LIMITS and FITS

By GEOMETER

EMPLOYING an established system of limits and fits removes a great deal of uncertainty from machining and fitting. There is no doubt about results; dimensions can be written condensed as ordinary fractions; and when one is used to ordinary fractions, a good " picture " is retained of dimensions.

Two systems are the Newall and the BS. The latter is the better for wide application, but the Newall is strongly recommended to model engineers for simplicity and meeting general requirements.

An example will show how easy it is. A force fit is required between a 3/8 in. hole and shaft. One writes, 3/8in. Newall A hole, 3/8 in. Newall ***F*** shaft. The picture is retained of 3/8 in. (0.375 in on the micrometer); and looking in a table of Newall limits for the size, an A hole is found to be plus or minus 1/4 thou, while an ***F*** shaft is plus 1/2 thou to plus 1 thou.

For a running fit, the hole can be left the same, and a Z shaft, say, specified with limits of minus 1/2 thou to minus 3/4 thou.

Without such a system, considerable practical experience is needed in deciding dimensions for fits; and these require figures which can look forbidding and destroy the simple picture.

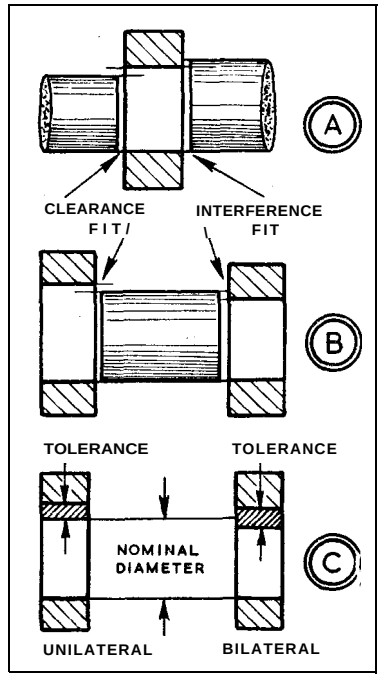
Basic **rule**

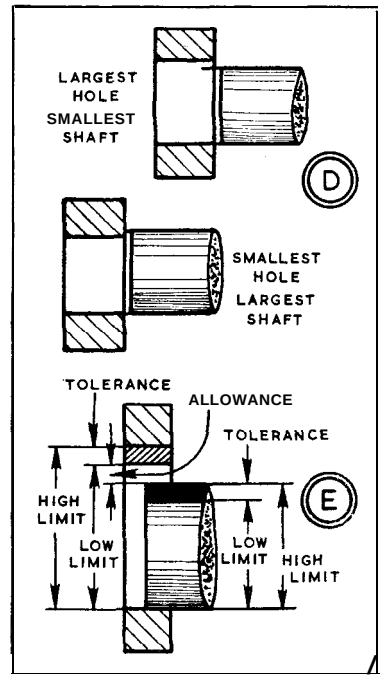
Systems of limits and fits are arrived at logically, and terms employed are universally accepted-though not infrequently misused. To get a force fit or a running fit, like those quoted, either the hole or the shaft must vary. In this instance, the shaft varies, and the system is " hole " basis, as at A. If the opposite were the method and the hole changed size, the system would be " shaft " basis, as at B. But with this, more " fixed " size tools like reamers, broaches and gauges would be needed, whereas shafts can easily be varied on lathes and grinders and checked by micrometers.

Hole basis being logically decided, hole sizes can vary through their tolerance, as at C, all above the nominal diameter (unilateral), or about the nominal diameter (bilateral). The BS system has both types of holes; but Newall holes are bilateral holes. Thus, one can legitimately use a new reamer cutting above nominal diameter and an old sharpened one cutting under nominal diameter, each within the tolerance. For unilateral holes, however, strict usefulness ends at the nominal diameter.

While fits have several descriptions there are only two basic ones: clearance and interference. The Newall Limits keep these separate; but making a choice from BS tolerances, it must be such as to avoid the contingency at ***D,*** the "transition" fit, which is clearance at one extreme, interference at the other.

Correct descriptions for dimensions are as at ***E.*** Each hole and shaft has a high and a low limit, and the difference between these is the tolerance-the variation that can be "tolerated." The allowance is the minimum possible difference between holes and shafts at their appropriate limits, increasing for both clearance and interference fits. Working midway in the tolerance, of course, gives best average results for all fits.





Running fits

In the Newall system, the following apply for diameters up to and including 1/2 in. A holes plus or minus 1/4 thou. ***B*** holes plus or minus 1/2 thou. F shafts (force tits) plus 1/2 thou to plus 1 thou. ***D*** shafts (driving fits) plus 1/4 thou to plus 1/2 thou. ***P*** shafts (push fits) minus 1/4thou to minus 3/4 thou. There are three running fits. X shafts (easy running fits for engine work) minus 1 thou to minus 2 thou. Y shafts (for. high speeds and good average machine work) minus 3/4 thou to minus 1-1/4 thou. Z shafts (for fine tool work) minus 1/2 thou to minus 3/4 thou.

Above 1/2 in. up to and including 1 in. the following apply. A holes plus 1/2 thou minus 1/4 thou. ***B*** holes plus 3/4 thou minus 1/2 thou. ***F*** shafts plus 1-1/2 thou to plus 2 thou.***D*** shafts plus 3/4 thou to plus 1 thou. ***P*** shafts minus 1/4 thou to minus 3/4 thou. X shafts minus l-1/4thou to minus 2-3/4 thou. Y shafts minus 1 thou to minus 2 thou. Z shafts minus 3/4 thou to minus 1-1/4 thou.