INTERNATIONAL COUNCIL FOR THE EXPLORATION OF THE SEA

C.M. 1987/B:21
Fish Capture Committee

NOISE LEVELS AND SOURCES ONBOARD DUTCH FISHING CUTTERS

by

F.A. Veenstra
Netherlands Institute for Fishery Investigations
P.O. Box 68, 1970 AB IJmuiden
The Netherlands

INTERNATIONAL COUNCIL FOR
THE EXPLORATION OF THE SEA

C.M.1987/B:21
Fish Capture Committee

NOISE LEVELS AND SOURCES ONBOARD DUTCH FISHING CUTTERS

by

F.A. Veenstra, M.Sc.
Netherlands Institute for Fishery Investigations
Technical Research Department
P.O. Box 68, 1970 AB IJmuiden
The Netherlands

Abstract

Due to the growing awareness of the habitability onboard fishing vessels, there is reason to believe that stricter recommendations or even legal regulations concerning noise levels will have to be met in the near future.
Before considering potentional noise control techniques onboard of the Dutch fishing cutters, especially the main group of beamers, it is of utmost importance to have statistical data and insight in the major noise sources.
A comparison of measured dBA values is given and related to (inter)national noise standards for newbuilding merchant marine vessels. The results of the survey clearly show that almost all the 20 vessels measured exceed the recommended noise limits with 5-20 dBA.
Based on an octave-band analysis onboard two representative beam trawlers some preliminary results are discussed, anticipating a current study on major beamer noise sources (propulsion engines, propeller) and sound transfer paths (structure-borne and airborne noise).
Although there is no immediate or magic solution to reduce the sound levels, design goals for newbuilding fishing cutters are given.

Contents Page

1. Introduction 2
2. Noise sources 4
3. Noise levels 5
4. Conclusions and recommendations 8

Acknowledgement

Tables 1-5 Noise sources and machinery specifications, comparison dBA values
Figures 1-5 Noise readings in dBA values
Figures 6-13 Octave-band sound pressure levels
Annex 1-3 Dutch beamer characteristics

1. INTRODUCTION

The Technical Research Department of the Netherlands Institute for Fishery Investigations (RIVO-TO) have been carried out noise measurements on board Dutch fishing cutters since 1984.
Before that year little was known about the state of the art and one should inevitably live with the high noise levels. On the one hand side owing to the acoustic difficult design features:

> "a smaller up-to medium sized fishing vessel, overpowered in relation to the main dimensions and with the major

noise sources adjacent to the accommodation and working spaces" (see also Annex 1)".

and at the other hand:

"the fishing vessels have always been excluded from the statutory regulations or recommendations, international such as the IMO "Code on noise levels on board ships" as well as national such as the "Recommendations to prevent noise annoyance on board ships" of the Dutch Shipping Inspectorate (SI)"

However in the near future this will change, due to the growing awareness of the importance of the general working and living conditions onboard ships (EEC-labour legislation, in Dutch the so-called "Arbo-Wet"). There is reason to believe that for newbuilding fishing vessels stricter noise recommendations or even limits have to be met in the nineties.

Database
By means of a RIVO-TO database with noise measurements, the concerning parties like the research institutes, shipyards, skippers and legislature can get a clear insight in the state of the art of the noise problem and noise control, by which unreasonable noise limits can be avoided for this type of Dutch fishing vessels.

Nowadays there is a general agreement that too high noise levels are undesirable and unhealthy, also onboard fishing vessels:

- it may cause hearing damage (health)
- it makes verbal communication difficult and hearing of audible alarms (safety)
- it may cause fatigue and stress (health)

Noise control
Noise control is a phenomenon that also enters upon the fishing cutters. Although shipboard noise control is attracting increased attention from some Dutch fishing shipyards and designers, either as a competitive design improvement and/or anticipating the (near) expected future labour legislation, a lot of work has still to be done, aiming at noise control as an integral part of the new cutter design and building.

Prior to acoustic design recommendations for fishing cutters sufficient noise measurements should be carried out (noise levels) and an analysis should be made of the acoustical design aspects of fishing cutters (noise sources).
Based on these data effective noise reduction measures can be taken and by which also the inevitable costs can be minimized, but only if the noise control is considered in an early design stage of the vessel.

This paper reports only about the first mentioned items: the

noise sources and noise surveys (1985, 1986) onboard of the Dutch beamers.
Last year a cooperative contract-research study by RIVO-TO and the Institute of Applied Physics TNO-TH (TPD-TNO) was started on sound transfer paths onboard of representative beamers of 220 kW (300 hp) and 1500 kW (2000 hp), authorised and funded by the National Foundation for Cooperative Maritime Research (CMO) and aiming at acoustical design guidelines for the Dutch beamers to be reported in 1987.

2. NOISE SOURCES

Sound in ships is mainly determined by the machinery propulsion plant and the auxiliary engines.

General

Noise sources are distinguished in the way sound propagates from the source to its surroundings, either by air = airborne noise and/or by ship structures = structure borne noise.
Separating decks and bulkheads are excited by both noises. The vibration of these structure parts will then be propagated to the boundaries of the accommodation, which will radiate noise into the crew's living and working spaces. The more separating constructions are installed, the easier and less expensive noise control will be.
However a luxury for smaller ships and the Dutch fishing cutters, viz. vessels with the major noise sources adjacent to the accommodation.

Beamer sources

Anticipating the results of the cooperative contract-research study, some interesting details with regard to the major noise sources can already be shown.
Based on the extensive measurements onboard the 220 kW (300 hp) and 1500 kW (2000 hp) beamers last year, the primary acoustical aspects to be considered are:

- main propulsion engine
- gear box
- propeller
- diesel generator sets

and to a lesser extent the winches and hydraulics, especially onboard of the 220 kW (300 hp) beamer.

In Table 1 details are given of these major noise sources with regard to the most applied trade-marks and also which noise contribution is found to be dominant for the ultimate noise readings in the compartments.
Except incidental application of resilient mountings of the diesel sets, no explicit noise control measures have been taken by the yards with of course a few exceptions.

The above mentioned conclusions do not imply that the other noise sources such as the ventilation-, exhaust- and intake-systems are not important, they may even largely spoil the achieved results by the main acoustical measures, but for these sources remedial measures later on are possible without affecting the ship-design too much.

3. NOISE LEVELS

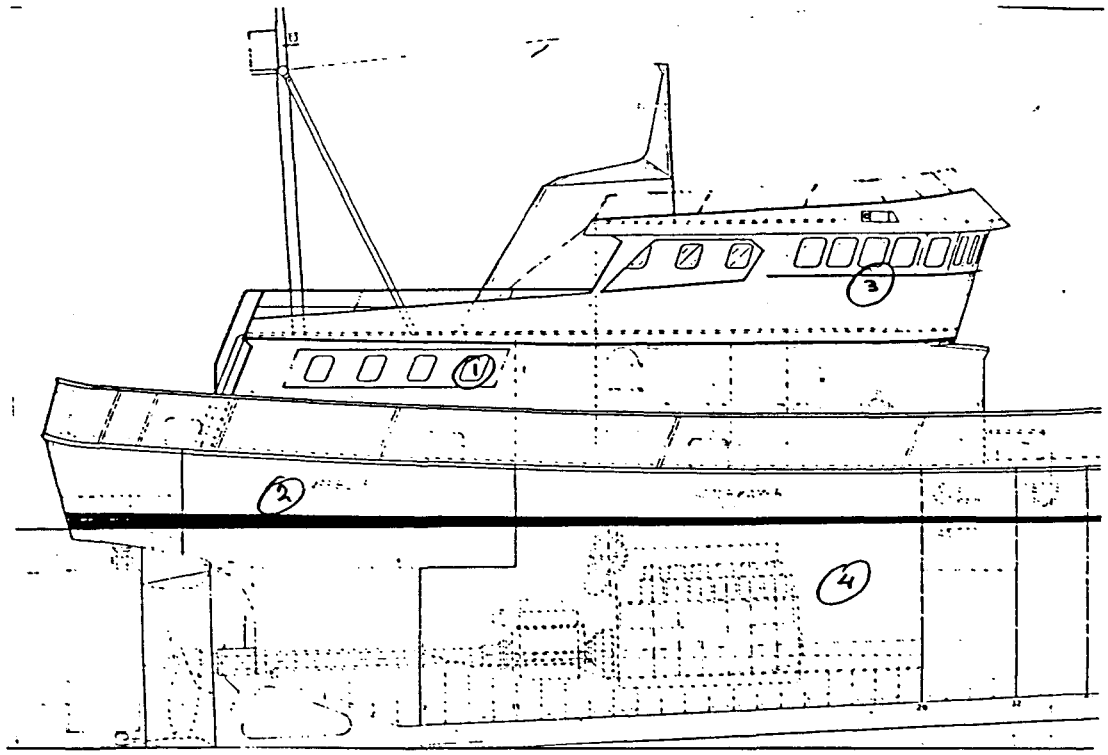
The measurements of the noise levels have been carried out in accordance with the Recommendations of the Dutch Shipping Inspectorate, although not applicable for new building fishing vessels.
These recommendations provide a good manual with regard to the survey method, sound level meters, measurement positions and operating conditions at sea. By which the data are reproducable and comparable with noise readings onboard ship types acoustical simular to fishing vessels, such as coastal merchant marine vessels, tug- and workboats and inshore vessels.

In Table 2 and 3 a summary of machinery specifications and the noise measurements of 20 fishing cutters have been given, mainly beamers (flatfish) and two pair trawlers (roundfish). The horse power range is from 220 kW (300 hp) upto 2200 kW (3000 hp), but the majority of the vessels have an installed power between 700 kW (1000 hp) and 1470 kW (2000 hp).
From twelf cutters the keel was laid in the eighties, while the remaining were built before the seventies. Some of these boats were fitted with a new engine in the seventies.

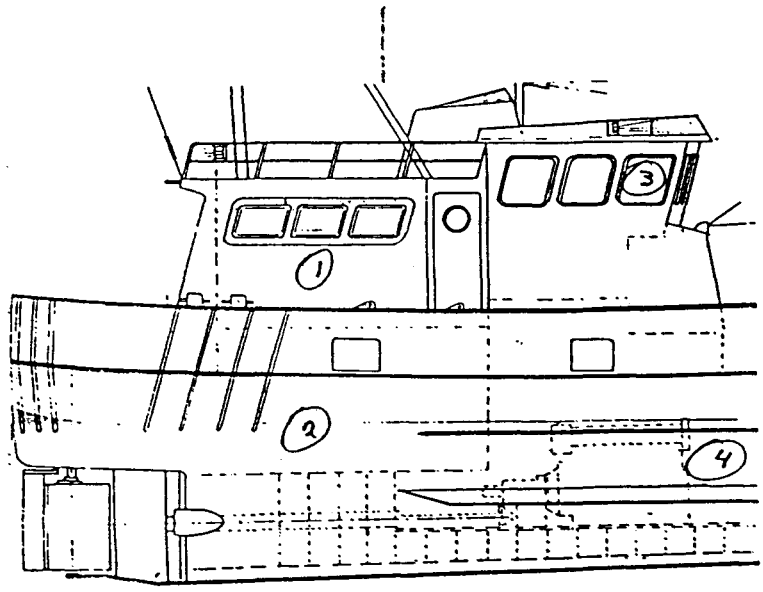
Survey method

The sound pressure levels have been taken with a precision grade sound level meter, Brüel & Kjaer, type 2230. The measurements were carried out as decibel-readings with a A-weighting filter and if possible, also followed by an octave-band analysis in the frequency range of 31.5 upto 8000 Hz. Before and after each measurement the sound level meter was calibrated.

