

ISO 16232:2018-12 (E)

Road vehicles - Cleanliness of components and systems

Contents	Page
Foreword	vi
Introduction	vii
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Symbols and abbreviated terms	11
5 Cleanliness inspection principles	13
5.1 General	13
5.2 Selecting the inspection method	14
5.3 Start parameters	15
5.4 Cleaning mechanism parameters	16
5.5 Staff skills	16
6 Qualification tests and blank level	16
6.1 General	16
6.2 Qualification tests	17
6.2.1 Principle	17
6.2.2 Materials and equipment	18
6.2.3 Procedure	18
6.3 Blank level	21
6.3.1 Principle	21
6.3.2 Deriving blank levels	22
6.3.3 Materials and equipment	23
6.3.4 Procedure	23
6.4 Exceptional cases	24
7 Extraction methods	24
7.1 Principles	24
7.2 General requirements of extraction equipment	25
7.3 Preparatory steps and post-treatment of test components	25
7.3.1 General	25
7.3.2 Unpacking	25
7.3.3 Clarifying which surfaces require inspection	25
7.3.4 Preparatory steps	26
7.3.5 Disassembly	26
7.3.6 Demagnetization	27
7.3.7 Post-treatment	27
7.4 Liquid extraction	27
7.4.1 General	27
7.4.2 Test liquid	27
7.4.3 Pressure-rinsing	28
7.4.4 Ultrasonic vibration	30
7.4.5 Internal rinsing	34
7.4.6 Agitation	36
7.4.7 Dissolving	38
7.5 Air extraction	40

7.5.1	General	40
7.5.2	Air jet extraction	40
7.5.3	Air through-flow extraction	42
8	Analysisfiltration	44
8.1	Principles	44
8.2	Selecting the analysis filtration method	44
8.2.1	General	44
	8.2.2 Chemical resistance	44
8.2.3	Particle retention capacity	45
8.2.4	Further properties of analysis filters	46
8.3	Handling analysis filters	46
8.4	Materials and equipment	46
8.5	Procedure	47
8.6	Verifying particle occupancy on the analysis filter	48
9	Analysis methods	49
9.1	Principles	49
9.2	Standard analysis	49
9.2.1	General	49
9.2.2	Gravimetry	49
9.2.3	Light-optical analysis	53
9.3	Extended analysis	68
9.3.1	Further light-optical analyses	69
9.3.2	SEM/EDX	73
9.3.3	LIBS	75
9.3.4	Raman spectroscopy	77
9.3.5	IR (infrared spectroscopy)	79
9.3.6	X-ray microtomography	81
9.4	Shortened analysis	83
9.4.1	General	83
9.4.2	Liquid particle counter	83
9.4.3	Filter-blocking (optical)	85
10	Documentation	87
10.1	Overview	87
10.2	General information	88
10.3	Information about the test component	89
10.4	Information about preparatory steps	89
10.5	Information about the extraction	89
10.5.1	General	89
10.5.2	Pressure-rinsing	90
10.5.3	Ultrasonic vibration	91
10.5.4	Internal rinsing	91
10.5.5	Agitation	92
10.5.6	Air jet extraction	92
10.5.7	Air through-flow extraction	93
10.6	Information about filtration	93
10.7	Information about the analysis	94
10.7.1	General	94
10.7.2	Standard analysis	94
10.7.3	Extended analysis (informative)	95
10.7.4	Shortened analysis (informative)	95
10.8	Reporting of the inspection results	95
10.8.1	General	95
10.8.2	Gravimetric analysis	95
10.8.3	Light-optical analysis	96
10.8.4	Extended analysis	98
10.8.5	Shortened analysis	99
10.8.6	Optional coding (informative)	99
10.9	Description of content of the various documents	102

10.9.1	Inspection specification	102
10.9.2	Qualification report	102
10.9.3	Inspection report	103
11	Handling components cleanly	103
11.1	Principles	103
11.2	Selected measures and recommendations	104
11.2.1	Staff	104
11.2.2	Packaging	104
11.2.3	Storage and transport	104
11.2.4	Facilities for inspecting cleanliness	105
11.3	Exclusion from an inspection -- invalid inspection	105
11.3.1	Deviations from required state on delivery	105
11.3.2	Deviations and errors in the inspection procedure	105
12	Designation	106
Annex A (informative) Selecting contamination extraction and analysis procedures		107
Annex B (normative) Qualification tests and blank level		117
Annex C (informative) Recovering test particles		121
Annex D (normative) Extraction		123
Annex E (informative) Filtration		137
Annex F (normative) Analysis methods		143
Annex G (informative) Documentation		154
Annex H (informative) Cleanliness specification		158
Annex I (informative) Technical cleanliness -- Interpretation and reaction		168
Annex J (informative) Staff training		170
Annex K (informative) Work safety and protection of the environment		171
Annex L (informative) Summary on updates included in this document		176
Bibliography		178