CUSTOMER DATA

CUSTOMER: Grace Membrane

P.O. NUMBER: GMS-202-000-23-GR 1605

TAG ITEM NO.: One

SERVICE: Gas/Gas Heat Exchanger

(1) Mod. 8D22-15-00-UU-6C6C

MISC.

> FABRICATED RETURN BEND HOUSING.

> SCH. 80 SHELL PIPES.

SPECIAL DATA

SURFACE PREP.: Sand Blast

PAINT SPEC.: One Coat Red Oxide Shop Primer

HEAT TREAT: Not Req'd.

CUSTOMER INSP.: Not Req'd.

NATL.BRD.NO.: Not Req'd.

CODE STAMP: (U) A.S.M.E. Section VIII, Div. 1, 1992 Ed. A-92

RT: 10% Per Customer

TUBE BUNDLE DATA

SIZE: 1" O.D. x.083" Min. Wall

COUNT: (22) One Pc. U-Tubes

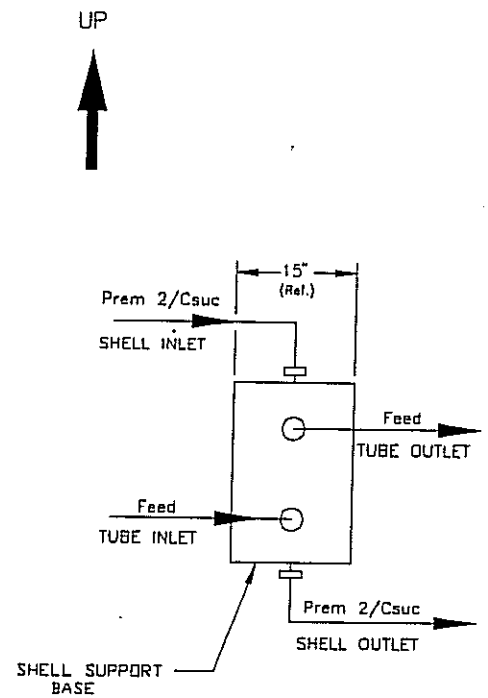
MATERIAL: SA-214

FINS/TUBE: None

MATERIAL: N/A

CUT & TWIST: N/A

WELD PROCEDURE: None



RECOMMENDED ARRANGEMENT

(END VIEW SCHEMATIC)

SHELL ASSY. DATA

SIZE: 8" Sch.80 Pipe

MATERIAL: SA-106-B

CONNECTIONS: 6" 600#R.F.W.N. Flgs.

WELD PROCEDURE: HE-3, HE-38

SECTION DATA

WEIGHT PER SECTION:

DRY: 4150 Lbs. WET: 4750 Lbs.

TOTAL UNIT WEIGHTS:

DRY: -0- WET: -0-

SURFACE AREA:

PER SECTION: 161 Sq. Ft.

TOTAL: -0-

DESIGN CONDITIONS

	SHELL	TUBE
DESIGN PSIG	1000	1000
TEST PSIG	1500	1500
METAL TEMP.	200 Deg.F.	200 Deg.F.
CORROSION	.125"	.125" Exc. Tubes
MDMT/PSIG	0 Deg. F./1000	-20 Deg. F./1000

— SECTION ARRANGEMENT —

ITEM NO.	NO. OF SECTIONS	SHELL		TUBE	
		PARALLEL	SERIES	PARALLEL	SERIES
One	1	1	1	1	1

REVISIONS:

Job No. 94-4714

Ref.

