vallourec

Including Oceanfit® grades

# Subsea Structures

Hot rolled MSH Sections for Oil & Gas Constructions

# Vallourec – Leader in Premium Tubular Solutions

Over
**125**
years' experience
in hot rolled
seamless tube production

## 125 Years of Experience

Incorporating the competence of seamless tube inventors and pioneers Mannesmann, Vallourec looks back upon a long tradition of excellence in premium tubular solutions. Today Vallourec is a world leader in this field, primarily serving the energy markets - oil and gas, power generation - but also extending to other demanding markets such as the industry sector including mechanical engineering, automotive and construction. With integrated steel producing and tube manufacturing facilities in more than 20 countries and cutting-edge R&D, Vallourec provides customers with innovative global solutions that respond to the energy challenges of the 21st century.

## Leading in Oil & Gas

Vallourec is committed to providing its customers with the best products and services available on the market through its unique global approach supported by local capabilities. The steadily growing demand for high quality tubes for oil and gas fields is catered for by Vallourec's OCTG Division, consisting of strategically positioned production facilities world wide plus a powerful network of more than 100 licensee workshops devoted to local support for the well-known, tried and tested product line VAM.

Premium connections and joints produced by Vallourec are used world- wide as part of highly demanding pipe projects. To complete offerings in the OCTG business, skilled Vallourec professionals are working around the clock to provide first-class customer service und support.

# MSH Sections – A Step Ahead in Quality

## MSH - A Milestone in Steel Construction

Hot rolled circular, square and rectangular **M**annesmann **S**tructural **H**ollow Sections – MSH sections, for short – have been used successfully for several decades in the most varied fields of engineering. They are used as modern structural elements in steel facade structures, bridge building, spectacular roof constructions and demanding automotive and crane designs.

What makes MSH sections so universal and flexible in use is their specific product profile, defined by features such as heavy wall thicknesses, extremely high yield strength level, good impact toughness at low temperatures, tight tolerances and excellent welding properties.

## Unique Product Features

- **Heavy Wall Thicknesses**
- **Unprecedented Yield Strength Level**
- **Good Impact Toughness at -50° C**
- **Extremely Tight Tolerances**
- **Seamless for Sizes up to 300 x 300 mm**


## MSH - First Choice Above and Below Sea Level

In fact, MSH sections have been well-known structural elements in the professional offshore environments for quite a while. The designs of

e.g.:
- Fixed and floating offshore production facilities
- Offshore cranes
- Freefall lifeboat support systems

frequently rely on the unique features of MSH. With many MSH offshore applications above sea level already successfully in operation, construction and processing advantages of the product range can easily be transferred to subsea applications. All the more, considering that testing and certification are based on the same internationally accepted standards and specifications.

# MSH Sections in Subsea Equipment

according to e. g.

