

SECTION 1, CHAPTER 3 .

TORQUE LOADING

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Introduction

1. **Torque Load.** The degree of tightness of the joint between components is dependent upon the load imposed on the nut and bolt assembly securing the joint. This load, which is applied by exerting a tangential force at the free end of the spanner, is known as the torque load and is equivalent to the applied force multiplied by the distance of its application from the axis of the bolt. It is expressed in lb./ft. or lb./in.

2. If the torque load does not strain the material beyond its elastic limit, the bolt will return to its original length when the load is removed. If the torque load causes strain beyond the elastic limit of the material, the bolt will yield and ultimate failure will occur.

Use of Spanners

3. Care must be taken when tightening screwed fittings to avoid the application of excessive torque. Over-tightening can result in threads being stripped and bolts or studs being broken or unduly strained. It is important, however, that all nuts are properly tightened. Normally, experience teaches a

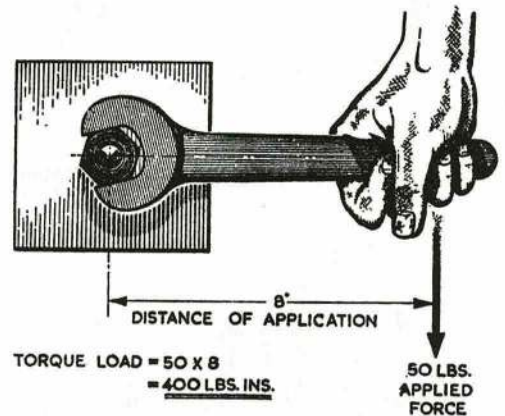


Fig. 1. TORQUE LOAD

mechanic the " feel " when a nut is correctly tightened. Always use the correct spanner. Tighten evenly without jerking and do not use a hammer, a tube over the spanner, or other means to obtain greater leverage ; such practices are **STRICTLY FORBIDDEN** except where authorised in special circumstances.

