AIRCRAFT LOCKNUT MANUFACTURERS ASSOCIATION
A subdivision of the IFI Aerospace Division



# GEOMETRIC DIMENSIONING AND TOLERANCING FOR BOLTS, SCREWS, STUDS, NUTS, AND NUT PLATES

CONTENTS



Date
May 30, 2019

## 1. SCOPE

1.1 Purpose. The standard practice established in this document provides a means for obtaining consistency in the usage and interpretation of geometric dimensioning & tolerancing (GD & T) symbols (as defined in ASME Y14.5M-2009) as they appear on National Aerospace Standards (NAS) prepared in the inch system of units.

1.2 Classification

The fastener types addressed in this standard practice are as follows:

Bolts/Screws/Studs

Nuts/Nut Plates

## 2. REFERENCED DOCUMENTS

The following documents form a part of this standard practice to the extent specified herein:

American Society of Mechanical Engineers

ASME Y14.5M-2009

Aerospace Industries Association

NAS380

## 3. DEFINITIONS

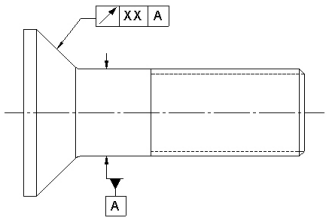
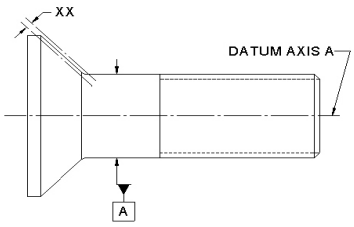
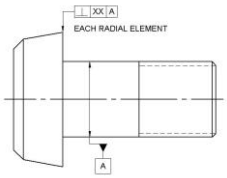
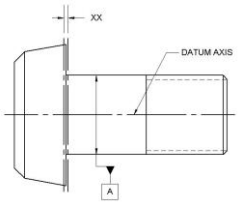
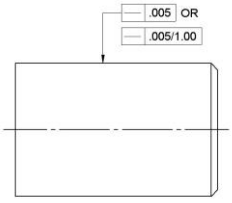
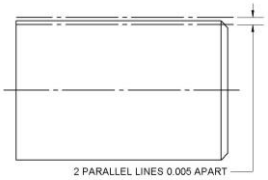
3.1 Symbol Definitions. Tables I and III define the complete set of geometric dimensioning and tolerancing symbols for each fastener classification. The ASME Y14.5M-2009 definition and a referee inspection method are shown for each symbol.

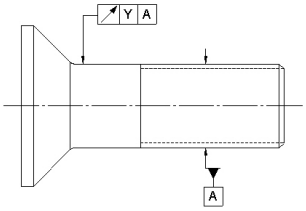
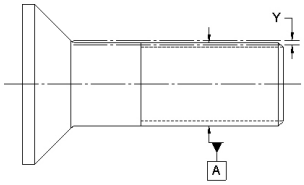
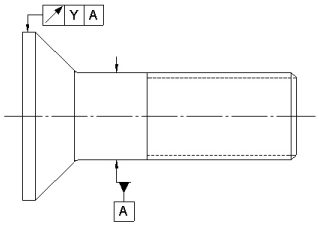
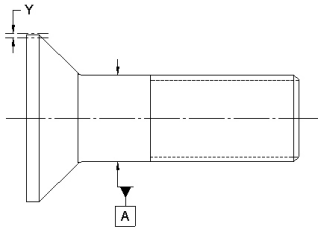
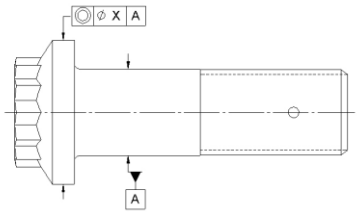
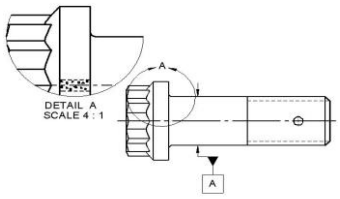
## 4. GENERAL REQUIREMENTS

4.1 General. The standard practices established in this document for the minimum set of requirements for drawings utilizing GD & T callouts shall be adhered to insofar as practical. Any GD & T symbol used on any part standard in the inch system must be included in ASME Y14.5M-2009.

4.2 Default Tolerances. Unless otherwise specified on the part standard, Tables II and IV shall be used as the default tolerance values for runout, concentricity, and straightness as identified in the feature control frame.

TABLE I - GD&T INTERPRETATION FOR BOLTS/SCREWS/STUDS

| ITEM | GD&T SYMBOL | MEANS THIS PER ASME Y14.5M-2009 | INSPECTION METHOD |
|---|---|---|---|
| 1 |  <br>-CONICAL SURFACE RUNOUT.<br><br>-CIRCULAR RUNOUT IS A COMPOSITE CONTROL THAT AFFECTS THE FORM, ORIENTATION, AND LOCATION OF CIRCULAR ELEMENTS (INDIVIDUALLY) OF A PART FEATURE RELATIVE TO A DATUM AXIS.<br><br>-A CIRCULAR RUNOUT CONTROL IS A GEOMETRIC TOLERANCE THAT LIMITS THE AMOUNT OF CIRCULAR RUNOUT OF A PART SURFACE. CIRCULAR RUNOUT APPLIES INDEPENDENTLY TO EACH CIRCULAR ELEMENT OF A DIAMETER. |  <br>-AT ANY MEASURING POSITION, EACH CIRCULAR ELEMENT OF THESE SURFACES MUST BE WITHIN THE SPECIFIED RUNOUT TOLERANCE ("XX" FULL INDICATOR MOVEMENT) WHEN THE PART IS ROTATED 360º ABOUT THE DATUM AXIS WITH THE INDICATOR FIXED IN A POSITION NORMAL TO THE TRUE GEOMETRIC SHAPE. THE FEATURE MUST BE WITHIN THE SPECIFIED LIMITS OF SIZE (THIS CONTROLS ONLY THE CIRCULAR ELEMENTS OF THE SURFACE, NOT THE TOTAL SURFACE). | -CONCENTRICITY GAGE (3 ROLLS) INDICATING THE CONICAL SURFACE TO THE DEFINED DATUM "A" TOLERANCE ZONE. |
| 2 |  <br>-BEARING FACE PERPENDICULARITY.<br><br>-PERPENDICULARITY IS THE CONDITION THAT RESULTS WHEN A SURFACE, AXIS, OR CENTERPLANE IS EXACTLY 90º TO A DATUM.<br><br>-A PERPENDICULARITY CONTROL IS A GEOMETRIC TOLERANCE THAT LIMITS THE AMOUNT A SURFACE, AXIS OR CENTERPLANE IS PERMITTED TO VARY FROM BEING PERPENDICULAR TO THE DATUM. |  <br>-EACH CIRCULAR ELEMENT OF THE SURFACE MUST LIE BETWEEN TWO PARALLEL PLANES "XX" APART WHICH ARE PERPENDICULAR TO DATUM A. THE SURFACE MUST BE WITHIN THE SPECIFIED LIMITS OF SIZE.<br><br>-THE SHAPE OF THE TOLERANCE ZONE IS TWO PARALLEL PLANES THAT ARE PERPENDICULAR TO THE DATUM PLANES. | -CONCENTRICITY GAGE (3 ROLLS) INDICATING THE PERPENDICULAR SURFACE TO THE DEFINED DATUM "A" TOLERANCE ZONE. |
| 3 |  <br>-SHANK STRAIGHTNESS REF: TABLE II.<br><br>-STRAIGHTNESS OF A LINE ELEMENT IS THE CONDITION WHERE EACH LINE ELEMENT (OR AXIS OF CENTERPLANE) IS A STRAIGHT LINE.<br><br>-A STRAIGHTNESS CONTROL DIRECTED TO A SURFACE IS A GEOMETRIC TOLERANCE THAT LIMITS THE AMOUNT OF STRAIGHTNESS ERROR ALLOWED IN EACH SURFACE LINE ELEMENT. THE TOLERANCE ZONE FOR A STRAIGHTNESS CONTROL (AS A SURFACE LINE ELEMENT CONTROL) IS TWO-DIMENSIONAL. |  <br>-EACH LONGITUDINAL ELEMENT OF THE SURFACE MUST LIE BETWEEN TWO PARALLEL LINES .005 APART.<br><br>-THE TOLERANCE ZONE FOR A STRAIGHTNESS CONTROL APPLIED TO SURFACE ELEMENTS IS TWO PARALLEL LINES SPACED APART A DISTANCE EQUAL TO THE STRAIGHTNESS TOLERANCE VALUE. | -SURFACE PLATE WITH .005 GAGE PIN. |

