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MFGT 123

Fabrication Methods 1

Manufacturing Processes & Project Prints

*This book should
come to every
Fabrication
class you have.
Every day!*

**Reference materials for
lay out, calculating weights,
cutting, drilling, bending
and manufacturing
parts.**



Written by:
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Associate Professor
NDSCS Manufacturing Dept.

Revised 5/4/2017

THE SCIENCE OF SUCCESS

INCH/METRIC TAP DRILL SIZES & DECIMAL EQUIVALENTS

| Drill Size | Decimal Equivalent | Tap Size | Drill Size | Decimal Equivalent | Tap Size | Drill Size | Decimal Equivalent | Tap Size | | | | | | | | | | |
|------------|--------------------|----------|------------|--------------------|------------|------------|--------------------|------------|-------------|------------|-------------|-------------|-------------|-----------|-----------|-----------|------------|--------|
| 1/64 | 80 | 0 - 80 | 13/64 | 10 | 1/4 - 20 | 59 | .9219 | 1 - 12 | | | | | | | | | | |
| | 79 | | | 9 | | .1960 | 64 | .9375 | 1 - 14 | | | | | | | | | |
| | 78 | | | 8 | | .1990 | 61 | .9531 | 1 1/8 - 7 | | | | | | | | | |
| | 77 | | | 7 | | .2010 | 64 31 | .9688 | | | | | | | | | | |
| | 76 | | | 6 | | .2031 | 63 32 | .9844 | | | | | | | | | | |
| | 75 | | | 5 | | .2040 | 64 | 1.0000 | 1 1/8 - 12 | | | | | | | | | |
| | 74 | | | 4 | | .2055 | 13/64 | 1.0469 | | | | | | | | | | |
| | 73 | | | 3 | | .2090 | 17/64 | 1.1094 | 1 1/4 - 7 | | | | | | | | | |
| | 72 | | | 2 | | .2130 | 7/32 | 1 11/64 | 1.1250 | 1 1/4 - 12 | | | | | | | | |
| | 71 | | | 1 | | .2188 | | 17/32 | 1.1719 | 1 3/8 - 6 | | | | | | | | |
| | 70 | | | A | | .2210 | | 1 19/64 | 1 11/32 | 1.2500 | 1 3/8 - 12 | | | | | | | |
| | 69 | | | | | .2280 | 119/64 | | 1.2969 | 1 1/2 - 6 | | | | | | | | |
| | 68 | | | | | .2340 | 15/64 | 1.3438 | 1 1/2 - 12 | | | | | | | | | |
| | 1/32 | | | 67 | | 1 - 64, 72 | 17/64 | B | | 5/16 - 18 | 127/64 | 1.4219 | | | | | | |
| | | | | 66 | | | | C | .2344 | | | | | | | | | |
| 65 | | D | .2380 | | | | | | | | | | | | | | | |
| 64 | | E | .2420 | | | | | | | | | | | | | | | |
| 63 | | F | .2460 | | | | | | | | | | | | | | | |
| 62 | | G | .2500 | | | | | | | | | | | | | | | |
| 61 | | H | .2570 | | | | | | | | | | | | | | | |
| 60 | | I | .2610 | | | | | | | | | | | | | | | |
| 59 | | J | .2656 | | | | | | | | | | | | | | | |
| 58 | | K | .2660 | | | | | | | | | | | | | | | |
| 57 | | L | .2720 | | | | | | | | | | | | | | | |
| 56 | | M | .2770 | | | | | | | | | | | | | | | |
| 3/64 | | 55 | 2 - 56, 64 | 9/32 | 9 | | | 5/16 - 24 | M1.6 x 0.35 | | 1.25 | .0492 | | | | | | |
| | | 54 | | | 8 | | | | | | .2810 | M1.8 x 0.35 | 1.45 | .0571 | | | | |
| | | 53 | | | 7 | | | | | | .2812 | M2 x 0.4 | 1.60 | .0630 | | | | |
| | 1/16 | 52 | | | 3 - 48 | 19/64 | 5/16 | | | 3/8 - 16 | M2.2 x 0.45 | 1.75 | .0689 | | | | | |
| | | 51 | | | | | | | | | N | .3020 | M2.5 x 0.45 | 2.05 | .0807 | | | |
| | | 50 | | | | | | | | | O | .3125 | M3 x 0.5 | 2.50 | .0984 | | | |
| | 49 | P | | | .3160 | 21/64 | Q | | | .3230 | M3.5 x 0.6 | 2.90 | .1142 | | | | | |
| | 48 | R | | | .3281 | | 11/32 | | | .3390 | M4 x 0.7 | 3.30 | .1299 | | | | | |
| | 5/64 | 47 | | | 3 - 56, 64 | 23/64 | 3/8 | | | 3/8 - 24 | M4.5 x 0.75 | 3.70 | .1457 | | | | | |
| | | 46 | | | | | | | | | S | .3438 | M5 x 0.8 | 4.20 | .1654 | | | |
| | | 45 | | | | | | | | | T | .3480 | M6 x 1 | 5.00 | .1968 | | | |
| | | 44 | | | | | | | | | U | .3580 | M7 x 1 | 6.00 | .2362 | | | |
| | | 43 | | | | | | | | | V | .3594 | 25/64 | M8 x 1.25 | 6.70 | .2638 | | |
| | | 42 | | | | | | | | | W | .3680 | | M8 x 1 | 7.00 | .2756 | | |
| | | 3/32 | | | | | | | | | 41 | 4 - 40 | 27/64 | 7/8 | 7/16 - 14 | M10 x 1.5 | 8.50 | .3346 |
| 40 | | | X | .3770 | | | | M10 x 1.25 | 8.70 | | .3425 | | | | | | | |
| 39 | | | Y | .3860 | | | | M12 x 1.75 | 10.20 | | .4016 | | | | | | | |
| 38 | | | Z | .3906 | | | | M12 x 1.25 | 10.80 | | .4252 | | | | | | | |
| 37 | | | 5 - 40 | 29/64 | | | | 7/16 | 7/16 - 20 | | M14 x 2 | | | | | 12.00 | .4724 | |
| 36 | | | | | | | | | | | M14 x 1.5 | | | | | 12.50 | .4921 | |
| 7/64 | | | 35 | 5 - 44 | | | | 31/64 | 1/2 | | 1/2 - 13 | | | | | M16 x 2 | 14.00 | .5512 |
| | | | 34 | | | | | | | | | | | | | M16 x 1.5 | 14.50 | .5709 |
| | | | 33 | | | | | | | | | | | | | M18 x 2.5 | 15.50 | .6102 |
| | 32 | | M18 x 1.5 | | 16.50 | .6496 | | | | | | | | | | | | |
| | 31 | | 6 - 40 | | 33/64 | 1/2 | 1/2 - 20 | | | M20 x 2.5 | | | | | | 17.50 | .6890 | |
| | 30 | | | | | | | | | M20 x 1.5 | | | | | | 18.50 | .7283 | |
| | 9/64 | | 29 | | 6 - 32, 36 | 35/64 | 3/4 | | | 9/16 - 12 | | | | | | M22 x 2.5 | 19.50 | .7677 |
| | | | 28 | | | | | | | | | | | | | M22 x 1.5 | 20.50 | .8071 |
| | | | 1/8 | | | | | | | | | | | | | 27 | 8 - 32, 36 | 37/64 |
| | | 26 | | | | | | | | | | M24 x 2 | 22.00 | .8661 | | | | |
| | | 25 | | | | | | | | | | M27 x 3 | 24.00 | .9449 | | | | |
| | | 24 | M27 x 2 | | | | | | | | | 25.00 | .9843 | | | | | |
| | | 23 | 10 - 24 | | | | | | | | | 39/64 | 3/4 | 5/8 - 18 | M30 x 3.5 | 26.50 | 1.0433 | |
| | | 22 | | | | | | | | | | | | | M30 x 2 | 28.00 | 1.1024 | |
| | | 5/32 | 21 | | | | | | | | | 10 - 32 | 41/64 | 7/8 | 7/8 - 9 | M30 x 2 | 28.00 | 1.1024 |
| 20 | | | M33 x 3.5 | 29.50 | | | | 1.1614 | | | | | | | | | | |
| 19 | | | M33 x 2 | 31.00 | | | | 1.2205 | | | | | | | | | | |
| 18 | | | M36 x 4 | 32.00 | | | | 1.2598 | | | | | | | | | | |
| 3/16 | | | 17 | 12 - 24 | | | | 43/64 | 1 | | 3/4 - 10 | | | | | M36 x 3 | 33.00 | 1.2992 |
| | | | 16 | | | | | | | | | | | | | M39 x 4 | 35.00 | 1.3780 |
| | | | 15 | | | | | | | | | | | | | M39 x 3 | 36.00 | 1.4173 |
| 14 | 12 - 28 | | 45/64 | 1 1/8 | 7/8 - 14 | M39 x 3 | 36.00 | 1.4173 | | | | | | | | | | |
| 13 | | | | | | M39 x 3 | 36.00 | 1.4173 | | | | | | | | | | |
| 12 | 12 - 28 | | 47/64 | 1 1/4 | 1 - 8 | | | | | | | | | | | | | |
| 11 | | | | | | | | | | | | | | | | | | |

| METRIC TAP DRILL SIZES | | |
|------------------------|----------------|----------------|
| Metric Tap | Tap Drill (mm) | Decimal (inch) |
| M1.6 x 0.35 | 1.25 | .0492 |
| M1.8 x 0.35 | 1.45 | .0571 |
| M2 x 0.4 | 1.60 | .0630 |
| M2.2 x 0.45 | 1.75 | .0689 |
| M2.5 x 0.45 | 2.05 | .0807 |
| M3 x 0.5 | 2.50 | .0984 |
| M3.5 x 0.6 | 2.90 | .1142 |
| M4 x 0.7 | 3.30 | .1299 |
| M4.5 x 0.75 | 3.70 | .1457 |
| M5 x 0.8 | 4.20 | .1654 |
| M6 x 1 | 5.00 | .1968 |
| M7 x 1 | 6.00 | .2362 |
| M8 x 1.25 | 6.70 | .2638 |
| M8 x 1 | 7.00 | .2756 |
| M10 x 1.5 | 8.50 | .3346 |
| M10 x 1.25 | 8.70 | .3425 |
| M12 x 1.75 | 10.20 | .4016 |
| M12 x 1.25 | 10.80 | .4252 |
| M14 x 2 | 12.00 | .4724 |
| M14 x 1.5 | 12.50 | .4921 |
| M16 x 2 | 14.00 | .5512 |
| M16 x 1.5 | 14.50 | .5709 |
| M18 x 2.5 | 15.50 | .6102 |
| M18 x 1.5 | 16.50 | .6496 |
| M20 x 2.5 | 17.50 | .6890 |
| M20 x 1.5 | 18.50 | .7283 |
| M22 x 2.5 | 19.50 | .7677 |
| M22 x 1.5 | 20.50 | .8071 |
| M24 x 3 | 21.00 | .8268 |
| M24 x 2 | 22.00 | .8661 |
| M27 x 3 | 24.00 | .9449 |
| M27 x 2 | 25.00 | .9843 |
| M30 x 3.5 | 26.50 | 1.0433 |
| M30 x 2 | 28.00 | 1.1024 |
| M33 x 3.5 | 29.50 | 1.1614 |
| M33 x 2 | 31.00 | 1.2205 |
| M36 x 4 | 32.00 | 1.2598 |
| M36 x 3 | 33.00 | 1.2992 |
| M39 x 4 | 35.00 | 1.3780 |
| M39 x 3 | 36.00 | 1.4173 |

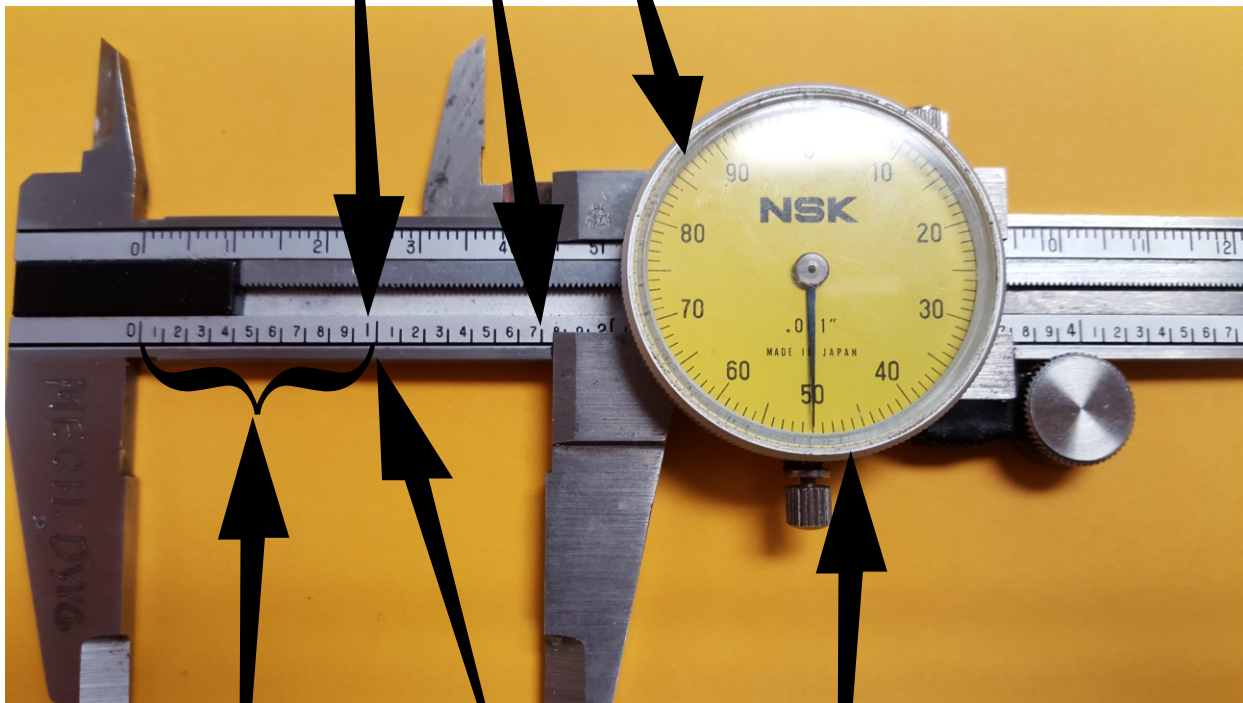
| Pipe Thread Sizes (NPSC) | | | |
|--------------------------|-------|----------------|---------|
| Thread | Drill | Thread | Drill |
| 1/8 - 27 | 11/32 | 1 1/2 - 11 1/2 | 1 3/4 |
| 1/4 - 18 | 7/16 | 2 - 11 1/2 | 2 7/32 |
| 3/8 - 18 | 37/64 | 2 1/2 - 8 | 2 21/32 |
| 1/2 - 14 | 23/32 | 3 - 8 | 3 1/4 |
| 3/4 - 14 | 59/64 | 3 1/2 - 8 | 3 3/4 |
| 1 - 11 1/2 | 15/32 | 4 - 8 | 4 1/4 |
| 1 1/4 - 11 1/2 | 11/2 | | |

MILLIMETER - INCH CONVERSION CHART

| mm | decimal | inch | mm | decimal | inch | mm | decimal | inch | mm | decimal | inch |
|----|---------|--------|----|---------|---------|----|---------|---------|-----|---------|---------|
| | 0.015 | 1/64 | 33 | 1.2992 | | 65 | 2.5591 | | 97 | 3.8189 | |
| | 0.031 | 1/32 | | 1.312 | 1-5/16 | | 2.562 | 2-9/16 | | 3.843 | 3-27/32 |
| 1 | 0.0394 | | 34 | 1.3386 | | | 2.593 | 2-19/32 | 98 | 3.8583 | |
| | 0.062 | 1/16 | | 1.343 | 1-11/32 | 66 | 2.5984 | | | 3.875 | 3-7/8 |
| 2 | 0.0787 | | | 1.375 | 1-3/8 | | 2.625 | 2-5/8 | 99 | 3.8976 | |
| | 0.093 | 3/32 | 35 | 1.3780 | | 67 | 2.6378 | | | 3.906 | 3-29/32 |
| 3 | 0.1181 | | | 1.406 | 1-13/32 | | 2.656 | 2-21/32 | 100 | 3.9370 | 3-15/16 |
| | 0.125 | 1/8 | 36 | 1.4173 | | 68 | 2.6772 | | | 3.968 | 3-31/32 |
| 4 | 0.156 | 5/32 | | 1.437 | 1-7/16 | | 2.687 | 2-11/16 | 101 | 3.9764 | |
| | 0.1575 | | 37 | 1.4567 | | 69 | 2.7165 | | | 4.000 | 4 |
| 5 | 0.187 | 3/16 | | 1.468 | 1-15/32 | | 2.718 | 2-23/32 | 102 | 4.0157 | |
| | 0.1969 | | 38 | 1.4961 | | | 2.750 | 2-3/4 | | 4.0310 | 4-1/32 |
| 6 | 0.218 | 7/32 | | 1.500 | 1-1/2 | 70 | 2.7559 | | 103 | 4.0551 | |
| | 0.2362 | | | 1.531 | 1-17/32 | | 2.781 | 2-25/32 | | 4.0620 | 4-1/16 |
| 7 | 0.250 | 1/4 | 39 | 1.5354 | | 71 | 2.7953 | | | 4.0930 | 4-3/32 |
| | 0.2756 | | | 1.562 | 1-9/16 | 72 | 2.812 | 2-13/16 | 104 | 4.0945 | |
| | 0.281 | 9/32 | 40 | 1.5748 | | | 2.8346 | | | 4.125 | 4-1/8 |
| | 0.312 | 5/16 | | 1.593 | 1-19/32 | 73 | 2.843 | 2-27/32 | 105 | 4.1339 | |
| 8 | 0.3150 | | 41 | 1.6142 | | | 2.8740 | | | 4.156 | 4-5/32 |
| | 0.343 | 11/32 | | 1.625 | 1-5/8 | | 2.875 | 2-7/8 | 106 | 4.1732 | |
| 9 | 0.3543 | | 42 | 1.6535 | | | 2.906 | 2-29/32 | | 4.187 | 4-3/16 |
| | 0.375 | 3/8 | | 1.656 | 1-21/32 | 74 | 2.9134 | | 107 | 4.2126 | |
| 10 | 0.3937 | | | 1.687 | 1-11/16 | | 2.9370 | 2-15/16 | | 4.218 | 4-7/32 |
| | 0.406 | 13/32 | 43 | 1.6929 | | 75 | 2.9528 | | | 4.250 | 4-1/4 |
| 11 | 0.4331 | | | 1.718 | 1-23/32 | | 2.968 | 2-31/32 | 108 | 4.2520 | |
| | 0.437 | 7/16 | 44 | 1.7323 | | 76 | 2.9921 | | | 4.281 | 4-9/32 |
| | 0.468 | 15/32 | | 1.750 | 1-3/4 | | 3.000 | 3 | 109 | 4.2913 | |
| 12 | 0.4724 | | 45 | 1.7717 | | | 3.0310 | 3-1/32 | | 4.312 | 4-5/16 |
| | 0.500 | 1/2 | | 1.781 | 1-25/32 | 77 | 3.0315 | | 110 | 4.3307 | |
| 13 | 0.5118 | | 46 | 1.8110 | | | 3.0620 | 3-1/16 | | 4.343 | 4-11/32 |
| | 0.531 | 17/32 | | 1.812 | 1-13/16 | 78 | 3.0709 | | 111 | 4.3701 | |
| 14 | 0.5512 | | | 1.843 | 1-27/32 | | 3.0930 | 3-3/32 | | 4.375 | 4-3/8 |
| | 0.562 | 9/16 | 47 | 1.8504 | | 79 | 3.1102 | | | 4.406 | 4-13/32 |
| 15 | 0.5906 | | | 1.875 | 1-7/8 | | 3.125 | 3-1/8 | 112 | 4.4094 | |
| | 0.593 | 19/32 | 48 | 1.8898 | | 80 | 3.1496 | | | 4.437 | 4-7/16 |
| | 0.625 | 5/8 | | 1.906 | 1-29/32 | | 3.156 | 3-5/32 | 113 | 4.4488 | |
| 16 | 0.6299 | | 49 | 1.9291 | | | 3.187 | 3-3/16 | | 4.468 | 4-15/32 |
| | 0.656 | 21/32 | | 1.9370 | 1-15/16 | 81 | 3.1890 | | 114 | 4.4882 | |
| 17 | 0.6693 | | | 1.968 | 1-31/32 | | 3.218 | 3-7/32 | | 4.500 | 4-1/2 |
| | 0.687 | 11/16 | 50 | 1.9685 | | 82 | 3.2283 | | 115 | 4.5276 | |
| 18 | 0.7087 | | | 2.000 | 2 | | 3.250 | 3-1/4 | | 4.531 | 4-17/32 |
| | 0.718 | 23/32 | 51 | 2.0079 | | 83 | 3.2677 | | | 4.562 | 4-9/16 |
| 19 | 0.7480 | | | 2.0310 | 2-1/32 | | 3.281 | 3-9/32 | 116 | 4.5669 | |
| | 0.750 | 3/4 | 52 | 2.0472 | | 84 | 3.3071 | | | 4.593 | 4-19/32 |
| | 0.781 | 25/32 | | 2.0620 | 2-1/16 | | 3.312 | 3-5/16 | 117 | 4.6063 | |
| 20 | 0.7874 | | 53 | 2.0866 | | | 3.343 | 3-11/32 | | 4.625 | 4-5/8 |
| | 0.812 | 13/16 | | 2.0930 | 2-3/32 | 85 | 3.3465 | | 118 | 4.6457 | |
| 21 | 0.8268 | | | 2.125 | 2-1/8 | | 3.375 | 3-3/8 | | 4.656 | 4-21/32 |
| | 0.843 | 27/32 | 54 | 2.1260 | | 86 | 3.3858 | | 119 | 4.6850 | |
| 22 | 0.8661 | | | 2.156 | 2-5/32 | | 3.406 | 3-13/32 | | 4.687 | 4-11/16 |
| | 0.875 | 7/8 | 55 | 2.1654 | | 87 | 3.4252 | | | 4.718 | 4-23/32 |
| 23 | 0.9055 | | | 2.187 | 2-3/16 | | 3.437 | 3-7/16 | 120 | 4.7244 | |
| | 0.906 | 29/32 | 56 | 2.2047 | | 88 | 3.4646 | | | 4.750 | 4-3/4 |
| | 0.937 | 15/16 | | 2.218 | 2-7/32 | | 3.468 | 3-15/32 | 121 | 4.7638 | |
| 24 | 0.9449 | | 57 | 2.2441 | | | 3.500 | 3-1/2 | | 4.781 | 4-25/32 |
| | 0.968 | 31/32 | | 2.250 | 2-1/4 | 89 | 3.5039 | | 122 | 4.8031 | |
| 25 | 0.9843 | | | 2.281 | 2-9/32 | | 3.531 | 3-17/32 | | 4.812 | 4-13/16 |
| | 1.000 | 1 | 58 | 2.2835 | | 90 | 3.5433 | | 123 | 4.8425 | |
| 26 | 1.0236 | | | 2.312 | 2-5/16 | | 3.562 | 3-9/16 | | 4.843 | 4-27/32 |
| | 1.0310 | 1-1/32 | 59 | 2.3228 | | 91 | 3.5827 | | | 4.875 | 4-7/8 |
| | 1.0620 | 1-1/16 | | 2.343 | 2-11/32 | | 3.593 | 3-19/32 | 124 | 4.8819 | |
| 27 | 1.0630 | | 60 | 2.3622 | | 92 | 3.6220 | | | 4.906 | 4-29/32 |
| | 1.0930 | 1-3/32 | | 2.375 | 2-3/8 | | 3.625 | 3-5/8 | 125 | 4.9213 | |
| 28 | 1.1024 | | 61 | 2.4016 | | | 3.656 | 3-21/32 | | 4.9370 | 4-15/16 |
| | 1.125 | 1-1/8 | | 2.406 | 2-13/32 | 93 | 3.6614 | | 126 | 4.9606 | |
| 29 | 1.1417 | | | 2.437 | 2-7/16 | | 3.687 | 3-11/16 | | 4.968 | 4-31/32 |
| | 1.156 | 1-5/32 | 62 | 2.4409 | | 94 | 3.7008 | | 127 | 5.000 | 5 |
| 30 | 1.1811 | | | 2.468 | 2-15/32 | | 3.718 | 3-23/32 | | | |
| | 1.187 | 1-3/16 | 63 | 2.4803 | | 95 | 3.7402 | | | | |
| | 1.218 | 1-7/32 | | 2.500 | 2-1/2 | | 3.750 | 3-3/4 | | | |
| 31 | 1.2205 | | 64 | 2.5197 | | 96 | 3.7795 | | | | |
| | 1.250 | 1-1/4 | | 2.531 | 2-17/32 | | 3.781 | 3-25/32 | | | |
| 32 | 1.2598 | | | | | | 3.812 | 3-13/16 | | | |
| | 1.281 | 1-9/32 | | | | | | | | | |

