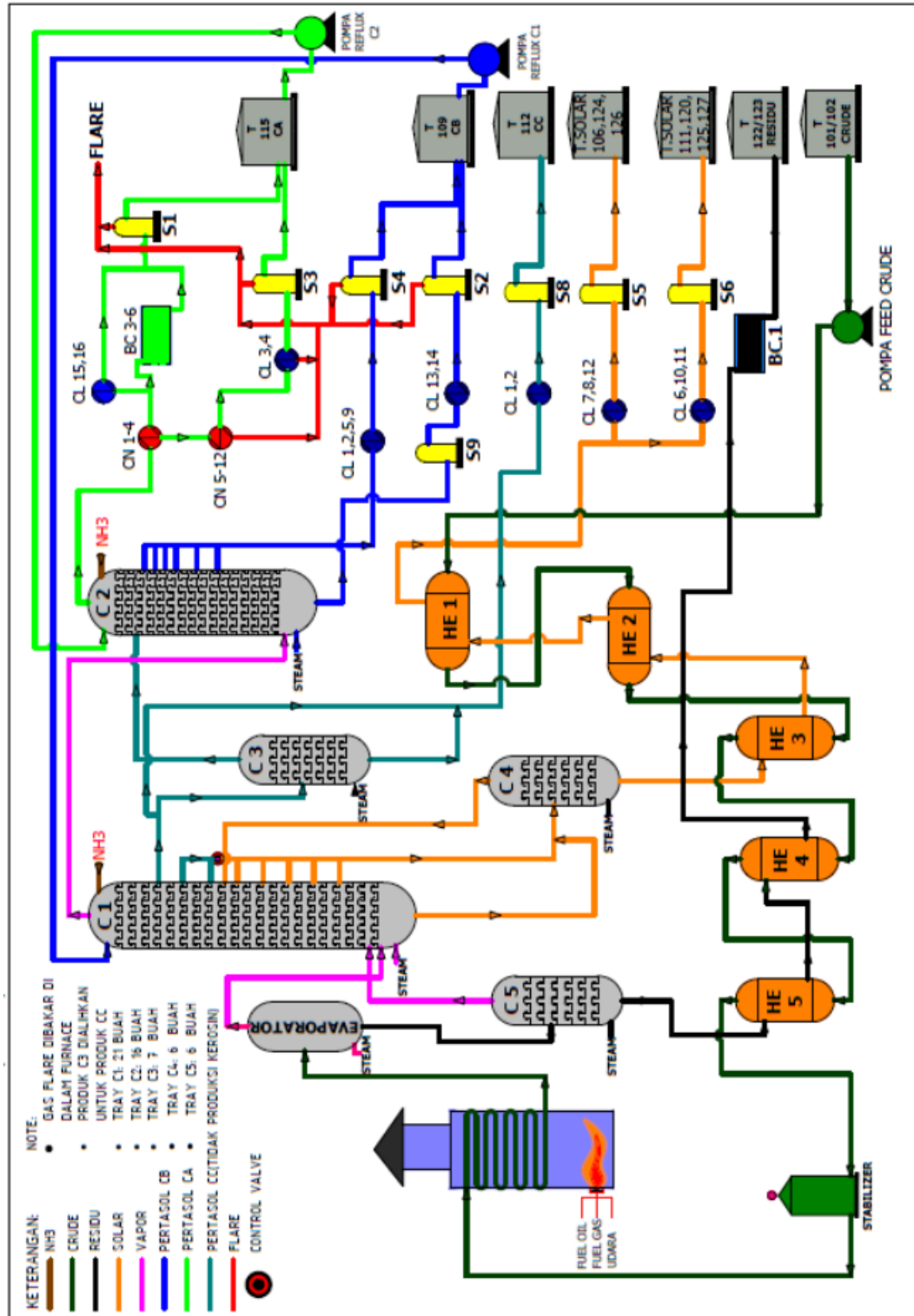


**LAMPIRAN**

Lampiran 1. Diagram Alir Unit Distilasi Atmosferik PPSDM MIGAS Cepu





**PRAKTIK KERJA LAPANG**  
**PUSAT PENGEMBANGAN SUMBER DAYA MANUSIA**  
**MINYAK DAN GAS BUMI (PPSDM) CEPU**



Lampiran 2. Data Laju Alir Crude Oil, Produk, dan Residu

Data laju alir crude oil, produk, dan residu pada hari 1

<b>Komponen</b>	<b>Rate (L/hari)</b>	<b>Densitas (15/15C)</b>	<b>Rate massa (kg/hari)</b>	<b>% Vol</b>
Bahan baku				
Crude oil	234535	0,8421	197501,9235	100
Produk				
Pertasol CA	16226	0,7237	11742,7562	6,92
Pertasol CB	2501	0,7749	1938,0249	1,02
Solar	151136	0,84	126954,24	64,44
Residu	64648	0,9122	58971,9056	27,56
Total	234511			99,94
Losses	24			0,06

Data laju alir crude oil, produk, dan residu pada hari 2

<b>Komponen</b>	<b>Rate (L/hari)</b>	<b>Densitas (15C)</b>	<b>Rate massa (kg/hari)</b>	<b>% Vol</b>
Bahan baku				
Crude oil	284575	0,845	240465,875	100
Produk				
Pertasol CA	29428	0,7305	21497,154	10,34
Pertasol CB	1654	0,7719	1276,7226	1,05
Solar	173902	0,838	145729,876	61,11
Residu	78217	0,9082	71036,6794	27,49
Total	283201			99,99
Losses	1374			0,01



**PRAKTIK KERJA LAPANG**  
**PUSAT PENGEMBANGAN SUMBER DAYA MANUSIA**  
**MINYAK DAN GAS BUMI (PPSDM) CEPU**



Data laju alir crude oil, produk, dan residu pada hari 3

Komponen	Rate (L/hari)	Densitas (15C)	Rate massa (kg/hari)	% Vol
Bahan baku				
Crude oil	280582	0,8425	236390,335	100
Produk				
Pertasol CA	32555	0,7265	23651,2075	11,6
Pertasol CB	1643	0,7668	1259,8524	0,69
Solar	172867	0,84	145208,28	61,61
Residu	73143	0,9108	66618,6444	26,07
Total	280208			99,97
Losses	374			0,03

Data laju alir crude oil, produk, dan residu pada hari 4

Komponen	Rate (L/hari)	Densitas (15C)	Rate massa (kg/hari)	% Vol
Bahan baku				
Crude oil	271644	0,83	225464,52	100
Produk				
Pertasol CA	49153	0,7352	36137,2856	18,09
Pertasol CB	1432	0,7598	1088,0336	0,32
Solar	184080	0,8404	154700,832	67,77
Residu	36835	0,9084	33460,914	13,56
Total	271500			99,74
Losses	144			0,26

Data laju alir crude oil, produk, dan residu pada hari 5

Komponen	Rate (L/hari)	Densitas (15C)	Rate massa (kg/hari)	% Vol
Bahan baku				
Crude oil	239735	0,829	198740,315	100
Produk				
Pertasol CA	34089	0,7381	25161,0909	14,22
Pertasol CB	1288	0,7361	948,0968	0,01
Solar	179452	0,838	150380,776	74,85
Residu	26595	0,9081	24150,9195	11,09
Total	241424			100,17
Losses	-1689			-0,17

