OCTAINT WEIGHS

OCTAINT 0-3, 1-2

Area = \[ \frac{200.93 + 56.93}{2} \times 14.724 \times 18.98 \text{ in}^2 \times 10^3 \]

Frames & skins = \[ 2(0.04 \times 2.2) + 0.1 \times 2 \] \( 18.98 \times 10^3 \times 11 = 795 \text{ lbs} \)

MAT = \[ 0.033 \text{ lb/in} \]

\[ = 0.033 \left[ \frac{200.93 + 56.93}{2} \times 44 \times 3 \right] = 642 \text{ lbs} \]

Electronics, Misc, Components

TOTAL:

MAT 0-3 10.27 lbs

OCTAINT 4-7

Area = \[ 18.93 - 1.434 = 17.54 \text{ in}^2 \times 10^3 \]

Weight = \[ \left( 795 + 642 \right) \times \frac{17.54}{18.93} + 200 = 1519 \text{ lbs} \]

OCTAINT 5-6

Area = \[ 107.37 \times \frac{\sqrt{13.93 + 56.93}}{2} \]

Weight = \[ (795 + 642) \left( \frac{10.83}{13.93} \right) + 150 = 965 \text{ lbs} \]
**Support Comps:**

**Octants 1, 2**

\[ W = 1627 \text{ lbs} \]
\[ R_1 = 1627 \times \frac{66.75}{115.3} = 942 \text{ lbs} \]
\[ R_2 = 1627 - 942 = 685 \text{ lbs} \]

**Octants 0, 3**

\[ R_3 = 1627 \times \frac{91}{153} = 912 \text{ lbs} \]
\[ R_4 = 1627 - 912 = 715 \text{ lbs} \]

**Octants 4, 7**

\[ W = 1517 \text{ lbs} \]
\[ R_5 = 1517 \times \frac{88.9}{153} = 900 \text{ lbs} \]
\[ R_6 = 1517 - 900 = 617 \text{ lbs} \]

**Octants 5, 6**

\[ W = 765 \text{ lbs} \]
\[ R_1 = 765 \times \frac{24.8}{116.3} = 163 \text{ lbs} \]
\[ R_2 = 765 - 163 = 602 \text{ lbs} \]
OCTANTS 1 & 2 SUPPORTS

DWG 390953, 9601980

P = 942 lbs
4x4x188 TUBE
I = 2.59 in
A = 277 in

\[ P_{cr} = \frac{C \pi^2 E}{L^2}, \quad C = 2.5 \]

\[ P_{cr} = \frac{0.25 \pi^2 \times 30 \times 10^6 \times 6.59}{67^2} = 108 \text{ kips} \quad \text{stable} \]

BEAM-COLUMN

Ref: Ron-K 6"x6" p 167 case 3a, a = 0

\[ M_b = \frac{M_o}{\cos(kL)} \]

\[ M_o = 942 \times 6.96 = 6.6 \text{ kip-in} \]

\[ K = \sqrt{\frac{P}{E I}} = \]

\[ K_i = \left(\frac{942}{30 \times 10^6 \times 6.59}\right)^{\frac{1}{2}} = 2.18 \times 10^{-3} \]

\[ M_b = \frac{6.96}{\cos(2.18 \times 10^{-3} \times 67)} = 7.04 \text{ in kip} \]

\[ f_b = \frac{2.4 \times 2}{6.59} = 2.1 \quad \text{ksi} \]

\[ f_b \times f_c = 2.1 \times \frac{942}{277} = 2.4 \text{ ksi} < 14 \text{ ksi} \]
These supports hold the Blayer Pixel plane in place. The loads are on the order of 100-200 lbs.

**Column Stiffness**

\[
P_{cr} = \frac{\pi^2 EI}{L^2}
\]

\[
P_{cr} = \frac{\pi^2 \times 30 \times 10^6 \times 0.17}{23.03^2}
\]

\[
P_{cr} = 2.9 \text{ kip} > 200 \text{ lbs}
\]

**Rod End**

3/4 Male Rod End

Allowable = \( \frac{491}{5} = 98.2 \text{ lbs} > 200 \text{ lbs} \)

**Quick Disconnect:**

3/8 Pull Down = \( \frac{1000}{5} = 200 \text{ lbs} = 200 \text{ lbs, Rated Load} \)

**Handling Load:**

\[
M = \frac{200 \times 23.03}{4} = 1132 \text{ in-lbs}
\]

\[
f_b = \frac{1132 \times \frac{90}{12}}{0.17} = 29 \text{ kpsi} < 96 \text{ kpsi, Yield} \]


