



INTERNAL GUIDANCE

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Approved by: **TC 1 — Pressure Equipment and the SAFed Technical Steering Committee**

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Reference: **Repairs to Welded Structures only (for Non-Pressure applications)**

BACKGROUND

An Engineer Surveyor will, on occasions, need to consider the suitability of welding repairs to structures and machinery as part of a Thorough Examination or other inspection activity. Where repairs or modifications have a significant affect on the integrity of the plant or where there is concern over its acceptability, advice should be sought from the appropriate technical specialist. Whilst repairs to thin sections of carbon steel are relatively common and impose less risk, care must be taken for thicker materials and where the type of material is unknown. Repairs that do not take account of such features, including welding alloyed or high strength steels without adequate precautions, could significantly weaken the item and potentially lead to catastrophic failure when returned to service.

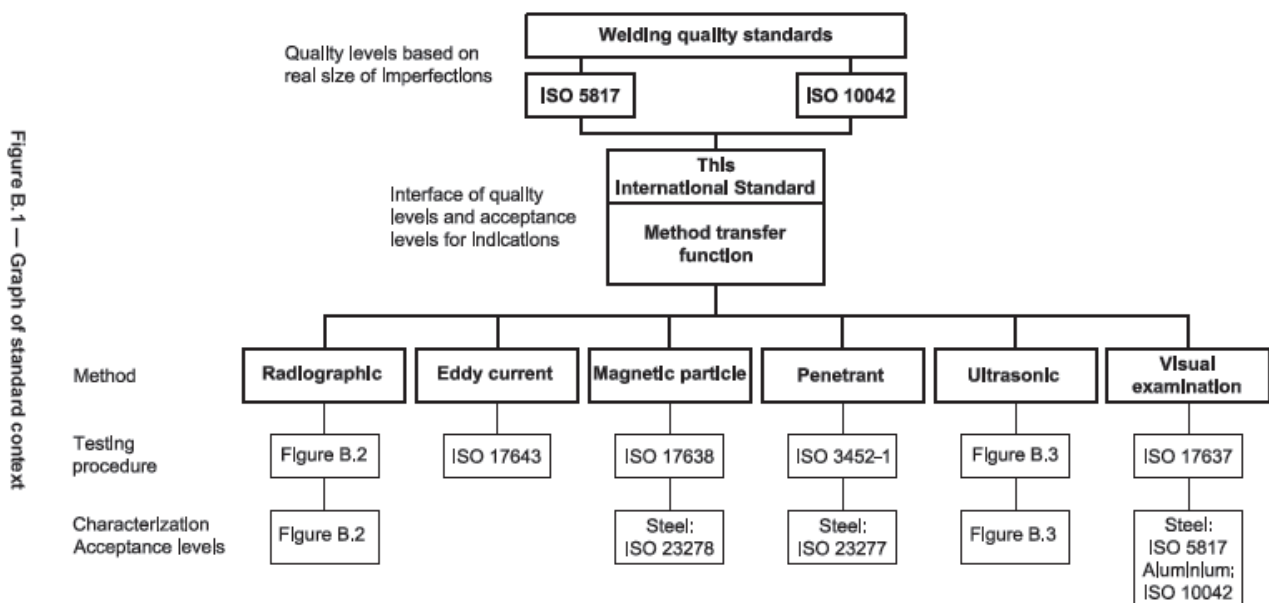
GUIDANCE

Prior knowledge of repair

When an Engineer Surveyor is made aware that a repair is to be undertaken, a detailed report of the defective area should be made prior to commencing the repair. A “method statement” shall be obtained from the repairer to provide confidence in both the repair method and personnel who are to perform the repair. The ‘method statement’ shall include details of the various steps to be used including requirements for verifying materials, acceptable methods of weld repair (pre-heat, PWHT, temper bead, consumable composition and strength rating) examination during and on completion of the repair. The method statement shall be supported by applicable weld procedure specifications, procedure qualification records, welder approvals (issued by a competent body for example a Notified Body, RTPO or audited under ISO 17020) and material certificates. BS EN ISO 17635: 2010 Annex. A provides reference list of standards and acceptance criteria for the NDT method chosen

Completed repair

Where an Engineer Surveyor is presented with a completed weld repair that has been undertaken since the last thorough examination, a review of the repair and possible causes of the originating defect should be undertaken. The object of the review being to ascertain if the item has been abused or if a common defect has manifested itself. In situations where the Engineer Surveyor is made aware of any significant repair, this should be noted on the report of the Thorough Examination. The applicable method statement and supporting documents should be reviewed retrospectively and an examination of the completed weld performed. The scope of the examination should be limited initially to a visual one, but in the event of concern this may be escalated to include appropriate non-destructive examination techniques. Whilst there may be no stipulated acceptance criteria, the suitability of welds should be based upon similar welds, design drawings, OEM recommendations and sound engineering practice. It should be noted that the standard of welding included in sound engineering practice may vary between, typically BS 4872 and BS EN 287/BS EN ISO 9606/BS EN 288/BS EN ISO 15614 standards and depending on the nature, material and service environment of the item being repaired. BS EN ISO 17635: 2010 Annex. A provides reference list of standards and acceptance criteria for the NDT method chosen



NOTE: Inspection acceptance criteria Level B or C as per ISO 5817 or ISO 10042 shall be selected based up on severity of repair and design/construction standard.

Typical weld defects

Typical defects that can occur during welding are shown in table 1:

Table 1 — Typical weld and parent material defects

Planar Defects	Volumetric Defects	Profile Defects
Cracking	Porosity	Incomplete fill
Lack of fusion	Trapped Slag	Misalignment
Incomplete penetration		Excess weld metal
Overlap		Excess convexity
Laminations		Fillet weld under/over size or not incorrect profile
		Undercut
		Poor restart

[**Note:** Whilst all defects can affect the performance of a weld, after repair, the most significant are those concerning the planar defects, as these can lead to accelerated failure.]

Examples of weld testing

Where the quality of welding is not considered acceptable, further testing, as shown in Table 2 should be called for which may include:

Table 2 — Examples of further weld testing

Type of test	Profile defects
Ultrasonic Examination	Volumetric Defects
Radiographic Examination	Volumetric Defects
Magnetic Particle Testing	Surface Defects / Partial Sub-Surface
Liquid Penetrant Testing	Surface Defects
Load Testing	

[**Note:** Engineer Surveyors should be aware that weld repairs might affect properties such as fatigue life and corrosion resistance, consequently the date for the next Thorough Examination may need to be reviewed. Any alterations to the periodicity of examination should be discussed with the client and relevant Technical Specialist.]