

	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید مخازن ذخیره گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0026_00)								
	Mechanical Calculation Book For Elevated Potable Water Tank (TK-2209)								
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طرح نگهداشت و افزایش تولید 27 مخزن

Mechanical Calculation Book For Potable Water Tank (TK-2209)

نگهداشت و افزایش تولید میدان نفتی بینک

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IFA: Issued For Approval

IFI: Issued For Information

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1) INTRODUCTION

Binak oilfield in Bushehr province is a part of the southern oilfields of Iran, is located 20 km northwest of Genaveh city. With the aim of increasing production of oil from Binak oilfield, an EPC/EPD Project has been defined by NIOC/NISOC and awarded to Petro Iran Development Company (PEDCO). Also, PEDCO (as General Contractor) has assigned the EPC-packages of the Project to "Hirgan Energy - Design and Inspection" JV.

GENERAL DEFINITION:

The following terms shall be used in this document.

CLIENT: National Iranian South Oilfields Company (NISOC)

PROJECT: Binak Oilfield Development – Manufacturing (w/Engineering & Material Supply) of Gas Dehydration Package.

EPD/EPC CONTRACTOR (GC): Petro Iran Development Company (PEDCO)

EPC CONTRACTOR/PURCHASER: Joint Venture of: Hirgan Energy – Design & Inspection Companies (HE/DI)

VENDOR: iDrill Middle East (iDrill M.E)

Purpose:

The purpose of this technical document is to provide the Mechanical Calculations for Elevated Potable Water Tank.

Note:

to check the calculations related to the structure, refer to the document "STRUCTURE CALCULATION FOR ELEVATED POTABLE WATER TANK (TK-2209)(BK-GCS-IDR-120-ST-CN-0003)"

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2)DESIGN DATA

DATA		UNIT	Remark														
GENERAL & PROCESS DATA																	
Item			TK-2209														
Fluid			POTABLE WATER TANK														
Design Code			API 650/AWWA D100a-11														
Nominal / Working Capacity		m ³	25 / 20														
Dimension	Internal Dia.	mm	3500														
	Height	mm	2600														
Density		kg/m ³	1000														
Design Pressure		barg	ATM + FULL OF WATER														
Design Temperature		°C	85														
Test Pressure		barg	ATM + FULL OF WATER														
Joint Efficiency		-	0.85														
Seismic Design:Design Code/Site Class/Import.Factor/Fa/Fv/Ss/S1		-	ASCE7-10/D/1.25/1/1.33/1.125/0.46														
Wind Design: Design Code/Wind Speed		-/Km/hr	ASCE7-10 / 232														
Corrosion Allowance Sheel& Bottom / Roof / Structure		mm	1.6 / 1.6 / 1.6														
Design Liquid Level (H):		mm	2250														
Materials																	
Bottom /F _y /Class		Mpa	A-283 Gr.C/103.4/0														
Roof/F _y /Class		Mpa	A-283 Gr.C/103.4/0														
Shell/F _y /Class		Mpa	A-283 Gr.C/103.4/0														
Table 3 Material classes <table><tr><th rowspan="2">Class</th><th colspan="2">F_y[*]</th></tr><tr><th>psi</th><th>(MPa)</th></tr><tr><td>0</td><td>F_y < 27,000</td><td>(F_y < 186.2)</td></tr><tr><td>1</td><td>27,000 ≤ F_y ≤ 34,000</td><td>(186.2 ≤ F_y ≤ 234.4)</td></tr><tr><td>2</td><td>F_y > 34,000</td><td>(F_y > 234.4)</td></tr></table> [*]Where F_y is the published minimum yield strength.				Class	F _y [*]		psi	(MPa)	0	F _y < 27,000	(F _y < 186.2)	1	27,000 ≤ F _y ≤ 34,000	(186.2 ≤ F _y ≤ 234.4)	2	F _y > 34,000	(F _y > 234.4)
Class	F _y [*]																
	psi	(MPa)															
0	F _y < 27,000	(F _y < 186.2)															
1	27,000 ≤ F _y ≤ 34,000	(186.2 ≤ F _y ≤ 234.4)															
2	F _y > 34,000	(F _y > 234.4)															

2.2.3.1.3 ASTM A283, grade A steel is to be used only for nonstructural items such as clips, roof sheets, and other low-stressed components less than 1 in. (25 mm) thick. Grade B and C shell plates are limited to a thickness of 1 in. (25 mm) when tension stress governs and 1 ½ in. (38 mm) when compression stress governs. Grade D shell plates are limited to a thickness of ¾ in. (19 mm).



