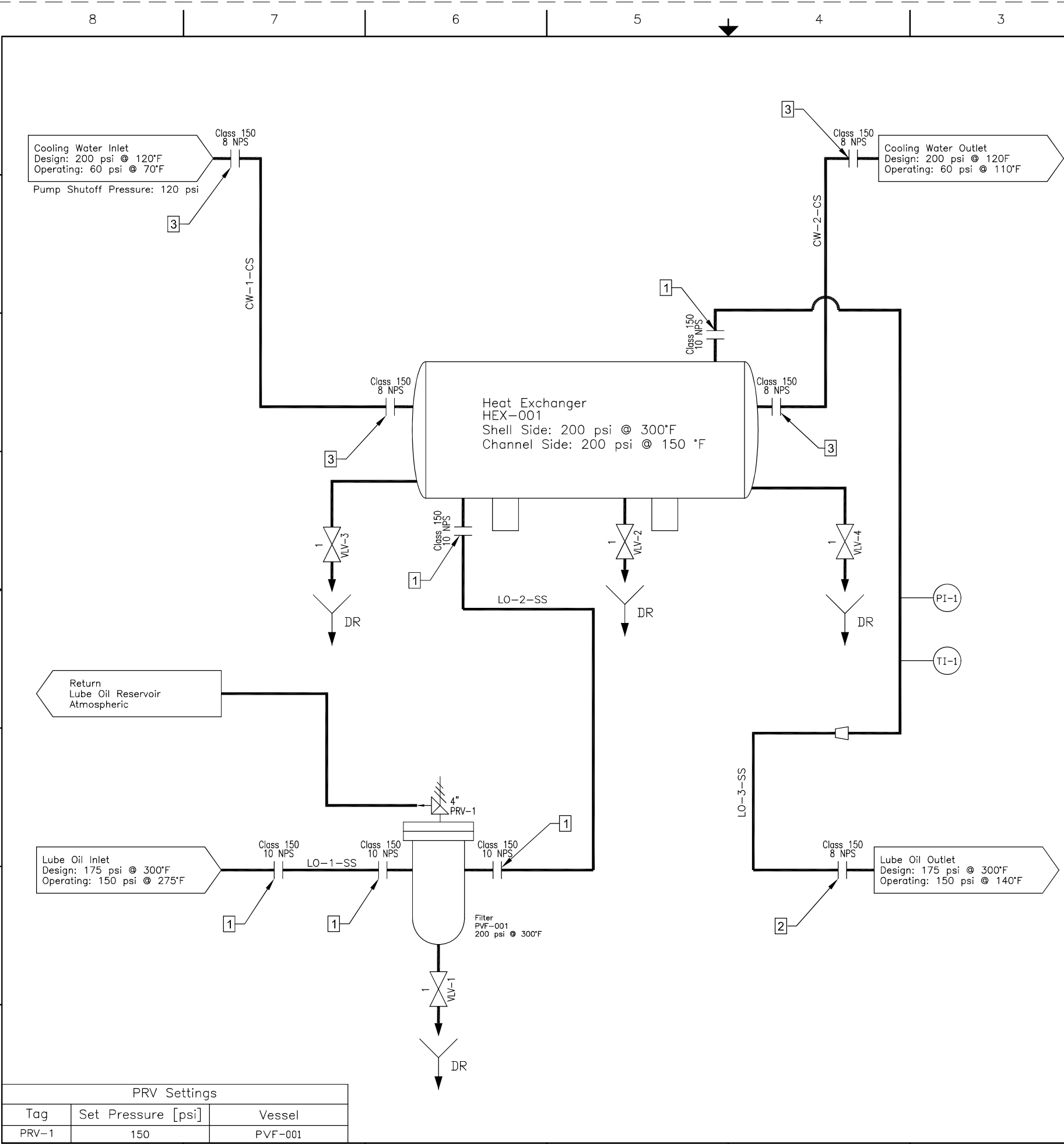




DESIGN DATA			
DESIGN CODE:	ASME B31.3 2012 Edition		
INTERNAL: DESIGN PRESSURE & TEMPERATURE:	Refer to line list 6950-Inst		
EXTERNAL: DESIGN PRESSURE & TEMPERATURE:	Refer to line list 6950-Inst		
HYDRO TEST PRESSURE AND TEMPERATURE:	Refer to line list 6950-Inst		
MDMT:	Refer to line list 6950-Inst		
CORROSION ALLOW.:	Refer to line list 6950-Inst		
PWHT:	None		
RADIOGRAPHY:	5%		
IMPACT TEST REQUIRED OR EXEMPTION:	323.2.2		
SEISMIC CODE:	N/A	WIND CODE:	N/A
MEDIUM:	Lube Oil and Water	CAPACITY:	N/A
WEIGHT EMPTY:	N/A	WEIGHT FULL:	N/A

- NOTES:
1. PIPING INSTALLER TO BE TSSA CERTIFIED
 2. ALL CONNECTIONS ARE FULL PENETRATION WELDS, UNLESS OTHERWISE SPECIFIED
 3. ALL WELDS SHALL BE NEAT IN APPEARANCE, FREE OF SLAG AND OTHER DEFECTS
 4. ALL PIPING TO SUPPORT NOMINAL LOADS ONLY
 5. ALL FITTINGS CONFORM TO B16.9 STANDARDS
 6. ALL FLANGES CONFORM TO B16.5 STANDARDS
 7. FLANGE BOLT HOLES TO STRADDLE NATURAL CENTERLINES
 8. ALL FITTINGS REQUIRE CRN CERTIFICATION FOR THE PROVINCE OF ONTARIO
 9. REFER TO 6950-Inst FOR THE PIPING LINE LIST
 10. REFER TO PVEDwg-6950-1.0 FOR PIPE SPOOL DRAWINGS

