### WELDING INSTRUCTION / SVETSINSTRUKTION / SCHWEISSANLEITUNG / TELAHOKKIEN HITSAUSOHJE





January 2014

# **INSTRUCTIONS FOR WELDING**

#### THE STRUCTURE OF BORON STEEL

Hardened boron steel has a very high yield point of 1000 – 1200 [MPa] and has a high carbon equivalent, CEIIW (0.55), CET (0.41), which directly affects the risk of cold/hydrogen cracking.

#### **COLD CRACKS**

Cold cracks occur in areas adjacent to the welding bead at low temperatures when hydrogen (from moisture, rust and snow) accumulates in areas with high tension and "explodes" the steel, forming small cracks. This means that the piece to be welded must be preheated, and electrodes must be kept as dry and clean as possible. Electrodes from an opened package must be dried in a drying cabinet before use. In addition, the material to be welded must be clean and dry.

Rutile flux-cored wires must not be used since they capture hydrogen.

#### HOT CRACKS

Hot cracks/solidification cracks are accumulations of an alloying element and contaminants (carbon, sulphur and phosphorus), in the centre of the weld. Welding using a high amperage and a low welding speed can produce this type of cracking.

#### FATIGUE

Fatigue properties of a joint are improved by a smooth transition between the weld and the base material.

#### RECOMMENDATIONS

Extensive tests have been carried out at Olofsfors AB and we recommend that you follow the information below and attached weld data sheets for best results. In all cases, welding must only take place after snow, dirt and any rust has been removed from the material.

When welding ice calks, the main weld must be along the length of the crossbar; <u>no welding across the crossbar must take place.</u>

Preheat the material according to the WPS. When welding in an environment where moisture can accumulate on the steel, the steel must always be heated first. The welding dimension is a4.

**ESAB OK 67.45** is a stainless austenitic filler metal and can be welded without pre-heating if the crossbar is free from snow, dirt, moisture and warmer than the surrounding. **See WPS111PA02-03** 

**ESAB OK 48.00** is a black filler metal and should be welded with the base material preheated to + 75 [°C] to avoid cold cracks. **See WPS111PA01-03** 

**ESAB OK Autrod 12.50/12.51** represents the MAG method and must be welded with the base material preheated to about + 50 [°C] to avoid cold cracks. **See WPS135PA04-03** 





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## **ECO-TRACKS**

# WELDING INSTRUCTION/SVETSINSTRUKTION



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# WELDING INSTRUCTION/SVETSINSTRUKTION

