Annex II-5-7 E Q U I P M E N T L I S T [FOUNDRY EQUIPMENTS]

| Item No. | Object No. | Kind of Object | Short Spec. | Purpose of Use | Condition | Year | Remark |
|---|---|---|---|---|---|---|---|
| 1 | ---- | Cupola Furnace | D = 43 cm, L = 225 cm, Capacity = 500 Kg | Melting scrap iron | usable | 1972 | Almost not-used |
| 2 | ---- | Furnace | D = 110 cm, L = 170 cm, Capacity = 1,000 Kg | Melting scrap iron | usable | 1970 | Mecanicaly broken, partial crack |
| 3 | ---- | Brass Furnance | L = 50 cm, W = 50 cm, H = 60 cm, Cap. = 50 kg | Melting brass | usable | 1970 | Often used |
| 4 | 0217 | Electric Motor | 500 V, 13.5 A, 2,900 rpm, 8.8 KW | Rotating furnace | movable | 1970 | Almost not-used |
| 5 | 3220 | Electric Motor | Same above | Blower operation | movable | 1970 | Almost not-used |
| 6 | 3218 | Blower | --------- | Vertilation of furnace | movable | 1928 | Almost not-used |
| 7 | ---- | Retort | 1 unit, 1 ton | Porting molten metals | usable | 1970 | Almost not-used |
| 8 | ---- | Molding Machine | 1 unit | Making mold | usable | 1970 | Broken much |
| 9 | ---- | Molding Tools | 1 unit | Making mold | usable | 1970 | Broken much |

# ANNEX IV

## ANNEX IV-2-1 DESIGN BASIS FOR NEW ATMOSPHERIC DISTILLATION UNIT

(1) Type of Crude Oil and Processing Volume

a) Type of Crude Oil: Kawengan and Ledok crude oil

b) Processing Volume: 2,000 BPSD for each crude based on blocked operation

(2) Crude Assay

a) Kawengan Crude: Analysis made by the Department of Refining and Chemistry, Indonesian Petroleum Institute, August 1972

b) Ledok Crude: Analysis made by the Department of Refining and Chemistry, Indonesian Petroleum Institute, October 1972

(3) Battery Limit Conditions

a) Crude Oil: Oil temperature 30°C

b) Run Down Temperature of Distillates and Residue

| | |
|---|---|
| Light Gasoline (Solvent): | 38°C |
| Heavy Gasoline | 38 |
| Kerosene | 38 |
| Gas Oil | 45 |
| Wax Distillate | 70 |
| Residue | 90 |

(4) Utilities Conditions

a) Cooling Water Temperature: inlet : 33°C (3.0kg/$cm^2$.G)
outlet: 45°C

b) Steam: outlet temperature of furnace: 316°C (3.2 kg/$cm^2$.G)

Annex IV-2-2 MAIN EQUIPMENT LIST OF NEW TOPPING UNIT (1)

| ITEM No. | EQUIPMENT NAME | SPECIFICATION | Q'TY | REMARKS |
|---|---|---|---|---|
| C1 | Main Column | Vertical Cylindrical Type<br>Diameter: 1,200mm/1,000mm<br>Vertical Height: 29,450mm<br>Material: Shell CS, Tray 304SS | 1 | No. of trays: 38 |
| C2 | Stripper No.1/Stripper No.2 | Vertical Cylindrical Type<br>Diameter: 400mm/600mm<br>Vertical Height: 11,200mm<br>Material: CS | 1 | Both Stripper No.1 and Stripper No.2 have 4 trays |
| C3 | Stripper No.3/Stripper No.4 | Vertical Cylindrical Type<br>Diameter: 400mm/600mm<br>Vertical Height: 10,750mm<br>Material: CS | 1 | Both Stripper No.3 and Stripper No.4 have 4 trays |
| C4 | Soda Mixer No.1 | Vertical Cylindrical Type<br>Dimension: 420mmø x 2,100mmH<br>Material: CS | 1 | |
| C5 | Soda Mixer No.2 | Vertical Cylindrical Type<br>Dimension: 440mmø x 2,200mmH<br>Material: CS | 1 | |
| C6 | Sand Filter No.1 | Vertical Cylindrical Type<br>Dimension: 750mmø x 1,600mmH<br>Material: CS | 1 | Sand Volume is about 40% of total volume |
| C7 | Sand Filter No.2 | Vertical Cylindrical Type<br>Dimension: 770mmø x 1,600mmH<br>Material: CS | 1 | Sand Volume is about 40% of total volume |
| V1 | Water Drain Pot | Vertical Cylindrical Type<br>Dimension: 200mmø x 700mmH<br>Material: CS | 1 | |
| V2 | Over Head Receiver | Horizontal Cylindrical Type<br>Dimension: 1,100mmø x 3,100mmH<br>Material: CS | 1 | |
| V3 | Soda Settler No.1 | Horizontal Cylindrical Type<br>Dimension: 740mmø x 2,800mmH<br>Material: CS | 1 | |
| V4 | Soda Settler No.2 | Horizontal Cylindrical Type<br>Dimension: 760mmø x 2,800mmH<br>Material: CS | 1 | |

Annex IV-2-2 MAIN EQUIPMENT LIST OF NEW TOPPING UNIT (2)

| ITEM No. | EQUIPMENT NAME | SPECIFICATION | Q'TY | REMARKS |
|---|---|---|---|---|
| E1 | Crude/Heavy Naphtha Exchanger | Shell and Tube, Horizontal and Floating Head Type<br>Surface Area: 5 m2<br>Material: CS | 1 | |
| E2 | Crude/Heavy naphtha Reflux Exchanger | Shell and Tube, Horizontal and Floating Head Type<br>Surface Area: 35 m2<br>Material: CS | 1 | |
| E3 | Crude/Kerosine Exchanger | Shell and Tube, Horizontal and Floating Head Type<br>Surface Area: 14 m2<br>Material: CS | 1 | |
| E4 | Crude/LGO Exchanger | Shell and Tube, Horizontal and Floating Head Type<br>Surface Area: 5 m2<br>Material: CS | 1 | |
| E5 | Crude/LGO Reflux Exchanger | Shell and Tube, Horizontal and Floating Head Type<br>Surface Area: 14 m2<br>Material: CS | 1 | |
| E6 | Crude/HGO Exchanger | Shell and Tube, Horizontal and Floating Head Type<br>Surface Area: 5 m2<br>Material: CS | 1 | |
| E7 | Crude/Residue Exchanger | Shell and Tube, Horizontal and Floating Head Type<br>Surface Area: 46 m2<br>Material: CS | 1 | |
| E8 | Over Head Condenser | Shell and Tube, Horizontal and Floating Head Type<br>Surface Area: 301 m2<br>Material: CS | 1 | |
| E9 | Heavy Naphtha Cooler | Shell and Tube, Horizontal and Floating Head Type<br>Surface Area: 10 m2<br>Material: CS | 1 | |

Annex IV-2-2 MAIN EQUIPMENT LIST OF NEW TOPPING UNIT (3)

| ITEM No. | EQUIPMENT NAME | SPECIFICATION | Q'TY | REMARKS |
|---|---|---|---|---|
| E10 | Kerosine Cooler | Shell and Tube, Horizontal and Floating Head Type<br>Surface Area: 34 m2<br>Material: CS | 1 | |
| E11 | LGO Cooler | Shell and Tube, Horizontal and Floating Head Type<br>Surface Area: 8 m2<br>Material: CS | 1 | |
| E12 | HGO Cooler | Shell and Tube, Horizontal and Floating Head Type<br>Surface Area: 3 m2<br>Material: CS | 1 | |
| E13 | Residue Cooler | Box Cooler<br>Surface Area: 50 m2<br>Material: CS | 1 | |
| F1 | Crude Furnace | Vertical Cylindrical Type<br>Heater Duty: 1,474 x $10^3$ Kcal/H<br>Dimmension: 3,000mmOD x 6,100mmH<br><br>Tube<br>Size: 76.3mmOD x 7.0mmthick<br>Eff. Length: 5,000 mm<br>No. of Tube: 50 pieces<br><br>Efficiency: 65%<br>(Excluding steam coil)<br><br>Fuel Oil: 260 Kg/H<br>Atomizing Steam: 40 Kg/H | 1 | with steam coil at convection |
| P1A /B | Crude Charge Pump | Centrifugal Pump<br>Capacity: 13.4 m3/H<br>Total Head: 256 m<br>Motor (Rated HP): 30 KW | 2 | |
| P2 | Over Head Reflux Pump | Centrifugal Pump<br>Capacity: 14.9 m3/H<br>Total Head: 57.4 m<br>Moter (Rated HP): 5.5 KW | 1 | |

Annex IV-2-2 MAIN EQUIPMENT LIST OF NEW TOPPING UNIT (4)

| ITEM No. | EQUIPMENT NAME | SPECIFICATION | Q'TY | REMARKS |
|---|---|---|---|---|
| P3A /B | Heavy Naphtha Reflux Pump | Centrifugal Pump<br>Capacity: 13.8 m3/H<br>Total Head: 45.2 m<br>Motor (Rated HP): 3.7 KW | 2 | |
| P4A /B | LGO Reflux Pump | Centrifugal Pump<br>Capacity: 23.5 m3/H<br>Total Head: 44.8 m<br>Motor (Rated HP): 5.5 KW | 2 | |
| P5A /B | Heavy Naphtha Pump | Centrifugal Pump<br>Capacity: 2.2 m3/H<br>Total Head: 56.2 m<br>Motor (Rated HP): 3.7 KW | 2 | |
| P6 | Kerosine Pump | Centrifugal Pump<br>Capacity: 5.7 m3/H<br>Total Head: 33.8 m<br>Motor (Rated HP): 2.2 KW | 1 | |
| P7 | LGO Pump | Centrifugal Pump<br>Capacity: 2.6 m3/H<br>Total Head: 36.5 m<br>Motor (Rated HP): 2.2 KW | 1 | |
| P8A /B | HGO Pump | Centrifugal Pump<br>Capacity: 3.4 m3/H<br>Total Head: 33.0 m<br>Motor (Rated HP): 2.2 KW | 2 | |
| P9A /B | Residue Pump | Centrifugal Pump<br>Capacity: 5.8 m3/H<br>Total Head: 40.8 m<br>Motor (Rated HP): 3.7 KW | 2 | |
| P10A /B | No.1 Soda Circulation Pump | Centrifugal Pump<br>Capacity: 0.8 m3/H<br>Total Head: 13.1 m<br>Motor (Rated HP): 0.55 KW | 2 | |
| P11 | No.2 Soda Circulation Pump | Centrifugal Pump<br>Capacity: 0.8 m3/H<br>Total Head: 13.1 m<br>Motor (Rated HP): 0.55 KW | 1 | |

ANNEX IV-2-3 ESTIMATION OF UTILITIES CONSUMPTION

(1) In case of the Existing Atmospheric Distillation Unit

a) Fuel oil

The estimation has been made based on the fuel oil consumption reported in "Laporan Bulan Januari Tahure-1985, Cepu" of January 1985, that is, 0.089 EFO.Kl/charge Kl. Therefore, the fuel oil consumption for 2,000 BPSD operation is estimated as follow:

2,000 BPSD x 0.159 Kl/B x 0.089 EFO Kl x 103 x 1/24
= 1,180 l/H

b) Steam

The estimation has been made based on the steam consumption figure of the refinery (excld. wax plant) reported in the above mentioned monthly report of the Centre, eg. 2,960 ton/month as indicated in the following calculation:

- Stripping Steam (Kawengan Crude)

| | BPSD | Yield of Residue | lb/Gal | |
|---|---|---|---|---|
| $V_1$ : | 2,000 x 0.159 = 250 Kg/H | x 0.31 | x 264.2 x 0.5 x 4.54 x $10^{-1}$ | / 24 |
| $C_1$, $C_4$: | 2,000 x 0.159 = 170 Kg/H | x 0.21 | x 264.2 x 0.5 x 4.54 x $10^{-1}$ | / 24 |
| | 170 Kg/H x 2 = 340 Kg/H | | | |
| $C_2$ : | 2,000 x 0.159 = 170 Kg/H | x 0.22 | x 264.2 x 0.5 x 4.54 x $10^{-1}$ | / 24 |
| $C_3$ : | 2,000 x 0.159 = 150 Kg/H | x 0.19 | x 264.2 x 0.5 x 4.54 x $10^{-1}$ | / 24 |
| $C_4$ : | Zero | | | |
| | Total: 910 Kg/H | | | |

- Atomizing Steam

1,180 Kg/H x 0.15 = 180 Kg/H

- Steam for Reboiler Pump

The reciprocating pumps (6 units) for products distribution located in the refinery are operated only during the day, and therefore, if the rate of capacity utilization of these pumps is assumed to be 80% in average during the day, they are equivalent to 6 x 1/3 x 0.8 = 1.6 units/Day. Moreover, if the steam requirement for crude oil mixing is assumed to be 1wt% of crude, the total amount of steam will be:

Steam consumption for Reboiller Pump

(2,960 - 70) - [(1.0 + 1.6) x 31 x 24] = 1.49 Ton/H

1.49 x 2,000 x 0.159 x 31/8,730 = 1.68 Ton/H

- Steam Consumption

910 + 180 + 1,680 = 2,770 Kg/H

c) Electricity

| | | | |
|---|---|---|---|
| P1A/B | 5.5KW | ( Standard Capacity ) | |
| P2A/B | 2.2KW | ( " ) | 9.2KW x 0.8 = 7.4KW |
| P3A/B | 1.5K | ( " ) | |
| P060/1A/B | 3.0KW | ( " ) | 7.0KW x 0.8 x 1/3 x 0.4 |
| P060/2A/B | 4.0KW | ( " ) | = 0.8 KW |
| P350/1/2/3 | 75.0KW | ( " ) | 53.2KW x 2 = 106.4KW (by Performance Curve) |
| P500 | 11.0KW | ( " ) | 11.0KW x 0.8 = 8.8KW |

Estimated Power consumption 7.4+0.8+106.4+8.8=123.4KW

d) Cooling water

Cooling water requirement is estimated either based on an assumption that the capacity of cooling tower pump for the atmospheric distillation unit is 450$m^3$/H/unit, or assuming a case that the heat exchangers of E1 to E6 for the new unit do not exist.

