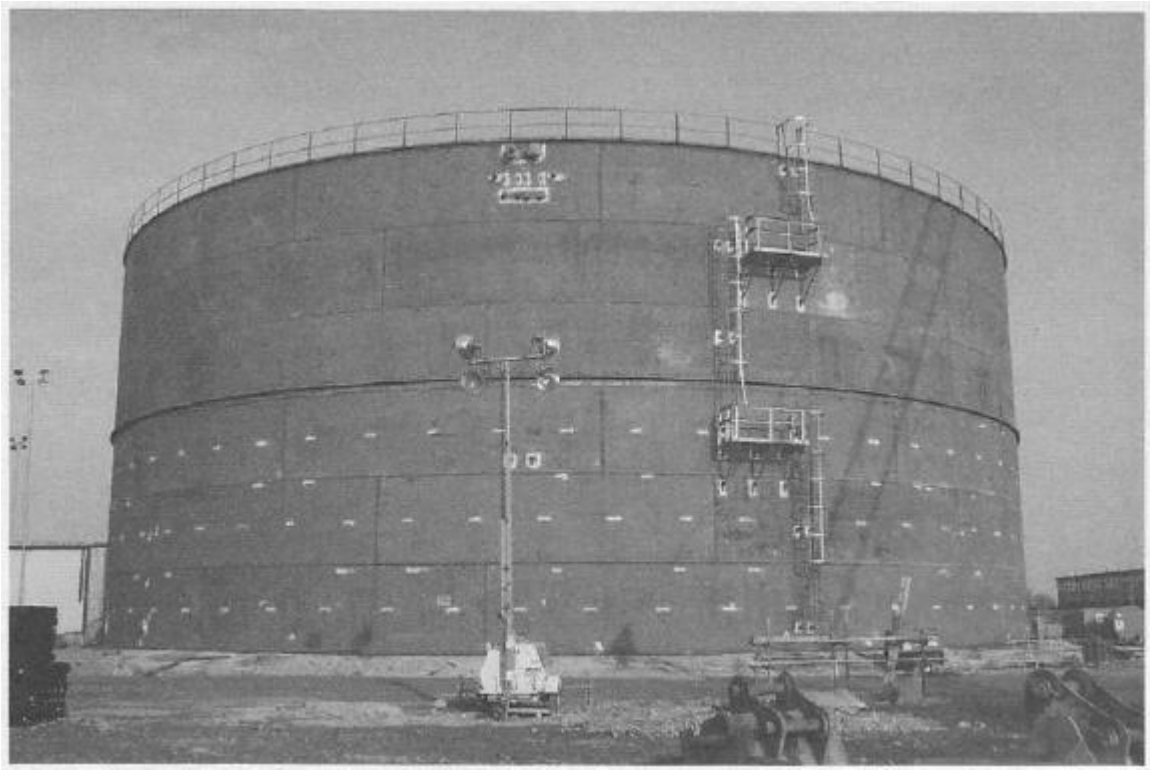
TANK DESIGN & DETAILING

Introduction

The API 650 standard is designed to provide the petroleum industry with tanks of adequate safety and reasonable economy for use in the storage of petroleum, petroleum products, and other liquid products commonly handled and stored by the various branches of the industry. This standard does not present or establish a fixed series of allowable tank sizes; instead, it is intended to permit the purchaser to select whatever size tank may best meet his needs. This standard is intended to help purchasers and manufacturers in ordering, fabricating, and erecting tanks; it is not intended to prohibit purchasers and manufacturers from purchasing or fabricating tanks that meet specifications other than those contained in this standard.
This standard has requirements given in two alternate systems of units. The requirements are similar but not identical. These minor differences are due to issues such as numerical rounding and material supply. When applying the requirements of this standard to a given tank, the manufacturer shall either comply with all of the requirements given in SI units or shall comply with all of the requirements given in US Customary units. The selection of which set of requirements (SI or US Customary) shall apply to a given tank shall be by mutual agreement between the manufacturer and purchaser.



Types of tanks (based on Roof fixing)

1. Fixed Roof Tank
2. Floating Roof Tank

Types of Tank based on Roof

1. Flat Roof
2. Cone Roof
3. Domed Roof

Types of Floating Roof Tanks

1. Internal Floating Roof Tank

2. External Floating Roof Tank

Mani Parts of Tank

1. Tank Shell
2. Bottom plate
3. Annular Plate
4. Backing strip
5. Anchor chairs and Anchor bolt arrangements
6. Draw of sump
7. Cleanout catch
8. Nozzles
9. Shell man way
10. Roof man way
11. Fire safety
12. Primary & Secondary Wind girder
13. Curb angle or compressen ring
14. Roof plate
15. Crown plate
16. Vent Nozzles
17. Overflow pipes
18. Roof Structures and support structures
19. Internal pipe supports
20. Internal man way rungs and internal ladder with support clips
21. External cage Ladder and spiral Staircase ladders and platforms with support clips
22. Roof handrails

For Floating Roof tanks

1. Drain system
2. Double Deck or single Deck
3. Seal or foum
4. Pantoon Legs
5. Deck legs
6. Rim plate & rim pantoons
7. Rollin ladder
8. Pantoon man way
9. Deck man way

Standards:

API Standard 650,	Welded Steel Tanks for Oil Storage
API Standard 620,	Recommended Rules for Design and Construction of Large Welded Low Pressure Storage Tanks
API RP 2000,	Venting Atmospheric and Low Pressure Storage Tanks

Standard Selection conditions:

Atmospheric pressure no refrigerated tanks shall be designed to API 650. Closed Top subject to low pressure shall additionally satisfy Appendix F.

