(R)  O-Ring Tension Testing Calculations

## RATIONALE

This document has been reaffirmed to comply with the SAE 5-year Review policy.

1.  SCOPE:

1.1  Purpose:

This document is intended to facilitate calculation of O-Ring tension testing values.

1.2  Application:

The calculation of the values for tensile strength, ultimate elongation, and modulus at 100% elongation from raw data obtained on O-Rings is outlined in its essentials in ASTM-D-1414. This document provides tables which simplify these calculations. Notations and symbols used herein are not identical to those used in ASTM D 1414.

2.  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 publicatioans shall be the issue in effect on 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.

2.1  SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

AS568    Aerospace Size Standard for O-Rings

2.2  ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM D 1414    Rubber O-Rings

3.  CALCULATIONS:

3.1  Elongation:

ASTM D 1414 provides the following equation for calculation of ultimate elongation.

$$\%E = \frac{(2d + G - C) \times 100}{C} \qquad \text{(Eq. 1)}$$

Where

G = circumference of one spool,
C = original inside circumference of O-Ring,
d = spool center-to-center distance at time of rupture, and
E = elongation.

The raw data consists of the inside diameter of the O-Ring (denoted as D in the following), the spool diameter (S), and the spool center-to-center distance (d) at break. It should be noted that one spool must be driven and the other freely rotating in order that the stress be uniformly distributed around the entire ring. Use of nonrotating pins leaves the contact length(s) of the O-Ring substantially unstressed because of friction between O-Ring and pin(s), unless the O-Ring is suitably lubricated (silicone oil or castor oil is suggested) immediately prior to testing. Laboratories attempting to correlate data should agree upon spool or pin diameters and the particular lubricant to be used.

Equation (5) below is derived from equation (1) and, with Table 1, is directly and simply applicable to the calculation of percent elongation.

$$C = \pi D \qquad \text{(Eq. 2)}$$

$$G = \pi S \qquad \text{(Eq. 3)}$$

$$E = \frac{2d + \pi S - \pi D}{\pi D} \qquad \text{(Eq. 4)}$$

$$E = \frac{2}{\pi D} d - \frac{D - S}{D} \qquad \text{(Eq. 5)}$$

The terms $\frac{2}{\pi D}$ and $\frac{D - S}{D}$ are constants for any given O-Ring size and spool diameter. Tables 1 and 1A give values for these terms for AS568 dash numbers when tested on either the standard 0.500 inch diameter spools for ring sizes which will be accepted by them, or 0.250 inch diameter spools for smaller sizes. Similar tables for other spool diameters can be constructed by using equation (5) above. In using the table, multiply the spool center-to-center distance, (d), by the number in the column headed "multiply (d) by", and subtract from the result the number in the column headed "and subtract". This result must then be multiplied by 100 in order to obtain percent elongation. The calculated terms given are based on the mean value of the O-Ring inside diameter.

3.2    Modulus at 100%:

The value for modulus at 100% elongation is the tensile stress at this elongation. In order to note the tensile stress, the spool center-to-center distance must be predetermined for 100% elongation. In order to do so, equation (5) is used, setting E = 1 in this case.

$$E \; = \; 1 \; = \; \frac{2}{\pi D} \; d - \frac{D - S}{D} \qquad\qquad \text{(Eq. 6)}$$

$$d_{100} \; = \; \frac{\left(1 + \dfrac{D - S}{D}\right)\pi D}{2} \qquad\qquad \text{(Eq. 7)}$$

$$d_{100} \; = \; \frac{\pi}{2} \, (2D - S) \qquad\qquad \text{(Eq. 8)}$$

The values for the spool center-to-center distance for 100% elongation, $d_{100}$, are calculated from equation (8) and given in Tables 2 and 2A. The machine readings for modulus at 100% must be converted to psi in accordance with the following discussion on tensile strength.

3.3    Tensile Strength:

Defined as follows:

$$T \; = \; \frac{F}{A} \qquad\qquad \text{(Eq. 9)}$$

Where

(T) is the tensile strength in psi,
(F) the force in pounds (i.e. machine reading) and
(A) is the area under stress.

In the case of O-Rings tested on spools the area (A), is equal to twice the cross section area of the ring. The total area (A), determined from the actual cross section diameter, (W), is:

$$A \; = \; 2\pi \left(\frac{W^2}{2}\right) \qquad\qquad \text{(Eq. 10)}$$

$$A \; = \; \frac{\pi W^2}{2} \qquad\qquad \text{(Eq. 11)}$$

3.3  (Continued):

Equation (9) may be restated as:

$$T \ = \ F\left(\frac{1}{A}\right) \ = \ F\left(\frac{2}{\pi W^2}\right) \qquad \text{(Eq. 12)}$$

The values for 1/A for each 0.001 inch interval within the AS568 tolerances are given in Table 3. To obtain tensile strength simply multiply the machine reading, (F), by the values given for 1/A in this table. This table is also used for calculation of modulus as mentioned in 3.2.

4.  EXAMPLE:

Size AS568-218
Measured W = 0.141 inch

From Table 2 determine that stress for 100% modulus is to be noted when spool center-to-center distance ($d_{100}$) is 3.09 inches.

If:

machine reading at $d_{100}$ = 21 pounds

machine reading at break = 43 pounds

spool center-to-center distance (d) at break = 5.6 inches

Then:

%E = [(0.516) (5.6) – 0.595] x 100

= [2.890 – 0.595] x 100

%E = 230%

The numbers 0.516 and 0.595 are taken from Table 1 opposite size AS568-218.