Date By ET

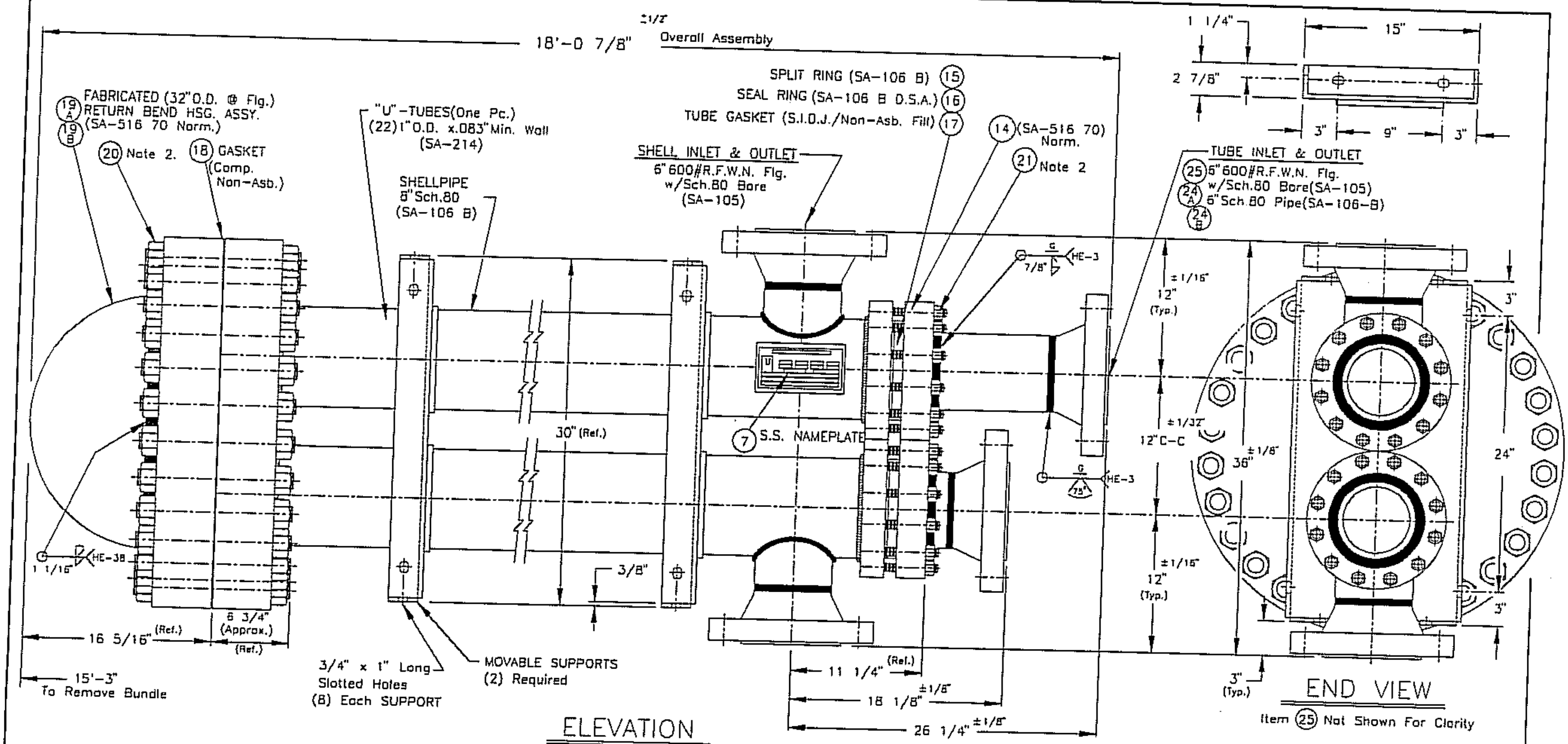
Approved For Const. By

Drawing No. 94-4714

Rev.

Sht. 1 of 6

GENERAL DATA



Notes:
1. Nozzle Flange Bolt Holes Straddle Normal Center Lines.
2. Bolting is SA-193 B7 & SA-194 2H
3. See Dwg. Sht.1 For Additional Information.