Higher pressure tanks up to 15 psig shall comply with API 620 and shall include all API 650 requirements for materials and examinations.

API 650 tanks with wall thickness up to and including 0.5 inch shall be to Appendix A except that Group I materials of Table 2-3 shall not be used below 20°F.

Shop assembled API 650 tanks shall comply with Appendix J except that a minimum of spot radiography shall be applied with joint efficiency of 0.85.

1. TANK GA PREPARATION:

1. Fix the layout for tank overall dimensions in elevation, top view and side view.
2. Compare the overall dimensions and reference dimensions
3. To draw all the attachments and tank parts should be maintain completely 1:1 scale
4. Put all the orientation for Man ways , draw of sump, Nozzles and internal and external ladder clips, earthing boss or Clips, wind girder, lightning clips, piping support clips and etc.
5. All nozzle sizes and standards, schedules, type of flanges to be used, type of faces to Be used in flanges, if required any blind flanges, Davit Man ways, hinged type man ways, Vent and all nozzle elevation should be Fixed in Bottom of tank (bottom of shell plate). These items should be come in nozzle Details.
6. General notes, assembly notes are added in notes.
7. Which type of materials used in tank and attachment parts is come in material of Construction.
8. Add the design notes in Design Data table

9. Total weight of the tank and centre of gravity should be added.
10. If any internal (or) external surface preparation is there, this notes also added.
11. Client gives any standards to be follow the tank detailing, that standard also should Give the Standard requirements
12. If any tolerance given, that is also added in overall dimensions
13. Structural also added in the GA drawing.
14. If any legends there these items also include

Major dimensions specified in GA Drawing

1. Tank total height
2. Tank ID
3. Tank plate thickness in via course
4. If any wind girder is there that elevation should be added
5. Nozzle orientations and ladder positions (internal or external), ladder clips And piping supports, all attachments. etc
6. Nozzle elevations (X,Y) minimum two dimensions
7. If Roof Nozzle there, that case angel and distance for center line of tank
8. Structural column to column distances overall length for columns
9. Sump Orientation

SURFACE PREPARATION AND PAINTING: (Example)

SURFACE PREPARATION AND PAINTING					
	DESCRIPTION		NO. OF COATS	DFT	REMARKS
INTERNAL SURFACES	SURFACE PREPARATION	BLAST CLEAN TO SA2.5	–	–	
EXTERNAL SURFACES (TANK & NOZZLES)	SURFACE PREPARATION	BLAST CLEAN TO SA2.5	–	–	
	PRIMER	INORGANIC ZINC SILICATE	1	75	
	INTERMEDIATE	EPOXY HIGH BUILD PAINT	1	100	
	FINISH	ACRYLIC POLYURETHANE PAINT	1	40	

Design Data (example):

DESIGN DATA		
DESIGN CODE		API 650 TENTH EDITION–NOVEMBER 1998
ITEM NO		TANK–1
INTERNAL DESIGN PRESSURE	Kg/cm2 (g)	10.5
EXTERNAL DESIGN PRESSURE	Kg/cm2 (g)	–
OPERATING PRESSURE	Kg/cm2 (g)	6.5 min/7.5 (NOM)
HYDROSTATIC PRESSURE	Kg/cm2 (g)	15.75
DESIGN TEMPERATURE	°C	60
OPERATING TEMPERATURE	°C	35(NOM)/43(MAX)
SHELL JOINT EFFICIENCY	%	100
HEAD JOINT EFFICIENCY	%	100
POST WELD HEAT TREATMENT		NO
X–RAY EXAMINATION		FULL
SHELL CORROSION ALLOWANCE	mm	1.5
HEAD CORROSION ALLOWANCE	mm	1.5
CAPACITY	m3	588.8
WIND		ASCE–7/02;EXPOSURE=D; I=1.15; V=38m/Sec
EARTHQUAKE		UBC–1997; ZONE 2A; I=1.00; SOIL FACTOR=5
THERMAL INSULATION	mm	NO
FLUID CONTAINED		WATER OR OIL

NOZZLE DATAS: (Example)