| ITEM | GD&T SYMBOL | MEAN THIS PER ASME Y14.5M-2009 | INSPECTION METHOD |
|---|---|---|---|
| 4 |  <br>-RUNOUT SHANK TO THREADS REF: TABLE II.<br><br>-CIRCULAR RUNOUT IS A COMPOSITE CONTROL THAT AFFECTS THE FORM, ORIENTATION, AND LOCATION OF CIRCULAR ELEMENTS (INDIVIDUALLY) OF A PART FEATURE RELATIVE TO A DATUM AXIS.<br><br>-A CIRCULAR RUNOUT CONTROL IS A GEOMETRIC TOLERANCE THAT LIMITS THE AMOUNT OF CIRCULAR RUNOUT OF A PART SURFACE.<br><br>-CIRCULAR RUNOUT APPLIES INDEPENDENTLY TO EACH CIRCULAR ELEMENT OF A DIAMETER. |  <br>-AT ANY MEASURING POSITION, EACH CIRCULAR ELEMENT OF THESE SURFACES MUST BE WITHIN THE SPECIFIED RUNOUT TOLERANCE (“Y” FULL INDICATOR MOVEMENT) WHEN THE PART IS ROTATED 360º ABOUT THE DATUM AXIS WITH THE INDICATOR FIXED IN A POSITION NORMAL TO THE TRUE GEOMETRIC SHAPE. THE FEATURE MUST BE WITHIN THE SPECIFIED LIMITS OF SIZE (THIS CONTROLS ONLY THE CIRCULAR ELEMENTS OF THE SURFACE, NOT THE TOTAL SURFACE). | -CONCENTRICITY GAGE (3 ROLLS) INDICATING THE SHANK DIAMETER TO THE TOLERANCE ZONE DEFINED TO THE THREADS. |
| 5 |  <br>-RUNOUT FLUSH HEAD O.D. TO SHANK REF: TABLE II.<br><br>-CIRCULAR RUNOUT IS A COMPOSITE CONTROL THAT AFFECTS THE FORM, ORIENTATION, AND LOCATION OF CIRCULAR ELEMENTS (INDIVIDUALLY) OF A PART FEATURE RELATIVE TO A DATUM AXIS.<br><br>-A CIRCULAR RUNOUT CONTROL IS A GEOMETRIC TOLERANCE THAT LIMITS THE AMOUNT OF CIRCULAR RUNOUT OF A PART SURFACE.<br><br>-CIRCULAR RUNOUT APPLIES INDEPENDENTLY TO EACH CIRCULAR ELEMENT OF A DIAMETER. |  <br>-AT ANY MEASURING POSITION, EACH CIRCULAR ELEMENT OF THESE SURFACES MUST BE WITHIN THE SPECIFIED RUNOUT TOLERANCE (“Y” FULL INDICATOR MOVEMENT) WHEN THE PART IS ROTATED 360º ABOUT THE DATUM AXIS WITH THE INDICATOR FIXED IN A POSITION NORMAL TO THE TRUE GEOMETRIC SHAPE. THE FEATURE MUST BE WITHIN THE SPECIFIED LIMITS OF SIZE (THIS CONTROLS ONLY THE CIRCULAR ELEMENTS OF THE SURFACE, NOT THE TOTAL SURFACE). | -CONCENTRICITY GAGE (3 ROLLS) INDICATING THE HEAD OUTSIDE DIAMETER TO THE TOLERANCE ZONE DEFINED TO THE SHANK O.D. |
| 6 |  <br>-CONCENTRICITY 12 POINT BOLT FLANGE DIAMETER TO SHANK REF: TABLE II.<br><br>-CONCENTRICITY IS THE CONDITION WHERE THE MEDIAN POINTS OF ALL DIAMETRICALLY OPPOSED ELEMENTS OF A CYLINDER (OR A SURFACE OF REVOLUTION) ARE CONGRUENT WITH THE AXIS OF A DATUM FEATURE. A MEDIAN POINT IS THE MIDPOINT OF A TWO POINT MEASUREMENT. |  <br>-THE TOLERANCE ZONE IS A CYLINDER CENTERED ABOUT THE DATUM AXIS.<br><br>-THE MEDIAN POINTS OF THE TOLERANCED FEATURE MUST BE WITHIN THE TOLERANCE ZONE. | -CONCENTRICITY GAGE (3 ROLLS) AND TWO OPPOSING INDICATORS THAT MEASURE CENTERLINE, ESTABLISH THE MIDPOINT AND CALCULATE MEASUREMENT COMPARED TO TOLERANCE FOR CONFORMANCE.<br><br>-NOTE: CONCENTRICITY CONTROLS ARE TYPICALLY USED WHEN PRODUCT BALANCE REQUIREMENTS ARE NECESSARY. |

