



RESISTANCE SPOT WELDING ACCEPTANCE TEST FOR ALUMINUM

Application

The procedure outlined herein is a standard welding acceptance test for a given aluminum alloy + pretreatment + lubricant + heat treatment system of a specific gauge from a specific supplier. Upon passing this procedure, the aluminum alloy system (gauge, pretreatment, lubricant, and heat treatment-specific) is recognized as resistance weldable by Ford Motor Company. Essentially, it is a procedure to approve the capability of a supplier or Company activity to obtain a spot weldable surface. This procedure shall constitute a method by which such a supplier or Company activity may become an approved supplier of spot weldable aluminum and as a quality control procedure for checking consistency of weldability.

Chemicals, materials, parts, and equipment referenced in this document must be used and handled properly. Each party is responsible for determining proper use and handling in its facilities.

Equipment Required

Resistance Spot Welder

This test shall be conducted using a Medium Frequency Direct Current (MFDC) inverter combined with servo-actuated force including force feedback and servo-inverter synchronization. The weld gun shall be capable of electrode forces up to 10 kN. It shall be equipped with a Ford approved aluminum resistance welding control and gun. The weld controller shall have current capacities to meet the requirements of the range of material to be tested at a minimum rate of 10 welds per minute. The welder must be equipped with electrode holders capable of sufficient water flow capacity so that a minimum of 2.0 gal/min will flow through each electrode holder with a 20 psi pressure differential. In addition, other cooling circuits (e.g. transformer, secondary conductors, and control panel) must meet the minimum manufacturer-specified flow rates and temperature requirements at the requisite duty cycle.

Welding Electrodes

Ford standard, male, $\frac{3}{4}$ ", "hi water flow" electrode caps, with two inch radius face (Ford part number: WC11R263), as specified in WC1-002, will be used for all tests. The electrode caps must be made from RWMA Class 2 CuCr (ISO Type A2/1) material, unless otherwise specified by the Ford Vehicle Operations Joining Supervisor. The electrode caps, adapters and holders to be used will be found under the following standards:

Identification	Ford Standard	Designation
Electrode Cap	WC1-002	WC11R263-A2/1
Cap Adapter	WB1	WB1S36-1XX

Tip Dresser

An electric or pneumatic, automatic tip dresser or a handheld tip dresser is required to dress the top and bottom electrodes to clean, fresh copper during the test setup and test procedures. Cutter blade and holder must be matched to the WC11R263 electrode cap face. Changer & Dresser Corporation Cutter Part Number KTW(U)-140 and Holder Part Number KTWH(U)-140 or equivalent are required.

Knife Edge Caliper

Mitutoyo Absolute Digimatic Model No. CD-6"CSX or equivalent is required to measure weld button diameter.

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2014 04 01	Released		E. Feltok / W. Moision, NA

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Page 1 of 8

Instrumentation

Calibrated Miyachi Weld Tester MM-380A or equivalent, capable of simultaneous measurement of force AND current and/or voltage, is required to set up and document weld schedule.

Metallurgical Sample Preparation and Microstructural Feature Measurement

Suitable equipment shall be available to cross section, polish, etch, and examine at 10x magnification welded samples.

Procedure

Surface Preparation of Material

The material submitted for approval shall be prepared according to the practice proposed to be used for production quantities. A letter shall accompany the material noting all pertinent data to identify completely the method of preparation. A minimum of 7.5 square meters of material shall be submitted in a width equal to the maximum capability of the surface preparation equipment.

The material shall be sheared in 25 mm x 300 mm and 100 mm x 300 mm pieces. Care shall be exercised to obtain pieces of each size from various positions of its width. All material is to be welded in the as-received condition, with no modification to the temper or surface condition.

The Welding Acceptance Test shall be conducted as outlined herein. If failure occurs, the material is rejected. If the material passes the initial Welding Acceptance Test, the unused portion of the submitted material shall be stored on a rack permitting exposure of both surfaces of the sheets to normal shop atmosphere for 90 days. The Welding Acceptance Test is then repeated on the material after 90 days of exposure.