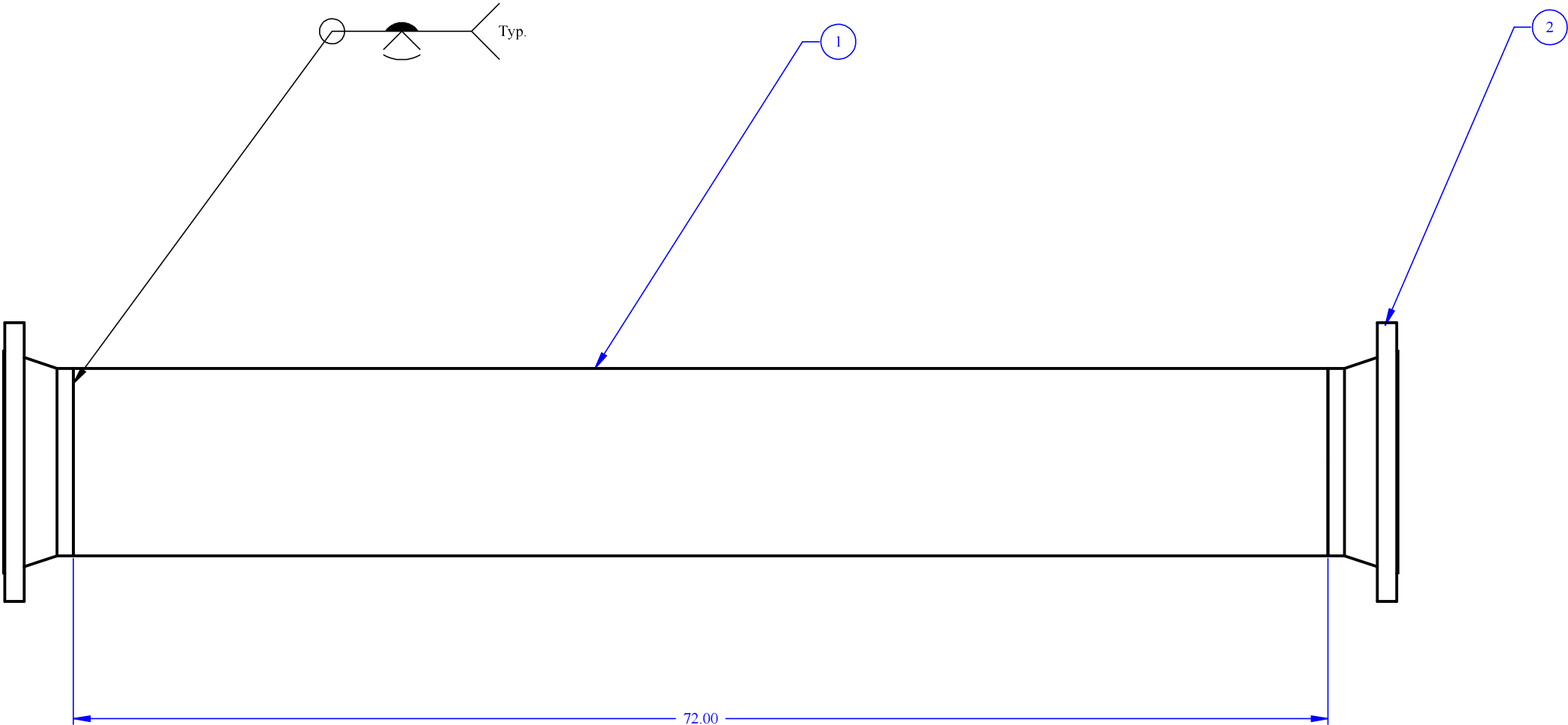
BILL OF MATERIALS			
Item	Qty.	Description	Material
1	60	7/8-9 UNC Studs x 5" Lg.	A-193 B7
	120	7/8-9 UNC Heavy Hex Nuts	A-194 2H
	5	NPS 10 Class 150 Spral Wound Gasket	304SS
2	8	3/4-10 UNC Studs x 4" Lg.	A-193 B7
	16	3/4-10 UNC Heavy Hex Nuts	A-194 2H
	1	NPS 8 Class 150 Spiral Wound Gasket	304SS
3	32	3/4-10 UNC Studs x 4" Lg.	A-193 B7
	64	3/4-10 UNC Heavy Hex Nuts	A-194 2H
	4	NPS 6 Class 150 Spral Wound Gasket	304SS

0	Release			10/17/13	CBM
REV	DESCRIPTION			DATE	INITIALS
REVISION HISTORY					
				Pressure Vessel Engineering Ltd 120 Randall Drive, Suite B Waterloo, Ontario, Canada N2V 1C6	
				www.pveng.com info@pveng.com Tel. 519-880-9808 Fax 519-880-9810	
TITLE					
Lube Oil Cooler					
SIZE	JOB NO	DRAWING NO			REV
C	PVE-6950	PVEpid-6950-1.0			0
SCALE	MATERIAL		SHEET		
NTS				1 of 1	
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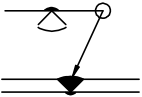
BILL OF MATERIALS			
ITEM	QTY	DESCRIPTION	MATERIAL
1	1	Pipe: 10 NPS Sch 40 Seamless	A-312 TP304
2	2	Flange: NPS 10 Class 150 RFWN Sch 40 Bore	A-182 F304

