SUPPLY TO SHIPS OF CHARTS, NAUTICAL DOCUMENTS AND INSTRUMENTS.

(continuation)

In continuation of the article published on this subject in *Hydrographic Review*, Vol. VII, N° 1, of May 1930 (pages 214 to 237) in which extracts are quoted from the regulations in force for the supply of charts, nautical documents and instruments to the vessels of Great Britain, Denmark, Italy and France, the regulations on the subject in *Germany, Spain, Norway,* the *Netherlands, Portugal* and *Sweden* are now given.

Information with regard to other countries will be published in the *Hydrographic Review* as soon as it is received by the International Hydrographic Bureau.

GERMANY.

The regulations relating to the issue and supply of documents and instruments to German ships are contained in the pamphlets published by the *Seeberufsgenossenschaft* (Seafarers Professional Association) of Hamburg entitled: *Unfallverhütungsvorschriften der Seeberufsgenossenschaft (Regulations for the prevention of Accidents, published by the Seafarers Professional Association).* One of these pamphlets contains the regulations for small sailing vessels navigating along the coasts; a second contains the rules for sailing vessels outside the zone of coastal navigation and a third contains the regulations for the use of steam and motor vessels.

Passages extracted from these pamphlets specially pertaining to the supplies to ships are given below.

The following organizations are charged with the duty of the elaboration and enforcement of these regulations in German territory:

a) The Seafarers Association draws up the regulations and sees that they are properly carried out.

b) The National Insurance Service (Reichsversicherungsamt) examines and approves the regulations.

c) The Reichsversicherungsamt is placed under the jurisdiction of the Ministry of Labour which is the final authority in the matter.

I.

EXTRACTS FROM REGULATIONS FOR THE PREVENTION OF ACCIDENTS, ISSUED BY THE SEAFARERS PROFESSIONAL ASSOCIATION FOR THE USE OF SMALL SAILING VESSELS OPERATING IN COASTAL WATERS AND IN SHALLOW WATERS. (1925 EDITION)

In consequence of a decision of the Administrative Council of the Association, the provisions given below shall be effective from 1st. June, 1925 at the latest:

IV. LIGHTS AND SIGNALS.

§ 27.

The pyrotechnic pieces intended for use as distress signals and pilot signals must be kept in metal boxes with suitable inscription, located in an easily accessible place and in such a manner that even when the vessel is working heavily the pyrotechnic pieces cannot rub against each other nor against the container.

IX. INVENTORY.

§ 50.

Charts and sailing directions, appropriate for the voyage, shall be on board every vessel except those restricted to navigation in shallow waters.

§ 52.

Every vessel must have on board the following articles:-

DESIGNATION OF ARTICLE.	*Coastal Navigation*	*Navigation in shallow waters.*	*Navigation in the Haffs, Bodden and Föhrden.*
Steering compass	1	1	1
Spare-compass (in a case and ready for installation) (1).	1	–	–
Barometer (2)	1	–	–
Sounding Stave	1	1	1
Hand-lead, weight 3-5 kg., lead line 35 to 45 m.	1	1	–
Log and 2 Sand-glasses	1	–	–
Telescope or night binoculars	1	1	1
Spare set of tested light screens for running lights	1	–	–

(1) *Not necessary for lighters.*
(2) *Not necessary for lighters.*

§ 53.

Inspection of the compasses and their compensation is obligatory at least once in three years; in cases where the vessel is laid up for more than three months, or when any major alterations or work of overhaul has been undertaken, a check of the compensation becomes necessary.

On the occasion of each examination and compensation of the compasses a certificate will be issued which must be retained on board.

§ 56.

All of the articles enumerated in the inventory as well as the equipment (such as lanterns and nautical instruments), must be kept constantly in good order and mounted and secured in accordance with the regulations.

II.

EXTRACTS FROM
RULES FOR THE PREVENTION OF ACCIDENTS ISSUED BY THE SEAFARERS PROFESSIONAL ASSOCIATION FOR THE USE OF SAILING VESSELS NAVIGATING OUTSIDE THE LIMITS OF COASTAL WATERS. (1925 EDITION).

III. LIFE BOATS AND LIFE SAVING APPARATUS.

§ 23.

Further, in the life-boats prescribed (§ 17, N^os^ 1 and 2) there shall be, among other things:
One boat compass;
One lantern capable of burning for at least 8 hours.
In the boats described under N° 3 of § 17 there shall be, besides the prescribed articles of equipment, the following:-
One boat compass.

IX. INVENTORY.

§ 71.

The charts and sailing directions appropriate for the voyage shall be on board every vessel.

§ 75.

Every vessel shall carry on board the following articles:-

DESCRIPTION OF ARTICLE.	*Deep Sea Navigation*	*General Coasting*	*Fishing Luggers*
Steering-compass	1	1 (1)	1
Standard compass, pelorus with device for taking bearings, for iron and steel vessels	1	–	–
Spare compass (in a case, ready for installation) (2)	1	1	1
Spare compass card	1	1	–
Chronometer	1	1 (3)	–
Sextant	1	1	–
Octant or sextant (4)	1	1	1
Barometer (5)	1	1	1
Thermometer (6)	1	1	–
Hand-lead, weight 3-5 kg., line 35 to 45 m.	1	1	1
Lead for medium depths, weight 8-10 kg., line 60 to 100 m. (9)	1	1	1
Deep-sea lead, weight 15-25 kg., line 200-230 m. (7-9)	1	1	–
Log and 2 Sand-glasses or patent log	1	1	1
Telescope or night binoculars	2	2	1
Spare set of tested navigational lights (8)	1	–	–
Spare set of tested light-screens	–	1	1

(1) *With bearing-plate.*
(2) *Not necessary for lighters navigating in the North part of the Baltic.*
(3) *Necessary only for vessels navigating beyond latitude* 61° *North or outside the English Channel.*
(4) (5) (6) (7) *Not necessary for lighters navigating in the North part of the Baltic.*
(8) *A pair of night binoculars will suffice for lighters navigating in the northern part of the Baltic.*
(9) *The lead-line for medium depths or the deep-sea lead may be replaced by an acoustic Sounding Device* (FALLOT *or* ECHOLOT).

§ 79.

Regulations as to compasses.

I. *Inspection and Compensation of Compasses.*

1. Before being used compasses must be inspected and found serviceable for the purpose for which they are intended. On board steel vessels or vessels considered as such, compasses shall be properly compensated before the vessel is placed in commission. The Seewarte and its branch offices, the schools of navigation and other establishments and persons under the authority of the Administrating Council of the Seafarers Association possess the requisite authority to examine and compensate compasses.

The examination of compasses or vessels built in foreign countries must be requested on their arrival in a German port.

2. Regular inspection of compasses and their compensation shall take place at least once every three years.

Inspections outside the regular course shall be made when, as a result of cleaning and overhaul or re-conditioning, there is reason to believe that some change has been made in the data given on the official certificate or by the last inspection.

Special inspections for compensation should be made after all alterations, major repairs and overhaul or when, after being laid up for a period of more than three months, the vessel is again put in service, or finally, when service at sea has shown some improvement in the compensation of the compass to be necessary. In this last case, the captain, provided he holds a certificate as master mariner, is authorized to carry out the compensation of the compass of his vessel. Every change in the compensation of the compass must be noted in the ship's log, and a certificate must be drawn up as described below.

Every special inspection of the compasses or special compensation begins a new period of three years for the regular inspection or compensation of the compass. This does not apply to compensations of the compass made by the captain of the ship.

3. After each inspection or compensation of the compasses a certificate shall be drawn up in the prescribed form and this certificate must be retained on board.

II. *The Compass Mounting.*

1. The standard compass, — or, in the case of extensive coastal navigation, the steering compass (where there is only one of this type on board) — shall be mounted on the centre-line of the vessel, on a solid base in some locality as free from vibrations as possible. It should be easily and safety accessible to the man on watch. The location and height of the binnacle should be such that there is a free range of visibility for taking bearings. If visibility from the compass is not sufficient bearing-plates shall be installed, wherever possible, in positions easily accessible to the watch officer and where visibility is clear.

2. For steel vessels and for those vessels in which iron enters into the construction — for example, vessels of reinforced concrete — the following are the regulations in force (1):

In this connection the term steel shall be taken to include all kinds of iron or steel which are susceptible to strong magnetization — but not bars of nickel or chrome steel which are not readily magnetized.

The standard compass — or the steering compass, where there is only one of this type on board — shall be mounted so that it is sheltered from the influence of large individual masses of steel, in such a manner that only the vessel as a whole acts upon the compass as a magnetic body. The extremities of the vessel are to be avoided as well as the forward and after edges of metallic superstructures. There shall be no masses of iron in the vicinity of the compass distributed unsymmetrically with respect to the median plane of the ship. In vessels of more than 8500 cubic metres or of 3000 tons gross (the figures are considered as approximate only, since in making up estimates or in building new ships the tonnage is not exactly known) the distance between the standard compass and the funnels, the masts of the cargo derricks and the derrick

(1) *These regulations apply only to vessels laid down after 1st. January,* 1925.

booms, and the steering and the capstan engines, should be at least 4 metres; movable iron masses, such as the boats, davits, ventilator cowls of large size, etc., at least 4 metres; vertical iron bulkheads and stanchions, masts, deck hatches, ventilators, etc., at least 3 metres.

These minimum distances, for vessels of 8500 to 2900 cubic metres (or from 3000 to 1000 gross R. T.) are reduced in proportion to the dimensions of the vessel and for vessels of 2900 cubic metres capacity to 50 % of the value given. The presence within a periphery of 1.50 m. around the compass of all iron not essential to its compensation should be avoided. The stanchions of the guard rails and hatches must if necessary have their continuity broken with non-magnetic material or else should be entirely constructed of such material. In vessels of less than 2900 cubic metres (or 1000 tons capacity) the compass shall be at least 1 metre from the nearest mass of iron. The distance from movable iron masses, such as hatch-covers, doors, steering-wheel, and ventilator cowls, should be such that the compass will not be subjected to their influence.

In the interests of safety of navigation it is recommended that the minimum distances prescribed above should be exceeded so far as the arrangement and the type of construction of the vessel permits. Whenever, in particular cases, special difficulties are encountered in fulfilling the necessary requirements, the authorization of the Administrative Council of the Seafarers Association must be obtained before they may be set aside.

3. In mounting the steering compass, as well as the other compasses, the above regulations shall be complied with as far as practicable. The distances between the two compasses, for all vessels laid down after 1st. January, 1925, must be sufficiently great so that the card and compensating devices of one will be at least 1.5 metres from the card and compensating devices of the other. Whenever, in small vessels, it is not possible to avoid placing the steering compass in an iron steering house, the compass shall be installed as far as possible from the walls in the middle of the compartment surrounded by iron.

4. For all compasses provision shall be made for arrangements necessary to the proper and safe securing of all compensating devices.

5. All of the mains for the electric lighting and power circuits which are within 5 metres of the card of the compass must have a bi-polar coupling so that the cables carrying the out going and the return current are run close against each other.

6. When mounting the compasses in a new vessel it is recommended that the plans of the vessel be first submitted, for a reasoned opinion, to the competent authorities, in order to make certain that the locations which have been chosen are the best possible from the magnetic point of view under existing conditions.

7. So far as local conditions permit, after launching, the vessel should be placed, during fitting out, heading in the opposite direction to that in which she lay during construction. It is advantageous also for vessels which have been lying for some time in port heading in one and the same direction to be turned so as to head in the opposite direction before putting to sea.

§ 80.

New sextants and octants, the acquisition of which is contemplated to replace the instruments in use on board, shall first be examined and pronounced in good order by the Seewarte, its branch offices or some other establishment or person whose competence in the matter is recognized by the Seafarers Association. The certificate issued on the occasion of this inspection must be retained on board. It is the duty of every captain and officer to make certain that these instruments are kept in good condition and that, for this purpose, they should be frequently examined in accordance with the methods recommended in the schools of navigation. If, in the course of these examinations, it is found that the instrument shows irregularities which the possessor of the instrument is incapable of correcting he shall take care that the faults are eliminated in the prescribed manner.

