

PLANT BEAUMONT PROJ N 6432 PON LPBC 96764U △ EN N 5111 T0611	
NOZZLE	REQ D
ROOTER CORPORATION L 5500	
NOZZLE DETAILS △ EN N 5111 T0611 FOR ACH TOPPING C LUMN E I DUPONT DE NEMOURS CO INC NEWARK, DELAWARE	
22789 P MEDLEY	BN H 5823
B N 70328	N 70328
SHEET 5	

NO.	REV.	WEL.	C.	BY	CHK.
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					

SEP28 1990

BPF 285559

SHEET # 5

FABRICATION RELEASE

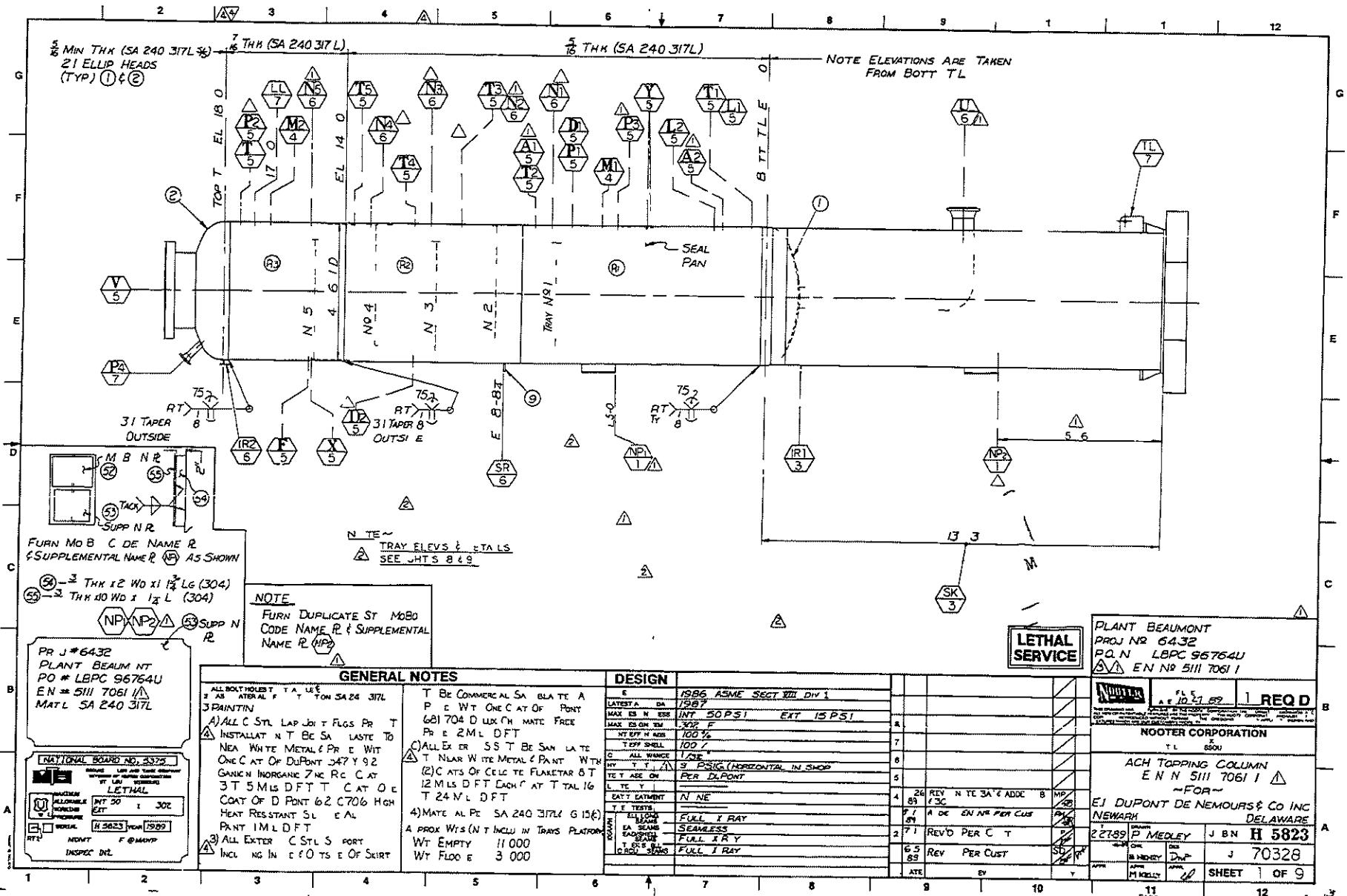
APPROVED

NOTICE

DATE

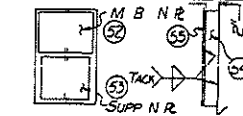
BY

988-90



3/8 MIN THK (SA 240 317L)  
21 ELLIP HEADS  
(TYP) ① & ②

NOTE ELEVATIONS ARE TAKEN FROM BOTTL TL



FURN MO B C DE NAME R  
& SUPPLEMENTAL NAME R (N) AS SHOWN

⑤ - 3/8 THK X 2 WD X 1 1/2 LG (304)  
⑥ - 3/8 THK X 10 WD X 1 1/2 L (304)

**NOTE**  
FURN DUPLICATE ST MO B CODE NAME R & SUPPLEMENTAL NAME R (N)

NOTE - TRAY ELEV & STALS SEE JHTS B & G

PR J # 6432  
PLANT BEAUM NT  
PO # LBPC 96764U  
EN # 5111 7061 I  
MATL SA 240 317L

**NATIONAL BOARD NO. 3375**

LETHAL

INT 30 EXT 1 302

H 3623 FROM 7999

INSPEC DTL

GENERAL NOTES	
1) ALL C STL LAP JOINT FLGS PR T	2) BE COMMERCIAL SA BLA TE A P E WT ONE C AT OF POINT 681 704 D LIX CH MATE FREE PH E 2ML DFT
3) INSTALL AT N T BE SA LASTE TO NEA WHITE METAL & PR E WIT ONE C AT OF DUPONT 447 Y 92 GANIC INORGANIC 7 IN RC C AT 3 T 5 MLS DFT T C AT D E COAT OF D POINT 62 C 70 6 HGH HEAT RESISTANT SL E AL PAINT 1 ML DFT	4) ALL EX ER S S T BE SAN LA TE T NEAR W TE METAL & PAINT W TH (2) C ATS OF CELC TE FLAKSTAR 8 T 12 MLS DFT EACH C AT T TAL 16 T 24 ML DFT
5) ALL EXTER C STL S PORT INCL NG IN C F O TS E OF SKIRT	6) MATE AL PE SA 240 317L G 15 (A PROX WTS (N T INCL IN TRAYS PLATFORM) WT EMPTY 11 000 WT FLOO E 3 000

DESIGN	
DESIGNER	1986 ASME SECT VIII DIV 1
LATEST A DA	1987
MAX ES N ESS	INT 50 PSI EXT 15 PSI
MAX ES ON TEM	372 F
NT EFF N AIDS	100%
T EFF SHELL	100%
C ALL WANCE	1/16"
WY T Y A	9 PSIG (HORIZONTAL IN SHOP)
TEST AGE ON	PER DUPONT
L T E Y	
EAT T EATMENT	N NE
T E TESTS	
ELLIP HEADS	FULL I RAY
SA SEAMS	SEAMLESS
SEAMS	FULL I R Y
CRS 3/8	FULL I RAY

