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**Glossary of terms used in iron and
steel (Testing)**

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Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee as the result of proposal for revision of Japanese Industrial Standard submitted by The Japan Iron and Steel Federation (JISF) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law applicable to the case of revision by the provision of Article 14.

Consequently, **JIS G 0202:1987** is replaced with this Standard.

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Glossary of terms used in iron and steel (Testing)

1 Scope

This Japanese Industrial Standard specifies main terms and definitions relating to tests of rolled, casted or forged steels and their products.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. For standards with the year indication, only the editions of the indicated year shall be applied and the revisions (including amendments) made thereafter shall not be applied. For those without the indication of the year, the most recent edition (including amendments) shall be applied.

JIS G 0553 *Steel—Macroscopic examination by etching*

JIS H 0401:1999 *Methods of test for hot dip galvanized coatings*

JIS Z 2274 *Method of rotating bending fatigue testing of metals*

JIS Z 2275 *Method of plane bending fatigue testing of metal plates*

3 Classification

The terms used in iron and steel (testing) are classified as follows.

a) Mechanical tests

- 1) Tensile test
- 2) Bend test
- 3) Impact test
- 4) Hardness test
- 5) Formability test
- 6) Brittle fracture test
- 7) Fatigue test
- 8) Creep test
- 9) Stress relaxation test
- 10) Other tests

b) Metallographic tests

- 1) Macrostructure and microstructure examination for steel
- 2) Case hardened, hardening test and decarburized depth test
- 3) Other tests

c) **Corrosion tests**

- 1) General terms
- 2) Weather resistance test
- 3) Terms concerning stainless steels
- 4) Terms concerning plated/paint coated steel sheets
- 5) Terms concerning tin

d) **Nondestructive tests**

- 1) Radiographic test
- 2) Ultrasonic testing
- 3) Magnetic particle testing
- 4) Liquid penetrant testing
- 5) Eddy current testing
- 6) Other nondestructive testing
- 7) Nondestructive testing personnel

e) **Tests for electric and magnetic properties**

4 Numbers, terms and definitions

The numbers, terms and definitions are as follows.

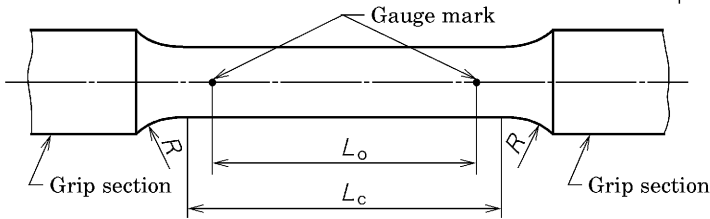
- NOTE 1 In the case where two or more terms are described in parallel in one space of the term column, priority in use shall be given in the order of description.
- NOTE 2 For the term a part of which is given in square brackets [], both of terms: those including characters given in square brackets and those from which characters in square brackets are omitted are allowed to be used, but priority shall be given to the terms without characters in square brackets (This is applicable to Japanese characters only).
- NOTE 3 Those which are parenthesized under the terms indicate how to read the terms which are liable to be misread (This is applicable to Japanese characters only). Equivalent English in the most right column is informative.

4.1 Mechanical tests

No.	Term (Japanese character)	Definition	English equivalent
1000	機械試験	test to examine the mechanical properties such as strength, toughness, ductility, hardness etc. There are tensile test, impact test, bend test, hardness test, fatigue test, creep test, stress relaxation test, etc.	mechanical test

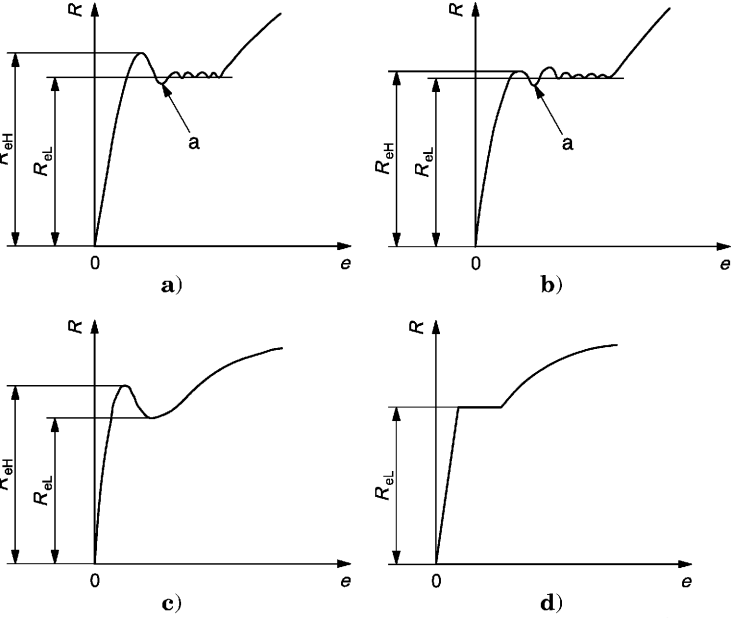
4.1.1 Tensile test

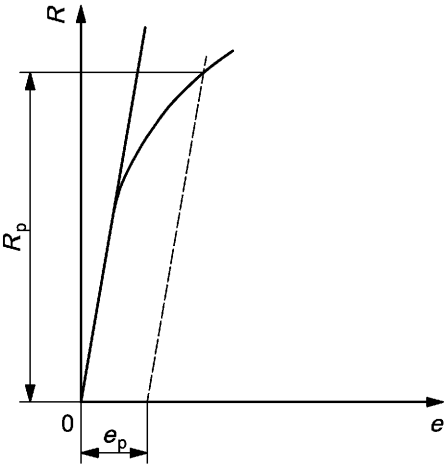
No.	Term (Japanese character)	Definition	English equivalent
1100	引張試験	test to measure one or more mechanical properties such as yield point, yield strength, tensile strength, yield elongation, elongation after fracture and reduction of area by loading tensile force to test piece and giving strain normally until fracture (see 1190 for tensile test at elevated temperature)	tensile test
1111	引張試験片	test piece to be used for tensile test According to the principles of determination of dimensions of each part of test piece, it is classified into proportional and non-proportional test pieces. Furthermore, according to the shape, it is classified into plate-like test piece, rod-like test piece, tubular test piece, arc-like test piece and lineal test piece (see 1191 for test piece for elevated temperature tensile test).	test piece for tensile test
1112	比例試験片	test piece for tensile test having original gauge length L_0 of test piece according to the formula $L_0 = k\sqrt{S_0}$ taking the original sectional area as S_0 . The parallel length is also determined according to L_0 . Normally, k is taken as 5.65, but 11.3 may be used. The value of elongation after fracture between test pieces of which k is same can be directly compared (see 1151 for conversion of elongation). In JIS , proportional test pieces of No. 2 (however, $L_0 = 8d_0$), No. 14A, No. 14B and No. 14C are specified.	proportional test piece
1113	定形試験片	test piece for tensile test having defined shape and constant dimensions of principal portion to be taken irrespective of the sectional area of parallel portion of test piece In JIS , non-proportional test pieces of No. 1A, No. 1B, No. 4, No. 5, No. 13A, No. 13B, etc. are specified.	non-proportional test piece

