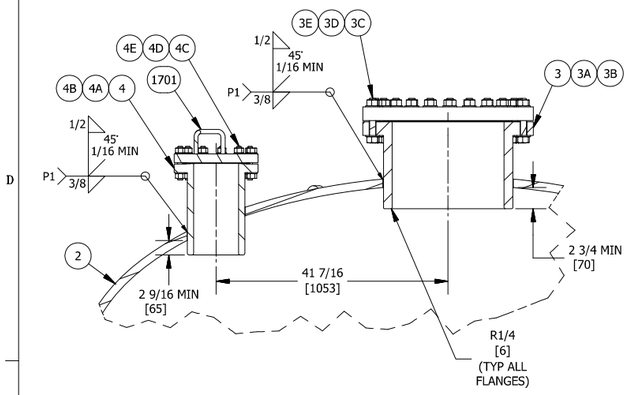
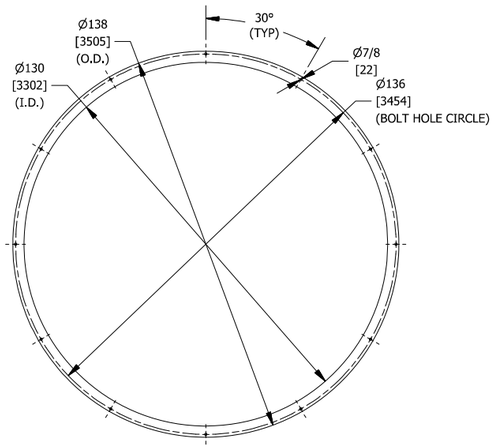


DETAIL 'A'

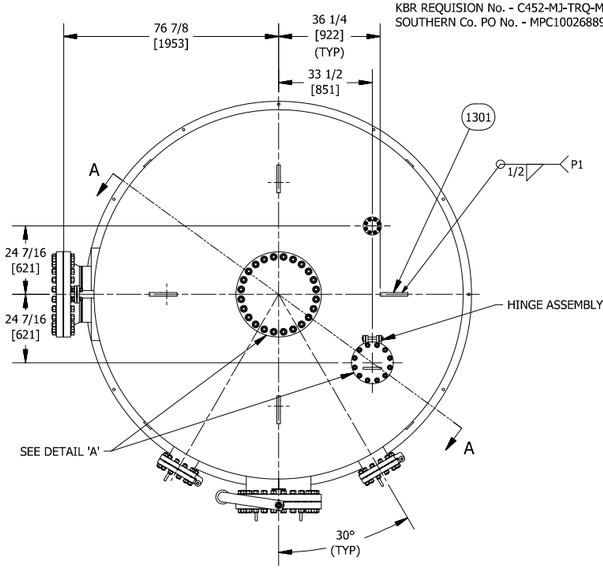


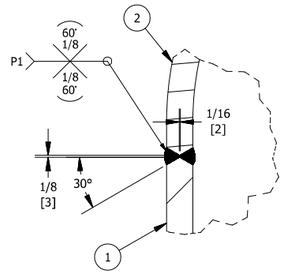
ITEM 1401

ANCHOR BOLT SIZE: Ø 3/4 (BY OTHERS)
MATERIAL: ASTM F1554 GR55 (BY OTHERS)

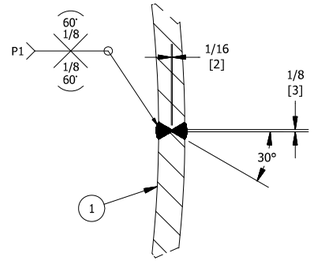
PKG TAG No: PG1080/2080
VESSEL TAG No: PG1080-DRA/B
PG2080-DRA/B

PROJECT - KEMPER COUNTY IGCC, UNIT 1
SERVICE - CO2 DEHYDRATION UNIT
TAG No. - PG1080/PG2080
KBR REQUISION No. - C452-MJ-TRQ-ML4-0001
SOUTHERN Co. PO No. - MPC10026889

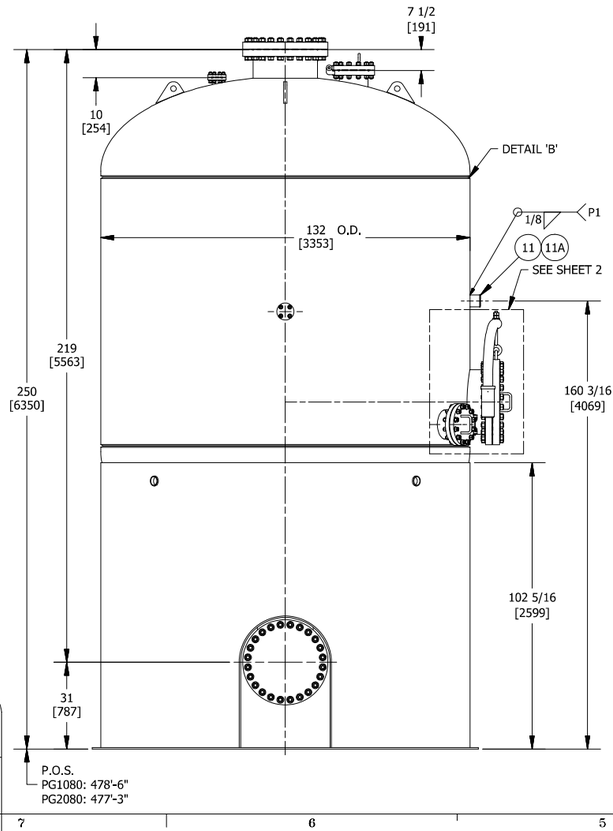


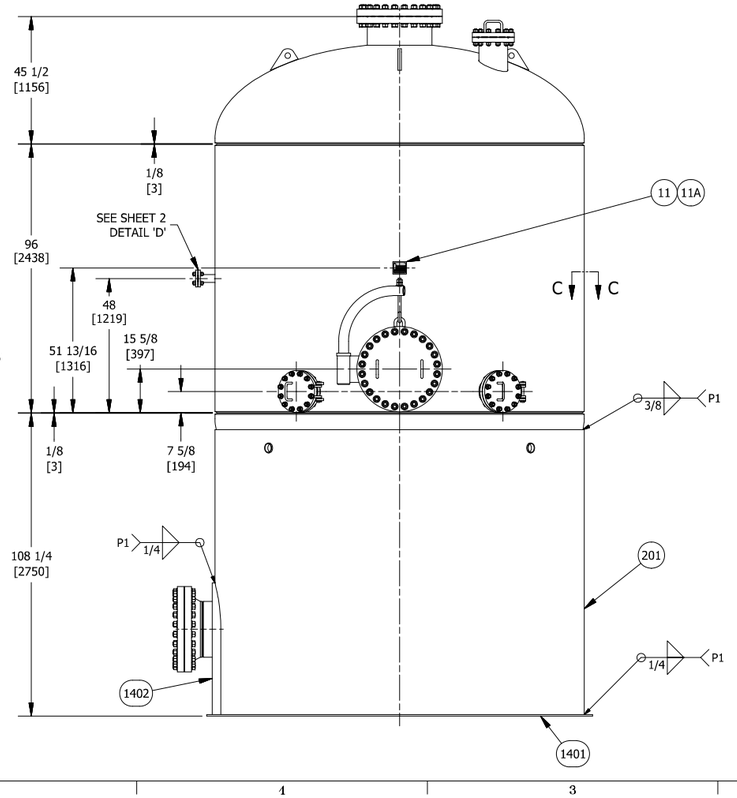


DETAIL 'B'



DETAIL 'C'





KBR

ACCEPTANCE
FOR ENGINEERING USE

THIS DOCUMENT IS:

ACCEPTED	(Code 1) X
ACCEPTED WITH COMMENTS	(Code 2)
NOT ACCEPTED	(Code 3)
NOT REVIEWED	(Code 4)

ACCEPTANCE DOES NOT RELIEVE SUPPLIER FROM FURNISHING MATERIAL IN CONFORMANCE WITH ORDER. REFER TO SDR-1 FOR FULL DEFINITION OF ACCEPTANCE CONDITIONS.

DISCIPLINE MJ BY TST
DATE 22 JUN 12

– REVISIONS –

ZONE	REV	DESCRIPTION	CHG BY	CHK BY	APP BY	REL BY	DATE
	A	UPDATED ALL WELD SYMBOLS PER FABRICATOR, UPDATED DRAWING PER CUTOMER AND FABRICATOR MARKUPS	DPM	DBR	DBR	SDM	10/14/11
	B	CHANGED MIN LENGTH & EXTERNAL PROJECTION OF N8	DPM	DPM	DPM	SDM	03/02/12
	C	CHANGED EXTERNAL PROJECTION OF N8	DPM	DPM	DPM	SDM	03/21/12
	D	UPDATED CUSTOMER PO No	DPM	DBR	DBR	SDM	05/30/12

- CUT TABLE -

ITEM	QTY	CUT	ENDS	CUT FROM DESCRIPTION
101	1	DETAIL	DETAIL	FORGING 24.250OD,19.25ID,SA105
201	1	DETAIL	DETAIL	PLATE,PVQ .375,SA516GR70
301	1	40 1/4	BBE	PIPE,WELDED 20.000,SCH 20,SA53B-ERW
401	2	DETAIL	DETAIL	PL,STOCK .750,SA36
402	1	DETAIL	DETAIL	PL,STOCK .750,SA36
403	2	DETAIL	DETAIL	PL,STOCK .750,SA36
404	2	DETAIL	DETAIL	PL,STOCK .750,SA36
405	6	DETAIL	DETAIL	PL,STOCK .750,SA36
406	6	DETAIL	DETAIL	PL,STOCK .750,SA36
407	6	DETAIL	DETAIL	PL,STOCK .750,SA36
408	1	DETAIL	DETAIL	PL,STOCK .750,SA36
501	2	38	DETAIL	BAR,EXTRUSN WT6X7,SA36
601	1	DETAIL	SBE	BAR,SQUARE SA36, .500X .500,HR,ORIGIN
701	1	DETAIL	SBE	BAR,RECT SA36,1.000X1.000,HR
801	2	DETAIL	REF,CTF	GRATING,BAR 2X3/16IN,CS,3X20FT
802	2	DETAIL	REF,CTF	GRATING,BAR 2X3/16IN,CS,3X20FT
901	2	128 3/4 DIA	REF,CTF	SHEET,PERF 20G,304SST,.063X.500,48X120
1001	1	DETAIL	DETAIL	PL,STOCK 1.000,SA36
1002	1	DETAIL	DETAIL	PL,STOCK 1.000,SA36
1101	1	DETAIL	SBE	PIPE,SMLS 3.000,SCH160,SA106B
1201	1	10	SBE	PIPE,SMLS 3.000,SCH160,SA106B
1301	4	DETAIL	DETAIL	PL,STOCK 1.250,SA36
1401	1	DETAIL	DETAIL	PL,STOCK .500-48.00X120.00,SA36
1402	1	DETAIL	DETAIL	PL,STOCK .500,SA36
1501	1	DETAIL	SBE	BAR,ROUND SA36,1.000,HR
1601	1	DETAIL	DETAIL	PL,STOCK .250,SA36
1602	1	DETAIL	DETAIL	PL,STOCK .250,SA36
1701	5	DETAIL	SBE	BAR,ROUND SA36, .750,HR
1702	3	7 1/2	SBE	BAR,ROUND SA36, .750,HR
1801	4	1 3/8	SBE	PIPE,SMLS 3.000,SCH 40,SA106B

*SEE PAGE 5 NOZZLE TABLE FOR MIN. NOZZLE LENGTHS

- BILL OF MATERIAL -

ITEM	DESCRIPTION	QTY
1	PLATE,PVQ SHELL 132.00 DIA, 1.5 THK,SA516GR70N	1
2	HEAD,2:1 ELP 132.000,1.500, 35.75,SA516GR70N	2
3	FLG,RFWN FLG,RFWN 20.000,CLS300,LONGWN,SA105	2
3A	FLG,BLIND 20.000,RF,CLS300,SA105 (2 FOR HYDRO)	3
3B	GSKT,FLANGE 20.00,.175,300#,RF,SPIRAL WOUND 304/GRPH/304	3
3C	STUD,THREAD 1.250- 8X 8.000,SA193B7,GALV A153	72
3D	NUT,HEXAGON 1.250- 8,SA194-2H,GALV A153	144
3E	WSHR,PLAIN 1.250,CS,NARROW,GALVANIZED A153	144
4	FLG,RFWN 8.000,CLS300,LONGWN,SA105	3
4A	FLG,BLIND 8.000,RF,CLS300,SA105	3
4B	GSKT,FLANGE 8.00,.175,300#,RF,SPIRAL WOUND 304/GRPH/304	3
4C	STUD,THREAD .875- 9X 6.000,SA193B7 GALV A153	36
4D	NUT,HEXAGON .875-9,SA194-2H GALVANIZED A153	72
4E	WSHR,PLAIN .875, CS, NARROW, HOT DIP GALV A153	72
5	HANDLE,LIFT 14X6,3/4DIA,SA36	1
6	ELBOW,WELD 16.00, LR,90,SCH 40,SA234GR	1
7	FLG,RFWN 20.000,CLS300,SCH 20,SA105	1
8	FLG,RFWN FLG,RFWN 2.000,CLS300,LONGWN,SA105	1
8A	FLG,BLIND 2.000,RF,CLS300,SA105 (FOR HYDRO)	1
8B	GSKT,FLANGE 2.00,.175,300#,RF,SPIRAL WOUND 304/GRPH/304	1
8C	STUD,THREAD .625- 11X 4.000,SA193B7 GALV A153	8
8D	WSHR,PLAIN .625,CS,NARROW,HOT DIP GALVANIZED A153	16
8E	NUT,HEXAGON .625-11,SA194-2H GALVANIZED A153	16
9	FLG,RFWN FLG,RFWN 1.500,CLS300,LONGWN,SA105	1
9A	FLG,BLIND 1.500.CLS300,SA105 (FOR HYDRO)	1
9B	GSKT,FLANGE 1.50,.175,300#,RF,SPIRAL WOUND 304/GRPH/304	1
9C	STUD,THREAD .750- 10X 4.000,SA193B7 GALV	4
9D	WSHR,PLAIN .750,CS,NARROW,HOT DIP GALVANIZED A153	8
9E	NUT,HEXAGON .750-10,SA194-2H GALVANIZED A153	8
10	BOLT,EYE 1.000- 8X 12.000,CS,GALV A153	1
10A	WSHR,PLAIN 1.000,CS,WIDE,GALV A153	1
10B	NUT,HEXAGON 1.000- 8,SA194-2H,GALV A153	2
11	NPL,STANDOFF SUPPLIER STANDOFF	1
11A	NPL,CODE SUPPLIER ASME NAMEPLATE	1
12A	BOLT,HEX .500-13X 2.750,SA193B8	18
12B	BOLT,HEX .500-13X 2.000,SA193B8	6
12C	NUT,HEXAGON .500-13,SA194B8	24
13	WSHR,PLAIN .750,CS,WIDE,GALVANIZED A153	6
14	WSHR,PLAIN .750,DELRIN,WIDE	6
15	PIN COTTER PIN 3/16" X 1-1/4",CS	3

		NAME	DATE
UNLESS OTHERWISE SPECIFIED:			
DIMENSIONS ARE IN: INCHES [MM]	DWN BY	DPM	08/01/11
SURFACE FINISH: N/A ✓	ENG BY	DBR	08/01/11
TOL. MM INCHES	CHK BY	WLB	08/01/11
X.	APP BY	DBR	08/01/11
.X	REL BY	SDM	08/09/11
.XX	MAT NO.	7405265	
.XXX			
FRACT: ±1/16 ANG: ±1/2°			
SCALE: 1/32			

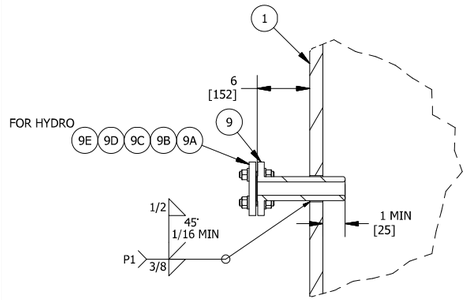
SPX
FLOW TECHNOLOGY USA, INC.
* DO NOT SCALE. USE DIMENSIONS ONLY *

ASSY,CHMBR
132"HP CNTRY,FLG,350PSI@450F

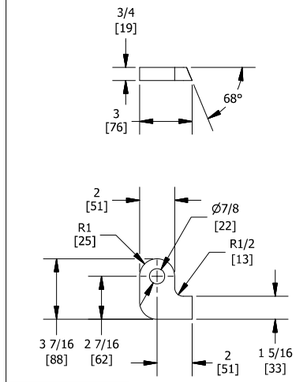
SIZE D | DWG. NO. 7405265 | REV. D | SHEET 1/5

Southern Company Generation **Kemper County**
MM84872 C Unit 1

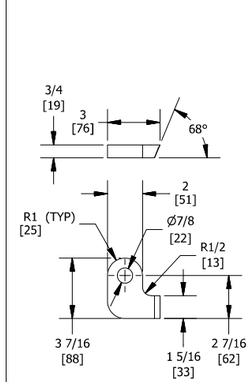
SPX FLOW TECHNOLOGY PO: MPC10026889
7405265 SH 1 Rev: D
IGCC - GASIFIER - CO2 DEHYDRATION UNIT - ASSEMBLY CHAMBER DRAWING



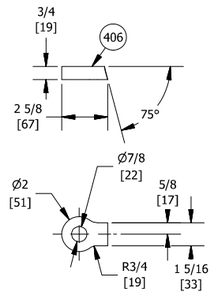
DETAIL 'D'



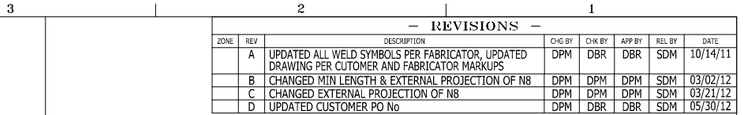
ITEM 405A QTY REQ'D: 3



ITEM 405B QTY REQ'D: 3



ITEM 406 QTY REQ'D: 6



KBR

ACCEPTANCE FOR ENGINEERING USE

THIS DOCUMENT IS:

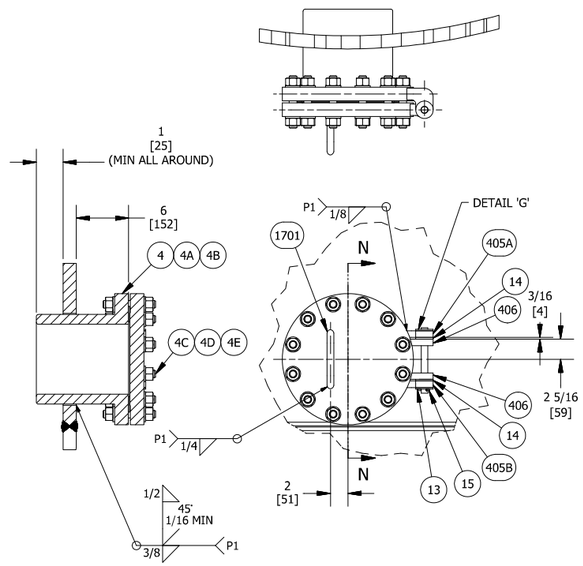
ACCEPTED (Code 1) X
ACCEPTED WITH COMMENTS (Code 2) ____
NOT ACCEPTED (Code 3) ____
NOT REVIEWED (Code 4) ____

ACCEPTANCE DOES NOT RELIEVE SUPPLIER FROM FURNISHING MATERIAL IN CONFORMANCE WITH ORDER. REFER TO SDR-1 FOR FULL DEFINITION OF ACCEPTANCE CONDITIONS.

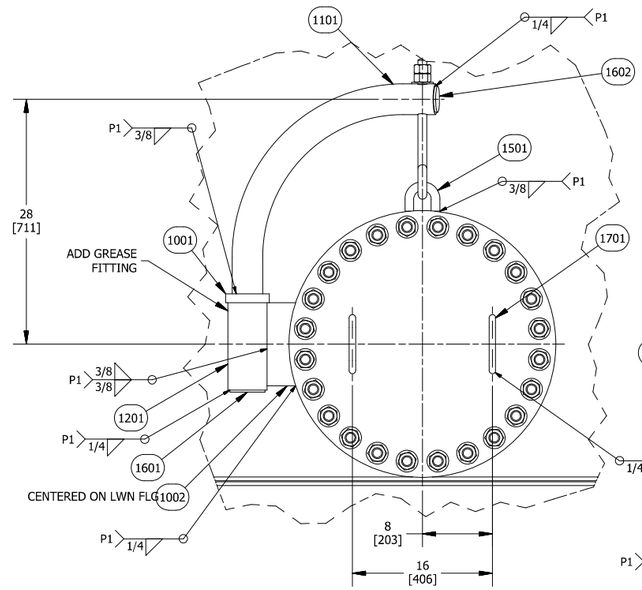
DISCIPLINE MJ BY TST
DATE 22 JUN 12

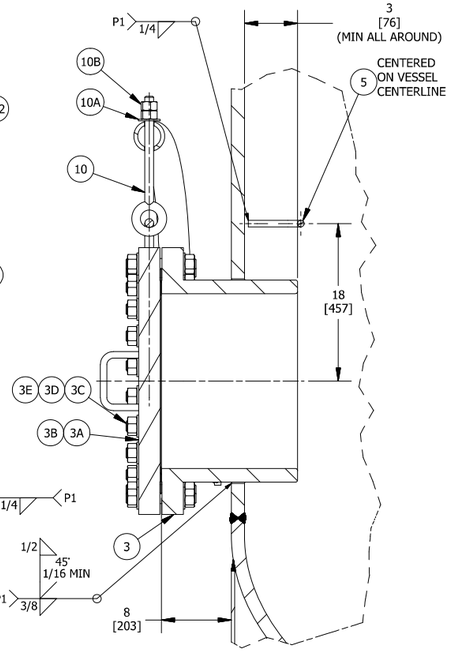
PROJECT - KEMPER COUNTY IGCC, UNIT 1
SERVICE - CO2 DEHYDRATION UNIT
TAG No. - PG1080/PG2080
KBR REQUISION No. - C452-MJ-TRQ-ML4-0001
SOUTHERN Co. PO No. - MPC10026889

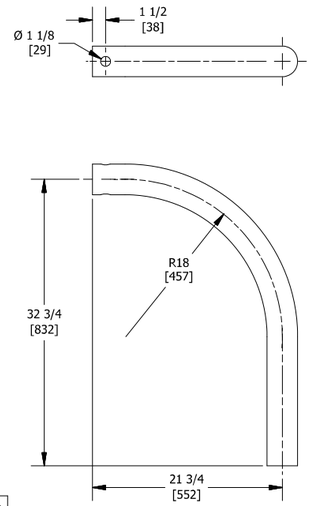
PKG TAG No: PG1080/2080
VESSEL TAG No: PG1080-DRA/B
PG2080-DRA/B



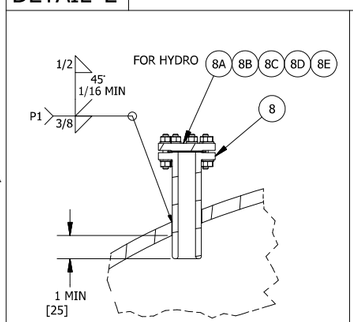
DETAIL 'E'







ITEM 1101



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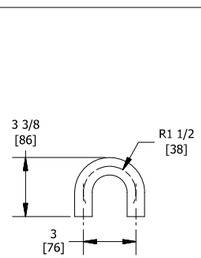
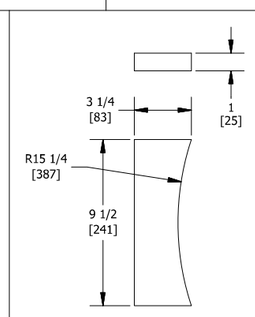
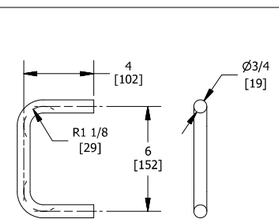


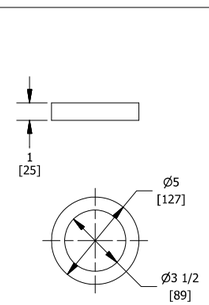
ITEM 1501



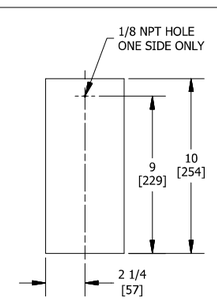
ITEM 1002



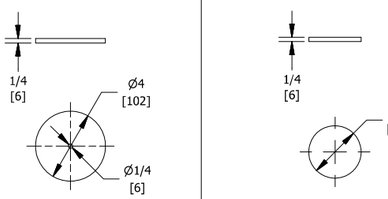
ITEM 1701



ITEM 1001



ITEM 1201



ITEM 1601

ITEM 1602

UNLESS OTHERWISE SPECIFIED:		NAME	DATE
DIMENSIONS ARE IN: INCHES [MM]	DWN BY	DPM	08/01/11
SURFACE FINISH: N/A	ENG BY	DBR	08/01/11
TOL. MM INCHES	CHK BY	WLB	08/01/11
X	APP BY	DBR	08/01/11
.XX	REL BY	SDM	08/09/11
.XXX	MAT NO.	7405265	
FRACT: ±1/16 ANG: ±1/2°			
SCALE: 1/25			

SPX FLOW TECHNOLOGY USA, INC.

* DO NOT SCALE. USE DIMENSIONS ONLY *

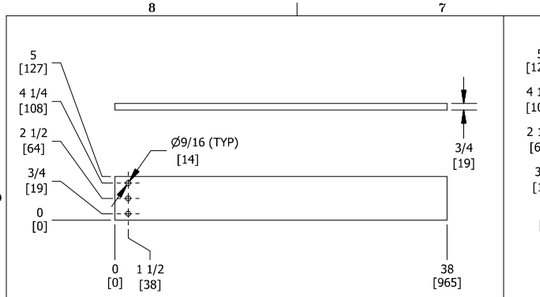
ASSY,CHMBR

132"HP CNTRY,FLG,350PSI@450F

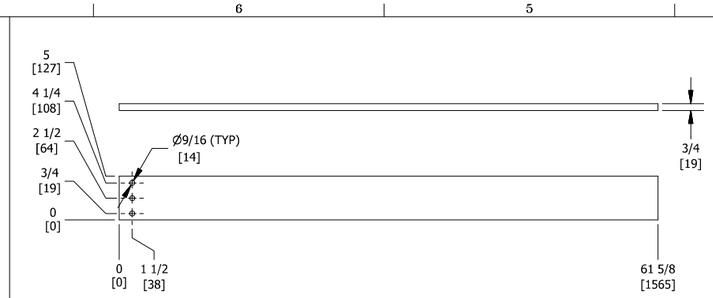
SIZE D | DWG. NO. 7405265 | REV. D | SHEET 2/5

Southern Company Generation Kemper County
MM84873 C Unit 1

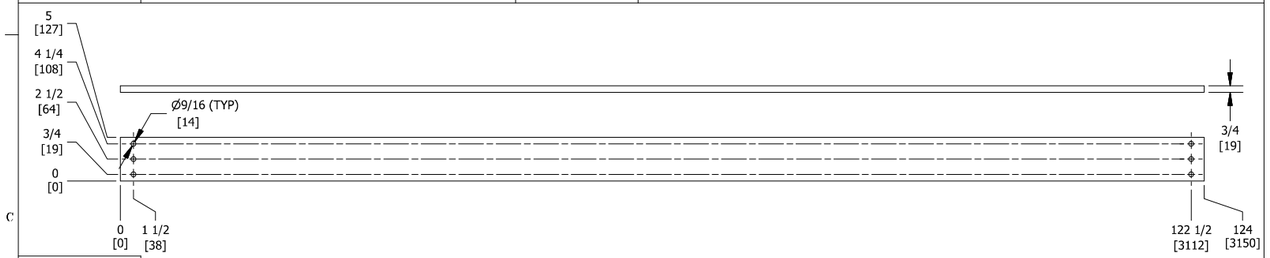
SPX FLOW TECHNOLOGY PO: MPC10026889
7405265 SH 2 Rev: D
IGCC - GASIFIER - CO2 DEHYDRATION UNIT - ASSEMBLY CHAMBER DRAWING



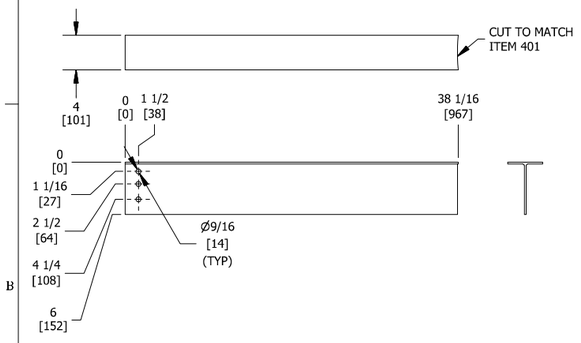
ITEM 401



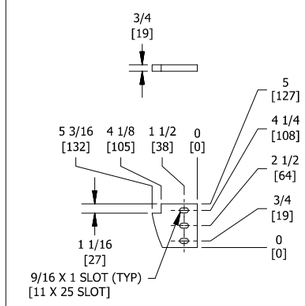
ITEM 403



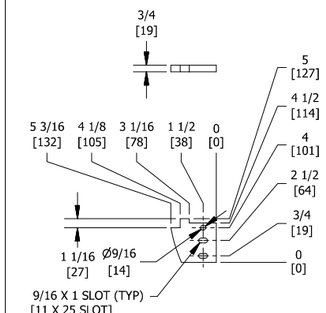
ITEM 402



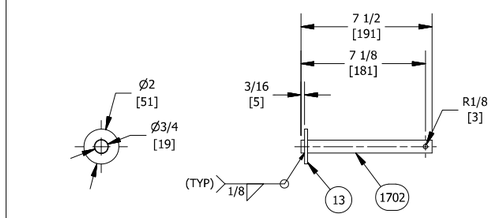
ITEM 501



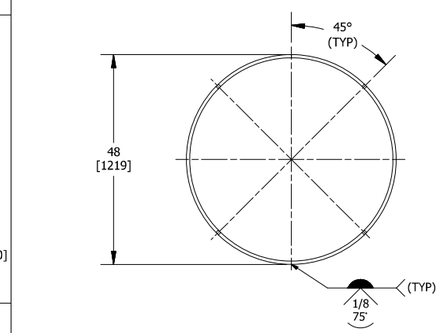
ITEM 407

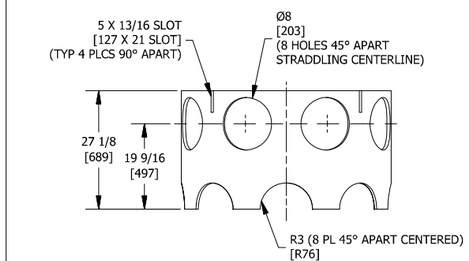


ITEM 404



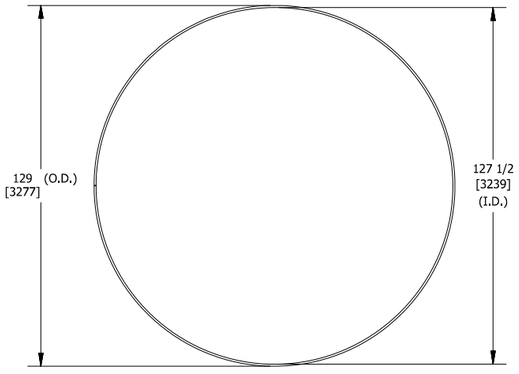
DETAIL 'G'



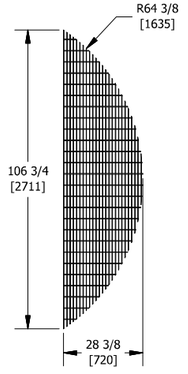


ITEM 408

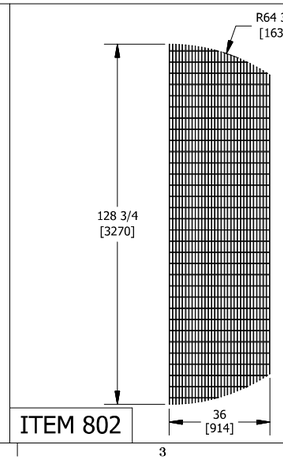
ITEM 701



ITEM 601



ITEM 801



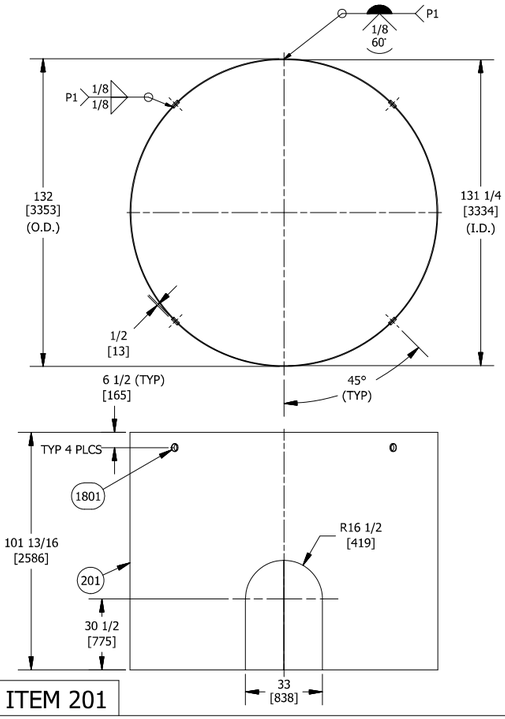
ITEM 802

— REVISIONS —

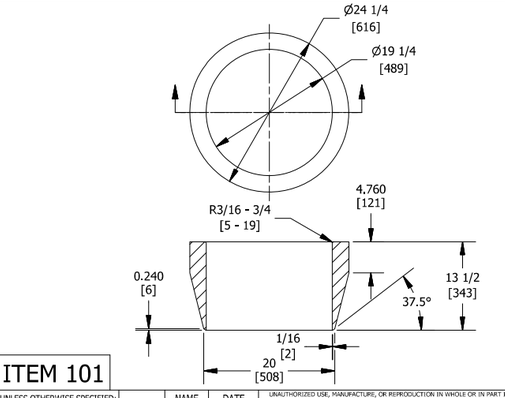
ZONE	REV	DESCRIPTION	CHG BY	CHK BY	APP BY	REL BY	DATE
	A	UPDATED ALL WELD SYMBOLS PER FABRICATOR, UPDATED DRAWING PER CUTOMER AND FABRICATOR MARKUPS	DPM	DBR	DBR	SDM	10/14/11
	B	CHANGED MIN LENGTH & EXTERNAL PROJECTION OF N8	DPM	DPM	DPM	SDM	03/02/12
	C	CHANGED EXTERNAL PROJECTION OF N8	DPM	DPM	DPM	SDM	03/21/12
	D	UPDATED CUSTOMER PO No	DPM	DBR	DBR	SDM	05/30/12

PKG TAG No: PG1080/2080
VESSEL TAG No: PG1080-DRA/B
PG2080-DRA/B

PROJECT - KEMPER COUNTY IGCC, UNIT 1
SERVICE - CO2 DEHYDRATION UNIT
TAG No. - PG1080/PG2080
KBR REQUISION No. - C452-MJ-TRQ-ML4-0001
SOUTHERN Co. PO No. - MPC10026889



ITEM 201



ITEM 101

UNLESS OTHERWISE SPECIFIED:		NAME	DATE
DIMENSIONS ARE IN: INCHES [MM]	DWN BY	DPM	08/01/11
SURFACE FINISH: N/A	ENG BY	DBR	08/01/11
TOL. MM INCHES	CHK BY	WLB	08/01/11
X	APP BY	DBR	08/01/11
.XX	REL BY	SDM	08/09/11
.XXX	MAT NO.	7405265	
FRACT: ±1/16 ANG: ±1/2°			
SCALE: 1/25			

SPX. FLOW TECHNOLOGY USA, INC.