Dial Caliper Reading

1.750



Tenths
.1, .2, .3,

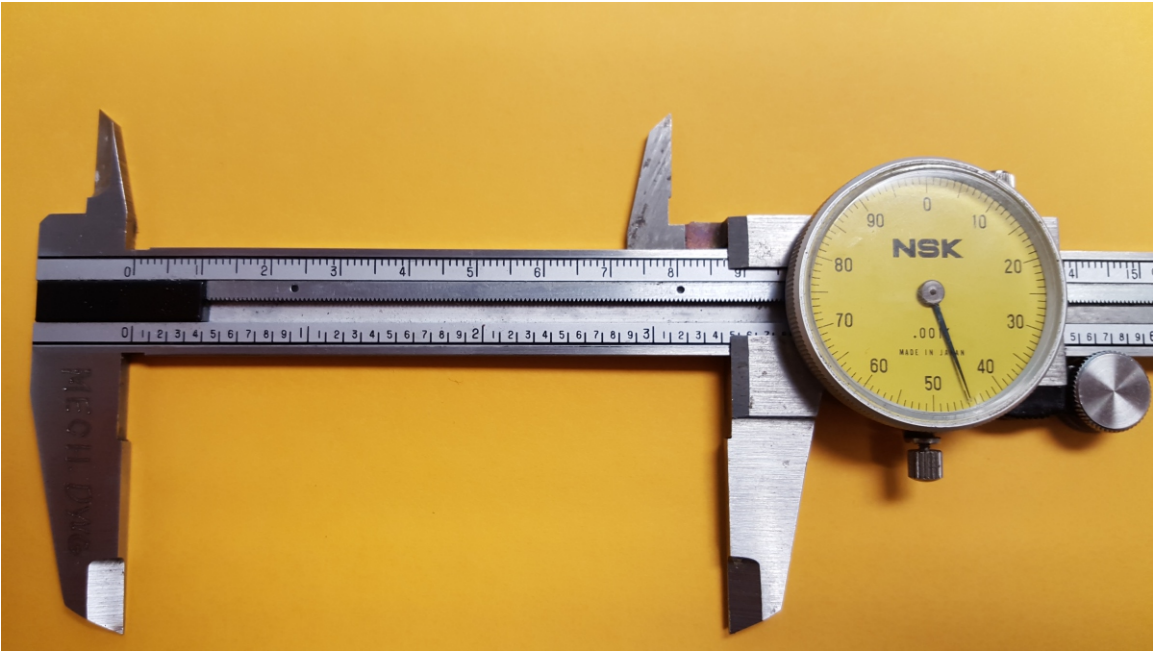
Inches
1, 2, 3,

Hundreths
.01, .02, .03
Thousandths
.015, .025, .035

Dial Caliper Reading



Dial Caliper Reading



Dial Caliper Reading





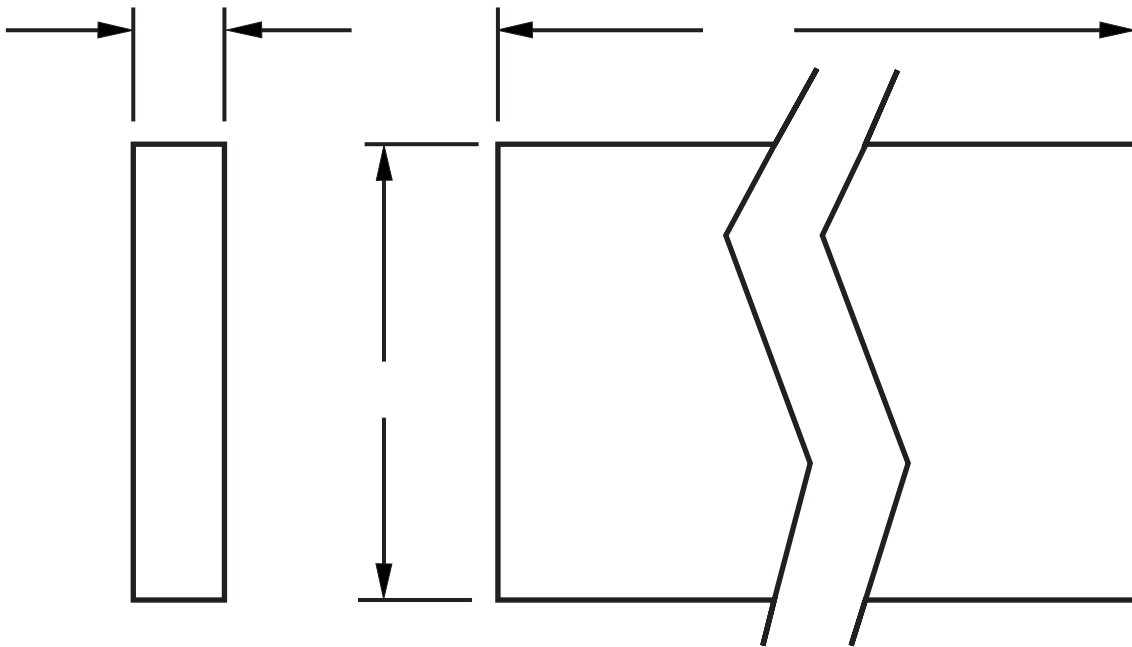
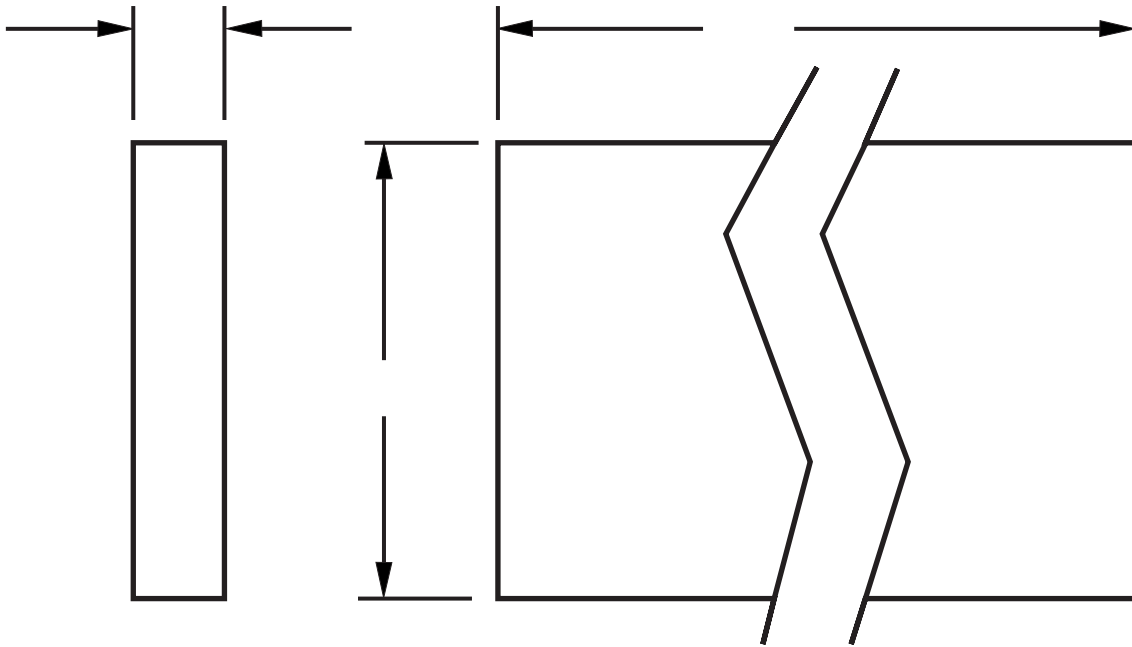






Weights of Materials

Use the McNeilus Reference Book

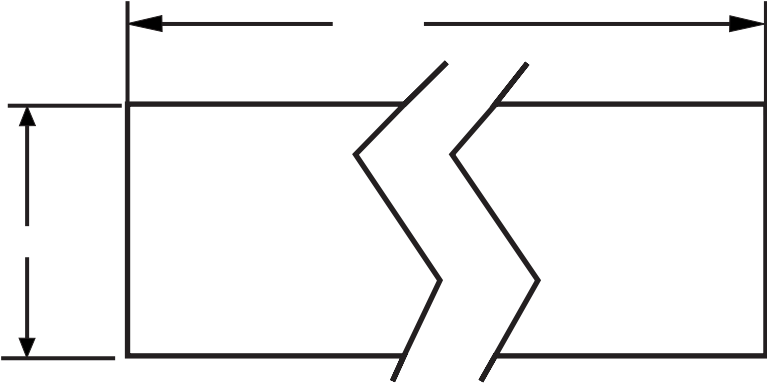
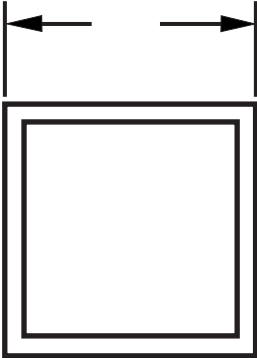
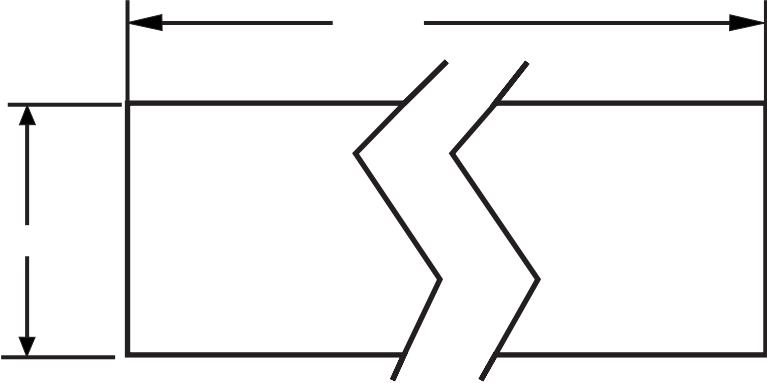
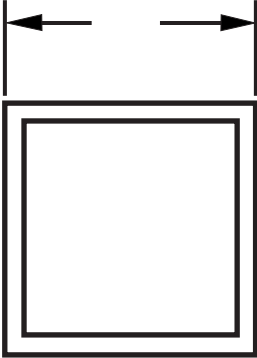


Weights of Materials

Use the McNeilus Reference Book

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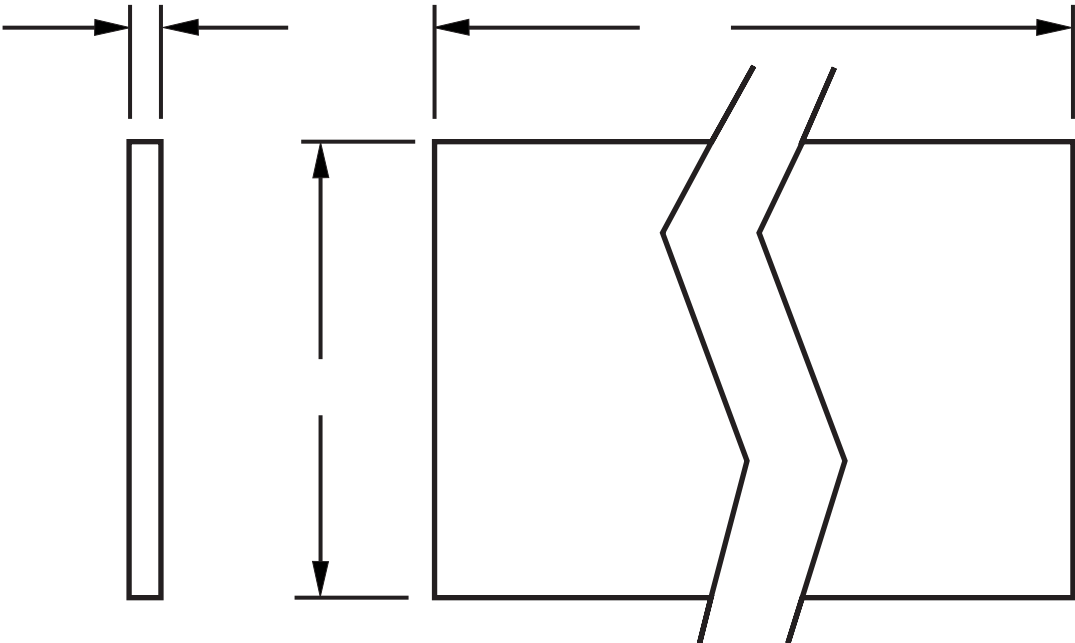
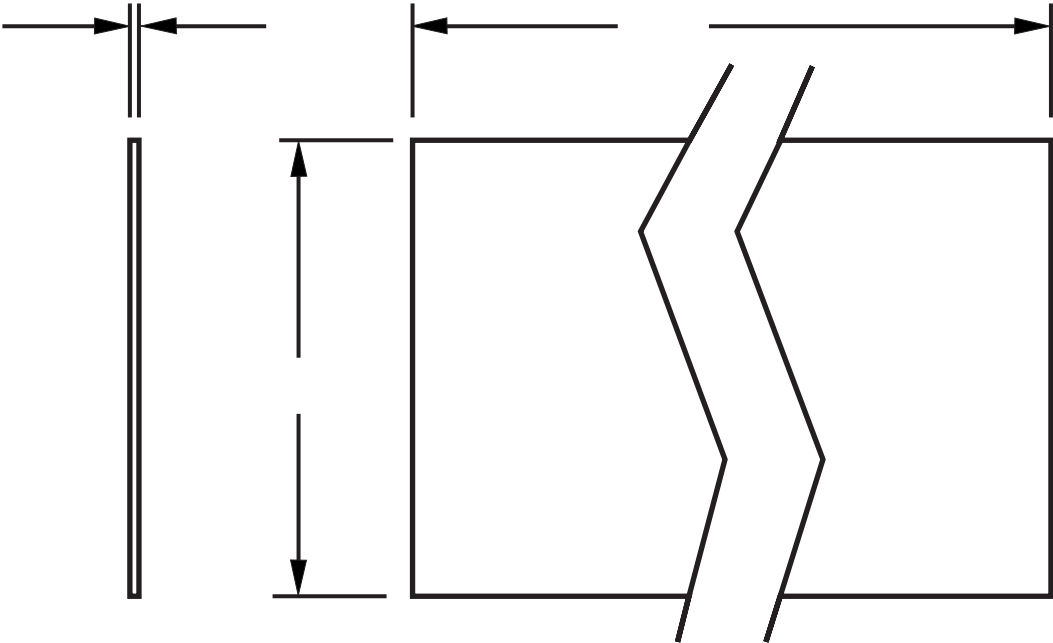


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Use the McNeilus Reference Book

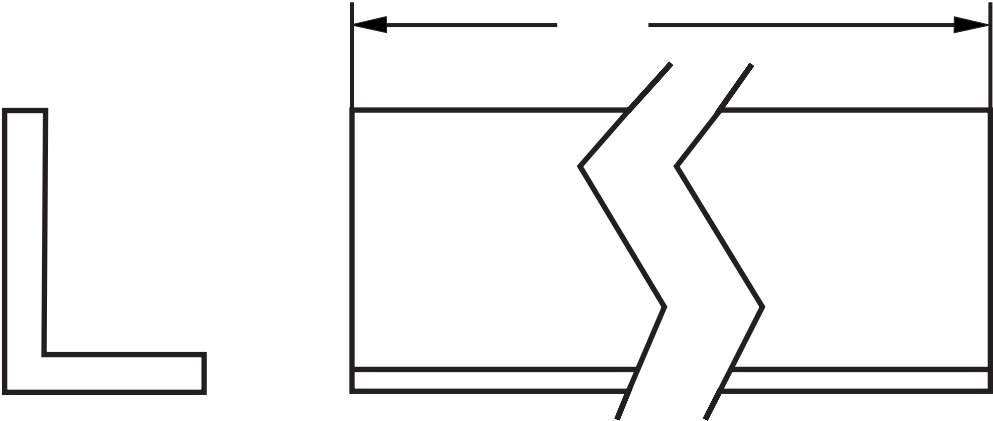
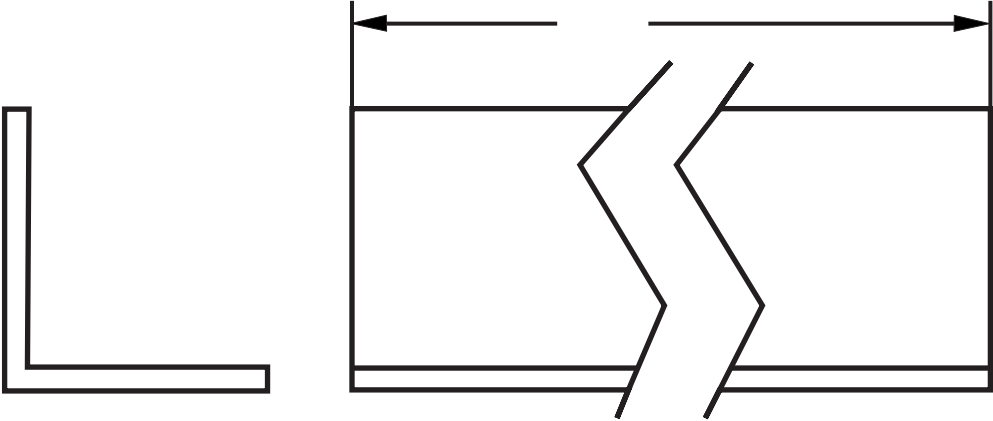


Weights of Materials

Use the McNeilus Reference Book

Weights of Materials

Use the McNeilus Reference Book



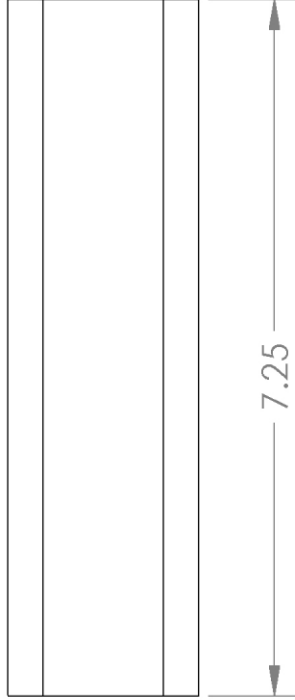
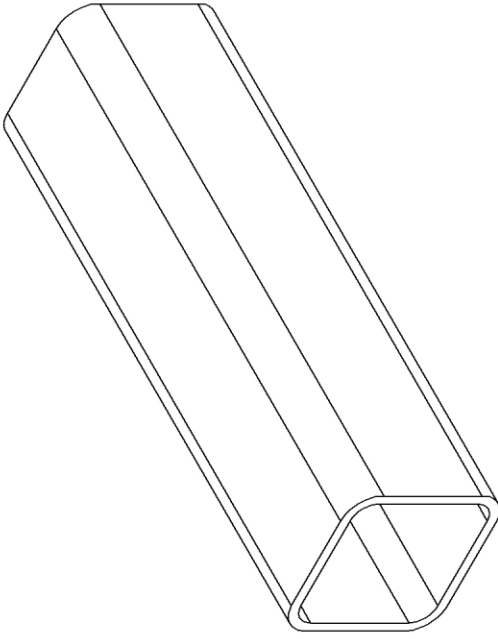
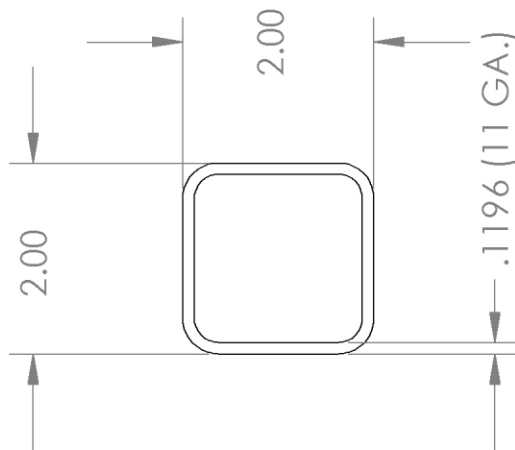
Weights of Materials

Use the McNeilus Reference Book



Weights of Materials

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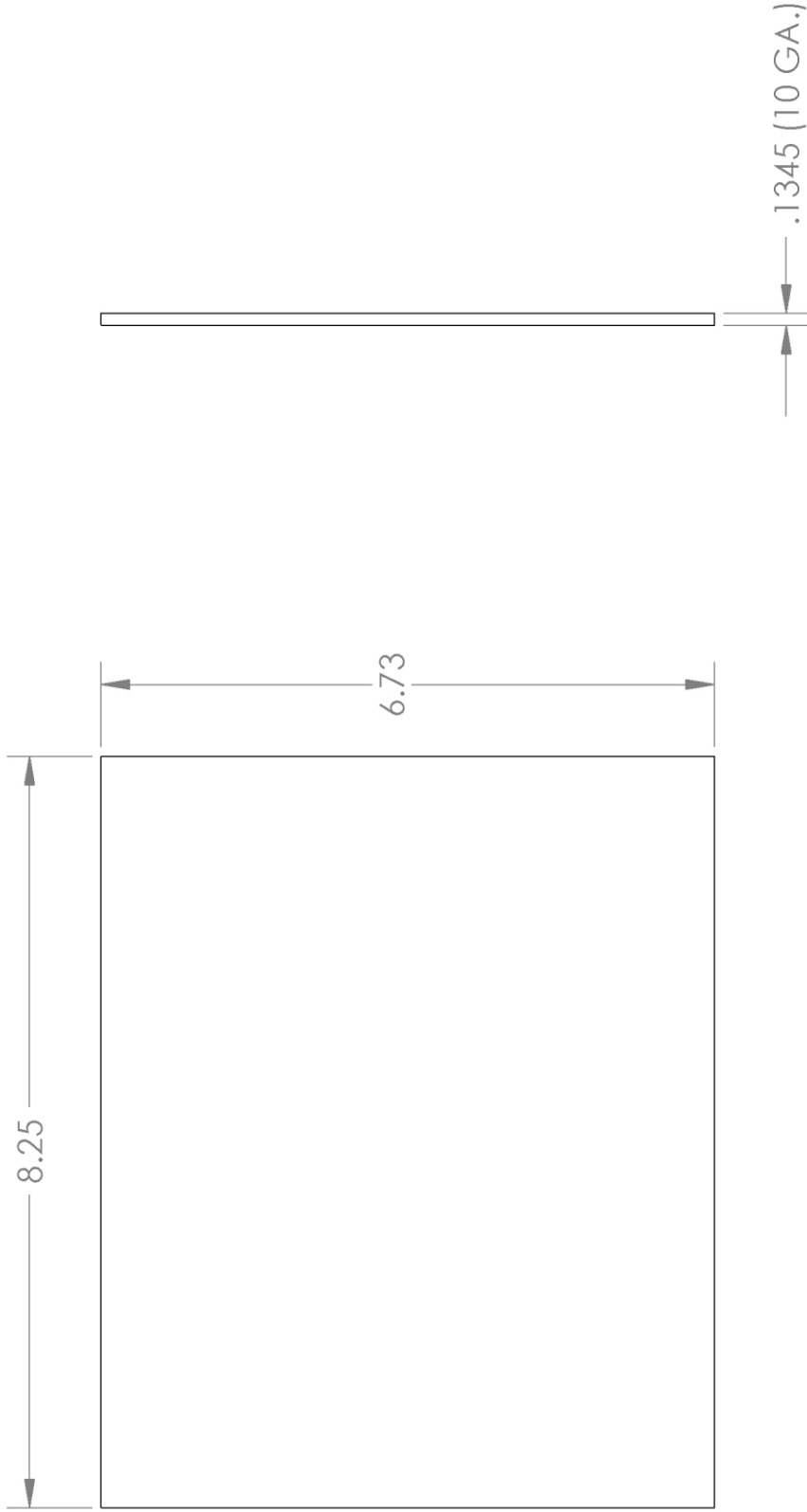
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|--------------------------------------|--------|-----------|------|
| DIMENSIONS ARE IN INCHES | | | |
| TOLERANCES: | | | |
| FRACTIONAL ± | | | |
| ANGULAR: MACH ± | BEND ± | | |
| TWO PLACE DECIMAL ± | | | |
| THREE PLACE DECIMAL ± | | | |
| INTERPRET GEOMETRIC TOLERANCING PER: | | | |
| MATERIAL | | COMMENTS: | |
| FINISH | | | |
| NEXT ASSY | | | |
| USED ON | | | |
| APPLICATION | | | |
| DO NOT SCALE DRAWING | | | |

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SIZE **A** DWG. NO. **2743** REV
 SCALE: 1:2 WEIGHT: SHEET 1 OF 1

Weights of Materials

Use the McNeilus Reference Book

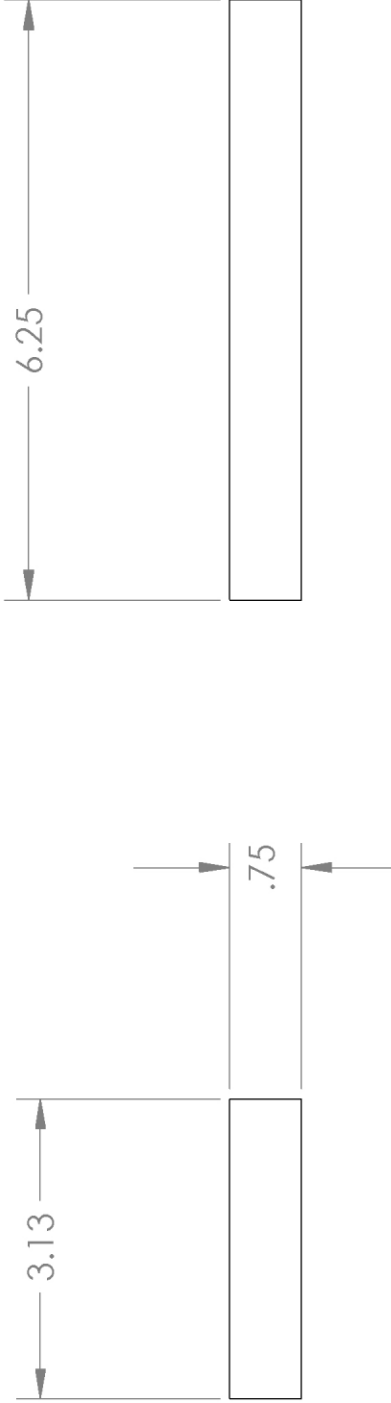
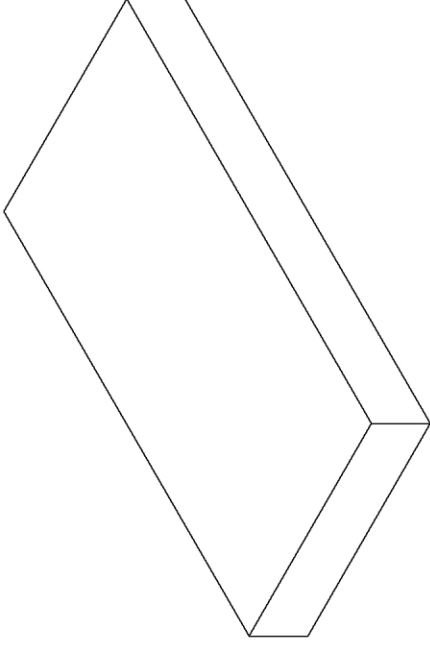


