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WORLD NUCLEAR TRANSPORT INSTITUTE

GOOD PRACTICE GUIDE

Good Practice Guide for
Installation of Socket Head Plugs
in UF6 Cylinders

Dedicated to the safe, secure, efficient and
reliable transport of radioactive materials

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Good Practice Guide for Installation of Socket Head Plugs in UF6 Cylinders

1. OBJECTIVE

This Industry good practice guide provides valuable information to achieve successful installation of socket head plugs in new, as well as, in-service cylinders.

2. BACKGROUND INFORMATION

For decades, the industry is and has been successfully using, so-called, hex head plug in 30 inch and 48 inch UF6 cylinders. A new developed plug type has been first introduced through an addendum to the 2001 Edition of ANSI N14.1.

The latest design of the now called socket head plug is specified in ANSI N14.1-2012 and now available for use as an alternate for the hex head plug. The revision of ISO 7195 will also incorporate the socket head plug.

Industry experience has shown that the installation process for socket head plugs requires specific engineering attention. Careful inspection and preparation of cylinder couplings is needed, as well as proper selection of plugs (size/tinning). The use of tight fitting tools and controlled torqueing is also essential.

3. CYLINDER COUPLING INSPECTION

3.1. General

The cylinder coupling requirements are specified in ANSI N14.1 and ISO 7195. Plug couplings can have a 1” or 1.5” NPT thread size.

3.2. New cylinders

The threads of new couplings shall be in accordance with the thread standard ANSI/ASME B1.20.1. Couplings have to be welded carefully into the cylinder head plates to avoid deformation due to excessive heat input.

After welding, the coupling shall be cleaned with an appropriate NPT tap (see Figure 1 a) to remove impurities. The tap shall be screwed into the coupling by hand until it blocks (see Figure 1 b). A wrench shall be used to facilitate the insertion of the tap with care. The tap used shall have no broken teeth or other damages.

Following removal of the tap, the coupling threads shall be cleaned (e.g. vacuum cleaner) and shall be visually inspected. No broken/damaged threads shall be seen and the threads shall be clean.

The coupling threads shall then be checked with an appropriate NPT gauge (Figure 2 and 3 show examples). The gauging shall confirm compliance with ANSI/ASME B1.20.1.

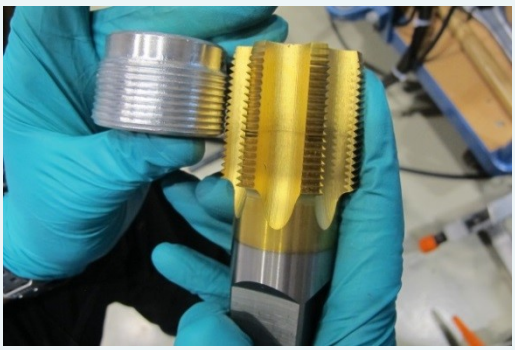
A too small or too large coupling and/or broken/damaged threads shall be reason for rejection. The aforementioned inspection steps may have to be repeated prior to plug installation.

3.3. In-service cylinders

Before installation of a plug into an in-service cylinder the coupling shall be cleaned with an appropriate NPT tap (see Figure 1 a) to remove residues of solder and other impurities. The tap shall be screwed into the coupling by hand until it blocks (see Figure 1 b). A wrench shall be used to facilitate the insertion of the tap with care.

After removal of the tap the coupling threads shall be cleaned (e.g. vacuum cleaner) and shall be visually inspected for missing or damaged threads. Guidance for acceptance is: No more than 10mm of thread damage at one spot or 15mm cumulative throughout the coupling thread length.

As a next step, it is recommended to check the threads with an appropriate NPT gauge (Figure 2 and 3 show examples) to determine the approximate coupling size (small/ nominal/large) and enable proper choice of plug size and tinning. Gauging according to ANSI/ASME B1.20.1 is not required.



