

DIN EN 12493:2018-08 (E)

LPG equipment and accessories - Welded steel pressure vessels for LPG road tankers - Design and manufacture (includes Amendment :2018)

Contents		Page
European foreword		6
Introduction		7
1	Scope	8
2	Normative references	8
3	Terms and definitions	10
4	Materials	11
4.1	Environmental	11
4.2	Suitability	11
4.3	Pressure retaining parts	12
4.4	Non-pressure retaining parts	12
4.5	Welding consumables	12
4.6	Non-metallic materials (gaskets)	12
4.7	Inspection documents for materials	12
5	Pressure vessel design	12
5.1	Design conditions	12
5.2	Minimum thickness	13
5.3	Surge plates	13
5.4	Doubler plates	13
5.5	Stresses due to motion	14
5.6	Self-supporting pressure vessels	14
5.7	Vacuum conditions	14
5.8	Pressure vessel mountings	14
5.9	Internal pipework	15
6	Openings	15
6.1	General	15
6.2	Reinforcement of openings	15
6.3	Threaded connections	15
6.4	Manhole	15
7	Non-pressure retaining parts	16
7.1	Attachment welds	16
7.2	Position of attachment welds	16
8	Workmanship and construction	16
8.1	General	16
8.2	Environment	16
8.3	Control of materials	16
8.4	Acceptable weld details	17
8.5	Heat treatment and forming	17
8.5.1	Cold forming	17
8.5.2	Hot forming	18
8.5.3	Testing of formed parts	18
8.5.4	Visual examination and control of dimensions	19
8.5.5	Marking	19

8.6	Welding	19
8.6.1	General	19
8.6.2	Longitudinal welds	19
8.6.3	Welding procedure specification (WPS)	19
8.6.4	Qualification of WPS	19
8.6.5	Qualification of welders and welding operators	19
8.6.6	Preparation of edges	20
8.6.7	Attachments and fastenings	20
8.6.8	Preheat	20
8.7	Post-weld heat treatment	20
8.8	Manufacturing tolerances	21
8.9	Repairs to pressure envelope and direct attachment welds	21
8.9.1	General requirements	21
8.9.2	Repair of surface imperfections in the parent metal	21
8.9.3	Repair of weld imperfections	21
9	Construction and workmanship of internal pipework	21
10	Manufacturing tests and examinations	21
10.1	General	21
10.2	Mechanical testing	22
10.2.1	Production test plates	22
10.2.2	Longitudinal welds	22
10.2.3	Circumferential welds	22
10.2.4	Mechanical tests	22
10.2.5	Test requirements	22
10.3	Non-destructive testing	23
10.3.1	General	23
10.3.2	Internal imperfections	23
10.3.3	Surface imperfections	23
10.4	Non-destructive testing for welds	24
10.4.1	Radiographic testing	24
10.4.2	Marking and identification of radiographs	24
10.4.3	Ultrasonic testing	24
10.4.4	Magnetic particle testing	24
10.4.5	Penetrant testing	24
10.5	Qualification of non-destructive testing personnel	24
10.6	Visual examination of welds	25
10.7	Acceptance criteria	25
10.8	#Safety precautions at the hydraulic test\$	25
11	External corrosion protection and finishing	25
11.1	External protection	25
11.2	Finishing operations	25
12	Marking	25
13	Records and documentation	25
13.1	Documentation obtained by the manufacturer	25
13.2	Records prepared by the manufacturer	26
13.3	Retention and supply of documents	26
Annex A (normative) Guidance on selection of material grades		27
Annex B (normative) Reference temperatures for design		28
B.1	Introduction	28
B.2	General	28
B.3	Developed pressure	28
B.4	Filling	28
Annex C (informative) Alternative reference temperatures for design		29

C.1	Introduction	29
C.2	General	29
C.3	Developed pressure	29
C.4	Filling	29
Annex D (normative) Design		30
D.1	Design stresses	30
D.2	Design pressure	30
D.3	Design formulae	30
D.3.1	Cylindrical shell calculation	30
D.3.2	Dished ends	31
D.3.3	Conical shell calculations	34
D.4	Nozzle reinforcement	38
D.5	Nozzle reinforcement by pads or flanges	40
D.6	Nozzle reinforcement by branches	40
Annex E (informative) Example of joints		45
Annex F (normative) Allowable tolerances		49
F.1	Pressure vessels	49
F.1.1	External diameter	49
F.1.2	Out of roundness	49
F.1.3	Deviation of straightness	49
F.1.4	Irregularities in profile	49
F.2	Dished end tolerance	50
F.2.1	Thickness of material	50
F.2.2	Profile	50
F.3	Assembly tolerances	52
F.3.1	Middle line alignment	52
F.3.2	Surface alignment	52
F.4	Attachments, nozzles and fittings	52
F.5	Overall length	53
Annex G (normative) Heat treatment		54
G.1	Method of post-weld heat treatment	54
G.2	Temperature control	54
G.3	Temperature limit	54
G.4	Temperature measurement	54
Annex H (informative) Typical method for measurement of shell peaking		55
H.1	Profile gauge	55
H.2	Peaking survey	55
Annex I (normative) Welding imperfections and test specimens		58
I.1	Imperfections	58
I.2	Test specimens	61
Annex J (informative) Choice of non-destructive test methods for welds		63
J.1	Internal imperfections	63
J.2	Surface imperfections	63
Annex K (normative) Hydraulic pressure test		64
K.1	Temporary fittings	64
K.2	Pressure gauges	64

K.3	Pressurizing agent	64
K.4	Avoidance of shock	64
K.5	Applied pressure	64
	Bibliography	66