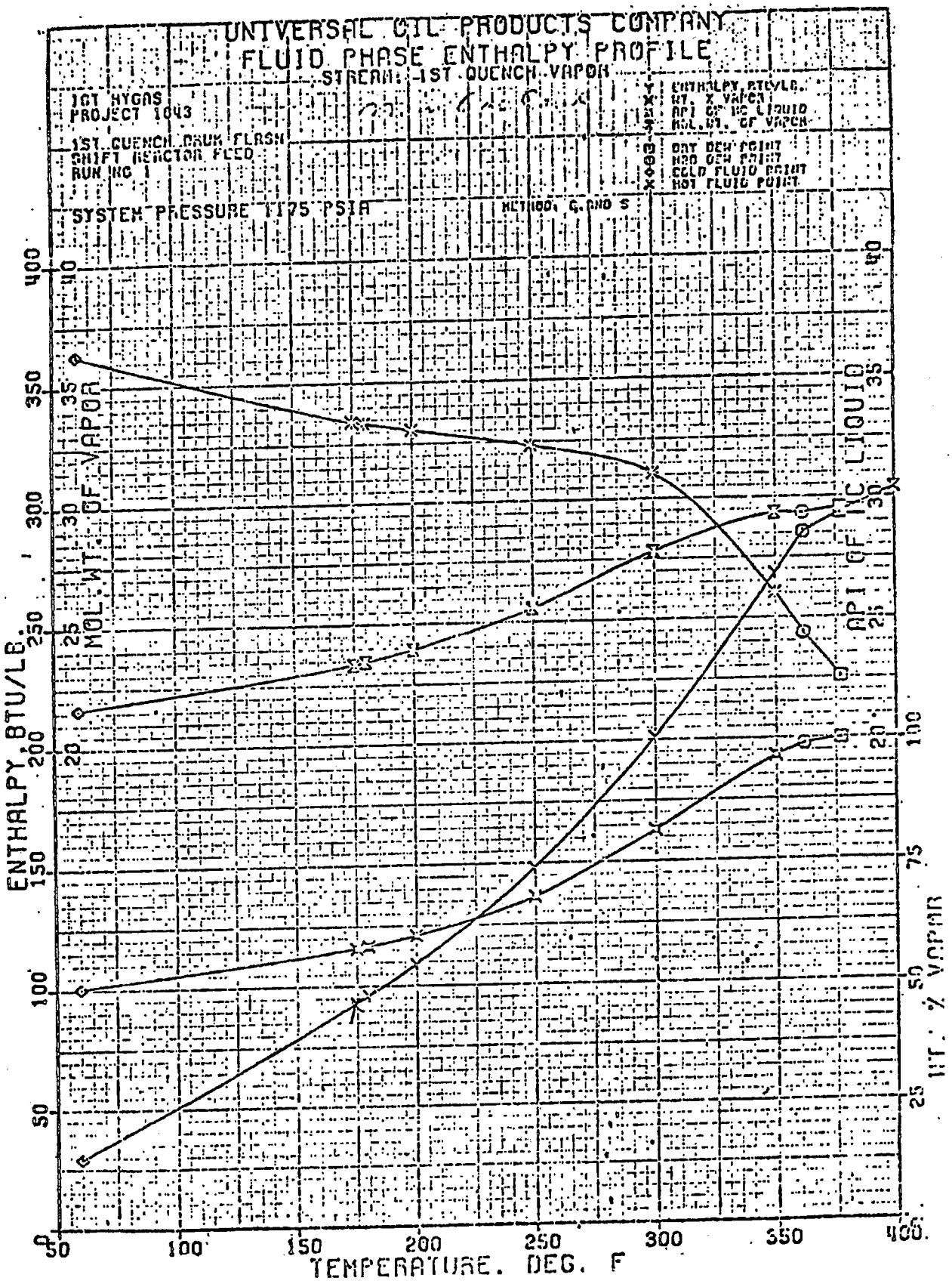

UNIVERSAL OIL PRODUCTS COMPANY
FLUID PHASE ENTHALPY PROFILE
STREAM: 1ST QUENCH VAPOR
IGT HYGAS
PROJECT 1043
1ST QUENCH DRUM FLASH
SHIFT REACTOR FEED
RUN NO. 1
SYSTEM PRESSURE 1175 PSIA
METHOD: C AND S
ENTHALPY, BTU/LB.
MOL. WT. OF VAPOR
API OF HC LIQUID
WT. % VAPOR
TEMPERATURE, DEG. F
0
50
100
150
200
250
300
350
400
20
25
30
35
40
75

AIR-COOLED EXCHANGER SPECIFICATION

Procon Incorporated

Customer IGT - Hygas Plant

Date 2/24/72 Engr. GSD Item No 21.07-02

Service Quench Cooler

Units Model Induced Forced Draft No of Bays 2

Surface Item External 232,000 Bare Tube Sq. Ft

Heat Exchanged . . . BTU Hr 151,830,000 Effective MTD °F

Transfer Rate . . . External Surface 4.3 Bare Tube Surface BTU/Hr. Sq. Ft. °F

PERFORMANCE DATA

TUBE SIDE

Fluid Circulated		$HC + H_2O + H_2S + CO_2 + Inerts$	Temperature In 360 °F
Total Fluid Entering	Lbs/Hr	4,543,574	Temperature Out 290 °F
Vapor			Inlet Pressure psia, psig
Liquid		4,543,574	Gravity – Liquid 0.71 @ 360°F
Steam			Viscosity 0.6 Cps @360 °F
Non-Condensables			Sp.Heat 0.475 B/# @360 °F
Vapor Condensed			Molecular Weight
Steam Condensed			Allowable Press Drop 10 psi
Fouling Res. I S	Hr. Sq. Ft. °F BTU	0.007	Design Pressure Drop psi

AIR SIDE

Air Quantity Item	Lbs Hr		Temperature In 95 °F
Air Quantity-Fan	ACFM		Temperature Out °F
			Altitude 100 Ft.

CONSTRUCTION

Design Pressure 430	PSI	Test Pressure ASME Code	Design Temperature 450 °F
SECTION		HEADER	TUBE
Size		Type Plug	Material 304 SS
No Item 2		Material SA-240	OD 1.0 In. 0.085" Min. Wall
Tube Support – Zn AL Filled Bands		No Rows Passes	No. Section
STRUCTURE – Carbon Steel		Plugs – Shoulder ASME Material SA 182	Length 30 Ft.
Surface Prep – Wire Brush		Gasket Material	Pitch In. △
Grade Mounted		Corrosion Allowance 1/8 In.	FIN
Finish – One Coat Primer		Size Inlet Nozzle In.	Material AL.
		Size Outlet Nozzle In.	Height
X Fan Guards		Series 900 RF	No /in
X Belt Guards		Vent & Drain Conn.	Type Extruded
Coupling Guards		Code - ASME XX Stamp Reqd.	

MECHANICAL EQUIPMENT

FAN MFGR.			DRIVER Elect. Motor		SPEED REDUCER
Model			Type		Type V-Belt
No Bay 4	No /Item 8		No Item 8	HP/Driver 30	No. Item 4
BHP Each	BHP Total		RPM 1750		Model
Diameter ft.	RPM		Enclosure TEFC		AGMA HP Rating
No Blades	Pitch		Volt 460 Phase 3 Cycle 60		Ratio
Blade Material Cast Al.			Mfgr Vendor Option – NEMA		Mfgr.
Hub Material					Support
Man Adj	Auto Variable		Vib Switch XX Req'd		

Notes

Provide steam coil & external recirculation.

Plot Size: 55' x 30'

Dimensions: Width Length Height Shipping Weight Lbs.

FORM NO. 410 120 9/70

Procon Incorporated

EXCHANGER DATA SHEET

		REQ. No.	21.07-51 A&B
CUSTOMER	IGT - HYGAS PLANT	PAGE No.	
ADDRESS		DATE	2/15/72
PLANT LOCATION		REVISED	
SERVICE OF UNIT	Steam Generator	ITEM NO.	21.07-51 A&B
SIZE	90" x 57" x 30'	TYPE	U-Tube Kettle BKU Horiz. CONNECTED IN
SURFACE PER UNIT	15,580	SHELLS PER UNIT	1
		SURFACE PER SHELL	15,580

PERFORMANCE OF ONE UNIT

	SHELL SIDE		TUBE SIDE	
FLUID CIRCULATED	Water		HC+H_2O+H_2S+CO+Inerts	
TOTAL FLUID ENTERING #/hr	50,303		2,690,000	
VAPOR "				
LIQUID "	50,303		2,690,000	
STEAM "				
NON-CONDENSABLES "				
FLUID VAPORIZED OR CONDENSED"	45,730			
STEAM CONDENSED "				
GRAVITY—LIQUID			0.71 @ 360°F	
VISCOSITY—LIQUID			0.6 cp @ 360°F	
MOLECULAR WEIGHT—VAPORS				
SPECIFIC HEAT—LIQUIDS		B.T.U./#	0.457 @ 360°F	B.T.U./#
LATENT HEAT—VAPORS		B.T.U./#		B.T.U./#
TEMPERATURE IN	180	°F	400	°F
TEMPERATURE OUT	341	°F	360	°F
OPERATING PRESSURE G	105	#/SQ. IN.	1210	#/SQ. IN.
NUMBER OF PASSES				
VELOCITY		FT./SEC.		FT./SEC.
PRESSURE DROP	0.5	#/SQ. IN.	10	#/SQ. IN.
Fouling Factor	.001		.006	

HEAT EXCHANGED—B.T.U./HR. 48,420,000 M.T.D. (Corrected) 37

TRANSFER RATE—SERVICE 84 CLEAN Heat Flux - 3100 Av.

CONSTRUCTION

DESIGN PRESSURE	130	#/SQ. IN.	1330	#/SQ. IN.	
TEST PRESSURE	CODE	#/SQ. IN.	CODE	#/SQ. IN.	
DESIGN TEMPERATURE	460	°F	500	°F	

TUBES SA-312-TP 304 NO 1323 U's O.D. 3/4 BWG. 14 LENGTH 30' PITCH 1" Δ

SHELL	C.S.	I.D.	O.D.	THICKNESS	
SHELL COVER	C.S.			FLOATING HEAD COVER	
CHANNEL	347 or 321 S.S. Cladding on C.S. per A264			CHANNEL COVER	
TUBE SHEETS—STATIONARY				FLOATING	
BAFFLES—CROSS	C.S.	TYPE		THICKNESS	
BAFFLE—LONG	C.S.	TYPE		THICKNESS	
TUBE SUPPORTS	C.S.			THICKNESS	
GASKETS					
CONNECTIONS—SHELL—IN	4	OUT	6" (v), 2" (l)	SERIES	
CHANNEL—IN	14	OUT	14	SERIES	
CORROSION ALLOWANCE—SHELL SIDE	1/8"			TUBE SIDE	1/8"
CODE REQUIREMENTS	ASME VIII			TEMA CLASS	R
WEIGHTS—EACH SHELL		BUNDLE		FULL OF WATER	

NOTE: INDICATE AFTER EACH PART WHETHER STRESS RELIEVED (S. R.) AND WHETHER RADIOGRAPHED (X-R)

REMARKS:

PROCON

STANDARD DATA SHEET FOR CENTRIFUGAL PUMPS

NO. 1843-21.08-1
SHEET NO. 1
TOTAL SHEETS 4
DATE 2-3-72 EJM
APPROVED

FOR IGT-HYGAS PLANT ITEM NO. 21.08-01 A, B & C
SITE UNIT 2100
SERVICE QUENCH OIL CIRCULATION MOTOR DRIVE TURBINE DRIVE 3
PUMP MFR SIZE AND TYPE NO. REQ'D 3

OPERATING CONDITIONS

LIQUID H.C. INCL BENZENE & OTHER AROMATICS **
PT F 360 △
SP GR at PT 0.710 △
VAP PRESS. at PT, psia 853 △
VIS at PT. 0.6 cp
CORR/EROS caused by Some H_2S, CO_2, HCN, PHENOL, WATER **

U.S. gpm at PT, NOR 6400 DES 7360 △
DISCH PRESS., psig 1302
SUCT PRESS., psig MAX 1320 DES 1175
DIFF PRESS., psi 127
DIFF HEAD, ft 413 △
NPSH AVAIL., ft 50 *

PERFORMANCE

PROPOSAL CURVE NO
NPSH REQ'D (WATER), ft *
NO. OF STAGES RPM
DES EFF BHP
MAX BHP DES IMP
MAX HEAD DES IMP, ft
MIN CONTINUOUS, gpm (BY MFR) ①
ROTATION FACING COUPLING END
WATER COOLING YES
BEARINGS YES
STUFF. BOX YES
TURBINE BRGS. YES
GLAND QUENCH - YES
TOTAL WATER REQ'D, gpm ①
C.W. PIPING PLAN "F" BY PUMP MFR.
FLUSH FLUID IS BENZENE AT 1450 PSIG, 100°F
FLUSHING TO INTERMEDIATE STAGE OF BREAKDOWN BUSHING, PART FLOW INTO PUMP, REST OUT AT SEAL END AT LOW PRESSURE. API PIPING PLAN 32 BY PUMP MFR.

CONSTRUCTION AND MATERIALS

CASING-MOUNTING (CENTERLINE X) (FOOT) (BRACKET) (VERTICAL)
① SPLIT (AXIAL) (RADIAL)
② TYPE (SINGLE VOLUTE) (DOUBLE VOLUTE X) (DIFFUSER)
TAPPED OPENINGS (VENT X) (DRAIN X) (GAGE CONNS.)

NOZZLES	SIZE	ASA RATING	FACING	POSITION
SUCTION				
DISCHARGE				

IMPELLER DIAM DES MAX TYPE CLOSED, DBL. SUCT.
MFR'S BEARING NO. RADIAL THRUST
COUPLING and GUARD THOMAS / YES BASE PLATE TRAIN F.M.
PACKING —
MECH SEAL YES. BAL. CLASS. CODE MFR
NOTE: PROVIDE PRESSURE BREAKDOWN BUSHINGS ALONG SHAFT, ARRANGED FOR CLEAN HIGH PRESSURE EXTERNAL FLUSH.

MATERIAL CODE—EXTERNAL CASING S INTERNAL PARTS S

1—CAST IRON
B—BRONZE
S—STEEL
C—11-13% CHROME
A—ALLOY
H—HARDENED
F—FACED
X—

INTERNALS CODE	I	B	S	C	X
IMPELLER	I	B	S	C	
INNER CASE PARTS	I	I	S	C	
SLEEVE (PACKED)	Ch	Ch	Af	Af	
SLEEVE (SEAL)	C	C	C	C	
WEAR PARTS	I	B	Ch	Ch	
SHAFT	S	S	S	S	

SHOP TESTS	REQUIRED	WITNESSED
RUNNING PERF	X	
NPSH		
ULTRASONIC INSPECTION OF PUMP CASING	X △	X △
HYDROSTATIC PSIG		

MAX ALLOW. WP PSIG F
WEIGHTS: PUMP BASE
MOTOR TURBINE

MOTOR DRIVER BY

ITEM NO. MTD BY
HP RPM FRAME
MFR
TYPE INSUL
ENC TEMP RISE C
VOLTS/PHASE/CYCLES
BEARINGS LUBE
FULL LOAD AMPS

TURBINE DRIVER BY ③ PUMP MFR

ITEM NO. A, B, & C MTD BY PUMP MFR
HP RPM MAT'L
MFR and TYPE ②
INLET STEAM, psig 250 TEMP F 456
EXHAUST 50 PSIG
STEAM RATE, FL lb/BHP/HR
BEARINGS LUBE

NOZZLES	SIZE	ASA RATING	FACING	POSITION
INLET				
EXHAUST				

MFR FINAL DATA (AS BUILT)

ACTUAL IMPELLER DIAM
TEST CURVE NO.
OUTLINE DWG NO.
PUMP SECT. DWG NO.
SEAL DIAM DWG NO.
PUMP SERIAL NO.

API STD. 610 GOVERNS UNLESS OTHERWISE STATED. * NPSH REQU. SHALL NOT EXCEED 25 FEET (WATER)
EXCEPTIONS (ITEMIZE): ** NOTE: LIQUID HAS LOW pH, SOME SOFT COAL DUST < 50 MESH. ① PLS. ADVISE. ② BETWEEN BEARING DESIGN REQUIRED. ③ PROVIDE SPEED REDUCTION GEARS FOR ECONOMICAL TURBINE SELECTION. ③ GENERAL PURPOSE API 611.

REV.	DATE	APPROVED	REV.	DATE	APPROVED	REV.	DATE	APPROVED
△1	2-9-72	EJM						
△2	2-10-72	EJM						

PROCON

STANDARD DATA SHEET FOR CENTRIFUGAL PUMPS

NO. 1843-21.08-1
SHEET NO. 2
TOTAL SHEETS 4
DATE 2-4-72 EJM
APPROVED

FOR IGT - HYGAS PLANT ITEM NO. 21.08-02 A & B
SITE UNIT 2100
SERVICE RECYCLE OIL MOTOR DRIVE 1 TURBINE DRIVE 1
PUMP MFR SIZE AND TYPE NO. REQ'D 2

OPERATING CONDITIONS

LIQUID H.C. INCL AROMATICS **
PT F 175
SP GR at PT 0.775
VAP PRESS. at PT, psia 1200
VIS at PT, Bar 1.0 cp.
CORR/EROS caused by H_2S, CO_2, HCN, PHENOL, WATER **

U.S. gpm at PT, NOR 152 DES 182
DISCH PRESS, psig 124.5
SUCT PRESS., psig MAX 1320 DES 1185
DIFF PRESS., psi 60
DIFF HEAD, ft 179
NPSH AVAIL., ft 12 *

CONSTRUCTION AND MATERIALS

CASING MOUNTING (CENTERLINE X) (FOOT) (BRACKET) (VERTICAL)
SPLIT (AXIAL) (RADIAL X)
① TYPE (SINGLE VOLUTE) (DOUBLE VOLUTE) (DIFFUSER)
TAPPED OPENINGS (VENT X) (DRAIN X) (GAGE CONNS)

NOZZLES	SIZE	ASA RATING	FACING	POSITION
SUCTION				
DISCHARGE				

IMPELLER DIAM DES MAX TYPE CLOSED
MFR'S BEARING NO. RADIAL THRUST
COUPLING and GUARD THOMAS / YES BASE PLATE DRAIN RIM
PACKING —
MECH SEAL YES, BAL. CLASS. CODE MFR
NOTE: PROVIDE PRESSURE BREAKDOWN BUSHINGS ALONG SHAFT, ARRANGED TO REDUCE TEES AT SEAL TO APPROXIMATELY

MATERIAL CODE—EXTERNAL CASING INTERNAL PARTS 1

1—CAST IRON
2—BRONZE
3—STEEL
6—11-13% CHROME
A—ALLOY
H—HARDENED
I—FACED
X—

INTERNALS CODE					
IMPELLER	1	B	S	6	X
INNER CASE PARTS	1	1	S	6	
SLEEVE (PACKED)	Ch	Ch	Al	Al	
SLEEVE (SEAL)	6	6	6	6	
WEAR PARTS	X	B	(Ch)	Ch	
SHAFT	S	S	S	S	

PERFORMANCE

PROPOSAL CURVE NO
NPSH REQ'D (WATER), ft *
NO. OF STAGES MPM
DES EFF BHP
MAX BHP DES IMP
MAX HEAD DES IMP, ft
MIN CONTINUOUS, gpm (DT MFR) ①
ROTATION FACING COUPLING END
WATER COOLING (TURBINE BEARINGS) ①
BEARINGS
STUFF. BOX
PEDESTAL
GLAND
TOTAL WATER REQ'D, gpm ①

FLUSH FLUID IS BENZENE AT 1450 PSIG, 100°F.
FLUSHING TO INTERMEDIATE STAGE OF BREAKDOWN BUSHING, PART FLOW INTO PUMP, REST OUT AT SEAL END AT LOW PRESSURE.
API PIPING PLAN 32 BY PUMP MFR.

SHOP TESTS	REQUIRED	WITNESSED
RUNNING PERF	X	
NPSH		
ULTRASONIC INSPECTION OF PUMP CASING	X ⚠1	X ⚠2
HYDROSTATIC PSIG		
MAX ALLOW. WP PSIG F		

WEIGHTS: PUMP BASE
MOTOR TURBINE

MOTOR DRIVER BY PUMP MFR.

ITEM NO. A MTD BY PUMP MFR
HP RPM FRAME
MFR
TYPE SCI INSUL B
ENC TEFC TEMP RISE C 80
VOLTS/PHASE/CYCLES 460/3/60
BEARINGS BALL LUBE GRS
FULL LOAD AMPS

TURBINE DRIVER BY PUMP MFR.

ITEM NO. B MTD BY PUMP MFR.
HP RPM MAT'L
MFR and TYPE ②
INLET STEAM, psig 250 TEMP F 456
EXHAUST 50 PSIG
STEAM RATE, FL lb/BHP/HR
BEARINGS ① LUBE ①

NOZZLES	SIZE	ASA RATING	FACING	POSITION
INLET				
EXHAUST				

MFR FINAL DATA (AS BUILT)

ACTUAL IMPELLER DIAM
TEST CURVE NO.
OUTLINE DWG NO.
PUMP SECT. DWG NO.
SEAL DIAM DWG NO.
PUMP SERIAL NO.

API STD. 610 GOVERNS UNLESS OTHERWISE STATED. * NPSH REQD. SHALL NOT EXCEED 6 FEET (WATER)
EXCEPTIONS (ITEMIZE): ** LIQUID HAS Low pH, SOME SOFT COAL DUST < 50 MESH. ① PLS. ADVISE, ② GENERAL PURPOSE - API 611.

REV.	DATE	APPROVED	REV.	DATE	APPROVED	REV.	DATE	APPROVED
⚠1	2-9-72	EJM						
⚠2	2-10-72	EJM						

PROCON

STANDARD DATA SHEET FOR CENTRIFUGAL PUMPS

NO. 1843-21.08-1
SHEET NO. 3
TOTAL SHEETS 4
DATE 2-7-72 EJM
APPROVED

FOR IGT-HYGAS PLANT ITEM NO. 21.08-03 A & B
SITE UNIT 2100
SERVICE QUENCH WATER MOTOR DRIVE TURBINE DRIVE 1
PUMP MFR SIZE AND TYPE NO. REQ'D 2

OPERATING CONDITIONS

LIQUID WATER *
PT T 175
SP GR at PT 0.972
VAP PRESS at PT, psia 6.6
VIS at PT, Saybolt 0.4 cp.
CORR/EROS caused by * H_2S, CO_2, HCN, PHENOL

U.S. gpm at PT, NOR 129 DES 142
DISCH PRESS., psig 1220
SUCT PRESS., psig MAX 1370 DES 1175
DIFF PRESS., psi 45
DIFF HEAD, ft 107
NPSH AVAIL., ft 16 **

CONSTRUCTION AND MATERIALS

CASING-MOUNTING (CENTERLINE X) (FOOT) (BRACKET) (VERTICAL)
SPLIT (AXIAL) (RADIAL X)
① TYPE (SINGLE VOLUTE) (DOUBLE VOLUTE) (DIFFUSER)
TAPPED OPENINGS (VENT X) (DRAIN X) (GAGE CONNS.)

NOZZLES	SIZE	ASA RATING	FACING	POSITION
SUCTION				
DISCHARGE				

IMPELLER DIAM DES MAX TYPE CLOSED
MFR'S BEARING NO. RADIAL THRUST
COUPLING and GUARD THOMAS /YES BASE PLATE DRAIN RIM
PACKING —
MECH SEAL YES-BAL. CLASS CODE MFR

MATERIAL CODE—EXTERNAL CASING S INTERNAL PARTS T

1—CAST IRON
B—BRONZE
S—STEEL
C—11-13% CHROME
A—ALLOY
h—HARDENED
f—FACED
X—

INTERNALS CODE	1	B	S	C	X
IMPELLER	1	B	S	C	
INNER CASE PARTS	1	1	S	C	
SLEEVE (PACKED)	Ch	Ch	Al	Al	
SLEEVE (SEAL)	C	C	C	C	
WEAR PARTS	X	B	Ch	Ch	
SHAFT	S	S	S	S	

PERFORMANCE

PROPOSAL CURVE NO
NPSH REQ'D (WATER), ft **
NO. OF STAGES RPM
DES EFF BHP
MAX BHP DES IMP
MAX HEAD DES IMP, ft
MIN CONTINUOUS, gpm (BY MFR) ①
ROTATION FACING COUPLING END
WATER COOLING TURBINE BEARINGS ①
BEARINGS
STUFF. BOX
PEDESTAL
GLAND
TOTAL WATER REQ'D, gpm ①
PACKING COOLING
FLUSHING API PLAN 12
AUX PIPING BY PUMP MFR.

SHOP TESTS	REQUIRED	WITNESSED
RUNNING PERF	X	
NPSH		
ULTRASONIC INSPECTION OF PUMP CASING	X ⚠1	X ⚠2
HYDROSTATIC PSIG		
MAX ALLOW. WP PSIG		P

WEIGHTS: PUMP BASE
MOTOR TURBINE

MOTOR DRIVER BY PUMP MFR

ITEM NO. A MTD BY PUMP MFR
HP RPM FRAME
MFR
TYPE SCI INSUL B
ENC. TEFC TEMP RISE C 80
VOLTS/PHASE/CYCLES 460/3/60
BEARINGS BALL LUBE GRS
FULL LOAD AMPS

TURBINE DRIVER BY PUMP MFR

ITEM NO. B MTD BY PUMP MFR
HP RPM MAT'L
MFR and TYPE ②
INLET STEAM, psig 250 TEMP F 456
EXHAUST 50 PSIG
STEAM RATE, FL lb/BHP/HR
BEARINGS LUBE

NOZZLES	SIZE	ASA RATING	FACING	POSITION
INLET				
EXHAUST				

MFR FINAL DATA (AS BUILT)

ACTUAL IMPELLER DIAM
TEST CURVE NO.
OUTLINE DWG NO.
PUMP SECT. DWG NO.
SEAL DIAM DWG NO.
PUMP SERIAL NO.

API STD. 610 GOVERNS UNLESS OTHERWISE STATED. * NPSH REQUIRED SHALL NOT EXCEED 8 FEET (WATER)
EXCEPTIONS (ITEMIZE): ① PLS. ADVISE ② GENERAL PURPOSE API 611.

REV.	DATE	APPROVED	REV.	DATE	APPROVED	REV.	DATE	APPROVED
⚠1	2-9-72	EJM						
⚠2	2-10-72	EJM						

PROCON

STANDARD DATA SHEET FOR CENTRIFUGAL PUMPS

NO. 1843-21.08-1
SHEET NO. 4
TOTAL SHEETS 4
DATE 2-7-72 EJM
APPROVED

FOR IGT - HYGAS PLANT ITEM NO. 21.08-04 A & B
SITE UNIT 2100
SERVICE HOT WATER CIRCULATION MOTOR DRIVE / TURBINE DRIVE /
PUMP MFR SIZE AND TYPE NO. REQ'D 2

OPERATING CONDITIONS

LIQUID WATER
PT F 255
SP GR at PT 0.94
VAP PRESS. at PT, psia 32.5
VIS at PT, cps 0.26 cP
CORR/EROS caused by

U.S. gpm at PT, NOR 1680 DES 1850
DISCH PRESS, psig 245
SUCT PRESS., psig MAX 50 DES 18.0
DIFF PRESS., psi 227
DIFF HEAD, ft 559
NPSH AVAIL., ft 20

CONSTRUCTION AND MATERIALS

CASING-MOUNTING (CENTERLINE X) (FOOT) (BRACKET) (VERTICAL)
SPLIT (AXIAL) (RADIAL X)
TYPE (SINGLE VOLUTE) (DOUBLE VOLUTE X) (DIFFUSER)
TAPPED OPENINGS (VENT X) (DRAIN X) (GAGE CONNS.)

NOZZLES	SIZE	ASA RATING	FACING	POSITION
SUCTION				
DISCHARGE				

IMPELLER DIAM DES MAX TYPE CLOSED DBL. SUCT.
MFR'S BEARING NO. RADIAL THRUST
COUPLING and GUARD THOMAS / YES BASE PLATE DRAIN RIM
PACKING —
MECH SEAL YES, BAL. CLASS. CODE MFR

PERFORMANCE

PROPOSAL CURVE NO.
NPSH REQ'D (WATER), ft
NO. OF STAGES RPM
DES EFF BHP
MAX BHP DES IMP
MAX HEAD DES IMP, ft
MIN CONTINUOUS, gpm (BY MFR) ①
ROTATION FACING COUPLING END
WATER COOLING YES
BEARINGS (TURBINE) ①
STUFF. BOX YES
PEDESTAL
GLAND QUENCH - YES
TOTAL WATER REQ'D, gpm ①
CW PIPING PLAN "J" PLUS QUENCH
PACKING COOLING
FLUSHING API PLAN 23
AUX PIPING BY PUMP MFR.

MATERIAL CODE—EXTERNAL CASING S INTERNAL PARTS C

1—CAST IRON
B—BRONZE
S—STEEL
C—11-13% CHROME
A—ALLOY
H—HARDENED
P—PACKED
X—

INTERNALS CODE					X
IMPELLER	I	B	S	C	
INNER CASE PARTS	I	I	S	C	
SLEEVE (PACKED)	Ch	Ch	Al	Al	
SLEEVE (SEAL)	C	C	C	C	
WEAR PARTS	I	B	Ch	Ch	
SHAFT	S	S	S	S	

SHOP TESTS	REQUIRED	WITNESSED
RUNNING PERF	X	
NPSH		
HYDROSTATIC PSIG		
MAX ALLOW. WP PSIG		

WEIGHTS: PUMP BASE
MOTOR TURBINE

MOTOR DRIVER BY PUMP MFR

ITEM NO. A MTD BY PUMP MFR
HP RPM FRAME
MFR
TYPE SCI INSUL B
ENC WP-II TEMP RISE C 80
VOLTS/PHASE/CYCLES 4160 / 3 / 60
BEARINGS SLEEVE LUBE OIL
FULL LOAD AMPS

TURBINE DRIVER BY PUMP MFR

ITEM NO. B MTD BY PUMP MFR
HP RPM MAT'L
MFR and TYPE (2)
INLET STEAM, psig 250 TEMP F 456
EXHAUST 50 PSIG
STEAM RATE, FL lb/BHP/HR
BEARINGS LUBE

NOZZLES	SIZE	ASA RATING	FACING	POSITION
INLET				
EXHAUST				

MFR FINAL DATA (AS BUILT)

ACTUAL IMPELLER DIAM
TEST CURVE NO.
OUTLINE DWG NO.
PUMP SECT. DWG NO.
SEAL DIAM DWG NO.
PUMP SERIAL NO.

API STD. 610 GOVERNS UNLESS OTHERWISE STATED.
EXCEPTIONS (ITEMIZE): ① PLS. ADVISE. ② GENERAL PURPOSE API 611.

REV.	DATE	APPROVED	REV.	DATE	APPROVED	REV.	DATE	APPROVED

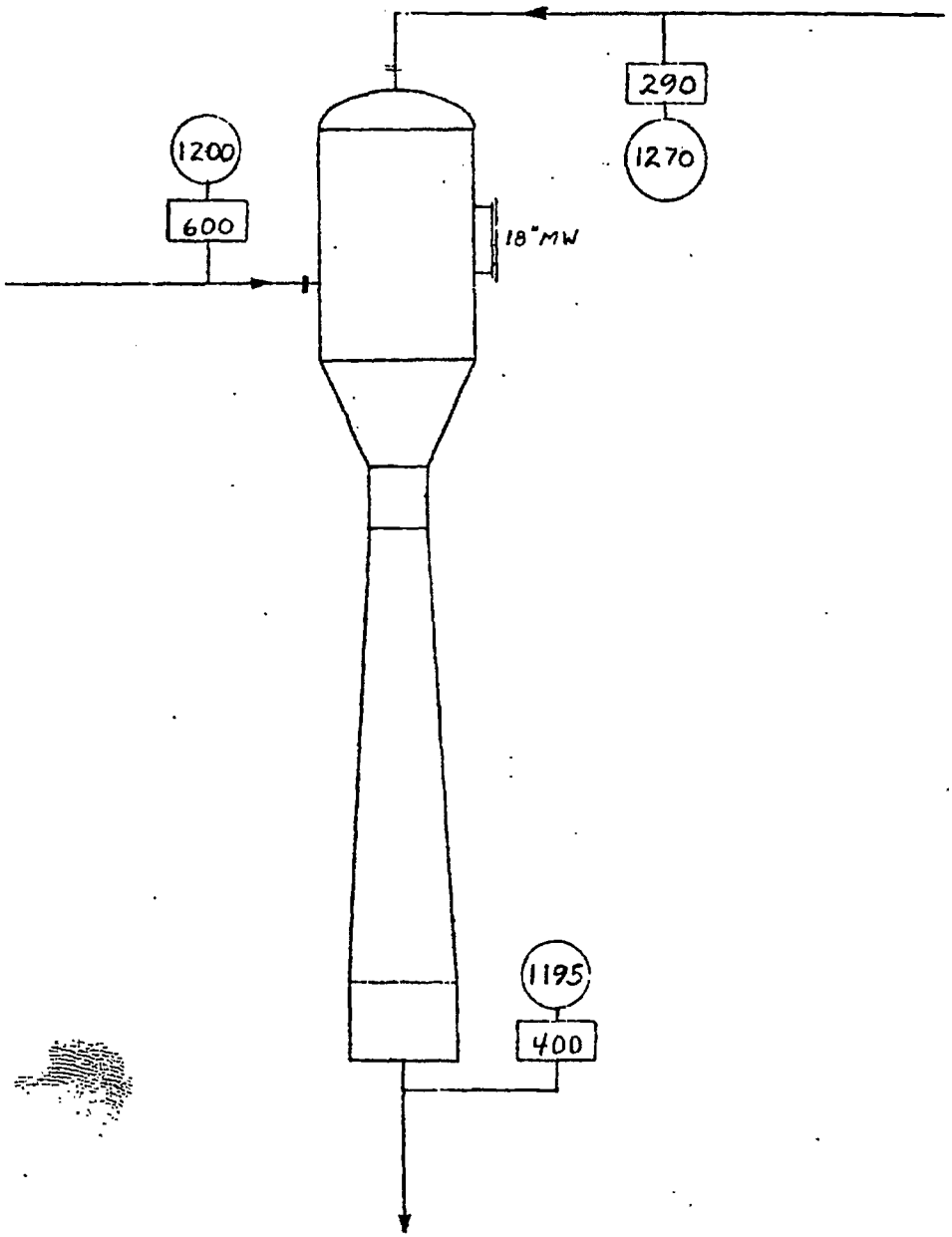
PROCON INCORPORATED

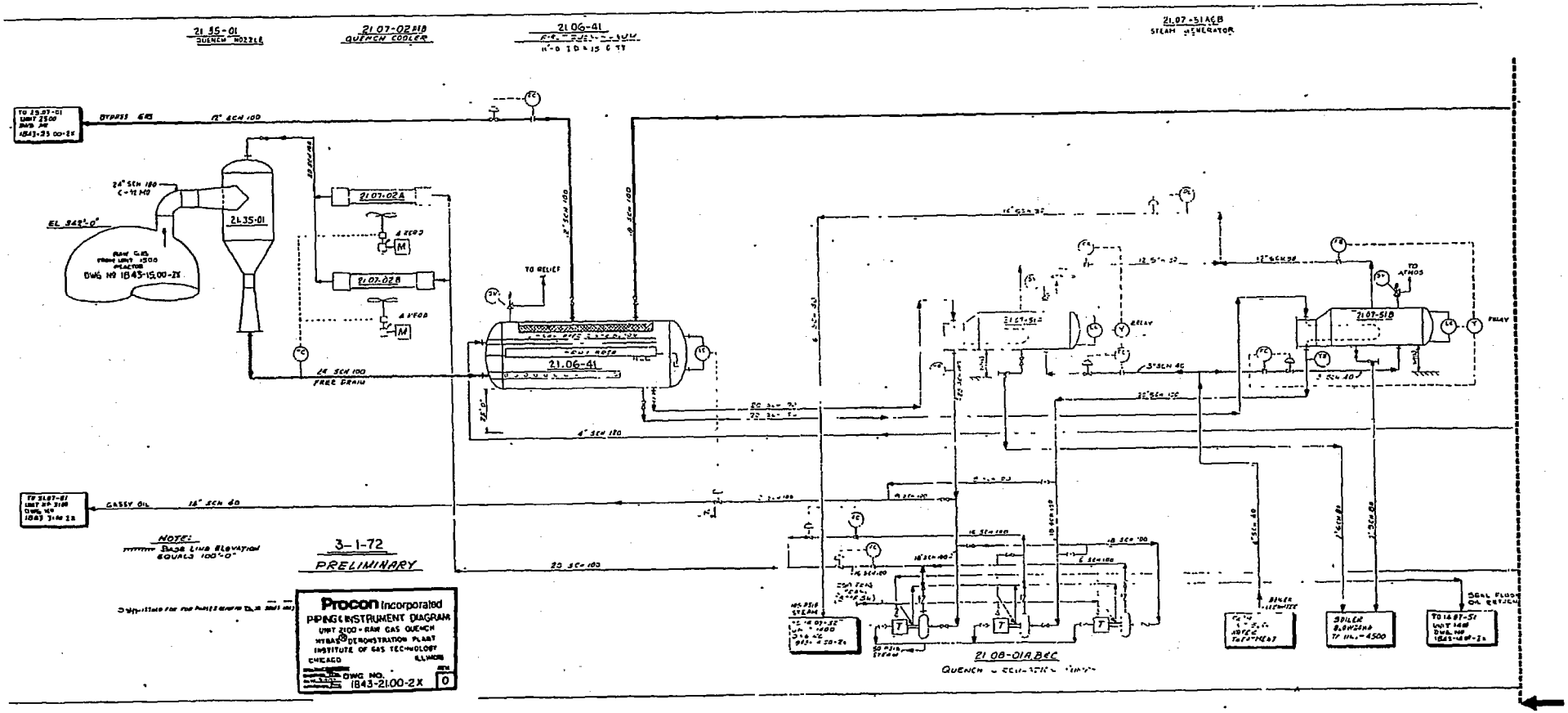
SUBJECT W-1843 UNIT 2100 DATE 3/3/72

FOR IGT HYGAS® DEMONSTRATION PLANT BY R. O. PETKUS

ITEM 21.35-01

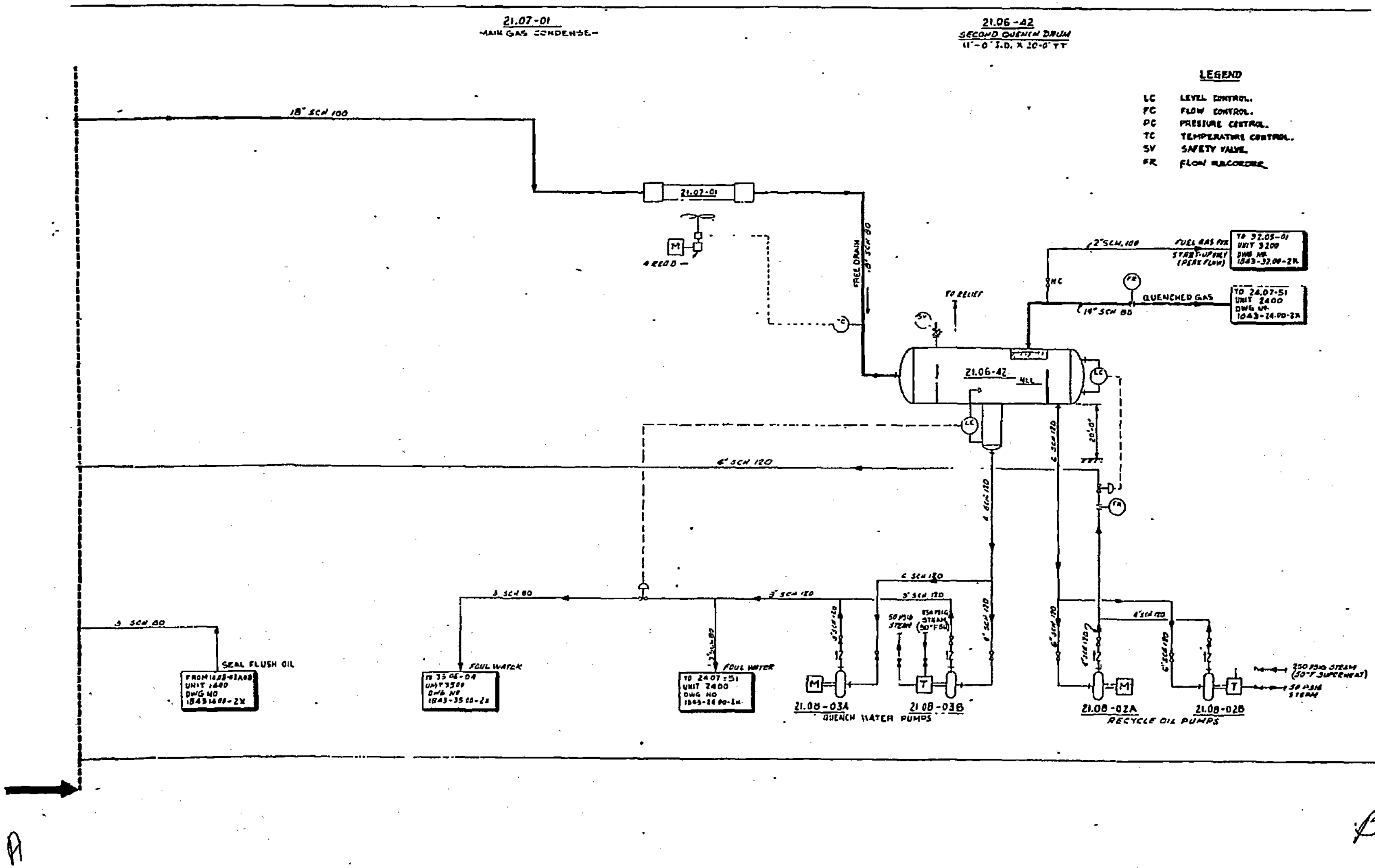
QUENCH NOZZLE



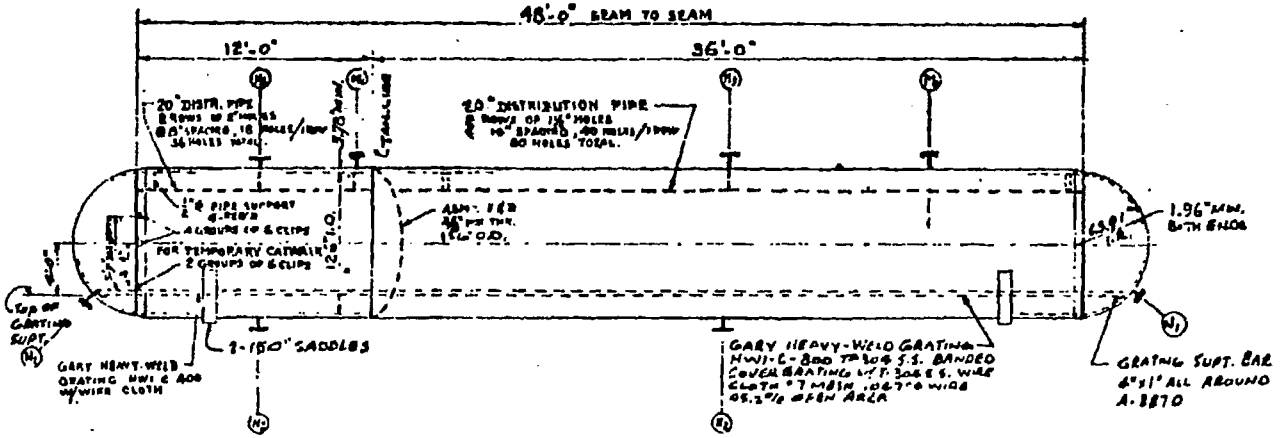


A B C

Preceding page blank



21.07-01
MAIN GAS CONDENSER
21.06-42
SECOND QUENCH DRUM
11'-0" I.D. X 20-0" TT
LEGEND
LC LEVEL CONTROL.
FC FLOW CONTROL.
PC PRESSURE CONTROL.
TC TEMPERATURE CONTROL.
SV SAFETY VALVE.
FR FLOW RECORDER.
18" SCH 100
FREE DRAIN
18" SCH 80
TO RELIEF
FUEL GAS FOR START-UPS (PEAK FLOW)
2" SCH 100
14" SCH 80
QUENCHED GAS
TO 24.07-51 UNIT 2400 DWG NO 1043-24.00-2X
6" SCH 120
SEAL FLUSH OIL
FOUL WATER
FOUL WATER
21.08-03A
21.08-03B
QUENCH WATER PUMPS
21.08-02A
21.08-02B
RECYCLE OIL PUMPS
250 PSIG STEAM (50°F SUPERHEAT)
50 PSIG STEAM



