Table 5-1 REQUIRED ANALYZERS INSTRUMENTS AND EQUIPMENT

CODE No.	Item (Equipment Name)	Note
1	Ambient CO Monitor	Range : 0～10/20/50/100 ppm
2	Ambient SO2 Monitor	Range : 0～0.1/0.2/0.5/1.0 ppm
3	Ambient NOx Monitor	Range : 0～0.1/0.2/0.5/1.0 ppm
4	Ambient O3 Monitor	Range : 0～0.1/0.2/0.5/1.0 ppm
5	Ambient HC (Hydrocarbons) Monitor	Range : 0～5/10/20/50 ppmC
6	Ambient SPM Monitor	Range : 0～0.25/0.5/1/5 mg/cm3
7	Meteorological Observation Instrument	Wind Vane & Anemometer, Thermometer, Hygrometer, Pyrheliometer, Net Exchange Radiometer
8	System Rack for Monitor	
9	Ambient HF (Hydrogen Fluoride) Monitor	
10	High Volume Air Sampler	
11	Low Volume Air Sampler	
12	Stand Sampler	
13	Automatic Water Still	
14	Electric Drying Oven	
15	Electric Balance	200g/0.1mg, 3,200g/10mg, 430g/1mg
16	Spectro Photometer	
17	Chemical Analysis Glass Ware	
18	Personal Computer (486PC)	Desktop Computer, Laptop computer, Lazer Type Printer
19	Multi Pen Recorder	
20	Atomospheric Sampling Pipeline	
21	Span Gas Cylinder Set	
22	Standard Gas Generation Apparatus	

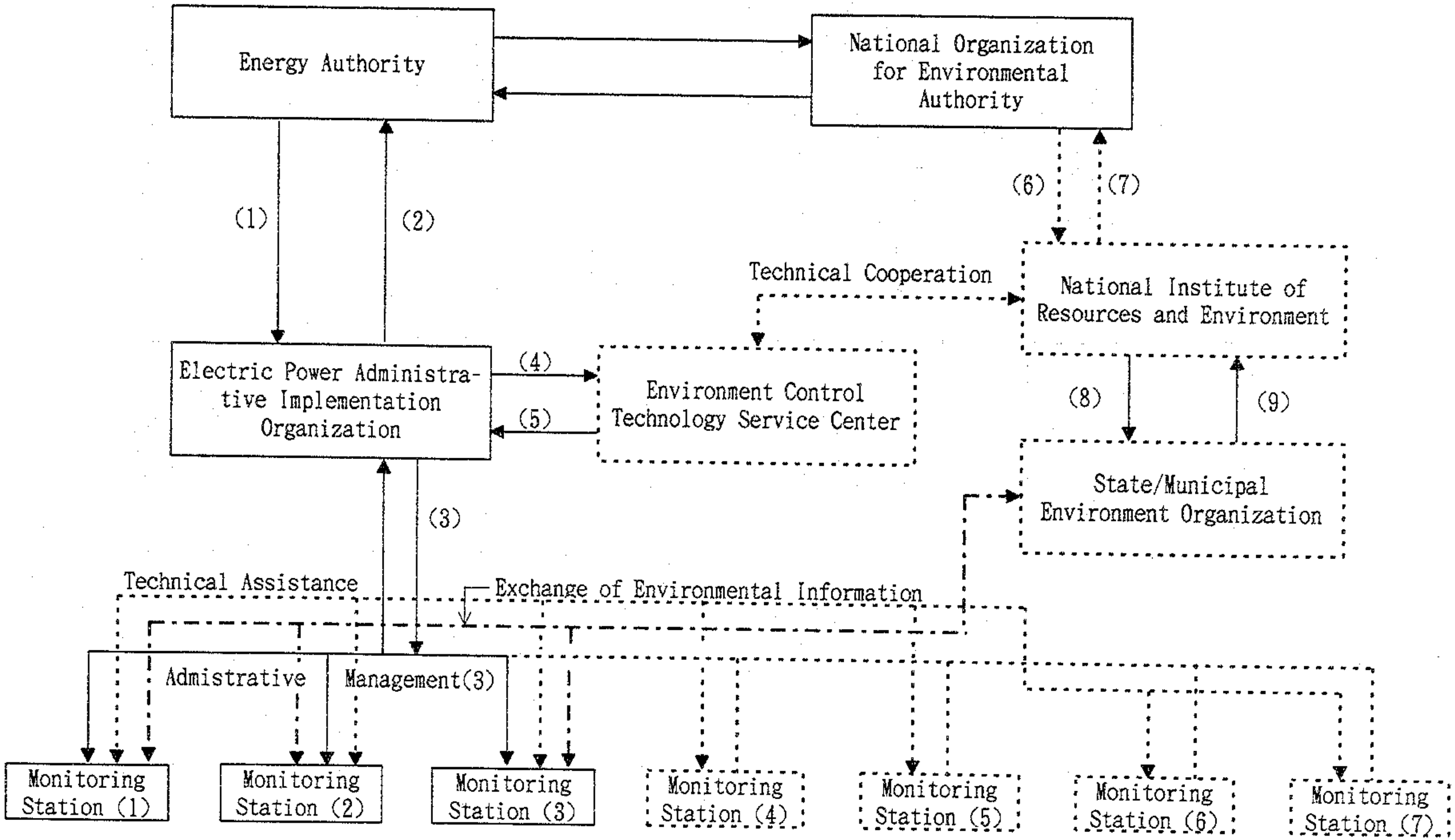


Figure 5-1 ESTABLISHMENT OF MONITORING STATION FOR THERMAL POWER PLANTS IN ARGENTINE REPUBLIC (PROPOSAL)

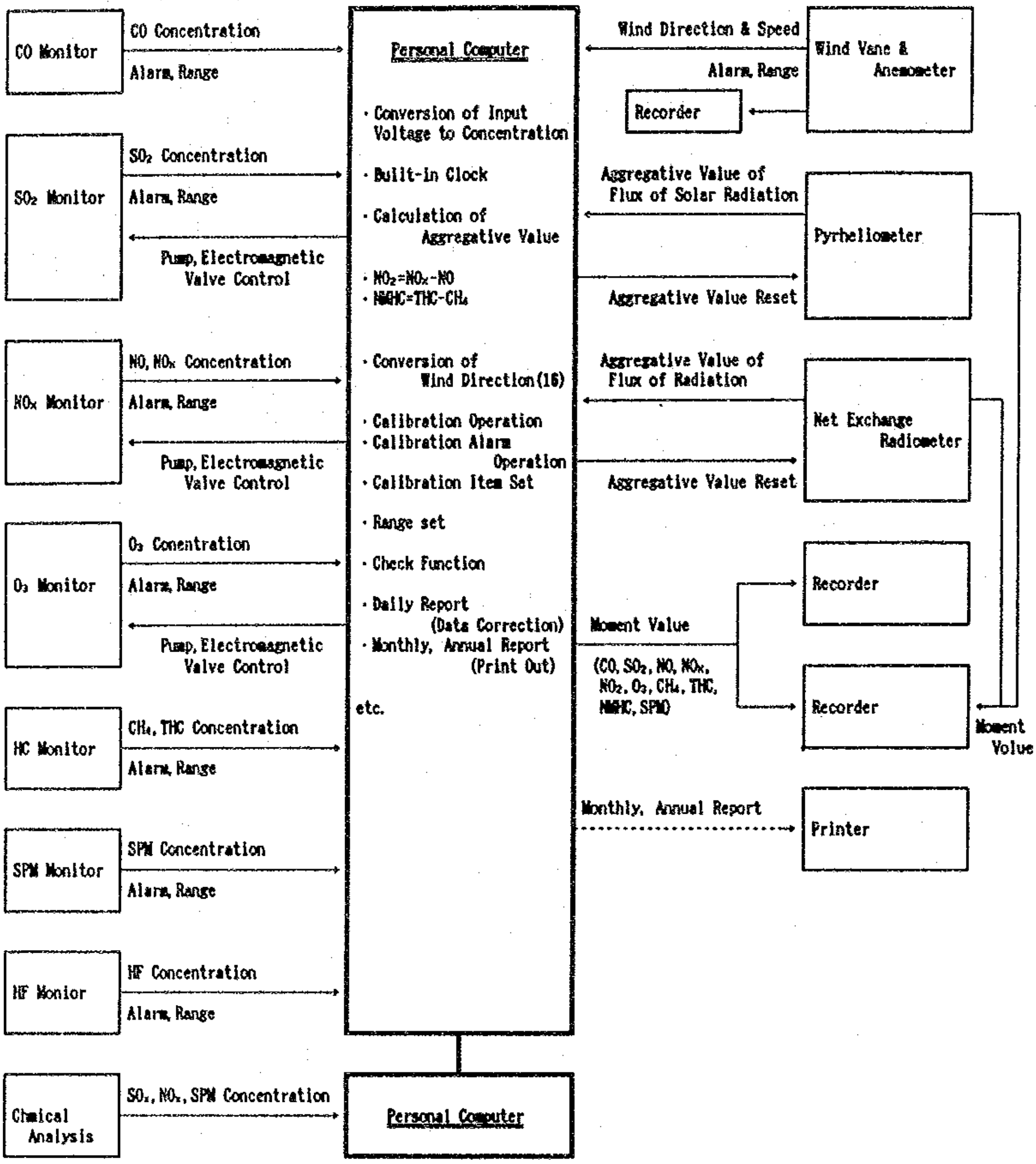


Figure 5-2 DIAGRAM FOR REGIONAL INSPECTION SYSTEM

Legend of Instruments and Equipments

CO	:Ambient CO Monitor
SO2	:Ambient SO2 Monitor
NOx	:Ambient ROx Monitor
O3	:Ambient O3 Monitor
HC	:Ambient HC(Hydrocarbons) Monitor
SPM	:Ambient SPM Monitor
MOE	:Meteorological Observation Equipment Wind Vane & Anemometer, Thermometer, Hygrometer, Pyrheliometer, Net Exchange Radiometer
HF	:Ambient HF(Hydrogen Fluoride) Monitor
HV	:High Volume Air Sampler
PC	:Personal Computer
ASP	:Atmospheric Sampling Pipeline
GC	:Gas Cylinder
Ta	:Table
Sc	:Scullery
Sh	:Shelf
AC	:Air Conditioner
Ve	:Ventilator
En	:Entrance

