

BR 3001 Chap 19
Amdt 27 4.86CHAPTER 19FUELS, FUEL OIL SYSTEMS, ANDASSOCIATED FITTINGSCONTENTS

<u>Article</u>		<u>Page</u>
1901	} Transferred to BR 3109	
1902		
1903		
1904		
1905		
1906		
1907		
1908		
1909		
1910	Pumpability of Furnace Fuel Oils	19.3
1911	Transferred to BR 3109	
1912	Ballasting of Fuel Tanks	19.4
1913	Tank Cleaning Lighters (TCL's); Functions, Administration and Allocation; Cleaning Processes and Requirements etc	19.4
1914	Replenishment at Sea; Stowage and Care of 6in Hoses	19.8
1915	RN Petroleum Fuels	19.8
1916	Commercial Diesel Fuels	19.9
1917	Distillate Fuels Supplied by NATO and SEATO Navies	19.9

TABLES

<u>Table</u>		<u>Page</u>
1913 TABLE 1	Cleaning Times	19.6

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BR 3001 Chap 19

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CHAPTER 19FUELS, FUEL OIL SYSTEMS, AND
ASSOCIATED FITTINGS

- NOTES**
- (i) Aviation and Motor Transport Fuel Systems. See BR 3321.
 - (ii) Instructions for the Operation and Maintenance of the Admiralty Suspended Flame Registers Fired by Spill, Simplex Pressure Jet, Shell Pillard or Steam Atomised Burners. See BR 3109 Chap 12 and the relevant Ship Class Operating Handbooks.
 - (iii) Instructions for Operating 1943 and Previous Admiralty Registers When Burning FFO Under Main Boilers (HM Ships BULWARK and FORTH). See BR 3109 Chap 12.

1901-1909

Transferred to BR 3109

1910PUMPABILITY OF FURNACE FUEL OILS

1. Under certain circumstances it may become difficult to pump FFO. The difficulty may be aggravated by the presence of water and the formation of emulsion.

Precautions to Ensure Pumpability

2. To ensure a reasonable pumpability of furnace fuel oil in HM Ships, the following precautions are to be observed:
 - (a) When the temperature of the sea surrounding the ship falls below 7 deg C (45 deg F), steam should be put on the necessary tank heating coils and the temperature of the fuel in these tanks kept at 15-21 deg C (60-70 deg F).
 - (b) In cold weather, when 30 per cent of the oil remains in a tank, heat to 15-21 deg C (60-70 deg F) and transfer all the oil to another tank. Where possible, FFO tanks are to be emptied before a ship is taken in hand for a major dockyard refit.
 - (c) If the use of a water-determining apparatus shows that unpumpability is due to the formation of an emulsion, this may in most cases be rendered pumpable by treating the oil in the manner described in BR 3009 Chap 8 Para 86 and 87.

NOTE To obtain maximum transfer rates of flow, it will be necessary in most cases to heat the fuel to 27 deg C (80 deg F).

Precautions Necessary in the Use of Tank and Suction Pipe Heaters

3. Care is to be taken when putting steam on the heating pipes because of the large number of water pockets unavoidable in such systems. The water in the drain tank should be examined as necessary to ensure that it is free from oil. If oil is present, the drain water should not be passed to the feed water system until the leakage has been located and the defect made good. Before heating oil in the suction pipes, the valves are to be opened so that the expansion of the oil in the pipes will not subject them to undue pressure.

Temperature of Fuel Oil Tanks Contiguous to Magazines

4. The temperature of fuel oil tanks contiguous to magazines is to be taken every 24 hours, and is not to exceed 32 deg C (90 deg F). Any unusual temperature noted is to be reported immediately to the Commanding Officer. Should the temperature of any tank be found to be increasing, it is to be kept under close observation until normal conditions again obtain. The temperatures taken are to be recorded in the Engineering Master Log.