DESIGN DATA		MATERIAL SPECIFICATIONS		ACCESSORIES TO BE SUPPLIED BY FABRICATOR	
CODE	ASME 1971 SECT. VIII DIV. 2	SHELL	SA-387 D N	LADDER AND PLATFORM CLIPS	YES
SPECS		HEADS	SA-387 D N, INTERM. PLATE SA-387 D	INSULATION CLIPS AND RINGS	YES
DESIGN	INT. 1236 PSIG @ 835 °F	SUPPORT	SA-387 D / SA-36	DAVIT SUPPORTS	NO
OPERATING CONDITIONS	EXT. PSIG @ °F	NOZZLE NECKS	SA-106 GR B	PIPE SUPPORT LUGS	NO
DESIGN PRESS	1124 PSIG @ 809 °F	FLANGES	SA-105 GR B	PIPE GUIDE LUGS	NO
RADIOGRAPHY	100% UT YES	INTERNALS	A-387 D N AS NOTED		
POST WELD HEAT TREAT	YES	GASKET	OCT. RING 1/8 CR 1/2 MO	FIREPROOFING	NO
JOINT EFF	100%	MANWAY (INSIDE DIAMETER)		INSULATION	2 1/2" BY OTHERS
CORROSION ALLOWANCE	1/8"	NOTES & REF DWGS.		PAINT	ALONE

NOZZLE NOTE
RADIAL NOZZLE AND MANHOLE PROJECTIONS ARE FROM OD OF VESSEL TO EXTREME FACE OF FLANGE EXCEPT FOR INTEGRAL REINFORCED NOZZLES OR OTHERWISE NOTED
SIZE PROJECTION SIZE PROJECTION
THRU THRU
THRU THRU

MARK NO.	QTY	SIZE	RATING	FACING	SERVICE
N3	2	24"	900#	RTJ	INLET w/ INT. PIPE
N2	2	14"	900#	RTJ	OUTLET
N1	2	10"	900#	RTJ	DRAWING w/ S.S. STUDS NUTS & GASKET
M	2	18"	900#	RTJ	MANHOLE w/ S.S. STUDS, NUTS & GASKET

NOZZLE SCHEDULE

NO.	REVISION	DATE	BY	CK.

Procon Incorporated

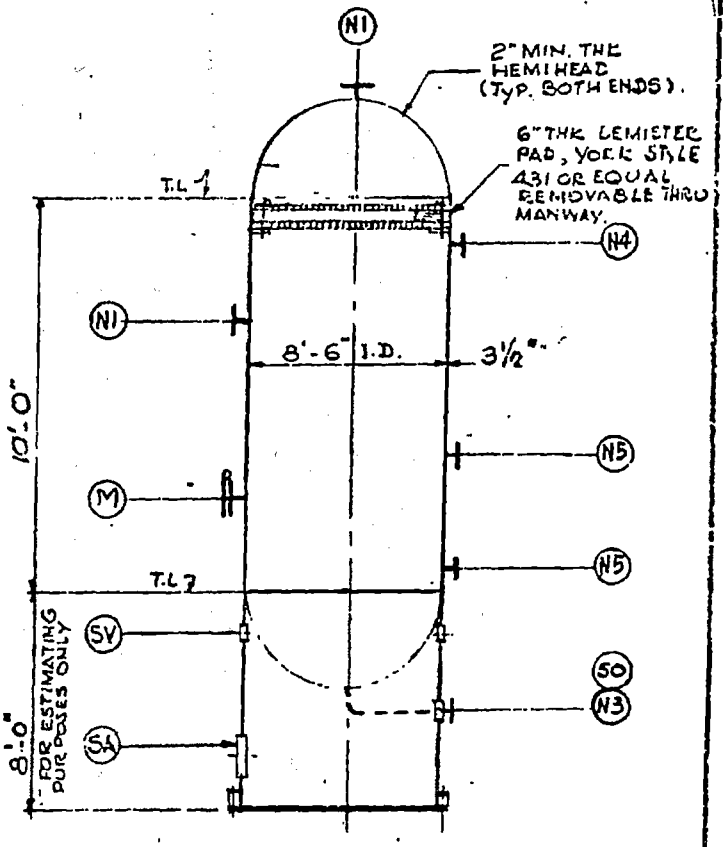
CATALYTIC SHIFT CONVERTER
ITEM NO. 29-06-01 UNIT 2900
HYGAS

I&T CHICAGO, ILL.

DRAWN JEF DATE 1-13-1976
CHECKED
APPROVED

8-B138

DESIGN DATA	
CODE ASME 1971 SECT. VIII. DIV 1.	
SPECS.	
DESIGN CONDITIONS	INT. 1080 PSIG @ 650 °F
	EXT. PSIG @ °F
OPER. PRESS.	PSIG @ 340 °F
RADIOGRAPHY	FULL
POST WELD HEAT TREAT	YES
JOINT EFF. SHELL 100%, HEAD 100%	
CORROSION ALLOWANCE - 1/8"	
NET FAB. WEIGHT	66,470 LBS
EMPTY WEIGHT	
OPER. WEIGHT	
TEST WEIGHT	
MATERIAL SPECIFICATIONS	
SHELL	SA-516-70
HEADS	SA-516-70
SUPPORT	A-36
NOZZLE NECKS	SA-106 Gr B
FLANGES	SA-105 Gr. 1
INTERNALS DEMISTER PAD	
MANWAY (HINGED [illegible])	
ACCESSORIES TO BE SUPPLIED BY FABRICATOR	
LADDER AND PLATFORM CLIPS	YES
DAVIT SUPPORTS	NO
PIPE SUPPORT LUGS	YES
PIPE GUIDE LUGS	YES
FIREPROOFING	-
INSULATION	1½" (BY OTHERS)
PAINT	ONE SHOP COAT PRIMER
LIFTING LUGS	YES



MARK NO.	NO. REQ'D	SIZE	RATING	FACING	SERVICE
50	1	16"	-	-	SKIRT OPENING
SA	1	18"	-	-	SKIRT ACCESS
SV	2	4"	-	-	SKIRT VENTS
M	1	18"	600#	R.F.	MANWAY W/ BF. STUDS, NUTS & GSKT
N5	2	2"	↓	↓	LEVEL CONTROL
N4	1	3"			RELIEF VALVE
N3	1	14"			FLASH LIQ. OUT
N2	1	10"			INLET
N1	1	12"	600#	R.F.	FLASH VAP. OUT

NOZZLE SCHEDULE

RADIAL NOZZLE AND MANHOLE PROJECTIONS ARE FROM O.D. OF VESSEL TO EXTREME FACE OF FLANGE EXCEPT FOR INTERGRAL REINFORCED NOZZLES OR OTHERWISE NOTED

SIZE	PROJECTION	SIZE	PROJECTION
1" THRU 3"	7"	4" THRU 8"	8"
10" THRU 18"	10"	20" THRU CLR	12"

NO.	REVISION	DATE	BY	CHK

Procon Incorporated

CONDENSATE COLLECTION DRUM
ITEM NO 74.06-41
HYGAS

I.G.T. CHICAGO, ILL

DRAWN JG
CHECKED
APPROVED

DATE 1-5-72
REQ. NO 1843-24.06-41

FORM NO. 410 120. 9/70

Procon Incorporated

EXCHANGER DATA SHEET

CUSTOMER	IGT HYGAS PLANT	REQ. No.	
ADDRESS		PAGE No.	
PLANT LOCATION		DATE	3/9/72
		REVISED	
SERVICE OF UNIT	STEAM ECONOMIZER	ITEM NO.	24.07-51
SIZE	TYPE BEU	CONNECTED IN	
SURFACE PER UNIT	2,520 ft.² SHELLS PER UNIT One	SURFACE PER SHELL	2520 ft.²

PERFORMANCE OF ONE UNIT

	SHELL SIDE		TUBE SIDE	
FLUID CIRCULATED	H_2, H.C., & WATER		H_2, H.C., & Steam	
TOTAL FLUID ENTERING	334,608		481,214	
VAPOR	296,086		353,268	
LIQUID	36,900			
STEAM	1,622		127,946	
NON-CONDENSABLES				
FLUID VAPORIZED OR CONDENSED	(1) 36,900(H_2O)		(2) 22,890	
STEAM CONDENSED				
GRAVITY—LIQUID				
VISCOSITY—LIQUID				
MOLECULAR WEIGHT—VAPORS	20.20		19.42	
SPECIFIC HEAT—LIQUIDS		B.T.U./#		B.T.U./#
LATENT HEAT—VAPORS		B.T.U./#		B.T.U./#
TEMPERATURE IN	175	°F	560	°F
TEMPERATURE OUT	345	°F	410	°F
OPERATING PRESSURE	1197	#/SQ. IN.	1152	#/SQ. IN.
NUMBER OF PASSES	One		Two	
VELOCITY		FT./SEC.		FT./SEC.
PRESSURE DROP	5	#/SQ. IN.	5	#/SQ. IN.
Fouling Factor	0.0015		0.0015	

HEAT EXCHANGED—B.T.U./HR. 55,400,000 M.T.D. (Corrected)

TRANSFER RATE—SERVICE CLEAN

CONSTRUCTION

DESIGN PRESSURE	1,250	#/SQ. IN.	1,210	#/SQ. IN.
TEST PRESSURE		#/SQ. IN.		#/SQ. IN.
DESIGN TEMPERATURE	500	°F	650	°F

TUBES C-1/2 Mo NO. 376 U' O.D. 1" BWG. 12Min LENGTH 12' E.S.T. PITCH 1 1/4" Triang.

SHELL C.S. I.D. O.D. 40" THICKNESS

SHELL COVER FLOATING HEAD COVER

CHANNEL C-1/2Mo CHANNEL COVER

TUBE SHEETS—STATIONARY C-1/2 Mo FLOATING

BAFFLES—CROSS C.S. TYPE Double Seg. THICKNESS

BAFFLE—LONG TYPE THICKNESS

TUBE SUPPORTS THICKNESS

GASKETS

CONNECTIONS—SHELL—IN OUT SERIES 600 #R.F.

CHANNEL—IN OUT SERIES 900 #R.F.

CORROSION ALLOWANCE—SHELL SIDE 1/8" TUBE SIDE 1/8"

CODE REQUIREMENTS A.S.M.E. Sec. VIII: Code Stamp TEMA CLASS R

WEIGHTS—EACH SHELL BUNDLE FULL OF WATER

NOTE: INDICATE AFTER EACH PART WHETHER STRESS RELIEVED (S. R.) AND WHETHER RADIOGRAPHED (X-R)

REMARKS: (1) Assume straight line vaporization curve.
(2) See attached cooling curve.

FORM NO. 410-128, 9/78

Procon Incorporated

EXCHANGER DATA SHEET

			REQ. No.
CUSTOMER	IGT HYGAS PLANT		PAGE No.
ADDRESS			DATE
PLANT LOCATION			REVISED
SERVICE OF UNIT	ECONOMIZER SUPERHEATER		ITEM NO. 24.07-52
SIZE	TYPE BEU		CONNECTED IN
SURFACE PER UNIT	2100 Ft.^{2}	SHELLS PER UNIT One	SURFACE PER SHELL 2100 Ft.^{2}

PERFORMANCE OF ONE UNIT

	SHELL SIDE		TUBE SIDE	
FLUID CIRCULATED	H_2, H. C. & Steam.		H_2, H.C. & Steam.	
TOTAL FLUID ENTERING Lb./Hr.	334,610		481,210.	
VAPOR	302,026		353,265	
LIQUID				
STEAM	32,584		127,945	
NON-CONDENSABLES				
FLUID VAPORIZED OR CONDENSED				
STEAM CONDENSED				
GRAVITY—LIQUID				
VISCOSITY—LIQUID				
MOLECULAR WEIGHT—VAPORS	20.11		19.42	
SPECIFIC HEAT—LIQUIDS		B.T.U./#		B.T.U./#
LATENT HEAT—VAPORS		B.T.U./#		B.T.U./#
TEMPERATURE IN	345	°F	660	°F
TEMPERATURE OUT	505	°F	560	°F
OPERATING PRESSURE	1189	#/SQ. IN.	1,157	#/SQ. IN.
NUMBER OF PASSES	1		2	
VELOCITY		FT./SEC.		FT./SEC.
PRESSURE DROP	5	#/SQ. IN.	5	#/SQ. IN.
Fouling Factor	0.0015		0.0015	

HEAT EXCHANGED—B.T.U./HR. 24.75 X 10^6 M.T.D. (Corrected)

TRANSFER RATE—SERVICE CLEAN

CONSTRUCTION

DESIGN PRESSURE	1250	#/SQ. IN.	1210	#/SQ. IN.
TEST PRESSURE		#/SQ. IN.		#/SQ. IN.
DESIGN TEMPERATURE	650	°F	700	°F

TUBES C - 1/2 Mo NO. 376 O.D. 1" BWG 12 MIN. LENGTH 10'ESTL PITCH 1 1/4" △

SHELL C - 1/2 Mo I.D. 40" THICKNESS

SHELL COVER FLOATING HEAD COVER

CHANNEL C - 1/2 Mo CHANNEL COVER

TUBE SHEETS—STATIONARY C - 1/2 Mo FLOATING

BAFFLES—CROSS C-1/2 Mo TYPE Double Seg. THICKNESS

BAFFLES—LONG TYPE THICKNESS

TUBE SUPPORTS THICKNESS

GASKETS

CONNECTIONS—SHELL—IN OUT SERIES 900 #R.F.

CHANNEL—IN OUT SERIES 900 #R.F.

CORROSION ALLOWANCE—SHELL SIDE 1/8" TUBE SIDE 1/8"

CODE REQUIREMENTS ASME Sec. VIII; Code Stamp TEMA CLASS R

WEIGHTS—EACH SHELL BUNDLE FULL OF WATER

NOTE: INDICATE AFTER EACH PART WHETHER STRESS RELIEVED (S. R.) AND WHETHER RADIOGRAPHED (X-R)

REMARKS:

FORM NO. 410-120. 9/70

Procon Incorporated

EXCHANGER DATA SHEET

CUSTOMER	IGT HYGAS PLANT			REQ. No.	
ADDRESS				PAGE No.	
PLANT LOCATION				DATE	3/7/1972
				REVISED	
SERVICE OF UNIT	Feed Effluent Exchanger			ITEM NO.	24.07-53
SIZE		TYPE	BJU	CONNECTED IN	
SURFACE PER UNIT	4,950 Ft.^{2}	SHELLS PER UNIT	One	SURFACE PER SHELL	4,950 Ft.^{2}

PERFORMANCE OF ONE UNIT

	SHELL SIDE		TUBE SIDE	
FLUID CIRCULATED	H_2, H.C., & Steam		H_2, H.C. & Steam	
TOTAL FLUID ENTERING Lb./Hr.	481,210		481,210	
VAPOR	302,085		353,265	
LIQUID				
STEAM	179,125		127,945	
NON-CONDENSABLES				
FLUID VAPORIZED OR CONDENSED				
STEAM CONDENSED				
GRAVITY—LIQUID				
VISCOSITY—LIQUID				
MOLECULAR WEIGHT—VAPORS	19.42		19.42	
SPECIFIC HEAT—LIQUIDS		B.T.U./#		B.T.U./#
LATENT HEAT—VAPORS		B.T.U./#		B.T.U./#
TEMPERATURE IN	510	°F	825	°F
TEMPERATURE OUT	650	°F	660	°F
OPERATING PRESSURE	1182	#/SQ. IN.	1162	#/SQ. IN.
NUMBER OF PASSES	Divided		Two	
VELOCITY		FT./SEC.		FT./SEC.
PRESSURE DROP	5	#/SQ. IN.	5	#/SQ. IN.
Fouling Factor	0.0015		0.0015	

HEAT EXCHANGED—B.T.U./HR. 41,230,000 M.T.D. (Corrected)

TRANSFER RATE—SERVICE CLEAN

CONSTRUCTION

DESIGN PRESSURE	1250	#/SQ. IN.	1230	#/SQ. IN.
TEST PRESSURE		#/SQ. IN.		#/SQ. IN.
DESIGN TEMPERATURE	700	°F	850	°F

TUBES C-1/2 Mo NO. 590U's O.D. 1" BWG 12Min LENGTH 16'ESTL. PITCH 1 1/4" △

SHELL C-1/2 Mo I.D. 50" THICKNESS

SHELL COVER FLOATING HEAD COVER

CHANNEL C-1/2 Mo CHANNEL COVER

TUBE SHEETS—STATIONARY C- 1/2 Mo FLOATING

BAFFLES—CROSS C- 1/2 Mo TYPE THICKNESS

BAFFLE—LONG TYPE THICKNESS

TUBE SUPPORTS THICKNESS

GASKETS

CONNECTIONS—SHELL—IN OUT SERIES 900 #R.F.

CHANNEL—IN OUT SERIES 1,500#R.F.

CORROSION ALLOWANCE—SHELL SIDE 1/8" TUBE SIDE 1/8"

CODE REQUIREMENTS A.S.M.E. Sec. VIII; Code Stamp TEMA CLASS R

WEIGHTS—EACH SHELL BUNDLE FULL OF WATER

NOTE: INDICATE AFTER EACH PART WHETHER STRESS RELIEVED (S. R.) AND WHETHER RADIOGRAPHED (X-R)

REMARKS:

FORM NO. 410-320, 9/70

Procon Incorporated

EXCHANGER DATA SHEET

CUSTOMER	IGT HYGAS PLANT	REQ. No.	
ADDRESS		PAGE No.	
PLANT LOCATION		DATE	3/8/72
SERVICE OF UNIT	WASTE HEAT STEAM GENERATOR	REVISED	
SIZE	TYPE BKU	ITEM NO.	24.07-54
SURFACE PER UNIT	5,250Ft.^{2} SHELLS PER UNIT One	CONNECTED IN	
		SURFACE PER SHELL	5,250 Ft.^{2}

PERFORMANCE OF ONE UNIT

	SHELL SIDE		TUBE SIDE	
FLUID CIRCULATED	Boiler Feed Water		H_2, HC and Steam	
TOTAL FLUID ENTERING LB./HR.	69,732		481,214	
VAPOR			353,268	
LIQUID(Includes 5% B.D.)	69,732		22,890	
STEAM			105,056	
NON-CONDENSABLES				
FLUID VAPORIZED OR CONDENSED	66,252		(1) 68,665	
STEAM CONDENSED				
GRAVITY—LIQUID				
VISCOSITY—LIQUID				
MOLECULAR WEIGHT—VAPORS	18.0		19.42	
SPECIFIC HEAT—LIQUIDS		B.T.U./#		B.T.U./#
LATENT HEAT—VAPORS		B.T.U./#		B.T.U./#
TEMPERATURE IN	180	°F	410	°F
TEMPERATURE OUT	297	°F	340	°F
OPERATING PRESSURE	50	#/SQ. IN.	1140	#/SQ. IN.
NUMBER OF PASSES	One		TWO	
VELOCITY		FT./SEC.		FT./SEC.
PRESSURE DROP	Nil	#/SQ. IN.	5	#/SQ. IN.
Fouling Factor	0.0005		0.0015	

HEAT EXCHANGED—B.T.U./HR. 71,910,000 M.T.D. (Corrected)

TRANSFER RATE—SERVICE CLEAN

CONSTRUCTION

DESIGN PRESSURE	120	#/SQ. IN.	1,200	#/SQ. IN.
TEST PRESSURE		#/SQ. IN.		#/SQ. IN.
DESIGN TEMPERATURE	650	°F	500	°F

TUBES C.S. NO. 486U's O.D. 1" BWG. 12Min LENGTH 20'ESTL PITCH 1 1/4" Triang.

SHELL C.S I.D.46"/78" THICKNESS

SHELL COVER FLOATING HEAD COVER

CHANNEL C.S. CHANNEL COVER

TUBE SHEETS—STATIONARY C.S. FLOATING

BAFFLES—CROSS C.S. TYPE THICKNESS

BAFFLE—LONG TYPE THICKNESS

TUBE SUPPORTS THICKNESS

GASKETS

CONNECTIONS—SHELL—IN OUT SERIES 150 # R.F.

CHANNEL—IN OUT SERIES 600 # R.F.

CORROSION ALLOWANCE—SHELL SIDE 1/8" TUBE SIDE 1/8"

CODE REQUIREMENTS A.S.M.E., Sec. VIII; Code Stamp TEMA CLASS R

WEIGHTS—EACH SHELL BUNDLE FULL OF WATER

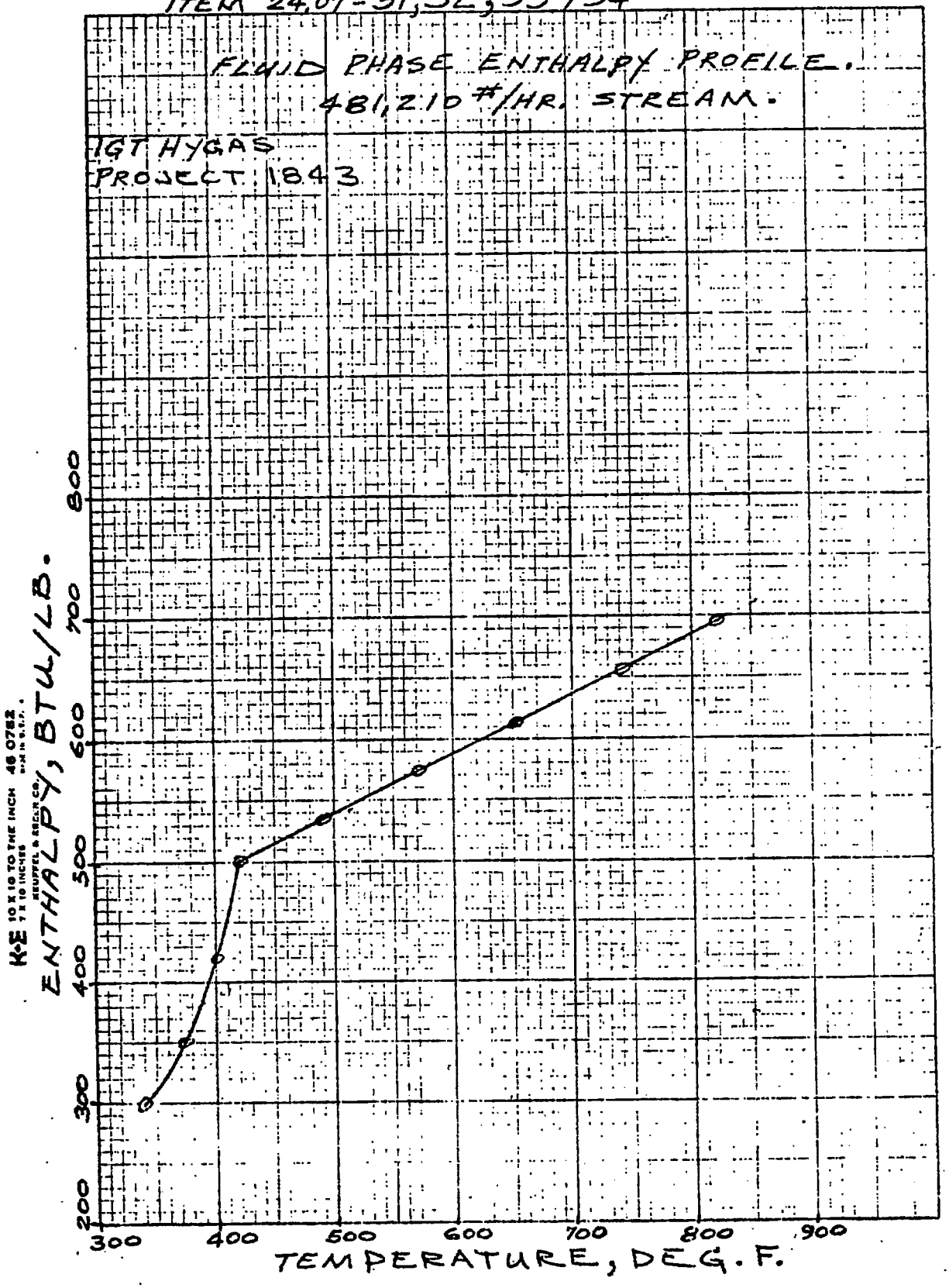
NOTE: INDICATE AFTER EACH PART WHETHER STRESS RELIEVED (S. R.) AND WHETHER RADIOGRAPHED (X-R)

REMARKS: (1) See Attached Cooling Curve.

ITEM 24.07-51, 52, 53 & 54

FLUID PHASE ENTHALPY PROFILE.
481,210 #/HR. STREAM.

IGT HYGAS
PROJECT 1843



PROCON

STANDARD DATA SHEET FOR CENTRIFUGAL PUMPS

NO. 1843-24.08-1
SHEET NO. 1
TOTAL SHEETS 1
DATE 1-25-72 EJM
APPROVED

FOR IGT - HYGAS PLANT ITEM NO. 24.08-01
SITE UNIT 2400
SERVICE START UP CHARGE PUMP MOTOR DRIVE TURBINE DRIVE
PUMP MFR SIZE AND TYPE NO. REQ'D 1

OPERATING CONDITIONS

LIQUID De AERATED, TREATED B.F. WATER, pH 7.5 To 8.5 — U.S. gpm at PT, NOR 50 DES 60
DISCH PRESS., psig 1085
PT F 180 — SUCT PRESS., psig MAX DES 50
SP GR at PT 0.97 — DIFF PRESS., psi 1035
VAP PRESS. at PT, psia 7.5 — DIFF HEAD, ft 2465
VIS at PT, Sau NPSH AVAIL., ft 15
CORR/EROS caused by

CONSTRUCTION AND MATERIALS

CASING-MOUNTING (CENTERLINE) (FOOT) (BRACKET) (VERTICAL X IN-LINE)
SPLIT (AXIAL) (RADIAL X)
TYPE (1) (SINGLE VOLUTE) (DOUBLE VOLUTE) (DIFFUSER)
TAPPED OPENINGS (VENT X) (DRAIN X) (GAGE CONNS.)

NOZZLES	SIZE	ASA RATING	FACING	POSITION
SUCTION				
DISCHARGE				

IMPELLER DIAM DES MAX TYPE STD. W/INDUCER
MFR'S BEARING NO. RADIAL THRUST
COUPLING and GUARD STD. ARRANGEMENT BASE PLATE INCL MTG. PLATE
PACKING —
MECH SEAL YES, BAL. CLASS. CODE MFR

MATERIAL CODE—EXTERNAL CASING S INTERNAL PARTS (2)

1—CAST IRON
B—BRONZE
S—STEEL
C—11-13% CHROME
A—ALLOY
h—HARDENED
f—FACED
X—

INTERNALS CODE					X
IMPELLER	I	B	S	C	
INNER CASE PARTS	I	I	S	C	
SLEEVE (PACKED)	Ch	Ch	Af	Af	
SLEEVE (SEAL)	C	C	C	C	
WEAR PARTS	I	B	Ch	Ch	
SHAFT	S	S	S	S	

PERFORMANCE

PROPOSAL CURVE NO.
NPSH REQ'D (WATER), ft
NO. OF STAGES RPM
DES EFF BHP
MAX BHP DES IMP
MAX HEAD DES IMP, ft
MIN CONTINUOUS, gpm (BY MFR) (2)
ROTATION FACING COUPLING END
WATER COOLING YES
BEARINGS
STUFF. BOX
GEAR BOX COOLER
TOTAL WATER REQ'D, gpm (2)
PACKING COOLING
FLUSHING
AUX PIPING BY PUMP MFR.
API SEAL PIPING PLAN 31 (WITH INTEGRAL CENT. SEPARATOR)

SHOP TESTS	REQUIRED	WITNESSED
RUNNING PERF	X	
NPSH		

HYDROSTATIC PSIG
MAX ALLOW. WP PSIG F
WEIGHTS: PUMP BASE
MOTOR TURBINE

MOTOR DRIVER BY Pump MFR.

ITEM NO. -01 MTD BY PUMP MFR.
HP RPM FRAME
MFR
TYPE SCI INSUL. B
ENC TEFC TEMP RISE C 80
VOLTS/PHASE/CYCLES 460/3/60
BEARINGS LUBE
FULL LOAD AMPS

TURBINE DRIVER BY

ITEM NO. MTD BY
HP RPM MAT'L
MFR and TYPE
INLET STEAM, psig TEMP F
EXHAUST
STEAM RATE, FL lb/BHP/HR
BEARINGS LUBE

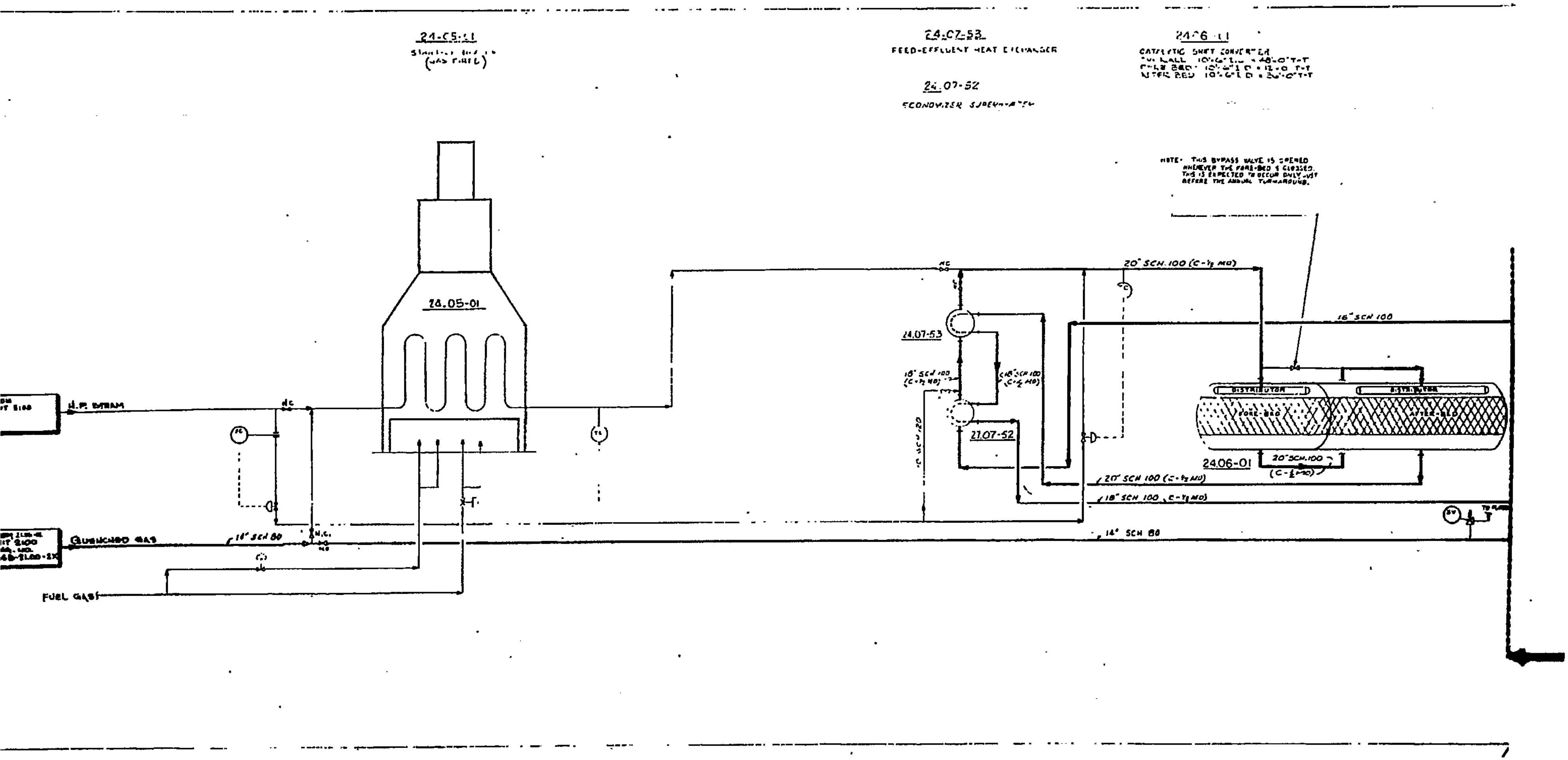
NOZZLES	SIZE	ASA RATING	FACING	POSITION
INLET				
EXHAUST				

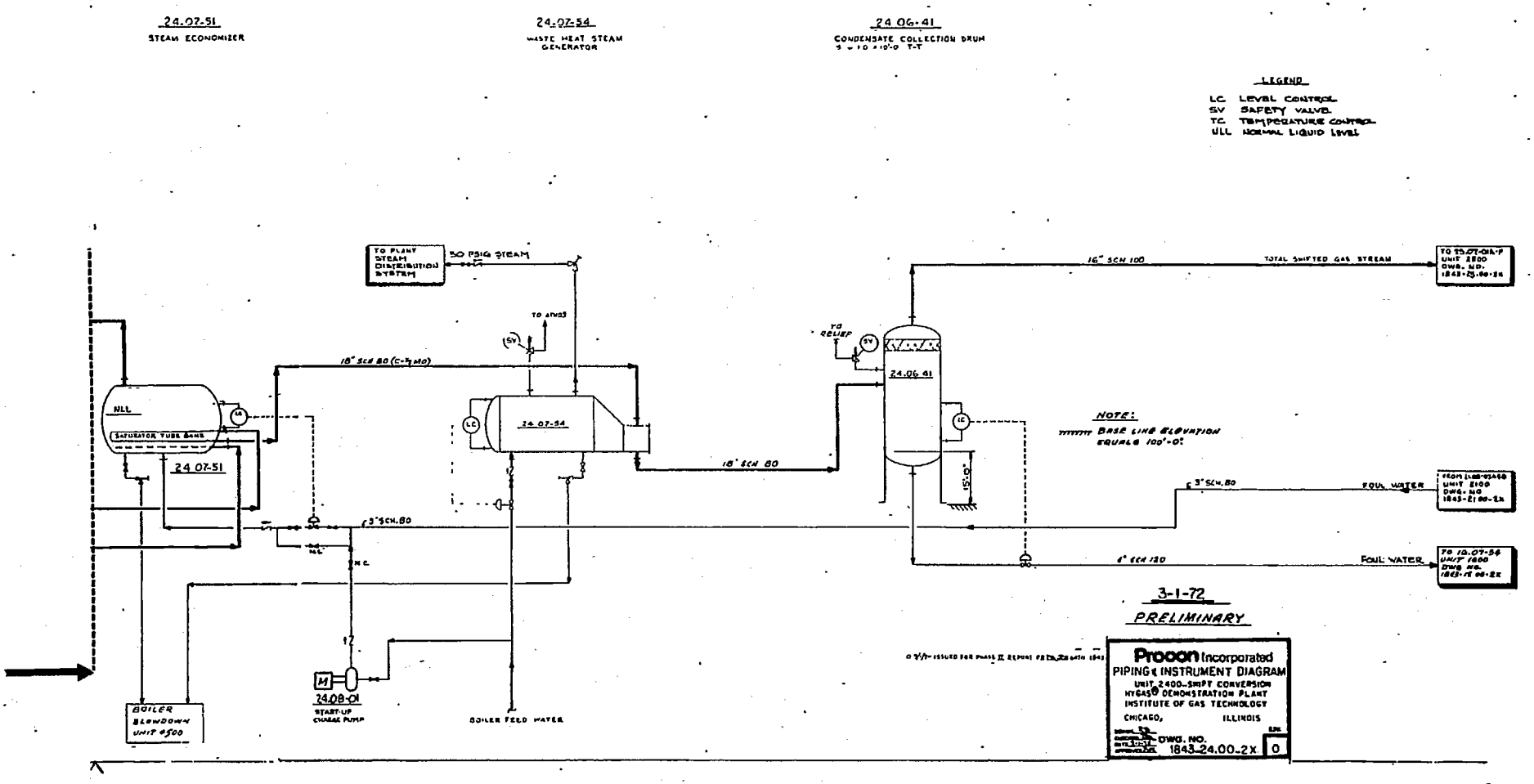
MFR FINAL DATA (AS BUILT)

ACTUAL IMPELLER DIAM
TEST CURVE NO.
OUTLINE DWG NO.
PUMP SECT. DWG NO.
SEAL DIAM DWG NO.
PUMP SERIAL NO.