* DO NOT SCALE. USE DIMENSIONS ONLY *

ASSY,CHMBR

132"HP CNTRY,FLG,350PSI@450F

SIZE	DWG. NO.	REV.	SHEET
D	7405265	D	3/5

Southern Company Generation **Kemper County**
MM84874 C Unit 1

SPX FLOW TECHNOLOGY PO: MPC10026889
7405265 SH 3 Rev: D
IGCC - GASIFIER - CO2 DEHYDRATION UNITS - ASSEMBLY CHAMBER DRAWIN

NOTES & SPECIFICATIONS

1. VESSELS TO BE BUILT IN ACCORDANCE WITH THE 2010 EDITION ADDENDA OF ASME SECTION VIII., DIV. 1. (REFERENCE CODE CALCULATIONS)
2. VESSELS TO BE INSPECTED AND STAMPED WITH CODE SYMBOL PER (UG-99 AND UG-116).
3. ALL INSIDE PROJECTING NOZZLES AND NOZZLE OPENINGS SHALL HAVE EDGES BROKEN WITH A RADIUS OR CHAMFER PER FIG AD610.1 OF DIV 2.
4. SUBSTANCE CONTAINED: CO2
5. DESIGN PRESSURE AND TEMPERATURE: 350 PSIG AT 450 °F / 2413 KPAG AT 232 °C
6. MDMT: 10 °F AT 350 PSIG / -12.2 °C AT 2413 KPAG
7. MATERIAL:
   SHELL: SA-516 GR 70 NORMALIZED
   HEAD: SA-516 GR 70 NORMALIZED
   * INCLUDES CORROSION ALLOWANCE
8. SHELL THK: 1.50 IN / 38.1 mm MIN CALC: 1.2193 IN * / 30.970 mm*
   HEAD THK: 1.50 IN / 38.1 mm MIN CALC: 1.1996 IN * / 30.470 mm*
9. CORROSION ALLOWANCE: .0625 IN / 1.587 mm
10. HYDROSTATIC TEST PRESSURE: 455 PSIG / 3137 KPAG AT AMBIENT TEMPERATURE FOR A MINIMUM OF 30 MINUTES.
    ONLY CLEAN FRESH WATER WITH pH BETWEEN 6 AND 8 SHALL BE USED FOR HYDROSTATIC TESTING.
    FOLLOWING THE HYDROSTATIC TEST, THE PRESSURE SHALL BE LOWERED TO FOUR-FIFTHS OF THE TEST PRESSURE AND PRESSURE SHALL BE MAINTAINED FOR A SUFFICIENT PERIOD OF TIME TO PERMIT COMPLETE EXAMINATION OF PARTS UNDER PRESSURE. THE HYDROSTATIC TEST SHALL BE CONSIDERED SATISFACTORY WHEN NO LEAK OR DROP IN PRESSURE IS OBSERVED.
11. N.D.T. REQUIREMENTS: RT-1, ALL NOZZLES TO SHELL/HEAD WELDS SHALL BE 100% VT AND MT EXAMINED
12. IMPACT TEST REQUIREMENTS: NONE
13. PWHT REQUIREMENTS: AS REQUIRED PER UCS-56
14. BOLT HOLES TO STRADDLE CENTERLINES.
15. CHINESE MATERIAL IS NOT PERMITTED.
16. CODE CALC FILE 7404131.
17. CONFORM TO QMS-001.
18. ALL WELDS SHALL BE FREE OF UNDERCUTS.
19. SAW MANUFACTURERS FLUX MUST MATCH THAT QUALIFIED ON THE PQR. REGROUND FUSED FLUX OR SLAG SHALL NOT BE USED.
20. GMAW IN THE SHORT CIRCUITING TRANSFER MODE MAY BE USED FOR TACK-WELDS, TEMPORARY ATTACHMENTS OR OTHER APPLICATIONS WHERE THE WELD METAL SHALL BE COMPLETELY REMOVED AND LIMITED TO GROOVE, FILLET AND STRUCTURAL WELDS IN MATERIAL 3/8" MAX THICKNESS OR ROOT WELDS IN GREATER THICKNESS IN WHICH DOWNHILL PROGRESSION ONLY IS PERMITTED.
21. THE FCAW PROCESS SHALL NOT BE USED FOR ROOT PASSES UNLESS THE BACKSIDE OF THE ROOT IS GROUND OR BACK GOUGED TO SOUND METAL AND BACKWELDED.
22. CODE TAGS SHALL BE ATTACHED WITH RIVETS. WELDING IS NOT PERMITTED.
23. PEENING IS NOT PERMITTED.
24. WELDING SLAG SHALL BE REMOVED FROM ALL WELDS.
25. FOR PREHEAT, SURFACE TEMPERATURE SHALL BE MEASURED IN THE WELD JOINT AND 1 INCH ON EACH SIDE OF THE JOINT IMMEDIATELY BEFORE INITIATION OF ARC WELD.
26. WELD JOINT SURFACES AND A MINIMUM OF 1 INCH OF THE INTERNAL AND EXTERNAL SURFACES OF THE ADJACENT BASE METAL SHALL BE CLEAN AND FREE FROM PAINT, OIL, DIRT, SCALE, OXIDES, AND OTHER FOREING MATERIAL DETRIMENTAL TO THE INTEGRITY OF THE WELD.
27. FOR P1 GROUP 1,2,3 175°F PREHEAT IS MANDATORY WHEN CC EXCEEDS 0.30% AND THICKNESS EXCEEDS 1 INCH. IN ADDITION, A MINIMUM PREHEAT 200 °F (95°C) SHALL BE APPLIED FOR CARBON STEEL WITH A THICKNESS GREATER THAN 1-1/4 INCHES. WHEN PREHEAT IS A REQUIREMENT FOR WELDING, IT IS ALSO A REQUIREMENT FOR ELECTRIC ARC CUTTING, FLAME, TACK WELDING, BACK GOUGING, ETC.
28. VESSEL NAMEPLATE SHALL INCLUDE: DESIGN PRESSURE @ DESIGN TEMPERATURE
    MAWP @ DESIGN TEMPERATURE
    MFG SERIAL NUMBER
    VESSEL TAG NUMBERS PG-1080 DR A, PG-1080 DR B, PG-2080 DR A, PG-2080 DR B
    WBS AREA: 180.

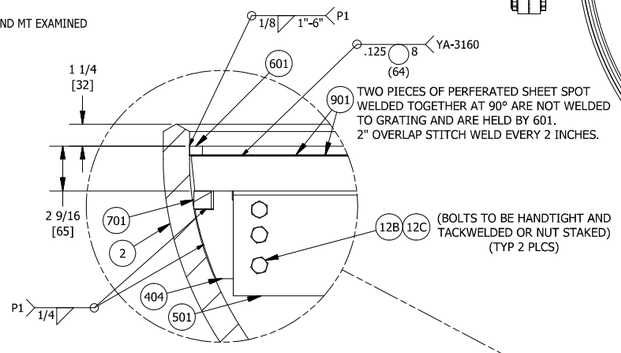
NOTES	P1 WPS	AS WELDED THK	PWHT THK
1,3	SA-1-1 (L56)	3/16" - 1 1/2"	3/16" - 8"
1,3	SA-TD-1-1 CVN	5/8" - 1 1/2"	5/8" - 8"
2	FC-1-1	3/16" - 1 1/2"	3/16" - 8"
2	SM-1-1	3/16" - 1 1/2"	3/16" - 8"
2,4	GT-1-1	3/16" - 1 1/2"	3/16" - 8"

1. LONG AND ROUND SEAM SHELL WELDS.
2. NOZZLES, COUPLINGS, PADS, ATTACHMENTS, ETC.
3. USE FC-1-1, SM-1-1, OR GT-1-1 FOR REPAIRS OR AS ALTERNATIVE.
4. USE GT-1-1 FOR ALL SINGLE SIDE OPEN ROOT STRINGER AND HOT PASSES

SEE DRAWING NOTES 18, 21, 23, 24, 25, 26 FOR SPECIAL WELDING REQUIREMENTS. ALL OTHER WELDING NOTES ARE COVERED BY THE WPS.

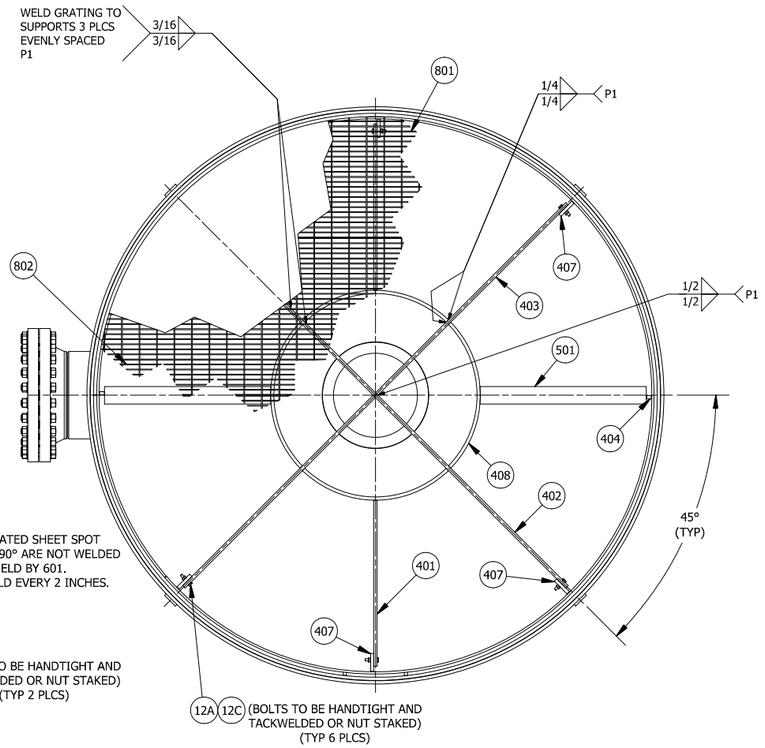
APPROXIMATE VESSEL WEIGHTS		
EMPTY WEIGHT	50,000 LBS	22,680 KGS
OPERATING WEIGHT	84,000 LBS	38,100 KGS
HYDRO TEST WEIGHT	118,000 LBS	53,525 KGS

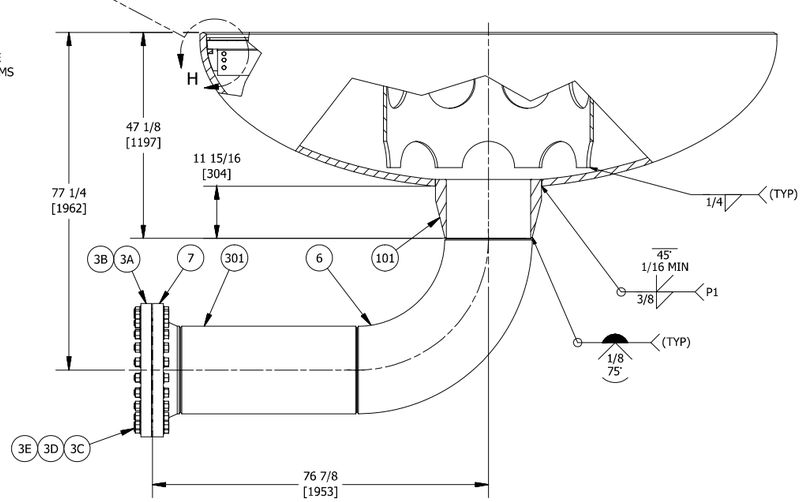
NOTES:
1. DESICCANT BED HEIGHT: 94 IN.
2. TYPE AND DIA OF DESICCANT: ACTIVATED ALUMINA, 4MM DIA.
3. DESICCANT BULK DENSITY: 48 LB/FT³



DETAIL 'H'

1/8" MIN - 1/4" MAX CLEARANCE ALL AROUND SHALL BE MAINTAINED BETWEEN INSIDE VESSEL SURFACE AND ITEMS 801, 802, & 901. CUT TO FIT.





REVISIONS							
ZONE	REV	DESCRIPTION	CHG BY	CHK BY	APP BY	REL BY	DATE
	A	UPDATED ALL WELD SYMBOLS PER FABRICATOR, UPDATED DRAWING PER CUTOMER AND FABRICATOR MARKUPS	DPM	DBR	DBR	SDM	10/14/11
	B	CHANGED MIN LENGTH & EXTERNAL PROJECTION OF N8	DPM	DPM	DPM	SDM	03/02/12
	C	CHANGED EXTERNAL PROJECTION OF N8	DPM	DPM	DPM	SDM	03/21/12
	D	UPDATED CUSTOMER PO# AND ADDED DESICCANT NOTES	DPM	DBR	DBR	SDM	05/30/12

KBR

ACCEPTANCE FOR ENGINEERING USE

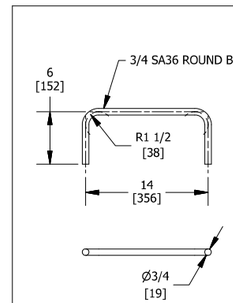
THIS DOCUMENT IS:
ACCEPTED (Code 1) X
ACCEPTED WITH COMMENTS (Code 2) ____
NOT ACCEPTED (Code 3) ____
NOT REVIEWED (Code 4) ____

ACCEPTANCE DOES NOT RELIEVE SUPPLIER FROM FURNISHING MATERIAL IN CONFORMANCE WITH ORDER. REFER TO SDR-1 FOR FULL DEFINITION OF ACCEPTANCE CONDITIONS.

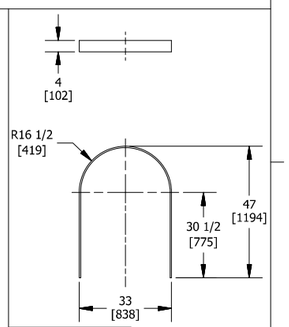
DISCIPLINE MJ BY TST
DATE 22 JUN 12

PROJECT - KEMPER COUNTY IGCC, UNIT 1
SERVICE - CO2 DEHYDRATION UNIT
TAG No. - PG1080/PG2080
KBR REQUISION No. - C452-MJ-TRQ-ML4-0001
SOUTHERN Co. PO No. - MPC10026889

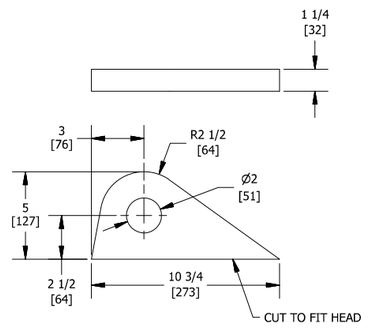
PKG TAG No: PG1080/2080
VESSEL TAG No: PG1080-DRA/B
PG2080-DRA/B



ITEM 5



ITEM 1402



ITEM 1301

UNLESS OTHERWISE SPECIFIED:		NAME	DATE
DIMENSIONS ARE IN: INCHES [MM]	DWN BY	DPM	08/01/11
SURFACE FINISH: N/A	ENG BY	DBR	08/01/11
TOL. MM INCHES	CHK BY	WLB	08/01/11
X.	APP BY	DBR	08/01/11
.X	REL BY	SDM	08/09/11
.XX	MAT NO.	7405265	
.XXX			
FRACT: ±1/16 ANG: ±1/2°			
SCALE: 1/25			

SPX. FLOW TECHNOLOGY USA, INC.
* DO NOT SCALE. USE DIMENSIONS ONLY *

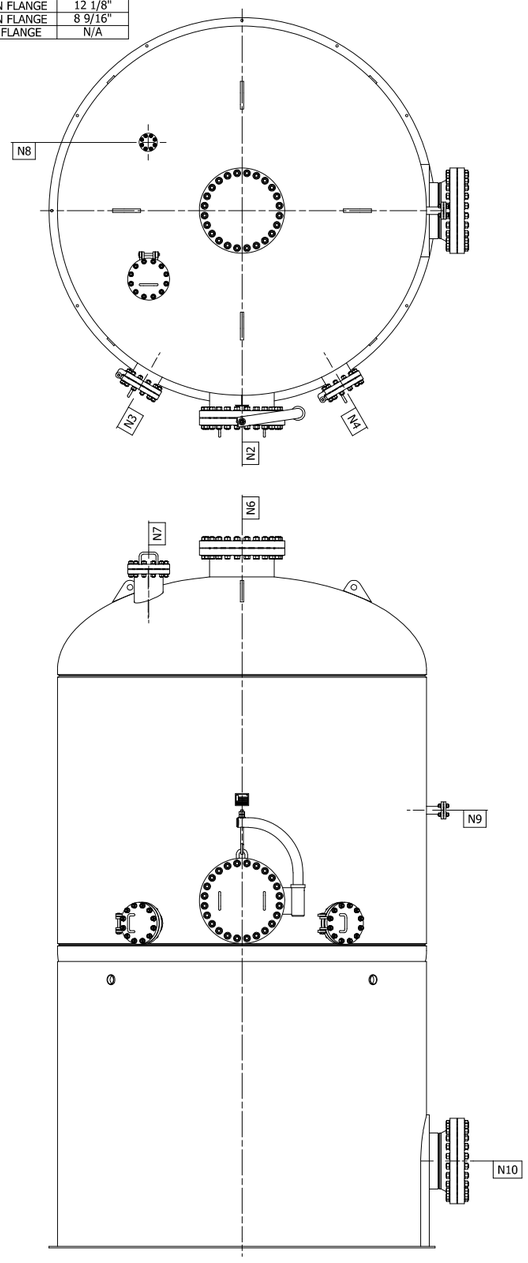
ASSY,CHMBR
132"HP CNTRY,FLG,350PSI@450F

SIZE D | DWG. NO. 7405265 | REV. D | SHEET 4/5

Southern Company Generation **Kemper County**
MM84875 C Unit 1

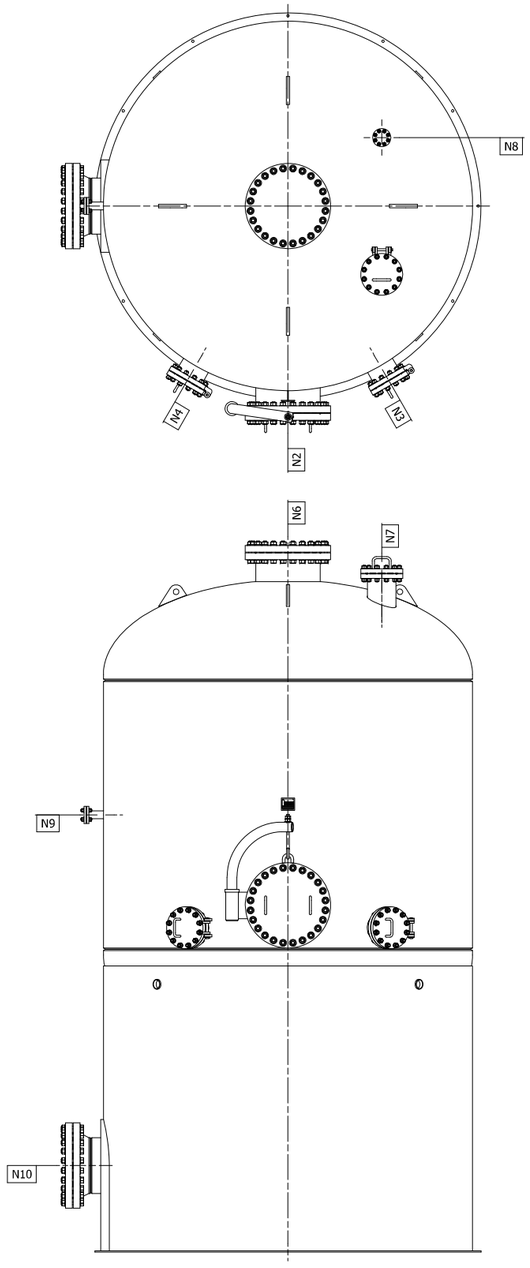
SPX FLOW TECHNOLOGY PO: MPC10026889
7405265 SH 4 Rev: D
IGCC - GASIFIER - CO2 DEHYDRATION UNIT - ASSEMBLY CHAMBER DRAWING

NOZZLE TABLE				
TAG	DESCRIPTION	SIZE	TYPE	MIN LENGTH
N2	MANWAY IN SHELL	20"	300# RF LWN FLANGE	13 1/2"
N3	DRAIN NOZZLE IN SHELL	8"	300# RF LWN FLANGE	7 13/16"
N4	DRAIN NOZZLE IN SHELL	8"	300# RF LWN FLANGE	7 13/16"
N6	INLET NOZZLE IN TOP HEAD	20"	300# RF LWN FLANGE	14 9/16"
N7	FILL NOZZLE IN TOP HEAD	8"	300# RF LWN FLANGE	16 5/16"
N8	RELIEF VALVE NOZZLE IN TOP HEAD	2"	300# RF LWN FLANGE	12 1/8"
N9	INSTRUMENT NOZZLE IN SHEET	1 1/2"	300# RF LWN FLANGE	8 9/16"
N10	WELD STUB OUTLET NOZZLE IN BOTTOM HEAD	20"	300# RF WN FLANGE	N/A



MAT# 7404131

TAG #'S: PG1080 DRA, PG2080 DRA



MAT# 7405265

TAG #'S: PG1080 DRB, PG2080 DRB

– REVISIONS –							
ZONE	REV	DESCRIPTION	CHG BY	CHK BY	APP BY	REL BY	DATE
	A	UPDATED ALL WELD SYMBOLS PER FABRICATOR, UPDATED DRAWING PER CUTOMER AND FABRICATOR MARKUPS	DPM	DBR	DBR	SDM	10/14/11
	B	CHANGED MIN LENGTH & EXTERNAL PROJECTION OF N8	DPM	DPM	DPM	SDM	03/02/12
	C	CHANGED EXTERNAL PROJECTION OF N8	DPM	DPM	DPM	SDM	03/21/12
	D	UPDATED CUSTOMER PO# AND BASE ANALYSIS TABLE	DPM	DBR	DBR	SDM	05/30/12

KBR

ACCEPTANCE FOR ENGINEERING USE

THIS DOCUMENT IS:

ACCEPTED (Code 1) X

ACCEPTED WITH COMMENTS (Code 2) ____

NOT ACCEPTED (Code 3) ____

NOT REVIEWED (Code 4) ____

ACCEPTANCE DOES NOT RELIEVE SUPPLIER FROM FURNISHING MATERIAL IN CONFORMANCE WITH ORDER. REFER TO SDR-1 FOR FULL DEFINITION OF ACCEPTANCE CONDITIONS.

DISCIPLINE MJ BY TST

DATE 22 JUN 12

BASE ANALYSIS AND FOUNDATION LOADING				
LOAD	VESSEL CONDITION	BASE MOMENT (lbf-ft)	W (lbf)	SHEAR (lbf)
WIND	OPERATING, CORRODED	236,165.7	151,412.4	9,464.0
WIND	OPERATING, NEW	236,165.8	155,963.5	9,464.0
WIND	EMPTY, CORRODED	236,165.7	150,488.6	9,464.0
WIND	EMPTY, NEW	236,165.8	155,039.7	9,464.0
SEISMIC	OPERATING, CORRODED	188,165.1	151,412.4	5,759.0
SEISMIC	OPERATING, NEW	193,701.1	155,963.5	5,932.0
SEISMIC	EMPTY, CORRODED	187,098.0	150,488.6	5,724.0
SEISMIC	EMPTY, NEW	192,634.1	155,039.7	5,899.0

PKG TAG No: PG1080/2080
VESSEL TAG No: PG1080-DRA/B
PG2080-DRA/B

PROJECT - KEMPER COUNTY IGCC, UNIT 1
SERVICE - CO2 DEHYDRATION UNIT
TAG No. - PG1080/PG2080
KBR REQUISION No. - C452-MJ-TRQ-ML4-0001
SOUTHERN Co. PO No. - MPC10026889

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN: INCHES [MM]
SURFACE FINISH: N/A
TOL. MM INCHES
X.
.X
.XX
.XXX
FRACT: ±1/16 ANG: ±1/2°
SCALE: 1/25

	NAME	DATE
DWN BY	DPM	08/01/11
ENG BY	DBR	08/01/11
CHK BY	WLB	08/01/11
APP BY	DBR	08/01/11
REL BY	SDM	08/09/11
MAT NO.	7405265	

SPX. FLOW TECHNOLOGY USA, INC.

* DO NOT SCALE. USE DIMENSIONS ONLY *

ASSY,CHMBR

132"HP CNTRY,FLG,350PSI@450F

SIZE D | DWG. NO. 7405265 | REV. D | SHEET 5/5

Southern Company Generation **Kemper County**
MM92923 A Unit 1

SPX FLOW TECHNOLOGY PO: MPC10026889
7405265 SH 5 Rev: D
IGCC - GASIFIER - CO2 DEHYDRATION UNIT - ASSEMBLY CHAMBER DRAWING

LIFTING LUG MAXIMUM LOAD CALCULATION
(VERTICAL MOUNTED LUGS)

S.O.:	1471495.1			Vessel Tag No.: PG-1080-DR A/B
LIFT LUG CAT.#	Drawing Detail			PG-2080-DR A/B
VESSEL DWG No.	7405265			
THICKNESS:	1.250	in	31.75	mm
MATERIAL:	SA36			

LUG TO SKID FILLET WELD LEG:	0.500	in	12.7	mm

YIELD STRENGTH VALUE:	30,000.00	psi	206,844.00	kpa
SHEAR STRESS AT YIELD:	15,000.00	psi	103,422.00	kpa
SAFETY FACTOR:	4			
YIELD STRENGTH WITH S.F. APPLIED:	7,500.00	psi	51,711.00	kpa
MAX. SHEAR STRESS WITH S.F. APPLIED:	3,750.00	psi	25,855.50	kpa

DEFINITION OF SYMBOLS:	
Aw =>	TOTAL LENGTH OF WELD (INCHES)
F =>	ALLOWABLE LOAD ON WELD (LBS/IN2 OF WELD LEG AREA)
w =>	FILLET WELD LEG DIMENSION (IN)
Sh =>	MATERIAL SHEAR STRENGTH (LBS/IN^2)
d =>	MIN DISTANCE FROM LIFTING LUG SLOT TO OUTSIDE EDGE (IN)
t =>	MATERIAL THICKNESS (IN)
Wl =>	MAXIMUM ALLOWABLE WELD LOAD (LBS)
Sl =>	MAXIMUM ALLOWABLE SHEAR LOAD (LBS)

Aw:	24.00	in	609.60	mm
F:	3,750	psi	25,855.50	kpa
w:	0.5	in	12.70	mm
Sh:	3,750	psi	25,855.50	kpa

t (Actual):	1.25	in	t (Min):	1.1111	in
t (Actual):	31.75	mm	t (Min):	28.2222	mm

d:	1.5	in	38.10	mm

MAXIMUM ALLOWABLE WELD LOAD: Wl = Aw*w*F

Wl = 45,000.00 lbs | 20,411.55 kg

MAXIMUM ALLOWABLE SHEAR LOAD: Sl= d*t*2*Sh

Sl = 14,062.50 lbs | 6,378.61 kg

MAXIMUM LOAD TO BE THE LESSER OF "Wl" OR "Sl"

MAX SINGLE LIFT LUG LOAD SHALL BE NO MORE THAN: 14,062.50 lbs | 6,378.61 kg

MAXIMUM TOTAL LOAD TO BE LIFTED: 50,000.00 lbs

LIFT LUG QTY:	4			
EACH LUG TO LIFT:	12500.00	lbs	5669.88	kg

BASED ON THE CALCULATIONS, THE REQUIRED THICKNESS EXCEEDS THE MINIMUM REQUIREMENT

THIS DESIGN PASSES

THE THICKNESS RATIO IS: 0.89

NOTE: The thickness ratio and reduction in minimum design metal temperature will allow the designer to rate specific materials at lower temperatures without the need for impact testing based on UCS-66, IMPACT TEST EXEMPTION CURVES, Section VIII, Div. 1, page 171

KBR

ACCEPTANCE
FOR ENGINEERING USE

THIS DOCUMENT IS:

ACCEPTED	(Code 1) X
ACCEPTED WITH COMMENTS	(Code 2)
NOT ACCEPTED	(Code 3)
NOT REVIEWED	(Code 4)

ACCEPTANCE DOES NOT RELIEVE SUPPLIER FROM FURNISHING MATERIAL IN CONFORMANCE WITH ORDER. REFER TO SDR-1 FOR FULL DEFINITION OF ACCEPTANCE CONDITIONS.

DISCIPLINE MJ BY TST

DATE 28 DEC 11

Created By: Daniel W. Brinton
Date: 6/17/2010

Project: Kemper County IGCC, UNIT 1
Service: CO2 Dehydration Package
Tag No.: PG1080 / PG2080
KBR Requisition No.: C452-MJ-TRQ-ML4-000
Southern Co. PO No.: MPC 10026889

Southern Company Generation **Kemper County**
MM84869 C Unit 1

SPX FLOW TECHNOLOGY PO: MPC10026889
1471495.1-1 Rev: NA
IGCC - GASIFIER -TRANSPORT AIR DRYERS - LIFTING LUG MAXIMUM LOAD

SPX Flow Technology USA, Inc.

4647 SW 40th Ave Ocala, Florida 34474

Date Printed: 5/16/2012

Project Description

Project: Kemper County IGCC, Unit 1
Service: CO2 Dehydration Unit
Tag No.: PG1080 / PG2080
KBR Requisition No.: C452-MJ-TRQ-ML4-0001
Southern Co. PO No.: MPC10026889

Vessel Tag no.: PG1080-DR A/B & PG2080-DR A/B

KBR

ACCEPTANCE
FOR ENGINEERING USE

THIS DOCUMENT IS:

ACCEPTED	(Code 1) X
ACCEPTED WITH COMMENTS	(Code 2)
NOT ACCEPTED	(Code 3)
NOT REVIEWED	(Code 4)

ACCEPTANCE DOES NOT RELIEVE SUPPLIER FROM FURNISHING MATERIAL IN CONFORMANCE WITH ORDER. REFER TO SDR-1 FOR FULL DEFINITION OF ACCEPTANCE CONDITIONS.

