

### 3.7.7 7178 ALLOY

3.7.7.0 *Comments and Properties.*—7178 is the highest strength Al-Zn-Mg-Cu alloy available in a variety of product forms.

Refer to Section 3.1.2.3 for comments regarding the resistance of the alloy to stress-corrosion cracking, and to Section 3.1.3.4 for comments regarding the weldability of the alloy. The T76-type temper provides for improved exfoliation and stress-corrosion resistance over T6-type temper with some decrease in strength.

Some material specifications for 7178 aluminum alloy are presented in Table 3.7.7.0(a). Room-temperature mechanical and physical properties are shown in Tables 3.7.7.0(b) through (e). The effect of temperature on the physical properties is shown in Figure 3.7.7.0.

TABLE 3.7.7.0(a). *Material Specifications for 7178 Aluminum Alloy*

| Specification   | Form                      |
|-----------------|---------------------------|
| QQ-A-250/14, 21 | Bare sheet and plate      |
| QQ-A-250/15, 22 | Clad sheet and plate      |
| QQ-A-200/13, 14 | Extrusion                 |
| QQ-A-250/28     | 7011 clad sheet and plate |

The temper index for 7178 is as follows:

| Section | Temper                            |
|---------|-----------------------------------|
| 3.7.7.1 | T6, T62, T651, T652, T6510, T6511 |
| 3.7.7.2 | T76, T7651, T76510, T76511        |

3.7.7.1 *T6, T62, T651, T652, T6510, T6511 Tempers.*—Elevated temperature curves are presented for various mechanical properties in Figures 3.7.7.1.1 and 3.7.7.1.5. Figures 3.7.7.1.6(a) through (l) present tensile and compressive stress-strain and tangent-modulus curves at room temperature for various products and tempers. Figures 3.7.7.1.6(m) and (n) are full-range stress-strain curves for extrusions at room temperature.



TABLE 3.7.7.0(c). Design Mechanical and Physical Properties of Clad 7178 Aluminum Alloy Sheet and Plate

| Specification<br>Form<br>Temper              | QQ-A-250/15 and QQ-A-250/22<br>Sheet and Plate |     |                 |     |                 |     |                 |     |                 |     |                              |     |                              |     |                              |     |                 |     |                 |     |
|--|--|-----|-----------------|-----|-----------------|-----|-----------------|-----|-----------------|-----|------------------------------|-----|------------------------------|-----|------------------------------|-----|-----------------|-----|-----------------|-----|
|  | T6 and T62 <sup>c</sup>                        |     |                 |     |                 |     |                 |     |                 |     | T651 and T62 <sup>c</sup>    |     |                              |     |                              |     |                 |     |                 |     |
|  | 0.015-<br>0.044                                |     | 0.045-<br>0.062 |     | 0.063-<br>0.187 |     | 0.188-<br>0.249 |     | 0.250-<br>0.499 |     | 0.500-<br>1.000 <sup>a</sup> |     | 1.001-<br>1.500 <sup>a</sup> |     | 1.501-<br>2.000 <sup>a</sup> |     | 0.045-<br>0.062 |     | 0.063-<br>0.187 |     |
|  | A  | B   | A               | B   | A               | B   | A               | B   | A               | B   | A                            | B   | A                            | B   | A                            | B   | S               | S   | S               | S   |
| Thickness, in. ....                          | 76   | 78  | 78              | 80  | 80              | 82  | 82              | 84  | 81              | 83  | 81                           | 83  | 81                           | 83  | 77                           | 78  | 69              | 70  | 70              | 72  |
| Basis .....                                  | 76   | 78  | 78              | 80  | 80              | 82  | 82              | 84  | 81              | 83  | 81                           | 83  | 81                           | 83  | 77                           | 78  | 69              | 70  | 70              | 72  |
| Mechanical properties:                       |  |     |                 |     |                 |     |                 |     |                 |     |                              |     |                              |     |                              |     |                 |     |                 |     |
| $F_{tu}$ , ksi:                              |  |     |                 |     |                 |     |                 |     |                 |     |                              |     |                              |     |                              |     |                 |     |                 |     |
| L .....                                      | 67   | 69  | 69              | 71  | 71              | 73  | 72              | 74  | 71              | 73  | 71                           | 73  | 71                           | 73  | 67                           | 68  | 60              | 61  | 62              | 60  |
| LT .....                                     | 66   | 68  | 68              | 70  | 70              | 72  | 71              | 73  | 71              | 73  | 71                           | 73  | 71                           | 73  | 68                           | 69  | 59              | 60  | 61              | 60  |
| $F_{ty}$ , ksi:                              |  |     |                 |     |                 |     |                 |     |                 |     |                              |     |                              |     |                              |     |                 |     |                 |     |
| L .....                                      | 67   | 69  | 69              | 71  | 71              | 73  | 72              | 74  | 71              | 73  | 71                           | 73  | 71                           | 73  | 68                           | 69  | 60              | 61  | 62              | 60  |
| LT .....                                     | 66   | 68  | 68              | 70  | 70              | 72  | 71              | 73  | 71              | 73  | 71                           | 73  | 71                           | 73  | 68                           | 69  | 59              | 60  | 61              | 60  |
| $F_{cy}$ , ksi:                              |  |     |                 |     |                 |     |                 |     |                 |     |                              |     |                              |     |                              |     |                 |     |                 |     |
| L .....                                      | 67   | 69  | 69              | 71  | 71              | 73  | 72              | 74  | 71              | 73  | 71                           | 73  | 71                           | 73  | 68                           | 69  | 60              | 61  | 62              | 60  |
| LT .....                                     | 66   | 68  | 68              | 70  | 70              | 72  | 71              | 73  | 71              | 73  | 71                           | 73  | 71                           | 73  | 68                           | 69  | 59              | 60  | 61              | 60  |
| $F_{su}$ , ksi:                              |  |     |                 |     |                 |     |                 |     |                 |     |                              |     |                              |     |                              |     |                 |     |                 |     |
| L .....                                      | 45   | 47  | 47              | 48  | 48              | 49  | 49              | 50  | 47              | 48  | 45                           | 46  | 42                           | 43  | 37                           | 41  | 42              | 43  | 42              | 42  |
| $F_{bu}$ <sup>b</sup> , ksi:                 |  |     |                 |     |                 |     |                 |     |                 |     |                              |     |                              |     |                              |     |                 |     |                 |     |
| (e/D=1.5) .....                              | 118  | 121 | 121             | 124 | 124             | 127 | 127             | 130 | 125             | 128 | 121                          | 124 | 115                          | 118 | 104                          | 108 | 110             | 110 | 113             | 112 |
| (e/D=2.0) .....                              | 152  | 156 | 156             | 160 | 160             | 164 | 164             | 168 | 154             | 158 | 148                          | 152 | 140                          | 143 | 126                          | 140 | 142             | 146 | 146             | 144 |
| $F_{br}$ <sup>b</sup> , ksi:                 |  |     |                 |     |                 |     |                 |     |                 |     |                              |     |                              |     |                              |     |                 |     |                 |     |
| (e/D=1.5) .....                              | 99   | 102 | 102             | 105 | 105             | 108 | 106             | 109 | 107             | 110 | 104                          | 106 | 98                           | 101 | 89                           | 91  | 93              | 95  | 95              | 93  |
| (e/D=2.0) .....                              | 115  | 119 | 119             | 122 | 122             | 126 | 124             | 128 | 127             | 130 | 122                          | 126 | 116                          | 120 | 106                          | 106 | 108             | 110 | 110             | 108 |
| $\epsilon$ , percent (S-basis):              |  |     |                 |     |                 |     |                 |     |                 |     |                              |     |                              |     |                              |     |                 |     |                 |     |
| L .....                                      | 7  | ... | ...             | ... | ...             | ... | ...             | ... | ...             | ... | ...                          | ... | ...                          | ... | ...                          | ... | ...             | ... | ...             | ... |
| LT .....                                     | 7  | ... | ...             | ... | ...             | ... | ...             | ... | ...             | ... | ...                          | ... | ...                          | ... | ...                          | ... | ...             | ... | ...             | ... |
| $E$ , 10 <sup>3</sup> ksi:                   |  |     |                 |     |                 |     |                 |     |                 |     |                              |     |                              |     |                              |     |                 |     |                 |     |
| Primary .....                                | 10.3   | ... | ...             | ... | ...             | ... | ...             | ... | ...             | ... | ...                          | ... | ...                          | ... | ...                          | ... | ...             | ... | ...             | ... |
| Secondary .....                              | 9.5  | ... | ...             | ... | ...             | ... | ...             | ... | ...             | ... | ...                          | ... | ...                          | ... | ...                          | ... | ...             | ... | ...             | ... |
| $E_c$ , 10 <sup>3</sup> ksi:                 |  |     |                 |     |                 |     |                 |     |                 |     |                              |     |                              |     |                              |     |                 |     |                 |     |
| Primary .....                                | 10.5   | ... | ...             | ... | ...             | ... | ...             | ... | ...             | ... | ...                          | ... | ...                          | ... | ...                          | ... | ...             | ... | ...             | ... |
| Secondary .....                              | 9.7  | ... | ...             | ... | ...             | ... | ...             | ... | ...             | ... | ...                          | ... | ...                          | ... | ...                          | ... | ...             | ... | ...             | ... |
| $G$ , 10 <sup>3</sup> ksi:                   |  |     |                 |     |                 |     |                 |     |                 |     |                              |     |                              |     |                              |     |                 |     |                 |     |
| $\mu$ .....                                  | 0.33   | ... | ...             | ... | ...             | ... | ...             | ... | ...             | ... | ...                          | ... | ...                          | ... | ...                          | ... | ...             | ... | ...             | ... |
| Physical properties:                         |  |     |                 |     |                 |     |                 |     |                 |     |                              |     |                              |     |                              |     |                 |     |                 |     |
| $\omega$ , lb/in. <sup>3</sup> .....         | 0.102  | ... | ...             | ... | ...             | ... | ...             | ... | ...             | ... | ...                          | ... | ...                          | ... | ...                          | ... | ...             | ... | ...             | ... |
| $C$ , Btu/(lb)(F) .....                      | ...  | ... | ...             | ... | ...             | ... | ...             | ... | ...             | ... | ...                          | ... | ...                          | ... | ...                          | ... | ...             | ... | ...             | ... |
| $K$ , Btu/(hr)(ft <sup>2</sup> )(F/ft) ..... | ...  | ... | ...             | ... | ...             | ... | ...             | ... | ...             | ... | ...                          | ... | ...                          | ... | ...                          | ... | ...             | ... | ...             | ... |
| $\alpha$ , 10 <sup>-6</sup> in./in./F .....  | ...  | ... | ...             | ... | ...             | ... | ...             | ... | ...             | ... | ...                          | ... | ...                          | ... | ...                          | ... | ...             | ... | ...             | ... |

