STANDARD SIZES FOR HEXAGON BOLT HEADS AND NUTS.

[In *Mechanics*, November, 1884, a communication on the above caption from Mr. C. E. Simonds, East Cambridge, Mass., was published. This we reproduce with some remarks by Mr. Coleman Sellers, Professor of Mechanics in the Institute, who was a member of the Committee of the Franklin Institute that reported on this subject December 15th, 1864.]

"The advantages of a system by which certain classes of machine-work can be constructed and placed upon the market are of untold value so long as the product is constructed according to the rule given. Adopting a rule is one thing, but universally working to it is another matter. On December 15, 1864, a system of bolt heads and nuts, as well as screw threads, was recommended and adopted by a committee of the Franklin Institute of Philadelphia, and adopted by the United States Government in May, 1868. It is well, perhaps, to state that this system is known as the Sellers' or Franklin Institute, likewise the United States' standard. The sizes or dimensions of the width of the parallel sides of a hexagon bolt head and nut are $1\frac{1}{2}$ times the diameter of the bolt plus $\frac{1}{8}$ inch when the nut or bolt head are in the rough state; thus it will be seen by the rule that a nut or bolt head for a 1-inch bolt should measure $1\frac{5}{8}$ inches. For a finished hexagon bolt head and nut the rule is $1\frac{1}{2}$ times the diameter of the bolt plus $\frac{1}{16}$ inch, and the nut and bolt head should thus measure $1\frac{9}{16}$ inches.

"The writer, some time ago, furnished drawings for a complete set of wrenches of the drop-forged system, and the sizes given were for bolts from $\frac{1}{4}$ inch to 6 inches inclusive. A large number of the wrenches were milled exact to size, case-hardened and placed upon the market, and the undertaking brought to light the astonishing fact that of all the manufacturers of hexagon bolt heads and nuts in the United States not one can be found who manufacture nuts and bolt heads according to the rule as given by the Franklin Institute. Messrs. Hoopes & Townsend, of Philadelphia, in their catalogue state that the nuts on pages 20 and 21 are United States' standard sizes and have been adopted as standard by several of the most prominent railroads. Pages 20 and 21 gives sizes of bolts and nuts from $\frac{1}{4}$ inch to 3 inches, the list including cold-punched, chamfered and trimmed nuts; also cold-punched nuts for cars and unfinished work. It is to be borne in mind that the manufacturers state that they are United States' standard

sizes. If the rule of $1\frac{1}{2}$ times the diameter of the bolt plus $\frac{1}{16}$ inch be correct, how is it that Messrs. Hoopes & Townsend, as well as all of the manufacturers of nuts and bolts, make their product $\frac{1}{16}$ inch larger, and distinctly state that the thread and outside of each bolt head and nut are made to an accurate gauge and to the standard adopted by the United States Government? What are mechanics to understand by these statements? Do goods manufactured $\frac{1}{16}$ inch over size mean that they are to be classed with articles manufactured $\frac{1}{16}$ inch less in size, which is the true size.

"Page 42 of their catalogue gives proportions for United States standard screw threads and nuts. Taking from their table a bolt of 1-inch diameter, it is shown that the width of the parallel sides of a nut are $1\frac{5}{8}$ inches; according to the Sellers or Franklin Institute system it should be $1\frac{9}{16}$ inches. Take, again, the list of sizes as given on page 7, which, by the way, are stated to be standard sizes of heads for bolts—it will be noticed that the word standard is affixed to everything on this page— $1\frac{9}{16}$ inches is given for the size of nut for a 1-inch bolt. This is correct. What does this mean? Perhaps Messrs. Hoopes & Townsend will explain what the word standard means. Haswell's pocket edition for mechanics and engineers for 1870 gives on page 123 a list of sizes of nuts and bolts from $\frac{1}{4}$ inch to 6 inches inclusive. This list gives as a rule $1\frac{1}{2}$ times the diameter of the bolt for the width of the nut, and hence by this rule we have another size of nut. On the next page Mr. Haswell gives the sizes of screw threads, bolt heads and nuts as per rule of the Franklin Institute. Why Mr. Haswell gives two sizes of nuts for the same bolt is a mystery to the writer. The sizes thus shown in this edition are $1\frac{1}{2}$ and $1\frac{9}{16}$ inches for a bolt of 1 inch diameter. In the revised edition for 1884, page 157 gives $1\frac{1}{2}$ times the diameter of the bolt for the width of the head, and $1\frac{1}{2}$ times the diameter plus $\frac{1}{8}$ inch as the width of the parallel sides of a hexagon nut. Rather poor information to be found in a revised edition. Mr. Trautwine in the revised edition of his pocket-book gives as a rule $1\frac{1}{2}$ times the diameter of the bolt for the width of the parallel sides of a hexagon bolt head and nut, and he says that some machinists add $\frac{1}{8}$ inch to this for all diameters of bolts. The word *some* is very amusing, taken as it is from the pages of a work devoted to the interests of mechanics.

