



EDELSTAHL GMBH J.P. SCHUMACHER

SPECIAL STEEL * BARS * BLOCKS * FORGINGS



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REPAIR WELDING OF PM-STEELS

INSTRUCTION

A) General

- a. Clean the welding area carefully; remove oil, dirt, rust, etc.
- b. Remove layers of chrome-plating / nitriding / case hardening - if any.
- c. Flux to detect any possible cracks.
- d. Avoid sharp edges, $r = \text{min. } 3 \text{ mm}$.
- e. PM-Steels are usually not welded at room temperature. Pre-heating and interpass temperature is determined by the type of steel, the size and shape of the tool.
- f. Welding - and filler rod material analysis as near to analysis of workpiece as possible.
- g. Welding has to be done with lowest heat input, which means using the lowest possible amperage and voltage.
- h. On cracks sensitive steels apply short stringer beads with small diameter electrode or wires to avoid risk of cracks caused by shrinkage stress.
- i. The welding deposit has to be peened immediately after a weld has been deposited and before the temperature falls below the lowest interpass temperature. **Never peen cold material.**
- g. After welding slow cooling is necessary and eventually an annealing to reduce welding stress. A post heat treatment is a must after a large welding deposit has been made (large repairs, pattern change or similar).

B) Specific

1. The welding of annealed workpieces:

- 1.1 Warm up thoroughly to the specific pre-heating temperature range (see page 2), weld at this temperature, re-heat, before the temperature of the tool falls below the minimum pre-heating (interpass) temperature.
- 1.2 Cool the workpiece down to 100°C in furnace or under insulating blankets.
- 1.3 Heat treatment after the welding: see page 2

2. The welding of h + t workpieces

- 2.1 Take care to avoid crack formation.
- 2.2 Repair only smaller areas resp. damages.
- 2.3 Warm up thoroughly to the specific pre-heating temperature range (see page 2) and weld at this temperature (re-heating: see section 1.1).
- 2.4 Heat treatment after the welding: see page 2

3. Special remark for crack sensitive PM Steels

If no immediate thermic treatment can be made right after the welding has been finished, a stress-relieve annealing at 650°C must be made as soon as possible to avoid cracks.

Steel-No	DIN - name	condition	preheating-temperature	welding-process	welding filler material	hardness weld metal	heat treatment after welding	remarks
1.0527	Ck 55	H + T	300-350°C	111 111 131+135 131+135	UTP 67 S UTP 65 D *) UTP A DUR 600 UTP A 651 *)	56-58 HRC ca. 240 HB 54-60 HRC ca. 240 HB	Tempering or new H + T process	10-20°C below the latest tempering temperature *) for intermediate layer
TGM	TIGERMOULD	H + T	300-350°C	111 111 131+135 141	SH Kupfer 1 K SH Kupfer 1 KC - Fontargen A 103 SW	ca. 170 HB ca. 180 HB - ca. 170 HB	no	H +T after bigger repairs
1.2311	40CrMnMo7	H + T	min. 350°C	111 111 131+135 141	UTP 73 G 3 Fontargen E 710 UTP A 73 G 3 UTP A 73 G 3	45-50 HRC ca. 43 HRC 42-46 HRC 42-46 HRC	Tempering or new H + T process	10-20°C below the latest tempering temperature
1.2738	40CrMnNiMo8.6.4	H + T	300-350°C	111 111 131+135 141	UTP 73 G 3 Fontargen E 710 UTP A 73 G 3 UTP A 73 G 3	45-50 HRC ca. 43 HRC 42-46 HRC 42-46 HRC	Tempering or new H + T process	10-20°C below the latest tempering temperature
GEST80	GOLDEN EAGLE STAR 80	Solution treated and age hardened	320-400°C	111 111 131+135 141	NAK-W NAK-W	38-42 HRC 38-42 HRC	Aging (post-heat treatment)	10-20°C below the latest aging temperature
1.2083	X42Cr13	H + T	200-250°C	111 141 131+135 141	STAVAX WELD STAVAX TIG-WELD UTP A 73 G 2 *) UTP A 73 G 2 *)	54-56 HRC 54-56 HRC 53-58 HRC 53-58 HRC	Tempering or new H + T process	10-20°C below the latest tempering temperature *) not corrosion-resistant
1.2085	X33CrS16	H + T	200-250°C	111 131+135 141	STAVAX WELD UTP A 73 G 2 *) UTP A 73 G 2 *)	54-56 HRC 53-58 HRC 53-58 HRC	Tempering or new H + T process	10-20°C below the latest tempering temperature *) not corrosion-resistant
1.2316	X36CrMo17	H + T	250-300°C	111 131+135 141	STAVAX WELD UTP A 73 G 3 *) UTP A 73 G 3 *)	54-56 HRC 42-46 HRC 42-46 HRC	Tempering or new H + T process	10-20°C below the latest tempering temperature *) not corrosion-resistant
1.2344	X40CrMoV5.1	annealed	min. 325°C	111 111 131+135 141	QRO 90 WELD UTP 73 G 2 UTP A 73 G 2 QRO 90 TIG-WELD	50-55 HRC ca. 55 HRC 53-58 HRC 50-55 HRC	annealing	
1.2714	56NiCrMoV7	H + T	300-350°C	111 111 131+135 +141	UTP 73 G 3 ESAB OK 83.28 UTP A 73 G 3 UTP A 73 G 4	45-50 HRC 38-42 HRC 42-46 HRC 38-42 HRC	Tempering or new H + T process	10-20°C below the latest tempering temperature
1.2379	X155CrVMo12.2	annealed	250-300°C	111 111 131+135 131+135	UTP 67 S UTP 65 D *) UTP A DUR 600 UTP A 651 *)	56-58 HRC ca. 240 HB 54-60 HRC ca. 240 HB	annealing	*) for intermediate layer

welding process (ISO 4063) : 111 – arc welding by hand 131 – metall inert gas welding (MIG) 135 – metall aktiv gas welding (MAG) 141 – Tungsten inert gas welding (TIG)