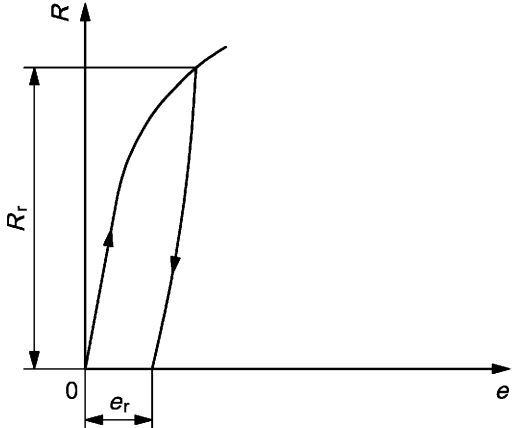
No.	Term (Japanese character)	Definition	English equivalent
1114	平行部 [試験片の]	portion with the same sectional dimensions at middle part of test piece for tensile test The length is called the “parallel length” (see figure 1).  L_o: original gauge length L_c: parallel length R: radius of fillet Figure 1 Name of each part of test piece for tensile test	parallel portion
1115	標点 [試験片の]	mark given on the parallel portion of test piece for the reference of measurement of elongation in tensile test (see figure 1)	gauge mark
1116	標点距離	length of parallel portion of test piece where the elongation is measured	gauge length
1117	原標点距離	gauge length marked on the test piece measured before testing at room temperature (see figure 1)	original gauge length
1118	伸び計標点距離	gauge length of extensometer before testing used in order to measure the elongation with extensometer In the measurement of yield point or yield strength, the extensometer gauge length should cover the parallel portion of test piece as much as possible. Ideally, the lower limit of extensometer gauge length should be longer than the 0.50 times the parallel length, and should be shorter than about 0.90 times the parallel length. Furthermore, in the case of the measurement of the maximum test force or more, the extensometer gauge length should be almost equal to the original gauge length.	extensometer gauge length
1119	伸び計伸び, 伸び計伸び (%)	increment of extensometer gauge length at any given point in time during test The increment of extensometer gauge length expressed as a percentage of the extensometer gauge length is called the percentage extension.	extension, percentage extension
1120	つかみ部 [試験片の]	end portion of test piece to be gripped by grip of tensile testing machine (see figure 1)	grip section, grip end
1121	肩部の半径 [試験片の]	in the test piece for tensile test with grip ends of sectional area larger than that of parallel portion, the radius of transition curve (fillet) of circular arc provided between the parallel portion and each grip end in order to distribute uniformly stress in parallel portion (see figure 1)	radius of fillet, radius of transition curve between grip and parallel portion

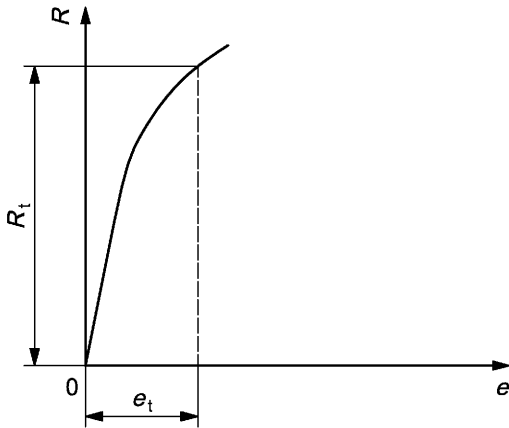
No.	Term (Japanese character)	Definition	English equivalent
1122	つかみ間の距離	length of test piece between grips of testing machine when the test piece is mounted on the testing machine For the test piece with the same sectional area for parallel portion and grip ends, the free length of test piece between grips shall be specified instead of the parallel length.	free length of test piece between grips
1131	公称応力	value of the test force at any given point in time divided by the original sectional area of test piece When there is no ambiguity, it is simply called the stress.	nominal stress, engineering stress
1132	真応力	value of the test force applied to the test piece divided by the sectional area of parallel portion of test piece at that time Under the condition in which the volume of parallel portion of test piece is constant, the true stress is expressed according to the following formula. $\sigma = R \left(1 + \frac{e}{100} \right)$ where, σ : true stress R : nominal stress e : elongation (%)	true stress
1133	伸び	increment of original gauge length at any given point in time during test The increment of original gauge length is often expressed as a percentage of the original gauge length. In this case, it is called the percentage elongation. See total elongation (1135) and elongation after fracture (1172).	elongation, percentage elongation
1134	真ひずみ, 対数伸び, 自然伸び	natural logarithm of the ratio of the gauge length of test piece when the test force is applied to the original gauge length $\varepsilon = \ln \left(\frac{L}{L_0} \right)$ The relation between the true strain and the elongation (strain), $e = \frac{L - L_0}{L_0}$, normally used is as follows. $\varepsilon = \ln (1 + e)$ where, ε : true strain e : elongation (strain) L_0 : original gauge length L : gauge length	true strain, logarithmic strain, natural strain
1135	全伸び	when the test force is applied to the test piece in the tensile test, the difference of length between the gauge length at this load and the original gauge length, i.e., the sum of elastic elongation and plastic elongation In JIS, this difference is expressed as a percentage of gauge length. $e = \frac{L - L_0}{L_0} \times 100 (\%)$ where, e : elongation (total elongation) L_0 : original gauge length L : gauge length	total elongation