API STD. 610 GOVERNS UNLESS OTHERWISE STATED.
EXCEPTIONS (ITEMIZE): (1) FURNISH SUNDYNE (2) MFR. TO ADVISE

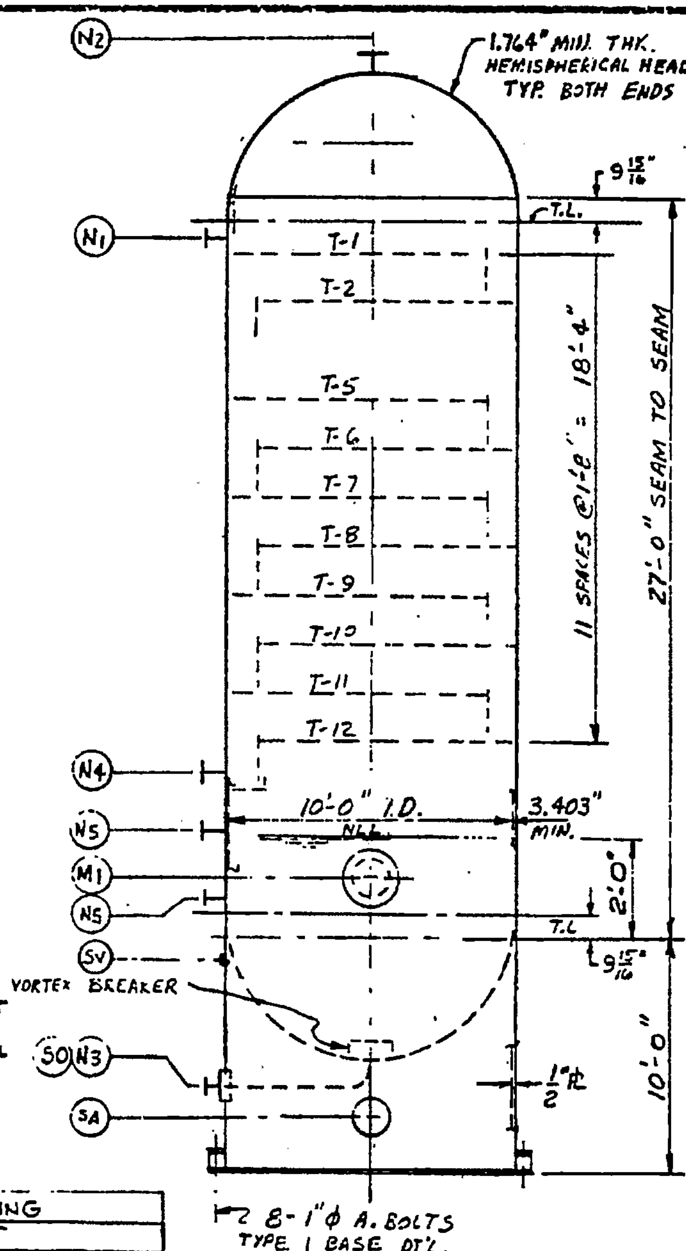
REV.	DATE	APPROVED	REV.	DATE	APPROVED	REV.	DATE	APPROVED


24-05-01
24-07-53
FEED-EFFLUENT HEAT EXCHANGER
24-07-52
ECONOMIZER SUPERHEATER
CATALYTIC SHIFT CONVERTER
24.05-01
24.07-53
21.07-52
24.06-01
DISTRIBUTOR
FORE-BED
AFTER-BED
NOTE: THIS BYPASS VALVE IS OPENED WHENEVER THE FORE-BED IS CLOSED. THIS IS EXPECTED TO OCCUR ONLY JUST BEFORE THE ANNUAL TURNAROUND.
20" SCH.100 (C-½ MO)
16" SCH 100
20" SCH 100 (C-½ MO)
18" SCH 100 (C-½ MO)
14" SCH 80
H.P. STEAM
QUENCHED GAS
FUEL GAS


24-07-51
STEAM ECONOMIZER
24-07-54
WASTE HEAT STEAM GENERATOR
24-06-41
CONDENSATE COLLECTION DRUM
LEGEND
LC LEVEL CONTROL
SV SAFETY VALVE
TC TEMPERATURE CONTROL
NLL NORMAL LIQUID LEVEL
TO PLANT STEAM DISTRIBUTION SYSTEM
50 PSIG STEAM
TO ATMOS
SV
18" SCH 80 (C-½ MO)
NLL
SATURATOR TUBE BANK
LC
24-07-51
24-07-54
18" SCH 80
TO RELIEF
SV
24-06-41
LC
15'-0"
16" SCH 100
TOTAL SHIFTED GAS STREAM
NOTE:
BASE LINE ELEVATION EQUALS 100'-0"
3" SCH. 80
FOUL WATER
4" SCH 120
FOUL WATER
3" SCH. 80
NLL
N.C.
M
24-08-01
START-UP CHARGE PUMP
BOILER FEED WATER
BOILER BLOWDOWN UNIT 6500
3-1-72
PRELIMINARY
Procon Incorporated
PIPING & INSTRUMENT DIAGRAM
UNIT 2400-SHIFT CONVERSION
HYGAS® DEMONSTRATION PLANT
INSTITUTE OF GAS TECHNOLOGY
CHICAGO, ILLINOIS
DWG. NO.
1843-24.00-2X
0

DESIGN DATA	
CODE	ASME SECT. VIII DIV. 2 1971
SPECS.	
DESIGN CONDITIONS	INT. 1210 PSIG @ 250 °F
	EXT. PSIG @ °F
OPER. PRESS.	1100 PSIG @ 200 °F
RADIOGRAPHY	FULL
POST WELD HEAT TREAT	YES
JOINT EFF.	100%
CORROSION ALLOWANCE	1/8"
NET FAB. WEIGHT	168,700#
EMPTY WEIGHT	203,800#
OPER. WEIGHT	
TEST WEIGHT	
MATERIAL SPECIFICATIONS	
SHELL	SA-515-70
HEADS	SA-515-70
SUPPORT	SA-283-C
NOZZLE NECKS	SA-106-B
FLANGES	SA-105-I
INTERNALS	C.S
MANWAY (HINGED ~~[illegible]~~)	
ACCESSORIES TO BE SUPPLIED BY FABRICATOR	
LADDER AND PLATFORM CLIPS	YES
DAVIT SUPPORTS	NO
PIPE SUPPORT LUGS	YES
PIPE GUIDE LUGS	YES
FIREPROOFING	YES
INSULATION	NO
PAINT	ONE S/C PRIMER

VESSEL FABR. TO SUPPLY TRAY SUPPORT RINGS; TRAYS WILL BE FURNISHED BY OTHERS BUT INSTALLED BY VESSEL FABR.



MARK NO	NO REQ'D	SIZE	RATING	FACING	SERVICE
SO	1	6"	—	—	SKIRT OPENING
SV	4	4"	—	—	SKIRT VENT
SA	1	20"	—	—	SKIRT ACCESS
N5	2	2"	600#	RF	LEVEL CONNS
N4	1	20"	↓	↓	VAPOR INLET
N3	1	4"			LIQUID OUTLET
N2	1	20"			VAPOR OUTLET
N1	1	4"	↓	↓	INLET
M1	1	18"	600#	RF	MANHOLE W/BF, STUDS, NUTS & GSKT

NOZZLE SCHEDULE

[illegible] OF VESSEL TO EXTREME FACE OF FLANGE EXCEPT FOR INTEGRAL REINFORCED NOZZLES OR OTHERWISE NOTED

SIZE	PROJECTION	SIZE	PROJECTION
___ THRU ___	___	___ THRU ___	___
___ THRU ___	___	___ THRU ___	___

NO.	REVISION	DATE	BY	CK

Procon Incorporated

AMMONIA SCRUBBER

ITEM NO 25.06-01 : UNIT 2500

HYGAS

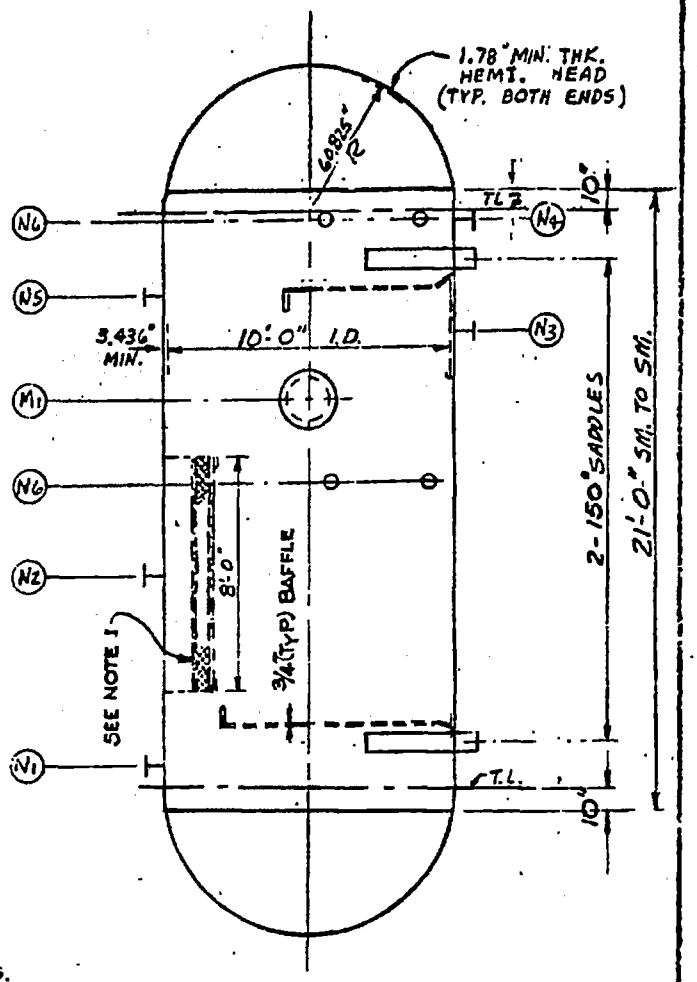
IGT CHICAGO, ILL.

DRAWN BEM DATE 2-4-72

CHECKED

APP. ... R. REQ'N # 1843-25.06-1

DESIGN DATA		
CODE ASME SECT. VIII DIV. 2 1971		
SPECS.		
DESIGN CONDITIONS	INT 1222 PSIG @ 250 °F	
	EXT. PSIG @ °F	
OPER. PRESS.	PSIG @ °F	
RADIOGRAPHY	FULL	
POST WELD HEAT TREAT	YES	
JOINT EFF.	100%	
CORROSION ALLOWANCE	1/8"	
NET FAB. WEIGHT	137,600 #	
EMPTY WEIGHT		
OPER. WEIGHT		
TEST WEIGHT		
MATERIAL SPECIFICATIONS		
SHELL	SA-515-70	
HEADS	SA-515-70	
SUPPORT	SA-283-C	
NOZZLE NECKS	SA-106-B	
FLANGES	SA-105-1	
INTERNALS	SA 283C OR SA-36.	
DEMISTER T-304 SS		
MANWAY (HINGED [redacted])		
ACCESSORIES TO BE SUPPLIED BY FABRICATOR		
LADDER AND PLATFORM CLIPS	NO	
DAVIT SUPPORTS	NO	
PIPE SUPPORT LUGS	NO	
PIPE GUIDE LUGS	NO	
FIREPROOFING	NO	
INSULATION	NO	
PAINT ONE SHOP COAT PRIMER		



NOTES. 1. DEMISTER, YORK STYLE 431 OR EQUAL. TOP & BOT. GRATING. REMOVABLE THROUGH MANWAY.

MARK	NO.	SIZE	RATING	FACING	SERVICE
N6	4	2"	600#	RF	LEVEL CONTROL
N5	1	4"			RELIEF VALVE
N4	1	3"			LIQUID OUT
N3	1	4"			AQUEOUS LIQUID OUT
N2	1	20"			VAPOR OUT
N1	1	24"			INLET
M1	1	18	600#	RF	MANWAY W/ BF. STUDS, NUTS & GSKT

NOZZLE SCHEDULE

ALL NOZZLE AND MANWAY PROJECTIONS ARE FROM OUTSIDE OF VESSEL TO EXTREME FACE OF FLANGE EXCEPT FOR INTERNAL REINFORCED NOZZLES OR OTHERWISE NOTED

SIZE	PROJECTION	SIZE	PROJECTION
THRU		THRU	
THRU		THRU	

NO.	REVISION	DATE	BY	CK.

Procon Incorporated

FLASH DRUM AND DECANTER

ITEM NO. 25.06-41 UNIT 2500

HYGAS

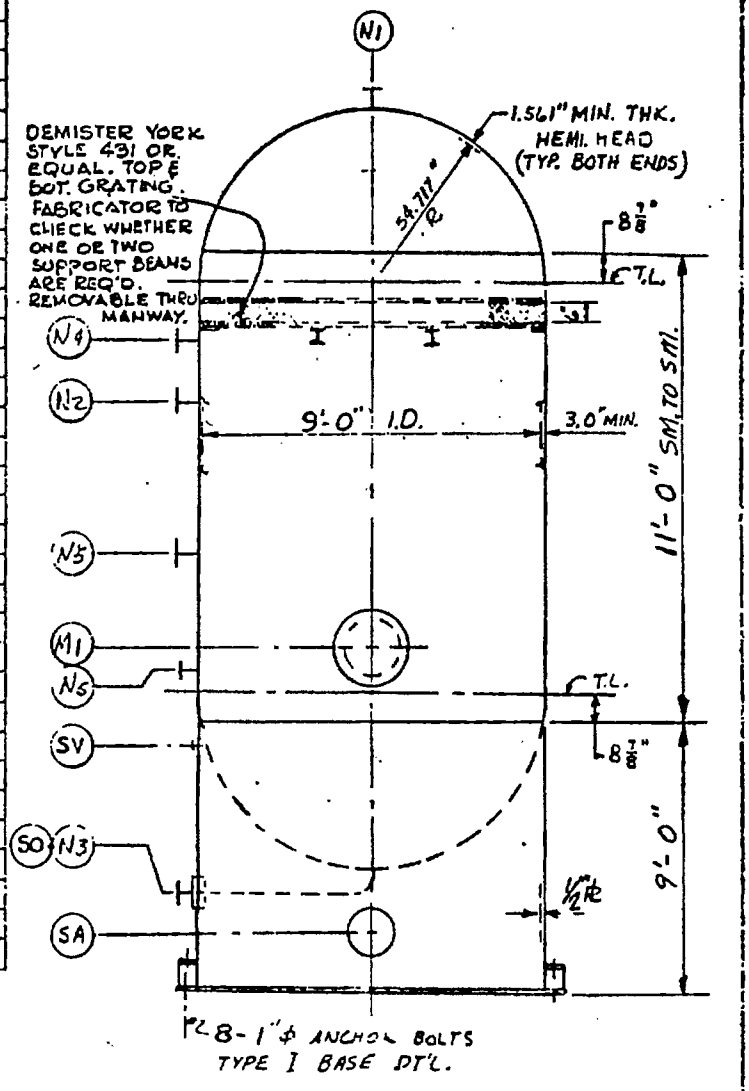
IGT CHICAGO, ILL.

DRAWN RCM DATE 2-7-72

CHECKED

APPROVED VP REQ'N NO. 1843-25.06-41

DESIGN DATA			
CODE	ASME SECT. VIII DIV. 2 1971		
SPECS.			
DESIGN CONDITIONS	INT.	1140 PSIG @ 150 °F	
	EXT.	PSIG @	°F
OPER. PRESS.		PSIG @	°F
RADIOGRAPHY	FULL		
POST WELD HEAT TREAT	YES		
JOINT EFF.	100 %		
CORROSION ALLOWANCE	1/8"		
NET FAB WEIGHT	60,800 #		
EMPTY WEIGHT			
OPER. WEIGHT			
TEST WEIGHT			
MATERIAL SPECIFICATIONS			
SHELL	SA-515-70		
HEADS	SA-515-70		
SUPPORT	SA-283-C		
NOZZLE NECKS	SA-106-B		
FLANGES	SA-105-1		
INTERNALS	CS; DEMISTER TP 304 SS		
BEAMS	SA-36		
MAN WAY (HINGED ~~BOLTED~~)			
ACCESSORIES TO BE SUPPLIED BY FABRICATOR			
LADDER AND PLATFORM CLIPS	NO		
DAVIT SUPPORTS	NO		
PIPE & PIPE SUPPORTS	NO		
FIRE HOSE LINES	NO		
FIRE PROOFING	YES		
INSULATION	NO		
PAINT	ONE SHOP COAT PRIMER		



MARK NO	NO. REQ'D	SIZE	RATING	FACING	SERVICE
SV	1	4"	—	—	SKIRT VENT
SA	1	18"	—	—	SKIRT ACCESS
N5	2	2"	600#	RF	LEVEL CONTROL
N4	1	4"	600#	RF	RELIEF VALVE
N3	1	2"	600#	RF	LIQUID OUTLET
N2	1	20"	600#	RF	INLET
N1	1	18"	600#	RF	VAPOR OUTLET
M1	1	18"	600#	RF	MANHOLE

NOZZLE SCHEDULE

ALL NOZZLE PROJECTIONS ARE MEASURED TO OUTSIDE FACE OF FLANGE EXCEPT FOR INTEGRAL REINFORCED NOZZLES OR OTHERWISE NOTED

SIZE	PROJECTION	SIZE	PROJECTION
THRU		THRU	
THRU		THRU	

NO.	REVISION	DATE	BY	CK

Procon Incorporated

OIL KNOCKOUT DRUM

ITEM NO 25.06-42 UNIT 2500

NYGAS

IGT CHICAGO, ILL.

DRAWN GEM DATE 2-7-72

CHECKED

APPROVED VR. REQ'N. NO. 1843-25.06-42

AIR-COOLED EXCHANGER SPECIFICATION

Procon Incorporated

Customer: IGT ≥ HYGAS PLANT

Date: ____ Engr: ____ Item No. 25.07-01

Service: Main Cooler Condenser

Units: ____ Model: ____ ~~XXXXX~~ Forced Draft No of Bays: 4

Surface Item: External 127,400 Ft.2 Approx. Bare Tube: ____ Sq Ft.

Heat Exchanged: ____ BTU Hr 99.17 x 10^6 Effective MTD: ____ °F

Transfer Rate: External Surface: ____ Bare Tube Surface: ____ BTU/Hr. Sq. Ft. °F

PERFORMANCE DATA

TUBE SIDE

Fluid Circulated	H_2 + H.C. + Steam	Temperature In	360 °F
Total Fluid Entering Lbs Hr.	565,860	Temperature Out	180 °F
Vapor	510,730	Inlet Pressure	1135 ~~psig~~ psig
Liquid		Gravity – Liquid	0.805 (Liq.)
Steam	55,130	Viscosity	Cps @ °F
Non-Condensables		Viscosity	Cps @ °F
Vapor Condensed	5,400	Molecular Weight	21.9 Vap.
Steam Condensed	54,075	Allowable Press Drop	15 psi
Fouling Res I S Hr Sq Ft. °F BTU	0.003	Design Pressure Drop	psi

AIR SIDE

Air Quantity Item Lbs Hr		Temperature In	95 °F
Air Quantity Fan ACFM		Temperature Out	°F
		Altitude	Ft.

CONSTRUCTION

Design Pressure 1200 PSI	Test Pressure ASME Code 1800	Design Temperature	500 °F
SECTION	**HEADER**	**TUBE**	
Size 12 x 30	Type Plug.	Material	C.S.
No Item 4	Material C.S.	OD 1 In	13 BWG Min. Wall
Tube Support – Zn-AL Filled Bands	No Rows Passes	No Section	
STRUCTURE – Carbon Steel	Plugs – Shoulder C.S. Material	Length	30 Ft.
Surface Prep – Wire Brush	Gasket Material Solid Metal	Pitch	In. △
	Corrosion Allowance 1/8" In	**FIN**	
Finish – One Coat Primer	Size Inlet Nozzle In	Material	AL
	Size Outlet Nozzle In.	Height	2½" O.D.
Fan Guards	Series 600# R.F.	No In.	
Belt Guards	Vent & Drain Conn	Type	
Coupling Guards	Code ASME ☒ Stamp Reqd Sec. VIII		

MECHANICAL EQUIPMENT

FAN MFGR		**DRIVER** Motor		**SPEED REDUCER**	
Model		Type		Type	
No. 'Bay	No Item	No Item 8	HP 'Driver 25	No. Item	
BHP Each	BHP Total	RPM		Model	
Diameter ft	RPM	Enclosure T.E.F.C.		AGMA HP Rating	
No Blades	Pitch	Volt Phase Cycle		Ratio	
Blade Material		Mfgr Vendor Option – NEMA		Mfgr.	
Hub Material				Support	
Man. Adj	Auto Variable	Vib Switch Not Req'd			

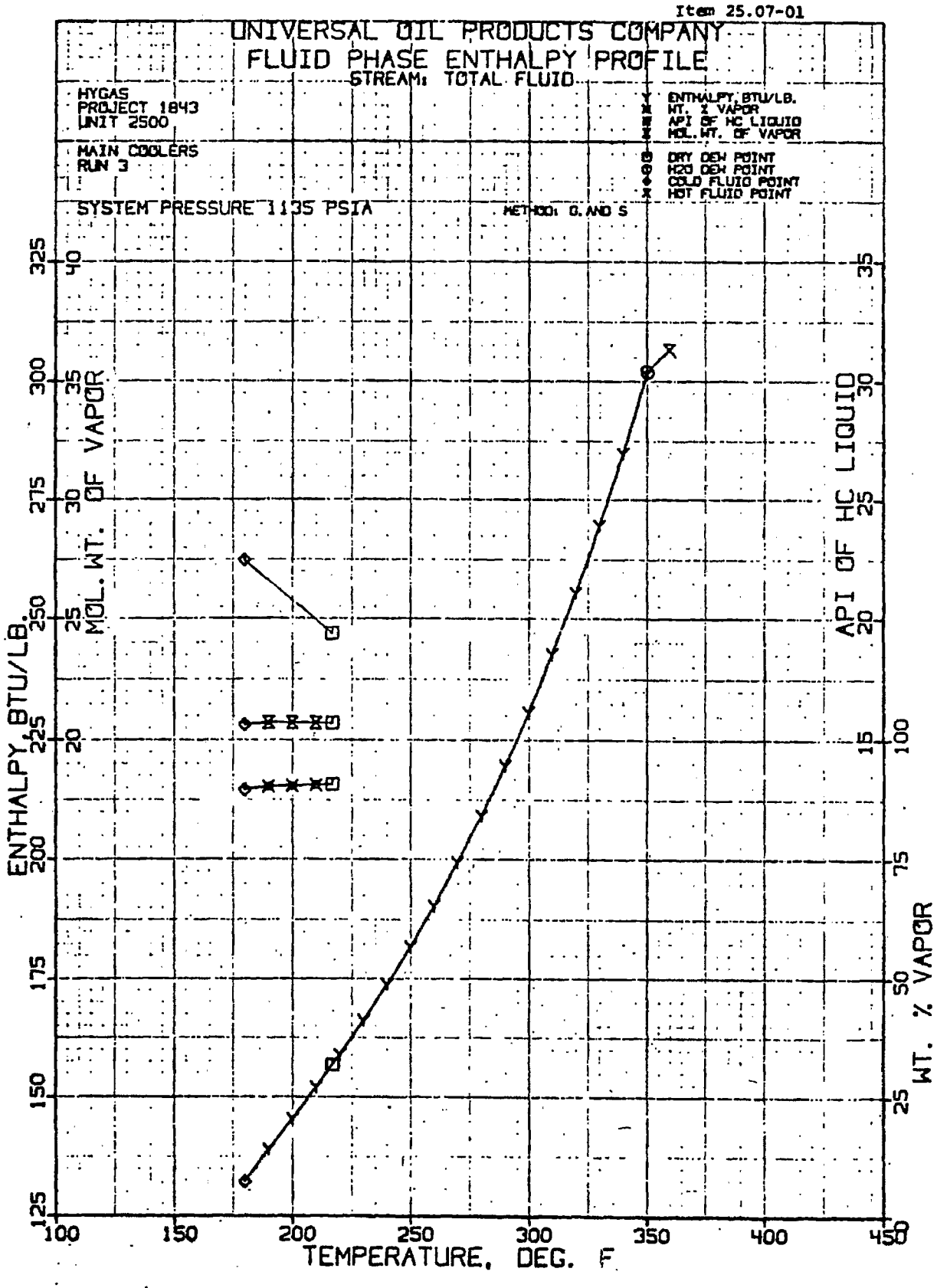
Notes:

See attached cooling curve.

Use external recirculation.

Dimensions: Width 48' Length 30' Height ____ Shipping Weight ____ Lbs.

Item 25.07-01


UNIVERSAL OIL PRODUCTS COMPANY
FLUID PHASE ENTHALPY PROFILE
STREAM: TOTAL FLUID
HYGAS
PROJECT 1843
UNIT 2500
MAIN COOLERS
RUN 3
SYSTEM PRESSURE 1135 PSIA
METHOD: G. AND S
Y ENTHALPY, BTU/LB.
X WT. % VAPOR
API OF HC LIQUID
MOL. WT. OF VAPOR
DRY DEW POINT
H2O DEW POINT
COLD FLUID POINT
HOT FLUID POINT
ENTHALPY, BTU/LB.
MOL. WT. OF VAPOR
API OF HC LIQUID
WT. % VAPOR
TEMPERATURE, DEG. F
125
150
175
200
225
250
275
300
325
20
25
30
35
40
15
20
25
30
35
0
25
50
75
100
100
150
200
250
300
350
400
450

FORM NO. 419-120, 9/70

Procon Incorporated

EXCHANGER DATA SHEET

CUSTOMER	IGT - HYGAS PLANT	REQ. No.	1843-25.07-1
ADDRESS		PAGE No.	
PLANT LOCATION		DATE	Feb. 15, 1972
		REVISED	
SERVICE OF UNIT	Water Cooler	ITEM NO.	25.07-51
SIZE	TYPE CET (Packed Nozzle)	CONNECTED IN	
SURFACE PER UNIT	3220 ft^2 SHELLS PER UNIT one	SURFACE PER SHELL	3220 $ft.^2$

PERFORMANCE OF ONE UNIT

	SHELL SIDE		TUBE SIDE	
FLUID CIRCULATED	Cooling Water		H_2, H.C., & Steam	
TOTAL FLUID ENTERING lb/hr.	532,850		506,380	
VAPOR			505,380	
LIQUID	532,850			
STEAM			1,000	
NON-CONDENSABLES				
FLUID VAPORIZED OR CONDENSED			7,500	
STEAM CONDENSED				
GRAVITY—LIQUID	1.0		0.9	
VISCOSITY—LIQUID	0.68		0.1	
MOLECULAR WEIGHT—VAPORS			20.5	
SPECIFIC HEAT—LIQUIDS		B.T.U./#		B.T.U./#
LATENT HEAT—VAPORS		B.T.U./#		B.T.U./#
TEMPERATURE IN	85	°F	180	°F
TEMPERATURE OUT	115	°F	120	°F
OPERATING PRESSURE	50	#/SQ. IN.	1100	#/SQ. IN.
NUMBER OF PASSES	one		one	
VELOCITY		FT./SEC.		FT./SEC.
PRESSURE DROP	5	#/SQ. IN.	5	#/SQ. IN.
Fouling Factor	.002		0.0015	
Conductivity, Vapor.			0.034	
HEAT EXCHANGED—B.T.U./HR.	16.3×10^6	M.T.D. (Corrected)		
TRANSFER RATE—SERVICE		CLEAN		

CONSTRUCTION

DESIGN PRESSURE	120	#/SQ. IN.	1180	#/SQ. IN.
TEST PRESSURE		#/SQ. IN.		#/SQ. IN.
DESIGN TEMPERATURE	650	°F	550	°F

TUBES C.S. NO. 1492 O.D. 3/4" swg 14 Min. LENGTH 12' PITCH 1" ☐

SHELL C.S. 56" I.D. XXX THICKNESS

SHELL COVER FLOATING HEAD COVER

CHANNEL CHANNEL COVER

TUBE SHEETS—STATIONARY FLOATING

BAFFLES—CROSS TYPE THICKNESS

BAFFLE—LONG TYPE THICKNESS

TUBE SUPPORTS THICKNESS

GASKETS

CONNECTIONS—SHELL—IN OUT SERIES 150# R.F.

CHANNEL—IN OUT SERIES 600 # R.F.

CORROSION ALLOWANCE—SHELL SIDE 1/8" TUBE SIDE 1/8"

CODE REQUIREMENTS A.S.M.E., Sec. VIII TEMA CLASS- R

WEIGHTS—EACH SHELL BUNDLE FULL OF WATER

NOTE: INDICATE AFTER EACH PART WHETHER STRESS RELIEVED (S. R.) AND WHETHER RADIOGRAPHED (X-R)

REMARKS: Assume straight line cooling curve.

FORM NO. 410-120, 9/70

Procon Incorporated

EXCHANGER DATA SHEET

		REQ. No.	1843-25.07-1
CUSTOMER	IGT - HYGAS PLANT	PAGE No.	
ADDRESS		DATE	2/16/72
PLANT LOCATION		REVISED	
SERVICE OF UNIT	Refrigerated Cooler	ITEM NO.	25.07-52
SIZE	TYPE AKU	CONNECTED IN	
SURFACE PER UNIT	3790 Ft.^{2} SHELLS PER UNIT one	SURFACE PER SHELL	3790 Ft.^{2}

PERFORMANCE OF ONE UNIT

	SHELL SIDE		TUBE SIDE	
FLUID CIRCULATED	Ammonium		H_2, H.C. & Steam	
TOTAL FLUID ENTERING lb/hr.	23,552		491,880	
VAPOR			490,830	
LIQUID				
STEAM			1050	
NON-CONDENSABLES				
FLUID VAPORIZED OR CONDENSED	23,552		7277.8	
STEAM CONDENSED			950	
GRAVITY—LIQUID			0.8	
VISCOSITY—LIQUID				
MOLECULAR WEIGHT—VAPORS	17.0		20.2	
SPECIFIC HEAT—LIQUIDS		B.T.U./#		B.T.U./#
LATENT HEAT—VAPORS	518	B.T.U./#		B.T.U./#
TEMPERATURE IN	60	°F	120	°F
TEMPERATURE OUT	60	°F	70	°F
OPERATING PRESSURE	93	#/SQ. IN.	1082	#/SQ. IN.
NUMBER OF PASSES				
VELOCITY		FT./SEC.		FT./SEC.
PRESSURE DROP	Nil	#/SQ. IN.	5	#/SQ. IN.
Fouling Factor	0.001		0.0015	
Conductivity Vapor.			0.034	
HEAT EXCHANGED—B.T.U./HR.	12.2 x 10^6	M.T.D. (Corrected)		
TRANSFER RATE—SERVICE		CLEAN		

CONSTRUCTION

DESIGN PRESSURE	120	#/SQ. IN.	1180	#/SQ. IN.
TEST PRESSURE		#/SQ. IN.		#/SQ. IN.
DESIGN TEMPERATURE	650	°F	550	°F

TUBES C.S. NO. 550 u's O.D. 1" BWG. 12 min LENGTH 12' ESTL PITCH 1¼" sq.

SHELL C.S. 50"/84" I.D. XXX THICKNESS

SHELL COVER FLOATING HEAD COVER

CHANNEL CHANNEL COVER

TUBE SHEETS—STATIONARY FLOATING

BAFFLES—CROSS TYPE THICKNESS

BAFFLES—LONG TYPE THICKNESS

TUBE SUPPORTS THICKNESS

GASKETS

CONNECTIONS—SHELL—IN OUT SERIES 150# R.F.

CHANNEL—IN OUT SERIES 600# R.F.

CORROSION ALLOWANCE—SHELL SIDE 1/8" TUBE SIDE 1/8"

CODE REQUIREMENTS A.S.M.E., Sec. VIII TEMA CLASS R

WEIGHTS—EACH SHELL BUNDLE FULL OF WATER

NOTE: INDICATE AFTER EACH PART WHETHER STRESS RELIEVED (S. R.) AND WHETHER RADIOGRAPHED (X-R)

REMARKS: Assume straight line cooling curve.

PROCON

STANDARD DATA SHEET FOR CENTRIFUGAL PUMPS

NO. 1843-25.08-1
SHEET NO. 1
TOTAL SHEETS 3
DATE 2-7-72 EJM
APPROVED

FOR IGT - HYGAS PLANT ITEM NO. 25.08-01 A & B
SITE UNIT 2500
SERVICE SCRUB WATER BOOSTER MOTOR DRIVE 2 TURBINE DRIVE
PUMP MFR SIZE AND TYPE NO. REQ'D 2

OPERATING CONDITIONS

LIQUID WATER
U.S gpm at PT, NOR 100 DES 110
DISCH PRESS, psig 1128
SUCT PRESS, psig MAX DES 988
DIFF PRESS., psi 140
DIFF HEAD, ft 727
NPSH AVAIL., ft 10+
T F 120
SP GR at PT 0.99
VAP PRESS. at PT, psia 1.7
VIS at PT, Sau
CORR/EROS caused by

CONSTRUCTION AND MATERIALS

CASING-MOUNTING (CENTERLINE X) (FOOT) (BRACKET) (VERTICAL)
SPLIT (AXIAL) (RADIAL X)
① TYPE (SINGLE VOLUTE) (DOUBLE VOLUTE) (DIFFUSER)
TAPPED OPENINGS (VENT X) (DRAIN X) (GAGE CONNS.)

NOZZLES	SIZE	ASA RATING	FACING	POSITION
SUCTION				
DISCHARGE				

IMPELLER DIAM DES MAX TYPE CLOSED
MFR'S BEARING NO. RADIAL THRUST
COUPLING and GUARD THOMAS /YES BASE PLATE DRAIN RIM
PACKING —
MECH SEAL YES, Dual CLASS. CODE MFR

PERFORMANCE

PROPOSAL CURVE NO
NPSH REQ'D (WATER), ft
NO. OF STAGES RPM
DES EFF BHP
MAX BHP DES IMP
MAX HEAD DES IMP, ft
MIN CONTINUOUS, gpm (BY MFR) ①
ROTATION FACING COUPLING END
WATER COOLING
BEARINGS
STUFF. BOX
PEDESTAL
GLAND
TOTAL WATER REQ'D, gpm
PACKING COOLING
FLUSHING API PLAN 12
AUX PIPING BY PUMP MFR.

MATERIAL CODE—EXTERNAL CASING S INTERNAL PARTS I

	INTERNALS CODE	I	B	S	C	X
I—CAST IRON	IMPELLER	I	B	S	C	
B—BRONZE	INNER CASE PARTS	I	I	S	C	
S—STEEL	SLEEVE (PACKED)	Ch	Ch	Al	Al	
C—11-13% CHROME	SLEEVE (SEAL)	C	C	C	C	
A—ALLOY	WEAR PARTS	X	B	(Ch)	Ch	
h—HARDENED	SHAFT	S	S	S	S	
f—FACED						
X—						

SHOP TESTS	REQUIRED	WITNESSED
RUNNING PERF	X	
NPSH		

HYDROSTATIC PSIG
MAX ALLOW. WP PSIG F
WEIGHTS: PUMP BASE
MOTOR TURBINE

MOTOR DRIVER BY PUMP MFR

ITEM NO. A & B MTD BY PUMP MFR
HP RPM FRAME
MFR
TYPE SCI INSUL B
ENC TEFC TEMP RISE C 80
VOLTS/PHASE/CYCLES 460/3/60
BEARINGS BALL LUBE GRS
FULL LOAD AMPS

TURBINE DRIVER BY

ITEM NO. MTD BY
HP RPM MAT'L
MFR and TYPE
INLET STEAM, psig TEMP F
EXHAUST
STEAM RATE, FL lb/BHP/HR
BEARINGS LUBE

NOZZLES	SIZE	ASA RATING	FACING	POSITION
INLET				
EXHAUST				

MFR FINAL DATA (AS BUILT)

ACTUAL IMPELLER DIAM
TEST CURVE NO.
OUTLINE DWG NO.
PUMP SECT. DWG NO.
SEAL DIAG DWG NO.
PUMP SERIAL NO.

API STD. 610 GOVERNS UNLESS OTHERWISE STATED.
EXCEPTIONS (ITEMIZE): ① PLS. ADVISE.

REV.	DATE	APPROVED	REV.	DATE	APPROVED	REV.	DATE	APPROVED

PROCON

STANDARD DATA SHEET FOR CENTRIFUGAL PUMPS

NO. 1843-25.08-1
SHEET NO. 2
TOTAL SHEETS 3
DATE 2-7-72 EJM
APPROVED

FOR IGT - HYGAS PLANT ITEM NO. 25.08-02 A & B
SITE UNIT 2500
SERVICE AMMONIA SCRUBBER BOOSTER MOTOR DRIVE 2 TURBINE DRIVE
PUMP MFR SIZE AND TYPE NO. REQ'D 2

OPERATING CONDITIONS

LIQUID OILY WATER (SOME AROMATICS)
PT F 120
SP GR at PT 0.9
VAP PRESS. at PT, psia (ENTRAINED GAS)
VIS at PT, Sau
CORR/EROS caused by H2S, CO2, NH3

U.S. gpm at PT. NOR 141 DES 155
DISCH PRESS., psig 1159
SUCT PRESS., psig MAX DES 1109
DIFF PRESS., psi 50
DIFF HEAD, ft 129
NPSH AVAIL., ft 16 *

CONSTRUCTION AND MATERIALS

CASING-MOUNTING (CENTERLINE X) (FOOT) (BRACKET) (VERTICAL)
SPLIT (AXIAL ,) (RADIAL X)
TYPE (SINGLE VOLUTE X) (DOUBLE VOLUTE) (DIFFUSER)
TAPPED OPENINGS (VENT X) (DRAIN X) (GAGE CONNS.)

NOZZLES	SIZE	ASA RATING	FACING	POSITION
SUCTION				
DISCHARGE				

IMPELLER DIAM DES MAX TYPE CLOSED
MFR'S BEARING NO. RADIAL THRUST
COUPLING and GUARD THOMAS / YES BASE PLATE DRAIN RIM
PACKING —
SHAFT SEAL YES, BAL CLASS. CODE MFR

PERFORMANCE

PROPOSAL CURVE NO.
NPSH REQ'D (WATER), ft *
NO OF STAGES RPM
DES EFF BHP
MAX BHP DES IMP
MAX HEAD DES IMP, ft
MIN CONTINUOUS, gpm (BY MFR) (1)
ROTATION FACING COUPLING END
WATER COOLING
BEARINGS
STUFF. BOX
PEDESTAL
GLAND
TOTAL WATER REQ'D, gpm
PACKING COOLING
FLUSHING API PLAN 32
FLUSH FLUID FROM PUMP 25-8-C1
AUX PIPING BY PUMP MFR.

MATERIAL CODE—EXTERNAL CASING S INTERNAL PARTS I (2)

I—CAST IRON	INTERNALS CODE	I	B	S	C	X
B—BRONZE	IMPELLER	I	B	S	C	
S—STEEL	INNER CASE PARTS	I	I	S	C	
C—11-13% CHROME	SLEEVE (PACKED)	Ch	Ch	Af	Af	
A—ALLOY	SLEEVE (SEAL)	C	C	C	C	
h—HARDENED	WEAR PARTS	X	B	(Ch)	Ch	
f—FACED	SHAFT	S	S	S	S	
X—						

SHOP TESTS	REQUIRED	WITNESSED
RUNNING PERF	X	
NPSH		
HYDROSTATIC PSIG		

MAX ALLOW. WP PSIG F
WEIGHTS: PUMP BASE
MOTOR TURBINE

MOTOR DRIVER BY PUMP MFR

ITEM NO. A & B MTD BY PUMP MFR
HP RPM FRAME
MFR
TYPE SCI INSUL B
ENC TEFC TEMP RISE C 80
VOLTS/PHASE/CYCLES 460/3/60
BEARINGS BALL LUBE GRS
FULL LOAD AMPS

TURBINE DRIVER BY

ITEM NO. MTD BY
HP RPM MAT'L
MFR and TYPE
INLET STEAM, psig TEMP F
EXHAUST
STEAM RATE, PL lb/BHP/HR
BEARINGS LUBE

NOZZLES	SIZE	ASA RATING	FACING	POSITION
INLET				
EXHAUST				

MFR FINAL DATA (AS BUILT)

ACTUAL IMPELLER DIAM
TEST CURVE NO.
OUTLINE DWG NO.
PUMP SECT. DWG NO.
SEAL DIAM DWG NO.
PUMP SERIAL NO.

API STD. 610 GOVERNS UNLESS OTHERWISE STATED. * NPSH REQUIRED SHALL NOT EXCEED 8 FEET (WATER)
EXCEPTIONS (ITEMIZE): (1) PLS. ADVISE. (2) OR RECOMMEND

REV.	DATE	APPROVED	REV.	DATE	APPROVED	REV.	DATE	APPROVED

PROCON

STANDARD DATA SHEET FOR CENTRIFUGAL PUMPS

NO. 1843-25.08-1
SHEET NO. 3
TOTAL SHEETS 3
DATE 2-8-72 EJM
APPROVED

FOR IGT - HYGAS PLANT ITEM NO. 25.08-03 A&B
SITE UNIT 2500
SERVICE OIL KNOCKOUT DRUM BOOSTER MOTOR DRIVE 2 TURBINE DRIVE
PUMP MFR SIZE AND TYPE NO. REQ'D 2

OPERATING CONDITIONS

LIQUID H.C. & WATER (SOME AROMATICS)
PT F 70
SP GR at PT 0.9
VAP PRESS. at PT, psia (ENTRAINED GAS)
VIS at PT, Sau
CORR. FACTORS

U.S. gpm at PT, NOR 18 DES 25
DISCH PRESS., psig 1159
SUCT PRESS., psig MAX DES 1100
DIFF PRESS., psi 59
DIFF HEAD, ft 152
NPSH AVAIL., ft 10 *

PERFORMANCE

PROPOSAL CURVE NO.
NPSH REQ'D (WATER), ft *
NO. OF STAGES RPM
DES EFF BHP
MAX BHP DES IMP
MAX HEAD DES IMP, ft
MIN CONTINUOUS, gpm (BY MFR) (1)
ROTATION FACING COUPLING END
WATER COOLING
BEARINGS
STUFF. BOX
PEDESTAL
GLAND
TOTAL WATER REQ'D, gpm
PACKING COOLING
FLUSHING API PLAN 32
FLUSH FLUID FROM PUMP 25.08-01
AUX PIPING BY PUMP MFR.