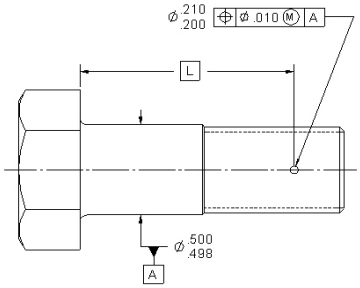
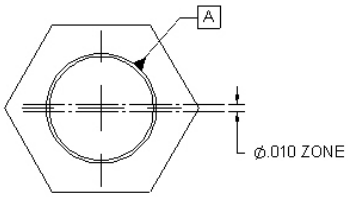
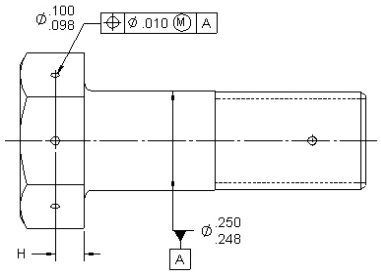
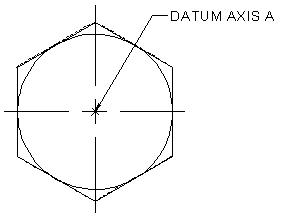
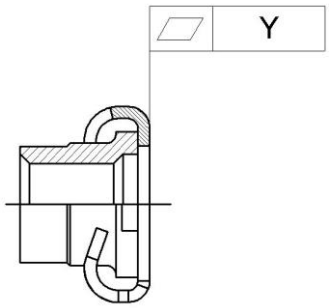
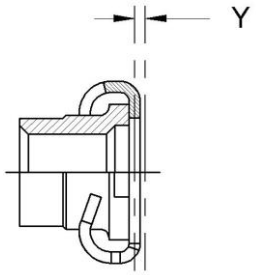
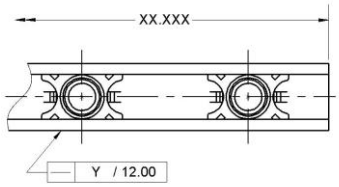
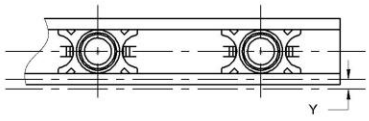
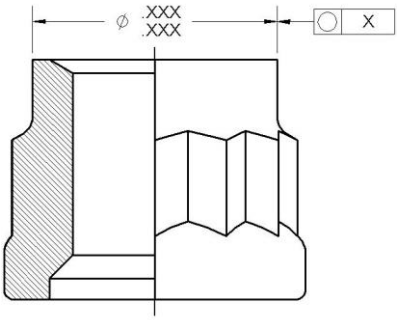
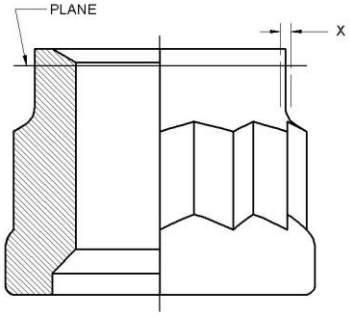
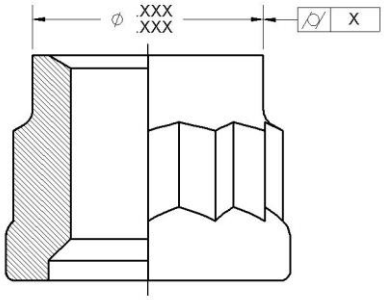
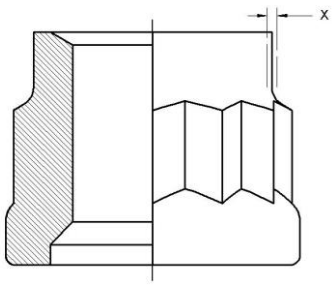
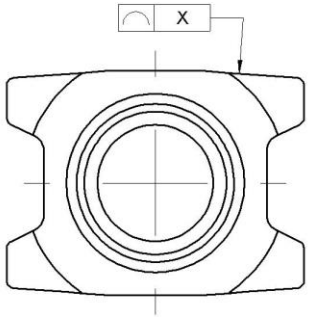
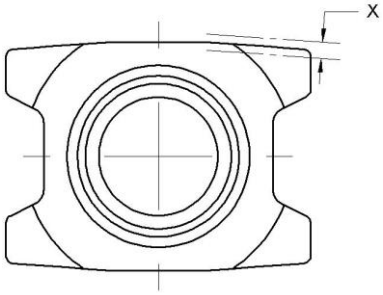
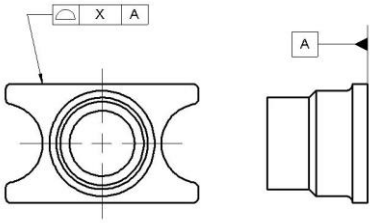
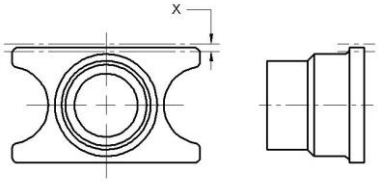
| ITEM | GD & T SYMBOL | MEANS THIS PER ASME Y14.5M-2009 | INSPECTION METHOD |
|---|---|---|---|
| 7 |  <br>-TRUE POSITION IS THE THEORETICAL EXACT LOCATION OF A FEATURE OF SIZE (FOS) AS DEFINED (COTTER PIN HOLE TO SHANK DIA.). |  <br>-AT EITHER END, THE HOLE MUST BE WITHIN THE SPECIFIED TOLERANCE TO THE DATUM AXIS.<br>-THE SHAPE OF THE TOLERANCE ZONE IS A VIRTUAL CONDITION CYLINDRICAL BOUNDARY.<br>-THE TOLERANCE ZONE IS LOCATED BY THE BASIC DIMENSIONS FROM THE DATUM PLANES.<br>-THE RELATIONSHIP BETWEEN THE CENTERLINE OF THE HOLE AND DATUM PLANE A IS AN IMPLIED BASIC 90° ANGLE. | -USE A BUSHING WITH A ∅.500+ HOLE. AT A DISTANCE "L" FROM ONE END HAVE A ∅.190 HOLE AND PIN THAT MUST ENTER THE COTTER PIN HOLE. |
| 8 |  <br>-TRUE POSITION IS THE THEORETICAL EXACT LOCATION OF A FEATURE OF SIZE (FOS) AS DEFINED (WIRE HOLES TO SHANK DIA.). |  <br>-HOLES SHALL BE WITHIN THE SPECIFIED TOLERANCE TO THE DATUM AXIS. | -BUSHING WITH A THROUGH HOLE ∅.250+ WITH A C'BORE TO ACCEPT THE HEX HEAD, AT A DISTANCE "H" FROM THE C'BORE BOTTOM A HOLE ∅.088 WITH A PIN PERPENDICULAR TO THE ID MUST ENTER THE HOLE(S). |

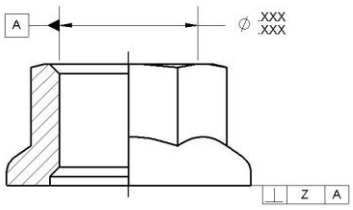
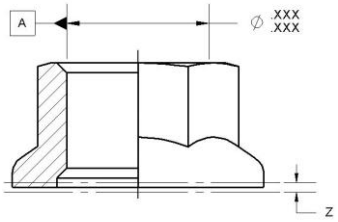
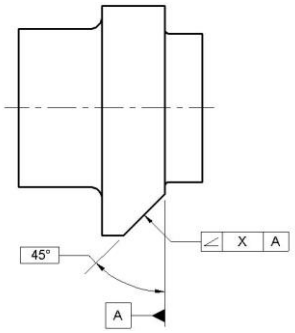
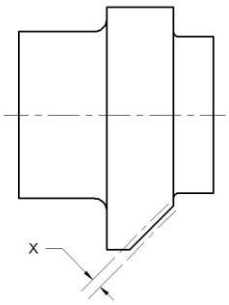
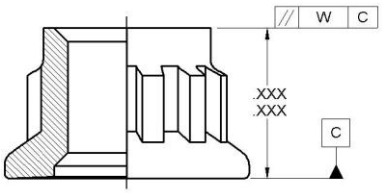
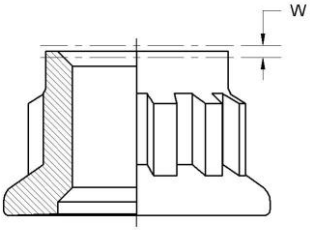
TABLE II - DEFAULT TOLERANCE VALUES FOR BOLTS/SCREWS/STUDS

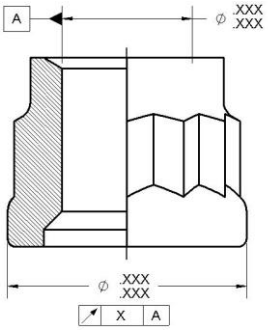
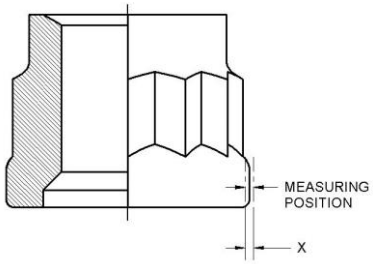
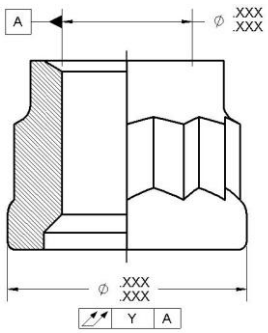
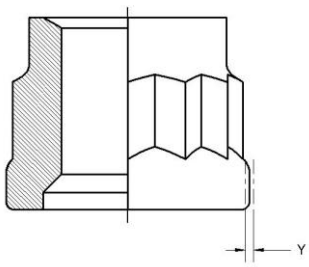
| DIAMETER | X (FIM) | | Y (FIM) | Z (FIM) |
|---|---|---|---|---|
| | RUNOUT: 12 SPLINE/12 POINT FLANGE TO SHANK AND 12 SPLINE/12 POINT TO SHANK | RUNOUT: PAN HEAD O.D. TO SHANK CONCENTRICITY: HEXAGON HEAD TO SHANK | RUNOUT: SHANK TO THREADS AND FLUSH HEAD O.D. TO SHANK | STRAIGHTNESS (PER INCH OF LENGTH): SHANK |
| .1120 | .003 | .004 | .004 | .0040 |
| .1380 & .1640 | .004 | .006 | .005 | .0040 |
| .1900 | .005 | .007 | .005 | .0040 |
| .2500 | .006 | .008 | .005 | .0030 |
| .3125 | .008 | .011 | .006 | .0030 |
| .3750 | .010 | .014 | .006 | .0025 |
| .4375 | .012 | .016 | .007 | .0025 |
| .5000 | .014 | .020 | .007 | .0020 |
| .5625 | .016 | .022 | .007 | .0020 |
| .6250 | .018 | .025 | .007 | .0020 |
| .7500 | .020 | .028 | .008 | .0020 |