In the former case, the requirement is

450 $m^3$/H x 0.5 = 230 $m^3$/H

while the latter case gives 250 $m^3$/H, therefore these assumptions are considered reasonable.

(2) In case of the New Atmospheric Distillation Unit

a) Fuel oil

Ledok Crude 1.47 x 106 Kcal/H/(0.65 x 9,250 x 0.940)
= 260 Kg/H

Kawengan Crude
0.98 x 106 Kcal/H/(0.65 x 9.250 x 0.940)
= 180 Kg/H

Fuel oil requirement is estimated as follow on the basis of a block operation of the two different kinds of crude, Kawengan and Ledok, for 5 days and 3 day, respectively.

(260 x 3 x 170 x 5) ÷ 8 = 200 Kg/H

b) Steam

Stripping Steam

Ledok Crude 680 Kg/H
Kawengan Crude 730
(680 x 3 + 730 x 5) ÷ 8 = 710 Kg/H

Atomizing steam

200 Kg/H x 0/15 = 30 Kg/H

Total Steam Consumption

710 + 30 = 740 Kg/H

c) Electricity

There is no significant difference in power consumption between the processing of Kaengan and Ledok crude.

| | | |
|---|---|---|
| P1A/B | 24.2 KW | x 1 |
| P2 | 4.7 KW | x 1 |
| P3A/B | 3.5 KW | x 1 |
| P4A/B | 4.6 KW | x 1 |
| P5A/B | 2.8 KW | x 1 |
| P6 | 1.9 KW | x 1 |
| P7 | 2.1 KW | x 1 |
| P8A/B | 2.0 KW | x 1 |
| P9A/B | 2.4 KW | x 1 |
| P10A/B | 0.4 KW | x 1 |
| P11 | 0.4 KW | x 1 |
| P350/1/2/3 | 49.4 KW | x 2 |
| P500 | 8.8 KW | x 1 |
| Total | 156.6 KW | |

d) Cooling water

| | Ledok Crude | Kawengon Crude |
|---|---|---|
| E 8 | 129 Ton/H | 87 Ton/H |
| E 9 | 1 | 1 |
| E10 | 15 | 7 |
| E11 | 6 | 10 |
| E12 | 3 | 12 |
| E13 | 11 | 23 |
| Total | 165 | 140 |

(165 x 3 + 140 x 5) ÷ 8 = 150 Ton/H

# Annex IV-2-4 RESULTS OF DESIGN CALCULATION OF THE ATMOSPHERIC DISTILLATION UNIT



****** RESULTS ******

** COLUMN SUMMARY

| TRAY | L / O | PRESS. KG/CM2-G | TEMP. C | LIQ.RATE KGMOL/H | VAP.RATE KGMOL/H | HEAT LOAD MMKCAL/H |
|---|---|---|---|---|---|---|
| (MAIN TOWER) | | | | | | |
| 1 | W | 0.35 | 38.00 | 63.20 | 5.47 | -1.0439 |
| 2 | | 0.91 | 85.93 | 72.16 | 108.64 | -0.0000 |
| 3 | | 0.94 | 97.99 | 70.94 | 117.60 | 0.0000 |
| 4 | | 0.98 | 106.59 | 68.71 | 116.37 | 0.0000 |
| 5 | V | 1.00 | 114.70 | 65.48 | 114.14 | 0.0000 |
| 6 | L | 1.01 | 124.44 | 61.39 | 107.64 | -0.0000 |
| 7 | L | 1.03 | 136.83 | 152.29 | 103.56 | -0.0000 |
| 8 | L | 1.04 | 149.30 | 151.95 | 129.78 | 0.0000 |
| 9 | V | 1.06 | 165.16 | 70.68 | 129.44 | 0.0000 |
| 10 | L | 1.07 | 183.53 | 63.99 | 114.77 | 0.0000 |
| 11 | | 1.09 | 204.02 | 44.82 | 108.08 | -0.0000 |
| 12 | | 1.11 | 219.52 | 42.61 | 104.10 | -0.0000 |
| 13 | L | 1.13 | 230.74 | 151.83 | 101.88 | -0.0000 |
| 14 | V L | 1.15 | 243.19 | 157.45 | 126.27 | -0.0000 |
| 15 | L | 1.17 | 257.69 | 70.73 | 119.46 | 0.0000 |
| 16 | | 1.18 | 270.09 | 51.26 | 117.56 | 0.0000 |
| 17 | V | 1.19 | 282.96 | 41.31 | 112.06 | -0.0000 |
| 18 | V L | 1.20 | 302.65 | 19.85 | 98.02 | -0.0000 |
| 19 | L | 1.22 | 321.63 | 13.46 | 15.09 | 0.0000 |
| 20 | V | 1.25 | 312.64 | 11.02 | 11.64 | -0.0000 |
| (STRIPPER NO. 1) | | | | | | |
| FROM MT 6 | | | | 9.82 | | |
| 1 | | 0.98 | 115.43 | 9.20 | 3.27 | 0.0000 |
| 2 | V | 1.00 | 106.76 | 8.24 | 2.65 | 0.0000 |
| (STRIPPER NO. 2) | | | | | | |
| FROM MT 10 | | | | 15.19 | | |
| 1 | | 1.04 | 171.00 | 13.48 | 7.90 | 0.0000 |
| 2 | V | 1.06 | 160.16 | 11.56 | 6.19 | 0.0000 |
| (STRIPPER NO. 3) | | | | | | |
| FROM MT 15 | | | | 13.97 | | |
| 1 | | 1.09 | 238.87 | 11.19 | 12.44 | -0.0000 |
| 2 | V | 1.11 | 222.93 | 8.75 | 9.67 | -0.0000 |
| (STRIPPER NO. 4) | | | | | | |
| FROM MT 18 | | | | 9.93 | | |
| 1 | | 1.17 | 297.35 | 9.02 | 4.09 | -0.0000 |
| 2 | V | 1.19 | 290.30 | 7.88 | 3.17 | -0.0000 |
| (PUMPAROUNDS) | | | | | | |
| 1 | 8 TO 7 | | 82.37 | 74.50 | | -0.3200 |
| 2 | 14 TO 13 | | 197.91 | 84.83 | | -0.4410 |
| (WATER) | | | | | | |
| FROM DECANTER | | | 38.00 | 39.96 | | |
| (FEED STREAMS) | | | | | | |
| 1 | MT 19 & 18 | | 360.19 | 6.98 | 61.47 | |
| 2 | MT 20 | | 313.76 | | 9.20 | |
| 3 | S1 2 | | 313.46 | | 1.69 | |
| 4 | S2 2 | | 313.53 | | 4.27 | |
| 5 | S3 2 | | 313.59 | | 7.22 | |
| 6 | S4 2 | | 313.69 | | 2.04 | |

| TRAY | LIQ.MW | VAP.MW | LIQ.DENS KG/M3 | VAP.DENS KG/M3 | LIQ.RATE KG/H MT | VAP.RATE KG/H MT |
|---|---|---|---|---|---|---|
| 1 | 88.18 | 88.18 | 691.96 | 4.92 | 5573.46 | 482.68 |
| 2 | 92.44 | 62.37 | 665.05 | 4.14 | 6670.66 | 6776.04 |
| 3 | 96.17 | 66.95 | 664.51 | 4.38 | 6821.93 | 7873.24 |
| 4 | 99.81 | 68.96 | 664.32 | 4.48 | 6857.56 | 8024.51 |
| 5 | 104.18 | 70.62 | 664.71 | 4.53 | 6821.44 | 8060.14 |
| 6 | 110.04 | 72.70 | 665.81 | 4.58 | 6756.09 | 7825.81 |
| 7 | 118.35 | 74.94 | 668.33 | 4.61 | 18023.09 | 7760.46 |
| 8 | 122.86 | 84.41 | 663.48 | 5.09 | 18669.43 | 10954.77 |
| 9 | 133.46 | 89.63 | 665.62 | 5.25 | 9432.98 | 11601.11 |
| 10 | 146.66 | 95.44 | 669.26 | 5.40 | 9385.62 | 10954.28 |
| 11 | 161.57 | 100.91 | 672.84 | 5.50 | 7242.15 | 10906.92 |
| 12 | 172.46 | 105.58 | 674.27 | 5.62 | 7348.29 | 10990.53 |
| 13 | 181.10 | 108.91 | 675.54 | 5.72 | 27496.09 | 11096.67 |
| 14 | 185.52 | 122.81 | 669.48 | 6.39 | 29210.17 | 15507.56 |
| 15 | 195.24 | 135.01 | 665.83 | 6.92 | 13808.82 | 16127.36 |
| 16 | 208.91 | 140.04 | 663.90 | 7.04 | 10708.95 | 16462.90 |
| 17 | 227.90 | 143.59 | 661.58 | 7.08 | 9415.31 | 16090.52 |
| 18 | 272.89 | 146.07 | 666.59 | 6.96 | 5417.58 | 14318.10 |
| 19 | 353.85 | 102.19 | 710.42 | 4.67 | 4761.15 | 1542.22 |
| 20 | 375.97 | 67.39 | 729.28 | 3.14 | 4142.48 | 784.48 |
| (STRIPPER NO. 1) | | | | | | |
| 1 | 110.30 | 60.69 | 675.98 | 3.83 | 1015.17 | 198.20 |
| 2 | 110.77 | 50.07 | 685.95 | 3.25 | 912.94 | 132.62 |
| (STRIPPER NO. 2) | | | | | | |
| 1 | 148.55 | 71.38 | 684.70 | 4.04 | 2001.93 | 563.83 |
| 2 | 150.53 | 54.71 | 697.97 | 3.19 | 1740.26 | 338.68 |
| (STRIPPER NO. 3) | | | | | | |
| 1 | 198.92 | 87.94 | 687.95 | 4.41 | 2226.05 | 1094.29 |
| 2 | 201.58 | 61.34 | 704.54 | 3.18 | 1763.29 | 592.85 |
| (STRIPPER NO. 4) | | | | | | |
| 1 | 280.05 | 117.10 | 675.55 | 5.49 | 2524.80 | 478.78 |
| 2 | 287.78 | 92.51 | 685.12 | 4.40 | 2267.98 | 293.55 |
| (PUMPAROUNDS) | | | | | | |
| 1 | 122.86 | 122.86 | 725.36 | 9.47 | 9153.45 | 0.0 |
| 2 | 185.52 | 185.52 | 709.95 | 11.26 | 15736.90 | 0.0 |

** DISTILLATION CURVES FOR PRODUCT STREAMS

* TBP CURVES ( .C )

| NO. | IP | 5 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 95 | EP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 5 | 30 | 44 | 62 | 65 | 68 | 74 | 80 | 86 | 93 | 98 | 105 | 116 |
| 3 | 74 | 93 | 97 | 105 | 110 | 120 | 125 | 131 | 136 | 145 | 156 | 166 | 185 |
| 4 | 123 | 141 | 153 | 165 | 174 | 184 | 194 | 202 | 209 | 221 | 232 | 238 | 256 |
| 5 | 197 | 223 | 230 | 239 | 247 | 253 | 257 | 265 | 273 | 282 | 298 | 306 | 329 |
| 6 | 232 | 258 | 274 | 294 | 307 | 319 | 338 | 357 | 379 | 420 | 448 | 465 | 543 |
| 7 | 260 | 294 | 310 | 345 | 380 | 424 | 441 | 458 | 483 | 547 | 551 | 554 | 556 |

* ASTM CURVES ( .C )

| NO. | IP | 5 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 95 | EP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 40 | 51 | 63 | 72 | 73 | 76 | 78 | 82 | 86 | 88 | 94 | 102 | 110 |
| 3 | 102 | 108 | 114 | 118 | 120 | 124 | 128 | 131 | 135 | 138 | 150 | 163 | 176 |
| 4 | 155 | 164 | 172 | 180 | 183 | 189 | 194 | 199 | 204 | 210 | 221 | 232 | 243 |
| 5 | 222 | 232 | 241 | 248 | 249 | 252 | 255 | 259 | 265 | 270 | 284 | 298 | 312 |
| 6 | 264 | 277 | 290 | 303 | 309 | 319 | 330 | 344 | 364 | 386 | 428 | 465 | 501 |
| 7 | 277 | 292 | 310 | 341 | 370 | 397 | 422 | 438 | 455 | 491 | 521 | 525 | 524 |