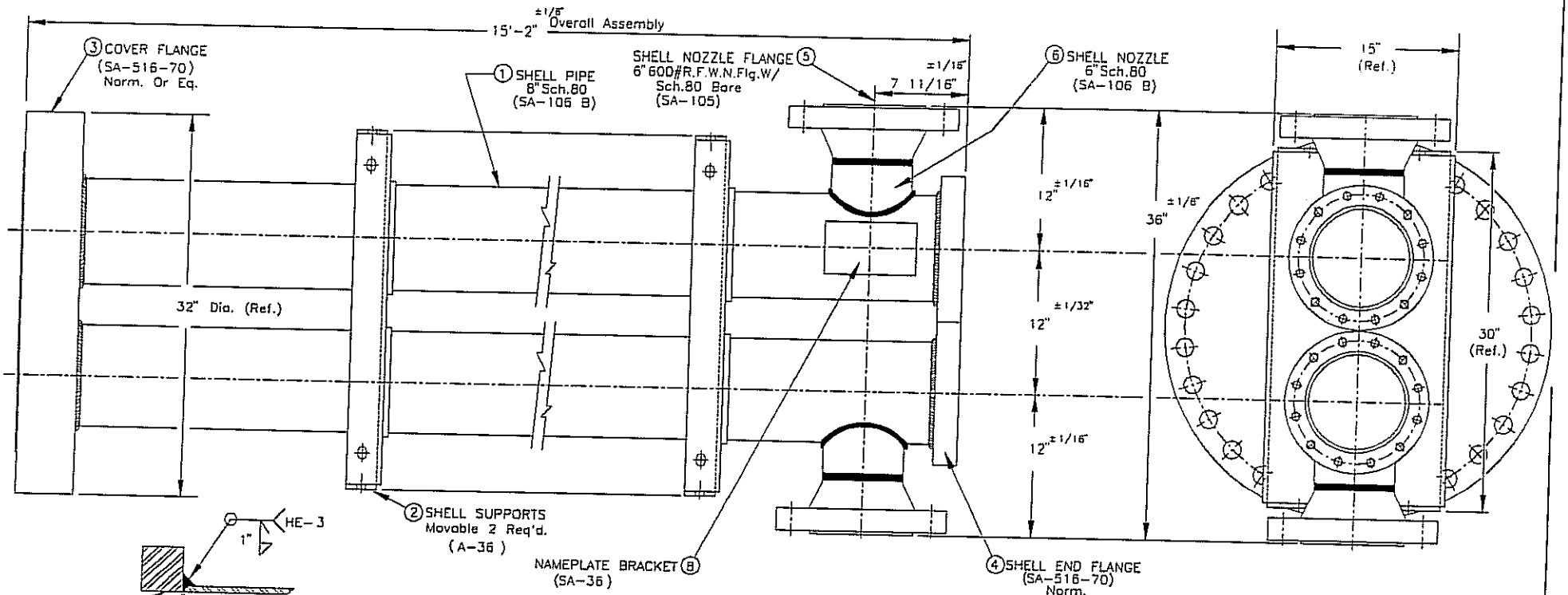
THIS DRAWING/DESIGN IS THE PROPERTY OF

R.W.HOLLAND,INC.
PETROFIN® Hairpin Heat Exchangers
TULSA, OKLAHOMA

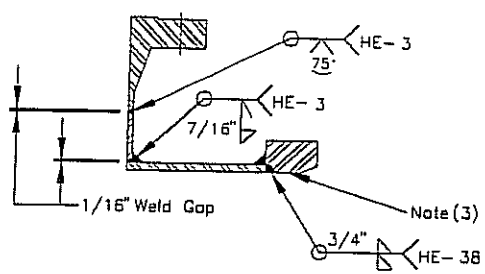
FOR SPECIFIED USE ONLY-NOT TO BE LOANED/COPIED

Job No. 94-4714	
Ref.	
Date	By ET
Approved For Const. By	
Drawing No. 94-4714 Sht. 2 of 6	Rev.

GENERAL OUTLINE & ASSEMBLY
Model: 8D22-15-00-UU-6C6C
P.O.#GMS-202-000-23-GR 1605 Item# One



Weld Detail For Cover Flange
Ref. A.S.M.E. Code Section VIII
Div. 1, Fig. UW-13.2(m)



Weld Details For Shell End Flanges
And Nozzles Ref. A.S.M.E. Code
Section VIII Div. 1, Fig. UW-13.2(n)
And Fig. UW-16.1(a)

Notes:

1) Special Requirements:
   A) "PT" Nozzle To Shell Welds Per R.W.H.
2) Use Weld Procedure (s) HE-3 & HE-38
3) "PT" Per UG-93(d)(4)(d) After Welding
4) All Gasket Surfaces To Be Protected From Weld Splatter Prior To Fit-Up
5) Nozzle Flange Bolt Holes To Straddle Normal Center Lines