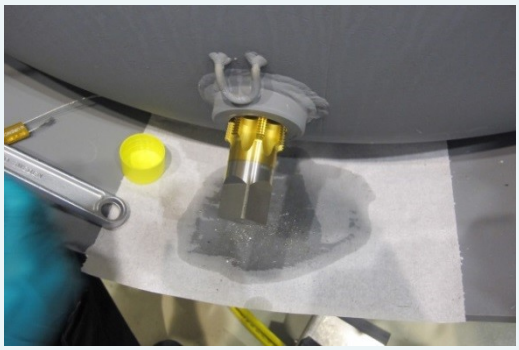


Figure 1 a / b: Tinned plug and NPT tap and insertion of the tap into a cylinder coupling

Figure 2:
Example of a standard NPT gauge

Figure 3:
NPT gauge inserted into a cylinder coupling

CAUTION!

No cutting fluid or lubricant shall be used to facilitate the insertion of the tap or gauge.

4. SOCKET HEAD PLUGS

4.1. General

The 1” and 1.5” socket head plugs are specified in ANSI N14.1-2012 Figure 17 part c and d (see appendix 1). The revision of ISO 7195 will cover the socket head plugs in a similar manner. Only new socket head plugs shall be used for installation, reuse is not permitted.

4.2. Plug thread sizing

The size of the plug threads and the E0 diameter (start diameter of the taper thread located at the top face of the plug) are specified in ANSI/ASME B1.20.1.

This standard allows the (un-tinned) taper thread to be;

1) Basic Size (nominal),
2) Max. Size (one turn large), or
3) Min. Size (one turn small)

Figure 4 shows an example of a standard NPT gauge.

Figure 4:
Example of a standard NPT gauge

Note: *The size of the plug, relative to the size of the coupling, influences the installation torque. It is recommended the purchaser specifies the required thread size to the manufacturer at the time of ordering and orders a range of sizes.*

4.3. Plug thread tinning

In accordance with ANSI N14.1 and ISO 7195 the thread roots shall be filled at least half full with a uniform coating of solder unless otherwise specified by the purchaser (see figure 1a).

To ease initial manual insertion of the plug it is recommended that the solder is removed from the first two threads using a proper die.

Note: *The amount of solder fill influences the installation torque; more solder increases the required torque for installation. It is recommended the purchaser specifies the required solder fill to the manufacturer at the time of ordering. This also may apply to the removal of the solder from the first two threads.*

4.4. Plug thread engagement and installation torques

Installation of socket head plugs is specified in ANSI N14.1 paragraph 7.2 as a maximum of three threads (0.261 in / 6.6mm) above flush with the outer face of the cylinder coupling (see figure 5 a) to a maximum of two threads (0.174 in / 4.4mm) beyond flush (see figure 5 b).

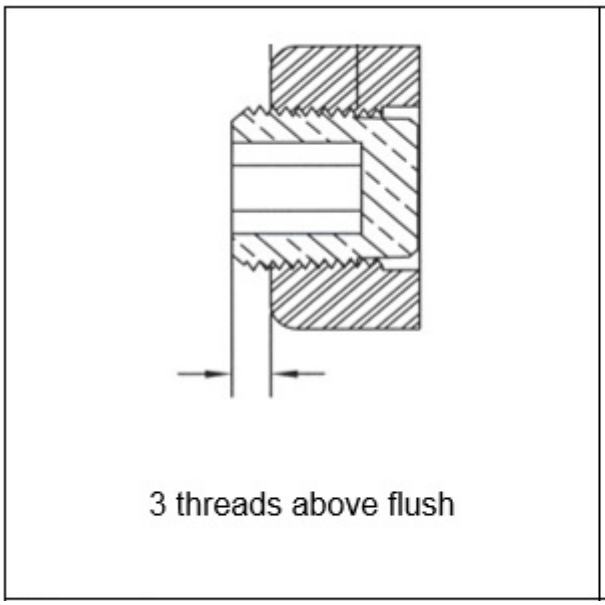


Figure 5 a:

