

Data sheet: E6.1

## COR-TEN<sup>®</sup>

### Hot rolled, weldable structural steel sections

#### General description

The COR-TEN<sup>®</sup> range of steel grades is high strength, low alloy structural steel in which the alloy content has been formulated to provide a protective oxide layer on the steel under normal atmospheric conditions. COR-TEN<sup>®</sup> steel has enhanced atmospheric corrosion resistance when compared to ordinary carbon steel, in order to give acceptable service in the unpainted condition and superior performance when painted.

COR-TEN<sup>®</sup> is used for hot rolled structural sections up to 12,7 mm thick. COR-TEN<sup>®</sup> B is used for sections thicker than 12,7 mm. It has a higher manganese content to improve its structural properties, but a slight reduction in the corrosion inhibiting elements. COR-TEN<sup>®</sup> C is a higher strength version of COR-TEN<sup>®</sup> A and B.

The full range of ArcelorMittal Steel South Africa's structural sections is available in COR-TEN<sup>®</sup> grades.

*Reference should be made to the following data sheets: I- Sections Taper flange - file reference E1.1, I Sections Parallel Flange – file reference E 1.2, Taper Flange Channel - file reference E2.1, Parallel Flange Channel - file reference E2.2 and Angles - file reference E3.1*

#### Weathering characteristics

To achieve the benefits of the enhanced atmospheric corrosion resistance of bare COR-TEN<sup>®</sup> steel, it is necessary that proper design, detailing, fabrication and erection procedures are observed. Care should be taken to avoid moisture entrapment. Ventilation should be sufficient to allow proper wet/dry cycles.

When COR-TEN<sup>®</sup> is exposed to the abovementioned conditions a homogeneous patina, consisting of corrosion products, forms. After an initial exposure period of two to three years, the patina stabilises, drastically reducing the rate of further corrosion. The presence of sulphur in the atmosphere contributes to the rapid formation of a stable film.

The patina is a dense, tightly adherent, thin oxide layer, which contains alloying elements in the same ratio as is found in the base metal. Insoluble sulphates of the alloying elements, such as Cu, Cr and Ni tend to block the pores, resulting in a dense protective layer.

Different rates of corrosion are expected in different atmospheres. ArcelorMittal Steel South Africa established test sites in typical rural, marine and industrial environments as part of an international COR-TEN<sup>®</sup> corrosion data collection programme. Sixteen years of data have been collected and the results are reflected in the accompanying graphs.

“Penetration” pertains to the reduction in thickness of the samples, one side only, resulting from corrosion. Under continuous wet or buried conditions the corrosion rate of COR-TEN<sup>®</sup> may be the same as carbon steel, as the patina does not stabilise and such use is therefore not recommended.

For further information, contact:

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In marine environments stable oxide films may form on the steel, provided chlorides are washed off regularly. Normally the use of unpainted COR-TEN<sup>®</sup> is not recommended for applications subjected to salt spray.

### Mechanical properties

Specification	Material thickness t (mm)	Min yield strength <sup>1</sup> (MPa)	Min tensile strength <sup>1</sup> (MPa)	Minimum elongation <sup>2</sup> %	
				in 50mm	in 200mm
⊗ COR-TEN <sup>®</sup> A <sup>5</sup>	t ≤ 12,7	345 <sup>3)</sup>	480 <sup>3)</sup>	20	16
⊗ COR-TEN <sup>®</sup> B	t ≤ 100	345	480	19	16
	100 < t ≤ 125	315	460	19	-
	125 < t ≤ 200	290	430	19	-
⊗ COR-TEN <sup>®</sup> C <sup>4</sup>	t ≤ 38	415	550	18	13

⊗ *Non-standard steel grade – Available on enquiry only*

1. *Minimum values shall be reduced by 35 MPa for products that are annealed or normalised, unless otherwise agreed upon. (This does not apply to COR-TEN<sup>®</sup> C)*

2. *COR-TEN<sup>®</sup> C is supplied in the as rolled condition up to 25mm thickness and has to be normalised from 25mm to 38mm thickness.*

