

SGS Report No. 1820/OGC21/136
SGS Order No. 7187
SGS Test No. M102-21 096; M102-21 097
Customer Order No. VIF/20210416
Customer Test ID. VIF-ULG 95 + SBA 1000 ppm (V/V)

Test Report

Inlet Valve Cleanliness in the MB M 102 E Engine Dirty-Up and Clean-Up Test

29. 11. 2021



SGS Czech Republic s.r.o.
Engine Test Centre Kolín
Ovčárecká 314
280 13 Kolín, CZ

1 General Information:

Test Laboratory:

SGS Czech Republic s.r.o., Engine Test Centre Kolín
Ovčárecká 314, 280 13 Kolín, Czech Republic

Test Identification:

Test Method: Dirty-Up and Clean-Up Test Procedure referring to CEC F-05-93*, incl. combustion chamber deposits evaluation acc. to CEC F-20-98

Test Description: Inlet Valve Cleanliness in the MB M 102 E Engine

Test Duration: DU - 60 hours CU - 60 hours

Test Number: M102-21 096 M102-21 097

Start of Test: 22.11.2021 25.11.2021

End of Test: 25.11.2021 28.11.2021

Technician: P. Smutný

Test Rating: Valid

Comments: No unexpected occurrences

Customer:

Customer: **VIF s.r.o. / LANG CHEMIE**

Contact: Ing. Boris Božuk / DI Gerhard Stöger

Address_1: Volutová 2523/14

Address_2: 158 00 Praha 13

Address_3: Česká republika

Fuel Data:

Receipt of Test Fuel: 21.11.2021

Dirty-up fuel: **VIF-ULG 95**

Comments: Test fuel by customer

Test Fuel ID: **2576**

Clean-up fuel: **SBA 1000 ppm (V/V)**

Comments: Test fuel by customer

Test Fuel ID: **2578**

Engine Data:

Engine Type: Daimler Chrysler M102E (2,3L; 100kW @ 5100 rpm)

Engine ID: 386 910

Engine Hours SOT: 872,0

Cylinder Head ID: M102_005

Cylinder Head Hours SOT: 2 269,00

Engine Test Oil: RL254, Batch 5

Test Results:

<u>Inlet Valve Deposits</u>	Dirty-up	135 mg per Valve
Inlet Valve Rating	Dirty-up	8,56
<u>Total Combustion Deposits *)</u>	Dirty-up	7 718 mg
<u>Inlet Valve Deposits</u>	Clean-up	19 mg per Valve
Inlet Valve Rating	Clean-up	9,64
Cleaned		86%
<u>Total Combustion Deposits *)</u>	Clean-up	9 041 mg

Kolín, 29. 11. 2021

Jakub Mistr
Engine Test Centre Manager



Testing laboratory no. 1152.1, accredited by Czech Accreditation Institute in accordance with ČSN EN ISO/IEC 17025:2018 and QMS certified in accordance with ČSN EN ISO 9001:2016.

* = Test Method not accredited

The test results refer to the tested samples only. The partial publication of this report is a subject to a written acceptance of the testing laboratory. Retain samples are provided upon a special request by the customer only.
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2 Operational Data

Average operational data obtained for stage 1 to 4 of the test cycle, **Dirty-Up Test:**

	Stage 1	Stage 2	Stage 3	Stage 4	Limits
	average	average	average	average	
Speed [min ⁻¹]	1003,4	1300,1	1849,9	2999,7	± 25
Torque [Nm]	8,2	28,6	32,5	34,9	± 2
Coolant outlet temperature [°C]	89,8	91,5	90,6	88,7	89 ± 5 Stage 2-4 only
Oil temperature gallery [°C]	96,3	95,9	96,8	99,6	96 ± 4
Exhaust temperature cyl. 1 [°C]	517,7	557,0	616,7	730,6	
Exhaust temperature cyl. 2 [°C]	519,8	579,9	625,5	717,5	
Exhaust temperature cyl. 3 [°C]	485,5	554,5	607,5	694,9	
Exhaust temperature cyl. 4 [°C]	475,0	515,6	566,1	652,6	
Intake air temperature [°C]	29,1	29,2	29,5	29,4	30 ± 5
Fuel temperature [°C]	25,3	25,4	25,4	25,3	27 ± 5
Oil pressure [bar]	0,8	1,2	1,9	3,2	> 0,5 Stage 1 only
Fuel pressure [bar]	5,55	5,55	5,54	5,53	5,45 ± 0,2
Exhaust back pressure [mbar]	0,0	2,1	3,9	19,5	16 - 36 Stage 4 only
Ambient pressure [mbar]	1001,8	1001,8	1001,8	1001,8	
Fuel flowrate [kg/hr]	1,01	1,81	2,83	4,68	
Oil consumption [g/test]	251,0				< 500
Fuel consumption [l/test]	214,0				230 ± 20