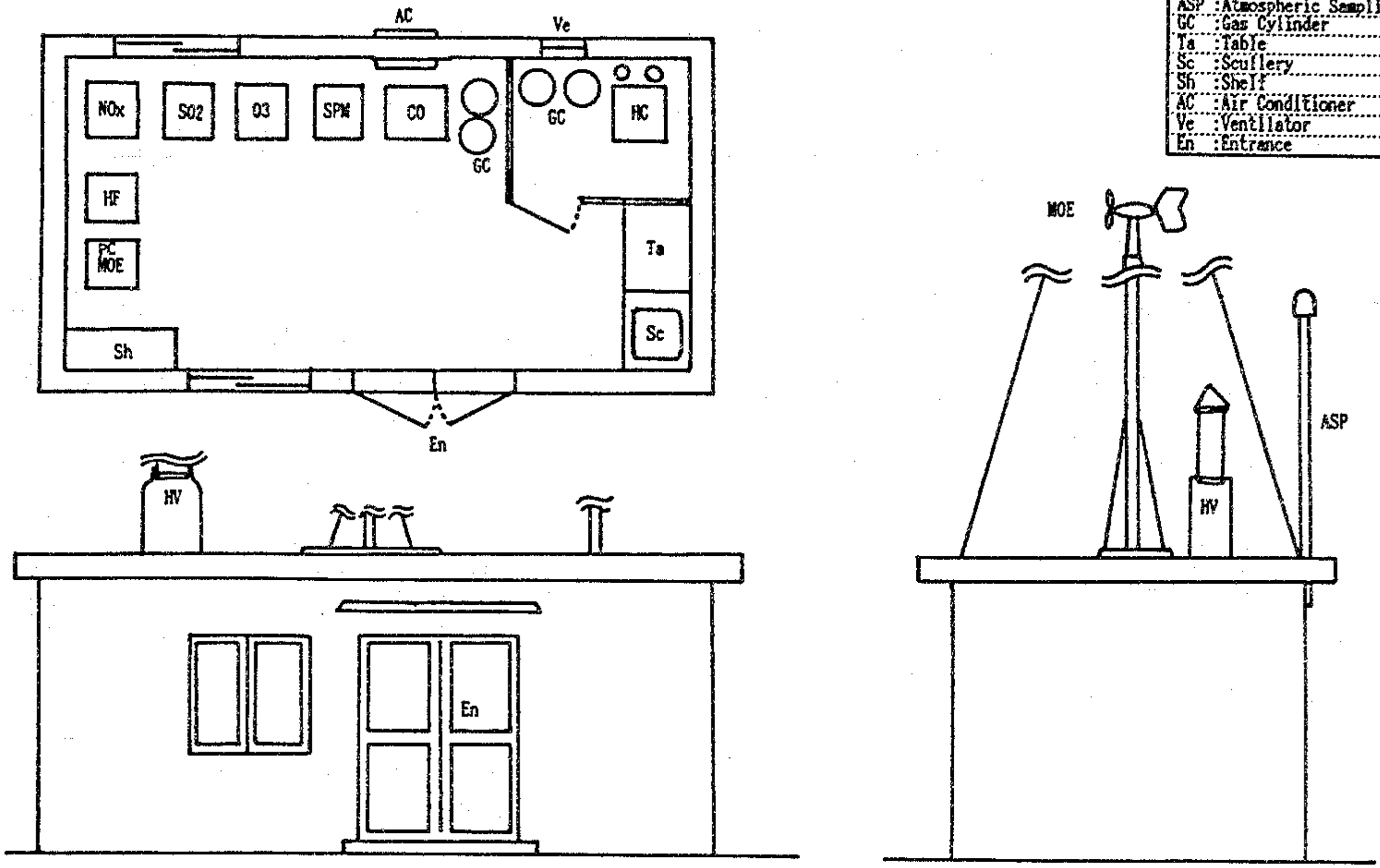
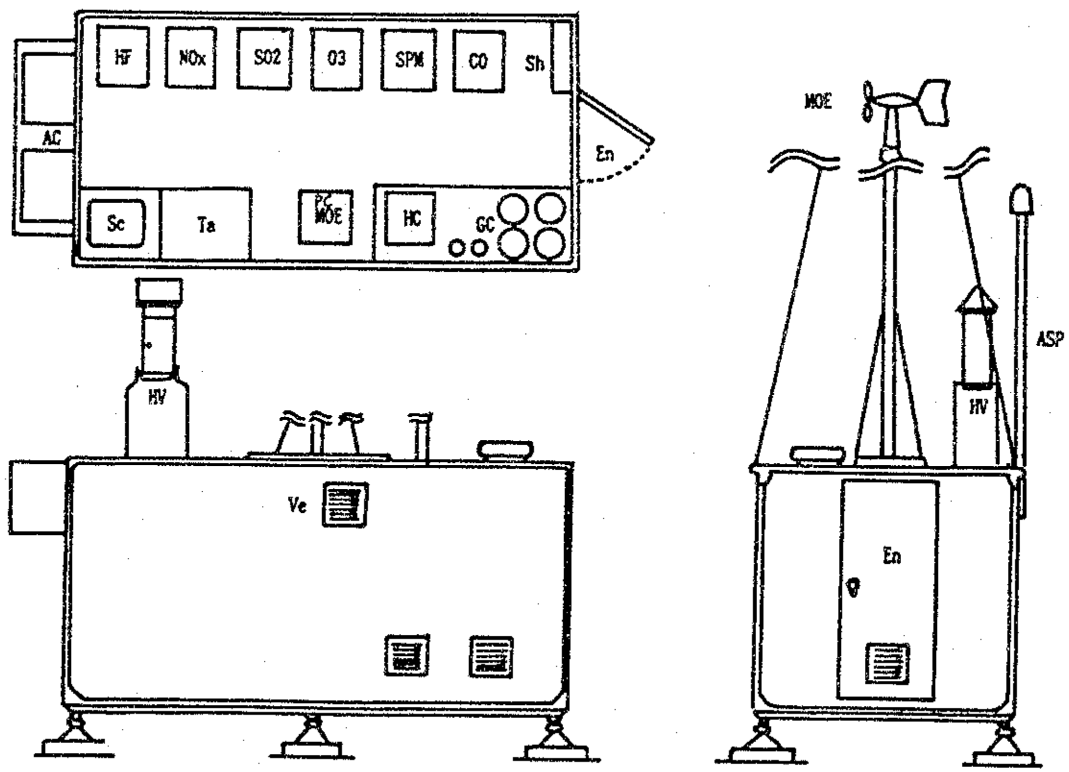


Figure 5-3 LAYOUT PLAN FOR INSPECTION STATION



Legend of Instruments and Equipments	
CO	:Ambient CO Monitor
SO2	:Ambient SO2 Monitor
NOx	:Ambient NOx Monitor
O3	:Ambient O3 Monitor
HC	:Ambient HC(Hydrocarbons) Monitor
SPM	:Ambient SPM Monitor
MOE	:Meteorological Observation Equipment Wind Vane & Anemometer, Thermometer, Hygrometer, Pyrheliometer, Net Exchange Radiometer
HF	:Ambient HF(Hydrogen Fluoride) Monitor
HV	:High Volume Air Sampler
PC	:Personal Computer
ASP	:Atmospheric Sampling Pipeline
GC	:Gas Cylinder
Ta	:Table
Sc	:Scullery
Sh	:Shelf
AC	:Air Conditioner
Ve	:Ventilator
En	:Entrance

Figure 5-4 LAYOUT PLAN FOR INSPECTION STATION (ALTERNATIVE)

Table 5-2(1) SUMMARY OF PROJECT COST

(Unit: 1,000 US$)

Code No.	Item	Total
1	Base Cost	
1-1	Equipment Cost	
1-1-1	Anayzer	1,007
1-1-2	Inland Transportation	17
1-1-3	Installation	33
	Sub-Total	1,057
1-2	Civil Works	
1-2-1	Construction Work	100
	Sub-Total	100
1-3	Maintenance	132
1-4	Pre-Operational Costs	17
	Total of equipment component (per 1 station)	1,307
1-5	Staff Development	
1-5-1	Domestic Training	100
1-5-2	Overseas Training	450
1-5-3	Invitation of Foreign Exports	400
	Sub-Total	950
1-6	Consultant Services	
1-6-1	Design and Supervision of Civil Engineering Works	100
1-6-2	Oversea Engineering Service Consultant	500
	Sub-Total	600
1-7	Taxes and Duties	0
	Total	4,163

Total project cost for three stations

1) Station cost :	3 x 1,307	= US$3,921
2) Other cost (1-5 - 1-6)		= US$1,551
Total		US$5,471

Table 5-2(2) BREAK DOWN FOR ANALYSER

No.	Item	Quantity	Unit Price (US$)
1	Equipment Cost		
1-1	Ambient CO Monitor	1	25,600
1-2	Ambient SO2 Monitor	1	40,850
1-3	Ambient NOx Monitor	1	48,570
1-4	Ambient O3 Monitor	1	39,090
1-5	Ambient HC (Hydrocarbons) Monitor	1	39,020
1-6	Ambient SPM Monitor	1	37,450
1-7	Meteorological Observation Equipment	1	50,580
1-8	System Rack for Monitor	1	93,230
1-9	Telemeter		
1-10	Ambient HF (Hydrogen Fluoride) Monitor	1	323,800
1-11	High Volume Air Sampler	1	5,940
1-12	Low Volume Air Sampler	1	4,840
1-13	Stand Sampler	1	1,820
1-14	Automatic Water Still	1	11,650
1-15	Electric Drying Oven	1	2,620
1-16	Electric Balance (200g/0.1mg)	1	5,550
	Electric Balance (3,200g/10mg)	1	2,310
	Electric Balance (430g/1mg)	1	3,170
1-17	Spectro Photometer	1	6,000
1-18	Chemical Analysis Glass Ware	1	2,540
1-19	Personal Computer (486PC)	2	20,560
	Desktop Computer		
	Laptop Computer		
	Lazer Type Printer		
1-20	Multi Pen Recorder	2	25,640
2	Spare Parts & Consumables for 2 Years	1	28,120
3	Ocean Freight	1	11,900
4	Export Packing	1	8,090

Table 5-3 SCHEDULE FOR MAN-POWER ASSIGNMENT FOR THE PROJECT

	SMI	RIS			FGIC	Subtotal
		RIS1	RIS2	RIS3		
1. Project Director	2					2
2. Project Manager	2	1	1	1	1	6
3. Chemical Resarcher					1	1
4. Environmental Engineer		1	1	1	1	4
5. Chemical Analyst		1	1	1	1	4
6. Chemical Technician		1	1	1	1	4
7. Mechanical Engineer		1			1	2
8. Process Engineer		1			1	2
9. Instrumentation Technician		1			1	2
10. Project Engineer	1				1	2
11. Programmer	1	1	1	1	1	5
12. Officer	1	1			1	3
13. Clerk		1	1	1	1	4
TOTAL	7	10	6	6	12	41

