

Appendix 9: Equipment Specifications for sound field systems in schools

Standard Loudspeakers

A standard specification for loudspeakers is difficult, since there are circumstances when specialised solutions are required. The specification provided below is a general recommendation for typical loudspeakers used in a set of four to six in a classroom within the normal range of sizes.

Specification Descriptor	Standard Symbol	Recommended value or range	Comments
Characteristic Sensitivity	L_p	>85 dB @ 1 W	
RMS Power		>10 W continuous bandlimited pink noise 150 Hz to 8 kHz	
Frequency Response		+/- 3 dB over range 150 Hz to 8 kHz	
Coverage Angle		Min 90° H x 60° V Min 90° H x 90° V	Wall mounting type Ceiling mounting type
Loudspeaker type		2-way, 100 V preferred	Must be matched to amplifier and system suitably wired.
Enclosure		Flame retarding for wall mounted applications. Fire rated back enclosure for all ceiling loudspeakers that penetrate a fire rated ceiling. Acoustically rated back enclosure for all ceiling loudspeakers that penetrate a ceiling separating classroom floors.	
Brackets		Brackets for wall mounted enclosures should provide lockable adjustment vertically and horizontally. Fixing to wall and loudspeaker to be a minimum of two secure screws or bolts each. Secondary safety bond to be provided between loudspeaker and mounting surface.	
Suppliers		Many	

NXT or other Distributed Mode Loudspeakers

These loudspeakers use new and emerging technology. An "exciter" causes a panel to vibrate and the panel emits sound. The characteristics of the exciter, its location on the panel and the panel material are all important for correct operation. Products include ceiling tiles, wall mounting posters, projection screens and whiteboards that serve also as loudspeakers. There are advantages in the use of these loudspeaker types, as they provide a better average sound coverage in a room and provide a better average speech intelligibility under some conditions. The reason for this is not fully understood. Less NXT type loudspeakers are required, and it may be found that one wall mounted whiteboard model will suffice for the smaller classroom.

Specification Descriptor	Standard Symbol	Recommended value or range	Comments
Characteristic Sensitivity	L _p	>85 dB @ 1 W	
RMS Power		>10 W continuous bandlimited pink noise 150 Hz to 8 kHz	
Frequency Response		+/- 3 dB over range 150 Hz to 8 kHz	
Coverage Angle		Avg 120° H x 120° V	
Loudspeaker type		100 V preferred for ceiling type as several will be connected in parallel.	Must be matched to amplifier and system suitably wired.
Enclosure		Most require no enclosure, but usually have to be spaced away from the wall on a mounting frame. Units for classroom use should be of Class 1 or better for spread of flame. Where used in an acoustically separating ceiling, provision must be made to maintain the sound insulation behind the loudspeakers.	
Brackets		Adjustment of aiming angle is not necessary. Brackets must provide a minimum of two fixing points.	
Suppliers		Amina, Wharfedale, Sound Advance, Armstrong Ceilings	

Mixer Amplifier

Specification Descriptor	Standard Symbol	Recommended value or range	Comments
Inputs	1 mic/line	Mic (-50 dBu sensitivity) line (-10 dBu sensitivity) switchable	<ul style="list-style-type: none"> • 1 mono, compatible with teacher radio microphone receiver • 1 stereo (mixed to mono), to enable music playback, connection to computer audio output. Alternatively built-in cassette player • Prefer minimum of 1 additional mono input to enable second microphone for class discussion use when child using personal FM system is present.
	1 stereo line	Stereo phono or 3.5 mm jack (-10 dBu sensitivity)	
	1 mic/line	Min/line switchable as above	
Equivalent input noise	Mic input	<-110 dB	
Frequency response		+/- 3 dB over range 80 Hz to 15 kHz	Mic or line input
Outputs	1 line level	-10 dBu, unbalanced, phono or mini-jack continuous bandlimited pink noise 150 Hz to 8 kHz	For connection of personal FM or induction loop amplifier. Can be formed by resistively attenuating the speaker output.
	1 speaker	100 V, 40 W continuous bandlimited pink noise 150 Hz to 8 kHz	For connection of 100 V type loudspeakers. Amplifiers are available with both low impedance and 100 V outputs. Usually only one should be used at a time. Amplifier MUST match with type of loudspeaker used.
Dynamic range		>75 dBA from amplifier noise floor to clipping point	Allows for usable listening range and scope for adjustment of controls.
Distortion	THD+N	< 2% from 150 Hz to 8 kHz	
Equalisers	Bass	min +/- 6 dB variation @ approx 100 Hz	Minimum 2 band equaliser operating on the mixed output signal. Preferred minimum 2 band equaliser operating on each input.
	Treble	min +/- 6 dB variation @ approx 10 kHz	
Hum and noise		>85 dB below maximum output level	Under normal range of control settings.
Suppliers		Many	

Radio Microphone System

A diversity receiver is preferred. See sidebar for further details.

