Dear Sirs and Madams

During the last few years MDT has noted an increasing number of claims relating to short lifetimes of fuel nozzles. Customers have seen poor fuel spray pattern and dripping fuel nozzles; in some cases after only a few hundred running hours. Good performance of the fuel equipment is essential for diesel engines, and the following problems can occur in case of poor performance of the fuel nozzles:

- Sticking valves
- Carbon deposits on exhaust valves and nozzle ring
- High wear rate on T/C nozzle ring
- Lube oil contamination
- Unusual wear on cylinder units

Based on the findings MDT recommends to install a 25µm abs duplex fuel safety filter (wire mesh type) in each of the inlet fuel lines close to the engine. We have experienced considerably prolonged lifetimes of the fuel nozzles after installation of 25µm abs duplex fuel filters.
Potential benefits:

- Longer lifetime of fuel nozzles
- Longer cleaning intervals for the T/C turbine side
- Less lube oil contamination

However, it is important that the fuel separator system is able to remove all particles down to 5µm according to our “Heavy Fuel Oil Specification”, but in case of a failure in the fuel separation system, the new 25µm duplex fuel safety filter will protect the engine for some time.
If the 25µm fuel duplex safety filter is blocking up within a short period, i.e. less than 10 days, a general inspection/repair of the external fuel system is required.

Some 25µm duplex fuel filter types have steel elements that can be cleaned and reused. For cleaning of fuel filter elements, we recommend using an Ultra Sonic system or similar.

Filters can be ordered at MAN Diesel & Turbo PrimeServ.
PrimeServ Frederikshavn: PrimeServ-frh@mandieselturbo.com
PrimeServ Holeby: PrimeServ-hol@mandieselturbo.com

Yours faithfully

Mikael C. Jensen
Vice President
Engineering

Kjeld Lorentzen
Superintendent
Design Warrenty

Action code: WHEN CONVENIENT

Fuel Safety Filter

SL13-577/KEL
September 2013

Concerns
Owners and operators of MAN Diesel & Turbo four-stroke diesel engines.
Type: L16/24, L21/31, L23/30H, L27/38, L28/32H, V28/32S

Summary
New fuel safety filter for prolonged lifetime of fuel equipment and ensure good engine performance on MDO and HFO.

Enclosure:
Heavy Fuel Oil Specification
Plate 51415-14

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German Reg.No.: HRB 22056
Amtsgericht Augsburg

Heavy fuel oil (HFO) specification

Prerequisites

MAN four-stroke diesel engines can be operated with any heavy fuel oil obtained from crude oil that also satisfies the requirements in Table 1, providing the engine and fuel processing system have been designed accordingly. To ensure that the relationship between the fuel, spare parts and repair / maintenance costs remains favorable at all times, the following points should be observed.

Heavy fuel oil (HFO)

Origin/Refinery process

The quality of the heavy fuel oil largely depends on the quality of crude oil and on the refining process used. This is why the properties of heavy fuel oils with the same viscosity may vary considerably depending on the bunker positions. Heavy fuel oil is normally a mixture of residual oil and distillates. The components of the mixture are normally obtained from modern refinery processes, such as Catcracker or Visbreaker. These processes can adversely affect the stability of the fuel as well as its ignition and combustion properties. The processing of the heavy fuel oil and the operating result of the engine also depend heavily on these factors.

Bunker positions with standardised heavy fuel oil qualities should preferably be used. If oils need to be purchased from independent dealers, also ensure that these also comply with the international specifications. The engine operator is responsible for ensuring that suitable heavy fuel oils are chosen.

Specifications

Fuels intended for use in an engine must satisfy the specifications to ensure sufficient quality. The limit values for heavy fuel oils are specified in Table 1. The entries in the last column of Table 1 provide important background information and must therefore be observed.

Different international specifications exist for heavy fuel oils. The most important specifications are ISO 8217-2010 and CIMAC-2003, which are more or less identical. The ISO 8217 specification is shown in Fig. 1. All qualities in these specifications up to K700 can be used, providing the fuel preparation system has been designed accordingly. To use any fuels, which do not comply with these specifications (e.g. crude oil), consultation with Technical Service of MAN Diesel & Turbo SE in Augsburg is required. Heavy fuel oils with a maximum density of 1,010 kg/m^3 may only be used if up-to-date separators are installed.

Important

Even though the fuel properties specified in the table entitled "The fuel specification and corresponding properties for heavy fuel oil" satisfy the above requirements, they probably do not adequately define the ignition and combustion properties and the stability of the fuel. This means that the operating behaviour of the engine can depend on properties that are not defined in the specification. This particularly applies to the oil property that causes formation of deposits in the combustion chamber, injection system, gas ducts and exhaust gas system. A number of fuels have a tendency towards incompatibility with lubricating oil which leads to deposits being formed in the fuel delivery pump that can block the pumps. It may therefore be necessary to exclude specific fuels that could cause problems.