Lampiran 3. Data Distilasi dan Suhu Koreksi ASTM Pertasol CB



Data distilasi dan suhu koreksi ASTM Pertasol CB hari 1

% Distilasi	Pertasol CB	
	Celcius (C)	Fahrenheit (F)
IBP		
5	132,5	270,5
10	139	282,2
20	149,5	301,1
30	163,5	326,3
40	166	330,8
50	173,5	344,3
60	182,5	360,5
70	193	379,4
80	207,5	405,5
90	232	449,6

Data distilasi dan suhu koreksi ASTM Pertasol CB hari 2

% Distilasi	Pertasol CB	
	Celcius (C)	Fahrenheit (F)
IBP		
5	131	267,8
10	139	282,2
20	148,5	299,3
30	157,5	315,5
40	165	329
50	172,5	342,5
60	181,5	358,7
70	192	377,6
80	205,5	401,9
90	236	456,8

Data distilasi dan suhu koreksi ASTM Pertasol CB hari 3

% Distilasi	Pertasol CB	
	Celcius (C)	Fahrenheit (F)
IBP		
5	134	273,2
10	141,5	286,7
20	148	298,4
30	157,5	315,5
40	165	329
50	173	343,4
60	182	359,6



**PRAKTIK KERJA LAPANG**  
**PUSAT PENGEMBANGAN SUMBER DAYA MANUSIA**  
**MINYAK DAN GAS BUMI (PPSDM) CEPU**



70	192,5	378,5
80	204	399,2
90	236	456,8

Data distilasi dan suhu koreksi ASTM Pertasol CB hari 4

% Distilasi	Pertasol CB	
	Celcius (C)	Fahrenheit (F)
5	154,5	310,1
10	163	325,4
20	170	338
30	178	352,4
40	186	366,8
50	194	381,2
60	202	395,6
70	211,5	412,7
80	223	433,4
90	252	485,6

Data distilasi dan suhu koreksi ASTM Pertasol CB hari 5

% Distilasi	Pertasol CB	
	Celcius (C)	Fahrenheit (F)
5	162,5	324,5
10	170	338
20	177,5	351,5
30	185	365
40	192,5	378,5
50	201,5	394,7
60	209	408,2
70	222,5	432,5
80	239	462,2
90	271	519,8



Lampiran 4. Data Distilasi dan Suhu Koreksi ASTM Solar

Data distilasi dan suhu koreksi ASTM Solar hari 1

% Distilasi	Suhu	
	Celcius (C)	Fahrenheit (F)
IBP		
5	169	336,2
10	187	368,6
20	208	406,4
30	222	431,6
40	240	464
50	260	500
60	280	536
70	301	573,8
80	326	618,8
90	354	669,2

Data distilasi dan suhu koreksi ASTM Solar hari 2

% Distilasi	Suhu	
	Celcius (C)	Fahrenheit (F)
IBP		
5	162	323,6
10	180	356
20	206	402,8
30	222	431,6
40	239	462,2
50	257	494,6
60	275	527
70	296	564,8
80	323	613,4
90	354	669,2

Data distilasi dan suhu koreksi ASTM Solar hari 3

% Distilasi	Suhu	
	Celcius (C)	Fahrenheit (F)
IBP		
5	156	312,8
10	174	345,2
20	190	374
30	210	410
40	220	428



**PRAKTIK KERJA LAPANG**  
**PUSAT PENGEMBANGAN SUMBER DAYA MANUSIA**  
**MINYAK DAN GAS BUMI (PPSDM) CEPU**



50	240	464
60	260	500
70	280	536
80	300	572
90	334	633,2

Data distilasi dan suhu koreksi ASTM Solar hari 4

% Distilasi	Suhu	
	Celcius (C)	Fahrenheit (F)
IBP		
5	171	339,8
10	188	370,4
20	206	402,8
30	226	438,8
40	245	473
50	263	505,4
60	284	543,2
70	302	575,6
80	327	620,6
90	365	689

Data distilasi dan suhu koreksi ASTM Solar hari 5

% Distilasi	Suhu	
	Celcius (C)	Fahrenheit (F)
IBP		
5	163	325,4
10	180	356
20	200	392
30	220	428
40	240	464
50	260	500
60	280	536
70	300	572
80	326	618,8
90	364	687,2





**PRAKTIK KERJA LAPANG**  
**PUSAT PENGEMBANGAN SUMBER DAYA MANUSIA**  
**MINYAK DAN GAS BUMI (PPSDM) CEPU**



Lampiran 5. Data %Distilasi dan Suhu Koreksi ASTM Tanggal 6 November 2023

Tanggal : 06-11-2023 2018  
 No. : /L.Rt/DS.02.02/18

LAPORAN HASIL UJI ANALISA FEED DAN PRODUK PERTAMINA  
 HASIL PENGOLAHAN KILANG PPSDM MIGAS

Shift		(16-AY)								
Jam		16 <sup>00</sup>	18 <sup>00</sup>	16 <sup>00</sup>	16 <sup>00</sup>	16 <sup>00</sup>	16 <sup>00</sup>	18 <sup>00</sup>		
Nama Contoh		C-017	A/S2	A/S1	C/S1Y	C/S2	SOLAR	RES	CC1	
Alliran / Tangki		al	al	al	al	al	al	al	7/13Y	
No.	Parameter Uji	Metode								
		ASTM / Lain								
1	Density / Temp °C Obs	D-1298	022/25	022/25	204/22	225/22	220/26	204/22	226/20	262/25
2	Density 15 °C, Kg/m <sup>3</sup>		842.3	805.4	824.0	825.4	866.6	809.2	913.2	824.4
2 Distilasi :										
IBP										
5 % Vol. rec °C			32	43	24	24	148			128
10 % Vol. rec °C			53	60	26	93	169			131
20 % Vol. rec °C			59	65	90	92	182			136
30 % Vol. rec °C			65	71	97	105	200			142
40 % Vol. rec °C			70	77	103	111	222			148
50 % Vol. rec °C			75	82	108	116	240			153
60 % Vol. rec °C			80	87	113	121	260			158
70 % Vol. rec °C			86	93	119	127	280			163
80 % Vol. rec °C			93	100	126	134	201			172
90 % Vol. rec °C (T.90)			104	112	135	145	226			184
95 % Vol. rec °C (T.95)			110	126	151	162	354			202
End Point, °C			130	139	165	186	270			219
Dry Point, °C			125	150	160	171				216
% Vol. rec at 200 °C										
% Vol. rec at 300 °C								69.0		
% Vol. rec at 370 °C								92.0		
Rendemen, % vol								94.0		
Residu, % vol								5.0		
Losses, % vol								1.0		
3	Titik Nyala, °C	D-56,93,92						50	21	
4	Titik Tuang, °C	D-97						6	45	
5	Titik Asap, mm	D-1322								
6	Nilai Jelaga, mg/kg	IP-10								
7	Warna Saybolt/ ASTM	D-156 / 1500	+20	+20	+22	+26	1.5			1.5
8	Viscositas, CSt	D-455								
9	Doctor Test	D-4952								
10	Korosi Bilah Tembaga	D-130								
11	Indeks Cetana	D-4737								
12	Kandungan Air, mg/Kg	D-1744								
13	kandungan Sulfur, %m/m	D-2622/1522								
14	Residu Karbon, % m/m	D-4530/189								
15	Kandungan Abu, % m/m	D-482								
16	Sediment Content, %m/m	D-473								
17	Bil. Asam Kuat, mg KOH/g	D-664								
18	Bil. Asam Total, mg KOH/g	D-664								
19	Partikulat, mg/L	D-2276								

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**PRAKTIK KERJA LAPANG**  
**PUSAT PENGEMBANGAN SUMBER DAYA MANUSIA**  
**MINYAK DAN GAS BUMI (PPSDM) CEPU**



