FORM U-1 MANUFACTURERS' DATA REPORT FOR PRESSURE VESSELS
As required by the Provisions of the ASME Code Rules, Section VIII, Division 1

E-206-3A

1. Manufactured by MISSOURI BOILER AND TANK COMPANY ST. LOUIS, MISSOURI
(Name and Address of Manufacturer)

2. Manufactured for HERCULES INCORPORATED WILMINGTON, N.C.
(Name and Address of Purchaser)

3. Type HORIZ (Horiz. or Vert.) Kind HT. EXCH. (Tank, Jacketed, Heat Exch.) Vessel No. (Mfr's. Serial) L-1070 (--) (State or State No.) Natl. Bd. No. 3523 Yr. Built 1973

Items 4-9 incl. to be completed for single wall vessels (such as air tanks), jackets of jacketed vessels, or shells of heat exchangers.

4. SHELL: Material (Kind and Spec. No.) SA-240-304 T.S. (Ftg. or P. V. Spec. Min. T.S.) 75,000 Nominal Thickness 1/4 In. Corrosion Allowance 0 In. Diam. 2 Ft. 7 In. Length 19 Ft. 11 3/4

5. SEAMS: Long (Welded, Dbl., Single, Lap, Butt) DBL. BUTT H.T. (Yes or No) NO R.T. (Spot or Complete) NONE Sectioned (Yes or No) NO Efficiency 70 %

Girth DBL. BUTT H.T. NO R.T. NONE Sectioned NO No. of Courses 3

If riveted describe seams fully on reverse side of form.

6. HEADS (a) Material T.S. (b) Material T.S.

Location (Top, bottom, ends)	Thickness	Crown Radius	Knuckle Radius	Elliptical Ratio	Conical Apex Angle	Hemispherical Radius	Flat Diameter	Side to Pressure (Convex or Concave)
(a)								
(b)								

If removable, bolts used (Material, Spec. No., T.S., Size, Number) Other fastening (Describe or Attach Sketch)

7. STAYBOLTS: (Material) If hollow (Size of Hole) Attachment (Threaded, Welded) Pitch (Diam.) X (Vert.) Diam. (Nominal)

8. JACKET CLOSURE: (Describe as ogee & weld, bar, etc. If bar, give dimensions. If bolted, describe or sketch)

9. Constructed for max. allowable working press. 75 psi at max. temp. 300 °F. Min. temp. (when less than -20°) -- °F. Hydrostatic / Pneumatic or Combination Test Press 127 psi.

Items 10 and 11 to be completed for tube sections.

10. TUBE SHEETS: Stationary, Material (Kind & Spec. No.) SA-240-304 Diam. (Subject to Pressure) 31 In. Thickness 1 7/8 In. Attachment (Welded, Bolted) WELDED

Floating. Material (Kind & Spec. No.) Diam. In. Thickness In. Attachment

11. TUBES: Material (Kind & Spec. No.) SA-249-304 O.D. 3/4 In. Thickness #16 BWG Inches or Gage Number 822 Type (Straight or U) STR.

Items 12-15 incl. to be completed for inner chambers of jacketed vessels, or channels of heat exchangers.

12. SHELL Material (Kind and Spec. No.) SA-285-C T.S. (Ftg. or P. V. Spec. Min. T.S.) 55,000 Nominal Thickness 3/8 In. Corrosion Allowance 1/16 In. Diam. 2 Ft. 6 3/4 In. Length 2 Ft. 2 3/4 In.

13. SEAMS: Long (Welded, Dbl., Single, Lap, Butt) DBL. BUTT H.T. (Yes or No) NO R.T. (Spot or Complete) NONE Sectioned (Yes or No) NO Efficiency 70 %

Girth SMLSS H.T. -- R.T. -- Sectioned --- No. of courses 2

If riveted describe seams fully on reverse side of form.

14. HEADS (a) Material T.S. (b) Material SA-515-70, 70,000 (c) Material T.S.

Location	Thickness	Crown Radius	Knuckle Radius	Elliptical Ratio	Conical Apex Angle	Hemispherical Radius	Flat Diameter	Side to Pressure (Convex or Concave)
(a) Top, bottom, ends								
(b) Channel	1 13/16"	--	--	--	--	--	35 5/8"	FLAT
(c) Floating								

If removable, bolts used (a) (Material, Spec. No., T.S., Size, Number) (b) SA-193 GR. B7, 100,000, 3/8, 24

(c) Other fastening (Describe or Attach Sketch)

15. Constructed for max. allowable working stress 100 psi at max. temp. 300 °F. Min. temp. (when less than -20°) -- °F. Hydrostatic / Pneumatic or Combination Test Press 150 psi.

