

# DIN EN 14620-2:2006-12 (E)

Design and manufacture of site built, vertical, cylindrical, flat-bottomed steel tanks for the storage of refrigerated, liquefied gases with operating temperatures between 0 °C and -165 °C - Part 2: Metallic components

---

<b>Contents</b>		<b>Page</b>
Foreword .....		4
<b>1</b>	<b>Scope .....</b>	<b>5</b>
<b>2</b>	<b>Normative references .....</b>	<b>5</b>
<b>3</b>	<b>Terms and definitions .....</b>	<b>7</b>
<b>4</b>	<b>Materials .....</b>	<b>8</b>
4.1	General .....	8
4.2	Temperatures .....	8
4.3	Primary and secondary liquid container .....	8
4.4	Vapour container/outer tank .....	11
4.5	Other components .....	12
<b>5</b>	<b>Design .....</b>	<b>13</b>
5.1	Design theory .....	13
5.2	Primary and secondary liquid container .....	16
5.3	Vapour container (outer tank) .....	29
5.4	Suspended roof .....	33
5.5	Nozzles .....	33
5.6	Primary and secondary containment, bottom connections .....	36
5.7	Connections between containers .....	36
5.8	Other details .....	36
<b>6</b>	<b>Fabrication .....</b>	<b>38</b>
6.1	Handling of materials .....	38
6.2	Plate preparation and tolerances .....	38
6.3	Tolerances .....	39
6.4	Roof .....	42
6.5	Temporary attachments .....	42
<b>7</b>	<b>Welding procedures .....</b>	<b>42</b>
7.1	General .....	42
7.2	WPAR requirements .....	43
7.3	Impact testing .....	43
7.4	9 % Nickel steel .....	43
7.5	Welders and welding operators .....	44
7.6	Production test plates .....	44
<b>8</b>	<b>Welding .....</b>	<b>45</b>
8.1	Tack and temporary welds .....	45
8.2	Atmospheric conditions .....	45
8.3	Preheating .....	45
8.4	Post-weld heat treatment .....	45
<b>9</b>	<b>Inspection .....</b>	<b>47</b>
9.1	Qualification of NDE personnel .....	47
9.2	Inspection procedures .....	47

9.3	Type of inspections .....	47
9.4	Visual inspection .....	51
9.5	Dye penetrant examination .....	51
9.6	Magnetic particle examination .....	51
9.7	Vacuum box examination .....	51
9.8	Ammonia tightness test .....	52
9.9	Soap bubble examination .....	52
9.10	Radiographic examination .....	52
9.11	Ultrasonic examination .....	53
9.12	Acceptance criteria .....	53
9.13	Unacceptable defects in horizontal welds .....	53
9.14	Acceptable thinning after grinding .....	54
Annex A (informative) Actions on membrane .....		55
Annex B (informative) Determination of the load and fatigue curves for membrane .....		56
Bibliography .....		57
Figures Figure 1 -- Typical bottom layout .....		18
Figure 2 -- Design flowchart for membranes .....		23
Figure 3 -- Typical shell-roof compression areas .....		32
Figure 4 -- Typical roof nozzle with thermal distance piece .....		35
Figure 5 -- Outward and inward peaking .....		41
Figure 6 -- Gauge for measuring peaking .....		41
Figure B.1 -- Flowchart for membranes .....		56
Tables Table 1 -- Product and steel class .....		9
Table 2 -- Minimum Charpy V-notch impact test energy .....		11
Table 3 -- Steel for vapour container/outer tank .....		12
Table 4 -- Determination of the maximum allowable design stress .....		14
Table 5 -- Partial load and material factors for types I, II, III and IV steel .....		16
Table 6 -- Minimum shell plate thickness .....		20
Table 7 -- k factors for S-N curves (normal distribution assumed) .....		28
Table 8 -- Minimum size of top corner ring .....		33
Table 9 -- Radius tolerances .....		39
Table 10 -- Maximum differences between the design and the as built profile .....		40
Table 11 -- Tolerance limits on local deformation in welds .....		40
Table 12 -- Misalignment at vertical joints .....		42
Table 13 -- Holding times at lower temperatures .....		46
Table 14 -- Weld inspections of primary and secondary liquid container .....		48

<b>Table 15 -- Extent of radiographic/ultrasonic examination of shell welds of primary and secondary liquid container .....</b>	<b>48</b>
<b>Table 16 -- Inspection of vapour barrier/liner .....</b>	<b>50</b>
<b>Table 17 -- Extent of radiographic and ultrasonic examination of shell plate welds of vapour containers .....</b>	<b>51</b>
<b>Table A.1 -- Static action .....</b>	<b>55</b>
<b>Table A.2 -- Cyclic action .....</b>	<b>55</b>
<b>Table A.3 -- Accidental action .....</b>	<b>55</b>