Chevron BB
014691

PLAINTIFF'S EXHIBIT

CHV-706

COST SUMMARY EF-513

COST SUMMARY FOR:
- ☐ Columns
- ☐ Vessels
- ☐ Exchangers
- ☐ Heaters
- ☒ Pumps
- ☐ Mechanical

Date 11/18
By [illegible]

Pumps

161,345
3.6
151,745
151,758
48 4
9600

Including Field Extras

Item	M	Rev. L ①	②	③
	4 3 2	6		
P-1A, B, C	22,490	1800		
P-2 & A	18,400	1600		
P-3 & A, P-4 & A	6205	2400		
P-5 & A, P-6 & A	6470	2700		
P-7 & A	11040	1200		
P-8 & A, P-11 & A	10610	1600		
P-9 & A, P-10 & A	9010	1600		
P-12 & A	820	1400		
P-13 & A	35,700	1600		
CORR. INH. SYS.	1000	1000		
DESALTER PUMP	see dismantling costs	400		
	$151,[illegible]5	$17,300		
Surplus Motors	− 2500			
	$1[illegible]45			
FIELD EXTRAS 10%	[illegible]	1700		
	[illegible]	19,000		
P-14	1200			
COMMON SPARES	−5000	−1000		
SUB-TOTAL	16[illegible],000	18,[illegible]		
Estimating Factor 5%	10,000	2000		
TOTAL CATEGORY	1[illegible],000	20,000		

Notes & Revisions

①

②

③

PRINTED IN USA

EF-513 (150-CD-3-60)

Chevron BB
014692

CALCULATION SHEET GO-144-2T

PROJECT No.

SHEET No.

TITLE

INITIALS JAL

SUBJECT

DATE 11/18

Surplus Motors — Scrap Yard

	RPM	HP	Pass. use	$ Saved less $ rework
MG-1612B	3550	60	P-8	400
MG-405A	3570	75	P-5*	500
MG-1801	3520	100	P-5A*	500
MG-516	3550	25	P-10	200
MG-2013	3585	125	P-1B*	$ 1000
				2600

* rework plus must be 2300V.

say take $2500 credit for use of these motors

GO-144-2T / 124M 8-5
PRINTED IN U.S.A.

Chevron BB
014693

CALCULATION SHEET GO-144-2T

PUMP TOTALS

22,490
58,000
6,205
6,470
11,040
10,610
9,010
820
35,700
5,280
8,640

174,265 PUMP & DRIVER COSTS
17,500 10% FOR FIELD EXTRAS
$191,765

SAY $192,000

PUMP SAVE

COMMON SPARE

P-3 & P-5 $2500
P-8 & P-11 2300
4800
FE- 10% 500
5300
5% EST FACT. + 300
5600

M L
deduct 5000 600
400
1000

INITIALS _____ PROJECT No. _____

DATE _____ SUBJECT _____

SHEET _____ OF _____

GO-144-2T (8-64) PRINTED IN U.S.

Chevron BB
014694

CALCULATION SHEET GO-144-2T

PROJECT No. _____ SHEET No. 1

TITLE _____ INITIALS JAC

SUBJECT _____ DATE 11/13

Pump Estimates

P1A, B, C. — use 3 motors — NO T.
P-2&A use ALT #2 CASE
use 2 M — NO T.
~~P-3&A~~ P-4&A check G-403 intact w/ M OK (IMPELLER OK)
G-403A gone
~~P-4&A~~ P-3&A check G-404 } need 2 new M (IMPELLER O.K)
G-404A gone
P-5&A use 2 M, NO T
P-6&A check G-406A } need 2 new M
G-406 gone IMPELLER O.K
P-7&A check G-407 — N.G.
G-407A gone } need 2 new M
~~STM PUMP. DON'T USE~~
P-8&A use 2 M
P-9&A use 2 M
P-10&A use 2 M
P-11&A check G-401 & A NO Good inf. M drivers NOT OK
Do sulfurizer 2501P — P-12&A check G-3505 & A inf. M drivers
P-13&A ~~new~~ use 1 M & 1 T

OFF PLOT P-101&A
P-102&A

ADD NEW IMPELLER & MOTOR TO G-3505
G-3505A & MOTOR ARE O.

Bender
G-2637&A new 3 M
G-2639

GO-144-2T (124M 8-5 PRINTED IN U.S.)

Chevron BB
014695

CALCULATION SHEET GO-144-2

Note 12" turbine (Coppus) is limited to 40 HP @ 385/40 psi	12" TURBINE ~~to 50~~ 40 HP	16" 40-150 HP ~~[illegible]~~
Base rate	38	[illegible]
Wheel Diam Corr	1.20	[illegible]
Exh	1.25	[illegible]
HP Corr	1.10	[illegible]
Superheat	[illegible]	[illegible]
Water rate	60 lb/HP-hr	54.[illegible]

Steam Conditions for all turbines

Inlet 385 psig
80 ~~100~~ SH

Exhaust 40 psig

For P-2A (490 HP) and P-13A (475 HP)

Steam 385 psi 100 F.SH / 40 psig

Select 28" wheel diam

Base rate	38
Wheel Diam Corr.	.65
Exh. Pr. Corr.	1.25
HP	1.0
Superheat	~~.96~~ .965

WR = 38 x .65 x 1.25 x 1.0 x .96
= 29.6 #/HP/hr

NOTES [illegible] PROJECT NO.
DATE 11-7-69 SUBJECT [illegible]
SHEET ___ OF ___

Chevron BB
014696

CHECK FOR USE AS PUMP P-4:

PUMP P-403 & P-403A 4X6X 8HH-SM BYRON JACKSON

CONDITIONS OF P-4

GPM = 800

ΔP = 44 PSI

$$\frac{44 \text{ PSI}}{(0.433 \times \text{SP. GR}) \text{ PSI/FT}} = \Delta P \text{ IN FEET}$$

$$\frac{44}{0.433 \times 0.655} = 155'$$

IMPELLER MAX/MIN = 8"/6½

CURRENT IMPELLER = 7"

USING CURRENT CURVE WE CAN GET 178' OF HEAD @ 800 GPM

∴ IMPELLER O.K.

FOR PUMP P-3:

CHECK P-404 & A

CONDITIONS TO BE MET

200GPM & @ ΔP = 102 PSI

$$\Delta P = \frac{102}{0.433 \times 0.67} = 352'$$

CURRENT IMPELLER WILL GIVE US 400' OF HEAD @ 200 GPM

∴ IMPELLER O.K.

FOR P-6

CHECK P-406

CONDITIONS TO BE MET

70 GPM. @ 149' OF HEAD

@ 70 GPM, P-406 WILL DELIVER ABOUT 215' OF HEAD.

∴ IMPELLER O.K.

(MAY BE CLOSE TO MIN FLOW)

ESTIMATE SHEET

FOR EL PASO ECC

ITEM TITLE TURBINE PRICING

REQUESTED BY	MADE BY	CHECKED BY	APPROVED BY

FILE

S.O. ITEM

SHEET OF

DATE 11-7-[illegible]

DRWG. NO.

DESCRIPTION	~~UNIT~~	~~QUANT.~~	~~PRICE~~	~~LABOR~~	~~MATL~~	~~TOTAL~~	
ALL TURBINES 3550 RPM							
CLASS II (385 psi 80FSH, 40 psi BP)							
12" WHEEL DIAM HP	5	15	16	20	22	30	37
PRICE	1880	1890	1900	1900	1910	1910	19[illegible]
EDC 279/237							
CURRENT PRICE	2220	2230	2240	2240	2250	2250	22[illegible]
WT 1200#							
FREIGHT 1200 × 7.45/100 =	Say 100						
TOTAL CURRENT PRICE	2320	2330	2340	2340	2350	2350	23[illegible]
16" WHEEL DIAM HP	41	42	85	140			
PRICE	2340	2340	2440	2540			
EDC 279/237							
CURRENT PRICE	2750	2750	2870	2990			
FREIGHT 1450# × 7.45/100 =	$110						
TOTAL CURRENT PRICE	$2860	2860	2980	3100			
28" WHEEL DIAM							
500 HP = $4660 ×		279/237	=	5480			
Freight 2850 × 7.45/100 =				220			
TOTAL CURRENT PRICE				$5700			

MFG.658 (16M-CD.7.55)
PRINTED IN U.S.A.

Chevron BB
014699

CALCULATION SHEET GO-144-2T

EXISTING PUMPS TO BE CONSIDERED FOR RE-USE

P-404A P-404 VIW 2" ESB impeller ok

~~P-403~~ for P-3 200 gpm @ 352' IMPELLER OK. 50 HP DRIVER

P-403A P-403 4x6x8HA SM B/C impeller ok

~~P-404~~ for P-4 800 gpm @ 155' IMPELLER O.K. 50 HP DRIVER

~~P-405~~ for P-5 165 gpm @ 650' NOT O.K

P-406 for P-6 70 gpm @ 149' IMPELLER O.K. 40 HP DRIVER

Steam Pump — don't use steam pump.

~~P-407~~ for P-7 750 gpm @ 414' NOT O.K.

P-507 for P-10 110 gpm @ 322'

~~P-401~~ for P-11 245 gpm @ 264' NOT O.K (GPM TOO HIGH)

P-3505 for P-12 155 gpm @ 418'

INITIALS BM PROJECT No.

DATE 11-10-69 SUBJECT

SHEET OF

GO-144-2T (8-64) PRINTED IN U.S.A.

Chevron BB
014700

ESTIMATE SHEET

FOR: EL PASO HCC

ITEM TITLE: MOTOR PRICING

REQUESTED BY | MADE BY: BAA | CHECKED BY | APPROVED BY

FILE

S.O. ITEM

SHEET OF

DATE 11-7-69

DRWG. NO.

DESCRIPTION			~~WIRE~~	~~QUANT.~~	~~PRICE~~	~~LABOR~~	~~METAL~~	~~TOTAL~~	
TEFC MOTORS HP	5	7½	20	25	40	50	100	125	150
(3550 RPM, 440V) HORIZ.									
BASE PRICE	120	130	300	370	580	750	1550	2[illegible]0	257[illegible]
INDEX	279/223	→							
CURRENT PRICE	$150	163	375	463	725	940	1940	2663	3227
INDEX AS OF 11/14	283/223	→							
PRICE AS OF 11/14	$152	165	380	470	735	950	1970	2680	3260

TEFC MOTOR
3550 Rpm, 2300v, 500 HP

12,760 × 279/223 = $15,950

FOR 200 HP
3550, TEFC
4220 × 283/223 = $5350

Chevron BB
014701

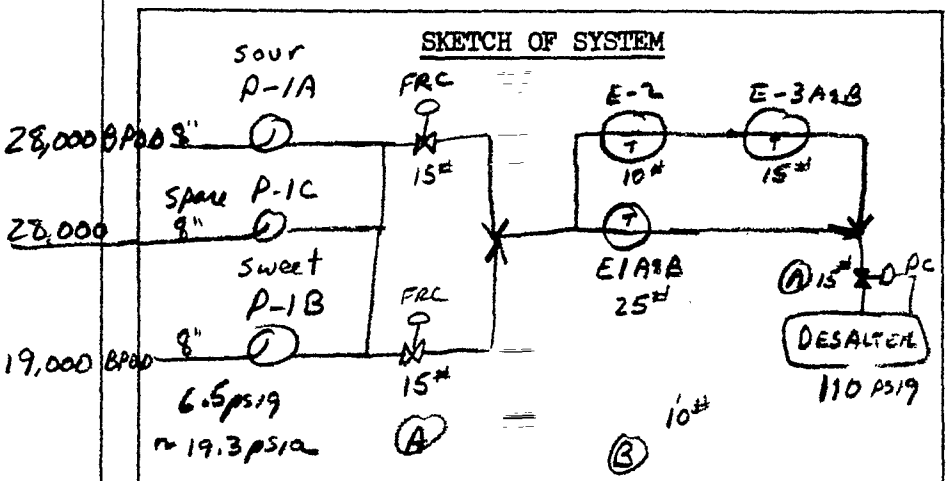
PUMP & DRIVER COST ESTIMATING WORK SHEET - EF-512

Date 10/22/69
By JHC

To be used in conjunction with EF-246

ITEM P-1 A, B, C

SKETCH OF SYSTEM



SUCTION
Initial

① 19.3 psig
②
③
④ 19.3 psia
At Pump

DISCHARGE
Terminal 123

A	CV	30
B	Ent.	25
C	FRICT	10
D	CONT & ELEV	10

At Pump 198

ΔP = 179 Psi

Design Flow _____ Specified _____
Proceed with selection via EF-246

P-1A	820 gpm	900 GPM
P-1C	820 gpm	900 GPM
P-1B	555 gpm	610 GPM

ITEM _____

SKETCH OF SYSTEM

SUCTION
Initial

①
②
③
④
At Pump

DISCHARGE
Terminal

A
B
C
D
At Pump

Design Flow _____ Specified _____
Proceed with selection via EF-246

ΔP = _____ Psi

PRINTED IN USA EF-512 (150-CD-3-60)

Chevron BB
014702

		SOUR	COMMON SPARE	SWEET		
GENERAL	ITEM NUMBER	P-1A	P-1C	P-1B		
	SERVICE	DESALTER FEED →				
	FLUID PUMPED	CRUDE 45 API →		41.5° API		
FLOW CONDITIONS	OPERATING TEMP. °F	80				
	SPECIFIC GRAVITY	0.80		0.82		
	VISCOSITY CS	7.5		4.5		
	VAPOR PRESSURE PSIA					
	GPM AT OPER. TEMP.	900	900	610		
	SUCTION PRESSURE PSIA	19				
	DISCHARGE PRESSURE PSIA	198				
	ΔP PSI	179				
	DIFFERENTIAL HEAD FT	515	515	515		
PUMP SELECTION	TYPE OF PUMP (CENT.-STEAM-POWER-ROTARY)	C	C	C		
	COST EST. BOOK ITEM NO.	120-3	→	120-3		
	MARK NO. OR SIZE	G-1	→	L-1		
	SPEED RPM	3550	→	3550		
	OPERATING BHP	170	→	110		
MATERIAL	MATERIAL CLASS NO. (SEE NOTE 2)	B-1	→	→		
	CASE OR CYLINDER MATERIAL	C.S	→	→		
	TRIM MATERIAL	C.I	→	→		
DRIVER SELECTION	TYPE OF DRIVER (MOTOR-TURBINE-ENGINE)	M	→	M		
	DRIVER HP	200	→	125		
	MOTOR ENCL./TURBINE SIZE	TEFC	→	TEFC		
	STEAM CONSUMPTION LB/HR.					
	STEAM INLET PRESS. PSIG					
	STEAM EXHAUST PRESS. PSIG					
	STEAM TEMP. °F					
PUMP PRICE	PUMP PRICE FROM C.E. BOOK $	1925	→	1670.		
	EXTRA COST FOR DESCR.	MECH SEAL	→	→		
	EXTRA COST FOR $	INCL. ABOVE	→	→		
	EXTRA COST FOR DESCR.					
	EXTRA COST FOR $					
	COST INDEX RATIO (1.29)	283/219	→	→	1	1
	CURRENT PRICE OF PUMP $	2480		2150.		
	FREIGHT $					
	TOTAL DELIVERED PRICE $	2480	→	2150.		
DRIVER PRICE	DRIVER PRICE FROM C.E. BOOK $	4220		2110		
	EXTRA COST FOR DESCR.					
	EXTRA COST FOR $					
	COST INDEX RATIO	283/223	→	→	1	1
	CURRENT PRICE OF DRIVER $	5350		2680		
	FREIGHT $					
	TOTAL DELIVERED PRICE $	5350	→	2680		
TOTAL COST PUMP & DRIVER $		8830	8830	4830		

4 3 2 1 REVISIONS

APPROVED

DATE ____ DR. ____ CH. ____ ENGR. ____ ENG. DEPT. ____ OPR'G. DEPT. ____

NOTES: 1. REFER TO COST ESTIMATING BOOK, SECTION G FOR INSTRUCTIONS ON ESTIMATING PUMPS AND DRIVERS.

2. FOR MATERIAL CLASS OF CENT. PUMPS SEE COST ESTIMATING BOOK ITEM G-120-1.

SUBTOTAL THIS PAGE	$ 22,490
FIELD EXTRAS ____ %	$
TOTAL THIS PAGE	$

COST ESTIMATE SHEET FOR PUMPS AND DRIVERS

PLANT:

PROJECT:

EF-246 (200-CD-2-64)
PRINTED IN U.S.A.

Chevron BB
014703

PUMP & DRIVER COST ESTIMATING WORK SHEET - EF-512

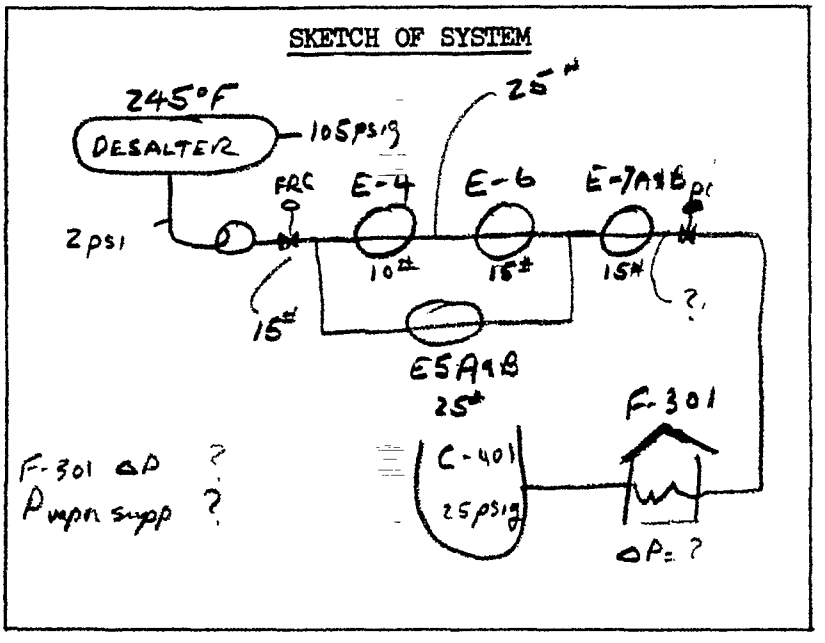
ALT #1 Out

Date 10/22/69
By JHC

To be used in conjunction with EF-246

ITEM P-2 & A

SKETCH OF SYSTEM



SUCTION
Initial 118 psia
① FRICT 2
②
③
④ 116 psia
At Pump

DISCHARGE
Terminal
Ⓐ E-4 & E6, E5A&B 25
Ⓑ E7A&B 15
Ⓒ FRC 15
Ⓓ FRICT 25
CONT 10
At Pump

Design Flow 1270 GPM Specified 1400 GPM
Proceed with selection via EF-246

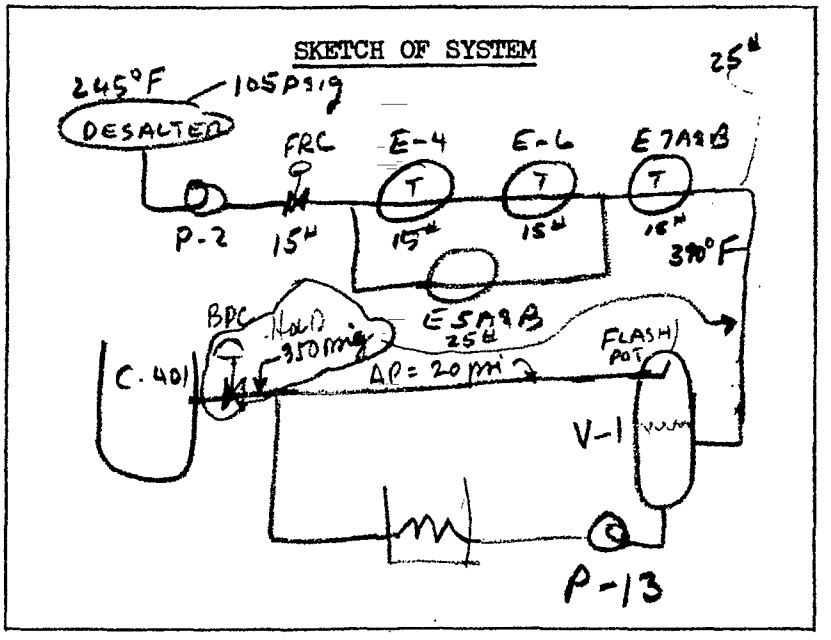
ΔP = Psi

ALT 2

USE FOR PST 1

ITEM P-2 & A

SKETCH OF SYSTEM



SUCTION
Initial 118 psi
① FRICT - 2
②
③
④ 116 psi
At Pump

DISCHARGE
Terminal (BPC) 365
Ⓐ E-4, E-6, E-5A&B 30
Ⓑ E7A&B 15
Ⓒ FRC 15
FRICT 25+20
Ⓓ CONT. 25
At Pump 495
ΔP = 379 Psi

Design Flow Specified
Proceed with selection via EF-246

PRINTED IN USA

EF-512 (150-CD-3-60)

Chevron BB

		ALT #1		ALT #2		
GENERAL	ITEM NUMBER	P2	P2A SPARE	P2	P2A SPARE	
	SERVICE	FRACT. FEED		FEED TO FLASH POT		
	FLUID PUMPED	CRUDE	41.5° API	→	→	
FLOW CONDITIONS	OPERATING TEMP. °F	245°F	→	→	→	
	SPECIFIC GRAVITY	0.744				
	VISCOSITY SSU OR CS					
	VAPOR PRESSURE PSIA					
	GPM AT OPER. TEMP.	1400	—		→	
	SUCTION PRESSURE PSIA			116		
	DISCHARGE PRESSURE PSIA			495		
	ΔP PSI			379		
	DIFFERENTIAL HEAD FT			1175		
PUMP SELECTION	TYPE OF PUMP (CENT.-STEAM-POWER-ROTARY)	C	C	C	C	
	COST EST. BOOK ITEM NO.	(TWO STAGE, DOUBLE OUTBOARD BEARINGS)		G-120-1	→	
	MARK NO. OR SIZE			E-3	→	
	SPEED RPM			3550	→	
	OPERATING BHP			530	→	
MATERIAL	MATERIAL CLASS NO. (SEE NOTE 2)	B-1	→	B1	→	
	CASE OR CYLINDER MATERIAL	C.S.		CS	→	
	TRIM MATERIAL	C.I.		CI	→	
DRIVER SELECTION	TYPE OF DRIVER (MOTOR-TURBINE-ENGINE)	M	T	M	M	
	DRIVER HP			600	600	
	MOTOR ENCL./TURBINE SIZE	TEFC		TEFC	TEFC	
	STEAM CONSUMPTION LB/HR.					
	STEAM INLET PRESS. PSIG		385			
	STEAM EXHAUST PRESS. PSIG		110			
	STEAM TEMP. °F		800°F S.H			
PUMP PRICE	PUMP PRICE FROM C.E. BOOK $			4575	→	4575
	EXTRA COST FOR DESCR. $	MECH SEAL	→	230	→	
	EXTRA COST FOR DESCR. $					
	COST INDEX RATIO	1	1	283/219	→	1
	CURRENT PRICE OF PUMP $			5700	→	
	FREIGHT $					
	TOTAL DELIVERED PRICE $			5700	→	
DRIVER PRICE	DRIVER PRICE FROM C.E. BOOK $			$14,580	→	
	EXTRA COST FOR DESCR. $					
	COST INDEX RATIO	1	1	283/223	→	1
	CURRENT PRICE OF DRIVER $					
	FREIGHT $					
	TOTAL DELIVERED PRICE $			18,500	→	
TOTAL COST PUMP & DRIVER $				24,200	24,200	

4 3 2 1 REVISIONS

DATE ____ DR. ____ ENG. DEPT. ____ OPR'G. DEPT. ____

APPROVED ____ ENGR. ____ CH. ____

NOTES: 1. REFER TO COST ESTIMATING BOOK, SECTION G FOR INSTRUCTIONS ON ESTIMATING PUMPS AND DRIVERS.

2. FOR MATERIAL CLASS OF CENT. PUMPS SEE COST ESTIMATING BOOK ITEM G-120-1.

SUBTOTAL THIS PAGE	$ 48,400
FIELD EXTRAS ____ %	$
TOTAL THIS PAGE	$

COST ESTIMATE SHEET FOR PUMPS AND DRIVERS

PLANT:

PROJECT:

EF-246 (200-CD-2-64)
PRINTED IN U.S.A.