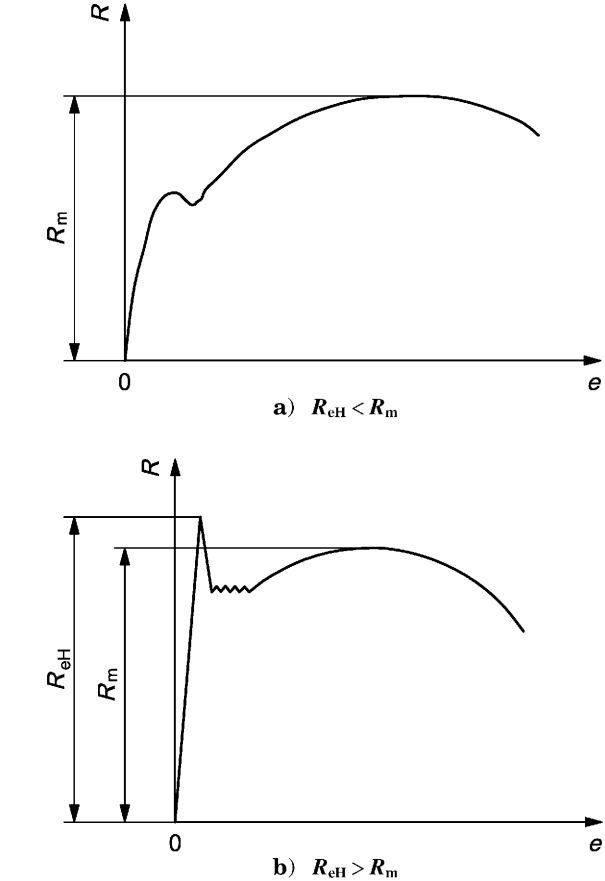
No.	Term (Japanese character)	Definition	English equivalent
1136	塑性伸び, 塑性ひずみ	elongation (strain) obtained by subtracting the elastic elongation from the total elongation NOTE: The elastic elongation (strain) is an elastic component of total elongation (strain), which refers to the value obtained by dividing the stress σ by Young's modulus E .	plastic elongation
1137	永久伸び	increment of original gauge length after the specified stress is removed, which is expressed as a percentage of the original gauge length	permanent elongation, percentage permanent elongation
1138	試験力-伸び 線図	curve representing the relation between the test force applied to test piece and the elongation corresponding to it in the whole process of tensile test	load-elongation diagram, load-extension diagram
1139	応力-ひずみ 線図, S-S 曲線	curve representing the relation between the nominal stress and the elongation (stress) of parallel portion of test piece in the whole process of tensile test	stress-strain diagram, stress-strain curve
1140	ひずみ速度	increment of strain per unit time measured from the extensometer gauge length	strain rate
1141	平行部の推定 ひずみ速度	increment of strain of parallel length of test piece per unit time that is obtained based on the crosshead separation rate and the parallel length of test piece	estimated strain rate over the parallel length
1142	クロスヘッド 変位速度	crosshead separation per time	crosshead separation rate
1143	応力増加速度	increment of stress per time Normally, the stress rate is applied only to the elastic region.	stress rate
1151	伸びの換算	estimation of the elongation after fracture to be obtained in test piece having a certain form and dimensions from that obtained by the testing of the test piece having other form and dimensions by using the relation formula between dimensions and value of elongation after fracture of test piece As the representative formulae, there are the following. Barba's formula: $\Delta L_f = a + bL_o$ Oliver's formula: $A = k \left(\frac{\sqrt{S_o}}{L_o} \right)^n$ where, ΔL_f : magnitude of elongation of fractured test piece A : elongation after fracture (%) L_o : original gauge length S_o : original sectional area of parallel portion a, b, k, n : constant NOTE: Variable conversion methods of elongation are specified in ISO 2566-1 .	conversion of elongation
1161	降伏点, 降伏応力	generic term for the upper yield point (see 1162) and the lower yield point (see 1163) occurred during tensile test When there is no ambiguity, the upper yield point is simply called the yield point.	yield point, yield stress, yield strength

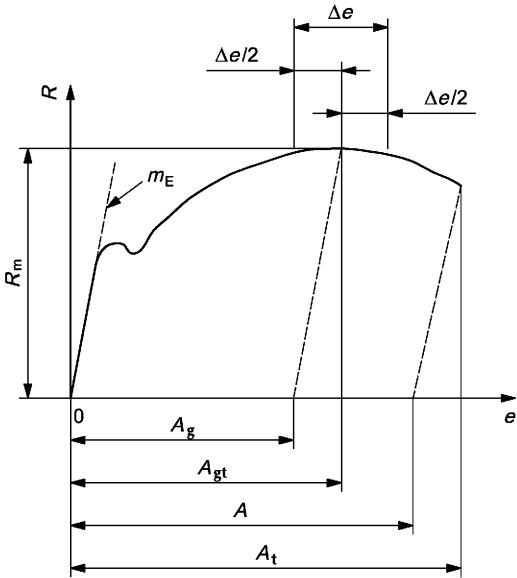
No.	Term (Japanese character)	Definition	English equivalent
1162	上降伏点 (かみこう ふくてん), 上降伏応力	maximum value of stress before the time when the reduction of test force is observed firstly (see figure 2)  e : elongation (%) R : stress R_{eH} : upper yield stress (upper yield point) R_{eL} : lower yield stress (lower yield point) a : initial transient effect (inertia effect) Figure 2 Yield point and yield elongation	upper yield point, upper yield stress, upper yield strength
1163	下降伏点 (しもこう ふくてん), 下降伏応力	minimum value of stress during plastic yield with disregarding initial transient effect (inertia effect) (see figure 2)	lower yield point, lower yield stress, lower yield strength

No.	Term (Japanese character)	Definition	English equivalent
1164	耐力	value of test force divided by the original sectional area of parallel portion when a specified elongation occurs in the tensile test For the material whose yield point is not clear, the yield strength is used instead. In JIS, unless otherwise specified, the value of plastic elongation shall be 0.2 %. The yield strength shall be determined by any one of the following methods in JIS. a) yield strength (offset method) stress when plastic elongation equals to elongation specified in percentage of the extensometer gauge length (see figure 3 and JIS Z 2241)  e : elongation (%) e_p : specified plastic elongation (%) R : stress R_p : yield strength (offset method) Figure 3 Yield strength (offset method)	yield strength, proof stress, proof strength proof stress (non-proportional elongation), yield strength by offset method, proof strength (plastic extension)

No.	Term (Japanese character)	Definition	English equivalent
1164	耐力 (continued)	b) yield strength (permanent elongation method) stress that generates plastic deformation of not more than the permanent elongation (%) or the extensometer permanent elongation (%) specified after the test force is removed The permanent elongation (%) and the extensometer permanent elongation (%) are expressed as a percentage of the original gauge length and the extensometer gauge length, respectively (see figure 4 and JIS Z 2241).  e : elongation (%) e_r : permanent elongation (%) R : stress R_r : specified stress of permanent elongation method Figure 4 Yield strength (permanent elongation method)	proving test for permanent set stress, permanent set strength

No.	Term (Japanese character)	Definition	English equivalent
1164	耐力 (concluded)	c) yield strength (total elongation method) stress when total elongation (sum of extensometer elastic elongation and plastic elongation) becomes equal to the elongation specified in percentage of the extensometer gauge length (see figure 5 and JIS Z 2241)  e : elongation (%) e_t : total elongation specified (%) R : stress R_t : yield strength (total elongation method) Figure 5 Yield strength (total elongation method)	proof stress (total elongation), yield strength by extension under load method, proof strength (total extension)
1165	最大引張試験力	maximum test force which a test piece has withstood during the test in the case of the material that does not show discontinuous yield [see figure 6 a)], or maximum test force which a test piece has withstood after the start of work hardening in the case of the material that shows discontinuous yield [see figure 6 b)]	maximum force

No.	Term (Japanese character)	Definition	English equivalent
1166	引張強さ	stress corresponding to the maximum force (see 1165 for definition of maximum force)  a) $R_{eH} < R_m$ b) $R_{eH} > R_m$ e : elongation (%) R : stress R_{eH} : upper yield stress (upper yield point) R_m : tensile strength Figure 6 Stress-elongation curve of different type for determination of tensile strength R_m	tensile strength
1167	降伏比	ratio of the yield point (normally upper yield point) or yield strength to the tensile strength NOTE: A yield ratio may become not less than 100 %.	yield ratio
1171	降伏伸び	elongation until the uniform work hardening starts from the initiation of yield in the case of the material that shows discontinuous yield, which is expressed in percentage of the extensometer gauge length	yield elongation, percentage yield elongation, percentage yield point extension

