Condenser Microphone Cartridges

types 4133, 4134, 4135, 4136, 4138, 4144, 4145, 4147, 4149, 4160, 4165, 4166, 4179 and 4180

FEATURES:

- Frequency ranges from below 0,01 Hz to 140 kHz
- Dynamic ranges from –34 dB to 180 dB SPL
- All operating characteristics well-defined
- All important data individually calibrated and supplied
- Very wide temperature range
- Artificially aged for long-term stability
- Flush mounted diaphragms
- Robust construction
- High resistance to humidity
- Wide range of accessories

USES:

- Precision acoustic measurements
- Pressure variation measurements

A complete range of externally polarized condenser microphones for accurate acoustic measurements, the B&K Condenser Microphones are precision engineered from materials selected to give long-term stability and operational reliability. Their resistance to humidity is very high, temperature range very wide and temperature coefficients extremely small. A robust construction makes them easy to handle in the field. Four microphone sizes are available:

1″ Types: 4144 for general laboratory use and low-level measurements; **4145** for low-level, low-frequency and laboratory use; **4160** and **4180** as laboratory references and for coupler measurements; **4179** for extremely low-level measurements.

½″ Types: 4133 for laboratory use and electroacoustic measurements; **4134** for coupler measurements and where good random incidence response is required; **4147** for ultra-low frequency and sonic boom measurements; **4149** for permanent outdoor use; **4165** and **4166** for general use and standardized noise measurements in accordance with IEC, ISO and ANSI standards.

¼″ Types: 4135 free-field and random responses, for high-level, high-frequency and model work; **4136** for coupler, high-level and high-frequency measurements.

⅛″ Type: 4138 for very high level, very high frequency measurements, pulse measurements and model work.

Each microphone cartridge is delivered in a protective mahogany box and supplied with an individual calibration chart giving the frequency response and all data necessary for precision measurements.

4144, 4145

4160

4179

4180

4147

4165, 4166

4133, 4134, 4149

4135, 4136

4138

General Description

Construction

The different cartridges have the same basic design (Figs. 2 and 3). The smaller diameters generally provide higher limits for the frequency and dynamic ranges, at the expense of a lower sensitivity.

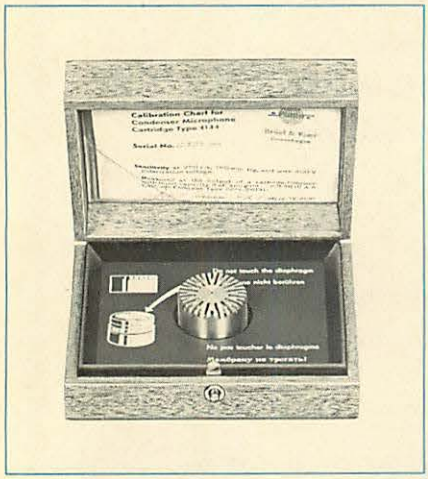


Fig. 1. 1″ microphone cartridge Type 4144 as delivered in mahogany case with individual calibration chart

Fig. 2 shows a sectional view of a condenser microphone cartridge. Depending on type, the insulator is made of either silicone-treated quartz, synthetic sapphire or a synthetic ruby to give dimensional stability. The diaphragm is made of pure nickel and the backplate and housing are made of high nickel alloys. This minimizes variations in sensitivity with temperature.

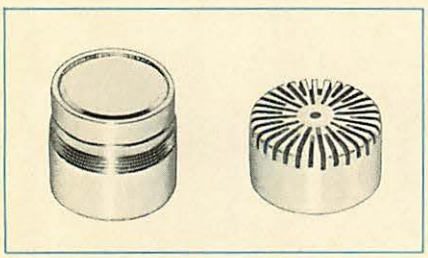


Fig. 3. 1″ microphone cartridge Type 4144 or 4145 with the protection grid removed. The diaphragm is flat and flush with the housing. This ensures a well-defined acoustic impedance and good omnidirectivity

During production the microphone cartridges are subjected to a high temperature (150°C), forced ageing process which ensures excellent long-term stability.

Special care has been taken in the design of the system for equalization of the static air pressure between the inside and outside of the cartridge to give a low and well-defined lower limiting frequency. The principles of the pressure equalization systems used are shown in Figs. 4 and 5. Half-inch Types 4147, 4149, 4165 and 4166 are back-vented for use with Dehumidifier UA 0308. With the exception of Type 4160, all other Types are side-vented.

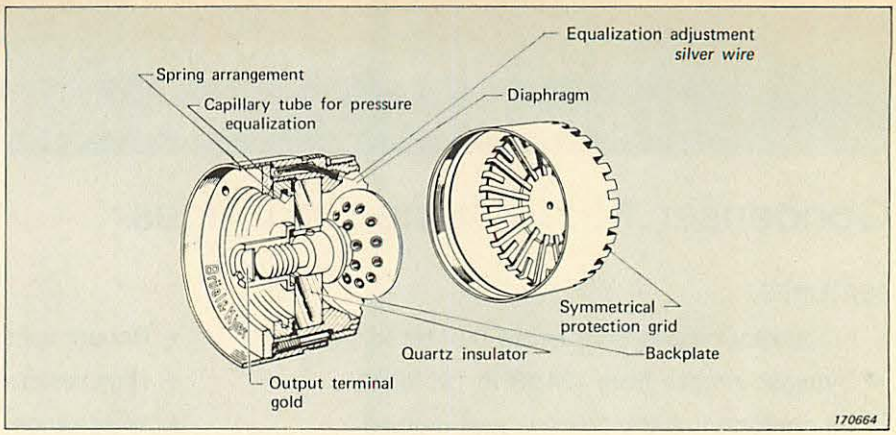


Fig. 2. Sectional view of a 1″ microphone cartridge

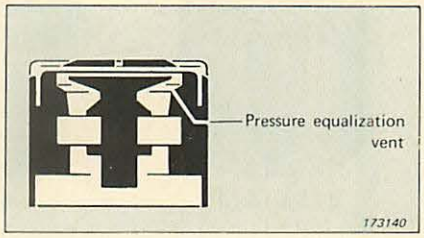


Fig. 4. Side-vented microphone cartridge

The cartridges are available with four different diameters:

1″ * Types: 23,77 mm diameter (Types 4144, 4145, 4160 and 4179)

1/2″ Types: 12,70 mm diameter (Types 4133, 4134, 4147, 4149, 4165 and 4166)

1/4″ Types: 6,35 mm diameter (Types 4135 and 4136)

1/8″ Type: 3,175 mm diameter (Type 4138)

This wide range of condenser microphones is made available to cover an extensive field of applications. Microphones Types 4144, 4145, 4133, 4134, 4165, 4166, 4135, 4136 and 4138 together cover the requirements for environment, frequency and dynamic ranges for most sound measurements, while the special Types 4147, 4149, 4160 and 4179 have been developed to suit particular applications.

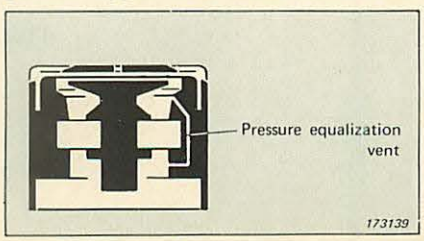


Fig. 5. Back-vented microphone cartridge

Each size is available with either linear 0° incidence free-field response or linear pressure response (1/8″ type, linear pressure response only). When using a free-field response microphone it should be pointed towards the sound source, if the sound is judged to come mainly from that direction. In some applications a pressure response microphone may be used for free field measurements if orientated so that the plane of the diaphragm is parallel to the direction of sound. In coupler measurements a pressure response microphone is used. In this case no specific orientation of the microphone in relation to the sound source is required. The smaller pressure response microphones (1/2″, 1/4″ and 1/8″ types) can be used for random incidence measurements at audio frequencies, as their frequency responses in this range are less dependent on the angle of incidence. 1″ free-field response microphone Type 4145 may also be used for random incidence measurements, when fitted with Random Incidence Corrector UA 0055.

In the following sections a short description of the characteristics and application ranges of each of the microphones described in this Product Data sheet is given. In addition to these types, four microphones which are described in separate literature are also available: **Type 4130** is a low-cost, 1/2″ condenser microphone cartridge for use with the self-contained micro-

* Exactly 0,936 inch in accordance with American Standard ANSI S1.12 – 1967 (R 1977)

phone system consisting of 1/2″ Microphone Preamplifier Type 2642 and the battery operated Two-channel Microphone Power Supply Type 2810. For further information, please refer to the separate Product Data sheet available for Types 4130, 2642 and 2810. **Types 4129, 4155** and **4176** are 1/2″ Prepolarized Condenser Microphones, utilizing a prepolarized "electret" layer which is deposited on the microphone backplate. They are also used with the range of B&K Sound Level Meters shown in Fig. 6. Type 4129 is acoustically equivalent to externally polarized Type 4130 and is used with Sound Level Meters Types 2225 and 2226. Type 4155 is acoustically equivalent to externally polarized Type 4165 and is used with Precision Integrating Sound Level Meters Types 2230 and 2233. Type 4176 is used with Precision Integrating Sound Level Meters Types 2221 and 2222 and Precision Sound Level Meter Type 2232. For further details, please see the separate Product Data sheet available for Types 4129, 4155 and 4176 and the Product Data sheets available for the Sound Level Meters.

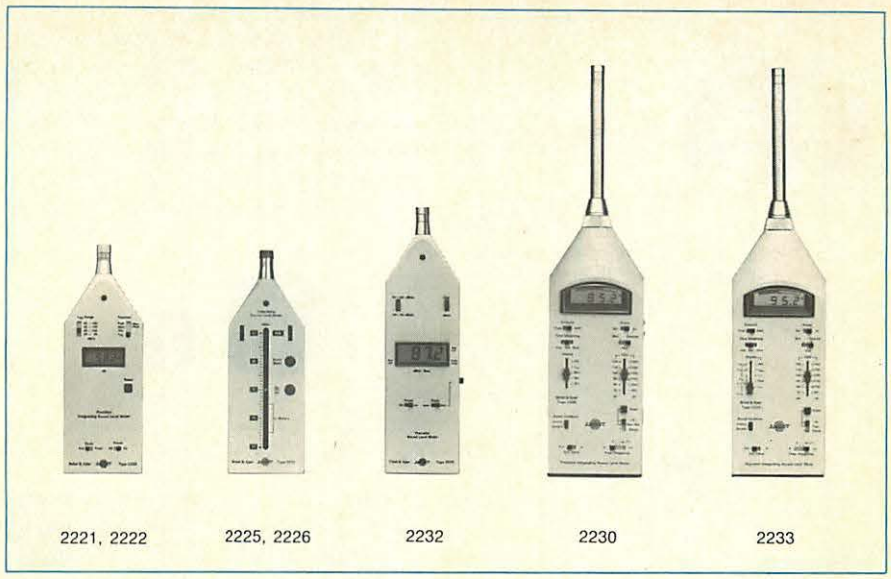


Fig. 6. B&K Sound Level Meters Types 2221, 2222, 2225, 2226, 2232, 2230 and 2233

General Purpose Types

Free-field Response Types

4145. 1″ diameter for laboratory use and low sound level measurements.

4133. 1/2″ diameter for general electroacoustic purposes, loudspeaker and microphone measurements.

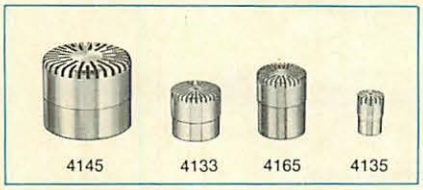


Fig. 7. Types 4145, 4133, 4165 and 4135

4165. 1/2″ diameter for general sound measurements, and for standardized noise measurements in accordance with IEC and ISO standards. It has a sensitivity similar to that of a 1″ cartridge, is more omnidirectional due to the smaller diameter and may therefore be used as a substitute for 1″ cartridges in applications where these would introduce an intolerable disturbance in the sound field. The 4165 has a quartz-covered diaphragm and is back-vented for use with the 1/2″ Dehumidifier UA0308 for measurements in humid environments.