### Chemical composition % (ladle analysis)

Specification	C	Mn	P	S	Si	Cu	Cr	Ni	V	Al
⊗ COR-TEN <sup>®</sup> A <sup>1</sup>	0,12x	0,20/ 0,50	0,07/ 0,15	0,50x	0,25/ 0,75	0,25/ 0,55	0,50/1,25	0,65x	-	-
⊗ COR-TEN <sup>®</sup> B <sup>1</sup>	0,19x	0,80/ 1,25	0,04x	0,05x	0,30/ 0,65	0,25/ 0,40	0,40/0,65	0,40x	0,02/0,10	0,015/0,06
⊗ COR-TEN <sup>®</sup> C <sup>1</sup>	0,19x	0,80/ 1,35	0,04x	0,05x	0,30/ 0,65	0,25/ 0,40	0,40/0,70	0,40x	0,04/0,10	0,015/0,06

⊗ *Non-standard steel grades – Available on enquiry only*

1. *For bare applications, the Si, Cu, Cr and Ni contents shall add up to a minimum of 1,40% and there shall be a minimum Ni content of 0,15%*

2. *For bare applications, there shall be a minimum Cr content of 0,75% and the Cu and Ni contents shall add up to a minimum of 0,50%*

### Welding

COR-TEN<sup>®</sup> steel can be welded by means of any of the usual arc welding processes such as shielded metal arc welding (SMAW), gas metal arc, flux-cored and submerged arc welding. Low hydrogen processes and procedures should be used. By using properly stored and dried AWS E7016 or E7018 electrodes in the SMAW process, low hydrogen content in the weld metal can be assured.

For thinner material and higher heat inputs, copper and chromium pick-up from the parent metal will contribute to the corrosion resistance of the weld metal. This pick-up could be adequate if the corrosion resistant properties of the welds are not important. For unpainted applications where colour matching and similar anti-corrosion performance of the weld metal and parent plate are important, a capping run of special consumables should be applied. Consumables suggested for capping runs contain Cr and Ni or Cu such as AWS E8018-G or Cr and Mo such as AWS E8018-B1.

For selection of pre-heat temperatures, it is advisable to refer to BS 5135 "Metal arc welding of carbon and carbon manganese steel".

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## Painting of COR-TEN<sup>®</sup>

For applications where the formation of a stabilised patina might be prevented, it is advisable to paint COR-TEN<sup>®</sup> steel. It should be emphasised that COR-TEN<sup>®</sup> can be painted with enhanced results when compared with normal carbon steel.

The same paint systems used for normal carbon steel can be applied to COR-TEN<sup>®</sup> to give up to twice the functional paint life obtained on carbon steel. This can be ascribed to the fact that under-film corrosion of COR-TEN<sup>®</sup> is prevented by the sealing of damaged areas of the paint film. The enhanced performance of paint systems on COR-TEN<sup>®</sup> should not, however, tempt one to specify an inferior paint system. For bare applications refer to the notes with the chemical composition table.

## Supply conditions

Material is supplied in terms of the general conditions of sale and ArcelorMittal Steel South Africa price lists for hot rolled plate and sheet, references: 110 and 120.

## Certification

Test and analysis certificates are supplied with all material.

The mechanical and chemical laboratories of ArcelorMittal Steel South Africa, Newcastle Steel are SANAS accredited facilities.

## Applications

Typical applications of COR-TEN<sup>®</sup> steel include transport containers, freight and passenger railway cars, electrification and light stands, transmission towers, a wide range of architectural/structural applications in the building and construction industry, highway guard-rails and surface structures related to mining.

## Dimensional tolerances

The material is supplied to tolerances laid down in the ArcelorMittal Steel South Africa data sheet (*refer to structural sections*)

## Surface conditions

The material is supplied in the as-rolled condition.

## Corrosion performance

Figures 1 to 3 compare the corrosion performance of COR-TEN<sup>®</sup> A and COR-TEN<sup>®</sup> B with plain carbon steel in three different environments.

