



AEROSPACE STANDARD

AS1132™**REV. K**

Issued 1970-02
Reaffirmed 2004-02
Revised 2021-03

Superseding AS1132J

Bolts, Screws, and Nuts - External Wrenching UNJ Thread, Inch - Design Standard

RATIONALE

This revision corrects typographical errors in Table 1A (dimensions ØV and T) and in Table 10 (AC runout tolerance for double hexagon across points) and corrects “minimum” “maximum” in 3.2.3.8. General editorial revisions and clarifications throughout.

1. SCOPE

The scope of this SAE Aerospace Standard (AS) is to define the following dimensional requirements for double hexagon, hexagon head and tee headed bolts, and nuts with AS8879 UNJ inch series threads primarily for use in propulsion systems. Design requirements are based on UNJC threads for sizes 0.1640 and smaller and UNJF threads for sizes 0.1900 and larger.

1.1 Bolts

- a. Head configurations and dimensions (see 3.1)
- b. Shank configurations and dimensions (see 3.2)
- c. Geometric control (see 3.3)
- d. Surface texture (see 3.4)

1.2 Nuts

- a. Configurations and dimensions (see 4.1)
- b. Geometric control (see 4.2)
- c. Surface texture (see 4.3)

1.3 Strength Classes

Double hexagon bolt heads are shown in two configurations for up to 220 ksi minimum ultimate tensile strength and up to 260 ksi minimum ultimate tensile strength. Nuts configurations are for up to 260 ksi minimum. However, the ability of a design to achieve a given strength class will ultimately depend on the selected material, associated processing, and the specific geometry.

SAE Executive Standards Committee Rules provide that: “This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user.”

SAE reviews each technical report at least every five years at which time it may be revised, reaffirmed, stabilized, or cancelled. SAE invites your written comments and suggestions.

Copyright © 2021 SAE International

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of SAE.

TO PLACE A DOCUMENT ORDER:
Tel: 877-606-7323 (inside USA and Canada)
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
<http://www.sae.org>

SAE WEB ADDRESS:

Full document details: [SAE AS1132K](#)

For more information on this standard, visit
<https://www.sae.org/standards/content/AS1132K/>

Documents

Document Sharing Hub

1.4 Dimensions

1.4.1 Dimensional Units

Dimensions and tolerances in this document are in inches, unless otherwise specified.

1.4.2 Plating and Coatings

Dimensions specified in this document apply after plating and before coating (e.g., dry film lubrication).

1.5 Nomenclature

As defined by the Federal Cataloging System, thread sizes less than 0.1900 are referred to as screws and larger sizes are referred to as bolts. For the purpose of this document, the term bolt will be used for all sizes.

1.6 Templates

Appendices A and B contain basic part drawing templates for a double hexagon bolt and a double hexagon nut based on the recommendations of this standard. They are shown in SAE AS Part Standard formats but can be adapted for use in any drawing format.

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 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.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

AS870	Wrenching Configuration, Bi-Hexagonal (12 Point) Drive, Design Standard For
AS3062	Bolts, Screws and Studs, Screw Thread Requirements
AS3063	Bolts, Screws, and Studs, Geometric Control Requirements
AS5443	Wrenching Element, Spline Drive - Dimensions for
AS8879	Screw Threads - UNJ Profile, Inch, Controlled Radius Root with Increased Minor Diameter

2.1.2 ASME Publications

Available from ASME, P.O. Box 2900, 22 Law Drive, Fairfield, NJ 07007-2900, Tel: 800-843-2763 (U.S./Canada), 001-800-843-2763 (Mexico), 973-882-1170 (outside North America), www.asme.org.

ASME B46.1	Surface Texture (Surface Roughness, Waviness, Lay)
ASME Y14.5M-1994	Dimensioning and Tolerancing
ASME Y14.36M	Surface Texture Symbols

3. GENERAL REQUIREMENTS

3.1 Head Dimensions

3.1.1 Double hexagon headed bolts up to a strength level of 220 ksi minimum fasteners shall have head configuration in accordance with Figure 1A and Table 1A.

3.1.1.1 Where heads are required to be drilled for lockwire or safety wire, the particulars in Figure 1B and Table 1B shall apply.

3.1.2 Double hexagon headed bolts for 260 ksi minimum fasteners shall have head configuration in accordance with Figure 2A and Table 2A.