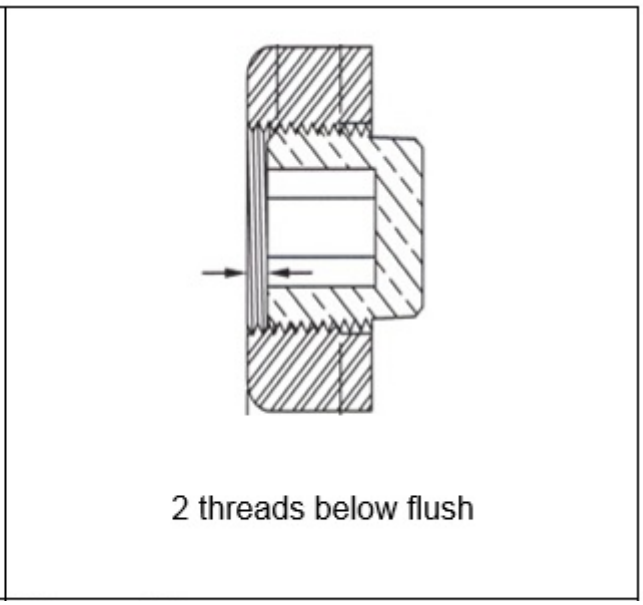


Figure 5 b:

The installation torque settings for the 1" socket head plugs are:

- Minimum 203Nm (150 ft/lb) and
- Maximum 881Nm (650 ft/lb).

The installation torque settings for the 1.5" socket head plugs are:

- Minimum 271Nm (200 ft/lb) and
- Maximum 1803Nm (1330 ft/lb)

Note: *Experience to date has shown that a torque of 1200Nm (900 ft/lb) for the 1.5" plug achieves leak tightness of the connection.*

5. TOOLING

5.1. Torque wrench/device

In accordance with ANSI N14.1 and ISO 7195 an adjustable or indicating torque measuring wrench / device shall be used for all operations. The use of an impact type wrench / device is not permitted.

Operational experience has shown that the use of a torque device in combination with a double sided torque reaction arm and a torque reaction hanging bracket improves the installation of the plug (see Figures 6 a / b).

Figures 6 a / b:
Example of torque device with a double sided torque reaction arm and torque reaction hanging bracket.

5.2. Tool bits and plug sockets

5.2.1. Tool bit and plug socket tolerances

The dimension of the sockets of the 1” and 1.5” socket head plugs are specified in ANSI N14.1-2012 Figure 17 part c and d. The 1” plug has a 5/8” socket and the 1.5” plug has a 1” socket. The dimensions of the 5/8” and 1” sockets and the tool bits are specified in ASME B18.3 table 6 dimension J for plug sockets and table 8 dimension W for tool bits.

Operational experience has shown that the tolerances for the dimensions of the tool bits and plug sockets in table 6 and 8 do overlap each other. The generous manufacturing tolerance for the 1” socket (from the ASME B18.3) can cause distortion of the socket during the installation process.

Therefore it is recommended to order the 1” and 1.5” socket head plugs according to Table 1 below.

Dimension 5/8” socket (1” plug)		**Dimension 1” socket (1.5”plug)**	
Minimum mm (inch)	Maximum mm (inch)	Minimum mm (inch)	Maximum mm (inch)
15.90 (0.626)	16.00 (0.630)	25.45 (1.002)	25.60 (1.008)

Table 1: Recommended dimensions of 5/8” and 1” plug sockets

Note: *At the time of writing this paper the tolerances from Table 1 have been incorporated in the revision of ISO 7195. Proposals to update ANSI N14.1 will follow in due course. It is recommended the purchaser specifies the socket dimensions to the manufacturer at the time of ordering plugs.*

5.2.2. Length of tool bits and depth of sockets

The depth of the socket of the 1” and 1.5” socket head plugs is specified in ANSI N14.1 2012 Figure 17 as Min 0.84” (21.3mm) / Max 0.87” (22.1mm).

Operational experience has shown that due to the high torques the socket can deform or in the worst case can crack during the installation process (see Figures 7 a / b).

The root cause for this failure is that the length of the tool bit was too short or the tool bit was not fully inserted during the installation process.

Therefore the length of the tool bit always has to be more than 0.87” (22.1mm) and the tool bit has to stay fully inserted during installation of the plug.

Figure 7 a / b: Example of unacceptable deformation and a cracked plug

Note: *The bottom face of tool bits shall be flat (without rounded edges) to ensure full contact with the bearing faces in the socket.*

5.2.3. Quality of tool bits

Operational experience has shown that due to the high torques tool bits did fail during the installation process (see Figure 8 a / b). The root cause for these failures has been attributed to inadequate materials of construction, poor material heat treatment, and poor tool bit geometry.

