International Council for
the Exploration of the Sea

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Preliminary proposal of a standardized procedure of noise measurements in fishing vessels.

Report from the Working Group on "Underwater Sound in Relation to Fish Capture".

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INTRODUCTION

In order to enable scientists to compare data from underwater noise measurements, a standardization of techniques, methods of data collection and presentation of the results is most desirable.

This report is intended as a preliminary proposal of a standardized procedure of noise measurements of fishing vessels. The described measuring technique is commonly used by SINTEF at the Technical University of Trondheim, and the SIMRAD Noise Measuring Range, Horten, Norway. Some modifications have been made in accordance with opinions of members of the Working Group, and it is hoped that further discussions will give a proposal for recommondation. The Working Group has proposed this to be an item on a later scientific discussion meeting on related problems.

In appendix VI is listed a bibliography of recent research work in this field.

NOISE MEASUREMENTS IN FISHING VESSELS

The purpose of the measurements is to describe the noise radiation into the water and the noise situation within the boat itself.

Measurements of underwater noise are necessary to evaluate the influence on fish behaviour. Inside noise measurements give information about the comfort of the crew and the working conditions of the hydro-acoustic instrumentation. Knowledge of noise and vibration transmission patterns throughout the boat is essential for noise abatement work onboard.

1. Measurement procedure.

1.1. Underwater noise.

Underwater noise is measured with a pressure hydrophone of omnidirectional sensitivity and with a frequency responce of at least 40-8000 Hz. The noise should be recorded on tape for later analysis.

The hydrophone is suspended at a depth of at least 10 meters. The depth at the measuring range should be at least 1.5 times the distance from the hydrophone to the boat, and this distance ought to be at least one boat length and not less than 50 meters. An anchored raft or a small boat may be used as the observation station.

Care should be taken for the chose of measuring range. A sheltered area away from traffic noise is most advisable for controlling the acoustic environment. Swift currents should also be avoided, as these may exite the measuring hydrophone mechanically and thus generate unwanted noise.

1.2. Airborne noise.

Measurements of airborne noise should be carried out with a sound level meter according to IEC Standard, Publication 123, or with a precision sound level meter according to IEC Standard, Publication 179. The noise level should be measured directly in octave bands, linearly and weighted according to weighting curve A, dB(A).

More exact noise measurements for assessment of possible annoyance or hearing damage risk, for instance according to ISO Draft Recommendation 1999, require that the noise level be recorded for later analysis.

1.3. Vibrations.

Vibrations are measured by means of an accelerometer magnetically coupled to the structure. The vibration is expressed as acceleration level. The vibration levels may be measured directly in octave or 1/3 octave bands (see point 2.3.) or recorded for later analysis.

2. Presentation of measurement results.

2.1. Underwater noise.

The noise should be analysed in 1/3 octave bands according to IEC Recommendation 225 covering the frequency range from at least 40 to 8000 Hz. An estimate of the measuring accuracy and standard deviation should be included.

The noise level should be stated as index value of noise spectrum level in dB refered to 1 µBar, 1 Hz and a distance of 1 meter from the appearent centre of the noise source.

The following equation is used to calculate the resulting noise level:

$$L_{is} = L_r + 20 \lg R - 10 \lg \Delta F$$

L_{is} = index value of noise spectrum level

L_r = recorded noise level

R = distance from source to hydrophone in meters

ΔF = filter bandwidth in Hz

The results should be presented in tables and in diagrams as noise pressure level vs. frequency for different operating conditions.

For a more detailed investigation more narrow filters may be used. The results may be given as spectrum lines or as noise spectrum levels. The actual filter bandwidth should be clearly stated.

The background noise at the measuring range should be stated.

If the noise is recorded for dynamic operating conditions, e.g. a simulated catching routine, the results should be presented as noise pressure level vs. time at at least three different frequencies: 40, 160 and 630 Hz. A description of the catching procedure should be included.

2.2. Airborne noise.

The sound pressure level is given as octave band levels in dB re $2 \cdot 10^{-5}$ N/m^2 (dBSPL) for the frequency range 31.5 to 8000 Hz. The overall noise level should also be given in dB (A) and measured linearly.

The results should be presented in tables and diagrams for different measuring positions and operating conditions.

2.3. Vibrations.

The vibration measurement results should be given as acceleration band levels in dB re 10^{-5} m/s^2.