Lampiran 6. Data %Distilasi dan Suhu Koreksi ASTM Tanggal 7 November 2023

Tanggal: 7-11-2023 2019  
No. /L.R/05.02.02/30

**LAPORAN HASIL UJI ANALISA FEED DAN PRODUK PERTAMINA**  
**HASIL PENGOLAHAN KILANG PPSDM MIGAS**

Shift	(16-04)							
Jam	2000	2000	2000	2000	2000	2000	2000	
Nama Contoh	C-07	CA/53	CA/51	CB/47	CB/42	10/2A	10/1A	
Allran / Tangki	a1	a1	a1	a1	a1	a1	7-120	
No.	Parameter Uji	Metode ASTM / Lain						
1	Density / Temp °C Obs	229/32	624/32	711/33	208/35	211/32	215/32	217/33
	Density 15 °C, Kg/m <sup>3</sup>	747	709.6	722.8	717.7	719.9	730.2	732.5
2	Distilasi :							
	IBP	82	57	78	80	80	179	151
	5 % Vol. rec °C	58	65	81	100	100	163	169
	10 % Vol. rec °C	62	70	86	106	106	180	182
	20 % Vol. rec °C	69	77	92	113	113	206	209
	30 % Vol. rec °C	74	82	98	119	119	222	230
	40 % Vol. rec °C	79	87	103	124	124	239	245
	50 % Vol. rec °C	84	93	108	129	129	257	260
	60 % Vol. rec °C	90	100	114	135	135	275	280
	70 % Vol. rec °C	97	108	121	142	142	296	300
	80 % Vol. rec °C	102	116	130	157	157	323	326
	90 % Vol. rec °C (T.90)	120	129	140	172	172	357	357
	95 % Vol. rec °C (T.95)							
	End Point, °C	133	140	152	196	196	370	370
	Dry Point, °C	125	137	161	181	181		
	% Vol. rec at 200 °C							
	% Vol. rec at 300 °C						74.0	70.0
	% Vol. rec at 370 °C						94.0	98.0
	Rendemen, % vol						95.0	94.0
	Residu, % vol						4.0	5.0
	Losses, % vol						1.0	1.0
3	Titik Nyala, °C	D-56,93,92						
4	Titik Tuang, °C	D-97						
5	Titik Asap, mm	D-1322						
6	Nilai Jelaga, mg/kg	IP-10						
7	Warna Saybolt/ ASTM	D-156 / 1500						
8	Viscositas, CSt	730	730	729	726	725	725	
9	Doctor Test	D-4952						
10	Korosi Bilah Tembaga	D-130						
11	Indeks Cetana	D-4737						
12	Kandungan Air, mg/Kg	D-1744						
13	kandungan Sulfur, %m/m	D-2622/1522						
14	Residu Karbon, % m/m	D-4530/189						
15	Kandungan Abu, % m/m	D-482						
16	Sediment Content, %m/m	D-473						
17	Bil. Asam Kuat, mg KOH/g	D-664						
18	Bil. Asam Total, mg KOH/g	D-664						
19	Partikulat, mg/L	D-2276						

Pengelola Laboratorium  
  
Setiyono  
NIP.19680412 199103 1 004



**PRAKTIK KERJA LAPANG**  
**PUSAT PENGEMBANGAN SUMBER DAYA MANUSIA**  
**MINYAK DAN GAS BUMI (PPSDM) CEPU**



Lampiran 7. Data %Distilasi dan Suhu Koreksi ASTM Tanggal 8 November 2023

Tanggal : 08-11-2023 2018  
 No. : /L.RI/DS.02.02/18

LAPORAN HASIL UJI ANALISA FEED DAN PRODUK PERTAMINA  
 HASIL PENGOLAHAN KILANG PPSDM MIGAS

Shift										
Jam										
Nama Contoh	11	( 16	-	21 )						
Alliran / Tangki	1600	1600	1600	1600	1600	1600	1600	1600		
No.	Parameter Uji	Metode ASTM / Lain	AL	CA/53	CA/51	CB/54	CB/52	SP42	SP42	RES
1	Density / Temp °C Obs	D-1298	828/37	824/34	716/37	734/40	750/36	818/34	819/37	873/34
2	Density 15 °C, Kg/m <sup>3</sup>		8437	7154	7858	7601	7684	8327	8343	8063
	Distilasi :									
	IBP									
	5 % Vol. rec °C		40	54	74	86	138	142		
	10 % Vol. rec °C		56	69	85	98	156	183		
	20 % Vol. rec °C		62	74	90	103	174	178		
	30 % Vol. rec °C		67	80	93	110	190	194		
	40 % Vol. rec °C		73	86	100	115	210	212		
	50 % Vol. rec °C		78	90	103	120	220	230		
	60 % Vol. rec °C		84	96	110	126	240	250		
	70 % Vol. rec °C		90	103	116	132	260	268		
	80 % Vol. rec °C		97	110	123	139	280	287		
	90 % Vol. rec °C (T.90)		109	118	130	148	300	306		
	95 % Vol. rec °C (T.95)		119	134	132	148	320	328		
	End Point, °C									
	Dry Point, °C		136	152	172	188	370	378		
	% Vol. rec at 200 °C		118	140	161	176				
	% Vol. rec at 300 °C									
	% Vol. rec at 370 °C									
	Rendemen, % vol						800	780		
	Residu, % vol						980	950		
	Losses, % vol						980	960		
3	Titik Nyala, °C	D-56,93,92					30	36		
4	Titik Tuang, °C	D-97					18	18	74	
5	Titik Asap, mm	D-1322					45	48	45	
6	Nilai Jelaga, mg/kg	IP-10					6	6		
7	Warna Saybolt/ ASTM	D-156 / 1500								
8	Viscositas, cSt	D-455	130	130	130	127	15	15		
9	Doctor Test	D-4952								
10	Korosi Bilah Tembaga	D-130								
11	Indeks Cetana	D-4737								
12	Kandungan Air, mg/Kg	D-1744								
13	kandungan Sulfur, %m/m	D-2622/1522								
14	Residu Karbon, % m/m	D-4530/189								
15	Kandungan Abu, % m/m	D-482								
16	Sediment Content, %m/m	D-473								
17	Bil. Asam Kuat, mg KOH/g	D-664								
18	Bil. Asam Total, mg KOH/g	D-664								
19	Partikulat, mg/l	D-2276								

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**PRAKTIK KERJA LAPANG**  
**PUSAT PENGEMBANGAN SUMBER DAYA MANUSIA**  
**MINYAK DAN GAS BUMI (PPSDM) CEPU**



Lampiran 8. Data %Distilasi dan Suhu Koreksi ASTM Tanggal 9 November 2023

JALAN SOROGO NO. 1 CEPU 58315 KABUPATEN BLORA - JAWA TIMUR  
TELEPON (0291) 421888 FAKSIMILE (0298) 421891 <http://www.ppsdmkismigas.esdm.go.id> e-mail : [informasi@ppsdmkismigas.esdm.go.id](mailto:informasi@ppsdmkismigas.esdm.go.id)

