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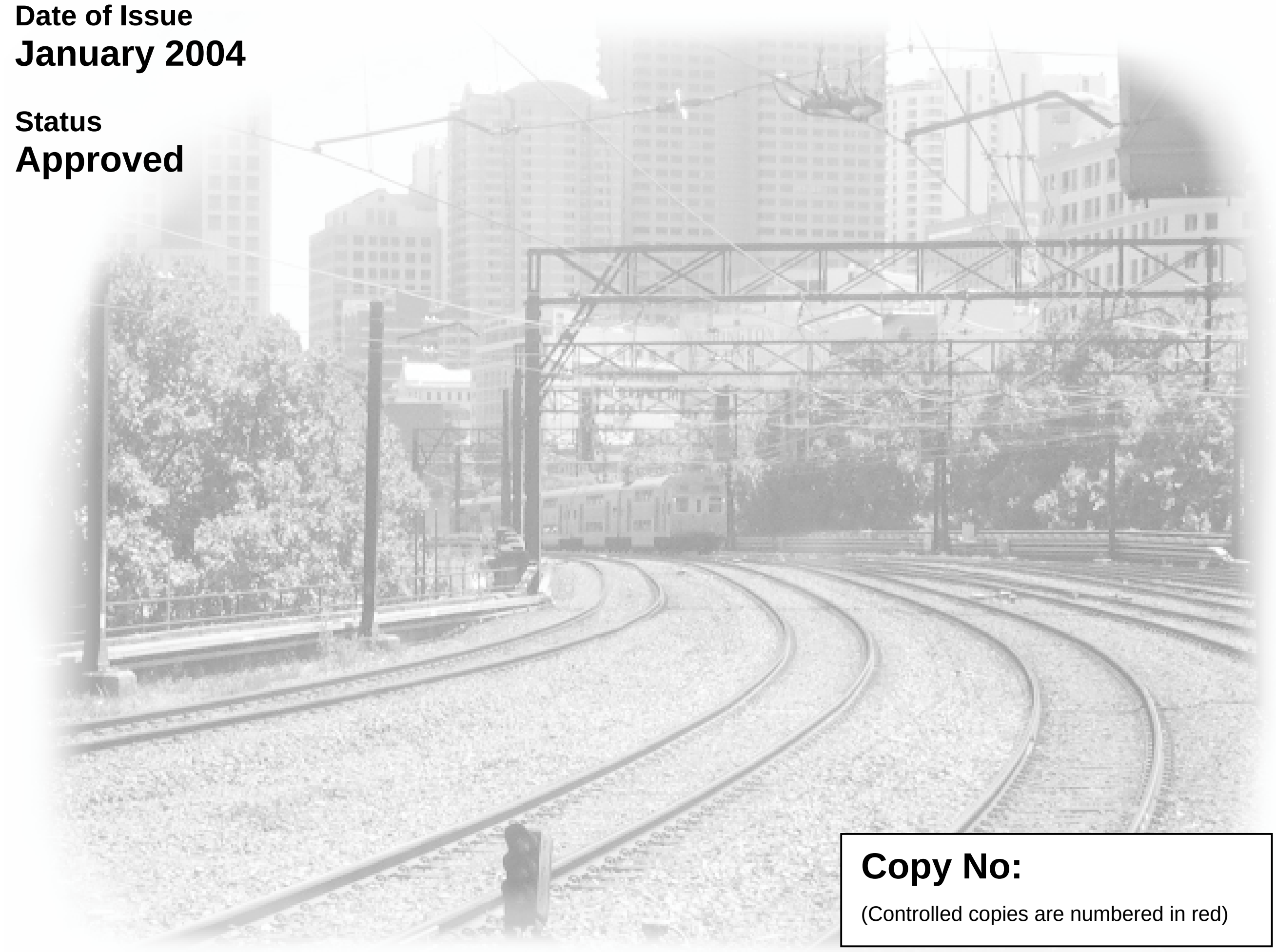

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About This Standard

This standard is based on the following TRS Standard:

TRS 1038 Specification for the Welding of Wear Plates – Welding Bulletin No. 25.