3.1.2.1 Where heads are required to be drilled for lockwire or safety wire, the particulars in Figure 2B and Table 2B shall apply.

3.1.3 Hexagon headed bolts shall have a head configuration in accordance with Figure 3A and Table 3A.

3.1.3.1 Where heads are required to be drilled for lockwire or safety wire, the particulars in Figure 3B and Table 3B (one hole) and Figure 3C and Table 3C (six holes) shall apply.

3.1.3.2 In the case of hexagon heads, it is necessary to increase the head height to accommodate the holes.

3.1.4 Formulae used for calculating hexagon across flats and the across corner dimensions are as follows:

3.1.4.1 Minimum Width Across Flats

$$AF \text{ min} = AF \text{ nom} - [0.010 (AF \text{ nom})^{0.25}] \quad (\text{Eq. 1})$$

where:

AF nom = nominal width across hexagon flats

3.1.4.2 Maximum Width Across Flats

$$AF \text{ max} = AF \text{ nom} + 0.001 \quad (\text{Eq. 2})$$

where:

AF nom = nominal width across hexagon flats less than 0.500

$$AF \text{ max} = AF \text{ nom} + 0.002 \quad (\text{Eq. 3})$$

where:

AF nom = nominal width across hexagon flats equal to or greater than 0.500

3.1.4.3 Minimum Distance Across Corners

$$E \text{ min} = 1.141 (AF \text{ min}) - 0.009 \quad (\text{Eq. 4})$$

where:

AF min = minimum width across hexagon flats

3.1.5 Tee head bolts shall have a head configuration in accordance with Figure 4 and Table 4A.

3.2 Shank Dimensions

3.2.1 Thread Runout and Lead Threads for Bolts

Thread runout and lead threads shall be in accordance with AS3062.

3.2.2 Coarse Tolerance Shank Bolts

These are bolts having a tolerance on the shank diameter greater than 0.001 and include full shank and pitch diameter shank bolts.

3.2.2.1 Length of bolt from under head (Dimension L, Figures 4B, 5A, and 5B) shall be in increments of 0.0625 up to 2.000 and in steps of 0.125 above 2.000 rounded to three decimal places.

3.2.2.2 Length of Threads, Bolts Not Threaded to Head

$$\text{Thread Length, } L_{\text{nom}} - M_{\text{max}} = 2D + 0.250 \quad (\text{Eq. 5})$$

where:

L nom = nominal overall shank length

M max = maximum length from under head to full thread

D = nominal thread diameter

3.2.2.3 Minimum Length of Plain Shank (N min) and Maximum Length from Under Head to First Full Thread (M max), see Figures 5A and 5B and Table 5

These dimensions fall into two categories with a transitional stage depending on under head overall length (L nom) as described in 3.2.2.3.1 and 3.2.2.3.2.

3.2.2.3.1 Bolts Not Threaded to Head

$$\text{Length to full thread, } M_{\text{max}} = L_{\text{nom}} - (2D + 0.250) \quad (\text{Eq. 6})$$

where:

M max = under head length to full thread, rounded to three decimal places

L nom = nominal overall shank length

D = nominal thread diameter

Length of plain shank (except for transitional sizes, see 3.2.2.3.2 and Table 5):

$$N_{\text{min}} = M_{\text{max}} - 2P - 0.060 \quad (\text{Eq. 7})$$

where:

N min = length of plain shank, rounded to three decimal places

0.060 = tolerance factor

P = pitch of thread

3.2.2.3.2 Bolts Threaded to Head

Where bolts with a simple under head radius, e.g., as in Figure 1A, are threaded to head, the following formulae will apply:

$$N_{\min} = R_{\max} \quad (\text{Eq. 8})$$

Where the bolt has a compound radius, e.g., as in Figure 4, under the head, the following formulae will apply:

$$N_{\min} = \sqrt{(R_2_{\max} - R_1_{\max})^2 - (R_2_{\max} - A_{\max})^2} + R_1_{\max} \quad (\text{Eq. 9})$$

$$M_{\max} = N_{\min} + 2P \quad (\text{Eq. 10})$$

where:

$N_{\min}$ = minimum length of plain shank

$M_{\max}$ = maximum length to full thread rounded to three decimal places

$R_{\max}$ = maximum under head radius

P = pitch of thread

See Figure 4 for $R_1_{\max}$, $R_2_{\max}$, and $A_{\max}$.

