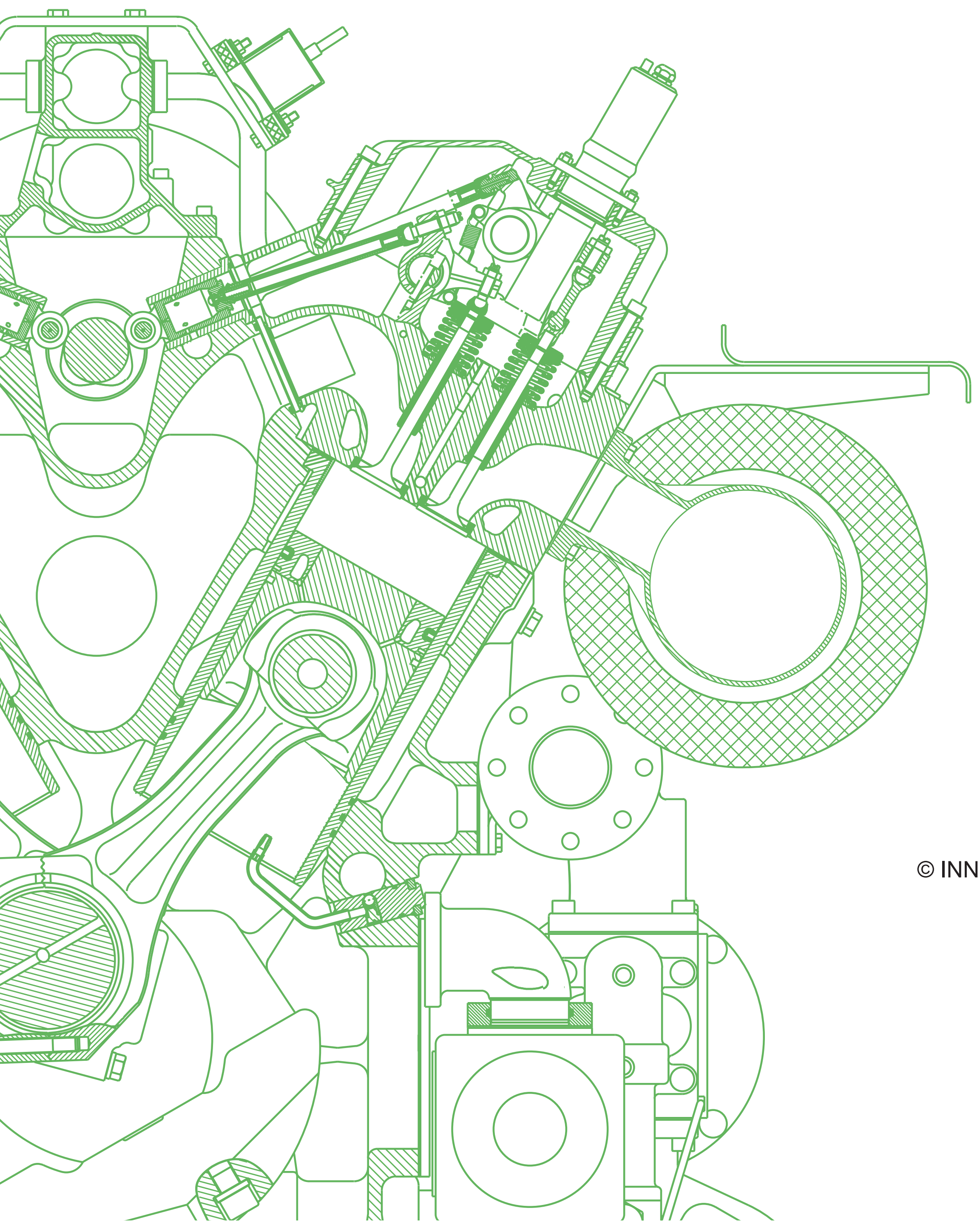
JENBACHER

TA 1000-0099B

Technical Instruction

Limit levels for used oil in Jenbacher gas engines



Achenseestr. 1-3
A-6200 Jenbach, Austria
www.innio.com

JENBACHER
INNIO

JENBACHER

TA 1000-0099B
Limit levels for used oil in Jenbacher gas engines

The target recipients of this document are:

Prospective Customers, Customers, Distribution Partners, Service Partners, Commissioning Partners, Subsidiaries/ Branches, Location Jenbach

NOTE

Observance of the conditions of this Technical Instruction and performance of the activities described therein is the basis of safe and efficient plant operation.

