Service Information No. 0004 com

Date: November 28, 2013
Subject: Expected Lifetime and TBO of engine components

Engine type: All

Expected Lifetime and Time Between Overhaul of engine components

Through our continuous follow-up activities in the field, we have become aware that several "Expected Lifetime" (lifetime) and "Time Between Overhaul" (TBO) indications for engine components that have been valid for many years and where some were even taken over from previous engine models, are no longer applicable to today's typical operating conditions. Therefore, the published TBO and lifetime data for the main components subject to wear and tear has been reviewed. The result is summarized in table 1 (page 4).

Based on analysis or experience under known usual operating conditions, these values can be reached. Because operating conditions can vary significantly, we still recommend determining optimal intervals for overhaul or exchange for your specific installation by means of own inspections, especially for components where wear is easily visible or measurable. In general, wear criteria given in the operators manual should be observed to determine the reusability of a component. The expected lifetime values in the attached table are indications that can be used for planning purposes. Only for components where no wear criteria exist, they should be understood as recommended exchange intervals. However, because relevant operating conditions, especially fuel quality and treatment, may vary significantly, the respective values must not be understood as a value guaranteed by the manufacturer, and the achievable lifetime may deviate from this value.

We kindly ask you to note that the updated data has not been integrated in the documentation you received with your engines at the time of commissioning. In case of contradicting data, the newer document is applicable.

The use of genuine MaK spare parts when exchanging components does not only assure that these parts comply with all OEM specifications, but also that your engine is in compliance with IMO regulations. In case of need, please contact your local MaK service dealer for more information or parts and service offers.

In the following, we would like to provide more detailed information on four components, where lifetime and/or TBO data is introduced for the first time or was changed compared to previously published data.

Introduction of Lifetime and TBO for piston skirts for all current engine models

With Service Information 12/07 we informed the operators of MaK M32 (C) – engines in autumn of 2007 about our recommendation to limit the lifetime of pistons. In the following years, we continued to conduct general investigations about the durability of pistons together with external material experts. It was determined that, contrary to previous belief (and according to the "Wöhler-curve"), the materials used do not have a true fatigue strength for an unlimited number of load cycles, but that the fatigue strength of the material continuously decreases over the lifetime of the component in use, even after the theoretical fatigue strength according to Wöhler has been reached (see graph 1, source: Fraunhofer Institut Betriebsfestigkeit). Due to the high thermal and mechanical load and the possibility for overhaul, piston **crowns** were always subject to a recommended lifetime. The