NOZZLE MARK	DESCRIPTION	QTY.	SIZE IN INCH	THK. (mm)	STD.	RATING	TYPE	FACING	HT	THK	NOZZ PROJ FROM ℄ OF VESSEL	REMARKS	FX	FY	FZ	MX	MY	MZ
			PIPE DIMENSION		FLANGE				SELFREINF				DIRECT LOADS (KN)			MOMENT LOADS (KN)		
A1	OPENING FOR N2,CN 1B	2	–	14	–	–	–	–	–	–	REF DWG		–	–	–	–	–	–
A0	SKIRT ACCESS	1	–	14	–	–	–	–	–	–	REF DWG		–	–	–	–	–	–
CN1A	LEVEL GAUGE	1	2	16.7	ASME B16.5	300#	LWN	RF	–	–	3365		1.1	1.1	1.5	0.2	0.2	0.3
CN1B	LEVEL GAUGE	1	2	8.7		300#	WN	RF	–	–	3365		1.1	1.1	1.5	0.2	0.2	0.3
M1	MANWAY	1	24	12		150#	WN-BF	RF	74	97	3350		17.9	17.9	25.3	33.8	33.8	47.7
J1	PRESSURE TRANSMITTER	1	2	16.7		300#	LWN	RF	–	–	REF DWG		1.1	1.1	1.5	0.2	0.2	0.3
N5	VENT	1	6	10.97		150#	WN-BF	RF	–	–	REF DWG		3.4	3.4	4.8	2.4	2.4	3.4
N4	AIR OUTLET	1	6	10.97		150#	WN	RF	58	32	REF DWG		3.4	3.4	4.8	2.4	2.4	3.4
N3	PRESSURE RELIEF VALVE	1	6	10.97		150#	WN	RF	58	32	REF DWG		3.4	3.4	4.8	2.4	2.4	3.4
N2	DRAIN	1	2	8.7		150#	WN	RF	–	–	REF DWG		0.9	0.9	1.2	0.2	0.2	0.3
N1	AIR INLET	1	6	10.97		150#	WN	RF	65	35	3265		3.4	3.4	4.8	2.4	2.4	3.4
NOZZLE SCHEDULE													NOZZLE LOADS					

STANDARDS, SPECIFICATIONS: (Example)

STANDARDS, SPECIFICATION AND DRAWING			
S.NO.	DOCUMENT No.	DESCRIPTION	REV.
1	00-RA-E-20023	TECHNICAL SUPPLY SPECIFICATION	02
2	8762-00-SP-808	NOZZLE DETAILS	F1
3	8762-00-SP-809	MINIMUM NOZZLE LOADS	F2
4	8762-00-SP-811	MANWAY DAVIT DETAILS	F1
5	8762-00-SP-800	ENGINEERING STD GENERAL REQUIREMENT FOR WELDED UNFIRED PRESSURE VESSELS	F3
6	8762-00-SP-827	NAMEPLATE AND BRACKET DETAILS	F1
7	8762-00-SP-832	FABRICATION DIMENSIONAL TOLERANCES	F2
8	8762-00-SP-842/00-ZA-E-20221	POSITIVE MATERIAL IDENTIFICATION	02/02
9	8762-00-SP-844	GENERAL REQUIREMENT FOR WELDING	F3
10	8762-00-SP-846/00-ZA-E-20220	GENERAL MATERIAL REQUIREMENT	F1/02
11	00-GA-E-60701	PROTECTIVE PAINT AND COATINGS	06
12	00-RA-E-20002	INSPECTION DATA SHEET	02
13	STD.CR.GEN.7009	ANCHOR BOX & SUPPORT FOR VERTICAL VESSEL	02
14	STD.CR.GEN.7071	LIFTING LUGS TO LIFT EQUIPMENT UP TO 2000KN	01
15	STD.CR.GEN.7076	RETENTION LUG APPLIED TO SKIRT BOTTOM	01
16	8762-00-SP-817	PLATFORM BRACKETS(VERTICAL VESSELS)	F2
17	8762-00-SP-818	LADDER CONNECTION TO VERTICAL VESSELS	F1
18	8762-00-SP-826	MANWAYS INTERNAL RINGS	F1

MATERIAL OF CONSTRUCTION: (Example)

MATERIAL OF CONSTRUCTION	
BOTTOM PLATE	SA 283 Gr.C
SHELL PLATE	SA 283 Gr.C
ROOF PLATE	SA 283 Gr.C
NOZZLE NECK FROM PIPE	SA 106.Gr.B
NOZZLE NECK FROM FORGING	S.A 105
FITTING	SA 234 WPB
WIND GRIDER	SA 283 Gr.C
CURBE ANGLE OR TOP RING	SA 283 Gr.C
STRUCTURALS	IS 2062 Gr.A
INTERNALS WELDED (REMOVABLE)	IS 2062 Gr.A
SUPPORTS ANDE CLIPS	IS 2062 Gr.A
INTERNAL BOLTING AND NUT	SA 193 Gr.b / SA 194 Gr.2H
GASKET	SPIRAL WOOND GASKET-WITH OUTER & INNER RING-
	TB-GUA 5365-3165.5+GRAPH.98%-C.S.