Average operational data obtained for stage 1 to 4 of the test cycle, **Clean-Up Test:**

	Stage 1	Stage 2	Stage 3	Stage 4	Limits
	average	average	average	average	
Speed [min ⁻¹]	1020,3	1301,4	1849,8	2999,8	± 25
Torque [Nm]	10,3	29,3	32,5	35,0	± 2
Coolant outlet temperature [°C]	89,0	91,3	90,3	88,8	89 ± 5 Stage 2-4 only
Oil temperature gallery [°C]	96,4	95,5	96,9	99,6	96 ± 4
Exhaust temperature cyl. 1 [°C]	551,9	561,6	615,0	724,5	
Exhaust temperature cyl. 2 [°C]	543,6	576,7	627,1	713,8	
Exhaust temperature cyl. 3 [°C]	515,0	547,4	598,2	688,0	
Exhaust temperature cyl. 4 [°C]	489,9	517,8	560,5	638,1	
Intake air temperature [°C]	28,4	28,4	28,8	28,7	30 ± 5
Fuel temperature [°C]	25,4	25,4	25,4	25,4	27 ± 5
Oil pressure [bar]	0,8	1,2	1,9	3,2	> 0,5 Stage 1 only
Fuel pressure [bar]	5,53	5,52	5,52	5,50	5,45 ± 0,2
Exhaust back pressure [mbar]	0,0	1,7	4,0	19,9	16 - 36 Stage 4 only
Ambient pressure [mbar]	977,1	977,1	977,1	977,1	
Fuel flowrate [kg/hr]	1,06	1,83	3,02	4,69	
Oil consumption [g/test]	213,0				< 500
Fuel consumption [l/test]	216,6				230 ± 20

Instances of operations outside specific limits and unusual occurrences:

- None

3 Test Evaluation according to CEC F-05-93

Dirty-Up:

Test no.	M102-21 096	Inlet valve deposits per valve	135	mg / valve
Test lubricant:	RL254, Batch 5	RATING	8,56	
Cylinder head no.:	M102_005	Oil consumption:	251	g
Test fuel:	VIF-ULG 95		ID:	2576

Valve no.	M102 E / IVD rating												
1	4,5	5,0	5,5	6,0	6,5	7,0	7,5	8,0	8,5	9,0	9,5	10,0	
s e e g m e n t	1								10			10	
	2								10			10	
	3							3	7			10	
	4							4	6			10	
	5								10			10	
	6								10			10	
	7								10			10	
	8								8		2	10	
	9								2		8	10	
	10								10			10	
total %	0	0	0	0	0	0	7	0	83	0	10	0	100
rating	0,0	0,0	0,0	0,0	0,0	0,0	0,5	0,0	7,1	0,0	1,0	0,0	8,53

EoT, Port & Combustion Side contaminated	90586	mg
EoT, Port Side contaminated, Combustion Side cleaned	90563	mg
SoT, New Valve	90425	mg
Inlet Valve Deposit	138	mg

Valve no.	M102 E / IVD rating												
2	4,5	5,0	5,5	6,0	6,5	7,0	7,5	8,0	8,5	9,0	9,5	10,0	
s e e g m e n t	1						7		3			10	
	2						1		5	4		10	
	3								7	3		10	
	4								6	4		10	
	5								5	5		10	
	6								1	9		10	
	7									10		10	
	8									10		10	
	9									5	5	10	
	10							9	1			10	
total %	0	0	0	0	0	0	17	1	32	50	0	0	100
rating	0,0	0,0	0,0	0,0	0,0	0,0	1,3	0,1	2,7	4,5	0,0	0,0	8,58