$M_{100}$  = (21) (32)

$M_{100}$  = 672 psi

T  = (43) (32)

T  = 1376 psi

The number 32.0 is taken from Table 3 opposite W = 0.141.

5.  COMMENTS:

Tables 1 and 2 on the following pages are based on the use of standard 0.500 inch diameter spools and show values for O-Rings from 1 to 6 inches nominal ID. Tables 1A and 2A are based on the use of 0.250 inch diameter spools and show values for O-Rings from 0.250 inch up to 1 inch nominal ID. In order to run the smallest of these sizes it is necessary to use nonrotating semicircular cross-section pins of 0.250 inch diameter. In this manner it is possible to reduce the pin "center-to-center distance" to virtually zero for the start of the test and install the rings on the pins without excessive prestressing. The use of spools or pins smaller than 0.250 inch diameter is not recommended, because the sharp bending stress where the ring passes over smaller pins can yield low and erratic values.

PREPARED UNDER THE JURISDICTION OF
AMS COMMITTEE "CE"

TABLE 1 - For 0.500 Inch Spools

| AS568 Dash Nos. | ID | W | Multiply "d" by | And Subtract |
|---|---|---|---|---|
| -022 | 0.989 ± 0.010 | 0.070 ± 0.003 | 0.644 | 0.494 |
| -023 | 1.051 ± 0.010 | 0.070 ± 0.003 | 0.606 | 0.524 |
| -024 | 1.114 ± 0.010 | 0.070 ± 0.003 | 0.571 | 0.551 |
| -025 | 1.176 ± 0.011 | 0.070 ± 0.003 | 0.541 | 0.575 |
| -026 | 1.239 ± 0.011 | 0.070 ± 0.003 | 0.514 | 0.596 |
| -027 | 1.301 ± 0.011 | 0.070 ± 0.003 | 0.489 | 0.616 |
| -028 | 1.364 ± 0.013 | 0.070 ± 0.003 | 0.467 | 0.633 |
| -029 | 1.489 ± 0.013 | 0.070 ± 0.003 | 0.428 | 0.664 |
| -030 | 1.614 ± 0.013 | 0.070 ± 0.003 | 0.394 | 0.690 |
| -031 | 1.739 ± 0.015 | 0.070 ± 0.003 | 0.366 | 0.712 |
| -032 | 1.864 ± 0.015 | 0.070 ± 0.003 | 0.342 | 0.732 |
| -033 | 1.989 ± 0.018 | 0.070 ± 0.003 | 0.320 | 0.749 |
| -034 | 2.114 ± 0.018 | 0.070 ± 0.003 | 0.301 | 0.763 |
| -035 | 2.239 ± 0.018 | 0.070 ± 0.003 | 0.284 | 0.777 |
| -036 | 2.364 ± 0.018 | 0.070 ± 0.003 | 0.269 | 0.788 |
| -037 | 2.489 ± 0.018 | 0.070 ± 0.003 | 0.256 | 0.799 |
| -038 | 2.614 ± 0.020 | 0.070 ± 0.003 | 0.244 | 0.809 |
| -039 | 2.739 ± 0.020 | 0.070 ± 0.003 | 0.232 | 0.817 |
| -040 | 2.864 ± 0.020 | 0.070 ± 0.003 | 0.222 | 0.825 |
| -041 | 2.989 ± 0.020 | 0.070 ± 0.003 | 0.213 | 0.833 |
| -042 | 3.239 ± 0.024 | 0.070 ± 0.003 | 0.197 | 0.846 |
| -043 | 3.489 ± 0.024 | 0.070 ± 0.003 | 0.182 | 0.857 |
| -044 | 3.739 ± 0.027 | 0.070 ± 0.003 | 0.170 | 0.866 |
| -045 | 3.989 ± 0.027 | 0.070 ± 0.003 | 0.160 | 0.875 |
| | | | | |
| -120 | 0.987 ± 0.010 | 0.103 ± 0.003 | 0.645 | 0.493 |
| -121 | 1.049 ± 0.010 | 0.103 ± 0.003 | 0.607 | 0.523 |
| -122 | 1.112 ± 0.010 | 0.103 ± 0.003 | 0.573 | 0.550 |
| -123 | 1.174 ± 0.012 | 0.103 ± 0.003 | 0.542 | 0.574 |
| -124 | 1.237 ± 0.012 | 0.103 ± 0.003 | 0.515 | 0.596 |
| -125 | 1.299 ± 0.012 | 0.103 ± 0.003 | 0.490 | 0.615 |
| -126 | 1.362 ± 0.012 | 0.103 ± 0.003 | 0.467 | 0.633 |
| -127 | 1.424 ± 0.012 | 0.103 ± 0.003 | 0.447 | 0.649 |
| -128 | 1.487 ± 0.012 | 0.103 ± 0.003 | 0.428 | 0.664 |
| -129 | 1.549 ± 0.015 | 0.103 ± 0.003 | 0.411 | 0.677 |
| -130 | 1.612 ± 0.015 | 0.103 ± 0.003 | 0.395 | 0.690 |
| -131 | 1.674 ± 0.015 | 0.103 ± 0.003 | 0.380 | 0.701 |
| -132 | 1.737 ± 0.015 | 0.103 ± 0.003 | 0.367 | 0.712 |
| -133 | 1.799 ± 0.015 | 0.103 ± 0.003 | 0.354 | 0.722 |
| -134 | 1.862 ± 0.015 | 0.103 ± 0.003 | 0.342 | 0.731 |
| -135 | 1.925 ± 0.017 | 0.103 ± 0.003 | 0.331 | 0.740 |
| -136 | 1.987 ± 0.017 | 0.103 ± 0.003 | 0.320 | 0.748 |
| -137 | 2.050 ± 0.017 | 0.103 ± 0.003 | 0.311 | 0.756 |

