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**ADMIRALTY FLEET ORDER**

**OIL BURNING EQUIPMENT—ADMIRALTY TYPE—  
INSTRUCTIONS FOR OPERATION**

ADMIRALTY, S.W.1,  
13th January, 1944.

The following Order having been approved by My Lords Commissioners of the Admiralty is hereby promulgated for information and guidance and necessary action.

By Command of their Lordships,

*H. V. Markham*

*To all Commanders-in-Chief, Flag Officers, Senior Naval Officers, Captains and Commanding Officers of H.M. Ships and Vessels, Superintendents or Officers in Charge of H.M. Naval Establishments, and Admiralty Overseers concerned.*

NOTE:—The scale of distribution is approximately half that shown in the Admiralty Fleet Order Volume, 1941, Instructions, paragraph 10.



## 250.—Oil Burning Equipment—Admiralty Type—Instructions for Operation

(D. 16796/43.—13 Jan. 1944.)

To ensure correct heat distribution and circulation in boilers with freedom from local overheating it is essential, particularly in highly-rated water-tube boilers such as are fitted in many of H.M. ships, that combustion of the fuel should be completed in the furnace.

Bad combustion with long flames, oil burning after splashing against back brickwork and "after burning" causing hot spots in the tube nests may result in a stoppage or reversal of circulation in the tubes, particularly those near the back casing and immediately outside the superheater, causing overheating and distortion which may be accompanied by circumferential cracking.

2. Owing to the increased demand for aviation petrol, motor spirit and gas oil under war conditions, fuel oil in current supply contains a higher percentage of the heavier fractions of the crude petroleum and unless special attention is given to the burning, large deposits of carbon will be built up, chiefly in the brick tubes.

These carbon deposits form an irregular aperture in the brick tube causing a lack of air at some parts of the flame. This necessitates an increase of air pressure to counteract the resulting black smoke, which in turn produces an excess of air in other regions of the flame. Excess air lowers the boiler efficiency and calls for an increased amount of fuel to be burnt to maintain steam output. The effects are, therefore, cumulative and similar to those caused by excessive forcing.

3. The best criterion of efficient burning is the appearance of the flames, and watchkeepers should be instructed to keep the flame under observation to see:—

- (i) That the flame is bright, clear and compact, and free from smoke or sparks.
- (ii) That the oil is not splashing off the back brickwork before combustion is complete.
- (iii) That the "drawback" or primary burning in the combustion tube is stable and not too heavy.
- (iv) That carbon is not building up on the brick tube and combustion tube.
- (v) That the "cone" of oil spray close to the sprayer cap is not streaky.

4. Further, for efficient combustion it is necessary to ensure:—

- (i) That there is a uniform spray atomised as finely as possible.
- (ii) That the correct amount of air is supplied to the burners.
- (iii) That good air/oil mixture is obtained.
- (iv) That the same quantity of oil is supplied by each sprayer.

(v) That the flame does not impinge on relatively cold brick surfaces during the initial stage of burning.

5. *To Obtain a Good Spray and the Best Atomisation.*—(i) The tangential holes, exit holes and in particular the outside edge of the exit orifice of the sprayer cap should be circular and undamaged. Sprayers should be cleaned whenever a streaky spray is observed. Great care should be taken in handling and cleaning the sprayer caps and only the cleaning tools described in A.F.O. 2771/42 are to be used.

(ii) The degree of atomisation depends upon the amount of energy imparted to the oil, in general, pressures above 100-lb. per sq. in. should be used. It is better to manoeuvre by shutting off a sprayer than by reducing the oil pressure below 100-lb. per sq. in.

(iii) The fineness of the spray also depends upon the viscosity of the oil. Unfortunately, it is not possible with the present grade of fuel to burn at as high a temperature as would be desirable as the oil breaks down on heating to form bituminous compounds which give rise to increased carbon deposits.

A review of oils supplied during 1942-43 shows that good average figures for oil-burning temperatures are as follows:—

Sprayers			Average oil burning temperature
Size No.	Pattern No.	Nominal capacity	
00	22	150-lb.	185° F.
0	19	250-lb.	
1	14	400-lb.	
2	15	600-lb.	
2A	23	750-lb.	180° F.
3	16	900-lb.	
3A	24	1,050-lb.	
4	17	1,200-lb.	175° F.
5	18	1,500-lb.	
6	20	1,800-lb.	
7	21	2,100-lb.	

See also A.F.O. 2058/42.