\$	STA	NDA	١RD	SVE	WPS	WPS						
Svetsda	WEL	DIN	IG F	RO	ÇEDI	JRE	111PA	111PA02-03				
Welding Procedure Specification						ICA	FOGUTE	ORMNING	GROOVE DES	SVETSFÖLJD/ W	ELDING SEQ.	
WELDING P	ROCESS			111				01011110			econto dela	
WPAR No	, ,		WPAR111PAG	)2-00								
Inträngningsgodkännade se svetsprover												
Penetration	approvar	MATERIALT	MATERIALTYP				1					
NDMATERIAL	BASE MATERIAL	MATERIAL T	YPE OR GRADE		W03			(				
		TJOCKLEKS	TJOCKLEKSOMRÅDE		50m	m	1					
		TH. RANGE	QUALIFIED		50111				$\langle \rangle \rangle \langle \rangle \langle \rangle \rangle \langle \rangle \langle \rangle \langle \rangle \rangle \langle \rangle \rangle \langle \langle \rangle \rangle \langle \rangle \rangle \langle \rangle \rangle \langle \rangle \langle \rangle \langle \rangle \rangle \langle \rangle \langle \rangle \rangle \langle \rangle \langle \rangle \langle \rangle \langle \rangle \rangle \langle \rangle $			
3		KOLEKVIVA	LENT Cew ( IW)									
		FABRIKAT TRADE NAME		ESAB		1						
		BENÄMNIN	5	ОК	OK 67.45				GILTIGHETSOMRÅDE	04.00		
¥	7	DIN / EN CO	DE	EN 1600: 8	188 Mn	842	ĝ		RANGE OF POSITION QUA.	PA, PB		
MTER	VIEBN	TORKNING	AV ELEKTRODER	ENL.LE	VERANTÖ	R			FÖR VÄR MNING STEMP.	,	Min. 20 C	
STIS	LER M	DRYING O	FELEKTRODES	ACC.	SUPPLIER		-		PREHEAT TEMP.		Min. 68 F	
1 III	3	FLUX							INTERPASS TEMP.	3	02-392° F	
		ROTSTÖD					NING	5	VÄRMNINGSMETOD	Acet	ylen/Propan	
		BACKING					NARM	18EHE	APPL. METHOD	Acety	lene/Propane	
	SHEEDBING GAS	SKYDDSGA	5				5	-	MÄTMETOD	Krita,	termometer	
		TYPE OF 9	HIELDING	<u> </u>					METHOD OF MEASUREMEN	rr Chalk,	thermometer	
		COMPOSITI	ON									
SAS		FLÖDE							VÄRMNING/KYLN: HAST.			
CVDD5		FLOW PATE							HEATING/COOLING RATE			
3		ROTGAS	ROTGAS GAS BACKING FABRIKAT					5	HÄLLTEMPERATUR			
		GAS BACKIN FABRIKAT					DUNG	HEAT TREAT	SOAKING TEMP.			
		TRADE NAM	κ.			EHAN 1	SOAKING TIME					
		STRÄNG,	STRÄNG, PENDLING		STRÄNG			POST WELD	VÄRMNINGSMETOD			
	TEOINIQUE	STRING, WEAVE BEAD		STRING		~	APPLICATION METHOD					
		RENGORING	RENGORINGSMETOD		GRINDING							
		HÄFTNINGS	METOD	SVETS WELDING			Anmä	irknina	/ remarks			
		FIT UP MET	100				Avlägsn	na snö, smuts och rost.		Remove snow,	Remove snow, dirt and rust.	
BONK		ROTSIDANS BEHANDLING ROOT PREPARATION					Material	et mäste v	ara helt torrt före svetsning.	The material mu	The material must be completely dry	
-								in the second	de bounded	before welding.	before weiding. Do not weld cleat on the short side	
		SINGLE/MU	SINGLE/DUBBELELEKTROD				Svetsale	j pa korts	da brodd.	Do not weld cle		
							Motsvet	s för önska	id inträngning: 5 - 10 grader	penetration: 5-1	penetration: 5-10 degree	
							NORM					
							CODE					
STRÂNG	METOD	TILLSATSI	MATERIAL									
BEAD	PROC.	FILLER M	TERIAL									
		StickOut	VARUNAMN	DIAM.	AC	POL.	AMPERE		VOLT	CM/MIN	STRÄCKENERGI	
	444	mm	TRADENAME	0.0	DC	1.1	MIN I	MAX	MIN MAX	TRAVELSP.	HEATINPUT	
1-4	111	<u> </u>	OK 67.45	3,2	DC	(+)	90	100	22 25	11 - 14	1.0	
—		01055507			KIIND					MANDICHET		
ğ	e,	OLOFSFORS			KUND					MINDIGHET		
WWW	TWACE			CLIENT								
0000	4day	DATUM	2012-05	-24						DATUM	DATUM	
3		DATE	2012-03	- 24	DATE					DATE		

January 2014

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# WELDING INSTRUCTION/SVETSINSTRUKTION

