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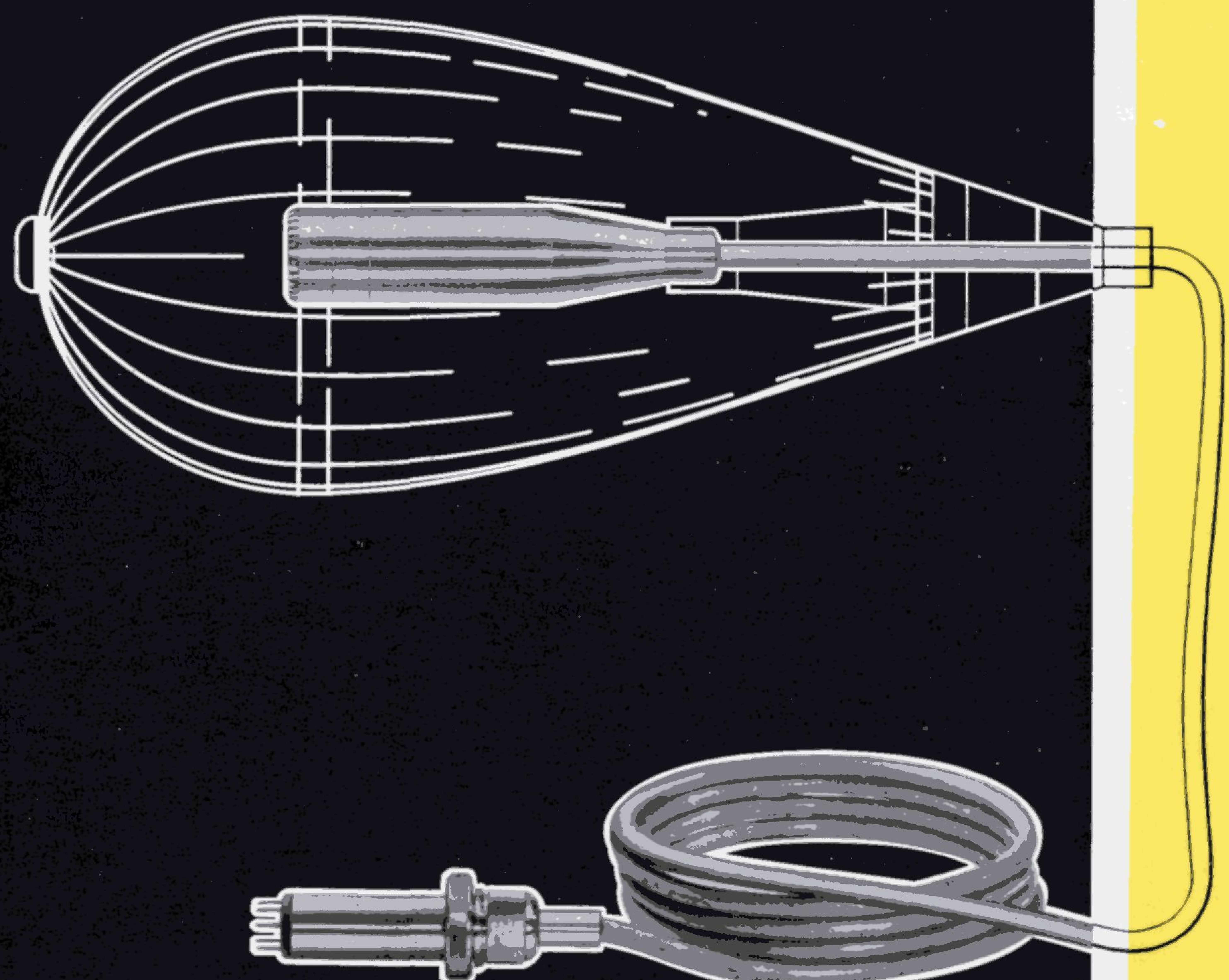
WINDSCREENS



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CONTENT

DET BERLINGSKE BOGTRYKKERI

Aerodynamically Induced Noise of Microphones and Windscreens.

by

Per V. Brüel, D. Sc.

SUMMARY

A newly designed windscreen with airfoil form and two new nose cones to protect condenser microphones against wind turbulence are investigated over a large wind speed range. Measurements are made both indoor on a rotating arm and outdoor on a car and a light aeroplane. The results are compared with the limited information given in the literature. Also the influence on the frequency response both from the windscreen and from the nose cones is measured for different angles of incidence, and it is shown how the nose cone converts a free field single direction microphone into a omnidirectional microphone over a large frequency range.

ZUSAMMENFASSUNG

Ein neuentwickelter stromlinienförmiger Windschirm und zwei neue Konusköpfe, welche Kondensatormikrophonen vor turbulenten Luftströmungen schützen sollen, werden in einem grossen Bereich verschiedener Windgeschwindigkeiten untersucht. Die Messungen werden sowohl im Labor als auch im Freien durchgeführt, erstere an einem rotierenden Arm, letztere an einem Kraftwagen und an einem leichten Flugzeug. Die Ergebnisse werden mit dem im Literaturverzeichnis angegebenen unvollkommenen Angaben verglichen. Es wird untersucht, in welchem Masse Windschirm und Konuskopf den Frequenzgang bei verschiedenen Schalleinfallsrichtungen beeinflussen. In einem grossen Frequenzbereich verwandelt der Konuskopf eine einseitig ausgeprägte Richtcharakteristik in eine Kugelcharakteristik.

RÉSUMÉ

On étudie, sous une gamme étendue de vitesses du vent, le comportement d'un écran-paravent de forme aérodynamique d'une conception nouvelle et de deux nouveaux cônes frontaux destinés à protéger les microphones à condensateur de la turbulence du vent. Les mesures ont été effectuées tant à l'intérieur qu'en plein air. A l'intérieur sur un bras tournant, puis au dehors sur voiture et sur un avion léger. Les résultats sont ensuite comparés aux informations peu nombreuses, trouvées dans la littérature citée en bibliographie. L'influence sur la réponse en fréquence de l'écran-paravent et des cônes frontaux a été relevée pour divers angles d'incidence et l'on montre comment les cônes frontaux convertissent un microphone uni-directionnel pour champ libre en un microphone omni-directionnel dans une large bande de fréquences.

When a measuring microphone is used out-of-doors the problem of noise generated by the wind is often of such consequence that it disturbs the measurements to a considerable degree. This wind noise is caused by the air flow creating turbulence around the microphone. In other words, if this turbulence can be avoided or decreased, the noise will disappear.

The most common method to reduce the wind noise is to make up a so-called windscreen which consists of a wire framework covered with a cloth-type material, which has a specific air resistance, the microphone being integrated at the centre of the structure. If the selected cloth is of an open mesh, the sound waves will penetrate without any considerable loss in energy, but the wind resistance of the material will be sufficient to dissipate any direct air-flow around the microphone. Naturally, the windscreen

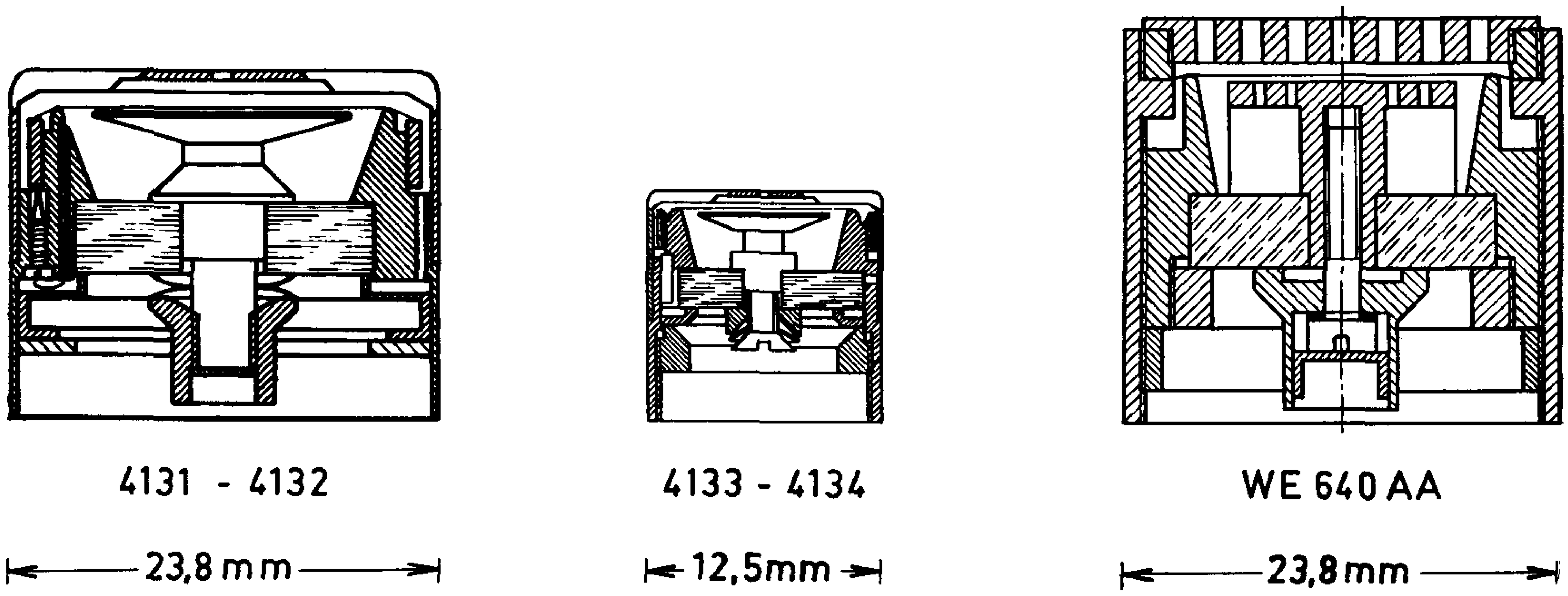

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Fig. 1. Microphone types used for wind noise measurements. Left: B & K Type 4131 with its standard protecting grill. In the middle: B & K Type 4133 ½" also with standard grill. Right: WE 640 AA with the standard perforated protecting cover.

will now act as a new source in introducing turbulence, but this turbulence will occur at a greater distance from the microphone, and therefore, the wind noise will be decreased at the point where the microphone diaphragm is located.

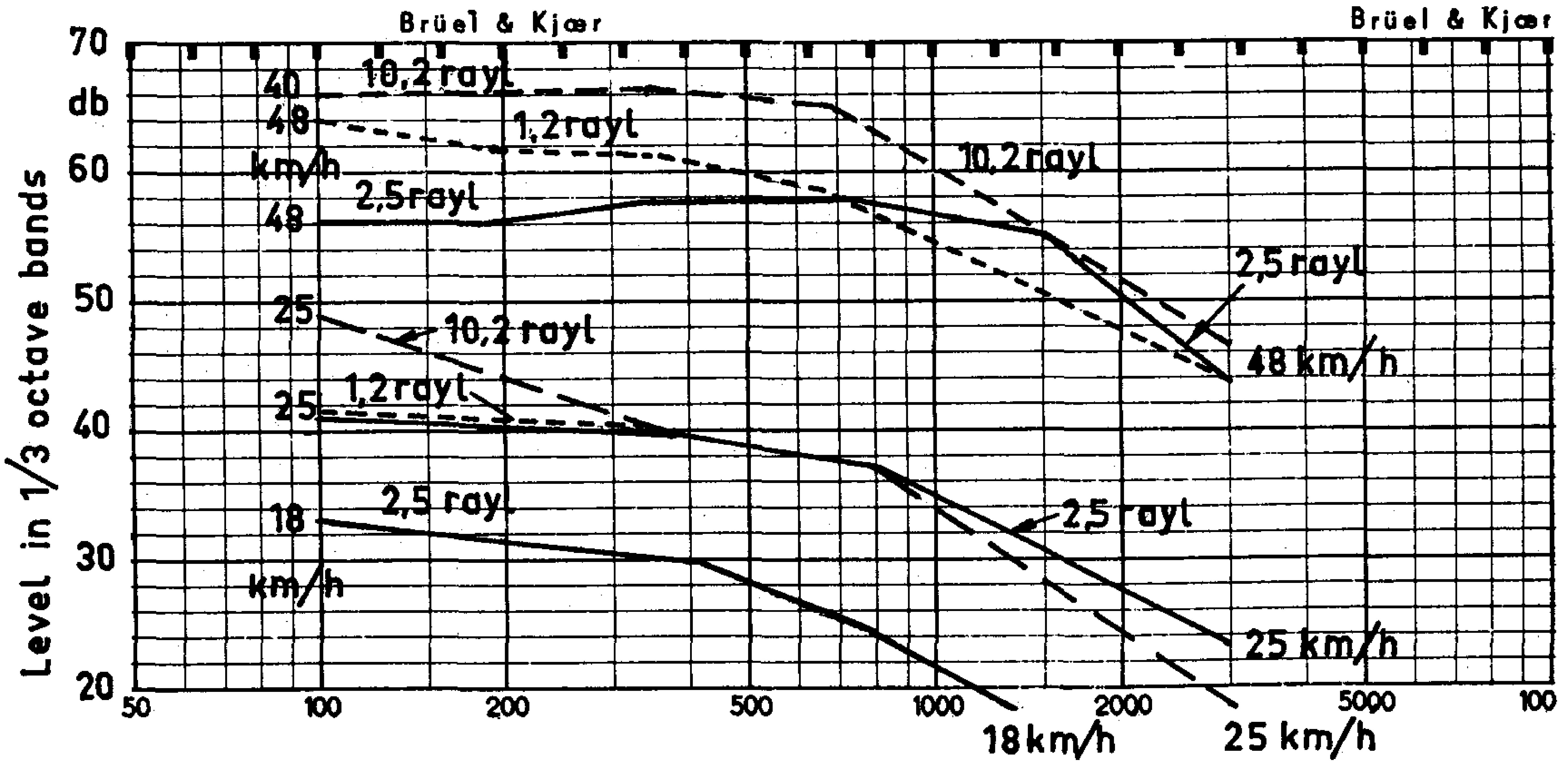

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Fig. 2. Dr. Leonard's measurements on a microphone in a windscreen covered with cloth, with different resistances varying from 1.2 rayl to 10.2 rayl. For comparison the original results are converted into bands of ⅓ octave and speeds into km/h.

In the reference literature to some extent the effect of windscreens is described, but only limited data as to the exact noise reduction is published.* It is therefore the purpose of this paper, and the entailed experiments to

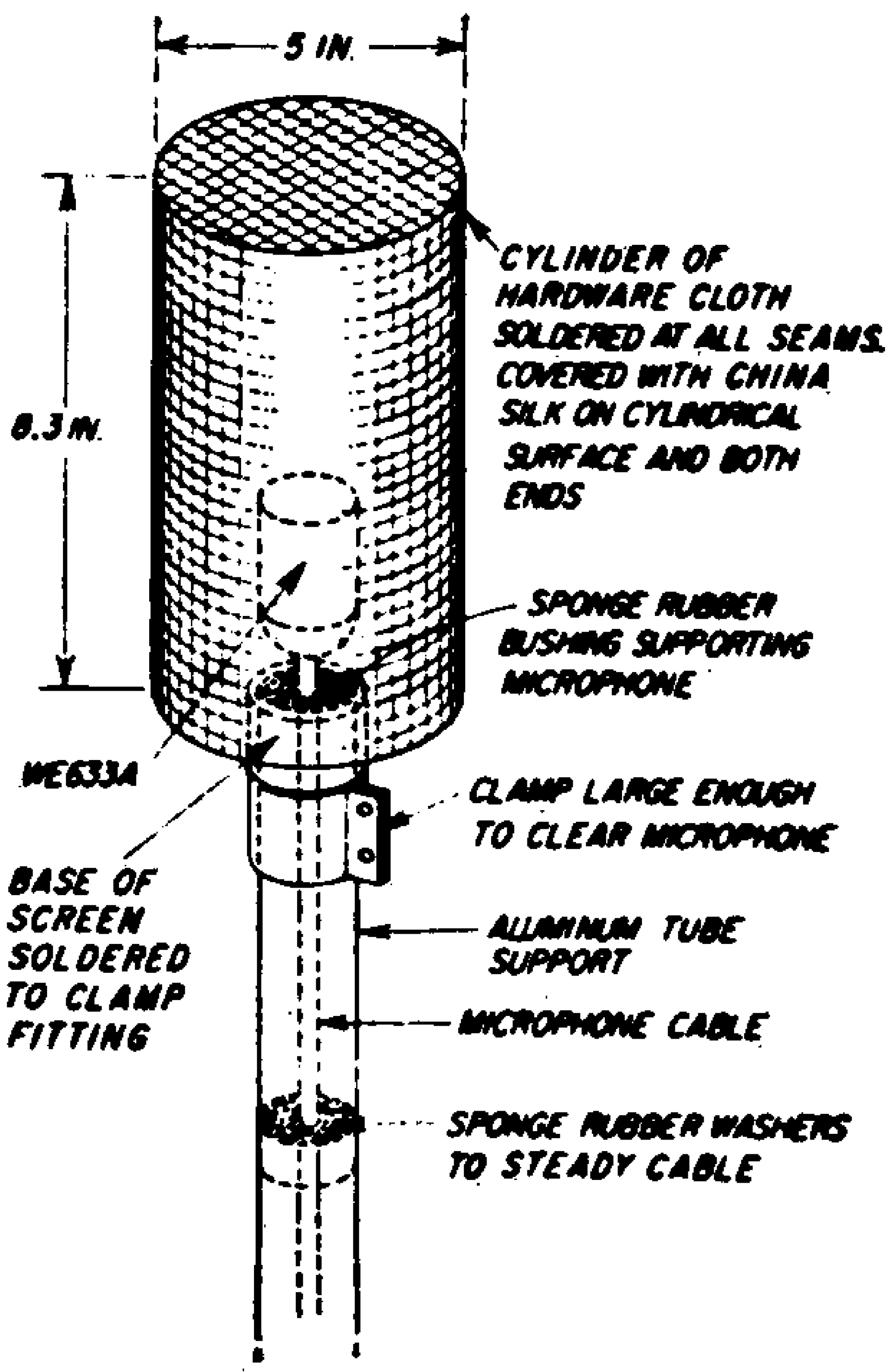

Fig. 3. A simple and convenient windscreen formed as a cylinder. The design is described by Dr. E. W. Leonard.

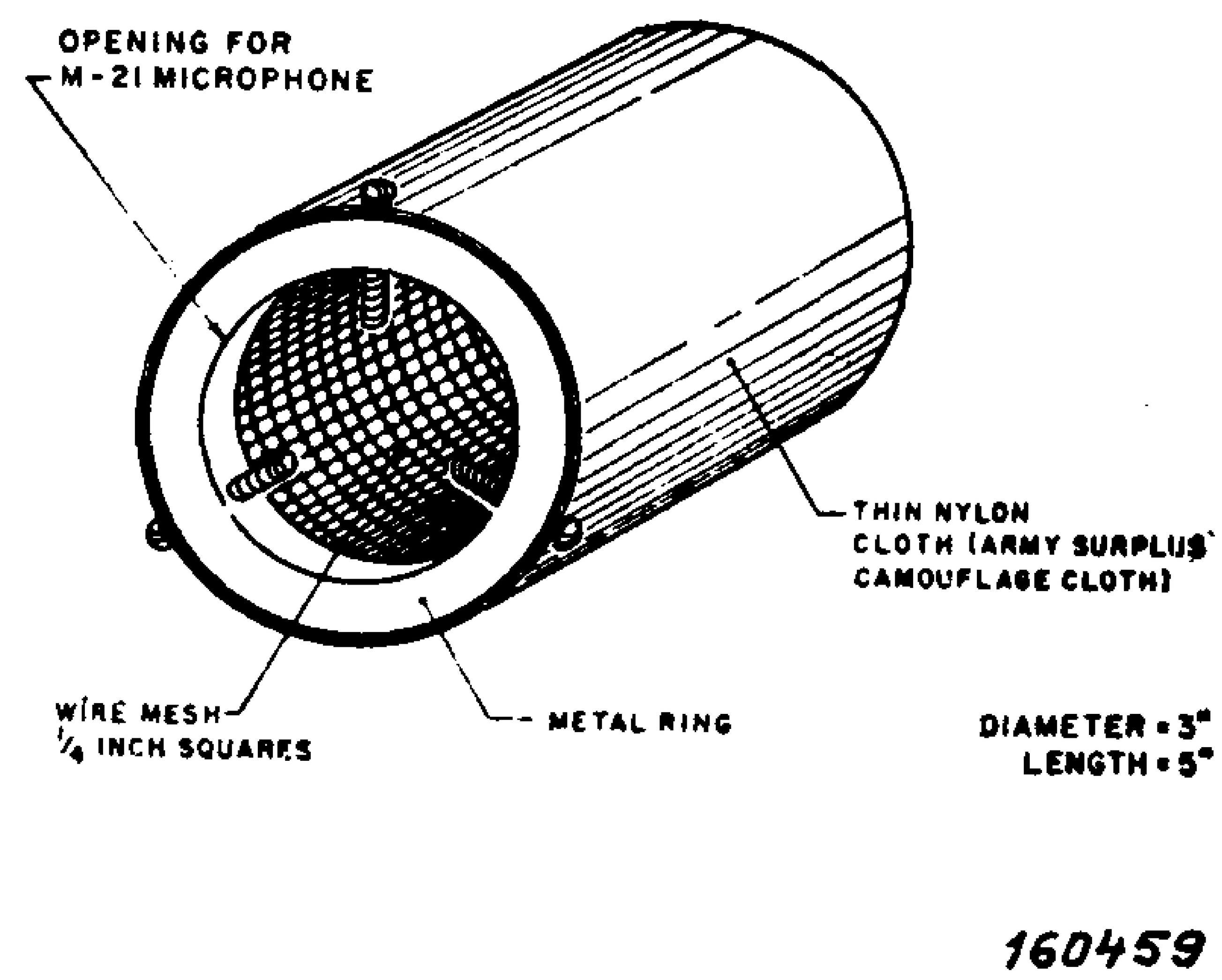

Fig. 4. Sketch of the windscreen used for the results in Fig. 5. No covering was used over the open end of the cylinder.