NOTES:

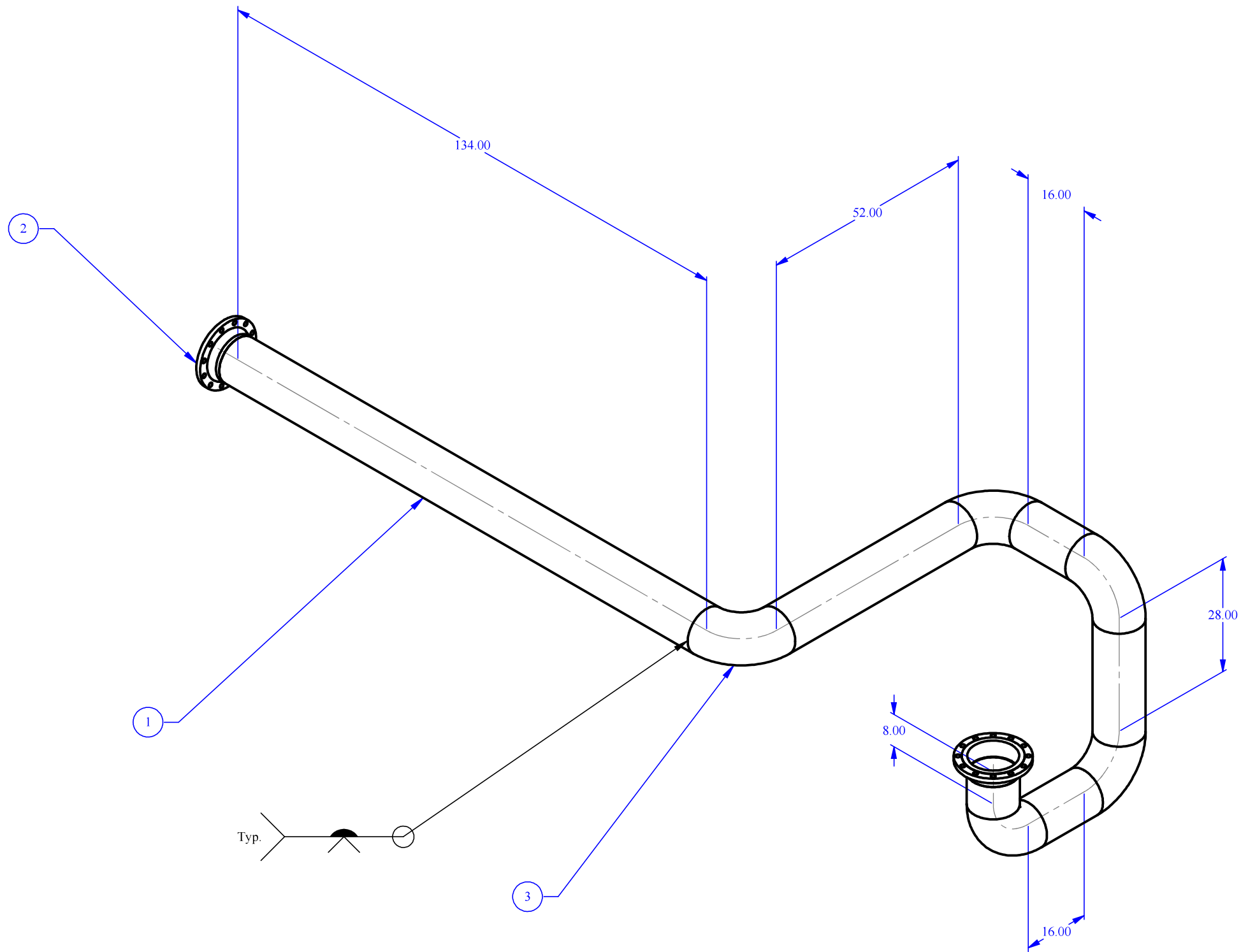
1. All dimensions in inches.
2. All welds shall be neat in appearance, free from slag and other defects.
3. Vessel to be cleaned of scale, oil,weld spatter and all other foreign material, prior to hydrostatic test.
4. Remove all sharp edges on nozzles (1/8" minimum radius)
5. Pipe to support nominal loads only.
6. Maximum misalignment of butt joints is limited to .25T
7. All fittings conform to B16.9 standards.
8. All flanges to conform to B16.5 standards.
9. Flange bolt holes to straddle natural centre lines.