DISCIPLINE MJ BY TST
DATE 11 JUN 12

Southern Company Generation **Kemper County**
MM84871 B Unit 1

SPX FLOW TECHNOLOGY PO: MPC10026889
7404131-PG-1080 Rev: NA
IGCC - GASIFIER - MULTIPAGE - CO2 DEHYDRATION UNIT - ASSEMBLY CHA

SPX Flow Technology USA, Inc.
4647 SW 40th Ave Ocala, Florida 34474

Date Printed: 5/16/2012

CUSTOMER

Southern Company
Project- Kemper County IGCC, Unit 1
Birmingham, AL 35202

VESSEL LOCATION

Mississippi Power Company

Kemper County
, MS 39352

VESSEL DESCRIPTION

Service - CO2 Dehydration Units

Vessel designed per the ASME Boiler & Pressure Vessel Code,
Section VIII, Division 1, 2010 Edition
with DesignCalcs, Version: 2012.4
Vessel is ASME Code Stamped

Wind Analysis performed in accordance with ASCE 7-05
Seismic Analysis performed in accordance with ASCE 7-05

Job No: 7404131
Vessel Number: PG-1080 2080
Desiccant Chamber No.: PG1080-DR A/B & PG2080-DR A/B

NAMEPLATE INFORMATION

Vessel MAWP:	350.00 PSI at 450 ℉
MDMT:	10 ℉ at 350.00 PSI
Serial Number(s):	_____
National Board Number(s):	_____
Year Built:	2011
Radiography:	RT 1
Postweld Heat Treated:	NONE
Construction Type:	W

Notes

Project: Kemper County IGCC, Unit 1
Service - CO2 Dehydration Unit
Desiccant Chamber No.: PG1080-DRA/DRB & PG2080-DRA/DRB
Nameplates stamped with Vessel Tag Numbers and "WBS AREA 180"

Signatures

Designed by::_____ Date: ____/____/____

Approved by::_____ Date: ____/____/____

Table of Contents

SPX Flow Technology USA, Inc.

132" OD ROLLED SHELL x 96" LG

Customer: **Southern Company**
Job No: 7404131
Number: 1

Vessel Number: PG-1080 2080
Mark Number: S1

Date Printed: 5/16/2012

Cylindrical Shell Design Information

Design Pressure:	350.00	PSI	Design Temperature:	450	℉
Static Head:	3.00	PSI	Long. Joint Efficiency:	100	%
Shell Material:	SA-516 Gr. 70		Factor B Chart:	CS-2	
Material Condition:	Normalized		Material Stress (hot):	20000	PSI
Shell Length:	96.0000	in.	Material Stress (cold):	20000	PSI
			Compressive Stress:	13100	PSI
Corrosion Allowance:	0.0625	in.	Actual Circumferential Stress:	16066	PSI
External Corrosion Allowance:	0.0000	in.	Actual Longitudinal Stress:	7857	PSI
Outside Diameter (new):	132.0000	in.	Extreme Fiber Elongation:	1.15	%
Outside Diameter (corroded):	132.0000	in.	Specific Gravity:	1.00	
Shell Surface Area:	276.46	Sq. Ft.	Weight of Fluid:	45381.19	lb.
Shell Estimated Volume:	5432.23	Gal.	Total Flooded Shell Weight:	61911.49	lb.
Circ. Joint Efficiency:	100	%	Shell Weight:	16530.31	lb.

Minimum Design Metal Temperature Data

Min. Temperature Curve:	D	Pressure at MDMT:	350.00 PSI
UCS-66(b) reduction:	Yes	Minimum Design Metal Temperature:	10 ℉
UCS-68(c) reduction:	No	Computed Minimum Temperature:	-34 ℉

Design Thickness Calculations

Longitudinal Stress Calculations per Paragraph UG-27(c)(2)

$$t = \frac{PR}{2SE + 0.4P} = \frac{353.00 * 64.5625}{2 * 20000 * 1.00 + 0.4 * 353.00} = 0.5678 + 0.0625_{\text{(corrosion)}} + 0.0000_{\text{(ext. corrosion)}}$$ = minimum of **0.6303** in.

Circumferential Stress Calculations per Appendix 1-1(a)(1)

$$t = \frac{PR_o}{SE + 0.4P} = \frac{353.00 * 66.0000}{20000 * 1.00 + 0.4 * 353.00} = 1.1568 + 0.0625_{\text{(corrosion)}} + 0.0000_{\text{(ext. corrosion)}}$$ = minimum of **1.2193** in.

External loads do not control design.

Nominal Shell Thickness Selected = **1.5000** in.

SPX Flow Technology USA, Inc.

132" OD HEAD, 2:1 ELLIP, BOTTOM

Customer: **Southern Company**
Job No: 7404131
Number: 1

Vessel Number: PG-1080 2080
Mark Number: H1

Date Printed: 5/16/2012

Ellipsoidal Head Design Information

Design Pressure:	350.00	PSI	Design Temperature:	450	F
Static Head:	0.00	PSI	Joint Efficiency:	100	%
Head Material:	SA-516 Gr. 70		Factor B Chart:	CS-2	
Material Condition:	Normalized		Material Stress (hot):	20000	PSI
Corrosion Allowance:	0.0625	in.	Material Stress (cold):	20000	PSI
External Corrosion Allowance:	0.0000	in.	Actual Head Stress:	17285	PSI
Head Location:	Bottom		Straight Flange :	2.0000	in.
Outside Diameter :	132.0000	in.	Head Depth (ho) :	33.7500	in.
Thin Out :	0.1250	in.			
$K = \frac{1}{6}[2 + (D/2h)^2]$:	1.00				
Extreme Fiber Elongation:	5.07	% (Hot Formed Head meets UCS-79(d) criteria)			
Head Surface Area:	134.60	Sq. Ft.	Specific Gravity:	1.00	
Head Estimated Volume:	1329.77	Gal.	Weight of Fluid:	11090.24	lb.
Head Weight:	8140.83	lb.	Total Flooded Head Weight:	19231.07	lb.

Minimum Design Metal Temperature Data

Min. Temperature Curve:	D	Pressure at MDMT:	350.00	PSI
UCS-66(b) reduction:	Yes	Minimum Design Metal Temperature:	10	F
UCS-68(c) reduction:	No	Computed Minimum Temperature:	-31	F

Design Thickness Calculations

Design Thickness Calculations per Appendix 1-4(c)

$$t = \frac{PD_oK}{2SE + 2P(K - 0.1)} = \frac{350.00 * 132.0000 * 1.00}{2 * 20000 * 1.00 + 2 * 350.00 * (1.00 - 0.1)}$$

$= 1.1371 + 0.0625_{\text{(corrosion)}} + 0.0000_{\text{(ext. corrosion)}} + 0.1250_{\text{(thin out)}}$ = minimum of **1.3246** in.

Nominal Head Thickness Selected = **1.5000** in.

SPX Flow Technology USA, Inc.

132" OD HEAD, 2:1 ELLIP, TOP

Customer: **Southern Company**
Job No: 7404131
Number: 2

Vessel Number: PG-1080 2080
Mark Number: H2

Date Printed: 5/16/2012

Ellipsoidal Head Design Information

Design Pressure:	350.00	PSI	Design Temperature:	450	F
Static Head:	0.00	PSI	Joint Efficiency:	100	%
Head Material:	SA-516 Gr. 70		Factor B Chart:	CS-2	
Material Condition:	Normalized		Material Stress (hot):	20000	PSI
Corrosion Allowance:	0.0625	in.	Material Stress (cold):	20000	PSI
External Corrosion Allowance:	0.0000	in.	Actual Head Stress:	17285	PSI
Head Location:	Top		Straight Flange :	2.0000	in.
Outside Diameter :	132.0000	in.	Head Depth (ho) :	33.7500	in.
Thin Out :	0.1250	in.			
$K = \frac{1}{6}[2 + (D/2h)^2]$:	1.00				
Extreme Fiber Elongation:	5.07	% (Hot Formed Head meets UCS-79(d) criteria)			
Head Surface Area:	134.60	Sq. Ft.	Specific Gravity:	1.00	
Head Estimated Volume:	1329.77	Gal.	Weight of Fluid:	11090.24	lb.
Head Weight:	8140.83	lb.	Total Flooded Head Weight:	19231.07	lb.

Minimum Design Metal Temperature Data

Min. Temperature Curve:	D	Pressure at MDMT:	350.00	PSI
UCS-66(b) reduction:	Yes	Minimum Design Metal Temperature:	10	F
UCS-68(c) reduction:	No	Computed Minimum Temperature:	-31	F

Design Thickness Calculations

Design Thickness Calculations per Appendix 1-4(c)

$$t = \frac{PD_oK}{2SE + 2P(K - 0.1)} = \frac{350.00 * 132.0000 * 1.00}{2 * 20000 * 1.00 + 2 * 350.00 * (1.00 - 0.1)}$$

$= 1.1371 + 0.0625_{(corrosion)} + 0.0000_{(ext.\ corrosion)} + 0.1250_{(thin\ out)}$ = minimum of **1.3246** in.

Nominal Head Thickness Selected = **1.5000** in.

SPX Flow Technology USA, Inc.

SMLS LWN (FVC) - 20" MANWAY IN SHELL

Customer: **Southern Company**
Job No: 7404131
Number: 2
ID Number: 2

Vessel Number: PG-1080 2080
Mark Number: N2

Date Printed: 5/16/2012

Nozzle Design Information

Design Pressure:	350.00	PSI	Design Temperature:	450	°F
Static Head:	3.00	PSI	Nozzle Efficiency (E):	100	%
Nozzle Material:	SA-105		Joint Efficiency (E_1):	1.00	
			Factor B Chart:	CS-2	
External Projection:	6.0000	in.	Allowable Stress at Design Temperature (S_n):	19800	PSI
Internal Projection:	3.0000	in.	Allowable Stress at Ambient Temperature:	20000	PSI
Inside Corrosion Allowance:	0.0625	in.	Correction Factor (F):	1.00	
External Corrosion Allowance:	0.0000	in.	Nozzle Path:	None	
Nozzle ID (new):	20.0000	in.	Nozzle Wall Thickness(new):	1.5600	in.
Nozzle ID (corroded):	20.1250	in.	Nozzle Wall Thickness(corroded):	1.4975	in.
			Upper Weld Leg Size(Weld 41):	0.3750	in.
			Internal Weld Leg Size(Weld 43):	0.5000	in.
			Outside Groove Weld Depth:	1.5000	in.

Minimum Design Metal Temperature

Min. Temp. Curve:	B	Pressure at MDMT:	350.00 PSI
UCS-66(b) reduction:	Yes	Minimum Design Metal Temperature:	10 °F
UCS-68(c) reduction:	No	Computed Minimum Temperature:	-89 °F

Host Component: Shell 1 - 132" OD ROLLED SHELL x 96" LG

Material:	SA-516 Gr. 70	Shell wall thickness(new):	1.5000 in.
Material Stress(S_V):	20000 PSI	Shell wall thickness(corroded):	1.4375 in.

Nozzle Detail Information

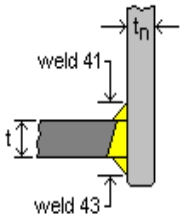


Fig. UW-16.1 (d)

Upper Weld Leg Size(Weld 41): 0.3750 in.

Internal Weld Leg Size(Weld 43): 0.5000 in.

Nozzle Wall Thickness(t_n): 1.5600 in.

Outside Groove Weld Depth: 1.5000 in.

Nozzle passes through the vessel, attached by a groove weld.
Nozzle is adequate for UG-45 requirements.
Opening is adequately reinforced for Internal Pressure.
Weld Strength Paths are adequate.

Required Shell Thickness per Paragraph UG-37(a)

$$\mathbf{tr} = \frac{PRo}{SE + 0.4P} = \frac{353.00 * 66.0000}{20000 * 1 + 0.4 * 353.00}$$ = **1.1567** in.

Nozzle Required Thickness Calculations

Required Nozzle Thickness for Internal Pressure per Paragraph UG-37(a)

$$\mathbf{trn} = \frac{PRn}{SE - 0.6P} = \frac{353.00 * 10.0625}{19800 * 1 - 0.6 * 353.00}$$ = **0.1813** in.

Strength Reduction Factors

fr1 $= \min\left(\frac{Sn}{Sv}, 1.0000\right) = \min\left(\frac{19800}{20000}, 1.0000\right) = 0.9900$ **fr2** $= \min\left(\frac{Sn}{Sv}, 1.0000\right) = \min\left(\frac{19800}{20000}, 1.0000\right) = 0.9900$

UG-45 Thickness Calculations

Nozzle Thickness for Pressure Loading (plus corrosion)

$$t_a = \frac{PRn}{SE - 0.6P} + Ca + \text{ext. } Ca = \frac{353.00 * 10.0625}{19800 * 1.00 - 0.6 * 353.00} + 0.0625 + 0.0000$$ = **0.2438** in.

Nozzle Thickness for Internal Pressure (plus corrosion) Based on Host

$$t_{b1} = \frac{PRo}{SE + 0.4P} + Ca + \text{ext. } Ca = \frac{353.00 * 66.0000}{20000 * 1 + 0.4 * 353.00} + 0.0625 + 0.0000$$ = **1.2192** in.

Minimum Thickness (plus corrosion) per Table UG-45

t_{b3} = minimum thickness (Table UG-45) + Ca + ext. Ca = **0.3905** in.

Nozzle Minimum Thickness Based on Host and Table UG-45

$t_b = \min[t_{b3}, \max(t_{b1}, t_{b2})]$ = **0.3905** in.

$t_{UG\text{-}45} = \max(t_a, t_b)$ = **0.3905** in.

Wall thickness = tn = **1.5600** is greater than or equal to UG-45 value of **0.3905**

Limits of Reinforcement (UG-40)

L_{par} = max(d, R_n + t + t_n) = max(20.1250, 10.0625 + 1.4375 + 1.4975) = **20.1250** in.

L_{noro} = min(2.5 t, 2.5 t_n + t_e) = min(2.5 * 1.4375, 2.5 * 1.4975 + 0.0000) = **3.5938** in.

L_{nori} = min(2.5 t, 2.5 t_i) = min(2.5 * 1.4375, 2.5 * 1.4350) = **3.5875** in.

Nozzle Reinforcement Calculations (Internal Pressure)

A = max{C [d t_r F + 2 t_n t_r F (1 - f_{r1})], 0} = max{1.0000 * [20.1250 * 1.1567 * 1.00 + 2 * 1.4975 * 1.1567 * 1.00 * (1 - 0.9900)], 0}
= **23.3132** sq. in.

A1 = max[(2 L_{par} - d) (E_1 t - F t_r) - 2 t_n (E_1 t - F t_r) (1 - f_{r1}), 0] =
max[(2 * 20.1250 - 20.1250) * (1.0000 * 1.4375 - 1.00 * 1.1567) - 2 * 1.4975 * (1.0000 * 1.4375 - 1.00 * 1.1567) * (1 - 0.9900), 0]
= **5.6427** sq. in.

A2 = max{2 min(h_o, L_{noro}) [min(t_n, L_{par} - 0.5 d) - t_{rn}] f_{r2}, 0} =
max{2 * min(6.0000, 3.5938) * [min(1.4975, 20.1250 - 0.5 * 20.1250) - 0.1813] * 0.9900, 0} = **9.3656** sq. in.

A3 = max{2 min(h, L_{nori}) min(t_i, L_{par} - 0.5 d) f_{r2}, 0} =
max{2 * min(2.9375, 3.5875) * min(1.4350, 20.1250 - 0.5 * 20.1250) * 0.9900, 0} = **8.3463** sq. in.

A41 = f_{r2} [L_{41}^2 - (L_{41} - $L_{41pareff}$)^2 - (L_{41} - $L_{41noreff}$)^2] =
0.9900 * [0.3750^2 - (0.3750 - 0.3750)^2 - (0.3750 - 0.3750)^2] = **0.1392** sq. in.

A42 = f_{r4} $L_{42pareff}$ $L_{42noreff}$ =
0.0000 * 0.0000 * 0.0000 = **0.0000** sq. in.

A43 = f_{r2} [L_{43}^2 - (L_{43} - $L_{43pareff}$)^2 - (L_{43} - $L_{43noreff}$)^2] =
0.9900 * [0.4107^2 - (0.4107 - 0.4107)^2 - (0.4107 - 0.4107)^2] = **0.1670** sq. in.

A5
= **0.0000** sq. in.

Area Available (Internal Pressure) = A1 + A2 + A3 + A41 + A42 + A43 + A5 = 23.6608 sq. in., which is **>=** A (23.3132)

Nozzle Weld Strength Calculations

Attachment Weld Strength per Paragraph UW-16 (Corroded Condition)

Weld 41 tmin = smaller of 0.75, t, or tn = smaller of 0.75, 1.4375, or 1.4975 = **0.7500** in.

$$\text{Weld 41 Leg min.} = \frac{\text{(smaller of 0.25 or (tmin * 0.7)) + ext. CA}}{0.7} = \frac{0.2500}{0.7} = \textbf{0.3571} \text{ in.}$$

Weld 41, actual weld leg = **0.3750** in.

Weld 43 tmin = smaller of 0.75, t, or tn = smaller of 0.75, 1.4375, or 1.4975 = **0.7500** in.

$$\text{Weld 43 Leg min.} = \frac{\text{(smaller of 0.25 or (tmin * 0.7)) + ca}}{0.7} = \frac{\text{(smaller of 0.25 or (0.7500 * 0.7)) + 0.0625}}{0.7} = \frac{0.3125}{0.7} = \textbf{0.4464} \text{ in.}$$

Weld 43, actual weld leg = **0.5000** in.

Unit Stresses per Paragraphs UG-45(c) and UW-15

Nozzle wall in shear = 0.70 * Sn = 0.70 * 19800 = **13860** PSI
Upper fillet, Weld 41, in shear = 0.49 * Material Stress = 0.49 * 19800 = **9702** PSI
Vessel groove weld, in tension = 0.74 * Material Stress = 0.74 * 19800 = **14652** PSI
Inner fillet, Weld 43, in shear = 0.49 * Material Stress = 0.49 * 19800 = **9702** PSI

Strength of Connection Elements

Nozzle wall in shear = ½ * π * mean nozzle diameter * tn * Nozzle wall in shear unit stress =
½ * π * 21.6225 * 1.4975 * 13860 = **704600** lb.
Upper fillet in shear = ½ * π * Nozzle OD * weld leg * upper fillet in shear unit stress = ½ * π * 23.1200 * 0.3750 * 9702 = **132100** lb.
Groove Weld in Tension = ½ * π * Nozzle OD * groove depth * groove weld tension unit stress =
½ * π * 23.1200 * 1.5000 * 14652 = **797800** lb.
Inner fillet in shear = ½ * π * Nozzle OD * weld leg * inner fillet in shear unit stress = ½ * π * 23.1200 * 0.4107 * 9702 = **144600** lb.

Load to be carried by welds, per UG-41(b)(1) and Fig. UG-41.1 sketch (a)

W = [A - A1 + 2 tn fr1(E1t - Ftr)] Sv = [23.3132 - 5.6427 + 2 * 1.4975 * 0.9900 * (1.00 * 1.4375 - 1.00 * 1.1567)] * 20000 = **370100** lb.
W1-1 = (A2 + A5 + A41 + A42) * Sv = (9.3656 + 0.0000 + 0.1392 + 0.0000) * 20000 = **190100** lb.
W2-2 = (A2 + A3 + A41 + A43 + 2 tn t fr1) Sv = (9.3656 + 8.3463 + 0.1392 + 0.1670 + 2 * 1.4975 * 1.4375 * 0.9900) * 20000 = **445600** lb.
W3-3 = (A2 + A3 + A5 + A41 + A42 + A43 + 2 tn t fr1) * Sv =
(9.3656 + 8.3463 + 0.0000 + 0.1392 + 0.0000 + 0.1670 + 2 * 1.4975 * 1.4375 * 0.9900) * 20000 = **445600** lb.

Check Strength Paths

Path 1-1 = Upper fillet in shear + Nozzle wall in shear = 132100 + 704600 = **836700** lb.
Path 2-2 = Upper fillet in shear + Groove weld in tension + Inner fillet in shear =
132100 + 797800 + 144600 = **1074500** lb.
Path 3-3 = Upper fillet in shear + Inner fillet in shear + Groove weld in tension = 132100 + 144600 + 797800 = **1074500** lb.

SPX Flow Technology USA, Inc.

SMLS LWN (FVC) - 8" DES DRAIN NOZZLE IN SHELL

Customer: **Southern Company**
Job No: 7404131
Number: 3
ID Number: 4

Vessel Number: PG-1080 2080
Mark Number: N3

Date Printed: 5/16/2012

Nozzle Design Information

Design Pressure:	350.00	PSI	Design Temperature:	450	°F
Static Head:	3.00	PSI	Nozzle Efficiency (E):	100	%
Nozzle Material:	SA-105		Joint Efficiency (E_1):	1.00	
			Factor B Chart:	CS-2	
External Projection:	5.0000	in.	Allowable Stress at Design Temperature (S_n):	19800	PSI
Internal Projection:	1.0000	in.	Allowable Stress at Ambient Temperature:	20000	PSI
Inside Corrosion Allowance:	0.0625	in.	Correction Factor (F):	1.00	
External Corrosion Allowance:	0.0000	in.	Nozzle Path:	None	
Nozzle ID (new):	8.0000	in.	Nozzle Wall Thickness(new):	1.1250	in.
Nozzle ID (corroded):	8.1250	in.	Nozzle Wall Thickness(corroded):	1.0625	in.
			Upper Weld Leg Size(Weld 41):	0.3750	in.
			Internal Weld Leg Size(Weld 43):	0.5000	in.
			Outside Groove Weld Depth:	1.5000	in.

Minimum Design Metal Temperature

Min. Temp. Curve:	B	Pressure at MDMT:	350.00 PSI
UCS-66(b) reduction:	Yes	Minimum Design Metal Temperature:	10 °F
UCS-68(c) reduction:	No	Computed Minimum Temperature:	-103 °F

Host Component: Shell 1 - 132" OD ROLLED SHELL x 96" LG

Material:	SA-516 Gr. 70	Shell wall thickness(new):	1.5000 in.
Material Stress(S_V):	20000 PSI	Shell wall thickness(corroded):	1.4375 in.

Nozzle Detail Information

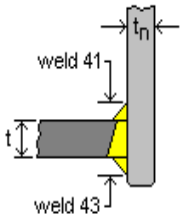


Fig. UW-16.1 (d)

Upper Weld Leg Size(Weld 41): 0.3750 in.

Internal Weld Leg Size(Weld 43): 0.5000 in.

Nozzle Wall Thickness(t_n): 1.1250 in.

Outside Groove Weld Depth: 1.5000 in.

Nozzle passes through the vessel, attached by a groove weld.
Nozzle is adequate for UG-45 requirements.
Opening is adequately reinforced for Internal Pressure.
Weld Strength Paths are adequate.

Required Shell Thickness per Paragraph UG-37(a)

$$\mathbf{tr} = \frac{PRo}{SE + 0.4P} = \frac{353.00 * 66.0000}{20000 * 1 + 0.4 * 353.00}$$ = **1.1567** in.

Nozzle Required Thickness Calculations

Required Nozzle Thickness for Internal Pressure per Paragraph UG-37(a)

$$\mathbf{trn} = \frac{PRn}{SE - 0.6P} = \frac{353.00 * 4.0625}{19800 * 1 - 0.6 * 353.00}$$ = **0.0732** in.

Strength Reduction Factors

fr1 $= \min\left(\frac{Sn}{Sv}, 1.0000\right) = \min\left(\frac{19800}{20000}, 1.0000\right) = 0.9900$ **fr2** $= \min\left(\frac{Sn}{Sv}, 1.0000\right) = \min\left(\frac{19800}{20000}, 1.0000\right) = 0.9900$

UG-45 Thickness Calculations

Nozzle Thickness for Pressure Loading (plus corrosion)

$$t_a = \frac{PRn}{SE - 0.6P} + Ca + \text{ext. } Ca = \frac{353.00 * 4.0625}{19800 * 1.00 - 0.6 * 353.00} + 0.0625 + 0.0000$$ = **0.1357** in.

Nozzle Thickness for Internal Pressure (plus corrosion) Based on Host

$$t_{b1} = \frac{PRo}{SE + 0.4P} + Ca + \text{ext. } Ca = \frac{353.00 * 66.0000}{20000 * 1 + 0.4 * 353.00} + 0.0625 + 0.0000$$ = **1.2192** in.

Minimum Thickness (plus corrosion) per Table UG-45

t_{b3} = minimum thickness (Table UG-45) + Ca + ext. Ca = **0.3815** in.

Nozzle Minimum Thickness Based on Host and Table UG-45

$t_b = \min[t_{b3}, \max(t_{b1}, t_{b2})]$ = **0.3815** in.

$t_{UG-45} = \max(t_a, t_b)$ = **0.3815** in.

Wall thickness = tn = **1.1250** is greater than or equal to UG-45 value of **0.3815**

Limits of Reinforcement (UG-40)

L_{par} = max(d, R_n + t + t_n) = max(8.1250, 4.0625 + 1.4375 + 1.0625) = **8.1250** in.
L_{noro} = min(2.5 t, 2.5 t_n + t_e) = min(2.5 * 1.4375, 2.5 * 1.0625 + 0.0000) = **2.6563** in.
L_{nori} = min(2.5 t, 2.5 t_i) = min(2.5 * 1.4375, 2.5 * 1.0000) = **2.5000** in.

Nozzle Reinforcement Calculations (Internal Pressure)

A = max{C [d t_r F + 2 t_n t_r F (1 - f_{r1})], 0} = max{1.0000 * [8.1250 * 1.1567 * 1.00 + 2 * 1.0625 * 1.1567 * 1.00 * (1 - 0.9900)], 0}
= **9.4228** sq. in.

A1 = max[(2 L_{par} - d) (E_1 t - F t_r) - 2 t_n (E_1 t - F t_r) (1 - f_{r1}), 0] =
max[(2 * 8.1250 - 8.1250) * (1.0000 * 1.4375 - 1.00 * 1.1567) - 2 * 1.0625 * (1.0000 * 1.4375 - 1.00 * 1.1567) * (1 - 0.9900), 0]
= **2.2755** sq. in.

A2 = max{2 min(h_o, L_{noro}) [min(t_n, L_{par} - 0.5 d) - t_{rn}] f_{r2}, 0} =
max{2 * min(5.0000, 2.6563) * [min(1.0625, 8.1250 - 0.5 * 8.1250) - 0.0732] * 0.9900, 0} = **5.2031** sq. in.

A3 = max{2 min(h, L_{nori}) min(t_i, L_{par} - 0.5 d) f_{r2}, 0} =
max{2 * min(0.9375, 2.5000) * min(1.0000, 8.1250 - 0.5 * 8.1250) * 0.9900, 0} = **1.8563** sq. in.

A41 = f_{r2} [L_{41}^2 - (L_{41} - $L_{41pareff}$)^2 - (L_{41} - $L_{41noreff}$)^2] =
0.9900 * [0.3750^2 - (0.3750 - 0.3750)^2 - (0.3750 - 0.3750)^2] = **0.1392** sq. in.

A42 = f_{r4} $L_{42pareff}$ $L_{42noreff}$ =
0.0000 * 0.0000 * 0.0000 = **0.0000** sq. in.

A43 = f_{r2} [L_{43}^2 - (L_{43} - $L_{43pareff}$)^2 - (L_{43} - $L_{43noreff}$)^2] =
0.9900 * [0.4107^2 - (0.4107 - 0.4107)^2 - (0.4107 - 0.4107)^2] = **0.1670** sq. in.

A5
= **0.0000** sq. in.

Area Available (Internal Pressure) = A1 + A2 + A3 + A41 + A42 + A43 + A5 = 9.6411 sq. in., which is **>=** A (9.4228)

Nozzle Weld Strength Calculations

Attachment Weld Strength per Paragraph UW-16 (Corroded Condition)

Weld 41 tmin = smaller of 0.75, t, or tn = smaller of 0.75, 1.4375, or 1.0625 = **0.7500** in.

Weld 41 Leg min. = $\frac{\text{(smaller of 0.25 or (tmin * 0.7)) + ext. CA}}{0.7} = \frac{0.2500}{0.7}$ = **0.3571** in.

Weld 41, actual weld leg = **0.3750** in.

Weld 43 tmin = smaller of 0.75, t, or tn = smaller of 0.75, 1.4375, or 1.0625 = **0.7500** in.

Weld 43 Leg min. = $\frac{\text{(smaller of 0.25 or (tmin * 0.7)) + ca}}{0.7} = \frac{\text{(smaller of 0.25 or (0.7500 * 0.7)) + 0.0625}}{0.7} = \frac{0.3125}{0.7}$ = **0.4464** in.

Weld 43, actual weld leg = **0.5000** in.

Unit Stresses per Paragraphs UG-45(c) and UW-15

Nozzle wall in shear = 0.70 * Sn = 0.70 * 19800 = **13860** PSI
Upper fillet, Weld 41, in shear = 0.49 * Material Stress = 0.49 * 19800 = **9702** PSI
Vessel groove weld, in tension = 0.74 * Material Stress = 0.74 * 19800 = **14652** PSI
Inner fillet, Weld 43, in shear = 0.49 * Material Stress = 0.49 * 19800 = **9702** PSI

Strength of Connection Elements

Nozzle wall in shear = ½ * π * mean nozzle diameter * tn * Nozzle wall in shear unit stress =
½ * π * 9.1875 * 1.0625 * 13860 = **212400** lb.
Upper fillet in shear = ½ * π * Nozzle OD * weld leg * upper fillet in shear unit stress = ½ * π * 10.2500 * 0.3750 * 9702 = **58500** lb.
Groove Weld in Tension = ½ * π * Nozzle OD * groove depth * groove weld tension unit stress =
½ * π * 10.2500 * 1.5000 * 14652 = **353700** lb.
Inner fillet in shear = ½ * π * Nozzle OD * weld leg * inner fillet in shear unit stress = ½ * π * 10.2500 * 0.4107 * 9702 = **64100** lb.

Load to be carried by welds, per UG-41(b)(1) and Fig. UG-41.1 sketch (a)

W = [A - A1 + 2 tn fr1(E1t - Ftr)] Sv = [9.4228 - 2.2755 + 2 * 1.0625 * 0.9900 * (1.00 * 1.4375 - 1.00 * 1.1567)] * 20000 = **154800** lb.
W1-1 = (A2 + A5 + A41 + A42) * Sv = (5.2031 + 0.0000 + 0.1392 + 0.0000) * 20000 = **106800** lb.
W2-2 = (A2 + A3 + A41 + A43 + 2 tn t fr1) Sv = (5.2031 + 1.8563 + 0.1392 + 0.1670 + 2 * 1.0625 * 1.4375 * 0.9900) * 20000 = **207800** lb.
W3-3 = (A2 + A3 + A5 + A41 + A42 + A43 + 2 tn t fr1) * Sv =
(5.2031 + 1.8563 + 0.0000 + 0.1392 + 0.0000 + 0.1670 + 2 * 1.0625 * 1.4375 * 0.9900) * 20000 = **207800** lb.

Check Strength Paths

Path 1-1 = Upper fillet in shear + Nozzle wall in shear = 58500 + 212400 = **270900** lb.
Path 2-2 = Upper fillet in shear + Groove weld in tension + Inner fillet in shear =
58500 + 353700 + 64100 = **476300** lb.
Path 3-3 = Upper fillet in shear + Inner fillet in shear + Groove weld in tension = 58500 + 64100 + 353700 = **476300** lb.

SPX Flow Technology USA, Inc.

SMLS LWN (FVC) - 8" DES DRAIN NOZZLE IN SHELL

Customer: **Southern Company**
Job No: 7404131
Number: 4
ID Number: 4

Vessel Number: PG-1080 2080
Mark Number: N4

Date Printed: 5/16/2012

Nozzle Design Information

Design Pressure:	350.00	PSI	Design Temperature:	450	°F
Static Head:	3.00	PSI	Nozzle Efficiency (E):	100	%
Nozzle Material:	SA-105		Joint Efficiency (E_1):	1.00	
			Factor B Chart:	CS-2	
External Projection:	6.0000	in.	Allowable Stress at Design Temperature (S_n):	19800	PSI
Internal Projection:	1.0000	in.	Allowable Stress at Ambient Temperature:	20000	PSI
Inside Corrosion Allowance:	0.0625	in.	Correction Factor (F):	1.00	
External Corrosion Allowance:	0.0000	in.	Nozzle Path:	None	
Nozzle ID (new):	8.0000	in.	Nozzle Wall Thickness(new):	1.1300	in.
Nozzle ID (corroded):	8.1250	in.	Nozzle Wall Thickness(corroded):	1.0675	in.
			Upper Weld Leg Size(Weld 41):	0.3750	in.
			Internal Weld Leg Size(Weld 43):	0.5000	in.
			Outside Groove Weld Depth:	1.5000	in.

