

DYNAMIC ENERGY ABSORPTION OF POLYURETHANE FOAM
Application

This test method evaluates the dynamic energy absorption capability of polyurethane foam used to fabricate side impact bolsters for use in door trim panels.

Test Samples

The standard test sample is a 254.0 x 254.0 x 63.5 mm block of foam with a 5° draft angle as shown in Figure 1.

Apparatus Required
Impacting Assembly

Consisting of the following (see Figure 2):

Impactor

Type I or Type II Note: Use Type I impactor unless otherwise specified:

Type I: Half cylinder

An aluminum half cylinder of 6.35 mm wall thickness with an external diameter of 152.4 mm and an overall length of 330.2 mm mounted via aluminum extensions to a 12.7 mm thick aluminum plate of equal length and 196.85 mm wide. When affixed to and traveling with the impact carriage, the axis of the impactor half cylinder must be vertical when viewed from the front and from the side.

Type II: Flat Square

A flat aluminum plate 12.7 mm thick 165.1 mm long and 165.1 mm wide mounted via aluminum extensions to an aluminum plate 12.7 mm thick 330.2 mm long and 196.9 mm wide. When affixed to and traveling with the impact carriage, the impacting surface of the plate and its side edges must be vertical and the impacting surface of the plate must be perpendicular to the direction of carriage travel.

Impact Carriage

A moveable assembly which when combined with the impactor weighs 18.14 kg and is **capable** of being accelerated so as to attain a constant speed in free-flight of at least 35.4 km/h just prior to impact.

Date	Action	Revisions
2001 03 28	Revised	Editorial – no technical change A. Cockman
1996 10 22		

Printed copies are uncontrolled

Page 1 of 9

Copyright © 2001, Ford Global Technologies, Inc.

Contact Switch (bullet end)

An electrically isolated copper foil contact switch is applied to the surface of the impactor along the vertical centerline such that it comes into contact with its counterpart on the impacted assembly.

Impacted Assembly

Consisting of the following (see Figure 3):

Test Sample

When the sample as described above is secured according to the test procedure outlined below, it forms a part of the impacted assembly.

Sample Fixture

Fixturing the sample is accomplished using side supports which mount to the load cell. These supports hold the sample in position prior to testing and provide lateral constraint to the sample during impact. These constraints are evident in the detail of figure 3.

Load Cell

The load cell is mounted between the sample fixture and the rigid facility backplate. It must form the only path by which load transferred from the sample through the sample fixture during impact can reach the rigid facility backplate; and thus measure the entire load imparted to the sample at impact. Load cell specifications are detailed in the instrumentation section.

Rigid Facility Backplate

The rigid facility backplate must provide any horizontal and vertical adjustment necessary to position the sample fixture such that the line of travel of the mass center of the impacting assembly passes through the center of the test sample. Further the backplate must provide any rotational adjustment necessary to align the sample fixture so that the impacted surface of the constrained sample is perpendicular to the line of travel of the mass center of the impacting assembly when viewed from the side and from above.

LVDT's

The LVDT body(ies) is/are mounted to the rigid facility backplate. Its/their core(s) pass through the backplate, sample fixture, and sample itself. A nut-plate is threaded onto the end of each LVDT core and set flush with the sample surface to measure the crush deflection of the surface of the sample. LVDT specifications are detailed in the instrumentation section. (Note that the Type I cylindrical impactor uses two (2) LVDT's while the Type II flat impactor uses only one (1).)

Contact Switch (target end)

A piece of copper foil is applied to the end nut/plate of the lower LVDT core and set flush with the sample surface such that it will contact the foil on the impacting assembly at the time of crush initiation.

Instrumentation

Load Cell(s)

The load cell(s) must be capable of measuring force loading on three orthogonal axis and may additionally measure bending moments. Bending moments must, however, be cancelled from the measured forces.

A single load cell when used for material measurements must have a full scale of at least 44,480 N but not to exceed 88,960 N.

In order to maintain a sufficiently high system natural frequency, overall load cell stiffness in the X & Y directions should be 1.75×10^6 N/mm minimum and in the Z direction 4.38×10^6 N/mm minimum. Axis definitions may be found in Figure 4. A Denton Model No. 3102 satisfies these requirements and is shown in reference Figures 3 and 4.

LVDT's

Linearity:	< 0.25 % deviation from Best Fit Straight Line
Linear range:	101.6 +/- 12.7 mm
Frequency response:	1000 Hz minimum

Switches

Contact

The contact switch is comprised of two pieces of copper foil, one affixed to the impactor, the other to the impacted sample, which complete a circuit upon contact.

Motion initiation

This switch is a proximity type switch used to indicate the start of carriage motion and signaling the beginning of data collection.

Speed Trap

The speed trap must be capable of measuring carriage velocity just prior to impact to +/- 0.16 km/h.

Test Set-up

Assembly

The impacting and impacted assemblies as described above are assembled according to the assembly drawings of Figures 2 and 3.

- Figure 3 Shows LVDT placement for the **Type II, flat square impactor assembly**. One LVDT is used with its core rod extending through the **central hole** of the single load cell.
- The **Type I, cylindrical impactor assembly**, requires **2 - LVDT's** (see page 2) spaced apart vertically in the holes shown about the central LVDT position in Figure 3.

The test sample is left out of the impacted assembly until testing as described in the test procedure below. Figure 4 shows the assembled apparatus and details the alignment described below.