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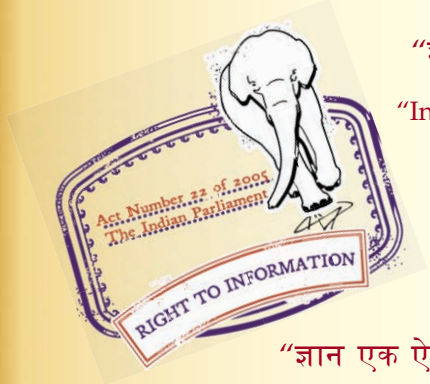

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Indian Standard

METHODS OF MEASUREMENT AND EVALUATION OF DEFECTS IN TIMBER

PART I LOGS

(First Revision)

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METHODS OF MEASUREMENT AND EVALUATION OF DEFECTS IN TIMBER

PART I LOGS

(First Revision)

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Indian Standard

METHODS OF MEASUREMENT AND EVALUATION OF DEFECTS IN TIMBER

PART I LOGS

(First Revision)

0. FOREWORD

0.1 This Indian Standard (Part I) (First Revision) was adopted by the Indian Standards Institution on 24 September 1976, after the draft finalized by the Timber Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 This standard was first published in 1965. The earlier version of the standard covered defects both in logs and converted timber. However, since some of the defects which are found in logs may not be there in converted timber and vice-versa, it was felt desirable, for the sake of easy reference, to deal with logs and converted timber in separate standards. Accordingly, the standard is now being published in two parts, Part I dealing with defects in logs and Part II dealing with defects in converted timber.

0.3 There are several Indian Standards and also individual specifications of various government departments which cover the use of timber of various species for various purposes. Timber being a natural product, contains several defects which may considerably influence its utilization. Being an important raw material for various industrial and engineering purposes the quality of species requires to be graded in several cases. Several international grading rules are available for various forms of hardwoods, conifers and teak. In order that a suitable and common basis may be provided for satisfactory grading, an attempt is made to standardize methods of measuring the various defects and establishing a system of quantitative evaluation of the commonly occurring ones. While occurrence, location and distribution of defects may serve as acceptance criteria for selection of material for any purpose, the cumulative effect of defects as indicated in their quantitative evaluation will help ultimate grading of the material, which is again reflected in price structure.

0.4 The provisions contained in this standard are based on many of the existing Indian Standards on timber and grading rules of Asia Pacific Forestry Commission. In cases where no guidance is available from these specifications a logical projection is made for such defects which have not been covered anywhere else so far.

0.5 While it may be remembered that an approximate relationship may exist between the grade of a material and the percentage of the utility value and price structure of the same, it requires to be emphasized that the quantitative evaluation of defects cannot be merely a result of mathematical calculations, but of a collection of the different aspects of a natural product brought on as close as possible to a technological pattern. As such, the use of the present standard is subject to the limitations of the best and the worst of human elements in inspectors of timber, who depend on this standard for their guidance.

0.6 Despite every attempt to harmonize different points of consideration in framing these rules it is anticipated that there would be several gaps between theory and practical work. It is, therefore, suggested that in the application of these rules many facts will come into light which would be incorporated in successive revisions of the present standard.

0.7 In the formulation of this standard due weightage has been given to international co-ordination among the standards and practices prevailing in different countries in addition to relating it to the practices in this field in this country.

0.8 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard (Part I) deals with methods of identification, measurement and quantitative evaluation of commonly occurring defects in logs.

2. TERMINOLOGY

2.0 For the purpose of this standard, the definitions given in IS : 707-1976† and the following shall apply.

2.1 Defect — An abnormality or irregularity in wood which lowers its technical quality or commercial value by decreasing it in strength and affecting adversely its use or its appearance or in further conversion. For the

*Rules for rounding off numerical values (*revised*).

†Glossary of terms applicable to timber technology and utilization (*second revision*).

purpose of this standard defects are divided according to kind and evaluated in units, with regard to their sizes.

2.2 Equivalent Defect — Any defect not listed but which can be rated the same as a defect mentioned in the standard and which causes equal degrade in further utilization.