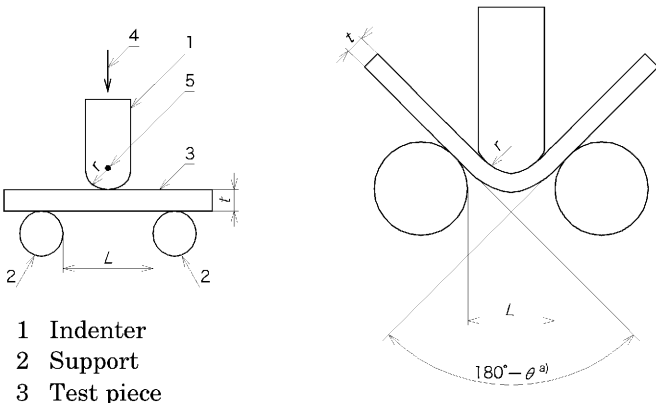
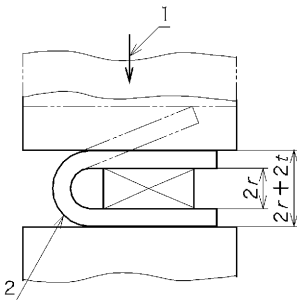
No.	Term (Japanese character)	Definition	English equivalent
1172	破断伸び	permanent elongation after fracture expressed in percentage of the original gauge length When there is no ambiguity, it is simply called the elongation. The total elongation (sum of extensometer elastic elongation and plastic elongation) at the time of fracture expressed as a percentage of the extensometer gauge length is called "total elongation at the time of fracture". $A = \frac{L_u - L_o}{L_o} \times 100$ where, A : elongation after fracture (%) L_o : original gauge length L_u : final gauge length after fracture	elongation after fracture, percentage elongation after fracture
1173	最大試験力時全伸び, 最大試験力時全伸び (%)	total elongation (sum of extensometer elastic elongation and plastic elongation) at the time of maximum test force The total elongation at the time of maximum test force expressed as a percentage of extensometer gauge length is called "percentage total extension at maximum force".	total extension at maximum force, percentage total extension at maximum force
1174	一様伸び, 均一伸び, 最大試験力時塑性伸び (%)	plastic elongation at maximum test force That expressed as a percentage of the the extensometer gauge length is called "percentage plastic extension at maximum force" (see figure 7). NOTE: In ASTM E8, the percentage total extension at maximum force is taken as the uniform elongation.  A : elongation after fracture (%) A_g : plastic extension at maximum force (%) A_{gt} : total extension at maximum force (%) A_t : total elongation after fracture (%) e : elongation (%) m_E : slope of stress-elongation (%) curve in elastic region R : stress R_m : tensile strength Δe : flat part range Figure 7 Definition of elongation	uniform elongation, percentage plastic extension at maximum force

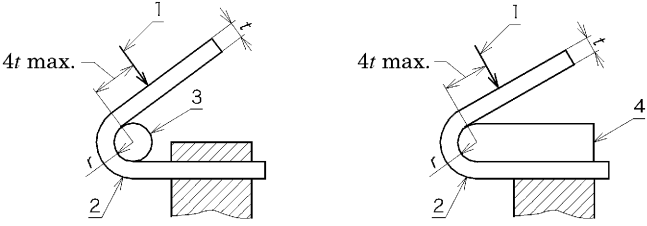
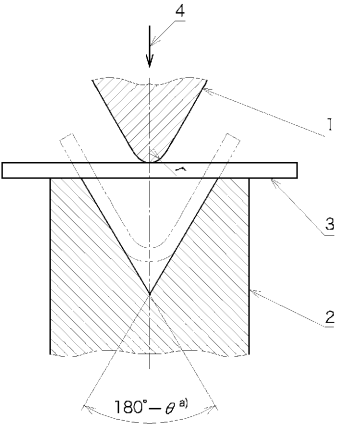
No.	Term (Japanese character)	Definition	English equivalent
1175	局部伸び	plastic elongation of the test piece in the tensile test ranging from the appearance of necking of a part of test piece due to reduction of sectional area after attainment of uniform elongation to fracture This is the value obtained by subtracting the uniform elongation from the elongation after fracture.	local elongation, necking elongation
1176	絞り	maximum variation of sectional area ($S_o - S_u$) that occurs during test expressed as a percentage of the original sectional area $Z = \frac{S_o - S_u}{S_o} \times 100$ where, S_o : original sectional area of parallel portion S_u : minimum sectional area after fracture Z : reduction of area NOTE: In ISO 6892-1 , it is described that in the case of a small rod-like test piece and the shape of test pieces other than the rod-like test piece, measurement cannot be conducted with an accuracy equivalent to that of the rod-like test piece.	reduction of area, percentage reduction of area
1181	加工硬化指数, n 値	value of n defined as an exponent of true strain in the following true stress-logarithmic strain relation in the plastic strain region when the test force is applied in the uniaxial direction $\sigma = C \times \varepsilon^n$ where, σ : true stress ε : true strain C : strength constant n : work hardening coefficient As for thin steel sheets, usually n -value is used as the characteristic value concerning the press formability, when the approximation is made in the range of elongation such as 5 % to 15 % or 10 % to 20 %.	work hardening coefficient, n -value, tensile strain hardening exponent
1182	r 値, ラン克福ード値, 塑性ひずみ比	ratio between the true strain in width direction and the true strain in thickness direction of test piece that are generated by applying uniaxial tensile stress to a plate test piece for tensile test It is also called the Lankford value or plastic strain ratio, and is defined according to the following formula. $r = \frac{\varepsilon_b}{\varepsilon_a}$ where, ε_a : true strain in thickness direction ε_b : true strain in width direction Normally, 15 %, 20 %, etc. is used for the strain amount.	r -value, Lankford value, plastic strain ratio