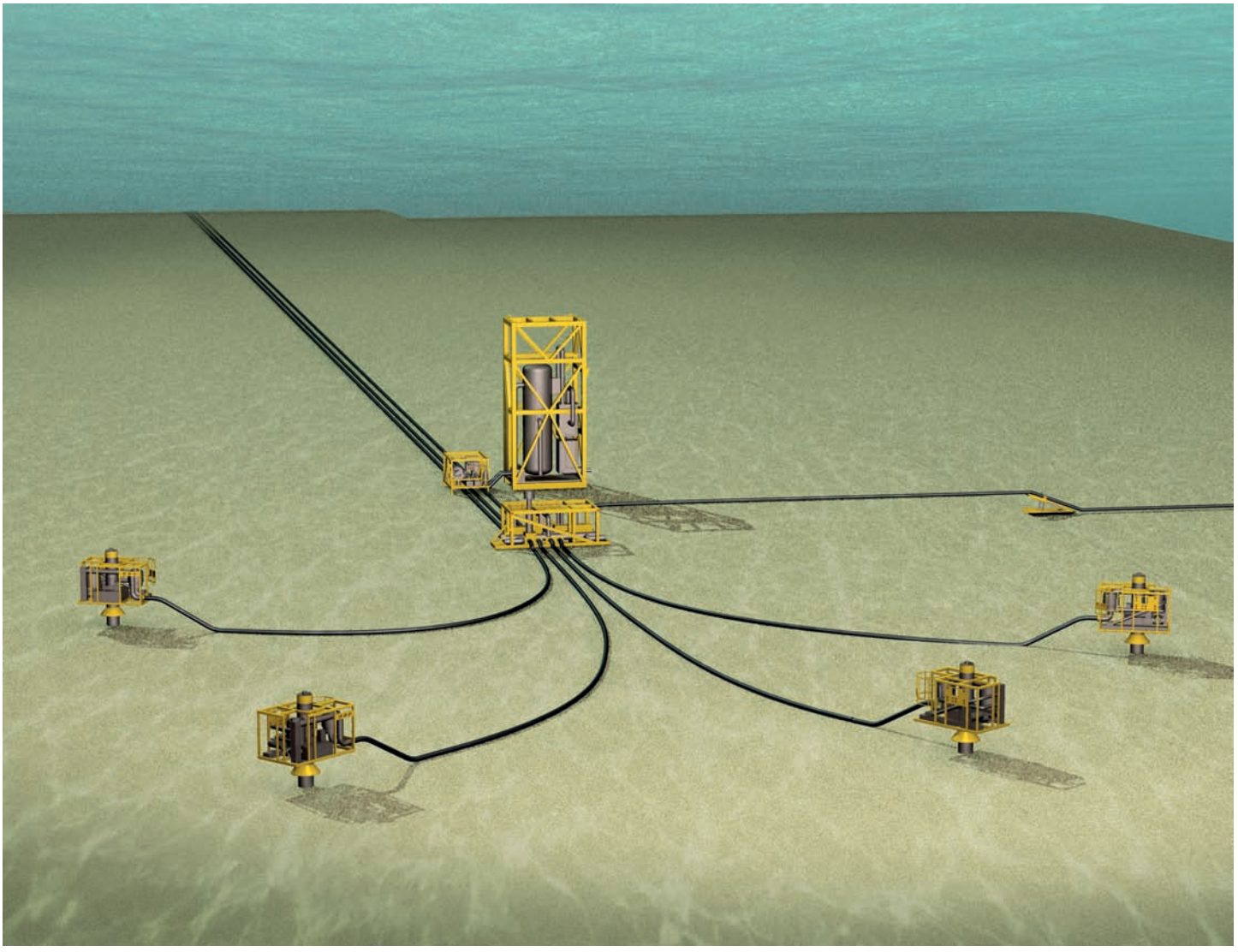
**NORSOK M-120**
**EN 10210**
**EN 10225**
**and much more**

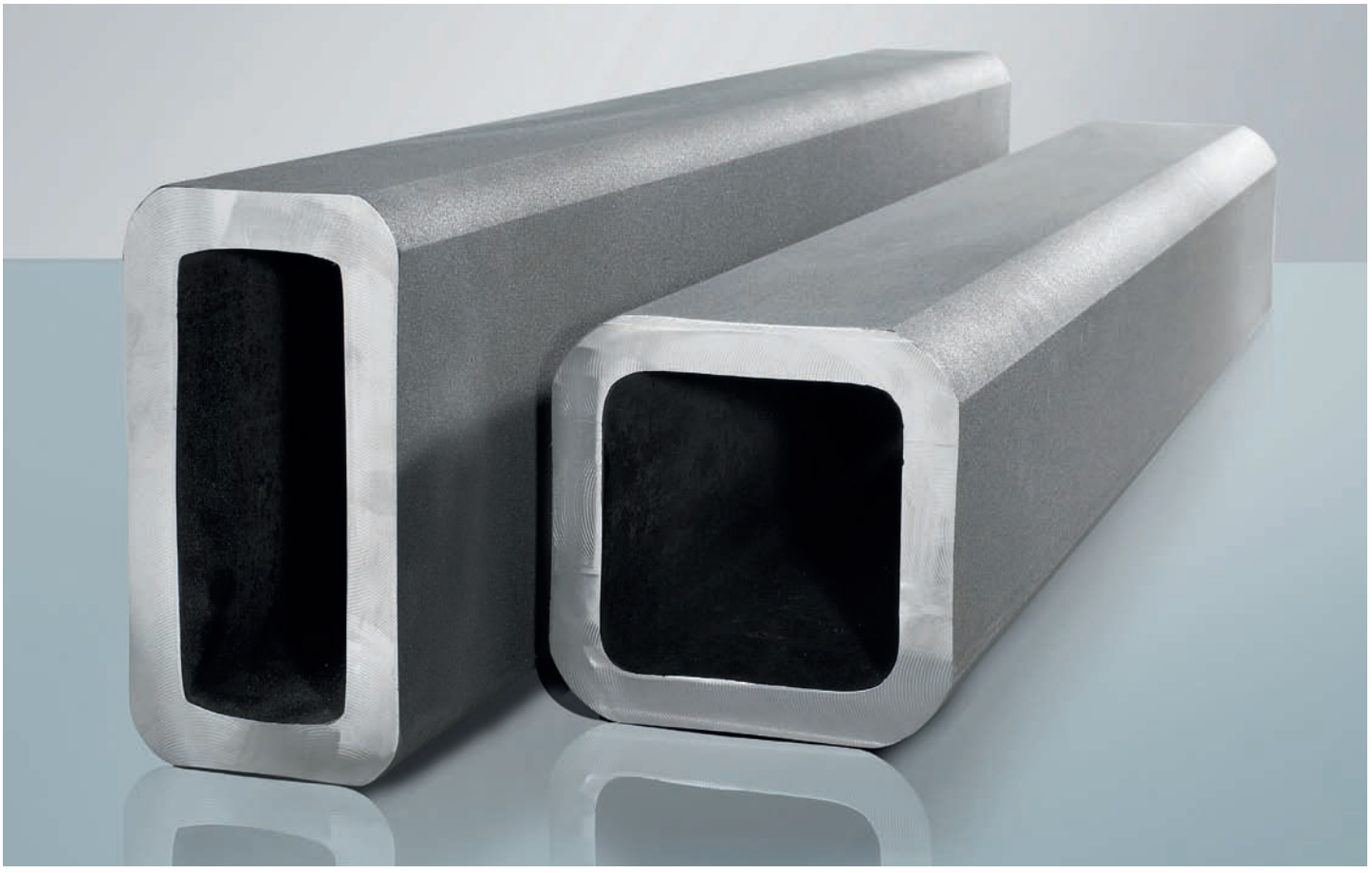
## According to Standards and Customer Specifications

