

**RECOMMENDED
PRACTICE SAE J610b**

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BY AMERICAN NATIONAL
STANDARDS INSTITUTE

**VALVE SEAT
INSERTS—ENGINE—SAE J610b**

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Definition—Valve seat inserts are defined as metallic rings which are installed in heads or blocks to provide a mating surface for the valve.

Scope—This SAE recommended practice on seat inserts is presented to provide engineers, designers, and metallurgists with the following information:

1. A general description of seat insert design and why they are required.
2. Recommended press fits, installation procedures, and standards for inserts and counterbores.
3. A general classification of seat inserts by type, material, and use.
4. Chemical and mechanical properties of typical insert materials.

Scope—In certain engine applications, to achieve a satisfactory endurance level, seat inserts are required. Combustion deposits, coupled with high temperature and corrosion necessitate the use of seat inserts in order to maintain a good seating surface and, thereby, extend valve life.

Seat inserts offer some property not satisfied by conventional structural casting materials such as resistance to pound-in, hot hardness, abrasion, or corrosion resistance.

The field maintenance of cylinder heads and blocks is simplified by the use of seat inserts. Some original equipment heads or blocks are counterbored and fitted with seat inserts to provide a ready fix for field seat deterioration, without the use of specialized tooling.

Installation Procedure, Press Fits, Insert and Counterbore Standards

Installation Procedures—Installation of valve seat inserts requires the use of a tool which will assure proper location and squareness of the insert with the counterbore. The tool may pilot in the valve guide, centering the insert by means of a short pilot, smaller in diameter than the insert inside diameter, and providing a square shoulder through which load is applied to drive the insert. Inserts are installed by pressing into location.

A common practice is to chill the inserts prior to installation. The decreased amount of press fit obtained reduces the tendency to shear the wall of the counterbore, and permits installation with the design press fit. Comparable results can be obtained by heating the cylinder head or block rather than chilling the inserts. In some instances, successful installations are made with both block/heads and inserts at room temperature.

Recommended Press Fits—The press fit required to retain an insert should be established, based on the expansion rate of the insert and head or block materials and the operating temperature differential present.

Lacking this information, a nominal press fit of 0.003 in on the diameter is recommended. Experience has shown this fit is useful in cast iron and aluminum for normal applications.

Different insert materials may be required in aluminum cylinder heads as compared to cast iron, due either to differences in insert maximum temperatures or the engine application.

Excessive press fits raise the compressive stress level in the insert. When the stress incurred exceeds the elastic limit of the material, plastic flow occurs, and the insert is loosened in its counterbore.

Insufficient press fits result in low compressive stress levels. Following a rapid engine shutdown, the insert is air quenched, shrinkage occurs, and the press fit is lost.

General Standards for Commercial Seat Inserts—Standards applicable to commercial quality seat inserts are detailed in Fig. 1.

Insert Counterbore Standards—Insert counterbore standards to be used in conjunction with commercial seat inserts are shown in Fig. 2.

Insert Types, Materials, Use

Insert Types—The most common insert type consists of a thin wall, short height cylindrical section. This type is used universally in all engine sizes. Typical inserts are shown in Figs. 3 and 4.

The thin wall section exposes a minimum surface to the combustion chamber, limiting the heat input to the insert. With the height-width ratio shown, good heat transfer occurs through the insert. The height specified presents an adequate cylindrical surface, in contact with the counterbore, to support a nominal compressive stress level.