<sup>a</sup>These values have been adjusted to represent the average properties across the whole section, including the 1-1/2 percent per side nominal cladding thickness.

<sup>b</sup>See Table 3.1.2.1.1. Bearing values are "dry pin" values per Section 1.4.7.1.

<sup>c</sup>The allowable shown for these tempers are based on and have been determined from the results obtained on testing of T6 and T651 temper material and on the testing of T62 temper samples for specification conformance. These allowables also apply when samples of material supplied in the O or F temper are heat treated to demonstrate response to heat treatment. Properties obtained by the user, however, may be lower than those listed if the material has been formed or otherwise cold or hot worked, particularly in the annealed temper, prior to solution heat treatment.

TABLE 3.7.7.0(d). Design Mechanical Properties of 7011 Clad 7178 Aluminum Alloy Sheet and Plate

| Specification<br>Form<br>Temper<br>Thickness, in.<br>Basis | QQ-A-00250/28           |                      |                      |                      |                      |                                   |   |                                   |                      |                      |                      |   |
|--|-------------------------|----------------------|----------------------|----------------------|----------------------|-----------------------------------|---|-----------------------------------|----------------------|----------------------|----------------------|---|
|  | Sheet                   |                      |                      |                      |                      |                                   | Plate                                       |                                   |                      |                      |                      |   |
|  | T6 and T62 <sup>a</sup> |                      |                      |                      |                      |                                   | T651 and T62 <sup>a</sup>                   |                                   |                      |                      |                      |   |
|  | 0.015-<br>0.044<br>S    | 0.045-<br>0.062<br>S | 0.063-<br>0.187<br>S | 0.188-<br>0.249<br>S | 0.250-<br>0.499<br>S | 0.500-<br>1.000 <sup>b</sup><br>S | 0.500-<br>1.001-<br>1.500 <sup>b</sup><br>S | 1.501-<br>2.000 <sup>b</sup><br>S | 0.045-<br>0.062<br>S | 0.063-<br>0.187<br>S | 0.188-<br>0.249<br>S | 0.250-<br>0.500-<br>1.000 <sup>b</sup><br>S |
| Mechanical properties:                                     |                         |                      |                      |                      |                      |                                   |   |                                   |                      |                      |                      |   |
| $F_{tu}$ , ksi:  |                         |                      |                      |                      |                      |                                   |   |                                   |                      |                      |                      |   |
| L  | 79                      | 81                   | 82                   | 83                   | 82                   | 82                                | 82  | 82                                | 78                   | 73                   | 74                   | 73  |
| LT   | 79                      | 81                   | 82                   | 83                   | 83                   | 83                                | 83  | 83                                | 79                   | 73                   | 74                   | 73  |
| $F_{ty}$ , ksi:  |                         |                      |                      |                      |                      |                                   |   |                                   |                      |                      |                      |   |
| L  | 70                      | 71                   | 72                   | 73                   | 73                   | 72                                | 72  | 72                                | 69                   | 62                   | 63                   | 61  |
| LT   | 69                      | 70                   | 71                   | 72                   | 72                   | 72                                | 72  | 72                                | 69                   | 62                   | 63                   | 61  |
| $F_{cy}$ , ksi:  |                         |                      |                      |                      |                      |                                   |   |                                   |                      |                      |                      |   |
| L  | 70                      | 71                   | 72                   | 73                   | 72                   | 71                                | 71  | 71                                | 68                   | ...                  | ...                  | ...   |
| LT   | 74                      | 75                   | 76                   | 77                   | 76                   | 75                                | 74  | 74                                | 70                   | ...                  | ...                  | ...   |
| $F_{su}$ , ksi:  |                         |                      |                      |                      |                      |                                   |   |                                   |                      |                      |                      |   |
| $F_{bru}$ , ksi:   | 47                      | 48                   | 49                   | 50                   | 48                   | 46                                | 42  | 37                                | ...                  | ...                  | ...                  | ...   |
| (e/D=1.5)  | 118                     | 121                  | 123                  | 124                  | 127                  | 122                               | 116   | 105                               | ...                  | ...                  | ...                  | ...   |
| (e/D=2.0)  | 150                     | 154                  | 156                  | 158                  | 156                  | 150                               | 141   | 127                               | ...                  | ...                  | ...                  | ...   |
| $F_{bry}$ , ksi:   |                         |                      |                      |                      |                      |                                   |   |                                   |                      |                      |                      |   |
| (e/D=1.5)  | 97                      | 98                   | 99                   | 101                  | 109                  | 108                               | 99  | 91                                | ...                  | ...                  | ...                  | ...   |
| (e/D=2.0)  | 110                     | 112                  | 114                  | 115                  | 128                  | 124                               | 118   | 107                               | ...                  | ...                  | ...                  | ...   |
| e, percent:  |                         |                      |                      |                      |                      |                                   |   |                                   |                      |                      |                      |   |
| L  | ...                     | ...                  | ...                  | ...                  | ...                  | ...                               | ...   | ...                               | ...                  | ...                  | ...                  | ...   |
| LT   | 7                       | 8                    | 8                    | 8                    | 8                    | 6                                 | 4   | 3                                 | 8                    | 8                    | 8                    | 6   |
| $E$ , 10 <sup>3</sup> ksi                                  | ...                     | 10.3                 | ...                  | ...                  | ...                  | 10.3                              | ...   | ...                               | 10.3                 | ...                  | ...                  | 10.3  |
| $E_c$ , 10 <sup>3</sup> ksi                                | ...                     | 10.5                 | ...                  | ...                  | ...                  | 10.6                              | ...   | ...                               | 10.5                 | ...                  | ...                  | 10.6  |
| $G$ , 10 <sup>3</sup> ksi                                  | ...                     | 3.9                  | ...                  | ...                  | ...                  | 3.9                               | ...   | ...                               | 3.9                  | ...                  | ...                  | 3.9   |
| $\mu$  | ...                     | 0.33                 | ...                  | ...                  | ...                  | 0.33                              | ...   | ...                               | 0.33                 | ...                  | ...                  | 0.33  |
| Physical properties:                                       |                         |                      |                      |                      |                      |                                   |   |                                   |                      |                      |                      |   |
| $\omega$ , lb/in. <sup>3</sup>                             | ...                     | ...                  | ...                  | ...                  | ...                  | ...                               | ...   | ...                               | ...                  | ...                  | ...                  | ...   |
| C, Btu/(lb)(F)   | ...                     | ...                  | ...                  | ...                  | ...                  | ...                               | ...   | ...                               | ...                  | ...                  | ...                  | ...   |
| K, Btu/[in. <sup>2</sup> (ft)(F)/ft]                       | ...                     | ...                  | ...                  | ...                  | ...                  | ...                               | ...   | ...                               | ...                  | ...                  | ...                  | ...   |
| $\alpha$ , 10 <sup>-4</sup> in./in./F                      | ...                     | ...                  | ...                  | ...                  | ...                  | ...                               | ...   | ...                               | ...                  | ...                  | ...                  | ...   |

<sup>a</sup>The allowables shown for these tempers are based on and have been determined from the results obtained on testing of T6 and T651 temper material and on the testing of T62 temper samples for specification conformance. These allowables also apply when samples of material supplied in the O or F temper are heat treated to demonstrate response to heat treatment. Properties obtained by the user, however, may be lower than those listed if the material has been formed or otherwise cold or hot worked, particularly in the annealed temper, prior to solution heat treatment.

<sup>b</sup>These values have been adjusted to represent the average properties across the whole section, including the 1-1/2 percent per side nominal cladding thickness.

<sup>c</sup>See Table 3.1.2.1.1. Bearing values are "dry pin" values per Section 1.4.7.1.

