



# AURORA

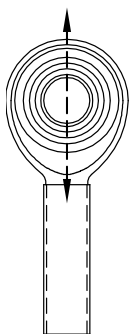
*The Motion-Transfer Specialists*

## ROD END & SPHERICAL BEARING CATALOG & RESOURCE GUIDE

Effective August 21st, 2023, the Naval Air Warfare Center Aircraft Division (NAWCAD) has disapproved Timken Aurora's qualification status for SAE-AS81820 and SAE-AS81935 specifications. Timken Aurora is working diligently to get requalified.

COMMERCIAL | MILITARY | AIRCRAFT

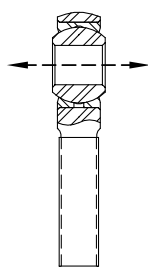
## ULTIMATE RADIAL STATIC LOAD CAPACITY ROD ENDS



The ultimate radial static load capacity is based upon the minimum mechanical properties of the design configuration in the stressed area. The ultimate radial static load capacity called out in the rod end specification charts is defined as a single cycle, unidirectional applied load to cause ultimate failure. Operating loads should be based on the static load ratings, incorporating appropriate safety factors to suit the application. When a rod end or spherical bearing is to be applied in full rotation, the surface speed of the ball should be kept below 20 feet per minute or the rotational speed should be below 100 RPM, whichever is lower, with the operating loads not to exceed 10% of the ultimate radial static load.

Load ratings listed in the standard detail pages are applicable to rod ends supplied without grease fittings. Load ratings for units employing fittings may be affected due to lighter cross section in the stressed area. For information on the rod end radial static load ratings with fittings and other specific load rating information, consult the Timken Aurora Bearing engineering department.

## AXIAL STATIC LOAD CAPACITY ROD ENDS



Axial static load capacity is the force that is applied through the bore of the ball. For Aurora two-piece rod ends, maximum axial static load capacity is recommended to be 15 percent of the ultimate radial static load capacity. For three-piece rod ends, maximum axial static load capacity is generally recommended as 10 percent of ultimate radial static load capacity. It should be noted, however, that on three-piece units factors such as race material, body material and dimensions may affect axial static load capacity. For further information, consult the Timken Aurora Bearing engineering department.

## RADIAL STATIC LIMIT LOAD CAPACITY SPHERICAL BEARINGS

Unless otherwise noted, radial static loads are maximum static based on the maximum permanent set in the bearing race of 0.2% of the ball diameter. If greater permanent set can be allowed or if alternate race materials are used consult our engineering department for change factors. Operating loads are based on the radial static load rating and appropriate safety factors should be utilized to suit the application.

Max axial load is recommended at 20 percent of the radial static load. Extreme care should be used on selecting a sufficiently strong housing to accept this type of bearing.