4135. 1/4″ diameter for general high-level, high-frequency measurements and model work.

Pressure Response Types

4144. 1″ diameter used for coupler measurements, audiometer calibration, low-frequency and low-level measurements, and as a laboratory standard.

4134. 1/2″ diameter for medium- and high-level measurements in the audio range and coupler measurements. Especially suitable where good random incidence characteristics are required.

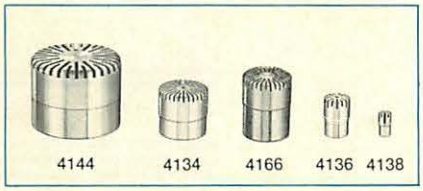


Fig. 8. Types 4144, 4134, 4166, 4136 and 4138

4166. 1/2″ diameter for random incidence measurements. Same application range as Type 4165. The 4166 also has a quartz-covered diaphragm and is back-vented for use with Dehumidifier UA0308. Type 4166 is especially suitable for noise measurements in accordance with ANSI standards.

4136. 1/4″ diameter for coupler, high-level and high-frequency measurements.

4138. 1/8″ diameter for high-level and very high frequency measurements, or for pulse measurements. Type 4138 is especially suitable for applications which require a high degree of spatial resolution or where space is limited, e.g. model testing.

Special Types

Very Low Frequency Type 4147

1/2″ diameter. Pressure response microphone, designed with special attention to the back-venting static pressure equalization arrangement to bring the lower limiting frequency below 0,01 Hz. It is used in conjunction with Adaptor UA0271 and Microphone Carrier System Type 2631 for measuring ultra-low frequency acoustic pulses such as sonic booms.

Fig. 9. Type 4147

Outdoor Microphone Type 4149

1/2″ diameter. Free-field response microphone. Similar to Type 4133 but with diaphragm and backplate covered with thin layer of quartz (Fig. 10), which increases the cartridge lifetime in humid or corrosive atmospheres. Type 4149 is back-vented for use with Dehumidifier UA0308 (see section "Accessories"). The 4149 is used in noise monitoring systems such as Type 4921, for permanent outdoor installations.

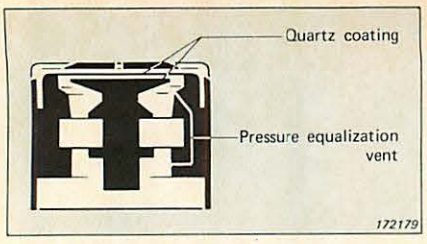


Fig. 10. Cross sectional view of the quartz-coated microphone Type 4149

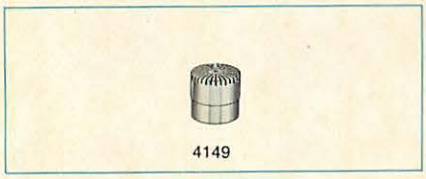


Fig. 11. Type 4149

Types 4160, 4180:

Pressure response microphones for coupler measurements and for use as laboratory standards. 1″ Type 4160 is equivalent to Western Electric WE 640 A, and has a flat frequency response up to 8 kHz. ½″ Type 4180 has a flat frequency response up to 20 kHz. Both microphones feature excellent long-term stability and environmental reliability. See separate Product Data for details.

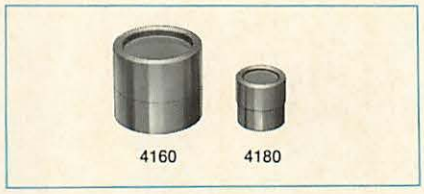


Fig. 12. Type 4160 and 4180

Low Noise Microphone Type 4179

1″ diameter. Very high sensitivity (100 mV/Pa). Designed for use with Preamplifier Type 2660 for very-low-level sound pressure and sound power measurements. System inherent noise floor of –2,5 dB(A). For further details, see the separate Product Data sheet available for Types 4179 and 2660.

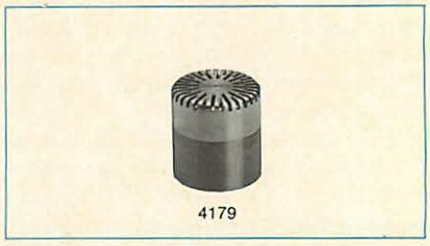


Fig. 13. Type 4179

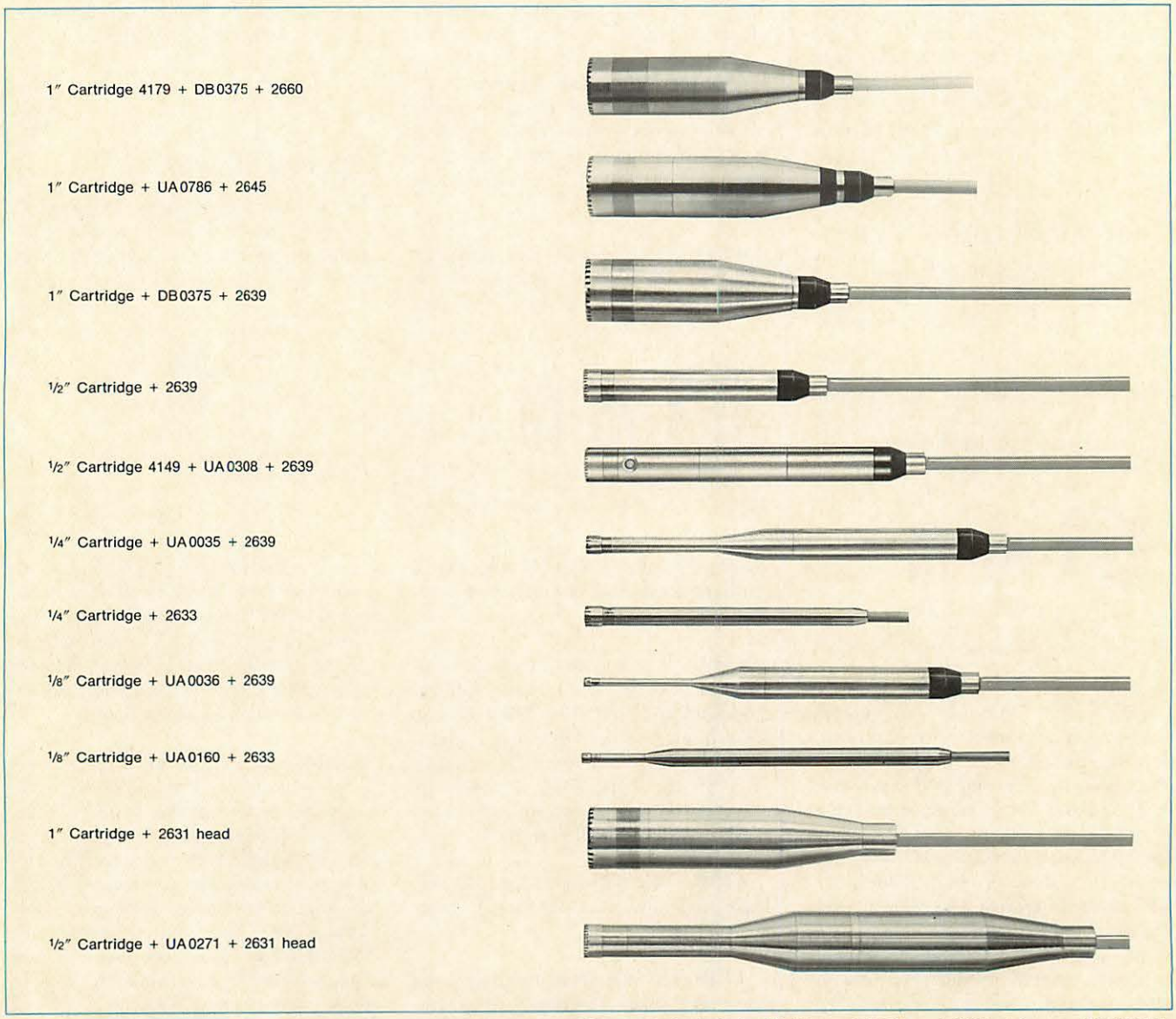


Fig. 14. Various microphone and preamplifier assemblies. Adaptor DB0375 is included with Types 2639 S and 2660, Adaptor UA 0786 is included with Type 2645 S. Other adaptors should be ordered separately

Microphone Assemblies

The Microphones described in this Product Data sheet are designed for use with an externally supplied DC polarization voltage of 200 V or with a 10 MHz carrier frequency. In general, a microphone assembly will consist of either a microphone cartridge and a microphone preamplifier when using the externally supplied DC polarization voltage, or of a microphone cartridge and the 10 MHz Carrier Frequency System Type 2631 when using the carrier frequency. Assemblies with propolarized microphones consist of a microphone cartridge and preamplifier (without polarization voltage supply). The cartridge polarization is provided by a permanent charge-carrying "electret" material which is deposited on the microphone backplate (see separate Product Data sheet for prepolarized Types 4129, 4155 and 4176).

The cartridges screw directly onto the preamplifier housing or the 2631 head if both have the same diameter, or use is made of adaptors if the diameters differ. Typical assemblies are shown in Fig. 14.

Four different microphone preamplifiers are available:

Type 2633 is a 1/4″ preamplifier which may be used with 1/4″ cartridges directly and with the 1/8″ cartridge via Adaptor UA 0160.

Type 2639, 1/2″ diameter, is used directly with 1/2″ microphone cartridges and with 1″, 1/4″ and 1/8″ cartridges using Adaptors DB 0375, UA 0035 and UA 0036, respectively. Type 2639 is available in two versions: 2639 S consists of the preamplifier together with accessories delivered in a mahogany case, while 2639 T consists of the preamplifier alone delivered in a plastic case.

Type 2645 is a 1/2″ diameter preamplifier which is similar in design, performance and application to Type 2639, but in addition includes an insert voltage calibration facility for insert voltage calibration of 1″ and 1/2″ microphones in accordance with IEC 327 and ANSI S 1.10 – 1966. The preamplifier may be operated in either driven or grounded shield modes. For insert voltage calibration purposes, 1″ microphones are fitted to the 2645 using Adaptor UA 0786 and 1/2″ microphone cartridges are fitted directly. Type 2645 may also be used with 1/4″ and 1/8″ cartridges which are fitted using Adaptors UA 0035 and UA 0036, respectively. Type 2645 is also available in two versions: 2645 S with accessories and 2645 T without accessories.

