



© **NiroFix** 

## **The stainless steel experts**

Special heavy-duty fixings for tunnel and bridge constructions  
Old buildings and historical monument refurbishment fixings  
Monument fortifications  
Custom-made products and special constructions





Wilhelm Modersohn  
(Board member Stainless Steel Information Centre)

## Stainless steel? Modersohn!

**Dear customers, dear business friends,**  
welcome to NiroFix, a division of the Wilhelm Modersohn GmbH & Co. KG!

We would like to introduce ourselves to you as a reliable and competent partner in all matters relating to stainless steel.

And you can take that literally, because high quality is a matter of course for us.

The company was founded in March 1970 and currently employs around 140 people.

In addition to the product groups presented, we are happy to be your contact for all special solutions in stainless steel.



Wilhelm Modersohn

## Reliability is not witchcraft

Service is a top priority for us, that's why we established this sales division more than 30 years ago.

The organisation was optimised to meet the needs of customers with special wishes and requirements.

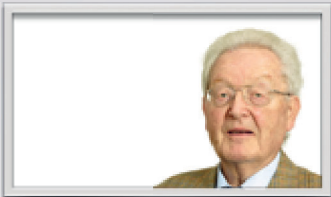
Our speciality is statically designed heavy-duty fixings for masonry and concrete.

We have special skills in the area of welding technology. As a member of the DVS (German Association for Welding Technology) and the Informationsstelle Edelstahl Rostfrei Düsseldorf, we are the competent contact for questions concerning connection and material questions.





# History / Timeline



Founded by W. Modersohn sen.



Member of the Stainless Steel Information Centre



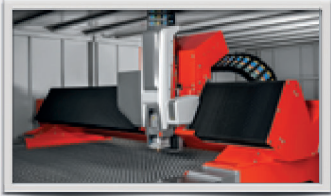
New approval for duplex steel in the construction sector



New water jet cutting system



Completion of the extended central and administration building



Investment in new waterjet cutting and fibre laser cutting system



Commissioning of the welding robot

1970

1972



Start of production in the former chicken coop



Takeover of the management by Wilhelm Modersohn jr.

2000



New office building

2006



Dipl.-Ing. J. Matzelle becomes technical managing director

2014



Acquisition of a property for use as a small parts warehouse - Expansion of the outdoor warehouse

2017



Construction of a new hall for surface processing

2019

2020

2020



*Modersohn celebrates its 50th anniversary*

# Competence and quality

Best services for individual wishes



EDELSTAHL  
**Rost  
frei**

**STAINLESS STEEL**



## We will be happy to help you:

As a processor and wholesaler you will find stainless steel products for all areas of industry.

With a processing capacity of over 1,500 tonnes of sheet metal per year, we are one of the larger service companies in the stainless steel sector.

In addition, we maintain for our customers delivery service with our own vehicles; for small and medium component sizes.

## Stainless steel is our world

Stainless steel - that is our passion and our competence.

We are constantly working to further develop our core competencies and focus on our strengths.

Our aim is to offer you a high-quality delivery service with very good product advice and product quality.

Our extremely flexible production allows very short delivery times for your special customised products.

In addition, in our production all processing steps are located at **one site**, which ensures an optimal throughput.





## Special heavy-duty fixings

Special heavy-duty fixings  
 Tunnel und bridge fixings  
 (Planning support, production and delivery)

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In our **NiroFix** sales division, we have special production facilities to satisfy our customers' individual wishes at short notice.  
 Our aim is to provide our customers with the widest possible range of processing options with our special wide range of processing possibilities.  
 This is the only way to produce complex projects and assemblies promptly and cost-effectively.

Our employees will help you quickly and reliably and offer you expert advice, quotations at short notice and inexpensive problem solutions to problems.



# Our processing services

## ▶ SPECIAL-HEAVY-DUTY-FIXINGS FOR TUNNEL AND BRIDGE CONSTRUCTION

▶ OLD BUILDING AND MONUMENT RENOVATION, RENOVATION OF FIGURES

▶ CHURCH RESTORATION, REHABILITATION OF WELLS

▶ SPECIAL CONCRETE FIXINGS ACCORDING TO CUSTOMER REQUIREMENTS

▶ SPECIAL CONSTRUCTIONS MADE OF HIGH-STRENGTH AND HIGHLY CORROSION RESISTANT STAINLESS STEEL



We are the specialists for the development, planning, production and delivery of stainless steel fastening systems, for the most diverse applications and industries.

**NiroFix** is the sales division of our company where **special sheet metal cuts up to more than 30 mm thickness, special welded constructions and heavy-duty fastenings, e.g. for bridge and tunnel construction or monument renovation,** can be commissioned and realised.

Depending on the functionality and optical requirements, **our manufacturing options for the component surface are very flexible.**

The premise of the **NiroFix** department is to fulfil the customer's special requests to their satisfaction in order to leave a lasting and long-lasting impression for the project and with the customer.

We offer planning support with our own engineering office for structural analysis.

With our extensive machinery and a large stock of pre-materials, we manufacture **customised products or special constructions;** from one-off production to series production.

We are a specialist welding company with manufacturer's qualification **DIN EN 1090-2 EXC3** and further proofs, and have **many years of experience in the manufacture of fastening structures** for monument restoration (e.g. Frauenkirche Dresden, Hercules figure in Bergpark Kassel-Wilhelmshöhe, Sanssouci Palace, etc.).

## 48-hour-Service

Our **K-line** is brand new and with it our **48-hour express service** for all those customers who need their stainless steel blanks and bent profiles, including Lean Duplex steel, particularly quickly.

Whether industry, craft or construction:

Depending on the quantity required (please consult the sales representative in advance!), orders can be made available for collection or dispatch within two working days under the following conditions.

- ▶ The order corresponds to the matrix of the K-line.
  - ▶ The order is received from monday to thursday (on working days) by 3.00 p.m. at the latest.
  - ▶ The required primary material is in stock in sufficient quantity and quality.
- Please note that this short delivery date is also quantity dependent.