Octave bands in the range 20 - 2000 Hz is used for a general vibration survey.

1/3 octave bands in the range 2 - 100 Hz is used for vibration measurements to investigate possible physical damage risk or annoyance effects, (ISO Proposal).

The results should be presented in tables and diagrams as acceleration level vs. frequency for different measuring positions and operating conditions.

2.4. Instrumentation and measurement conditions.

The following information should be included in the report: date and location for measurements, wind speed and sea state,

the water depths of the range, and a description of bottom conditions.

A block diagram showing the instrumentation used for measurements and analysis should be given together with information about make and type of instruments. Possible integration constants should be specified.

A brief description of the rooms where airborne noise has been measured, including possible absorbing panels, etc. should be stated.

2.5. Ship parameters.

A detailed technical specification of the ship should be given along with other relevant data (see the following checklist).

Ship's name, year of construction, ship yard and yardnumber.

Owner's name.

Type of boat.

Main dimentions: length o.a., length p.p.
moulded breadth
moulded depth
size
hull construction.

Main engine : Type, power, rpm
mounting

Auxiliaries : Type, power, rpm
location and mounting

Propellers : Type, number of blades,
reduction gear, thrusters (if any).

Main drawings indicating measuring points should be included.

3. Complete measurement program.

3.1. Underwater noise.

A. Main engine turned off.
   a) starboard auxiliary engine
   b) port auxiliary engine
   c) auxiliary + other machinery, pumps etc.

B. Main engine idleing, propeller disconnected.
   a) main engine at different speeds at suitable intervals, from min. to max. rpm.
   b) possible side thrusters working.

C. Service conditions, main engine max. rpm
   a) full propeller pitch
   b) half propeller pitch

Boats with fixed-pitch propeller:
   a) full ahead
   b) half ahead

D. Simulated catching routine.

3.2. Airborne noise.

A. Service speed.
   a) Wheel house
   b) Mess room
   c) Engine room
   d) Cabins on all decks
   e) Typical working areas

B. Catching conditions, pumps, winches etc. working.
   Same measuring points as above.

C. Engine room, main engine idleing
   a) starboard auxiliary engine working
   b) port auxiliary engine working
   c) auxiliary engine plus other machinery, one at a time.

3.3. Vibrations.

A. Service speed.
   a) vertical acceleration of frame on all decks (cross section through wheel house)
   b) acceleration in 3 axis of main engine frame. Both sides of possible elastic mountings.

B. Engine room, main engine idleing.
   Measurements on both side of possible resilient mountings.
   a) vertical acceleration of starboard auxiliary
   b) vertical acceleration of port auxiliary
   c) acceleration in 3 axis of main engine
   d) vertical acceleration of other machinery.

C. Low frequency vibration measurements in typical working areas.

In appendix I - V are shown examples of curve sheets for data presentation.