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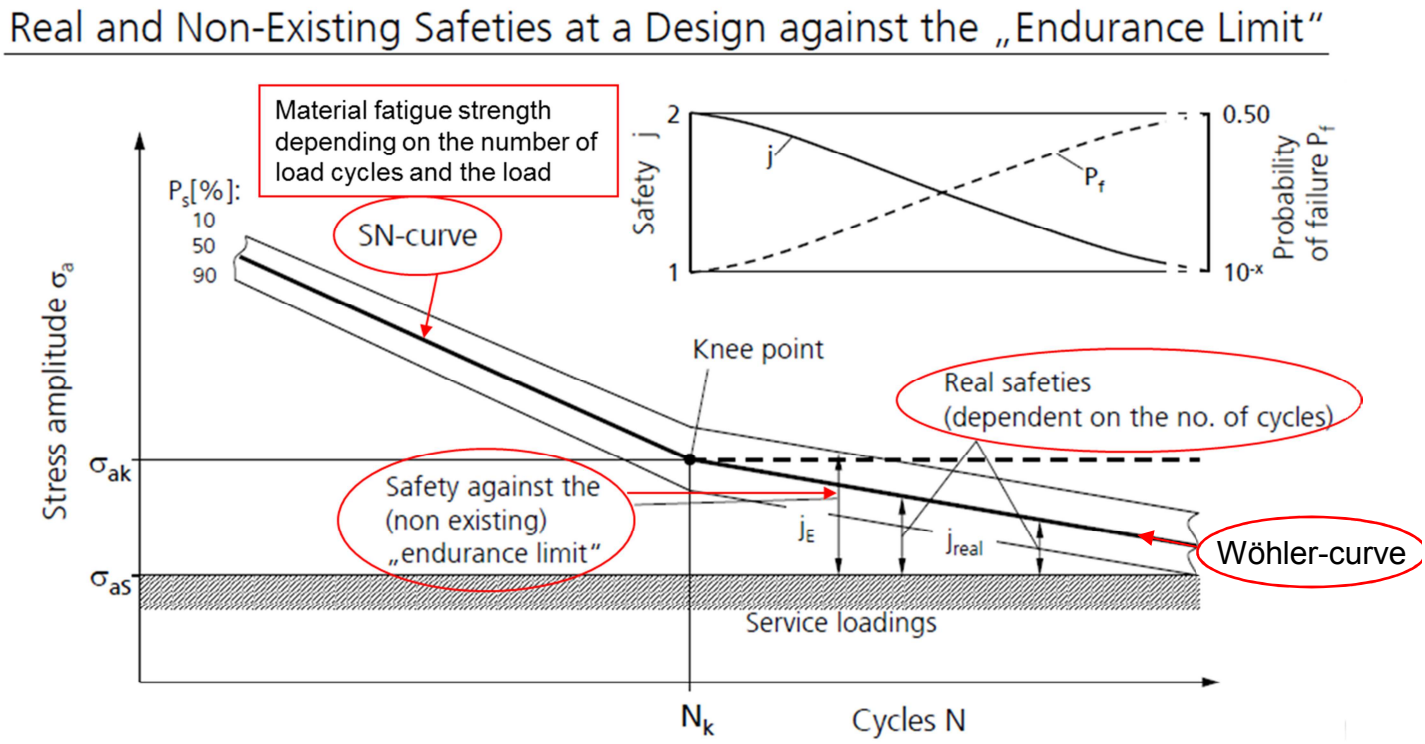
recommendation to limit the lifetime of pistons **skirts** for all current engine models however, is new and based on the investigations mentioned above.

The limit values for piston skirts mentioned in table 1 (page 4) take into account field experience, new insights into the long-term characteristics of the materials under cyclic load and the dimensional design of the component. These recommendations are valid as long as the engine is operated within the specified conditions at all times.



Graph 1 according to Fraunhofer Institut Betriebsfestigkeit

Piston Pin Bushing lifetime limitation

Until now, no lifetime limitation has been recommended from the manufacturer's side. The limitation published now takes into account that this component is subject to continuous wear. The given lifetime is to be understood as a rather conservative indication only, since the wear rate of this component varies significantly. In cases where an inspection after 60,000 operating hours reveals an uncritical wear condition, the bushing can continue to operate until the next scheduled overhaul provided the operating conditions remain unchanged.

Reduction of the recommended lifetime of injection nozzle elements for HFO operation

The combination of higher injection pressures and decreasing fuel qualities at the same time lead to an increased load on the injection system components, especially the fuel injection nozzle elements. Based on the experience gathered over the past several years and respective reports from dealers and customers, we now recommend all operators of MaK engines of the current production models to reduce the operating hours of injection nozzle elements to 5,000 hours with HFO (previously 7,500 h).

Please note that overly worn nozzle elements may lead to irregular or incomplete combustion, which, in the longer term, may lead to reduced lifetimes of other engine components, increased emission levels and/or higher fuel consumption. Unfortunately, it is hardly possible to reliably determine the wear condition of modern nozzle elements. The standard testing tool for the injector opening pressure is not suitable for this purpose. Experience shows that the engines' operating behavior and readings typically change when nozzles wear out. In case all operating readings remain stable, injection nozzles can be used for longer operating hours. However, our current experience is that significant nozzle element wear is typically reached after approximately 5,000 operating hours with HFO.

Increasing lifetime and TBO of crankshaft torsional vibration dampers (Except M20)

Based on the experience gathered over the past several years and respective reports from dealers and customers, the recommended interval for overhaul and exchange of crankshaft torsional vibration dampers were increased from 30/45Th to 30/60Th. Besides the longer utilization time, the new exchange interval has the advantage to fall within the interval of the main engine overhaul every 30,000 operating hours, where significant work is performed on the engine anyway.
Assuming the operating conditions are as specified, we do not see a significant risk for safe engine operation with this increased exchange interval.