Table 5-4 SPECIFICATION OF AUTOMATIC ANALYZER OZONE BY ULTRAVIOLET ABSORPTION METHOD

Item	Type Measurement priciple	APOA-350E Ultraviolet absorption method	1006-AHJ Ultraviolet absorption method	MODEL-49 Ultraviolet absorption method	GUX-32 Ultraviolet absorption method	840 Ultraviolet absorption method
Performance	1. Measuring range and change of range manual or automatic	Instantaneous value 0~0.1/0.2/0.5/1.0ppm Manual change Selection by external signal	Instantaneous value 0~1.0 ppm Mono-range	Instantaneous value 0~0.1/0.2/.05/1.0ppm	Instantaneous value 0~0.2/0.5/1.0 ppm Manual change Output signal of 1hr ave. on same range (Auto)	Instantaneous value 0~1000 ppb Mono-range Output of 1hr ave.
	2. Repeatability	max. ±2 %FS	max. ±1 %FS	±1 ppb	max. ±0.5 %FS	max. ±2 %FS
	3. Drift a. zero	max. ±1 ppb/day	max. ±0.5%FS/mon.	max. ±0.5%FS/mon.	max. ±5 %FS/day	max. ±1 ppb/day
	b. span	max. ±2 %FS/day	max. ±0.5%FS/mon.	max. ±1 %FS/mon.	max. ±5 %FS/day	max. ±2 %FS/day
	4. Linearlity	max. ±2 %FS/day	max. ±1 %FS	±1 ppb	max. ±2 %FS	max. ±2 %FS
	5. Variation of voltage	max. ±1 %FS/ 100 V ± 10 V	max. ±1 %FS/ 100 V ± 10 V	max. ±1 %FS/ 100 V ± 10 V	max. ±1 %FS/ 100 V ± 10 V	max. ±1 %FS/ 100 V ± 10 V
	6. Response time	max. 2 min. (90%)	max. 36 sec. (90%)	max. 20 sec. (90%)	max. 2 min. (90%)	max. 10 sec. (90%)
	7. Detection limit	2 ppb	0.001 ppm	2 ppm	1 ppb	1 ppb
	8. Resolution	Four figures of dicimals point	Three figures of dicimals point	Three figures of dicimals point	Three figures of dicimals point	Three figures of dicimals point
	9. Outputs	0~1V·0~10VDC 4~20mADC	0~1VDC	0~10mV·0~1VDC	0~1VDC	0~1VDC
Sampling	1. Inlet tube of ambient air sample					
	outer piping tube a. material	Teflon	Teflon	Teflon	Teflon	Teflon
	b. inner diameter (outer diameter)	φ6 (φ8)	φ4 (φ6)	φ4 (φ6), φ6 (φ8), 1/4"	φ6 (φ8)	φ4.75 (φ6.3)
	inner piping tube a. material	Teflon	Vinylone	Teflon	Teflon	Teflon
	b. inner diameter (outer diameter)	φ4 (φ6)	φ5 (φ8)	1/4"	φ4 (φ6)	φ4.75 (φ6.3)
	3. Filter a. material	Teflon	Teflon	Teflon	Teflon	Teflon
	b. size(φ)	φ54	φ47	φ47 or φ40	φ55	φ47
	4. Flow meter a. kind	Area flow meter	Area flow meter	Area flow meter	Area flow meter	Area flow meter
	b. scale	0~31/min.	0.5~6/min.	0.2~21/min.	0.3~31/min.	0~21/min.
	c. min. scale of sampling flow rate	0.21/min.	0.21/min.	0.11/min.	0.11/min.	0.51/min.
	5. Capacity of suction pump	51/min.	41/min.	61/min.	51/min.	71/min.
	6. Flow rate of sampling	21/min.	21/min.	21/min.	21/min.	1.51/min.
	7. Ethylene gas a. kind					
	b. scale					
	c. min. scale of sampling flow rate					
Others	1. Warming-up time	min. 120min	min. 30min	min. 30min	min. 40min	min. 120min
	2. Ambient temperature	0~40℃	0~40℃	0~50℃	0~40℃	5~40℃
	3. Power source	AC100/115/220V 50/60Hz to be desinated	AC100±10% 50/60Hz both use	AC100±10% 50 or 60Hz	AC100±10% 50/60Hz both use	AC100±10% 50 or 60Hz both use
	4. Consumption of electric power	approx. 180VA	approx. 75VA	approx. 150VA	approx. 150VA	approx. 100VA
	5. Outer size a. main	550(D)×430(W)×221(H)	560(D)×440(W)×140(H)	590(D)×480(W)×220(H)	550(D)×430(W)×220(H)	500(D)×486(W)×220(H)
	b. pump					
	6. Weight a. main	approx. 20kg	approx. 10kg	approx. 16kg	approx. 30kg	approx. 20kg
	b. pump					

Table 5-5 SPECIFICATION OF AUTOMATIC ANALYZER FOR ACID RAIN

Type	DRM-200E(S)	DRM-200K	US-750	US752	AR-102SNA	Remarks
Construction						
Water receiving trap diameter	200mm	200mm	200mm	200mm	300mm	
Diameter of falling dry matters receiver	200mm	200mm	200mm	200mm	280mm	
Rain detector	ca. 1mmφ precipitation detector Internal heater	ca. 0.5mmφ precipitation detector Internal heater	ca. 0.5mmφ precipitation detector Internal heater	ca. 0.5mmφ precipitation detector Internal heater	None requirement Internal heater	
Resolution of rain	0.5mm	0.5mm	0.5mm	0.5mm	0.5mm	
Tank for storage sample	Yes	with cooling storage unit	Yes	with cooling storage unit	Yes	
Measuring Item and Method						
Precipitation	Reversing bottle by 0.5mm	Reversing bottle by 0.5mm with additional rain gauge	Reversing bottle by 0.5mm	Reversing bottle by 0.5mm with additional rain gauge	Reversing bottle by 0.5mm with additional rain gauge	
pH	Glass electrode Temperature compensation	Glass electrode Temperature compensation	Glass electrode Temperature compensation	Glass electrode Temperature compensation	Glass electrode Temperature compensation	
Conductivity (EC)	Twin electrode diode 25℃ NaCl base	Twin electrode diode 25℃ NaCl base	Twin electrode diode 25℃ NaCl base	Twin electrode diode 25℃ NaCl base	Twin electrode diode 25℃ NaCl base	
Temperature of rain water	Platinum resistance	Platinum resistance	Platinum resistance	Platinum resistance	Platinum resistance	
$SO_4(2-)$	-	-	-	-	Turbidimetric by $BaCl_2$	} every 1mm rain fal (for 2 measurements for pH & EC)
$NO_3(-)$	-	-	-	-	Ultraviolet spectrophotometry (temperature compensation)	
Measuring Range and Precision						
pH	0-10±0.1pH	0-10±0.1pH	0-10±0.1pH	0-10±0.1pH	0-10±0.05pH	
Conductivity	0-500μS/cm FS±3%	0-500μS/cm FS±3%	0-500μS/cm FS±5%	0-500μS/cm FS±5%	0-500μS/cm FS±2%	
Temperature of rain water	0-40±0.5℃	0-40±0.5℃	0-40±0.5℃	0-40±0.5℃	0-40±0.5℃	
$SO_4(2-)$	-	-	-	-	0-20μg/ml, FS±5%	
$NO_3(-)$	-	-	-	-	0-10μg/ml, FS±5%	
Others						
Washing method of receiver	Automatic washing	Automatic washing	Automatic washing	Automatic washing	Automatic washing	
Warming-up time	30min Timer set for 1,2,3,4hrs	3hrs fixed	3hrs fixed	3hrs fixed	standard: 3hrs arbitrary celection	
Range for temperature compensation	pH, EC: 0-40℃	pH, EC: 0-40℃	-	pH, EC: 0-40℃	pH, EC: 0-40℃	
Heater for winterization	by limit switch (max.7℃)	by limit switch (max.7℃)	by limit switch (max.5℃)	by limit switch (max.5℃)	by temp. limit switch	
Cooling fan	by limit switch	by limit switch	by limit switch (including for dissoloing of snow)	by limit switch (including for dissoloing of snow)	by temp. limit switch	

Table 5-6 SPECIFICATION OF AUTOMATIC ANALYZER BY PIEZO ELECTRIC BALANCE METHOD AND LIGHT SCATTERING METHOD

Item / Measurement principle / System	Piezoelectric Balance Method SYSTEM3611	Light Scattering Method AP635
Performance		
Measuring range and selection	0-5mg/m3 (2min measurement) 0-0.4mg/m3 (30min average)	10-10,000CPM 0.01-10mg/m3
Resolution	1μg/m3	1μg/m3
Repeatability (triple)		max. ±2%
Drift (24hr) a. zero (full scale) b. span (full scale)		 max. ±2% (24hr) max. ±2% (24hr)
Blank test (24hr)		
Linearity a. for calibration particle b. for parcicle suspended in atmosphere	 max. ±10% or max. ±10μg/m3 max. ±20% or max. ±10μg/m3	 max. ±10% max. ±20%
Stability of flow rate of ambient air	max. ±5%/day	max. ±5%/day
Fluctuation of power source (±10%)	max. ±1μg/m3	max. ±1%
Output of telemeter	DC 0-1V	none voltage contact outlet signal
Sampling		
Ambient air sampling pipe a. external piping b. internal piping	 polyfuron 9mm polyethylene 6.35mm	 chlorinated vinyl 18mm hard chlorinated vinyl 16mm
Equal velocity aspiration side	aspiration side 25l/min detection side 6l/min	550l/min
Flow rate of sampling	aspiration side 20l/min detection side 1l/min	35l/min
Flow meter	surface flow meter 3.2-32l/min	none
Flow rate stabilyzer	sonic-nozzle	none
For high concentration	repeat measurement	-
Pressure difference allowable	-	-
Sampling time (total sampling time in repeated measurement)	28min x 2	60min
Particle separation system	inpactor	none
Collecting method	electrostatic collection by corona discharge	-
Filter paper	-	-
Collection efficiency	min.95% (max.10μ particle)	-
Form of collection area	-	-
Detection unit		
Detection source a. type b. half life		optical lamp standard 5V3A operating velocity 4V min. 4 months
Detector a. type b. detector life		photo-electron amplifyer R-366 operating voltage 500-700V min.2 yrs
Mechanism of collection detector	fig. 2-6-13	fig. 2-6-14
Detection unit	sensitivity 1Hz variable compatible theoretical weight sensitivity coefficient 180Hz/0.001mg variation of frequency 100-3000Hz	
Others		
Warming-up time	2 min	3hr
Adjustment of zero		pre-setted decreasing method
Adjustment of span	referrence armature	standard scattering plate method
Average calculation system type required time	 1hr	 accumulation counting method 1hr
Power source	AC100V±10V	AC100V±15%
Power supply	max. 150W	approx. 100VA
Weight	50kg	40kg
Size	522 x 640 x 1210	540 x 270 x 470
Ambient tenperature	5-40℃	-10-40℃

Table 5-7 SPECIFICATION OF SULFER DIOXIDE ANALYZER BY ULTRAVIOLET FLUOROMETRY

Item / Type / Measurement principle	365 Ultraviolet Fluorometry	GFS-32 Ultraviolet Fluorometry	43A Ultraviolet-puls Fluorometry	ASPA-350E Ultraviolet Fluorometry
Performance				
1 Measuring range and selection of range manual or automatic	Instantaneous value 0-200/500/100ppb Automatic change and fix Output of 1hr average at same range	Instantaneous value 0-0.1/0.2/0.5/1.0ppb Manual selection 1hr average (saw tooth type) 0-0.05/0.1/0.2/0.5/1.0ppm Automatic selection	Instantaneous value 0-0.1/0.2/0.5/1.0ppb Manual selection	Instantaneous value 0-0.1/0.2/0.5/1.0ppb Manual selection
2 Repeatability (Reproducibility)	max. ±1%FS	max. ±2%FS	max. ±1%FS	max. ±2%FS
3 Drift a. zero	max. ±2ppb/day	max. ±1%FS/day	max. ±1ppb/day max. ±0.05%/℃	max. ±2ppb/day
b. span	max. ±1%/day	max. ±2%FS/day	max. ±0.5%FS/week max. ±0.1%/℃	max. ±2%FS/day
4 Linearlity	max. ±1%FS	max. ±2%FS	max. ±1%FS	max. ±2%FS/day
5 Variation of voltage	max. ±1%FS/100V±10V	max. ±2%FS/100V±10V	max. ±1%FS/100V±10V	max. ±1%FS/100V±10V
6 Response time	max. 3min(90%)	max. 4min(90%)	max. 2min or max. 4min selection (95%)	max. 3min(90%)
7 Detection limit	1ppb	1ppb	0.6ppb	2ppb
8 Resolution	1ppb	Three figures of decimal point	Four figures ppb	Four figures of decimal point
9 Outputs	DC0-1V	DC0-1V (Insulation of input signal) Instantaneous value and average	0-10mV or DC0-1V	DC0-1V, 0-10V DC4-20A
Collection of Sample				
1 Inlet tube of ambient air sample				
Outer piping tube a. materials	Teflon	Teflon	Teflon	Teflon
b. inner diameters(outer diameters)	φ4.75(φ6.3)	φ7(φ8)	φ4(φ6), φ6(φ8), 1/8"(1/4")	φ4(φ6)
Inner piping tube a. materials	Teflon	Teflon	Teflon	Teflon
b. inner diameters(outer diameters)	φ1.8(φ3.16)	φ4(φ6) or φ2(φ3)	1/8"(1/4")	φ4(φ6)
2 Filter a. materials	Teflon	Teflon	Teflon	Teflon (for sample, for purging)
b. size	φ47	φ55	φ40 or φ47	φ54
3 Flow meter a. kind	Surface flow meter	Surface flow meter	Surface flow meter	Surface flow meter
b. scale	0-1L/min	0.5-2.0L/min	0.1-1L/min	0-1L/min
c. min. scale of sampling flow rate	0.2L/min	0.5L/min	0.05L/min	0.1L/min
4 Capacity of suction pump	8L/min	5L/min	6L/min	6L/min
5 Flow rate of sampling	0.4L/min	0.8-1.0L/min	0.5L/min	0.8L/min
6 Method of removed for hydro carbon	Elimination by penetrating tube			
Others				
1 Warming-up time	max. 120min	max. 2hrs	max. 60min	max. 120min
2 Ambient-temperature	5-40℃	0-40℃	0-40℃	0-40℃
3 Power source	AC100V±10% 50 or 60Hz	AC100V±10% 50 or 60Hz	AC100V±10% 50 or 60Hz	AC100/115/220V 50/60Hz both use
4 Consumption of electric power	300VA	150W	100W	approx. 120VA
5 Outer size main	620(D)x520(W)x490(H)mm	550(D)x430(W)x220(H)mm	590(D)x432(W)x222(H)mm	550(D)x430(W)x221(H)mm
pump	280(D)x240(W)x415(H)mm	-	-	
6 Weight main	65kg	27kg	19.5kg	20kg
pump	5kg	-	-	

