ing with a test gauge, as any kind of force pump will serve the purpose, and in the absence of a special pump the boiler feed pump can be utilized. Gauges can be tested by fitting them to a piece of lead pipe, a gauge at either end, the pipe being bent to bring the gauges vertically. The pipe should be filled with water and then inserted between the jaws of a vise, when screwing up on the vise will bring pressure to bear on both gauges. This is, perhaps, as convenient a way as any, providing the lead pipe can be obtained, for in the absence of a vise a lever can be applied which will serve a similar purpose. An occasional test of a gauge should be made if its indications are to be relied upon, and it is better to keep the pressure gauge in good order, and be certain that it records correctly, than to depend on the safety valve, whether of the lever or spring type, for these, too, are liable to improper working, if not given proper attention.

STEPHEN H. EMMENS, of Youngwood, Pa., writes as follows to the *Engineering and Mining Journal*, of New York, touching on the peculiarities of Canadian nickel: "Your interesting editorial of May 13th upon the subject of nickel contains the remark: 'Indeed, it may be said that the day of wet processes for nickel-winning is past.' Will you allow me to suggest a qualification of this assertion? The word nickel has two significations in commerce. It may mean true elemental nickel, commercially pure, or it may signify an alloy of nickel and cobalt, associated with appreciable quantities of copper, arsenic, sulphur, iron and manganese. For some purposes, such as armor plates, the nickel-cobalt alloy is good enough; but for the manufacture of German silver, and for anodes in 'silver-white' nickel plating, first-class results can only be obtained by using pure nickel. And as no wholly dry process hitherto employed is capable of separating cobalt, or even (to a thoroughly satisfactory extent) copper, arsenic, and manganese, from nickel, it would appear that a portion of the nickel consumed in the world's industries will continue to be produced either altogether in the wet way, or by a judicious combination of wet and dry methods. The introduction of the Canadian nickel into the market has caused the distinction here drawn to become of practical importance. So long as the market was supplied with metal from the comparatively pure New Caledonian ore, there was not very much to choose between the French article and that made in the wet way by America's 'Nickel King,' Mr. J. Wharton, of Camden, N. J. But the Canadian pyrrhotite carries much copper, cobalt, arsenic, and manganese, in addition to its normal iron, sulphur, and nickel; and metal produced by dry methods from such a raw material is not fitted for fine uses. Hence, there are now two grades of fine nickel in the market, and consumers are becoming aware of the fact."

T. J. MILTON, Chief Engineer Surveyor of Lloyd's, says that though the cylindrical form of boilers is the one generally made use of, under the idea of its perfect equilibrium under a uniform pressure, yet there are several conditions thus given rise to, which result in deformations. The most important changes are the variations of transverse dimensions of the combustion chambers, and the alteration of shape of the cylindrical shell. The sides of the combustion chambers are stayed to the shell, and unless the staying be continuous round the crown and bottom of the boiler, the pull of the stays must distort the boiler, lessening its horizontal and increasing its vertical diameter. With regard to flat surfaces, when unequal surfaces are stayed together, it is evident that the load on the larger surface, being greater than that on the smaller, cannot produce supporting forces in the stays sufficient to prevent all yielding. The stays moving in the direction of the larger surface will bulge outwards, while the smaller surface will be drawn inwards. Thus, the area of the front tube plate is greater than the combined areas of the three back tube plates. They are tied together by the tubes, and when under pressure the front tube plate bulges outwards, drawing the back tube plates with it. The pressure on the sides of the combustion chamber tends to bulge them inwards, and this puts a tension on the stays which distorts the shell from a truly cylindrical form. In one case, the increase of vertical diameter of the shell of the boiler at a working pressure of 160 pounds was 1-16 inch, whilst at the test pressure the increase in vertical diameter was ⅛-inch, the test pressure being double the working pressure. On the other hand, the decrease of horizontal diameter at the test pressure was 1-32 inch. This was a boiler 14 feet in diameter and 10 feet long, having 3 flues. The thickness of shell plates was 1⅛ inches.

A BOILER'S HORSE POWER.

The horse power of a boiler is now nearly always figured by engineers upon the basis of the amount of water it will evaporate under certain conditions. The term, however, is somewhat misleading. The boiler simply supplies steam for an engine to use, and it is in the engine itself that the horse power developed by the steam shows itself. If a boiler driven its hardest could just furnish steam enough for 100-horse power developed in an engine using forty pounds weight of steam per hour per horse power, this would be an evaporation of $40 \times 100 = 4000$ pounds of water into steam. The useful work of the boiler produces but 100-horse power. If, however, the engine used but 20 pounds weight of steam per horse power per hour, then the 4,000 pounds that the boiler evaporated would in this engine produce $4{,}000 \div 20 = 200$-horse power, or twice as much power. The standard of horse power used for a boiler has nothing whatever to do with horse power. It signifies simply the amount of water the boiler will evaporate, and because the name is a common one, this unit of duty is called a horse power. This unit is the evaporation per hour of 30 pounds of water at 100° temperature to a steam pressure of 70 pounds. The standard of horse power of a boiler serves the purpose of being a measure of its ability compared with other boilers. It simply measures the absorption of heat by the water in a given time, and does not undertake to account for the consumption of coal.

MARINE BOILERS.

The main problem before the marine engineer, says Prof. W. F. Durand, in the *American Shipbuilder*, is to obtain from the minimum weight of material the maximum amount of power, due regard being had to first cost, durability, reliability and economy generally. The boiler, which is a part of the engine in which these conditions must be rigorously observed, consists naturally of two parts, a place for the fire and a place for the water. These must be separated by a surface through which the heat is transferred from one to the