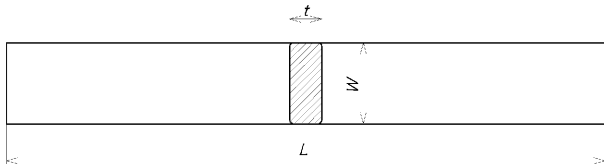
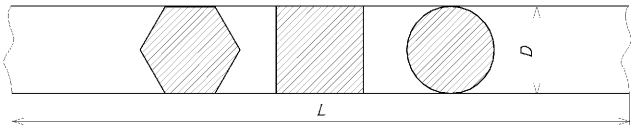
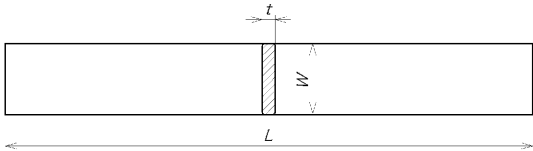
No.	Term (Japanese character)	Definition	English equivalent
1183	平均塑性ひずみ比	weighted average obtained according to the following formula using the plastic strain ratio of test pieces sampled from each direction in parallel, at 45° and at 90° with respect to the rolling direction of plate face and measured $\bar{r} = \frac{r_0 + 2r_{45} + r_{90}}{4}$ where, r_0 : plastic strain ratio measured when test piece is sampled in parallel with rolling direction of plate face r_{45} : plastic strain ratio measured when test piece is sampled in 45° of rolling direction of plate face r_{90} : plastic strain ratio measured when test piece is sampled in 90° of rolling direction of plate face	weighted average plastic strain ratio
1184	面内異方性	value obtained according to the following formula using the plastic strain ratio of test pieces sampled from each direction in parallel, at 45° and at 90° with respect to the rolling direction of a plate face and measured $\Delta r = \frac{r_0 - 2r_{45} + r_{90}}{2}$	degree of planar, anisotropy
1190	高温引張試験	test to measure the yield point, yield strength, tensile strength, elongation after fracture, reduction of area, etc. by holding test piece at constant elevated temperature and loading tensile force on it gradually	tensile test at elevated temperature, high temperature tensile test
1191	高温引張試験片	test piece to be used for tensile test at elevated temperature The test piece shall usually be of circular section and the diameter of parallel portion shall be 10 mm (6 mm, 8 mm and 12 mm may be used). The gauge length shall be 5 times the diameter ($\frac{L_0}{\sqrt{A}} = 5.65$) Plate test piece may be used.	test piece for elevated temperature tensile test, test piece for high temperature tensile test

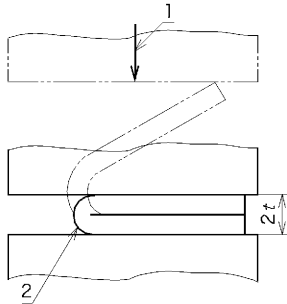
4.1.2 Bend test

No.	Term (Japanese character)	Definition	English equivalent
1200	曲げ試験	test to examine materials for the deformability Usually, it examines the existence of cracks and other defects on outside surface of bent portion when the test piece is bent at the specified angle or over with specified inside radius When the inside radius of bending is specified, bending is conducted with the inside radius of not more than the specified value that is taken as the upper limit.	bend test
1201	曲げ性	degree capable of bending without causing cracks	bendability

No.	Term (Japanese character)	Definition	English equivalent
1211	押曲げ法, ローラ曲げ法	one type of bend test in which the test force is gradually applied to the test piece placed on two supports by pressing an indenter to the middle part of the test piece to be bent to specified form When the bend angle is 180°, the test piece is compressed after being bent to about 170° by the method in figure 8 on both ends towards one another by using an insert having a thickness two times the specified inside radius as shown in figure 9. Or the test piece is deemed to have been bent to 180° when pressed until it passes through the clearance between the supports by the method in figure 8 (see JIS Z 2248).  1 Indenter 2 Support 3 Test piece 4 Direction of test force 5 Centre of radius of indenter end L Distance between supports r Inside radius t Thickness of test piece Note ^{a)} θ is specified bend angle. Figure 8 Press bend method (roller bend method)  1 Direction of test force 2 Test piece r Inside radius t Thickness of test piece Figure 9 180° bending	pressing bend method, roller bend method

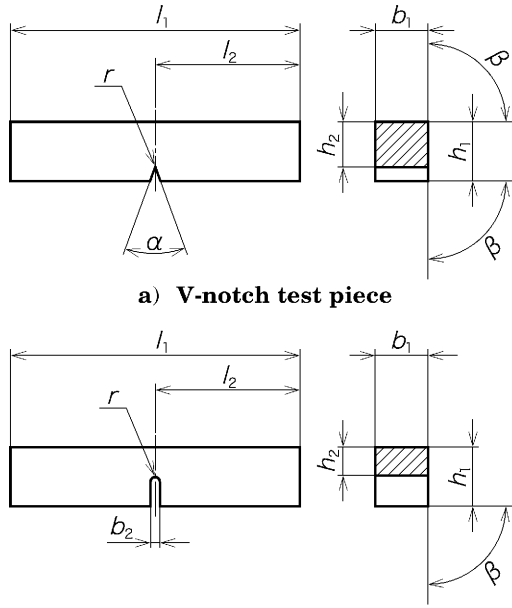
No.	Term (Japanese character)	Definition	English equivalent
1212	巻付け法	one type of bend test in which the test force is gradually applied to the test piece to be wound around a mandrel or a mould (see figure 10) In the case of bend angle of 180°, especially small inside diameter or closely contact bending, the test piece shall be bent up to 180°, then the 180° bending in figure 9 or the closely contact test shall be conducted at times.  a) Case of using mandrel b) Case of using mould 1 Test force r Inside radius 2 Test piece t Thickness of test piece 3 Shaft 4 Mandrel Figure 10 Winding bend method	winding bend method
1213	Vブロック法	one type of bend test in which the test force is gradually applied to the test piece placed on V block by pressing an indenter to the middle part of the test piece to be bent to the specified form (see figure 11)  1 Indenter 2 V-block 3 Test piece 4 Direction of test piece r Inside radius Note ^{a)} θ is the bend angle specified. Figure 11 V-block bend method	V-block bend method

No.	Term (Japanese character)	Definition	English equivalent
1221	曲げ試験片	test piece used for bend test Test pieces are divided into test piece No. 1, test piece No. 2 and test piece No. 3. Test piece No. 1 is used mainly for the bend test of plates, strips and sections of thickness of 3 mm or more (see figure 12). Test piece No. 2 is used mainly for the bend test of bars (see figure 13). Test piece No. 3 is used mainly for the bend test of plates of thickness less than 3 mm (see figure 14). NOTE: If the original thickness of plates, strips and sections is more than 25 mm, or if the original diameter or inscribed circle diameter of bars is more than 30 mm, the test piece shall be machined until the thickness of test piece or the inscribed circle diameter of bars becomes 25 mm or more (see JIS Z 2248).  t : thickness (original thickness) W : width (20 mm to 50 mm) L : length (according to thickness of test piece and testing apparatus to be used) Figure 12 Test piece No. 1  $D^{a)}$: diameter (case of circular cross-section) or inscribed circle diameter (case of polygonal cross-section) Note ^{a)} Shall be the original dimension. L : length (according to D of test piece and testing apparatus to be used) Figure 13 Test piece No. 2  t : thickness (original thickness) W : width (15 mm to 50 mm) L : length (according to thickness of test piece and testing apparatus to be used) Figure 14 Test piece No. 3	test piece for bend test
1231	内側半径 (うちがわはんけい)	radius of curvature of inner surface of test piece bent in bend test The radius of curvature of indenter, shaft, or tip of mandrel are taken as radius of inner surface.	radius of inner surface, radius of mandrel, inside radius, radius of bend