With its comprehensive range of MSH sections, Vallourec provides the ideal construction elements for all needs in subsea applications. MSH sections meet all relevant requirements specific to subsea use in terms of their mechanical, technological and geometrical properties. In many cases Vallourec fulfills proprietary customer specifications that by far exceed the requirements laid down in the applicable standard.

Considering specific subsea environments, equipment and systems, there are quite a few applications MSH sections are tailored for, among them:
- Processing and boosting systems
- Manifolds
- Trees
- Active pipeline supports
- ROV operated bending tools
- Dynamic loaded significant structural elements with 3-axial complex stress distribution

As an integral structural part of all the above mentioned and many more similar systems, MSH sections serve as the ideal material to take over load-bearing functions in a reliable, flexible and cost-effective way.





# A Large Range of Sizes

| | Circular | Square | Rectangular |
|---|---|---|---|
| **Outside dimension** | 21.3 mm to 660 mm | Seamless: 40 x 40 to 300 x 300 mm<br>Welded: 250 x 250 to 400 x 400 mm | Seamless: 50 x 30 to 300 x 200 mm<br>Welded: 300 x 200 to 500 x 300 mm |
| **Wall thickness** | 2.3 mm to 100 mm | max. 25 mm* | max. 25 mm* |
| **Possible combinations** | 740 | 225 | 450 |

*) All available dimensions listed in the brochure “Technical Information No. 1”.

## MSH Sections: More than 1400 Sizes – Lengths up to 16 m

At 25 mm, the maximum wall thickness of hot rolled square and rectangular MSH sections is significantly greater than in cold formed hollow sections. Design engineers can thus choose the optimum structural hollow sections for each specific application and load profile from the world‘s largest range of sizes – the MSH manufacturing programme of Vallourec. Where tremendous loads have to be supported and transmitted in restricted space conditions, an MSH Section with an appropriately large wall thickness can be chosen. On top we offer circular hollow sections for projects in more than 800 size combinations.

Conversely, where crucial design calculations have to be carried out – for example, to minimise a structure‘s dead weight – a suitable intermediate dimension can be specified for MSH sections. Vallourec supplies MSH sections in standard lengths of up to 12 m. This length can be handled comfortably during transportation and storage. For special cases, requiring a reduction in the number of structural elements and hence butt welds, greater mill lengths of up to 16 m are available.