TABLE 3.7.7.0(e<sub>1</sub>). Design Mechanical and Physical Properties of 7178 Aluminum Alloy Extrusion

| Specification<br>Form<br>Temper  | QQ-A-200/13                   |                 |                 |                 |                 |                 |                 |            |                  |                 |                 |                 |            |                        |            |                        |
|--|-------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|------------|------------------|-----------------|-----------------|-----------------|------------|------------------------|------------|------------------------|
|  | Extruded rod, bar, and shapes |                 |                 |                 |                 |                 |                 |            |                  |                 |                 |                 |            |                        |            |                        |
|  | 16, T6510 and T6511           |                 |                 |                 |                 |                 |                 |            | T62 <sup>a</sup> |                 |                 |                 |            |                        |            |                        |
| Cross-sectional area, in. <sup>2</sup><br>Thickness, in. <sup>b</sup><br>Basis | <20                           |                 |                 |                 | <25             |                 |                 |            | <20              |                 |                 |                 | <25        |                        |            |                        |
|  | Up to<br>0.061                | 0.062-<br>0.249 | 0.250-<br>0.499 | 0.500-<br>0.749 | 0.750-<br>1.499 | 1.500-<br>2.499 | 2.500-<br>2.999 | >25<br><32 | Up to<br>0.061   | 0.062-<br>0.249 | 0.250-<br>1.499 | 1.500-<br>2.499 | >25<br><32 | <25<br>1.500-<br>2.499 | >25<br><32 | <25<br>1.500-<br>2.999 |
|  | A B                           | A B             | A B             | A B             | A B             | A B             | A B             | S          | A B              | A B             | A B             | A B             | S          | S                      | S          | S                      |
| Mechanical properties:   |                               |                 |                 |                 |                 |                 |                 |            |                  |                 |                 |                 |            |                        |            |                        |
| $F_{tu}$ , ksi:  |                               |                 |                 |                 |                 |                 |                 |            |                  |                 |                 |                 |            |                        |            |                        |
| L  | 82 86                         | 84 88           | 87 90           | 87 90           | 87 90           | 86 90           | 84 86           | 84         | 79               | 82              | 86              | 86              | 84         | 86                     | 84         | 82                     |
| LT   | 79 83                         | 80 84           | 82 85           | 81 84           | 79 82           | 74              | 74              | ...        | ...              | ...             | ...             | ...             | ...        | ...                    | ...        | ...                    |
| $F_{ty}$ , ksi:  |                               |                 |                 |                 |                 |                 |                 |            |                  |                 |                 |                 |            |                        |            |                        |
| L  | 76 80                         | 76 80           | 78 81           | 78 81           | 78 81           | 77 81           | 77 81           | 75         | 73               | 74              | 77              | 77              | 75         | 77                     | 75         | 71                     |
| LT   | 71 75                         | 71 75           | 72 75           | 71 74           | 69 71           | 64              | 64              | ...        | ...              | ...             | ...             | ...             | ...        | ...                    | ...        | ...                    |
| $F_{cy}$ , ksi:  |                               |                 |                 |                 |                 |                 |                 |            |                  |                 |                 |                 |            |                        |            |                        |
| L  | 76 80                         | 75 78           | 77 79           | 77 79           | 77 79           | 76 79           | 76 79           | ...        | ...              | ...             | ...             | ...             | ...        | ...                    | ...        | ...                    |
| LT   | 76 80                         | 78 82           | 79 82           | 78 81           | 77 80           | 72              | 72              | ...        | ...              | ...             | ...             | ...             | ...        | ...                    | ...        | ...                    |
| $F_{su}$ , ksi:  |                               |                 |                 |                 |                 |                 |                 |            |                  |                 |                 |                 |            |                        |            |                        |
| L  | 44 46                         | 42 44           | 44 45           | 44 45           | 44 45           | 43              | 43              | ...        | ...              | ...             | ...             | ...             | ...        | ...                    | ...        | ...                    |
| $F_{bu}^c$ , ksi:  |                               |                 |                 |                 |                 |                 |                 |            |                  |                 |                 |                 |            |                        |            |                        |
| (e/D=1.5)  | 107 112                       | 120 126         | 124 128         | 123 127         | 121 126         | 117             | 117             | ...        | ...              | ...             | ...             | ...             | ...        | ...                    | ...        | ...                    |
| (e/D=2.0)  | 131 138                       | 150 157         | 154 160         | 154 159         | 152 157         | 147             | 147             | ...        | ...              | ...             | ...             | ...             | ...        | ...                    | ...        | ...                    |
| $F_{br}^c$ , ksi:  |                               |                 |                 |                 |                 |                 |                 |            |                  |                 |                 |                 |            |                        |            |                        |
| (e/D=1.5)  | 99 104                        | 99 104          | 102 106         | 102 106         | 102 106         | 101             | 101             | ...        | ...              | ...             | ...             | ...             | ...        | ...                    | ...        | ...                    |
| (e/D=2.0)  | 106 112                       | 116 122         | 119 123         | 119 123         | 119 123         | 117             | 117             | ...        | ...              | ...             | ...             | ...             | ...        | ...                    | ...        | ...                    |
| $e$ , percent (S-basis):   |                               |                 |                 |                 |                 |                 |                 |            |                  |                 |                 |                 |            |                        |            |                        |
| L  | 5                             | 5               | 5               | 5               | 5               | 5               | 5               | 5          | 5                | 5               | 5               | 5               | 5          | 5                      | 5          | 5                      |
| $E$ , 10 <sup>3</sup> ksi  |                               |                 |                 |                 |                 |                 |                 |            |                  |                 |                 |                 |            |                        |            |                        |
| $E_c$ , 10 <sup>3</sup> ksi  |                               |                 |                 |                 |                 |                 |                 |            |                  |                 |                 |                 |            |                        |            |                        |
| $G$ , 10 <sup>3</sup> ksi  |                               |                 |                 |                 |                 |                 |                 |            |                  |                 |                 |                 |            |                        |            |                        |
| $\mu$  |                               |                 |                 |                 |                 |                 |                 |            |                  |                 |                 |                 |            |                        |            |                        |
| Physical properties:   |                               |                 |                 |                 |                 |                 |                 |            |                  |                 |                 |                 |            |                        |            |                        |
| $\omega$ , lb/in. <sup>3</sup>   |                               |                 |                 |                 |                 |                 |                 |            |                  |                 |                 |                 |            |                        |            |                        |
| $C$ , Btu/(lb)(F)  |                               |                 |                 |                 |                 |                 |                 |            |                  |                 |                 |                 |            |                        |            |                        |
| $K$ , Btu/(hr)(ft <sup>2</sup> )(F/ft)   |                               |                 |                 |                 |                 |                 |                 |            |                  |                 |                 |                 |            |                        |            |                        |
| $\alpha$ , 10 <sup>-6</sup> in./in./F  |                               |                 |                 |                 |                 |                 |                 |            |                  |                 |                 |                 |            |                        |            |                        |

<sup>a</sup>These properties apply when samples of material supplied in the O or F temper are heat treated to demonstrate response to heat treatment. Properties obtained by the user, however, may be lower than those listed if the material has been formed or otherwise cold or hot worked, particularly in the annealed temper, prior to solution heat treatment.

<sup>b</sup>For extrusions with outstanding legs, the load carrying ability of such legs shall be determined on the basis of the properties in the appropriate column corresponding to the leg thickness.

<sup>c</sup>Bearing values are "dry pin" values per Section 1.4.7.1.

TABLE 3.7.7.0(e<sub>2</sub>). *Design Mechanical and Physical Properties of 7178 Aluminum Alloy Extrusion—Continued*

|  |                               |             |             |             |
|--|-------------------------------|-------------|-------------|-------------|
| Specification .....                                  | QQ-A-00200/14                 |             |             |             |
| Form .....   | Extruded bar, rod, and shapes |             |             |             |
| Temper .....   | T76, T76510, T76511           |             |             |             |
| Cross-Sectional Area, in. <sup>2</sup> .....         | ≤ 20                          |             |             |             |
| Thickness <sup>a</sup> , in. ....                    | 0.125-0.249                   | 0.250-0.499 | 0.500-0.749 | 0.750-1.000 |
| Basis .....  | S                             | S           | S           | S           |
| Mechanical properties:                               |                               |             |             |             |
| <i>F<sub>tu</sub></i> , ksi:                         |                               |             |             |             |
| L .....  | 76                            | 77          | 77          | 77          |
| LT .....   | 74                            | 74          | 72          | 71          |
| <i>F<sub>ty</sub></i> , ksi:                         |                               |             |             |             |
| L .....  | 66                            | 67          | 67          | 67          |
| LT .....   | 63                            | 63          | 62          | 61          |
| <i>F<sub>cy</sub></i> , ksi:                         |                               |             |             |             |
| L .....  | 67                            | 68          | 67          | 67          |
| LT .....   | 69                            | 69          | 68          | 67          |
| <i>F<sub>su</sub></i> , ksi .....                    | 42                            | 43          | 43          | 43          |
| <i>F<sub>bru</sub></i> <sup>b</sup> , ksi:           |                               |             |             |             |
| (e/D=1.5) .....                                      | 113                           | 114         | 113         | 112         |
| (e/D=2.0) .....                                      | 140                           | 141         | 140         | 139         |
| <i>F<sub>bry</sub></i> <sup>b</sup> , ksi:           |                               |             |             |             |
| (e/D=1.5) .....                                      | 90                            | 92          | 92          | 92          |
| (e/D=2.0) .....                                      | 106                           | 107         | 107         | 107         |
| <i>e</i> , percent:                                  |                               |             |             |             |
| L .....  | 7                             | 7           | 7           | 7           |
| <i>E</i> , 10 <sup>3</sup> ksi .....                 | 10.4                          |             |             |             |
| <i>E<sub>c</sub></i> , 10 <sup>3</sup> ksi .....     | 10.7                          |             |             |             |
| <i>G</i> , 10 <sup>3</sup> ksi .....                 | 4.0                           |             |             |             |
| <i>μ</i> .....                                       | 0.33                          |             |             |             |
| Physical properties:                                 |                               |             |             |             |
| <i>ω</i> , lb/in. <sup>3</sup> .....                 | 0.102                         |             |             |             |
| <i>C</i> , Btu/(lb)(F) .....                         | See Figure 3.7.7.0            |             |             |             |
| <i>K</i> , Btu/[ (hr)(ft <sup>2</sup> )(F)/ft] ..... | See Figure 3.7.7.0            |             |             |             |
| <i>α</i> , 10 <sup>-6</sup> in./in./F .....          | See Figure 3.7.7.0            |             |             |             |

<sup>a</sup>For extrusions with outstanding legs, the load carrying ability of such legs shall be determined on the basis of the properties in the appropriate column corresponding to the leg thickness.

