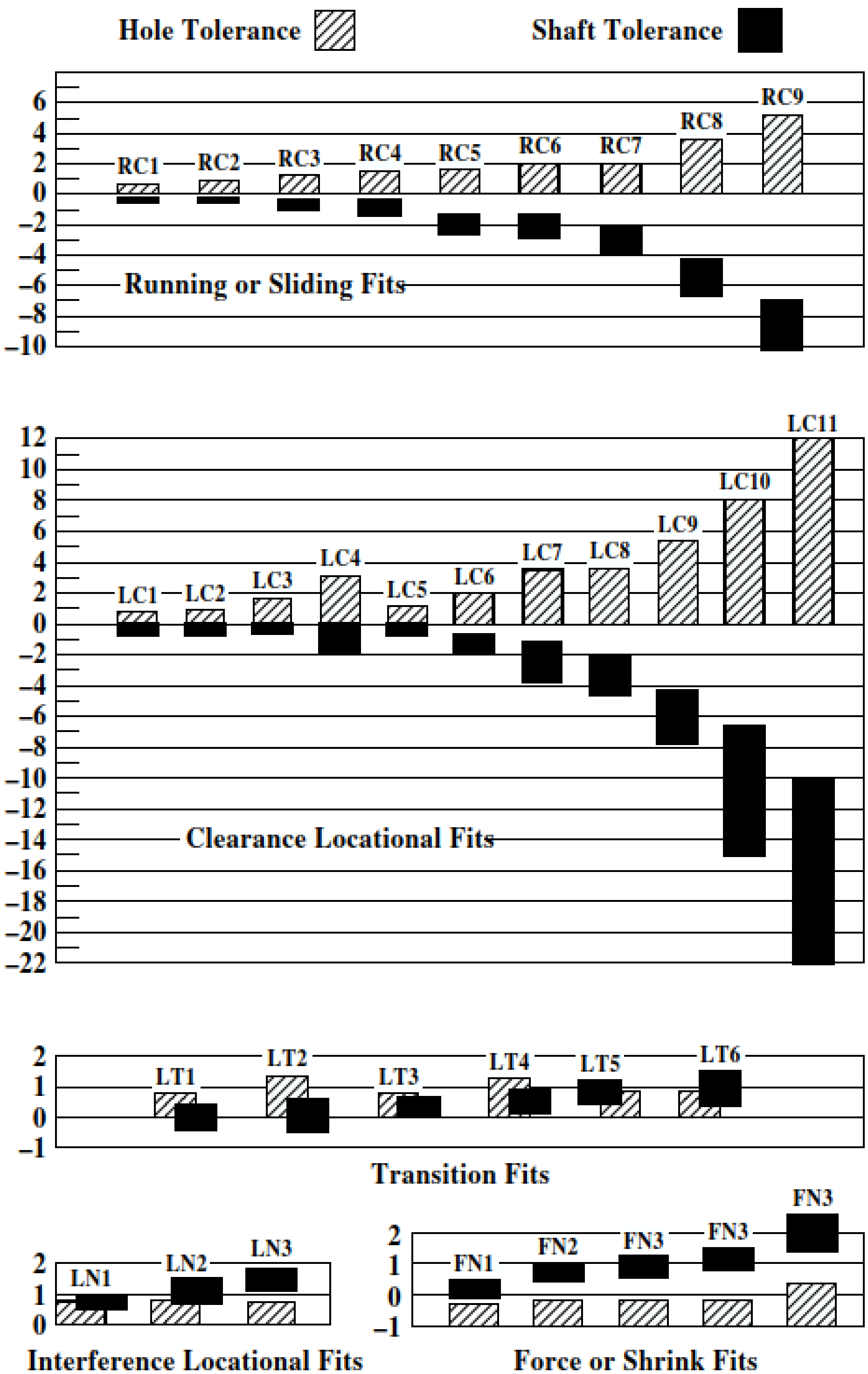
# Fit Tolerances

This document covers fit types and tolerances for American National Standard circular fits. References to pages in a PDF or a textbook are referring to *Machinery's Handbook (27th Edition).* These fits have two things which need to be assigned a tolerance: a hole and a shaft. The type of fit you want between these two can be broken into five different types, outlined below. More detailed explanations of these fits is available on pages 655 and 656 of the textbook.