# A Choice of Grades for Subsea Equipment

## Standard … and much more

MSH sections are available in non-alloyed and finegrain steels in as rolled, normalised and quenched & tempered condition. Vallourec complements the portfolio of standard grades which are currently available on the market for hot rolled hollow sections by two Vallourec proprietary grade series offering unprecedented yield strength levels.
There is even one special series of grades from Vallourec, which is exclusively dedicated to applications in demanding, aggressive offshore environments - the Oceanfit® series.
The Oceanfit® series consists of fine-grain high-strength steels with nominal minimum yield strength in the range of above 500 MPa up to impressive levels of about 900 MPa.
A very high degree of toughness even at temperatures well below zero and weldability are combined in this series with tested and certified application standards such as EN 10225 for offshore constructions.

**Extract of grade portfolio for hot rolled hollow sections in subsea and offshore equipment**

| EN 10210 | EN 10225 | EN 10210 | Vallourec special offer |
|---|---|---|---|
| S460NH* Seamless | S355G15+N* Seamless | S460NLH* Seamless | Oceanfit® 890* Seamless |
| S355NH Seamless/ welded* | S355G14+N* Seamless | S355NLH Seamless/ welded* | Oceanfit® 770* Seamless |
| S355J2H Seamless/ welded* | S355G13+N Welded | | Oceanfit® 690* Seamless |

* depending on dimension and on request

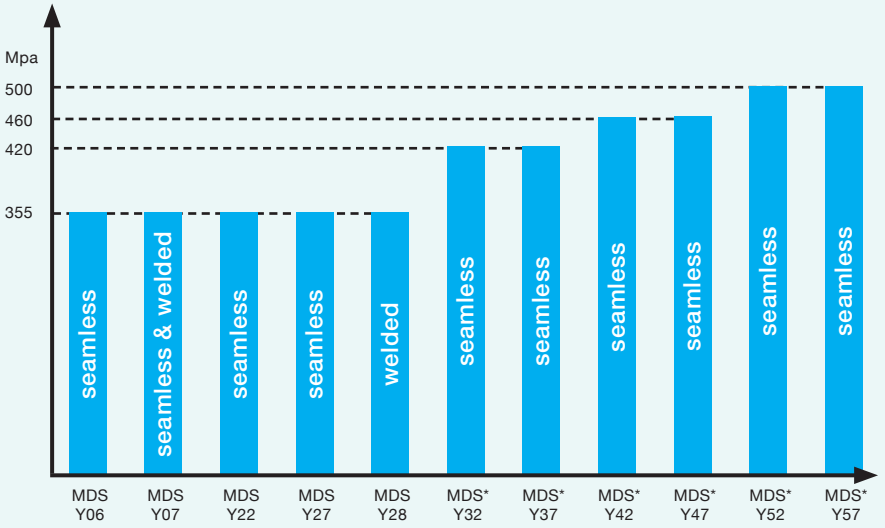
**Impact toughness [°C]**

| – 20°C | – 40°C | – 50°C | – 50°C |
|---|---|---|---|

# NORSOK Standard

## MSH section according to NORSOK standard

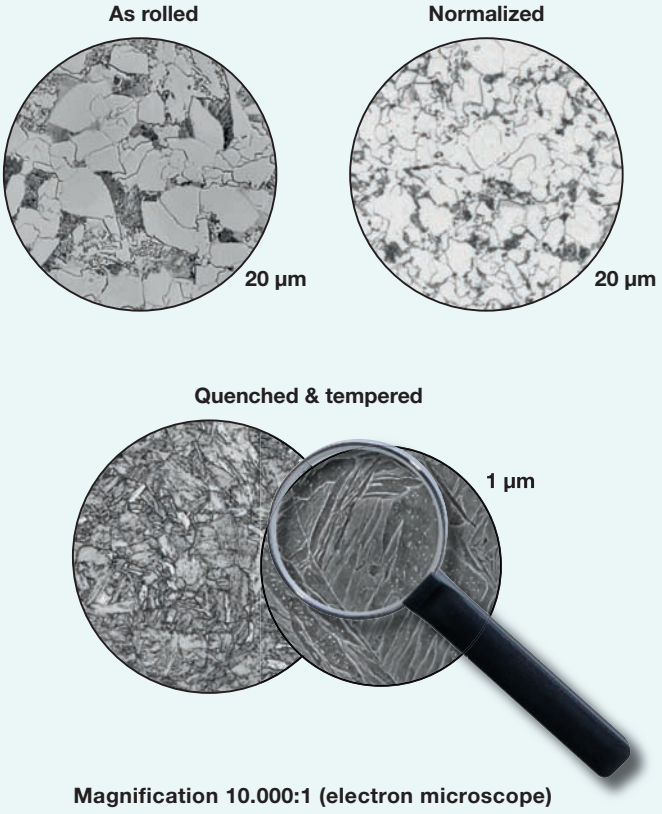
The NORSOK standards, developed by the Norwegian petroleum industry to ensure adequate safety, value adding and cost effectiveness for petroleum industry developments and operations, are internationally recognized as entry level to demanding offshore applications. MSH sections are qualified according to NORSOK M-120 Material Data Sheets (MDS) applicable to selected material standards and grades for use in steel structures.



