

Dimensions and Tolerances

Application and interpretation of dimensions and tolerances shall be in accordance with ASME Y14.100 Engineering Drawing Practices and ASME Y14.5 Dimensioning and Tolerancing Standard for procured items.

Angles

All angles, other than 90° angles, shall be specified on the drawing. Angles shown, as right angles shall be 90° within the general tolerance specified on the drawing except when “squareness” (perpendicularity) of a machined surface is a requirement.

Flatness

Machined Surfaces

Machined surfaces shall be flat with the tolerances of the applicable linear dimensions of the drawing unless a specific flatness requirement is designated.

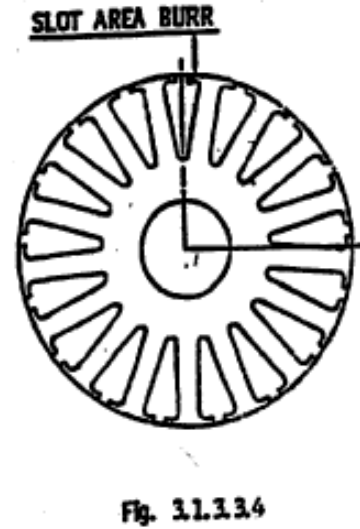
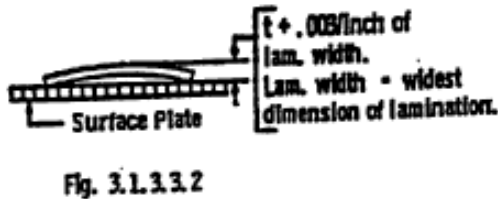
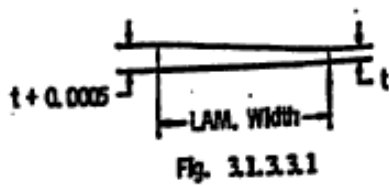
Sheet Metal Surface

Sheet metal surfaces shall be free of wrinkles, sharply defined depressions or ridges, and shall be flat within the tolerances of the applicable dimensions of the drawing. Surface irregularities such as bowing, oil-canning, spring back, and warpage, that can be brought within acceptable limits during fabrication and assembly by the application of “thumb pressure” are acceptable provided the discrepant part or assembly, when installed, is positively retained in the correct position or shape, and functions as designed without impairing the function of mating parts or assemblies.

Lamination Surface

Lamination surfaces shall be free of wrinkles, sharply defined depressions or ridges. If no flatness tolerances are given on the drawing, the following are to be applied.

- The lamination thickness shall be uniform from side-to-side within 0.0005 inches. See Figure 3.1.3.3.1.
- Surface irregularities such as bowing, oil-canning, spring back and warpage that exceed the tolerances given in Figure 3.1.3.3.2 are not allowed. This applies to the finished lamination; i.e. after anneal, if it is an annealed lamination.
- The maximum burr height allowed, if not specified on the drawing, shall be less than 0.002 inches. If this is evident at one or more locations on the lamination, it is indicating that the die is chipped or broken at those areas and the supplier is to be notified to repair the die prior to a subsequent order being filled.
- Burrs that extend into the slot or shaft hole areas are not allowed. An example of this type of burr is given in Figure 3.1.3.3.4.



Concentricity

Unless otherwise specified, the concentricity of adjacent machined elements shall be within 0.0005 inch total indicator reading (TIR) for items up to 3 inches in diameter, plus 0.0003 inch per inch of diameter above 3 inches. A maximum limit of 0.012 inch TIR shall prevail for all machined elements on a single rigid item. A maximum of 0.018 inch TIR shall prevail for all machined elements on a single item having machined elements greater than 6.0 inch diameter and subject to ready deflection as a result of a thin-wall condition.

Gundrilled Holes

Concentricity of gundrilled holes in shafts shall not exceed .005 to any adjacent diameter for the first two inches of drilled depth. The remainder of the gundrilled hole shall be concentric within an amount equal to .005 plus an additional .001 for each inch of depth beyond two inches to the point of measurement and not exceeding .015 total unless otherwise specified in the drawing.

Roundness

The roundness of all cylindrical or conical elements shall be such that the major and minor diameters of any section at any point must fall within the specified diametrical tolerances. The method of specifying a roundness tolerance for non-ridge parts shall be interpreted in accordance with ASME Y14.5, "Dimensioning and Tolerancing" Standard.

