Technical Circular 30-02

Cooling system protective agent

Affected engines:

☒ MAG 24.4 X 41XA	☒ MAH 33.3 TI 311A
☒ MAG 33.3 X 31XA	☒ MAH 49.4 TI 211A
☒ MAG 49.4 X 21XA	☒ MAH 74.6 TI 211A
☒ MAG 74.6 X 21XA	☒ MAH 84.6 TI 211A
☒ MAG 84.6 X 21XA	☒ customer-specific special engines
☒ MAG 13.6 X 11XA	

1. General

This circular describes the handling and release of cooling system protection agents for gas engines. Older technical circulars lose their validity with this version.
All information is based on the current state of knowledge.

They do not release the operator from his own duty of care due to the possible influences when using these products.

The cooling system protective agent must be used exclusively for the purpose stated (intended use). Any use beyond this is considered improper use.

The operator is solely liable for any damage resulting from this.

The user is responsible for observing the relevant country-specific legal regulations.

If you have any questions, please contact your MAMotec partner.

For liquid-cooled engines, the coolant must be prepared according to the engine requirements and checked and documented at the specified maintenance intervals.

This prevents damage to the cooling system, such as corrosion, cavitation or freezing.

In the section “Product Recommendation” you will find the products which are approved as cooling system protection agents for the engines of MAMotec GmbH according to the manufacturer's or supplier's specifications.

Damage is to be expected if non-approved products are used or the installation conditions are not observed.

These damages are not covered by the warranty of MAMotec GmbH.

The heat transfer value is reduced if antifreeze is used (heat capacity, thermal conductivity) of the coolant. It must be ensured that the cooling system is designed for this.

The term engine cooling circuit refers to those cooling circuits in which the cooling water flows directly through the engine, such as high-temperature and low-temperature circuits (in turbocharged engines).

The term heating circuit refers to all cooling circuits where the cooling water does NOT flow through the engine cooling circuit.

2. Selection criteria for the use of cooling system protection

The cooling water for the engine cooling circuit must always be conditioned with corrosion inhibitors.

According to the installation conditions on site (risk of frost), the cooling water in the engine cooling and heating circuit must contain anti-freeze.

The following cooling system protection agents are commonly used:

- Chemical corrosion protection agent
- Antifreeze with corrosion inhibitors

3. Types of protection means

3.1. Chemical corrosion protection agent

Corrosion protection	good
Cavitation protection	satisfactory
Freeze protection	none
Maintenance	low
Operational safety	good

Chemical corrosion inhibitors are compounds that form a protective film on metal surfaces through chemical reaction. Advantages are easy application and monitoring.

Liquid corrosion protection agents can be added directly in the engine, powdery corrosion protection agents must be pre-mixed. Concentration and monitoring of the chemical corrosion protection agent have to be carried out according to the manufacturer's instructions.

The manufacturer or supplier must check the resistance to the materials (e.g. rubber and Viton seals, iron, aluminium and non-ferrous metal).

Danger of destruction !

Caution with aluminium components in the cooling system. Not all chemical corrosion protection agents are suitable for this. The correct dosage is particularly important here, because an under-concentration of chemical corrosion protection agents usually has a damaging effect depending on the system. The products listed in the Product Recommendation section take into account the suitability of the chemical corrosion protection agent for engines with aluminium components.

Chemical corrosion inhibitors containing silicates can have a negative effect on the service life of mechanical seals of water pumps. These agents are no longer listed in the current product recommendations.

All existing systems must be converted in accordance with the current product recommendations when the coolant in the engine cooling and heating circuits is next changed.

If chemical corrosion protection agents and antifreeze are to be mixed, the compatibility of the products must be checked with the manufacturer or supplier.

Danger to life !

Mixing amine-based additives with nitrite-based additives is strictly prohibited, as carcinogenic nitrosamines are formed.

3.2. Antifreeze with corrosion protection inhibitors

Corrosion protection	good
Cavitation protection	satisfactory
Antifreeze	up to -45 °C depending on mix. ratio
maintenance	low
Operational safety	good

Antifreeze is generally used for MAMotec gas engines when ambient temperatures below freezing point can occur. As a rule, anti-freeze agents based on ethylene glycol are used.

When using antifreeze agents without corrosion inhibitors, suitable chemical corrosion inhibitors have to be used additionally to ensure corrosion protection. In this case, consultation with the manufacturer or supplier regarding the compatibility of the products is necessary.

The corrosion inhibitors contained in the antifreeze are substances that prevent the corrosion process by forming a protective film.

Mixing ratio		
Antifreeze	Water	Cold protecton up to
35%	65%	-22° C
40%	60%	-28° C
45%	55%	-35° C
50%	50%	-45° C

When using antifreeze agents with chemical corrosion protection agents, these must remain in the cooling system for corrosion protection even at outside temperatures above freezing point. The concentration is at least 35%.