## Special heavy-duty fixings

### Tunnel fixings

- ▲ Tie rods or anchoring brackets for suspensions
- ▲ Profile substructures, e.g. for fire protection panels
- ▲ Cladding constructions
- ▲ Access ladders for shafts
- ▲ Cable ducts, also with radius and with screwed cover
- ▲ Line supports, e.g. pipe supports, pipe suspensions with pipe clamps
- ▲ Rail systems for stepless fixings
- ▲ Stainless steel reinforcing bars in rod shape, bent or as a welded construction

### Bridge fixings

- ▲ Substructures as bracing trusses
- ▲ Tension and deflection constructions for bracing
- ▲ Supports, load-bearing and retaining structures for concrete elements and pipelines
- ▲ Channels, gutters, sealing and clamping profiles

## Renovation of old buildings and monuments, renovation of churches and wells

### Special solutions for new construction and refurbishment in stainless steel

- ▲ Rehabilitation and reconstruction of historic buildings
- ▲ Fortifications for churches, castles and other listed buildings
- ▲ Tension anchors
- ▲ Deflector constructions
- ▲ End plates
- ▲ Profiles and beam constructions
- ▲ Needle anchors
- ▲ Tap wrenches
- ▲ Wooden beam fixings

## Concrete fixings

### Concrete reinforcement and connection systems

- ▲ Facade fixings and reinforcement constructions
- ▲ Stair step protection profiles

## Special services stainless steel

### Load-bearing structures made of stainless steel, welded by experts

- ▲ Custom-made products and special constructions
- ▲ Joining technology

## Product examples



▲ Substructure North Bridge Minden



▲ Herkules, Bergpark Kassel-Wilhelmshöhe: Supports (foundation ring), reinforcements and figure supporting structures



▲ Brandenburg Parliament Potsdam: Column anchors, support anchors for sandstones, cornice brackets



# Special heavy-duty fixings



## Special heavy-duty fixings, tunnel and bridge fixings

### Your advantages

**We are specialists in the development, planning, production and delivery of stainless steel fastening systems for a wide range of applications and industries.**

- ▲ Planning support with our own engineering office for structural analysis.  
**Production of special constructions or custom-made products** with an extensive machine park and a large stock of primary material, from the individual production to the series
- ▲ **Specialist welding company with manufacturer qualification DIN EN 1090-2 EXC3** and further proofs, see item „Tests and approvals“ on our website.
- ▲ **Many years of experience in the production of fastening constructions** for the restoration of monuments (e.g. Frauenkirche Dresden, Hercules figure in the Bergpark Kassel-Wilhelmshöhe, colonnades at Sanssouci Palace, etc.).

## Product examples



▲ Cantilever beams



▲ Duct fixings for bridge tensioning constructions



▲ Pedestrian bridge Freiburg-Ebnet:  
Welded constructions for supports and cut-to-size parts as custom-made products

Foto: © Holzbau Amann





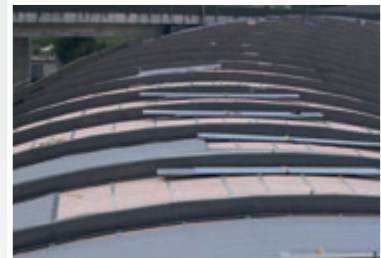
## Special heavy-duty fixings

### Performance data

- ▲ Mounting plate thicknesses up to 150 mm
- ▲ Profile lengths up to approx. 12,000 mm
- ▲ Component piece weights up to 4 tons
- ▲ Materials B-Class III (materials for each resistance requirement, according to EC3): 1.4362, 1.4404, 1.4571, 1.4401, 1.4062, 1.4162
- ▲ Materials B-Class IV (materials for each resistance requirement, according to EC3): 1.4462, 1.4539, 1.4439
- ▲ Materials B-Class V (materials for each resistance requirement, according to EC3): 1.4529, 1.4565, 1.4410



▲ Tunnel Petuelring Munich:  
Cable ducts with access ladders



▲ Tunnel portal Switzerland



▲ Tension wire guides for bridges

## Tunnel fixings

### Performance data

- ▲ Tie rods or anchoring brackets for suspensions
- ▲ Profile substructures, e.g. for fire protection panels
- ▲ Cladding constructions
- ▲ Access ladders for shafts
- ▲ Cable ducts, also with radius and with screwed cover
- ▲ Line supports, such as pipe supports or pipe suspensions with pipe clamps
- ▲ Rail systems for stepless fixings
- ▲ Stainless steel reinforcing bars in rod shape, curved or as welded construction

## Bridge fixings

### Performance data

- ▲ Substructures as stiffening trusses made of stainless steel
- ▲ Tension and deflection constructions for bracing
- ▲ Support, bearing and retaining structures for concrete elements and lines
- ▲ Channels, gutters, sealing and clamping profiles



▲ Substructure North Bridge Minden

## Product examples



▲ Metro station „Mezhdunarodnaya“ Moscow:  
Natural stone fixings, door handles,  
lamp holders



▲ Lamp holders made of stainless steel



▲ Federal motorway A42 Duisburg-Beeck:  
Deflection brackets for bridge

# Old building and monument renovation fortifications



## Renovation of old buildings and monuments

### Restoration and reconstruction of historical buildings

Renovation measures on listed buildings are linked to close coordination with the authorities. The use of stainless steel ensures **lasting stability and avoids expensive follow-up costs**.

Stainless steel from professionals - for durable renovation of historical monuments and old buildings. Whether fastening, cladding or decorative element, we fulfil your wishes, together with our own **engineering office for structural analysis**.

- ▲ **Individual production** - up to a unit weight of 4 tonnes or unit lengths of over 14,000 mm - **or series production on automatic production lines**
- ▲ Laser cutting, shear cuts, sawing and deflection
- ▲ **Highest manufacturing precision** through a waterjet cutting system of the latest generation
- ▲ **Professional surface treatment**; from automated pickling to blasting to hand grinding

## Product examples



- ▲ Frauenkirche Dresden: Copper bonnet with the supporting emperor's stick (see page 11) as the centrepiece directly under the church cross



- ▲ City Palace Berlin: support and special support anchors, special welded constructions, special profiles, threaded rods



- ▲ Colonnades New Palace Sanssouci Potsdam: custom-made profiles, welded constructions, anchor plates, anchor elements and threaded rods



## Renovation of old buildings and monuments

### Performance data

- ▲ Tension anchorages, stressing anchors
- ▲ Support profile and truss constructions
- ▲ St. Andrew's crosses, retaining plates, decorative plates
- ▲ Needle anchors, threaded rods, reinforcing bars
- ▲ Winding irons for windows
- ▲ Timber beam fixings
- ▲ Mortar support anchors, paddle anchors
- ▲ Substructures for spires and tower bonnets