Version History

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1 Scope

This Specification is issued for the guidance of Engineers, Supervisors, Foremen and Welding Operators and applies to quenched and tempered wear plate, spring steel, austenitic manganese steel, case hardened steel and mild steel wear plate.

1.1 Description

Considerable use is made in RIC of replaceable wear plates and pads at points of heavy wear on rolling stock components. Typical applications include gangway diaphragms, buffer beams, draft gears, axlebox openings, bogie brake rigging and bogie pivot centres. A variety of materials are used in these applications, including quenched and tempered wear plate, spring steel (Resilflex), 11-14% austenitic manganese steel, case hardened steel and mild steel. In most cases wear plates are welded in place with fillet welds.

With each of these steels the welding technique is of fundamental importance if cracking either in the weld or in the heat affected zones is to be avoided.

It is the purpose of this Standard/Instruction to detail the welding specification that shall be followed for each material to minimize the possibility of cracking and thus avoid loss of plates in service and the consequent additional maintenance costs.

While drawings usually specify the wear plate material, in practice it does not always follow that the actual plates supplied in each case are of the material specified. Before any welding is carried out therefore, it is necessary to identify the material actually supplied and also the material to which the wear plate is to be attached i.e. steel or cast iron.

Wear plates must not be welded onto cast iron as provision is made to bolt them on.

Welding of the various wear plate materials shall comply with the following requirements:-

1.2 Quenched And Tempered Wear Plate (Eg. QT 250, WR 400, Bisalloy 360, etc) and Spring Steel.

1.2.1 General

These steels are regarded as hard-to-weld because high hardness can develop in the weld heat affected zone, if cooling is rapid. High heat affected zone hardness and restraint can easily result in underbead cracking of welds, which will propagate in service. Thus, great care is required to prevent rapid cooling of the weld area.

1.2.2 Identification of Plates

Quenched and tempered wear plate, and spring steel are strongly magnetic and although hardened, may be filed in the as-received condition. If a small piece or a corner is heated to a bright red and quenched in water it cannot be filed. These properties should enable identification by comparison with other plates.

1.2.3 Preparation of Mating Surfaces

It is very important that both the wear plate and the surface to which it is being attached are flat and free of oil, grease, paint, rust. etc.

Intimate contact must be made between the base surface and plate so that there are no gaps at the areas to be welded. Without these precautions fatigue cracks may form at the weld toe during service. To achieve flatness, grinding of the base surface, rather than the wear plate should be employed.

Where practicable, plates shall be clamped in position for welding, but clamps must not be used to deform the plate. If fit-up is not satisfactory, grinding of the base surface should be employed or build up by welding followed by grinding if grinding alone would result in prescribed tolerances being exceeded. If it is necessary to build up the base surface by welding, a weld procedure must be developed.

1.2.4 Electrode

Use a hydrogen controlled process. In using the manual metal-arc welding process special precautions must be taken with these electrodes to ensure that they contain no moisture. Large stocks of these electrodes should not be maintained, but requirements procured in small batches at more frequent intervals. Drying and conditioning of Electrodes shall be in accordance with WTIA Tech Note No. 3 or the manufacturer’s recommendations.

1.2.5 Welding

A welding procedure must be developed.

The following instructions need to be incorporated as part of the procedure.

Preheating of the section to which the wear plate is to be attached, particularly if it is thick, is required: the preheat temperature shall be at least $100^{o}C$.

Welding heat input is to be as high as possible and therefore the use of high amperage or large size electrodes is required; clamp the wear plate in position and complete the weld run making sure that the crater at the end is filled.

The weld runs should be peened (using a needle gun or similar) across the face of the weld while still very hot (not less than 400^{o}C), as this will minimise restraint cracking. Peening also minimises pillowing effects on the plate due to contraction and will thus improve resistance to fatigue cracking. Care is to be taken not to peen too heavily and peening must not be done when the weld temperature falls below 400^{o}C as cracks may be formed. In practice, this means that a short weld run, about 2-3 cm in length, needs to be deposited and peened immediately the arc is extinguished.