2.3 Units of Defects — It is a quantitative representation of the approximate degrade of the utilizable material for each defect. A sum of units of various defects gives a total estimate of the entire degrade due to all defects present simultaneously in the material under consideration. The units of various defects are mentioned in the corresponding tables given under each defect.

3. IDENTIFICATION AND MEASUREMENTS OF DEFECTS

3.1 Burr or Burl — It is identified as a large bulge or excrescence that is formed on the trunk or branches of a tree. It shall be measured by the maximum diameter of the bulge formation on the trunk and shall be described along with its position in the material. Though technically a defect in wood, it is generally not evaluated quantitatively. However, if so required, it shall be evaluated as given in Table 1.

TABLE 1 DEFECT VALUES FOR BURRS

Diameter of the Bulge Formation on the Trunk, *Max*	Unit
(1)	(2)
cm	
10	0·08
20	0·16
30	0·24
40	0·36
50	0·48
60	0·60
70	0·75

Note 1 — For more than one burr, the values may be added.

Note 2 — For intermediate values, the next higher measurement of the defect shall be taken.

3.2 Check — It is identified as a fine crack indicating separation of fibres along the grain, not extending through the piece from one surface to another. This is measured by the length and maximum width of separation of fibres. When the width of check is less than 2 mm and the checks are numerous on any surface, they are evaluated on the basis of their average length and the affected area on the cylindrical surface, expressed as a percentage of the whole area as given in Table 2. When the width of check is more than 2 mm, this is evaluated in the same manner as shake (*see* Table 9).

TABLE 2 DEFECT VALUES FOR CHECKS OF LESS THAN 2 mm WIDTH

(*Clause* 3.2)

Length of an Average Check	Affected Area Expressed as Percentage of the Whole Area on Which They Appear				
	20	40	60	80	100
(1)	(2)	(3)	(4)	(5)	(6)
cm					
5	0·01	0·02	0·04	0·08	0·16
10	0·02	0·04	0·08	0·16	0·32
15	0·03	0·06	0·12	0·24	0·48
20	0·04	0·08	0·16	0·32	0·64
25	0·05	0·10	0·20	0·40	0·80
30	0·06	0·12	0·24	0·48	0·96
35	0·07	0·14	0·28	0·56	1·12
40	0·08	0·16	0·32	0·64	1·28
45	0·09	0·18	0·36	0·72	1·44
50	0·10	0·20	0·40	0·80	1·60

NOTE 1 — Group of checks less than 5 cm in length or fine checks shall be ignored.

NOTE 2 — The above values are applicable for material of length of 10 m and fraction thereof. For material of greater length the values shall be multiplied by $10/L$, where L is the length of the material in metres.

NOTE 3 — For intermediate values, the next higher measurement of the defect shall be taken.

3.3 Curvature (Bend) — It is identified by any deviation from straightness of the log and is measured by the chord which the curvature makes between the extreme edges of deviation and by the depth at the middle portion. It is evaluated by the ratio of maximum deviation (d) to the length of the chord (l) as given in Table 3.

TABLE 3 DEFECT VALUES FOR CURVATURE (BEND)

Ratio of Maximum Deviation to the Length of the Chord (d/l)	Unit
(1)	(2)
0·01	0·01
0·02	0·02
0·03	0·05
0·04	0·08
0·05	0·12
0·06	0·16
0·07	0·22
0·08	0·30
0·09	0·40
0·10	0·50

NOTE — For intermediate values the next higher measurement of defect shall be taken.

3.4 Decay or Rot — These are identified as brownish or light grey patches on the surface of the log. The condition of decay is judged by the degree of softness as detected by the relative ease of penetration of a sharp knife or similar tool. The decay is estimated by the approximate affected area expressed as a percentage of the total cylindrical area. The units of defects for decay or rot are given in Table 4.

3.5 Flute — It is identified as the longitudinal depression on the surface of the log, usually near the butt end and is measured by its length on the longitudinal surface and the depth at its maximum point, that is, between the bottom of the flute and a tape taken round the log. The depth is some times expressed as a percentage of the girth of the log. Flute is quantitatively evaluated as in Table 5.