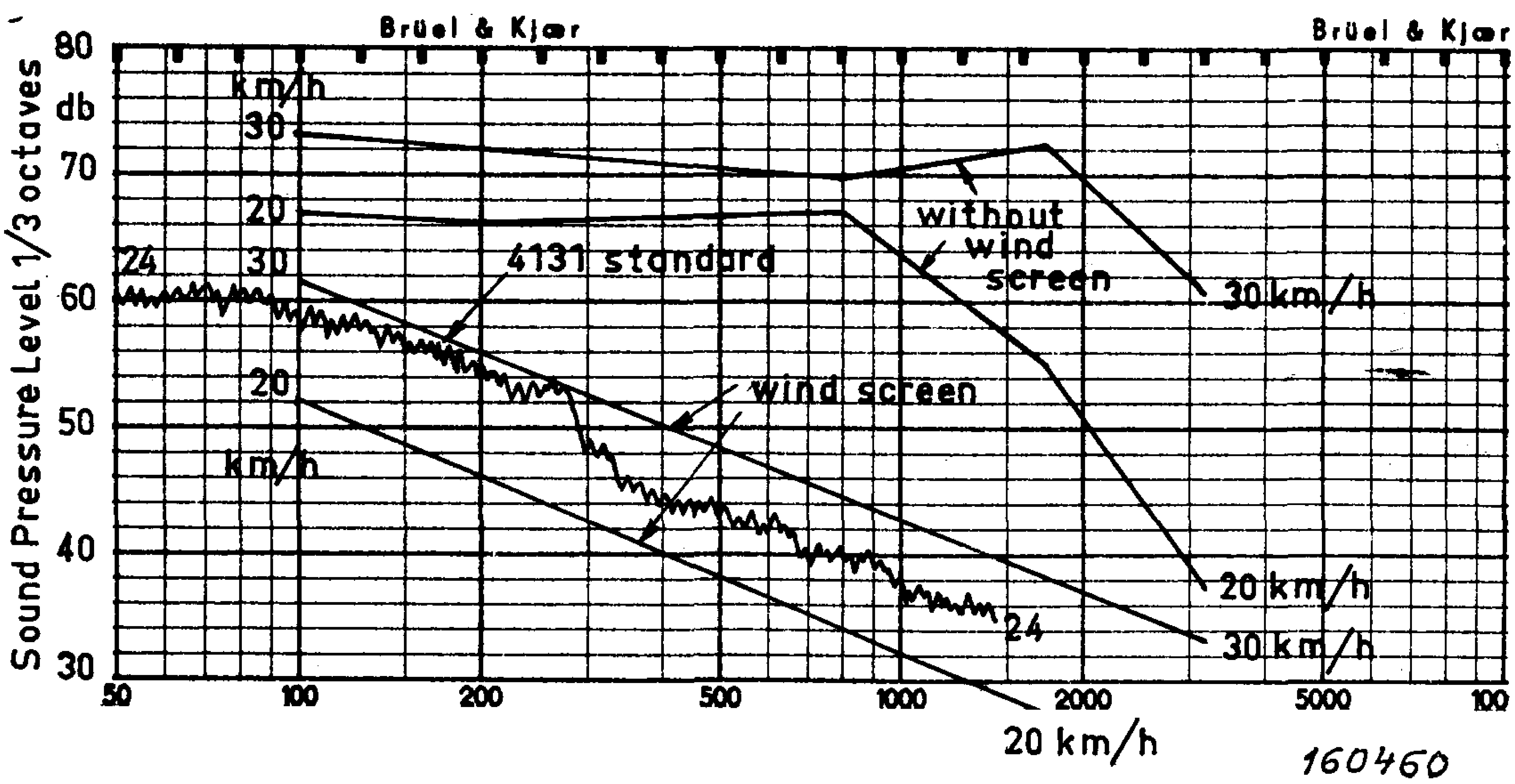

Fig. 5. Noise generated by a microphone 21-B with and without cylindrical open-ended windscreen measured at two different wind speeds. Continuously recorded curve of noise from a B & K Microphone 4131 with standard protection grill. The original octave band sound pressure levels are converted into ⅓ octave bands.

* H. F. Olson: Acoustical Engineering, p. 322.

give some exact measuring figures which cover a wide range of wind velocities. The microphones used were the B & K 4131 microphone and the B & K 4133 ½″ microphone, while for comparison in measurements, which are described in the reference literature, a form of the WE 640 AA was utilised. In Fig. 1 can be seen a cross-sectional diagram of each of the three microphones.

Dr. Beranek** has described, that according to some unpublished data from the Electro-Acoustic Laboratory, Harvard, the resistance of the cloth in a windscreen should be between 5 and 10 rayls to obtain the best noise reduction. Also, the windscreen should be large compared to the diameter of the microphone to get a good result. No theoretical explanation is given, but a noise reduction of up to 30 db is reported.

Dr. R. W. Leonard*** has described both a streamlined and a cylindrical windscreen, and when comparing these it has been found that the streamlined form is in the order of 3-5 db better than the cylindrical one. Dr. Leonard has also tried the effect of different covering materials. On Fig. 2 the results are shown, from which it is seen that even for large variations in the resistance of the cloth, only minor changes in noise reduction are obtained, except at the very low frequencies. The windscreen used in those measurements was a cylindrical open-ended form of a very simple mode, as shown in Fig. 3.

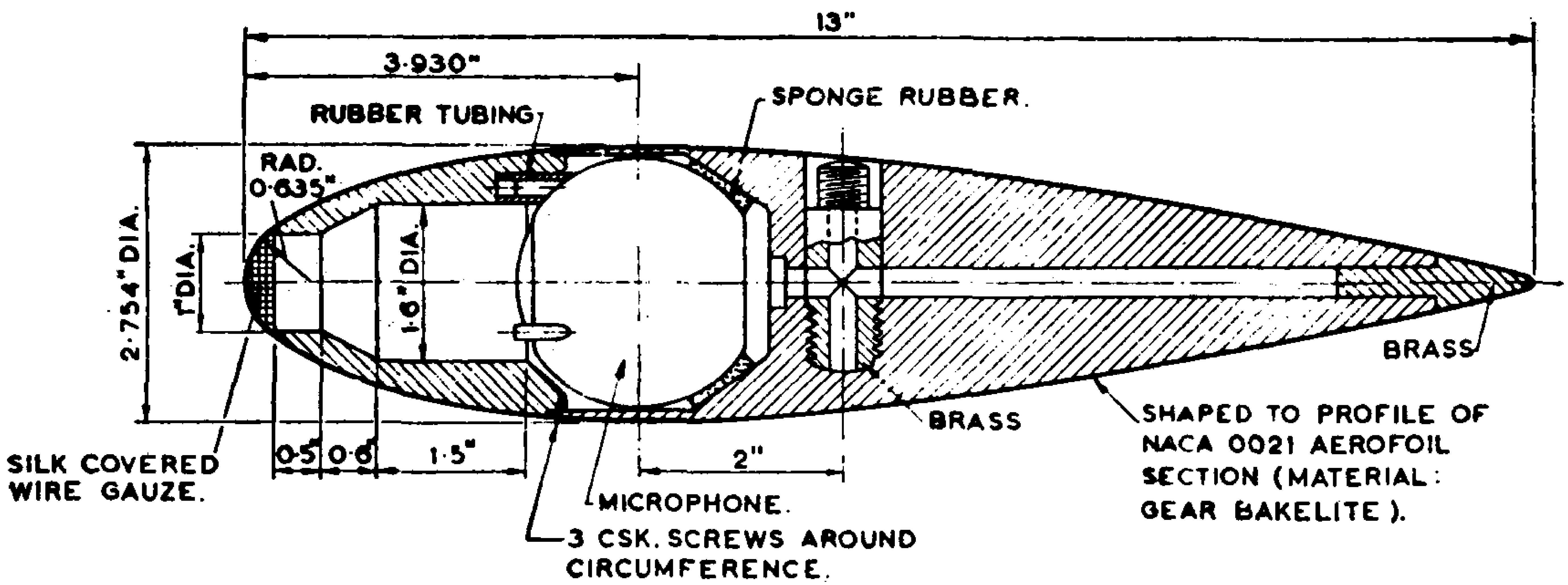

Fig. 6. Dynamic microphone built in an airfoil structure. Van Niekerk.

Dr. Beranek and his associates* describe the noise reducing effect gained from a simple cylindrical windscreen placed on a condenser microphone of the type Altex 21B. This type of windscreen is shown on Fig. 4, thin nylon being used as the covering material. Fig. 5 shows the results given for the

** L. L. Beranek: Acoustic Measurements, p. 258.

*** R. W. Leonard: Report from first ICA congress in Delft, p. 110. 1954. G. Hirzel Verlag, Zürich.

* Beranek, Reynolds and Wilson: Predicting Ventilation System Noise. J. A. S. A. Vol. 25, p. 313 (1953).

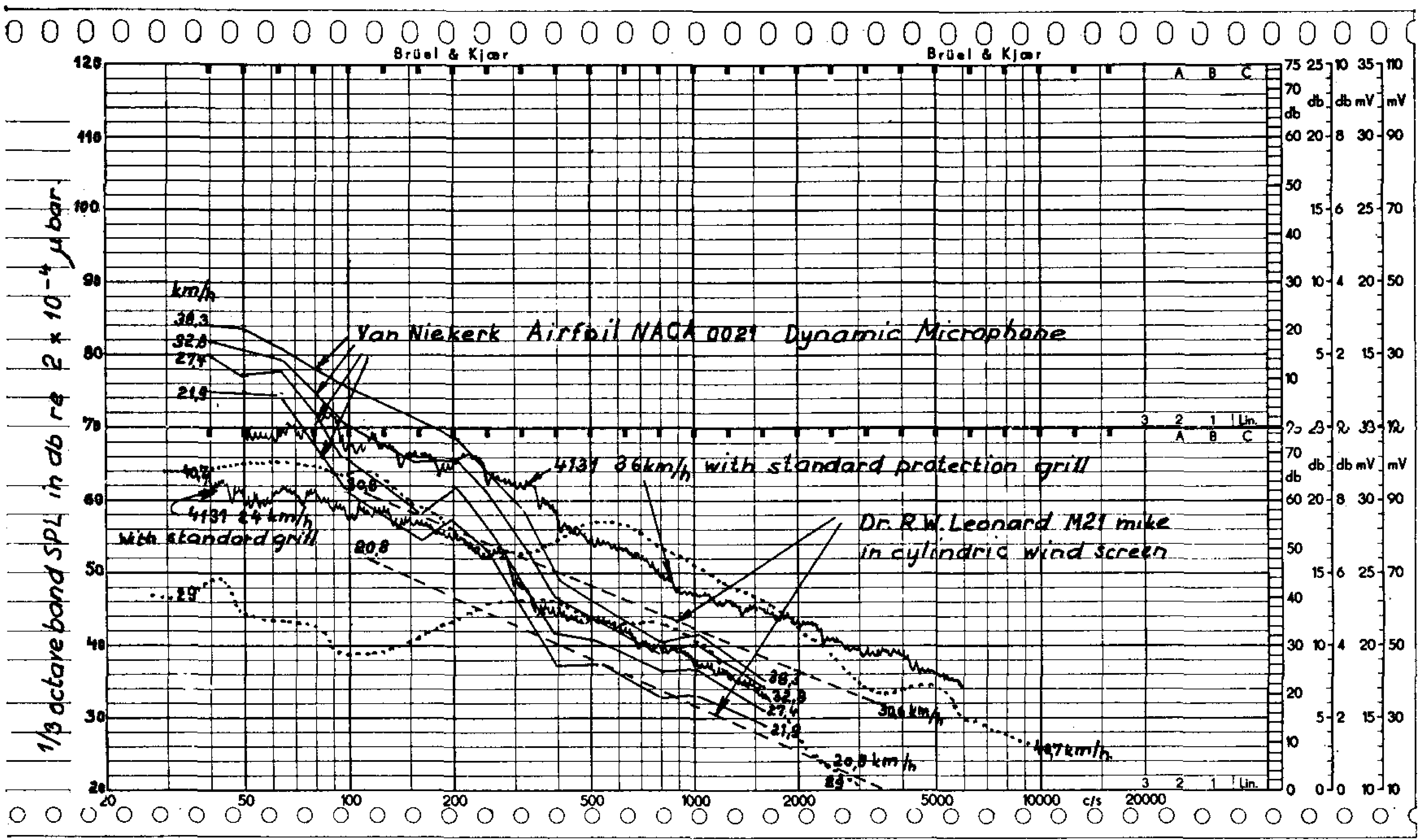

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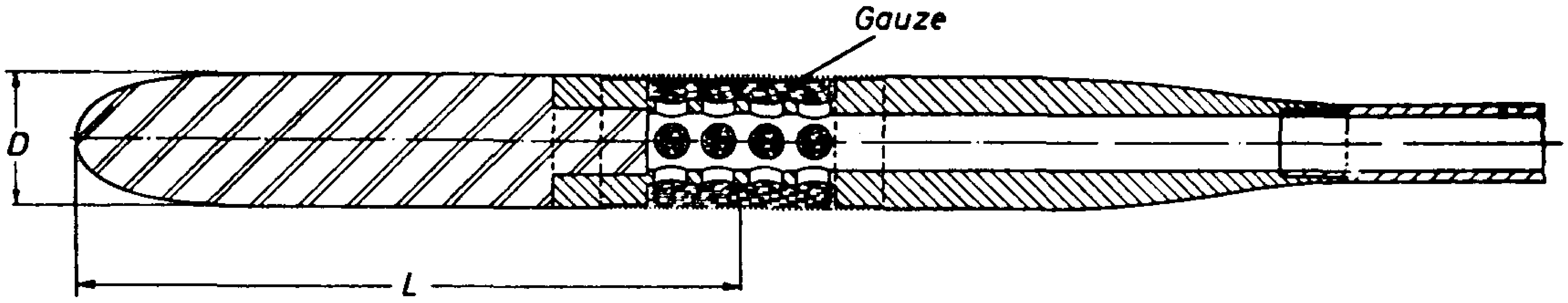
Fig. 7. Aerodynamically induced noise of the shielded microphone shown in Fig. 6. Noise levels are given in SPL for ⅓ octave bands. The shielded dynamic microphone is compared with an unshielded B & K 4131 with its standard protecting grill.

noise as a function of frequency, for both the unshielded microphone and when it is enclosed in the windsreen. Two different wind velocities have been used. For comparison, the wind-noise for the B & K Condenser Micro-



Probe Microphone 160463

Fig. 8. Airfoil probe microphone developed by Meyer, Mechel and Kurtze. = 5 D. Wiremesh at microphone opening 30/80 µm.

phone 4131 with its standard protection grill in position, and the wind direction at right-angles to the diaphragm, is given. It should be noted, that the noise of this unscreened microphone is about the same level as for the 21B microphone mounted within a windscreen. This also explains why it is possible to obtain 25-30 db noise reduction by screening a 21B microphone, against only 8-12 db when screening a 4131, a description of which is given later.

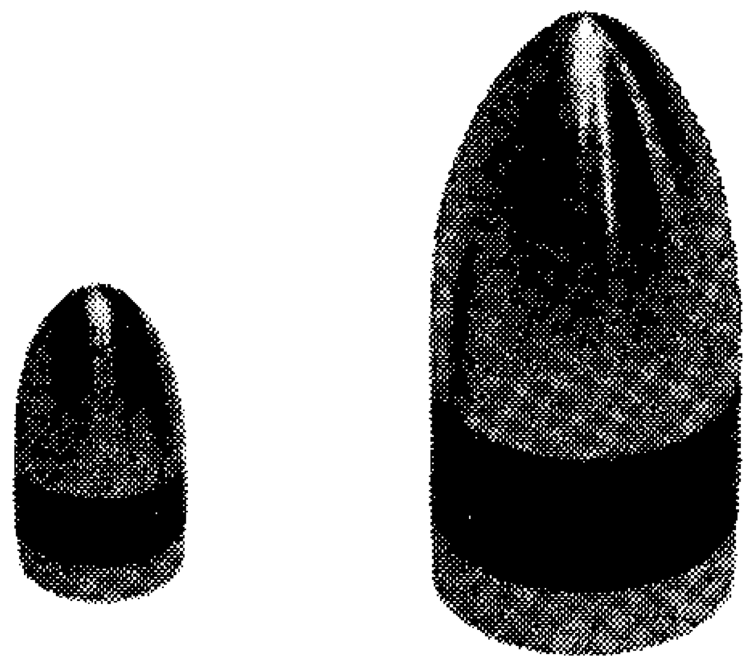


Fig. 9. Nose Cones UA 0052 and UA 0051 for shielding the condenser microphone cartridges 4133/34 and 4131/32 respectively against wind.

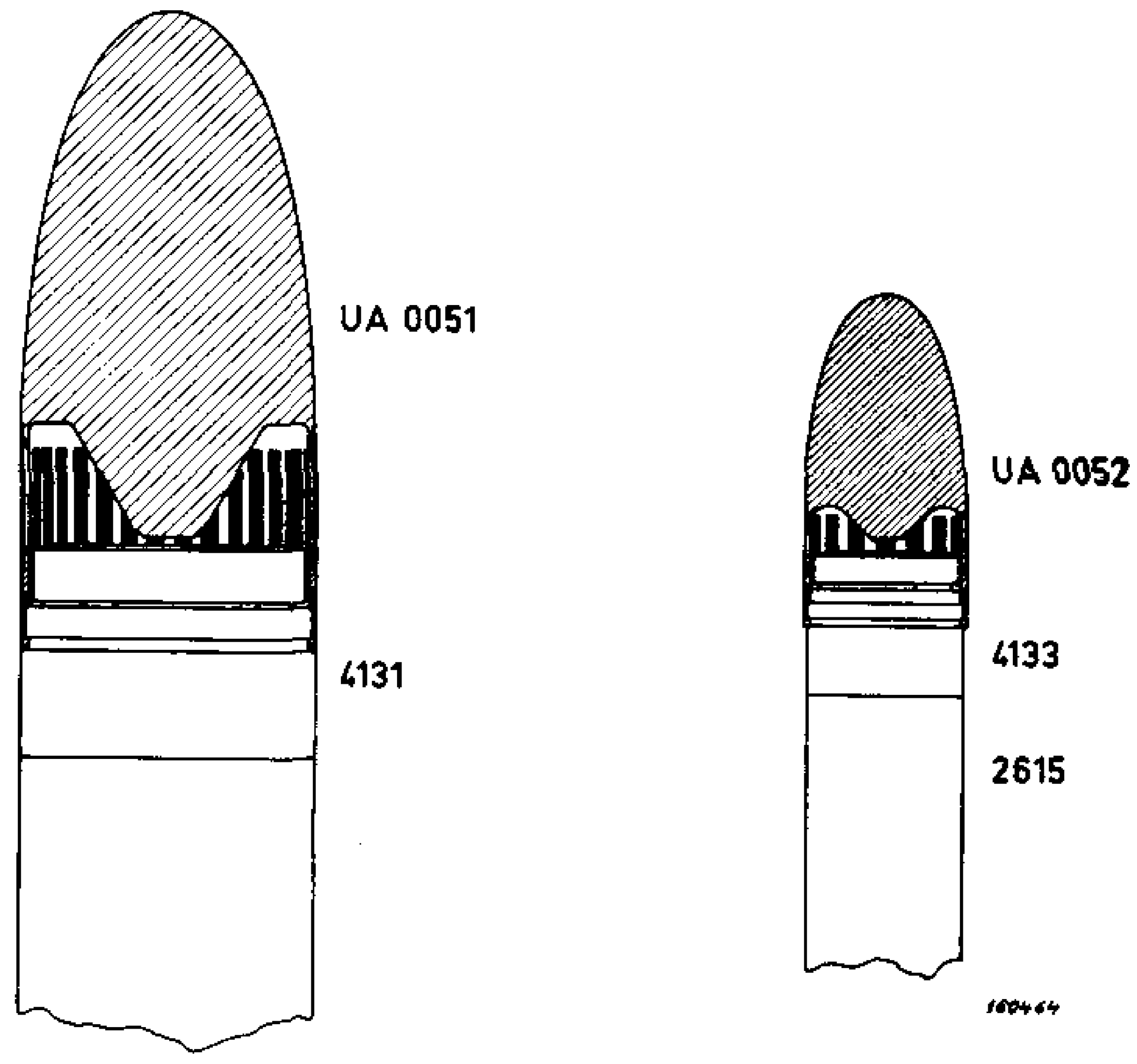


Fig. 10. Section of Nose Cones UA 0051 and UA 0052 mounted on the Condenser Microphone 4131 and 4133, together with the associated cathode followers.

