Welding

Recommendations for rail steels

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These welding recommendations...

...are based on information and experiences of numerous testing institutes, welding specialist firms and local traffic operators who participated in the preparation of this non-prescriptive welding document.

The objective of these welding recommendations is the trouble-free welding processing of rails.

Steel grade labelling
in the rolling mark according to DIN EN 13674-1 and DIN EN 14811

Steel grade	Hardness range	Description	Rolling mark
R200 (700)	200-240	Carbon-manganese (C-Mn) steel	Without rolling mark
R200V (700V)*	220-260	Carbon-manganese (C-Mn) steel	**V**
R220	220-260	Carbon-manganese (C-Mn) steel	
R220G1 (800)	220-260	Carbon-manganese (C-Mn) steel	
R260 (900)	260-300	Carbon-manganese (C-Mn) steel	
R260V (900V)*	280-320	Carbon-manganese (C-Mn) steel	 **V**
R350HT	350-390	Carbon-manganese (C-Mn) steel tempered	

* Steel grade has not yet been included in DIN EN 14811!

Materials for Vignol rails and Grooved rails
in according to DIN EN 13674-1 and DIN EN 14811

Chemical composition ▪ mechanical values

Steel grades	Chemical composition			
	C	**Si**	**Mn**	**P max.**
Naturally hard steel grades				
R200 (700)	0,40-0,60	0,15-0,58	0,70-1,20	0,035
R200V (700V)*	0,40-0,48	0,15-0,58	0,70-1,10	0,035
R220	0,50-0,60	0,20-0,60	1,00-1,25	0,025
R220G1 (800)	0,50-0,65	0,15-0,58	1,00-1,25	0,025
R260 (900)	0,62-0,80	0,15-0,58	0,70-1,20	0,025
R260V (900V)*	0,53-0,58	0,10-0,58	0,90-1,35	0,025
Tempered steel grades				
R350HT	0,72-0,80	0,15-0,58	0,70-1,20	0,020

▪ **Maximum weight percentage of additional elements in %**

Cr 0,15 ▪ **Mo** 0,02 ▪ **Al** 0,004 ▪ **Cu** 0,15 ▪ **Cu + 10Sn** 0,35

Cr + Mo + V 0,35

			Mechanical values		
S max.	V max.	H2 max.	Rm min.	A5 min.	Hardness
		(ppm)	MPa	(%)	(HB)
0,035		3	≥ 680	≥ 14	200-240
0,035	0,20	3	≥ 680	≥ 15	220-260
0,025	0,03		≥ 770	≥ 12	220-260
0,025		3	≥ 780	≥ 12	220-260
0,025		2,5	≥ 880	≥ 10	260-300
0,025	0,20	2,5	≥ 880	≥ 12	280-320
0,025	0,030		≥ 1175	≥ 9	350-390

* Steel grade has not yet been included in DIN EN 14811!

Steel grade R200 in accordance with DIN EN 13674-1 and DIN EN 14811 with a hardness of 200 HB to 240 HB

Thermite welding

- Welding processes for vignole rails SKV, SKV-Elite, SKV-Elite L25, SoW-5 and HPW. These welding processes are approved in accordance with EN 14730-1.
- Preheating times for the processes SKV, SKV-Elite, SKV-Elite L25 with short preheating time approx. 1.5 to 2 minutes, depending on the rail profile
- Preheating time for the process SoW-5 3 to 6 minutes, depending on the profile
- Preheating time for the process HPW approx. 3.5 minutes
- Thermite weld portion Z70

- Welding processes for grooved rails SRZ (SRE also possible)
- Preheating time approx. 4 to 6 minutes
- Thermite weld portion H210

Joint welding with covered electrodes in accordance with the metal arc welding procedure

- Preheating to 300° C
- Weld the complete rail joint (foot, web and head) with redried stick electrodes E 46 6 B 34 H10 in accordance with DIN EN ISO 2560-A (e.g. BOR-SP 6).
- From an economic perspective, the use of longer stick electrodes with the dimensions 5 x 550 mm or, if available on the market, 6 x 550 mm is recommended.