Approval Criteria

Approval is granted when all of the following conditions are met:

- (1) Welding Acceptance Test on material before and after 90 days exposure to shop atmosphere produces a minimum of 2500 consecutive acceptable welds on panels without failure. Identical weld parameters are to be used on both sets of material (i.e. fresh and post-90-day storage).
- (2) 25 mm x 300 mm test strips are free of surface expulsion (whiskers), not assignable to operator error.
- (3) Surface indentation (I_1 and I_2), as shown in Figure 1, does not exceed 15% of original sheet thickness (t_1 and t_2 , respectively).
- (4) No sheet separation or buckling occurs due to indentation.
- (5) Surface roughness meets applicable paintability specification requirements.
- (6) Metallographic acceptance criteria are achieved at setup and at the 2500th weld interval.

Following approval, no changes in material or processing may be made without prior written approval from the responsible Ford activity.

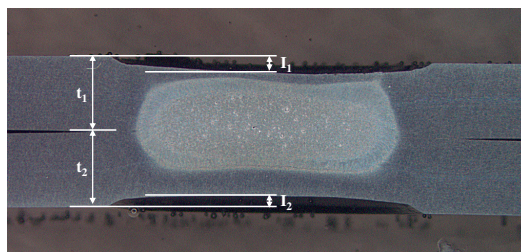


Figure 1. Measurement of surface indentation

Welding Acceptance Test

Equipment Setup

The electrode caps shall be installed in the machine so that they are in precise alignment in the vertical plane and their welding faces are parallel under the electrode force requirement for the thickness of the material under test.

Test Setup Procedure

The following procedural details shall be followed during the test setup:

- (1) Contact Ford Vehicle Operations Joining Supervisor for initial weld schedules and weld setup procedures.
- (2) Dress electrodes prior to commencing setup and after every 5 setup strips. Top and bottom electrode cap faces shall be dressed to clean, fresh copper at each dress interval.
- (3) Using 25 mm x 300 mm test strips, make six welds on the centerline approximately 35 mm–50 mm apart, as shown in Figure 2.
- (4) Do not measure the first weld on each test strip (the “shunt weld”).
- (5) Measure the minimum and maximum diameter of the remaining five weld buttons using the method described in the section entitled “Determination of Spot Weld Diameter” and record the data on the sheet provided in Appendix A (or similar).
- (6) Governing metal thickness (GMT) for double panel welding is defined as the thickness of the thinnest sheet.
- (7) Setup is achieved when the average button diameter of the five measured welds on the strip is $5\sqrt{\text{GMT}}$, with no single weld falling below $(5\sqrt{\text{GMT}} - 0.5 \text{ mm})$.
- (8) Note that only button pull / plug failure is deemed an acceptable fracture mode for this weldability assessment. Partial thickness and interfacial fracture areas are not to be included in averages.
- (9) Setup shall be confirmed via metallographic examination. A second strip is to be welded at the same settings employed to achieve setup button size. One of the five non shunt welds shall be cross sectioned, polished, and etched as closely as possible through the weld center. The weld shall be examined at 10X magnification for compliance with ESXXX-1B325-XX with respect to nugget diameter, weld penetration, indentation, porosity, cracks, and inclusions.
- (10) The set points as well as the actual delivered values of secondary current, weld time, and electrode force are to be recorded on the data sheet.
- (11) After establishing the proper weld button diameter, electrode caps are to be changed and dressed and the test commenced without any additional modifications to the weld schedule.

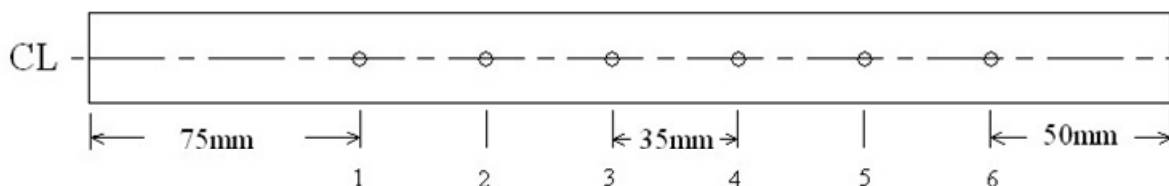


Figure 2. 25 mm x 300 mm test strip with 6 welds at 35 mm spacing