

## Welding instruction (WPS) for arc welding with stick electrodes SMAW

Cutting of the rails for performing the square butt joint can happen either mechanically using a cutting-off wheel, or by oxy-fuel cutting. If a square butt joint is made by flame cutting and the rail is used before the welding operation, it is required as per national or international requirements to heat the rail on both sides of the joint prior to flame cutting.

Rail steel grade R200 and R220 must be preheated to 350° C.

R260 and up to R350 to 400°C.

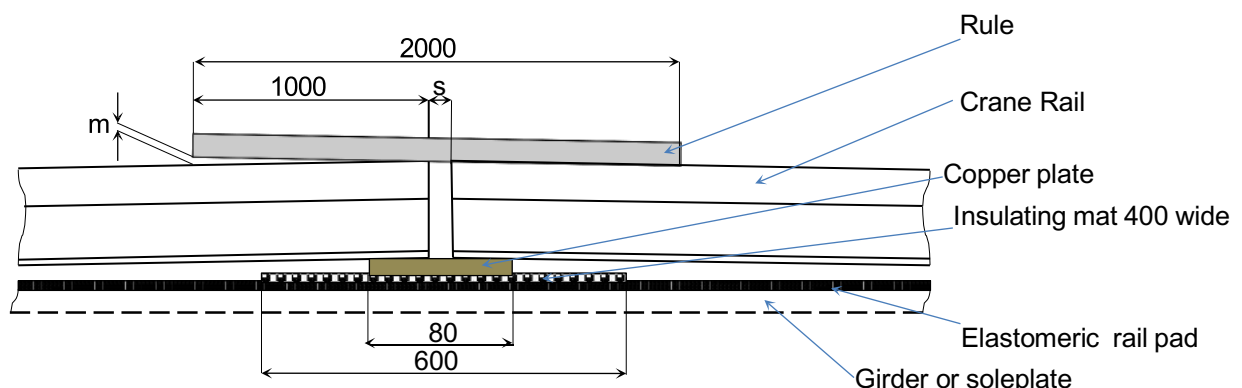
R320Cr must be preheated to 500° C

The following works are to be performed prior to starting welding:

- . Detach rail fixation on a length of 3 m
- . Pre-align the rail joint and prepare the welding gap.

The welding gap is prepared using a cutting torch or a cutting-off wheel. The gap is to be adapted to the electrode diameter used and the size of the rail, so that the electrode can easily weave during welding. For types of stick electrodes the welding gap width should approximately 15 – 20 mm depending on the size of the rail. If necessary, welding gap can be enlarged for repair welding. The maximum gap is 25 mm for repairs.

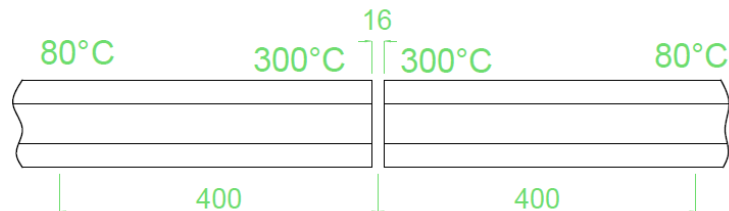
The joint is aligned vertically and horizontally with the aid of a ruler. Next, the joint is to be lifted. The lift required depends on the rail section, the welding gap and the heat input. The lift usually amounts to 2 – 3 mm.



For arc welding with stick electrodes, the rails are to be preheated up to 400° C. It depends from the rail steel grade. Rail steel grade R200 and R220 must be preheated to 350° C, R260 and up to R350 to 400°C, rail steel grade R320Cr must be uniformly preheated to 500° C in a

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length of 100 mm on both sides. Additionally, the rails are to be heated 50° C over a length of 400 mm. The temperature is controlled with a suitable measuring device, for example with a temperature indicator or with a digital thermo-meter.



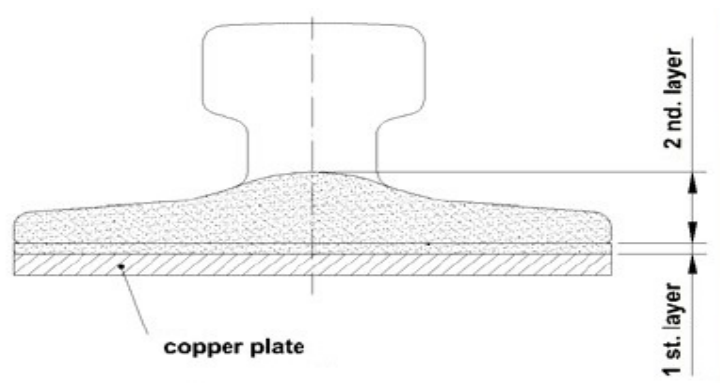
Should welding be interrupted, attention must be paid to the rail temperature in the heat-affected zone (HAZ) does not drop below 250° C; if necessary, reheat the rail again to 350°C over a length of 100 mm on both sides of the joint. The temperature is to control with a suitable measuring device, for example with a temperature indicator like “Tempilstick” or with a digital thermometer.

