RAVENOL®

BRAKE FLUIDS

MADE IN GERMANY
SINCE 1648

UNDERSTANDING BRAKE FLUIDS

SELECTING THE RIGHT BRAKE FLUID

Most drivers today probably have no idea what type of brake fluid they have in their car. Brake fluids which do not meet the current DOT specifications can lead to premature wear and tear on brake components and to faults in the ABS, ESP or emergency brake system.

BRAKE FLUID SPECIFICATIONS

The DOT (Department of Transportation) is the American transport ministry. It lays down standards such as the FMVSS (Federal Motor Vehicle Safety Standard) which are very similar to the Japanese JIS or German DIN standards. AS (Australian Standards), SAE and ISO also establish standards for brake fluids.

The table below shows the brake fluid specifications:

	AS 1960.1			FMVSS 116			SAE		ISO
PROPERTY	GRADE 1	GRADE 2	GRADE 3	DOT 3	DOT 4	DOT 5.1	J1703	J1704	4925
Boiling point – DERBP °C min	230	260	260	205	230	260	205	230	205
Wet boiling point – WERBP °C min	140	155	170	140	155	180	140	155	140
Viscosity (-40 °C) max	1500	1800	1800	1500	1800	900	1800	1800	1800

DERBP (Dry Equilibrium Reflux Boiling Point) – Boiling point:
The boiling point temperature if the fluid is new and has not absorbed any moisture yet.

WERBP (Wet Equilibrium Reflux Boiling Point) – Wet boiling point:
The boiling point of a brake fluid containing 3.7 percent by volume of water, usually after 1 to 2 years of use.

BRAKE FLUID TYPES

Mineral oil based:

Mineral oil based brake fluids of the type used by Rolls Royce on some models in the 1980's and by other motor manufacturers are hydraulic fluids and brake fluids that have different properties from DOT fluids.

Silicone oil based:

Silicone based brake fluids are also known as DOT 5 brake fluids. Silicone brake fluids are not hygroscopic so do not absorb any moisture. They are

extremely expensive compared with conventional polyglycol based fluids.

VISCOSITY

Viscosity is a property which indicates the flow characteristics of a brake fluid. The higher the viscosity, the less easily the fluid flows. If the viscosity is high at a low air temperature then the fluid can adversely affect the performance of the ABS system.

pH

The pH indicates the acidity or alkalinity of a solution. If the pH is below 7.0 (acid) the fluid can accelerate the corrosion of other brake components.

WHAT IS THE BOILING POINT?

The boiling point is the temperature at which a fluid boils. Water boils at 100 °C, whereas a brake fluid with a high boiling point only boils at over 300 °C. A brake fluid with a low boiling point boils at approx. 140 °C, depending on the condition of the fluid.

WHY IS A LOW BOILING POINT NOT ACCEPTABLE?

Brake pads can reach extremely high temperatures (up to 300 °C) when a vehicle is running. The brake calipers dissipate this heat through the brake fluid and this can increase the fluid's temperature to over 200 °C. If the brake fluid is repeatedly heated above its boiling point, some of it will evaporate and result in air pockets in the brake lines. This can result in a highly dangerous situation in which the brake lines conduct air and not brake fluid. Since air can be compressed it has to be bled out of the brake system so that the brake fluid can correctly compress the pistons in the brake caliper and operate the brakes to optimum effect.

WHAT IS 'PERCENTAGE BY VOLUME OF WATER'?

The most common component of brake fluid is glycol ether. This fluid is hygroscopic, i.e. it absorbs moisture from the surrounding air. The 'percentage by volume' indicates the amount of water in the brake fluid.

HOW OFTEN DOES BRAKE FLUID NEED TO BE CHANGED?

With everyday journeys and a brake fluid which exceeds the DOT 4 specification, changing it every 2 years is enough. If a DOT 3 fluid is used then we recommend changing it each year. For routes that are tough on brakes, such as hairpin bends and switchbacks, we recommend changing the brake fluid every 12 months. For driving on racetracks, changing the fluid before each race is recommended.