Example for thread size 0.1900 - 32, is as follows:

$$N_{\min} = R_{\max} = 0.025$$

$$M_{\max} = N_{\min} + 2P = 0.025 + 0.0625 = 0.0875; \text{ rounded to } 0.088$$

The transition stage for bolts threaded to head occurs when $N_{\min}$ obtained from Equation 7 provides a value less than the under head maximum radius ($R_{\max}$) which is not acceptable.

At this transition stage, the following formulae apply:

$$N_{\min} = R_{\max}, \text{ for threaded to head bolts (Equation 8),}$$

and

$$M_{\max} = L_{\text{nom}} - (2D + 0.250), \text{ for bolts not threaded to head (Equation 6).}$$

The shortest threaded to head bolt length is determined by the following:

$$\text{The shortest to head shank length } L_{\text{nom}} = N_{\min} + 3.5P + 0.8D + 0.062 \quad (\text{Eq. 11})$$

where:

$N_{\min} = R_{\max}$, maximum under head radius

$3.5P$ = thread pitch allowance for lead ($1.5P$) and runout threads ($2P$)

$0.8D$ = nominal nut thickness

0.062 = factor for bolt length increment

Results to be rounded up to the nearest 0.0625 for lengths less than 2.000; for lengths 2.000 and greater, round up to the nearest 0.1250.

The nominal under head shank lengths (L nom) for the shortest and longest threaded to head bolts are listed in Table 4B and Table 5.

3.2.2.4 Diameter of Shank

3.2.2.4.1 Coarse Tolerance Full Shank Bolts

Coarse tolerance full shank bolts (see Figure 6A) shall have a shank 0.001 less than the nominal bolt diameter rounded to 3 decimal places. The tolerance shall be in accordance with Table 6.

3.2.2.4.2 Pitch Diameter Shank Bolts

Pitch diameter shank bolts (see Figure 6B) shall have a shank diameter equal to the maximum (basic) pitch diameter with a plus and minus tolerance of 0.005, see Table 6.

3.2.2.4.3 Threaded to Head Bolts

All bolts where plain shank $N_{min} = R_{max}$ (this includes transitional sizes, see 3.2.1.3.2) shall be designed with pitch diameter shanks.

3.2.3 Close Tolerance Full Shank Bolts

These are bolts with a shank diameter tolerance of 0.001 or less.

3.2.3.1 Nominal length of bolt from under head is determined by $M_{max} + \text{thread length}$. Tolerance applied shall be ± 0.010 .

3.2.3.2 Grip Length (N)

Shall be computed as follows, see Figure 7. Results shall be rounded up to the nearest 0.0625:

$$N_{min} = R_{max} + 0.3D \quad (\text{Eq. 12})$$

where:

N_{min} = minimum grip length

R_{max} = maximum under head fillet radius

D = nominal thread size

0.3 = minimum body length factor

3.2.3.3 Start of First Full Thread (M)

See Figure 7. Shall be computed as follows:

$$M_{max} = N_{min} + 2P + 0.010 \quad (\text{Eq. 13})$$

where:

M_{max} = under head maximum length to full thread

N_{min} = minimum grip length

P = pitch of thread

0.010 = allowance for length tolerance

3.2.3.4 Length of Thread

Length of thread shall be computed as follows, see Figure 7.

$$\text{Thread Length} = 0.062 + \text{maximum nut height} - \text{sum of internal chamfers in nut} + 3P \quad (\text{Eq. 14})$$

where:

0.062 = bolt length increment

3P = 1.5P for lead threads + 1.5P for tolerances on clamped parts and bolt overall length

P = pitch of thread

NOTE 1: For the maximum nut height for strength classes less than 260 ksi, use values in Figures 10 and 14. For strength class 260 ksi, use a factor of 1.4D (D = nominal thread diameter).

NOTE 2: The term “sum of internal chamfers in nut” is included only when the nominal chamfer diameter is greater than the basic major diameter of the nut thread.

NOTE 3: The 1.5P lead threads take into account the fact that the thread pitch diameter will conform to the thread specification at a distance 1.5P from the end of the bolt and therefore will be the start of the full thread.