Items below to be completed for all vessels where applicable.

16. SAFETY VALVE OUTLETS: Number Size Location

17. NOZZLES

Purpose (Inlet, Outlet, Drain)	Number	Diam. or Size	Type	Material	Thickness	Reinforcement Material	How Attached
IN & OUT	2	12"	SER 15 S.O.	SA-106-B	STD. WT.	--	WELDED
IN	1	18" O.D.	SER 15 L.J.	SA-240-304	1/4"	--	do
VENT	2	6"	do	SA-312-304	SCH 40S	--	do
DRAIN	2	4"	do	do	do	--	do
VENT & DRAIN	2	3/4"	CPLG	F.S.	3,000#	--	do

[1] If postweld heat-treated. [2] List under remarks other internal or external pressures with coincident temperature when applicable.

(Over)

#10402

FORM U-1 (back)

18. INSPECTION OPENINGS: Manholes, No. _____ Size _____ Location _____
Handholes, No. _____ Size _____ Location _____
Threaded, No. _____ Size _____ Location _____

19. SUPPORTS: Skirt NO (Yes or No) Lugs _____ (Number) Legs _____ (Number) Other 2-SADDLES (Describe) Attached WELDED TO SHELL (Welded or Bolted)

20. REMARKS: RECLAIM M.E.O.H. STILL CONDENSER
EQUIP. # E-206-3A
P.O. # 026-57570

(Brief description of purpose of the vessel, as Air Tank, After Cooler, Jacketed Cooker, etc. State contents of each part.)

We certify that the statements made in this report are correct and that all details of design, material, construction, and workmanship of this vessel conform to the ASME Code for Pressure Vessels, Section VIII, Division 1.

Date June 15 19 73 Signed MISSOURI BOILER & TANK CO. (Manufacturer) By Robert J. Owen

Certificate of Authorization Expires 12/31/73

CERTIFICATE OF SHOP INSPECTION

VESSEL MADE BY MISSOURI BOILER & TANK COMPANY at ST. LOUIS, MISSOURI

I, the undersigned, holding a valid commission issued by the National Board of Boiler and Pressure Vessel Inspectors and or the State or Province of H.B. and employed by LIEBERMAN'S MUTUAL CASUALTY COMPANY of CHICAGO, ILLINOIS have inspected the pressure vessel described in this manufacturer's data report on June 15, 1973, and state that to the best of my knowledge and belief, the manufacturer has constructed this pressure vessel in accordance with the applicable sections of the ASME Boiler and Pressure Vessel Code.

By signing this certificate neither the Inspector nor his employer makes any warranty, expressed or implied, concerning the pressure vessel described in this manufacturer's data report. Furthermore, neither the Inspector nor his employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from or connected with this inspection.

Date June 15 1973

R. L. Erickson Commissions 6180
Inspectors Signature Nat'l Board, State, or Province and No.

CERTIFICATE OF FIELD ASSEMBLY INSPECTION

I, the undersigned, holding a valid commission issued by the National Board of Boiler and Pressure Vessel Inspectors and/or the State or Province _____ and employed by _____ of _____ have compared the statements in this manufacturer's data report with the described pressure vessel and state that parts referred to as data items _____, not included in the certificate of shop inspection have been inspected by me and that to the best of my knowledge and belief the manufacturer has constructed and assembled this pressure vessel in accordance with the applicable sections of the ASME Boiler and Pressure Vessel Code. The described vessel was hydrostatic tested at _____ psi.

By signing this certificate neither the Inspector nor his employer makes any warranty, expressed or implied, concerning the pressure vessel described in this manufacturer's data report. Furthermore, neither the Inspector nor his employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from or connected with this inspection.

Date _____ 19 _____

_____ Commissions _____
Inspector's Signature Nat'l Board, State, or Province and No.

MO. BO. 88-9/72

BY T.L.F. DATE 3-9-73
CHKD. E.B. DATE 3/13/73
NO. UNITS ONE
TYPE CJN (VERT.) (HOR.)

MISSOURI BOILER & TANK CO.
ST. LOUIS, MO.
HEAT EXCHANGER DESIGN CALC.