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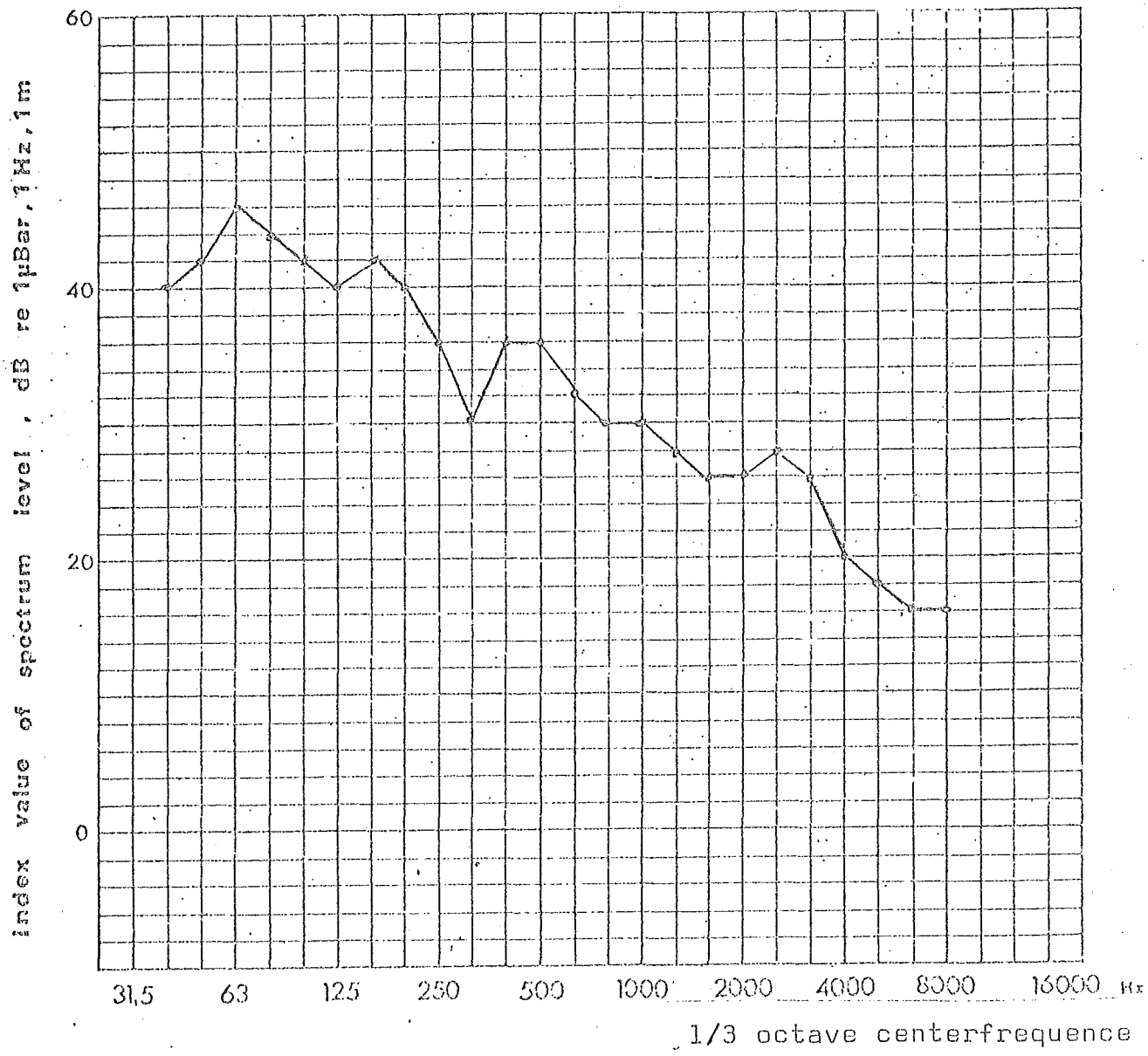
Presentation of underwater noise measurements