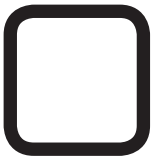
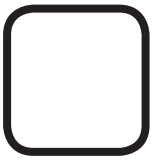
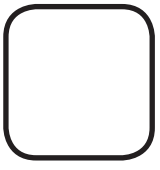
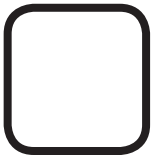

*on request

## Experience has led to Fine Grain Steels

We have five decades of experience in manufacturing hot rolled hollow sections and continuous improvement of our production processes have led to the development of an extraordinary grade: Vallourec's Oceanfit® finegrain steels owe their outstanding properties to the material's microstructure and grain size which are the results of meticulously controlled chemical compositions and advanced heat treatment methods.
Optimally adjusted heating temperatures and cooling rates during heat treatment as well as defined phosphorus and carbon contents are the prerequisites for achieving a homogeneous fine-grained micro-structure in all Oceanfit® steels. And this, in turn, makes it possible to unite three important properties, which had previously been almost incompatible: high strength, good impact toughness, and weldability.

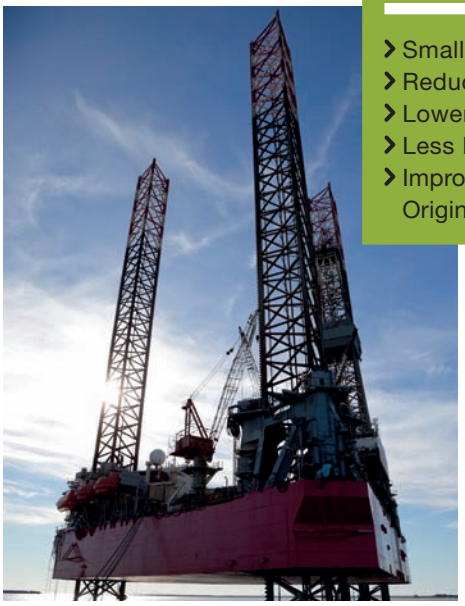



**Magnification 10.000:1 (electron microscope)**

| | S235JR | S355NH | S460NH | Oceanfit® 690 ImpactFit 50 | Oceanfit® 890 ImpactFit 50 |
|---|---|---|---|---|---|
| • Higher tensile strength permits an increase in load-bearing capacity without having to increase the cross section or wall thickness. At the same time, substantial weight savings can thus be achieved. |   |   |   |   |   |
| • With the same outside dimension and wall thickness (here: 220 mm edge length, 16 mm wall thickness), load-bearing capacity can be increased by 333 %. | 100 % | 151 % | 197 % | 295 % | 333 % |
| • With the same load-bearing capacity, the wall thickness can be reduced to a quarter of the original dimension, resulting in more slender and substantially lighter structures. | t = 20.0 mm   | t = 12.5 mm  | t = 8.8 mm  | t = 6.3 mm  | t = 5.0 mm  |
| • With the same load-bearing capacity, the cross section of the hollow section and thus the weight of the entire structure can be reduced by up to 75 %. | 100 %  | 65 %  | 50 %  | 30 %  | 25 %  |

## Same Strength with

- Smaller Sizes
- Reduced Wall Thickness
- Lower Weight
- Less Logistics Costs
- Improved Load with Original Dimension