**LETHAL SERVICE**

PLANT BEAUMONT  
PROJ NR 6432  
P.O. N LBPC 96764U  
EN NR 5111 7061 I

**REQUIREMENTS**

FILE # 10 27 82

1 REQ D

**ROOTER CORPORATION**

T L 880U

ACH TOPPING COLUMN  
EN N 5111 7061 I

FOR

**EJ DUPONT DE NEMOURS & CO INC**  
NEWARK DELAWARE

22189 P MEDLEY J BN H 5823

DATE 10/2/82

BY M KELLY

J 70328

SHEET 1 OF 9

SEP 28 1990

BPF 285599

STILL # 1

REVISIONS

DATE

BY

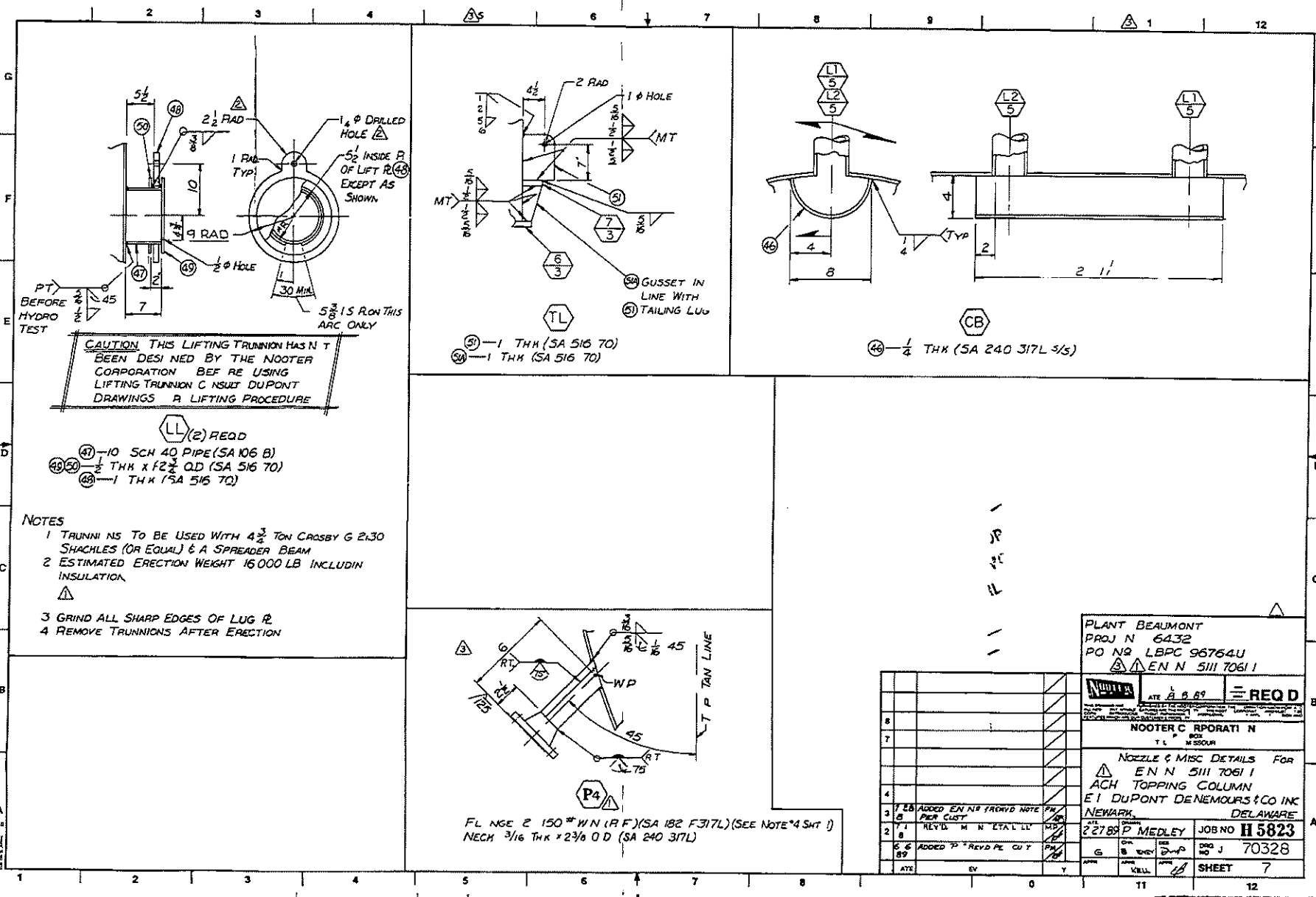
DESCRIPTION

10/2/82

M KELLY

ACH TOPPING COLUMN

89 26 90



PLANT BEAUMONT  
 PROJ N 6432  
 PO NO LBPC 96764U  
 EN N 5111 7061 I

REQD	ATE 8 8 89
NOOTER CORPORATION NEWARK, DELAWARE	
NOZZLE & MISC DETAILS FOR EN N 5111 7061 I ACH TOPPING COLUMN E I DUPONT DENEMOURS & CO INC NEWARK, DELAWARE	
22789 P	MEDLEY
DATE	EV
DATE	EV

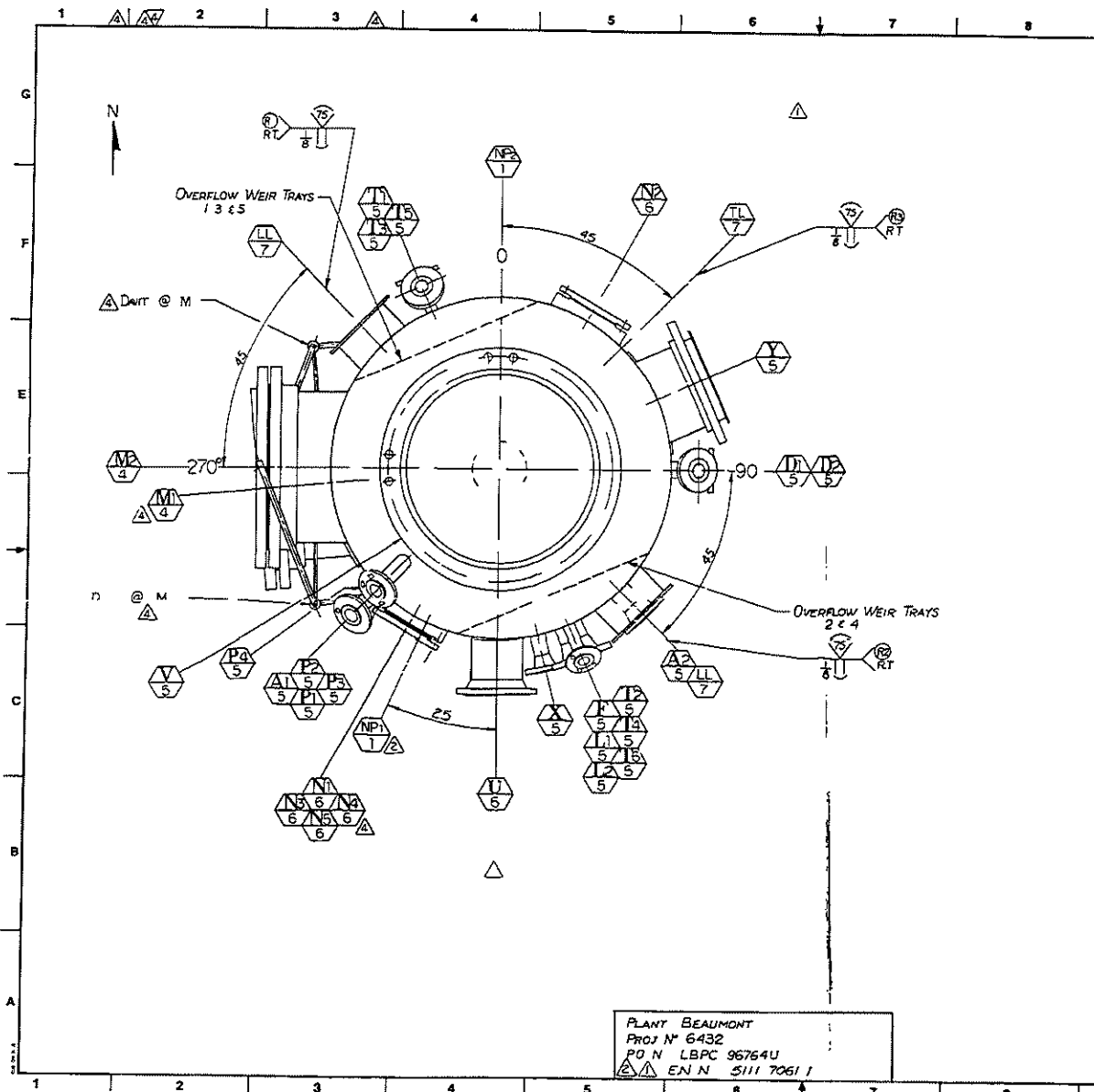
JOB NO H 5823  
 70328  
 SHEET 7

SEP28 1990

BPF 285559

SHEET # 7

FA R AT IRE ED  
 f a i s  
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 A 3 1 L S  
 T O E  
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 J 3/10  
 Doodh 9-26-89



PLANT BEAUMONT  
 PROJ N° 6432  
 PD N LBPC 96764U  
 EN N 5111 7061 1

NOZZLE DATA		III		IV		V		VI		VII		VIII		IX		X		XI		XII		SERVICE	
NOZ	SIZE/TYPE	LOCATION																					
D1	2	(R1)	6	6	90																		
F	4	(R2)	15	2 1/2	156																		INLET
L1	Δ 2"	(R1)	Δ 0	6	156																		LEVEL
L2	Δ 2	(R1)	1	9	156																		LEVEL
M1	24	(R1)	Δ 5	6	265	Δ																	M NWAY
M2	24"	(R2)	Δ 16	6	270																		MANWAY
P1	2	(R1)	6	6	225																		LEVEL Δ
P2	2	(R2)	Δ 17	6	225																		LEVEL Δ
P3	2	(R1)	Δ 5	0	225																		PRESSURE
T1	1 1/2"	(R1)	0	6	336																		TEMP
T2	1 1/2"	(R1)	7	9	156	Δ																	TEMP
T3	1 1/2"	(R2)	10	2	336	Δ																	TEMP
T4	1 1/2"	(R2)	11	9	156	Δ																	TEMP
T5	1 1/2"	(R2)	13	9	336	Δ																	TEMP
T6	1 1/2"	(R2)	17	6	156																		TEMP
U	8	BOIT HEAD								X 0 0	Y 0 0												LIQUID OUT
V	30	TOP HEA								X 0 0	Y 0 0												VAPOR OUT
X	2	(R2)	16	1'	166	Δ																	INLET
Y	14	(R1)	4	0	Δ 67.5																		VAPOR IN
N	6	(R1)	8	0	210	Δ																	INSPECTION WITH BLIND FLG
N2	6	(R2)	10	2	Δ 30																		INSPECTION WITH BLIND FL
N3	6	(R2)	12	0"	210	Δ																	INSPECTION WITH BLIND FLG
N4	6	(R2)	14	0	210	Δ																	INSPECTION WITH BLIND FLG
N5	6	(R2)	16	0	210	Δ																	INSPECTION WITH BLIND FL
A1	2	(R1)	7	9	225																		SPARE
A2	3	(R1)	1	6	135																		SPARE
D2	2	(R2)	11	9	90																		SPARE/DRAIN
P4	2	TOP HEAD			225					X 1 2 1/2	Y 1 2 1/2												PRESSURE