Non-observance of the conditions of this Technical Instruction and/or non-performance of the prescribed activities or any departure from the prescribed activities may result in the loss of guarantee rights.

The activities and conditions defined in this Technical Instruction shall be performed and/or observed by the plant operator. This shall not apply if this Technical Instruction is expressly allocated to the area of responsibility of INNIO Jenbacher GmbH & Co OG or a contractual agreement between the operator and INNIO Jenbacher GmbH & Co OGprovides for a different arrangement.

1 Application:

This Technical Instruction gives directions on the oil care for Jenbacher Gas Engines.

Other applicable Technical Instructions:	1000-0099C (analysis intervals)
	1000-0099D (determination of the ipH value)

1000-0112 (sampling)

INNIO Jenbacher GmbH & Co OG oil monitoring programme

The scope of the analysis and the assessment and evaluation of the used oil analyses can only be guaranteed to have been carried out in accordance with INNIO Jenbacher guidelines if the INNIO Jenbacher GmbH & Co OG analysis system is used (part no. 510132).

The special INNIO Jenbacher GmbH & Co OG colour code allows simple decisions to be taken about necessary measures (Caution: only applicable to INNIO Jenbacher GmbH & Co OG partner laboratories)

Green	No action necessary before the next sample
Yellow	Change the oil before the next sample
Red	Contact your Technical Service Hotline

Caution

The INNIO Jenbacher GmbH & Co OG colour code and the actions derived from it only apply to the INNIO Jenbacher GmbH & Co OG oil monitoring programme. Third-party laboratories may possibly use the same traffic light colours but not the same derived necessary actions. The use of third-party laboratories is allowed. However, the scope of the analysis, evaluation of the data and the measures based on these recommended by third party laboratories do not necessarily comply with the INNIO Jenbacher GmbH & Co OGguidelines.

Evaluation of the used oil analysis data and measures based on it must be done by the responsible person in accordance with the INNIO Jenbacher GmbH & Co OG guidelines (see Sections 2 and 3)>

1.1 Brief Instruction

- Lubricating oil in internal combustion engines changes and ages as a function of the operating conditions.
- The lubricating oil in Jenbacher Gas Engines must be changed depending on its condition. Jenbacher Gas Engines does not issue any guaranteed fixed oil change intervals.
- Lubricating oil must be tested for serviceability on a regular basis. (See TA 1000-0099C) for the analysis interval).
- The analysis programme must be carried out in its entirety (see Section 2).
- The limit and alarm values must be observed (see Section 2).
- The analysis reports must be documented and kept by the customer, and submitted to Jenbacher Gas Engines in a suitable form on request.
- The analysis reports must show a trend. At least 5 analysis reports (see Section 5 for an example).
- See Section 3 for the interpretation of the analysis data, and for measures to be taken.
- The customer is responsible for ensuring that samples are sent to the laboratory immediately after they are taken. The time between a sample being taken and its arrival at the laboratory must not exceed 5 days.
- If a change is made to another brand of lubricating oil, the products must not be mixed in the storage tank or oil pan. The amount of residual oil held in the engine and storage tank must be kept as low as possible. If oils are mixed, the various oil characteristics can no longer be correctly interpreted.

2 Analysis programme - limit / alarm values

Parameters and limit values only apply for lubricants approved for GE Distributed Power engines in accordance with TA 1000-1109.

Parameters and alarm levels apply to wear and corrosion products. These alarm levels are not applicable when bypass filters are used.