Noise from M/S FISHING BOAT

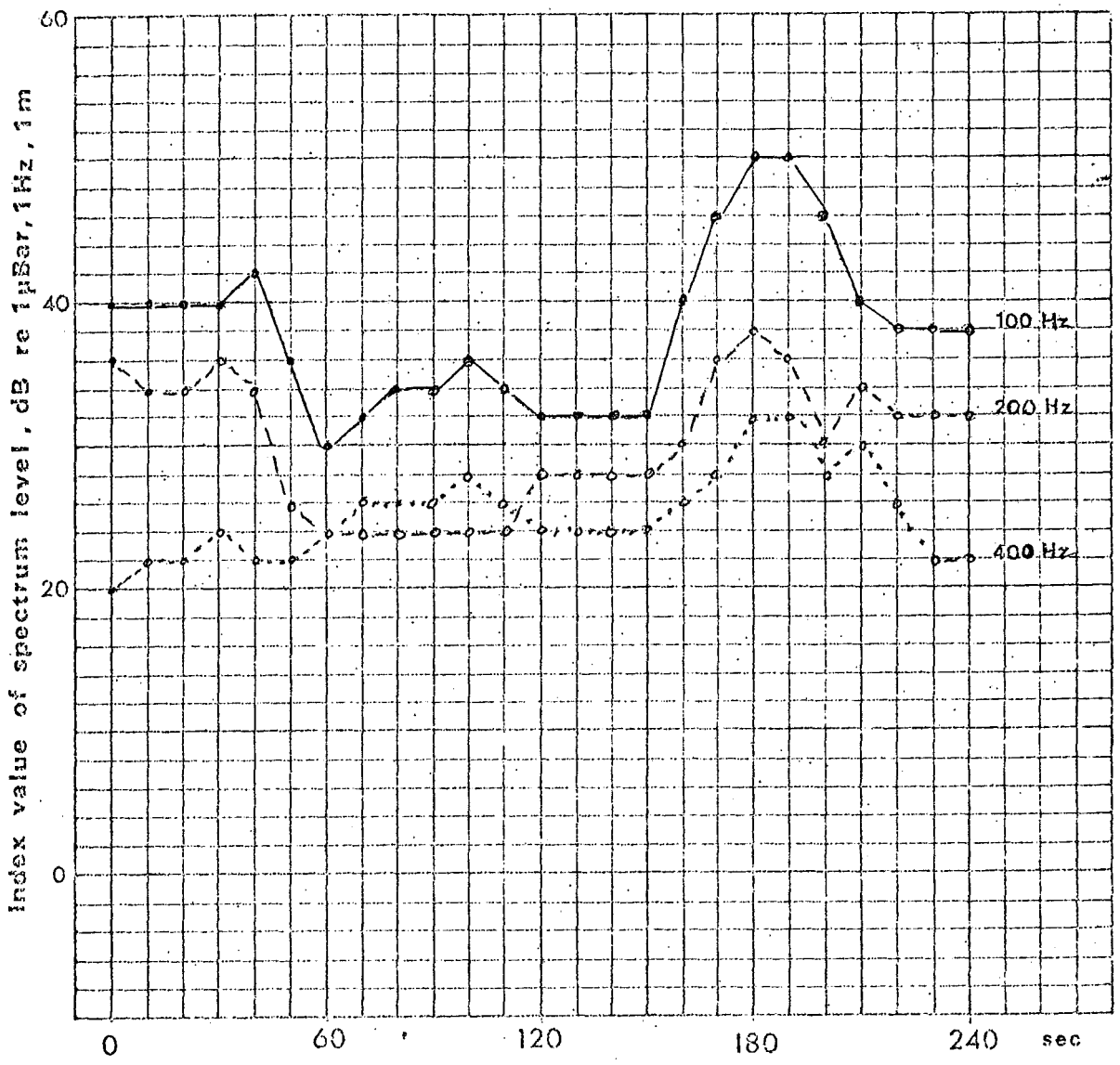
Main engine : 350 rpm

Propeller pitch: ½

Port auxiliary engine working.

Appendix 1

Presentation of underwater noise measurements



Noise from M/S FISHING BOAT
Simulated purse seining.