1911

Transferred to BR 3109

BR 3001 Chap 19
Amdt 27 4.86

1912

BALLASTING OF FUEL TANKS

1. In ships which are equipped with ballasting, stripping, and renovating systems the possibility of emulsion formation is reduced to a minimum. The following precautions, issued primarily to reduce the tendency towards emulsification in ships which have no stripping and renovating systems and which have to ballast are, however, relevant for all ballasting operations in all ships.
2. Before ballasting, the quantity of fuel remaining in the tank is to be reduced to a minimum. If possible when FFO is embarked, this operation should be carried out by heating the last third of the fuel in the tank to between 38 deg C (100 deg F) and 54 deg C (130 deg F) and then pumping out to another tank. The temperature of the oil must not exceed 54 deg C (130 deg F) [or 32 deg C (90 deg F) if the tank is adjacent to a magazine, see BR 3000 Art 1912]. The tank is then to be filled to within three to four inches of the crown of the tank. When ballasting, agitation of the water and oil should, as far as practicable, be avoided. Care must be taken to avoid putting a pressure on the tank during this operation. TP 98 Ballasting of Fuel Tanks should be consulted.

Refuelling

3. Before refuelling, remove as much water as possible by pumping until suction is lost, using the residue suction. After refuelling, pump out by means of the residue suction any water which may settle out. The water is to be passed to the settling system where fitted. Care must be taken to avoid sea pollution, see BR 3000 Art 1914. After water has been removed, using the settling system where fitted, normal operation may be resumed.

Water Displacement

4. Water displacement systems are fitted in certain ship classes using Dieso as their propulsion fuel. These systems should be operated in accordance with the class instructions authorised by the MOD.

Discharge of Fuel Oil

5. When discharging fuel oil by means of a fire and bilge pump, it is to be ascertained before the pumping of oil commences that all pump discharge valves not required for this service are shut and lashed, and that they are tight under pressure.

1913

TANK CLEANING LIGHTERS (TCL's); FUNCTIONS, ADMINISTRATION AND ALLOCATION; CLEANING PROCESSES AND REQUIREMENTS ETC.

1. Tank cleaning lighters (TCL's) are now in operation at the following UK Naval Bases:

(a) Portsmouth	—	TCL 1901 and TCL 1905
(b) Devonport	—	TCL 1906 and TCL 1907
(c) Rosyth	—	TCL 1903 and TCL 1904
(d) Clyde (Faslane)	—	TCL 1902

Functions

2. The functions of a TCL are to assist ship's staff with cleaning of:
 - (a) Boilers externally at maintenance periods and during refits.
 - (b) All FFO, Dieso, AVCAT and lub oil tanks at the start of refits and at other times before the necessary repair of defects or the cleaning of contamination in such tanks.
 - (c) Slop drain and sewage tanks.
 - (d) Machinery space bilges of ships which are not equipped with chemical bilge cleaning equipment.

Administration

3. TCL's will be under the general administration of the respective Port Admirals of the Naval Bases where they are based, and will be manned by Royal Maritime Auxiliary Service personnel under the Captain of the Port.

BR 3001 Chap 19
Amdt 27 4.86

Allocation

4. Normally the Port Admirals of the Naval Bases where TCL's are based will allocate the TCL's for work at their home ports, and also away from the port when applications under Para 5(b) are received. Where circumstances prevent a Port Admiral meeting a request for the service of a TCL, he should make arrangements with the Port Admiral of another Naval Base to allocate TCL for such service. If this service cannot be met from any of the Naval Bases concerned, the matter should be reported to the MOD (Director of Marine Services) for direction.

Priorities

5. Priorities for the allocation of TCL's will be given as follows:

- (a) Nuclear submarines.
- (b) Ships requesting repair work under OPDEF procedure.
- (c) Ships preparing for planned DED periods, where known defects necessitate the cleaning of particular tanks before repair.
- (d) Ships preparing for planned refits.
- (e) Ships coming to the end of refit.
- (f) Ships in planned Assisted Maintenance Periods.
- (g) Ships in planned Self Maintenance Periods.
- (h) Ships refitting.
- (j) Repayment work for other Navies and merchant ships.

