

Group standard

TL 774

Issue 2016-09

Class. No.: 57341

Descriptors: coolant additive, ethylene glycol, glycerin, freezing point depression, boiling point elevation, corrosion protection, ready-to-use coolant

Ethylene-Glycol-Based Coolant Additive

Materials Requirements

8 Types: C, F, G, H, J, K, L, M

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, 2010-08, 2012-09, 2012-11, 2013-10, 2014-09, 2015-07

Changes

The following changes have been made to TL 774: 2015-07:

- Correction to an error and to the formatting in section 3.5 "Standard-part numbers"

1 Scope

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

2 Designation

Example of a violet coolant additive:

Coolant additive as per TL 774-G

3 Requirements

3.1 Basic requirements

Approval of first supply and changes as per Volkswagen standard [VW 01155](#).

Always use the latest version of this standard.

This electronically generated standard is authentic and valid without signature.

The English translation is believed to be accurate. In case of discrepancies, the German version is alone authoritative and controlling.

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VWNORM-2015-07d

Avoidance of hazardous substances as per [VW 91101](#)

The manufacturer must deliver 60 l of the coolant additive to the Volkswagen Fuels, Coolants, Fluids and Lubricants Laboratory for evaluation.

Diagrams showing the essential physical properties of coolant/coolant additive blends are contained in the in-house working folder "Produktive Betriebsstoffe" (Fuels, Coolants, Fluids and Lubricants Used in Production). They can be obtained from the Fuels, Coolants, Fluids and Lubricants Laboratory.

3.2 Miscibility

The different types of coolant additives 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

[G11] For all engines, including light-metal engines. Blue-green color (must no longer be used for factory filling of Volkswagen Group vehicles).

3.4.2 TL 774-F

[G12+] For all engines, including all-aluminum engines. Violet color (must no longer be used for factory filling of Volkswagen Group vehicles).

3.4.3 TL 774-G

[G12++] For all engines, including all-aluminum engines. Violet color.

3.4.4 TL 774-H

[G12++Di] For all engines, including all-aluminum engines. Only for engine run-in test stands. Colorless.

3.4.5 TL 774-J

[G13] For all engines, including all-aluminum engines. Violet color.

3.4.6 TL 774-K

[G16] For all engines, including all-aluminum engines. Yellow color.

3.4.7 TL 774-L

[G12^{EVO}] For all engines, including all-aluminum engines. Violet color.

3.4.8 TL 774-M

[G15] For fuel cell applications. Colorless.

3.5 Standard-part numbers

- TL 774-C, blue-green
 - TL 774-F, violet
 - TL 774-G, violet
 - TL 774-H, colorless
 - TL 774-J, violet
- N 052 774 C0
 - N 052 774 F0
 - N 052 774 F1 (only for Porsche ¹⁾)
 - N 052 774 G0
 - N 052 774 G1 (blend of 40% N 052 774 G0 and 60% water as per TL 52541)
Only for factory filling.
 - N 052 774 G5 (blend of 50% N 052 774 G0 and 50% water as per TL 52541)
 - N 052 774 GA (G12++, concentrate)
 - N 052 774 GB (blend of 40% N 052 774 GA and 60% water as per TL 52541)
 - N 052 774 GC (blend of 50% N 052 774 GA and 50% water as per TL 52541)
 - N 052 774 GD (G12++, concentrate)
 - N 052 774 GE (blend of 40% N 052 774 GD and 60% water as per TL 52541)
 - N 052 774 GF (blend of 50% N 052 774 GD and 50% water as per TL 52541)
 - N 052 774 GG (G12++, concentrate)
 - N 052 774 GH (blend of 40% N 052 774 GG and 60% water as per TL 52541)
 - N 052 774 GJ (blend of 50% N 052 774 GG and 50% water as per TL 52541)
 - N 052 774 H0
 - N 052 774 H4 (blend of (40 ±3)% N 052 774 H0 and 60% water as per TL 52541]
 - N 052 774 H5 (blend of (50 ±3)% N 052 774 H0 and 50% water as per TL 52541]
 - N 052 774 J0 (G13, concentrate)
 - N 052 774 J1 (G13, concentrate only for combined heat and power plant (CHP plant) ²⁾)
 - N 052 774 J2 (blend of 40% N 052 774 J1 and 60% water). Only for CHP plant ²⁾.
 - N 052 774 J3 (blend of 20% N 052 774 J1 and 80% water). Colorless. Only for CHP plant ²⁾.
 - N 052 774 J4 (blend of 40% N 052 774 J0 and 60% water as per TL 52541).