REVISIONS					
REV.	REVISION HISTORY		DATE	DRW	CHK
0	Release		17-Oct-13	CBM	JLL
PV Eng Pressure Vessel Engineering, Ltd. 120 Randall Drive, Suite B Waterloo, Ontario, Canada N2V 1C6 www.pveng.com info@pveng.com Tel. 519-880-9808 Fax 519-880-9810					
Title					
LO-1-SS					
Size	Job ID		Drawing No.		Revision:
B	PVE-6950		PVEdwg-6950-1.0		0
Scale	Material			Sheet	
1:8	See BOM			1 OF 5	
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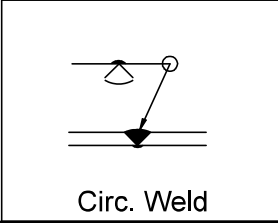
Circ. Weld



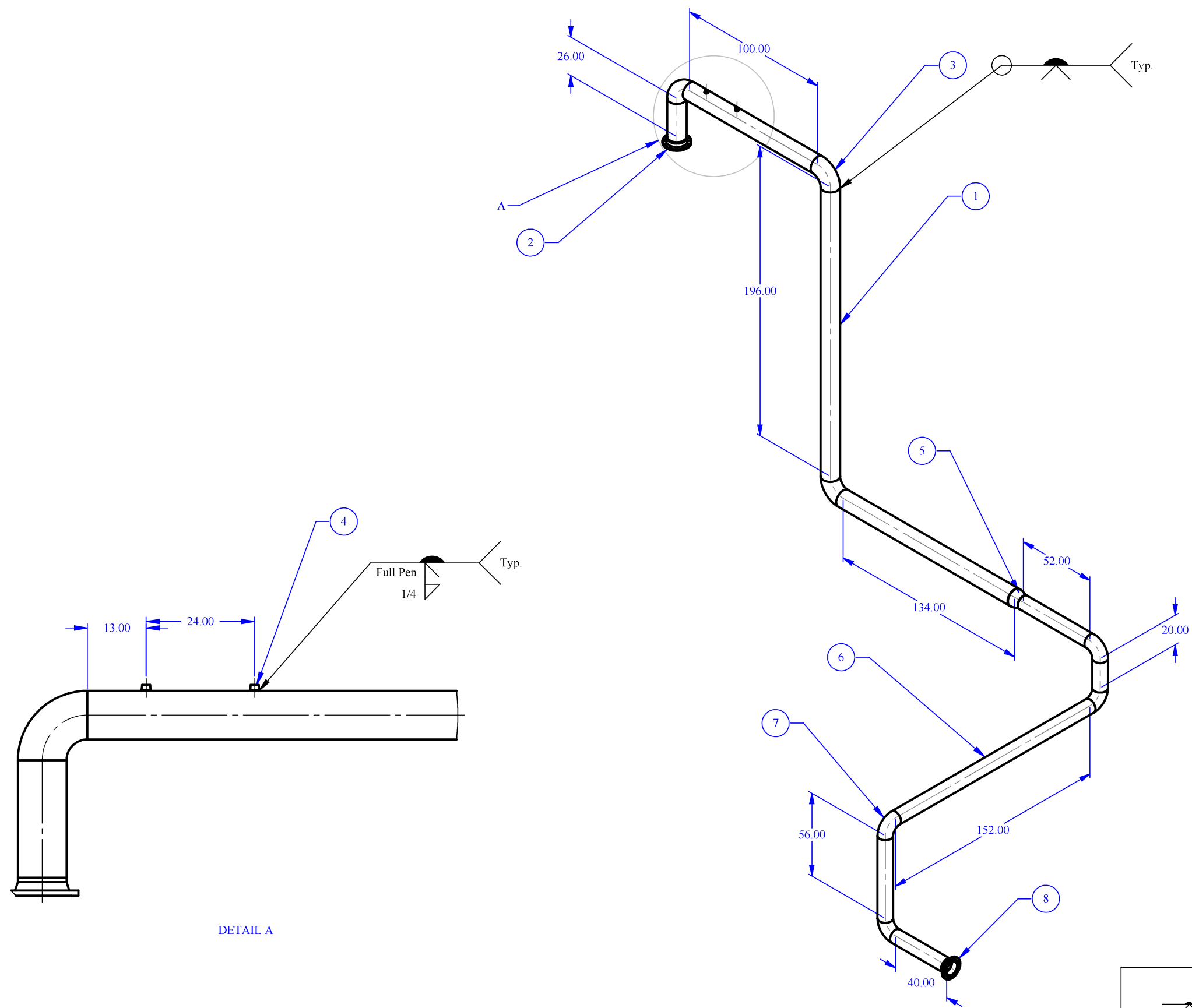
BILL OF MATERIALS			
ITEM	QTY	DESCRIPTION	MATERIAL
1	6	Pipe: 10 NPS Sch 40 Seamless	A-312 TP304
2	2	Flange: NPS 10 Class 150 RFWN Sch 40 Bore	A-182 F304
3	5	LR Elbow: 10 NPS Sch 40	A-403 WP304

NOTES:

1. All dimensions in inches.
2. All welds shall be neat in appearance, free from slag and other defects.
3. Vessel to be cleaned of scale, oil, weld spatter and all other foreign material, prior to hydrostatic test.
4. Remove all sharp edges on nozzles (1/8" minimum radius)
5. Pipe to support nominal loads only.
6. Maximum misalignment of butt joints is limited to .25T
7. All fittings conform to B16.9 standards.
8. All flanges to conform to B16.5 standards.
9. Flange bolt holes to straddle natural centre lines.