Application

6. Wherever possible, two months notice of the requirement for a TCL should be given. Requests should be made by letter whenever time permits, as follows:

- (a) From ships which will be at a port on which a TCL is based. To the Port Admiral of the Naval Base concerned, with copies to the appropriate Captain Fleet Maintenance.
- (b) From ships which will be at a port on which no TCL is based. To the Port Admiral of the nearest Naval Base on which a TCL is based, with copies to the appropriate Captain Fleet Maintenance and to the Port Admiral of the Naval Base or Senior Officer of the port at which the ship will be.

Application Form

7. Applications are to be in the standard form given below:

- (a) Give earliest date ship will be available, followed by latest acceptable date for completion of the work.
- (b) Give number, types and total capacity in tonnes of each of the types of tank to be cleaned, and remark concerning any residue which will remain in them, eg '4 wing 208 tonnes, 5DB 173 tonnes. Heavy sludge 2 wing tanks, normal sludge remainder'.
- (c) Give reason why cleaning is required, eg '5DB dockyard repairs 4 wing survey'.
- (d) Give state of bilges required to be degreased with any remarks as to urgency, eg 'X BR bilges fuel oil spill'.
- (e) Give number of boilers to be cleaned externally.

Process for Cleaning Furnace Fuel Tanks and Bilges

8. The surfaces of the FFO fuel tanks and bilges to be cleaned are sprayed with a detergent through 2in or 1.1/2in hoses at a temperature of about 49 deg C (120 deg F) and a pressure of 130 lbf/in². The oil and sludge washed off, together with the detergent solution, is cleared from the compartment by vacuum pumps through 3in fuel hoses. Ship's staff are to complete the work by wiping compartments dry by hand.

NOTE Any residue of detergents remaining in fuel tanks after cleaning will prevent correct operation of water coalescers in the fuel system. When a tank is associated with a fuel system containing a coalescer, the tank should normally be cleaned without using detergents. If detergents must be used in such tanks, great care must be taken to ensure the complete removal of detergents after cleaning by repeated flushing with fresh water alone.

Process for Cleaning Diesel and AVCAT Fuel Tanks

9. The cleaning of Diesel and AVCAT fuel tanks by hot detergent liquid presents certain hazards, especially when undertaken by TCL or other external source, owing to their comparatively low flash points and the following procedures should be closely observed, see also Para 8 NOTE and BR 3000 Art 1938.

- (a) The temperature of the detergent liquid in the detergent tank in the TCL must not exceed 49 deg C (120 deg F).

BR 3001 Chap 19
Amdt 27 4.86

- (b) The sludge in the sludge tank of the TCL must never be heated above 49 deg C (120 deg F) in any circumstances during the operating life of the vessel, so that any danger of heating small remaining isolated pockets of fuel in the sludge tank above its flash point will be avoided.
- (c) The vacuum and sludge tanks in the TCL need not be cleaned in between cleaning Diesel or AVCAT tanks and FFO tanks owing to the immensity of the task and the safe temperature of the inflowing sludge under all conditions.
- (d) Sludge tank surfaces need not be specially painted internally.
- (e) TCL sludge tanks should be emptied into the sludge lighter as soon as possible after cleaning Diesel fuel and AVCAT tanks.
- (f) All precautions must be taken to ensure that no sparks, lighted matches, etc can gain access to the vacuum pumps or vacuum and sludge tank outlets.
- (g) Materials for cleaning furnace fuel oil, diesel oil and AVCAT tank compartments. The following materials may be used for cleaning and drying out fuel oil compartments and tanks in HM Ships, oilers or shore establishments:
 - (i) Old bunting
 - (ii) Cotton rags (including old jean clothing, etc)
 - (iii) Old towelling
 - (iv) Canvas rags
 - (v) Woollen rags (including those from old blankets)
 - (vi) Linen rags
 - (vii) Old fearnought.