Table 5-8 SPECIFICATION OF AUTOMATIC ANALYZER ON OZONE BY CHEMILUMINESCENCE

Item / Type / Measurement principle	830P Chemiluminescence selection	GLX-31 Chemiluminescence selection
Performance		
1 Measuring range and selection of range	Instantaneous value 0-200/500/2000ppb	Instantaneous value 0-0.1/0.2/0.5ppb
manual or automatic	Automatic change and fix	Manual selection
	Output of 1hr average at same range (automatic range)	Output of 1hr average at same range (automatic range)
2 Repeatability (Reproducibility)	max. ±2%FS	max. ±2%FS
3 Drift a. zero	max. ±2ppb/day	max. ±1%FS/day
b. span	max. ±2ppb/day	max. ±2%FS/day
4 Linearlity	max. ±2%FS	max. ±2%FS/day
5 Variation of voltage	max. ±1%FS/100V±10V	max. ±1%FS/100V±10V
6 Response time	max. 1min(90%)	max. 1min(90%)
7 Detection limit	1ppb	1ppb
8 Resolution	Three figures of decimals	Three figures of decimal
9 Outputs	None	DC 0-1V
Collection of Sample		
1 Sample air introducing pipe		
Outer piping tube a. materials	Teflon	Teflon
b. inner diameters(outer diameters)	φ4.75(φ6.3)	φ6(φ8)
2 Inner piping tube a. materials	Teflon	Teflon
b. inner diameters(outer diameters)	φ4.75(φ6.3)	φ2(φ3)
3 Filter a. materials	Teflon	Teflon
b. size	φ47	φ55
4 Flow meter a. type	Surface flow meter	Surface flow meter
b. measurement range	0-1.0L/min	0.2-1.5L/min
c. min. measurement	0.5L/min	0.2L/min
5 Capacity of suction pump	12L/min	5L/min
6 Flow rate of sampling	0.6L/min	2L/min
7 Flow meter for Ethylene gas a. type	Pressure set	Surface type
b. measurement range	0-2kg/cm2	3-20mL/min
c. min. measurement	1.3kg/cm2	3mL/min
Others		
1 Warming-up time	max. 120min	max. 60min
2 Ambient-temperature	5-40℃	0-40℃
3 Power source	AC100V±10% 50 or 60Hz	AC100V±10% 50/60Hz
4 Consumption of electric power	400VA	approx. 400VA
5 Outer size body	570(D)x500(W)x525(H)mm	550(D)x430(W)x270(H)mm
pump		285(D)x270(W)x280(H)mm
6 Weight body	approx. 65kg	approx. 20kg
pump		approx. 6kg

Table 5-9(1) SPECIFICATION FOR WINDMILL TYPE WIND DIRECTION/VELOCITY METER (PHOTO-PULSE TYPE)

Item / Mechanism		
Mechanism	Wind direction	Delection electrically transmitted by sincronous motor of movement of fail wing
Item	Wind velocity	Delection of photo pulse from rotation of windmill
Performance		
1 Measurement range	Wind direction	all directions 0-550° (360° shift type)
	Wind velocity	0.4-10m/s or 0.4-20m/s
2 Measurement precision	Wind direction	±0.3m/s and less for 10m/s and less
	Wind velocity	±3m/s of value and less for 10m/s and over
3 Repeatability	span: max. ±0.1%	
4 Electrical fluctuation	No fluctuation for 100V±10%	
5 Outlet signal for telemeter	Wind direction	DC0-1V for 0-540°
	Wind velocity	DC0-1V for 0-10m/s or 0-20m/s
		average both for wind direction and wind velocity
Others		
1 Warming-up time	0.5hr	
2 Electrical source	AC100V±10V	
3 Power consumption	approx.50VA and less	
4 Standard specification	power shot-down and under adjustment	
5 Weight	Transmitter	approx.5kg and less
6 Ambient comp. permitted	Indoor instrument	0-40℃

Table 5-9(2) SPECIFICATION FOR WINDMILL TYPE WIND DIRECTION/VELOCITY METER (ENGINE TYPE)

Item / Mechanism		
Mechanism	Wind direction	Delection electrically transmitted by sincronous motor of movement of fail wing
Item	Wind velocity	Delection of photo pulse from rotation of windmill
Performance		
1 Measurement range	Wind direction	all directions 0-550° (360° shift type)
	Wind velocity	0.4-10m/s or 0.4-20m/s
2 Measurement precision	Wind direction	±0.3m/s and less for 10m/s and less
	Wind velocity	±3m/s of value and less for 10m/s and over
3 Repeatability	span: max. ±0.1%	
4 Electrical fluctuation	No fluctuation for 100V±10%	
5 Outlet signal for telemeter	Wind direction	DC0-1V for 0-540°
	Wind velocity	DC0-1V for 0-10m/s or 0-20m/s average both for wind direction and wind velocity
Others		
1 Warming-up time	0.5hr	
2 Electrical source	AC100V±10V	
3 Power consumption	approx.60VA and less	
4 Standard specification	power shot-down and under adjustment	
5 Weight	Transmitter	approx.5kg
6 Ambient comp. permitted	Indoor instrument 0-40℃	

Table 5-10 ALLOWABLE ERROR CLASSIFIED BY TESTING ITEM FOR TARGET ANALYZER

	SOx	NOx	OX	NMHC	CO	SPM
Zero drift	±2%	±2%	±2%	±1%	±2%	±2%
Span drift	±2%	±2%	±4%	±2%	±2%	±3%
Repeatability	±2%	±2%	±2%	±1%	±2%	±2%
Lineality	±4%	±4%	±5%	±5%	±5%	±5%
Stability of sampling flow-rate	±7%	±7%	±10%	±1%	±2%	±7%

Table 5-11 SPECIFICATION OF AUTOMATIC ANALYZER ON NITROGEN OXIDES BY CHEMILUMINESCENCE

Item \ Type/measurement priciple	42 Chemiluminescence Method	APNA-350E Chemiluminescence Method	265P Chemiluminescence Method	GLN-31 Chemiluminescence Method
Performance				
1. Measurement range and	Instantaneous	ditto	ditto	ditto
range selection	0~0.05, 0.1, 0.2, 0.5, 1, 2, 5	0~0.1, 0.2, 0.5, 1.0ppm	1~200ppb 0~0.2, 0.5, 2.0ppm	0~0.1, 0.2, 0.5, 1.0, 2, 5ppm
manual/auto	10, 20ppm manual selection	manual selection	manual or automatic change of range	change between manual (a moment) and manual or automatic (1hr average)
2. Repeatability (Reproducibility)	max. ±1%FS	max. ±2%FS	ditto	ditto
3. Drift a. zero	max. ±0.5ppb/day	max. ±2ppb/day, max. ±8ppb/14days	max. ±2ppb/day	max. ±2%FS/day
b. span	max. ±2%FS/day	max. ±2%FS, max. ±8%FS/14days	max. ±2%/day	max. ±2%FS/day
4. Linearlity	within ±1 %FS	max. ±2%FS	within ±2 %	max. ±2 %FS
5. Stability for fluctuation of power source	within ±1 %FS/100±10 V	ditto	within ±1 %/100±10 V	max. ±2 %FS/100±10 V
6. Response time	within 40 min. (90%)	180min (90%, 0.1ppm range)	100 min. (90%)	180min (90%, 0.1ppm range)
7. Detection resolution	0.5 ppb	2 ppb	1 ppb	1 ppb
8. Output signal	DC 0~10mV or DC 0~1V	DC 0~1/10 V, DC 4~20 mA	DC 0~1 V	←
Collection of sampling				
1. Inlet tube of ambient air sampling				
- Outer piping a. material	4-fluoroethylene polymer	ditto	ditto	ditto
b. inner diameter (Outer diameter)	φ4(φ6), φ6(φ8), 1/4"	φ6(φ8)	φ4.75(φ6.3)	φ6(φ8)
2. - Inner piping a. material	4-fluoroethylene polymer	ditto	ditto	ditto
b. inner diameter (Outer diameter)	1/4"	φ4(φ6)	φ4.75(φ6.3)	φ2(φ3)
3. Filter a. material	4-fluoroethylene polymer	ditto	ditto	ditto
b. size	φ47 or φ40	φ54	φ47	φ55
4. Capacity of sample air aspiration	6 l/min.	ditto	7 l/min.	8 l/min.
5. Flow rate sampling	app. 0.7 l/min.	app. 0.8 l/min.	app. 0.5 l/min.	ditto
Others				
1. Warming-up time	min. 60 min.	min. 120 min.	ditto	ditto
2. Ambient temperature	5~40℃	0~40℃	5~40℃	0~40℃
3. Power source	AC 100±10 V 50 or 60 HZ	AC 100, 110, 220 V 50/60 HZ	AC 100 V 50 or 60 HZ	AC 100 V 50/60 HZ
4. Power consumption	300 W	app. 400 VA	500 VA, 300 W	250 VA
5. Outer size body	584(D)×432(W)×222(H)	550(D)×430(W)×221(H)	570(D)×500(W)×525(H)	550(D)×430(W)×270(H)
6. Weight body	22 kg	30 kg	65 kg	32 kg

Table 5-12 SPECIFICATION OF HYDROGEN GENERATOR

Type	OPGU-70A	OPGU-1500	ELHYGEN MARK V
Generation system	Electrolysis of water	←	←
Purity of water (%)	Min. 99.999	Min. 99.999	←
Purification system	Pd alloy membrane penetration method	Solid high pd-ymev. electrolyte	Pd membrane pentration method
Flow rate of generation	150	225	150
Pressure of generation	0~3	0.2~4	0~4.2
Variation of pressure	Non-variation	←	
Warming-up time	20~40	←	app. 60
Ambient temperature	5~40	←	←
Consumption of distilled water	20	app. 10	app. 20
Safety measure	Water level alarm Protection devices for leakage of electrolytic solution by Pd-membvane destractive detector	Water level alarm Protection cercuit for overvoltage of electrolytic cell-monitoring circute of temp of electrolytic cell	
Power source	100±10%	←	115 V
Consumption of electric power	400	200	110
Size	367×276×571	330×220×310	330×381×647
Weight	33	11	app. 25