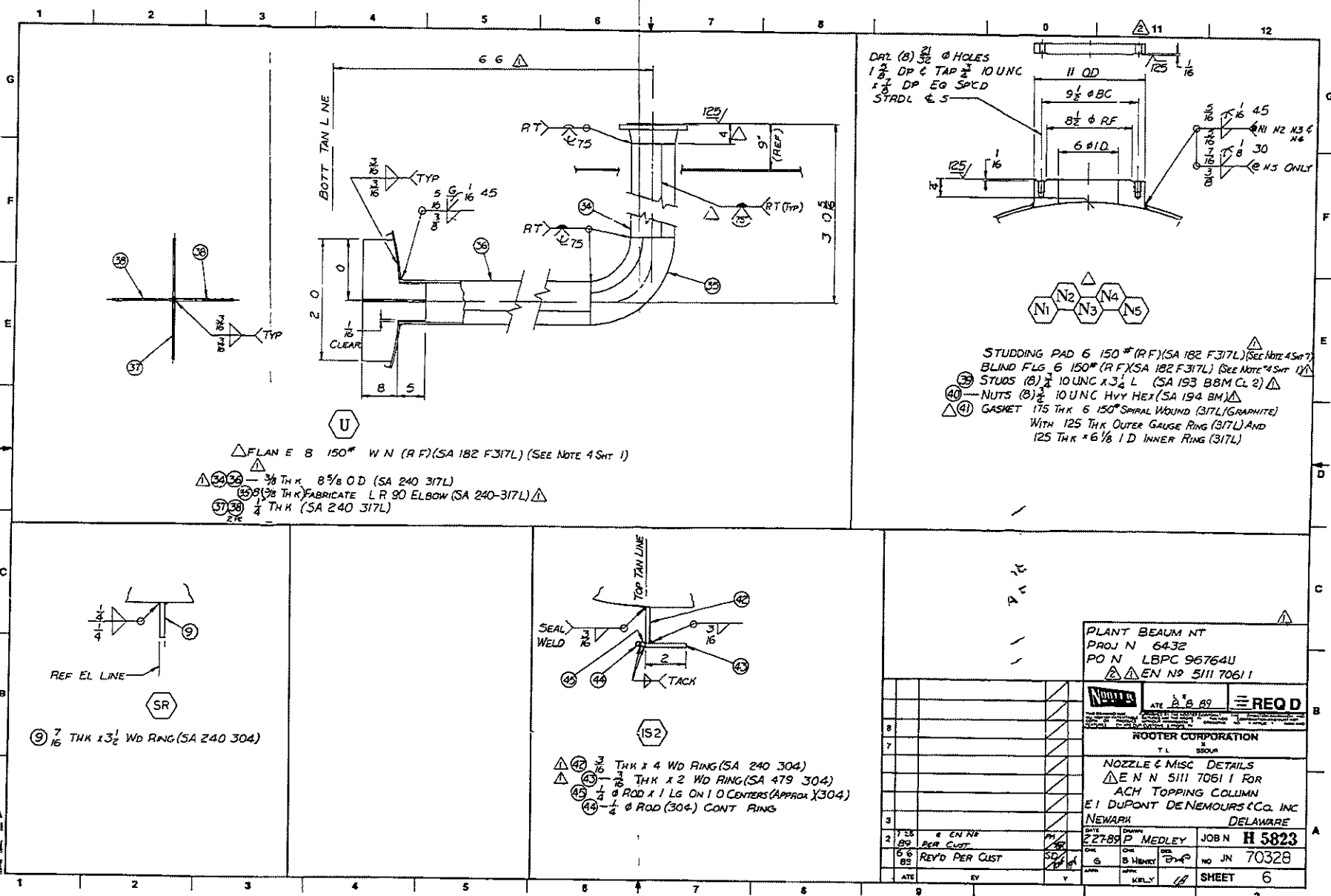
NOZZLES		REQ D	
NOOTER CORPORATION 802 T. L. U. WESCO B.			
ACH TOPPIN COLUMN ORIENTATION EN N 5111 7061 1 FOR E I DUPONT DE NEMOURS & CO INC NEWARK DELAWARE			
227 89 P MEDLEY		JOB NO H 5823	
B ME 21		DR J 70328	
M KELLY		SHEET 2	
FABRICATION RELEASE			

SEP28 1990

BPF 285559

Sheet # 2

AP VL  
 A P D E AS  
 N TE  
 I TA VE  
 B ME 21  
 M KELLY  
 9/26/90



DRILL (8)  $\frac{3}{16}$  Ø HOLES  
 1  $\frac{1}{8}$  DP C TAP  $\frac{1}{2}$  10 UNC  
 1  $\frac{1}{8}$  DP EQ SPCD  
 STADL & S

- STUDDING PAD 6 150\* (R F) (SA 182 F317L) (SEE NOTE 4 SH 7)
- BLIND FLG 6 150\* (R F) (SA 182 F317L) (SEE NOTE 4 SH 1)
- (39) STUDS (8)  $\frac{1}{2}$  10 UNC X 3  $\frac{1}{4}$  L (SA 193 B8M CL 2)  $\Delta$
- (40) NUTS (8)  $\frac{1}{2}$  10 UNC HVY HEX (SA 194 BM)  $\Delta$
- (41) GASKET 175 THK 6 150\* SPIRAL WOUND (317L) (GRAPHITE) WITH 125 THK OUTER GAUGE RING (317L) AND 125 THK \* 6 1/8 I D INNER RING (317L)

- $\Delta$  FLANGE 6 150\* W N (R F) (SA 182 F317L) (SEE NOTE 4 SH 1)
- (39)  $\frac{3}{16}$  THK 8 5/8 O D (SA 240 317L)
- (38)  $\frac{3}{16}$  THK FABRICATE L R 90 ELBOW (SA 240-317L)  $\Delta$
- (37)  $\frac{1}{4}$  THK (SA 240 317L)

(9)  $\frac{7}{16}$  THK X 3  $\frac{1}{2}$  WD RING (SA 240 304)

- (42)  $\frac{3}{16}$  THK X 4 WD RING (SA 240 304)
- (43)  $\frac{1}{2}$  THK X 2 WD RING (SA 479 304)
- (45)  $\frac{1}{2}$  Ø ROD X 1 LG ON I O CENTERS (APPROX X 304)
- (46)  $\frac{1}{2}$  Ø ROD (304) CONT RING

PLANT BEAUM NT  
 PROJ N 6432  
 PO N LBPC 96764U  
 $\Delta$  EN N 5111 7061 I

		<b>REQ'D</b> <small>REQUIREMENTS</small>
<b>ROOTER CORPORATION</b> T L BEELER		
NOZZLE & MISC DETAILS $\Delta$ EN N 5111 7061 I FOR ACH TOPPING COLUMN E I DUPONT DE NEMOURS CO. INC NEWARK DELAWARE		
DATE 2789	DRAWN P MEDLEY	JOB N H 5823
REV'D PER CUST	CHECKED B HENRY	NO JN 70328
DATE 89	BY Y	SHEET 6