NOTE Unduly small pieces of material should not be used.

- (h) Materials not to be used. Oakum, cotton waste, cleaning cloth and tank flannel are not to be used for cleaning and drying out fuel oil compartments or tanks in HM Ships, oilers or shore establishments, as threads and strands from these materials are liable to choke the strainers. Sawdust is not to be used in the fuel oil compartments of HM Ships or oilers.

Process for External Cleaning of Boilers — see BR 2000(25)(1)

Preservation of Fuel Tanks

10. If required, TCL's can preserve tanks after they have been cleaned, by spraying with protective composition PX4, 0475/910-0484. This process may prejudice the award of a 'gas-free' certificate, and is not necessary if the tank is soon to be refilled.

Time Required for Cleaning Tanks

11. The average rates for different types of tanks and bilges are as follows:

TABLE 1 CLEANING TIMES

SHIP	TANKS	MACHINERY SPACE BILGES	REMARKS
INVINCIBLE ILLUSTRIOUS	22 days	4 days	Main Machinery Spaces only.
LPD	15 days	5 days	A further 25 days are required if all ballast tanks need cleaning.

Continued

BR 3001 Chap 19
Amdt 27 4.86

TABLE 1 (Continued)

SHIP	TANKS	MACHINERY SPACE BILGES	REMARKS
BRITANNIA	10 days	3 days	<p>These average times are for Fuel Tanks only and do not include FW Tanks, WTC's etc.</p> <p>The times quoted allow for overtime and are based on full ship's staff and dockyard co-operation.</p>
Type 82/ County Class	7 days	3 days	
Type 42	6 days	2 days	
Type 22	6 days	3 days	
Type 21	5 days	2 days	
LEANDER (WCFS)	6 days (8 days)	2 days	
Type 81	5 days	2 days	
Type 12	6 days	2 days	
Submarines and Minesweepers	2 days	1 day	

Time Required for External Boiler Cleaning

12. The average time required for external boiler cleaning may be taken as two boilers per day, but longer will be required if the boilers are in an unusually dirty state.

Requirements for Ships being Cleaned

13. TCL's are worked to a very tight programme and the times assessed in Para 11 and 12 are based on full co-operation from the ship being cleaned. Amongst the most important requirements from the user ship are:
- (a) A clear billet alongside as close as practicable to the tanks to be cleaned, and arrangements for berthing the TCL without delay. If necessary a TCL can work across one destroyer or smaller vessel.
 - (b) Tanks to be cleaned are to be pumped out to the limits of the residue suctions, the oil being heated as necessary to ensure flow through the limber holes. Up to four tanks should be opened and ventilated ready to work in by the time the TCL arrives.
 - (c) In some cases it may be necessary to saturate the tanks to be cleaned with steam to soften any skin that may be adhering to the sides (see BR 3000 Art 1938 for AVCAT fuel tanks). The TCL normally supplies the steam and equipment for this.
 - (d) If the TCL has been allocated to degrease bilges, it is essential that bilges are pumped out and cleared of all cotton waste and other solid matter liable to choke the suction strainers of the vacuum pumps.
 - (e) Final drying of the tanks and bilges is the responsibility of the user ship.

Prevention of Oil Pollution

14. When pumping out fuel tanks and bilges prior to cleaning by TCL's, and during all phases of the work associated with the operation of the vessels, due precautions are to be taken to ensure that the existing instructions concerning the prevention of oil pollution are not infringed, see BR 3000 Art 1914 and 1915.

BR 3001 Chap 19
Amdt 27 4.86

Confirmatory Signal

15. Twenty-four hours before the TCL is due to arrive, the ship to be cleaned is to make a signal addressed to the Port Admiral of the Naval Base, copy to TCL, indicating the side and station it is intended to berth the TCL, and confirming that tanks to be cleaned are being pumped out to the limits of the residue suction.