<sup>b</sup>Bearing values are "dry pin" values per Section 1.4.7.1.

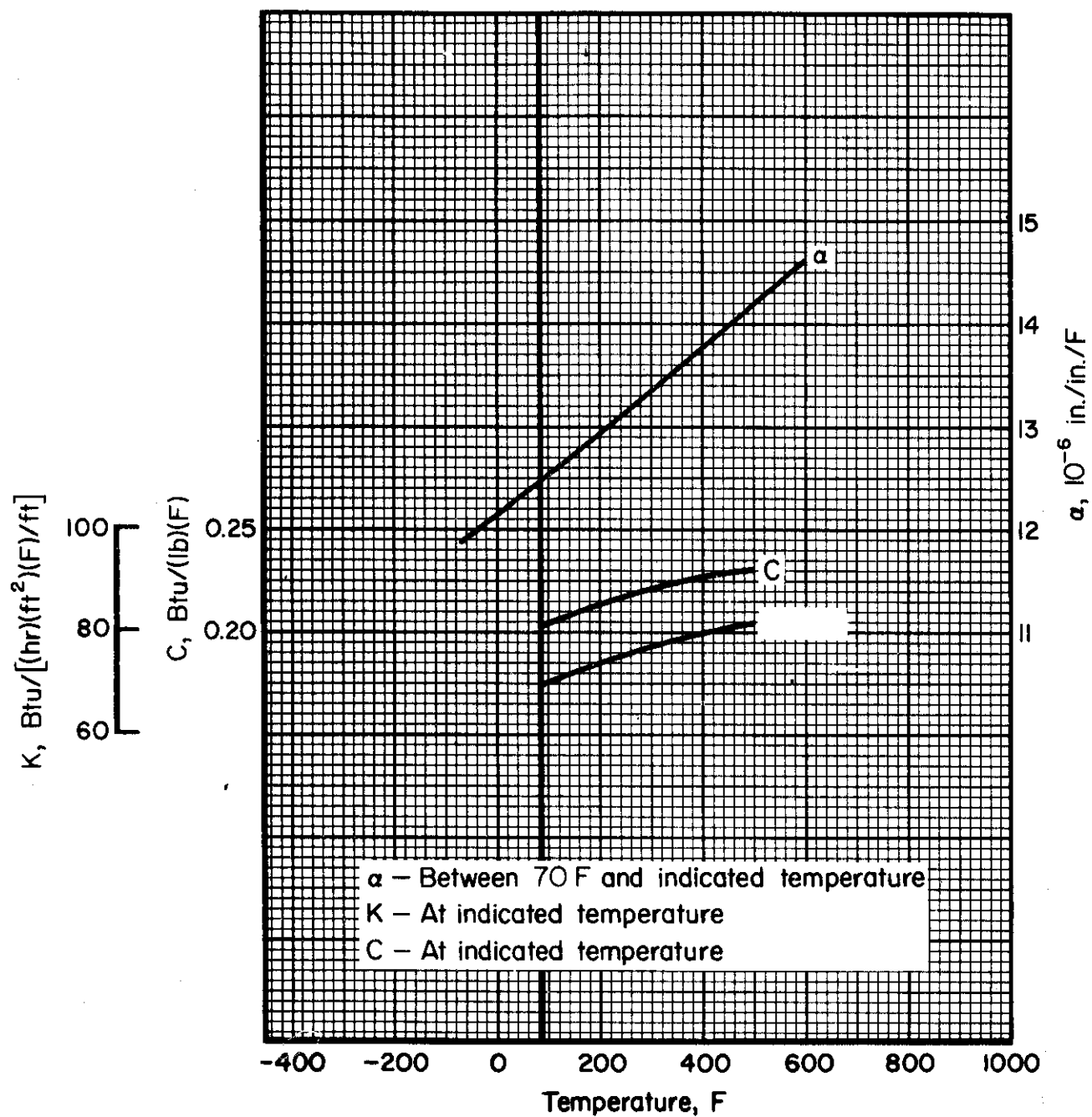


FIGURE 3.7.7.0. Effect of temperature on the physical properties of 7178 aluminum alloy.

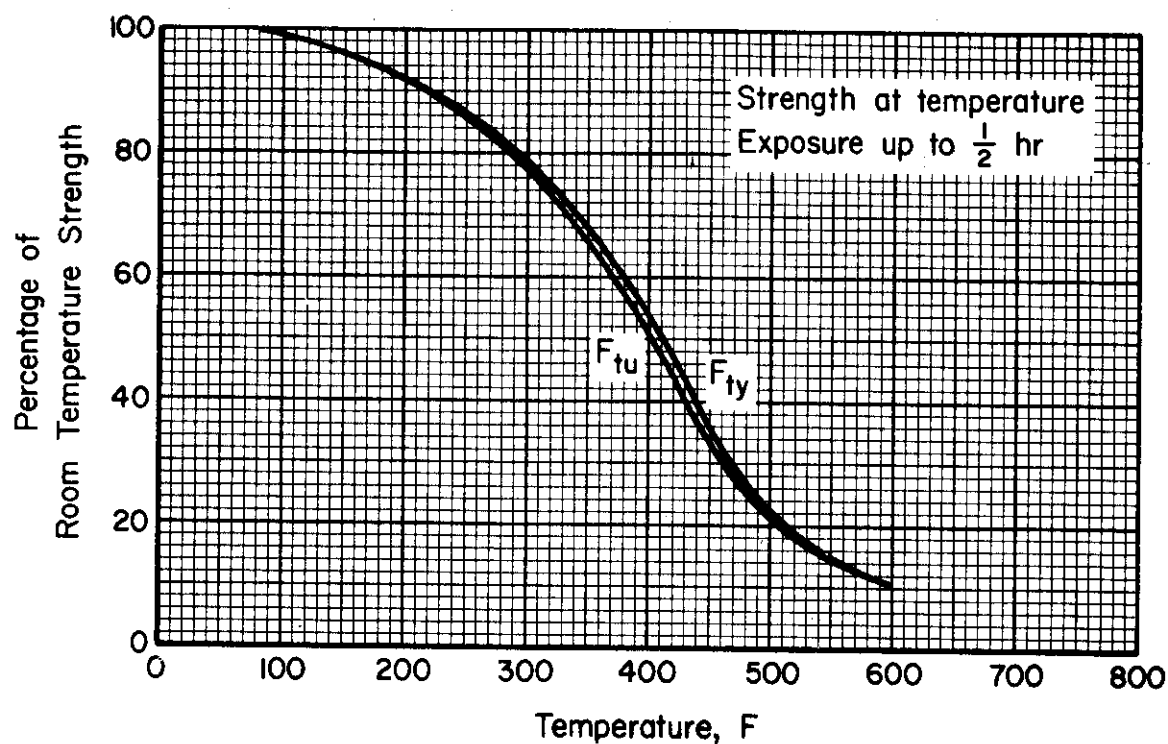


FIGURE 3.7.7.1.1. Effect of temperature on the tensile ultimate strength ( $F_{tu}$ ) and the tensile yield strength ( $F_{ty}$ ) of 7178-T6 aluminum alloy.

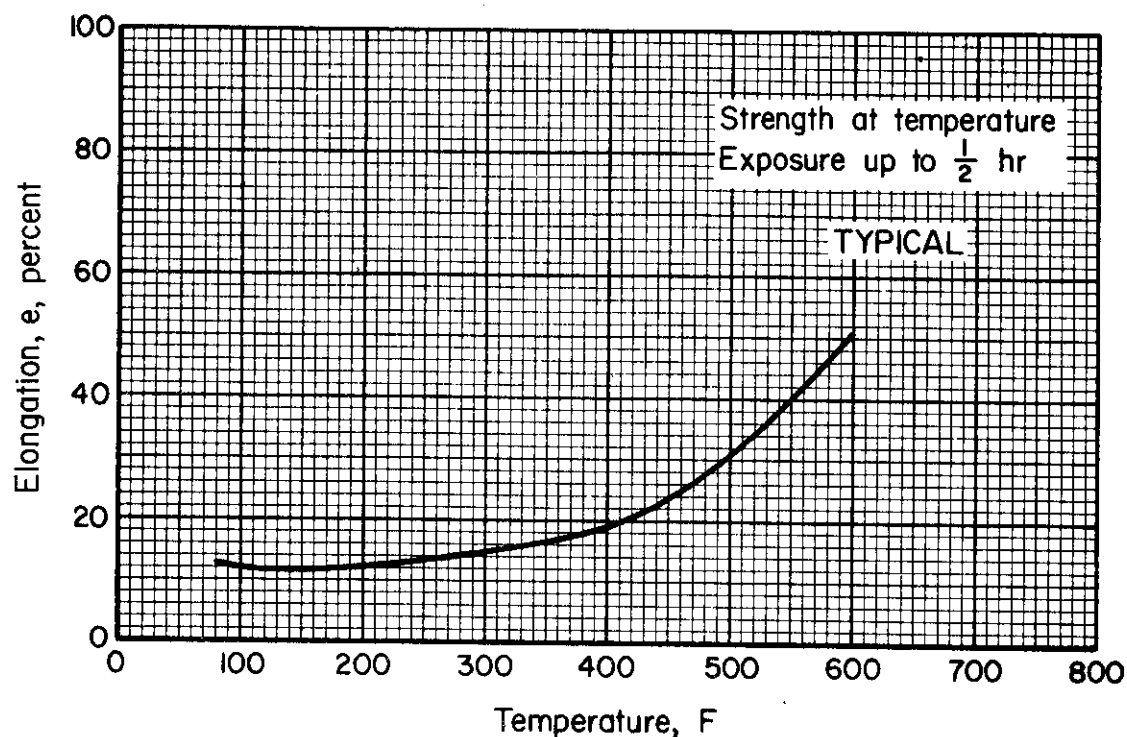


FIGURE 3.7.7.1.5. Effect of temperature on the elongation ( $e$ ) of 7178-T6 aluminum alloy.