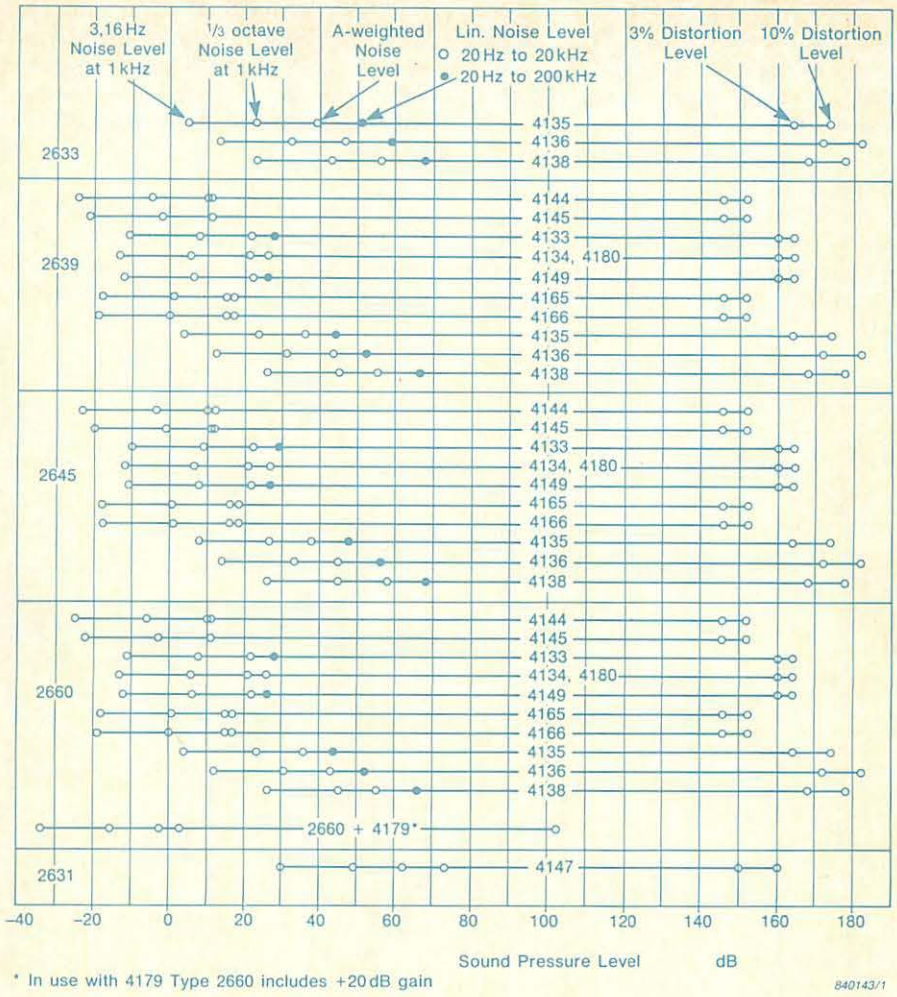


Fig. 15. Typcial dynamic ranges of various B&K Condenser Microphone and Preamplifier assemblies. The upper limit is given for two degrees of distortion at 100 Hz, while the lower limit indicates the system noise floor for various bandwidths of the associated measurement equipment. The limits for 3,16 Hz and 1/3 octave bandwidths are valid at 1 kHz only

Type 2660 has been especially designed as part of a low noise microphone system consisting of the 2660 and 1″ cartridge Type 4179. Together, these instruments constitute a system for sound pressure and sound power level measurements of very-low-level sources. The 2660 may also be used with other microphone cartridges, accepting 1/2″ cartridges directly and 1″, 1/4″ and 1/8″ cartridges by means of Adaptors DB 0375, UA 0035 and UA 0036, respectively. A three-position switch allows selection of 0 dB gain, +20 dB gain or special "4179" position.

The Microphone Preamplifiers are carefully designed to achieve a high input impedance, low output impedance and very low inherent noise. Fig. 15 illustrates the dynamic ranges, from inherent noise floor to distortion limit, of the preamplifiers and the Carrier System Type 2631, when used with different microphone cartridges. For further details, see the separate Product Data sheets available for Types 2633, 2639, 2645, 2660 and 2631.

Power Supply

The stabilized polarization voltage for the microphone cartridges (200 V) and the power supply for the microphone preamplifiers are available via the 7-pin preamplifier input socket fitted to the range of B&K measuring amplifiers and frequency analyzers to which the microphone assemblies can be connected directly.

For operation with other equipment and for special applications a microphone assembly can be powered from Power Supplies Types 2804 or 2807, Eight Channel Multiplexer Type 2811,

or use can be made of the Outdoor Microphone Unit Type 4921 or Microphone Carrier System Type 2631. Further information can be found under "Accessories".

Assembly Response

With the exception of certain data for Type 4179, all data given in succeeding sections are open circuit values, which means that the cartridges look into an infinitely large impedance. In practice, however, the microphone cartridges are used together with a preamplifier which will influence the response of the total assembly.

The size of the influence depends on the preamplifier input impedance, the capacitance of the microphone (and adaptor), the load due to extension cables connected to the preamplifier and the attenuation of the preamplifier itself. The total response is found by adding the open circuit response to the response curves given in the Product Data sheet for the preamplifiers.

For detailed information on the response of Microphone Type 4147 used with 10 MHz carrier frequency, see the Product Data sheet for Microphone Carrier System Type 2631.

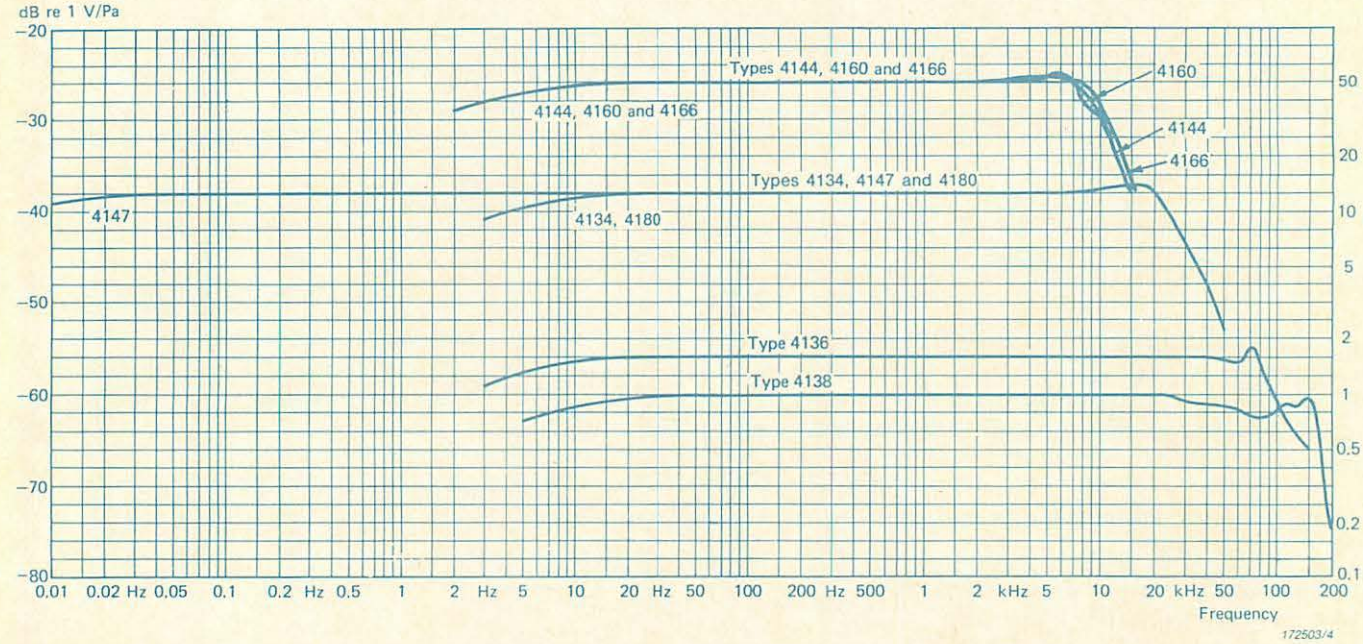


Fig. 16. Typical frequency responses of the different pressure response microphones recorded by means of the electrostatic actuator method

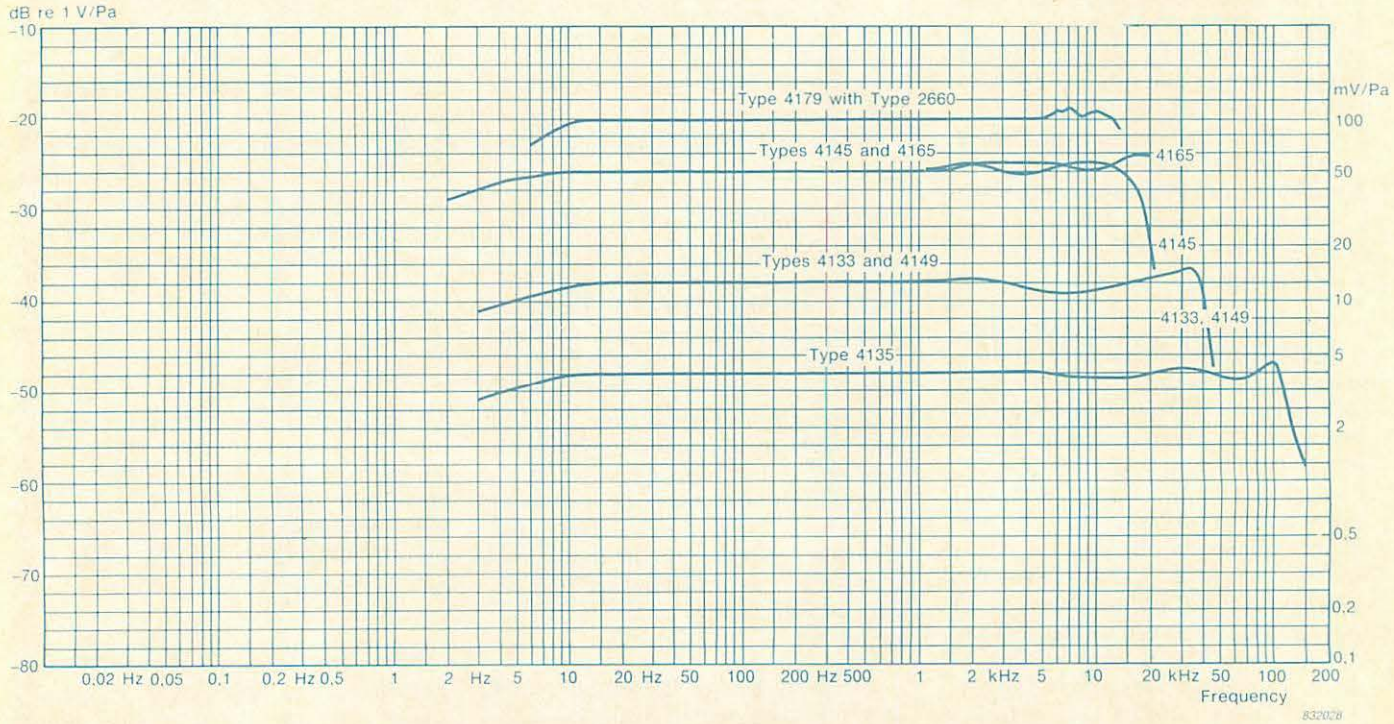


Fig. 17. Typical 0° incidence free-field frequency responses of the different free-field response microphones recorded by means of the electrostatic actuator method and corrected according to the curves shown in Fig. 20

Cartridge Response

The microphone cartridges have well-defined operating characteristics. Their sensitivities are high in relation to their dimensions and as can be seen from Figs. 16 and 17, their frequency ranges are very wide.

The long-term stability of the cartridges is extremely good. The stability is of the order of 1 dB in several hundred years at room temperatures (see specifications) while the same change occurs in a few hours at 150°C.

Individual Calibration

The microphone cartridges fulfil the requirements of ANSI S1.12–1967 "Specifications for Laboratory Standard Microphones", as indicated in Table 1.

Each cartridge is supplied with an individual calibration chart which includes a complete frequency response curve recorded by the electrostatic actuator method. In the case of the free-field cartridges Types 4133, 4135, 4145, 4149, 4165 and 4179, the 0° incidence free-field response is also given. An example of a calibration chart for 1″ cartridge Type 4145 is shown in Fig. 18. The 0° incidence free-field response is derived by adding the 0° incidence free-field corrections to the recorded pressure (electrostatic actuator) response. For Types 4134, 4135 and 4166 the diffuse field response of the cartridge is determined and given on the calibration chart.