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|--------------------------------------|--|--------------|------|
| DIMENSIONS ARE IN INCHES | | | |
| TOLERANCES: | | DRAWN | |
| FRACTIONAL ± | | CHECKED | |
| ANGULAR: MACH ± BEND ± | | ENG APPR. | |
| TWO PLACE DECIMAL ± | | MFG APPR. | |
| THREE PLACE DECIMAL ± | | G.A. | |
| INTERPRET GEOMETRIC TOLERANCING PER: | | COMMENTS: | |
| MATERIAL | | MILD STEEL | |
| FINISH | | USED ON | |
| NEXT ASSY | | APPLICATION | |
| DO NOT SCALE DRAWING | | SCALE: 1:2 | |
| DWG. NO. 2744 | | WEIGHT: 1 | |
| SIZE A | | SHEET 1 OF 1 | |

Weights of Materials

Use the McNeilus Reference Book



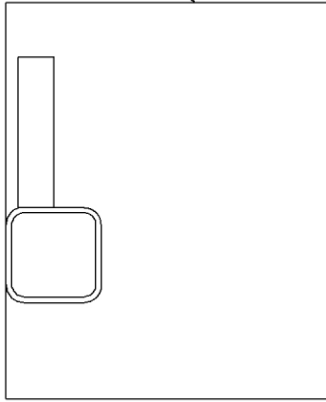
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| UNLESS OTHERWISE SPECIFIED: | | DRAWN | NAME | DATE |
| DIMENSIONS ARE IN INCHES | | CHECKED | | |
| TOLERANCES: | | ENG APPR. | | |
| FRACTIONAL ± | | MFG APPR. | | |
| ANGULAR: MACH ± BEND ± | | Q.A. | | |
| TWO PLACE DECIMAL ± | | COMMENTS: | | |
| THREE PLACE DECIMAL ± | | | | |
| INTERPRET GEOMETRIC TOLERANCING PER: | | | | |
| MATERIAL | | | | |
| MILD STEEL | | | | |
| FINISH | | | | |
| NEXT ASSY | | | | |
| USED ON | | | | |
| APPLICATION | | | | |
| DO NOT SCALE DRAWING | | | | |

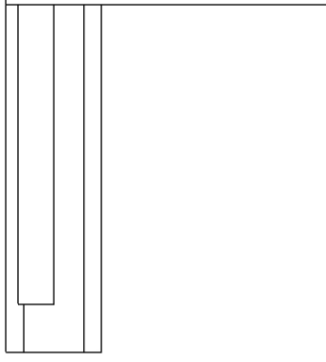
SIZE **A** DWG. NO. **2745** REV
 SCALE: 1:2 WEIGHT: SHEET 1 OF 1

Weights of Materials

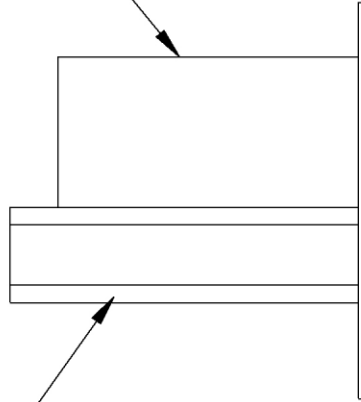
Use the McNeilus Reference Book



2744



2743



2745

NAME: _____

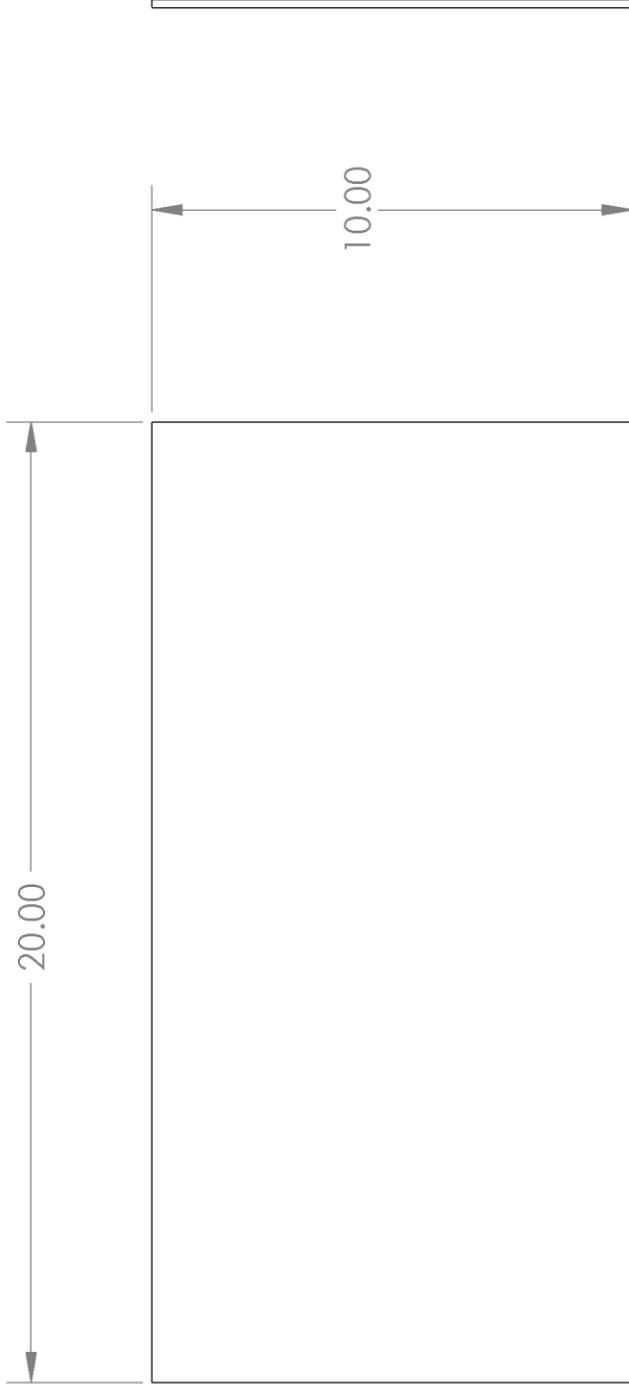
WEIGHT: _____

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| UNLESS OTHERWISE SPECIFIED: | | DRAWN | | NAME | | DATE | |
| DIMENSIONS ARE IN INCHES | | CHECKED | | | | | |
| TOLERANCES: | | ENG APPR. | | | | | |
| FRACTIONAL: ± | | MFG APPR. | | | | | |
| ANGULAR: MACH ± BEND ± | | G.A. | | | | | |
| TWO PLACE DECIMAL ± | | COMMENTS: | | | | | |
| THREE PLACE DECIMAL ± | | | | | | | |
| INTERPRET GEOMETRIC TOLERANCING PER: | | | | | | | |
| MATERIAL | | | | | | TITLE: | |
| FINISH | | | | | | WEIGHT TEST ASSEMBLY | |
| NEXT ASSY | | | | | | SIZE DWG. NO. | |
| USED ON | | | | | | A 2746 | |
| APPLICATION | | | | | | SCALE: 1:4 WEIGHT: | |
| DO NOT SCALE DRAWING | | | | | | SHEET 1 OF 1 | |

Weights of Materials

Use the McNeilus Reference Book

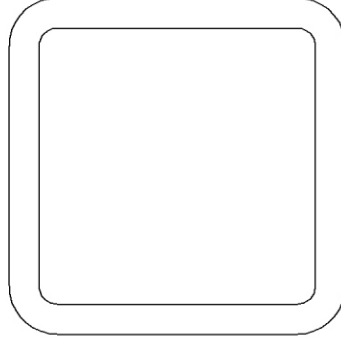
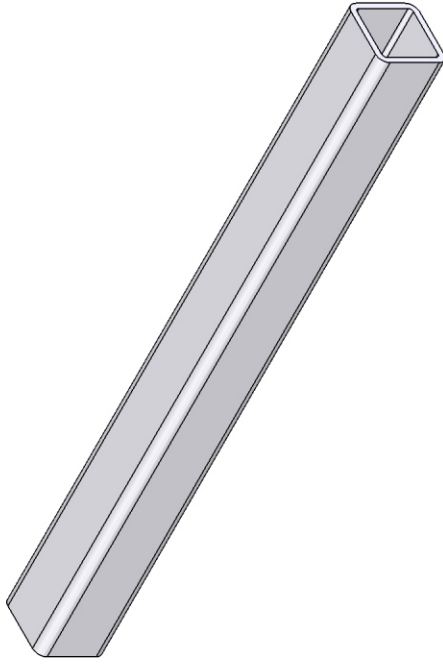
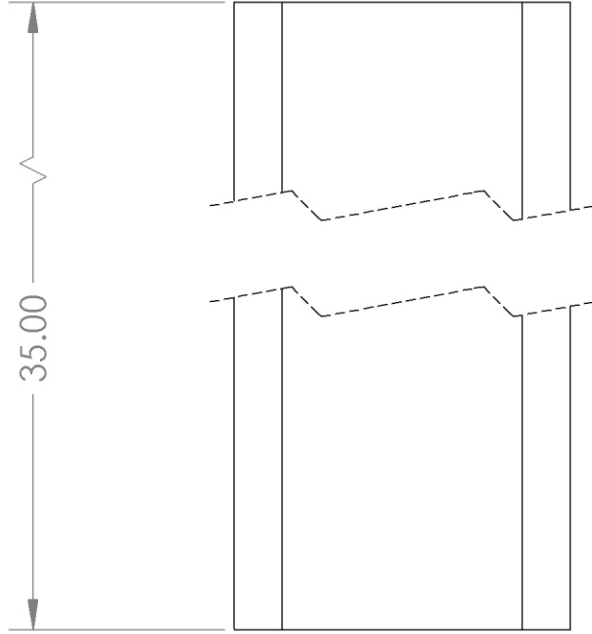


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| UNLESS OTHERWISE SPECIFIED: | | NAME | DATE |
| DIMENSIONS ARE IN INCHES | | DRAWN | |
| TOLERANCES: | | CHECKED | |
| FRACTIONAL ± | ANGULAR: MACH ± BEND ± | ENG APPR. | |
| TWO PLACE DECIMAL ± | THREE PLACE DECIMAL ± | MFG APPR. | |
| INTERPRET GEOMETRIC TOLERANCING PER: | | Q.A. | |
| MATERIAL | | COMMENTS: | |
| 8GA. HR SHEET | | | |
| FINISH | | | |
| NEXT ASSY | USED ON | | |
| APPLICATION | | | |
| DO NOT SCALE DRAWING | | | |
| TITLE: | | BOTTOM PLATE | |
| SIZE | DWG. NO. | REV | |
| A | 2747 | | |
| SCALE: 1:4 | | WEIGHT: | SHEET 1 OF 1 |

Weights of Materials

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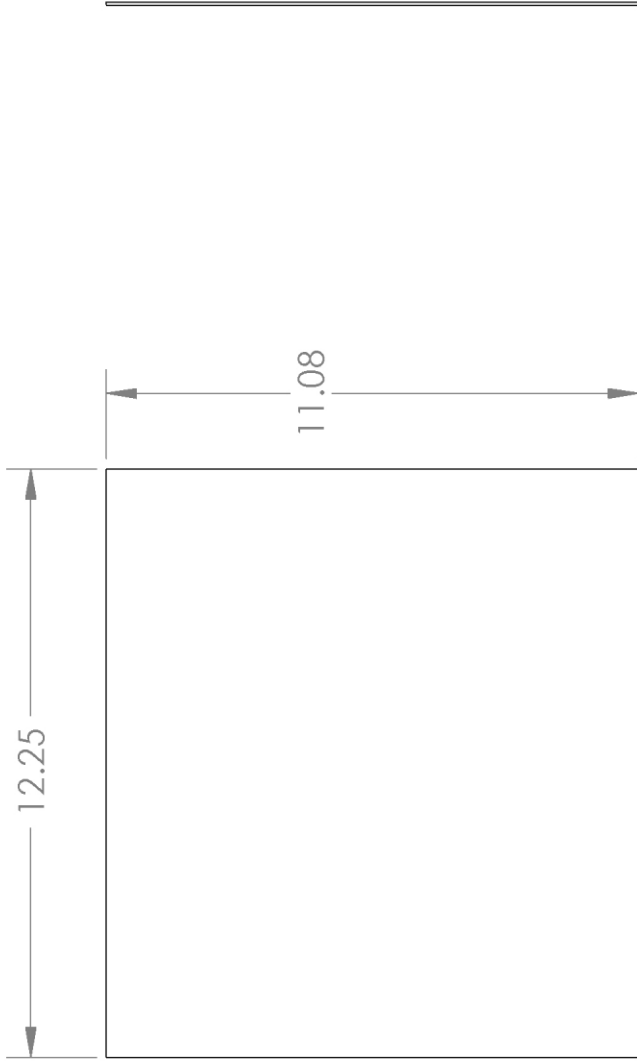


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|--------------------------------------|----------------------|-----------|--------------|
| UNLESS OTHERWISE SPECIFIED: | | NAME | DATE |
| DIMENSIONS ARE IN INCHES | | DRAWN | |
| TOLERANCES: | | CHECKED | |
| FRACTIONAL ± | | ENG APPR. | |
| ANGULAR: MACH ± | BEND ± | MFG APPR. | |
| TWO PLACE DECIMAL ± | | Q.A. | |
| THREE PLACE DECIMAL ± | | COMMENTS: | |
| INTERPRET GEOMETRIC TOLERANCING PER: | | | |
| MATERIAL | | | |
| 3-1/2 SQX5/16W TUBE | | | |
| FINISH | | | |
| | DO NOT SCALE DRAWING | | |
| NEXT ASSY | USED ON | | |
| APPLICATION | | | |
| TITLE: | | SUPPORT | |
| SIZE | DWG. NO. | | REV |
| A | 2748 | | |
| SCALE: 1:8 | WEIGHT: | | SHEET 1 OF 1 |

Weights of Materials

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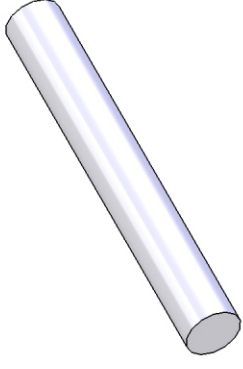


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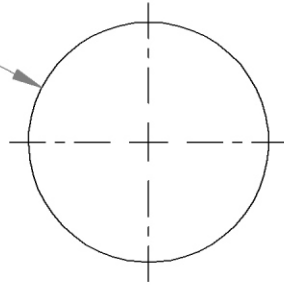
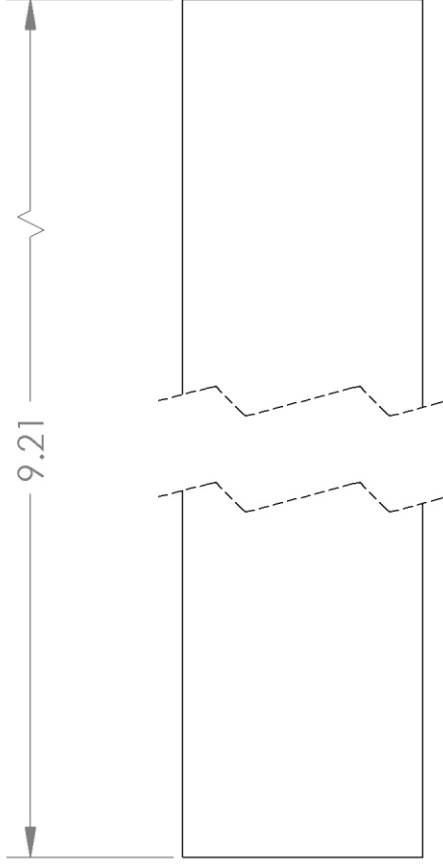
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| UNLESS OTHERWISE SPECIFIED: | | NAME | DATE |
| DIMENSIONS ARE IN INCHES | | DRAWN | |
| TOLERANCES: | | CHECKED | |
| FRACTIONAL ± | ANGULAR: MACH ± BEND ± | ENG APPR. | |
| TWO PLACE DECIMAL ± | THREE PLACE DECIMAL ± | MFG APPR. | |
| INTERPRET GEOMETRIC TOLERANCING PER: | | Q.A. | |
| MATERIAL | | COMMENTS: | |
| 16 GA SHEET STEEL | | | |
| FINISH | | | |
| DO NOT SCALE DRAWING | | | |
| NEXT ASSY | USED ON | | |
| APPLICATION | | | |
| TITLE: | | SIDE PLATE | |
| SIZE | DWG. NO. | SCALE: 1:4 | WEIGHT: |
| A | 2749 | | |
| REV | | SHEET 1 OF 1 | |

Weights of Materials

Use the McNeilus Reference Book



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| UNLESS OTHERWISE SPECIFIED: | | NAME | DATE |
| DIMENSIONS ARE IN INCHES | | | |
| TOLERANCES: | | | |
| FRACTIONAL \pm | | | |
| ANGULAR: MACH \pm BEND \pm | | | |
| TWO PLACE DECIMAL \pm | | | |
| THREE PLACE DECIMAL \pm | | | |
| INTERPRET GEOMETRIC TOLERANCING PER: | | | |
| MATERIAL | | COMMENTS: | |
| 1-1/4 CR ROUND 10-18 | | | |
| FINISH | | | |
| NEXT ASSY | USED ON | | |
| APPLICATION | | DO NOT SCALE DRAWING | |

TITLE:

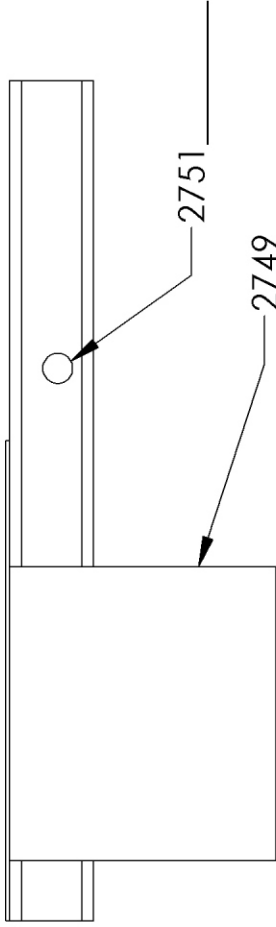
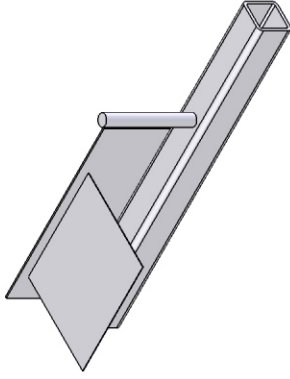
SHAFT

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SIZE **A** DWG. NO. **2751** REV
 SCALE: 1:4 WEIGHT: SHEET 1 OF 1

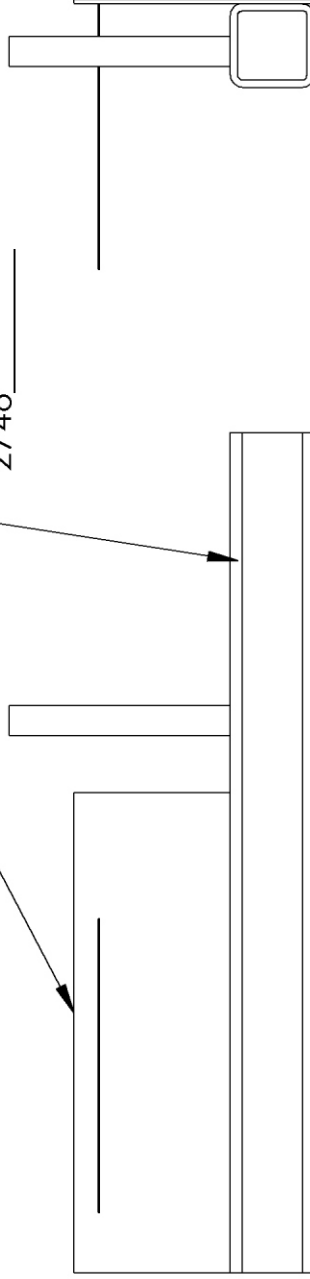
Weights of Materials

Use the McNeilus Reference Book



2747

2748



NAME _____

WEIGHT _____

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|--|----------------|---|--|------------------|------------------------------------|-----------------------------|
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| <p>MATERIAL NOTED FINISH</p> | | <p>INTERPRET GEOMETRIC TOLERANCING PER:</p> | | <p>CHECKED</p> | <p>TITLE: ASSEMBLY</p> | |
| <p>NEXT ASSY</p> | <p>USED ON</p> | <p>COMMENTS: Q.A.</p> | | <p>ENG APPR.</p> | <p>SIZE A</p> | <p>DWG. NO. 2750</p> |
| <p>APPLICATION</p> | | <p>DO NOT SCALE DRAWING</p> | | <p>MFG APPR.</p> | <p>SCALE: 1:8</p> | <p>WEIGHT:</p> |
| <p>5</p> | | <p>3</p> | | <p>2</p> | | <p>SHEET 1 OF 1</p> |





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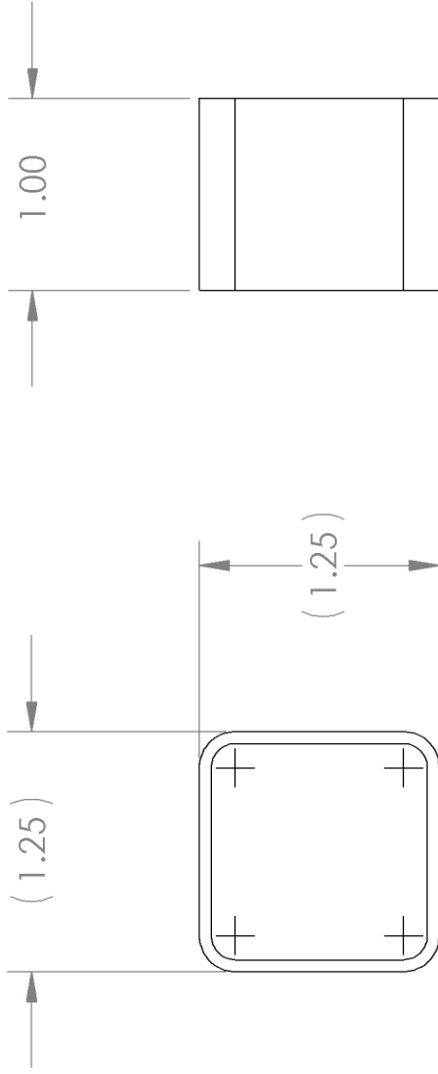
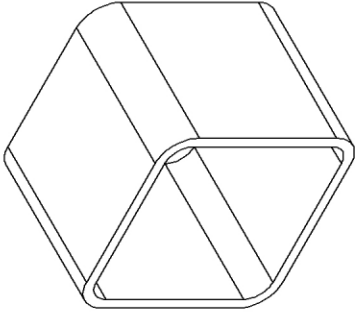
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Spacing Project



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| | | | | | |
|---|--|---|------|------|--|
| UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES | | DRAWN | NAME | DATE | NORTH DAKOTA STATE COLLEGE of SCIENCE |
| TOLERANCES: FRACTIONAL ±1/16 ANGULAR: MACHINING ±0.25 BEND ±1.5 TWO PLACE DECIMAL ±.03 THREE PLACE DECIMAL ±.004 | | CHECKED | | | |
| INTERPRET GEOMETRIC TOLERANCING PER: | | ENG APPR. | | | TITLE: SQ TUBE |
| MATERIAL 1-1/4 X 16 GA SQ TUBE FINISH | | MFG APPR. | | | SIZE DWG. NO. A spacing project tube REV |
| APPLICATION NEXT ASSY USED ON | | Q.A. | | | SCALE: 2:1 WEIGHT: SHEET 1 OF 1 |
| DO NOT SCALE DRAWING | | COMMENTS: 1-1/4 X 16 GA SQ TUBE | | | |

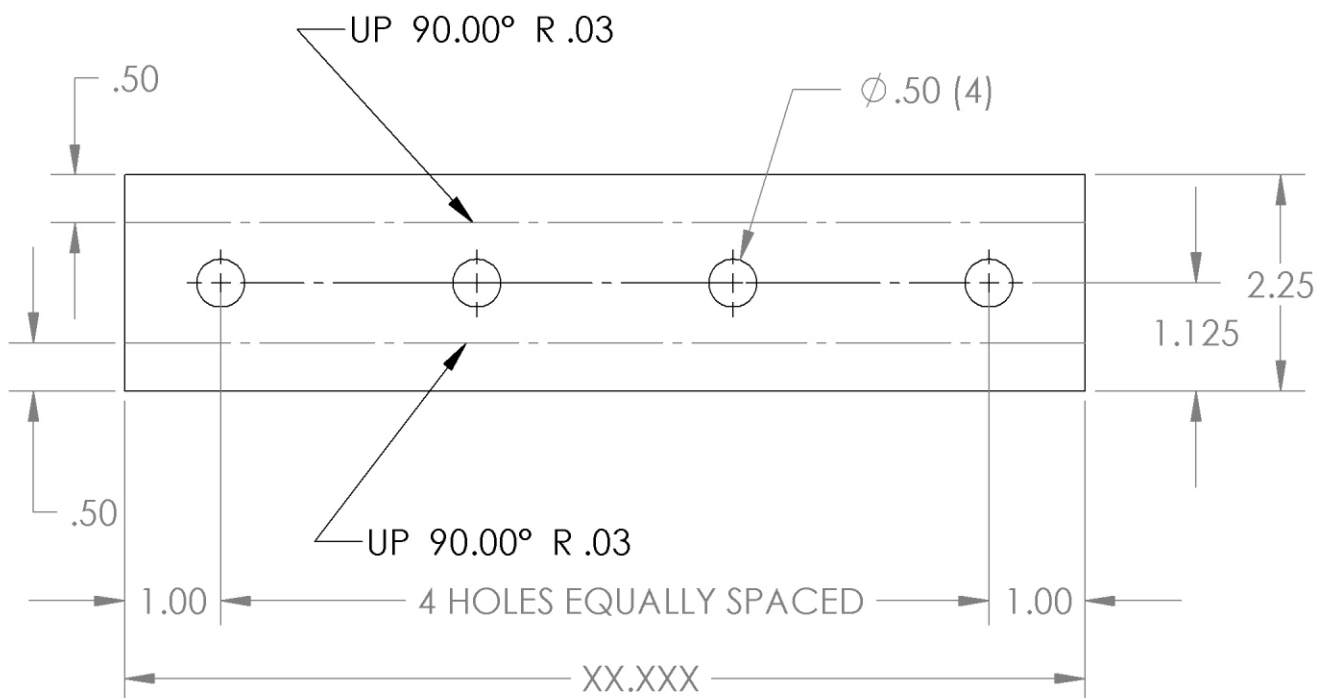
- NOTE: 1. TEACHER WILL ASIGN INDIVIDUAL FLAT PATTERN LENGTH.
 2. SHEER 16 GA HR SHEET MATERIAL TO REQUIRED SIZE.
 3. SHOW ALL HOLE SPACING CALCULATIONS ON THIS SHEET.