Figure 8 a / b: Distorted and broken tool bits

Figure 8 a / b: Distorted and broken tool bits

Therefore tool bits have to be properly dimensioned and made from high quality materials. Figures 9 a to d show examples of the tools to be used.

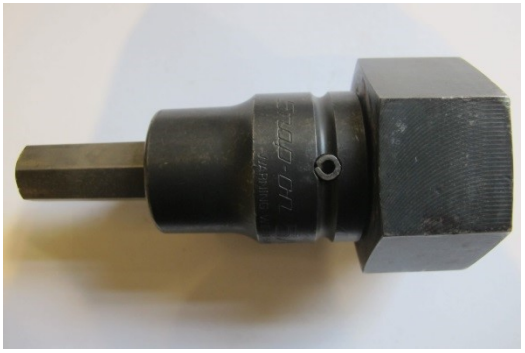


Figure 9 a / b: Example of 1" and 1/5" hardened tool bits

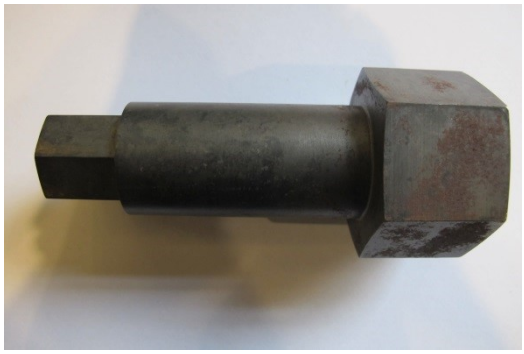


Figure 9 a / b: Example of 1" and 1/5" hardened tool bits

Figure 9 c / d Example of hardened tool bit and adapter

Figure 9 c / d Example of hardened tool bit and adapter

6. INSTALLATION STEPS

STEP 1

After coupling inspection (see § 3), start the insertion of the plug by hand to ensure there is no cross threading. Continue to fit the plug using a tool bit and a small ratchet spanner until tight (see Figures 10 a / b).

Figure 10 a / b: Start insertion of the plug by hand and with ratchet spanner till tight.

STEP 2

Attach the torque reaction hanging bracket to the cylinder but do not tighten the locking screws located on the underside. (See Figure 11)

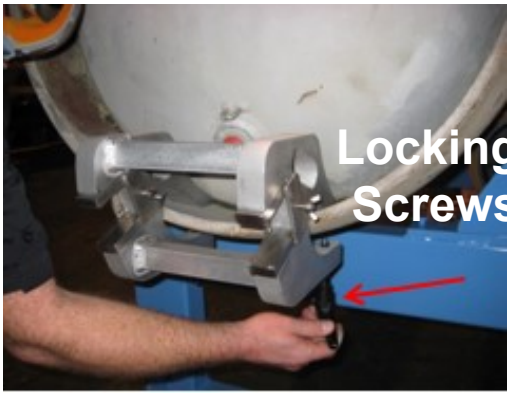
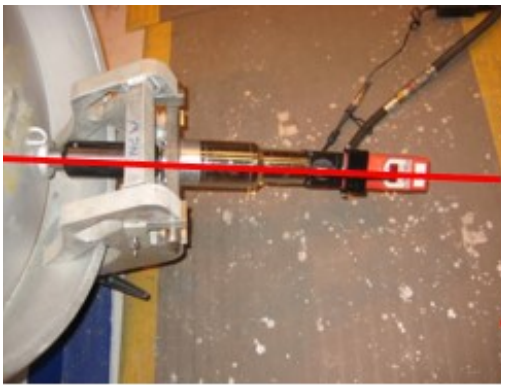
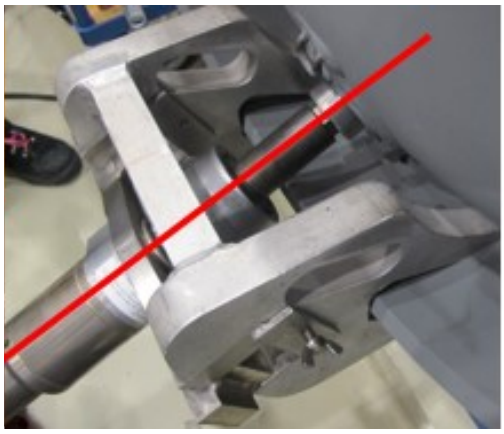


Figure 11: The torque reaction hanging bracket and locking screws.