2.1 Oil condition

Programme point	Unit	Limit value	Guideline	Information Oil	Information Engine	Information Gas
Viscosity at 100°C	mm²/sec, cSt	≥ fresh oil +3 and ≥ 17**≥16.9 *)**	DIN 51562	x		
Viscosity at 40°C	mm²/sec, cSt	≥ fresh oil +25%	DIN 51562	x		
Base number BN (TBN)	mg KOH/g	≤ 50% of the fresh oil **≤ 2.5 *)**	DIN ISO 3771	x		
Acid number AN (TAN)	mg KOH/g	≥ fresh oil value +2.5 **≥ fresh oil value +3 *)**	DIN ISO 3771	x		
ipH value	-	≤ 4.0 INNIO Jenbacher method ≤ 4.5 Mobil method	TA 1000-099D	x		
Ageing (oxidation)	ABS/cm	≥ 20 ≥ **30 *)**	IR spectroscopy	x		
IR nitration	ABS/cm	≥ 20 ≥ **30 *)**	IR spectroscopy	x		
Soot	%	≥ 2	IR spectroscopy	x		

***) for Mobil Pegasus 1005 only**

2.2 Contaminants

Programme point	Unit	Limit value	Guideline	Information Oil	Information Engine	Information Gas
Sodium (Na)	ppm, mg/kg	20	DIN 51396/3		x	
Potassium (Ka)	ppm, mg/kg	5	DIN 51396/3		x	
Chlorine (Cl)	ppm, mg/kg	-	DIN 51396/3			x
Glycol	%	0.02			x	
Water	%	0.2			x	x
Silicon (Si)	ppm, mg/kg	20 (Class A)	DIN 51396/3			x
Silicon (Si)	ppm, mg/kg	200 (Class B, C)	DIN 51396/3			x
Sulphur (S)	ppm, mg/kg	-	DIN 51396/3	x		x

2.3 Metallic elements

Programme point	Unit	Alarm levels	Guideline	Information		
				Oil	Engine	Gas
Iron (Fe)	ppm, mg/kg	20	DIN 51396/3		x	
Aluminium (Al)	ppm, mg/kg	15	DIN 51396/3		x	
Chromium (Cr)	ppm, mg/kg	5	DIN 51396/3		x	
Copper (Cu)	ppm, mg/kg	15	DIN 51396/3		x	
Tin (Sn)	ppm, mg/kg	5	DIN 51396/3		x	
lead (Pb)	ppm, mg/kg	20	DIN 51396/3		x	

2.4 Oil additive elements

Programme point	Unit	Limit values	Guideline	Information		
				Oil	Engine	Gas
Calcium (Ca)	ppm, mg/kg	-	DIN 51396/3	x		
Zinc (Zn)	ppm, mg/kg	-	DIN 51396/3	x		
Phosphorus (Ph)	ppm, mg/kg	-	DIN 51396/3	x		
Boron (B)	ppm, mg/kg	-	DIN 51396/3	x		
Molybdenum (Mb)	ppm, mg/kg	-	DIN 51396/3	x		

3 Interpretation of used oil values and measures based on them

It is quite normal for the properties of lubricating oil to change (through ageing) in the course of operation. The lubricating oil must therefore be changed in good time, in other words before it becomes unserviceable. The lubricating oil can be prevented from becoming unserviceable if it is changed when the limit values of an analysis variable are reached.

3.1 Oil condition characteristics

Viscosity ➢ If the limit value has been reached, the oil must be changed.

Viscosity is a measure of the fluidity of lubricating oil and is temperature-dependent. Viscosity increases as a result of thermal loading and ageing of the oil.

Oxidation ➢ If the limit value has been reached, the oil must be changed.

Ageing

Oil oxidation is due to the lubricating oil reacting with oxidised combustion products. Oxidation increases during usage. Oxidation products can contribute to the formation of organic acids, so that corrosion cannot be ruled out.

Nitration ➢ If the limit value has been reached, the oil must be changed.

Oil nitration is due to the lubricating oil reacting with oxides of nitrogen. Nitration increases during usage. There is a danger of the formation of corrosive reaction products.

Base number ➢ If the limit value has been reached, the oil must be changed.

The base number (BN, TBN) denotes the alkaline reserve of the lubricating oil, and characterises its chemical neutralising capacity. The alkaline reserve of the lubricating oil is constantly reduced with continued usage due to its reaction with acids. A rapid reduction in the total base number is to be expected when operating with contaminated fuel gases (biogases, sludge gases or landfill gases).