Joint welding with flux cored electrodes in accordance with the metal arc welding procedure

- Preheating to 150° C
- Weld the rail foot and web and approx. 3/4 of the rail head with a flux cored electrode T 38 Z V N3 in accordance with DIN EN ISO 17632-A (e.g. Innershield NS-3M)
- Weld the last 1/4 of the rail head (approx. 10 mm) with a stick

electrode E Fe1 in accordance with DIN EN 14700 (e.g. Citorail, Oerlikon Schweißtechnik GmbH) or flux cored electrode T Fe1 (e.g. Lincore 33, The Lincoln Electric Company); the use of weld electrodes with a hardness of 250 to 300 HB is recommended.

Overlay welding with covered electrodes in accordance with the metal arc welding procedure

- Preheating to 300° C, deposit site and roughly 100 mm on both sides across the entire rail section
- Hard deposit with a stick electrode E Fe1 in accordance with DIN EN 14700 with a hardness of approx. 300 HB (e.g. CARBODUR 300, CARBO-WELD)

Overlay welding with flux cored electrodes in accordance with the metal arc welding procedure

- Preheating to 300° C, deposit site and roughly 100 mm on both sides across the entire rail section
- Hard deposit with a 2.0 mm flux cored electrode T Fe1 in accordance with DIN EN 14700 with a hardness of approx. 300 HB (e.g. Lincore 33, The Lincoln Electric Company)

Building up by welding of grooved rails in accordance with the metal arc welding procedure

- Preheating temperature of the rail head to 120° C with advance flame
- Head flank hardfacing and cover pass with filler material 1.4370 (18 8 Mn), e.g. DT – 1.4370, DRATEC Draht-Technik GmbH or CORODUR 250 K, Corodur Fülldraht GmbH
- The interlayer temperature should at least correspond to the preheating temperature

Steel grade R200V in accordance with material number 1.0542 with a hardness of 220 HB to 260 HB

Thermite welding

- Welding processes for vignole rails SKV, SKV-Elite, SKV-Elite L25, SoW-5 and HPW. These welding processes are approved in accordance with EN 14730-1.
- Preheating times for the processes SKV, SKV-Elite, SKV-Elite L25 with short preheating time approx. 1.5 to 2 minutes, depending on the rail profile
- Preheating time for the process SoW-5 3 to 6 minutes, depending on the profile
- Preheating time for the process HPW approx. 3.5 minutes
- Thermite weld portion Z70-80

- Welding processes for grooved rails SRZ (SRE also possible)
- Preheating time approx. 4 to 6 minutes
- Thermite weld portion H230

Joint welding with covered electrodes in accordance with the metal arc welding procedure

- Preheating to 300° C
- Weld the complete rail joint (foot, web and head) with redried stick electrodes E 46 6 B 34 H10 in accordance with DIN EN ISO 2560-A (e.g. BOR-SP 6).
- From an economic perspective, the use of longer stick electrodes with the dimensions 5 x 550 mm or, if available on the market, 6 x 550 mm is recommended.

Joint welding with flux cored electrodes in accordance with the metal arc welding procedure

- Preheating to 150° C
- Weld the rail foot and web and approx. 3/4 of the rail head with a flux cored electrode T 38 Z V N3 in accordance with DIN EN ISO 17632-A (e.g. Innershield NS-3M).
- Weld the last 1/4 of the rail head (approx. 10 mm) with a flux

cored electrode T Fe1 in accordance with DIN EN 14700 (e.g. Lincore 33, The Lincoln Electric Company) or stick electrode E Fe1 in accordance with DIN EN 14700 (e.g. Citorail, Oerlikon Schweißtechnik GmbH); the use of weld electrodes with a hardness of 250 to 300 HB is recommended.