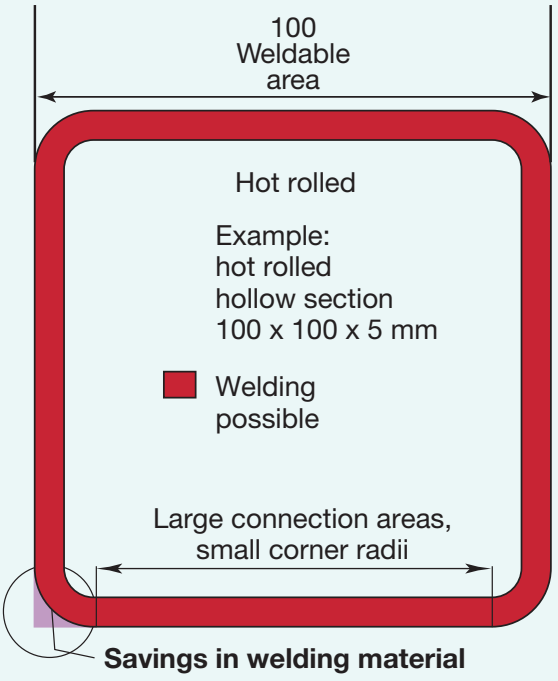


# Welding – Techniques and Advantages

In line with the state of technology for processing high-strength fine-grain structural steels, hot rolled MSH sections in steel grades Oceanfit® 690 and Oceanfit® 890 are weldable by applying all current techniques. The excellent weldability of Vallourec grades is attributable to their finegrained microstructure and a minimum amount of contaminants or accompanying elements. These properties support the manufacture of welded joints with good mechanical properties even in the event of high heat input. In other words, crack-free welds with high toughness can be executed even when high-output and economic welding processes are used. Welding and thermal cutting processes must be performed on the basis of the applicable standards and specifications, depending on the intended application.

## Preheating of Fine Grain Steels

Compared to lower-strength or thermo-mechanically treated steels, materials Oceanfit® 690 and Oceanfit® 890 usually have a higher alloying content and a higher carbon equivalent. This must be taken into account with appropriate preheating to the interpass temperature and/or 8/5 times matching the material. For example, in order to avoid impermissible hardness peaks, preheating to approximately 150 °C may be necessary depending on the design when MIG welding Oceanfit® 690 base material with a wall thickness of 10 mm.




## Unrestricted Welding in Corner Areas

Since the sections are hot rolled, there are no restrictions regarding welding in the corner area. Figure 2 shows an example of a welded joint between two sections. It should be pointed out that increased hardness levels must be expected in the root base of welds of this type. Special attention must be devoted to weld preparation in the area of the corner radius. Unless machining (e.g. milling) to close tolerances is carried out in this area and the section's geometry as delivered is used as welding preparation, the welds must be checked and tested with particular care. In all cases, the sections should be cleaned and adhering scale should be removed, e.g. by grinding or a suitable shot blasting process.

› Microsection of two MSH sections welded together

› Figure 2

# Connecting – Easy and Secure through Extra Tight Corner Radii

## Unique Quality Feature

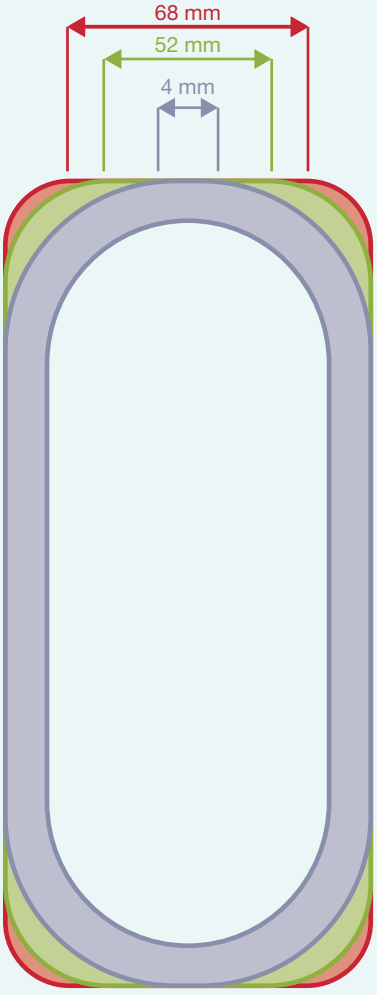
Special developments in our hot rolling processes allow Vallourec to create extra-tight corner radii (Ra ≤ 1 · T). Unlike competing products, MSH corner radii do not lead tangentially into the side faces but form a clean corner. This unique feature of MSH sections not only represents an excellent weld preparation and reduces the amount of welding material required, it also simplifies the secure and reliable mounting of additional components to the specific structure through wider contact surfaces.

With MSH sections' tight corner radii Vallourec offers a further unique MSH feature that simplifies and secures connecting - whether using welding or other joining techniques - a specific MSH characteristic that by far surpasses the requirements of EN 10210-2 in terms of the maximum permissible value (Ra ≤ 3 · T).