Because the scope of this paper is the state of the art of the noise levels and sources onboard of the Dutch fishing cutters, only the dBA-values are given and for the representative 220 kW (300 hp) and 1500 kW (2000 hp) beamers also the octave-bands. Both for the steaming conditions and in the following locations:



(1) - messroom/galley
(2) - accommodation/cabin
(3) - wheelhouse
(4) - engine-room



Results
The noise readings are given in Table 3, 4 and 5 in dBA values as well as in figures 1-5, while the plots of the octave-band analysis for the two representative beamers are given in figures 6-14. Although the data give a various range of noise levels, for each compartment a major and characteristic group of dBA values with a minimum, maximum and average level can be given:

Messroom/galley (1)

Main group	Number of vessels	Minimum	Maximum	Total number of vessels
71-80 dBA	17	64 dBA	83 dBA	20

Five of the measured fishing vessels have a lower dBA value than the average value of 76 dBA, but all different readings. Above the upper limit of the range 3 vessels have a measurement of 82 and 83 dBA.
The plots of the octave-band analysis are showing that onboard of the two representative beamers (No.18, No.20) the highest levels are in the lower frequency range, oiz. 31.5 and 63 Hz with a steep decline in noise levels above 250 Hz.

With reference to the IMO-noise limits and the Dutch S.I. recommendations, only one fishing vessel (No.16) is satisfying the required 65 dBA limit for merchant marine vessels.

Accommodation/cabins (2)

Main group	Number of vessels	Minimum	Maximum	Total number of vessels
72-82 dBA	16	60 dBA	84 dBA	19

Below the main deck in the aft end of the ship, the noise readings follow a similar pattern as the messroom/galley readings and also with an average value of 75-76 dBA.
Most of the remaining vessels outside the main group are showing a different level, varying from 72, 68 down to 60 dBA.
Above the upper limit four vessels have a 81, 82 and 84 dBA value.
The octave-band plots give the same characteristics as shown in the messroom, high noise levels in low frequences 31.5 and 63 Hz and a steep decline from 125-250 Hz.

Only one fishing vessel (No.16) is satisfying the IMO-limits and Dutch S.I. recommendations for the merchant marine vessels of 60

dBa.

Wheelhouse (3)

Main group	Number of vessels	Minimum	Maximum	Total number of vessels
72-78 dBA	17	69 dBA	79 dBA	19

The wheelhouse noise readings have a smaller variation then the above given levels. However no vessel has a level below the IMO- and Dutch S.I. recommendations for merchant marine vessels of 65 dBA, but the main group values is far better then in the messroom and accommodation, however with the same average of 75 dBA.
The octave-band plots are showing again a similar picture as before, the highest levels in the low frequency range.
Between the 220 kW (300 hp) and the 1500 kW (2000 hp) beamer, the maximum noise level frequency differs more than in the accommodation and messroom, resp. 31.5 Hz and 125 Hz.

Engine-room (4)

Main group	Number of vessels	Minimum	Maximum	Total number of vessels
107-112 dBA	14	102 dBA	112 dBA	19

With reference to the IMO-noise limits and Dutch S.I. recommendations for unmanned engine-rooms (merchant marine vessel) three quarter of the vessels have noise limits lower than 110 dBA. Characteristic noise levels for the beamer engine-room are 107-112 dBA with no vessels above and six vessels with dBA values of 102, 103, 104 and 105.
The plots of the octave-band analysis give the highest noise levels in the medium frequency range, 125-1 kHz.

4. CONCLUSIONS AND RECOMMENDATIONS

Fishing cutters, especially the beamers, are very difficult to silence compared with larger ships; the dominant noise sources are adjacent to the living and operating spaces and the strongly increased horse powers and bigger propellers compared to the smaller increase in main dimensions, mean higher noise levels for the newbuilt vessels in the eighties.
Up to now only a few noise control measures have been taken, such as rockwool insulation and noise insulated floors, but an integral acoustical design approach is still absent.

Noise levels

The results of the survey clearly show that almost all the 20 vessels exceed the IMO and Dutch S.I. noise limit references, recommendations for newbuilding vessels other then fishing vessels:

Compartment	Main group dBa levels (average)	Exceed dBA value	IMO-recommendation
Messroom	76 dBA	10 dBA	65 dBA
Accommodation	75-76 dBA	15 dBA	60 dBA
Wheelhouse	75 dBA	10 dBA	65 dBA

However the engine-room noise levels are almost all below the upper IMO-limit of 110 dBA based on the assumption of the daily Dutch fishing practice that the engine-room is unmanned, otherwise 90 dBA is required.
Only one vessel (No.16) is nearly satisfying the standard considered, but on the one hand side the level meter was not calibrated and on the other hand the fishing vessel was built under special circumstances. A bankrupcy of the shipyard forced the skipper to supervise the final stages of building by himself, but at any cost: application of heavy construction parts (aft end steel plating of 20 mm) and extensive noise control techniques, by which this beamer is absolutely not reproducable and representative.

Looking at table 3, where the noise measurements have been arranged according increased horse powers, one can see that above 1500 kW (2000 hp) the average noise levels increased with 2-3 dBA, except in the wheelhouse, where a reduction of 3 dBA can be observed. The same picture, however less clearly, can be seen in table 4, where the fishing vessels sorted out according the dates of delivery, have a discontinuity of 2-3 dBA for fishing cutters built before and in the eighties. This can be declared by the fact that owing to the growing awareness of noise control, some low cost modifications were incorporated in the design and building of the new, higher powered cutters in the eighties with the best results for the wheelhouse, where the sound transfer paths are longer.

Noise sources

Similar to many other shiptypes the propulsion engines and propellers were found to be the dominant noise sources on board of the Dutch fishing cutters. Anticipating the results of the co-operative current noise research studies (1986/'87: RIVO-TO/TPD-TNO) on board of the representative 220 kW (300 hp; No.20) and 1500 kW (2000 hp; No.18) beamer, it can already be observed (a.o. Fig. 6-14) that the structure-born noise from the hard mounted diesels adversely impacted all living and operating

spaces. Especially in the low frequency range, 63 and 125 Hz, and also for the propeller induced structure-borne noise. Besides airborne-diesel noise in the higher frequencies, the exhaust systems have an adversely impact for the wheelhouse noise levels.The diesel generator sets, often resilient-mounted and gear box seem to have no clear contribution to the high noise levels, also the steering engine, ventilators and compressors.

RECOMMENDATIONS

Even for fishing vessels it should be possible to achieve lower noise levels, because for simular acoustical difficult shiptypes like tugboats and small working boats conceptual noise control techniques were developed.
Of course for the Dutch fishing cutters there is no immediate or magic solution to the reduction of sound levels, but if our knowledge increases, gradual improvement may be expected, so that at least normal conversation is possible outside the engine room. That is to the authors opinion noise levels lower than 73 dBA, a noise level which is also many times measured on the open deck during the steaming condition to the fishing grounds.
As interim design goals for new fishing cutters the following dBA-values should be aimed at:

Design goal	dBA values - new fishing cutters
messroom	65 dBA, max. 70 dBA (above main deck)
accommodation	65 dBA, max. 70 dBA (below main deck, aft end)
wheelhouse	65 dBA, max. 70 dBA (above winchhouse)
engine room	110 dBA (unmanned)

Anyway before final noise recommendations or even regulations may be applied on fishing vessels, cost effective studies are necessary. Noise reducing measures have a certain cost, but this can only be kept to a minimum and reasonable costs if acoustic engineering is considered at the early design-stage (drawing-board, specifications), however as an integral design approach; i.e. paying attention to many details throughout the design, construction and outfitting process.

ACKNOWLEDGEMENT

The author would like to thank all shipyards, especially Visser (Den Helder), Maaskant (Stellendam) and Padmos (Stellendam) and also the skippers/owners and crew, especially Mr. Vlaming (Texel) and Mr. Visser (Goedereede), who kindly placed their

boats at our disposal for noise measurements and design details.

TABLE 1 - CHARACTERISTICS/MAKE OF MAJOR [redacted]RCES

Noise sources	Sound propagation	220 kW (300 hp) beamer	1500 kW (2000 hp) beamer	Noise control measures
Main propulsion diesel engines	. structure - borne noise . airborne noise . exhaust noise	number: 1 manufacturer: . Mitsubishi . Deutz . Caterpillar . Scania . Mercedes . Cummins . Guascor . Stork Type: high speed Rev's: 1500 - 1800 rpm Blower: --	number: 1 manufacturer: . Stork . MAK . Deutz . Crepelle . Bolnes . Man Type: medium speed Rev's: 600-1000 rpm Blower: BBC	. no specific noise control . exhaust silencer
Gear box	. structure - borne noise	number: 1 manufacturer: . Masson Type: elastic/hydraulic coupling Reduction: 1 : 4.5-9.9 pto: hydropump	number: 1 manufacturer: . Rhenania . Lohmans . Reintjes . Sempress Type: elastic with hydraulic reverse coupling Reduction: 1 : 3-6 pto: generator	. no noise control
Propeller	. structure - borne noise	number: 1 manufacturer: . van Voorden . Lips Type: f.p. with nozzle Blades: 3-4 Diameter: 1400-1900 mm	number: 1 manufacturer: . van Voorden . Lips Type: f.p. with nozzle Blades: 4 Diameter: 2700-3000 mm	. no noise control
Diesel generator set	. structure - borne noise . airborne noise	number: 1-2 manufacturer: . Mitsubishi . Daf . Scania . Volvo . Valmet Type: high speed Rev's: 1500 rpm Power: 30-60 kW	number: 1-2 manufacturer: . Mitsubishi . Daf . Scania . Volvo Type: high speed Rev's: 1500 rpm Power: 110-250 kW	. resilent mounting . soundproofing separation
Winches	. structure - borne noise	number: 1 manufacturer: . Padmos . Maaskant . Luyt Type: 6 drum Power: Hydraulic/electric drive	number: 1 manufacturer: . Maaskant . Ridderinkhof Type: 8 drum Power: electric drive	no noise control
Hydraulics	. structure - borne noise . fluid-borne noise	. pto's . deck equipment . Promac . Bruienhof	--	no noise control