G. van Niekerk has described a streamlined housing for a dynamic microphone as shown in Fig. 6. The actual sound reduction for the microphone is not reported, but only the total noise of the shielded microphone. In order to compare the results a B & K Microphone Type 4131 with the standard protection grill in positions was selected, the wind velocities being between 20 and 40 km/h at right-angles to the microphone, and the noise expressed as ⅓ octave band SPL in db re 2×10^{-4} μbar. The resultant graphs are displayed in Fig. 7, and again it is of interest to note, that the generated noise from the Microphone 4131 is very low and practically of the same order as the noise generated by the shielded dynamic microphone. Meyer,

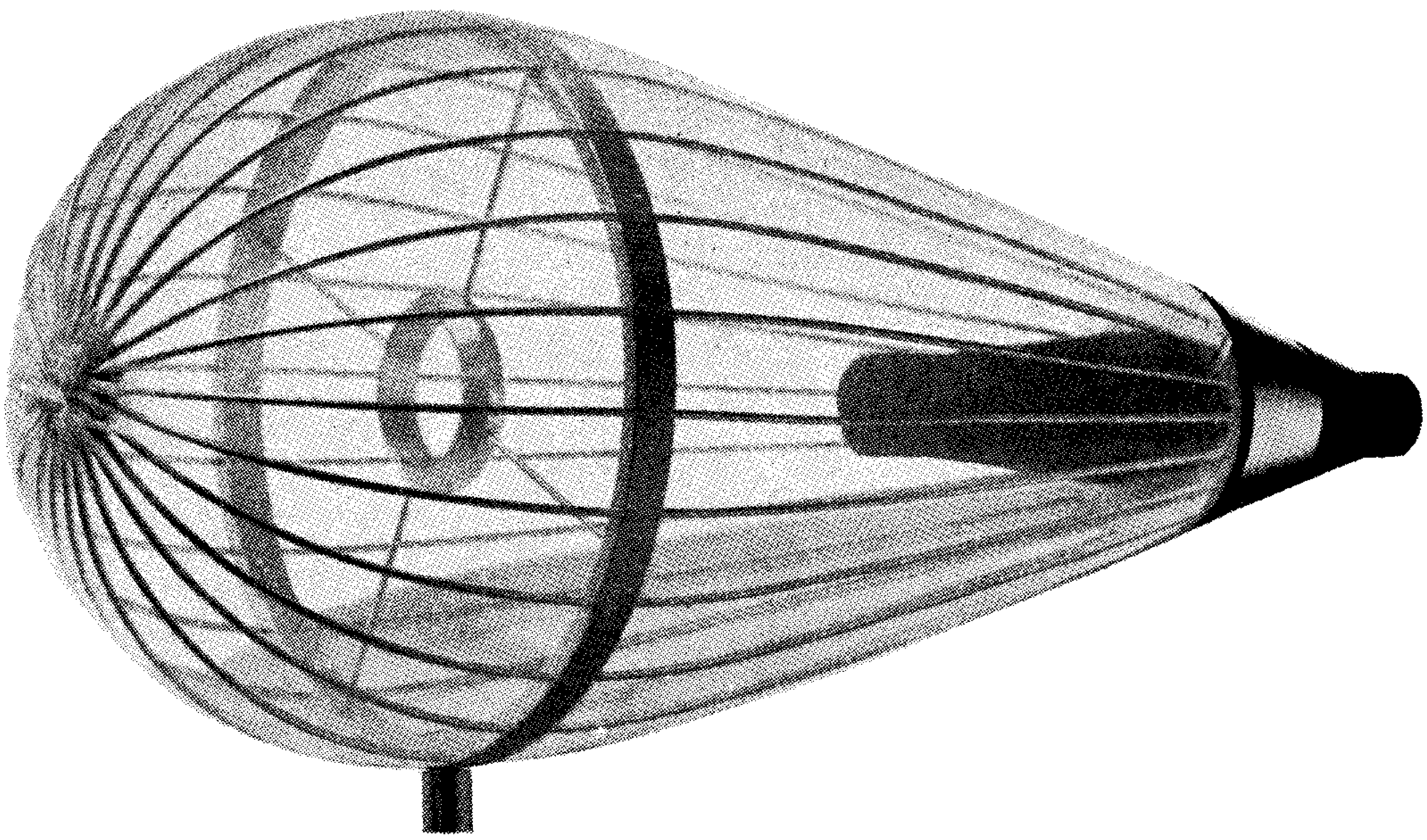


Fig. 11. Photo of the streamlined Windscreen UA 0050.

Mechel & Kurtze** also give a description of enclosing a microphone in an airfoil structure, in this instance the microphone is of the probe type, and the authors stress that the opening into the probe should be placed at least a total of 5 times the diameter of the tube from the tip of the cone. A replica of this is drawn, and shown in Fig. 8.

B & K have developed a nose cone, which replaces the microphone grill, a photo and cross-section of this being shown in Figs. 9 and 10 respectively. It is a streamlined unit, conical in shape, and to the rear of the cone and around the circumference is placed a fine wire mesh of brass, which enables the sound waves to penetrate to the microphone diaphragm. In order to cut

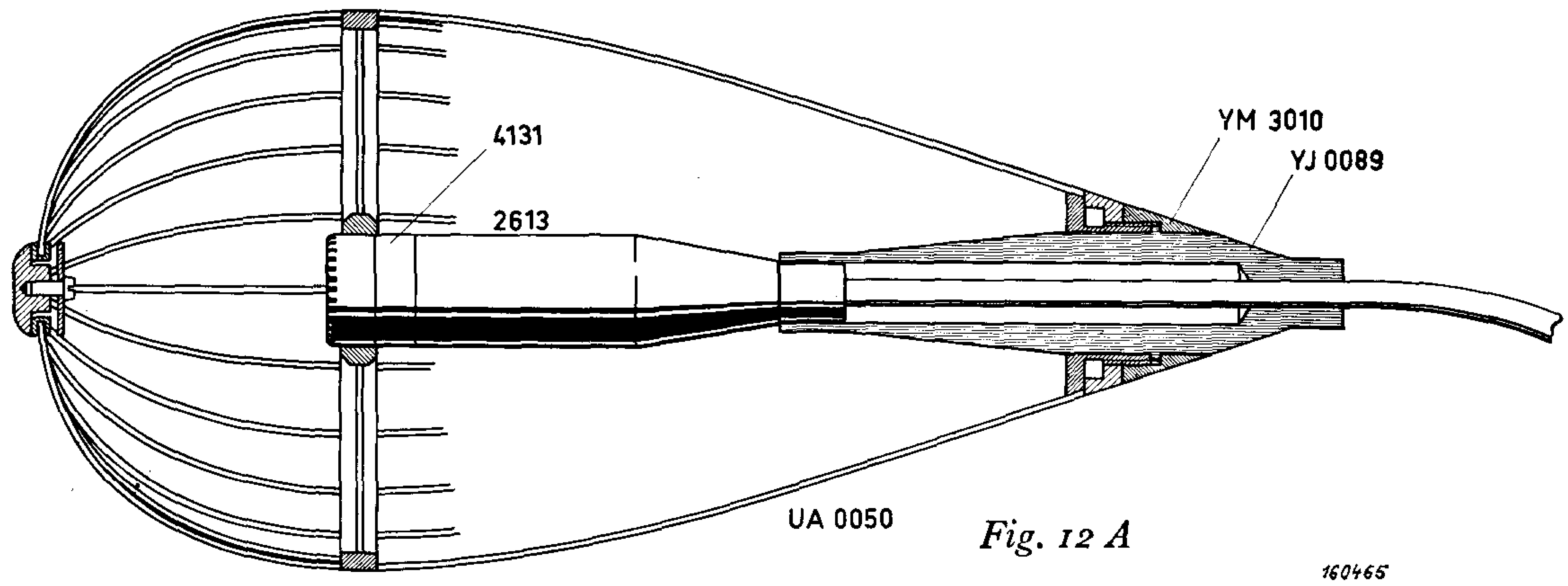


Fig. 12 A

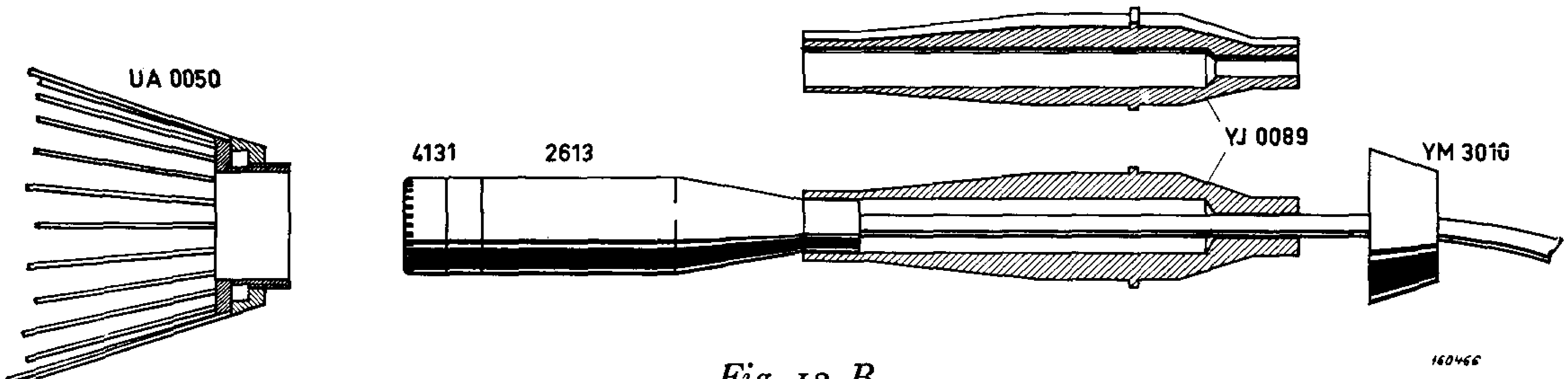


Fig. 12 B

Fig. 12. Section of the Windscreen UA 0050 with Condenser Microphone 4131 and Cathode Follower 2613 installed. The different parts are also shown before assembly in the screen.

down the alternating flow of air through the mesh, a method has been adopted, reducing the volume of air behind the mesh and on the diaphragm, by conically machining the rear of the cone to take up a major portion of the interior volume, as can be seen in Fig. 10. In this manner it has been possible to obtain only a very small variation in the frequency characteristic of the microphone with and without the nose cone, as will be shown later in this paper.

** Meyer, Mechel and Kurtze: Experiments on the Flow and Sound Attenuation in Absorbing Ducts. J. A. S. A. Vol. 30, p. 165 (1958).

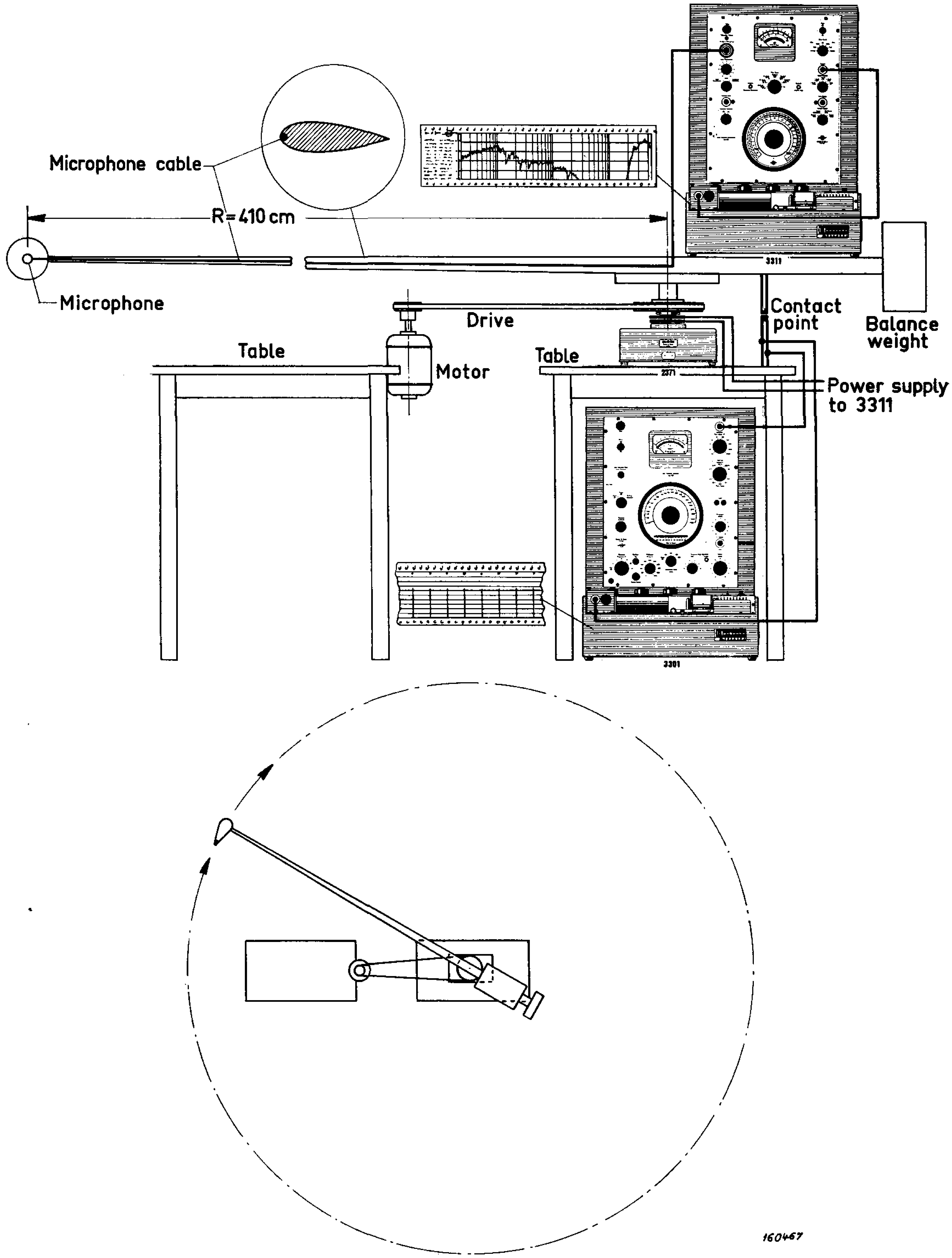


Fig. 13. Set-up for measuring and analyzing aerodynamically induced noise on microphones at low air speeds. The measurement is made indoors.

B & K have also designed a streamlined windscreen which is so acoustically "open" that the sensitivity and the frequency response of the microphone have only minor changes in the audio frequency range. This is UA 0050 and can be seen in Fig. 11.

The windscreen is a streamlined housing, made up of a light fabricated framework and covered with a thin black-elastic nylon mesh. The mesh selected has a flow resistance of around 2 to 5 rayls for optimum noise reduction at lower wind velocities.

The housing is so designed to fit the full range of B & K microphones, an example of a fully mounted Microphone 4131 and associated Cathode Follower and Cable 2613 being demonstrated in Fig. 12 A. In Fig. 12 B is shown the assembly and mounting rings YJ 0089 and YM 3010, prior to fitting. By the incorporation of an appropriate mounting ring Microphone 4133 and 4134 with their Cathode Follower 2615 can be readily used, and by a mechanical enlargement of the hole in the support, gooseneck type Cathode Followers 2612 and 2614 can also be utilised.

Measurements at Low Wind Speeds.

To take measurements at the lower wind velocities the set-up shown in Fig. 13 was used indoors. The complete measuring arrangement, i. e. frequency analyzer and the corresponding level recorder, being placed on a turn-table together with the 4 m long arm holding the microphone at the tip. By introducing

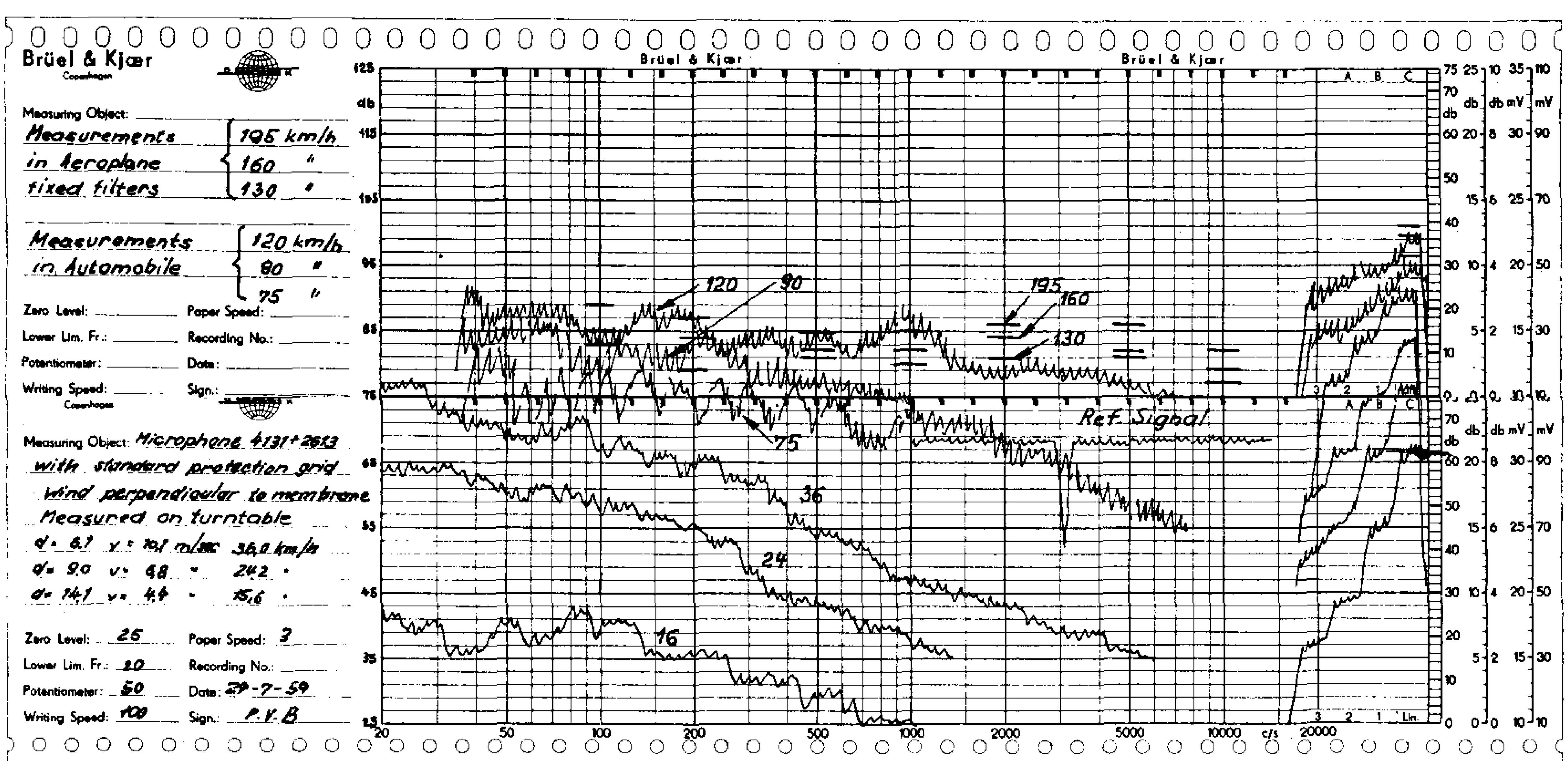


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Fig. 14. B & K Condenser Microphone 4131 with Cathode Follower 2613. Standard protection grill is used and the direction of the air-flow is perpendicular to the diaphragm of the microphone. The 3 lower curves are recorded on the rotating arm with velocities of 16, 24, and 36 km/h. The 3 upper curves are taken in an automobile with velocities 75, 90, and 120 km/h. The indicated horizontal bars are measurements made in an aircraft with velocities 130, 160, and 195 km/h respectively.