§ 81.

New barometers to replace that or those in use, the acquisition of which is intended, shall first be examined as to their serviceability either by the Seewarte, its branch offices or by some

establishment or person recognised as competent by the Seafarers Association. This inspection shall be repeated every three years. The certificate issued on the occasion of these inspections must be retained on board. If the captain is not in a position to have this inspection undertaken, because at the end of the three year period he is unable to put into a port where a competent person or establishment is available to make this inspection, the formality should be completed at the first port of call where such inspection is possible. If the inspection reveals errors in the barometer, care should be taken to remove them and a note to this effect shall be entered in the ship's log.

§ 82.

New chronometers, which are about to be acquired, must be first inspected by the Seewarte and the certificate of inspection issued on this occasion is to be retained on board. At least every three years and also after every serious accident, the chronometers shall be cleaned by a competent chronometer expert recognised by the Administrative Council of the Seafarers Association, and he shall test the error and the rate; for this the following are qualified:- the Seewarte and its branch offices and other persons and establishments recognized by the Administrative Council of the Seafarers Association. The certificate furnished on this occasion is to be retained on board.

§ 83.

It shall be the duty of every captain to obtain regularly the Notices to Mariners, to keep them on board, and to take care that the charts are kept strictly up-to-date by means of them. This provision does not apply to fishing vessels.

III.

EXTRACTS FROM RULES FOR THE PREVENTION OF ACCIDENTS, ISSUED BY THE SEAFARERS ASSOCIATION FOR THE USE OF STEAM AND MOTOR VESSELS.

(1925 Edition).

III. Boats and live-saving Equipment.

§ 26.

In the standard life-boats (§ 21, N° 1 and 2) there shall be among and in addition to the other equipment:-

One boat compass.

IV. Lights and Signals.

§ 39.

In every vessel, the signal apparatus necessary for the production of the sound signal required by the Rules of the Road shall be complete and in proper condition. The steam whistle or siren shall be so constructed that under service conditions it shall sound clearly as soon as operated, and for this purpose care shall be taken that the steam leads are so arranged that condensed steam shall not accumulate in the pipes. The whistle or the siren as well as the ship's bell shall be placed at such height that the sound may radiate freely in all directions.

§ 40.

Every vessel shall carry on board a commercial ensign, the international code of signals with the various supplements pertaining thereto, which have been issued, together with the nec-

cessary signal flags and a Morse lantern. Vessels up to 700 cubic metres gross capacity, except fishing vessels, are not required to carry on board the international code of signals, the flags and the Morse lantern when navigating within the limits of the Baltic.

§ 41.

Vessels which regularly carry on board more than 30 persons or having a gross registered capacity of more than 2000 tons, shall be equipped with a radio-telegraphic installation approved by the competent authority. The installation shall be kept ready for service at all times while the vessel is at sea and the personnel qualified to operate the installation shall be on board. For regular voyages in which the vessel is never more than 150 nautical miles from the nearest coast, the radio-telegraphic installation is not necessary.

§ 42.

The use of signals of distress is governed by the provisions contained in the Rules of the Road.

Every vessel shall have on board the appliances necessary for making signals of distress and, outside of the limits of coastal navigation, shall carry at least 12 rockets or a corresponding number of Very-light cartridges as well as 12 gun charges or an equivalent apparatus with adequate ammunition for making explosive signals.

§ 43.

The use of pilot signals is prescribed by the Rules of the Road in the section pertaining to pilot signals for vessels at sea and in coastal waters. Every vessel shall carry on board the appliances necessary for the display of pilot signals and, outside the zone of coastal navigation, at least 12 blue lights or 12 Bengal flares.

§ 44.

The pyrotechnic pieces intended for distress signals and for pilot signals shall be kept in metal boxes, suitably labelled, in an easily accessible place, and secured in such a manner that even when the vessel labours heavily the pieces shall not rub against each other nor against the sides of the box.

INVENTORY.

§ 84.

Every vessel, except those engaged in navigation in shallow waters, shall carry the maritime charts and Sailing Directions appropriate for her voyage.

§ 88.

Every vessel shall have the following articles on board:-

DESCRIPTION OF ARTICLES.	Long Sea voyages.	VOYAGES		Shallow waters.	Steam Fishing Vessels not navigating to Nd of Lat. 61°.	Steam tugs on long voyage within the Baltic North Sea or English Channel.
		General Coasting	Short Coasting			
Steering or Gyroscopic Compass	1	1	1	1	1 (1)	1
Standard Compass with device for taking bearings (2)	1	1	–	–	–	1
Spare steering Compass (in case ready for mounting)	1	1	1	–	1	–
Spare compass card (3)	2	2	–	–	1	1
Chronometer	1	1 (4)	–	–	–	–
Sextant	1	–	–	–	–	–
Octant (or sextant)	1	1	–	–	–	–
Barometer	1	1	1	–	–	–
Thermometer	2	1	–	–	–	–
Hand-lead, 3-5 kg., line 35-45 m.	2	2	1	1 (5)	1	2
(6) Sounding lead for medium depths, 8-10 kg., 60-100 m.	1	1	1	1	–	1
(6) Deep-sea lead, 15-25 kg., line 200-230 m.	1	1	–	–	1 (7)	–
Log with line	2	2	1	–	1	1
Sand glasses	2	2	2	–	2	2
Telescope or night binoculars	2	2	1	1	1	2
Spare set of running lights (tested)	1	–	–	–	–	–
Spare set of running-light glasses (tested)	–	1	1	–	1	1

(1) *With arrangement for taking bearings.*

(2) *In cases where the standard compass is not in an open position there shall be an azimuth compass on board.*

(3) *Not necessary with liquid compass.*

(4) *Does not apply except to vessels navigating northward of latitude* 61° N, *and outside of the Channel.*

(5) *Or a marked sounding spar.*

(6) *In the place of the lead for medium and great depths it is allowable to use an acoustic sounding device for measuring the depth by the emission of audible sounds,* (e. g. *the "dropping lead" or* ECHOLOT). *The cartridges required or the other articles pertaining to the device shall be protected from theft by the captain or by an officer of the vessel designated for this duty. The place in which they are stored shall be at a sufficient distance from the stoke-holds or heating installations : steam pipes, etc., in order that they may be safeguarded from dangerous heating. The use of the cartridges is permitted under the supervision of an officer only.*

(7) *A line of* 150 *metres will suffice.*

§ 92.

With regard to compasses the following regulations are in force:-

I. *Inspection and compensation of compasses.*

II. *Mounting of compasses.*

(Text similar to § 79 of the Regulations given above for sailing vessels).

§ 93.

SEXTANTS AND OCTANTS.

(Text similar to § 80 of the Regulations given above for sailing vessels).

§ 94.

BAROMETERS.

(Text similar to that in § 81 of the Regulations for sailing vessels).

§ 95.

CHRONOMETERS.

(Text similar to that in § 82 of the Regulations for sailing vessels).

§ 96.

Outside of the zone of coastal navigation, it is the duty of every captain to obtain regularly the "Notices to Mariners", to keep them on board and to see that the charts in his possession are kept strictly up-to-date in accordance with them.

XIII. SPECIAL TYPES OF VESSELS.

B) *Small motor vessels running short trips within the haffs, bodden and föhrden and in shallow waters.*

§ 128.

Every motor boat shall possess the following equipment:

1 steering compass;
1 boat-hook which may be used as a sounding spar;
1 hand-lead with lead-line;
1 telescope or night binoculars;
1 spare set of accessories for each pump.

XV. PROCEDURE FOR CARRYING OUT THE REGULATIONS.

§ 156.

Every ship-owner must keep his vessel in readiness for the formalities of inspection by the organizations authorized by the Association.

By virtue of § 1217, together with § 889 on the Rules issued by the National Insurance Service, 19th. July, 1911, the permanent members of the National Insurance Service shall also be allowed access to his vessels, in order that they may assure themselves that the regulations for the prevention of accident have been complied with.

§ 157.

Every ship-owner must submit entirely to the requirements resulting from the application of the above prescriptions which are issued by the Administrative Council of the Association.

§ 158.

Infringements by ship-owners of the prescriptions may entail the imposition of a fine by the Administrative Council of the Association and this fine may reach the legal maximum provided for each case.

By virtue of §§ 1202 & 1208 of the State Insurance Regulations, the Captain is jointly responsible, with the Owner, for the proper observance of the prescriptions issued. Any omission to do so may be dealt with by any Maritime Tribunal which may ascertain it, which shall impose a fine which may reach the legal maximum provided for each case.

SPAIN.

The information regarding the regulations as to the bases for the supply of documents and nautical instruments to vessels of the Spanish Merchant Marine is contained in the appendix to the *Rol Reglementario de Despacho y Dotacion*; by Royal Ordinance of 23rd. November, 1923, an official copy of these regulations is delivered to all vessels.

A list taken from this document, of the nautical material which all merchant vessels are required to have on board in conformity with the Royal Decree of 12th. February, 1914, is given below:-

1.) Every sea-going vessel and every vessel engaged in general coasting voyages shall be equipped with the following instruments:-

One chronometer, one spare chronometer or chronograph (the latter is not obligatory for vessels equipped with W. T.); one barometer; one thermometer; one standard compass (installed in such a manner that it is little influenced by the iron of the ship) fitted with bearing plate; one steering compass, with a spare card; one large sounding-lead of 14 kg. with a line of 200 metres and its reel; two hand-leads of 3 kg. with lead-lines of 50 metres; two logs; three sand-glasses; one telescope; one pair of marine binoculars; one deck watch; the nautical charts, both general and local of recent issue, covering the seas and the coasts on which the ship is to sail; the Sailing Directions pertaining to the seas in which the vessel is to navigate; two compasses; one ruler; two protractors; one sextant or octant with astronomic telescope; the curve or table of deviation for the standard compass; one megaphone; one fog-horn or equivalent apparatus if a sailing vessel; one bell of not less than 20 kg. weight.

2.) Vessels engaged in coastal navigation shall be equipped with the following instruments:

One deck watch; one steering compass; — if the vessel displaces more than 300 tons she shall also be equipped with an azimuth compass unless the steering compass is so located, and is equipped with the necessary devices, that bearings may be taken with it — one spare card for the compass in question; two hand-leads of 3 kg. with 50 metres of lead-line; one log; one sand-glass; the general and local nautical charts of recent issue covering the seas and coasts for the voyage of the vessel; two compasses; one ruler; two protractors; one fog-horn, or other equivalent apparatus (if the ship is a sailing vessel); one bell, which, for vessels of more than 30 tons, must weigh at least 20 kg.

The compasses, by virtue of Royal Ordinance of 4th. December, 1920, shall be compensated every four years, and no vessel shall be authorized to sail until after compliance with this regulation.

The documents required to be on board the vessels of the Merchant Marine include the following:-

The Light Lists and charts of the seas in which the vessel is to navigate; the International Code of Signals (vessels engaged in the coasting trade are exempted from having the International Code of Signals).

The representatives of the maritime authorities of the Inspection Commission shall inspect the nautical instruments and verify their condition and their installation. It shall condemn those which are manifestly unserviceable.

It shall examine also the table or the curve of deviations, which shall not be more than four years old, and should any deviation exceed 5°, a new compensation shall be required within one month. If this delay be exceeded without the new compensation having been made by a competent person authorized by the maritime authorities or the Consul on the certificate, the said operation shall be carried out by an officer appointed by the Naval Commandant, to whom a fee shall be paid and the fact shall be entered on the commission of the captain. The date and place for compensating the compass and the preparation of the table of deviation shall be selected by the captain or by the ship-owner so that never more than four years shall elapse between each operation.

Further, the same representative shall be supplied with the last absolute error and rate of the chronometer and the date showing when these were obtained. The azimuth compass may be replaced by a pelorus or by bearing plates on appropriate mountings, the checking of which shall be carried out during the visits of inspection.

NORWAY.