General Shop Practice

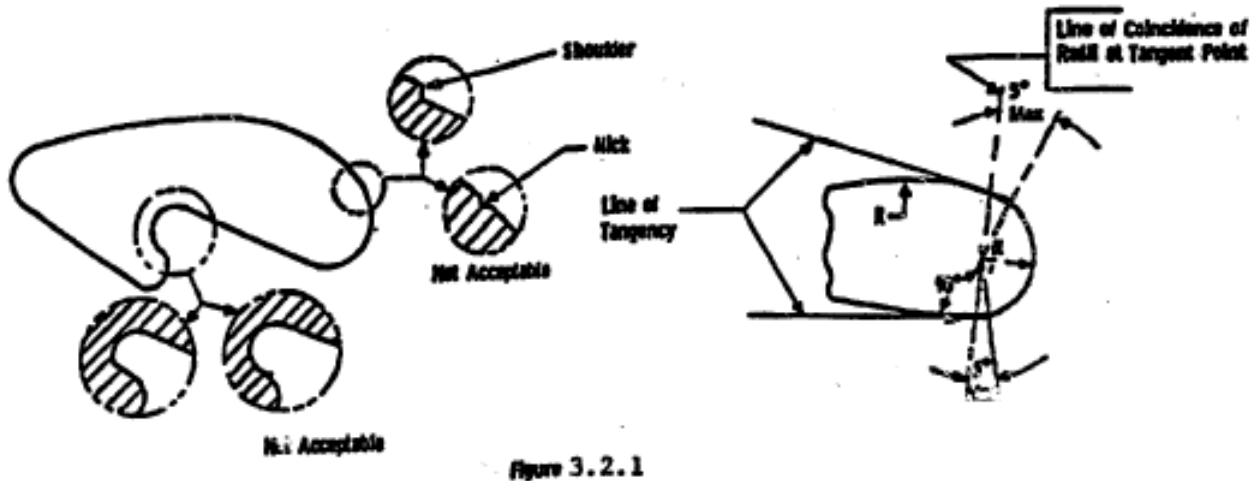
Blended Surfaces

Connected curved surfaces, or curved and plane surfaces shown as tangent, must blend smoothly without evidence of nicks, shoulders, re-entrant cuts, etc. The juncture of a radius with other radii or planes may have a 5° maximum angle of tangency for tool runout (see Figure 3.2.1). Blends between adjacent planer surfaces

of essentially flat and parallel nature shall be smooth and flat or slightly convex; concave blends establishing re-entry intersections are not permissible.

Internal Corners

All internal corners of machined parts shall have a radius between 0.020 and 0.040 inch, unless otherwise specified.



Breaking Sharp Edges

Unless otherwise specified on the detail drawing, all sharp edges shall be broken 0.005 to 0.020 inch. The breaking of the edge may be in the form of a radius or a combination of a chamfer and radii. Edges after breaking must be free of burrs. A flat chamfer evidencing corner sharpness from burrs, or a concave radius within the chamfer flat, is not acceptable. The breaking of edges on sheet metal parts 1/32 inch or less in thickness is not mandatory such edges must be free from burrs. This breaking of edges does not apply to parts fabricated from elastomers or non-rigid polymers.

Note: Dimensions to intersecting surfaces are theoretically to sharp corners and must be met before breaking edge or including fillets unless specifically delineated on the drawing.

Chamfer

Chamfers, when specified on a drawing, may be at the intersection of two surfaces of any geometrical shape, the exterior edge of a cylindrical surface, the internal edge of a hole irrespective of hole shape, or a circular hole too large for countersinking tools.

Note: Holes 2.00 inches in diameter or larger are considered too large for countersinking.

Chamfer on Internal Thread Ends

A chamfer with an included angle of 80° to 120° shall be used at internal thread ends unless otherwise specified by dimensional notation or specification reference on the drawing. The minimum diameter of the chamfer shall be equal to the major diameter of the thread. The maximum diameter of the chamfer shall be equal to the major diameter of the thread plus 0.030 inch.

Chamfer on External Thread Ends

Unless otherwise specified by dimensional notation or specification reference on the drawing, externally threaded parts shall be chamfered at the ends, extending to the minor diameter of the thread. The angle of the chamfer shall be $45^\circ +5^\circ / -15^\circ$. The minimum length of the chamfer shall equal the depth of the external thread, from the major to the minor diameter.