ANSI Type	B&K Type
XL	4144, 4145, 4147, 4133, 4134, 4149, 4160, 4165, 4166
L	4144, 4145, 4160
M	4133, 4134, 4135, 4136, 4147, 4149, 4180
H	4135, 4136, 4138

T00964GB0

Table 1. Classification of B&K Condenser Microphones (except Type 4179) under ANSI S1.12–1967

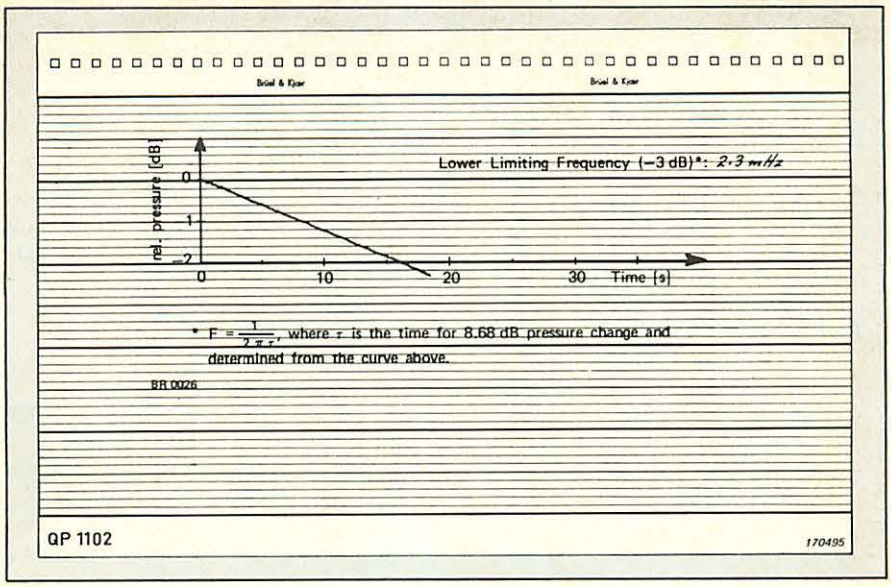


Fig. 19. Additional calibration chart delivered with the Condenser Microphone Cartridge Type 4147

Type 4147, which is designed for very low frequency measurements, is supplied with an additional individual calibration chart showing the time constant of the pressure equalization system. From this chart the lower limiting frequency can easily be determined. An example of this calibration chart is shown in Fig 19.

A comprehensive handbook is available for the microphones. This describes the design, theory and the operation of each microphone together with extensive documentation of its properties. Also described are the application of accessories and the influence of environmental factors, such as temperature, atmospheric pressure, humidity.

Free-field Corrections

The free-field corrections are added to the pressure (actuator) response of the microphone in order to obtain the free-field response at a particular an-

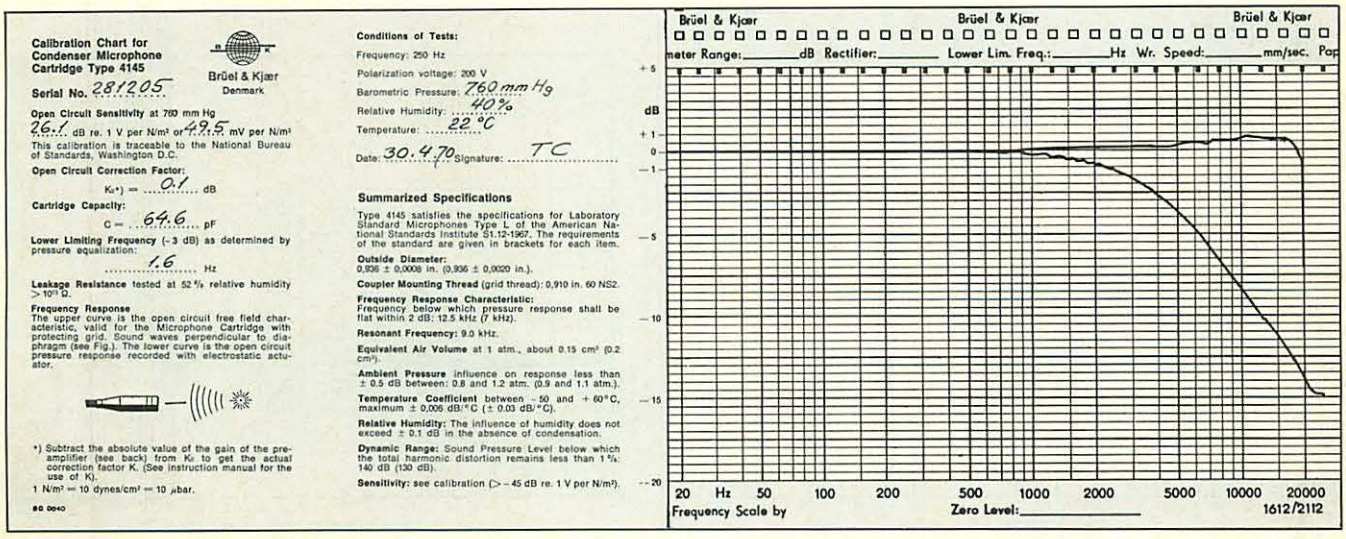
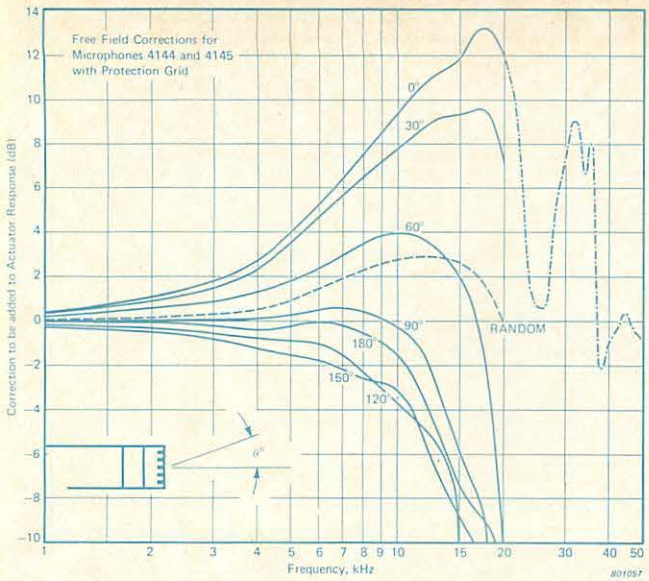
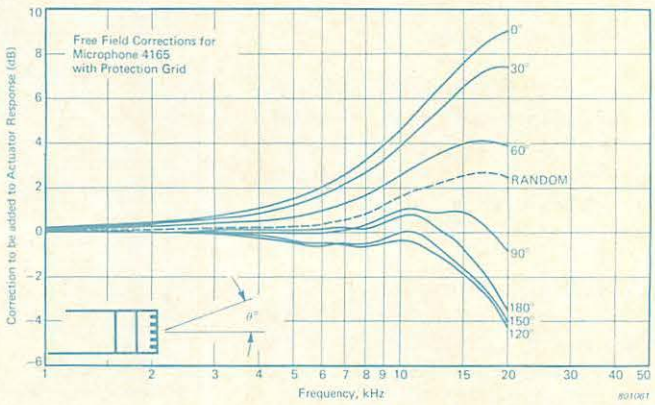
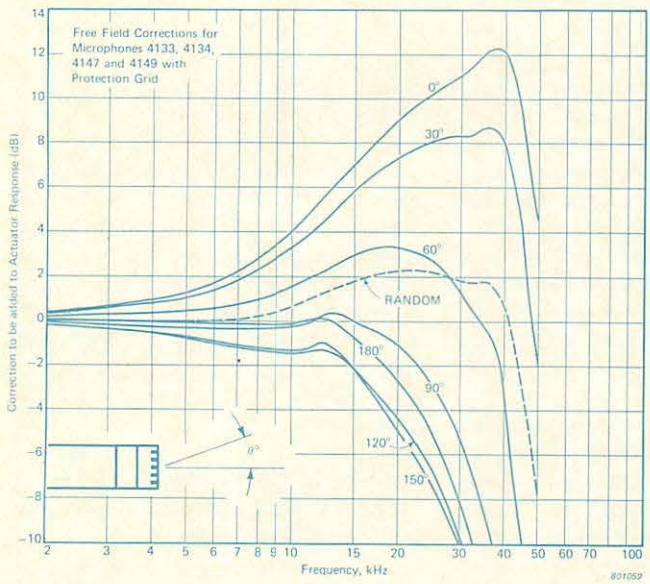
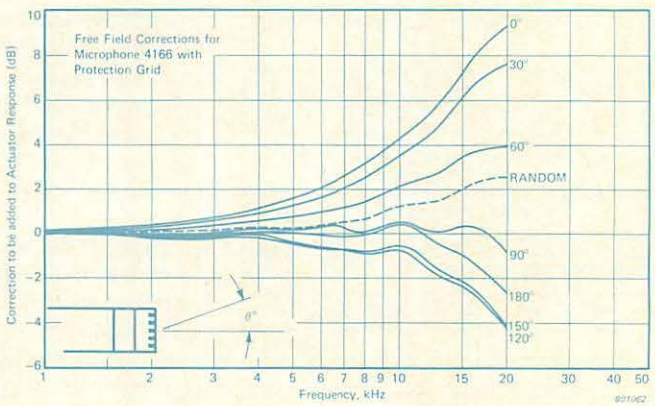


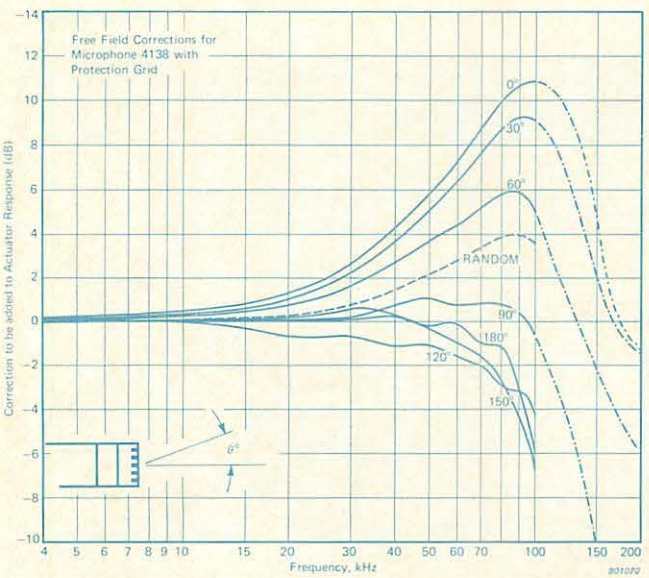
Fig. 18. Complete calibration chart delivered with the condenser microphone cartridges











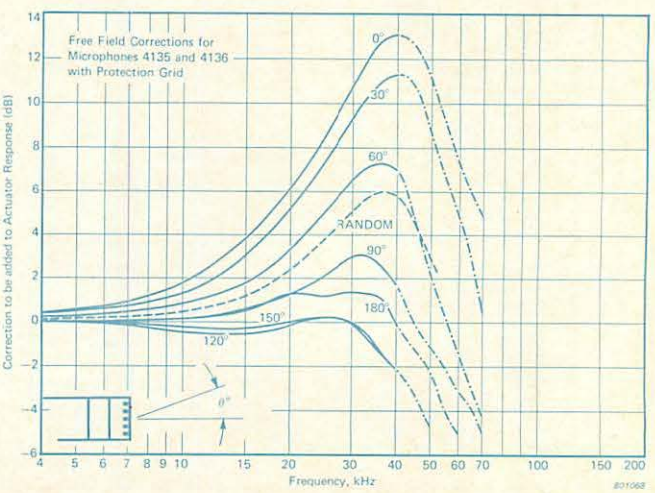


Fig. 20. Free-field correction curves for the various B&K condenser microphone cartridges

gle of incidence. Free-field corrections represent the increase of sound pressure caused by diffraction of the sound waves around the microphone and are only significant at high frequencies where the wavelength is comparable with the external dimensions of the microphone.

The free-field correction curves for diverse angles of incidence are given in Fig. 20. It can be seen that the random incidence (diffuse-field) corrections are very small at audio frequencies.

A microphone (1/2″ to 1/8″ diameter) with a flat pressure frequency characteristic should be preferred for measurements in diffuse fields, for example in most indoor measurements. However, by mounting specially designed correctors (Nose Cones) the response of 1″ Type 4145 and the 1/2″ and 1/4″ free-field microphones can be made practically independent of angle of incidence over an extended frequency range.

A detailed description of the characteristics and specifications of the microphones can be found in the handbook available.

Accessories

To facilitate sound measurements under various conditions a variety of accessory equipment has been developed. A short description of these accessories is given in this section. For further information please see separate Product Data sheets and the handbook available for the microphones.