I. — The requirements as to the documents and nautical instruments prescribed for captains and imposed on the vessels of the Norwegian Merchant Marine are contained in the *Lov om Sjöfarten av* 20 *Juli* 1893 (Navigation Law of 20th. July 1893) and in the *Lov om Statskontroll med skibbes Sjödyktighet av* 9 *Juni* 1903) (Law governing the State Control of the seaworthiness of Vessels, 9th June, 1903).

Article 26 of the first of these laws is worded as follows :-

(*Translation of the Norwegian text*).

The captain, before starting any voyage, shall assure himself of the seaworthiness of his vessel and shall take care in adequate time that his vessel is duly equipped and provided with a sufficient crew and suitable provisions, water, and pharmaceutical outfit as well with as coal, and essential machinery if the craft is a steam vessel.

He shall also make sure that the signal apparatus and the life-saving equipment conform to the regulations and that the charts and instruments necessary to the voyage are on board.

Further article 51 of the Law of 9th June, 1903 is worded as follows :-

(*Translation of the Norwegian text*).

The vessel shall bear all necessary expenses for charts, Sailing Directions, Light Lists and Lists of Buoys. The captain shall see that these are adequate and that they are up-to-date.

II. — The *Forskrifter om Signalapparater, Instrumenter m. v. for Skibe,* (Regulations governing signal apparatus, instruments, etc, for vessels) of Sept 10th. 1909, prescribe the method of provision and the basis of supply to Norwegian merchant vessels of nautical instruments.

The following are extracts from this law :-

(*Translation from the Norwegian text*).

REGULATIONS PERTAINING TO SIGNAL APPARATUS, INSTRUMENTS, etc., FOR VESSELS (1) *IN CONFORMITY WITH THE NAVIGATION LAW OF* 20th. *JULY,* 1893, *ARTICLE* 26, *AND THE LAW GOVERNING THE STATE CONTROL OF THE SEAWORTHINESS OF VESSELS OF* 9th. *JUNE,* 1903, *ARTICLES* 49 *AND* 50. (APPROVED BY ROYAL DECREE OF 10th. SEPT. 1909).

INSTRUMENTS, etc...

ART. 10.

1. The following navigation equipment shall be on board all vessels required to obtain a certificate of registry:

DESCRIPTION OF OBJECT.	*Outside European Waters.*	*In European Waters.*	*Coastal voyages.*	*On short voyages in Inland Waters.* (*)
Steering compass	1	1	1	1
Standard compass	1 (1)	1 (1)	–	–
Spare steering compass (3)	1	1	1 (2)	–
Pelorus (Bearing plate)	1 (1)	1 (1)	–	–
Sextant or octant (4)	2	2	–	–
Chronometer	1	1 (5)	–	–
Barometer	1	1	1 (2)	–
Thermometer	1 (6)	1	–	–
Hand log (ordinary)	1	1	1	–
Sand-glass	2	2	1	–
Recording log with line	1	1 (7)	–	–
Hand-lead, 40-60 m. line	1	1	1	1
Deep-sea lead, 150-200 m. line	1	1	–	–
Mechanical sounding apparatus (8)	1	1	–	–
Deck watch	2	2	1	1
Binoculars (telescope)	2	2	1	1 (2)

(*) *Also for rivers and inland waters.*

(1) *Does not apply to wooden sailing vessels.*

(2) *Applies only to passenger steamers.*

(3) *Not necessary when the standard compass is fitted with a device for taking bearings.*

(4) *This assumes that as a general rule the captain and the mate have their instruments with them.*

(5) *Does not apply to vessels not holding a passenger certificate which navigate in the North Sea and Baltic, or to Great Britain, Ireland, the Faroe Isles or Iceland.*

(6) *In waters where drift may occur there shall be also a thermometer for taking the temperature of water.*

(7) *Does not apply to sailing vessels.*

(8) *Applies to vessels of* 300 *gross registered tonnage or more only. It is required of the mechanical sounding devices that they shall give satisfactory results in ordinary depths and also that they can be used with the vessel having slight way upon her. The line shall be wound upon a reel with supports and a return pulley in order that it may be easily reeled in. Up to the present those types of sounding machines only had been allowed which indicate depth by water pressure. In older sailing vessels the sounding apparatus admitted is the deep sea lead provided with a float through which the line passes and which firmly grips the line when it is hauled in, and thus marks the depth to which the lead had sunk.*

(1) *Includes pleasure craft.*

For voyages on which the services of a navigating officer are not required, the chronometer, the sextant and the octant may be omitted.

But for voyages requiring the services of a navigating officer, a sextant or octant should always be on board.

Voyages to Denmark and along the west coast of Sweden in vessels which have not passenger certificates will be considered as inland navigation at home or as coastal voyages. Fishing vessels are included in the category of vessels sailing in European waters.

ART. 11.

Before being placed in service, all compasses intended for use in vessels for which registration is compulsory, shall previously be provided with a certificate delivered by one of the testing stations for navigational instruments recognised by the Department of Commerce, Navigation and Industry; this certificate shall state that the compasses have been tested and found satisfactory in conformity with the regulations in force. This certificate shall be retained on board, and a copy shall be kept at the testing station and sent on request to the Sjöfartskontor (Marine Shipping Office). For iron or steel vessels navigating in European and extra-European waters, as well as for coasting steamers of more than 100 tons, gross tonnage, the certificate shall be of Category A.

For all other vessels, a certificate of Category B is sufficient.

For the spare steering compass, a certificate of Category B suffices for all waters.

After any major repair each compass so repaired shall be retested; a new certificate shall also be drawn up after compulsory examination, which shall take place at least every five years.

ART. 14.

Steamships and iron or steel vessels, the dimensions of which make registration obligatory shall be equipped with both a steering compass and a standard compass, compensated; the deviation of these compasses shall have been determined by one of the experts authorised by the Department of Commerce, Navigation and Industry.

A new determination of deviation shall be made by one of these experts after each alteration or major work of repair to the ship, as well as after the laying of electric conductors and, lastly, at the time when a new certificate for the compass is drawn up. If the deviation test shows the necessity for a new compensation of the compass, this shall be done on the same occasion as the test.

A statement attesting the compensation, with a deviation table, shall be required from and issued by the person who carried out the compensation and such statement shall be retained on board.

ART. 15.

Sextants and octants shall be accompanied by a certificate issued by one of the nautical instrument testing stations recognised by the Department of Commerce, Navigation and Industry, or by an authorised expert, and this shall state that these instruments have been examined and approved as fulfilling the requirements of the regulations in force.

Vessels navigating in European waters shall have on board at least one sextant or one octant with the necessary certificate therefor.

ART. 18.

On the occasion of the tests mentioned in the preceding articles, as well as of the fitting on board and of the compensation of a compass, the testing station concerned, the authorised expert or the controller of compasses shall draw up a Report which shall be handed to the Sjöfartskontor on demand, for indorsement.

Each instrument for which a certificate has been issued shall bear a stamped or engraved test mark. This mark shall be composed of the distinctive sign of the testing station concerned recognized by the Sjöfartskontor, or of that of an authorised expert, together with the number of the Report on the instrument. A new test mark shall be affixed after each new test of the instrument.

At the end of each quarter, a statement of the tests and compensations carried out during the preceding three months shall be sent to the Sjöfartskontor.

The certificates and deviation tables shall be drawn up in the form laid down by the Sjöfartskontor.

ART. 19.

Captains of vessels so far as they are able, are charged with the checking of instruments on board. They shall give particular attention to checking the deviation every 24 hours, so as to be able to issue orders accordingly. If any part of the cargo consists of material likely to affect the compasses, the captain shall, if possible, cause a check of the deviation to be made before the ship sails.

Seeing that, up till now, no certificate has been required for chronometers, it shall be the captain's duty to take every occasion to check their rates and errors.

ART. 20.

When an inspection of navigational lights or instruments takes place, or when compasses are fitted on board or compensated, these facts should be noted in the ship's log mentioning by whom the examination was made and the result obtained. This applies also to the tests for deviation dealt with in the preceding articles.

III. — Control is exercised by government employees directly attached to the "Sjöfartskontoret, Handelsdepartmentet" (Ministry of Commerce, Navigation, Labour and Fisheries - Bureau of Navigation); this control is both direct and indirect:- direct, because at the periodical inspections as well as at non-periodical inspections, to which every vessel is subject, it shall be ascertained whether the nautical material which every ship must have on board according to the regulations, is actually on board; and indirect, because of the fact that every loss or damage shall be the object of an inquiry into the cause of the accident; if the cause arises from infraction of any regulation, this infraction shall be brought to the knowledge of the Tribunal.

Instruks for de offentlige Kontrollkontorer for Skibs Instrumenter (The Instructions for public Stations for testing ships' Instruments) contained in the Royal Decree of 17th. June, 1921, give details concerning the rules to be followed when inspecting, and tests to be applied to, various nautical instruments, as well as rules for drawing up certificates therefor.

A few extracts from these Rules are given below:-

GENERAL REGULATIONS.

1.

The Directors and Assistants of the public Testing Stations are appointed by the Department on the advice of the Municipal Administration and of the President.

These employees shall obey the instructions issued by the Department.

2.

The duties of the Testing Stations are:-

a) To decide whether the lights, etc., instruments, etc., submitted for inspection conform to the rules and regulations in force and, in addition, whether they are in good condition and usable.

b) To encourage the national manufacture of lights, etc., and of nautical instruments.

c) To help shipowners and seamen in the purchase of ships' lights, etc., instruments, etc., at the same time giving them explanations as to their use.

d) To fit the ships' lights, etc., instruments, etc., on board; to make tests for compensation and correction of compasses, in conformity with the regulations in force dealing therewith.

e) To correct the charts as well as to carry out certain minor cartographic and hydrographic work, in special cases and insofar as it is possible for them to do so, when there is a valid reason for undertaking such work.

f) To take charge of chronometers.

3.

The right to draw up certificates in conformity with the present instructions rests solely with the public Testing Stations for nautical instruments.

4.

The Department may modify these instructions as may be deemed advisable.

COMPASSES.

A) General Regulations.

1. The bowl shall be cylindrical or cylindrical with hemispherical bottom.

It must be capable of being closed and rendered air and water-tight. It must be well-balanced, hang horizontally and be free from iron. The axes of the gimbals must be perpendicular to each other and the horizontal plane passing through the axes, within the bowl, must be bounded by the circumference of a circle.

The lubbers line must have a thickness of about ½ m/m. The vertical plane passing through this line and through the point of the pivot must pass through one of the axes of the gimbals.

2. The pivot must be of tempered steel, iridium or other hard material and must be in the centre of the bowl. The point of the pivot must be well polished and coincide exactly with the point of intersection of the axes of the gimbals.

3. The gimbals must allow the bowl to move freely about the axes of suspension without unnecessary play. An elastic suspension should be used only to connect the outer rolling trunnions with the binnacle.

4. The magnets of the compass card must be arranged in such a way that they do not cause sextantal or octantal deviation.

The extent to which this condition is fulfilled may be determined approximately by examination of the mechanical dimensions of the system of magnets. If the card has two magnets, the poles must be placed on the radii which lie at an angle of 30° from the N.-S. line.

If there are several magnets, the poles must be placed symmetrically with respect to the N.-S. line on the diameters at 30° therefrom. In this case the poles may be considered as situated at 1/12th. of the length of the magnets from their extremities. New cards shall be submitted to an accurate test. No value of the coefficient *H* greater that 1° should be produced by the influence of the quadrantal correctors at the customary distances on board.

5. The compass card must be well-balanced and hang exactly horizontal. Its point of suspension must be situated at such distance from the plane of the card that a swing of the bowl of 5° does not produce a lateral deviation greater than about ½°.

6. The collimation error of the card, its errors of graduation and eccentricity, together, must not exceed ½° in any direction whatsoever.

7. The cap of the compass must be of sapphire or other hard precious stone free from blisters or other faults. The bottom must be perfectly polished.