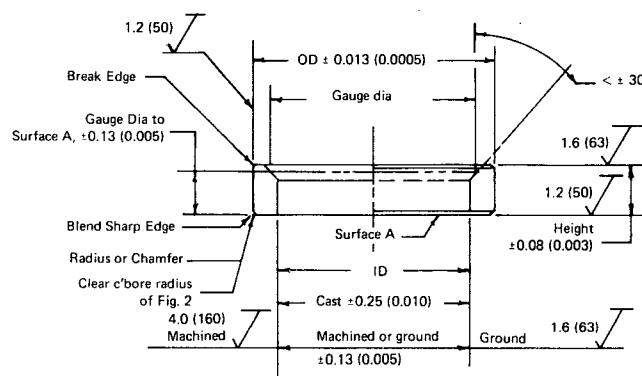
In some air cooled engines flexible seat inserts, Fig. 4, are used. The clearance area, between the insert major diameter and the cylinder head, permits movement of the cylinder head deck, without upsetting the seating surface. The deep skirt press fit into an area of reduced temperature is effective in cooling the insert and retaining it.

Other specialized insert types are used in a limited number of applications.

Insert Materials and Use—A wide range in materials is utilized for seat inserts. The final material selection will be influenced by the type of engine (gasoline, diesel, dry gas), size, output, and particular field application.

Seat insert materials can be broadly classified under the following groups:

1. Plain Cast Irons—Plain cast irons are made with the normal elements, iron, carbon, silicon, phosphorus, and sulfur. Negligible additions of other



Dimensions are mm (in); roughness, AA μm (μin)

OD to be square with surface A within 0.005 mm per mm or in per in of height.

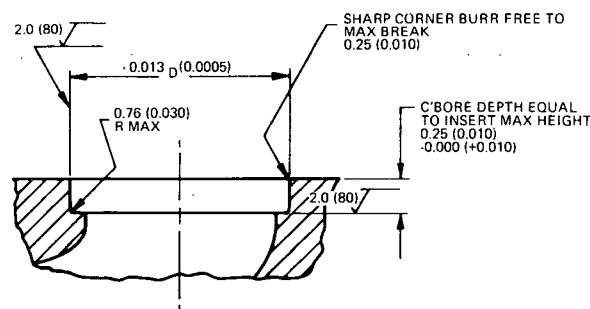
Planes of surface A and opposite surface to be parallel within 0.05 (0.002) TIR.

ID and OD to be concentric within 0.13 (0.005) TIR if machined or within 0.25 (0.010) TIR as cast.

Seat to be concentric with OD within 0.13 (0.005) TIR.

These standards apply up to 76.2 (3.0) max OD finished ready for installation.

FIG. 1—COMMERCIAL SEAT INSERTS



DIMENSIONS ARE mm (in); ROUGHNESS μm (μin)
C'BORE TO BE CONCENTRIC WITH GUIDE HOLE WITHIN 0.08 (0.003) TIR
BOTTOM OF C'BORE TO BE PERPENDICULAR TO GUIDE CENTERLINE WITHIN 0.05 (0.002) TIR
ADJUST D DIAMETER TO CLOSEST WHOLE mm (or 1/32 in STANDARD FRACTIONAL DIMENSION)

FIG. 2—INSERT COUNTERBORES

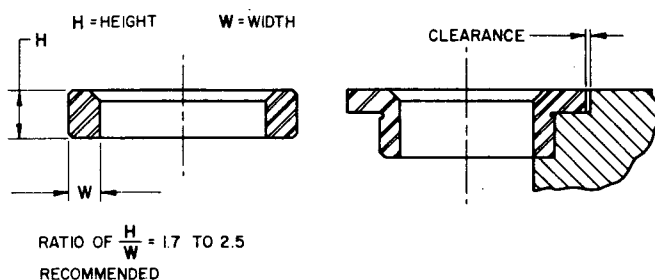


FIG. 3—CONVENTIONAL TYPE INSERT

FIG. 4—FLEXIBLE TYPE INSERT

elements such as chromium, nickel, manganese, and molybdenum, sometimes are specified.

Plain cast irons vary as a function of alloy content, casting technique, section size, and heat treatment, and have a broad range in chemical and mechanical properties.

2. Alloy Cast Irons—Alloy cast irons are classified as plain cast irons with higher additions of certain elements such as chromium, nickel, molybdenum,