PV Eng Pressure Vessel Engineering, Ltd. 120 Randall Drive, Suite B Waterloo, Ontario, Canada N2V 1C6 www.pveng.com info@pveng.com Tel. 519-880-9808 Fax 519-880-9810			
Title LO-2-SS			
Size B	Job ID PVE-6950	Drawing No. PVEdwg-6950-1.0	Revision: 0
Scale 1:24	Material See BOM	Sheet 2 OF 5	
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DETAIL A

BILL OF MATERIALS

ITEM	QTY	DESCRIPTION	MATERIAL
1	4	Pipe: 10 NPS Sch 40 Seamless	A-312 TP304
2	1	Flange: NPS 10 Class 150 RFWN Sch 40 Bore	A-182 F304
3	3	LR Elbow: 10 NPS Sch 40	A-403 WP304
4	2	Threadolet: NPS 10x1 Class 3000	A-182 F304
5	1	Concentric Reducer: NPS 10x8 Sch 40	A-403 WP304
6	5	Pipe: 8 NPS Sch 40 Seamless	A-312 TP304
7	4	LR Elbow: 8 NPS Sch 40	A-403 WP304
8	1	Flange: NPS 8 Class 150 RFWN Sch 40 Bore	A-182 F304

NOTES:

1. All dimensions in inches.
2. All welds shall be neat in appearance, free from slag and other defects.
3. Vessel to be cleaned of scale, oil,weld spatter and all other foreign material, prior to hydrostatic test.
4. Remove all sharp edges on nozzles (1/8" minimum radius)
5. Pipe to support nominal loads only.
6. Maximum misalignment of butt joints is limited to .25T
7. All fittings conform to B16.9 standards.
8. All flanges to conform to B16.5 standards.
9. Flange bolt holes to straddle natural centre lines.

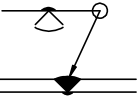
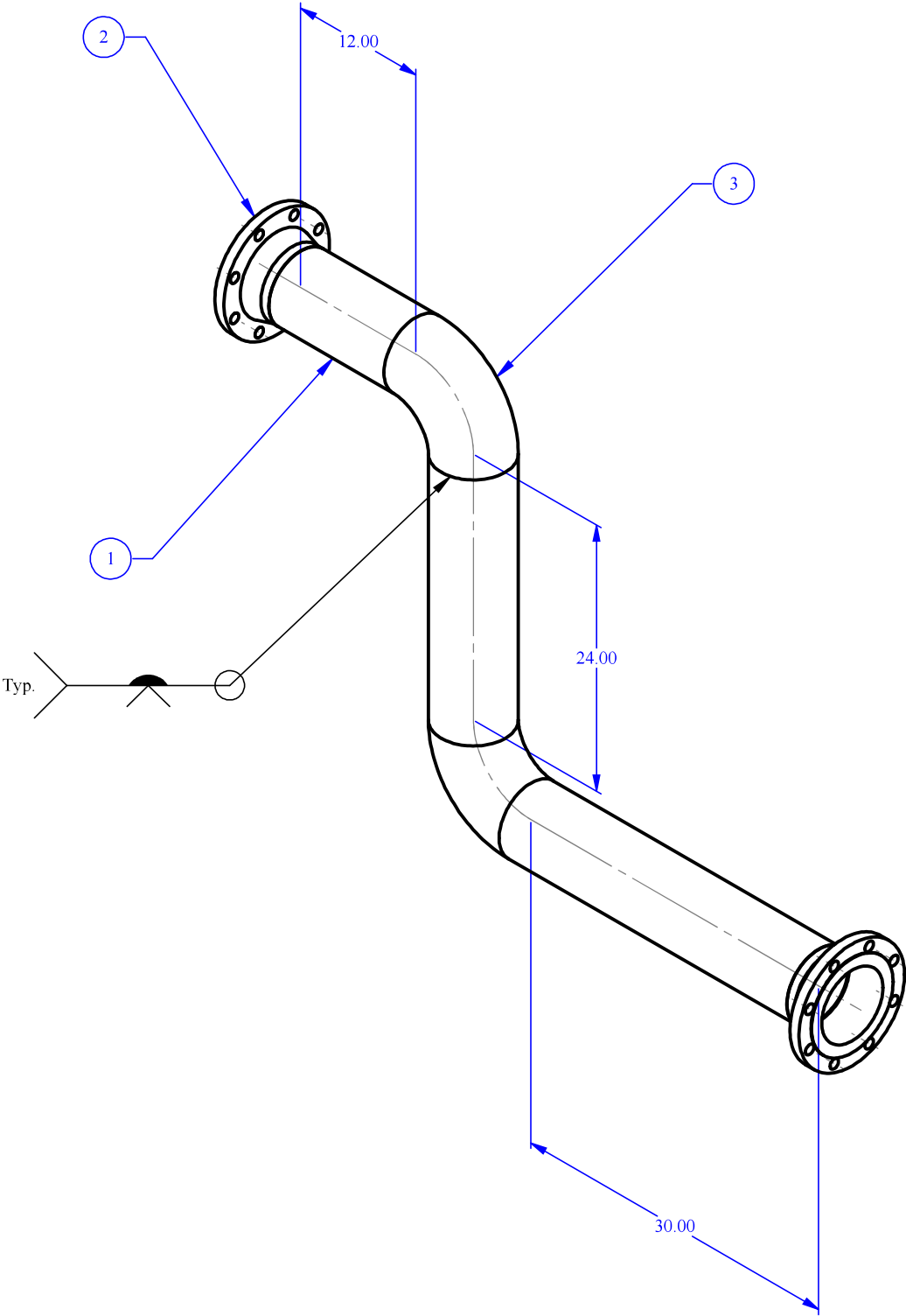
PV Eng Pressure Vessel Engineering, Ltd.
120 Randall Drive, Suite B
Waterloo, Ontario, Canada
N2V 1C6
www.pveng.com
info@pveng.com
Tel. 519-880-9808
Fax 519-880-9810