TABLE III - GD&T INTERPRETATION FOR NUT/NUT PLATES

| ITEM | GD & T SYMBOL | MEANS THIS PER ASME Y14.5M-2009 | INSPECTION METHOD |
|---|---|---|---|
| 1 |  <br>-FLATNESS IS THE CONDITION OF A SURFACE HAVING ALL ELEMENTS IN ONE PLANE. |  <br>-THE SURFACE MUST LIE BETWEEN TWO PARALLEL PLANES "Y" APART. THE SURFACE MUST BE WITHIN THE SPECIFIED LIMITS IN SIZE. | -FLATNESS GAGE AND INDICATOR RUNNING OVER SURFACE OF PART.<br>-HEIGHT GAGE ON SURFACE PLATE WITH FIXED SPECIMEN.<br>-DROP GAGE AND INDICATOR AT SEVERAL POINTS. |
| 2 |  <br>-STRAIGHTNESS IS THE CONDITION WHERE AN ELEMENT OF A SURFACE OR AN AXIS IS A STRAIGHT LINE. |  <br>-EACH LONGITUDINAL ELEMENT OF THE SURFACE MUST LIE BETWEEN TWO PARALLEL LINES "Y" APART. | -SURFACE PLATE WITH GAGE PINS.<br>-COMPARATOR AND OVERLAY.<br>-COORDINATE MEASURING MACHINE. |
| 3 |  <br>-CIRCULARITY IS THE CONDITION OF A SURFACE FOR A FEATURE OTHER THAN A SPHERE, WHERE ALL POINTS OF THE SURFACE INTERSECTED BY ANY PLANE PERPENDICULAR TO AN AXIS ARE EQUIDISTANT FROM THAT AXIS. |  <br>-EACH CIRCULAR ELEMENT OF THE SURFACE IN A PLANE PERPENDICULAR TO AN AXIS MUST LIE BETWEEN TWO CONCENTRIC CIRCLES, ONE HAVING A RADIUS "X" LARGER THAN THE OTHER. EACH CIRCULAR ELEMENT OF THE SURFACE MUST BE WITHIN THE SPECIFIED LIMITS OF SIZE. | -CONCENTRICITY GAGE WITH INDICATOR. |

| ITEM | GD & T SYMBOL | MEANS THIS PER ASME Y14.5M 2009 | INSPECTION METHOD |
|---|---|---|---|
| 4 |  <br>-CYLINDRICITY IS THE CONDITION OF A SURFACE OF REVOLUTION IN THAT ALL POINTS OF THE SURFACE ARE EQUIDISTANT FROM A COMMON AXIS. |  <br>-EACH CIRCULAR ELEMENT OF THE CYLINDRICAL SURFACE MUST LIE BETWEEN TWO CONCENTRIC CYLINDERS, ONE HAVING A RADIUS “X” LARGER THAN THE OTHER. THE SURFACE MUST BE WITHIN THE SPECIFIED LIMITS OF SIZE. | -CONCENTRICITY GAGE WITH INDICATOR. |
| 5 |  <br>-PROFILE OF LINE IS THE TOLERANCING THAT SPECIFIES A UNIFORM BOUNDARY ALONG THE TRUE PROFILE WITHIN WHICH THE ELEMENTS OF THE LINE MUST LIE. |  <br>-EACH LINE ELEMENT OF THE SURFACE AT ANY CROSS SECTION MUST LIE “X” APART. THE SURFACE MUST BE WITHIN THE SPECIFIED LMITS OF SIZE. | -COMPARATOR WITH OR WITHOUT AN OVERLAY.<br><br>-CALIBRATED JIGS AND FIXTURES. |
| 6 |  <br>-PROFILE OF SURFACE IS THE TOLERANCING THAT SPECIFIES A UNIFORM BOUNDARY ALONG THE TRUE PROFILE WITHIN WHICH THE ELEMENTS OF THE SURFACE MUST LIE. |  <br>-THE SURFACE MUST LIE BETWEEN TWO PARALLEL PLANES “X” APART, EQUALLY DISPOSED ABOUT A TRUE PLANE, WHICH IS BASICALLY ORIENTED IN RELATION TO THE SPECIFIED DATUM. | -COMPARATOR WITH OR WITHOUT AN OVERLAY.<br><br>-CALIBRATED JIGS AND FIXTURES. |

| ITEM | GD & T SYMBOL | MEANS THIS PER ASME Y14.5M 2009 | INSPECTION METHOD |
|---|---|---|---|
| 7 |  <br>-PERPENDICULARITY IS THE CONDITION OF A SURFACE, CENTERLINE OR AN AXIS AT A RIGHT ANGLE (90°) TO A DATUM PLANE OR AXIS. |  <br>-EACH CIRCULAR ELEMENT OF THE SURFACE MUST LIE BETWEEN TWO PARALLEL PLANES "X" APART WHICH ARE PERPENDICULAR TO DATUM B. THE SURFACE MUST BE WITHIN THE SPECIFIED LIMITS OF SIZE. | -A) THREADED:<br>1. SHOULDERED GAGE WITH THREADED MANDREL AND FEELER GAGE.<br>2. THREADED MANDREL AND GAGE WITH INDICATOR.<br><br>-B) NONTHREADED:<br>1. CLOSE FIT PIN OR PLUG WITH INDICATOR.<br>2. CLOSEST FIT NONTHREADED PIN FINGER TIGHT TO SHOULDER. |
| 8 |  <br>CENTERPLANE OR AXIS, WHICH IS AT A SPECIFIED ANGLE (OTHER THAN 90°) FROM A DATUM PLAN OR AXIS. |  <br>-THE SURFACE MUST LIE BETWEEN TWO PARALLEL PLANES "X" APART WHICH ARE INCLINED AT 45° TO DATUM PLANE A. THE SURFACE MUST BE WITHIN THE SPECIFIED LIMITS OF SIZE. | -OPTICAL COMPARATOR WITH OR WITHOUT OVERLAY.<br><br>-CALIBRATED JIGS AND FIXTURES. |
| 9 |  <br>-PARALLELISM IS THE CONDITION OF A SURFACE OR CENTERPLANE EQUIDISTANT AT ALL POINTS FROM A DATUM PLANE; OR AN AXIS, EQUIDISTANT ALONG ITS LENGTH FROM ONE OR MORE DATUM PLANES OR A DATUM AXIS. |  <br>-THE SURFACE MUST LIE BETWEEN TWO PARALLEL PLANES "W" APART, WHICH ARE PARALLEL TO DATUM PLANE A. THE SURFACE MUST BE WITHIN THE SPECIFIED LIMITS OF SIZE. | -OPTICAL COMPARATOR WITH PART TURNED TO SHOW HIGH AND LOW SPOT AT 180°.<br><br>-CALIPER OR MICROMETER MEASURED AT SEVERAL POINTS.<br><br>-CALIBRATED JIGS AND FIXTURES. |