3.2.3.5 Diameter of Shank

Close tolerance full shank bolts shall have a shank diameter 0.0005 inch less than the nominal bolt diameter with a tolerance of minus 0.001.

3.2.3.6 The maximum thread major diameter shall be modified and be equal to the minimum shank diameter less 0.001.

3.2.3.7 Thread Chamfer

The thread chamfer at the lead threads is controlled by a diameter ($\varnothing AB$) and a 45 degree chamfer; see Figure 6A and Table 6. The requirement is applicable to coarse tolerance full shank bolts, PD shank bolts and close tolerance shank bolts. The values for $\varnothing AB$ in Table 6 are calculated (rounded to three decimal places) as follows:

$$\varnothing AB \text{ max} = \text{Thread D Minimum minor diameter} \quad (\text{Eq. 15})$$

$$\varnothing AB \text{ min} = \varnothing AB \text{ max} - 0.020 \quad (\text{Eq. 16})$$

3.2.3.8 The permissible offset (AK) of the chamfer relative to Thread D maximum major diameter is based on:

$$AK \text{ min} = (\text{Thread D maximum major diameter} - \varnothing AB \text{ max}) 0.5 - 0.005 \quad (\text{Eq. 17})$$

3.3 Geometric and Positional Controls

Geometric and positional controls shall be in accordance with ASME Y14.5M-1994 and AS3063.

NOTE: For definition of the terms coarse tolerance and close tolerance shank bolts as used in Tables 8 and 9, see 3.2.2 and 3.2.3.

3.3.1.1 Straightness

Straightness of the axis of the threads shall be in accordance with the tolerance specified in Table 8 and the requirements of AS3063.

3.3.2 Circular Runout

Circular runout of the plain shank surface to the thread pitch cylinder shall be in accordance with the tolerance specified in Table 9 and the requirements of AS3063.

Circular runout of the double hexagon head flange outer surface, crest of double hexagon, and the crest of the hexagon wrenching surfaces relative to the plain shank surfaces for a length not less than 1.5 times the nominal bolt diameter from the bearing surface shall be in accordance with the tolerance in Table 10 and the requirements of AS3063.

For bolts having a plain shank less than 1.5 times the nominal bolt diameter, the thread pitch cylinder shall replace the plain shank surface (Datum "Y" in Figure 8) and the tolerance in Table 10 are relative to the thread pitch cylinder (Datum "Z" in Figure 8) instead of the plain shank surface.

For close tolerance shank bolts and additional true positional control of the thread major diameter relative to the plain shank is necessary, see Figure 8.

Circular runout of the hexagon head washer face diameter and the double hexagon head flange OD relative to the shank shall be in accordance with Table 10 and the requirements of AS3063.

3.3.3 Perpendicularity.

Perpendicularity of the bearing surface of the double hexagon or hexagon, as applicable, relative to shank shall be in accordance with Table 12 and the requirements of AS3063.

3.4 Surface Texture

Symbols shall be in accordance with ASME Y14.36M and requirements in accordance with ASME B46.1. Head to shank fillet, thread flanks, thread root, shank diameter, and bearing surface shall be 32 microinches (μin). Other surfaces shall be 125 microinches (μin) Ra. See Figure 9.