Theoretical Single Surface

When two or more machining cuts are required to produce a surface shown on the drawing as a single surface, the maximum misalignment between intersecting or adjacent surfaces shall not exceed 0.010 inch or must be contained within the limits of dimensional size, whichever is the smaller. When a continuous surface is required, this requirement shall be designated on the detailed drawing.

Drilled Holes

Depth

The depth of a drilled hole, as specified on the drawing, shall be measured along with the axis of the hole from the surface drilled (reference surface) to the depth of the full diameter exclusive of the drill point.

Angularity

The angularity of all drilled holes must be within the tolerance zone established by the center line position, over the full depth of the hole. The tolerance zone may be extended beyond the hole depth (above the reference plane) by special notation on the drawing.

Roundness

The deviation from roundness of the drilled hole shall not exceed the tolerances of the hole diameter.

Countersink, Counterbore and Spot Face

Countersink

Term used to designate a conical surface at the edge of a circular hole. It does not apply to holes of 2.00 inch diameter or larger. Countersink major diameter and included angle must be specified on the drawing.

Counterbore

A requirement for counterboring must be designated on the drawing. When required, the diameter and depth, or the diameter and material thickness below the counterbore must be specified on the drawing. Counterbore corner radii shall be 0.032 inch maximum.

Spot Face

When spot facing is required, the spot face diameter shall be specified on the drawing. The following depth limits shall apply:

- a. Minimum depth shall be the depth necessary to provide 75% clean-up of spot face area.
- b. Maximum depth shall be 0.010 inch beyond 100% clean-up.
- c. Spot Face corner radii shall be 0.032 inch maximum.

Machining Centers

Center drilling may be desirable in shafts, spindles and other cylindrical or symmetrical parts to receive machine centers for work support. Unless otherwise specified on the drawing, their use is optional within the parameters stated below.

Pinions

The major diameter of the conical portion of the drilled center shall not exceed 60% of the pinion root diameter.

Solid Shafts

A No. 0 or 00 center drill shall be used for shaft diameters approximating 1/8 inch. A No. 1 center drill may be used for shaft diameters approximating 3/16 inch. In no case shall the major diameter of the center drill hole be greater than 75% of the part O.D. For shaft sizes greater than 3/16 inch diameter, center drills conforming to good machining practice may be used. In the latter cases there shall not be less than a 0.030 inch thick circular flat separating the major diameter of the conical portion of the center drilled hole and the nearest concentric external surface.

Thread Length, Internal, Blind Holes

The thread length dimension indicated on the drawing, unless otherwise noted, is the gaging length or the length of thread having full form. An additional length equal to at least five (5) times the thread pitch is allowable for lead of tap where hole depth permits without break through.

Applicability of Dimensions and References

Finished Parts

All dimensions on a component part drawing indicate the end product design for final form and size only without reference to methods of manufacture. (If specific manufacturing methods are required for the proper functional operation of a unit, they must be specified on the drawing). All dimensions are applicable after such operations as treating, aging, sand blasting, buffing, etc.

Surface Coatings

When a drawing does not specify whether dimensions apply before or after the application of a surface coating, the following interpretation shall apply.

- Inorganic Finishes: Dimensional limits and surface roughness designations apply after the application of inorganic finishes such as plating, ceramic coatings, chromates, oxides, etc., except in the case of phosphate coat (TT-C-490, Type I); or MIL-DTL-16232, dimensional limits will apply before the application of the coating.

- Organic Finishes: Dimensional limits and surface roughness designations apply prior to the application of organic finishes such as lacquers, varnishes, enamels, plastic coatings, etc.

Sand Castings and Forgings

Dimensions to a cast or forged surface apply to the plane of such surface or check points as designated by Manufacturing Engineering, local depressions and projections are to be ignored.

Referenced Specifications

All specifications referenced on detailed drawings, or in related documentation of designation, shall apply in the version current at the time of internal manufacture or at the time of receipt of order.

Definitions of Terminology

Address inquiries to the Engineering Manager, Beaver Aerospace & Defense, Engineering Division.

