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CEYLON STANDARDS 84 – Part VII: 1969

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QUANTITIES AND UNITS OF ACOUSTICS

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BUREAU OF CEYLON STANDARDS

QUANTITIES AND UNITS OF ACOUSTICS

C.S. 84 — Part VII : 1969

Gr.5

Ceylon Standards are subject to periodical revision in order to accommodate the progress made by industry. Suggestions for improvement will be recorded and brought to the notice of the Committees to which the revisions are entrusted.

This Standard does not purport to include all the necessary provisions of a contract.

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FOREWORD

This Ceylon Standard containing a table of Quantities and Units of Acoustics, is part of a series of Ceylon Standards dealing with quantities and units in various fields of science and technology. It was adopted as a Ceylon Standard by the Council of the Bureau of Ceylon Standards on 6th December, 1969.

The other parts of the series are:-

C.S. 84 — Part I : 1969 - Basic quantities and units of the SI and quantities and units of space and time.

C.S. 84 — Part II : 1969 - Quantities and units of periodic and related phenomena.

C.S. 84 — Part III : 1969 - Quantities and units of mechanics.

C.S. 84 — Part IV : 1969 - Quantities and units of heat.

C.S. 84 — Part V : 1969 - Quantities and units of electricity and magnetism.

C.S. 84 — Part XI . 1971 - Mathematical signs and symbols for use in physical sciences and technology.

This Standard is based on ISO Recommendation R 31 - Part VII 1965 - Quantities and Units of Acoustics.

SPECIAL REMARKS

The explanations in the definition columns for quantities presuppose in general linear systems.

When it is necessary to use subscripts to aviod confusion between similar symbols in different domains, the subscript "*a*" is recommended for the acoustical case.

The preference given to the units of the International System of Units has been indicated by placing them first.

Item No.	Quantity	Symbol	Definition[1])	Remarks
7-1.1	period, periodic time	T	Time of one cycle	
7-2.1	frequency	f,ν	$f = 1/T$	Concerning the standard tuning frequency (standard musical pitch), see ISO/R 16-1955.*
7-3.1	frequency interval		The frequency interval between two frequencies is the logarithm to a specified base of the ratio between them.	
7-4.1	angular frequency, circular frequency	ω	$\omega = 2\pi f$	
7-5.1	wavelength	λ		
7-6.1	circular wave number	k	$k = \frac{2\pi}{\lambda}$	
7-7.1	density (mass density)	p	Mass divided by volume.	

* ISO-R 16-1955: Standard Tuning Frequency (Standard Musical pitch).

1) *The statements in this column are given merely for identification and they are not intended to be complete definitions.*

7. Acoustics

Units.

Item No.	Name of unit and in certain cases abbreviation for this name	International symbol for unit	Definition	Conversion factors	Remarks
7-1	**second**	s	See 0-3.*)		
7-2	hertz	Hz	1 Hz is the frequency of a periodic phenomenon of which the periodic time is 1 s.		1 Hz = $1s^{-1}$ Cycle per second, c/s, is used primarily in English speaking countries 1 c/s = 1 Hz
7-3	octave		When the specified base of the logarithm is 2, the frequency interval is measured in octaves.		
7-4	reciprocal second	s^{-1}			
7-5	**metre**	m	See 0-1*)		
7-6	reciprocal metre	m^{-1}			
7-7	kilogramme per cubic metre	kg/m^3			1 $kg/m^3 = 10^{-3}$ g/cm^3

* C. S. 84 — Part I : 1969

Item No.	Quantity	Symbol	Definiton[1])	Remarks
7-8.1	static pressure	p_s	Pressure that would exist with no sound waves present.	
7-8.2	(instantaneous) sound pressure	p	The difference between the instantaneous pressure and the static pressure.	
7-9.1	(instantaneous) sound particle displacement.	ξ, (x)	Instantaneous displacement of particle of the medium from its mean position.	The root mean square value of the quantities 7-8.2, 7-9.1, 7-10.1, 7-11.1 and 7-12.1 are often called "effective" values and the same symbols are often used without modification to denote the effective values.
7-10.1	(instantaneous) sound particle velocity.	u, v	$u = \frac{\partial \xi}{\partial t}$	
7-11.1	(instantaneous) sound particle acceleration.	a	$a = \frac{\partial u}{\partial t}$	
7-12.1	(instantaneous) volume velocity.	q, U	Instantaneous rate of volume flow due to sound wave across an area.	
7-13.1	velocity of sound	c	Velocity of propagation of sound wave.	