Minimum Design Metal Temperature

Min. Temp. Curve:	B	Pressure at MDMT:	350.00 PSI
UCS-66(b) reduction:	Yes	Minimum Design Metal Temperature:	10 °F
UCS-68(c) reduction:	No	Computed Minimum Temperature:	-103 °F

Host Component: Shell 1 - 132" OD ROLLED SHELL x 96" LG

Material:	SA-516 Gr. 70	Shell wall thickness(new):	1.5000 in.
Material Stress(S_V):	20000 PSI	Shell wall thickness(corroded):	1.4375 in.

Nozzle Detail Information

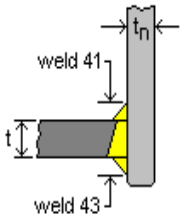


Fig. UW-16.1 (d)

Upper Weld Leg Size(Weld 41): 0.3750 in.

Internal Weld Leg Size(Weld 43): 0.5000 in.

Nozzle Wall Thickness(t_n): 1.1300 in.

Outside Groove Weld Depth: 1.5000 in.

Nozzle passes through the vessel, attached by a groove weld.
Nozzle is adequate for UG-45 requirements.
Opening is adequately reinforced for Internal Pressure.
Weld Strength Paths are adequate.

Required Shell Thickness per Paragraph UG-37(a)

$$\mathbf{tr} = \frac{PRo}{SE + 0.4P} = \frac{353.00 * 66.0000}{20000 * 1 + 0.4 * 353.00}$$ = **1.1567** in.

Nozzle Required Thickness Calculations

Required Nozzle Thickness for Internal Pressure per Paragraph UG-37(a)

$$\mathbf{trn} = \frac{PRn}{SE - 0.6P} = \frac{353.00 * 4.0625}{19800 * 1 - 0.6 * 353.00}$$ = **0.0732** in.

Strength Reduction Factors

fr1 $= \min\left(\frac{Sn}{Sv}, 1.0000\right) = \min\left(\frac{19800}{20000}, 1.0000\right) = 0.9900$ **fr2** $= \min\left(\frac{Sn}{Sv}, 1.0000\right) = \min\left(\frac{19800}{20000}, 1.0000\right) = 0.9900$

UG-45 Thickness Calculations

Nozzle Thickness for Pressure Loading (plus corrosion)

$$t_a = \frac{PRn}{SE - 0.6P} + Ca + \text{ext. } Ca = \frac{353.00 * 4.0625}{19800 * 1.00 - 0.6 * 353.00} + 0.0625 + 0.0000$$ = **0.1357** in.

Nozzle Thickness for Internal Pressure (plus corrosion) Based on Host

$$t_{b1} = \frac{PRo}{SE + 0.4P} + Ca + \text{ext. } Ca = \frac{353.00 * 66.0000}{20000 * 1 + 0.4 * 353.00} + 0.0625 + 0.0000$$ = **1.2192** in.

Minimum Thickness (plus corrosion) per Table UG-45

t_{b3} = minimum thickness (Table UG-45) + Ca + ext. Ca = **0.3815** in.

Nozzle Minimum Thickness Based on Host and Table UG-45

$t_b = \min[t_{b3}, \max(t_{b1}, t_{b2})]$ = **0.3815** in.

$t_{UG\text{-}45} = \max(t_a, t_b)$ = **0.3815** in.

Wall thickness = tn = **1.1300** is greater than or equal to UG-45 value of **0.3815**

Limits of Reinforcement (UG-40)

L_{par} = max(d, R_n + t + t_n) = max(8.1250, 4.0625 + 1.4375 + 1.0675) = **8.1250** in.
L_{noro} = min(2.5 t, 2.5 t_n + t_e) = min(2.5 * 1.4375, 2.5 * 1.0675 + 0.0000) = **2.6688** in.
L_{nori} = min(2.5 t, 2.5 t_i) = min(2.5 * 1.4375, 2.5 * 1.0050) = **2.5125** in.

Nozzle Reinforcement Calculations (Internal Pressure)

A = max{C [d t_r F + 2 t_n t_r F (1 - f_{r1})], 0} = max{1.0000 * [8.1250 * 1.1567 * 1.00 + 2 * 1.0675 * 1.1567 * 1.00 * (1 - 0.9900)], 0}
= **9.4229** sq. in.

A1 = max[(2 L_{par} - d) (E_1 t - F t_r) - 2 t_n (E_1 t - F t_r) (1 - f_{r1}), 0] =
max[(2 * 8.1250 - 8.1250) * (1.0000 * 1.4375 - 1.00 * 1.1567) - 2 * 1.0675 * (1.0000 * 1.4375 - 1.00 * 1.1567) * (1 - 0.9900), 0]
= **2.2755** sq. in.

A2 = max{2 min(h_o, L_{noro}) [min(t_n, L_{par} - 0.5 d) - t_{rn}] f_{r2}, 0} =
max{2 * min(6.0000, 2.6688) * [min(1.0675, 8.1250 - 0.5 * 8.1250) - 0.0732] * 0.9900, 0} = **5.2540** sq. in.

A3 = max{2 min(h, L_{nori}) min(t_i, L_{par} - 0.5 d) f_{r2}, 0} =
max{2 * min(0.9375, 2.5125) * min(1.0050, 8.1250 - 0.5 * 8.1250) * 0.9900, 0} = **1.8655** sq. in.

A41 = f_{r2} [L_{41}^2 - (L_{41} - $L_{41pareff}$)^2 - (L_{41} - $L_{41noreff}$)^2] =
0.9900 * [0.3750^2 - (0.3750 - 0.3750)^2 - (0.3750 - 0.3750)^2] = **0.1392** sq. in.

A42 = f_{r4} $L_{42pareff}$ $L_{42noreff}$ =
0.0000 * 0.0000 * 0.0000 = **0.0000** sq. in.

A43 = f_{r2} [L_{43}^2 - (L_{43} - $L_{43pareff}$)^2 - (L_{43} - $L_{43noreff}$)^2] =
0.9900 * [0.4107^2 - (0.4107 - 0.4107)^2 - (0.4107 - 0.4107)^2] = **0.1670** sq. in.

A5
= **0.0000** sq. in.

Area Available (Internal Pressure) = A1 + A2 + A3 + A41 + A42 + A43 + A5 = 9.7013 sq. in., which is **>=** A (9.4229)

Nozzle Weld Strength Calculations

Attachment Weld Strength per Paragraph UW-16 (Corroded Condition)

Weld 41 tmin = smaller of 0.75, t, or tn = smaller of 0.75, 1.4375, or 1.0675 = **0.7500** in.

$$\text{Weld 41 Leg min.} = \frac{\text{(smaller of 0.25 or (tmin * 0.7)) + ext. CA}}{0.7} = \frac{0.2500}{0.7}$$ = **0.3571** in.

Weld 41, actual weld leg = **0.3750** in.

Weld 43 tmin = smaller of 0.75, t, or tn = smaller of 0.75, 1.4375, or 1.0675 = **0.7500** in.

$$\text{Weld 43 Leg min.} = \frac{\text{(smaller of 0.25 or (tmin * 0.7)) + ca}}{0.7} = \frac{\text{(smaller of 0.25 or (0.7500 * 0.7)) + 0.0625}}{0.7} = \frac{0.3125}{0.7}$$ = **0.4464** in.

Weld 43, actual weld leg = **0.5000** in.

Unit Stresses per Paragraphs UG-45(c) and UW-15

Nozzle wall in shear = 0.70 * Sn = 0.70 * 19800 = **13860** PSI
Upper fillet, Weld 41, in shear = 0.49 * Material Stress = 0.49 * 19800 = **9702** PSI
Vessel groove weld, in tension = 0.74 * Material Stress = 0.74 * 19800 = **14652** PSI
Inner fillet, Weld 43, in shear = 0.49 * Material Stress = 0.49 * 19800 = **9702** PSI

Strength of Connection Elements

Nozzle wall in shear = ½ * π * mean nozzle diameter * tn * Nozzle wall in shear unit stress =
½ * π * 9.1925 * 1.0675 * 13860 = **213500** lb.
Upper fillet in shear = ½ * π * Nozzle OD * weld leg * upper fillet in shear unit stress = ½ * π * 10.2600 * 0.3750 * 9702 = **58600** lb.
Groove Weld in Tension = ½ * π * Nozzle OD * groove depth * groove weld tension unit stress =
½ * π * 10.2600 * 1.5000 * 14652 = **354000** lb.
Inner fillet in shear = ½ * π * Nozzle OD * weld leg * inner fillet in shear unit stress = ½ * π * 10.2600 * 0.4107 * 9702 = **64200** lb.

Load to be carried by welds, per UG-41(b)(1) and Fig. UG-41.1 sketch (a)

W = [A - A1 + 2 tn fr1(E1t - Ftr)] Sv = [9.4229 - 2.2755 + 2 * 1.0675 * 0.9900 * (1.00 * 1.4375 - 1.00 * 1.1567)] * 20000 = **154800** lb.
W1-1 = (A2 + A5 + A41 + A42) * Sv = (5.2540 + 0.0000 + 0.1392 + 0.0000) * 20000 = **107900** lb.
W2-2 = (A2 + A3 + A41 + A43 + 2 tn t fr1) Sv = (5.2540 + 1.8655 + 0.1392 + 0.1670 + 2 * 1.0675 * 1.4375 * 0.9900) * 20000 = **209300** lb.
W3-3 = (A2 + A3 + A5 + A41 + A42 + A43 + 2 tn t fr1) * Sv =
(5.2540 + 1.8655 + 0.0000 + 0.1392 + 0.0000 + 0.1670 + 2 * 1.0675 * 1.4375 * 0.9900) * 20000 = **209300** lb.

Check Strength Paths

Path 1-1 = Upper fillet in shear + Nozzle wall in shear = 58600 + 213500 = **272100** lb.
Path 2-2 = Upper fillet in shear + Groove weld in tension + Inner fillet in shear =
58600 + 354000 + 64200 = **476800** lb.
Path 3-3 = Upper fillet in shear + Inner fillet in shear + Groove weld in tension = 58600 + 64200 + 354000 = **476800** lb.

SPX Flow Technology USA, Inc.

SMLS LWN (FVC) - 20" INLET NOZZLE IN TOP HEAD

Customer: **Southern Company**
Job No: 7404131
Number: 6
ID Number: 6

Vessel Number: PG-1080 2080
Mark Number: N6

Date Printed: 5/16/2012

Nozzle Design Information

Design Pressure:	350.00	PSI	Design Temperature:	450	°F
Static Head:	0.00	PSI	Nozzle Efficiency (E):	100	%
Nozzle Material:	SA-105		Joint Efficiency (E_1):	1.00	
			Factor B Chart:	CS-2	
External Projection:	6.0000	in.	Allowable Stress at Design Temperature (S_n):	19800	PSI
Internal Projection:	2.7500	in.	Allowable Stress at Ambient Temperature:	20000	PSI
Inside Corrosion Allowance:	0.0625	in.	Correction Factor (F):	1.00	
External Corrosion Allowance:	0.0000	in.	Nozzle Path:	None	
Nozzle ID (new):	20.0000	in.	Nozzle Wall Thickness(new):	1.5626	in.
Nozzle ID (corroded):	20.1250	in.	Nozzle Wall Thickness(corroded):	1.5001	in.
			Upper Weld Leg Size(Weld 41):	0.3750	in.
			Internal Weld Leg Size(Weld 43):	0.5000	in.
			Outside Groove Weld Depth:	1.5000	in.

Minimum Design Metal Temperature

Min. Temp. Curve:	B	Pressure at MDMT:	350.00 PSI
UCS-66(b) reduction:	Yes	Minimum Design Metal Temperature:	10 °F
UCS-68(c) reduction:	No	Computed Minimum Temperature:	-89 °F

Host Component: Head 2 - 132" OD HEAD, 2:1 ELLIP, TOP

Material:	SA-516 Gr. 70	Head wall thickness(new):	1.5000 in.
Material Stress(S_V):	20000 PSI	Head wall thickness - thin out (corroded):	1.3125 in.

Nozzle Detail Information

Upper Weld Leg Size(Weld 41): 0.3750 in.

Internal Weld Leg Size(Weld 43): 0.5000 in.

Nozzle Wall Thickness(t_n): 1.5626 in.

Outside Groove Weld Depth: 1.5000 in.

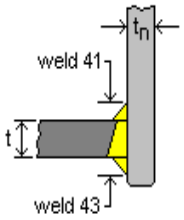


Fig. UW-16.1 (d)

Nozzle passes through the vessel, attached by a groove weld.
Nozzle is adequate for UG-45 requirements.
Opening is adequately reinforced for Internal Pressure.
Weld Strength Paths are adequate.

Required Head Thickness per Paragraph UG-37(a)

$$\mathbf{tr} = \frac{P\ K1\ Do}{(2SE + 0.8P)} = \frac{350.00 * 0.9000 * 132.0000}{(2 * 20000 * 1 + 0.8 * 350.00)}$$ = **1.0323** in.

Nozzle Required Thickness Calculations

Required Nozzle Thickness for Internal Pressure per Paragraph UG-37(a)

$$\mathbf{trn} = \frac{PRn}{SE - 0.6P} = \frac{350.00 * 10.0625}{19800 * 1 - 0.6 * 350.00}$$ = **0.1798** in.

Strength Reduction Factors

$$\mathbf{fr1} = \min\left(\frac{Sn}{Sv}, 1.0000\right) = \min\left(\frac{19800}{20000}, 1.0000\right) = 0.9900 \qquad \mathbf{fr2} = \min\left(\frac{Sn}{Sv}, 1.0000\right) = \min\left(\frac{19800}{20000}, 1.0000\right) = 0.9900$$

UG-45 Thickness Calculations

Nozzle Thickness for Pressure Loading (plus corrosion)

$$t_a = \frac{PRn}{SE - 0.6P} + Ca + ext.\ Ca = \frac{350.00 * 10.0625}{19800 * 1.00 - 0.6 * 350.00} + 0.0625 + 0.0000$$ = **0.2423** in.

Nozzle Thickness for Internal Pressure (plus corrosion) Based on Host

$$t_{b1} = \frac{P\ K\ Do}{(2SE + 2P(K - 0.1))} + Ca + ext.\ Ca = \frac{350.00 * 1.0000 * 132.0000}{(2 * 20000 * 1 + 2 * 350.00 * (1.0000 - 0.1))} + 0.0625 + 0.0000$$ = **1.1996** in.

Minimum Thickness (plus corrosion) per Table UG-45

t_{b3} = minimum thickness (Table UG-45) + Ca + ext. Ca = **0.3905** in.

Nozzle Minimum Thickness Based on Host and Table UG-45

$t_b = \min[t_{b3}, \max(t_{b1}, t_{b2})]$ = **0.3905** in.

$t_{UG\text{-}45} = \max(t_a, t_b)$ = **0.3905** in.

Wall thickness = tn = **1.5626** is greater than or equal to UG-45 value of **0.3905**

Limits of Reinforcement (UG-40)

L_{par} = max(d, R_n + t + t_n) = max(20.1250, 10.0625 + 1.3125 + 1.5001) = **20.1250** in.
L_{noro} = min(2.5 t, 2.5 t_n + t_e) = min(2.5 * 1.3125, 2.5 * 1.5001 + 0.0000) = **3.2813** in.
L_{nori} = min(2.5 t, 2.5 t_i) = min(2.5 * 1.3125, 2.5 * 1.4376) = **3.2813** in.

Nozzle Reinforcement Calculations (Internal Pressure)

A = max{C [d t_r F + 2 t_n t_r F (1 - f_{r1})], 0} = max{1.0000 * [20.1250 * 1.0323 * 1.00 + 2 * 1.5001 * 1.0323 * 1.00 * (1 - 0.9900)], 0}
= **20.8060** sq. in.

A1 = max[(2 L_{par} - d) (E_1 t - F t_r) - 2 t_n (E_1 t - F t_r) (1 - f_{r1}), 0] =
max[(2 * 20.1250 - 20.1250) * (1.0000 * 1.3125 - 1.00 * 1.0323) - 2 * 1.5001 * (1.0000 * 1.3125 - 1.00 * 1.0323) * (1 - 0.9900), 0]
= **5.6306** sq. in.

A2 = max{2 min(h_o, L_{noro}) [min(t_n, L_{par} - 0.5 d) - t_{rn}] f_{r2}, 0} =
max{2 * min(6.0000, 3.2813) * [min(1.5001, 20.1250 - 0.5 * 20.1250) - 0.1798] * 0.9900, 0} = **8.5778** sq. in.

A3 = max{2 min(h, L_{nori}) min(t_i, L_{par} - 0.5 d) f_{r2}, 0} =
max{2 * min(2.6875, 3.2813) * min(1.4376, 20.1250 - 0.5 * 20.1250) * 0.9900, 0} = **7.6498** sq. in.

A41 = f_{r2} [L_{41}^2 - (L_{41} - $L_{41pareff}$)^2 - (L_{41} - $L_{41noreff}$)^2] =
0.9900 * [0.3750^2 - (0.3750 - 0.3750)^2 - (0.3750 - 0.3750)^2] = **0.1392** sq. in.

A42 = f_{r4} $L_{42pareff}$ $L_{42noreff}$ =
0.0000 * 0.0000 * 0.0000 = **0.0000** sq. in.

A43 = f_{r2} [L_{43}^2 - (L_{43} - $L_{43pareff}$)^2 - (L_{43} - $L_{43noreff}$)^2] =
0.9900 * [0.4107^2 - (0.4107 - 0.4107)^2 - (0.4107 - 0.4107)^2] = **0.1670** sq. in.

A5
= **0.0000** sq. in.

Area Available (Internal Pressure) = A1 + A2 + A3 + A41 + A42 + A43 + A5 = 22.1645 sq. in., which is **>=** A (20.8060)

Nozzle Weld Strength Calculations

Attachment Weld Strength per Paragraph UW-16 (Corroded Condition)

Weld 41 tmin = smaller of 0.75, t, or tn = smaller of 0.75, 1.3125, or 1.5001 = **0.7500** in.

$$\text{Weld 41 Leg min.} = \frac{\text{(smaller of 0.25 or (tmin * 0.7)) + ext. CA}}{0.7} = \frac{0.2500}{0.7} = \textbf{0.3571} \text{ in.}$$

Weld 41, actual weld leg = **0.3750** in.

Weld 43 tmin = smaller of 0.75, t, or tn = smaller of 0.75, 1.3125, or 1.5001 = **0.7500** in.

$$\text{Weld 43 Leg min.} = \frac{\text{(smaller of 0.25 or (tmin * 0.7)) + ca}}{0.7} = \frac{\text{(smaller of 0.25 or (0.7500 * 0.7)) + 0.0625}}{0.7} = \frac{0.3125}{0.7} = \textbf{0.4464} \text{ in.}$$

Weld 43, actual weld leg = **0.5000** in.

Unit Stresses per Paragraphs UG-45(c) and UW-15

Nozzle wall in shear = 0.70 * Sn = 0.70 * 19800 = **13860** PSI
Upper fillet, Weld 41, in shear = 0.49 * Material Stress = 0.49 * 19800 = **9702** PSI
Vessel groove weld, in tension = 0.74 * Material Stress = 0.74 * 19800 = **14652** PSI
Inner fillet, Weld 43, in shear = 0.49 * Material Stress = 0.49 * 19800 = **9702** PSI

Strength of Connection Elements

Nozzle wall in shear = ½ * π * mean nozzle diameter * tn * Nozzle wall in shear unit stress =
½ * π * 21.6251 * 1.5001 * 13860 = **705900** lb.
Upper fillet in shear = ½ * π * Nozzle OD * weld leg * upper fillet in shear unit stress = ½ * π * 23.1252 * 0.3750 * 9702 = **132100** lb.
Groove Weld in Tension = ½ * π * Nozzle OD * groove depth * groove weld tension unit stress =
½ * π * 23.1252 * 1.5000 * 14652 = **797900** lb.
Inner fillet in shear = ½ * π * Nozzle OD * weld leg * inner fillet in shear unit stress = ½ * π * 23.1252 * 0.4107 * 9702 = **144700** lb.

Load to be carried by welds, per UG-41(b)(1) and Fig. UG-41.1 sketch (a)

W = [A - A1 + 2 tn fr1(E1t - Ftr)] Sv = [20.8060 - 5.6306 + 2 * 1.5001 * 0.9900 * (1.00 * 1.3125 - 1.00 * 1.0323)] * 20000 = **320200** lb.
W1-1 = (A2 + A5 + A41 + A42) * Sv = (8.5778 + 0.0000 + 0.1392 + 0.0000) * 20000 = **174300** lb.
W2-2 = (A2 + A3 + A41 + A43 + 2 tn t fr1) Sv = (8.5778 + 7.6498 + 0.1392 + 0.1670 + 2 * 1.5001 * 1.3125 * 0.9900) * 20000 = **408600** lb.
W3-3 = (A2 + A3 + A5 + A41 + A42 + A43 + 2 tn t fr1) * Sv =
(8.5778 + 7.6498 + 0.0000 + 0.1392 + 0.0000 + 0.1670 + 2 * 1.5001 * 1.3125 * 0.9900) * 20000 = **408600** lb.

Check Strength Paths

Path 1-1 = Upper fillet in shear + Nozzle wall in shear = 132100 + 705900 = **838000** lb.
Path 2-2 = Upper fillet in shear + Groove weld in tension + Inner fillet in shear =
132100 + 797900 + 144700 = **1074700** lb.
Path 3-3 = Upper fillet in shear + Inner fillet in shear + Groove weld in tension = 132100 + 144700 + 797900 = **1074700** lb.

SPX Flow Technology USA, Inc.

SMLS LWN (FVC) - 8" DES FILL NOZZLE IN TOP HEAD

Customer: **Southern Company**
Job No: 7404131
Number: 7
ID Number: 7

Vessel Number: PG-1080 2080
Mark Number: N7

Date Printed: 5/16/2012

Nozzle Design Information

Design Pressure:	350.00	PSI	Design Temperature:	450	°F
Static Head:	0.00	PSI	Nozzle Efficiency (E):	100	%
Nozzle Material:	SA-105		Joint Efficiency (E_1):	1.00	
			Factor B Chart:	CS-2	
External Projection:	6.0000	in.	Allowable Stress at Design Temperature (S_n):	19800	PSI
Internal Projection:	2.5625	in.	Allowable Stress at Ambient Temperature:	20000	PSI
Inside Corrosion Allowance:	0.0625	in.	Correction Factor (F):	1.00	
External Corrosion Allowance:	0.0000	in.	Nozzle Path:	None	
Nozzle ID (new):	8.0000	in.	Nozzle Wall Thickness(new):	1.1300	in.
Nozzle ID (corroded):	8.1250	in.	Nozzle Wall Thickness(corroded):	1.0675	in.
Developed Opening:	8.5196	in.	Tangential Dimension L:	38.0000	in.
			Upper Weld Leg Size(Weld 41):	0.3750	in.
			Internal Weld Leg Size(Weld 43):	0.5000	in.
			Outside Groove Weld Depth:	1.5000	in.

Minimum Design Metal Temperature

Min. Temp. Curve:	B	Pressure at MDMT:	350.00 PSI
UCS-66(b) reduction:	Yes	Minimum Design Metal Temperature:	10 °F
UCS-68(c) reduction:	No	Computed Minimum Temperature:	-103 °F

Host Component: Head 2 - 132" OD HEAD, 2:1 ELLIP, TOP

Material:	SA-516 Gr. 70	Head wall thickness(new):	1.5000 in.
Material Stress(S_V):	20000 PSI	Head wall thickness - thin out (corroded):	1.3125 in.

Nozzle Detail Information

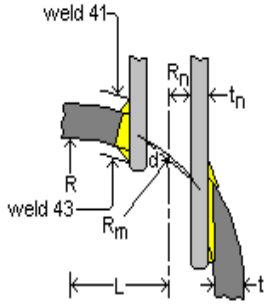


Fig. UW-16.1 (d)

Upper Weld Leg Size(Weld 41): 0.3750 in.

Internal Weld Leg Size(Weld 43): 0.5000 in.

Nozzle Wall Thickness(t_n): 1.1300 in.

Outside Groove Weld Depth: 1.5000 in.

tangential to the vessel wall, attached by a groove weld.
Nozzle is adequate for UG-45 requirements.
Opening is adequately reinforced for Internal Pressure.
Weld Strength Paths are adequate.

Required Head Thickness per Paragraph UG-37(a)

$$\mathbf{tr} = \frac{P\ K1\ Do}{(2SE + 0.8P)} = \frac{350.00 * 0.9000 * 132.0000}{(2 * 20000 * 1 + 0.8 * 350.00)}$$ = **1.0323** in.

Nozzle Required Thickness Calculations

Required Nozzle Thickness for Internal Pressure per Paragraph UG-37(a)

$$\mathbf{trn} = \frac{PRn}{SE - 0.6P} = \frac{350.00 * 4.0625}{19800 * 1 - 0.6 * 350.00}$$ = **0.0726** in.

Strength Reduction Factors

$$\mathbf{fr1} = \min\left(\frac{Sn}{Sv}, 1.0000\right) = \min\left(\frac{19800}{20000}, 1.0000\right) = 0.9900 \qquad \mathbf{fr2} = \min\left(\frac{Sn}{Sv}, 1.0000\right) = \min\left(\frac{19800}{20000}, 1.0000\right) = 0.9900$$

UG-45 Thickness Calculations

Nozzle Thickness for Pressure Loading (plus corrosion)

$$t_a = \frac{PRn}{SE - 0.6P} + Ca + ext.\ Ca = \frac{350.00 * 4.0625}{19800 * 1.00 - 0.6 * 350.00} + 0.0625 + 0.0000$$ = **0.1351** in.

Nozzle Thickness for Internal Pressure (plus corrosion) Based on Host

$$t_{b1} = \frac{P\ K\ Do}{(2SE + 2P(K - 0.1))} + Ca + ext.\ Ca = \frac{350.00 * 1.0000 * 132.0000}{(2 * 20000 * 1 + 2 * 350.00 * (1.0000 - 0.1))} + 0.0625 + 0.0000$$ = **1.1996** in.

Minimum Thickness (plus corrosion) per Table UG-45

t_{b3} = minimum thickness (Table UG-45) + Ca + ext. Ca = **0.3815** in.

Nozzle Minimum Thickness Based on Host and Table UG-45

$t_b = \min[t_{b3}, \max(t_{b1}, t_{b2})]$ = **0.3815** in.

$t_{UG\text{-}45} = \max(t_a, t_b)$ = **0.3815** in.

Wall thickness = tn = **1.1300** is greater than or equal to UG-45 value of **0.3815**

Limits of Reinforcement (UG-40)

L_{par} = max(d, R_n + t + t_n) = max(8.6446, 4.3223 + 1.3125 + 1.0675) = **8.6446** in.

L_{noro} = min(2.5 t, 2.5 t_n + t_e) = min(2.5 * 1.3125, 2.5 * 1.0675 + 0.0000) = **2.6688** in.

L_{nori} = min(2.5 t, 2.5 t_i) = min(2.5 * 1.3125, 2.5 * 1.0050) = **2.5125** in.

Nozzle Reinforcement Calculations (Internal Pressure)

A = max{C [d t_r F + 2 t_n t_r F (1 - f_{r1})], 0} = max{1.0000 * [8.6446 * 1.0323 * 1.00 + 2 * 1.0675 * 1.0323 * 1.00 * (1 - 0.9900)], 0}
= **8.9459** sq. in.

A1 = max[(2 L_{par} - d) (E_1 t - F t_r) - 2 t_n (E_1 t - F t_r) (1 - f_{r1}), 0] =
max[(2 * 8.6446 - 8.6446) * (1.0000 * 1.3125 - 1.00 * 1.0323) - 2 * 1.0675 * (1.0000 * 1.3125 - 1.00 * 1.0323) * (1 - 0.9900), 0]
= **2.4162** sq. in.

A2 = max{2 min(h_o, L_{noro}) [min(t_n, L_{par} - 0.5 d) - t_{rn}] f_{r2}, 0} =
max{2 * min(6.0000, 2.6688) * [min(1.0675, 8.6446 - 0.5 * 8.6446) - 0.0726] * 0.9900, 0} = **5.2572** sq. in.

A3 = max{2 min(h, L_{nori}) min(t_i, L_{par} - 0.5 d) f_{r2}, 0} =
max{2 * min(2.5000, 2.5125) * min(1.0050, 8.6446 - 0.5 * 8.6446) * 0.9900, 0} = **4.9748** sq. in.

A41 = f_{r2} [L_{41}^2 - (L_{41} - $L_{41pareff}$)^2 - (L_{41} - $L_{41noreff}$)^2] =
0.9900 * [0.3750^2 - (0.3750 - 0.3750)^2 - (0.3750 - 0.3750)^2] = **0.1392** sq. in.

A42 = f_{r4} $L_{42pareff}$ $L_{42noreff}$ =
0.0000 * 0.0000 * 0.0000 = **0.0000** sq. in.

A43 = f_{r2} [L_{43}^2 - (L_{43} - $L_{43pareff}$)^2 - (L_{43} - $L_{43noreff}$)^2] =
0.9900 * [0.4107^2 - (0.4107 - 0.4107)^2 - (0.4107 - 0.4107)^2] = **0.1670** sq. in.

A5
= **0.0000** sq. in.

Area Available (Internal Pressure) = A1 + A2 + A3 + A41 + A42 + A43 + A5 = 12.9544 sq. in., which is **>=** A (8.9459)

Nozzle Weld Strength Calculations

Attachment Weld Strength per Paragraph UW-16 (Corroded Condition)

Weld 41 tmin = smaller of 0.75, t, or tn = smaller of 0.75, 1.3125, or 1.0675 = **0.7500** in.

$$\text{Weld 41 Leg min.} = \frac{\text{(smaller of 0.25 or (tmin * 0.7)) + ext. CA}}{0.7} = \frac{0.2500}{0.7} = \textbf{0.3571} \text{ in.}$$

Weld 41, actual weld leg = **0.3750** in.

Weld 43 tmin = smaller of 0.75, t, or tn = smaller of 0.75, 1.3125, or 1.0675 = **0.7500** in.

$$\text{Weld 43 Leg min.} = \frac{\text{(smaller of 0.25 or (tmin * 0.7)) + ca}}{0.7} = \frac{\text{(smaller of 0.25 or (0.7500 * 0.7)) + 0.0625}}{0.7} = \frac{0.3125}{0.7} = \textbf{0.4464} \text{ in.}$$

Weld 43, actual weld leg = **0.5000** in.

Unit Stresses per Paragraphs UG-45(c) and UW-15

Nozzle wall in shear = 0.70 * Sn = 0.70 * 19800 = **13860** PSI
Upper fillet, Weld 41, in shear = 0.49 * Material Stress = 0.49 * 19800 = **9702** PSI
Vessel groove weld, in tension = 0.74 * Material Stress = 0.74 * 19800 = **14652** PSI
Inner fillet, Weld 43, in shear = 0.49 * Material Stress = 0.49 * 19800 = **9702** PSI

Strength of Connection Elements

Nozzle wall in shear = ½ * π * mean nozzle diameter * tn * Nozzle wall in shear unit stress =
½ * π * 9.1925 * 1.0675 * 13860 = **213500** lb.
Upper fillet in shear = ½ * π * Nozzle OD * weld leg * upper fillet in shear unit stress = ½ * π * 10.2600 * 0.3750 * 9702 = **58600** lb.
Groove Weld in Tension = ½ * π * Nozzle OD * groove depth * groove weld tension unit stress =
½ * π * 10.2600 * 1.5000 * 14652 = **354000** lb.
Inner fillet in shear = ½ * π * Nozzle OD * weld leg * inner fillet in shear unit stress = ½ * π * 10.2600 * 0.4107 * 9702 = **64200** lb.

Load to be carried by welds, per UG-41(b)(1) and Fig. UG-41.1 sketch (a)

W = [A - A1 + 2 tn fr1(E1t - Ftr)] Sv = [8.9459 - 2.4162 + 2 * 1.0675 * 0.9900 * (1.00 * 1.3125 - 1.00 * 1.0323)] * 20000 = **142400** lb.
W1-1 = (A2 + A5 + A41 + A42) * Sv = (5.2572 + 0.0000 + 0.1392 + 0.0000) * 20000 = **107900** lb.
W2-2 = (A2 + A3 + A41 + A43 + 2 tn t fr1) Sv = (5.2572 + 4.9748 + 0.1392 + 0.1670 + 2 * 1.0675 * 1.3125 * 0.9900) * 20000 = **266200** lb.
W3-3 = (A2 + A3 + A5 + A41 + A42 + A43 + 2 tn t fr1) * Sv =
(5.2572 + 4.9748 + 0.0000 + 0.1392 + 0.0000 + 0.1670 + 2 * 1.0675 * 1.3125 * 0.9900) * 20000 = **266200** lb.

