VOLKSWAGEN
AKTIENGESELLSCHAFT

Group Standard

TL 774

Issue 2010-08

Class. No.: 57341

Descriptors: coolant additive, ethylene glycol, glycerin, freezing point depression, boiling point elevation, corrosion protection

Ethylene Glycol-Based Coolant Additive

Material Requirements

5 Types: C, F, G, H, J

Previous issues

TL 774: 1973-05, 1974-07, 1975-10, 1976-06, 1977-06, 1979-09, 1980-12, 1982-04, 1983-12, 1984-03, 1988-11, 1989-11, 1990-08, 1994-09, 1996-11, 1999-07, 2002-02, 2002-10, 2004-06, 2005-10, 2008-06, 2008-11, 2009-10

Changes

The following changes have been made as compared to TL 774: 2009-10:

- Section 8 "Requirements on the glycerin quality" added
- Standard part numbers N 052 774 J1 and J2, coolant additive for CHP plant (combined heat and power plant), added
- Referenced standards updated

1 Scope

This TL (Technical Supply Specification) specifies the material requirements for ethylene glycol-based and ethylene glycol/glycerin-based coolant additives.

2 Description

Example of a violet coolant additive:

Coolant additive acc. to TL 774-G

Technical responsibility			Standards Department	
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3 Requirements

3.1 General requirements

Approval of first supply and changes according to Volkswagen standard VW 01155.

Avoidance of hazardous substances acc. to VW 91101.

The manufacturer must deliver 10 l to the Operating Fluids Laboratory for evaluation.

Diagrams showing the most important physical properties of coolant/coolant additive mixtures are contained in the in-house working folder "Produktive Betriebsstoffe" (Operating Fluids Used in Production). They may be obtained from the Operating Fluids Laboratory.

3.2 Miscibility

The coolant additives of the respective types must be miscible with each other in any ratio with all coolants of the same type without any degradation of the functional characteristics.

3.3 Shelf life

Shelf life in unopened original packaging must be > 1 year at -30 °C to +50 °C.

3.4 Types

3.4.1 TL 774-C

For all engines, including light alloy engines. Blue-green color.

3.4.2 TL 774-F

For all engines, including all-aluminum engines. Violet color.

3.4.3 TL 774-G

For all engines, including all-aluminum engines. Violet color.

3.4.4 TL 774-H

Only for engine run-in test beds. Colorless.

3.4.5 TL 774-J

For all engines, including all-aluminum engines. Violet color.

3.5 Standard part numbers

–	TL 774-C, blue-green	N 052 774 C0
–	TL 774-F, violet	N 052 774 F0
–	TL 774-F, violet	N 052 774 F1 (only for Porsche[1)])
–	TL 774-G, violet	N 052 774 G0
–	TL 774-G, violet	N 052 774 G1 (mixture consisting of 40% N 052 774 G0 and 60% water acc. to TL 52541)
–	TL 774-H, colorless	N 052 774 H0
–	TL 774-J, violet	N 052 774 J0
–	TL 774-J, violet	N 052 774 J1 (only for CHP plant[2)])
–	TL 774-J, violet	N 052 774 J2 (mixture consisting of 40% N 052 774 J1 and 60% water)

3.6 Technical engineering approval (BMG)

Coolant additives are **subject to engineering approval**.

Responsible department for Volkswagen AG:	GQL-LB/2

4 Release procedure

For a laboratory release within the framework of technical engineering approval, the coolant manufacturer must submit 10 liters of the product manufactured under series production conditions along with the first-sample test report to the Volkswagen Operating Fluids Laboratory. Other tests, such as functional tests and road tests, are required for a production sample test. Approx. 200 liters of coolant concentrate are required for this. In order to receive technical engineering approval, engine bed tests as well as a road test (fleet test) are necessary, in addition to the laboratory release.

Only tested and approved pre-products (glycols, additives, etc.) must be used for blending of the first sample (e.g. re-blend).

The evaluation statement automatically expires 3 years after the release is granted or when the coolant additive formulation is changed.

The release will remain in effect if both regular deliveries and verification of quality control acc. to test plan are ensured. The quality assurance department of the ordering plant will receive a test report (acc. to sample) with each delivery. The test report includes the manufacturing and batch number as well as the test values according to the test schedule in compliance with Table 1. In addition, the Volkswagen Operating Fluids Laboratory must be provided with a test report acc. to Table 1 each year.