Tanggal : 09-11-2023 2018  
No. : /L.Rt/DS.02.02/10

**LAPORAN HASIL UJI ANALISA FEED DAN PRODUK PERTAMINA**  
**HASIL PENGOLAHAN KILANG PPSDM MIGAS**

Shift	(16	-	21)						
Jam	1600	1600	1600	1600	1600	1600	1600		
Nama Contoh	C-D	CA/53	CA/51	CA/52	CA/52	SAHR	RF3		
Aliran / Tangki	A2	A1	A1	A1	A1	A1	A1		
No.	Parameter Uji	Metode ASTM / Lain							
1	Density / Temp °C Obs	D-1298	815/36	713/31	729/38	745/40	753/38	822/36	806/50
	Density 15 °C, Kg/m3		8302	7364	7495	7670	7701	8428	9097
2	Distilasi :								
	IBP			52	60	90	96	152	
	5 % Vol. rec °C			69	71	101	107	171	
	10 % Vol. rec °C			74	76	106	114	188	
	20 % Vol. rec °C			79	83	110	120	206	
	30 % Vol. rec °C			80	88	115	126	228	
	40 % Vol. rec °C			83	93	120	132	245	
	50 % Vol. rec °C			94	98	125	139	263	
	60 % Vol. rec °C			100	100	130	144	284	
	70 % Vol. rec °C			108	110	136	151	302	
	80 % Vol. rec °C			110	118	143	160	327	
	90 % Vol. rec °C (T.90)			123	136	162	180	365	
	95 % Vol. rec °C (T.95)								
	End Point, °C			146	154	180	200	370	
	Dry Point, °C			130	142	176	190		
	% Vol. rec at 200 °C								
	% Vol. rec at 300 °C							690	
	% Vol. rec at 370 °C							930	
	Rendemen, % vol							940	
	Residu, % vol							56	
	Losses, % vol							10	
3	Titik Nyala, °C	D-56,93,92						64	78
4	Titik Tuang, °C	D-97						9	45
5	Titik Asap, mm	D-1322							
6	Nilai Jelaga, mg/kg	IP-10							
7	Warna Saybolt/ ASTM	D-156 / 1500		130	130	129	125	20	
8	Viscositas, cSt	D-455							
9	Doctor Test	D-4952							
10	Korosi Bilah Tembaga	D-130							
11	Indeks Cetana	D-4737							
12	Kandungan Air, mg/Kg	D-1744							
13	kandungan Sulfur, %m/m	D-2622/1522							
14	Residu Karbon, % m/m	D-4530/189							
15	Kandungan Abu, % m/m	D-482							
16	Sediment Content, %m/m	D-473							
17	Bil. Asam Kuat, mg KOH/g	D-664							
18	Bil. Asam Total, mg KOH/g	D-664							
19	Partikulat, mg/L	D-2276							

Pengelola Laboratorium





**PRAKTIK KERJA LAPANG**  
**PUSAT PENGEMBANGAN SUMBER DAYA MANUSIA**  
**MINYAK DAN GAS BUMI (PPSDM) CEPU**



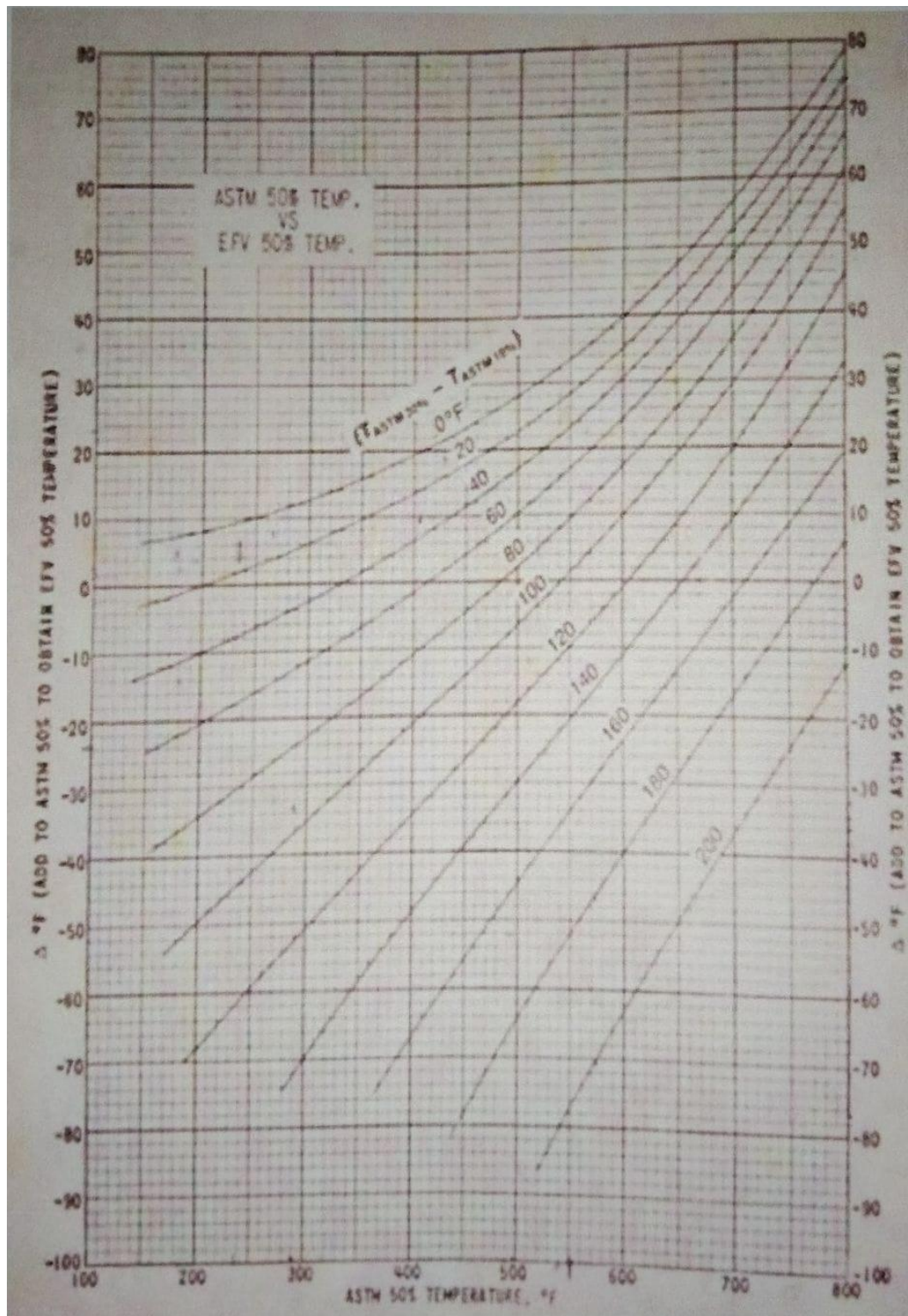
Lampiran 9. Data %Distilasi dan Suhu Koreksi ASTM Tanggal 10 November 2023