Table 1

TABLE .' SUMMARY OF MACHINERY SPECIFICATION (No. 01-20)

Vessel No.	Type of fishing cutter	Date of delivery	Main dimensions L_{oa} x B x D (m)	PROPULSION MACHINERY Horse power in kW (hp)	Engine rev's	Gearbox : 1	Propeller nozzle	propeller diameter	propeller blades	(Aux) Machinery Remarks
01	beamer/roundfish	< 1970	30.5 x 6.6 x 3.1	680 (920)	800	--	yes	--	4	re-engine 1981
02	beamer (= flatfish)	< 1975	33 x 7.5 x 4.1	1100 (1350)	820	4.55 : 1	yes	2500	4	re-engine 1981
03	beamer	> 1980	40.2 x 9 x 5.1	1750 (2400)	800	4.5 : 1	yes	3000	4	pto (winch)
04	sterntrawler/beamer	< 1970	30.3 x 6.6 x 3.1	600 (800)	800	2.9 : 1	yes	--	4	re-engine 1979
05	beamer	< 1970	30 x 6.4 x 3.1	600 (800)	800	--	no	--	4 - cpp	re-engine 1977
06	beamer	> 1980	44.4 x 9 x 5.1	2400 (3200)	900	4.9 : 1	yes	3000	4	pto (2x)
07	beamer	> 1980	40.2 x 9 x 5.1	1750 (2400)	865	5.3 : 1	yes	3000	4	--
08	beamer	> 1980	40.2 x 9 x 5.1	1750 (2400)	900	5.3 : 1	yes	3000	4	--
09	beamer	> 1980	40.2 x 9 x 5.1	2000 (2700)	900	5.3 : 1	yes	3000	4 - cpp	pto (2x)
10	beamer/roundfish	> 1980	42 x 9 x 5.1	1700 (2300)	900	--	yes	3000	4	pto (1x)
11	beamer	> 1980	40 x 9 x 5.1	1400 (1800)	800	5.3 : 1	yes	3000	4	pto (1x)
12	beamer/roundfish	> 1985	32.9 x 7.3 x 5.8	590 (800)	850	4.95 : 1	yes	2400	4	--
13	beamer	> 1980	42 x 9 x 5.1	2000 (2700)	900	5.3 : 1	yes	3000	4 - cpp	pto (1x)
14	beamer	> 1980	40.1 x 8 x 4.7	1500 (2000)	900	5 : 1	yes	2700	4	--
15	beamer	> 1985	42.4 x 8.5 x 4.8	2000 (2700)	600	3.5 : 1	yes	2900	4	--
16	beamer	> 1980	40.7 x 9 x 5.0	1600 (2100)	900	5.8 : 1	yes	3000	4	--
17	beamer	< 1975	32.8 x 7 x 3.6	880 (1200)	800	--	yes	--	4	--
18	beamer	> 1980	40.4 x 8 x 4.4	1500 (2000)	850	5.2 : 1	yes	2900	4	--
19	beamer	> 1985	38.1 x 8.25x 4.4	1500 (2000)	850	--	yes	3000	4	--
20	beamer/shrimps/roundf.	> 1980	24.4 x 6 x 2.7	220 (300)	1500	4.5 : 1	yes	1400	3 - cpp	pto (1x)

Table 2

TABLE 3 - STEAMING

Location	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Recommended noise level IMO/SI☆ (newbuilding excl. fishing vessels)
Messroom/galley	76	77	78	80	74	76	82	79	83	78	71	76	79	73	76	64	76	75	83	72	65
Accommodation/cabin	79	76	75	78	84	82	76	75	77	72	68	81	74	--	73	60	82	76	80	76	60
Wheelhouse	78	77	75	77	75	72	76	--	73	74	72	75	75	79	69	70	75	72	73	72	65
Engine room	--	110	111	105	102	109	108	108	112	110	112	107	108	110	108	104	103	112	112	104	110 (unmanned)

TABLE 4 - STEAMING (INCREASING HORSE POWER)

Location	0 - 800 kW (1100 hp)					800 - 1500 kW (2000 hp)						1500 - 1900 kW (2500 hp)					1900-2200 kW (3200 hp)				Recommended noise level IMO/SI ☆ (newbuilding, excl. fishing vessels)
	01	04	05	12	20	02	11	14	17	18	19	03	07	08	10	16	09	13	15	06	
Messroom/galley	76	80	74	76	72	77	71	73	76	75	83	78	82	79	78	64	83	79	76	76	65
Accommodation/cabin	79	78	84	81	76	76	68	--	82	76	80	75	76	75	72	60	77	74	73	82	60
Wheelhouse	78	77	75	75	72	77	72	79	75	72	73	75	76	--	74	70	73	75	69	72	65
Engine room	--	105	102	107	104	110	112	110	103	112	112	111	108	108	110	104	112	108	108	109	110 (unmanned)

TABLE 5 - STEAMING (DECREASING DATE OF DELIVERY)

Location	< 1970			< 1975		1980 <				< 1985								> 1985			Recommended noise levels IMO/SI ☆ (newbuilding, excl. fishing vessels)
	01	04	05	02	17	03	06	07	08	09	10	11	13	14	16	18	20	12	15	19	
Messroom/galley	76	80	74	77	76	78	76	82	79	83	78	71	79	73	64	75	72	76	76	83	65
Accommodation/cabin	79	78	84	76	82	75	82	76	75	77	72	68	74	--	60	76	76	81	73	80	60
Wheelhouse	78	77	75	77	75	75	72	76	--	73	74	72	75	79	70	72	72	75	69	73	65
Engine room	--	105	102	110	103	111	109	108	108	112	110	112	108	110	104	112	104	107	108	112	110 (unmanned)

☆ IMO = International Maritime Organization
SI = Dutch Shipping Inspectorate

Table 3, 4 and 5

Figure 1

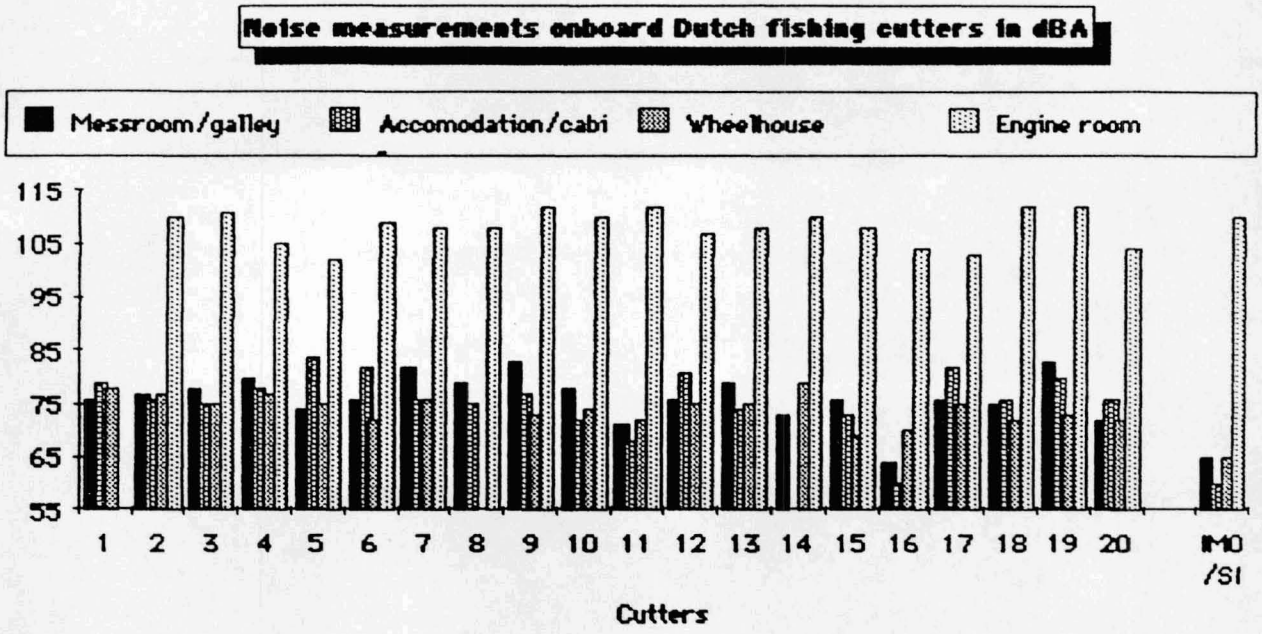

Noise measurements onboard Dutch fishing cutters in dBA
Messroom/galley
Accomodation/cabi
Wheelhouse
Engine room
115
105
95
85
75
65
55
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
IMO
/SI
Cutters

Figure 2

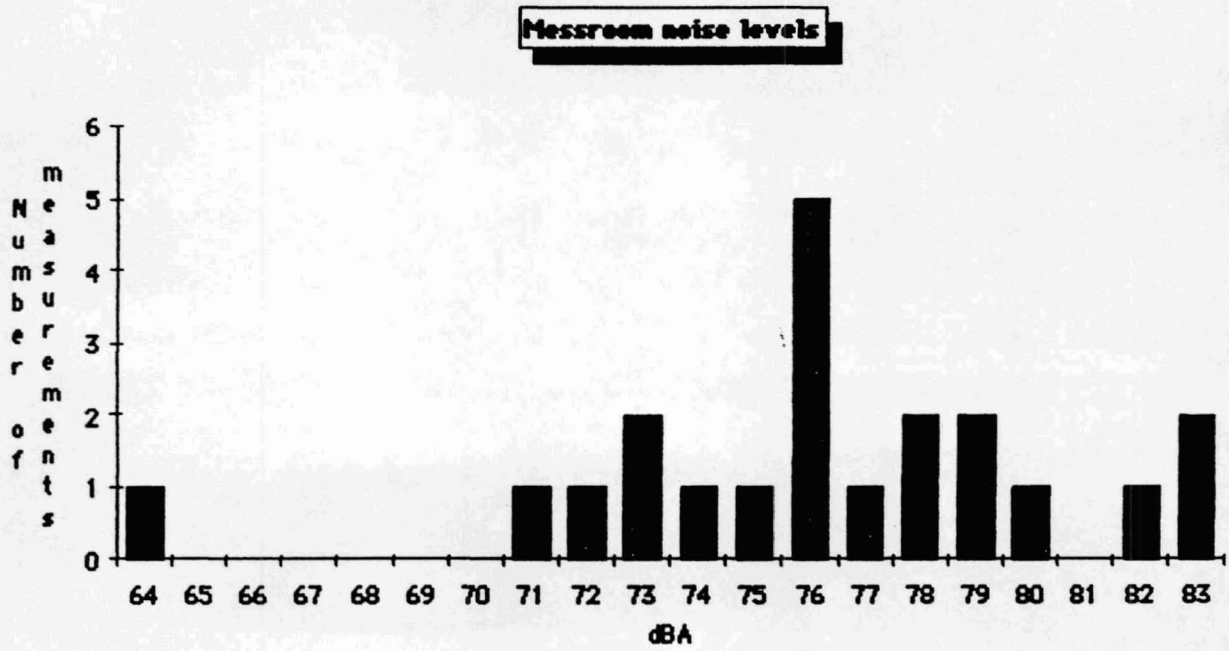

Messroom noise levels
Number of measurements
0
1
2
3
4
5
6
64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83
dBA