TABLE 1 - For 0.500 Inch Spools  (Continued)

| AS568 Dash Nos. | ID | W | Multiply "d" by | And Subtract |
|---|---|---|---|---|
| -138 | 2.112 ± 0.017 | 0.103 ± 0.003 | 0.301 | 0.763 |
| -139 | 2.175 ± 0.017 | 0.103 ± 0.003 | 0.293 | 0.770 |
| -140 | 2.237 ± 0.017 | 0.103 ± 0.003 | 0.285 | 0.776 |
| -141 | 2.300 ± 0.020 | 0.103 ± 0.003 | 0.277 | 0.783 |
| -142 | 2.362 ± 0.020 | 0.103 ± 0.003 | 0.270 | 0.788 |
| -143 | 2.425 ± 0.020 | 0.103 ± 0.003 | 0.263 | 0.794 |
| -144 | 2.487 ± 0.020 | 0.103 ± 0.003 | 0.256 | 0.799 |
| -145 | 2.550 ± 0.020 | 0.103 ± 0.003 | 0.250 | 0.804 |
| -146 | 2.612 ± 0.020 | 0.103 ± 0.003 | 0.244 | 0.809 |
| -147 | 2.675 ± 0.022 | 0.103 ± 0.003 | 0.238 | 0.813 |
| -148 | 2.737 ± 0.022 | 0.103 ± 0.003 | 0.233 | 0.817 |
| -149 | 2.800 ± 0.022 | 0.103 ± 0.003 | 0.227 | 0.821 |
| -150 | 2.862 ± 0.022 | 0.103 ± 0.003 | 0.222 | 0.825 |
| -151 | 2.987 ± 0.024 | 0.103 ± 0.003 | 0.213 | 0.833 |
| -152 | 3.237 ± 0.024 | 0.103 ± 0.003 | 0.197 | 0.846 |
| -153 | 3.487 ± 0.024 | 0.103 ± 0.003 | 0.183 | 0.857 |
| -154 | 3.737 ± 0.028 | 0.103 ± 0.003 | 0.170 | 0.866 |
| -155 | 3.987 ± 0.028 | 0.103 ± 0.003 | 0.160 | 0.875 |
| -156 | 4.237 ± 0.030 | 0.103 ± 0.003 | 0.150 | 0.882 |
| -157 | 4.487 ± 0.030 | 0.103 ± 0.003 | 0.142 | 0.889 |
| -158 | 4.737 ± 0.030 | 0.103 ± 0.003 | 0.134 | 0.894 |
| -159 | 4.987 ± 0.035 | 0.103 ± 0.003 | 0.128 | 0.900 |
| -160 | 5.237 ± 0.035 | 0.103 ± 0.003 | 0.122 | 0.905 |
| -161 | 5.487 ± 0.035 | 0.103 ± 0.003 | 0.116 | 0.909 |
| -162 | 5.737 ± 0.035 | 0.103 ± 0.003 | 0.111 | 0.913 |
| -163 | 5.987 ± 0.035 | 0.103 ± 0.003 | 0.106 | 0.916 |
| | | | | |
| -214 | 0.984 ± 0.010 | 0.139 ± 0.004 | 0.647 | 0.492 |
| -215 | 1.046 ± 0.010 | 0.139 ± 0.004 | 0.609 | 0.522 |
| -216 | 1.109 ± 0.012 | 0.139 ± 0.004 | 0.574 | 0.549 |
| -217 | 1.171 ± 0.012 | 0.139 ± 0.004 | 0.544 | 0.573 |
| -218 | 1.234 ± 0.012 | 0.139 ± 0.004 | 0.516 | 0.595 |
| -219 | 1.296 ± 0.012 | 0.139 ± 0.004 | 0.491 | 0.614 |
| -220 | 1.359 ± 0.012 | 0.139 ± 0.004 | 0.468 | 0.632 |
| -221 | 1.421 ± 0.012 | 0.139 ± 0.004 | 0.448 | 0.648 |
| -222 | 1.484 ± 0.015 | 0.139 ± 0.004 | 0.429 | 0.663 |
| -223 | 1.609 ± 0.015 | 0.139 ± 0.004 | 0.396 | 0.689 |
| -224 | 1.734 ± 0.015 | 0.139 ± 0.004 | 0.367 | 0.712 |
| -225 | 1.859 ± 0.018 | 0.139 ± 0.004 | 0.342 | 0.731 |
| -226 | 1.984 ± 0.018 | 0.139 ± 0.004 | 0.321 | 0.748 |
| -227 | 2.109 ± 0.018 | 0.139 ± 0.004 | 0.302 | 0.763 |
| -228 | 2.234 ± 0.020 | 0.139 ± 0.004 | 0.285 | 0.776 |
| -229 | 2.359 ± 0.020 | 0.139 ± 0.004 | 0.270 | 0.788 |
| -230 | 2.484 ± 0.020 | 0.139 ± 0.004 | 0.256 | 0.799 |
| -231 | 2.609 ± 0.020 | 0.139 ± 0.004 | 0.244 | 0.808 |

