

**FASTENER PROJECTION WELDING ACCEPTANCE TEST FOR STEEL****Application**

The procedure outlined herein is a standard fastener projection welding acceptance test for a given fastener (nut or bolt) to a given single sheet steel. This procedure is used to approve the capability of a Supplier or Ford activity to produce welds which meet active Fastener Projection Welding Engineering Specification (ES) requirements. If found acceptable, the fastener-to-sheet combination is recognized as fastener projection-weldable by Ford Motor Company. Therefore, this procedure shall constitute a method by which a Supplier or Ford activity may:

- become an approved provider of projection-welded fasteners,
- become an approved provider of fastener projection-weldable sheet steel, or
- prove weldability of given fastener-to-sheet combination.

Apparatus and Materials Required**Resistance Projection Welder**

This test shall be conducted using a pedestal welder meeting the following requirements:

- The machine frame and electrode assembly are rigid enough to avoid flexing under load.
- The welder is capable of providing electrode forces to meet fastener-to-sheet combination requirements and has force actuation which provides fast follow up characteristics.
- The welder uses a Medium Frequency Direct Current (MFDC) inverter.
- The welder is equipped with a Ford-approved resistance weld controller. The weld controller shall have current and current rise-time capacities to meet the requirements of the range of fasteners and steel to be tested at a minimum rate of 5 welds per minute. These metrics shall be recorded and included in the test report.
- The welder is equipped with electrode holders capable of sufficient water flow capacity. 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

Geometries as required for the nut being tested. Material used shall be documented.

Instrumentation

A calibrated Miyachi Weld Tester MM-380A or equivalent, capable of simultaneous measurement of force, current, and voltage is recommended to set up and document weld schedules. Alternatively, separate meters may be used to accomplish the same purpose.

Metallurgical Sample Preparation and Microstructural Feature Measurement

Suitable equipment shall be available to cross section, polish, etch, and examine welded samples at up to 100X magnification.

Note: 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.

Date	Action	Revisions	Rev. 00
2018 03 06	Released		

**Documents**

Document Sharing Hub

Procedure

Preparation of Material

A minimum of 200 weld nuts and 0.5 square meters of material shall be submitted per each fastener-to-sheet combination. The material shall be sheared in 50 mm x 50 mm pieces. Holes shall be added as specified in the most current release of ESBUS5A-1294-AB, *Global Generic Tolerances for Sheet Metal Components*. All material must be welded in the as-received condition, with no modification to the surface condition.

Welding Acceptance Test

Equipment Setup

The electrodes (reference the most current release of ESJU5A-1N265-AA, *Projection Welding of Nuts and Bolts*) 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 fastener-to-sheet combination being tested.

Fracture Mode Definitions

The following fracture modes are used when evaluating the performance of a given projection upon fastener and sheet separation using the Push-Out Test as described in the active ES:

Full Button (FB)

Exceeds 70% of base projection diameter and leaves HOLE in mating sheet.

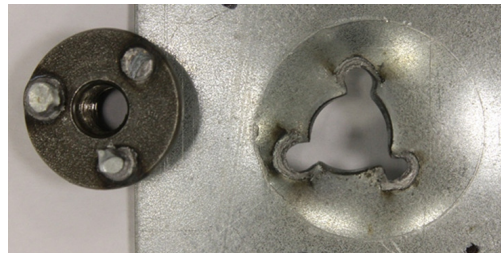


Figure 1 – Full Button Example

Partial Button (PB)

Exceeds 70% of base projection diameter and leaves CAVITY in mating sheet.

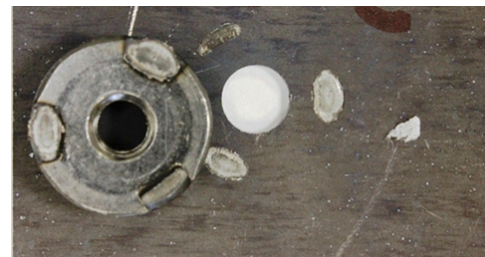


Figure 2 – Partial Button Example

Interfacial Fracture (IF)

Exceeds 70% of base projection diameter and has EVIDENCE OF FUSION with crystalline fracture surface.