1) Must not be used in Volkswagen Group vehicles due to different antifoam components.

2) Must not be used in Volkswagen Group vehicles due to higher amounts of dye.

Table 1 – Test plan

Tests	Each delivery batch (certificate of analysis)	Delivery batch every 3 years
Laboratory tests	Table 2, no. 4, no. 5; Table 3, no. 1, no. 3, no. 5, no. 6	All tests acc. to the first-sample test report.

The supplier is obliged to ensure that each delivery batch meets the requirements specified in this Technical Supply Specification. Each pre-product must be tested prior to use for blending of the end product. If the supplier of the coolant additive removes one or more separate partial quantities from the total quantity of a manufacturing batch at different times and delivers them to the ordering party or stores them, each partial quantity must be designated as its own fill batch and given a batch number, in addition to the manufacturing report number.

For delivery in drums, clean drums must always be used. For container deliveries, the containers must be cleaned appropriately prior to being filled. Corresponding cleaning certificates must be submitted upon request.

If there are changes to the formulation, the manufacturing method, the production location, or with the pre-supplier, the Volkswagen Operating Fluids Laboratory and the responsible engineering department must be notified; these changes necessitate new sampling checks and a new written release. If the release is revoked, the supplier is responsible for forwarding this information to the concerned parts suppliers of the Volkswagen Group as well as any re-brand users of the product released by the technical engineering approval process.

5 Composition and color

See Table 2.

Table 2

<table>
<tr><th>No.</th><th>Property</th><th>Unit</th><th colspan="5">Requirement</th></tr>
<tr><th colspan="3"></th><th>TL 774-C</th><th>TL 774-F</th><th>TL 774-G</th><th>TL 774-H</th><th>TL 774-J</th></tr>
<tr><td>1</td><td>Ethylene glycol (1,2-ethanediol)</td><td>Weight %</td><td colspan="5">Balance</td></tr>
<tr><td>2</td><td>Glycerin (1,2,3-propanetriol)</td><td>Weight %</td><td colspan="4">Not permitted</td><td>20</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">Corrosion inhibitors total</td><td rowspan="3">Weight %</td><td>≥ 5</td><td colspan="4">3,5 to 5</td></tr>
<tr><td colspan="5">The use of borax as the sole corrosion inhibitor is not permitted.</td></tr>
<tr><td colspan="5">Heavy metals (such as molybdates or vanadates) are also not permitted as inhibitors.</td></tr>
<tr><td>4</td><td>Free water (not including water produced by crystallization and reaction) See Section 9.1</td><td></td><td colspan="4">≤ 3</td><td>≤ 5</td></tr>
</table>

No.	Property	Unit	Requirement				
			TL 774-C	TL 774-F	TL 774-G	TL 774-H	TL 774-J
5	Silicates Determination by: ICP-OES and/or AAS	mg/l	500 to 680 calculated as SiO_2, including a stabilizer containing ≈ 10% Si	Not permitted	400 to 500		400 to 500
6	Borax		-	Not permitted			
7	Amines		Not permitted				
8	Imidazol		-	Not permitted			
9	Phosphates		Not permitted				
10	Nitrite [a)]		Not permitted				
11	Bitter substance "Bitrex®"		25			without	25
12	Color		Blue-green	Violet	Violet	Colorless	Violet
13	Dye [b)]		Optional	Remazol brilliant violet 5R (10 ± 1) ppm + Rhodamine 5/(2 to 3) ppm	Remazol brilliant violet 5R (10 ± 1) ppm + Rhodamine 5/(2 to 3) ppm	-	Remazol brilliant violet 5R (10 ± 1) ppm + Rhodamine 5/(2 to 3) ppm
14	Vapor phase inhibitor		-	-	-	Additive required	-

a) Nitro aromatics are also not permitted.

b) The dye used must be stable with regard to temperature and must not degrade the corrosion protection.

6 Further properties

See Table 3.