TABLE 1 - For 0.500 Inch Spools  (Continued)

| AS568 Dash Nos. | ID | W | Multiply "d" by | And Subtract |
|---|---|---|---|---|
| -232 | 2.734 ± 0.024 | 0.139 ± 0.004 | 0.233 | 0.817 |
| -233 | 2.859 ± 0.024 | 0.139 ± 0.004 | 0.223 | 0.825 |
| -234 | 2.984 ± 0.024 | 0.139 ± 0.004 | 0.213 | 0.832 |
| -235 | 3.109 ± 0.024 | 0.139 ± 0.004 | 0.205 | 0.839 |
| -236 | 3.234 ± 0.024 | 0.139 ± 0.004 | 0.197 | 0.845 |
| -237 | 3.359 ± 0.024 | 0.139 ± 0.004 | 0.190 | 0.851 |
| -238 | 3.484 ± 0.024 | 0.139 ± 0.004 | 0.183 | 0.856 |
| -239 | 3.609 ± 0.028 | 0.139 ± 0.004 | 0.176 | 0.861 |
| -240 | 3.734 ± 0.028 | 0.139 ± 0.004 | 0.170 | 0.866 |
| -241 | 3.859 ± 0.028 | 0.139 ± 0.004 | 0.165 | 0.870 |
| -242 | 3.984 ± 0.028 | 0.139 ± 0.004 | 0.160 | 0.874 |
| -243 | 4.109 ± 0.028 | 0.139 ± 0.004 | 0.155 | 0.878 |
| -244 | 4.234 ± 0.030 | 0.139 ± 0.004 | 0.150 | 0.882 |
| -245 | 4.359 ± 0.030 | 0.139 ± 0.004 | 0.146 | 0.885 |
| -246 | 4.484 ± 0.030 | 0.139 ± 0.004 | 0.142 | 0.888 |
| -247 | 4.609 ± 0.030 | 0.139 ± 0.004 | 0.138 | 0.892 |
| -248 | 4.734 ± 0.030 | 0.139 ± 0.004 | 0.134 | 0.894 |
| -249 | 4.859 ± 0.035 | 0.139 ± 0.004 | 0.131 | 0.897 |
| -250 | 4.984 ± 0.035 | 0.139 ± 0.004 | 0.128 | 0.900 |
| -251 | 5.109 ± 0.035 | 0.139 ± 0.004 | 0.125 | 0.902 |
| -252 | 5.234 ± 0.035 | 0.139 ± 0.004 | 0.122 | 0.904 |
| -253 | 5.359 ± 0.035 | 0.139 ± 0.004 | 0.119 | 0.907 |
| -254 | 5.484 ± 0.035 | 0.139 ± 0.004 | 0.116 | 0.909 |
| -255 | 5.609 ± 0.035 | 0.139 ± 0.004 | 0.113 | 0.911 |
| -256 | 5.734 ± 0.035 | 0.139 ± 0.004 | 0.111 | 0.913 |
| -257 | 5.859 ± 0.035 | 0.139 ± 0.004 | 0.109 | 0.915 |
| -258 | 5.984 ± 0.035 | 0.139 ± 0.004 | 0.106 | 0.916 |
| | | | | |
| -318 | 0.975 ± 0.010 | 0.210 ± 0.005 | 0.653 | 0.487 |
| -319 | 1.037 ± 0.010 | 0.210 ± 0.005 | 0.614 | 0.518 |
| -320 | 1.100 ± 0.012 | 0.210 ± 0.005 | 0.579 | 0.545 |
| -321 | 1.162 ± 0.012 | 0.210 ± 0.005 | 0.548 | 0.570 |
| -322 | 1.225 ± 0.012 | 0.210 ± 0.005 | 0.520 | 0.592 |
| -323 | 1.287 ± 0.012 | 0.210 ± 0.005 | 0.495 | 0.611 |
| -324 | 1.350 ± 0.012 | 0.210 ± 0.005 | 0.472 | 0.630 |
| -325 | 1.475 ± 0.015 | 0.210 ± 0.005 | 0.432 | 0.661 |
| -326 | 1.600 ± 0.015 | 0.210 ± 0.005 | 0.398 | 0.688 |
| -327 | 1.725 ± 0.015 | 0.210 ± 0.005 | 0.369 | 0.710 |
| -328 | 1.850 ± 0.015 | 0.210 ± 0.005 | 0.344 | 0.730 |
| -329 | 1.975 ± 0.018 | 0.210 ± 0.005 | 0.322 | 0.747 |
| -330 | 2.100 ± 0.018 | 0.210 ± 0.005 | 0.303 | 0.762 |
| -331 | 2.225 ± 0.018 | 0.210 ± 0.005 | 0.286 | 0.775 |
| -332 | 2.350 ± 0.018 | 0.210 ± 0.005 | 0.271 | 0.787 |
| -333 | 2.475 ± 0.020 | 0.210 ± 0.005 | 0.257 | 0.798 |
| -334 | 2.600 ± 0.020 | 0.210 ± 0.005 | 0.245 | 0.808 |