Surface Roughness, Waviness and Lay

- Requirements for surface roughness, waviness and lay shall be interpreted in accordance with ASME B46.1 "Surface Texture" Standard.
- When the surface roughness is not specified, the referenced material specification or normal commercial practices as applicable, shall be the standard governing the control of surfaces that are forged, cast, rolled, extruded, flame cut, sawed, sheared, sand blasted, shot blasted, or hydro-blasted. The following are also included: Commercial finished materials, the ends of bolts, screws, studs and dowels and the heads of bolts and screws.
- The surface roughness height for those surfaces listed in Table I shall not be greater than that indicated, unless otherwise noted.

TABLE I

Surface Type	Roughness Height, Maximum R _a (microinches)
Ground threads, shaped splines, rolled serrations, reamed holes	63
Spot face or counterbore flats, hobbed or broached splines, countersinks, broached holes	125
Finished turned surfaces, milled surfaces, drilled holes of ¼ inch diameter or less	125
Machined surfaces not listed above or otherwise limited by drawing notation (not applicable to pierced or sheared surfaces)	125

- When machined surfaces are not designated on small radii or changes in contour, the surface finish supplied shall not exceed 125 R_a.

Matched Machined Sets

Each part of a set of parts machined as a matched set shall be marked or identified so that the original set can be identified without problems.

General Surface Condition

- The material surfaces of parts that are subject to heat treating, welding, brazing, soldering, etc., shall be clean and free of all markings from lead pencils, wax crayons, grease pencils, carbon and all other foreign substances. After processing, all scale, weld splatter, solder slag, excess filler metal, etc. shall be removed.
- All edges and surfaces shall be free of burrs, tears, or flashing that might break the operator's skin in normal handling of the part or that may interfere in assembly use or part function.
- When machined castings are subject to magnetic particle inspection specification ASTM-E-1444 – Magnetic Particle Inspection Standard applies.

Assembly Factors

Location

When a drawing does not specify the precise location of a component for assembly and when there are alternative locations possible, the installation location shall be optional but shall be consistent from one assembly to the next within the same lot. However, the location of such features as wrenching flats, bolt heads, nuts, cotter pin holes, and screw driver slots shall not interfere with the function of other components.

Torquing

Unless otherwise specified, the acceptable torque values for threaded fasteners shall be in accordance with Beaver Aerospace & Defense manufacturing practice standard, "Standard Wrenching Torques" (in this procedure). Lubricants shall not be used for the assembly of threaded fasteners unless specifically called out on the drawing.

Adhesives

Cyanoacrylate adhesives per A-A-3097 – Adhesives Standard may have been used during assembly in order to position parts. Any residue from the adhesive is permitted as long as dimensional tolerances are maintained.

Component, Part, or Assembly Protection

All items shall be suitably protected from time of Beaver Aerospace & Defense receipt or manufacture until ultimate incorporation in an end product, to prevent damage in the course of normal plant handling. Particular attention must be given to the protection of parts designated as bearings, seals, seal glands, or surfaces bearing journals, gaskets, diaphragms, etc., and components of known or suspected sensitivity to mechanical or thermal shock.

Machining of Assemblies and Non-Metallic Materials

Liquid coolants shall not be used in the machining of laminated or molded plastics, graphite, or assemblies such as slip-rings or commutators, etc., unless specifically authorized by notation on the drawing or by directive from manufacturing engineering.

Marking of Parts

When required, part marking shall be accomplished as noted on the drawing. Unless specific method of marking is detailed on drawing, the method applied shall be as directed by manufacturing engineering. In the latter case the selected method shall be recorded on the Production Routing or Purchase Data, as applicable. The method selected shall not conflict with the requirements of MIL-STD-130 –Identification Marking.

Quality Assurance Provisions

The Director, Quality Assurance for Beaver Aerospace & Defense shall provide for the surveillance required to assure practical compliance with the requirements of this specification. All sampling, inspection, and monitoring operations required shall be determined by the Quality Assurance function.

Preparation for Delivery

Items produced in facilities other than those of Beaver Aerospace & Defense shall be prepared for delivery in accordance with the requirements of the Beaver Aerospace & Defense purchase order and any Beaver Aerospace & Defense packaging drawings referenced, as applicable. Consideration shall be given to the protection of the individual item from damage resulting from normal handling practices during transit and in-plant storage prior to assembly use.