Chevron BB
014705

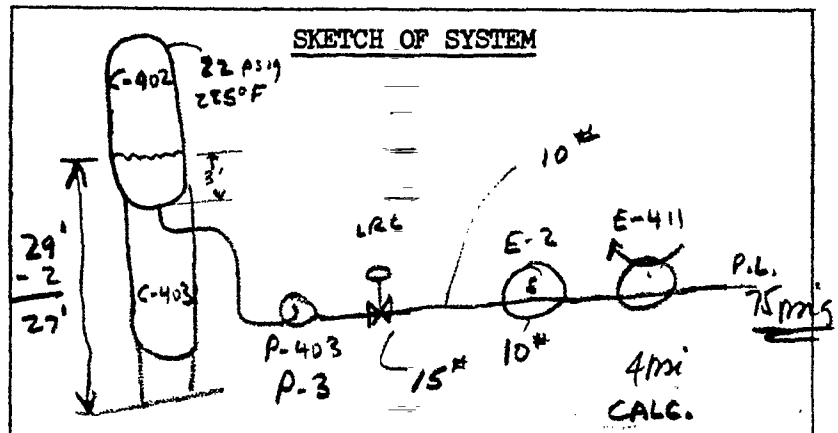
PUMP & DRIVER COST ESTIMATING WORK SHEET - EF-512

Date 10/22/69
By JHC

To be used in conjunction with EF-246

ITEM P-3 & A (G-403) HSR - 50°API

SKETCH OF SYSTEM



G-404

Look at EXISTING ~~G-403~~ TO SEE IF OK

BUY NEW SPARE AS ~~G-403A~~ GONE
G-404A

SUCTION
Initial 35 psia

① ELEV + 7.8
② FRICT - 1.
③
④ 41.8 psia
At Pump

DISCHARGE
Terminal 90 psia

Ⓐ	LRC	15
	FRICT	10
Ⓑ	E-2	10
Ⓒ	E-411	4
	CONT.	15
Ⓓ		

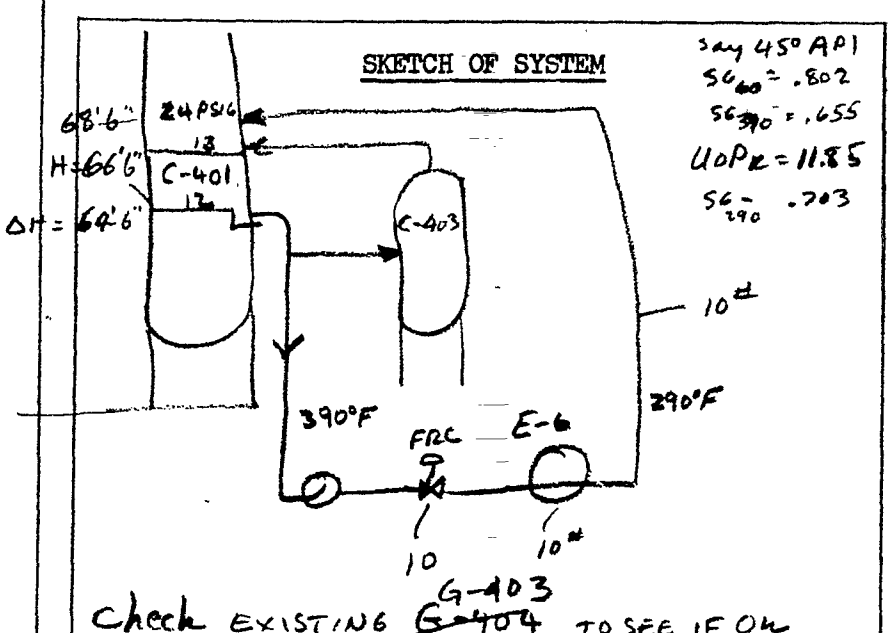
At Pump 146

ΔP = 102 Psi

Design Flow 180 GPM Specified 200 GPM
Proceed with selection via EF-246

ITEM P-4 (G-404) C-401 INTER. REFLUX

SKETCH OF SYSTEM



G-403

Check EXISTING ~~G-404~~ TO SEE IF OK

~~G-403A~~ ~~G-404A~~ IS GONE

SUCTION
Initial 37 psia

① ELEV. 18.4
② - FRICT - 2
③
④ 53.4 psia
At Pump

DISCHARGE
Terminal 37 psia

Ⓐ	E-6	10
Ⓑ	FRC	10
Ⓒ	ELEV	20.3
	FRICT	10
Ⓓ	CONT.	10
		97.3

At Pump

ΔP = 44 Psi

Design Flow 730 Specified 800
Proceed with selection via EF-246

Chevron BB

check existing G-404 | check existing G-403

GENERAL	ITEM NUMBER	P3	P3A	P4	P4A
	SERVICE	C-402 BTMS		C-401 INTER. REFLUX	
	FLUID PUMPED	HSR		K/N	
FLOW CONDITIONS	OPERATING TEMP. °F	285		390	
	SPECIFIC GRAVITY	0.67		.655	
	VISCOSITY SSU OR CS				
	VAPOR PRESSURE PSIA	35		37	
	GPM AT OPER. TEMP.	200		800	
	SUCTION PRESSURE PSIA	41.8		53.4	
	DISCHARGE PRESSURE PSIA	144		97.4	
	ΔP PSI	102		44	
	DIFFERENTIAL HEAD FT	352		155	
PUMP SELECTION	TYPE OF PUMP (CENT.-STEAM-POWER-ROTARY)	C	C	C	C
	COST EST. BOOK ITEM NO.		G-120-3		G-120-1
	MARK NO. OR SIZE		H1		M1
	SPEED RPM		3550		3550
	OPERATING BHP		31		38
MATERIAL	MATERIAL CLASS NO. (SEE NOTE 2)	B-1	→	B-2	→
	CASE OR CYLINDER MATERIAL	CS	→	CS	→
	TRIM MATERIAL	CI	→	CI	→
DRIVER SELECTION	TYPE OF DRIVER (MOTOR-TURBINE-ENGINE)	M	M		M
	DRIVER HP	~~30~~ 40	~~30~~ 40		~~30~~ 40
	MOTOR ENCL./TURBINE SIZE	TEFC	TEFC		TEFC
	STEAM CONSUMPTION LB/HR.				
	STEAM INLET PRESS. PSIG				
	STEAM EXHAUST PRESS. PSIG				
	STEAM TEMP. °F				
PUMP PRICE	PUMP PRICE FROM C.E. BOOK $	rework old pump	1365	rework old pump	1740
	EXTRA COST FOR DESCR. $		MECH. SEAL INCL. ABOVE		MECH SEAL 25.
	EXTRA COST FOR DESCR. $				
	COST INDEX RATIO	1/1	283/219	/	283/219 1
	CURRENT PRICE OF PUMP $				
	FREIGHT $				
	TOTAL DELIVERED PRICE $		1760.		2240
DRIVER PRICE	DRIVER PRICE FROM C.E. BOOK $	580	580		580
	EXTRA COST FOR DESCR. $				
	COST INDEX RATIO	283/223	283/223	1	283/223 1
	CURRENT PRICE OF DRIVER $				
	FREIGHT $				
	TOTAL DELIVERED PRICE $	735	735		735
TOTAL COST PUMP & DRIVER $		735.	2495.		2975.

REVISIONS

4 3 2 1

APPROVED

DATE ____ DR. ____ ENG. DEPT. ____ OPR'G. DEPT. ____ CH. ____ ENGR. ____

NOTES: 1. REFER TO COST ESTIMATING BOOK, SECTION G FOR INSTRUCTIONS ON ESTIMATING PUMPS AND DRIVERS.

2. FOR MATERIAL CLASS OF CENT. PUMPS SEE COST ESTIMATING BOOK ITEM G-120-1.

SUBTOTAL THIS PAGE	$ 6,205
FIELD EXTRAS ____ %	$
TOTAL THIS PAGE	$

COST ESTIMATE SHEET FOR PUMPS AND DRIVERS

PLANT:

PROJECT:

ok for P-3

DATA AND OPERATING LIMITS - PUMPS

gone

[redacted] DATA

SERVICE Circ. Reflux [redacted] SERVICE Spar[redacted] Sam[redacted] (1) [redacted]

PUMP		PUMP	
MFR.	Byron Jackson	MFR.	
TYPE	Centrifugal MODEL 4X6X8HH	TYPE	MODEL
MFR. SER. NO.	260135 EQUIP. NO. G-404	MFR. SER. NO.	260136 EQUIP. NO. G-404 A
ORDER NO.	1404-2 DATA SHEET NO. GD-6590	ORDER NO.	DATA SHEET NO. GD-6591
DRAWINGS	2B-7133 1F-2138	DRAWINGS	2B-7136
PRES: SUCTION	28 psia DISCH. 74 psia	PRES: SUCTION	psia DISCH. psi
MFR. MAX. PRES. RATING	500 psi G	MFR. MAX. PRES. RATING	psi
GPM	1110 @ 530 F SPEED 3550 RPM	GPM	@ F SPEED RPM
IMP. DIA: INST.	7 MAX. 8	IMP. DIA: INST.	MAX.
INLET: SIZE	6 " RATING 150 psi FACING S.G.	INLET: SIZE	" RATING psi FACING
OUTLET: SIZE	4 " RATING 150 psi FACING S.G.	OUTLET: SIZE	" RATING psi FACING
MAT'L: CASE	C.S. IMP. 11-13 Cr.	MAT'L: CASE	IMP.
: CYL.	PISTON	: CYL.	PISTON
LINING		LINING	
TEST NEW	psi SHUT OFF HEAD FT.	TEST NEW	psi SHUT OFF HEAD FT

DRIVER		DRIVER	
MFR.	Elliott	MFR.	Continental Elec. NOW ON G-1902 2-15-68
TYPE	2AYR	TYPE	NF-444S
MFR. SER. NO.	15943 EQUIP. NO. TG-404	MFR. SER. NO.	693295 EQUIP. NO. MS-404A
ORDER NO.	1404-1 DATA SHEET NO. GD 6609	ORDER NO.	1404-6 DATA SHEET NO. GE-6508
DRAWINGS	612911, 100B	DRAWINGS	C-40500-B

MOTOR	TURBINE	MOTOR	TURBINE
H.P.	H.P. 42	H.P. 50	H.P.
SPEED RPM	OVERSPEED SET. 3900 RPM	SPEED 3600 RPM	OVERSPEED SET. RPM
VOLTS	PRES. INLET 110 psi G	VOLTS 440	PRES. INLET psi
CYCLE	PRES. OUTLET 15 psi G	CYCLES 60	PRES. OUTLET psi
PHASE	MAT'L. CASE	PHASE 3	MAT'L. CASE
	MAT'L. ROTOR		MAT'L. ROTOR

REVISIONS

APPROVALS

5/29 WCH

ENG. DEPT.

5/29 OFT

OPRG. DEPT.

DATE

DR.

CH.

ENGR.

OPERATING LIMITS

(CONSULT DESIGNS ENGINEER BEFORE EXCEEDING THESE LIMITS)

DESIGN PRES. 103 psi A @ 530 F	DESIGN PRES. 103 psi A @ 530
BASED ON Mfr Data	BASED ON Mfr Data
PROTECTED BY SAFETY VALVE ON None	PROTECTED BY SAFETY VALVE ON None
S.V. SET AT psi	S.V. SET AT psi
MAX. SAFE SPEED FOR UNIT 4090 *	MAX. SAFE SPEED FOR UNIT
TEST PRESSURE 750 psi G	TEST PRESSURE 750 psi G

* Turbine Manuf. Rec. Maximum

SAFETY PRECAUTIONS

REFER TO GENERAL SAFETY INSTRUCTION SHEETS ME-5102 Sheets 1 to 3 and 13 to 15, FOR NOTES ON HAZARDS OF EQUIPMENT FAILURE, WITH RECOMMENDATIONS FOR THEIR AVOIDANCE, AND FOR INSPECTIONS AND TESTS.

NOTE BELOW ANY SPECIAL HAZARDS, RECOMMENDATIONS, INSPECTIONS, OR TESTS THAT ARE IMPORTANT FOR THE ABOVE EQUIPMENT.

(1) TRANSFERRED TO PLT 13

5-67

SAFETY INSTRUCTION SHEET

PUMPS AND DRIVERS

El Paso (Refinery) Synthetic Crude (Plant) PLT 04

DWG. NO. GE-6600

Sheet 30 of 42

MFG.-600-6 (5C-CD-4-4

Chevron BB 014708

Ok for P-4

DATA AND OPERATING LIMITS - PUMPS

EQUIPMENT DATA

SERVICE	Upper Reflux	Spare for G-403 SAME AS G-403 EXCEPT AS NOTED
NO.	G-403	G-403
PUMP		
MFR.	Pacific Pumps Inc.	
TYPE	Centrifugal	
MODEL	2"x SVA	
MFR. SER. NO.	23247	23246
EQUIP. NO.	G-403	G-403A
ORDER NO.	STR-104-6-2	
DATA SHEET NO.	PD-12137	
DRAWINGS	ESTR-104-G-2-1 thru 5	
PRES: SUCTION psia	40.7	
DISCH. psia	110.7	
MFR. MAX. PRES. RATING psig	400	
GPM @ F	230 @ 330	
SPEED RPM	3530	
IMP. DIA: INST.	7 7/8	
MAX.	8 1/2	
INLET: SIZE "	4	
RATING psi	300	
FACING	RF	
OUTLET: SIZE "	2	
RATING psi	300	
FACING	RF	
MAT'L: CASE	Steel	
IMP.	C.I.	
CYL.		
PISTON		
LINING		
TEST NEW psig	600	
SHUT OFF HEAD FT.	245	
DRIVER		
MFR.	Elliott	GE
TYPE	JR	TEFC Type K
MFR. SER. NO.	R2713	2M464439
EQUIP. NO.	TG-403	MG-403A
ORDER NO.	STR-104-6-2	STR-104-6-2
DATA SHEET NO.	PD-12124	PD-12138
DRAWINGS	FSTR-104-6-2-2	FSTR-104-6-2-4
MOTOR		
H.P.		20
SPEED RPM		3600
VOLTS		440
CYCLE		60
PHASE		3
N.F.		2864
TURBINE		
H.P.	19	
OVERSPEED SET. RPM	4000	
PRES. INLET psig	105	
PRES. OUTLET psig	20	
MAT'L. CASE	C.I.	
MAT'L. ROTOR		

REVISIONS

APPROVALS

4/24/56
ENG. DEPT.

OPRG. DEPT.

DATE 4-13-56

DR.

CH.

ENGR.

OPERATING LIMITS

(CONSULT DESIGNS ENGINEER BEFORE EXCEEDING THESE LIMITS)

DESIGN PRES. psig @ F	400 @ 330	400 @ 330
BASED ON	Mfr's Rating	Mfr's Rating
PROTECTED BY SAFETY VALVE ON		
S.V. SET AT psi		
MAX. SAFE SPEED FOR UNIT	4090*	
TEST PRESSURE psi		

*Turbine Mfr's Rec. Maximun

SAFETY PRECAUTIONS

REFER TO GENERAL SAFETY INSTRUCTION SHEETS ME-5102 Sheets 1 to 3 and 13 to 15, FOR NOTES ON HAZARDS OF EQUIPMENT FAILURE, WITH RECOMMENDATIONS FOR THEIR AVOIDANCE, AND FOR INSPECTIONS AND TESTS.

NOTE BELOW ANY SPECIAL HAZARDS, RECOMMENDATIONS, INSPECTIONS, OR TESTS THAT ARE IMPORTANT FOR THE ABOVE EQUIPMENT.

SAFETY INSTRUCTION SHEET
PUMPS AND DRIVERS

EL PASO (Refinery) SYNTHETIC CRUDE (Plant)

DWG. NO. GE-660

Sheet 29 of 4

MFG. 800-6 15C-CD-

Chevron BB
014709

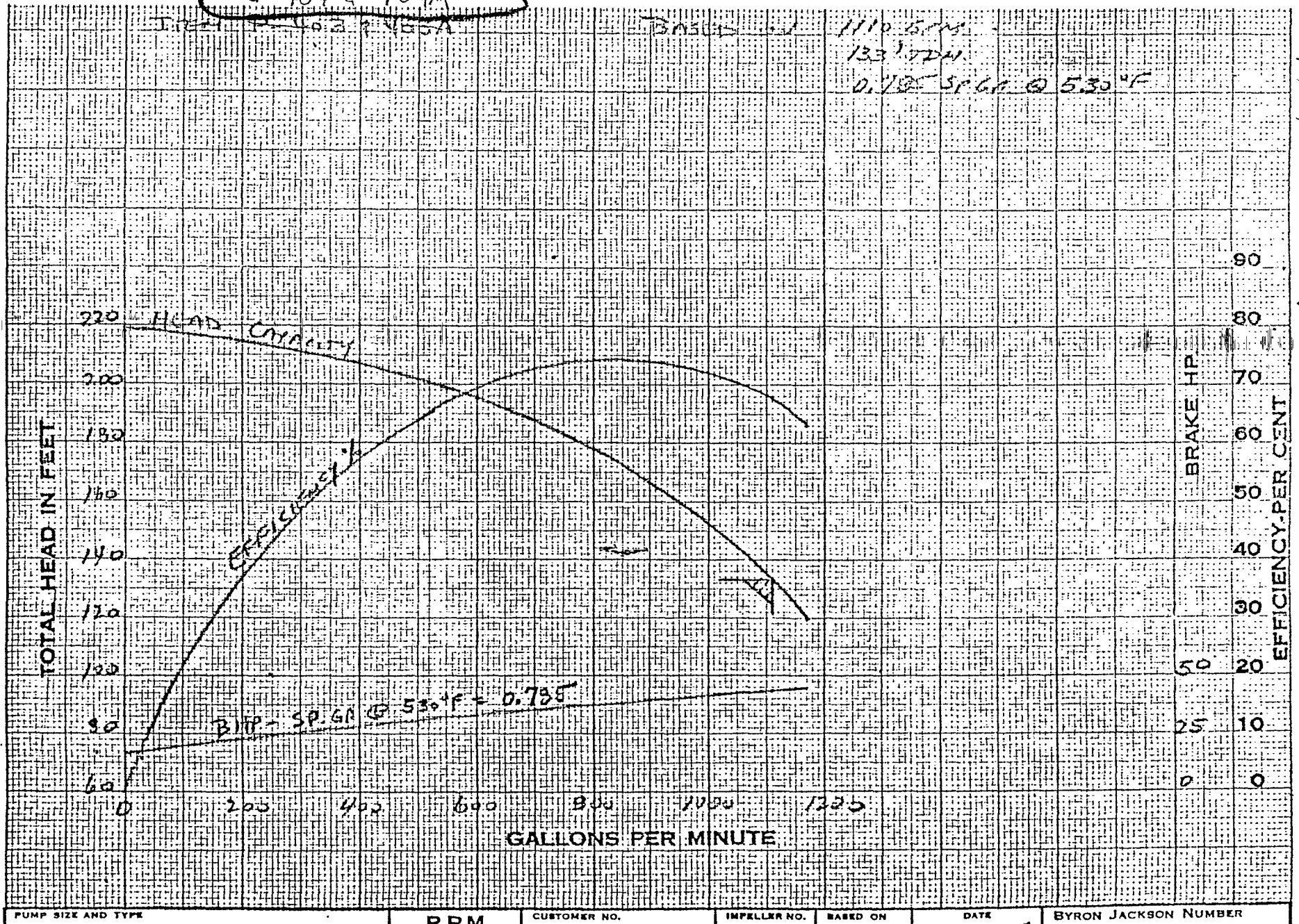
Chevron BB
014710

Chevron BB
n14711

P-200RPC 20M 10-50

BYRON JACKSON CO.

G-404 & 404A



PUMP SIZE AND TYPE	RPM	CUSTOMER NO.	IMPELLER NO.	BASED ON	DATE	BYRON JACKSON NUMBER
4×6×8 HH-SM	3550	G. S.	BRANCH NO.	DATA BY	DRAWN BY GS	PC 260135
				SH-1593	12-18-57	

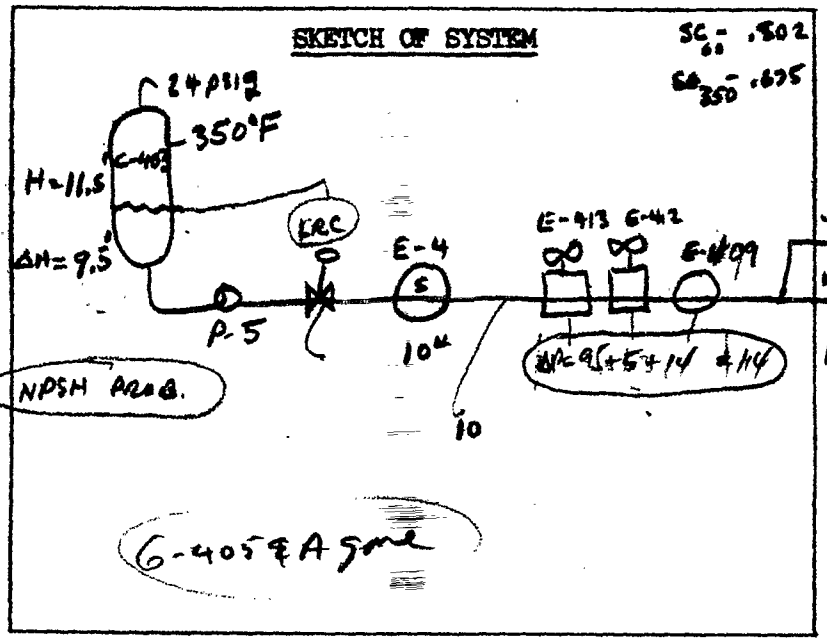
PUMP & DRIVER COST ESTIMATING WORK SHEET - EF-512

Date 10/22/69
By JHL

To be used in conjunction with EF-246

ITEM P-5 C-403 BTMS

SKETCH OF SYSTEM



SG_{60} = .802
SG_{350} = .675

SUCTION
Initial 37 psia

①	ELEV.	2.8
②	-FRICT	.3
③		
④		39.5 psia

At Pump

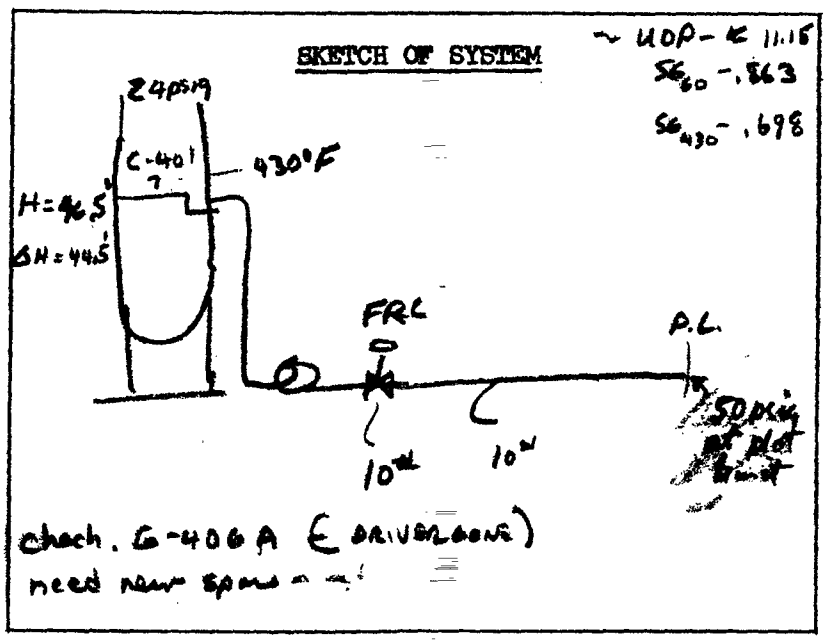
DISCHARGE Terminal	JP-4	K/J
	65	65 psia
Ⓐ E-4	10	10
Ⓑ LRC	15	15
E-413, 412 409	114	114
Ⓒ	—	—
Ⓔ FRICT	10	10
CONT	15	15

At Pump 229 psia

ΔP = 190. Psi

ITEM P-6 DIESEL S/C

SKETCH OF SYSTEM



SG_{60} = .863
SG_{430} = .698

SUCTION
Initial 37 psia

①	ELEV.	13.5
②	-FRICT	1
③		
④		49.5 psia

At Pump

DISCHARGE Terminal	
	85#
Ⓐ FRICT	10
Ⓑ FRC	10
Ⓒ CONT	10
Ⓓ	

Design Flow 150 GPM Specified 165 GPM
Proceed with selection via EF-246

Design Flow 60 Specified 70
Proceed with selection via EF-246

At Pump
ΔP = 85 Psi

PRINTED IN USA

EF-512 (150-CD-3-60)

Chevron BB
014712

check existing G-406 A

GENERAL	ITEM NUMBER	P-5	P-5A	P-6	P-6A	
	SERVICE	C-403	BTMS	DIESEL	S/C	
	FLUID PUMPED	K/J		DIESEL		
FLOW CONDITIONS	OPERATING TEMP. °F	350		430		
	SPECIFIC GRAVITY	.675		.698		
	VISCOSITY SSU OR CS					
	VAPOR PRESSURE PSIA	37		37		
	GPM AT OPER. TEMP.	165		70		
	SUCTION PRESSURE PSIA	39.5		49.5		
	DISCHARGE PRESSURE PSIA	229		95		
	ΔP PSI	190		45		
	DIFFERENTIAL HEAD FT	650		149		
PUMP SELECTION	TYPE OF PUMP (CENT.-STEAM-POWER-ROTARY)	C	C	C	C	
	COST EST. BOOK ITEM NO.	G-140-3	→	G-120-3		
	MARK NO. OR SIZE	D-1	→	A-1		
	SPEED RPM	3550	→	3550		
	OPERATING BHP	~~42.5~~ 61	61	5.1	→	
MATERIAL	MATERIAL CLASS NO. (SEE NOTE 2)	B-2	→	B-2	→	
	CASE OR CYLINDER MATERIAL	CS	→	CS		
	TRIM MATERIAL	CI	→	CS		
DRIVER SELECTION	TYPE OF DRIVER (MOTOR-TURBINE-ENGINE)	M	M	M		
	DRIVER HP	~~50~~ 75	~~50~~ 75	~~7.5~~ 5		
	MOTOR ENCL./TURBINE SIZE	TEFC	TEFC	TEFC		
	STEAM CONSUMPTION LB/HR.					
	STEAM INLET PRESS. PSIG					
	STEAM EXHAUST PRESS. PSIG					
	STEAM TEMP. °F					
PUMP PRICE	PUMP PRICE FROM C.E. BOOK $	1215	1215			
	EXTRA COST FOR DESCR. $	MECH SEAL 25	SEAL 25	new pump	new pump	
	EXTRA COST FOR DESCR. $					
	COST INDEX RATIO	283/219	283/219	/	/	/
	CURRENT PRICE OF PUMP $					
	FREIGHT $					
	TOTAL DELIVERED PRICE $	1600	1600			
DRIVER PRICE	DRIVER PRICE FROM C.E. BOOK $	1160	1160	130	130	
	EXTRA COST FOR DESCR. $					
	COST INDEX RATIO	283/223	→	283/223	→	/
	CURRENT PRICE OF DRIVER $					
	FREIGHT $					
	TOTAL DELIVERED PRICE $	1470	1470	165	165	
TOTAL COST PUMP & DRIVER $		3070	3070	165	165	

REVISIONS 4 3 2 1

APPROVED

DATE ____ DR. ____ CH. ____ ENGR. ____ ENG. DEPT. ____ OPR'G. DEPT. ____

NOTES: 1. REFER TO COST ESTIMATING BOOK, SECTION G FOR INSTRUCTIONS ON ESTIMATING PUMPS AND DRIVERS.

2. FOR MATERIAL CLASS OF CENT. PUMPS SEE COST ESTIMATING BOOK ITEM G-120-1.

SUBTOTAL THIS PAGE	$ 6470
FIELD EXTRAS ____ %	$
TOTAL THIS PAGE	$

COST ESTIMATE SHEET FOR PUMPS AND DRIVERS

PLANT:

PROJECT:

EF-246 (200-CD-2-64)
PRINTED IN U.S.A.

Chevron BB
014713

Sh for P-6

DATA AND OPERATING LIMITS - PUMPS

EQUIPMENT DATA

SERVICE: LIGHT GAS OIL PUMP - SPARE	NO. G-406A
SERVICE: C-401 Btms.	NO. G-408

PUMP

MFR.	PACIFIC	MFR.	UNION
TYPE	SVCMB	MODEL	5X3½X12
MFR. SER. NO.	21785	EQUIP. NO.	G-406A
ORDER NO.		DATA SHEET NO.	PD-10435
DRAWINGS			
PRES: SUCTION	24 psia	DISCH.	134 psia
MFR. MAX. PRES. RATING	CASE 600 psig		
GPM	81 @ 400° F	SPEED	3510 RPM
IMP. DIA: INST.	9¼"	MAX.	10⅛"
INLET: SIZE	2" RATING 300 psig FACING R.F.		
OUTLET: SIZE	1½" RATING 300 psig FACING R.F.		
MAT'L: CASE	STEEL	IMP.	C.N. C.I.
CYL.		PISTON	
LINING	NONE		
TEST NEW	900 psig	SHUT OFF HEAD	317 FT.

MFR.	UNION
TYPE	MODEL 5X3½X12
MFR. SER. NO.	247300 EQUIP. NO. G-408
ORDER NO.	DATA SHEET NO.
DRAWINGS	45464-35-22
PRES: SUCTION	psia DISCH. psia
MFR. MAX. PRES. RATING	450 psi
GPM	@ F SPEED RPM
IMP. DIA: INST.	MAX.
INLET: SIZE	2½" RATING 150 psi FACING ST&G
OUTLET: SIZE	2" RATING 150 psi FACING ST&G
MAT'L: CASE	IMP.
CYL.	PISTON
LINING	
TEST NEW	psi SHUT OFF HEAD FT

DRIVER

MFR.	GENERAL ELECTRIC
TYPE	K MODEL 5K4256B1
MFR. SER. NO.	UL281289 EQUIP. NO. MG-406A
ORDER NO.	DATA SHEET NO. GE-6527
DRAWINGS	

MOTOR		TURBINE	
H.P.	15	H.P.	
SPEED	3530 RPM	OVERSPEED SET.	RPM
VOLTS	440	PRES. INLET	psi
CYCLE	60	PRES. OUTLET	psi
PHASE	3	MAT'L CASE	
		MAT'L ROTOR	

DRIVER

MFR.	
TYPE	
MFR. SER. NO.	EQUIP. NO.
ORDER NO.	DATA SHEET NO.
DRAWINGS	

MOTOR		TURBINE	
H.P.		H.P.	
SPEED	RPM	OVERSPEED SET.	RP
VOLTS		PRES. INLET	psi
CYCLES		PRES. OUTLET	psi
PHASE		MAT'L CASE	
		MAT'L ROTOR	

OPERATING LIMITS

(CONSULT DESIGNS ENGINEER BEFORE EXCEEDING THESE LIMITS)

DESIGN PRES.	420 psig @ 450° F
BASED ON	80% OF FLANGE RATING (1)
PROTECTED BY SAFETY VALVE ON	NONE
S.V. SET AT	— psi
MAX. SAFE SPEED FOR UNIT	
TEST PRESSURE	630 psig

DESIGN PRES.	psi @
BASED ON	
PROTECTED BY SAFETY VALVE ON	
S.V. SET AT	psi
MAX. SAFE SPEED FOR UNIT	
TEST PRESSURE	psi

SAFETY PRECAUTIONS

REFER TO GENERAL SAFETY INSTRUCTION SHEETS ME-5102 Sheets 1 to 3 and 13 to 15, FOR NOTES ON HAZARDS OF EQUIPMENT FAILURE, WITH RECOMMENDATIONS FOR THEIR AVOIDANCE, AND FOR INSPECTIONS AND TESTS.