Paddle anchor



- ▲ German State Opera Berlin:  
Cornice fastening parts and support anchor brackets in special design



- ▲ Museum Barberini Potsdam:  
Cantilever beams made of Lean Duplex steel, 1.4062 and 1.4162

## Renovation of figures

### Performance data

- ▲ Substructures for monuments and figures, e.g. foundation rings (Hercules figure Kassel)
- ▲ Holding structures
- ▲ Interior constructions for monuments and figures (e.g. Golden Town Hall Man Dresden)
- ▲ Fastening elements

Foundation ring  
Hercules Kassel



Emperor's stick  
Frauenkirche  
Dresden



- ▲ Hercules figur Kassel-Wilhelmshöhe:  
Interior construction



- ▲ Coat of arms figure „Griffin“ Schwerin:  
Interior construction

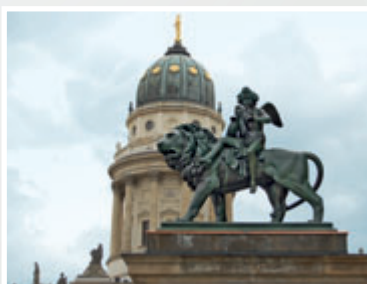
## Product examples



- ▲ National Library Berlin:  
Support profiles as special constructions made of Lean Duplex stainless steel



- ▲ Golden Town Hall Man Dresden:  
Interior construction



- ▲ Animal figures at the Schauspielhaus Berlin:  
Base constructions

# Renovation of listed buildings



## Renovation of listed buildings

### Fortifications for churches, castles and other listed buildings

In addition to the new Lean Duplex stainless materials, such as 1.4362, we also offer the well-known material grades 1.4404 (A4), 1.4401 (A4), 1.4571 (A5), 1.4541 (A3) and 1.4301 (A2).

All of them have a very high resistance to aggressive environmental influences (corrosion).

Particularly for fastening and cladding constructions for churches, cathedrals, castles and palaces whose building fabric is to be preserved for centuries, stainless steel is the ideal material.

In the course of time, moisture penetrates into almost every area of old building fabric and attacks important load-bearing components (steel, but also wood).

This also applies to galvanised steel, as the thin zinc layer has no permanent resistance, especially in damp brickwork or in the damp alkaline environment of mortar and concrete!

## Product examples



▲ Brackwede church:  
Tie rods and various winding irons for the windows



▲ Groß Escherde church:  
Tension anchorages with bricked-in end plates



▲ Bönningen church:  
Tension anchorages with visible St. Andrew's crosses



### Church restoration

#### Performance data

- ▲ Tension connections in the form of tension rods, with end or connecting links. Available with clamping sleeve (with right-hand/left-hand thread) or only as a joint with connecting sleeve (only with right-hand thread). Modersohn can produce welded joints for the common round steel dimensions without X-ray or ultrasonic testing; even for very large cross-sections.
- ▲ Tension rods made of round steel with partial thread on both sides
- ▲ Deflector constructions for correct power transmission
- ▲ End plates (St. Andrew's crosses, round or angular decorative plates as well as very simple retaining and pressure distribution plates)
- ▲ Profiles, beam and supporting structures up to 20 mm material thickness (Manufacturer qualification according to DIN EN ISO 3834-2 and welding certificate EXC3 according to EN 1090-2)
- ▲ Needle anchors: extensive stock of building authority approved stainless steel 1.4571 (A5), 1.4362 (D4) and 1.4482 (special alloy). 1.4482 (special alloy). Reinforcing bars with rolled up or cut open thread at the end of the bar can also be used. Alternatively, threaded rods in lengths of up to 3 m (in stock) can be used for needling. Advantage here: Anchor plates or force deflection constructions can be screwed on straight away.
- ▲ Winding iron: thick flat steel with attached bolts for the glass enclosure. A thinner flat blank with round holes serves as an abutment. With the help of our laser system, round or differently shaped glass enclosures can also be produced.
- ▲ Timber beam fixings:
  - Support shoes
  - Mounting brackets
  - Nail plates
  - Fitting mandrels
  - Wood screws



▲ St. Andrew's crosses



▲ Tie rods and needle anchors



▲ Winding iron for glass edging

### Renovation of wells

#### Performance data

- ▲ Handrails and fountain basins made of stainless steel, e.g. made of austenitic steel, material no. 1.4404 or 1.4571; alternatively made of Lean Duplex steel, 1.4362 or 1.4062



▲ Ludwig-Krüder-Fountain, Bremerhaven

### Product examples



▲ Tension rods



▲ Retaining plates



▲ Screw fittings in different shapes and lengths

# Concrete fixings

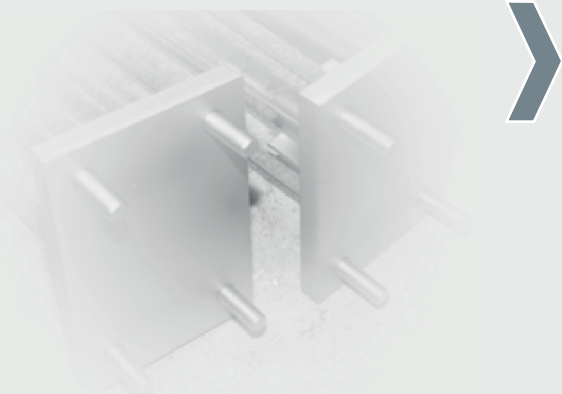


## Concrete fixings

### Concrete reinforcement and connection systems

Stainless steel reinforcing bars are required:

- ▲ In the case of concrete components that come into heavy contact with moisture or wetness and where the reinforcement is very close under the surface
- ▲ For structures or buildings in which, for example, sensitive measuring equipment is located and in the vicinity of which there must be no reinforcement that can be magnetised (austenite, exception standard austenites cold forming - forming martensite). (> Permeability)
- ▲ For trades that are at high risk of cracking from the outset in damp or wet areas.
- ▲ For buildings that require **special safety measures** due to inaccessibility and necessary longevity



## Product examples



▲ Anchor plates with threaded bolts



▲ Mounting bracket with reinforcing bar brackets



▲ Concrete reinforcement brackets





## Concrete fixings

### Performance data

- ▲ Facade fixings (support and retaining anchors for all applications)
- ▲ Edge protection and frame constructions
- ▲ Reinforcement constructions
- ▲ Joint coverings
- ▲ Clamping constructions
- ▲ Supporting constructions
- ▲ Cladding for in-situ concrete and precast slabs or columns
- ▲ Assembly centring systems for precast elements (precast supports on in-situ concrete)
- ▲ Dowel connections
- ▲ Lifting anchor systems with accessories
- ▲ Recess bodies
- ▲ Anchor channels
- ▲ Elastomeric bearings

We have the welding certificate according to DIN EN ISO 17660 (reinforcing steel welding).  
Our extensive warehouse also realises deadline requests at short notice.