1914

REPLENISHMENT AT SEA; STOWAGE AND CARE OF 6 INCH HOSES

1. The 6 inch hoses referred to in this article are NS Cat Nos 0249/458-9461, 9462, 9498, 9499 (Abeam) and 9512, 9513, 9516, 9517 (Astern) used for replenishment at sea.
2. One of the more serious defects which necessitate scrapping a hose has been the stripping of its inner lining. It has been established that the main contributory cause for this particular form of defect is severe crushing or kinking of the hose.
3. To avoid damage of the kind described above, and to preserve hoses as long as possible, the following rules should be carefully observed:
 - (a) The hose selected for use should be compatible with the oil/spirit transferred.
 - (b) Hoses held in store in HM Ships and RFAs are to be stowed under cover in straight lengths, and separated at intervals by wood battens to allow for air circulation. The hoses should not be stowed more than five high, but this restriction on height does not apply where special cantilever hose racks are in use. In some ships, where conditions are restricted, it may not be possible to stow a hose completely straight. In these circumstances the hose may be stowed with a slight bend over a generous bending radius, but in no circumstances should it be "flaked" or kinked.
 - (c) Severe kinking or crushing is to be avoided. The placing of heavy loads on the hose is one of the most likely causes of failure. Cutting of, or damage to, the outer casing should always be avoided, as penetration by water causes a rapid loss of fabric strength.
 - (d) The couplings, which are bonded into the hose, are made of aluminium alloy for lightness, but they are prone to seizure due to metal flaking off the screw threads, and so damaging the mating threads when being connected. It is therefore essential that the hose coupling be examined closely before attempting to couple-up. Any incipient or obvious cracks on the side and crests of screw threads, or burrs on the surfaces of threads and end seal-rings, are to be removed by dressing-up to ensure that no piece of metal could break off and jam between the threads. The threads are to be thoroughly cleaned of all dirt, products of erosion/corrosion, and any metal particles left after dressing-up. They are then to be lightly coated with Anti-seize Compound, High Temperature, NS Cat No 0474/944-0585. Caps NS Cat No 0249/458-9467 and Plugs NS Cat No 0249/458-9468 should always be fitted when a hose is not in use, and the threads should be treated with Anti-seize compound before the hose is used again.

Examinations and Tests

4. (a) Examinations. Monthly and before use. Particular attention should be given to the external condition as far as this can be observed.
- (b) Tests. These are to be in accordance with BR 875: Regulations and Instructions for RFAs, as follows:
 - (i) Annually: Hoses in frequent use, eg those in use by Fleet Replenishment Ships and Carriers.
 - (ii) At Refits (interval not exceeding 5 years): Hoses in infrequent use.
- (c) Hoses over 10 years old are not to be employed under conditions of severe use.

1915

RN PETROLEUM FUELS

1. FFO (NATO Code F-77 and F-82) consists of the residues from refining operations, with lighter distillate added to give the specified viscosity. The residue contains two highly undesirable elements, sulphur and vanadium. FFO may contain up to 3.5 per cent sulphur but no limit to the vanadium content can be specified. See also BR 3009 Chap 8.
2. Dieso (NATO F-75 and F-76) is a middle distillate fuel, without residue, with a maximum sulphur content of 1 per cent and negligible vanadium. Its viscosity at normal ambient temperature is much lower than that of FFO at the same temperature and is somewhat lower than that of FFO at its normal firing temperature. Its calorific value per unit mass is greater than that of FFO.

BR 3001 Chap 19

Amdt 20 4.81

3. AVCAT (NATO F-44) is similar to Dieso but is a rather lighter distillate and is a much cleaner fuel. Its viscosity and "lubricity" are slightly lower than those of Dieso. AVCAT is primarily provided for naval aircraft use but it may be used in ships' machinery (see BR 3000 Art 1942).