Blends

The addition of engine oils (old lubricating oil, ULO –used lubricating oil) and additives that are not manufactured from mineral oils, (coal-tar oil, for example), and residual products of chemical or other processes such as solvents (polymers or chemical waste) is not permitted. Some of the reasons for this

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are as follows: abrasive and corrosive effects, unfavourable combustion characteristics, poor compatibility with mineral oils and, last but not least, adverse effects on the environment. The order for the fuel must expressly state what is not permitted as the fuel specifications that generally apply do not include this limitation.

If engine oils (old lubricating oil, ULO – used lubricating oil) are added to fuel, this poses a particular danger as the additives in the lubricating oil act as emulsifiers that cause dirt, water and catfines to be transported as fine suspension. They therefore prevent the necessary cleaning of the fuel. In our experience (and this has also been the experience of other manufacturers), this can severely damage the engine and turbocharger components.

The addition of chemical waste products (solvents, for example) to the fuel is prohibited for environmental protection reasons according to the resolution of the IMO Marine Environment Protection Committee passed on 1st January 1992.

Leak oil collector

Leak oil collectors that act as receptacles for leak oil, and also return and overflow pipes in the lube oil system, must not be connected to the fuel tank. Leak oil lines should be emptied into sludge tanks.

Viscosity (at 50 °C)	mm^2/s (cSt)	max.	700	Viscosity/injection viscosity
Viscosity (at 100 °C)		max.	55	Viscosity/injection viscosity
Density (at 15 °C)	g/ml	max.	1.010	Heavy fuel oil processing
Flash point	°C	min.	60	Flash point (ASTM D 93)
Pour point (summer)		max.	30	Low-temperature behaviour (ASTM D 97)
Pour point (winter)		max.	30	Low-temperature behaviour (ASTM D 97)
Coke residue (Conradson)	Weight %	max.	20	Combustion properties
Sulphur content			5 or legal requirements	Sulphuric acid corrosion
Ash content			0.15	Heavy fuel oil processing
Vanadium content	mg/kg		450	Heavy fuel oil processing
Water content	Vol. %		0.5	Heavy fuel oil processing
Sediment (potential)	Weight %		0.1	
Aluminium and silicium content (total)	mg/kg	max.	60	Heavy fuel oil processing
Acid number	mg KOH/g		2.5	
Hydrogen sulphide	mg/kg		2	
Used lubricating oil (ULO)	mg/kg			The fuel must be free of lubricating oil (ULO = used lubricating oil, old oil). Fuel is considered as contaminated with lubricating oil when the following concentrations occur: Ca > 30 ppm and Zn > 15 ppm or Ca > 30 ppm and P > 15 ppm.

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Asphaltene content	Weight %		2/3 of coke residue (according to Conradson)	Combustion properties
Sodium content	mg/kg		Sodium < 1/3 Vanadium, Sodium < 100	Heavy fuel oil processing
The fuel must be free of admixtures that cannot be obtained from mineral oils, such as vegetable or coal-tar oils. It must also be free of tar oil and lubricating oil (old oil), and also chemical waste products such as solvents or polymers.				

Table 1: The fuel specification and corresponding characteristics for heavy fuel oil

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Characteristic		Unit	Limit	Category ISO-F-											Test method reference
				RMA	RMB	RMD	RME	RMG				RMK			
				10	30	80	180	180	380	500	700	380	500	700	
Kinematic viscosity at 50 °C		mm^2/s	max.	10,00	30,00	80,00	180,0	180,0	380,0	500,0	700,0	380,0	500,0	700,0	ISO 3104
Density at 15 °C		kg/m^3	max.	920,0	960,0	975,0	991,0	991,0				1010,0			see 7.1 ISO 3675 or ISO 12185
CCAI		—	max.	850	860	860	860	870				870			see 6.3 a)
Sulfur		mass %	max.	Statutory requirements											see 7.2 ISO 8754 ISO 14596
Flash point		°C	min.	60,0	60,0	60,0	60,0	60,0				60,0			see 7.3 ISO 2719
Hydrogen sulfide		mg/kg	max.	2,00	2,00	2,00	2,00	2,00				2,00			IP 570
Acid number		mg KOH/g	max.	2,5	2,5	2,5	2,5	2,5				2,5			ASTM D664
Total sediment aged		mass %	max.	0,10	0,10	0,10	0,10	0,10				0,10			see 7.5 ISO 10307-2
Carbon residue: micro method		mass %	max.	2,50	10,00	14,00	15,00	18,00				20,00			ISO 10370
Pour point (upper)	winter quality	°C	max.	0	0	30	30	30				30			ISO 3016
	summer quality	°C	max.	6	6	30	30	30				30			ISO 3016
Water		volume %	max.	0,30	0,50	0,50	0,50	0,50				0,50			ISO 3733
Ash		mass %	max.	0,040	0,070	0,070	0,070	0,100				0,150			ISO 6245
Vanadium		mg/kg	max.	50	150	150	150	350				450			see 7.7 IP 501, IP 470 or ISO 14597
Sodium		mg/kg	max.	50	100	100	50	100				100			see 7.8 IP 501 IP 470