- |                                    |                                    |
|------------------------------------|------------------------------------|
| ▲ Diameter / bearing factory stock | Ø 4 - 20 mm                        |
| ▲ Authorised version               | Wst. 1.4486 - Ø 6 - 20 mm          |
|                                    | Wst. 1.4362 - Ø 6 - 12 mm          |
|                                    | Wst. 1.4571 - Ø 6 - 14 mm          |
| ▲ Cuttings                         | Ø 4 - 20 mm, lenght up to 6.000 mm |
| ▲ Bearing lengths                  | chopped off, sawed off             |
| ▲ Curved                           | edged, rounded                     |
| ▲ Partial thread                   | rolled up or cut                   |
| ▲ Welded                           | see welding tests                  |



▲ Anchor channels



▲ Anchor plates



▲ Support bracket

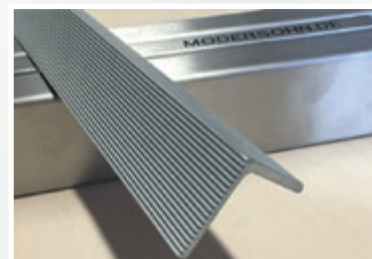
## MOSO® Stair step protection angle

### Performance data

The MOSO® stainless steel stair protection angles are particularly suitable for concrete stairs that require a stable and corrosion-free tread edge with anti-slip protection.

Subsequent blasting with fine glass bead grain creates a attractive, silky-matt surface at the visible edges.

Available in different versions; fixed lengths according to customer specifications.



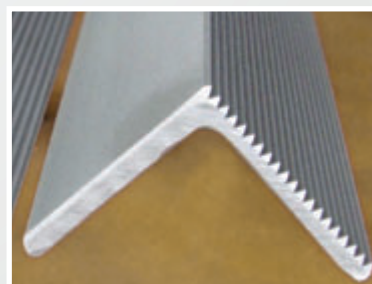
▲ Detailed view stair step protection angle



▲ Stair step protection angle



▲ Stair step protection angle - Top view



▲ Stair step protection angle in profile

# Special services stainless steel



## Custom-made products and special constructions

### Load-bearing structures made of stainless steel, welded by experts

In addition to our own product systems for heavy-duty fastening technology, we manufacture a wide variety of custom-made products and special constructions in the **NiroFix** division, mainly made of stainless steel.

- ▲ Mechanical engineering (components for machines for the food industry, medical technology, packaging industry, vehicle supply industry, etc.).
- ▲ Plant engineering and environmental technology (components for materials handling technology, waste water treatment plants, ultra-pure water production, water sterilisation technology, hazardous materials storage, system tanks and containers, wind power plants, solar plants, biogas plants, etc.).
- ▲ Locksmith's shops and metal construction (heavy stainless steel welded constructions and constructions made of materials with higher processing requirements, such as high-strength stainless steels in joining technology).

## Product examples



▲ Container with lid for water treatment



▲ Door mounting frame for cooling vans



▲ Facade substructure for the architectural sector





## Joining technology

### Performance data

- ▲ In the sensitive area of joining technology, we enable perfect execution with all the necessary welding test certificates, procedure qualification tests and product approvals.
- ▲ Manufacturer's qualification for welding steel structures according to DIN 1090 EXC3
- ▲ Manufacturer's qualification for welding of reinforcing steels according to DIN EN ISO 17660:2006
- ▲ Proof of welding quality requirements according to DIN EN 3834- 2
- ▲ Procedure tests for solid austenitic and duplex steels available
- ▲ Materials: 1.4003, 1.4301, 1.4307, 1.4541, 1.4401, 1.4404, 1.4571, 1.4435, 1.4439, 1.4539, 1.4547, 1.4529, 1.4062, 1.4162, 1.4482, 1.4362, 1.4662, 1.4637, 1.4462, 1.4501, 1.4507, 1.4410, 1.4658, 1.4828, 1.4841, Normal steel grades, concrete reinforcing bar steel BST500B etc.
- ▲ Various welding techniques, depending on customer requirements
- ▲ Welding even of different materials; e.g. black and white connections

Our extensive warehouse also realises deadline requests at short notice.



▲ Weld seam according to execution class EXC3

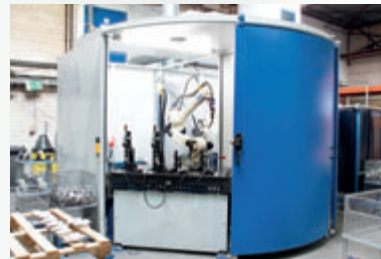


▲ Special welded construction

## Welding techniques

### Performance data

- ▲ 20 modern welding workstations
- ▲ Welding techniques:
  - MIG / MAG
  - WIG
  - Electrode welding
  - Stud welding with drawn arc and capacitor discharge stud welding
  - Resistance spot welding
  - Robot welding
- ▲ Extensive range of sizes: from small and filigree constructions up to large components with a weight of up to 4 tons can be welded
- ▲ **Six-axis welding robot with special control for precise sheet metal welding**
  - Possible welding types: MIG / MAG
  - Part size up to 1.400 x 900 x 800 mm
  - Part weight up to 1.000 kg