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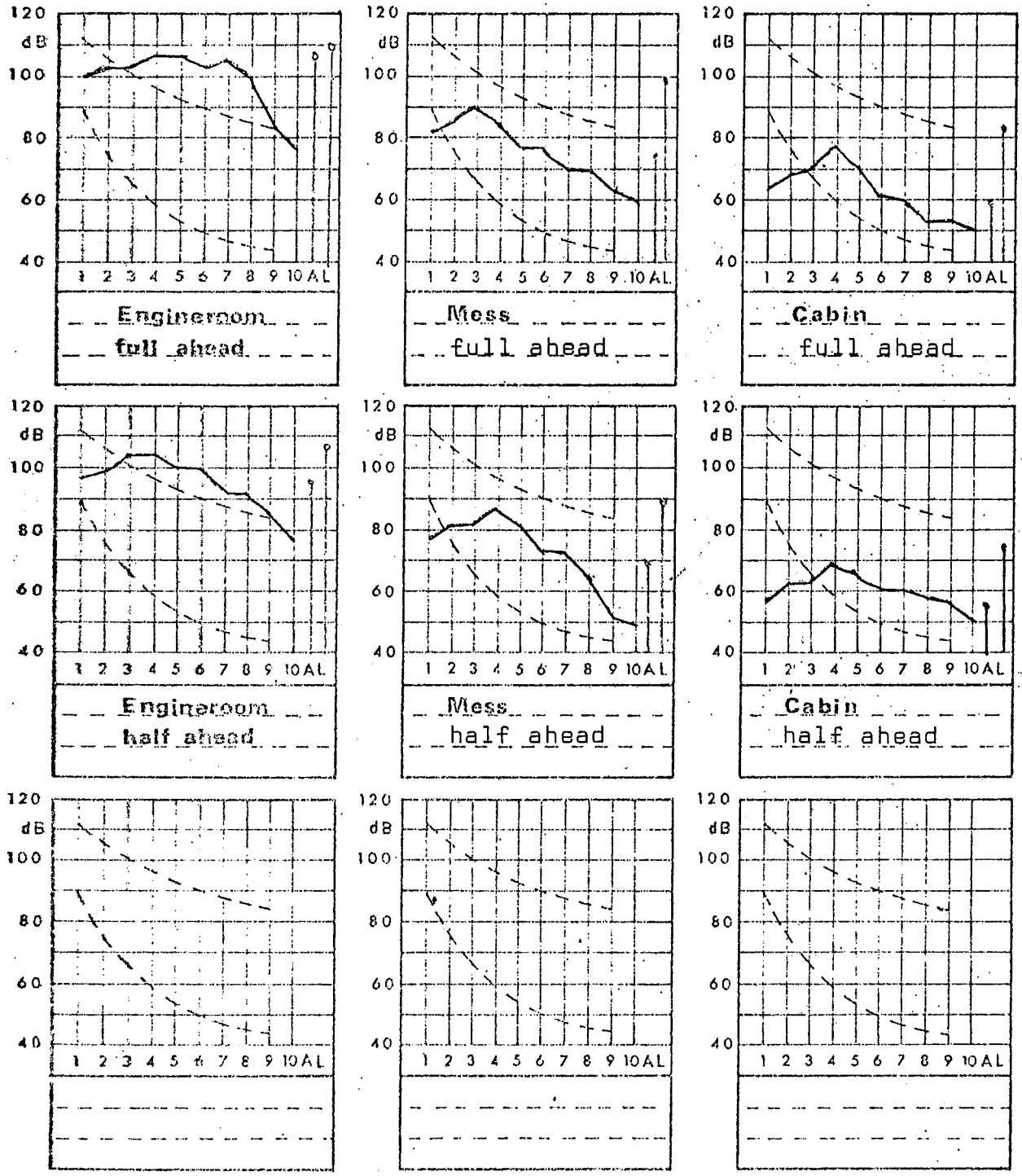


Diagram for airborne noise measurements.

Dashed lines are noise rating curves N 60 and N 90.

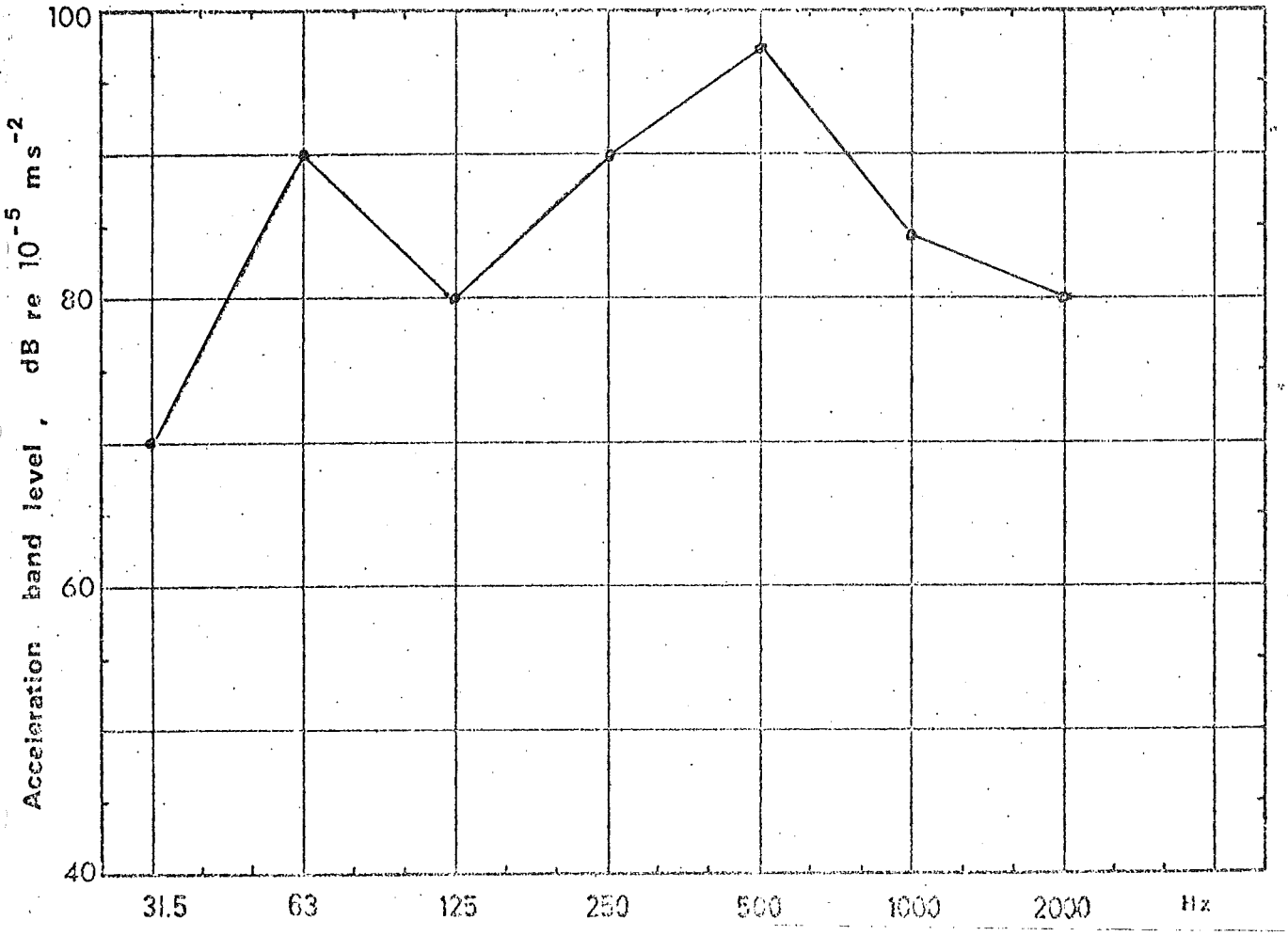
Oktavbånd nr.	1	2	3	4	5	6	7	8	9	10
Senterfrekvens	31.5	63	125	250	500	1000	2000	4000	8000	16000