Overlay welding with covered electrodes in accordance with the metal arc welding procedure

- Preheating to 300° C, deposit site and roughly 100 mm on both sides across the entire rail section
- Hard deposit with a stick electrode E Fe1 in accordance with DIN EN 14700 with a hardness of approx. 300 HB (e.g. CARBODUR 300, CARBO-WELD)

Overlay welding with flux cored electrodes in accordance with the metal arc welding procedure

- Preheating to 300° C, deposit site and roughly 100 mm on both sides across the entire rail section
- Hard deposit with a 2.0 mm flux cored electrode T Fe1 in accordance with DIN EN 14700 with a hardness of approx. 300 HB (e.g. Lincore 33, The Lincoln Electric Company)

Building up by welding of grooved rails in accordance with the metal arc welding procedure

- Preheating temperature of the rail head to 120° C with advance flame
- Head flank hardfacing and cover pass with filler material 1.4370 (18 8 Mn), e.g. DT – 1.4370, DRATEC Draht-Technik GmbH or CORODUR 250 K, Corodur Fülldraht GmbH
- The interlayer temperature should at least correspond to the preheating temperature

Steel grade R220 in accordance with DIN EN 13674-1 and steel grade R220G1 in accordance with DIN EN 14811 with a hardness of 220 HB to 260 HB

Thermite welding

- Welding processes for vignole rails SKV, SKV-Elite, SKV-Elite L25, SoW-5 and HPW. These welding processes are approved in accordance with EN 14730-1.
- Preheating times for the processes SKV, SKV-Elite, SKV-Elite L25 with short preheating time approx. 1.5 to 2 minutes, depending on the rail profile
- Preheating time for the process SoW-5 3 to 6 minutes, depending on the profile
- Preheating time for the process HPW approx. 3.5 minutes
- Thermite weld portion Z70-80

- Welding processes for grooved rails SRZ (SRE also possible)
- Preheating time approx. 4 to 6 minutes
- Thermite weld portion Z70-80

Joint welding with covered electrodes in accordance with the metal arc welding procedure

- Preheating to 300° C
- Weld the complete rail joint (foot, web and head) with redried stick electrodes E 46 6 B 34 H10 in accordance with DIN EN ISO 2560-A (e.g. BOR-SP 6).
- From an economic perspective, the use of longer stick electrodes with the dimensions 5 x 550 mm or, if available on the market, 6 x 550 mm is recommended.

Joint welding with flux cored electrodes in accordance with the metal arc welding procedure

- Preheating to 150° C
- Weld the rail foot and web and approx. 3/4 of the rail head with a flux cored electrode T 38 Z V N3 in accordance with DIN EN ISO 17632-A (e.g. Innershield NS-3M).

- Weld the last 1/4 of the rail head (approx. 10 mm) with a flux cored electrode T Fe1 in accordance with DIN EN 14700 (e.g. Lincore 33, The Lincoln Electric Company) or stick electrode E Fe1 in accordance with DIN EN 14700 (e.g. Citorail, Oerlikon Schweißtechnik GmbH), the use of weld electrodes with a hardness of 250 to 300 HB is recommended.

Overlay welding with covered electrodes in accordance with the metal arc welding procedure

- Preheating to 300° C, deposit site and roughly 100 mm on both sides across the entire rail section
- Hard deposit with a stick electrode E Fe1 in accordance with DIN EN 14700 with a hardness of approx. 300 HB (e.g. CARBODUR 300, CARBO-WELD)

Overlay welding with flux cored electrodes in accordance with the metal arc welding procedure

- Preheating to 300° C, deposit site and roughly 100 mm on both sides across the entire rail section
- Hard deposit with a 2.0 mm flux cored electrode T Fe1 in accordance with DIN EN 14700 with a hardness of approx. 300 HB (e.g. Lincore 33, The Lincoln Electric Company)

Building up by welding of grooved rails in accordance with the metal arc welding procedure