▲ Welding robot



▲ Special constructions

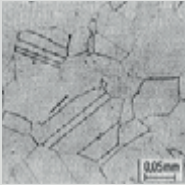


▲ Container welding



▲ Welding certificate EXC3 according to DIN EN 1090-2

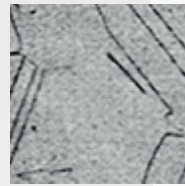
## Properties of microstructure types



▲ Microstructure  
Austenitic steel

### Austenitic Stainless Steels

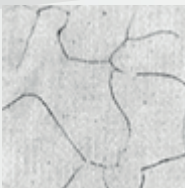
- Not magnetisable (exception: standard austenites, cold forming, forming martensite).
- **Very good corrosion resistance** with increasing alloy content
- Susceptible to stress corrosion cracking
- **High toughness even at low temperatures**
- **Very good hot and cold formability** (Ductility, Elongation)
- Not hardenable by heat treatment, strength increase through cold forming
- **Good weldability**
- High coefficient of thermal expansion
- Low thermal conductivity



▲ Microstructure  
Manganese-Austenitic  
Stainless steel

### Manganese-Austenitic Stainless Steels

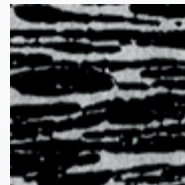
- **Less expensive than nickel-austenitic stainless steels**
- **High strength**
- **Moderate to comparatively poor corrosion resistance**
- Higher demands on cold formability among other things due to strong strain hardening
- **Very good thermoforming and hydroforming properties**
- Poor machinability
- Difficult to weld (hot cracks)
- High surface effort in the steel production
- Inhomogeneous material properties with large cross-sections



▲ Microstructure  
Ferritic steel

### Ferritic stainless steels

- Magnetisable
- Weldable to a limited extent, coarse grain formation during welding, loss of notched impact strength at higher temperatures (Chi phase, Sigma phase)
- Lower elongation at fracture (20 %) compared to austenites (> 40%)
- Machinable to a limited extent and cold workable
- Lower strength, not hardenable and heat treatable
- Not suitable for low temperatures
- Not crevice corrosion resistant
- High resistance to chloride-induced stress corrosion cracking
- **Coefficient of thermal expansion like Stainless steel**



▲ Microstructure  
Stainless duplex steel

### Austenitic-ferritic stainless steels (duplex stainless structures)

- **Magnetisable**
- 0.2% yield strength above the austenites, with good toughness values
- **Good corrosion resistance**
- **Favourable fatigue strength**
- **Good resistance to chloride and hydrogen-induced stress corrosion cracking**
- **Machinable to a limited extent**  
In the variants with little to no molybdenum, a **very low 475°C embrittlement**, i.e. the notched impact strength values remain sufficiently high
- **Good weldability**
- Moderate coefficient of thermal expansion
- Low thermal conductivity



▲ Microstructure  
Martensitic steel

### Martensitic stainless steels

- Magnetisable
- **High strength**
- **Hardenable** or heat treatable by heat treatment
- Moderate hot and cold formability
- Heat treatment effort, especially after welding
- Lower elongation at fracture compared to austenites
- High wear resistance and cutting edge retention
- Low coefficient of thermal expansion
- High thermal conductivity



# Materials / Properties / Designations

Steel structure	Market description steel group	EN material no. *1 *2	AISI no. *3	ASTM UNS no. *4	Steel type short name acc. to DIN EN 10027, 10088-1 or SEW 400 *5	Standard parts steel type acc. to DIN EN ISO 3506	Approved for the building industry, acc. to Eurocode 3, DIN EN 1993 Part 1-4	Comparison corrosion resistance class acc. to DIN EN 1993-1-4 *7	Currently common forms of delivery	
Ferritic/ Austenitic	Stainless Lean Duplex Steel	1.4062	-	S32202	X2CrNi22-2	D4	yes	III / medium	Metal sheet	Wire / Round
Ferritic/ Austenitic	Stainless Lean Duplex Steel	1.4162	-	S32101	X2CrMnNiN21-5-1	D4	yes	III / medium	Metal sheet	Wire / Round
Ferritic/ Austenitic	Stainless Lean Duplex Steel	1.4482	-	S32001	X2CrMnNiMoN21-5-3	D2	yes	II / moderate	Metal sheet	Wire / Round
Ferritic/ Austenitic	Stainless Lean Duplex Steel	1.4362	-	S32304	X2CrNiN23-4	D2	yes	III / medium	Metal sheet	Wire / Round
Ferritic/ Austenitic	Stainless Lean Duplex Steel	1.4637*6	-	S82031	New, currently no indication	-	no	(III / medium)	Thin metal sheet	
Ferritic/ Austenitic	Stainless Lean Duplex Steel	1.4662	-	S32404	X2CrNiMnMoCuN24-4-3-2	D4	yes	III / medium	Metal sheet	
Ferritic/ Austenitic	Stainless Standard Duplex Steel	1.4462	-	S31803/ S32205	X2CrNiMoN22-5-3	D6	yes	IV / strong	Metal sheet / Rohr	Wire / Round
Ferritic/ Austenitic	Stainless Super Duplex Steel	1.4410	-	S32750	X2CrNiMoN25-7-4	D8	yes	V / super strong	Metal sheet / Tube	Wire / Round
Ferritic/ Austenitic	Stainless Super Duplex Steel	1.4501	-	S32760	X2CrNiMoCuWN25-7-4	D8	yes	V / super strong	Metal sheet	Round
Ferritic/ Austenitic	Stainless Super Duplex Steel	1.4507	255	S32550	X2CrNiMoCuN25-6-3	D8	yes	V super strong	Metal sheet	Round
Ferritic/ Austenitic	Stainless Hyper Duplex Steel	1.4658	-	S32707	X2CrNiMoCoN28-8-5-1	-	no	> V / super strong	Seamless tubes	
Ferriticer Stahl	Ferritic chromium steel	1.4003	-	S40977	X2CrNi12	-	yes	I / low	Metal sheet	Wire / Round
Ferritic steel	Ferritic chromium steel	1.4512	409	S40910	X2CrTi12	-	yes	I / low	Metal sheet	Wire / Round
Ferritic steel	Ferritic chrome steel	1.4016	430	S43000	X6Cr17	-	yes	I / low	Metal sheet	Wire / Round
Austenitic steel	Spring steel	1.4310	301	S30100	X10CrNi18-8	A1	no	I / low	Metal sheet	Wire / Round
Austenitic steel	Standard steel	1.4301 (1.4307)	304	S30400	X5CrNi18-10	A2	yes	II / moderate	all	Wire / Round
Austenitic steel	Standard Low Carbon	1.4307	304L	S30403	X2CrNi18-9	A2L	yes	II / moderate	all	
Austenitic steel	Standard stabilized	1.4541	321	S32100	X6CrNiTi18-10	A3	yes	II / moderate	Metal sheet	Wire / Round
Austenitic steel	Standard steel	1.4401 (1.4404)	316	S31600	X5CrNiMo17-12-2	A4	yes	III / medium	all	
Austenitic steel	Standard Low Carbon	1.4404	316L	S31603	X2CrNiMo17-12-2	A4L	yes	III / medium	all	
Austenitic steel	With higher Ni + Mo content	1.4435	316L	S31603	X2CrNiMo18-14-3	-	no	III / medium	Metal sheet	
Austenitic steel	Standard stabilized	1.4571	316Ti	S31635	X6CrNiMoTi17-12-2	A5	yes	III / medium	all	
Austenitic steel	Higher Mo content + Nitrogen	1.4439	317 LNM	S31726	X2CrNiMoN17-13-5	-	yes	IV / strong	Metal sheet	
Austenitic steel	Fully austenitic steel	1.4539	904L	N08904	X1NiCrMoCu25-20-5	-	yes	IV / strong	Metal sheet	Wire / Round
Austenitic steel	Fully austenitic steel	1.4529	-	N08925/6	X1NiCrMoCuN25-20-7	A8	yes	V / very strong	Metal sheet	Wire / Round
Austenitic steel	Fully austenitic steel	1.4547	-	S31254	X1CrNiCuN20-18-7	A8	yes	V / very strong	Metal sheet	
Austenitic steel	Heat resistant	1.4828	309	S30900	X15CrNiSi20-12	-	no	(low)	Metal sheet	Wire / Round
Austenitic steel	Heat resistant	1.4841	314	S31400	X15CrNiSi25-21	-	no	(very good)	Metal sheet	Wire / Round