Table 3

No.	Property	Unit	Requirement				
			TL 774-C	TL 774-F	TL 774-G	TL 774-H	TL 774-J
1	Density d_{20} acc. to DIN 51757	kg/m^3	1,11 to 1,14				1,11 to 1,16
2	Flash point acc. to DIN EN ISO 2719	°C	≥ 110				

No.	Property	Unit	Requirement				
			TL 774-C	TL 774-F	TL 774-G	TL 774-H	TL 774-J
3	Refractive index n_D acc. to DIN 51423-1		1,425 to 1,438				1,425 to 1,445
4	Boiling point acc. to ASTM D 1120 , undiluted	°C	170 to 185				
5	Reserve alkalinity (ml HCL, 0,1 mol/l)		≥ 11	≥ 5,0			
6	pH value						
6.1	33 volume percent in distilled water		7,7 to 8,5				
6.2	50 volume percent in distilled water		≥ 7,5	-			
7	Corrosion protection acc. to ASTM D 1384 and Section 9.2						
7.1	Heavy metals						
7.1.1	Weight loss	g/m^2	≤ 4	≤ 3			
7.1.2	Weight increase after cleaning with water	g/m^2	Omitted	≤ 1			
7.2	For aluminum alloys, see Section 9.3						
7.2.1	Weight loss	g/m^2	≤ 2				
7.2.2	Weight increase after cleaning with water	g/m^2	Omitted	≤ 2			
8	Protection against crevice corrosion acc. to PV 1432		Maximum characteristic value 2				
8.1	Ground test surface		Beginning discoloration permissible				
8.2	Milled test surface		Discoloration and beginning blackening permissible.				
9	For foam formation, see Section 9.4						
10	Paint compatibility acc. to ASTM D 1882		No formation of spots				
11	Silicate stability acc. to ASTM D 4340 (also see Section 9.5) and acc. to PV 1426		No flocculation	Test omitted	No flocculation		
12	Inhibitor stability acc. to ASTM D 4340 (also see Section 9.5)		Omitted	No flocculation			

No.	Property	Unit	Requirement				
			TL 774-C	TL 774-F	TL 774-G	TL 774-H	TL 774-J
13	Long-term stability acc. to ASTM D 4340 (see Section 9.5)		Omitted				No significant changes in the physical properties
14	Hard water stability acc. to PV 1426		No flocculation				
15	Degree of corrosion acc. to DIN 51360-2 Concentration:						
15.1	20 volume percent	Code number	max. 3	max. 4			
15.2	40 volume percent	Code number	max. 1	max. 2			
16	Temperature pattern for 30 h See Section 9.6 Max. increase	°C	-	≤ 10			

6.1 Corrosion behavior and cavitation behavior

Acc. to the guidelines set by the Internal Combustion Engines Research Association, hereinafter referred to as FVV (German abbreviation), and acc. to Section 9.7.

6.1.1 Behavior in the oscillation test

Concentrations are 20 and 40 volume percent of the coolant additive. See Table 4.

Table 4

Metal	Medium	Standardized weight loss				
		TL 774-C	TL 774-F	TL 774-G	TL 774-H	TL 774-J
Aluminum	Fresh	≤ 1,2	≤ 2,0			
Gray cast iron	Fresh	≤ 0,10	≤ 0,15			
Standardized weight loss:		$\frac{\text{Weight loss in the test medium}}{\text{Weight loss in water with 10°dH}}$				

6.1.2 Behavior in the dynamic corrosion test (Volkswagen elevated-temperature test system) as well as visual findings according to FVV guidelines, Vol. R 443 (1986 edition)

6.1.2.1 Type C

For concentration, see Table 5.

Table 5

Volume percent of coolant additive:		20 %	40 %
Metal	**Medium**	**Weight loss in mg**	
Aluminum	Deionized water, fresh	≤ 50	≤ 20
	Water, 10°dH, fresh	≤ 50	≤ 20
Gray cast iron	Deionized water, fresh	≤ 40	≤ 20
	Water, 10°dH, fresh	≤ 40	≤ 20

Only surface corrosion permissible, no pitting corrosion.

6.1.2.2 Types F, G, H, and J

For concentration, see Table 6.

Table 6

Volume percent of coolant additive:		20 %	40 %
Metal	**Medium**	**Weight loss in mg**	
Aluminum	Deionized water, fresh	≤ 100	≤ 40
	Water, 10°dH, fresh	≤ 80	≤ 30
Gray cast iron	Deionized water, fresh	≤ 80	≤ 40
	Water, 10°dH, fresh	≤ 60	≤ 30

Only surface corrosion permissible, no pitting corrosion.