- Preheating temperature of the rail head to 120° C with advance flame
- Head flank hardfacing and cover pass with filler material 1.4370 (18 8 Mn), e.g. DT – 1.4370, DRATEC Draht-Technik GmbH or CORODUR 250 K, Corodur Fülldraht GmbH
- The interlayer temperature should at least correspond to the preheating temperature

Steel grade R260 in accordance with DIN EN 13674-1 and DIN EN 14811 with a hardness of 260 HB to 300 HB

Flash-butt welding (test results based on stationary tests with the flash-butt welding machine GAAS80 from Schlatter – valid for vignole rails in accordance with DIN EN 13674-1 only)

- Preheating: pulsating
- Flashing: linear at first, then progressive
- Feeding rate 50 mm to 100 mm/sec, depending on the stability of the rail steel
- The specific upset force should be at least 50 KN/mm^2
- Cooling time from 800° C to 500° C at least 200 seconds
- no accelerated cooling and no postheating

Thermite welding

- Welding processes for vignole rails SKV, SKV-Elite, SKV-Elite L25, SoW-5 and HPW. These welding processes are approved in accordance with EN 14730-1
- Preheating times for the processes SKV, SKV-Elite, SKV-Elite L25 with short preheating time approx. 1.5 to 2 minutes, depending on the rail profile
- Preheating time for the process SoW-5 3 to 6 minutes, depending on the profile
- Preheating time for the process HPW approx. 3.5 minutes
- Thermite weld portion Z90

- Welding processes for grooved rails SRZ (SRE also possible)
- Preheating time approx. 4 to 6 minutes
- Thermite weld portion H260

Connection weld with covered electrodes in accordance with the metal arc welding procedure

- Preheating to 400° C
- Weld the foot, web and 3/4 of the rail head with redried stick electrodes E 46 6 B 34 H10 in accordance with DIN EN ISO 2560-A (e.g. BOR-SP 6).

- Weld the last 1/4 of the rail head (approx. 10 mm) with a covered electrode E Fe1 in accordance with DIN EN 14700 with a hardness of approx. 300 HB (e.g. Citorail, Oerlikon Schweißtechnik GmbH), the use of weld electrodes with a hardness of 250 to 300 HB is recommended.
- From an economic perspective, the use of longer stick electrodes with the dimensions 5 x 550 mm or, if available on the market, 6 x 550 mm is recommended.

Joint welding with flux cored electrodes in accordance with the metal arc welding procedure

- Preheating to 150° C
- Weld the rail foot and web and approx. 3/4 of the rail head with a flux cored electrode T 38 Z V N3 in accordance with DIN EN ISO 17632-A (e.g. Innershield NS-3M).
- Weld the last 1/4 of the rail head (approx. 10 mm) with a stick electrode E Fe1 in accordance with DIN EN 14700 (e.g. Citorail, Oerlikon), the use of weld electrodes with a hardness of 250 to 300 HB is recommended.

Overlay welding with covered electrodes in accordance with the metal arc welding procedure

- Preheating to 400° C, deposit site and roughly 100 mm on both sides across the entire rail section
- Hard deposit with a stick electrode E Fe1 in accordance with DIN EN 14700 with a hardness of approx. 300 HB (e.g. CARBODUR 300, CARBO-WELD)

Overlay welding with flux cored electrodes in accordance with the metal arc welding procedure

- Preheating to 400° C, deposit site and roughly 100 mm on both sides across the entire rail section
- Hard deposit with a 2.0 mm flux cored electrode T Fe1 in accordance with DIN EN 14700 with a hardness of approx. 300 HB (e.g. Lincore 33, The Lincoln Electric Company)

Steel grade R260V in accordance with material number 1.0629 with a hardness of 260 HB to 330 HB

Thermite welding

- Welding processes for vignole rails SKV, SKV-Elite, SKV-Elite L25, SoW-5 and HPW. These welding processes are approved in accordance with EN 14730-1.
- Preheating times for the processes SKV, SKV-Elite, SKV-Elite L25 with short preheating time approx. 1.5 to 2 minutes, depending on the rail profile
- Preheating time for the process SoW-5 3 to 6 minutes, depending on the profile
- Preheating time for the process HPW approx. 3.5 minutes
- Thermite weld portion Z90