3.6 Heart Rot — It is identified as the decomposed and discoloured central portion of the log resulting from decay and is measured as the percentage of the maximum diameter of the rot portion to that of the least diameter of the log at that cross section as given in Table 6.

TABLE 4 DEFECT VALUES FOR DECAY OR ROT

(*Clause* 3.4)

Percentage Area of Decay or Rot	Unit
(1)	(2)
1	0·01
2	0·02
5	0·05
10	0·10
15	0·15
20	0·20
25	0·25
30	0·30
35	0·35
40	0·40
45	0·45
50	0·50

Note 1 — More than 50 percent area decayed shall not be considered in ogs, squares or converted timber.

Note 2 — If the decay is on both the ends, the defect values shall be added together and multiplied by ½.

TABLE 5 DEFECT VALUES FOR FLUTES IN LOGS

(*Clause* 3.5)

Length of Flute	Depth of Flute								
	5 cm	7·5 cm	10·0 cm	12·5 cm	15·0 cm	17·5 cm	20·0 cm	22·5 cm	25·0 cm
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
m									
0·5	0·04	0·06	0·06	0·08	0·10	0·12	0·14	0·16	0·18
1·0	0·06	0·14	0·14	0·16	0·20	0·24	0·26	0·30	0·34
1·5	0·10	0·14	0·20	0·26	0·30	0·36	0·40	0·46	0·55
2·0	0·14	0·20	0·26	0·32	0·40	0·46	0·54	0·60	0·65
2·5	0·16	0·26	0·34	0·42	0·50	0·58	0·66	0·76	0·86
3·0	0·20	0·30	0·40	0·50	0·60	0·70	0·80	0·90	1·00
3·5	0·24	0·34	0·46	0·58	0·70	0·82	0·94	1·06	1·18
4·0	0·26	0·40	0·54	0·66	0·80	0·94	1·06	1·20	1·34
4·5	0·30	0·46	0·60	0·76	0·90	1·06	1·20	1·34	1·48
5·0	0·34	0·50	0·66	0·84	1·00	1·16	1·34	1·50	1·66

NOTE 1 — The defect values for flutes thus determined is for depth of flute up to 25 cm. For bigger flutes, the values are modified as follows:

Depth of Flute cm	*Multiply Defect Value of 25 cm Depth by*
Above 25 up to 35	1·25
„ 35 „ 50	1·50
„ 50 „ 65	2·00
„ 65 „ 80	2·50

NOTE 2 — For the intermediate values the next higher measurement of defect shall be taken.

NOTE 3 — The above unit of defects applies for logs of length of 10 m and above. For shorter lengths, the unit of defect shall be multiplied by $10/L$, where L is the length of the log.

NOTE 4 — If the number of flutes is more than one, the respective unit of defect shall be added.

TABLE 6 DEFECT VALUES FOR HEART ROT

(*Clause* 3.6)

Percentage Heart Rot	Unit
(1)	(2)
5	0·05
10	0·10
15	0·15
20	0·20
25	0·25
30	0·30
35	0·35
40	0·40
45	0·45
50	0·50

Note 1 — More than 50 percent area of heart rot in logs shall not be considered.

Note 2 — In case of heart rot occurring on both the ends of the log, the defect values shall be added together and multiplied by 3/4.

3.7 Hole — It is identified as cavities caused by worms, insects, birds or mechanical means and is expressed by the diameter of the hole. When occurring in large numbers, it shall be described by the number present in any 100 cm^2 area of the surface on which it occurs. This includes borer holes, grub holes, insect holes but pin holes and knot holes (loose knot) are excluded. This is quantitatively evaluated as in Table 7.

TABLE 7 DEFECT VALUES FOR HOLES

Concentration of Holes per 100 cm^2 not More than	Diameter of the Largest Hole in any Concentration				
	Up to 5 cm	Above 5 up to 10 cm	Above 10 up to 15 cm	Above 15 up to 20 cm	Above 20 up to 25 cm
(1)	(2)	(3)	(4)	(5)	(6)
1	0·01	0·03	0·06	0·09	0·18
2	0·02	0·06	0·12	0·18	0·36
3	0·03	0·09	0·18	0·27	0·54
4	0·04	0·12	0·24	0·36	0·72
5	0·05	0·15	0·30	0·45	0·90

Note 1 — If holes are concentrated separately at more than one place, the defect units will be added for all places.