Fig. 21. Pistonphone Type 4220 and Sound Level Calibrator Type 4230

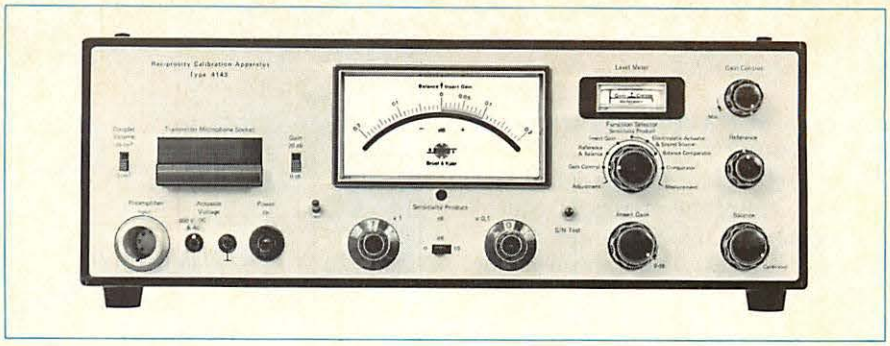


Fig. 22. Reciprocity Calibration Apparatus Type 4143

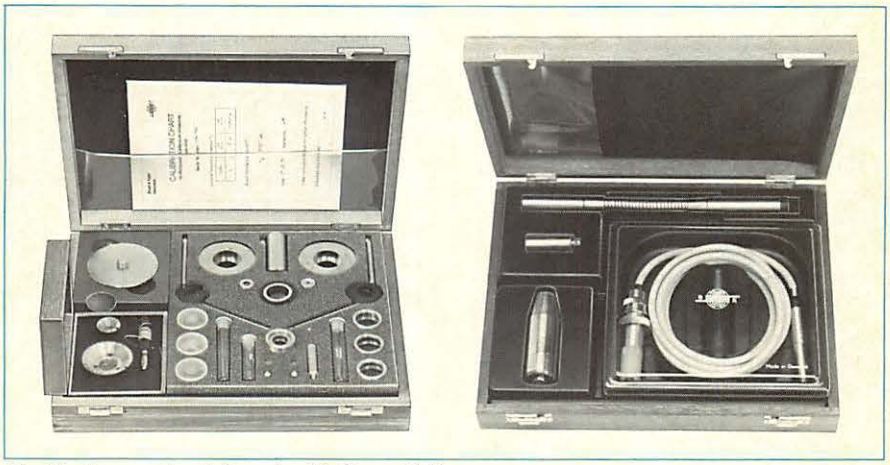


Fig. 23. Accessories delivered with Type 4143

Calibration Equipment Types 4220, 4230, 4143, 2645 and 4221

For accurate calibration of the microphones and complete sound measurement systems either in the laboratory or in the field, the Pistonphone Type 4220 or Sound Level Calibrator Type 4230 can be used. These are shown in Fig. 21. Both are battery operated and easy to handle. The 4220 gives a signal of 124 dB re 20 μPa at 250 Hz and calibrates with an accuracy of ±0,15 dB. The Sound Level Calibrator Type 4230 gives a signal of 94 dB re 20 μPa at 1000 Hz and calibrates with an accuracy of ±0,3 dB.

For laboratory calibration of standard microphones in accordance with IEC R 327 and IEC R 402 (reciprocity method) and for measurement of the frequency response of 1″, 1/2″, 1/4″ and 1/8″ condenser microphones by the electrostatic actuator method, the Reciprocity Calibration Apparatus Type 4143 is available (see Fig. 22). It is an advanced, fast and easily operated high precision laboratory instrument. The 4143 can also be used for comparison calibration of 1″ and 1/2″ microphones, measurement of front and equivalent volume, reciprocity and comparison calibration of accelerometers, reference sound source, ratio voltmeter and zero indicator. The 4143 is delivered with an individual calibration chart and a comprehensive range of accessories. See Fig. 23.

For calibration of 1″, 1/2″, 1/4″ and 1/8″ condenser microphones at high sound levels the High Pressure Microphone Calibrator Type 4221 is an ideal tool (Fig. 24). Due to the low acoustic impedance of the 4221 the sound pressure produced in the couplers is practically independent of variation in coupler volume, atmospheric pressure and changes in the process from adiabatic to isothermal at low frequencies. Calibration can be performed in the frequency ranges 3 Hz to 1000 Hz and 10^{-2} Hz to 95 Hz at SPLs up to 164 dB. In connection with tonebursts, sup-

Fig. 24. High Pressure Microphone Calibrator Type 4221

plied from the Gating System Type 4440, calibration up to 170 dB SPL can be performed.

Electrostatic Actuators UA 0023 and UA 0033

The Actuators are designed for measurement of the pressure frequency response of the condenser microphone cartridges. They are available in two sizes UA 0023 for 1″ microphones and UA 0033 for ½″ microphones. The UA 0033 can also be used with ¼″ and ⅛″ cartridges by means of the adaptors DB 0264 (¼″ to ½″) and DB 0900 (⅛″ to ½″). These Actuators are not however suitable for use with the 1″ Type 4160, nor ½″ Type 4180.

Electrostatic actuators not only enable laboratory frequency response calibration of microphones to high levels of accuracy but also allow users without extensive laboratory facilities to carry out periodic checks on the frequency response characteristics of their own microphones to ensure that they remain within acceptable limits.

Nose Cones UA 0387, UA 0386, UA 0385 and UA 0355

The Nose Cones (Fig. 25) are designed to reduce the aerodynamically induced noise present when the microphones are exposed to high wind speeds in a known direction, for example during sound measurements in wind tunnels, ducts, etc. They are designed to replace the normal protection grid of the microphones, and are of a streamlined shape with a highly polished surface in order to give the least possible air resistance. The fine wire mesh around the circumference allows sound waves to penetrate to the microphone diaphragm.

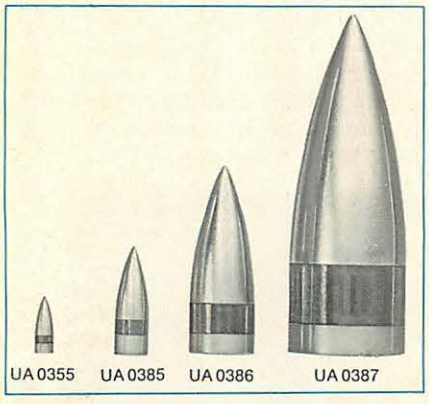


Fig. 25. Nose Cones UA 0355, UA 0385, UA 0386 and UA 0387

Fig. 26 shows the aerodynamically induced noise at various windspeeds in the microphone cartridge Type

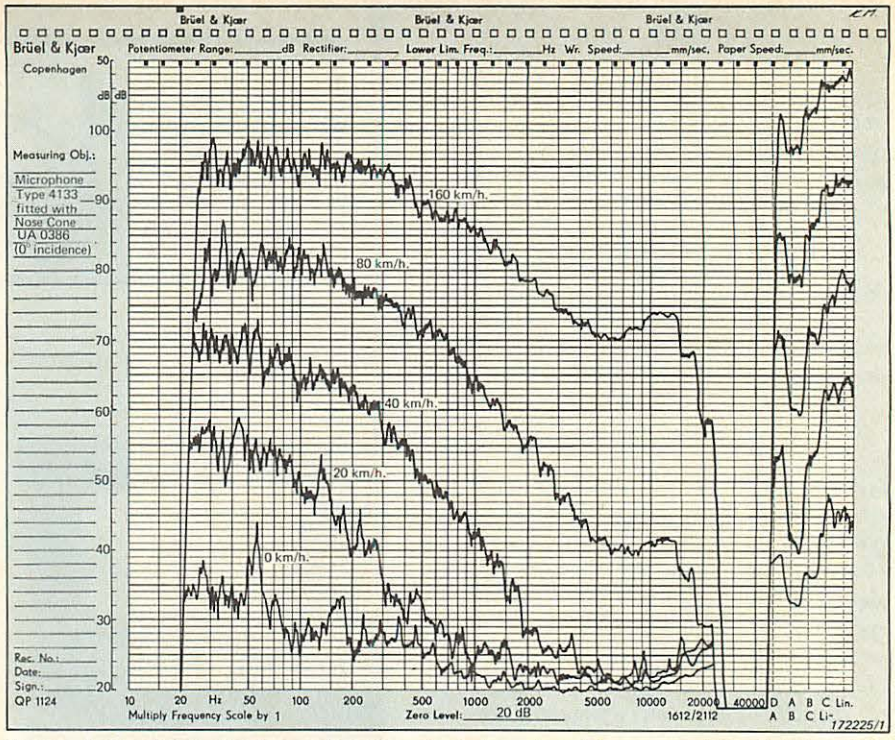


Fig. 26. Induced noise levels as a function of windspeed and frequency of the ½″ free-field Condenser Microphone Cartridge Type 4133 fitted with Nose Cone UA 0386

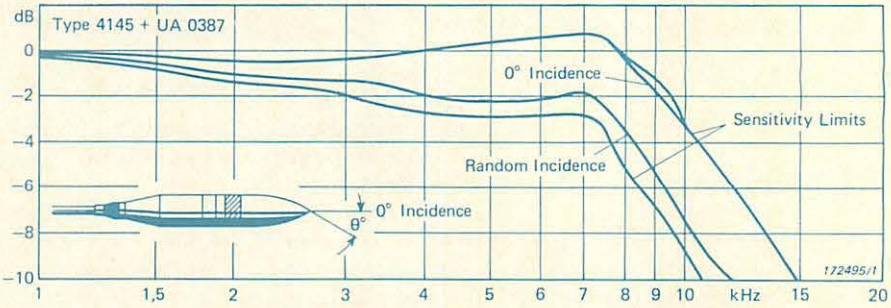


Fig. 27. Frequency response of the 1″ free-field Condenser Microphone Cartridge Type 4145 fitted with Nose Cone UA 0387

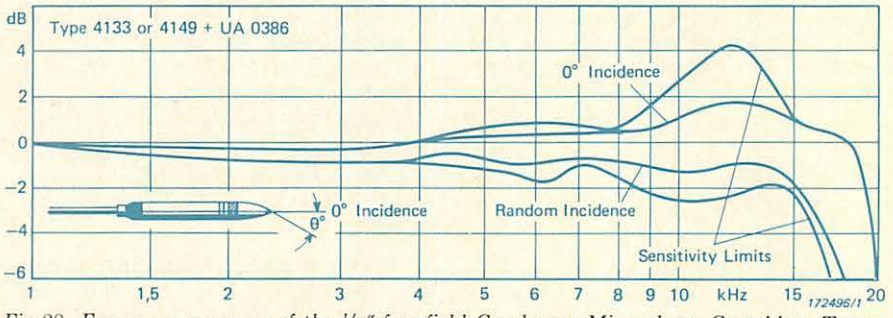


Fig. 28. Frequency response of the ½″ free-field Condenser Microphone Cartridges Types 4133 and 4149 fitted with Nose Cone UA 0386

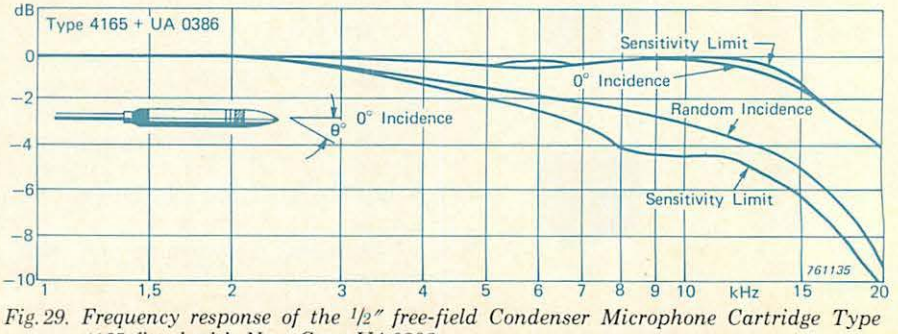


Fig. 29. Frequency response of the ½″ free-field Condenser Microphone Cartridge Type 4165 fitted with Nose Cone UA 0386

4133 fitted with Nose Cone UA 0386. The diagram is valid for microphone Type 4149.

