

Measurements of Meshes of Trawl Nets

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To adopt a minimum size of mesh for fishing nets is considered an efficient method of conserving the fishery resources. Regulations prescribe therefore certain minimum sizes of mesh for the North Sea and Northwest Atlantic, which have to be observed by the contracting parties. As the mesh-size can be checked by different methods with deviating results, rules for measuring the meshes were issued. These shall be discussed here in detail.

4 Methods for determining the size of mesh are generally used in fisheries:

- 1) stating the circumference of the mesh-gauge used for knitting the net. That method is particularly preferred by net manufacturers;
- 2) measuring the distance from knot center to knot center, either with knots in juxtaposition or with opposite, diagonally stretched meshes. That method is mainly used in practical fishing of our area;
- 3) fixing the circumference of plate-gauge or peg which can be inserted into a mesh, and
- 4) counting the number of knots of diagonally stretched meshes of a prescribed length.

The International Commission for the Northwest Atlantic Fisheries as well as the London Convention of 1946 have decided to determine the mesh-size by inserting a plate-gauge. Only in that way the interior circumference of the mesh can be determined, which is alone essential. It is known, that the interior circumference of the meshes decreases, the thicker the twine is, because the circumference of the knot increases, although the distance from the knot center to knot center remains the same. The same refers to the use of double net twine.

In the Convention signed at London on 5th of April, 1946, for the regulation of meshes of fishing nets etc. it is said:

"The minimum size of mesh for nets... shall be such that when the mesh is stretched diagonally lengthwise of the net a flat gauge 110 mm (or 80 mm) broad and 2 mm thick shall pass through it easily when the net is wet."

This description of measuring the meshes is not quite clear, as the term "easily" can be interpreted in various ways. Generally speaking, the procedure means linear measurement of a twine. There does not exist any standard prescription for a linear measurement of textile twines or cords all over the world, which

does not require the tested material to be stretched. Usually the weight of 100 m of twine is taken as a basis, sometimes substantially more. The exactness of the measuring standard is then fixed for small sections for 1 mm. This refers also to net-meshes.

With nets made of thin twines the meshes can be stretched diagonally without difficulties, where as it is not possible to do it without a certain force with all types of trawl nets made of Manila or Sisal.

The Northwest Atlantic Convention provides therefore that the size of mesh shall be determined as follows: "measured with a flat, wedge-shaped gauge having a taper of 2 cm in 8 cm and a thickness of $\frac{3}{32}$ " (= 2,3 mm) inserted into the mesh under a pressure of not less than 10 lbs (= 4,5 kg) and not more than 15 lbs (= 6,8 kg)."

Boerema submitted to the recent ICES meeting at Paris a discussion dealing with the problem of the measuring pressure required for the determination of the mesh-size. It is stated there:

"The practice usually is that the gauge is pushed into the meshes until a distinct resistance is felt. What is judged to be a distinct resistance depends to a certain degree on the observer. We found that in our mesh size estimations the force put on the gauge was about 4 kg."

It will be difficult to adopt a standard measuring pressure that can be used for nets manufactured of all types of material. It would therefore be necessary to establish a conventional method. It might also be expected that test methods, in particular, if many measurements have to be carried out, would not be too difficult. Also from that point of view a measuring pressure of 4 kg appears to be acceptable.

For our own measurements a "pressure gauge" was used, which permitted a measurement with several degrees of pressure, i.e. 2, 4, 6, and 8 kg (drawing No. 1). The differences in the mesh sizes resulting from the various pressures of 2 to 8 kg can be fairly considerable.

Drawing No. 2 shows the mesh sizes resulting from a pressure of 2 to 8 kg with three various wet nets made of Manila net twines (4/600, 3/900 and 3/1600), not yet used in fisheries, which had been made of single (---) or double twines (-----) by means of knitting woods of various circumferences (65, 85, 105, and 125).

Here, too, the meshes made of double twine are smaller than those made of single twine of the same size. Moreover, the meshes knitted of double twine are smaller, when thicker twines are used than those made of thinner twines, the knots of which are tight immediately. Thus the following sizes of mesh were found with Manila 4/600 knitted with a wood of 65 mm:

Pressure	2	4	6	8 kg
single	82	86	88	92 mm
double	50	55	59	63 mm

The applied pressure must affect the measurement of the size of mesh, depending on the degree of tension of the net material.

Sisal or Manila net twines have a small tension. Perlon, however, has a relatively great tension. That can be seen from a comparison between a Manila cord 4/600 with a tensile strength of 150 kg and a braided Perlon cord of 117 kg at a measuring pressure of 4 kg (drawing No. 3). It is not possible to compare any net twines, but only those which can be exchanged for fishing purposes.