Figure 1: ISO 8217-2010 specification for heavy fuel oil

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ISO 8217:2010(E)

Characteristic	Unit	Limit	Category ISO-F-											Test method reference
			RMA	RMB	RMD	RME	RMG				RMK			
			10[a]	30	80	180	180	380	500	700	380	500	700	
Aluminium plus silicon	mg/kg	max.	25	40	40	50	60				60			see 7.9 IP 501, IP 470 or ISO 10478
Used lubricating oils (ULO): calcium and zinc; or calcium and phosphorus	mg/kg	—	The fuel shall be free from ULO. A fuel shall be considered to contain ULO when either one of the following conditions is met: calcium > 30 and zinc > 15; or calcium > 30 and phosphorus > 15											see 7.10 IP 501 or IP 470 IP 500

Figure 2: ISO 8217-2010 specification for heavy fuel oil (continued)

Additional information

The purpose of the following information is to show the relationship between the quality of heavy fuel oil, heavy fuel oil processing, the engine operation and operating results more clearly.

Selection of heavy fuel oil

Economic operation with heavy fuel oil within the limit values specified in the table entitled *"The fuel specification and corresponding properties for heavy fuel oil"* is possible under normal operating conditions, provided the system is working properly and regular maintenance is carried out. If these requirements are not satisfied, shorter maintenance intervals, higher wear and a greater need for spare parts is to be expected. The required maintenance intervals and operating results determine which quality of heavy fuel oil should be used.

It is an established fact that the price advantage decreases as viscosity increases. It is therefore not always economical to use the fuel with the highest viscosity as in many cases the quality of this fuel will not be the best.

Viscosity/injection viscosity

Heavy fuel oils with a high viscosity may be of an inferior quality. The maximum permissible viscosity depends on the preheating system installed and the capacity (flow rate) of the separator.

The prescribed injection viscosity of 12 - 14 mm^2/s (for GenSets, 23/30H and 28/32H: 12 - 18 cSt) and corresponding fuel temperature upstream of the engine must be observed. This is the only way to ensure efficient atomisation and mixture formation and therefore low-residue combustion. This also prevents mechanical overloading of the injection system. For the prescribed injection viscosity and/or the required fuel oil temperature upstream of the engine, refer to the viscosity temperature diagram.

Heavy fuel oil processing

Whether or not problems occur with the engine in operation depends on how carefully the heavy fuel oil has been processed. Particular care should be taken to ensure that highly-abrasive inorganic foreign matter (catalyst particles, rust, sand) are effectively removed. It has been shown in practice that wear as a result of abrasion in the engine increases considerably if the aluminium and silicium content is higher than 15 mg/kg.

Viscosity and density influence the cleaning effect. This must be taken into account when designing and making adjustments to the cleaning system.

Settling tank

Heavy fuel oil is precleaned in the settling tank. The longer the fuel remains in the tank and the lower the viscosity of heavy fuel oil is, the more effective the precleaning process will be (maximum preheating temperature of 75 °C to prevent the formation of asphalt in heavy fuel oil). A settling tank is sufficient for heavy fuel oils with a viscosity of less than $380^2/s$ at 50 °C. If the heavy fuel oil has a high concentration of foreign matter, or if fuels in accordance with ISO-F-RM, G/H/K380 or H/K700 are to be used, two settling tanks will be required one of which must be sized for 24-hour operation. Before the content is moved to the service tank, water and sludge must be drained from the settling tank.

Separators

A separator is particularly suitable for separating material with a higher specific density – water, foreign matter and sludge, for example. The separators must be self-cleaning (i.e. the cleaning intervals must be triggered automatically).

Only new generation separators should be used. They are extremely effective throughout a wide density range with no changeover required, and can separate water from heavy fuel oils with a density of up to 1.01 g/ml at 15 °C.