SHEET 1 OF
JOB NO. L-1070
ITEM NO. E-206-3A
SIZE 31"X240" CUSTOMER HERCULES

DESIGN DATA

COMPARTMENT		SH. SIDE	TB. SIDE
PRESSURE PSIG	INT.	75	100
	EXT.	—	—
DESIGN TEMP. °F		300	300
CORROSION ALLOW. IN.		NONE	0.063(4.5)
RADIOGRAPH		NONE	NONE
JOINT EFF. LONG.		0.70	0.70
POSTWELD HEAT TREAT		NONE	NONE
HYDRO. TEST PSIG		127	150
AIR TEST PSI		—	—
PASSES		DIVIDED	TWO
TEST RING (~~YES~~) (NO)		CODE STAMP (YES) (~~NO~~)	

ITEM		MATERIAL	ALLOW. TENS. STR. DES. TEMP.	ALLOW. TENS. STR. AMBIENT
SH. SD.	SHELL	SA-240-304 S/S	16600	18700
	HEAD	—	—	—
	BODY FLG.	—	—	—
TB. SD.	SHELL	SA-285-C	13700	13700
	HEAD	—	—	—
	BODY FLG.	SA-181-GR II	17500	17500
TUBE SHEET		SA-240-304 S/S	16600	18700
TUBES	NO. 822 O.D. 3/4 PITCH 15/16 Δ GA. 16	SA-249-304 S/S	11900	15900

SPECS. – A.S.M.E. SECT. VIII (DIV. 1), TEMA CLASS B, AND HERCULES SPECS

OPERATING DATA

EX PAN. JT.	OPENS	CLOSES
NO	—	—

CYCLIC SERVICE	PULSATING SERVICE
NO	NO

PHASE			SWT °F	TWT °F	DIFF. OF EXPAN. Δ	
NORMAL OPER.			14.8	117	-0.069	IN.
~~START-UP~~	SH. SD.	TB. SD.				~~IN.~~
~~UP-SET~~						~~IN.~~

+Δ, TB'S, EXPAND MORE THAN SH.
–Δ, SH. EXPANDS MORE THAN TBS.

SHELL

	SH. SD.	TB. SD.
P	75	100
D_o	31.50	31.50
S_{ALL}	16600	13700

	SHELL SIDE E = ~~0.85~~ 0.70	SHELL SIDE @ 0.80 x Spiral E = 1.0	TUBE SIDE E = ~~0.85~~ 0.70	TUBE SIDE @ 0.80 x Spiral E = 1.0
REQ'D. THICKNESS	0.101	0.089	0.164	0.143
CORR. ALLOW.	—	—	0.063	0.063
REQ'D. THKN'S. + C.A.	0.101	0.089	0.227	0.206
THKN'S. USED	1/4" A	0.250	3/8" A	0.375
EXCESS		0.161		0.169
REINF. INTEG. (YES) (~~NO~~)			REINF. INTEG. (YES) (~~NO~~)	

HEADS

	SH. SD.	TB. SD.
TYPE		
D. R.		
K. R.		

	SHELL SIDE KNUCKLE	SHELL SIDE SPH. PORT.	TUBE SIDE KNUCKLE	TUBE SIDE SPH. PORT.
REQ'D. THICKNESS				
CORR. ALLOW.				
REQ'D. THKN'S. + C.A.				
THKN'S. USED				
EXCESS				

REV.	SHEETS	BY / CHK	DATE

#104042

#104042

HERCULES INCORPORATED

HEAT EXCHANGER SPECIFICATIONS

REFERENCE

1 PLANT	Wilmington, N.C. JOB NO. 026057	EQUIP. NAME	Reclaim MeOH Still Pre-
2 AREA	Process NO.	EQUIP. NO.	E-206-3A Condenser
3 BLDG.	Esterification NO.	NO. UNITS	one
4 ORDER	VENDOR	B.P.F. NO.	
5 MADE BY	W.F. Filbert CHKD. BY	APPR. BY	DATE