Circumference of knitting wood	Manila 4/600		Perlon cord	
	single	double	single	double
65	64	34	72	69
85	86	55	91	77
105	107	73	97	94
125	128	90	114	109

Single-knitted Manila produces certainly a mesh, the size of which corresponds to the circumference of the knitting wood, but that does not occur with double-knitting, which is under discussion here (double lines in Drawing No. 3). With Perlon the differences between the circumference of the knitting wood and the resulting meshes are not so great, but the meshes of 80/110 mm in size, which are important to us, are also smaller than they should be according to the circumference of the knitting wood.

These deviating results depend on the varying tension of the material. Drawing No. 4 gives a so-called pressure-tension curve for several net twines. In my opinion, that explains the varying selective effect of meshes of apparently the same size, even with the same type of fishing gear, but manufactured of different material. Therefore, nothing else can be done, but to investigate by means of comparative fishing not only the selective effect of the several fishing gear, but also to examine the several net material and the "selectivity equivalent". It is not possible to distinguish "heavy" and "light trawls" by the strongness of the material. It is the material itself that makes the difference.

Another point which has to be considered in this connexion is, at which spots the measurement should be carried out. It is a well-known fact, that the net-meshes shrink in water. When the net is then to be used, the originally loose knots draw tight and the meshes get larger again. But that does not occur uniformly in the cod-end. Apart from the fact that this development is influenced by the taken quantity, it is even varying within the cod-end. John R. Clark of the Fish and Wildlife Service has carried out measurements in 4 sections of a cod-end (1952). Converted from inches into millimeters the following figures were obtained.

	End of Cod-end		Beginning of cod-end		Average
	1	2	3	4	
new, dry	130	130	133	130	130 mm
after 3 hauls	108	105	98	98	102
" 16 "	113	108	102	97	105
" 25 "	113	108	100	100	105
" 28 "	114	106	100	98	105

These figures show, that the first part of the cod-end stretches lesser than the end. Our own measurements were made in the following way: With a double knitted Manila cod-end lateral series of 10 to 20 meshes (i.e. accross the netting of the cod-end) were measured, always interrupted by a series of 5 meshes, and then the average figure was computed. The following drawings show the results in mm:

- a) with a new, dry and unused cod-end, knitted with a knitting wood of 110 mm, double Manila (Drawing No. 5)
- b) after the first haul (drawing No. 6)
- c) after the fifth haul (drawing No. 7) and
- d) after the tenth haul (Drawing No. 8).

Thus the meshes shrink in a considerable varying degree. The largest meshes were at the edge, where the cod-end is attached to the tunnel, not at first at the end. That was due to the fact that the short-termed trial fishing produced only small catches. Ten hauls produced only a total output of approximately 100 baskets. Therefore a cod-end of the same design and made of the same material was measured after having taken about 3.000 baskets (drawing No. 9). This measurement shows 3 maxima:

The first again near the edge towards the tunnel, the second at the lifting attachment. Here a protective cloth was attached to the net, the third maximum is in the terminal meshes.

Here too, like with Clark's measurements, the original mesh size was in no case attained. It is not possible to say, all meshes are of equal size, because the net is machine-made, for the variations develop during fishing.

Any protective cloth prevents the extension of the meshes, although above the upper edge of the seam a maximum stretch of the meshes may occur. It is sometimes necessary to have such a protective cloth even on the upperside of the cod-end near the lifting attachment. The regulations of the Northwest Atlantic Fisheries deal very exactly with that question. This netting shall not have a mesh size less than that of the cod-end. The mesh size measured wet after use shall be the average of the measurements of twenty consecutive meshes in a series across the netting.

"This netting must be fastened to the cod-end only along the forward and lateral edges of the netting and at no other place in it and shall not exceed 16 meshes in length counted parallel to the long axis of the cod-end.

This width of this netting shall be at least one and a half times the width of the area of the cod-end which is covered, such widths to be measured at right angles to the long axis of the cod-end."

The differences in the several parts of the cod-end, however, indicate also, that it is essential, where the meshes are measured. In the Northwest Atlantic Convention the following is required:

"In the cod-end of the net, the average of the measurements of any fifty consecutive meshes running parallel to the long axis of the cod-end, beginning at the after end of the cod-end, and being at least ten meshes from the lacing, or, if the cod-end contains less than fifty meshes, the average of the measurements of the meshes in any series of consecutive meshes running the full length of the cod-end, parallel to the long axis of the cod-end and at least ten meshes from the lacings."

In the anterior net it shall be a longitudinal row of 20 consecutive meshes. The measurement is thereby distinctly explained. Therefore, I think it necessary to establish a clearly defined area for the measurement, because the investigations made by Graham, Beverton, Margetts and Gulland (1954) showed, that the cod-end meshes altered by 7 mm only changed the average size of plaice by not more than 1,5 cm.