STEP 3

Engage the tool bit within the socket of the plug and then tighten the locking screws of the torque reaction hanging bracket (see Figures 11 and 12 a / b).
This will secure the torque reaction hanging bracket in place whilst fitting the plug.





Figures 12 a / b: Engaging the tool bit within the socket of the plug

CAUTION!
During the installation process ensure the tool bit is always inserted to the full depth of the socket, to avoid distortion or cracking (see §5.2.2). To enable full insertion of the tool bit there must be sufficient clearance between the double sided torque reaction arm and the torque reaction hanging bracket in order to allow the torque device to move forward as the plug is inserted (see Figure 13).

Figure 13: Clearance between the double sided torque reaction arm and the torque reaction hanging bracket.

STEP 4

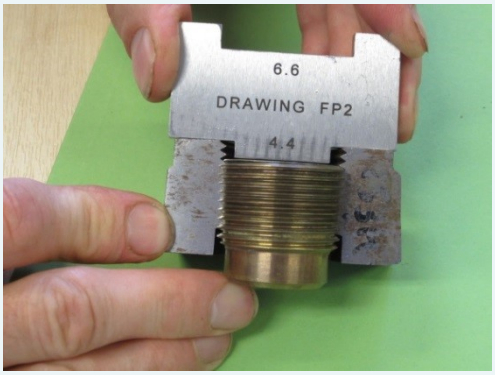
Install the plug by continuous movement and low rotation speed (this reduces installation torques and improves leak tightness) until the thread engagement limit and minimum torque limit have been reached, then record the torque reading from the tool.

STEP 5

Confirm the plug thread engagement by using a GO / NO GO gauge (figures 14 and 15 shows some examples).

To confirm the minimum installation of the plug is within the +6.6mm limit, the gauge should show no gap between the outer surface of the coupling and the gauge in any position.

To confirm the maximum installation of the plug is within the -4.4mm limit, the gauge should show always a (small) gap between the outer surface of the coupling and the gauge in any position.



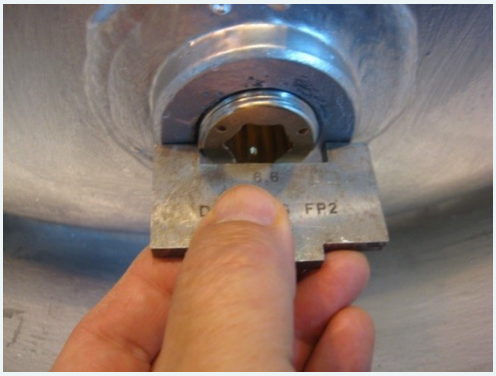
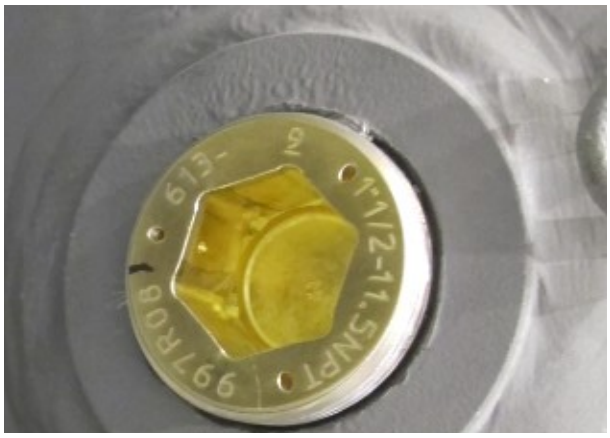


Figure 14: Westinghouse Turner gauge

Figure 15: URENCO gauge (+6.6mm side is showing). Note a gap is showing between the outer surface of coupling and the gauge and therefore the plug installation is not sufficient.

STEP 6

Perform a visual Inspection of the plug installation. The socket shall show no large deformations or cracks (see Figure 7 a / b). Figures 16 a / b shows acceptable deformation.



