



# HICfit pressure vessel plates for sour service

## Excellent resistance against hydrogen induced cracking (HIC)

HICfit pressure vessel plates for sour service are characterized by their excellent resistance against hydrogen induced cracking (HIC).

HICfit heavy plates are made of slabs produced in our own steel plant. All measures to ensure highest cleanliness of steel are applied during production. This especially includes steel making via the LD process and the state of the art soft reduction process during continuous casting.

Looking back on a long-term experience in production of HIC resistant material, various steel grades can be produced, which fulfill the most stringent requirements.

This data sheet is representing the following steel grades of the respective standards:

- » ASTM/ASME: S/A 516, S/A 537 Cl.1
- » EN 10028-2: P265 GH, P295 GH, P355 GH
- » EN 10028-3: P275N/NL1/NL2  
P355 N/NL1/NL2

Additional steel grades for sour service, not mentioned in the table above as well as any other specifications and requirements can be confirmed upon request.

voestalpine HICfit pressure vessel plates for sour service are produced in accordance with the most demanding requirements of international specifications.



PREMIUM QUALITY  
WITH REDUCED  
CARBON FOOTPRINT

## HIC-Test

A standard HIC-test is carried out in our certified laboratory and in accordance with NACE TM 0284. Depending on the plate thickness the tested sample consists of three or more specimen, which are exposed to the testing solution A for 96 hours. The solution A contains 5% NaCl with 0.5% acetic acid. It has a minimum pH of 2.7 but not exceeding 4.0 after end of testing. If not specified differently, one HIC-test will be carried out per heat.

After immersion, the specimens are cut into three pieces to perform metallographic crack evaluation. The crack dimensions are put into relation to the specimen dimensions and are expressed by CLR (crack length ratio), CTR (crack thickness ratio) and CSR (crack sensitivity ratio) values.

The acceptance criteria CLR, CTR and CSR can either be determined per each single cross section, as arithmetical mean value of one specimen or as arithmetical mean value per sample (all specimen).

If not specified differentially and as stated hereunder, the test result is the average of the three cross sections of one single specimen.

## Acceptance criteria

with test solution A

Acceptance criteria	CLR <sup>1)</sup>	CTR <sup>1)</sup>	CSR <sup>1)</sup>	As-delivered condition <sup>2)</sup>
HICfit Class I	≤ 5	≤ 1.5	≤ 0.5	
HICfit Class II	≤ 10	≤ 3.0	≤ 1.0	N (+T)
HICfit Class III	≤ 15	≤ 5.0	≤ 2.0	

<sup>1)</sup> Average value – arithmetical mean value per specimen (three cross-sections)

If not defined explicitly at the time of order placement, the mean value is seen as the average value of three cross sections per test specimen.

Different acceptance criterion can be confirmed upon request.

<sup>2)</sup> N ... Normalized; T ... Tempered

## Available dimensions

	Plate thickness [mm]	Max. width [mm]	Max. length [mm]	Max. weight [t]
HICfit Class I	12 - 60			
HICfit Class II	12 - 80	3,950	16,000	20
HICfit Class III	12 - 117			

Additional dimensions upon request.

Plates thinner than 12 mm can be produced but due to the low thickness only the CLR values can be confirmed and CTR values will be given for information.

## As-delivered condition

The plates are typically delivered in normalized condition. In order to achieve the specified HIC resistance, a stress relieving after the obligatory normalizing heat treatment is mandatory. If the customer does not intend to apply a post weld heat treatment on the material, a stress relieving treatment of the plates has to be ordered and conducted at voestalpine. In this case, the as-delivered condition is normalized and tempered (N+T).

### Mechanical and chemical properties

All applicable requirements of common standards that are used for equipment in sour service are met in each as-delivered conditions, as well as after applying usual PWHTs in accordance with ASME VIII Div 1 and 2.

We confirm all requirements mentioned in NACE MR 0175 / ISO 15156 and NACE MR 0103, that relate to the material, thus the max. Ni content of  $Ni_{max} = 1\%$  and a hardness of  $HRC_{max} = 22$  ( $\approx 237$  HB) are considered. The maximal hardness of 237 HB is confirmed without determination. Anyhow, the customer can order a separate hardness testing.

The lean chemical composition of our HIC resistant heavy plates fulfill the requirements of the a.m. standards and guarantee good weldability. In addition, the accompanying elements phosphorus and sulfur are remarkably restricted compared to the standards.

Guaranteed values:

- » **P  $\leq$  0.010 %<sup>1)</sup>**
- » **S  $\leq$  0.001 %**

<sup>1)</sup> The aim for the heat analysis is always a maximum Phosphorus content of 80ppm. We guarantee a maximum of 100ppm

### Production process

In order to guarantee the required HIC resistance, HICfit pressure vessel plates for sour service by voestalpine are following the most stringent production process route and are passing following production steps:

- » **Desulfurization of pig iron to achieve very low levels of sulfur**
- » **LD-BOF converter treatment**
- » **Vacuum degassing**
- » **Shape modification of inclusions**
- » **Optimized continuous casting process with soft reduction to minimize segregation and to assure high cleanliness**
- » **High thickness reduction during the rolling sequence**
- » **Normalizing treatment**
- » **Stress relieving treatment upon request (see "As-delivered condition")**

### Ultrasonic testing

As a standard on all plates for sour service, 100% of the surface is ultrasonic tested according to EN 10160 S3/E3 or S/A 578 Level C, depending on the requested steel grade. Like for all other requirements, also for NDT examination different acceptance criterion are possible upon request.

# OUR PATH TO A GREENER FUTURE

## Premium products in the greentec steel Edition

With greentec steel, voestalpine is pursuing an ambitious step-by-step plan in the long-term decarbonization of steel production. The declared objective is to achieve carbon-neutral production by 2050, and the initial steps have already been taken. Process-optimized production operations already prevent up to 10% of the direct CO<sub>2</sub> emissions at the Linz site. The material and processing properties of the steel are not affected in any way in this production route. Each voestalpine heavy plate product is available in premium quality in the greentec steel Edition with a reduced carbon footprint and unique benefits.



Premium quality with reduced carbon footprint

Heavy plates (excl. heads and clad plates) – greentec steel Edition

Max. carbon footprint 2.21 kg CO<sub>2</sub>e per kg of steel <sup>1)</sup>

<sup>1)</sup> per EN 15804+A2 (EPD methodology) cradle to gate

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