For Germany I have proposed to measure 5 rows of 10 meshes with a pressure-gauge of 4 kg at the end of the net parallel to the long axis of the cod-end.

Finally, it is also pointed to the necessity of studying the changes of the net, beginning with the new dry net. For the net-manufacturer the circumference of his knitting wood is the mesh-gauge. But he must be informed, in which way the sizes of mesh can be attained, which meet the requirement of the Fisheries Convention. Here too, it can be pointed to the works of the International Commission for the Northwest Atlantic Fisheries. H. W. Graham (1953) reports, that the US Government issued certifications for nets having a certain mesh size "between knot centers" and made of a certain material, indicating that these nets had the correct mesh size, "at the half life of the average cod-end". That would be useful to the net manufacturers and also in the interest of the Convention.

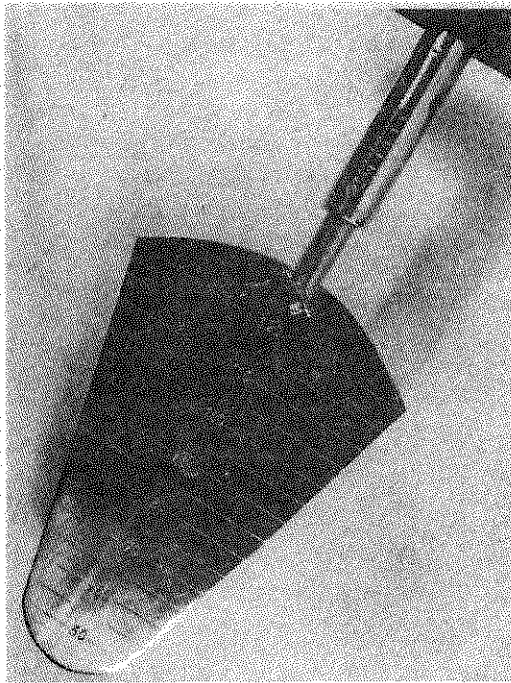
Summary

Summarizing the following can be said:

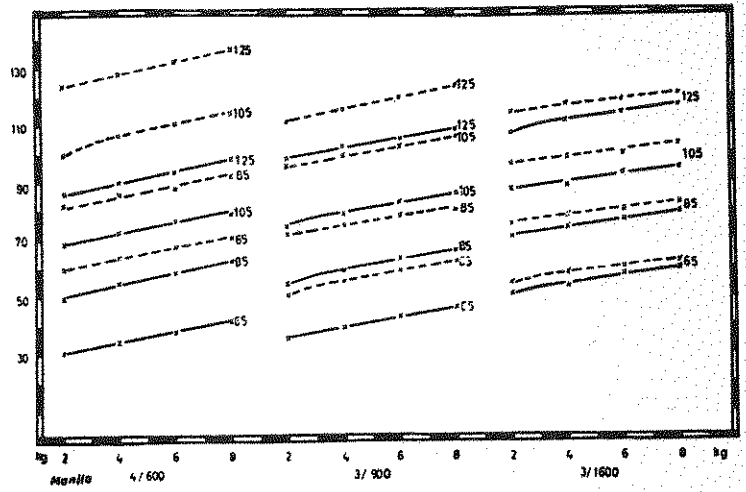
- 1) A comparative measurement of meshes can only be carried out by keeping to a certain measuring pressure. With reference to previous suggestions it is proposed to adopt a pressure of 4 kg.
- 2) The regulation of the size of mesh will only be successful if the net material is simultaneously considered. The selectivity of meshes of the same size does not only differ in fishing gear of various type but even in those of the same design, but made of different material. The "selectivity equivalent" has therefore to be found for all net twines.
- 3) The regulations for the mesh sizes should also mention a description how to attach a protective cloth to the superior side of the cod-end near the lifting attachment, as it cannot be defended from the commercial point of view, that any covering of the superior part of the cod-end would be prohibited.
- 4) It should be defined more precisely, in which way the measurement of meshes would have to be carried out, considering the varying extension of meshes of the cod-end, as the meshes in the cod-end stretch in a varying degree depending on the fishing activity. It is suggested to act in a similar way like the Northwest Atlantic Convention.