Tanggal : 08-11-2023 2018  
No. : /L.RI/DS.02.02/18

LAPORAN HASIL UJI ANALISA FEED DAN PRODUK PERTAMINA  
HASIL PENGOLAHAN KILANG PPSDM MIGAS

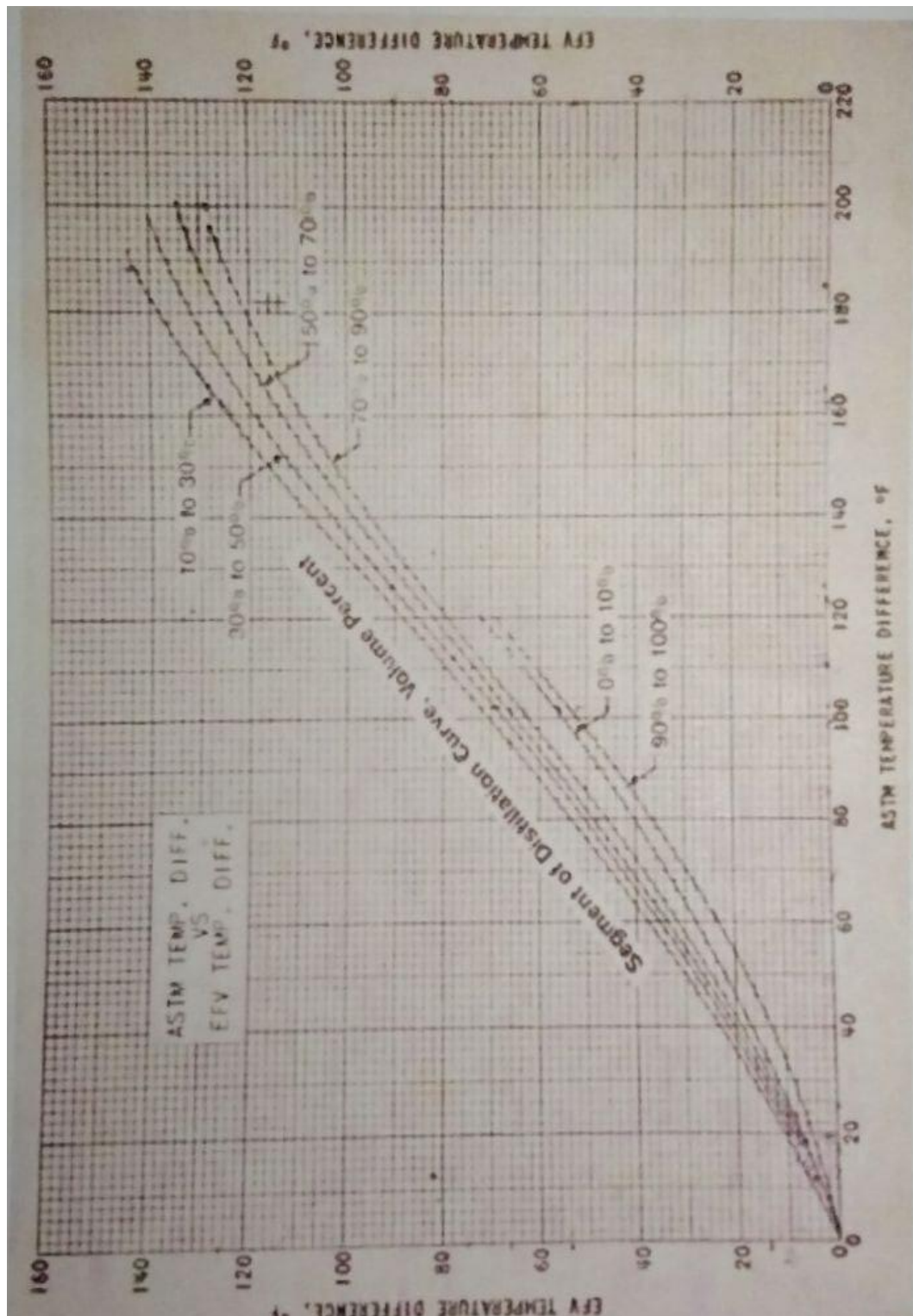
Shift										
Jam										
Nama Contoh	11	C 16	-	2A						
Allran / Tangki	C O	CA/S3	CA/S1	CB/S4	CB/S2	SALAR	SALAR	RES		
No.	Parameter Uji	Metode ASTM / Lain								
1	Density / Temp °C Obs	D-1298	818/37	894/34	716/37	734/40	754/36	818/34	818/37	873/34
2	Density 15 °C, Kg/m3		8437	7154	7858	7601	7684	8327	8243	8983
	IBP									
	5 % Vol. rec °C		40	54	74	86	128	142		
	10 % Vol. rec °C		56	69	85	98	156	183		
	20 % Vol. rec °C		62	74	90	103	174	178		
	30 % Vol. rec °C		67	80	95	118	190	194		
	40 % Vol. rec °C		73	88	100	115	210	212		
	50 % Vol. rec °C		78	90	103	120	220	230		
	60 % Vol. rec °C		84	96	110	126	240	250		
	70 % Vol. rec °C		90	103	116	132	260	268		
	80 % Vol. rec °C		97	110	123	139	280	287		
	90 % Vol. rec °C (T.90)		103	118	130	148	300	306		
	95 % Vol. rec °C (T.95)		119	134	152	168	334	338		
	End Point, °C									
	Dry Point, °C		136	152	172	188	370	378		
	% Vol. rec at 200 °C		128	140	161	176				
	% Vol. rec at 300 °C									
	% Vol. rec at 370 °C						800	780		
	Rendemen, % vol						980	950		
	Residu, % vol						980	970		
	Losses, % vol						20	30		
3	Titik Nyala, °C	D-56,93,92					18	18		
4	Titik Tuang, °C	D-97					45	48	74	
5	Titik Asap, mm	D-1322					6	6		
6	Nilai Jelaga, mg/kg	IP-10								
7	Warna Saybolt/ ASTM	D-156 / 1500								
8	Viscositas, cSt	D-455	130	130	130	127	1.5	1.5		
9	Doctor Test	D-4952								
10	Korosi Bilah Tembaga	D-130								
11	Indeks Cetana	D-4737								
12	Kandungan Air, mg/Kg	D-1744								
13	kandungan Sulfur, %m/m	D-2622/1522								
14	Residu Karbon, % m/m	D-4530/189								
15	Kandungan Abu, % m/m	D-482								
16	Sediment Content, %m/m	D-473								
17	Bil. Asam Kuat, mg KOH/g	D-664								
18	Bil. Asam Total, mg KOH/g	D-664								
19	Partikulat, mg/l	D-2276								