AKUSTISK LABORATORIUM SINTEF Norges tekniske høgskole Trondheim	**Oppdrag:** (Contract)	**Oppdragsnr.:** (Contract number): **Date:** (Date): **Lydmåler:** (Sound level meter) **Anm.:** (Comments) **Sign:**

Table for airborne noise measurements.

Måle nr.	Oktavbåndnivå, dB ref. $2 \cdot 10^{-5}$ N/m^2										Lin.	A	D	Anm.
	31.5	63	125	250	500	1000	2000	4000	8000	16000				

Presentation of acceleration measurements



M/S FISHINGCAT
Vertical acceleration, galley
Main engine : 350 rpm
Propeller pitch : ½
Port auxiliary engine working

Appendix VI

Reports on noise from fishing vessels.

Anon. 1964. F.R.S. "Explorer", noise trials. Report by Admirality Research Laboratory.

Anon. 1972. Underwater noise generated by fishing vessels. Simonsen Radio A/S, Oslo, Norway. SIMRAD bulletin No 8.

Anon. 1972. Støyreduserende tiltak ombord i fiskefartøy. [Noise reduction in fishing vessels.] 3-F prosjektet, Techn. Univ. Norway. Trondheim, Norway.

Gjestland, T. 1971. Støymåling av fiskebåter. [Noise measurements of fishing vessels.] 3-F prosjektet, Techn. Univ. Norway. Trondheim, Norway, KLEA 351.

Hawkins, A.D. and C.J. Chapman 1969. Noise trials, F.V. "Selma".

Hawkins, A.D., D.N. MacLennan and A. Corrigall 1971. Report on noise trials of the purse-seiner M.F.V. "Vigilant". Department of Agriculture and Fisheries for Scotland, Internal report, 1 R 71-8.

Ojak, W. 1972. Vibration and noise on fishery research vessels. Andre Mayer Fellowship report, FAO, Rome.

Vatz, J.P. and R.F. Williams Jr. 1962. Development of noise control specifications for the Woods Hole oceanographic research vessel. SNAME, New England Section, Bethlehem Steel Company, Quincy 69, Mass. USA.

Further references on relevant literature may be found in:

FAO Fisheries Report No 76 1970. Report on a meeting for consultations on underwater noise, Rome, Italy, 17-19 Dec. 1968.