CONSTRUCTION AND MATERIALS

CASING-MOUNTING (CENTERLINE - X) (FOOT) (BRACKET) (VERTICAL)
SPLIT (AXIAL) (RADIAL X)
TYPE (SINGLE VOLUTE X) (DOUBLE VOLUTE) (DIFFUSER)
TAPPED OPENINGS (VENT X) (DRAIN X) (GAGE CONNS.)

NOZZLES	SIZE	ASA RATING	FACING	POSITION
SUCTION				
DISCHARGE				

IMPELLER DIAM DES MAX TYPE CLOSED
MFR'S BEARING NO RADIAL THRUST
COUPLING and GUARD THOMAS /YES BASE PLATE DRAIN RIM
PACKING —
MECH SEAL YES / BAL CHAR. CODE MFR

MATERIAL CODE—EXTERNAL CASING S INTERNAL PARTS I (2)

I—CAST IRON
B—BRONZE
S—STEEL
C—11-13% CHROME
A—ALLOY
h—HARDENED
f—FACED
X—

INTERNALS CODE	I	B	S	O	X
IMPELLER	I	B	S	O	
INNER CASE PARTS	I	I	S	O	
SLEEVE (PACKED)	Ch	Ch	Af	Af	
SLEEVE (SEAL)	O	C	C	O	
WEAR PARTS	X	B	Ch	Ch	
SHAFT	S	S	S	S	

SHOP TESTS	REQUIRED	WITNESSED
RUNNING PERF	X	
NPSH		
HYDROSTATIC PSIG		
MAX ALLOW. WP PSIG		F

WEIGHTS: PUMP BASE
MOTOR TURBINE

MOTOR DRIVER BY PUMP MFR.

ITEM NO. A & B MTD BY PUMP MFR
HP RPM FRAME
MFR
TYPE SCI INSUL B
ENC TEFC TEMP RISE C 80
VOLTS/PHASE/CYCLES 460/3/60
BEARINGS BALL LUBE GRS
FULL LOAD AMPS

TURBINE DRIVER BY

ITEM NO MTD BY
HP RPM MAT'L
MFR and TYPE
INLET STEAM, psig TEMP F
EXHAUST
STEAM RATE, FL lb/BHP/HR
BEARINGS LUBE

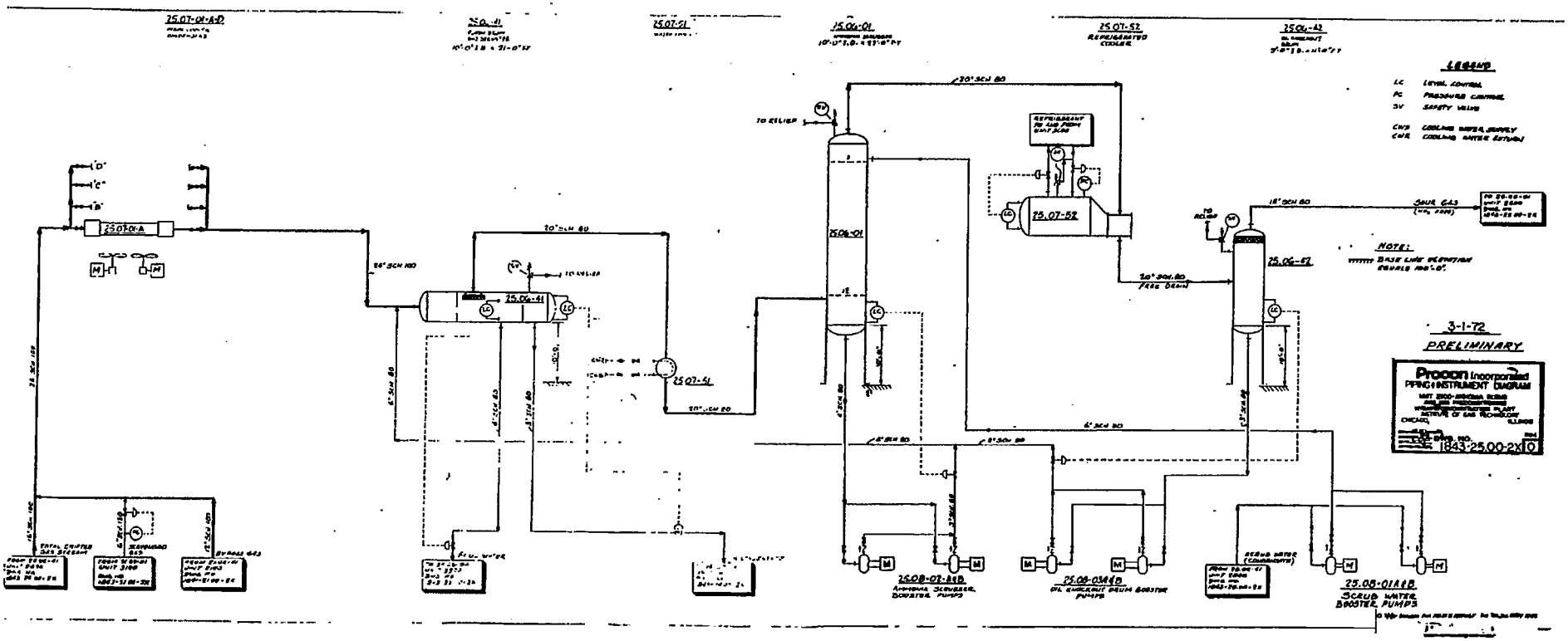
NOZZLES	SIZE	ASA RATING	FACING	POSITION
INLET				
EXHAUST				

MFR FINAL DATA (AS BUILT)

ACTUAL IMPELLER DIAM
TEST CURVE NO.
OUTLINE DWG NO.
PUMP SECT. DWG NO.
SEAL DIAM DWG NO.
PUMP SERIAL NO.

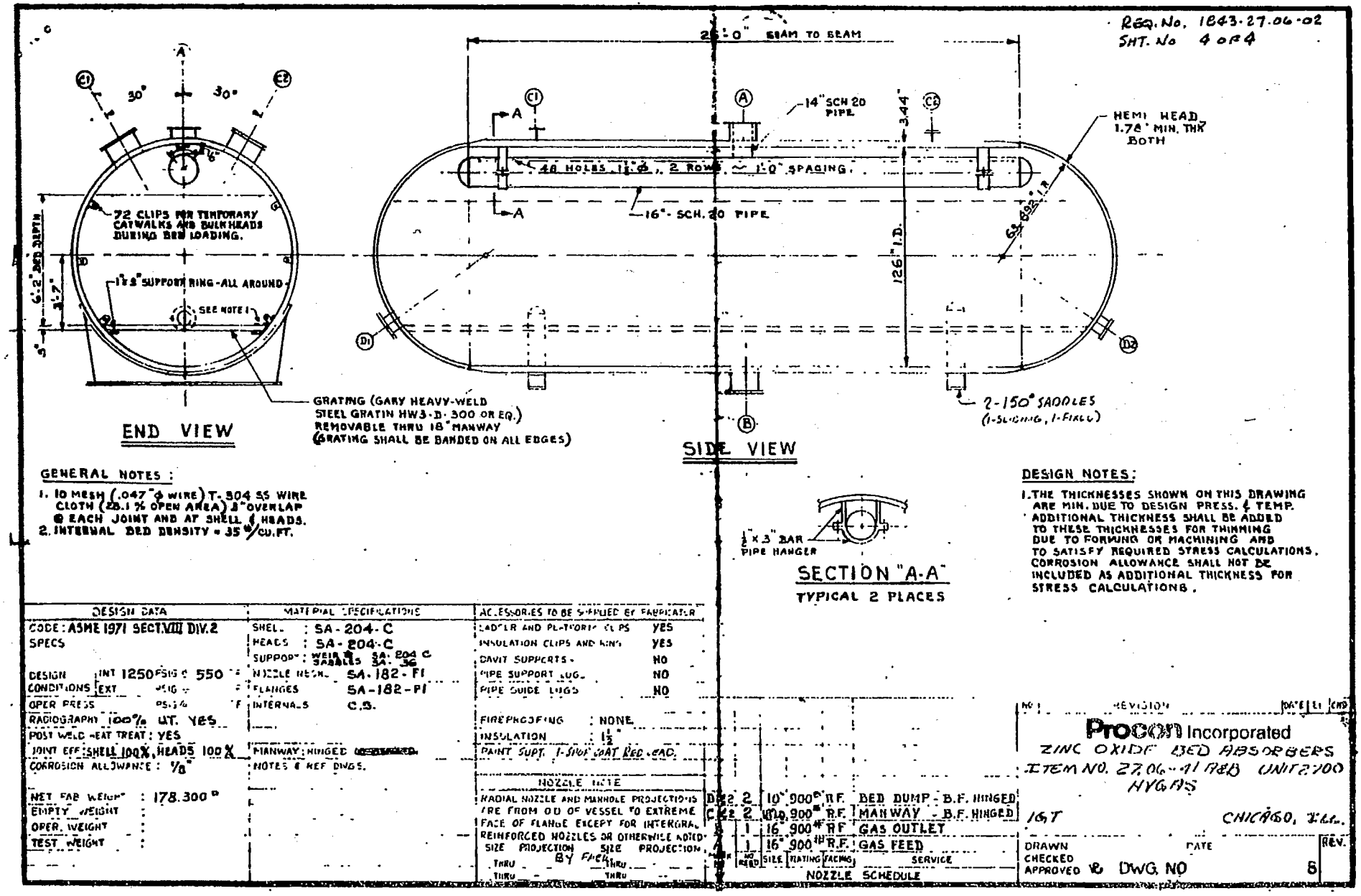
API STD. 610 GOVERNS UNLESS OTHERWISE STATED. * NPSH REQUIRED SHALL NOT EXCEED 5 FEET (WATER)
EXCEPTIONS (ITEMIZE): (1) ADVISE (2) OR RECOMMEND

REV.	DATE	APPROVED	REV.	DATE	APPROVED	REV.	DATE	APPROVED


25.07-01-A-D
25.06-41
25.07-51
25.06-01
25.07-52
REFRIGERANTED COOLER
25.06-43
LEGEND
LC LEVEL CONTROL
PC PRESSURE CONTROL
SV SAFETY VALVE
CWS COOLING WATER SUPPLY
CWR COOLING WATER RETURN
25.07-01-A
25.06-41
25.07-51
25.06-01
25.07-52
25.06-42
NOTE:
BASE LINE ELEVATION EQUALS 100'-0".
3-1-72
PRELIMINARY
Proconn Incorporated
PIPING & INSTRUMENT DIAGRAM
1843-25.00-2X
25.08-01 A&B
SCRUB WATER BOOSTER PUMPS

A B C

Req. No. 1843-27.06-02
SHT. No 4 OF 4



GENERAL NOTES:

1. 10 MESH (.047" ø WIRE) T-304 SS WIRE CLOTH (28.1 % OPEN AREA) 3" OVERLAP @ EACH JOINT AND AT SHELL & HEADS.
2. INTERNAL BED DENSITY = 35 #/CU.FT.

DESIGN NOTES:

1. THE THICKNESSES SHOWN ON THIS DRAWING ARE MIN. DUE TO DESIGN PRESS. & TEMP. ADDITIONAL THICKNESS SHALL BE ADDED TO THESE THICKNESSES FOR THINNING DUE TO FORMING OR MACHINING AND TO SATISFY REQUIRED STRESS CALCULATIONS. CORROSION ALLOWANCE SHALL NOT BE INCLUDED AS ADDITIONAL THICKNESS FOR STRESS CALCULATIONS.

DESIGN DATA		MATERIAL SPECIFICATIONS		ACCESSORIES TO BE SUPPLIED BY FABRICATOR	
CODE: ASME 1971 SECT. VIII DIV. 2		SHELL	SA-204-C	LADDER AND PLATFORM CLIPS	YES
SPECS		HEADS	SA-204-C	INSULATION CLIPS AND RING	YES
DESIGN CONDITIONS	INT 1250 PSIG @ 550 °F	SUPPORTS	WEIR & SADDLES SA-204 C SA-36	DAVIT SUPPORTS	NO
	EXT — PSIG @ — °F	NOZZLE NECK	SA-182-F1	PIPE SUPPORT LUGS	NO
OPER PRESS	PSIG @ °F	FLANGES	SA-182-F1	PIPE GUIDE LUGS	NO
RADIOGRAPHY	100% U.T. YES	INTERNALS	C.S.		
POST WELD HEAT TREAT: YES				FIREPROOFING	NONE
JOINT EFF: SHELL 100%, HEADS 100%		MANWAY: HINGED		INSULATION	1½"
CORROSION ALLOWANCE: ⅛"		NOTES & REFERENCES		PAINT SUPT. 1-SHOP COAT RED LEAD	
NET FAB WEIGHT	: 178,300 #				
EMPTY WEIGHT	:				
OPER. WEIGHT	:				
TEST WEIGHT	:				

NOZZLE NOTE

RADIAL NOZZLE AND MANHOLE PROJECTIONS ARE FROM OD OF VESSEL TO EXTREME FACE OF FLANGE EXCEPT FOR INTEGRAL REINFORCED NOZZLES OR OTHERWISE NOTED. SIZE PROJECTION BY FIELD THRU — THRU —

NOZZLE SCHEDULE

NO	NO REQ'D	SIZE	RATING	FACING	SERVICE
D	2	10"	900#	R.F.	BED DUMP - B.F. HINGED
C	2	18"	900#	R.F.	MANWAY - B.F. HINGED
B	1	16"	900#	R.F.	GAS OUTLET
A	1	16"	900#	R.F.	GAS FEED

NO	REVISION	DATE	BY	CHD

PROCON Incorporated
ZINC OXIDE BED ABSORBERS
ITEM NO. 27.06-41 REV UNIT 2700
HYDRS
I&T CHICAGO, ILL.

DRAWN DATE REV.
CHECKED
APPROVED & DWG NO 8

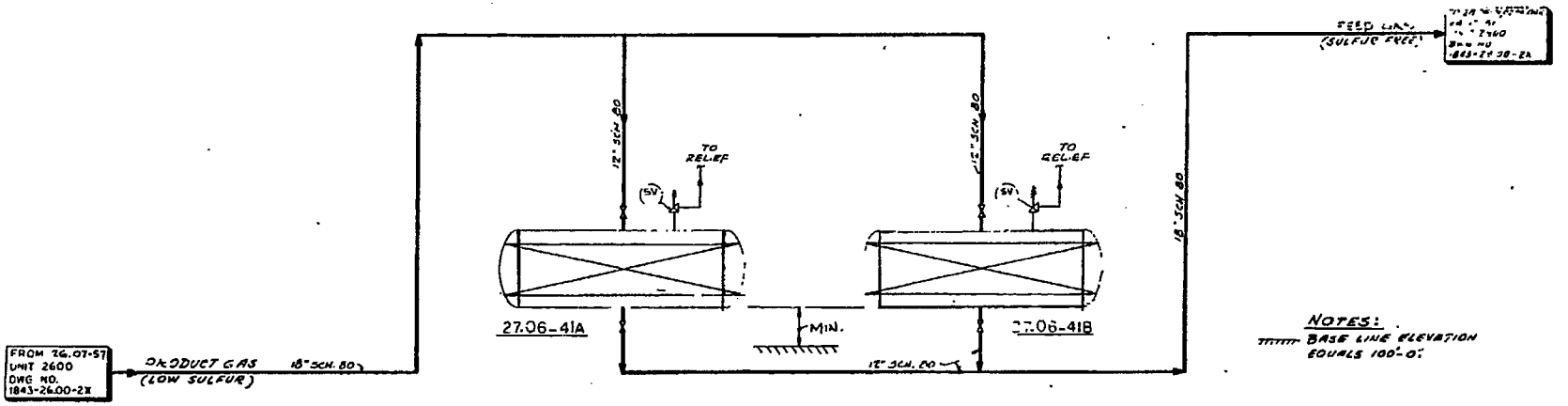
8-B159

27.06-41A

27.06-41B

LEGEND

SV SAFETY VALVE



NOTES:

BASE LINE ELEVATION EQUALS 100'-0"

3-1-72

PRELIMINARY

Procon Incorporated

PIPING & INSTRUMENT DIAGRAM

UNIT 2700-SULFUR CLEAN-UP GUARD BEDS

HYGAS® DEMONSTRATION PLANT

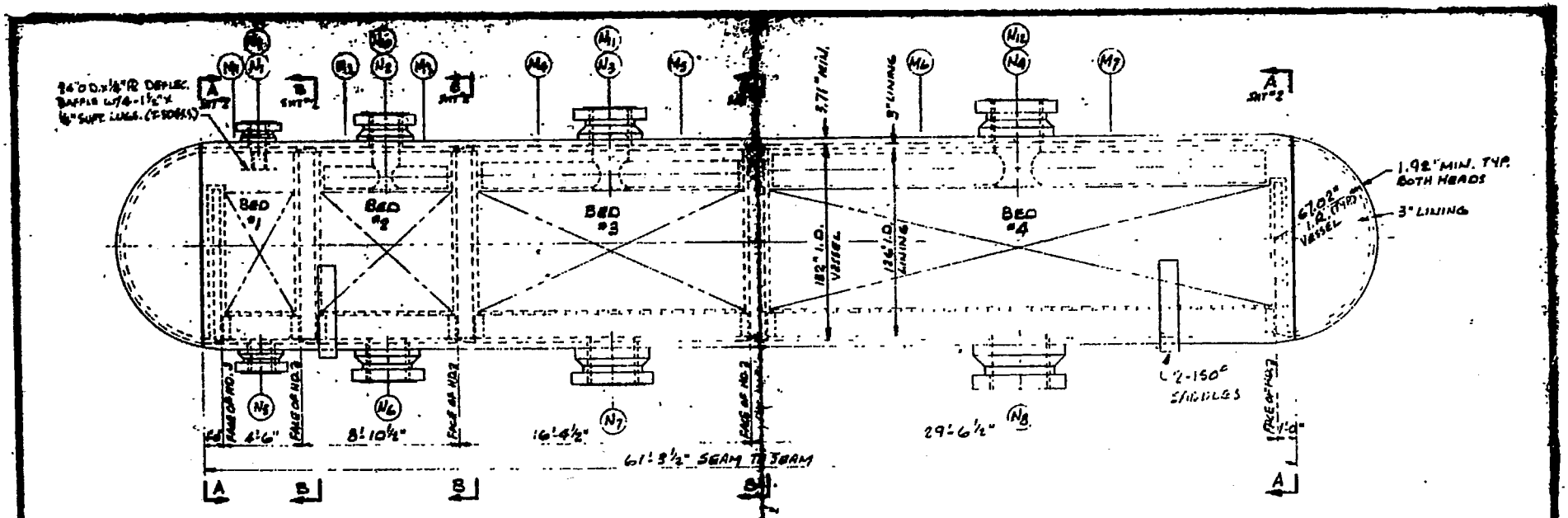
INSTITUTE OF GAS TECHNOLOGY

CHICAGO, ILLINOIS

DWG. NO. 1843-27.00-2X REV. 0

A

B



NOTES:

1. THE THICKNESSES SHOWN ON THIS DRAWING ARE MIN. DUE TO DESIGN PRESS. & TEMP. ADDITIONAL THICKNESS SHALL BE ADDED TO THESE THICKNESSES FOR THINNING DUE TO FORMING OR MACHINING AND TO SATISFY REQUIRED STRESS CALCULATIONS. CORR. ALLOW. SHALL NOT BE CONSIDERED AS ADDITIONAL THICKNESS FOR STRESS CALCULATIONS.
2. REFRACTORY LINING WT. 65 #/CU.FT. (BY OTHERS).
3. CATALYST WT. 80 #/CU.FT. (BY OTHERS).
4. VESSEL FABR. SHALL FURNISH ON THE COMPLETE INTERNAL SURFACE OF SHELL & HEADS) NELSON STUDS TYPE S7X (D=0.145 L=1.5 MATERIAL TYPE 304 S.S.) ON 6" STAGGERED CENTERS.

DESIGN DATA	
CODE	ASME 1971 SECT. VIII DIV. 2
SPECS.	
DESIGN CONDITIONS	INT. 1250 PSIG @ 650 °F
	EXT. °PSIG @ °F
OPER. PRESS.	1195 PSIG @ 500 °F
RADIOGRAPHY	100% U.T. YES
POST WELD HEAT TREAT	YES
JOINT EFF.	100%
CORROSION ALLOWANCE	SHELL NOZZLES ⅛" INTER. ⅛" ALL SURFACES
NET FAB. WEIGHT	478700#
CMF'Y WEIGHT	636700#
OPER. WEIGHT	819700#
TEST WEIGHT	1246600#

MATERIAL SPECIFICATIONS	
SHELL	SA-387-DN
HEADS	SA-387-DN
SUPPORT REINF. & A-387 D SADDLE = A-36	
NOZZLE NECKS	SA-336 F22
FLANGES	SA-336 F22
INTERNALS	SA-387 D AS NOTED
EST. CLIPS	A-387 D
MANWAY (HINGED [illegible])	
NOTES & REF. DWGS.	

ACCESSORIES TO BE SUPPLIED BY FABRICATOR	
LADDER AND PLATFORM CLIPS	YES
INSULATION CLIPS AND RINGS	YES
DAVIT SUPPORTS	NO
PIPE SUPPORT LUGS	NO
PIPE GUIDE LUGS	NO
FIREPROOFING	NO
INSULATION YES 1"	
PAINT	

NOZZLE NOTE

RADIAL NOZZLE AND MANHOLE PROJECTIONS ARE FROM O.D. OF VESSEL TO FACE OF FLANGE EXCEPT FOR INTEGRAL REINFORCED NOZZLES OR OTHERWISE NOTED

SIZE PROJECTION	SIZE PROJECTION
PER FABR.	
THRU	THRU
THRU	THRU

MARK NO.	NO. REQD.	SIZE	RATING	FACING	SERVICE
M1-7	7	20"	600#	RTJ	MANHOLE w/B.F.& HINGE
M8-12	4	16"	600#	RTJ	DUMP NOZ w/B.F.& HINGE
N8	1	40"	1500#	RTJ	OUTLET
N7	1	34"	1500#	RTJ	OUTLET
N6	1	28"	1500#	RTJ	OUTLET
N5	1	18"	1500#	RTJ	OUTLET
N4	1	34"	1500#	RTJ	INLET
N3	1	28"	1500#	RTJ	INLET
N2	1	22"	1500#	RTJ	INLET
N1	1	14"	1500#	RTJ	INLET

NOZZLE SCHEDULE

NO.	REVISION	DATE	BY

Procon Incorporated

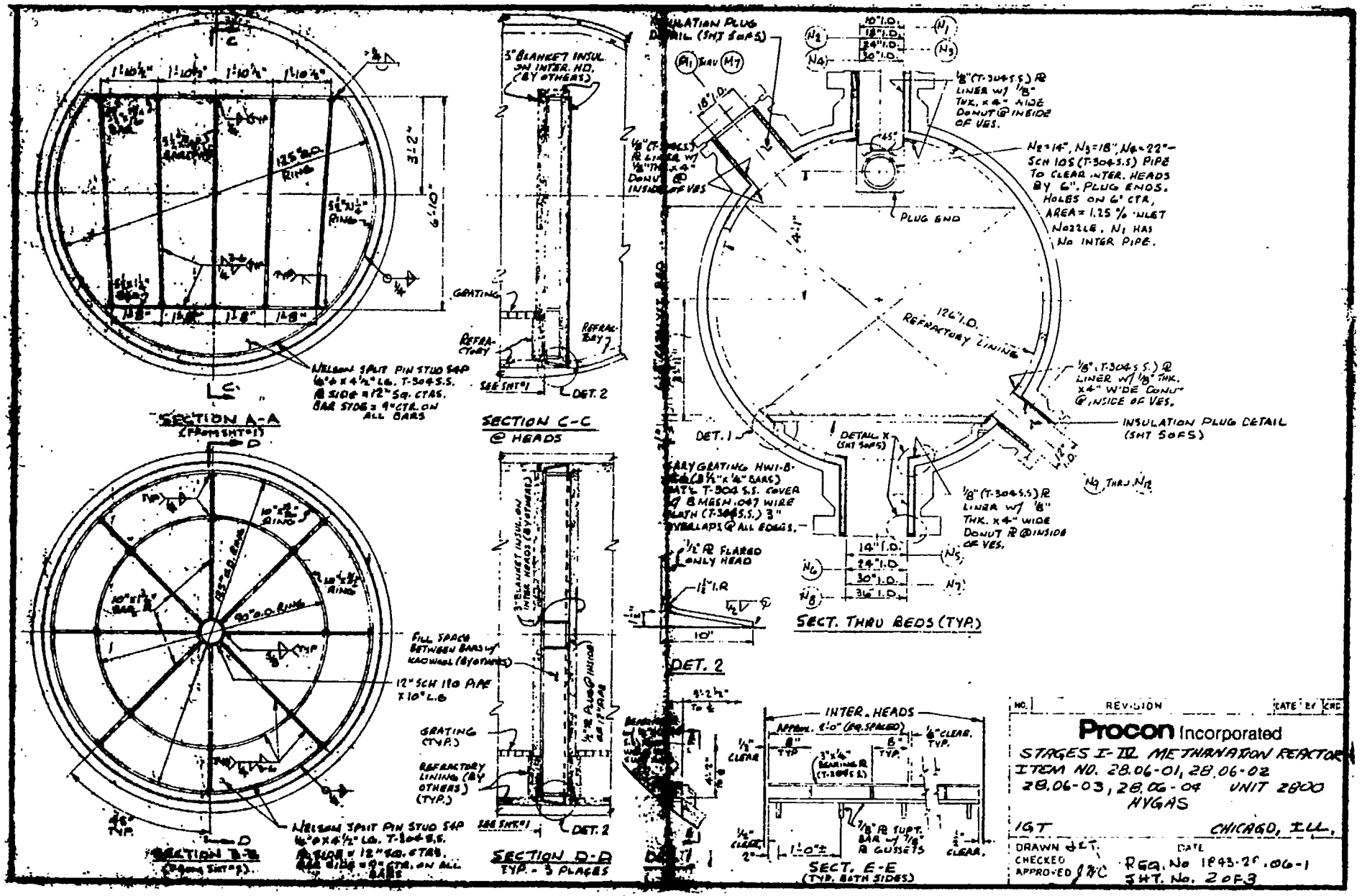
STAGES I-IV METHANATION REACTOR
ITEM NO 28.06-01, 28.06-02,
28.06-03, 28.06-09 UNIT 2800
NYGAS

IGT CHICAGO, ILL.

DRAWN JET
CHECKED JWC
APPROVED JR

DATE
REQ. NO. 1943-"B.06-1
SHT. NO. 1 OF 3

8-B191


SECTION A-A
SECTION C-C @ HEADS
SECTION B-B
SECTION D-D TYP. - 3 PLACES
SECT. THRU HEDS (TYP.)
DET. 1
DET. 2
SECT. E-E (TYP. BOTH SIDES)
INSULATION PLUG DETAIL (SHT 5 OF 5)
PLUG END
126" I.D. REFRACTORY LINING
GRATING
REFRACTORY
INTER. HEADS
Procon Incorporated
STAGES I-II METHANATION REACTOR
ITEM NO. 28.06-01, 28.06-02
28.06-03, 28.06-04 UNIT 2800
HYGAS
IGT CHICAGO, ILL.
DRAWN
CHECKED
APPROVED
DATE
REQ. No 1843-28.06-1
SHT. No. 2 OF 3

8-B162

Procon Incorporated

28.06-01-04 METHANATION REACTOR DETAILS

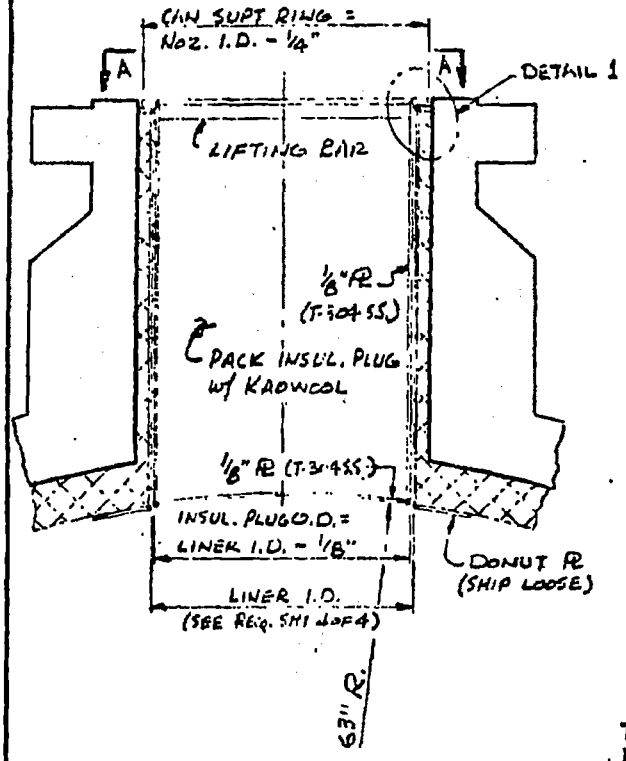
IGT HYGAS

REQ. No. 1843-28.06-1

SH. NO. 3 OF 3

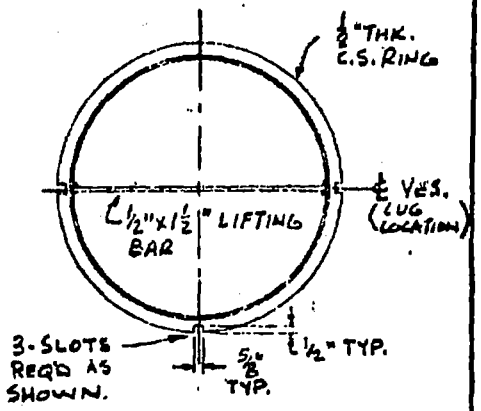
BY JST

DATE



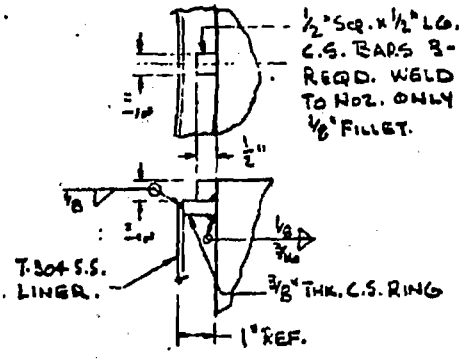
INSULATION PLUG DETAIL

(FOR No2. N9 THRU N12 & M.H M1 THRU M7)

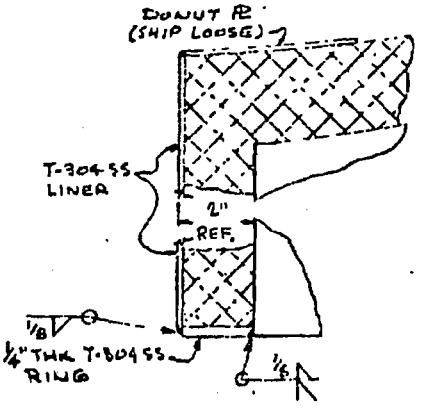


SECT. 'A-A'

(PLAN OF INSUL. PLUG)



DETAIL 1

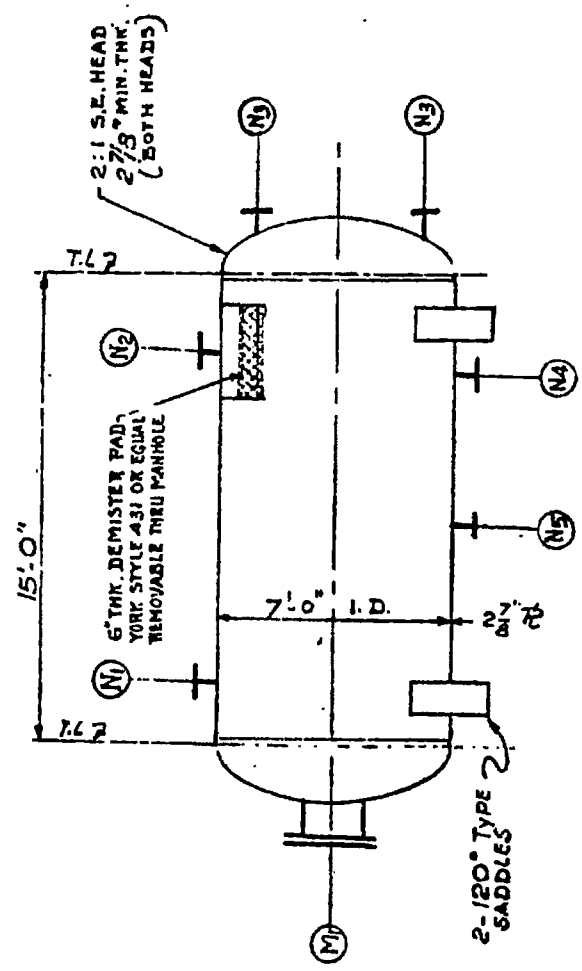


DETAIL X

(FROM SHT 4 OF 5)

FOR No2. N1 THRU N8 ONLY

DESIGN DATA		
CODE ASME 1971 SECT. VIII DIV. 1		
SPECS.		
DESIGN CONDITIONS	INT. 1100 PSIG @ 200°F	
	EXT. PSIG @ °F	
OPER. PRESS.	PSIG @ °F	
RADIOGRAPHY	FULL	
POST WELD HEAT TREAT	YES	
JOINT EFF.	100%	
CORROSION ALLOWANCE	1/8"	
HEX FAB WEIGHT	60,500 #	
EMPTY WEIGHT		
OPER. WEIGHT		
TEST WEIGHT		
MATERIAL SPECIFICATIONS		
SHELL SA-516-70		
HEADS SA-516-70		
SUPPORT A-283C		
NOZZLE NECKS SA-106 Gr. B		
FLANGES SA-105 Gr. I		
INTERNALS: DEMISTER PAD		
MANWAY (PURSED [redacted])		
ACCESSORIES TO BE SUPPLIED BY FABRICATOR		
LADDER AND PLATFORM CLIPS	NO	
DAVIT SUPPORTS	NO	
PIPE SUPPORT LUGS	NO	
PIPE GUIDE LUGS	NO	
FIRE PROOFING	NO	
INSULATION	NO	
PAINT ONE SHOP COAT PRIMER		



MARK NO.	QTY.	SIZE	RATING	FACING	SERVICE
N5	1	2"			DRAIN
N4	1	4"			OUTLET-LIQUID
N3	2	2"			LEVEL CONTROL
N2	1	20"			OUTLET-VAPOR
N1	1	20"			INLET (VAPOR + LIQUID)
M1	1	18" [illegible]		RF	MANWAY 'BF' STUDS, NUTS & GSKT.

NOZZLE SCHEDULE

RATED NOZZLE AND MANHOLE NECKS ARE FURNISHED OF MODEL TO EXTREME FACE OF FLANGE EXCEPT FOR INTEGRAL REINFORCED NOZZLES OR OTHERWISE NOTED

SIZE	PROJECTION	SIZE	PROJECTION
THRU		THRU	
THRU		THRU	

NO.	REVISION	DATE	BY	CHK

Procon Incorporated

CONDENSATE COLLECTION DRUM

ITEM NO. 28.06-41 UNIT 2800

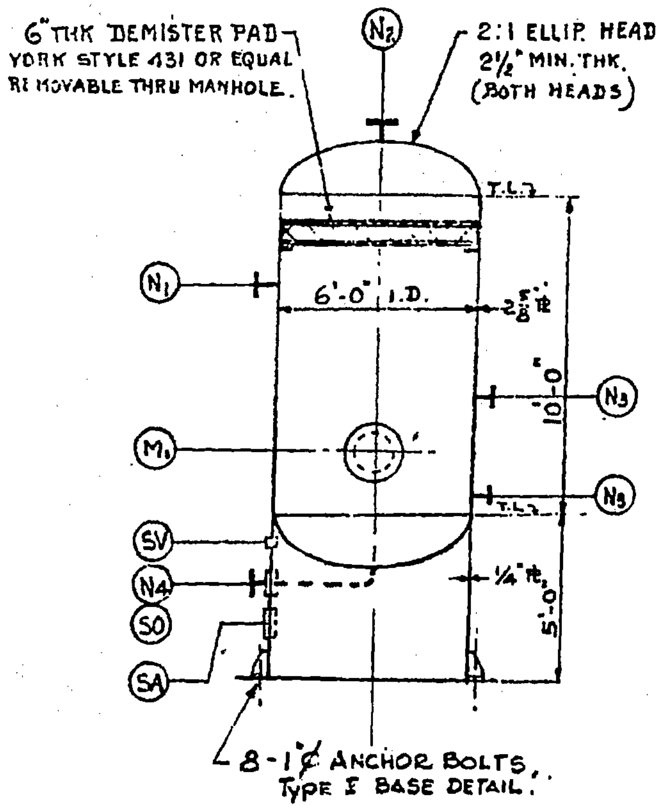
HYGAS

IGT. CHICAGO, ILL.

DRAWN JG DATE 2-5-72

APPROVED [illegible] REQ. NO. 1843-28.06-41

DESIGN DATA	
CODE	ASME 1971 SECT.VIII DIV.I
SPECS.	
DESIGN CONDITIONS	INT. 1140 PSIG @ 160 °F
	EXT. PSIG @ °F
OPER. PRESS.	PSIG @ °F
RADIOGRAPHY	FULL
POST WELD HEAT TREAT	YES
JOINT EFF.	
CORROSION ALLOWANCE	
NET FAB. WEIGHT	27500 LBS.
EMPTY WEIGHT	
OPER. WEIGHT	
TEST WEIGHT	
MATERIAL SPECIFICATIONS	
SHELL	SA 516-70
HEADS	SA 516-70
SUPPORT	SA 283 C
NOZZLE NECKS	SA 53 B.
FLANGES	SA 181-I
INTERNALS	SA 283-C
MANWAY (HINGED ~~[illegible]~~)	
ACCESSORIES TO BE SUPPLIED BY FABRICATOR	
LADDER AND PLATFORM CLIPS	YES
DAVIT SUPPORTS	NO
PIPE SUPPORT LUGS	NO
PIPE GUIDE LUGS	NO
FIREPROOFING	NO
INSULATION	NO
PAINT ONE SHOP COAT PRIMER	



MARK	NO.	SIZE	RATING	FACING	SERVICE
SA	1	18"	—	—	SKIRT ACCESS
SV	2	4"	—	—	SKIRT VENT
SO	1	4"	—	—	SKIRT OPENING
N4	1	2"	↑	↑	LIQUID OUTLET
N3	2	2"			LEVEL CONTROL
N2	1	12"			VAPOR OUTLET
N1	1	12"			VAPOR & LIQUID INLET
M1	1	18" I.D.	600#	R.F.	MANHOLE

SIZE OF BOLT

[illegible] SIZE AND NOZZLE PROJECTION ARE GIVEN [illegible] OF VESSEL TO EXTREME FACE OF FLANGE [illegible] INTEGRAL REINFORCED NOZZLE, OR OTHERWISE NOTED

SIZE	PROJECTION	SIZE	PROJECTION
THRU		THRU	
THRU		THRU	

NO.	REVISION	DATE	BY	CHK.

Procon Incorporated

PRODUCT GAS WATER K.O. DRUM

ITEM NO. 28.06-42 UNIT 2800

HYGAS

IGT CHICAGO, ILL

DRAWN J.G. DATE 2-4-'72

CHECKED

APPROVED RC REQ. NO 1843-28.06-41

AIR-COOLED EXCHANGER SPECIFICATION

Procon Incorporated

Customer: IGT-Hygas Plant

Date: 2/15/72 Engr.: GSD Item No.: 28.07-01

Service: Recycle Gas Cooler Condenser

Units: Model: XXXXX Forced Draft No. of Bays: 4

Surface Item - External: 250,000 (Approx) Bare Tube: Sq. Ft.