NOTE BELOW ANY SPECIAL HAZARDS, RECOMMENDATIONS, INSPECTIONS, OR TESTS THAT ARE IMPORTANT FOR THE ABOVE EQUIPMENT.

(1) ALLOWS FOR SOME CORROSION.

REVISIONS

APPROVALS

RCR 3-12

ENG. DEPT.

WWL 3/16

OPRG. DEPT.

E.W.D.

DATE 12/29/58

DR.

CH.

ENGR. JLS

SAFETY INSTRUCTION SHEET
PUMPS AND DRIVERS

EL PASO (Refinery) SYN. CRUDE DISTILLATION (Plant) PLT 94

DWG. NO. GE-6600

Sheet 32 of 42

MFG. 800-6 (SC-CD-4..

Chevron BB

Chevron BB
014715

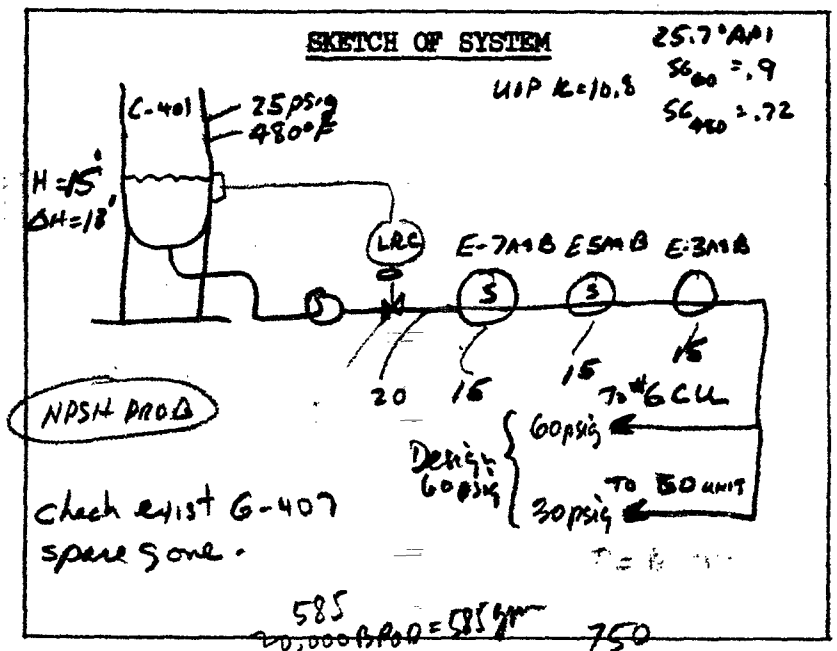
PUMP & DRIVER COST ESTIMATING WORK SHEET - EF-512

Date 10/22/69
By JHG

To be used in conjunction with EF-246

ITEM P-7 C-401 BTMS

SKETCH OF SYSTEM



Design Flow 750 GPM Specified 825 GPM
Proceed with selection via EF-246

SUCTION
Initial 38 psig
ELEV. 4
① FRICT − .6
②
③
④ 41.5 psig
At Pump

DISCHARGE Terminal		#6 CU	GO
		15	45 psig
① E-7A&B, ② E-5A&B, ③ E-3A&B		45	45
ⓒ	FRICT	20	20
	LRC	15	15
Ⓔ	CONT.	15	15

At Pump 140 140 psig

ΔP = 129 Psi

ITEM _____

SKETCH OF SYSTEM

SUCTION
Initial
①
②
③
④
At Pump

DISCHARGE
Terminal
Ⓐ
Ⓑ
Ⓒ
Ⓓ
At Pump

Design Flow _____ Specified _____
Proceed with selection via EF-246

ΔP = _____ Psi

PRINTED IN USA EF-512 (150-CD-3-60)

Chevron BB
014716

Case I To #6 C.U. check list 6-407

Case II to G.O. Unit

GENERAL	ITEM NUMBER	P7	P7A		P-7 & 7A	
	SERVICE	C-401 BTMS				
	FLUID PUMPED	GAS OIL				
FLOW CONDITIONS	OPERATING TEMP. °F	460				
	SPECIFIC GRAVITY	.72				
	VISCOSITY SSU OR CS					
	VAPOR PRESSURE PSIA	38				
	GPM AT OPER. TEMP.	350			39	
	SUCTION PRESSURE PSIA	41.5			41.5	
	DISCHARGE PRESSURE PSIA	170			140	
	ΔP PSI	129			99	
	DIFFERENTIAL HEAD FT	414			318	
PUMP SELECTION	TYPE OF PUMP (CENT.-STEAM-POWER-ROTARY)	C	C			
	COST EST. BOOK ITEM NO.	C-120-3	→		C-120-3	
	MARK NO. OR SIZE	P-1	→			
	SPEED RPM	3550	→		3550	
	OPERATING BHP	110 ~~80~~	→			
MATERIAL	MATERIAL CLASS NO. (SEE NOTE 2)	B-3	→		Select Pump for Case I	
	CASE OR CYLINDER MATERIAL	CS	→			
	TRIM MATERIAL	12 Cr.	→			
DRIVER SELECTION	TYPE OF DRIVER (MOTOR-TURBINE-ENGINE)	M	M			
	DRIVER HP	125 ~~100~~	~~125~~			
	MOTOR ENCL./TURBINE SIZE	TEFC	~~TEFC~~			
	STEAM CONSUMPTION LB/HR.					
	STEAM INLET PRESS. PSIG					
	STEAM EXHAUST PRESS. PSIG					
	STEAM TEMP. °F					
PUMP PRICE	PUMP PRICE FROM C.E. BOOK $	2090	2090			
	EXTRA COST FOR DESCR.	MECH SEAL	→			
	EXTRA COST FOR $	115	115			
	EXTRA COST FOR DESCR. $					
	COST INDEX RATIO	283/219	→	/	/	/
	CURRENT PRICE OF PUMP $					
	FREIGHT $					
	TOTAL DELIVERED PRICE $	2840	2840			
DRIVER PRICE	DRIVER PRICE FROM C.E. BOOK $	2110	2110			
	EXTRA COST FOR DESCR. $					
	COST INDEX RATIO	283/223	283/223	/	/	/
	CURRENT PRICE OF DRIVER $					
	FREIGHT $					
	TOTAL DELIVERED PRICE $	2680	2680			
TOTAL COST PUMP & DRIVER $		5520	5520			

NOTES: 1. REFER TO COST ESTIMATING BOOK, SECTION G FOR INSTRUCTIONS ON ESTIMATING PUMPS AND DRIVERS.

2. FOR MATERIAL CLASS OF CENT. PUMPS SEE COST ESTIMATING BOOK ITEM G-120-1.

SUBTOTAL THIS PAGE	$ 11040
FIELD EXTRAS ____ %	$
TOTAL THIS PAGE	$

REVISIONS

4 3 2 1

APPROVED

DATE ____ DR. ____ CH. ____ ENGR. ____ ENG. DEPT. ____ OPR'G. DEPT. ____

COST ESTIMATE SHEET FOR PUMPS AND DRIVERS

PLANT:

PROJECT:

EF-246 (200-CD-2-64)
PRINTED IN U.S.A.

Chevron BB
014717

Consider for P-7 — No Good

DATA AND OPERATING LIMITS - PUMPS

Gone

EQUIPMENT DATA

SERVICE Quench [redacted] SERVICE [redacted] Sam [redacted] 407A

PUMP		PUMP	
MFR.	Byron Jackson	MFR.	
TYPE	Centrifugal MODEL 4x6x8H	TYPE	MODEL
MFR. SER. NO.	260137 EQUIP. NO. G-407	MFR. SER. NO.	260138 EQUIP. NO. G-407A
ORDER NO.	1404-2 DATA SHEET NO. GD-6591	ORDER NO.	DATA SHEET NO.
DRAWINGS	2B-7138 1F-2138	DRAWINGS	2B-7136
PRES: SUCTION	16 psia DISCH. 53 psia	PRES: SUCTION	psia DISCH. psia
MFR. MAX. PRES. RATING	500 psi G	MFR. MAX. PRES. RATING	psi
GPM	685 @ 525 F SPEED 3550 RPM	GPM	@ F SPEED RPM
IMP. DIA: INST.	6 3/8 MAX. 8	IMP. DIA: INST.	MAX.
INLET: SIZE	6 " RATING 350 psi FACING S.G.	INLET: SIZE	" RATING psi FACING
OUTLET: SIZE	4 " RATING 150 psi FACING S.G.	OUTLET: SIZE	" RATING psi FACING
MAT'L: CASE	C.S. IMP. 11-13 Cr.	MAT'L: CASE	IMP.
: CYL.	PISTON	: CYL.	PISTON
LINING		LINING	
TEST NEW	psi SHUT OFF HEAD FT.	TEST NEW	psi SHUT OFF HEAD FT.

DRIVER		DRIVER	
MFR.	Elliott NOW AT PLT 14 TG-1940-A 2-14-68	MFR.	Continental Elec
TYPE	2AYR	TYPE	NF 405S
MFR. SER. NO.	15944 EQUIP. NO. TG-407	MFR. SER. NO.	693294 EQUIP. NO. MG-407A
ORDER NO.	1404-1 DATA SHEET NO. GD 6609	ORDER NO.	1404-6 DATA SHEET NO. GE-6508
DRAWINGS	612911, 100B	DRAWINGS	C-40500-B

MOTOR	TURBINE	MOTOR	TURBINE
H.P.	H.P. 37	H.P. 40	H.P.
SPEED RPM	OVERSPEED SET. 3900 RPM	SPEED 3600 RPM	OVERSPEED SET. RPM
VOLTS	PRES. INLET 110 psi G	VOLTS 440	PRES. INLET psi
CYCLE	PRES. OUTLET 15 psi G	CYCLES 60	PRES. OUTLET psi
PHASE	MAT'L. CASE	PHASE 3	MAT'L. CASE
	MAT'L. ROTOR		MAT'L. ROTOR

Gone

REVISIONS

OVALS

5/29 WFT

ENG. DEPT.

5/29 OFT

OPRG. DEPT.

DATE

DR.

CH.

ENGR.

OPERATING LIMITS

(CONSULT DESIGNS ENGINEER BEFORE EXCEEDING THESE LIMITS)

DESIGN PRES. 101 psi A @ 525 F	DESIGN PRES. 101 psi A @ 525 F
BASED ON Mfr Data	BASED ON Mfr. Data
PROTECTED BY SAFETY VALVE ON None	PROTECTED BY SAFETY VALVE ON None
S.V. SET AT psi	S.V. SET AT psi
MAX. SAFE SPEED FOR UNIT 4090 *	MAX. SAFE SPEED FOR UNIT
TEST PRESSURE 750 psi G	TEST PRESSURE 750 psi G

*Turbine Manuf. Rec. Maximum

SAFETY PRECAUTIONS

REFER TO GENERAL SAFETY INSTRUCTION SHEETS ME-5102 Sheets 1 to 3 and 13 to 15, FOR NOTES ON HAZARDS OF EQUIPMENT FAILURE, WITH RECOMMENDATIONS FOR THEIR AVOIDANCE, AND FOR INSPECTIONS AND TESTS.

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SAFETY INSTRUCTION SHEET
PUMPS AND DRIVERS

El Paso (Refinery) Synthetic Crude (Plant) Pt. 04

DWG. NO. GE-6600

Sheet 35 of 42

MFG. 600-6 (SC-CD-4-4

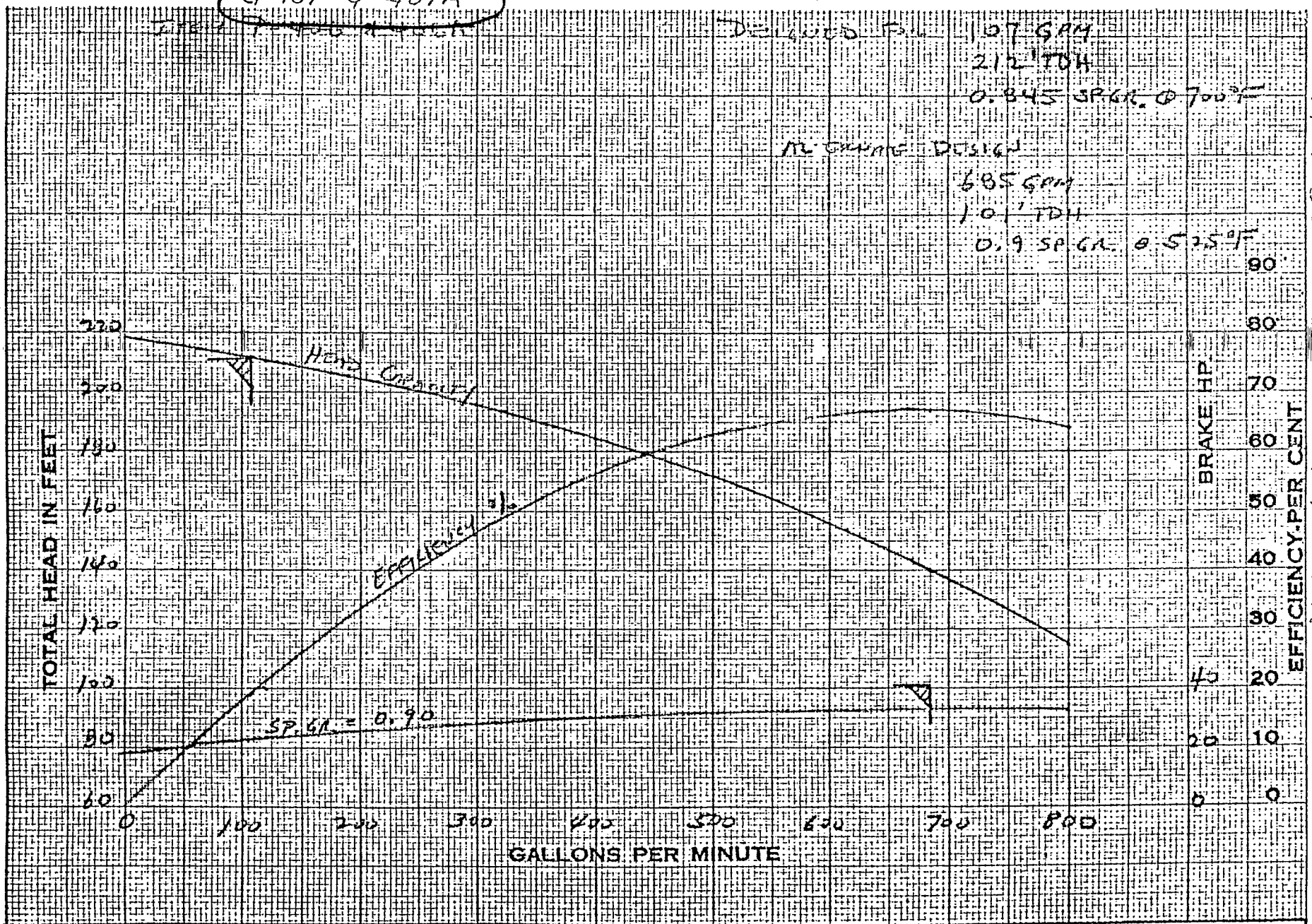
Chevron BB
014718

Chevron BB
014719

P-200RPC 20H 10-50

BYRON JACKSON CO.

G-407 & 407A



PUMP SIZE AND TYPE	RPM	CUSTOMER NO.	IMPELLER NO.	BASED ON	DATE	BYRON JACKSON NUMBER
4x6x8H-SM	3550	G. S.		SM-1592	12-18-57	PC - 260137
			BRANCH NO.	DATA BY	DRAWN BY GB	

ETS-G-1404-2-6-8-0

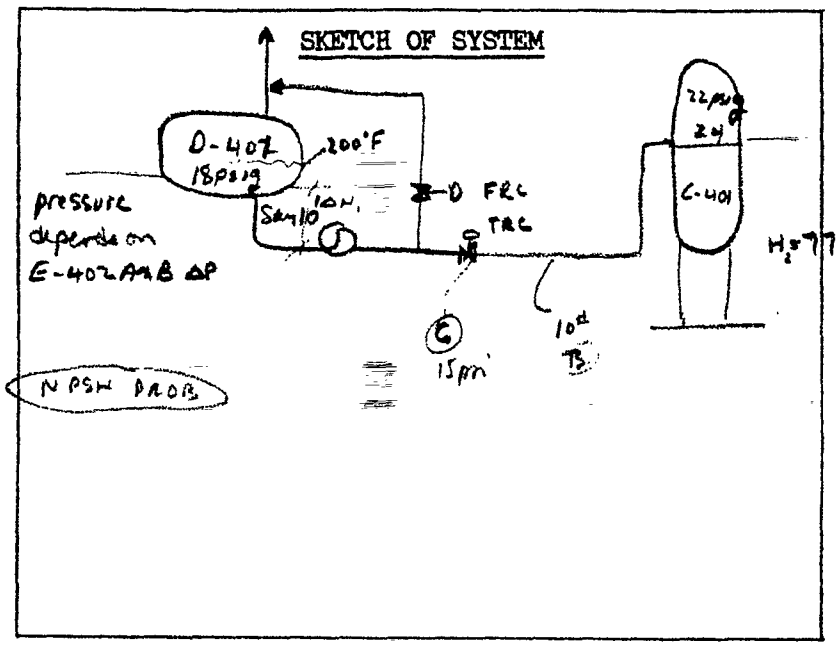
PUMP & DRIVER COST ESTIMATING WORK SHEET - EF-512

Date 10/23/65
By VHC

To be used in conjunction with EF-246

ITEM P8 FRACTIONATOR REFLUX

SKETCH OF SYSTEM



SUCTION
Initial 31 psia

① ELEV. + 2.3 = 8'
② FRICT. - 5
③
④ 28.3

At Pump

DISCHARGE
Terminal 35psia

Ⓐ ELEV 22 = 77'
Ⓑ FRICT 10
Ⓒ TRC 15
CONT. 10
Ⓓ

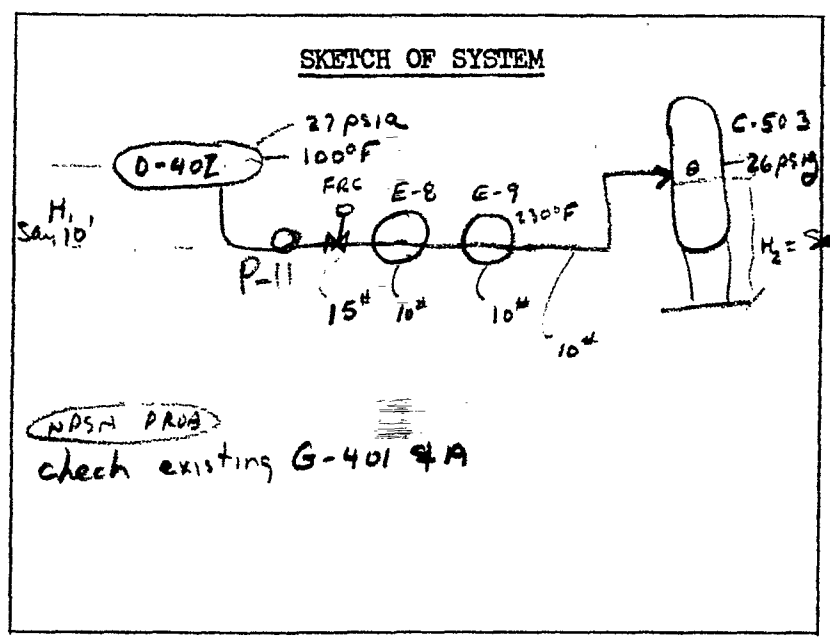
At Pump 92

Design Flow 450 GPM Specified 500 GPM
Proceed with selection via EF-246

ΔP = 60 Psi

ITEM P-11 RERUN FEED

SKETCH OF SYSTEM



SUCTION
Initial 27 psia

① ELEV. + 2.3
FRICT -5
②
③
④

At Pump 25

DISCHARGE
Terminal 39psig

Ⓐ ELEV 10.9 = 36'
Ⓑ E-8 10
E-9 10
Ⓒ FRICT 10
FRC 15
Ⓓ CONT. 10

At Pump 105

Design Flow 240 GPM Specified 265 GPM
Proceed with selection via EF-246

ΔP = 80 Psi

Chevron BB
014720

check G-401A & B

GENERAL	ITEM NUMBER	P-8	P-8A	P-11	P-11A
	SERVICE	FRACT. REFLUX		RERUN	FEED
	FLUID PUMPED	REFLUX		MSR & C4	SR & C4
FLOW CONDITIONS	OPERATING TEMP. °F	200		100	
	SPECIFIC GRAVITY	.66		.70	
	VISCOSITY SSU OR CS	.23 cp		.23 cp	
	VAPOR PRESSURE PSIA	31		27	
	GPM AT OPER. TEMP.	500		265	
	SUCTION PRESSURE PSIA	28		25	
	DISCHARGE PRESSURE PSIA	92		105	
	ΔP PSI	64		80	
	DIFFERENTIAL HEAD FT	224		264	
PUMP SELECTION	TYPE OF PUMP (CENT.-STEAM-POWER-ROTARY)	C	C	C	C
	COST EST. BOOK ITEM NO.	C-120-3	→	C-120-3	→
	MARK NO. OR SIZE	M-1	→	F-1 ~~H-1~~	→
	SPEED RPM	3550	→	3550	→
	OPERATING BHP	45 ~~30.4~~	→	27 ~~18.9~~	→
MATERIAL	MATERIAL CLASS NO. (SEE NOTE 2)	B-1	→	B-1	→
	CASE OR CYLINDER MATERIAL	CS	→	CS	→
	TRIM MATERIAL	CI	→	CI	→
DRIVER SELECTION	TYPE OF DRIVER (MOTOR-TURBINE-ENGINE)	M	~~M 40 HP~~ M	M	~~M 15 HP~~ M
	DRIVER HP	50 ~~40~~	50	40 ~~25~~	40
	MOTOR ENCL./TURBINE SIZE	TEFC	TEFC	TEFC	TEFC
	STEAM CONSUMPTION LB/HR.				
	STEAM INLET PRESS. PSIG				
	STEAM EXHAUST PRESS. PSIG				
	STEAM TEMP. °F				
PUMP PRICE	PUMP PRICE FROM C.E. BOOK $	1615	1615	1195	1195
	EXTRA COST FOR DESCR.				
	$				
	EXTRA COST FOR DESCR.	MECH SEAL		MECH SEAL	MECH SEAL →
	$	INCL. ABOVE		INCL ABOVE	→
	COST INDEX RATIO	283/219	→	283/219	→ /
	CURRENT PRICE OF PUMP $				
	FREIGHT $				
	TOTAL DELIVERED PRICE $	2080	2080	1540	1540
DRIVER PRICE	DRIVER PRICE FROM C.E. BOOK $	750	→	580	→
	EXTRA COST FOR DESCR.				
	$				
	COST INDEX RATIO	283/223	→	283/223	→ /
	CURRENT PRICE OF DRIVER $				
	FREIGHT $				
	TOTAL DELIVERED PRICE $	950	950	735	735
TOTAL COST PUMP & DRIVER $		3030	3030	2275	2275

4 3 2 1 REVISIONS

APPROVED

ENGR. CH. ENG. DEPT. OPR'G. DEPT.

DATE DR.

NOTES: 1. REFER TO COST ESTIMATING BOOK, SECTION G FOR INSTRUCTIONS ON ESTIMATING PUMPS AND DRIVERS.

2. FOR MATERIAL CLASS OF CENT. PUMPS SEE COST ESTIMATING BOOK ITEM G-120-1.

SUBTOTAL THIS PAGE	$ 10,610
FIELD EXTRAS ____ %	$
TOTAL THIS PAGE	$

COST ESTIMATE SHEET FOR PUMPS AND DRIVERS

PLANT:

PROJECT:

Chevron BB
014721

EF-246 (200-CD-2-64
PRINTED IN U.S.A.

considered for P-11 & A — No Good

DATA AND OPERATING LIMITS - PUMPS

SERVICE	Top Reflux	[redacted] DATA SERVICE	Spa[redacted]

PUMP		PUMP	
MFR.	United	MFR.	
TYPE	Centrifugal MODEL 3"ES-B	TYPE	MODEL
MFR. SER. NO.	54908 EQUIP. NO. G-401	MFR. SER. NO.	54909 EQUIP. NO. G-401A
ORDER NO.	1404-4 DATA SHEET NO. GD-6590	ORDER NO.	DATA SHEET NO.
DRAWINGS	2G-1274, PD5745-S	DRAWINGS	2G-1287
PRES: SUCTION	17 psia DISCH. 60 psia	PRES: SUCTION	psia DISCH. psia
MFR. MAX. PRES. RATING	333 psi G	MFR. MAX. PRES. RATING	psi
GPM	234 @ 200 F SPEED 1750 RPM	GPM	@ F SPEED RPM
IMP. DIA: INST.	10 5/8 MAX. 10 5/8	IMP. DIA: INST.	MAX.
INLET: SIZE	6" " RATING 250 psi FACING FF	INLET: SIZE	" RATING psi FACING
OUTLET: SIZE	3" " RATING 250 psi FACING FF	OUTLET: SIZE	" RATING psi FACING
MAT'L: CASE	Cr.Ni C.I. IMP. C.I.	MAT'L: CASE	IMP.
: CYL.	PISTON	: CYL.	PISTON
LINING		LINING	
TEST NEW	psi SHUT OFF HEAD FT.	TEST NEW	psi SHUT OFF HEAD FT.

DRIVER		DRIVER	
MFR.	Elliott	MFR.	Continental Elec
TYPE	2AYR	TYPE	NF-326
MFR. SER. NO.	15941 EQUIP. NO. TG-401	MFR. SER. NO.	693296 EQUIP. NO. MG-401A
ORDER NO.	1404-1 DATA SHEET NO. GD 6609	ORDER NO.	1404-6 DATA SHEET NO. GE-6508
DRAWINGS	612911, 100B	DRAWINGS	C-40500-A

MOTOR	TURBINE	MOTOR	TURBINE
H.P.	H.P. 11	H.P. 15	H.P.
SPEED RPM	OVERSPEED SET. 1925 RPM	SPEED 1800 RPM	OVERSPEED SET. RPM
VOLTS	PRES. INLET 110 psi G	VOLTS 440	PRES. INLET psi
CYCLE	PRES. OUTLET 15 psi G	CYCLES 60	PRES. OUTLET psi
PHASE	MAT'L. CASE	PHASE 3	MAT'L. CASE
	MAT'L. ROTOR		MAT'L. ROTOR

REVISIONS 4 3 2 1

APPROVALS

5/29 [illegible]

ENG. DEPT.