6. *The Correct Amount of Air.*—(i) The correct quantity of air is being supplied when the flame appears bright and compact without smoke or sparks.

(ii) The air pressure should be adjusted to suit each change of oil output.

(iii) In closed front registers the quantity of air passing should never be controlled by partially closing the air shut-off tube. Shut-off tubes must on all occasions be fully open whenever the burner is in use and closed immediately the burner is shut off.

7. *Good Air/Oil Admixture.*—For best air/oil mixing the air velocity through the brick tube should be kept as high as possible without excess air. For this reason better burning is obtained with a small number of burners at high oil fuel pressure than with a larger number of burners at low pressure.

8. *The Same Quantity of Oil to Each Sprayer.*—(i) It is essential that the same quantity of oil shall be supplied by each sprayer. All sprayer caps are calibrated and should have equal outputs at equal pressures.

(ii) Instances have occurred where the output of individual sprayers has been reduced by restriction in the supply system, either in the ports of the sprayer control valves or in the supply pipes themselves. By inserting a T-piece carrying a pressure gauge between the supply pipe and the sprayer body the drop of pressure at the sprayer can be measured. This should not exceed 7-lb. when the sprayer is burning with 150-lb. oil pressure at the pressure gauge fitted on the sprayer manifold.

9. *Impingement of Flame on Cold Brick Surfaces.*—(i) The comparatively cold surfaces where carbon is most likely to collect if the flame strikes them during the initial stages of combustion are:—

(a) the brick tube, (b) the furnace floor.

The deposits on the brick tubes can be reduced to a minimum by advancing the oil fuel sprayer so that the edge of the spray just touches the surface of the brick tube remote from the operator. Advancing the spray will, however, weaken the drawback of flame in the combustion tube. If too weak a drawback is maintained the oil will spray through the primary flame, carbon will be deposited on the furnace floor and the flame in the combustion tube will be unstable and liable to become extinguished. When the flame in the combustion tube becomes extinguished oil will be sprayed straight into the furnace and burning will take place in the tube nests and in the uptakes resulting in inefficient burning, smoke, and interference with the correct circulation of water in the boiler tubes which may lead to their distortion. The sprayer must, therefore, be advanced as far as possible consistent with a stable drawback. It will be found that the sprayer can be advanced further at high oil pressures than at low pressures.



(ii) Excess air will tend to blow the flame out of the combustion tube, especially if the scissor plates have been incompletely closed, and this will prevent the maximum advance of the sprayer.

(iii) Boiler room watchkeepers must be taught to detect immediately a sprayer which has become extinguished and the need to be constantly on the lookout for such an occurrence must be impressed upon them.

10. *Operation and Maintenance.*—(i) *Lining up sprayers.*—Sprayers must be lined up so as to be concentric with the brick tube. Because sprayers have been correctly set with the boiler cold it does not follow that they will remain central when steaming, and each sprayer must be examined whilst burning and the carriage lined up if necessary.

(ii) *Carbon deposits.*—Accumulated carbon must be removed from the brick tube and combustion tube before it becomes too heavy. A light tool in the form of a hoe is preferable to a heavy poker which, when carelessly used, may cause much damage to the throat bricks. If the carbon is hard do not attempt to scrape it off right down to the bricks if the sprayer is not immediately required. If left alone the carbon will burn off.

If the sprayer is correctly set up and carried well forward no carbon should be deposited on the combustion tube. Deposits of carbon on the combustion tube cause local overheating resulting in distortion, burning and cracking of the combustion tube. These deposits therefore should never be allowed to accumulate.

(iii) *Air shut-off tubes.*—Closing the air shut-off tubes of closed front registers, even to a very limited extent when the sprayer is in use will cause serious damage to the oil fuel burning equipment in a very short time. Unless this shut-off tube is fully open the whole region inside this tube will become a zone of low pressure and will fill with flame. The register will quickly overheat and the combustion tube and its supports, the bowl, and the shut-off tube itself will burn and distort, also the oil spray will impinge on the combustion tube, causing dripping which may result in fires in the drip pans or bilges. This effect should be demonstrated to boiler room watchkeepers by removing side doors on the air box casings. If necessary additional sight holes should be cut in the air casings.

(iv) *Throat bricks.*—Brick tubes should be maintained in as good a condition as possible. If there is not sufficient time to renew the bricks in a damaged throat, it can be patched by using a mixture of 50 per cent. fireclay and 50 per cent. coarse crushed brick with just sufficient water for binding or preferably by the use of plastic refractories which will shortly be obtainable as Naval Stores.