EoT, Port & Combustion Side contaminated	90671	mg
EoT, Port Side contaminated, Combustion Side cleaned	90658	mg
SoT, New Valve	90544	mg
Inlet Valve Deposit	114	mg

Valve no.	M102 E / IVD rating												
3	4,5	5,0	5,5	6,0	6,5	7,0	7,5	8,0	8,5	9,0	9,5	10,0	
s e e g m e n t	1								1	9		10	
	2								1	9		10	
	3								1	9		10	
	4								1	9		10	
	5								1	9		10	
	6								1	9		10	
	7										10	10	
	8										10	10	
	9										10	10	
	10									4	6	10	
total %	0	0	0	0	0	0	0	0	6	58	36	0	100
rating	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,5	5,2	3,4	0,0	9,15

EoT, Port & Combustion Side contaminated	91227	mg
EoT, Port Side contaminated, Combustion Side cleaned	91211	mg
SoT, New Valve	91163	mg
Inlet Valve Deposit	48	mg

Valve no.	M102 E / IVD rating												
4	4,5	5,0	5,5	6,0	6,5	7,0	7,5	8,0	8,5	9,0	9,5	10,0	
s e e g m e n t	1					6		2	2			10	
	2						2	3	5			10	
	3							4	6			10	
	4							3	7			10	
	5							1	6		3	10	
	6								2	4	4	10	
	7								8	2		10	
	8							1	7	2		10	
	9							10				10	
	10						10					10	
total %	0	0	0	0	0	16	14	35	28	7	0	0	100
rating	0,0	0,0	0,0	0,0	0,0	1,1	1,1	2,8	2,4	0,6	0,0	0,0	7,98

EoT, Port & Combustion Side contaminated	91043	mg
EoT, Port Side contaminated, Combustion Side cleaned	91018	mg
SoT, New Valve	90780	mg
Inlet Valve Deposit	238	mg

Rated by: P. Smutny
 Date: 25.11.2021
 Approved by: J. Mistr

Clean-Up:

Test no.	M102-21 097	Inlet valve deposits per valve	19	mg / valve
Test lubricant:	RL254, Batch 5	RATING	9,64	
Cylinder head no.:	M102_005	Oil consumption:	213	g
Test fuel:	VIF-ULG 95 + SBA 1000 ppm (V/V)			ID: 2578

Valve no.	M 102 E / IVD rating												
1	4,5	5,0	5,5	6,0	6,5	7,0	7,5	8,0	8,5	9,0	9,5	10,0	
s e e g m e n t	1									5		5	10
	2									1		9	10
	3									1		9	10
	4									2		8	10
	5									4		6	10
	6									8		2	10
	7									8		2	10
	8									1	7	2	10
	9										8	2	10
	10										7	3	10
total %	0	0	0	0	0	0	0	0	0	30	22	48	100
rating	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	2,7	2,1	4,8	9,59

EoT, Port & Combustion Side contaminated	90476	mg
EoT, Port Side contaminated, Combustion Side cleaned	90436	mg
SoT, New Valve	90425	mg
Inlet Valve Deposit	11	mg

Valve no.	M 102 E / IVD rating												
2	4,5	5,0	5,5	6,0	6,5	7,0	7,5	8,0	8,5	9,0	9,5	10,0	
s e e g m e n t	1									2	7	1	10
	2										9	1	10
	3									2	7	1	10
	4									3	7		10
	5									1	9		10
	6							1			9		10
	7										10		10
	8										1	9	10
	9											10	10
	10										8	2	10
total %	0	0	0	0	0	0	0	1	0	9	85	5	100
rating	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,0	0,8	8,1	0,5	9,47

EoT, Port & Combustion Side contaminated	90613	mg
EoT, Port Side contaminated, Combustion Side cleaned	90573	mg
SoT, New Valve	90544	mg
Inlet Valve Deposit	29	mg

