

DESIGN HANDBOOK

Table 5-11A. STANDARD BEND RADII - ALUMINUM ALLOYS

| Material Thickness (in.) | 2024-O 2219-O 3003-O 5052-O 6061-O | 3003-H14 5052-H32 6061-T4 6061-T451 7075-O | 2219-T31 2219-T351 5052-H34 6061-T6 6061-T651 | 2024-T3 2024-T351 2024-T4 2219-T37 | 2014-T6 2014-T651 2024-T36 2219-T62 7050-T73651 7075-T6 7075-T651 7075-T73 7075-T7351 7475-T7351 | 2024-T62 2024-T81 2024-T851 2024-T86 2219-T81 2219-T851 2219-T87 |
|-----------------------------|--|--|---|---|---|--|
| | Room Temperature | | | | | |
| .012 | .03 | .03 | .03 | .06 | .09 | .09 |
| .016 | .03 | .03 | .03 | .06 | .09 | .09 |
| .020 | .03 | .03 | .03 | .06 | .09 | .12 |
| .025 | .03 | .03 | .03 | .09 | .12 | .16 |
| .032 | .03 | .03 | .06 | .12 | .12 | .19 |
| .040 | .06 | .06 | .09 | .12 | .16 | .25 |
| .050 | .06 | .06 | .09 | .16 | .19 | .31 |
| .063 | .06 | .09 | .12 | .19 | .25 | .41 |
| .071 | .06 | .12 | .16 | .22 | .28 | .44 |
| .080 | .09 | .12 | .16 | .31 | .44 | .50 |
| .090 | .09 | .16 | .19 | .38 | .47 | .56 |
| .100 | .09 | .19 | .22 | .41 | .53 | .66 |
| .125 | .12 | .22 | .28 | .50 | .62 | .84 |
| .160 | .16 | .28 | .34 | .66 | .75 | 1.06 |
| .190 | .19 | .38 | .47 | .81 | .91 | 1.38 |
| .250 | .28 | .63 | .75 | 1.13 | 1.25 | 2.00 |
| .313 | .35 | .81 | 1.25 | 1.50 | 1.75 | -- |
| .375 | .41 | 1.00 | 1.50 | 1.88 | 2.00 | -- |
| .500 | .69 | 1.50 | 2.00 | 2.50 | 2.50 | -- |

Table 5-11B. STANDARD BEND RADII - COPPER ALLOYS

| Material Thickness (in.) | 110-Ann. 510-Soft | 172-1/4H | 110-1/2H 510-1/2H | 110-Hard | 172-Hard | 510-Spring |
|-----------------------------|----------------------|----------|----------------------|----------|----------|------------|
| | Room Temperature | | | | | |
| .012 | .03 | .06 | .09 | .13 | .19 | .31 |
| .016 | .03 | .06 | .13 | .19 | .25 | .44 |
| .020 | .03 | .09 | .16 | .22 | .31 | .50 |
| .025 | .06 | .13 | .22 | .25 | .38 | .63 |
| .032 | .06 | .13 | .25 | .38 | .50 | .75 |
| .040 | .09 | .16 | .31 | .44 | .63 | 1.00 |
| .050 | .09 | .22 | .38 | .50 | .75 | 1.25 |
| .063 | .13 | .25 | .50 | .69 | 1.00 | 1.50 |
| .071 | .13 | .31 | .50 | .75 | 1.13 | 1.75 |
| .080 | .16 | .31 | .69 | .88 | 1.25 | 2.00 |
| .090 | .16 | .38 | .75 | 1.00 | 1.38 | -- |
| .100 | .19 | .44 | .75 | 1.13 | 1.50 | -- |
| .125 | .25 | .50 | 1.00 | 1.38 | 1.88 | -- |
| .160 | .31 | .69 | 1.25 | 1.75 | -- | -- |
| .190 | .38 | .88 | 1.50 | 2.00 | -- | -- |

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Table 5-11C. STANDARD BEND RADII - NICKEL ALLOYS

| Material Thickness (in.) | Inconel 718 - Ann. Monel - Ann. Room Temp. | Material Thickness (in.) | Inconel 718 - Ann. Monel - Ann. Room Temp. |
|--------------------------|--|--------------------------|--|
| .012 | .03 | .080 | .09 |
| .016 | .03 | .090 | .09 |
| .020 | .03 | .100 | .13 |
| .025 | .03 | .112 | .13 |
| .028 | .03 | .125 | .13 |
| .032 | .03 | .140 | .16 |
| .036 | .06 | .160 | .16 |
| .040 | .06 | .180 | .19 |
| .045 | .06 | .190 | .19 |
| .050 | .06 | .200 | .22 |
| .056 | .06 | .224 | .22 |
| .063 | .06 | .250 | .25 |
| .071 | .09 | | |