Shell Assembly
Model: 8D22-15-00-UU-6C6C
P.O.#GMS-202-000-23-GR 1605 Item# One

Job No. 94-4714	
Ref.	
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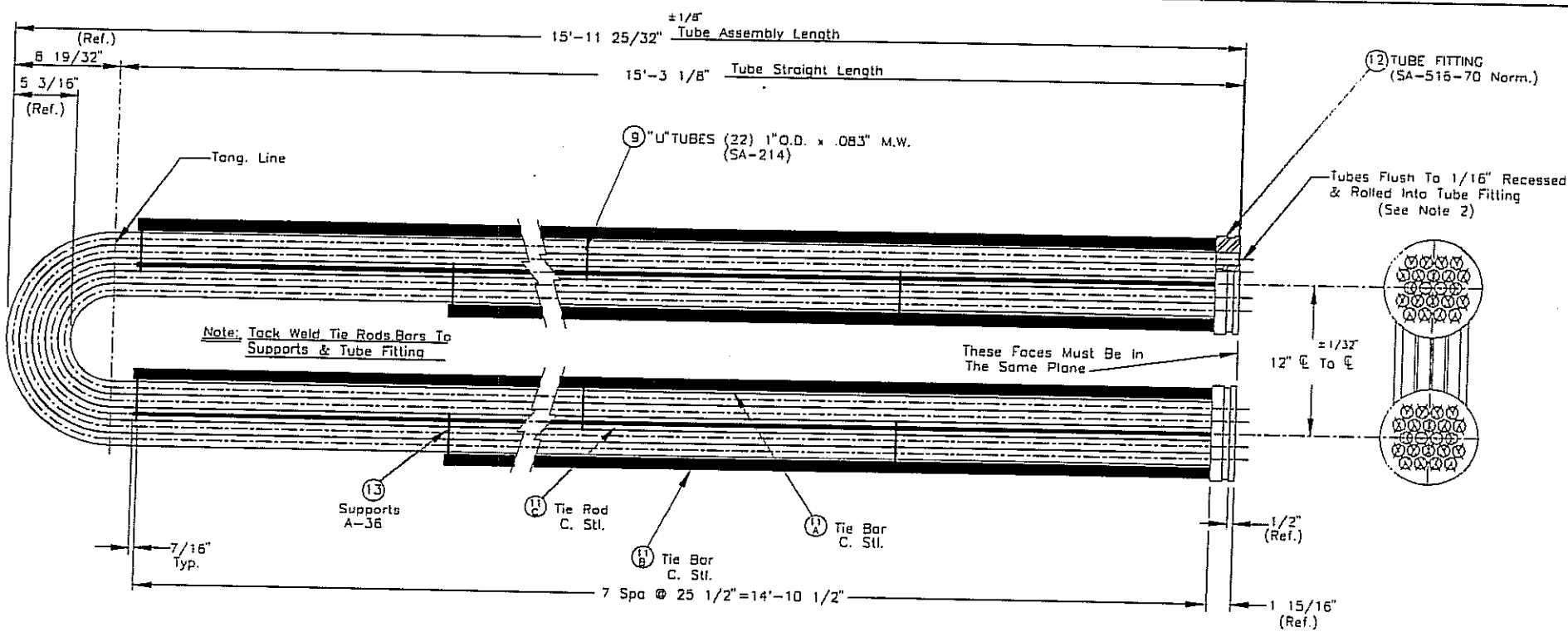
Sht. 3 of 6	



Notes:
1. Protect Gasket Surfaces From Scarring Prior To Installation.
2. Tube Holes Are Grooved Per T.E.M.A. R-7.44

Job No. 94-4714	
Ref.	
Date By ET	
Approved For Const. By	
Tube Bundle Assembly Model: 8D22-15-00-UU-6C6C P.O.# GMS-202-000-23-GR 1605 Item# One (Soft Iron Gask.)	Drawing No. 94-4714 Sht. 4 of 6
	Rev.

R.W. HOLLAND, INC.

A.S.M.E. CODE CALCULATION SHEET
(See Section VIII, Div. 1, latest edition &/or addenda for Nomenclature)
(ENGLISH UNITS)

Serial No. : 94-4714
Date:
By : ET

Customer: Grace
Item No.: One
P.O. No.: GMS-202-000-23
Exchanger Model 8D22-15-00-UU-6C6C

	SHELL	TUBE
Pressure, P, (psig)	1000	1000
Temperacure, (Deg. F)	200	200
Corrosion Allowance, (in.)	0.125	0.125 (exc. tubes)

Radiographic Requirement: Spot Per A.S.M.E. & Cust.
Comments: The following C. Stl. mat'l is exempt from impact testing/UG-20(f).