**Octants 1, 2 Support**

\[ \begin{align*}
11 &= 742 \times 12.8 = 12 \times 13 \times 19 \text{ lbs} \\
\text{Fastener Loads:} \\
P_4 &= \frac{12 \times 0.3}{15.25 \times 2} = 396 \text{ lbs} \\
P_4 &= \frac{396}{1417} = 0.27 \text{ ksi} \quad \text{allow} \\
P_s &= \frac{742}{6 \times 19.9} = 1.16 \text{ ksi} \quad \text{allow}
\end{align*} \]
SUPPORT WELDMENT 0, 3, 4, 7 OUTBOARD

\[ P_{03} = R_3 = 963 \text{ lbs} \]
\[ P_{47} = R_3 = 330 \text{ lbs} \]

STABILITY OF RIVETED MEMBER:

\[ P_{cr} = \frac{n^2 E I}{L^2} = \frac{n^2 \times 30 \times 10^6 \times 2.5}{71^2} = 146 \text{ kip} \]

Freebody:

\[ 924 \text{ lbs} \]

\[ P = 1064 \text{ lbs} \]

FASTENER LOADS:

SHEAR, VERTICAL

\[ S_v = \frac{924}{6} = 154 \text{ lbs} \]

\[ S_h = \frac{1064}{6} = 177 \text{ lbs} \]

\[ 1 + 1 \left[ \frac{134^2 + 177^2}{2} \right]^{\frac{1}{2}} = 234 \text{ lbs} \]

\[ f_2 = \frac{234}{114} = 2 \text{ kpsi (low)} \]

WELDS TO EFF STEEL:

\[ f_s = \frac{(1064^2 + 924^2)^{\frac{1}{2}}}{10 \times 2 \times 375 \times \frac{1}{2}} = 2 \text{ kpsi} \]
B CATER MOT SUPPORTS

OCTANT C-3 INBOARD MOUNT

Fasteners:

\[ P_t = \frac{968 \times 12.9}{2 \times 5.25} = 1189 \text{ lbs} \]

\[ P_y = \frac{1189}{1417} = 0.84 \text{ kips} \]

\[ P_x = \frac{968}{4 \times 1417} = 1.71 \text{ kips} < 2 \text{ kips} \]

FASTENER ALLOWANCE = 90 kips x 1417 = 9.2 ksi

\[ P = 968 \text{ lbs} \]

WELD:

Assume weld on top and bottom only

\[ F_x = \frac{968 \times 12.3}{4 \times 4 \times 2.5} = 4.2 \text{ kips} < 6 \text{ kips} \]

OCTANT C-3 SUBBOARD MOUNT:

THE MOUNT ATTACHMENT IS THE SAME AS C-2 SUB.

THE LOAD IS 990 lbs.

OCTANT S-6 UPPER MOUNT

LOAD = 630 lbs.
SCOTTER PLATE

\[ M = 968 \times 6.96 = 6.6 \text{ kips} \]

\[ \sigma_b = \frac{6.6}{0.3 \times 6.3} = 4.95 \text{ ksi} \]

\[ \sigma_c \leq 12 \text{ ksi} \]

Torsion:

\[ \sigma_t = \frac{T}{k \cdot a^2 \cdot b} \]

\[ k_3 = 0.3 \]

\[ \sigma_t = \frac{968 \times 1.33}{0.3 \times 0.5 \times 4} = 4.45 \text{ ksi} \leq 6 \text{ ksi} \]

Deflection:

\[ d = \frac{T \cdot L^2}{6 \cdot E \cdot I} = \frac{968 \times 3.8 \times 6.5^2}{(3 \times 0.5 \times 4) \times 12 \times 10^6} = 0.021 \text{ in} \]

Weld:

\[ f_w = \frac{968 \times 4.5 \times 6}{4^2 \times 0.25} = 9.2 \text{ ksi} < 12 \text{ ksi} \]

Combine bending and torsion:

\[ f_{max} \] maximum occur at different locations, thus not combined.

Shear stress:

\[ f_v = \frac{968}{4 \times 0.5} = 484 \text{ psi} \]
CLEVIS BRACKET, Tc Model = G211 KS7

MATERIAL ALLOWABLE:

DUCTILE IRON CASTING

\[ F_{yy} = 40 \text{ ksf} \]
\[ F_{y1} = \frac{43}{3} = 13.3 \text{ ksf} \]

NOTE:

THIS CLEVIS IS USED ON AIR CYLINDERS

\[ P_{max} = 250 \text{ psi} \]

\[ 2\frac{1}{4} \text{ in. bore} = \]

\[ P_{max} = 1227 \text{ lbs } \text{ ca. } 100 \text{ psi} \]