5/29 OFT

OPRG. DEPT.

DATE

DR.

CH.

ENGR.

OPERATING LIMITS

(CONSULT DESIGNS ENGINEER BEFORE EXCEEDING THESE LIMITS)

DESIGN PRES. 61 psi A @ 200 F	DESIGN PRES. 61 psi A @ 200 F
BASED ON Mfr Data	BASED ON Mfr Data
PROTECTED BY SAFETY VALVE ON None	PROTECTED BY SAFETY VALVE ON None
S.V. SET AT psi	S.V. SET AT psi
MAX. SAFE SPEED FOR UNIT 2010 *	MAX. SAFE SPEED FOR UNIT
TEST PRESSURE 500 psi G	TEST PRESSURE 500 psi G

*Turbine Manuf. Rec. Maximum

SAFETY PRECAUTIONS

REFER TO GENERAL SAFETY INSTRUCTION SHEETS ME-5102, Sheets 1 to 3 and 13 to 15, FOR NOTES ON HAZARDS OF EQUIPMENT FAILURE, WITH RECOMMENDATIONS FOR THEIR AVOIDANCE, AND FOR INSPECTIONS AND TESTS.

NOTE BELOW ANY SPECIAL HAZARDS, RECOMMENDATIONS, INSPECTIONS, OR TESTS THAT ARE IMPORTANT FOR THE ABOVE EQUIPMENT.

SAFETY INSTRUCTION SHEET
PUMPS AND DRIVERS

El Paso (Refinery) Synthetic Crude (Plant) PLT 04

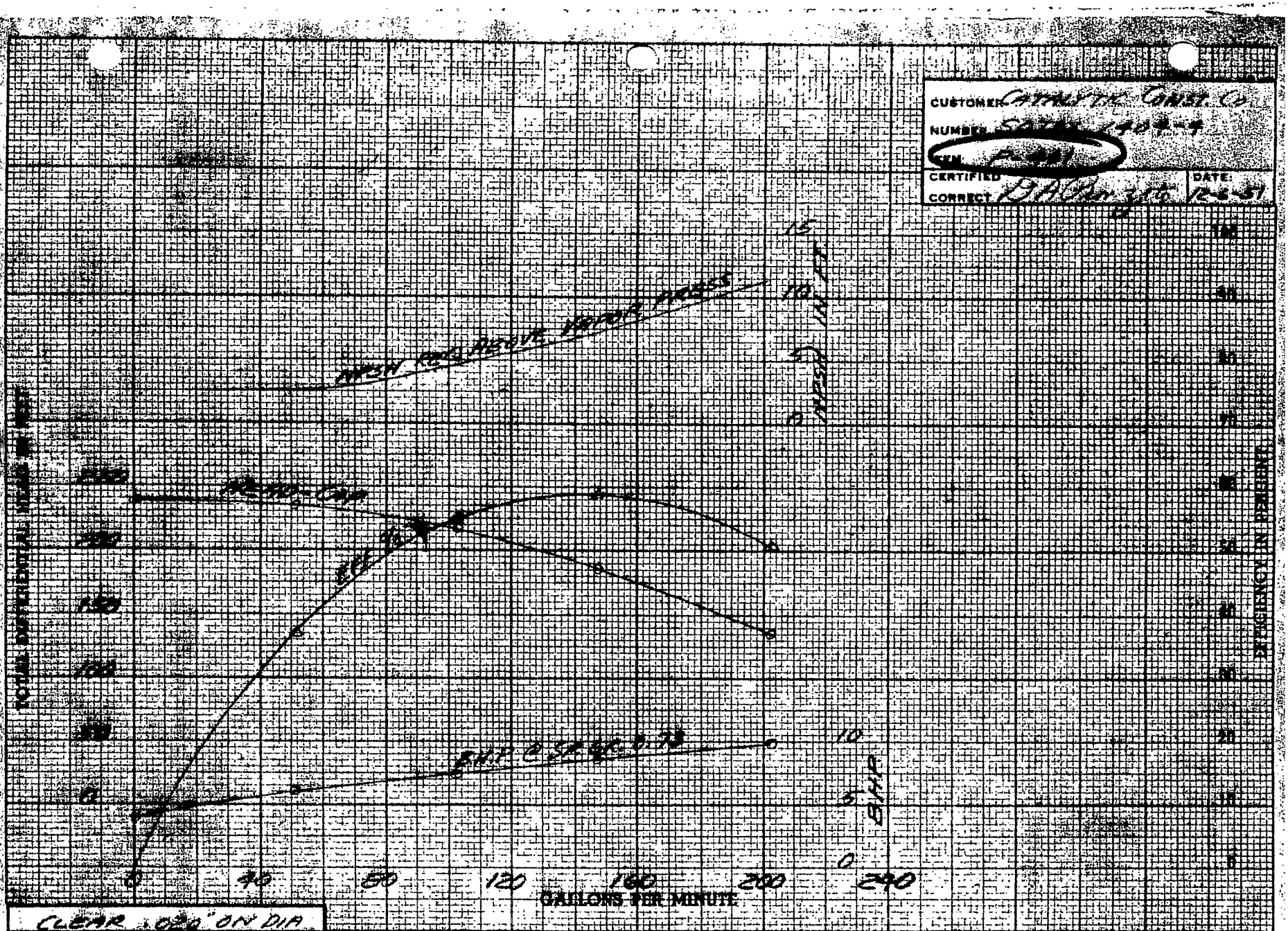
DWG. NO. GE-6600

Sheet 27 of 42

MFG. 600-5 (SC-CD-4-48)

Chevron BB
014722

Chevron BB
014723



	MATERIAL	MAX. DIA.	NO. VANE	PATT. NO.	DIA.	U. F.
IMPELLER	C.I.	10"	4	921-H	7 3/4	
1ST STG. IMP.						

VOLUTE PATT. NO.	CASE PATT. NO.	EYE AREA	ASSEMBLY DWG.	BY	DATE
	442-AW	37	16-179	CBW	12-6-51

UNITED CENTRIFUGAL PUMPS
DIVISION OF
UNITED IRON WORKS
OAKLAND CALIFORNIA

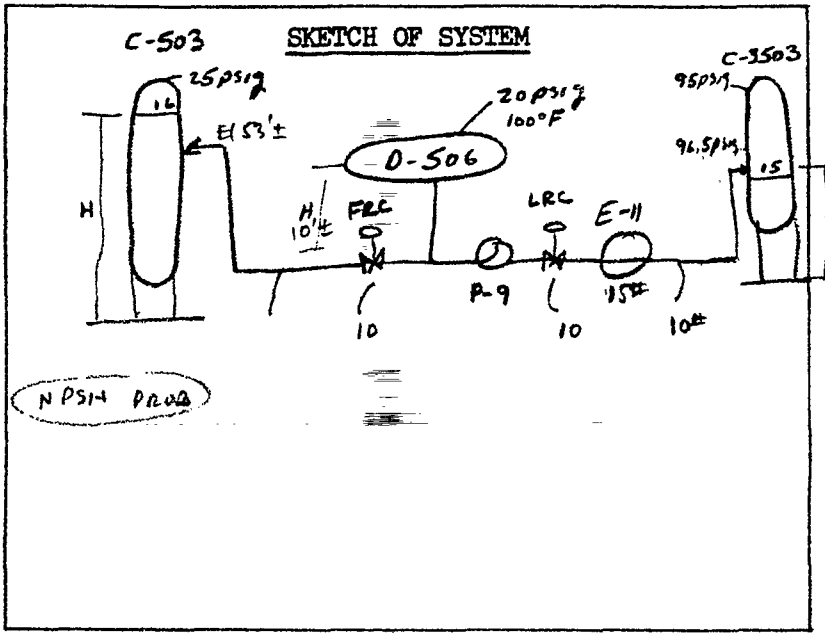
1½" E5-B PUMP
SER. NO. 54910
RPM 3550
57 T 330-A

PUMP & DRIVER COST ESTIMATING WORK SHEET - EF-512

Date 10/23/69
By VHL

To be used in conjunction with EF-246

ITEM P-9 RERUN REFLUX



SUCTION
Initial 33 psig
① ELEV. +2.1 8'
② FRICT −3
③
④

At Pump 32

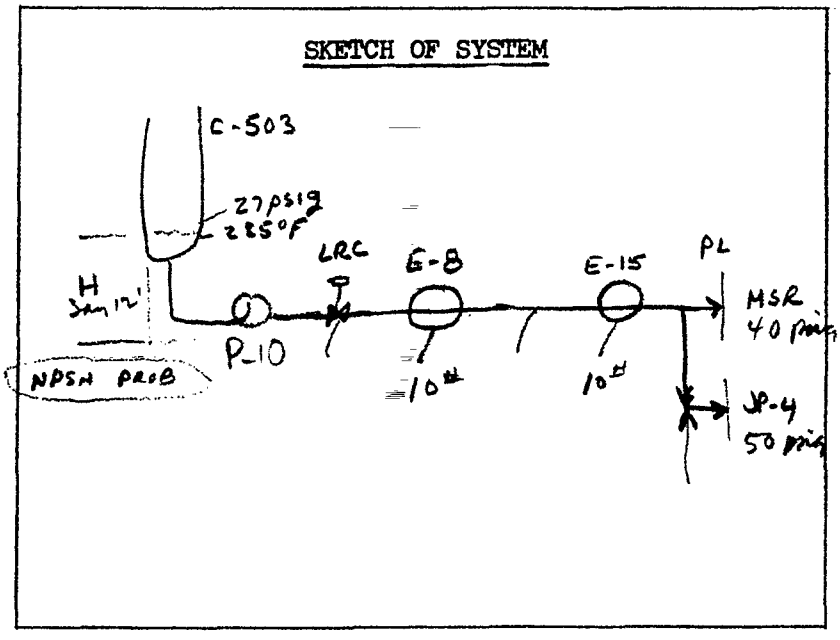
DISCHARGE Terminal	C-503 38 psia	C-3503 108 psia
Ⓐ ELEV	13.5	13.5
Ⓑ CV	10	10
Ⓒ E-11	—	15
FRICT	10	10
Ⓓ CONT.	10	10
	68	166.5

At Pump

Design Flow 270 GPM Specified 300 GPM
Proceed with selection via EF-246

ΔP = 135 Psi

ITEM P-10 C-503 RERUN BTMS



SUCTION
Initial 40 psia
① ELEV 3.9 12'
② FRICT −2
③
④

At Pump 42

DISCHARGE Terminal	MSR 55	JP-4 65
Ⓐ E-8	15	20
Ⓑ E-15	15	20
FRICT	10	15
Ⓒ LRC	15	15
Ⓓ CONT.	10	10
	120	145

At Pump

Design Flow 100 GPM Specified 110 GPM
Proceed with selection via EF-246

ΔP = 103 Psi

Chevron BB
014724

(P-11 Follows P-8

GENERAL	ITEM NUMBER	P-9	P-9A	P-10	P-10A	
	SERVICE	RERUN	REFLUX	RERUN	BTMS	
	FLUID PUMPED	LSR + C_4^-		MSR		
FLOW CONDITIONS	OPERATING TEMP. °F	100		285		
	SPECIFIC GRAVITY	.62		.74		
	VISCOSITY SSU OR CS					
	VAPOR PRESSURE PSIA	33		40		
	GPM AT OPER. TEMP.	300		110		
	SUCTION PRESSURE PSIA	32		42		
	DISCHARGE PRESSURE PSIA	167		145		
	ΔP PSI	135		103		
	DIFFERENTIAL HEAD FT	294		322		
PUMP SELECTION	TYPE OF PUMP (CENT.-STEAM-POWER-ROTARY)	C	C	C	C	
	COST EST. BOOK ITEM NO.	G-120-3	→	G-120-3	→	Select larger pump for NPSH problem
	MARK NO. OR SIZE	H-1	→	F-1 G-1	→	
	SPEED RPM	3550	→	3550	→	
	OPERATING BHP	31.~~19.9~~	→	18 ~~14~~	→	
MATERIAL	MATERIAL CLASS NO. (SEE NOTE 2)	B-1	→	B-1	→	
	CASE OR CYLINDER MATERIAL	CS	→	CS	→	
	TRIM MATERIAL	CI	→	CI	→	
DRIVER SELECTION	TYPE OF DRIVER (MOTOR-TURBINE-ENGINE)	M	~~M 25HP~~	M	~~M 20 HP~~ M	
	DRIVER HP	40 ~~25~~	40	25 ~~20~~	25	
	MOTOR ENCL./TURBINE SIZE	TEFC	~~TEFC~~	TEFC	~~TEFC~~	
	STEAM CONSUMPTION LB/HR.					
	STEAM INLET PRESS. PSIG					
	STEAM EXHAUST PRESS. PSIG					
	STEAM TEMP. °F					
PUMP PRICE	PUMP PRICE FROM C.E. BOOK $	1365	1365	1195	1195	
	EXTRA COST FOR DESCR.	MECH SEAL	→	MECH-	SEAL →	
	$	INCL. ABOVE	→	INCL. ABOVE	→	
	EXTRA COST FOR DESCR.					
	$					
	COST INDEX RATIO	283/219	→	→	→	1
	CURRENT PRICE OF PUMP $					
	FREIGHT $					
	TOTAL DELIVERED PRICE $	1760	1760	1540	1540	
DRIVER PRICE	DRIVER PRICE FROM C.E. BOOK $	550	580	370	370	
	EXTRA COST FOR DESCR.					
	$					
	COST INDEX RATIO	283/223	→	→	→	1
	CURRENT PRICE OF DRIVER $					
	FREIGHT $					
	TOTAL DELIVERED PRICE $	735	735	470	470	
TOTAL COST PUMP & DRIVER $		2495	2495	2010	2010	

REVISIONS 4 3 2 1

APPROVED

DATE ____ DR. ____ CH. ____ ENG. DEPT. ____ ENGR. ____ OPR'G. DEPT. ____

NOTES: 1. REFER TO COST ESTIMATING BOOK, SECTION G FOR INSTRUCTIONS ON ESTIMATING PUMPS AND DRIVERS.

2. FOR MATERIAL CLASS OF CENT. PUMPS SEE COST ESTIMATING BOOK ITEM G-120-1.

SUBTOTAL THIS PAGE	$ 9010
FIELD EXTRAS ____ %	$
TOTAL THIS PAGE	$

COST ESTIMATE SHEET FOR PUMPS AND DRIVERS

PLANT:

PROJECT:

EF-246 (200-CD-2-64)
PRINTED IN U.S.A.

Chevron BB
014725

P-10 Gone Gone

DATA AND OPERATING LIMITS - PUMPS

EQUIPMENT DATA

	Lean Oil (NORTH)	Spare P-507 (SOUTH) Same as P-507
SERVICE NO.	P-507	P-507A
PUMP		
MFR.	Byron Jackson	
TYPE	Centrifugal	
MODEL	2X3X11 1/2 SM	
MFR. SER. NO.	260141	260142
EQUIP. NO.	~~P-507~~ G-507	~~P-507~~ G-507A
ORDER NO.	1405-5	
DATA SHEET NO.	GD-5671	GD-5674
DRAWINGS	1F-1712	
PRES: SUCTION	18 psia	psia
DISCH.	290 psia	psia
MFR. MAX. PRES. RATING	500 psi G	psi
GPM	210 @ 465 F	@ F
SPEED	3550 RPM	RPM
IMP. DIA: INST.	11	
MAX.	11 1/2	
INLET: SIZE	3 "	"
RATING	300 psi	psi
FACING	Sml. Grv	
OUTLET: SIZE	2 "	"
RATING	300 psi	psi
FACING	Sml. Grv	
MAT'L: CASE	C.S.	
IMP.	C.I.	
: CYL.		
PISTON		
LINING		
TEST NEW	psi	psi
SHUT OFF HEAD	FT.	FT.
DRIVER		
MFR.	Westinghouse	Continental Elec
TYPE	E-116	NF 5045
MFR. SER. NO.		693289
EQUIP. NO.	~~T-507~~ G-507	~~M-507~~ MG50
ORDER NO.	1405-2	1405-12
DATA SHEET NO.	FTG-G-1405-2-9-R-0	GE 5525
DRAWINGS		C-40500 B
MOTOR		
H.P.		75
SPEED	RPM	3600 RPM
VOLTS		440
CYCLE		60
PHASE		3
TURBINE		
H.P.	77	
OVERSPEED SET.	3900 RPM	RPM
PRES. INLET	~~400~~ 400 psi	psi
PRES. OUTLET	~~110~~ 110 psi	psi
MAT'L. CASE		
MAT'L. ROTOR		

OPERATING LIMITS

(CONSULT DESIGNS ENGINEER BEFORE EXCEEDING THESE LIMITS)

DESIGN PRES.	312 psi A @ 465 F	312 psi A @ 465 F
BASED ON	Mfr Data	Mfr Data
PROTECTED BY SAFETY VALVE ON	None	None
S.V. SET AT	psi	psi
MAX. SAFE SPEED FOR UNIT	3900 *	
TEST PRESSURE	750 psi G	750 psi G

*Turbine Manuf. Rec. Maximum

SAFETY PRECAUTIONS

REFER TO GENERAL SAFETY INSTRUCTION SHEETS ME-5102 Sheets 1 to 3 and 13 to 15, FOR NOTES ON HAZARDS OF EQUIPMENT FAILURE, WITH RECOMMENDATIONS FOR THEIR AVOIDANCE, AND FOR INSPECTIONS AND TESTS.

NOTE BELOW ANY SPECIAL HAZARDS, RECOMMENDATIONS, INSPECTIONS, OR TESTS THAT ARE IMPORTANT FOR THE ABOVE EQUIPMENT.

SAFETY INSTRUCTION SHEET
PUMPS AND DRIVERS

El Paso (Refinery) Gas Recovery (Plant)

DWG. NO. GE-5722

Sheet 64 of 75

MFG. 600-6 (SC-CD-4-48)

REVISIONS

4 3 2 1

Changed Inlet & Outlet Pressure Of Turbine From 16 Outlet To 110 & Inlet To 400 & Changed Turbine Speed From 3600 To 3900 RPM 4-24-48 WHW

APPROVALS

5/29 WHW

ENG. DEPT.

5/29 OFT

OPRG. DEPT.

DATE

DR.

CH.

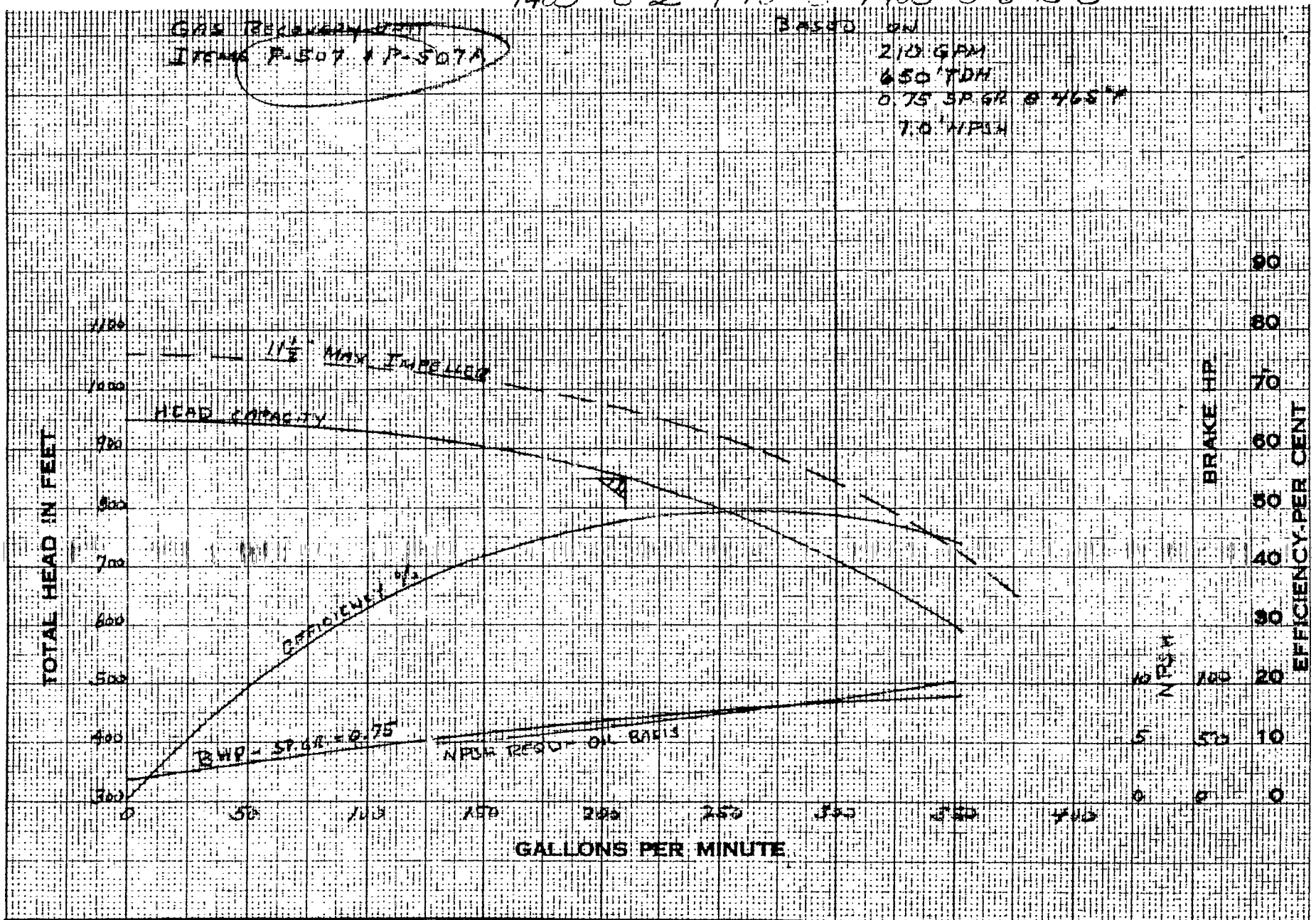
ENGR.

Chevron BB
014726

P 200RPC 201 10

BYRON O JACKSON CO.

1405-G-2 FTB-G-1405-5-6-2-0



PUMP SIZE AND TYPE	RPM	CUSTOMER NO.	IMPELLER NO.	BASED ON	DATE	BYRON JACKSON NUMBER
2 × 3 × 11½ - 2 STG - SM	3550	G. S.	BRANCH NO. / DATA BY	PS-440	11-14-51	PC # 260141-42
				DRAWN BY: GB		

Chevron RR

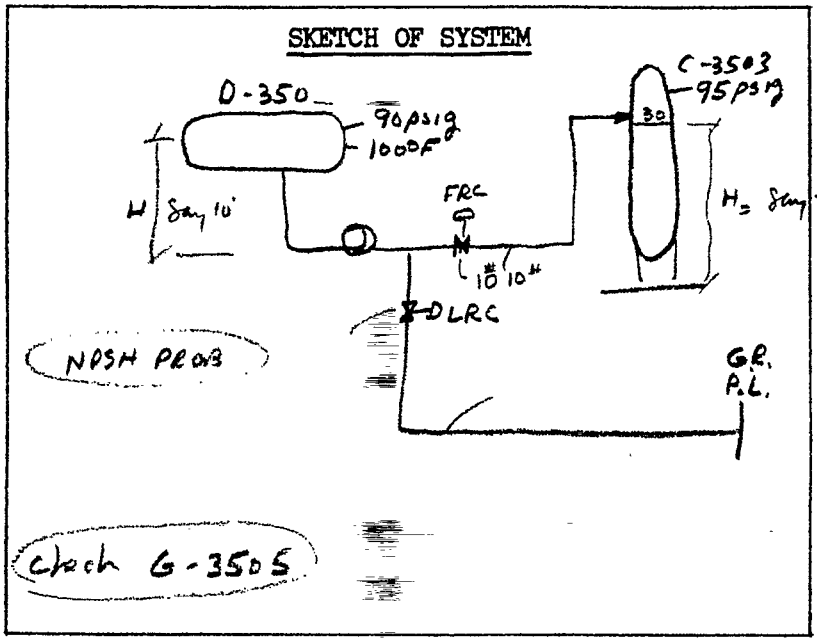
PUMP & DRIVER COST ESTIMATING WORK SHEET - EF-512

Date 10/23/69
By JHL

To be used in conjunction with EF-246

ITEM P-12 (P-3505) STABILIZER REFLUX

SKETCH OF SYSTEM



SUCTION			
Initial		103 psia	
①	ELEV.	1.8	8'
	FRICT	-2	
②			
③			
④			
		At Pump	103
	REFLUX		P L
DISCHARGE			
Terminal		108psia	240
Ⓐ	ELEV.	?	17 75
Ⓑ	CV	10	10
Ⓒ	FRICT	10	10
	CONT.		15
Ⓓ			
		At Pump	287
		ΔP =	184 Psi

Design Flow 140 GPM Specified 155 GPM
Proceed with selection via EF-246

ITEM _____

SKETCH OF SYSTEM

SUCTION		
Initial		
①		
②		
③		
④		
	At Pump	
DISCHARGE		
Terminal		
Ⓐ		
Ⓑ		
Ⓒ		
Ⓓ		
	At Pump	
	ΔP =	Psi

Design Flow _____ Specified _____
Proceed with selection via EF-246

Chevron BB
014728

check existing G-3505

GENERAL	ITEM NUMBER		P-12	P-12A				
	SERVICE		STABILIZER	REFLUX				
	FLUID PUMPED		C4⁻					
FLOW CONDITIONS	OPERATING TEMP.	°F	100					
	SPECIFIC GRAVITY		.526					
	VISCOSITY	SSU OR CS						
	VAPOR PRESSURE	PSIA	103					
	GPM AT OPER. TEMP.		155					
	SUCTION PRESSURE	PSIA	103					
	DISCHARGE PRESSURE	PSIA	287					
	ΔP	PSI	184					
	DIFFERENTIAL HEAD	FT	418					
PUMP SELECTION	TYPE OF PUMP (CENT.-STEAM-POWER-ROTARY)		C	C				
	COST EST. BOOK ITEM NO.		C-120-2					
	MARK NO. OR SIZE		I1		Select oversize pump for low NPSH			
	SPEED	RPM	3550					
	OPERATING BHP		18.4					
MATERIAL	MATERIAL CLASS NO. (SEE NOTE 2)		B-1					
	CASE OR CYLINDER MATERIAL		CS					
	TRIM MATERIAL		CI					
DRIVER SELECTION	TYPE OF DRIVER (MOTOR-TURBINE-ENGINE)		M	M-25HP ~~T~~				
	DRIVER HP		25	20				
	MOTOR ENCL./TURBINE SIZE		TEFL	12" Cl 2				
	STEAM CONSUMPTION LB/HR.							
	STEAM INLET PRESS.	PSIG		385				
	STEAM EXHAUST PRESS.	PSIG		40				
	STEAM TEMP.	°F		80°F SH				
PUMP PRICE	PUMP PRICE FROM C.E. BOOK	$						
	EXTRA COST FOR	DESCR. $	NEW IMPELLER 350					
	EXTRA COST FOR	DESCR. $						
	COST INDEX RATIO		rework old pump	rework old pump	/	/	/	
	CURRENT PRICE OF PUMP	$						
	FREIGHT	$						
	TOTAL DELIVERED PRICE	$						
DRIVER PRICE	DRIVER PRICE FROM C.E. BOOK	$	370					
	EXTRA COST FOR	DESCR. $						
	COST INDEX RATIO		283/223	/	/	/	/	
	CURRENT PRICE OF DRIVER	$						
	FREIGHT	$						
	TOTAL DELIVERED PRICE	$	470					
TOTAL COST PUMP & DRIVER		$	820					

NOTES: 1. REFER TO COST ESTIMATING BOOK, SECTION G FOR INSTRUCTIONS ON ESTIMATING PUMPS AND DRIVERS.