Heat Exchanged ..... BTU/Hr: 112,000,000 Effective MTD: °F

Transfer Rate - External Surface: Bare Tube Surface: BTU/Hr. Sq. Ft. °F

PERFORMANCE DATA

TUBE SIDE

Fluid Circulated	Methanator Effluent	Temperature In	350 °F
Total Fluid Entering Lbs Hr	484,068	Temperature Out	150 °F
Vapor	425,899 CH_4	Inlet Pressure	1040 psia, psig
Liquid		Gravity - Liquid	
Steam	51,292	Viscosity	Cps @ °F
Non-Condensables	134-CO, 1430-CO_2, 4664 - H_2	Viscosity	Cps @ °F
Vapor Condensed		Molecular Weight	15.2
Steam Condensed	49,975	Allowable Press. Drop	2.0 psi
Fouling Res I.S. - Hr Sq Ft °F BTU	0.001	Design Pressure Drop	psi

AIR SIDE

Air Quantity Item SCFM XXXXX		Temperature In	95 °F
Air Quantity, Fan ACFM		Temperature Out	°F
		Altitude	100 Ft

CONSTRUCTION

Design Pressure: 1145 PSI	Test Pressure ASME Code 1720 PSI	Design Temperature: 450 °F
SECTION	**HEADER**	**TUBE**
Size	Type: plug	Material: steel
No./Item: 2	Material: Steel	001.0 In. 0.095" Min. Wall
Tube Support - Zn. AL Filled Bands	No. Rows Passes: 3	No./Section
STRUCTURE - Carbon Steel	Plugs - Shoulder: ASME Material: A105 II	Length: 30' Ft.
Surface Prep - Wire Brush	Gasket Material	Pitch In. △
Section Frame Galv. Stl.	Corrosion Allowance: 1/8 In.	FIN
Finish - One Coat Primer	Size Inlet Nozzle: (2) 6 In.	Material: Aluminum
Grade Mounted	Size Outlet Nozzle: (2) 6 In.	Height
XX Fan Guards	Series: 600 RF	No./In
XX Belt Guards	Vent & Drain Conn.	Type: Extruded
Coupling Guards	Code - ASME XXX Stamp Req'd	

MECHANICAL EQUIPMENT

FAN MFGR		DRIVER	SPEED REDUCER
Model		Type: Electric Motor	Type: V-belt
No. Bay: 2	No./Item: 8	No./Item / HP/Driver: 30 approx	No. Item: 2
BHP Each	BHP Total	RPM: 1750	Model
Diameter ft.	RPM	Enclosure: TEFC	AGMA HP Rating
No. Blades	Pitch	Volt: 460 Phase: 3 Cycle: 60	Ratio
Blade Material: Cast Al.		Mfgr. Vendor Option - XXXX	Mfgr.
Hub Material			Support
Man. Adj.	Auto Variable	Vib. Switch XXX Req'd	

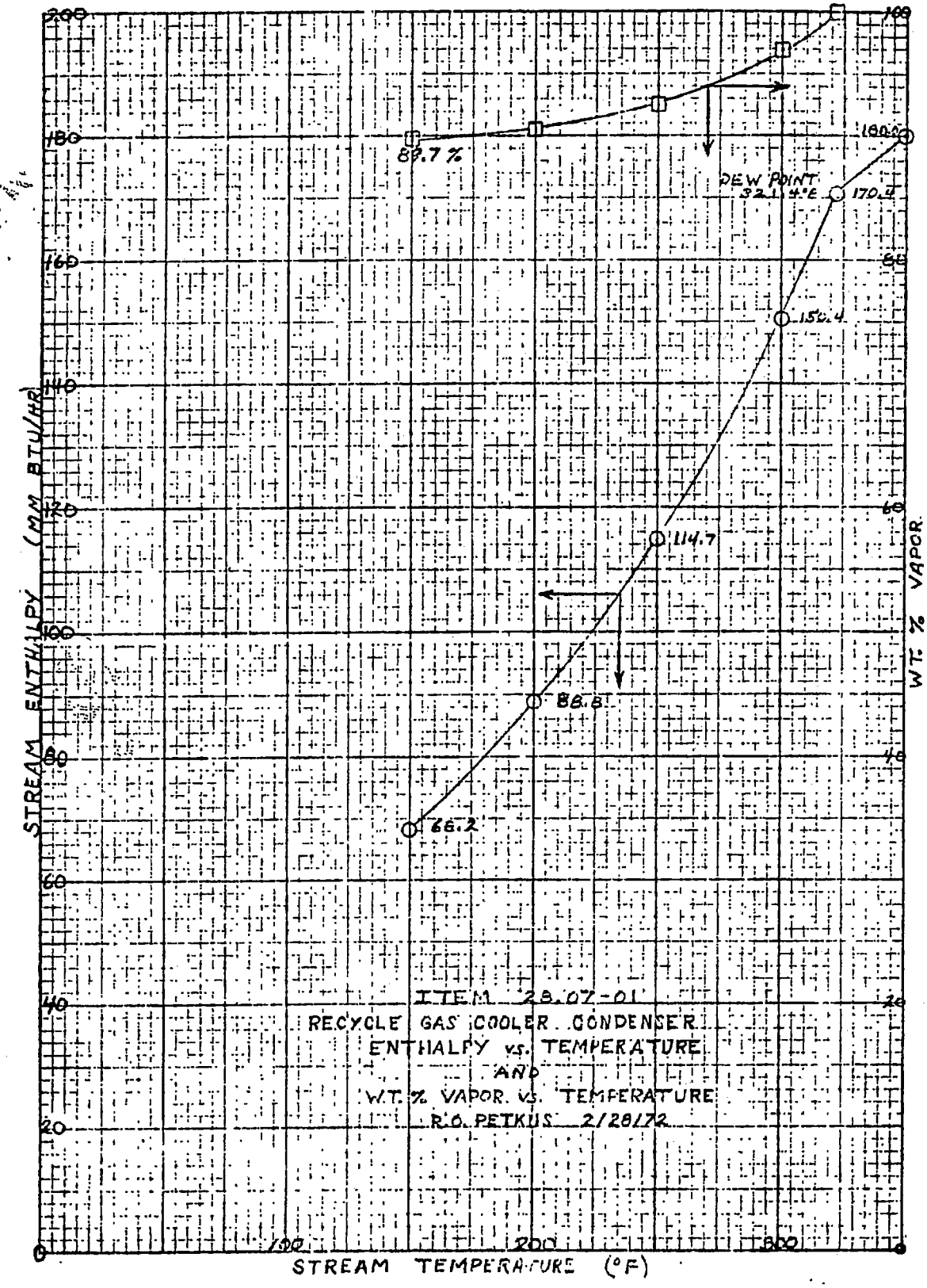
Notes:

Provide steam coil & external recirculation, tubes to be sloped 6"

Refer to attached condensing curve.

Plot Area - 90' x 30'

Dimensions: Width Length Height Shipping Weight Lbs.



ITEM 28.07-01

RECYCLE GAS COOLER CONDENSER

ENTHALPY vs. TEMPERATURE

AND

W.T. % VAPOR vs. TEMPERATURE

R.O. PETKUS 2/28/72

K&E 10 X 10 TO THE INCH 46 0782
7 X 10 INCHES
KEUFFEL & ESSER CO.

FORM NO. 419 126. 8/70

Procon Incorporated

EXCHANGER DATA SHEET

CUSTOMER	IGT-HYGAS PLANT	REQ. No.	1843-28.07-2
ADDRESS		PAGE No.	
PLANT LOCATION		DATE	2/15/72
		REVISED	
SERVICE OF UNIT	Feed Effluent Heat Exchanger	ITEM NO.	28.07-51
SIZE	31-20-476 TYPE BJU	CONNECTED IN	
SURFACE PER UNIT	476 SHELLS PER UNIT 1	SURFACE PER SHELL	476

PERFORMANCE OF ONE UNIT

	SHELL SIDE		TUBE SIDE	
FLUID CIRCULATED	Methanator Effluent Gas		Methanator Feed Gas	
TOTAL FLUID ENTERING #/hr	484,068		61,152	
VAPOR "	425,899 CH_4		53,676 CH_4	
LIQUID "				
STEAM "	51,940		218	
NON-CONDENSABLES "	134 CO, 1430 CO_2, 4664 H_2		5201-CO, 238CO_2, 1753-H_2	
FLUID VAPORIZED OR CONDENSED				
STEAM CONDENSED				
GRAVITY—LIQUID				
VISCOSITY—LIQUID				
MOLECULAR WEIGHT—VAPORS	15.2		13.7	
SPECIFIC HEAT—LIQUIDS		B.T.U./#		B.T.U./#
LATENT HEAT—VAPORS		B.T.U./#		B.T.U./#
TEMPERATURE IN	900	°F	150	°F
TEMPERATURE OUT	860	°F	550	°F
OPERATING PRESSURE	1017	#/SQ. IN.	1033	#/SQ. IN.
NUMBER OF PASSES				
VELOCITY		FT./SEC.		FT./SEC.
PRESSURE DROP Allow./Cal.	3/	#/SQ. IN.	3/	#/SQ. IN.
Fouling Resistance	.001		.001	

HEAT EXCHANGED—B.T.U./HR.	17,000,000	M.T.D. (Corrected)	480
TRANSFER RATE—SERVICE	74.5	CLEAN	

CONSTRUCTION

DESIGN PRESSURE	1150	#/SQ. IN.	1170	#/SQ. IN.
TEST PRESSURE	CODE	#/SQ. IN.	CODE	#/SQ. IN.
DESIGN TEMPERATURE	975	°F	750	°F

TUBES C-½ Mo NO. 61 u's O.D. 3/4" BWG. 14 Min LENGTH 20'-0" PITCH 1" Sq. ☐

SHELL	1¼ CR - ½ Mo - Si I.D. 0.D. 31"	THICKNESS	
SHELL COVER	1¼ CR - ½ Mo - Si	FLOATING HEAD COVER	
CHANNEL	C-½ Mo	CHANNEL COVER	C-½ Mo
TUBE SHEETS—STATIONARY	1¼ Cr - ½ Mo - Si	FLOATING	
BAFFLES—CROSS	1¼ Cr-½ Mo-Si TYPE	THICKNESS	
BAFFLE—LONG	TYPE	THICKNESS	
TUBE SUPPORTS		THICKNESS	
GASKETS			
CONNECTIONS—SHELL—IN	20" OUT (2) 20"	SERIES	1500# RF
CHANNEL—IN	8" OUT 8"	SERIES	900# RF
CORROSION ALLOWANCE—SHELL SIDE	1/8"	TUBE SIDE	1/8"
CODE REQUIREMENTS	ASME VIII Stamp-yes	TEMA CLASS	R
WEIGHTS—EACH SHELL	BUNDLE	FULL OF WATER	

NOTE: INDICATE AFTER EACH PART WHETHER STRESS RELIEVED (S. R.) AND WHETHER RADIOGRAPHED (X-R)

REMARKS:

FORM NO. 410-120.9/70

Procon Incorporated

EXCHANGER DATA SHEET

REQ. No. 1843-28.07-2
CUSTOMER IGT - HYGAS PLANT — PAGE No.
ADDRESS — DATE 2/16/72
PLANT LOCATION — REVISED

SERVICE OF UNIT Product Gas Cooler — ITEM NO. 28.07-52
SIZE 25-192 — TYPE BEU — CONNECTED IN
SURFACE PER UNIT 965 — SHELLS PER UNIT 1 — SURFACE PER SHELL 965

PERFORMANCE OF ONE UNIT

	SHELL SIDE		TUBE SIDE	
FLUID CIRCULATED	Cooling Water		Wet Product Gas	
TOTAL FLUID ENTERING #/hr.	219,200		131,597	
VAPOR "			129,111 CH_4	
LIQUID "	219,200			
STEAM "			618	
NON-CONDENSABLES "			39-CO, 418-CO_2, 1411-H_2	
FLUID VAPORIZED OR CONDENSED "				
STEAM CONDENSED			429	
GRAVITY—LIQUID				
VISCOSITY—LIQUID				
MOLECULAR WEIGHT—VAPORS			15.0	
SPECIFIC HEAT—LIQUIDS		B.T.U./#		B.T.U./#
LATENT HEAT—VAPORS		B.T.U./#		B.T.U./#
TEMPERATURE IN	85	°F	160	°F
TEMPERATURE OUT	105	°F	110	°F
OPERATING PRESSURE GAGE	75	#/SQ. IN.	1060	#/SQ. IN.
NUMBER OF PASSES				
VELOCITY		FT./SEC.		FT./SEC.
PRESSURE DROP Allow/Cal.	10/	#/SQ. IN.	3/	#/SQ. IN.
Fouling Resistance	.002		.001	

HEAT EXCHANGED—B.T.U./HR. 4,800,000 — M.T.D. (Corrected) 33
TRANSFER RATE—SERVICE 137.6 — CLEAN

CONSTRUCTION

DESIGN PRESSURE	150	#/SQ. IN.	1170	#/SQ. IN.
TEST PRESSURE	CODE	#/SQ. IN.	CODE	#/SQ. IN.
DESIGN TEMPERATURE	450	°F	450	°F

TUBES C.S. — NO. 120u's — O.D. 1" — BWG 12 Min — LENGTH 16'-0" — PITCH 1¼" sq. □
SHELL C.S. — I.D. ~~XX~~ 25" — THICKNESS
SHELL COVER C.S. — FLOATING HEAD COVER
CHANNEL C.S. — CHANNEL COVER C.S.
TUBE SHEETS—STATIONARY C.S. — FLOATING
BAFFLES—CROSS C.S. — TYPE — THICKNESS
BAFFLE—LONG — TYPE — THICKNESS
TUBE SUPPORTS — THICKNESS
GASKETS
CONNECTIONS—SHELL—IN 6" — OUT 6" — SERIES 150# R.F.
CHANNEL—IN 10" — OUT 10" — SERIES 600# R.F.
CORROSION ALLOWANCE—SHELL SIDE 1/8" — TUBE SIDE 1/8"
CODE REQUIREMENTS ASME VIII Stamp - yes — TEMA CLASS R
WEIGHTS—EACH SHELL — BUNDLE — FULL OF WATER
NOTE: INDICATE AFTER EACH PART WHETHER STRESS RELIEVED (S. R.) AND WHETHER RADIOGRAPHED (X-R)
REMARKS:

FORM NO. 418-128, 9/70

Procon Incorporated

EXCHANGER DATA SHEET

CUSTOMER	IGT HYGAS PLANT	REQ. No.	1843--28.07-2
ADDRESS		PAGE No.	
PLANT LOCATION		DATE	
		REVISED	
SERVICE OF UNIT	Start Up Heater	ITEM NO.	28.07-53
SIZE	TYPE BEU	CONNECTED IN	
SURFACE PER UNIT 900 sq.ft.	SHELLS PER UNIT one	SURFACE PER SHELL	900

PERFORMANCE OF ONE UNIT

	SHELL SIDE		TUBE SIDE	
FLUID CIRCULATED	Steam		Methanator Feed Gas	
TOTAL FLUID ENTERING lb/hr	32,000 (Max)		62,576	
VAPOR "			55,622 CH_4	
LIQUID "				
STEAM "	32,000		126	
NON-CONDENSABLES "			4984-CO; 176 CO_2; 1668 H_2	
FLUID VAPORIZED OR CONDENSED "	32,000			
STEAM CONDENSED				
GRAVITY—LIQUID				
VISCOSITY—LIQUID				
MOLECULAR WEIGHT—VAPORS			13.9	
SPECIFIC HEAT—LIQUIDS		B.T.U./#		B.T.U./#
LATENT HEAT—VAPORS		B.T.U./#		B.T.U./#
TEMPERATURE IN	570	°F	120	°F
TEMPERATURE OUT	570	°F	550	°F
OPERATING PRESSURE Inlet gage	1200	#/SQ. IN.	1075	#/SQ. IN.
NUMBER OF PASSES	1		2	
VELOCITY		FT./SEC.		FT./SEC.
PRESSURE DROP Allowable	2	#/SQ. IN.	3	#/SQ. IN.
Fouling Factor	0.0005		0.001	
HEAT EXCHANGED—B.T.U./HR. 19 x 10^6		M.T.D. (Corrected)		
TRANSFER RATE—SERVICE		CLEAN		

CONSTRUCTION

DESIGN PRESSURE	1320	#/SQ. IN.	1185	#/SQ. IN.		
TEST PRESSURE	Code	#/SQ. IN.	Code	#/SQ. IN.		
DESIGN TEMPERATURE	650	°F	650	°F		
TUBES C-½ Mo	NO 114 U's O.D. 3/4	BWG 14 MIN.	THICKNESS 20'-0"	PITCH 15/16" Tri.		
SHELL C.S.	I.D.	O.D.	THICKNESS			
SHELL COVER C.S.			FLOATING HEAD COVER			
CHANNEL C-½ Mo			CHANNEL COVER			
TUBE SHEETS—STATIONARY C-½ Mo			FLOATING			
BAFFLES—CROSS	TYPE		THICKNESS			
BAFFLE—LONG	TYPE		THICKNESS			
TUBE SUPPORTS C.S.			THICKNESS			
GASKETS						
CONNECTIONS—SHELL—IN 6	OUT 3		SERIES 900 R.F.			
CHANNEL—IN 8	OUT 8		SERIES 900 R.F.			
CORROSION ALLOWANCE—SHELL SIDE 1/8"			TUBE SIDE 1/8"			
CODE REQUIREMENTS ASME, Sect. VIII Code Stamp			TEMA CLASS R			
WEIGHTS—EACH SHELL	BUNDLE		FULL OF WATER			

NOTE: INDICATE AFTER EACH PART WHETHER STRESS RELIEVED (S. R.) AND WHETHER RADIOGRAPHED (X-R)

REMARKS: No steam flow after startup - some tube side flow as temperature control in reactor circuit.

FORM NO. 410-120. 9/70

Procon Incorporated

EXCHANGER DATA SHEET

REQ. No. 1843-28.07-2
CUSTOMER IGT - HYGAS PLANT — PAGE No.
ADDRESS — DATE 2/15/72
PLANT LOCATION — REVISED
SERVICE OF UNIT Waste Heat Boiler — ITEM NO. 28-07-54
SIZE 49/65 - 229 — TYPE BKU — CONNECTED IN Parallel
SURFACE PER UNIT 10,552 — SHELLS PER UNIT 2 — SURFACE PER SHELL 5276

PERFORMANCE OF ONE UNIT

	SHELL SIDE		TUBE SIDE	
FLUID CIRCULATED	Boiler Feed Water		Methanator Effluent Gas	
TOTAL FLUID ENTERING #/hr	155,100		484,068	
VAPOR "			425,899 CH_4	
LIQUID "	155,100(Inc. 5% B.D.)			
STEAM "			51,292	
NON-CONDENSABLES "			112 CO, 968 CO_2, 5024 H_2	
FLUID VAPORIZED OR CONDENSED "	147,700			
STEAM CONDENSED				
GRAVITY—LIQUID				
VISCOSITY—LIQUID				
MOLECULAR WEIGHT—VAPORS			15.2	
SPECIFIC HEAT—LIQUIDS		B.T.U./#		B.T.U./#
LATENT HEAT—VAPORS		B.T.U./#		B.T.U./#
TEMPERATURE IN	180	°F	860	°F
TEMPERATURE OUT	406	°F	450	°F
OPERATING PRESSURE	250	#/SQ. IN.	1040	#/SQ. IN.
NUMBER OF PASSES	Kettle with Weir		2	
VELOCITY		FT./SEC.		FT./SEC.
PRESSURE DROP Allow./Cal.	Nil/Nil	#/SQ. IN.	2/2	#/SQ. IN.
Fouling Resistance	.0005		.001	

HEAT EXCHANGED—B.T.U./HR. 156,100,000 — M.T.D. (Corrected) 194.9
TRANSFER RATE—SERVICE 75.9 — CLEAN

CONSTRUCTION

DESIGN PRESSURE	290	#/SQ. IN.	1145	#/SQ. IN.
TEST PRESSURE	CODE	#/SQ. IN.	CODE	#/SQ. IN.
DESIGN TEMPERATURE	650	°F	900	°F

TUBES C-½ Mo — NO. 528u's O.D. 1" BWG. 12 MIN. LENGTH 19'-0" PITCH 1¼" □
SHELL C.S. — 60" I.D. O.D. — THICKNESS
SHELL COVER C.S. — FLOATING HEAD COVER
CHANNEL C-½ Mo. — CHANNEL COVER C-½ Mo
TUBE SHEETS—STATIONARY C-½ Mo. — FLOATING
BAFFLES—CROSS C.S. — TYPE — THICKNESS
BAFFLE—LONG – — TYPE — THICKNESS
TUBE SUPPORTS C.S. — THICKNESS
GASKETS
CONNECTIONS—SHELL—IN 4" — OUT 12" vp., 2" liq. — SERIES 300# R.F.
CHANNEL—IN 20" — OUT 20" — SERIES 1500# R.F.
CORROSION ALLOWANCE—SHELL SIDE 1/8" — TUBE SIDE 1/8"
CODE REQUIREMENTS ASME Sec. I, Stamp-yes — TEMA CLASS R
WEIGHTS—EACH SHELL — BUNDLE — FULL OF WATER
NOTE: INDICATE AFTER EACH PART WHETHER STRESS RELIEVED (S. R.) AND WHETHER RADIOGRAPHED (X-R)
REMARKS: Provide inlet distributor for boiler feed water.

FORM NO. 419-120, 9/70

Procon Incorporated

EXCHANGER DATA SHEET

		SIG. No.	1843-28.07-2
CUSTOMER	IGT - HYGAS PLANT	PAGE No.	
ADDRESS		DATE	2/15/72
PLANT LOCATION		REVISED	
SERVICE OF UNIT	Product Gas Cooler	ITEM NO.	28.07-55
SIZE	47/66-120	TYPE	BKU
SURFACE PER UNIT	2637	SHELLS PER UNIT	1
		CONNECTED IN	
		SURFACE PER SHELL	2637

PERFORMANCE OF ONE UNIT

		SHELL SIDE		TUBE SIDE	
FLUID CIRCULATED		Boiler Feed Water		Methanator Effluent Gas	
TOTAL FLUID ENTERING	#/hr	33,000		484,068	
VAPOR	"			425,899 CH_4	
LIQUID	"	33,000 (incl.5% B.D.)			
STEAM	"			51,940	
NON-CONDENSABLES	"			134CC, 1430 CO_2, 4664 H_2	
FLUID VAPORIZED OR CONDENSED	"	31,400			
STEAM CONDENSED					
GRAVITY—LIQUID					
VISCOSITY—LIQUID					
MOLECULAR WEIGHT—VAPORS				15.2	
SPECIFIC HEAT—LIQUIDS			B.T.U./#		B.T.U./#
LATENT HEAT—VAPORS			B.T.U./#		B.T.U./#
TEMPERATURE IN		180	°F	450	°F
TEMPERATURE OUT		298	°F	350	°F
OPERATING PRESSURE	Gage	50	#/SQ. IN.	1040	#/SQ. IN.
NUMBER OF PASSES		Kettle with Weir		2	
VELOCITY			FT./SEC.		FT./SEC.
PRESSURE DROP	Allow./Cal.	Nil/Nil	#/SQ. IN.	Nil/3	#/SQ. IN.
Fouling Resistance		.0005		.001	

HEAT EXCHANGED—B.T.U./HR. 32,600,000 M.T.D. (Corrected) .95

TRANSFER RATE—SERVICE 125.4 CLEAN

CONSTRUCTION

DESIGN PRESSURE	150	#/SQ. IN.	1145	#/SQ. IN.
TEST PRESSURE	Code	#/SQ. IN.	Code	#/SQ. IN.
DESIGN TEMPERATURE	500	°F	550	°F

TUBES C.S. NO. 504 O.D. 1" BWG. 12 MIN. LENGTH 10'-0" PITCH 1¼" □

SHELL C.S. I.D. 66" THICKNESS

SHELL COVER C.S. FLOATING HEAD COVER

CHANNEL C.S. CHANNEL COVER C.S.

TUBE SHEETS—STATIONARY C.S. FLOATING

BAFFLES—CROSS C.S. TYPE THICKNESS

BAFFLE—LONG TYPE THICKNESS

TUBE SUPPORTS C.S. THICKNESS

GASKETS

CONNECTIONS—SHELL—IN 3" OUT vp.10"; Liq.1½" SERIES 150# R.F.

CHANNEL—IN 24" OUT 24" SERIES 600# R.F.

CORROSION ALLOWANCE—SHELL SIDE 1/8" TUBE SIDE 1/8"

CODE REQUIREMENTS ASME, Sec. I, Stamp-yes TEMA CLASS R

WEIGHTS—EACH SHELL BUNDLE FULL OF WATER

NOTE: INDICATE AFTER EACH PART WHETHER STRESS RELIEVED (S. R.) AND WHETHER RADIOGRAPHED (X-R)

REMARKS: Provide inlet distributor for B.F.W. Steam shall contain not over 0.5% moisture when steaming @ 125% of rated capacity

PROCON

STANDARD DATA SHEET FOR CENTRIFUGAL PUMPS

NO. 1843-28.08-1
SHEET NO. 1
TOTAL SHEETS 1
DATE 2-8-72 EJM
APPROVED

FOR IGT - HYGAS PLANT ITEM NO. 28.08-01 A & B
SITE UNIT 2800
SERVICE BOILER FEED MOTOR DRIVE 1 TURBINE DRIVE 1
PUMP MFR SIZE AND TYPE NO. REQ'D 2

OPERATING CONDITIONS

LIQUID DE-AERATED, TREATED WATER, pH 7.5 to 8.5
PT F 180
SP GR at PT 0.97
VAP PRESS. at PT, psia 7.5
VIS at PT, Sau
CORR/EROS caused by
U.S. rpm at PT, NOR 320 DES 350
DISCH PRESS., psig 260
SUCT PRESS., psig MAX DES 65
DIFF PRESS., psi 195
DIFF HEAD, ft 465
NPSH AVAIL., ft 14+

PERFORMANCE

PROPOSAL CURVE NO.
NPSH REQ'D (WATER), ft
NO. OF STAGES RPM
DES EFF BHP
MAX BHP DES IMP
MAX HEAD DES IMP, ft
MIN CONTINUOUS, gpm (BY MFR) (1)
ROTATION FACING COUPLING END
WATER COOLING
BEARINGS
STUFF. BOX
PEDESTAL
GLAND
TOTAL WATER REQ'D, gpm
PACKING COOLING
FLUSHING API PLAN 12 (FLUSH TO SEAL FACES)
AUX PIPING BY PUMP MFR

CONSTRUCTION AND MATERIALS

CASING-MOUNTING (CENTERLINE X) (FOOT) (BRACKET) (VERTICAL)
SPLIT (AXIAL) (RADIAL X)
TYPE (SINGLE VOLUTE) (DOUBLE VOLUTE X) (DIFFUSER)
TAPPED OPENINGS (VENT X) (DRAIN X) (GAGE CONNS.)

NOZZLES	SIZE	ASA RATING	FACING	POSITION
SUCTION				
DISCHARGE				

IMPELLER DIAM DES MAX TYPE CLOSED
MFR'S BEARING NO. RADIAL THRUST
COUPLING and GUARD THOMAS / YES BASE PLATE DRAIN RIM
PACKING —
MECH SEAL YES, BAL, GLAND CODE MFR

MATERIAL CODE—EXTERNAL CASING S INTERNAL PARTS 1

	INTERNALS CODE					
1—CAST IRON	IMPELLER	1	B	S	O	
B—BRONZE	INNER CASE PARTS	1	1	S	O	
S—STEEL	SLEEVE (PACKED)	Ch	Ch	Al	Al	
C—11-13% CHROME	SLEEVE (SEAL)	O	O	O	O	
A—ALLOY	WEAR PARTS	X	B	(Ch)	Ch	
h—HARDENED	SHAFT	S	S	S	S	
f—FACED						
X—						

SHOP TESTS	REQUIRED	WITNESSED
RUNNING PERF	X	
NPSH		
HYDROSTATIC PSIG		

MAX ALLOW. WP PSIG F
WEIGHTS: PUMP BASE
MOTOR TURBINE

MOTOR DRIVER BY PUMP MFR

ITEM NO. A MTD BY PUMP MFR
HP RPM FRAME
MFR
TYPE SCI INSUL B
ENC TEFC TEMP RISE C 80
VOLTS/PHASE/CYCLES 460/3/60
BEARINGS BALL LUBE GRS
FULL LOAD AMPS

TURBINE DRIVER BY PUMP MFR

ITEM NO. — MTD BY PUMP MFR
HP RPM MAT'L
MFR and TYPE (2)
INLET STEAM, psig 250 TEMP F 456
EXHAUST 50 PSIG
STEAM RATE, FL lb/BHP/HR
BEARINGS LUBE

NOZZLES	SIZE	ASA RATING	FACING	POSITION
INLET				
EXHAUST				

MFR FINAL DATA (AS BUILT)

ACTUAL IMPELLER DIAM
TEST CURVE NO.
OUTLINE DWG NO.
PUMP SECT. DWG NO.
SEAL DIAM DWG NO.
PUMP SERIAL NO.

API STD. 610 COVERNS UNLESS OTHERWISE STATED.
EXCEPTIONS (ITEMIZE): (1) PLS. ADVISE (2) GENERAL PURPOSE API 611

REV.	DATE	APPROVED	REV.	DATE	APPROVED	REV.	DATE	APPROVED

PROCON, INCORPORATED
CENTRIFUGAL COMPRESSOR DATA SHEET NO. 1 OF 10

REQ'N. NO. 1843-28.09-1
DATE 2-15-72 BY EJM

PURCHASER IGT - HYGAS PLANT MANUFACTURER
DESTINATION TYPE AND SIZE
UNIT 2800 SERIAL NO.
ITEM NO. 28.09-01 NO. REQUIRED ONE QUOTE NO. DATE
SERVICE METHANATION RECYCLE PURCHASER ORDER NO. DATE

PROCESS REQUIREMENTS

	Normal	Rated	Other Conditions A	B	C
GAS HANDLED ①	CH_4 & H_2				
BAROMETER, psia					
~~STD CONDITIONS~~ (14.7 psia & 60 F ~~Dry~~) MMSCFD (WET)	262.9				
OR WEIGHT FLOW, lb per min					
INLET CONDITIONS Pressure, psia	993				
Temperature, deg F	150				
Relative Humidity, percent					
Molecular Weight (M)	~15.0				
Cp/Cv (K_1)	~1.3				
Compressibility (Z_1)	~0.95				
Inlet Volume, cfm	~3180				
DISCHARGE CONDITIONS Pressure, psia	1065				
Temperature, deg F					
Cp/Cv (K_2)					
Compressibility (Z_2)					
HORSEPOWER REQUIRED BY DRIVER					
SPEED, rpm					
ESTIMATED SURGE, ICFM (At Speed Above)					
ADIABATIC HEAD (Hg)					
PERFORMANCE CURVE NO.					

CORROSIVENESS AND REMARKS REGARDING GAS ① GAS ANALYSIS ON SHEET 2

PROCON, INCORPORATED
GAS ANALYSIS DATA SHEET

JOB NO. 1843 ITEM NO. 28.09-01
PURCHASE ORDER NO.
REQUISITION NO. 1843-28.09-1
Sheet No. 2 OF 10 BY EJM
DATE 3-15-72

MATERIAL	SYMBOL		MOL/HR
	CO_2		32.5
	CO		4.8
	H_2		2313.3
	CH_4		26549.3
	H_2O		109.1
TOTALS			29009.0
MOLECULAR WEIGHT	APPROX.		15.0

PROCON, INCORPORATED — REQ'N. NO. 1843-28.09-1

CENTRIFUGAL COMPRESSOR DATA SHEET NO. 3 OF 10 — DATE 2-15-72 BY EJM

CONSTRUCTION FEATURES

SPEEDS (rpm): Max Cont..... Criticals: 1st ..... 2nd .....

ROTATION, Viewed from Coupling End of Compressor .....

CASING: Type VERT. SPLIT-OVERHUNG Material CAST STEEL

Thickness .....Corrosion Allowance .....

Max Oper Temp..... Max Oper Press. .....Test Press. .....

IMPELLERS: Type CLOSED-WELDED.....Material.....

No. .....Diameters.....

DIAPHRAGMS: Material.....Cooling .....

LABYRINTHS: Material .....Radial Clearance .....

SHAFT: Material .....Diameter at Impellers .....

BEARING HOUSING CONSTRUCTION EXTERNAL (MFR. STD.)

RADIAL BEARINGS: Span .....Diameter.. .....Length.....

Total Clearance .....Oil Press.....

THRUST BEARING: Type .....Size.....

Location .....Oil Press.....

OTHER COMPONENTS: Material.....

.....

.....

INLET NOZZLE: Size.....Rating.....Facing .....Location .....

Allowable Loads	Force, lb	Moment, ft-lb
Parallel to Shaft		
Vertical		
Horiz 90 deg to Shaft		

DISCHARGE NOZZLE: Size.. .....Rating.....Facing . .....Location .....

Allowable Loads	Force, lb	Moment, ft-lb
Parallel to Shaft		
Vertical		
Horiz 90 deg to Shaft		

CASING CONNECTIONS: Vents, No.....Type and Size.....

Suction Nozzle: - Pressure Connection ——————Type and Size.....

Temperature Connection ——————Type and Size.....

Discharge Nozzle: Pressure Connection - ——————Type and Size.....

Temperature Connection — ——————Type and Size.....

Casing Drains: No.....Type and Size.....

Water Connection: No.....Type and Size.....

Lube Oil Connection: Inlet Type and Size.....

Outlet Type and Size.....

Seal Oil Connection: Inlet Type and Size.....

Outlet Type and Size.....

Other Connection: Service .....

Type and Size.....

COUPLINGS:	Driver-Compressor [redacted]	Gear-Compressor
Make	FAST OR WALDRON	
Type	FLEXIBLE, SPACER, GEAR	
Lubrication	CONTINUOUSLY LUBRICATED	
Mounting		

PROCON, INCORPORATED
CENTRIFUGAL COMPRESSOR DATA SHEET NO. 4 of 10

REQ'N. NO. 1843-28.09-1
DATE 2-15-72 BY EJM

CONSTRUCTION FEATURES—Continued

BASEPLATE: Type COMMON (COMPRESSOR & DRIVER)
CONTROLS: Method
Control Device
Signal: Source
Type Range
Effect on Change

LUBE OIL SYSTEM

TYPE COMMON TO COMPRESSOR, DRIVER & COUPLING
SEPARATE CONSOLE

PRESS.: Driver Gear Control System Design
RELIEF VALVE SETTING SCHEMATIC DIAGRAM
GPM: Compressor Driver Gear Control Oil
MAIN PUMP: Make IMO Type SCREW Casing Material STEEL
Flanges Speed rpm
Driver STEAM TURBINE (API 611) hp Coupling THOMAS SS DISC
Location ON CONSOLE Control
SPARE PUMP: Make IMO Type SCREW Casing Material STEEL
Flanges Speed rpm
Driver EXP. PROOF ELEC. MOTOR hp Coupling THOMAS SS DISC
Location ON CONSOLE Control
COOLERS: No. TWO Make Type FLOATING HEAD
Duty Surface Code TEMA C/ASME
Shell: OD Thickness Design Press.
Tubes: OD (3/4" min.) Length Bwg (16 min.) No.
Material: Shell STEEL Channel STEEL Tubes INH. ADM.
Switch Valve: Make KRAISSL Material STEEL
Water: Temp In 85°F Out Press 65 PSIG gpm
FILTERS: No TWO Make Type EACH SIZED 1.2 X PUMP CAP'Y.
Casing Material STEEL Flanges
Design Press. ΔP Micron 10
Switch Valve: Make SAME VALVE AS COOLERS Material —
RESERVOIR: Location ON CONSOLE Size 8 MIN. RETENTION Material STEEL
Flanges Interior Coating
Heating Coil STEAM (50 PSIG) Insulation Supports
ALL OIL PIPING COMPONENTS SHALL BE STEEL.

SEAL OIL SYSTEM

TYPE OF SEAL LIQUID FILM (WITH ELEVATED HEAD TANK)
TYPE OF SYSTEM COMBINED WITH LUBE OIL SYSTEM

GPM TO SEALS SYSTEM DESIGN PRESS.
RELIEF VALVE SETTING SCHEMATIC DIAGRAM
MAIN PUMP: Make IMO (BOOSTER) Type SCREW Casing Material STEEL
Flanges Speed rpm
Driver STEAM TURBINE (API 611) hp Coupling THOMAS SS DISC
Location ON CONSOLE Control

PROCON, INCORPORATED
CENTRIFUGAL COMPRESSOR DATA SHEET NO. 5 OF 10

REQ'N. NO. 1843-28.09-1
DATE 2-15-72 BY EJM

SEAL OIL SYSTEM—Continued

SPARE PUMP: Make IMO (BOOSTER) Type SCREW Casing Material STEEL
Flanges ..... Speed ..... rpm.....
Driver EXP. PROOF ELEC. MOTOR hp ..... Coupling THOMAS SS DISC
Location ON CONSOLE Control .....
COOLERS: No. ..... Make ..... Type .....
Duty ..... Surface ..... Code .....
Shell: OD ..... Thickness ..... Design Press. .....
Tubes: OD ..... Length ..... Dwg ..... No. .....
Material: Shell ..... Channel ..... Tubes .....
Switch Valve: Make ..... Material .....
Water Temp: In ..... Out ..... Press. ..... gpm .....
FILTERS: No. TWO Make ..... Type BACKWASH. 1.2 x PUMP CAP'Y.
Casing Material STEEL Flanges .....
Design Press. ..... ΔP ..... Micron 10
Switch Valve: Make KRAISSL ..... Material STEEL
RESERVOIR: Location ..... Size ..... Material .....
Flanges ..... Interior Coating .....
Heating Coil ..... Insulation Supports .....

INSTRUMENTATION

PRESS. GAGES: Make ..... Type and Size .....
TEMP GAGES: Make ..... Type and Size .....
LEVEL GAGES: Make ..... Type and Size .....
.....
SIGHT FLOW: Make ..... Type and Size .....
TACHOMETER: Make ..... Type and Range ELECTRONIC
ALARMS: Type CONTACTS TO OPEN (FURNISH TOTAL OF 15 DUAL SWITCHES ①)
Setting: Lube Oil Lo. PR. - 3 ..... Control Oil Grv. Lo. PR - 1 ..... Seal Oil HEAD TK. LEVELS - 4
Compressor Discharge Temp. HIGH - 1 ..... Bearing Temp. — .....
Others RESVR. Lo. LEVEL - 1, FILTER HI. ΔP - 2, START AUX. PUMPS - 3 .....
TRIPS: Type CONTACTS TO CLOSE (FURNISH 2 DUAL SWITCHES ①)
Setting: Lube Oil HEADER Lo. PR. ..... Control Oil — ..... Seal Oil HEAD TK. Lo. LEVEL .....
Compressor Discharge Temp. — ..... Bearing Temp. — .....
Others — .....
INSTRUMENT PANEL BY PURCHASER

① EACH (DUAL) SWITCH SHALL CONSIST OF TWO ELECTRICALLY SEPARATE SINGLE POLE DOUBLE THROW SWITCHES, WITH INDIVIDUALLY ADJUSTABLE CONTACTS (MIN. 10 AMPS/115 V)

INSPECTION AND TESTS

	Not Witnessed	Witnessed
SHOP INSPECTION		YES
HYDROSTATIC		YES
MECHANICAL RUN		YES
PERFORMANCE, AIR		
PERFORMANCE, GAS		
AUXILIARY EQUIPMENT		
DRIVER WITH COMPRESSOR		

PROCON, INCORPORATED
CENTRIFUGAL COMPRESSOR DATA SHEET NO. 6 OF 10

REQ'N NO. 1843-28.09-1
DATE 2-15-72 BY EJM

WEIGHTS

COMPRESSOR ..... DRIVER ..... GEAR ..... BASE .....
ROTORS: Compressor ..... Driver .....
COMPRESSOR UPPER CASE ..... AUXILIARIES (if separate) .....
TOTAL SHIPPING WEIGHT ..... MAX FOR MAINTENANCE .....

INSTALLATION CONDITIONS

ENCLOSURE TYPE UNHEATED SHELTER WITH ROOF AND PARTIAL SIDES.
SETTING: Grade X Balcony Ft Above Grade
TEMP AT COMPRESSOR: Max 95 °F Min -20 °F

WINTERIZING (Outdoor Installations)

Item	By
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	

UTILITY CONDITIONS

STEAM*:	Driver	Auxiliaries
Inlet, Min	psig F	psig F
Normal	psig F	250 psig 456 F
Max	psig F	psig F
Exhaust, Min	psig F	psig F
Normal	psig F	50 psig F
Max	psig F	psig F
Total lb per hour		

* Indicate by an asterisk (*) steam condition at which steam rate shall be guaranteed.

ELECTRIC:	Driver	MOTORS - Auxiliaries	- CONTROL
Voltage		460	115
Cycle		60	60
Phase		3	1
Power factor			
Total kw			

COOLING WATER: Temp 85 °F Press 65 PSIG Allowable Rise 25 °F
Fouling Factor 0.002 (WATER SIDE) Total gpm .....
OTHER

PROCON, INCORPORATED — REQ'N. NO. 1843-28.09-1

CENTRIFUGAL COMPRESSOR DATA SHEET NO. 7 OF 10 — DATE 2-15-72 — BY E JM

DRIVER

TYPE: SPECIAL PURPOSE STEAM TURBINE MAKE.....

