

Shrink Fitting Tool and Die Inserts

A shrink fit holds an insert in its retainer by interference, and the interference puts the insert into radial compression that works against the tensile stresses which crack it. The tables below give the interference band a die application is built on, and the hardness, dimensions and contact requirements each half of the joint is held to.

Reference only. This is a reference summary of published practice and it is not a specification of ours. The interference values and the design points are reproduced from Tool and Die Making Troubleshooter, and the fit actually required depends on the section, the materials and the load in the die. Working stresses and shrinkage stresses have to be checked against the strength of both parts. Final dimensions are confirmed on the drawing.

What the fit does for an insert

Interference, the number the fit is built on

Interference, in./in. (mm/mm)	What it produces in the assembly	How it behaves in service
Under 0.001	Little radial compressive stress on the insert	Too loose to help. The fit does not put the insert into compression, so it does nothing about the tensile stresses that crack an insert in a die application.
0.003 to 0.004	High joint strength, with radial pressure set up on the mating surfaces	The working band. The retainer carries tensile stress and the insert carries compressive stress, and the compression is what suppresses chipping and cracking.
0.006 or more	Radial pressure beyond what the pair was sized for	Excessive interference. Working stresses plus the shrinkage stresses can pass the strength of the insert or the retainer and produce a failure by stress overload.

The interference range recommended for shrink fitting tools and dies into retainers, from the shrink fitting section of Tool and Die Making Troubleshooter.

The design points that decide whether the fit holds

Design point	The rule	Why it is in the list
Retainer material	An alloy steel capable of hardening to 32 to 43 HRC	The retainer is the part in tension, so it has to be strong enough to hold the fit without yielding.
Heavy duty retainers	Shock resisting tool steel heat treated to 48 to 52 HRC	Where the die takes impact as well as the fit load, a tougher retainer material is specified in place of the general alloy steel.
Stress balance	Working stresses plus shrinkage stresses must stay inside the strength of both parts	The fit adds stress to a tool that will already see service stress. The two add together.
Retainer outside diameter	At least twice and preferably three times the inside diameter	The wall around the insert has to carry the hoop stress from the interference without distorting.
Taper	A tapered design is not used on either the insert or the retainer	A tapered seat cannot hold even contact around the circumference, and the pressure concentrates where the fit is tightest.
Corners and edges	Chamfer corners and edges and provide generous fillets	The same stress raisers that crack a die in heat treatment are present in the retainer.
Mating surfaces	Ground to a smooth finish of approximately 5 to 25 microinches (0.13 to 0.64 micrometres)	Contact has to be continuous around the joint for the radial pressure to develop as designed.
Machining tolerance	Grind to within 0.0005 in. (0.013 mm) of the required dimension	The interference is the difference between two diameters, so both of them are held to a fraction of the interference itself.
Assembly clearance	Provide the clearance needed in the expanded or the contracted state	The parts have to go together while one is hot or one is cold, and a fit that only assembles with force is a fit that has already been damaged.

Design and preparation points for shrink fitting a tool or die component into its retainer, from the shrink fitting section of Tool and Die Making Troubleshooter.

Assembly, by heat, by cold, or both

Where a shrink fit goes wrong

Where to go next

Aobo Steel, tool steel supplier

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