Table 5-11D. STANDARD BEND RADII - STAINLESS STEEL ALLOYS

| Material Thickness (in.) | A286-ST 301-Ann. 302-Ann. 304-Ann. 304L-Ann. 316-Ann. 316L-Ann. 321-Ann. 347-Ann. 410-Ann. | 15-5 PH-ST | 301-1/4H 302-1/4H | 301-1/2H 302-1/2H | 301-Hard 302-Hard | 410-H&T 15-5 PH-H1025 17-7 PH-Cond. C |
|--------------------------|---|------------|----------------------|----------------------|----------------------|---|
| | Room Temperature | | | | | |
| .012 | .03 | .03 | .03 | .03 | .09 | .13 |
| .016 | .03 | .03 | .03 | .03 | .09 | .13 |
| .020 | .03 | .03 | .03 | .06 | .13 | .16 |
| .025 | .03 | .03 | .06 | .06 | .16 | .16 |
| .028 | .03 | .03 | .06 | .09 | .16 | .25 |
| .032 | .03 | .03 | .06 | .09 | .16 | .25 |
| .036 | .03 | .06 | .09 | .09 | .19 | .25 |
| .040 | .06 | .06 | .09 | .09 | .22 | .31 |
| .045 | .06 | .06 | .09 | .13 | .25 | .34 |
| .050 | .06 | .06 | .09 | .13 | .25 | .38 |
| .056 | .06 | .06 | .13 | .16 | .31 | .47 |
| .063 | .06 | .09 | .13 | .16 | .31 | .50 |
| .071 | .09 | .09 | .16 | .19 | .38 | .56 |
| .080 | .09 | .13 | .16 | .19 | .41 | .63 |
| .090 | .09 | .16 | .16 | .22 | .47 | .75 |
| .100 | .13 | .19 | .19 | .25 | .50 | -- |
| .112 | .13 | .19 | .22 | .28 | .56 | -- |
| .125 | .13 | .22 | .25 | .31 | .62 | -- |
| .140 | .16 | .22 | .25 | .38 | .62 | -- |
| .160 | .16 | .25 | .31 | .38 | .78 | -- |
| .180 | .19 | .25 | .38 | .44 | .78 | -- |
| .190 | .19 | .34 | .38 | .44 | .94 | -- |
| .200 | .22 | .41 | .41 | .47 | 1.00 | -- |
| .224 | .22 | .44 | .44 | .53 | 1.13 | -- |
| .250 | .25 | .50 | .50 | .59 | 1.25 | -- |
| .313 | .31 | -- | -- | -- | -- | -- |
| .375 | .38 | -- | -- | -- | -- | -- |
| .500 | .50 | -- | -- | -- | -- | -- |

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Table 5-11E. STANDARD BEND RADII - STEEL ALLOYS

| Material Thickness (in.) | Low Carbon 1095-Ann. T-1 - Q&T 4340-Ann. | 4130-Norm. | HSLA - As Formed |
|-----------------------------|---|------------|---------------------|
| | Room Temperature | | |
| .012 | .03 | .06 | .06 |
| .016 | .03 | .06 | .06 |
| .020 | .06 | .06 | .09 |
| .025 | .06 | .06 | .09 |
| .028 | .06 | .09 | .13 |
| .032 | .06 | .09 | .13 |
| .036 | .09 | .12 | .13 |
| .040 | .09 | .12 | .16 |
| .045 | .09 | .12 | .16 |
| .050 | .13 | .12 | .16 |
| .056 | .13 | .16 | .19 |
| .063 | .13 | .16 | .22 |
| .071 | .16 | .22 | .25 |
| .080 | .16 | .22 | .28 |
| .090 | .19 | .25 | .31 |
| .100 | .22 | .28 | .34 |
| .112 | .22 | .28 | .38 |
| .125 | .25 | .31 | .41 |
| .140 | .28 | .38 | .47 |
| .160 | .31 | .41 | .56 |
| .180 | .38 | .47 | .63 |
| .188 | .38 | .47 | .63 |
| .200 | .41 | .50 | .69 |
| .224 | .44 | .56 | .75 |
| .250 | .50 | .62 | .88 |
| .313 | .63 | .78 | 1.25 |
| .375 | .75 | .94 | 1.50 |
| .500 | 1.00 | 1.25 | 2.00 |

Table 5-11F. STANDARD BEND RADII - TITANIUM ALLOYS

| Material Thickness (in.) | 6Al-4A - Ann. 6Al-4V - Ann. Material | |
|-----------------------------|---|-------------|
| | Room Temp. | 1200-1450°F |
| .012 | .09 | .02 |
| .016 | .09 | .03 |
| .020 | .13 | .04 |
| .025 | .16 | .05 |
| .028 | .16 | .06 |
| .032 | .19 | .06 |
| .036 | .22 | .07 |
| .040 | .25 | .08 |
| .045 | .25 | .09 |
| .050 | .28 | .10 |
| .056 | .31 | .11 |
| .063 | .38 | .13 |
| .071 | .38 | .18 |
| .080 | .47 | .20 |
| .090 | .50 | .22 |
| .100 | .56 | .25 |
| .112 | .63 | .28 |
| .125 | .72 | .31 |
| .140 | .88 | .42 |
| .160 | 1.00 | .48 |
| .180 | 1.13 | .54 |
| .190 | 1.25 | .57 |