When the Nose Cones are used, the omnidirectional characteristics are improved (Figs. 27, 28, 29 and 30). Fig. 31 shows the omnidirectional characteristics of the 1/8″ pressure cartridge fitted with Nose Cone UA 0355.

Random Incidence Corrector UA 0055

The UA 0055 (Fig. 32) screws directly onto the one inch microphone Type 4145 instead of the normal protection grid. It improves the microphone's omnidirectional characteristics so that IEC 651 Type 1 is fulfilled up to 10 kHz. See Fig. 33.

Fig. 32. Random Incidence Corrector UA 0055 and Rain Cover UA 0393

Rain Cover UA 0393

The Rain Cover (Fig. 32) is designed to be mounted on B & K 1/2″ condenser microphones instead of the normal protection grid, and allows permanent outdoor installation even under adverse weather conditions. When fitted, the Rain Cover will improve the omnidirectional characteristics of the 1/2″ free-field microphones (see Fig. 34). The combination of a 1/2″ free-field cartridge, UA 0393 and Windscreen UA 0570 fulfils the requirements on directivity given in IEC 651 for Type 1 Sound Level Meters. To allow remote calibration and checking of remote microphone installations the UA 0393 has a built-in electrostatic actuator. The Rain Cover can be delivered calibrated at the factory together with a 1/2″ microphone cartridge to give an equivalent SPL of 90 ± 1 dB by injection of an AC voltage of 215 V.

The B & K plugs JP 0012, which fit the actuator terminal are available in sets UA 0129, 20 plugs with mounting tool and UA 0130, 25 plugs only. The cable AC 0010 for plug JP 0012 is available in free length.

It is recommended that, whenever weather protection is important, the

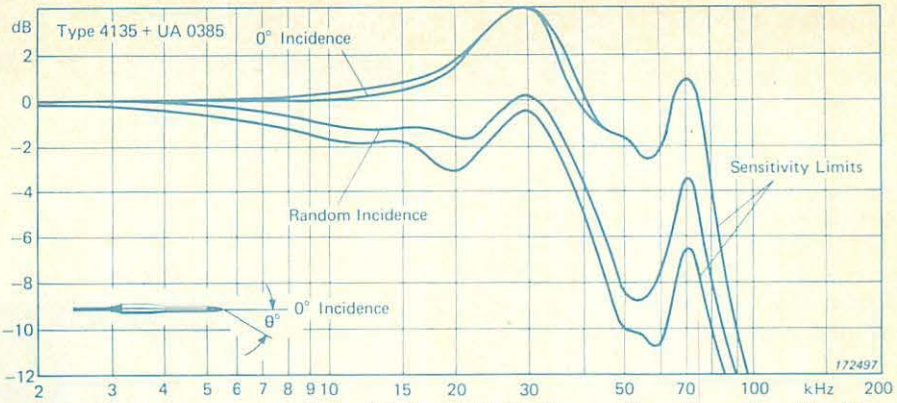


Fig. 30. Frequency response of the 1/4″ free-field Condenser Microphone Cartridge Type 4135 fitted with Nose Cone UA 0385

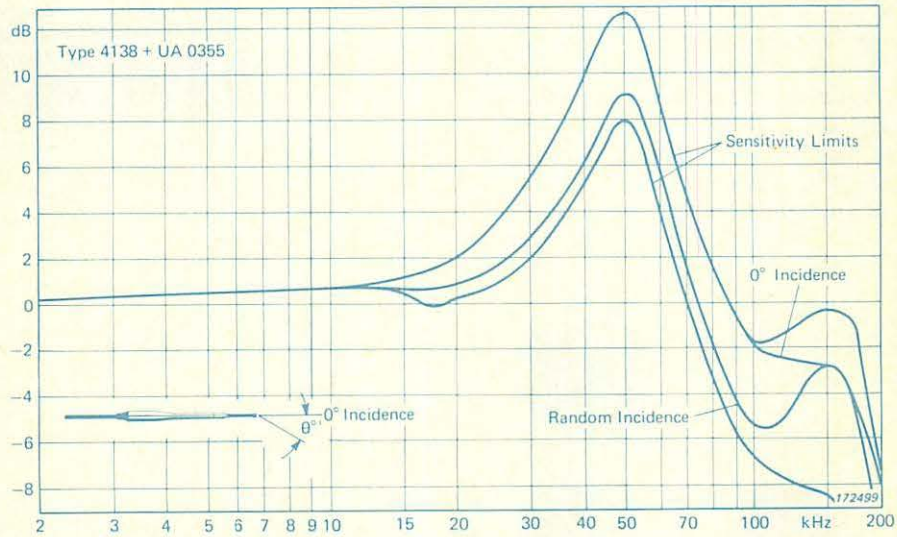


Fig. 31. Frequency response of the 1/8″ pressure Condenser Microphone Cartridge Type 4138 fitted with Nose Cone UA 0355

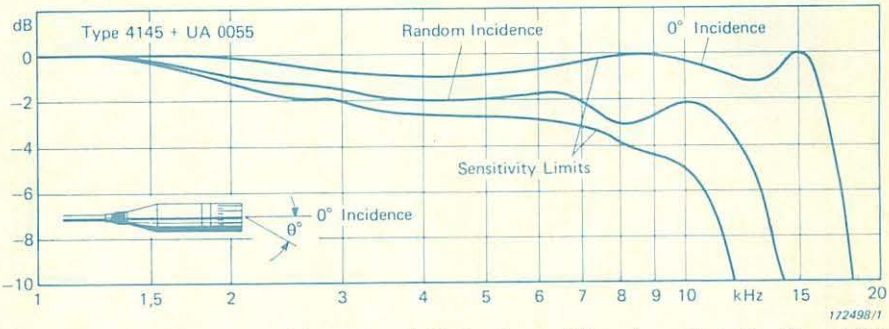


Fig. 33. Frequency response of the 1″ free-field Condenser Microphone Cartridge Type 4145 fitted with Random Incidence Corrector UA 0055. The linearity is maintained practically up to 10 kHz, and the omnidirectivity is effective within ±3 dB. (See also Fig. 20)

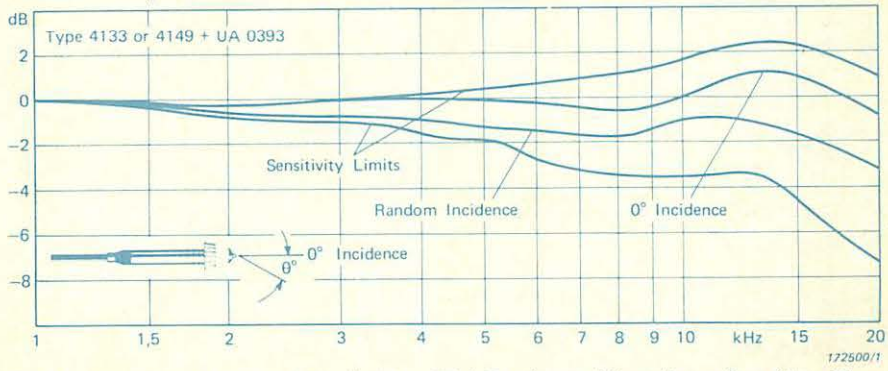


Fig. 34. Frequency response of the 1/2″ free-field Condenser Microphone Cartridges Type 4133 and 4149 fitted with Rain Cover UA 0393

Permanent Outdoor Windscreen UA 0570 is always used in conjunction with the Rain Cover UA 0393, and that the Preamplifier heating element operates continuously.

Permanent Outdoor Windscreen UA 0570

The Permanent Outdoor Windscreen UA 0570 (Fig. 35) for ½″ microphones, reduces the aerodynamically induced noise during outdoor sound measurements. The Windscreen is designed for mounting on the microphone assembly and gives an effective reduction, of the order of 10 dB or higher, of wind induced noise at lower wind velocities. It is well suited to permanent outdoor installations in connection with Rain Cover UA 0393. Additionally, it is equipped with spikes to prevent birds from resting on top. The Windscreen is recommended for all unattended noise measurements.

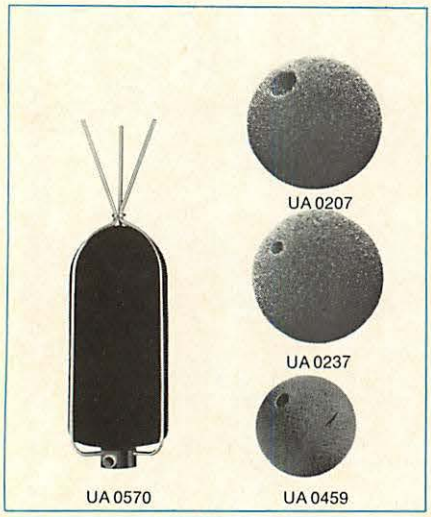


Fig. 35. Windscreens UA 0570, UA 0207, UA 0237 and UA 0459

Windscreens UA 0207, UA 0237 and UA 0459

The Windscreens UA 0207 and UA 0237 (Fig. 35) fit the 1″ and ½″ microphone assemblies respectively. They are made of specially prepared porous polyurethane sponge attenuating wind noise 10 to 12 dB, at lower wind velocities, and are well suited for hand-held outdoor sound measurements. These windscreens are only available as sets. **Set UA 0253** contains six 1″ windscreens UA 0207, and set **UA 0254** contains six ½″ windscreens UA 0237.

The Windscreen UA 0459, 65 mm diameter, is designed to fit the ½″ Condenser Microphone Type 4130 but can also be used with the other ½″ microphones if a small screen is required. The UA 0459 has approximately the same properties as the UA 0237. The windscreen is available in sets of six as **UA 0469.**

For complete curves showing the influence of any of the windscreens upon the free-field corrections see the handbook for the microphones.

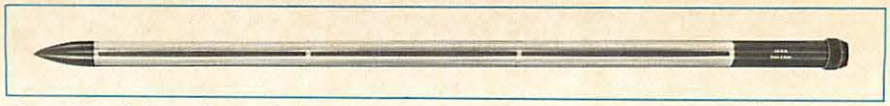


Fig. 36. Turbulence Screen UA 0436

Turbulence Screen UA 0436

The Turbulence Screen UA 0436 (Fig. 36) is designed to attenuate turbulence noise, when measuring airborne noise in ducts, wind tunnels etc. The UA 0436 can be used together with any ½″ free-field condenser microphone mounted on a ½″ microphone preamplifier. The turbulence noise suppression obtained using the UA 0436 is approximately 16 dB better than that obtained with the Nose Cone UA 0386 in the frequency range 70 Hz to 1,5 kHz.

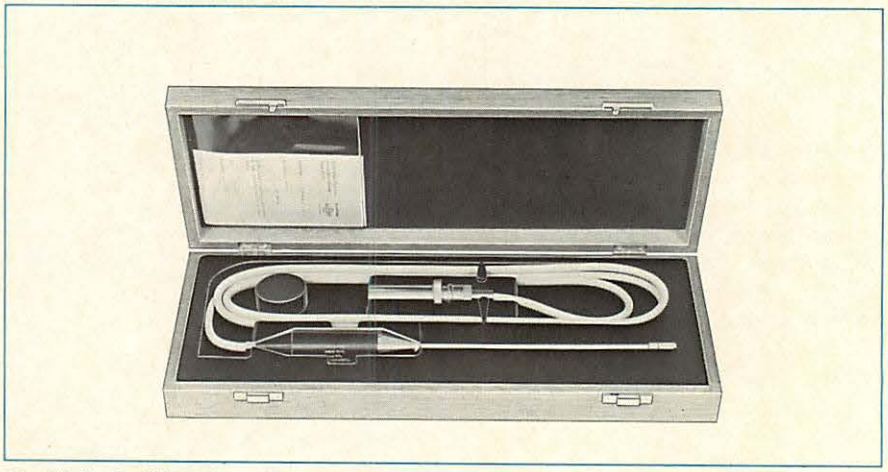


Fig. 37. Probe Microphone Type 4170

Probe Microphone Type 4170

Probe microphones can be used in a variety of applications, such as measurements inside the ear and inside ear protectors, measurements on sound insulating materials and inside intricate machinery, as well as in other confined spaces such as small ducts. Type 4170 can also be used for measurements at several hundred degrees centigrade, inside furnaces, oilburners etc., although only short-term use is possible since corrosion is greatly accelerated at these temperatures and a non-reversible change in characteristics also occurs.