TABLE 1 - For 0.500 Inch Spools  (Continued)

| AS568 Dash Nos. | ID | W | Multiply "d" by | And Subtract |
|---|---|---|---|---|
| -335 | 2.725 ± 0.020 | 0.210 ± 0.005 | 0.234 | 0.817 |
| -336 | 2.850 ± 0.020 | 0.210 ± 0.005 | 0.223 | 0.825 |
| -337 | 2.975 ± 0.024 | 0.210 ± 0.005 | 0.214 | 0.832 |
| -338 | 3.100 ± 0.024 | 0.210 ± 0.005 | 0.205 | 0.839 |
| -339 | 3.225 ± 0.024 | 0.210 ± 0.005 | 0.197 | 0.845 |
| -340 | 3.350 ± 0.024 | 0.210 ± 0.005 | 0.190 | 0.851 |
| -341 | 3.475 ± 0.024 | 0.210 ± 0.005 | 0.183 | 0.856 |
| -342 | 3.600 ± 0.028 | 0.210 ± 0.005 | 0.177 | 0.861 |
| -343 | 3.725 ± 0.028 | 0.210 ± 0.005 | 0.171 | 0.866 |
| -344 | 3.850 ± 0.028 | 0.210 ± 0.005 | 0.165 | 0.870 |
| -345 | 3.975 ± 0.028 | 0.210 ± 0.005 | 0.160 | 0.874 |
| -346 | 4.100 ± 0.028 | 0.210 ± 0.005 | 0.155 | 0.878 |
| -347 | 4.225 ± 0.030 | 0.210 ± 0.005 | 0.151 | 0.882 |
| -348 | 4.350 ± 0.030 | 0.210 ± 0.005 | 0.146 | 0.885 |
| -349 | 4.475 ± 0.030 | 0.210 ± 0.005 | 0.142 | 0.888 |
|  |  |  |  |  |
| -425 | 4.475 ± 0.030 | 0.275 ± 0.006 | 0.142 | 0.888 |
| -426 | 4.600 ± 0.030 | 0.275 ± 0.006 | 0.138 | 0.891 |
| -427 | 4.725 ± 0.030 | 0.275 ± 0.006 | 0.135 | 0.894 |
| -428 | 4.850 ± 0.030 | 0.275 ± 0.006 | 0.131 | 0.897 |
| -429 | 4.975 ± 0.037 | 0.275 ± 0.006 | 0.128 | 0.899 |
| -430 | 5.100 ± 0.037 | 0.275 ± 0.006 | 0.125 | 0.902 |
| -431 | 5.225 ± 0.037 | 0.275 ± 0.006 | 0.122 | 0.904 |
| -432 | 5.350 ± 0.037 | 0.275 ± 0.006 | 0.119 | 0.907 |
| -433 | 5.475 ± 0.037 | 0.275 ± 0.006 | 0.116 | 0.909 |
| -434 | 5.600 ± 0.037 | 0.275 ± 0.006 | 0.114 | 0.911 |
| -435 | 5.725 ± 0.037 | 0.275 ± 0.006 | 0.111 | 0.913 |
| -436 | 5.850 ± 0.037 | 0.275 ± 0.006 | 0.109 | 0.915 |
| -437 | 5.975 ± 0.037 | 0.275 ± 0.006 | 0.107 | 0.916 |
|  |  |  |  |  |
| -913 | 0.986 ± 0.010 | 0.116 ± 0.004 | 0.646 | 0.493 |
| -914 | 1.047 ± 0.010 | 0.116 ± 0.004 | 0.608 | 0.522 |
| -916 | 1.171 ± 0.010 | 0.116 ± 0.004 | 0.544 | 0.573 |
| -918 | 1.355 ± 0.012 | 0.116 ± 0.004 | 0.470 | 0.631 |
| -920 | 1.475 ± 0.014 | 0.118 ± 0.004 | 0.432 | 0.661 |
| -924 | 1.720 ± 0.014 | 0.118 ± 0.004 | 0.370 | 0.709 |
| -928 | 2.090 ± 0.018 | 0.118 ± 0.004 | 0.305 | 0.761 |
| -932 | 2.337 ± 0.018 | 0.118 ± 0.004 | 0.272 | 0.786 |