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3)Shell Thickness

Shell Thickness Of The Tank As Per Para 3.7 & Table 3-14 Should Be Calculated As Follow:

h_{TCL} :	The height of liquid from top capacity level to the bottom of shell in Meter=	2.25	m
h_p :	The height of liquid from top capacity level to the bottom of shell course being designed in Meter	2.25	m
h_{co1} :	The height of shell course no.#1 in Meter	2	m
h_{co2} :	The height of shell course no.#2 in Meter	0.6	m
D:	The nominal Tank Diameter in Meter	3.5	m
G:	Product Specific gravity (1 For water)	1	
E:	Joint Efficiency	0.85	
S:	Allowable Design Stress @design temperature in Mpa	103.4	Mpa
C.A:	Corrosion Allowance Shell	1.6	mm
	Corrosion Allowance Bottom	1.6	mm
	Corrosion Allowance Roof	1.6	mm
t_d :	The required design shell plate thickness in Millimeter		mm

3.1)Shell course no.#1 thickness calculation for design condition

h_{co1} :	The height of shell course no.#1 in Meter	2	m
h_{p1} :	The height of liquid from top capacity level to the bottom of shellcourse no.#1 in Meter	2.25	m
$t_{d-co\#1}$ =	$(4.9 \times h_{p1} \times D \times G) / (S \times E) + G$	2.04	mm
Minimum thickness as per section 3-10 & Table 16 is 6.35 millimeter + C.A.		7.95	mm

3.2)Shell course no.#1 thickness calculation for test condition

h_{co1} :	The height of shell course no.#1 in Meter	2	m
h_{hw1} :	The height of hydrotest water from top of shell to the bottom of shell course no. 1 in Meter	2.25	m
$t_{t-co\#1}$ =	$(4.9 \times h_{hw1} \times D \times G) / (S \times E) + G$	2.1	mm
Selected thickness for co. no, #1		8	mm

3.3)Shell course no.#2 thickness calculation for design condition

h_{co2} :	The height of shell course no.#2 in Meter	0.6	m
h_{p2} :	The height of hydrotest water from top of shell to the bottom of shell course no. #2 in Meter	0.25	m
$t_{d-co\#2}$ =	$(4.9 \times h_{p2} \times D \times G) / (S \times E) + G$	1.6	mm
Minimum thickness as per section 3-10 & Table 16 is 6.35 millimeter + C.A.		7.95	mm

3.4)Shell course no.#2 thickness calculation for test condition

h_{co2} :	The height of shell course no.#2 in Meter	0.6	m
h_{hw2} :	The height of hydrotest water from top of shell to the bottom of shell course no. #2 in Meter	2.25	m
$t_{t-co\#2}$ =	$(4.9 \times h_{hw2} \times D \times G) / (S \times E) + G$	2.1	mm
Selected thickness for co. no, #2		8	mm



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4)Bottom Plate

Minimum Thickness of bottom plate as per article 3-10 of AWWA -D100 -11 is 6.35 millimeter except corrosion allowance

$$t_b = 7.95 \text{ mm}$$

Selected thickness for Bottom Plates = 8 mm

5)Roof Plate

Minimum Thickness of Roof plate as per article 3.10.2 of AWWA -D100 -11 is 4.76 millimeter except corrosion allowance

$$t_r = 6.36 \text{ mm}$$

Selected thickness for Bottom Plates = 8 mm



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6) Tank Capacity:

Maximum Tank Capacity Is The Volume Of Product In A Tank When The Tank Is Filled To Its Design Liquid Level As:

Design Liquid Level (H): 2.25 m

Tank Diameter (ID): 3.5 m

Minimum Capacity 21.6 m³

7) Water Load:

ID Inside Diameter Of Tank: 3500 mm

H_s Tank Shell Height: 2600 mm

ID Conical Bottom Diameter: 3500 mm

α Conical Bottom Angel: 32 °

H_{cl} Conical Bottom Height: 1094 mmro Water Specific Gravity: 1000 Kg/m³

Mw Water mass: 26,908 kg

Fwa Water Load: 263,967 N

8) Snow Load

β Maximum Angel For The Roof 17 °

H_{cu} Conical Roof Height 535 mmAr Surface Area Of The Roof Cone 9.2 m²M_{SA} Minimum Snow Load 1,205 N/m² AS PER CODE PARA 3.1.3.1M_s Snow Mass 1,131 kgF_s Snow Load 11,087 N

9) Wind Load

P_{cy} Wind Pressure Load On Cylindrical 18 lb/sq. ft → 862 N/m² AS PER CODE PARA 3.1.4P_{co} Wind Pressure Load On Cones 15 lb/sq. ft → 718 N/m² AS PER CODE PARA 3.1.4W_v Wind Velocity 232 Km/hr → 65 m/s → 145.5 mphA_{cy} Projected Areas Of Cylinder Shell 9.1 m²A_{cu} Projected Areas Of Upper Cone 1.9 m²A_{cl} Projected Areas Of Lower Cone 3.8 m²F_{wi} Total Force Act On Tank 11,937 N This Force Act On The Center Of Gravity Of The Tank (PARA 3.1.4.2)

10) Body Load

10.1) Shall Weight= 1795 kg → 17612 N

10.2) Bottom Weight= 240 kg → 2358 N

10.3) Roof Weight= 118 kg → 1154 N

Sum: 2153 kg → 21124 N