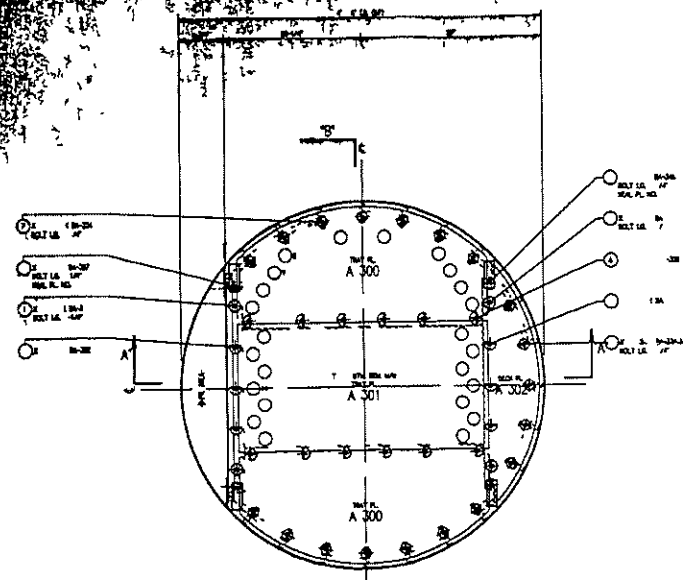
SEP28 1990

BPF 285559

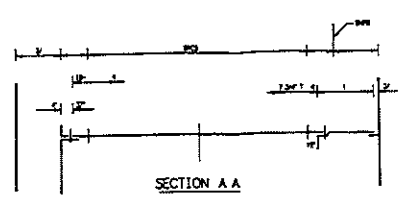
Sheet # 6

E E ALDOP  
 L S N C WLS  
 RE P  
 A PROVE  
 A PROVE AS  
 TC  
 N T A F V  
 E O OR  
 9-25-91

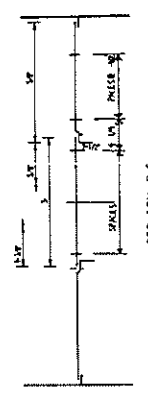




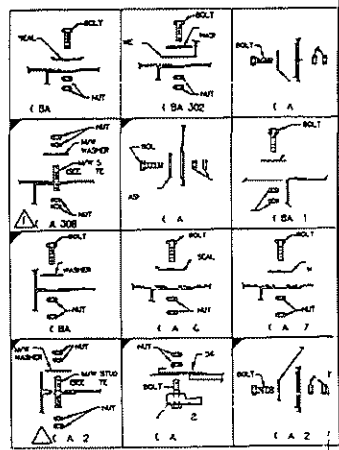
PLAN OF TRAYS  
 USS TYPE AC 5 U CAPS/TRAY  
 TRAYS NO ONE S  
 5 TRAYS REQD MKD A



SECTION A A

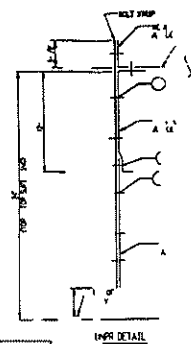
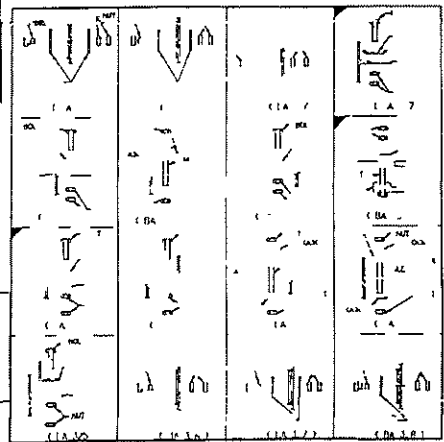


SECTION B B

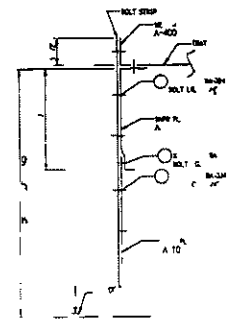


NOTES  
 1. ALL PARTS MUST BE PROOF IN MARK  
 2. HARDWARE TO BE IDENTIFIED FOR ONE TRAY ONLY  
 3. 1/2" DIA. TRAY BOLT/ NUT TO BE 1/2" DIA. RIVET  
 4. 1/4" ST. AC 5 U HAS SCREW RIVER LOT C WASH FIT  
 5. ALL BOLTS TO BE 3/8" B LESS TENSE  
 6. NUTS TO BE 1/2" DIA. RIVET  
 7. ALL ANGLES TO BE F TRAY  
 8. BOLTING ASSY BLY ETALS

REFERENCE DRAWINGS  
 AR ANGE C T F TRAY 3 E 1  
 BOLTING ASSY BLY ETALS 3 E 1



UPPER DETAIL



LOWER DETAIL

MATERIAL	QUANTITY	DESCRIPTION	UNIT	HARDWARE	TYPED	REMARKS
TRAY PARTS	1	TRAY NO. 1	ROOF			
CIVIL CAPS	1	1/2" DIA. RIVET				
DRIFT PIN	1	1/4" DIA. RIVET				
AREA CENTER	1	1/2" DIA. RIVET				
SEA RING	1	1/2" DIA. RIVET				
BEAM CLIP	1	1/2" DIA. RIVET				
UPPER ATTACHMENTS						
UPPER FLANGE	1	1/2" DIA. RIVET				
UPPER FLANGE	1	1/2" DIA. RIVET				
UPPER FLANGE	1	1/2" DIA. RIVET				

PLAN	BEA	T
Pr N	6432	
P N	LBPC 96764	
EN N	5111 7061 1	
7		
4		
3		
2		
1		
8 30 AD	YES	YS 1
89	RE ONE LOCKWAS ERS	
NO. ATR		

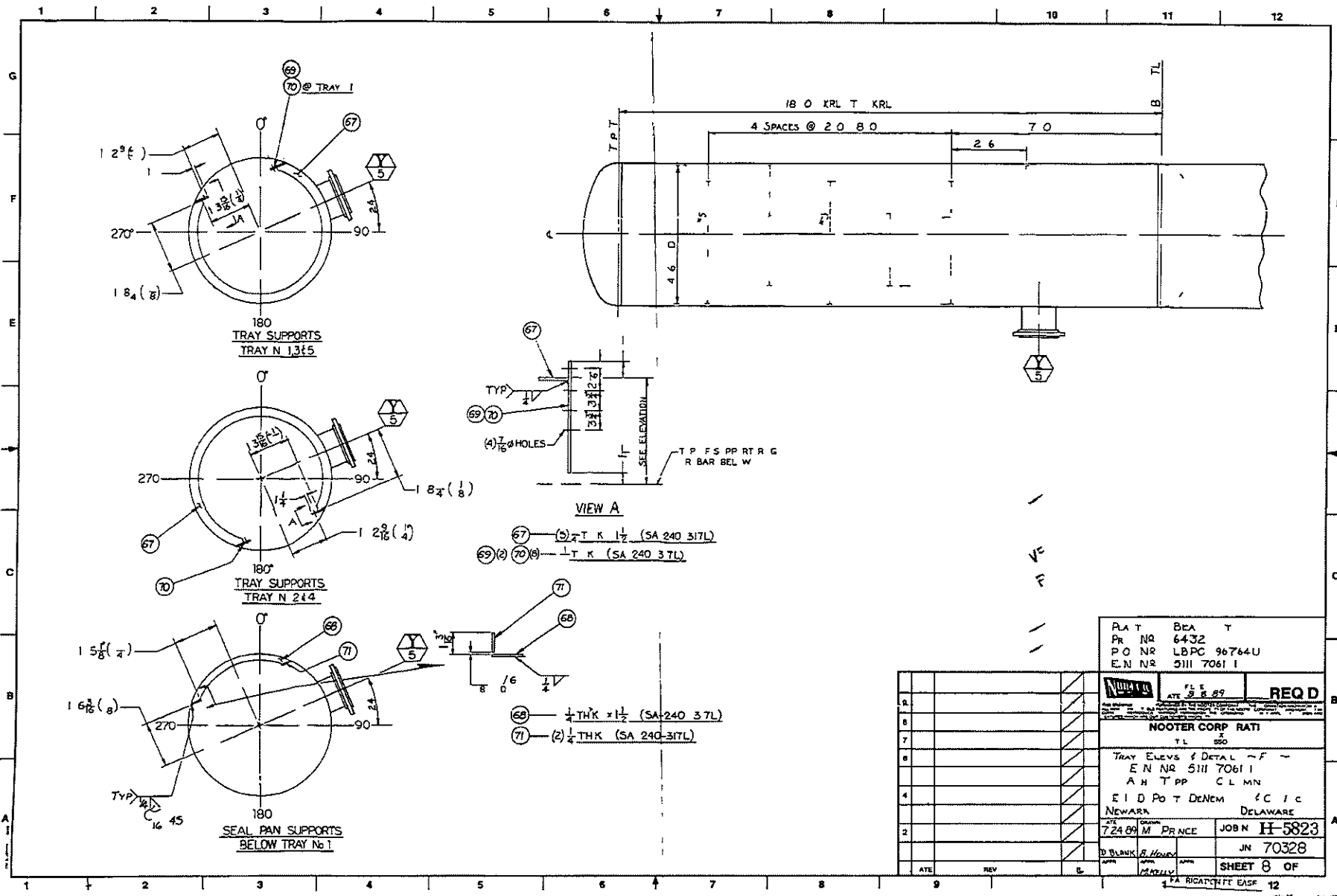
REQ D	
NO. TER CORPORAT O	
7 LOU 330A	
TR Y	DETA
EN NR	5111 7061 1
AC T P	CL N
E I D P NT	De Ne r C C Inc
NEWARK	DELAWARE
7 24 89	M PRINCE
JOB	H 5823
NO. JN	70328
SHEET 9	
SCALE	1/4" = 1'-0"
DATE	7 23 89
DR. BY	T. B. ST.
APP	

SEP 28 1990

BPF 280559

SHEET 10

A R I A T R E I A E  
 A R E A  
 A Y A  
 I T E  
 N T A  
 L



PLA T	BEA T
PR NR	6432
P O NR	LBPC 96764U
E N NR	5111 7061 I
<b>REQD</b>	
<b>MOOTER CORP RATI</b>	
T L 850	
TRAY ELEV & DETAL ~ F ~	
E N NR 5111 7061 I	
A H T P P C L M N	
E I D P O T D E N E M C I C	
NEWARK DELAWARE	
DATE	7 24 89 M PRNCE
JOB N	H-5823
JN	70328
SHEET 8 OF	

SEP 28 1990

BPF 285559

Sheet # 9

Handwritten notes and signatures at the bottom right of the page.