MIXING BRAKE FLUIDS

Mixing different brake fluids is not advisable. Mixing new brake fluid with old fluid may mean mixing brake fluid that contains water with a new product, thereby affecting braking efficiency and reducing the service life of the new fluid. DOT 3, DOT 4, Super DOT 4 and DOT 5.1 fluids can be mixed but this is not recommended. DOT 5 fluid CANNOT be mixed with DOT 3, DOT 4, Super DOT 4 or DOT 5.1 fluids.

BRAKE FLUID

RAVENOL DOT 4

Art.: 1350601

Specification/classification: ISO 4925, FMVSS 116 DOT 4
Notes on use/specifications:
DOT 4 brake fluid for all vehicles with ABS properties.

SAE J1704

RAVENOL DOT 4 LV

Art.: 1350605

Specification/classification: ISO 4925 (6), FMVSS 116 DOT 4
Notes on use/specifications: A brake a clutch fluid that meets the latest standard ISO 4925 Class 6 and is particularly suitable for use at low temperatures.

SAE J 1703, SAE J 1704 and ISO 4925 (Class 3, 4 & 6)

RAVENOL DOT 5.1

Art.: 1350602

Specification/classification: ISO 4925, FMVSS 116 DOT 5.1
Notes on use/specifications: A DOT 5.1 brake fluid for all vehicles with ABS properties that require this specification.

SAE J1704

RAVENOL Racing Brake Fluid R 325+

Art.: 1350604

Specification/classification: A thermally very heavy-duty brake fluid that meets the most demanding DOT 4 requirements. Very low boiling and wet boiling points. An ideal brake fluid for motor sports (cars and motorcycles).

Exceeds the requirements of FMVSS 116 DOT 4, DOT 5.1, SAE J1703, SAE J1704

	Millilitre		Litre	
Product	250	500	1	208
DOT 4	•	•	•	•
DOT 4 LV	-	-	•	-
DOT 5.1	-	-	•	•
Racing Brake Fluid R 325+	-	•	-	-

		RAVENOL DOT 4 	RAVENOL DOT 4 LV 	RAVENOL DOT 5.1 	RAVENOL Racing Brake fluid 325+ 		
Article number		1350601	1350605	1350602	1350604		
Properties	Unit					Audit	Specification
Technical parameters							
Colour		light yellow	light yellow	light yellow	yellow	visual	waterwhite
							to yellow
Density at 20 °C	kg/m³	1052	1052	1069	1078	EN ISO 12185	
Boiling point	°C	271	267	269	328	FMVSS 116	Min. 260°C
Wet boiling point	°C	169	172	187	204	FMVSS 116	Min. 180°C
Viscosity at -40 °C	cSt	1340	675	810	1495	ASTM D445	Max. 900 cSt
Viscosity at 100 °C	cSt	2,41	2,1	2,16	2,59	ASTM D445	Min. 1,5 cSt
pH		8,53	8,53	7,49	7,15		7 – 11,5
High temperature stability	°C	-1	-1	0	-1		Max. +/- 3,0°C
Chemical stability	°C	1	1	1,5	1		Max. +/- 3,0°C
Evaporation loss	%w/w	61	61	68	50		Max. 80%
Flowability and appearance at -40 °C		i.O., 4s	i.O., 4s	i.O., 2s	i.O., 4s		Fluid, foam
							max. 10s
Flowability and appearance at -50 °C		i.O., 8s	i.O., 8s	i.O., 4s	i.O., 7s		Fluid, foam
							max. 35s
Water absorption at -40 °C		Clear, 3s	Clear, 3s	Clear, 2s	Clear, 5s		Max. 10s
Water absorption at +60 °C		Clear, no deposits	Clear, no deposits	Clear, no deposits	Clear, no deposits		Deposits <0,05% v/v
Miscibility at -40 °C		Clear, no phase separation	Clear, no phase separation	Clear, no phase separation	Clear, no phase separation		no phase separation
Miscibility at +60 °C		Clear, no deposits	Clear, no deposits	Clear, no deposits	Clear, no deposits		Deposits <0,05% v/v
Water content	%	<0,2	<0,2	0,1	<0,20		
Corrosion resistance							
Galvanised iron	Δ mg/cm²	-0,03	-0,03	-0,01	0,03		Max. 0.2
	Appearance	Good	Good	Good	Good		No pitting or etched
Steel	Δ mg/cm²	-0.01	-0.01	-0.004	+0.01		Max. 0.2
	Appearance	Good	Good	Good	Good		No pitting or etched
Aluminium	Δ mg/cm²	0	0	-0,02	0,02		Max. 0.1
	Appearance	Good	Good	Good	Good		No pitting or etched
Cast iron	Δ mg/cm²	-0,03	-0,03	-0,01	-0,1		Max. 0.2
	Appearance	Good	Good	Good	Good		No pitting or etched
Brass	Δ mg/cm²	-0,08	-0,08	-0,05	-0,04		Max. 0.4
	Appearance	Good	Good	Good	Good		No pitting or etched
Copper	Δ mg/cm²	-0,05	-0,05	-0,03	-0,05		Max. 0.4
	Appearance	Good	Good	Good	Good		No pitting or etched
Zinc	Δ mg/cm²	0,01	0,01	0,03			Max. 0.4
	Appearance	Good	Good	Good			No pitting or etched

