# University of California at Berkeley
# College of Engineering
# Department of Mechanical Engineering

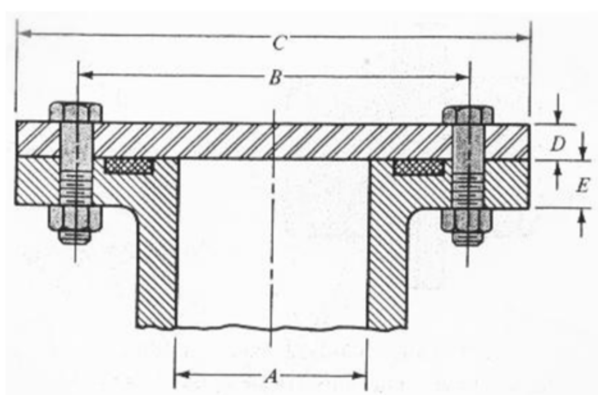
**ME102B, Fall 2018** **Liwei Lin**

**Problem Set #1**

**Due October 1 (Monday)**

**Problem 1 (Power screws)**
A single-square-threaded 25-mm (major diameter) power screw is 25 mm in diameter with a pitch of 5 mm. A vertical load on the screw reaches a maximum of 6kN. The coefficients of friction are 0.05 for collar and 0.08 for the threads. The frictional diameter of the collar is 40 mm. Find the overall efficiency and the torque to "raise" and "lower" the load.

**Problem 2 (load factor)**
The figure illustrates the connection of a cylinder head to a pressure vessel using 10 bolts and a confined-gasket seal. The effective sealing diameter is 100 mm. Other dimensions are: A = 100, B = 200, C = 300, D = 20, and E = 25, all in millimeters. The cylinder is used to store gas at a static pressure of 6 MPa. ISO 8.8 bolts, coarse-pitch, with a diameter of 12 mm have been selected. This provides acceptable bolt spacing for reused connections. What load factors of yielding and separation result from this selection? The joint constant has been calculated as 0.24. (hint: you will need to find the bolt information from Table 8-1 and 8-11)



## Table 8–11

| Property Class | Size Range, Inclusive | Minimum Proof Strength,† MPa | Minimum Tensile Strength,† MPa | Minimum Yield Strength,† MPa | Material | Head Marking |
|---|---|---|---|---|---|---|
| 4.6 | M5–M36 | 225 | 400 | 240 | Low or medium carbon |  |
| 4.8 | M1.6–M16 | 310 | 420 | 340 | Low or medium carbon |  |
| 5.8 | M5–M24 | 380 | 520 | 420 | Low or medium carbon |  |
| 8.8 | M16–M36 | 600 | 830 | 660 | Medium carbon, Q&T |  |
| 9.8 | M1.6–M16 | 650 | 900 | 720 | Medium carbon, Q&T |  |
| 10.9 | M5–M36 | 830 | 1040 | 940 | Low-carbon martensite, Q&T |  |

**Table 8–1**

Diameters and Areas of Coarse-Pitch and Fine-Pitch Metric Threads (All Dimensions in Millimeters)*

| Nominal Major Diameter $d$ | Coarse-Pitch Series | | | Fine-Pitch Series | | |
|---|---|---|---|---|---|---|
| | Pitch $p$ | Tensile-Stress Area $A_t$ | Minor-Diameter Area $A_r$ | Pitch $p$ | Tensile-Stress Area $A_t$ | Minor-Diameter Area $A_r$ |
| 1.6 | 0.35 | 1.27 | 1.07 | | | |
| 2 | 0.40 | 2.07 | 1.79 | | | |
| 2.5 | 0.45 | 3.39 | 2.98 | | | |
| 3 | 0.5 | 5.03 | 4.47 | | | |
| 3.5 | 0.6 | 6.78 | 6.00 | | | |
| 4 | 0.7 | 8.78 | 7.75 | | | |
| 5 | 0.8 | 14.2 | 12.7 | | | |
| 6 | 1 | 20.1 | 17.9 | | | |
| 8 | 1.25 | 36.6 | 32.8 | 1 | 39.2 | 36.0 |
| 10 | 1.5 | 58.0 | 52.3 | 1.25 | 61.2 | 56.3 |
| 12 | 1.75 | 84.3 | 76.3 | 1.25 | 92.1 | 86.0 |
| 14 | 2 | 115 | 104 | 1.5 | 125 | 116 |
| 16 | 2 | 157 | 144 | 1.5 | 167 | 157 |
| 20 | 2.5 | 245 | 225 | 1.5 | 272 | 259 |
| 24 | 3 | 353 | 324 | 2 | 384 | 365 |
| 30 | 3.5 | 561 | 519 | 2 | 621 | 596 |
| 36 | 4 | 817 | 759 | 2 | 915 | 884 |
| 42 | 4.5 | 1120 | 1050 | 2 | 1260 | 1230 |
| 48 | 5 | 1470 | 1380 | 2 | 1670 | 1630 |
| 56 | 5.5 | 2030 | 1910 | 2 | 2300 | 2250 |
| 64 | 6 | 2680 | 2520 | 2 | 3030 | 2980 |
| 72 | 6 | 3460 | 3280 | 2 | 3860 | 3800 |
| 80 | 6 | 4340 | 4140 | 1.5 | 4850 | 4800 |
| 90 | 6 | 5590 | 5360 | 2 | 6100 | 6020 |
| 100 | 6 | 6990 | 6740 | 2 | 7560 | 7470 |
| 110 | | | | 2 | 9180 | 9080 |

*The equations and data used to develop this table have been obtained from ANSI B1.1-1974 and B18.3.1-1978. The minor diameter w… from the equation $d_r = d - 1.226\,869p$, and the pitch diameter from $d_p = d - 0.649\,519p$. The mean of the pitch diameter and th… diameter was used to compute the tensile-stress area.

Square and Acme threads, shown in Fig. 8–3*a* and *b*, respectively, are … screws when power is to be transmitted. Table 8–3 lists the preferred pitches for … series Acme threads. However, other pitches can be and often are used, since the … for a standard for such threads is not great.

Modifications are frequently made to both Acme and square threads. For … the square thread is sometimes modified by cutting the space between the teeth … have an included thread angle of 10 to 15°. This is not difficult, since these thre… usually cut with a single-point tool anyhow; the modification retains most of the … efficiency inherent in square threads and makes the cutting simpler. Acme thre…