TABLE 1A - For 0.250 Inch Spools

| AS568 Dash Nos. | ID | W | Multiply "d" by | And Subtract |
|---|---|---|---|---|
| -010 | 0.239 ± 0.005 | 0.070 ± 0.003 | 2.664 | 0.046 |
| -011 | 0.301 ± 0.005 | 0.070 ± 0.003 | 2.115 | 0.169 |
| -012 | 0.364 ± 0.005 | 0.070 ± 0.003 | 1.749 | 0.313 |
| -013 | 0.426 ± 0.005 | 0.070 ± 0.003 | 1.494 | 0.413 |
| -014 | 0.489 ± 0.005 | 0.070 ± 0.003 | 1.302 | 0.489 |
| -015 | 0.551 ± 0.007 | 0.070 ± 0.003 | 1.155 | 0.546 |
| -016 | 0.614 ± 0.009 | 0.070 ± 0.003 | 1.037 | 0.593 |
| -017 | 0.676 ± 0.009 | 0.070 ± 0.003 | 0.942 | 0.630 |
| -018 | 0.739 ± 0.009 | 0.070 ± 0.003 | 0.861 | 0.662 |
| -019 | 0.801 ± 0.009 | 0.070 ± 0.003 | 0.795 | 0.688 |
| -020 | 0.864 ± 0.009 | 0.070 ± 0.003 | 0.737 | 0.711 |
| -021 | 0.926 ± 0.009 | 0.070 ± 0.003 | 0.687 | 0.730 |
| | | | | |
| -108 | 0.237 ± 0.009 | 0.103 ± 0.003 | 2.686 | 0.055 |
| -109 | 0.299 ± 0.009 | 0.103 ± 0.003 | 2.129 | 0.164 |
| -110 | 0.362 ± 0.009 | 0.103 ± 0.003 | 1.759 | 0.309 |
| -111 | 0.424 ± 0.009 | 0.103 ± 0.003 | 1.501 | 0.410 |
| -112 | 0.487 ± 0.009 | 0.103 ± 0.003 | 1.307 | 0.487 |
| -113 | 0.549 ± 0.007 | 0.103 ± 0.003 | 1.160 | 0.545 |
| -114 | 0.612 ± 0.009 | 0.103 ± 0.003 | 1.040 | 0.592 |
| -115 | 0.674 ± 0.009 | 0.103 ± 0.003 | 0.945 | 0.629 |
| -116 | 0.737 ± 0.009 | 0.103 ± 0.003 | 0.864 | 0.661 |
| -117 | 0.799 ± 0.010 | 0.103 ± 0.003 | 0.797 | 0.687 |
| -118 | 0.862 ± 0.010 | 0.103 ± 0.003 | 0.739 | 0.710 |
| -119 | 0.924 ± 0.010 | 0.103 ± 0.003 | 0.689 | 0.729 |
| | | | | |
| -202 | 0.234 ± 0.010 | 0.139 ± 0.004 | 2.721 | 0.068 |
| -203 | 0.296 ± 0.010 | 0.139 ± 0.004 | 2.151 | 0.155 |
| -204 | 0.359 ± 0.010 | 0.139 ± 0.004 | 1.773 | 0.304 |
| -205 | 0.421 ± 0.010 | 0.139 ± 0.004 | 1.512 | 0.406 |
| -206 | 0.484 ± 0.010 | 0.139 ± 0.004 | 1.315 | 0.483 |
| -207 | 0.546 ± 0.007 | 0.139 ± 0.004 | 1.166 | 0.542 |
| -208 | 0.609 ± 0.009 | 0.139 ± 0.004 | 1.045 | 0.589 |
| -209 | 0.671 ± 0.010 | 0.139 ± 0.004 | 0.949 | 0.627 |
| -210 | 0.734 ± 0.010 | 0.139 ± 0.004 | 0.867 | 0.659 |
| -211 | 0.796 ± 0.010 | 0.139 ± 0.004 | 0.800 | 0.686 |
| -212 | 0.859 ± 0.010 | 0.139 ± 0.004 | 0.741 | 0.709 |
| -213 | 0.921 ± 0.010 | 0.139 ± 0.004 | 0.691 | 0.729 |
| | | | | |
| -309 | 0.412 ± 0.010 | 0.210 ± 0.005 | 1.545 | 0.393 |
| -310 | 0.475 ± 0.010 | 0.210 ± 0.005 | 1.340 | 0.526 |
| -311 | 0.537 ± 0.007 | 0.210 ± 0.005 | 1.186 | 0.534 |
| -312 | 0.600 ± 0.009 | 0.210 ± 0.005 | 1.061 | 0.583 |

TABLE 1A - For 0.250 Inch Spools  (Continued)

| AS568 Dash Nos. | ID | W | Multiply "d" by | And Subtract |
|---|---|---|---|---|
| -313 | 0.662 ± 0.009 | 0.210 ± 0.005 | 0.962 | 0.622 |
| -314 | 0.725 ± 0.010 | 0.210 ± 0.005 | 0.878 | 0.655 |
| -315 | 0.787 ± 0.010 | 0.210 ± 0.005 | 0.809 | 0.682 |
| -316 | 0.850 ± 0.010 | 0.210 ± 0.005 | 0.749 | 0.706 |
| -317 | 0.912 ± 0.010 | 0.210 ± 0.005 | 0.698 | 0.726 |
|  |  |  |  |  |
| -902 | 0.239 ± 0.010 | 0.064 ± 0.003 | 2.664 | 0.046 |
| -903 | 0.301 ± 0.010 | 0.064 ± 0.003 | 2.115 | 0.169 |
| -904 | 0.351 ± 0.010 | 0.072 ± 0.003 | 1.814 | 0.288 |
| -905 | 0.414 ± 0.010 | 0.072 ± 0.003 | 1.538 | 0.396 |
| -906 | 0.468 ± 0.010 | 0.078 ± 0.003 | 1.360 | 0.466 |
| -907 | 0.530 ± 0.007 | 0.082 ± 0.003 | 1.201 | 0.528 |
| -908 | 0.644 ± 0.009 | 0.087 ± 0.003 | 0.989 | 0.612 |
| -909 | 0.706 ± 0.009 | 0.097 ± 0.003 | 0.902 | 0.646 |
| -910 | 0.755 ± 0.009 | 0.097 ± 0.003 | 0.843 | 0.669 |
| -911 | 0.863 ± 0.009 | 0.116 ± 0.004 | 0.738 | 0.710 |
| -912 | 0.924 ± 0.009 | 0.116 ± 0.004 | 0.689 | 0.729 |

