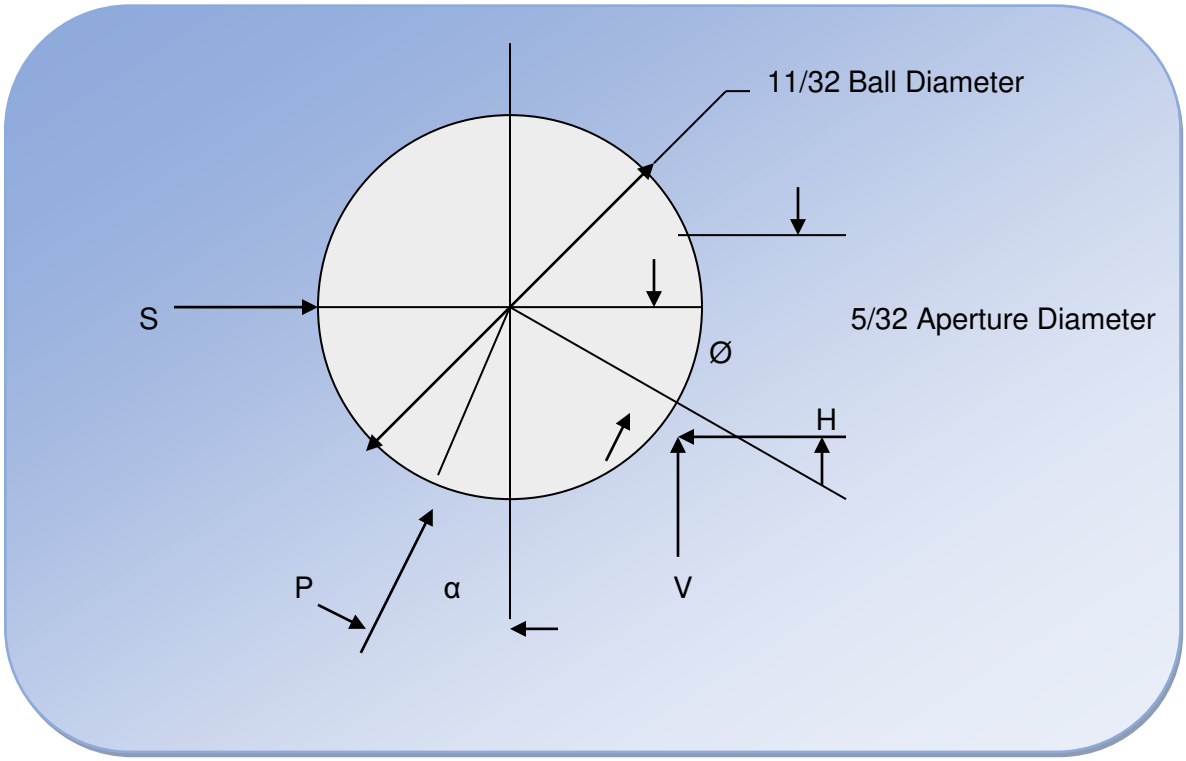
WHY OMNI-G INDICATES FROM ALL DIRECTIONS

A shock vector of pre-calibrated magnitude perpendicular to a spring-ball axis causes the balls to dislodge. Obviously, a vector parallel to the cylindrical axis of the OMNI-G housing would be perpendicular to both spring-ball assemblies and both assemblies would dislodge. Vectors perpendicular to the housing axis can occur at any angle up to 45 degrees from being perpendicular to either spring-ball assembly. Thus it must be proved that the balls will dislodge from any shock vector of pre-calibrated magnitude up to 45 degrees from perpendicular to the spring axis in order to provide the omni-directional sensitivity of the instrument.

In the diagram, **S** represents the spring force holding the balls against their seats and **P** represents the applied shock vector at angle α from perpendicular to the spring. The condition for dislodging balls occurs when the seat is relieved of reacting the spring force to the extent that the only force exerted by the aperture is a reaction at one point on the circle of normal contact. This reaction, directed to the center of the ball, would be in equilibrium with **P** and **S**. In effect, the applied shock vector **P** is causing the ball to roll out of its seat, and the ball must bear at one point on the seat to do this. **H** and **V** are the components of this point reaction respectively parallel and perpendicular to the spring.



For equilibrium, the sum of forces parallel and perpendicular to the spring must balance. Hence, the following equations:

$$S - P \sin = H \quad (1)$$
$$P \cos = V \quad (2)$$

Angle Ø is known and related only to the ball and seat aperture diameters -

$$\sin Ø = \frac{\text{Aperture dia.}}{\text{Ball dia.}}$$

$$= \frac{5/32}{11/32}$$

$$= .454$$

$$Ø = 27º$$

$$\frac{V}{H} = \tan Ø = .510 \quad (3)$$

From (1), (2), and (3)

$$\frac{P \cos}{S - P \sin} = .510 \quad (4)$$

Solving (4) for P

$$P - \frac{.510\ S}{\cos + .510 \sin}$$

Investigating the range of variation of **P** for all values of up to 45 degrees we find:

P max = .510 S at = 0º
P min + .454 S at = 0 = 27º

The total variation from .454 to .510 is 12.3 percent. The units are calibrated close to the mean of this range so that the theoretical responding accuracy should be within plus or minus 6.15 percent for any angle of the applied shock vector.

The claimed accuracy (±10%) allows generously for any slight differences between the theoretical and actual.