Pressure rating

Design pressures up to 500 mbar:
Non-pressure, up to 10 mbar
Low-pressure, up to 25 mbar
High-pressure, up to 60 mbar
Very high-pressure, up to 500 mbar

Maximum negative pressure = -20 mbar.
Valid for negative pressure = up to -8.5 mbar

Temperature range is from 300ºC down to -40ºC.

SHELL DEVELPOMENT DRAWING

Vertical Joints in Shell

Butt joints with complete penetration and complete fusion as attained by double Welding or by other means which will obtain the same quality of joint

Horizontal Joints in Shell

Complete penetration and complete fusion butt weld.

Shell to Bottom Plate Joint

Continuous fillet weld laid on each side of the shell plate. The size of each weld shall be the thickness of the thinner plate.

1. Shell plate development detail (use pi * D formula, D is mean dia of tank)
2. Cutting layout drawing
3. Shell plate to Annular plated welding detail
4. shell plate to Shell plate (longitudinal and circumference) welding details
5. Wind Girder to shell plate welding detail
6. Wind Girder to Wind girder welding details
7. Curb angle to shell plate welding detail
8. Bill of materials
9. General notes
10. Section Views for plate to plate welding details

Shell plate Development Drawing involved components

1. Nozzle od and Rf pad od locations and dimensions
2. Man way od and man way Rf pad od locations and clean out catch
3. Earthing Boss or clips locations and overall dimensions
4. Lightening clips, Piping supports clips (X or Y dimension and plate weld line to clip end dimension
5. Wind Girder positions and welding joints
6. Curb angle locations
7. Internal and external ladder clips locations

Shell course design details one foot method (example)

Allowable steel stresses:

To keep the selection of shell plate material within the band of **carbon and carbon manganese** weldable steels the maximum allowable design stress which may be used is 260 N/mm2 or two thirds of the material, specified minimum yield strength at room temperature, whichever is the lower. This limit of 260 N/mm'
discourages the use of steels with a minimum specified yield strength in excess of **390 N/mm2, because of their increased hardness and reduced weldability**.

(CL 3.6.3.2, TABLE 3.2 & CL 3.6.1.1 Note:1of API-650)

t_t = 4.9 D (H-0.3)/St - Hydro test thick

t_d = 4.9 D (H-0.3)G/Sd + CA – Design calculated thick.

Shell course (Number from Bottom most)	Considered Material Specification	Ht of Course (m)	Assumed Thickness (mm)	Nominal Tank Dia (m)	Ht from Bottom of Courses to Bottom of overflow nozzle (m)	Sd (Mpa)	(C.A) (mm)	Cal. Thick (mm)	Hydro test Thick (mm)	Provided Ht(m)x Thk.(mm) course
First (Bottom most)	S355 J 2 G 3 FF	2.5	12	36.012	11.719	196	1.5	11.57	9.6	2.5mx12mm
Second	S355 J 2 G 3 FF	2.5	10	36.010	9.219	196	1.5	9.37	7.5	2.5mx10mm
Third	S355 J 2 G 3 FF	2.5	8	36.008	6.719	196	1.5	7.16	5.4	2.5mx8mm
Fourth	S235 JRG 2 FN	1.5	6	36.006	4.219	157	1.5	5.82	4.04	1.5mx6mm
Fifth	S235 JRG 2 FN	1.5	6	36.006	2.719	157	1.5	4.16	2.50	1.5mx6mm
Sixth	S235 JRG 2 FN	1.425	6	36.006	1.219	157	1.5	2.51	0.95	1.425mx6mm

D – Dia of tank
H – Design Liquid level
G – Specific gravity of liquid
Sd – 2/3 of yield stress
2/5 of tensile stress
Less value only taken
St –3/4 of yield stress
3/7 of tensile stress
Less value only taken

Thickness of the bottom course or ring, which is restricted by API 650 to a maximum of **1¾ inch**.

Major Dimensions specified:

1. Overall length
2. Course length
3. circumference length
4. orientation angle
5. between angles length
6. weld to weld distance (longitudinal and circumference) length
7. weld Gap (longitudinal and circumference)
8. Nozzle positions angles and distance
9. Attachments and all types of clips positions and angles
10. welding details should be maintain weld sizes, welding angles, which type of weld should be used
11. part no. in all plates, curb angle, all attachment clips with out nozzle and nozzle pads
12. If any legends there these items also include

BOTTOM PLATE DEVELOPMENT

Bottom Plates

Single-welded full-fillet lap joint or single-welded butt joint with backing strip.

