PROP

Engineering Change Order

Team Environmental Services, Inc.

ENGINEERING
P.O. BOX 123
ALVIN, TEXAS 77511

Letter: C

ECO# 7228	DWG.#/ITEM# 74298
Requested by: ERIC	CSC#: P37 JOB #: 079832N
Department: CSC 37 Date: 8/2/98	Date Effective: ☒ Immediate ☐ Phase In ☐ Record Only
Request Approved by: CL	Changed By: CYL
Date: 8/2/98	Date: 8/2/98

Description:
1. CHANGE SIZE & NUMBER OF SET SCREWS ON DWG SHT 1 OF 3 (NO SET SCREWS)
2. VOID DWG SHT 1a OF 3
3. VOID DWG SHT 1b OF 3
4. VOID MATERIAL FOR SET SCREWS
5. NOTE TO MILL SPLIT LINE
6. VOID MAX INJ. PRESSURE NOTE & ADD "DO NOT INJECT"
7. CHANGE THRUST CALC. (CALC SHT 7 OF 9)
8. ADD MTR TO ALL MATERIAL
9. ADD CALC SHT 7a-7c OF 9
10. ADD TORQUE VALVE

Reason For Change: BASE OF MFG
PLANT REQUEST

Effect On Structural

Integrity Of Clamp: SHOWN IN CALC

Checked By: CL Date: 8/2/98

Approved By: CL Date: 8/2/98

Items Affected

Raw Materials	Scrap ☐	Change ☐	Use ☐
Parts In Stock	Scrap ☐	Change ☐	Use ☐
Parts in Process	Scrap ☐	Change ☐	Use ☐
Vendor	Scrap ☐	Change ☐	Use ☐

Copies To:

Manufacturing Department

Q.A.

Purchasing

Environmental Services, Inc.

[redacted]INEERING
BOX 123
ALVIN, TEXAS 77511

Engineering Change Order Request

Requested By: ERIC	DWG.#/ITEM# 74298
Department: CSC27	CSC#: P37 JOB #: 075832N
Request Received By: CXL Date: 8/2/98	Date Effective: ☒ Immediate ☐ Phase In ☐ Record Only

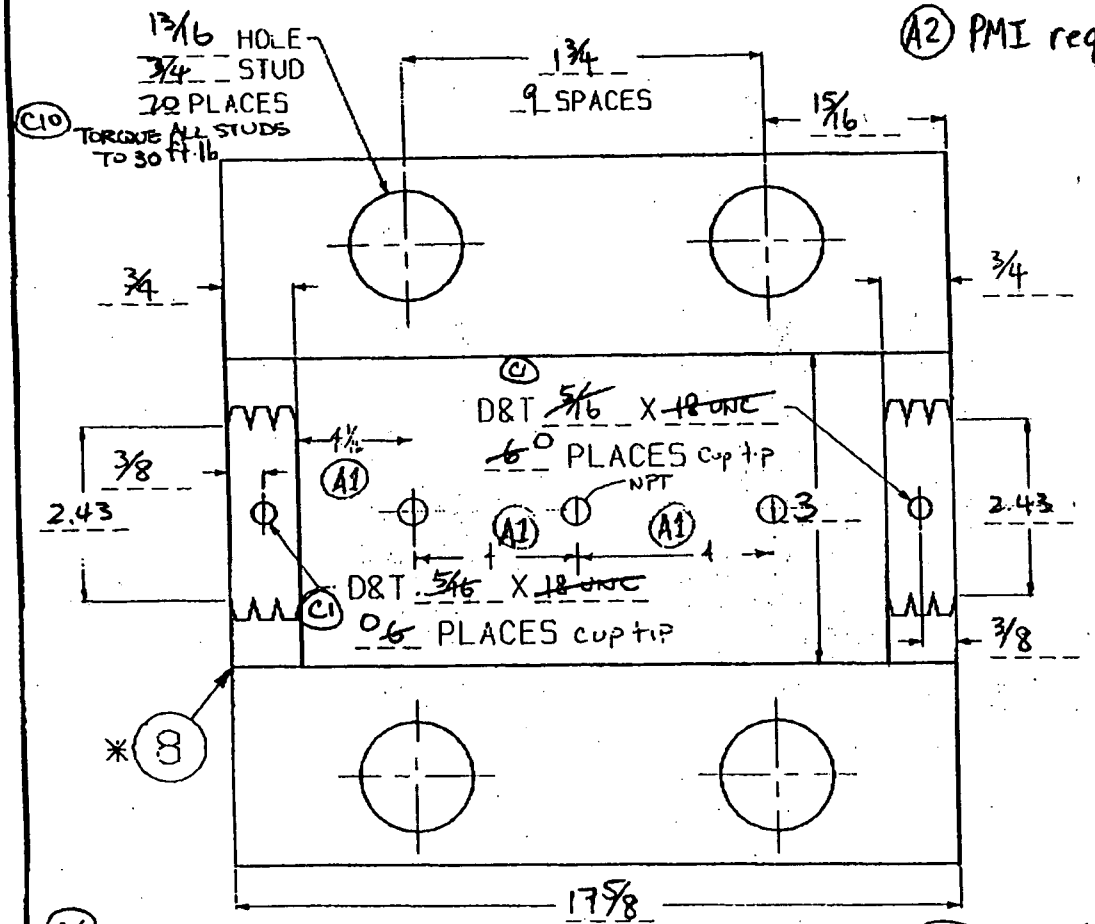
Description of Change: ~~CHANGE SIZE & # OF SET SCREWS~~
DUE TO NOT INJECTING ENCLOSURE
VOID SET SCREWS
MOD CLAMP TO ACT AS CRUNCH RING.