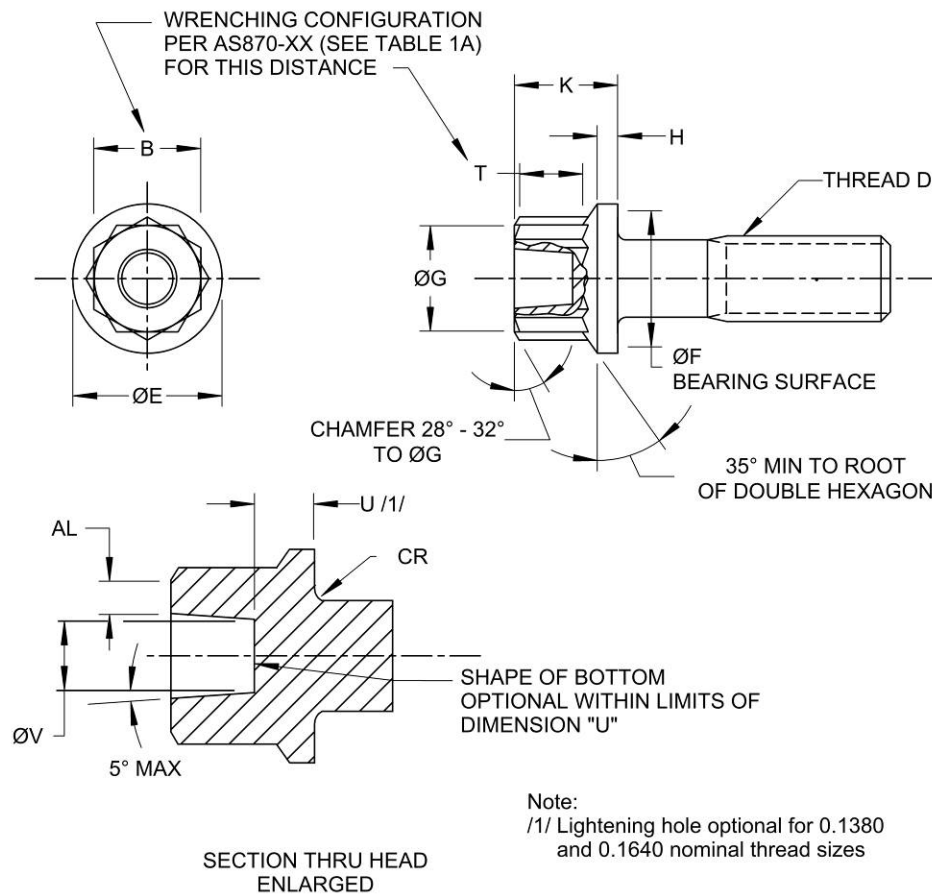


Figure 1A - Head dimensions for double hexagon head bolts

Table 1A - Head dimensions for double hexagon head bolts

D Nominal Thread Size	AS870 Dash No.	B Nominal Size	ØE	ØF Min	ØG	H Min	K	CR	T Min	U	ØV	AL
0.1380	06	0.1875	0.260-0.280	0.230	0.175-0.198	0.030	0.195-0.215	0.010-0.020	0.101	0.068 MIN	0.076 MAX	0.033
0.1640	07	0.2188	0.302-0.322	0.272	0.209-0.229	0.030	0.211-0.231	0.010-0.020	0.112	0.080 MIN	0.082 MAX	0.046
0.1900	08	0.2500	0.365-0.385	0.335	0.240-0.260	0.040	0.248-0.268	0.015-0.025	0.122	0.120-0.160	0.090-0.110	0.047
0.2500	10	0.3125	0.428-0.448	0.398	0.302-0.322	0.060	0.293-0.313	0.015-0.025	0.144	0.158-0.207	0.140-0.160	0.052
0.3125	12	0.3750	0.490-0.510	0.460	0.365-0.385	0.070	0.328-0.348	0.015-0.025	0.166	0.166-0.225	0.196-0.216	0.054
0.3750	14	0.4375	0.552-0.572	0.522	0.428-0.448	0.090	0.373-0.393	0.015-0.025	0.188	0.174-0.243	0.250-0.270	0.055
0.4375	16	0.5000	0.678-0.698	0.648	0.490-0.510	0.110	0.444-0.464	0.020-0.030	0.210	0.202-0.280	0.300-0.320	0.057
0.5000	18	0.5625	0.740-0.760	0.710	0.552-0.572	0.125	0.485-0.505	0.020-0.030	0.232	0.240-0.329	0.360-0.380	0.058
0.5625	20	0.6250	0.865-0.885	0.835	0.615-0.635	0.130	0.551-0.571	0.020-0.030	0.254	0.280-0.382	0.430-0.450	0.052
0.6250	22	0.6875	0.926-0.948	0.898	0.677-0.697	0.150	0.608-0.628	0.025-0.035	0.336	0.325-0.443	0.490-0.510	0.052
0.7500	26	0.8125	1.052-1.072	1.022	0.802-0.822	0.178	0.701-0.721	0.025-0.035	0.371	0.380-0.511	0.560-0.580	0.078
0.8750	30	0.9375	1.239-1.259	1.209	0.927-0.947	0.198	0.798-0.818	0.035-0.045	0.442	0.435-0.580	0.640-0.660	0.095
1.0000	34	1.0625	1.430-1.450	1.400	1.052-1.072	0.222	0.913-0.933	0.045-0.055	0.512	0.490-0.651	0.730-0.750	0.107
1.1250	40	1.2500	1.610-1.630	1.580	1.240-1.260	0.258	1.041-1.064	0.045-0.055	0.572	0.560-0.740	0.830-0.850	0.146
1.2500	42	1.3125	1.800-1.820	1.770	1.302-1.322	0.269	1.145-1.165	0.045-0.055	0.636	0.604-0.804	0.940-0.960	0.117
1.3750	46	1.4375	1.988-2.008	1.958	1.428-1.448	0.274	1.256-1.276	0.055-0.065	0.706	0.683-0.905	1.060-1.080	0.117
1.5000	52	1.6250	2.176-2.196	2.146	1.615-1.635	0.335	1.424-1.444	0.055-0.065	0.849	0.747-0.942	1.190-1.210	0.137