BENDING:

\[ M = 968 \times 7.5 = 7261 \text{ in. lbs} \]

\[ P_{b} = \frac{726 \times 6}{2 \times 5 \times 12} = 4.3 \text{ ksf } < 13.3 \text{ ksf} \]

\[ P_{s} = \frac{926}{1} = 926 \text{ psi } < 745 \text{ psi} \]

FASTENERS:

\[ P_{s} = \frac{968}{4} = 242 \text{ lbs} \]

\[ P_{f} = \frac{968 \times 1.13}{2183 \times 2} = 243 \text{ lbs} \]

\[ \frac{5}{16} - 13 \]

\[ f_c = \frac{242}{.0524} = 46.6 \text{ ksf } < 45 \text{ ksf} \]

\[ f_f = \frac{242}{.0524} = 47.1 \text{ ksf } < 90 \text{ ksf} \]

D Appendix A Ductile Iron Data
LEVIS BRACKET (cont.)

Eccentric lug analysis:

\[ P_{ey} = K_{ey} \frac{A_{ey}}{\lambda} \]

\[ A_{ey} = 0.25 \]

\[ A_{br} = 0.25 \times 1 = 0.25 \]

\[ A_{b} = 1.0, \quad K_{ey} = 1.0 \]

\[ P_{ey} = 1.0 \times 0.25 \times 40 = 10 \text{ kip} \]

Allowable load = \( \frac{10}{3} = 3.3 \text{ kip} > 968 \text{ lb} \)

**Pin Shear:**

\[ \phi_s = \frac{968}{2 \times 1.619} = 3.4 \text{ ksi} \]

**Pin Bending:**

\[ M = \frac{968}{2} \times 25 = 121 \text{ kips} \]

\[ N_b = \frac{121 \times 25}{1.6 \times 10^6} = 18 \text{ kpsi} < 30 \text{ kpsi} \]

*An area is calculated for a \( \frac{1}{2} \)" bolt, the clevis pin is supplied separately bracket.*

---

" Bruhn, Analysis & Design of Flight Vehicle Structures, P. 128"
**SUBJECT**
BLASTER MOT SUPPORTS

**DATE**
7/31/20

**REVISION DATE**

---

**POD EVO**
Mc Master = 6064 X 16 1/2" Male

**Loop Rating** = 8338 lbs

Allowable load = \( \frac{8338}{5} = 1667 \) > 969 lbs

**TURN BICYCLE:**

\( \frac{1}{2} \times 6 \) MATERIAL = 1035 STEEL, FORGED PER ASME FS-45-92

Working load limit = 2200 lbs < 969 lbs

**PIN SHEAR:**

\( \frac{1}{2} \) pin double shear:

\[
\sigma_s = \frac{969}{2 \times 0.1419} = 3.4 \text{ ksi}
\]
WELD 9 TO 2E 120V

OC7AUTS 1 1/2

\[ P = 942 \text{ lbs} \]
\[ M = 942 \times 12.9 = 12.1 \text{ kip ft} \]
\[ \sigma_S = \frac{942}{10 \times 2 \times 0.375^{1/2}} = 177 \text{ PSI} \]

\[ \varepsilon = \frac{(3.75 \times 2)}{\sqrt{2}} \left[ \frac{6^2 \times 4 + 7^2 \times 4}{180} \right] = 180 \text{ in}^4 \]

\[ f = \frac{121 \times 7}{180} = 431 \text{ PSI} \]

\[ f_s + f_t = 177 + 471 = 640 \text{ PSI} \]

OC7AUTS 0.3 & 4.7

\[ \sigma_S = \frac{[924^2 + 1044^2]^{1/2}}{10 \times 2 \times 0.375^{1/2}} = 265 \text{ PSI} \]

\[ f_s + f_t = 265 + 471 = 737 \text{ PSI} \]
B LAYER MDT SUPPORTS

WELDS TO BE IRON

OCTANT 0.3 IN BD

\[ \frac{3}{8} \times 2" \text{ welds} \]

\[ 7" \text{ sq} \]

\[ P = 968 \text{ lbs} \]

\[ M = 968 \times 12.9 = 12.5 \text{ kip-in} \]

\[ 2 \times A d^2 = \frac{2 \times 7.5 \times 2}{\frac{12}{2}} = 39.2 \]

\[ s = \frac{968}{8 \times 2 \times 3.75} = 223 \text{ psi} \]

\[ f = \frac{968 \times 12.1 \times 3.5}{39.2} = 1043 \text{ psi} \]

\[ f_{\text{typical}} = 1043 + 223 = 1274 \text{ psi} \]

TYPICAL STRESS IN A LAYER MOUNTS is 2 KS1
Performance Data

Front or Rear Flange
Use this flange on either the front or rear of your cylinder.