Figures 16 a / b: Examples of acceptable deformation

STEP 7

Perform a 7 barg leak test to confirm a leak tightconnection. Following acceptance, the plug should be sealed (see Figure 17).

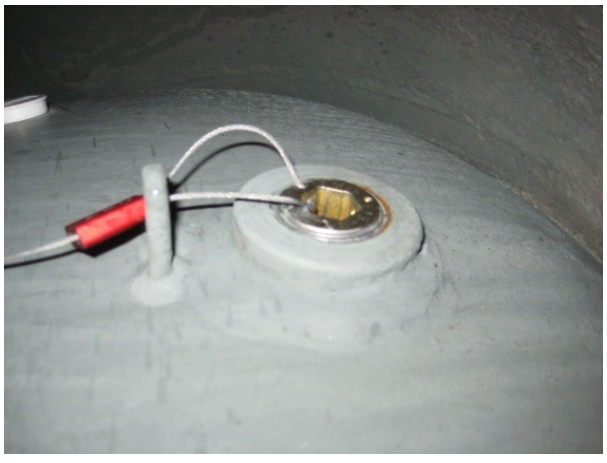


Figure 17: Example of sealing

7. DISCLAIMER AND RECOMMENDATIONS

This guidance document has been prepared by WNTI Members and other stakeholders involved in the manufacture, use and maintenance of UF6 cylinders and related components and is not a working instruction.

The official documents cited in the text must be consulted for a definitive description of their purpose and contents.

The information presented should be used by industry members to prepare specific working instructions for their facility operations