D

C

B

A



FLAT PATTERN

16 GA HR SHEET

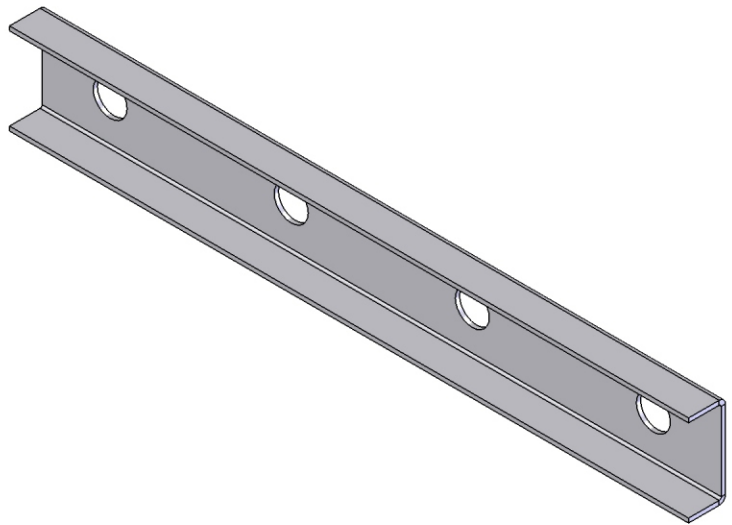
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3

2

1

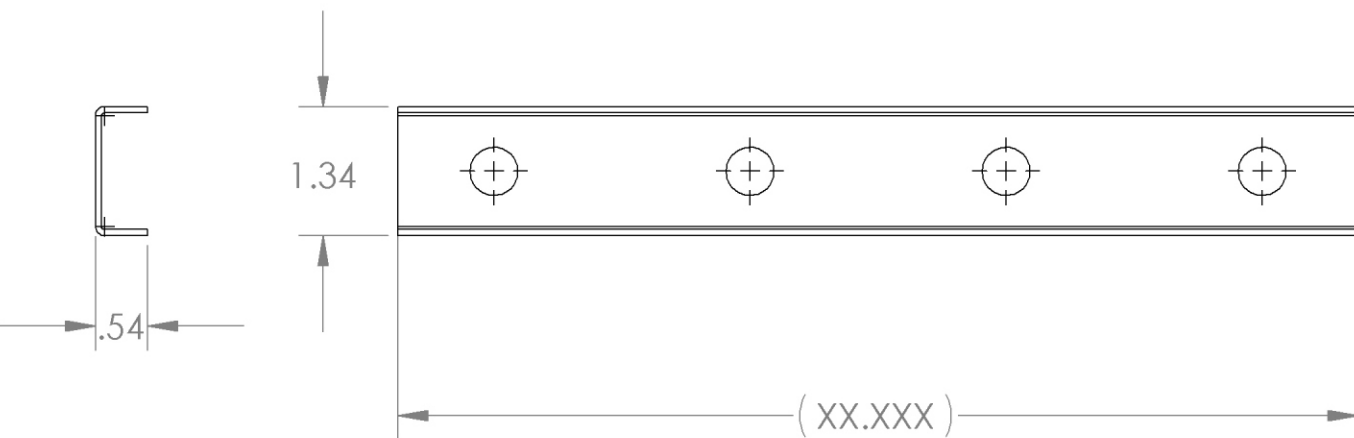


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| | | | | | | | |
|-------------|---------|--|-----------|------|--|-------------------------------|------------------------------|
| | | UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL $\pm 1/16$ ANGULAR: MACHINING ± 0.25 BEND ± 1.5 TWO PLACE DECIMAL $\pm .03$ THREE PLACE DECIMAL $\pm .004$ INTERPRET GEOMETRIC TOLERANCING PER: MATERIAL 16 GA HR SHEET FINISH | NAME | DATE | North Dakota State College of Science | | |
| | | | DRAWN | | | | TITLE: FLAT (BENT) |
| | | | CHECKED | | | | |
| | | | ENG APPR. | | | | |
| | | MFG APPR. | | | | | |
| | | | Q.A. | | | | |
| | | | COMMENTS: | | | | |
| NEXT ASSY | USED ON | | | | SIZE B | DWG. NO. spacing project flat | REV |
| APPLICATION | | DO NOT SCALE DRAWING | | | SCALE: 2:1 | WEIGHT: | SHEET 1 OF 1 |

4

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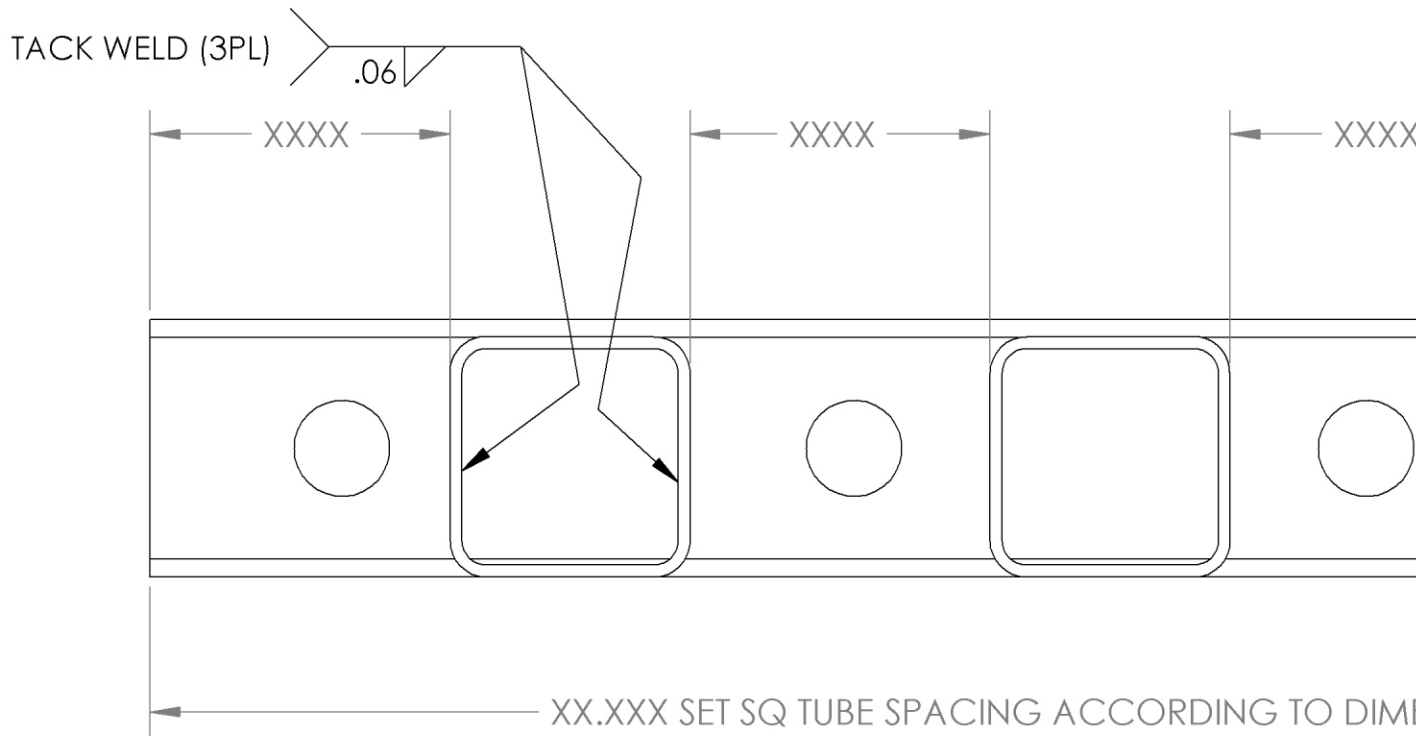
NOTE: SHOW ALL SQ TUBE SPACING CALCULATIONS ON THIS SHEET.

D

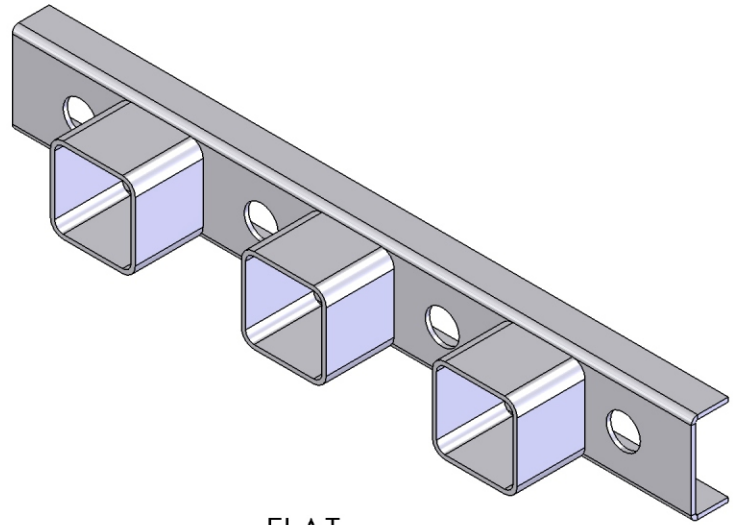
C

B

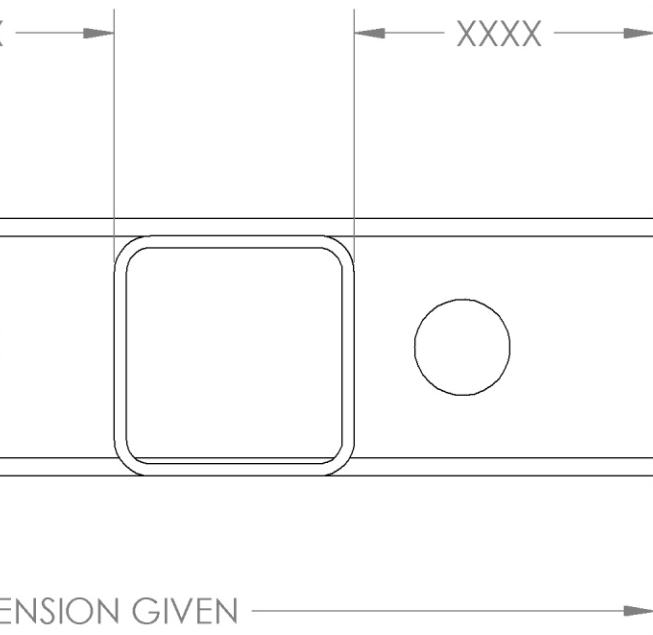
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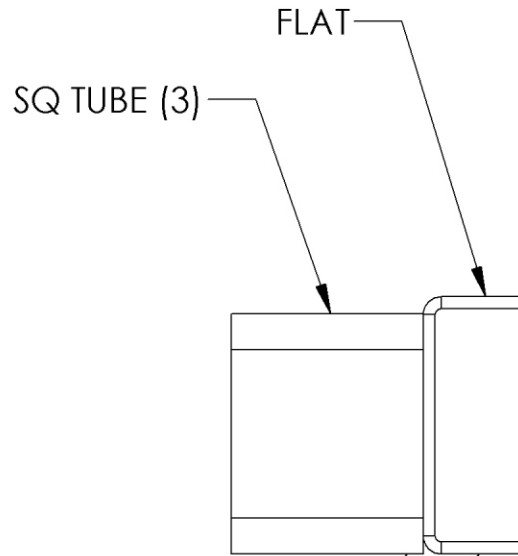
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D



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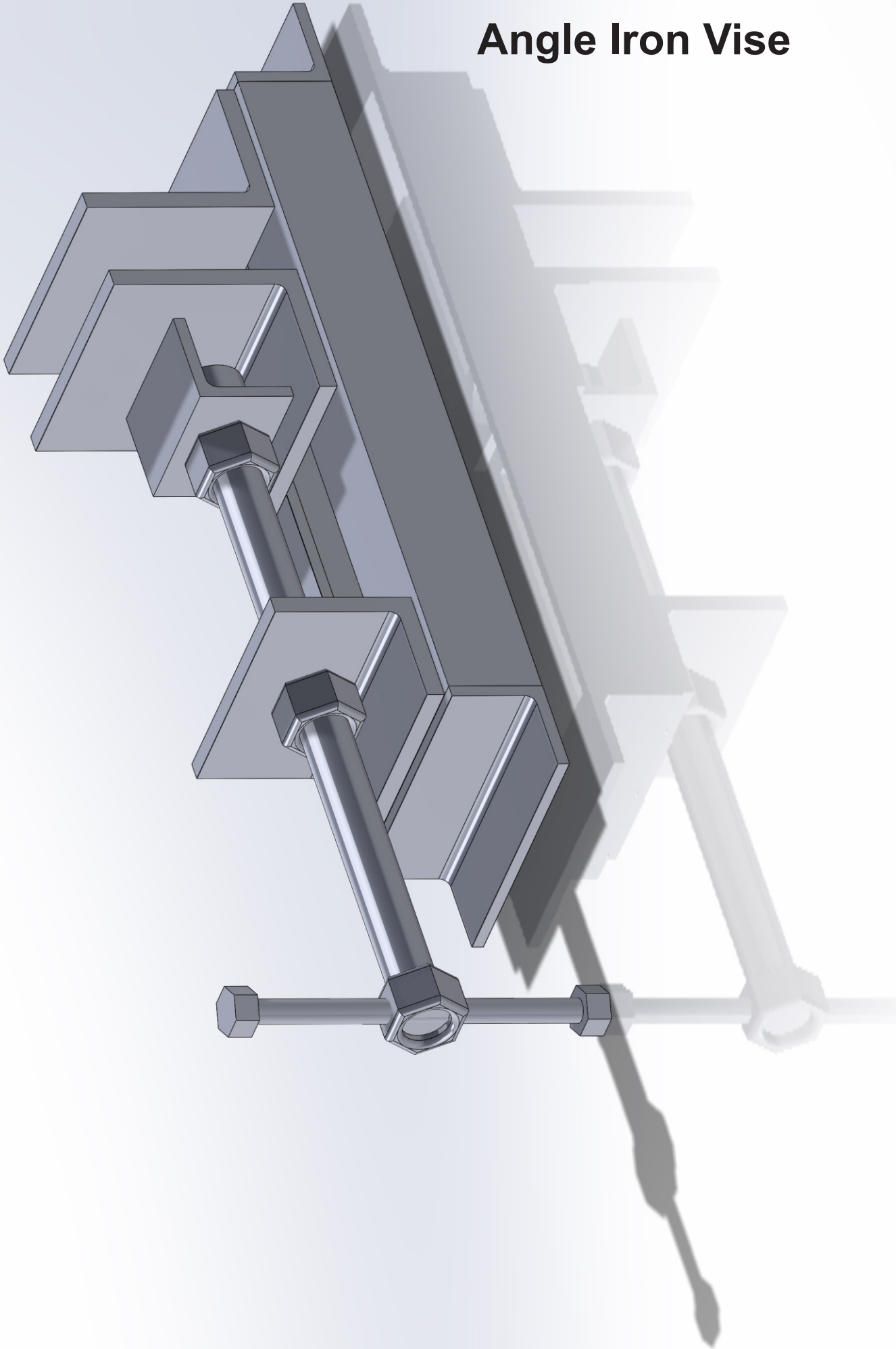
ALIGN EDGES OF SQ TUBE AND FLAT BEFORE TACKING IN PLACE (3PL). USE THE SAME EDGE OF FLAT FOR ALL SQ TUBES

A

| | | | | | | |
|-------------|---------|--------------------------------------|-----------|------|---|--|
| | | UNLESS OTHERWISE SPECIFIED: | NAME | DATE | North Dakota State College of Science | |
| | | DIMENSIONS ARE IN INCHES | DRAWN | | TITLE: SPACING PROJECT | |
| | | TOLERANCES: | CHECKED | | | |
| | | FRACTIONAL ±1/16 | ENG APPR. | | | |
| | | ANGULAR: | MFG APPR. | | | |
| | | MACHINING ±0.25 BEND ±1.5 | Q.A. | | | |
| | | TWO PLACE DECIMAL ±.03 | COMMENTS: | | SIZE B DWG. NO. spacing project Assy REV | |
| | | THREE PLACE DECIMAL ±.004 | | | SCALE: 1:1 WEIGHT: SHEET 1 OF 1 | |
| | | INTERPRET GEOMETRIC TOLERANCING PER: | | | | |
| | | MATERIAL NOTED | | | | |
| NEXT ASSY | USED ON | FINISH | | | | |
| APPLICATION | | DO NOT SCALE DRAWING | | | | |