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Clevis Bracket with Pin

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Rod Clevis with Pin

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Pivot Bracket

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Use the pivot bracket with either the clevis bracket with pin or the rod clevis with pin (as shown below) for additional mounting versatility.
**More About Drop-In Tie Rod Air Cylinders**

NFPA—The National Fluid Power Association sets industry standards for a wide variety of pneumatic and hydraulic products. For air cylinders, those standards specify bore size and mounting configuration.

When you're replacing a cylinder, how do you know if it's an NFPA cylinder? For some cylinders, it's easy—they're marked "NFPA." Others aren't marked, so you'll have to look at the end cap. Measure the center-to-center distance between the tie rods (shown as dimension "D" on the schematic at right), then refer to specifications below. A 1⅛" "D" dimension, for example, tells you that you have an NFPA cylinder; the same is true for a 1 ⅜" "D" dimension, a 2⅛" "D" dimension, and so on. Some NFPA cylinders have tie rods with countersunk mounting holes on each end and other NFPA cylinders have tie rods with nuts on each end. In either case, the "D" dimension is the same.

**Tie Rod Body Design**—Our NFPA tie rod cylinders have external high-tensile steel threaded tie rods that hold the cylinder together, but also allow for easy disassembly and repair. Simply unthread the tie rods and remove the end caps for access to the cylinder interiors. End caps also have NFPA tapped holes for mounting the cylinder without attachments. The end caps are machined from solid 6061-T6 aluminum bar stock.

Designed for smooth operation and long life, the cylinder barrel is anodized aluminum, hard-coated to Rockwell 60C with a fine finish. The piston is solid high-alloy aluminum with two wear-compensating PTFE seals and a high-tensile ground and polished chrome-plated steel piston rod. Rod is threaded for connecting to whatever you want to push or pull.

The Teflon-impregnated anodized-aluminum rod bearing provides rod stability and allows the cylinder to handle side loads. Cylinders have a Teflon rod wipe to help prevent dirt and debris from entering the cylinder.

---

**Table: Tie Rod Cylinder Specifications**

| Bore Size | Port Size, NPT Female | Overall & Ext. (Dia.) | Rod Thread | Rod Dia. | End Cap | Tie Rod, Stroke Lg. (in) | Size of Mounting Holes, Center to Center (in) | Mounting Holes, Port Center to Center (A) | End Cap Thick. (in) | Bore Size, Port Size, NPT Female | Overall & Ext. (Dia.) | Rod Thread | Rod Dia. | End Cap | Tie Rod, Stroke Lg. (in) | Size of Mounting Holes, Center to Center (in) | Mounting Holes, Port Center to Center (A) | End Cap Thick. (in) |
|-----------|-----------------------|-----------------------|------------|---------|---------|------------------------|---------------------------------------------|---------------------------------------------|------------------|--------------------------|------------------------|------------|---------|---------|---------|------------------------|---------------------------------------------|---------------------------------------------|------------------|
| 1⅛"      | 1/8"                  | 6⅛" to 20             | ⅛"        | 7/16"   | ⅛"     | 2"                     | 1⅛" to 20                                   | 1⅛" to 20                                   | ⅛"              | 6⅛" to 20               | 1/8"                  | 6⅛" to 20             | 20             | ⅛"        | 7/16"   | ⅛"     | 2"                     | 1⅛" to 20                                   | 1⅛" to 20                                   | ⅛"              |
| 2"        | ⅜"                   | 6⅛" to 20             | ⅜"        | 1⅛"    | ⅜"     | 3"                     | 1⅛" to 20                                   | 1⅛" to 20                                   | ⅜"              | 6⅛" to 20               | ⅜"                   | 1⅛" to 20             | 20             | ⅜"        | 1⅛"    | ⅜"     | 3"                     | 1⅛" to 20                                   | 1⅛" to 20                                   | ⅜"              |
| 2½"       | ⅜"                   | 6⅛" to 20             | ⅜"        | 3"     | ⅜"     | 4"                     | 1⅛" to 20                                   | 1⅛" to 20                                   | ⅜"              | 6⅛" to 20               | ⅜"                   | 3"                     | 20             | ⅜"        | 3"     | ⅜"     | 4"                     | 1⅛" to 20                                   | 1⅛" to 20                                   | ⅜"              |
| 3⅛"       | ⅛"                   | 9" to 24              | ⅛"        | 1⅛"    | ⅛"     | 4"                     | 1⅛" to 24                                   | 1⅛" to 24                                   | ⅛"              | 9" to 24                | ⅛"                   | 1⅛" to 24             | 20             | ⅛"        | 1⅛"    | ⅛"     | 4"                     | 1⅛" to 24                                   | 1⅛" to 24                                   | ⅛"              |
| 4"        | ⅛"                   | 9" to 24              | ⅛"        | ⅛"     | ⅛"     | ⅛"                     | 9" to 24                                    | 9" to 24                                     | ⅛"              | 9" to 24                | ⅛"                   | ⅛"                     | 20             | ⅛"        | ⅛"     | ⅛"     | ⅛"                     | 9" to 24                                    | 9" to 24                                     | ⅛"              |

