



CarElso™ 70 SA-516 gr. 70

CarElso™ 70: Steel for Pressure Equipment in Mild Sour Service

CarElso™ 70 is a special high strength normalised CMn steel adapted for pressure equipment. CarElso™ 70 is manufactured via the electric arc furnace with desulfurisation, dephosphorisation, ladle refining and vacuum degassing to provide a reproducible, clean and homogeneous steel.

CarElso™ 70 has been designed with the aim of reducing the carbon content in order to provide excellent weldability and toughness properties. The low carbon equivalent allows this grade to meet the hardness requirements of NACE MR0175/ISO 15156 under suitable welding conditions.

This steel is particularly suitable for pressure equipment in both refinery and gas treatment applications in mild sour service conditions, where wet H₂S corrosion can be a problem.

PROPERTIES

STANDARDS

- > EN 10028 - 3 P 355 (N - NH - NL1 - NL2)
- > ASTM A 516 gr. 70
- > ASME II Part A SA 516 gr. 70

Please consult for multiple certification

CHEMICAL ANALYSIS - WEIGHT %

C	Mn	Si	P	S	Ni	Cr	Mo	Cu
≤ 0.22	0.85 - 1.20	0.15 - 0.40	≤ 0.010	≤ 0.003	≤ 0.4	≤ 0.30	≤ 0.12	≤ 0.20

Guaranteed values on heat.

Ceq. ≤ 0.43% for thickness ≤ 105 mm (≤ 4 inches). Please consult for higher thickness.

(Ceq (%)) = C + Mn/6 + (Cr+Mo+V)/5 + (Ni+Cu)/15).

MECHANICAL PROPERTIES

Typical transverse tensile values at room temperature after PWHT

Guaranteed values as per applicable National Standard

	YS (MPa/ksi)	TS (MPa/ksi)		Elongation%
	Min	Min	Max	Min
t < 35 mm	355/52	490/71	580/84	21
35 < t ≤ 50 mm	345/50			21
50 < t ≤ 70 mm	325/47			20
70 < t ≤ 100 mm	315/46	485/70	575/83	20
100 < t ≤ 150 mm	295/43			20
150 < t ≤ 250 mm	295/43			19

Plate soundness guaranteed to ultrasonic levels determined by ASTM A 578 level B or EN 10160 - S1E2. CarElso™ 70 guarantees reduction in area in through - thickness tensile testing Z% ≥ 35% average/25% mini as per ASTM A770 / EN 10164 (testing an added extra). Guaranteed high temperature tensile properties as per EN 10028 - 3 P 355 (N - NH - NL1 - NL2).



IMPACT PROPERTIES

Transverse Charpy toughness values of 20J average / 14J minimum can be guaranteed down to - 46°C / - 50°F for plates ≤ 150 mm for the PWHT conditions given above. Please consult for higher thickness and other impact requirements or PWHT conditions.

PLATE PROCESSING

HEAT TREATMENT

Normalising treatment. PWHT 600°C ± 10°C / 1120°F ± 20°F during 2 minutes per mm or 1 hour per inch.

For other requirements, please consult.

FORMING

Cold forming (+ stress relief for high strains) or hot forming can be applied:

- > cold forming (< 500°C/930°F): to be followed by Post - Weld Heat Treatment (PWHT)
- > hot forming (900 - 1100°C/1650 - 2010°F): to be followed by complete heat treatment + PWHT

Please contact us for full heat treatment details.

WELDING CONDITIONS

The reduced carbon equivalent content allows the use of low preheating temperatures