## Example: 200 x 100 x 16 mm

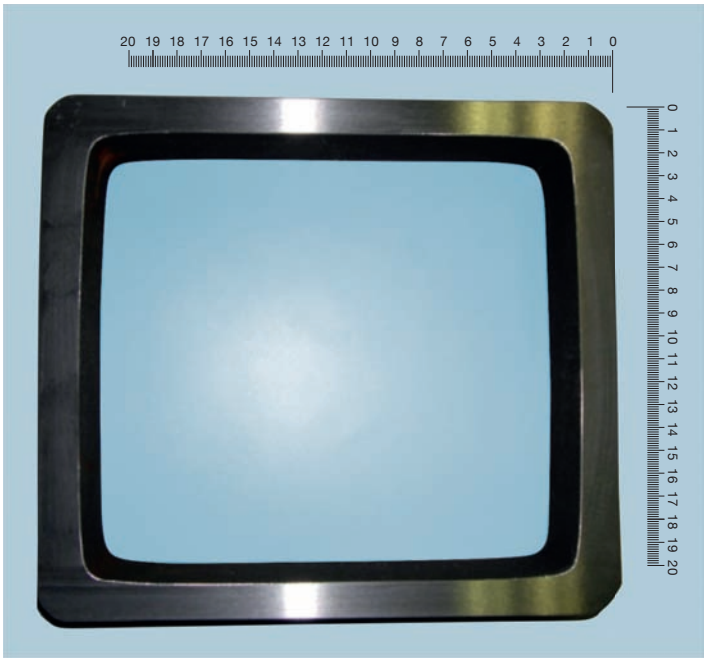
| | |
|---|---|
| Standard acc. EN 10210-2: | C ≤ 3.0 T |
| Special profile with improved corner radius*: | C ≤ 2.0 T |
| External corner radius for static calculation acc. to EN 10210-2 | C ≤ 1.5 T |
| Special profile with extra tight corner radius*: | C ≤ 1.0 T |

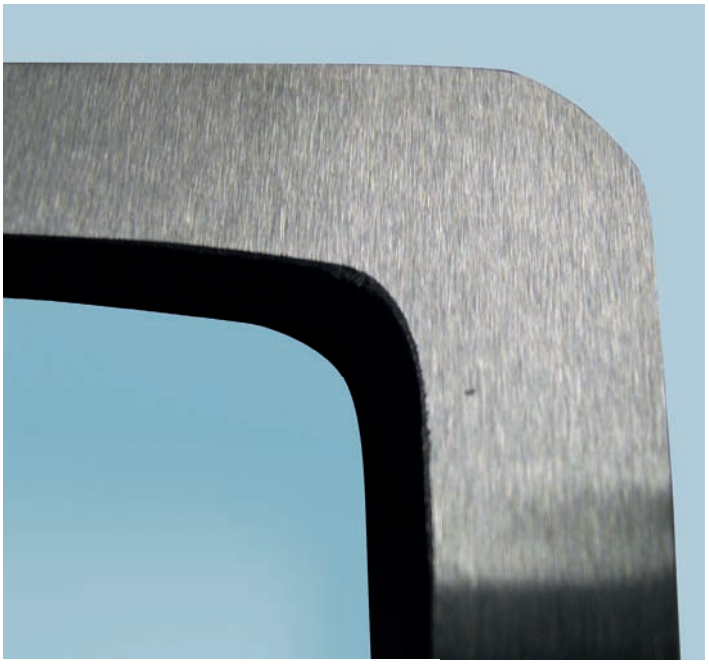
*on request




## Variable contact surface / corner radius

| | |
|---|---|
| 100 mm – (2 x 3.0 x 16 mm) = | 4 mm |
| 100 mm – (2 x 2.0 x 16 mm) = | 36 mm |
| 100 mm – (2 x 1.5 x 16 mm) = | 52 mm |
| 100 mm – (2 x 1.0 x 16 mm) = | 68 mm |