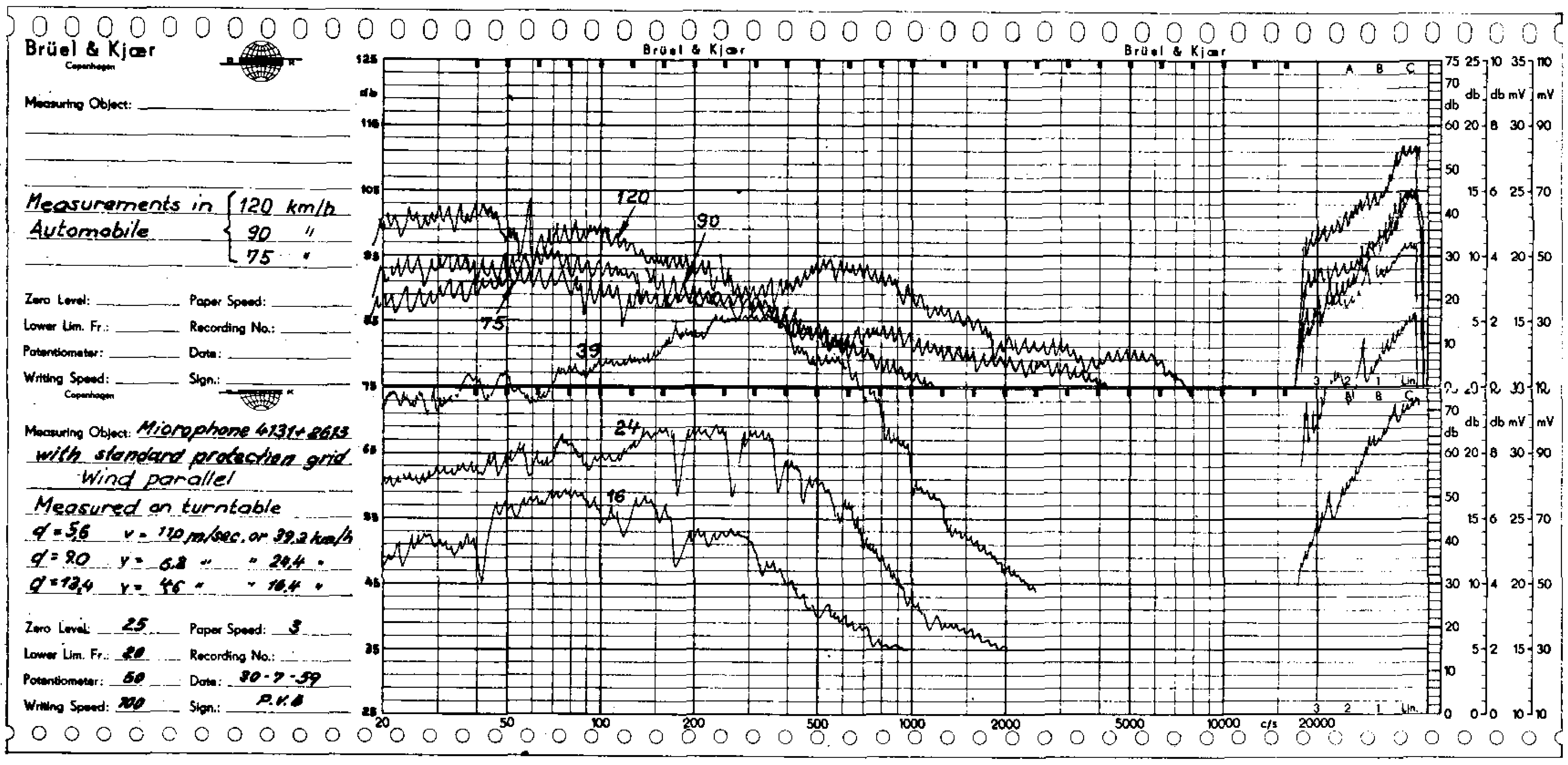

Fig. 15. B & K Condenser Microphone 4131 with standard protection grill as in Fig. 14, but the wind direction parallel to the diaphragm. No measurements were made in aircraft.

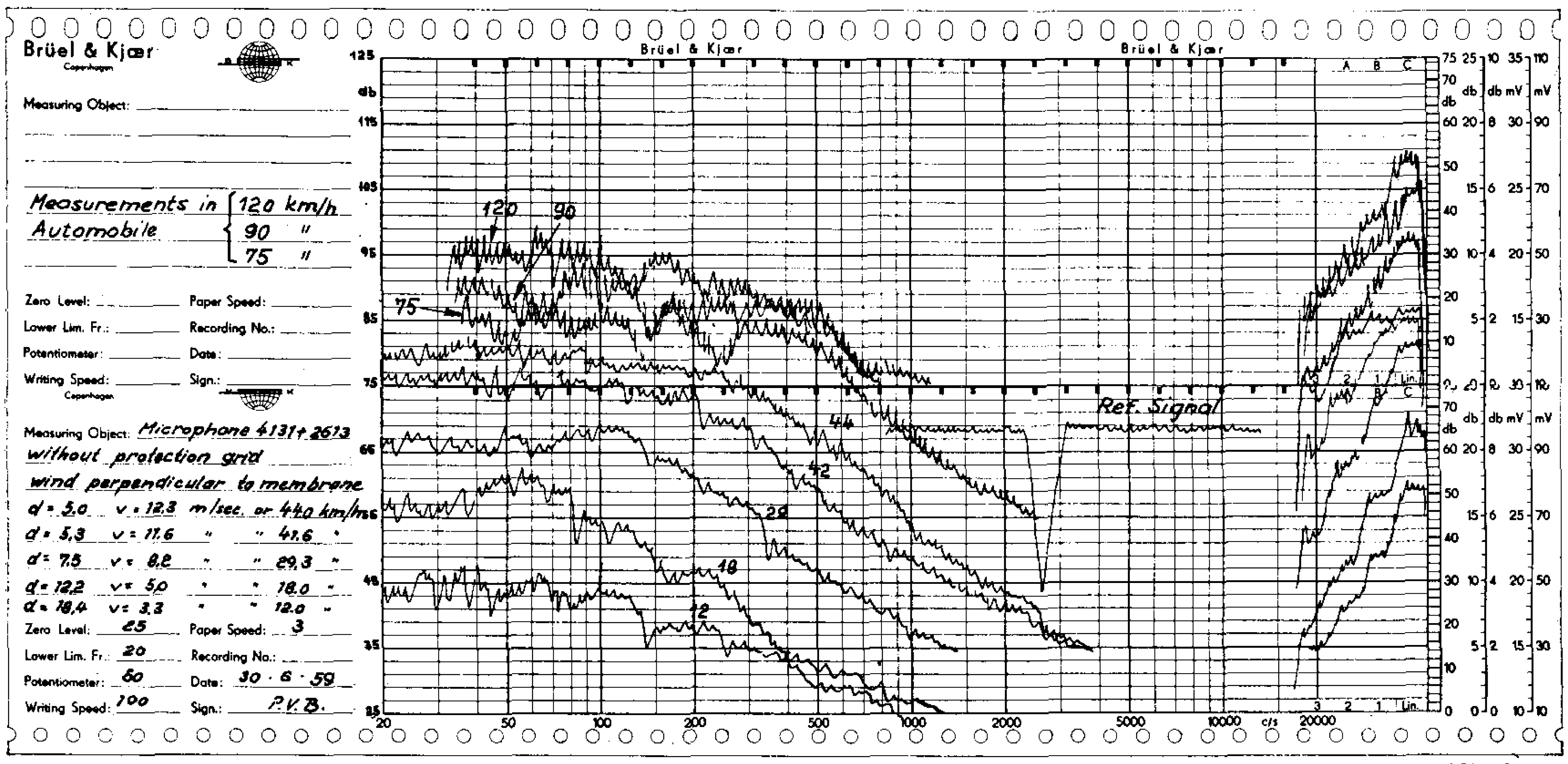

Fig. 16. Condenser Microphone 4131 without any protection grill. Wind perpendicular to diaphragm. No measurements in an aircraft.

a special motor with a rubber drive, the microphone and the measuring apparatus were rotated at varying speeds. Initially there was some trouble from noise being generated by the rotating arm, and therefore, it was necessary to redesign this arm with very close aerodynamic characteristics. It was also necessary to locate the microphone cable in the arm.

To determine the exact velocity, a contact on the arm passed a timing signal to a second recorder, on which the recording paper was driven by a motor running in complete synchronization with the motor of the spectrum recorder.

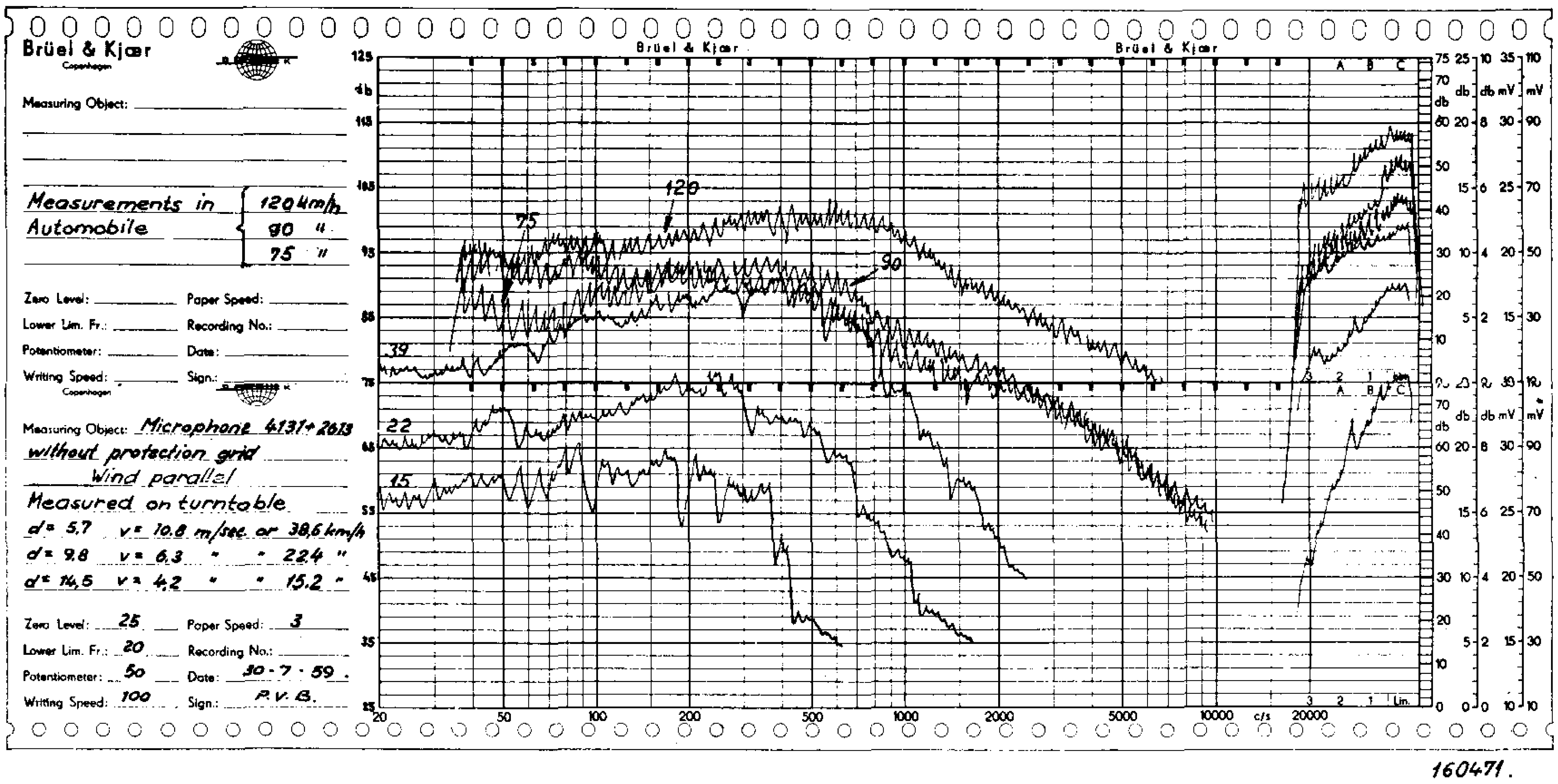

Fig. 17. Same as in Fig. 16, but wind direction parallel to diaphragm. No aircraft measurements.

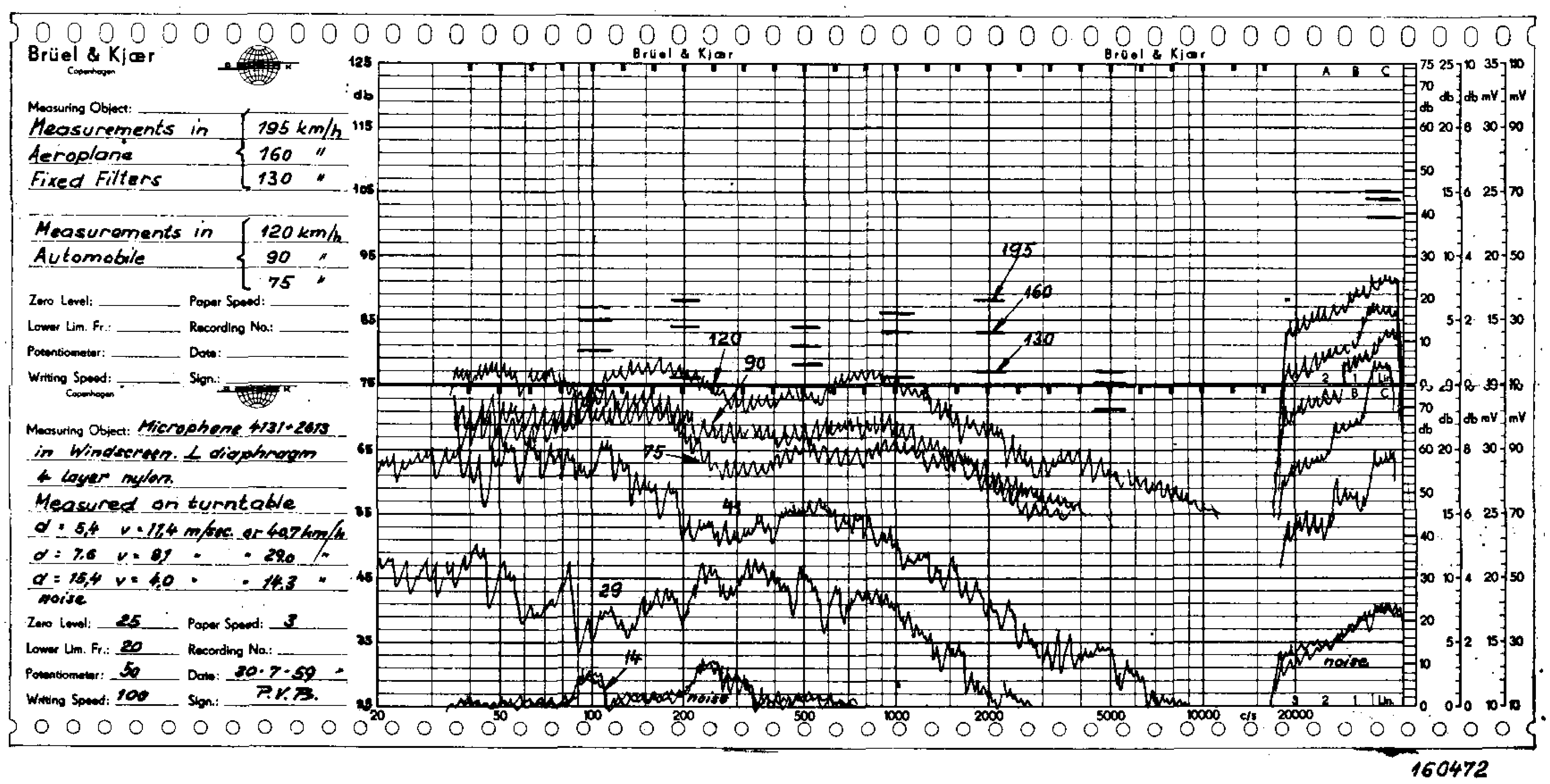

Fig. 18. Condenser Microphone 4131 + 2612 mounted in a Windscreen UA 0050. Wind direction perpendicular to diaphragm.

In this way it was possible to later determine the exact velocity of the microphone.

In the experiment the whole velocity range from about 10 km/h up to around 40 km/h was covered. At speeds below 10 km/h, the noise produced by the microphone was so low that the noise picked up from the driving motor disturbed the measurements, and at higher speeds of more than 40 km/h it was difficult to take satisfactory measurements owing to the limited mechanical strength of the set-up.

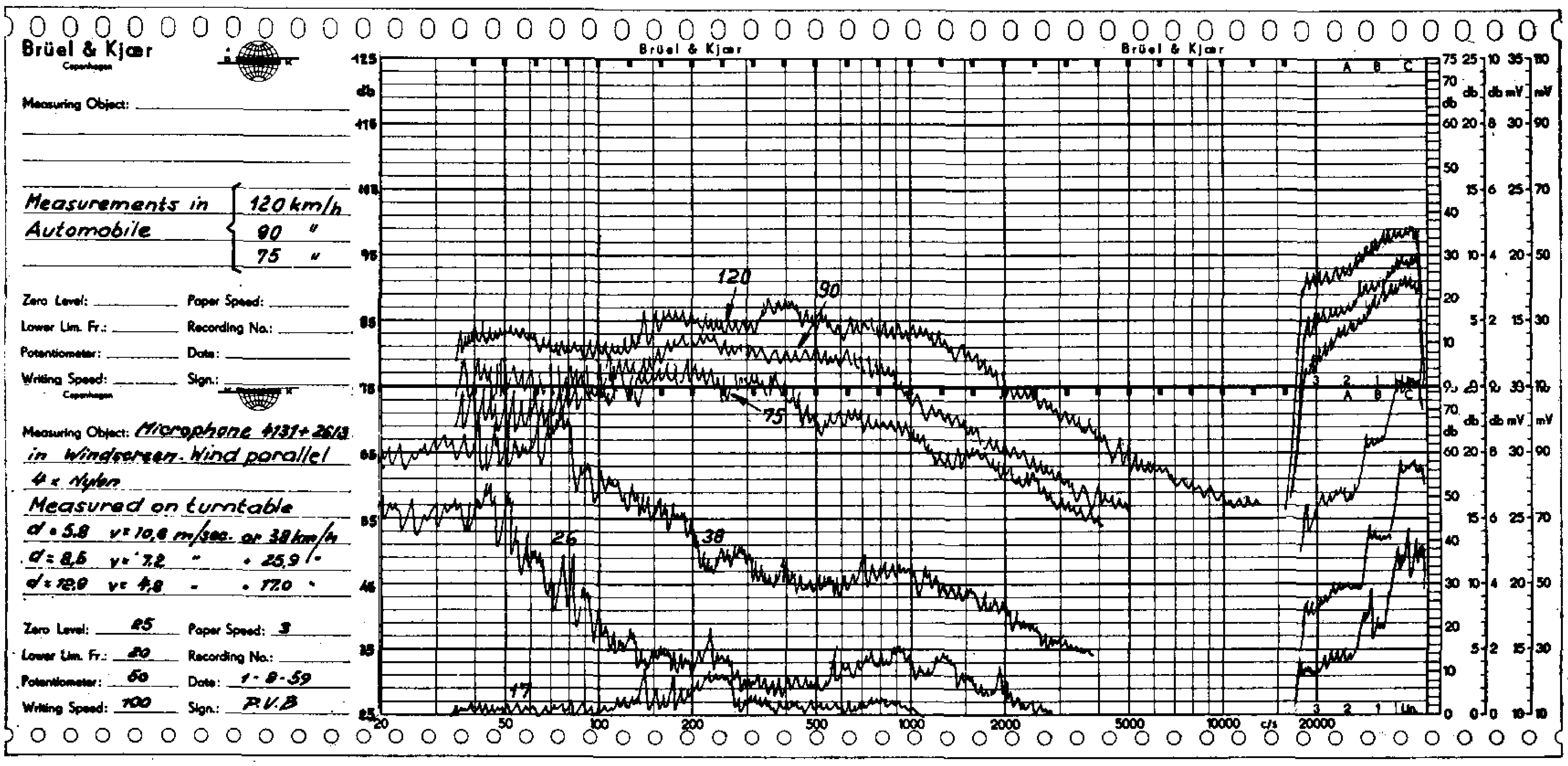

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Fig. 19. Same as in Fig. 18, but wind direction parallel to diaphragm.

