SCREWED FASTENERS IN MACHINERY SERVICES

BY

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In recent years there has been a radical change in the approach to the use of nuts and bolts, and in the materials of which they are made. It is believed that there may be some confusion in the minds of engineer officers as to the grades of fasteners available from Naval Stores, the service for which they are intended, and the precautions which should be observed. The purpose of this article is to clarify the position.

The Bright Bolt

Until a few years ago, the normal type of nut and bolt supplied for general use in the fleet, was known as the ' bright bolt'. This was of plain carbon steel, machined from solid, and could be manufactured by ship's staff if required. It usually had a Whitworth thread. This material was good enough for most work, but suffered greatly in steam systems from a form of deterioration known as strain-age embrittlement.

Carbon-Manganese Steel

In order to avoid the disadvantages of the bright bolt, attention was turned to heat-treated bolts and studs of carbon-manganese steel, with a tensile strength of 45–55 tons/sq in, which were almost immune from embrittlement. These fasteners, sometimes called ' D ' quality, were being used very extensively in the aircraft industry, where a higher U.T.S./Yield ratio over the normal bright bolt was required. Provided the Admiralty kept to standard sizes, avoiding collars and other non-standard shapes so well liked by the marine industry, there was plenty of manufacturing capacity which could, however, be tapped for Naval use. These bolts and studs were introduced into the Service about 1943 and were so successful that it was eventually decided to abandon the bright bolt, even for minor services, to simplify stocking and avoid the risk of confusion.

En.16, En.100, En.6 and En.7

In spite of the need for standardization, it was evident that some non-standard bolts and studs would be required. It is beyond the capacity of ship's staff to make bolts, which are formed from wire or bar with the heads either hot or cold forged, and a suitable bar material had to be provided from which bolts could be turned. Eventually two steels were included from the B.S.970 series, numbered En. 16 and En. 100 : both of these are heat treated and, to indicate this, stock is held by the Naval Store as bar steel—En. 16R or En.100R.

With the development of the higher tensile steel bolt, its use expanded until it is now available from Naval Stores as bolts and stud-bolts in B.S.F., unified coarse or fine threads and as studs and set-screws in Whitworth threads, as well as B.S.F. and unified. These fasteners are bought under sub-head B.2 (d) and can be found in the Rate Book of Naval Stores under this heading. They are purchased under Contract Schedule 92A and E.-in-C. Specification 6Fa2 is the authorizing technical document.

The nuts for these bolts, and stud-bolts, are of carbon-manganese steel, En.6 or En.7, but with the slightly lower tensile strength of 35–45 tons/sq in. Both faces are chamfered to facilitate machining on automatic machines and because the stress distribution is better in this form. A case hardened steel washer should be fitted under each nut in steam systems.

Carbon-Chrome-Molybdenum Steel

With the increase of steam pressures and temperatures, a better quality of fastener became necessary, having creep properties more able to meet the new conditions than the ordinary high tensile bolt, which reached its limit at 750°F. The material eventually adopted was a carbon-chrome-molybdenum steel to B.S.970 En 20. This is also heat treated, to condition ' T ', giving a minimum tensile strength of 55 tons/sq in. Because these bolts should only be used where temperatures exceed 750°F. (i.e. steam services), stud-bolts and studs only are provided, and these will be found under sub-head B.2 (d) of the Rate Book of Naval Stores. They are purchased under Contract Schedule 92B and E.-in-C. Specification 3Fa5 is the authorizing technical document. These stud-bolts and studs are supplied with B.S.F., unified coarse or fine threads.

The nuts for these fasteners are of manganese-molybdenum steel, to a specification supplied by the manufacturers, and it has no B.S. equivalent. These nuts are copper plated to prevent seizure of threads at high temperature. It is intended that a case hardened steel washer should be fitted under each nut.

Manganese-Chrome-Molybdenum Steel

Since these high temperature bolts reach the limit of their useful creep range at 900°F. and as higher temperatures were already contemplated, a more creep resistant material became necessary. This condition has been met by a manganese-chrome-molybdenum steel to B.S. 1506–661 giving a tensile strength of 55 tons/sq in and having good creep properties over 900°F. working temperature. This material will be used for studs and stud-bolts and although, at the moment, provision is made for B.S.F. or unified threads, it is probable that, by the time these fasteners are required, unified threads only will be provided. The nuts for these fasteners are of manganese-molybdenum steel to B.S. 1750 giving a tensile strength of 40 tons/sq in. They are copper plated.

These fasteners have not yet been adopted in the Rate Book of Naval Stores but E.-in-C. Specification 3Fa8 is the authorizing document.

Identification

It is important that a fastener should be correctly identified before use, and the following are the correct markings :—

High Tensile Bolts to Contract Schedule 92A
E.-in-C. Specification 6Fa2

These have a smooth, black, oxidized finish, including the thread, as distinct from a ' black ' bolt which is a rough, black forging, except for a bright machined thread. All bolt heads have the letter ' R ' and a manufacturer's brand mark stamped on the head, except for two qualities stamped ' NEWALL—H.T.' or 'NEWALLOY'. The ends of all studs and stud-bolts above $\frac{3}{8}$ in. diameter are stamped with the code letter ' R'. Nuts are not marked, but are bright all over and recent supplies are chamfered on both sides. They are readily identified from the ' black ' nuts previously used for hull and minor services, which are machined on the top and underside only.

High Temperature Steel Bolts and Studs to Contract Schedule 92B
E.-in-C. Specification 3Fa5

All stud-bolts and studs are stamped on the plain portion of the shank with the legend ' EN 20 '. The nuts are not identified but they are copper plated.

High Temperature Steel Bolts and Studs to
E.-in-C. Specification 3Fa8

All stud-bolts and studs will be stamped ' B 14 ' on the plain portion of the shank but, as these fasteners are not yet in service, the information is merely academic. The marking of the nuts, which will also be copper plated, has not yet been decided.

Uses

The general categories for which the various fasteners are designed are therefore :—

General machinery purposes and steam up to, and including, 750°F.—
E.-in-C. Specification 6Fa2.

Steam above 750°F. and up to, but not including, 900°F.—E.-in-C. Specification 3Fa5.

Steam at 900°F. and above—E.-in-C. Specification 3Fa8.

It will be appreciated that all fasteners now supplied for machinery services are heat treated and hence the practice of applying an oxy-acetylene flame, or other forms of heating, to remove seized nuts should be avoided as far as possible. If, however, it is impossible to avoid doing so, the nut and bolt complete should be discarded and new fitted. A new nut and bolt is not usually required when a flange is broken, because these new fasteners do not suffer from strain-age embrittlement. These should be replaced only if the threads have suffered damage.

The manufacture of standard bolts by ship's staff is an uneconomical procedure and every effort should be made to use standard sizes demanded from the store. It will be found that the ordinary hack-saw blades issued will not cut the high tensile stud fasteners but ' Blades, Patt. Nos. 9426–9428 ', will be quite satisfactory.