Check Strength Paths

Path 1-1 = Upper fillet in shear + Nozzle wall in shear = 58600 + 213500 = **272100** lb.
Path 2-2 = Upper fillet in shear + Groove weld in tension + Inner fillet in shear =
58600 + 354000 + 64200 = **476800** lb.
Path 3-3 = Upper fillet in shear + Inner fillet in shear + Groove weld in tension = 58600 + 64200 + 354000 = **476800** lb.

SPX Flow Technology USA, Inc.

SMLS LWN (FVC) - 2" RELIEF VALVE NOZZLE IN TOP HEAD

Customer: **Southern Company**
Job No: 7404131
Number: 8
ID Number: 8

Vessel Number: PG-1080 2080
Mark Number: N8

Date Printed: 5/16/2012

Nozzle Design Information

Design Pressure:	350.00	PSI	Design Temperature:	450	°F
Static Head:	0.00	PSI	Nozzle Efficiency (E):	100	%
Nozzle Material:	SA-105		Joint Efficiency (E_1):	1.00	
			Factor B Chart:	CS-2	
External Projection:	6.0000	in.	Allowable Stress at Design Temperature (S_n):	19800	PSI
Internal Projection:	1.0000	in.	Allowable Stress at Ambient Temperature:	20000	PSI
Inside Corrosion Allowance:	0.0625	in.	Correction Factor (F):	1.00	
External Corrosion Allowance:	0.0000	in.	Nozzle Path:	None	
Nozzle ID (new):	2.0000	in.	Nozzle Wall Thickness(new):	0.6600	in.
Nozzle ID (corroded):	2.1250	in.	Nozzle Wall Thickness(corroded):	0.5975	in.
Developed Opening:	2.1288	in.	Tangential Dimension L:	38.0000	in.
			Upper Weld Leg Size(Weld 41):	0.3750	in.
			Internal Weld Leg Size(Weld 43):	0.5000	in.
			Outside Groove Weld Depth:	1.5000	in.

Minimum Design Metal Temperature

Min. Temp. Curve:	B	Pressure at MDMT:	350.00 PSI
UCS-66(b) reduction:	Yes	Minimum Design Metal Temperature:	10 °F
UCS-68(c) reduction:	No	Computed Minimum Temperature:	-133 °F

Host Component: Head 2 - 132" OD HEAD, 2:1 ELLIP, TOP

Material:	SA-516 Gr. 70	Head wall thickness(new):	1.5000 in.
Material Stress(S_v):	20000 PSI	Head wall thickness - thin out (corroded):	1.3125 in.

Nozzle Detail Information

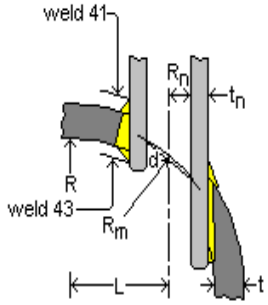


Fig. UW-16.1 (d)

Upper Weld Leg Size(Weld 41): 0.3750 in.

Internal Weld Leg Size(Weld 43): 0.5000 in.

Nozzle Wall Thickness(t_n): 0.6600 in.

Outside Groove Weld Depth: 1.5000 in.

tangential to the vessel wall, attached by a groove weld.
Nozzle is adequate for UG-45 requirements.
Opening is adequately reinforced for Internal Pressure.
Reinforcement calculations are not required per UG-36(c)(3)(a)See Uw-14 for exceptions.
Weld Strength Paths are adequate.

Required Head Thickness per Paragraph UG-37(a)

$$\mathbf{tr} = \frac{P\ K1\ Do}{(2SE + 0.8P)} = \frac{350.00 * 0.9000 * 132.0000}{(2 * 20000 * 1 + 0.8 * 350.00)}$$ = **1.0323** in.

Nozzle Required Thickness Calculations

Required Nozzle Thickness for Internal Pressure per Paragraph UG-37(a)

$$\mathbf{trn} = \frac{PRn}{SE - 0.6P} = \frac{350.00 * 1.0625}{19800 * 1 - 0.6 * 350.00}$$ = **0.0190** in.

Strength Reduction Factors

$$\mathbf{fr1} = \min\left(\frac{Sn}{Sv}, 1.0000\right) = \min\left(\frac{19800}{20000}, 1.0000\right) = 0.9900 \qquad \mathbf{fr2} = \min\left(\frac{Sn}{Sv}, 1.0000\right) = \min\left(\frac{19800}{20000}, 1.0000\right) = 0.9900$$

UG-45 Thickness Calculations

Nozzle Thickness for Pressure Loading (plus corrosion)

$$t_a = \frac{PRn}{SE - 0.6P} + Ca + ext.\ Ca = \frac{350.00 * 1.0625}{19800 * 1.00 - 0.6 * 350.00} + 0.0625 + 0.0000$$ = **0.0815** in.

Nozzle Thickness for Internal Pressure (plus corrosion) Based on Host

$$t_{b1} = \frac{P\ K\ Do}{(2SE + 2P(K - 0.1))} + Ca + ext.\ Ca = \frac{350.00 * 1.0000 * 132.0000}{(2 * 20000 * 1 + 2 * 350.00 * (1.0000 - 0.1))} + 0.0625 + 0.0000$$ = **1.1996** in.

Minimum Thickness (plus corrosion) per Table UG-45

t_{b3} = minimum thickness (Table UG-45) + Ca + ext. Ca = **0.2515** in.

Nozzle Minimum Thickness Based on Host and Table UG-45

$t_b = \min[t_{b3}, \max(t_{b1}, t_{b2})]$ = **0.2515** in.

$t_{UG\text{-}45} = \max(t_a, t_b)$ = **0.2515** in.

Wall thickness = tn = **0.6600** is greater than or equal to UG-45 value of **0.2515**

Nozzle Weld Strength Calculations

Attachment Weld Strength per Paragraph UW-16 (Corroded Condition)

Weld 41 tmin = smaller of 0.75, t, or tn = smaller of 0.75, 1.3125, or 0.5975 = **0.5975** in.

Weld 41 Leg min. = $\frac{\text{(smaller of 0.25 or (tmin * 0.7)) + ext. CA}}{0.7} = \frac{0.2500}{0.7}$ = **0.3571** in.

Weld 41, actual weld leg = **0.3750** in.

Weld 43 tmin = smaller of 0.75, t, or tn = smaller of 0.75, 1.3125, or 0.5975 = **0.5975** in.

Weld 43 Leg min. = $\frac{\text{(smaller of 0.25 or (tmin * 0.7)) + ca}}{0.7} = \frac{\text{(smaller of 0.25 or (0.5975 * 0.7)) + 0.0625}}{0.7} = \frac{0.3125}{0.7}$ = **0.4464** in.

Weld 43, actual weld leg = **0.5000** in.

Unit Stresses per Paragraphs UG-45(c) and UW-15

Nozzle wall in shear = 0.70 * Sn = 0.70 * 19800 = **13860** PSI
Upper fillet, Weld 41, in shear = 0.49 * Material Stress = 0.49 * 19800 = **9702** PSI
Vessel groove weld, in tension = 0.74 * Material Stress = 0.74 * 19800 = **14652** PSI
Inner fillet, Weld 43, in shear = 0.49 * Material Stress = 0.49 * 19800 = **9702** PSI

Strength of Connection Elements

Nozzle wall in shear = ½ * π * mean nozzle diameter * tn * Nozzle wall in shear unit stress =
½ * π * 2.7225 * 0.5975 * 13860 = **35400** lb.
Upper fillet in shear = ½ * π * Nozzle OD * weld leg * upper fillet in shear unit stress = ½ * π * 3.3200 * 0.3750 * 9702 = **19000** lb.
Groove Weld in Tension = ½ * π * Nozzle OD * groove depth * groove weld tension unit stress =
½ * π * 3.3200 * 1.5000 * 14652 = **114600** lb.
Inner fillet in shear = ½ * π * Nozzle OD * weld leg * inner fillet in shear unit stress = ½ * π * 3.3200 * 0.4107 * 9702 = **20800** lb.

Load to be carried by welds, per UG-41(b)(1) and Fig. UG-41.1 sketch (a)

W = [A - A1 + 2 tn fr1(E1t - Ftr)] Sv = [2.3389 - 1.0670 + 2 * 0.5975 * 0.9900 * (1.00 * 1.3125 - 1.00 * 1.0323)] * 20000 = **32100** lb.
W1-1 = (A2 + A5 + A41 + A42) * Sv = (1.7110 + 0.0000 + 0.1392 + 0.0000) * 20000 = **37000** lb.
W2-2 = (A2 + A3 + A41 + A43 + 2 tn t fr1) Sv = (1.7110 + 0.9931 + 0.1392 + 0.1670 + 2 * 0.5975 * 1.3125 * 0.9900) * 20000 = **91300** lb.
W3-3 = (A2 + A3 + A5 + A41 + A42 + A43 + 2 tn t fr1) * Sv =
(1.7110 + 0.9931 + 0.0000 + 0.1392 + 0.0000 + 0.1670 + 2 * 0.5975 * 1.3125 * 0.9900) * 20000 = **91300** lb.

Check Strength Paths

Path 1-1 = Upper fillet in shear + Nozzle wall in shear = 19000 + 35400 = **54400** lb.
Path 2-2 = Upper fillet in shear + Groove weld in tension + Inner fillet in shear =
19000 + 114600 + 20800 = **154400** lb.
Path 3-3 = Upper fillet in shear + Inner fillet in shear + Groove weld in tension = 19000 + 20800 + 114600 = **154400** lb.

SPX Flow Technology USA, Inc.

SMLS LWN (FVC) - 1-1/2" INSTRUMENT CONN IN SHELL

Customer: **Southern Company**
Job No: 7404131
Number: 9
ID Number: 9

Vessel Number: PG-1080 2080
Mark Number: N9

Date Printed: 5/16/2012

Nozzle Design Information

Design Pressure:	350.00	PSI	Design Temperature:	450	℉
Static Head:	0.00	PSI	Nozzle Efficiency (E):	100	%
Nozzle Material:	SA-105		Joint Efficiency (E_1):	1.00	
			Factor B Chart:	CS-2	
External Projection:	6.0000	in.	Allowable Stress at Design Temperature (S_n):	19800	PSI
Internal Projection:	1.0000	in.	Allowable Stress at Ambient Temperature:	20000	PSI
Inside Corrosion Allowance:	0.0625	in.	Correction Factor (F):	1.00	
External Corrosion Allowance:	0.0000	in.	Nozzle Path:	None	
Nozzle ID (new):	1.5000	in.	Nozzle Wall Thickness(new):	0.6250	in.
Nozzle ID (corroded):	1.6250	in.	Nozzle Wall Thickness(corroded):	0.5625	in.
			Upper Weld Leg Size(Weld 41):	0.3750	in.
			Internal Weld Leg Size(Weld 43):	0.5000	in.
			Outside Groove Weld Depth:	1.5000	in.

Minimum Design Metal Temperature

Min. Temp. Curve:	B	Pressure at MDMT:	350.00 PSI
UCS-66(b) reduction:	Yes	Minimum Design Metal Temperature:	10 ℉
UCS-68(c) reduction:	No	Computed Minimum Temperature:	-135 ℉

Host Component: Shell 1 - 132" OD ROLLED SHELL x 96" LG

Material:	SA-516 Gr. 70	Shell wall thickness(new):	1.5000 in.
Material Stress(S_V):	20000 PSI	Shell wall thickness(corroded):	1.4375 in.

Nozzle Detail Information

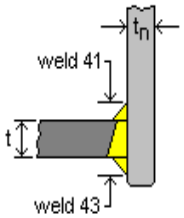


Fig. UW-16.1 (d)

Upper Weld Leg Size(Weld 41): 0.3750 in.

Internal Weld Leg Size(Weld 43): 0.5000 in.

Nozzle Wall Thickness(t_n): 0.6250 in.

Outside Groove Weld Depth: 1.5000 in.

Nozzle passes through the vessel, attached by a groove weld.
Nozzle is adequate for UG-45 requirements.
Opening is adequately reinforced for Internal Pressure.
Reinforcement calculations are not required per UG-36(c)(3)(a)See Uw-14 for exceptions.
Weld Strength Paths are adequate.

Required Shell Thickness per Paragraph UG-37(a)

$$\mathbf{tr} = \frac{PRo}{SE + 0.4P} = \frac{350.00 * 66.0000}{20000 * 1 + 0.4 * 350.00} = \mathbf{1.1470} \text{ in.}$$

Nozzle Required Thickness Calculations

Required Nozzle Thickness for Internal Pressure per Paragraph UG-37(a)

$$\mathbf{trn} = \frac{PRn}{SE - 0.6P} = \frac{350.00 * 0.8125}{19800 * 1 - 0.6 * 350.00} = \mathbf{0.0145} \text{ in.}$$

Strength Reduction Factors

$$\mathbf{fr1} = \min\left(\frac{Sn}{Sv}, 1.0000\right) = \min\left(\frac{19800}{20000}, 1.0000\right) = 0.9900 \qquad \mathbf{fr2} = \min\left(\frac{Sn}{Sv}, 1.0000\right) = \min\left(\frac{19800}{20000}, 1.0000\right) = 0.9900$$

UG-45 Thickness Calculations

Nozzle Thickness for Pressure Loading (plus corrosion)

$$t_a = \frac{PRn}{SE - 0.6P} + Ca + \text{ext. } Ca = \frac{350.00 * 0.8125}{19800 * 1.00 - 0.6 * 350.00} + 0.0625 + 0.0000 = \mathbf{0.0770} \text{ in.}$$

Nozzle Thickness for Internal Pressure (plus corrosion) Based on Host

$$t_{b1} = \frac{PRo}{SE + 0.4P} + Ca + \text{ext. } Ca = \frac{350.00 * 66.0000}{20000 * 1 + 0.4 * 350.00} + 0.0625 + 0.0000 = \mathbf{1.2095} \text{ in.}$$

Minimum Thickness (plus corrosion) per Table UG-45

t_{b3} = minimum thickness (Table UG-45) + Ca + ext. Ca = **0.2405** in.

Nozzle Minimum Thickness Based on Host and Table UG-45

$t_b = \min[t_{b3}, \max(t_{b1}, t_{b2})]$ = **0.2405** in.

$t_{UG\text{-}45} = \max(t_a, t_b)$ = **0.2405** in.

Wall thickness = tn = **0.6250** is greater than or equal to UG-45 value of **0.2405**

Nozzle Weld Strength Calculations

Attachment Weld Strength per Paragraph UW-16 (Corroded Condition)

Weld 41 tmin = smaller of 0.75, t, or tn = smaller of 0.75, 1.4375, or 0.5625 = **0.5625** in.

$$\text{Weld 41 Leg min.} = \frac{\text{(smaller of 0.25 or (tmin * 0.7)) + ext. CA}}{0.7} = \frac{0.2500}{0.7}$$ = **0.3571** in.

Weld 41, actual weld leg = **0.3750** in.

Weld 43 tmin = smaller of 0.75, t, or tn = smaller of 0.75, 1.4375, or 0.5625 = **0.5625** in.

$$\text{Weld 43 Leg min.} = \frac{\text{(smaller of 0.25 or (tmin * 0.7)) + ca}}{0.7} = \frac{\text{(smaller of 0.25 or (0.5625 * 0.7)) + 0.0625}}{0.7} = \frac{0.3125}{0.7}$$ = **0.4464** in.

Weld 43, actual weld leg = **0.5000** in.

Unit Stresses per Paragraphs UG-45(c) and UW-15

Nozzle wall in shear = 0.70 * Sn = 0.70 * 19800 = **13860** PSI
Upper fillet, Weld 41, in shear = 0.49 * Material Stress = 0.49 * 19800 = **9702** PSI
Vessel groove weld, in tension = 0.74 * Material Stress = 0.74 * 19800 = **14652** PSI
Inner fillet, Weld 43, in shear = 0.49 * Material Stress = 0.49 * 19800 = **9702** PSI

Strength of Connection Elements

Nozzle wall in shear = ½ * π * mean nozzle diameter * tn * Nozzle wall in shear unit stress =
½ * π * 2.1875 * 0.5625 * 13860 = **26800** lb.
Upper fillet in shear = ½ * π * Nozzle OD * weld leg * upper fillet in shear unit stress = ½ * π * 2.7500 * 0.3750 * 9702 = **15700** lb.
Groove Weld in Tension = ½ * π * Nozzle OD * groove depth * groove weld tension unit stress =
½ * π * 2.7500 * 1.5000 * 14652 = **94900** lb.
Inner fillet in shear = ½ * π * Nozzle OD * weld leg * inner fillet in shear unit stress = ½ * π * 2.7500 * 0.4107 * 9702 = **17200** lb.

Load to be carried by welds, per UG-41(b)(1) and Fig. UG-41.1 sketch (a)

W = [A - A1 + 2 tn fr1(E1t - Ftr)] Sv = [1.8768 - 1.1587 + 2 * 0.5625 * 0.9900 * (1.00 * 1.4375 - 1.00 * 1.1470)] * 20000 = **20800** lb.
W1-1 = (A2 + A5 + A41 + A42) * Sv = (1.5258 + 0.0000 + 0.1392 + 0.0000) * 20000 = **33300** lb.
W2-2 = (A2 + A3 + A41 + A43 + 2 tn t fr1) Sv = (1.5258 + 0.9281 + 0.1392 + 0.1670 + 2 * 0.5625 * 1.4375 * 0.9900) * 20000 = **87200** lb.
W3-3 = (A2 + A3 + A5 + A41 + A42 + A43 + 2 tn t fr1) * Sv =
(1.5258 + 0.9281 + 0.0000 + 0.1392 + 0.0000 + 0.1670 + 2 * 0.5625 * 1.4375 * 0.9900) * 20000 = **87200** lb.

Check Strength Paths

Path 1-1 = Upper fillet in shear + Nozzle wall in shear = 15700 + 26800 = **42500** lb.
Path 2-2 = Upper fillet in shear + Groove weld in tension + Inner fillet in shear =
15700 + 94900 + 17200 = **127800** lb.
Path 3-3 = Upper fillet in shear + Inner fillet in shear + Groove weld in tension = 15700 + 17200 + 94900 = **127800** lb.

SPX Flow Technology USA, Inc.

SMLS WELD STUB (FVC) - 20"

Customer: **Southern Company**
Job No: 7404131
Number: 10
ID Number: 10

Vessel Number: PG-1080 2080
Mark Number: N10

Date Printed: 5/16/2012

Nozzle Design Information

Design Pressure:	350.00	PSI	Design Temperature:	450	°F
Static Head:	0.00	PSI	Nozzle Efficiency (E):	100	%
Nozzle Material:	SA-105		Joint Efficiency (E_1):	1.00	
			Factor B Chart:	CS-2	
External Projection:	3.2500	in.	Allowable Stress at Design Temperature (S_n):	19800	PSI
Internal Projection:	0.0000	in.	Allowable Stress at Ambient Temperature:	20000	PSI
Inside Corrosion Allowance:	0.0625	in.	Correction Factor (F):	1.00	
External Corrosion Allowance:	0.0000	in.	Nozzle Path:	None	
Nozzle ID (new):	19.2500	in.	Nozzle Wall Thickness(new):	2.5000	in.
Nozzle ID (corroded):	19.3750	in.	Nozzle Wall Thickness(corroded):	2.4375	in.
			Upper Weld Leg Size(Weld 41):	0.3750	in.
			Internal Weld Leg Size(Weld 43):	0.0000	in.
			Outside Groove Weld Depth:	1.5000	in.

Minimum Design Metal Temperature

Min. Temp. Curve:	B	Pressure at MDMT:	350.00 PSI
UCS-66(b) reduction:	Yes	Minimum Design Metal Temperature:	10 °F
UCS-68(c) reduction:	No	Computed Minimum Temperature:	-89 °F

Host Component: Head 1 - 132" OD HEAD, 2:1 ELLIP, BOTTOM

Material:	SA-516 Gr. 70	Head wall thickness(new):	1.5000 in.
Material Stress(S_V):	20000 PSI	Head wall thickness - thin out (corroded):	1.3125 in.

Nozzle Detail Information

Upper Weld Leg Size(Weld 41): 0.3750 in.

Nozzle Wall Thickness(t_n): 2.5000 in.

Outside Groove Weld Depth: 1.5000 in.

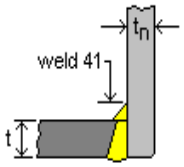


Fig. UW-16.1 (d)

Nozzle passes through the vessel, attached by a groove weld.
Nozzle is adequate for UG-45 requirements.
Opening is adequately reinforced for Internal Pressure.
Weld Strength Paths are adequate.

SPX Flow Technology USA, Inc.

SMLS WELD STUB (FVC) - 20"

Job No: 7404131
Number: 10
ID Number: 10

Vessel Number: PG-1080 2080
Mark Number: N10

Date Printed: 5/16/2012

Required Head Thickness per Paragraph UG-37(a)

$$\mathbf{tr} = \frac{P\ K1\ Do}{(2SE + 0.8P)} = \frac{350.00 * 0.9000 * 132.0000}{(2 * 20000 * 1 + 0.8 * 350.00)}$$ = **1.0323** in.

Nozzle Required Thickness Calculations

Required Nozzle Thickness for Internal Pressure per Paragraph UG-37(a)

$$\mathbf{trn} = \frac{PRn}{SE - 0.6P} = \frac{350.00 * 9.6875}{19800 * 1 - 0.6 * 350.00}$$ = **0.1731** in.

Strength Reduction Factors

$$\mathbf{fr1} = \min\left(\frac{Sn}{Sv}, 1.0000\right) = \min\left(\frac{19800}{20000}, 1.0000\right) = 0.9900 \qquad \mathbf{fr2} = \min\left(\frac{Sn}{Sv}, 1.0000\right) = \min\left(\frac{19800}{20000}, 1.0000\right) = 0.9900$$

UG-45 Thickness Calculations

Nozzle Thickness for Pressure Loading (plus corrosion)

$$t_a = \frac{PRn}{SE - 0.6P} + Ca + ext.\ Ca = \frac{350.00 * 9.6875}{19800 * 1.00 - 0.6 * 350.00} + 0.0625 + 0.0000$$ = **0.2356** in.

Nozzle Thickness for Internal Pressure (plus corrosion) Based on Host

$$t_{b1} = \frac{P\ K\ Do}{(2SE + 2P(K - 0.1))} + Ca + ext.\ Ca = \frac{350.00 * 1.0000 * 132.0000}{(2 * 20000 * 1 + 2 * 350.00 * (1.0000 - 0.1))} + 0.0625 + 0.0000$$ = **1.1996** in.

Minimum Thickness (plus corrosion) per Table UG-45

t_{b3} = minimum thickness (Table UG-45) + Ca + ext. Ca = **0.3905** in.

Nozzle Minimum Thickness Based on Host and Table UG-45

$t_b = \min[t_{b3}, \max(t_{b1}, t_{b2})]$ = **0.3905** in.

$t_{UG\text{-}45} = \max(t_a, t_b)$ = **0.3905** in.

Wall thickness = tn = **2.5000** is greater than or equal to UG-45 value of **0.3905**

Limits of Reinforcement (UG-40)

L_{par} = max(d, R_n + t + t_n) = max(19.3750, 9.6875 + 1.3125 + 2.4375) = **19.3750** in.
L_{noro} = min(2.5 t, 2.5 t_n + t_e) = min(2.5 * 1.3125, 2.5 * 2.4375 + 0.0000) = **3.2813** in.
L_{nori} = min(2.5 t, 2.5 t_i) = min(2.5 * 1.3125, 2.5 * 2.3750) = **3.2813** in.

Nozzle Reinforcement Calculations (Internal Pressure)

A = max{C [d t_r F + 2 t_n t_r F (1 - f_{r1})], 0} = max{1.0000 * [19.3750 * 1.0323 * 1.00 + 2 * 2.4375 * 1.0323 * 1.00 * (1 - 0.9900)], 0}
= **20.0511** sq. in.

A1 = max[(2 L_{par} - d) (E_1 t - F t_r) - 2 t_n (E_1 t - F t_r) (1 - f_{r1}), 0] =
max[(2 * 19.3750 - 19.3750) * (1.0000 * 1.3125 - 1.00 * 1.0323) - 2 * 2.4375 * (1.0000 * 1.3125 - 1.00 * 1.0323) * (1 - 0.9900), 0]
= **5.4152** sq. in.

A2 = max{2 min(h_o, L_{noro}) [min(t_n, L_{par} - 0.5 d) - t_{rn}] f_{r2}, 0} =
max{2 * min(3.2500, 3.2813) * [min(2.4375, 19.3750 - 0.5 * 19.3750) - 0.1731] * 0.9900, 0} = **14.5714** sq. in.

A3 = max{2 min(h, L_{nori}) min(t_i, L_{par} - 0.5 d) f_{r2}, 0} =
max{2 * min(0.0000, 3.2813) * min(2.3750, 19.3750 - 0.5 * 19.3750) * 0.9900, 0} = **0.0000** sq. in.

A41 = f_{r2} [L_{41}^2 - (L_{41} - $L_{41pareff}$)^2 - (L_{41} - $L_{41noreff}$)^2] =
0.9900 * [0.3750^2 - (0.3750 - 0.3750)^2 - (0.3750 - 0.3750)^2] = **0.1392** sq. in.

A42 = f_{r4} $L_{42pareff}$ $L_{42noreff}$ =
0.0000 * 0.0000 * 0.0000 = **0.0000** sq. in.

A43 = f_{r2} $L_{43pareff}$ $L_{43noreff}$ =
0.9900 * 0.0000 * 0.0000 = **0.0000** sq. in.

A5
= **0.0000** sq. in.

Area Available (Internal Pressure) = A1 + A2 + A3 + A41 + A42 + A43 + A5 = 20.1258 sq. in., which is **>=** A (20.0511)

Nozzle Weld Strength Calculations

Attachment Weld Strength per Paragraph UW-16 (Corroded Condition)

Weld 41 tmin = smaller of 0.75, t, or tn = smaller of 0.75, 1.3125, or 2.4375 = **0.7500** in.

Weld 41 Leg min. = $\frac{\text{(smaller of 0.25 or (tmin * 0.7)) + ext. CA}}{0.7} = \frac{0.2500}{0.7}$ = **0.3571** in.

Weld 41, actual weld leg = **0.3750** in.

Unit Stresses per Paragraphs UG-45(c) and UW-15

Nozzle wall in shear = 0.70 * Sn = 0.70 * 19800 = **13860** PSI
Upper fillet, Weld 41, in shear = 0.49 * Material Stress = 0.49 * 19800 = **9702** PSI
Vessel groove weld, in tension = 0.74 * Material Stress = 0.74 * 19800 = **14652** PSI

Strength of Connection Elements

Nozzle wall in shear = ½ * π * mean nozzle diameter * tn * Nozzle wall in shear unit stress =
½ * π * 21.8125 * 2.4375 * 13860 = **1156900** lb.
Upper fillet in shear = ½ * π * Nozzle OD * weld leg * upper fillet in shear unit stress = ½ * π * 24.2500 * 0.3750 * 9702 = **138500** lb.
Groove Weld in Tension = ½ * π * Nozzle OD * groove depth * groove weld tension unit stress =
½ * π * 24.2500 * 1.3125 * 14652 = **732200** lb.

Load to be carried by welds, per UG-41(b)(1) and Fig. UG-41.1 sketch (a)

W = [A - A1 + 2 tn fr1(E1t - Ftr)] Sv = [20.0511 - 5.4152 + 2 * 2.4375 * 0.9900 * (1.00 * 1.3125 - 1.00 * 1.0323)] * 20000 = **319800** lb.
W1-1 = (A2 + A5 + A41 + A42) * Sv = (14.5714 + 0.0000 + 0.1392 + 0.0000) * 20000 = **294200** lb.
W2-2 = (A2 + A3 + A41 + A43 + 2 tn t fr1) Sv = (14.5714 + 0.0000 + 0.1392 + 0.0000 + 2 * 2.4375 * 1.3125 * 0.9900) * 20000
= = **420900** lb.
W3-3 = (A2 + A3 + A5 + A41 + A42 + A43 + 2 tn t fr1) * Sv =
(14.5714 + 0.0000 + 0.0000 + 0.1392 + 0.0000 + 0.0000 + 2 * 2.4375 * 1.3125 * 0.9900) * 20000 = **420900** lb.

Check Strength Paths

Path 1-1 = Upper fillet in shear + Nozzle wall in shear = 138500 + 1156900 = **1295400** lb.
Path 2-2 = Upper fillet in shear + Groove weld in tension + Inner fillet in shear =
138500 + 732200 + 0 = **870700** lb.
Path 3-3 = Upper fillet in shear + Inner fillet in shear + Groove weld in tension = 138500 + 0 + 732200 = **870700** lb.

SPX Flow Technology USA, Inc.

Skirt

Customer: **Southern Company**
Job No: 7404131
Number: 1

Vessel Number: PG-1080 2080
Mark Number: SK1

Date Printed: 5/16/2012

Cylindrical Skirt Design Information

Design Temperature:	450	℉	Joint Efficiency:	70	%
Skirt Material:	SA-36		Factor B Chart:	CS-2	
			Material Stress(hot):	16600	PSI
Skirt Length:	102.0000	in.	Material Stress(cold):	16600	PSI
Corrosion Allowance:	0.0625	in.	Yield Strength:	30050	PSI
Outside Diameter:	132.0000	in.	Modulus of Elasticity:	27.4	10^6 PSI
			Density:	0.2800	lb/in.^3
Surface Area:	293.7389	Sq. Ft.	Weight:	4428.71	lb.
Long. Factor A:	0.0005919		Long. Factor B:	8053	PSI

Nominal Skirt Thickness Selected = **0.3750** in.

SPX Flow Technology USA, Inc.

Base Ring

Customer: **Southern Company**
Job No: 7404131
Mark Number: BP1

Vessel Number: PG-1080 2080

Date Printed: 5/16/2012

Base Ring Design Information

Design Temperature:	450	℉			
Base Ring Material:	SA-36		Yield Strength:	30050	PSI
			Density:	0.2800	lb/in.^3
Base Plate Thickness (T_b):	0.5000	in.	Skirt OD at Bottom (D_{sk}):	132.0000	in.
Base Plate OD (OD_b):	138.0000	in.	Base Plate ID (ID_b):	130.0000	in.
Base Plate Width (W_b):	4.0000	in.	Width Outside of Skirt (W_{bo}):	3.0000	in.

Anchor Bolt Information

Anchor Bolt Material:	SA-325		Material Stress(hot):	20200	PSI
			Material Stress(cold):	20200	PSI
Bolt Size:	3/4"	in.	Density:	0.2800	lb/in.^3
Bolt Circle (BC):	136.0000	in.	Number of Bolts (N_b):	12	
Nominal Diameter (D_b):	0.7500	in.	Bolt Hole Diameter (D_{bh}):	0.8750	in.
Root Area (A_b):	0.3020	sq. in.	Distance across Flats of Bolting Nut:	1.2500	in.
Threads Per Inch (thd):	10.00		Ultimate 28 Day Concrete Strength:	2500	PSI

Base Support Analysis - Operating Pressurized Condition - Occasional Loads - Seismic Case 5

Total Weight of Tower as adjusted by load case combinations **W = 92244 lb.**

Maximum total moment at base of tower **M = 519240 in.-lb.**

Base Ring Calculations - Operating Pressurized Condition - Occasional Loads - Seismic Case 5

No uplift, therefore

$f_s = 0$ PSI

$$f_{c\,max} = \left(\frac{M}{Zc}\right) + \left(\frac{W}{Ac}\right) = \left(\frac{519240}{54824}\right) + \left(\frac{92244}{1683.89}\right)$$

$f_{c\,max} = 64$ PSI

$$\text{Base ring stress, } S_b = W_{bo}{}^2 * \left(\frac{3 * f_{c\,max}}{Tb^2}\right) = 3.0000^2 * \left(\frac{3 * 64}{0.5000^2}\right)$$

$S_b = 6939$ PSI

Anchor Bolt and Concrete Stresses - Operating Pressurized Condition - Occasional Loads - Seismic Case 5

Anchor bolt stress, Sbolt = f_s **$S_{bolt} = 0$ PSI**

Concrete stress, $S_c = f_{c\,max}$ **$S_c = 64$ PSI**

Base Support Allowable Stresses - Operating Pressurized Condition - Occasional Loads - Seismic Case 5

Base support material yield strength, S_y **$S_y = 30050$ PSI**

Base ring allowable stress, $S_{ba} = 1.0 * 0.6 * Sy = 1.0 * 0.6 * 30050$ **$S_{ba} = 18030$ PSI**

Anchor bolt allowable stress, S_{bolta} **$S_{bolta} = 20200$ PSI**

Concrete safe bearing load, $S_{ca} = 0.3 *$ 28 day concrete strength $= 0.3 * 2500.00$ **$S_{ca} = 750$ PSI**

Base Support Stress Ratios - Operating Pressurized Condition - Occasional Loads - Seismic Case 5

Base Ring, R_b	**R_b = 0.385**
Bolting, R_{bolt}	**R_{bolt} = 0.000**
Concrete, R_c	**R_c = 0.086**

* NOTE: Stress ratios greater than 1.0 represent overstressed conditions.

