GALLAGHER
PRECISION POLYURETHANE MOLDING

3908 Morrison Drive ▪ Gurnee, IL 60031-1284
**Toll Free** 800-373-8793 ▪ **Phone** 847-249-3440 ▪ **Fax** 847-249-3473
www.gallaghercorp.com ▪ orders@gallaghercorp.com

*Great Products, On-Time*

## IMPACT RESISTANCE

Unusually high levels of stress and deformation can occur in structures, machinery and other equipment due to shock or impact loads. When one rigid member strikes another, stress levels spike because there is no gradual dissipation of the kinetic energy. When impact loading is repetitive, conditions of impact fatigue, wear and fretting may develop. Polyurethane elastomers can be used to substantially reduce high levels of stress and/or deformation that can occur with shock and impact loads. The polyurethane elastomer acts as a spring to gradually reduce the kinetic energy during impact.

The Izod Impact Method (ASTM D-256) is a standard test used to determine an elastomer’s resistance to impact loading. In the Izod test, a sample of material is held rigid and struck with a hammer on a swinging pendulum. The sample is placed at the lowest point of the arc traveled by the pendulum head. By measuring the difference in the distance of the upswing of the pendulum after the impact, compared to the same upswing with nothing in its path, determines the energy in breaking the sample which is the measure of impact strength.

Most of the polyurethane compounds used by the Gallagher Corporation flex and bend in this type of test. The table below shows a comparison of 73, Shore D polyurethane to Nylon, Acetal and Acrylic. The higher numbers for the polyurethane indicate that it is more impact resistant than the other materials in the table.

| **IMPACT RESISTANCE, IZOD, FT/IN (ASTM D-256)** | | | | | |
|---|---|---|---|---|---|
| | **Nylon** | **Acetal** | **Acrylic** | **GC1090** | **GC1090** |
| **Hardness (Rockwell or Durometer)** | Rockwell R108 | Rockwell R120 | Rockwell M103 | | Durometer 73D (Rockwell R90) |
| **Notched 75°F** | 2.0 | 1.4 | 0.3 | 4.0 | 15.0 |
| **Notched -40°F** | 0.5 | 1.2 | 0.3 | – | 1.1 |

For decades, Gallagher has been successful in supplying these types of shock absorbers to customers around the world to extend the life of their equipment. Below is an example of how the team at Gallagher would size a shock absorber for a given set of conditions. For more information or to talk about your specific application feel free to contact us and speak with one of our engineers.

### Impact Resistance Example Problem

An agricultural equipment company is experiencing failures in the field due to impact shock loading. A 500-pound grain container is striking the main frame of the equipment at a velocity of 3.5 feet per second. The design engineer has determined the hardened steel frame deflects 0.002 inches as a result of this impact.

a) The current impact shock load:

$$\textit{Kinetic Energy (KE)} = \frac{1}{2} \times mass \times velocity^2$$

$$KE = \frac{1}{2} \times \left( \frac{500\ lb}{32.2 \frac{ft}{sec^2}} \right) \times \left( 3.5 \frac{ft}{sec} \right)^2 = 95\ ft.\ lbs. = 1140\ in.\ lbs.$$

$$\textit{Force of Impact} = \frac{KE}{\frac{1}{2} \times Deflection}$$

$$\textit{Force of Impact} = \frac{11{,}400\ in.\ lbs.}{\frac{1}{2} \times 0.002\ in.} = 1{,}140{,}000\ lbs.$$

The design engineer for the agricultural equipment company would like to reduce the force of impact down to 15,000 lbs using a polyurethane bumper. How far will the bumper need to deflect to achieve this force reduction?

b) The polyurethane bumper deflection:

$$Deflection = \frac{KE}{\frac{1}{2} \times Force}$$

$$Deflection = \frac{1{,}140\ in.\ lbs.}{\frac{1}{2} \times 15{,}000\ lbs.} = 0.150\ in.$$