2. FOR MATERIAL CLASS OF CENT. PUMPS SEE COST ESTIMATING BOOK ITEM G-120-1.

SUBTOTAL THIS PAGE	$ 820
FIELD EXTRAS ____ %	$
TOTAL THIS PAGE	$

COST ESTIMATE SHEET FOR PUMPS AND DRIVERS

PLANT:

PROJECT:

REVISIONS 4 3 2 1

APPROVED

DATE ____ DR. ____ ENG. DEPT. ____ OPR'G. DEPT. ____ CH. ____ ENGR. ____

EF-246 (200-CD-2-64)
PRINTED IN U.S.A.

Chevron BB
014729

P-128A

DATA AND OPERATING LIMITS - PUMPS

EQUIPMENT DATA

SERVICE	After Fractionator Bottoms	Stabilizer Reflux AND BUTANE TO #6C5
NO.	G-3503 (was G-4A)	G-3505 (was G-5)

PUMP

MFR.	Byron Jackson Co.	Byron Jackson Co.
TYPE / MODEL	Centr. Single Stg / 1-1/2 TLM-1025	Centr. Sing. Stg / 2x3x10-1/2 1050
MFR. SER. NO.	H210321	H210323
EQUIP. NO.	P-133 G-3503	P-135 G-3505
ORDER NO.	H.E. 24655	H.E. 24655
DATA SHEET NO.	GD-100182	GD-100182
DRAWINGS	GFP-4164-0, 4234-0	GFP-4163-0, 4204-0
PRES: SUCTION	23 psig	95 psig
DISCH.	60 psig	150 psig
MFR. MAX. PRES. RATING	250 psig	300 psig
GPM	127 @ 170 F	144 @ 100° F
SPEED	3550 RPM	3550 RPM
IMP. DIA: INST.	5-11/16	8-1/2"
MAX.	6-1/16	10-3/4"
INLET: SIZE	2 "	3 "
RATING	125 psig	250 psig
FACING	F.F.	F.F.
OUTLET: SIZE	1-1/2 "	2 "
RATING	125 psig	250 psig
FACING	F.F.	F.F.
MAT'L: CASE	C.I.	C.I.
IMP.	Bronze	~~Bronze~~ C.I.
CYL.		
PISTON		
LINING	None	
TEST NEW	400 psig	400 psig
SHUT OFF HEAD	188 FT.	483 FT.

DRIVER

MFR.	Continental Electric Co., Inc.	NEWMAN ELECTRIC (3)
TYPE	NP 225 (Horiz. Mounting)	NP 3[illegible] (Horiz. Mounting)
MFR. SER. NO.	548786	A-881811
EQUIP. NO.	M-116 MG-3503	MG-3505
ORDER NO.	H.E. 24652	H.E. 24652
DATA SHEET NO.	GB-4194	[illegible]
DRAWINGS		

MOTOR

H.P.	5	25
SPEED	~~3575~~ 3550 RPM	3420 RPM
VOLTS	220/440	330/440 V
CYCLE	~~50~~ 60	60
PHASE	3	3
		FRAM 324/U

TURBINE

H.P.		
OVERSPEED SET.	RPM	RPM
PRES. INLET	psi	psi
PRES. OUTLET	psi	psi
MAT'L. CASE		
MAT'L. ROTOR		

OPERATING LIMITS

(CONSULT DESIGNS ENGINEER BEFORE EXCEEDING THESE LIMITS)

DESIGN PRES.	150 ~~60~~ psig @ 250° ~~170~~ F	150 psig @ 100 F
BASED ON	TEMP. & PRESS RATING 125# CAST IRON FLANGE	
PROTECTED BY SAFETY VALVE ON		
S.V. SET AT	psi	psi
MAX. SAFE SPEED FOR UNIT		
TEST PRESSURE	26 psig	psi

SAFETY PRECAUTIONS

REFER TO GENERAL SAFETY INSTRUCTION SHEETS ME-5102 Sheets 1 to 3 and 13 to 15, FOR NOTES ON HAZARDS OF EQUIPMENT FAILURE, WITH RECOMMENDATIONS FOR THEIR AVOIDANCE, AND FOR INSPECTIONS AND TESTS.

NOTE BELOW ANY SPECIAL HAZARDS, RECOMMENDATIONS, INSPECTIONS, OR TESTS THAT ARE IMPORTANT FOR THE ABOVE EQUIPMENT.

---

(1) REPLACED MOTOR 2-68 JP

(2) CHANGED DESIGN PRESS FROM 60 @ 170°F (was) 5-1-42 JP

(3) 99-11-1 JP

REVISIONS

APPROVALS

ENG. DEPT.

OPRG. DEPT.

DATE 10-11-49

DR. JP

CH.

ENGR. JP

Mercedes Drawing PE-100257

SAFETY INSTRUCTION SHEET
PUMPS AND DRIVERS

El Paso (Refinery) Perco Desulfurizer, Butane Treater (Plant)

DWG. NO. PE-4484

Sheet 124 of 136

MFG. 800-6 (SC-CD-4-48)

Chevron BB 014730

PUMP & DRIVER COST ESTIMATING WORK SHEET - EF-512

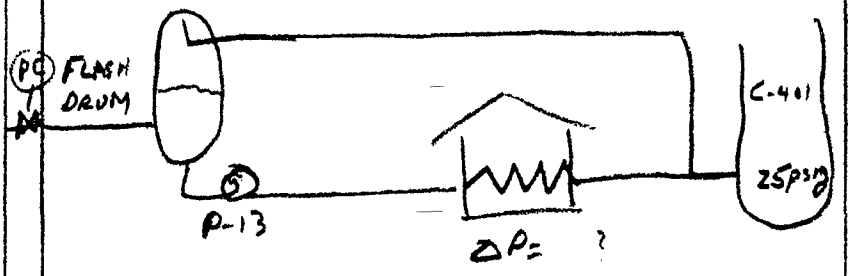
ALT 2 CASE

Date 10/22/65
By JHL

To be used in conjunction with EF-246

ITEM P-13

SKETCH OF SYSTEM



SUCTION
Initial

① ② ③ ④

At Pump

DISCHARGE
Terminal

Ⓐ Ⓑ Ⓒ Ⓔ

ΔP est by JH Lyle at El Paso

At Pump

ΔP = 375 Psi
= 1275'

Design Flow 1320 GPM Specified 1450 GPM
Proceed with selection via EF-246

ITEM

SKETCH OF SYSTEM

SUCTION
Initial

① ② ③ ④

At Pump

DISCHARGE
Terminal

Ⓐ Ⓑ Ⓒ Ⓓ

At Pump
ΔP = Psi

Design Flow Specified
Proceed with selection via EF-246

PRINTED IN USA EF-512 (150-CD-3-60)

Chevron BB
014731

ALT 2

GENERAL	ITEM NUMBER		P-13	P-13A			
	SERVICE		F-301 FEED	SPARE			
	FLUID PUMPED		CRUDE				
FLOW CONDITIONS	OPERATING TEMP.	°F	390				
	SPECIFIC GRAVITY		0.679				
	VISCOSITY	SSU OR CS					
	VAPOR PRESSURE	PSIA					
	GPM AT OPER. TEMP.		1450				
	SUCTION PRESSURE	PSIA					
	DISCHARGE PRESSURE	PSIA					
	ΔP	PSI	375				
	DIFFERENTIAL HEAD	FT	1275				
PUMP SELECTION	TYPE OF PUMP (CENT.-STEAM-POWER-ROTARY)		C	C			
	COST EST. BOOK ITEM NO.		G-120-4				
	MARK NO. OR SIZE		E-3		DOUBLE OUTBOARD		
	SPEED	RPM	3550		BEARING TYPE		
	OPERATING BHP		590 ~~462~~				
MATERIAL	MATERIAL CLASS NO. (SEE NOTE 2)		B-2	B-2			
	CASE OR CYLINDER MATERIAL		C.S.				
	TRIM MATERIAL		C.I				
DRIVER SELECTION	TYPE OF DRIVER (MOTOR-TURBINE-ENGINE)		M	T			
	DRIVER HP		600 ~~500~~	675			
	MOTOR ENCL./TURBINE SIZE		TEFC	28" CR 2			
	STEAM CONSUMPTION LB/HR.						
	STEAM INLET PRESS.	PSIG		385			
	STEAM EXHAUST PRESS.	PSIG		110			
	STEAM TEMP.	°F		80°F S.H			
PUMP PRICE	PUMP PRICE FROM C.E. BOOK	$	4575	→			
	EXTRA COST FOR	DESCR.	MECH SEAL	→			
		$	230	→			
	EXTRA COST FOR	DESCR.					
		$					
	COST INDEX RATIO		283/219	→	/	/	/
	CURRENT PRICE OF PUMP	$					
	FREIGHT	$					
	TOTAL DELIVERED PRICE	$	5700	5700			
DRIVER PRICE	DRIVER PRICE FROM C.E. BOOK	$	14580	4860			
	EXTRA COST FOR	DESCR.					
		$					
	COST INDEX RATIO		283/223	283/237	/	/	/
	CURRENT PRICE OF DRIVER	$					
	FREIGHT	$					
	TOTAL DELIVERED PRICE	$	18500	5800			
TOTAL COST PUMP & DRIVER		$	24,200	11,500			

NOTES: 1. REFER TO COST ESTIMATING BOOK, SECTION G FOR INSTRUCTIONS ON ESTIMATING PUMPS AND DRIVERS.

2. FOR MATERIAL CLASS OF CENT. PUMPS SEE COST ESTIMATING BOOK ITEM G-120-1.

SUBTOTAL THIS PAGE	$ 35,700
FIELD EXTRAS ____ %	$
TOTAL THIS PAGE	$

REVISIONS: 4 3 2 1

APPROVED

DATE ____ DR. ____ ENG. DEPT. ____ OPR'G. DEPT. ____ CH. ____ ENGR. ____

COST ESTIMATE SHEET FOR PUMPS AND DRIVERS

PLANT:

PROJECT:

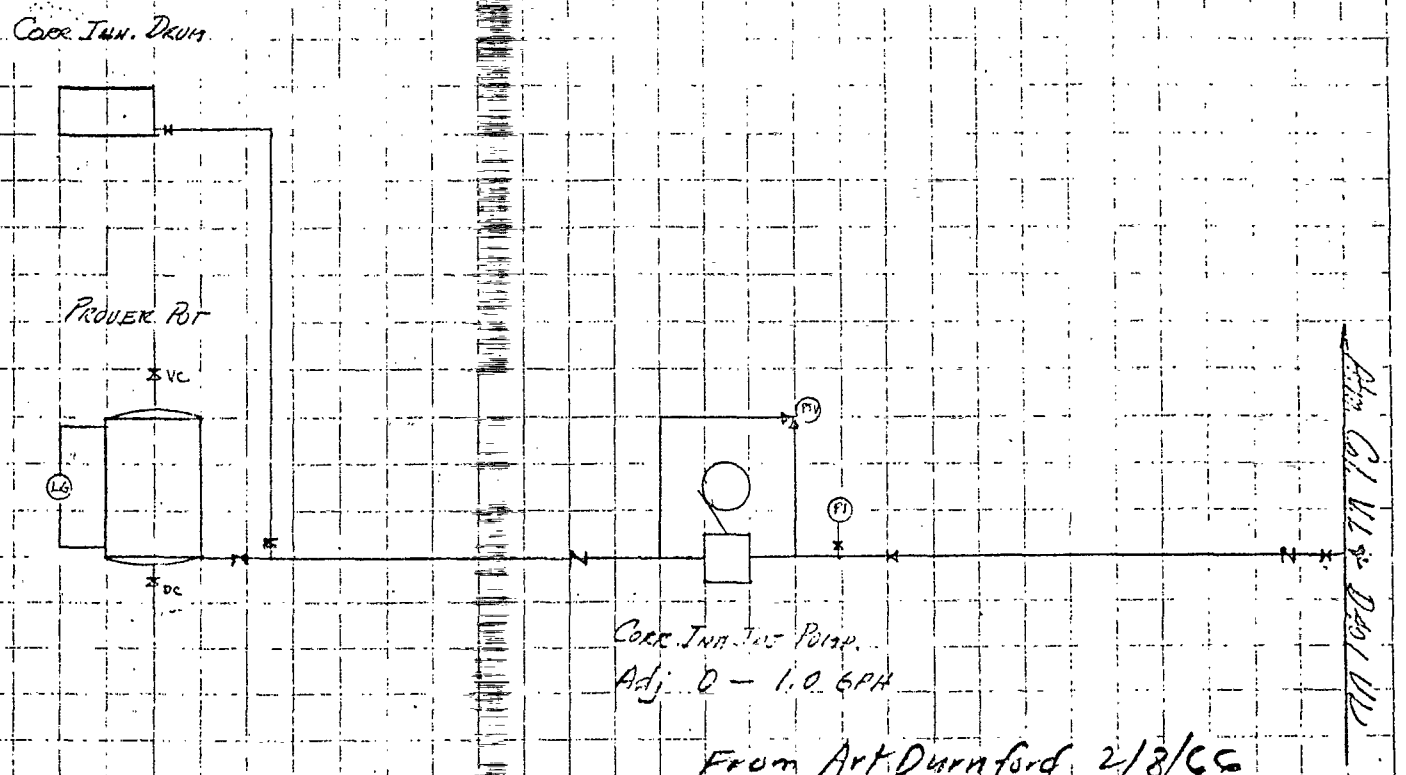
EF-246 (200-CD-2-64)
PRINTED IN U.S.A.

Chevron BB
014732

CALCULATION SHEET GO-144-2

No 7 Crude Unit

Corrosion Inhibitor Injection



From Art Durnford 2/8/66

Costs – (Piping allowance Already Incl. in "L":	Mat'l
Pump per G-CE-342 – C.I. Plunger	450
1/4 hp motor	50
Prover Pot 40 to 50 gal	200
Instruments	500
	1,200
Say	~~1,800~~
~~HLE 2/9/66~~	
use	2000

JHL 11/13/65

INITIALS _____ PROJECT No. _____

DATE _____ SUBJECT _____

SHEET _____ OF _____

G-144-2 (8-64) PRINTED IN U.S.A.

Chevron BB
014734

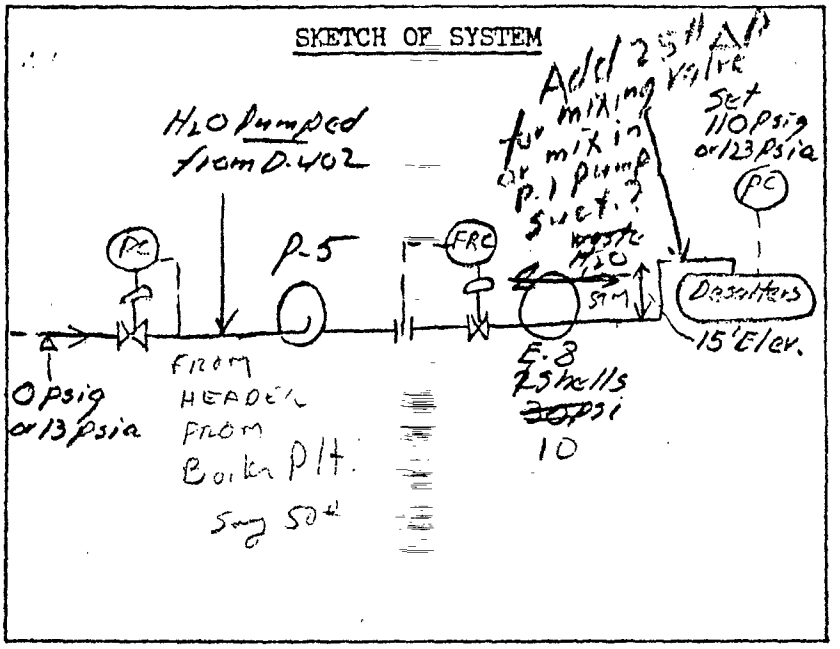
PUMP & DRIVER COST ESTIMATING WORK SHEET - EF-512

Date 1/21/66
By [illegible]

To be used in conjunction with EF-246

ITEM P-4 H2O Pump to Desalters

SKETCH OF SYSTEM



SUCTION
Initial 13 psia

①	PCV	-5
②	Frict.	-1
③		
④		

At Pump ~~7~~ 5 psia

DISCHARGE
Terminal 123

Ⓐ	15' elev	7
Ⓑ	E-3	~~10~~ 10
Ⓒ	FRC v.	15
	Frict.	5
Ⓓ	contng.	10

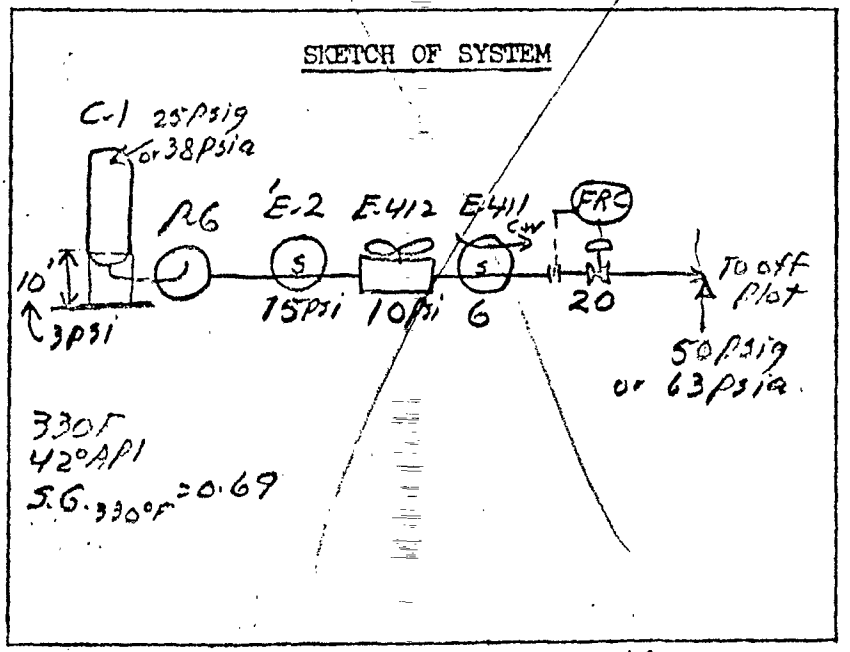
At Pump ~~190~~ 115

ΔP = ~~133~~ 115 Psi

Design Flow 75 Specified 85
Proceed with selection via EF-246

ITEM P-6 S.C. Stripper Btms

SKETCH OF SYSTEM



SUCTION
Initial 38 psia

①	Elev.	3
②	Frict.	-1
③		
④		

At Pump 40 psia

DISCHARGE
Terminal 63 psi

Ⓐ	C.W.(FRC)	20
Ⓑ	E-411	6
Ⓒ	E-412	10
	E-2	15
	Frict.	10
Ⓓ	Contng.	10
		131

Design Flow 140 Specified 160
Proceed with selection via EF-246

Chevron BB
014735

CALCULATION SHEET GO-144-2

CORR. INH IN OH SYSTEM

CRC - 2 - 20 ppm by vol 20ppm = 0.002 vol%

	Case A	Case B
Nat Oil Liq	9350	8450
Reflux	14200	13350
	23550 BPOD	21800 BPOD

$23550 \frac{B}{D} \times 0.00002 = 0.47$ Bbl / Day MAX

0.047 B / D MIN

$0.47 \frac{B}{D} \times \frac{D}{24 Hr} \times \frac{D\,Gal}{Bbl} = 0.82$ GPH MAX

0.08 GPH MIN

PUMP 0 - 1 GPH

INITIALS _____ PROJECT No. _____

DATE _____ SUBJECT _____

SHEET _____

Chevron BB
014736

COST ESTIMATING DATA

ITEM G-120-1

Mat'l. Class		A-3	B-1 & B-2	B-3	F-2
Service		Water & General Service to 212F	Process B-1, to 250F B-2, 250F to 450F	Process 450F to 700F	Corrosive Packed to 700 Mech. Seal to 450F
Case		Cast Iron	Cast Steel	Cast Steel	316 S.S.
Impeller		Cast Iron, Brass or Bronze	Cast Iron	12% Chrome	316 S.S.
Impeller Wear Rings		Cast Iron, Brass or Bronze	Cast Iron	12% Chrome Hardened	316 S.S.
Case Wear Rings		Cast Iron, Brass or Bronze	Cast Iron	12% Chrome Hardened	Stellite No.1 over 316 S.S.
Shaft		Carbon Steel or AISI 4140	Carbon Steel or AISI 4140	Carbon Steel or AISI 4140	316 S.S.
Shaft Sleeve (Packed Pump)		Hard Bronze, Chrome Plate or Equal	Stellite or Colmonoy over Steel	Stellite or Colmonoy over Steel	Stellite No. over 316 S.S
Shaft Sleeve (Mech.Seal Pump)		Bronze of 12% Chrome	18-8 or Chrome Plated Steel	None	316 S.S.
Gland		Cast Iron or Carbon Steel	Carbon Steel (Bronzed Bushed with Packing)	Carbon Steel Bronzed Bushed	316 S.S.
Casing Studs		Carbon Steel	B7 Alloy	B7 Alloy	316 S.S.
Mech. Seal	Seal Ring	Carbon	Carbon	None	Carbon
	Mating Seal Ring	Stellite over 18-8 S.S.	Stellite over 18-8 S.S.	None	Ceramic
	Collars, Cages, etc.	Brass, Bronze or 18-8 S.S.	18-8 S.S.	None	316 S.S.
	Springs	18-8 S.S.	18-8 S.S.	None	316 S.S.
	Gaskets	Buna N	Buna N-for B-1 Teflon-for B-2	None	Teflon

DATE- Aug., 1962	MATERIAL CLASSIFICATION FOR	STANDARD OIL COMPANY OF CALIFORNIA
EDC INDEX-	CENTRIFUGAL PUMPS	ENGINEERING DEPT. SAN FRANCISCO
APPROVALS-		G-CE-227-1

FF-585-F (400-CD-9-57)

Chevron BB 014737

COST ESTIMATING DATA

Material Class (Per Item G-2)	A-3 (Cast Iron)		B-1 & B-2 (Steel)		F-2 (316 Stainless Steel)		Weight Pump & Base (Lb)
Max. Temp.	212F		300F (See Note 3)		300F (See Note 3)		
Pump Mark	Price $	Max. Case Working Pressure	Price $	Max. Case Working Pressure	Price $	Max. Case Working Pressure	
1	506	200	524	200	686	200	237
2	546	200	564	200	756	200	247
3	586	200	604	200	831	200	257
4	522	300	618	200	857	200	358
5	547	300	658	200	932	200	368
6	572	300	698	200	997	200	386
7	612	300	748	200	1077	200	396
8	586	175	710	200	982	200	386
9	628	175	760	200	1077	200	473
10	651	175	807	200	1137	200	493
11	671	175	845	200	1207	200	513
12	691	175	875	200	1267	200	556
13	752	150	774	150	1091	150	352
14	852	150	874	150	1261	150	423
15	937	150	959	150	1386	150	446
16	987	150	1009	150	1481	150	461
17	1047	150	1069	150	1566	150	588

Notes

1. Refer to Item G-120-2, page 2 for selection.

2. Price includes pump, coupling, coupling guard, and base fob West Coast. All pumps comply with Spec. EG-983.

3. Max. Temp. of 300F for B-1, B-2 and F-2 materials may be extended to 350F if pump is equipped with a water jacketed stuffing box or mech. seal. Additions for STUFFING BOX JACKETS are as follows:

Pumps	Jacket Cost - B-1 & B-2 Mat'ls	Jacket Cost - F-2 Mat'ls
(1) through (3)	Not available	Not available
(4) through (7)	$29	$58
(8) through (12)	$35	$69
(13) through (17)	$42	$83

4. To equip pumps with MECHANICAL SEALS add $75 per pump. (Good for all Mat'l Classes)

5. All Monel - (J-1 Material Class)

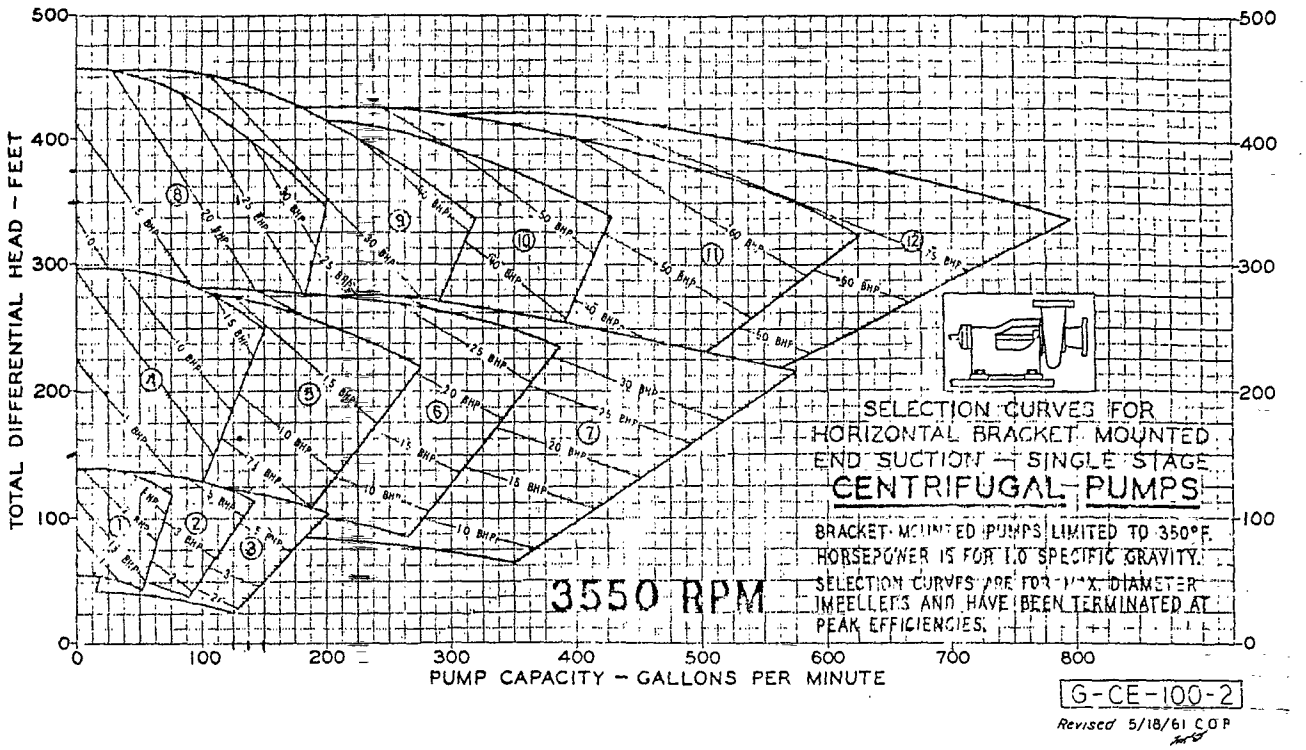
   For pumps with monel case, impeller, shaft, wear rings, shaft sleeve and gland, multiply F-2 material cost X 1.35. If pumps require either mechanical seals or stuffing box jackets the additional cost must be added to the F-2 mat'l cost before the multiplier for monel materials is applied.

6. All Alloy 20 - (J-1 Material Class)

   For pumps with Alloy 20 case, impeller, shaft, wear rings, shaft sleeve and gland multiply F-2 material cost X 1.12. If pumps require either mechanical seals or stuffing box jackets, the additional cost must be added to the F-2 mat'l cost before the multiplier for Alloy 20 materials is applied.