Lampiran 10. Grafik 12.8 Edmister

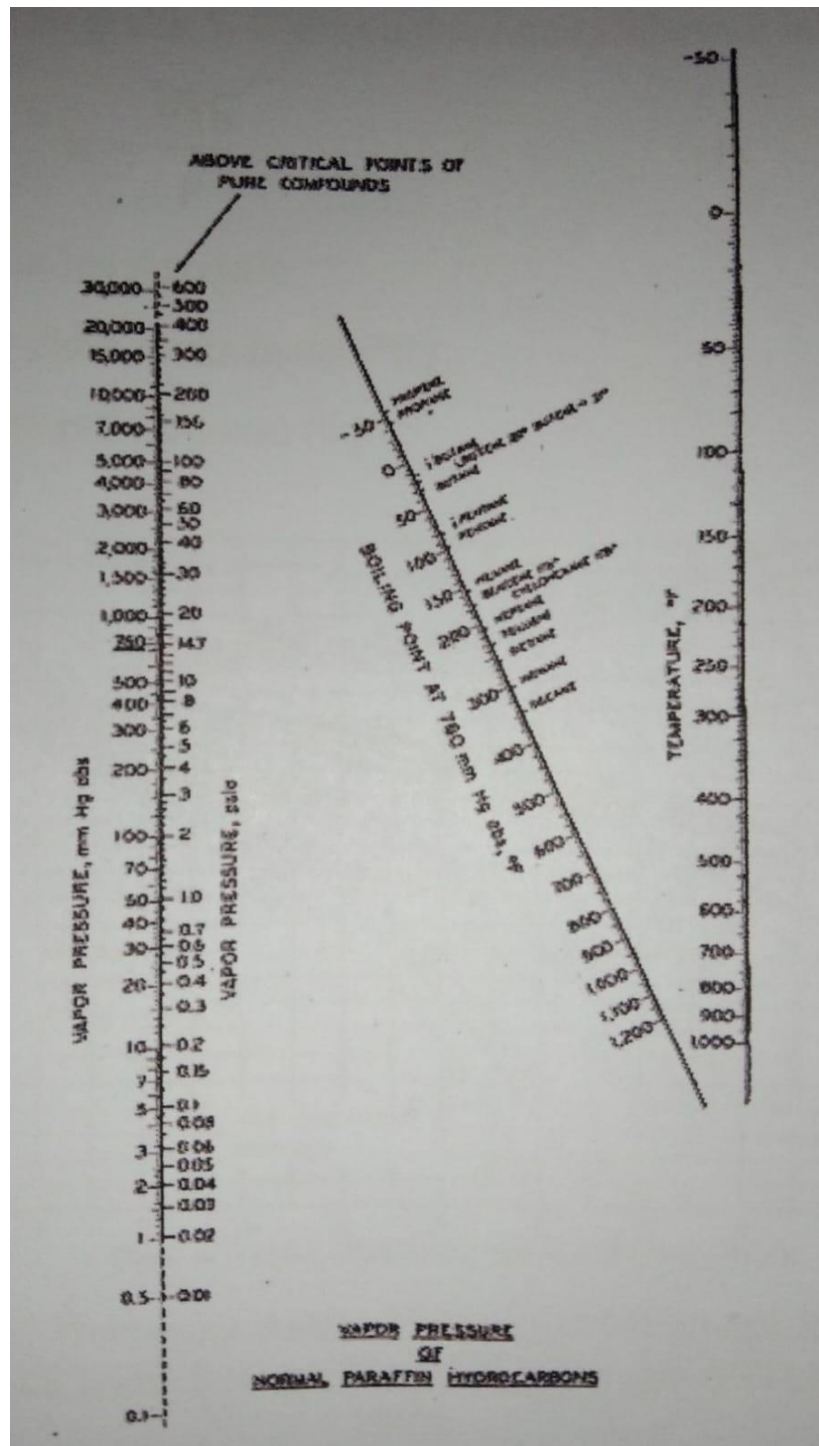


Grafik 12.9 Edmister



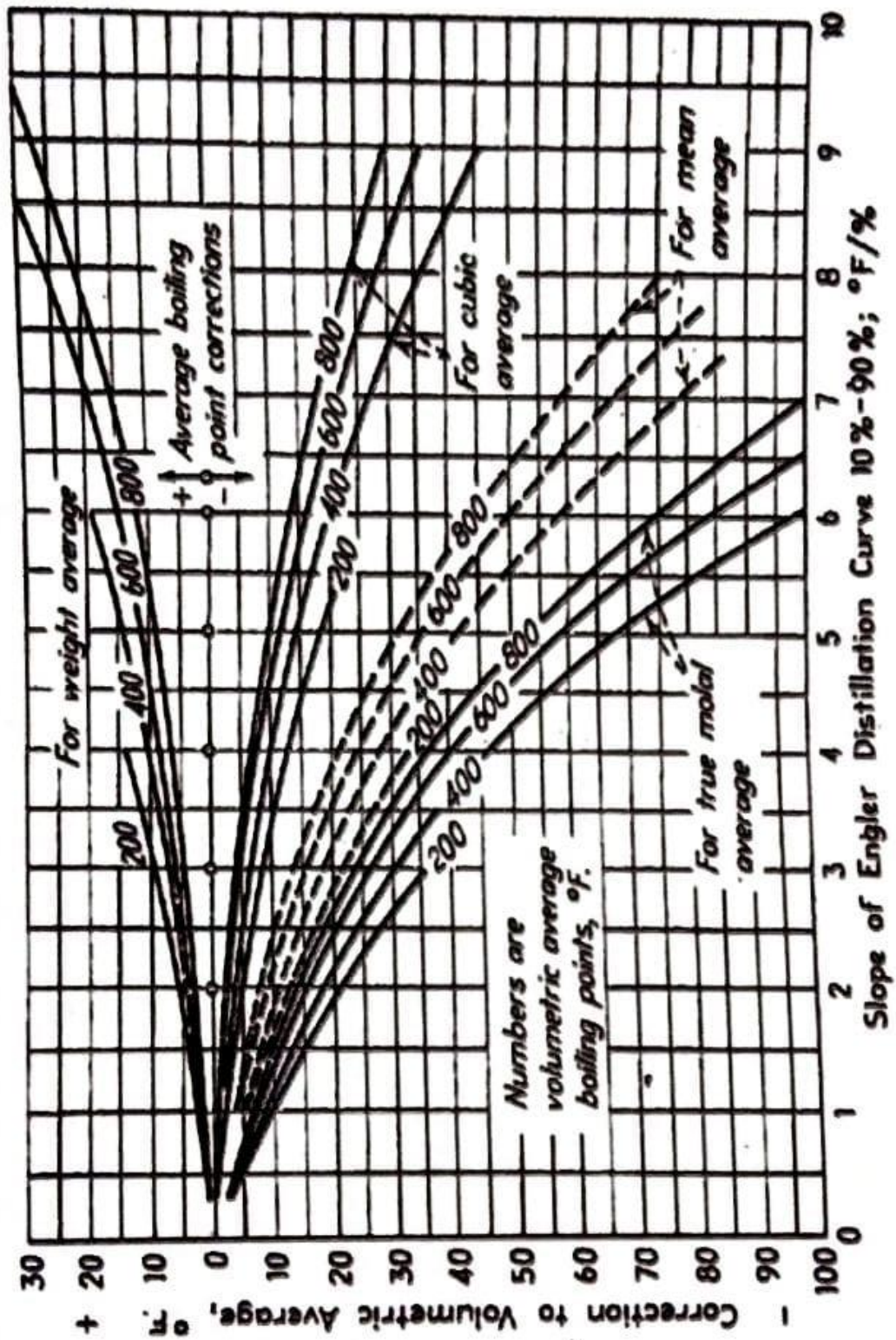


Grafik 5.27 Nelson

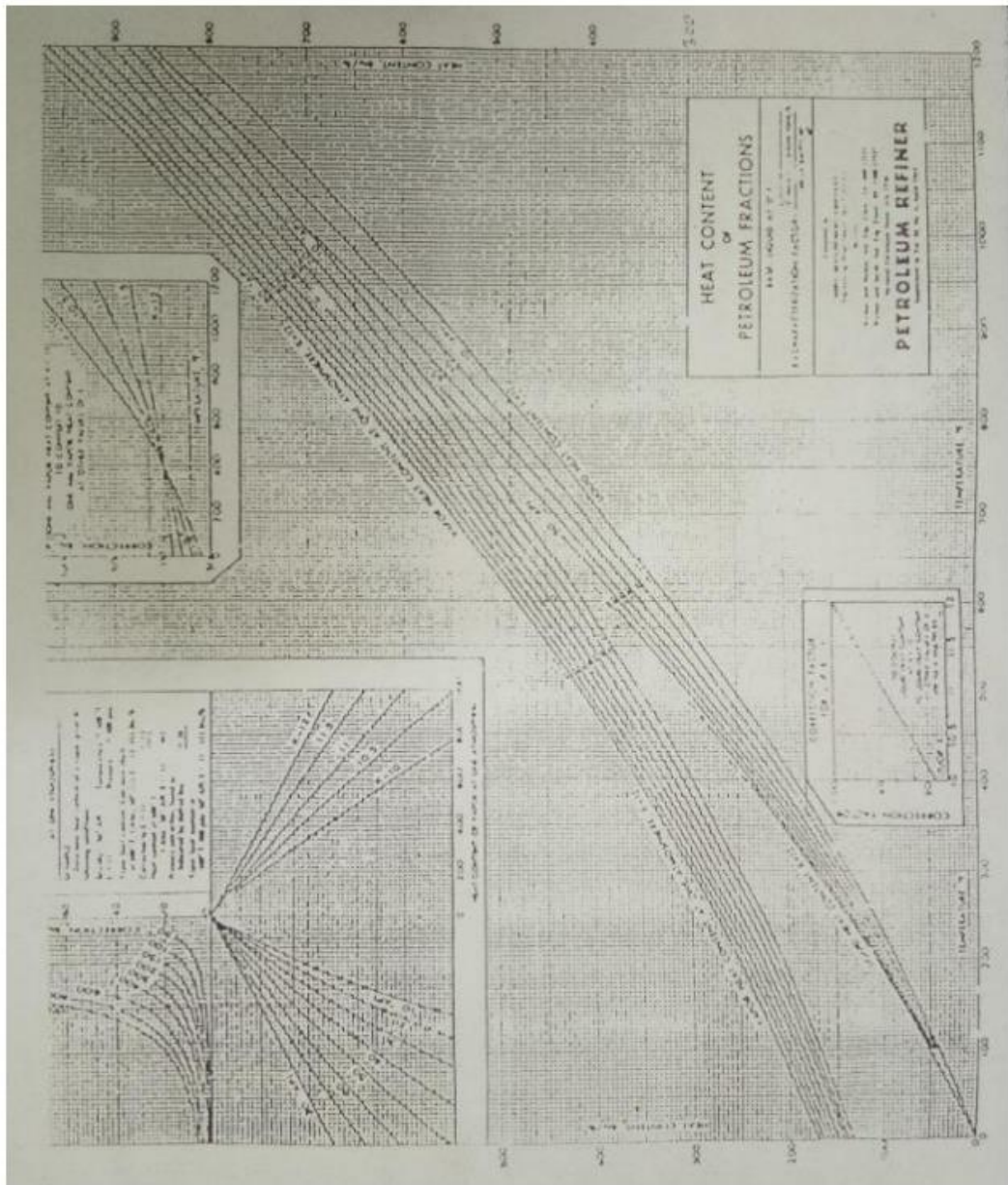


Grafik 5.4 Nelson





Grafik 5.3 Nelson



Steam table Smith, J. M.





**PRAKTIK KERJA LAPANG**  
**PUSAT PENGEMBANGAN SUMBER DAYA MANUSIA**  
**MINYAK DAN GAS BUMI (PPSDM) CEPU**



Table E.3. Saturated Steam, English Units (Continued)

t (°F)	P (psia)	SPECIFIC VOLUME V		INTERNAL ENERGY U				ENTHALPY H			ENTROPY S		
		sat. liq.	evap.	sat. liq.	evap.	sat. liq.	evap.	sat. liq.	evap.	sat. liq.	evap.	sat. liq.	evap.
460	458.87	0.0196	0.9746	8.9942	439.04	579.0	1118.9	441.54	763.2	1204.8	0.6405	0.8299	1.4704
465	490.32	0.0197	0.9285	8.9402	445.44	573.4	1118.9	447.23	757.5	1204.7	0.6468	0.8192	1.4657
470	514.67	0.0198	0.8818	8.9008	451.06	567.7	1118.8	452.95	751.6	1204.6	0.6527	0.8084	1.4611
475	539.94	0.0199	0.8379	8.8678	456.71	562.0	1118.7	458.70	745.7	1204.4	0.6584	0.7977	1.4565
480	566.15	0.0200	0.7972	8.8412	462.39	556.1	1118.5	464.48	739.6	1204.1	0.6640	0.7871	1.4519
485	593.32	0.0201	0.7595	8.7787	468.09	550.2	1118.3	470.29	733.5	1203.8	0.6708	0.7764	1.4472
490	621.48	0.0202	0.7228	8.7422	473.82	544.2	1118.0	476.14	727.2	1203.5	0.6789	0.7657	1.4426
495	650.65	0.0203	0.6874	8.7077	479.57	538.3	1117.8	482.02	720.8	1203.2	0.6890	0.7550	1.4380
500	680.86	0.0204	0.6545	8.6740	485.36	532.3	1117.7	487.94	714.3	1202.9	0.6990	0.7443	1.4333
505	712.12	0.0205	0.6233	8.6430	491.2	526.1	1117.5	493.9	707.7	1202.6	0.7091	0.7336	1.4286
510	744.47	0.0207	0.5936	8.6143	497.3	519.2	1117.2	499.9	700.9	1202.3	0.7202	0.7229	1.4240
515	777.93	0.0208	0.5654	8.5882	503.9	512.7	1117.0	505.9	694.1	1202.0	0.7320	0.7122	1.4193
520	812.53	0.0209	0.5385	8.5598	508.8	506.1	1116.9	512.0	687.0	1199.0	0.7433	0.7013	1.4146
525	848.28	0.0210	0.5131	8.5342	514.8	499.3	1116.2	518.1	679.9	1196.0	0.7544	0.6904	1.4099