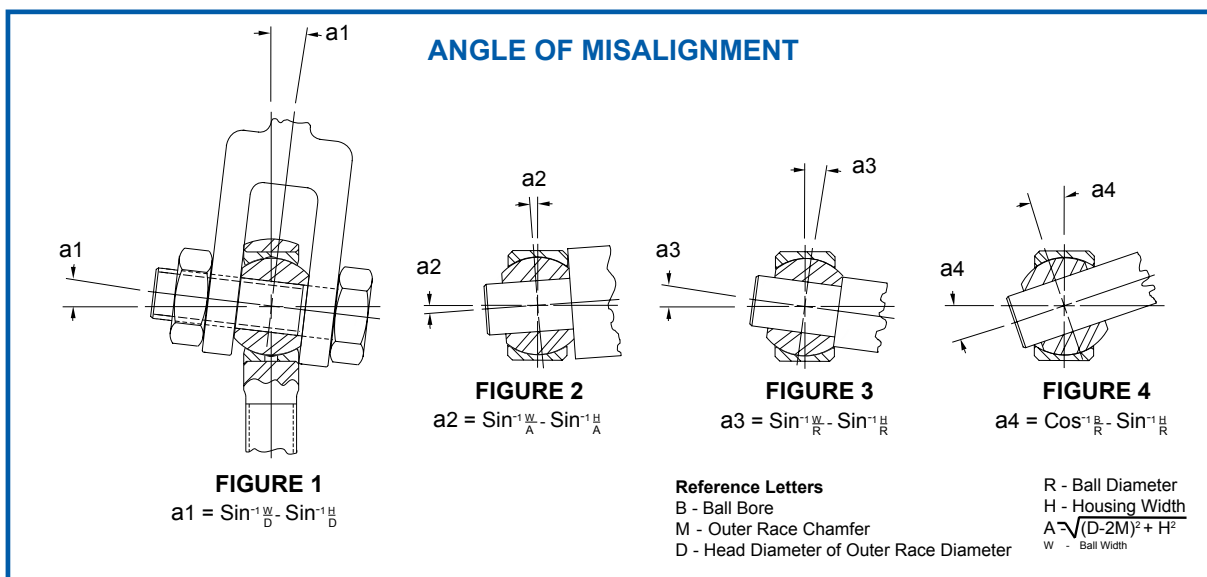
## BEARING MISALIGNMENT

A rod end or spherical bearing's ability to misalign is measured by the degree of angle the ball can accommodate without interference.

The angle of misalignment in a rod end is limited by the ball width and head diameter as shown in figure 1. This arrangement is called a clevis mount, and is the type represented in the standard rod end detail pages. If added misalignment is necessary, this can be accomplished by utilizing spacers between the clevis mounting and ball face, or by using special rod ends designed to meet specific requirements.

Misalignment angle in a spherical bearing is limited by the ball and race width with respect to the ball diameter, illustrated in figure 3. This is the mounting type represented in the standard detail pages for spherical bearings.

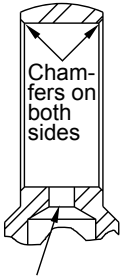
Mounting arrangements for spherical bearings such as shown in figures 2 through 4 are also used with rod ends. The misalignment angle is then calculated by selecting the proper formula.



## 3-Piece Unit



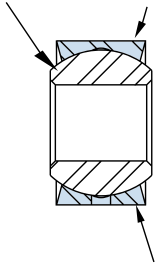
**HOUSING**



NOTE - Re-Lube hole for lubrication through shank of housing.

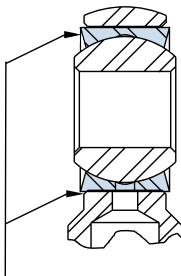
**INSERT**

Consists of BALL and RACE



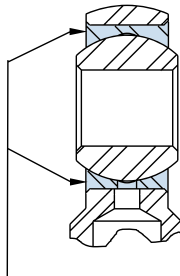
**Single piece race,** steel, heat-treated (optional), features swaged construction for maximum performance. Alternate race materials available to suit your application.

**ASSEMBLED HOUSING AND INSERT IN PRE-STAKING POSITION**



Note extension of race beyond width of housing in the pre-staking position.

**ASSEMBLED HOUSING AND INSERT IN STAKED POSITION**

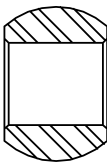


After staking, the sides of race have been upset into chamfers. Ball is subsequently loosened holding close tolerance fits between ball and race.

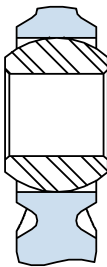
## 2-Piece Unit



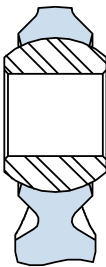
Housing ready for swaging



Precision ground ball - (available in alternate materials) - for close tolerance fits.



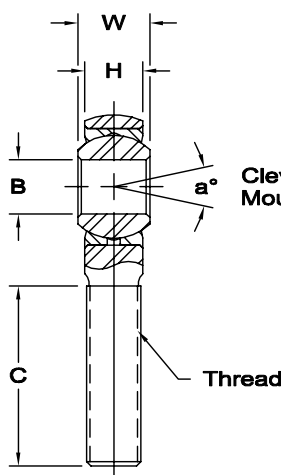
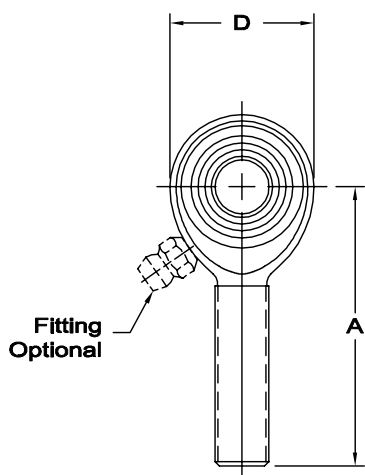
Housing and Ball in pre-swaging position.