---

**Diagram:**

[Diagram of air cylinder with components labeled]

---

**Diagram:**

[Diagram showing cylinder with switches added]

---

**Diagram:**

[Diagram showing cylinder end view and side view]
DUCTILE IRON DATA
FOR DESIGN ENGINEERS

ENGINEERING DATA

TENSILE PROPERTIES

Yield Strength

The yield strength, or proof stress is the stress at which a material begins to exhibit significant plastic deformation. The sharp transition from elastic to plastic behaviour exhibited by annealed and normalized steels (Figure 3.3) gives a simple and unambiguous definition of yield strength. For Ductile Iron the offset method is used in which the yield strength is measured at a specified deviation from the linear relationship between stress and strain. This deviation, usually 0.2 %, is included in the definition of yield strength or proof stress in international specifications (see Section XII) and is often incorporated in the yield strength terminology, e.g. "0.2 % yield strength". Yield strengths for Ductile Iron typically range from 40,000 psi (275 MPa) for ferritic grades to over 90,000 psi (620 MPa) for martensitic grades.
Fittings and Connections, Bolted and Riveted.

Bolt or Pin Bending.

The subject of bolt bending strength is treated in Art. Dl.14.

Dl.12 Lug Strength Analysis Under Transverse Loading.

Cases arise where the lug of a fitting unit is subjected to only a transverse load. Melcon and Hobbit in (Ref. 4) express the ultimate transverse or failing load by a single equation:

\[ P_{tu} = K_{tu} A_{br} F_{tu} \]  \( -(10) \)

Similarly the yield strength of lug is,

\[ P_{ty} = K_{ty} A_{br} F_{ty} \]  \( -(11) \)

The efficiency failing and yield coefficients \( K_{tu} \) and \( K_{ty} \) are given by the curves in Fig. Dl.15. The curve nomenclature for the curves in Fig. Dl.15 is given in Table Dl.4. In using Fig. Dl.15, a value called \( A_{av} \) is needed, the value of which is shown in the equation shown on Fig. Dl.15.

Dl.13 Lug Strength Analysis Under Oblique Loads.

Fitting lugs are often subjected to oblique loads. Ref. 4 gives the following approach to this loading case.

Resolve the applied load into axial and transverse components. Then use the following interaction equation:

\[ R_a + R_{tr} = 1 \]  \( -(12) \)

or margin of safety is,

\[ M.S. = \frac{1}{R_a + R_{tr}} \]

where, \( R_a \) = axial component of applied ultimate load divided by the smaller of the

Fig. Dl.14 (Ref. 5)
Values of Shear-Bearing Factors of Lugs

\[ P_{tu} = K_{ury} A_{br} F_{ty} \]

FOR ALL MATERIALS

\[ 0.5 \leq \frac{\text{D}}{D} \leq 1.5 \]

\[ K_{ury} \]

\[ \frac{\text{D}}{D} \]

Fig. Dl.15 Lug Design Data
Tension Efficiency Factors for Transversely Loaded Lugs (Ref. 3, 4)
(See Table Dl.4 for Curve Nomenclature)

<table>
<thead>
<tr>
<th>Curve</th>
<th>1 - 4130 and 8630 Steel thru 125 KSI H. T.</th>
</tr>
</thead>
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<td>Curve 3</td>
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<td>356-T8 and 2024-T4 Plate</td>
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<td>Curve 5</td>
<td>2024-T3 and 2024-T4 Plate</td>
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<td>2024-T4 Sand Castings</td>
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<td>220-T4 Sand Castings</td>
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<td>Curve 8</td>
<td>2024-T8 and 7075-T6 Plate</td>
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<tr>
<td>Curve 9</td>
<td>2024-T3 and 2024-T4 Plate</td>
</tr>
<tr>
<td>Curve 10</td>
<td>Approximate Cantilever Strength for All Aluminum and Steel Alloys. If ( K_{tu} ) is Below this Curve a Separate Calculation as a Cantilever Beam is Warranted.</td>
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<td>Curve 12</td>
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<td>Curve 13</td>
<td>2024-T6 and 7075-T6 Die Forgings</td>
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<td>Curve 14</td>
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Table Dl.4
(to be used with Fig. Dl.15)
Curve Nomenclature for Transverse Loading

\[ M.S. = \frac{1}{(R_a + R_{tr})} \]  \( -(13) \)
Linkages & Ball Joint Bearings

Yoke End Linkages

**Threaded yokes** have female right-hand threads on the shank that let you adjust the overall length of the linkage. They’re typically screwed onto the threaded end of a rod, pipe, tube or cable linkage and secured with a clevis pin. Machined to Society of Automotive Engineers (SAE) standards.