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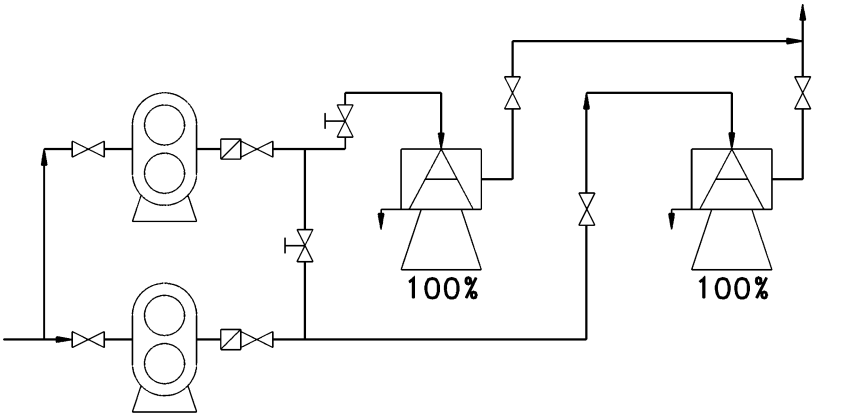
Table *"Achievable proportion of foreign matter and water (following separation)"* shows the prerequisites that must be met by the separator. These limit values are used by manufacturers as the basis for dimensioning the separator and ensure compliance.

The manufacturer's specifications must be complied with to maximize the cleaning effect.



Application in ships and stationary use: parallel installation

1 Separator for 100 % flow rate

1 Separator (reserve) for 100 % flow rate

Figure 3: Location of heavy fuel oil cleaning equipment and/or separator

The separators must be arranged according to the manufacturers' current recommendations (Alpha Laval and Westfalia). The density and viscosity of the heavy fuel oil in particular must be taken into account. If separators by other manufacturers are used, MAN Diesel should be consulted.

If processing is carried out in accordance with the MAN Diesel specifications and the correct separators are chosen, it may be assumed that the results stated in the table entitled *"Achievable proportion of foreign matter and water"* for inorganic foreign matter and water in the heavy fuel oil will be achieved at the engine inlet.

Results obtained during operation in practice show that the wear occurs as a result of abrasion in the injection system and the engine will remain within acceptable limits if these values are complied with. In addition, an optimum lubricating oil treatment process must be ensured.

Definition	Particle size	Quantity
Inorganic foreign matter including catalyst particles	< 5 µm	< 20 mg/kg
Al+Si content	--	< 15 mg/kg
Water content	--	< 0.2 % by vol. %

Table 2: Achievable proportion of foreign matter and water (after separation)

Water

It is particularly important to ensure that the water separation process is as thorough as possible as the water takes the form of large droplets, and not a finely distributed emulsion. In this form, water also promotes corrosion and sludge formation in the fuel system and therefore impairs the supply, atomisation and combustion of the heavy fuel oil. If the water absorbed in the fuel is seawater, harmful sodium chloride and other salts dissolved in this water will enter the engine.

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	Water-containing sludge must be removed from the settling tank before the separation process starts, and must also be removed from the service tank at regular intervals. The tank's ventilation system must be designed in such a way that condensate cannot flow back into the tank.
Vanadium/Sodium	If the vanadium/sodium ratio is unfavourable, the melting point of the heavy fuel oil ash may fall in the operating area of the exhaust-gas valve which can lead to high-temperature corrosion. Most of the water and water-soluble sodium compounds it contains can be removed by pretreating the heavy fuel oil in the settling tank and in the separators. The risk of high-temperature corrosion is low if the sodium content is one third of the vanadium content or less. It must also be ensured that sodium does not enter the engine in the form of seawater in the intake air. If the sodium content is higher than 100 mg/kg, this is likely to result in a higher quantity of salt deposits in the combustion chamber and exhaust-gas system. This will impair the function of the engine (including the suction function of the turbocharger). Under certain conditions, high-temperature corrosion can be prevented by using a fuel additive that increases the melting point of the heavy fuel oil ash (also see "Additives for heavy fuel oils”).
Ash	Fuel ash consists for the greater part of vanadium oxide and nickel sulphate (see above chapter for more information). Heavy fuel oils containing a high proportion of ash in the form of foreign matter, e.g. sand, corrosion compounds and catalyst particles, accelerate the mechanical wear in the engine. Catalyst particles produced as a result of the catalytic cracking process may be present in the heavy fuel oils. In most cases, these are aluminium silicate particles that cause a high degree of wear in the injection system and the engine. The aluminium content determined, multiplied by a factor of between 5 and 8 (depending on the catalytic bond), is roughly the same as the proportion of catalyst remnants in the heavy fuel oil.
Homogeniser	If a homogeniser is used, it must never be installed between the settling tank and separator, as otherwise it will not be possible to ensure satisfactory separation of harmful contaminants, particularly seawater.
Flash point (ASTM D 93)	National and international transportation and storage regulations governing the use of fuels must be complied with in relation to the flash point. In general, a flash point of above 60 °C is prescribed for diesel engine fuels.
Low-temperature behaviour (ASTM D 97)	The pour point is the temperature at which the fuel is no longer flowable (pumpable). As the pour point of many low-viscosity heavy fuel oils is higher than 0 °C, the bunker facility must be preheated, unless fuel in accordance with RMA or RMB is used. The entire bunker facility must be designed in such a way that the heavy fuel oil can be preheated to around 10°C above the pour point.
Pump characteristics	If the viscosity of the fuel is higher than 1000 mm^2/s (cST), or the temperature is not at least 10 °C above the pour point, pump problems will occur. For more information, also refer to “Low-temperature behaviour (ASTM D 97)”.
Combustion properties	If the proportion of asphalt is more than two thirds of the coke residue (Conradson), combustion may be delayed which in turn may increase the formation of combustion residues, leading to such as deposits on and in the injection nozzles, large amounts of smoke, low output, increased fuel consumption and a rapid rise in ignition pressure as well as combustion close to the cylinder wall (thermal overloading of lubricating oil film). If the ratio of asphalt to coke residues reaches the limit 0.66, and if the asphalt content exceeds 8%, the risk of deposits forming in the combustion chamber and injection