| ITEM | GD & T SYMBOL | MEANS THIS PER ASME Y14.5M 2009 | INSPECTION METHOD |
|---|---|---|---|
| 10 |  <br>-CIRCULAR RUNOUT IS THE COMPOSITE DEVIATION FROM THE DESIRED FORM AND ORIENTATION OF ALL ELEMENTS OF A PART SURFACE AT ALL CIRCULAR AND PROFILE MEASURING POSITION DURING FULL ROTATION (360°) OF THE PART ON A DATUM AXIS. |  <br>-AT ANY MEASURING POSITION, EACH CIRCULAR ELEMENT OF THESE SURFACES MUST BE WITHIN THE SPECIFIED RUNOUT TOLERANCE ("Y" FULL INDICATOR MOVEMENT) WHEN THE PART IS ROTATED 360° ABOUT THE DATUM AXIS WITH THE INDICATOR FIXED IN A POSITION NORMAL TO THE TRUE GEOMETRIC SHAPE. THE FEATURE MUST BE WITHIN THE SPECIFIED LIMITS OF SIZE (THIS CONTROLS ONLY THE CIRCULAR ELEMENTS OF THE SURFACE, NOT THE TOTAL SURFACE). | -CONCENTRICITY GAGE AND INDICATOR WITH DATUM FIXED BY SOME MEANS. |
| 11 |  <br>-TOTAL RUNOUT IS THE COMPOSITE DEVIATION FROM THE DESIRED FORM AND ORIENTATION OF ALL ELEMENTS OF A PART SURFACE AT ALL CIRCULAR AND PROFILE MEASURING POSITIONS DURING FULL ROTATION (360°) OF THE PART ON A DATUM AXIS. |  <br>-THE ENTIRE SURFACE MUST LIE WITHIN THE SPECIFIED RUNOUT TOLERANCE ZONE ("Y" FULL INDICATOR MOVEMENT) WHEN THE PART IS ROTATED 360° ABOUT THE DATUM AXIS WITH THE INDICATOR PLACED AT EVERY LOCATION ALONG THE SURFACE IN A POSITION NORMAL TO THE TRUE GEOMETRIC SHAPE WITHOUT RESET OF THE INDICATOR. THE FEATURE MUST BE WITHIN THE SPECIFIED LIMITS OF SIZE. | -CONCENTRICITY GAGE AND INDICATOR WITH DATUM FIXED BY SOME MEANS. |

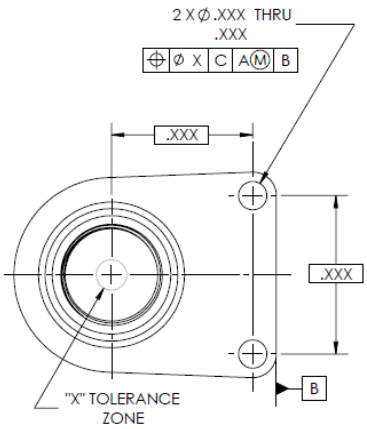
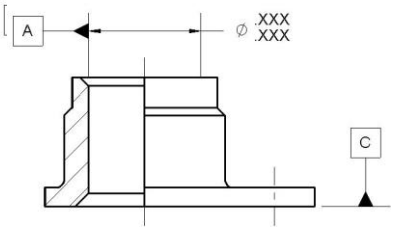
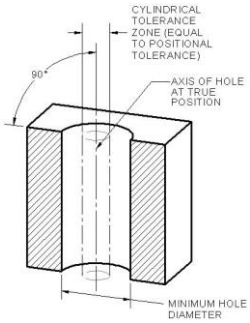
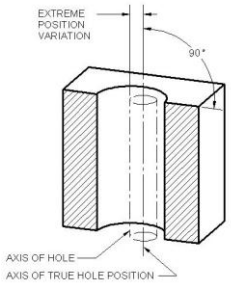
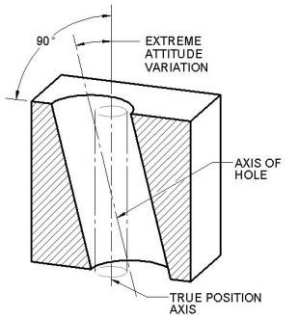
| ITEM | GD & T SYMBOL | MEANS THIS PER ASME Y14.5M 2009 | INSPECTION METHOD |
|---|---|---|---|
| 12 |  <br>  <br>-TRUE POSITION IS THE TERM USED TO DESCRIBE THE PERFECT (EXACT) LOCATION OF A POINT LINE OR PLANE OF A FEATURE IN RELATIONSHIP WITH A DATUM REFERENCE OR OTHER FEATURE. |  <br>-AXIS OF HOLE IS COINCIDENT WITH TRUE POSITION AXIS<br>  <br>-AXIS OF HOLE IS LOCATED AT EXTREME POSITION TO THE LEFT OF TRUE POSITION AXIS (BUT WITHIN TOLERANCE ZONE).<br>  <br>-AXIS OF HOLE IS INCLINED TO EXTREME ATTITUDE WITHIN TOLERANCE ZONE.<br>NOTE THAT THE LENGTH OF THE TOLERANCE ZONE IS EQUAL TO THE LENGTH OF THE FEATURE, UNLESS OTHERWISE SPECIFIED ON THE DRAWING. | -COMPARATOR.<br>-CALIPERS.<br>-COORDINATE MEASURING MACHINE.<br>-CALIBRATED JIGS AND FIXTURES. |

TABLE IV - DEFAULT TOLERANCE VALUES FOR NUTS/NUT PLATES

| THREAD SIZE | W(FIM) | X(FIM) | Y(FIM) | Z(FIM) | | |
|---|---|---|---|---|---|---|
| | | | | 125 KSI & LOWER | 130 KSI THRU 160 KSI | 165 KSI & GREATER |
| .0860 THRU .2500 | .004 | .005 | .010 | .006 | .004 | .003 |
| .3125 THRU .3750 | .006 | .005 | .010 | .008 | .006 | .004 |
| .4375 THRU .5000 | .008 | .010 | .015 | .010 | .007 | .005 |
| .5625 THRU 1.0000 | .008 | .010 | .015 | .012 | .008 | .006 |
| 1.125 THRU 1.5000 | .008 | .015 | .020 | .012 | .008 | .006 |

2. **DETAIL REQUIREMENTS**

5.1 Preparation. When preparing or maintaining NAS part standards, NAS380 shall be adhered to insofar as practicable. Additionally, the appropriate template described herein shall be used.

5.2 Templates. Figures 1 through 8 are the templates that describe the format that shall be used when GD&T symbology is chosen as the preferred method of defining geometric and tolerancing requirements.

5.3 Inspection Methods. Unless otherwise specified, the manufacturer will determine the inspection method that will be used for inspecting the requirements defined on the part standard. In the event that the inspection technique is questioned, the applicable inspection method described herein shall be used as a referee.

5.4 Identification of ASME Y14.5M-2009. Each part standard that utilizes GD&T symbology shall include the following statement: “Interpretation per ASME Y14.5M-2009.”

5.5 Clarification of Terminology. NAS part standards that contain words as opposed to GD&T symbology to define requirements shall be interpreted as follows:

5.5.1 Concentricity. The inspection of all “concentricity” requirements shall be interpreted to mean “runout” as defined in ASME Y14.5M-2009.

5.5.2 Bearing Surface Squareness. “Bearing surface squareness” shall be interpreted to mean “perpendicularity” of a surface as defined in ASME Y14.5M-2009.

5.5.3 Shank Straightness. “Shank straightness” shall be applicable to the shank diameter, as opposed to the surface of the shank and shall be as defined in ASME Y14.5M-2009.

5.5.3.1 Shank Diameter. The shank diameter datum reference shall be identified as Datum “A”.

5.5.3.2 Pitch Diameter. The pitch diameter datum reference shall be identified as Datum “C”.

5.5.3.3 Datum Reference. Fasteners having a shank less that 1 times the nominal shank diameter, and for those externally threaded fasteners threaded to the head, the pitch diameter Datum C will be used for the datum reference.