# Certified Excellence

## MSH Sections – Multi-certified Quality Products

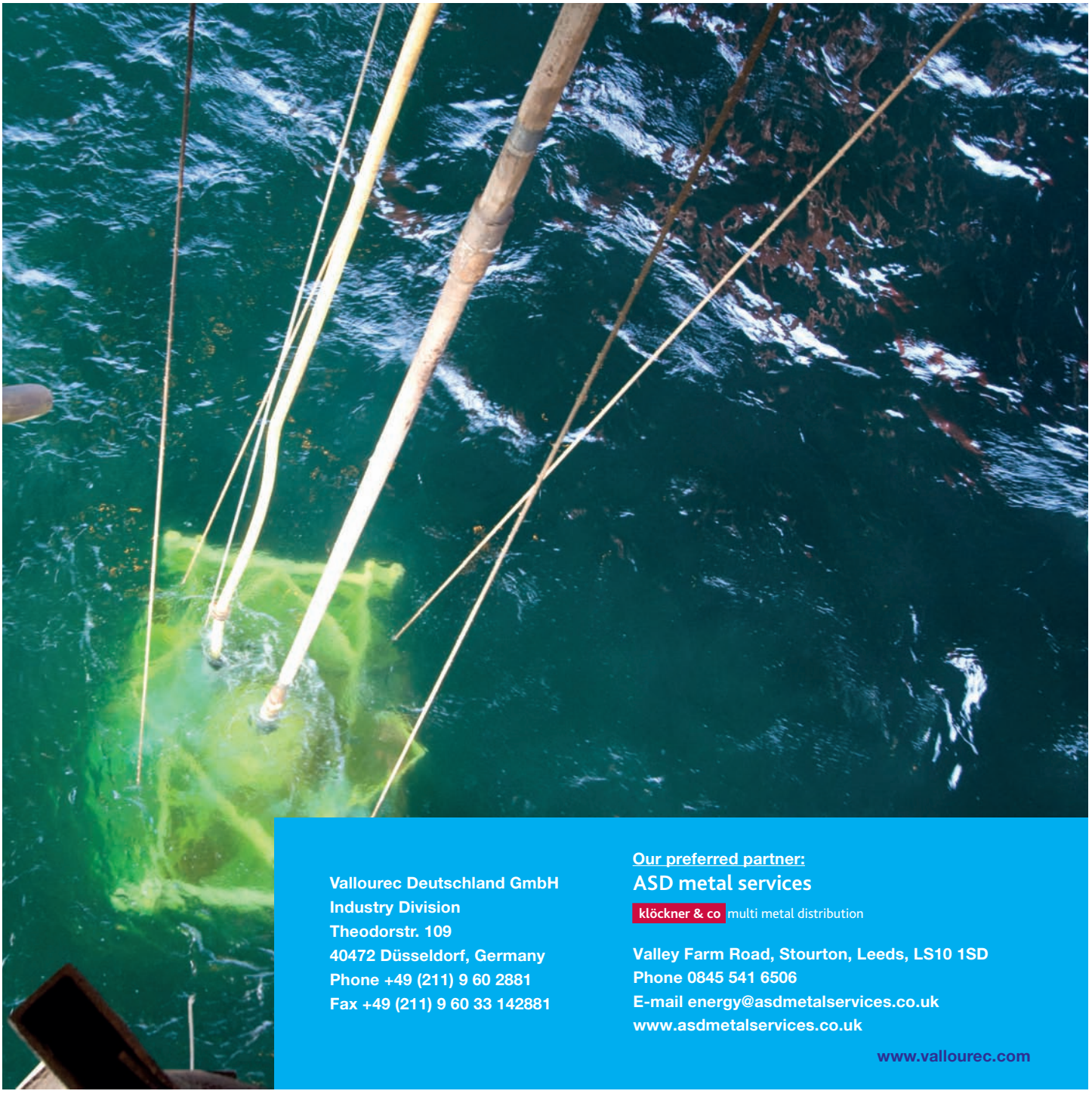
Hot rolled MSH sections are quality products tested in accordance with EN 10210 and similar national or international standards. All tests are carried out on the finished product, so adherence both to the specified mechanical and technological characteristics of the materials as well as dimensional tolerances is ensured.

Our quality management system has been approved for many years in accordance with national and international standards and specifications (e.g. ISO 9001). MSH sections in steel grades compliant with EN 10210-1 and intended for construction projects subject to building supervision requirements are of course supplied together with the necessary verification of compliance (CE sign). For special applications, e.g. in the ship-building and offshore industries, third party inspection by an organisation such as Technischer Überwachungsverein (TÜV) or Lloyds Register of Shipping (LRS) can be arranged (according to offshore standard EN 10225).

## Further Testing on Request

If required, further tests can be agreed upon in addition to the standard scope of testing:

- Pcm (composition parameter)
- Tensile test at elevated temperatures
- Transverse tensile test
- Transverse Charpy impact test
- Microstructure examination

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