The bottom plates shall project at least 1inch width beyond the outside edge of the weld attaching the bottom to shell plate

1. Bottom plate development drawing
2. Cutting layout drawing
3. plate to plate welding detail
4. three plate welding detail
5. Bottom plate to Annular plate and Back strip welding detail
6. Section Views for plate to plate welding details
7. Bill of materials
8. General Notes

DESIGN OF BOTTOM PLATE:

(CL 3.4.1 of API-650) and BS 2654

Bottom plate thickness = 6mm + C.A

Min plate thickness for **Stainless steel tanks**

Lap welded bottom plate = 5tmm

But welded bottom plate = 3mm

Min plate thickness for **Carbon steel tanks**

Lap welded bottom plate = 6mm

But welded bottom plate = 5mm

DESIGN OF ANNULAR PLATE:

(CL 3.5.3 & Table 3.1 of API-6500)

Hydrostatic Stress $= \frac{4.9 \text{ x D x } (H - 0.3)}{THK}$ **(example)**

$$= \frac{4.9\text{x } 36.012\text{x } (11.719 - 0.3)}{12}$$

= 167.92 < 210 (210 is material allowable stress in design temperature)

Hydrostatic Stress < 210 Mpa

Annular Plate Thickness provided = 12mm

Annular plate width

(CL 3.5.2 of API-650)

Annular plate radial width = $215\ t_b / (HG)^{0.5}$
Min radial width will be maintain 600 mm as per Cl 3.5.2

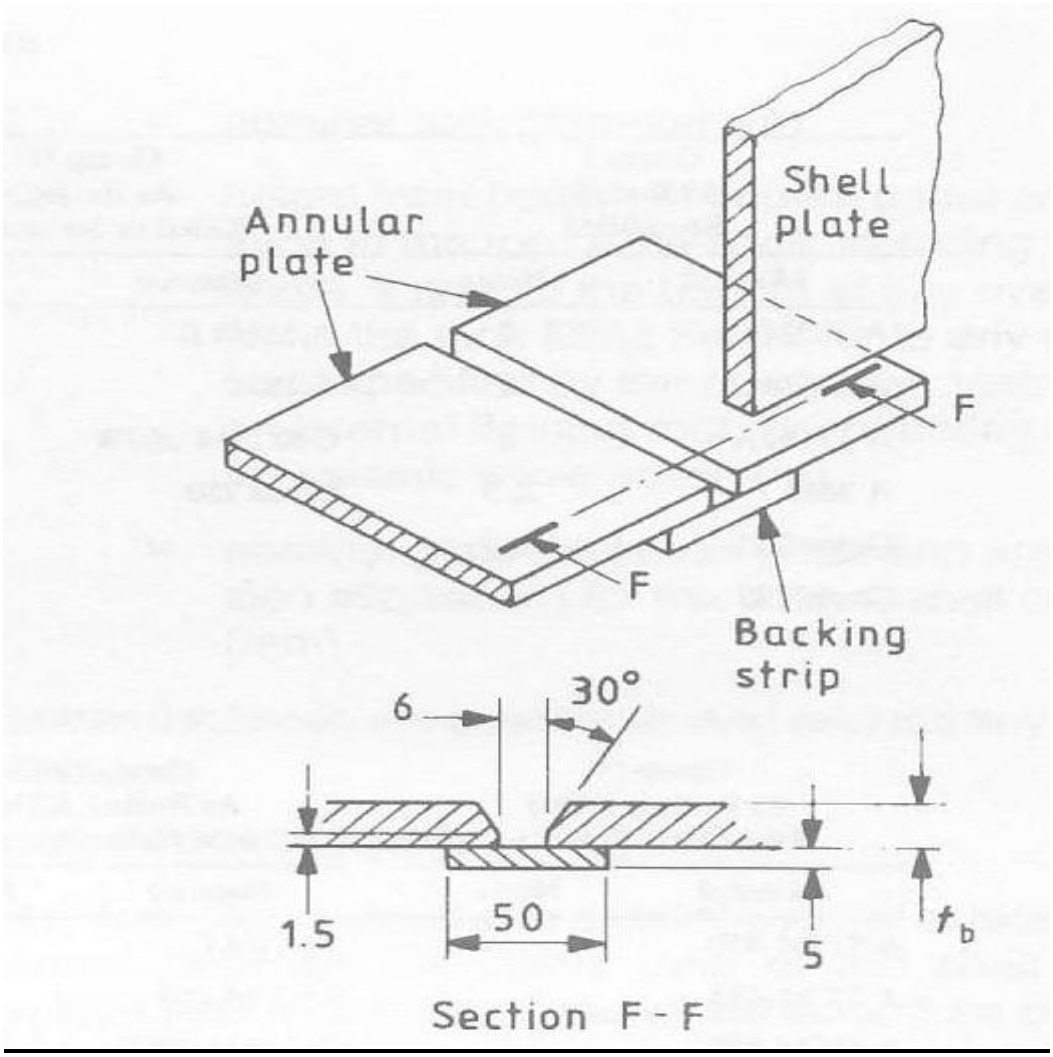
t_b = Thickness of the annular plate in mm