- Welding processes for grooved rails SRZ (SRE also possible)
- Preheating time approx. 4 to 6 minutes
- Thermite weld portion H260

Joint welding with covered electrodes in accordance with the metal arc welding procedure

- Preheating to 400° C
- Weld the foot, web and 3/4 of the rail head with redried stick electrodes E 46 6 B 34 H10 in accordance with DIN EN ISO 2560-A (e.g. BOR-SP 6).
- Weld the last 1/4 of the rail head (approx. 10 mm) with a covered electrode E Fe1 in accordance with DIN EN 14700 with a hardness of approx. 300 HB (e.g. Citorail, Oerlikon Schweißtechnik GmbH).
- From an economic perspective, the use of longer stick electrodes with the dimensions 5 x 550 mm or, if available on the market, 6 x 550 mm is recommended.

Joint welding with flux cored electrodes in accordance with the metal arc welding procedure

- Preheating to 150° C
- Weld the rail foot and web and 3/4 of the rail head with a flux

cored electrode T 38 Z V N3 in accordance with DIN EN ISO 17632-A (e.g. Innershield NS-3M).
- Weld the last 1/4 of the rail head (approx. 10 mm) with a flux cored electrode T Fe1 in accordance with DIN EN 14700 (e.g. Lincore 33, The Lincoln Electric Company) or stick electrode E Fe1 in accordance with DIN EN 14700 (e.g. Citorail, Oerlikon), the use of weld electrodes with a hardness of 250 to 300 HB is recommended.

Overlay welding with covered electrodes in accordance with the metal arc welding procedure

- Preheating to 400° C, deposit site and roughly 100 mm on both sides across the entire rail section
- Hard deposit with a stick electrode E Fe1 in accordance with DIN EN 14700 with a hardness of approx. 300 HB (e.g. CARBODUR 300, CARBO-WELD)

Overlay welding with flux cored electrodes in accordance with the metal arc welding procedure

- Preheating to 400° C, deposit site and roughly 100 mm on both sides across the entire rail section
- Hard deposit with a 2.0 mm flux cored electrode T Fe1 in accordance with DIN EN 14700 with a hardness of approx. 300 HB (e.g. Lincore 33, The Lincoln Electric Company)

Building up by welding of grooved rails in accordance with the metal arc welding procedure

- Preheating temperature of the rail head to 120° C with advance flame
- Head flank hardfacing and cover pass with filler material 1.4370 (18 8 Mn), e.g. DT – 1.4370, DRATEC Draht-Technik GmbH or CORODUR 250 K, Corodur Fülldraht GmbH
- The interlayer temperature should at least correspond to the preheating temperature

Steel grade R320Cr in accordance with DIN EN 13674-1 with a hardness of 320 HB to 360 HB

Flash-butt welding (test results based on stationary tests with the flash-butt welding machine GAAS80 from Schlatter)

- Preheating: pulsating
- Flashing: linear at first, then progressive
- Feeding rate 50 mm to 100 mm/sec, depending on the stability of the rail steel
- The specific upset force should be at least 60 KN/mm^2
- Delayed cooling time from 800° C to 500° C according to the ZTU diagram
- Postheating with 3 to 5 postheating pulses approx. 2.5 to 4 seconds

Thermite welding

- Welding processes for vignole rails SKV, SKV-Elite, SKV-Elite L25, SoW-5 and HPW. These welding processes are approved in accordance with EN 14730-1.
- Preheating times for the processes SKV, SKV-Elite, SKV-Elite L25 with short preheating time approx. 1.5 to 2 minutes, depending on the rail profile
- Preheating time for the process SoW-5 3 to 6 minutes, depending on the profile
- Preheating time for the process HPW approx. 3.5 minutes
- Thermite weld portion Z110

