

DIN EN 1473:2016-10 (E)

Installation and equipment for liquefied natural gas - Design of onshore installations

Contents		Page
European foreword		7
Introduction		8
1	Scope	9
2	Normative references	9
3	Terms and definitions	13
4	Safety and environment	18
4.1	General	18
4.2	Environmental impact	19
4.3	Safety general	20
4.4	Hazard assessment	24
4.5	Safety engineering during design and construction	30
4.6	Safety during operation	33
5	Jetties and marine facilities	34
5.1	General	34
5.2	Siting	34
5.3	Engineering design	34
5.4	Safety	35
6	Storage and retention systems	35
6.1	General	35
6.2	Types of tank	35
6.3	Types of containment	36
6.4	Design principles	37
6.5	General design rules	39
6.6	Foundations	40
6.7	Operating instruments	40
6.8	Pressure and vacuum protection	42
6.9	Bund walls and impounding area for single and double containment	43
6.10	Safety equipment	45
6.11	Tank piping	46
6.12	Distance between tanks	46
6.13	Commissioning and decommissioning	47
6.14	Testing	47
7	LNG pumps	47
7.1	General	47
7.2	Materials	48
7.3	Specific requirements	48
7.4	Inspection and testing	48
8	Vaporization of LNG	48
8.1	General requirements	48
8.2	Design conditions	50
8.3	Vaporiser requirements	50
9	Pipe-work	50

9.1	General	50
9.2	Piping systems	50
9.3	Rules for design	52
9.4	Pressure tests	53
9.5	Piping components	53
9.6	Valves	56
9.7	Relief valves	56
9.8	Thermal insulation	57
9.9	Pipe rack/pipe way	61
9.10	Corrosion	61
10	Reception/send out of natural gas	61
10.1	Metering	61
10.2	Gas quality	62
10.3	Odourizing	62
11	Boil off recovery and treatment plants	62
11.1	General	62
11.2	Boil off collection system	63
11.3	System of gas return to tanker(s) or to export terminal	63
11.4	Boil off gas recovery	64
11.5	Gas compressor	64
11.6	Flare/vent	64
12	Auxiliary circuits and buildings	66
12.1	Electrical equipment	66
12.2	Lightning and earthing	67
12.3	Cathodic protection	68
12.4	Warning lights	68
12.5	Sea water supply	68
12.6	Gas contaminant removal plant	68
12.7	Instrument air	68
12.8	Fuel (utility) gas	69
12.9	Nitrogen system	69
12.10	Buildings	70
13	Hazard management	70
13.1	Inherent safety	70
13.2	Passive protection	72
13.3	Security	73
13.4	Incident detection and signalling	74
13.5	Emergency Shutdown System	75
13.6	Active protection	76
13.7	Other requirements	80
14	Control and monitoring systems	81
14.1	General description	81
14.2	Process control system	81
14.3	Safety control system	82
14.4	Access control system	84
14.5	Anti-intrusion system	84
14.6	CCTV	84
14.7	Jetty and marine monitoring and control	84
14.8	Communications	85
14.9	Environmental monitoring and control	85
15	Construction, commissioning and turnaround	85
15.1	Quality assurance and quality control	85
15.2	Acceptance tests	85
15.3	Preparation at start-up and shutdown	85

16	Preservation and corrosion protection	86
16.1	Painting	86
16.2	Cathodic protection	87
17	Training for operations	87
18	Pre-operational marine training	87
Annex A (normative) Thermal radiation threshold values		88
A.1	Heat radiation from LNG fires	88
A.2	Heat radiation from flare or ignited vent stack	89
Annex B (normative) Definitions of reference flow rates		91
B.1	General	91
B.2	VT (heat input)	91
B.3	VL (fluid input)	91
B.4	VO (over filling)	91
B.5	VF (flash at filling)	91
B.6	VR (LNG recirculation by a submersible pump)	92
B.7	VA (variation in atmospheric pressure)	92
B.8	VV (control valve failure)	93
B.9	VI (heat input in the course of a fire)	93
B.10	VD (fluid suction)	93
B.11	VC (compressors suction)	93
B.12	VB (roll-over)	94
Annex C (informative) Seismic classification		95
C.1	Introduction	95
C.2	Some basic principles	95
C.3	Example of safety approach after SSE	95
C.4	Example of classification for SSE	96
Annex D (normative) Specific requirements for LNG pumps		97
D.1	Introduction	97
D.2	Design	97
D.3	Inspection	97
D.4	Testing	98
D.5	Declared values	100
D.6	Marking	100
D.7	Particular requirements for submerged pumps and related cables	101
D.8	Vertical external motor pumps	102
Annex E (normative) Specific requirements for LNG vaporizers		103
E.1	Operating parameters/declared performance	103
E.2	Water stream vaporizers: Open rack type (ORV)	103
E.3	Water stream vaporizers : Closed type (STV)	105
E.4	Intermediate fluid vaporizers (IFV)	106
E.5	Submerged combustion type vaporizers (SCV)	106
E.6	Ambient air vaporizers (AAV)	108
Annex F (normative) Criteria for the design of pipes		109
Annex G (informative) Description of the different types of onshore LNG installations		111
G.1	LNG liquefaction plant	111

G.2	LNG receiving terminals	111
G.3	LNG peak shaving plants	112
G.4	LNG satellite plants	112
G.5	LNG bunkering stations	112
Annex H (informative) Definition of different types of LNG tanks		113
H.1	General	113
H.2	Spherical storage tank	113
H.3	Cryogenic concrete tank	113
Annex I (informative) Frequency ranges		116
Annex J (informative) Classes of consequence		117
Annex K (informative) Levels of risk		118
K.1	General	118
K.2	Acceptability criteria	118
Annex L (informative) Typical process steps of liquefaction		120
L.1	Introduction	120
L.2	Treatment of natural gas/extraction of acid gases	120
L.3	Natural gas treatment/dehydration	122
L.4	Treatment of natural gas/removal of mercury	123
L.5	Natural gas liquefaction unit	124
Annex M (informative) Odourant systems		129
M.1	Odourants in general	129
M.2	Odourant systems requirements	129
M.3	Odourant handling	130
M.4	Odourant injection	130
M.5	Odourant leakage	131
M.6	Safety of personnel	131
Bibliography		132