[1]) See page 6

Item No	Name of unit and in certain cases abbreviation for this name	International symbol for unit	Definition	Conversion factors	Remarks
7-8.*a*	pascal	Pa	see note 0-7*		1 Pa = 1 N/m^2
7-8.*b*	bar	bar		1 bar = 10^5 Pa, (exactly)	The microbar (1 μbar = 1 dyn/cm^2) is also called barye
7-8.*c*	dyne per square centimetre	dyn/cm^2		1 dyn/cm^2 = 10^{-1} Pa (exactly)	
7-9	metre	m			
7-10	metre per second	m/s			
7-11	metre per second squared	m/s^2			
7-12	cubic metre per second	m^3/s			
7-13	metre per second	m/s			

* C. S. 84 — Part 1 - 1969

Item No.	Quantity	Symbol	Definition[1])	Remarks
7-14.1	sound energy density	E	Mean sound energy in a given volume divided by that volume.	If the energy density is varying with time, the mean must be taken over an interval during which the sound may be considered statistically stationary.
7-15.1	sound energy flux, sound power	P, (N, W)	Sound energy transferred in a certain time interval, divided by the duration of that interval.	
7-16.1	sound intensity	I, J	For unidirectional sound energy flux, sound energy flux through an area normal to the direction of propagation divided by that area.	
7-17.1	specific acoustic impedance	Z_s, (W)	The complex representation of sound pressure at a point in a sound wave divided by the complex representation of particle velocity at that point	In these definitions, the quantities entering the numerators and denominators are here assumed to be sinusoidal

[1]) See Page 6

Item No.	Name of unit and in certain cases abbreviation for this name	International symbol for unit	Definition	Conversion factors	Remarks
7-14.a	joule per cubic metre	J/m^3			
7-14.b	erg per cubic centimetre	erg/cm^3		1 $erg/cm^3 = 10^{-1}$ J/m^3 (exactly)	
7-15.a	watt	W			
7-15.b	erg per second	erg/s		1 erg/s = 10^{-7} W (exactly)	
7-16.a	watt per square metre	W/m^2			
7-16.b	erg per second square centimetre.	erg/s cm^2		1 erg/s cm^2 = 10^{-3} W/m^2 (exactly)	
7-17.a	newton second per metre cubed	N s/m^3			
7-17.b	dyne second per centimetre cubed	dyn s/cm^3		1 dyn s/cm^3 = 10 N s/m^3 (exactly)	This unit is sometimes referred to as rayl.

Item No.	Quantity	Symbol	Definition [1]	Remarks
7-18.1	acoustic impedance	Z_a, (Z)	The complex representation of average sound pressure at a vibarting surface divided by the complex representation of volume velocity at that surface.	$Z_a = \frac{Z_s}{S}$; $Z_m = SZ_s$, where S is the area of the surface considered.
7-19.1	mechanical impedance	Z_m, (w)	The complex representation of total force at a surface (or at a point) of a mechanical system divided by the complex representation of average particle velocity at that surface (or of particle velocity at that point) in the direction of the force.	
7-20.1	sound power level	L_P,(L_N, L_W)	Ten times the common (Briggsian) logarithm of the ratio of a given sound power to a reference power.	The reference power must be explicitly stated.
7-21.1	sound pressure level	L_P (L)	Twenty times the common (Briggsian) logarithm of the ratio of a given sound pressure to a reference pressure.	The reference pressure must be explicitly stated. It is recommended that for sound in air the value 2×10^{-5} Pa (2×10^{-4} dyn/cm^2) should be universally adopted as the reference pressure.

[1]) See Page 6

Item No.	Name of unit and in certain cases abbreviation for this name	International symbol for unit	Definition	Conversion factors	Remarks
7-18.a	newton second per metre to the fifth	$N\ s/m^5$			
7-18.b	dyne second per centimetre to the fifth	$dyn\ s/cm^5$		1 $dyn\ s/cm^5 = 10^5\ N\ s/m^5$ (exactly)	
7-19.a	newton second per metre	$N\ s/m$			
7-19.b	dyne second per centimetre	$dyn\ s/cm$		1 $dyn\ s/cm = 10^{-3}\ N\ s/m$ (exactly)	
7-20	decibel	dB			
7-21	decibel	dB			See also remark to 2-8.a. C.S. 84 : Part II.