Note 2 — Pin holes are not evaluated quantitatively.

Note 3 — Knot holes (loose knot) shall be evaluated as unsound knots.

3.8 Inbark — It is identified as patches of bark or other material partially or wholly enclosed inside the wood and is measured and evaluated in the same way as knot.

3.9 Knot — This is identified as basal portion of branches which has been either cut off at the trunk or covered with bark, appearing as embedded material circular in shape. The maximum diameter shall be taken as the size of the knot and shall be described along with its form and position in the log. These are quantitatively evaluated in terms of number of knots on a surface and the mean of maximum diameter of knots as given in Table 8.

TABLE 8 DEFECT VALUES FOR SOUND KNOTS

No. of Knots	Mean of Maximum Diameter of Knots			
	Up to 5 cm	Above 5 up to 10 cm	Above 10 up to 15 cm	Above 15 up to 20 cm
(1)	(2)	(3)	(4)	(5)
1	0·01	0·04	0·08	0·12
2	0·02	0·08	0·16	0·24
3	0·03	0·12	0·24	0·36
4	0·04	0·16	0·32	0·48
5	0·05	0·20	0·40	0·60
6	0·06	0·24	0·48	0·72
7	0·08	0·30	0·60	0·90
8	0·10	0·40	0·80	1·20
9	0·13	0·54	1·08	1·62
10	0·17	0·70	1·40	2·10
11	0·21	0·84	1·60	2·42
12	0·25	1·00	2·00	3·00
13	0·29	1·16	2·32	3·48
14	0·33	1·32	2·64	3·96
15	0·38	1·50	3·00	4·50

Note 1 — Defect values shall be doubled for unsound or decayed knots.

Note 2 — The above values are applicable for logs of length of 10 m and above. For shorter lengths, the defect values shall be multiplied by $10/L$, where L is the length of the log.

3.10 Pitch Pocket — This is identified as cavities containing accumulation of resin between growth rings and is measured by its length and maximum width. This is not evaluated quantitatively for units of defects.

3.11 Shake — This is identified as partial or complete separation between adjoining layers of tissues as seen in end surfaces of logs and is classified as heart shake, ring or cup shake and star shake. All shakes other than star shakes shall be measured by the length and the maximum width of the opening, the latter serving also as an indication of the approximate depth of the opening. The shakes shall be described along with the form and location on the cross section of the material. This is quantitatively evaluated as given in Table 9.

3.11.1 Star shakes are identified as number of shakes occurring at or near the pith giving the appearance of star on the end surface of the logs and shall be evaluated by the length and width of the longest shake in the star and by half the number of shakes in the star as given in Table 9.

TABLE 9 DEFECT VALUES OF SHAKES

(*Clauses* 3.2, 3.11 *and* 3.11.1)

Length of Shake	Width of the Shake							
	0·2 cm	0·4 cm	0·6 cm	0·8 cm	1·0 cm	1·5 cm	2·0 cm	2·5 cm
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
cm								
2	0·06	0·06	0·06	0·08	0·10	0·10	0·12	0·14
4	0·10	0·12	0·14	0·16	0·18	0·20	0·24	0·26
6	0·14	0·16	0·20	0·26	0·28	0·30	0·36	0·40
7	0·20	0·24	0·26	0·32	0·36	0·40	0·46	0·54
8	0·26	0·30	0·34	0·42	0·46	0·50	0·58	0·66
9	0·30	0·36	0·40	0·50	0·56	0·60	0·70	0·80
10	0·34	0·40	0·46	0·58	0·64	0·70	0·82	0·94
12	0·40	0·48	0·54	0·66	0·74	0·80	0·94	1·06
14	0·50	0·58	0·66	0·84	0·92	1·00	1·16	1·34
16	0·54	0·64	0·74	0·92	1·02	1·10	1·28	1·46
18	0·60	0·70	0·80	1·00	1·10	1·20	1·40	1·60
20	0·66	0·76	0·86	1·08	1·20	1·30	1·52	1·74

NOTE 1 — For more than one shake the values may be added.