		RAVENOL DOT 4 	RAVENOL DOT 4 LV 	RAVENOL DOT 5.1 	RAVENOL Racing Brake fluid 325+ 		
Appearance of the fluid		i.O.	i.O.	i.O.	i.O.		No crystallisation or gelling
Deposits	%	<0,05	<0,05	<0,05	<0,05		<0,1%
pH		8,2	8,2	7,33	7,51		7 - 11,5
Change in diameter of rubber		0,16	0,16	0,03	0,03		Max. +1,4
Change in hardness	°IRHD	-4	-4	-6	-4		Max. -15 °IRHD
Appearance		i.O.	i.O.	i.O.	i.O.		Decay
Oxidation resistance							
Galvanised iron	Δ mg/cm²	0,04	0,04	-0,01	0,03		Max. 0.3
	Appearance	Good	Good	Good	Good		No pitting or etched
Aluminium	Δ mg/cm²	0,02	0,02	-0,01	-0,01		Max. 0.05
	Appearance	Good	Good	Good	Good		No pitting or etched
Resistance to rubber							
SBR at 70°C	Ø Change, mm	0,56	0,56	0,44	0,76		0,15 to 1,40
	Δ Hardness, IRHD	-3	-3	-6	-4		0 to -10
	Δ Volume, %	6,21	6,21	4,31	8,34		1 to 16
	Appearance	Good	Good	Good	Good		No blistering, separation or decomposition
SBR at 120°C	Ø Change, mm	0,73	0,73	0,72	1,05		0,15 to 1,40
	Δ Hardness, IRHD	-7	-7	-11	-7		0 to -15
	Δ Volume, %	7,69	7,69	8,47	10,41		1 to 16
	Appearance	Good	Good	Good	Good		No blistering, separation or decomposition
EPDM at 70°C (SAE J1703n requirement)	Δ Hardness, IRHD	-2	-2	-2	-1		0 to -10
	Δ Volume, %	1,39	1,39	0,74	0,93		0 to 10
	Appearance	Good	Good	Good	Good		No blistering, separation or decomposition
EPDM at 120°C	Δ Hardness, IRHD	-2	-2	-3	-2,5		0 to -15
	Δ Volume, %	1,91	1,91	1,73	1,8		0 to 10
	Appearance	Good	Good	Good	Good		No blistering, separation or decomposition
Natural at 70 °C (ISO 4925 requirement)	Ø Change, mm	0,38	0,38	0,42			0,15 to 1,40
	Δ Hardness, IRHD	-5	-5	-6			0 to -10
	Δ Volume, %	4,61	4,61	3,62			1 to 16
	Appearance	Good	Good	Good			No blistering, separation or decomposition

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MADE IN GERMANY
since 1946

DAkkS
Deutsche
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D-PL-18751-01-00

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