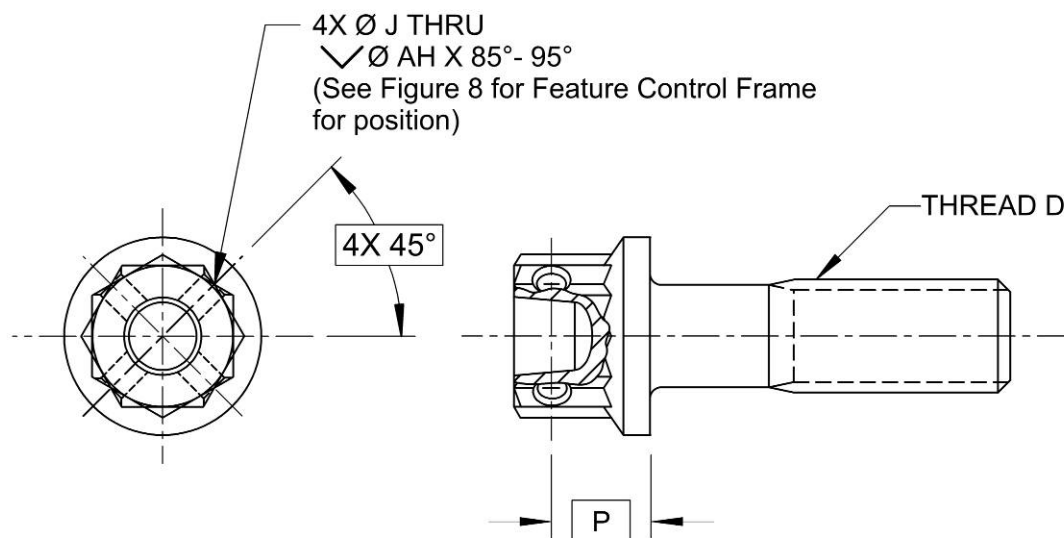


Figure 1B - Drilled head dimensions for double hexagon head bolts

Table 1B - Drilled head dimensions for double hexagon head bolts

D Nominal Thread Size	ØJ	P	ØAH
0.1380	0.042-0.052	0.137	0.060-0.070
0.1640	0.042-0.052	0.152	0.060-0.070
0.1900	0.042-0.052	0.187	0.060-0.070
0.2500	0.060-0.070	0.219	0.080-0.090
0.3125	0.060-0.080	0.241	0.090-0.110
0.3750	0.060-0.080	0.283	0.090-0.110
0.4375	0.060-0.080	0.351	0.090-0.110
0.5000	0.060-0.080	0.389	0.090-0.110
0.5625	0.060-0.080	0.452	0.090-0.110
0.6250	0.060-0.080	0.500	0.090-0.110
0.7500	0.060-0.080	0.555	0.090-0.110
0.8750	0.090-0.110	0.610	0.120-0.145
1.0000	0.090-0.110	0.660	0.120-0.145
1.1250	0.115-0.135	0.730	0.145-0.170
1.2500	0.115-0.135	0.810	0.145-0.170
1.3750	0.115-0.135	0.870	0.145-0.170
1.5000	0.115-0.135	0.925	0.145-0.170