* EFV CURVES ( .C )

| NO. | IP | 5 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 95 | EP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 56 | 61 | 66 | 71 | 72 | 73 | 73 | 75 | 76 | 77 | 79 | 82 | 84 |
| 3 | 117 | 119 | 121 | 123 | 124 | 126 | 128 | 129 | 130 | 131 | 136 | 141 | 146 |
| 4 | 178 | 182 | 185 | 188 | 190 | 193 | 195 | 197 | 199 | 202 | 206 | 210 | 214 |
| 5 | 247 | 251 | 255 | 258 | 258 | 259 | 260 | 262 | 264 | 267 | 273 | 279 | 284 |
| 6 | 305 | 311 | 317 | 324 | 328 | 332 | 338 | 346 | 358 | 372 | 399 | 423 | 446 |
| 7 | 336 | 342 | 351 | 372 | 393 | 412 | 428 | 437 | 447 | 470 | 489 | 491 | 490 |

****** RESULTS ******

** COLUMN SUMMARY

| TRAY | I / O | PRESS. KG/CM2-G | TEMP. .C | LIQ.RATE KGMOL/H | VAP.RATE KGMOL/H | HEAT LOAD MMKCAL/H |
|---|---|---|---|---|---|---|
| (MAIN TOWER) | | | | | | |
| 1 | W | 0.35 | 38.00 | 111.40 | 13.63 | -1.5457 |
| 2 | | 0.91 | 91.84 | 129.85 | 162.49 | -0.0000 |
| 3 | | 0.94 | 105.09 | 128.49 | 180.94 | 0.0000 |
| 4 | | 0.98 | 113.77 | 125.13 | 179.58 | -0.0000 |
| 5 | V | 1.00 | 121.59 | 119.63 | 176.22 | -0.0000 |
| 6 | L | 1.01 | 131.25 | 112.90 | 164.27 | -0.0000 |
| 7 | L | 1.03 | 143.28 | 184.13 | 157.54 | 0.0000 |
| 8 | L | 1.04 | 154.55 | 177.87 | 184.17 | -0.0000 |
| 9 | V | 1.06 | 170.13 | 99.10 | 177.91 | 0.0000 |
| 10 | L | 1.07 | 195.93 | 77.84 | 142.10 | 0.0000 |
| 11 | | 1.09 | 234.62 | 39.77 | 120.84 | 0.0000 |
| 12 | | 1.11 | 255.98 | 38.52 | 114.49 | 0.0000 |
| 13 | L | 1.13 | 266.60 | 72.15 | 113.24 | -0.0000 |
| 14 | V L | 1.15 | 277.64 | 72.13 | 125.17 | 0.0000 |
| 15 | L | 1.17 | 286.82 | 47.37 | 120.42 | -0.0000 |
| 16 | | 1.18 | 295.13 | 35.52 | 117.36 | 0.0000 |
| 17 | V | 1.19 | 304.55 | 26.67 | 112.21 | -0.0000 |
| 18 | V L | 1.20 | 319.94 | 9.37 | 101.09 | -0.0000 |
| 19 | L | 1.22 | 330.10 | 8.41 | 8.56 | 0.0000 |
| 20 | V | 1.25 | 321.92 | 7.14 | 7.02 | 0.0000 |
| (STRIPPER NO. 1) | | | | | | |
| FROM MT 6 | | | | 16.58 | | |
| 1 | | 0.98 | 118.46 | 15.00 | 6.45 | -0.0000 |
| 2 | V | 1.00 | 108.10 | 13.15 | 4.86 | 0.0000 |
| (STRIPPER NO. 2) | | | | | | |
| FROM MT 10 | | | | 31.72 | | |
| 1 | | 1.04 | 182.22 | 27.15 | 18.23 | 0.0000 |
| 2 | V | 1.06 | 171.64 | 22.99 | 13.66 | 0.0000 |
| (STRIPPER NO. 3) | | | | | | |
| FROM MT 15 | | | | 6.70 | | |
| 1 | | 1.09 | 275.22 | 5.67 | 4.73 | -0.0000 |
| 2 | V | 1.11 | 263.03 | 4.63 | 3.70 | 0.0000 |
| (STRIPPER NO. 4) | | | | | | |
| FROM MT 18 | | | | 2.79 | | |
| 1 | | 1.17 | 312.10 | 2.39 | 2.28 | 0.0000 |
| 2 | V | 1.19 | 302.91 | 2.00 | 1.88 | -0.0000 |
| (PUMPAROUNDS) | | | | | | |
| 1 | 8 TO 7 | | 75.87 | 61.19 | | -0.3200 |
| 2 | 14 TO 13 | | 199.20 | 21.70 | | -0.2410 |
| (WATER) | | | | | | |
| FROM DECANTER | | | 38.00 | 37.46 | | |
| (FEED STREAMS) | | | | | | |
| 1 | MT 19 & 18 | | 362.07 | 3.36 | 75.23 | |
| 2 | MT 20 | | 313.76 | | 5.74 | |
| 3 | S1 2 | | 313.46 | | 3.01 | |
| 4 | S2 2 | | 313.53 | | 9.49 | |
| 5 | S3 2 | | 313.59 | | 2.66 | |
| 6 | S4 2 | | 313.69 | | 1.50 | |

| TRAY | LIQ.MW | VAP.MW | LIQ.DENS KG/M3 | VAP.DENS KG/M3 | LIQ.RATE KG/H WT | VAP.RATE KG/H WT |
|---|---|---|---|---|---|---|
| 1 | 88.35 | 88.35 | 679.22 | 4.93 | 9842.10 | 1203.97 |
| 2 | 93.76 | 72.13 | 651.37 | 4.73 | 12174.88 | 11721.02 |
| 3 | 97.65 | 77.67 | 651.30 | 5.01 | 12546.73 | 14053.81 |
| 4 | 101.17 | 80.33 | 650.72 | 5.16 | 12658.88 | 14425.66 |
| 5 | 105.41 | 82.50 | 650.56 | 5.23 | 12609.65 | 14537.80 |
| 6 | 111.06 | 85.62 | 650.50 | 5.34 | 12538.93 | 14065.49 |
| 7 | 118.84 | 88.83 | 651.65 | 5.42 | 21881.63 | 13994.77 |
| 8 | 124.43 | 95.38 | 649.59 | 5.71 | 22132.93 | 17565.11 |
| 9 | 136.61 | 100.14 | 654.08 | 5.83 | 13537.40 | 17816.44 |
| 10 | 160.11 | 108.81 | 665.52 | 6.02 | 12461.99 | 15462.39 |
| 11 | 191.59 | 119.06 | 671.13 | 6.11 | 7619.34 | 14386.98 |
| 12 | 206.85 | 127.72 | 666.98 | 6.35 | 7967.56 | 14623.21 |
| 13 | 216.30 | 132.21 | 664.15 | 6.51 | 15606.46 | 14971.43 |
| 14 | 223.28 | 141.92 | 658.88 | 6.93 | 16104.44 | 17765.19 |
| 15 | 232.48 | 147.62 | 656.76 | 7.16 | 11011.87 | 17776.15 |
| 16 | 243.97 | 149.36 | 658.47 | 7.17 | 8665.53 | 17528.70 |
| 17 | 260.20 | 149.18 | 664.68 | 7.06 | 6940.59 | 16739.96 |
| 18 | 296.01 | 146.43 | 684.36 | 6.75 | 2774.04 | 14801.67 |
| 19 | 361.74 | 91.84 | 735.08 | 4.13 | 3041.86 | 785.82 |
| 20 | 378.49 | 63.27 | 753.42 | 2.90 | 2701.42 | 443.95 |
| (STRIPPER NO. 1) | | | | | | |
| 1 | 111.46 | 65.61 | 665.27 | 4.12 | 1671.54 | 423.08 |
| 2 | 112.03 | 52.01 | 677.15 | 3.37 | 1472.92 | 252.91 |
| (STRIPPER NO. 2) | | | | | | |
| 1 | 164.49 | 75.31 | 685.27 | 4.16 | 4466.59 | 1372.55 |
| 2 | 168.67 | 55.67 | 700.58 | 3.16 | 3877.33 | 760.26 |
| (STRIPPER NO. 3) | | | | | | |
| 1 | 238.15 | 102.95 | 672.75 | 4.83 | 1350.00 | 487.03 |
| 2 | 241.41 | 75.53 | 685.63 | 3.63 | 1118.56 | 279.44 |
| (STRIPPER NO. 4) | | | | | | |
| 1 | 308.96 | 93.56 | 701.53 | 4.24 | 738.52 | 213.36 |
| 2 | 318.48 | 67.42 | 716.08 | 3.11 | 638.48 | 127.04 |
| (PUMPAROUNDS) | | | | | | |
| 1 | 124.43 | 124.43 | 722.16 | 9.87 | 7614.05 | 0.0 |
| 2 | 223.28 | 223.28 | 724.75 | 14.24 | 4845.13 | 0.0 |

** DISTILLATION CURVES FOR PRODUCT STREAMS

* TBP CURVES ( .C )

| NO. | IP | 5 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 95 | EP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 8 | 29 | 35 | 49 | 62 | 65 | 71 | 82 | 91 | 94 | 96 | 104 | 116 |
| 3 | 74 | 94 | 95 | 104 | 113 | 118 | 124 | 131 | 137 | 145 | 156 | 165 | 181 |
| 4 | 124 | 147 | 160 | 174 | 189 | 205 | 221 | 230 | 248 | 259 | 272 | 284 | 296 |
| 5 | 225 | 256 | 267 | 282 | 292 | 295 | 298 | 305 | 313 | 321 | 333 | 342 | 370 |
| 6 | 262 | 295 | 312 | 331 | 343 | 365 | 377 | 390 | 415 | 441 | 466 | 482 | 584 |
| 7 | 277 | 312 | 331 | 364 | 382 | 414 | 445 | 472 | 574 | 579 | 585 | 588 | 590 |

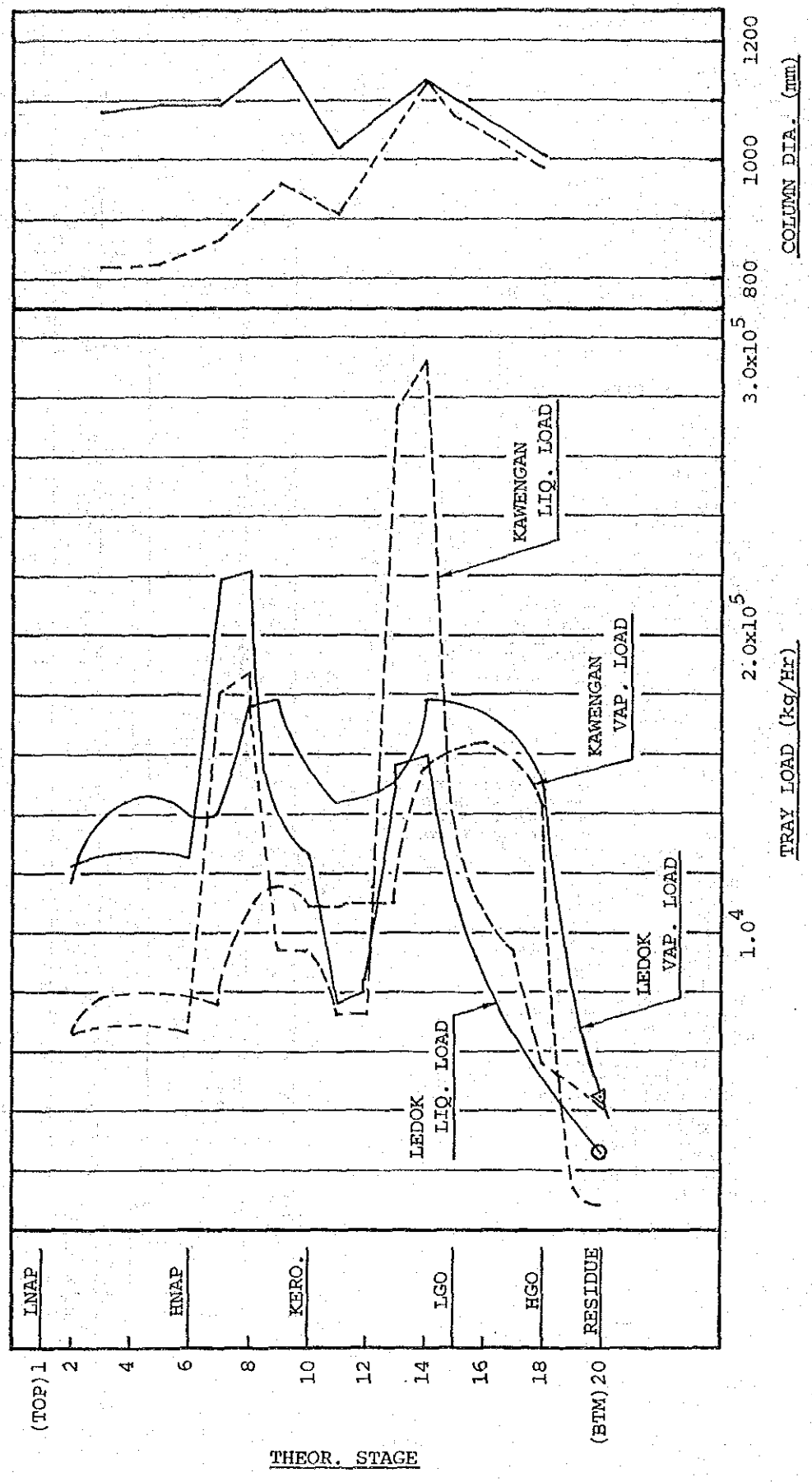
* ASTM CURVES ( .C )

| NO. | IP | 5 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 95 | EP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 41 | 48 | 56 | 65 | 71 | 73 | 75 | 82 | 89 | 88 | 92 | 101 | 110 |
| 3 | 103 | 107 | 112 | 118 | 121 | 124 | 127 | 131 | 136 | 139 | 149 | 160 | 172 |
| 4 | 161 | 171 | 182 | 193 | 199 | 209 | 220 | 230 | 239 | 246 | 257 | 269 | 280 |
| 5 | 251 | 264 | 276 | 287 | 289 | 291 | 293 | 297 | 303 | 305 | 318 | 334 | 351 |
| 6 | 293 | 309 | 325 | 338 | 343 | 353 | 366 | 379 | 395 | 405 | 442 | 485 | 528 |
| 7 | 298 | 315 | 333 | 354 | 371 | 393 | 425 | 485 | 539 | 550 | 547 | 549 | 551 |