SHELL

Material : SA-106-B
Stress, S : 15000 psi
Shell Size : 8 " nom.
Schedule : 80
Shell O.D. : 8.625 "

Nom. Wall Thk. : .500 "
Min. Wall, t min : .438 "
Joint Eff., E (1) : 1.0
Inside Radius, R (corroded) : 3.938 "

(2) tr = PR/SE-.6P = .273 "
tr + C.A. = .398 "

Comments:

SHELLSIDE NOZZLE

Material : SA-106-B
Stress, S : 15000 psi
Nozzle Size : 6 " nom.
Schedule : 160
Nozzle O.D. : 6.625 "

Nom. Wall Thk. : .718 "
Min. Wall, t min : .628 "
Joint Eff., E (1) : 1.0
Inside Radius, R (corroded) : 2.72 "

(2) trn = PR/SE-.6P = .189 "
trn + C.A. = .314 "

Comments:

REINFORCEMENT CALCULATION (3)
Applicable Stress (psi) : 15000
[Areas are in square inches]

A1 = Larger of
(t-tr)d = .552
or (t-tr)(tn+t)2 = .197

A2 = Smaller of
(tn-trn)5t = .758
or (tn-trn)5tn = 1.198

A3 = Area of Inward Noz. Ext.
h = -
(tn-C.A.)2h = -

A4 = Area of Weld = .5

Total Area Avail.
A1+A2+A3+A4 = 1.81

A = Area Required
d x tr = 1.487

EXCESS AREA = .323
[If >= 0 reinf. is adequate]

Comments:

Area Required per Appendix 1-7 (4)
[When applicable]

A1 = Shell Area Avail. is Larger of
.5(t-tr)d = .276
or (t-tr)(tn+t)2 = .197

A2 = Nozzle Area Avail. = .758
(A2 above)

Total Area Avail.
A1+A2 = 1.034

A = Area Reguired
.666(d x tr) = .99

EXCESS AREA = .043
[If >= 0 reinf. is adequate]

Comments:

HEMISPHERICAL HEAD
[O.D. FORMULA]

Material : SA-516-70
Stress, S : 17500 psi
Head O.D. : 22 "

Nom. Wall Thk. : 0.75 "
Joint Eff., E (1) : .85
Mill Tolerance : 0.1875 "

tr = PRo/(2SE+.8P) = .36 "
[per APPENDIX 1]

tr + C.A. = .485 "

Comments:

TUBESIDE NOZZLE

Material : SA-106-B
Stress, S : 15000 psi
Nozzle Size : 6 " nom.
Schedule : 80
Nozzle O.D. : 6.625 "

Nom. Wall Thk. : .432 "
Min. Wall, t Min. : .378 "
Joint Eff., E (1) : 1.0
Inside Radius, R (corroded) : 3.006 "

(2) trn = PR/SE-.6P = .209 "
trn + C.A. = .334 "

Comments:

TUBE FITTING

T/S Material: SA-516-70 or Eq.
Stress, S : 17500 psi
Pressure, P : 1000

U-Tubes? (Y/N) : Y
G (mean dia.) : 7 "
C.A.(shellside + tubeside) = .25 "

n = 0.3743
F = 1.25

(5) T = FG/3 x SQRT(P/nS) = 1.14 "
T + C.A. = 1.39 "
USE T = 1.9375 " Nom. Thk.

TUBE

Material: SA-214
Outside Dia., Do : 1. "
Wall Thk, t : .083 "
Min. or Avg. Wall (M/A) : M
Mean Radius Smallest Bend, Rb : 3.375 "

Stress, S (psi) : 10000
Joint Eff., E (1) : 1.0
Inside Radius, R : .417 "
Mill Tolerance, mt : 0.0
Thin. Factor , f(6) : 1.074

FOR INTERNAL PRESSURE (2)

tr = PR/SE-.6P = .044 "
tr x f = .048 "
Use t = t(1-mt) = .083 " Min. Wall

FOR EXTERNAL PRESSURE (7)

Tube Length, L : 180 "
L/Do = 180
Do/t = 13.012 (*)

Factor A : .00738 [Fig. G Geometric Chart]
Factor B : 13400. [Fig. CS-1 Chart]

if Do/t is >= 10
Pa = 4B/3(Do/t) = 1373.

if Do/t is < 10
Pa is the smaller of:
Pa1 = (2.167/(Do/t)-.0833)B = 1115.4
or
Pa2 = 2S/(Do/t)(1-1/(Do/t)) = 2837.8

Where S 20000 , as defined in UG-28(c)(2)(a)(b).

Comments:

(*) t is reduced by the U-bend thinning factor (6), if applicable.