1) Must not be used in Volkswagen Group vehicles due to different anti-foaming components.

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

Only for factory filling.

- N 052 774 J5 (blend of 50% N 052 774 J0 and 50% water as per TL 52541)
- N 052 774 JA (G13, concentrate)
- N 052 774 JB (blend of 40% N 052 774 JA and 60% water as per TL 52541)
- N 052 774 JC (blend of 50% N 052 774 JA and 50% water as per TL 52541)
- N 052 774 JD (G13, concentrate)
- N 052 774 JE (blend of 40% N 052 774 JD and 60% water as per TL 52541)
- N 052 774 JF (blend of 50% N 052 774 JD and 50% water as per TL 52541)
- N 052 774 JG (G13, concentrate)
- N 052 774 JH (blend of 40% N 052 774 JG and 60% water as per TL 52541)
- N 052 774 JJ (blend of 50% N 052 774 JG and 50% water as per TL 52541)
- N 052 774 JK (G13, concentrate)
- N 052 774 JL (blend of 40% N 052 774 JK and 60% water as per TL 52541)
- N 052 774 JM (blend of 50% N 052 774 JK and 50% water as per TL 52541)
- N 052 774 JN (G13, concentrate)
- N 052 774 JP (blend of 40% N 052 774 JN and 60% water as per TL 52541)
- N 052 774 JQ (blend of 50% N 052 774 JN and 50% water as per TL 52541)
- TL 774-K, yellow
 - N 052 774 K0 (G16, concentrate variant)
 Supplier-independent part number
 - N 052 774 K1 (G16, "ready-to-use" coolant; protection against freezing down to -27 °C)
 Supplier-independent part number
 - N 052 774 K2 (G16, "ready-to-use" coolant; protection against freezing down to -37 °C)
 Supplier-independent part number
 - N 052 774 KA (G16, concentrate variant)
 - N 052 774 KB (G16, "ready-to-use" coolant; protection against freezing down to -27 °C)
 - N 052 774 KC (G16, "ready-to-use" coolant; protection against freezing down to -37 °C)
 - N 052 774 KD (G16, concentrate variant)
 - N 052 774 KE (G16 "ready-to-use" coolant; protection against freezing down to -27 °C)

- N 052 774 KF (G16, "ready-to-use" coolant; protection against freezing down to -37 °C)
 - N 052 774 KG (G16, concentrate variant)
 - N 052 774 KH (G16, "ready-to-use" coolant; protection against freezing down to -27 °C)
 - N 052 774 KJ (G16, "ready-to-use" coolant; protection against freezing down to -37 °C)
- TL 774-L, violet
 - N 052 774 L0 (G12^{EVO}, concentrate)
 - N 052 774 L4 (blend of 40% N 052 774 L0 and 60% water as per TL 52541)
Only for factory filling.
 - N 052 774 L5 (blend of 50% N 052 774 L0 and 50% water as per TL 52541)
 - N 052 774 LA (G12^{EVO}, concentrate)
 - N 052 774 LB (blend of 40% N 052 774 LA and 60% water as per TL 52541)
 - N 052 774 LC (blend of 50% N 052 774 LA and 50% water as per TL 52541)
 - N 052 774 LD (G12^{EVO}, concentrate)
 - N 052 774 LE (blend of 40% N 052 774 LD and 60% water as per TL 52541)
 - N 052 774 LF (blend of 50% N 052 774 LD and 50% water as per TL 52541)
 - N 052 774 LG (G12^{EVO}, concentrate)
 - N 052 774 LH (blend of 40% N 052 774 LG and 60% water as per TL 52541)
 - N 052 774 LJ (blend of 50% N 052 774 LG and 50% water as per TL 52541)
 - N 052 774 LK (G12^{EVO}, concentrate)
 - N 052 774 LL (blend of 40% N 052 774 LK and 60% water as per TL 52541)
 - N 052 774 LM (blend of 50% N 052 774 LK and 50% water as per TL 52541)
 - N 052 774 LN (G12^{EVO}, concentrate)
 - N 052 774 LP (blend of 40% N 052 774 LN and 60% water as per TL 52541)
 - N 052 774 LQ (blend of 50% N 052 774 LN and 50% water as per TL 52541)
- TL 774-M, colorless
 - N 052 774 MA (G15, "ready-to-use" coolant)
 - N 052 774 MB (G15, "ready-to-use" coolant)
 - N 052 774 MC (G15, "ready-to-use" coolant)
 - N 052 774 MD (G15, "ready-to-use" coolant)
 - N 052 774 ME (G15, "ready-to-use" coolant)