Figure 3

Accommodation noise levels

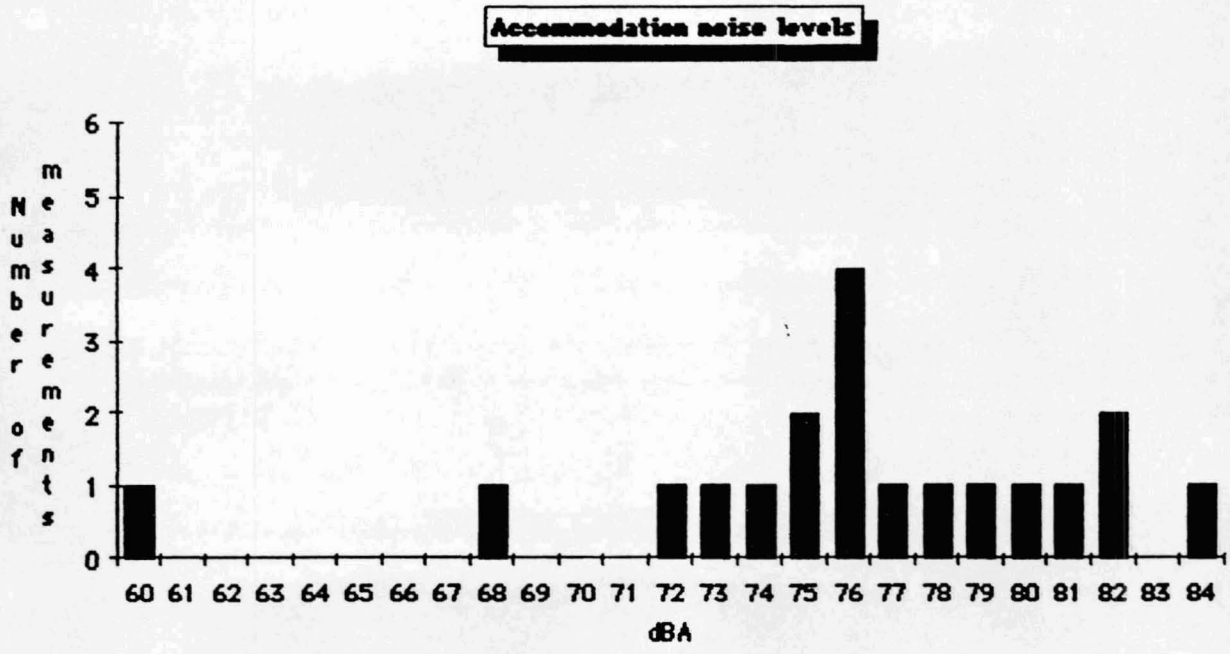
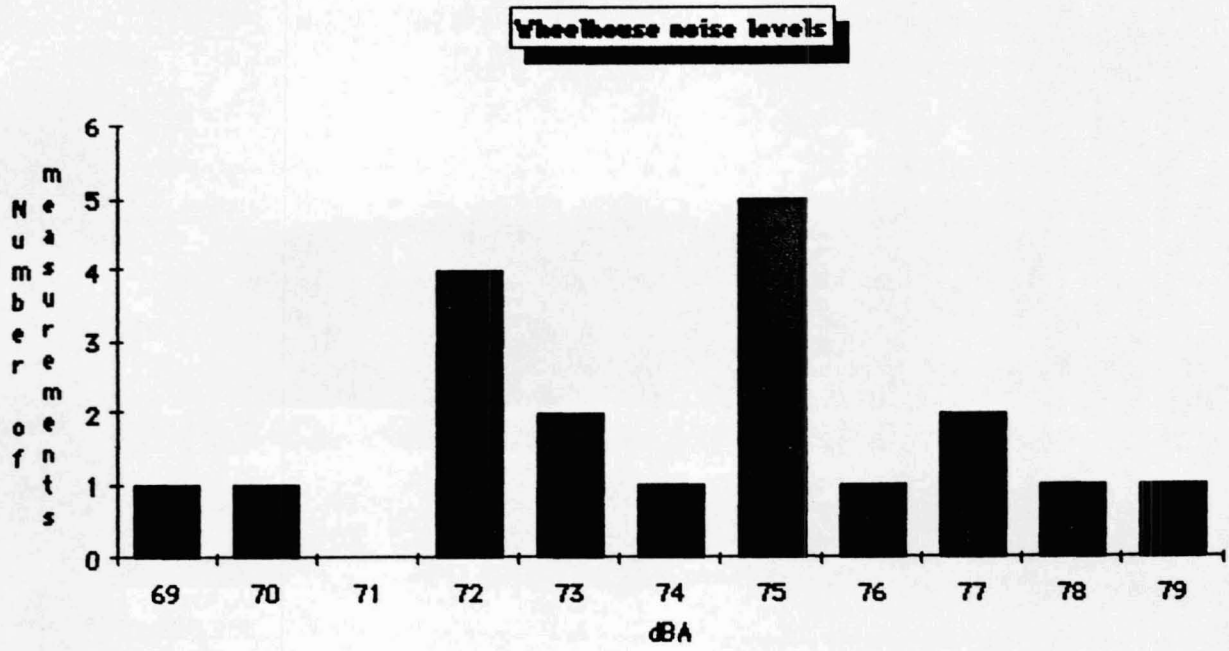
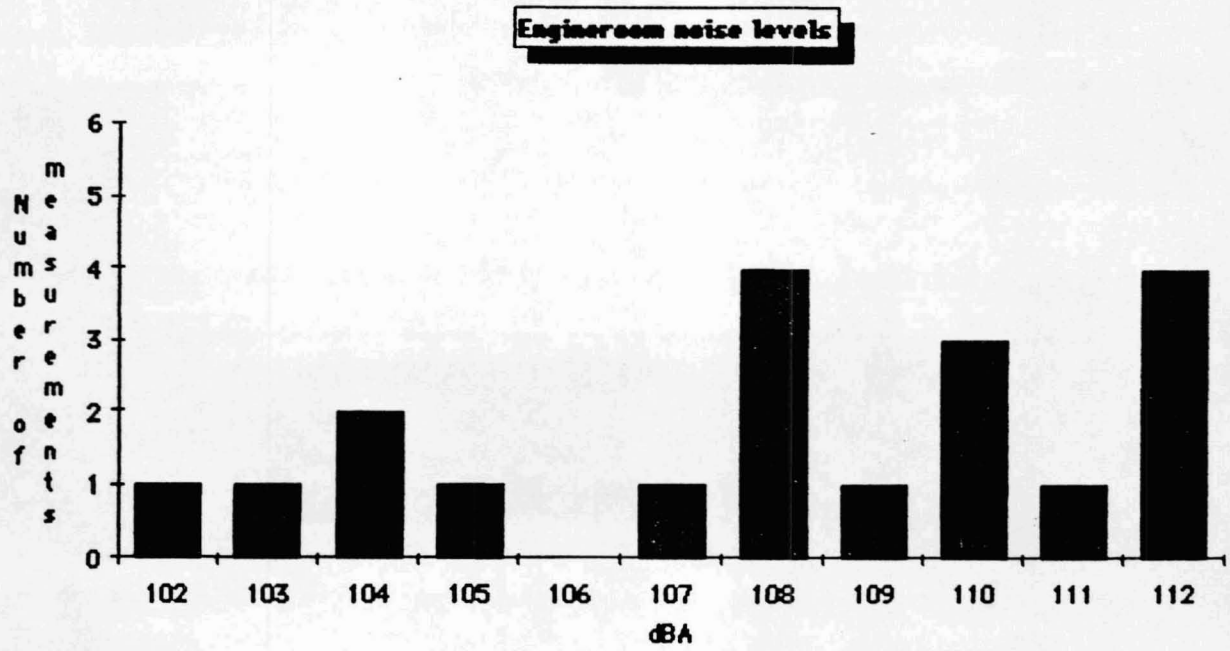