Literature

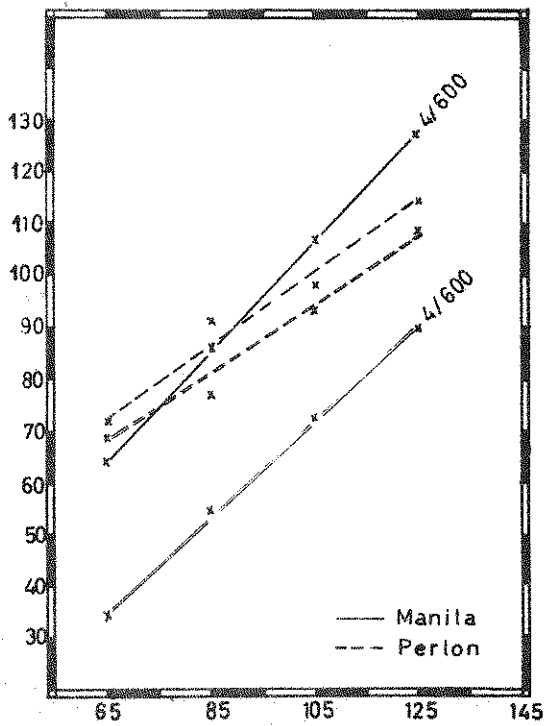
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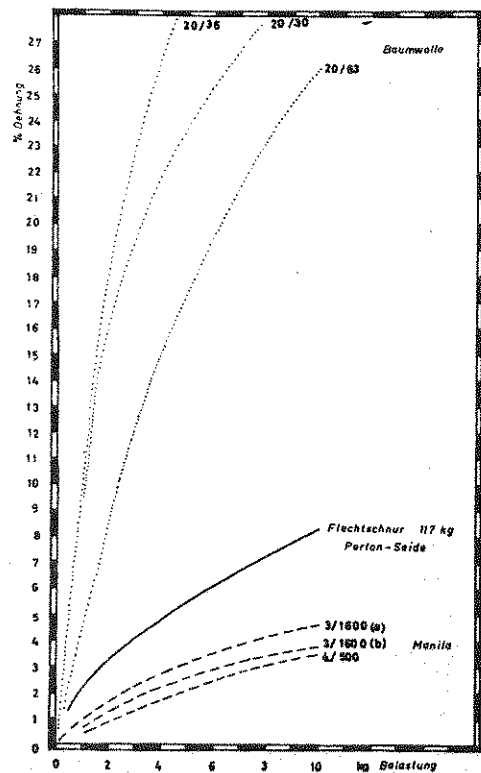
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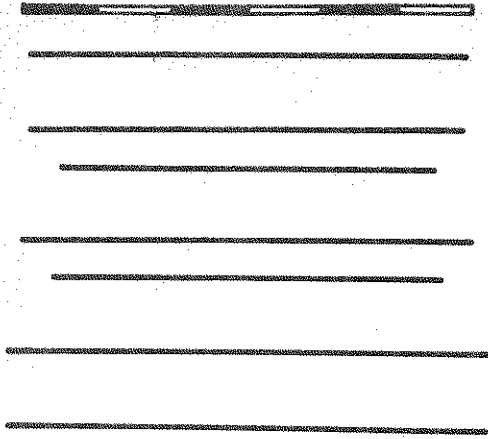


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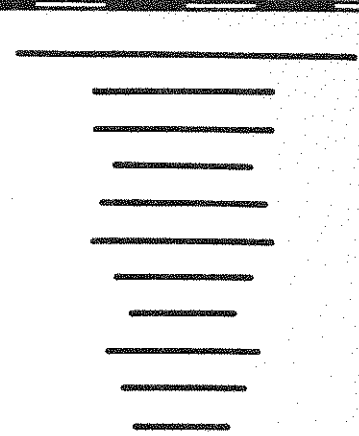
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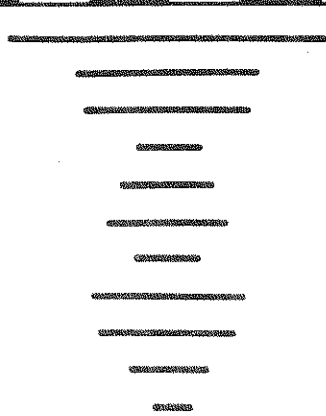
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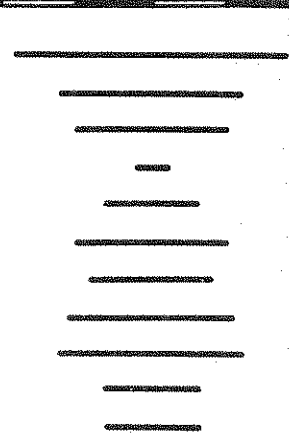
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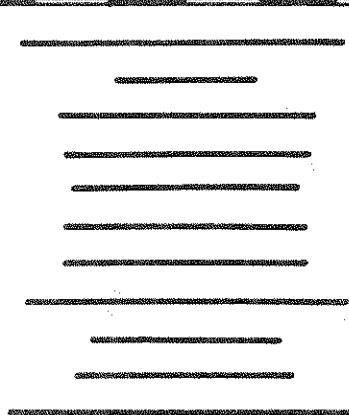
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