



Requirements to be met by filler metals used for rail joint welding and rail resurfacing by welding

1. Fundamental requirements

Detailed specifications regarding the use of filler metals for resurfacing welding work on rails and other parts of the permanent way and for the welding of rail joints are provided in DB Guideline 824.

Certification of the filler metals is carried out by DB Systemtechnik. The scope of type qualification testing shall be agreed between the **certification body for product certification** and the **product testing centre** (see section 4.1). The certification body for product certification shall specify the product testing centre to be used following consultation with the applicant. Before filler metals are used for work for DB AG, **operational testing** shall be carried out by **DB Netz AG** in addition to type qualification testing.

2. Supplementary requirements to be met by filler metals used for rail joint welding

2.1 Fundamental requirements:

Welded rail joints between rails of R260 grade steel (as defined in DIN EN 13674-1) with a minimum tensile strength of 880 MPa shall exhibit a minimum fatigue strength of 200 MPa (relative to rail foot).

The fatigue strength of welded rail joints shall be determined by means of a flexural fatigue strength test as set out in DIN 50100. Testing shall be carried out on a critical rail joint (critical in terms of the rail profile and the rail material) for which certification is sought.

The manufacturing quality of the weld being tested shall correspond to the subsequent actual state (manufacture in the track/workshop).

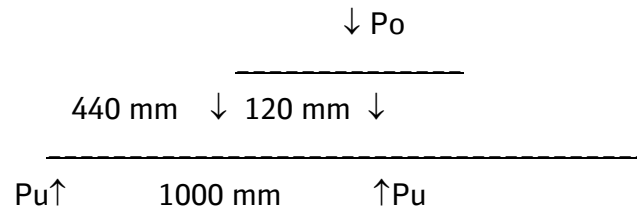
Mechanical aftertreatment of the butt weld interfaces, contrary to any standard aftertreatment, is not permitted.

2.2 Test implementation:

- Test equipment: Servo-hydraulic testing machine
- Position of rails: As determined by existing track geometry
- Transmission of test forces: Via double-roller die
- Load cycle frequency: 60 Hz
- Maximum applied force, minimum applied force, number of load cycles:

Rail profile	Steel grade as per DIN EN 13674-1	Maximum applied force (Po)	Minimum applied force (Pu)	No. of load cycles
UIC	R260, R350HT	- 340 kN	+ 10 kN	2 x 10 ⁶
S 54	R260, R350HT	- 250 kN	+ 10 kN	2 x 10 ⁶
S 49	R260	- 225 kN	+ 10 kN	2 x 10 ⁶

- Schematic loading diagram:



3. Supplementary requirements to be met by welding filler metals used in rail resurfacing work

Resurfacing welds on the rail steel included in the application shall meet the following hardness requirements, which depend on the strength of the parent rail steel:

- | | |
|---|--------------|
| - Steel grade R350HT / LHT DIN EN 13674-1 (≤ 1175 MPa): | 350 - 390 HB |
| - Steel grade R320Cr DIN EN 13674-1 (≤ 1080 MPa): | 320 - 360 HB |
| - Steel grade R260 DIN EN 13674-1 (≤ 880 MPa): | 260 - 300 HB |
| - Steel grade R220 DIN EN 13674-1 (≤ 770 MPa): | 220 - 260 HB |
| - Steel grade R200 DIN EN 13674-1 (≤ 680 MPa): | 200 - 240 HB |

To test the filler metal, a stepped three-layer weld shall be built-up on the rail head rail made from the rail steel included in the application, whereby at least 4 beads shall be applied next to each other (see Figure 1).

If the build-up weld necessitates use of a buffer electrode, this shall be applied accordingly under the layers of the build-up weld.

When manufacturing the test specimen a non-overlapped area of min. 70 mm shall be implemented on the first and second layer.