Angle Iron Vice

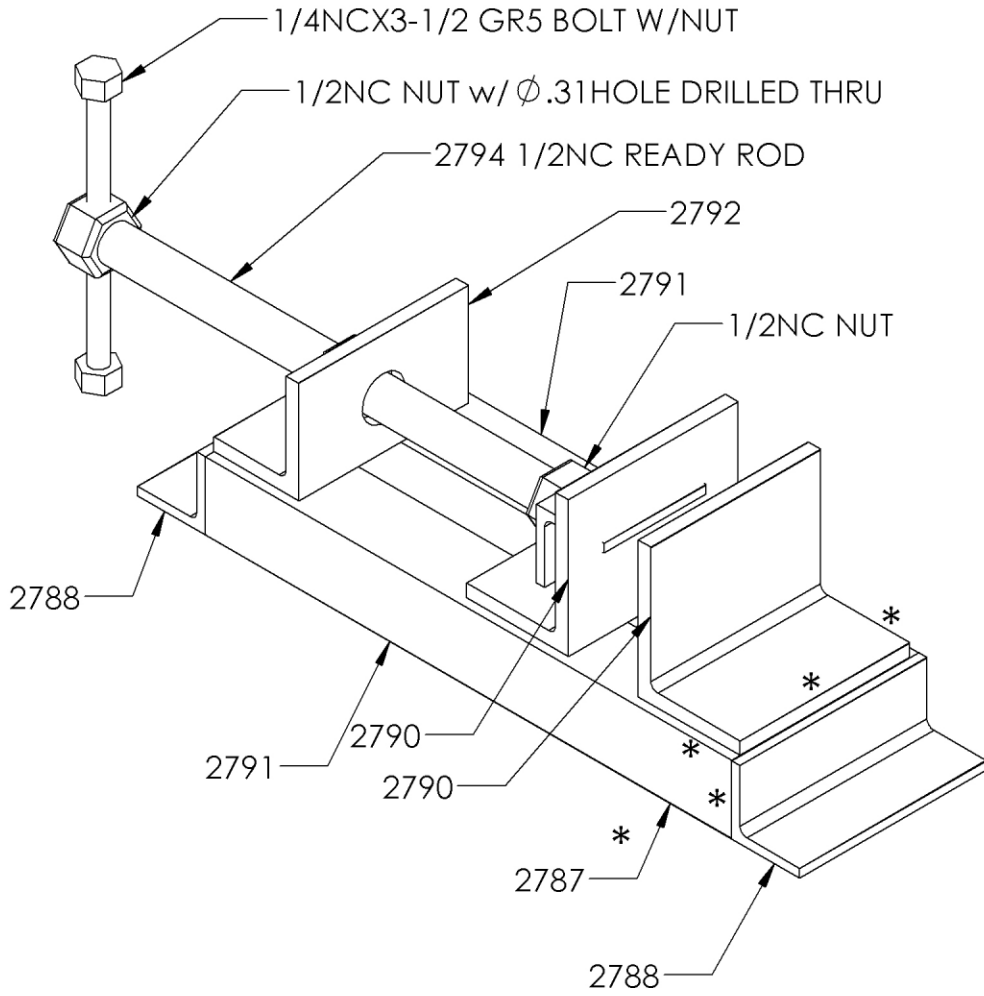


Angle Iron Vice

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B



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4

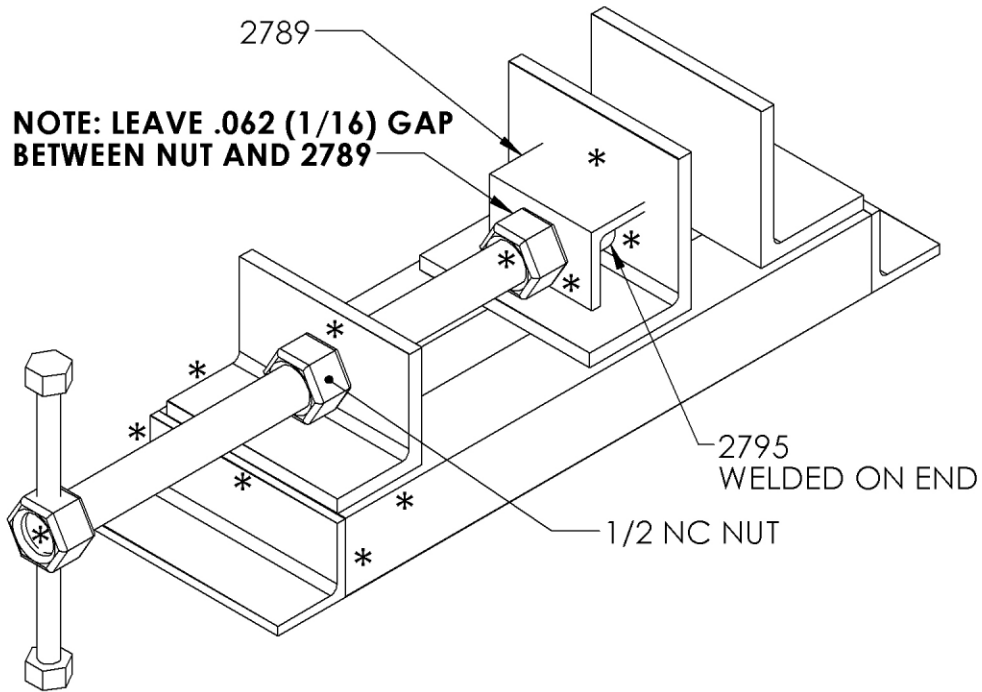
3

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NOTE: SEE SUB-WELDMENT PRINTS FOR CORRECT WELDING LOCATIONS

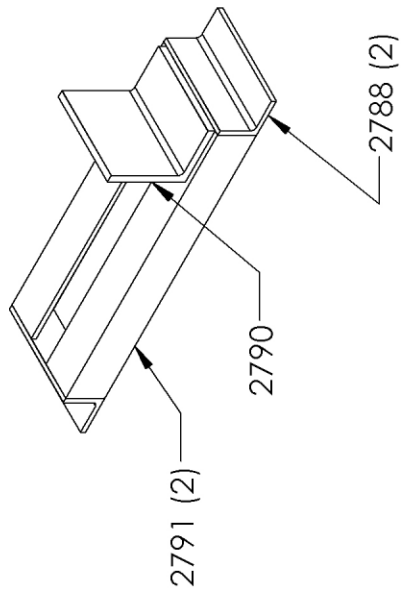
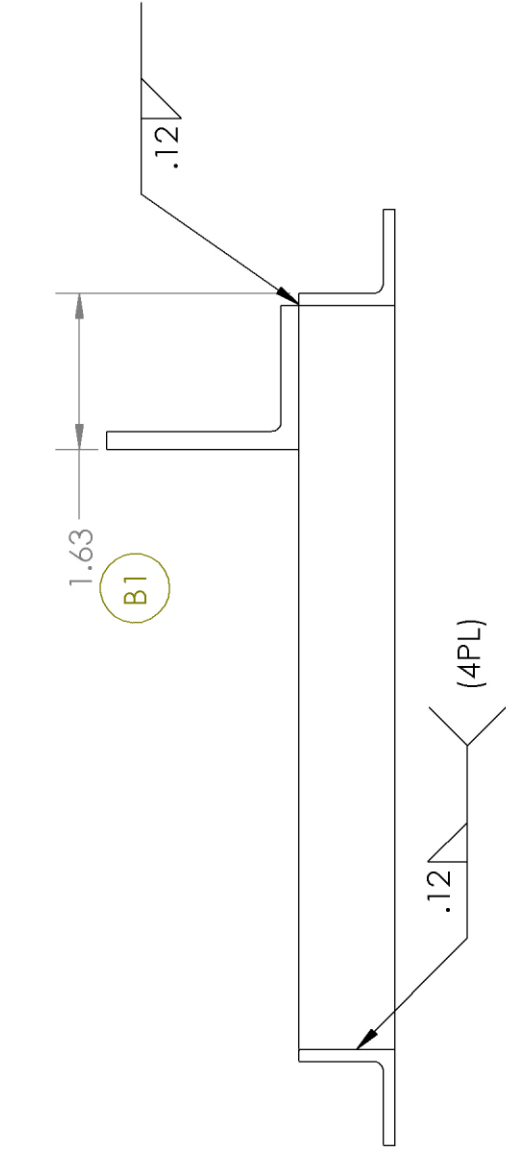
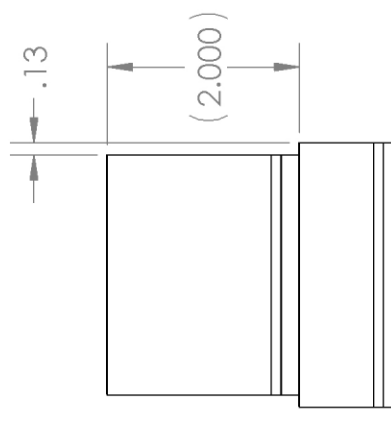
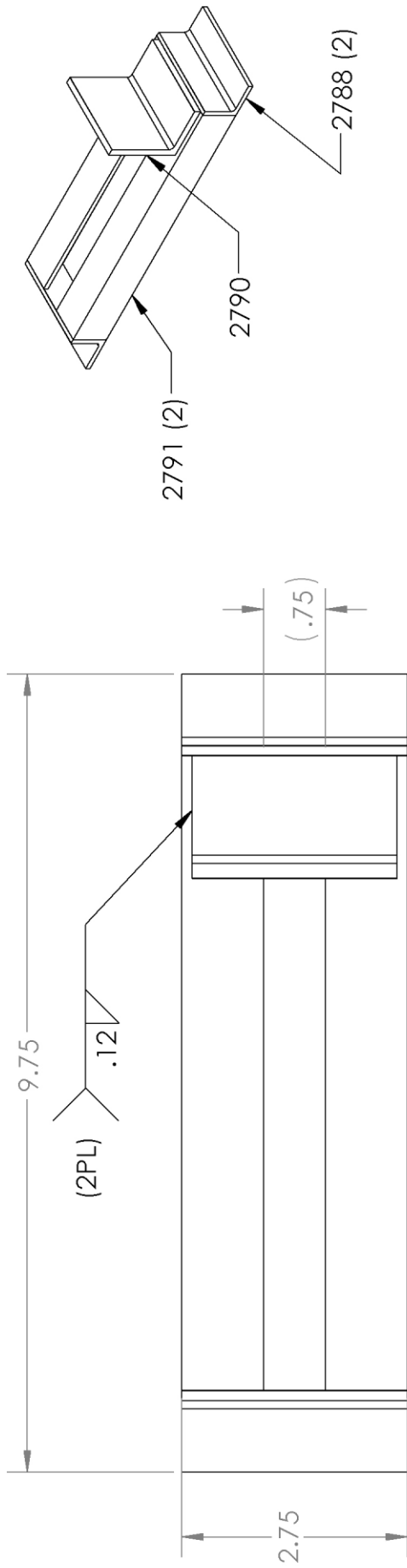


NOTE: WELDING SYMBOLS FOR ASSEMBLY

| | | | | | | |
|-------------|---------|---|-----------|------|------------------------------------|--|
| | | UNLESS OTHERWISE SPECIFIED: | NAME | DATE | TITLE: VICE ASSEMBLY | |
| | | DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ± | DRAWN | | | |
| | | INTERPRET GEOMETRIC TOLERANCING PER: | CHECKED | | SIZE DWG. NO. REV B 2799 | |
| | | MATERIAL | ENG APPR. | | | |
| NEXT ASSY | USED ON | FINISH | MFG APPR. | | SCALE: 1:4 WEIGHT: SHEET 1 OF 2 | |
| APPLICATION | | DO NOT SCALE DRAWING | Q.A. | | | |
| | | | COMMENTS: | | | |

B

A

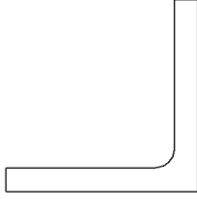
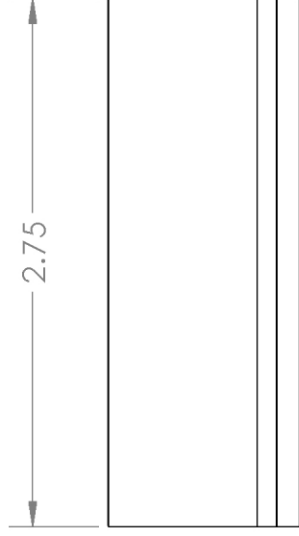
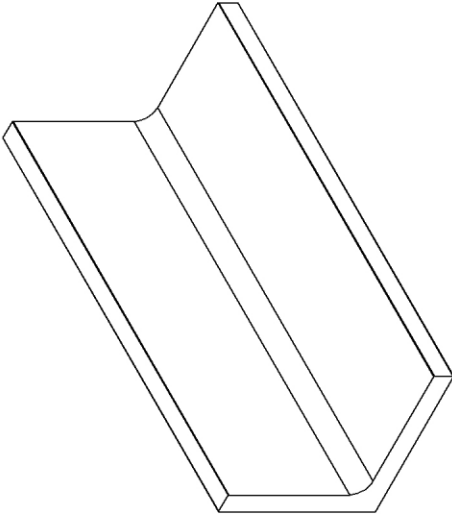


B1 / 11.17.15 / was 1.38

| | |
|--|----------------------|
| North Dakota State College of Science | |
| TITLE: DRILL VISE BASE SUB-WELD | |
| SIZE A | DWG. NO. 2787 |
| SCALE: 1:4 | WEIGHT: SHEET 1 OF 1 |

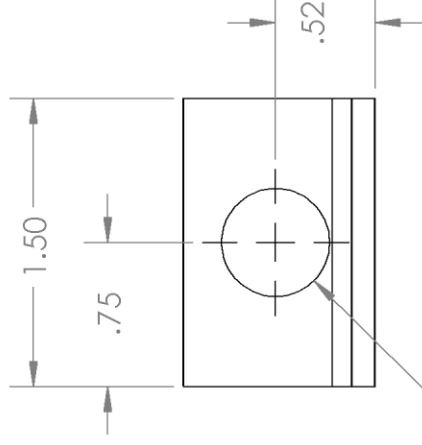
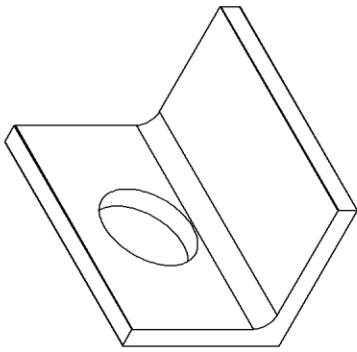
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|--|-----------|------|------|
| UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES | DRAWN | NAME | DATE |
| TOLERANCES: FRACTIONAL ± 1/16 ANGULAR: MACH ± .5° BEND ± 1° TWO PLACE DECIMAL ± .06 THREE PLACE DECIMAL ± .031 | CHECKED | | |
| INTERPRET GEOMETRIC TOLERANCING PER: | ENG APPR. | | |
| MATERIAL NOTED | MFG APPR. | | |
| FINISH | Q.A. | | |
| DO NOT SCALE DRAWING | COMMENTS: | | |

| | | | | |
|---|-------------|---------|---|---|
| PROPRIETARY AND CONFIDENTIAL | APPLICATION | 3 | 2 | 1 |
| THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF NORTH DAKOTA STATE COLLEGE OF SCIENCE. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF NDS CS IS PROHIBITED. | NEXT ASSY | USED ON | | |

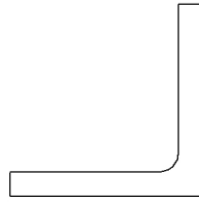


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| | | | | | |
|--|---------|-----------|------|------|--|
| UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES | | DRAWN | NAME | DATE | North Dakota State College of Science TITLE: END CAP SIZE DWG. NO. A 2788 SCALE: 1:1 WEIGHT: SHEET 1 OF 1 |
| TOLERANCES: FRACTIONAL $\pm 1/16$ ANGULAR: MACH $\pm .5^\circ$ BEND $\pm 1^\circ$ TWO PLACE DECIMAL $\pm .06$ THREE PLACE DECIMAL $\pm .031$ | | CHECKED | | | |
| INTERPRET GEOMETRIC TOLERANCING PER: | | ENG APPR. | | | |
| MATERIAL 1x1x.125 ANGLE FINISH | | MFG APPR. | | | |
| DO NOT SCALE DRAWING | | Q.A. | | | |
| APPLICATION | | COMMENTS: | | | |
| NEXT ASSY | USED ON | | | | |

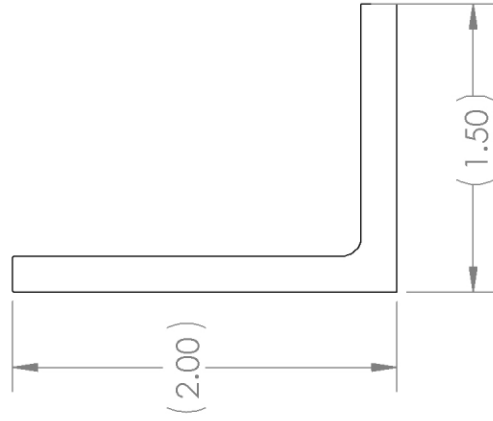
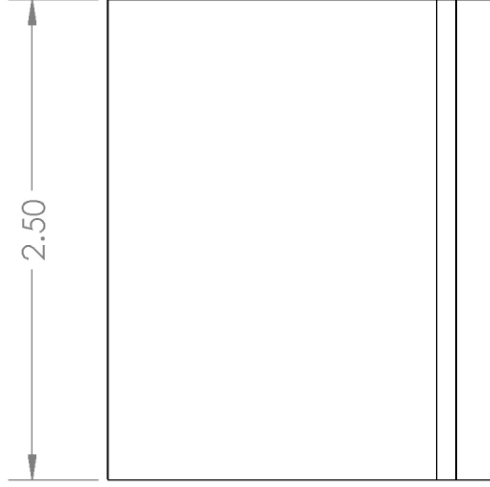
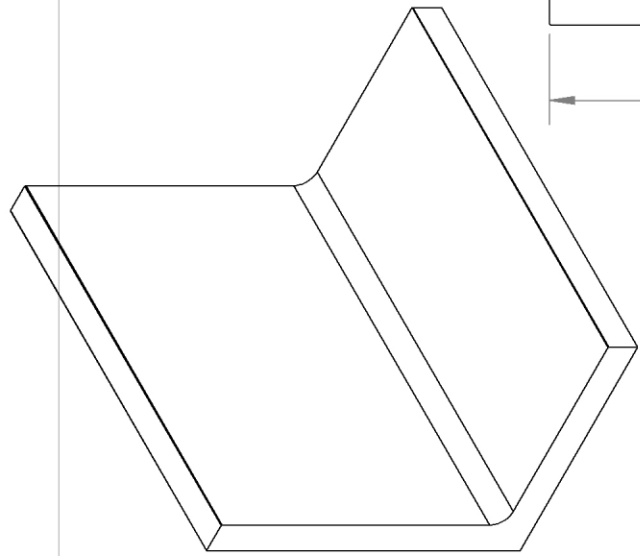


$\phi .563$



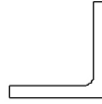
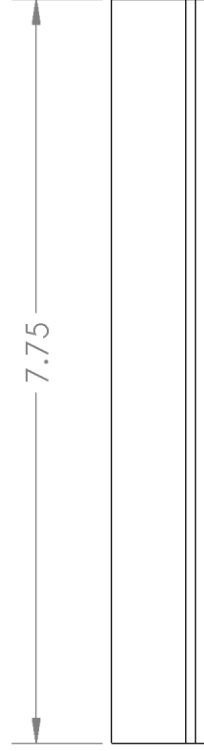
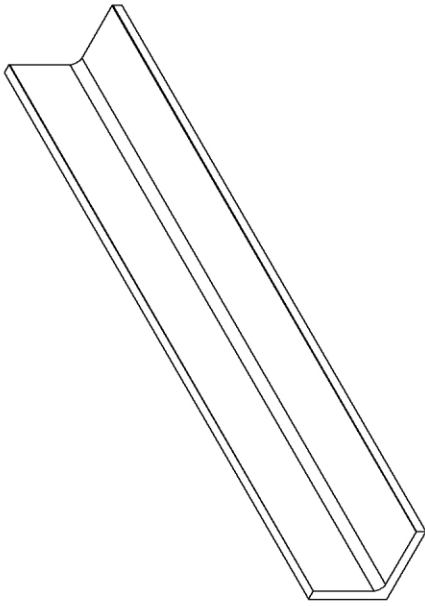
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| | | | | | |
|--|---------|-----------|------|------|---|
| UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES | | DRAWN | NAME | DATE | North Dakota State College of Science FRONT SCREW HOLDER SIZE DWG. NO. A 2789 REV SCALE: 1:1 WEIGHT: SHEET 1 OF 1 |
| TOLERANCES: FRACTIONAL $\pm 1/16$ ANGULAR, MACH $\pm .5^\circ$ BEND $\pm 1^\circ$ TWO PLACE DECIMAL $\pm .06$ THREE PLACE DECIMAL $\pm .031$ | | CHECKED | | | |
| INTERPRET GEOMETRIC TOLERANCING PER: | | ENG APPR. | | | |
| MATERIAL 1X1.125 ANGLE | | MFG APPR. | | | |
| FINISH | | Q.A. | | | |
| DO NOT SCALE DRAWING | | COMMENTS: | | | |
| NEXT ASSY | USED ON | | | | |
| APPLICATION | | | | | |



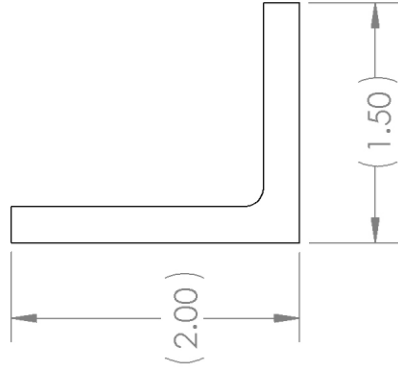
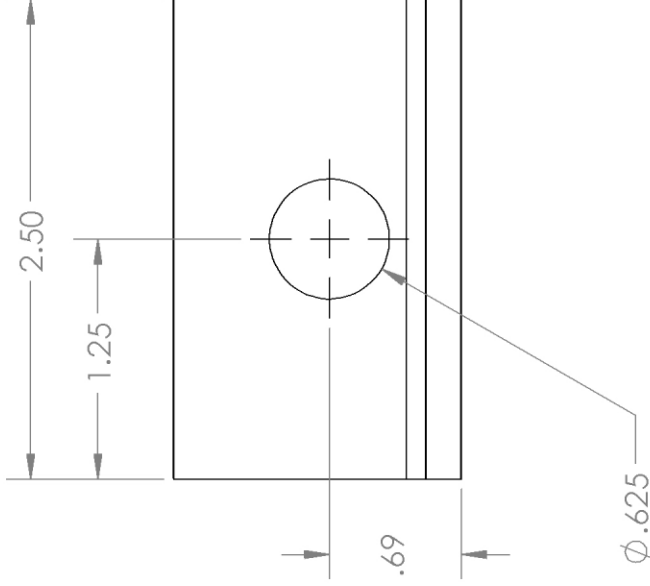
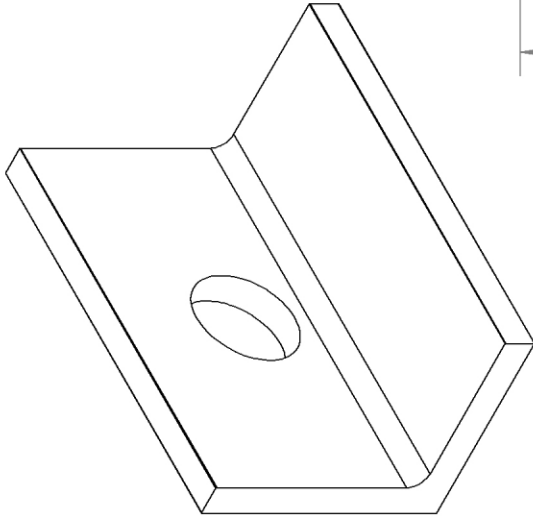
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| | | | | | |
|--|--|----------------------|------|------|--|
| UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES | | DRAWN | NAME | DATE | North Dakota State College of Science JAW TITLE: SIZE DWG. NO. A 2790 SCALE: 1:1 WEIGHT: SHEET 1 OF 1 |
| TOLERANCES: FRACTIONAL ± 1/16 ANGULAR: MACH ± .5° BEND ± 1° TWO PLACE DECIMAL ± .06 THREE PLACE DECIMAL ± .031 | | CHECKED | | | |
| INTERPRET GEOMETRIC TOLERANCING PER: | | ENG APPR. | | | |
| MATERIAL 2x1.50x.188 ANGLE FINISH | | MFG APPR. | | | |
| NEXT ASSY | | Q.A. | | | |
| APPLICATION | | COMMENTS: | | | |
| USED ON | | DO NOT SCALE DRAWING | | | |



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| | | | | | | |
|---|--|----------------------|------|------|--|-------------|
| UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES | | DRAWN | NAME | DATE | North Dakota State College of Science | |
| TOLERANCES: FRACTIONAL: $\pm 1/16$ ANGULAR: MACH $\pm .5^\circ$ BEND $\pm 1^\circ$ TWO PLACE DECIMAL $\pm .06$ THREE PLACE DECIMAL $\pm .031$ | | CHECKED | | | TITLE: RAIL | |
| INTERPRET GEOMETRIC TOLERANCING PER: | | ENG APPR. | | | SIZE | DWG. NO. |
| MATERIAL 1X1X.125 ANGLE | | MFG APPR. | | | A | 2791 |
| FINISH | | Q.A. | | | SCALE: 1:2 | WEIGHT: |
| NEXT ASSY | | COMMENTS: | | | REVISIONS | REV |
| APPLICATION | | DO NOT SCALE DRAWING | | | | |
| 5 | | 4 | | 3 | | 2 |
| 1 | | | | | | 1 |



North Dakota State College of Science

TITLE:

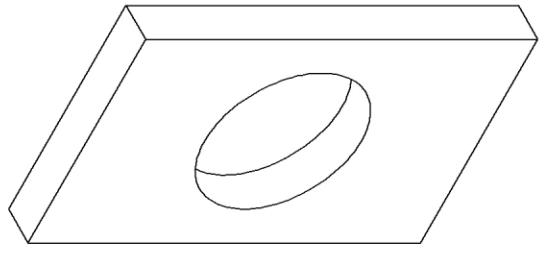
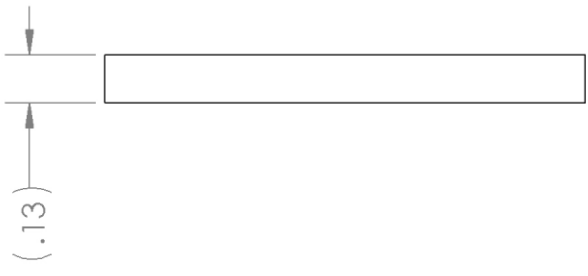
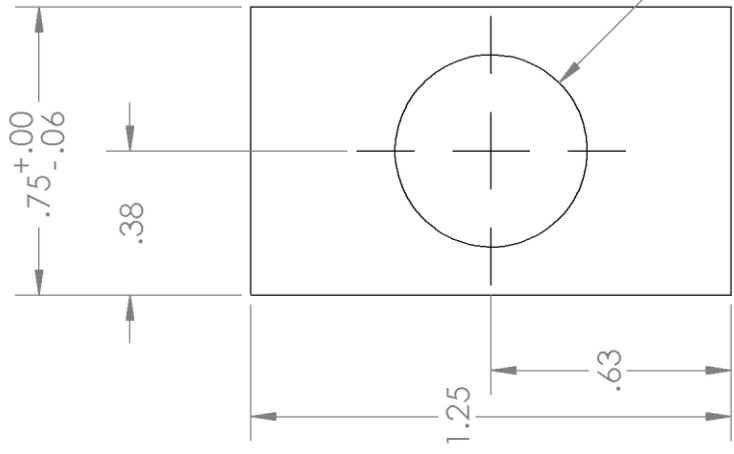
REAR HOLDER

SIZE **A** DWG. NO. **2792** REV

SCALE: 1:1 WEIGHT: SHEET 1 OF 1

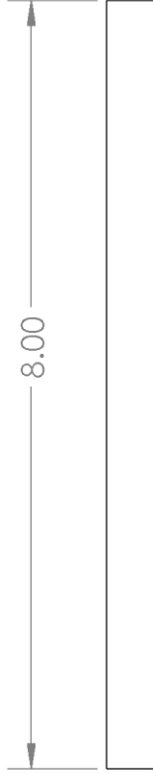
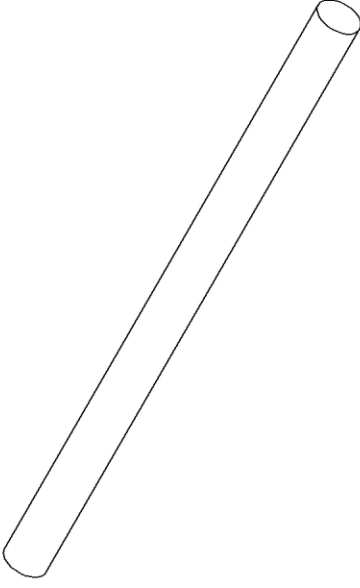
| UNLESS OTHERWISE SPECIFIED: | DRAWN | NAME | DATE |
|--------------------------------------|-----------|------|----------------------|
| DIMENSIONS ARE IN INCHES | CHECKED | | |
| TOLERANCES: | ENG APPR. | | |
| FRACTIONAL ± 1/16 | MFG APPR. | | |
| ANGULAR: MACH ± .5° BEND ± 1° | G.A. | | |
| TWO PLACE DECIMAL ± .06 | COMMENTS: | | |
| THREE PLACE DECIMAL ± .031 | | | |
| INTERPRET GEOMETRIC TOLERANCING PER: | | | |
| MATERIAL | | | |
| 2x1.50x.188 ANGLE | | | |
| FINISH | | | |
| NEXT ASSY | USED ON | | |
| APPLICATION | | | |
| | | | DO NOT SCALE DRAWING |

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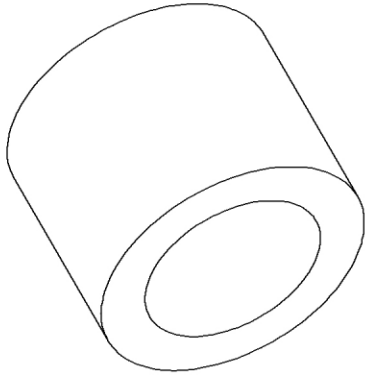
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| | | | | | |
|---|--|----------------------|------|------|--|
| UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES | | DRAWN | NAME | DATE | North Dakota State College of Science TITLE: SLIDE SIZE A DWG. NO. 2793 SCALE: 2:1 WEIGHT: SHEET 1 OF 1 |
| TOLERANCES: FRACTIONAL ± 1/16 ANGULAR: MACH ± 5° BEND ± 1° TWO PLACE DECIMAL ± .06 THREE PLACE DECIMAL ± .031 | | CHECKED | | | |
| INTERPRET GEOMETRIC TOLERANCING PER: | | ENG APPR. | | | |
| MATERIAL .125x.75 STRIP | | MFG APPR. | | | |
| FINISH | | G.A. | | | |
| NEXT ASSY | | COMMENTS: | | | |
| APPLICATION | | DO NOT SCALE DRAWING | | | |