Title LO-3-SS			
Size B	Job ID PVE-6950	Drawing No. PVEdwg-6950-1.0	Revision: 0
Scale 1:60	Material See BOM	Sheet 3 OF 5	
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BILL OF MATERIALS			
ITEM	QTY	DESCRIPTION	MATERIAL
1	3	Pipe: 6 NPS Sch 40	A-106 B
2	2	Flange: NPS 6 Class 150 RFWN Sch 40 Bore	A-105
3	2	LR Elbow: NPS 6 Sch 40	A-234 WPB

NOTES:

1. All dimensions in inches.
2. All welds shall be neat in appearance, free from slag and other defects.
3. Vessel to be cleaned of scale, oil,weld spatter and all other foreign material, prior to hydrostatic test.
4. Remove all sharp edges on nozzles (1/8" minimum radius)
5. Pipe to support nominal loads only.
6. Maximum misalignment of butt joints is limited to .25T
7. All fittings conform to B16.9 standards.
8. All flanges to conform to B16.5 standards.
9. Flange bolt holes to straddle natural centre lines.



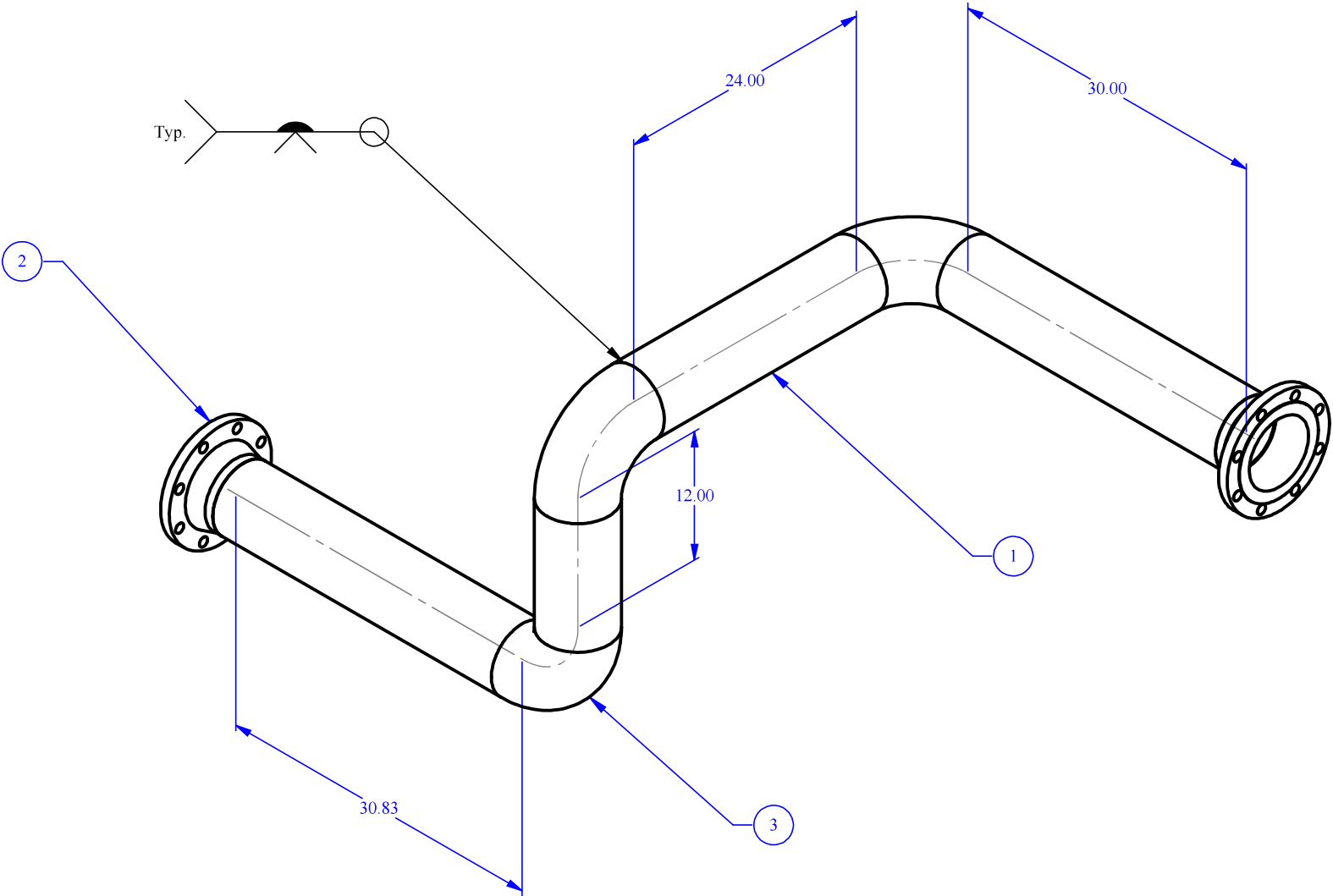
Circ. Weld

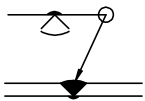
PV Eng		Pressure Vessel Engineering, Ltd. 120 Randall Drive, Suite B Waterloo, Ontario, Canada N2V 1C6	www.pveng.com info@pveng.com Tel. 519-880-9808 Fax 519-880-9810
Title			
CW-1-CS			
Size	Job ID	Drawing No.	Revision:
B	PVE-6950	PVEdwg-6950-1.0	0
Scale	Material		Sheet
1:12	See BOM		4 OF 5
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BILL OF MATERIALS			
ITEM	QTY	DESCRIPTION	MATERIAL
1	4	Pipe: 6 NPS Sch 40	A-106 B
2	2	Flange: NPS 6 Class 150 RFWN Sch 40 Bore	A-105
3	3	LR Elbow: NPS 6 Sch 40	A-234 WPB