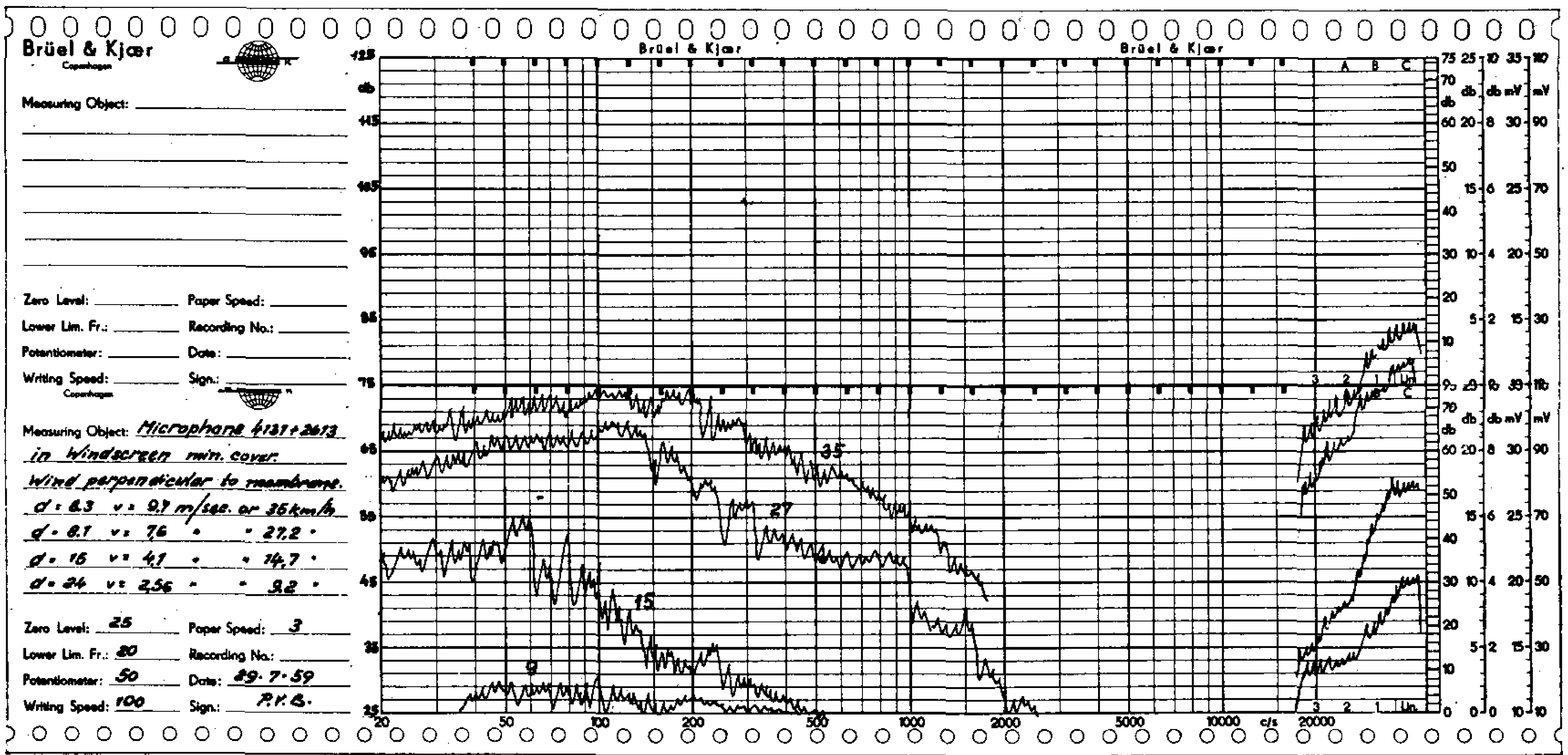

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Fig. 20. Microphone mounted in a windscreen covered with a very thin nylon fabric having an air-flow resistance of 1.5 rayl. Measurements on rotating arm only.

From Figs. 14—24 will be seen noise spectograms taken by means of the different combinations of the microphone and the windscreens. Measurements are taken with the wind coming both perpendicular and parallel to the diaphragm. The indicated db levels are for the frequency range 20 c/s—20,000 c/s SPL in 1/3 octave bands, and the last part of the curve under 3, 2 (A), 1 (B), and Lin (C) are total SL taken with the weighting characteristics inserted as laid down in the standard for sound level meters. Position Lin (C) is linear in the frequency band 20—20,000 c/s.

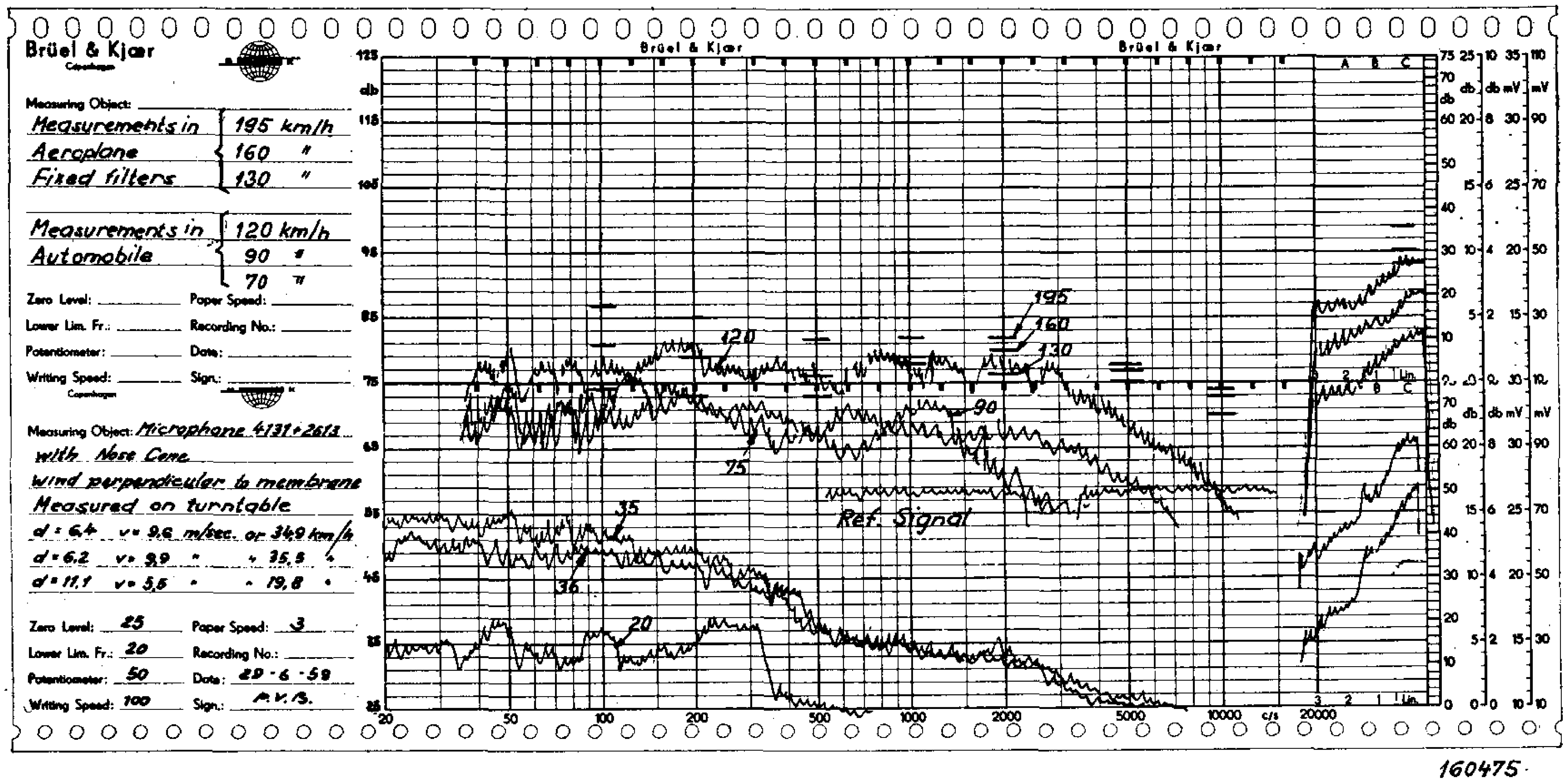

Fig. 21. Condenser Microphone 4131 + 2613 supplied with Nose Come UA 0051. Wind perpendicular to diaphragm.

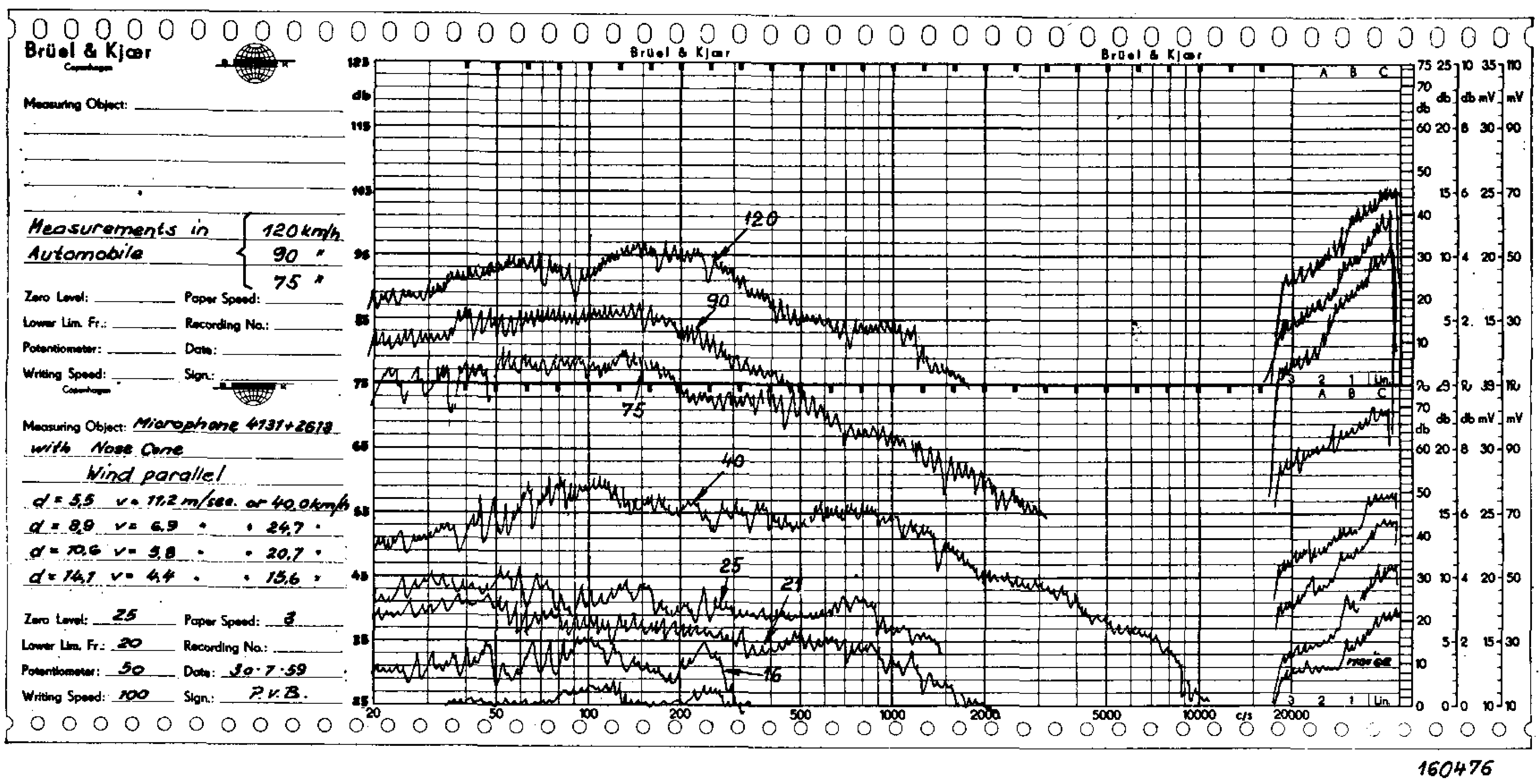

Fig. 22. Same as in Fig. 21, but wind parallel to diaphragm.

Generally it will be seen that frequencies from 200 c/s to 400 c/s are more pronounced than frequencies in the middle range. At the low speeds there are practically no high frequencies recorded for aerodynamic noise, but obviously it is very difficult for the finally measured results to give any set rules for the frequency distribution of the noise. It will be seen that the noise level is very dependent on the wind speed, but again it is extremely difficult to define any exact rule according to the measured results.

Medium Wind Speed Measurements.

At speeds over 40 km/h measurements were made in an automobile, the microphone and the windscreens used being mounted on an airfoil and extended

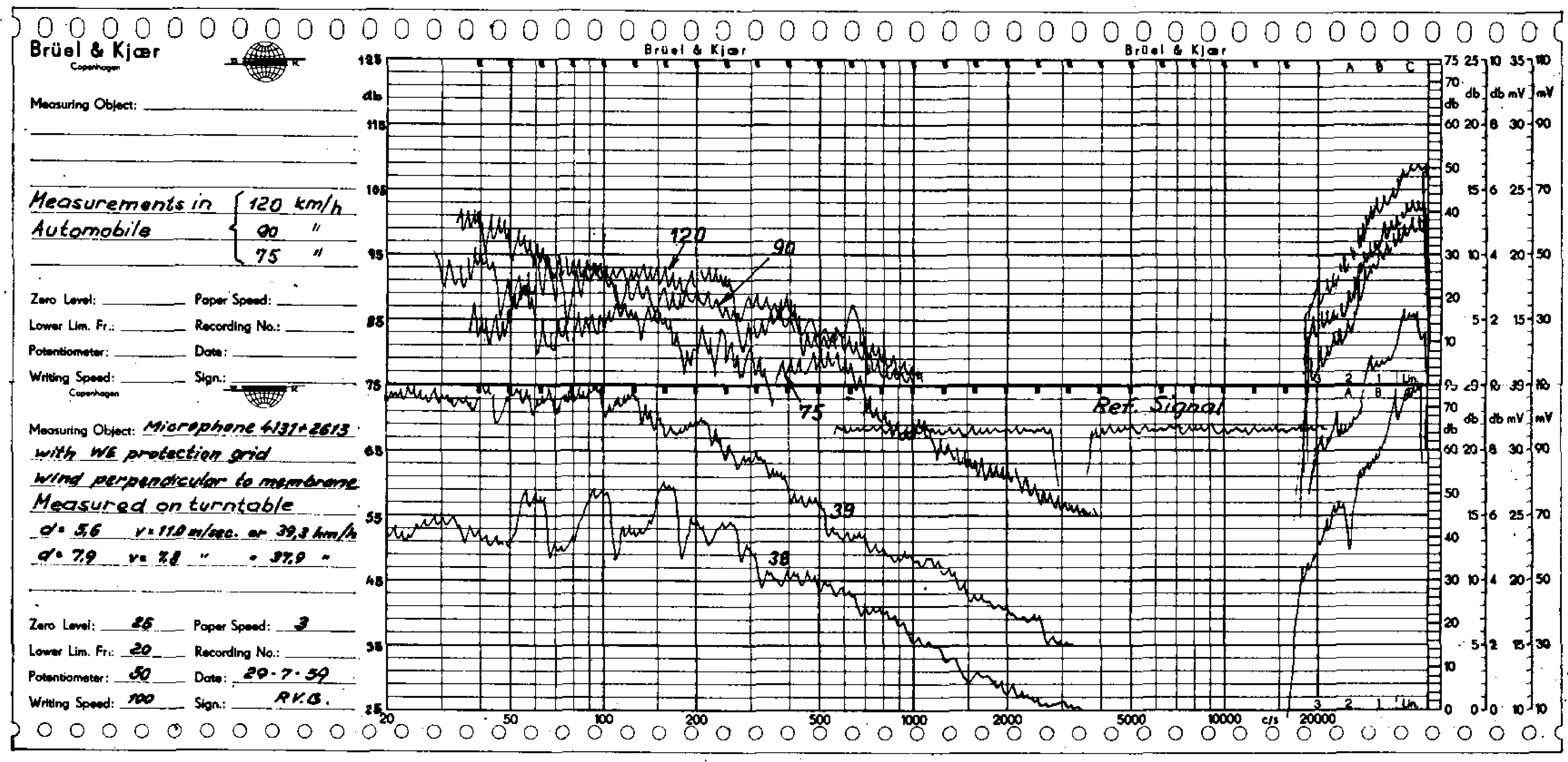

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Fig. 23. Condenser Microphone of the WE 640 AA form with its standard protection cover. Wind perpendicular to diaphragm.

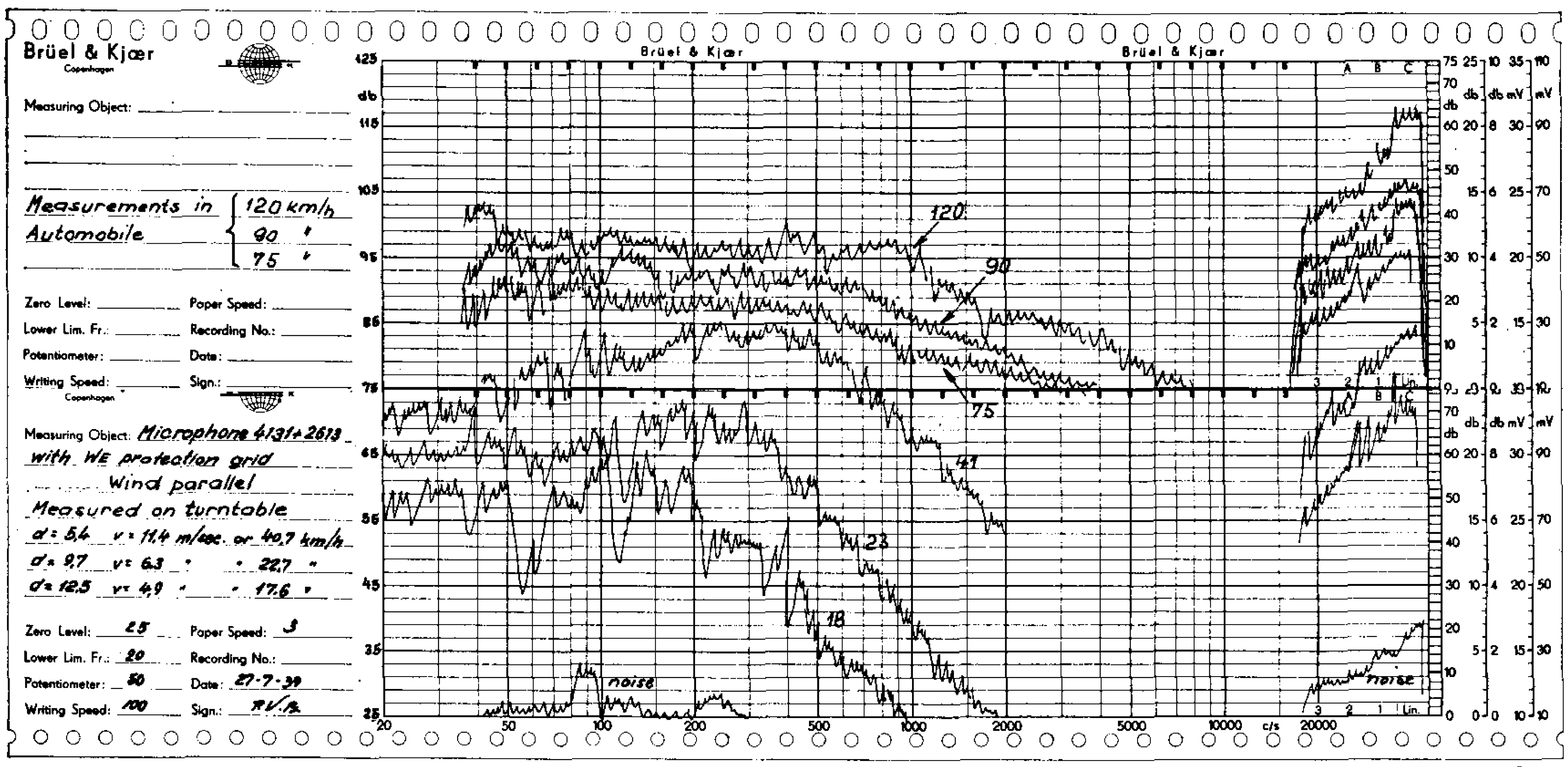

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Fig. 24. Same as in Fig. 23, but wind parallel to diaphragm.

above the streamlined vehicle, as can be seen in Fig. 25. The measuring equipment, which consisted of the analyzer and the recorder, was placed inside the car, the necessary power being supplied by a small rotary converter from a 12 volts battery.