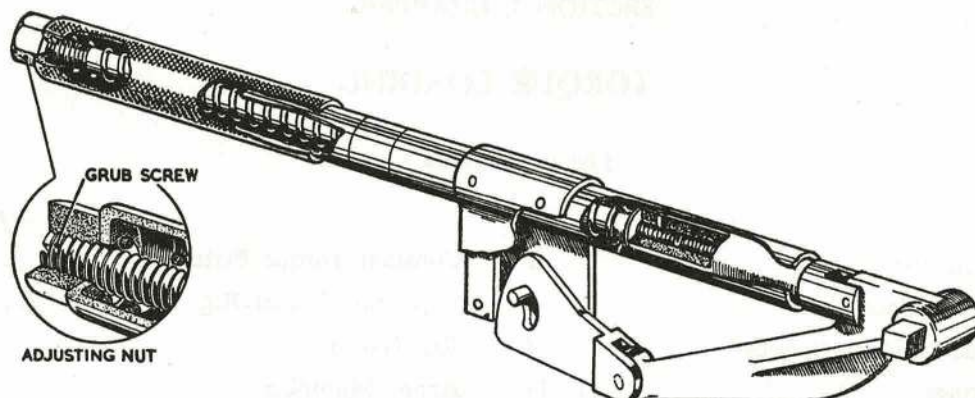


Fig. 2. BREAK-BACK TORQUE WRENCH

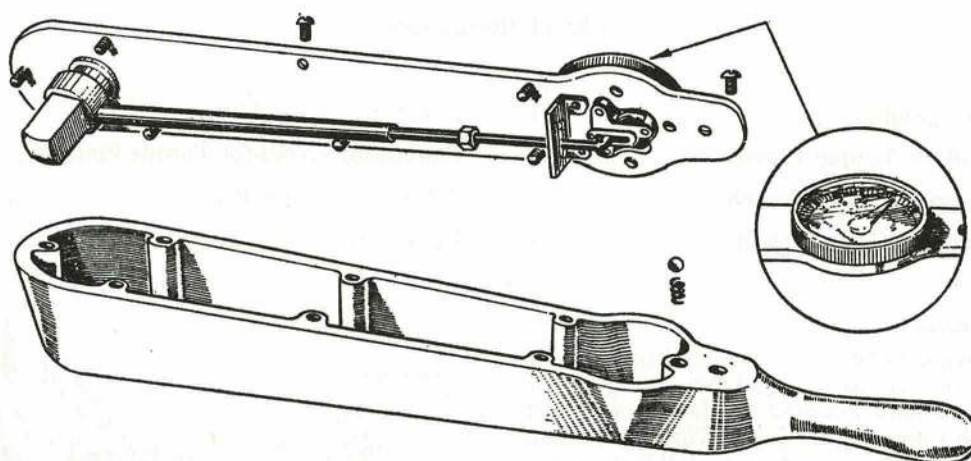


Fig. 3. TORQUOMETER TYPE WRENCH

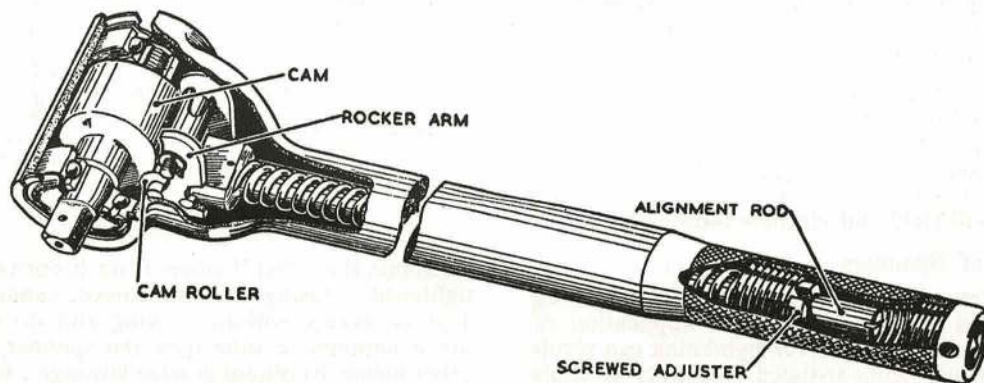


Fig. 4. "ACRATORK" WRENCH

Torque Loading Devices

4. The need for correct torque loading of certain bolts and studs is of such importance that, either the stretch of the bolt is measured, or special torque loading devices are used. Measuring the stretch of a bolt is only suitable for bolts which can be measured for length on the job. Consequently, the use of torque loading devices is the method most frequently adopted.

5. **"Break-Back" Torque Wrench.** This is a spring-loaded wrench, which "breaks" at a knuckle joint when the limiting torque load is reached. It is suitable for torque loads of 40-150 lb./ft., and may be set, within this range, by adjusting the compression of the spring in the wrench handle. The wrench illustrated is adjusted by removing the grub screw, turning the adjusting nut in the desired direction (tightening increases the load), locking the setting with the grub screw, and finally re-checking the setting.

6. The wrench is used in conjunction with a socket spanner, various sizes of which are available to suit the various sizes of nuts. Each socket spanner has a squared recess in which fits the squared boss or pilot on the wrench.

7. **Torquometer.** This wrench incorporates a steel rod which deflects when torque is applied. The steel rod operates a pointer over a calibrated dial which shows when the desired load is attained. Adjustment is effected by removal of the screws on the face of the wrench, and varying the length of the steel rod at the dial end. The zero setting is altered by rotating the bezel.

8. Several sizes of this type of wrench are available and are used in conjunction with socket or extension spanners. Where an extension spanner is used, the requisite torque loading will be obtained with a lower dial reading.

9. **"Acratork" Wrench.** "Acratork" torque wrenches are available in a variety of sizes to suit various ranges of torque loading. All models of the wrench are similar in design and the construction details are shown in the diagram. The wrench operates auto-

matically to release a totally enclosed spring-loaded cam mechanism when its pre-set torque loading has been applied.

10. A wrench is used in conjunction with the appropriate socket spanner. When the spanner is in use, tightening of the nut is continued until, at the pre-set torque, the spring loading is overcome and the roller is forced out of engagement with the cam. The roller then rolls around the periphery of the cam and no further tightening of the nut is possible. When the roller is re-engaged in the cam, a dot on the end of the cam spindle is in line with an arrow on the head of the wrench; the wrench is then set ready for use.

Note.—A right hand "Acratork" wrench must not be used to apply a torque load to a nut having a left-hand thread.

Markings

11. It is a requirement that every wrench, except the torquometer or dial wrenches, must be etched on the handle with a serial number and the torque loading to which it is set. If the torque loading of a wrench is subsequently altered, the original loading figure must be erased and the new torque loading figure substituted.

12. Torquometer or dial type wrenches should bear an etched serial number, so that each wrench may be identified in the records of periodic checks.

