GM WORLDWIDE ENGINEERING STANDARDS	Test Procedure	GMW16854

Cup Ductility Test for Sheet and Strip Metal

1 Introduction

Note: Nothing in this standard supercedes applicable laws and regulations.

Note: In the event of conflict between the English and domestic language, the English language shall take precedence.

1.1 Purpose. This standard covers the apparatus and procedure for a cup ductility test (22.2 mm (7/8 in) diameter ball type), applicable to metals in sheet and strip form. The test is used to provide information on the drawability of metals.

1.2 Applicability. This procedure is intended for use as part of the GM approval process for decorative and structural stainless steel sheet metal.

2 References

Note: Only the latest approved standards are applicable unless otherwise specified.

2.1 External Standards/Specifications.

ASTM E643

2.2 GM Standards/Specifications.

None

3 Resources

3.1 Facilities. Not applicable.

3.1.1 Calibration. The test facilities and equipment shall be in good working order and shall have a valid calibration label.

3.1.2 Alternatives. Alternative test facilities and equipment may also be used. However, all measuring variables as specified in this standard shall be determined correctly with respect to their physical definition.

3.2 Equipment.

3.2.1 The apparatus shall simulate a typical sheet metal forming press in which a cup-like impression is formed in sheet or strip metal by a male die pushing the metal into a female die or cavity while the metal is held under controlled conditions by grippers at the perimeter of the die cavity.

3.2.2 The apparatus shall be of the motor driven hydraulically actuated type.

3.2.3 The gripping dies shall consist of an upper and lower die, made of hardened steel, ground on significant surfaces. The outside diameter of both dies shall be no less than 90 mm and the inside diameter of the lower die shall be 25.4 mm. Interchangeable upper dies shall be as shown in Table 1.

Table 1: Sample Stock Thickness vs. Upper Gripping Die Diameter

Stock Thickness (mm)	Inner Diameter (ID) of Upper Die (mm)
Thru 1.6	25.4
Over 1.6 thru 3.2	28.6
Over 3.2 thru 4.0	31.8

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3.2.4 The radius on the inside diameter of the upper die gripping surface shall be maintained at 0.76 mm and smoothly polished.

3.2.5 The cupping tool shall be a finely polished 22.2 mm diameter hardened steel ball, free of surface pits, rust, etc.

3.2.6 The cup depth indicator shall be a standard dial indicator graduated in 0.025 mm increments and having a 25.4 mm travel.

3.2.7 The loading apparatus shall consist of a motor driven pump and hydraulic system with a large dial to indicate pounds load and an adjustable calibrated valve to control the speed of load applications.

3.2.8 The gripping mechanism shall be such as to prevent slippage of the specimen during the test.

3.2.9 A diagram of a suitable apparatus for this testing is shown in ASTM E643.

3.3 Test Vehicle/Test Piece. Not applicable.

3.4 Test Time. Test time may vary between suppliers.

3.5 Test Required Information. Not applicable.

3.6 Personnel/Skills. Not applicable.

4 Procedure

4.1 Preparation. The sheet specimen shall be no less than 90 mm in either dimension. It shall be free of burrs which might affect gripping of specimen. The specimen shall be wiped with a lightly oiled cloth to remove dirt and provide lubrication. Specimens having obvious defects should not be used.

4.2 Conditions.

4.2.1 Environmental Conditions. Testing shall be run at room temperature.

4.2.2 Test Conditions. Deviations from the requirements of this standard shall have been agreed upon. Such requirements shall be specified on component drawings, test certificates, reports, etc.

4.3 Instructions.

4.3.1 Speed of Testing. The speed of testing shall be 0.1 mm/s to 0.5 mm/s, except during the final 1.3 mm of travel where it shall be controlled to 0.10 mm/s maximum.

4.3.2 End Point. The end point of the test is the cup depth at the maximum load reached during the test. The depth indicator shall be read just as the load indicator hand starts to drop.

5 Data

5.1 Calculations. Not applicable.

5.2 Interpretation of Results. Not applicable.

5.3 Test Documentation. Not applicable.

6 Safety

This Engineering Standard may involve safety requirements for hazardous materials, the method of operations and equipment. This standard does not propose to address all the safety issues associated with its use. It is the responsibility of the user of this standard to ensure compliance with all appropriate safety and health practices. This would include any specific training that may be required. The safety and health standards include site specific rules and procedures, company rules and procedures, and Government Standards. Contact shall be made with the appropriate site Safety and Health personnel for further direction and guidance in these matters.

7 Notes

7.1 Glossary. Not applicable.

7.2 Acronyms, Abbreviations, and Symbols.

GSSLT Global Subsystem Leadership Team

ID Inner Diameter

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