Specification Descriptor	Standard Symbol	Recommended value or range	Comments
System Main Parameters		<p>Wideband FM Radio Microphone System operating in the VHF high band channels allocated for use in personal FM systems.</p> <p>Must conform to IR 2030, published by the Radiocommunications Agency under the category Short Range Devices. See www.radio.gov.uk for latest standards.</p> <p>If necessary to accommodate a large number of channels within a single school or site, licensed radio microphone units operating in the UHF band can be used.</p>	<p>These channels are provided for service to the hearing impaired without requirement for a license.</p> <p>These channels require a license, with an associated annual fee.</p>
Channel Selection		It is preferred that the system has a user programmable channel selection.	This enables a spare unit to support all units within a school or group of schools. Also enables channels to be easily changed in the event of interference or the desire to tune the system to match a compatible personal FM receiver brought in by a student.
Microphone Input		Compatible with plug-in dynamic and electret microphones. Robust connector with locking mechanism and high quality cable retention is required. A permanently wired microphone is not acceptable.	
Transmitter Antenna Connection		Can be used with a $\frac{1}{4}$ wave cable antenna. Robust connector with locking mechanism and high quality cable retention is required. A permanently wired antenna is not acceptable.	
Transmitter Controls and Indicators	<p>Volume or gain</p> <p>On/Off Switch</p>	<p>Transmitter should be provided with a means to adjust the level of the signal. This should be recessed or screwdriver controlled to minimise the risk of accidental adjustment.</p> <p>A switch should be provided to enable the transmitter to be switched off to preserve battery life. This should be recessed to prevent accidental operation.</p>	<p>Some cheaper transmitters provide no gain adjustment. This limits use with other microphones and some users. This actually controls the modulation of the radio section of the transmitter.</p> <p>An on/off switch should not be used unless the receiver is also turned off. If the TX is off, the receiver may pick up an alternative source on the same channel.</p>

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<i>continued</i>	Mute switch	A switch should be provided to enable the audio signal output from the transmitter to be muted without turning off the transmitter.	This allows the audio to be turned off to allow private conversation, etc.
	Battery Switch	A means of indicating the battery transmitter to be switched off to preserve battery life. This should be recessed to prevent accidental operation.	An alternative means of testing batteries can be provided instead.
	Transmitter level indicator	It is preferred that there is a means of checking the operating level of the transmitter, either on the transmitter unit, or on the receiver.	Transmitter level is actually easy to measure at either end.
	Channel selector	Channel selection should be available by means of an easy to understand control that is protected against accidental operation.	
Receiver Antenna		Diversity receiver with dual antennas. Built-in or detachable telescopic or helical antennas.	Diversity provides protection against signal loss due to reflections in the room. Reduces signal "drop-out".
Receiver Controls and Indicators	Volume Control	An output volume control aids in setting up a system.	Alternatively, given compatibility with the amplifier, the gain may be adjusted there instead.
	On/Off switch	A front panel operable on/off switch is required.	
System Frequency Response		100 Hz to 10 Hz \pm 1 dB	Performance of whole transmitter to receiver system without microphone connected.
Dynamic Range		\geq 85 dB	This sets the maximum signal to noise ratio available from the equipment. It is the performance of the whole transmitter to receiver system without the microphone connected.
Distortion	THD+N	< 0.5% from 150 Hz to 8 kHz at any signal level	
Transmitter Battery	Life	\geq 6 hours from a rechargeable nicad battery under continuous transmission conditions Battery compartment should be robust, enabling battery to slide in. A loose, plug-on battery connection is not acceptable.	Battery life should be measured under real operating conditions. Many published figures are not trustworthy as they actually for a standby condition.

Headworn Microphone

Specification Descriptor	Standard Symbol	Recommended value or range	Comments
Microphone type		Omni-directional headworn microphone. Robust cable and connector with locking mechanism and good cable retention. Condenser microphone types must be compatible with radio microphone transmitter powering system or contain easily changed battery with long service life.	
Frequency response		100 Hz to 12 kHz \pm 3 dB when used in recommended operating position	Microphone response is partly dependent upon surrounding surfaces. Microphone response should be considered when used as intended, not in an anechoic measurement.
Sensitivity		Microphone sensitivity should match the gain range of the transmitter enabling full transmitter modulation to be achieved when worn as recommended and used with a raised voice level.	
Dynamic range		> 65 dBA	
Sensitivity		> -46 dBV re 1 V/Pa Suitable for use in close proximity to the mouth	