* EFV CURVES ( .C )

| NO. | IP | 5 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 95 | EP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 53 | 55 | 58 | 63 | 66 | 67 | 68 | 71 | 74 | 73 | 75 | 78 | 81 |
| 3 | 115 | 117 | 119 | 121 | 123 | 124 | 125 | 126 | 128 | 130 | 133 | 137 | 141 |
| 4 | 192 | 196 | 200 | 206 | 210 | 215 | 221 | 225 | 230 | 233 | 238 | 242 | 246 |
| 5 | 280 | 286 | 292 | 297 | 299 | 299 | 300 | 301 | 303 | 305 | 310 | 316 | 323 |
| 6 | 340 | 348 | 355 | 362 | 365 | 371 | 377 | 385 | 394 | 398 | 422 | 451 | 482 |
| 7 | 362 | 369 | 378 | 391 | 403 | 418 | 439 | 478 | 512 | 517 | 514 | 515 | 515 |

Annex IV-2-5 RELATIONSHIP BETWEEN TRAY LOAD AND TOWER DIAMETER



# PROCESS SKETCH

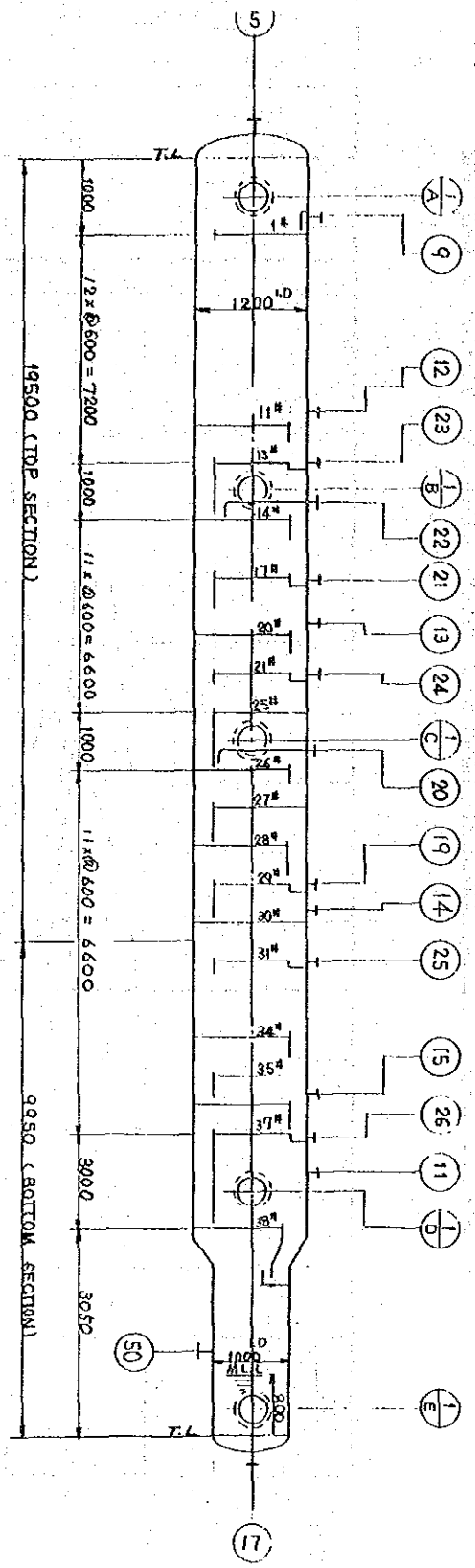
Annex IV-2-6

JOB No. 7431
ITEM No. _____ Comb'd with _____
Equipment Name: MAIN COLUMN
Customer: _____
Process Name: _____
Diameter: 1200 / 1000 mm & _____ mm
Vertical Height: 29,450 mm Skirt: _____ mm
Horizontal Length: _____ mm
Heads: Ellips. V Dished _____ Cone _____ Flat _____
Code: _____
Stress Relieved: Yes ___ No ___
Radiographed: Yes ___ No ___
Operating Temp. Top _____ ℃ Bot'm _____ ℃
Operating Press: _____ kg/cm²G _____ ( )
Design Temp. (TOP/BTM) 320/380 ℃
Design Press: 3.5 & FV kg/cm²G _____ ( )
Corrosion Allowance: Shell 1.0 mm & _____ mm
Material: Shell SB42 Jacket _____ Coil _____
Tray 304SS Liner _____ (Th'k _____ mm)
Insulation: Conservation _____ Protection _____ No ___
Fire Protection: Yes ___ No ___

| NOZZLE No. | REQ'D No. | SIZE | SERVICE & SYMBOL |
|---|---|---|---|
| 1 | | | MANHOLE |
| 2 | | | MANHOLE |
| 3 | | | HANDHOLE, HATCH |
| 4 | | | COMBINED WITH |
| 5 | | | VAPOR OUTLET TO |
| 6 | | | VAPOR OUTLET TO |
| 7 | | | VAPOR OUTLET TO |
| 8 | | | VENT |
| 9 | | | REFLUX IN FROM |
| 10 | | | REFLUX IN FROM |
| 11 | | | FEED FROM |
| 12 | | | FEED FROM No 1 STRIPPER |
| 13 | | | FEED FROM No 2 STRIPPER |
| 14 | | | FEED FROM No 3 STRIPPER |
| 15 | | | FEED FROM No 4 STRIPPER |
| 16 | | | EQUALIZING LINE WITH |
| 17 | | | BOTTOM OUTLET TO |
| 18 | | | LIQUID OUTLET TO |
| 19 | | | DRAWOFF TO |
| 20 | | | RETURN FROM |
| 21 | | | DRAWOFF TO |
| 22 | | | RETURN FROM |
| 23 | | | LIQ. OUT TO No 1 STRIPPER |
| 24 | | | LIQ. OUT TO No 2 STRIPPER |
| 25 | | | LIQ OUT TO No 3 STRIPPER |
| 26 | | | LIQ OUT TO No 4 STRIPPER |
| 27 | | | COIL IN FROM |
| 28 | | | COIL OUT TO |
| 29 | | | SPARE NOZZLE |
| 30 | | | AIR FOAM CONNECTION |
| 31 | | | DRAIN |
| 32 | | | SAMPLE CONNECTION (S), COOLER (SSC) |
| 33 | | | SAFETY CONNECTION (SV, SRD, VB) |
| 34 | | | SAFETY CONNECTION |
| 35 | | | UTILITY |
| 36 | | | PRESSURE CONNECTION (P ) |
| 37 | | | PRESSURE CONNECTION (P ) |
| 38 | | | PRESSURE CONNECTION (P ) |
| 39 | | | PRESSURE CONNECTION (P ) |
| 40 | | | TEMPERATURE CONNECTION (T ) |
| 41 | | | TEMPERATURE CONNECTION (T ) |
| 42 | | | TEMPERATURE CONNECTION (T ) |
| 43 | | | TEMPERATURE CONNECTION (T ) |
| 44 | | | LEVEL CONNECTION (L ) |
| 45 | | | LEVEL CONNECTION (L ) |
| 46 | | | LEVEL CONNECTION (L ) |
| 47 | | | LEVEL CONNECTION (L ) |
| 48 | | | SIGHT GLASS, LIGHT HOLE |
| 49 | | | |
| 50 | | | STEAM INLET |

NOTE : Internal Fluid
Liquid Density kg/m³
Piping Spec.

TRAY TYPE . VALVE




REMARKS : _____

| REV. | DWN | DATE | APP. | DATE | APP. | DATE |
|---|---|---|---|---|---|---|
| 3 | | | | | | |
| 2 | | | | | | |
| 1 | | Sep 8 '76 | K.S | | | |

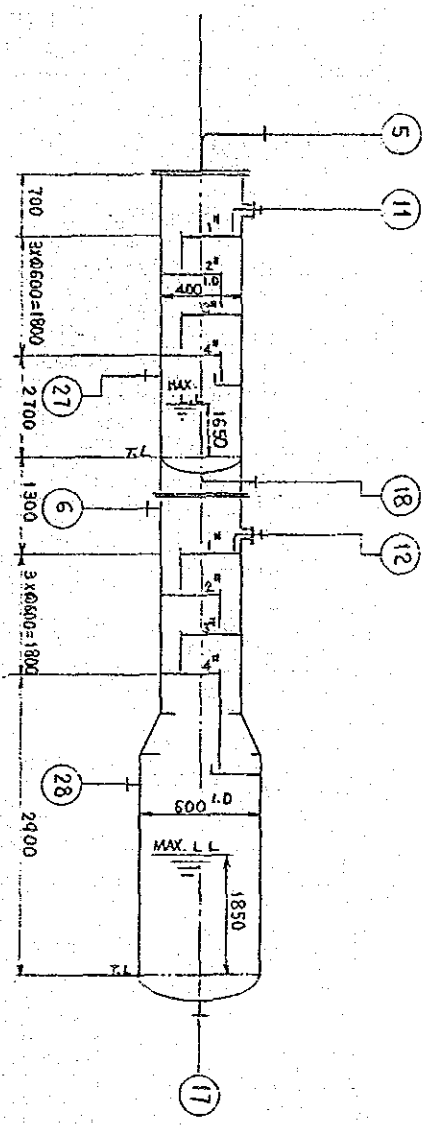
JOB No. _____ ITEM No. _____

# PROCESS SKETCH

JOB No. _____
ITEM No. _____ Comb'd with _____
Equipment Name: STRIPPER No.1 / STRIPPER No.2
Customer: _____
Process Name: _____
Diameter: 400 / 600 mm & _____ mm
Vertical Height: 11,200 mm Skirt: _____ mm
Horizontal Length: _____ mm
Heads: Ellips. 4 Dished _____ Cone _____ Flat _____
Code: _____
Stress Relieved: Yes ___ No ___
Radiographed: Yes ___ No ___
Operating Temp. Top _____ ℃ Bot'm _____ ℃
Operating Press: _____ kg/cm²G _____ ( )
Design Temp. No1/No2 130 / 200 ℃
Design Press: No1/No.2 3.5 kg/cm²G _____ ( )
Corrosion Allowance: Shell _____ mm & _____ mm
Material: Shell CS Jacket _____ Coil _____
Tray _____ Liner _____ (Th'k _____ mm)
Insulation: Conservation _____ Protection _____ No ___
Fire Protection: Yes ___ No ___

| NOZZLE No. | REQ'D No. | SIZE | SERVICE & SYMBOL |
|---|---|---|---|
| 1 | | | MANHOLE |
| 2 | | | MANHOLE |
| 3 | | | HANDHOLE, HATCH |
| 4 | | | COMBINED WITH |
| 5 | | | VAPOR OUTLET TO MAIN COLUMN |
| 6 | | | VAPOR OUTLET TO MAIN COLUMN |
| 7 | | | VAPOR OUTLET TO |
| 8 | | | VENT |
| 9 | | | REFLUX IN FROM |
| 10 | | | REFLUX IN FROM |
| 11 | | | FEED FROM MAIN COLUMN |
| 12 | | | FEED FROM MAIN COLUMN |
| 13 | | | FEED FROM |
| 14 | | | TO (REBOILER)(REB.PUMP) |
| 15 | | | FROM REBOILER |
| 16 | | | EQUALIZING LINE WITH |
| 17 | | | BOTTOM OUTLET TO |
| 18 | | | LIQUID OUTLET TO |
| 19 | | | DRAWOFF TO |
| 20 | | | RETURN FROM |
| 21 | | | DRAWOFF TO |
| 22 | | | RETURN FROM |
| 23 | | | DRAWOFF TO |
| 24 | | | RETURN FROM |
| 25 | | | JACKET IN FROM |
| 26 | | | JACKET OUT TO |
| 27 | | | STEAM IN |
| 28 | | | STEAM IN |
| 29 | | | SPARE NOZZLE |
| 30 | | | AIR FOAM CONNECTION |
| 31 | | | DRAIN |
| 32 | | | SAMPLE CONNECTION (SI, COOLER (SSC) |
| 33 | | | SAFETY CONNECTION (SV, SRD, VB) |
| 34 | | | SAFETY CONNECTION |
| 35 | | | UTILITY |
| 36 | | | PRESSURE CONNECTION (P ) |
| 37 | | | PRESSURE CONNECTION (P ) |
| 38 | | | PRESSURE CONNECTION (P ) |
| 39 | | | PRESSURE CONNECTION (P ) |
| 40 | | | TEMPERATURE CONNECTION (T ) |
| 41 | | | TEMPERATURE CONNECTION (T ) |
| 42 | | | TEMPERATURE CONNECTION (T ) |
| 43 | | | TEMPERATURE CONNECTION (T ) |
| 44 | | | LEVEL CONNECTION (L ) |
| 45 | | | LEVEL CONNECTION (L ) |
| 46 | | | LEVEL CONNECTION (L ) |
| 47 | | | LEVEL CONNECTION (L ) |
| 48 | | | SIGHT GLASS, LIGHT HOLE |
| 49 | | | |
| 50 | | | |

NOTE : Internal Fluid
Liquid Density kg/m³
Piping Spec.