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system is higher. These problems can also occur when using unstable heavy fuel oils, or if incompatible heavy fuel oils are mixed. This would lead to an increased deposition of asphalt (see "Compatibility").

Ignition quality

Nowadays, to achieve the prescribed reference viscosity, cracking-process products are used as the low viscosity ingredients of heavy fuel oils although the ignition characteristics of these oils may also be poor. The cetane number of these compounds should be < 35. If the proportion of aromatic hydrocarbons is high (more than 35 %), this also adversely affects the ignition quality.

The ignition delay in heavy fuel oils with poor ignition characteristics is longer; the combustion is also delayed which can lead to thermal overloading of the oil film at the cylinder liner and also high cylinder pressures. The ignition delay and accompanying increase in pressure in the cylinder are also influenced by the end temperature and compression pressure, i.e. by the compression ratio, the charge-air pressure and charge-air temperature.

The disadvantages of using fuels with poor ignition characteristics can be limited by preheating the charge air in partial load operation and reducing the output for a limited period. However, a more effective solution is a high compression ratio and operational adjustment of the injection system to the ignition characteristics of the fuel used, as is the case with MAN Diesel & Turbo piston engines.

The ignition quality is one of the most important properties of the fuel. This value does not appear in the international specifications because a standardised testing method has only recently become available and not enough experience has been gathered at this point in order to determine limit values. The parameters, such as the calculated carbon aromaticity index (CCAI), are therefore aids that are derived from quantifiable fuel properties. We have established that this method is suitable for determining the approximate ignition quality of the heavy fuel oil used.

A testing instrument has been developed based on the constant volume combustion method (fuel combustion analyser FCA) and is currently being tested by a series of testing laboratories.
The instrument measures the ignition delay to determine the ignition quality of fuel and this measurement is converted into a an instrument-specific cetane number (FIA-CN or EC). It has been established that in some cases, heavy fuel oils with a low FIA cetane number or ECN number can cause operating problems.

As the liquid components of the heavy fuel oil decisively influence the ignition quality, flow properties and combustion quality, the bunker operator is responsible for ensuring that the quality of heavy fuel oil delivered is suitable for the diesel engine. (Also see illustration entitled *"Nomogram for determining the CCAI – assigning the CCAI ranges to engine types"*).