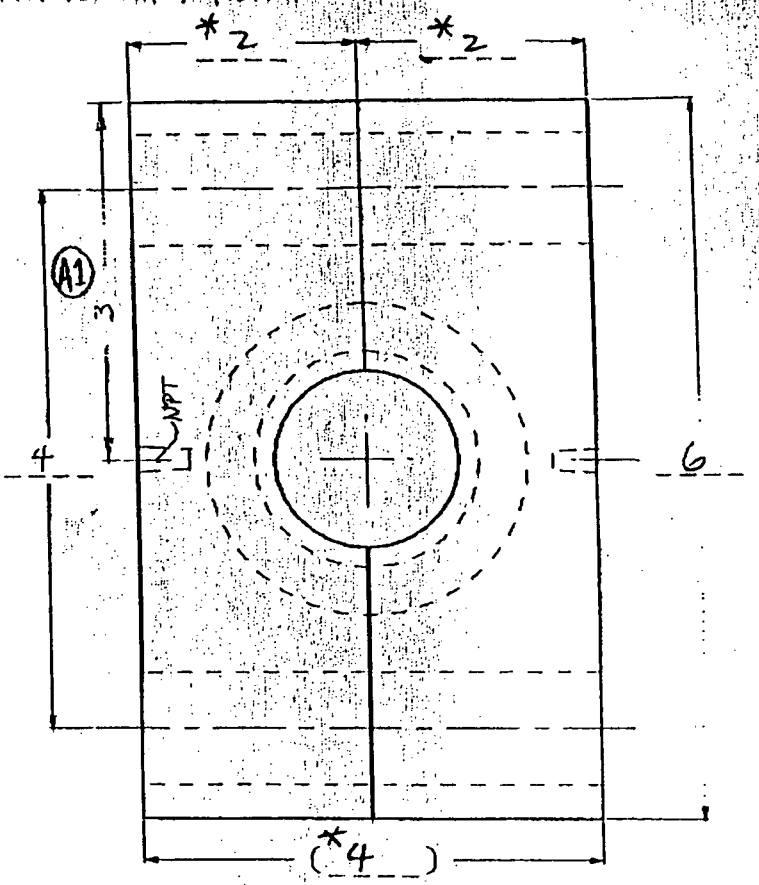
Reason For Change: ~~CASE~~ OF MFG, PLANT REQUEST

ALL DIMENSIONS TYPICAL UNLESS OTHERWISE NOTED

ECO# 7228 C 8/7/98

ECO# 7224 A 7/31/98





A2 PMI required for all materials

C6 DO NOT INJECT ~~LIMIT MAX INJ. PRESSURE TO 1100 psi + STATIC~~

C5 MILL 1/16" FROM SPLIT LINE (EACH HALF)

* DIMS BEFORE MILL

"CONFIDENTIAL"

PROPRIETARY INFORMATION

NUCLEAR

DO NOT PAINT

* WELDED ENDPLATES OPTIONAL

0.110 CRUNCH

D&T 6 - 1/8 NPT (CAVITY)