No.	Term (Japanese character)	Definition	English equivalent
1232	曲げ角度	angle between straight portions of two legs of bent test piece by changing from 180° in bend test	angle of bend, bending angle
1233	180度曲げ, 密着曲げ	state of bent test piece in which angle of bend has reached 180° Especially when radius of inner surface is zero it is called "flat on itself" (see figure 15)  1 direction of test force 2 test piece t thickness of test piece Figure 15 Flat on itself	180° degree bend, flat on itself, closely overlap, closely contact
1251	二重曲げ試験	one type of bend test to bend to flat on itself being folded in four	double bend test
1252	表曲げ試験 (おもてまげしけん)	one type of bend test in which test pieces of butt welded joint are bent with the face of weld to be tensioned, and test piece of clad steel such as clad steel plate is bent so that clad metal side is outside (base metal side inside)	face bend test, bend test having the cladding in tension
1253	裏曲げ試験	one type of bend test in which test pieces of weld of butt welded joint are bent with the root of weld to be tensioned, and test piece of clad steel such as clad steel plate is bent so that base metal side is outside (clad metal side inside)	root bend test, bend test having the base metal in tension
1254	側曲げ試験 (がわまげしけん)	one type of bend test to bend test pieces of steel product or welded joint to the side so that both sides are respectively tensioned or compressed	side bend test

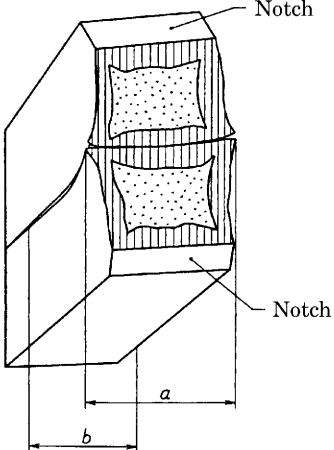
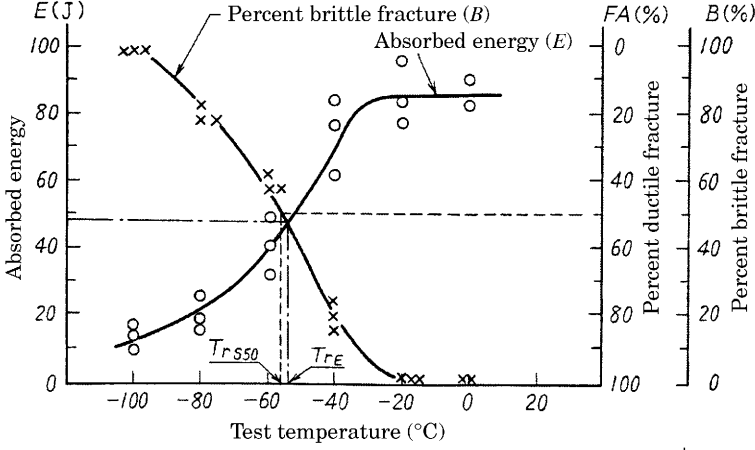
4.1.3 Impact test

No.	Term (Japanese character)	Definition	English equivalent
1300	衝撃試験	test for evaluating toughness or brittleness of materials to examine the magnitude of absorbed energy, fracture appearance, deformation behaviour, crack propagation behaviour, etc. in breaking test piece by applying impact test force According to the manners to apply impact test force, there are various test methods such as impact tensile, impact compression, impact bending and impact torsion.	impact test
1301	シャルピー衝撃試験	test to measure the absorbed energy, impact value, percent fracture, transition temperature, etc. with Charpy impact testing machine in which test piece is supported by two supports distant by 40 mm so that the notch meets the middle between supports and is broken by striking with one blow of pendulum to the face opposite the notch	Charpy impact test

No.	Term (Japanese character)	Definition	English equivalent
1302	アイゾット衝撃試験	test to measure Izod impact value with Izod impact testing machine in which one end of test piece is fixed at notch and the test piece is broken by striking with one blow of pendulum at the position distant by 22 mm from the notch on the notched surface NOTE: This is not adopted in JISs of metallic materials, but still specified in ASTM E23.	Izod impact test
1311	シャルピー衝撃試験片	test piece used for Charpy impact test  a) V-notch test piece b) U-notch test piece Figure 16 Types of Charpy impact test piece	test piece for Charpy impact test

No.	Term (Japanese character)	Definition	English equivalent					
1311	シャルピー衝撃試験片 (concluded)	Table 1 Dimensions and tolerances of test piece						
		Designation		Symbol	V-notch test piece		U-notch test piece	
					Dimension	Tolerance	Dimension	Tolerance
		Length		l_1	55 mm	± 0.60 mm	55 mm	± 0.60 mm
		Height		h_1	10 mm	± 0.05 mm	10 mm	± 0.05 mm
		Width		b_1	10 mm	± 0.05 mm	10 mm	± 0.05 mm
		Width (subsize test piece)			7.5 mm	± 0.05 mm	7.5 mm	± 0.05 mm
		Width (subsize test piece)			5 mm	± 0.05 mm	5 mm	± 0.05 mm
		Width (subsize test piece)			2.5 mm	± 0.05 mm	2.5 mm	± 0.05 mm
		Angle of V-notch/width of U-notch		α/b_2	45°	± 2°	2 mm	± 0.14 mm
		Height below notch		h_2	8 mm	± 0.05 mm	5 mm ^{a)}	± 0.05 mm
		Radius of curvature at base of notch		r	0.25 mm	± 0.025 mm	1 mm	± 0.07 mm
		Distance of symmetry of notch from ends of test piece	For machines without automatic positioning	l_2	27.5 mm	± 0.40 mm	27.5 mm	± 0.40 mm
			For machines with automatic positioning		27.5 mm	± 0.165 mm	27.5 mm	± 0.165 mm
		Angle between plane of symmetry of notch and longitudinal axis of test piece			90°	± 2°	90°	± 2°
		Angle between adjacent longitudinal faces of test piece except for end faces		β	90°	± 2°	90°	± 2°
		Note ^{a)} If another height is specified, the corresponding tolerances shall also be specified, which shall be ± 0.05 mm for 8 mm of height below notch.						
		Height of test piece: distance between notched face and opposite face						
		Width of test piece: dimension perpendicular to height parallel to notch						
		Length of test piece: dimension at right angles to notch						
1312	サブサイズ試験片	test piece which is less than 10 mm in width and same in other dimensions as Charpy test piece test piece In JIS , width in this case shall be taken as 7.5 mm, 5 mm or 2.5 mm.	subsize test piece					
1321	ひょう量, 定格容量エネルギー	energy designated by the manufacturer of Charpy impact testers In JIS , it is specified that the Charpy impact tester normally shall use absorbed energy of not more than 80 % of initial potential energy.	capacity of impact testing machine, (nominal energy), (nominal initial potential energy)					
1322	初期位置エネルギー	potential energy of pendulum at the lifted position (angle) against the impact position of test piece, which is the energy to be actually measured and determined by direct verification	initial potential energy					
1323	持上げ角度	rotated angle of pendulum when pendulum is lifted from free hanging position to the defined fall height to impact the test piece in Charpy impact test This is preliminarily defined for each tester.	angle of fall					