**Blank yokes** have a solid unfinished stem that you can thread, weld, or form for a custom fit. They’re typically welded to a shaft or inside a tube ID.

**Neoprene-Isolated Rod Ends**

No metal-on-metal sliding surfaces—the oil-resistant neoprene insert in each of these rod ends helps eliminate noise, vibration, and the risk of brinelling (scratching a wear pattern in the metal). Ideal for use in suspensions and linkages.

Each rod end consists of a plated steel housing and a neoprene insert (the neoprene insert is bonded to a nylon sleeve and has an inner steel mounting sleeve).

**Ball Joint Bearings**

Make your own custom ball joints with these bearings. Mount them inside a hole drilled in a rod end blank (sold separately on page 899). They’re also ideal for use in areas where shanks won’t fit. Bearings with **steel housing and ball** have oil holes and grooves on the ID and OD of the race for easy lubrication. Bearings with **steel housing and ball with Teflon lining** offer lubrication-free operation. Bearings with **stainless steel housing and steel ball with Teflon lining** have a Type 17-4PH stainless steel housing for good corrosion resistance and offer lubrication-free operation.

**Steel Housing and Ball**

(B) (C) (D) (E) Each

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**Stainless Steel Housing and Steel Ball with Teflon Lining**

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**Blank yokes** are great for near 360° pivot point linkages of shafts, rods, and other assemblies. Also known as clevis ends, they’re furnished with clevis and cotter pins (except where noted).
Chicago Drop Forged Steel Turnbuckles

(C-1035 Steel)

Available with hot galvanized or self-colored finish. Jaw types supplied with round pins and cotter keys unless nuts and bolts are specified. Locking nuts are also available. To ascertain extended length add amount of take-up to length in closed position.

Turnbuckles meet ASTM F1145-92 Specification
## Overall Lengths - Inches *Closed Position

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**Chicago Forged Turnbuckle Fittings**

Maximum load ratings are based on a straight vertical lift in a gradually increasing manner. Any deviations as angular lifts, shock loads, modification of the basic part, etc., will result in drastically reduced maximum loads.

**Specifications**

**Eye Dimensions - Strength**
### Turnbuckles

<table>
<thead>
<tr>
<th>Diameter</th>
<th>ID Eye</th>
<th>OD Eye</th>
<th>Thickness of Eye</th>
<th>Max. Load Lbs.</th>
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### Hook Dimensions - Strength

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### Jaw Dimensions - Strength

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<th>Hole Center to Shank</th>
<th>Inside Jaw Width</th>
<th>OD Jaweye</th>
<th>ID Jaweye</th>
<th>Pin Diameter</th>
<th>Max Load Lbs.</th>
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</table>
NOTES:
- All welds to conform to A.W.S. D1.1-2000 (Standard for welding Procedure and Performance Qualifications)
- Approximate weight: 90 pounds
A. All welds to conform to A.W.S. D1.1-2000 (Standard for Welding Procedure and Performance Qualifications)
- Approximate weight: 100 pounds

Parts List

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<td>2</td>
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<td>Attachment Plate</td>
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<td>4</td>
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Originator: TONY LEVANO
Approved: TONY LEVANO
NOTES:
- ALL WELDS TO CONFORM TO A.W.S. DI-1-2000
  (STANDARD FOR WELDING PROCEDURE AND
  PERFORMANCE QUALIFICATIONS)
- APPROXIMATE WEIGHT = 35 POUNDS
- THIS DRAWING IS A LEFT HAND VERSION OF #C-386965

A
4 COMM./STK. ATTACHMENT PLATE 1
3 MC-386948 4,313-18 UNC-2B HEX STEEL WELD NUT
  ("MASTER-CAVN (BEGINUNG OR EQUAL)"
  1
2 COMM./STK. 4.04.0 x .19 A500 GR.B STRUCTURAL STL. TUBE 1.5"
1 MC-386955 MOUNTING PLATE 1

ITEM PART NO. DESCRIPTION OR SIZE QTY.