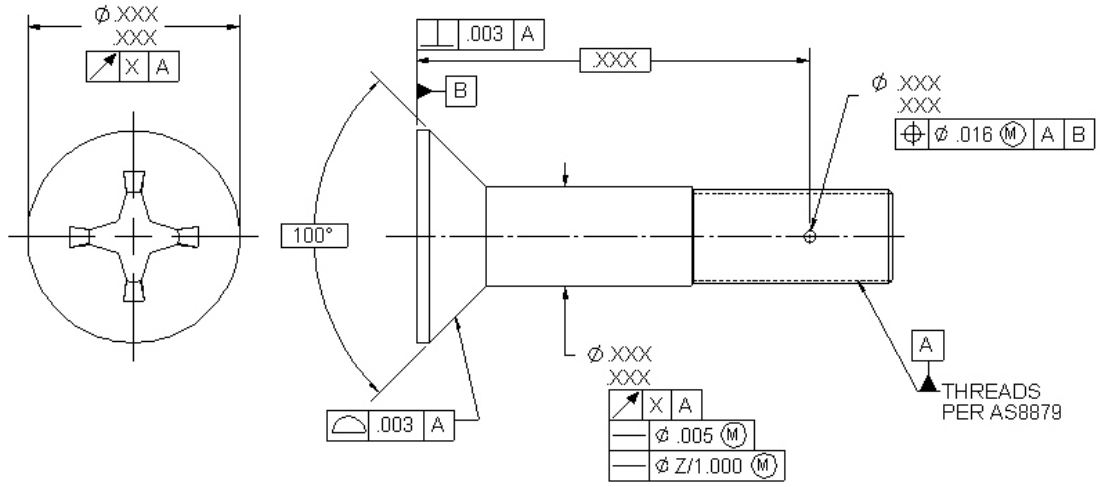



FIGURE 1 – TEMPLATE FOR 100° FLUSH HEAD SCREWS

SEE TABLE I FOR INTERPRETATION AND SUGGESTED INSPECTION METHODS

SEE TABLE II FOR DEFAULT TOLERANCE VALUES

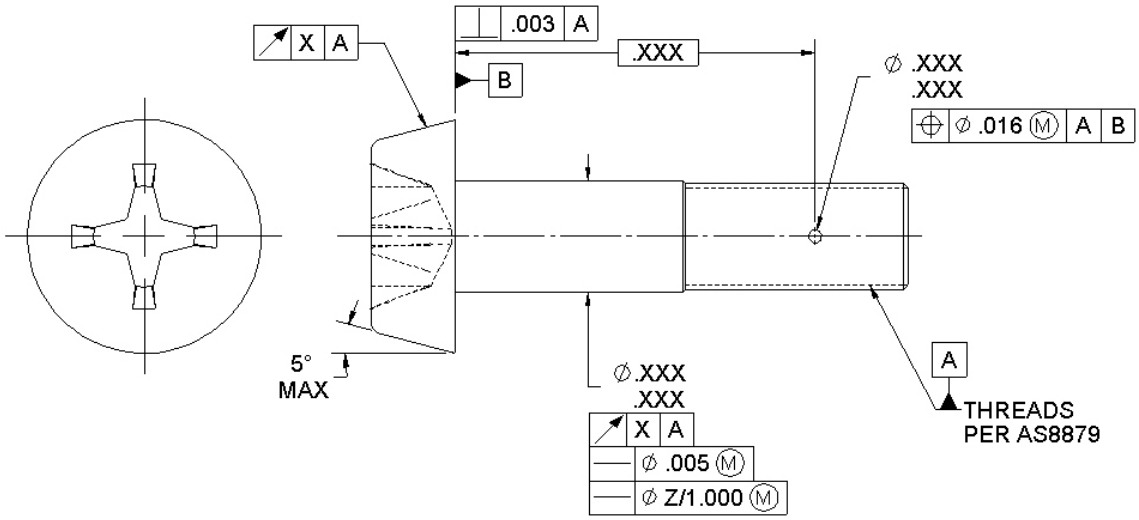



FIGURE 2 – TEMPLATE FOR PROTRUDING HEAD SCREWS

SEE TABLE I FOR INTERPRETATION AND SUGGESTED INSPECTION METHODS

SEE TABLE II FOR DEFAULT TOLERANCE VALUES

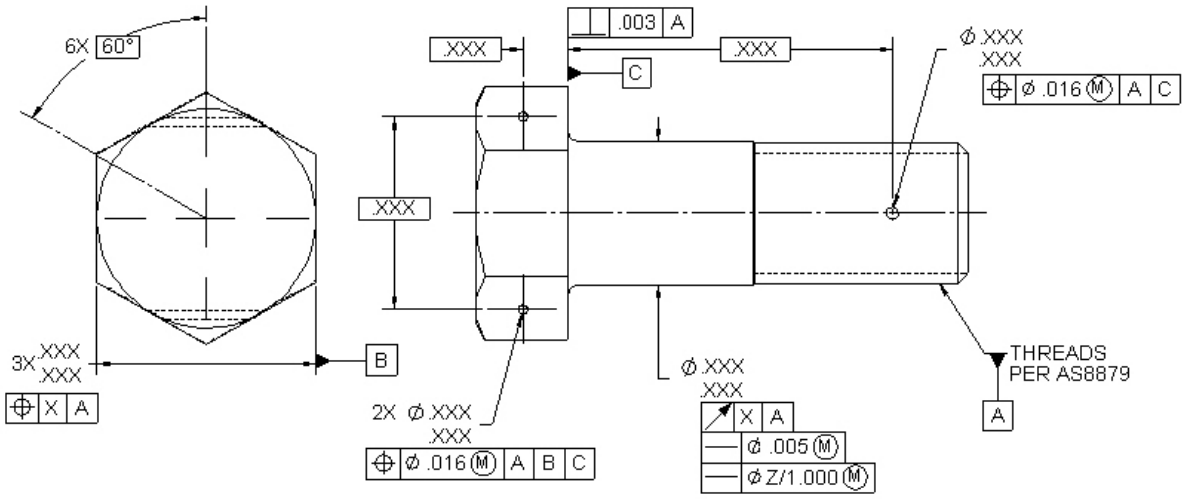



FIGURE 3 – TEMPLATE FOR HEX HEAD FASTENERS

SEE TABLE I FOR INTERPRETATION AND SUGGESTED INSPECTION METHODS