No.	Term (Japanese character)	Definition	English equivalent
1324	振上がり角度	rotated angle of pendulum from vertical position when pendulum has risen in opposite side at most after falling pendulum from defined angle of fall and breaking test piece in Charpy impact test	angle of rise
1331	吸収エネルギー	energy required to break the test piece in impact test In Charpy impact test, $A_v = M(\cos\beta - \cos\alpha)$ $M = F \times l_2$ where, A_v : absorbed energy M : moment of pendulum F : force exerted by pendulum when measured at distance of l_2 l_2 : distance to point of application of force F from axis of rotation α : angle of fall of pendulum β : angle of rise of pendulum When it is necessary to take the loss due to shaft bearing friction and air resistance into consideration, energy loss is measured and it is subtracted from absorbed energy.	absorbed energy
1332	シャルピー吸収エネルギー	energy required to break test piece in Charpy impact test Letter of V or U indicating the notch shape of test piece and figure of 2 or 8 indicating the radius of an impact cutting edge are attached as a subscript, for example, shown as KV_2 .	Charpy absorbed energy, Charpy impact strength
1333	シャルピー衝撃値	value of Charpy absorbed energy divided by original sectional area of notched portion (J/cm^2)	Charpy impact value
1334	ぜい性破面率	percentage of area of brittle fracture to total area of fracture of test piece Brittle fracture is the fracture which appears brilliant by cleavage fracture or brittle fracture of many crystal grains. $B = \frac{C}{A} \times 100$ where, B : percent brittle fracture (%) A : total area of fracture (mm^2) C : area of brittle fracture (mm^2)	percent brittle fracture, percent cleavage fracture, percent crystalline fracture
1335	延性破面率	percentage of area of ductile fracture to total area of fracture of test piece Ductile fracture is the fracture which is dim and no brilliant by fibrous shear fracture. $FA = \frac{D}{A} \times 100$ where, FA : percentage ductile fracture (%) A : total area of fracture (mm^2) D : area of ductile fracture (mm^2)	percent ductile fracture, percent shear fracture, percent fibrous fracture

No.	Term (Japanese character)	Definition	English equivalent
1336	横膨出	increase in width of test piece on impact side (opposite side of notch) relative to the original dimension of width (see figure 17)  $LE = a - b$ where, LE : lateral expansion (mm) Figure 17 Lateral expansion	lateral expansion
1361	遷移温度	temperature corresponding to the phenomenon in which absorbed energy decreases (or increases) abruptly, or appearance of fracture changes from ductile to brittle (or from brittle to ductile) when impact test at different temperature is conducted on a material	transition temperature
1362	遷移曲線	curve representing the relation among test temperature near to the transition temperature, absorbed energy or percent fracture, etc. (see figure 18)  Figure 18 Fracture transition temperature and energy transition temperature	transition curve

No.	Term (Japanese character)	Definition	English equivalent
1363	エネルギー遷移温度	temperature T_{te} equivalent to the mean absorbed energy of absorbed energy corresponding to lowest temperature at which percent ductile fracture attains 100 % and the absorbed energy corresponding to highest temperature at which percent brittle fracture attains 100 % (see figure 18) As simplified method, it is frequently determined as the temperature equivalent to 1/2 of absorbed energy at lowest temperature at which percent ductile fracture attains 100 %.	energy transition temperature
1364	破面遷移温度	transition temperature corresponding to the change of fracture appearance, i.e. temperature at which a specific percentage ductile fracture or percentage brittle fracture is attained Usually, it is determined as temperature T_{rs50} at which percent ductile fracture attains 50 % in Charpy impact test with using 2 mm V-notched test piece (see figure 18). NOTE: As a transition temperature, there are also a lateral expansion transition temperature, nil-ductility transition temperature, 20.4 J (15 ft-lb) transition temperature, etc.	fracture appearance transition temperature

4.1.4 Hardness test

No.	Term (Japanese character)	Definition	English equivalent
1400	硬さ試験	generic term for test to measure hardness with hardness testing machine according to the method to press hard indenter of specified form into the surface of test piece or product under specified static test force or to drop hammer from specifies height or others Value of hardness is not appended with unit.	hardness test
1401	押込み硬さ試験	generic term of hardness test in which specified indenter considered as rigid body is pressed into test surface of test piece and the hardness of test piece is determined from applied pressing test force and magnitude of permanent indentation occurred on test piece There are Brinell hardness test, Vickers hardness test, Rockwell hardness test, etc. Further, the method to press test pieces of specific form and dimensions to each other is included in indentation hardness test, but at present, it is not practiced.	indentation hardness test
1402	反発硬さ試験	generic term of hardness test in which the test surface of test piece is struck by specific hammer with definite energy and the hardness of test piece is determined from energy of hammer rebound from the test surface Typical one is shore hardness test and Leeb hardness test.	rebound hardness test

