ARTICLE KM-2
MECHANICAL PROPERTY TEST REQUIREMENTS FOR METALS

KM-200 GENERAL REQUIREMENTS
As permitted by KM-100, all forms of metal products may be used subject to meeting the requirements of the material specification as well as the mechanical test and examination requirements of this Division.

KM-201 DEFINITION OF THICKNESS
The requirements in this Article make reference to a thickness. For the purpose intended, the following definitions of thickness T at the time of heat treatment apply.

KM-201.1 Plates. The thickness is the dimension of the short transverse cross-section of the plate.

KM-201.2 Forgings. The thickness is the dimension defined as follows:
(a) for hollow forgings in which the axial length is greater than the radial thickness, the thickness is measured between the minimum inside and maximum outside surfaces (radial thickness), excluding flanges (protrusions) whose thicknesses are less than the wall thickness of the cylinder.
(b) for disk forgings in which the axial length is less than or equal to outside diameter, the thickness is the axial length.
(c) for ring forgings where the maximum axial length is less than the radial thickness, the maximum axial dimension is considered the thickness
(d) for rectangular solid forgings, the least rectangular dimension is the thickness.
(e) for round, hexagonal, and octagonal solid forgings, the nominal thickness is the diameter or distance across the flats (axial length > diameter or distance across the flats).

KM-201.3 Bars and Bolting Materials. The thickness for bars and bolting materials shall be the diameter for round bars, the lesser of the two cross-sectional dimensions for rectangular bars, and the distance across the flats for hexagonal bars; or the length of a given bar, whichever is less.

KM-201.4 Pipe. The thickness for pipe shall be the nominal wall thickness.

KM-210 PROCEDURE FOR OBTAINING TEST SPECIMENS AND COUPONS
For austenitic stainless steels and for nonferrous alloys, the procedure for obtaining test specimen coupons shall conform to the applicable material specification. These materials are exempt from the requirements of KM-211.

KM-211 PRODUCT FORMS

KM-211.1 Plates. (a) For thicknesses less than 2 in. (50 mm), specimens shall be taken in accordance with the requirements of the applicable material specification. (b) For thicknesses 2 in. (50 mm) and greater, the centerline of the test specimen shall be taken in accordance with the requirements of the applicable material specification, but not closer than T to any heat-treated edge and 7/2 to the nearest plate surface.

(c) Where a separate test coupon is used to represent the vessel material, it shall be of sufficient size to ensure that the cooling rate of the region from which the test specimens are removed represents the cooling rate of the material at T/2 deep and at least T from any edge of the product. Unless cooling rates applicable to the bulk pieces or product are simulated in accordance with KM-220, the dimensions of the coupon shall be not less than 3T by 3T by T, where T is the maximum material thickness.

KM-211.2 Forgings. The datum point, defined as the midpoint of the gage length of tension test specimens or the area under the notch of impact test specimens, shall be located in accordance with one of the following methods. All testing shall be from integral prolongations of the forging, except as permitted in (d), and shall be performed after final heat treatment (see KT-111). In addition to the following, for quenched and tempered materials, the location of the datum point shall be equal to or farther from the nearest quenched surface than any pressurized surface or area of significant loading is from the quenched surface. The design, manufacturer, or the design point locations within the forging refers to the rules of this Division.

(a) For forgings having a maximum quenched thickness not exceeding 4 in. (100 mm), the datum points of the test specimens shall be located in the forging or test forging at mid-thickness and at least 27/3 T is the maximum heat-treated thickness) from the quenched end surface or nearest adjacent surfaces.
(b) For forgings having a maximum quenched thickness in excess of 4 in. (100 mm), the datum points of the test specimens shall be removed $T/4$ from the nearest quenched surface and $2T/3$ from the quenched end surface or nearest adjacent surfaces. $T/4$ diameter or thickness from a heat-treated end may be used for precipitation hardening and age hardening materials listed in Tables B-1 to B-100-2M (UNS Nos. S13800, S15500, S45000, S45500, and S66286) that have been air quenched after aging.

(c) For forgings that are contour shaped or machined to essentially the finished product configuration prior to heat treatment, find the interior location that has the greatest distance to the nearest quenched surface. Designate this distance $t/2$. Test specimens shall be taken no closer to any quenched surface than one half of this distance ($\frac{1}{2}t$ location). The mid-point of the specimen shall be a minimum of $t/2$ from any second quenched surface.