Joint welding with covered electrodes in accordance with the metal arc welding procedure

- Preheating to 500° C
- Weld the foot, web and 3/4 of the rail head with redried stick electrodes E 46 6 B 34 H10 in accordance with DIN EN ISO 2560-A (e.g. BOR-SP 6).
- Weld the last 1/4 of the rail head (approx. 10 mm) with a covered electrode E Fe1 in accordance with DIN EN 14700 with a hardness of approx. 350 to 400 HB (e.g. SUPRADUR 400B, Oerlikon Schweißtechnik GmbH).

- It is imperative to avoid abrupt cooling from the heat of the welding process of the Cr alloyed rail steel due to the risk of martensite formation.
- From an economic perspective, the use of longer stick electrodes with the dimensions 5 x 550 mm or, if available on the market, 6 x 550 mm is recommended.

Joint welding with flux cored electrodes in accordance with the metal arc welding procedure

- Preheating to 400° C
- Weld the rail foot and web and approx. 3/4 of the rail head with a flux cored electrode T 38 Z V N3 in accordance with DIN EN ISO 17632-A (e.g. Innershield NS-3M).
- Weld the last 1/4 of the rail head (approx. 10 mm) hard deposit with a flux cored electrode T Fe3 in accordance with DIN EN 14700 (e.g. Hard-face TN-O, Welding Alloys Deutschland GmbH) or stick electrode E Fe1 in accordance with DIN EN 14700 (e.g. Citodur 400B, Oerlikon Schweißtechnik GmbH) in accordance with DIN EN 14700, the use of weld electrodes with a hardness of 350 to 400 HB is recommended.
- It is imperative to avoid abrupt cooling from the heat of the welding process of the Cr alloyed rail steel due to the risk of martensite formation.

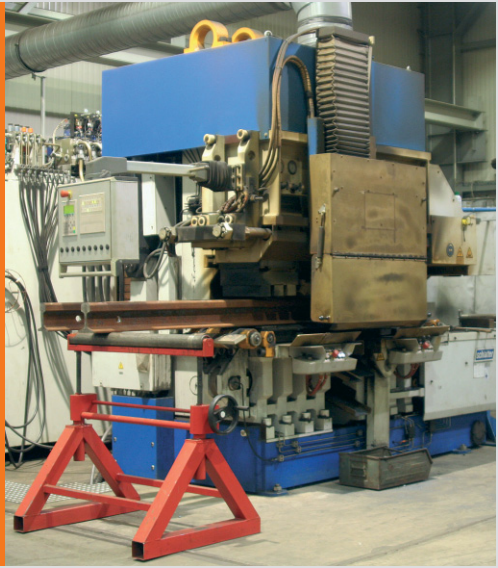
Overlay welding with covered electrodes in accordance with the metal arc welding procedure

- Preheating to 500° C, deposit site and roughly 100 mm on both sides across the entire rail section
- Hard deposit with a stick electrode E Fe1 (e.g. Citodur 400B, Oerlikon Schweißtechnik GmbH) in accordance with DIN EN 14700 with a hardness of 350 to 400 HB
- It is imperative to avoid abrupt cooling from the heat of the welding process of the Cr alloyed rail steel due to the risk of martensite formation.

Steel grade R320Cr in accordance with DIN EN 13674-1 with a hardness of 320 HB to 360 HB

Overlay welding with flux cored electrodes in accordance with the metal arc welding procedure

- Preheating to 400 to 500° C, deposit site and roughly 100 mm on both sides across the entire rail section
- Hard deposit with a flux cored electrode T Fe3 (e.g. Hardface TN-O, Welding Alloys Deutschland GmbH) in accordance with DIN EN 14700 with a hardness of 350 to 400 HB
- It is imperative to avoid abrupt cooling from the heat of the welding process of the Cr alloyed rail steel due to the risk of martensite formation.



