

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, L_0	21
7.5 Determination of the reference length, L_r	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 T_c 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 K_t = 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