Sides of housing are closed around ball for maximum strength unit.

# MM & MB SERIES MALE ROD ENDS

General Purpose - Precision (PTFE Liners Available)



Clevis Mounted

**Body** - Low carbon steel, protective coated for corrosion resistance. No. 16 series standard body is alloy steel not heat treated.

**Race** - Low carbon steel, protective coated for corrosion resistance.

**Ball** - Alloy steel, heat treated, hard chrome plated.

**Notes** - All sizes available with studs upon request.



\* Check availability.

\*\* Grease fitting not available.

1 Threads 6-32 UNC.

2 Threads 1-14 UNS.

3 Tolerance variation: "D"  $\pm .020$ , "A"  $\pm .020$ , "B"  $\pm .0035$ ,  $-.0005$ , "H"  $\pm .010$

4 Tolerance variation: "D"  $\pm .51$ , "A"  $\pm .51$ , "B"  $\pm .089$ ,  $-.013$ , "H"  $\pm .25$

Units are supplied without grease fittings. When grease fittings are required, specify by adding suffixes as designated.

Z Zerk type fitting Ex: MM-6Z

F Flush type fitting Ex: MM-6F

T PTFE liner Ex: MM-6T

Load ratings apply only to rod ends without grease fittings. For load ratings with fittings, please consult our engineering department.

| ROD END NO.   |              | DIMENSIONS IN INCHES    |                       |                 |                 |                 |                   |                       |                   | a°<br>Misalign.<br>Angle | Ultimate<br>Radial<br>Static Load<br>Capacity<br>Lbs. | Approx.<br>Brg. Wt.<br>Lbs. |
|---------------|--------------|-------------------------|-----------------------|-----------------|-----------------|-----------------|-------------------|-----------------------|-------------------|--------------------------|-------------------------------------------------------|-----------------------------|
| Right<br>Hand | Left<br>Hand | B<br>+ .0015<br>- .0005 | W<br>+ .000<br>- .005 | H<br>$\pm .005$ | A<br>$\pm .015$ | D<br>$\pm .010$ | Ball<br>Dia. Ref. | C<br>+ .062<br>- .031 | Thread<br>UNF-3A  |                          |                                                       |                             |
| ** MM-2       | MB-2         | .1250                   | .250                  | .187            | .937            | .500            | .312              | .562                  | 6-32 <sub>1</sub> | 16                       | 502                                                   | .01                         |
| MM-3          | MB-3         | .1900                   | .312                  | .250            | 1.250           | .625            | .437              | .750                  | 10-32             | 13                       | 1,169                                                 | .03                         |
| MM-4          | MB-4         | .2500                   | .375                  | .281            | 1.562           | .750            | .500              | 1.000                 | 1/4-28            | 16                       | 2,158                                                 | .04                         |
| MM-5          | MB-5         | .3125                   | .437                  | .344            | 1.875           | .875            | .625              | 1.250                 | 5/16-24           | 14                       | 2,784                                                 | .07                         |
| MM-6          | MB-6         | .3750                   | .500                  | .406            | 1.938           | 1.000           | .719              | 1.250                 | 3/8-24            | 12                       | 3,915                                                 | .11                         |
| MM-7          | MB-7         | .4375                   | .562                  | .437            | 2.125           | 1.125           | .812              | 1.375                 | 7/16-20           | 14                       | 4,218                                                 | .16                         |
| MM-8          | MB-8         | .5000                   | .625                  | .500            | 2.438           | 1.312           | .937              | 1.500                 | 1/2-20            | 12                       | 6,660                                                 | .25                         |
| MM-10         | MB-10        | .6250                   | .750                  | .562            | 2.625           | 1.500           | 1.125             | 1.625                 | 5/8-18            | 16                       | 7,364                                                 | .38                         |
| MM-12         | MB-12        | .7500                   | .875                  | .687            | 2.875           | 1.750           | 1.312             | 1.750                 | 3/4-16            | 14                       | 11,518                                                | .60                         |
| * MM-14       | MB-14        | .8750                   | .875                  | .765            | 3.375           | 2.000           | 1.375             | 2.000                 | 7/8-14            | 7                        | 18,476                                                | .91                         |
| * MM-14-1     | MB-14-1      | .8750                   | .875                  | .687            | 3.375           | 2.000           | 1.312             | 1.875                 | 7/8-14            | 12                       | 22,843                                                | .91                         |
| 3 MM-16       | MB-16        | 1.0000                  | 1.375                 | 1.000           | 4.125           | 2.750           | 1.875             | 2.125                 | 1 1/4-12          | 17                       | 43,541                                                | 2.41                        |
| 3 MM-16-1     | MB-16-1      | 1.0000                  | 1.375                 | 1.000           | 4.125           | 2.750           | 1.875             | 2.125                 | 1-14 <sub>2</sub> | 17                       | 43,541                                                | 2.13                        |
| 3 MM-16-2     | MB-16-2      | 1.0000                  | 1.375                 | 1.000           | 4.125           | 2.750           | 1.875             | 2.125                 | 1-12              | 17                       | 43,541                                                | 2.13                        |