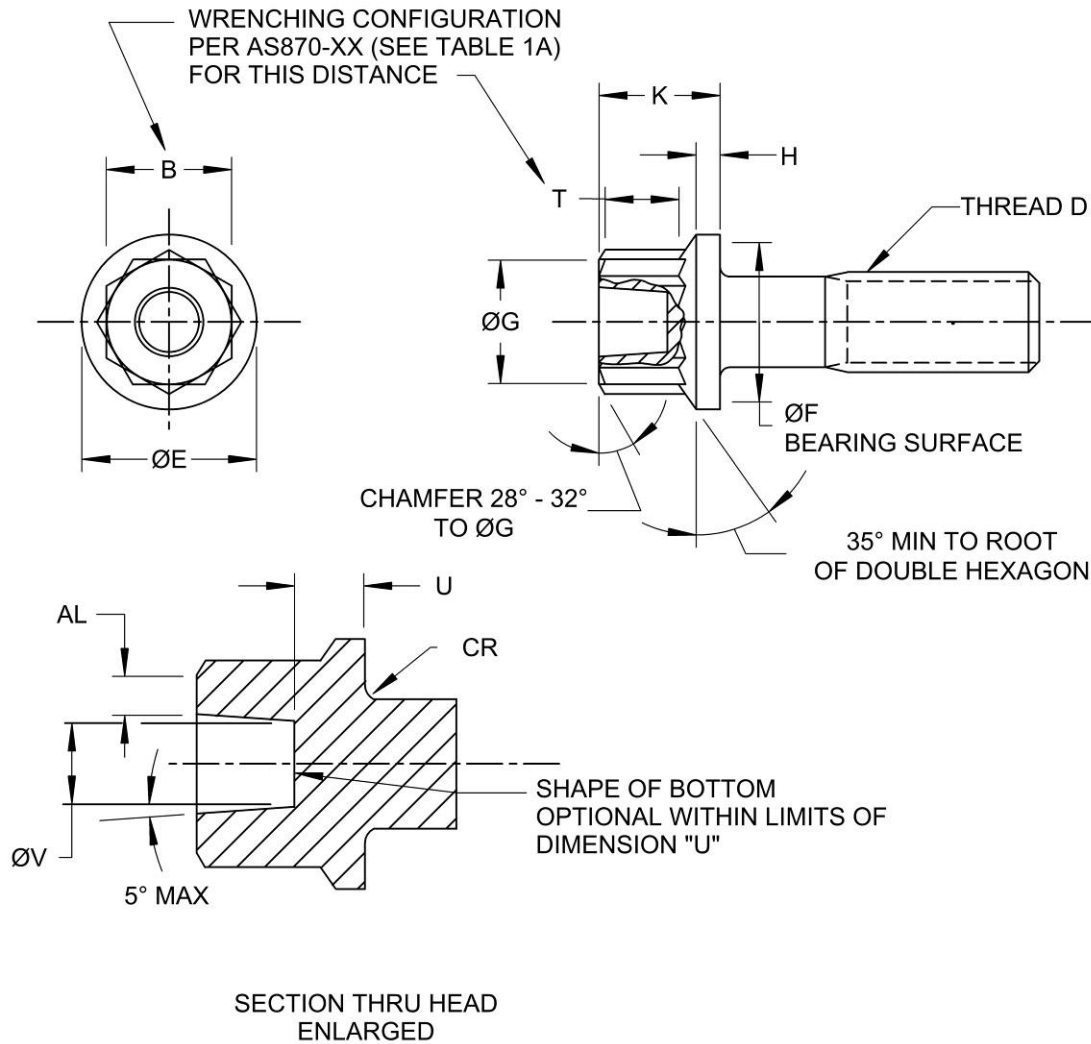


Figure 2A - Head dimensions for double hexagon head bolts (260 ksi min)

Table 2A - Head dimensions for double hexagon head bolts (260 ksi min)

