

ISO 12135:2016-11 (E)

Metallic materials - Unified method of test for the determination of quasistatic fracture toughness

Contents		Page
Foreword		v
1	Scope	1
2	Normative references	1
3	Terms and definitions	1
4	Symbols and designations	2
5	General requirements	5
5.1	General	5
5.2	Fracture parameters	7
5.3	Fracture toughness symbols	8
5.4	Test specimens	8
5.4.1	Specimen configuration and size	8
5.4.2	Specimen preparation	12
5.5	Pre-test requirements	18
5.5.1	Pre-test measurements	18
5.5.2	Crack shape/length requirements	19
5.6	Test apparatus	19
5.6.1	Calibration	19
5.6.2	Force application	19
5.6.3	Displacement measurement	19
5.6.4	Test fixtures	20
5.7	Test requirements	24
5.7.1	Three-point bend testing	24
5.7.2	Compact tension testing	24
5.7.3	Specimen test temperature	24
5.7.4	Recording	25
5.7.5	Testing rates	25
5.7.6	Test analyses	25
5.8	Post-test crack measurements	25
5.8.1	General	25
5.8.2	Initial crack length, a_0	25
5.8.3	Stable crack extension, a	28
5.8.4	Unstable crack extension	28
6	Determination of fracture toughness for stable and unstable crack extension	29
6.1	General	29
6.2	Determination of plane strain fracture toughness, K_{Ic}	30
6.2.1	General	30
6.2.2	Interpretation of the test record for FQ	30
6.2.3	Calculation of KQ	31
6.2.4	Qualification of KQ as K_{Ic}	32
6.3	Determination of fracture toughness in terms of	32
6.3.1	Determination of F_c and V_c , F_u and V_u , or F_{uc} and V_{uc}	32
6.3.2	Determination of F_m and V_m	34
6.3.3	Determination of V_p	34
6.3.4	Calculation of	34
6.3.5	Qualification of fracture toughness value	35

6.4	Determination of fracture toughness in terms of J	35
6.4.1	Determination of F_c and q_c , F_u and q_u , or F_{uc} and q_{uc}	35
6.4.2	Determination of F_m and q_m	36
6.4.3	Determination of U_p	36
6.4.4	Calculation of J_0	37
6.4.5	Qualification of J_0 fracture toughness value	37
7	Determination of resistance curves J-a and J-a and initiation toughness $J_{0,2BL}$ and $J_{0,2BL}$ and J_i and J_i for stable crack extension	38
7.1	General	38
7.2	Test procedure	38
7.2.1	General	38
7.2.2	Multiple-specimen procedure	38
7.2.3	Single-specimen procedure	38
7.2.4	Final crack front straightness	38
7.3	Calculation of J and J	39
7.3.1	Calculation of J	39
7.3.2	Calculation of J	39
7.4	R-curve plot	40
7.4.1	Plot construction	41
7.4.2	Data spacing and curve fitting	42
7.5	Qualification of resistance curves	42
7.5.1	Qualification of J-a resistance curves	42
7.5.2	Qualification of J-a resistance curves	43
7.6	Determination and qualification of $J_{0,2BL}$ and $J_{0,2BL}$	44
7.6.1	Determination of $J_{0,2BL}$	44
7.6.2	Determination of $J_{0,2BL}$	45
7.7	Determination of initiation toughness J_i and J_i by scanning electron microscopy (SEM) 46 8 Test report	46
8.1	Organization	46
8.2	Specimen, material and test environment	47
8.2.1	Specimen description	47
8.2.2	Specimen dimensions	47
8.2.3	Material description	47
8.2.4	Additional dimensions	47
8.2.5	Test environment	47
8.2.6	Fatigue precracking conditions	47
8.3	Test data qualification	48
8.3.1	Limitations	48
8.3.2	Crack length measurements	48
8.3.3	Fracture surface appearance	48
8.3.4	Pop-in	48
8.3.5	Resistance curves	48
8.3.6	Checklist for data qualification	48
8.4	Qualification of K_{Ic}	49
8.5	Qualification of the J-R Curve	49
8.6	Qualification of the J-R Curve	50
8.7	Qualification of $J_{0,2BL(B)}$ as $J_{0,2BL}$	50
8.8	Qualification of $J_{0,2BL(B)}$ as $J_{0,2BL}$	50
Annex A	(informative) Determination of J_i and J_i	51
Annex B	(normative) Crack plane orientation	56
Annex C	(informative) Example test reports	57
Annex D	(normative) Stress intensity factor coefficients and compliance relationships	66
Annex E	(informative) Measurement of load-line displacement q in the three-point bend test	71

Annex F (informative) Derivation of pop-in formulae	76
Annex G (informative) Analytical methods for the determination of V_p and U_p	78
Annex H (informative) Guidelines for single-specimen methods	80
Annex I (normative) Power-law fits to crack extension data (see Reference [42])	95
Bibliography	96