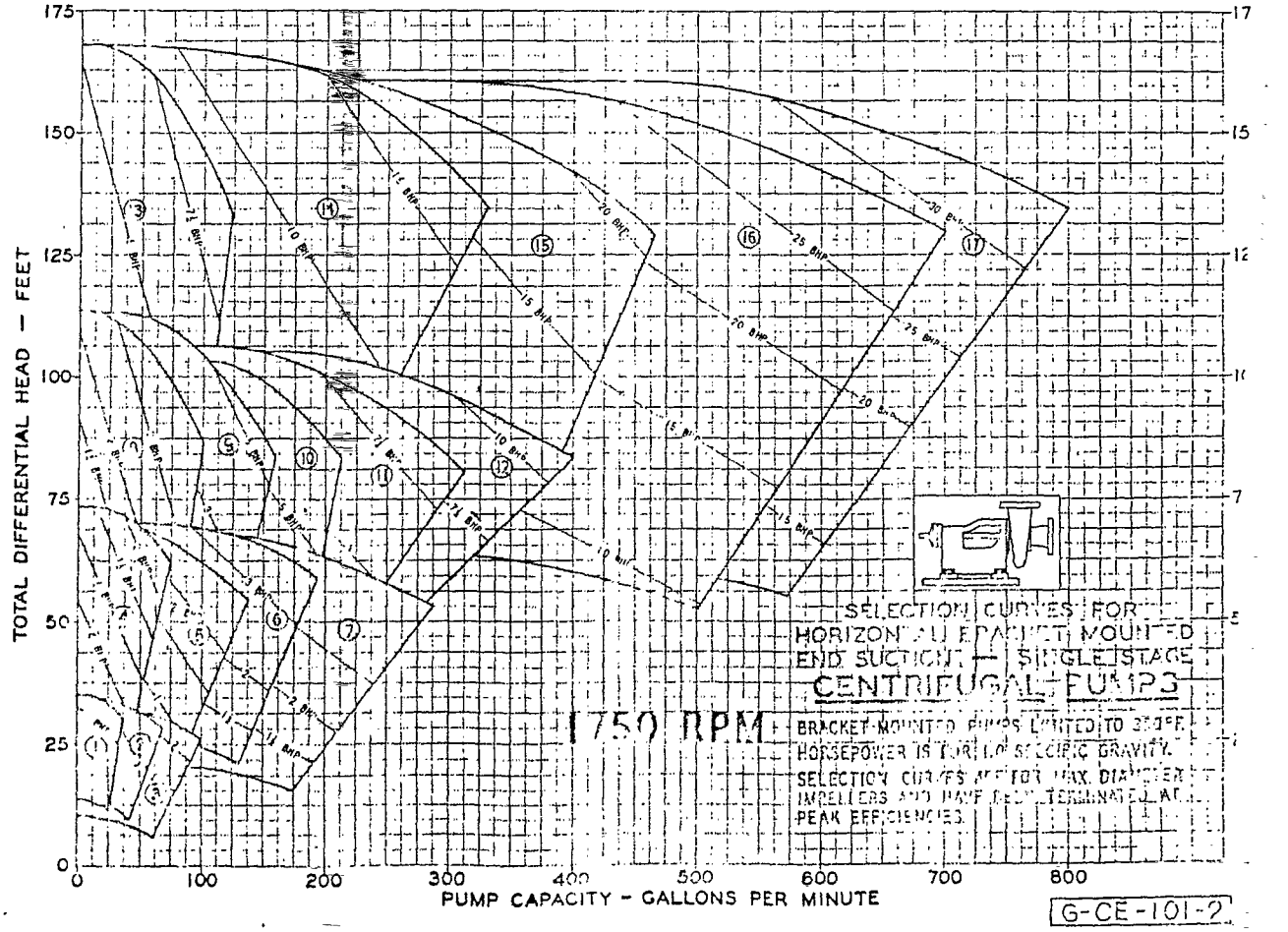
DATE- Aug., 1962	ESTIMATING PRICES FOR	STANDARD OIL COMPANY OF CALIFORNIA
EDC INDEX- 219	SINGLE-STAGE CENTRIFUGAL PUMPS	ENGINEERING DEPT. SAN FRANCISCO
APPROVALS-	BRACKET MOUNTED, END SUCTION	G-CE-228-1

Chevron BB 314738



G-CE-100-2

Revised 5/18/61 COP



G-CE-101-2

Revised 5/18/61 COP

Chevron BB
014739

COST ESTIMATING DATA

ITEM G-120-3

Material Class / Pump Mark	Prices: B-1 & B-2 Packed Pumps	B-1 & B-2 Built-in Mech Seal Pumps (See Note 4)	B-3 Packed Pumps	F-2 Packed Pumps	F-2 Built-in Mech Seal Pumps	Weight (lb) Pump & Base	Max. Case Working Pressure (psig)
A_1	$1060	$1010	$1175	$1705	$1645	575	600
B_1	1110	1040	1235	1835	1745	800	600
C_1	1305	1200	1425	2115	2010	1100	600
D_1	1340	1215	1465	2225	2100	1260	600
E_1	1265	1180	1380	1985	1900	625	600
F_1	1280	1195	1420	2105	2000	825	600
G_1	1410	1310	1530	2195	2115	700	600
H_1	1480	1365	1615	2385	2270	950	600
I_1	1595	1460	1740	2660	2545	1400	600
J_1	1580	1480	1725	2475	2330	800	600
K_1	1700	1575	1865	2720	2610	1225	600
L_1	1820	1670	1990	3055	2875	1450	600
M_1	1740	1615	1900	2810	2675	1000	600
N_1	1720	1595	1880	2780	2650	1050	600
P_1	1915	1740	2090	3100	2905	1350	600
Q_1	2085	1925	2280	3520	3405	1600	600
R_1	2045	1905	2235	3295	3145	1260	600
S_1	2190	2025	2395	3560	3350	1680	600
T_1	2180	*	2380	3680	*	2400	600
[illegible]$_1$	2890	2780	3200	4705	4580	1425	600
V_1	3660	*	3980	5650	*	2730	600
W_1	3980	*	4280	5975	*	2730	600
X_1	2945	2740	3230	4840	4675	1700	600
Y_1	2975	*	3265	4990	*	2525	400
Z_1	3755	*	4110	6420	*	3150	525
A_2	3910	*	4290	6720	*	3575	375
B_2	4285	*	4705	7610	*	3625	375

NOTES:

1. Refer to Item G-120-3, page 2 for Pump Selection.
2. Price includes Pump, Coupling, Coupling Guard, and Base - fob West Coast.
3. Price for Built-in Mech. Seal Pumps also includes Mech. Seal.
4. Price for built-in mechanical seal pumps are for B-1 materials. Add $25 per pump for B-2 materials.
5. To equip pumps designed for packing with mechanical seals, add the following to the prices listed above for packed pumps.

   Mat'l. Class B-1 & B-2 - $115 per seal)
   Mat'l. Class F-2 - $230 per seal) Seals good to 450F

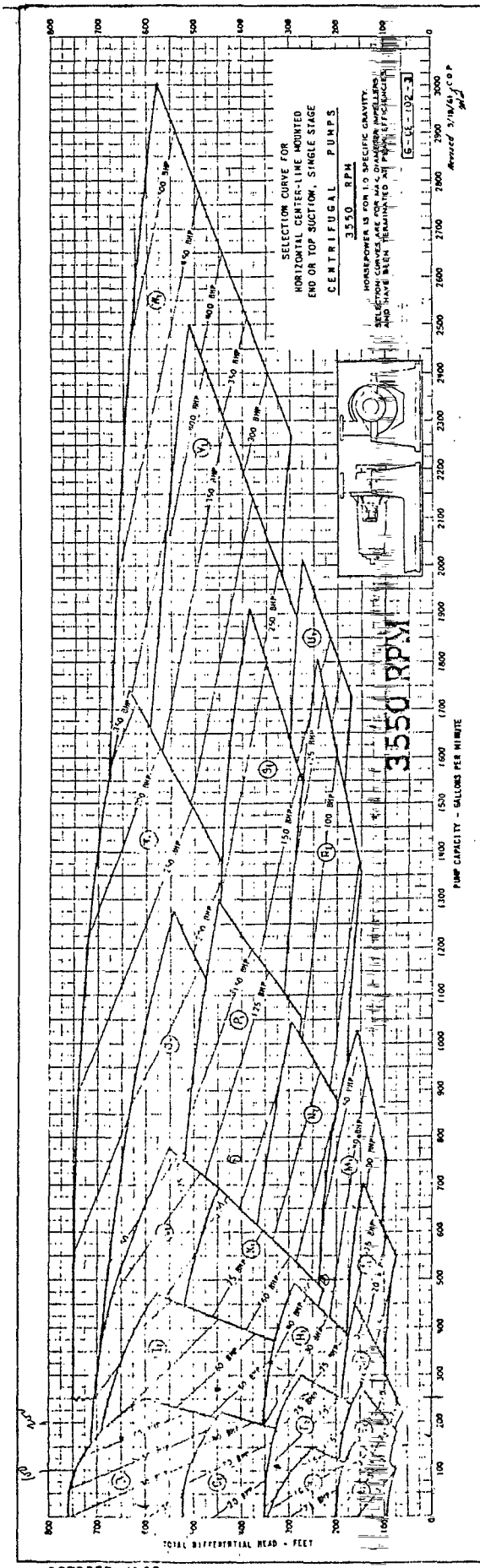
6. For B-5 Material Class (Ni-resist Impeller and Impeller Wear Rings) add 5% to B-1 material cost.
7. For 12% Chrome Case (for Temperatures of 700°-800°F) add 20% to B-3 material cost.

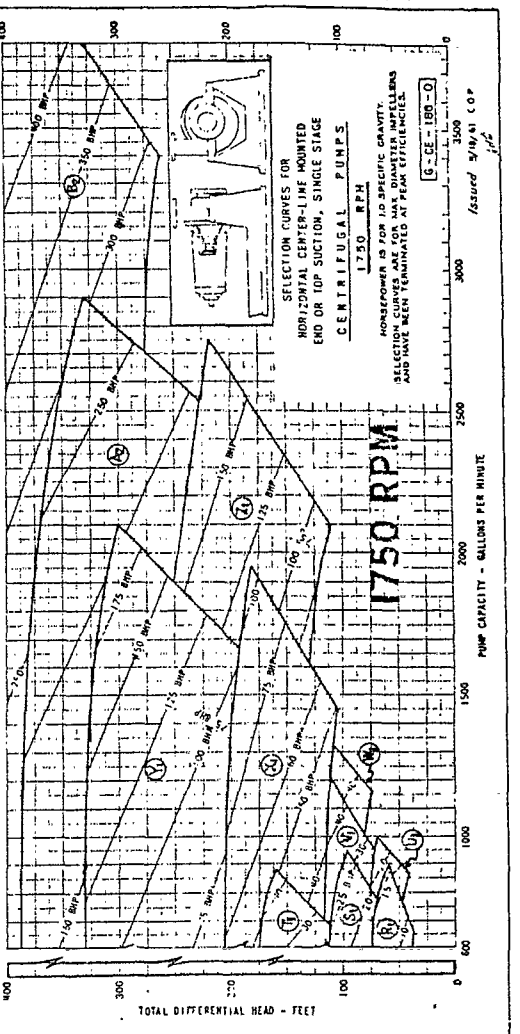
DATE- Aug., 1962	ESTIMATING PRICES FOR	STANDARD OIL COMPANY OF CALIFORNIA ENGINEERING DEPT. SAN FRANCISCO
EDC INDEX- 219	SINGLE-STAGE CENTRIFUGAL PUMPS	G-CE-229-2
APPROVALS-	CENTERLINE MOUNTED	

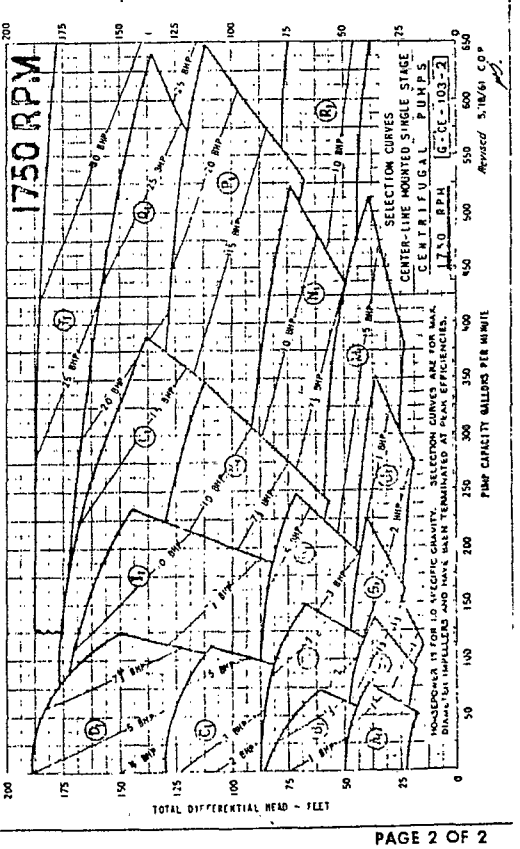
PRINTED IN U.S.A.

EF-585-E (400-CD-9-62)
PAGE 1 OF 2

Chevron BB
014740







Chevron BB
014741

Material Class (Per Item G-2) / Pump Mark	Prices						Wt. Pump & Base Lb	Max Case Workg Press psig
	B-1 & B-2 (Steel - CI Trim)		B-3 (Steel-12 CHR Trim)		F-2 (316 S.S.)			
	Overhung Impellers	Double Outboard Bearings	Overhung Impellers	Double Outboard Bearings	Overhung Impellers	Double Outboard Bearings		
A_3	$2100	-	$2300	-	$3415	-	1000	675
B_3	2605	$3500	2855	$3840	4375	$5620	1800	800
C_3	2920	3800	3195	4175	4800	6020	1900	800
D_3	3330	4200	3650	4600	5620	6840	2300	800
E_3	-	4575	-	5000	-	7620	3700	800
F_3	-	5775	-	6320	-	9610	4900	900
G_3	-	7930	-	8720	-	12880	7000	800

NOTES:

1. Refer to Item G-120-4, page 2 for selection.
2. Price includes pump, coupling, coupling guard, and base fob West Coast.
3. To equip pumps with MECHANICAL SEALS add the following per pump.

	Overhung Impeller Design	Double Outboard Bearing Design	
Mat'l Class B-1 & B-2	$115/pump	$230/pump)	Seals Good to 450F
Mat'l Class F-2	$280/pump	$560/pump)	

4. For 12% Chrome Case (for Temperatures of 700°-800°F) add 20% to B-3 material cost.

DATE- Aug., 1962	ESTIMATING PRICES FOR	STANDARD OIL COMPANY OF CALIFORNIA ENGINEERING DEPT. SAN FRANCISCO
EDC INDEX- 219	TWO-STAGE CENTRIFUGAL PUMPS	G-CE-230-2
APPROVALS-	3550 RPM - CENTERLINE MOUNTED, TOP SUCTION	

Chevron BB 014742

Chevron BB
014743

Chevron BB
014744

MATERIAL CLASS (PER ITEM G-2)	B-1 & B-2 (STEEL)		MAXIMUM CASE WORKING PRESSURE PSIG	WEIGHT PUMP & BASE (LB)	MATERIAL CLASS (PER ITEM G-2)	B-1 & B-2 (STEEL)		MAXIMUM CASE WORKING PRESSURE PSIG	WEIGHT PUMP & BASE (LB)
MAXIMUM TEMPERATURE	350°F (SEE NOTE 3)				MAXIMUM TEMPERATURE	350°F (SEE NOTE 3)			
PUMP MARK (SEE NOTE 5)	PRICE $				PUMP MARK (SEE NOTE 5)	PRICE $			
A_4	4,710		700	2,400	E_4	7,280		850	4,300
A_6	5,300		700	2,700	E_6	8,360		1,100	5,600
A_8	5,820		1,000	3,100	E_8	9,440		1,450	6,400
A_{10}	6,800		1,100	3,600	F_4	8,430		950	5,800
B_4	5,540		550	2,950	F_6	9,750		1,300	6,850
B_6	6,280		920	3,250	F_8	11,100		1,600	7,900
B_8	7,020		1,100	3,650	G_4	9,285		1,330	6,400
B_{10}	8,100		1,250	4,450	G_6	12,000		1,500	8,700
C_4	5,960		550	3,050	H_3	7,900		1,265	6,850
C_6	6,800		920	3,550	I_4	9,955		1,330	6,500
C_8	7,650		1,100	4,050	I_6	12,735		1,535	8,850
C_{10}	8,850		1,350	4,850	J_2	8,160		1,200	7,200
D_4	6,600		750	3,650	J_4	11,925		1,470	8,700
D_6	7,390		1,000	4,350					
D_8	8,340		1,150	5,050					
D_{10}	10,250		1,475	5,950					

NOTES

1. REFER TO ITEM G-120-5, PAGE 2 FOR SELECTION CURVES.
2. PRICE INCLUDES PUMP, COUPLING, COUPLING GUARD, AND BASE; F.O.B. WEST COAST.
3. HORIZONTALLY SPLIT CASE PUMPS, PUMPING FLAMMABLE OR TOXIC LIQUIDS ARE LIMITED TO 350°F, OR A VAPOR PRESSURE AT PUMPING TEMPERATURE OF 14 PSIA OR LESS. FOR SERVICES NOT WITHIN THESE CONDITIONS SEE ITEM G-120-6.
4. TO EQUIP PUMPS WITH MECHANICAL SEALS ADD $685 PER PUMP. MECHANICAL SEAL PRICE BASED ON JOHN CRANE 88 SEAL OR EQUAL, AND INCLUDES EXTRA FOR SPACER TYPE COUPLING. THIS TYPE SEAL CAN BE REPAIRED WITHOUT REMOVING TOP HALF OF PUMP CASE.
5. PUMP MARK SUBSCRIPTS INDICATE THE NUMBER OF STAGES.

REVISIONS				DATE - AUGUST 1962	ESTIMATING PRICES FOR	STANDARD OIL COMPANY OF CALIFORNIA ENGINEERING DEPT. SAN FRANCISCO
	4			EDC INDEX- 219	MULTI-STAGE CENTRIFUGAL PUMPS	
	3			APPROVALS-		G-CE-225-1
	2				3550 RPM - HORIZONTALLY SPLIT CASE	SHEET 1 OF 1
	1					

COST ESTIMATING DATA

ITEM G-120-5

SURES						
	150			160		210
PUMP PSIA	151			15		18
PSI	97			86		272
PSIA	248			110		290
FT	420			312		850
FT	6			6		7
P FT	4.5			5.25		6.5
ELLER EYE AT RATING FT/SEC	8.8			9.9		9.6
3Q IN.	5.5			5.5		7.0
ESSURE PSIG	267			267		500
ZE AND TYPE PUMP	United	VESCO		United	VESCO	Bf Woolsackson
	2"ES-BM			2"ES-B		2x3 V 11½ SM
	1			1		2
DATA SHEET)	54882	54883		54884	54885	260141
	50	47.5		55.5	56	48
	17.A	17.3		16.8	16.5	20.4
ELLER DIAMETER	27.5	25.3		22.6	23	90.0
	2.3	25		21.7	25	7.6
MAXIMUM / MINIMUM IN.	11 1/8	/		11 1/8	/	11 1/2
ATING IN.	10 3/8			10		11
	3550			3550		3550
COUPLING (CW) (CCW)	CCW			CCW		CCW
R COUPLED SHAFT	Coupled			Coupled		Yes
OR TURBINE	Turbine	Motor		Turbine	Motor	Turbine
HED BY	Purch			Purch		
OTOR		365-S			NF 365S	
MATERIAL						
	C.I.			C.I.		C.S.
	C.I.			C.I.		C.I.
	C.I.			C.I.		C.I.
	11-13 Cr			11-13 Cr Hd		11-13 Cr
	11-13 Cr			11-13 Cr Hd		11-13 Cr
REST WEAR RING IN.	3 3/4			3-3/4		
CLEARANCE IN.	0.020			0.020		
	SAE 4140			SAE 4140		11-13 Cr
	SAE 1020			SAE 1020		11-13 Cr Hd
TEND THROUGH GLAND?	Yes			Yes		Yes
	None			None		

STUFFING BOX, JACKETED OR PLAIN	JATO
MECHANICAL SEAL - TYPE	
NO. RINGS OF PACKING	7
DIMENSIONS: LENGTH OF STUFF. BOX IN.	3½
INSIDE DIAM IN.	2 3/8
DIAM SHAFT OR SHAFT SLEEVE IN.	1 5/8
WIDTH LANTERN RING IN.	3/4
℄ LANT. RING TO OPEN END BOX IN.	1 5/8
SIZE PACKING IN.	7/8 SF

H. BEARINGS & LUBRICATION

RADIAL - TYPE (SAE NO.)	Ball
THRUST - TYPE (SAE NO.)	Ball
TYPE OF CLOSURES	337 274
LUBRICATION: F = FLOOD, R = RING, G = GREASE	F
VISIBLE LUBRICATORS, ALVOR OR TRICO: CAP. OZ	Trico

I. CONNECTIONS

SUCTION: SIZE	3
RATING ASA	250
FACING	FF
NOZZLE DIRECTION	End
DISCHARGE: SIZE	2
RATING ASA	250
FACING	FF
NOZZLE DIRECTION	Top

J. TESTING

DYNAMIC BALANCING OF IMPELLER AT RATED SPEED	Yes
PERFORMANCE TEST (WITNESSED) (NOT WITNESSED)	Not Wit
HYDROSTATIC TEST (WITNESSED) (NOT WITNESSED)	Wit
HYDROSTATIC TEST PRESSURE, PSIG	400
INSPECTION REQUIRED?	Yes
RUNNING TEST WITH ACTUAL DRIVER	No

K. MISCELLANEOUS

PRICE EACH (FOB) (FAS) (NOT INCL. DRIVER)	
EXTRA COST FOR DRIVER	
EXTRA COST FOR	
EXTRA COST FOR	
WEIGHT OF BARE PUMP LB	
SHIPMENT FROM RECEIPT OF ORDER WEEKS	
OUTLINE DIMENSION DRAWING NO.	2C-1079
CROSS SECTION DRAWING NO.	PD57995
PERFORMANCE CURVE	5T273-A 5/1

Plant

MANUFACTURER:

REV. 1									APPROVALS
REV. 2									WPT
REV. 3									

Chevron BB
314745

Chevron BB
014746

CENTRIFUGAL PUMP DATA SHEET

IF EACH COLUMN IS NOT FILLED OUT FOR EACH PUMP BID WILL BE CONSIDERED INCOMPLETE.

THIS SHEET IS PART OF SPECIFICATION NO.

POWER: VOLTS 440 CYCLES 60 PHASES 3

STEAM: LBS./SQ. IN. GA. 100

SEE ATTACHED SHEET NO.

FOR REFERENCES, IF ANY See Hudson Eng. FILE NO. 24655

	G-3501 G-1	G-3501A G-1A	G-3502 G-2	G-3503 G-3	G-3504 G-4	G-3505 G-5
A. SERVICE						
B. LIQUID CHARACTERISTICS						
1. LIQUID PUMPED	Feed Gasoline	Spare for G-1 Gasoline	A. Fract. Reflux Gasoline	Side Cut Gasoline	A. Fract. Bottoms Naphtha	Stabilizer Reflux Butane
2. GPM AT FLOW TEMP.	298	292	165	112	127	144
3. SPEC. GRAV. AT FLOW TEMP.	0.70	0.70	0.62	0.69	0.79	0.55
4. FLOW TEMP. °F.	90	90	115	100	170	180
5. VISCOSITY AT FLOW TEMP. (SAE) Cent: Poise	0.47	0.43	0.24	0.70	1.4	0.13
6. VAPOR PRESS AT FLOW TEMP. (LBS./SQ.IN.ABS.)						
C. PRESSURES: (LBS./SQ. IN.)						
1. SUCTION AT PUMP (INCL. C-5) GAUGE OR ABSOLUTE	0	0	20	23	23	95
2. DIFFERENTIAL	170	170	35	32	37	55
3. DISCHARGE	170	170	55	55	60	150
4. HYDROSTATIC TEST ON CASE 1-1/2XB-12 GAUGE	600	600	400	400	400	400
5. EQUIV. LIQUID HEAD ABOVE LIQUID ~~WATER BASIS AT IMPELLER EYE~~ (NPSH) (FT.) Min.	6	6	5.5	5.5	5.5	5
6. DIFFERENTIAL HEAD (FT)	560	560	130	107	108	230
D. OPERATION						
1. EFFICIENCY AT RATING	71	71	66	67	68	45
2. BHP AT RATING	40	40	5.1	3.2	4.0	10.3
3. MINIMUM IMPELLER DIA. (INS.)	Lc	Lc	5-1/2"	5-1/2"	5-7/8"	8-1/2
4. BID IMPELLER DIA. (INS.)	LC, H5	Lc, H5	5-7/8"	5-1/2"	5-11/16"	8-1/2
5. MAXIMUM IMPELLER DIA. (INS.)	H	H	7-5/16	6-1/16	6-1/16	10-3/4
6. MAX. BHP FOR BID IMP. DIA.	50	50	6.5	3.2	4.3	12
7. MAX. BHP FOR MAX. IMP. DIA.	70	70	13.5	5.2	6	27.5
8. ENTRANCE VEL. AT RATING (FT./SEC.)	8	8	10.5	10.5	13	7.2
9. RPM	3550	3550	3550	3550	3550	3550
10. DIRECTION OF ROTATION: CW CCW (FACING PUMP COUPLING)	CCW	CCW	CW	CW	CW	CCW
11. NUMBER OF STAGES	6	6	1	1	1	1
12. MAX. CASING WORKING PRESS (LBS./SQ.IN.GA.) (SUPPLIER TO FILL OUT C-4)	400	400	250	250	250	300
E. CONSTRUCTION AND MATERIAL STATE EXTRA COST, IF ANY, FOR EACH ITEM						
1. CASE: INNER	C.1	C.1	None	None	None	None
OUTER	S teel	Steel	C.1	C.1	C.1	C.1
2. IMPELLER WEAR RINGS	None	None	None	None	None	Bronze
3. CASE WEAR RINGS	None	None	C.1.	C.1	C.1	C.1
4. SHAFT	12 Chrome	12 Chrome	1020	1020	1020	1020
5. SHAFT SLEEVES	12 Chrome	12 Chrome	12 Chrome	12 Chrome	12 Chrome	12 Chrome
6. IMPELLER	Bronze	Bronze	Bronze	Bronze	Bronze	Bronze
7. PACKING: NO. OF RINGS	8	8	9	8	9	8
8. LANTERN RING	Bronze	Bronze	Bronze	Bronze	Bronze	Bronze
9. THROAT BUSHING	Bronze	Bronze	None	None	None	None
10. CASING GASKET	Durd.	Durd.	Durd.	Durd.	Durd.	Durd.
11. CASING STUDS	12 Chrome	12 Chrome	4140	4140	4140	4140
12. GLAND BOLTS	4140	4140	4140	4140	4140	4140
13. FLEXIBLE COUPLING	B.J.	B.J.	Waldron	Waldron	Waldron	Waldron
14. BASE PLATE	Steel	Steel	S teel	Steel	Steel	Steel
15. STAGE PIECES	Bronze	Bronze	None	None	None	None
16. GLANDS	Steel	Steel	Steel	S teel	Steel	Steel
K. MANUFACTURER'S SIZE & TYPE PUMP	ORLc	ORLc	1-1/2 TLM2x3x10	1-1/2 TLM2x3x10	1-1/2 TLM2x3x10	1-1/2 TLM2x3x10
	ORH5	ORH5	1085	1085	1085	1050