Table 5-13 SPECIFICATION OF AUTOMATIC ANALYZER BY β-RAY ADSORPTION SYSTEM

Item	Priciple / Type	DUB-32	DUB-33	185	BAM101	BAM102	RTG102B	RTG102U	APDA3000	APDA-350E
		β-ray adsorption method								
Performance	Measuring range and charge of tange	0-5 mg/m3	←	0-5 mg/m3	0-10 mg/m3	0-5 mg/m3	0-10 mg/m3	←	0-5 mg/m3	0-1.5 mg/m3
	Resolution	1 μg/m3	←	←	←	←	←	←	←	←
	Repetability (triple)	max. ±2%	←	←	max. ±3%	max. ±2%	←	←	←	←
	Drift (24hr) a. zero(full scale) b. span(full scale)	 max. ±2% max. ±3%	 ← ←	 max. ±2% max. ±2%	 max. ±2% max. ±3%	 ← ←	 max. ±2% max. ±3%	 ← ←	 max. ±2% max. ±3%	 ← ←
	Blank test (24hr)	max. avarage 10 μg/m3	←	←	←	←	max. 5 μg/m3	←	max. avarage	←
	Linearity a. for perticle calibration b. for particle suspended in air	 max. ±10% max. ±10%	 ← ←	 max. ±10% max. ±5%	 max. ±10% max. ±10%	 ← ←	 max. ±10% max. 100 μg/m3 ±10 μg/m3 min. 100 100 μg/m3 ±10%	 ← ←	 max. ±10% max. ±10%	 ← ←
	Stability of flow rate of sampling air	max. ±7% /10 days	← ←	max. ±5%	max. ±7% /10 days	max. ±5% /10 days	max. ±5%	←	max. ±5%	←
	Fluctuation of power source(±10%)	Span max. ±3% Flow rate max. ±5%	←	Span max. ±3% Flow rate max. ±5%	max. ±3% (Span)	max. ±2% (Span)	Span max. ±3% Flow rate max. ±5%	←	Span max. ±2% Flow rate max. ±5%	←
	Out-put of telemeter	0-1 V	←	1 puls for 1 μg/m3 or 0-1 V	0-1 V	←	1 puls for 1 μg/m3 or 0-1 V	←	0-1 V	0-1, 10 V, 0-16 mA
Sampling	Inlet tube of ambiant air sample a. outer piping b. inner piping	Vinyl chloride 15mm Stainless steel 7mm Vinyl chloride 7mm	← ←	? 12 mmφ ? 12 mmφ	? 10 mm Natural rubber 6 mm	← ←	Vinyl chloride 15mm Vinyl chloride 15mm	←	Vinyl chloride 9mm Hard Vinyl chloride 9mm	←
	Capacity of suction pump	50 l/min	60 l/min	60 l/min	140 l/min	40 l/min	120 l/min	←	50 l/min	←
	Flow rate of sampling	18 l/min	←	18 l/min	15 l/min	←	20 l/min	←	15 l/min	16.7 l/min
	Flow meter	Area flow meter	←	←	←	Mass flow meter	Area flow meter 3-30 l/min	←	Area flow meter	Mass flow meter
	Flow rate stabilyzer	Flow rate analyzer	←	←	Constant flow controller	Mass flow controler	Regulator-type recycle flow controller	←	Mass flow controler	←
	For high concentration	repeat	←	repeat	stop	repeat	←	←	←	←
	Range of difference of pressure at measurment	210 mmHg, 310 mmHg	180 mmHg, 410 mmHg	210 mmHg, 340 mmHg	250 mmHg, 450 mmHg	150-180 mmHg 300 mmHg	200 mmHg, 500 mmHg	←	150 mmHg, 350 mmHg	←
	Sampling time	55.5 min.	55.5 min.	57 min.	55 min.	48-55 min.	53 min. (52 min.)	53 min. (52 min.)	55 min. (50 min.)	←
	Sieve system	Cyclone type	←	←	←	←	←	←	←	Optional: cyclone/ inpactor
	Collecting method	Filtoring	←	←	←	←	←	←	←	←
	Filter paper	AP-20	←	AP-20	AP-20 60 m (3 month)	AP-20 20 m (2 month)	GR-25R roll type 60 m (3 month)	←	Glass fiber filter (roll type, 30mm x 10m)	Glass fiber filter (roll type, 30mm x 20m)
	Tapping efficiency	99.9 %	←	←	←	←	←	←	←	←
	Form of trapping surface	10 mmφ	←	11 mmφ	9 mmφ	11 mmφ	11 mmφ	←	12 mmφ	←
Detection unit	β-ray source a. kind b. half-life	147PM100 μCi 2.62 years	← ←	← ←	14C 100 μCi 5730 years	← ←	14C 100 μCi 5730 years	← ←	14C 100 μCi 5730 years	← ←
	Detection apparatus a. kind b. desfined life	Semi-conductor detector Semi-eternal	← ←	Plactic scinlillation probe	←	←	←	←	← more than 2 years	← ←
Others	Warming-up time	2 hr.	←	max. 2 hr.	1 hr.	←	no need	←	2 hr.	←
	Adjustment of zero	Auto-zero adjustment	←	←				←	Auto adjustment	←
	Adjustment of span	Adsorption film system	←	←	←	←	←	←	←	←
	Average calculation syeytem, type, time required	Area count system, 1 hr.	←	Saw tooth type	–	–	–	–	Integrating count system 1hr	Saw tooth type 30 min. 1 hr 3 hr. 12 hr. 24 hr.
	Power source voltage	AC 100 V 50/60 Hz	←	AC 100 V ±10%	←	AC 100 V ±10%	←	←	←	←
	Power supply	app.120 W (average) 150 VA	app.300 W (average) 400 VA	520 VA	less than 500 VA	Main 75 VA Pump 200 VA	less than 500 VA	←	350 VA (100 VA)	400 VA
	Weight	70 kg	75 kg	60 kg	100 kg	80 kg	140 kg	←	60 kg(40 kg)	30 kg
	Size	460 x 500 x 1060	←	Main 385 x 590 x 250	600 x 570 x 1180	475 x 495 x 1235	700 x 500 x 1100	←	450 x 700 x 950 (370 x 230 x 230)	310 x 430 x 350
	Ambient temperature	-10~40℃	←	←	5~40℃	-10~40℃	-5~40℃	←	5~35℃	0~40℃

Table 5-14 SPECIFICATION OF AUTOMATIC ANALYZER FOR OXIDANT

Item		Type / Principle	GXH-71M, 72M / Spectrophotometry	GXH-73M / Spectrophotometry
Performance	1	Measuring rage and selection of range	a moment 0-0.2, 0-0.5 ppm average 0-0.2, 0-0.5 ppm automatic	a moment 0-0.2, 0-0.5 ppm average 0-0.2, 0-0.5 ppm automatic
	2	Repeatability (triple, full scale)	max. ±2%	max. ±2%
	3	Drift (24 hr.) a. zero (full scale) b. span (full scale)	a. max. ±2% b. max. ±4%	a. max. ±2% b. max. ±4%
	4	Linearlity (full scale)	max. ±5%	max. ±5%
	5	Compensation of temperature	(GXH-72M option)	0.0~-5.0%/℃
	6	Stability of flow rate of sampling	max. ±5%/max. 10 days	max. ±5%/max. 10 days
	7	Fluctuation of power	max. ±1% of full scale	max. ±1% of full scale
	8	Responce time (full scale 90%)	max. 10 min.	max. 10 min.
	9	Inference of nitrogen oxides	NO max. 4.5±1.5 % NO2 max. 4.5±1.5 %	NO max. 4.5±1.5% NO2 max. 4.5±1.5%
	10	Efficiency of scrubber	min. 99 %	min. 99 %
	11	Out-put of telemeter	a moment DC 0-1 V average DC 0-1 V 0-200, 0-500 count/hr (0-500)	a moment DC 0-1 V average DC 0-1 V 0-200, 0-500 count/hr (0-500)
Collection of sample	1	Inlet tube of air sample, outer piping tube a. material b. inner diameter	a. teflon b. 7 mm	a. teflon b. 7 mm
	2	Inlet tube of air sample, inner piping tube a. material b. inner diameter	a. teflon b. 7 mm	a. teflon b. 7 mm
	3	Filter a. type b. Size(φ)	a. teflon b. 55 mm	a. teflon b. 55 mm
	4	Flow meter a. type b. scale c. minimum measurement at targeted flow rate of aspiration	a. float type area flow meter b. 0.5-5 l/min c. 0.1 l/min	a. float type area flow meter b. 0.5-5 l/min c. 0.1 l/min
	5	Capacity of suction pump	app. 8 l/min	app. 8 l/min
	6	Scrubber a. composition b. volume	a. Glass fiber filter being dipped in Chromium tri-oxide, and sulfuric acid b. 800 cm3	a. ditto b. 800 cm3
Gas	1	Flow rate of sampling	3 l/min	3 l/min
	2	Liquid volume	3 ml/min	3 ml/min
	3	Absorbing liquid a. compositon b. tank volume c. compensation of temperature d. method of using solution	a. dissolve 200g of potassium iodide, 140g of potassium dihydrogenphosphate and 360g of disodium hydrogenphosphate into 10 l of water b. 10 l c. non d. circulating type	a. dissolve 200g of potassium iodide, 140g of potassium dihydrogenphosphate and 360g of disodium hydrogenphosphate into 10 l of water b. 10 l c. non d. circulating type
	4	Absorption filter a. material b. volume	a. activated corbon b. 500 ml	a. actirated corbon b. 500 ml
	5	Pump for absorption liquid a. volume b. material	a. 10 ml/min b. hard vinyl chloride	a. 10 ml/min b. hard chloronated binyl
	6	Purification of counter-current absorbing tube a. volume b. delivery pump c. suction pump. d. distilled water, waste water tank		a. 40-50 ml/min b. purification by distilbed water c. Recovery of washing water d. 5 l polyethylence tank

Item		Type / Principle	GXH-71M, 72M Spectrophotometry	GXH-73M Spectrophotometry
Photometry	1	Cell a. length b. form c. capacity d. materials	a. 20 mm b. c. 2.7 ml d. glass	a. 20 mm b. c. 2.7 ml d. glass
	2	Ligtht source a. specification b. vlotage of power source c. distined length (continuous use)	a. 8 V 50 W b. 40 V c. min. 6 months	a. 8 V 50 W b. 40 V c. min. 6 months
	3	Light tube a. specification b. vlotage of power source c. life time (continuous use)	a. PV-16 b. 68 V DC c. min. 1 year	a. PV-16 b. 68 V DC c. min. 1 year
	4	Interfence filter a. wave length b. meterials	a. 365 nm, 20-25 nm b. metal interfence filter	a. 365 nm, 20-25 nm b. metal interfence filter
Others	1	Warming-up time	4 hr.	4 hr.
	2	Adjustment of zero-span a. zero b. span	a. auto. manual zero adjustment b. auto. manual span adjustment	a. auto. manual zero adjustment b. auto. manual span adjustment c.
	3	Average calculation system a. type b. required time of average	a. b. 1 hr.	a. b. 1 hr.
	4	Washing	non	auotmatic or manual
	5	Power source voltage	AC 100 V ± 10 %	AC 100 V ± 10 %
	6	Power supply	app. 150 VA	app. 150 VA
	7	Weight	app. 110 kg	app. 11.5 kg
	8	Size	450(D) x 450(W) x 1580(H)	450(D) x 450(W) x 1580(H)
	9	Ambient temperature	0~40℃	0~40℃