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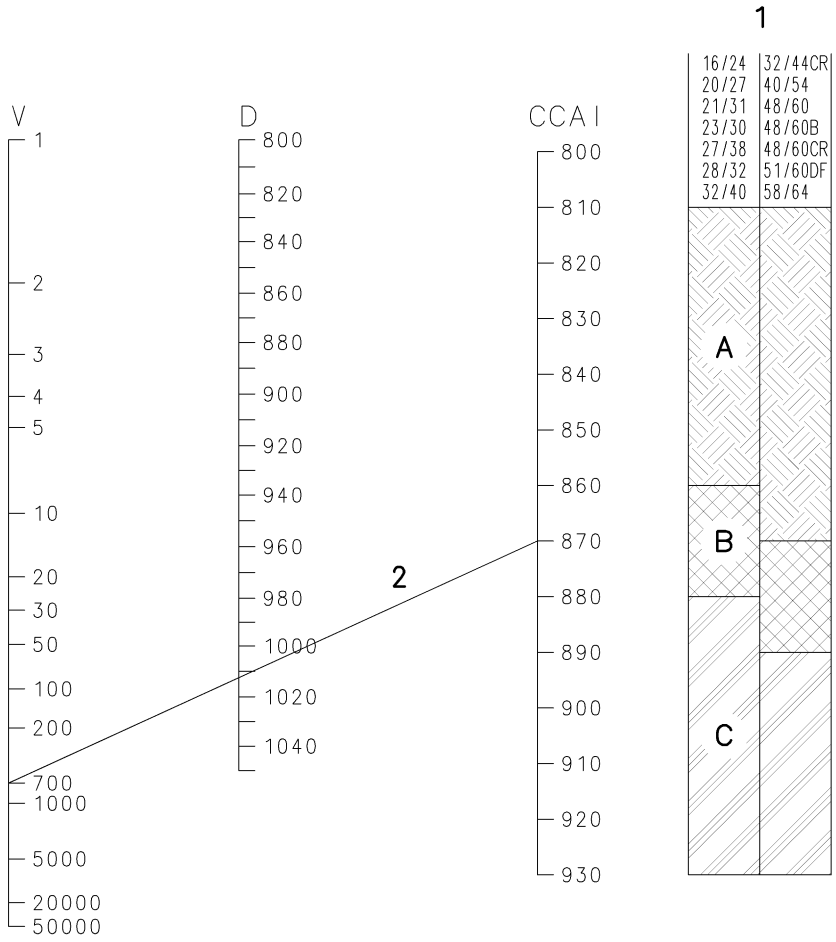

V Viscosity in mm²/s (cSt) at 50° C
D Density [in kg/m³] at 15° C

*CCAI **C**alculated **C**arbon **A**romaticity **I**ndex*

1 Engine type

A Normal operating conditions
B The ignition characteristics can be poor and require adapting the engine or the operating conditions.
C Problems identified may lead to engine damage, even after a short period of operation.
2 The CCAI is obtained from the straight line through the density and viscosity of the heavy fuel oils.

Figure 4: Nomogram for determining the CCAI – assigning the CCAI ranges to engine types

The CCAI can be calculated using the following formula:

CCAI = D - 141 log log (V+0.85) - 81

Sulphuric acid corrosion

The engine should be operated at the cooling water temperatures prescribed in the operating handbook for the relevant load. If the temperature of the components that are exposed to acidic combustion products is below the acid dew point, acid corrosion can no longer be effectively prevented, even if alkaline lubricating oil is used.

The BN values specified in Section 010.000.023-11 are sufficient, providing the quality of lubricating oil and the engine's cooling system satisfy the requirements.

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Compatibility

The supplier must guarantee that the heavy fuel oil is homogeneous and remains stable, even after the standard storage period. If different bunker oils are mixed, this can lead to separation and the associated sludge formation in the fuel system during which large quantities of sludge accumulate in the separator that block filters, prevent atomisation and a large amount of residue as a result of combustion.

This is due to incompatibility or instability of the oils. Therefore heavy fuel oil as much as possible should be removed in the storage tank before bunkering again to prevent incompatibility.

Blending the heavy fuel oil

If heavy fuel oil for the main engine is blended with gas oil (MGO) to obtain the required quality or viscosity of heavy fuel oil, it is extremely important that the components are compatible (see "Compatibility").

Additives for heavy fuel oils

MAN Diesel & Turbo engines can be operated economically without additives. It is up to the customer to decide whether or not the use of additives is beneficial. The supplier of the additive must guarantee that the engine operation will not be impaired by using the product.

The use of heavy fuel oil additives during the warranty period must be avoided as a basic principle.

Additives that are currently used for diesel engines, as well as their probable effects on the engine's operation, are summarised in the table below *"Additives for heavy fuel oils – classification/effects"*.

Precombustion additives	▪ Dispersing agents/stabilisers ▪ Emulsion breakers ▪ Biocides
Combustion additives	▪ Combustion catalysts (fuel savings, emissions)
Post-combustion additives	▪ Ash modifiers (hot corrosion) ▪ Soot removers (exhaust-gas system)

Table 3: Additives for heavy fuel oils – Classification/effects

Heavy fuel oils with low sulphur content

From the point of view of an engine manufacturer, a lower limit for the sulphur content of heavy fuel oils does not exist. We have not identified any problems with the low-sulphur heavy fuel oils currently available on the market that can be traced back to their sulphur content. This situation may change in future if new methods are used for the production of low-sulphur heavy fuel oil (desulphurisation, new blending components). MAN Diesel & Turbo will monitor developments and inform its customers if required.

If the engine is not always operated with low-sulphur heavy fuel oil, corresponding lubricating oil for the fuel with the highest sulphur content must be selected.