Table designation (table right page)

\*1 Values in brackets = the materials commonly used today. The EN material no. „...01“ may still be used for the newer alloy with less carbon [ $< 0.03\%$ ].

\*2 According to EN10088, ISO 1872, management by Steel Centre Düsseldorf

\*3 AISI = numbering system for steels, administered by the American Iron and Steel Institute, materials under the AISI number similar to the German versions!

\*4 Unified Numbering System for all materials, administered by the American Society for Testing and Materials (ASTM).

\*5 Steel-iron materials sheet „SEW“ from the publishing house *Stahl Eisen* (Steel Centre Düsseldorf) for non-standardised materials

\*6 New Lean Duplex steel with high elongation at break A80 > 35% - deep-drawable

\*7 Information of the values in brackets, materials not be included in Eurocode 3, assessment according to general tests and experience

# Mechanical and physical properties

The following are the stainless steel material grades frequently processed by Modersohn:

## Mechanical and physical properties

Material no.	at room temperature (20°C)					at different temperatures						
	Tensile strength MPa min.	Yield strength $R_{p0.2}$ Delivery condition with- out strain hardening, MPa min. <sup>*1</sup>	Breaking elongation A in % min. (lengthwise / crosswise) $k = 5,65 \cdot \sqrt{L_0}$ $L_0 = k \cdot \sqrt{S_0}$	Modulus of elasticity GPa acc. to DIN EN 1993-1-4 <sup>*4</sup>	Hardness <sup>*3</sup> HB max (typical values)	Electrical resistance value $\frac{W}{m} \cdot \frac{mm^2}{m}$	Magnetisability	Thermal conductivity $\lambda = W/(m \cdot K)$	Thermal expansion coefficient [10 <sup>6</sup> /K]	Cold toughness properties, recommendation for load-bearing constructions min. °C <sup>*4</sup> for thicknesses > 3 mm	Recommended max. operating temperature in air until °C, <sup>*5</sup> permanent load	
1.4062	650	450	30	200	290 (225-235)	0,68	yes	15	13 (9,5) <sup>*6</sup>	-40	on request	
1.4162	650	450	30	200	290 (225-235)	0,75	yes	15	13	-40	on request	
1.4482	650	450	25	200	290 (220-255)	0,80	yes	13	13	-40	on request	
1.4362	600	400	25	200	260 (210-235)	0,80	yes	15	13	-40	on request	
1.4637	700	500	35	(205)	k. A.	0,80	yes	14,5	13	k. A.	on request	
1.4662	680	480	25	200	290 (230-250)	0,80	yes	15	13	-40	on request	
1.4462	650	450	25	200	270 (230-250)	0,80	yes	15	13	-40	250 (300)	
1.4410	730	530	25	200	290 (250-270)	0,80	yes	14	13	-40	250 (300)	
1.4501	730	530	25	200	270	0,80	yes	15	13	-40	250 (300)	
1.4507	730	530	25	200	270	0,80	yes	15	13	-40	250 (300)	
1.4658	920	700	25	(197)	320	0,80	yes	12	12,5	k. A.	k. A.	
1.4003	450	240	20	220	200	0,60	yes	25	10,4	-40	300	
1.4512	380	200	25	220	200	0,60	yes	25	10,5	+10	350	
1.4016	400	240	20	220	200	0,60	yes	25	10	+10	400	
1.4310	500	250	40	(195)	230	0,73	no <sup>*7</sup>	15	17	k. A.	300	
1.4301	500	190	45 / 35	200	215	0,73	no <sup>*7</sup>	15	16	-200	450	
1.4307	500	175	45 / 35	200	215	0,73	no <sup>*7</sup>	15	16	-200	450	
1.4541	500	190	40 / 30	200	215	0,73	no <sup>*7</sup>	15	16	-273	500	
1.4401	500	200	40 / 30	200	215	0,75	no <sup>*7</sup>	15	16	-200	450	
1.4404	500	200	40 / 30	200	215	0,75	no <sup>*7</sup>	15	16	-200	450	
1.4435	500	200	40 / 30	200	215	0,75	no <sup>*7</sup>	15	16	-200	450	
1.4571	500	200	40 / 30	200	215	0,75	no <sup>*7</sup>	15	16,5	-273	500	
1.4439	580	280	35 / 30	200	250	0,85	no <sup>*7</sup>	14	16	-200	450	
1.4539	530	230	35 / 30	195	230	1,00	no	12	16	k. A.	500	
1.4529	650	300	40 / 35	195	250	1,00	no	12	16	k. A.	500	
1.4547	650	300	40 / 35	195	260	0,85	no	14	16,5	k. A.	500	
1.4828	500	230	30	(196)	223	0,85	no <sup>*7</sup>	15	16,5	k. A.	1.000	
1.4841	550	230	30	(196)	223	0,90	no <sup>*7</sup>	15	15,5	k. A.	1.120	

### Mechanical and physical properties

\* Values in brackets = factory data or from DIN EN 10088-1 (guide values without strain hardening!)

