

AWS D14.1/D14.1M:2005
An American National Standard



**Specification for
Welding of
Industrial and Mill
Cranes and Other
Material Handling
Equipment**



American Welding Society



7.4.12.2 Tack welds which are incorporated into the final weld shall be made with electrodes meeting the requirements of the final weld. Multipass tack welds shall have cascaded ends. Tack welds shall be cleaned prior to depositing additional weld metal.

7.4.12.3 Tack welds not incorporated into final welds shall be removed.

7.4.13 Arc Strikes. Arc strikes outside the area of permanent welds should be avoided on any base metal. Cracks or blemishes caused by arc strikes shall be ground to a smooth contour and examined to ensure soundness (see 12.2.2).

7.5 Control of Distortion and Shrinkage Stresses

7.5.1 The procedure and welding sequence for assembling and joining parts of a structure or of built up members and for welding reinforcing parts to members, shall be designed to minimize distortion and shrinkage.

7.5.2 When practicable, all welds shall be deposited in a sequence that will balance the applied heat while welding progresses.

7.5.3 A program for welding sequence and distortion control shall be provided where shrinkage stresses or distortion are likely to affect the adequacy of the structure.

7.5.4 Joints that are expected to produce large shrinkage should usually be welded with as little restraint as possible before other joints that are expected to cause less shrinkage are welded.

7.5.5 Peening may be used on intermediate weld layers for control of shrinkage stresses in thick welds to prevent cracking (see 7.8). No peening shall be done on the root pass. Peening of the final weld layer shall be for fatigue enhancement purposes only and shall be done according to an approved written procedure (see 7.8.3).

7.5.6 In making welds under conditions of severe external shrinkage restraint, the welding shall be carried continuously to completion or to a point that will ensure freedom from cracking before the joint is allowed to cool below the minimum specified preheat temperature. Where preheat and interpass temperatures are not specified, welding shall continue to a point where freedom from cracking is assured.

7.6 Stress Relief. Where required by the contract drawings or specifications, welded assemblies shall be stress relieved.

7.6.1 All stress relief operations shall follow an approved written procedure.

7.6.2 Localized stress relieving may be employed, subject to approval by the Design Engineer, when it is

impractical to stress relieve the entire weldment. A written procedure shall address the variables given in 7.6.3.

7.6.3 The procedures for furnace stress relief shall address the following:

- (1) Temperature at the start of the thermal cycle.
- (2) Rate of heating to temperature.
- (3) Maximum allowable variation of temperature throughout the portion of the part being heated.
- (4) Maximum temperature tolerance at stress relief temperature.
- (5) Holding time at stress relief temperature.
- (6) Rate of cooling to a temperature suitable for removal of work from the furnace.
- (7) The thermocouples shall have surface contact with the weldment and be shielded from direct impingement of the heat source. The records shall include the location, calibration and thermal chart of each thermocouple, along with traceable weldment documentation. The records and data shall become part of the weldment documentation.
- (8) Support of the weldment to minimize sagging and distortion.
- (9) Spacing of multiple items so all pieces will heat uniformly.
- (10) Use of baffles or insulating material to protect the weldment from direct impingement of the heat source.

7.6.4 Stress relieving of weldments of A514, A517, A709 Grades 100 and 100W, and A710 steels is not recommended. Stress relieving may be necessary for those applications where weldments must retain dimensional stability during machining or where stress corrosion may be involved, neither condition being unique to weldments involving A514, A517, A709 Grades 100 and 100W, and A710 steels. However, the results of notch toughness tests have shown that stress relieving may actually impair weld metal toughness, and intergranular cracking may sometimes occur in the grain-coarsened region of the weld heat affected zone. Such steels should only be stress relieved after consultation with the steel producer and in strict accordance with the producer's recommendations.

Precautionary Note: Consideration must be given to possible distortion due to stress relief.

7.7 Vibratory Conditioning

7.7.1 Vibratory conditioning to obtain dimensional stability of the weldment may be employed with the approval of the Engineer. The conditioning shall be done in accordance with the recommendations of the manufacturer of the vibratory equipment. It shall not be substituted for thermal stress relief.

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**Specification for
Welded Joints in
Machinery and
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improved fatigue life in the weld joint as a result of the surface material being placed in compression.^{12, 13, 14}

10.4 Vibratory Conditioning

10.4.1 Vibrational conditioning has been used successfully to provide dimensional stability on some

12. Bremen, U., Smith, I. F. C., and Hirt, M. A.: "Crack Growth Behavior in a Welded Joint Improved by Residual Stress Method," International Conference: Fatigue of Welded Construction: Maddos, S. J. (ed), The Welding Institute, Abington, Cambridge, 1987.

13. Booth, G. S. (ed): "Improving the Fatigue Performance of Welded Joints," The Welding Institute, Abington, Cambridge, 1983.

14. Metal Improvement Company, Inc.: *Shot Peening Application*, Eighth Edition.

structures; however, the dimensional geometry, structural complexity and rigidity have a marked effect on the success of the method employed. Vibrational conditioning after welding is minimally effective (approximately up to 15% reduction) in reducing residual stress; but has been found to be moderately effective during welding, to minimize distortion in mild steel weldments.

10.4.2 Vibrational conditioning of welded structures to obtain dimensional stability for machining of the weldment may be employed with the approval of the Engineer.

10.4.3 Vibrational conditioning is not to be substituted for thermal stress relief.