(v) *Position of combustion tube.*—The correct proportion of primary to secondary air is maintained when the combustion tube is in the position shown on the ship's drawings; this should be checked.

(vi) *Condition of register generally.*—All moveable parts must be kept free and clean, accumulation of oily deposits must be prevented.

In the open front registers care must be taken to see that the doors open freely on to the stops and that the closing clips are in good condition. With the 1941 open front, the door stop adjustment should be examined periodically to ensure that the doors open to 35° and no more. The door operating gear must be kept clean.

With the old pattern register fitted with an inner and outer tube the annular space between the tubes forming the passageway for the secondary air must be kept free from carbon deposits.

(vii) *Changing and cleaning sprayers.*—When changing sprayers the use of a long-handled spanner on the fuel pipe union nut should be avoided, excessive force may cause distortion of the sprayer body, carriage or bracket.

When removing the sprayer cap the sprayer should not be held by the square on the body. If a vice is used the head should be gripped by the flats provided on it, flat steel strips being inserted to increase the clearance between the jaws of the vice as necessary. Preferably, however, the sprayer should be held in a cradle as shown in A.F.O. Diagram 11/44. If not already available suitable cradles should be made by ship's staff with assistance from dockyard or repair ship if required.

The sprayer cap should always be handled with the greatest care as damage will result in bad atomisation, see paragraph 5.

(viii) *Oil fuel pressure and temperature.*—The O.F. pressure and temperature should be maintained as steady as possible at all times, wide variations in pressure and/or temperature will result in bad burning. In ships fitted with direct acting O.F. pumps it is essential to charge the air vessel to obtain a steady discharge pressure.

It is important to bear in mind that owing to the capacity of the system an appreciable time must elapse before a change in the steam supply to the O.F. heater results in a corresponding change in the oil temperature recorded at the sprayers, changes in steam supply to the heater should therefore be made gradually having due regard to changes in output of oil from the sprayers when manoeuvring, otherwise large fluctuations in the temperature of the oil at the sprayers will occur.

(ix) *Adjustment of air pressure.*—Changes of oil output must be accompanied by a corresponding change of air pressure. On increasing the oil output increase the air pressure first and on decreasing the oil output decrease the air pressure last.

11. *Banked Boilers* (large ships only).—When it is necessary to keep a boiler banked in the same boiler room as another which is steaming, the air supply to the banked boiler should *not* be regulated by adjusting the air shut-off tube for reasons stated in paragraph 10 (iii).

The difficulty of keeping alight the sprayer in use on the banked boiler can be largely overcome by the following means:—

(a) By avoiding the use of sprayers smaller than No. 3 size.

(b) By drawing the sprayer as far back in its carriage as possible so as to increase the stability of the flame.

(c) The stability of the flame in the banked boiler will be greater when a high oil-fuel pressure is used even if this entails a slightly higher air pressure in the boiler room. The number of sprayers on the steaming boiler should therefore be adjusted to carry the highest permissible oil pressure.

12. *Funnel Temperature.*—The funnel gas temperature provides the best guide to the efficiency of combustion. A high uptake temperature indicates inefficient combustion and in particular the type of combustion which is likely to lead to interference with the circulation and to distortion of tubes—(see paragraph 1).

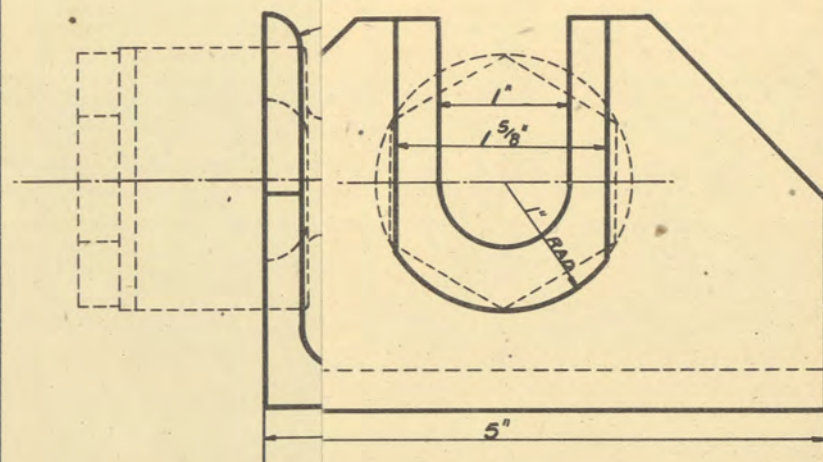
In ships fitted with air preheaters, thermometers are fitted to record the gas temperature above and below the air heaters. Where these fittings are available steps should be taken to observe and record the gas temperatures under various conditions of output of the boilers and on all occasions when unusually high gas temperatures are noted the cause should be investigated and remedied as soon as possible.