TABLE 2 - For 0.500 Inch Spools

| AS568 Dash Nos. | ID | W | $d_{100}$ |
|---|---|---|---|
| -022 | 0.989 ± 0.010 | 0.070 ± 0.003 | 2.32 |
| -023 | 1.051 ± 0.010 | 0.070 ± 0.003 | 2.52 |
| -024 | 1.114 ± 0.010 | 0.070 ± 0.003 | 2.71 |
| -025 | 1.176 ± 0.011 | 0.070 ± 0.003 | 2.91 |
| -026 | 1.239 ± 0.011 | 0.070 ± 0.003 | 3.11 |
| -027 | 1.301 ± 0.011 | 0.070 ± 0.003 | 3.30 |
| -028 | 1.364 ± 0.013 | 0.070 ± 0.003 | 3.50 |
| -029 | 1.489 ± 0.013 | 0.070 ± 0.003 | 3.89 |
| -030 | 1.614 ± 0.013 | 0.070 ± 0.003 | 4.29 |
| -031 | 1.739 ± 0.015 | 0.070 ± 0.003 | 4.68 |
| -032 | 1.864 ± 0.015 | 0.070 ± 0.003 | 5.07 |
| -033 | 1.989 ± 0.018 | 0.070 ± 0.003 | 5.46 |
| -034 | 2.114 ± 0.018 | 0.070 ± 0.003 | 5.86 |
| -035 | 2.239 ± 0.018 | 0.070 ± 0.003 | 6.25 |
| -036 | 2.364 ± 0.018 | 0.070 ± 0.003 | 6.64 |
| -037 | 2.489 ± 0.018 | 0.070 ± 0.003 | 7.03 |
| -038 | 2.614 ± 0.020 | 0.070 ± 0.003 | 7.43 |
| -039 | 2.739 ± 0.020 | 0.070 ± 0.003 | 7.82 |
| -040 | 2.864 ± 0.020 | 0.070 ± 0.003 | 8.21 |
| -041 | 2.989 ± 0.020 | 0.070 ± 0.003 | 8.60 |
| -042 | 3.239 ± 0.024 | 0.070 ± 0.003 | 9.39 |

TABLE 2 - For 0.500 Inch Spools  (Continued)

| AS568 Dash Nos. | ID | W | $d_{100}$ |
|---|---|---|---|
| -043 | 3.489 ± 0.024 | 0.070 ± 0.003 | 10.18 |
| -044 | 3.739 ± 0.027 | 0.070 ± 0.003 | 10.96 |
| -045 | 3.989 ± 0.027 | 0.070 ± 0.003 | 11.75 |
|  |  |  |  |
| -120 | 0.987 ± 0.010 | 0.103 ± 0.003 | 2.32 |
| -121 | 1.049 ± 0.010 | 0.103 ± 0.003 | 2.51 |
| -122 | 1.112 ± 0.010 | 0.103 ± 0.003 | 2.71 |
| -123 | 1.174 ± 0.012 | 0.103 ± 0.003 | 2.90 |
| -124 | 1.237 ± 0.012 | 0.103 ± 0.003 | 3.10 |
| -125 | 1.299 ± 0.012 | 0.103 ± 0.003 | 3.30 |
| -126 | 1.362 ± 0.012 | 0.103 ± 0.003 | 3.49 |
| -127 | 1.424 ± 0.012 | 0.103 ± 0.003 | 3.69 |
| -128 | 1.487 ± 0.012 | 0.103 ± 0.003 | 3.89 |
| -129 | 1.549 ± 0.015 | 0.103 ± 0.003 | 4.08 |
| -130 | 1.612 ± 0.015 | 0.103 ± 0.003 | 4.28 |
| -131 | 1.674 ± 0.015 | 0.103 ± 0.003 | 4.47 |
| -132 | 1.737 ± 0.015 | 0.103 ± 0.003 | 4.67 |
| -133 | 1.799 ± 0.015 | 0.103 ± 0.003 | 4.87 |
| -134 | 1.862 ± 0.015 | 0.103 ± 0.003 | 5.06 |
| -135 | 1.925 ± 0.017 | 0.103 ± 0.003 | 5.26 |
| -136 | 1.987 ± 0.017 | 0.103 ± 0.003 | 5.46 |
| -137 | 2.050 ± 0.017 | 0.103 ± 0.003 | 5.65 |
| -138 | 2.112 ± 0.017 | 0.103 ± 0.003 | 5.85 |
| -139 | 2.175 ± 0.017 | 0.103 ± 0.003 | 6.05 |
| -140 | 2.237 ± 0.017 | 0.103 ± 0.003 | 6.24 |
| -141 | 2.300 ± 0.020 | 0.103 ± 0.003 | 6.44 |
| -142 | 2.362 ± 0.020 | 0.103 ± 0.003 | 6.64 |
| -143 | 2.425 ± 0.020 | 0.103 ± 0.003 | 6.83 |
| -144 | 2.487 ± 0.020 | 0.103 ± 0.003 | 7.03 |
| -145 | 2.550 ± 0.020 | 0.103 ± 0.003 | 7.23 |
| -146 | 2.612 ± 0.020 | 0.103 ± 0.003 | 7.42 |
| -147 | 2.675 ± 0.022 | 0.103 ± 0.003 | 7.62 |
| -148 | 2.737 ± 0.022 | 0.103 ± 0.003 | 7.81 |
| -149 | 2.800 ± 0.018 | 0.103 ± 0.003 | 8.01 |
| -150 | 2.862 ± 0.018 | 0.103 ± 0.003 | 8.21 |
| -151 | 2.987 ± 0.024 | 0.103 ± 0.003 | 8.60 |
| -152 | 3.237 ± 0.024 | 0.103 ± 0.003 | 9.38 |
| -153 | 3.487 ± 0.024 | 0.103 ± 0.003 | 10.17 |
| -154 | 3.737 ± 0.028 | 0.103 ± 0.003 | 10.95 |
| -155 | 3.987 ± 0.028 | 0.103 ± 0.003 | 11.74 |
| -156 | 4.237 ± 0.030 | 0.103 ± 0.003 | 12.53 |
| -157 | 4.487 ± 0.030 | 0.103 ± 0.003 | 13.31 |
| -158 | 4.737 ± 0.030 | 0.103 ± 0.003 | 14.10 |
| -159 | 4.987 ± 0.035 | 0.103 ± 0.003 | 14.88 |
| -160 | 5.237 ± 0.035 | 0.103 ± 0.003 | 15.67 |