RATED Hp..... RATED rpm..... SERIAL NO.....

DATA SHEET (SEE SHEETS 8,9 & 10) FURNISHED BY AND MOUNTED BY COMPR. MFR.

GEAR UNIT: Make and Type.....

Gear Ratio .....hp Rating .....AGMA Service Factor.....

Mechanical Efficiency.....Bearings, Diameter.....Length.....

Gears: Pitch Diameter.....Width.....Material.....

SUPPLEMENTAL SPECIFICATIONS AND DATA SHEETS

COMPRESSOR API 617

DRIVER API 612

OTHER

ADDITIONAL DATA

1. VENDOR SHALL MAKE COMPLETE LATERAL AND TORSIONAL ANALYSIS OF COMPRESSOR-DRIVER UNIT.

2. COMPRESSOR SHALL HAVE PROVISIONS FOR FUTURE INSTALLATION OF TWO VIBRATION DETECTORS (~ 90° APART) AT EACH RADIAL BEARING. VENDOR SHALL FURNISH AND INSTALL ONE VIBRATION DETECTOR AT COUPLING END, ONE AXIAL MOVEMENT DETECTOR, REQUIRED CABLE, PROXIMETERS AND EXP. PROOF HOUSING. (BENTLY-NEVADA) MONITORS BY PURCHASER.

3. ALL ELECTRICAL COMPONENTS SHALL BE SUITABLE FOR CLASS I, GROUP B, DIV. 2.

PROCON, INCORPORATED
SPECIAL-PURPOSE STEAM TURBINE DATA SHEET

JOB. NO. _____ ITEM NO. 28.09-01
PURCHASE ORDER NO. _____
REQUISITION NO. 1843-28.09-1
INQUIRY NO. _____
Sheet No. 8 OF 10 BY EJM
DATE 2-15-72 REVISION _____

APPLICABLE TO: ☒ PROPOSALS ○ PURCHASE ○ AS BUILT
FOR SGT-HYGAS PLANT UNIT _____
SITE _____ SERIAL NO. _____ RATED HP _____
SERVICE METHANATION RECYCLE COMPRESSOR DRIVE NO. REQ'D ONE
MANUFACTURER _____ OUTLINE DWG. _____ SECTION DWG. _____
MODEL _____ TURBINE _____ TYPE _____ DRIVEN EQUIPMENT CENT. COMPR.

NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER; ☐ BY MANUFACTURER
PARAGRAPH NUMBERS WITHIN ( ) REFER TO APPLICABLE PARTS OF THIS STANDARD

OPERATING CONDITIONS

INDICATE GUARANTEE POINT BY *

	HORSEPOWER	SPEED, RPM	STEAM RATE LB/HP/HR
RATED			
NORMAL			

1ST CRITICAL SPEED ____ RPM 2ND CRITICAL SPEED ____ RPM
TRIP SPEED ____ RPM

STEAM CONDITIONS
INLET STEAM

NORMAL	250 PSIG	456 °FTT
MAX. INITIAL		
MIN. INITIAL		

EXHAUST STEAM

NORMAL	50 PSIG	°FTT
MAX.		
MIN.		

○ EXTRACTION ○ ADMISSION ○ NONRETURN VALVE
○ CONTROLLED ○ UNCONTROLLED

	FLOW, LB/HR	PSIG	°FTT
NORMAL			
MIN.			
MAX.			

PERFORMANCE CURVE NO. _____
MAX. TURBINE FLOW, LB/HR _____
MAX. FLOW TO CONDENSER, LB/HR @ ___ IN. HG _____

DUTY ☒ CONT ○ INTERMIT ○ STANDBY HR/YR
APPROX STEAM RATE DESIRED _____ LB/BHP/HR
STEAM COST _____ $/MLB PAYOUT PERIOD _____ YEARS
LOCATION (6b)
○ INDOOR ○ HEATED ☒ UNDER ROOF
○ OUTDOOR ☒ UNHEATED ☒ PARTIAL SIDES
☒ GRADE ○ MEZZANINE
SITE ELEVATION _____ FT, BAR 14.3 PSIA/~~MMHG~~
MIN. TEMP °F 95 SUMMER -20 WINTER
☒ WINTERIZATION REQ'D ○ TROPICALIZATION REQ'D
ATMOSPHERIC CONDITIONS ○ DUST ○ FUMES ○ OTHER
COOLING WATER SUPPLY TEMP 85° F, PRESS. 65 PSIG, ΔP ___

CONSTRUCTION FEATURES

TYPE ○ VERTICAL ☒ HORIZONTAL ☐ NO. STAGES ___
CASING SPLIT ☒ HORIZONTAL ○ VERTICAL
ROTOR ☒ SOLID ☐ BUILT UP
ROTATION (FROM GOV. END) ○ CW ○ CCW
MAX. TIP SPEED _____ RPM

GOVERNOR TYPE
○ MECH ○ HYDR ☒ OIL RELAY NEMA CLASS D (31a)
GOVERNOR MFR. WOODWARD MODEL _____
NO. AUTO VALVES ___ TYPE LIFT ☐ CAM ☐ BAR
HAND VALVES. ○ MIN. STEAM PRESS. ○ ECONOMY (31c)
☒ AIR HEAD FOR INSTRUMENT CONTROL (31d) ○ JACKSCREW
RANGE ___ RPM. ○ ___ PSIG ___ RPM @ ___ PSIG
HAND SPEED CHANGER: RPM ___ MAX ___ MIN. (31b)
SEPARATE TRIP THROTTLE VALVE: ☒ HYD ○ MECH (32)
○ REMOTE TRIP ○ ACTUATION _____

BEARINGS
RADIAL TYPE _____ AREA _____ SQ IN.
THRUST TYPE _____ AREA _____ SQ IN.
MAX. THRUST LOAD _____ LB
THRUST CAPACITY _____ LB

PACKING TYPE (16c)
INTERSTAGE GLAND SEALS _____
END GLAND SEALS LABYRINTH NO. PER BOX _____
☒ INSULATION ☒ JACKET MATL STEEL (20a)

TACHOMETER ○ VIBR. REED ○ ELECTRIC ☒ ELECTRONIC
○ NO. SPEED INDICATOR REQ'D BY PURCH. (34c)
LOCATION _____
○ TACHOMETER MFR _____ MODEL _____
☒ SENTINEL WARNING VALVE SET @ _____ PSIG (7c)
○ BASEPLATE BY COMPR. MFR. (21a)
○ UNDER TURBINE ONLY
○ UNDER TURBINE AND GEAR
☒ UNDER TURBINE AND DRIVEN EQUIPMENT
○ SOLEPLATES BY _____

GLAND SEALING SYSTEM
☒ STEAM EJECTOR REQ'D 50 PSIG SAT. °FTT (16a)
☒ GLAND CONDENSER REQ'D ○ VACUUM DEVICE ___ (16b)
☒ TEMA "C" TEMA "B" OTHER
TUBE OD _____ IN., BWG _____ MATL _____

ELECTRICAL AREA CLASS GR. B DIV. 2 (6k)

PROCON, INCORPORATED

SPECIAL-PURPOSE STEAM TURBINE DATA SHEET (Cont'd)

Req'n. No. 1843-28.09-1
JOB NO. _____ ITEM NO. 28.09-01
Sheet No. 9 OF 10 BY E.J.M.
DATE 2-15-72 REVISION _____

CONNECTIONS

	SIZE	BASIS RATING	FACING	POSITION
INLET				
EXHAUST				
EXTRACTION				
ADMISSION				

ALLOWABLE PIPING FORCES AND MOMENTS

	INLET		EXHAUST		EXTRACTION	
	FORCE LB	MOMT FT-LB	FORCE LB	MOMT FT-LB	FORCE LB	MOMT FT-LB
PARALLEL TO SHAFT						
VERTICAL						
HORIZ. 90°						

WEIGHTS AND DIMENSIONS

NET WT _____ LB SHIPPING WT _____ LB
MAX. ERECTION WT _____ LB MAX. MAINT. WT _____ LB
APPROX. FLOOR SPACE: LENGTH _____
WIDTH _____ HEIGHT _____

[ ] POTENTIAL MAX. FUTURE BHP _____
[ ] MAX. STEAM FLOW INLET VALVE _____ LB/HR
[ ] MAX ALLOWABLE CASING PRESS ON EXHAUST END _____ PSIG

TURBINE MATERIALS

[ ] HIGH-PRESS. CASING ___ [ ] STEAM CHEST _____
[ ] EXHAUST CASING _____ [ ] DIAPHRAGMS _____
[ ] NOZZLES _____ [ ] NOZZLE RINGS _____
[ ] BLADES _____ [ ] SHROUDS _____
[ ] WHEEL _____ [ ] GOV VALVE TRIM _____
[ ] SHAFT _____
[ ] SHAFT MATERIAL UNDER SEALS _____ (14b)
[ ] APPLIED BY SPRAYING ___ [ ] PLATING _____

LUBE OIL

O SEPARATE [X] COMMON
O WITH DRIVER (26a) [X] WITH DRIVEN UNIT
O MAIN OIL PUMP O SHAFT DRIVEN O SEPARATELY DRIVEN
O SS OIL DRAIN HEADER (17c)
O SS OIL SUPPLY HEADER
[ ] OIL VISCOSITY ___ SUS @ 100 F ___ SUS @ 210 F
[ ] MAX. PERMISSIBLE OIL VISCOSITY @ STARTUP _____ SUS

COUPLING

[X] MOUNT ½ COUPLING (17a) O TYPE _____ (17d)
MFR _____ (17b-1)
O SPACER REQ'D
[X] COUPLING FURNISHED BY COMPR. MFR. (17d)
TURBINE SHAFT O TAPER O CYLINDRICAL
DRIVEN SHAFT O TAPER O CYLINDRICAL
COUPLING GUARD O MFR STD O OTHER

APPLICABLE SPECIFICATIONS

API 612 SPECIAL-PURPOSE STEAM TURBINE

TORSIONAL AND LATERAL CRITICAL SPEED ANALYSIS

BY COMPR. MFR. (18b)

SHOP TESTS	REQUIRED	WITNESSED	(36b)
SHOP INSPECTION			(35a)
HYDROSTATIC	[X]	[X]	
MECHANICAL RUN	[X]	[X]	
RUN SPARE ROTOR	O	O	
PERFORMANCE TEST	O	O	(39)
AUXILIARY EQUIPMENT TEST	O	O	
DISMANTLE REASSEMBLY	O	O	
_____	O	O	(36b-5)
_____	O	O	
_____	O	O	

GEAR

O SPECIAL PURPOSE GEAR REQ'D
O GEAR FURNISHED BY _____

CONTROL PANEL

FURNISHED BY O VENDOR [X] OTHERS
MOUNTING O ON TURBINE O FREE STANDING OFF GROUND

ALARM CONTACTS SHALL (34g)

O OPEN TO SOUND ALARM O CLOSE TO SOUND ALARM
SHUTDOWN CONTACTS SHALL.
O OPEN TO SHUT DOWN O CLOSE TO SHUT DOWN
CONTROL CURRENT ___ VOLTS ___ PHASE ___ HERTZ
SWITCH ENCLOSURE O EXP PROOF O WEATHERPROOF O___

Req'n. No. 1844-28.09-1

PROCON, INCORPORATED
SPECIAL-PURPOSE STEAM TURBINE DATA SHEET (Cont'd)

JOB NO. _____ ITEM NO. 28.09-01
Sheet No. 10 OF 10 BY EJM
DATE 2-15-72 REVISION _____

ALARMS AND SHUTDOWNS (34f)

	ALARM	SHUT-DOWN
O STANDBY LUBE OIL PUMP OPERATING	O	O
O LOW OIL PRESSURE (EACH LEVEL)	O	O
X OVERSPEED TRIP OPERATION	O	O
O HIGH TURBINE EXTRACTION PRESSURE	O	O
O HIGH EXHAUST PRESSURE	O	O
O HIGH OIL FILTER ΔP	O	O
O HIGH AND LOW OIL RESERVOIR LEVEL	O	O
O HIGH OIL COOLER OUTLET TEMPERATURE	O	O
O EXCESSIVE VIBRATION OF TURBINE	O	O
O EXCESSIVE AXIAL DISPLACEMENT OF TURBINE	O	O
O _____ (34f)	O	O
X SEE NOTE 1 BELOW	O	O
O _____	O	O

INSTRUMENT PANEL (33)

O STEAM INLET PRESSURE GAGE
O EXHAUST STEAM PRESSURE GAGE
O STEAM CHEST PRESSURE GAGE
O FIRST-STAGE PRESSURE GAGE
O EXTRACTION PRESSURE GAGE
O STEAM SEAL PRESSURE GAGE
O LUBE OIL PRESSURE GAGE
O CONTROL OIL PRESSURE GAGE
O SPEED INDICATOR
O GAGES FOR DRIVEN EQUIPMENT
O ALARM HOWLER
O ANNUNCIATOR
O _____
O _____
O _____

VIBRATION DETECTORS SEE NOTE 2 (34a)

☐ TYPE _____ ☐ MODEL _____
☐ MFR _____
☐ NO. _____ AT EACH SHAFT BEARING TOTAL NO. _____
O NO. OF VIBRATION MONITORS _____
O ALARM O SHUTDOWN
O TIME DELAY _____ SEC
☐ MONITOR LOCATION _____
☐ MONITOR ENCLOSURE _____

AXIAL MOVEMENT DETECTOR SEE NOTE 2. (34e)

☐ TYPE _____
☐ MFR _____
O NO. REQUIRED _____
O NO. OF VIBRATION MONITORS _____
O ALARM O SHUTDOWN
O TIME DELAY _____ SEC
☐ MONITOR LOCATION _____
☐ MONITOR ENCLOSURE _____

O PROVISIONS FOR FIELD BALANCING (19e)

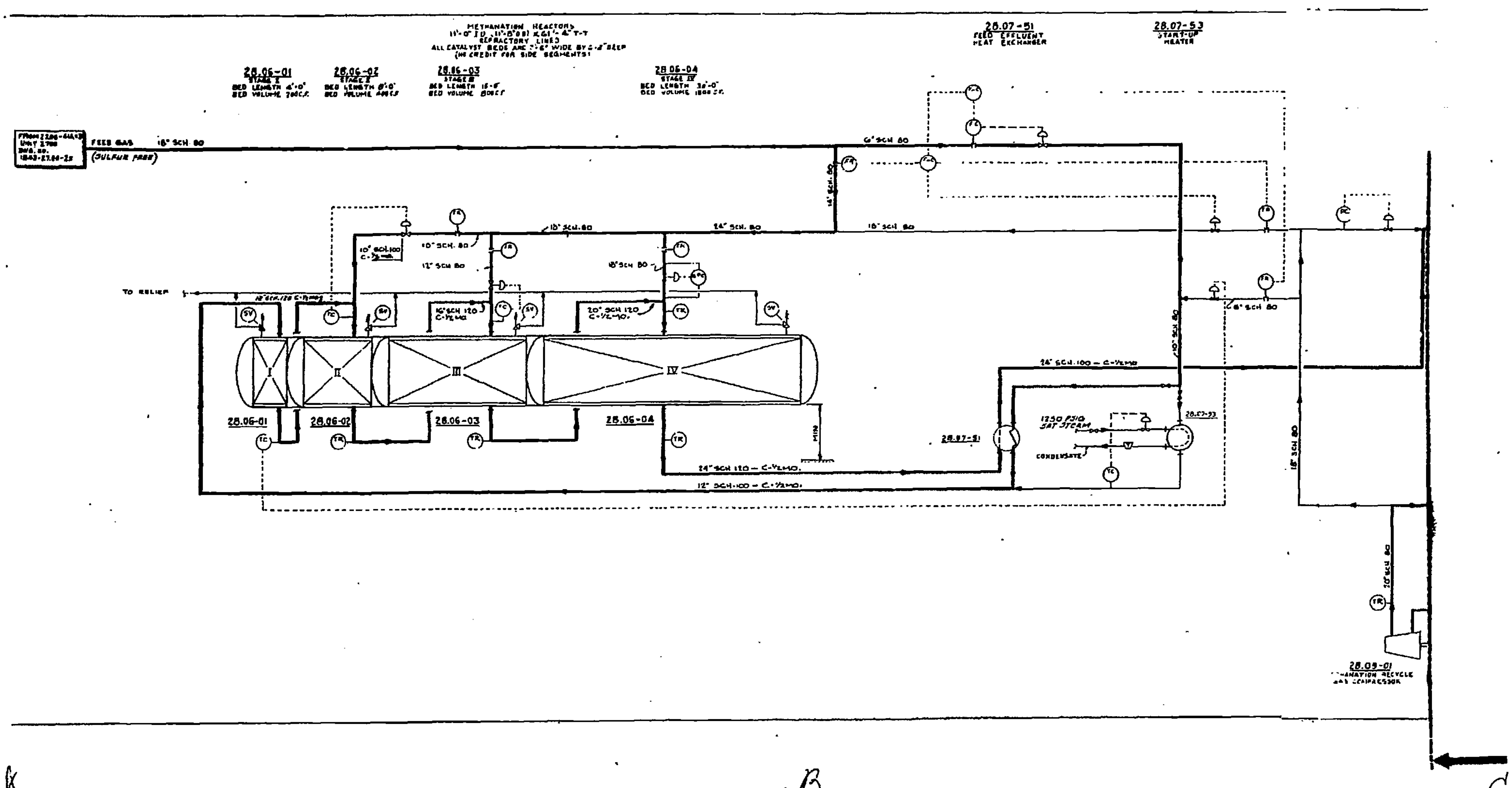
O VENDOR'S REVIEW AND COMMENT ON PURCHASER'S PIPING AND FOUNDATION DRAWINGS ARE REQUIRED (6d)

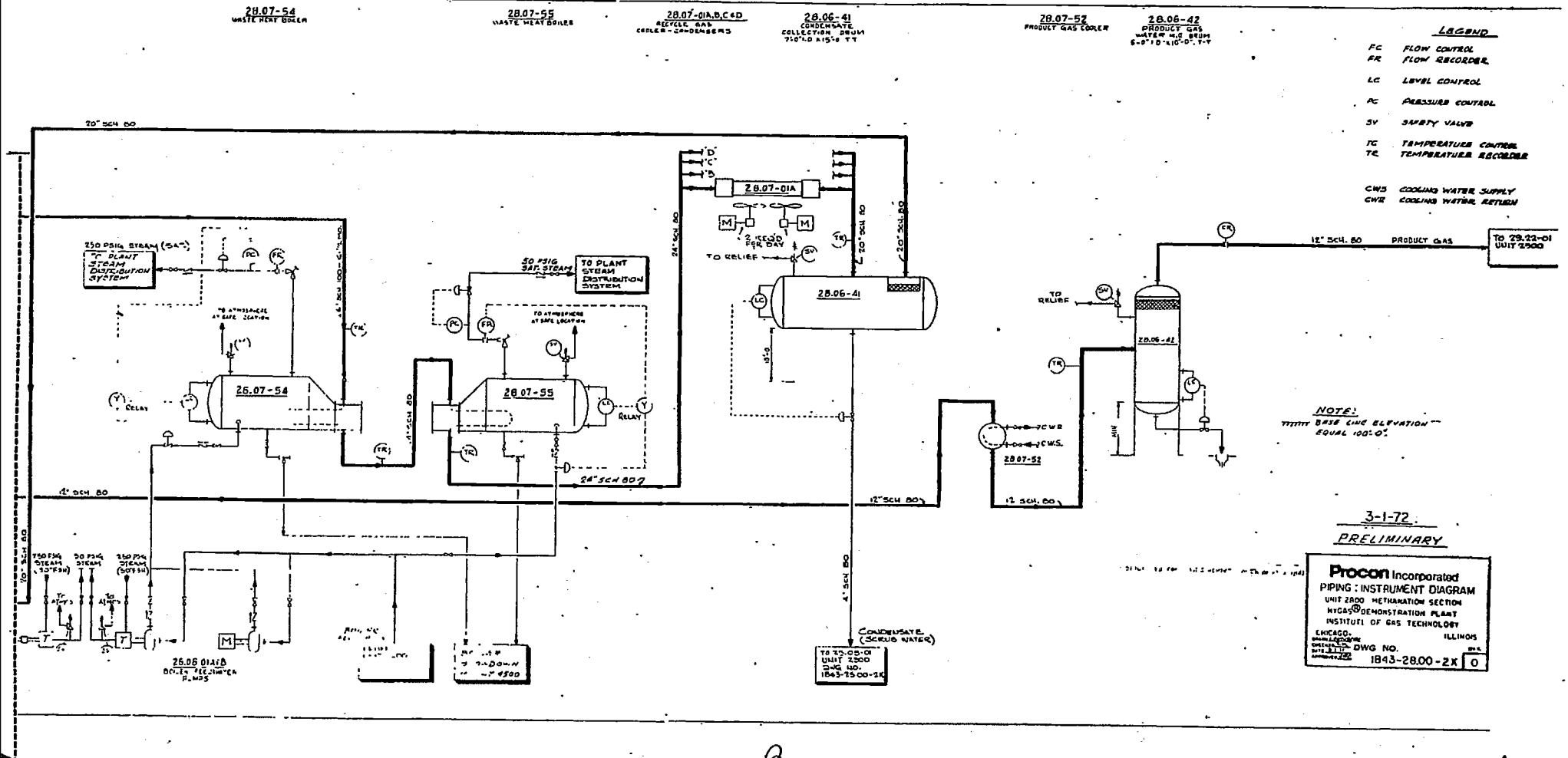
SKETCH

NOTE 1 PROVIDE LIMIT SWITCH AT TRIP AND THROTTLE VALVE. ALL ELEC. SWITCHES SHALL BE DUAL SPDT.

NOTE 2 TURBINE SHALL HAVE PROVISIONS FOR INSTALLATION OF TWO VIBRATION DETECTORS AT EACH RADIAL BEARING. VENDOR SHALL FURNISH AND INSTALL ONE VIBRATION DETECTOR AT COUPLING END, ONE AXIAL MOVEMENT DETECTOR, CABLE, PROXIMETERS AND X.P. HOUSING. (BENTLY-NEVADA)

NOTE 3 TURBINE SHALL BE EQUIPPED WITH A LABYRINTH SEAL RING FOR PRESSURIZING WITH INSTRUMENT AIR, AT INBOARD SIDE OF EACH RADIAL BEARING.


METHANATION REACTORS
REFRACTORY LINED
28.06-01
28.06-02
28.06-04
28.07-51
FEED EFFLUENT HEAT EXCHANGER
28.07-53
START-UP HEATER
FEED GAS 18" SCH 80
(SULFUR FREE)
TO RELIEF
24" SCH 80
18" SCH 80
6" SCH 80
8" SCH 80
24" SCH 100 – C-½MO
24" SCH 120 – C-½MO
12" SCH 100 – C-½MO
1250 PSIG SAT STEAM
CONDENSATE
MIN
28.09-01
20" SCH 80


28.07-54
WASTE HEAT BOILER
28.07-55
WASTE HEAT BOILER
28.07-01A,B,C&D
RECYCLE GAS COOLER-CONDENSERS
28.06-41
CONDENSATE COLLECTION DRUM
28.07-52
PRODUCT GAS COOLER
28.06-42
PRODUCT GAS WATER KO DRUM
LEGEND
FC FLOW CONTROL
FR FLOW RECORDER
LC LEVEL CONTROL
PC PRESSURE CONTROL
SV SAFETY VALVE
TC TEMPERATURE CONTROL
TR TEMPERATURE RECORDER
CWS COOLING WATER SUPPLY
CWR COOLING WATER RETURN
70" SCH 80
250 PSIG STEAM (54")
"A" PLANT STEAM DISTRIBUTION SYSTEM
TO ATMOSPHERE AT SAFE LOCATION
50 PSIG SAT. STEAM
TO PLANT STEAM DISTRIBUTION SYSTEM
28.07-01A
TO RELIEF
28.06-41
28.07-54
28.07-55
RELAY
24" SCH 80
20" SCH 80
12" SCH 80
PRODUCT GAS
TO 29.22-01 UNIT 2300
28.06-42
28.07-52
CWR
CWS
4" SCH 80
CONDENSATE (SCRUB WATER)
TO 25.05-01 UNIT 2200 DWG NO. 1843-2500-2K
28.06-01A&B
BOILER FEEDWATER PUMPS
NOTE:
BASE LINE ELEVATION EQUAL 100'-0"
3-1-72
PRELIMINARY
Procon Incorporated
PIPING : INSTRUMENT DIAGRAM
UNIT 2800 METHANATION SECTION
HYGAS® DEMONSTRATION PLANT
INSTITUTE OF GAS TECHNOLOGY
CHICAGO, ILLINOIS
DWG NO. 1843-28.00-2X
0

A B C

Procon Incorporated

DES PLAINES, ILLINOIS U.S.A.

REQUISITION

NO. 1843-29.22-1

SHEET NO. 1

TOTAL SHEETS 1

DATE 11-4-71

APPROVED

MATERIAL INCLUDES –

GAS DRYER
PRODUCT GAS DRYING SECTION - UNIT 2900

INSTITUTE OF GAS TECHNOLOGY CHICAGO, ILLINOIS

DESCRIPTION OF MATERIAL	COST ACCOUNT NO.	PURCHASE ORDER NO.

OPERATING CONDITIONS

Flow rate - 80 MM SCFD
Inlet Temperature - 125°F
Inlet Pressure - 1010 PSIG
Feed Composition, Dry :

COMP.	MOLS/HR
CO_2	5
CO	4
H_2	547
CH_4	8174

Allowable pressure drop across absorber - 5 psi

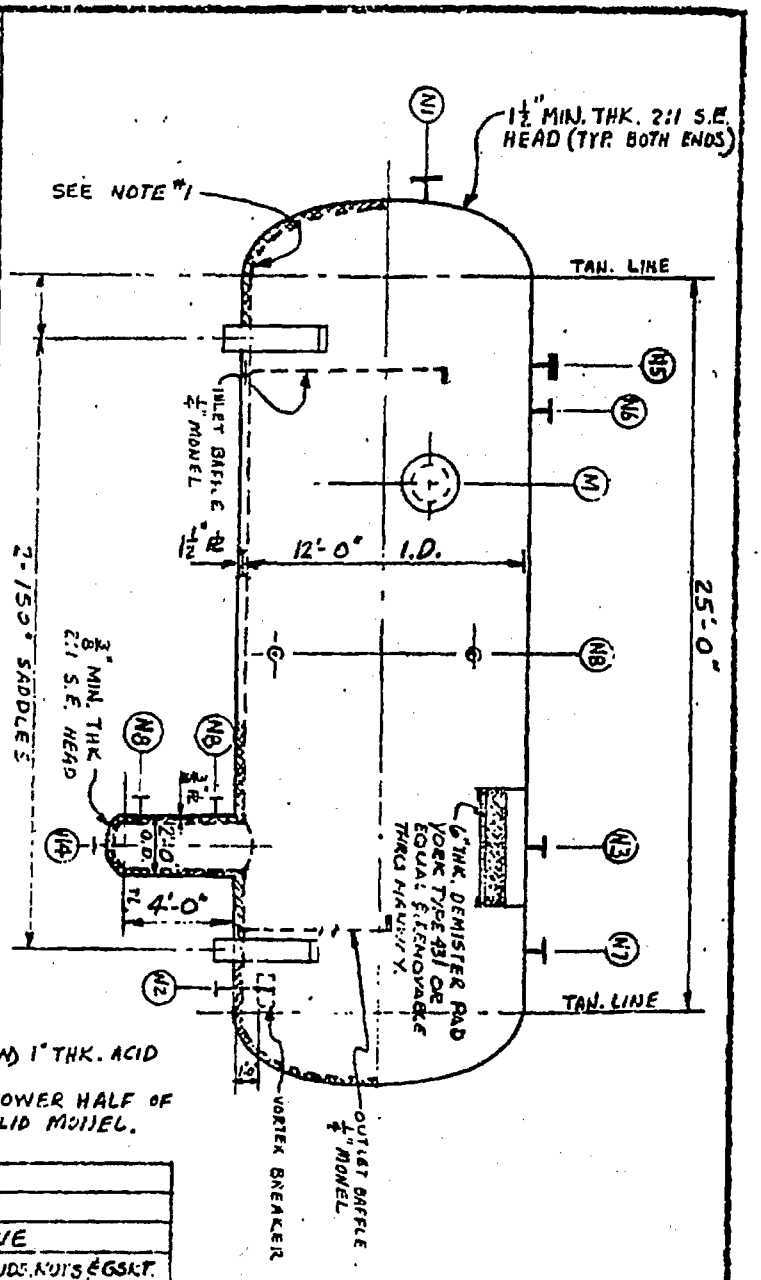
Dry gas shall not contain more than 6 lbs water per MM SCF

Absorber : Design pressure - 1100 PSIG
Design temperature - 450°F

UTILITY INFORMATION

Steam : 1200 PSIG, Sat.
Cooling water: Supply -85°F
Return - 105°F
Nitrogen : as required
Power : 460/3/60

DESIGN DATA		
CODE ASME SECT VIII DIV. 1 1971		
SPECS.		
DESIGN CONDITIONS	INT. 325 PSIG @ 450 °F	
	EXT. – PSIG @ – °F	
OPER. PRESS.	– PSIG @ – °F	
RADIOGRAPHY	FULL	
POST WELD HEAT TREAT	YES	
JOINT EFF.	100 %	
CORROSION ALLOWANCE	1/8"	
WET FAB. WEIGHT	85,800 #	
EMPTY WEIGHT	99,150 #	
OPER. WEIGHT	159,150 #	
TEST WEIGHT	299,150 #	
MATERIAL SPECIFICATIONS		
SHELL	SA-515-70	
HEADS	SA-515-70	
SUPPORT	SA-36	
NOZZLE NECKS	SA-106-B	
FLANGES	SA-181-1	
INTERNALS DEMISTER - T-304 SS		
VORTEX BREAKER - MONEL		
MANWAY (HINGED ~~OR DAVIT~~ ED)		
ACCESSORIES TO BE SUPPLIED BY FABRICATOR		
LADDER AND PLATFORM CLIPS	YES	
DAVIT SUPPORTS	NO	
PIPE SUPPORT LUGS	NO	
PIPE GUIDE LUGS	NO	
FIREPROOFING	NONE	
INSULATION	1½" THK, BY OTHERS	
PAINT ONE S/C PRIMER		



NOTES
1. LOWER HALF OF TANK TO BE LINED W/ 1" THK. ACID RESISTANT CONCRETE.
2. ALL NOZZLES AND INTERNALS IN LOWER HALF OF TANK TO BE MONEL LINED OR SOLID MONEL.

MARK NO.	QTY.	SIZE	RATING	FACING	SERVICE
N8	4	2"	300#	RF	L.C.
N7	1	3"	1	1	VENT
N6	1	3"	1	1	RELIEF VALVE
N5	1	10"			VENT W/B.F., STUDS, NUTS & GSKT.
N4	1	2"			WATER OUTLET
N3	1	8"			VAPOR OUTLET
N2	1	10"	1	1	H.C. OUTLET
N1	1	12"	300#	RF	INLET
M	1	18"	300#	RF	MANHOLE W/ COVER

NOZZLE SCHEDULE

RADIAL NOZZLE AND MANHOLE PROJECTIONS ARE FROM OD OF VESSEL TO EXTERNAL FACE OF FLANGE EXCEPT FOR INTEGRAL REINFORCED NOZZLES OR OTHERWISE NOTED

SIZE	PROJECTION	SIZE	PROJECTION
1" THRU 3"	7"	4" THRU 8"	8"
10" THRU 18"	10"	20" THRU OVER	12"

NO.	REVISION	DATE	BY	CHK.
1	REV. NOZZLE SIZES ADDED BAFFLES	4/6/72	PMS	

Procon Incorporated

FIRST STAGE BLOWDOWN DRUM

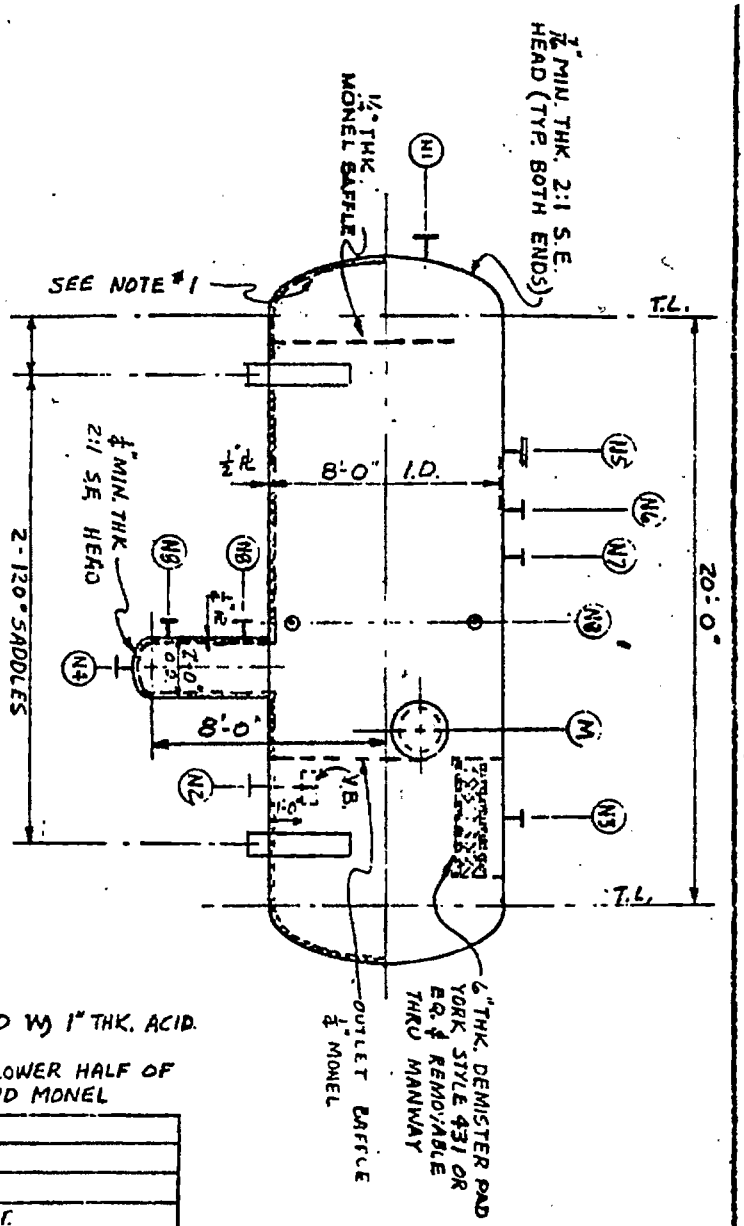
ITEM NO. 31.06-41 UNIT 3100

HYGAS

IGT CHICAGO, ILL.

DRAWN MEAM DATE 1-3-72
CHECKED
APPROVED REQ'N. 1843-31.06-41

DESIGN DATA		
CODE ASME SECT. VIII DIV 1 1971		
SPECS.		
DESIGN CONDITIONS	INT. 85 PSIG @ 350 °F	
	EXT. PSIG @ °F	
OPER. TEMPS.	PSIG @ °F	
RADIOGRAPHY	SPOT PER CODE	
POST YIELD HEAT TREAT	NO	
JOINT EFF. 85% SHELL	100% HEADS	
CORROSION ALLOWANCE	1/8"	
NET FAB. WEIGHT	17,570 #	
EMPTY WEIGHT	23,830 #	
OPER. WEIGHT	43,830 #	
TEST WEIGHT	92,830 #	
MATERIAL SPECIFICATIONS		
SHELL	SA-285-C	
HEADS	SA-285-C	
SUPPORT	SA-36	
NOZZLE NECKS	SA-106-B	
FLANGES	SA-181-I	
INTERNALS	DEMISTER - T-30455	
	VORTEX BREAKER - MONEL	
MANWAY (HINGED OR DAVITED)		
ACCESSORIES TO BE SUPPLIED BY FABRICATOR		
LADDER AND PLATFORM CLIPS	YES	
DAVIT SUPPORTS	NO	
PIPE SUPPORT LUGS	NO	
PIPE GUIDE LUGS	NO	
FIREPROOFING	NONE	
INSULATION	1" THK. BY OTHERS	
PAINT	ONE S/C PRIMER	



NOTES
1. LOWER HALF OF TANK TO BE LINED W/ 1" THK. ACID RESISTANT CONCRETE.
2. ALL NOZZLES AND INTERNALS IN LOWER HALF OF TANK TO BE MONEL LINED OR SOLID MONEL

MARK NO.	QTY.	SIZE	RATING	FACING	SERVICE
N9	1	6"	150#	RF	INLET
N8	4	2"	150#	RF	L C
N7	1	3"	1	1	VENT
N6	1	4"			RELIEF VALVE
N5	1	10"			VENT W/ COVER
N4	1	2"			WATER OUTLET
N3	1	8"			VAPOR OUTLET
N2	1	10"	1	1	OUTLET
N1	1	10"	150#	RF	INLET
M	1	18"	150#	RF	MANHOLE W/ COVER

NOZZLE SCHEDULE

RADIAL NOZZLE AND MANHOLE PROJECTIONS ARE FROM O.D. OF VESSEL TO EXTREME FACE OF FLANGE EXCEPT FOR INTEGRAL REINFORCED NOZZLES OR OTHERWISE NOTED

SIZE	PROJECTION	SIZE	PROJECTION
1" THRU 3"	7"	4" THRU 8"	8"
10" THRU 18"	10"	20" THRU 24"	12"

NO.	REVISION	DATE	BY	CHK.
1	REVISED SIZES, ADDED BAFFLES & N9	2/5/73	HWH	

Procon Incorporated

SECOND STAGE BLOWDOWN DRUM

ITEM NO. 31.06-42 UNIT 3100

HYGAS

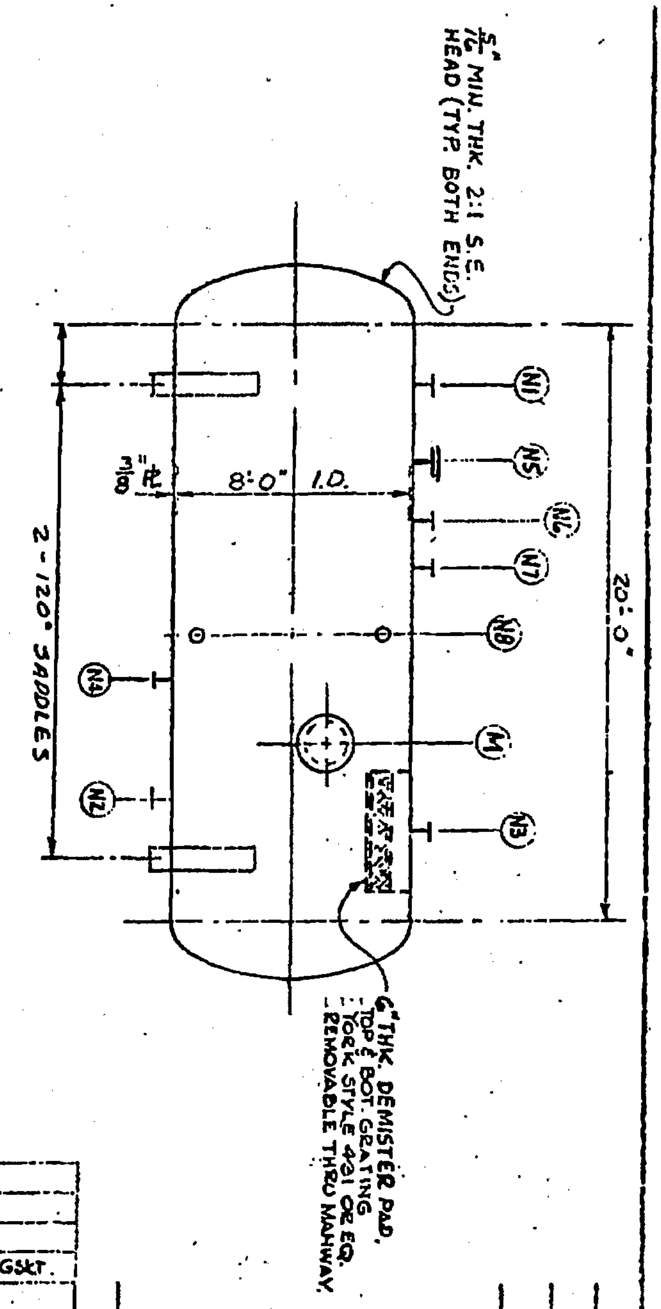
IGT CHICAGO, ILL

DRAWN JSH
CHECKED
APPROVED R

DATE 1-3-73

REQ'N NO. 1843-31.06-42

DESIGN DATA		
CODE ASME SECT. VIII DIV. 1 1971		
SPECS.		
DESIGN CONDITIONS	INT. 50 PSIG @ 350°F	EXT. PSIG @ °F
OPTR. PRESS.	PSIG @ °F	
RADIOGRAPHY SPOT PER CODE		
POST WELD HEAT TREAT	NO	
JOINT EFF. 85% SHELL	100% HEADS	
CORROSION ALLOWANCE	1/8"	
NET FAB. WEIGHT	13,900 #	
EMPTY WEIGHT	16,300 #	
OPER. WEIGHT	38,300 #	
TEST WEIGHT	85,300 #	
MATERIAL SPECIFICATIONS		
SHELL	SA-285-C	
HEADS	SA-285-C	
SUPPORT	SA-36	
NOZZLE NECKS	SA-106-B	
FLANGES	SA-181-I	
INTERNALS	DEMISTER - T-304 SS	
MANWAY (HINGED [illegible])		
ACCESSORIES TO BE SUPPLIED BY FABRICATOR		
LADDER AND PLATFORM CLIPS	YES	
DAVIT SUPPORTS	NO	
PIPE SUPPORT LUGS	NO	
PIPE GUIDE LUGS	NO	
FIREPROOFING	NONE	
INSULATION	1" THK, BY OTHERS.	
PAINT SHOP S/C PRIMER		



MARK NO.	NR. REQD.	SIZE	RATING	FACING	SERVICE
N8	2	2"	150#	RF	L.C.
N7	1	3"			VENT
N6	1	4"			RELIEF VALVE
N5	1	10"			VENT W/BF, STUDS, NUTS & GSKT.
N4	1	2"			DRAIN
N3	1	8"			VAPOR OUTLET
N2	1	12"			OUTLET
N1	1	10"	150#	RF	INLET
M	1	18"	150#	RF	MANHOLE W/ COVER

NOZZLE SCHEDULE

RADIAL NOZZLE AND MANHOLE PROJECTIONS ARE FROM CL OF VESSEL TO EXTERNAL FACE OF FLANGE EXCEPT FOR INTERNAL REINFORCED NOZZLES OR OTHERWISE NOTED.