| ROD END NO.   |              | DIMENSIONS IN MILLIMETERS |                     |                |                |                |                   |                      |                   | a°<br>Misalign.<br>Angle | Ultimate<br>Radial<br>Static Load<br>Capacity<br>Newtons | Approx.<br>Brg. Wt.<br>Grams |
|---------------|--------------|---------------------------|---------------------|----------------|----------------|----------------|-------------------|----------------------|-------------------|--------------------------|----------------------------------------------------------|------------------------------|
| Right<br>Hand | Left<br>Hand | B<br>+ .038<br>- .013     | W<br>+ .00<br>- .13 | H<br>$\pm .13$ | A<br>$\pm .38$ | D<br>$\pm .25$ | Ball<br>Dia. Ref. | C<br>+ 1.57<br>- .79 | Thread<br>UNF-3A  |                          |                                                          |                              |
| ** MM-2       | MB-2         | 3.175                     | 6.35                | 4.75           | 23.80          | 12.70          | 7.92              | 14.27                | 6-32 <sub>1</sub> | 16                       | 2,236                                                    | 6                            |
| MM-3          | MB-3         | 4.826                     | 7.92                | 6.35           | 31.75          | 15.88          | 11.10             | 19.05                | 10-32             | 13                       | 5,197                                                    | 13                           |
| MM-4          | MB-4         | 6.350                     | 9.53                | 7.14           | 39.67          | 19.05          | 12.70             | 25.40                | 1/4-28            | 16                       | 9,600                                                    | 20                           |
| MM-5          | MB-5         | 7.938                     | 11.10               | 8.74           | 47.63          | 22.23          | 15.88             | 31.75                | 5/16-24           | 14                       | 12,385                                                   | 33                           |
| MM-6          | MB-6         | 9.525                     | 12.70               | 10.31          | 49.23          | 25.40          | 18.26             | 31.75                | 3/8-24            | 12                       | 17,416                                                   | 51                           |
| MM-7          | MB-7         | 11.113                    | 14.27               | 11.10          | 53.98          | 28.58          | 20.62             | 34.93                | 7/16-20           | 14                       | 18,759                                                   | 73                           |
| MM-8          | MB-8         | 12.700                    | 15.88               | 12.70          | 61.93          | 33.32          | 23.80             | 38.10                | 1/2-20            | 12                       | 29,624                                                   | 113                          |
| MM-10         | MB-10        | 15.875                    | 19.05               | 14.27          | 66.68          | 38.10          | 28.58             | 41.28                | 5/8-18            | 16                       | 32,752                                                   | 173                          |
| MM-12         | MB-12        | 19.050                    | 22.23               | 17.45          | 73.03          | 44.45          | 33.32             | 44.45                | 3/4-16            | 14                       | 51,237                                                   | 273                          |
| * MM-14       | MB-14        | 22.225                    | 22.23               | 19.43          | 85.73          | 50.80          | 34.93             | 50.80                | 7/8-14            | 7                        | 82,185                                                   | 411                          |
| * MM-14-1     | MB-14-1      | 22.225                    | 22.23               | 17.45          | 85.73          | 50.80          | 33.32             | 47.63                | 7/8-14            | 12                       | 101,601                                                  | 411                          |
| 4 MM-16       | MB-16        | 25.400                    | 34.93               | 25.40          | 104.78         | 69.85          | 47.63             | 53.98                | 1 1/4-12          | 17                       | 193,670                                                  | 1,091                        |
| 4 MM-16-1     | MB-16-1      | 25.400                    | 34.93               | 25.40          | 104.78         | 69.85          | 47.63             | 53.98                | 1-14 <sub>2</sub> | 17                       | 193,670                                                  | 965                          |
| 4 MM-16-2     | MB-16-2      | 25.400                    | 34.93               | 25.40          | 104.78         | 69.85          | 47.63             | 53.98                | 1-12              | 17                       | 193,670                                                  | 965                          |