Item No.	Quantity	Symbol	Definition[1])	Remarks
7-22.1	damping coefficient	δ	If a quantity is a function of time t given by $F(t) = Ae^{-\delta t} \sin \frac{2\pi (t-t_0)}{T}$, then δ is the damping coefficient.	
7-23.1	logarithmic decrement	Λ	Product of damping coefficient and period.	See also C.S. 84 — Part II
7-24.1	attenuation coefficient	α	If a quantity is a function of distance x given by $F(x) = Ae^{-\alpha x} \cos \beta (x-x_0)$, then α is the attenuation coefficient an d β is the phase coefficient.	See also C.S. 84 — Part II
7-24.2	phase coefficient	β		When α is negligible, β is often replaced by k, the circular wave number. See 7-6.1
7-24.3	propagation coefficient	γ	$\gamma = \alpha + j\beta$	
7-25.1	dissipation coefficient	δ	Ratio of the sound energy flux dissipated to the incident sound energy flux.	These quantities are dimensionless.

1) See Page 6

Item No.	Name of unit and in certain cases abbreviation for this name	International symbol for unit	Definition	Conversion factors	Remarks
7-22	neper per second	Np/s			See also C.S. 84 — Part II
7-23	neper	Np			See also remark to 2-7.a. C.S. 84 — Part II
7-24	reciprocal metre	m^{-1}			

Item No.	Quantity	Symbol	Definition[1]	Remarks
7-25.2	reflection coefficient	r, ρ	Ratio of the sound energy flux reflected to the incident sound energy flux.	
7-25.3	transmission coefficient	$\bar{\tau}$	Ratio of the sound energy flux transmitted to the incident sound energy flux.	$\delta + \rho + \bar{\tau} = 1$
7-25.4	acoustic absorption coefficient.	α , (α_a)	$\alpha = \delta + \bar{\tau}$	
7-26.1	sound reduction index, sound transmission loss	R	$10 \log_{10} \frac{1}{\bar{\tau}}$	
7-27.1	equivalent absorption area of a surface or object	A	The equivalent absorption area of a surface or object in a diffuse sound field is that area of a surface having the absorption factor of unity which, if diffraction effects are neglected, would in the same diffuse sound field absorb the same power.	
7-28.1	reverberation time	T	Time required for the average sound energy density in an enclosure to decrease to 10^{-6} of the initial value (by 60 dB) after the source has stopped.	

1) See page 6

Item No.	Name of unit and in certain cases abbreviation for this name	International symbol for unit	Definition	Conversion factors	Remarks
7-26	decibel	dB			
7-27.a	square metre	m^2			
7-27.b	square foot	ft^2		1 ft^2 = **0.092 903 0** m^2	
7-28	second	s			

Item No.	Quantity	Symbol	Definition [1]	Remarks
7-29.1	loudness level	L_N, (A)	The loudness level of a sound is defined by $L_N = 20 \log_{10}\left(\frac{p_{eff}}{p_{o\,eff}}\right)$ 1 kHz where p_{eff} is the effective sound pressure of a standard pure tone of 1 kHz which is judged by a normal observer under standardized listening conditions as being equally loud and $p_{o\,eff} = 2 \times 10^{-5}$ Pa	These quantities are dimensionless.
7-30.1	loudness	N	The loudness is the normal observer's auditory estimate of the ratio between the strength of the sound considered and that of a reference sound having a loudness level of 40 phons.	These are not purely physical quantities but entail subjective evaluation.

[1]) See page 6

Item No.	Name of unit and in certain cases abbreviation for this name	International symbol for unit	Definition	Conversion factors	Remarks
7-29	phon				
7-30	sone				A standard relation between loudness in sone and loudness level in phon has been adopted for practical use.

BUREAU OF CEYLON STANDARDS

The Bureau of Ceylon Standards (BCS) is the national standards organisation of Ceylon and was established by the Hon. Minister of Industries and Fisheries, as provided for by the Bureau of Ceylon Standards Act, No. 38 of 1964.

The principal objects of the Bureau as set out in the Act are to promote standards in industry and commerce, prepare national Standards Specifications and Codes of Practice and operate a Standardisation Marks Scheme and provide testing facilities, as the need arises.

The Bureau is financed by Government grants and the sale of its publications. Financial and administrative control is vested in a Council appointed in accordance with the provisions of the Act.

The detailed preparation of Standard Specifications is done by Drafting Committees composed of experts in each particular field assisted by permanent officers of the Bureau. These Committees are appointed by Divisional Committees, which are appointed by the Council. All members of the Drafting and Divisional Committees render their services in an honorary capacity. In preparing the Standard Specifications the Bureau endeavours to ensure adequate representation of all view points.

In the international field the Bureau represents Ceylon in the International Organisation for Standardisation (ISO) and will participate in such fields of Standardisation as are of special interest to Ceylon.