SIZE	PROJECTION	SIZE	PROJECTION
1" THRU 3"	7"	4" THRU 8"	8"
10" THRU 16"	10"	20" THRU [illegible]	12"

NO.	REVISION	DATE	BY	CHK.
1	REVISED NOZZLE SIZES	[illegible]	[illegible]	

Procon Incorporated

THIRD STAGE BLOWDOWN DRUM

ITEM 31.06-43 UNIT 3100

HYGAS

IGT CHICAGO, ILL.

DRAWN [illegible] DATE 1-3-7[illegible]

CHECKED

APPROVED [illegible] REQ'N. NO. 1843-31.06-43

AIR-COOLED EXCHANGER SPECIFICATION

Procon Incorporated

Customer: IGT- Hygas Plant

Date: 2/25/72 | Engr.: GSD | Item No.: 31.07-01

Service: Gassy Oil Cooler

Units | Model | Induced Forced Draft | No. of Bays: 2

Surface/Item ... External: 200,000 FT.² (APROX.) | Bare Tube | Sq. Ft.

Heat Exchanged ... BTU/Hr: 88,330,000 | Effective MTD | °F

Transfer Rate ... External Surface: 4.5 | Bare Tube Surface | BTU/Hr. Sq. Ft. °F

PERFORMANCE DATA

TUBE SIDE

Fluid Circulated		$HC + H_2O + H_2S + CO_2 + Inerts$	Temperature In	360 °F
Total Fluid Entering	Lbs/Hr	836,462	Temperature Out	150 °F
Vapor		15,970	Inlet Pressure	340 psia, psig
Liquid		797,087	Gravity – Liquid	12.3
Steam		8,449	Viscosity	0.6 Cps @ 360°F
Non-Condensables		14,957		Sp. Heat 0.475 B/#/360 °F
Vapor Condensed			Molecular Weight	
Steam Condensed			Allowable Press. Drop	15 psi
Fouling Res. I.S.	Hr. Sq. Ft. °F/BTU	0.003	Design Pressure Drop	psi

AIR SIDE

Air Quantity-Item	Lbs/Hr		Temperature In	95 °F
Air Quantity-Fan	ACFM		Temperature Out	°F
			Altitude	Ft.

CONSTRUCTION

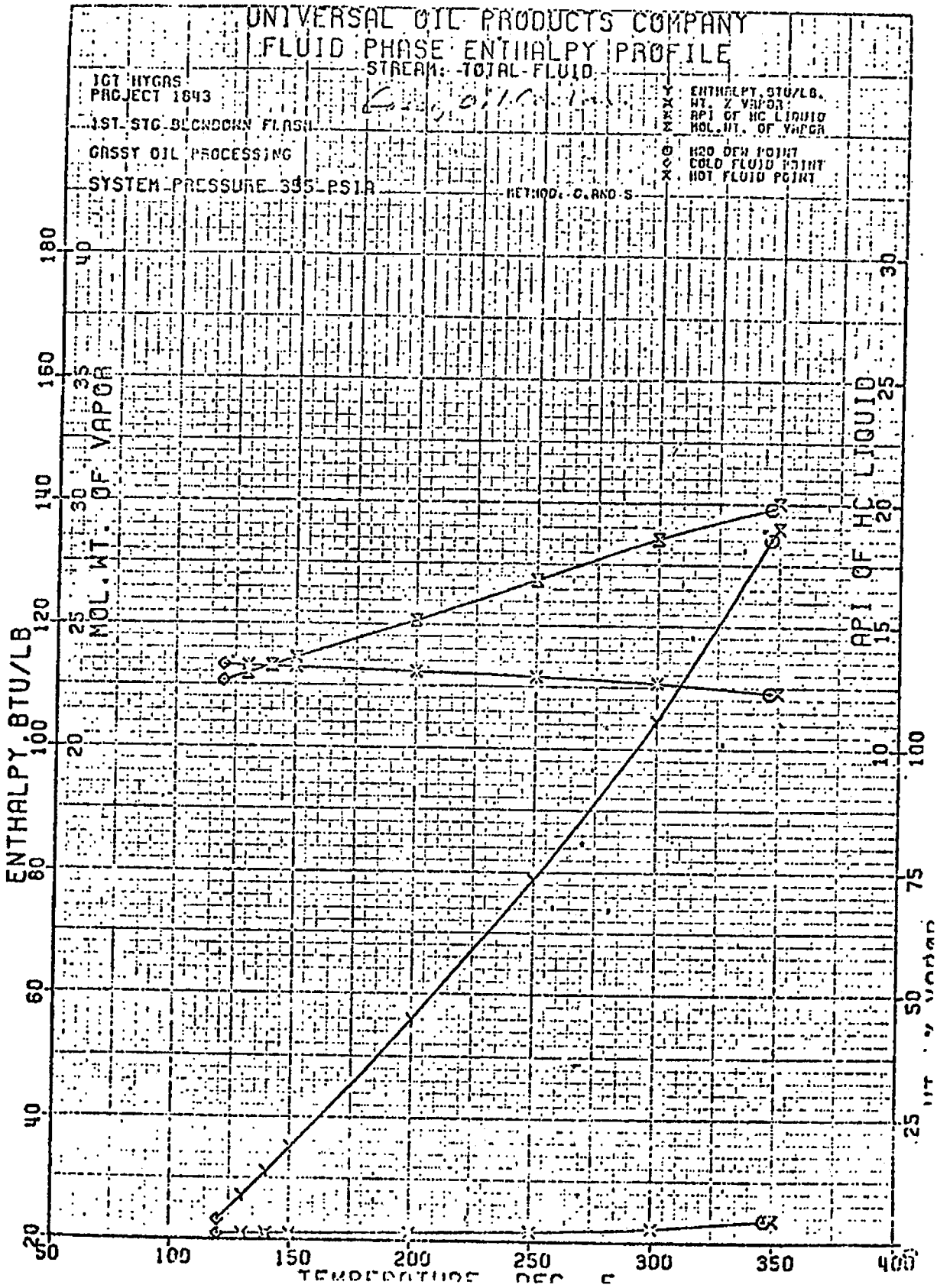
Design Pressure: 400 PSI	Test Pressure: ASME Code		Design Temperature: 450 °F
SECTION	**HEADER**		**TUBE**
Size	Type: Plug		Material: C.S.
No. Item: 2	Material: C. S.		OD 1.0 in. 0.085" Min. Wall
Tube Support – Z- AL Filled Bands	No. Rows Passes		No./Section
STRUCTURE – Carbon Steel	Plugs – Shoulder ASME Material: C.S.		Length: 30 Ft.
Surface Prep – Wire Brush	Gasket Material		Pitch: In. △
Grade Mounted	Corrosion Allowance: 1/8 in.		**FIN**
Finish – One Coat Primer	Size Inlet Nozzle: In.		Material
	Size Outlet Nozzle: In.		Height
X Fan Guards	Series: 150 RF		No./In.
X Belt Guards	Vent & Drain Conn.		Type
Coupling Guards	Code ASME No. Stamp Reqd		

MECHANICAL EQUIPMENT

FAN MFGR		**DRIVER**		**SPEED REDUCER**
Model		Type: Elect. Motor		Type: V-Belt
No./Bay: 2	No. Item: 4	No. Item: 4	HP/Driver: 25	No./Item: 4
BHP Each	BHP Total	RPM		Model
Diameter ft	RPM	Enclosure		AGMA HP Rating
No. Blades	Pitch	Volt: 460 Phase: 3 Cycle: 60		Ratio
Blade Material: Cast Al.		Mfgr. Vendor Option – NEMA		Mfgr.
Hub Material				Support
Man. Adj.	Auto Variable	Vib. Switch Not Req'd		

Notes: Please refer to fluid flow Enthalpy curve.
Provide Steam Coil & external recirculation
Plot Size: 45' X 30'

Dimensions: Width | Length | Height | Shipping Weight Lbs.


UNIVERSAL OIL PRODUCTS COMPANY
FLUID PHASE ENTHALPY PROFILE
STREAM: TOTAL FLUID
IGT HYGAS
PROJECT 1643
1ST STG BLOWDOWN FLASH
OASSY OIL PROCESSING
SYSTEM PRESSURE 335 PSIA
METHOD: C. AND S.
ENTHALPY, BTU/LB.
WT. % VAPOR
API OF HC LIQUID
MOL. WT. OF VAPOR
H2O DEW POINT
COLD FLUID POINT
HOT FLUID POINT
ENTHALPY, BTU/LB
MOL. WT. OF VAPOR
API OF HC LIQUID
TEMPERATURE, DEG. F

FORM NO. 410-120 5/70

Procon Incorporated

EXCHANGER DATA SHEET

CUSTOMER	IGT - Hygas Plant	REQ. No.	31.07-51
ADDRESS		PAGE No.	
PLANT LOCATION		DATE	2-29-72
		REVISED	
SERVICE OF UNIT	Combined feed cooler	ITEM NO.	31.07-51
SIZE	43 x 240 TYPE AES	CONNECTED IN	
SURFACE PER UNIT	4580 ft.^{2} SHELLS PER UNIT 1	SURFACE PER SHELL	4580 ft.^{2}

PERFORMANCE OF ONE UNIT

	SHELL SIDE		TUBE SIDE	
FLUID CIRCULATED	Cooling water		HC + H_2O + H_2S + Inerts	
TOTAL FLUID ENTERING #/hr.	665,000		859,181	
VAPOR "			9,206	
LIQUID "	665,000		817,459	
STEAM "			1,196	
NON-CONDENSABLES "			31,318	
FLUID VAPORIZED OR CONDENSED "			588	
STEAM CONDENSED "			1,084	
GRAVITY—LIQUID			13.7	
VISCOSITY—LIQUID			1.0 @ 160°F	
MOLECULAR WEIGHT—VAPORS			24	
SPECIFIC HEAT—LIQUIDS		B.T.U./#	0.39 @ 160°F	B.T.U./#
LATENT HEAT—VAPORS		B.T.U./#		B.T.U./#
TEMPERATURE IN	85	°F	160	°F
TEMPERATURE OUT	105	°F	120	°F
OPERATING PRESSURE	65	#/SQ. IN.	315	#/SQ. IN.
NUMBER OF PASSES	1		2	
VELOCITY		FT./SEC.		FT./SEC.
PRESSURE DROP	10	#/SQ. IN.	10	#/SQ. IN.
Fouling Resistance	.002		.003	

HEAT EXCHANGED—B.T.U./HR. 13,300,000 M.T.D. (Corrected)

TRANSFER RATE—SERVICE CLEAN

CONSTRUCTION

DESIGN PRESSURE	90	#/SQ. IN.	350	#/SQ. IN.		
TEST PRESSURE		#/SQ. IN.		#/SQ. IN.		
DESIGN TEMPERATURE	350	°F	190	°F		
TUBES	304 SS	NO. 1190	O.D. 3/4"	BWG. 16min	LENGTH 20'	PITCH 1" ◇
SHELL	C.S.		I.D. [illegible] 43"		THICKNESS	
SHELL COVER	C.S.				FLOATING HEAD COVER	
CHANNEL	304 S.S. (1)				CHANNEL COVER	304SS (1)
TUBE SHEETS—STATIONARY	304 ss (1)				FLOATING	304 SS (1)
BAFFLES—CROSS	C.S.	TYPE SEG			THICKNESS	304 SS (1)
BAFFLE—LONG		TYPE			THICKNESS	
TUBE SUPPORTS					THICKNESS	
GASKETS						
CONNECTIONS—SHELL—IN		OUT			SERIES	150#
CHANNEL—IN		OUT			SERIES	400#
CORROSION ALLOWANCE—SHELL SIDE	1/8"				TUBE SIDE	—
CODE REQUIREMENTS	ASME VIII				TEMA CLASS	R
WEIGHTS—EACH SHELL		BUNDLE			FULL OF WATER	

NOTE: INDICATE AFTER EACH PART WHETHER STRESS RELIEVED (S. R.) AND WHETHER RADIOGRAPHED (X-R)

REMARKS, (1) Lined or Clad

FORM NO. 410-120. 9/70

Procon Incorporated

EXCHANGER DATA SHEET

CUSTOMER	IGT Hygas Plant	REQ. No.	31.07-52
ADDRESS		PAGE No.	
PLANT LOCATION		DATE	2-29-72.
		REVISED	
SERVICE OF UNIT	Flashed vapor condenser	ITEM NO.	31.07-52
SIZE	24 x 192 TYPE AES	CONNECTED IN	
SURFACE PER UNIT	800 ft.^{2} SHELLS PER UNIT 1	SURFACE PER SHELL	800 ft.^{2}

PERFORMANCE OF ONE UNIT

	SHELL SIDE		TUBE SIDE	
FLUID CIRCULATED	Cooling water		$HC+CO_2+H_2S+H_2O$+ Inerts	
TOTAL FLUID ENTERING #/hr.	221,000		12,764	
VAPOR "			7,253	
LIQUID "	221,000			
STEAM "			1,560	
NON-CONDENSABLES "			3,951	
FLUID VAPORIZED OR CONDENSED "			3,944	
STEAM CONDENSED "			1,485	
GRAVITY—LIQUID				
VISCOSITY—LIQUID				
MOLECULAR WEIGHT—VAPORS			4.15	
SPECIFIC HEAT—LIQUIDS		B.T.U./#		B.T.U./#
LATENT HEAT—VAPORS		B.T.U./#		B.T.U./#
TEMPERATURE IN	85	°F	446	°F
TEMPERATURE OUT	105	°F	120	°F
OPERATING PRESSURE	65	#/SQ. IN.	75	#/SQ. IN.
NUMBER OF PASSES	1		2	
VELOCITY		FT./SEC.		FT./SEC.
PRESSURE DROP	10	#/SQ. IN.	10	#/SQ. IN.
Fouling Resistance	.002		.003	

HEAT EXCHANGED—B.T.U./HR. 4,420,000 M.T.D. (Corrected)

TRANSFER RATE—SERVICE CLEAN

CONSTRUCTION

DESIGN PRESSURE	90	#/SQ. IN.	100	#/SQ. IN.	
TEST PRESSURE		#/SQ. IN.		#/SQ. IN.	
DESIGN TEMPERATURE	190	°F	550	°F	

TUBES 304 SS NO. 262 O.D. 3/4" BWG. 16min LENGTH 16' PITCH 1" ◇

SHELL C.S. XXX OD 24" THICKNESS

SHELL COVER C.S. FLOATING HEAD COVER 304 SS (1)

CHANNEL 304 SS (1) CHANNEL COVER 304 SS (1)

TUBE SHEETS—STATIONARY 304 SS (1) FLOATING 304 SS (1)

BAFFLES—CROSS C.S. TYPE SEG THICKNESS

BAFFLE—LONG TYPE THICKNESS

TUBE SUPPORTS THICKNESS

GASKETS

CONNECTIONS—SHELL—IN OUT SERIES 150#

CHANNEL—IN OUT SERIES 150#

CORROSION ALLOWANCE—SHELL SIDE 1/8" TUBE SIDE —

CODE REQUIREMENTS ASME VIII TEMA CLASS R

WEIGHTS—EACH SHELL BUNDLE FULL OF WATER

NOTE: INDICATE AFTER EACH PART WHETHER STRESS RELIEVED (S. R.) AND WHETHER RADIOGRAPHED (X-R)

REMARKS: (1) Lined or Clad

FORM NO. 410-120 3/70

Procon Incorporated

EXCHANGER DATA SHEET

		REQ. No.	31.07-53
CUSTOMER	IGT - HYGAS PLANT	PAGE No.	
ADDRESS		DATE	2-29-72
PLANT LOCATION		REVISED	
SERVICE OF UNIT	Third Stage Blowdown Preheater	ITEM NO.	31.07-53
SIZE	24 X 192 TYPE BEU	CONNECTED IN	
SURFACE PER UNIT	850 Ft.^{2} SHELLS PER UNIT 1	SURFACE PER SHELL	850 Ft.^{2}

PERFORMANCE OF ONE UNIT

	SHELL SIDE		TUBE SIDE	
FLUID CIRCULATED	HC + H_2O + H_2S + Inerts		Steam	
TOTAL FLUID ENTERING #/hr	825,881		17,555	
VAPOR "	–			
LIQUID "	825,881			
STEAM "			17,555	
NON-CONDENSABLES "	12,764			
FLUID VAPORIZED OR CONDENSED #/hr.				
STEAM CONDENSED "			17,555	
GRAVITY—LIQUID	0.85 @ 133°F			
VISCOSITY—LIQUID	0.6 @ 133°F			
MOLECULAR WEIGHT—VAPORS	44.4			
SPECIFIC HEAT—LIQUIDS		B.T.U./#		B.T.U./#
LATENT HEAT—VAPORS		B.T.U./#		B.T.U./#
TEMPERATURE IN	116	°F	298	°F
TEMPERATURE OUT	150	°F	298	°F
OPERATING PRESSURE	60	#/SQ. IN.	50	#/SQ. IN.
NUMBER OF PASSES	1		2	
VELOCITY		FT./SEC.		FT./SEC.
PRESSURE DROP	10	#/SQ. IN.	5	#/SQ. IN.
Fouling Resistance	.003		.0005	

HEAT EXCHANGED—B.T.U./HR.	16,010,000	M.T.D. (Corrected)	
TRANSFER RATE—SERVICE		CLEAN	

CONSTRUCTION

	SHELL SIDE		TUBE SIDE	
DESIGN PRESSURE	85	#/SQ. IN.	75	#/SQ. IN.
TEST PRESSURE		#/SQ. IN.		#/SQ. IN.
DESIGN TEMPERATURE	250	°F	400	°F

TUBES C. S.   NO. 132U's   O.D. 3/4"   BWG 14 Min   LENGTH 16' Eff.   PITCH 1" ◇

SHELL	C. S.	I.D. ~~O.D.~~	24"	THICKNESS	
SHELL COVER	C. S.			FLOATING HEAD COVER	—
CHANNEL	C. S.			CHANNEL COVER	C.S.
TUBE SHEETS—STATIONARY	C.S.			FLOATING	–
BAFFLES—CROSS	C.S.	TYPE		THICKNESS	
BAFFLE—LONG		TYPE		THICKNESS	
TUBE SUPPORTS				THICKNESS	
GASKETS					
CONNECTIONS—SHELL—IN		OUT		SERIES	150 #
CHANNEL—IN		OUT		SERIES	150 #
CORROSION ALLOWANCE—SHELL SIDE	1/8"			TUBE SIDE	1/8"
CODE REQUIREMENTS	ASME VIII			TEMA CLASS	R
WEIGHTS—EACH SHELL		BUNDLE		FULL OF WATER	

NOTE: INDICATE AFTER EACH PART WHETHER STRESS RELIEVED (S. R.) AND WHETHER RADIOGRAPHED (X-R)

REMARKS: (1) Assume straight line vaporization

PROCON

STANDARD DATA SHEET FOR CENTRIFUGAL PUMPS

NO. 1843 - 31.08-1
SHEET NO. 1
TOTAL SHEETS 1
DATE 2-7-72 EJM
APPROVED

FOR IGT - HYGAS PLANT ITEM NO. 31.08-01 A & B
SITE UNIT 3100
SERVICE STABILIZED OIL MOTOR DRIVE 1 TURBINE DRIVE 1
PUMP MFR SIZE AND TYPE NO. REQ'D 2

OPERATING CONDITIONS

LIQUID H.C. INCLUDING AROMATICS *
PT T 150
SP GR at PT 0.83
VAP PRESS. at PT, psia 14.5
VIS at PT, cp 1.5 cp.
CORR/EROS caused by * H_2S, CO_2, HCN, PHENOL, WATER
U.S. gpm at PT, NOR. 1955 DES. 2150
DISCH PRESS., psig 65
SUCT PRESS., psig MAX. 50 DES. 0
DIFF PRESS., psi 65
DIFF HEAD, ft 181
NPSH AVAIL., ft 25 **

CONSTRUCTION AND MATERIALS

CASING-MOUNTING (CENTERLINE X) (FOOT) (BRACKET) (VERTICAL)
(1) SPLIT (AXIAL) (RADIAL)
TYPE (SINGLE VOLUTE) (DOUBLE VOLUTE X) (DIFFUSER)
TAPPED OPENINGS (VENT X) (DRAIN X) (GAGE CONNS.)

NOZZLES	SIZE	ASA RATING	FACING	POSITION
SUCTION				
DISCHARGE				

IMPELLER DIAM DES MAX TYPE CLOSED
MFR'S BEARING NO RADIAL THRUST
COUPLING and GUARD THOMAS / YES BASE PLATE DRAIN RIM
PACKING —
MECH SEAL YES, BAL. CLASS. CODE MFR

MATERIAL CODE—EXTERNAL CASING 5 INTERNAL PARTS I

1—CAST IRON	INTERNALS CODE	I	B	S	O	X
B—BRONZE	IMPELLER	I	B	S	O	
S—STEEL	INNER CASE PARTS	I	I	S	O	
O—11-19% CHROME	SLEEVE (PACKED)	Ch	Ch	Af	Af	
A—ALLOY	SLEEVE (SEAL)	O	O	O	O	
h—HARDENED	WEAR PARTS	X	B	(Ch)	Ch	
f—FACED	SHAFT	S	S	S	S	
X—						

PERFORMANCE

PROPOSAL CURVE NO.
NPSH REQ'D (WATER), ft **
NO. OF STAGES RPM
DES EFF BHP
MAX BHP DES IMP
MAX HEAD DES IMP, ft
MIN CONTINUOUS, gpm (BY MFR) (1)
ROTATION FACING COUPLING END
WATER COOLING (TURBINE BEARINGS) (1)
BEARINGS
STUFF. BOX
PEDESTAL
GLAND
TOTAL WATER REQ'D, gpm (1)
PACKING COOLING
FLUSHING API PLAN 12
AUX PIPING BY PUMP MFR.

SHOP TESTS	REQUIRED	WITNESSED
RUNNING PERF	X	
NPSH		

HYDROSTATIC PSIG
MAX ALLOW. WP PSIG F
WEIGHTS: PUMP BASE
MOTOR TURBINE

MOTOR DRIVER BY PUMP MFR

ITEM NO. A MTD BY PUMP MFR
HP RPM FRAME
MFR
TYPE SCI INSUL B
ENC TEFC TEMP RISE O 80
VOLTS/PHASE/CYCLES 460/3/60
BEARINGS BALL LUBE GRS
FULL LOAD AMPS

TURBINE DRIVER BY (2) PUMP MFR

ITEM NO. B MTD BY PUMP MFR
HP RPM MAT'L
MFR and TYPE (3)
INLET STEAM, psig 250 TEMP F 456
EXHAUST 50 PSIG
STEAM RATE, FL lb/BHP/HR
BEARINGS LUBE

NOZZLES	SIZE	ASA RATING	FACING	POSITION
INLET				
EXHAUST				

MFR FINAL DATA (AS BUILT)

ACTUAL IMPELLER DIAM
TEST CURVE NO.
OUTLINE DWG NO.
PUMP SECT. DWG NO.
SEAL DIAM DWG NO.
PUMP SERIAL NO.

API STD. 610 GOVERNS UNLESS OTHERWISE STATED. ** NPSH REQUIRED SHALL NOT EXCEED 12 FEET (WATER)
EXCEPTIONS (ITEMIZE): (1) PLS. ADVISE. (2) FURNISH SPEED REDUCTION GEAR, IF REQUIRED FOR ECONOMICAL TURBINE SELECTION. (3) GENERAL PURPOSE API 611.

REV.	DATE	APPROVED	REV.	DATE	APPROVED	REV.	DATE	APPROVED

PROCON, INCORPORATED
RECIPROCATING COMPRESSOR DATA SHEET

JOB NO. 1843 ITEM NO. 31.09-01 & 02 ⚠
PURCHASE ORDER NO. _____
REQUISITION NO. _____
INQUIRY NO. _____
Sheet No. 1 OF 5 BY EJM

APPLICABLE TO: PROPOSALS ☒ PURCHASE ☐ AS BUILT ☐ DATE 2-21-72 (REV. 1)
FOR IGT - HYGAS PLANT UNIT 3100
SITE SERIAL NO.
⚠ SERVICES FIRST AND SECOND STAGES, SCAVANGE GASSES NO. REQ'D ONE (100%)
MANUFACTURER RPM: MAX. 514 RATED MIN.
TYPE BALANCED OPPOSED
DRIVER TYPE ELEC. MOTOR DRIVER RATED HP _____ RPM _____ DRIVER FURNISHED BY: ☒ COMPR MFR. ☐ _____

RATED OPERATING CONDITIONS (EACH MACHINE)

ITEM NO./SERVICE ① 31.09	-01	-02	⚠
STAGE			
GAS COMPRESSED	1ST STAGE	2ND STAGE	
CORROSIVE DUE TO			
RELATIVE HUMIDITY			
MOL WGT. AT INTAKE	27.1	38.8	
C_p/C_v VALUE, AT SUCTION			
C_p/C_v VALUE, AT DISCHARGE			
INLET TEMP, DEG F	120	116	
③ INLET PRESS., PSIA	309.7	74.7	
DISCHARGE TEMP, DEG F			
③ DISCHARGE PRESS., PSIA	1159.7	344.7	
Z AT SUCTION			
Z AT DISCHARGE			
CAPACITY—NORMAL			
LB PER HR, WET			
INLET CFM (Corrected)			
MMSCFD @ 60°F	5.299	5.325	
BRAKE HORSEPOWER/STAGE			
NORMAL BRAKE HORSEPOWER			
CAPACITY—RATED			
LB PER HR, WET			
INLET CFM (Corrected)			
MMSCFD SCFM			
BRAKE HORSEPOWER/STAGE			
MAX. BRAKE HORSEPOWER (GUARANTEED)			

APPLICABLE SPECIFICATIONS
☒ API STANDARD 618
☐ API STANDARD ⚠
☐ _____

ACCESSORIES ⑤
COMPR MFR SHALL FURNISH:
☒ PULSATION ~~DAMPENER~~ (VOLUME ② BOTTLES)
☐ INTERSTAGE PIPING _____
☐ INTERCOOLERS _____
☐ SEPARATE MOISTURE SEPARATORS W/TRAPS
☐ AFTERCOOLERS (BY PURCH. IF REQ'D)
☒ COOLING WATER PIPING, SINGLE INLET-OUTLET MANIFOLD
☒ INSTRUMENT PANEL (SEE REMARKS ON SHEET 4)
☒ SIGHT FLOW INDICATORS
☒ INTERCONNECTING UTILITY PIPING

NET WGT COMPLETE UNIT INCLUDING COMPR DRIVER AND BASEPLATE, LB _____
ERECTION WGT, LB _____
MAINTENANCE WGT, LB _____
APPROX FLOOR SPACE: L _____ W _____ H _____
ROD REMOVAL DISTANCE _____

CAPACITY CONTROL

TO PERMIT OPERATION AT AN INLET CFM OF			
POCKETS/VALVES OPEN			
INLET PRESS., PSIA			
DISCHARGE PRESS., PSIA			
DISCHARGE TEMP, DEG F			
BRAKE HORSEPOWER/STAGE			
TOTAL BRAKE HORSEPOWER			
TO PERMIT OPERATION AT AN INLET CFM OF			
POCKETS/VALVES OPEN			
INLET PRESS., PSIA			
DISCHARGE PRESS., PSIA			
DISCHARGE TEMP, DEG F			
BRAKE HORSEPOWER/STAGE			
TOTAL BRAKE HORSEPOWER			

CAPACITY CONTROL SHALL BE BY:
☐ VARIABLE SPEED TO _____% RATED
☐ PURCHASERS BYPASS
☐ MFR STANDARD AUTOMATIC CONTROL
☐ START-STOP ☐ 2 STEP
☐ 3 STEP ☐ 5 STEP
☐ PILOTED BY REC PRESS.
☐ PILOTED BY PURCH INSTR W/_____ PSIG AIR SIGNAL
☐ CLEARANCE POCKETS
☐ FIXED ☐ VARIABLE
☐ MANUAL ☐ AUTOMATIC
☒ SUCTION VALVE UNLOADING ④
☒ MANUAL ☐ AUTOMATIC
ON AIR/POWER FAILURE COMPR SHALL:
☐ UNLOAD ☐ LOAD

⚠REMARKS ① TWO SERVICES ON ONE MULTI-CYLINDER MACHINE IS THE DESIRED ARRANGEMENT. ② COMPLETE ANALOG STUDY INCLUDING INLET & DISCH PIPING IS REQD. ③ THE PRESSURES LISTED ARE AT DAMPER-LINE CONNECTIONS. ④ FOR START-UP (PNEUMATIC) (Manufacturer to fill in all missing data) ⑤ VENDOR SHALL FURNISH RAILS & SOLEPLATES FOR PRE-ALIGNMENT ON PURCHASER'S FOUNDATION.

PROCON, INCORPORATED
GAS ANALYSIS DATA SHEET
MOLES / HR

JOB NO. 1843 ITEM NO. 31.09-01 & 02 Δ
PURCHASE ORDER NO.
REQUISITION NO.
Sheet No. 2 OF 5 BY EJM
DATE 2-21-72 (REV. 1)

MATERIAL	SYMBOL	M.W.	31.09 -01		31.09 -02		Δ		
CARBON DIOXIDE		44	192.4		297.5				
HYDROGEN SULFIDE		34	22.0		73.6				
HYDROGEN CYANIDE		27	0.1		0.1				
CARBONYL SULFIDE		60.1	0.05		0.05				
CARBON DISULFIDE		76.1	0.018		0.018				
AMMONIA		17.0	7.8		20.7				
WATER		18.0	3.2		27.1				
HYDROGEN		2.02	90.0		7.1				
CARBON MONOXIDE		28	130.0		22.9				
METHANE		16	139.5		69.8				
ETHANE		30	8.9		16.7				
BENZENE		78	4.6		40.5				
TOLUENE		92	0.9		9.0				
O-XYLENE		106	0.07		0.07				
CUMENE		120	0.014		0.014				
NAPHTHALENE		128	0.006		0.0006				
PHENOL		94	0.002		0.002				
CRESOL		108	0.0002		0.0002				
LIGHT OIL		172	0.06		0.06				
HEAVY OIL		278	0.0001		0.00001				
TOTALS			593.6		585.2				
MOLECULAR WEIGHT			27.1		38.8				

PROCON, INCORPORATED
RECIPROCATING COMPRESSOR DATA SHEET (Cont'd)

JOB NO. 1843 ITEM NO. 31.09-01 & 02 Δ
PURCHASE ORDER NO.
REQUISITION NO.
Sheet No. 3 OF 5 BY EJM
DATE 2-21-72 (REV. 1)

CYLINDER DATA

ITEM NO./SERVICE	31.09 -01	-02	Δ
STAGE			
NO. OF CYL PER STAGE			
TYPE CYLINDER			
SINGLE/DOUBLE ACTING			
CYLINDER LINER, YES/[redacted]			
CYLINDER LINER, [redacted]/DRY			
OD LINER, IN.			
BORE, IN.			
STROKE, IN.			
PISTON DISPLACEMENT, CFM			
CLEARANCE, %			
VOLUMETRIC EFFICIENCY, %			
AVG VALVE GAS VELOCITY, FPM			
NO. OF INLET-OUTLET VALVES			
TYPE OF VALVES			
MAX. ALLOW. PISTON SPEED, FPM	900	→	
NORMAL PISTON SPEED, FPM			
ROD DIAMETER, IN.			
MAX. ALLOW. ROD LOADING, T			
MAX. ALLOW. ROD LOADING, C			
RATED ROD LOADING, T			
RATED ROD LOADING, C			
MAX. ALLOW. CYL. PRESS., PSIG			
MAX. ALLOW. CYL TEMP. DEG F			
SUCTION VOLUME BOTTLE, CU FT			
DISCHARGE VOLUME BOTTLE, CU FT			
RECOM RELIEF VALVE, PSIG			
HYDROSTATIC TEST, PSIG			
SUCTION SIZE: RATING			
FACING			
DISCHARGE SIZE: RATING			
FACING			

COMPRESSOR MATERIALS ①

	31.09 -01	-02	Δ
CYLINDERS	CS	CI	
CYLINDER LINERS			
PISTONS			
PISTON RINGS			
PISTON RODS			
VALVE SEATS			
VALVE STOPS			
VALVE PLATES			
VALVE SPRINGS			

COMPRESSOR PACKING

- ☐ STANDARD FIBROUS
- ☒ FULL-FLOATING VENTED SEGMENTAL PACKING
  - W/STAINLESS STEEL SPRINGS
- ☒ FORCED-FEED LUBRICATED
- ☐ NONLUBRICATED ☒ TEFLON ☐ CARBON
- ☒ WATER-COOLED ②
- VENTED TO FLARE ③

DISTANCE PIECE

- ☐ STANDARD
- ☐ EXTRA LONG SINGLE COMPARTMENT
- ☒ TWO COMPARTMENT
- ☒ SOLID COVER ☐ OPEN

LUBRICATION

FRAME
- ☐ SPLASH SYSTEM
- ☒ PRESSURE SYSTEM, INCLUDING THE FOLLOWING:
  - ☒ OIL PUMP DRIVEN BY COMPR SHAFT
  - ☒ OIL PUMP DRIVEN BY ELECTRIC MOTOR
  - ☐ HAND-OPERATED PUMP FOR STARTING

SYSTEM OIL CAPACITY ____ GAL
TYPE OIL ____ GRADE ____
☒ ELECTRIC HEATER W/THERMOSTAT ____ KW

CYLINDERS
LUBRICATOR TO BE DRIVEN BY:
☒ COMPRESSOR SHAFT ☐ ELECTRIC MOTOR
LUBRICATOR CAPACITY ____ QT
TYPE OIL ____ GRADE ____

LUBRICATOR ALSO TO BE EQUIPPED WITH:
- ☐ STEAM COIL
- ☒ ELECTRIC HEATER W/THERMOSTAT ____ KW

NO. OF COMPARTMENTS ____ NO. OF PUMPS ____

COUPLING—LOW SPEED
MFR ____ MODEL ____
TYPE ____

COUPLING—HIGH SPEED
MFR ____ MODEL ____
TYPE ____

AIR INTAKE FILTER
MFR ____ MODEL ____
TYPE ____

REMARKS ① ALL MATERIALS IN H_2S SERVICE SHALL HAVE LESS THAN 90,000 PSI YIELD STRENGTH AND HARDNESS LESS THAN ROCKWELL C-20, INCL. WELDS. EXCEPTIONS MAY BE PISTON RODS AND VALVE PLATES & SPRINGS. ② ITEMS 31.09-01 & 02 REQUIRE DIRECTLY COOLED PACKING CUPS. ③ PACKING FOR ITEM 31.09-01 SHALL HAVE 3 VENT CONNECTIONS.

(Manufacturer to fill in all missing data)

PROCON, INCORPORATED
RECIPROCATING COMPRESSOR DATA SHEET (Cont'd)

JOB NO. 1843 ITEM NO. 31.09-01 & e
PURCHASE ORDER NO.
REQUISITION NO.
Sheet No. 4 OF 5 BY E.J.M
DATE 2-21-72 (REV. 1)

SITE DATA

ALTITUDE FT BAROMETER 14.3 PSIA
DESIGN TEMP, DEG F 95 SUMMER -20 WINTER MIN.
DESIGN WET BULB TEMP, DEG F
COOLING WATER (CW)
PRESS., PSIG 65 SUPPLY RETURN
TEMP, DEG F 85 SUPPLY 110 RETURN MAX.
ELECTRIC POWER
300 HP & OVER 4160 VOLTS 3 PH 60 CYCLES
1/3 HP to 250 HP 460 VOLTS 3 PH 60 CYCLES
HP & LESS VOLTS PH CYCLES
AUXILIARY MOTORS
☐ TEFC ☒ EXP PROOF ☐ DRIP PROOF
☐ OPEN ☐
INSULATION TYPE CLASS
EQUIPMENT SHALL BE SUITABLE FOR:
☐ INDOORS ☐ HEATED ☒ UNHEATED
☒ OUTDOORS ☒ UNDER ROOF ☐ WITHOUT ROOF
STEAM SUPPLY
NORMAL PRESS. PSIG @ FTT
MIN. PRESS. PSIG @ FTT
INSTRUMENT AIR SUPPLY PSIG
STEAM EXHAUST
NORMAL PRESS. PSIG @ FTT
MAX. PRESS. PSIG @ FTT
FUEL GAS: NORMAL PRESS. PSIG @ F
HEATING VALUE, BTU PER CU FT LHV HHV
QUANTITY H_2S GRAINS PER 100 CU FT
STARTUP FUEL, SEE GAS ANALYSIS DATA SHEET

UTILITY CONSUMPTION

ELECTRIC	HP	LOCKED ROTOR AMPS	FULL LOAD AMPS
MAIN DRIVER			
MAIN LUBE OIL PUMP			
STARTING AIR COMPR			
M.G. SET			
MECH LUBRICATOR			
LUBRICATOR HEATER	WATTS	VOLTS	PH
SPACE HEATER	WATTS	VOLTS	PH

STEAM
MAIN DRIVER #/HR, PSIG FTT to PSIG
LUBR HEATER #/HR, PSIG FTT to PSIG
#/HR, PSIG FTT to PSIG

FUEL GAS—MAIN DRIVER NORMAL FUEL

RATED RPM,	100	75	50
BTU/HP/HR			
TOTAL BTU/HR			

COOLING WATER ①④

	COMPR CYL	L.O. COOLER	TURBO AIR COOLER	PACKING	ENG JKT COOLER
TYPE WATER	②TW	CW		CW	
QUANTITY, GPM					
INLET TEMP, DEG F					
OUTLET TEMP, DEG F					
PRESS. DROP, PSIG					
MAX. PRESS., PSIG					
TOTAL C.W., GPM					

INSPECTION AND SHOP TESTS

☒ SHOP INSPECTION BY PURCHASER DURING CONSTRUCTION
☒ MANUFACTURERS STANDARD SHOP TESTS
☒ BARRING OVER TO CHECK CLEARANCES
☐ RUNNING TEST WITH SHOP DRIVER
☐ RUNNING TEST WITH SHOP FUEL AT RATED LOAD
☐ HELIUM LEAK TEST ON COMPR CYL
☐ OTHER TESTS
PURCHASER SHALL WITNESS THE FOLLOWING:
☒ HYDROSTATIC TEST ☐ MECH RUN TEST
☐ PERFORMANCE TEST ☐ AUX EQUIP. OPER TEST
☐ DISMANTLE-REASSEMBLY INSPECTION
☐ HELIUM LEAK TEST

ALARMS AND SHUTDOWNS

COMPR MFR SHALL FURNISH CONTACTS FOR: ③

	ALARM	SHUTDOWN
LUBE OIL PRESS.	☒	☒
LOW MECH LUBR OIL LEVEL	☒	☒
LOW COMP J.W. FLOW	☒	☐
HIGH ENG J.W. TEMP	☐	☐
HIGH GAS DISCH TEMP	☒	☒
HIGH VIBRATION	☐	☐

REMOTE SHUTDOWN: ☐ ELECTRONIC ☐ PNEUMATIC ☐ HYDRAULIC
ALARM CONTACTS SHALL:
☒ OPEN ☐ CLOSE TO SOUND ALARM
SHUTDOWN CONTACTS SHALL:
☐ OPEN ☒ CLOSE TO SHUTDOWN
CONTROL CURRENT 115 VOLTS, 1 PHASE 60 CYCLES
SWITCH ENCLOSURE ☒ EXP PROOF ☐ WEATHERPROOF

REMARKS ① ADVISE ALL REQUIREMENTS ② PURCHASER WILL SUPPLY TEMPERED WATER (T.W) FOR COOLING CYLINDER JACKETS. ③ ALL ELEC. SWITCHES SHALL BE DPDT. ④ VENDOR SHALL FURNISH TEMP. GAGE IN EACH CYL. JKT COOLING WATER OUTLET.
NOTE: VENDOR SHALL SUPPLY FREE STANDING INSTRUMENT PANEL INCLUDING FOLLOWING INSTRUMENTS: PI & TI FOR LUBE OIL SYSTEM AND FOR PROCESS GAS PRESSURES AND TEMPERATURES, ALARM & S.D. INDICATING LIGHTS, AND UNLOADERS CONTROL VALVE.