DANGER

Improper handling of operating fluids

If operating fluids are improperly handled, this can pose a danger to health, safety and the environment. The relevant safety information by the supplier of operating fluids must be observed.

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Tests

Sampling

To check whether the specification provided and/or the necessary delivery conditions are complied with, we recommend you retain at least one sample of every bunker oil (at least for the duration of the engine's warranty period). To ensure that the samples taken are representative of the bunker oil, a sample should be taken from the transfer line when starting up, halfway through the operating period and at the end of the bunker period. “Sample Tec" by Mar-Tec in Hamburg is a suitable testing instrument which can be used to take samples on a regular basis during bunkering.

Analysis of samples

To ensure sufficient cleaning of the fuel via the separator, perform regular functional check by sampling up- and downstream of the separator.

Analysis of HFO samples is very important for safe engine operation. We can analyse fuel for customers at our laboratory (PrimeServLab).

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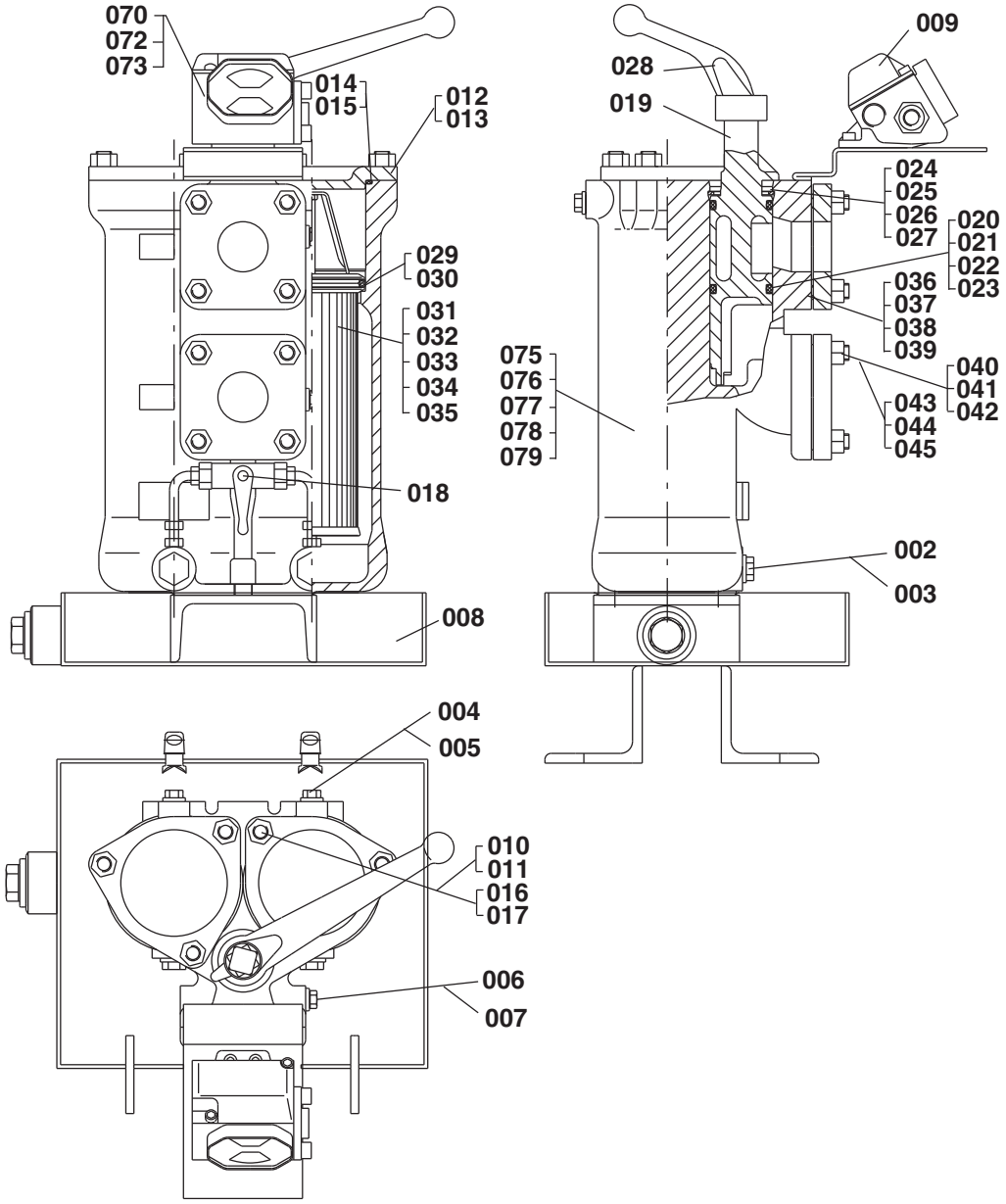
General



