that the machinery also conforms with the requirements of the rules and has obtained a separate certificate.

Certain steam vessels obtain a □ which encloses the in front of the class mark. This signifies that the arrangement of the water- tight bulkheads is such as theoretically to ensure the floatability of the ship when the sea has access to one or two of her compartments.

The tests for steel material to be used in building the ships, as required by the same societies, may be tabulated as follows :—

|  |  |  |  |
| --- | --- | --- | --- |
|  | Ultimate Tensile Strength. | Elongation in Length of 8 in. | Temperature Test. |
| Lloyd’s Register  British Corporation . .  Registro Nazionale Italiano . ♦  Norske Veritas  Bureau Veritas  Record of American Shipping .  Gcrmanischer Lloyd .... | Between 28 and 32 tons per sq. in.  ft J»  ïf If  f f fl  Between 27 and 32 tons per sq. in.  Between 58,000 and 68,000 lb per sq. in.  Between 26 and 31 tons per sq. in. | Not less than 20% for plates f in. thick and upwards.  f > II  »1 H  »1 f»  f» »»  22 % for plates weighing 18 lb per sq. ft. and upwards.  20% for plates io mm. in thickness and upwards. | Sample heated to a low cherry red and cooled in water at 8oo F. and doubled over a radius of 1$ times the thick- ness of the plate tested. |

For plates less than ⅜ in. in thickness the first four societies in the above table allow an elongation of 16%; the *Bureau Veritas* allows an elongation varying between 20% and 10% for plates between 16/50ths and 4/50ths of an inch in thickness; the *Record of American Shipping* allows an elongation of 18% for plates weighing less than 18 lb per square foot ; the *Germanischer Lloyd* allows an elongation of 16% for plates between 10 mm. and 5 mm. in thickness and 14% for plates less than 5 mm. in thickness. For steel plates to be flanged cold *Lloyd's Register* and the *British Corporation* require a minimum tensile strength of 26 tons, and for sectional material such as angles, bulb angles and channels the tensile strength may be as high as 33 tons. For rivet steel the tensile strength must be between 25 and 30 tons per square inch, with a minimum elongation of 25% on a gauge length of eight times the diameter of the bar. Hot and cold bending and forge tests for angle bars are also prescribed.

The regulation of certain matters connected with the design of merchant ships falls upon the Marine Department of the Board of Trade. The authority of the Board is the Merchant Shipping Act of 1894, which consolidated previous enactments. These matters include the measurement of tonnage, and provision for the safety and comfort of passengers and crew. The former is discussed in a separate article (see Tonnage), but it may be mentioned here that the following countries have at various dates accepted the British rules for tonnage: United States, Denmark, Austria-Hungary, Germany, France, Italy, Spain, Sweden, Netherlands, Norway, Greece, Russia, Finland, Hayti, Belgium and Japan. The amount of deduction for propelling power varies in Spain, Sweden, Nether- lands, Greece, Russia and Belgium, but option is granted to owners to have the engine-room remeasured under the rules of allowance for engine-room relating to British ships. Special certificates are at present also issued, on application, to vessels trading to Italian ports, as the Italian authorities do not at present recognize certain sections of the Act of 1894 in regard to deductions from tonnage and exemptions from measurement. Special tonnage certificates are also issued for the Suez Canal, where the measurements of ships and deductions from tonnage vary from British rules, and are detailed at length by the Board of Trade in their Instructions to Surveyors.

With regard to safety and comfort the surveyors have to sec, among other matters, that the crews are properly accommodated and the passengers not too crowded ; that the boats and life-saving appliances are sufficient; that the lights and signals are in order; that the freeboard is sufficient and ship otherwise seaworthy; that grain cargoes are properly stowed; and that coal cargoes are adequately ventilated. Any question of doubt as to the strength of passenger vessels has to be referred to the Board of Trade, and in future midship sections, with all particulars marked thereon, are to be submitted in the case of all new steamships building under survey for which passenger certificates arc required. A passenger certificate is required whenever a steamer carries more than twelve passengers. In granting it the Board of Trade recognizes five different services, ranging from foreign-going steamers to excursion steamers in smooth water. The Board of Trade rules for scantlings are not published officially.