CHKD. BY *ES* DATE 2/27/89

ST. LOUIS, MO.

JOB NO. H5823

COMPANY DUPONT  
JOB DESCRIPTION ACH TOPPING COLUMN

BASIC VESSEL DES. -956

### LETHAL SERVICE

FILE NAME: H5823

DESIGN PRESSURE: INTERNAL = 50. P.S.I.G. EXTERNAL = 15.0 P.S.I.G.

DESIGN TEMPERATURE = 302. DEGREES FAHRENHEIT

SPECIFIC GRAVITY OF CONTENTS = 1.00

SHELL/HEAD CALCULATION JOINT EFFICIENCY: 1.000

CORROSION ALLOWANCE/CLAD THICKNESS: HEADS & SHELLS = .031" NOZTLES = .031"

A.N.S.I. FLANGE RATING CLASS: 150 #

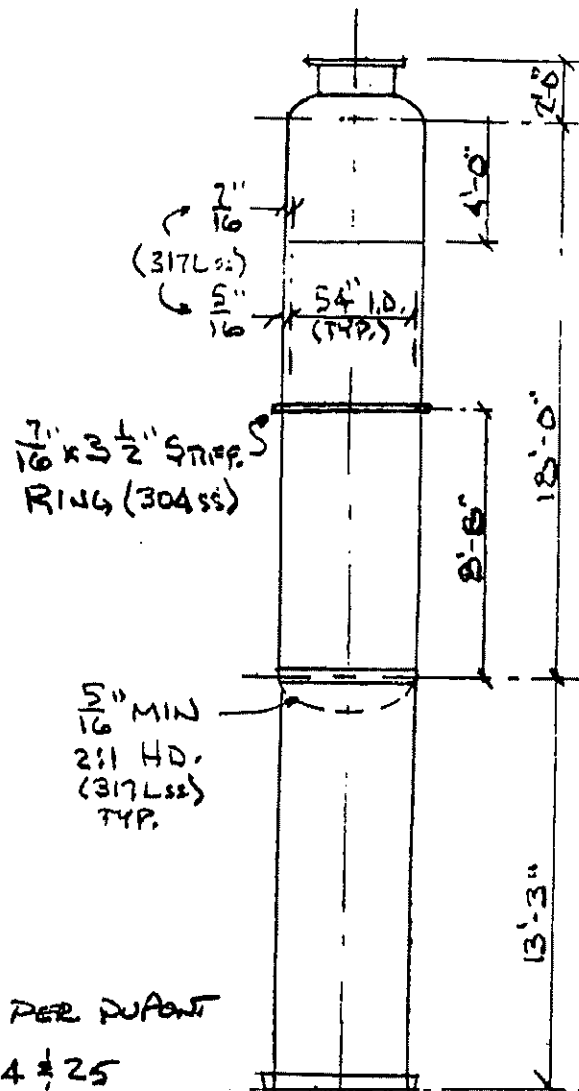
M.D.M.T. = +15° F

NO HEAT TREATMENT

### HYDRO TEST $\Delta$

SHOP: 90PSIG @ TOP (HORIZ. POSITION)

FIELD: 100PSIG @ TOP PER DUPONT



$\Delta$  REV. HYDRO TEST, FLG. BOLTING, & GASKETS PER DUPONT  
 DMP 5/24/89 REV. SH'S. 1, 2, 4, 8, 9, 10, 17, 18, 22, 24 & 25  
 ADD SH'S. 16A & 12A

COMPANY DUPONT  
 JOB DESCRIPTION ACH TOPPING COLUMN

BASIC VESSEL DES. -956

COMPONENT IDH 2:1 ELLIPSOIDAL HEAD

COMPONENT DESCRIPTION - BOTTOM HEAD

HEAD SKIRT I.D. = 54.00 INCHES  
 MATERIAL = SA240317L  
 DESIGN TEMPERATURE = 302, DEG F  
 DESIGN ALLOWABLE STRESS = 18394, PSI  
 AMBIENT ALLOWABLE STRESS = 18000, PSI  
 CORR. ALLOW / CLAD = .031 INCHES  
 JOINT EFFICIENCY = 1.00  
 DESIGN PRESSURE = 50.0 PSIG  
 LIQUID HEAD = 21.2 FT  
 SPECIFIC GRAVITY = 1.00

REQUIRED THICKNESS FOR INTERNAL PRESSURE (UG-32)

$$P = 50.0 + .433 (1.00) (21.2) = 59.2 \text{ PSIG}$$

$$t = \frac{(59.2) (54.06)}{2 (18394.) (1.00) - (.2) (59.2)} + .031$$

$$= .087 + .031 = .118 \text{ INCHES (}.12 \text{ INCHES)}$$

NEW THICKNESS USED IN CALCULATIONS = .313 INCHES

5/16" MIN. 317 LSS (PER DUPONT)

△  
 FUTURE HYDROTEST:  $P = \frac{2}{3} [90 + 21.2 \times .433] = 66 \text{ PSI}$

O.K. BY INSPECTION

COMPANY DUPONT  
 JOB DESCRIPTION ACH TOPPING COLUMN

BASIC VESSEL DES. -656

COMPONENT BH

COMPONENT DESCRIPTION - BOTTOM HEAD

MINIMUM THICKNESS OF VESSEL HEAD FOR A GIVEN  
 EXTERNAL PRESSURE -- 2:1 ELLIPSOIDAL HEAD (UG-33)

EXTERNAL PRESSURE = 15.0 PSI  
 DESIGN TEMPERATURE = 302. DEG F  
 MATERIAL = SA240317L  
 HEAD I.D. @ TAN. LINE = 54.00 INCHES  
 CORR. ALLOW / CLAD = .031 INCHES

NEW THICKNESS USED IN CALCULATIONS = .313 INCHES

DO = 54.00 + (2) (.313) = 54.63 INCHES

t(corr) = .313 - .031 = .282 INCHES

t(min) = .146 INCHES O.K.

RO = .9(DO) = 49.2 INCHES

A = (.125T) / RO = .000371

FROM FIG. 5-UHA-28.4 B = 5070. PSI

PA = B(T) / RO = 15.0 PSI

COMPANY DUPONT  
JOB DESCRIPTION ACH TOPPING COLUMN

BASIC VESSEL DES. -556

COMPONENT LS CYLINDRICAL SHELL (PLATE)

COMPONENT DESCRIPTION - LOWER SHELL

I.D. = 54.00 INCHES  
 MATERIAL = SA240317L  
 DESIGN TEMPERATURE = 302. DEG F  
 DESIGN ALLOWABLE STRESS = 18394. PSI  
 AMBIENT ALLOWABLE STRESS = 18000. PSI  
 CORR. ALLOW / CLAD = .031 INCHES  
 JOINT EFFICIENCY = 1.00  
 DESIGN PRESSURE = 50.0 PSIG  
 LIQUID HEAD = 20.0 FT  
 SPECIFIC GRAVITY = 1.00

REQUIRED THICKNESS FOR INTERNAL PRESSURE (UG-27)

$$P = 50.0 + .433 (1.00) (20.0) = 58.7 \text{ PSIG}$$

$$t = \frac{(58.7) (27.03)}{(18394.) (1.00) - (.6) (58.7)} + .031$$

$$= .006 + .031 = .118 \text{ INCHES } (< .12 \text{ INCHES})$$

NEW THICKNESS USED IN CALCULATIONS = .313 INCHES

5/16" 317L (PER DUPONT)

By INSPECTION 6" STUDDING OUTLETS INHERENTLY  
 REINFORCED FOR INT. & EXT. PRESSURE

By INSPECTION D.K. FOR VERT. HYDROTEST

$$\Delta P = \frac{2}{3} [90 + 20 \times .433] = 66 \text{ PSI}$$

COMPANY DUPONT  
 JOB DESCRIPTION ACH TOPPING COLUMN

BASIC VESSEL DES. -556

COMPONENT LS

COMPONENT DESCRIPTION - LOWER SHELL (BTM. T.L. TO STIFF.)