TERM INC ALVIN, TEXAS	JOB NO. P37-079832N	MATERIAL SEE MS SHEET	WEIGHT 112.41b
	CLAMP NO. 74298	UNLESS NOTED OTHERWISE: MACHINED SURFACES 250 √; Break Sharp Corners .005 .020; TOLERANCES: 2 Place Decimal ± .005, 3 Place Decimal ± .01, 1 Place Decimal ± .1, ANGLES ± 1/2°, FRACTIONS ± 1/32, ALL DIMENSIONS IN INCHES	VOID 68.5in³ BC
	EST. NO.		CON-ED IP2
	WELDING SPEC. NO. SEE WELD MAP		
DRAWN BY: CXL	7/30/98		DWG NO. sb_cr_2w_ss2 REV
CHECKED: JBM	7/31/98		SCALE: NTS Sheet: 1 of 3
APPROVED:			

TEAM INC ALVIN TEXAS

MATERIAL SPECIFICATIONS

C 8/2/98

☐ NON-CRITICAL/NUCLEAR ☒ CRITICAL/NUCLEAR

SHT. 3 OF 3

DRAWN BY: CAL 7/30/98 CSC NO. P37 JOB NO. 079832N

CHECKED BY: JBM 7/31/98 ITEM NO. 74298

CUSTOMER: CON-ED IP2 EST. NO.

COMPONENT	MATERIAL SPECIFICATION	ALLOW STRESS	MTR	COC	NR
CLAMP					
RING					
EARS					
ENCLOSURES					
PIPE					
SOLID BLOCK	SA240 GR 304	11400	X		
END PLATES	SA240 GR304	"	X		
SIDE BARS					
STRONGBACK BAR					
S.B. EARS/FINGERS					
FASTENERS			(C8)		
STUDS CLAMP/ENCL.	SA193 GR B8/1	11400	X	X	
STUDS STRONGBACK			(C8)		
NUTS CLAMP/ENCL.	SA194 GR B8	-	X	X	
NUTS STRONGBACK	(C4)				
SET SCREWS ~~(35)~~	~~ANSI B18.3~~	X		X	
MISCELLANEOUS					

ECO#7228
C 8/2/98

TEAM INC
ALVIN, TEXAS

CLAMPS & ENCLOSURES

CALCULATIONS

Sht. 7 of 9

DESIGNED BY: CYL DATE: 7/30/98 CSC NO. P37 JOB NO. 579832N
CHECKED BY: JRM DATE: 7/31/98 ITEM NO. 74298
DGN. TEMP. _____ DGN. PSIG _____ EST. NO. _____
SKIN TEMP. _____ OPER. PSIG _____ CALC NO. _____

THRUST FOR UNEQUAL BORES

T=HYDRAULIC THRUST
D=LARGE CLOSING DIAMETER
d=SMALL CLOSING DIAMETER
P=PUMPING PRESSURE
1000 psi (MIN), 2*DGN PRESS,
OPER PRESS + 1000 psi (MAX),
OR DGN PRESS (PERI. SEAL OR SEP.)
N=# OF STRONGBACKS
F=FORCE PER STRONGBACK

$T=(D^2-d^2)*(\pi/4)*P$

(17) $(4.35^2-1.9^2)\pi/4(4100) + 1.9^2\pi/4(600)$

INJECTION THRUST + LINE SEPARATION

SAFETY FACTOR $T=$ ~~37048~~ 17017

$T=5.T$

$F=T/N$ (6) $= 8506.$

$F=$ ~~617.5~~

TYPES OF STRONGBACK

A. BOLTS

BS=BOLT STRENGTH
A=TENSILE AREA OF STUD
S=ALLOWABLE STRESS

$BS=A*S$ $BS=$ _____ $\geq F$

B. SMOOTH TONGUE

WL=WORKING LOAD OF TONGUE
DIA=DIAMETER OF FLANGE
t=TONGUE THICKNESS
S=ALLOWABLE STRESS

$WL=\pi*DIA*t*S$ $WL=$ _____ $\geq T$

C. SET SCREWS

Hp=HOLDING POWER OF SET SCREWS

~~5/16~~ X ~~18~~ UNC

☒ CUP TIP
☐ CONE TIP

$Hp=$ ~~625~~ $\geq F$

D. WELD

WS=WELD STRENGTH
S=ALLOWABLE STRESS
L=LENGTH OF WELD
tl=THROAT LENGTH

$WS=tl*\sqrt{2}/2*L*S*.45$ $WS=$ _____ $\geq T$

C 8/2/98

(CA) ADD

Sheet 7a of 9

Crunch Ring Strongback Analysis

Designed By: CYL Date: 8/2/98

Checked By: CL Date: 8-2-98

Customer: CON-ED IP2

Location:

CSC # P37 Job # 079832N

Calculation #

Estimate #

Item # 74298

Purpose: This analysis will calculate the frictional force caused by the Crunch Ring Strongback and the internal stresses of the Crunch Ring Strongback due to the bolting.