STRIPPER No.1

STRIPPER No.2

REMARKS : _____

| | | | | | | |
|---|---|---|---|---|---|---|
| 3 | | | | | | |
| 2 | | | | | | |
| 1 | | | | | | |
| REV. | DWN | DATE | APP. | DATE | APP. | DATE |

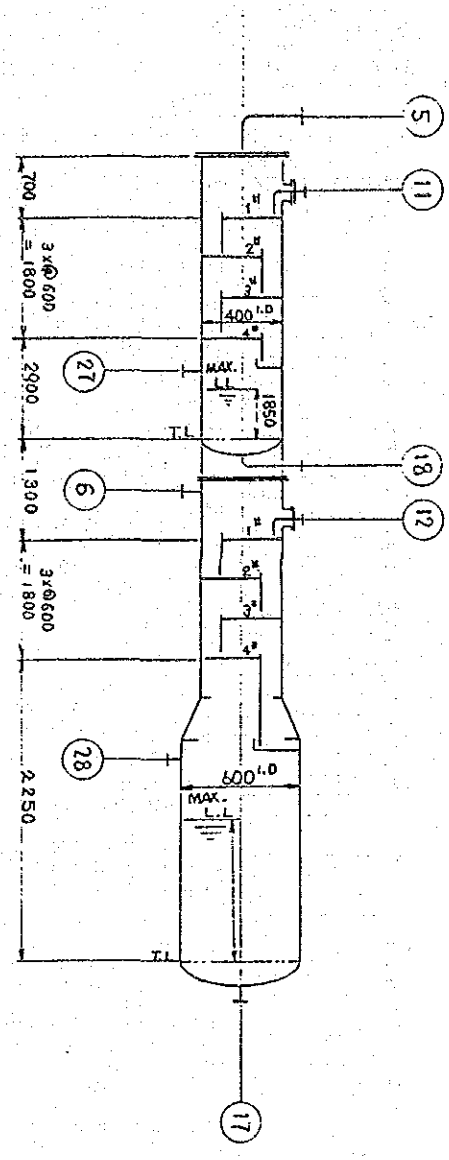
JOB No. _____ ITEM No. _____

# PROCESS SKETCH

JOB No. _____
ITEM No. _____ Comb'd with _____
Equipment Name: STRIPPER No.3 / STRIPPER No.4
Customer: _____
Process Name: _____
Diameter: 400/600 mm & _____ mm
Vertical Height: 10,750 mm Skirt: _____ mm
Horizontal Length: _____ mm
Heads: Ellips. ✓ Dished _____ Cone _____ Flat _____
Code: _____
Stress Relieved: Yes ____ No ____
Radiographed: Yes ____ No ____
Operating Temp. Top _____ ℃ Bot'm _____ ℃
Operating Press: _____ kg/cm²G _____ ( )
Design Temp. No.3/No.4 290/330 ℃
Design Press: No.3/No.4 3.5 kg/cm²G _____ ( )
Corrosion Allowance: Shell _____ mm & _____ mm
Material: Shell CS Jacket _____ Coil _____
Tray _____ Liner _____ (Th'k _____ mm)
Insulation: Conservation _____ Protection _____ No _____
Fire Protection: Yes ____ No ____

| NOZZLE No. | REQ'D No. | SIZE | SERVICE & SYMBOL |
|---|---|---|---|
| 1 | | | MANHOLE |
| 2 | | | MANHOLE |
| 3 | | | HANDHOLE, HATCH |
| 4 | | | COMBINED WITH |
| 5 | | | VAPOR OUTLET TO MAIN COLUMN |
| 6 | | | VAPOR OUTLET TO MAIN COLUMN |
| 7 | | | VAPOR OUTLET TO |
| 8 | | | VENT |
| 9 | | | REFLUX IN FROM |
| 10 | | | REFLUX IN FROM |
| 11 | | | FEED FROM MAIN COLUMN |
| 12 | | | FEED FROM MAIN COLUMN |
| 13 | | | FEED FROM |
| 14 | | | TO (REBOILER)(REB.PUMP) |
| 15 | | | FROM REBOILER |
| 16 | | | EQUALIZING LINE WITH |
| 17 | | | BOTTOM OUTLET TO |
| 18 | | | LIQUID OUTLET TO |
| 19 | | | DRAWOFF TO |
| 20 | | | RETURN FROM |
| 21 | | | DRAWOFF TO |
| 22 | | | RETURN FROM |
| 23 | | | DRAWOFF TO |
| 24 | | | RETURN FROM |
| 25 | | | JACKET IN FROM |
| 26 | | | JACKET OUT TO |
| 27 | | | STEAM IN |
| 28 | | | STEAM IN |
| 29 | | | SPARE NOZZLE |
| 30 | | | AIR FOAM CONNECTION |
| 31 | | | DRAIN |
| 32 | | | SAMPLE CONNECTION (S), COOLER (SSC) |
| 33 | | | SAFETY CONNECTION (SV, SRD, VB) |
| 34 | | | SAFETY CONNECTION |
| 35 | | | UTILITY |
| 36 | | | PRESSURE CONNECTION (P ) |
| 37 | | | PRESSURE CONNECTION (P ) |
| 38 | | | PRESSURE CONNECTION (P ) |
| 39 | | | PRESSURE CONNECTION (P ) |
| 40 | | | TEMPERATURE CONNECTION (T ) |
| 41 | | | TEMPERATURE CONNECTION (T ) |
| 42 | | | TEMPERATURE CONNECTION (T ) |
| 43 | | | TEMPERATURE CONNECTION (T ) |
| 44 | | | LEVEL CONNECTION (L ) |
| 45 | | | LEVEL CONNECTION (L ) |
| 46 | | | LEVEL CONNECTION (L ) |
| 47 | | | LEVEL CONNECTION (L ) |
| 48 | | | SIGHT GLASS, LIGHT HOLE |
| 49 | | | |
| 50 | | | |

NOTE : Internal Fluid
Liquid Density kg/m³
Piping Spec.



