene-Werft (Wolgast) to supply recessed bulkheads for the cargo tank of a clean-up ship made of 1.4462 and 1.4565. Approx. 450 m of DN 50 pipes made of 1.4565 to be used as heating coils were also produced, bent and welded to form registers that were ready to install. A particular challenge for the technical skill



The clean-up ship Arkona was furnished with various fittings and pipes from BUTTING

of our staff was the supply of DN 250 to DN 600 mm waste gas end pieces to be furnished with flanges and double-walled mitre bends. These are required for the cooling of waste gases by introducing sea water into the double-walled casing.

### Quieter, faster, deeper – naval shipbuilding

Advanced drive systems for German naval shipbuilding are realised by BUTTING using pipe bodies and fittings.

For our longstanding customer HDW in Kiel, we are constantly producing oxygen tanks and H<sub>2</sub> reservoirs in the non-magnetic steel 1.3964. Our extensive experience in the forming and welding of this material, used at low tempera-

tures, was one of the key reasons why we won this order. The pipe bodies that we produce are used in class 212 A and 214 and Dolphin class submarines. These are operated, for example, by the Greek and Portuguese navies.

BUTTING manufactures the jackets of the tanks and the control cabinets for the submarines' oxygen system. Reinforcing rings are also pulled over the jackets and welded. Adherence to the tightest form and positional tolerances is a matter of course for us.

These projects represent just a small part of our range of services. We will of course be happy to provide you with a more comprehensive overview of our current references in shipbuilding on request.

### Class 212 submarines are the most up-to-date in the world



Preparation of shipbuilding components for dispatch



**Safely around the globe**

BUTTING products need to reach their destination anywhere in the world safely and quickly – and undamaged. Suitable packaging helps to get the products to the recipient safely and in the condition in which they left the manufacturer. To prevent damage or defects to pipes, elbows and components during transport, BUTTING has developed its own packaging methods as part of a comprehensive quality assurance process. In addition to standard packaging in the form of crates, seaworthy pipe bundles and supports, containers with storage aids developed in-house to suit the relevant dimensions are among the packaging options for exports. Depending on the product and the transport conditions, the packaging may be specified and tailor-made for a given project.

**Project requirements in line with demands**

If special surface requirements have to be fulfilled, those will be protected by special measures, e.g. piggable pipes being provided with caps or polished pipes wrapped in PE foil. The pipes, piping parts and components are combined together into packaging units using suitable wooden structures. In this way, the products cannot come into direct, unprotected contact with the means of transport.

**Our packaging – additional benefits for you**

Our packaging also rationalises the logistical processes in various ways, e.g. through shorter loading/unloading times, less time spent on securing the load, simpler unloading of individually packaged goods and through the option of storage

without any additional facilities. In addition to shipment by truck, there is also the option of transport by rail in Knesebeck, via our own factory rail link. For shipment from Knesebeck by barge, we use our direct access to the Elbe Lateral Canal through the harbour at Wittingen. The construction of a new inland port on the river Oder has improved the connection between our workshop in Schwedt and European waterways.

**Everything from one source**

BUTTING offers its customers an all round service – from advice on the selection of suitable materials, to handling the shipment of piping parts which are ready to install. Our reliable, punctual project management has proved a success in many different projects around the world. Use our experience.



By ship: transport of blow tanks for the pulp mill in Stendal



Transport by rail





**Longitudinally welded pipes**

Produced continuously from coil in sizes of 15 mm – 762 mm OD and wall thicknesses up to 16 mm

From plate: in sizes of 33.7 mm – 3,000 mm OD and wall thicknesses up to 60 mm

Pipes in special shapes

In random length up to 24 m with circumferential welds



**Clad pipes**

Mechanically bonded BuBi®-pipes in sizes of 114.3 mm – 660 mm OD

Metallurgically clad pipes

In random length up to 24 m with circumferential welds



**Vessel construction**

Up to 6,000 mm OD: complete prefabrication at the mill

Above 6,000 mm OD: prefabrication at the mill and assembly on site



**Pre-fabrication**

Piping components ready for assembly

Pipe bends acc. to drawings, piping segments, isometric drawings



**Fittings**

Tees, reducers, special fittings

Pipe bends acc. to DIN 2605

Collars acc. to DIN 2642

Elbows with long radii



**Piping technology**

Pipes with special tolerances, e.g. furnace rollers, jackets for pumps

Pipes with special surface requirements, e.g. for the pharmaceutical industry, architecture

Further processing of pipes using forming, grinding, laser cutting, e.g. jackets for pumps, valves and lamps

Special products, e.g. BUTTING HeRo® (an uncooled furnace roller)



**Assemblies**

Vessels

Linepipes

Special constructions, equipment



**Surface treatment**

Pickling (also on subcontract basis)

Blasting, peening (also on subcontract basis)

Grinding (also on subcontract basis)



**Services**

Expert technical and metallurgical guidance

CAD-facilities, isometric drawings

Metallurgical testing and non-destructive testing

**Material selection**

- Steels containing 10.5% Cr min, e.g.
  - Stainless steels
  - Heat resisting steels
  - Creep resisting steels
- Nickel alloys
- Titanium
- Aluminium and aluminium alloys
- Special alloys
- Clad materials

**Approvals**

- By TÜV acc. to AD-WO/HPO and TRD 100/201 and DIN EN 729-2
- DGRL (pressure equipment directive)
- Acc. to the water supply rules (WHG) § 19 I
- Quality Management System acc. to DIN EN ISO 9001:2000
- Accreditation of the laboratory acc. to DIN EN ISO/IEC 17025:2000
- Statement of Assessment ASD-EASE acc. to EN 9100 (without design)
- Environmental Management System acc. to DIN EN ISO 14001
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Photographs  
 • Aerial view: Keller GbR  
 • Cover and Inside: Company archive Knesebeck and Schwedt, Heike Butting, Siegfried Wilke, HDW/Kiel



Aerial view BUTTING Knesebeck



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