NOTE 2 — When applying this table for star shakes, only the largest shake is taken into consideration but the values may be taken by multiplication of the above with half the number of shakes in the star.

NOTE 3 — These values are applicable for logs whose area of cross section does not exceed 0·5 cm^2. For material of larger cross section, the same values shall be halved.

NOTE 4 — This table is also used for checks of width more than 2 mm (*see* 3.2).

NOTE 5 — For intermediate values the next higher measurement of the defect shall be taken.

3.12 Spiral Grain (Twist of the Tree) — It is identified as spiraling grain with regard to the axis of the log and is measured by the acute angle it makes with the line on the surface parallel to the axis of the log. It is described either in clockwise or anti-clockwise, or right-handed or left-handed, depending on the progress of the spiral from butt to the top as viewed from the top end. Twist or spiral grain is also measured as a gradient expressing the ratio of the two sides of a right angle, one parallel to the axis and the other tangential to the circumference of the log with the spiral as the hypotenuse. It is quantitatively evaluated as given in Table 10.

TABLE 10 DEFECT VALUES OF SPIRAL GRAIN

(*Clause* 3.12)

SLOPE	UNIT
(1)	(2)
5 to 10°	0·20
11 „ 20°	0·45
21 „ 30°	0·65
31 „ 40°	0·80
41 „ 50°	0·90
Above 50°	1·00

NOTE — Slope up to 5° will not be considered.

3.13 Split — It is identified as a separation of fibres as seen both on the cross section as well as on the longitudinal surface of the log. It is measured by the length on the longitudinal surface and by the depth at the end section (that is, the extent of the split as measured on the end section). This is quantitatively evaluated as given in Table 11.

TABLE 11 DEFECT VALUES FOR SPLITS

LENGTH OF SPLIT ON THE LONGITUDINAL SURFACE	DEPTH OF THE SPLIT AT THE END SURFACE						
	1·0 cm	1·5 cm	2·0 cm	2·5 cm	3·0 cm	3·5 cm	4·0 cm
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
m							
0·25	0·06	0·06	0·06	0·08	0·10	0·10	0·12
0·50	0·10	0·12	0·14	0·16	0·18	0·20	0·24
0·75	0·14	0·16	0·20	0·26	0·28	0·30	0·36
1·00	0·20	0·24	0·26	0·32	0·36	0·40	0·46
1·25	0·26	0·30	0·34	0·42	0·46	0·50	0·58
1·50	0·30	0·36	0·40	0·50	0·56	0·60	0·70
1·75	0·34	0·40	0·46	0·58	0·64	0·70	0·82
2·00	0·40	0·48	0·54	0·60	0·74	0·80	0·94
2·25	0·46	0·54	0·60	0·76	0·84	0·90	1·06
2·50	0·50	0·58	0·66	0·84	0·92	1·00	1·16
2·75	0·54	0·64	0·74	0·92	1·02	1·10	1·28
3·00	0·60	0·70	0·80	1·00	1·10	1·20	1·40
3·25	0·66	0·76	0·86	1·08	1·20	1·30	1·52
3·50	0·70	0·82	0·94	1·16	1·28	1·40	1·64
3·75	0·74	0·88	1·00	1·26	1·38	1·50	1·76
4·00	0·80	0·94	1·06	1·32	1·46	1·60	1·86

NOTE 1 — For more than one split but less than three, the values may be added.

NOTE 2 — For splits more than three in number, the largest split may be considered and multiplied by half the number of total splits.

NOTE 3 — The above values are applicable for material of length of 10 m and fraction thereof. For material of greater length, the values should be multiplied by $10/L$, where L is the length of the material in metres.

NOTE 4 — For intermediate values the next higher measurement of the defect shall be taken.

3.14 Sap Stain — It is identified as discoloration usually in the sapwood on the surface of the material. This is not to be evaluated quantitatively for units of defects.

