

Contents

	Page
Foreword	vii
14.6 Hydraulic performance acceptance tests	1
14.6.1 Introduction	1
14.6.1.1 Purpose	1
14.6.1.2 Scope	1
14.6.1.3 Terms and definitions	2
14.6.2 Factory performance tests	11
14.6.2.1 General	11
14.6.2.2 Nonwitnessed pump test	11
14.6.2.3 Witnessed pump test	11
14.6.3 Pump acceptance tests	11
14.6.3.1 General	11
14.6.3.2 Guarantees	12
14.6.3.3 Measurement uncertainty	13
14.6.3.4 Performance test acceptance grades and tolerances	15
14.6.4 Default test acceptance grades	16
14.6.5 Test procedures	20
14.6.5.1 General	20
14.6.5.2 Date of testing	20
14.6.5.3 Test procedure	20
14.6.5.4 Testing equipment	20
14.6.5.5 Records and report	20
14.6.5.6 Test arrangements	20
14.6.5.7 Test conditions	21
14.6.5.8 NPSH tests	21
14.6.6 Analysis	22
14.6.6.1 Translation of the test results to the guarantee conditions	22
14.6.6.2 Obtaining specified characteristics	24
Appendix A Test arrangements (normative)	26
A.1 General	26
A.2 Measurement principles	26
A.3 Various measurement methods	27
A.4 Simulated test arrangements	32
A.5 Pumps tested with fittings	32
A.6 Pumping installation under submerged conditions	33
A.7 Self-priming pumps	35
A.8 Friction losses at inlet and outlet	35
Appendix B Hydrostatic pressure testing (normative)	39
B.1 Purpose and scope	39
B.2 Definitions	39
B.3 General	39
B.4 Timing of the test	39
B.5 Preparation for testing	40
B.6 Test liquid	40
B.7 Test pressure	40

B.8	Test procedure	40
B.9	Acceptance criteria	41
B.10	Repairs	41
B.11	Test records	41
B.12	Test certificate.	42
B.13	Test report	42
Appendix C	Purpose of test tolerances (informative)	43
C.1	Explanation of test tolerances - variations	43
C.2	Manufacturing variations.	43
C.3	Effect of accessories on mechanical losses (power)	44
C.4	Selection of pump test acceptance grades and corresponding tolerance bands	44
Appendix D	Recommended tests (informative)	45
D.1	General	45
D.2	Recommended test specification matrix	46
Appendix E	Mechanical test (informative)	47
E.1	Mechanical test objective	47
E.2	Mechanical test setup	47
E.3	Mechanical test operating conditions	47
E.4	Mechanical test instrumentation	47
E.5	Mechanical test procedure	48
E.6	Mechanical test acceptance criteria	48
E.7	Mechanical test records	49
Appendix F	NPSH test arrangements (informative)	50
F.1	General	50
F.2	Characteristics of the circuit	50
F.3	Characteristics of the test liquid	50
F.4	Allowable air content during NPSH testing	50
F.5	Determination of the vapor pressure.	51
F.6	Example of test arrangements	52
Appendix G	Tests performed on the entire equipment set - string test (informative)	55
Appendix H	Reporting of test results (informative)	57
H.1	Performance test report	57
Appendix I	Measurement equipment (informative)	61
I.1	Head measuring apparatus.	61
I.2	Measurement of rotating speed	61
I.3	Measurement of flow rate	62
I.4	Measurement of pump power input	64
I.5	Special cases	65
I.6	Determination of motor pump unit overall efficiency.	65
Appendix J	Suitable time periods for calibration of test instruments (informative)	66
J.1	Recalibration interval	66
Appendix K	Special test methods (informative)	67
K.1	General	67
K.2	Model tests for pump acceptance.	67