"In *Mechanics* for March 18, 1882, a correspondent asks for information regarding the sizes of standard bolt heads and nuts of the Frank-

lin Institute system, in which he feels sure that it would be conferring a great favor upon many readers, and would at the same time enlighten many workmen who are not posted upon the subject. The sizes, as well as the information thus given, are taken from the revised edition of Mr. Nystrom's pocket-book, and it is stated that the sizes are those of the Franklin Institute system, which, by the way, is not the case, inasmuch as the sizes given are $\frac{1}{16}$ inch over size. At the end of the article it is stated that the workman should bear in mind that these dimensions are finished sizes, and are intended for use on either black or bright work; and, furthermore, that the same size wrench will fit either finished or unfinished bolt heads and nuts. The *Scientific American Supplement*, No. 443, page 7072, for June 28, 1884, contains the best and only correct table ever published. To the railroad master-mechanic, master car-builders and mechanics in general the questions arise, Is it possible to ever correct the error which has existed for a period of over 20 years? Is it not best to drop the word standard, and forget that there was ever such a word? It looks something like counting chickens before they are hatched. We have got the word standard, but where are we to find the nuts or the manufacturers who know what the standard is and who work to it?"—*C. E. Simonds, in Mechanics.*

REMARKS ON THE FOREGOING:

The Franklin Institute standard of *bolt threads* is the same as that of the United States Government, as fixed by the board under Mr. Isherwood, then Chief of the Bureau of Steam Engineering, May 15, 1868. In regard to the size of the heads of bolts and also the size of nuts the Franklin Institute standard is *not* the same as that adopted by the United States Board and now called the United States standard. Mr. Simonds correctly states the Institute standard for finished bolt heads and nuts to measure, for the width between the parallel sides of hexagon nuts, once and one-half the diameter of the bolt plus one-sixteenth of an inch. That is to say, rough bolts made one and one-half plus *one-eighth* of an inch can be planed or dressed to the finished size, there being sufficient stock for that purpose. The Government Board decided that all bolt heads and nuts should be made the same size, whether black (that is rough) or finished, so that the same wrench could be used on either. Unfortunately they adopted as the size of the finished bolt head and nut the rough size, as indicated by the

Franklin Institute committee. Messrs. Hoopes & Townsend are hence quite correct in calling their product the United States standard. Accepting the fact that there has thus come to be a discrepancy between the standard recommended by the Institute and the United States, it may be well to say a few words about the principle involved. I may say that there are many very large concerns, which, having adopted the Franklin Institute standard of bolt heads and nuts, have come, since the introduction of the improved methods of making forgings and cold pressed nuts, to call all nuts and bolt heads *finished* that are made to gauge either in the smith shop or in the machine shop. It would be doing injustice to the very good nuts, for instance, made by Messrs Hoopes & Townsend, to call their cold pressed nuts, sized by passing through gauged dies, "unfinished" or "rough" nuts. They are as accurate to size as the nuts finished and polished in many machine shops. It is no very easy matter, nor is it wise, for those who have adopted the smaller size of the Franklin Institute, to revert to the larger size recommended by the Government Board. Machines having bosses raised on the patterns for the bolt heads and nuts, will require such bosses to be enlarged for the larger size. Bolts placed near to flanges, in corners or near edges, will have to be moved away from the flange or farther from the corner to allow room for the use of wrench. Good engineering calls for the head and the nut to be as small as is consistent with strength and utility in manipulation, to permit the placing of the bolt in the best position, that is, in the closest proximity to flanges and in corners. Very often the removal to a greater distance from the edge will necessitate the use of a larger bolt. All these matters were considered by the committee of the Institute, and confirm the writer in his preference for the standard of the Franklin Institute, as all bolts can be reduced in size of head without prejudicing their position, while enlargement involves practical difficulties without any good result. We have now two standards, and, that there are many who know how to work to either, is shown by the fact that all makers of bolts and nuts furnish what they are required to do under one or the other name, even if they do only publish as standard that adopted by the Government Board.

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