(†	lof	sfoi	rs <i>A</i> B	STANDARD SVETSPROCEDUR							WPS		
Svetsda	WELDING PROCEDURE							111PA01-03					
SVETSMETO	SPECIFICATIO			FOGUTEO	RMNING/ G	ROOVE DES.	FÖLJD/ WELDING SE	0.					
WELDING P	111												
WPAR No	1-00												
Inträngningsgodkännade se svetsprover Penetration approval see welding tests													
		MATERIALT	rP	, I	102		1						
NDWATERAL	BASE MATERIAL	MATERIAL T	YPE OR GRADE	<u> </u>	105			(					
		TJOCKLEKS	OMRĂDE	5.	50m	m	]						
		TH. RANGE	QUALIFIED		50111								
8		KOLEKVIVAI	LENT Cew (IIW)										
		CARBON EQ	UIVQLENT Cew	<u> </u>			-						
		TRACE NAM	TRADE NAME		ESAB								
		BENÄMNING	-	OK	48.0	0			GLTIGHETSOMRÅDE				
7		DIN/ENCO	DE	EN 499: E 42	4 B 42 H		õ	4EAT	RANGE OF POSITION QUA.		PA, PB		
UTERU/	LERIA I	TORKNING	AV ELEKTRODER	ENL LE	VERANTÖ	R			FÖRVÄRMNINGSTEMP.			75° C	
TSMA	RMA1	DRYING O	F ELEKTRODES	ACC.	SUPPLIER				PREHEAT TEMP.		1	67° F	
ILLSA	FILLER	PULVER					1		MELLANSTRÄNGSTEMP.		150-200° C		
-		FLUX					y y		INTERPASS TEMP.		302	2-392° F	
		ROTSTÖD					SRVÄRMNIN		VÄRMNINGSMETOD		Acetyle	n/ Propan	
		BACKING		<u> </u>				686	APPL. METHOD		Acetylen	e/ Propane	
	SHEEDOING GAS	SKYDDSGAS	LIFE PART				FC		MATMETOD		Krita, te	ermometer	
		CAMMANCE	TTMING	<u> </u>					METHOD OF MEASUREM	AE NI	Chaik, th	emoneter	
		COMPOSITI	DN										
3		FLÖDE							VÅRMINING/KYLN. HAST.				
500		FLOW RATE							HEATING/COOLING RATE				
8		ROTGAS	ROTGAS GAS BACKING				5MI	EATM	HÅLLTEMPERATUR				
		GAS BACKIN							SOAKING TEMP.				
		FABRIKAT					MNDL	AT TR	HÂLLTID				
		TRADE NAME		CTOINC		VÅRMEBEH	POST WELD HE	SOAKING TIME					
	TECHNIQUE	STRANG, PENDLING STRING, WEAVE BEAD RENGÖRINGSMETOD CLEANING METHOD HÄFTNINGSMETOD HT UP METHOD ROTSIDANS BEHANDLING ROTSIDANS BEHANDLING ROOT PREPARATION ENKEL/DUBBELELEKTROD		STRING STRING SLIP GRINDING SVETS WELDNING				VARMNINGSMETOD					
								APPER ATION METHOD					
						Anmärkning/ remarks							
~						Avlägsna	snö, smut	och rost.	Remove snow, dirt and rust.				
TEKNI						Materiale	t mäste vara	helt torrt före svetsning.	The material must be completely dry before welding. Do not weld cleat on the short side Backhand welding for best deep penetration: 5-10 degree				
						Svetsa ej	på kortsida l	wodd.					
						Motsvets	för önskad i	nträngning: 5 - 10 grader					
		SINGLE/M	SINGLE, MULTIPLE ELECTRODE										
						NORM							
				CODE									
STRÄNG	METOD	TILLSATS	MATERIAL	1									
BEAD	PROC.	FILLER MA	TERIAL	<u> </u>									
		StickOut	VARUNAMN	DIAM.	AC	POL.	AMPERE		VOLT		CM/MIN	STRÄCKENERGI	
		mm	TRADENAME		DC		MIN	MAX	MIN MAX		TRAVELSP.	HEATINPUT	
1	111		OK 48.00	3,2	DC	(+)	95	105	24 - 26	6	11 - 17	1,0	
2 - 5	111		OK 48.00	3,2	DC	(+)	140	150	25 - 27	7	16 - 24	1,2	
		OLOFSFORS	KUND							MYNDIGHET			
PROVALS			CLIENT										
		0.47								O TUN			
× Sol	MM	DATUM	2012-06-11			DATOM						DATUM	
		DATE			DATE						DATE		

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# WELDING INSTRUCTION/SVETSINSTRUKTION