Base Support Analysis - Operating Pressurized Condition - Occasional Loads - Wind Case 5

Total Weight of Tower as adjusted by load case combinations	**W = 90186 lb.**
Maximum total moment at base of tower	**M = 396118 in.-lb.**

Base Ring Calculations - Operating Pressurized Condition - Occasional Loads - Wind Case 5

No uplift, therefore

f_s = 0 PSI

$$f_{c\,max} = \left(\frac{M}{Zc}\right) + \left(\frac{W}{Ac}\right) = \left(\frac{396118}{54824}\right) + \left(\frac{90186}{1683.89}\right)$$

$f_{c\,max}$ = 61 PSI

$$\text{Base ring stress, } S_b = W_{bo}{}^2 * \left(\frac{3 * f_{c\,max}}{Tb^2}\right) = 3.0000^2 * \left(\frac{3 * 61}{0.5000^2}\right)$$

S_b = 6565 PSI

Anchor Bolt and Concrete Stresses - Operating Pressurized Condition - Occasional Loads - Wind Case 5

Anchor bolt stress, Sbolt = f_s	**S_{bolt} = 0 PSI**
Concrete stress, $S_c = f_{c\,max}$	**S_c = 61 PSI**

Base Support Allowable Stresses - Operating Pressurized Condition - Occasional Loads - Wind Case 5

Base support material yield strength, S_y	**S_y = 30050 PSI**
Base ring allowable stress, $S_{ba} = 1.0 * 0.6 * Sy = 1.0 * 0.6 * 30050$	**S_{ba} = 18030 PSI**
Anchor bolt allowable stress, S_{bolta}	**S_{bolta} = 20200 PSI**
Concrete safe bearing load, S_{ca} = 0.3 * 28 day concrete strength = 0.3 * 2500.00	**S_{ca} = 750 PSI**

Base Support Stress Ratios - Operating Pressurized Condition - Occasional Loads - Wind Case 5

Base Ring, R_b	**R_b = 0.364**
Bolting, R_{bolt}	**R_{bolt} = 0.000**
Concrete, R_c	**R_c = 0.081**

* NOTE: Stress ratios greater than 1.0 represent overstressed conditions.

SPX Flow Technology USA, Inc.

Base Ring

Job No: 7404131
Mark Number: BP1

Vessel Number: PG-1080 2080

Date Printed: 5/16/2012

Base Support Analysis - Operating Pressurized Condition - Sustained Loads

Total Weight of Tower as adjusted by load case combinations **W = 90186 lb.**

Maximum total moment at base of tower **M = 0 in.-lb.**

Base Ring Calculations - Operating Pressurized Condition - Sustained Loads

No uplift, therefore

$f_s = 0$ PSI

$$f_{c\,max} = \left(\frac{M}{Zc}\right) + \left(\frac{W}{Ac}\right) = \left(\frac{0}{54824}\right) + \left(\frac{90186}{1683.89}\right)$$

$f_{c\,max} = 54$ PSI

$$\text{Base ring stress, } S_b = W_{bo}{}^2 * \left(\frac{3 * f_{c\,max}}{Tb^2}\right) = 3.0000^2 * \left(\frac{3 * 54}{0.5000^2}\right)$$

$S_b = 5784$ PSI

Anchor Bolt and Concrete Stresses - Operating Pressurized Condition - Sustained Loads

Anchor bolt stress, Sbolt = f_s $S_{bolt} = 0$ PSI

Concrete stress, $S_c = f_{c\,max}$ $S_c = 54$ PSI

Base Support Allowable Stresses - Operating Pressurized Condition - Sustained Loads

Base support material yield strength, S_y $S_y = 30050$ PSI

Base ring allowable stress, $S_{ba} = 1.0 * 0.6 * Sy = 1.0 * 0.6 * 30050$ $S_{ba} = 18030$ PSI

Anchor bolt allowable stress, S_{bolta} $S_{bolta} = 20200$ PSI

Concrete safe bearing load, $S_{ca} = 0.3 *$ 28 day concrete strength $= 0.3 * 2500.00$ $S_{ca} = 750$ PSI

Base Support Stress Ratios - Operating Pressurized Condition - Sustained Loads

Base Ring, R_b $R_b = 0.321$

Bolting, R_{bolt} $R_{bolt} = 0.000$

Concrete, R_c $R_c = 0.071$

* NOTE: Stress ratios greater than 1.0 represent overstressed conditions.

Base Support Analysis - Operating Unpressurized Condition - Occasional Loads - Seismic Case 5

Total Weight of Tower as adjusted by load case combinations **W = 92244 lb.**

Maximum total moment at base of tower **M = 519240 in.-lb.**

Base Ring Calculations - Operating Unpressurized Condition - Occasional Loads - Seismic Case 5

No uplift, therefore

$f_s = 0$ PSI

$$f_{c\,max} = \left(\frac{M}{Zc}\right) + \left(\frac{W}{Ac}\right) = \left(\frac{519240}{54824}\right) + \left(\frac{92244}{1683.89}\right)$$

$f_{c\,max} = 64$ PSI

$$\text{Base ring stress, } S_b = W_{bo}{}^2 * \left(\frac{3 * f_{c\,max}}{Tb^2}\right) = 3.0000^2 * \left(\frac{3 * 64}{0.5000^2}\right)$$

$S_b = 6939$ PSI

Anchor Bolt and Concrete Stresses - Operating Unpressurized Condition - Occasional Loads - Seismic Case 5

Anchor bolt stress, Sbolt = f_s **$S_{bolt} = 0$ PSI**

Concrete stress, $S_c = f_{c\,max}$ **$S_c = 64$ PSI**

Base Support Allowable Stresses - Operating Unpressurized Condition - Occasional Loads - Seismic Case 5

Base support material yield strength, S_y **$S_y = 30050$ PSI**

Base ring allowable stress, $S_{ba} = 1.0 * 0.6 * Sy = 1.0 * 0.6 * 30050$ **$S_{ba} = 18030$ PSI**

Anchor bolt allowable stress, S_{bolta} **$S_{bolta} = 20200$ PSI**

Concrete safe bearing load, $S_{ca} = 0.3 *$ 28 day concrete strength $= 0.3 * 2500.00$ **$S_{ca} = 750$ PSI**

Base Support Stress Ratios - Operating Unpressurized Condition - Occasional Loads - Seismic Case 5

Base Ring, R_b **$R_b = 0.385$**

Bolting, R_{bolt} **$R_{bolt} = 0.000$**

Concrete, R_c **$R_c = 0.086$**

* NOTE: Stress ratios greater than 1.0 represent overstressed conditions.

Base Support Analysis - Operating Unpressurized Condition - Occasional Loads - Wind Case 5

Total Weight of Tower as adjusted by load case combinations **W = 90186 lb.**

Maximum total moment at base of tower **M = 396118 in.-lb.**

Base Ring Calculations - Operating Unpressurized Condition - Occasional Loads - Wind Case 5

No uplift, therefore

$\mathbf{f_s}$ = 0 PSI

$f_{c\,max} = \left(\frac{M}{Zc}\right) + \left(\frac{W}{Ac}\right) = \left(\frac{396118}{54824}\right) + \left(\frac{90186}{1683.89}\right)$ $\mathbf{f_{c\,max}}$ = 61 PSI

Base ring stress, $S_b = W_{bo}^2 * \left(\frac{3 * f_{c\,max}}{Tb^2}\right) = 3.0000^2 * \left(\frac{3 * 61}{0.5000^2}\right)$ $\mathbf{S_b}$ = 6565 PSI

Anchor Bolt and Concrete Stresses - Operating Unpressurized Condition - Occasional Loads - Wind Case 5

Anchor bolt stress, Sbolt = f_s $\mathbf{S_{bolt}}$ = 0 PSI

Concrete stress, $S_c = f_{c\,max}$ $\mathbf{S_c}$ = 61 PSI

Base Support Allowable Stresses - Operating Unpressurized Condition - Occasional Loads - Wind Case 5

Base support material yield strength, S_y $\mathbf{S_y}$ = 30050 PSI

Base ring allowable stress, $S_{ba} = 1.0 * 0.6 * Sy = 1.0 * 0.6 * 30050$ $\mathbf{S_{ba}}$ = 18030 PSI

Anchor bolt allowable stress, S_{bolta} $\mathbf{S_{bolta}}$ = 20200 PSI

Concrete safe bearing load, S_{ca} = 0.3 * 28 day concrete strength = 0.3 * 2500.00 $\mathbf{S_{ca}}$ = 750 PSI

Base Support Stress Ratios - Operating Unpressurized Condition - Occasional Loads - Wind Case 5

Base Ring, R_b $\mathbf{R_b}$ = 0.364

Bolting, R_{bolt} $\mathbf{R_{bolt}}$ = 0.000

Concrete, R_c $\mathbf{R_c}$ = 0.081

* NOTE: Stress ratios greater than 1.0 represent overstressed conditions.

Base Support Analysis - Operating Unpressurized Condition - Sustained Loads

Total Weight of Tower as adjusted by load case combinations **W = 90186 lb.**

Maximum total moment at base of tower **M = 0 in.-lb.**

Base Ring Calculations - Operating Unpressurized Condition - Sustained Loads

No uplift, therefore

$f_s = 0$ PSI

$$f_{c\,max} = \left(\frac{M}{Zc}\right) + \left(\frac{W}{Ac}\right) = \left(\frac{0}{54824}\right) + \left(\frac{90186}{1683.89}\right)$$

$f_{c\,max} = 54$ PSI

$$\text{Base ring stress, } S_b = W_{bo}^2 * \left(\frac{3 * f_{c\,max}}{Tb^2}\right) = 3.0000^2 * \left(\frac{3 * 54}{0.5000^2}\right)$$

$S_b = 5784$ PSI

Anchor Bolt and Concrete Stresses - Operating Unpressurized Condition - Sustained Loads

Anchor bolt stress, Sbolt = f_s **S_{bolt} = 0 PSI**

Concrete stress, $S_c = f_{c\,max}$ **S_c = 54 PSI**

Base Support Allowable Stresses - Operating Unpressurized Condition - Sustained Loads

Base support material yield strength, S_y **S_y = 30050 PSI**

Base ring allowable stress, $S_{ba} = 1.0 * 0.6 * Sy = 1.0 * 0.6 * 30050$ **S_{ba} = 18030 PSI**

Anchor bolt allowable stress, S_{bolta} **S_{bolta} = 20200 PSI**

Concrete safe bearing load, $S_{ca} = 0.3 *$ 28 day concrete strength $= 0.3 * 2500.00$ **S_{ca} = 750 PSI**

Base Support Stress Ratios - Operating Unpressurized Condition - Sustained Loads

Base Ring, R_b **R_b = 0.321**

Bolting, R_{bolt} **R_{bolt} = 0.000**

Concrete, R_c **R_c = 0.071**

* NOTE: Stress ratios greater than 1.0 represent overstressed conditions.

Base Support Analysis - Empty Pressurized Condition - Occasional Loads - Seismic Case 5

Total Weight of Tower as adjusted by load case combinations **W = 50364 lb.**

Maximum total moment at base of tower **M = 270467 in.-lb.**

Base Ring Calculations - Empty Pressurized Condition - Occasional Loads - Seismic Case 5

No uplift, therefore

$f_s = 0$ PSI

$$f_{c\,max} = \left(\frac{M}{Zc}\right) + \left(\frac{W}{Ac}\right) = \left(\frac{270467}{54824}\right) + \left(\frac{50364}{1683.89}\right)$$

$f_{c\,max} = 35$ PSI

$$\text{Base ring stress, } S_b = W_{bo}{}^2 * \left(\frac{3 * f_{c\,max}}{Tb^2}\right) = 3.0000^2 * \left(\frac{3 * 35}{0.5000^2}\right)$$

$S_b = 3763$ PSI

Anchor Bolt and Concrete Stresses - Empty Pressurized Condition - Occasional Loads - Seismic Case 5

Anchor bolt stress, Sbolt = f_s $S_{bolt} = 0$ PSI

Concrete stress, $S_c = f_{c\,max}$ $S_c = 35$ PSI

Base Support Allowable Stresses - Empty Pressurized Condition - Occasional Loads - Seismic Case 5

Base support material yield strength, S_y $S_y = 30050$ PSI

Base ring allowable stress, $S_{ba} = 1.0 * 0.6 * Sy = 1.0 * 0.6 * 30050$ $S_{ba} = 18030$ PSI

Anchor bolt allowable stress, S_{bolta} $S_{bolta} = 20200$ PSI

Concrete safe bearing load, $S_{ca} = 0.3 *$ 28 day concrete strength $= 0.3 * 2500.00$ $S_{ca} = 750$ PSI

Base Support Stress Ratios - Empty Pressurized Condition - Occasional Loads - Seismic Case 5

Base Ring, R_b $R_b = 0.209$

Bolting, R_{bolt} $R_{bolt} = 0.000$

Concrete, R_c $R_c = 0.046$

* NOTE: Stress ratios greater than 1.0 represent overstressed conditions.

Base Support Analysis - Empty Pressurized Condition - Occasional Loads - Wind Case 5

Total Weight of Tower as adjusted by load case combinations **W = 49241 lb.**

Maximum total moment at base of tower **M = 396118 in.-lb.**

Base Ring Calculations - Empty Pressurized Condition - Occasional Loads - Wind Case 5

No uplift, therefore

$\mathbf{f_s}$ = 0 PSI

$f_{c\,max} = \left(\frac{M}{Zc}\right) + \left(\frac{W}{Ac}\right) = \left(\frac{396118}{54824}\right) + \left(\frac{49241}{1683.89}\right)$ $\mathbf{f_{c\,max}}$ = 36 PSI

Base ring stress, $S_b = W_{bo}^2 * \left(\frac{3 * f_{c\,max}}{Tb^2}\right) = 3.0000^2 * \left(\frac{3 * 36}{0.5000^2}\right)$ $\mathbf{S_b}$ = 3938 PSI

Anchor Bolt and Concrete Stresses - Empty Pressurized Condition - Occasional Loads - Wind Case 5

Anchor bolt stress, Sbolt = f_s $\mathbf{S_{bolt}}$ = 0 PSI

Concrete stress, $S_c = f_{c\,max}$ $\mathbf{S_c}$ = 36 PSI

Base Support Allowable Stresses - Empty Pressurized Condition - Occasional Loads - Wind Case 5

Base support material yield strength, S_y $\mathbf{S_y}$ = 30050 PSI

Base ring allowable stress, $S_{ba} = 1.0 * 0.6 * Sy = 1.0 * 0.6 * 30050$ $\mathbf{S_{ba}}$ = 18030 PSI

Anchor bolt allowable stress, S_{bolta} $\mathbf{S_{bolta}}$ = 20200 PSI

Concrete safe bearing load, S_{ca} = 0.3 * 28 day concrete strength = 0.3 * 2500.00 $\mathbf{S_{ca}}$ = 750 PSI

Base Support Stress Ratios - Empty Pressurized Condition - Occasional Loads - Wind Case 5

Base Ring, R_b $\mathbf{R_b}$ = 0.218

Bolting, R_{bolt} $\mathbf{R_{bolt}}$ = 0.000

Concrete, R_c $\mathbf{R_c}$ = 0.049

* NOTE: Stress ratios greater than 1.0 represent overstressed conditions.

SPX Flow Technology USA, Inc.

Base Ring

Job No: 7404131 Vessel Number: PG-1080 2080

Mark Number: BP1

Date Printed: 5/16/2012

Base Support Analysis - Empty Pressurized Condition - Sustained Loads

Total Weight of Tower as adjusted by load case combinations **W = 49241 lb.**

Maximum total moment at base of tower **M = 0 in.-lb.**

Base Ring Calculations - Empty Pressurized Condition - Sustained Loads

No uplift, therefore

$f_s = 0$ PSI

$$f_{c\,max} = \left(\frac{M}{Zc}\right) + \left(\frac{W}{Ac}\right) = \left(\frac{0}{54824}\right) + \left(\frac{49241}{1683.89}\right)$$

$f_{c\,max} = 29$ PSI

$$\text{Base ring stress, } S_b = W_{bo}{}^2 * \left(\frac{3 * f_{c\,max}}{Tb^2}\right) = 3.0000^2 * \left(\frac{3 * 29}{0.5000^2}\right)$$

$S_b = 3158$ PSI

Anchor Bolt and Concrete Stresses - Empty Pressurized Condition - Sustained Loads

Anchor bolt stress, Sbolt = f_s **S_{bolt} = 0 PSI**

Concrete stress, $S_c = f_{c\,max}$ **S_c = 29 PSI**

Base Support Allowable Stresses - Empty Pressurized Condition - Sustained Loads

Base support material yield strength, S_y **S_y = 30050 PSI**

Base ring allowable stress, $S_{ba} = 1.0 * 0.6 * Sy = 1.0 * 0.6 * 30050$ **S_{ba} = 18030 PSI**

Anchor bolt allowable stress, S_{bolta} **S_{bolta} = 20200 PSI**

Concrete safe bearing load, $S_{ca} = 0.3 *$ 28 day concrete strength $= 0.3 * 2500.00$ **S_{ca} = 750 PSI**

Base Support Stress Ratios - Empty Pressurized Condition - Sustained Loads

Base Ring, R_b **R_b = 0.175**

Bolting, R_{bolt} **R_{bolt} = 0.000**

Concrete, R_c **R_c = 0.039**

* NOTE: Stress ratios greater than 1.0 represent overstressed conditions.

Base Support Analysis - Empty Unpressurized Condition - Occasional Loads - Seismic Case 5

Total Weight of Tower as adjusted by load case combinations — **W = 50364 lb.**

Maximum total moment at base of tower — **M = 270467 in.-lb.**

Base Ring Calculations - Empty Unpressurized Condition - Occasional Loads - Seismic Case 5

No uplift, therefore

$f_s = 0$ PSI

$$f_{c\,max} = \left(\frac{M}{Zc}\right) + \left(\frac{W}{Ac}\right) = \left(\frac{270467}{54824}\right) + \left(\frac{50364}{1683.89}\right)$$

$f_{c\,max} = 35$ PSI

$$\text{Base ring stress, } S_b = W_{bo}^2 * \left(\frac{3 * f_{c\,max}}{Tb^2}\right) = 3.0000^2 * \left(\frac{3 * 35}{0.5000^2}\right)$$

$S_b = 3763$ PSI

Anchor Bolt and Concrete Stresses - Empty Unpressurized Condition - Occasional Loads - Seismic Case 5

Anchor bolt stress, Sbolt = f_s — $S_{bolt} = 0$ PSI

Concrete stress, $S_c = f_{c\,max}$ — $S_c = 35$ PSI

Base Support Allowable Stresses - Empty Unpressurized Condition - Occasional Loads - Seismic Case 5

Base support material yield strength, S_y — $S_y = 30050$ PSI

Base ring allowable stress, $S_{ba} = 1.0 * 0.6 * Sy = 1.0 * 0.6 * 30050$ — $S_{ba} = 18030$ PSI

Anchor bolt allowable stress, S_{bolta} — $S_{bolta} = 20200$ PSI

Concrete safe bearing load, $S_{ca} = 0.3 *$ 28 day concrete strength $= 0.3 * 2500.00$ — $S_{ca} = 750$ PSI

Base Support Stress Ratios - Empty Unpressurized Condition - Occasional Loads - Seismic Case 5

Base Ring, R_b — $R_b = 0.209$

Bolting, R_{bolt} — $R_{bolt} = 0.000$

Concrete, R_c — $R_c = 0.046$

* NOTE: Stress ratios greater than 1.0 represent overstressed conditions.

Base Support Analysis - Empty Unpressurized Condition - Occasional Loads - Wind Case 5

Total Weight of Tower as adjusted by load case combinations — **W = 49241 lb.**

Maximum total moment at base of tower — **M = 396118 in.-lb.**

Base Ring Calculations - Empty Unpressurized Condition - Occasional Loads - Wind Case 5

No uplift, therefore

$\mathbf{f_s}$ = 0 PSI

$f_{c\,max} = \left(\frac{M}{Zc}\right) + \left(\frac{W}{Ac}\right) = \left(\frac{396118}{54824}\right) + \left(\frac{49241}{1683.89}\right)$ $\mathbf{f_{c\,max}}$ = 36 PSI

Base ring stress, $S_b = W_{bo}^2 * \left(\frac{3 * f_{c\,max}}{Tb^2}\right) = 3.0000^2 * \left(\frac{3 * 36}{0.5000^2}\right)$ $\mathbf{S_b}$ = 3938 PSI

Anchor Bolt and Concrete Stresses - Empty Unpressurized Condition - Occasional Loads - Wind Case 5

Anchor bolt stress, Sbolt = f_s $\mathbf{S_{bolt}}$ = 0 PSI

Concrete stress, $S_c = f_{c\,max}$ $\mathbf{S_c}$ = 36 PSI

Base Support Allowable Stresses - Empty Unpressurized Condition - Occasional Loads - Wind Case 5

Base support material yield strength, S_y $\mathbf{S_y}$ = 30050 PSI

Base ring allowable stress, $S_{ba} = 1.0 * 0.6 * Sy = 1.0 * 0.6 * 30050$ $\mathbf{S_{ba}}$ = 18030 PSI

Anchor bolt allowable stress, S_{bolta} $\mathbf{S_{bolta}}$ = 20200 PSI

Concrete safe bearing load, S_{ca} = 0.3 * 28 day concrete strength = 0.3 * 2500.00 $\mathbf{S_{ca}}$ = 750 PSI

Base Support Stress Ratios - Empty Unpressurized Condition - Occasional Loads - Wind Case 5

Base Ring, R_b $\mathbf{R_b}$ = 0.218

Bolting, R_{bolt} $\mathbf{R_{bolt}}$ = 0.000

Concrete, R_c $\mathbf{R_c}$ = 0.049

* NOTE: Stress ratios greater than 1.0 represent overstressed conditions.

SPX Flow Technology USA, Inc.

Base Ring

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Mark Number: BP1

Date Printed: 5/16/2012

Base Support Analysis - Empty Unpressurized Condition - Sustained Loads

Total Weight of Tower as adjusted by load case combinations **W = 49241 lb.**

Maximum total moment at base of tower **M = 0 in.-lb.**

Base Ring Calculations - Empty Unpressurized Condition - Sustained Loads

No uplift, therefore

$f_s = 0$ PSI

$$f_{c\,max} = \left(\frac{M}{Zc}\right) + \left(\frac{W}{Ac}\right) = \left(\frac{0}{54824}\right) + \left(\frac{49241}{1683.89}\right)$$

$f_{c\,max} = 29$ PSI

$$\text{Base ring stress, } S_b = W_{bo}{}^2 * \left(\frac{3 * f_{c\,max}}{Tb^2}\right) = 3.0000^2 * \left(\frac{3 * 29}{0.5000^2}\right)$$

$S_b = 3158$ PSI

Anchor Bolt and Concrete Stresses - Empty Unpressurized Condition - Sustained Loads

Anchor bolt stress, Sbolt = f_s **S_{bolt} = 0 PSI**

Concrete stress, $S_c = f_{c\,max}$ **S_c = 29 PSI**

Base Support Allowable Stresses - Empty Unpressurized Condition - Sustained Loads

Base support material yield strength, S_y **S_y = 30050 PSI**

Base ring allowable stress, $S_{ba} = 1.0 * 0.6 * Sy = 1.0 * 0.6 * 30050$ **S_{ba} = 18030 PSI**

Anchor bolt allowable stress, S_{bolta} **S_{bolta} = 20200 PSI**

Concrete safe bearing load, S_{ca} = 0.3 * 28 day concrete strength = 0.3 * 2500.00 **S_{ca} = 750 PSI**

Base Support Stress Ratios - Empty Unpressurized Condition - Sustained Loads

Base Ring, R_b **R_b = 0.175**

Bolting, R_{bolt} **R_{bolt} = 0.000**

Concrete, R_c **R_c = 0.039**

* NOTE: Stress ratios greater than 1.0 represent overstressed conditions.

SPX Flow Technology USA, Inc.

Base Ring

Job No: 7404131 Vessel Number: PG-1080 2080

Mark Number: BP1

Date Printed: 5/16/2012

Base Support Analysis - Test Conditon

Total Weight of Tower as adjusted by load case combinations **W = 104756 lb.**

Maximum total moment at base of tower **M = 0 in.-lb.**

Base Ring Calculations - Test Conditon

No uplift, therefore

$f_s = 0$ PSI

$$f_{c\,max} = \left(\frac{M}{Zc}\right) + \left(\frac{W}{Ac}\right) = \left(\frac{0}{54824}\right) + \left(\frac{104756}{1683.89}\right)$$

$f_{c\,max} = 62$ PSI

$$\text{Base ring stress, } S_b = W_{bo}{}^2 * \left(\frac{3 * f_{c\,max}}{Tb^2}\right) = 3.0000^2 * \left(\frac{3 * 62}{0.5000^2}\right)$$

$S_b = 6719$ PSI

Anchor Bolt and Concrete Stresses - Test Conditon

Anchor bolt stress, Sbolt = f_s $S_{bolt} = 0$ PSI

Concrete stress, $S_c = f_{c\,max}$ $S_c = 62$ PSI

Base Support Allowable Stresses - Test Conditon

Base support material yield strength, S_y $S_y = 30050$ PSI

Base ring allowable stress, $S_{ba} = 1.0 * 0.6 * Sy = 1.0 * 0.6 * 30050$ $S_{ba} = 18030$ PSI

Anchor bolt allowable stress, S_{bolta} $S_{bolta} = 20200$ PSI

Concrete safe bearing load, $S_{ca} = 0.3 *$ 28 day concrete strength $= 0.3 * 2500.00$ $S_{ca} = 750$ PSI

Base Support Stress Ratios - Test Conditon

Base Ring, R_b $R_b = 0.373$

Bolting, R_{bolt} $R_{bolt} = 0.000$

Concrete, R_c $R_c = 0.083$

* NOTE: Stress ratios greater than 1.0 represent overstressed conditions.

ASME Flange Design Information

Host	Description	Type	Size (in.)	Material	ASME Class	Material Group	MAP (PSI)
SMLS LWN (FVC) - 20" M	Smls LWN (FVC) - 20"	Weld Neck	20		300	1.1	620.00
SMLS LWN (FVC) - 8" DE	Smls LWN (FVC) - 8"	Weld Neck	8		300	1.1	620.00
Smls LWN (FVC) - 16"	Smls LWN (FVC) - 16"	Weld Neck	16		300	1.1	620.00
SMLS LWN (FVC) - 20" I	Smls Long Weld Neck-2	Weld Neck	20		300	1.1	620.00
SMLS LWN (FVC) - 8" DE	Smls LWN (FVC) - 8"	Weld Neck	8		300	1.1	620.00
SMLS LWN (FVC) - 2" RE	Smls LWN (FVC) - 2"	Weld Neck	2		300	1.1	620.00
SMLS LWN (FVC) - 1-1/2	Smls LWN (FVC) - 1-1/	Weld Neck	1.5		300	1.1	620.00
SMLS WELD STUB (FVC) -	Smls LWN (FVC) - 20"	Weld Neck	20		300	1.1	620.00
SMLS LWN (FVC) - 8" DE	Smls Long Weld Neck-	Weld Neck	8		300	1.1	620.00

WRC-107 Loading Information

Design Pressure:	350.00	PSI	Allowable Stress Multiplier:	3.0	
Design Temperature:	450	℉	Yield Multiplier:	1.0	

Elliptical Vessel Information

Outside Diameter:	130.5000	in.	Design Temperature:	450	°F
Thickness:	1.3750	in.	Corrosion Allowance:	0.0625	in.
Material:	SA-516 Gr. 70				
Material Condition:	Normalized		Allowable Stress at Design Temperature:	20000	PSI
Density:	0.2800	lb/in.^3	Allowable Stress at Ambient Temperature:	20000	PSI
Modulus of Elasticity:	27.4	10^6 PSI	Yield Strength:	31750	PSI

Rigid Square Attachment Information

Square Width:	5.1400	in.	Design Temperature:	450	℉
Material:	SA-36				
			Allowable Stress at Design Temperature:	16600	PSI
Density:	0.2800	lb/in.^3	Allowable Stress at Ambient Temperature:	16600	PSI
Modulus of Elasticity:	27.4	10^6 PSI	Yield Strength:	30050	PSI
Factor Kn:	1.00		Factor Kb:	1.00	

Solve For Stresses

Radial Load, P:	= 50000 lb.
External shear load in the 2-2 direction, V1:	= 25000 lb.
External shear load in the 1-1 direction, V2:	= 0 lb.
External overturning moment in the 1-1 direction, M1:	= 0 Ft.-lb.
External overturning moment in the 2-2 direction, M2:	= 0 Ft.-lb.
External torsional moment, Mt:	= 0 Ft.-lb.

Geometric Parameters

$$U = \frac{c_1}{0.875\sqrt{R_m * T}} = \frac{2.5700}{0.875\sqrt{64.5938 * 1.3125}} = 0.3190$$

Allowable Stress:
min[Yield Multiplier * min(Host Yield, Attachment Yield), Stress Multiplier * min(Host Stress, Attachment Stress)] = 30050

The Vessel Combined Stress Intensity is less than or equal to the Allowable Stress

From Figure	Read Curves For	Absolute values of stress	A_U	A_L	B_U	B_L	C_U	C_L	D_U	D_L
		Pressure	8560	8560	8560	8560	8560	8560	8560	8560
SR-2	$\frac{Nx\ T}{P}$ = 0.1829	$Kn * \frac{Nx\ T}{P} * \frac{P}{T^2}$ = 5308	-5308	-5308	-5308	-5308	-5308	-5308	-5308	-5308
	$\frac{Mx}{P}$ = 0.1305	$Kb * \frac{Mx}{P} * \frac{6P}{T^2}$ = 22723	-22723	22723	-22723	22723	-22723	22723	-22723	22723
SR-3	$\frac{Nx\ T\sqrt{Rm\ T}}{M_1}$ = 0.1625	$Kn * \frac{Nx\ T\sqrt{Rm\ T}}{M_1} * \frac{M_1}{T^2\sqrt{RmT}}$ = 0					0	0	0	0
	$\frac{Mx\sqrt{Rm\ T}}{M_1}$ = 0.5126	$Kb * \frac{Mx\sqrt{Rm\ T}}{M_1} * \frac{6M_1}{T^2\sqrt{RmT}}$ = 0					0	0	0	0
	$\frac{Nx\ T\sqrt{Rm\ T}}{M_2}$ = 0.1625	$Kn * \frac{Nx\ T\sqrt{Rm\ T}}{M_2} * \frac{M_2}{T^2\sqrt{RmT}}$ = 0	0	0	0	0				
	$\frac{Mx\sqrt{Rm\ T}}{M_2}$ = 0.5126	$Kb * \frac{Mx\sqrt{Rm\ T}}{M_2} * \frac{6M_2}{T^2\sqrt{RmT}}$ = 0	0	0	0	0				
		σx Stress Totals	-19472	25975	-19472	25975	-19472	25975	-19472	25975
		Pressure	8560	8560	8560	8560	8560	8560	8560	8560
SR-2	$\frac{Ny\ T}{P}$ = 0.0551	$Kn * \frac{Ny\ T}{P} * \frac{P}{T^2}$ = 1598	-1598	-1598	-1598	-1598	-1598	-1598	-1598	-1598
	$\frac{My}{P}$ = 0.0393	$Kb * \frac{My}{P} * \frac{6P}{T^2}$ = 6836	-6836	6836	-6836	6836	-6836	6836	-6836	6836
SR-3	$\frac{Ny\ T\sqrt{Rm\ T}}{M_1}$ = 0.0505	$Kn * \frac{Ny\ T\sqrt{Rm\ T}}{M_1} * \frac{M_1}{T^2\sqrt{RmT}}$ = 0					0	0	0	0
	$\frac{My\sqrt{Rm\ T}}{M_1}$ = 0.1281	$Kb * \frac{My\sqrt{Rm\ T}}{M_1} * \frac{6M_1}{T^2\sqrt{RmT}}$ = 0					0	0	0	0
	$\frac{Ny\ T\sqrt{Rm\ T}}{M_2}$ = 0.0505	$Kn * \frac{Ny\ T\sqrt{Rm\ T}}{M_2} * \frac{M_2}{T^2\sqrt{RmT}}$ = 0	0	0	0	0				
	$\frac{My\sqrt{Rm\ T}}{M_2}$ = 0.1281	$Kb * \frac{My\sqrt{Rm\ T}}{M_2} * \frac{6M_2}{T^2\sqrt{RmT}}$ = 0	0	0	0	0				
		σy Stress Totals	126	13797	126	13797	126	13797	126	13797
	Due to load, V_1	$\frac{V_1}{\pi r_o T}$ = 1853					-1853	-1853	1853	1853
	Due to load, V_2	$\frac{V_2}{\pi r_o T}$ = 0	0	0	0	0				
		Shear Stress Totals	0	0	0	0	-1853	-1853	1853	1853
		Combined Stress Intensities	19598	25975	19598	25975	19945	26251	19945	26251

1) When τ <> 0, Combined Stress Intensity = largest absolute magnitude of either
$\frac{1}{2}[\sigma_x + \sigma_y \pm \sqrt{(\sigma_x - \sigma_y)^2 + 4\tau^2}]$
or
$\sqrt{(\sigma_x - \sigma_y)^2 + 4\tau^2}$

2) When $\tau = 0$, Combined Stress Intensity = largest absolute magnitude of σ_x, σ_y, or $(\sigma_x - \sigma_y)$

Allowable Stress:
min[Yield Multiplier * min(Host Yield, Attachment Yield), Stress Multiplier * min(Host Stress, Attachment Stress)] = 30050
The Largest Vessel Combined Stress Intensity = 26251 PSI

WRC-107 Loading Information

Design Pressure:	350.00	PSI	Allowable Stress Multiplier:	3.0	
Design Temperature:	450	℉	Yield Multiplier:	1.0	

Elliptical Vessel Information

Outside Diameter:	130.5000	in.	Design Temperature:	450	°F
Thickness:	1.3750	in.	Corrosion Allowance:	0.0625	in.
Material:	SA-516 Gr. 70				
Material Condition:	Normalized		Allowable Stress at Design Temperature:	20000	PSI
Density:	0.2800	lb/in.^3	Allowable Stress at Ambient Temperature:	20000	PSI
Modulus of Elasticity:	27.4	10^6 PSI	Yield Strength:	31750	PSI

Hollow Cylinder Attachment Information

Outside Radius, ro:	11.5626	in.	Design Temperature:	450	℉
Thickness, t:	1.5626	in.	Corrosion Allowance:	0.0625	in.
Material:	SA-105				
			Allowable Stress at Design Temperature:	19800	PSI
Density:	0.2800	lb/in.^3	Allowable Stress at Ambient Temperature:	20000	PSI
Modulus of Elasticity:	27.4	10^6 PSI	Yield Strength:	30050	PSI
Factor Kn:	1.00		Factor Kb:	1.00	

Solve For Stresses

Radial Load, P:	= 100000 lb.
External shear load in the 2-2 direction, V1:	= 100000 lb.
External shear load in the 1-1 direction, V2:	= 100000 lb.
External overturning moment in the 1-1 direction, M1:	= 50000 Ft.-lb.
External overturning moment in the 2-2 direction, M2:	= 50000 Ft.-lb.
External torsional moment, Mt:	= 50000 Ft.-lb.