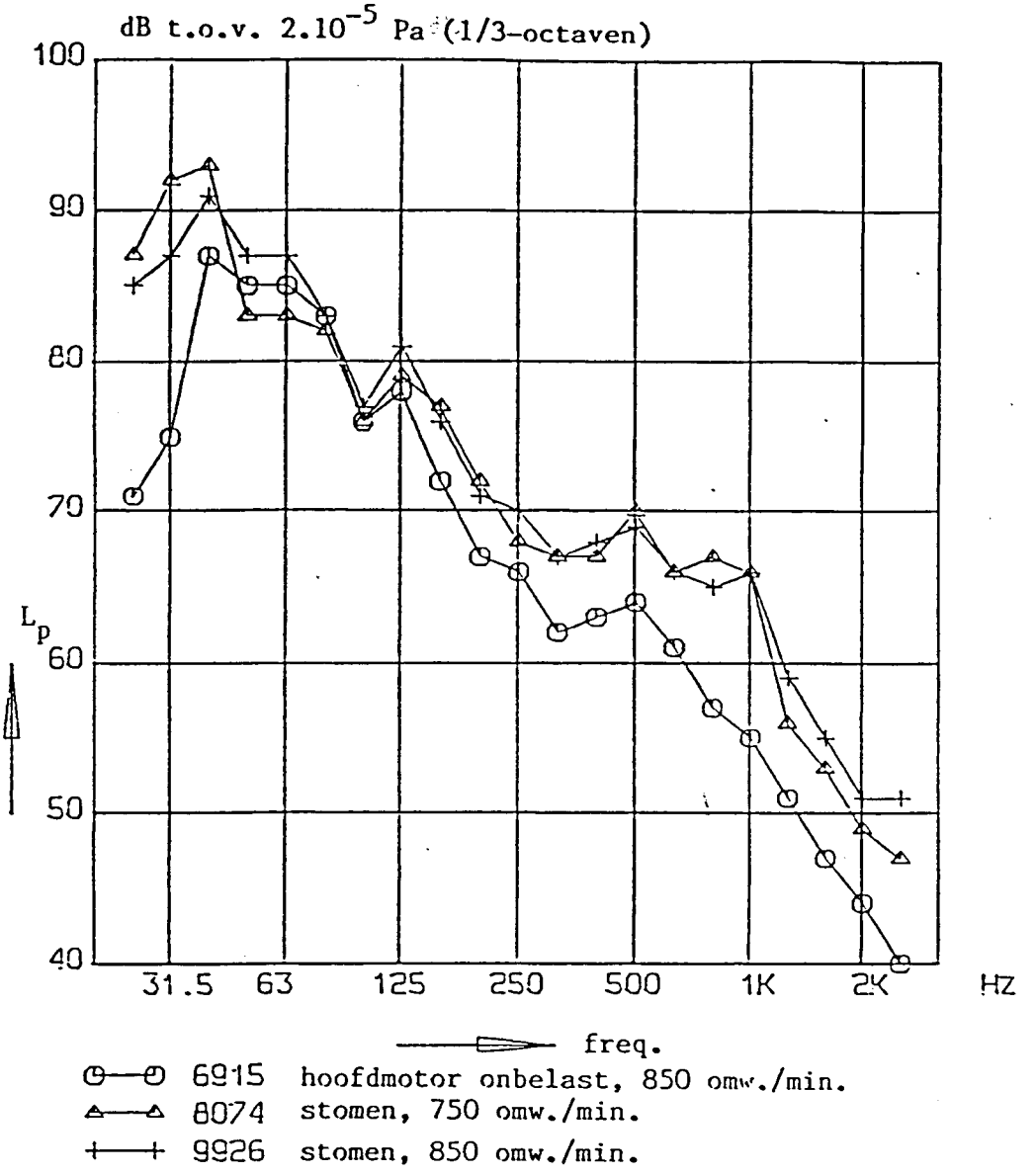
Figure 4


Wheelhouse noise levels
Number of measurements
0
1
2
3
4
5
6
69
70
71
72
73
74
75
76
77
78
79
dBA

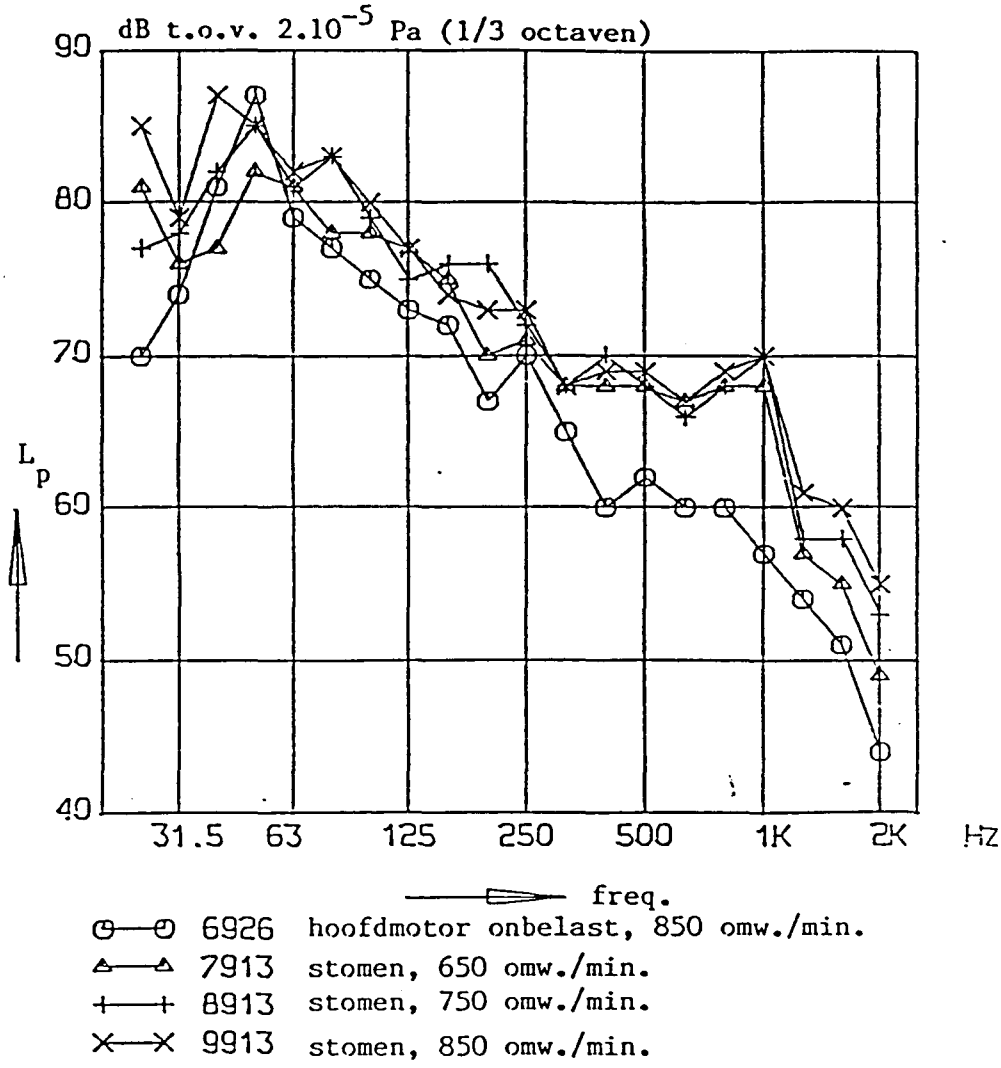
Engineroom noiselevels

Figure 5

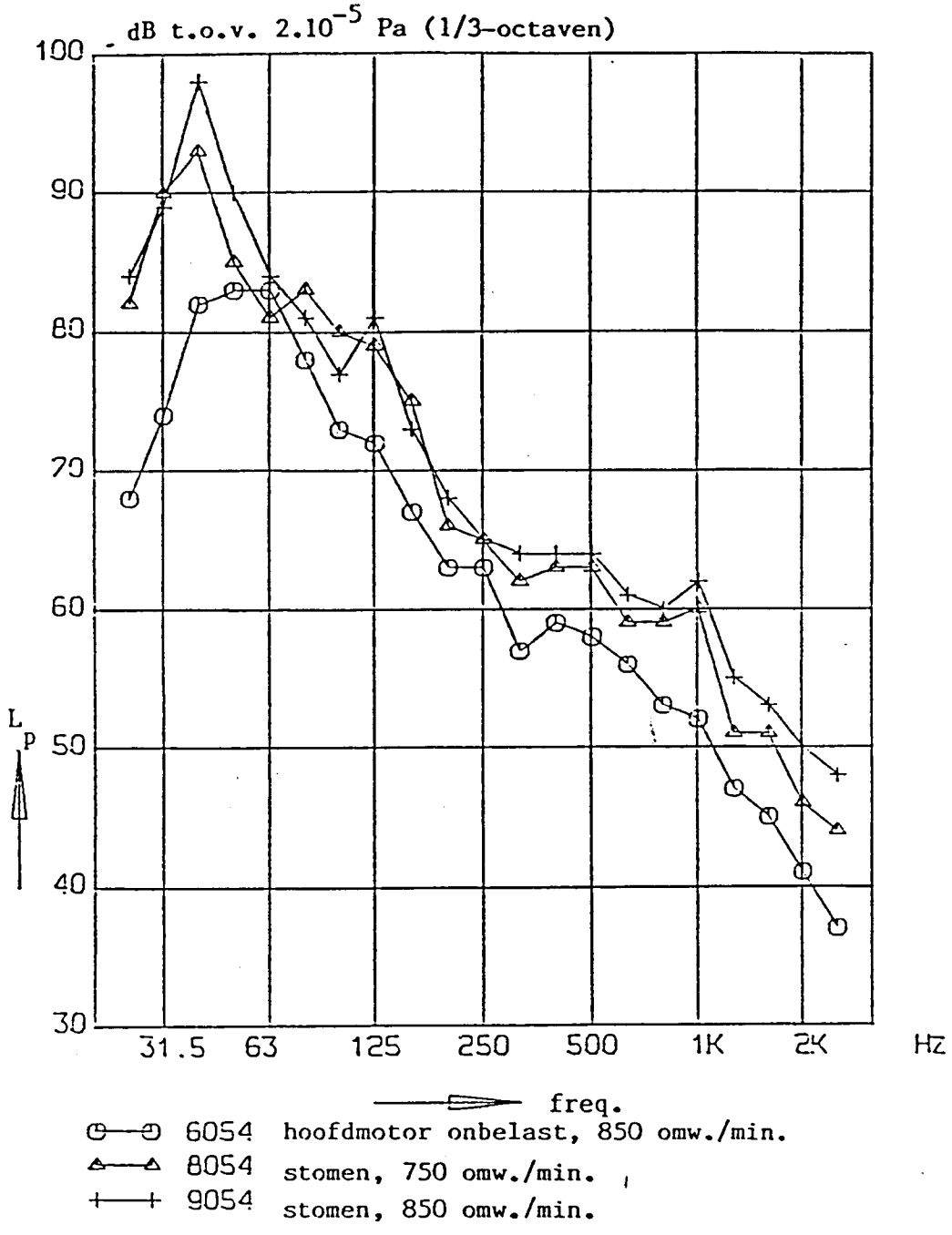




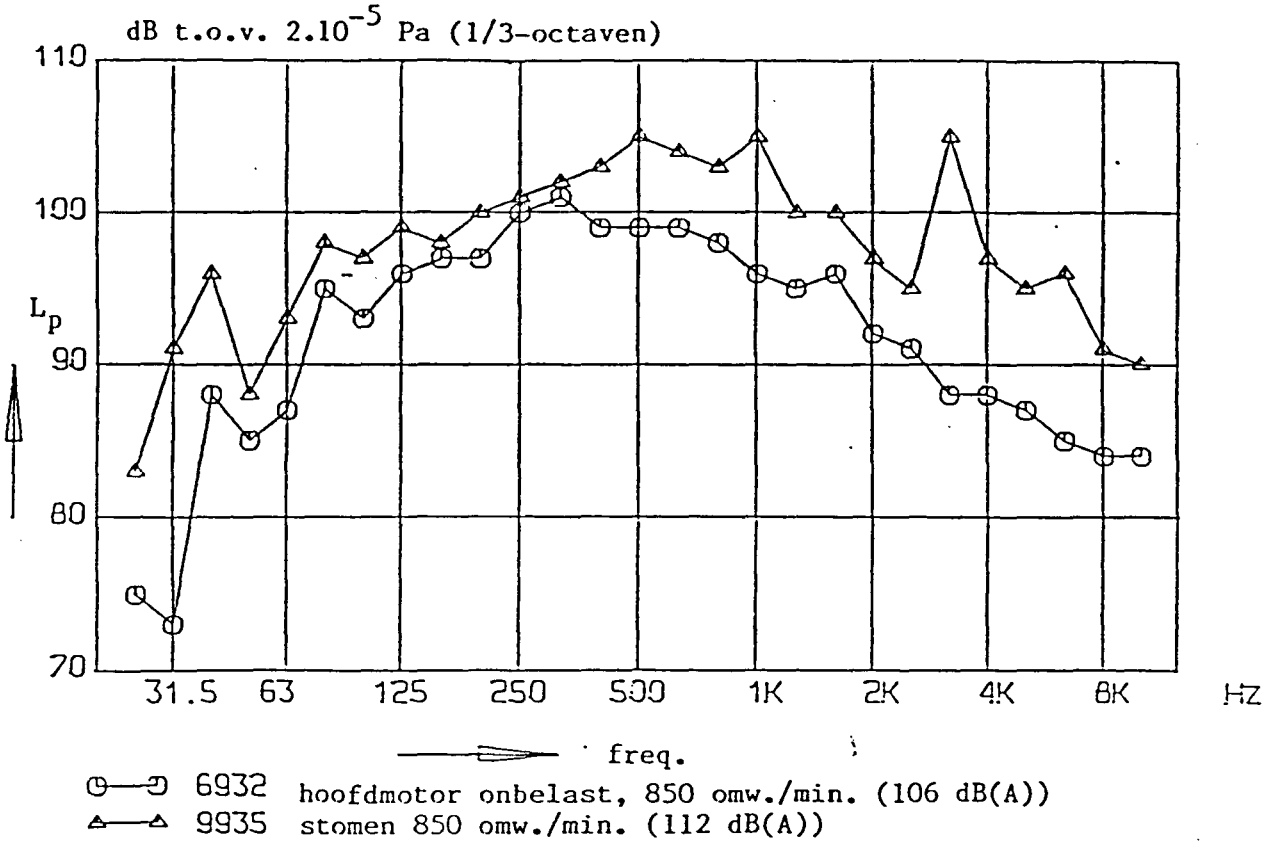
Sound pressure levels in messroom (1)