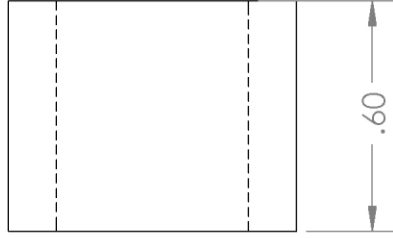
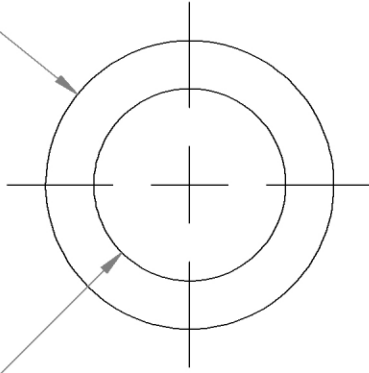
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| | | | | |
|---|--|--|------|---------------------------------------|
| UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES | | NAME | DATE | North Dakota State College of Science |
| TOLERANCES: FRACTIONAL $\pm 1/16$ ANGULAR: MACH. $\pm .5^\circ$ BEND $\pm 1^\circ$ TWO PLACE DECIMAL $\pm .06$ THREE PLACE DECIMAL $\pm .031$ | | DRAWN | | |
| INTERPRET GEOMETRIC TOLERANCING PER: | | CHECKED | | TITLE: WISE SCREW |
| MATERIAL 1/2-13 UNC READY ROD FINISH | | ENG APPR. | | SIZE DWG. NO. A 2794 |
| NEXT ASSY | | MFG APPR. | | SCALE: 1:2 WEIGHT: |
| USED ON | | Q.A. | | REV |
| APPLICATION | | COMMENTS: DO NOT SCALE DRAWING | | SHEET 1 OF 1 |



$\phi .750$

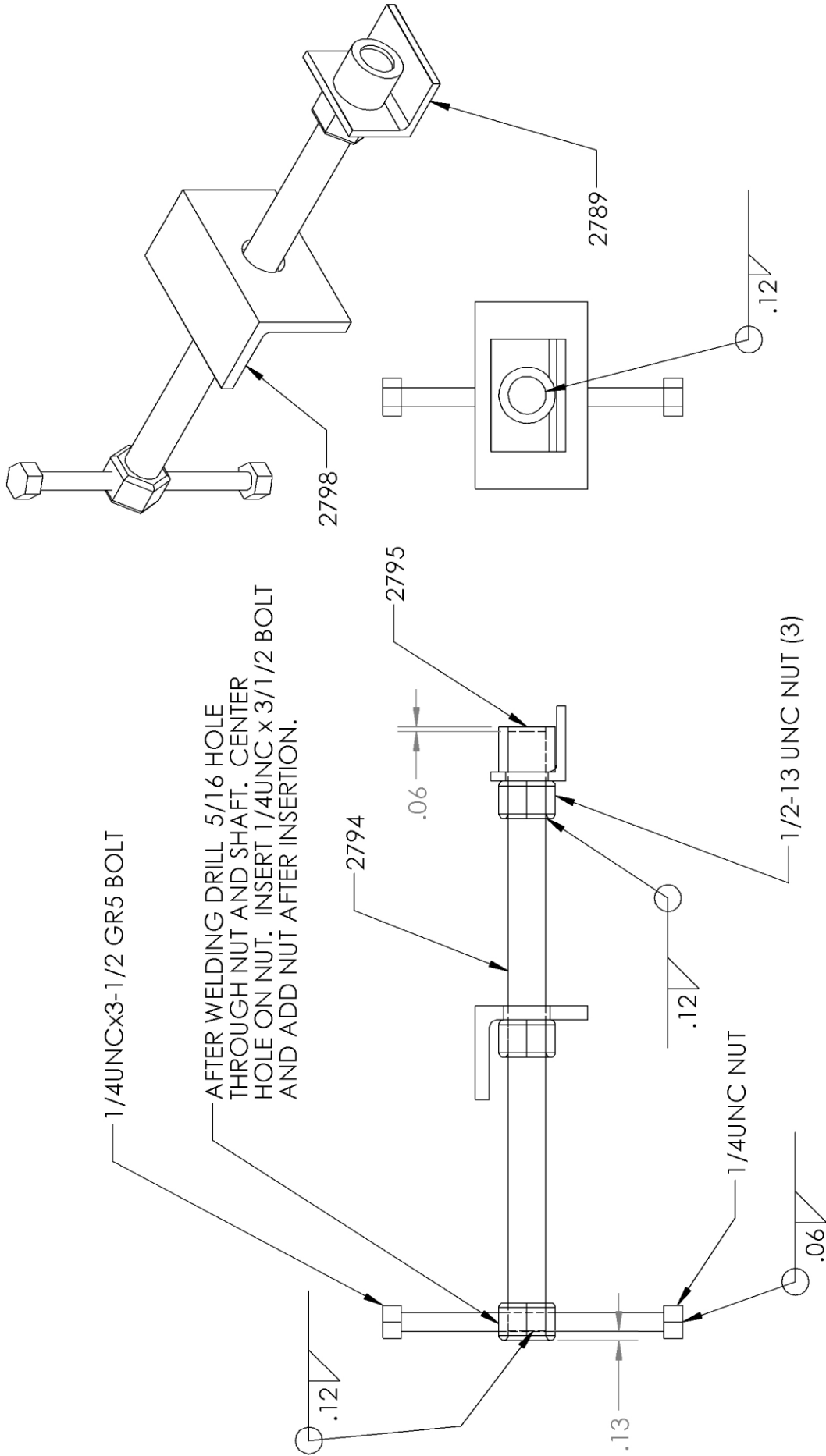
$\phi .500$



.60

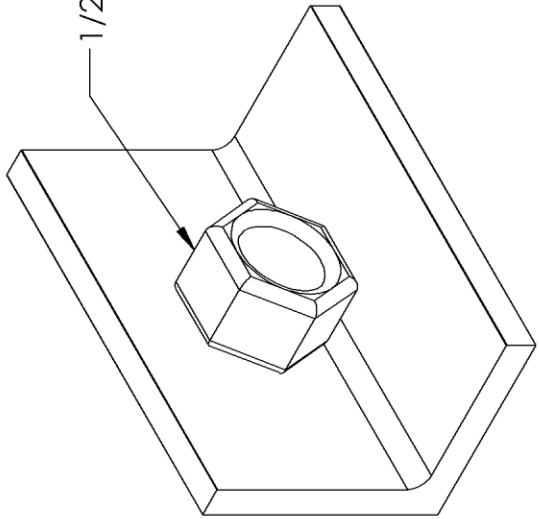
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| | | | | | |
|---|--|-----------|------|------|---------------------------------------|
| UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES | | DRAWN | NAME | DATE | North Dakota State College of Science |
| TOLERANCES: FRACTIONAL $\pm 1/16$ ANGULAR, MACH $\pm 5^\circ$ BEND $\pm 1^\circ$ TWO PLACE DECIMAL $\pm .06$ THREE PLACE DECIMAL $\pm .031$ | | CHECKED | | | |
| INTERPRET GEOMETRIC TOLERANCING PER: | | ENG APPR. | | | SIZE DWG. NO. A 2795 |
| MATERIAL .75 OD X.12W TUBE | | MFG APPR. | | | REV |
| FINISH | | Q.A. | | | SCALE: 2:1 WEIGHT: SHEET 1 OF 1 |
| NEXT ASSY USED ON | | COMMENTS: | | | |
| APPLICATION | | | | | |
| DO NOT SCALE DRAWING | | | | | |



| | | | | | |
|--|--|-------------|------|------|--|
| UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES | | DRAWN | NAME | DATE | North Dakota State College of Science TITLE: SCREW SUB-WELDMENT |
| TOLERANCES: FRACTIONAL ± 1/16 ANGULAR: MACH ± .5° BEND ± 1° TWO PLACE DECIMAL ± .06 THREE PLACE DECIMAL ± .001 | | C-CHECKED | | | |
| INTERPRET GEOMETRIC TOLERANCING PER: | | ENG APPR. | | | |
| MATERIAL | | MFG APPR. | | | |
| FINISH | | G.A. | | | |
| DO NOT SCALE DRAWING | | COMMENTS: | | | SIZE DWG. NO. A 2796 REV |
| APPLICATION | | NEXT ASSY | | | SCALE: 1:2 WEIGHT: |
| USED ON | | APPLICATION | | | SHEET 1 OF 1 |

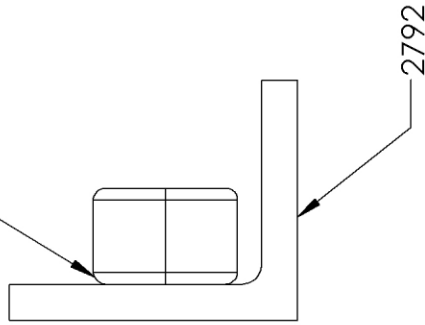
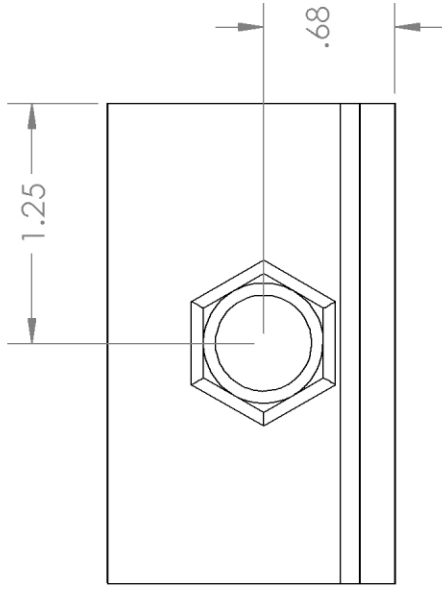
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1/2-13 UNC NUT

WELD AS MUCH AS POSSIBLE

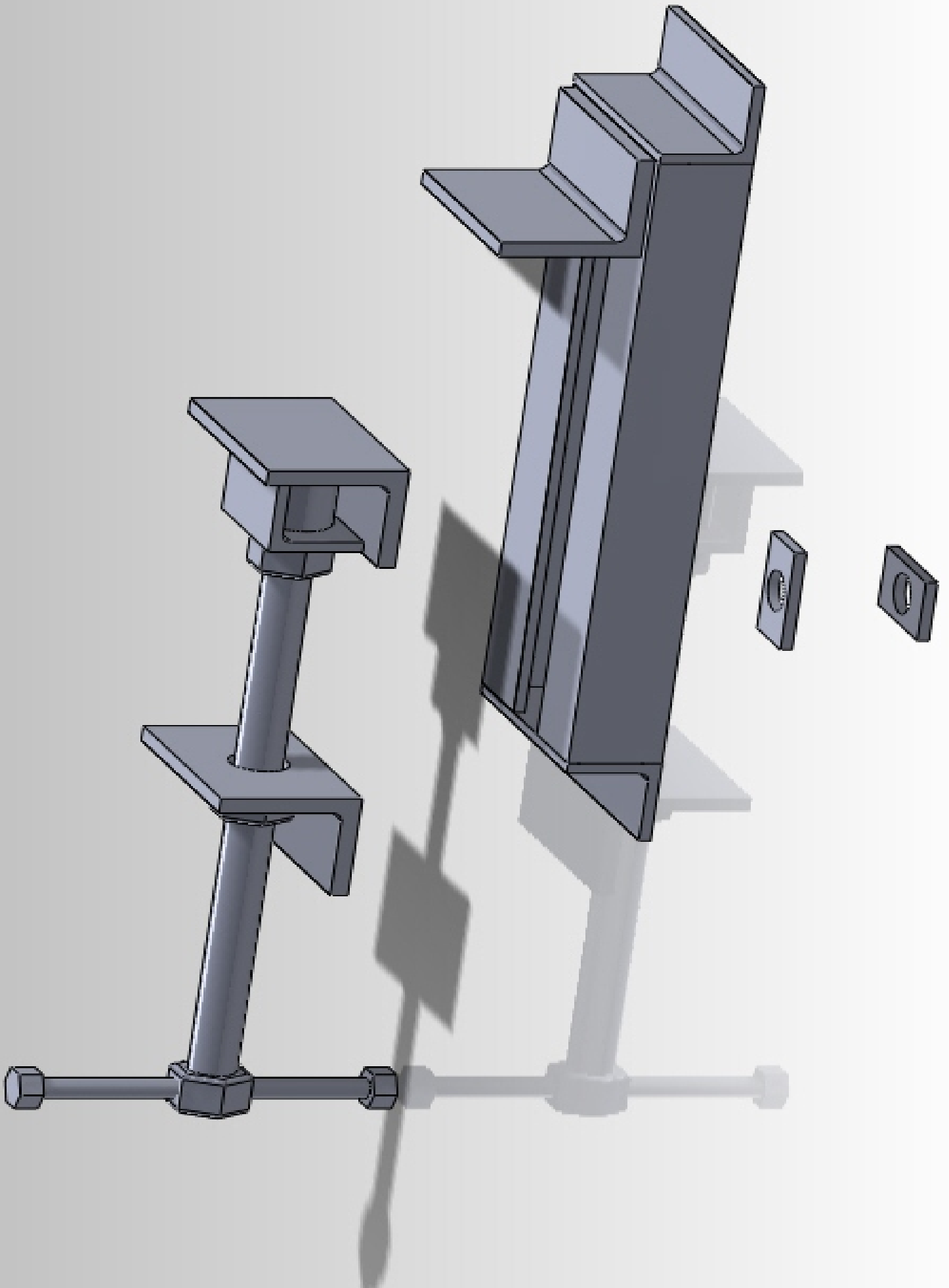
.13



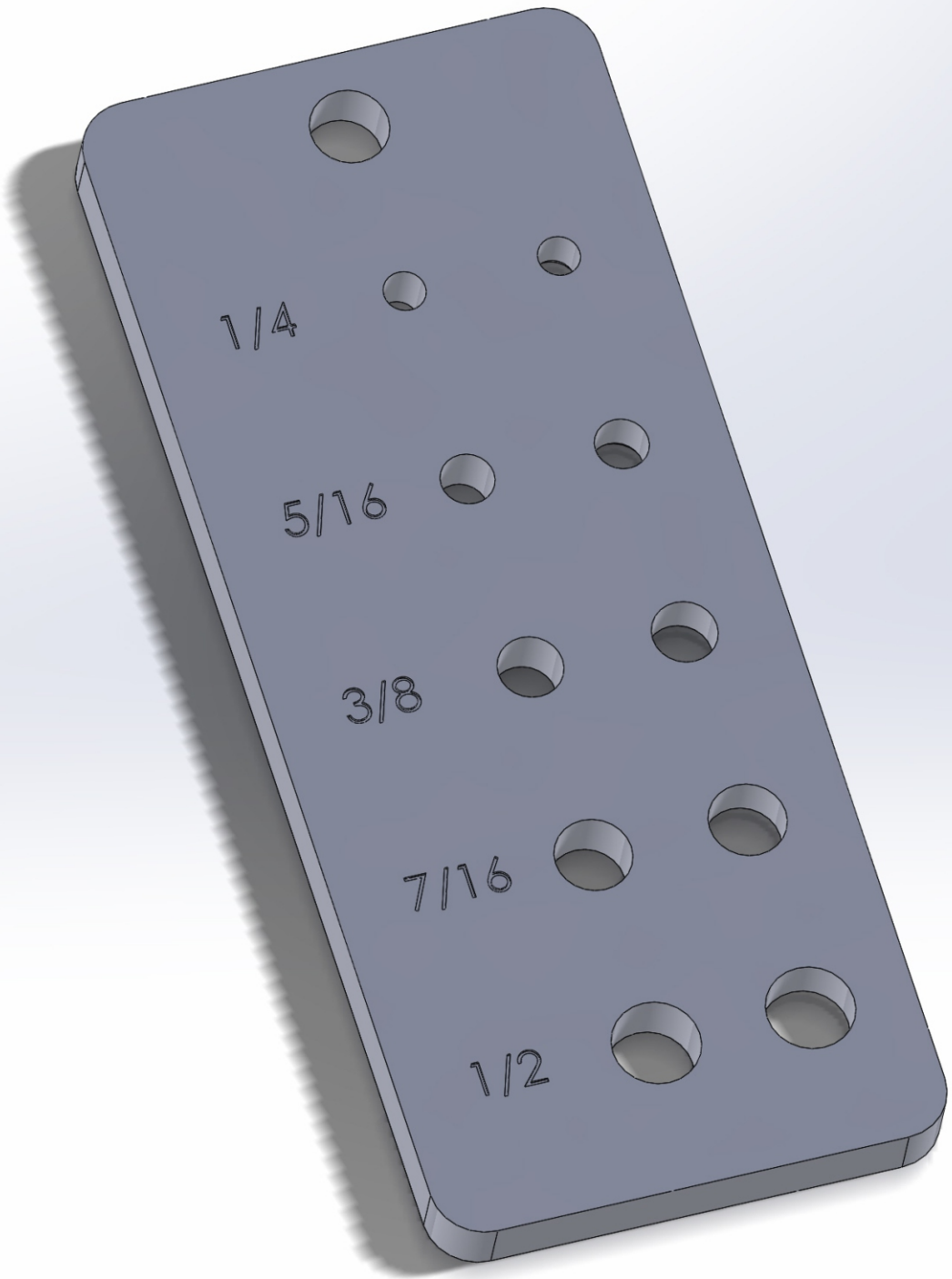
2792

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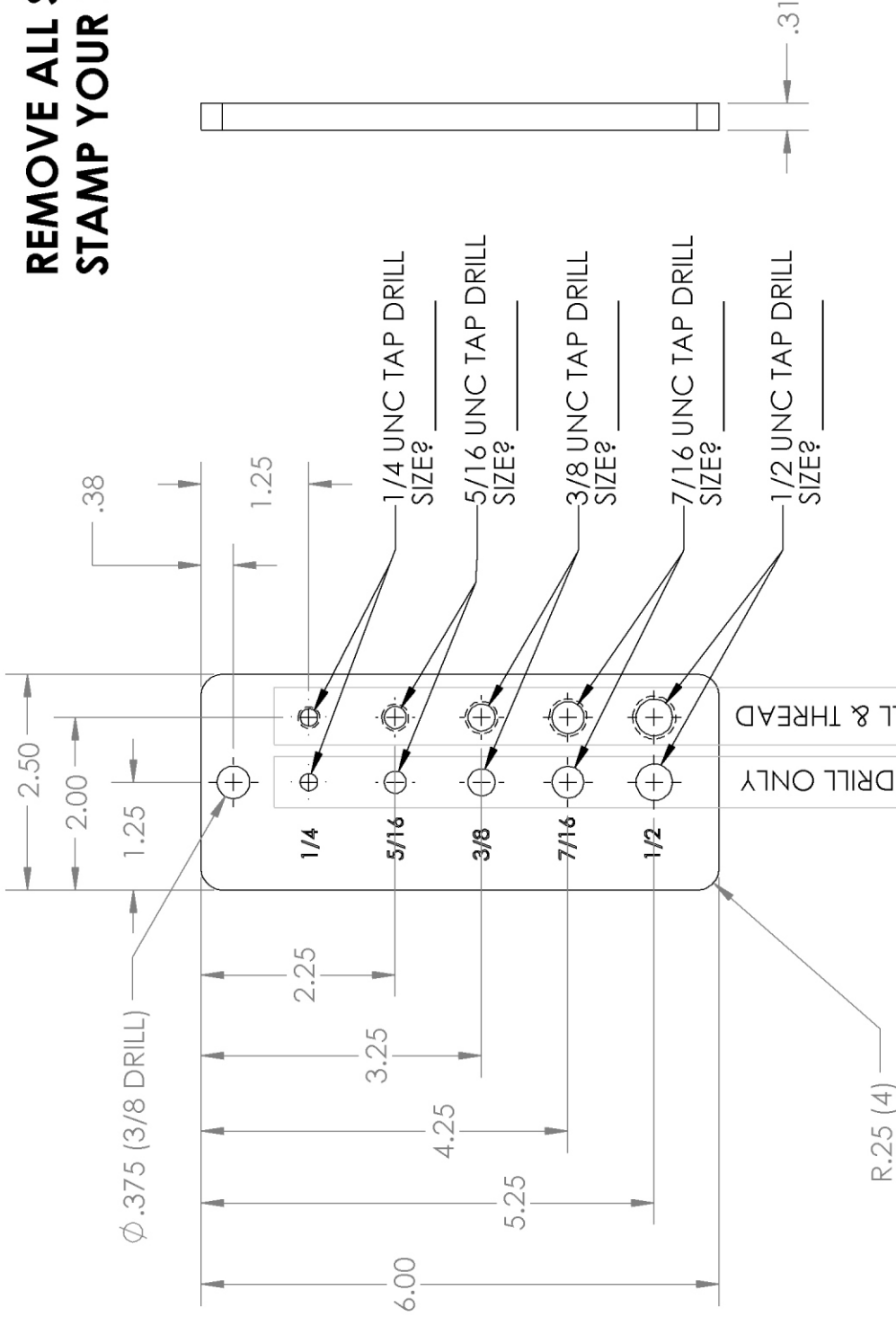
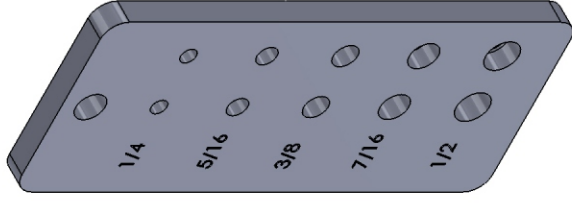
| | | | | | |
|--|---------|-----------|------|------|---|
| UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES | | DRAWN | NAME | DATE | North Dakota State College of Science TITLE: REAR HOLDER SUB-WELD SIZE DWG. NO. A 2798 REV SCALE: 1:1 WEIGHT: SHEET 1 OF 1 |
| TOLERANCES: FRACTIONAL ± 1/16 ANGULAR: MACH ± .5° BEND ± 1° TWO PLACE DECIMAL ± .06 THREE PLACE DECIMAL ± .031 | | CHECKED | | | |
| INTERPRET GEOMETRIC TOLERANCING PER: | | ENG APPR. | | | |
| MATERIAL | | MFG APPR. | | | |
| FINISH | | Q.A. | | | |
| DO NOT SCALE DRAWING | | COMMENTS: | | | |
| NEXT ASSY | USED ON | MATERIAL | | | |
| APPLICATION | | FINISH | | | |
| | | NOTED | | | |



Tap & Drill Gauge



**REMOVE ALL SHARP EDGES,
STAMP YOUR NAME ON BACK**



| | | | |
|--------------------------------------|--|-----------|------|
| UNLESS OTHERWISE SPECIFIED: | | NAME | DATE |
| DIMENSIONS ARE IN INCHES | | DRAWN | |
| TOLERANCES: | | CHECKED | |
| Diameter ± .06 | | ENG APPR. | |
| Angular: ± 1° | | MFG APPR. | |
| Two Place Decimal ±.06 | | Q.A. | |
| Three Place Decimal ±.005 | | COMMENTS: | |
| INTERPRET GEOMETRIC TOLERANCING PER: | | | |
| MATERIAL | | | |
| FINISH | | | |
| NEXT ASSY | | | |
| USED ON | | | |
| APPLICATION | | | |
| DO NOT SCALE DRAWING | | | |

North Dakota State College of Science

TITLE:

**TAP & DRILL
GAUGE**

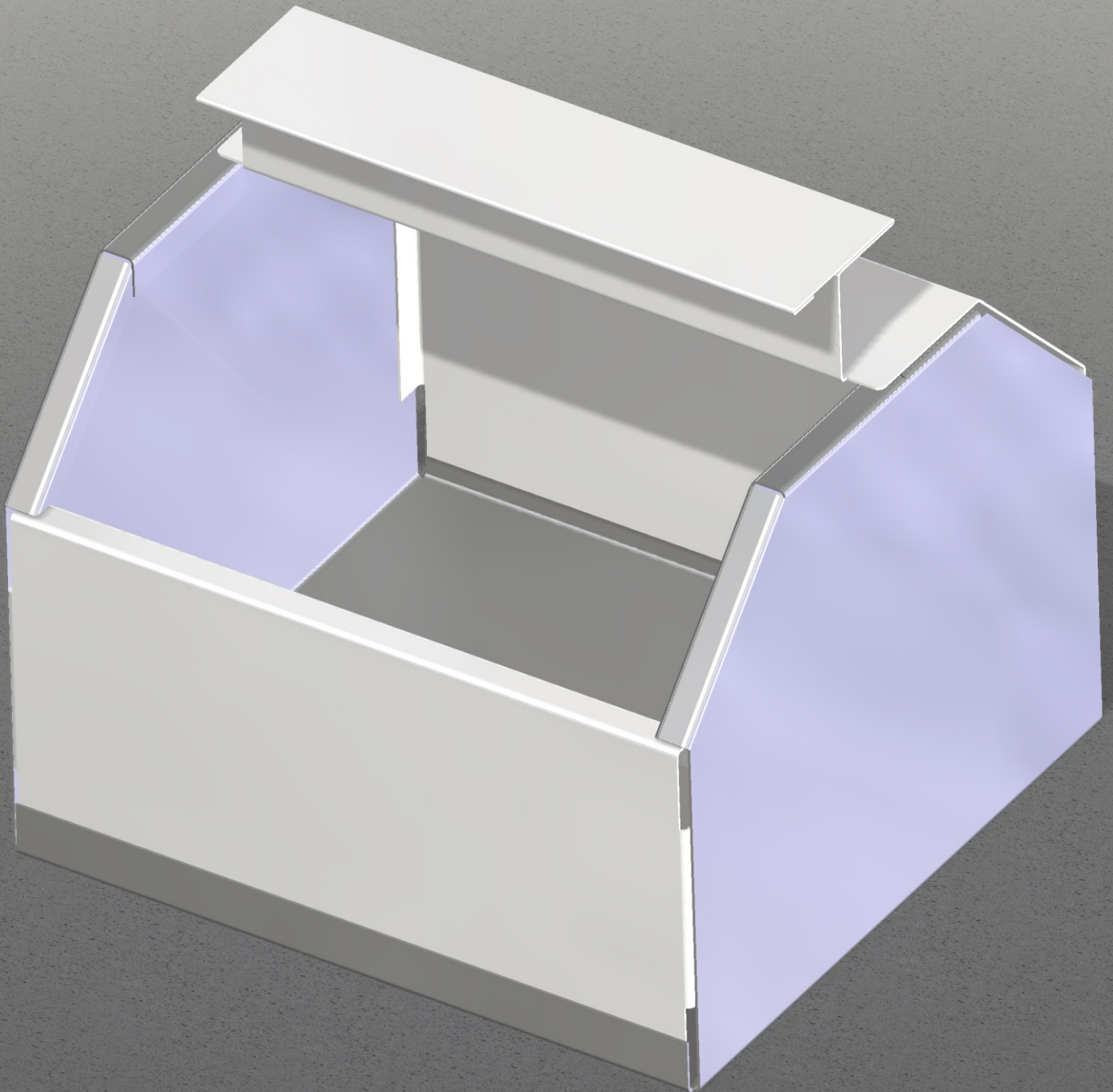
SIZE DWG. NO. REV
ATap&Drill Ga.