TABLE 2 - For 0.500 Inch Spools  (Continued)

| AS568 Dash Nos. | ID | W | $d_{100}$ |
|---|---|---|---|
| -161 | 5.487 ± 0.035 | 0.103 ± 0.003 | 16.45 |
| -162 | 5.737 ± 0.035 | 0.103 ± 0.003 | 17.24 |
| -163 | 5.987 ± 0.035 | 0.103 ± 0.003 | 18.02 |
| | | | |
| -214 | 0.984 ± 0.010 | 0.139 ± 0.004 | 2.31 |
| -215 | 1.046 ± 0.010 | 0.139 ± 0.004 | 2.50 |
| -216 | 1.109 ± 0.012 | 0.139 ± 0.004 | 2.70 |
| -217 | 1.171 ± 0.012 | 0.139 ± 0.004 | 2.89 |
| -218 | 1.234 ± 0.012 | 0.139 ± 0.004 | 3.09 |
| -219 | 1.296 ± 0.012 | 0.139 ± 0.004 | 3.29 |
| -220 | 1.359 ± 0.012 | 0.139 ± 0.004 | 3.48 |
| -221 | 1.421 ± 0.012 | 0.139 ± 0.004 | 3.68 |
| -222 | 1.484 ± 0.015 | 0.139 ± 0.004 | 3.88 |
| -223 | 1.609 ± 0.015 | 0.139 ± 0.004 | 4.27 |
| -224 | 1.734 ± 0.015 | 0.139 ± 0.004 | 4.66 |
| -225 | 1.859 ± 0.015 | 0.139 ± 0.004 | 5.05 |
| -226 | 1.984 ± 0.015 | 0.139 ± 0.004 | 5.45 |
| -227 | 2.109 ± 0.015 | 0.139 ± 0.004 | 5.84 |
| -228 | 2.234 ± 0.020 | 0.139 ± 0.004 | 6.23 |
| -229 | 2.359 ± 0.020 | 0.139 ± 0.004 | 6.63 |
| -230 | 2.484 ± 0.020 | 0.139 ± 0.004 | 7.02 |
| -231 | 2.609 ± 0.020 | 0.139 ± 0.004 | 7.41 |
| -232 | 2.734 ± 0.024 | 0.139 ± 0.004 | 7.80 |
| -233 | 2.859 ± 0.024 | 0.139 ± 0.004 | 8.20 |
| -234 | 2.984 ± 0.024 | 0.139 ± 0.004 | 8.59 |
| -235 | 3.109 ± 0.024 | 0.139 ± 0.004 | 8.98 |
| -236 | 3.234 ± 0.024 | 0.139 ± 0.004 | 9.37 |
| -237 | 3.359 ± 0.024 | 0.139 ± 0.004 | 9.77 |
| -238 | 3.484 ± 0.024 | 0.139 ± 0.004 | 10.16 |
| -239 | 3.609 ± 0.028 | 0.139 ± 0.004 | 10.55 |
| -240 | 3.734 ± 0.028 | 0.139 ± 0.004 | 10.95 |
| -241 | 3.859 ± 0.028 | 0.139 ± 0.004 | 11.34 |
| -242 | 3.984 ± 0.028 | 0.139 ± 0.004 | 11.73 |
| -243 | 4.109 ± 0.028 | 0.139 ± 0.004 | 12.12 |
| -244 | 4.234 ± 0.030 | 0.139 ± 0.004 | 12.52 |
| -245 | 4.359 ± 0.030 | 0.139 ± 0.004 | 12.91 |
| -246 | 4.484 ± 0.030 | 0.139 ± 0.004 | 13.30 |
| -247 | 4.609 ± 0.030 | 0.139 ± 0.004 | 13.69 |
| -248 | 4.734 ± 0.030 | 0.139 ± 0.004 | 14.09 |
| -249 | 4.859 ± 0.035 | 0.139 ± 0.004 | 14.43 |
| -250 | 4.984 ± 0.035 | 0.139 ± 0.004 | 14.87 |
| -251 | 5.109 ± 0.035 | 0.139 ± 0.004 | 15.26 |
| -252 | 5.234 ± 0.035 | 0.139 ± 0.004 | 15.66 |
| -253 | 5.359 ± 0.035 | 0.139 ± 0.004 | 16.05 |
| -254 | 5.484 ± 0.035 | 0.139 ± 0.004 | 15.44 |