8. The directive force of the card and its sensitiveness shall be examined in a field reduced to 0.5 Gauss Units. After having been deflected by about 35°, the card should return to its original reading after uniformly decreasing oscillations. The sensitiveness is examined by carefully moving the card from its position of rest by 2° at most. When, afterwards, the magnet system has returned to rest, its position is read off. This is then repeated on the other side of the lubbers line. The difference between the two readings is the measure of sensitiveness of the card; it must not exceed 1°.

B) Dry Compasses.

9. The weight of the card must not exceed :-

30 gms. for a diameter of 250 m/m or more.
20 " " " less than 250 m/m.

No certificate is given for cards the diameter of which is less than 175 m/m.

10. The ratio of the magnetic moment of the card, M, in thousand GAUSS Units, and its weight, p, in grammes, must be of the following values:-

For cards of 30 gms. $\frac{M}{p}$ shall not be less than $0.18.10^6$.
" " " 20 " " " " " $0.16.10^6$.
" " " 15 " " and less, $\frac{M}{p}$ must not be less than $0.15.10^6$.

11. The period of oscillation of the card in the unreduced terrestrial magnetic field is determined by deflecting it about 35° from its position of rest. It is taken as the mean of at least 4 oscillations, and is the interval of time between the instant when the card passes the position of rest and that when it returns to this position on the return swing.

Note. One of the conditions of suitability of the card of a dry compass, apart from the above requirements, is the faculty of remaining undisturbed in a seaway. The period of oscillation and the moment of inertia are the determining factors of this.

The period of oscillation which best suits each type of vessel is a matter of experiment. For this reason, rules for minimum values of periods of oscillation have not been fixed.

The moment of inertia of the card, K, is intimately associated with the period of oscillation: an attempt must be made to make it as great as possible in proportion to the weight p of the card. As a guide on this subject, the following may be mentioned:-

For cards of 250 m/m diameter and beyond, $\frac{K}{p}$ must not be less than 7.10^6 and for those of smaller diameter, this ratio must not be less than 6.10^6.

12. It is permissible to use a magnetic damper with a dry steering compass if, in addition to the latter, a standard compass has been properly fitted on board.

The damper shall be fixed on the glass cover of the compass in such a manner that it may be easily removed. It should be fitted with a glass cover so that its movements may be checked. It must not be attached to the bottom of the bowl. It must be so constructed that its needles move freely under the influence of the card without catching.

The card used in conjunction with the damper must have such magnetic moment that the value $\frac{M}{p}$ is at least 0.25.

The period of oscillation of the compass shall be examined with, as well as without, the damper, and the fact that this has been done shall be recorded in the certificate.

C) LIQUID COMPASSES.

13. Liquid compasses must be fitted with an expansion device permitting a rise in the temperature of the liquid to + 40° C, without breaking the glass, and a fall of temperature to -10° C without serious formation of bubbles. The test shall be applied at the Test Stations within appropriate limits and the temperatures to which the test was made shall be mentioned in the certificate.

The liquid must be composed of a mitxure of alcohol and water in the proportion 2 to 3.

In a liquid of this density, the weight of the card must not be less than 4 gms. or greater than 12 gms.

14. The magnetic moment of liquid compasses must be of sufficient magnitude to overcome the friction in the liquid easily and to give the card the necessary directive force and sensitiveness when the pivot and the stone are in good condition.

As a guide in this matter the following rules are given:-

For a card of 200 m/m diameter, $M = 26$ thous. GAUSS units (at least).
175 " " " $= 20$ " " " "
150 " " " $= 15$ " " " "
125 " " " $= 11$ " " " "
100 " " " $= 9$ " " " "

When the magnetic moment has been examined (which may be done without withdrawing the card from the bowl), its value shall be noted on the certificate. No certificate shall be supplied for a card of less than 100 $^m/_m$ diameter.

15. In an unreduced magnetic field, the card must make at least two oscillations before returning to the position of rest, after having been deviated 35°.

16. The period of oscillation is that of the first oscillation. As its value varies with the temperature and the composition of the liquid, these data should also be entered on the certificate. Local atmospheric temperature may be taken as the temperature of the liquid, after the compass has been in the place where the test is to take place for from three to four hours.

D) Certificates.

17. The results of an inspection shall be entered on the certificate and in this connection it should be noted that Nos 7 (weight) and 14 are filled in for dry compasses only — Nos 3, 4 and 12 for liquid compasses only—. The note "very good" shall be entered against Nos 1, 2, 4, 5, 8, 10 and 11 when the requirements of the regulations have been entirely fulfilled; the word "good", against any of these Nos when the error referred to by each is slight or without practical importance, or when it is within the limits allowed by the regulations. If the inspection gives rise to any special remarks, these shall be entered in the space provided for this purpose or in place of the note "very good" or "good".

18. A certificate dealing with the card only may be drawn up. In this case the note:

"*Refers to the card only*"

shall be inserted at the top of the certificate under the heading: "Compass Certificate".

Note. Compass cards must be tested in the same liquid mixture and in a bowl of the same diameter as those which are actually employed. The certificate must mention that this has been done. When cards are presented for inspection the bowls and the liquids must accompany them.

19. A certificate may also be issued for a compass though the pivot, the stone or the liquid mixture have not been examined, if the other requirements of the regulations have been satisfied. For new and for repaired compasses, the maker of the instrument must indicate of what material the stone and the pivot are composed, as well as the composition of the liquid.

POSITION FINDING INSTRUMENTS.

A) Bearing Plates (Pelorus).

1. The instrument shall be of strong and suitable construction: in addition it should be well balanced and hang horizontally.

2. The alidade must be able to move freely in both directions around a vertical axis situated in the centre of the graduated circle.

3. The sighting plane, *i. e.* the plane passing through the openings of the sight-vanes or through the wires of the dioptric devices of the objective, must be perpendicular to the plane of the graduated circle and pass through the axis of rotation. The reading index also must be in the sighting plane.

4. The graduation of the disk or of the circle must be correct and its centre must be at the axis of rotation.

5. If a mirror or a reflecting prism is used, the plane of reflection, in any position of the mirror or prism, must coincide with the sighting plane. If a telescope is employed, its optical axis must coincide with or be parallel to the sighting plane.

6. The total error due to slight divergences from the requirements of clauses 1 to 5 above, must not exceed ½°.

B) Other position finding instruments.

The same conditions as those required for bearing plates, sofar as possible, are applicable to appliances for taking bearings intended for use on the covers of compasses. This holds good also for course-correctors. In every case the apparatus must be trustworthy and work easily; also the sighting plane must pass through the axis of rotation. The reading index must be situated in the sighting plane and the apparatus must in all cases be so constructed that bearings, both of heavenly bodies and of terrestrial objects, may be taken with ease.

SEXTANTS AND OCTANTS.

1. The axis of rotation of the index arm must be perpendicular to the plane of the instrument; the arm should slide with slight friction on the limb. Its screws must be of good quality.

2. The division of the limb shall be on silver, platinum or gold. It must be even, clear and suitable to the vernier.

The division of the vernier shall be on silver, platinum or gold; it must be even, clear and fit the arc exactly.

3. Provision shall be made for setting the index mirror perpendicular to the plane of the instrument with ease and accuracy. Its attachment must be of robust construction.

The screws for adjustment of parallelism and perpendicularity of the horizon mirror must act freely and with accuracy. The attachment of this mirror must be of strong construction.

5. The surfaces of the mirrors must be plane and parallel; the silvering must be free from defect. However, an index mirror, the error in parallelism of which in any direction is not greater than 5", may be approved.

6. The shade glasses must be plane and parallel. They shall, however, be approved when they do not separately produce an error greater than ½'. The magnitude of this error must be determined and noted on the certificate.

7. The telescopes must be good and give clear and well-defined images. The optical axis must be parallel to the plane of the instrument. A maximum divergence of 1/3 of a degree may however, be admitted.

8. The total instrumental error in the measured angle (without using a shade glass) shall be determined by means of the sextant testing apparatus. It should not be greater than 3' and the increase or decrease should be uniform. In the table of errors drawn up, each error shall be rounded off to the nearest direct vernier reading possible on the instrument, *i. e.* to 10", 15" or 30".

9. All other instruments used in navigation for the measurement of angles shall be examined, both those used for fixing position and those used for the measurement of horizontal angles, and a declaration as to their suitability for use shall be made; however, no certificate shall be issued.

CHRONOMETERS.

A) Determination of error and rate.

1. So as to be able to determine the error of a chronometer, the Test Station shall be in possession of one well regulated chronometer or, preferably, a clock the error of which shall be determined, so far as possible, daily.

2. The determination of the rate may be undertaken when the chronometer has been under observation for 7 days. The chronometer shall be placed in a locality where a fairly even temperature can be maintained and where there is normal humidity. The mean temperature for each 24 hours shall be noted.

The chronometer error shall be determined daily. For the requirements of the inspection, the mean daily rate shall be deduced therefrom and be noted in the chronometer log; the mean temperature also will be noted therein.

B) CARE OF THE CHRONOMETERS WHILE IN STORE.

3. Chronometers handed to the stations are to be placed in the locality mentioned in Article 2. The mean temperature for each 24 hours is to be noted. Every 10 days the error of the chronometer on Greenwich mean time shall be determined. The mean rate and the mean temperature for the 10 days is deduced therefrom. When delivering the chronometer, an entry shall be made on the "rate card" stating its error and probable rate for the mean temperature during the period occupied by the determination of the rate.

C) TEMPERATURE TESTS.

4. Before commencing a temperature test, chronometers shall be placed under observation for at least 7 days at the ordinary local temperature.

The temperature test covers five periods of 8 days at temperatures of 30°, 20°, 10°, 20°, 30°, respectively. On the first day of each period the temperature shall be regulated to that fixed for the period in question, and this day is not taken into account when calculating the daily rate.

5. During the temperature test, the chronometers shall be compared with the clock every day: in this way their errors on Greenwich mean time may be determined within 1/10th. second.

During each period the following shall be ascertained:-

a) the mean daily rate;

b) the variation in the mean daily rate.

With regard to periods at the same temperature, the mean of the values obtained under (*a*) and (*b*) will be adopted. The values thus determined for the daily rate and for the daily variation of rate serve to classify the chronometers and also to calculate the coefficients of temperature.

6. *Classification.*

A indicates the greatest mean variation of daily rate for the three temperatures;

B indicates the greatest variation of daily rate for a variation of 1° in temperature;

C indicates the daily variation in rate between two successive periods at the same temperature. This is determined by dividing the difference between the mean rates of the two periods at a temperature of 30° by the number of days separating the middles of these periods.

For inclusion in	*Category* 1	*Category* 2
A shall not be greater than	0.3 sec.	1.0 sec.
B " " " "	0.18 "	0.3 "
C " " " "	0.02 "	0.05 "

7. It is assumed that the rate curve of chronometers is a parabola the major axis of which is parallel to the axis of the rates. The equation of this curve may be expressed by the formula:-

$$g = g_0 - c\ (t - t_0)^2$$

in which g_0 is the rate of the chronometer for the temperature t_0, c = a constant, and g is the rate of the chronometer for a given temperature t.

g_0, c, and t_0 may be calculated by means of the corresponding values of

$t = 10°$, $20°$ and $30°$, for $g = g_{10°}$, $g_{20°}$, and $g_{30°}$.

Let: $g_{30°} - g_{20°} = d_2$

$g_{20°} - g_{10°} = d_1$

then:

$$c = \frac{d_2 - d_1}{200}$$

$$t_0 = 15^\circ - \frac{10\ d_1}{d_2 - d_1}$$

and

$$g_0 = g_{20^\circ} - c\ (20^\circ - t_0)^2$$

The rate curve is drawn and a table of temperature corrections prepared.

Note. The simple formulae used above for the calculation of c and of t_0 assume that the temperature test was made for 10°, 20° and 30°. If this were not the case or if the mean temperature of the periods, by reason of faulty regulation of temperature, differs by more than 1°, the general formula, from which the above formulae have been deduced, should be used.

D) Keeping of Chronometer Logs.