SEE TABLE II FOR DEFAULT TOLERANCE VALUES

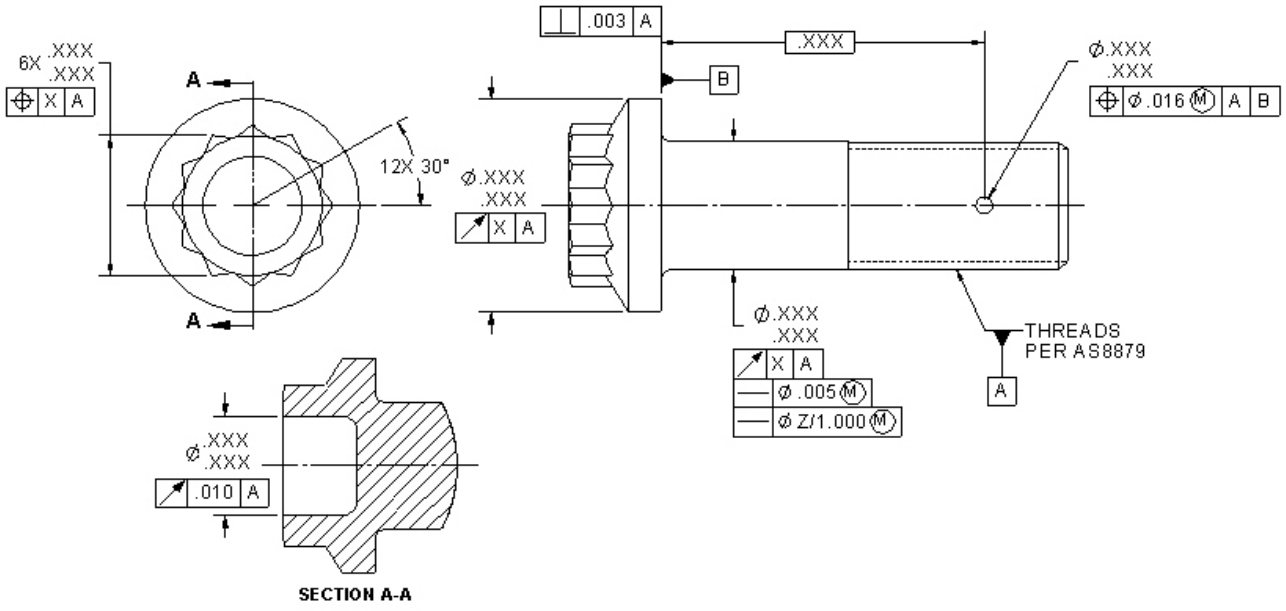



FIGURE 4 – TEMPLATE FOR 12 POINT AND 12 SPLINE FASTENERS

SEE TABLE I FOR INTERPRETATION AND SUGGESTED INSPECTION METHODS

SEE TABLE II FOR DEFAULT TOLERANCE VALUES

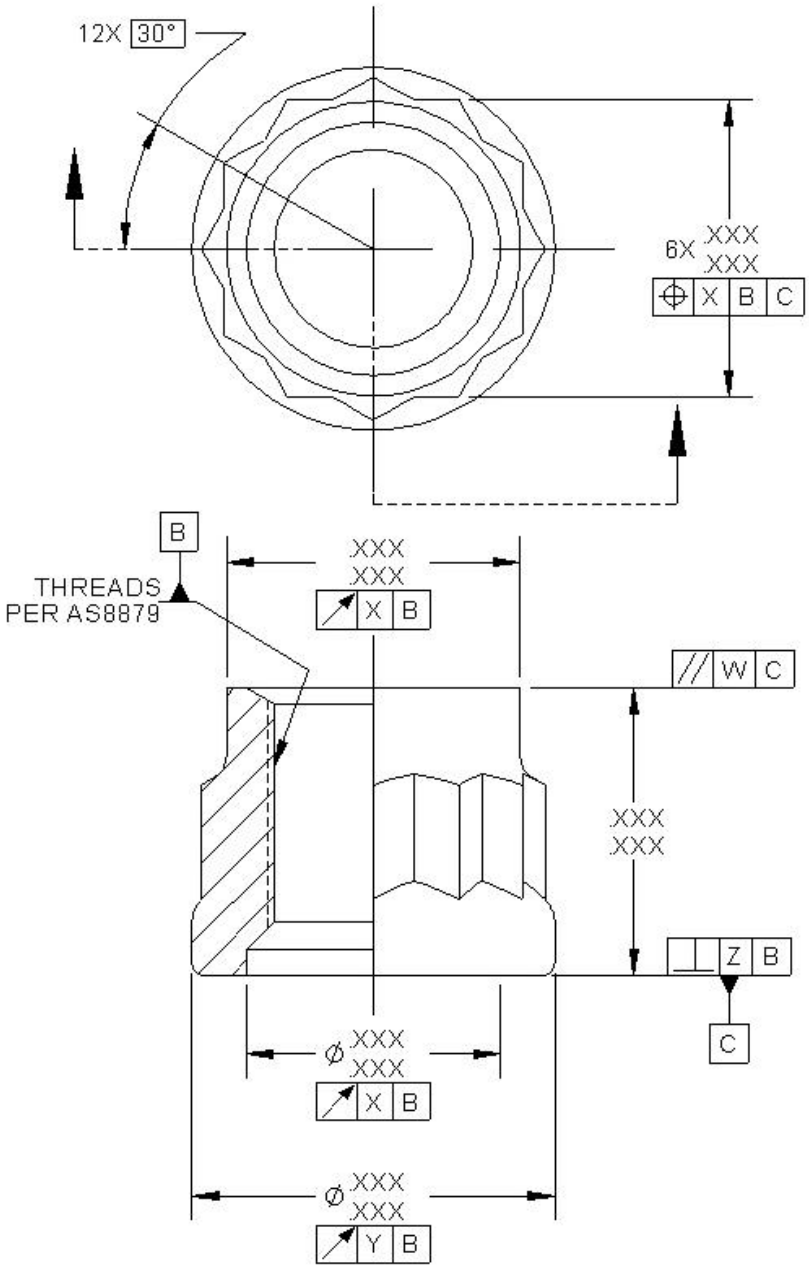



FIGURE 5 – TEMPLATE FOR 12 POINT NUT

SEE TABLE III FOR INTERPRETATION AND SUGGESTED INSPECTION METHODS

SEE TABLE IV FOR DEFAULT TOLERANCE VALUES

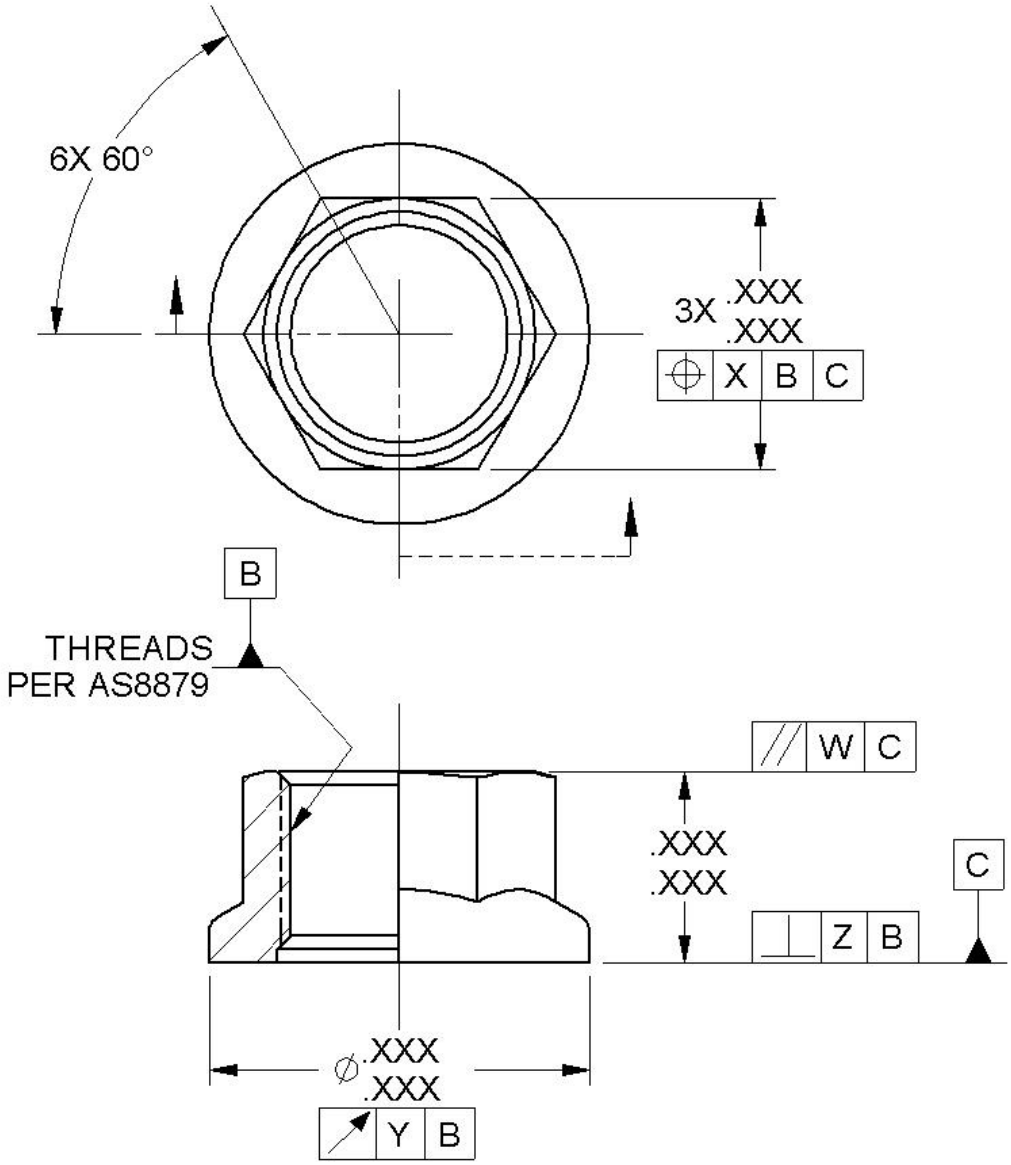



