SAE Aerospace
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AEROSPACE RECOMMENDED PRACTICE

SAE ARP4988

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Procedure for Determining Thrust Wire Lengths and Minimum Insertion Depths

RATIONALE

ARP4988 has been reaffirmed to comply with the SAE five-year review policy.

1. SCOPE:

The scope of this ARP is to define methods of determining wire lengths and minimum insertion depths of thrust wires used for retaining components together.

1.1 Application:

The equations presented herein were developed for use with hexagonal nuts. If an exterior configuration other than hexagon is used, adjustments to the minimum insertion depth equation would be required.

2. REFERENCES:

2.1 Applicable Documents:

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect of the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

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2.1.1 SAE Publications: Available from the SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

AS1790	Nut, Retained, Lightweight
AS1791	Wire, Retainer, Tube Coupling Nut
AS4701	Wire, Retainer, Tube Coupling Nut, Short Flareless
AS4702	Nut, Retained, Short Flareless
AS4370	Nut, Swivel, Wired On

2.1.2 U.S. Government Publications: Available from DODSSP, Subscription Service Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

MS27073	Nut, Tube Coupling - Swivel

2.2 Definitions:

The equations presented herein were developed using the following parameters:

A = Wire Length

B = Wire Diameter

C = Wire Tip Radius

F = Distance from Nut Center to Wire Entrance Hole

G = Nut Hex Size

K = Wire Groove Diameter in Nut

3. ASSUMPTIONS AND PREMISES:

The following assumptions and premises were used in the development of these equations:

3.1 100% circumferential engagement is impossible due to insertion tool interferences.

3.2 The maximum length of wire will completely fill a minimum nut wire groove when the wire diameter is maximum, as shown in Figures 1 and 2. This will minimize the installed gap.

3.3 The driving end of the wire maybe square or radiused. For ease of calculation, it is shown radiused.

3.4 The leading end of the wire has a maximum radius equal to the minimum wire diameter/2. This provides adequate insertion engagement angle and minimizes the installed wire gap.

3.5 Because the leading end radius has a negligible affect on calculated values, for ease of calculation purposes the wire end radius is assumed to be ½ the maximum wire diameter.

3.6 Bending allowance for the wire from experience has been shown to be immeasurable or zero.

3.7 Minimum insertion of the wire will be at insertion tool tangency with the radiused end of the wire with max. wire length, minimum groove diameter and maximum wire diameter, as shown in Figure 2.

3.8 All dimensions are in inches.

4. EQUATIONS:

4.1 Wire Length:

The developed equation for thrust wire length "A" is shown on its associated Figure 1.

4.2 Minimum Insertion Depth:

The developed equation for thrust wire minimum insertion depth from hex surface is shown on its associated Figure 2.

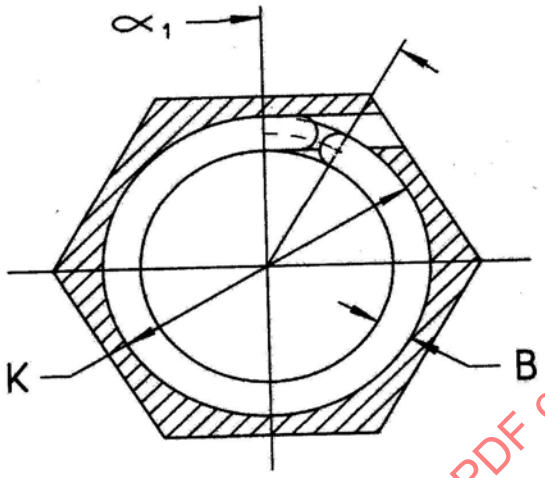

FIGURE 1 - Positioning Used for Calculation of Thrust Wire Length

Assuming a reasonable tolerance on A = ±.015, then:

$$A \pm .015 = \pi(K_{MIN} - B_{MAX})\left(\frac{(360 - \alpha 1)}{360}\right) + \left(\frac{(K_{MIN} - B_{MAX})}{2}\right)\text{SIN}\alpha 1 - .015 \qquad \text{(Eq. 1)}$$

where:

A = Thrust Wire Length

$$\alpha 1 = \text{ACOS}\left(\frac{(K_{MIN} - 2B_{MAX})}{(K_{MIN} - B_{MAX})}\right) \qquad \text{(Eq. 2)}$$

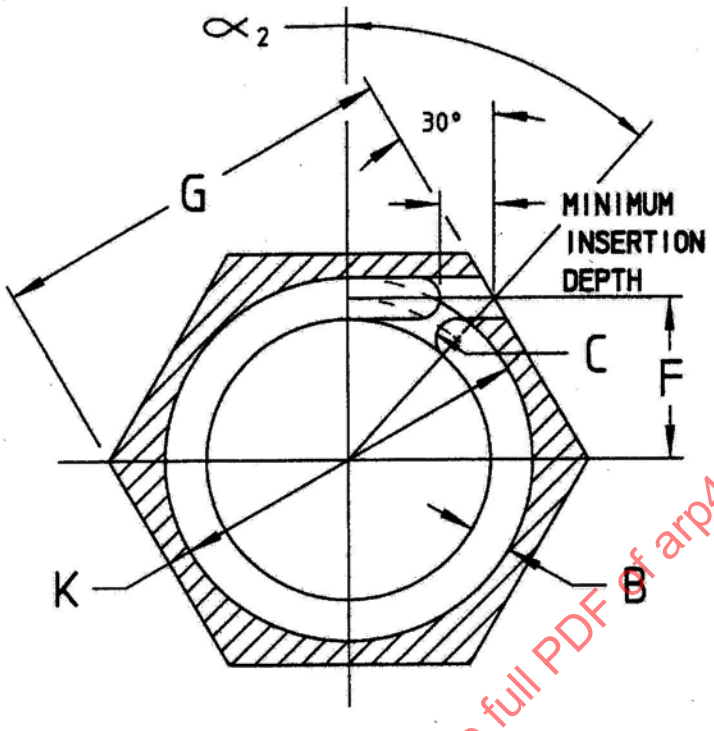

FIGURE 2 - Positioning Used for Calculation of Thrust Wire Minimum Insertion Depth

$$\text{Min. Insertion} = \frac{G_{MIN}}{2\cos 30^\circ} - F_{MAX}(\tan 30^\circ) - A_{MAX} + \pi(K_{MIN} - B_{MAX})\left(\frac{(360 - \alpha 2)}{360}\right) + \frac{B_{MAX}}{2} \qquad \text{(Eq. 3)}$$

where:

$$\alpha 2 = \text{ACOS}\left(\frac{(K_{MIN} - 3B_{MAX})}{(K_{MIN} - B_{MAX})}\right) \qquad \text{(Eq.4)}$$