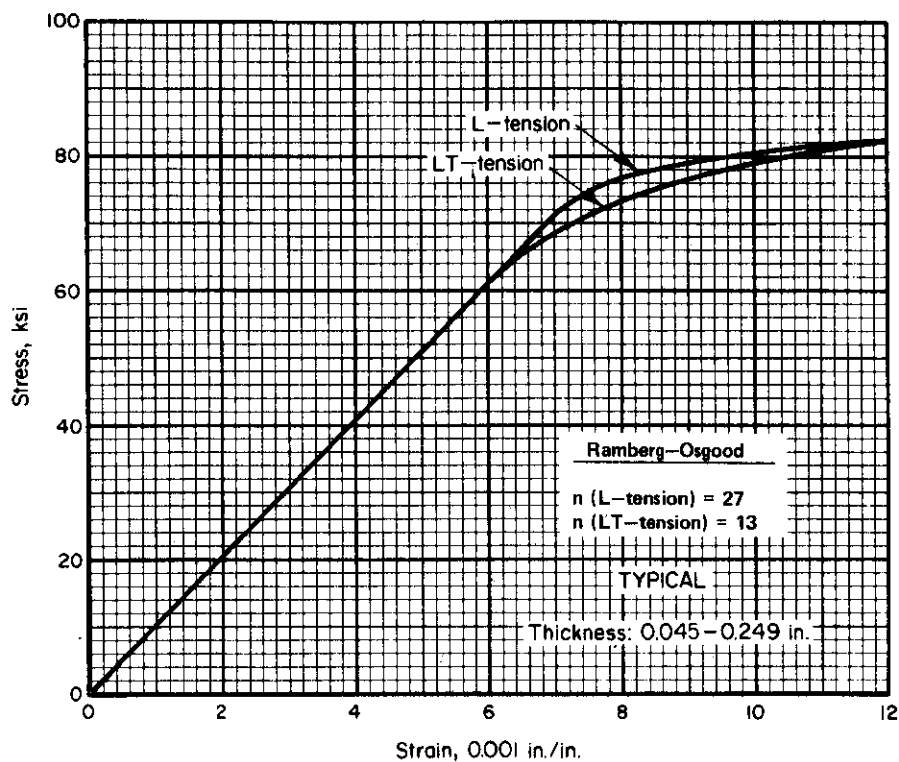


FIGURE 3.7.7.1.6(a). Typical tensile stress-strain curves for 7178-T6 aluminum alloy sheet at room temperature.

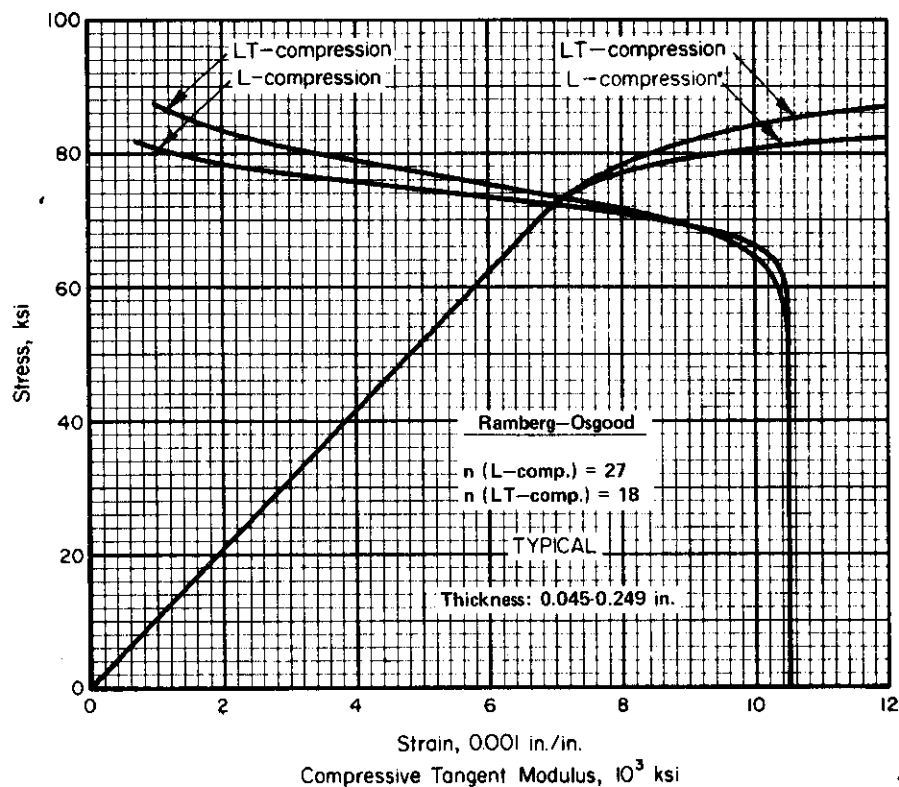


FIGURE 3.7.7.1.6(b). Typical compressive stress-strain and compressive tangent-modulus curves for 7178-T6 aluminum alloy sheet at room temperature.

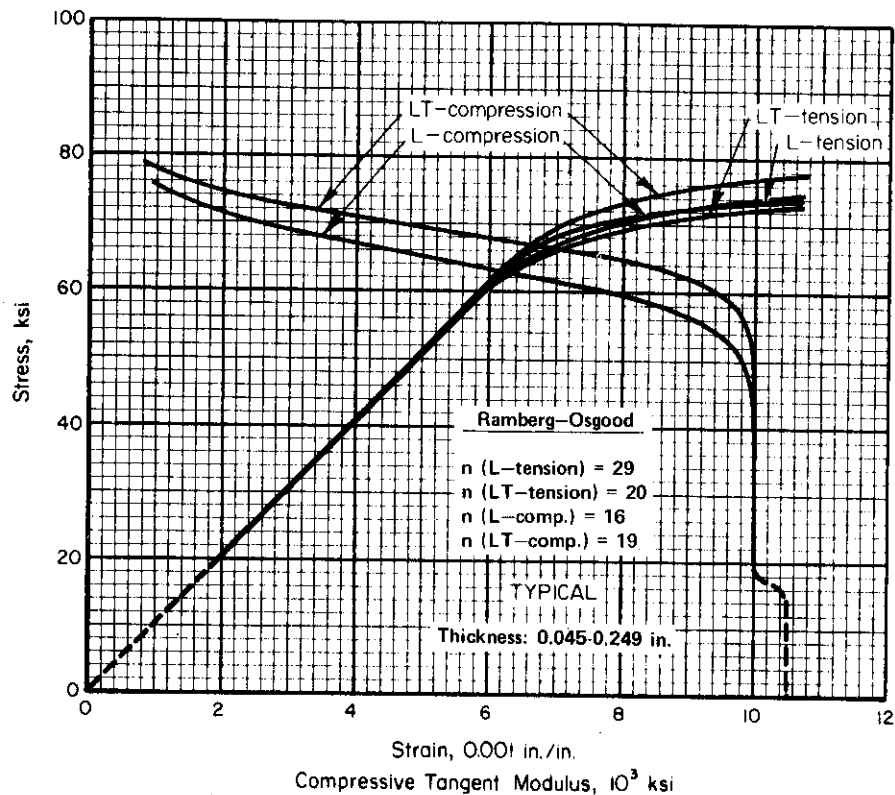


FIGURE 3.7.7.1.6(c). Typical stress-strain and compressive tangent-modulus curves for clad 7178-T6 aluminum alloy sheet at room temperature.

