ISO 7278-2:2022-11 (E)

Petroleum measurement systems - Part 2: Pipe prover design, calibration and operation

Contents

Page

Foreword v

Introduction vi

1 Scope 1

2 Normative references 1

3 Terms,definitions,symbolsandunits 1
3.1 Terms and definitions 1
3.2 Symbols and units 8

4 Designclassificationofpipeprovers 9
4.1 Common features 9
4.2 Sphere provers 11
4.2.1 General 11
4.2.2 Unidirectional sphere provers 11
4.2.3 Bidirectional sphere provers 13
4.3 Piston provers 15
4.3.1 General 15
4.3.2 Unidirectional piston provers 16
4.3.3 Bidirectional piston provers 16

5 Operationalclassificationofprovers 16
5.1 General 16
5.2 Conventional prover 17
5.3 Reduced volume prover 18
5.4 Small volume prover 18

6 Design 20
6.1 General considerations 20
6.2 Prover barrel 21
6.2.1 End chambers (launch and receive chambers) 21
6.2.2 Run-in length 22
6.2.3 Prover pipe or barrel 22
6.2.4 Internal finish 22
6.3 Proprietary small volume piston provers 23
6.4 Sizing of provers 24
6.4.1 General 24
6.4.2 Calibrated volume 25
6.4.3 Length between detectors 25
6.4.4 Diameter and Velocity 26
6.4.5 Pressure loss 26
6.5 Displacers 27
6.5.1 General 27
6.5.2 Spheres 27
6.5.3 Pistons 28
6.6 Displacer Velocity 28
6.6.1 General 28
6.6.2 Minimum velocity 28
6.6.3 Maximum velocity 29

6.7 Detectors 29
6.8 Prover valves 30
6.9 Additional design considerations 31

7 Ancillary equipment 32
7.1 Overview of temperature and pressure measurement 32
7.2 Temperature measurement 32
7.3 Pressure measurement 33
7.4 Calibration connections 33

7.5 System control 34

8 Pulse interpolation 34

9 Installation 34
9.1 Mechanical installation 34
9.1.1 General 34
9.1.2 Fixed provers 37
9.1.3 Mobile provers 37
9.2 Electrical installation 38
9.3 Other installation recommendations 38

10 Traceability 38

11 Calibration 40
11.1 General 40
11.2 Calibration circuits and equipment 40
11.3 Water draw calibration method 42
11.3.1 Description 42
11.3.2 Volumetric measure as reference 43
11.3.3 Gravimetric as reference 45
11.4 Master meter calibration method 47
11.5 Sequential master meter method 50
11.6 Concurrent master meter method 51
11.7 Calibration procedures 51

12 Operationtoproveaflowmeter 52
12.1 Setting up a prover 52
12.2 Mobile prover prior to arrival on site 52
12.3 Mobile prover on arrival on site 52
12.4 Stabilizing temperature 53
12.5 Periodical checks of factors affecting accuracy 53
12.6 Meter proving operation 53
12.7 Preliminary assessment of the results 54
12.8 Fault finding 55

13 Safety 55
13.1 General 55
13.2 Permits 56
13.3 Opening end chambers and removing a displacer 56
13.4 Special precautions when proving with LPG 56
13.5 Fire precautions 57
13.6 Miscellaneous safety precautions 57
13.7 Safety records 57

Annex A (informative) Calculations 59

Annex B (informative)Selectingaprovervolumeforaflowmeter 70

Annex C (informative)Acceptancecriteriaandperformancespecification 72

Annex D (informative) Troubleshooting 83

Annex E (informative) Sphere or detector replacement and twin pairs of detectors 89

Annex F (informative) Pulse interpolation 91

Annex G (informative) Alternative designs 95

Annex H (informative) Calibration procedures 97

Annex I (informative)Exampleofprovercalibrationcertificate 102

Bibliography 107