NOTES:

- 1. All dimensions in inches.
- 2. All welds shall be neat in appearance, free from slag and other defects.
- 3. Vessel to be cleaned of scale, oil,weld spatter and all other foreign material, prior to hydrostatic test.
- 4. Remove all sharp edges on nozzles (1/8" minimum radius)
- 5. Pipe to support nominal loads only.
- 6. Maximum misalignment of butt joints is limited to .25T
- 7. All fittings conform to B16.9 standards.
- 8. All flanges to conform to B16.5 standards.
- 9. Flange bolt holes to straddle natural centre lines.





Circ. Weld



Pressure Vessel Engineering, Ltd.
120 Randall Drive, Suite B
Waterloo, Ontario, Canada
N2V 1C6

www.pveng.com
info@pveng.com
Tel. 519-880-9808
Fax 519-880-9810

Title CW-2-CS			
Size B	Job ID PVE-6950	Drawing No. PVEdwg-6950-1.0	Revision: 0
Scale 1:12	Material See BOM	Sheet 5 OF 5	
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Pressure Vessel Engineering Ltd.

ASME Calculations - CRN Assistance - Vessel Design - Finite Element Analysis

Design Conditions

Code: **ASME B31.3**

Year: **2012**

Addenda: -

MAWP: **200** psi

MEAWP: **0** psi

Max. Temp.: **120** °F

MDMT: **32** °F

MDMT Press.: **200** psi

Corrosion Allowance: **0.0625** in

Hydrotest: **301** psi

Impact Testing: **None**

Impact Exemption: **323.2.2**

Radiography: **5%**

301 Loads Considered

(301.2) Design Pressure: **Yes**

(301.3) Design Temperature: **Yes**

(301.4) Ambient Effects: **No**

(301.5) Dynamic Effects: **No**

(301.6) Weight Effects: **No**

301.7) Thermal Expansion Effects: **No**

(301.8) Support Effects: **No**

(301.9) Reduced Ductility Effects: **No**

(301.10) Cyclic Effects: **No**

(301.11) Air Condensation Effects: **No**

ASME B31.3 Piping Calculations

Cust: **Pressure Vessel Engineering**

File: **PVEclc-6950-2.0**

Desc: **Cooling Water Piping**

Dwg: **PVEpid-6950-1.0**

Date: **October 17, 2013**

Author: **Cameron Moore**

Reviewer: **Laurence Brundrett, P. Eng.**

Conclusion: The cooling water piping has been calculated to ASME B31.3. and is found to be acceptable for the given pressure and temperature ratings.

Table of Contents

Description	Page	Description	Page
Cover	1	8 inch Pipe	4
Table of Contents	2	8 inch Elbow	5
Material Properties	3	CI 150 Flange	6

	Author	Reviewer
Drawing:	CBM	JLL
Calculation Method:	CBM	JLL
Calculation Results:	CBM	JLL

Revision(s)			
Rev	Description	Date	By
0	Release	17-Oct-13	CBM

Cooling Water Piping <- Description**Design Pressure:****200.0** <- P, internal operating pressure at top of vessel (psig)**0.0** <- mPa, external operation pressure**Water** <- Operating Fluid**3** <- h, fluid height (ft)**1.000** <- rho, fluid density (1.0 for water)**Static Head** = $0.4331 \cdot \rho \cdot h$ = $0.4331 \cdot 1 \cdot 3$ **sH** = **1.3****Design Pressure** = $P + sH$ = $200 + 1.3$ **mDp** = **201.3****Hydro Test** (ASME B31.3-2008 - 345.4.2)**Test Pressure** = $1.5 \cdot mDp \cdot MR - sH$ = $1.5 \cdot 201.3 \cdot 1 - 1.3$ **mTp** = **301****Material Properties** (ASME B31.3 Table A-1)**120** <- mTemp, design temp °F

Test at ambient temp

Material	Where Used	Ambient Strength	Design Strength	Strength Ratio	Max °F	Ext Graph
CS Spec A-106 Gr-B pipes & tubes	Pipe	20000	20000	1.000	1100	
CS Spec A-105 forgings	Flanges & O-lets	23300	23170	1.006	1100	
CS Spec A-234 Gr-WPB forgings	Elbows	20000	20000	1.000	1100	
Min Ratio (MR) =				1.000		

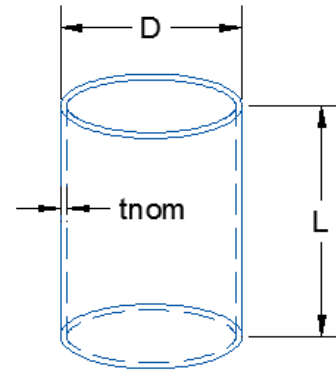
Per ASME B16.9, Reducers are calculated as equivalent straight seamless pipe