Valve no.	M 102 E / IVD rating												
3	4,5	5,0	5,5	6,0	6,5	7,0	7,5	8,0	8,5	9,0	9,5	10,0	
s e e g m e n t	1											10	10
	2											10	10
	3											10	10
	4										3	7	10
	5										3	7	10
	6										1	9	10
	7								1		9		10
	8										5	5	10
	9										4	6	10
	10											10	10
total %	0	0	0	0	0	0	0	0	1	1	33	65	100
rating	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,1	3,1	6,5	9,81

EoT, Port & Combustion Side contaminated	91190	mg
EoT, Port Side contaminated, Combustion Side cleaned	91170	mg
SoT, New Valve	91163	mg
Inlet Valve Deposit	7	mg

Valve no.	M 102 E / IVD rating													
4	4,5	5,0	5,5	6,0	6,5	7,0	7,5	8,0	8,5	9,0	9,5	10,0		
s e e g m e n t	1									3		7	10	
	2									2	2	6	10	
	3									2	7	1	10	
	4									1	9		10	
	5											10	10	
	6										1	9	10	
	7										3	3	4	10
	8										6	4	10	
	9										2	6	2	10
	10										5	5	10	
total %	0	0	0	0	0	0	0	0	0	13	39	48	100	
rating	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1,2	3,7	4,8	9,68	

EoT, Port & Combustion Side contaminated	90841	mg
EoT, Port Side contaminated, Combustion Side cleaned	90807	mg
SoT, New Valve	90780	mg
Inlet Valve Deposit	27	mg

Rated by: P. Smutný
 Date: 28.11.2021
 Approved by: J. Mistr

The test precision is defined in the precision statement of the test method F-05-93 in Section 11: Precision for F-05-93 is ± 43 mg per valve for deposit of fuels without additives and 12 mg/valve for deposit of fuels with additives.

The precision is evaluated during the latest round robin.

Extended measurement uncertainty is a product of standard measurement uncertainty and an extension coefficient $k=2$ which corresponds to about 95% probability coverage for standard distribution. Standard measurement uncertainty was determined in accordance with document EA 4/02.

4 Combustion Chamber Deposits according to CEC F-20-98

Dirty-Up:

Test no.: **M102-21 096**
 Date: **25.11.2021**
 Rated by: **P. Smutný**
 Test fuel: **VIF-ULG 95**
 Test fuel ID: **2576**

Cylinder head no.: **M102_005**
 Test lubricant: **RL254, Batch 5**
 Oil Consumption [g/Test]: **251 g**
 Fuel Consumption [l/Test]: **214,0 l**

	Valve/Cylinder no. 1	Valve/Cylinder no. 2	Valve/Cylinder no. 3	Valve/Cylinder no. 4
Filter clean	[mg] 1562	[mg] 1914	[mg] 1716	[mg] 1827
Filter loaded	[mg] 3427	[mg] 3779	[mg] 3438	[mg] 4093
Deposits (incl. Combustion Side Deposits)	[mg] 1865	[mg] 1865	[mg] 1722	[mg] 2266

	Piston Top	Fire Land+ Head Gasket	Cylinder Head w/o V.	Inlet Valves Comb. Side	Outlet Valves Comb. Side	Inlet Valves Port Side	Outlet Valves Port Side
Deposits	[mg] 3886	[mg] 892	[mg] 2852	[mg] 77	[mg] 11	[mg] 538	[mg] 6
Inlet Valve Deposits per Valve						[mg] 135	
Piston Top Deposits	[mg] 4778						
Cylinderhead Combustion Deposits				[mg] 2940			
Total Combustion Deposits	[mg] 7718						

Inlet Valves		Valve 1	Valve 2	Valve 3	Valve 4
S.O.T.	[mg]	90425	90544	91163	90780
E.O.T.	Port & Combustion Side contaminated [mg]	90586	90671	91227	91043
E.O.T.	Port Side contaminated, Combustion Side cleaned [mg]	90563	90658	91211	91018
Deposits Combustion Side	[mg]	23	13	16	25
Deposits Port Side	[mg]	138	114	48	238