<sup>\*1</sup> The yield strength  $R_{p0.2}$  is one of the most important mechanical values for structural design. Work hardening can significantly increase the values while changing other mechanical and physical properties. If you want to take strain hardening into account in the calculation, you must ensure that the stiffness (i.e. the modulus of elasticity) decreases and that the strain hardening is reduced again (depending on the temperature level) in the case of subsequent high-temperature influences! Frequently, work hardening is completely eliminated by e.g. welding and thermal cutting in the heat-affected zones and may no longer be applied to the complete component! Then only the minimum yield strength  $R_{p0.2}$  given here is to be expected.

<sup>\*2</sup>  $S_0$  = Output cross-section  
 $L_0$  = Initial dimension length  
 $k$  = International factor (5,65)

During cold forming, a minimum radius must always be maintained for ferritic chromium steels and duplex steels due to the lower elongation at fracture. Up to 3 mm material thickness for flat products  $r$  (inner radius) =  $t$  (thickness).

This is calculated on the basis of the tool yields with the adjacent table:

See the current „General technical approval Z-30.3-6“ of March 5th 2018 under point 4.4 (page 14).

<sup>\*3</sup> This value is for orientation only. Depending on heat treatment and rolling, the value may vary.

<sup>\*4</sup> The temperature value for cold toughness behaviour is one of the most important bases for deciding whether or not a material is suitable for load-bearing constructions in normal ambient atmospheres (with winter phase, Europe to max. -40°C), especially for fastening technology. For the building authority approval, the materials are tested with the notched impact bending method at -40°C, and an energy value of at least 40 joules to be achieved. The ferritic chromium steels generally perform poorly, especially in the temperature influence range of welds. In addition, the thickness of the material used has a great influence on failure due to cold embrittlement. Basically, the thicker the material, the faster you get glass-fracture-like failures, especially with components that are subject to high mechanical loads and stress. Therefore, most ferritic chromium steels should only be used as thin sheets with a material thickness of max. 2.99 mm if the application takes place in temperature ranges below 10°C. The austenitic steels, on the other hand, have no problems due to their high nickel content and can even be used for cryotechnical applications. The cold toughness values of duplex steels are still in a good range for normal atmospheric applications. Duplex steels with a higher nickel content, such as 1.4462 or 1.4362, have an advantage here. These can still bear loads at -50° or -60°C without any problems.

<sup>\*5</sup> Values for continuous high-temperature loading. The strength values, especially those of the austenitic steel grades, decrease sharply with increasing temperature. The advantage of austenitic steel grades is their continued high toughness even at high temperatures. Duplex stainless steel containing molybdenum becomes even stronger as the temperature rises (high-temperature strength), but tends to become brittle above 300°C, this is due to the so-called „475°C brittleness“. There are examples where heat exchangers have functioned perfectly for many years even at temperatures of 350°C, but there are also individual cases where considerable embrittlement has occurred in welded joints after about 30,000 - 40,000 hours and temperatures above 250°C. (Source: *Brücken 1997*). The new Lean Duplex steels without molybdenum perform significantly better at the recommended maximum service temperature. Lean duplex steels with little or no molybdenum still remain sufficiently tough, even after 50 hours with temperature influence up to over 950°C. Currently, a research project is investigating details of the temperature or strip resistance.

<sup>\*6</sup> Value in brackets for factory specification ArcelorMittal Stainless Steel Europe Print 2009 (Aperam), compared to the value from EN 10088-1.

<sup>\*7</sup> Small amounts of ferrite and / or martensite lead to an increase in magnetisability when cold formed, slightly magnetic after cold forming.

$$r = (4,2 - A_2/10) \cdot t$$

$r$  = Minimum inner radius

$A_2$  = Minimum elongation at break in % (unconsolidated)

