

Table of contents

European Foreword	6
1 Scope	7
2 Normative references	8
3 Terms, definitions and abbreviated terms	10
3.1 Terms from other standards.....	10
3.2 Terms specific to the present standard	10
3.3 Abbreviated terms.....	12
3.4 Symbols.....	13
3.5 Nomenclature	13
4 Cleanliness requirements	14
4.1 General.....	14
4.2 Design requirements.....	15
4.2.1 General	15
4.2.2 Components.....	15
4.2.3 System.....	17
4.2.4 Ground support equipment (GSE).....	17
4.3 Manufacturing	18
4.3.1 General	18
4.3.2 Manufacturing processes	18
4.3.3 Machined parts	18
4.3.4 Tubing and manifolds.....	18
4.3.5 Components.....	19
4.3.6 Subsystems and systems.....	21
4.3.7 Final rinsing solutions.....	21
4.4 Cleanliness classes definition	21
4.4.1 Particulate	21
4.4.2 Non-volatile residues (NVR).....	25
4.4.3 Dryness and liquid residuals	25
4.4.4 Requirements on process fluids to meet cleanliness classes	26

4.5	Test methods.....	27
4.6	Code usage	27
5	Cleaning techniques	28
5.1	General.....	28
5.2	Environment, health and safety.....	29
5.2.1	General	29
5.2.2	Hardware configuration requirements.....	29
5.2.3	Cleaning process approval	30
5.3	Pre-cleaning	30
5.3.1	General	30
5.3.2	Mechanical pre-cleaning	30
5.3.3	Chemical pre-cleaning	31
5.4	Precision cleaning.....	32
5.4.1	General	32
5.4.2	Re-cleaning operational systems	32
5.5	Drying methods	33
5.5.1	General	33
5.5.2	Gaseous purge-drying.....	33
5.5.3	Drying sample	34
5.5.4	Flow rates during purging.....	35
5.5.5	Vacuum drying procedure	35
5.6	Excepted components, subsystems and systems	36
6	Cleanliness verification requirements	37
6.1	Surface.....	37
6.1.1	Visual and UV inspection	37
6.1.2	pH-test	37
6.2	Acceptance inspection of items cleaned in a controlled environment.....	38
6.2.1	General	38
6.2.2	Test fluids	38
6.2.3	Test fluid volume for analysis	38
6.2.4	Analysis of test fluid-flush sample (solvent).....	39
6.2.5	Analysis of aqueous-based, liquid-flush sample	40
6.2.6	Drying	41
6.2.7	Vacuum drying	41
6.3	Maintaining cleanliness.....	42
6.3.1	Pressurant gas purge	42
6.3.2	Installation and marking of temporary hardware	42

6.3.3	Temporary hardware replacement	42
6.3.4	Component replacement	43
6.4	Dryness verification	43
6.4.1	General	43
6.4.2	Purge dryness	43
6.4.3	Vacuum dryness	43
6.4.4	Sample test and qualified procedure	44
7	Acceptance inspection of packaging materials	45
7.1	Environmental control	45
7.2	Sampling	45
7.3	Thickness of packaging film	45
7.4	Static electricity	46
7.5	Verification of cleanliness level	46
7.5.1	General	46
7.5.2	Minimum surface area for test	46
7.5.3	Sample preparation	46
7.5.4	Rinsing procedures	47
8	Packaging and protection	48
8.1	Approved coverings	48
8.2	Packaging operations	48
8.3	Certification labels	48
9	Deliverables	50
10	Test procedures	51
10.1	Test liquid-flush procedure (solvent)	51
10.2	Gas flow test procedure	51
11	Sampling and analytical practices	52
11.1	Cleanliness level test methods	52
11.1.1	General	52
11.1.2	Method I "Liquid Flush Test"	52
11.1.3	Method II "Liquid Flow Test"	53
11.1.4	Method III "Gas Flow Test"	53
11.1.5	Method IV "Liquid flow test under operating conditions"	53
12	Determination of particle population and NVR analysis	55
12.1	Microscopic particle population	55
12.2	Gravimetric NVR analysis method	56

Annex A (normative) Cleanliness Requirements Analysis (CRA) for spacecraft propulsion components, subsystems and systems - DRD .	57
Annex B (normative) Cleaning Technique Selection (CTS) for spacecraft propulsion components, subsystems and systems - DRD	59
Annex C (normative) Cleanliness Certificate (CC) for spacecraft propulsion components, subsystems and systems - DRD	61
Annex D (normative) Typical test and cleaning liquids.....	64
Annex E (informative) Pre-cleaning sequences.....	67
Annex F (informative) Cleanliness certificate	69
Bibliography.....	71

Figures

Figure F-1 : Example of a cleanliness certificate.....	70
--	----

Tables

Table 4-1: Cleanliness classes	24
Table 4-2: NVR contamination levels.....	25
Table 4-3: Visible contamination levels.....	27
Table 7-1: Packaging materials	46
Table D-1 : Typical test and cleaning fluids	64
Table E-1 : Typical pre-cleaning sequence for common materials.....	67