Checking

13. Torque wrenches that are in constant use are to be checked weekly; those used less frequently should be checked on each occasion before use. A record is to be kept of all checks and of any adjustments made to the wrenches.

14. Although the rigs and fixtures differ in detail, they all provide a means of applying a known torque with which the setting of the torque wrenches can be compared and adjusted as necessary. Two methods are described in the following text.

Constant Torque Fixture

15. When the appropriate fixture for a wrench is not available, the constant torque fixture

can be used. The required torque is obtained by applying weights to a lever and segment with an effective length of 8 inches, the load being applied by a steel wire rope passing over a pulley to which is attached a weight carrier. Three weights are supplied, each embossed with its torque value in lb./ft., but where a torque value cannot be obtained by a combination of the weights, suitable weights may be locally manufactured.

16. Fit the appropriate adapter to the shaft of the fixture, insert the pilot drive of the wrench into the adapter, turn the wrench in a clockwise direction to raise the unloaded weight carrier, and then restrain the handle grip of the wrench from turning as the weight carrier is loaded. The carrier should be loaded to give somewhat less than the desired torque value, and small weights should then be carefully added until the wrench "break" mechanism operates, or in the case of a torqueometer, the dial reading should be noted. The torque value of the applied weight may then be computed from the graph. The wrench must not be turned to lift the weights, as this will produce increased friction and inertia errors.

Note. The applied torque on the graph is given in lb./in. ; if required torque load is expressed in lb./ft. it should be converted before reading the graph.

"Acratork" Test Rig

17. This test rig is used for testing and setting the torque loading of torque wrenches and has a range of 0-400 lb./ft. For this purpose there are provided two adapters and three different sizes of adjusting keys.

18. Remove the end-cap from the wrench handle and fit the wrench into the rig, ensuring that the wrench is placed in as nearly horizontal a position as possible. Press downwards on the wrench handle until a sudden drop in resistance of the handle is felt ; then return the wrench to its starting position and remove the wrench. Set the pointer on the dial to zero and replace the wrench on the rig. Press downwards on the wrench handle, and note the reading on the dial at the point where the drop in resistance occurs. This reading is the torque loading to which the wrench is set.