H = Maximum design liquid level

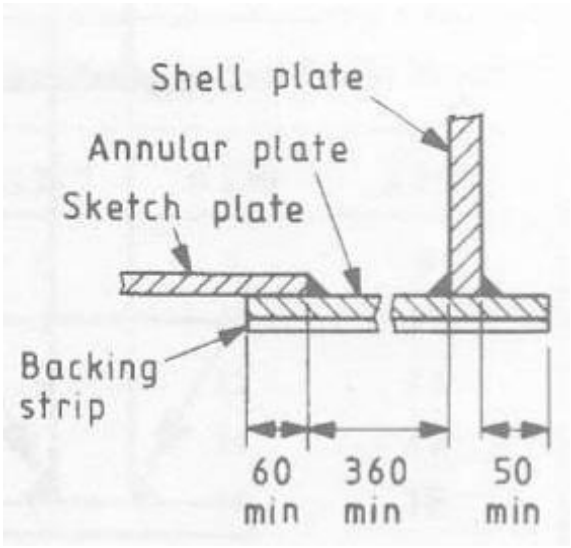
G = Design specific gravity of the liquid to be stored

Major Dimensions specified:

1. Overall developed OD
2. plate course width
3. welding gap
4. Center of Bottom plate to middle plate fixing dimensions(vertical & horizontal)
5. Bottom plate slope
6. Type of weld, welding size and welding angle
7. plate edge preparation dimensions in welding detail
8. If any draw of sump is there that is also put the weld detail


Annular plate
Shell plate
F
F
Backing strip
6
30°
1.5
50
5
t_b

Section F - F


Shell plate
Annular plate
Sketch plate
Backing strip
60 min
360 min
50 min

ROOF PLATE DEVELOPMENT

Roof Plates

Single-welded full-fillet lap joint. Roof plates shall be welded to the top angle of the tank with continuous fillet weld on the top side only.

1. Roof plate development drawing
2. Cutting layout drawing
3. plate to plate welding detail
4. Section Views for plate to plate welding details
5. Bill of materials
6. General Notes
7. Crown plate to Roof plate detail

Types of Roofs

1. Fixed Roof
    1. Cone Roof
    2. Doom Roof
    3. Umbrella Roof
2. External floating roofs
    1. Types of external floating roof
        1. Single-deck pontoon type
        2. Double-deck type
    2 Other types of floating roof
        1. BIPM roof
        2. Buoy roof
3 Internal floating roofs
    1. Types of internal floating roofs
        1. Pan roof
        2. Honeycomb roof
        3. Pontoon and skin roof

DESIGN OF ROOF PLATE:

For CONE

$t = D/400 \sin \theta$
$t = ½$ in (Max)
$\theta = 37$ deg (9:12 slope)
$\theta = 9.28$ deg (2:12 slipe)

Fro DOOM

$t = R/200$ but not lesser than 3/16 in
$t = ½$ in
$R = 0.8\ D$ (min)
$R = 1.2D$ (max)

Unless otherwise specified by the purchaser

(Cl 3.10.2.2 of API-650)

Minimum Thickness of Roof Plate = 5mm + C.A
Considering the Bottom Plate Thickness as 6mm.
Roof plate Thickness provided min = 5mm

Major Dimensions specified:

1. Overall developed OD
2. Plate course width
3. Welding gap

4. Center of Roof plate to middle plate fixing dimensions (vertical & horizontal)
5. Roof plate slope
6. Type of weld, welding size and welding angle
7. Plate edge preparation dimensions in welding detail
8. Roof Nozzles, RF pads, Roof man ways, positions and angles
9. Roof cutting angle
10. Crown plate cutting angle.

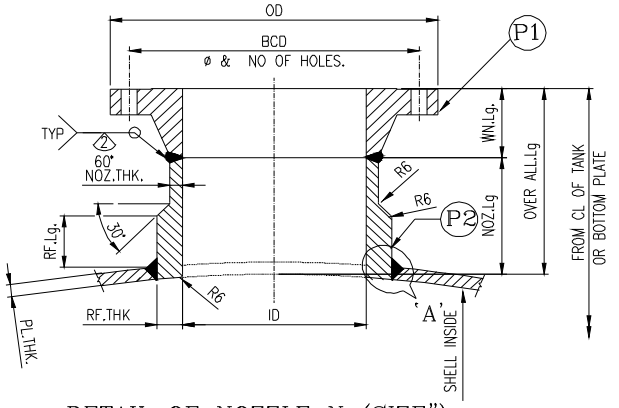
CUTTING ANGLE CALCULATION :

$$(R / r * 360) - 360$$

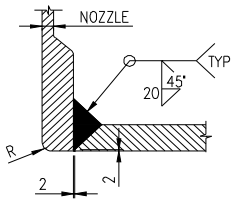
NOZZLE DETAILING

1. Nozzle and Man way weld details
2. Nozzle design as per CL 3.7 in API 650 follow

Reinforce nozzle welding detail (example)