Item		Type / Principle	OX-7 Spectrophotometry	OX-8 Spectrophotometry	APOA-3100 Spectrophotometry
Performance	1	Measuring range and change of range	a moment, average 0-0.2ppm, 0-0.5ppm manual, automatic	a moment, average 0-0.2ppm, 0-0.5ppm manual, automatic	a moment, average 0-0.2ppm, 0-0.5ppm 0-1.0ppm(average) manual, automatic
	2	Repeatability (triple, full scale)	max. ±2%	max. ±2%	max. ±2%
	3	Drift (24 hr.) a. zero (full scale) b. span (full scale)	a. max. ±1% b. max. ±2%	a. max. ±2% b. max. ±2%	a. max. ±2% b. max. ±4%
	4	Lineraliry (full scale)	max. ±2%	max. ±2%	max. ±2%
	5	Stability of flow rate of ambient air	±5%/max. 10 days	±5%/max. 10 days	±5%/max. 10 days
	6	Variation of voltage	max. ±1% of full scale	max. ±1% of full scale	max. ±1% of full scale
	7	Responce time (full scale 90%)	max. 9 min.	max. 9 min.	max. 10 min.
	8	Inference of nitrogen oxides	NO max. 4±1% NO2 max. 4±1%	NO max. 4±1% NO2 max. 4±1%	NO max. 4.5±1.5% NO2 max. 4.5±1.5%
	9	Efficiency of scrubber	min. 99 %	min. 99 %	min. 99 %
	10	Oup-put of telemeter	instantaneous DC 0-1 V average DC 0-1 V	instantaneous DC 0-1 V average DC 0-1 V	instantaneous DC 0-1 V average DC 0-1 V 0.16 mA or 4-20 mA
Collection of sample	1	Inlet tube of air sample, outer piping tube a. material b. inner diameter	a. teflon b. 6 mm	a. teflon b. 6 mm	a. teflon b. 6 mm
	2	Inlet tube of air sample, inner piping tube a. material b. inner diameter	a. teflon b. 6 mm	a. teflon b. 6 mm	a. teflon b. 4 mm, 6 mm
	3	Filter a. kind b. Size(φ)	a. teflon b. 47 mm	a. teflon b. 47 mm	a. teflon b. 90 mm
	4	Flow meter a. kind b. scale c. min. scale of sampling flow rate	a. area flow meter b. 0.5-5 l/min c. 0.1 l/min	a. area flow meter b. 0.5-5 l/min c. 0.1 l/min	a. float type area flow meter b. 0.5-5 l/min c. 0.1 l/min
	5	Capacity of suction pump	12 l/min	6 l/min	5 l/min
	6	Scrubber a. composition b. volume	a. Glass fiber filter being dipped in chromium trioxide, sulfuric acid and solution b. app. 100 cm3	a. Glass fiber filter being dipped in chromium trioxide, sulfuric acid and solution b. app. 100 cm3	a. Glass fiber filter being dipped in chromium trioxide, sulfuric acid and solution b. app. 800 cm3
Gass	1	Flow rate of sampling	3 l/min	3 l/min	3 l/min
	2	Liquid volume	3 ml/min	3 ml/min	3 ml/min
	3	Absorbing liquid a. compositon b. tank volume c. compensation of temperature d. method of using solution	a. dissolve 200g of potassium iodide, 140g of potassium dihydrogenphosphate and 360g of disodium hydrogenphosphate into 10l of water b. 10 l c. non d. circulating type	a. dissolve 200g of potassium iodide, 140g of potassium dihydrogenphosphate and 360g of disodium hydrogenphosphate into 10l of water b. 10 l c. non d. circulating type	a. dissolve 200g of potassium iodide, 140g of potassium dihydrogenphosphate and 360g of disodium hydrogenphosphate into 10l of water b. 10 l c. non d. circulating type
	4	Absorption filter a. material b. volume	a. actirated corbon b. app. 400 ml	a. actirated corbon b. app. 400 ml	a. actirated corbon b. app. 400 ml
	5	Pump for absorption liquid a. volume b. material	a. 15 ml/min b. teflon coating diaphragm pump	a. 10 ml/min b. silicon tube	a. 10 ml/min b. hard chloronated benyl-teflon

Item		Type / Principle	OX-7 / Spectrophotometry	OX-8 / Spectrophotometry	APOA-3100 / Spectrophotometry
Photometry	1	Cell a. length b. form c. capacity d. materials	a. 35 mm b. 10 mm cell c. 3.5 ml d. pylex glass	a. 35 mm b. 10 mm cell c. 3.5 ml d. pylex glass	a. 20 mm b. 10 mm cell c. 2.5 ml d. pylex glass
	2	Ligtht source a. specification b. voltage of power source c. life (continious use)	a. 12 V-23 W single source b. 7.0 V c. app. 4 months	a. 7 V-13 W single source b. 6.0 V c. app. 4 months	a. 4 W black light b. 100 V c. more than 1 year
	3	Light tube a. specification b. vlotage of power source c. life (continious use)	a. PV-16 b. DC 70 V c. app. 2 years	a. R-414 b. DC 15 V c. app. 2 years	a. G-1127 b. DC 70 V c. more than 1 year
	4	Interfence filter a. wave length b. meterials	a. 365 nm b. metal interfence filter	a. 365 nm b. metal interfence filter	a. 365 nm b. collar glass filter
Others	1	Obsorption time	1 hr.	1 hr.	1 hr.
	2	Adijustment of zero-span a. zero b. span	a. auto zero adjustment b. manual span adjustment	a. auto zero adjustment b. manual span adjustment	a. auto zero adjustment b. manual span adjustment
	3	Average calculation a. type b. required time of average	a. AD-18 b. 1 hr.	a. non b. 1 hr.	a. non b. 1 hr.
	4	Power source voltage	AC 100 V ± 10 %	AC 100 V ± 10 %	AC 100 V ± 10 %
	5	Power supply	normal 150 VA maximum 250 VA	normal 150VA(210VA) max. 250VA(260VA)	normal 150 VA maximum 250 VA
	6	Weight	app. 80 kg	app. 80 kg	app. 130 kg
	7	Size	500(D) x 450(W) x 1550(H)	450(D) x 530(W) x 1565(H)	590(D) x 450(W) x 1650(H)
	8	Ambient temperature	0~30℃	5~35℃	0~40℃

Table 5-15 SPECIFICATION OF AUTOMABIC ANALYZER ON CARBON MONO OXIDE

Principle	Type	APMA-3000 NDIR	APMA-3500 ←	540 ←	COA-401A ←	AIR-122 ←	GIA-72M ←
Performance	Measurement range and selection of range manual, automatic	(1)0-5, 0-10, 0-20, 0-50 (2)0-5, 0-10, 0-20, 0-50 (3)0-10, 0-20, 0-50 0-100 (4)0-10, 0-25, 0-50 0-100 a moment, manual change intergrated value, manual change	(1)0-5, 0-10, 0-20, 0-50 (2)0-5, 0-10, 0-20, 0-50 (3)0-10, 0-20, 0-50 0-100 (4)0-10, 0-25, 0-50 0-100 a moment, manual change intergrated value, manual change	0-10, 0-20, 0-50ppm automation manual change	0-50, 0-100ppm manual change	0-10, 0-20, 0-50ppm a moment value is manual change average value is automatic manual change	(1)0-10, 0-20, 0-50 (2)0-5, 0-10, 0-20 (3)0-2, 0-5, 0-10 a moment manual change for 3 range automatic or manual change for 3 range
	Repeatability (triple, full scale)	max. ±2%←	max. ±1%	max. ±1%	max. ±1%	max. ±1%	max. ±1%
	Drift (24 hr.) a. zero (full scale) b. span (full scale)	a. zero b. max. ±2% /7 days	a. zero b. max. ±2% /7 days	a. max. ±1% b. max. ±2%	a. max. ±2% b. max. ±1%	a. zero b. max. ±2%	a. max. ±0.5% b. max. ±1.5%
	Linearlity (full scale)	max. ±2%	max. ±2%←	max. ±2%	max. ±1%	max. ±2%	max. ±2%
	Stability of flow rate of ambient air	max. ±3% /7 days	←	max. ±5%	max. ±5%/day max. ±10% /7 days	max. ±5%/day max. ±10% /7 days	max. ±3%
	Fluctuation of voltage	max. ±1% ←	←	max. ±1%	max. ±1%	max. ±1%	max. ±1%
	Stability for fluctuation of the atmospheric pressure	max. ±1% ←	←	max. ±1%	max. ±1%	max. ±1%	max. ±1%
	Interference	min. 0.5 ppm	min. 0.2 ppm	max. 0.5 ppm	min. 2 ppm	min. 0.1 ppm	min. 0.5 ppm
	Response time (full scale 90 %)	min. 60 sec.	←	120 sec.	max. 60 sec.	max. 120 sec.	max. 120 sec.
	Out-put of telemeter	DC 0-1V 0-16mA ← or DC 0-1V 4-20mA	←	DC 0-1V	DC 0-1V	DC 0-1V	average and a instantaneous value DC 0-1V
	Flow rate of sampling	app. 6 l/min.	app. 2 l/min.	2.0 l/min.	1 l/min.	app. 5 l/min.	app. 2 l/min.
	Inlet tube of ambient air sample Outer piping tube Inner piping tube a. materials b. inner diameter	a. teflon ← b. 6 mm a. teflon ← b. 4 mm	← ←	a. teflon b. 7 mm a. poly ethylene b. 7 mm	a. teflon b. 6 mm	a. teflon b. 6 mm a. teflon b. 4 mm	a. teflon b. 7 mm a. teflon b. 4 mm
	Coarse filter a. materials b. inner diameter	None	←	a. glass wool b. 55mm	a. glass wool b. 120mm	None	None
	Fine filter a. materials b. inner diameter	a. glass wool b. expension filter 320cm	a. glass wool b. 55mm	a. glass wool b. 55mm	a. glass wool b. 55mm	a. glass wool b. 70mm	a. glass wool b. 55mm
	Flow meter a. type b. scale c. min. scale	← b. 1-10 l/min. c. 0.5 l/min.	← b. 1-3 l/min. c. 1 l/min.	a. rotary meter b. 0.2-2.0 l/min. c. 0.1 l/min.	a. float type flow meter b. 0.2-2.0 l/min. c. 0.5 l/min.	a. rotary meter b. 0.3-3.0 l/min. c. 0.1 l/min.	a. float type flow meter b. 0.2-2.0 l/min. c. 0.2 l/min.
	Capacity of suction pump	12 l/min.	7 l/min.	3 l/min.	app. 13 l/min.	app. 5 l/min.	
	Temperature adjustment method	ditto	ditto	with temp. calibration system	PID control	- excluding dehumidifier - Analysis: PID control	
	Cell a. length b. form c. volume d. materials	a. 35mm b. cylindrical c. app. 8ml d. kild steel	a. 110mm B. ditto c. 108ml d. Stainless steel and gold plating internal	a. 500mm b. cylindrical c. 108ml d. Sus 27 and internal, Gold plating	a. 250mm b. cylindrical c. 75ml d. glass, glass and internal gold plating	a. 450mm b. cylindrical c. app. 140ml d. glass and internal gold plating	a. 500mm b. cantal wire c. app. 200ml d. Sus 304 internal gold plating

Principle	Type	APMA-3000 NDIR	APMA-3500 ←	540 ←	COA-401A ←	AIR-122 ←	GIA-72M ←
	Light a. specification b. voltage of power source c. Life (continious use)	a. cantal wire b. DC 10V c. app. 5 years	a. cantal wire b. DC 5V c. app. 5 years	a. ditto b. DC 20V c. app. 5 years	a. ditto b. DC 7.6V c. app. 3 years	a. - excluding dehumidifier - Analysis: PID control b. DC 12V c. app. 5 years	a. ditto b. DC 20V c. app. 5 years
	Detector a. type b. destined length (continious use)	a. condenser and micro panel b. app. 5 years	a. ditto b. app. 5 years	a. micro flow type b. app. 5 years	a. ditto b. app. 5 years	a. ditto b. app. 5 years	a. micro flow type b. app. 5 years
	Interference filter a. wave b. materials	a. 4.7μ	←	CO2 gas filter	None	None	a. CO2 gas filter b. CO2 gas filter
Others	Warming-uptime	4 hours	4 hours	4 hours	8 hours	1 hour	app. 4 hours
	Adjustment of zero-span a. zero b. span	a. No need b. automatic calibration	a. None b. automatic calibration	a. equipment for zero-gas b. automatic calibration	a. automatic calibration b. automatic calibration	a. None b. automatic calibration	a. automatic calibration b. automatic calibration
	Average calcualation a. type b. required time of average	a. None b. 1 hour	a. None b. 1 hour	a. None b. 1 min., 5min., 1 hr	a. VMH-102 b. 1 hr	a. None b. 1 hr	a. None V. 1 hour
	Power source voltage	AC100 V±10%	AC100 V±10%	AC100 V±10%	AC100 V±10%	AC100 V±10%	AC100 V±10%
	Power supply	a. normal 250VA b. max. apporoximately 600VA (start)	a. normal app. 200VA b. max. apporoximately 300VA	a. ave. 200VA b. max. 240VA	a. normal 350VA b. normal 500VA	500VA	app. 250VA
	Weight	app. 120kg	app. 60kg	135kg	app. 150kg	app. 100kg	app. 160kg
	Size	590×450×1650	550×450×1650	570×600×1560	600×600×1600	520×450×1180	500×460×1580
	Ambient temperature	0~40℃	0~40℃	5~40℃	0~35℃	0~40℃	0~40℃