The Test Station shall keep a log in which the daily error and the daily rate of the clock shall be entered, as well as the daily comparisons made in connection with points *A*, *B* and *C* mentioned above.

The results of inspections shall be entered in the inspection log.

BAROMETERS.

A) Marine Barometer.

1. Barometers must not pump too much nor should they be sluggish. Inspection of this factor shall be made by carefully turning the instrument until the tube is completely filled with mercury. The barometer shall then be hung in a vertical position; about twenty minutes must elapse before an accurate reading of atmospheric pressure is given.

2. The barometer is then compared with a standard barometer in a chamber which is hermetically sealed and fitted with an air pump. The operation is begun by exhausting sufficient air to bring the standard barometer to 0.5 m/m below the scale divisions. If the barometer examined does not fall to the last division, it may be concluded that the cistern is too narrow and must be modified or else that it contains too much mercury.

A little air is then allowed to enter the chamber so that the mercury gradually rises and the reading is taken at the end of half an hour. After several readings have been taken, just enough air is allowed to enter to cause the mercury to rise about 10 m/m — a second series of readings being taken at the end of another half-hour.

The operation shall be continued for the whole range of the scale.

The readings of the standard barometer must be corrected for the constant error of the instrument. The difference between the barometric heights thus corrected and the reading of the marine barometer gives the constant error of the latter. The constant error of a marine barometer must not be greater than 1 m/m.

B) Aneroid Barometer.

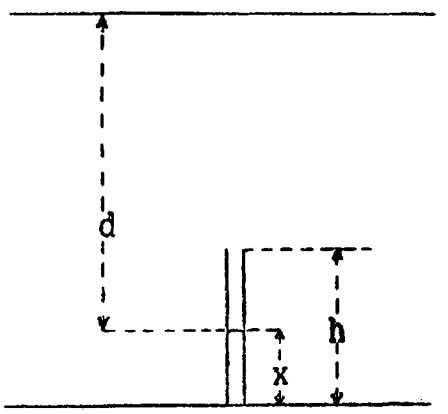
First, the aneroid is regulated by means of the standard barometer and the inspection is continued by comparisons with the standard barometer at each 10 m/m from 710 m/m up to 790 m/m under both increasing and decreasing pressures.

The aneroid must register the variations of atmospheric pressure quickly and accurately.

Each reading of the standard barometer must be reduced to a temperature of 0° and be corrected for the constant error. The differences between the barometric heights thus corrected and the indications of the aneroid shall be entered in the form of a graph, one for increasing pressures and another for decreasing pressures. The temperature at which the test was made shall also be mentioned on any certificate which may be prepared certifying the suitability of the aneroid to indicate variations in barometric heights.

SOUNDING APPLIANCES.

A) SOUNDING APPLIANCES BASED ON WATER PRESSURE AND AIR COMPRESSIBILITY.



Let

s = the specific gravity of sea water.
p = atmospheric pressure.
p_1 = pressure in the tube at the depth d.

$$\frac{p_1}{p} = \frac{h}{h-x} \text{ (MARIOTTE'S law).}$$

$$p_1 = p + sd$$

$$\frac{p+sd}{p} = \frac{h}{h-x}$$

$$p + sd = \frac{ph}{h-x}$$

$$sd = p\left(\frac{h}{h-x} - 1\right)$$

$$sd = p\frac{x}{h-x} \qquad (1)$$

The specific gravity of sea water varies between 1.0 and 1.04. For British sounding scales a value of 1.025 is usually adopted; in Germany the value 1.018 is often used.

In formula (1) the two sides of the equation express the pressure: the right-hand side expresses the excess of pressure over the atmospheric pressure, which maintains sea water in equilibrium.

In the testing apparatus this excess of pressure is measured by means of a good pressure gauge; let M indicate the reading of this gauge. We then have:-

$$s.d.100 = M.\ 1000 \qquad d = \frac{M.\ 10}{s}$$

where d is expressed in metres and M in kilogrammes.

For the sake of convenience, a table may be drawn up giving d for a given value of s which, in the greater number of cases, is 1.025.

During the test, care must be taken:-

1) that before the test, the tubes (or bathometers) are placed in water at the same temperature as that in the testing apparatus.

2) that the test is made for every 10 m. up to 50 m. and thereafter for each 25 m. up to 200 m.

3) that the depth read on the scales is corrected for the barometric height before being compared to d.

4) that the result of the test is drawn in the form of a graph and inserted in a table of corrections.

5) that certificates are not delivered for sounding appliances which have shown differences greater than 2 m. for depths smaller than 50 m. Any difference must increase or decrease uniformly.

6) The length of the glass tube must not differ by more than 3 $^{m}/_{m}$ from the correct length (length of the section).

B) Sounding Appliances based on other principles shall be tested if a suitable opportunity occurs; a statement with regard to their suitability may be furnished but no certificate.

TELESCOPES AND BINOCULARS.

1. Telescopes must be free from *spherical aberration.* If, for instance, the telescope is examined when sighting a star, the latter must appear in the form of a clearly-defined point and not as an indistinct disc.

2. Telescopes must be free from *chromatic aberration.* The image must not be surrounded by a coloured border.

3. Telescope lenses must be *accurately centred.* This is ascertained by supporting the instrument in a fixed direction while observing a distant clearly defined object. Rotation of the telescope about its mechanical axis should produce no change of position of the image in the field.

4. The *angle of definition* of binoculars, *i. e.* the least angle under which a clearly defined object may be distinctly seen, is considered as:-

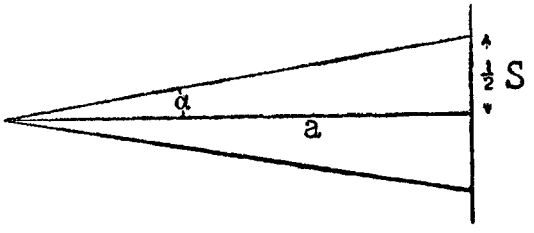
"Very good" when it is from 9 to 10 seconds of arc;
"Good" " " " 10 to 12 " "
"Usable" " " " 12 to 15 " "
"Unsuitable" for marine binoculars when it exceeds 15 seconds of arc.

The angle of definition may be examined by means of a board with horizontal lines in 3 zones. The lines and intermediary spaces between each zone must be of the same width and may be $2 - 2\frac{1}{2} - 3$ m/m respectively, when the table is placed at a distance of 45 m.

The angle of definition of telescopes is "very good" when the 2 m/m lines can be clearly distinguished at 150 m. distance; "good" when at the same distance the $2\frac{1}{2}$ m/m lines can be clearly distinguished; "usable" when only the 3 m/m lines can be clearly distinguished.

5. *Magnifying power of telescopes.* This can be determined by comparing scale divisions as seen through the telescope with the same scale as seen by the naked eye.

6. *Field of Vision.* This may be determined by placing a scale perpendicular to the line of sight at a known distance from the telescope and observing how many scale divisions are included in the field of vision. According to the figure, the field of vision is: 2α;



besides $tan\ \alpha = \frac{\frac{1}{2} S}{a}$.

The field of vision for binoculars must be at least from 2 to 4°.
For small telescopes it should be at least from 1 ½ to 2°.
For large telescopes it should be at least from 1 to 1 ½°.

The following should be used on board:-
Day use: Telescopes with a magnifying power of from 15 to 25.
Binoculars (ordinary marine) of a magnifying power of from 3 to 6.
Prismatic binoculars having a magnifying power of from 6 to 12.
Night use: Ordinary marine binoculars having a magnifying power of about 3 and fitted with large eye-piece ring (10 to 14 m/m).
Prismatic binoculars having a magnifying power of about 6.

CHARTS, ETC.

Norwegian charts and other nautical documents shall be kept up-to-date by means of information furnished by the *Fyrvesen* and the *Norges Geografiske Opmåling.*

Foreign charts, etc., will be checked as opportunity arises for the station to do so.

REGULATIONS, CONCERNING THE KEEPING OF REGISTERS, DRAWING UP OF CERTIFICATES, etc., AS WELL AS CHARGES LEVIED FOR TESTS.

Each station shall keep a register of correspondence received, and a copying book for correspondence sent out, a record of the fitting and compensation of compasses, of the correction of charts, etc., as well as special registers for tests of ships' lights, compasses, instruments for taking bearings, sextants and octants, chronometers, barometers, sounding appliances, and telescopes. Test-registers must be in accordance with the standard form and of folio size; the pages must be numbered and the registers shall be kept in the Station's archives when completely filled up.

If the test shows that the lantern or the instrument submitted fulfils the requisite conditions, it shall be approved and the fact noted in the certificate *ad hoc*. This certificate will contain a copy of the inspection results as entered in the register and is to be drawn up in the same form as the register. If the lantern or instrument does not fulfil the conditions mentioned above the inspection results are to be entered in the register as before, but in some place where it will be apparent, the word "Kassert" (withdrawn from use) shall be inserted in red ink, or by means of a stamp, accompanied by a note to the effect that the conditions have not been fulfilled. It is recommended that separate "withdrawn from use" registers be kept, the arrangement of which might be the same as that of the test-registers. A copy of the inspection results shall be delivered to the person interested on request, with the additional remark, but under no circumstances must this copy be drawn up on a form of the standard certificate.

Every instrument tested and approved, for which a certificate has been supplied, is marked with the distinctive sign of the Station:

Marinens Navigasjonsvesen *M. N.*

Fredrikstad	*Fr.*	Trondhjem	*Tr.*
Kristiania	*K.*	Harstad	*Ha.*
Tönsberg	*Tö.*	Sandefjord	*S. f. j.*
Porsgrunn	*Pg.*	Kristiansund	*Kr.*
Kristiansand	*Ks.*	Aalesund	*Aa.*
Stavanger	*St.*	Arendal	*A.*
Haagesund	*H.*	Tromsö	*Trö.*
Bergen	*B.*		

including the test number; this number must be entered on the register as well as on the certificate.

No duplicate of a certificate may be drawn up unless no doubt exists as to the instrument (lantern, etc.) and its various parts being the same as at the date of inspection. In case of doubt, the instrument (lantern) must be again presented: if this cannot be done, the following must be inserted on the duplicate in red ink:- "This duplicate has been drawn up at the request of..... from data in the test-register."

Charts, etc., shall be stamped with the Station's mark accompanied by the date of notification of the last correction, — so long as the chart, on account of its age or the importance of the correction, is not liable to be withdrawn from use.

In the latter case, charts must be clearly stamped with the word "Kassert" accompanied by the date and the Station's mark.

List of Charges
for the guidance of Public Marine Instrument Testing Stations.
(Applicable on and after 1st. July – 1925).

A. The charges for test and drawing up a certificate shall be as follows:-

For a lantern	6 Kr.
For a compass or instrument taking bearings	6 "
For a sextant or octant	14 "
For a ship's barometer	14 "
For a sounding appliance	14 "
For a telescope	4 "
For a chronometer, temperature test	30 "
For a determination of error only	6 "

Half of the above tariff is payable for testing instruments which are not approved.

B. For carrying out an inspection of the compensation and deviation of compasses, the following charges will be made according to tonnage:-

a)	Up to 25 gross tonnage, inclusive	20 Kr.
b)	Exceeding 25 gross tonnage up to 50 gross tonnage (inclusive)	35 "
c)	" 50 " " " 100 " " " "	55 "
d)	" 100 " " " 200 " " " "	85 "
e)	" 200 " " " 1000 " " " "	125 "
f)	" 1000 " " " 2000 " " " "	165 "
g)	" 2000 gross tonnage	200 "

The above mentioned charges cover 2 compasses.
For every compass beyond that number, the charge will be ..... 40 Kr.
For newly-built vessels in which the compasses are tested for the first time, a supplementary charge of 10 Kr. will be made, in addition to the above-mentioned charges.