FIGURE 6 – TEMPLATE FOR 6 POINT NUT

SEE TABLE III FOR INTERPRETATION AND SUGGESTED INSPECTION METHODS

SEE TABLE IV FOR DEFAULT TOLERANCE VALUES

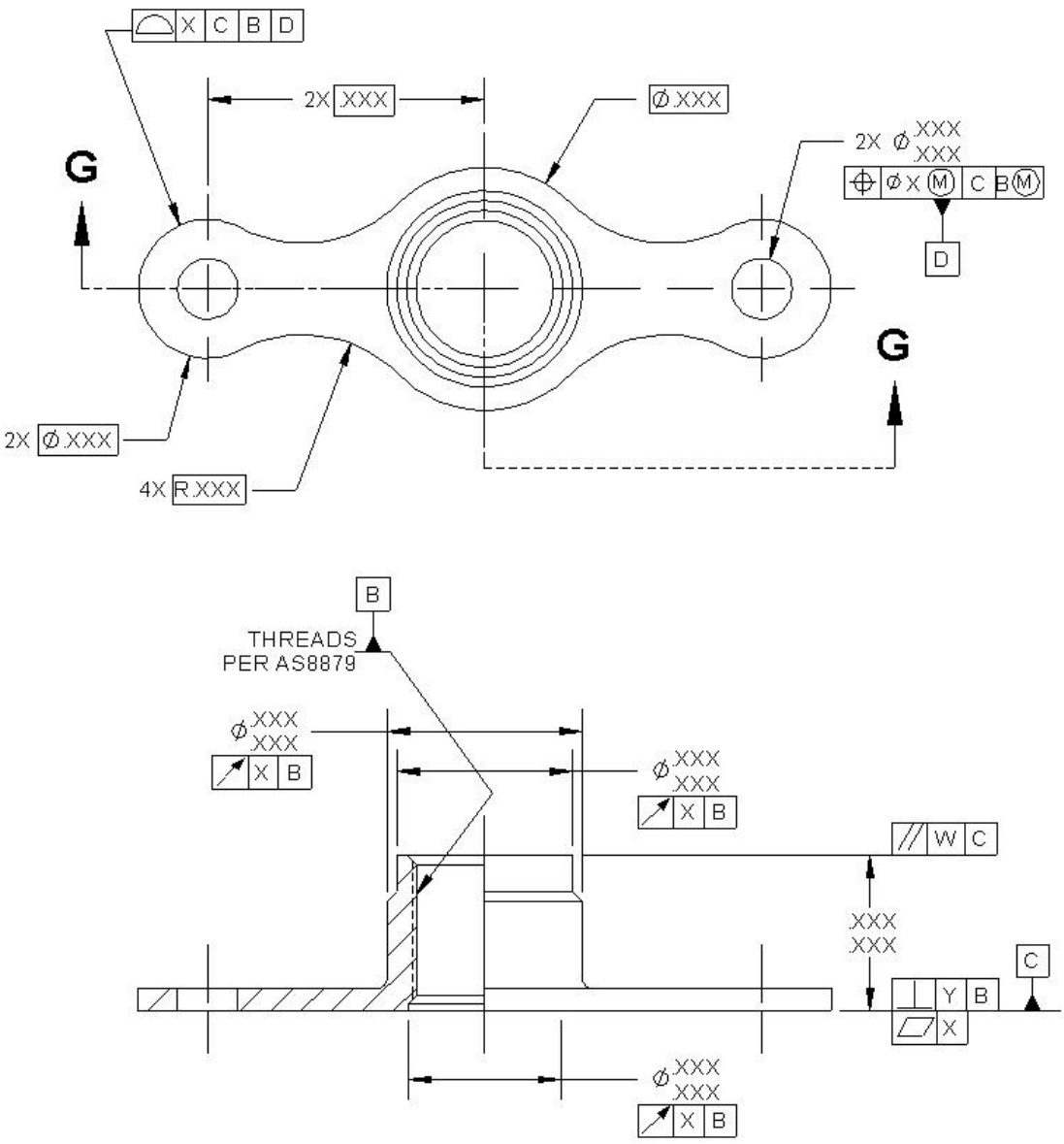



FIGURE 7 – TEMPLATE FOR ANCHOR NUT, TWO LUG

SEE TABLE III FOR INTERPRETATION AND SUGGESTED INSPECTION METHODS

SEE TABLE IV FOR DEFAULT TOLERANCE VALUES

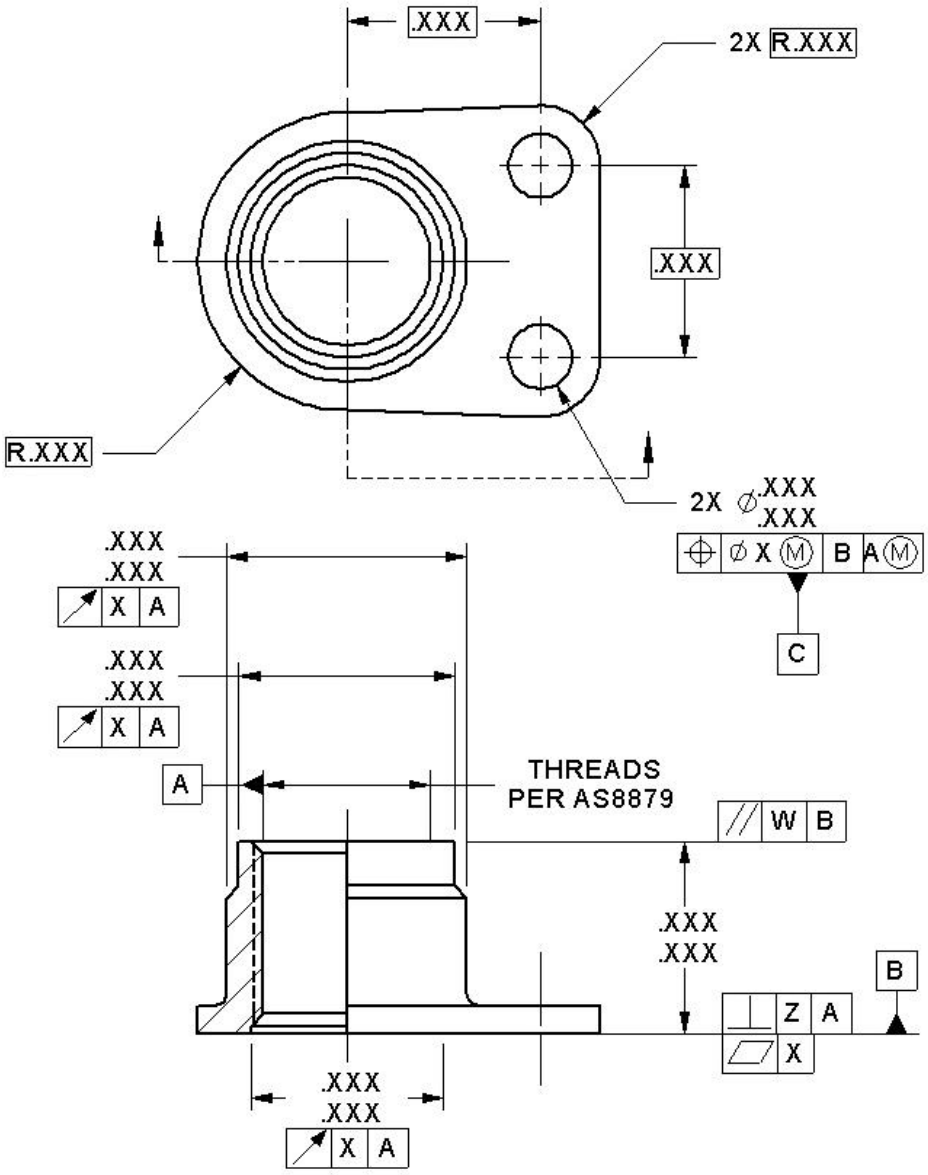



FIGURE 8 – TEMPLATE FOR ANCHOR NUT, SHORT LUG

SEE TABLE III FOR INTERPRETATION AND SUGGESTED INSPECTION METHODS

SEE TABLE IV FOR DEFAULT TOLERANCE VALUES