Prior starting welding the electrodes must be re-dried approx. 2,0 h @ 350° C. Stick electrodes must be properly stored. Information about re-drying is printed on the package label. This applies for joint welding and hard facing stick electrodes.

Welding of the foot rail is performed using a weld pool backup, e.g. copper plate with a groove. Root welding is started at the lowest point of the rail foot (slag run-off).

When the first pass is welded, the arc must always be guided within the weld pool. When using weld pool backup elements made of copper, this procedure prevents the copper from melting and passing into the weld metal.

After welding the root pass, the slag is to be removed and the root is to be inspected from below using a mirror. Should lack of fusion or copper inclusions be found, the complete root pass is to be removed. Prior to continuing welding, the foot plate is to be fitted again.



Reaching both sides of the rail flanks, the electrode should be stopped for a short time to obtain a perfect penetration.

The welding of the foot must be completed in 3 - 4 layers; depending on the skill of the welder. Prior to welding the rail web, the welding gap is to be checked for dimensional accuracy. The slag must be removed from the last layer; and the copper backings are to be fixed on the web. Distance from the web to the backing 3 mm, by copper rivets.



The electrode is introduced vertically from above into the welding gap. During welding the electrode is weaved, reaching both sides of the rail flanks, its stops for a short time. If the weld pool overheats during welding, welding must be interrupted for some time. We recommend checking the amperage and reduce it if necessary.

During welding have an eye on the slag discharge. If the slag does not run off laterally from the copper backings, this shows that the backings sit too close to the web, welding has to be interrupted and the slag is to be removed from the web or head. When the slag cannot run off, it rises quickly above the liquid weld pool. Due to the worse electrical transmission, the arc changes its melting behaviour. The slag solidifies and thus included in the weld metal. Hence, perfect welding is no longer possible.

When welding the head pay attention to overheating; in case of overheating the welding is to be interrupted.

The last 10 mm of the rail (must) be welded using hard facing electrodes. Prior using the first electrode, make sure that the temperature of the weld metal must not exceed more than 250° C. Only then use the hard facing electrode. The hardness of the hard facing electrode must be adapted to the corresponding of the rail steel grade. The stick electrodes must be approved

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for the respective steel grade. The same applies also for stick electrodes for joint welding of rails.

To reinforce the rail foot, apply a cover pass on both sides: width 35 – 40 mm, thickness 2 – 3 mm, prior to welding the cover pass. Remove the slag from the surface of the rail foot. Check the rail temperature and if necessary reheat the welding area to a temperature ranging from 300° C to 400° C, it depending on the steel grade.

When using stick electrodes, apply amperage in accordance with the electrode diameter. The amperage is given on the package labelling, or from the information data sheet of the electrode. The amperage depends on the diameter of the electrodes. 40 to 50 amperes per electrode diameter (mm) is a good indicator. The rail must cool down slowly. During the cooling phase, the rail support (e.g. wedges) remains in its place. It is not necessary to heat the rail additionally. When the rail has cooled down, the support is removed. In case of cold or rainy weather condition an insulated covering is used.

After welding and rough grinding, check the vertical and horizontal alignment of the joint and readjust it, if necessary, using the oxy-fuel flame.

The preparatory works, heating, consumables and the execution of the welding (e.g. weld procedures of the joint welded) are to be recorded in a welding report. Depending on the weld requirements, the weld joints are to be inspected by ultrasonic. The test result is to be recorded in a welding report. Should any unacceptable defects be found within the weld, which might cause later rail failures, the rail joint is to be removed and replaced.

The rail is fixed by clamps and screws (clamping actuated by adherence). When the weld has cooled completely, finishing grinding true to the rail profile is performed. After finishing grinding and re-profiling of the rail head, all works are completed. The acceptance test will be made by the plant user. The level and alignment can be checked with a 1 m ruler at the weld joint rail head and flange. The ISO 12488-1 2012, Table 6, can be used as a reference. All results are to be recorded in a weld report and to be documented in a final report rail report.

Prior to the first movement of transport equipment on the rail, remove all weld spatters from the rail surface.

**Electrode Voestalpine Boehler Fox K 55 3.2 mm. 4 mm. 5 mm.**

Classifications

EN ISO 2560-A	EN ISO 2560-B	AWS A5.1 / SFA-5.1	AWS A5.1M
E 46 4 B 3 2 H5	E 4916 A	E7016	E4916