Type 4170 (Fig. 37) is a pre-adjusted probe microphone with built-in preamplifier. It uses an acoustical exponential horn to couple a probe tube to a ½″ condenser microphone. An acoustic matching impedance at the microphone equalizes the frequency response of the assembly, thereby obtaining a frequency response from 30 Hz to 8 kHz within 3 dB. In order to obtain minimum disturbance in the sound field being measured the probe tube is very thin and has a high acoustic orifice impedance. The probe microphone is delivered with an individual calibration chart and an adaptor DP 0181 for fitting it to the Pistonphone Type 4220 or to the Calibrator Type 4230 for calibration.

Power Supplies 2804 and 2807

The Power Supply Type 2804 is battery driven and can be used with Preamplifier Types 2633, 2639 and 2645. It supplies all necessary voltages for two microphone assemblies and can be adjusted to give 28 or 200 V polarization voltage. Two Channel Power Supply Type 2807 can also be used with these preamplifiers and supplies all voltages for two microphone assemblies using 200 V polarization voltage. It also allows automatic switching between the measuring points, e.g. for sound insulation measurements. Types 2804 and 2807 are shown in Fig. 38.

Eight Channel Multiplexer Type 2811

For multichannel measurements, the Eight Channel Multiplexer Type 2811 (Fig. 39) can supply all necessary voltages for up to eight microphone assemblies using Types 2633, 2639 and

2645. The polarization voltage may be 0, 28 or 200 V and manual, automatic or external scanning may be selected. The 2811 has a built-in IEC/IEEE interface.

Outdoor Microphone Unit 4921

The Outdoor Microphone Unit Type 4921 (Fig. 40) has been designed to allow permanent outdoor noise monitoring. It consists of the ½″ quartz-coated microphone Type 4149 fitted with Windscreen UA 0570, Rain Cover UA 0393 and a preamplifier all mounted on a stainless steel tube. A weather-proof case, to which the steel tube is connected, contains power supply, amplifier, calibration generator and a dehumidification system. Several different output possibilities are available to suit any particular measuring requirement. Moreover facilities for remote control and external

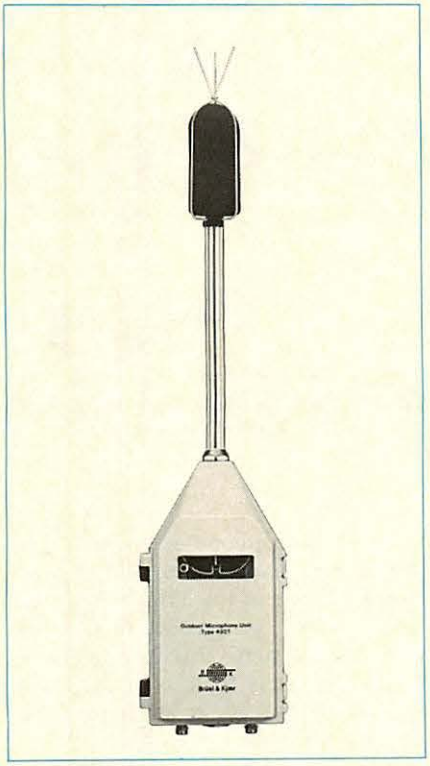


Fig. 40. Outdoor Microphone Unit Type 4921

supply of power and calibration signal are included. For further information, see System Development sheet "Airport Noise Monitoring Systems".

Microphone Carrier System 2631

The Microphone Carrier System Type 2631 (Fig. 41) is made for measurement of low frequency pressure variations and shock waves and should be used with the microphone cartridge Type 4147. It supplies a carrier frequency of 10 MHz to the microphone cartridge instead of the normal 200 V polarization voltage.

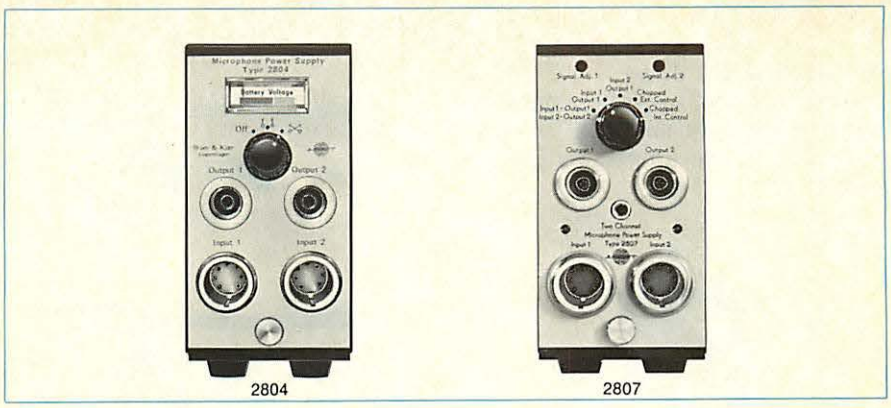


Fig. 38. Power Supplies Types 2804 and 2807

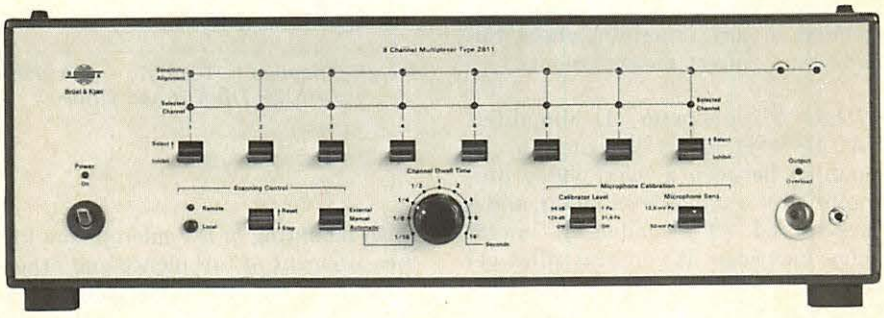


Fig. 39. Eight Channel Multiplexer Type 2811

Artificial Ears, Ear Simulator and Couplers

The Artificial Ears Type 4152 and 4153, Ear Simulator Type 4157 (Fig. 42) and the couplers DB 0138, DB 0909, and DB 0161 have been developed for measurements on head- and earphones.

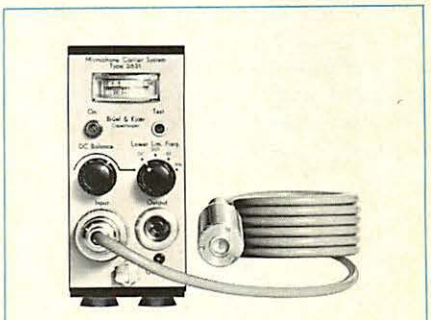


Fig. 41. Microphone Carrier System Type 2631

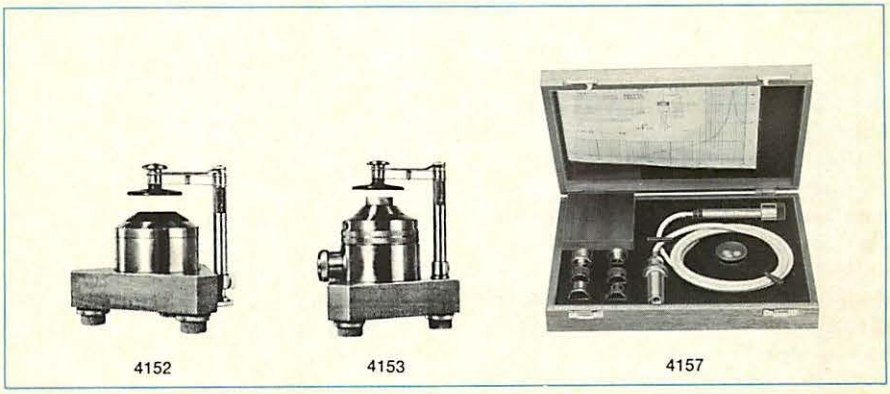


Fig. 42. Artificial Ears Types 4152 and 4153, and Ear Simulator Type 4157

Sealing Kit UA 0240

This kit (Fig. 43) is for sealing cartridge Types 4144 and 4145 so that measurements down to 0,1 Hz can be made.

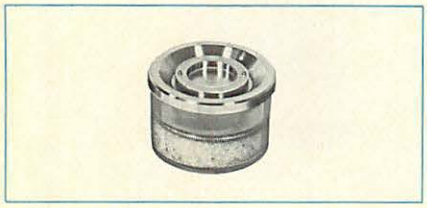


Fig. 43. Sealing Kit UA 0240

Dehumidifier UA 0308

Use of a dehumidifier is recommended in any situation where humidity may affect measurements.

The ½″ diameter Dehumidifier UA 0308 (Fig. 44) is designed to be mounted between a microphone preamplifier or a sound level meter, and a back-vented ½″ condenser microphone cartridge. It contains silica gel and effectively removes humidity from the air in the microphone. A small window in the Dehumidifier's case allows the humidity content in the silica gel to be controlled, as the gel changes colour from blue in dry state to red when saturated. By heating for some hours at 100°C, or longer at lower temperatures, the gel is easily dried out again. When used in 100% RH the Dehumidifier requires drying-out approximately once a month.

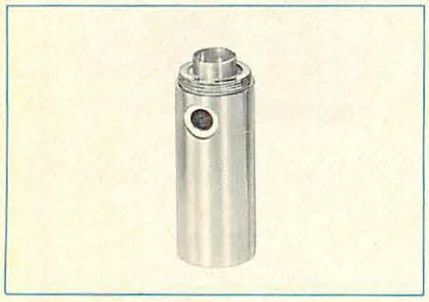


Fig. 44. ½″ Dehumidifier UA 0308

Flexible Adaptors UA 0122 and UA 0123

The Flexible Adaptors (Fig. 45) allow the ½″ and ¼″ microphones to be mounted on the ½″ preamplifiers. The UA 0123 has a straight connector while the UA 0122 has a right angled connector. The flexbility of the adaptors makes the microphone assembly less sensitive to mechanical vibration and high temperatures (150°C). Both sets are delivered with adaptors for

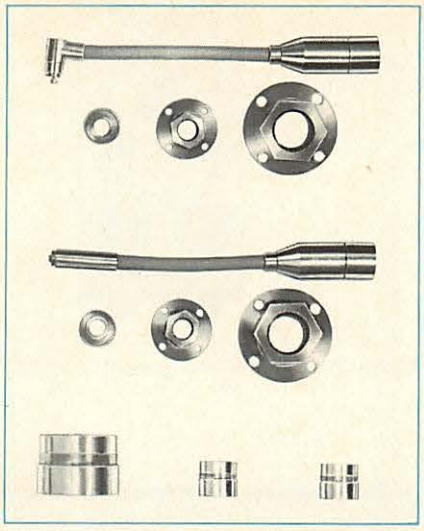


Fig. 45. Adaptors UA 0122, UA 0123, DB 0225, DB 0264 and DB 0900

flush mounting of the microphone for measurement of turbulence and other pressure variations in the plane of a surface.

Adaptor DB 0225

The ½″ to 1″ Adaptor DB 0225 (Fig. 45) screws onto the ½″ microphones to give them the same external dimensions as the 1″ microphones. For use of ½″ microphones with 1″ standard couplers, or 1″ actuator with ½″ microphones.

Adaptor DB 0264

The ¼″ to ½″ Adaptor DB 0264 (Fig. 45) screws onto the ¼″ microphones to give them the same external dimensions as the ½″ microphones. For use of ½″ accessories with ¼″ microphones, e.g. with ½″ actuator.