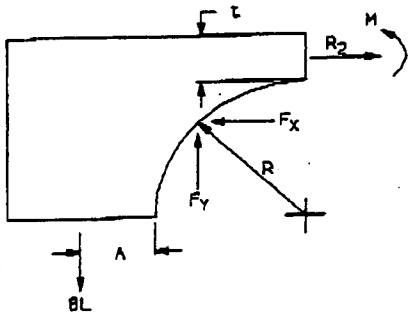
References: ASME Boiler and Pressure Vessel Code, Section II, Part D, (Table for Maximum Allowable Stresses, 1995 Edition)

Mechanics of Materials by Beer and Johnston, 1981

Machinery's Handbook, 23rd Edition, pages 1278-1279 and 1498-1520

Data:

Design Pressure	$P := 600 \cdot psi$
Design Temperature	$T := 600 \cdot deg$
Inside Radius of Clamp	$R := 1.215 \cdot in$
Width of Crunch (CONTACT AREA)	$W := .6 \cdot in$
Friction Factor Dry/Dry Steel	$\mu := 0.3$
Minimum Wall Thickness	$t := .785 \cdot in$
Bolt CL To Inside Radius	$A := .785 \cdot in$
Number of Studs	$n := 5$
Tensile Area of Stud	$A_t := .3196 \cdot in^2$
Allowable Stress of Strongback	$S_a := 11400 \cdot psi$
Allowable Stress of Stud	$S_b := 11400 \cdot psi$
Torque Application Factor	$T_q := .65$
Hydraulic Thrust	$T_h := 8506 \cdot lbf$
Width of Clamp	$W1 := 8.8125 \cdot in$



Analysis:

-Bolt Load

$BL := S_b \cdot A_t \cdot n \cdot T_q$ $BL = 11841.18 \cdot lbf$

- Summation of forces in Y-direction

Fy - BL = 0

BL = Fy = Pcr * R * W

- External pressure caused by crunch ring on pipe

$P_{cr} := \frac{BL}{R \cdot W}$ $P_{cr} = 16243.045 \cdot psi$

- Nominal force on circumferance of pipe

$N := P_{cr} \cdot 2 \cdot \pi \cdot R \cdot W$ $N = 74400.328 \cdot lbf$

- Friction force of crunch ring strongback

$F_f := \mu \cdot N$ $F_f = 22320.098 \cdot lbf$

- Summation of forces in X-direction

R2 - Fx = 0

R2 = Fx = Fy

$R_2 := BL$ $R_2 = 11841.18 \cdot lbf$

- Summation of moment about R2

M - Fx (t/2 + R - R*sin45) - Fy (R*sin45) + BL (R + A) = 0

$M := BL\left(\frac{t}{2} - A\right)$ $M = -4647.663 \cdot in \cdot lbf$

-Tensile Stress of Crunch Ring Strongback

$Area := t \cdot Wl$ $Area = 6.918 \cdot in^2$

$\sigma_1 := \frac{R_2}{Area}$ $\sigma_1 = 1711.694 \cdot psi$

- Bending Stress of Crunch Ring Strongback

$c := \frac{t}{2}$ $c = 0.392 \cdot in$

$I := \frac{1}{12} \cdot Wl \cdot t^3$ $I = 0.355 \cdot in^4$

$\sigma_2 := \frac{M \cdot c}{I}$ $\sigma_2 = -5135.083 \cdot psi$

- Combined Stresses of Crunch Ring Strongback

$\sigma_{c1} := \sigma_1 + \sigma_2$ $\sigma_{c1} = -3423.389 \cdot psi$

or

$\sigma_{c2} := \sigma_1 - \sigma_2$ $\sigma_{c2} = 6846.777 \cdot psi$

Summary

	Greater Than	Allowable
Friction Force of Crunch Ring Strongback $F_f = 22320.098 \cdot lbf$		$T_h = 8506 \cdot lbf$
	Less Than	
Tensile Stress of Crunch Ring Strongback $\sigma_1 = 1711.694 \cdot psi$		$S_a = 11400 \cdot psi$
Bending Stress of Crunch Ring Strongback $\sigma_2 = -5135.083 \cdot psi$		$S_a = 11400 \cdot psi$
Combined Stresses of Crunch Ring Strongback $\sigma_{c1} = -3423.389 \cdot psi$ $\sigma_{c2} = 6846.777 \cdot psi$		$S_a \cdot 1.5 = 17100 \cdot psi$

MATERIAL SPECIFICATIONS

TERM INC
ALVIN TEXAS

☐ NON-CRITICAL/NUCLEAR
☒ CRITICAL/NUCLEAR

SHT. 3 OF 3

DRAWN BY: CRL 7/30/98 CSC NO. 737 JOB NO. 079832N

CHECKED BY: JBM 7/31/98 ITEM NO. 74298

CUSTOMER: CON-ED IP2 EST. NO.