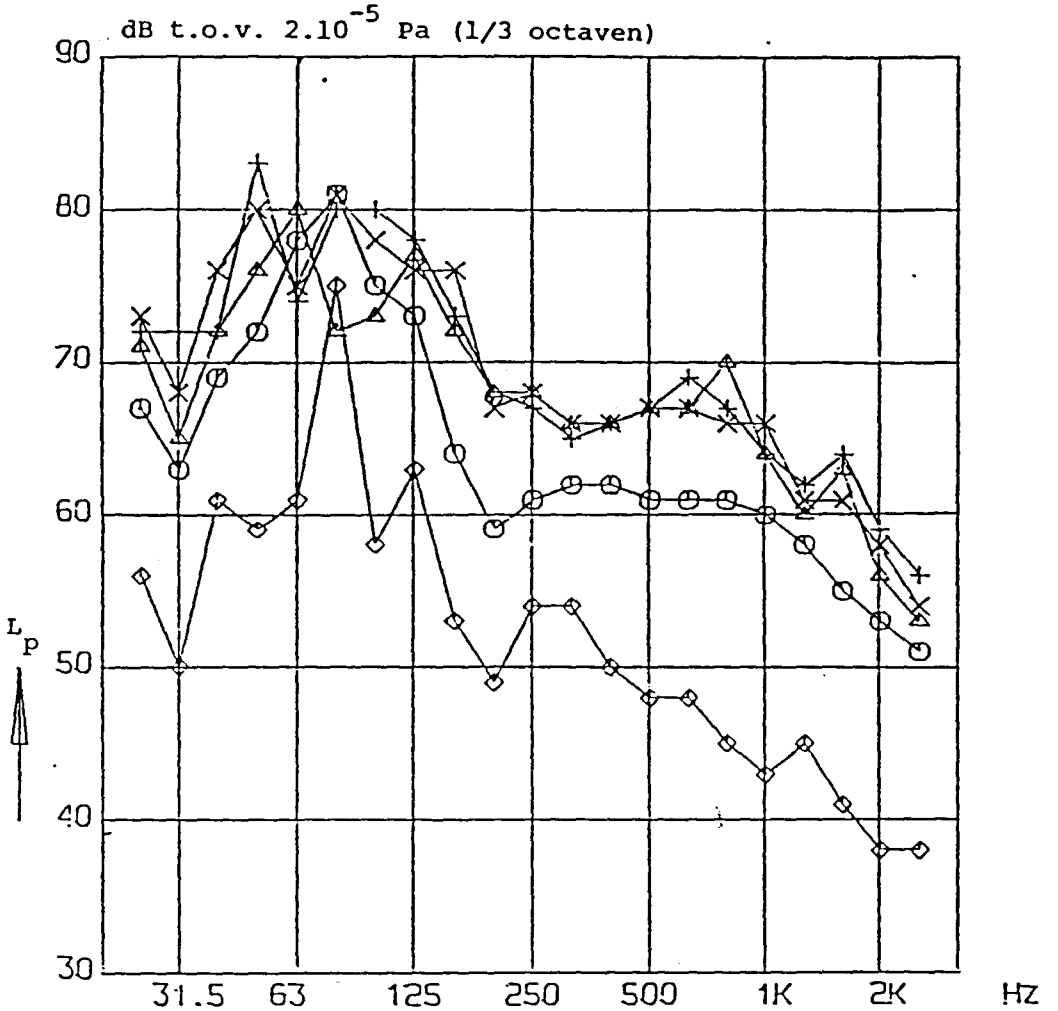
Sound pressure levels in accommodation (2)



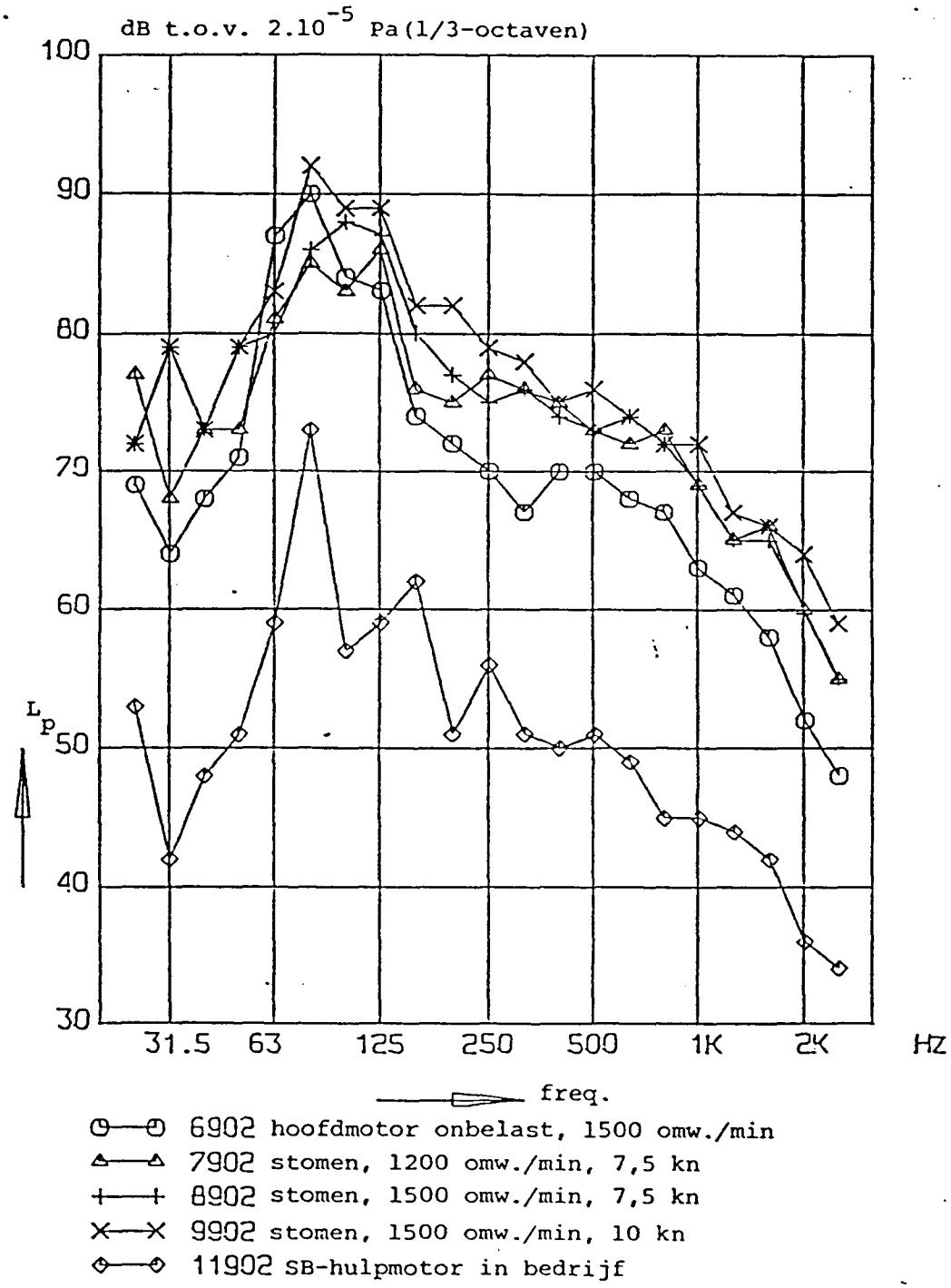
Sound pressure levels in wheelhouse (3)