Omission of the overhaul interval for the spring-leaf camshaft torsional vibration damper (9M43C and 16VM43C only)

The overhaul interval of the spring-leaf camshaft torsional vibration damper on 9M43C and 16VM43C of 15.000 operating hours is omitted and replaced by an exchange interval of 30.000 operating hours. This change is based on experience gathered over the past several years and respective reports from dealers and customers about this component. Based on today's knowledge, assuming the operating conditions are as specified, we do not see a significant risk for safe engine operation without the overhaul interval.

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CATERPILLAR® Expected Lifetime / TBO Core Components (x 1000 hours)

Core components	M20					M25					M32 & VM32					M43 & VM43				
	TBO	Lifetime				TBO	Lifetime				TBO	Lifetime				TBO	Lifetime			
		Propulsion		GenSet			Propulsion		GenSet			Propulsion		GenSet			M43		VM43	
		MDO	HFO	MDO	HFO		MDO	HFO	MDO	HFO		MDO	HFO	MDO	HFO		MDO	HFO	MDO	HFO
Piston crown (Lifetime incl. 2 stages rework)	60	60	60	60	60	30	90	90	90	90	30	90	90	90	90	30	90	90	90	90
Piston skirt cast iron (standard)	-	-	-	-	-	-	60	60	60	60	-	60	60	60	60	-	60	60	60	60
Piston skirt steel (optional)	-	-	-	-	-	-	-	-	-	-	-	90	90	90	90	-	90	90	90	90
Piston skirt Aluminium	-	60	60	60	60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Piston rings	-	30	30	30	30	-	30	30	30	30	-	30	30	30	30	-	30	30	30	30
Piston pin bearing	-	60	60	60	60	-	60	60	60	60	-	60	60	60	60	-	60	60	60	60
Cuff / Antipolishing ring	-	30	30	30	30	-	30	30	30	30	-	30	30	30	30	-	30	30	30	30
Cylinder liner	-	90	60	90	60	-	90	60	90	60	-	90	60	90	60	-	90	60	90	60
Cylinder head	15	90	90	90	90	15	90	90	90	90	15	90	90	90	90	15	90	90	90	90
Inlet valve	15	30	30	30	30	15	30	30	30	30	15	30	30	30	30	15	30	30	30	30
Exhaust valve	15	30	30	30	30	15	30	30	30	30	15	30	30	30	30	15	30	30	30	30
Nozzle element	-	7.5	5	7.5	5	-	7.5	5	7.5	5	-	7.5	5	7.5	5	-	7.5	5	7.5	5
Pump element	-	15	15	15	15	-	15	15	15	15	-	15	15	15	15	-	15	15	15	15
Main bearing	-	30	30	30	30	-	30	30	30	30	-	30	30	30	30	-	30	30	30	30
Big-end bearing	-	30	30	30	30	-	30	30	30	30	-	30	30	30	30	-	30	30	30	30
Camshaft bearing	-	45	45	45	45	-	45	45	45	45	-	45	45	45	45	-	45	45	45	45
Turbocharger plain bearing	-	12	12	12	12	-	12	12	12	12	-	12	12	12	12	-	12	12	12	12
CR - Injector	-	-	-	-	-	-	-	-	-	-	6	18	18	18	18	-	-	-	-	-
Vibration damper camshaft (Visco)	-	15	15	15	15	-	15	15	15	15	-	15	15	15	15	-	15	15	15	15
Vibration damper camshaft (Spring / only 9M43 + 16VM43)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30	30	30	30
Vibration damper crankshaft	15	-	-	-	-	30	60	60	60	60	30	60	60	60	60	30	60	60	60	60

The above-mentioned data are only indicative and relate to an average component life expectancy under favorable operating conditions.
Actual lifetime can deviate significantly as a result of, amongst others, fuel quality, load & operating profile/conditions and quality of maintenance.

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Table 1

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