HILL ENGINEERING

PROCEDURE FOR CHECKING DRAWINGS
(HOW TO DO IT)

Drawings are the key element in the translation of engineering principles, calculations and thoughts to reality. Drawings have an important effect on manufacturing and development cost. Most manufacturing and development problems arise from some small "detail" being incorrect or not carefully and completely thought out. The reputations and professional respect for engineers, designers, and drafters among clients, manufacturers and co-workers are strongly influenced by the drawings and specifications that bear their names. The purpose of the following procedural outline is to provide organized and consistent checking of drawings.

1. Obtain and organize reference documents, e.g., prints of similar parts previously drawn and manufactured; layouts from which the detail drawing is made; engineer's sketches; stack-up dimension drawings or sketches, etc.
2. Obtain a check print and familiarize yourself with the function of the part including locating surfaces, physical environment, stress levels, etc. Have red and yellow colored markers on hand. Correct items are to be marked through in yellow. Incorrect items are to be marked through in red with the correction or addition noted in red.
3. Take an overall look at all the views and sections on the drawing sheet(s). Are all the views correctly located according to the standard projection of the drawing? Are section views properly oriented according to the arrows on the section-cutting plane? Are section views located in convenient locations near where the section is taken? Confirm that the drawing scale is accurate and is a standard ratio. Make a quick "gross" check of all dimensions, scaling where necessary to determine large errors or inconsistencies. This is especially important on drawings that are not scaled or printed to actual size.
4. Check that geometric dimensioning and tolerancing (GD&T) principles have been used if appropriate for the type of part or assembly depicted. Use of basic dimensions, true position tolerancing and other features of GD&T can improve part quality while decreasing cost. Intelligent use of GD&T can greatly simplify a drawing as well, reducing the number of dimensions and notes required on the drawing.
5. Check the beginning reference datum surface for dimensioning and be sure it is compatible with the functional surface(s) on the part so that unnecessary tolerances will not be accumulated.
6. Check all dimensions for correctness in relation to the layout, mating part fits or other necessary reference material.
7. Review tolerances on all dimensions to determine which ones can be "opened up." Note that the title block usually covers one, two and 3 place decimal standards and angles. Do not use three places (usually ±.005) where two or one (usually ±.010 or ±.03) will suffice. If tolerances larger than ±.03 are permissible, dimension them accordingly using upper and lower limit notation.

8. Look for redundant dimensions - be sure any such dimensions that are useful to show are labeled "REF" or are placed inside parentheses. Reference dimensions are nominal and no tolerance applies.
9. Check that dimension lines do not overlap or obscure other dimensions. Check for missing dimensions. Check for specification of fillets, radii or chamfers on all corners not covered by a general note.
10. Check notes for completeness and spelling. Sufficient notes should be present to fully specify all aspects of the part or its manufacturing processing which cannot be shown by dimensions or notes directly on the object of the drawing. These notes include:
    - Standard corner radii and fillets or edge breaks
    - Inspection requirements (sonic, dye penetrant, radiographic, pressure tight, etc.) and reference standard such as MIL specification
    - Heat treatment or stress relief
    - Welding process and reference standard such as AWS
    - Finish (sand blast, paint, plate, etc.)
11. Check the title block information for completeness and spelling:
    - Part number
    - Part name
    - Material specification
    - Reference (project number, next assembly, etc.)
    - Revision block
12. On assembly drawings check that item numbers in balloons match the items numbers in the bill of materials.
13. Mentally process the part through the manufacturing operations to determine that every dimension and note necessary is present and that it appears in a convenient way for manufacturing purposes. This is the acid test of a drawing before release to manufacture.

The check print with every dimension marked in either yellow or red is returned to its originator for incorporation of corrections and additions.

When corrected, the original drawing, or a new check print if revisions are extensive, along with the original check print is returned to the checker for final review.

The checker is to mark over all red marks in yellow as they are found to be corrected.

When the drawing is all corrected, the check box is initialed and dated by the checker and the drawing and check prints are passed on to the project engineer.

Design Maxims and Homilies

1. Be careful - pencil erases, metal don't.
2. Start simple and work your way into complexity.
3. Do machinists like you?
4. Parts and components eliminated from the design will not require any development.
5. Checking is a necessary evil. Checkers aren't necessarily evil.
6. A good designer has several "gears" so s/he can shift from one level of product sophistication to another as the occasion demands.
7. No matter how simple an operation or part is, the product will be less expensive without it.
8. Before settling on a design solution, consider as many alternatives as you can think of. Your first thought is frequently not your best.
9. Product weight is the fundamental variable for cost of manufacture in any particular product class.
10. Drawing checkers always appeared unnecessarily fussy until I had to make and assemble an unchecked design.