Appendix L	Determination, application, and calculation of instrument (systematic) uncertainty (informative)	73
L.1	Determination, application, and calculation of instrument (systematic) uncertainty	73
L.2	Distribution of probability.	74
L.3	Examples of measurement uncertainty calculations.	75
Appendix M	Properties of Test Water (informative)	85
M.1	Test Water Properties.	85
M.2	Temperature correction.	85
Appendix N	Unit conversions (informative)	87
Appendix O	References (informative).	89

Figures

14.6.1.3 — NPSH datum elevation for various pump designs at eye of first-stage impeller	9
14.6.3.4.2a — Unilateral tolerance acceptance	17
14.6.3.4.2b — Bilateral tolerance acceptance	17
14.6.3.4.3a — Tolerance field for acceptance grades 1U and 2U	18
14.6.3.4.3b — Tolerance field for acceptance grade 1E	18
14.6.3.4.3c — Tolerance field for acceptance grades 1B, 2B, and 3B	18
A.1 — Determination of the pump total head (isometric illustration)	28
A.2 — Flow at suction at part load	29
A.3 — Error in measurement of $H(Q)$ depending on distance of suction pressure gauge from impeller	29
A.4 — Correction of suction pressure for suction recirculation	30
A.5 — Pressure tapping perpendicular to the plane of the volute or to the plane of a bend, respectively	30
A.6 — Requirements for static pressure tappings	31
A.7 — Four pressure tappings connected by a ring manifold (grade 1)	31
A.8 — One pressure tapping (general for grade 2 and 3)	31
A.9 — Bowl assembly total head determination for vertically suspended pumps	34
A.10 — Determination of pump head	37
A.11 — Bowl assembly total head determination for vertically suspended pump with a closed suction	38
F.1 — Air separating at the pump suction nozzle as a function of NPSHA if the pump draws cold water from a tank with air-saturated water. Air pressure above tank equal to atmospheric pressure	51
F.2 — Variation of NPSHA in a closed loop by head and/or temperature controlled	53
F.3 — Variation of NPSHA by control of liquid level at pump inlet sump	54
F.4 — Variation of NPSHA by means of an inlet throttle valve	54
H.1 — Sample pump test curve	58
H.2 — Example test sheet	60
I.1 — Arrangement for determination of reference plane of spring pressure gauges	61
L.1 — Output signal vs. pressure value	82

Tables

14.6.1.3a — List of quantities	2
14.6.1.3b — Alphabetical list of basic letters used as symbols	10
14.6.1.3c — List of letters and numbers used as subscripts	10
14.6.3.3.2 — Permissible amplitude of fluctuation as a percentage of mean value of quantity being measured.....	13
14.6.3.3.3 — Maximum permissible measurement device uncertainty at guarantee point	14
14.6.3.4 — Pump test acceptance grades and corresponding tolerance band	15
14.6.4 — Default acceptance grade based on purchaser's intended service	19
14.6.5.8.2.1 — Methods of determining NPSH3	23
B.1 — Requirements for longer test periods	41
D.1 — Matrix of recommended tests	46
G.1 — Influencing factors for calculating pump efficiency for different configurations.....	56
J.1 — Default instrument recalibration intervals.....	66
L.1 — Lab pressure calibrator calibration data	76
L.2 — Published accuracy of lab calibration devices.....	76
L.3 — Lab precision DC current measurement device calibration data.....	77
L.4 — Lab DC current source calibration data.....	77
L.5 — Pressure transducer calibration.....	78
L.6 — DA system current measurement module (output) calibration data	78
L.7 — Calculation of percent uncertainty for the discharge pressure, full system of 300 psi pressure transducer and data acquisition system	80
L.8 — Differential pressure transducer information	81
L.9 — Signal measurement device information	81
L.10 — Venturi information - BIF 2-in s/n 12345	81
L.11 — Differential pressure transducer calibration data.....	82
L.12 — Differential pressure transducer calibration data analysis.....	82
L.13 — Venturi flowmeter calibration data and analysis	83
L.14 — Calculation of individual device uncertainty and total uncertainty	84
M.1 — Corrections due to water temperature	85
N.1 — Conversion factors	87