$t$  = Sheet thickness or diameter of round bars



# Chemical properties

## Chemical components stainless steel



Material no.	Analysis <sup>*3</sup>												Effective sum (WS) <sup>*4</sup> International „PRE“ Standard range ranking for pitting / crevice corrosion
	Short name DIN	C	Si	Mn	P	S	Cr	Mo	Ni	N	Cu	Sonstige	
		%	%	%	%	%	%	%	%	%	%	%	
		From to / max.	From to / max.	From to / max.	From to / max.	From to / max.	From to / max.	From to / max.	From to / max.	From to / max.	From to / max.	From to / max.	
1.4062	X2CrNi22-2	0,03	1,00	2,00	0,04	0,01	21,5-24,0	≤ 0,45	1,00-2,90	0,16-0,28	-	-	25 - 30
1.4162	X2CrMnNiN21-5-1	0,04	1,00	4,0-6,0	0,04	0,015	21,0-22,0	0,10-0,80	1,35-1,90	0,20-0,25	0,10-0,80	-	25 - 29
1.4482	X2CrMnNiMoN21-5-3	0,03	1,00	4,0-6,0	0,035	0,03	19,5-21,5	0,10-0,60	1,50-3,50	0,05-0,20	1,00	-	21 - 27
1.4362	X2CrNiN23-4	0,03	1,00	2,00	0,035	0,015	22,0-24,0	0,10-0,60	3,50-5,50	0,05-0,20	0,10-0,60	-	23 - 29
1.4637	New, currently no indication	0,02	k. A.	≤ 2,5	k. A.	k. A.	19,0-22,0	0,6-1,4	2,0-4,0	0,14-0,24	0,40	-	23 - 30
1.4662	X2CrNiMoCuN24-4-3-2	0,03	0,70	2,5-4,0	0,035	0,005	23,0-25,0	1,0-2,0	3,0-4,5	0,20-0,30	0,10-0,80	-	30 - 36
1.4462	X2CrNiMoN22-5-3	0,03	1,00	2,00	0,035	0,015	21,0-23,0	2,50-3,50	4,50-6,50	0,10-0,22	-	-	31 - 38
1.4410	X2CrNiMoN25-7-4	0,03	1,00	2,00	0,035	0,015	24,0-26,0	3,0-4,5	6,0-8,0	0,24-0,35	-	-	38 - 46
1.4501	X2CrNiMoCuWN25-7-4	0,03	1,00	1,00	0,035	0,015	24,0-26,0	3,0-4,0	6,0-8,0	0,20-0,30	0,50-1,0	W: 0,50-1,00	38 - 46
1.4507	X2CrNiMoCuN25-6-3	0,03	0,70	2,00	0,035	0,015	24,0-26,0	3,0-4,0	6,0-8,0	0,20-0,30	1,00-2,50	-	37 - 44
1.4658	X2CrNiMoCoN28-8-5-1	0,03	0,50	1,50	0,035	0,01	26,0-29,0	4,0-5,0	5,5-9,5	0,3-0,5	1,0	Co: 0,50-2,00	44 - 54
1.4003	X2CrNi12	0,03	1,00	1,50	0,04	0,015	10,5-12,5	-	0,30-1,00	0,030	-	-	11 - 13
1.4512	X2CrTi12	0,03	1,00	1,00	0,04	0,015	10,5-12,5	-	-	-	-	Ti [6 x (C+N)] up to 0,65 <sup>*2</sup>	11 - 13
1.4016	X6Cr17	0,08	1,00	1,00	0,04	0,015 <sup>*1</sup>	16,0-18,0	-	-	-	-	-	16 - 18
1.4310	X10CrNi18-8	0,05-0,15	2,00	2,00	0,045	0,015	16,0-19,0	≤ 0,80	6,00-9,50	0,100	-	-	([16] - 22) <sup>*5</sup>
1.4301	X5CrNi18-10	0,07	1,00	2,00	0,045	0,015 <sup>*1</sup>	17,5-19,5	-	8,00-10,5	0,100	-	-	18 - 20
1.4307	X2CrNi18-9	0,03	1,00	2,00	0,045	0,015 <sup>*1</sup>	17,5-19,5	-	8,00-10,5	0,100	-	-	18 - 20
1.4541	X6CrNiTi18-10	0,08	1,00	2,00	0,045	0,015 <sup>*1</sup>	17,0-19,0	-	9,0-12,0	-	-	Ti:5xC up to 0,70	17 - 19
1.4401	X5CrNiMo17-12-2	0,07	1,00	2,00	0,045	0,015 <sup>*1</sup>	16,5-18,5	2,00-2,50	10,0-13,0	0,10	-	-	23 - 27
1.4404	X2CrNiMo17-12-2	0,03	1,00	2,00	0,045	0,015 <sup>*1</sup>	16,5-18,5	2,00-2,50	10,0-13,0	0,10	-	-	23 - 27
1.4435	X2CrNiMo18-14-3	0,03	1,00	2,00	0,045	0,015 <sup>*1</sup>	17,0-19,0	2,50-3,00	12,5-15,0	0,10	-	-	25 - 29
1.4571	X6CrNiMoTi17-12-2	0,08	1,00	2,00	0,045	0,015 <sup>*1</sup>	16,5-18,5	2,00-2,50	10,5-13,5	-	-	Ti:5xC up to 0,70	23 - 27
1.4439	X2CrNiMoN17-13-5	0,03	1,00	2,00	0,045	0,015	16,5-18,5	4,0-5,0	12,5-14,5	0,12-0,22	-	-	30 - 35
1.4539	X1NiCrMoCu25-20-5	0,02	0,70	2,00	0,03	0,01	19,0-21,0	4,0-5,0	24,0-26,0	0,15	1,20-2,00	-	32 - 38
1.4529	X1NiCrMoCuN25-20-7	0,02	0,50	1,00	0,03	0,01	19,0-21,0	6,0-7,0	24,0-26,0	0,15-0,25	0,50-1,50	-	39 - 44
1.4547	X1CrNiMoCuN20-18-7	0,02	0,70	1,00	0,03	0,01	19,5-20,5	6,0-7,0	17,5-18,5	0,18-0,25	0,50-1,00	-	39 - 44
1.4828	X15CrNiSi20-12	0,20	1,50-2,50	2,00	0,045	0,015	19,0-21,0	-	11,0-13,0	0,10	-	-	19 - 21
1.4841	X15CrNiSi25-21	0,20	1,50-2,50	2,00	0,045	0,015	24,0-26,0	-	19,0-22,0	0,10	-	-	24 - 26

<sup>\*1</sup> For products to be machined S 0.015-0.030%; long products S ≤ 0.030%; to ensure suitability for welding S 0.008-0.030%; to ensure polishability S ≤ 0.015%.

<sup>\*2</sup> Equivalent: Nb (mass fraction in %) = Zr (mass fraction in %) = 7/4 Ti (mass fraction in %)

<sup>\*3</sup> The decisive factor for corrosion resistance is essentially the chromium ratio! Molybdenum for austenites and nitrogen for duplex steels also increase corrosion resistance. Higher carbon, phosphorus and sulphur contents, on the other hand, greatly reduce the corrosion resistance. Nickel increases the resistance in acidic environments from 8%, but at the same time leads to an increased risk of stress corrosion cracking with this mass proportion!

<sup>\*4</sup> Effective sum formula WS = %Cr + 3.3 · (%Mo + 0.5 · %W) + x · %N; (Mo ≥ 1.0 %; Austenite/Ferrite: x=0; Duplex: x=16)

The effective sum of a material is always determined as an arithmetic medium from the lowest and highest values of the alloy components resulting from the delivery standard DIN EN 10088 Part 1-3.

The effective sum results calculated in this way are not precise assessments of corrosion resistance, but only a rough guide!

Especially with the manganese-containing Lean Duplex steels, the values are very inaccurate!

The user must also always bear in mind that the exact corrosion resistance as a system property of numerous environmental, surface and material conditions can only ever be determined on an exact application.

This requires a detailed case-related practical investigation.

The Federal Institute for Materials Research and Testing (BAM) in Berlin already has many test results for Lean Duplex steels in certain atmospheric ranges.

Please enquire with us first.

<sup>\*5</sup> Comparable to stainless steel 1.4307/1.4301. The disadvantage in corrosion resistance with the higher carbon content is compensated by the addition of some molybdenum. [...]

Value depending on manufacturer's works.

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