General

Item no	Qty.	Designation	Benævnelse
002	2/F	**Screw plug**	Propskrue
003	2/F	**Gasket**	Pakning
004	2/F	**Screw plug**	Propskrue
005	2/F	**Gasket**	Pakning
006	2/F	**Screw plug**	Propskrue
007	2/F	**Gasket**	Pakning
008	1/F	**Oilpan**	Bundkar
009	1/F	**Differential pressure indicator**	ifferential trykindikator
010	6/F	**Bolt, DN 25, DN 32**	Bolt, DN 25, DN 32
011	6/F	**Bolt, DN 40, DN 50, DN 65**	Bolt, DN 40, DN 50, DN 65
012	2/F	**Cover, DN 25, DN 32**	Dæksel, DN 25, DN 32
013	2/F	**Cover, DN 40, DN 50, DN 65**	Dæksel, DN 40, DN 50, DN 65
014	2/F	**O-ring, DN 25, DN 32**	O-ring, DN 25, DN 32
015	2/F	**O-ring, DN 40, DN 50, DN 65**	O-ring, DN 40, DN 50, DN 65
016	6/F	**Nut, DN 25, DN 32**	Møtrik, DN 25, DN 32
017	6/F	**Nut, DN 40, DN 50, DN 65**	Møtrik, DN 40, DN 50, DN 65
018	1/F	**Ball valve**	Kugleventil
019	1/F	**Cock**	Hane
020	2/F	**O-ring, DN 25, DN 32**	O-ring, DN 25, DN 32
021	2/F	**O-ring, DN 40**	O-ring, DN 40
022	2/F	**O-ring, DN 50**	O-ring, DN 50
023	2/F	**O-ring, DN 65**	O-ring, DN 65
024	1/F	**Circlip ring, DN 25, DN 32**	Sikringsring, DN 25, DN 32
025	1/F	**Circlip ring, DN 40**	Sikringsring, DN 40
026	1/F	**Circlip ring, DN 50**	Sikringsring, DN 50
027	1/F	**Circlip ring, DN 65**	Sikringsring, DN 65
028	1/F	**Plug key**	Prop
029	2/F	**Gasket, DN 25, DN 32**	Pakning, DN 25, DN 32
030	2/F	**Gasket, DN 40, DN 50, DN 65**	Pakning, DN 40, DN 50, DN 65
031	2/F	**Filter element, DN 25**	Filterelement, DN 25
032	2/F	**Filter element, DN 32**	Filterelement, DN 32
033	2/F	**Filter element, DN 40**	Filterelement, DN 40
034	2/F	**Filter element, DN 50**	Filterelement, DN 50
035	2/F	**Filter element, DN 65**	Filterelement, DN 65
036	2/F	**Gasket, DN 25, DN 32**	Pakning, DN 25, DN 32
037	2/F	**Gasket, DN 40**	Pakning, DN 40
038	2/F	**Gasket, DN 50**	Pakning, DN 50
039	2/F	**Gasket, DN 65**	Pakning, DN 65
040	8/F	**Bolt, DN 25, DN 32**	Bolt, DN 25, DN 32
041	8/F	**Bolt, DN 40, DN 50**	Bolt, DN 40, DN 50
042	8/F	**Bolt, DN 65**	Bolt, DN 65
043	8/F	**Nut, DN 25, DN 32**	Møtrik, DN 25, DN 32
044	8/F	**Nut, DN 40, DN 50**	Møtrik, DN 40, DN 50
045	8/F	**Nut, DN 65**	Møtrik, DN 65
070	2/F	**Screw**	Skrue
072	2/F	**Nut**	Møtrik
073	2/F	**Spring washer**	Fjederskive
075	1/E	**Fuel oil filter duplex, DN 25, complete**	Brændselsoliespaltefilter, DN 25, Komplet
076	1/E	**Fuel oil filter duplex, DN 32, complete**	Brændselsoliespaltefilter, DN 32, Komplet
077	1/E	**Fuel oil filter duplex, DN 40, complete**	Brændselsoliespaltefilter, DN 40, Komplet
078	1/E	**Fuel oil filter duplex, DN 50, complete**	Brændselsoliespaltefilter, DN 50, Komplet
079	1/E	**Fuel oil filter duplex, DN 65, complete**	Brændselsoliespaltefilter, DN 65, Komplet

When ordering spare parts, see also page 500.50.

* = **Only available as part of a spare parts kit.**
Qty./E = Qty./Engine
Qty./F = Qty./Filter

Ved bestilling af reservedele, se også side 500.50.

* = Kun tilgængelig som en del af et reservedelssæt.
Qty./E = Qty./Engine
Qty./F = Qty./Filter