8 inch Pipe Description**Dimensions:**

8.625	D [in] - outside diameter
0.322	tnom [in] - nominal thickness
0.000	h [in] - thread allowance B1.20.2
12.500%	UT [%] - undertolerance allowance
0.063	Ca [in] - corrosion allowance
0.000	Ma [in] - mechanical allowance

Material and Conditions:

FerriticSteel	Group - material group
120	Temp [°F] - design temperature
Spec A-106 Gr-B	Material
Table211	Table - applicable material group in B16.5
20,000	S [psi] - allowable stress level
1.00	E - longitudinal efficiency (circ. stress)
1.00	W - weld joint reduction factor
201.3	P [psi] - design pressure

**Variables:**

ci [in] = Ma+Ca	0+0.063 = 0.0625
co [in] = h	0 = 0.0000
c [in] = ci+co	0.0625+0 = 0.0625
T [in] = tnom*(1-UT)	0.322*(1-0.125) = 0.2818
d [in] = D-2*T	8.625-2*0.2818 = 8.0615
Y1 = From Table 304.1.1	= 0.40
Y2 = (d+2*c)/(D+d+2*c)	(8.0615+2*0.0625)/(8.625+8.0615+2*0.0625) = 0.4870

Interior Pressure: B31.3-304.1.2

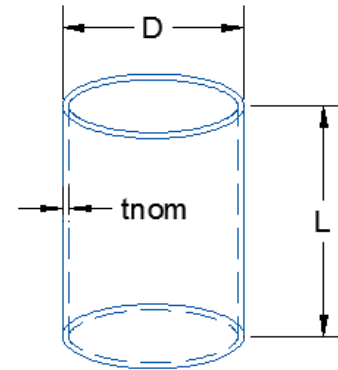
t1 [in] = $P \cdot D / (2 \cdot (S \cdot E \cdot W + P \cdot Y1))$	$201.3 \cdot 8.625 / (2 \cdot (20000 \cdot 1 \cdot 1 + 201.3 \cdot 0.4)) =$ 0.0432
t2 [in] = $P \cdot D / (2 \cdot (S \cdot E \cdot W + P \cdot Y2))$	$201.3 \cdot 8.625 / (2 \cdot (20000 \cdot 1 \cdot 1 + 201.3 \cdot 0.487)) =$ 0.0432
t [in] = if(t1>=D/6,t2,t1)	IF(0.0432>=8.625/6,0.0432,0.0432) = 0.0432
tm [in] = t+c	0.0432+0.0625 = 0.1057
CheckT = T >= tm	0.2818 >= 0.1057 = Acceptable

8 inch Elbow Description**Dimensions:**

8.625	D [in] - outside diameter
0.322	tnom [in] - nominal thickness
0.000	h [in] - thread allowance B1.20.2
12.500%	UT [%] - undertolerance allowance
0.063	Ca [in] - corrosion allowance
0.000	Ma [in] - mechanical allowance

Material and Conditions:

FerriticSteel	Group - material group
120	Temp [°F] - design temperature
Spec A-234 Gr-WPB	Material
Table221	Table - applicable material group in B16.5
20,000	S [psi] - allowable stress level
1.00	E - longitudinal efficiency (circ. stress)
1.00	W - weld joint reduction factor
201.3	P [psi] - design pressure

**Variables:**

ci [in] = Ma+Ca	0+0.063 = 0.0625
co [in] = h	0 = 0.0000
c [in] = ci+co	0.0625+0 = 0.0625
T [in] = tnom*(1-UT)	0.322*(1-0.125) = 0.2818
d [in] = D-2*T	8.625-2*0.2818 = 8.0615
Y1 = From Table 304.1.1	= 0.40
Y2 = (d+2*c)/(D+d+2*c)	(8.0615+2*0.0625)/(8.625+8.0615+2*0.0625) = 0.4870

Interior Pressure: B31.3-304.1.2

t1 [in] = $P \cdot D / (2 \cdot (S \cdot E \cdot W + P \cdot Y1))$	$201.3 \cdot 8.625 / (2 \cdot (20000 \cdot 1 \cdot 1 + 201.3 \cdot 0.4)) =$ 0.0432
t2 [in] = $P \cdot D / (2 \cdot (S \cdot E \cdot W + P \cdot Y2))$	$201.3 \cdot 8.625 / (2 \cdot (20000 \cdot 1 \cdot 1 + 201.3 \cdot 0.487)) =$ 0.0432
t [in] = if(t1>=D/6,t2,t1)	IF(0.0432>=8.625/6,0.0432,0.0432) = 0.0432
tm [in] = t+c	0.0432+0.0625 = 0.1057
CheckT = T >= tm	0.2818 >= 0.1057 = Acceptable

B16.5 Flange Rating ver 6.00

CI 150 Flange Description

Flange Inputs:

SA 105 Material

150 Class - pressure class

201.3 P [psi] - design pressure

120 Temp [°F] - design temperature

Geometry Constraints and Data:

Comp = Vlookup(Material,FlangeMatChart,3) composition

Table = Vlookup(Material,FlangeMatChart,2) pressure table

TM [°F] = Vlookup(Material,FlangeMatChart,5) max temperature

ckTemp = TM>=Temp

C-Si

Table211

1000

1000>=120 = **Acceptable**

Pressure Rating:

Pclass [psi] = PVELookup(Table,"Int1Dlin",Class,Temp) rated pressure

ckP = Pclass>=P

280

280>=201.3 = **Acceptable**