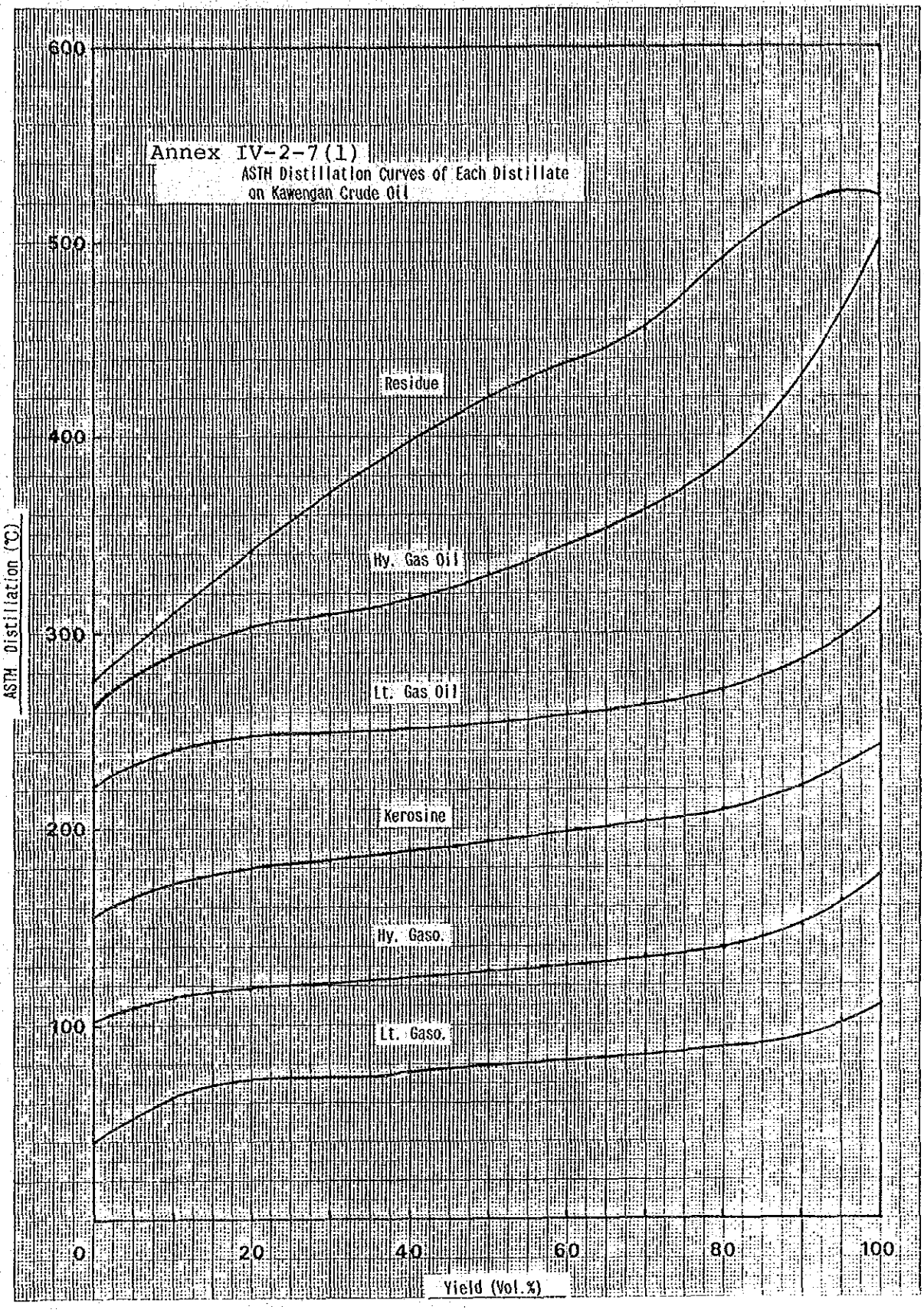

STRIPP No.3

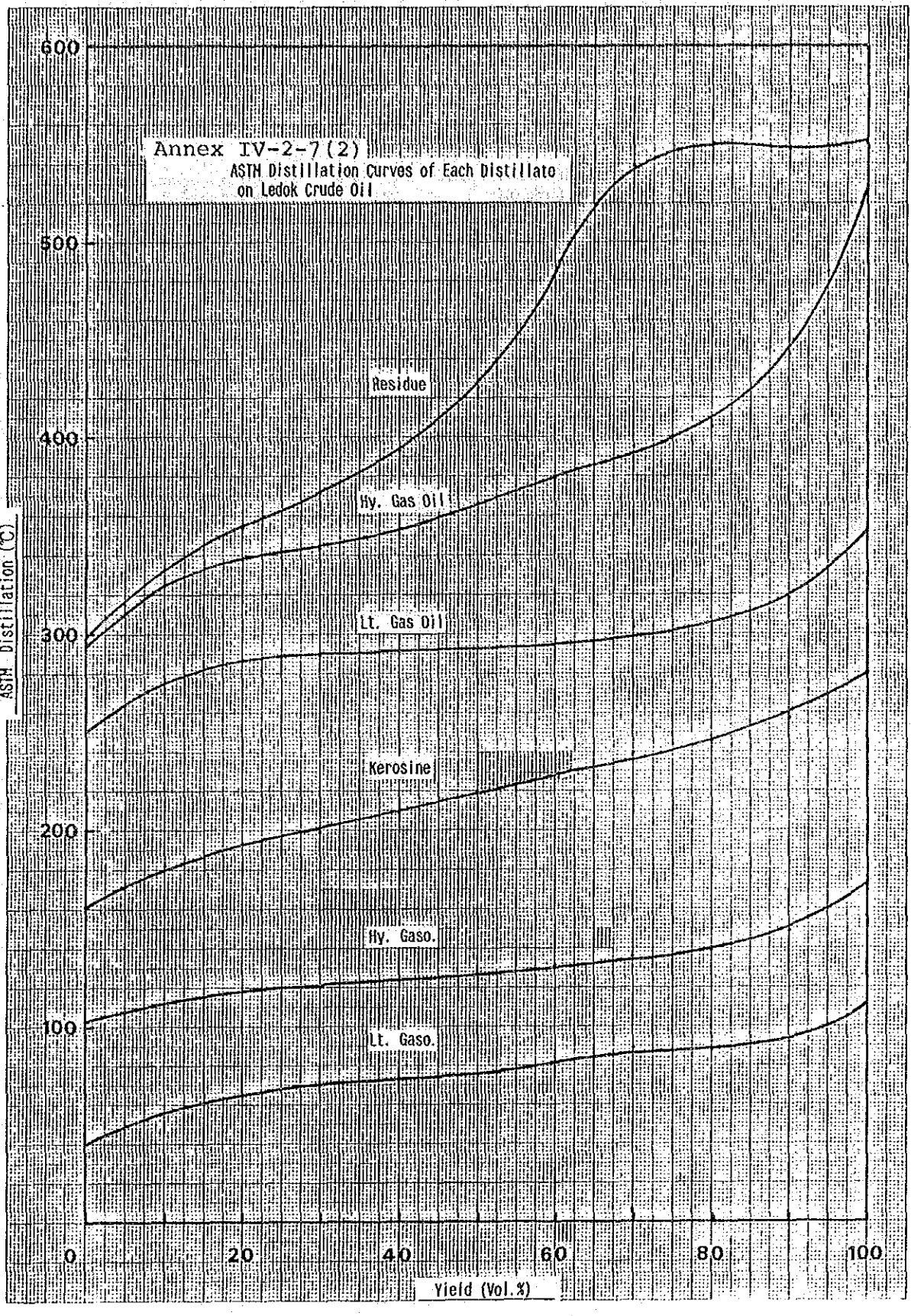
STRIPPER No.4

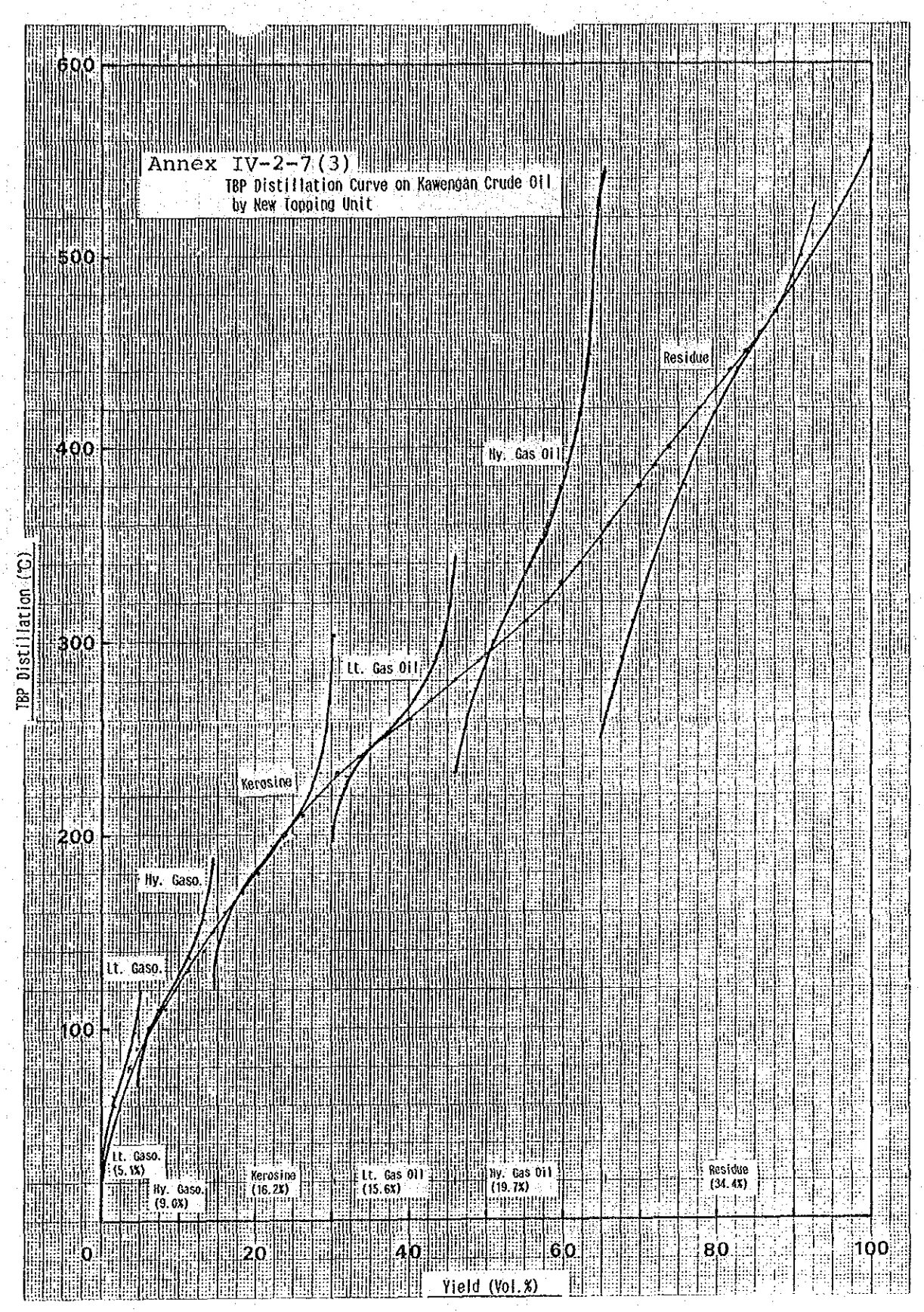
REMARKS : _____

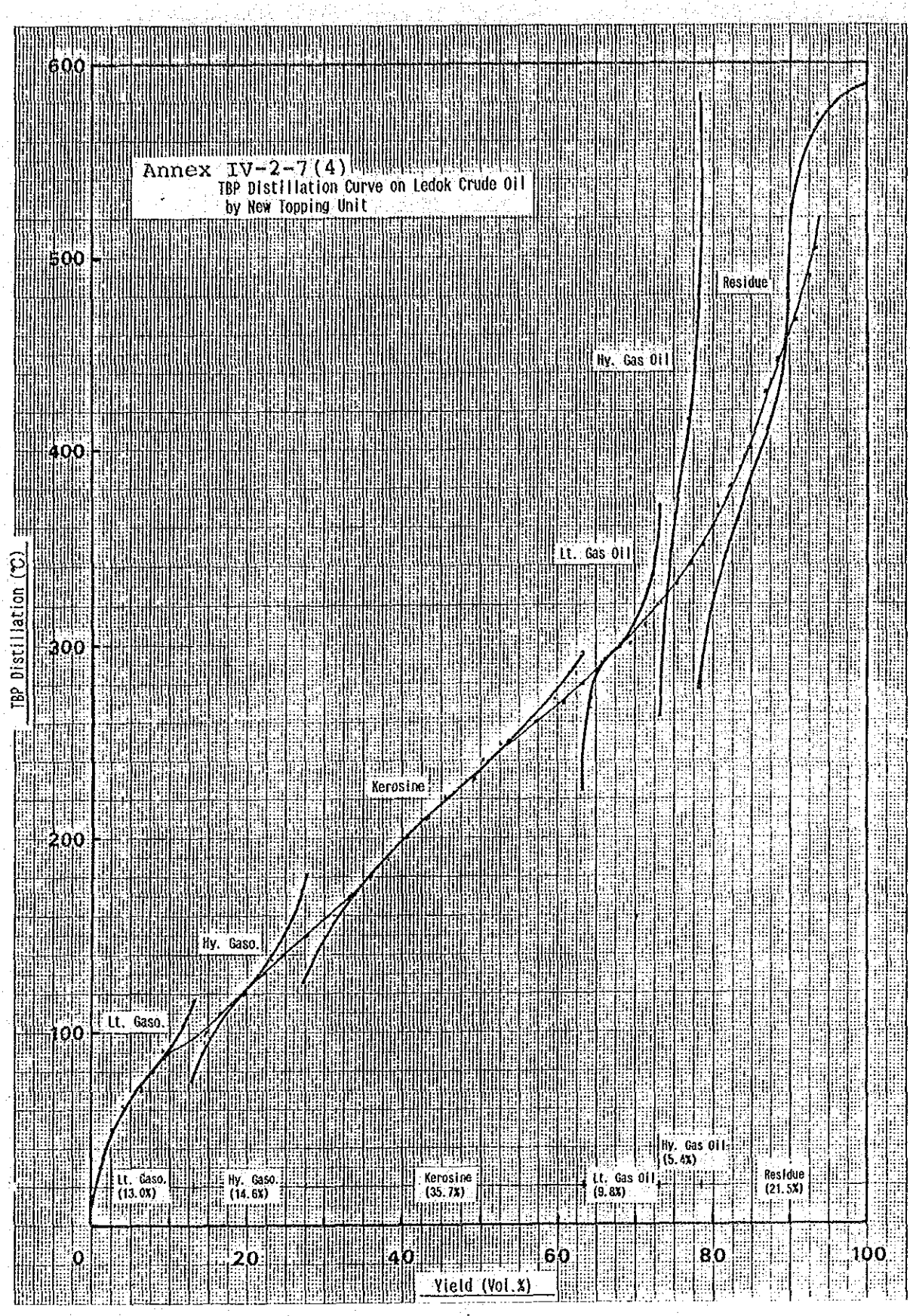
| REV. | DWN | DATE | APP. | DATE | APP. | DATE |
|---|---|---|---|---|---|---|
| 3 | | | | | | |
| 2 | | | | | | |
| 1 | | | | | | |

JOB No. _____ ITEM No. _____


Annex IV-2-7(1)
ASTM Distillation Curves of Each Distillate
on Kawengan Crude Oil
600
500
400
300
200
100
0
ASTM Distillation (℃)
Residue
Hy. Gas Oil
Lt. Gas Oil
Kerosine
Hy. Gaso.
Lt. Gaso.
20
40
60
80
100
Yield (Vol.%)


Annex IV-2-7(2)
ASTM Distillation Curves of Each Distillate
on Ledok Crude Oil
600
500
400
300
200
100
0
ASTM Distillation (°C)
Residue
Hy. Gas Oil
Lt. Gas Oil
Kerosine
Hy. Gaso.
Lt. Gaso.
20
40
60
80
100
Yield (Vol.%)


Annex IV-2-7(3)
TBP Distillation Curve on Kawengan Crude Oil
by New Topping Unit
TBP Distillation (°C)
600
500
400
300
200
100
0
20
40
60
80
100
Yield (Vol.%)
Lt. Gaso.
Hy. Gaso.
Kerosine
Lt. Gas Oil
Hy. Gas Oil
Residue
Lt. Gaso. (5.1%)
Hy. Gaso. (9.0%)
Kerosine (16.2%)
Lt. Gas Oil (15.6%)
Hy. Gas Oil (19.7%)
Residue (34.4%)


Annex IV-2-7(4)
TBP Distillation Curve on Ledok Crude Oil
by New Topping Unit
TBP Distillation (℃)
600
500
400
300
200
100
0
20
40
60
80
100
Yield (Vol.%)
Lt. Gaso.
Hy. Gaso.
Kerosine
Lt. Gas Oil
Hy. Gas Oil
Residue
Lt. Gaso. (13.0%)
Hy. Gaso. (14.6%)
Kerosine (35.7%)
Lt. Gas Oil (9.8%)
Hy. Gas Oil (5.4%)
Residue (21.5%)

Annex IV-4-1 LIST OF NEW LABORATORY EQUIPMENT AND APPARATUS
(Refinery Laboratory for Routine Work)

| No. | Name | Test Method | Q'ty | Automatic /Manual | SPEC. | Replacement /Addition |
|---|---|---|---|---|---|---|
| 1 | Specific Gravity | | | | | |
| | Bunsen-Schilling Effusiometer and Sampling Balloon | IP 59 (Method C) | 1 | M | for refinery gas, natural gas and fuel gases | AD |
| 2 | Distillation | | | | | |
| | (1) Distillation of Crude Petroleum | ASTM D285 | 1 | M | for crude oil | AD |
| | (2) Distillation of Petroleum Products | ASTM D86 | 1 | A | for gasoline, kerosine and gas oil | AD |
| 3 | Flash Point | | | | | |
| | (1) Tag Closed Tester | ASTM D56 | 1 | A | for crude oil and kerosine (≤ 95°C) | AD |
| | (2) Pensky-Martens Closed Tester | ASTM D93 | 1 | A | for gas oil and fuel oil (≥ 50°C) | AD |
| 4 | Smoke Point | ASTM D1322 | 1 | M | for kerosine | R |
| 5 | Reid Vapor Pressure | ASTM D323 | 1 | M | for crude oil and gasoline | R |
| 6 | Pour Point | ASTM D97 | 1 | M | for crude oil, gas oil and fuel oil | R |
| 7 | Water and Sediment | ASTM D96 | 1 | M | for crude oil, gas oil and fuel oil | R |
| 8 | Conradson Carbon Residue | ASTM D189 | 1 | A | for crude oil, gas oil and fuel oil | AD |
| 9 | Sulfur | | | | | |
| | (1) Lamp Method | ASTM D1266 | 1 | M | for gasoline and kerosine | AD |
| | (2) High Temperature Method | ASTM D1551 | 1 | M | for crude oil, gas oil and fuel oil | AD |
| 10 | Doctor Test | ASTM D484 | 1 | M | for gasoline and kerosine | AD |
| 11 | Copper Corrosion | ASTM D130 | 1 | M | for gasoline, kerosine and gas oil | R |
| 12 | Colour (Saybolt) | ASTM D156 | 1 | M | for kerosine and petroleum wax | AD |
| 13 | Aniline Point | ASTM D611 | 1 | M | for gasoline and kerosine | R |
| 14 | Hydrocarbon Types (Fluorescent Indicator Adsorption) | ASTM D1319 | 1 | M | for petroleum distillates | AD |
| 15 | Heat of Combustion (Liquid) | ASTM D240 | 1 | M | for crude oil and petroleum oils | AD |
| 16 | Needle Penetration | ASTM D1321 | 1 | M | for petroleum wax | R |
| 17 | Oil Content | ASTM D721 | 1 | M | for petroleum wax | AD |
| 18 | pH by Glass Electrode | ASTM D1293 | 2 | M | for boiler water, cooling water and waste water | R |
| 19 | Alkalinity and Acidity (Color Change Titration) | ASTM D1067 | 1 | M | for boiler water, cooling water and waste water | AD |
| 20 | Turbidity | ASTM D1889 | 1 | M | for boiler water and cooling water | R |
| 21 | Hardness (Titrimetric Method) | ASTM D1126 | 1 | M | for boiler water and cooling water | R |
| 22 | Waterborne Oils | ASTM D3414 | 1 | M | for boiler water, cooling water and waste water | R |
| 23 | Solid Content | ASTM D1888 | 1 | M | for boiler water, cooling water and waste water | R |
| 24 | Dissolved Oxygen meter | | 1 | M | for boiler water 0 - 200ppm, with battery | R |
| 25 | Orsat Gas Analysis and Sampling Balloon | | 1 | M | for flue gas | AD |
| 26 | Hot Plate with Magnetic Stirrer | | 2 | M | for preparating titration reagent, etc | R |
| 27 | Drying Oven | | 2 | M | 40 - 250°C | R |
| 28 | Ice Machine | | 1 | A | Capacity: 250 kg/D | AD |