4. Conditioning of the coolant

The coolant is conditioned by adding a cooling system protection agent to the fresh water.

4.1. Water quality of fresh water

For conditioning the cooling liquid, the quality of the fresh water must be ensured. Fresh water in accordance with the fresh water limit list must be used for this purpose.

Never use distilled water, demineralised water, lake water, river water, brackish water or industrial waste water to treat the coolant.

Information on water quality can be obtained from the local waterworks. If this is not possible, a water sample should be taken and examined in an accredited laboratory.

If the analytical values of the fresh water are not known, they must be determined by means of a water analysis.

Limit value list fresh water

Property	**Unit**	**Limit value**
Appearance	-	Colourless, clear, free of mechanical impurities
pH value at 25°C	-	8,2 bis 8,5
Odour	-	neutral
Alkaline earth (hardness)	mmol//l	Max. 0,02
	°dH	Max. 0,1
Conductivity	µS/cm	Max. 250
Chlorides	mg/l	Max. 10
Sulphates	ppm	Max. 150
Phosphates (PO4)	mg/l	5 bis10

IMPORTANT:

The limit values mentioned for the mixed water are for technical orientation, from which no legal claims can be made, as the water conditions are too different depending on the location. The water may therefore contain numerous unknown combinations of the accompanying substances. The responsibility for safe operation lies with the customer.Mamotec Gasmotoren recommends the use of a premixed water-antifreeze mixture.

If there are deviations in the analysis values, the fresh water must be treated accordingly.

- pH value too low
  - Remedy by mixing in diluted caustic soda or potash lye.
  - The preparation of small sample mixtures is recommended.

- Total hardness or carbonate hardness too low
  - Remedy by mixing with harder water.
  - Harder water is in most cases available in the form of drinking water (city water).

- Total hardness or chlorides and/or sulphates too high
  - Remedy by mixing with softened water.

    Softened water is distilled water, pH-neutral condensed water or water treated with ion exchangers.

After treating the fresh water, a new analysis must be carried out.

4.2. Checking the coolant

The cooling system must be constantly checked and maintained at regular intervals. The monitoring of the cooling system includes checking the coolant level, the contamination of the coolant and checking the cooling system protection concentration.

Checking the coolant differs depending on the cooling system protection agent used.

The coolant change depends on the operating time (hours/year) of the engine, depending on which operating time is reached first.

Operating hours = preheating time + engine operating time

- Chemical corrosion inhibitor
- Antifreeze with corrosion inhibitors

The conditioned coolant changes its properties depending on the cooling system protection agent.

The antifreeze must be tested using an antifreeze tester.

After preparing the coolant for the engine cooling circuit, check the cooling system protection concentration. For testing the corrosion protection agent concentration, the manufacturers or suppliers provide suitable control options, e.g. test sticks.

If exhaust gas heat exchangers are installed in the engine circuit, the coolant for the engine cooling circuit must be checked again after conditioning. In order to avoid damage to the components, the limit values according to the limit value list must be observed without fail.

The limit values of the conditioned coolant for the heating circuit must also be checked according to the limit value list.

All inspections must be documented in maintenance protocols or operating logs!

5. Cleaning the cooling system

If one or more of the following points are detected, clean the cooling system and replace the coolant:

- in case of conspicuous turbidity due to corrosion residues or other suspended matter.
- in case of oil leakage.
- for external water ingress.
- in case of product change.

All coolant must be drained off and the cooling system flushed with a suitable cleaning agent.

When changing to another cooling system protection agent, the cooling system must also be completely drained and cleaned.

The manufacturer or supplier must guarantee the suitability of the cleaning agent.

6. Disposal of the coolant

Coolant and cooling system protection agent must not be disposed of into the environment. Proper disposal must be carried out by an approved disposal company in accordance with the respective country-specific, legal regulations and information provided by the manufacturer or supplier.

7. Antifreeze - concentrates for cooling systems containing light metals

Manufacturer	Brand name	Inhibitors					operating hours hours / year	Comments/ Materialnumber
		organic	Silicium	Nitrite	Phosphate	Molybdate		
BASF SE	Glysantin G48 blues green	X	X				9000/5	X00058054 (25 l) X00058053 (210 l)
	Glysantin G40 pink	X	X				9000/3	X00066724 (20 l) X00066725 (210 l) Application concentration: 40 bis 50 Vol.-%
BayWa AG	Tectrol Coolprotect	X	X				9000/5	
BP Lubricants	ARAL Antifreeze Extra	X	X				9000/5	
ExxonMobil	Mobile Antifreeze Extra	X	X				9000/5	
Fuchs Petrolub SE	Maintain Fricofin	X	X				9000/5	
Total	Glacelf MDX	X	X				9000/5	
Valvoline	Zerex G-48	X	X				9000/3	

MAMotec GmbH reserves the right to make technical changes in the course of further product development.

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