To give as accurate results as possible the measurements were made under practically no-wind conditions and on a smooth road. Recording was only carried out when no other traffic appeared in the vicinity. Also, as it was essential to keep external noise to an absolute minimum the car was fitted with smooth soft tyres, and for further reduction of the noise level, the measurements were made with only the engine idling and the car running down-

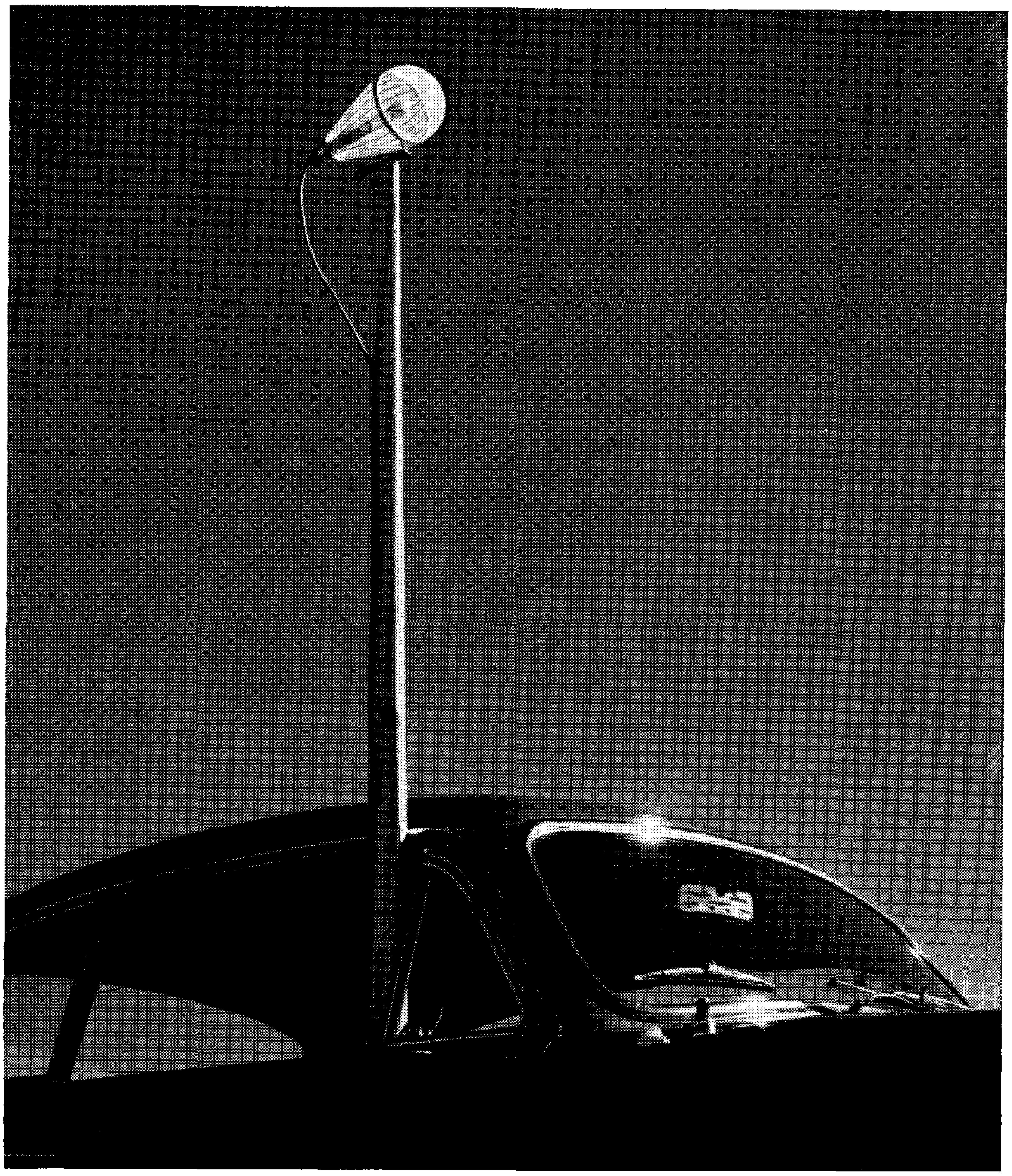


Fig. 25. The mounting of microphones and windscreens on a streamlined car for measurements of aerodynamically induced noise.

hill. Under these conditions it was possible to obtain the measurements without disturbing noise.

To maintain positive control on the level of disturbing noise, a sound level meter was placed just inside an open window and the indicated level was at all times 20 db lower than the measured level for the microphone under test. The results of these measurements, which were all made at three fixed speeds, 75, 90, and 120 km/h, are also recorded on Figs. 14—24.

As in the previous chapter no exact rules can be set for the frequency distribution and for the noise levels as a function of the wind velocity.

High Wind Speed Measurements.

Finally to obtain measurements at high wind velocities a small aircraft was used, the microphone under test being placed on a bar situated forward of

Fig. 26. Mounting of microphones and windscreens on a light aircraft for measurements of aerodynamically induced noise in speed range from 120—200 km/h.

one of the wings but outside any slip-stream from the propeller as shown in Fig. 26. The equipment consisted in this case of a 1/3 Octave Filter Set and a battery-operated amplifier and microphone, but due to the difficulty of installing the recorder in this aircraft, the results were read from the meter. Not all of the ⅓ octave filters were inserted.

The obtained results are shown in Figs. 14, 18, and 21 being indicated with small horizontal lines which represent the ⅓ octave sound pressure levels. At the extreme right-hand side of the figures is shown a recording of the noise level obtained with a flat frequency response in the frequency range from 20 to 20,000 c/s.

As in the case of the automobile, the measurements were made with idling engine but with the aircraft in a dive on three occasions at a carefully maintained speed of 130, 160, and 195 km/h respectively.

It should be noted that the results obtained from the aircraft, in practically all instances, compare favourably with the results taken in the automobile. On perusal of the graphs it is observed that at low speeds it is mainly low frequencies which are generated, which is also quite natural, but on an increase of speed a considerable amount of high frequency components appear in the noise spectrum.

Comparison of Results.

To compare the different results, the graphs Figs. 27—30 were prepared, in which the total noise level as a function of speed is drawn. To provide a

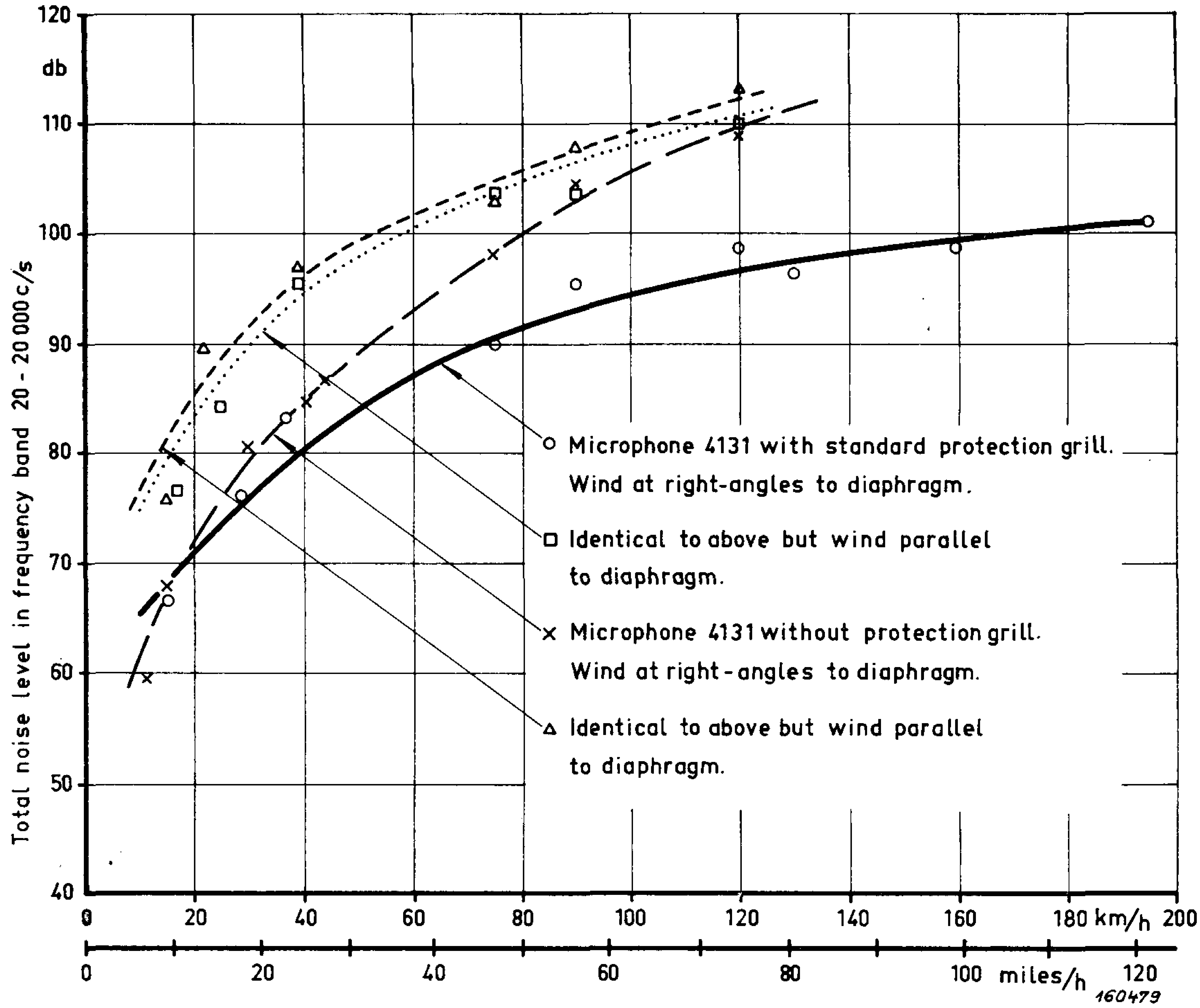


Fig. 27. Comparison of total aerodynamically induced noise levels in the frequency band 20—20,000 c/s with different wind speeds for Condenser Microphone 4131, with and without protection grill.

reference the noise produced by Microphone 4131 with the standard protection grill in position is drawn in. It can be seen that whereas the ordinary Windscreen UA 0050 gives good results for low velocities, it is rather poor or nearly useless for the high wind velocities. Naturally, the noise product from a parallel wind is higher than that from a wind flowing normally to the diaphragm across the surface of the airfoil windscreen. For use at higher speeds a Nose Cone UA 0051 on the 0.936″ microphone and a UA 0052 Cone on the ½″ microphone will be of considerably more advantage than the windscreen.

In general it can be said, that neither the windscreen nor the nose cones will give a sound reduction of more than 10—20 db with reference to the microphones when the standard protection grills are in position. These results will seem rather poor compared to the 25—30 db reported in the references, and mentioned at the beginning of this paper. On the other hand, the explanation is quite simple, for in B & K produced microphones the diaphragm is placed completely at the front, thereby considerably reducing turbulence

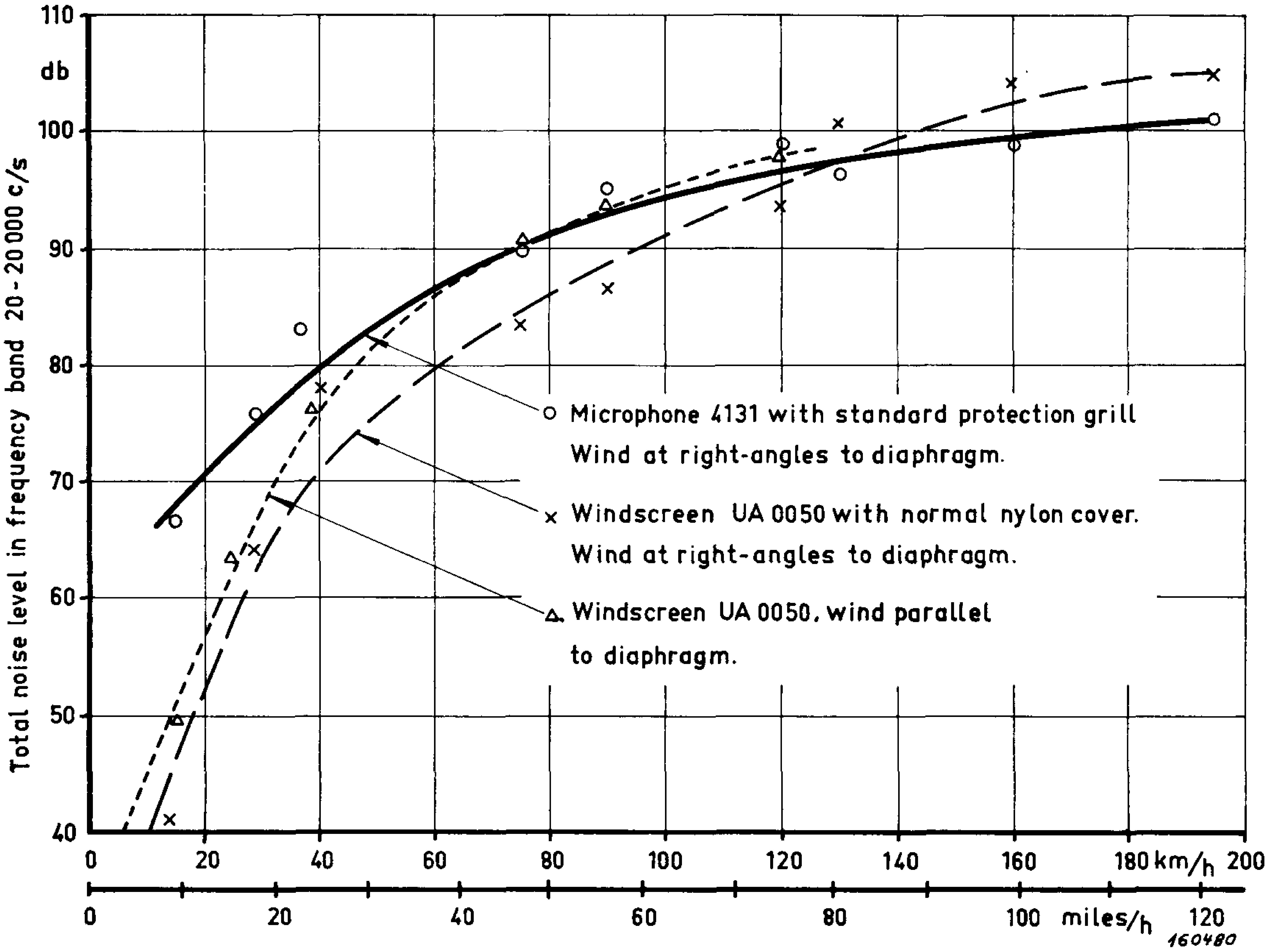


Fig. 28. Aerodynamically induced noise level curves of Windscreen UA 0050 and for condenser microphone fitted with its standard protection grill.

compared to other microphones with a more irregular form. As can be seen in Fig. 30 the WE 640 AA form was tested as an example of a microphone with more irregular mechanical features, compared with the B & K Type 4131. To finalise, the previously outlined measurements should also be compared with Dr. Leonard's results using a condenser microphone type M 21. In Fig. 5 the results measured by Dr. Leonard are drawn as a comparison with the results measured on Type 4131, and it is observed that the M 21 without any form of windscreen is relatively very noisy. Consequently, when the microphone type M 21 was placed in a windscreen, the noise reduction factor was in the order 25—30 db as reported. However, it naturally follows, that when the Microphone Type 4131 is placed in a windscreen or equipped with a nose cone, there is not such a correspondingly high increase in the noise reduction factor as compared to other microphones, because the standard protection cover in itself provides considerable wind noise reduction.

Frequency and Directional Response Measurements.

In the evaluation of a windscreen, not only the noise reduction factor is of importance, but also the influence of the windscreen on the frequency response of the microphone. In the reference literature very little information is given

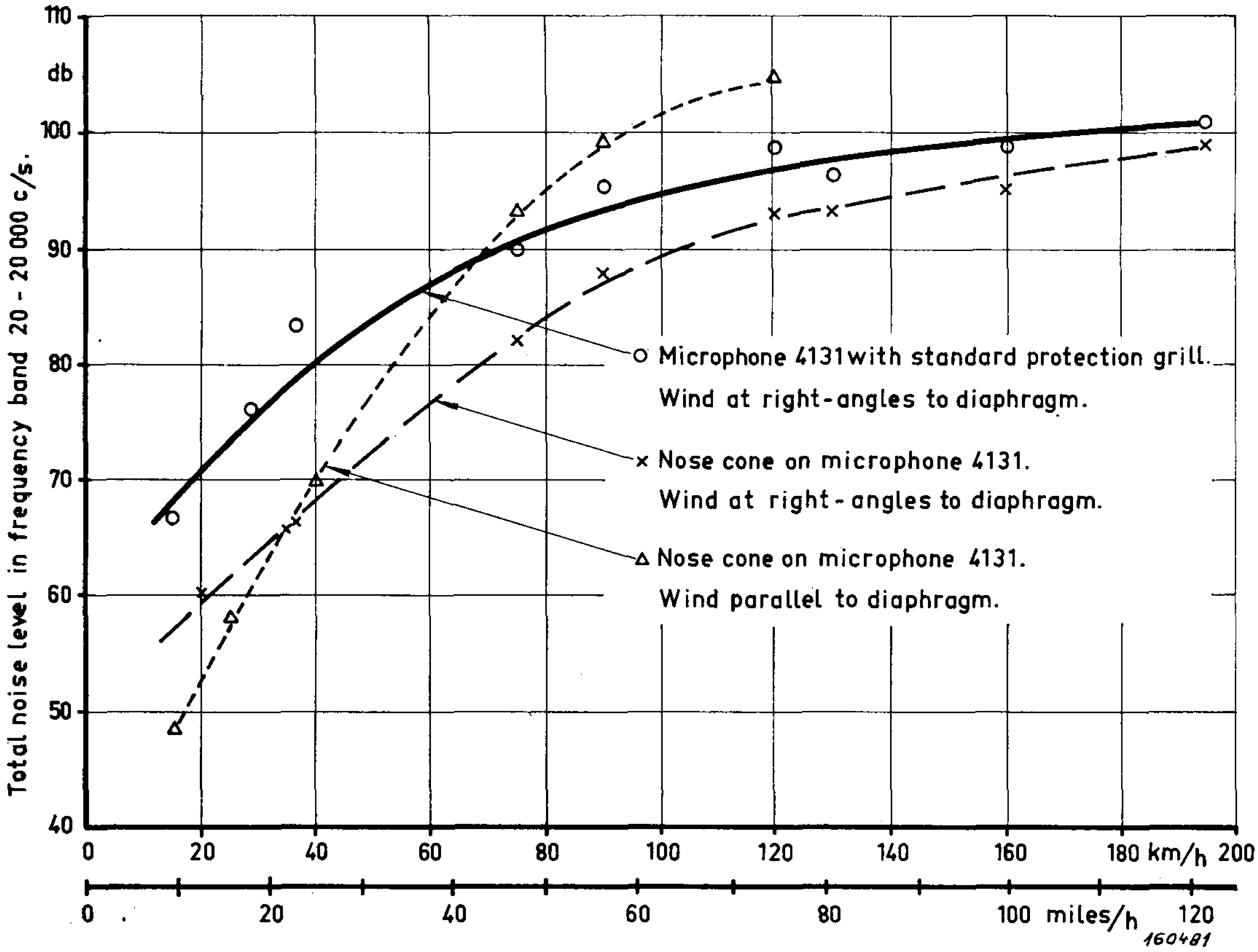


Fig. 29. Aerodynamically induced noise level curves when the Nose Cone UA 0051 is mounted the Microphone 4131 and for Microphone 4131 when fitted with its standard protection grill.

on this important point. With this in mind, a series of measurements on the frequency characteristics of microphones, with and without windscreens or nose cones, has been carried out in an anechoic chamber. As all measurements need only show the comparison between the same microphone with and without a screen or nose cone, the accuracy obtained its relatively high.