Acid number ➢ If the limit value has been reached, the oil must be changed.

TAN, AN

Oxidation and nitration processes can lead to the formation of weak organic acids which are only partially neutralised by the basic reserve of the lubricating oil. The TAN increases during usage. A sharp increase in the acid number is to be expected when operating with contaminated fuel gases (biogases, sludge gases or landfill gases).

ipH value ➢ If the limit value has been reached, the oil must be changed.

Determination of the ipH value is absolutely essential when using non-natural gas fuels. The presence of acids in these fuel gases before combustion cannot be ruled out, even if the BN value has not yet reached its limit. The ipH value decreases steadily during usage.

Soot ➢ If the limit value has been reached, the oil must be changed.

Experience has shown that gas engines do not form soot. However, soot formation cannot be ruled out on more recent engine versions. The soot content of the oil must therefore be routinely checked.

3.2 Impurities

Sodium ➢ If the limit value has been reached, the oil must be changed and the cooling system checked for leaks.

Sodium is a typical element in cooling water corrosion protection additives. An increase in the sodium content of used oil indicates contamination with cooling water. In many instances no water can be proved in the oil despite a high sodium content.

Potassium ➢ If the limit value has been reached, the oil must be changed and the cooling system checked for leaks.

Potassium is a typical element in cooling water corrosion protection additives. An increase in the potassium content of used oil indicates contamination with cooling water.

Potassium is a possible impurity in wood gas, which is sometimes used as a fuel. If potassium is suspected in the fuel gas, no limit value applies.

Chlorine ➢ Pay particular attention to the BN, AN and ipH values

Chlorine in small quantities in oil may be an additive element. Chlorine is known as an impurity in biogas, special gas or landfill gas if these used as fuel. Chlorine can exist in lubricating oil in a various compounds, some of which can cause severe corrosion. The chlorine content itself has no limit.

Glycol ➢ If the limit value has been reached, the oil must be changed and the cooling system checked for leaks.

If coolants with antifreeze products are used, glycol is an indicator of cooling water leaks. Glycol is incompatible with mineral oil and reacts with the additives in lubricating oil to form sludge. This severely impairs the lubricity of the oil.

Water ➢ If the limit value has been reached, the oil must be changed and the cooling system checked for leaks.

Check for leaks. It is essential to check whether uncontrolled condensation processes are occurring in the lubricating oil system or whether the oil is being incorrectly stored.

Water contained in the oil of a gas engine generally leads to the formation of an emulsion, which reduces the overall usefulness of the oil. Water in the oil leads in particular to increased wear and corrosion.

Silicon (fuel gas classes A, B and C) ➢ If the limit value has been reached, the oil must be changed and the air filters inspected or replaced.

- Fuel gas classes A and B ➢ dust:

If class A or B fuel gas B is used, silicon in the oil is due to dust in the combustion air. Dust consists of relatively large silicon particles and causes severe wear.

- Fuel gas class C ➢ siloxanes:

Siloxanes are organic compounds produced when Class C fuel gases are used. The increased silicon content in the gas results in heavier deposits in the combustion chamber which in turn can cause increased wear to pistons, rings and liners. Increase exhaust gas wear is also known as a consequence of the silicon content of the fuel gas. It is possible to establish whether the silicon found in the oil will cause damage in a particular case by determining the operational value, SiB, as described in TA 1000-0300.

The SiB value must be regularly calculated and documented. A regular inspection of the combustion chamber with an endoscope is recommended. Any increase in abrasive metals such as iron, chromium and aluminium must be carefully noted. Increased attention must also be paid to the correct valve play adjustment.

- Anti-foaming agents

The silicon content for steady-state gas engines is generally between 4 and 7 ppm and is not critical for engine operation.

An analytical determination of the origin of the silicon in the used oil is not possible.

Sulphur ➢ Pay particular attention to the BN, AN and ipH values

Sulphur is a major component of the lubricating oil. The sulphur in the lubricating oil is not a problem for engine operation, but gives information about the quality of the lubricating oil. Sulphur is known as an impurity in class B and C fuel gases. Sulphur from the fuel gas produces acidic compounds in the lubrication oil, thereby increasing the danger of corrosion. The sulphur content itself has no limit.