D Nominal Thread Size	AS870 Dash No.	B Nominal Size	ØE	ØF Min	ØG	H Min	K	CR	T Min	U	ØV	AL
0.1900	08	0.2500	0.365-0.385	0.335	0.240-0.260	0.020	0.248-0.268	0.015-0.025	0.122	0.114-0.154	0.090-0.110	0.046
0.2500	10	0.3125	0.455-0.475	0.425	0.302-0.322	0.026	0.293-0.313	0.020-0.030	0.144	0.150-0.199	0.140-0.160	0.051
0.3125	12	0.3750	0.570-0.590	0.540	0.365-0.385	0.035	0.354-0.374	0.026-0.036	0.166	0.188-0.247	0.196-0.216	0.053
0.3750	14	0.4375	0.686-0.706	0.656	0.428-0.448	0.044	0.405-0.425	0.033-0.043	0.188	0.225-0.294	0.250-0.270	0.056
0.4375	16	0.5000	0.802-0.822	0.772	0.490-0.510	0.053	0.462-0.482	0.039-0.049	0.210	0.262-0.340	0.300-0.320	0.060
0.5000	18	0.5625	0.917-0.937	0.887	0.552-0.572	0.062	0.510-0.530	0.045-0.055	0.232	0.300-0.389	0.360-0.380	0.060
0.5625	20	0.6250	1.032-1.052	1.002	0.615-0.635	0.071	0.558-0.578	0.051-0.061	0.254	0.338-0.440	0.430-0.450	0.056
0.6250	22	0.6875	1.148-1.168	1.118	0.677-0.697	0.080	0.635-0.655	0.058-0.068	0.336	0.375-0.488	0.490-0.510	0.054
0.7500	26	0.8125	1.379-1.399	1.349	0.802-0.822	0.098	0.735-0.755	0.070-0.080	0.371	0.450-0.576	0.560-0.580	0.079
0.8750	30	0.9375	1.610-1.630	1.580	0.927-0.947	0.116	0.875-0.895	0.083-0.093	0.442	0.525-0.665	0.640-0.660	0.096
1.0000	34	1.0625	1.841-1.861	1.811	1.052-1.072	0.134	0.975-0.995	0.095-0.105	0.512	0.600-0.756	0.730-0.750	0.111

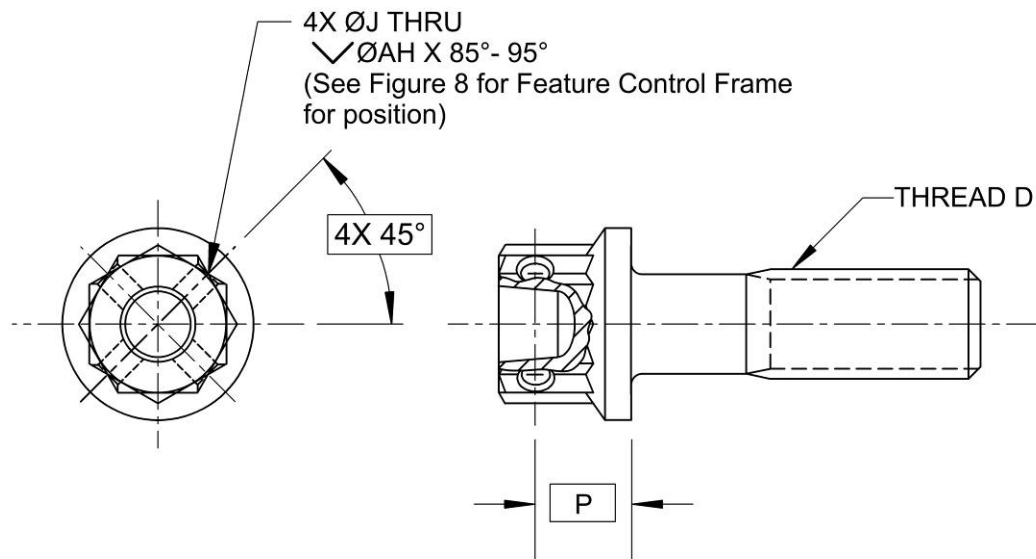


Figure 2B - Drilled head dimensions for double hexagon head bolts (260 ksi min)

Table 2B - Drilled head dimensions for double hexagon head bolts (260 ksi min)

D Nominal Thread Size	ØJ	P	ØAH
0.1900	0.042-0.052	0.188	0.060-0.070
0.2500	0.060-0.070	0.229	0.080-0.090
0.3125	0.060-0.080	0.285	0.090-0.110
0.3750	0.060-0.080	0.335	0.090-0.110
0.4375	0.060-0.080	0.392	0.090-0.110
0.5000	0.060-0.080	0.440	0.090-0.110
0.5625	0.060-0.080	0.488	0.090-0.110
0.6250	0.060-0.080	0.525	0.090-0.110
0.7500	0.060-0.080	0.620	0.090-0.110
0.8750	0.090-0.110	0.715	0.120-0.145
1.0000	0.090-0.110	0.790	0.120-0.145