(Manufacturer to fill in all missing data)

PROCON, INCORPORATED
MOTOR DATA SHEET

JOB NO. 1843 ITEM NO. 31.09-01 & 02 A
PURCHASE ORDER NO. _____
REQUISITION NO. _____
Sheet No. 5 OF 5 BY EJM
DATE 2-31-72 (REV.1)

MOTOR DESIGN DATA

DRIVE SYSTEM: [X] DIRECT CONNECTED, ENGINE MTD. [ ] GEAR REDUCER [ ] V-BELTS
CURRENT CONDITIONS 4160 VOLTS 3 PHASE 60 CYCLES
TYPE MOTOR: [ ] SQUIRREL CAGE IND NEMA DESIGN ____ [X] SYNCHRONOUS, BRUSHLESS [ ] WOUND ROTOR INDUCTION
ENCLOSURE: [ ] CLASS I, GROUP D, EXP PROOF [ ] TEFC/TEFV [X] WEATHER PROTECTED ● (II) [ ] FORCED VENTILATED [ ] OPEN-DRIPPROOF [ ] ____
NAMEPLATE HORSEPOWER _____
SERVICE FACTOR _____
SITE ALTITUDE _____
SYNCHRONOUS, RPM _____
POWER FACTOR REQ'D 1.0
INSULATION CLASS B TYPE SEALED
TEMPERATURE RISE, DEG C 80
SYN MOTOR ROTOR: [ ] SOLID [ ] SPLIT
SYN MOTOR HUB: [ ] SOLID [ ] SPLIT
STARTING: [X] FULL VOLTAGE [X] UNLOADED [ ] LOADED [ ] REDUCED VOLTAGE ____%

TRANSMISSION EQUIPMENT

[ ] SPEED-REDUCING GEAR
[ ] INTEGRAL [ ] SEPARATE
MFR _____ SIZE & TYPE _____
MAX. CONT HP RATING _____
AGMA SERVICE FACTOR _____
RATIO _____ MECH EFFICIENCY _____
[ ] PRESSURE LUBE [ ] SPLASH LUBE
[ ] V-BELTS AND V-BELT SHEAVES [ ] STATIC CONDUCTING
[ ] GUARD REQUIRED

WEIGHTS AND DIMENSIONS

MOTOR: NET WGT _____
MAX. ERECTION WGT _____ HEIGHT _____
FLOOR SPACE: L _____ W _____ H _____
GEAR: NET WGT _____
MAX. ERECTION WGT _____ MAX. MAINT WGT _____
FLOOR SPACE: L _____ W _____ H _____

MANUFACTURERS DATA

MFR _____
FRAME NO. _____ FULL LOAD RPM _____
EFFICIENCY: F.L. _____ 3/4 L. _____ 1/2 L. _____
POWER FACTOR: F.L. _____ 3/4 L. _____ 1/2 L. _____
CURRENT: FULL LOAD _____ LOCKED ROTOR _____
FULL-LOAD TORQUE, FT-LB _____
STARTING TORQUE, FT-LB _____
PULL-OUT TORQUE, FT-LB _____
ACCELERATION TIME _____ SEC
ROTATION FACING COUPLING END _____
NUMBER CONSECUTIVE STARTS _____
FIELD DISCHARGE RESISTOR _____ OHMS
BEARINGS, TYPE _____ LUBR. _____
TOTAL SHAFT END FLOAT _____
LIMIT END FLOAT TO _____

ACCESSORY EQUIPMENT

[ ] BASEPLATE [X] SOLEPLATE [X] STATOR SHIFT FOR _____
[ ] SPACE HEATERS: KW _____ VOLTS _____ PHASE _____ CYCLES
[X] RESISTANCE TEMPERATURE DETECTORS
NUMBER 6 RESISTANCE MAT'L _____
SELECTOR SWITCH AND INDICATOR BY:
[ ] PURCHASER R.T.D.'S SET @ _____ C
[X] MFR
[X] D.C. EXCITATION
KW REQ'D _____ VOLTS _____
BY: [ ] PURCHASER [X] MANUFACTURER
DESCRIPTION _____
[ ] MOTOR ARRANGED FOR DIFFERENTIAL PROTECTION
[ ] EXTENDED LEADS LENGTH _____ FT
[ ] ENCLOSED COLLECTOR RINGS
[ ] PURGED
MEDIUM _____ PRESS. _____ PSIG
[ ] EXPLOSION-RESISTANT NONPURGED
[ ] FORCED VENTILATION
CFM _____ PRESS. DROP _____ IN. H2O
CONDUIT BOX SIZED FOR:
[X] R.T.D.'S IN SEPARATE BOX
[X] MAIN MOTOR LEADS (STRESS CONES)
[ ] C.T.'S FOR DIFF PROTECTION
[ ] SURGE PROTECTION

REMARKS _____

(Manufacturer to fill in all missing data)

PROCON, INCORPORATED
RECIPROCATING COMPRESSOR DATA SHEET

JOB NO. 1843 ITEM NO. 31.09-03
PURCHASE ORDER NO.
REQUISITION NO.
INQUIRY NO.
Sheet No. 1 OF 5 BY EJM

APPLICABLE TO: PROPOSALS ☐ PURCHASE ☐ AS BUILT ☐ DATE 2-21-72
FOR TGT - HYGAS PLANT UNIT 3100
SITE SERIAL NO.
SERVICE THIRD STAGE SCAVANGE GAS NO. REQ'D ONE (100%)
MANUFACTURER RPM: MAX. 514 RATED MIN.
TYPE BALANCED OPPOSED
DRIVER TYPE GAS MOTOR DRIVER RATED HP ____ RPM ____ DRIVER FURNISHED BY: ☒ COMPR. MFR. ☐ ____

RATED OPERATING CONDITIONS (EACH MACHINE)

ITEM NO./SERVICE	31.09-03
STAGE ①	
GAS COMPRESSED	3RD STAGE
CORROSIVE DUE TO	
RELATIVE HUMIDITY	
MOL WGT. AT INTAKE	43.1 ⚠
C_p/C_v VALUE, AT SUCTION	
C_p/C_v VALUE, AT DISCHARGE	
INLET TEMP, DEG F	150
⑤ INLET PRESS., PSIA	19.7 ⚠
DISCHARGE TEMP, DEG F	
③ DISCHARGE PRESS., PSIA	89.7
Z AT SUCTION	
Z AT DISCHARGE	
CAPACITY—NORMAL	
LB PER HR, WET	
INLET CFM (Corrected)	
MMSCFD [redacted] @ 60°F	2.613
BRAKE HORSEPOWER/STAGE	
NORMAL BRAKE HORSEPOWER	
CAPACITY—RATED	
LB PER HR, WET	
INLET CFM (Corrected)	
MMSCFD [redacted] SCFM	
BRAKE HORSEPOWER/STAGE	
MAX. BRAKE HORSEPOWER (GUARANTEED)	

APPLICABLE SPECIFICATIONS
☒ API STANDARD 618
☒ API STANDARD [redacted] 660/TEMA R
☐ ____

ACCESSORIES ⑤
COMPR MFR SHALL FURNISH:
☒ PULSATION ([redacted]) VOLUME ② BOTTLES)
☒ INTERSTAGE PIPING
☒ INTERCOOLERS
☒ SEPARATE MOISTURE SEPARATORS W/DRAINS
☐ AFTERCOOLERS (BY PURCH. IF REQ'D)
☒ COOLING WATER PIPING, SINGLE INLET-OUTLET MANIFOLD
☒ INSTRUMENT PANEL (See Sheet 4)
☒ SIGHT FLOW INDICATORS
☒ INTERCONNECTING UTILITY PIPING

NET WGT COMPLETE UNIT INCLUDING COMPR, DRIVER AND BASEPLATE, LB ____
ERECTION WGT, LB ____
MAINTENANCE WGT, LB ____
APPROX FLOOR SPACE:
L ____ W ____ H ____
ROD REMOVAL DISTANCE ____

CAPACITY CONTROL

TO PERMIT OPERATION AT AN INLET CFM OF	
POCKETS/VALVES OPEN	
INLET PRESS., PSIA	
DISCHARGE PRESS., PSIA	
DISCHARGE TEMP, DEG F	
BRAKE HORSEPOWER/STAGE	
TOTAL BRAKE HORSEPOWER	
TO PERMIT OPERATION AT AN INLET CFM OF	
POCKETS/VALVES OPEN	
INLET PRESS., PSIA	
DISCHARGE PRESS., PSIA	
DISCHARGE TEMP, DEG F	
BRAKE HORSEPOWER/STAGE	
TOTAL BRAKE HORSEPOWER	

CAPACITY CONTROL SHALL BE BY:
☐ VARIABLE SPEED TO ____% RATED
☐ PURCHASERS BYPASS
☐ MFR STANDARD AUTOMATIC CONTROL
☐ START-STOP ☐ 2 STEP
☐ 3 STEP ☐ 5 STEP
☐ PILOTED BY REC PRESS.
☐ PILOTED BY PURCH INSTR W/____ PSIG AIR SIGNAL
☐ CLEARANCE POCKETS
☐ FIXED ☐ VARIABLE
☐ MANUAL ☐ AUTOMATIC
☒ SUCTION VALVE UNLOADING ④
☒ MANUAL ☐ AUTOMATIC
ON AIR/POWER FAILURE COMPR SHALL:
☐ UNLOAD ☐ LOAD

REMARKS ① TWO STAGE COMPRESSOR REQ'D. ③ COMPLETE ANALOG STUDY INCLUDING INLET & DISCH PIPING AND INTERSTAGE ACCESSORIES IS REQ'D. ⑤ PRESSURES ARE AT DAMPER-LINE CONNECTIONS. ④ FOR START-UP (PNEUMATIC) ⑤ VENDOR SHALL FURNISH
(Manufacturer to fill in all missing data) RAILS & SOLE PLATES AND PREALIGN ON PURCH. FOUNDATION.
REV. ⚠ 4-3-72 EJM

PROCON, INCORPORATED
GAS ANALYSIS DATA SHEET

MOLES/HR

JOB NO. 1843 ITEM NO. 31.09-03
PURCHASE ORDER NO.
REQUISITION NO.
Sheet No 2 OF 5 BY EJM
DATE 2-21-72

MATERIAL	SYMBOL	M.W.	31.09 -0-						
CARBON DIOXIDE		44	146.9	⚠					
HYDROGEN SULFIDE		34	3.94						
HYDROGEN CYANIDE		27	0.07						
CARBONYL SULFIDE		60.1	0.07						
CARBON DISULFIDE		76.1	0.03						
AMMONIA		17	7.9						
WATER		18	54.0	⚠					
HYDROGEN		2.02	0.19						
CARBON MONOXIDE		28	1.2						
METHANE		16	12.6						
ETHANE		30	1.0						
BENZENE		78	73.8						
TOLUENE		92	16.0						
O-XYLENE		106	1.2						
CUMENE		120	0.2						
NAPHTHALENE		128	0.01						
PHENOL		94	0.003						
CRESOL		108	0.003						
LIGHT OIL		172	0.06						
HEAVY OIL		278	0.002						
TOTALS			354.4	⚠					
MOLECULAR WEIGHT			43.1	⚠					

REV. ⚠ 4-3-72 EJM

PROCON, INCORPORATED
RECIPROCATING COMPRESSOR DATA SHEET (Cont'd)

JOB NO. 1843 ITEM NO. 31.09-03
PURCHASE ORDER NO. ____
REQUISITION NO. ____
Sheet No. 3 OF 5 BY EJM
DATE 3-31-72

CYLINDER DATA

ITEM NO./SERVICE	31.09-03
STAGES (Two Req'd)	
NO. OF CYL PER STAGE	
TYPE CYLINDER	
SINGLE/DOUBLE ACTING	
CYLINDER LINER, YES/[redacted]	
CYLINDER LINER, [redacted]/DRY	
OD LINER, IN.	
BORE, IN.	
STROKE, IN.	
PISTON DISPLACEMENT, CFM	
CLEARANCE, %	
VOLUMETRIC EFFICIENCY, %	
AVG VALVE GAS VELOCITY, FPM	
NO. OF INLET-OUTLET VALVES	
TYPE OF VALVES	
MAX. ALLOW. PISTON SPEED, FPM	900
NORMAL PISTON SPEED, FPM	
ROD DIAMETER, IN.	
MAX. ALLOW. ROD LOADING, T	
MAX. ALLOW. ROD LOADING, C	
RATED ROD LOADING, T	
RATED ROD LOADING, C	
MAX. ALLOW. CYL PRESS., PSIG	
MAX. ALLOW. CYL TEMP. DEG F	
SUCTION VOLUME BOTTLE, CU FT	
DISCHARGE VOLUME BOTTLE, CU FT	
RECOM RELIEF VALVE, PSIG	
HYDROSTATIC TEST, PSIG	
SUCTION SIZE: RATING	
FACING	
DISCHARGE SIZE: RATING	
FACING	

COMPRESSOR MATERIALS (1)

CYLINDERS	CI
CYLINDER LINERS	
PISTONS	
PISTON RINGS	
PISTON RODS	
VALVE SEATS	
VALVE STOPS	
VALVE PLATES	
VALVE SPRINGS	

COMPRESSOR PACKING

- ☐ STANDARD FIBROUS
- ☒ FULL-FLOATING VENTED SEGMENTAL PACKING
  - W/STAINLESS STEEL SPRINGS
- ☒ FORCED-FEED LUBRICATED
- ☐ NONLUBRICATED ☒ TEFLON ☐ CARBON
- ☒ WATER-COOLED
- VENTED TO FLARE

DISTANCE PIECE

- ☐ STANDARD
- ☐ EXTRA LONG SINGLE COMPARTMENT
- ☒ TWO COMPARTMENT
- ☒ SOLID COVER ☐ OPEN

LUBRICATION

FRAME
- ☐ SPLASH SYSTEM
- ☒ PRESSURE SYSTEM, INCLUDING THE FOLLOWING:
  - ☒ OIL PUMP DRIVEN BY COMPR SHAFT
  - ☒ OIL PUMP DRIVEN BY ELECTRIC MOTOR
  - ☐ HAND-OPERATED PUMP FOR STARTING

SYSTEM OIL CAPACITY ____ GAL
TYPE OIL ____ GRADE ____
☒ ELECTRIC HEATER W/THERMOSTAT ____ KW

CYLINDERS
LUBRICATOR TO BE DRIVEN BY:
☒ COMPRESSOR SHAFT ☐ ELECTRIC MOTOR
LUBRICATOR CAPACITY ____ QT
TYPE OIL ____ GRADE ____
LUBRICATOR ALSO TO BE EQUIPPED WITH:
☐ STEAM COIL
☒ ELECTRIC HEATER W/THERMOSTAT ____ KW
NO. OF COMPARTMENTS ____ NO. OF PUMPS ____

COUPLING—LOW SPEED
MFR ____ MODEL ____
TYPE ____

COUPLING—HIGH SPEED
MFR ____ MODEL ____
TYPE ____

AIR INTAKE FILTER
MFR ____ MODEL ____
TYPE ____

REMARKS (1) ALL MATERIALS IN H_2S SERVICE SHALL HAVE LESS THAN 90,000 PSI YIELD STRENGTH AND HARDNESS LESS THAN ROCKWELL C-20, INCL. WELDS. EXCEPTIONS MAY BE PISTON RODS AND VALVE PLATES & SPRINGS.

(Manufacturer to fill in all missing data)

PROCON, INCORPORATED
RECIPROCATING COMPRESSOR DATA SHEET (Cont'd)

JOB NO. 1843 ITEM NO. 31.09-03
PURCHASE ORDER NO. ____
REQUISITION NO. ____
Sheet No. 4 of 5 BY BJM
DATE 2-21-72

SITE DATA

ALTITUDE ____ FT BAROMETER 14.5 PSIA
DESIGN TEMP, DEG F 95 SUMMER -30 WINTER MIN.
DESIGN WET BULB TEMP, DEG F ____
COOLING WATER (CW)
PRESS., PSIG 65 SUPPLY ____ RETURN
TEMP, DEG F 85 SUPPLY 110 RETURN MAX.
ELECTRIC POWER
300 HP & OVER 4160 VOLTS 3 PH 60 CYCLES
1/2 HP to 250 HP 460 VOLTS 3 PH 60 CYCLES
____ HP & LESS ____ VOLTS ____ PH ____ CYCLES
AUXILIARY MOTORS
☐ TEFC ☒ EXP PROOF ☐ DRIP PROOF
☐ OPEN ☐ ____
INSULATION TYPE ____ CLASS ____
EQUIPMENT SHALL BE SUITABLE FOR:
☐ INDOORS ☐ HEATED ☒ UNHEATED
☒ OUTDOORS ☒ UNDER ROOF ☐ WITHOUT ROOF
STEAM SUPPLY
NORMAL PRESS. ____ PSIG @ ____ FTT
MIN. PRESS. ____ PSIG @ ____ FTT
INSTRUMENT AIR SUPPLY ____ PSIG
STEAM EXHAUST
NORMAL PRESS. ____ PSIG @ ____ FTT
MAX. PRESS. ____ PSIG @ ____ FTT
FUEL GAS: NORMAL PRESS. ____ PSIG @ ____ F
HEATING VALUE, BTU PER CU FT ____ LHV ____ HHV
QUANTITY H_2S ____ GRAINS PER 100 CU FT
STARTUP FUEL, SEE GAS ANALYSIS DATA SHEET

UTILITY CONSUMPTION

ELECTRIC	HP	LOCKED ROTOR AMPS	FULL LOAD AMPS
MAIN DRIVER			
MAIN LUBE OIL PUMP			
STARTING AIR COMPR			
M.G. SET			
MECH LUBRICATOR			

LUBRICATOR HEATER ____ WATTS ____ VOLTS ____ PH
SPACE HEATER ____ WATTS ____ VOLTS ____ PH

STEAM
MAIN DRIVER ____ #/HR ____ PSIG ____ FTT to ____ PSIG
LUBE HEATER ____ #/HR ____ PSIG ____ FTT to ____ PSIG
____ #/HR ____ PSIG ____ FTT to ____ PSIG

FUEL GAS—MAIN DRIVER NORMAL FUEL

RATED RPM.	100	75	50
BTU/HP/HR			
TOTAL BTU/HR			

COOLING WATER (1)(4)

	COMPR CYL	L.O. COOLER	TURBO AIR COOLER	PACKING	ENG JKT COOLER
TYPE WATER	(3) TW	CW		(1)	
QUANTITY, GPM					
INLET TEMP, DEG F					
OUTLET TEMP, DEG F					
PRESS. DROP, PSIG					
MAX. PRESS., PSIG					
TOTAL C.W., GPM					

INSPECTION AND SHOP TESTS

☒ SHOP INSPECTION BY PURCHASER DURING CONSTRUCTION
☒ MANUFACTURERS STANDARD SHOP TESTS
☒ BARRING OVER TO CHECK CLEARANCES
☐ RUNNING TEST WITH SHOP DRIVER
☐ RUNNING TEST WITH SHOP FUEL AT RATED LOAD
☐ HELIUM LEAK TEST ON COMPR CYL ____
☐ OTHER TESTS ____

PURCHASER SHALL WITNESS THE FOLLOWING:
☒ HYDROSTATIC TEST ☐ MECH RUN TEST
☐ PERFORMANCE TEST ☐ AUX EQUIP. OPER TEST
☐ DISMANTLE-REASSEMBLY INSPECTION
☐ HELIUM LEAK TEST

ALARMS AND SHUTDOWNS

COMPR MFR SHALL FURNISH CONTACTS FOR: (2)

	ALARM	SHUTDOWN
LUBE OIL PRESS.	☒	☒
LOW MECH LUBR OIL LEVEL	☒	☒
LOW COMP J.W. FLOW	☒	☐
HIGH ENG J.W. TEMP	☐	☐
HIGH GAS DISCH TEMP	☒	☒
HIGH VIBRATION	☐	☐

REMOTE SHUTDOWN: ☐ ELECTRONIC ☐ PNEUMATIC ☐ HYDRAULIC

ALARM CONTACTS SHALL:
☒ OPEN ☐ CLOSE TO SOUND ALARM
SHUTDOWN CONTACTS SHALL:
☐ OPEN ☒ CLOSE TO SHUTDOWN
CONTROL CURRENT 115 VOLTS 1 PHASE 60 CYCLES
SWITCH ENCLOSURE ☒ EXP PROOF ☐ WEATHERPROOF

REMARKS (1) ADVISE REQUIREMENTS (2) PURCHASER WILL SUPPLY TEMPERED WATER (TW) FOR COOLING CYLINDER JACKETS. (3) ALL SWITCHES SHALL BE DUAL SPDT. (4) VENDOR SHALL FURNISH TEMP. GAGE IN EACH CYL. JKT. COOLING WATER OUTLET.
NOTE: VENDOR SHALL SUPPLY FREE STANDING INSTRUMENT PANEL, INCLG. FOLLOWING INSTRUMENTS: PI & TI FOR LUBE OIL SYSTEM AND FOR PROCESS GAS PRESSURES AND TEMPERATURES, ALARM & S.D. INDICATING LIGHTS, AND UNLOADERS CONTROL VALVE.

(Manufacturer to fill in all missing data)

PROCON, INCORPORATED
MOTOR DATA SHEET

JOB NO. 1843 ITEM NO. 31.09-03
PURCHASE ORDER NO. ____
REQUISITION NO. ____
Sheet No. 5 OF 5 BY EJM
DATE 4-21-72

MOTOR DESIGN DATA

DRIVE SYSTEM: [X] DIRECT CONNECTED, ENGINE MTD.
[ ] GEAR REDUCER
[ ] V-BELTS

CURRENT CONDITIONS
4160 VOLTS 3 PHASE 60 CYCLES

TYPE MOTOR: [X] SQUIRREL CAGE IND NEMA DESIGN ____
[ ] SYNCHRONOUS ____
[ ] WOUND ROTOR INDUCTION

ENCLOSURE: [ ] CLASS I, GROUP D, EXP PROOF
[ ] TEFC/TEFV
[X] WEATHER PROTECTED ~~II~~ (II)
[ ] FORCED VENTILATED
[ ] OPEN-DRIPPROOF
[ ] ____

NAMEPLATE HORSEPOWER ____
SERVICE FACTOR ____
SITE ALTITUDE ____
SYNCHRONOUS, RPM ____
POWER FACTOR REQ'D ____
INSULATION CLASS B TYPE SEALED
TEMPERATURE RISE, DEG C 80
SYN MOTOR ROTOR: [ ] SOLID [ ] SPLIT
SYN MOTOR HUB: [ ] SOLID [ ] SPLIT
STARTING: [ ] FULL VOLTAGE [ ] UNLOADED
[ ] LOADED [ ] REDUCED VOLTAGE ____ %

TRANSMISSION EQUIPMENT

[ ] SPEED-REDUCING GEAR
[ ] INTEGRAL [ ] SEPARATE
MFR ____ SIZE & TYPE ____
MAX. CONT HP RATING ____
AGMA SERVICE FACTOR ____
RATIO ____ MECH EFFICIENCY ____
[ ] PRESSURE LUBE [ ] SPLASH LUBE
[ ] V-BELTS AND V-BELT SHEAVES [ ] STATIC CONDUCTING
[ ] GUARD REQUIRED

WEIGHTS AND DIMENSIONS

MOTOR: NET WGT ____
MAX. ERECTION WGT ____ HEIGHT ____
FLOOR SPACE: L ____ W ____ H ____
GEAR: NET WGT ____
MAX. ERECTION WGT ____ MAX. MAINT WGT ____
FLOOR SPACE: L ____ W ____ H ____

MANUFACTURERS DATA

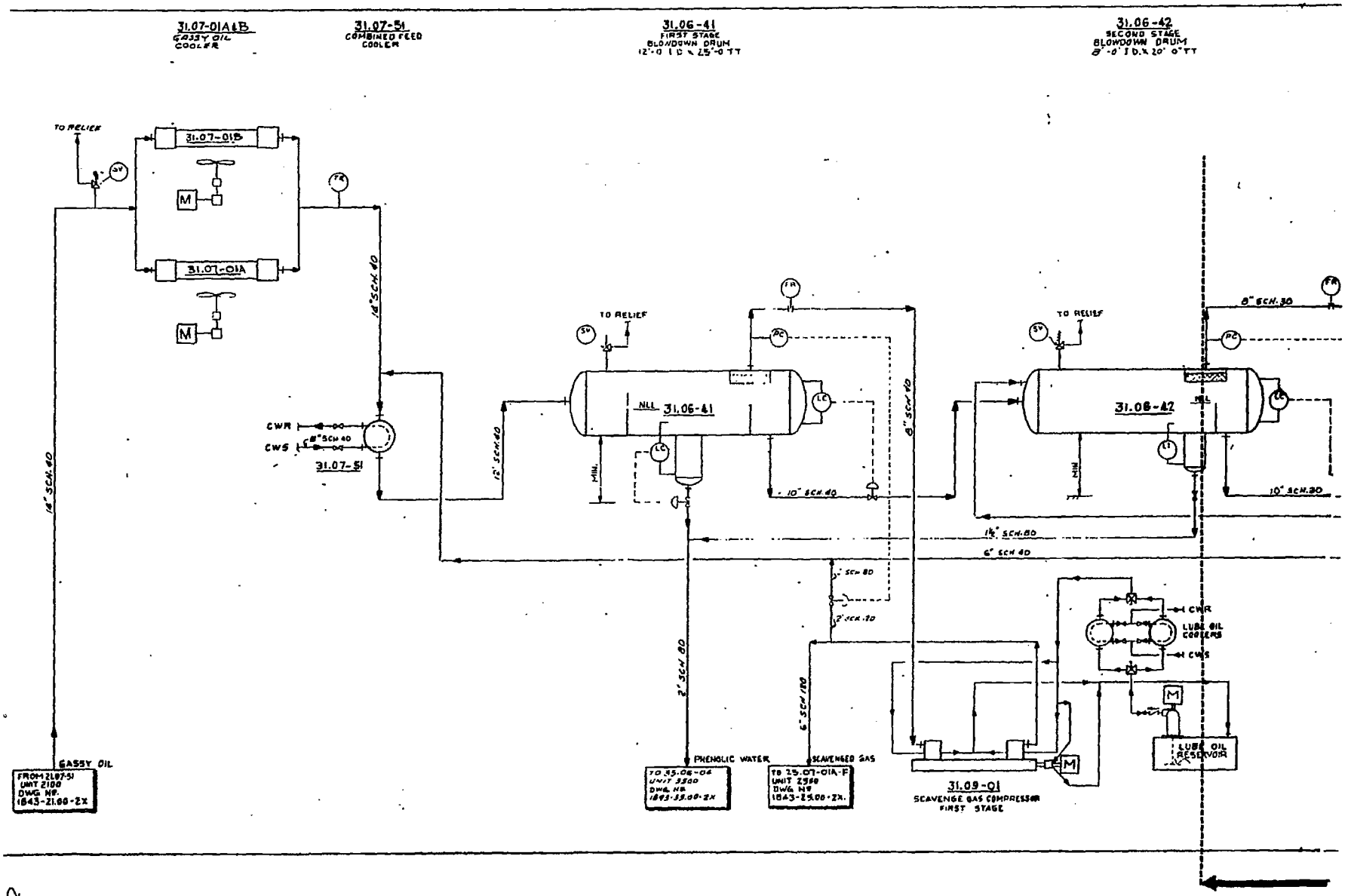
MFR ____
FRAME NO ____ FULL LOAD RPM ____
EFFICIENCY: F.L. ____ 3/4 L ____ 1/2 L ____
POWER FACTOR: F.L. ____ 3/4 L ____ 1/2 L ____
CURRENT: FULL LOAD ____ LOCKED ROTOR ____
FULL-LOAD TORQUE, FT-LB ____
STARTING TORQUE, FT-LB ____
PULL-OUT TORQUE, FT-LB ____
ACCELERATION TIME ____ SEC
ROTATION FACING COUPLING END ____
NUMBER CONSECUTIVE STARTS ____
FIELD DISCHARGE RESISTOR ____ OHMS
BEARINGS, TYPE ____ LUBR ____
TOTAL SHAFT END FLOAT ____
LIMIT END FLOAT TO ____

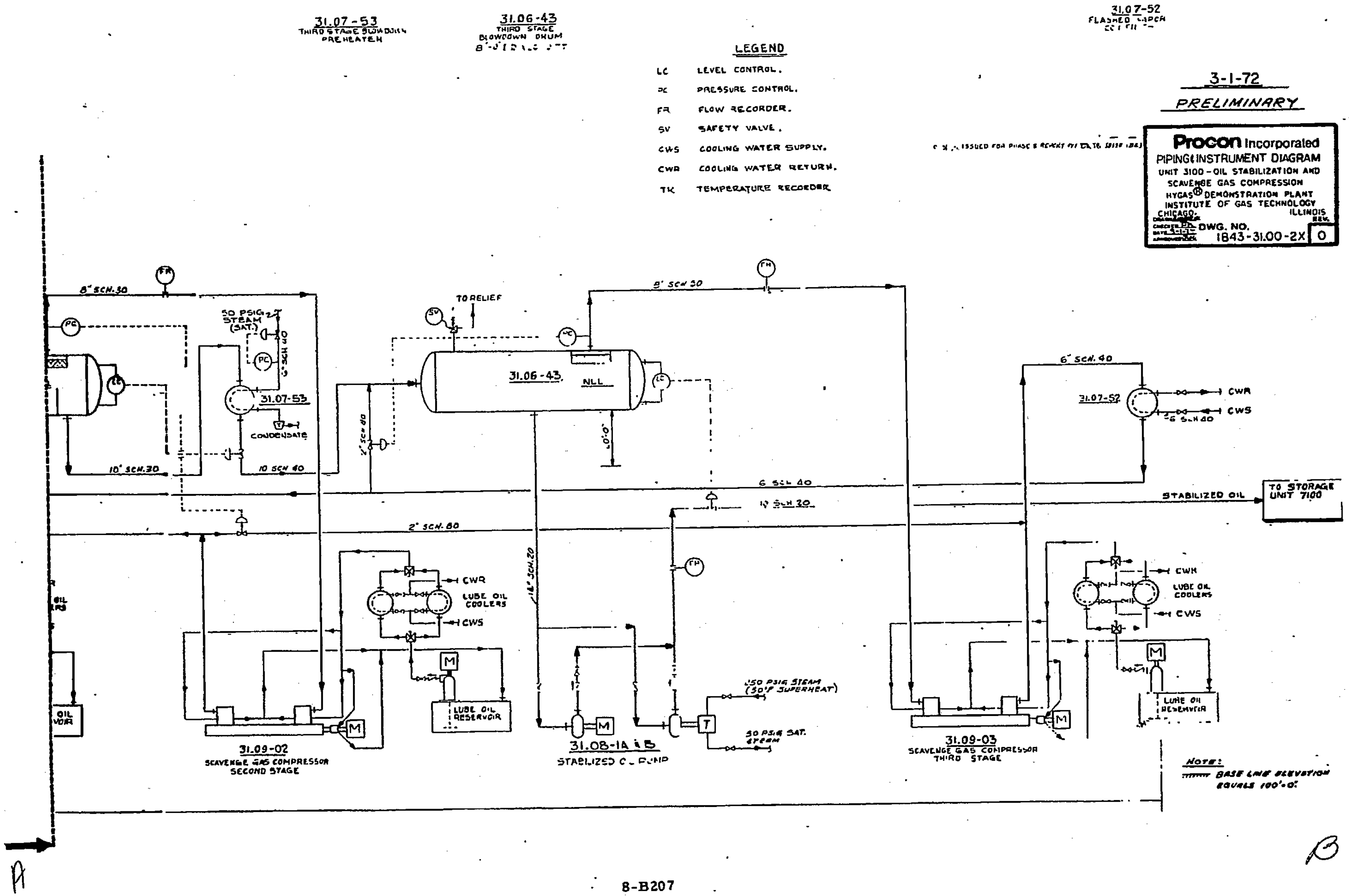
ACCESSORY EQUIPMENT

[ ] BASEPLATE [ ] SOLEPLATE [ ] STATOR SHIFT
FOR ____
[ ] SPACE HEATERS: KW ____
____ VOLTS ____ PHASE ____ CYCLES
[ ] RESISTANCE TEMPERATURE DETECTORS
NUMBER ____ RESISTANCE MAT'L ____
SELECTOR SWITCH AND INDICATOR BY:
[ ] PURCHASER R.T.D.'S SET @ ____ C
[ ] MFR
[ ] D.C. EXCITATION
KW REQ'D ____ VOLTS ____
BY: [ ] PURCHASER [ ] MANUFACTURER
DESCRIPTION ____
[ ] MOTOR ARRANGED FOR DIFFERENTIAL PROTECTION
[ ] EXTENDED LEADS LENGTH ____ FT
[ ] ENCLOSED COLLECTOR RINGS
[ ] PURGED
MEDIUM ____ PRESS. ____ PSIG
[ ] EXPLOSION-RESISTANT NONPURGED
[ ] FORCED VENTILATION
CFM ____ PRESS. DROP ____ IN. H2O
CONDUIT BOX SIZED FOR:
[ ] R.T.D.'S IN SEPARATE BOX
[X] MAIN MOTOR LEADS (STRESS CONES)
[ ] C.T.'S FOR DIFF PROTECTION
[ ] SURGE PROTECTION

REMARKS ____

(Manufacturer to fill in all missing data)


31.07-01A&B
GASSY OIL COOLER
31.07-51
COMBINED FEED COOLER
31.06-41
FIRST STAGE BLOWDOWN DRUM
12'-0" I.D. x 25'-0" T.T.
31.06-42
SECOND STAGE BLOWDOWN DRUM
8'-0" I.D. x 20' 0" T.T.
TO RELIEF
31.07-01B
31.07-01A
M
TE
14" SCH 40
CWR
CWS
6" SCH 40
31.07-51
12" SCH 40
TO RELIEF
NLL 31.06-41
LC
MIN.
10" SCH 40
8" SCH 40
FR
PC
TO RELIEF
31.06-42
NLL
LT
MIN.
8" SCH 30
10" SCH 30
14" SCH 80
6" SCH 40
3" SCH 80
2" SCH 80
2" SCH 40
6" SCH 100
CWR
LUBE OIL COOLERS
CWS
LUBE OIL RESERVOIR
31.09-01
SCAVENGE GAS COMPRESSOR FIRST STAGE
GASSY OIL
FROM 21.07-51 UNIT 2100 DWG NO. 1843-21.00-2X
PHENOLIC WATER
TO 35.06-04 UNIT 3500 DWG NO 1843-35.00-2X
SCAVENGED GAS
TO 25.07-01A-F UNIT 2500 DWG NO 1843-25.00-2X.


31.07-53
THIRD STAGE BLOWDOWN PREHEATER
31.06-43
THIRD STAGE BLOWDOWN DRUM
31.07-52
LEGEND
LC LEVEL CONTROL.
PC PRESSURE CONTROL.
FR FLOW RECORDER.
SV SAFETY VALVE.
CWS COOLING WATER SUPPLY.
CWR COOLING WATER RETURN.
TK TEMPERATURE RECORDER
3-1-72
PRELIMINARY
Procon Incorporated
PIPING & INSTRUMENT DIAGRAM
UNIT 3100 - OIL STABILIZATION AND SCAVENGE GAS COMPRESSION
HYGAS® DEMONSTRATION PLANT
INSTITUTE OF GAS TECHNOLOGY
CHICAGO, ILLINOIS
DWG. NO. 1843-31.00-2X
REV. 0
8" SCH.30
50 PSIG STEAM (SAT.)
TO RELIEF
8" SCH 30
6" SCH.40
31.07-52
CWR
CWS
31.07-53
CONDENSATE
10" SCH.30
10 SCH 40
NLL
6 SCH 40
STABILIZED OIL
TO STORAGE UNIT 7100
2" SCH.80
CWR
LUBE OIL COOLERS
CWS
LUBE OIL RESERVOIR
OIL
31.09-02
SCAVENGE GAS COMPRESSOR SECOND STAGE
31.08-1A & B
150 PSIG STEAM (50°F SUPERHEAT)
50 PSIG SAT. STEAM
31.09-03
SCAVENGE GAS COMPRESSOR THIRD STAGE
NOTE:
BASE LINE ELEVATION EQUALS 100'-0"
A
B

PART IX

PROCESS ECONOMICS

TABLE OF CONTENTS, PART IX

9.1 Discussion

Several economics studies pertaining to the HYGAS Process conversion of coal to pipeline-quality SNG were performed between July 1964 and September 1972, the period reported in this HYGAS Final Report 381.

The reader should bear in mind that cost estimates are usually subject to comparison, if not in a formal tabulation, then more casually in the reader's mind with reference to some prior knowledge. One must always keep in mind the comparability of different estimates.

Specifically, one should recognize that process design, degree of detail, source of costs, timing of estimates, cost of coal, financial factors and methods employed to arrive at a process price may vary greatly between analyses.

With these thoughts in mind, the reader is referred to the bibliography that pertains to the economics of producing pipeline-quality SNG from coal; all were prepared by HYGAS engineering economists during the contract period, and explore the economics of the HYGAS Process in that period.

The reader is referred, also, to the Final Report of the Supply Technical Advisory Task Force – Synthetic Gas-Coal by the Federal Power Commission dated April 1973, specifically, Chapter VII, "Economics of Pipeline Gas From Coal," paragraph B, Processes Evaluated et. seq. The "single set of data" felt to be representative of a "Typical New Process," although not actually HYGAS data, are, for practical purposes, similar.

9.2 Bibliography

1. "Process Design and Cost Estimate for Production of 265 Million SCF/Day of Pipeline Gas by the Hydrogasification of Bituminous Coal," R&D Rep. No. 22, Interim Rep. No. 1. C. L. Tsaros, S. J. Knabel and L. A. Sheridan. Washington, D.C.: Office of Coal Research, 1965.

2. "The Economics of Coal Hydrogasification," C. L. Tsaros and T. J. Joyce. Proceedings of the Synthetic Pipeline Gas Symposium, 43-56. New York: American Gas Association, 1966.

3. "Process Design and Cost Estimate for Production of 265 Million SCF/Day of Pipeline Gas by the Hydrogasification of Bituminous Coal – Hydrogen by the Steam-Iron Process," R&D Rep. No. 22, Interim Rep. No. 2, C. L. Tsaros, S. J. Knabel and L. A. Sheridan. Washington, D.C.: Office of Coal Research, 1966.

4. "Process Design and Cost Estimate for a 258 Billion Btu/Day Pipeline Gas Plant – Hydrogasification Using Synthesis Gas Generated by Electrothermal Gasification of Spent Char," R&D Rep. No. 22, Interim Rep. No. 3, S. J. Knabel and C. L. Tsaros. Washington, D.C.: Office of Coal Research, 1967.

5. "Cost Estimate of 500 Billion Btu/Day Pipeline Gas Plant Via Hydrogasificiation and Electrothermal Gasification of Lignite," R&D Rep. No. 22, Interim Rep. No. 4, C. L. Tsaros, J. L. Arora, B. S. Lee, L. S. Pimentel, D. P. Olson and F. C. Schora, Jr. Washington, D.C.: Office of Coal Research, 1968.

6. "Hydrogen: A Key to the Economics of Pipeline Gas From Coal," C. L. Tsaros. Paper presented at the 158th National Meeting of the Division of Fuel Chemistry of the American Chemical Society, Chicago. September 13-18, 1970.

7. "The Effect of Accounting Factors on the Economics of Synthetic Pipeline Gas," R&D Rep. No. 22, Interim Rep. No. 5, T. K. Subramaniam and C. L. Tsaros. Washington, D.C.: Office of Coal Research, 1970.

8. "Electrothermal HYGAS Process Escalated Costs," C. L. Tsaros and T. K. Subramaniam, R&D Rep. No. 22, Interim Rep. No. 6. Washington, D.C.: Office of Coal Research, 1971.

U.S. DEPARTMENT OF COMMERCE
Technology Administration
National Technical Information Service
Springfield, VA 22161 (703) 605-6000