Geometric Parameters

$$U = \frac{r_o}{\sqrt{R_m * T}} = \frac{11.5626}{\sqrt{64.5938 * 1.3125}} = 1.2558$$

$$\Upsilon = \frac{r_m}{t} = \frac{10.8126}{1.5001} = 7.2079$$

$$\rho = \frac{T}{t} = \frac{1.3125}{1.5001} = 0.8749$$

Allowable Stress:
min[Yield Multiplier * min(Host Yield, Attachment Yield), Stress Multiplier * min(Host Stress, Attachment Stress)] = 30050

The Vessel Combined Stress Intensity is less than or equal to the Allowable Stress

From Figure	Read Curves For	Absolute values of stress	A_U	A_L	B_U	B_L	C_U	C_L	D_U	D_L
		Pressure	8560	8560	8560	8560	8560	8560	8560	8560
SP1 to 10	$\frac{Nx\,T}{P}$ = 0.0304	$Kn * \frac{Nx\,T}{P} * \frac{P}{T^2}$ = 1765	-1765	-1765	-1765	-1765	-1765	-1765	-1765	-1765
	$\frac{Mx}{P}$ = 0.0304	$Kb * \frac{Mx}{P} * \frac{6P}{T^2}$ = 10588	-10588	10588	-10588	10588	-10588	10588	-10588	10588
SM1 to 10	$\frac{Nx\,T\sqrt{Rm\,T}}{M_1}$ = 0.0353	$Kn * \frac{Nx\,T\sqrt{Rm\,T}}{M_1} * \frac{M_1}{T^2\sqrt{RmT}}$ = 1335					-1335	-1335	1335	1335
	$\frac{Mx\sqrt{Rm\,T}}{M_1}$ = 0.0440	$Kb * \frac{Mx\sqrt{Rm\,T}}{M_1} * \frac{6M_1}{T^2\sqrt{RmT}}$ = 9986					-9986	9986	9986	-9986
	$\frac{Nx\,T\sqrt{Rm\,T}}{M_2}$ = 0.0353	$Kn * \frac{Nx\,T\sqrt{Rm\,T}}{M_2} * \frac{M_2}{T^2\sqrt{RmT}}$ = 1335	-1335	-1335	1335	1335				
	$\frac{Mx\sqrt{Rm\,T}}{M_2}$ = 0.0440	$Kb * \frac{Mx\sqrt{Rm\,T}}{M_2} * \frac{6M_2}{T^2\sqrt{RmT}}$ = 9986	-9986	9986	9986	-9986				
		σx Stress Totals	-15115	26035	7529	8732	-15115	26035	7529	8732
		Pressure	8560	8560	8560	8560	8560	8560	8560	8560
SP1 to 10	$\frac{Ny\,T}{P}$ = 0.0615	$Kn * \frac{Ny\,T}{P} * \frac{P}{T^2}$ = 3570	-3570	-3570	-3570	-3570	-3570	-3570	-3570	-3570
	$\frac{My}{P}$ = 0.0095	$Kb * \frac{My}{P} * \frac{6P}{T^2}$ = 3309	-3309	3309	-3309	3309	-3309	3309	-3309	3309
SM1 to 10	$\frac{Ny\,T\sqrt{Rm\,T}}{M_1}$ = 0.0609	$Kn * \frac{Ny\,T\sqrt{Rm\,T}}{M_1} * \frac{M_1}{T^2\sqrt{RmT}}$ = 2304					-2304	-2304	2304	2304
	$\frac{My\sqrt{Rm\,T}}{M_1}$ = 0.0169	$Kb * \frac{My\sqrt{Rm\,T}}{M_1} * \frac{6M_1}{T^2\sqrt{RmT}}$ = 3836					-3836	3836	3836	-3836
	$\frac{Ny\,T\sqrt{Rm\,T}}{M_2}$ = 0.0609	$Kn * \frac{Ny\,T\sqrt{Rm\,T}}{M_2} * \frac{M_2}{T^2\sqrt{RmT}}$ = 2304	-2304	-2304	2304	2304				
	$\frac{My\sqrt{Rm\,T}}{M_2}$ = 0.0169	$Kb * \frac{My\sqrt{Rm\,T}}{M_2} * \frac{6M_2}{T^2\sqrt{RmT}}$ = 3836	-3836	3836	3836	-3836				
		σy Stress Totals	-4458	9831	7820	6767	-4458	9831	7820	6767
	Due to load, V_1	$\frac{V_1}{\pi r_o T}$ = 2097					-2097	-2097	2097	2097
	Due to load, V_2	$\frac{V_2}{\pi r_o T}$ = 2097	2097	2097	-2097	-2097				
	Due to Torsion, M_T	$\frac{M_T}{2\pi r_o^2 T}$ = 544	544	544	544	544	544	544	544	544
		Shear Stress Totals	2642	2642	-1553	-1553	-1553	-1553	2642	2642
		Combined Stress Intensities	15734	26455	9235	9588	15337	26182	10320	10568

1) When $\tau <> 0$, Combined Stress Intensity = largest absolute magnitude of either
$$\tfrac{1}{2}\left[\sigma_x + \sigma_y \pm \sqrt{(\sigma_x - \sigma_y)^2 + 4\tau^2}\right]$$
or
$$\sqrt{(\sigma_x - \sigma_y)^2 + 4\tau^2}$$

2) When $\tau = 0$, Combined Stress Intensity = largest absolute magnitude of σ_x, σ_y, or $(\sigma_x - \sigma_y)$

Allowable Stress:
min[Yield Multiplier * min(Host Yield, Attachment Yield), Stress Multiplier * min(Host Stress, Attachment Stress)] = 30050
The Largest Vessel Combined Stress Intensity = 26455 PSI

SPX Flow Technology USA, Inc.

WRC - Nozzle 10 Bottom

Customer: **Southern Company**
Job No: 7404131
Number: 3

Vessel Number: PG-1080 2080

Date Printed: 5/16/2012

WRC-107 Loading Information

Design Pressure:	350.00	PSI	Allowable Stress Multiplier:	3.0	
Design Temperature:	450	℉	Yield Multiplier:	1.0	

Elliptical Vessel Information

Outside Diameter:	130.5000	in.	Design Temperature:	450	°F
Thickness:	1.3750	in.	Corrosion Allowance:	0.0625	in.
Material:	SA-516 Gr. 70				
Material Condition:	Normalized		Allowable Stress at Design Temperature:	20000	PSI
Density:	0.2800	lb/in.^3	Allowable Stress at Ambient Temperature:	20000	PSI
Modulus of Elasticity:	27.4	10^6 PSI	Yield Strength:	31750	PSI

Hollow Cylinder Attachment Information

Outside Radius, ro:	12.1250	in.	Design Temperature:	450	℉
Thickness, t:	2.5000	in.	Corrosion Allowance:	0.0625	in.
Material:	SA-105				
			Allowable Stress at Design Temperature:	19800	PSI
Density:	0.2800	lb/in.^3	Allowable Stress at Ambient Temperature:	20000	PSI
Modulus of Elasticity:	27.4	10^6 PSI	Yield Strength:	30050	PSI
Factor Kn:	1.00		Factor Kb:	1.00	

Solve For Stresses

Radial Load, P:	= 100000 lb.
External shear load in the 2-2 direction, V1:	= 100000 lb.
External shear load in the 1-1 direction, V2:	= 100000 lb.
External overturning moment in the 1-1 direction, M1:	= 50000 Ft.-lb.
External overturning moment in the 2-2 direction, M2:	= 50000 Ft.-lb.
External torsional moment, Mt:	= 50000 Ft.-lb.

Geometric Parameters

$$U = \frac{r_o}{\sqrt{R_m * T}} = \frac{12.1250}{\sqrt{64.5938 * 1.3125}} = 1.3169$$

$$\Upsilon = \frac{r_m}{t} = \frac{10.9063}{2.4375} = 4.4744$$

$$\rho = \frac{T}{t} = \frac{1.3125}{2.4375} = 0.5385$$

Allowable Stress:
min[Yield Multiplier * min(Host Yield, Attachment Yield), Stress Multiplier * min(Host Stress, Attachment Stress)] = 30050

The Vessel Combined Stress Intensity is less than or equal to the Allowable Stress

From Figure	Read Curves For	Absolute values of stress	A_U	A_L	B_U	B_L	C_U	C_L	D_U	D_L
		Pressure	8560	8560	8560	8560	8560	8560	8560	8560
SP1 to 10	$\frac{Nx\,T}{P}$ = 0.0310	$Kn * \frac{Nx\,T}{P} * \frac{P}{T^2}$ = 1800	-1800	-1800	-1800	-1800	-1800	-1800	-1800	-1800
	$\frac{Mx}{P}$ = 0.0299	$Kb * \frac{Mx}{P} * \frac{6P}{T^2}$ = 10414	-10414	10414	-10414	10414	-10414	10414	-10414	10414
SM1 to 10	$\frac{Nx\,T\sqrt{Rm\,T}}{M_1}$ = 0.0332	$Kn * \frac{Nx\,T\sqrt{Rm\,T}}{M_1} * \frac{M_1}{T^2\sqrt{RmT}}$ = 1256					-1256	-1256	1256	1256
	$\frac{Mx\sqrt{Rm\,T}}{M_1}$ = 0.0436	$Kb * \frac{Mx\sqrt{Rm\,T}}{M_1} * \frac{6M_1}{T^2\sqrt{RmT}}$ = 9896					-9896	9896	9896	-9896
	$\frac{Nx\,T\sqrt{Rm\,T}}{M_2}$ = 0.0332	$Kn * \frac{Nx\,T\sqrt{Rm\,T}}{M_2} * \frac{M_2}{T^2\sqrt{RmT}}$ = 1256	-1256	-1256	1256	1256				
	$\frac{Mx\sqrt{Rm\,T}}{M_2}$ = 0.0436	$Kb * \frac{Mx\sqrt{Rm\,T}}{M_2} * \frac{6M_2}{T^2\sqrt{RmT}}$ = 9896	-9896	9896	9896	-9896				
		σx Stress Totals	-14805	25814	7498	8535	-14805	25814	7498	8535
		Pressure	8560	8560	8560	8560	8560	8560	8560	8560
SP1 to 10	$\frac{Ny\,T}{P}$ = 0.0473	$Kn * \frac{Ny\,T}{P} * \frac{P}{T^2}$ = 2746	-2746	-2746	-2746	-2746	-2746	-2746	-2746	-2746
	$\frac{My}{P}$ = 0.0084	$Kb * \frac{My}{P} * \frac{6P}{T^2}$ = 2926	-2926	2926	-2926	2926	-2926	2926	-2926	2926
SM1 to 10	$\frac{Ny\,T\sqrt{Rm\,T}}{M_1}$ = 0.0459	$Kn * \frac{Ny\,T\sqrt{Rm\,T}}{M_1} * \frac{M_1}{T^2\sqrt{RmT}}$ = 1736					-1736	-1736	1736	1736
	$\frac{My\sqrt{Rm\,T}}{M_1}$ = 0.0142	$Kb * \frac{My\sqrt{Rm\,T}}{M_1} * \frac{6M_1}{T^2\sqrt{RmT}}$ = 3223					-3223	3223	3223	-3223
	$\frac{Ny\,T\sqrt{Rm\,T}}{M_2}$ = 0.0459	$Kn * \frac{Ny\,T\sqrt{Rm\,T}}{M_2} * \frac{M_2}{T^2\sqrt{RmT}}$ = 1736	-1736	-1736	1736	1736				
	$\frac{My\sqrt{Rm\,T}}{M_2}$ = 0.0142	$Kb * \frac{My\sqrt{Rm\,T}}{M_2} * \frac{6M_2}{T^2\sqrt{RmT}}$ = 3223	-3223	3223	3223	-3223				
		σy Stress Totals	-2071	10227	7848	7253	-2071	10227	7848	7253
	Due to load, V_1	$\frac{V_1}{\pi r_o T}$ = 2000					-2000	-2000	2000	2000
	Due to load, V_2	$\frac{V_2}{\pi r_o T}$ = 2000	2000	2000	-2000	-2000				
	Due to Torsion, M_T	$\frac{M_T}{2\pi r_o^2 T}$ = 495	495	495	495	495	495	495	495	495
		Shear Stress Totals	2495	2495	-1505	-1505	-1505	-1505	2495	2495
		Combined Stress Intensities	15277	26204	9188	9530	14981	25958	10174	10470

1) When τ <> 0, Combined Stress Intensity = largest absolute magnitude of either
$$\tfrac{1}{2}\left[\sigma_X + \sigma_Y \pm \sqrt{(\sigma_X - \sigma_Y)^2 + 4\tau^2}\right]$$
or
$$\sqrt{(\sigma_X - \sigma_Y)^2 + 4\tau^2}$$

2) When $\tau = 0$, Combined Stress Intensity = largest absolute magnitude of σ_X, σ_Y, or $(\sigma_X - \sigma_Y)$

Allowable Stress:
min[Yield Multiplier * min(Host Yield, Attachment Yield), Stress Multiplier * min(Host Stress, Attachment Stress)] = 30050
The Largest Vessel Combined Stress Intensity = 26204 PSI

Loading Summary						
Type	Starting Elevation (in.)	Ending Elevation (in.)	Density (lb./Ft^3)	Thickness (in.)	Wind Diameter (in.)	Wind Pressure (lb./ft.²)
Liquid	104.0000	200.0000	46.0000	-	-	100.00

Attachment Summary					
Attachment No.	Elevation (in.)	Description	Attachment Weight (lb.)	Horizontal Force (lb.)	Attachment Moment (in.-lb.)
1	140.0000	misc. dssc, bed	12000.00	0	0

Tower Analysis

Operating Pressurized Condition - Occasional Loads - Seismic Case 5

First Period of Natural Vibration for Operating conditions: 0.0298 seconds/cycle

ASCE 7-05 Seismic Design Information

0.2 s Spectral Response Accel (S_s):	0.163		
1 s Spectral Response Accel. (S_1):	0.099	Response Modification Factor (R):	3.000
Seismic Use Group:	II	Site Class:	C
Total seismic shear force at the base (V):	4410 lb.		

ASCE 7-05 Seismic Analysis

Segment Type	Segment No.	Wi Weight (lb.)	Hi Mid-Elevation (in.)	Wi * Hi (Ft.-lb.)	Segment Seismic Force (lb.)	Shear @ Top (lb.)	Moment @ Bottom (Ft.-lb.)	Seismic Stress (PSI)
Head	1	16317.98	214.8750	292194	792	0	1485	1
Shell	2	15102.87	183.5000	230948	626	792	4407	3
Shell	3	15102.87	154.5000	194449	527	1418	8682	5
Attach	4t	12000.00	140.0000	140000	379			
Shell	4	18748.39	122.0000	190609	517	2324	16687	11
Shell	5	344.38	103.0000	2956	8	2841	17161	11
Head	6t	8140.83	102.0000	69197	188			
Skirt	6	1107.18	89.2500	8235	22	3036	23644	67
Skirt	7	1107.18	63.7500	5882	16	3058	30166	85
Skirt	8	1107.18	38.2500	3529	10	3074	36712	104
Skirt	9	1107.18	12.7500	1176	3	3084	43270	122
Total		**90186.03**		**1139175**				

Stress Summary

Segment Type	Segment No.	Sm Attachments With Wind or Seismic (PSI)	Sp Internal Pressure Stress (PSI)	Sp External Pressure Stress (PSI)	Sw Weight Stress (PSI)	Maximum Tensile Stress (PSI)	Maximum Compressive Stress (PSI)
Head	1	1	7947	0	14	7934	-15
Shell	2	3	8017	0	23	7997	-26
Shell	3	5	8017	0	31	7991	-37
Shell	4	11	8017	0	63	7964	-74
Shell	5	11	8017	0	64	7964	-74
Skirt	6	67	0	0	687	-620	-754
Skirt	7	85	0	0	696	-611	-781
Skirt	8	104	0	0	705	-601	-808
Skirt	9	122	0	0	714	-591	-836

Positive values represent tensile stress, and negative values represent compressive.
Stress ratios greater than 1.0 represent overstressed conditions.

Stress Comparisons

Segment Type	Segment No.	Maximum Tensile Stress (PSI)	Allowable Stress (PSI)	Maximum Tensile Stress Ratio	Maximum Compressive Stress (PSI)	Allowable Stress (PSI)	Maximum Compressive Stress Ratio	Critical Buckling Stress (PSI)	Critical Buckling Ratio
Head	1	7934	20000	0.3967	-15	-13100	0.0011	-15875	0.0009
Shell	2	7997	20000	0.3998	-26	-13100	0.0020	-15875	0.0016
Shell	3	7991	20000	0.3995	-37	-13100	0.0028	-15875	0.0023
Shell	4	7964	20000	0.3982	-74	-13100	0.0056	-15875	0.0046
Shell	5	7964	20000	0.3982	-74	-13100	0.0057	-15875	0.0047
Skirt	6	-620	-8053	0.0770	-754	-8053	0.0936	-9008	0.0837
Skirt	7	-611	-8053	0.0758	-781	-8053	0.0970	-9008	0.0867
Skirt	8	-601	-8053	0.0746	-808	-8053	0.1004	-9008	0.0898
Skirt	9	-591	-8053	0.0734	-836	-8053	0.1038	-9008	0.0928

Operating Pressurized Condition - Occasional Loads - Wind Case 5

ASCE 7-05 Wind Design Information

Basic Wind Speed (V):	100 MPH	Wind Exposure type:	C
Importance factor (I):	1.15	Force (shape) coefficient (C_f):	0.7
Total deflection of top of tower is :	0.0006 in.		
Total deflection dist. per 100 ft height is :	0.0033 in.		

First Period of Natural Vibration for Operating conditions: 0.0298 seconds/cycle

ASCE 7-05 Wind Analysis

Segment Type	Segment No.	Segment Height (in.)	Wind Load Diameter (in.)	Projection Area (Sq. Ft.)	(Kz) Exposure Factor	Wind Pressure (lb./ft.²)	Wind Force (lb.)	Shear @ Top (lb.)	Moment @ Bottom (Ft.-lb.)	Wind Stress (PSI)
Head	1	33.7500	132.0000	30.9375	0.90	16.7	516	0	726	0
Shell	2	29.0000	132.0000	26.5833	0.87	16.1	429	516	2492	2
Shell	3	29.0000	132.0000	26.5833	0.85	15.8	419	945	5284	3
Shell	4	36.0000	132.0000	33.0000	0.85	15.8	520	1365	10158	6
Shell	5	2.0000	132.0000	1.8333	0.85	15.8	29	1885	10475	7
Skirt	6	25.5000	132.0000	23.3750	0.85	15.8	369	1914	14934	42
Skirt	7	25.5000	132.0000	23.3750	0.85	15.8	369	2283	20176	57
Skirt	8	25.5000	132.0000	23.3750	0.85	15.8	369	2651	26201	74
Skirt	9	25.5000	132.0000	23.3750	0.85	15.8	369	3020	33010	93

Stress Summary

Segment Type	Segment No.	Sm Attachments With Wind or Seismic (PSI)	Sp Internal Pressure Stress (PSI)	Sp External Pressure Stress (PSI)	Sw Weight Stress (PSI)	Maximum Tensile Stress (PSI)	Maximum Compressive Stress (PSI)
Head	1	0	7947	0	14	7934	-14
Shell	2	2	8015	0	22	7995	-24
Shell	3	3	8015	0	31	7988	-34
Shell	4	6	8015	0	62	7960	-68
Shell	5	7	8015	0	62	7960	-69
Skirt	6	42	0	0	672	-630	-714
Skirt	7	57	0	0	680	-623	-737
Skirt	8	74	0	0	689	-615	-763
Skirt	9	93	0	0	698	-604	-791

Positive values represent tensile stress, and negative values represent compressive.
Stress ratios greater than 1.0 represent overstressed conditions.

Stress Comparisons

Segment Type	Segment No.	Maximum Tensile Stress (PSI)	Allowable Stress (PSI)	Maximum Tensile Stress Ratio	Maximum Compressive Stress (PSI)	Allowable Stress (PSI)	Maximum Compressive Stress Ratio	Critical Buckling Stress (PSI)	Critical Buckling Ratio
Head	1	7934	20000	0.3967	-14	-13100	0.0011	-15875	0.0009
Shell	2	7995	20000	0.3997	-24	-13100	0.0018	-15875	0.0015
Shell	3	7988	20000	0.3994	-34	-13100	0.0026	-15875	0.0021
Shell	4	7960	20000	0.3980	-68	-13100	0.0052	-15875	0.0043
Shell	5	7960	20000	0.3980	-69	-13100	0.0053	-15875	0.0043
Skirt	6	-630	-8053	0.0782	-714	-8053	0.0887	-9008	0.0793
Skirt	7	-623	-8053	0.0774	-737	-8053	0.0916	-9008	0.0819
Skirt	8	-615	-8053	0.0764	-763	-8053	0.0948	-9008	0.0847
Skirt	9	-604	-8053	0.0750	-791	-8053	0.0982	-9008	0.0878

Operating Pressurized Condition - Sustained Loads

First Period of Natural Vibration for Operating conditions: 0.0298 seconds/cycle

Moment Analysis

Segment Type	Segment No.	Weight (lb.)	Elevation (in.)	Segment Force (lb.)	Shear @ Top (lb.)	Moment @ Bottom (Ft.-lb.)	Stress (PSI)
Head	1	16317.98	214.8750	0	0	0	0
Shell	2	15102.87	183.5000	0	0	0	0
Shell	3	15102.87	154.5000	0	0	0	0
Attach	4t	12000.00	140.0000	0			
Shell	4	18748.39	122.0000	0	0	0	0
Shell	5	344.38	103.0000	0	0	0	0
Head	6t	8140.83	102.0000	0			
Skirt	6	1107.18	89.2500	0	0	0	0
Skirt	7	1107.18	63.7500	0	0	0	0
Skirt	8	1107.18	38.2500	0	0	0	0
Skirt	9	1107.18	12.7500	0	0	0	0
Total		**90186.03**					

Stress Summary

Segment Type	Segment No.	Sm Attachments With Wind or Seismic (PSI)	Sp Internal Pressure Stress (PSI)	Sp External Pressure Stress (PSI)	Sw Weight Stress (PSI)	Maximum Tensile Stress (PSI)	Maximum Compressive Stress (PSI)
Head	1	0	7947	0	14	7933	-14
Shell	2	0	8015	0	22	7993	-22
Shell	3	0	8015	0	31	7985	-31
Shell	4	0	8015	0	62	7954	-62
Shell	5	0	8015	0	62	7953	-62
Skirt	6	0	0	0	672	-672	-672
Skirt	7	0	0	0	680	-680	-680
Skirt	8	0	0	0	689	-689	-689
Skirt	9	0	0	0	698	-698	-698

Positive values represent tensile stress, and negative values represent compressive.
Stress ratios greater than 1.0 represent overstressed conditions.

Stress Comparisons

Segment Type	Segment No.	Maximum Tensile Stress (PSI)	Allowable Stress (PSI)	Maximum Tensile Stress Ratio	Maximum Compressive Stress (PSI)	Allowable Stress (PSI)	Maximum Compressive Stress Ratio	Critical Buckling Stress (PSI)	Critical Buckling Ratio
Head	1	7933	20000	0.3967	-14	-13100	0.0011	-15875	0.0009
Shell	2	7993	20000	0.3997	-22	-13100	0.0017	-15875	0.0014
Shell	3	7985	20000	0.3992	-31	-13100	0.0023	-15875	0.0019
Shell	4	7954	20000	0.3977	-62	-13100	0.0047	-15875	0.0039
Shell	5	7953	20000	0.3977	-62	-13100	0.0047	-15875	0.0039
Skirt	6	-672	-8053	0.0834	-672	-8053	0.0834	-9008	0.0746
Skirt	7	-680	-8053	0.0845	-680	-8053	0.0845	-9008	0.0755
Skirt	8	-689	-8053	0.0856	-689	-8053	0.0856	-9008	0.0765
Skirt	9	-698	-8053	0.0866	-698	-8053	0.0866	-9008	0.0774

Operating Unpressurized Condition - Occasional Loads - Seismic Case 5

First Period of Natural Vibration for Operating Unpressurized conditions: 0.0298 seconds/cycle

ASCE 7-05 Seismic Design Information

0.2 s Spectral Response Accel (S_s):	0.163		
1 s Spectral Response Accel. (S_1):	0.099	Response Modification Factor (R):	3.000
Seismic Use Group:	II	Site Class:	C
Total seismic shear force at the base (V):	4410 lb.		

ASCE 7-05 Seismic Analysis

Segment Type	Segment No.	Wi Weight (lb.)	Hi Mid-Elevation (in.)	Wi * Hi (Ft.-lb.)	Segment Seismic Force (lb.)	Shear @ Top (lb.)	Moment @ Bottom (Ft.-lb.)	Seismic Stress (PSI)
Head	1	16317.98	214.8750	292194	792	0	1485	1
Shell	2	15102.87	183.5000	230948	626	792	4407	3
Shell	3	15102.87	154.5000	194449	527	1418	8682	5
Attach	4t	12000.00	140.0000	140000	379			
Shell	4	18748.39	122.0000	190609	517	2324	16687	11
Shell	5	344.38	103.0000	2956	8	2841	17161	11
Head	6t	8140.83	102.0000	69197	188			
Skirt	6	1107.18	89.2500	8235	22	3036	23644	67
Skirt	7	1107.18	63.7500	5882	16	3058	30166	85
Skirt	8	1107.18	38.2500	3529	10	3074	36712	104
Skirt	9	1107.18	12.7500	1176	3	3084	43270	122
Total		**90186.03**		**1139175**				

Stress Summary

Segment Type	Segment No.	Sm Attachments With Wind or Seismic (PSI)	Sp Internal Pressure Stress (PSI)	Sp External Pressure Stress (PSI)	Sw Weight Stress (PSI)	Maximum Tensile Stress (PSI)	Maximum Compressive Stress (PSI)
Head	1	1	0	0	14	-13	-15
Shell	2	3	70	0	23	50	-26
Shell	3	5	70	0	31	44	-37
Shell	4	11	70	0	63	17	-74
Shell	5	11	70	0	64	17	-74
Skirt	6	67	0	0	687	-620	-754
Skirt	7	85	0	0	696	-611	-781
Skirt	8	104	0	0	705	-601	-808
Skirt	9	122	0	0	714	-591	-836

Positive values represent tensile stress, and negative values represent compressive.
Stress ratios greater than 1.0 represent overstressed conditions.

Stress Comparisons

Segment Type	Segment No.	Maximum Tensile Stress (PSI)	Allowable Stress (PSI)	Maximum Tensile Stress Ratio	Maximum Compressive Stress (PSI)	Allowable Stress (PSI)	Maximum Compressive Stress Ratio	Critical Buckling Stress (PSI)	Critical Buckling Ratio
Head	1	-13	-13100	0.0010	-15	-13100	0.0011	-15875	0.0009
Shell	2	50	20000	0.0025	-26	-13100	0.0020	-15875	0.0016
Shell	3	44	20000	0.0022	-37	-13100	0.0028	-15875	0.0023
Shell	4	17	20000	0.0009	-74	-13100	0.0056	-15875	0.0046
Shell	5	17	20000	0.0008	-74	-13100	0.0057	-15875	0.0047
Skirt	6	-620	-8053	0.0770	-754	-8053	0.0936	-9008	0.0837
Skirt	7	-611	-8053	0.0758	-781	-8053	0.0970	-9008	0.0867
Skirt	8	-601	-8053	0.0746	-808	-8053	0.1004	-9008	0.0898
Skirt	9	-591	-8053	0.0734	-836	-8053	0.1038	-9008	0.0928

Operating Unpressurized Condition - Occasional Loads - Wind Case 5

ASCE 7-05 Wind Design Information

Basic Wind Speed (V):	100 MPH	Wind Exposure type:	C
Importance factor (I):	1.15	Force (shape) coefficient (C_f):	0.7
Total deflection of top of tower is :	0.0006 in.		
Total deflection dist. per 100 ft height is :	0.0033 in.		

First Period of Natural Vibration for Operating Unpressurized conditions: 0.0298 seconds/cycle

ASCE 7-05 Wind Analysis

Segment Type	Segment No.	Segment Height (in.)	Wind Load Diameter (in.)	Projection Area (Sq. Ft.)	(Kz) Exposure Factor	Wind Pressure (lb./ft.²)	Wind Force (lb.)	Shear @ Top (lb.)	Moment @ Bottom (Ft.-lb.)	Wind Stress (PSI)
Head	1	33.7500	132.0000	30.9375	0.90	16.7	516	0	726	0
Shell	2	29.0000	132.0000	26.5833	0.87	16.1	429	516	2492	2
Shell	3	29.0000	132.0000	26.5833	0.85	15.8	419	945	5284	3
Shell	4	36.0000	132.0000	33.0000	0.85	15.8	520	1365	10158	6
Shell	5	2.0000	132.0000	1.8333	0.85	15.8	29	1885	10475	7
Skirt	6	25.5000	132.0000	23.3750	0.85	15.8	369	1914	14934	42
Skirt	7	25.5000	132.0000	23.3750	0.85	15.8	369	2283	20176	57
Skirt	8	25.5000	132.0000	23.3750	0.85	15.8	369	2651	26201	74
Skirt	9	25.5000	132.0000	23.3750	0.85	15.8	369	3020	33010	93

Stress Summary

Segment Type	Segment No.	Sm Attachments With Wind or Seismic (PSI)	Sp Internal Pressure Stress (PSI)	Sp External Pressure Stress (PSI)	Sw Weight Stress (PSI)	Maximum Tensile Stress (PSI)	Maximum Compressive Stress (PSI)
Head	1	0	0	0	14	-13	-14
Shell	2	2	68	0	22	47	-24
Shell	3	3	68	0	31	41	-34
Shell	4	6	68	0	62	13	-68
Shell	5	7	68	0	62	13	-69
Skirt	6	42	0	0	672	-630	-714
Skirt	7	57	0	0	680	-623	-737
Skirt	8	74	0	0	689	-615	-763
Skirt	9	93	0	0	698	-604	-791

Positive values represent tensile stress, and negative values represent compressive.
Stress ratios greater than 1.0 represent overstressed conditions.