C. For fitting a ship's compass or a bearing plate, vessels shall pay:-

a)	Up to 25 tons gross tonnage inclusive	8 Kr.
b)	Exceeding 25 gross tonnage and up to 200 gross tonnage (incl.)	16 "
c)	" 200 gross tonnage	24 "

For testing the adjustment of lanterns on board, vessels shall pay:-

d)	Up to 25 gross tonnage (inclusive)	16 Kr.
e)	Exceeding 25 gross tonnage up to 200 gross tonnage (inclusive)	24 "
f)	" 200 gross tonnage	32 "

D. For hydrographic or other similar work the tariff of the *Norges Geografiske Opmåling* shall be applied.

E. For keeping a ship's chronometer the charge per month or part of a month is... 4 Kr.

F. With regard to special work carried out by the Station, such, for instance, as making copies of charts, or position charts for the use of maritime tribunals, etc., the charge shall be fixed by mutual agreement.

G. When work under paragraphs *B*, *C*, and *D* above has to be done outside of the Station, the employee assigned to do such work shall be paid a portion of the charge which will be determined as follows:-

For *B.*	*a*	up to	8 Kr.
	b-d	"	20 "
	e-g	"	38 "
For *C.*	*a-b*	up to	5 Kr.
	c	"	10 "
	d	"	5 "
	e	"	10 "
	f	"	15 "

For *D.* Up to half the charge.

If it be requested that work included under *B* be carried out on a public holiday or after 6 p. m. on a working day, an extra charge of 10 Kr. will be made and this shall be paid to the employee assigned to do the work.

REGISTER Page..... [Standard Form]

COMPASS CERTIFICATE.

Compass.....

Manufacturer : *Bowl*.....
Card.....

Submitted by.....

BOWL : 1. Position of lubbers line :
2. Pivot : Material : Position :
3. Nature of liquid and its composition :
4. Expansion device : Between ° and ° C.
5. Suspension device :

CARD : 6. Diameter : m/m Number of magnets :
7. Division in weight (*p*) grms.
8. Balance :
9. Error of collimation and eccentricity :
N: S: E: W:
10. Arrangement of system of magnets :
11. Directive force and sensitiveness :
12. Magnetic moment (*M*) : Thousand GAUSS Units.
13. Period of oscillation in unreduced field : for.....° C.
14. $\frac{M}{p}$ = $\times 10^6$ $\frac{K}{p}$ = $\times 10^6$

Remarks :

In conformity with the preceding, the compass satisfies the conditions of the Instructions to Public Marine Instrument Testing Stations.

p.p. PUBLIC MARINE INSTRUMENT TESTING STATION.

.....19...

The charge of..... Kr.
has been paid.

REGISTER. Page..... [Standard Form]

SEXTANT CERTIFICATE.

Octant.....
Sextant marked :.....
Submitted by :.....

LIMB : MATERIAL : RADIUS : m/m

The division is uniform and coincides with that of the vernier.
The degrees of the limb are divided into parts.
The smallest reading with the vernier is :

The astronomical telescope is and magnifies times
The terrestrial telescope is " " "
Index mirror { error on the longitudinal axis :
" " " transversal axis :
Horizon mirror :
Shade glasses :

The following corrections are employed :-

In front of the Index mirror N° 1 :
N° 2 :
N° 3 :
N° 4 :

At the back of the Horizon mirror : N° 1 :
N° 2 :
N° 3 :

The following corrections must be applied to angles measured (neglecting the error due to the shade glass).

For	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	110°	120°	130°
Correction.....	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″

The sign + indicates that the correction is additive.
" " — " " " " " subtractive.
The reading having been previously corrected for the zero (index) error.

In conformity with the preceding the sextant fulfils the requirements contained in the Instructions to Public Marine Instrument Testing Stations.

p.p. PUBLIC MARINE INSTRUMENTS TESTING STATION.

.....19...

The charge of..... Kr.
has been paid.

REGISTER. Page..... [Standard Form].

CERTIFICATE FOR CHRONOMETER.

for.....

Chronometer..... *N°*.....
Submitted by.....

The chronometer has been under test from..... to.....
at temperatures from 10° to 30° C.

with the following results:-

Mean temperature.	*Mean daily rate.*	*Mean variation of daily rate (Maximum Value = A).*	Greatest variation of daily rate for 1° variation of temperature.
30° CELSIUS			$B =$
20° CELSIUS			Daily variation of rate between two successive periods at the same temperature
10° CELSIUS			$C =$

Temperature to which maximum rate pertains.	*Rate of Chronometer at t_0*	*Constant for Calculation of g_0*	*Remarks.*
$t_0 =$	$g_0 =$	$c =$	For rate curve and table of corrections for temperature, see back.

g = the rate of the chronometer for another temperature is calculated by introducing the value of the temperature = t in the formula:-

$$g = g_0 - c\,(t - t_0)^2$$

In conformity with the preceding the chronometer fulfils the conditions of the Instructions to Public Marine Instrument Testing Stations for entry under Category.....

p.p. PUBLIC MARINE INSTRUMENT TESTING STATION.

.....19...

The charge of..... Kr.
has been paid.

[*Back of Certificate for Chronometers*].

RULES FOR CLASSIFICATION.

For entry in	Category 1.	Category 2.
A must not exceed.....	0.3 seconds.	1.0 seconds.
B " " "	0.18 "	0.3 "
C " " "	0.02 "	0.05 "

RATE CURVE

CORRECTION FOR TEMPERATURE.

Temp.	$c\,(t-t_0)^2$	*Temp.*	$c\,(t-t_0)^2$
10°		22°	
12°		24°	
14°		26°	
16°		28°	
18°		30°	
20°			

CALCULATION OF THE NEW g_0

t and c are constant for a long interval of time, while g_0 varies gradually and for this reason must often be recalculated.

For this purpose the formula :-

$$g_0 = g - c\,(t-t_0)^2$$

is employed where g is the mean rate and t the mean between two determinations of rate.

REGISTER. Page..... [Standard Form].

CERTIFICATE FOR SOUNDING APPLIANCES.

Type..... *Maker*.....
Submitted by.....

The following corrections must be applied to depth readings on the scale (in addition to corrections for temperature) :

10 m. :	75 m. :
20 " :	100 " :
30 " :	120 " :
40 " :	150 " :
50 " :	200 " :

Remarks :

In conformity with the preceding, the sounding appliance fulfils the conditions of the Instructions to Public Marine Instrument Testing Stations.

p.p. PUBLIC MARINE INSTRUMENT TESTING STATION.
.....19...

The charge of..... Kr.
has been paid.

REGISTER. Page..... [Standard Form].

CERTIFICATE FOR A TELESCOPE.....

Type..... *Maker*.....
Submitted by.....

1) The telescope is free from spherical aberration.
2) The telescope is free from chromatic aberration.
3) The lenses are correctly centred.
4) The angle of definition is °.
5) The telescope magnifies times.
6) The field of vision is °.

Remarks :

In conformity with the preceding, the telescope fulfils the conditions of the Instructions to Public Marine Instrument Testing Stations.

p.p. PUBLIC MARINE INSTRUMENT TESTING STATION.
.....19...

The charge of..... Kr.
has been paid.

THE NETHERLANDS.

The regulations covering the supply and the keeping up-to-date of nautical charts, documents and Sailing Directions for the Netherlands are contained in the *Schepenwet* (Maritime Law) of the Netherlands (Maritime Law of Holland of 1st. July, 1909 and subsequent amendments) from which the following is an extract :-

(Translation from the Dutch Text).

CHAPTER II. § 1. SAFETY REGULATIONS.

A. ART. 4. Before undertaking a voyage with his vessel the Captain shall assure himself, among other things, that :-

.....

b) The necessary charts, sailing directions and nautical instruments are on board ; that the charts and sailing directions are up-to-date ; that the instruments have been examined and adjusted.

The authority charged with the enforcement of these regulations is laid down by para. 2 of Art. 10 of the *Schepenwet* ; from which the following is an extract :-

§ 2. SUPERVISION.

B. ART. 10. — 1. All vessels are subject to the supervision of the Government.

2. Under the orders of Our Minister this supervision is exercised by the officials whom We appoint ; from amongst these officials We will appoint one as Chief of the Maritime Inspection, who shall be designated Inspector-in-Chief.

3. The duties and authority of the officials mentioned in the preceding paragraph shall be regulated by General Rules of the Administration.

These questions are dealt with in detail by Royal Decree N° 418 of 28 th. November 1913. The regulations may be summarized as follows :-

On board every vessel there shall be :-

1. The charts for the voyage contemplated on a scale adequate to ensure navigation in safety. The charts shall be kept up-to-date in accordance with the Notices to Mariners ; a chart of the currents in the North Sea and the English Channel must be on board ;

2. Two triangular rulers or a parallel ruler and a pair of compasses ;

3. A List of Lights for the coasts to be visited ;

4. For vessels of more than 200 tons, the Sailing Directions (corrected to date) necessary for the proposed voyage and a *Nautical Almanac.*

The compasses shall be compensated and a table of deviations prepared and kept up-to-date either by observations at sea or by an expert on board.

In small fishing vessels (of less than 200 tons) one compass will suffice ; all other vessels shall be provided with two fixed compasses.

There shall be on board a telescope and an instrument for measuring angles, except in vessels whose destination is the western part of the Baltic and the east coast of the North Sea which vessels need not carry sextants.

Vessels of more than 200 tons proceeding from Europe to the N. W. coast of Africa shall carry on board at least one chronometer ; in other vessels an accurate watch will suffice.

Every vessel shall carry one accurate barometer, one lead and line, one sounding machine and a log.

The Service of the *Scheepvaartinspectie* (Navigation Inspection Service) is charged with the duty of enforcing the laws and decrees. Chronometers shall be tested by one of the branches of the Royal Meteorological Institute of Holland; sextants and barometers should be tested by experts.

PORTUGAL.

The regulations as to the supply of charts, nautical documents and instruments to the vessels of the Portuguese mercantile marine are contained in Decree N° 14.639 of 25th. November, 1927, entitled :- *Cartas, Publicaçôes e Instrumentos Nauticos de que devem ser munidas as Embarcaçôes que vao para o Mar.* (Charts, publications and instruments which should be carried by vessels navigating the high seas).

The Ministry of Marine is charged with all the arrangements of a technical character contained in the above Decree as well as with their enforcement. Some extracts from these regulations are given below :-

ART. 1. Every vessel navigating at sea shall be equipped with recently issued charts, nautical instruments, Light Lists, Nautical Tables, Azimuth Tables and Nautical Almanacs, sufficient for the projected voyage as well as for the various ports of call which the conditions of navigation may require.

1. The charts employed shall be those published by the official national Government Services or those of foreign countries or charts published privately but the use of which is officially recognised as being entirely reliable.

2. The Captain of the Port may exempt from these requirements vessels making short coasting voyages and all small vessels which are capable of navigating without the use of the charts, nautical instruments, etc., required by this Article.

ART. 2. Before putting to sea, every vessel shall be provided with the objects mentioned in the following table :-

NAME.	*Long voyage.*	*Long coastal voyage.*	*Short coastal voyage.*	*Remarks.*
Steering compass	1	1	1	
Standard compass with bearing plate.....	1	1	1	Colliers and tugs shall be fitted with an azimuth compass as well as a steering compass.
Emergency steering compass	1	1	–	In addition to the steering compass for steam steering, vessels must be fitted with a properly compensated compass for the emergency hand steering station.