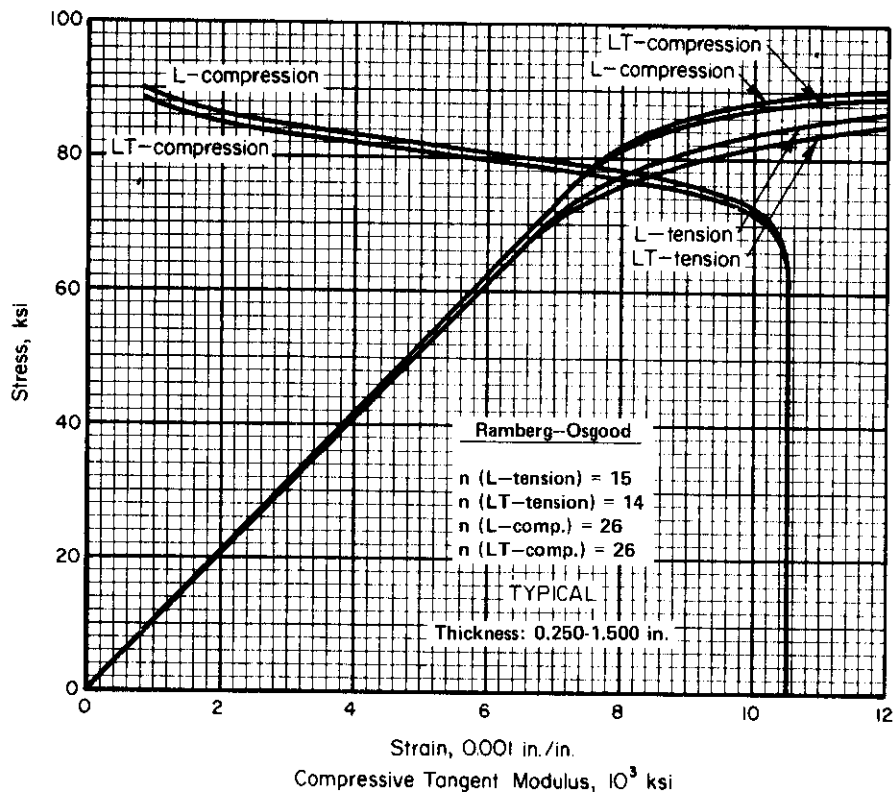


FIGURE 3.7.7.1.6(d). Typical tensile and compressive stress-strain and compressive tangent-modulus curves for 7178-T62 aluminum alloy plate at room temperature.

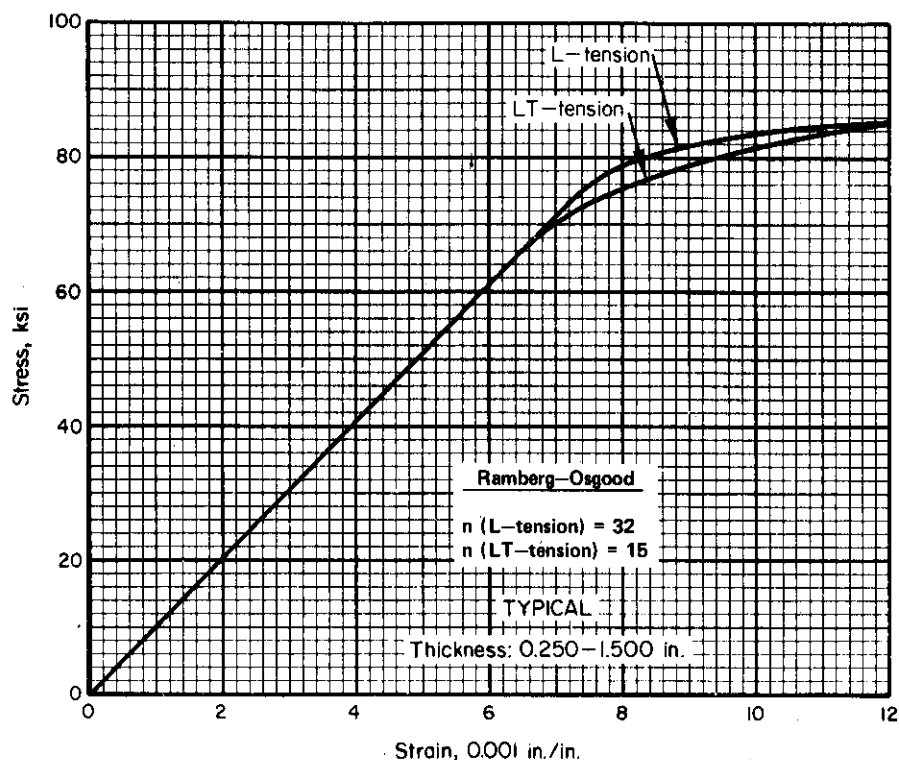


FIGURE 3.7.7.1.6(e). Typical tensile stress-strain curves for 7178-T651 aluminum alloy plate at room temperature.

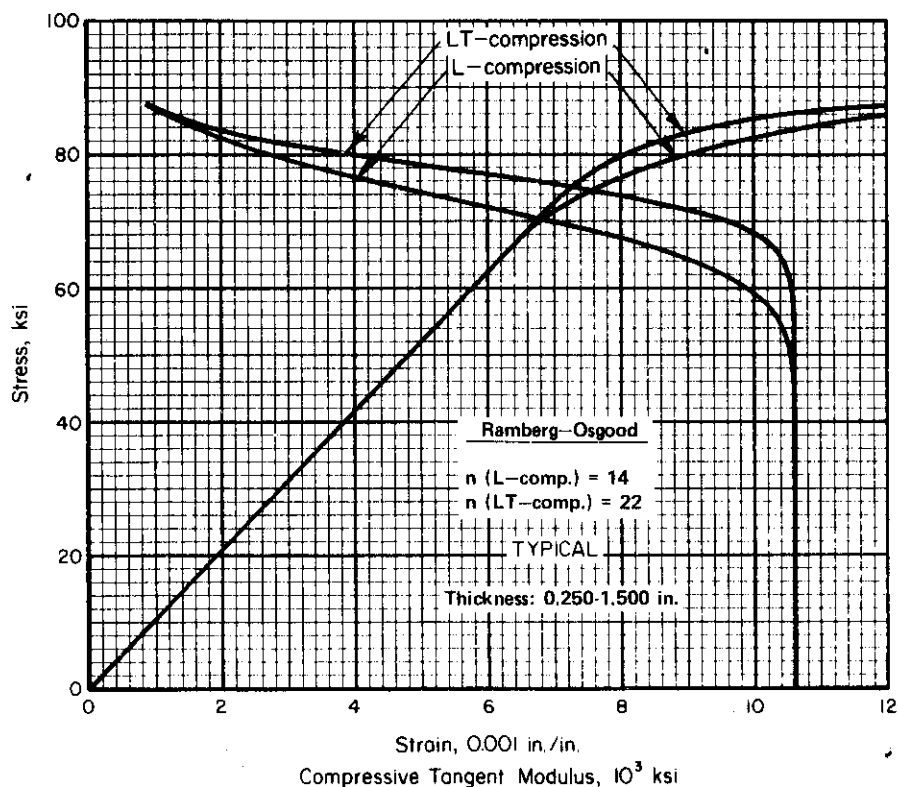


FIGURE 3.7.7.1.6(f). Typical compressive stress-strain and compressive tangent-modulus curves for 7178-T651 aluminum alloy plate at room temperature.

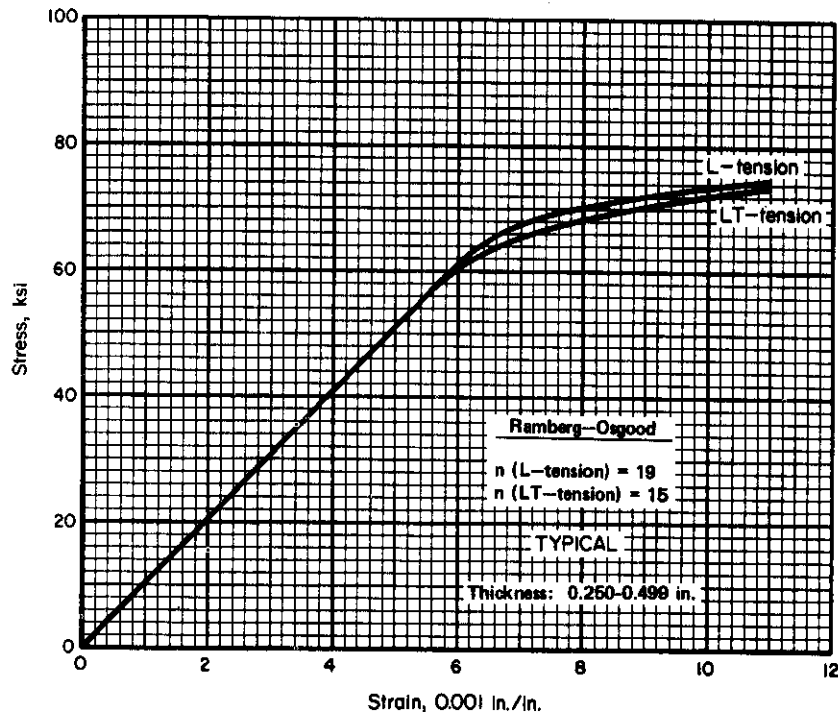


FIGURE 3.7.7.1.6(g). Typical tensile stress-strain curves for clad 7178-T6 aluminum alloy plate at room temperature.

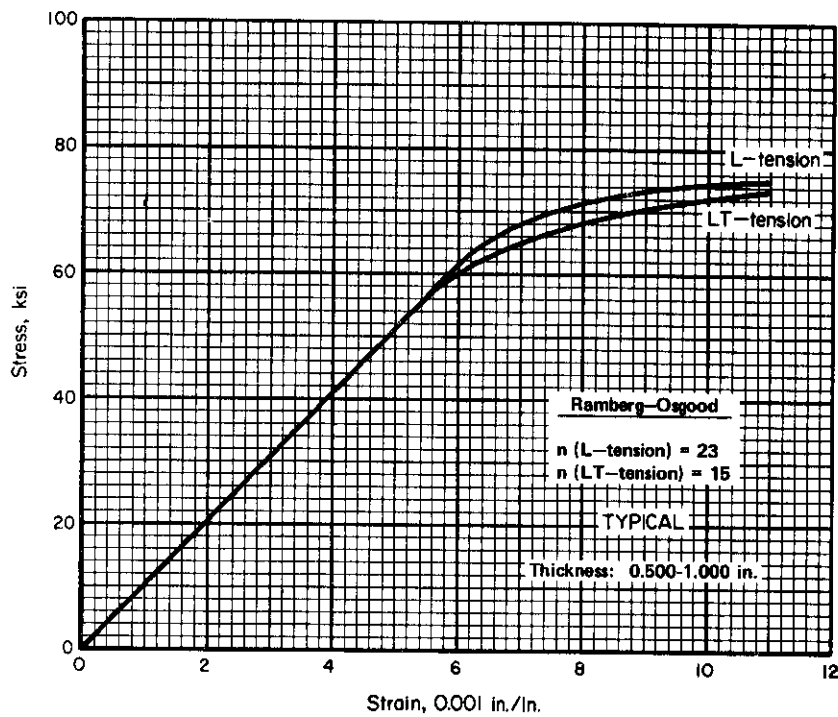


FIGURE 3.7.7.1.6(h). Typical tensile stress-strain curves for clad 7178-T6 aluminum alloy plate at room temperature.

