**TAB 4 - DESIGNING WITH**

**Important Notes**

1. Select the proper threaded insert for your base material and installation method.
2. Design the assembly
3. Specify the proper hole configuration for the threaded insert.
4. Verify the required performance before entering production.

*Note that performance and installation characteristics will vary depending upon the specific base material used, actual hole dimensions, and installation parameters. Preproduction prototype testing is strongly recommended to evaluate your specific application.*

Threaded inserts are designed to create greater clamping pressure between a base material and a mating component using a standard machine screw. To better use the load-bearing capacity of high-tensile-strength machine screws, designing for threaded insert performance involves three considerations:

- Proper specification of mating components to avoid unnecessary forces between the threaded insert and the base material
- Sufficient base material wall thickness to support the threaded insert
- Proper hole dimensions

The performance of threaded inserts is usually measured in terms of the axial or torsional forces required to shear the threaded insert from the base material. **Pull-Out Resistance** is the axial force required to pull the insert free of the base material, and **Torque Resistance** is the axial torque required to twist the threaded insert free of the base material. See fig. 5a and 5b.

Proper design for threaded inserts involves creating axial clamping forces on the threaded insert while minimizing excessive torques and jacking forces. See fig. 5c.

**Boss Diameter**
To properly support the threaded insert, there must be sufficient material around the threaded insert. This is usually specified in terms of a minimum wall thickness or minimum boss diameter. When considering inserts installed near the edge of a part, minimum wall thickness is defined as the minimum thickness of base material around the drilled or molded hole for the threaded insert. In soft metal base materials, the minimum wall thickness should be 25% to 50% of the threaded insert diameter. In plastics, the minimum wall thickness should be increased to be 50% to 100% of the threaded insert diameter. When considering circular bosses, the minimum boss diameter should be the diameter of the threaded insert plus two times the minimum wall thickness (fig. 7).

**Hole Configuration**
Hole configuration, hole diameter, and hole depth can have a significant impact on threaded insert performance and installation. Recommended hole configuration and dimensions are included with the insert specifications which follow. However, there are some useful general guidelines to follow. Groov-Pin recommends one of three hole configurations depending upon insert type:

- For softer metals and brittle plastics, a straight hole with up to 1-degree taper and counterbore or countersink (fig. 8a).
- For plastics, a straight hole with taper up to 3-degrees and no counterbore or countersink (fig. 8b).

- For plastics, a hole with a taper of 8-degrees and no counterbore or countersink (fig. 8c).

**Hole Diameter**
Recommended hole diameters are included with the insert specifications which follow. Counterbore dimensions are included where appropriate. Note that actual hole dimensions are specified and not core-pin or drill sizes.

When evaluating insert performance, hole diameter may be adjusted to optimize threaded insert installation and performance. Although the inserts are designed to operate over a range of hole sizes, smaller hole sizes yield higher pull-out resistance in softer materials and larger hole sizes provide easier installation in more brittle or higher-tensile-strength materials.

When considering bosses in a plastic part, stepped holes may be specified to minimize undesirable sink marks (fig. 7). Limit the maximum diameter of the stepped hole to 80% of the diameter of a straight hole (fig. 8a,b) or to the minor diameter of a tapered hole (fig. 8c).

**Measure of Performance**

| | | |
|---|---|---|
| **FIG. 5A**<br>**Pull-Out Resistance**<br>*Axial force applied to mating fastener which causes threaded insert to shear from base material.* | **FIG. 5B**<br>**Torque Resistance**<br>*Excessive torque applied via mating fastener which causes threaded insert to twist in base material.* | **FIG. 5C**<br>**Jack-Out Resistance**<br>*Indirect measure of pull-out resistance. Torque applied via mating fastener through stepped washer which causes threaded insert to "jack" or shear from base material.* |

**Design of Mating Components**
The threaded insert should be installed perpendicular to the surface of the base material so that the forces on the insert are axial. Mating components should be mounted flush to the surface of the base material to minimize the effects of uneven or rotational forces. To minimize jacking forces, holes in mating components for fasteners should be large enough for the fastener to not contact the base material when fully installed. See fig. 6.

**FIG. 6**

| **DO** | **DON'T** |
|---|---|
| Mount threaded insert perpendicular to surface.<br><br>Flush mount mating components.<br><br>Specify access holes for fasteners smaller than the insert diameter.<br><br>Specify proper length fastener to avoid contact with loose material. | Create unnecessary forces between mating part and insert.<br><br>Create jacking forces with access holes larger than insert diameter.<br><br>Create jacking forces with mating fasteners. |

**Hole Depth**

Hole depth for blind holes should be at least the depth of the threaded insert plus two pitches of the internal thread (fig. 5c). This will allow full engagement of the mating fastener and avoid fouling of the internal thread by base material during installation. A hole depth of 1.2 times the insert length is recommended. For through holes, the material thickness should be greater than the length of the threaded insert.

**FIG. 7**

*Minimum wall thickness (W) and minimum boss diameter (BD) are important parameters for performance of threaded inserts. They are also key factors in avoiding bulges or sink marks on the outside surface of the component. Minimum boss diameter is twice the minimum wall thickness plus the maximum diameter of the threaded insert.*

**Three Hole Configurations**

| | | |
|---|---|---|
| **FIG. 8A**<br>**Straight Hole with Counterbore**<br>*Straight hole with taper up to 1-degree of diameter H and minimum depth of 1.2 times insert length L. Counterbore of diameter equal to insert diameter D and depth C. Alternatively, a countersink of diameter D with 60-degree included angle may be specified for metals. Minimum wall thickness W.* | **FIG. 8B**<br>**Straight Hole with No Counterbore**<br>*Straight hole with taper up to 3-degrees of diameter H and minimum depth 1.2 times insert length L. Minimum wall thickness W. No counterbore or countersink.* | **FIG. 8C**<br>**Tapered Hole**<br>*Tapered hole with 8-degree taper of major diameter H1 and minor diameter H2 with minimum depth L2 equal to insert length L plus .030 inch.* |