



FLANGING TEST PROCEDURE FOR ALUMINUM ALLOY SHEET

Application

Scope

This document covers the operation of a flanging die set for testing the 90 degree flanging performance of aluminum sheet for body exterior applications.

Significance and Use

This procedure shall be used to establish the maximum pre-strain for which an aluminum alloy sheet can be flanged. Flange acceptability is based on the visual inspection and rating of the flange surface appearance.

Applicable materials

This test applies to aluminum alloy sheet used in body exterior applications.

Applicable Documents

ASTM Standard E290-97a Test Methods for the Bend Testing of Material for Ductility
ISO 7438 Metallic Materials – Bend Test

Conflicts

In the event of a conflict between the text of this procedure and the references cited herein, the text of this procedure shall take precedence.

Definitions

Orange Peel - A pebble-grained surface that develops in forming coarse-grained aluminum sheet. Orange peel roughening is linked with the less constrained deformation of individual grains, with different orientations, at a free surface. It is related to grain size and is not noticeable on fine-grained material, since the individual crystals produce only extremely fine slip lines¹.

Quality Assurance Requirements

Unless otherwise specified, the users of this procedure are responsible for all inspection and the test requirements specified herein, and may use internal testing facilities as long as they meet the requirements of this procedure and any other test agencies acceptable to Ford Motor Company.

Sampling

Samples shall be prepared from a single production lot of alloy. The test report shall contain as a minimum, the following information.

- Generic and specific product description of each alloy including lot number and date alloy was made.
- Baseline material properties for each aluminum alloy.
- Material processing information.
- Flange test ratings for each specimen tested.

Replicates

At least four (4) sample replicates are required per test condition.

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2014 11 12	Released		C. Mracna, NA

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Data Reporting

All physical and mechanical data shall be submitted using the Supplemental Data Reporting Package (SDRP) in Table 1, which is comprised of the form in the reporting section. The SDRP serves as the required reporting format for submitting material data. All material data requested herein shall be manually recorded onto the reporting forms. Graphs and other requested materials shall be packaged and sent with the SDRP.

Apparatus Required

Flanging Die

A flanging die is described below and shown in Figures 1 and 2. The die is designed to function within a single action press or load frame. An air spring within the die set provides a second action holding the specimen prior to and during the forming operation of each station. The station creates a 90° bend in the sheet of the specimen (Fig. 2a, 2b) by flanging over a radius block. Alternatively this test method may be done using the first (flanging) station of the three station hemming die described in FLTM BB 115-01.

Maintenance

The die faces should be cleaned with acetone periodically to remove oil and residue from test specimens. All threads, sliding blocks, and bearings must be kept clean and lightly lubricated.