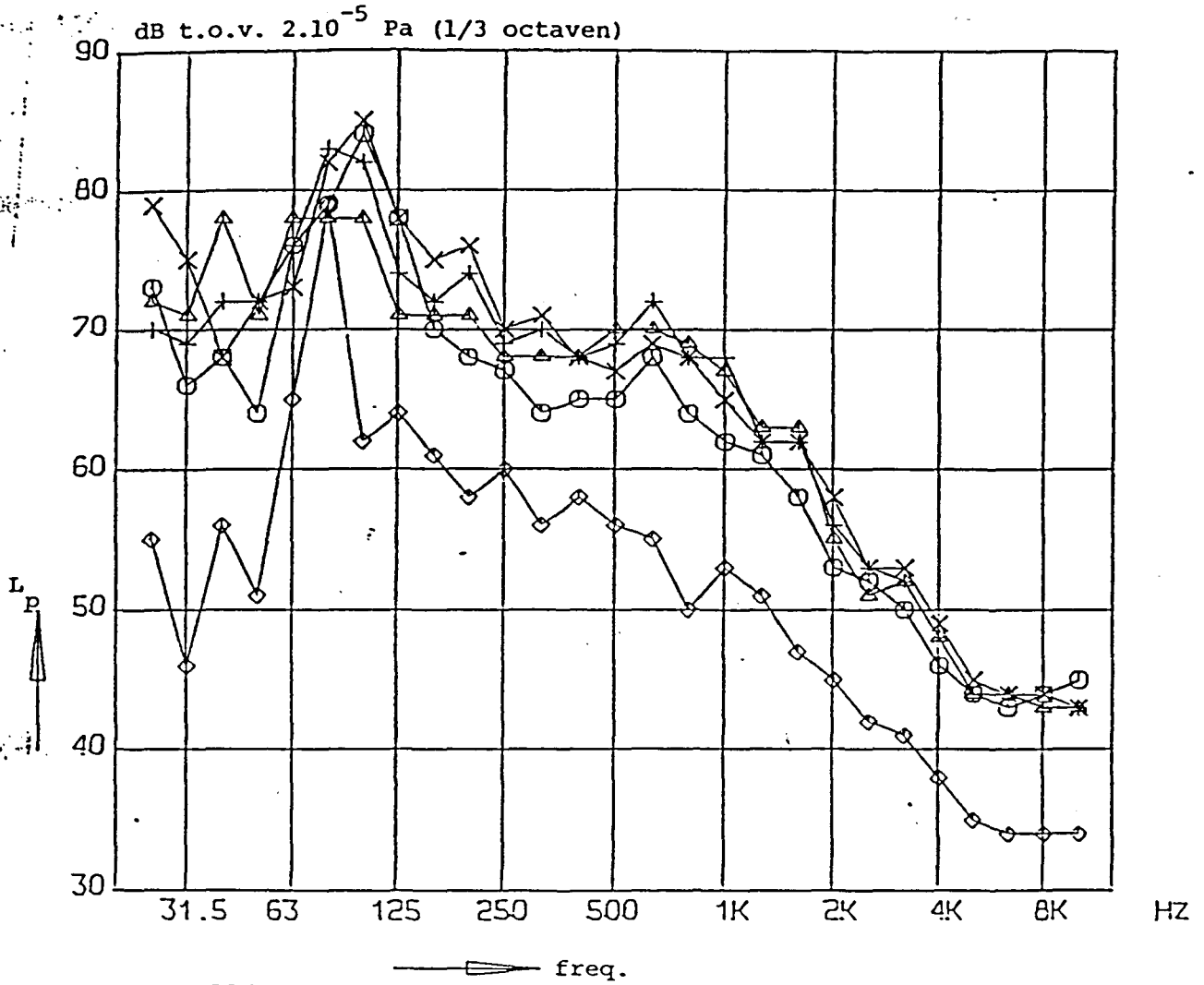
Sound pressure levels in engineroom (4)



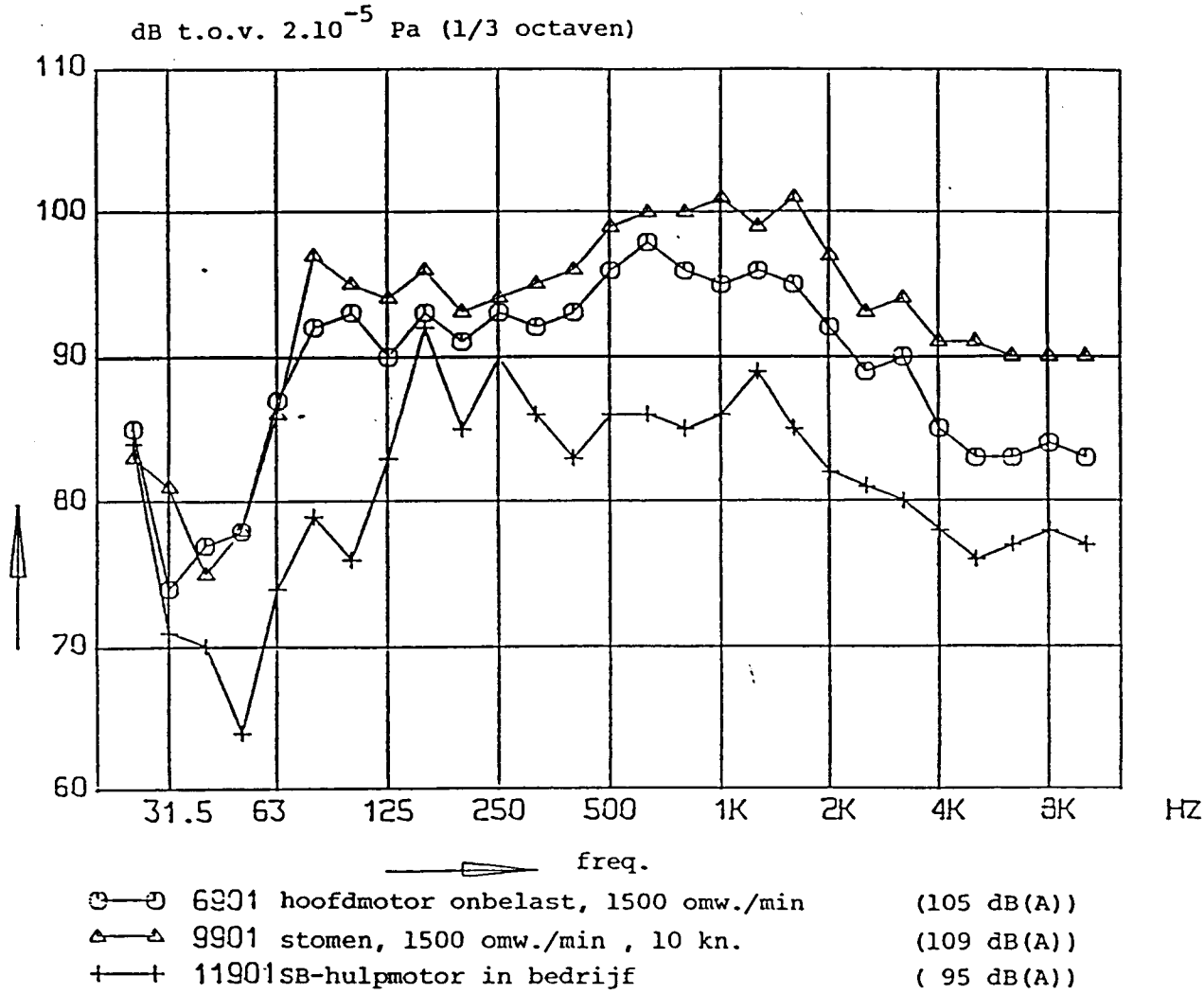
Sound pressure levels in messroom (1)



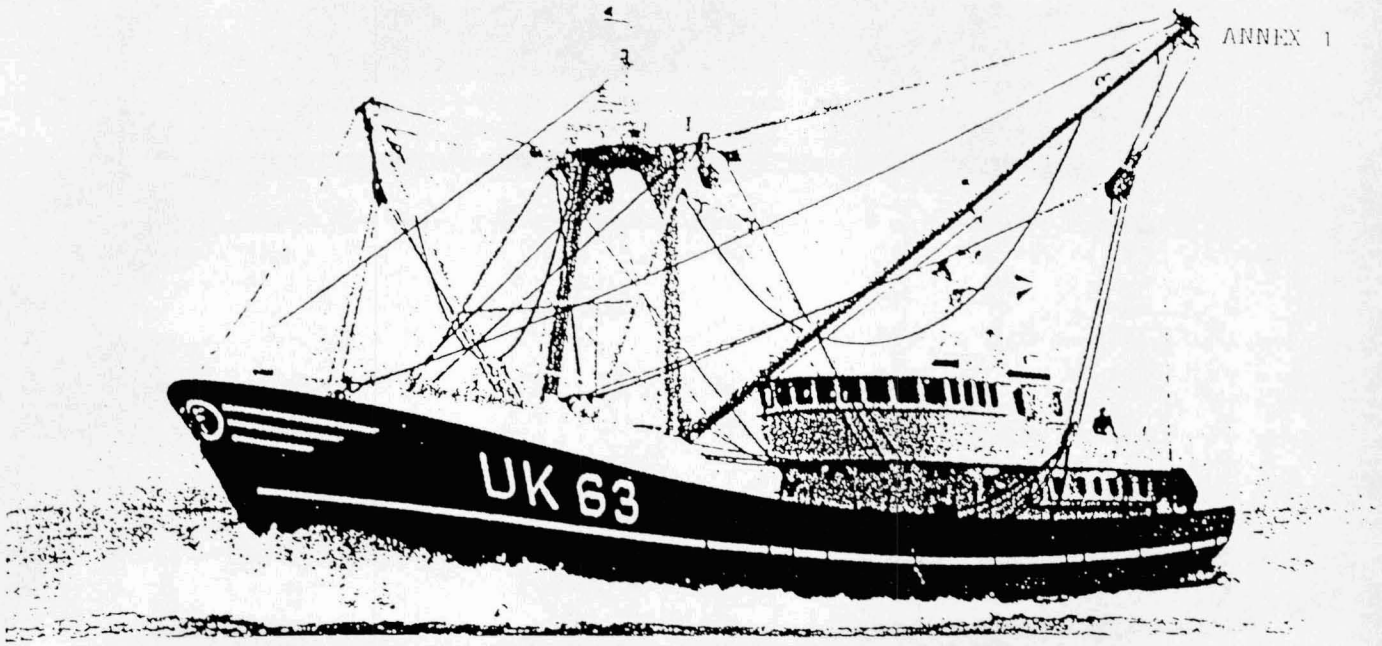
Sound pressure levels in accommodation (2)