	G-3501 G-1	G-3501A G-1A	G-3502 G-2	G-3503 G-3	G-3504 G-4	G-3505 G-5
17. SHAFT SLEEVES EXTEND THRU GLAND	Feed Yes	Spare for G-1 Yes	A. Fract Reflux Yes	Side Cut Yes	A. Fract. Bottoms Yes	Stabili Reflux Yes
18. COUPLING GUARD	No	No	Yes	Yes	Yes	Yes
19. STUFFING BOXES, (JACKETED OR PLAIN)	Jacketed	Jacketed	Plain	Plain	Jacket	Jacket
20. STUFFING BOXES – LENGTH INCHES	3-7/8"	3-7/8"	3-1/16"	3-1/16	3-1/16	3-7/8
21. STUFFING BOXES – INSIDE DIAM. INCHES	2-3/8"	2-3/8"	2-1/8"	2-1/8	2-1/8	2-5/8
22. DIAM. SHAFT SLEEVE INCHES	1-5/8"	1-5/8"	1-1/2"	1-1/2	1-1/2	1-7/8
23. WIDTH OF LANTERN RING INCHES	3/8"	3/8"	5/8	5/8	5/8	7/8
24. O.L. LANTERN RING TO OPEN END OF STUFF.BOX, IN.	1-1/4"	1-1/4"	1-3/16	1-3/16	1-3/16	2-3/8
25. SIZE OF PACKING IN.	3/8"	3/8"	5/16	5/16	5/16	5/8
F. BEARINGS AND LUBRICATION STATE EXTRA COST, IF ANY, FOR EACH ITEM						
1. THRUST: (SAE NO. ON FINAL DATA SHEET) Type & Make	See	See	307	307	307	5308
2. RADIAL: (SAE NO. ON FINAL DATA SHEET)	Driver	Driver	208	208	208	210
3. GREASE PACKED / FLOOD OILING / RING OILING	Driver	Driver				
THRUST	Driver	Driver	B	B	B	B
RADIAL	Driver	Driver	B	B	B	B
4. TYPE OF CLOSURES	Driver	Driver	B.J	B.J	B.J	B.J.
5. METHOD OF SEALING Labrinth Deflector	Driver	Driver	Yes	Yes	Yes	Yes
6. VISIBLE LUBRICATORS: TYPE Alyor	Driver	Driver	Yes	Yes	Yes	Yes
7. VISIBLE LUBRICATORS: CAPACITY	Driver	Driver	4 Oz.	4 oz.	4 oz.	4 oz.
G. CONNECTIONS						
1. SUCTION: SIZE	6"	6"	2-1/2"	2"	2"	3
2. SUCTION: RATING	150#	150#	125#	125#	125#	250#
3. SUCTION: FACING	ASA R.F.	ASA R.F.	F.F.	F.F.	F.F.	F.F.
4. DISCHARGE: SIZE	4"	4"	2"	1-1/2"	1-1/2"	2"
5. DISCHARGE: RATING	150#	150#	125#	125#	125#	250#
6. DISCHARGE: FACING	ASA R.F.	ASA R.F.	F.F.	F.F.	F.F.	F.F.
7. VENTS AND DRAINS 1/2" MINIMUM	1/2"	1/2"	3/8"	3/8"	3/8"	1/4"
H. TESTING STATE EXTRA COST, IF ANY, FOR EACH						
1. DYNAMIC BALANCING OF IMPELLERS	No	No	No	No	No	No
2. WITNESSED PERFORMANCE TEST	No	No	No	No	No	No
3. HYDROSTATIC TEST	Yes	Yes	Yes	Yes	Yes	Yes
4. INSPECTION	No	No	No	No	No	No
5. RUNNING TEST WITH ACTUAL DRIVER	No	No	No	No	No	No
J. MISCELLANEOUS						
1. PRICE EACH FOR El Paso	$1232.50	$1232.50	$475.00	$475.00	$527.50	$780.00
2. WEIGHT (LBS.)	1400	1400	300	300	300	1100
3. SHIPMENT FROM RCPT. OF ORDER, WEEKS						
4. SUCTION: DOUBLE OR SINGLE	Single	Single	Single	Single	Single	Single
5. DRIVER HP	71	50	7-1/2	5	5	15
6. TYPE OF DRIVER: MOTOR OR TURBINE	Turbine	Motor	Motor	Motor	Motor	Motor
7. DRIVER: INTEGRAL, COUPLED	Coupled	Coupled	Coupled	Coupled	Coupled	Coupled
8. PERFORMANCE CURVE	210318	210317	210319	210320	210321	210322
9. OUTLINE DRAWING	LF-1729	LF-1729	2B-5280	2B-5277	2B-5277	2B-5278
10. CROSS SECTION DWG.	1A210318	1A210317	1B-2197	1B-2197	1B-2198	1B-2200
11. HERS SERIAL NO. ON FINAL DATA SHEET	H210318	H210317	H210319	H210320	H210321	H210322
For Characteristic Rating Sheets see			TL-2-1	TL-2-1	TL-2-1	TL-2-1

PLANT: Pasco Manufacturer
El Paso Refinery
Standard Oil Co. of Tex.

MANUFACTURER: Byron Jackson Company

REV. 1
REV. 2
REV. 3

APPROVALS

11/8/47

(2) 160,182

Chevron BB
014747

DIRECT - ACTING STEAM PUMP DATA SHEET

THIS SHEET IS A PART OF SPECIFICATION NO. E-1002 FILE NO.

PUMP NUMBER	P-403 Reserved w/ G-406	P-403A Reserved w/ G-406	G-406	G-406
A. SERVICE	Hvy	Spare	Lt.	Syn Col
B. LIQUID CHARACTERISTICS	Gasoline	P402	Gas Oil	Bottoms
LIQUID PUMPED	Gasoline		Gas Oil	—
SPECIFIC GRAVITY AT FLOW TEMPERATURE	.795		.845	0.83
FLOW TEMPERATURE — F	345		380	700
VISCOSITY AT FLOW TEMPERATURE — (CENTISTOKES OR SSU)	0.46		0.50	0.88
VAPOR PRESSURE AT FLOW TEMPERATURE — PSIA				
C. CAPACITY AND PRESSURES				
GPM AT FLOW TEMPERATURE	17		15	19
SUCTION PRESSURE AT PUMP — PSIA	39		20	25
DIFFERENTIAL — PSI	41		68	14
DISCHARGE — PSIA	80		88	39
NET POSITIVE SUCTION HEAD AVAILABLE — PSI	70		18	18
NET POSITIVE SUCTION HEAD REQUIRED BY PUMP — PSI				
STALLING PRESSURE AT RATED SUCTION PRESSURE — PSI	143		143	143
MAX. ALLOWABLE LIQUID END WORKING PRESSURE — PSIG	450		450	450
MAX. ALLOWABLE STEAM END WORKING PRESSURE — PSIG	200		200	200
D. STEAM CHARACTERISTICS				
INLET STEAM — PSIG	110		110	110
QUALITY — %	100		100	100
SUPERHEAT — °	0		0	0
EXHAUST PRESSURE — PSIG	15		15	15
E. MANUFACTURER'S SIZE AND TYPE PUMP	Union	Same	Union	Union
SIZE: DIAM STEAM X DIAM LIQUID X STROKE — IN.	5x3½x12		5x3½x12	5x3½x12
MFR'S MODEL NO. OR CATALOG REFERENCE	105		105	105
SIMPLEX OR DUPLEX	Simplex		Simplex	Simplex
PISTON OR PLUNGER	Piston		Piston	Piston
VALVE PLATE (VP), SIDE PORT (SP), CLOSE CLEARANCE (CC)	SP		SP	SP
PUMP SERIAL NO. (OR FINAL DATA SHEET)	247277	247278	247279	247300
F. OPERATING DATA				
VELOCITY THRU VALVES — FT/MIN	95		84	106
TOTAL SUCTION VALVE AREA — SQ. IN.	3.546		3.546	3.546
RPM AT RATING	19		16.5	21.0
MAX. ALLOWABLE RPM	30		30	30
PISTON SPEED AT RATING — FT/MIN	38		33	42
PRESSURE REQUIRED TO LIFT SUCTION VALVES — PSI				
G. CONSTRUCTION AND MATERIAL				
LIQUID END				
CYLINDER MATERIAL	C.I.		C.I.	C.S.
CYLINDER LINER MATERIAL	C.I.		C.I.	C.I.
CYLINDER LINER: [REMOVABLE] OR [REPLACEABLE (PRESSED IN)]	Remove		Remove	Remove
CYLINDER GASKETS MATERIAL	Asbes.		Asbes.	Asbes.
STUFFING BOX (JACKETED) (PLAIN)	Jacket		Jacket	Jacket
GLAND	C.I.		C.I.	C.I.
GLAND BOLTS	Stl.		Stl.	Stl.
CYLINDER STUDS	Stl.		Stl.	Stl.
PISTON (OR PLUNGER)	C.I.		C.I.	C.I.
PISTON PACKING	C.I.		C.I.	C.I.
PISTON ROD	11-13 Cr		11-13 Cr	11-13 Cr
VALVES: MATERIAL	11-13 Cr		11-13 Cr	11-13 Cr
VALVES: TYPE	Wing		Wing	Wing
VALVE SEATS	11-13 Cr		11-13 Cr	11-13 Cr
VALVE STEMS				
VALVE SPRINGS				

	P-403 Reserved w/ G-406	P-403A Reserved w/ G-406	G-406	G-406
STEAM END:				
VALVE: TYPE	Burnham	Same	Burnham	Burnham
TYPE AND SIZE OF LUBRICATOR	Manzel		Manzel	Manzel
H. CONNECTIONS				
SUCTION: SIZE	2½		2½	2½
RATING — ASA	250		250	150
FACING	RF		RF	SM GR
DISCHARGE: SIZE	2		2	2
RATING — ASA	250		250	150
FACING	RF		RF	SM GR
STEAM INLET: SIZE	½		½	½
RATING — ASA				
FACING	PT		PT	PT
EXHAUST: SIZE	¾		¾	¾
RATING — ASA				
FACING	PT		PT	PT
COMPANION FLANGES (WELDING) (SCREWED) — INDICATE IF FURNISHED	None		None	None
VENTS, SIZE				
DRAINS, SIZE				
J. STUFFING BOX DIMENSIONS				
LIQUID END:				
LENGTH OF STUFFING BOX — IN.	6 5/8		6 5/8	6 5/8
INSIDE DIAMETER OF STUFFING BOX — IN.	2		2	2
DIAMETER OF ROD — IN.	1 1/4		1 1/4	1 1/4
WIDTH OF LANTERN RING — IN.	1 3/8		1 3/8	1 3/8
C. LANTERN RING TO OPEN END OF BOX — IN.				
SIZE PACKING — IN.	3/8		3/8	3/8
NO. RINGS PACKING PER BOX	13		13	13
STEAM END:				
LENGTH OF STUFFING BOX — IN.	2 ½		2 ½	2 ½
INSIDE DIAMETER OF STUFFING BOX — IN.	2 ¼		2 ¼	2 ¼
DIAMETER OF ROD — IN.	1 ¼		1 ¼	1 ¼
SIZE OF PACKING — IN.	½		½	½
NO. RINGS PACKING PER BOX	5		5	5
VALVE RODS:				
LENGTH OF STUFFING BOX — IN.	1 1/4		1 1/4	1 1/4
INSIDE DIAMETER OF BOX — IN.	5/8		5/8	5/8
DIAMETER OF ROD — IN.	3/8		3/8	3/8
SIZE PACKING — IN.	1/8		1/8	1/8
NO. RINGS PACKING PER BOX	8		8	8
NO. BOXES PER PUMP	2		2	2
K. TESTING				
HYDROSTATIC TEST OF ASSEMBLED LIQUID END — PSIG	650		650	650
(WITNESSED) (NOT WITNESSED)	No		No	No
INSPECTION REQUIRED?	Yes		Yes	Yes
L. MISCELLANEOUS				
PRICE, EACH (FOB) (FAS)				
EXTRA COST FOR				
EXTRA COST FOR				
WEIGHT OF BARE PUMP				
SHIPPING WEIGHT	640		640	700
SHIPMENT FROM RECEIPT OF ORDER — WEEKS				
OUTLINE DIMENSION DRAWING NO.	55463		55463	45464
CROSS-SECTION DRAWING NO.	SS-22		SS-22	SS-22

PLANT: Syn Crude Unit

MANUFACTURER:

REV.	
REV.	
REV.	

APPROVALS: WRH 5-1-52

GD-6572-1

EF-13 (500-CO - 6-50)

Chevron BB
014748

THIS SHEET IS PART OF SPECIFICATION NO. E 1002

HORIZONTAL CENTRIFUGAL PUMP DATA SHEET

FILE NO.

PUMP NUMBER	G-404A	G-405	G-405A	G-407	G-407A
	Spare G-404	Recycle Gas Oil	Spare G-405	Quench	Spare G-407
A. SERVICE					
B. LIQUID CHARACTERISTICS					
LIQUID PUMPED	Syn Cl Ref.	Gas Oil		Quench Oil	
SPECIFIC GRAVITY AT FLOW TEMP	0.785	0.78		0.9 / .845	
FLOW TEMP F	530	530		525 / 700	
VISCOSITY AT FLOW TEMP (CENTISTOKES) (SSU)					
VAPOR PRESSURES AT FLOW TEMP PSIA					
C. CAPACITY AND PRESSURES					
GPM AT FLOW TEMP	1110	205		685 / 107	
SUCTION PRESSURE AT PUMP PSIA	28	74		16 / 16	
DIFFERENTIAL PSI	46	133		37 / 77	
DISCHARGE PSIA	74	207		53 / 93	
DIFFERENTIAL HEAD FT	133	395		101 / 212	140
NPSH AVAILABLE FT	40	200		8.5	
NPSH REQUIRED BY PUMP FT	14.5	9.6		8.5	
ENTRANCE VEL. AT IMPELLER EYE AT RATING FT/SEC	16.6	8.45		10.25	
IMPELLER EYE AREA SQ IN.	21.5	7.8		21.5	
MAX. CASE WORKING PRESSURE PSIG	500	285		500	
D. MANUFACTURER'S SIZE AND TYPE PUMP	Byron Jackson 4x6x8HH	United 2" TC-B	Same	Byron Jackson 4x6x8H	Same
NUMBER OF STAGES	1	1		1	
SERIAL NO. (ON FINAL DATA SHEET)	260136	55333	55334	260137	260138
E. OPERATION					
EFFICIENCY AT RATING %	68	53		67 / 19	
BHP AT RATING	43	30.2		32.5 / 25.5	32.5
MAX. BHP FOR BID IMPELLER DIAMETER	44.2	45	46.5	31.0	33.0
DRIVER HORSEPOWER	50	46	40	37.2	40.0
IMPELLER DIAMETER, MAXIMUM / MINIMUM IN.	8 1/4	13/9		8 / 6	8 / 6
IMPELLER DIAM FOR RATING IN.	7	10 1/2		6 3/8	6 3/8
RPM	3550	3550		3550	3550
ROTATION FACING PUMP COUPLING (CW) (CCW)	CCW	CCW			
DRIVER: INTEGRAL OR COUPLED SHAFT	Motor	Coupled Turbine	Motor	Turbine	Motor
TYPE DRIVER: MOTOR OR TURBINE		Pump			
DRIVER TO BE FURNISHED BY					
MOTOR DATA SHEET NO.					
NEMA FRAME NO. OF MOTOR			405 S		
F. CONSTRUCTION AND MATERIAL					
CASE: OUTER	C.S.	C.S.		C.S.	
INNER	—	—			
IMPELLER	11-13 Cr	12% Cr		11-13 Cr	
CASE WEAR RINGS	11-13 Cr	Type 410		11-13 Cr	
IMPELLER WEAR RINGS	11-13 Cr	Type 410		11-13 Cr	
NOMINAL DIAM OF LARGEST WEAR RING IN.	6 7/16	5 1/2		6 7/16	
DIAMETRAL WEAR RING CLEARANCE IN.	.031	0.030		.036	
SHAFT	11-13 Cr	SAE 4140		11-13 Cr	
SHAFT SLEEVES	11-13 Cr Steel	11-13 Cr		11-13 Cr Steel	
DO SHAFT SLEEVES EXTEND THROUGH GLAND?	Yes	Yes		Yes	
STAGE PIECES		NONE			

	G-404A	G-405	G-405A	G-407	G-407A
THROAT BUSHING	11-13 Cr	18-8		11-13 Cr	
LANTERN RING	11-13 Cr	18-8		11-13 Cr	
GLAND (BRONZE-LINED, SPLIT, COWL-TYPE REQ'D)	11-13 Cr Bronze	C.S. Bronze		11-13 Cr Bronze	
GLAND BOLTS	11-13 Cr	12% Cr		11-13 Cr	
CASING STUDS	SAE 4140	4140		SAE 4140	
CASING GASKET		Asbestos			
BASE PLATE (DRAIN-RIM TYPE) (EXT. FOR DRIVER)	STL	STL		STL	
FLEXIBLE COUPLING, TYPE	Waldron	Falk		Waldron	
COUPLING GUARD REQUIRED?	Yes	Yes		Yes	
G. STUFFING BOX DETAILS					
STUFFING BOX, JACKETED OR PLAIN	Jacket	Jkt'd		Jacket	
MECHANICAL SEAL TYPE					
NO. RINGS OF PACKING	8	9		8	
DIMENSIONS: LENGTH OF STUFF-BOX IN.	5 4/16	5 1/8		5 5/16	
INSIDE DIAM IN.	3 1/8	3 1/4		3 1/8	
DIAM SHAFT OR SHAFT SLEEVE IN.	2 1/8	2 1/4		2 1/8	
WIDTH LANTERN RING IN.		1			
℄ LANT.-RING TO OPEN END BOX IN.		3 1/8			
SIZE PACKING IN	1/2	1/2 sq		1/2	
H. BEARINGS & LUBRICATION					
RADIAL - TYPE (SAE NO.)	Ball	Ball	Same	Ball	Same
THRUST - TYPE (SAE NO.)	Ball	Ball 180		Ball	
TYPE OF CLOSURES	CI	230		CI	
LUBRICATION: F = FLOOD, R = RING, G = GREASE	R	R		R	
VISIBLE LUBRICATORS, ALVOR OR TRICO: CAP. OZ	Alvor	Trico		Alvor	
I. CONNECTIONS					
SUCTION: SIZE	6	4		6	
RATING ASA	150	300		150	
FACING	S.G.	S.G.		S.G.	
NOZZLE DIRECTION	End	End		End	
DISCHARGE: SIZE	4	2		4	
RATING ASA	150	300		150	
FACING	S.G.	S.G.		S.G.	
NOZZLE DIRECTION	Top	Top		Top	
J. TESTING					
DYNAMIC BALANCING OF IMPELLER AT RATED SPEED	Yes	Yes		Yes	
PERFORMANCE TEST (WITNESSED) (NOT WITNESSED)		Not Wit.			
HYDROSTATIC TEST (WITNESSED) (NOT WITNESSED)		Not T.			
HYDROSTATIC TEST PRESSURE, PSIG	750	500		750	
INSPECTION REQUIRED?	Yes	Yes		Yes	
RUNNING TEST WITH ACTUAL DRIVER	No	No		No	
K. MISCELLANEOUS					
PRICE EACH (FOB) (FAS) (NOT INCL. DRIVER)					
EXTRA COST FOR DRIVER					
EXTRA COST FOR					
EXTRA COST FOR					
WEIGHT OF BARE PUMP LB					
SHIPMENT FROM RECEIPT OF ORDER WEEKS					
OUTLINE DIMENSION DRAWING NO.	28-7134	2C-1118	2G-12174	28-7133	28-7126
CROSS SECTION DRAWING NO.	1F-2138	*	*	1F-2138	
PERFORMANCE CURVE	260135	52772-1	52773	260137	

PLANT: Syn. Crude Unit

MANUFACTURER:

REV.	
1	Cross Section
2	
3	

APPROVALS: WFW 5-1-56

GD-6591-1

FF-153 (500-CD - 5-56)

Chevron BB
014749

THIS SHEET IS PART OF SPECIFICATION NO. E-1002

HORIZONTAL CENTRIFUGAL PUMP DATA SHEET

FILE NO.

PUMP NUMBER	G-401	G-401A	G-402	G-402A	G-404
	Top Reflux	Spare G-401	Light Gasoline	Spare G-402	Circ. Reflux
A. SERVICE					
B. LIQUID CHARACTERISTICS					
LIQUID PUMPED	Synth Ref.	"	Lt Gasoline	"	Synth Ref.
SPECIFIC GRAVITY AT FLOW TEMP	0.766		0.73		0.775
FLOW TEMP °F	300		100		530
VISCOSITY AT FLOW TEMP (CENTISTOKES) (SSU)					
VAPOR PRESSURES AT FLOW TEMP PSIA					
C. CAPACITY AND PRESSURES					
GPM AT FLOW TEMP.	234		93		1180
SUCTION PRESSURE AT PUMP PSIA	17		16		23
DIFFERENTIAL PSI	43		69		46
DISCHARGE PSIA	60		85		74
DIFFERENTIAL HEAD FT.	130		218		133
NPSH AVAILABLE FT.	6		6		40
NPSH REQUIRED BY PUMP FT.	2.7		4.35		14.5
ENTRANCE VEL. AT IMPELLER EYE AT RATING FT/SEC	6.15		8.1		16.6
IMPELLER EYE AREA SQ IN.	12.2		3.7		21.5
MAX. CASE WORKING PRESSURE PSIG	333		267		500
D. MANUFACTURER'S SIZE AND TYPE PUMP	Unifab 3"ES-B	Same	United 1½ ES-B	Same	Byron Jackson 4x6x9 HM
NUMBER OF STAGES	1		1		1
SERIAL NO. (ON FINAL DATA SHEET)	54908	54909	54910	54911	266135
E. OPERATION					
EFFICIENCY AT RATING %	65	70	53		68
BHP AT RATING	4.65	5.66	7.45	7.12	11.3
MAX. BHP FOR BID IMPELLER DIAMETER	5.6	6.5	9.95	10	14.2
DRIVER HORSEPOWER	12	15	18		15
IMPELLER DIAMETER, MAXIMUM / MINIMUM IN.	10 5/8 / 9 3/4	"	10 / 6 1/4	"	8 3/4 / 7 1/4
IMPELLER DIAM FOR RATING IN.	10 5/8		7 3/4		7
RPM	1750		3550		3550
ROTATION FACING PUMP COUPLING	CCW		CCW		CCW
DRIVER: INTEGRAL OR COUPLED SHAFT	Coupled		Coupled		Coupled
TYPE DRIVER: MOTOR OR TURBINE	Terbine Purch	Motor	Turbine	Motor	Turbine
DRIVER TO BE FURNISHED BY					
MOTOR DATA SHEET NO.					
NEMA FRAME NO. OF MOTOR		326		284	
F. CONSTRUCTION AND MATERIAL					
CASE: OUTER	Cr-Ni c.i.		Cr-Ni c.i.		C.S.
INNER					
IMPELLER	c.i.		c.i.		11-13 Cr
CASE WEAR RINGS	Type 420		11-13 Cr		11-13 Cr
IMPELLER WEAR RINGS	Type 420		11-13 Cr		11-13 Cr
NOMINAL DIAM OF LARGEST WEAR RING IN.	5 3/8		4"		6 7/16
DIAMETRAL RADIATING CLEARANCE IN.	0.021		0.020		.031
SHAFT	SAE 4140		SAE 4140		11-13 Cr
SHAFT SLEEVES	SAE 1020	"	SAE 1020	"	11-13 Cr SAE
DO SHAFT SLEEVES EXTEND THROUGH GLAND?	Yes		Yes		Yes
STAGE PIECES	None		None		

	G-401	G-401A	G-402	G-402A	G-404
THROAT BUSHING	None		None		11-13 Cr
LANTERN RING	C.I.		C.I.		11-13 Cr
GLAND (BRONZE-LINED, SPLIT, COMPRESSION TYPE)	C.S.		C.S.		11-13 Cr
GLAND BOLTS	11-13 Cr		11-13 Cr.		11-13 Cr
CASING STUDS	4140		4140		SAE 4140
CASING GASKET	Durabla		Durabla		Durabla
BASE PLATE (DRAIN-RIM TYPE) (EXT FOR DRIVER)	STL		STL		STL
FLEXIBLE COUPLING, TYPE	Waldron		Waldron		Waldron
COUPLING GUARD REQUIRED?	yes		yes		Yes
G. STUFFING BOX DETAILS					
STUFFING BOX, JACKETED OR PLAIN	Plain		Plain		Jacket
MECHANICAL SEAL - TYPE					
NO. RINGS OF PACKING	7		7		8
DIMENSIONS: LENGTH OF STUFF. BOX IN.	3½		3½		5 5/16
INSIDE DIAM IN.	2 3/8		2 3/8		3 1/8
DIAM SHAFT OR SHAFT SLEEVE IN.	1 5/8		1 5/8		2 1/8
WIDTH LANTERN RING IN.	¾		¾		
LANT. RING TO OPEN END BOX IN.	1 5/8		1 5/8		
SIZE PACKING IN.	½ SQ		½ SQ		½
H. BEARINGS & LUBRICATION					
RADIAL - TYPE (SAE NO.)	Ball	Same	Ball	Same	Ball
THRUST - TYPE (SAE NO.)	Ball		Ball		Ball
TYPE OF CLOSURES	Felt		Felt		CI
LUBRICATION: F = FLOOD, R = RING, G = GREASE	F		F		R
VISIBLE LUBRICATORS, ALVOR OR TRICO: CAP. OZ.	Trico		Trico		Alvor
I. CONNECTIONS					
SUCTION: SIZE	6"		3"		6"
RATING ASA	250		250		150
FACING	FF		FF		S.G.
NOZZLE DIRECTION	End		End		End
DISCHARGE: SIZE	3"		1½"		4"
RATING ASA	250		250		150
FACING	FF		FF		S.G.
NOZZLE DIRECTION	Top		Top		Top
J. TESTING					
DYNAMIC BALANCING OF IMPELLER AT RATED SPEED	Yes		Yes		Yes
PERFORMANCE TEST (WITNESSED) (NOT WITNESSED)	Not Wit.		Not Wit.		
HYDROSTATIC TEST (WITNESSED) (NOT WITNESSED)	Wit.		Wit.		
HYDROSTATIC TEST PRESSURE, PSIG	500		400		750
INSPECTION REQUIRED?	Yes		Yes		Yes
RUNNING TEST WITH ACTUAL DRIVER	No		No		No
K. MISCELLANEOUS					
PRICE EACH (FOB) (FAS) (NOT INCL. DRIVER)					
EXTRA COST FOR DRIVER					
EXTRA COST FOR					
EXTRA COST FOR					
WEIGHT OF BARE PUMP LB					
SHIPMENT FROM RECEIPT OF ORDER WEEKS					
OUTLINE DIMENSION DRAWING NO.	26-1274	26-1287	26-1275	26-1285	27-1133
CROSS SECTION DRAWING NO. * PD-5775-5	PD-5775	"	"	"	PF-2128
PERFORMANCE CURVE	517-325	517-326	517-326A	517-326-A	266135

PLANT: Syn. Crude Unit

MANUFACTURER:

REV.	Changed pump numbers 5-21	HCL
REV.		
REV.		