530	885.23	0.0212	0.4889	8.5100	520.8	492.5	1116.0	524.2	672.6	1195.9	0.7653	0.6796	1.4051
535	923.38	0.0213	0.4657	8.4870	526.9	485.8	1115.4	530.3	665.1	1195.6	0.7768	0.6688	1.4003
540	962.79	0.0215	0.4437	8.4651	532.9	478.5	1115.4	536.8	657.3	1194.7	0.7890	0.6577	1.3954
545	1003.5	0.0216	0.4226	8.4442	539.1	471.2	1115.3	543.1	649.7	1193.8	0.7999	0.6467	1.3906
550	1045.4	0.0218	0.4025	8.4243	545.3	463.9	1115.1	549.3	641.8	1192.7	0.8101	0.6356	1.3856
555	1088.7	0.0219	0.3834	8.4053	551.5	456.4	1114.9	555.9	633.6	1191.5	0.8197	0.6244	1.3807
560	1133.4	0.0221	0.3651	8.3871	557.8	448.7	1114.5	562.4	625.3	1190.7	0.8285	0.6132	1.3757
565	1179.4	0.0222	0.3475	8.3698	564.1	440.9	1114.0	569.0	616.8	1190.0	0.8367	0.6019	1.3706
570	1226.9	0.0224	0.3306	8.3532	570.5	432.9	1113.4	575.8	608.0	1189.3	0.8443	0.5906	1.3654
575	1275.8	0.0225	0.3147	8.3373	577.0	424.8	1113.2	582.3	599.1	1188.4	0.8513	0.5790	1.3602
580	1326.2	0.0228	0.2994	8.3222	583.5	416.4	1112.9	589.1	589.9	1179.0	0.8575	0.5673	1.3550
585	1378.1	0.0230	0.2848	8.3076	590.1	407.9	1112.0	596.0	580.4	1178.4	0.8630	0.5556	1.3496
590	1431.5	0.0232	0.2705	8.2932	596.9	399.1	1111.9	602.9	570.8	1175.7	0.8684	0.5437	1.3442
595	1486.6	0.0234	0.2569	8.2800	603.8	390.2	1111.7	610.0	561.6	1170.8	0.8737	0.5317	1.3386
600	1543.2	0.0236	0.2438	8.2675	610.4	381.0	1111.5	617.1	552.8	1167.4	0.8784	0.5196	1.3330
605	1601.5	0.0239	0.2313	8.2554	617.3	371.5	1111.0	624.4	543.8	1164.4	0.8826	0.5072	1.3273
610	1661.5	0.0241	0.2191	8.2430	624.4	361.8	1110.1	631.8	534.2	1160.9	0.8867	0.4947	1.3214
615	1723.3	0.0244	0.2075	8.2318	631.5	351.8	1109.3	639.3	524.9	1157.2	0.8904	0.4819	1.3154
620	1786.9	0.0247	0.1967	8.2208	638.6	341.4	1108.2	646.9	515.2	1152.2	0.8937	0.4689	1.3092
625	1852.2	0.0250	0.1852	8.2102	646.2	330.7	1107.8	654.7	494.2	1148.9	0.8967	0.4556	1.3028
630	1919.5	0.0253	0.1746	8.2000	654.3	319.5	1107.2	662.7	481.8	1144.2	0.8994	0.4419	1.2962