SCALE: 1:2 WEIGHT: SHEET 1 OF 1

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Tool Box



8

7

6

5

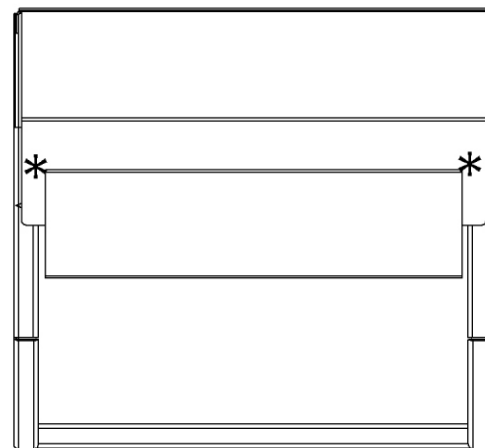
NOTE: 1. TABS ON PARTS 2454 AND 2453 GO TO INSIDE OF PART 2452

D

C

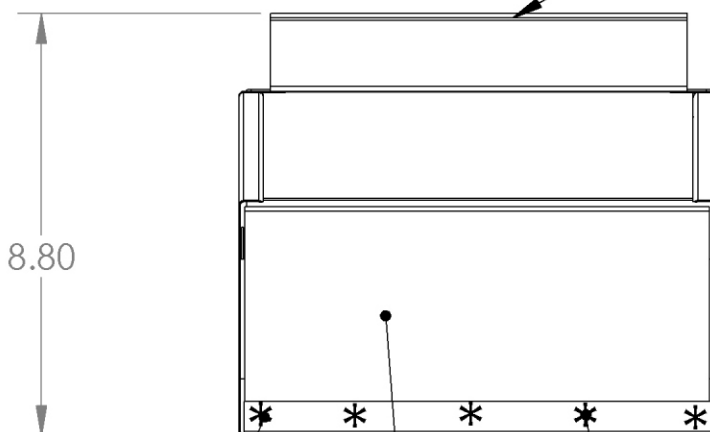
B

A



9.97

2453



8.80

2454

20 PL LOCATIONS MARKED WITH *

.25 SEC. ○

THESE SPOT WELDS FRONT AND BACK IN APPROX. LOCATIONS SHOWN.

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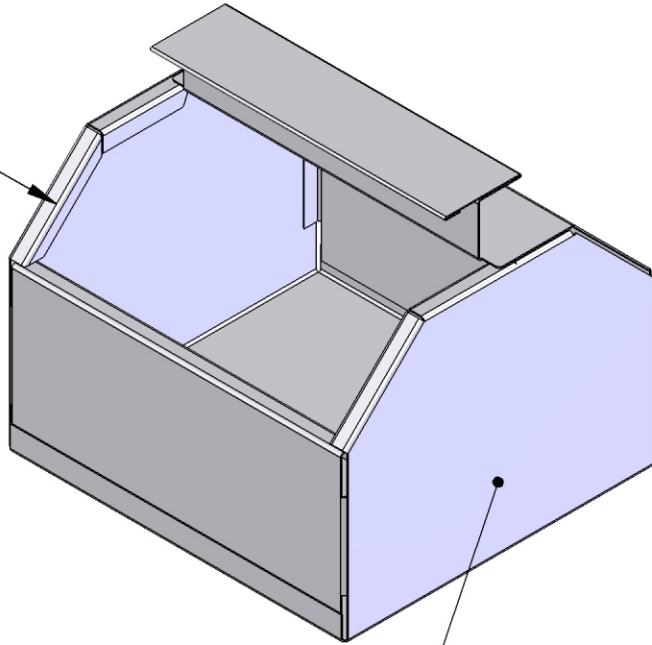
8

7

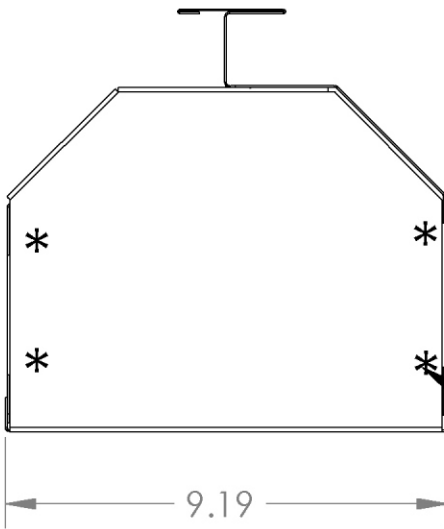
6

5

BENDS GO TO OPENING
SIDE OF TOOLBOX



2452



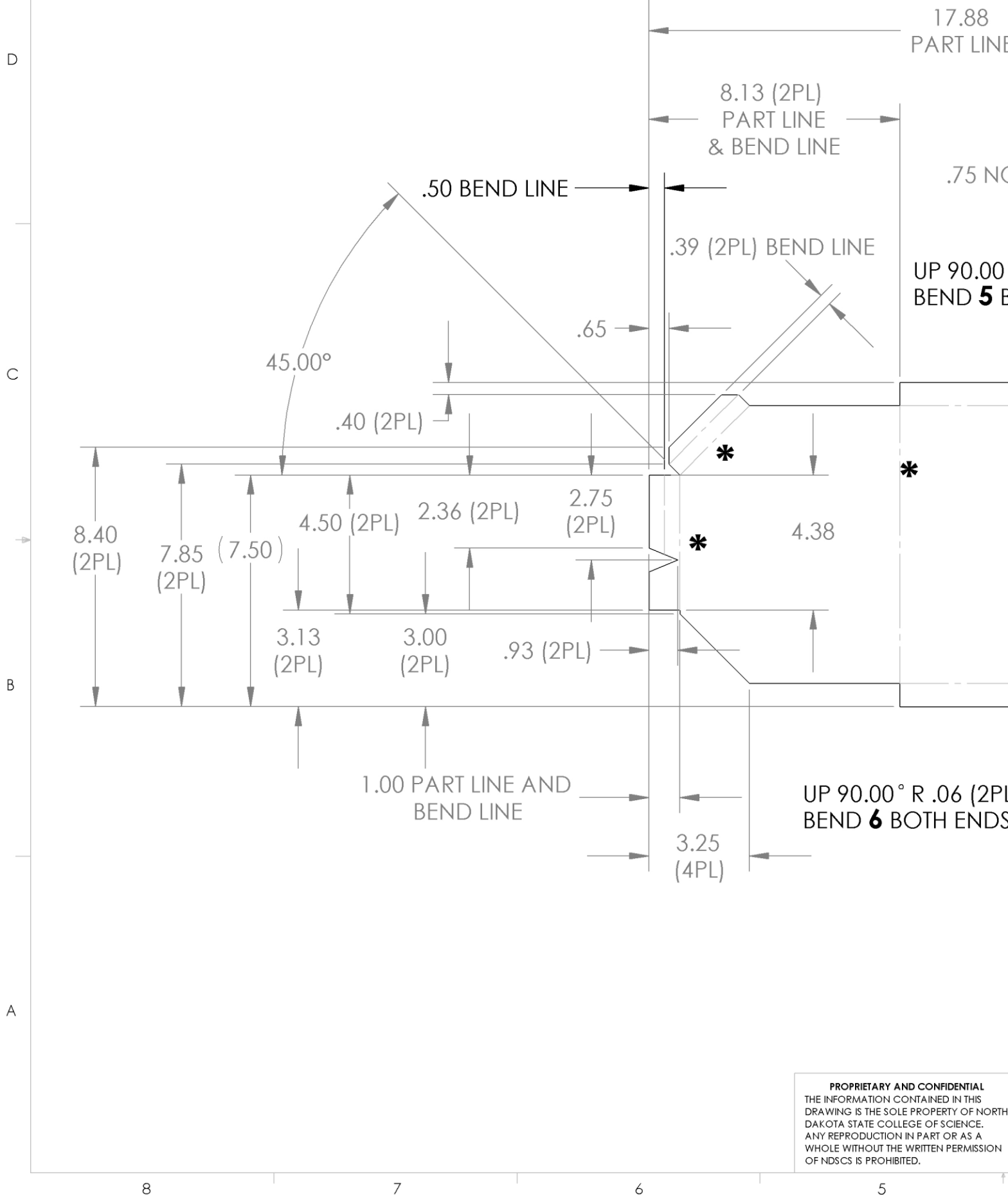
THESE SPOT WELDS ARE ON BOTH
ENDS IN APPROX. LOCATION
SHOWN.

D
C
B
A

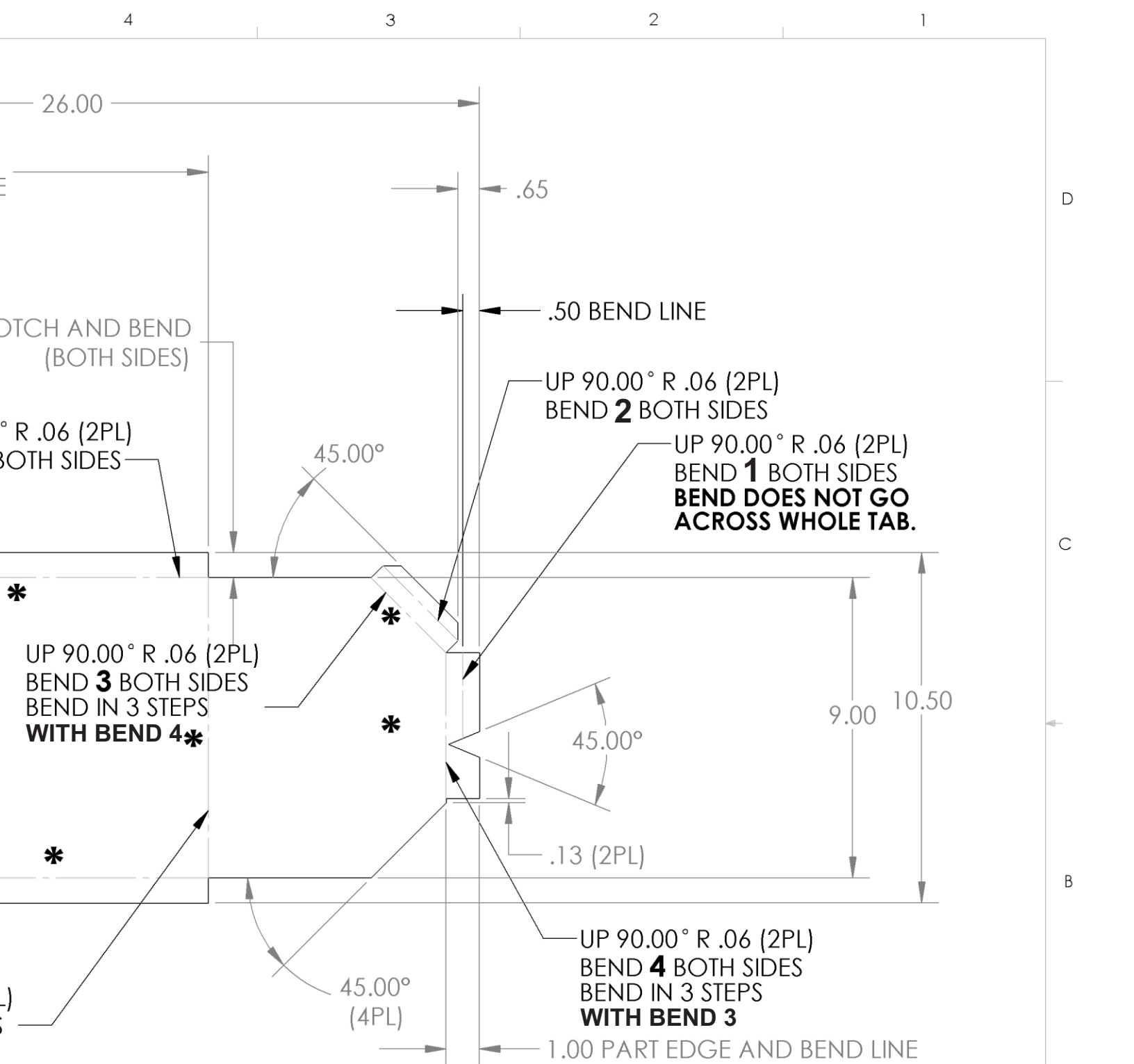
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| | | UNLESS OTHERWISE SPECIFIED: | NAME | DATE | North Dakota State College of Science | | |
| | | DIMENSIONS ARE IN INCHES | DRAWN | | TITLE: TOOL BOX ASSEMBLY | | |
| | | TOLERANCES: | CHECKED | | | | |
| | | FRACTIONAL ±1/16 | ENG APPR. | | | | |
| | | ANGULAR: | MFG APPR. | | | | |
| | | MACHINING ±0.25 BEND ±1.5 | Q.A. | | SIZE | DWG. NO. | REV |
| | | TWO PLACE DECIMAL ±.03 | COMMENTS: | | B | 2451 | |
| | | THREE PLACE DECIMAL ±.004 | | | SCALE: 1:4 | WEIGHT: | SHEET 1 OF 1 |
| | | INTERPRET GEOMETRIC TOLERANCING PER: | | | | | |
| | | MATERIAL NOTED | | | | | |
| NEXT ASSY | USED ON | FINISH NDSCS BLACK | | | | | |
| APPLICATION | | DO NOT SCALE DRAWING | | | | | |

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NOTE: * = CLAMP SIDE



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| | | UNLESS OTHERWISE SPECIFIED: | | NAME | DATE | North Dakota State College of Science | | | |
| | | DIMENSIONS ARE IN INCHES | | DRAWN | | TITLE: TOOLBOX BASE | | | |
| | | TOLERANCES: | | CHECKED | | | | | |
| | | FRACTIONAL ±1/16 | | ENG APPR. | | | | | |
| | | ANGULAR: | | MFG APPR. | | | | | |
| | | MACHINING ±0.25 BEND ±1.5 | | Q.A. | | | | | |
| | | TWO PLACE DECIMAL ±.03 | | COMMENTS: | | SIZE | DWG. NO. | REV | |
| | | THREE PLACE DECIMAL ±.004 | | | | B | 2452 | | |
| | | INTERPRET GEOMETRIC TOLERANCING PER: | | | | SCALE: 1:4 | | WEIGHT: | SHEET 1 OF 2 |
| | | MATERIAL | | | | | | | |
| | | 20 GA. HR SHEET | | | | | | | |
| NEXT ASSY | | USED ON | | | | | | | |
| | | FINISH | | | | | | | |
| | | NONE | | | | | | | |
| APPLICATION | | DO NOT SCALE DRAWING | | | | | | | |

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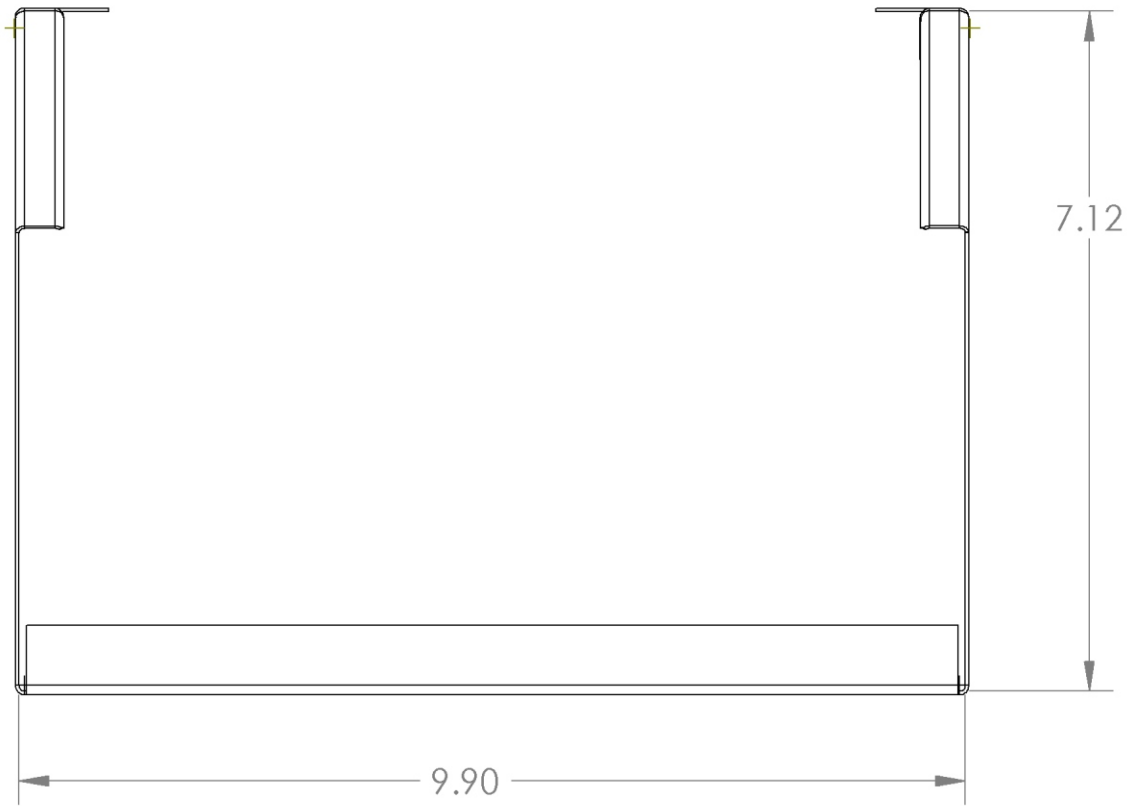
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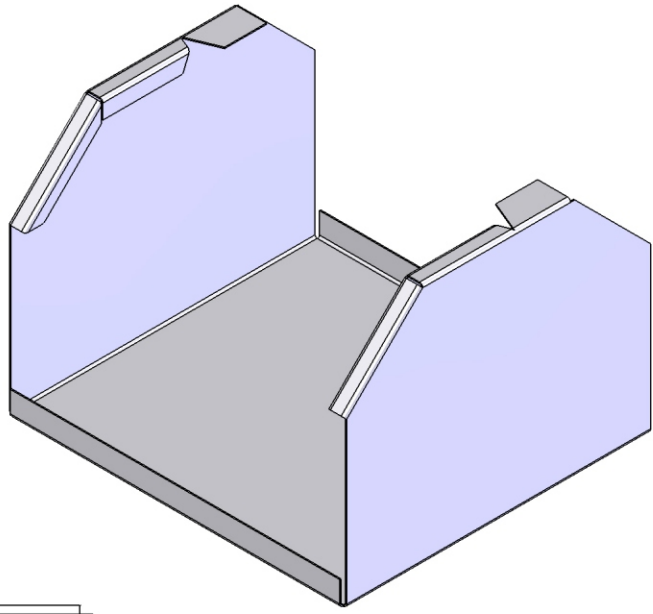
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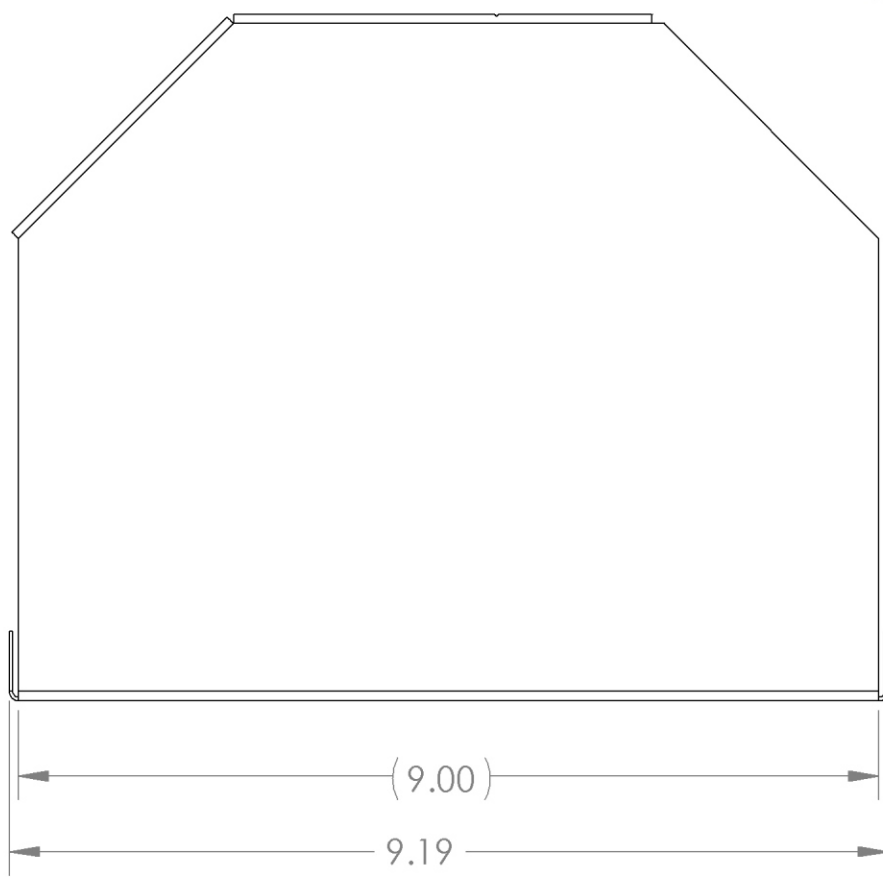
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| | | UNLESS OTHERWISE SPECIFIED: | NAME | DATE | North Dakota State College of Science | | |
| | | DIMENSIONS ARE IN INCHES | DRAWN | | TITLE: TOOLBOX BASE | | |
| | | TOLERANCES: | CHECKED | | | | |
| | | FRACTIONAL ±1/16 | ENG APPR. | | | | |
| | | ANGULAR: | MFG APPR. | | | | |
| | | MACHINING ±0.25 BEND ±1.5 | Q.A. | | SIZE | DWG. NO. | REV |
| | | TWO PLACE DECIMAL ±.03 | COMMENTS: | | B | 2452 | |
| | | THREE PLACE DECIMAL ±.004 | | | SCALE: 1:2 | WEIGHT: | SHEET 2 OF 2 |
| | | INTERPRET GEOMETRIC TOLERANCING PER: | | | | | |
| | | MATERIAL | | | | | |
| | | 20 GA. HR SHEET | | | | | |
| NEXT ASSY | USED ON | FINISH | | | | | |
| | | NONE | | | | | |
| APPLICATION | | DO NOT SCALE DRAWING | | | | | |