1. ***Running or Sliding Clearance Fit (RC)***
    1. A looser fit that allows things to be assembled easily
    2. Play in the fitting allows rotation and sliding
    3. Should be used for parts which need to move often relative to one another
2. ***Locational Clearance Fit (LC)***
    1. A fit that's right on the border of what you can easily slide or rotate around
    2. Allows things to be assembled and disassembled but not quite as freely as an RC fit
    3. Should not be used for parts that need to be assembled & disassembled by hand but do not move relative to one another during normal operation
3. ***Transition Clearance or Interference (LT)***
    1. A series of fits that range from very slight clearance to very slight interference
    2. Should be used when you want to minimize stress due to an interference fit but ensure the shaft is accurately positioned within the hole.
4. ***Locational Interference Fit (LN)***
    1. An interference fit that should be used when the position of the shaft in the hole is very important
    2. These fits aren't strong enough to transmit forces through the friction between parts, but they are strong enough to ensure that the two parts are rigidly connected for the purposes of positioning things
5. ***Force or Shrink Fit (FN)***
    1. These fits are what you think of when you make a typical "press fit"
    2. FN fits provide enough interference between parts to depend upon friction between faces to transmit loads
    3. Based on specific tolerance ranges you select, these fits can either be light press fits (very very easy to do on the arbor press) or fits with so much interference that you wouldn't be able to assemble the parts on the arbor press

A visual representation of the tolerance ranges of these parts can be found on pg. 657 and is copied here, where the vertical axis is in thousandths of an inch (I believe).

**Graphical Representation of ANSI Standard Limits and Fits**
*ANSI B4.1-1967 (R1999)*




Diagrams show disposition of hole and shaft tolerances (in thousandths of an inch) with respect to basic size (0) for a diameter of 1 inch.

Once you've decided which fit class and number you would like to use, it's time to head to the tables to determine which tolerances you have to meet for your part. Page numbers of these tables are as follows

| Fit Type | Table Page Number(s) |
|---|---|
| *RC* | 658 & 659 |
| *LC* | 660 & 661 |
| *LT* | 662 |
| *LN* | 665 |
| *FN* | 664 |

Reading these tables can be a bit daunting. The main thing to keep in mind is that the nominal size range -- far left column -- is in inches, but each other value in the table is in thousandths of an inch. Serving as an example below is the columns that describe an LC6 fit. First, you select the row from the red column which corresponds to the nominal (un-tolerance) size of your shaft or hole. For example, a 1/4-28 bolt has a nominal size of 0.25 inches. You then look to the two green columns to get your tolerances for the hole and the shaft. These numbers are in 0.001 of an inch (one "thou").

| Nominal Size Range, Inches | Class LC 6 | | |
|---|---|---|---|
| | | Std. Tolerance Limits | |
| Over – To | Clearance[a] | Hole H9 | Shaft f8 |
| 0 – 0.12 | 0.3<br>1.9 | +1.0<br>0 | −0.3<br>−0.9 |
| 0.12 – 0.24 | 0.4<br>2.3 | +1.2<br>0 | −0.4<br>−1.1 |
| 0.24 – 0.40 | 0.5<br>2.8 | +1.4<br>0 | −0.5<br>−1.4 |
| 0.40 – 0.71 | 0.6<br>3.2 | +1.6<br>0 | −0.6<br>−1.6 |
| 0.71 – 1.19 | 0.8<br>4.0 | +2.0<br>0 | −0.8<br>−2.0 |
| 1.19 – 1.97 | 1.0<br>5.1 | +2.5<br>0 | −1.0<br>−2.6 |
| 1.97 – 3.15 | 1.2<br>6.0 | +3.0<br>0 | −1.0<br>−3.0 |
| 3.15 – 4.73 | 1.4<br>7.1 | +3.5<br>0 | −1.4<br>−3.6 |
| 4.73 – 7.09 | 1.6<br>8.1 | +4.0<br>0 | −1.6<br>−4.1 |
| 7.09 – 9.85 | 2.0<br>9.3 | +4.5<br>0 | −2.0<br>−4.8 |
| 9.85 – 12.41 | 2.2<br>10.2 | +5.0<br>0 | −2.2<br>−5.2 |
| 12.41 – 15.75 | 2.5<br>12.0 | +6.0<br>0 | −2.5<br>−6.0 |
| 15.75– 19.69 | 2.8<br>12.8 | +6.0<br>0 | −2.8<br>−6.8 |

Part of the beauty of using standard fits is that you don't need to call out specific numerical tolerances on your engineering drawings. If I wanted to make a part that had an LC6 fit like that shown above, all I would need to do is call out the nominal diameter of my shaft/hole and note an H9 tolerance for the hole and an f8 tolerance for the shaft. The drawing snippet below calls out a hole tolerance for an LC3 fitting using these standard fit types