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PETROLEUM REFINERY ENGINEERING

For ordinary conditions the following amounts of steam are used:

	Lb per gal
Naphtha.....	0.2-0.5
Kerosene or diesel fuel.....	0.2-0.6
Gas oil.....	0.1-0.5
Neutral oils.....	0.4-0.9
Topped crude oil.....	0.4-1.2
Residual cylinder stock.....	1.0 up

Distillation with Extractive Solvents. Hydrocarbons of nearly the same boiling point (1 to 3°C) or constant-boiling mixtures cannot readily be separated by plain fractionation, and hence a combination of fractionation and solvent extraction known as the "Distex process" is employed.<sup>2</sup>

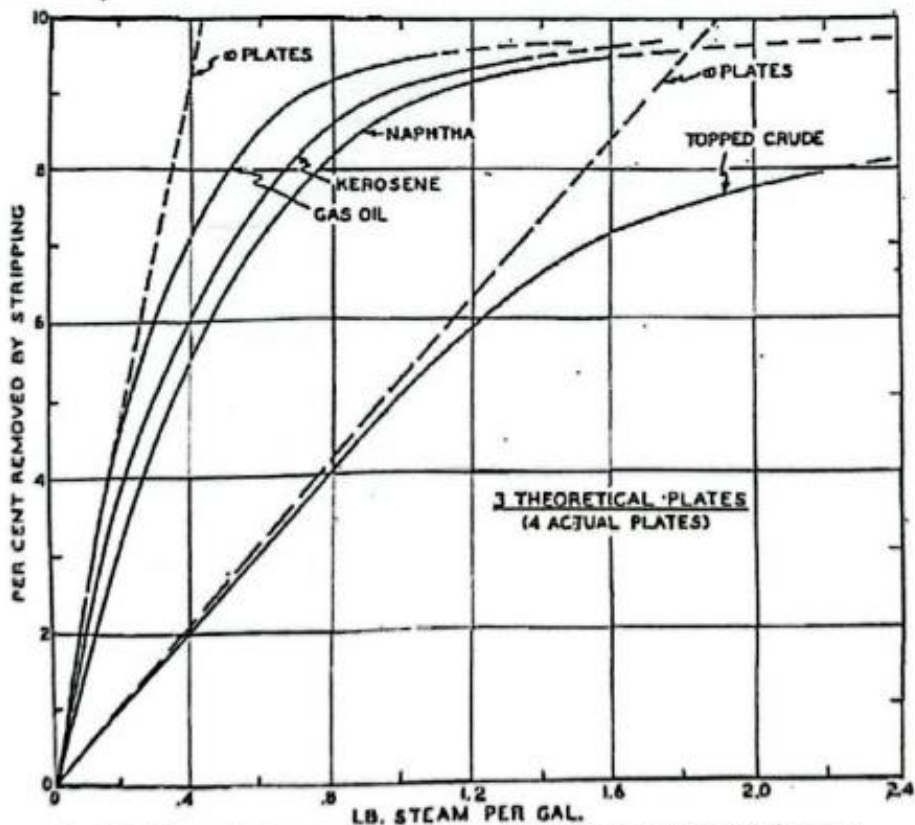


Fig. 7-4. Approximate steam required to strip with three theoretical plates.

It is particularly valuable in separating aromatic hydrocarbons which tend to form constant-boiling mixtures with many other hydrocarbons. Solvents such as aniline, furfural, phenol, nitrobenzene, or chlorex are introduced at the top of the fractionating column and withdrawn at the bottom. The solvent is recovered from the bottoms products by means

<sup>2</sup> Oriswold, Andrea, Van Derg, and Kasch, *Ind. Eng. Chem.*, 38, 65 (1946).

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the bottoms product of heavy-oil towers. The hot oil is contacted with the steam in a so-called "stripping tower" which may be a packed tower (up to 20 in. diameter) but usually consists of bubble trays or side-to-side pans. The use of four bubble trays (about seven side-to-side pans) is common, but in the extreme ten plates have been used. If as much as 6 to 10 per cent of low-boiling material must be removed by stripping, it is usually more economical to adjust the composition of the product in the fractionating tower than to steam-strip.

The approximate relation between flash point and (0 to 10 per cent) boiling range is given in Eq. (4-6a).

With this relationship it is possible to estimate the amount of material that should be removed by stripping in order to obtain a satisfactory flash point. Figures 7-3 and 7-4 indicate the approximate amounts of steam required in stripping naphtha, kerosene, distillate, gas oil, topped crude oil, and similar products.<sup>2</sup> Figure 4-49 indicates the wide range of kerosenes (or similar products) that can be produced by adjustment of the fractionating tower and degree of stripping. The dotted lines (Fig. 7-4) are examples of the effect of infinite plates on gas oil and on topped crude oil. Stocks such as topped crude oil (which are wide-boiling or have been disengaged from a wide-boiling material (such as crude oil) require large amounts of stripping steam.

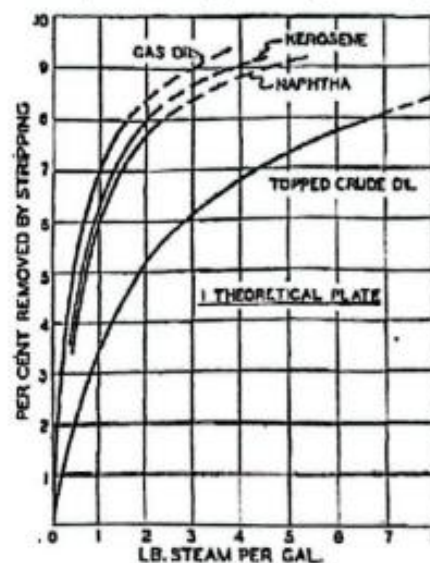


FIG. 7-3. Approximate steam required to strip when using only a bath of liquid, i.e., only one theoretical plate.

**Example 7-1. Amount of Stripping Steam.** An unstripped kerosene has an initial boiling point of 200°F, a 5 per cent point of 310°F, and a 10 per cent point of 355°F, which is an average temperature of about 288°F. Its flash point is about 90°F.

According to Eq. (4-6a), a 0 to 10 per cent front boiling range of 344°F will be required to obtain a flash point of 120°F. Six or seven per cent of the material must be removed to produce a 344°F front end; and, according to Figs. 7-3 and 7-4,

No. of plates	Lb steam per gal
1 (Fig. 7-3)	1.0
4 (Fig. 7-4)	0.45
10 (Reference 2)	0.40

<sup>2</sup> Nelson, W. L., *Oil Gas J.*, Mar. 2, 1944, p. 72; July 21, 1945, p. 128; and May 12, 1945, p. 51.