3.6 Build sample approval (BMG)

Coolant additives are **subject to build sample approval**.

Responsible department for Volkswagen GQL-B/5
AG:

4 Release procedure

For a laboratory release within the framework of build sample approval, the coolant manufacturer must submit **10 l** of the product manufactured under production conditions along with the initial sample inspection report to the Volkswagen Fuels, Coolants, Fluids and Lubricants Laboratory. Other tests, such as function checks and road testing, are required for a build sample test. **Approx. 800 l** of coolant concentrate are required for this. Engine test bed tests as well as a road test (fleet test) are necessary in addition to the laboratory release in order for build sample approval to be issued.

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

The evaluation statement automatically expires three years after the release is granted or when the formulation of the coolant additives is changed.

The release will remain in effect if regular deliveries are made and quality controls are verified on a regular basis as per the test plan (table 1). The Quality Assurance department of the ordering plant will receive an inspection report (as per sample) with each delivery. The inspection report includes the manufacturing number and batch number as well as the test values as per the test plan. In addition, the Volkswagen Fuels, Coolants, Fluids and Lubricants Laboratory must be provided with an inspection report as per table 1 each year, as well as every 3 years.

Table 1 – Test plan

Tests	Each delivery batch (certificate of analysis)	Annual inspection report	Inspection report every 3 years/ initial sample inspection/build-sample test
Laboratory examinations (supplier)	Table 2: no. 4, no. 5, Table 3: no. 1, no. 3, no. 5, no. 6	All tests as per table 2 and table 3	All tests as per TL 774 (pertinent type)

The supplier must ensure that each delivery batch meets the requirements specified in this TL. Each pre-product must be tested before being used 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 labeled with 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 before being filled. Corresponding cleaning certificates must be submitted upon request.

Incoming goods inspections/analyses for production at the individual locations are conducted as per the "Einlagerung und Befüllung von Kühlmittelzusätzen und Scheibenreinigungsflüssigkeiten" (Storage and Filling of Coolant Additives and Window Washer Fluids) Technical Quality Standard (TQS).

If there are changes to the formulation, the manufacturing method, the production location, or the pre-supplier, the Volkswagen Fuels, Coolants, Fluids and Lubricants Laboratory and the appropriate department must be notified. These changes necessitate new sample inspections 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 to any re-brand users of the product released with the build sample approval.

5 Composition and color

See [table 2](#).

Table 2 – (Coolant concentrates)

No.	Property	Unit	Requirement					
			TL 774-C	TL 774-F	TL 774-G	TL 774-H	TL 774-J	
1	Ethylene glycol (1.2-ethanediol)	Weight per-cent	Balance					
2	Glycerin (1.2.3-propanetriol)	Weight per-cent	Not permitted					10 to 40 (as per sample)
3	Corrosion inhibitors total	Weight per-cent	≥ 5	3.5 to 5				
			The use of borax as the sole corrosion inhibitor is not permitted.					
			Heavy metals (such as molybdates or vanadates) are also not permitted as inhibitors.					
4	Free water (not including water produced by crystallization and reaction) see section 10.1		≤ 3					≤ 5
5	Silicates Determination by: inductively coupled plasma optical emission spectrometry (ICP-OES) or atomic absorption spectrometry (AAS)	mg/l	500 to 680 computed 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	Imidazole		-	Not permitted				
9	Phosphates		Not permitted					
10	Nitrite ^{a)}		Not permitted					
11	Bitterant "Bitrex" [®]		25			None	25	
12	Color		Blue-green	Violet	Violet	Colorless	Violet	