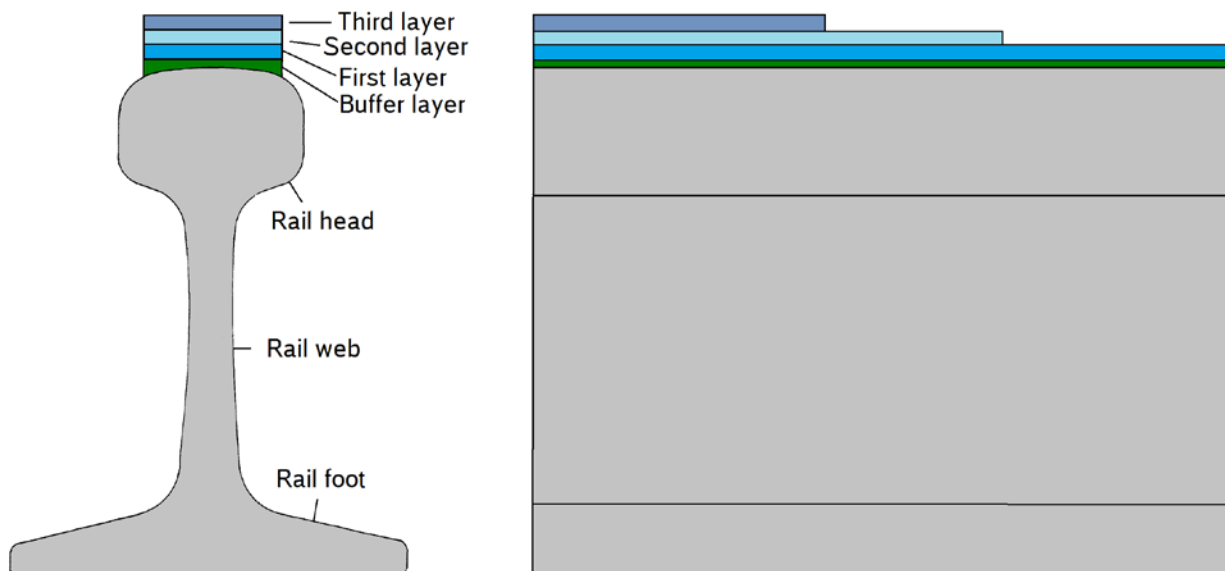


Figure 1 Test specimen for the material examination of welding filler metals

The following tests are to be performed:

- Determination of weldability, flow behaviour and slag formation in the welding positions PA and PC.
- Materials testing
 - Surface crack testing using magnetic-particle inspection,
 - A hardness test HB (after surface grinding of built-up weld),
 - Depending on the number of layers, a macrosection (transverse section) through the rail head for testing of
 - deep penetration and internal defects,
 - hardness profile, HV 10, three rows vertically (weld - HAZ - parent metal); one row laterally along the HAZ, and in the parent metal of the rail head,
 - surface hardness using three hardness indentations after Brinell (HB).
 - One microsection in each case on the microstructure transition of the individual layers with corresponding microstructure description as proof.
- Chemical composition of the weld metal
 - Weld metal specimen (8-layer weld build-up on S235) based on specs in DIN EN 26 847.

4. Operational testing of welding filler metals used in rail resurfacing work

Operational tests are carried out to determine the usability of the filler metals and welding consumables for rail resurfacing work.

Filler metals used in rail resurfacing work shall produce defect-free welds under normal operating conditions and during adverse weather and these surface welds shall exhibit the required hardness under varying loads relative to the parent rail material.

In sections of track that are subject to heavy loading $\geq 60,000$ tonnes of load, three built-up welds shall be made under normal operating conditions (mixed operations) at each of the following locations: in the switch, at common crossings and on the track.

The following material tests shall be carried out:

- a.) After making the test welds:
 - Ultrasonic testing to detect weld defects.
- b.) After a total gross load of 30 million tonnes has been reached
 - Ultrasonic testing to detect internal defects,
 - Examination of wear behaviour (ruler, feeler gauge - indication of length and max. depth of wear),
 - Redetermination of hardness profiles (Equotip, test impactor G).