APPROVALS: WPH 5-1-52

GD-6570-1

FF-150 (400-CB-1-49)

COST SUMMARY FOR:
- ☐ Columns
- ☐ Vessels
- ☐ Exchangers
- ☐ Heaters
- ☐ Pumps
- ☐ Mechanical

J. INSTRUMENTS

HCC

Da
By

Item

Rev. ①

	M	M	T	③
	80,000	35,000		
less credit for reuse of mat'l	8,000	4,000		
	72,000	31,000		
+15%	14,000	4,000		
	$86,000	$33,000	$109,000	
+ ALKY CR MOD.	2,000	2,000		
	79,000	35,000	122,000	
PSV's	4,000	2,000		
	83,000	37,000		
use	80,000	40,000		
SUB-TOTAL				
Estimating Factor				
TOTAL CATEGORY	90,000	40,000		

Including Field Extras

Notes & Revisions

①

②

③

PRINTED IN USA

EF-513 (150-CD-3-60)

Chevron BB
014751

CALCULATION SHEET GO-144-2T

PROJECT No. _____ SHEET No. _____

TITLE J. INITIALS _____

SUBJECT _____ DATE _____

Reuse of CV's & PSV's

x out on reuse

	LINE SIZE	NEW CV SIZE	EXIST CV #	EXIST CV SIZE
C-401 DIESEL	3"	2"		ok
C-401 BTMS	6"	4"	TRC-402, 406 (4)	4" ok
C-401 to C-403	6"	6"	LRC-403	1½ x
C-401 to C-402	4"	4"	LC-404	1¼" X
C-401 Top reflux	6"	4"	LC-405 ok	(2") X
C-402 Btms	4"	3"	TCV-403	(3") X
C-403 BTms	3"	2"	FRC-411 ok	1¼" X
C-401 inter. reflux	6"	4"	TCV-404 ok	1¼ x
E-18 quench	2"	1½"	FRC-406	6" ok
D-402 OH	6"	4"	LRC-408	1" ok
D-402 BTMS	4"	3"	PC-410	10" ok
C-503 Btms	3"	2"	LRC-409	(2") X
C-503 reflux	3"	2"	FCV-508	3" ok
C-503 net OH	3"	2"	FCV-510	1" ok
			LRC-516	2" ok

NEED – 1 – 6"
1 – 4"
1 – 3"

¾	1	1½	2	3	4	6
		1	𝍸	𝍷	𝍸	1
		1	5	2	5	1

plus 1 good

2	5	8	13	2

NEED △ 2 (4) 3 9 (1) 1

400 500

– $2000 2000

– 2000

for reuse of CV's. $4,000

GO-144-2T (124M-8 51)
PRINTED IN U.S.A.

Chevron BB
014752

MEMORANDUM GO-144

MR. J.H. LYLE 11/6 19 69

FROM: MR. D.A. Bellamy/GIR 11/7/69

SUBJECT: EL PASO HCC CONVERSION TO CU OUR FILE: W.O. 6728

YOUR FILE:

Pursuant to your memo of October 22, we have prepared estimates of the instrument costs for the conversion of the HCC unit, the installation of the Jet Bender Treater, and the relocation of the Vacuum Flasher board instruments to the Gas Recovery control room.

The HCC conversion and Jet Bender estimates were based on the assumption that all instrumentation will be new, i.e., new transmitters, controllers, recorders, control values, control panel, annunciator, etc. Please refer to the attached list of items not included in these estimates.

The Vacuum Flasher estimate is for the installation of a new control panel (complete with controllers, recorders, indicators, annunciator, and temperature multi-point) in the Gas Recovery control room. This estimate assumes that: 1) only existing field instrumentation (transmitters, control values, etc.) will be used; 2) there is adequate existing spare pneumatic tubing to transmit signals from the HCC control room to the Gas Recovery control room; 3) there is an existing

Chevron BB
014753

MEMORANDUM GO-144

MR. JHL 11/6 1969

FROM: MR. DAB/CGJR

SUBJECT: OUR FILE:

YOUR FILE:

emergency power supply for the new panel. The estimate was based on the use of Foxboro 1000 series pneumatic instruments. The estimate also includes $3000 for the removal and replacement of a control room wall to allow entry of the new control panel.

ESTIMATE	MAT'L.	LABOR	TOTAL
HCC CONVERSION	80,000	35,000	115,000
JET BENDER	25,000	15,000	40,000
VACUUM FLASHER	22,000	13,000	35,000

We will be glad to provide any further details concerning these estimates upon your request.

Chevron BB
014754

ITEMS NOT INCLUDED IN HCC CONVERSION & J.. EER

B. Related equipment and materials

These items are usually included with the estimates for other material categories.

1. Relief valves.
2. Control valve manifold and labor to install control valves.
3. Rotameter manifolds and labor to install rotameters.
4. Instrument air supply headers in main pipeways and instrument air supply piping to instrument panels.
5. Plant instrument air compressor, dryers, oil mist removal, knockout pots.
6. Support structures - Racks attached to main pipeways for instrument tubing and conduit.
7. Underground conduit for instrument tubing or wiring cables.
8. Insulation on instruments and instrument leads.
9. Steam supply and condensate removal piping for steam traced instruments.
10. Electronic instrument signal cables or field terminal boxes.
11. Alarm and signal wire and conduit.
12. Thermocouples and thermocouple extension wires, conduit, and connecting hardware.
13. Orifice flanges and labor to install orifice plates.
14. Access ladders and platforms to instruments.
15. Electrical power supply, batteries, chargers, static inverters.
16. First connections on lines and vessels, i.e., the boss or flange.
17. Control room clocks.
18. Control room chart tables.
19. Field painting.
20. "Package" instrumentation supplied with equipment.
21 Tank gaging.

C. Other

1. Instrument spare parts.
2. Instrument shop facilities, laboratory equipment, testing equipment.
3. Other miscellaneous material as noted on the estimate sheets.

Note that the various sections and paragraphs on the forms are numbered in the left-hand column. To save space, the paragraphs have not been indented in many cases, only the reference numbers are indented. The numbering system is designed for the Spade J computer instrument estimating system.

Chevron BB
014755

P N E U M A T I C

HOUDRY FRACTIONATOR CONVERSION
GEORGE J ROESSLER

EL PASO REFINERY
OCT 29,1969

ENGINEERING DEPARTMENT PROGRAM - SPADE J
PROBLEM NO. 1

C O N T R O L V A L V E
I N F O R M A T I O N

	NUMBER OF VALVES OF EACH SIZE(IN) .75	1.0	1.5	2.0	3.0	4.0	6.0	8.0	10.	12.	12.+	COST OF VALVES($) FOR EACH TYPE OF MATERIAL	LABOR	NUMBER OF CONTROL VALVE POSITIONERS	RATIO OF NUMBER OF ALLOY CONTROL VALVES TO NUMBER OF CARBON STEEL CONTROL VALVES
STANDARD	2		5	8	13	2						15396.	4761.		
ALLOY														23	

U T I L I T Y A N D E Q U I P M E N T
I N F O R M A T I O N

ITEM	NUMBER	MATERIAL COST($)	LABOR COST($)
UTILITY STREAMS--NUMBER,COST OF INSTRUMENTATION			
UTILITY WINTERIZATION			
PANEL ANNUNCIATORS--COSTS ONLY		1409.	
PANEL MOUNTED,MULTIPOINT TEMPERATURE INDICATORS	1	1557.	
TOTAL COSTS OF MINOR INSTRUMENTS		2169.	2022.
STANDARD PRESSURE GAUGES	4		
ALLOY PRESSURE GAUGES			
DIAL THERMOMETERS	3		
STANDARD LEVEL GAUGES	1		
ALLOY LEVEL GAUGES			
FIELD ALARM SWITCHES	2		
TRANSMITTED AIR ALARMS--NUMBER ONLY	3		
TOTAL NUMBER OF INSTALLED ALARMS	5		
T I POINTS WITH FLANGED THERMOWELLS			
T I POINTS WITH SCREWED THERMOWELLS	22		
TOTAL NUMBER OF T I POINTS	22		

plant will require all new tubing & [illegible] since old instruments were in VF control room.
most minor instr will be reconditioned & reused.

P A N E L
I N F O R M A T I O N

NUMBER OF SMALL CASE PANEL INSTRUMENTS	38
NUMBER OF LARGE CASE PANEL INSTRUMENTS	
LENGTH OF SEMI-GRAPHIC SECTION OF PANEL(FT.)	12
LENGTH OF NON-GRAPHIC SECTION OF PANEL(FT.)	3
TOTAL LENGTH OF CONTROL PANEL	16

A I R
C O N S U M P T I O N

	NUMBER	VOLUME(SCFH)
PANEL MOUNTED CONTROLLERS	29	47.
FIELD CONTROLLERS	1	1.
TRANSMITTERS	38	31.
VALVE POSITIONERS	23	29.
TOTAL VOLUME CONSUMPTION		108.

C O S T T O T A L S

EDC INDICES BASE	CURRENT	MATERIAL BEFORE EDC	AFTER EDC	LABOR BEFORE EDC	AFTER EDC	TOTAL (MATERIAL + LABOR) BEFORE EDC	AFTER EDC
262	279	75500.	80399.	32732.	34856.	108232.	115255.

80,000 deduct $4000 for rental of CV's

35,000 $72,000 + 31,000 = $103,000

$115,000 + share of building work

Chevron BB
014756

COST ESTIMATE FOR INSTRUMENTS

HOUDRY FRACTIONATOR CONVERSION
GEORGE J ROESSLER

EL PASO REFINERY
OCT 29,1969

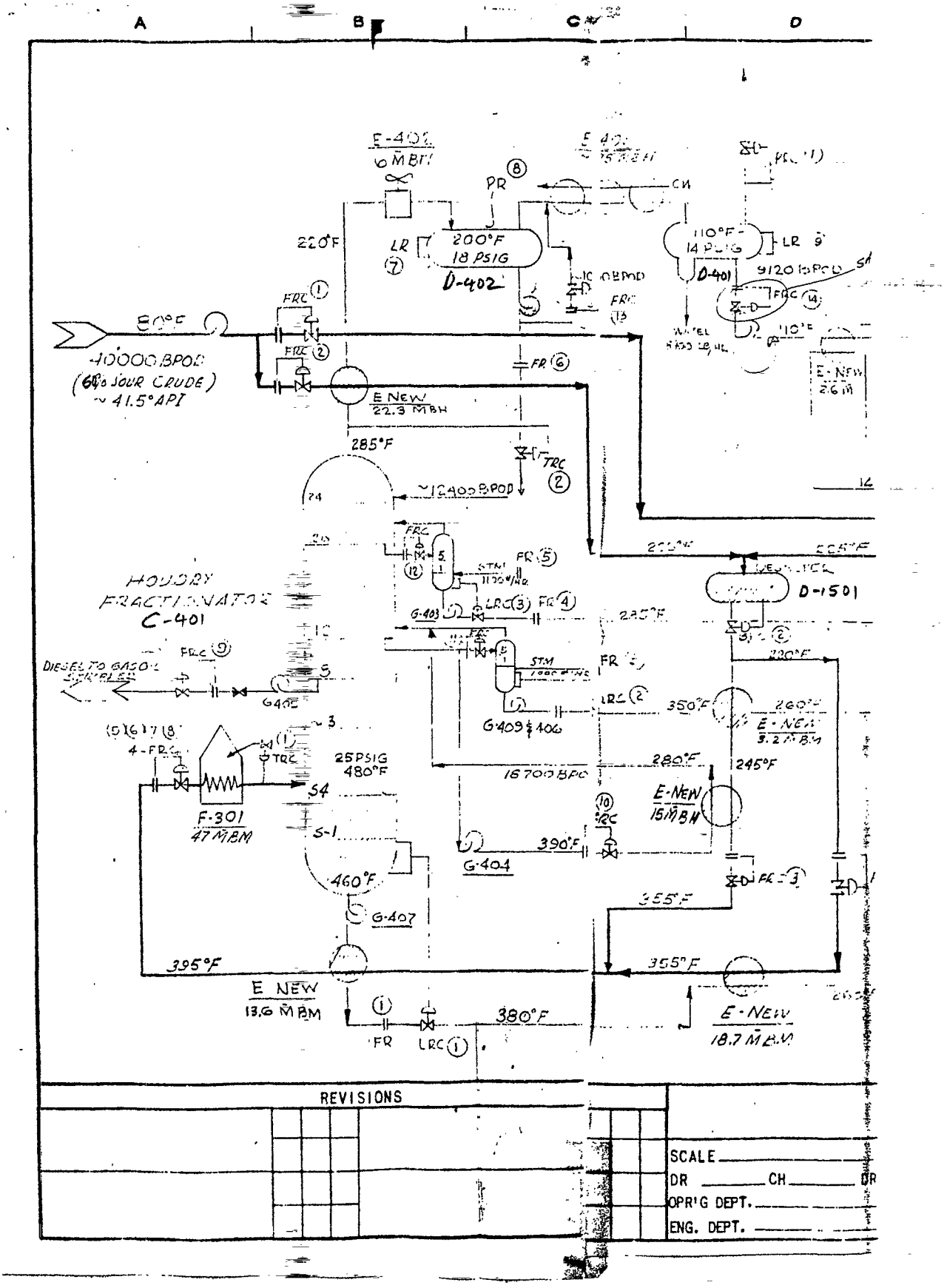
ENGINEERING DEPARTMENT PROGRAM - SPADE J
PROBLEM NO. 1

PNEUMATIC

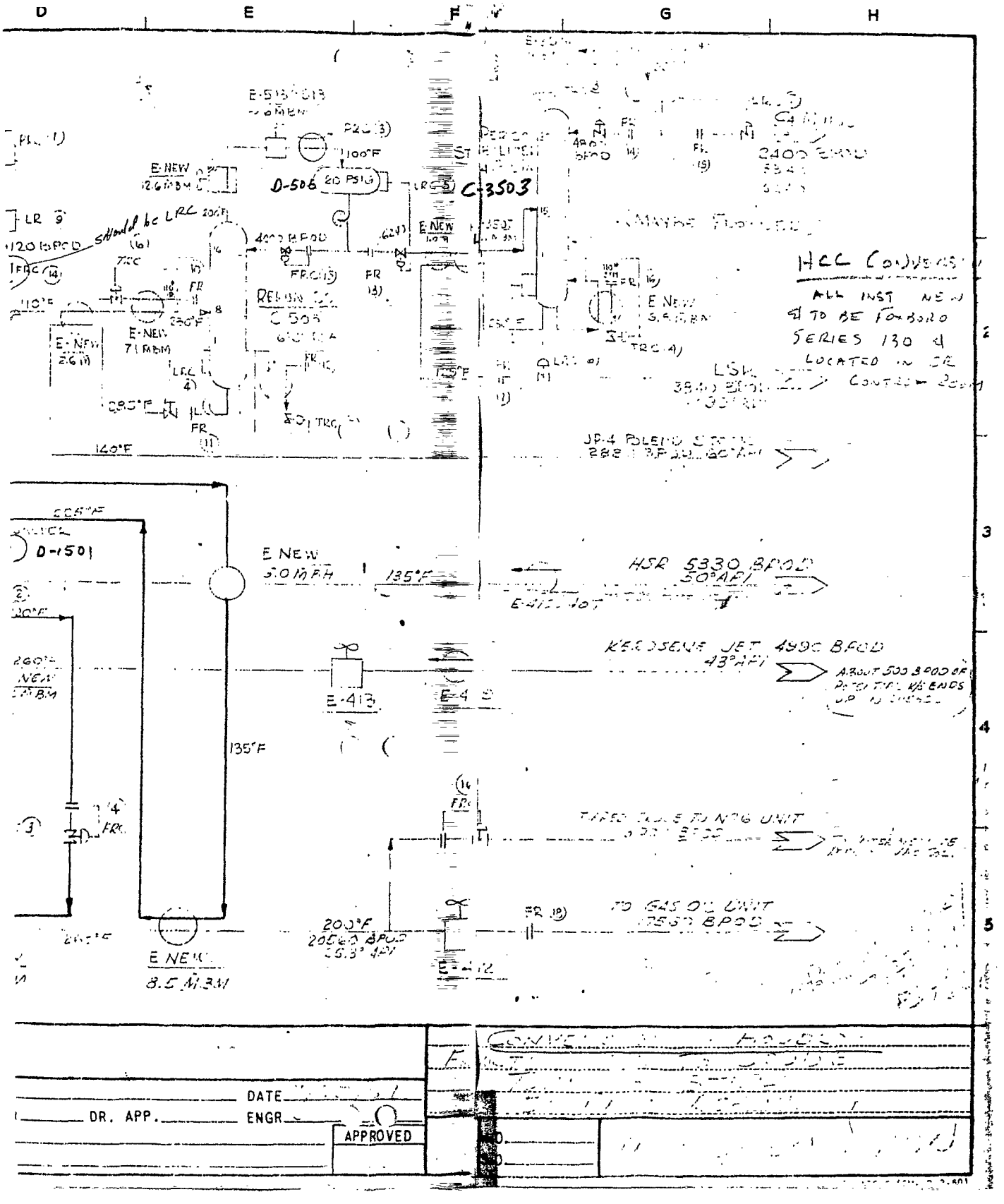
RECORDER--CONTROLLER INFORMATION

DESCRIPTION	NUMBER	COST		
		MATERIALS($)	LABOR($)	TOTAL($)
STANDARD PANEL CONTROL LOOPS	29	40944.	15271.	56215.
STANDARD PANEL RECORDER AND INDICATOR	9	8872.	4318.	13190.
STANDARD FIELD CONTROL LOOPS	1	384.	290.	674.
STANDARD FIELD RECORDER AND INDICATOR	4	1472.	512.	1984.
WINTERIZATION		3297.	5558.	8855.

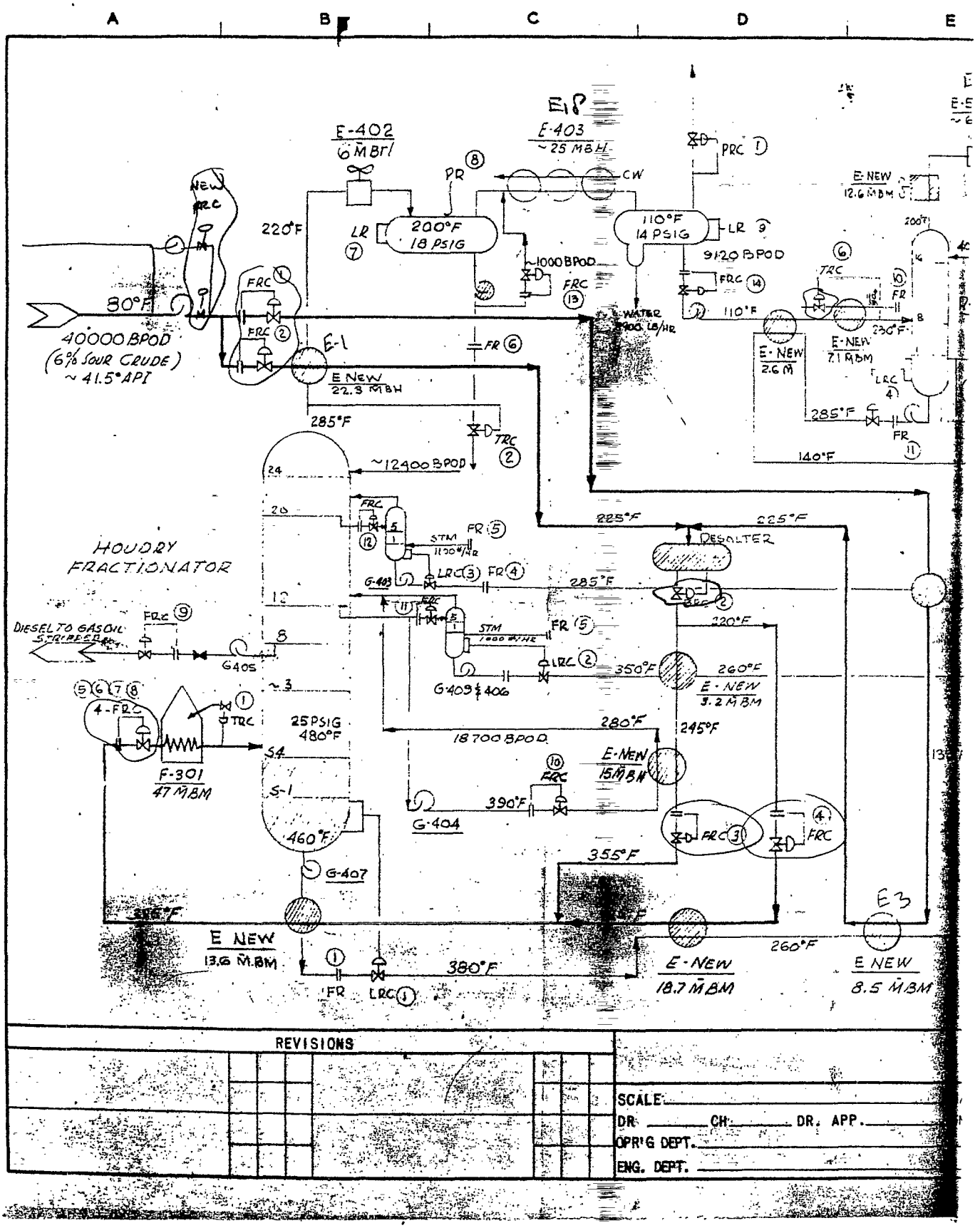
Chevron BB
014757



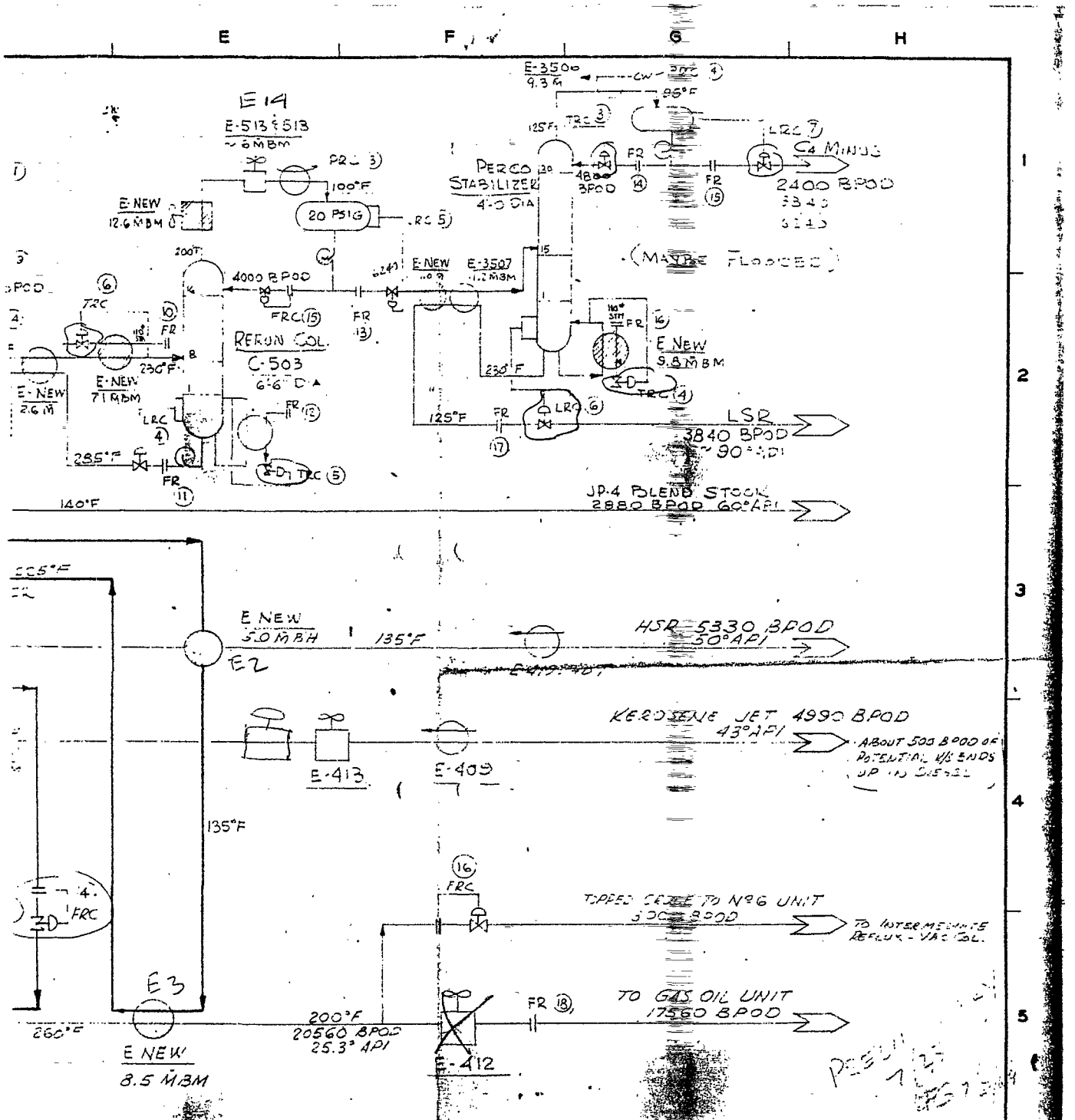
Chevron BB
014758



Chevron BB
014759



Chevron BB
014760



CONVERSION OF HOUDRY FRACTIONATOR TO CRUDE TOPPING STILL
EL PASO REFINERY

DATE 7/25/61
DR. APP.
ENGR J H A
APPROVED
W.O.
S.O.
INSTRUMENTATION

GO-450-C (5M-CD-3-60)

Chevron BB
014761

PROJECT NO. _____ PAGE 2

TITLE _____ BY Joe

SUBJECT V. PSV's DATE 11/18

SUMMARY

	2	- 4"x6" 150#	@ 375	750
	1	- 6"x8" 150#	@ 850	850
3	6	- 3"x4" 300#	@ 225	1350
	1	- 2x3 300#	@ 200	200
2 men	1	- 2x3" 150#	@ 175	175
Labor - pop & set ea valve - 2hrs	4	- 1½x3" 150#	@ 160	640
install. 4"< - 2hrs	7	- ¾x1 150#	@ 50	350
<4" - 4"	19			$4315

19 valves 8 MH ea. + 2 MH HAND = 10(6) = 60(19) = 1140

3 valves 12 MH ea 14(6) = 84(3) 252

1392

	M	L
	4315	1400
EST FACTOR 15%	685	600
	5000	2000
take credit for other existing PSV's	-1000	
	4000	2000

CALCULATION SHEET GO-144-2T

PROJECT No. _____ SHEET No. 1

TITLE _____ INITIALS JHL

SUBJECT ✓ PSV's DATE 11/18

PSV's reqd — HCC

1.	C-401, E1A & shell B, E-402, D-407, E-18, D-401 C-402, C-403, E-6 shell, D-1	2 — 4"x6" 150# @ 375	= 750
2.	DESALTER, P-1, E1A&B tubs, E-2, E3A	1 — 6"x8" 150# BELLOWS @ 850	850
3.	P-2&A, E-4, E3B, E5A&B, E-6, E-7 tube	1 — 3"x4" 300# @ 225	225
4.	F-301	4 = 3x4" 300# @ 225	900
5.	P-7, E7A&B, E5A&B, E3A, E3B	1 — 3x4" 300# @ 225	225
6.	P-5, E-4, E-412, 413, E-409	1 — 2x3 300# @ 200	200
7.	P-3, E-2, E-411	1 — 2x3 150# @ 175	175
8.	E-9, E-8	1 — 1½x3 150# @ 160	160
9.	C-503, E-10, E-13, D-506	reuse existing PSV.	
10.	P-10, E-8, E-16	1 — 1½x3 150# @ 160	160
11.	E-11,	1 — 1½x3 150# @ 160	160
12.	C-3503, E-17, D-3504, E-12	reuse existing PSV.	
13.	E-11, E-15	1 — 1½x3 150# @ 160	160
14.	CW	7 — ¾"x1" @ 50	350

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