No.	Property	Unit	Requirement				
			TL 774-C	TL 774-F	TL 774-G	TL 774-H	TL 774-J
13	Dye ^{b)}		At supplier's discretion	As per sample	As per sample	-	As per sample
14	Vapor phase inhibitor		-	-	-	Admixture 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 as per DIN 51757	g/cm³	1.11 to 1.14					1.11 to 1.16
2	Flash point as per DIN EN ISO 2719	°C	≥ 110					
3	Refractive index n _D as per DIN 51423-1		1.425 to 1.438					1.425 to 1.445
4	Boiling point as per ASTM D1120, undiluted	°C	170 to 185					
5	Reserve alkalinity (ml HCl, 0.1 mol/l) as per ASTM D1121		≥ 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 as per ASTM D1384 and section 10.2							
7.1	Heavy metals							
7.1.1	Weight loss	g/m²	≤ 4	≤ 3				
7.1.2	Weight increase after cleaning with water	g/m²	Omitted	≤ 1				
7.2	For aluminum alloys, see section 10.3							
7.2.1	Weight loss	g/m²	≤ 2					
7.2.2	Weight increase after cleaning with water	g/m²	Omitted	≤ 2				

No.	Property	Unit	Requirement					
			TL 774-C	TL 774-F	TL 774-G	TL 774-H	TL 774-J	
8	Protection against crevice corrosion as per Test Specification PV 1432		Maximum characteristic value 2					
8.1	Ground test surface		Incipient oxidation tint permissible					
8.2	Milled test surface		Oxidation tint and incipient blackening permissible					
9	For foam formation, see section 10.4							
10	Paint compatibility as per ASTM D1882		No formation of spots					
11	Silicate stability as per ASTM D4340 (also see section 10.5) and as per PV 1426		No flocculation	Omitted	No flocculation			
12	Inhibitor stability as per ASTM D4340 (also see section 10.5)		Omitted	No flocculations				
13	Long-term stability as per ASTM D4340 (see section 10.5)		Omitted					No significant changes in the physical properties
14	Hard water stability as per PV 1426		No flocculations					
15	Foam degeneration capability as per PV 1474 see section 10.8	s	< 10					
16	Degree of corrosion as per DIN 51360-2 Concentration:							
16.1	20 volume percent	Characteristic factor	max. 3	max. 4				
16.2	40 volume percent	Characteristic factor	max. 1	max. 2				
17	Temperature curve over 30 h see section 10.6 for max. increase	°C	-	≤ 10				

6.1 Corrosion properties and cavitation behavior

As per the guidelines set by the Internal Combustion Engines Research Association (FVV), and as per section 10.7.

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	Substance	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:		$\frac{\text{Weight loss in the test medium}}{\text{Weight loss in water with } 10^{\circ}\text{dH}}$				

6.1.2 Behavior in the dynamic corrosion test (Volkswagen elevated-temperature test system) as well as visual findings as per 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	Substance	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.

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	Substance	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.

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	Substance	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.

6.1.4 Residual silicate content after repeated 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: as per sample

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

See table 8.

Table 8

[illegible]

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

6.1.6.1 Test with ion-exchanged water as per 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
Specimens from the hot chamber	40 volume per-cent	As per sample				
Specimens from the specimen package						

6.1.6.2 Test with synthetically hard water as per 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
Specimens from the hot chamber	40 volume per-cent	As per sample				
Specimens from the specimen package						

7 Requirements for the water used as mixing water for factory filling and "ready-to-use" coolants

The water to be mixed with coolant additives must be of drinking-water quality (water suitable for human consumption or water for other uses that requires a high level of cleanliness), see [table 11](#). The use of deionized water only is not permissible.

Table 11

No.	Property	Unit	Requirement
1	pH value	pH units	6.0 to 8.0
2	Water hardness	°dH	< 20
3	Conductivity	µS	100 to 400
4	Calcium	mg/l	< 60
5	Copper	mg/l	< 0.1

No.	Property	Unit	Requirement
6	Sulfate	mg/l	< 50
7	Chloride	mg/l	< 40
8	Iron	mg/l	< 0.2
9	Fluoride	mg/l	< 50
10	Cleanliness code as per ISO 4406	Cleanliness code	≤ 15/14/9

A mixture of drinking water and deionized water is permissible in compliance with the values specified in table 11. See also TL 52541 "Water Used as Mixing Water for Factory Filling."

