

# DIN EN 14359:2007-02 (E)

## Gas-loaded accumulators for fluid power applications

---

<b>Contents</b>		<b>Page</b>
Foreword .....		5
<b>1</b>	<b>Scope .....</b>	<b>6</b>
<b>2</b>	<b>Normative references .....</b>	<b>7</b>
<b>3</b>	<b>Terms, definitions, symbols, units and abbreviated terms .....</b>	<b>8</b>
3.1	Terms and definitions .....	8
3.2	Symbols, units and abbreviated terms .....	9
3.2.1	General .....	9
3.2.2	Inter-relation of thickness definitions .....	10
<b>4</b>	<b>Materials .....</b>	<b>10</b>
4.1	Requirements for metallic materials .....	10
4.2	Material certificates for components of the pressure containing envelope .....	11
<b>5</b>	<b>Basic design and calculation criteria .....</b>	<b>11</b>
5.1	General .....	11
5.2	Corrosion .....	11
5.3	Qualification by similarity .....	11
5.4	Design methods .....	11
5.4.1	General .....	11
5.4.2	Basic symbols, units and description .....	12
5.4.3	Maximum allowable values for the nominal design stress for pressure bearing parts .....	13
5.5	Design and calculation methods common to all accumulator types .....	13
5.5.1	General .....	13
5.5.2	Specific definitions .....	13
5.5.3	Cylindrical shells .....	14
5.5.4	Dished ends under internal pressure .....	14
5.5.5	Isolated openings and nozzles in spherical shells and spherical centre areas of dished ends .....	17
5.5.6	Thread calculation .....	23
5.6	Specific design criteria for piston accumulators .....	25
5.6.1	Threaded end caps .....	25
5.6.2	Tie-rod retained end caps .....	30
5.6.3	Split-ring retained end caps .....	32
5.7	Specific design criteria for diaphragm accumulators .....	35
5.7.1	General .....	35
5.7.2	Two-part screwed shell design .....	36
5.7.3	Three-part screwed shell design .....	38
5.7.4	Gas-precharging openings .....	42
5.8	Specific design criteria for oil ports mainly used in bladder type accumulators .....	43
5.8.1	General .....	43
5.8.2	Oil port design and calculation .....	43
<b>6</b>	<b>Manufacture .....</b>	<b>46</b>
6.1	General .....	46
6.2	Special manufacturing processes for welded diaphragm accumulators .....	46
6.2.1	General .....	46
6.2.2	Requirements for the use of permanent backing strips .....	46
6.2.3	Electron and laser beam welding .....	47
6.2.4	Welded nozzles .....	47

6.2.5	Heat treatment .....	47
6.2.6	Approval of special welding procedures .....	48
6.2.7	Qualification of welding procedure specifications .....	48
6.2.8	Verification and utilization of welding procedure specifications when applied to welding machines .....	48
6.3	Forming of bladder accumulator shells .....	48
6.3.1	Processes .....	48
6.3.2	Heat treatment .....	49
6.3.3	Verification of mechanical properties .....	49
6.3.4	Visual and ultrasonic examination .....	50
7	Inspection and testing .....	51
7.1	General .....	51
7.2	Design documentation .....	51
7.3	Design review and design examination .....	52
7.4	Inspection during manufacture .....	52
7.5	Hydrostatic pressure test .....	52
7.6	Fatigue test .....	53
7.6.1	General .....	53
7.6.2	Basic symbols and units .....	53
7.6.3	Test equipment and preparation of test accumulator .....	54
7.6.4	Accuracy .....	55
7.6.5	Test conditions and procedure .....	55
7.6.6	Method of evaluating and interpreting fatigue test results using the gradient of the stress-number curve and a probability of failure .....	57
7.6.7	Fatigue assessment of gas loaded accumulators - Guarantee factor method ) .....	63
7.7	Marking and labelling .....	70
7.7.1	General .....	70
7.7.2	Marking method .....	71
7.7.3	Marking contents .....	71
7.7.4	Information labelling .....	71
7.8	Documentation .....	71
7.8.1	General .....	71
7.8.2	Process records .....	72
8	Safety instructions and equipment for accumulators .....	72
8.1	Introduction .....	72
8.2	Safety equipment .....	72
8.2.1	General .....	72
8.2.2	Limitation of pressure .....	73
8.2.3	Pressures gauges .....	74
8.2.4	Shut-off devices .....	74
8.2.5	Fluid side pressure release devices .....	74
8.2.6	Gas side release devices .....	74
8.3	Tests and examinations before first operation .....	75
8.3.1	Examination of documentation including instructions for first operation, stamps and CE-marks .....	75
8.3.2	Examination of proper mounting .....	75
8.3.3	Examination of safety equipment .....	75
8.4	Supervision and maintenance .....	76
Annex A (informative) Categories of gas-loaded accumulators including reference to modules of conformity assessment .....		77
Annex B (informative) Summary of activities in respect to conformity assessment modules .....		78
Annex C (informative) Examples of safety equipment configuration .....		79
Annex D (informative) Manufacturer's declaration of conformity form .....		86
Annex E (informative) Example of the application of the method of evaluating and interpreting fatigue test results carried out on complete accumulators .....		87

<b>E.1</b>	<b>General</b> .....	<b>87</b>
<b>E.1.1</b>	<b>General</b> .....	<b>87</b>
<b>E.1.2</b>	<b>Consider a population of accumulators with the following characteristics:</b> .....	<b>87</b>
<b>E.1.3</b>	<b>Calculation of CVM</b> .....	<b>87</b>
<b>E.1.4</b>	<b>Calculation of M</b> .....	<b>88</b>
<b>E.1.5</b>	<b>Calculation of CVE</b> .....	<b>88</b>
<b>Annex F (informative) Abacus</b> .....		<b>90</b>
<b>Annex G (informative) Alternative relations for normal distributions</b> .....		<b>93</b>
<b>Annex H (informative) Variation coefficients of equipment material</b> .....		<b>94</b>
<b>Annex I (informative) Quality / severity condition of equipment / environment</b> .....		<b>95</b>
<b>I.1</b>	<b>Equipment quality: ki values</b> .....	<b>95</b>
<b>I.2</b>	<b>Severity conditions of environment: Ej values</b> .....	<b>95</b>
<b>Annex ZA (informative) Relationship between this European Standard and the Essential Requirements of EU Directive 97/23/EC</b> .....		<b>96</b>
<b>Bibliography</b> .....		<b>97</b>