

# DIN EN ISO 7278-2:2023-03 (E)

## Petroleum measurement systems - Part 2: Pipe prover design, calibration and operation (ISO 7278-2:2 022)

---

<b>Contents</b>	<b>Page</b>
<b>European foreword</b> .....	<b>4</b>
<b>Foreword</b> .....	<b>5</b>
<b>Introduction</b> .....	<b>6</b>
<b>1 Scope</b> .....	<b>7</b>
<b>2 Normative references</b> .....	<b>7</b>
<b>3 Terms, definitions, symbols and units</b> .....	<b>7</b>
3.1 Terms and definitions.....	7
3.2 Symbols and units.....	14
<b>4 Design classification of pipe provers</b> .....	<b>15</b>
4.1 Common features.....	15
4.2 Sphere provers.....	17
4.2.1 General.....	17
4.2.2 Unidirectional sphere provers.....	17
4.2.3 Bidirectional sphere provers.....	19
4.3 Piston provers.....	21
4.3.1 General.....	21
4.3.2 Unidirectional piston provers.....	22
4.3.3 Bidirectional piston provers.....	22
<b>5 Operational classification of provers</b> .....	<b>22</b>
5.1 General.....	22
5.2 Conventional prover.....	23
5.3 Reduced volume prover.....	24
5.4 Small volume prover.....	24
<b>6 Design</b> .....	<b>26</b>
6.1 General considerations.....	26
6.2 Prover barrel.....	27
6.2.1 End chambers (launch and receive chambers).....	27
6.2.2 Run-in length.....	28
6.2.3 Prover pipe or barrel.....	28
6.2.4 Internal finish.....	28
6.3 Proprietary small volume piston provers.....	29
6.4 Sizing of provers.....	30
6.4.1 General.....	30
6.4.2 Calibrated volume.....	31
6.4.3 Length between detectors.....	31
6.4.4 Diameter and Velocity.....	32
6.4.5 Pressure loss.....	32
6.5 Displacers.....	33
6.5.1 General.....	33
6.5.2 Spheres.....	33
6.5.3 Pistons.....	34
6.6 Displacer Velocity.....	34
6.6.1 General.....	34
6.6.2 Minimum velocity.....	34
6.6.3 Maximum velocity.....	35

6.7	Detectors.....	35
6.8	Prover valves.....	36
6.9	Additional design considerations.....	37
<b>7</b>	<b>Ancillary equipment.....</b>	<b>38</b>
7.1	Overview of temperature and pressure measurement.....	38
7.2	Temperature measurement.....	38
7.3	Pressure measurement.....	39
7.4	Calibration connections.....	39
7.5	System control.....	40
<b>8</b>	<b>Pulse interpolation.....</b>	<b>40</b>
<b>9</b>	<b>Installation.....</b>	<b>40</b>
9.1	Mechanical installation.....	40
9.1.1	General.....	40
9.1.2	Fixed provers.....	43
9.1.3	Mobile provers.....	43
9.2	Electrical installation.....	44
9.3	Other installation recommendations.....	44
<b>10</b>	<b>Traceability.....</b>	<b>44</b>
<b>11</b>	<b>Calibration.....</b>	<b>46</b>
11.1	General.....	46
11.2	Calibration circuits and equipment.....	46
11.3	Water draw calibration method.....	48
11.3.1	Description.....	48
11.3.2	Volumetric measure as reference.....	49
11.3.3	Gravimetric as reference.....	51
11.4	Master meter calibration method.....	53
11.5	Sequential master meter method.....	56
11.6	Concurrent master meter method.....	57
11.7	Calibration procedures.....	57
<b>12</b>	<b>Operation to prove a flowmeter.....</b>	<b>58</b>
12.1	Setting up a prover.....	58
12.2	Mobile prover prior to arrival on site.....	58
12.3	Mobile prover on arrival on site.....	58
12.4	Stabilizing temperature.....	59
12.5	Periodical checks of factors affecting accuracy.....	59
12.6	Meter proving operation.....	59
12.7	Preliminary assessment of the results.....	60
12.8	Fault finding.....	61
<b>13</b>	<b>Safety.....</b>	<b>61</b>
13.1	General.....	61
13.2	Permits.....	62
13.3	Opening end chambers and removing a displacer.....	62
13.4	Special precautions when proving with LPG.....	62
13.5	Fire precautions.....	63
13.6	Miscellaneous safety precautions.....	63
13.7	Safety records.....	63
<b>Annex A (informative) Calculations.....</b>		<b>65</b>
<b>Annex B (informative) Selecting a prover volume for a flowmeter.....</b>		<b>76</b>
<b>Annex C (informative) Acceptance criteria and performance specification.....</b>		<b>78</b>
<b>Annex D (informative) Troubleshooting.....</b>		<b>89</b>
<b>Annex E (informative) Sphere or detector replacement and twin pairs of detectors.....</b>		<b>95</b>

**Annex F (informative) Pulse interpolation.....97**  
**Annex G (informative) Alternative designs.....101**  
**Annex H (informative) Calibration procedures.....103**  
**Annex I (informative) Example of prover calibration certificate..... 108**  
**Bibliography..... 113**