8 Requirements for the glycerin quality

The glycerin used in coolants must always be pre-cleaned by distillation and come from the following sources: recycling (e.g., processing of edible fat), animal cadaver rendering, 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 as per DIN 51405 (GC)	Weight percent	> 99.5
2	Density d_{20} as per DIN 51757	kg/m ³	> 1.26
3	Water content as per DIN 51777-1	%	< 0.5
4	pH value as per ASTM D1287		
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 Requirements for "ready-to-use" coolants

"Ready-to-use" coolants must always be prepared using released coolant additives with build sample approval and mixing water qualities as per TL 52541. The inhibitors (both organic and inorganic additives) must constitute at least half of the coolant concentrate as specified. "Ready-to-use" coolants require a separate release by GQL-B.

Please refer to table 13 for further requirements.

Table 13

No.	Property	Unit	Requirement	
			TL 774-G (N 052 774 G5)	TL 774-J (N 052 774 J5)
1	Free water see section 10.1	%	49 to 51	
2	Density d_{20} as per DIN 51757	kg/m ³	1.065 to 1.080	1.075 to 1.085
3	Flash point as per DIN EN ISO 2719	°C	≥ 110	
4	Refractive index n_D as per DIN 51423-1		1.385 to 1.392	1.382 to 1.395
5	Boiling point as per ASTM D1120 in as-received condition	°C	106 to 111	
6	Crystallization point as per ASTM D1177 in as-received condition	°C	≤ -35	
7	pH value		8.1 to 8.5	
8	Inhibitor stability as per ASTM D4340 in as-received condition		No flocculations	
9	Mixing water stability as per PV 1426 Deviating: in as-received condition		No flocculations	

10 Notes on testing

10.1 Free water

Determination as per the Karl Fischer method

10.2 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 before 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 water cleaning treatment, chemical cleaning and weight determination are carried out as usual.

10.3 Aluminum alloys

AlSi6Cu4 as per TL 115 will supersede the alloy as per SAE 329 Al used as per ASTM D1384.

The ASTM chain is being expanded to include the following aluminum alloys on the steel/aluminum side: AISi12; AlMn.

For use in Audi engines, AISi10Mg(Cu) will supersede the Al alloy as per TL 115.

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

Pitting is not permissible.

10.4 Foam formation

50 ml of a 33-volume percent coolant additive in distilled water is shaken for 1 min 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 min.

10.5 Stability

Deviating from ASTM D4340, synthetic hard water as per 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).

10.6 Temperature curve over 30 h

The temperature increase must not exceed 10 °C over a testing period of 30 h, with the first measurement 30 min after the test start.

Example:

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

10.7 Corrosion properties and cavitation behavior

Test procedure as per FVV guidelines (Vol. R 443, 1986).

For sample deliveries and first deliveries, the complete inspection report as per the FVV must be submitted; however, this is not necessary for the monthly inspector certificates.

10.8 Foam degeneration ability

Deviating from PV 1474, a mixture of 40 volume percent of the coolant additive under test and 60 volume percent of distilled water is used.

11 Applicable documents

The following documents cited in this standard are necessary to its application.

Some of the cited documents are translations from the German original. The translations of German terms in such documents may differ from those used in this standard, resulting in terminological inconsistency.

Standards whose titles are given in German may be available only in German. Editions in other languages may be available 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
PV 1474	Windshield Washer Fluids; Testing of the Volume Reducing Behavior of Foam
TL 115	Aluminum Cast Alloy; Material Requirements
TL 52541	Water Used As Mixing Water for Factory Filling; Material Requirements
VW 01155	Vehicle Parts; Approval of First Supply and Changes
VW 91101	Environmental Standard for Vehicles; Vehicle Parts, Materials, Operating Fluids; Avoidance of Hazardous Substances
ASTM D1120	Standard Test Method for Boiling Point of Engine Coolants
ASTM D1121	Standard Test Method for Reserve Alkalinity of Engine Coolants and Antirusts
ASTM D1177	Standard Test Method for Freezing Point of Aqueous Engine Coolants
ASTM D1287	Standard Test Method for pH of Engine Coolants and Antirusts
ASTM D1384	Standard Test Method for Corrosion Test for Engine Coolants in Glassware
ASTM D1882	Standard Test Method for Effect of Cooling System Chemical Solutions on Organic Finishes for Automotive Vehicles
ASTM D4340	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