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**Method for hemming test of high
strength aluminium alloy sheets for
automotive use**

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Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of Economy, Trade and Industry, through deliberations at the Japanese Industrial Standards Committee as the result of proposal of revision of Japanese Industrial Standard submitted by The Foundation of Osaka Science & Technology Center (OSTEC) /Japanese Standards Association(JSA) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law applicable to the case of revision by the provision of Article 14.

Consequently **JIS H 7701:2003** is replaced with this Standard.

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Method for hemming test of high strength aluminium alloy sheets for automotive use

1 Scope

This Japanese Industrial Standard specifies the test method for straight and curved hemming tests of high strength aluminium alloy sheets for automotive use of not less than 0.8 mm and not more than 1.2 mm thickness.

2 Terms and definitions

For the purpose of this Standard, the following terms and definitions apply.

NOTE : General terms regarding hemming and detrimental phenomena in hemming except the terms as defined in this clause are shown in Annex B.

2.1 test force

the force to be applied to a test piece at the time of bending for the purpose of the test

2.2 tensile pre-strain

the permanent elongation applied to a test piece, prior to hemming, indicated by the increment of gauge length converted to percentage (%)

2.3 hemming

bending process of the edge of an outer or inner sheet flange in order to join the outer and inner sheets into one piece

2.4 straight hemming

hemming in which the bent edge forms a straight line

2.5 curved hemming

hemming in which the bent edge forms a concave or convex with a certain curvature and which involves deformation caused by stretch or shrink flange

2.6 flanging

bending process to make a hem flange or standing flange prior to hemming

2.7 pre-hemming

bending the flange to the angle necessary for final hemming

It is also referred to as “pre-bending”.

2.8 final hemming

bending process to get the final shape after pre-hemming

3 Principle

A test piece which has been subjected to a specified tensile pre-strain is tested, by means of specified equipment, in each of the flanging, pre-hemming and final hemming processes to check if there is any fissure or other defects on the bend periphery of the test piece.

4 Types of tests

Types of tests are as follows.

- a) **Straight hemming test** Straight hemming test is applied, as a simplified test method, to the cases where asperity or fissures regarded as typical hemming limits depending mainly on the characteristics of the materials to be processed are checked.
- b) **Curved hemming test** Curved hemming test is applied to the cases where more practical hemming limits not only in the material characteristics but also in other aspects including deformation shapes, deformation conditions and working processes are checked.

5 Straight hemming test

5.1 Test equipment

5.1.1 Equipment for applying tensile pre-strain The equipment shall be capable of applying a specified tensile pre-strain to the test piece.

5.1.2 Dimension measuring instrument The instrument shall be capable of measuring the gauge length and its change to the nearest 0.1 mm.

5.1.3 Test tools The test tools shall be as follows.

- a) **Pre-hemming tool** The pre-hemming tool consists of a punch and dies as an example is shown in figure 1. The top end of the punch shall have a cylindrical surface of the curvature radius, r , of any of 0.5 mm, 1.0 mm or 2.5 mm. In the case of either 0.5 mm or 1.0 mm, the portion adjacent to the cylindrical surface of the top end should have a tapered shape as shown in figure 1b). The contact part of the dies to the test piece shall be cylindrical surface with a radius not less than 10 mm. The length of the top end of the punch and the cylindrical implosion of the dies shall be larger than the width of the test piece.

Unit : mm

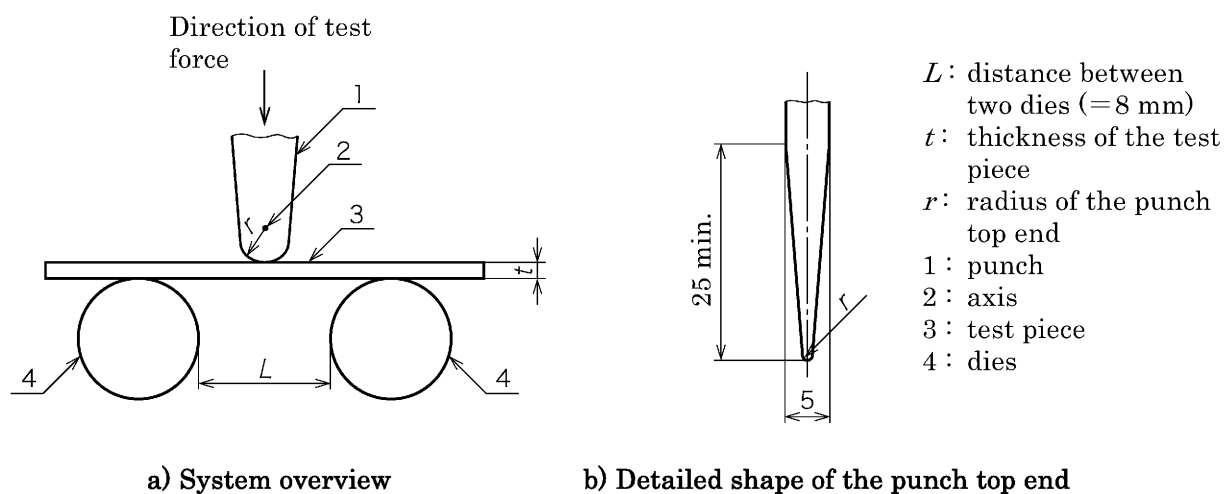


Figure 1 Example of pre-hemming tool for testing straight hemming

- b) **Final hemming tool** The final hemming tool consists of the dies as shown in figure 2. The middle plate material should be the same as that of the test piece and the thickness shall be agreed upon between the purchaser and the supplier.