Table 5-16 SPECIFICATION OF AUTOMATIC ANALYZER ON HYDRO-CARBON

1/2

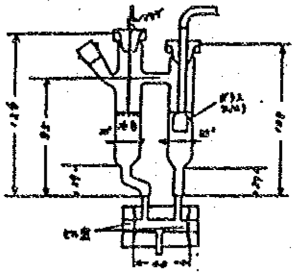
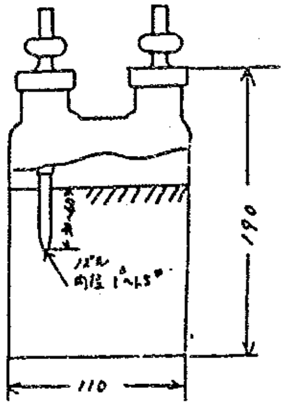
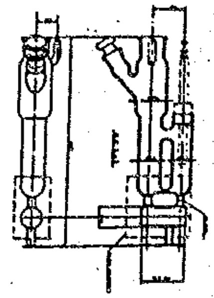
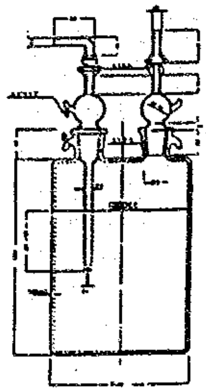
	GHC-75M	HCM-3AS	HCM-4A	AG-202	AG-203	APHA-3000	730
Function							
Principle	gas-chromatography	←	←	←	←	←	←
Component	CH4,NMHC	CH4,NMHC (or NMHC,THC)	CH4,NMHC,THC	CH4(or THC) NMHC	CH4,NMHC,THC	CH4,NMHC	←
Range (ppmc)	0-5 0-10	←	Required FS for 0-5 0-10 10-50	0-5 0-20 (2 sets) 0-10 0-50	0-5 0-20 0-10 0-50 (arbitary setting)	0-5 0-10 0-25	←
Measurement cycle (min)	10	10	←	←	←	6	←
Type of recording	4-pens recorder Instantaneous value of each component Trend record 1hr average Saw tooth record	6-pens recorder Instantaneous value of each component Trend record 1hr average Saw tooth record Trend record	Colour wise record of instantaneous value, average for Methane, non-methan, and total hydro-carbon	6-pens recorder Instantaneous value of each component 1hr average Trend record Saw tooth (option)	6-pens recorder Instantaneous value of each component Trend record 1hr average Saw tooth Selection of trend record	4-pens recorder Instantaneous value of each component Trend record 1hr average Saw tooth record	←
Recorder							
a. Effective record width	180mm	←	←	←	←	←	←
b. Input voltage (DC)	0-1V	0-10mV	←	←	←	0-1V	0-1V
Zero, span adjustment							
a. intake of zero-gas	Auto	Electrical zero setting	Not necessary	←	←	Manual	←
b. zero calibration	Auto	←	Not necessary	←	←	←	←
c. intake of span gas	Auto, Manual	←	Auto-adjustment by automatically introduced standard gas every one to 30 days	←	←	←	←
d. span calibration	Auto, Manual					←	
Signal of telemeter							
a. output (DC)	C-1V	←	←	←	←	←	←
b. kind of signal	in addition to GHC signal: -NMHC instantaneous analog output -NMHC average analog output -THC instantaneous value analog output -THC instantaneous analog output -THC average analog output -Trouble output (abnormal of base value) -Trouble output (failure of adjustment)	-Burn-out of flame -Electrical shut-down signal -Signal under adjustment -Measurement range signal -Introduction signal	-CH4,NMHC,THC instantaneous value -CH4,NMHC,THC average value -Correction of fixed time, under failure, adjustment -Saw tooth type output reset -external correction -TM trouble, Electrical shut-down, time set 5ppm range, 10ppm range etc.	-CH4,NMHC instantaneous value -CH4,NMHC average value -Under adjustment telemeter down -Correction data reset -Failure -Burn-out of flame -Electrical shut-down	-CH4,NMHC,THC instantaneous value -CH4,NMHC,THC average value -Measurement range, data reset -Signal under adjustment telemeter down -Under correction signal -Remote correction -Burn-out of flame -Correction failure signal -Remote-on of pilot -Failure signal (CPU abnormal, pressuredown, temperature abnormal, methane value abnormal, electrical shut-down)	-CH4,NMHC instantaneous value and -Measurement range signal -Confirmation signal (under correction, under maintenance, correction failure, electrical shutdown, FID, burn-out) -Telemeter command signal (reset, under failure, auto-correction start)	-CH4,NMHC,THC instantaneous value -Electrical shut-down signal -Signal under adjustment -Reset signal -Shut-down of central station -Measurement range signal
Hydrogen gas shut-down devices	-Detection of temp. of flame -Hydrogen shut-down valve working	-Thermo-couple type -Hydrogen generator, power source shut-down type	Magnet(optional supply) shut-down for nitrogen generator power source or feed of hydrogen	-Sensorless -Shut-off on magnet	←	-Thermo-couple type, -Shut-off on magnet	Detection of flame temp. Hydrogen shut-down valve type
Performance							
Repeatability (triple)(full scale)	max. ±1%	←	←	max. ±1%	←	←	←
Drift							
a. zero (full scale)	max. ±1%	←	max. ±1%	←	←	←	←
b. span (full scale)	max. ±2%	max. ±1%	max. ±2%	←	←	max. ±2%	←
Linearity (full scale)	max. ±5%	max. ±0.5%	max. ±2%	max. ±5%	←	max. ±2%	←
Warming-up time (hr)	4	1	1	max. 4	←	4	2

	GHC-75M	HCM-3AS	HCM-4A	AG-202	AG-203	APHA-3000	730
Stability for change of ambient temperature a. zero-drift	-among the zero drift field	←	←	←	←	←	←
b. span-drift	-among the span drift field	←	←	←	←	←	←
Voltage resistance	Not abnormal	←	←	←	←	←	←
Variation of voltage	±1% of max. measurement	±0.2% of max. measurement	±1% of max. measurement	±1% of max. measurement	←	←	←
Insulation resistance	min. 4MΩ at DC500V	←	min. 10MΩ	min. 2MΩ	←	min. 2MΩ at DC500V	←
Collection of sample							
Inlet tube of ambient air sample							
Outer piping tube a. materials	Teflon	←	4-flolide ethylene resin	←	←	←	←
b. inner diameter (mm)	6	←	6	←	←	←	1/4 inch
Inner piping tube a. materials	Teflon, SUS	Teflon	4-flolide ethylene resin stenless steel	Teflon, SUS	←	Teflon	Teflon
b. inner diameter (mm)	4,2,1	2	2,1	Teflon 4, SUS1	←	4	1/2 inch
Filter a. materials	Glass fiber	40	4-flolide ethylene resin	Teflon	←	←	←
b. size (diameter, mm)	55		40	40	←	90	47
Flow rate of sampling	3	1	approx. 2	1-2	←	1	1
Capacity of sampling tube	4.5-5.0	10	10	5	←	←	4
Separation of sample							
Separation dolumn a. filler	Porapach	Porapach Q (Pre-column) Activated carbon (Main column)	Polymer bease (Pre-column) Activated carbon (Main column)	OV-275 (Column1) Porapach PS (Column2) Activated carbon(Column3)	←	Silicon DC 550 Porapach Q (Column1) MS-13x (Column2)	Porapach Q (Column1) Durapach (Column2) Carbo sheep S(Column3)
b. mesh of filler	50-80	80-100 (Pre-column) 30-60 (Main-column)	60 (Pre-column) 60 (Main-column)	80-100 (Pre-column) 60-80 (Main-column)	←	60-80	each column 60-80
c. length (m)	1.5+1.5	1 (Pre-column) 0.5 (Main-column)	1(Pre-column, main column)	1.5 (column 1), 1 (column 2), 0.2 (column 3),	←	1.7 column 1, 0.3 column 2	3 feet (column 1) 2feet 1 feet (column 2, 3)
d. inner diameter (mm)	3	2 (Pre-column) 3 (Main-column)	3 (Pre-column, main column)	3	←	3	2.4
e. destined length	1 year	2 years	1-2 years	min. 1 year	←	←	2 years
Temperature of column(℃)	60	←	←	←	←	65	70
Combustion							
Carrier gas a. kind	N2	←	←	←	←	←	←
b. flow rate (ml/min)	45	100-150	60-80	30-40	←	approx. 60	50
Fuel gas a. kind	H2	←	←	←	←	←	←
b. flow rate (ml/min)	approx. 40	←	40-50	approx. 30	←	approx. 40	←
Ignition-improving gas a. kind	Removal of hydro carbon from ambient air	air	air	←	←	←	←
b. flow rate (ml/min)	0.5	1	0.5	0.5	←	0.35	0.5
c. purification	Contacting fixed method by catalyst	Combustion heating		Contacting fixed method by catalyst	←	Combustion method by catalyst	←
Others							
Ambient temperature (℃)	50-40	0-40	50-40	50-40	←	0-40	←
Power source voltage (AC)	100V±10%	←	←	←	←	←	←
Consumption of electric power (VA)	550	max. 1200	800	450	←	700	560
Weight (kg)	100	84	approx. 150	90	approx. 88	140	approx. 150
Size (mm)	500x460x1580	698x384x520	600x530x1600	510x520x1600	550x470x1500	590x450x1650	570x500x1560

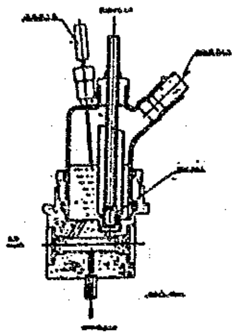
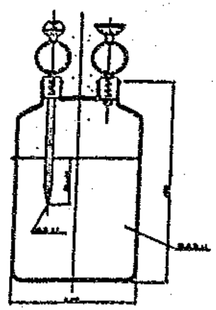
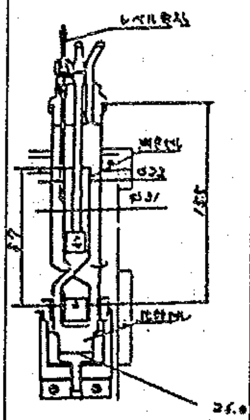
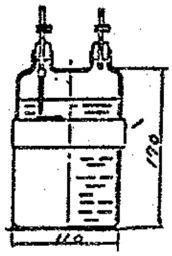
Table 5-17 SPECIFICATIONS FOR AUTOMATIC ANALYZER FOR NITROGEN OXIDES

