

DIN EN 14359:2011-04 (E)

Gas-loaded accumulators for fluid power applications (includes Amendment A1:2010)

Contents		Page
Foreword		5
1	Scope	6
2	Normative references	7
3	Terms, definitions, symbols, units and abbreviated terms	8
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
4	Materials	10
4.1	Requirements for metallic materials	10
4.2	Material certificates for components of the pressure containing envelope	10
5	Basic design and calculation criteria	11
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
6	Manufacture	46
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	48
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
C.1	EXAMPLE 1	79
C.2	EXAMPLE 2	80
C.3	EXAMPLE 3	81

C.4	EXAMPLE 4	82
C.5	EXAMPLE 5	83
C.6	EXAMPLE 6	84
C.7	EXAMPLE 7	85
Annex D (informative) Manufacturer's declaration of conformity form		86
Annex E (informative) !Example of application of the method of evaluating and interpreting fatigue test results carried out on complete accumulators		87
E.1	General	87
E.1.1	General	87
E.1.2	Consider a population of accumulators with the following characteristics:	87
E.1.3	Calculation of CVM	87
E.1.4	Calculation of M	88
E.1.5	Calculation of CVE"	88
Annex F (informative) !Abacus"		91
Annex G (informative) Alternative relations for normal distributions		95
Annex H (informative) Variation coefficients of equipment material		96
Annex I (informative) !Quality / Severity condition of equipment / environment		97
I.1	Equipment quality: ki values	97
I.2	Severity conditions of environment: Ej values"	97
Annex ZA (informative) Relationship between this European Standard and the Essential Requirements of EU Directive 97/23/EC		98
Bibliography		99