Studs available per notes and comments, page 76



# MW & MG SERIES FEMALE ROD ENDS

General Purpose - Precision (PTFE Liners Available)

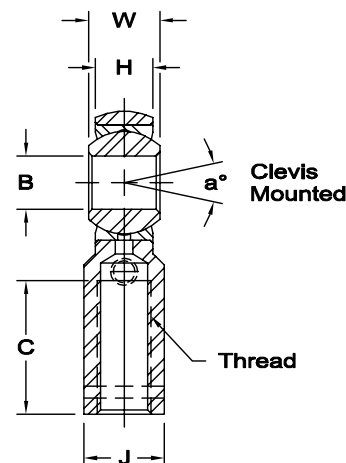
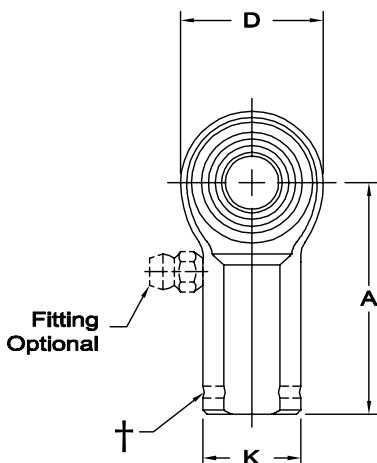


**Body** - Low carbon steel, protective coated for corrosion resistance. No. 16 series standard body is alloy steel not heat treated.

**Race** - Low carbon steel, protective coated for corrosion resistance.

**Ball** - Alloy steel, heat treated, hard chrome plated.

**Notes** - All sizes available with studs upon request.



\* Check for availability

† Left hand units have identification groove near end of shank

1 Threads 6-32 UNC

2 Threads 1-14 UNS

3 Tolerance variation: "D"  $\pm .020$ , "A"  $\pm .020$  "B"  $\pm .0035$ ,  $-.0005$ , "H"  $\pm .010$ , "K"  $\pm .015$ , "J"  $\pm .015$

4 Tolerance variation: "D"  $\pm .51$ , "A"  $\pm .51$  "B"  $\pm .089$ ,  $-.013$ , "H"  $\pm .25$ , "K"  $\pm .38$ , "J"  $\pm .38$

\*\* Grease fitting not available. Units are supplied without grease fittings. When a grease fitting is required, specify by adding suffix as designated.