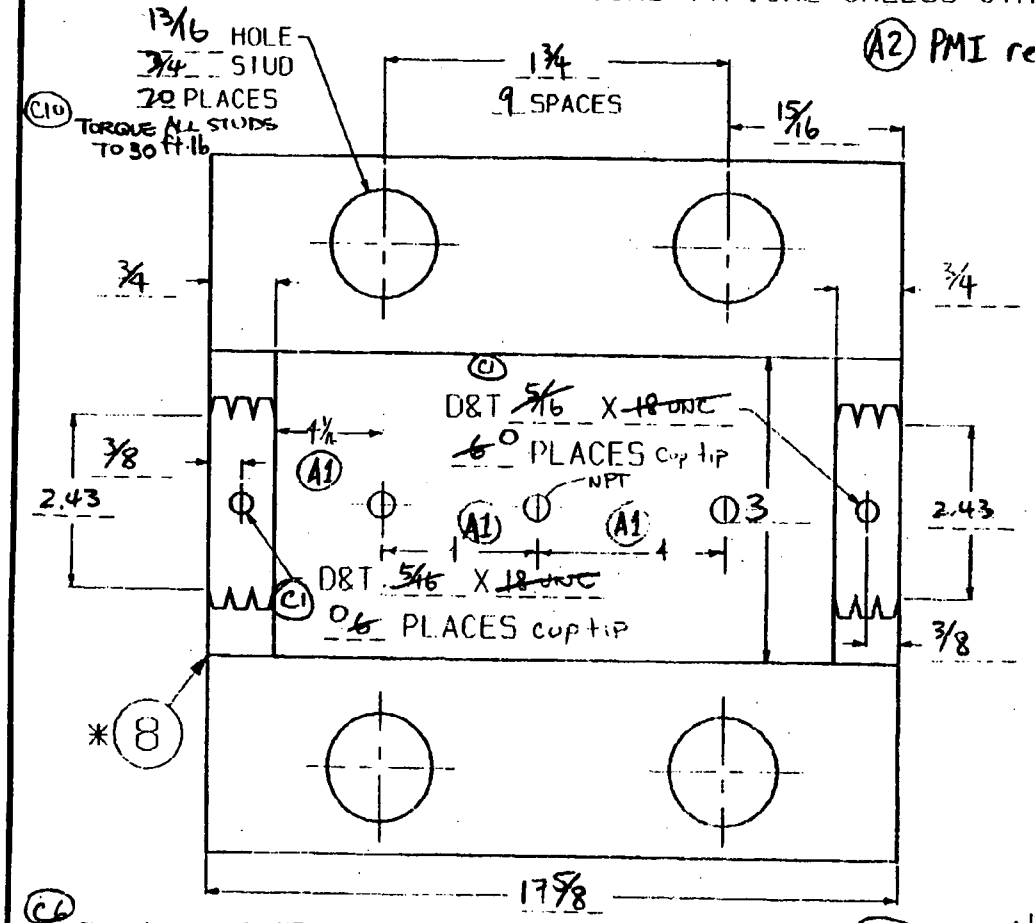
COMPONENT	MATERIAL SPECIFICATION	ALLOW STRESS	MTR	COC	NR
CLAMP					
RING					
EARS					
ENCLOSURES					
PIPE					
SOLID BLOCK	SA240 GR 304	11400	X		
END PLATES	SA240 GR304	"	X		
SIDE BARS					
STRONGBACK BAR					
S.B. EARS/FINGERS					
FASTENERS					
STUDS CLAMP/ENCL.	SA193 GR B8/1	11400		X	
STUDS STRONGBACK					
NUTS CLAMP/ENCL.	SA194 GR B8	—		X	
NUTS STRONGBACK					
SET SCREWS (SS)	ANSI B18.3	—		X	
MISCELLANEOUS					