PARTS LIST

UNLESS OTHERWISE SPECIFIED ORIGINATOR TONY LEVAND 08/16/00

DECIMAL TOLERANCES DRAWN K. POTTER 08/16/00

±.01. 0+03.000 OR LESS CHECKED TONY LEVAND 08/26/00

NORMAL TOLERANCES: 0" APPROVED TONY LEVAND 08/26/00

1) BRUSH ALL SAWDUST. OILS, ETC. WIPED ON
2) DO NOT SCALE DRAWING.
3) REMARK NO BOLT SIZE OR MATERIAL
4) NO. ALL BOLT SIZES 1/4-

FERMI NATIONAL ACCELERATOR LABORATORY
UNITED STATES DEPARTMENT OF ENERGY

PPD/MECHANICAL SUPPORT
B LAYER MDT OCTANT SUPPORT
SUB-FRAME WELDMENT

CREATED WITH: MS2.1 GROUP: DOMG
I was IMC-386948
K POTTER 09/07/00

B1 WAS 7.06, B2 WAS 11.14
K POTTER 09/11/00

1

NOTES:
- ALL MELDS TO CONFORM TO A.W.S. D1.1-2000
  (STANDARD FOR WELDING PROCEDURE AND PERFORMANCE QUALIFICATIONS)
- APPROXIMATE WEIGHT - 35 POUNDS
- THIS DRAWING IS A RIGHT HAND VERSION OF IMC-386971!

PARTS LIST

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Fermi National Accelerator Laboratory
United States Department of Energy

PPD/Mechanical Support
B Layer MDT Octant Support Sub-Frame Weldment

Plotter: A, Sep-2000, File: 3869650 drawings
NOTES:
- ALL WELDS TO CONFORM TO A.W.S. D1.1-2000 (STANDARD FOR WELDING PROCEDURE AND PERFORMANCE QUALIFICATIONS)
- APPROXIMATE WEIGHT: 120 POUNDS

Fermi National Accelerator Laboratory
United States Department of Energy

PPD/Mechanical Support
B Layer MDT Octant Support
Sub-Frame Weldment

Scale 0.90
Drawing Number 3823.130-MC-386966
Sheet 1 of 1

Created with: MS2.1 Group: Dnns
NOTES:
- All welds to conform to A.W.S. D1.1-2000 (Standard for Welding Procedure and Performance Qualifications)
- Approximate weight: 60 pounds
- This drawing is a RIGHT HAND VERSION of IMC-386963

PARTS LIST
- Unless otherwise specified
- Originator: Tony Levand
- Drawn: Kent Potter
- Checked: Tony Levand
- Approved: Tony Levand

FERMI NATIONAL ACCELERATOR LABORATORY
UNITED STATES DEPARTMENT OF ENERGY

PPD/Mechanical Support
B Layer MDT Octant Support
Sub-Frame Weldment
NOTES:
- ALL WELDS TO CONFORM TO A.W.S. D1.1-2000 (STANDARD FOR WELDING PROCEDURE AND PERFORMANCE QUALIFICATIONS)
- APPROXIMATE WEIGHT = 60 POUNDS
- THIS DRAWING IS A LEFT HAND VERSION OF MC-386954

ALL SHAPED OUTS = 0.0625" (1.6 mm) EXCEPT AS SHOWN

6.55 (4.00) 8.5

3.94 (4.00)

12.89

REV DESCRIPTION DRAWN DATE
A WAS MC-38694B TONY LEVAND 08/16/00
B 11 WAS 2.03, A2 WAS 6.07, A3 WAS 11.14 TONY LEVAND 08/16/00

COMM./SK. ATTACHMENT PLATE
1 3 MC-386945 MOUNTING PLATE
2 2 COMM./SK. 4.04, D1. 19 A500 GR.B STRUCTURAL STL TUBE
1 1 MC-386955 MOUNTING PLATE

ITEM PART NO. DESCRIPTION OR SIZE
01

PARTS LIST

UNLESS OTHERWISE SPECIFIED ORIUGATN TONY LEVAND 08/16/00
DECIMAL TOLERANCE 0.002
DRAWN K. POTTER 08/16/00
CHECKED K. POTTER 08/16/00
APPROVED TONY LEVAND 08/28/00

FERMI NATIONAL ACCELERATOR LABORATORY
UNITED STATES DEPARTMENT OF ENERGY

PPD/MECHANICAL SUPPORT
B LAYER MDT OCTANT SUPPORT
SUB-FRAME WELDMENT

CREATED WITH: WPS2.1 GROUP: DOMS
NOTES:

- ALL WELDS TO CONFORM TO A.W.S. D1.1-2000 (STANDARD FOR WELDING PROCEDURE AND PERFORMANCE QUALIFICATIONS)
- APPROXIMATE WEIGHT - 470 POUNDS
- THIS DRAWING IS A LEFT HAND VERSION OF IMC-386951

PARTS LIST

UNLESS OTHERWISE SPECIFIED

PART NO.