MINIMUM THICKNESS OF TUBE OR VESSEL SECTION FOR A GIVEN  
 EXTERNAL PRESSURE -- CYLINDRICAL SHELL (PLATE) (UG-28)

EXTERNAL PRESSURE = 15.0 PSI  
 DESIGN TEMPERATURE = 302. DEG F  
 MATERIAL = SA240317L  
 SHELL I.D. = 54.00 INCHES  
 CORR. ALLOW / CLAD = .031 INCHES  
 UNSUPPORTED LENGTH = 108.5 INCHES

NEW THICKNESS USED IN CALCULATIONS = .313 INCHES

DO = 54.00 + (2) (.313) = 54.63 INCHES

t(corr) = .313 - .031 = .282 INCHES

T(MIN) = .238 INCHES

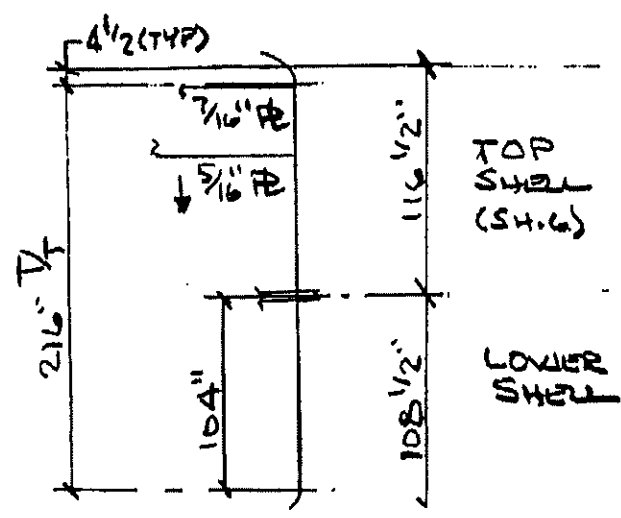
DO / T = 229.9

L / DO = 1.99

FROM FIG. 5-UGO-28.0 A = .000190

FROM FIG. 5-UHA-28.4 B = 2590. PSI

PA = 4B / [ 3(DO / T) ] = 15.0 PSI



5

COMPANY DUPONT  
JOB DESCRIPTION ACH TOPPING COLUMN

BASIC VESSEL DES. -S56

COMPONENT TS

COMPONENT DESCRIPTION - TOP SHELL (STIFF. RING TO TOP T.L.)

MINIMUM THICKNESS OF TUBE OR VESSEL SECTION FOR A GIVEN  
EXTERNAL PRESSURE -- CYLINDRICAL SHELL (PLATE) (UG-28)

EXTERNAL PRESSURE	=	15.0 PSI
DESIGN TEMPERATURE	=	302. DEG F
MATERIAL	=	SA240317L
SHELL I.D.	=	54.00 INCHES
CORR. ALLOW / CLAD	=	.031 INCHES
UNSUPPORTED LENGTH	=	116.5 INCHES

CONSERVATIVE - 48" OF THIS SECTION IS 1/16" TH'K.

NEW THICKNESS USED IN CALCULATIONS = .313 INCHES

DO = 54.00 + (2) (.313) = 54.63 INCHES

t(corr) = .313 - .031 = .282 INCHES

T(MIN) = .244 INCHES

DO / T = 223.9

L / DO = 2.13

FROM FIG. 5-UGO-28.0 A = .000185

FROM FIG. 5-UHA-28.4 B = 2520. PSI

PA = 4B / [ 3(DO / T) ] = 15.0 PSI

COMPANY DUPONT

JOB DESCRIPTION ACH TOPPING COLUMN

BASIC VESSEL DES. -656

COMPONENT SR

COMPONENT DESCRIPTION - STIFFENING RINGREQUIRED STIFFENER RING FOR CYLINDRICAL SHELL FOR A GIVEN  
EXTERNAL PRESSURE -- (UG-29)

EXTERNAL PRESSURE = 15.0 PSI  
 DESIGN TEMPERATURE = 302. DEG F  
 SHELL MATERIAL = SA240317L  
 RING MATERIAL = SA240304  
 RING I.D. (SHELL O.D.) = 54.63 INCHES  
 SHELL CORR. ALLOW / CLAD = .031 INCHES  
 UNSUPPORTED LENGTH = 112.5 INCHES

SHELL NEW THICKNESS USED IN CALCULATIONS = .313 INCHES

TCORR = .313 - .031 = .282 INCHES

B =  $3/4 [ (PDD) / (T+AS / LS) ]$  = 2080. PSI

FROM FIG. 3-UHA-28.1 A = .0001550

IS' =  $[ (DO**2)LS(T+AS/LS)A ] / 10.9$  = 1.4 (IN\*\*4)~~USE : 3.50 X .438 BAR WITH SHELL~~

I' = 4.0 (IN\*\*4)

AS = 1.5 (IN\*\*2)

L STIFF. SIZE PER DUPONT



COMPANY DUPONT  
 JOB DESCRIPTION ACH TOPPING COLUMN

BASIC VESSEL DES. -956

COMPONENT UG CYLINDRICAL SHELL (PLATE)

COMPONENT DESCRIPTION - UPPER SHELL (4'-0" LONG)

I.D. = 54.00 INCHES  
 MATERIAL = SA240317L  
 DESIGN TEMPERATURE = 302. DEG F  
 DESIGN ALLOWABLE STRESS = 18394. PSI  
 AMBIENT ALLOWABLE STRESS = 18000. PSI  
 CORR. ALLOW / CLAD = .031 INCHES  
 JOINT EFFICIENCY = 1.00  
 DESIGN PRESSURE = 50.0 PSIG  
 LIQUID HEAD = 6.0 FT  
 SPECIFIC GRAVITY = 1.00

REQUIRED THICKNESS FOR INTERNAL PRESSURE (UG-27)

$$P = 50.0 + .433 (1.00) (6.0) = 52.6 \text{ PSIG}$$

$$t = \frac{(52.6) (27.03)}{(18394.) (1.00) - (.6) (52.6)} + .031$$

$$= .077 + .031 = .109 \text{ INCHES } (.11 \text{ INCHES})$$

NEW THICKNESS USED IN CALCULATIONS = .438 INCHES

7/16" 317L (PER DUPONT)

BY INSPECTION 6" STUDDING OUTLETS INHERENTLY  
 REINFORCED FOR INT. & EXT. PRESSURE

Δ BY INSPECTION O.K. FOR VERT. HYDROTEST

COMPANY DUPONT  
 JOB DESCRIPTION ACH TOPPING COLUMN

BASIC VESSEL DES. -S56

COMPONENT TH 2:1 ELLIPSOIDAL HEAD

COMPONENT DESCRIPTION - TOP HEAD

HEAD SKIRT I.D. = 54.00 INCHES  
 MATERIAL = SA240317L  
 DESIGN TEMPERATURE = 302. DEG F  
 DESIGN ALLOWABLE STRESS = 18394. PSI  
 AMBIENT ALLOWABLE STRESS = 18800. PSI  
 CORR. ALLOW / CLAD = .031 INCHES  
 JOINT EFFICIENCY = 1.00  
 DESIGN PRESSURE = 50.0 PSIG  
 LIQUID HEAD = 2.0 FT  
 SPECIFIC GRAVITY = 1.00

REQUIRED THICKNESS FOR INTERNAL PRESSURE (UG-32)

$$P = 50.0 + .433 (1.00) (2.0) = 50.9 \text{ PSIG}$$

$$t = \frac{(50.9) (54.06)}{2 (18394.) (1.00) - (.2) (50.9)} + .031$$

$$= .075 + .031 = .106 \text{ INCHES } ( .11 \text{ INCHES})$$

NEW THICKNESS USED IN CALCULATIONS = .313 INCHES

5/16" MIN. 317L (PER DUPONT)

▲ BY INSPECTION O.K. FOR VERT. HYDROTEST

COMPANY DUPONT  
JOB DESCRIPTION ACH TOPPING COLUMN

BASIC VESSEL DES. -556

DESCRIPTION: NOZZLE Y - 14"

COMPONENT LABEL: Y

PAD REINFORCEMENT FOR EXTERNAL PRESSURE OF  
PLATE NOZZLE IN LOWER SHELL (LS )  
ON LONG. SECTION (CIRCUM. STRESS)

EXTERNAL PRESSURE (PSI) = 15.0 DESIGN TEMPERATURE (F) = 302.

(ITEM)	(NOZZLE)	(PAD)	(VESSEL)
MATERIAL =	SA240317L	SA51670	SA240317L
ALLOW. STRESS-OPER (PSI) =	18394.	17500.	18394.
CORROSION ALLOW/CLAD (IN) =	.031		.031

NOZZLE OD(IN)= 14.000 ID(IN)= 13.500 THK.(IN)= .250 INSERT(IN)= 2.000  
 PAD WIDTH (IN)= 2.000 PAD THKS (IN)= .250  
 TANGENTIAL OFFSET (IN) = .000 CIRC. ANGLE = .00 LONG. ANGLE = .00  
 SPECIAL LIMITS ; NORMAL (IN) = .000 PARALLEL (IN) = .000  
 FILLET WELDS ; OUTSIDE NOZ. = .250 INSIDE NOZ. = .250 PAD = .188  
 GROOVE WELDS ; OUTSIDE NOZ. = .250 INSIDE NOZ. = .313

P = 15.0 PSI EFFECTIVE SHELL LENGTH AT NOZ. = 108.5 IN.  
 T = .313 - .031 = .282 TR = .238  
 TN = .250 - .031 = .219 D = (13.500 + 2 X .031) = 13.563  
 TRN = .033 IN. EFFECTIVE NOZ. NECK LENGTH = 9.00 IN.

AREA OF REINFORCEMENT REQUIRED: [ WHERE: SN/S = 1.000 ]  
 A = .5 X D X TR  
 = .5 X 13.563 X .238 = 1.61 SQ. IN.

AREA OF REINFORCEMENT AVAILABLE: [ WHERE: SN/S = 1.000 & SP/S = .951 ]

A1 = (E1 X T - TR)D  
 = (1.00 X .282 - .238)13.563 = .599 SQ. IN.