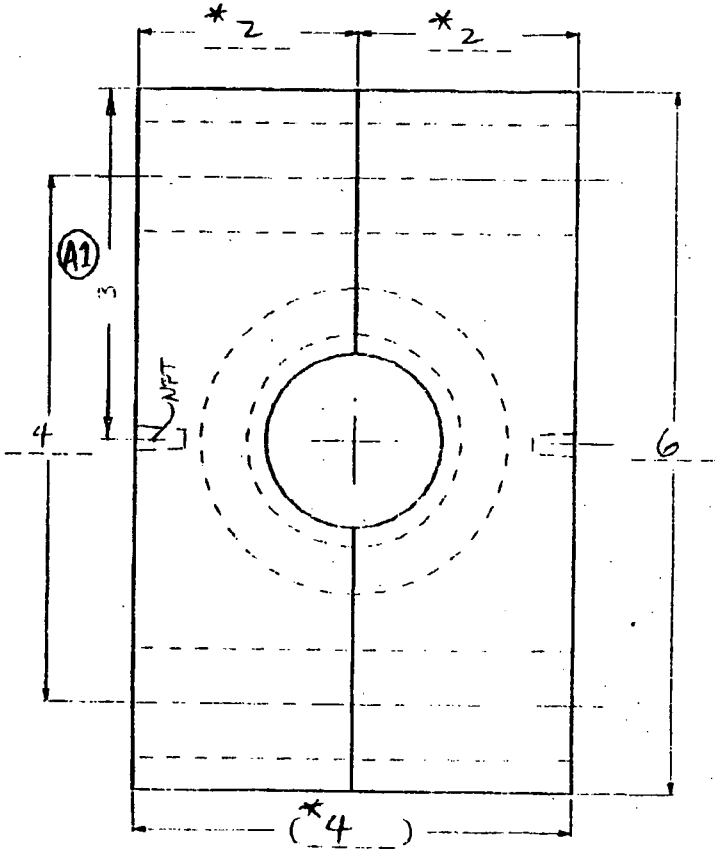
ALL DIMENSIONS TYPICAL UNLESS OTHERWISE NOTED

ECO# 7228
C 8/2/98

ECO# 7224
A 7/31/98

(A2) PMI required for all materials





(C6) DO NOT INJECT
~~LIMIT MAX INJ. PRESSURE TO 1100 PSI + STATIC~~

(C5) MILL 1/16" FROM SPLIT LINE (EACH HALF)

* DIMS BEFORE MILL

"CONFIDENTIAL"
PROPRIETARY INFORMATION

NUCLEAR
DO NOT PAINT

* ~~WELDED~~ ENDPLATES OPTIONAL

0.110 CRUNCH

D&T 6 - 1/8 NPT (CAVITY)

TERM INC ALVIN, TEXAS	JOB NO. P37-079832N	MATERIAL SEE MS SHEET	WEIGHT 112.41b	VOID 68.5 in³ BC	
	CLAMP NO. 74298	UNLESS NOTED OTHERWISE: MACHINED SURFACES 250 √; Break Sharp Corners .005; TOLERANCES: 3 Place Decimal ± .005, 2 Place Decimal ± .01, 1 Place Decimal ± .1, ANGLES ± 1/2°, FRACTIONS ± 1/32; ALL DIMENSIONS IN INCHES	CON-ED IP2		
	EST. NO.				
	WELDING SPEC. NO. SEE WELD MAP				
DRAWN BY: CKL	7/30/98		DWG. NO. sb_cr_2w_ss2		REV
CHECKED: JBM	7/31/98		SCALE: NTS	Sheet 1 of 3	
APPROVED:					

TERM INC
ALVIN, TEXAS

CLAMPS & ENCLOSURES

CALCULATIONS

Sht 7 of 9

DESIGNED BY: CKL DATE: 7/30/98 CSC NO. 937 JOB NO. 579832N
CHECKED BY: JRM DATE: 7/31/98 ITEM NO. 74298
DGN. TEMP. _____ DGN. PSIG _____ EST. NO. _____
SKIN TEMP. _____ OPER. PSIG _____ CALC NO. _____

THRUST FOR UNEQUAL BORES

T=HYDRAULIC THRUST
D=LARGE CLOSING DIAMETER
d=SMALL CLOSING DIAMETER
P=PUMPING PRESSURE
1000 psi (MIN), 2*DGN PRESS,
OPER PRESS + 1000 psi (MAX),
OR DGN PRESS (PERI. SEAL OR SEP.)
N=# OF STRONGBACKS
F=FORCE PER STRONGBACK