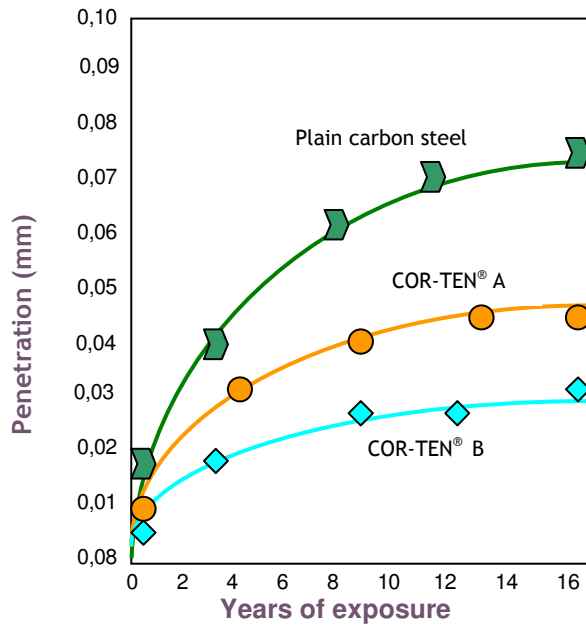
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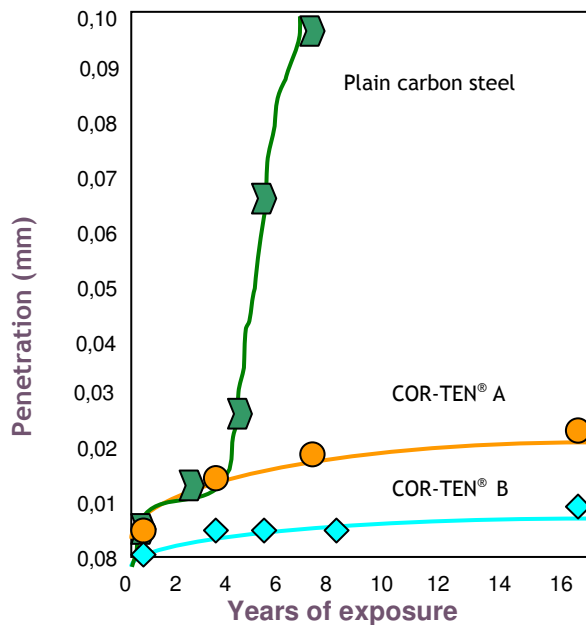
### Average corrosion penetration - rural environment

Test site situated 8 km east of Pretoria city centre.



### Average corrosion penetration - rural marine environment

Test site situated 30 km south of Richards Bay, 100m above sea level, 500m from the beach.



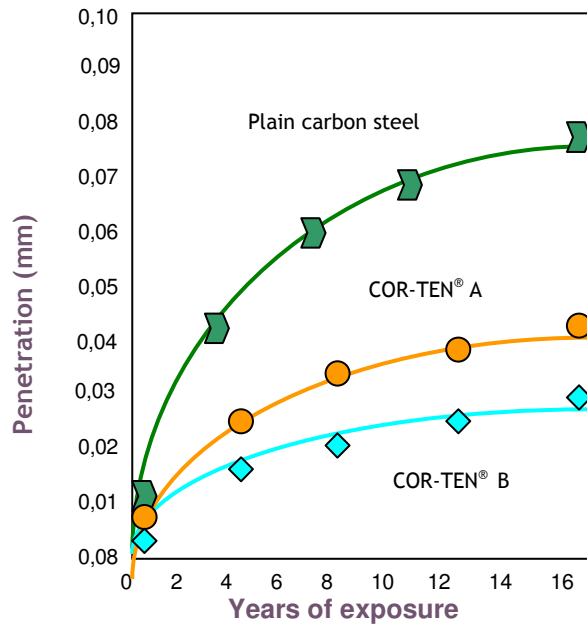
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## Average corrosion penetration - semi-industrial environment

Test site situated 8 km west of Pretoria city centre.



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