NAME.	*Long voyage.*	*Long coastal voyage.*	*Short coastal voyage.*	*Remarks.*
Bearing compass (Azimuth)	1	1	–	In passenger vessels a bearing compass should be installed in the after part, when the standard compass is not so arranged that bearings can be taken astern or when peloruses are not mounted on the bridge near the standard compass.
Sand-glasses.....	2	2	1	
Barometers	2 (or more)	1	1	In passenger vessels one of these should be a barograph.
Fog Horns.....	1	1	1	
Hand log, line and reel.....	1	1	1	
Binoculars.....	2 (at least).	2	1	
Chronometers.....	3	3	–	When the ship is not provided with three chronometers, there shall be one reliable chronometer in addition to a hack chronometer. These chronometers must always be accompanied by their logs kept up-to-date.
Artificial horizon.....	1	–	–	Obligatory for passenger vessels.
Sounding machine.....	1	1	–	In passenger vessels the sounding machines should be fitted with chemical or mechanical depth indicators.
Megaphone	1	1	–	
Mechanical log.....	2	1	–	In passenger vessels one of these should be of the Neptune type, standard or electric with counter in the chart house. Does not apply to sailing vessels.
Hand leads and lines.....	5	3	2	Graduated in fathoms or metres with a minimum length of line of 20 fathoms or 40 metres.
Clocks	2 (at least)	2 (at least)	1	
Sextant or octant	1	1	–	It being understood that every captain and deck officer should possess either a sextant or octant.
Sounding lead and line of 150-200 *m., or* 80-100 *fathoms*.....	1	1	–	
Thermometers	2 (or more)	1	1	In passenger vessels one of these shall be a thermograph.

1. When there is no navigating officer on board, the chronometer, and sextant or octant are not required.

2. The sextant or octant shall be inspected by the maritime authorities.

3. Generally, the nautical instruments shall be checked by the captain every day or whenever such check be possible.

4. On the occasion of each inspection the harbour master's office shall make certain that all the nautical instruments are on board, that the compasses are supplied with the certificates required under the existing laws and that the certificates are still valid.

5. The harbour master's office shall verify the accuracy of the markings of lead lines and determine whether there are means provided on board for a quick check of these markings.

6. The marking of the sounding line should be as follows:-

.....

ART. 3. During the course of construction of every vessel built to sail on the high seas and particularly during the preliminary studies as to location of the superstructure, the hatches, the navigating bridge, etc., the choice of the location of the compass must be made with the greatest care in order to avoid, as far as possible, the presence of large or small masses of iron in the immediate vicinity of the compass, in accordance with the regulations quoted above.

1. In the case of vessels newly constructed in Portugal of or more than 100 R. T. gross MOORSON, the constructors shall send the building plans to the Technical Compass Bureau of the Ministry of Marine. The final location of the compass will depend on the approval of this Bureau.

2. In the case of vessels constructed in foreign countries in which the location of the compass has been approved by a maritime authority, the Technical Compass Bureau of the Ministry of Marine may accept the actual location of the compass.

3. As a rule the standard compass should be located on the centre line of the ship in such a manner that the horizon is visible to the maximum possible extent and it should also be located as far as possible from masses of iron and particularly from vertical iron, it being laid down that the distance from the centre of the magnets to a piece of vertical iron 2 metres high should be at least 1.50 metres. This will give some idea of the factors to be borne in mind when choosing the location of the compass so that it may be as far as possible from masses of iron such as funnels, masts, cargo derricks, ventilators, bitts, bollards, etc., etc...

4. In cases where it is not possible to apply the rule given above the objects in question shall be constructed where possible of non-magnetic metal or of wood.

ART. 4. With regard to electric installations, it should be remembered that the dynamos, motors, electric conductors carrying current and, in general, all circuits earthed to the hull, exert an influence on the compass.

1. As a general rule, in order to diminish the electro-magnetic influence of electric conductors and electric machines, these shall be installed as far as possible in the median longitudinal plane of the vessel.

2. The maximum deviation d produced on the compass by a direct electric current of I amperes at a distance of D centimetres from the compass is given by the following equation:-

$$\tan d = \frac{0.2 \times I}{H' \times D}$$

in which H' represents the value of the mean magnetic field at the place the compass is located and which may be given the value $0.9\,H$ (once the compass has been compensated), H being the horizontal component of the terrestrial magnetism, at the place under consideration, expressed in C. G. S. units.

3. In conformity with the requirements of this article and those of the preceding paragraph, the following rules shall be observed:-

a) *Low-power circuits.* The electric lamp employed to illuminate the compass card should not consume more than 0.6 amps. It shall be located in such manner that no point traversed by the current shall be less than 0.17 m. from the card magnets.

The conductors to the lamp should:-

Run in the median longitudinal plane of the vessel;

Be as short and as straight as possible in the interior of the binnacle.

The wires shall be laid together and the spiral form shall be avoided.

b) Electric installations with a single conductor are forbidden within a radius of 9 metres of any compass.

c) It is preferable, particularly in small vessels, that in future the electric installations be made with return wires in order that the eventuality of a new installation may be avoided; in view of the fact that thus the influence on the compass is very much less than with a single conductor.

d) Within a radius of 9 metres about the compass the two wires for the supply and the return current should be in the form of a twin conductor cable, or in cases where the two wires are separate they should be at an equal distance from the card throughout their length and as close to each other as possible.

e) Circuits carrying more than 10 amps. shall be placed at least 2.50 m. from the standard compass.

f) The searchlights and the Morse signal apparatus, which use currents greater than 10 amps. shall be mounted at least 4 metres from the standard compass.

g) Armoured cables and conductors with iron armatures are prohibited within a radius of 3 metres around the compass.

h) Electric motors, dynamos, resistances, etc., shall be located at such distance from the compass that they will not produce a deviation greater than 1°.

i) The installation of electric motors shall always be such that the electric fields of these motors cannot disturb the magnetic field of the compass closest to them.

3. The radio telegraph station on board should be at a distance of not less than 10 metres from the compass and it must be remembered that the insulation of the aerial and its accessories should be perfect.

4. The shrouds and rigging shall be well insulated wherever there is a possibility that they may be touched by the radio aerial, thus possibly greatly modifying the magnetism of the hull of the vessel.

ART. 5. On the occasion of the inspection for the purpose of obtaining the first navigation certificate of the ship, the representatives of the captain of the port shall require that all the compasses of passenger steamers, or the standard compass of other vessels, or steering compass where there is no standard compass installed, shall have been compensated and adjusted by the Technical Compass Bureau of the Ministry of Marine or by some person whose competence is judged equivalent.

1. If the vessel is equipped with an electric installation the adjustment of the compass shall be carried out as a general rule both with the dynamos stopped and running.

2. For this shipowners shall be required to present a certificate made out in the following form if they do not submit a table of deviations:-

I..... the undersigned, certify that the compasses of the vessel..... have been compensated and adjusted by me and that they are in good condition at the moment. The respective tables of deviation for the compasses have been made out and the location of the correctors is noted on the report which accompanies the above-mentioned tables.

Dated....., ...

(Signature) .....

3. The captains or masters shall not change the position of the correctors except in exceptional cases and in such cases they shall justify the changes made before the Technical Compass Bureau.

4. Vessels carrying passengers which go into the other magnetic hemisphere during their first voyage, and after having made a compensation, shall be required to have at least one standard compass with a definite compensation. After returning from the first voyage the captain shall submit to the Technical Compass Bureau the deviations on the E. W. headings for the most southerly latitude reached by the vessel. If this be not done the compensation shall be made again.

5. Vessels equipped with gyroscopic compasses are not exempt from carrying at least one magnetic compass.

6. Since the use of radiogoniometric bearings is somewnat complicated, the employment of the radio compass is optional on board passenger steamers. Notwithstanding this and in order that the bearings thus obtained may be serviceable, the radio compass should be adjusted every six months.

ART. 6. The captains and masters of iron or steel vessels which have not been to sea for some time or which have been undergoing repairs or alterations comprising additions or modifications in the metal parts of the vessel (plates, sheathing of hull, boilers, masts, funnels, etc.), as a result of which changes are brought about in magnetic intensity, shall present a new certificate of compensation of the compasses when requesting the certificate of navigability.

1. The compensation shall be made again if the new deviations exceed 5°.

2. The Captain shall check the deviations whenever it is possible to do so.

3. If the cargo exerts an influence on the compasses the Captain shall cause a new compensation to be made before putting to sea.

4. On the occasion of an inspection, even though there be no apparent motive for a new compass compensation, the Captain of the Port may require the Captain to submit a written statement certifying that the condition of the compasses is satisfactory and that the deviations to be applied during the voyage contemplated are known.

ART. 7. The results of every inspection of the nautical instruments and all the compensations and adjustments of compasses, together with the respective tables of deviation, shall be entered in the ship's log.

ART. 8. The charges to be made for the compensation and adjustment of compasses and the cost of the certificate pertaining to this work when carried out under the Technical Compass Bureau of the Ministry of Marine shall be fixed by the departmental regulations.

SWEDEN.

The texts of the laws and regulations governing the supply of nautical documents and instruments to the vessels of the Swedish mercantile marine are contained in :-

the *Svensk Författningssamling* N° 184, 1927 (Bulletin of the Swedish Laws N° 184, 1927);

the *Svensk Författningssamling* N° 300, 1927 (Bulletin of the Swedish Laws N° 300, 1927);

the *Kommerskollegii kungörelse* (Decree of the Governing Council for Commerce and Industry) of 30th. June, 1927.

1. The text of the law which governs the supply to ships of charts and

nautical documents is given on page 184 of the *Svensk Författningssamling* N° 184, of 1927.

2. With regard to the equipment of vessels with nautical instruments, the regulations are contained in the *Svensk Författningssamling* N° 184, 1927, pages 281 *et seq.*; in the *Svensk Författningssamling* N° 300, 1927, pages 526 *et seq.*; and in the *Kommerskollegii kungörelse* of 30th. June, 1927.

Several extracts are given below from these various regulations.

3. The authority for testing compasses and lights is the *Kungl. Sjökartverket* (Swedish Hydrographic Office) while the *Kungl. Maj:ts och Rikets KommersKollegium* (Royal Trade Council) carries out the inspections through its agents in the various ports.

(*Translation from Swedish text*).

SVENSK FÖRFATTNINGSSAMLING

(*Bulletin of Swedish Laws*). 1927 - N° 184 of 3rd. June, 1927.

ROYAL DECREE

REGARDING THE CONSTRUCTION AND EQUIPMENT OF VESSELS.

(Given at the Castle of Stockholm, 20th. of May, 1927).

FIFTH CHAPTER. — II. OTHER EQUIPMENT.

ART. 54.

Publications, Marine Charts, etc...

1. Every vessel, except lighters, fishing vessels and whaling vessels, shall carry on board:-

a) For coastal navigation or for long voyages, the groups of "Notices to Mariners" published by the Sjökartverk for the past 12 months, or the corresponding foreign "Notices to Mariners", as well as the charts necessary for the voyage, corrected, as far as possible, up to the preceding year, the Sailing Directions and the List of Lights.

b) For navigation in the North Sea or on long voyages the tide tables and nautical tables, in addition to the above.

2. Every vessel over 100 gross R. T., which is not a fishing or whaling vessel, shall carry on board a printed copy of the regulations issued by the Governing Council for Commerce and Industry as well as the Rules governing the carrying of dangerous cargoes at sea.

3. Fishing and whaling vessels navigating in the North Sea or on long voyages shall be equipped with charts.

ART. 51.

Compasses.

The vessel shall be equipped with compasses as specified in the table in Art. 52 below. The steering compass shall be portable on lighters, as well as where the Governing Council for Commerce and Industry has not decided otherwise, as also on vessels navigating in inland waters. The reserve compass shall be portable on wooden sailing vessels of less than 500 gross R. T.

Every steering, standard and spare compass shall be supplied with a certificate of serviceability. In the case of vessels navigating in the Baltic or on long voyages the age of this certificate shall not exceed five years, whether delivered by the Sköjartverk or by any foreign government authority or else by a foreign institute of which the certificate conforms to the attesta-

tions prescribed by the Governing Council for Commerce and Industry. The certificates for steering and standard compasses in vessels constructed of iron or wood and iron, of 100 gross R.T. or more, and intended for service on long voyages or in the Baltic (always excepting lighters, fishing and whaling vessels) shall be of the highest class. For other vessels the certificate may be of the lower class.

Provided that it is not to be used as a portable compass, the deviation of a magnetic compass shall be determined and the necessary compensation carried out, before it is put into service.

ART. 52.

Various Equipment.

