cylinder, and of the same nominal power, but of better construction, may give out, and frequently does give out, real and effective power equal to that of 150 horses. Real or effective power, and nominal or mercantile power, are seldom identical, and should always be dis­tinguished from each other.

Even the nominal or mercantile standard of power is not so perfectly invariable as may be desired. It varies a few inches according to the practice or policy of the engineer, who is frequently called upon to give an inch or two more in his mercantile dimensions, than the strict letter of his agreement might demand. Another cause of variation is this, that some engineers will prefer to sell a larger actual dimension under the name of a less number of horse power, that their engines of a given nominal power may apparently do more work than those of other people. It is a third cause of variation, that some engine-makers give more than the actual dimen­sion belonging to the power, in order that, under even the most unfavourable circumstances, the possessors of the engine may derive from it more than the full measure of the actual effective power which they require.

The following table has been constructed from a comparison of the practice of the most eminent marine steam engine makers, with the principles of their con­struction. But under the dimensions given, the engines of best construction will give ont from one-fourth to one- third more than their nominal power. We know, for example, that a cylinder of 74 inches diameter has been constructed under the designation of 200 horses, whereas its proper nominal power is above 225 horses, and its actual effective power, as given out in the ship, was more than 300 horses. The contraction H.P. is gener­ally used instead of the words horse power.

*Table of the Dimensions of the Cylinder of a Marine Steam-Engine of given Horse power.*

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Nominal Power. | |  | Dimensions of Cylinder | |  |  |  |
| Diameter (within.) | | Length of Stroke. |  | |
| 10 | H.P. | 20 | Inches. | 2 Feet | | 0 | In. |
| 15 | ,, | 24 | ,, | 2 | ,, | 2 | ,, |
| 20 | ,, | 27 | ,, | 2 | ,, | 6 | ,, |
| 25 | ,, | 30 | ,, | 2 | ,, | 10 | ,, |
| 30 | ,, | 32 | ,, | 3 | **,,** | 2 | ,, |
| 35 | ,, | 34 | ,, | 3 | ,, | 3 | ,, |
| 40 | ,, | 36 | ,, | 3 | ,, | 6 | ,, |
| 45 | ,, | 38 | ,, | 3 | ,, | 9 | ,, |
| 50 | ,, | 40 | ,, | 4 | ,, | 0 | ,, |
| 60 | ,, | 43 | ,, | 4 | **,,** | 3 | ,, |
| 70 | ,, | 46 | ,, | 4 | ,, | 6 | ,, |
| 80 | ,, | 49 | ,, | 4 | ,, | 9 | ,, |
| 90 | ,, | 52 | ,, | 5 | ,, | 0 | ,, |
| 100 | ,, | 55 | ,, | 5 | ,, | 6 | ,, |
| 110 | ,, | 57 | ,, | 5 | ,, | 6 | ,, |
| 115 | ,, | 57 | ,, | 5 | ,, | 9 | ,, |
| 125 | ,, | 59 | ,, | 6 | ,, | 0 | ,, |
| 130 | ,, | 60 | ,, | 6 | ,, | 0 | ,, |
| 150 | ,, | 62 | ,, | 6 | ,, | 3 | ,, |
| 165 | ,, | 65 | ,, | 6 | ,, | 6 | ,, |
| 175 | ,, | 66 | ,, | 6 | ,, | 6 | ,, |
| 200 | ,, | 70 | ,, | 7 | ,, | 0 | ,, |
| 225 | ,, | 73 | ,, | 7 | ,, | 3 | ,, |
| 250 | ,, | 76 | ,, | 7 | ,, | 6 | ,, |
| 275 | ,, | 79 | ,, | 7 | ,, | 9 | ,, |
| 300 | ,, | 82 | ,, | 8 | ,, | 0 | ,, |
| 350 | ,, | 87 | ,, | 8 | ,, | 6 | ,, |
| 400 | ,, | 92 | ,, | 9 | ,, | 2 | ,, |
| 500 | ,, | 100 | ,, | 10 | ,, | 0 | ,, |

This table shows that the power of the steam-engine increases more rapidly than the area of the cylinder or the square of the diameter. By the rule of the square of the diameter, the power of an engine of 74 inches would be about 200 instead of about 225; and 100 inches dia­meter would give only 333 horse power; but the same rule would give too small a diameter for the lower powers. We believe that engines of the dimensions of this table will all work to more than their nominal power.

The best proportion between the diameter of the cylinder and the length of the stroke, has been the sub­ject of much dispute, and of opposite practice. In Ame­rica, a diameter of 40 inches is sometimes combined with a stroke of 10 or 11 feet, being more than double the length given in this country. On the Clyde, we have seen the opposite extreme, a diameter of 60 inches with a stroke of only 4 feet. For sea-going ships, the pro­portions we have given are the most convenient. In deviating from this proportion, a longer stroke will be preferable to a shorter ; and with the necessary altera­tions required for high velocities of piston, a longer stroke working the steam expansively is likely to be attended with many advantages.

By means of a long stroke or great velocity of piston, considerable advantages are gained. The pressure upon the journals and working parts of the engine, and the consequent strain, is lessened in proportion to a given power. All the parts of the engine might be lighter than with a shorter stroke and a greater diameter of cylinder. A short stroke has however this advantage, that with a given length of lever and connecting rod, the angles of oblique pressure are smaller, and the intervals of time between maximum and minimum pres­sure are shorter. There are other peculiarities of smaller importance. On the whole, a longer stroke than that of the present British engine, as given in the table, is to be reckoned considerably preferable to a shorter one.

The velocity of the piston in the cylinder of a steam- engine is generally reckoned in this country at 220 feet a- minute, and all the arrangements of the engine and its work are made on that principle. We can find no better reason for this than that a horse going at that speed, viz. two miles an hour, can draw 150 lbs. eight hours a-day, all the year round. Tredgold finds it to be a law of nature. It is strange how much this arbitrary dogma, transmitted without question, has retarded the improvement of steam navigation. It is a rule as uni­versal in its acceptation as it is groundless and inju­rious. With large condensers, and large ports and valves, double the speed may be employed with great advantage.

*The Condenser and Air-Pump.—*The condenser is the most wonderful part of the marine-engine, as indeed of the ordinary steam-engine. It is here that the whole process carried on in the boiler in so great bulk, and at so much expense, is instantly reversed, and all its laborious effects at once, as it were, annihilated. It is the instan- taneity of condensation that is its virtue : without this the whole of its virtue in the steam-engine is lost. Sup­pose a condenser capable of condensing the steam as fast as it is generated by the boiler, and given off in the cylinder, and no faster, what would be the conse­quence ? The power of the engine would cease, the elastic force of the steam above the atmosphere would alone act, the steam being only condensed as the piston carried it out of the cylinder ; the engine would become nothing else in power but a high-pressure engine, whose steam is merely condensed before going out into the atmosphere. It is by forming a perfect vacuum in the