1.3 11-14% Austenitic Manganese Steel

1.3.1 General

Austenitic manganese steel has excellent wear resistance as it work hardens in service. It cannot be hardened by heat treatment. If it is excessively heated during fabrication or welding, grain growth and carbide precipitation rapidly occur leading to serious embrittlement.

Mild steel and hydrogen controlled electrodes must never be used to weld these steels.

1.3.2 Identification of Plates

Austenitic manganese steel is non-magnetic in the normal condition, however, if work hardened or overheated it may become slightly magnetic.

1.3.3 Preparation of Mating Surfaces

As for welding quenched and tempered wear plate and spring steel (See 1.2.3).

1.3.4 Electrode

Use only austenitic stainless steel electrodes. The preferred electrode is type 309. If cracking persists a type 312 should provide the best protection.

If using a manual metal-arc welding process the electrodes are to be handled with care to avoid moisture pickup. If required, they can be redried at a temperature of 150^{o}C in 1/2 hour. WTIA Tech Note No. 3 gives further recommendations.

1.3.5 Welding

A welding procedure must be developed.

The following instructions need to be incorporated as part of the procedure.

To avoid overheating the wear plate, heat input should be as low as possible. Thus, no preheat is used and welding is done with a small electrode at as low a current as possible (eg. use 2.6 mm electrodes when welding 6mm plate). Weld runs should be intermittent approximately 3-4 cm long with the same length gap. Weld profiles should be convex and it is important that the crater be filled at the end of each run. In general the welding shall proceed from the centre to the open edges of the plate, keeping heat to a minimum and the work should never be hotter than can be borne by the hand before the next run is deposited in that area. Peening by use of a needle gun or similar should be carried out immediately the arc is extinguished.

1.4 Case Hardened Steel

1.5 General

The welding of case hardened steel is not generally recommended unless the hardened case has been ground away in the vicinity of the welding. However, for case hardened wear plates, practice has shown that with appropriate care, satisfactory attachment welds can be made.

1.5.1 Identification of Plates

Case hardened wear plate is strongly magnetic and cannot be filed in the as-received condition. There may be a small hole near one edge of the plate used for suspending it in the hardening bath by a wire.

1.5.2 Preparation of Mating Surfaces

As for welding quenched and tempered and spring steel wear plate (see 1.2.3).

1.5.3 Electrode

As for quenched and tempered and spring steel wear plate (see 1.2.4).

1.5.4 Welding

As for welding quenched and tempered and spring steel wear plates (see 1.2.3). Because of the high carbon content of the hardened case, the stated specification must be closely adhered to.

1.6 Mild Steel

Where mild steel is substituted for any of the foregoing wear plates no special precautions are necessary apart from ensuring intimate contact of surfaces. For welding to a steel base surface if using the manual metal-arc welding process any general purpose mild steel electrode may be used except when welding to a casting when hydrogen controlled electrode may be used.

Peening of the weld faces will reduce pillowing effects and thereby improve resistance to fatigue cracking during service.

1.7 Austenitic Stainless Steel

1.7.1 General

This steel hardens in service and is therefore suitable for wear plate applications. However, it has a higher thermal expansion than mild steel, resulting in distortion problems. Heat input shall therefore be minimised to avoid distortion and to reduce carbide precipitation.

1.7.2 Identification of plates

Austenitic stainless steel is non-magnetic and has a silvery metallic appearance.

1.7.3 Preparation of mating surfaces

As for welding quenched and tempered and spring steel wear plates (see 1.2.3).

1.7.4 Electrode

As for austenitic manganese steel (see 1.3.4).

1.7.5 Welding

A welding procedure must be developed.

The following instructions need to be incorporated as part of the procedure.

To avoid overheating the wear plate heat input should be as low as possible. Thus, no preheat is used and welding is done with a small electrode at as low a current as possible (e.g. with the manual metal-arc welding process use 2.6 mm electrodes when welding 6mm plate). Weld runs should be approximately 3-4 cm long. Weld profiles should be convex and it is important that the crater be filled in at the end of each run. The work must never be hotter than can be borne by the hand before the next run is deposited in that area.

2 References