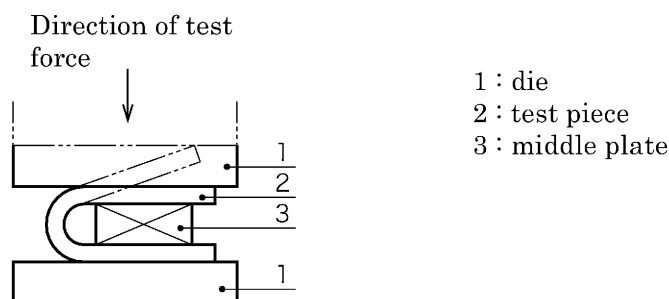


Figure 2 Example of final hemming tool for testing straight hemming

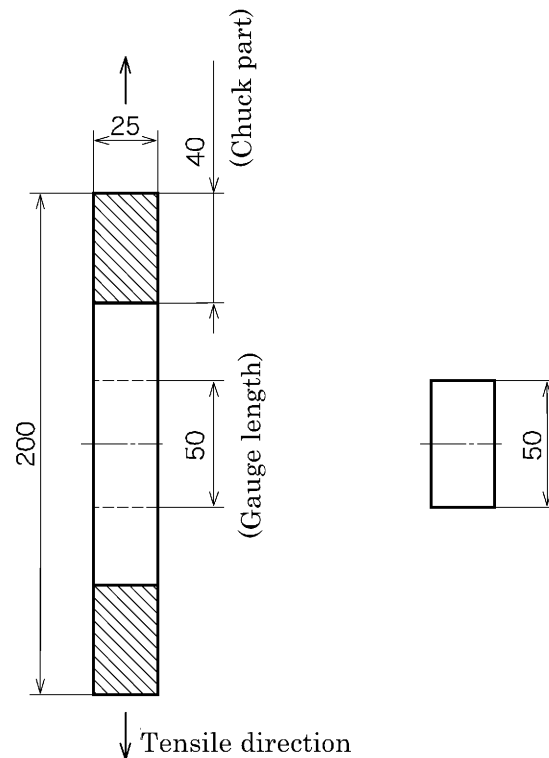
5.1.4 Test equipment for straight hemming The test equipment for straight hemming shall be capable of mounting the test tool (5.1.3) and applying the test force in the vertical direction. Generally, equipment such as a press machine shall be used.

5.2 Test piece

The test piece to be used for the test shall be as follows.

- a) The shape and dimensions of test piece shall be in accordance with figure 3. Figure 3 a) shows the test piece to be subjected to tensile pre-strain, and figure 3 b) shows the hemming test piece to be cut off from the centre of the test piece pre-strained in figure 3 a) to have a length of 50 mm.

Unit : mm



a) Tensile pre-strain test piece

b) Bending and hemming test piece

Figure 3 Straight hemming test piece

- b) The gauge length [see figure 3 a)] shall be 50 mm and the gauge mark shall usually be marked by using a marking pin. However, when the quality of test material is sensitive to the surface flaw, the gauge mark shall usually be marked on the coated paint by using a marking pin.
- c) The angle to the rolling direction in which the test piece is to be sampled shall be as agreed between the purchaser and the supplier.
- d) The cut surface of the test piece shall be left as it is. The test piece shall be free from unnecessary deformation or heating which may influence the test results.
- e) The surface of the test piece shall be free from detrimental defects such as scratch to influence the results.

5.3 Test

5.3.1 Test temperature

The test temperature shall be within the range between 10 °C and 35 °C.

5.3.2 Application of tensile pre-strain

The tensile pre-strain shall be applied to the test piece [figure 3 a)] by using a tensile tester until the tensile pre-strain reaches approximately 8 %. The tensile speed shall

be about 10 mm/min. After application of the strain, the gauge length shall be measured at least to the nearest 0.1 mm and the tensile pre-strain shall be calculated. The measurement of gauge length is normally made with the tensile force removed. If the gauge length measured with the tensile force applied can be converted to that with the tensile force removed, the pre-strain can be calculated from the converted value. When the tensile pre-strain obtained by calculation from the measured value is outside the range of $8 \% \pm 0.8 \%$, the used test piece shall be invalidated, and a new test piece [figure 3 a)] shall be subjected to tensile pre-strain.

5.3.3 Pre-hemming

A test piece [see figure 3 b)] that has been cut off from the test piece to which the tensile pre-strain was added in 5.3.2 shall be used for pre-hemming. In pre-hemming, the test piece shall be bent until the punch is lowered completely below the dies using the pre-hemming tool [5.1.3 a)] and the test equipment for straight hemming (5.1.4).

The punching speed in pre-hemming should be within the range between 10 mm/min and 100 mm/min.

5.3.4 Final hemming

The test piece that has been pre-hemmed in 5.3.3 shall be used for final hemming. In the final hemming, the test force is added to both ends of the test piece using the final hemming tool [5.1.3 b)] with a middle plate placed in between. The distance between the inner face of the bent test piece and the middle plate edge shall be 3 mm (see B.1.4, inner clearance). The test force shall be approximately 10 kN. As agreed between the purchaser and the supplier, instead of adding the test force, the thickness of the bent piece after the final hemming (die-to-die distance) may be within -10% of the total value of the two times test piece thickness and the middle plate thickness.

The hemming die speed shall be not more than 5 mm/min.

WARNING : Carry out the test securing safety.

6 Curved hemming test

6.1 Test equipment

6.1.1 Equipment for applying tensile pre-strain See 5.1.1 for the equipment for applying tensile pre-strain.

6.1.2 Dimension measuring instrument See 5.1.2 for the dimension measuring instrument.

6.1.3 Test tools The test tools shall be as follows.

- a) **Flanging tool** An example of the shape and dimensions of a flanging tool is shown in figure 4.
- b) **Pre-hemming tool** An example of the shape and dimensions of a pre-hemming tool is shown in figure 5.