SYSTEM CONSIDERATIONS FOR DIESO OR AVCAT

Fuel Heating

4. Dieso and AVCAT are burnt under boilers at ambient temperature. To reduce the fire risk it is important to ensure that these fuels are not heated in FFO heaters where these remain in the system, particularly where no by-pass is provided. Steam lines to FFO heaters should be blanked and drain valves shut off.
5. In general, tank heating is not required and steam heating lines to fuel tanks should be blanked. If transfer pumping difficulties are observed at low ambient temperature when burning Diesel oil from other than RFA or RN Fuel Depot sources, the fuel oil may be heated to approximately 24 deg C (75 deg F) in order to dissolve the waxy constituents which may have been generated at low temperatures.

Fuel System Pipes, Valves and Components

6. The low viscosity of distillate fuels gives a risk of leakage from pipe joints, pump and valve glands, and through isolating valves, including particularly burner shut-off valves etc. Such leaks create a fire/explosion hazard. Lubricated plug valves are liable to leak when used in conjunction with Dieso. Where such valves are fitted, enough of the correct Sealing Compound must be inserted to make the valve somewhat stiff to turn (see Art 1113).
7. Dieso and AVCAT are likely to loosen deposits/scale in fuel tanks and systems, particularly that left by previous use of FFO. These deposits may choke strainers, filters and atomisers, and can cause pump wear. The probability of this is much reduced if the systems are circulated back to a convenient fuel tank before the first occasion of going to sea following system disturbance for repair or refit.

1916

COMMERCIAL DIESEL FUELS

1. In general these fuels may be divided into three categories by commonly used terms:
 - (a) 'Gas Oil'.
 - (b) 'Marine Diesel Oil'.
 - (c) 'Light, Medium and Heavy Fuel Oils'.
2. Most 'Gas Oils' have similar characteristics to Dieso. Some have low flash points and must not be embarked in HM Ships, see BR 3000 Art 1908.
3. 'Marine Diesel Oil' is a distillate fuel usually containing a small percentage of residual fuel. This may be burnt satisfactorily under main boilers in lieu of Dieso. The small amount of residual fuel may increase deposits but may aid boiler control because some visible smoke will arise if combustion is not correct. Some supplies may have a viscosity exceeding 7 cST at 37.8 deg C (100 deg F). To achieve a viscosity at the atomiser of about 15 cST, it will need to be at a temperature of perhaps 15 deg C (60 deg F) to 25 deg C (80 deg F) - (see BR 3009 Appendix I Viscosity Curves). This may necessitate the use of heaters.
4. Marine Diesel Oil is not suitable for use in auxiliary boilers, gas turbines or diesel engines in HM Ships.
5. 'Light, Medium and Heavy Fuel Oils' are used in large, slow running diesel engines and under boilers, in merchants ships. Light Fuel Oil is generally similar to FFO. Medium and Heavy Fuel Oils have high viscosities and their use under Naval boilers should be avoided (see BR 3009 Chap 5 Para 59 to 62). If embarked in an emergency, constant heating of fuel tanks is likely to be necessary in all climates to ensure pumpability.
6. The fuels in Para 1(b) and (c) have poor water separation properties and should not be embarked in water-displaced fuel tanks.

1917

DISTILLATE FUELS SUPPLIED BY NATO AND SEATO NAVIES

1. Fuels equivalent to RN Dieso. These fuels are available from virtually all NATO and SEATO navies under Code No F-76, pour point minus 6 deg C (20 deg F) and F-75, pour point minus 18 deg C (0 deg F).

BR 3001 Chap 19

Amdt 20 4.81

2. Fuels equivalent to RN AVCAT. These fuels are obtainable from some NATO and SEATO navies under Code No F-44.
3. Motor transport diesel fuels. Diesel fuels provided for land use, under NATO/SEATO Code No F-54 and F-56, have too low a flashpoint for safe embarkation in the 'unprotected' fuel stowages of RN ships.