A2 = (TN - TRN)5T  
 = (.219 - .038) X 5 X .282 = .255 SQ. IN.

A3 = 2(TN - C)(2.5TN)  
 = 2(.219 - .031)(2.5 X .219) = .205 SQ. IN.

A4 = 2 X .5(L1\*\*2 + L2\*\*2)(SP/S) + 2 X .5(L3\*\*2)  
 = 2 X .5(.250\*\*2 + .188\*\*2)(.951) + 2 X .5(.250\*\*2) = .155 SQ. IN.

A5 = (DP-D-2TN)TE(SP/S)  
 = (18.000 - 13.563 - 2 X .219) .250(.951) = .951 SQ. IN.

AT = A1 + A2 + A3 + A4 + A5 = 2.17 SQ. IN.

OPENING IS ADEQUATELY REINFORCED

BY INSPECTION O.K. FOR INT. PRESS.

" " OK FOR VERT. HYDROTEST  
 Δ

1/4" x 2" PAD (SA-516-70) / 10

COMPANY DUPONT  
JOB DESCRIPTION ACH TOPPING COLUMN

BASIC VESSEL DES. -956

COMPONENT (Y ) : NOZZLE Y

UNIT STRESSES (PAR. UW-15(C))

-----  
PAD TO SHELL FILLET WELD SHEAR = .49 X 17500. = 8575. PSI  
PAD TO NOZ. NECK FILLET WELD SHEAR = .49 X 17500. = 8575. PSI  
PAD TO NOZ. NECK GROOVE WELD TENSION = .74 X 17500. = 12950. PSI  
SHELL TO NOZ. NECK INNER GROOVE WELD TENSION = .74 X 18394. = 13612. PSI  
SHELL TO NOZ. NECK INNER FILLET WELD SHEAR = .49 X 18394. = 9013. PSI  
NOZZLE NECK SHEAR = .70 X 18394. = 12876. PSI

WELD AND MEAN NOZZLE NECK LENGTHS

-----  
C1 = MEAN NOZZLE NECK CIRCUM. = 3.1416 X (14.000 - .219) = 43.30 IN.  
C2 = WELD CIRCUM. AT NOZZLE O.D. = 3.1416 X 14.000 = 43.98 IN.  
C3 = WELD CIRCUM. AT PAD O.D. = 3.1416 X (14.000 + 2 X 2.000) = 56.55 IN.

STRENGTH OF CONNECTION ELEMENTS

-----  
(A) PAD TO NOZZLE NECK FILLET WELD  
1/2 X C2 X WELD LEG X UNIT STRESS  
1/2 X 43.98 X .250 X 8575. = 47144. LBS.  
  
(B) PAD TO NOZZLE NECK GROOVE WELD  
1/2 X C2 X WELD DEPTH X UNIT STRESS  
1/2 X 43.98 X .250 X 12950. = 71197. LBS.  
  
(C) SHELL TO NOZZLE NECK INNER GROOVE WELD  
1/2 X C2 X (WELD DEPTH - CA) X UNIT STRESS  
1/2 X 43.98 X (.313 - .031) X 13612. = 84108. LBS.  
  
(D) SHELL TO NOZZLE NECK INNER FILLET WELD  
1/2 X C2 X WELD LEG X UNIT STRESS  
1/2 X 43.98 X .250 X 9013. = 49552. LBS.  
  
(E) NOZZLE NECK SHEAR  
1/2 X C1 X CORRODED THICKNESS X UNIT STRESS  
1/2 X 43.30 X .219 X 12876. = 60972. LBS.  
  
(F) PAD TO SHELL FILLET WELD SHEAR  
1/2 X C3 X WELD LEG X UNIT STRESS  
1/2 X 56.55 X .188 X 8575. = 45460. LBS.

COMPANY DUPONT  
 JOB DESCRIPTION ACH TOPPING COLUMN

BASIC VESSEL DES. -856

COMPONENT (Y ) : NOZZLE Y

LOAD TO BE CARRIED BY WELDS (PAR. UG-41(B))

---

$$\begin{aligned}
 W(1-1) &= (A2 + A5 + A41 + A42) * S &= 23894, \text{ LBS.} \\
 W(2-2) &= (A2 + A3 + A41 + A43 + 2*TN+T*SN/S) * S &= 12968, \text{ LBS.} \\
 W(3-3) &= (A2 + A3 + A4 + A5 + 2*TN*T*SN/S) * S &= 31083, \text{ LBS.} \\
 W &= (A - 2*(LIM-RN-TN)*(E1*T-F*TR)) * S &= 18967, \text{ LBS.}
 \end{aligned}$$

POSSIBLE PATHS OF FAILURE

---

\*\*\* FULL PENETRATION WELDS THRU SHELL (OR HEAD) AND PAD \*\*\*

PATH 1 (THRU NOZZLE NECK AND PAD TO SHELL WELD)

$$\begin{aligned}
 &= (E) + (F) \\
 &= 60972. + 45460. \\
 &= 106432. \text{ LBS.} \quad ( 18967. \text{ LBS. MIN.})
 \end{aligned}$$

PATH 2 (THRU PAD TO NOZ. NECK AND SHELL TO NOZ. NECK WELDS)

$$\begin{aligned}
 &= (A) + (B) + (C) + (D) \\
 &= 47144. + 71197. + 84188. + 49552. \\
 &= 252080. \text{ LBS.} \quad ( 12968. \text{ LBS. MIN.})
 \end{aligned}$$

PATH 3 (THRU SHELL TO NOZ. NECK AND PAD TO SHELL WELDS)

$$\begin{aligned}
 &= (C) + (D) + (F) \\
 &= 84188. + 49552. + 45460. \\
 &= 179200. \text{ LBS.} \quad ( 18967. \text{ LBS. MIN.})
 \end{aligned}$$

ALL PATHS ARE STRONGER THAN THE LOAD TO BE CARRIED BY THE WELDS.

PAD TO SHELL WELD STRENGTH (PAR. UG-41(B))

---

$$\begin{aligned}
 \text{PAD STRENGTH} &= ( .951)(18394.) = 17500. \text{ LBS.} \quad (W = 18967. \text{ LBS.}) \\
 \text{FILLET WELD STRENGTH} &= 45460. \text{ LBS.}
 \end{aligned}$$

THE PAD TO SHELL FILLET WELD STRENGTH IS ADEQUATE.

COMPANY DUPONT  
JOB DESCRIPTION ACH TOPPING COLUMN

BASIC VESSEL DES. -S56

DESCRIPTION: NOZZLE V-30"

COMPONENT LABEL: V

PAD REINFORCEMENT FOR EXTERNAL PRESSURE OF  
PLATE NOZZLE IN TOP HEAD (TH )  
ON MERIDIONAL SECTION (LATITUDINAL STRESS)

EXTERNAL PRESSURE (PSI) = 15.0 DESIGN TEMPERATURE (F) = 302.

(ITEM)	(NOZZLE)	(PAD)	(VESSEL)
MATERIAL =	SA240317L	SA51670	SA240317L
ALLOW. STRESS-OPER (PSI) =	18394.	17500.	18394.
CORROSION ALLOW/CLAD (IN) =	.031		.031

NOZZLE OD(IN)= 30.000 ID(IN)= 29.500 THK.(IN)= .250 INSERT(IN)= .000  
PAD WIDTH (IN)= 2.000 PAD THKS (IN)= .250  
HILLSIDE OFFSET (IN)= .000 MERID. ANGLE = .00 LATERAL SKEW ANGLE = .00  
SPECIAL LIMITS : NORMAL (IN) = .000 PARALLEL (IN) = 21.000  
FILLET WELDS : OUTSIDE NOZ. = .250 INSIDE NOZ. = .000 PAD = .188  
GROOVE WELDS : OUTSIDE NOZ. = .250 INSIDE NOZ. = .313

P = 15.0 PSI EFFECTIVE SHELL LENGTH AT NOZ. = .0 IN.  
T = .313 - .031 = .282 TR = .146 (SPHERICAL SECTION OF HEAD)  
TN = .250 - .031 = .219 D = (29.500 + 2 X .031) = 29.563  
TRN = .067 IN. EFFECTIVE NOZ. NECK LENGTH = 12.00 IN.

AREA OF REINFORCEMENT REQUIRED: [ WHERE: SN/S = 1.000 ]  
A = .5 X D X TR  
= .5 X 29.563 X .146 = 2.16 SQ. IN.

AREA OF REINFORCEMENT AVAILABLE: [ WHERE: SN/S = 1.000 & SP/S = .951 ]  
A1 = (E1 X T - TR)(2(SPECIAL LIM.) - D)  
= (1.00 X .282 - .146)(2(21.00) - 29.563) = 1.691 SQ. IN.  
A2 = (TN - TRN)5T  
= (.219 - .067) X 5 X .282 = .214 SQ. IN.  
A3 = = 0. SQ. IN.  
A4 = 2 X .5(L1\*\*2 + L2\*\*2)(SP/S)  
= 2 X .5(.250\*\*2 + .188\*\*2)(.951) = .093 SQ. IN.  
A5 = (DP-D-2TN)TE(SP/S)  
= (34.000 - 29.563 - 2 X .219) .250(.951) = .951 SQ. IN.  
AT = A1 + A2 + A3 + A4 + A5 = 2.95 SQ. IN.