Vessels shall be equipped in conformity with the table given below:-

MECHANICALLY PROPELLED VESSELS, SAILING VESSELS AND SAILING VESSELS WITH MECHANICAL AUXILIARY PROPULSION (with the exception of fishing and whaling vessels).

EQUIPMENT.	*Navigation on high Seas.*	*Navigation in North Sea.*	*Navigation in Baltic.*	*Coastal Navigation.*	*Navigation in inland waters.*
Steering compass (See § 51)	1	1	1	1	1 (1)
Standard Compass (2) (See § 51)	1	–	–	–	–
Spare Compass (See § 51)	1	1	1 (3)	–	–
Azimuth Tables for lat. comprised by voyage, and instrument (4)	1	1	–	–	–
Chronometer	1	–	–	–	–
Sextant or similar instrument for measuring angles	1	1	–	–	–
Deck watch	1	1	–	–	–
Binoculars	2	1	1	1	1 (1)
Barometer	1	1	–	–	–
Thermometer	1	1	–	–	–
Hand lead with at least 50 metres of line	1	1	1	1	–
Deep-sea lead of at least 12.5 kg. with 150 m. line (5)	1	1	1	–	–
Automatic sounding machine (6)	1	1	–	–	–
Logs	2	2	2	1	–
Signal flags, complete set and international signal book (7)	1	1	–	–	–

(1) *Not required for vessels engaged exclusively in service in rivers, in ports, canals or other inland waterways, unless the Governing Council for Commerce and Industry decides otherwise.*

(2) *Not necessary for wooden sailing vessels.*

(3) *Not necessary for vessels under* 100 *gross R. T.*

(4) *Not necessary for vessels other than those of iron.*

(5) *Where the vessel is of less than* 150 *gross R. T. the* 12.5 *kg. deep-sea lead may be replaced by the medium lead of* 6.7 *kg. with* 100 *metres of line.*

(6) *Not necessary for vessels of less than* 150 *gross R. T. The sounding machine shall be capable of giving soundings in depths of* 90 *metres* (50 fms) *when the vessel is moving at a speed of* 5 *knots at least.*

(7) *Not necessary for vessels of less than* 150 *gross R. T.*

FISHING AND WHALING VESSELS.

EQUIPMENT.	*Deep-Sea Navigation.*	*Navigation in North Sea.*	*Navigation in Baltic.*	*Coasting voyages.*	*Inland waters.*
Steering Compass. (See § 51)	1	1	1	1	1 (1)
Spare Compass. (See § 51)	1	1 (2)	1 (2,3)	–	–
Ship's clock.....	1	1	1	–	–
Binoculars.....	2	1	1	–	–
Barometer	1	1	–	–	–
Hand-lead with at least 50 metres of line.....	1	1	1	–	–
Deep-sea lead weighing at least 12,5 kg., 150 m. line minimum (4)...	1	1	–	–	–
Log	1	1	1	–	–

(1) *Not required for vessels employed exclusively in ports, in rivers, canals or other inland waterways, unless the Governing Council for Commerce and Industry decides otherwise.*

(2) *May be omitted in cases where the steering compass is located in the wheel-house.*

(3) *Not required in vessels of less than* 100 *gross R. T.*

(4) *Where the gross R. T. is less than* 150 *the deep-sea lead may be replaced by the lead of medium weight of* 6.7 *kg. with a line of at least* 100 *metres.*

LIGHTERS.

EQUIPMENT.	*Deep-Sea Navigation.*	*Navigation in North Sea.*	*Navigation in Baltic.*	*Coasting voyages.*	*Inland waters.*
Steering Compass. (See § 51)	1	1	1	–	–
Clock	1	1	1	–	–
Hand-lead with at least 50 metres of line.....	1	1	1	1	–

It lies within the province of the Governing Council for Commerce and Industry to grant exceptions, either general or special, to the above mentioned rules and regulations.

KUNGL. MAJ : TS OCH RIKETS KOMMERSKOLLEGII KUNGORELSE.

DECREE OF H. M. THE KING AND OF THE GOVERNING COUNCIL FOR COMMERCE AND INDUSTRY OF THE REALM

WITH THE RULES PERTAINING TO SHIPS' LIGHTS AND COMPASSES AND AS TO THE REQUIREMENTS WHICH THEY MUST FULFILL IN ORDER TO BE ACCEPTED AS SERVICEABLE.

(Given at the Castle of Stockholm, 30th. June, 1927).

SECOND CHAPTER. SHIPS' COMPASSES.

CLASSIFICATION.

ART. 21.

With regard to equipment, every vessel shall be supplied with the compasses required by the special regulations.

In order to obtain the certificate of the highest class (*A*) delivered by the Inspecting Agencies of the Sjökartverk (Hydrographic Office) a ship's (magnetic) compass must conform in every detail to the requirements in Arts. 22 to 27 below. Particulars as to certificates of the lower class (*B*) are given later on.

GENERAL REQUIREMENTS.

ART. 22.

The bowl shall be cylindrical with a flat or hemispherical base, and balanced so as to maintain a horizontal position. The cover shall be air and water tight. The lubbers line shall be correctly located und shall have a thickness of about ½ m/m. It shall be at right angles with respect to the axes of suspension. The error in this case shall not exceed ½°.

The pivot shall be fitted in the centre of the bowl in such a manner that it coincides with the intersection of the axes of suspension (of the gimbals).

The gimbals shall be of such width that the bowl may swing freely therein. An elastic suspension shall not be employed except at the extreme ends of the rolling trunnions attached to the binnacle.

The bowl and gimbals shall be practically free from iron.

The card shall possess adequate rigidity. The magnets shall be so arranged that no sextantal or octantal deviations can be produced capable of engendering a coefficient *H* greater than 1°. The point of support of the card shall not be situated at a distance greater than that which might produce a displacement of ½° at an inclination of the card of 5°.

The cap shall be adequate in size with regard to the pivot. The stones shall be of sapphire, beryl or some other precious stone of equal hardness and without defects. The point of the pivot shall be of an appropriate metal of sufficient hardness, which is not liable to attack by the air or the liquid in the compass.

The friction between the stone and the pivot shall not exceed that which would cause an error of less than 1° if the field was diminished by 0.05 C.G.S. units.

The collimation, division and eccentricity errors of the card together shall not exceed ½°.

The circular oscillation error shall be tested in an artificial field increasing to 0.12 C.G.S. units.

ART. 23.

Among other conditions governing the acceptibility of a compass, it is necessary that the name of the firm, or maker, and the number of the compass be clearly inscribed on the bowl and on the card, or that the compass have some other identifying mark which is acceptable to the authorities charged with the inspection.

ART. 24.

The possessor of a compass in category *A* shall undertake, to the Inspecting Agency issuing the certificate, to cause the compass to be tested again before the expiration of the period of validity of the certificate, without extra charge, to ascertain that the existing conditions as shown by the certificate have been maintained without change.

SPECIAL PROVISIONS.

Dry Compasses.

ART. 25.

Cards of a diameter less than 17.5 $^c/_m$ are not acceptable. The weight of the card shall not exceed 30 gms. for a diameter of 25 $^c/_m$ or more, or 20 gms. for a diameter under 25 $^c/_m$.

The magnetic moment of the card in hundreds of C. G. S. units ($1/100\ M$) per gramme weight of the card shall be:-

For a card of 30 gms. not less than 0.18;
" " " 20 " " " 0.16;
" " " 15 " and less not less than 0.15.

For cards weighing 15 gms. or less, the word "good" shall be inserted in the certificate when the coefficients show values less than 0.19, and "very good" when the values reach 0.19 and above.

The moment of inertia of the cards in tens of C. G. S. units ($1/10\ K$) per gramme weight of the cards shall be:-

For a card of 25 $^c/_m$ or more, not less than 7.
For smaller cards, not less than 6.

For cards weighing 15 gms. or less, the word "good" shall be inscribed in the certificate when the coefficients show a value of less than 9, and the word "very good" when the values reach 9 or above.

Liquid Compasses.

ART. 26.

Before a liquid compass, whether new or repaired, can be certified in good condition, a statement showing the materials of which the pivot and stone are made must first be furnished.

ART. 27.

A liquid compass shall be fitted with an expansion device which is fully capable of adapting itself to the variations in the volume of the liquid.

The freezing point of the liquid of the compass must be below — 30° C.

The weight of the card in the liquid shall be such that the card will always rest with a certain pressure on the pivot.

Cards of diameter less than 10 $^c/_m$ are not acceptable.

SPECIAL REQUIREMENTS FOR THE CERTIFICATE IN CATEGORY *B*.

ART. 28.

The so-called *B* certificates for compasses may be issued for those which, although they have not fulfilled all the requirements of the regulations, are yet found usable on examination, or may be considered serviceable for vessels of certain categories or vessels engaged in special services.

SVENSK FORFATTNINGSSAMLING

(*Bulletin of the Swedish Laws*). N° 300, of 8th. July, 1927.

INSTRUCTIONS OF H. M. THE KING TO THE INSPECTING AGENCIES OF THE SJOKARTVERK (HYDROGRAPHIC SERVICE).

(Given this 1st. July, 1927, at the Castle of Stockholm).

Inspections.

Art. 9.

At every Inspecting Agency there shall be at least the following standard instruments for test :-

.....

d) The necessary instruments for checking compasses, and all accessory appliances necessary for this purpose.

.....

All the standard and test instruments shall be submitted to the Sjökartverk for the purpose of careful check before being placed in service and further, these instruments shall be subject to the constant supervision of that office. The Sjökartverk shall exercise a permanent supervision over the activities of the Agencies under its jurisdiction.

It shall also be the duty of the Sjökartverk to submit its own standard and testing instruments, as well as those of the Inspecting Agencies, to comparison with those of neighbouring countries as often as circumstances render such check necessary.

Art. 10.

The regulations governing the inspections by the Agencies shall be issued by the Chief of the Sjökartverk. In drawing up these regulations he shall see that they conform as closely as possible with the regulations of the institutions in foreign countries charged with such inspections, without sacrificing, however, any of the accuracy deemed necessary in the inspections, and without relaxing the sustained effort by which the navigators of the country have had the benefit of the best possible instruments.

Art. 11.

Inspection of the equipment submitted for test shall be accomplished as rapidly as possible and in principle in the order in which it is received. If the inspection cannot be carried out as soon as the object is received, the Inspecting Agency shall be responsible that the interested party is notified as to the period which must elapse before the object can be inspected.

Art. 12.

On receipt of the object to be inspected, the Inspecting Agency shall deliver a receipt detached from a block of numbered receipts drawn up in a form approved by the Chief of the Sjökartverk.

The receipt given by the Agency shall be returned when the object under inspection is removed and the return of this receipt form together with the amount of the fee paid shall be entered in the register. Receipts which have been spoiled shall be cancelled but shall be preserved in the records of the office. Charges for storage shall be noted on the receipts.

ART. 13.

The object of the inspection of navigational lights and compasses is to make certain that they conform in all respects to the regulations in force concerning these articles of equipment.

Certificates for navigational lights and compasses which have been tested and accepted as suitable for service afloat shall be delivered on a form approved by the Chief of the Sjökartverk.

.....

ART. 17.

The results of the measurements and observations necessary for the tests of compasses and the calculations made for this purpose shall be entered in a Register of Observations with numbered pages. The results inscribed in the Register of Certificates shall be transcribed from this register, the sheets of the forms being numbered to conform to the numbers on the pages of the latter. In this Register of Observations there shall be a reference to the insertion of the data in the Certificate Register and vice versa.

ART. 18.

When the compass does not carry the name of the manufacturing firm and its serial number on the card or on the bowl, it shall be stamped by the Inspecting Agency after the instrument has been accepted as serviceable. This shall be done by cutting the initials of the Agency on the glass of the cover as well as an appropriate sign to indicate whether the certificate delivered concerns a compass of the higher category or the lower category.

ART. 19.

A certificate may be delivered for a card of a dry compass without the bowl being submitted for inspection; the same holds good for a bowl without the card.

ART. 20.

In cases where the inspection does not result in the establishment of a certificate, a written statement to this effect shall be delivered.