In Fig. 31 is shown the change in frequency response of the Microphone 4131 when mounted in the Windscreen UA 0050. It can be seen that the absolute changes in response is not too large for the lower frequencies, and in particular where the wave length is large compared with the dimensions of the screen, there is no change in frequency response or sensitivity. However, as the frequency increases the correction curve becomes increasingly irregular and is very dependent on the angle of incidence. Therefore, at the medium and high frequencies the Windscreen UA 0050 has to be very carefully used to obtain the maximum degree of accuracy.

In Fig. 32 similar correction curves for the frequency response are shown when the Nose Cone UA 0051 is used in connection with the Condenser Microphone 4131. This microphone is so designed that it has flat free field response for sound waves coming perpendicular to the diaphragm. (Reference

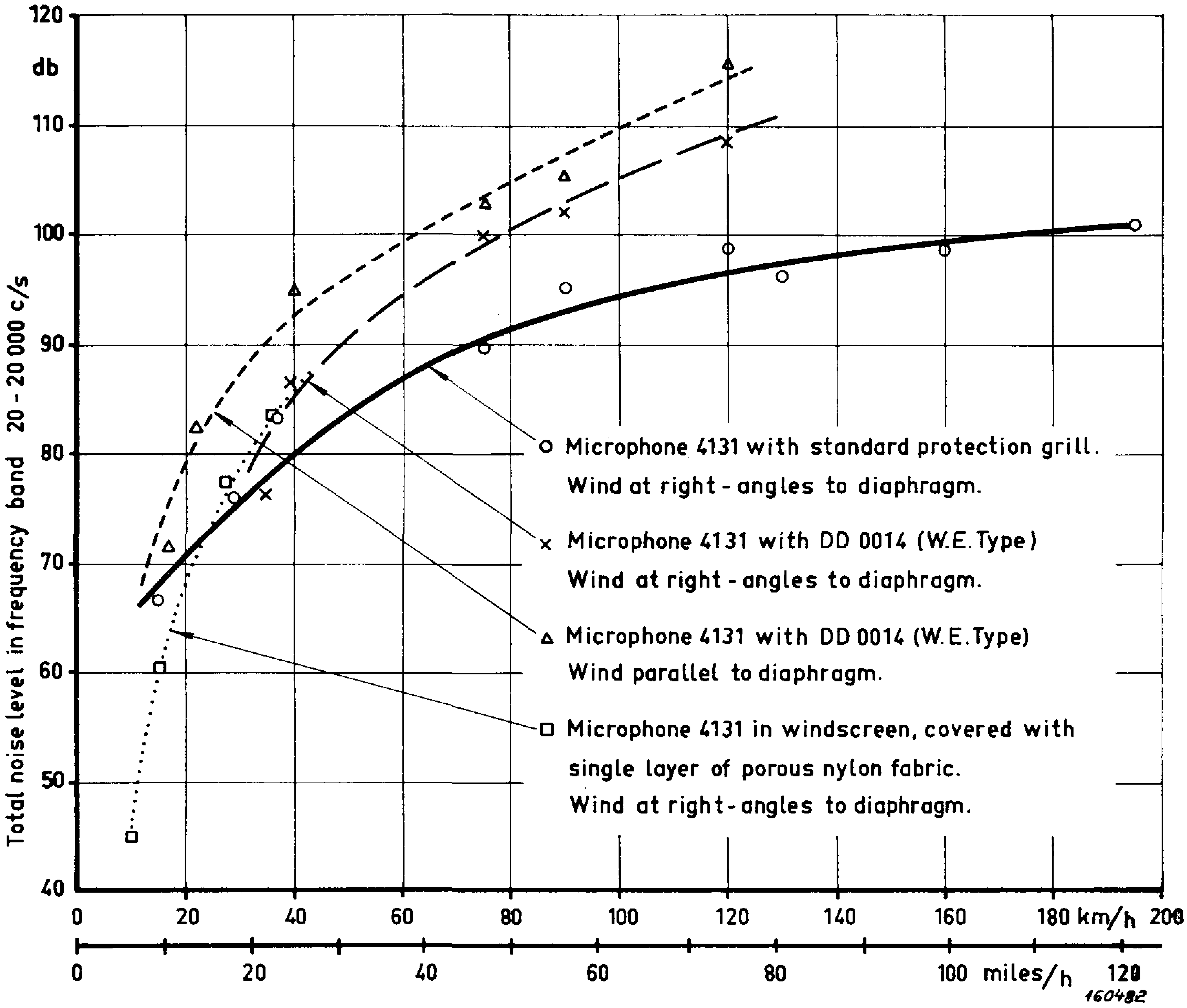


Fig. 30. Aerodynamically induced noise level curves for microphone of WE 640 AA form and for standard microphone 4131. Also noise curves for a windscreen covered with a very thin material.

should be made to Fig. 33, where both the flat free field response and the pressure response for Type 4131 and for the ½″ Type 4133 are shown). It will be seen that the pressure sensitivity for these types of microphones decreases towards the higher frequencies, thus compensating for the increased pressure built up by the reflection of the sound waves around the microphone. It will have been noted from Fig. 32 that the nose cone correction to the response curve for all angles of incidence have a tendency to increase at frequencies between 4 and 9 kc/s. Therefore, when the Nose Cone UA 0051 is used in combination with a free field Cartridge Type 4131 with a declining pressure response, the result will be an excellent microphone with a nearly flat response for all angles of incidence in the frequency range up to 8 kc/s, as shown in Fig. 34. Naturally, the random incidence response curve will be very usable and smooth over the same frequency range. This means that the nose cone does not only decrease the wind noise around the microphone, but also makes it more omnidirectional up to around one octave below its upper frequency limit as a free field 0° incidence microphone.

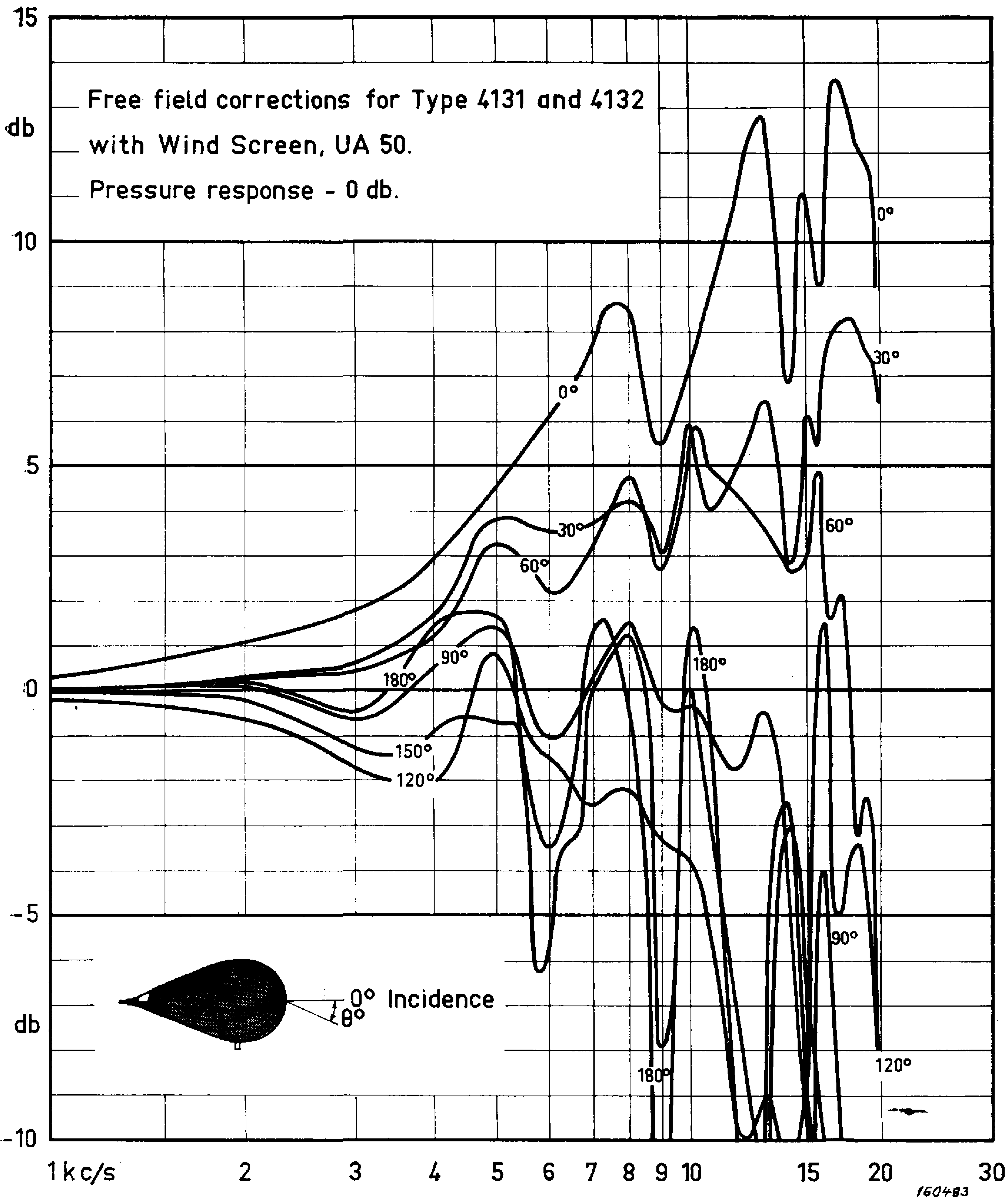


Fig. 31. Corrections for the response curve when Windscreen UA 0050 is mounted around Condenser Microphone 4131 + 2613. Corrections are given for different angles of incidence.

Similar correction curves have been made for the ½″ Nose Cone UA 0052 fitted on the ½″ free field Cartridge 4133 and the corresponding Cathode Follower Type 2614 or 2615, as shown in Fig. 35. As in the case of the curves in Fig. 32 once again there is an increase in the correction, but at a higher frequency range. A final response curve for the free field ½″ Microphone

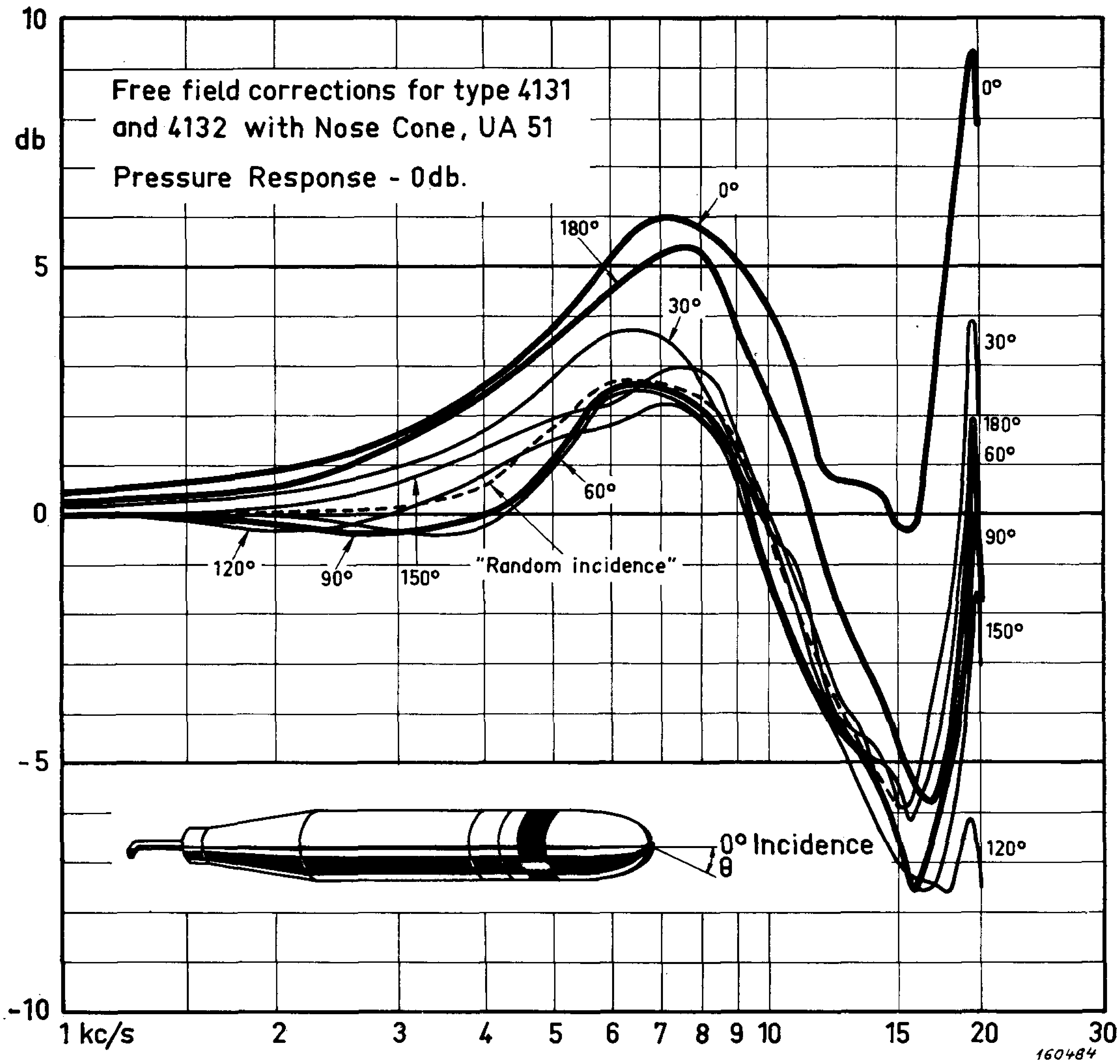


Fig. 32. Correction for the response curve when Nose Cone UA 0051 is mounted on standard Condenser Microphone 4131 or 4132. Given for different angles of incidence.

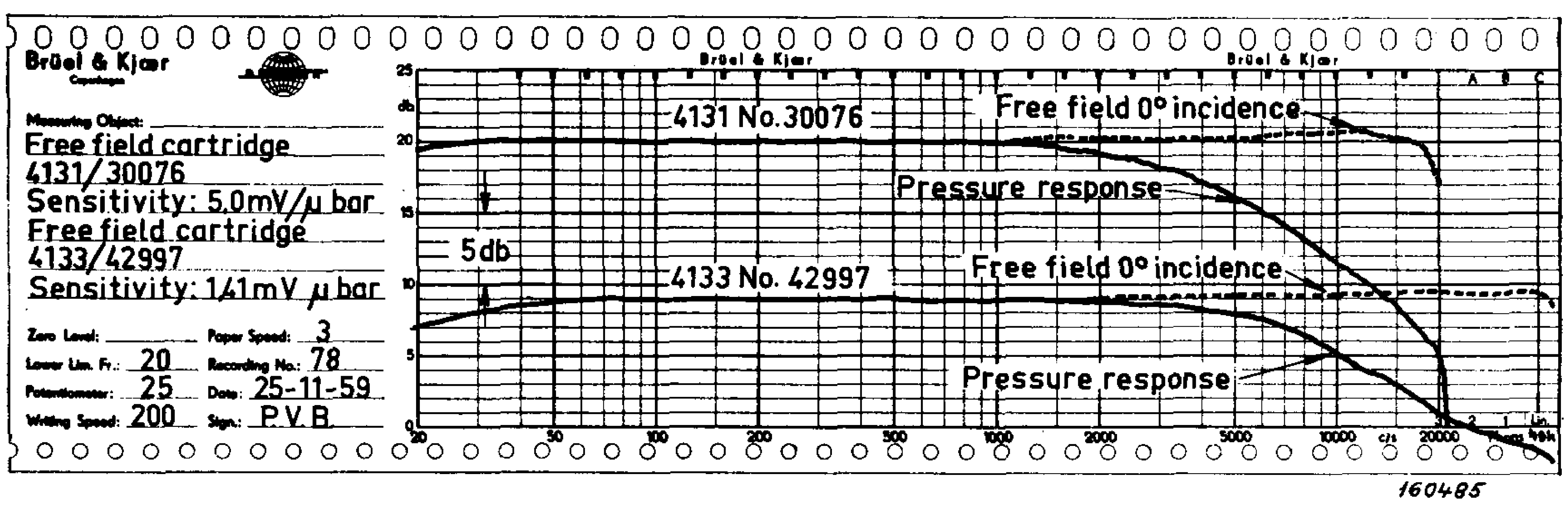


Fig. 33. Free field response at 0° incidence (sound perpendicular to diaphragm) for free field Cartridges 4131 and 4133 (dotted curve) and the pressure response the same microphone.

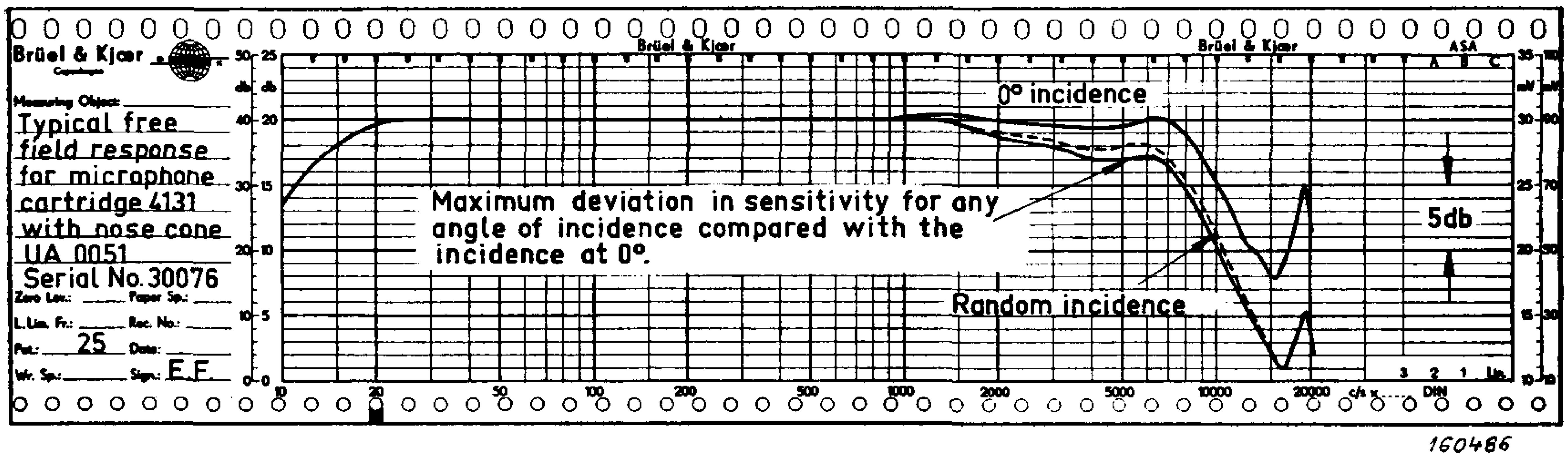


Fig. 34. Free field response at 0° incidence, other angles of incidence and random incidence for Microphone Type 4131 fitted with Nose Cone UA 0051.