Notes: A = Automatic, M = Manual, R = Replacement, AD = Addition

Annex IV-4-2(1) LIST OF NEW LABORATORY EQUIPMENT AND APPARATUS (1/2)
(Oil Laboratory in Training Laboratory)

| No. | Name | Test Method | Q'ty | Automatic /Manual | SPEC. | Replacement /Addition |
|---|---|---|---|---|---|---|
| 1 | Specific Gravity | | | | | |
| | (1) Hydrometer | ASTM D1298 | 1 | M | for crude oil and petroleum oils | R |
| | | ASTM D1657 | 1 | M | for LPG, condensate and light flash distillates | AD |
| | (2) Gravitometer | ASTM D1070 | 1 | M | for refinery gas, natural gas and fuel gases | AD |
| 2 | Distillation | | | | | |
| | (1) Distillation of crude petroleum | ASTM D285 | 1 | M | for crude oil | AD |
| | (2) Distillation of petroleum products | ASTM D86 | 1 | M | for gasoline, kerosine and gas oil | R |
| | (3) Distillation of reduced pressure | ASTM D1160 | 1 | M | for crude residue | AD |
| 3 | Flash Point | | | | | |
| | (1) Tag Closed Tester | ASTM D56 | 1 | M | for crude oil and kerosine (≦ 95°C) | R |
| | (2) Abel Tester | IP 170 | 1 | M | for crude oil and kerosine | R |
| | (3) Pensky-Martens Closed Tester | ASTM D93 | 1 | M | for gas oil and fuel oil (≧ 50°C) | R |
| | (4) Cleveland Open Cup Tester | ASTM D92 | 1 | M | for asphalt and petroleum wax (≧ 80°C) | R |
| 4 | Smoke Point | ASTM D1322 | 1 | M | for kerosine | R |
| 5 | Reid Vapor Pressure | ASTM D323 | 1 | M | for crude oil and gasoline | R |
| 6 | Viscosity (Saybolt) | ASTM D88 | 1 | M | for gas oil and fuel oil | R |
| 7 | Water Content | ASTM D95 | 1 | M | for crude oil, gas oil and fuel oil | R |
| 8 | Water and Sediment | ASTM D96 | 1 | M | for crude oil, gas oil and fuel oil | R |
| 9 | Conradson Carbon Residue | ASTM D189 | 1 | M | for crude oil, gas oil and fuel oil | R |
| 10 | Ash | ASTM D482 | 1 | M | for crude oil, gas oil and fuel oil | R |
| 11 | Sulfur | | | | | |
| | (1) Lamp Method | ASTM D1266 | 1 | M | for gasoline and kerosine | AD |
| | (2) High-Temperature Method | ASTM D1551 | 1 | M | for crude oil, gas oil and fuel oil | AD |
| | (3) Total Sulfur in Fuel Gases | ASTM D1072 | 1 | M | for refinery gas, natural gas and manufactured gas | AD |
| 12 | Doctor Test | ASTM D484 | 1 | M | for gasoline and kerosine | AD |

Notes: A = Automatic, M = Manual, R = Replacement, AD = Addition

Annex IV-4-2(1) LIST OF NEW LABORATORY EQUIPMENT AND APPARATUS (2/2)
(Oil Laboratory in Training Laboratory)

| No. | Name | Test Method | Q'ty | Automatic /Manual | SPEC. | Replacement /Addition |
|---|---|---|---|---|---|---|
| 13 | Copper Corrosion | ASTM D130 | 1 | M | for gasoline, kerosine and gas oil | R |
| 14 | Existent Gum | ASTM D381 | 1 | M | for gasoline | R |
| 15 | Induction Period (Oxidation Stability) | ASTM D525 | 1 | M | for gasoline | R |
| 16 | Neutralization Number | ASTM D974 | 1 | M | for gas oil and fuel oil | AD |
| 17 | Hydrocarbon Types | | | | | |
| | (1) Gas Chromatograph | ASTM D2163 | 1 | M | for LPG | AD |
| | | ASTM D1945 | 1 | M | for refinery gas, natural gas and manufactured gas | AD |
| | (2) Fluorescent Indicator Adsorption | ASTM D1319 | 1 | M | for petroleum distillates | AD |
| 18 | Heat of Combustion (Gas) | ASTM D900 | 1 | M | for refinery gas, natural gas and manufactured gas | AD |
| 19 | Softening Point (Ring & Ball) | ASTM D36 | 1 | M | for asphalt | AD |
| 20 | Needle Penetration | ASTM D5 | 1 | M | for asphalt | R |
| | | ASTM D1321 | 1 | M | for petroleum wax | R |
| 21 | Ductivity | ASTM D113 | 1 | M | for asphalt | R |
| 22 | Melting Point | ASTM D87 | 1 | M | for petroleum wax | R |
| 23 | Oil Content | ASTM D721 | 1 | M | for petroleum wax | AD |
| 24 | Freezing Point | ASTM D2386 | 1 | M | for aviation fuel | AD |
| 25 | Water Reaction | ASTM D1094 | 1 | M | for petroleum oils and wax | AD |
| 26 | Volume Measurement | | | | for natural gas and fuel gases | |
| | (1) Container | ASTM D1071 | 1 | M | Cubic-foot bottle, immersion type of moving-tank type | AD |
| | (2) Gas Meter | ASTM D1071 | 1 | M | Liquid-sealed relating-drum meters | AD |
| 27 | Sampling Apparatus | | | | | |
| | (1) Sampling Container | JIS K2301 | 2 | M | for natural gas and fuel gases: 300 - 500 ml sampling cylinder | AD |
| | | ASTM D1265 | 2 | M | for LPG: two-valve sampling container | AD |
| | (2) Weighted Beaker | ASTM D4057 | 1 | M | for crude oil and petroleum oil | AD |
| 28 | Analytical Balance | | 1 | M | Range: 0 - 160 g/Precision: ±0.05 mg | AD |

Notes: A = Automatic, M = Manual, R = Replacement, AD = Addition

Annex IV-4-2(2) LIST OF NEW BENCH PLANT FOR UNIT OPERATION (1/2)
(Oil Laboratory in Training Laboratory)

| No. | Name | Q'ty | SPEC. | Replacement /Addition |
|---|---|---|---|---|
| 1 | Fluid Circuit Friction Experimental Apparatus | 1 | Circulation water pump: 73 l/min. x 15 m<br>Driver motor: 0.75 kW<br>Storage water tank: 50 - 100 l<br>Friction loss setter<br>Pipe network (1/2 in, 3/4 in, 1 in), Pipe fittings and bends<br>Instruments<br>Flow meters (Orifice meter, Venturi-meter, rotameter), manometers and pressure select manifold | R |
| 2 | Gas/Liquid Absorption Bench Plant<br>Measurement of:<br>(1) Flow rates of diluted NaOH and CO2 Gas<br>(2) Pressure drop of absorption column<br>Calculation and analysis of:<br>Absorption factor over Reynolds Number and CO2 flow rate | 1 | Absorption tower (Transparent column)<br>Dimensions: 50 mmD x 800 mmL<br>Packing: Porcelain, Rasching Ring<br>Measuring Tank: 3 l, Vinylchloride<br>Gas flow section<br>Electric heater: 170 W<br>Flow meter: Gas meter<br>Solution flow section<br>Store tank: 30 l<br>Feed pump and drive moter: 40 W<br>Flow meter : Rotameter<br>Range 0.2 to 2 l/min. | AD |
| 3 | Distillation Experimental Apparatus | 1 | | R |
| 4 | Water to Water Heat Exchanger Bench Plant | 1 | Hot water source<br>Head tank, flow meter (Max. 200 l/H) thermometers and electrically immersion heater (5 kW)<br>Cold water source<br>Head tank, flow meter (Max. 500 l/H) and thermometers<br>Heat Exchanger<br>Double tubes heat exchanger<br>1 in(Dia) x 1000 mm(Length)<br>Parallel or counter flow select valve<br>3 way valve<br>Controller unit<br>Hot water temperature control unit | R |

Notes: R = Replacement, AD = Addition

Annex IV-4-2(2) LIST OF NEW BENCH PLANT FOR UNIT OPERATION (2/2)
(Oil Laboratory in Training Laboratory)

| No. | Name | Q'ty | SPEC. | Replacement /Addition |
|---|---|---|---|---|
| 5 | Packed Column Bench Plant | 1 | Transparent column type and for measuring pressure drop | AD |
| 6 | Filter Press Experimental Apparatus | 1 | Filter chamber<br>Flush type, cast iron 125mm x 125mm<br>Feed pump and dive motor<br>5 l/min. x 4.5 kg/cm2·G, 200 W<br>Reservior tank<br>340mm(Dia) x 500mm(Height) | R |
| 7 | Cyclone Separator Experimental Apparatus | 1 | Cyclone separator (Transparent)<br>Air blower and drive motor<br>6.0 m3/min. x 285 mmAg., 400 W<br>Dust feeder and drive moter<br>Screw forced feeder, 6 W<br>Bag filter, Pitot Static tube and manometer | AD |
| 8 | Cabitation Phenomenon Experimental Equipment<br>(Cabitation Demonstration Apparatus) | 1 | Water circuit pump and drive motor<br>25 m3/h, 3.7 kW<br>Decompression tank<br>254mm(Dia) x 950mm(Height)<br>Vacuum pump and drive moter<br>Max. Vacuum pressure -500 mmHg, 3.7 kW<br>Cavitation observation device<br>Transparent window<br>Vacuum gauge, pressure gauges and flow meter | AD |
| 9 | Mass and Heat Transfer Experimental Apparatus<br>(Mass and Heat Transfer in Forced Draft Cooling Tower) | 1 | Hot water supply device<br>Hot water tank with immersion electric heater (3 kW x 2) and automatic temperature control unit<br>Cooling air device<br>Blower and drive motor (0.75 kW), air heating unit (3 kW), automatic temperature control unit<br>Mass and heat transfer unit<br>Wooden filling device, Transparent view window<br>Instrument and panel<br>Thermometer, hygrometer, flow meter, etc. | AD |
| 10 | Compressor Performance Bench Plant | 1 | | AD |

Notes: R = Replacement, AD = Addition

Annex IV-4-2(3) LIST OF NEW LABORATORY EQUIPMENT AND APPARATUS (1/2)
(Chemical Laboratory in Training Laboratory)

| No. | Name | Test Method | Q'ty | Automatic /Manual | SPEC. | Replacement /Addition |
|---|---|---|---|---|---|---|
| 1 | Atomic Absorption Spectrometry | ASTM D526, ASTM D3557, ASTM D1126, etc. | 1 | M | Wavelength Range: 190 - 900 nm<br>Slit: 3 or 4 stage changeover<br>Analytycal mode: Atomic absorption flame<br>Measuring Mode: Direct Indication, Integration | AD |
| 2 | Infrared Absorption Spectrometry (Infrared Analyzer) | ASTM D4053, ASTM D3414, ASTM E204, etc. | 1 | M | Wavelength Range: 4,000 - 650 cm-1<br>Resolution Capacity:<br>Max. 0.4 cm-1/1,000 cm-1<br>Wavelength Accuracy<br>±6 cm-1 (for 4,000 - 2,000 cm-1)<br>±3 cm-1 (for 2,000 - 650 cm-1)<br>Reproducibility: 0.5% | AD |
| 3 | Ultraviolet Absorption Spectrometry (Ultraviolet and visible-radiation Analyzer) | ASTM E169, ASTM D2269, ASTM D1096, etc. | 1 | M | Wavelength Range: 190 - 900 nm<br>UV 190 - 350 nm<br>Vis 350 - 900 nm<br>Wavelength Accuracy:<br>within ± 0.4 nm<br>Wavelength Reproducibility:<br>within ± 0.2 nm | AD |
| 4 | Photoelectric Colorimeter | ASTM D859, ASTM D515, ASTM D1691, etc. | 1 | M | Wavelength: 450 nm, 530 nm, 620 nm within + 5 nm<br>Resolution Capacity:<br>within 0.1%T or 0.001 Abs. | AD |
| 5 | Potentiometric Titrator | ASTM D465, ASTM D1491, etc. | 1 | A | Control Method: amount of drops to be added and waiting time using micro-computer<br>Detection End Point: Automatic detection based on set point or differentiation<br>Display Method: 4 digit display, pH, mV, and ml selectable | AD |
| 6 | Karl Fischer Moisture Counter (for determination water content) | ASTM E700, ASTM D1364, ASTM D1744, etc. | 1 | A | Measuring Range: 10μgH2O - 10mgH2O<br>Detection Sensitivity: 0.5μgH2O<br>Display Method: 4 digits digital display | AD |