$$T = (D^2 - d^2) * (\pi/4) * P$$

$(2.435^2 - 1.9^2)\,\pi/4\,(1100)$ + $1.9^2\,\pi/4\,(600)$

INJECTION THRUST — LINE SEPARATION

T= 3704.8

F=T/N
6

F= 617.5

TYPES OF STRONGBACK

A. BOLTS

BS=BOLT STRENGTH
A=TENSILE AREA OF STUD
S=ALLOWABLE STRESS

BS=A*S

BS= _____ ≥ F

B. SMOOTH TONGUE

WL=WORKING LOAD OF TONGUE
DIA=DIAMETER OF FLANGE
t=TONGUE THICKNESS
S=ALLOWABLE STRESS

WL=π*DIA*t*S

WL= _____ ≥ T

C. SET SCREWS

Hp=HOLDING POWER OF SET SCREWS

5/16 X 18 UNC

☒ CUP TIP
☐ CONE TIP

Hp= 625 ≥ F

D. WELD

WS=WELD STRENGTH
S=ALLOWABLE STRESS
L=LENGTH OF WELD

WS=tl*√2/2*L*S*.45

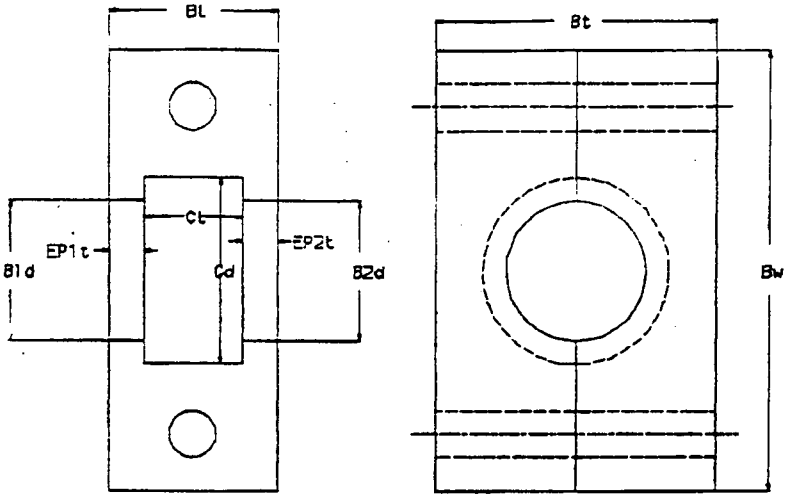
tl=THROAT LENGTH

WS= _____ ≥ T

Weight Calculations for a Bar Clamp:

Designed by: CYL Date: 7/30/98
Checked by: [redacted] Date: 7/31/98
Customer: CON-ED IP2
Location:

Job No. P37-[redacted]32N
Clamp No. 74298
Estimate No.
Calculation No.



Data:

Block Length	Bl := 17.625·in	Bore 1 Diameter	Bld := 2.43·in
Block Width	Bw := 6·in	Endplate 1 Thickness	EP1t := .75·in
Block Thickness	Bt := 4·in		
		Bore 2 Diameter	B2d := 2.43·in
Cavity Diameter	Cd := 3·in	Endplate 2 Thickness	EP2t := .75·in
Cavity Length	Cl := 16.125·in		
		Sealant Void (Before Compression)	Void := 68.49·in^3
Stud Size	SS := .75·in	Sealant Density	$\rho s := 0.07 \cdot \frac{lb}{in^3}$
Number of Studs	N := 20		
Stud Length	SL := 8·in	Compression Ratio	CR := 1.50
Stud Bore Oversize	SBO := 0.0625·in		
Stud Weight (per unit lenght)	$SW := 0.13 \cdot \frac{lb}{in}$	Enclosure Density	$\rho := 0.2833 \cdot \frac{lb}{in^3}$
Nut Weight (per nut)	NW := 0.19·lb	Number of Injection Valves	NIV := 6

$Block := \rho \cdot (Bl \cdot Bw \cdot Bt)$	Block = 119.84 lb
$Cavity := \rho \cdot Cd^2 \cdot \frac{\pi}{4} \cdot Cl$	Cavity = 32.29 lb
$EndPlate1 := \rho \cdot (Bld^2) \cdot \frac{\pi}{4} \cdot EP1t$	EndPlate1 = 0.99 lb
$EndPlate2 := \rho \cdot (B2d^2) \cdot \frac{\pi}{4} \cdot EP2t$	EndPlate2 = 0.99 lb
$StudHoles := \rho \cdot (SS + SBO)^2 \cdot N \cdot \frac{\pi}{4} \cdot Bt$	StudHoles = 11.75 lb
Studs := N·SL·SW	Studs = 20.8 lb
Nuts := (2·N)·NW	Nuts = 7.6 lb
Sealant := Void·ρs·CR	Sealant = 7.19 lb
InjValves := NIV·0.50·lb	InjValves = 3 lb

Weight := Block − Cavity − EndPlate1 − EndPlate2 − StudHoles + Studs + Nuts + Sealant + InjValves