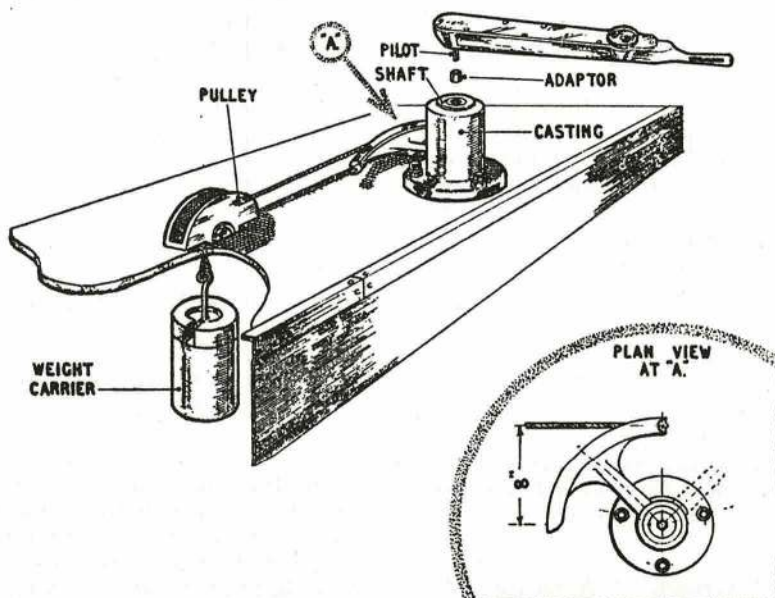


Fig. 5. CONSTANT TORQUE FIXTURE

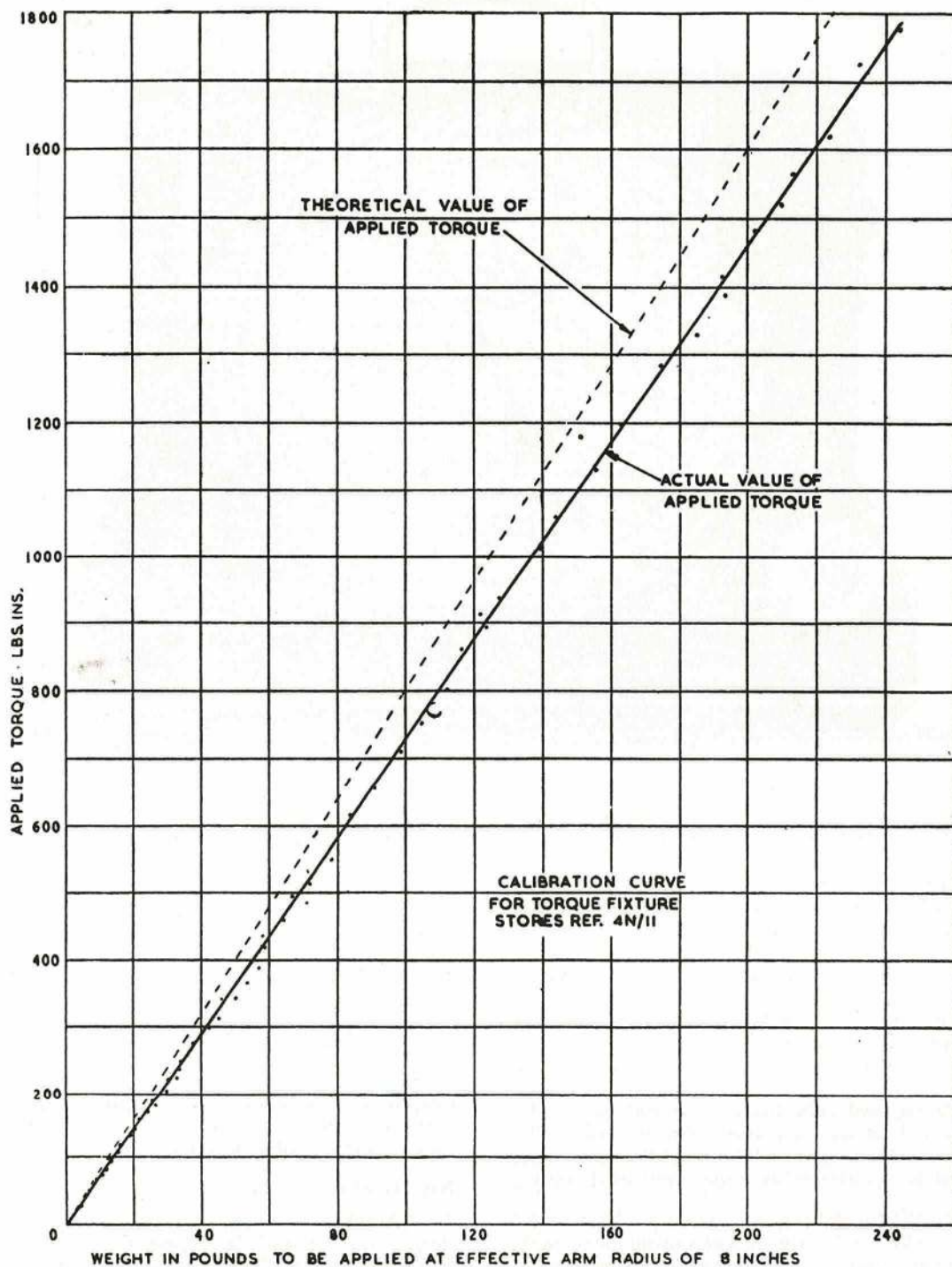


Fig. 6. CALIBRATION CURVE FOR TORQUE FIXTURE

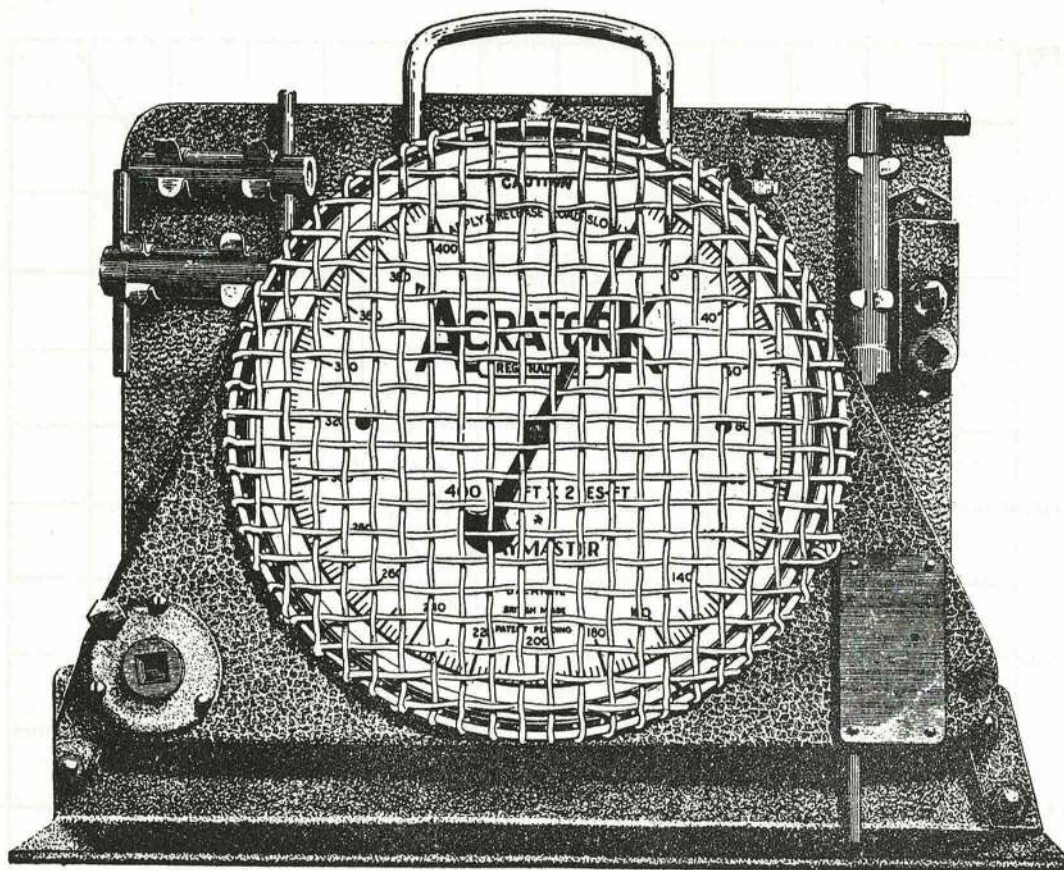


Fig. 7. "ACRATORK" TEST RIG

19. To increase the torque loading of the wrench, tighten the screw adjuster inside the handle (R.H. thread) by means of the adjusting key. This can be done without removing the wrench from the rig. Re-test the wrench and set the screw adjuster until the correct reading of the load required is obtained. Ensure that the dot and arrow on the head of the wrench are in line before removing the wrench from the rig. Keep the handle firmly under control when setting the wrench to its starting position. Remove the wrench from the rig and refit the handle end cap. The wrench is then set and ready for use. The torque loading of an "Acratork" wrench must not be set above the upper limit of its range.

20. When setting or testing "Acratork" wrenches in the rig, or when using the wrench, always keep the handle firmly under control when moving it back to the starting position, i.e. when the dot and arrow are in line.

During this movement, the handle will give a sudden pull to the right, the intensity of the pull varying according to the setting of the wrench. To adjust the wrench the handle must be returned to the starting position. The back pull must therefore be controlled to avoid any risk of damage to the wrench mechanism or the setting rig.