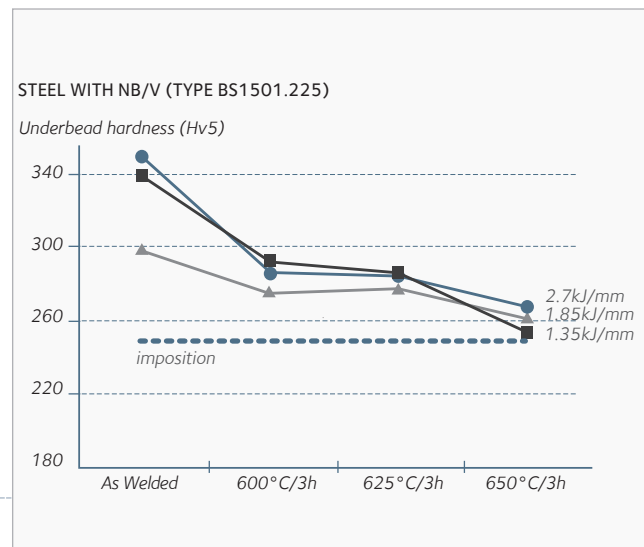
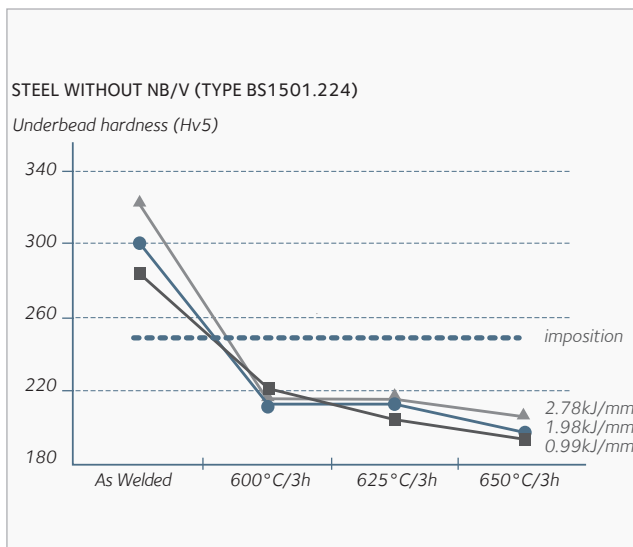
Heat Input	Hydrogen Content	Preheating Temperature	Post - heating
1.0 - 2.0 kJ/mm	$3 \leq H_2 < 5$ ml/100 g (SAW, SNAW)	100 °C	100 °C / 2h
1.0 - 1.5 kJ/mm	$H_2 \leq 3$ ml/100 g (FCAW, GMAW)	100 °C	100 °C / 2h

Minimum preheating temperature as defined by implant testing (NFA 89100).

HAZ PROPERTIES

In H₂S service, it is necessary to limit the maximum HAZ hardness to ≤ 22 HRC or ≤ 248 Hv10 in order to reduce the risk of Sulfide Stress Cracking (SSC). CarElso™ 70 has been designed to comply fully with these limits imposed by NACE Standard MR 0175/ISO 15156.

In order to control the maximum HAZ hardness, the carbon equivalent must be limited, ideally to $\leq 0.43\%$, and microalloying additions should be avoided for normalised steels. In such cases, the hardness limit can be met for CarElso™ 70 after PWHT under a wide range of welding conditions.



Microalloying additions of Niobium and Vanadium both increase the HAZ hardness in the as - welded condition and reduce the softening effect of PWHT. As can be seen in the comparison above, microalloying hardens the HAZ, which does not achieve sufficient softening to meet NACE MR0175 requirements under normal PWHT conditions.

The toughness of the HAZ is excellent, as shown by the following results obtained across the weldment in the as - welded condition (impact values in Joules).

Temperature	Fusion line		FL + 1 mm		AC ₁	
0 °C (32 °F)	200	Av 198				
	218					
	176					
-40 °C (-40 °F)	110	Av 146	208	Av 217	222	Av 186
	148		222		166	
	180		220		170	

FILLER MATERIALS

Consumables used for the welding of CarElso™ 70 must correspond to the following standards:

	SMAW	GMAW	FCAW	SAW
				Wire + Flux
AWS	A5 - 5	A5 - 18	A5 - 20	A5 - 17
	E 70 xx	ER 70 S - x	E 7xT5 - x	F7P4 - Exxx
EN	EN 499	EN 440	EN 758	EN 756 / EN 760
	E 42 X X X H5	G 42 X X	T 42 X X H5	S 42 X X

A non - exclusive list of suitable filler materials is given hereafter:

	SMAW	GMAW	FCAW	SAW	
				Wire	Flux
BÖHLER	Fox Ev 50	EM K7		EM S3	
ESAB	OK 48.00	OK 12.51	OK 15.00	OK 15.00S	OK 10.71
LINCOLN	Excalibur 7018	SuperArc L - 56	Outershield 75C	Lincolnweld L - 56	880M
OERLIKON	TENACITO	CARBOFIL 1	FLUXOFIL 31	OE - S3	OP122
SAF	SAFDRIY 58	NERTALIC 70A	SAFDUAL 200	AS 36	AS 462
T - PUT	Phoenix SH G K 70	Union K56	Union BA70	Union S3	UV 421 TT

This list of filler materials has been determined according to suppliers' data. Please confirm this choice with your supplier.

APPLICATIONS

CarElso™ 70 is suitable for pressure vessels where H₂S is present, such as processing equipment in the oil and gas industry. It can also be provided as clad plate, with cladding in 304L, 316L, 904L, 625...

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Technical data and information are to the best of our knowledge at the time of printing. However, they may be subject to some slight variations due to our ongoing research programme on steels. Therefore, we suggest that information be verified at time of enquiry or order. Furthermore, in service, real conditions are specific for each application. The data presented here are only for the purpose of description, and considered as guarantees when written formal approval has been delivered by our company. Further information may be obtained from the address opposite.