3.3 Metallic elements

➢ If the alarm level is reached, contact your Technical Service Hotline.

3.4 Additive elements

No limits are in operation. Most additive elements remain relatively stable over the service life of the oil. Determination of the additive elements supports the product control.

4 Used oil reports

Used oil reports must include the following data:

- Client:
- Engine type:
- Fuel gas:
- Jenbacher ZU number:
- Sample date:
- Engine operating hours:

- Lubricating oil product:
- Oil operating hours:

5 Documentation for used oil analyses

Example of suitable documentation for used oil analyses:

Client:				Plant data:			
Name:		BioPower		Engine type:		JMS 420 GS-B.L	
Address:		Grünwalden		Fuel gas:		Biogas	
Contact:		Mr. A.N. Other		Lubricating oil:		Product name: ----------------------	
				Engine number:		XXXXXXX	
				INNIO J ID number:		J XXXX	
Sample number		29	30	31	32	33	34
Sample date		12/10/2010	20/10/2010	29/10/2010	16/11/2010	23/11/2010	03/12/2010
Analysis date		17/10/2010	27/10/2010	05/11/2010	24/11/2010	30/11/2010	08/12/2010
Oil operating hours		602	803	1004	202	417	613
Engine operating hours		11615	11816	12017	12351	12566	12762
	Unit						
Viscosity at 40°C	cSt	158	165	172	149	157	162
Viscosity at 100°C	cSt	15.4	15.9	16.3	14.9	15.5	15.8
Oxidation/Ageing	ABS/cm	13	15	18	7	12	15
Nitration	ABS/cm	> 1	> 1	> 1	2	> 1	> 1
TAN	mgKOH/g	2.14	2.56	3.08	2.02	2.17	2.56
TBN	mgKOH/g	3.6	3	2.8	4.1	3.6	3.1
IPH	----	6.83	5.96	5.48	7.29	6.71	5.74
Silicon	ppm	1	2	2	2	2	2
Sodium	ppm	2	2	2	2	2	2
Boron	ppm	1	1	1	1	1	1
Sulphur	ppm	7800	7700	7700	8500	8500	8400
Chlorine	ppm	<50	<50	<50	<50	<50	<50
Glycol	% by weight	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Water	% by weight	<0.05	<0.05	<0.05	<0.016	<0.05	<0.01
Potassium	ppm	<1	<1	<1	<1	<1	<1
Iron	ppm	4	4	5	2	2	5
Chromium	ppm	<1	<1	<1	1	<1	<1
Molybdenum	ppm	<1	<1	<1	<1	<1	<1
Aluminium	ppm	1	2	1	1	1	2
Copper	ppm	<1	<1	<1	<1	<1	<1
Lead	ppm	<1	<1	<1	<1	<1	<1
Tin	ppm	<1	<1	<1	<1	<1	<1

Nickel	ppm	<1	<1	<1	<1	<1	<1
Magnesium	% by weight	0.0004	0.0004	0.0005	0.0005	0.0005	0.0006
Calcium	% by weight	0.1290	0.1373	0.1459	0.1252	0.1325	0.1214
Phosphorus	% by weight	0.0273	0.0287	0.0317	0.0287	0.0305	0.0360
Zinc	% by weight	0.0293	0.0336	0.0359	0.0309	0.0350	0.0399

6 Revision code

Revision history

Index	**Date**	**Description / Revision summary**	**Expert** *Auditor*
7	30.04.2019	GE durch INNIO ersetzt / GE replaced by INNIO	**Opoku** *Pichler R.*
6	26.05.2015	Ergänzung „Klassifizierung – Potenzieller Kunde“ / Additional „Classification - Prospective Customers“	**Bilek** *Kelly*
5	05.11.2014	Hinweis zur Einhaltung der Bedingungen / Information on observing the conditions	**Bilek** *Lippert*
4	06.09.2012	Ergänzung rechtlicher Hinweis / legal notice added	**Provin** *Spieker*