Weight = 112.41 lb

Sheet 9 of 9

Void Calculations:

$$V := (Cd)^2 \cdot \left(\frac{\pi}{4}\right) \cdot Cl - \left[(1.9 \cdot in)^2 \cdot \left(\frac{\pi}{4}\right) \cdot (16.425 \cdot in)\right] - \left[(0 \cdot in)^2 \cdot \left(\frac{\pi}{4}\right) \cdot (0 \cdot in)\right] - \left[(0 \cdot in)^2 \cdot \left(\frac{\pi}{4}\right) \cdot (0 \cdot in)\right]$$

$$V := V + (NIV \cdot 0.18 \cdot in^3)$$

$$V = 68.49 \cdot in^3$$

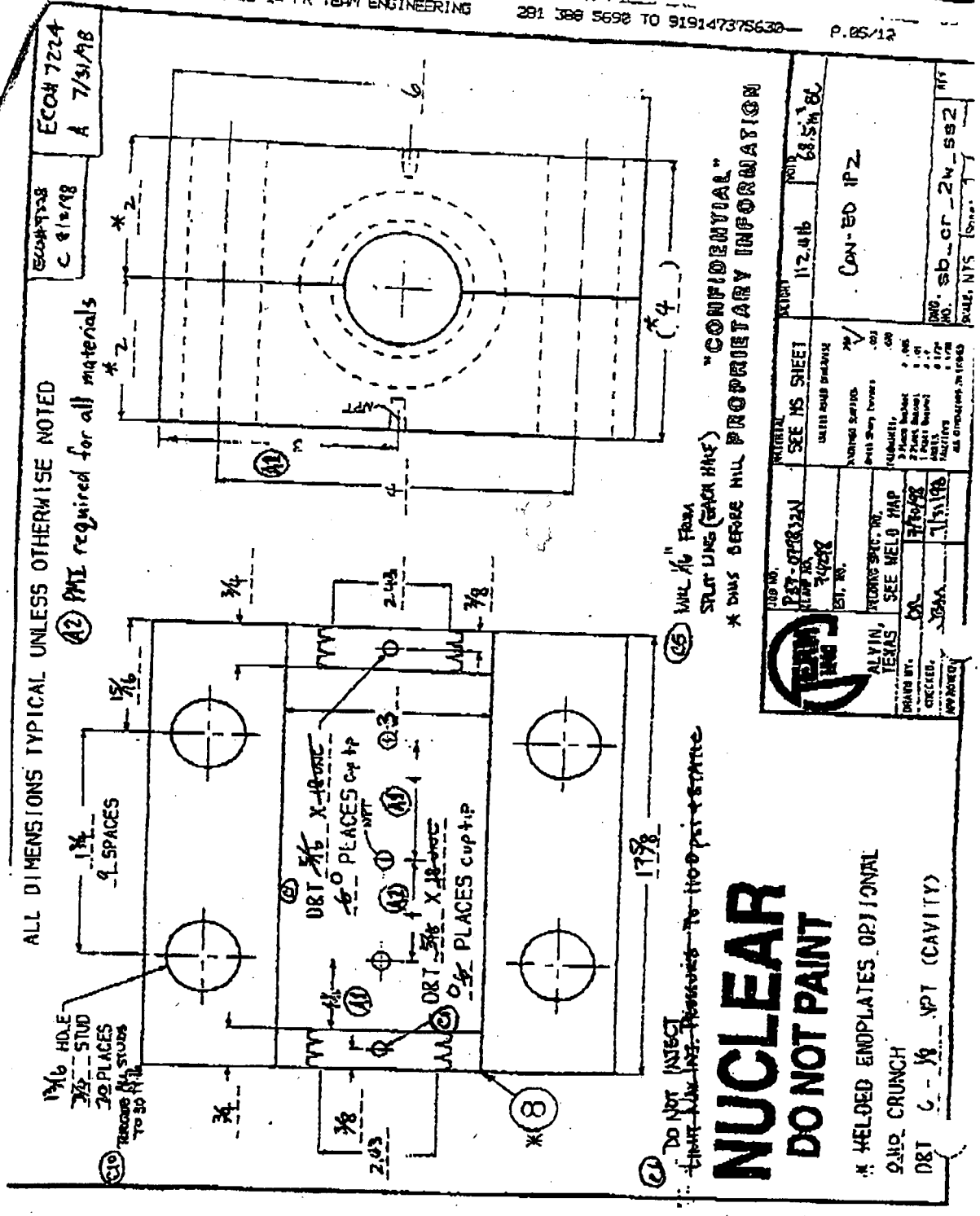


Figure3
Proposed Clamp Design

6