6.1.3 Behavior in the dynamic corrosion test (Volkswagen elevated-temperature test system) after cleaning with water

6.1.3.1 Types F, G, H, and J

For concentration, see Table 7.

Table 7

Volume percent of coolant additive:		20 %	40 %
Metal	**Medium**	**Weight loss in mg**	
Aluminum	Deionized water, fresh	≤ 20	≤ 5
	Water, 10°dH, fresh	≤ 25	≤ 10
Gray cast iron	Deionized water, fresh	≤ 20	≤ 5
	Water, 10°dH, fresh	≤ 20	≤ 10

Only surface corrosion permissible, no pitting corrosion.

6.1.4 Residual silicate content after repeat dynamic corrosion test (Volkswagen elevated-temperature test system), types C, G, H, and J only

The concentration is 40 volume percent of the coolant additive.

The FVV elevated-temperature test is repeated with the same liquid but with a new Al specimen. After the second test, it is not the corroded amount of the Al specimen that is measured. In this case, the residual silicate content in the liquid is decisive.

Residual silicate content: Acc. to sample

6.1.5 Behavior in the cavitation chamber (knock chamber) acc. to FVV guidelines, Vol. R 530 (2005 edition)

See Table 8.

Table 8

Metal	Concentration	Weight loss, mg/specimen				
		TL 774-C	TL 774-F	TL 774-G	TL 774-H	TL 774-J
Cavitation chamber specimens	20 volume percent	Acc. to sample				
Specimen package specimens						
Cavitation chamber specimens	40 volume percent	Acc. to sample				
Specimen package specimens						

6.1.6 Behavior in the corrosion test with heat phase (FVV elevated-temperature test, MHTA) acc. to FVV guidelines, Vol. R 530 (2005 edition)

6.1.6.1 Test with ion-exchanged water acc. to FVV guidelines, Vol. R 530 (2005 edition), Appendix A 1.1

See Table 9.

Table 9

Metal	Concentration	Weight loss, mg/specimen				
		TL 774-C	TL 774-F	TL 774-G	TL 774-H	TL 774-J
Hot chamber specimens	40 volume percent	Acc. to sample				
Specimen package specimens						

6.1.6.2 Test with synthetically hard water acc. to FVV guidelines, Vol. R 530 (2005 edition), Appendix A 1.2

See Table 10.

Table 10

Metal	Concentration	Weight loss, mg/specimen				
		TL 774-C	TL 774-F	TL 774-G	TL 774-H	TL 774-J
Hot chamber specimens	40 volume percent	Acc. to sample				
Specimen package specimens						

7 Requirements on the water used to prepare the factory fill coolant

The water to be mixed with coolant additives must exhibit drinking water quality (water intended to be used as an aliment for human consumption or water intended for other applications requiring special sanitary care), see Table 11. The exclusive use of deionized water is not permissible.

Table 11

No.	Property	Unit	Requirement
1	pH value	pH units	6,5 to 7,5
2	Water hardness	°dH	< 20
3	Conductivity	µS	100 to 500
4	Calcium	mg/l	< 100
5	Copper	mg/l	< 0,1
6	Sulfate	mg/l	< 100
7	Chloride	mg/l	< 80
8	Iron	mg/l	< 0,2
9	Fluoride	mg/l	< 50
10	Purity class acc. to ISO 4406	Purity class	≤ 15 / 14 / 9

A mixture of drinking water and deionized water may be used to ensure compliance with the values set forth in Table 11. See also TL 52541, Water Used As Mixing Water for Factory Filling.

8 Requirements on the glycerin quality

The glycerin used in coolants must always be pre-cleaned by distillation and come from the following sources: Recycling (e.g., edible fat preparation), animal cadaver utilization, or biodiesel extraction (use of renewable resources). The requirements on the glycerin used are represented in Table 12 and must be complied with and regularly documented by the coolant supplier.

Table 12

No.	Property	Unit	Requirement
1	Glycerin content acc. to DIN 51405 (GC)	Weight %	> 99,5
2	Density d_{20} acc. to DIN 51757	kg/m³	> 1,26
3	Water content acc. to DIN 51777-1	%	< 0,5

No.	Property	Unit	Requirement
4	pH value acc. to ASTM D 1287		
4.1	50 volume percent in distilled water		6 to 8
5	Aldehydes	ppm	< 10
6	Organic halogens	ppm	< 30
7	Copper	ppm	< 0,1
8	Chlorides	ppm	< 10
9	Iron	ppm	< 0,2
10	Heavy metals	ppm	< 5

9 Notes on testing

9.1 Free water

Determination acc. to Karl Fischer.