13. Additional copies of this Order may be obtained from the Editor of Fleet Orders, c/o H.M. Stationery Office, Wealdstone, Harrow.

(A.F.Os. 2771/42 and 2058/42.)



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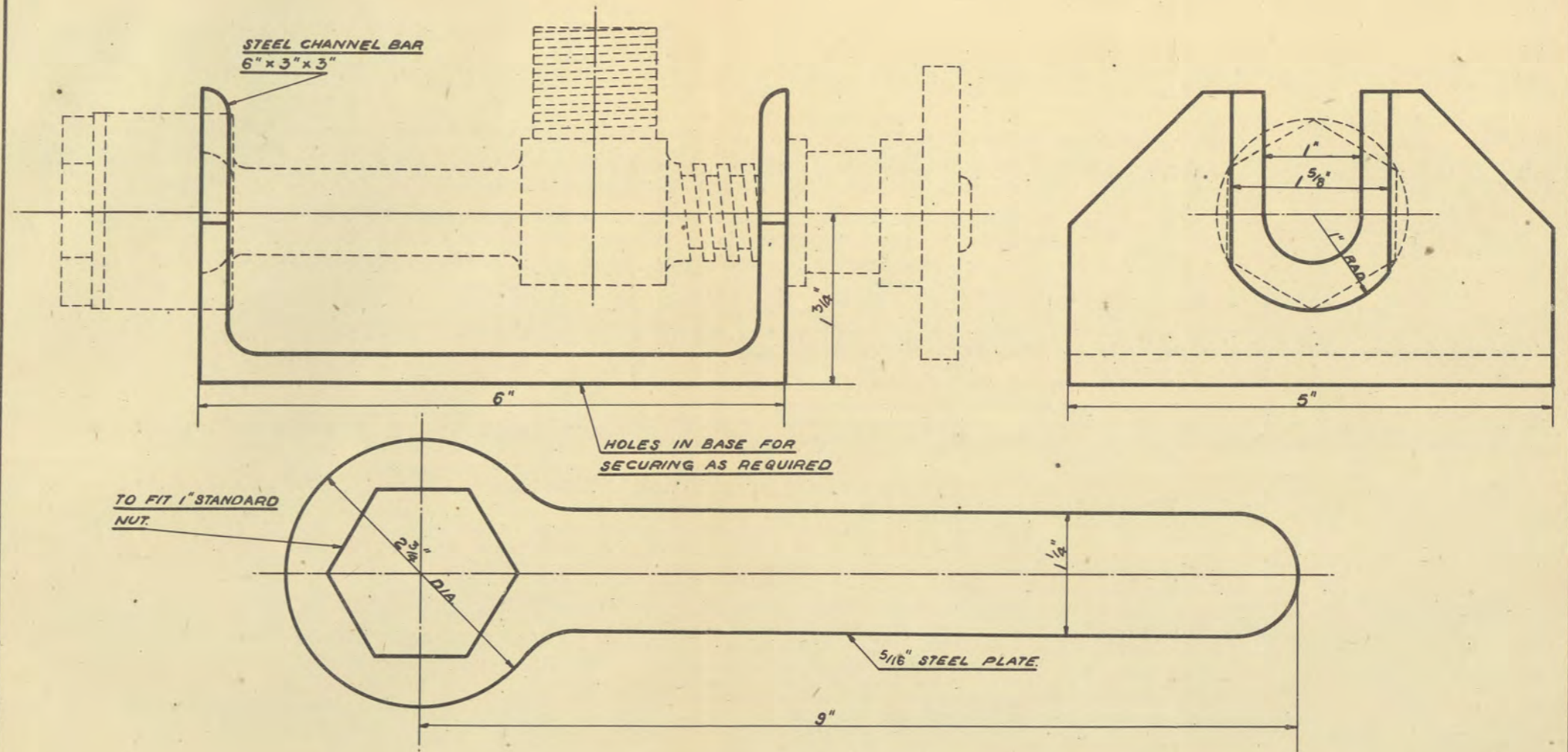


TO FIT 1" STAND  
NUT.





# HOLDER & SPANNER FOR DISMANTLING SPRAYERS.



HOLDER & SPANNER FOR DISMANT