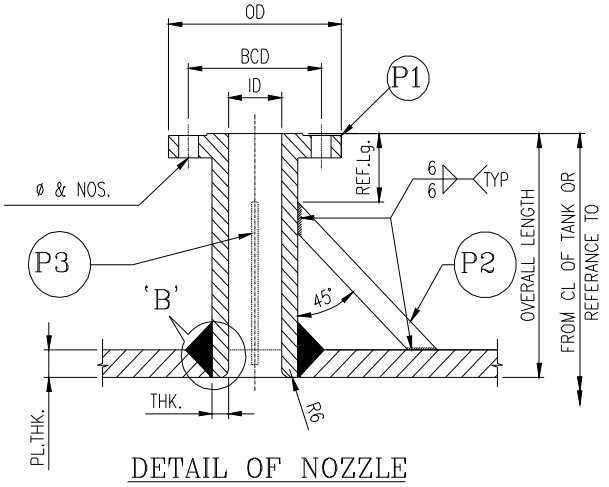


DETAIL OF NOZZLE N (SIZE")

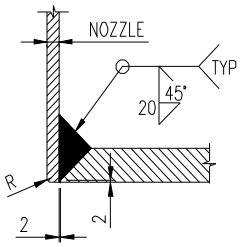


DETAIL 'A'

DETAIL OF LONG WELD NECK NOZZLE & NOZZLE WITH RF PAD

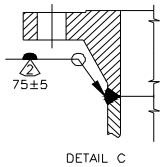


DETAIL OF NOZZLE

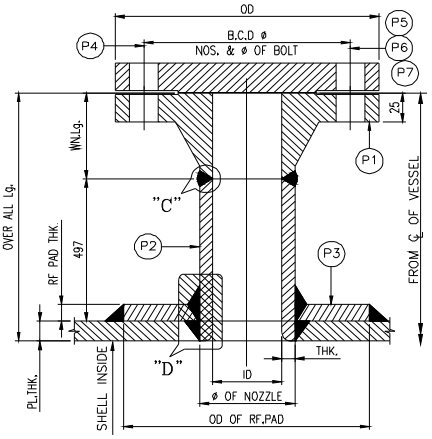


DETAIL 'B'

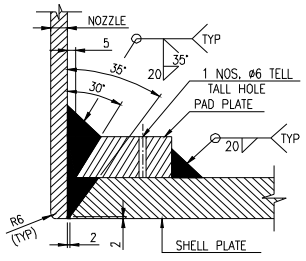
Lesser than 3" and 250 and above lg provide Stiffener plate 2 no apart 90 deg in 45 deg angle



DETAIL C



DETAIL OF NOZZLE



DETAIL D
WITH PAD PLATE
WELDING DETAILS

Manways

The number of manways to be provided are shown in the table below:

TANK NOMINAL DIA. (FT)	MANWAYS IN SHELL	MANWAYS FIXED ROOF	IN ROOF FLOATING ROOF DECK
Up to 20	1 - 24 inch	1 - 24 inch	1 - 30 inch
over 20 to 60	2 - 24 inch	1 - 24 inch	1 - 30 inch
over 60 to 120	3 - 24 inch	1 - 24 inch	2 - 30 inch
over 120	2 - 24 inch 1 - 30 inch	2 - 24 inch	2 - 30 inch

Floating roofs

Types

1. Metallic pan roofs:
These are in contact with the liquid and have peripheral rim

2. Metallic bulkhead roofs:
These are in contact with the liquid and have open – top bulkheads.

3. Metallic pontoon roofs
These are in contact with the liquid and have closed pontoons

4. Metallic double - deck roofs:
These are in contact with the liquid

5. Metallic roof on floats:
These roofs have their deck above the liquid.

6. Metallic sandwich – panel roofs:
These have surface – coated honeycomb panels and are in contact with the liquid

7. Plastic sandwich – panel roofs:
These are surface coated rigid panels and are in contact with the liquid

8. Roof seals design shall:

1. Be sufficiently flexible and have sufficient range of movement to accommodate roof movements and flexing of the roof and tank wall.

2. Remain stable in sunlight, tank liquid, tank vapour etc.

3. Prevent contact between organic materials and the tank contents.

4. Have metallic components galvanised unless otherwise agreed.

5. Ensure contact between seal and shell above liquid level. Shoe type seals to have 90% minimum contact and flexible seal type 100% minimum contact. No gap shall exceed 0.25 inch or be circumferentially longer than 48 inches.

6. Include primary and secondary seals unless otherwise agreed.

7. Include rim seal vents.

8. Sleeves for leg supports shall remain above liquid level when the deck is fully deflected.

9. Internal floating roofs shall comply with API 650 Appendix H except that minimum thickness shall be 6mm for aluminium and stainless steel. Pan type floating roofs shall not be used. Fixed internal ladders are not permitted.