Figure 3 – Interfacial Fracture Example

Lack of Fusion (LF)

Cannot be categorized in one of the three ways above, i.e. less than 70% of base projection diameter down to no weld created.

Note: The fracture modes also apply to continuous ring projection fasteners. 100% of the ring circumference must be used.

Test Procedure – Screening for Optimized Parameters

These steps shall be followed to find an optimized weld schedule (see also Figure 4 for reference):

- Develop a minimum nine-box weld lobe using the 50 mm x 50 mm coupons, See Figure 5.
 - Select a starting current, time, and force.
 - Keep force fixed.
 - Adjust current in 750 A increments and time in 15 ms increments.

Note: Heavy weld spatter shall be avoided as part of optimization.
- Perform Dimensional, Visual, and Thread Test Inspection as described in the active ES on each coupon. This inspection must pass to move on to the next step.
- Perform Non-Destructive Torque Test as described in the active ES on each coupon. This inspection must pass to move on to the next step.
- Perform Push-Out or Pull-Out Test as described in the active ES on each coupon and evaluate the fracture mode of the projections.
 - Three of three projections or 100% of a ring projection with fusion (Full Button, Partial Button, or Interfacial Fracture) shall be rated green with a “3” in the box.
 - Two of three projections or 70-99% of a ring projection with fusion shall be rated yellow with a “2” in the box.
 - Zero or one of three projections or less than 70% of a ring projection with fusion shall be rated red with a “0” or “1” as applicable in the box.
- Select an optimized schedule based on a matrix with at least a nine-green box window by choosing a setting in the center of the green. See Figure 5 for example.

Note: The schedule used needs agreement from Ford. If a nine-green box window cannot be found, Ford will determine whether yellow boxes may be included in the nine-box window.

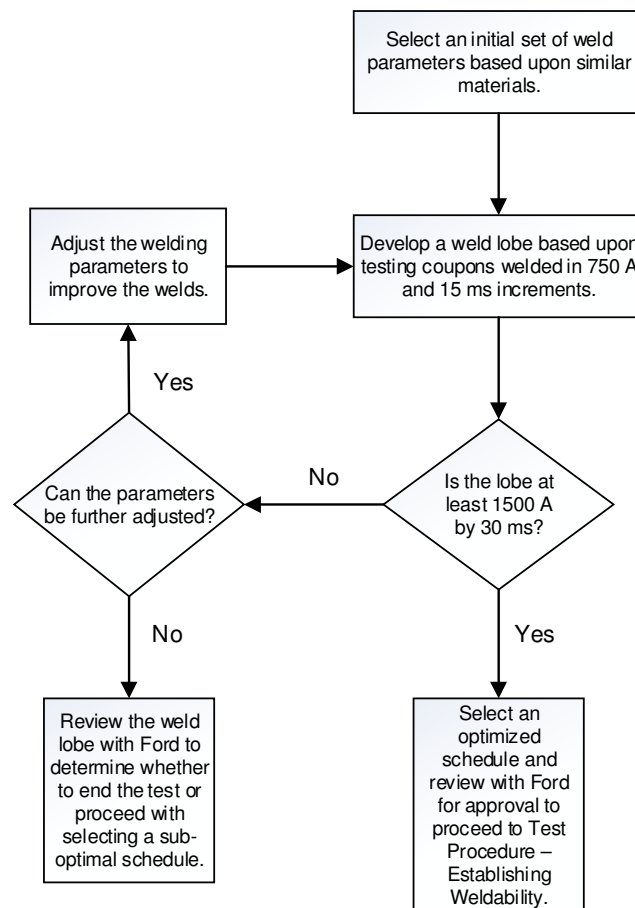


Figure 4 – Weld Lobe Development Procedure