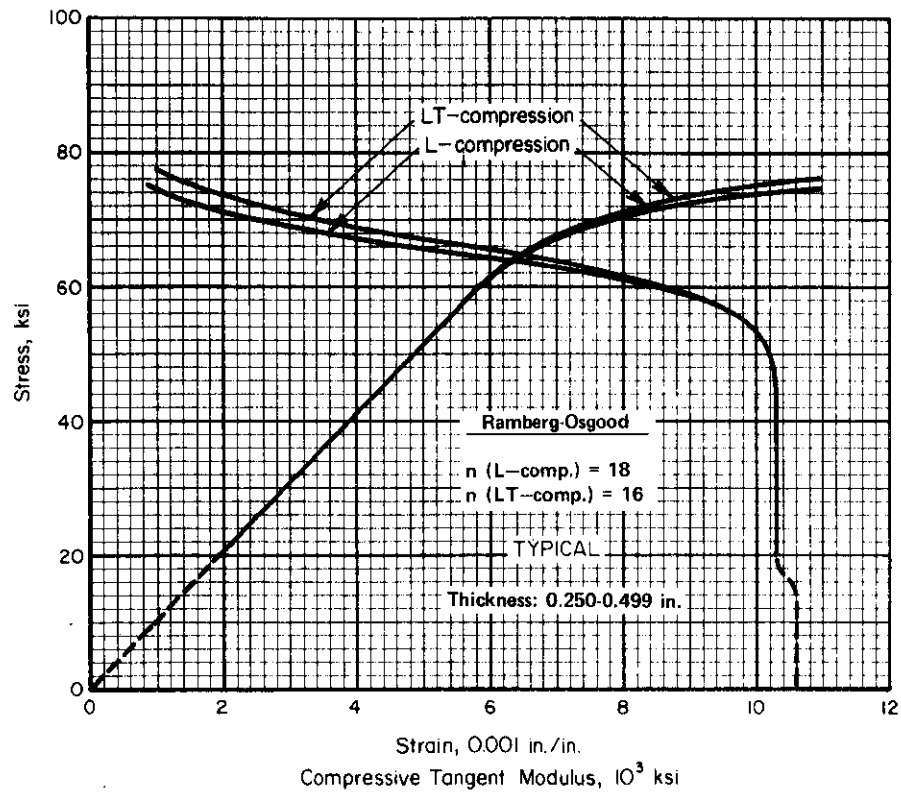


FIGURE 3.7.7.1.6(i). Typical compressive stress-strain and compressive tangent-modulus curves for clad 7178-T6 aluminum alloy plate at room temperature.

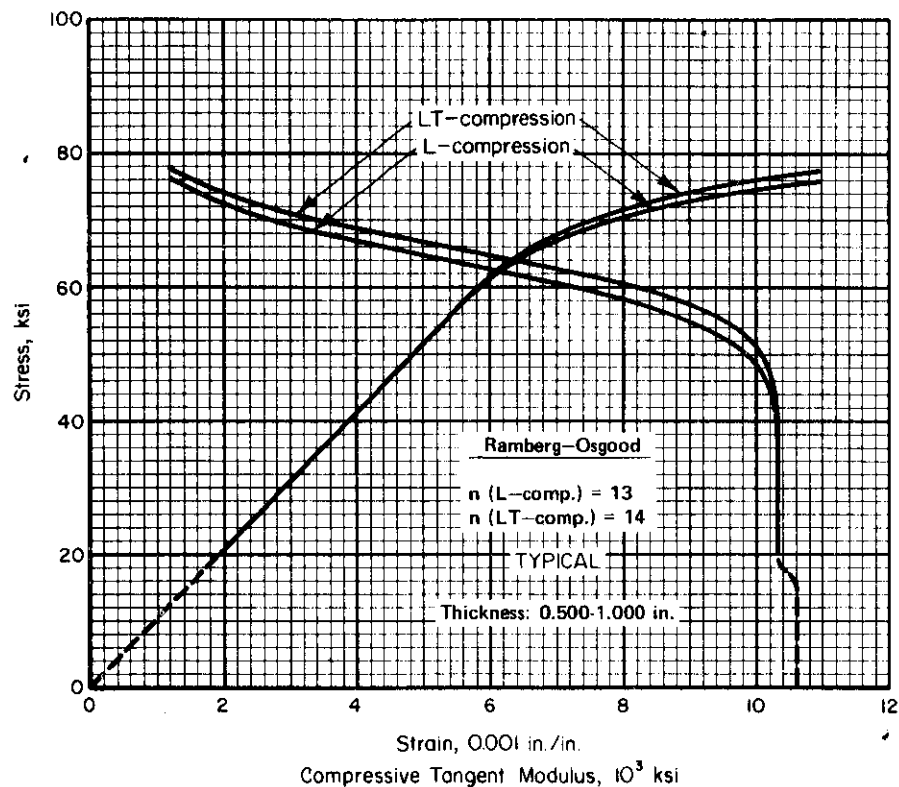


FIGURE 3.7.7.1.6(j). Typical compressive stress-strain and compressive tangent-modulus curves for clad 7178-T6 aluminum alloy plate at room temperature.

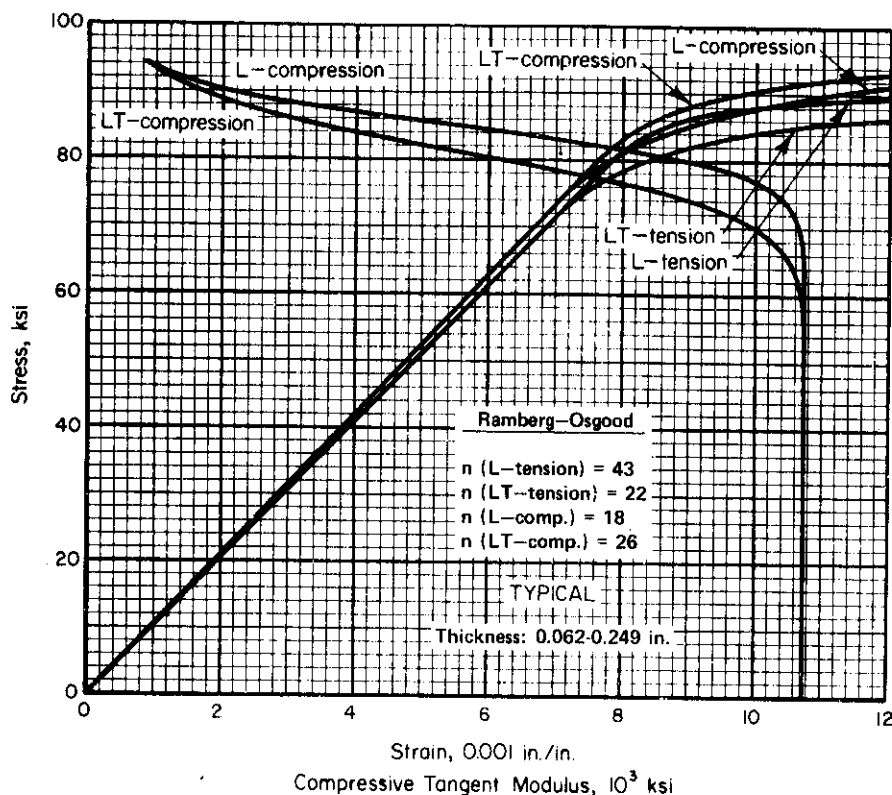


FIGURE 3.7.7.1.6(k). Typical stress-strain and compressive tangent-modulus curves for 7178-T651X aluminum alloy extrusion at room temperature.