Steel grade R350HT in accordance with DIN EN 13674-1 with a hardness of 350 HB to 390 HB

Flash-butt welding (test results based on stationary tests with the flash-butt welding machine GAAS80 from Schlatter)

- Preheating: pulsating
- Flashing: first linearly, then progressively
- Feeding rate 50 mm to 100 mm/sec in depending on the stability of the rail steel
- The specific upset force should be at least 50 KN/mm^2
- As little heat input as possible in order to maintain the fine pearlitic microstructure and the related stability of the tempered rail steel
- Accelerated cooling of the rail head in order to create a hardness suitable for the rail steel in the welding area

Thermite welding

- Welding processes for vignole rails SKV, SKV-Elite, SKV-Elite L25, SoW-5 and HPW. These welding processes are approved in accordance with EN 14730-1.
- Preheating times for the processes SKV, SKV-Elite, SKV-Elite L25 with short preheating time approx. 1.5 to 2 minutes, depending on the rail profile
- Preheating time for the process SoW-5 3 to 6 minutes, depending on the profile
- Preheating time for the process HPW approx. 3.5 minutes
- Thermite weld portion Z120 for the SKV, SKV-Elite, SKV-Elite L25, SoW-5 procedures
- Thermite weld portion Z120 for the SKV, SKV-Elite, SKV-Elite L25, SoW-5 procedures with additional post-weld heat treatment (HC standard procedure: duration of the heat treatment (B) of 100 seconds; covering time (C) of 120 seconds)
- Thermite weld portion Z90 + plug „20+3" for the HPW procedure (special container for connection to the covering plug), the required hardness in the welding area is achieved by means of the alloy elements contained

Steel grade R350HT in accordance with DIN EN 13674-1 with a hardness of 350 HB to 390 HB

Joint welding with covered electrodes in accordance with the metal arc welding procedure

- Preheating to 400° C
- Weld the foot, web and 3/4 of the rail head with redried stick electrodes E 46 6 B 34 H10 in accordance with DIN EN ISO 2560-A (e.g. BOR-SP 6).
- Weld the last 1/4 of the rail head (approx. 10 mm) with a covered electrode E Fe1 in accordance with DIN EN 14700 with a hardness of approx. 350 to 400 HB (e.g. SUPRADUR 400B, Oerlikon Schweißtechnik GmbH).
- From an economic perspective, the use of longer stick electrodes with the dimensions 5 x 550 mm or, if available on the market, 6 x 550 mm is recommended.

Joint welding with flux cored electrodes in accordance with the metal arc welding procedure

- Preheating to 400° C
- Weld the rail foot and web and 3/4 of the rail head with a flux cored electrode T 38 Z V N3 in accordance with DIN EN ISO 17632-A (e.g. Innershield NS-3M)
- Weld the last 1/4 of the rail head (approx. 10 mm) hard deposit with a flux cored electrode T Fe3 in accordance with DIN EN 14700 (e.g. Hardface TN-O, Welding Alloys Deutschland GmbH) or stick electrode E Fe1 in accordance with DIN EN 14700 (e.g. Citodur 400B, Oerlikon Schweißtechnik GmbH), the use of weld electrodes with a hardness of 350 to 400 HB is recommended.

Overlay welding with covered electrodes in accordance with the metal arc welding procedure

- Preheating to 400° C, deposit site and roughly 100 mm on both sides across the entire rail section
- Hard deposit with a stick electrode E Fe1 in accordance with DIN EN 14700 (e.g. Citodur 400B, Oerlikon Schweißtechnik GmbH)

with a hardness of 350 to 400 HB

Overlay welding with flux cored electrodes in accordance with the metal arc welding procedure

- Preheating to 400° C, deposit site and roughly 100 mm on both sides across the entire rail section
- Hard deposit with a flux cored electrode T Fe3 in accordance with DIN EN 14700 (e.g. Hardface TN-O, Welding Alloys Deutschland GmbH) with a hardness of 350 to 400 HB

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