APPENDIX 1

ANSI N14.1-2012 § 8.4 and Figure 17 (c and d) 1" and 1.5" Socket Head Plugs

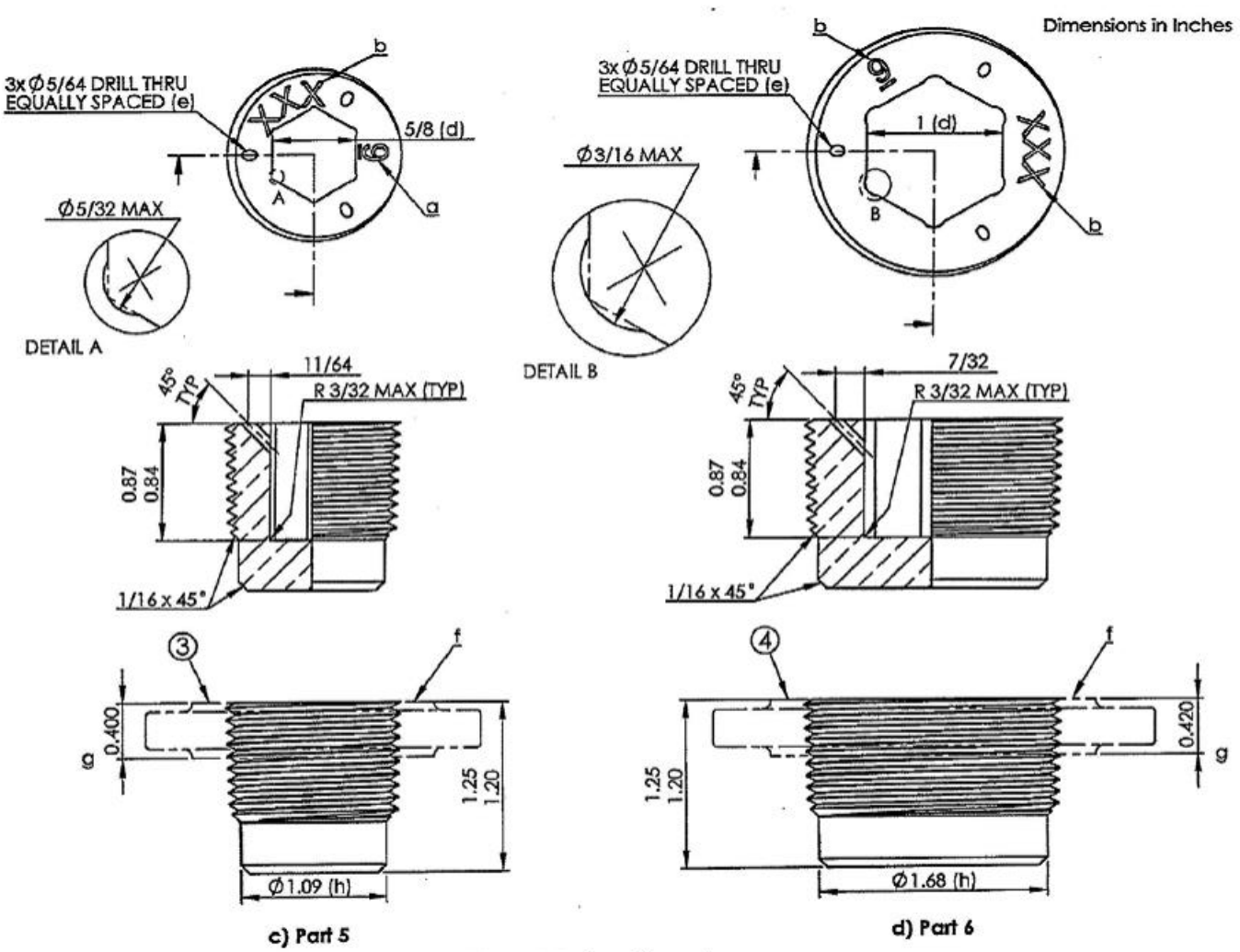


Figure 17 - (continued)

Dimensions in Inches

PARTS

1 Hex head plug with 1-11.5 NPT.
2 Hex head plug with 1 1/2-11.5 NPT.
3 Standard L-1 1-11.5 NPT ring gage.
4 Standard L-1 1 1/2-11.5 NPT ring gage.
5 Socket head plug with 1-11.5 NPT.
6 Socket head plug with 1 1/2-11.5 NPT.

NOTES

Dimensional tolerances are ± 1/16 or ±2° unless otherwise indicated.

All threads and gages shall conform to ASME B1.20.1.

a Stamp or engrave the number of threads. Use approx. 3/8 text for hex head plugs and approx. 3/16 text for socket head plugs.
b Stamp or engrave a material traceability code which shall be linked to the certificate(s) for the plug.
c The thread form shall be measureable with a standard gage, with the gage face (small end) being flush with the end of the plug (± 1 turn).
d Dimension to accomodate a standard hexagon key bit socket wrench per ASME B18.3. Depending on manufacturing process used clearance maybe be required to accomodate the wrench, see detail A and B.
e Provided for the use of a seal wire/TID.
f The thread form shall be measureable with a standard gage, with the gage face (large end) being flush with the top face of the plug to +1 turn small (plug face up to 1 turn below flush with gage large end face).
g The location of E_0, per ASME B1.20.1.
h Approximate, maximum diameter to completely remove the threads at the small end as shown.

Figure 17 - (continued)

APPENDIX 2

Recommended Tooling

Part / Drawing No	Supplier / manufacturer	Description
18114-BO8	Norbar Torque Tools Ltd	PTM-72-2000-B-IC INTERNAL SHUT OFF TOOL
18293	Norbar Torque Tools Ltd	DOUBLE SIDED TORQUE REACTION ARM
16704	Norbar Torque Tools Ltd	LUBRO CONTROL UNIT
863-204010-00-00	URENCO	TOOL BIT 1.5" SOCKET HEAD PLUGS
863-204011-00-00	URENCO	TOOL BIT 1" SOCKET HEAD PLUGS
863-204012-00-00	URENCO	30B CYLINDER TORQUE REACTION HANGING BRACKET
863-204006-00-00	URENCO	48Y CYLINDER TORQUE REACTION HANGING BRACKET
863-204001-00-00	URENCO	URENCO GO / NO GO GAUGE
AA433856	WESTINGHOUSE	TURNER GAUGE
LD4835	WESTINGHOUSE	TORQUE ADAPTER AND TOOL BIT
LD4928	WESTINGHOUSE	MODIFICATION TO Norbar DOUBLE SIDED TORQUE REACTION ARM

Note: *The latest revision of the drawings can be requested from the above mentioned companies.*

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