PROCESS AND GENERAL

		SHELL SIDE	TUBE SIDE
6	SURFACE AREA: EACH UNIT 3230 SQ. FT.	EACH SHELL SQ. FT.	
7	NO. SHELLS		
8	WEIGHTS — EACH SHELL LB.	BUNDLE LB.	FULL OF WATER LB.
9			
10	FLUID CIRCULATED	Methanol	Cooling H_2O
11	TOTAL FLUID ENTERING	42340 LB./HR.	800000 LB./HR.
12	TOTAL VAPOR ENTERING	42340 LB./HR.	LB./HR.
13	TOTAL LIQUID ENTERING	LB./HR.	800000 LB./HR.
14	TOTAL STEAM ENTERING	LB./HR.	LB./HR.
15	TOTAL NON-CONDENSABLES ENTERING	LB./HR.	LB./HR.
16	FLUIDS VAPORIZED OR VAPORS CONDENSED	42340 (c)	
17	STEAM CONDENSED		
18	SPECIFIC GRAVITY @ TEMPERATURE	.75 @ °F.	.99 @ °F.
19	VISCOSITY IN	.35 CP.	.85 CP.
20	VISCOSITY OUT	CP.	.65 CP.
21	THERMAL CONDUCTIVITY	.115 BTU/HR.-FT./°F.	.368 BTU/HR.-FT./°F.
22	MOLECULAR WEIGHT OF VAPORS	32	
23	SPECIFIC HEAT OF LIQUIDS	.67 BTU/LB./°F.	1 BTU/LB./°F.
24	LATENT HEAT OF VAPORS	468 BTU/LB.	BTU/LB.
25	TEMPERATURE IN	152 °F.	88 °F.
26	TEMPERATURE OUT	145 °F.	113 °F.
27	OPERATING PRESSURE	16 psia PSIG	50 PSIG
28	DESIGN PRESSURE — TEMPERATURE	75 PSIG @ 300 °F.	100 PSIG @ 300 °F.
29	TEST PRESSURE — HYDROSTATIC	PSIG	PSIG
30	PRESSURE DROP — ALLOWABLE	.5 PSIG	10 PSIG
31	PRESSURE DROP — CALCULATED	PSIG	PSIG
32	PASSES PER SHELL	1-divided flow	2
33	VELOCITY	FT./SEC.	3.9 FT./SEC.
34	FOULING RESISTANCE	.001	.0015
35	CODE REQUIREMENTS ASME Sec VIII	TEMA CLASS B	TEMA TYPE DESIGNATION
36	HEAT EXCHANGED 20,000,000 BTU/HR.	MTD. (CORRECTED) 46.4	
37	TRANSFER RATE — SERVICE 133.4	CLEAN 200.1	

CONSTRUCTION AND MATERIALS

38	TUBES: MATERIAL 304 SS	QUAN 822	O.D. .75 IN.	16 GA.	LENGTH 240 IN.	PITCH (△) ☐ ◊			
39	TUBE ATTACHMENT ☐ ROLLED	☐ WELDED	☒ GROOVED AND ROLLED		PITCH 15/16 INCHES				
40	TUBE SUPPORTS 304SS 45%cut	PITCH 30"		THICKNESS IN.	NO. TIE RODS				
41	TUBE SHEETS 304SS (1) ☐ STATIONARY	☐ FLOATING							
42	SHELL: 304SS	I.D. 31 IN.	O.D. IN.	THICKNESS IN.	☐ VERT.	☐ HORIZ.			
43	SHELL COVER	THICKNESS INCHES	O.D. INCHES	☐ REMOV.	☐ INTEG.				
44	FLOATING HEAD COVER	THICKNESS INCHES	O.D. INCHES						
45	EXPANSION JOINTS ☐ YES	☐ NO	TYPE						
46	EXPANSION JOINT DESIGN CRITERIA	SHELL TEMP 215 °F.	TUBE TEMP 50 °F.						
47	CHANNEL OR BONNET CS	THICKNESS INCHES	CHANNEL COVER CS	THICKNESS INCHES					
48	BAFFLES — CROSS	PITCH	TYPE	THICKNESS INCHES					
49	BAFFLES — LONG	TYPE		THICKNESS INCHES					
50	GASKETS JM-60	TEST GASKETS JM-60							
51	CONNECTIONS: SHELL IN 18	OUT L=2-4" V=2-6" (2)	SERIES 150 psi R.F.						
52	CONNECTIONS: CHANNEL IN 12	OUT 12	SERIES 150 psi R.F.						
53	IMPINGEMENT PLATES ☒ YES	☐ NO	THICKNESS INCHES						
54	CORROSION ALLOWANCE: SHELL SIDE none	TUBE SIDE 1/16 on CS only							
55	PAINTING exterior CS only per 11CS-661								

REMARKS

56 (1) clad tube sheets satisfactory

57

58 (2)=L liquid drains V= vapor vents

59

60

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