9.2 Corrosion protection

The organic corrosion protection inhibitors (mono/dicarboxylic acids) form molecular protective layers on the metal surface which are completely destroyed by chemical cleaning. Therefore, the metal surface must be cleaned with water prior to chemical cleaning.

The metal is then rinsed off with acetone and dried in a drying oven for 1 h at 100 °C.

It is subsequently weighed (after cooling).

After this so-called water cleaning treatment, the procedure is as usual (chemical cleaning and weight determination).

9.3 Aluminum alloys

AlSi6Cu4 according to TL 023 will replace the SAE 329 Al alloy used according to ASTM D 1384.

The ASTM chain is being expanded to include the following aluminum alloys on the steel/aluminum side: AlSi12; AlMn.

For use in Audi engines, the Al alloy according to TL 023 is being replaced by AlSi10Mg (Cu).

Discoloration is permissible, provided it does not represent corrosion products.

Pitting is not permissible.

9.4 Foam formation

50 ml of a 33 volume percent coolant additive in distilled water is shaken for 1 minute in a 100 ml shaking flask.

Using the same solution, this test is subsequently repeated at 20 °C, 80 °C, and again at 20 °C.

The amount of foam is determined immediately after testing and after 1 minute.

9.5 Stability

Deviating from ASTM D 4340, synthetically hard water according to FVV guidelines, Vol. R 530 (2005 edition), Appendix A 1.2, is used.

The concentration is 40 volume percent.

Deviating from the aforementioned ASTM standard, the testing time is increased to 1 000 h for the test of long-term stability (type J only).

9.6 Temperature pattern over 30 h

Temperature increase must not exceed 10 ℃ over a testing period of 30 h, with the measurement 30 min after the testing start.

Example:

After 30 min	147 °C
After 30 h	≤ 157 °C

9.7 Corrosion behavior and cavitation behavior

Test procedure acc. to FVV guidelines (Vol. R 443, 1986).

In the case of sample supplies and first supplies, the complete test report acc. to the FVV must be submitted; however, this is not necessary for monthly test certificates.

10 Referenced documents

The following documents cited in this standard are necessary for application.

In this Section terminological inconsistencies may occur as the original titles are used.

Standards with the titles given in German are either only available in German or may be procured in other languages from the institution issuing the standard.

PV 1426	Coolant Additives/Glass Cleaners; Testing of Silicate and Hard Water Stability
PV 1432	Coolant Additives; Testing of Protective Effect against Crevice Corrosion
TL 023	Aluminum Cast Alloy; Material Requirements
TL 52541	Water Used As Mixing Water for Factory Filling; Material Requirements
VW 01155	Vehicle Supply Parts; Approval of First Supply and Changes
VW 91101	Environmental Standard for Vehicles; Vehicle Parts, Materials, Operating Fluids; Avoidance of Hazardous Substances
ASTM D 1120	Standard Test Method for Boiling Point of Engine Coolants
ASTM D 1287	Standard Test Method for pH of Engine Coolants and Antirusts
ASTM D 1384	Standard Test Method for Corrosion Test for Engine Coolants in Glassware
ASTM D 1882	Standard Test Method for Effect of Cooling System Chemical Solutions on Organic Finish for Automotive Vehicles

ASTM D 4340	Standard Test Method for Corrosion of Cast Aluminum Alloys in Engine Coolants Under Heat-Rejecting Conditions
DIN 51360-2	Testing of cooling lubricants; determination of corrosion preventing characteristics of cooling lubricants mixed with water; chip/filter paper method
DIN 51405	Testing of mineral oil hydrocarbons, similar liquids and solvents for paints and varnishes - Analysis by gas chromatography - General working principles
DIN 51423-1	Testing of mineral oils - Part 1: Measurement of the relative refractive index with the precision refractometer
DIN 51757	Testing of mineral oils and related materials; determination of density
DIN 51777-1	Testing of mineraloil hydrocarbons and solvents; determination of water content according to Karl Fischer; direct method
DIN EN ISO 2719	Determination of flash point - Pensky-Martens closed cup method
ISO 4406	Hydraulic fluid power - Fluids - Method for coding the level of contamination by solid particles