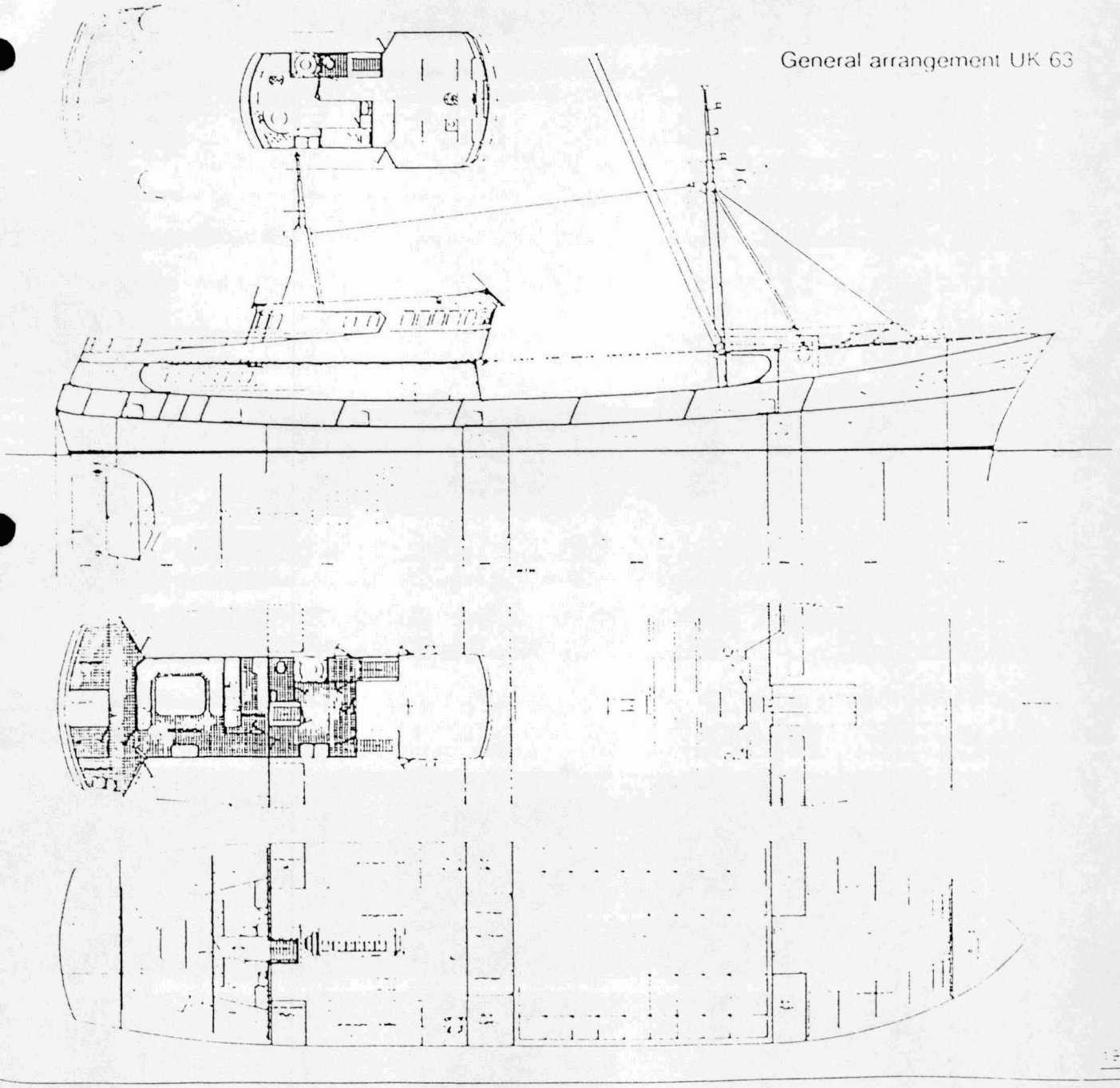
Sound pressure levels in wheelhouse (3)

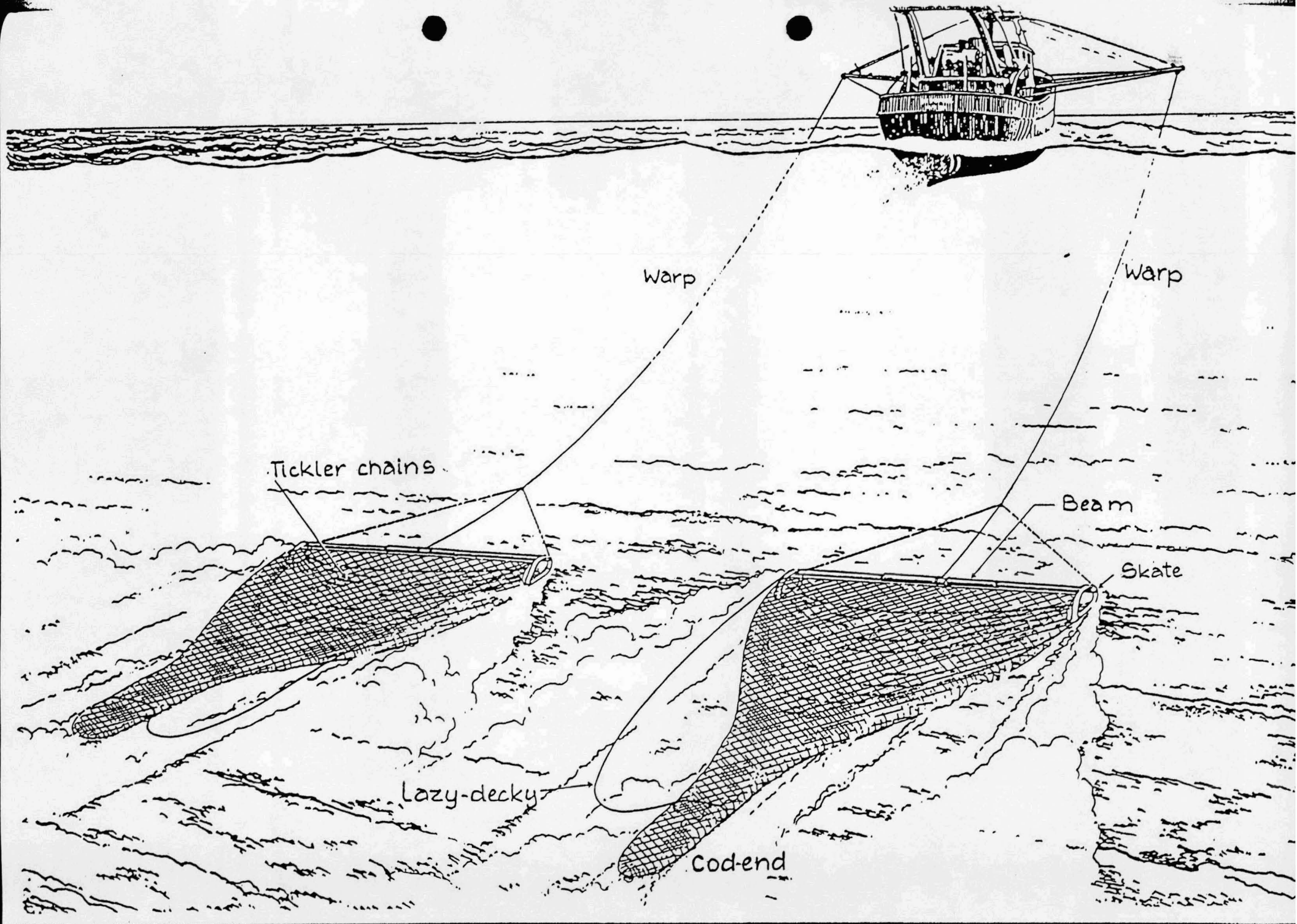


Sound pressure levels in engineroom (4)



General arrangement UK 63




Warp
Warp
Tickler chains
Beam
Skate
Lazy-decky
Cod-end

Appendix III

General arrangement, installations and equipment Dutch beamer.

As the major part of the 600 Dutch fishing cutters is of the beamtrawler type, the cutter will be featured here on the basis of a beamer.
In figure 1 (general arrangement) and figure 2 (beam trawling) it can be seen that the applied fishing method dictates the lay-out to a greater extent.
All existing flatfish beamtrawlers are towing two trawlnets by means of booms or so-called outriggers perpendicular to the shipsides and supported by a heavy gantry mast on the foreship.
The characteristic construction is a single deck hull with design trim and extended forecastle and aftward the superstructure with the crew's accommodation, wheelhouse and winchroom. The accommodation comprises cabins, washroom, shower, toilet, galley, messroom and mostly also crew's quarters below deck in the aft end. The quarters are suitable for a complement of 4-7 persons.
Below the main deck the hull is often subdivided in:

- fore peak (chainlocker, bowthruster, ballast);
- auxiliary machinery space (harbour set, oil- and freshwater bunkers);
- fishhold (insulated, crush ice machine, ice and fish box-storage, bunkers below);
- net store (oil bunkers below);
- main engine room (medium or high speed diesel engines, pto's and/or diesel generator set(s), reverse/reduction gear box, separators, hydrophore, heating and refrigerating plant);
- crew's quarters (tanks);
- aftpeak (steering gear, nozzled f.p. propeller below).

As usual the forecastle runs well aft to form a large sprayhood protecting the fishermen working on the main deck.
Below this sprayhood are the stainless steel fish sorting, stripping and washing machinery, to which the fish is transported by means of a conveyor belt, out of the flush fish dumping pound in the forward main deck. Over the shipsides the codend contents is dumped into this pound. To which extent the above mentioned fish processing equipment is fitted depends on the skipper-owner and stability requirements. The stripped and cleaned fish is transported via a flush hatch into the fishhold below deck. Here the fish is stored with crush ice in the plastic fishboxes (40 kg), stacked upto 4-5 boxes.

Increasingly the 4 or 5 stacked boxes will be discharged in the harbour by means of a separate hoist winch.

The midship section of the maindeck is a large yang or teakwood covered deck area (40-80 mm) for fish gear handling and net storage after fishing.

The trawl winch is installed in the winchroom in the forward part of the superstructure and below the wheelhouse. The number of fishline openings in the front bulkhead is depending on the winch type, mostly 6-8 drums. The winches are electric driven and pneumatic controlled, in the wheelhouse as well as locally on deck. However onboard the 220 kW (300 hp) beamers the winch is usually hydraulic driven.

The wheelhouse is characteristic for this type of fishing vessel: spacious with good visibility on the working deck and horizon but less aftward owing to the skippers cabin on this deck. The engines, generators and trawlwinch are bridge-controlled in front- and side panels, between which the skipper has a central position.
Besides modern navigational aids and communication equipment, sophisticated electronic fish finding systems are installed, mostly double.

In the engine room a main propulsion diesel engine (medium or high speed) is installed which drives, coupled to a reverse and reduction gear (3.5 - 9 : 1), a fixed pitch nozzled propeller (3-4 blades). These fixed pitch propellers are designed for the fishing condition, maximum pull at a 4-7 knots speed.
Only incidentally a 4 blade controllable pitch propeller is installed.
Characteristic for the here concerning fishing method is the continuously varying engine loads, because of fishing weeks of 100 hours with about every two hours hauling.
Upto 600 kW (800 hp) the diesels are electrically started.

The electrical installation of beamtrawlers consists of two ship's mains, a continuous current (110 V/D.C.) and three phase current (220-380 V/A.C.) with a 24 V/D.C. emergency installation.
The D.C.-main supplies electricity to the fishwinch and bowthruster, while the A.C.-main is indispensable for the auxiliarily machineries of the propulsion plant and for the ship's safety.
Both mains are generated independently, either diesel engine driven (high speed) and(partly)/or diesel main engine driven (power take offs).

Depending on the choice of the fuel operation (gas oils - 180 cSt), a more or less sophisticated oil treatment equipment is necessary. However the decreasing and varying quality of the presentday fuels stress the need for separators, both for gas- and marine diesel oils.

A fully automatic cool- and crush ice unit is installed in the fish hold, resp. for maintaining a fishhold temperature of appr. $0^{o}C$ and making crush ice or flake ice for storing the flatfish in the fish boxes.

For heating the accommodation a boiler is installed in the engine room with sometimes also a heat exchanger connected to the main engine cooling water system, while a hydrophore is supplying fresh water.

The beamers are designed and built according the Rules and Regulations of the Dutch Shipping Inspectorate for Seagoing Cutters ("Voorschriften Vissersvaartuigen 1970").