4. OTHER DEFECTS

4.1 Any defect not listed above but which will debar any piece from its expected utility can be considered as equivalent defect to any of the above for purposes of measurement and evaluation depending on the appearance, size, location and distribution.

4.2 Defect values for those which cannot be considered as equivalent defects but which can be definitely categorized as those which reduce the utility of timber, a value of 0·10 may be added to the total for safety.

5. TOLERANCES IN MEASUREMENT OF DEFECTS AND THEIR EVALUATION

5.1 All linear measurements of defects shall be made correct to 1 mm and surface area measurements shall be calculated correct to 1 cm^2 based on linear measurements.

5.2 The units of defects shall be evaluated correct to a second place of decimal.

5.3 Where ready figures for the units are not available in Tables 1 to 11 and an estimate is required to be made, the same shall be proportionately obtained in accordance with the general pattern of the concerned table. In all cases of doubt the next higher point will be chosen from the table.

5.4 All defects are expected to be evaluated on the basis of cylindrical logs with all undue projections dressed down to the cylinder.

6. INFLUENCE OF DEFECTS ON THE PROPERTIES OF TIMBER

6.1 The following indicates the general influence of some of the defects mentioned in the standard. In some cases influence of defects not mentioned in the standard is also given for general guidance.

6.1.1 *Checks, Splits and Shakes* — These defects reduce the out-turn of good quality timber in conversion of logs.

6.1.2 *Compression Wood* — Compression wood has an increased density and increased shrinkage and decreased shock resistance. At the same time compression wood has lower water absorbing capacity and increased hardness and crushing strength parallel to the grain.

6.1.3 *Tension Wood* — It has high longitudinal shrinkage tending it to warp and split on machining the surface tends to be fibrous or woothy especially when green.

6.1.4 *Heartwood Rot* — This defect besides lowering the mechanical properties of wood, reduces the volume of useful timber in full sized logs.

6.1.5 *Knots* — The presence of knots in the logs may involve greater resistance in the sawing operation and affect the quality of sawn material. Conversion of logs shall thus be carefully laid out for obtaining the best material.

6.1.6 *Sap Rot* — The wood damaged by sap rot has a decreased shock resistance and increased water absorption. If wood damaged by sap rot is insufficiently seasoned or is again moistened after drying fungi may develop in the wood in service.

6.1.7 *Wane* — Wane reduces the mechanical properties of wood and the volume of useful timber.

6.1.8 *Worm Holes* — Shallow worm holes as well as small holes do not affect the quality of cut timber considerably but deep large worm holes spoil the appearance and reduce the mechanical properties of timber. This affect should be taken into consideration while converting the logs.

6.1.9 *Pith Pockets* — Pith pockets affect the appearance of timber and destroy the integrity of the wood.

6.1.10 *Mould* — Mould spoils the appearance of wood. Under favourable conditions, mould can pass on to other organic material from mouldy timber. This defect may be ignored in preservative treated timber.

6.1.11 *Sap Stain* — Sap stain, of which blue stain is more important does not affect the strength properties of timber, but spoils its appearance. Sap stain may be taken to indicate that wood is in a receptive condition for the attack of wood rotting fungi under favourable conditions. This defect may be ignored in preservative treated timber.

(*Continued from page 2*)

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INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

Base Units

Quantity	*Unit*	*Symbol*
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Supplementary Units

Quantity	*Unit*	*Symbol*
Plane angle	radian	rad
Solid angle	steradian	sr

Derived Units

Quantity	*Unit*	*Symbol*	*Conversion*
Force	newton	N	1 N = 1 kg.1 m/s^2
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m^2
Frequency	hertz	Hz	1 Hz = 1 c/s (s^{-1})
Electric conductance	siemens	S	1 S = 1 A/V
Pressure, stress	pascal	Pa	1 Pa = 1 N/m^2

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PART 1 LOGS

(First Revision)

(*Page* 11, *Table* 9, *Note* 3) — Substitute '0·5 m^2' *for* '0·5 cm^2'.

(CED 9)

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