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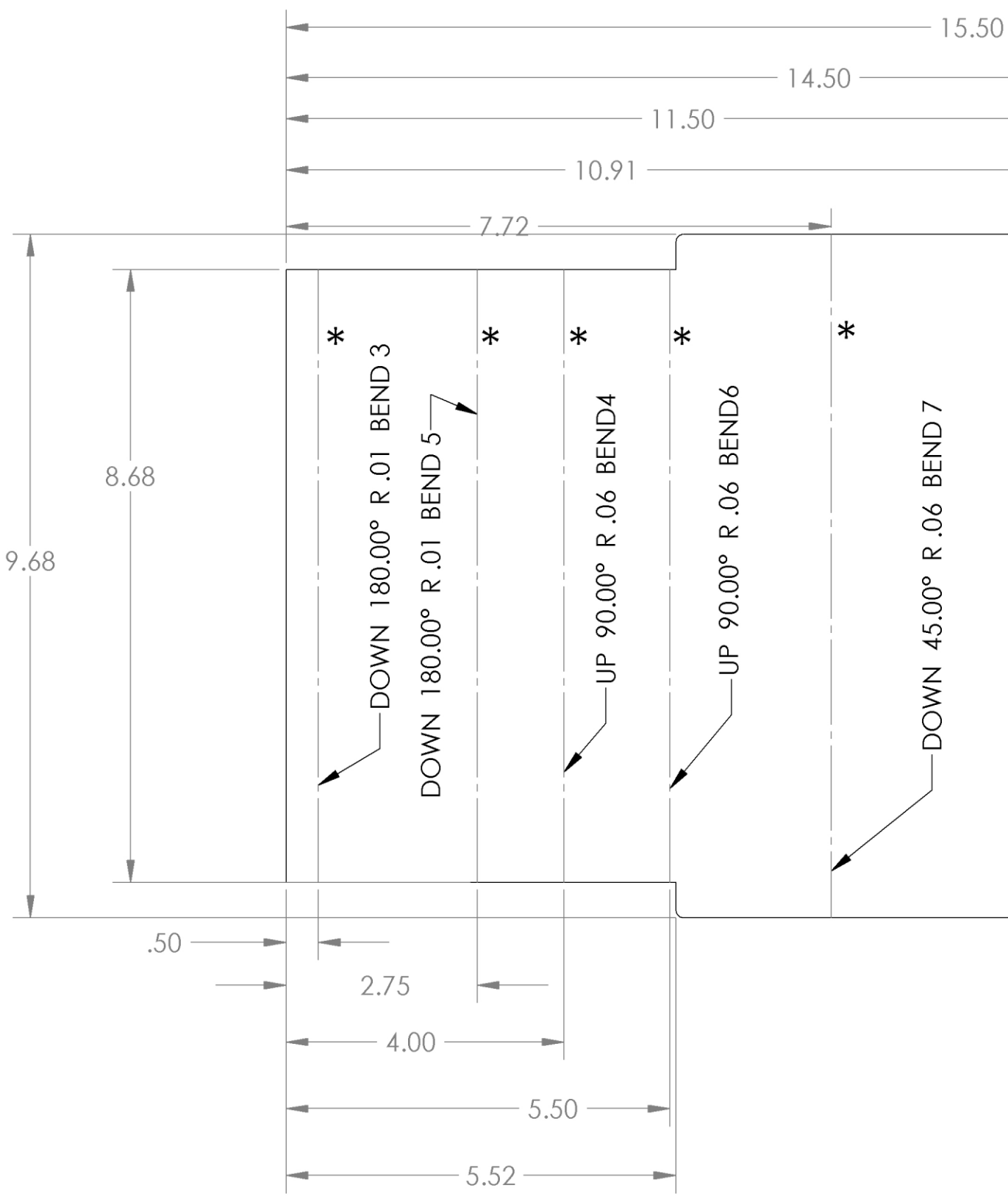
NOTE: * =CLAMP SIDE

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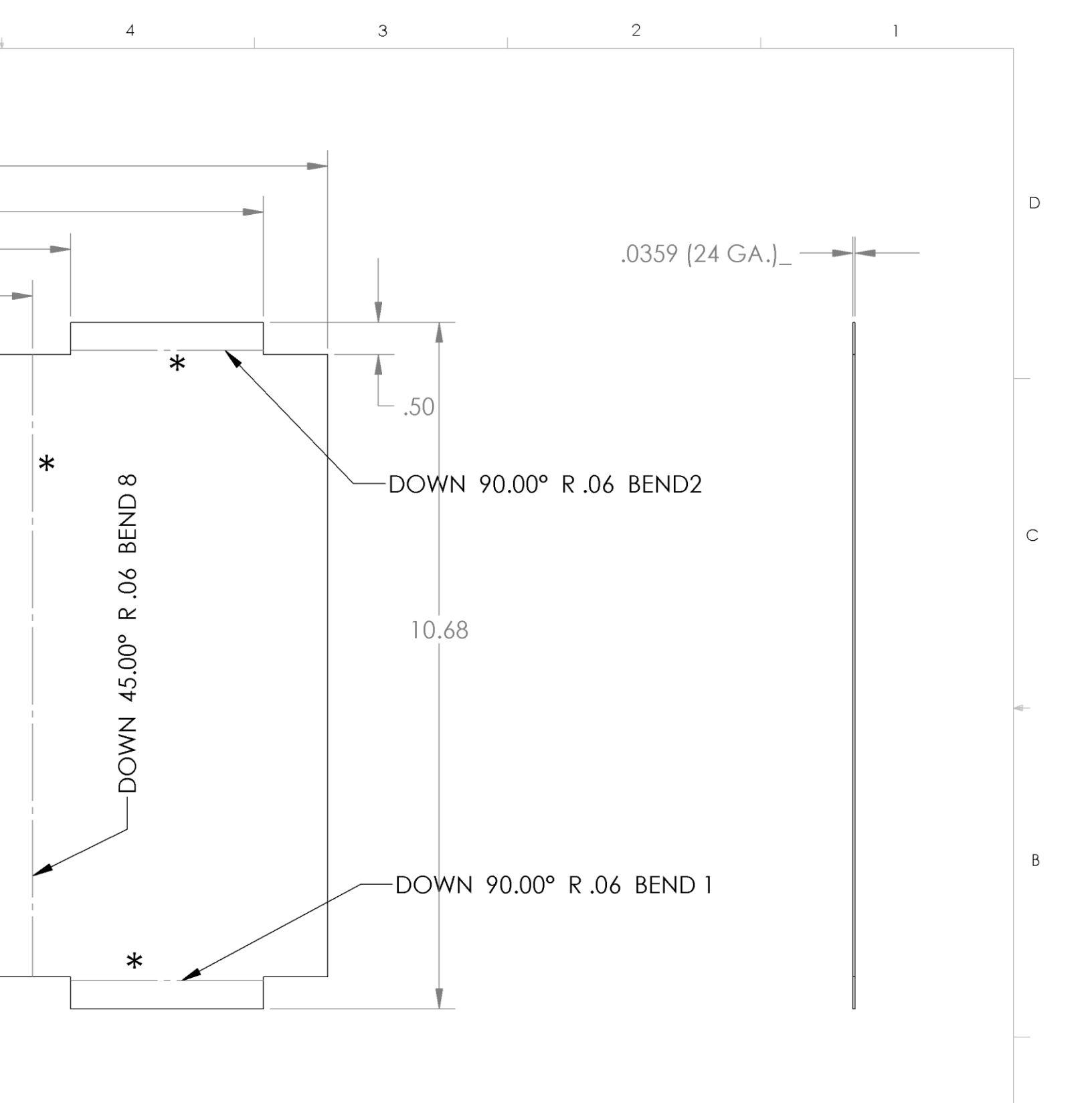
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| | | UNLESS OTHERWISE SPECIFIED: | | NAME | DATE | NDSCS | |
| | | DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ± | | DRAWN | | | |
| | | INTERPRET GEOMETRIC TOLERANCING PER: | | ENG APPR. | | SIZE DWG. NO. REV B 2453 | |
| | | MATERIAL 20 GA HR SHEET | | MFG APPR. | | | |
| NEXT ASSY | | USED ON | | Q.A. | | COMMENTS: | |
| APPLICATION | | DO NOT SCALE DRAWING | | | | | |
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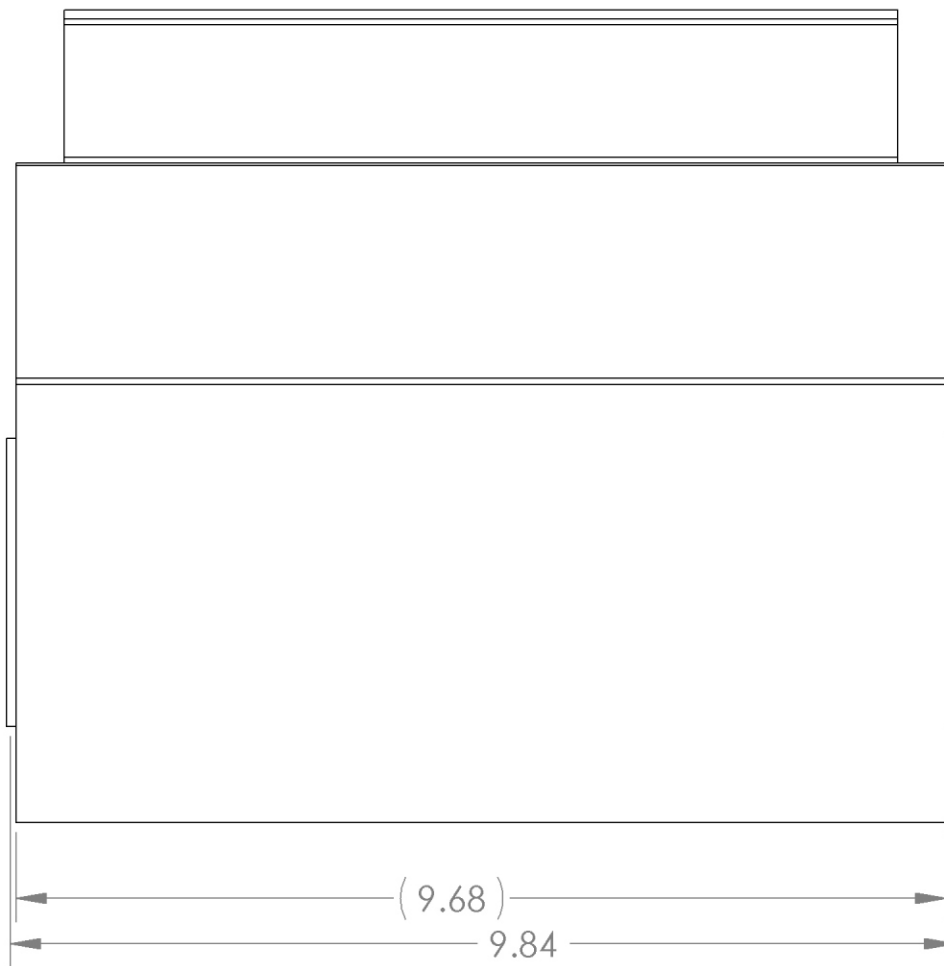
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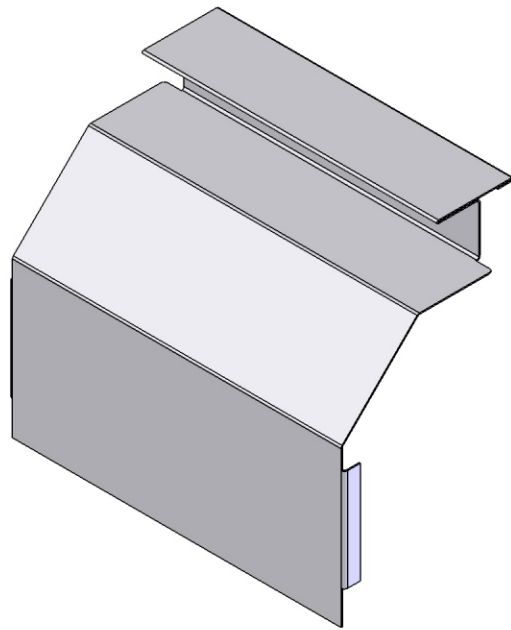
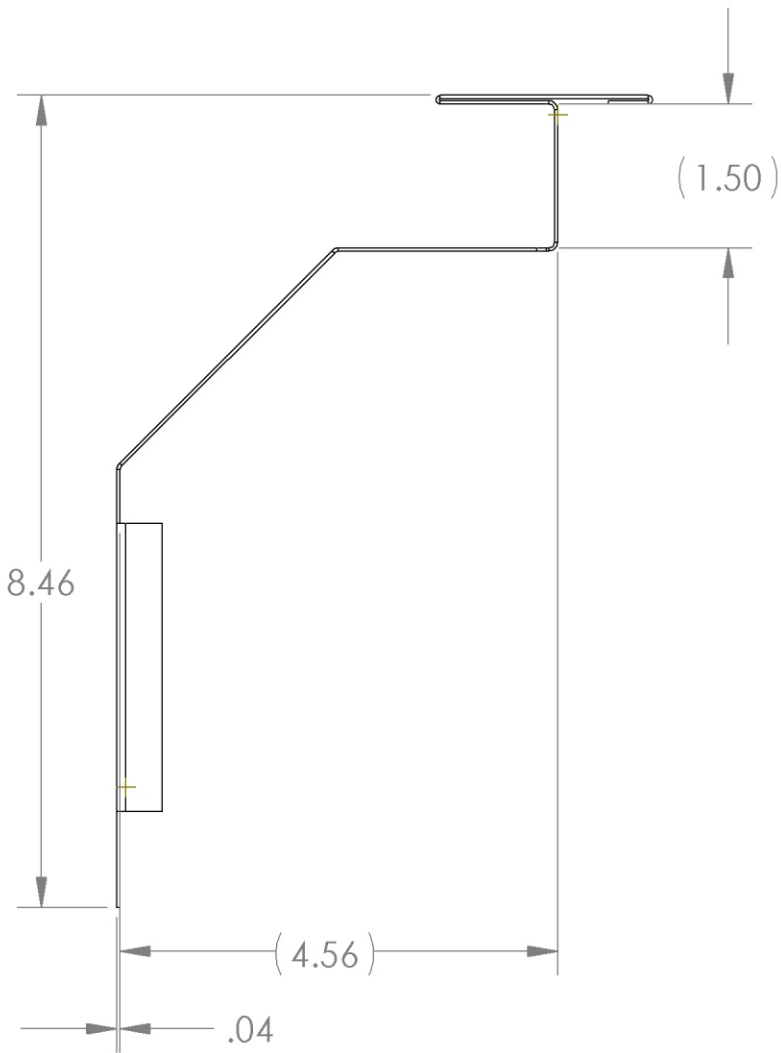
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UNLESS OTHERWISE SPECIFIED:

DIMENSIONS ARE IN INCHES
 TOLERANCES:
 FRACTIONAL ±
 ANGULAR: MACH ± BEND ±
 TWO PLACE DECIMAL ±
 THREE PLACE DECIMAL ±

INTERPRET GEOMETRIC
 TOLERANCING PER:

MATERIAL
20 GA. HR SHEET

FINISH
NONE

DO NOT SCALE DRAWING

NAME

DATE

DRAWN

CHECKED

ENG APPR.

MFG APPR.

Q.A.

COMMENTS:

NDSCS

TITLE:

TOOLBOX BACK

SIZE

DWG. NO.

REV

B

2453

SCALE: 1:2

WEIGHT:

SHEET 2 OF 2

NEXT ASSY

USED ON

APPLICATION

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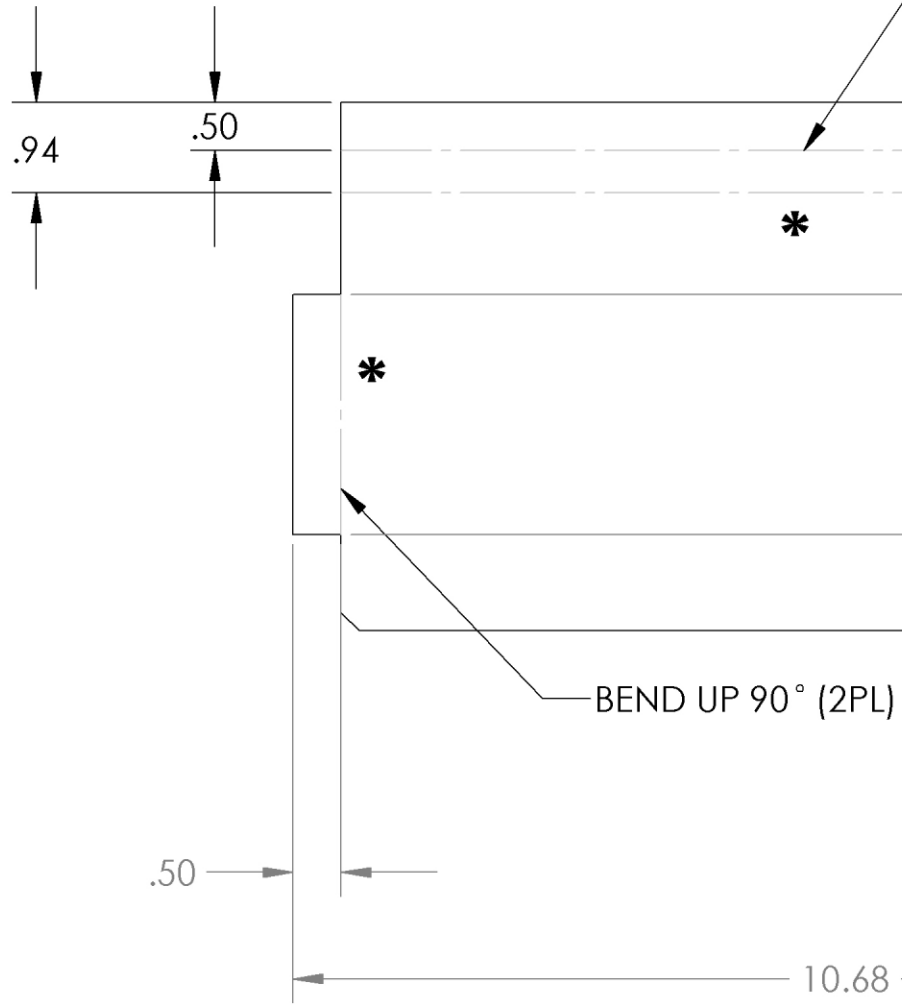
NOTE: * = CLAMP SIDE

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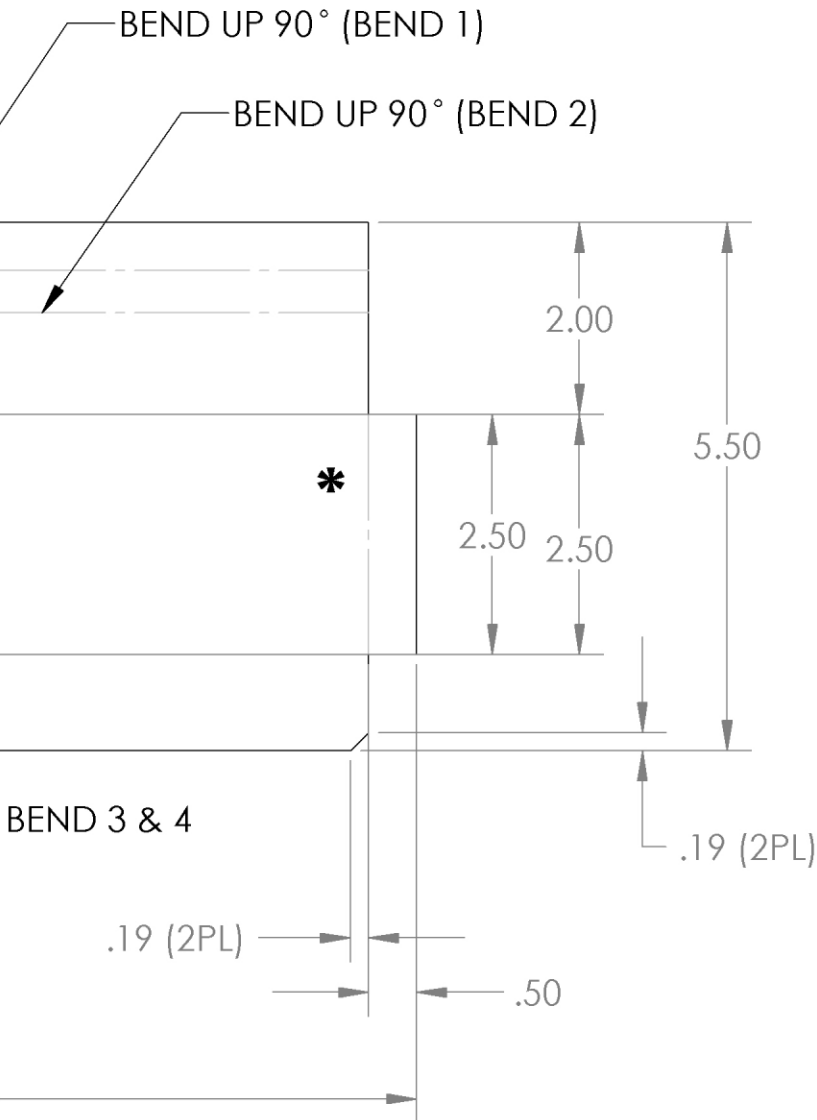
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| | | UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ±1/16 ANGULAR: MACHINING ±0.25 BEND ±1.5 TWO PLACE DECIMAL ±.03 THREE PLACE DECIMAL ±.004 INTERPRET GEOMETRIC TOLERANCING PER: MATERIAL 20GA HR SHEET FINISH NONE | | NAME | DATE | North Dakota State College of Science | | | |
| | | | | DRAWN | | | TITLE: TOOLBOX FRONT | | |
| | | | | CHECKED | | | | | |
| | | | | ENG APPR. | | | | | |
| | | | | MFG APPR. | | | | | |
| | | | Q.A. | | | SIZE | DWG. NO. | REV | |
| | | | COMMENTS: | | | B | 2454 | | |
| NEXT ASSY | USED ON | | | | | SCALE: 1:2 | WEIGHT: | SHEET 1 OF 2 | |
| APPLICATION | | DO NOT SCALE DRAWING | | | | | | | |

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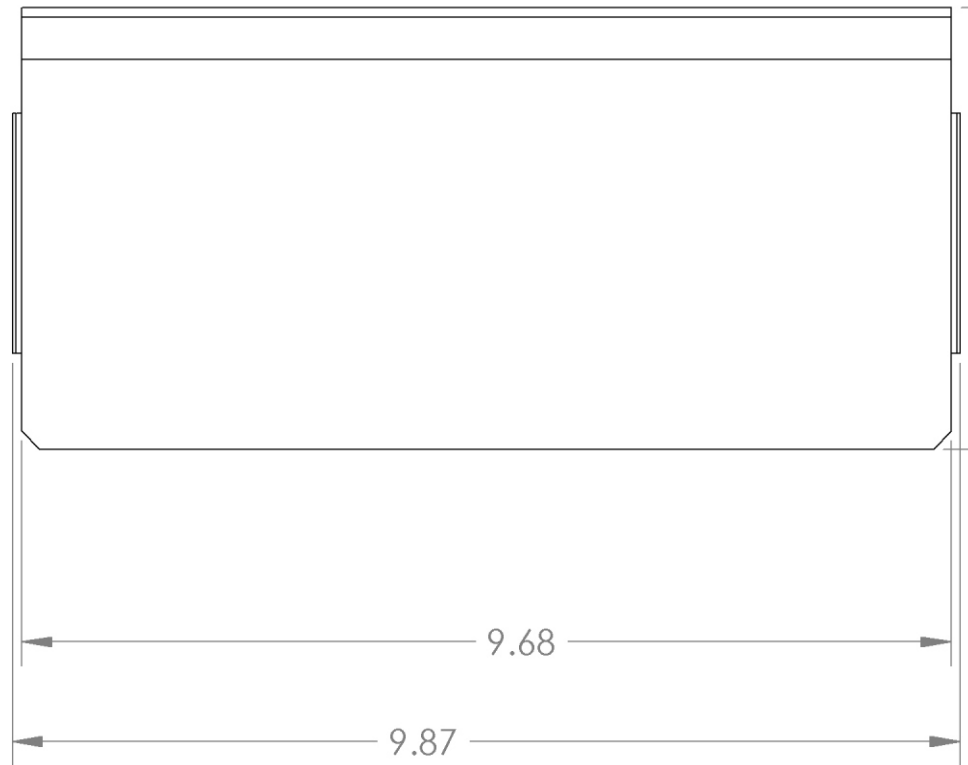
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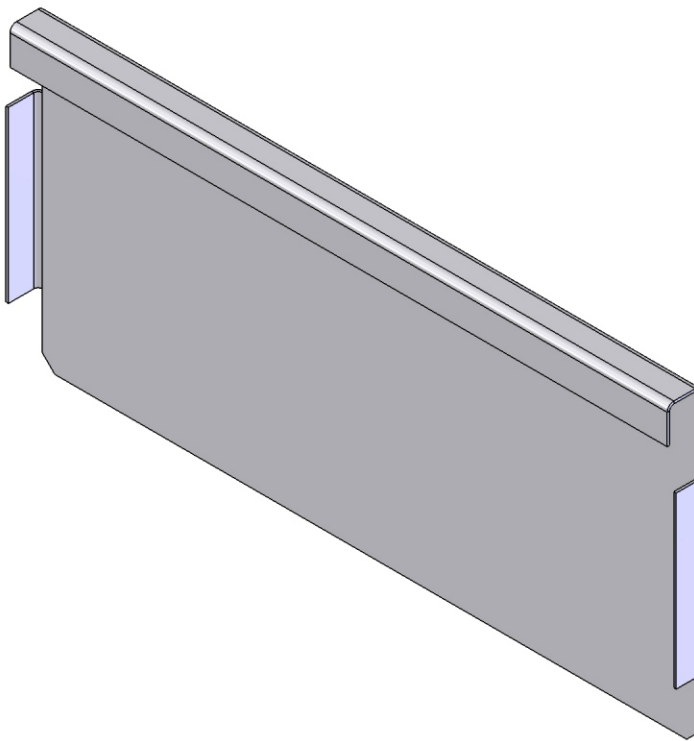
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| | | UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL $\pm 1/16$ ANGULAR: MACHINING ± 0.25 BEND ± 1.5 TWO PLACE DECIMAL $\pm .03$ THREE PLACE DECIMAL $\pm .004$ | DRAWN | NAME | DATE | North Dakota State College of Science | | |
| | | | CHECKED | | | TITLE: TOOLBOX FRONT | | |
| | | | ENG APPR. | | | Q.A. | | |
| | | | MFG APPR. | | | COMMENTS: | | |
| | | INTERPRET GEOMETRIC TOLERANCING PER: | | | | SIZE | DWG. NO. | REV |
| | | MATERIAL | | | | B | 2454 | |
| | | FINISH | | | | | | |
| NEXT ASSY | USED ON | 20 GA. HR SHEET | | | | | | |
| APPLICATION | | DO NOT SCALE DRAWING | | | | SCALE: 1:2 | WEIGHT: | SHEET 2 OF 2 |

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