Stress Comparisons

Segment Type	Segment No.	Maximum Tensile Stress (PSI)	Allowable Stress (PSI)	Maximum Tensile Stress Ratio	Maximum Compressive Stress (PSI)	Allowable Stress (PSI)	Maximum Compressive Stress Ratio	Critical Buckling Stress (PSI)	Critical Buckling Ratio
Head	1	-13	-13100	0.0010	-14	-13100	0.0011	-15875	0.0009
Shell	2	47	20000	0.0024	-24	-13100	0.0018	-15875	0.0015
Shell	3	41	20000	0.0020	-34	-13100	0.0026	-15875	0.0021
Shell	4	13	20000	0.0006	-68	-13100	0.0052	-15875	0.0043
Shell	5	13	20000	0.0006	-69	-13100	0.0053	-15875	0.0043
Skirt	6	-630	-8053	0.0782	-714	-8053	0.0887	-9008	0.0793
Skirt	7	-623	-8053	0.0774	-737	-8053	0.0916	-9008	0.0819
Skirt	8	-615	-8053	0.0764	-763	-8053	0.0948	-9008	0.0847
Skirt	9	-604	-8053	0.0750	-791	-8053	0.0982	-9008	0.0878

Operating Unpressurized Condition - Sustained Loads

First Period of Natural Vibration for Operating Unpressurized conditions: 0.0298 seconds/cycle

Moment Analysis

Segment Type	Segment No.	Weight (lb.)	Elevation (in.)	Segment Force (lb.)	Shear @ Top (lb.)	Moment @ Bottom (Ft.-lb.)	Stress (PSI)
Head	1	16317.98	214.8750	0	0	0	0
Shell	2	15102.87	183.5000	0	0	0	0
Shell	3	15102.87	154.5000	0	0	0	0
Attach	4t	12000.00	140.0000	0			
Shell	4	18748.39	122.0000	0	0	0	0
Shell	5	344.38	103.0000	0	0	0	0
Head	6t	8140.83	102.0000	0			
Skirt	6	1107.18	89.2500	0	0	0	0
Skirt	7	1107.18	63.7500	0	0	0	0
Skirt	8	1107.18	38.2500	0	0	0	0
Skirt	9	1107.18	12.7500	0	0	0	0
Total		**90186.03**					

Stress Summary

Segment Type	Segment No.	Sm Attachments With Wind or Seismic (PSI)	Sp Internal Pressure Stress (PSI)	Sp External Pressure Stress (PSI)	Sw Weight Stress (PSI)	Maximum Tensile Stress (PSI)	Maximum Compressive Stress (PSI)
Head	1	0	0	0	14	-14	-14
Shell	2	0	68	0	22	46	-22
Shell	3	0	68	0	31	37	-31
Shell	4	0	68	0	62	7	-62
Shell	5	0	68	0	62	6	-62
Skirt	6	0	0	0	672	-672	-672
Skirt	7	0	0	0	680	-680	-680
Skirt	8	0	0	0	689	-689	-689
Skirt	9	0	0	0	698	-698	-698

Positive values represent tensile stress, and negative values represent compressive.
Stress ratios greater than 1.0 represent overstressed conditions.

Stress Comparisons

Segment Type	Segment No.	Maximum Tensile Stress (PSI)	Allowable Stress (PSI)	Maximum Tensile Stress Ratio	Maximum Compressive Stress (PSI)	Allowable Stress (PSI)	Maximum Compressive Stress Ratio	Critical Buckling Stress (PSI)	Critical Buckling Ratio
Head	1	-14	-13100	0.0011	-14	-13100	0.0011	-15875	0.0009
Shell	2	46	20000	0.0023	-22	-13100	0.0017	-15875	0.0014
Shell	3	37	20000	0.0019	-31	-13100	0.0023	-15875	0.0019
Shell	4	7	20000	0.0003	-62	-13100	0.0047	-15875	0.0039
Shell	5	6	20000	0.0003	-62	-13100	0.0047	-15875	0.0039
Skirt	6	-672	-8053	0.0834	-672	-8053	0.0834	-9008	0.0746
Skirt	7	-680	-8053	0.0845	-680	-8053	0.0845	-9008	0.0755
Skirt	8	-689	-8053	0.0856	-689	-8053	0.0856	-9008	0.0765
Skirt	9	-698	-8053	0.0866	-698	-8053	0.0866	-9008	0.0774

Empty Pressurized Condition - Occasional Loads - Seismic Case 5

First Period of Natural Vibration for Empty Pressurized conditions: 0.0228 seconds/cycle

ASCE 7-05 Seismic Design Information

0.2 s Spectral Response Accel (S_s):	0.163		
1 s Spectral Response Accel. (S_1):	0.099	Response Modification Factor (R):	3.000
Seismic Use Group:	II	Site Class:	C
Total seismic shear force at the base (V):	2408 lb.		

ASCE 7-05 Seismic Analysis

Segment Type	Segment No.	Wi Weight (lb.)	Hi Mid-Elevation (in.)	Wi * Hi (Ft.-lb.)	Segment Seismic Force (lb.)	Shear @ Top (lb.)	Moment @ Bottom (Ft.-lb.)	Seismic Stress (PSI)
Head	1	8140.83	214.8750	145772	423	0	794	1
Shell	2	4993.53	183.5000	76359	222	423	2174	1
Shell	3	4993.53	154.5000	64292	187	645	4034	3
Attach	4t	12000.00	140.0000	140000	407			
Shell	4	6198.86	122.0000	63022	183	1238	8115	5
Shell	5	344.38	103.0000	2956	9	1421	8352	5
Head	6t	8140.83	102.0000	69197	201			
Skirt	6	1107.18	89.2500	8235	24	1631	11852	33
Skirt	7	1107.18	63.7500	5882	17	1655	15392	43
Skirt	8	1107.18	38.2500	3529	10	1672	18960	54
Skirt	9	1107.18	12.7500	1176	3	1682	22539	64
Total		**49240.68**		**580420**				

Stress Summary

Segment Type	Segment No.	Sm Attachments With Wind or Seismic (PSI)	Sp Internal Pressure Stress (PSI)	Sp External Pressure Stress (PSI)	Sw Weight Stress (PSI)	Maximum Tensile Stress (PSI)	Maximum Compressive Stress (PSI)
Head	1	1	7947	0	14	7934	-15
Shell	2	1	7947	0	23	7926	-24
Shell	3	3	7947	0	31	7918	-34
Shell	4	5	7947	0	63	7889	-68
Shell	5	5	7947	0	64	7889	-69
Skirt	6	33	0	0	363	-330	-397
Skirt	7	43	0	0	372	-329	-416
Skirt	8	54	0	0	381	-327	-434
Skirt	9	64	0	0	390	-326	-453

Positive values represent tensile stress, and negative values represent compressive.
Stress ratios greater than 1.0 represent overstressed conditions.

Stress Comparisons

Segment Type	Segment No.	Maximum Tensile Stress (PSI)	Allowable Stress (PSI)	Maximum Tensile Stress Ratio	Maximum Compressive Stress (PSI)	Allowable Stress (PSI)	Maximum Compressive Stress Ratio	Critical Buckling Stress (PSI)	Critical Buckling Ratio
Head	1	7934	20000	0.3967	-15	-13100	0.0011	-15875	0.0009
Shell	2	7926	20000	0.3963	-24	-13100	0.0018	-15875	0.0015
Shell	3	7918	20000	0.3959	-34	-13100	0.0026	-15875	0.0021
Shell	4	7889	20000	0.3945	-68	-13100	0.0052	-15875	0.0043
Shell	5	7889	20000	0.3944	-69	-13100	0.0053	-15875	0.0043
Skirt	6	-330	-8053	0.0410	-397	-8053	0.0493	-9008	0.0440
Skirt	7	-329	-8053	0.0408	-416	-8053	0.0516	-9008	0.0461
Skirt	8	-327	-8053	0.0406	-434	-8053	0.0539	-9008	0.0482
Skirt	9	-326	-8053	0.0405	-453	-8053	0.0563	-9008	0.0503

Empty Pressurized Condition - Occasional Loads - Wind Case 5

ASCE 7-05 Wind Design Information

Basic Wind Speed (V):	100 MPH	Wind Exposure type:	C
Importance factor (I):	1.15	Force (shape) coefficient (C_f):	0.7
Total deflection of top of tower is :	0.0006 in.		
Total deflection dist. per 100 ft height is :	0.0033 in.		

First Period of Natural Vibration for Empty Pressurized conditions: 0.0228 seconds/cycle

ASCE 7-05 Wind Analysis

Segment Type	Segment No.	Segment Height (in.)	Wind Load Diameter (in.)	Projection Area (Sq. Ft.)	(Kz) Exposure Factor	Wind Pressure (lb./ft.²)	Wind Force (lb.)	Shear @ Top (lb.)	Moment @ Bottom (Ft.-lb.)	Wind Stress (PSI)
Head	1	33.7500	132.0000	30.9375	0.90	16.7	516	0	726	0
Shell	2	29.0000	132.0000	26.5833	0.87	16.1	429	516	2492	2
Shell	3	29.0000	132.0000	26.5833	0.85	15.8	419	945	5284	3
Shell	4	36.0000	132.0000	33.0000	0.85	15.8	520	1365	10158	6
Shell	5	2.0000	132.0000	1.8333	0.85	15.8	29	1885	10475	7
Skirt	6	25.5000	132.0000	23.3750	0.85	15.8	369	1914	14934	42
Skirt	7	25.5000	132.0000	23.3750	0.85	15.8	369	2283	20176	57
Skirt	8	25.5000	132.0000	23.3750	0.85	15.8	369	2651	26201	74
Skirt	9	25.5000	132.0000	23.3750	0.85	15.8	369	3020	33010	93

Stress Summary

Segment Type	Segment No.	Sm Attachments With Wind or Seismic (PSI)	Sp Internal Pressure Stress (PSI)	Sp External Pressure Stress (PSI)	Sw Weight Stress (PSI)	Maximum Tensile Stress (PSI)	Maximum Compressive Stress (PSI)
Head	1	0	7947	0	14	7934	-14
Shell	2	2	7947	0	22	7927	-24
Shell	3	3	7947	0	31	7920	-34
Shell	4	6	7947	0	62	7892	-68
Shell	5	7	7947	0	62	7892	-69
Skirt	6	42	0	0	355	-313	-397
Skirt	7	57	0	0	364	-307	-421
Skirt	8	74	0	0	372	-298	-446
Skirt	9	93	0	0	381	-288	-474

Positive values represent tensile stress, and negative values represent compressive.
Stress ratios greater than 1.0 represent overstressed conditions.

Stress Comparisons

Segment Type	Segment No.	Maximum Tensile Stress (PSI)	Allowable Stress (PSI)	Maximum Tensile Stress Ratio	Maximum Compressive Stress (PSI)	Allowable Stress (PSI)	Maximum Compressive Stress Ratio	Critical Buckling Stress (PSI)	Critical Buckling Ratio
Head	1	7934	20000	0.3967	-14	-13100	0.0011	-15875	0.0009
Shell	2	7927	20000	0.3963	-24	-13100	0.0018	-15875	0.0015
Shell	3	7920	20000	0.3960	-34	-13100	0.0026	-15875	0.0021
Shell	4	7892	20000	0.3946	-68	-13100	0.0052	-15875	0.0043
Shell	5	7892	20000	0.3946	-69	-13100	0.0053	-15875	0.0043
Skirt	6	-313	-8053	0.0389	-397	-8053	0.0493	-9008	0.0441
Skirt	7	-307	-8053	0.0381	-421	-8053	0.0522	-9008	0.0467
Skirt	8	-298	-8053	0.0370	-446	-8053	0.0554	-9008	0.0496
Skirt	9	-288	-8053	0.0357	-474	-8053	0.0589	-9008	0.0526

Empty Pressurized Condition - Sustained Loads

First Period of Natural Vibration for Empty Pressurized conditions: 0.0228 seconds/cycle

Moment Analysis

Segment Type	Segment No.	Weight (lb.)	Elevation (in.)	Segment Force (lb.)	Shear @ Top (lb.)	Moment @ Bottom (Ft.-lb.)	Stress (PSI)
Head	1	8140.83	214.8750	0	0	0	0
Shell	2	4993.53	183.5000	0	0	0	0
Shell	3	4993.53	154.5000	0	0	0	0
Attach	4t	12000.00	140.0000	0			
Shell	4	6198.86	122.0000	0	0	0	0
Shell	5	344.38	103.0000	0	0	0	0
Head	6t	8140.83	102.0000	0			
Skirt	6	1107.18	89.2500	0	0	0	0
Skirt	7	1107.18	63.7500	0	0	0	0
Skirt	8	1107.18	38.2500	0	0	0	0
Skirt	9	1107.18	12.7500	0	0	0	0
Total		**49240.68**					

Stress Summary

Segment Type	Segment No.	Sm Attachments With Wind or Seismic (PSI)	Sp Internal Pressure Stress (PSI)	Sp External Pressure Stress (PSI)	Sw Weight Stress (PSI)	Maximum Tensile Stress (PSI)	Maximum Compressive Stress (PSI)
Head	1	0	7947	0	14	7933	-14
Shell	2	0	7947	0	22	7925	-22
Shell	3	0	7947	0	31	7917	-31
Shell	4	0	7947	0	62	7886	-62
Shell	5	0	7947	0	62	7885	-62
Skirt	6	0	0	0	355	-355	-355
Skirt	7	0	0	0	364	-364	-364
Skirt	8	0	0	0	372	-372	-372
Skirt	9	0	0	0	381	-381	-381

Positive values represent tensile stress, and negative values represent compressive.
Stress ratios greater than 1.0 represent overstressed conditions.

Stress Comparisons

Segment Type	Segment No.	Maximum Tensile Stress (PSI)	Allowable Stress (PSI)	Maximum Tensile Stress Ratio	Maximum Compressive Stress (PSI)	Allowable Stress (PSI)	Maximum Compressive Stress Ratio	Critical Buckling Stress (PSI)	Critical Buckling Ratio
Head	1	7933	20000	0.3967	-14	-13100	0.0011	-15875	0.0009
Shell	2	7925	20000	0.3963	-22	-13100	0.0017	-15875	0.0014
Shell	3	7917	20000	0.3958	-31	-13100	0.0023	-15875	0.0019
Shell	4	7886	20000	0.3943	-62	-13100	0.0047	-15875	0.0039
Shell	5	7885	20000	0.3943	-62	-13100	0.0047	-15875	0.0039
Skirt	6	-355	-8053	0.0441	-355	-8053	0.0441	-9008	0.0394
Skirt	7	-364	-8053	0.0452	-364	-8053	0.0452	-9008	0.0404
Skirt	8	-372	-8053	0.0462	-372	-8053	0.0462	-9008	0.0413
Skirt	9	-381	-8053	0.0473	-381	-8053	0.0473	-9008	0.0423

Empty Unpressurized Condition - Occasional Loads - Seismic Case 5

First Period of Natural Vibration for Empty Unpressurized conditions: 0.0228 seconds/cycle

ASCE 7-05 Seismic Design Information

0.2 s Spectral Response Accel (S_s):	0.163		
1 s Spectral Response Accel. (S_1):	0.099	Response Modification Factor (R):	3.000
Seismic Use Group:	II	Site Class:	C
Total seismic shear force at the base (V):	2408 lb.		

ASCE 7-05 Seismic Analysis

Segment Type	Segment No.	Wi Weight (lb.)	Hi Mid-Elevation (in.)	Wi * Hi (Ft.-lb.)	Segment Seismic Force (lb.)	Shear @ Top (lb.)	Moment @ Bottom (Ft.-lb.)	Seismic Stress (PSI)
Head	1	8140.83	214.8750	145772	423	0	794	1
Shell	2	4993.53	183.5000	76359	222	423	2174	1
Shell	3	4993.53	154.5000	64292	187	645	4034	3
Attach	4t	12000.00	140.0000	140000	407			
Shell	4	6198.86	122.0000	63022	183	1238	8115	5
Shell	5	344.38	103.0000	2956	9	1421	8352	5
Head	6t	8140.83	102.0000	69197	201			
Skirt	6	1107.18	89.2500	8235	24	1631	11852	33
Skirt	7	1107.18	63.7500	5882	17	1655	15392	43
Skirt	8	1107.18	38.2500	3529	10	1672	18960	54
Skirt	9	1107.18	12.7500	1176	3	1682	22539	64
Total		**49240.68**		**580420**				

Stress Summary

Segment Type	Segment No.	Sm Attachments With Wind or Seismic (PSI)	Sp Internal Pressure Stress (PSI)	Sp External Pressure Stress (PSI)	Sw Weight Stress (PSI)	Maximum Tensile Stress (PSI)	Maximum Compressive Stress (PSI)
Head	1	1	0	0	14	-14	-15
Shell	2	1	0	0	23	-21	-24
Shell	3	3	0	0	31	-29	-34
Shell	4	5	0	0	63	-58	-68
Shell	5	5	0	0	64	-58	-69
Skirt	6	33	0	0	363	-330	-397
Skirt	7	43	0	0	372	-329	-416
Skirt	8	54	0	0	381	-327	-434
Skirt	9	64	0	0	390	-326	-453

Positive values represent tensile stress, and negative values represent compressive.
Stress ratios greater than 1.0 represent overstressed conditions.

Stress Comparisons

Segment Type	Segment No.	Maximum Tensile Stress (PSI)	Allowable Stress (PSI)	Maximum Tensile Stress Ratio	Maximum Compressive Stress (PSI)	Allowable Stress (PSI)	Maximum Compressive Stress Ratio	Critical Buckling Stress (PSI)	Critical Buckling Ratio
Head	1	-14	-13100	0.0010	-15	-13100	0.0011	-15875	0.0009
Shell	2	-21	-13100	0.0016	-24	-13100	0.0018	-15875	0.0015
Shell	3	-29	-13100	0.0022	-34	-13100	0.0026	-15875	0.0021
Shell	4	-58	-13100	0.0044	-68	-13100	0.0052	-15875	0.0043
Shell	5	-58	-13100	0.0045	-69	-13100	0.0053	-15875	0.0043
Skirt	6	-330	-8053	0.0410	-397	-8053	0.0493	-9008	0.0440
Skirt	7	-329	-8053	0.0408	-416	-8053	0.0516	-9008	0.0461
Skirt	8	-327	-8053	0.0406	-434	-8053	0.0539	-9008	0.0482
Skirt	9	-326	-8053	0.0405	-453	-8053	0.0563	-9008	0.0503

Empty Unpressurized Condition - Occasional Loads - Wind Case 5

ASCE 7-05 Wind Design Information

Basic Wind Speed (V):	100 MPH	Wind Exposure type:	C
Importance factor (I):	1.15	Force (shape) coefficient (C_f):	0.7
Total deflection of top of tower is :	0.0006 in.		
Total deflection dist. per 100 ft height is :	0.0033 in.		

First Period of Natural Vibration for Empty Unpressurized conditions: 0.0228 seconds/cycle

ASCE 7-05 Wind Analysis

Segment Type	Segment No.	Segment Height (in.)	Wind Load Diameter (in.)	Projection Area (Sq. Ft.)	(Kz) Exposure Factor	Wind Pressure (lb./ft.²)	Wind Force (lb.)	Shear @ Top (lb.)	Moment @ Bottom (Ft.-lb.)	Wind Stress (PSI)
Head	1	33.7500	132.0000	30.9375	0.90	16.7	516	0	726	0
Shell	2	29.0000	132.0000	26.5833	0.87	16.1	429	516	2492	2
Shell	3	29.0000	132.0000	26.5833	0.85	15.8	419	945	5284	3
Shell	4	36.0000	132.0000	33.0000	0.85	15.8	520	1365	10158	6
Shell	5	2.0000	132.0000	1.8333	0.85	15.8	29	1885	10475	7
Skirt	6	25.5000	132.0000	23.3750	0.85	15.8	369	1914	14934	42
Skirt	7	25.5000	132.0000	23.3750	0.85	15.8	369	2283	20176	57
Skirt	8	25.5000	132.0000	23.3750	0.85	15.8	369	2651	26201	74
Skirt	9	25.5000	132.0000	23.3750	0.85	15.8	369	3020	33010	93

Stress Summary

Segment Type	Segment No.	Sm Attachments With Wind or Seismic (PSI)	Sp Internal Pressure Stress (PSI)	Sp External Pressure Stress (PSI)	Sw Weight Stress (PSI)	Maximum Tensile Stress (PSI)	Maximum Compressive Stress (PSI)
Head	1	0	0	0	14	-13	-14
Shell	2	2	0	0	22	-21	-24
Shell	3	3	0	0	31	-27	-34
Shell	4	6	0	0	62	-55	-68
Shell	5	7	0	0	62	-56	-69
Skirt	6	42	0	0	355	-313	-397
Skirt	7	57	0	0	364	-307	-421
Skirt	8	74	0	0	372	-298	-446
Skirt	9	93	0	0	381	-288	-474

Positive values represent tensile stress, and negative values represent compressive.
Stress ratios greater than 1.0 represent overstressed conditions.

Stress Comparisons

Segment Type	Segment No.	Maximum Tensile Stress (PSI)	Allowable Stress (PSI)	Maximum Tensile Stress Ratio	Maximum Compressive Stress (PSI)	Allowable Stress (PSI)	Maximum Compressive Stress Ratio	Critical Buckling Stress (PSI)	Critical Buckling Ratio
Head	1	-13	-13100	0.0010	-14	-13100	0.0011	-15875	0.0009
Shell	2	-21	-13100	0.0016	-24	-13100	0.0018	-15875	0.0015
Shell	3	-27	-13100	0.0021	-34	-13100	0.0026	-15875	0.0021
Shell	4	-55	-13100	0.0042	-68	-13100	0.0052	-15875	0.0043
Shell	5	-56	-13100	0.0042	-69	-13100	0.0053	-15875	0.0043
Skirt	6	-313	-8053	0.0389	-397	-8053	0.0493	-9008	0.0441
Skirt	7	-307	-8053	0.0381	-421	-8053	0.0522	-9008	0.0467
Skirt	8	-298	-8053	0.0370	-446	-8053	0.0554	-9008	0.0496
Skirt	9	-288	-8053	0.0357	-474	-8053	0.0589	-9008	0.0526

Empty Unpressurized Condition - Sustained Loads

First Period of Natural Vibration for Empty Unpressurized conditions: 0.0228 seconds/cycle

Moment Analysis

Segment Type	Segment No.	Weight (lb.)	Elevation (in.)	Segment Force (lb.)	Shear @ Top (lb.)	Moment @ Bottom (Ft.-lb.)	Stress (PSI)
Head	1	8140.83	214.8750	0	0	0	0
Shell	2	4993.53	183.5000	0	0	0	0
Shell	3	4993.53	154.5000	0	0	0	0
Attach	4t	12000.00	140.0000	0			
Shell	4	6198.86	122.0000	0	0	0	0
Shell	5	344.38	103.0000	0	0	0	0
Head	6t	8140.83	102.0000	0			
Skirt	6	1107.18	89.2500	0	0	0	0
Skirt	7	1107.18	63.7500	0	0	0	0
Skirt	8	1107.18	38.2500	0	0	0	0
Skirt	9	1107.18	12.7500	0	0	0	0
Total		**49240.68**					

Stress Summary

Segment Type	Segment No.	Sm Attachments With Wind or Seismic (PSI)	Sp Internal Pressure Stress (PSI)	Sp External Pressure Stress (PSI)	Sw Weight Stress (PSI)	Maximum Tensile Stress (PSI)	Maximum Compressive Stress (PSI)
Head	1	0	0	0	14	-14	-14
Shell	2	0	0	0	22	-22	-22
Shell	3	0	0	0	31	-31	-31
Shell	4	0	0	0	62	-62	-62
Shell	5	0	0	0	62	-62	-62
Skirt	6	0	0	0	355	-355	-355
Skirt	7	0	0	0	364	-364	-364
Skirt	8	0	0	0	372	-372	-372
Skirt	9	0	0	0	381	-381	-381

Positive values represent tensile stress, and negative values represent compressive.
Stress ratios greater than 1.0 represent overstressed conditions.

Stress Comparisons

Segment Type	Segment No.	Maximum Tensile Stress (PSI)	Allowable Stress (PSI)	Maximum Tensile Stress Ratio	Maximum Compressive Stress (PSI)	Allowable Stress (PSI)	Maximum Compressive Stress Ratio	Critical Buckling Stress (PSI)	Critical Buckling Ratio
Head	1	-14	-13100	0.0011	-14	-13100	0.0011	-15875	0.0009
Shell	2	-22	-13100	0.0017	-22	-13100	0.0017	-15875	0.0014
Shell	3	-31	-13100	0.0023	-31	-13100	0.0023	-15875	0.0019
Shell	4	-62	-13100	0.0047	-62	-13100	0.0047	-15875	0.0039
Shell	5	-62	-13100	0.0047	-62	-13100	0.0047	-15875	0.0039
Skirt	6	-355	-8053	0.0441	-355	-8053	0.0441	-9008	0.0394
Skirt	7	-364	-8053	0.0452	-364	-8053	0.0452	-9008	0.0404
Skirt	8	-372	-8053	0.0462	-372	-8053	0.0462	-9008	0.0413
Skirt	9	-381	-8053	0.0473	-381	-8053	0.0473	-9008	0.0423

Test Condition

First Period of Natural Vibration for Test Condition conditions: 0.0301 seconds/cycle

Moment Analysis

Segment Type	Segment No.	Weight (lb.)	Elevation (in.)	Segment Force (lb.)	Shear @ Top (lb.)	Moment @ Bottom (Ft.-lb.)	Stress (PSI)
Head	1	19236.87	214.8750	0	0	0	0
Shell	2	18684.91	183.5000	0	0	0	0
Shell	3	18684.91	154.5000	0	0	0	0
Shell	4	23195.06	122.0000	0	0	0	0
Shell	5	1288.61	103.0000	0	0	0	0
Head	6t	19236.87	102.0000	0			
Skirt	6	1107.18	89.2500	0	0	0	0
Skirt	7	1107.18	63.7500	0	0	0	0
Skirt	8	1107.18	38.2500	0	0	0	0
Skirt	9	1107.18	12.7500	0	0	0	0
Total		**104755.96**					

Stress Summary

Segment Type	Segment No.	Sm Attachments With Wind or Seismic (PSI)	Sp Internal Pressure Stress (PSI)	Sp External Pressure Stress (PSI)	Sw Weight Stress (PSI)	Maximum Tensile Stress (PSI)	Maximum Compressive Stress (PSI)
Head	1	0	7613	0	13	7599	-13
Shell	2	0	7613	0	21	7591	-21
Shell	3	0	7613	0	29	7583	-29
Shell	4	0	7613	0	40	7573	-40
Shell	5	0	7613	0	40	7572	-40
Skirt	6	0	0	0	654	-654	-654
Skirt	7	0	0	0	661	-661	-661
Skirt	8	0	0	0	668	-668	-668
Skirt	9	0	0	0	676	-676	-676

Positive values represent tensile stress, and negative values represent compressive.
Stress ratios greater than 1.0 represent overstressed conditions.

Stress Comparisons

Segment Type	Segment No.	Maximum Tensile Stress (PSI)	Allowable Stress (PSI)	Maximum Tensile Stress Ratio	Maximum Compressive Stress (PSI)	Allowable Stress (PSI)	Maximum Compressive Stress Ratio	Critical Buckling Stress (PSI)	Critical Buckling Ratio
Head	1	7599	20000	0.3800	-13	-13100	0.0010	-15875	0.0008
Shell	2	7591	20000	0.3796	-21	-13100	0.0016	-15875	0.0013
Shell	3	7583	20000	0.3792	-29	-13100	0.0023	-15875	0.0019
Shell	4	7573	20000	0.3786	-40	-13100	0.0030	-15875	0.0025
Shell	5	7572	20000	0.3786	-40	-13100	0.0031	-15875	0.0025
Skirt	6	-654	-8053	0.0812	-654	-8053	0.0812	-11507	0.0568
Skirt	7	-661	-8053	0.0821	-661	-8053	0.0821	-11507	0.0575
Skirt	8	-668	-8053	0.0830	-668	-8053	0.0830	-11507	0.0581
Skirt	9	-676	-8053	0.0839	-676	-8053	0.0839	-11507	0.0587

MDMT Report by Components

Design MDMT is 10 ℉

Component	Material	Curve	Pressure	MDMT
132" OD ROLLED SHELL x 96" LG	SA-516 Gr. 70	D	350.00 PSI	-34 ℉
Smls LWN (FVC) - 20"	SA-105	B	350.00 PSI	-89 ℉
SMLS LWN (FVC) - 20" MANWAY IN SHELL	SA-105	B	350.00 PSI	-89 ℉
SMLS LWN (FVC) - 8" DES DRAIN NOZZLE	SA-105	B	350.00 PSI	-103 ℉
SMLS LWN (FVC) - 8" DES DRAIN NOZZLE	SA-105	B	350.00 PSI	-103 ℉
SMLS LWN (FVC) - 1-1/2" INSTRUMENT C	SA-105	B	350.00 PSI	-135 ℉
132" OD HEAD, 2:1 ELLIP, BOTTOM	SA-516 Gr. 70	D	350.00 PSI	-31 ℉
SMLS WELD STUB (FVC) - 20"	SA-105	B	350.00 PSI	-89 ℉
132" OD HEAD, 2:1 ELLIP, TOP	SA-516 Gr. 70	D	350.00 PSI	-31 ℉
Smls LWN (FVC) - 16"	SA-105	B	350.00 PSI	-89 ℉
SMLS LWN (FVC) - 20" INLET NOZZLE IN T	SA-105	B	350.00 PSI	-89 ℉
SMLS LWN (FVC) - 8" DES FILL NOZZLE I	SA-105	B	350.00 PSI	-103 ℉
SMLS LWN (FVC) - 2" RELIEF VALVE NOZ	SA-105	B	350.00 PSI	-133 ℉

Component with highest MDMT: 132" OD HEAD, 2:1 ELLIP, BOTTOM.

Computed MDMT = -31 ℉

The required design MDMT of 10 ℉ has been met or e xceeded for the calculated MDMT values.

ASME Flanges Are Not Included in MDMT Calculations.

Summary Information

	Dry Weight	Flooded Weight
Shell	16530.31 lb.	61911.49 lb.
Head	16281.66 lb.	38462.14 lb.
Nozzle	1971.76 lb.	1971.76 lb.
ASME Flange	1667.00 lb.	1667.00 lb.
Skirt	4428.71 lb.	4428.71 lb.
Totals	40879.44 lb.	108441.11 lb.

	Volume
Shell	5432.23 Gal.
Head	2659.53 Gal.
Nozzle	52.35 Gal.
Totals	8144.11 Gal.

	Area
Shell	276.46 Sq. Ft.
Head	269.21 Sq. Ft.
Nozzle	48.82 Sq. Ft.
Skirt	293.74 Sq. Ft.
Totals	888.23 Sq. Ft.

SPX Flow Technology USA, Inc.

Customer: **Southern Company**
Job No: 7404131

Vessel Number: PG-1080 2080

Date Printed: 5/16/2012

Hydrostatic Test Information Par. UG-99(b)
Gauge at Top

Component	Const.	x	STest	/	SDesign	x	Pressure	=	Component Hydro Test Pressure
132" OD HEAD, 2:1 ELLI	1.3	x	20000	/	20000	x	350.00	=	**455.00**
132" OD HEAD, 2:1 ELLI	1.3	x	20000	/	20000	x	350.00	=	455.00
132" OD ROLLED SHELL x	1.3	x	20000	/	20000	x	350.00	=	455.00
SMLS LWN (FVC) - 1-1/2	1.3	x	20000	/	19800	x	350.00	=	459.60
SMLS LWN (FVC) - 2" RE	1.3	x	20000	/	19800	x	350.00	=	459.60
SMLS LWN (FVC) - 20" I	1.3	x	20000	/	19800	x	350.00	=	459.60
SMLS LWN (FVC) - 20" M	1.3	x	20000	/	19800	x	350.00	=	459.60
SMLS LWN (FVC) - 8" DE	1.3	x	20000	/	19800	x	350.00	=	459.60
SMLS LWN (FVC) - 8" DE	1.3	x	20000	/	19800	x	350.00	=	459.60
SMLS LWN (FVC) - 8" DE	1.3	x	20000	/	19800	x	350.00	=	459.60
SMLS WELD STUB (FVC) -	1.3	x	20000	/	19800	x	350.00	=	459.60

Calculated Test Pressure: 455.00 PSI

Special Notes:

This calculation assumes one chamber.

This calculation is limited by the lowest component pressure per chamber.