•	STA	NDA		WPS									
◆ Svetsda	WEL		ROC	EDU	RE	135PA04-03							
Weldin	SPE	CIF	CAT	ON				REV: 01					
SVETSMETO WELDING PR	135			FOGUTE	ORMNING	GROOVE DES.	SVETSFOLJD/ V	ELDING SEQ.					
WPAR No	4-00			1									
Inträngningsgodkännade se svetsprover													
rencoabon	approva	MATERIALT	YP				1						
7	BASE MATEPIAL	MATERIAL T	YPE OR GRADE		W03								
OMATERU		TJOCKLEKS TH. RANGE	OMRÂDE QUALIFIED	5	- 50n	۱m	1						
GRUNI		KOLEKVIVA CARBON EQ	LENT Cew (IIW) UIVOLENT Cew				1						
		FABRIKAT TRADE NAM	VE.	1	ESAB		1,						
		BENÄMNIN	5	AUTOR	OD 12.	50/51			GILTIGHETSOMRÅDE				
*	_ L	DIN / EN CO	OE	EN 440:	G 42 3 M	G35i1	ž		RANGE OF POSITION QUA.	PA, PB			
ATER	TERUA	TORKNING	AV ELEKTRODER	ENL I	EVERANT	ÔR.			FÖRVÄRMNINGSTEMP.		50° C		
ATSM	68 MA	DRYING OF ELEKTRODES PULVER		ACC. SUPPLIER					PREHEAT TEMP.		122° F		
ULLS	FILLE								MELLANSTRÄNGSTEMP.	1	50-200º C		
		FLUX					- 2		INTERPASS TEMP.	3	02-392º F		
		ROTSTOD			INNI	HEAT	VÄRMNINGSMETOD	Acety	/len/ Propan				
		BACKING						분	APPL.METHOD	Acety	termometer		
		TYPE OF S	TYPE OF SHIELDING		ATAL		~		METHOD OF MEASUREMENT	Chalk	thermometer		
	SHELDING GAS	SAMMANSA							METHOD OF MENDOREMENT	- Crising	unerritorine ter		
		COMPOSITI	ON	Ar + 18% CO2									
545		FLÖDE		16 - 22 L/min				VÄRMNING/KYLN. HAST.					
2002		FLOW RATE					EATM.	HEATING/COOLING RATE					
×		ROTGAS GAS BACKING							HÅLLTEMPERATUR				
								NO.	SOAKING TEMP.				
		FABRIKAT	κ.	Aiı	rLiquid		HAND	EAT TH	HÅLLTID SOAKING TIME				
		STRÄNG, I	PENDLING	STRĂNG			DWEB	ED .	VÄRMNINGSMETOD	<u> </u>			
	TECHNIQUE	STRING, WEAVE BEAD RENGÖRINGSMETOD CLEANING METHOD HAFTNINGSMETOD FIT UP METHOO ROTSIDANS BEHANDLING ROOT PREPARATION ENKEL/DUBBELELEKTROD		STRING			Ň	05T W	APPLICATION METHOD				
				SLIP		E E							
				GRINDING SVETS WELDING									
							Anmä	irkning	/ remarks				
X							Avlägsna	snö, smuts i	och rest.	Remove snow, dirt and rust. The material must be completely dry before welding.			
ě.						Materiale	t måste vara	helt tont före svetsning.					
							Svetsa e	på kortsid	a brodd.	Do not weld clear	Do not weld cleat on the short side		
		SINGLE/M	SINGLE/MULTIPLE ELECTRODE										
							CODE						
STRÄNG				1			0000						
BEAD	PROC	FILLER MATERIAL											
		StickOut	VARUNAMN	DIAM	AC	POL	AMPERE		VOLT	CM/MIN	STRÄCKENERGI		
		mm	TRADENAME	- to the	DC		MIN	MAX	MIN HAY	TRAVELSP	HEATINPUT		
1	135	15.17	AUTOROD 12 50	12	DC	(+)	140	150	20 - 22	17 - 20	0.9		
2.5	135	15.17	AUTOROD 12.50	1.2	50	(+)	220	265	20 - 22	34 45	1.0		
2-5	133	13-17	A010R00 12.00	1,2	00	(+)	230	203	29 - 30	34 - 45	1,0		
	I	a: a											
8		OLOFSFORS		KUND					MYNDIGHET				
MAM	DVALS			CUENT					1				
DKÄN	NPPR	DATUM	~	DATUM									
8	-	DATE	2012-05	-24	DATE					DATE			

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