(d) With prior approval of the Manufacturer, test specimens may be taken from a separate test forging under the same reduction and type of hot working as the main body of the forging for which the tests are being conducted, if permitted by the material specification. The dimensional requirements specified in (a), (b), (c), or (e) shall be met as applicable.

(e) For large forgings that require testing from each end in accordance with KM-231(b) or KM-231(c), test specimen locations according to (a), (b), (c), and (d) may be designated at each end independently based on the thickness at that end, provided at least one end represents the thickest dimension of the entire forging.

KM-211.3 Bars and Bolting Materials.

(a) For diameters or thicknesses less than 2 in. (50 mm), the specimens shall be taken in accordance with the requirements of the applicable material specification.

(b) For diameters or thicknesses 2 in. (50 mm) and over, the datum point of the test specimen defined as the midpoint of the gage length of a tension test specimen or the area under the notch of the impact specimen shall be located at $T/4$ from the outside rolled surface or deeper and no closer than $2T/3$ diameter or thickness from a heat-treated end. $T/4$ diameter or thickness from a heat treated end or deeper may be used for precipitation hardening and age hardening steels that have been air quenched after aging.

KM-211.4 Pipe.

(a) For thicknesses less than 2 in. (50 mm), specimens shall be taken in accordance with the requirements of the applicable material specification.

(b) For thicknesses 2 in. (50 mm) and over, specimens shall be taken in accordance with the requirements of the applicable material specification and at least $T/4$ from any heat-treated surface, where $T$ is the maximum wall thickness of the pipe, and with the ends of the specimens no closer than $T$ from a heat-treated end of the pipe. Test specimens shall be removed from integral prolongations from the pipe after completion of all heat treatment and forming operations.

KM-212 CHARPY IMPACT SPECIMENS

(a) Test specimens shall be the standard 10 mm × 10 mm size and shall be oriented parallel to the axis of the bolt.

(b) Where Charpy V-notch impact testing is to be conducted and bolt diameter does not permit specimens in accordance with (a), subsize specimens may be used. Test temperature shall be reduced in accordance with Table KM-212.

(c) Where bolt diameter or length does not permit specimens in accordance with (a) or (b), impact testing is not required.

KM-212.2 Pressure-Retaining Component Materials, Other Than Bolting, Not Containing Welds.

(a) Specimens for Charpy specimens shall be oriented such that the major axes lie transverse to the direction of maximum elongation during rolling or to the direction of major working during forging. Examples of acceptable Charpy V-notch impact specimen orientations removed from plate and pipe are shown in Figure KM-212 illustrations (a) and (b), respectively. Since the direction of major working in a forging can vary significantly depending upon its shape and the forging method used, a single, representative example of an acceptable Charpy specimen removed from such a forging cannot be shown. Corners of Charpy specimens parallel to and

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**Table KM-212**

Charpy Impact Test Temperature Reduction Below Minimum Design Metal Temperature

<table>
<thead>
<tr>
<th>Actual Material Thickness or Charpy Impact Specimen Width Along the Notch, in. (mm)</th>
<th>Temperature Reduction, °F (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.394 (10.00) (full-size standard bar)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>0.354 (9.00)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>0.315 (8.00)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>0.295 (7.50) ($\frac{1}{8}$ bar size)</td>
<td>5 (3)</td>
</tr>
<tr>
<td>0.276 (7.00)</td>
<td>8 (4)</td>
</tr>
<tr>
<td>0.262 (6.67) ($\frac{1}{8}$ bar size)</td>
<td>10 (6)</td>
</tr>
<tr>
<td>0.236 (6.00)</td>
<td>15 (8)</td>
</tr>
<tr>
<td>0.197 (5.00) ($\frac{1}{8}$ bar size)</td>
<td>20 (11)</td>
</tr>
<tr>
<td>0.158 (4.00)</td>
<td>30 (17)</td>
</tr>
<tr>
<td>0.131 (3.33) ($\frac{1}{8}$ bar size)</td>
<td>35 (19)</td>
</tr>
<tr>
<td>0.118 (3.00)</td>
<td>40 (22)</td>
</tr>
<tr>
<td>0.098 (2.50) ($\frac{1}{8}$ bar size)</td>
<td>50 (28)</td>
</tr>
</tbody>
</table>

NOTE: (1) Straight line interpolation for intermediate values is permitted.