Outlet Valves		Valve 1	Valve 2	Valve 3	Valve 4
S.O.T.	[mg]	89800	89571	89678	89594
E.O.T.	Port & Combustion Side contaminated [mg]	89803	89578	89679	89600
E.O.T.	Port Side contaminated, Combustion Side cleaned [mg]	89802	89573	89678	89596
Deposits Combustion Side	[mg]	1	5	1	4
Deposits Port Side	[mg]	2	2	0	2

Clean-Up:

Test no.: **M102-21 097**
 Date: **28.11.2021**
 Rated by: **P. Smutný**
 Test fuel: **VIF-ULG 95 + SBA 1000 ppm (V/V)**
 Test fuel ID: **2578**

Cylinder head no.: **M102_005**
 Test lubricant: **RL254, Batch 5**
 Oil Consumption [g/Test]: **213** g
 Fuel Consumption [l/Test]: **216,6** l

	Valve/Cylinder no. 1	Valve/Cylinder no. 2	Valve/Cylinder no. 3	Valve/Cylinder no. 4
Filter clean [mg]	2122	2109	1770	1968
Filter loaded [mg]	4318	4312	4001	4379
Deposits (incl. Combustion Side Deposits) [mg]	2196	2203	2231	2411

	Piston Top	Fire Land+ Head Gasket	Cylinder Head w/o V.	Inlet Valves Comb. Side	Outlet Valves Comb. Side	Inlet Valves Port Side	Outlet Valves Port Side
Deposits [mg]	4403	1006	3483	134	15	74	13
Inlet Valve Deposits per Valve [mg]						19	
Piston Top Deposits [mg]	5409						
Cylinderhead Combustion Deposits [mg]				3632			
Total Combustion Deposits [mg]				9041			

86% Cleaned

Inlet Valves		Valve 1	Valve 2	Valve 3	Valve 4
S.O.T.	[mg]	90425	90544	91163	90780
E.O.T.	Port & Combustion Side contaminated [mg]	90476	90613	91190	90841
E.O.T.	Port Side contaminated, Combustion Side cleaned [mg]	90436	90573	91170	90807
Deposits Combustion Side	[mg]	40	40	20	34
Deposits Port Side	[mg]	11	29	7	27

Outlet Valves		Valve 1	Valve 2	Valve 3	Valve 4
S.O.T.	[mg]	89800	89571	89678	89594
E.O.T.	Port & Combustion Side contaminated [mg]	89817	89575	89679	89600
E.O.T.	Port Side contaminated, Combustion Side cleaned [mg]	89813	89571	89678	89594
Deposits Combustion Side	[mg]	4	4	1	6
Deposits Port Side	[mg]	13	0	0	0

5 Pictures

Dirty-Up

Inlet Valve 1

Inlet Valve 2

Inlet Valve 3

Inlet Valve 4

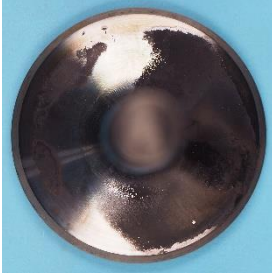


Spark Plugs



Clean-Up:

Inlet Valve 1



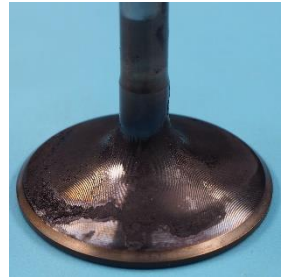
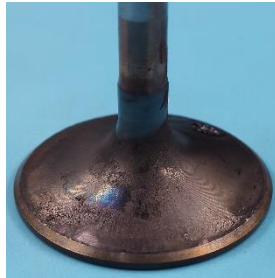
Inlet Valve 2



Inlet Valve 3



Inlet Valve 4



Spark Plugs



Dirty-Up:

Cylinder 1



Cylinder 2



Cylinder 3



Cylinder 4



Clean-Up:

Cylinder 1



Cylinder 2



Cylinder 3



Cylinder 4