No.	Term (Japanese character)	Definition	English equivalent																																																																																																																			
1403	微小硬さ試験	generic term of hardness test belonging to indentation hardness test using with very small test force In JIS , micro Vickers hardness test to be conducted with test force under 1.961 N {0.2 kgf} and knoop hardness test to be conducted with test force 19.614 N {2 kgf} or under are specified.	microhardness test																																																																																																																			
1411	初試験力	definite test force to be applied to press the indenter on the test surface of test piece preliminarily in order to settle the position to be taken as reference for measurements of indented depth of indenter in Rockwell hardness test (see table 2) Table 2 Scale and related matters of Rockwell hardness and Rockwell superficial hardness <table><tr><th></th><th>Scale</th><th>Hardness symbol</th><th>Indenter</th><th>Preliminary test force F_0 N</th><th>Additional test force F_1 N</th><th>Total test force F N</th><th>Applicable range</th></tr><tr><td rowspan="9">Rockwell hardness</td><td>A</td><td>HRA</td><td>Diamond cone</td><td>98.07</td><td>490.3</td><td>588.4</td><td>20 HRA to 88 HRA</td></tr><tr><td>B</td><td>HRB</td><td>Ball of 1.587 5 mm</td><td>98.07</td><td>882.6</td><td>980.7</td><td>20 HRB to 100 HRB</td></tr><tr><td>C</td><td>HRC</td><td>Diamond cone</td><td>98.07</td><td>1 373</td><td>1 471</td><td>20 HRC to 70 HRC</td></tr><tr><td>D</td><td>HRD</td><td>Diamond cone</td><td>98.07</td><td>882.6</td><td>980.7</td><td>40 HRD to 77 HRD</td></tr><tr><td>E</td><td>HRE</td><td>Ball of 3.175 mm</td><td>98.07</td><td>882.6</td><td>980.7</td><td>70 HRE to 100 HRE</td></tr><tr><td>F</td><td>HRF</td><td>Ball of 1.587 5 mm</td><td>98.07</td><td>490.3</td><td>588.4</td><td>60 HRF to 100 HRF</td></tr><tr><td>G</td><td>HRG</td><td>Ball of 1.587 5 mm</td><td>98.07</td><td>1 373</td><td>1 471</td><td>30 HRG to 94 HRG</td></tr><tr><td>H</td><td>HRH</td><td>Ball of 3.175 mm</td><td>98.07</td><td>490.3</td><td>588.4</td><td>80 HRH to 100 HRH</td></tr><tr><td>K</td><td>HRK</td><td>Ball of 3.175 mm</td><td>98.07</td><td>1 373</td><td>1 471</td><td>40 HRK to 100 HRK</td></tr><tr><td rowspan="6">Rockwell superficial hardness</td><td>15N</td><td>HR15N</td><td>Diamond cone</td><td>29.42</td><td>117.7</td><td>147.1</td><td>70 HR15N to 94 HR15N</td></tr><tr><td>30N</td><td>HR30N</td><td>Diamond cone</td><td>29.42</td><td>264.8</td><td>294.2</td><td>42 HR30N to 86 HR30N</td></tr><tr><td>45N</td><td>HR45N</td><td>Diamond cone</td><td>29.42</td><td>411.9</td><td>441.3</td><td>20 HR45N to 77 HR45N</td></tr><tr><td>15T</td><td>HR15T</td><td>Ball of 1.587 5 mm</td><td>29.42</td><td>117.7</td><td>147.1</td><td>67 HR15T to 93 HR15T</td></tr><tr><td>30T</td><td>HR30T</td><td>Ball of 1.587 5 mm</td><td>29.42</td><td>264.8</td><td>294.2</td><td>29 HR30T to 82 HR30T</td></tr><tr><td>45T</td><td>HR45T</td><td>Ball of 1.587 5 mm</td><td>29.42</td><td>411.9</td><td>441.3</td><td>10 HR45T to 72 HR45T</td></tr></table>		Scale	Hardness symbol	Indenter	Preliminary test force F_0 N	Additional test force F_1 N	Total test force F N	Applicable range	Rockwell hardness	A	HRA	Diamond cone	98.07	490.3	588.4	20 HRA to 88 HRA	B	HRB	Ball of 1.587 5 mm	98.07	882.6	980.7	20 HRB to 100 HRB	C	HRC	Diamond cone	98.07	1 373	1 471	20 HRC to 70 HRC	D	HRD	Diamond cone	98.07	882.6	980.7	40 HRD to 77 HRD	E	HRE	Ball of 3.175 mm	98.07	882.6	980.7	70 HRE to 100 HRE	F	HRF	Ball of 1.587 5 mm	98.07	490.3	588.4	60 HRF to 100 HRF	G	HRG	Ball of 1.587 5 mm	98.07	1 373	1 471	30 HRG to 94 HRG	H	HRH	Ball of 3.175 mm	98.07	490.3	588.4	80 HRH to 100 HRH	K	HRK	Ball of 3.175 mm	98.07	1 373	1 471	40 HRK to 100 HRK	Rockwell superficial hardness	15N	HR15N	Diamond cone	29.42	117.7	147.1	70 HR15N to 94 HR15N	30N	HR30N	Diamond cone	29.42	264.8	294.2	42 HR30N to 86 HR30N	45N	HR45N	Diamond cone	29.42	411.9	441.3	20 HR45N to 77 HR45N	15T	HR15T	Ball of 1.587 5 mm	29.42	117.7	147.1	67 HR15T to 93 HR15T	30T	HR30T	Ball of 1.587 5 mm	29.42	264.8	294.2	29 HR30T to 82 HR30T	45T	HR45T	Ball of 1.587 5 mm	29.42	411.9	441.3	10 HR45T to 72 HR45T	preliminary test force
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1412	試験力	definite force applied to press indenter into the test piece under test in indentation hardness test	test force																																																																																																																			
1413	追加試験力 〔ロックウェル硬さ試験の〕	definite test force to be applied for pressing indenter further after preliminary test force has been applied in Rockwell hardness test (see table 2)	additional test force [(total test force)– (preliminary test force)]																																																																																																																			
1414	負荷時間	one type of expression of speed to press indenter into the test piece in indentation hardness test Time from beginning to apply test force on indenter contacted with test surface of test piece until attaining complete specified force.	time for the application of the test force (loading time)																																																																																																																			
1415	試験力保持時間	time of holding constantly the specified magnitude of test force from the time for application of test force to the time removing the test force in indentation hardness test	duration of the test force (full load application time)																																																																																																																			

No.	Term (Japanese character)	Definition	English equivalent
1416	硬さ基準片	metal block manufactured according to the specified requirements (e.g., JIS) having small fluctuation in hardness from its specified hardness value for the purpose of indirect verification of hardness testing machine Some blocks used for adjustment, ordinary inspection, etc. of hardness testing machines which are not complying with the requirements of JIS are used too, but these are designated as hardness comparison blocks or hardness adjustment blocks, etc. and are discriminated from the standardized block.	standardized block
1421	ブリネル硬さ試験	test to measure the hardness of test piece from the size of permanent indentation occurred in pressing of ball indenter into test surface of test piece by specified test force In JIS , hardmetal balls of diameter 1 mm, 2.5 mm, 5 mm or 10 mm are specified. For the test force, it is specified in the range of 9.807 N to 29.42 kN {1 kgf to 3 000 kgf} combined with the diameter of indenter.	Brinell hardness test
1422	ブリネル硬さ	value of applied test force (N) divided by the surface area of permanent indentation (mm ²) HBW is used for the hardness symbol.	Brinell hardness
1431	ビッカース硬さ試験	test to measure the hardness of test piece from the magnitude of permanent indentation caused by pressing the square pyramidal diamond indenter with face angle 136° into the test surface of material by predetermined test force In JIS , test method with test force of 0.098 07 N to 980.7 N {10 gf to 100 kgf} is specified. Further, test with test force under 1.961 N {0.2 kgf} is discriminated as the micro hardness test (micro Vickers hardness test).	Vickers hardness test
1432	ビッカース硬さ	value of applied test force (N) divided by the surface area of permanent indentation (mm ²) in Vickers hardness test HV is used for the hardness symbol.	Vickers hardness
1441	ヌープ硬さ試験	test to measure the hardness of test piece from the magnitude of permanent indentation caused by pressing rhombic pyramidal diamond indenter with twin dihedral angles 172.5° and 130° into test surface of material with predetermined test force In JIS , it is specified as micro hardness test with the test force of 0.098 07 N to 19.614 N {10 gf to 2 000 gf} is specified (see 1403).	Knoop hardness test
1442	ヌープ硬さ	value of used test force (N) divided by projected area of permanent indentation (mm ²) HK is used for the hardness symbol.	Knoop hardness