Notes: A = Automatic, M = Manual, R = Replacement, AD = Addition

Annex IV-4-2(3) LIST OF NEW LABORATORY EQUIPMENT AND APPARATUS (2/2)
(Chemical Laboratory in Training Laboratory)

| No. | Name | Test Method | Q'ty | Automatic /Manual | SPEC. | Replacement /Addition |
|---|---|---|---|---|---|---|
| 7 | Equilibrium Distillation Apparatus | | 1 | M | Modification of the Othmer Still Distillation Apparatus made of glass | AD |
| 8 | Abbe's Refractometer | | 1 | M | Measuring Range:<br>refractive index nD 1.3000 to 1.7100<br>saccharic % Brix 0 to 85%<br>Minimum Scale:<br>saccharic % Brix 0.1%<br>Scale accuracy:<br>saccharic % Brix ±0.05% | AD |
| 9 | Polarimeter | | 1 | M | Range 0 - 360°, in 1° divisions,<br>Sodium lamp and 589 nm.<br>mono-chromatic filter | R |
| 10 | Constant Temperature Bath | | 1 | M | Bath Capacity: 3 l<br>Max. Temperature: 100°C<br>Pump Capacity: 8 l/min. | R |
| 11 | Vacuum Pump | | 1 | M | Suction Capacity: 4.3 m3/h | R |
| 12 | Electric Heating Mantle | | 8 | M | Max. Temperature 350°C,<br>Capacity: 500 ml, 1,000 ml, 2,000 ml,<br>3,000 ml | R |
| 13 | Analytical Balance | | 1 | M | Range: 0.- 160 g<br>Precision: ±0.05 mg | AD |

Notes: A = Automatic, M = Manual, R = Replacement, AD = Addition

Annex IV-4-2(4) LIST OF NEW LABORATORY EQUIPMENT AND APPARATUS
(Civil Eng. Laboratory in Training Laboratory)

| No. | Name | Test Method | Q'ty | Automatic /Manual | SPEC. | Replacement /Addition |
|---|---|---|---|---|---|---|
| 1. | Permeability Tester | ASTM D2434 | 1 | M | | AD |
| 2. | Moisture-Density Relations Tester by Rammer | ASTM D698 | 1 | M | | AD |
| 3. | Unconfined Compression Tester | ASTM D2166 | 1 | M | | AD |
| 4. | Shrinkage Factor Tester | ASTM D427 | 1 | M | | AD |
| 5. | Probing Ring | | 1 | M | 300 Kg | AD |
| 6. | Hydraulic Jack | | 1 | M | 100 Ton | AD |
| 7. | Electric Oven | | 1 | M | 110-220 Volt | AD |
| 8. | Analytical Balance | | 1 | M | 250 g | AD |
| 9. | Concrete Slump Tester | JIS A1101 | 2 | M | | AD |
| 10. | Abrasion Tester of Coarse Aggregate | ASTM C241 | 1 | M | | AD |
| 11. | Screen | | each 1 set | M | 3", 2", 1-1/2", 1", 3/4", 3/8" No.4, No.8, No.16 | AD |
| 12. | Concrete Mixer | | 1 | M | | AD |
| 13. | Vicat's Needle Apparatus | | 1 | M | | AD |
| 14. | Standard Penetration Tester | ASTM D1586 | 1 | M | | AD |
| 15. | Vane Shear Apparatus | ASTM D2573 | 1 | M | | AD |
| 16. | Boring Rod | | 20 | M | | AD |
| 17. | Sampling Tube | | 20 | M | | AD |

Notes: A = Automatic, M = Manual, R = Replacement, AD = Addition

Annex IV-5-1 INSPECTION EQUIPMENT LIST

CONDITION MONITORING EQUIPMENT

| ITEM NO. | NAME OF TEST EQUIPMENT | SPEC. OUTPUT | MFG | TYPE OR MODEL | QT'Y |
|---|---|---|---|---|---|
| C1 | Machine checker | | ANRITSU Electric | MCV-021 | 1 |
| C2 | Vibration checker | DISP DENSHI | SAN Denshi | MD-250 | 1 |
| C3 | Portable Vibration meter | | RION | VM-61 | 1 |
| C4 | Bearing checker Lubtecs | | A.JOHNSON JAPAN | TZ-05C | 1 |
| C5 | Bearing analyzer | | A.JOHNSON JAPAN | BEA-52 | 1 |
| C6 | Sound level meter | | RION | NL-10A | 1 |
| C7 | Electronic stethoscope | | A.JOHNSON JAPAN | ELS-12 | 1 |
| C8 | Data recorder | | TEAC | R-61 | 1 |
| C9 | Tracking vibration recorder system | | TOYO TECHNICA | 2521 | 1 |

STATIC EQUIPMENT MONITORING EQUIPMENT

| | | | | | |
|---|---|---|---|---|---|
| S1 | Ultraprobe | 20 Hz - 100 kHz | KYOKUTO BOIKI | 2000 | 1 |
| S2 | Acoustic valve leak detector | | ITOH CHU | 5120 | 1 |
| S3 | Thermoviewer | 40°C - 1600°C | NIHON DENSHI | JTG-3100 | 1 |

RADIOGRAPHIC EXAMINATION

| | | | | | |
|---|---|---|---|---|---|
| R1 | Portable X-ray unit | 200 KVP AC220V | RIGAKU | RF-200EG -S2 | 1 |
| R2 | Portable X-ray unit | 250 KVP AC220V | RIGAKU | RF-250EG -S2 | 1 |
| R3 | Gamma radiation equipment | 192 Ir. | Pony Atomic Industry | RI-104H | 1 |
| R4 | Film cassette | - | Pony Atomic Industry | 3-1/3X12" | 20 |
| R5 | Film mark | - | Pony Atomic Industry | X-2 | 1 |
| R6 | Intensifying screen | - | Pony Atomic Industry | 3-1/3X12" 0.03X0.1 | 20 |

| ITEM NO. | NAME OF TEST EQUIPMENT | SPEC. OUTPUT | MFG | TYPE OR MODEL | QT'Y |
|---|---|---|---|---|---|
| R7 | Magnet holder | - | Pony Atomic Industry | | 4 |
| R8 | Renetrameter | Hole type | Pony Atomic Industry | ASME V No.5 - No.12 | 8 |
| R9 | Renetrameter | Hole type | Pony Atomic Industry | ASME V No.15 - No.20 | 4 |
| R10 | Renetrameter | Hole type | Pony Atomic Industry | ASME V No.25 - No.40 | 4 |
| R11 | Constant temp. equipment | AC100V | Seiko-Rika | DPK-1 | 1 |
| R12 | Film dryer | AC100V | Seiko-Rika | SDS-3 | 1 |
| R13 | Film viewer | AC100V | Seiko-Rika | SK-4 | 1 |
| R14 | Dark room alarm clock | - | Pony Atomic Industry | - | 1 |
| R15 | Film hanger | SUS | Pony Atomic Industry | 3-1/3X12" | 20 |
| R16 | Densitometer | - | KONISHI ROKU | PDA-85 | 1 |
| R17 | Radiation detector | Ionizing chamber | Pony Atomic Industry | PO-128 | 1 |
| R18 | Radiation detector | GM survey meter | Pony Atomic Industry | PO-126 | 1 |
| R19 | Pocket dosimeter | - | STEPHEN | 2200A | 4 |
| R20 | Charger for above | - | STEPHEN | STEPHEN | 1 |
| R21 | Warning symbol for restricted area | - | STEPHEN | PA-18 | 10 |

MAGNETIC PARTICLE EXAMINATION

| | | | | | |
|---|---|---|---|---|---|
| M1 | Portable magnetic inspection unit | 2700AT AC100V | EISHIN | A-4 | 2 |
| M2 | Black light | - | EISHIN | SC-125 | 2 |
| M3 | Fluorescent magnetic particle | - | EISHIN | SY-7000 | 3 kg |
| M4 | Dispersible agents | - | - | BLENDEX-C | 10 |

## LIQUID PENETRANT EXAMINATION

| ITEM NO. | NAME OF TEST EQUIPMENT | SPEC. OUTPUT | MFG | TYPE OR MODEL | QT'Y |
|---|---|---|---|---|---|
| P1 | Penetrant | General use | EISHIN | R-1A | 10 |
| P2 | Developer | General use | EISHIN | R-1S | 5 |
| P3 | Remover | General use | EISHIN | R-1N | 15 |

## ULTRASONIC EXAMINATION

| | | | | | |
|---|---|---|---|---|---|
| U1 | Ultrasonic flaw detector | - | MITSUBISHI Electric | FD-610S | 1 |
| U2 | Ultrasonic thickness gauge | - | IIC | UTR S-58 | 2 |
| U3 | Probe | Normal | MITSUBISHI Electric | PC-5Z10 N-G | 2 |
| U4 | Probe | Normal | MITSUBISHI Electric | PC-2Z10 N-G | 2 |
| U5 | Probe | Angle beam | MITSUBISHI Electric | PC-2Z10X 10A45-G | 2 |
| U6 | Probe | Angle beam | MITSUBISHI Electric | PC-5Z10X 10A45-G | 2 |
| U7 | Probe | Angle beam | MITSUBISHI Electric | PC-2Z10X 10A70-G | 2 |
| U8 | Probe | Angle beam | MITSUBISHI Electric | PC-5Z10X 10A70-G | 2 |
| U9 | Heating furnace tube flaw detector | AC1000 | NDIC | - | 1 |

## EDDY CURRENT EXAMINATION

| | | | | | |
|---|---|---|---|---|---|
| E1 | Eddy current flaw detector | - | MAGNAFLUX CO., LTD. | ED-800 | 1 |
| E2 | Pen recorder | 4 channel pen type | Nihon denki Sanei | 8K-21 | 1 |

## MATERIAL EXAMINATION

| | | | | | |
|---|---|---|---|---|---|
| MA1 | Metal analyzing equipment | Quantitative | SHANDON SOUTHERN | Meta scope | 1 |

OTHER TESTING

| ITEM NO. | NAME OF TEST EQUIPMENT | SPEC. OUTPUT | MFG | TYPE OR MODEL | QT'Y |
|---|---|---|---|---|---|
| 01 | Carburizing inspection equipment | - | KETT | LST-2200H | 1 |
| 02 | Hardness tester | EQUO TIP | SWISS | D | 2 |
| 03 | Tube inside tester | Fiber | OLYMPUS | C060-052-090-60 | 1 |
| 04 | Tube inside tester | Bore | OLYMPUS | IF-11D3-30 | 1 |
| 05 | Pin hole detector | AC100V | SANKO | TRS-10A | 1 |
| 06 | Oxgen detector | - | KOSMOS | XO-324 | 2 |
| 07 | Gas detector | - | KOSMOS | XO-316 | 2 |
| 08 | Film thickness gage | - | SANKO | SL-200E | 1 |

## Annex IV-5-2 MAINTENANCE TOOLS

(1) Jet Cleaner

Number of Unit: 1 unit

| | Delivery Pressure ($kg/cm^2G$) | Flow Rate (l/min) |
|---|---|---|
| Delivery Pressure and Flow Rate: | 700 | 37 |
| | 490 | 55.5 |
| | 420 | 64.4 |
| | 350 | 77.2 |
| | 280 | 96.5 |

Pump: - Type; Horizontal 3 Cylinders Plunger
- Driver; Diesel Engine
- Horse Power; 75 PS

Base: Trailer Mounted

Accessories: Pressure Regulator, Gun Jet Nozzle, High Pressure Hose, etc.

(2) High Pressure Compressor

Number of Unit: 1 unit
Delivery Pressure: 40 $kg/cm^2G$
Flow Rate: 2 $m^3/min$
Compressor Type: Reciprocating
Driver: Diesel Engine
Horse Power: 62 PS
Base: Trailer Mounted
Accessories: Accumulator, Safety Valve, High Pressure Hose, etc.

(3) Medium Pressure Compressor

| | |
|---|---|
| Number of Unit: | 1 unit |
| Delivery Pressure: | 15 kg/cm2G |
| Flow Rate: | 1 m3/min |
| Compressor Type: | Reciprocating |
| Driver: | Diesel Engine |
| Horse Power: | 24 PS |
| Base: | Trailer Mounted |
| Accessories: | Accumulator, Safety Valve, High Pressure Hose, etc. |

(4) Tube Expander

| | |
|---|---|
| Number of Unit: | 1 unit |
| Type: | Pneumatic Automatic Control Expander |
| Applicable Size: | ø 9.0mm - ø 91.0mm |

(5) Dynamic Balancing Machine: 1 unit

(6) Torque Wrench: 1 set

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