Z Zerk type fitting

Ex: MW-6Z

F Flush type fitting

Ex: MW-6F

T PTFE liner

Ex: MW-6T

| ROD END NO.   |               | DIMENSIONS IN INCHES    |                       |             |             |             |             |             |                   |                       |                   | a°<br>Misalign.<br>Angle | Ultimate<br>Radial<br>Static Load<br>Capacity<br>Lbs. | Approx.<br>Brg. Wt.<br>Lbs. |
|---------------|---------------|-------------------------|-----------------------|-------------|-------------|-------------|-------------|-------------|-------------------|-----------------------|-------------------|--------------------------|-------------------------------------------------------|-----------------------------|
| Right<br>Hand | Left<br>Hand† | B<br>+ .0015<br>- .0005 | W<br>+ .000<br>- .005 | H<br>± .005 | A<br>± .015 | D<br>± .010 | K<br>± .010 | J<br>± .010 | Ball<br>Dia. Ref. | C<br>+ .062<br>- .031 | Thread<br>UNF-2B  |                          |                                                       |                             |
| MW-2          | MG-2          | .1250                   | .250                  | .187        | .812        | .500        | .312        | .250        | .312              | .437                  | 6-32 <sub>1</sub> | 16                       | 1,202                                                 | .02                         |
| MW-3          | MG-3          | .1900                   | .312                  | .250        | 1.062       | .625        | .406        | .312        | .437              | .562                  | 10-32             | 13                       | 1,531                                                 | .04                         |
| MW-4          | MG-4          | .2500                   | .375                  | .281        | 1.312       | .750        | .469        | .375        | .500              | .750                  | 1/4-28            | 16                       | 2,539                                                 | .06                         |
| MW-5          | MG-5          | .3125                   | .437                  | .344        | 1.375       | .875        | .500        | .437        | .625              | .750                  | 5/16-24           | 14                       | 3,133                                                 | .09                         |
| MW-6          | MG-6          | .3750                   | .500                  | .406        | 1.625       | 1.000       | .687        | .562        | .719              | .937                  | 3/8-24            | 12                       | 3,915                                                 | .15                         |
| MW-7          | MG-7          | .4375                   | .562                  | .437        | 1.812       | 1.125       | .750        | .625        | .812              | 1.062                 | 7/16-20           | 14                       | 4,218                                                 | .20                         |
| MW-8          | MG-8          | .5000                   | .625                  | .500        | 2.125       | 1.312       | .875        | .750        | .937              | 1.187                 | 1/2-20            | 12                       | 6,660                                                 | .33                         |
| MW-10         | MG-10         | .6250                   | .750                  | .562        | 2.500       | 1.500       | 1.000       | .875        | 1.125             | 1.500                 | 5/8-18            | 16                       | 7,364                                                 | .48                         |
| MW-12         | MG-12         | .7500                   | .875                  | .687        | 2.875       | 1.750       | 1.125       | 1.000       | 1.312             | 1.750                 | 3/4-16            | 14                       | 11,518                                                | .72                         |
| MW-14         | MG-14         | .8750                   | .875                  | .765        | 3.375       | 2.000       | 1.300       | 1.125       | 1.375             | 1.875                 | 7/8-14            | 7                        | 18,476                                                | 1.03                        |
| MW-14-1       | MG-14-1       | .8750                   | .875                  | .687        | 3.500       | 2.000       | 1.312       | 1.187       | 1.312             | 1.812                 | 7/8-14            | 12                       | 22,843                                                | 1.03                        |
| MW-16         | MG-16         | 1.0000                  | 1.375                 | 1.000       | 4.125       | 2.750       | 1.625       | 1.500       | 1.875             | 2.125                 | 1 1/4-12          | 17                       | 40,889                                                | 2.13                        |
| MW-16-1       | MG-16-1       | 1.0000                  | 1.375                 | 1.000       | 4.125       | 2.750       | 1.625       | 1.500       | 1.875             | 2.125                 | 1-14 <sub>2</sub> | 17                       | 43,541                                                | 2.41                        |
| MW-16-2       | MG-16-2       | 1.0000                  | 1.375                 | 1.000       | 4.125       | 2.750       | 1.625       | 1.500       | 1.875             | 2.125                 | 1-12              | 17                       | 43,541                                                | 2.41                        |