Tank Height to Dia ratio by Sesmic Zone

Sesmic Zone	Max tank height (Height to Dia ratio)
1	2.4:1
2	1.25:1
3	0.67:1
4	0.5:1 (Small tank, soft soil)
4	0.6:1 (large tank, firm soil)

Rectangular Tanks

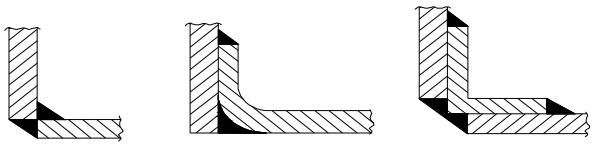
Ratio of sides

The sides are equal

B = 3 root of V
V = Volume

If Rectangular

Length = 1.5 B
Width = 0.667 B



Welding for corer plates (welding size – 0.75 x Thick of min size plate)

Materials selection

Nominal composition	Criteria
C – Steel	Plain Carbon steel
C – Si Steel	Exceed 0.1%Silicon
C – Mn Steel	Exceed 1.0%Mangnese
C – Mo Steel	Carbon with molybdenum added at the midpoint of the Range specified
C – Mn – Si Steel	

I. Selection of Materials for Service Environment

1. Design Factors

Design factors to consider include:

- Operating temperature and pressure
- Service environment
- Cost
- Design life
- Reliability and safety

2. Typical selections
3. Application Criteria for Common Pressure Vessels Materials
4. Summary of Temperature Limitations

II. Selection of Materials for Brittle Fracture Prevention

1. Definition of Brittle Fracture
2. Design to Prevent Brittle Fracture
3. Recommended Practice for Selecting Steels for New Construction of Pressure Vessels
4. Typical Carbon Steel Selections to Avoid Brittle Fracture in Pressure Vessels
5. Steel Selection for Pressure Vessels Subject to Auto refrigeration
6. Factors Controlling Susceptibility to Brittle Fracture: Additional Technical Information

III. Material Selections idias and construction

1. Determine Minimum design metal temperature" (MDMT).
2. Determine Minimum pressuring temperature" (MPT)
3. Maximum allowable stress values shall be in accordance with the API Standard, section 3.6.2 Table 3.2.
4. For austenitic stainless steel tanks the allowable stress shall be to the rules of API 620 Appendix Q
5. Annular bottom plates shall be to the same material specification and grade as the bottom shell course.
6. Cast fittings shall not be used in the shell or bottom of the tank
7. For stainless steel tanks to API rules, the material specifications and allowable stress rules of API 620 Appendix Q shall be used.
8. Corrosion allowance shall be added to the minimum annular plate thicknesses of API 650 Table 3-1.
9. Minimum thicknesses of internal structural members shall be 6mm plus corrosion allowance.
10. Wind girders on floating roof tanks shall be 3 feet 6 inches below the top of the curb angle and shall have a minimum width of 18 inches outside the curb angle. If used as a walkway the girder shall comply with API 650 paragraph 3.9.4.
11. For stainless steel tanks the wind girder section modules of API 650 shall be multiplied by 21000/S, where S is the stainless steel design stress (psi).
12. Fixed roof API 650 tanks shall have a frangible joint between the top angle and the roof plates.
13. For fixed roof pressurised design to API 650 Appendix F the area formula in F.5. shall also be multiplied by 24000/S, for stainless steel design.
14. For Floting roof Bearing plates 0.375 inches thick shall be provided under each support leg.
15. For Floting roof Thickness of the outer rim shall be 0.25 inches plus corrosion allowance minimum.
16. Roof decks shall be continuously welded from the top side and pontoon bulkheads shall be welded at the top to be vapour tight.

17. A continuous foam dam shall be provided on tanks 100 feet diameter and over. The dam shall be of 0.187 inch plate and shall be to NFPA No. 11 Appendix A-3.2.11.1.

Information to be specified by the purchaser

1 The following basic information to be specified bythe purchaser shall be fully documented. Both the definitive requirements specified throughout the Standard and the documented items shall be satisfied before a claim of comoliance with the Standard can be made and verified.

2 (a) Geographical location of the tank.

3 (b) Diameter and height or the capacity of the tank, including ullage. Where only the capacity of the tank is specified

4 Ground conditions shall be included.

5 (c) Whether fixed or floating roof into be supplied and the type of roof if the purchaser has specific preferences, i.e. for Fixed roofs (cone, dome, membrane, etc.) or floating roofs (pontoon, double deck, etc.).

6 (d) All relevant properties of the contained fluid, including the relative density and corrosion allowance (if, how and Where required).

7 (e) The design vapor pressure and vacuum conditions inside the tank

8 (f) The minimum and maximum design metal temperatures

9 (g) The size, number and type of all mountings required showing locations. Maximum filling and emptying rates And any special venting arrangement

10 (h) The minimum depth of product which is always present in the tank

11 (i) If the tank is to be thermally insulated

12 0) Areas of responsibility between the designer, the manufacturer and the erector ofthe tank when these are not the same.

13 (k) Quality ofthe water to be used during tank water test

14 (l) Expected maximum differential settlements during water testing and service lifetime of the tank (see AppendixA).

15 (m) Other specifications which are to be read in conjunction with this Standard.

For Refernece

1. Guide to storage tanks and equipment design by: Bob Long and Bob Garner
2. API 650 Standard

Prepared by

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