REFERENCES:
(1) UW-12(d) (2) UG-27(C)(1) (3) Fig. UG-37.1
(4) Appendix 1-7 Calc. is not required when nom. nozz. I.D. (not to exceed 20") is < or = to the shell O.D./2, refer to UG-36(b)(1).
(5) TEMA RCB-7.132 (6) TEMA RCB-2.31 [1 + Do/4Rb]
(7) UG-28 (8) UG-16(b) (9) UG-16(b)(5)
(10) UG-45(b)(1) (11) UG-45(b)(4)

DRAWING No.
94-4714
Sht.5 of 6

R. W. HOLLAND, INC.

EXCHANGER SPECIFICATION SHEET (ENGLISH UNITS)

CUSTOMER: GRACE MEMBRANE — IND. NO:
LOCATION: — DATE: JUN. 9, 1994 — QUOTE NO: 94-356
SERVICE: GAS / GAS HEAT EXCHANGER — ITEM: 1
SIZE: — MODEL: BD22-15-00-UU-6C6C — PAR SHL/TUBE 1/ 1
TOT. SURF.: 181 SQ.FT. — SEC./UNIT: 1 — SURF./SEC.: 181 SQ.FT.

PERFORMANCE OF ONE UNIT

		SHELLSIDE PERM2/CSUC	TUBESIDE FEED
FLUID CIRCULATED			
TOTAL FLOW	LB/HR	32415.	64097.
VAPOR IN	LB/HR	32415.	64097.
LIQUID IN	LB/HR	0.	0.
FLUID VAP OR COND	LB/HR	0.	0.
TEMP. IN	DEG F	130.0	70.0
TEMP. OUT	DEG F	90.0	84.5
CP-LIQUID	BTU/LB/F	.000	.000
CP-VAPOR	BTU/LB/F	.245	.341
S.G. IN OR AVG		.000	.000
S.G. OUT		.000	.000
VISC. IN OR AVG	CP	.000	.000
VISC. OUT	CP	.000	.000
K-LIQUID	BTU/HR/FT/DEG F	.000	.000
VISC. GAS	CP	.015	.014
K-GAS	BTU/HR/FT/DEG F	.011	.014
MW-IN OR AVG.		39.34	34.46
MW-OUT		39.34	34.46
OPER. PRESS.	PSIG	145.00	525.00
VELOCITY	FT/SEC	43.100	57.200
PRESS. DROP ALLOW/CALC	PSI	3.00/ 2.80	5.00/ 8.07
FOULING	HR-FT-DEG F/BTU	.0010	.0010

DUTY - BTU/HR 317000. MTD - DEG F 31.0
SERVICE TRANSFER RATE-BTU/HR/FT2/DEG F 56.5

CONSTRUCTION

CORROSION ALLOWANCE IN.	.1250	.1250 EX.TUBES
DESIGN/TEST PRESSURE PSIG	1000./CODE	1000./CODE
DESIGN TEMPERATURE DEG F	200.	200.

TUBES - MAT'L: SA-214 1.000" O.D. THK: .083"MW NO. 22 LG. 15'-0"
SHELL - MAT'L: SA-106-B 8.00" IPS THK: XH
RETURN BEND HOUSING MAT'L: SA-516-70 TYPE: F.F.
SHELL FLANGES - MAT'L: SA-516-70
TUBESHEET - MAT'L: SA-516-70 CHANNEL MAT'L: C. STL.
GASKETS - SHELL: COMP. NON-ASB TUBE: S.W. SS/NON-ASB
CONNECTIONS -SIZE & RATING - SHELL: 6"-600# RF TUBE: 6"-600# RF
CODE REQUIREMENTS: ASME SECTION VIII DIV. 1, W/ STAMP.
REMARKS: SANDBLAST AND PRIME
X-RAY 10 % OF THE BUTT WELDS

U
W

CERTIFIED BY R.W. HOLLAND, INC. TULSA, OK

	MAWP PSI	TEMP. °F	MDMT °F	AT PSI
SHELL	1000	200	0	1000
TUBE	1000	200	-20	1000

SERIAL NO. 94-4714 YEAR BUILT 1994

CUST.: GRACE MEMBRANE

P.O.:GMS-202-000-23-GR 1605

ITEM: ONE

EXCHANGER SPECIFICATION SHEET AND NAMEPLATE FACSIMILE

Job No. 94-4714
Rel.
Date By ET
Approved For Const. By
Drawing No. 94-4714
Rev.
Sht. 6 of 6