

Subject

Scuffing and excessive wear of cylinder liners as well as the wear, sticking or breakage of piston rings, and deposit formation in the piston crown and ring areas of two-stroke main engines using VLSFO

# ClassNK

## Technical Information

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To whom it may concern

Several cases of scuffing, excessive wear of cylinder liners as well as the wear, sticking or breakage of piston rings, and deposit formations in the piston crown and ring areas of two-stroke main engines have been reported since the global use of very low sulphur fuel oil with max. 0.5% sulphur (VLSFO) began on 1 January 2020. Figure 1 shows a scuffed liner and Figure 2 shows deposit build up on piston lands.

Along with information on the characteristics of VLSFOs that the Society has investigated to date, this TEC also provides information on possible measures which can be taken to prevent the above-mentioned damage; therefore, please conduct the following recommended scavenge port inspections and cylinder drain total iron analyses as necessary.



Fig. 1 Cylinder liner scuffing



Fig. 2 Deposits on piston lands

Although the characteristics of VLSFOs tend to vary to a greater degree than the characteristics of traditional high sulphur fuel oils (HSFOs), samples of the VLSFOs that the Society has investigated to date were confirmed to conform to the specifications of ISO 8217. Table 1 shows the characteristics of some of these samples.

(To be continued)

NOTES:

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	Average									
	Sulfur(mass%)	Density(kg/m <sup>3</sup> )	Viscosity(cSt)	Pour Point(°C)	Al+Si(ppm)	MCR(mass%)	Ash(mass%)	TSP(mass%)	CCAI	
Japan (666 caces)	0.36	930	38	5	9	2.8	0.01	0.010	821	
	0.23 - 0.48	904 - 955	3 - 141	-35 - 24	1 - 50	0.43 - 16.0	0.00 - 0.10	0.000 - 0.110	800 - 860	
Korea (335 caces)	0.44	929	105	14	12	4.2	0.01	0.014	807	
	0.15 - 0.50	895 - 982	6 - 383	-40 - 30	0 - 54	1.0 - 16.6	0.00 - 0.07	0.000 - 0.100	782 - 878	
China (468 caces)	0.44	944	133	16	25	6.0	0.03	0.017	819	
	0.25 - 0.53	880 - 987	7 - 356	-6 - 30	1 - 69	0.1 - 12.1	0.00 - 0.08	0.010 - 0.220	793 - 865	
Singapore (890 caces)	0.47	944	110	14	27	5.6	0.03	0.021	821	
	0.21 - 0.56	875 - 984	9 - 359	-30 - 36	1 - 122	0.1 - 14.2	0.00 - 0.30	0.000 - 0.260	783 - 865	
Others of East Asia (678 caces)	0.43	916	86	17	20	5.6	0.02	0.019	804	
	0.30 - 0.50	868 - 979	3 - 493	0 - 30	1 - 58	0.0 - 15.0	0.00 - 0.07	0.000 - 0.220	774 - 866	
Middle East (191 caces)	0.46	929	173	22	19	6.5	0.03	0.014	801	
	0.40 - 0.50	889 - 961	14 - 374	0 - 30	1 - 119	2.0 - 10.0	0.01 - 0.06	0.010 - 0.070	786 - 914	
Europe (301 caces)	0.48	950	146	8	19	6.7	0.02	0.024	827	
	0.35 - 0.62	876 - 1030	7 - 501	-42 - 36	1 - 214	0.7 - 15.0	0.00 - 0.15	0.010 - 0.350	784 - 888	
Africa (64 caces)	0.46	939	90	8	13	6.9	0.02	0.018	823	
	0.40 - 0.51	901 - 986	15 - 307	-18 - 30	0 - 57	2.7 - 11.2	0.01 - 0.06	0.010 - 0.060	789 - 871	
North America (East) (72 caces)	0.49	945	82	6	26	5.9	0.02	0.024	831	
	0.34 - 0.57	887 - 987	6 - 325	-12 - 27	2 - 95	1.0 - 13.0	0.00 - 0.07	0.010 - 0.150	791 - 868	
US Gulf (53 caces)	0.45	939	89	11	19	4.8	0.02	0.030	824	
	0.10 - 0.55	855 - 989	5 - 321	-9 - 30	0 - 51	0.2 - 9.9	0.00 - 0.06	0.010 - 0.180	766 - 865	
North America (West) (119 caces)	0.46	945	84	2	22	4.9	0.02	0.014	837	
	0.35 - 0.52	874 - 990	3 - 382	-12 - 33	1 - 56	1.5 - 13.0	0.00 - 0.06	0.000 - 0.160	770 - 870	
South America* (232 caces)	0.46	932	91	8	19	4.8	0.02	0.031	816	
*including Panama	0.22 - 0.54	878 - 971	5 - 366	-12 - 33	1 - 65	0.2 - 12.5	0.00 - 0.07	0.010 - 0.420	795 - 854	
Trouble Fuel* (24 caces)	0.45	941	73	7	29	4.8	0.03	0.040	828	
*all areas	0.31 - 0.50	876 - 980	7 - 290	-27 - 30	1 - 56	0.7 - 13.0	0.00 - 0.07	0.010 - 0.130	788 - 861	

Table 1 Characteristics of sample VLSFOs

Investigations so far have not identified any clear pattern in the characteristics of fuels or cylinder lubrication oil (CLO) related to the reported damage. The mechanism leading to such damage seems to be far from straightforward. It may involve the fuel, the CLO and its feed rate, operation conditions as well as various combinations of related parameters. The proper selection of a fuel-specific CLO and its corresponding feed rate is considered particularly important not only to achieve good acid neutralization capability and alkaline detergency, but also to help avoid excessive hard deposit formation on piston lands, especially on the top land due to running on too high BN oils or using too high oil feed rates. Therefore, the OEM's guidance on selection and use of CLOs is to be followed.

As mentioned above, since identifying the parametric patterns that may cause damage seems to be difficult, condition monitoring by all possible means becomes increasingly important. The following two measures are recommended for evaluating the conditions of cylinder liners, pistons and rings.

- (1) Scavenge port inspections (surface conditions of cylinder liners, pistons and piston rings)
- (2) Cylinder drain oil total iron (Fe) analyses (wear condition of piston liners and rings)

With respect to the intervals of scavenge port inspections and cylinder drain oil analyses as well as detailed analysis methods, the OEM's guidance is to be followed.

(To be continued)

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