21. The "Acratork" rig may also be used for checking and setting "break-back" type wrenches, and for testing the accuracy of torquometer wrenches. The rig must, however, be set to zero on all occasions before the torque loading of a wrench is checked.

Rig Testing

22. "Acratork" torque wrench testing and setting rigs should be tested for accuracy every two years. The rigs will be tested at the appropriate test establishments, as follows :—

(a) Those held at Units in the United Kingdom and the 2nd Tactical Air Force—At No. 30 M.U., Stoke Heath.

(b) Those held in other overseas Commands—At a standards room selected by the C.A.I.O. of the Command concerned.

The procedure to be followed when submitting the equipment for test is detailed in Air Publication 3158, Vol. 2, leaflet J.2 ; documentation should be in accordance with Air Publication 3163, leaflet F.2.

Range Multiplier

23. Provided that it has a tolerance in its torque loading, a nut may be tightened to bring it into line with its split pin hole, and in

this case a range multiplier is used with an "Acratork" wrench. The multiplier is fitted between the wrench and the nut socket, and adds 2 lb./ft. upwards according to the size of the multiplier used.

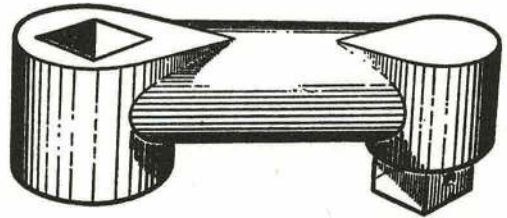


Fig. 8. RANGE MULTIPLIER