OPENING IS ADEQUATELY REINFORCED

ALL REINF. IN SPH. SECT. OF HEAD

1/4" X 2" PAD (SA-516-70)

COMPANY DUPONT  
JOB DESCRIPTION ACH TOPPING COLUMN

BASIC VESSEL DES. -S56

COMPONENT (V ) : NOZZLE V

UNIT STRESSES (PAR. UW-15(C))

-----  
 PAD TO SHELL FILLET WELD SHEAR = .49 X 17500. = 8575. PSI  
 PAD TO NOZ. NECK FILLET WELD SHEAR = .49 X 17500. = 8575. PSI  
 PAD TO NOZ. NECK GROOVE WELD TENSION = .74 X 17500. = 12950. PSI  
 SHELL TO NOZ. NECK INNER GROOVE WELD TENSION = .74 X 18394. = 13612. PSI  
 NOZZLE NECK SHEAR = .70 X 18394. = 12876. PSI

WELD AND MEAN NOZZLE NECK LENGTHS

-----  
 C1 = MEAN NOZZLE NECK CIRCUM. = 3.1416 X (30.000 - .219) = 93.56 IN.  
 C2 = WELD CIRCUM. AT NOZZLE O.D. = 3.1416 X 30.000 = 94.25 IN.  
 C3 = WELD CIRCUM. AT PAD O.D. = 3.1416 X (30.000 + 2 X 2.000) = 106.81 IN.

STRENGTH OF CONNECTION ELEMENTS

- (A) PAD TO NOZZLE NECK FILLET WELD  
 1/2 X C2 X WELD LEG X UNIT STRESS  
 1/2 X 94.25 X .250 X 8575. = 101022. LBS.  
 (B) PAD TO NOZZLE NECK GROOVE WELD  
 1/2 X C2 X WELD DEPTH X UNIT STRESS  
 1/2 X 94.25 X .250 X 12950. = 152564. LBS.  
 (C) SHELL TO NOZZLE NECK INNER GROOVE WELD  
 1/2 X C2 X (WELD DEPTH - CA) X UNIT STRESS  
 1/2 X 94.25 X (.313 - .031) X 13612. = 180403. LBS.  
 (D) SHELL TO NOZZLE NECK INNER FILLET WELD  
 1/2 X C2 X WELD LEG X UNIT STRESS  
 1/2 X 94.25 X .000 X 0. = 0. LBS.  
 (E) NOZZLE NECK SHEAR  
 1/2 X C1 X CORRODED THICKNESS X UNIT STRESS  
 1/2 X 93.56 X .219 X 12876. = 131761. LBS.  
 (F) PAD TO SHELL FILLET WELD SHEAR  
 1/2 X C3 X WELD LEG X UNIT STRESS  
 1/2 X 106.81 X .188 X 8575. = 85869. LBS.

COMPANY DUPONT  
 JOB DESCRIPTION ACH TOPPING COLUMN

BASIC VESSEL DES. -956

COMPONENT (V ) : NOZZLE V

LOAD TO BE CARRIED BY WELDS (PAR. UG-41(B))  
 -----

$$\begin{aligned} W(1-1) &= (A2 + A5 + A41 + A42) * S &= 23142. \text{ LBS.} \\ W(2-2) &= (A2 + A3 + A41 + A43 + 2*TN+T*SN/S) * S &= 7294. \text{ LBS.} \\ W(3-3) &= (A2 + A3 + A4 + A5 + 2*TN*T*SN/S) * S &= 25409. \text{ LBS.} \\ W &= (A - 2*(LIM-RN-TN)*(E1*T-F*TR)) * S &= 9639. \text{ LBS.} \end{aligned}$$

POSSIBLE PATHS OF FAILURE  
 -----

\*\*\* FULL PENETRATION WELDS THRU SHELL (OR HEAD) AND PAD \*\*\*

PATH 1 (THRU NOZZLE NECK AND PAD TO SHELL WELD)

$$\begin{aligned} &= (E) + (F) \\ &= 131761. + 85869. \\ &= 217630. \text{ LBS.} \quad ( 9639. \text{ LBS. MIN.}) \end{aligned}$$

PATH 2 (THRU PAD TO NOZ. NECK AND SHELL TO NOZ. NECK WELDS)

$$\begin{aligned} &= (A) + (B) + (C) + (D) \\ &= 101022. + 152564. + 180403. + 0. \\ &= 433989. \text{ LBS.} \quad ( 7294. \text{ LBS. MIN.}) \end{aligned}$$

PATH 3 (THRU SHELL TO NOZ. NECK AND PAD TO SHELL WELDS)

$$\begin{aligned} &= (C) + (D) + (F) \\ &= 180403. + 0. + 85869. \\ &= 266271. \text{ LBS.} \quad ( 9639. \text{ LBS. MIN.}) \end{aligned}$$

ALL PATHS ARE STRONGER THAN THE LOAD TO BE CARRIED BY THE WELDS.

PAD TO SHELL WELD STRENGTH (PAR. UG-41(B))  
 -----

$$\begin{aligned} \text{PAD STRENGTH} &= ( .951)(18394.) = 17500. \text{ LBS.} \quad (W = 9639. \text{ LBS.}) \\ \text{FILLET WELD STRENGTH} &= 85869. \text{ LBS.} \end{aligned}$$

THE PAD TO SHELL FILLET WELD STRENGTH IS ADEQUATE.



COMPANY DUPONT  
JOB DESCRIPTION ACH TOPPING COLUMN

BASIC VESSEL DES. -S56

DESCRIPTION: NOZZLE V-30'

COMPONENT LABEL: V

PAD REINFORCEMENT FOR INTERNAL PRESSURE OF  
PLATE NOZZLE IN TOP HEAD (TH )  
ON MERIDIONAL SECTION (LATITUDINAL STRESS)

DESIGN PRESSURE (PSI) = 50.0  
LIQUID HEAD (FT.) = 1.0

DESIGN TEMPERATURE (F) = 302.  
SPECIFIC GRAVITY = 1.00

(ITEM)	(NOZZLE)	(PAD)	(VESSEL)
MATERIAL	SA240317L	SA51670	SA240317L
ALLOW. STRESS-OPER (PSI)	18394.	17500.	18394.
CORROSION ALLOW/CLAD (IN)	.031		.031

NOZZLE OD(IN)= 30.000 ID(IN)= 29.500 THK.(IN)= .250 INSERT(IN)= .000  
 PAD WIDTH (IN)= 2.000 PAD THKS (IN)= .250  
 HILLSIDE OFFSET (IN)= .000 MERID. ANGLE = .00 LATERAL SKEW ANGLE = .00  
 SPECIAL LIMITS ; NORMAL (IN) = .000 PARALLEL (IN) = 21.000  
 FILLET WELDS ; OUTSIDE NOZ. = .250 INSIDE NOZ. = .000 PAD = .188  
 GROOVE WELDS ; OUTSIDE NOZ. = .250 INSIDE NOZ. = .313

$P = 50.0 + .433 ( 1.00 ) ( 1.0 ) = 50.4 \text{ PSI}$   
 $T = .313 - .031 = .282$  TR = .067 (SPHERICAL SECTION OF HEAD)  
 $TN = .250 - .031 = .219$  D = (29.500 + 2 X .031) = 29.563  
 $TRN = ( 50.4 X 14.781 ) / ( 18394. X 1.00 - .6 X 50.4 ) = .041 \text{ IN.}$

AREA OF REINFORCEMENT REQUIRED: [ WHERE: SN/S = 1.000 ]  
 $A = D X TR X F$   
 $= 29.563 X .067 X 1.0 = 1.98 \text{ SQ. IN.}$

AREA OF REINFORCEMENT AVAILABLE: [ WHERE: SN/S = 1.000 & SP/S = .951 ]  
 $A1 = (E1 X T - F X TR) ( 2(SPECIAL LIM.) - D )$   
 $= ( 1.00 X .282 - 1.0 X .067 ) ( 2(21.00) - 29.563 ) = 2.671 \text{ SQ. IN.}$

$A2 = (TN - TRN) 5T$   
 $= ( .219 - .041 ) X 5 X .282 = .251 \text{ SQ. IN.}$

$A3 = 0. \text{ SQ. IN.}$

$A4 = 2 X .5(L1**2 + L2**2)(SP/S)$   
 $= 2 X .5( .250**2 + .188**2 ) ( .951 ) = .093 \text{ SQ. IN.}$

$A5 = (DP-D-2TN)TE(SP/S)$   
 $= ( 34.000 - 29.563 - 2 X .219 ) .250 ( .951 ) = .951 \text{ SQ. IN.}$

$AT = A1 + A2 + A3 + A4 + A5 = 3.97 \text{ SQ. IN.}$

OPENING IS ADEQUATELY REINFORCED

*PATH OF FAILURE CALC'S. NOT RECD.*

*ALL REINF. IN SPH. SECT. OF HEAD*

*1/4" X 2" PAD OK* /16