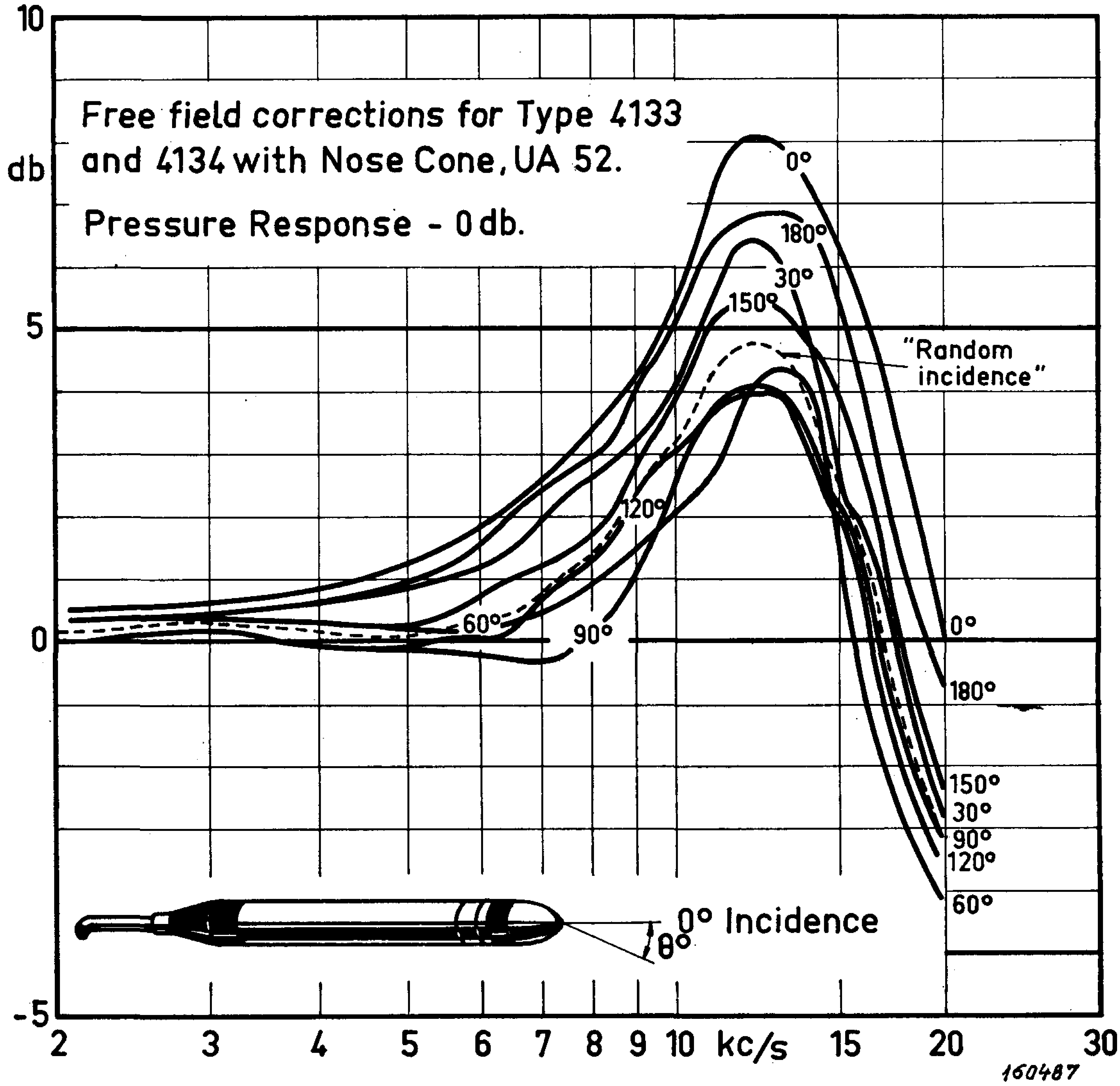


Fig. 35. Correction for response curve when Nose Cone UA 0052 is mounted on ½" Microphones Types 4133 and 4134. Different angles of incidence.

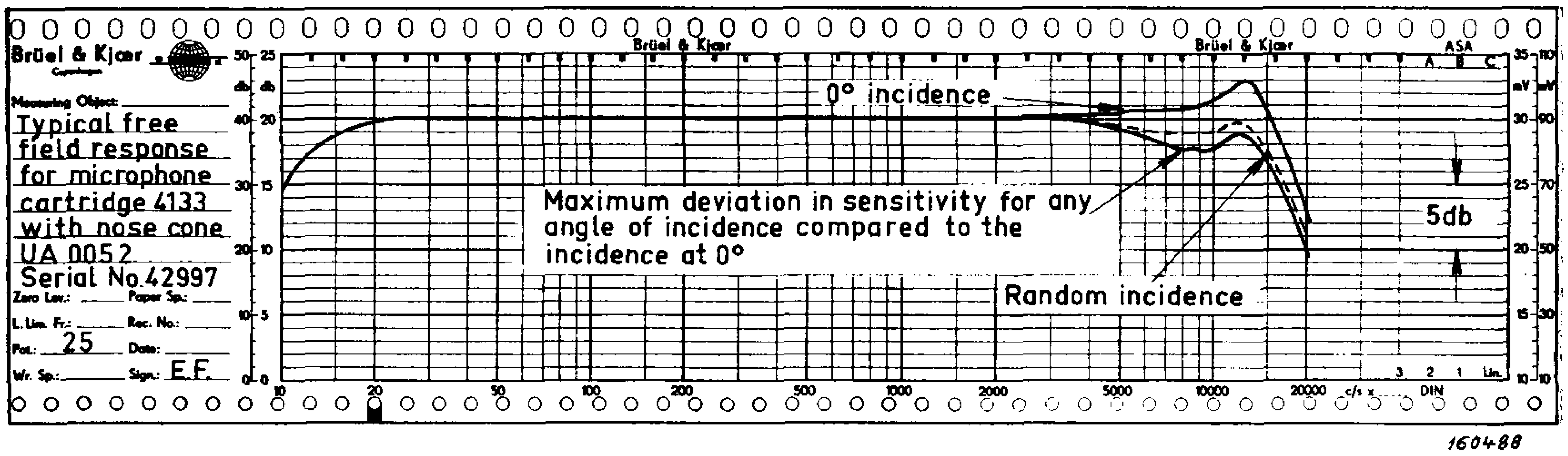


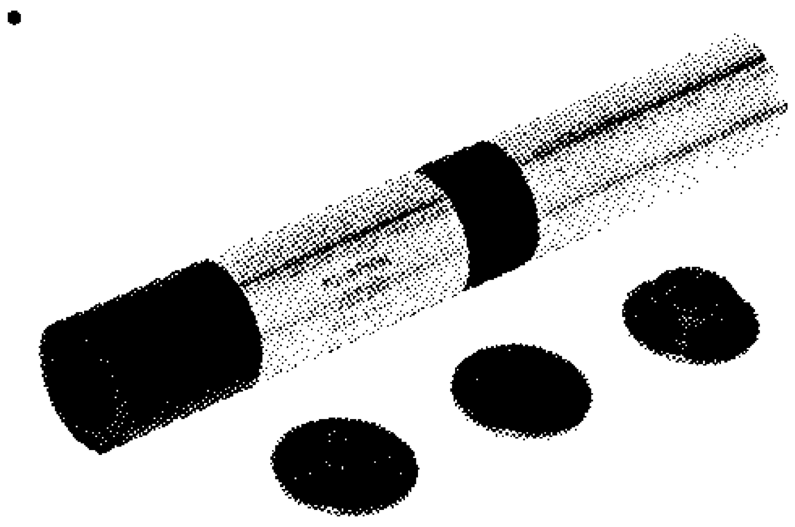
Fig. 36. Free field response at 0° incidence, other angles of incidence and random incidence for Microphone Types 4133 fitted with Nose Cone UA 0052.

4133 fitted with the Nose Cone UA 0052 is shown in Fig. 36. Once again it can be seen that the sensitivity depends little on the angle of incidence, and correspondingly the random incidence curve is almost linear up to 15 kc/s.

To conclude, the nose cones for both the Microphone 4131 and for the ½″ Microphone 4133 do not only increase the omnidirectional characteristics of the microphones and decrease the wind noise, but also provide a very efficient mechanical method of protection. They are particularly well suited for outdoor use in noise measurements. However, note should be taken that the cones will give an excellent frequency response when used in conjunction with the free field Cartridge Type 4131 and 4133, while when used with the flat pressure response microphones Type 4132 and 4134, the response will deviate seriously from linear.

News from the Factory.

Pistonphone Type 4220.

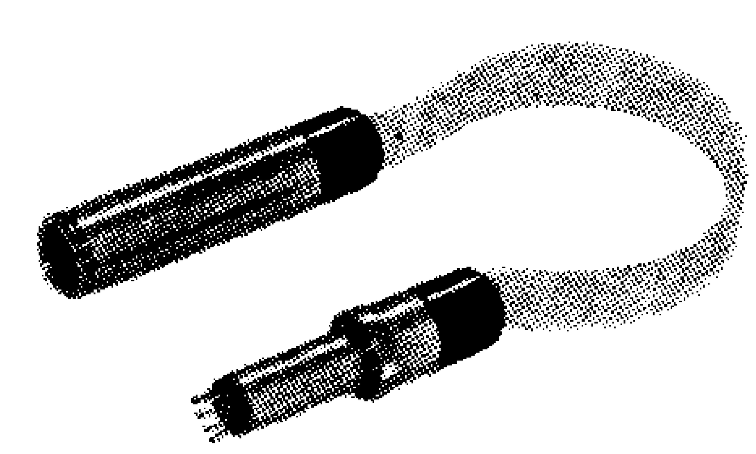


The Pistonphone Type 4220.

The Pistonphone Type 4220 is a small, portable, battery-operated unit designed for accuracy calibration of sound measuring systems. It consists of a D. C. motor with transistorized speed control, an acoustic coupler, and the batteries necessary to drive the motor. The sound pressure in the acoustic coupler is produced by means of two moving pistons and is 124 db re 2×10^{-4} μbar. Accuracy 0.2 db. Non-linear distortion around 2%. The measuring frequency used for calibration is 250 c/s. An additional position of the on-off switch of the motor is marked "Check" and is intended for easy checking of the battery charge. With the switch in this position, the frequency is somewhat higher (350—400 c/s) for fresh batteries.

The instruments is supplied with an individual calibration chart and correction data is provided for calibration under various atmospheric pressures. Included are adapters for use in connection with all new B & K microphones. A barometer for direct reading of corrections in db, due to variation in atmospheric pressure and altitude is also incorporated. The pistonphone is supplied with mercury cell batteries featuring very long storage life.

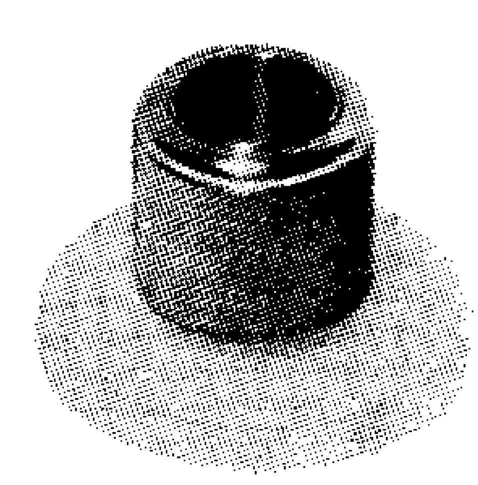
Tape Microphone Cable AR 0001.



The Table Microphone Cable AR 001.

The Tape Microphone Cable AR 0001 is a 7-cored 0.2 mm thick, flat microphone cable to be used when sound insulation and reverberation measurements are made in buildings where the microphone cable is carried through closed doors or windows. The flat cable, which is made of polyester film, can be bent sharply over or around any obstruction.

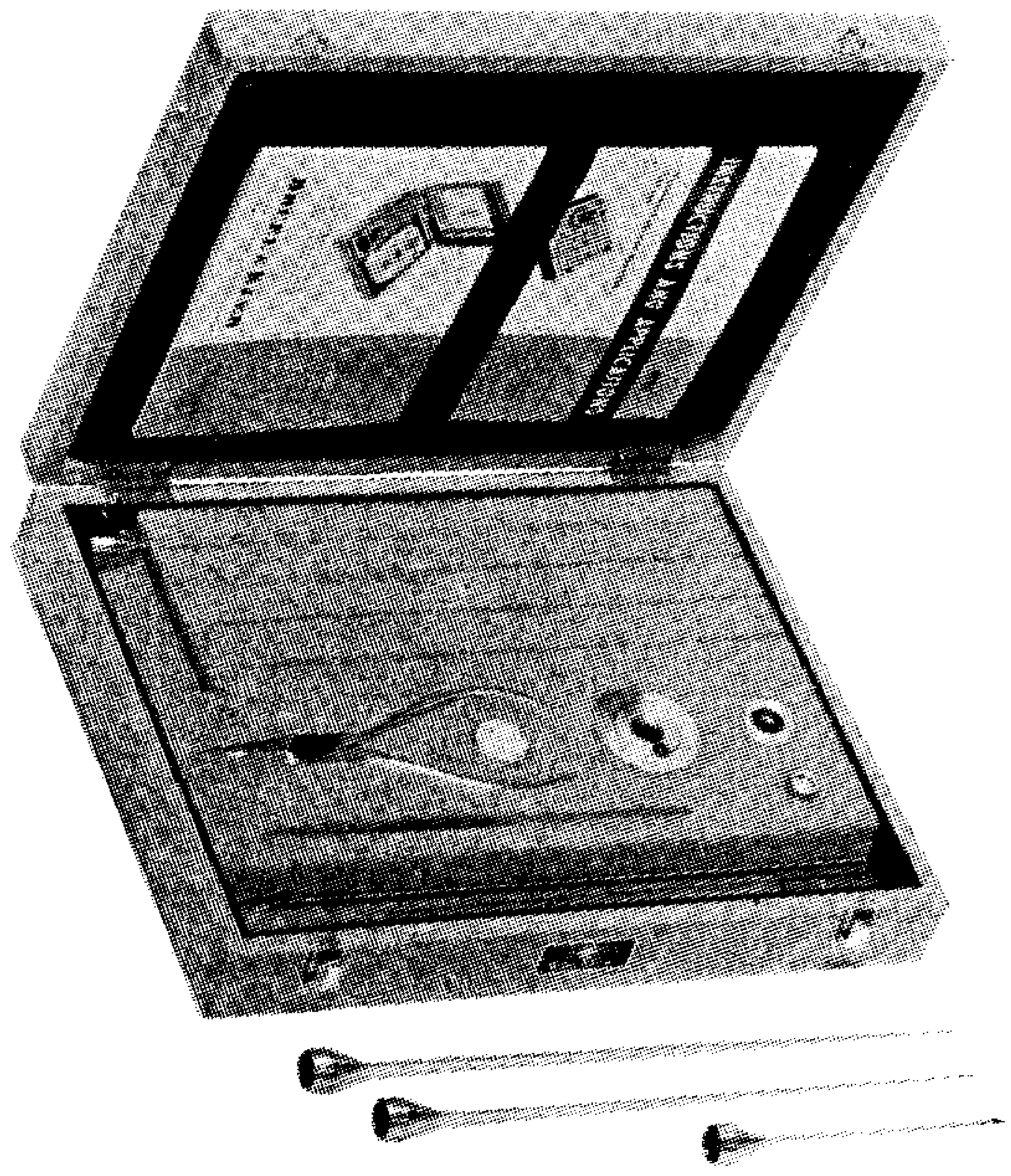
Flush Mounting UA 0034.



The Flush Mounting UA 0034.

The Flush Mounting UA 0034 is designed to facilitate the mounting of ½″ B & K Condenser Microphones in a position where the microphone diaphragm will lie flush with the plane of a large, smooth surface. The mounting piece is made of nylon in order to avoid disturbing currents in the grounds leads.

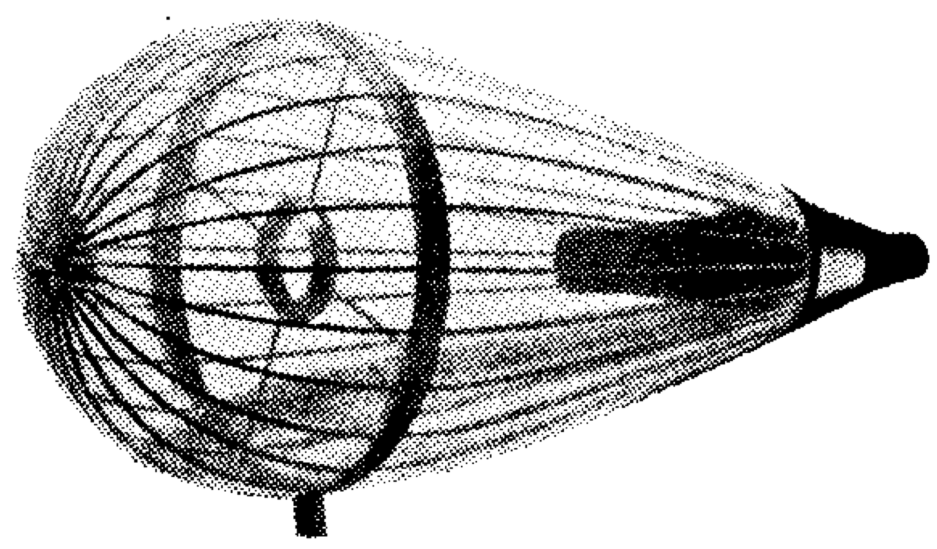
Probe Microphone Kit UA 0040.



The Probe Microphone Kit UA 0040.

The Probe Microphone Kit consists of 4 probe tubes which can be mounted on the B & K ½″ microphones. The outer diameters of the various probes are: 0.5 — 1 — 2 and 4 mm, and the length of the tubes can be adjusted by the user according to the specific purpose. Maximum length of probe 240 mm.
To allow calibration of the probe tube microphone, an accurate coupler and sound source are supplied with the Kit. The sound source consists of a small earphone as normally used on hearing aid sets.
By means of the coupler calibration it is possible to determine the frequency response and sensitivity curves of the probe microphone, and to adjust the damping of the microphones so that a smooth frequency response is obtained. The necessary tools and materials for cutting the probes and inserting damping materials are also supplied.

Windscreen UA 0050.

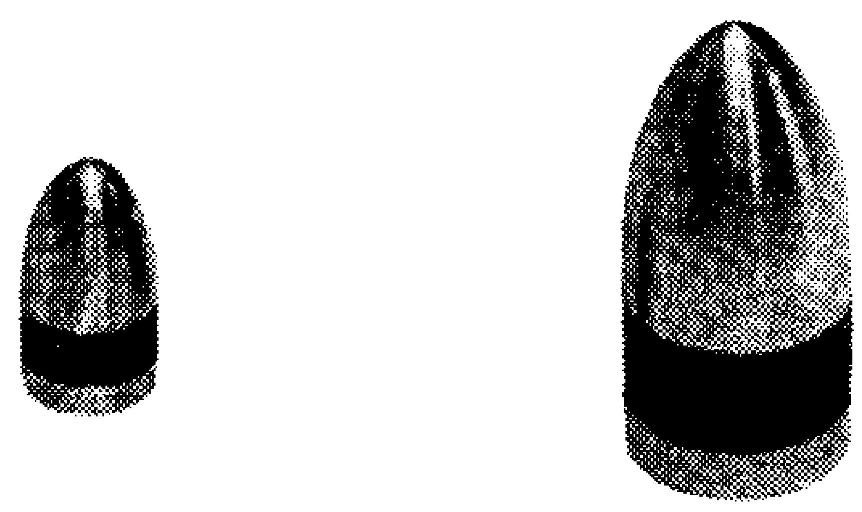


The Windscreen UA 0050.

The Windscreen is used to suppress wind noise especially for low wind velocities. See also preceding article "Aerodynamically Induced Noise of Microphones and Windscreens".

Nose Cones.

UA 0051 for 24 mm ϕ Microphones
UA 0052 for ½″ Microphones



The Nose Cones UA 0051 and UA 0052.

The Nose Cones are mounted in front of the Condenser Microphone instead of the protection grill. They are very useful for wind-tunnel measurements, and measurements at high wind velocities. See also preceding article "Aerodynamically Induced Noise of Microphones and Windscreens". When used together with the 4131 or 4133 microphone cartridges, excellent omnidirectional properties are obtained for the combination Microphone + Nose Cone.

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