DESCRIPTION OR SIZE

1

MC-386949 MOUNTING PLATE

2

MC-386948 ATTACHMENT PLATE

3

COMM./STK. 4.0×4.0×18 AS500 GR.B STRUCTURAL ST. TUBE

4

COMM./STK. 4.0×4.0×18 UNCI-3B HEX STEEL WELD NUT ("MACMASTER-CARR 90564530 OR EQUAL"

5

COMM./STK. 3.0×2.0×16 AS500 GR.B STRUCTURAL ST. TUBE

- THIS DRAWING IS A LEFT HAND VERSION OF IMC-386951

Fermi National Accelerator Laboratory
United States Department of Energy

PPD/MECHANICAL SUPPORT
B LAYER MDT OCTANT SUPPORT
SUB-FRAME WELDMENT
REV
DESCRIPTION

A1 WAS 2.43, A2 WAS 6.03, A3 WAS 10.20

X. POTTER 08-13-00

TONY LEVAND 08-28-00

NOTES:
- ALL WELDS TO CONFORM TO AWS D1.1-2000
  (STANDARD FOR WELDING PROCEDURE AND PERFORMANCE QUALIFICATIONS)
- APPROXIMATE WEIGHT = 470 POUNDS
- THIS DRAWING IS A RIGHT HAND VERSION OF A1-386961

PARTS LIST

UNLESS OTHERWISE SPECIFIED OR OTHERWISE NOTED

ITEM PART NO. DESCRIPTION OR SIZE

5 COMM/STK 3.0x4.0 10 A500 GR.B STRUCTURAL ST. TUBE 21.5
3 COMM/STK 4.0x4.0 10 A500 GR.B STRUCTURAL ST. TUBE 21.5
2 MC-386948 ATTACHMENT PLATE
1 MC-386949 MOUNTING PLATE

FERMI NATIONAL ACCELERATOR LABORATORY
UNITED STATES DEPARTMENT OF ENERGY

PPD/MECHANICAL SUPPORT
B LAYER MDT OCTANT SUPPORT
SUB-FRAME WELDMENT
**SS Series**

**Quick Disconnect**

Quick Disconnect assemblies with good wear characteristics. Patented design features "key hole" retaining sleeve which insures that the assembly can only be put together with the sleeve positively aligned with the ball cavity. When the spring is released, alignment is automatic, thereby eliminating any possibility of partial closure. Body and ball stud are of low carbon steel. Ball studs are surface hardened for wear resistance. All components except the stainless steel spring are plated and yellow dichromate treated for corrosion resistance.

**Description and Specifications**

Type SS ball joints are high strength, quick disconnect assemblies with good wear characteristics. Patented design features "key hole" retaining sleeve which insures that the assembly can only be put together with the sleeve positively aligned with the ball cavity. When the spring is released, alignment is automatic, thereby eliminating any possibility of partial closure. Body and ball stud are of low carbon steel. Ball studs are surface hardened for wear resistance. All components except the stainless steel spring are plated and yellow dichromate treated for corrosion resistance.

**Materials of Construction**

Body and ball stud are of low carbon steel. Ball studs are surface hardened for wear resistance. All components except the stainless steel spring are plated and yellow dichromate treated for corrosion resistance.

**Disconnection**

Simplified because of the disconnect feature.

The hardened spring steel retaining clip accepts ball stud member at 19 pounds maximum push-in load and permits removal of ball stud with 14 pounds minimum pull-out load.

**Materials of Construction**

Body and ball stud are of low carbon steel. Ball studs are surface hardened for wear resistance. All components except the stainless steel spring are plated and yellow dichromate treated for corrosion resistance.

**P Series**

**Disconnect**

Body and ball stud are of low carbon steel. Ball studs are surface hardened for wear resistance. All components except the stainless steel spring are plated and yellow dichromate treated for corrosion resistance.
MSM Series
2-Piece, Metal to Metal

Dimensions in inches

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<th>A</th>
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Dimensions in millimeters

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<th>W</th>
<th>B</th>
<th>A</th>
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Notes:
1. For standard zerk lubrication fitting add ‘Z’ to suffix. Example: MSM8Z
2. This series is also available in a studded configuration. (refer to chart in this catalog, page 47) Specify by adding ‘S’ to suffix. Example: MSM8S

* Lubrication fittings are not supplied on these units