A Bill, introduced into parliament in 1869, dealing with the load line question, contained a clause requiring the draught of water to be recorded at which a vessel is floating when leaving port. This Bill did not pass; but in the following year the Merchant Shipping Code Bill was brought in, containing the same provision, and, in addition, requiring a scale showing the draught of water to be marked on stem and stern post of every British ship. This became law in 1871. The same Act empowered the Board of Trade to record the draught of water of all sea-going ships on leaving port by surveyors duly authorized. In March 1873 a Royal Commission on “ Unseaworthy Ships ” was

appointed by the British government, and one of the questions considered was that of the load line. In the final report in 1874 the conclusion was arrived at that a settlement of a load line should, in the main, be guided by reserve buoyancy as a first consideration. The commissioners were, however, of opinion that an act of parlia- ment, framed to enforce any scale of freeboard, would be mischievous, if not impossible, as would be any universal rule for the safe loading of merchant ships.

In 1874, in a paper read before the Institution of Naval Architects

by Mr B. Martell, who was then the chief surveyor to *Lloyd's Register,* tables of freeboard were suggested from data collected at all the principal ports in the United Kingdom. These tables were based on the principle of reserve buoyancy, and were intended to apply to the loading of the various types of sea-going ships then to be dealt with. As an indication of the form of the vessel, it was suggested that a tonnage coefficient of fineness should be used, in order that the tables proposed might be readily adapted to all sea-going ships, whether at that time at sea or in port. In 1875 a short Act was passed, to remain in force only until October of the following year, which embodied as its chief feature the requirement of what was afterwards universally known as the “ Plimsoll mark ” (after the late Mr S. Plimsoll, M.P., the prime mover in securing legislation for the prevention of over- loading in British ships). All British ships were to have the position of the deck shown on the side of the ship, and every foreign-going British ship was to have a circular disk marked below the deck line, indicating the maximum draught to which it was intended to load. The Act in no way fixed the amount of freeboard; this was left to the shipowner. The provisions of the 1875 Act were con­firmed by a more comprehensive Act in 1876, which extended the compulsory marking of the deck line and disk to all British ships, except those under 80 tons engaged in fishing and the coasting trades, also excepting yachts or war vessels. Before this Act was passed the Board of Trade took action, by appointing a committee to consider the possibility of framing rules for the regulation of freeboard. The committee was to be composed of representatives of the Board of Trade, *Lloyd's Register,* and the Liverpool Under- writers’ Registry. This attempt to establish an authorized scale of freeboard failed. Meanwhile the subject was not lost sight of; the collection of data was continued, investigations were carried out, and six years later (in 1882) the committee of *Lloyd's Register* issued freeboard tables, and undertook to assign freeboard, on the basis of the tables issued, on owners making application for the same. In the course of three years 944 vessels had freeboards thus assigned to them, and in the case of 775 of this number the owners voluntarily accepted the freeboards assigned. In December 1883 the Load Line Committee was appointed by the Board of Trade; and after two years’ careful deliberation and investigation, involving much labour, the committee presented its report. This report was accompanied by tables, which agreed closely with those previously issued by *Lloyd's Register’,* and they were accepted by the committee of that society in September 1885. Between 1885 and June 1890 (the latter being the date the Load Line Act was passed) 2850 steam and sailing vessels had freeboards fixed by *Lloyd's Register,* and of these 2520 were taken from the tables. After the passing of the Act in 1890 appointments to assign freeboards were granted to *Lloyd's Register, Bureau Veritas* and the *British Corporation.*

In 1893 the original tables were modified with respect to some of the ports in the United States on the Atlantic, the sailing from or to which in the winter was to subject the ship to a few inches addi- tional freeboard. In 1898 they were further modified (*a*) to exempt ships over 33o ft. in length from the additional freeboard just men­tioned, and to limit the additional freeboard in smaller ships; (*b*) to give some concession to turret-deck steamers; and (*c*) in some other minor matters.

In 1906 the Shipping Laws were amended so that all foreign vessels loading at British ports required to be provided either with a free- board assigned under the British tables, or under tables of a foreign country which had been certified by the British Board of Trade as being equally effective with the British freeboard tables.

In the same year the British tables were revised throughout in the light of the experiences of previous years of practical administration, by a committee whose members were drawn from the Board of Trade and the three assigning bodies—Lloyd’s, British Corporation, and the Bureau Veritas. Important modifications were