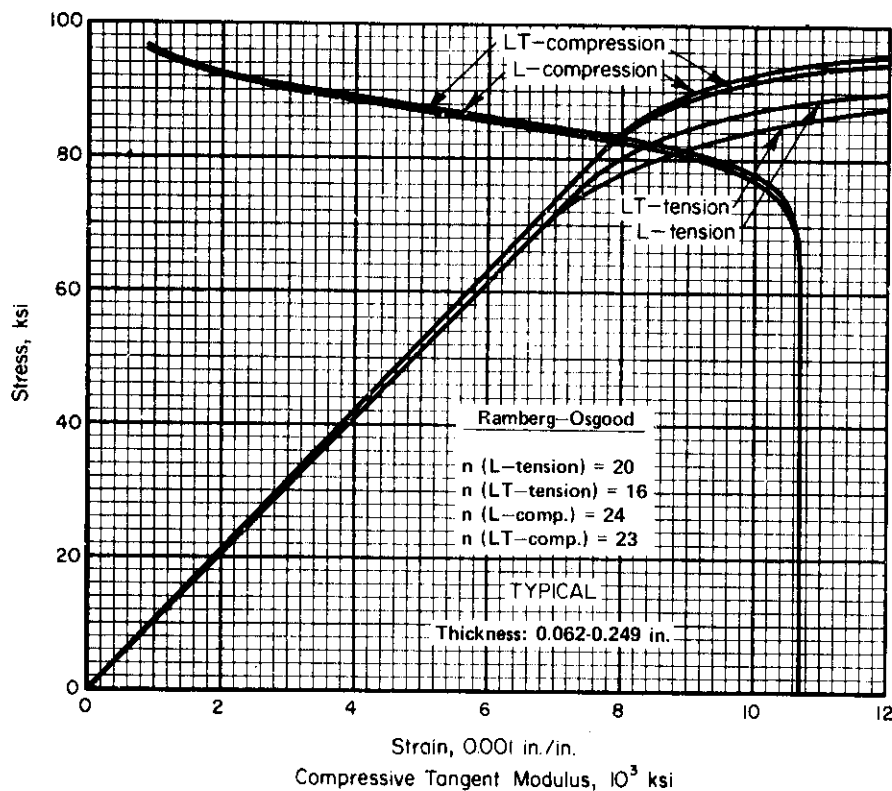


FIGURE 3.7.7.1.6(l). Typical stress-strain and compressive tangent-modulus curves for 7178-T62 aluminum alloy extrusion at room temperature.

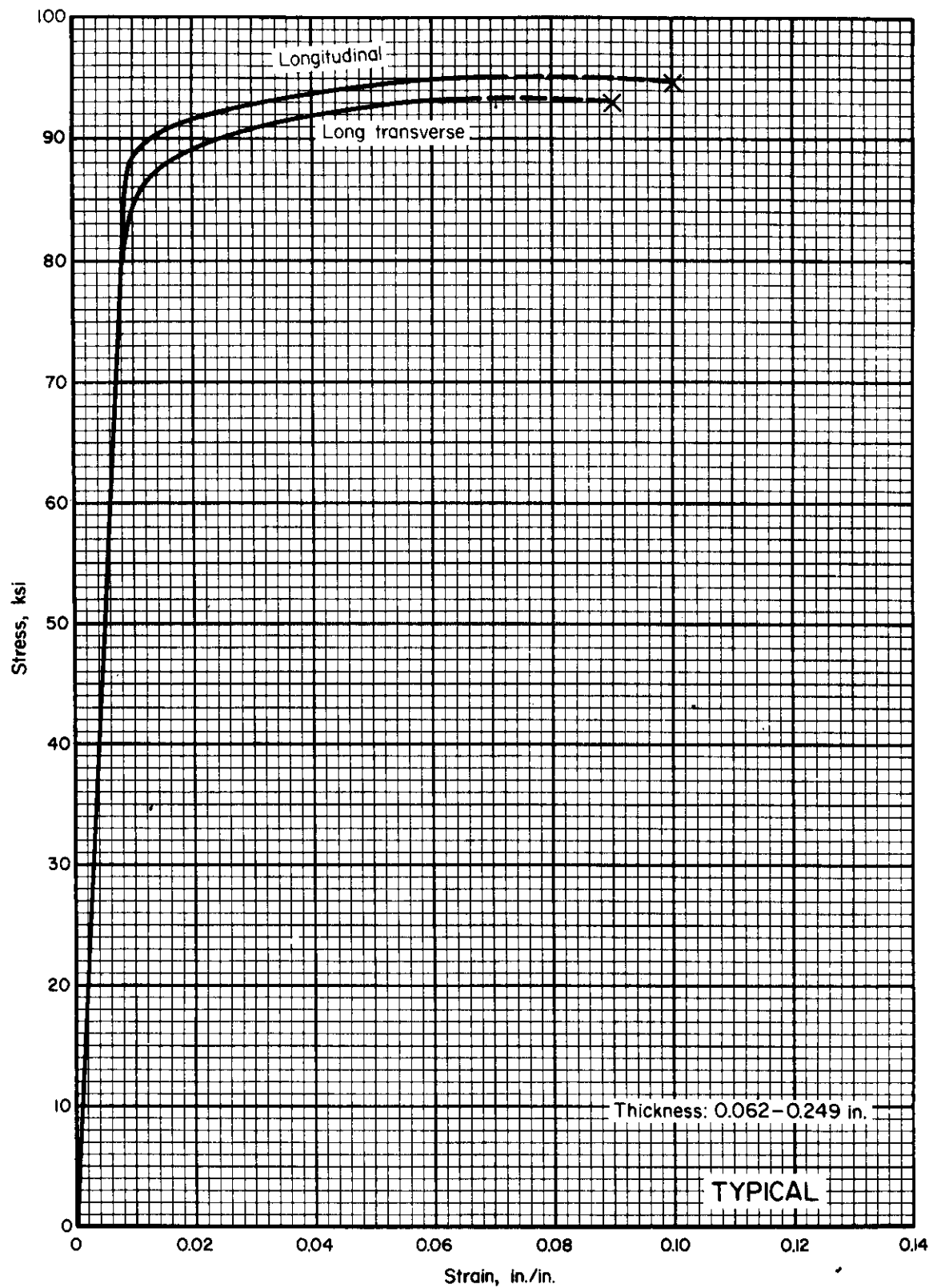


FIGURE 3.7.7.1.6(m). Typical tensile stress-strain curves (full range) for 7178-T651X aluminum alloy extrusion at room temperature.

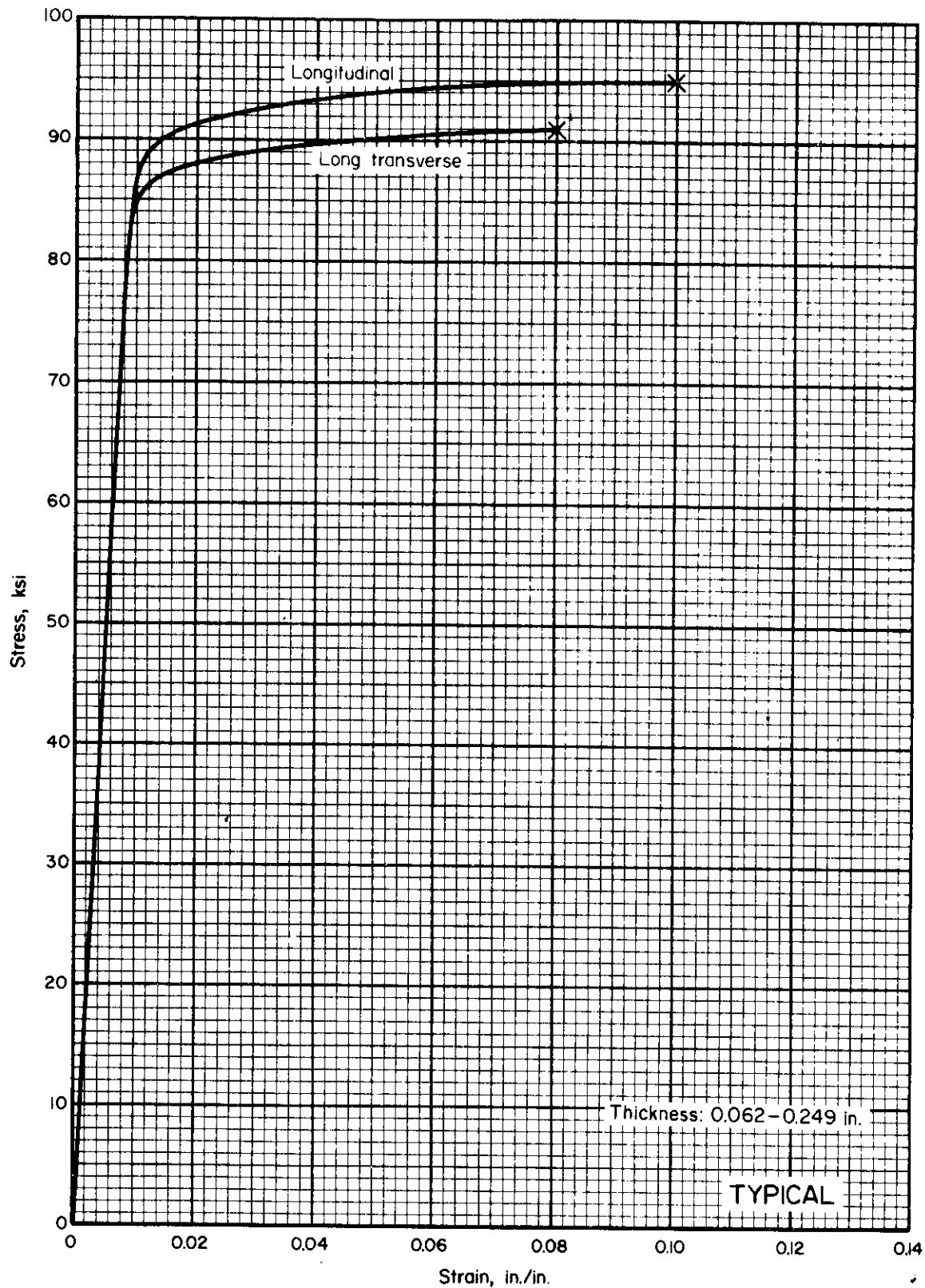


FIGURE 3.7.7.1.6(n). Typical tensile stress-strain curves (full range) for 7178-T62 aluminum alloy extrusion at room temperature.