

### Table of contents

---

<b>European Foreword</b> .....	<b>6</b>
<b>1 Scope</b> .....	<b>8</b>
<b>2 Normative references</b> .....	<b>9</b>
<b>3 Terms, definitions and abbreviated terms</b> .....	<b>10</b>
3.1 Terms from other standards.....	10
3.2 Terms specific to the present standard.....	11
3.3 Abbreviated terms.....	16
3.4 Nomenclature.....	18
<b>4 Principles</b> .....	<b>19</b>
<b>5 Fracture control programme</b> .....	<b>21</b>
5.1 General.....	21
5.2 Fracture control plan.....	22
5.3 Reviews.....	22
5.3.1 General.....	22
5.3.2 Safety and project reviews.....	22
<b>6 Identification and evaluation of PFCI</b> .....	<b>24</b>
6.1 Identification of PFCIs.....	24
6.2 Evaluation of PFCIs.....	27
6.2.1 Damage tolerance.....	27
6.2.2 Fracture critical item classification.....	29
6.3 Compliance procedures.....	29
6.3.1 General.....	29
6.3.2 Safe life items.....	30
6.3.3 Fail-safe items.....	30
6.3.4 Contained and restrained items.....	31
6.3.5 Low-risk fracture items.....	32
6.4 Documentation requirements.....	38
6.4.1 Fracture control plan.....	38
6.4.2 Lists.....	38

6.4.3	Analysis and test documents.....	38
6.4.4	Fracture control summary report .....	38
<b>7</b>	<b>Fracture mechanics analysis.....</b>	<b>40</b>
7.1	General.....	40
7.2	Analytical life prediction .....	41
7.2.1	Identification of all load events .....	41
7.2.2	Identification of the most critical location and orientation of the crack.....	42
7.2.3	Derivation of stresses for the critical location.....	42
7.2.4	Derivation of the stress spectrum .....	42
7.2.5	Derivation of material data .....	43
7.2.6	Identification of the initial crack size and shape.....	44
7.2.7	Identification of an applicable stress intensity factor solution.....	46
7.2.8	Performance of crack growth calculations .....	47
7.3	Critical crack-size calculation .....	47
<b>8</b>	<b>Special requirements .....</b>	<b>49</b>
8.1	Introduction.....	49
8.2	Pressurized hardware.....	49
8.2.1	General .....	49
8.2.2	Pressure vessels.....	50
8.2.3	Pressurized structures .....	51
8.2.4	Pressure components, including lines and fittings .....	52
8.2.5	Low risk sealed containers .....	53
8.2.6	Hazardous fluid containers.....	53
8.2.7	Pressurized components with non-hazardous LBB failure mode.....	54
8.3	Welds .....	54
8.3.1	Nomenclature.....	54
8.3.2	Safe life analysis of welds .....	55
8.4	Composite, bonded and sandwich structures.....	56
8.4.1	General .....	56
8.4.2	Defect assessment.....	56
8.4.3	Damage threat assessment .....	58
8.4.4	Compliance procedures .....	60
8.5	Non-metallic items other than composite, bonded, sandwich and glass items .....	62
8.6	Rotating machinery.....	63
8.7	Glass components .....	63
8.8	Fasteners .....	64
8.9	Alloys treated with electric discharge manufacturing (EDM).....	65

<b>9 Material selection .....</b>	<b>66</b>
<b>10 Quality assurance and NDT .....</b>	<b>67</b>
10.1 Overview .....	67
10.2 Nonconformances.....	67
10.3 NDT of PFCI.....	67
10.3.1 General .....	67
10.3.2 NDT of raw material .....	69
10.3.3 NDT of safe life finished items.....	69
10.4 Non-destructive testing of metallic materials .....	70
10.4.1 <<deleted>> .....	70
10.4.2 NDT categories versus initial crack size .....	70
10.4.3 <<deleted>> .....	71
10.5 <<deleted>> .....	72
10.5.1 <<deleted>> .....	72
10.5.2 <<deleted>> .....	73
10.6 Traceability .....	73
10.6.1 General .....	73
10.6.2 Requirements.....	74
10.7 Detected defects.....	74
10.7.1 General .....	74
10.7.2 Acceptability verification .....	75
10.7.3 Improved probability of detection.....	76
<b>11 Reduced fracture control programme .....</b>	<b>77</b>
11.1 Applicability.....	77
11.2 Requirements .....	77
11.2.1 General .....	77
11.2.2 Modifications .....	77
<b>Annex A (informative) The ESACRACK software package.....</b>	<b>84</b>
<b>Annex B (informative) References .....</b>	<b>85</b>
<b>Bibliography.....</b>	<b>86</b>
<b>Figures</b>	
Figure 5-1: <<deleted, modified and moved to clause 6 as new Figure 6-1> .....	22
Figure 6-1: Identification of PFCI .....	26
Figure 6-2: Fracture control evaluation procedures .....	28

Figure 6-3: Safe life item evaluation procedure for metallic materials .....	35
Figure 6-4: Safe life item evaluation procedure for composite, bonded and sandwich items .....	36
Figure 6-5: Evaluation procedure for fail-safe items.....	37
Figure 7-1: Initial crack geometries for parts without hole .....	45
Figure 7-2: Initial crack geometries for parts with holes .....	46
Figure 7-3: Initial crack geometries for cylindrical parts .....	46
Figure 8-1: Procedure for metallic pressure vessel and metallic liner evaluation .....	51
Figure 10-1: <<deleted and moved to 7.2.6 as Figure 7-1>> .....	72
Figure 10-2: <<deleted and moved to 7.2.6 as Figure 7-2>> .....	72
Figure 10-3: <<deleted and moved to 7.2.6 as Figure 7-3>> .....	72

**Tables**

Table 8-1: Factor on stress for sustained crack growth analysis of glass items .....	64
Table 10-1: <<deleted (moved to ECSS-Q-ST-70-15)>> .....	71