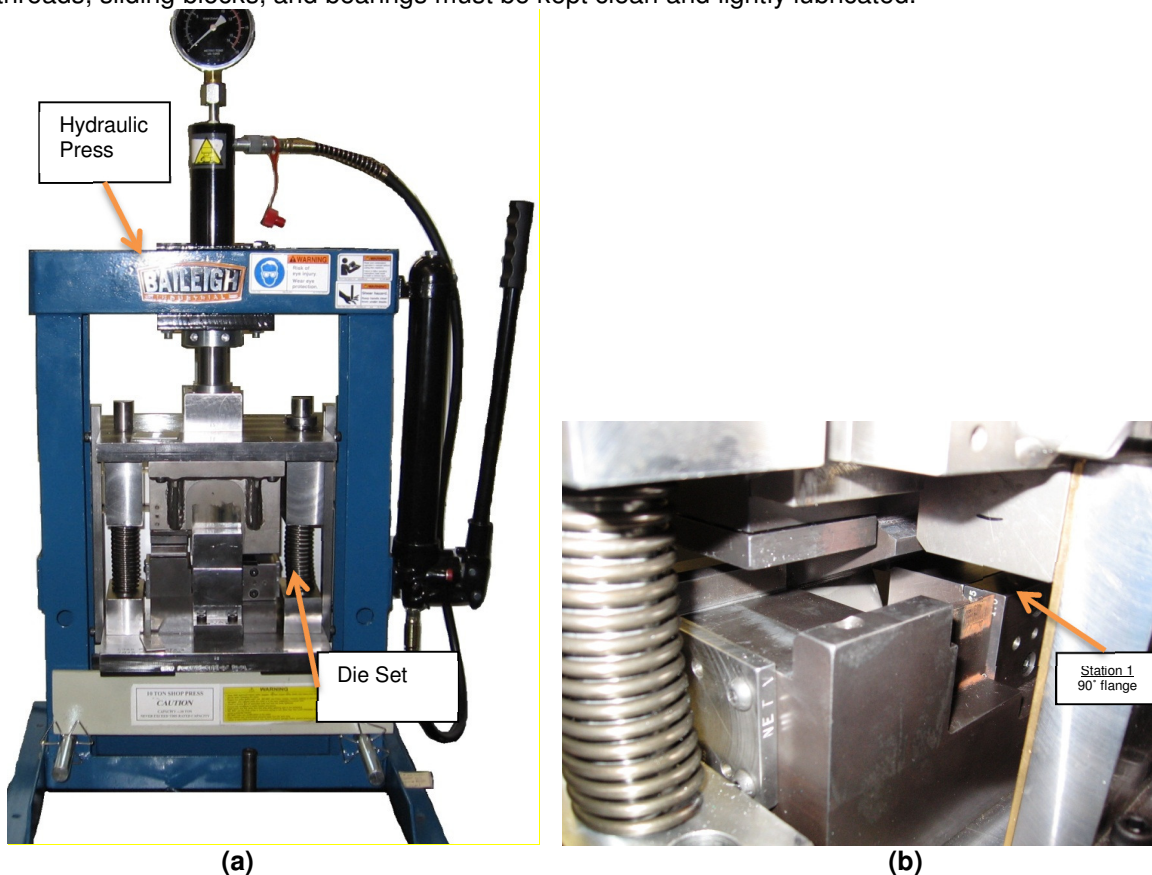


Figure 1. (a) Die set within a manual hydraulic press. (b) Flanging station lineup within die.

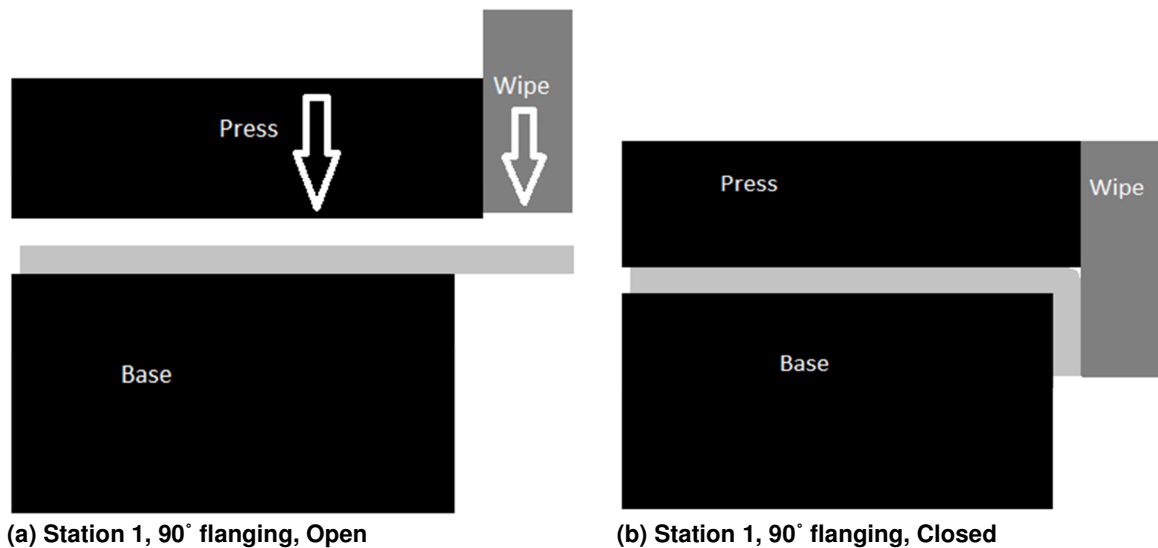


Figure 2. Open and close positions for flanging station.

Test Specimen Dimensions

Each flange specimen shall have dimensions of 73.5 ± 0.5 mm long by 25.5 ± 0.5 mm wide. Mark the rolling direction on each sheet in the flange. Longitudinal specimens are defined as having the length of the sheet parallel to the rolling direction (the bend line is perpendicular to the rolling direction). Transverse specimens are defined as having the length of the sheet perpendicular to the rolling direction (the bend line is parallel to the rolling direction). All specimens shall be flanged with the production intent lubricant and coating weight.

Dummy Specimen Dimensions

This test method may be done using the first (flanging) station of the three station hemming die described in FLTM BB 115-01. When flanging a coupon in the first station the tool may be balanced by placing a dummy specimen (or shim) in the third (flat hem) station. The thickness of the dummy specimen (or shim) shall be equal to twice the thickness sheet being flanged.

Test Specimen Preparation

The sheet for each specimen may be fabricated with a shear or by electrical discharge machining (EDM). The shear may cause a burr to form on the edge of the specimen that shall be filed down with medium grit sand paper for a smoother more uniform edge. Cracks observed within one thickness of the edge of the specimen are to be neglected in the bend surface rating analysis for both fabrication methods (shear or EDM).

Number of Test Specimens

No fewer than four (4) bend specimens per alloy be tested for each test condition.

Flanging Procedure

Test Conditions: Laboratory ambient conditions are assumed to be $23 \pm 2^\circ\text{C}$ and 50 ± 5 % Relative Humidity. Exceptions should be noted and reported.

1. Pre-strain sheet materials according following procedure in Appendix B.