Twenty-Eighth Edition

Machinery's Handbook

Industrial Press

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A REFERENCE BOOK
FOR THE MECHANICAL ENGINEER, DESIGNER,
MANUFACTURING ENGINEER, DRAFTSMAN,
TOOLMAKER, AND MACHINIST

Machinery's Handbook

28th Edition

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P = the infeed method adjustment – positive (not available on all controls)
F = the feed rate (thread lead)

Two Block Cycle: The two-block G76 format includes several additional programmable features that make the cycle more flexible. For a two-block G76 cycle, the format is:

N__ G76 P__ Q__ R__
N__ G76 X__ Z__ R__ P__ Q__ F__

Where the first block:
P = a six-digit data entry in three pairs:

Digits 1 and 2 – number of finishing cuts (01-99)
Digits 3 and 4 – number of leads for gradual pull-out (0.0-9.9 times lead), no decimal point used (00-99)
Digits 5 and 6 – angle of thread (00, 29, 30, 55, 60, 80 degrees only)

Q = the minimum cutting depth (positive radial value - no decimal point)
R = the fixed amount for finish allowance (decimal point allowed)

Where the second block:
X = the diameter of the last threading pass
Z = the end of thread along the Z axis
R = the amount of taper over the total length (per side)
P = the single depth of the thread (positive radial value - no decimal point)
Q = the depth of the first threading pass (positive radial value - no decimal point)
F = the feed rate (thread lead)

The P/Q/R addresses of the first block are not related to the P/Q/R addresses of the second block. They have their own meaning, applied within each block only.

The G76 threading cycle is used to program the majority of CNC thread cutting operations. Several of parameters of the G76 cycle can be changed at the machine to optimize the threading operation.

Example: The code block for cutting an external thread on 2 inch diameter, 12 threads per inch, using tool number 6 to the length of 1.5 inches (thread ends in a recess) would be:

N31 T0600; N32 G97 S800 M03; N33 G00 X2.2 Z0.3 T0606 M08 (START POINT FOR THE THREAD); N34 G76 P010060 Q0040 R0.002; N35 G76 X1.8978 Z–1.5 R0 P0511 Q0100 F0.083333; N36 G00 X8.0 Z5.0 T0600; N37 M01;

Multi-start Threads.—Threads with more than one start can be programmed using either G32 or G76 threading commands. The lead (and feed rate) for multi-start threads is always the number of starts times the pitch. For example, a triple start thread with the pitch of 0.0625 (16 TPI) will be 0.1875 (F0.1875). In order to achieve proper distribution of each start around the cylinder, each thread has to start at an equal angle, determined by the following calculation:

Thread cylindrical spacing angle = 360 / Number of starts

To achieve this angular spacing, the Z-axis point for each start must be one pitch further than the previous start:

Shift amount = Pitch
Number of shifts = Number of starts – 1

Subprograms, Macros and Parametric Programming

CNC programs use several techniques to allow the programmer to create complex pieces of code using CNC code building blocks.

Subprograms.—*Subprograms* (also known as subroutines), are specially designed programs that can be called on demand by another program and repeated as desired. Such rep-

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ACME SCREW THREADS

American National Standard Acme Screw Threads

This American National Standard ASME/ANSI B1.5-1997 is a revision of American Standard ANSI B1.5-1988 and provides for two general applications of Acme threads, namely, General Purpose and Centralizing.

The limits and tolerances in this standard relate to single-start Acme threads, and may be used, if considered suitable, for multi-start Acme threads, which provide fast relative traversing motion when this is necessary. For information on additional allowances for multi-start Acme threads, see later section on page 1828.

General Purpose Acme Threads.—Three classes of General Purpose threads, 2G, 3G, and 4G, are provided in the standard, each having clearance on all diameters for free movement, and may be used in assemblies with the internal thread rigidly fixed and movement of the external thread in a direction perpendicular to its axis limited by its bearing or bearings. It is suggested that external and internal threads of the same class be used together for general purpose assemblies, Class 2G being the preferred choice. If less backlash or end play is desired, Classes 3G and 4G are provided. Class 5G is not recommended for new designs.

Thread Form: The accompanying Fig. 1 shows the thread form of these General Purpose threads, and the formulas accompanying the figure determine their basic dimensions. Table 1 gives the basic dimensions for the most generally used pitches.

Angle of Thread: The angle between the sides of the thread, measured in an axial plane, is 29 degrees. The line bisecting this 29-degree angle shall be perpendicular to the axis of the screw thread.

Thread Series: A series of diameters and associated pitches is recommended in the Standard as preferred. These diameters and pitches have been chosen to meet present needs with the fewest number of items in order to reduce to a minimum the inventory of both tools and gages. This series of diameters and associated pitches is given in Table 3.

Chamfers and Fillets: General Purpose external threads may have the crest corner chamfered to an angle of 45 degrees with the axis to a maximum width of $P/15$, where P is the pitch. This corresponds to a maximum depth of chamfer flat of $0.0945P$.

Basic Diameters: The max major diameter of the external thread is basic and is the nominal major diameter for all classes. The min pitch diameter of the internal thread is basic and is equal to the basic major diameter minus the basic height of the thread, h. The basic minor diameter is the min minor diameter of the internal thread. It is equal to the basic major diameter minus twice the basic thread height, $2h$.

Length of Engagement: The tolerances specified in this standard are applicable to lengths of engagement not exceeding twice the nominal major diameter.

Major and Minor Diameter Allowances: A minimum diametral clearance is provided at the minor diameter of all external threads by establishing the maximum minor diameter 0.020 inch below the basic minor diameter of the nut for pitches of 10 threads per inch and coarser, and 0.10 inch for finer pitches. A minimum diametral clearance at the major diameter is obtained by establishing the minimum major diameter of the internal thread 0.020 inch above the basic major diameter of the screw for pitches of 10 threads per inch and coarser, and 0.010 inch for finer pitches.

Major and Minor Diameter Tolerances: The tolerance on the external thread major diameter is $0.05P$, where P is the pitch, with a minimum of 0.005 inch. The tolerance on the internal thread major diameter is 0.020 inch for 10 threads per inch and coarser and 0.010 for finer pitches. The tolerance on the external thread minor diameter is $1.5 \times$ pitch diameter tolerance. The tolerance on the internal thread minor diameter is $0.05P$ with a minimum of 0.005 inch.

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