Adaptor DB 0900

The ⅛″ to ½″ Adaptor DB 0900 (Fig. 45) screws onto the ⅛″ microphone to give it the same external dimensions as the ½″ microphones. For use of ½″ accessories with the ⅛″ microphone, e.g. ½″ actuator.

Portable Floor Stands UA 0587 and UA 0801

These portable tripods are of rugged construction. UA 0587 (Fig. 46) is intended for heavy-duty applications such as a support for the Rotating Microphone Boom Type 3923, while UA 0801 provides an extremely lightweight tripod for easy field measurements using B&K Sound Level Meters and microphone assemblies. The microphone assembly is held in position by means of the Tripod Adaptors UA 0588 (½″) or UA 0802 (1″). Adaptors UA 0588 and UA 0802 may be ordered separately for use on any stand with ⅜″ W thread. A ⅜″ W to ¼″ W adaptor DB 1112 is supplied.

NB. The Adaptor UA 0588 does not accept the ¼″ Preamplifier Type 2633.

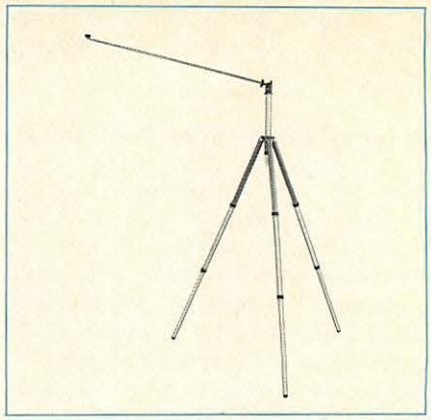


Fig. 46. Portable Floor Stand UA 0587

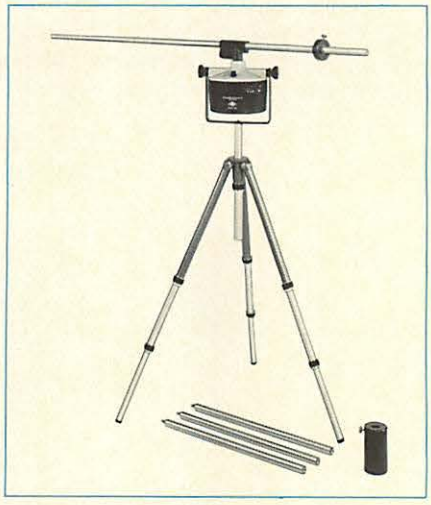


Fig. 47. Rotating Microphone Boom Type 3923 mounted on a tripod

Rotating Microphone Boom Type 3923

Type 3923 (Fig. 47) is designed for use in sound power measurements to ISO 3741 and in building acoustics. It is battery powered, from rechargeable NiCd-cells, but can also be operated from mains via the battery charger ZG 0113. It has rotation times of 16, 32 and 64 s and a built-in microswitch allows synchronization of external equipment. The length of the boom can be varied from 50 cm to 200 cm.

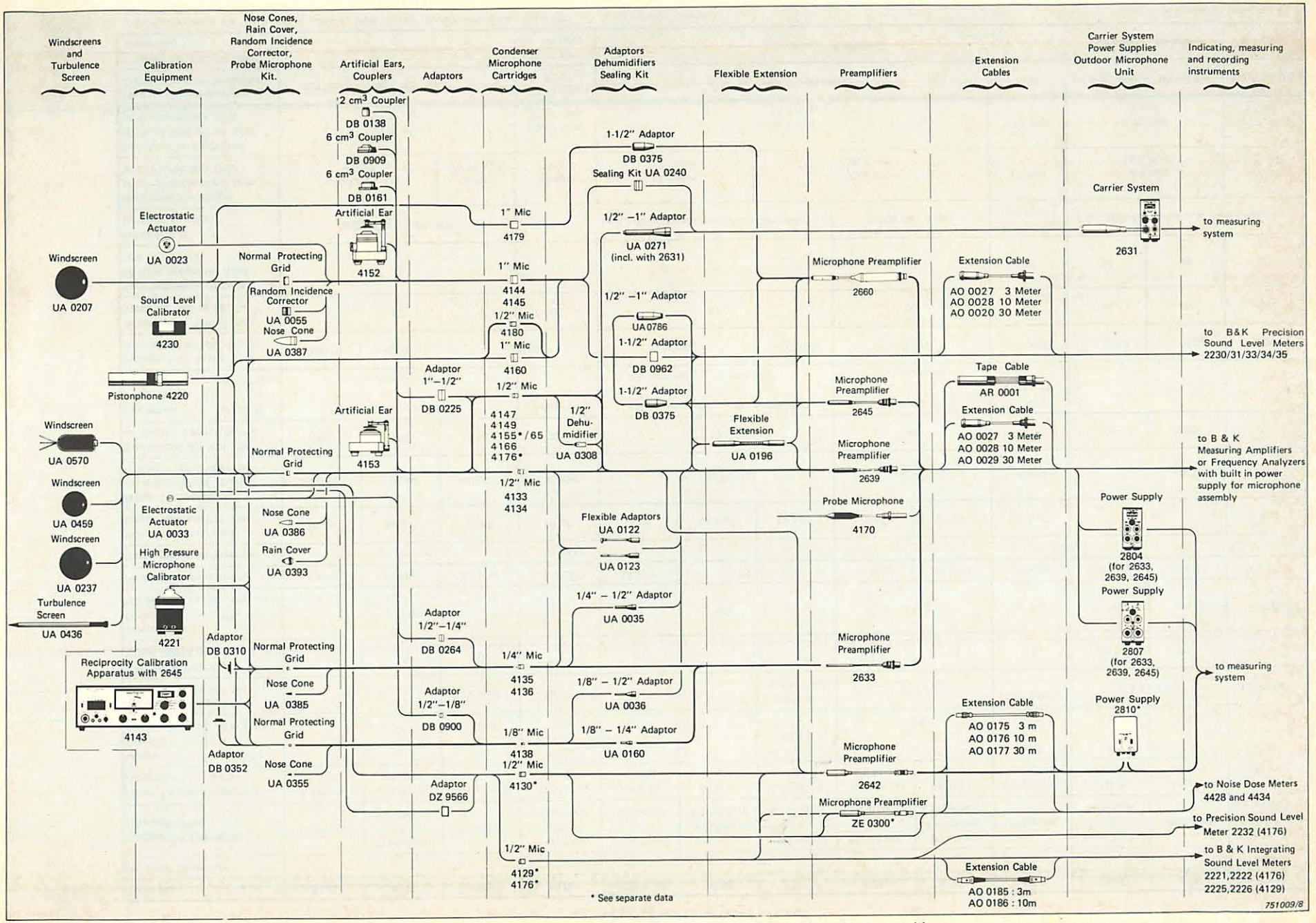


Fig. 48. Survey of adaptors and accessories for the condenser microphone cartridges

Specifications

Type No.		4144	4145	4160	4179	4133, 4149	4134	4147*	4165	4166*	4180	4135	4136	4138
Nominal Diameter		1″				1/2″						1/4″		1/8″
Frequency Response Characteristic		Pressure	Free-Field 0° Incidence	Pressure	Free-Field 0° Incidence	Free-Field 0° Incidence	Random Incidence & Pressure	Random Incidence & Pressure	Free-Field 0° Incidence	Random Incidence & Pressure	Pressure	Free-Field & Random	Pressure	Random Incidence & Pressure
Open Circuit Frequency Response* (± 2 dB)		2,6 Hz to 8 kHz	2,6 Hz to 18 kHz	Up to 8 kHz ± 1 dB	10 Hz to 10 kHz**	4 Hz to 40 kHz	4 Hz to 20 kHz	0,0065 Hz to 18 kHz	2,6 Hz to 20 kHz	2,6 Hz to 10 kHz	up to 20 kHz ± 1,5 dB	4 Hz to 100 kHz	4 Hz to 70 kHz	6,5 Hz to 140 kHz
Open Circuit Sensitivity*	mV/Pa	50		47	100	12,5		$1{,}1 \times 10^3$ pF/Pa	50		12,5	4	1,6	1,0
	dB re.1 V/Pa	−26		−26,5	−20	−38		—	−26		−38	−48	−56	−60
Lower Limiting Frequency, −3 dB		1 to 2 Hz		1 to 2 Hz+	5 to 7 Hz	1 to 3 Hz		10^{-3} to 5×10^{-3} Hz	1 to 2 Hz		1 to 3 Hz+	0,3 to 3 Hz		0,05 to 5 Hz
Cartridge Thermal Noise (dB(A))		9,5	10	9,5	−2,5***	20	18		14,5	15	18	29,5	30,5	—
Open Circuit Distortion Limit, 3%, at 100 Hz (dB re. 20 μPa)		> 146			140	> 160			> 146		> 160	> 164	> 172	> 168
Resonance Frequency		8 kHz	11 kHz	8,5 kHz	7 kHz	24 kHz	23 kHz		14 kHz	11 kHz	23 kHz	100 kHz	70 kHz	160 kHz
Polarization Voltage (V)		200						—	200					
Polarized Cartridge Capacitance at 250° Hz*		55 pF	66 pF	55 pF	40 pF	18 pF	18,5 pF	19,5 pF	19 pF	21 pF	17,5 pF	6,4 pF		3,5 pF
Mean Temperature Co-efficient (at 250 Hz) −10 to +50°C (dB/°C)		−0,003	−0,002	−0,003	−0,004	−0,002			−0,007		−0,002	−0,01		
Equivalent Air Volume at 250 Hz, 1 atm. (mm^3)		148	130	148	400	10			40		9,3	0,6	0,25	0,1
Expected Long Term Stability	at 20°C	> 1000 years/dB			250 years/dB	> 1000 years/dB (> 200 years/dB[b]) < > 2 hours/dB (> 20 min./dB[b])			> 600 years/dB > 1 hour/dB		> 400 years/dB	—		
	at 150°C	> 2 hours/dB			—									
Influence of Static Pressure at 250 Hz (dB/mbar)		−0,0016	−0,0015	−0,0016		−0,0007		−0,00025	−0,001		−0,0007	−0,0007	−0,00025	−0,001
Influence of 1 m/s² Axial Vibration (dB re. 20 μPa)[c]		67			60	67			60		65	59	69	58
Typ. Influence of 50 Hz, 80 A/m magnetic field (dB re. 20 μPa)		18			12	20			30		20	30	38	40
Influence of Relative Humidity		0,0025 dB/100% RH			< 0,1 dB in the absence of condensation				0,004 dB/% RH		0,0008 dB /100% RH	< 0,1 dB in the absence of condensation		
Height of Cartridge: Without Protection Grid		17 mm		19 mm	23 mm	11,5 mm		15,2 mm			12 mm	9,0 mm		6 mm
With Protection Grid		19 mm		19,35 mm	25 mm	12,6 mm		16,3 mm				10,5 mm		6,7 mm
Diameter of Cartridge Without Protection Grid		23,77 mm			23,77 mm	12,7 mm					13,2 mm	6,35 mm		3,175 mm
With Protection Grid		23,77 mm			23,77 mm	13,2 mm						7 mm		3,5 mm
Thread for Protection Grid or Coupler Mounting		23,11 mm — 60 UNS		—	23,11 mm — 60 UNS	12,7 mm — 60 UNS					—	6,35 mm — 60 UNS		M3,175 × 0,2
Thread for Preamplifer Mounting		23,11 mm — 60 UNS			23,11 mm — 60 UNS	11,7 mm — 60 UNS						5,7 mm — 60 UNS		M3 × 0,2

a) For specifications with 10 MHz carrier, see data sheet for Microphone Carrier System Type 2631
b) Type 4149
c) Typical value

* Individually calibrated
** With frequency response compensation network built-in to Preamplifier Type 2660
*** A-weighted noise floor of combined assembly (4179 + 2660)

\+ vent exposed to sound field

T00910GB0

T00911GB0