ThyssenKrupp Steel Europe

Normalized pressure vessel steel	Steel Grade		Material No.	Material Specification
	TKSE-Short name	EN-Short name		
Heavy plate	**X-COR®**	**P355**	**-**	900 September 2013

Scope

X-COR is a special steel grade for pressure vessels according to ASME/ASTM resp. EN 10028 with specific properties for usage in sour media. The specific corrosion resistance against hydrogen induced cracking (HIC) is an add-on to standard pressure vessel steels.

General information

X-COR equivalent to ASME/ASTM (S)A516, P355 according to ASME/ASTM/ EN 10028.

Delivery condition: Normalized

Plate thickness: 5 mm - 50 mm (0.197 in. – 1.969 in.)

Chemical composition:

The chemical composition corresponds to the conditions according ASME/ASTM resp. EN 10028. To achieve HIC-resistance, P an S are limited to P ≤ 0,015 % and S ≤ 0,0010 %.

Mechanical properties

The mechanical properties are in accordance to the specified standards, even after PWHT. Verification of mechanical properties in normalized condition. Hardness ≤ 22 HRC will be achieved in the base material without specific testing. Additional requirements upon request.

HIC-resistance

HIC-resistance is tested in normalized and stress relieved condition (PWHT: 605 +/- 10 °C; holding time 60 min). HIC-testing according to NACE TM 0284, Aramco 01-SAMMS-016. Test solution A (pH 3), metallographic examination according to NACE TM 0284, Aramco 01-SAMMS-016. Acceptance criteria CLR ≤ 5 %, CTR ≤ 1,5 %, CSR ≤ 0,5 %. Acceptance criteria are the mean values of crack dimension ratios of all metallographic examinations of all specimens. Mean values per specimen upon agreement (orientation values CLR ≤ 10 %, CTR ≤ 3 %, CSR ≤ 1 %). Test frequency - one HIC-test per heat.

HSCC-resistance: Test upon request.

General processing information

Prior to any processing, it is advisable to make use of the information available from the steel producer in order to draw on that experience for the processing. The following information can deal with only a few essential points. Recommendations for welding are also given in EN 1011 part 1 and part 2 - Welding, Recommendation for welding of metallic materials. It is left to the discretion of the processor/fabricator to decide which of the familiar precautions must be adopted to avoid cracking during thermal cutting and welding under the prevailing construction and fabrication conditions.

Cold forming

Cold forming: Hardening through cold forming reduces the HIC-resistance. To avoid reduction in HIC-resistance the cold formed components are recovered by exposing to stress relief heat treatment according PWHT.
If the degree of cold deformation exceeds 5 % it is recommended to normalize and stress relief the component in order to recover its HIC-resistance. If the construction is not subjected to cold forming, the whole plate must be subjected to PWHT for achieving its HIC-resistance before processing.

Hot forming

For hot forming, the general rules regarding time and temperature must be taken into consideration. A stress relief heat treatment according PWHT is recommended after hot forming to recover the HIC-resistance.

Welding

X-COR steel grade is suitable for all known welding processes in accordance with the corresponding standards. Mechanical properties of the heat affected zone (HAZ) and the welding material depend on welding conditions. Mandatory PWHT for stress relief annealing after welding limits the hardness in weld seam and HAZ to max 22 HRC. We recommend using only certified consumables for the production of pressure vessels.

Ultrasonic testing: Test upon request.

Identification

Stamping/marking of the plate in accordance with standards, additional markings upon request.

References

STAHL-EISEN-Werkstoffblätter	Verlag Stahleisen GmbH, Postfach 10 51 64, D-40042 Düsseldorf
EN-Standards	Beuth Verlag GmbH, Postfach, D-10772 Berlin
ASME-Standards	ASME Standards
ASTM-Standards	ASTM Standards, Vol. 01.04
NACE TM 0284	NACE International
Aramco 01-SAMMS-016	Latest revision