| ROD END NO.   |               | DIMENSIONS IN MILLIMETERS |                     |            |            |            |            |            |                   |                      |                   | a°<br>Misalign.<br>Angle | Ultimate<br>Radial<br>Static Load<br>Capacity<br>Newtons | Approx.<br>Brg. Wt.<br>Grams |
|---------------|---------------|---------------------------|---------------------|------------|------------|------------|------------|------------|-------------------|----------------------|-------------------|--------------------------|----------------------------------------------------------|------------------------------|
| Right<br>Hand | Left<br>Hand† | B<br>+ .038<br>- .013     | W<br>+ .00<br>- .13 | H<br>± .13 | A<br>± .38 | D<br>± .25 | K<br>± .25 | J<br>± .25 | Ball<br>Dia. Ref. | C<br>+ 1.57<br>- .79 | Thread<br>UNF-2B  |                          |                                                          |                              |
| MW-2          | MG-2          | 3.175                     | 6.35                | 4.75       | 20.62      | 12.70      | 7.92       | 6.35       | 7.92              | 11.10                | 6-32 <sub>1</sub> | 16                       | 5,344                                                    | 9                            |
| MW-3          | MG-3          | 4.826                     | 7.92                | 6.35       | 26.97      | 15.88      | 10.31      | 7.92       | 11.10             | 14.27                | 10-32             | 13                       | 6,805                                                    | 17                           |
| MW-4          | MG-4          | 6.350                     | 9.53                | 7.14       | 33.32      | 19.05      | 11.91      | 9.53       | 12.70             | 19.05                | 1/4-28            | 16                       | 11,297                                                   | 27                           |
| MW-5          | MG-5          | 7.938                     | 11.10               | 8.74       | 34.93      | 22.23      | 12.70      | 11.10      | 15.88             | 19.05                | 5/16-24           | 14                       | 13,934                                                   | 42                           |
| MW-6          | MG-6          | 9.525                     | 12.70               | 10.31      | 41.28      | 25.40      | 17.45      | 14.27      | 18.26             | 23.80                | 3/8-24            | 12                       | 17,416                                                   | 69                           |
| MW-7          | MG-7          | 11.113                    | 14.27               | 11.10      | 46.02      | 28.58      | 19.05      | 15.88      | 20.62             | 26.97                | 7/16-20           | 14                       | 18,759                                                   | 90                           |
| MW-8          | MG-8          | 12.700                    | 15.88               | 12.70      | 53.98      | 33.32      | 22.23      | 19.05      | 23.80             | 30.15                | 1/2-20            | 12                       | 29,624                                                   | 149                          |
| MW-10         | MG-10         | 15.875                    | 19.05               | 14.27      | 63.50      | 38.10      | 25.40      | 22.23      | 28.58             | 38.10                | 5/8-18            | 16                       | 32,752                                                   | 216                          |
| MW-12         | MG-12         | 19.050                    | 22.23               | 17.45      | 73.03      | 44.45      | 28.58      | 25.40      | 33.32             | 44.45                | 3/4-16            | 14                       | 51,237                                                   | 328                          |
| MW-14         | MG-14         | 22.225                    | 22.23               | 19.43      | 85.73      | 50.80      | 33.02      | 28.58      | 34.93             | 47.63                | 7/8-14            | 7                        | 82,185                                                   | 67                           |
| MW-14-1       | MG-14-1       | 22.225                    | 22.23               | 17.45      | 88.90      | 50.80      | 33.32      | 30.15      | 33.32             | 46.02                | 7/8-14            | 12                       | 101,601                                                  | 467                          |
| MW-16         | MG-16         | 25.400                    | 34.93               | 25.40      | 104.78     | 69.85      | 41.28      | 38.10      | 47.63             | 53.98                | 1 1/4-12          | 17                       | 193,670                                                  | 964                          |
| MW-16-1       | MG-16-1       | 25.400                    | 34.93               | 25.40      | 104.78     | 69.85      | 41.28      | 38.10      | 47.63             | 53.98                | 1-14 <sub>2</sub> | 17                       | 193,670                                                  | 1,093                        |
| MW-16-2       | MG-16-2       | 25.400                    | 34.93               | 25.40      | 104.78     | 69.85      | 41.28      | 38.10      | 47.63             | 53.98                | 1-12              | 17                       | 193,670                                                  | 1,093                        |

Studs available per notes and comments, page 76