DIN EN ISO 204:2019-04 (E)

Metallic materials - Uniaxial creep testing in tension - Method of test (ISO 204:2018)

Contents

Page

European foreword 5

Foreword 6

Introduction 7

1 Scope 8

2 Normative references 8

3 Terms and definitions 8

4 Symbols and designations 13

5 Principle 15

6 Apparatus 15

7 Test pieces 19
7.1 Shape and dimensions 19
7.1.1 Shape and dimension of smooth test pieces 19
7.1.2 Shape and dimension of notched test pieces 20
7.2 Preparation 20
7.3 Determination of the original cross-sectional area 21
7.4 Marking of the original gauge length, Lo 21
7.5 Determination of the reference length, Lr 21

8 Test procedure 22
8.1 Heating of the test piece 22
8.2 Application of the test force 22
8.3 Test interruptions 23
8.3.1 Planned interruptions of the test 23
8.3.2 Multiple test piece machine with several test pieces in line 23
8.3.3 Combined test 23
8.3.4 Accidental interruption of the test 23
8.4 Recording of temperature and elongation or extension 23
8.4.1 Temperature 23
8.4.2 Elongation and extension 23
8.4.3 Elongation-time diagram or extension-time diagram 24

9 Determination of results 24

10 Test validity 24

11 Accuracy of the results 24
11.1 Expression of the results 24
11.2 Final uncertainty 25

12 Test report 25

Annex A (informative) Information concerning drift of thermocouples 30

A.1 General ... 30
A.2 Consequences of drift ... 30
A.3 Drift data ... 30
A.4 Concluding remarks ... 32

Annex B (informative) Information concerning methods of calibration of thermocouples ... 33

Annex C (normative) Creep testing using test pieces with V or blunt circumferential notches ... 34

C.1 General ... 34
C.2 V-notched test pieces ... 34
C.3 Blunt circumferential notches ... 36

Annex D (informative) Method of estimating the uncertainty of the measurement in accordance with the Guide to the expression of uncertainty in measurement (GUM) ... 38

D.1 General ... 38
D.2 Purpose ... 38
D.3 Statements of uncertainty ... 38
D.3.1 Background ... 38
D.3.2 Statement of uncertainty: creep testing ... 41
D.4 A reference material for creep testing ... 42
D.4.1 General ... 42
D.4.2 Using the CRM 425 for assessing uncertainty ... 43
D.5 Uncertainties in creep testing of single crystal nickel-base superalloy at 1 100 °C ... 43

Annex E (informative) Representation of results and extrapolation ... 45

E.1 General ... 45
E.2 Symbols for strength values and their calculation ... 45
E.2.1 Strain ... 45
E.2.2 Creep rupture strength ... 45
E.2.3 Stress-to-specific-plastic-strain ... 45
E.3 Creep testing in single test piece machines and/or multiple test piece machines ... 45
E.4 Evaluation ... 47
E.4.1 General ... 47
E.4.2 Logarithmic creep diagram ... 49
E.4.3 Creep rupture diagram ... 49
E.4.4 Creep rupture elongation diagram ... 50
E.4.5 Creep diagram with linear scales ... 50
E.5 Extrapolation ... 52
E.5.1 General ... 52
E.5.2 Extrapolation and creep rupture diagram ... 52
E.5.3 Extrapolation by means of time-temperature-parameters ... 52
E.5.4 Other Extrapolation Methods ... 52
E.6 Test report, recommended additional information ... 52

Annex F (informative) Computer compatible representation of standards ... 55

Bibliography ... 56

Figures Figure 1 -- Schematic stress -- Extension diagram ... 26

Figure 2 -- Examples of test pieces ... 28

Figure 3 -- Creep curves ... 29

Figure A.1 -- Type PR thermocouple drift data measured after creep testing (Miyazaki, H and Kimura, K, 2005)[64] ... 31

Figure A.2 -- Type R thermocouple drift data measured after creep testing[63] ... 32

Figure C.1 -- Combined notched and unnotched test piece 35

Figure C.2 -- Geometry of the test pieces type DIN, BS and E 35

Figure C.3 -- Schematic diagram of a notched test piece with a circular cross-section 36

Figure C.4 -- Three possible types of Bridgman notch[18] 37

Figure D.1 -- Outline procedure for estimation of uncertainty 40

Figure D.2 -- Detailed procedure for estimating uncertainty in accordance with the GUM 41

Figure E.1 -- Schematic representation of creep curves generated in non-interrupted creep test mode (a, b), interrupted creep test (c) and creep test to be started in non-interrupted creep test mode and continued as interrupted creep test (d) 47

Figure E.2 -- Example for the representation of test results for constant test temperature and constant tensile force 49

Figure E.3 -- Linear creep diagram (schematic) 51

Figure E.4 -- Exemplary extrapolation cases in creep strain (rupture) diagram 54

Tables Table 1 -- Symbols and designations 13

Table 2 -- Permitted deviations between Tc and T and maximum permissible temperature variation along the test piece 16

Table 3 -- Shape tolerances of test pieces with circular cross-sections 20

Table 4 -- Shape tolerances of test pieces with square or rectangular cross-sections 20

Table C.1 -- Examples of dimensions of notched test pieces with circular cross-sections and with an elastic stress concentration factor Kt = 4,5 ± 0,5[10] 34

Table D.1 -- Range of uncertainties for tp0,2 and tp1 42

Table D.2 -- Certified values for the Nimonic 75 Creep Reference Material, BCR425 43

Table D.3 -- Acceptable data range for creep testing using the Creep Reference Material, CRM 425 .43

Table D.4 -- Chemical composition of tested alloy (mass %) 44

Table D.5 -- Summary of the creep rupture tests reported by five laboratories TMS-82+, 137 MPa and 1 100 °C 44