1/6

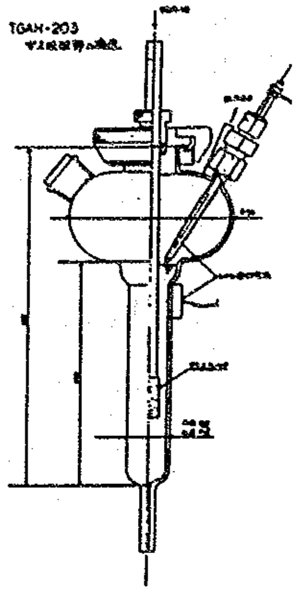
Item / Measuring Method (Type)	GPH-74M	232
Item Measuring Method	Molecular Absorption	←
Performance		
1 Measuring ranges and change of the ranges	NO, NO2, 0-0.1, 0.2, 0.5ppm	←
manual/automatic	manual or automatic change over switch	←
2 Repeatability (reproducibility)(3 times, on full scale)	within±2%	←
3 Drift (in 24hr) a. zero (on full scale)	a. within±2%	←
b. span (on full scale)	b. within±2%	←
4 Linearlity (indication error)(on full scale)	within±4%	←
5 Stability of flow rate of sample ambient air to ageing (specified flow rate)	within±7%/10 days	←
6 Stability to variation in power source (variation of ±10% of the rated voltage on full scale)	within±1%	←
7 Error in sampling quantity of absorbing solution	within±2%	←
8 Netrogen-dioxide-collecting rate (NO2 0.1-2ppm)	97% or more	99% or more
9 Output of telemeter	DC 0-1V	←
Collection of Sample		
1 Sample ambient air inlet		
- Outer piping tube a. materials	a. Teflon	←
b. inner diameter	b. 7mm	←
2 Sample ambient air inlet		
- Inner piping tube a. materials	a. Teflon	←
b. inner diameter	b. 4mm	←
3 Dust filter a. materials	a. Teflon	←
b. outer diameter	b. 55mm	b. 47mm
4 Flow-meter a. type	a. float type variable area flow-meter	←
b. range	b. 50-600ml/min	b. 30-300ml/min
c. measuring precision at measuring points	c. 10ml/min	c. 5ml/min
5 Capacity of sample ambient air suction pump	approx. 8L/min	approx. 5L/min
Nitrogen dioxide absorber		
Sampling time	55min 30sec	56min
Flow rate of sample ambient air	300ml/min	200ml/min
Volume of absorbing solution	42ml	30ml
Absorbing solution a. composition (amount of reagent per 20L)	a. sulphanilic acid 100g	←
	acetic acid 1000ml	←
	N-1-naphthyl-ethylene-diamine dihydrochloride 1g	←
b. method of using solution	b. circulating type	←
c. capacity of tank	c. 20L	←
d. compensation for temperature	d. temperature control at 20℃ in the measuring section	d. temperature control at 25℃ in the measuring section

Item	Type / Measuring Method	GPH-74M / Molecular Absorption	232 / ←
Constitution of absorber		 	 
Colorimeter			
1 Cell	a. length	a. approx.40.6mm	a. approx.40mm
	b. form	b. cylindrical	←
	c. capacity	c. approx.42ml	c. approx.25ml
	d. material	d. PVC hard glass (cell window)	d. Pyrex
2 Light source	a. specification	a. LED; 550nm width 25nm	a. LED; 555nm width 25nm
	b. power voltage	b. 2-3(50mA) pulse lighting	b. 30mA pulse lighting
	c. life (continous use)	c. more than one year	c. more than 10 years
3 Photometry part	a. specification	a. silicon-planar photo diode	a. silicon photo diode
	b. voltage	b.	b.
	c. destined length (continous use)	c. semi-eternal	c. more than 10 years
4 Interference filter	a. wave length	a.	a.
	b. meterial	b.	b.
Others			
1 Warming-up time		2 hrs	4 hrs
2 Adjustment of zero-span	a. zero	a. automatic-zero adjustment	←
	b. span	b. manual-span adjustment	←
3 Power source voltage		AC 100V ±10%	←
4 Consumption of electric power		approx.200VA	approx.190VA
5 Weight		approx.125kg (including 20L absorbing solution)	approx.110kg
6 Size		500 x 460 x 1580	570 x 500 x 1550
7 Ambient temperature		0-40℃	5-35℃

Item / Type / Measuring Method	NX/18 Molecular Absorption	APNA-3100 ←
Performance		
1 Measuring ranges and change of the ranges manual/automatic	NO, NO2, 0-0.1, 0.2, 0.5ppm (NO 1.0ppm) change of manual or automatic	change of manual or automatic
2 Repeatability (reproducibility)(3 times, on full scale)	within±2%	←
3 Drift (in 24hr) a. zero (on full scale)	a. within±2%	←
b. span (on full scale)	b. within±2%	←
4 Linearlity (indication error)(on full scale)	within±4%	←
5 Stability of flow rate of sample ambient air to ageing (specified flow rate)	within±7%/10 days	←
6 Stability to variation in power source (variation of ±10% of the rated voltage on full scale)	within±1%	←
7 Error in sampling quantity of absorbing solution	within±4%	←
8 Netrogen-dioxide-collecting rate (NO2 0.1-2ppm)	98% or more	95% or more
9 Output of telemeter	DC 0-1V	DC 0-1V (0.6mA, 4-2mA)
Collection of Sample		
1 Sample ambient air inlet		
- Outer piping tube a. materials	a. Teflon	←
b. inner diameter	b. 6mm	←
2 Sample ambient air inlet		
- Inner piping tube a. materials	a. Teflon	←
b. inner diameter	b. 4mm	←
3 Dust filter a. materials	a. Teflon	←
b. outer diameter	b. 47mm	b. 55mm
4 Flow-meter a. type	a. variable area flow-meter	a. float type area flow-meter
b. range	b. 50-500ml/min	←
c. measuring precision at measuring points	c. 10ml/min	←
5 Capacity of sample ambient air suction pump	5L/min	←
Nitrogen dioxide absorber		
Sampling time	56min	←
Flow rate of sample ambient air	300ml/min	200ml/min
Volume of absorbing solution	60ml	40ml
Absorbing solution a. composition (amount of reagent per 20L)	a. sulphanilic acid 100g	←
	acetic acid 1000ml	←
	N-1-naphthyl-ethylene-diamine dihydrochloride 1g	←
b. method of using solution	b. circulating type	←
c. capacity of tank	c. 20L	←
d. compensation for temperature	d. temperature control at 25℃ in the measuring section	←

Item / Type / Measuring Method	NX/18 Molecular Absorption	APNA-3100 ←
Constitution of absorber	 	 
Colorimeter		
1 Cell a. length	a. 35mm	a. 20m
b. form	b. cylindrical	←
c. capacity	c. 2.8ml	c. 9.2ml
d. material	d. PVC hard glass (cell window)	d. PVC hard glass
2 Light source a. specification	a. LED	a. LED diode; 550nm
b. power voltage	b. 5V	b. 1-2V pulse lighting
c. life (continous use)	c. more than one year	←
3 Photometry part a. specification	a. silicon photo diode	←
b. voltage	b.	b.
c. destined length (continous use)	c. semi-eternal	←
4 Interference filter a. wave length	a. 565nm	a.
b. meterial	b. metal interference filter	b.
Others		
1 Warming-up time	2 hrs	←
2 Adjustment of zero-span a.zero	a. automatic-zero adjustment	←
b.span	b. manual-span adjustment	←
3 Power source voltage	AC 100V ±10%	←
4 Consumption of electric power	400VA	300VA
5 Weight	approx.80kg	approx.125kg
6 Size	450 x 500 x 1730	550 x 450 x 1650
7 Ambient temperature	5-35℃	0-40℃

Type Item / Measuring Method	TGAH-203 Molecular Absorption	
Performance		
1 Measuring ranges and change of the ranges manual/automatic	NO, NO2, 0-0.1, 0.2, 0.5ppm manual or automatic change over switch	
2 Repeatability (reproducibility)(3 times, on full scale)	within±2%	
3 Drift (in 24hr) a. zero (on full scale) b. span (on full scale)	a. within±2% b. within±2%	
4 Linearlity (indication error)(on full scale)	within±4%	
5 Stability of flow rate of sample ambient air to ageing (specified flow rate)	within±10%/10 days	
6 Stability to variation in power source (variation of ±10% of the rated voltage on full scale)	within±1%	
7 Error in sampling quantity of absorbing solution	within±4%	
8 Netrogen-dioxide-collecting rate (NO2 0.1-2ppm)	95% or more	
9 Output of telemeter	DC 0-1V	
Collection of Sample		
1 Sample ambient air inlet		
- Outer piping tube a. materials	a. Teflon	
b. inner diameter	b. 6mm	
2 Sample ambient air inlet		
- Inner piping tube a. materials	a. Teflon	
b. inner diameter	b. 4mm	
3 Dust filter a. materials	a. Teflon	
b. outer diameter	B. 45mm	
4 Flow-meter a. type	a. variable area flow-meter	
b. range	b. 50-600ml/min	
c. measuring precision at measuring points	c. 10ml/min	
5 Capacity of sample ambient air suction pump	2L/min	
Nitrogen dioxide absorber		
Sampling time	56min 22sec	
Flow rate of sample ambient air	300ml/min	
Volume of absorbing solution	20ml	
Absorbing solution a. composition (amount of reagent per 20L)	a. sulphanilic acid 100g acetic acid 1000ml N-1-naphthyl-ethylene-diamine dihydrochloride 1g	
b. method of using solution	b. once	
c. capacity of tank	c. 20L	
d. compensation for temperature	d. isohtermalization in isothermal room	

Item / Type / Measuring Method	TGAH-203 / Molecular Absorption	
Constitution of absorber		
Colorimeter		
1 Cell a. length	a. 15mm	
b. form	b. cylindrical	
c. capacity	c. 20ml	
d. material	d. hard glass	
2 Light source a. specification	a. 6V 1A tungsten lamp	
b. power voltage	b. DC 4.5V	
c. life (continous use)	c. more than 3 months	
3 Photometry part a. specification	a. CdS light conduction cell	
b. voltage	b. DC 2-5.8V	
c. destined length (continous use)	c. semi-eternal	
4 Interference filter a. wave length	a. 545nm	
b. meterial	b. metal interfence filter	
Others		
1 Warming-up time	2 hrs	
2 Adjustment of zero-span a. zero	a. automatic-zero adjustment	
b. span	b. manual-span adjustment	
3 Power source voltage	AC 100V ±10%	
4 Consumption of electric power	approx. 150VA	
5 Weight	approx. 110kg	
6 Size	525 x 485 x 1415	
7 Ambient temperature	0-40℃	

Chapter 6 IMPLEMENTATION SCHEDULE FOR FLUE GAS MONITORING SYSTEM

Chapter 6 Implementation Schedule for Flue Gas Monitoring System

As mentioned in Section 2 of Chapter 4, a few hundreds to a dozen hundreds of regional monitoring stations are needed when Argentina's vast land is considered, but SE's responsibility is monitoring pollutants from thermal power stations.

For that reason, six sites segmented by SE's administrative districts and meteorological groupings first should become a base on mid- to long-range terms. When the future plan and roles to be played by the State government have been clarified for other sectors in the country, efficient plans for monitoring stations should be established considering overall plans and pollutant levels of thermal power stations.

Under the circumstances, set-up of stations at three sites in view of SE's administrative districts and meteorological segments demanding eventual installation is defined as Phase 1, and set-up at the other three sites for SE's completion of the proposed initial planning as Phase 2. The four steps given below are desirable for implementation of the plan.

Step 1 : SE's mid- to long-range plan for electric power is to be used as a base and review is to be made of concrete implementation of environmental preservation policy from administrative and technical viewpoints.

Step 2 : Based on the above concept, basic plans for mid- to long-range monitoring should be laid out, and the plans should be presented to related organizations both in the country and overseas.

Step-3 : This is a step where, in line with progress made in Step 2, monitoring implementation plans are laid out and the plans is executed.

Step-4 : This is a step where the project is actually executed, for which SE's organization is streamlined, and plans for education and training are implemented.

The schedule prepared in line with the above concept is given in Figure 6-1.

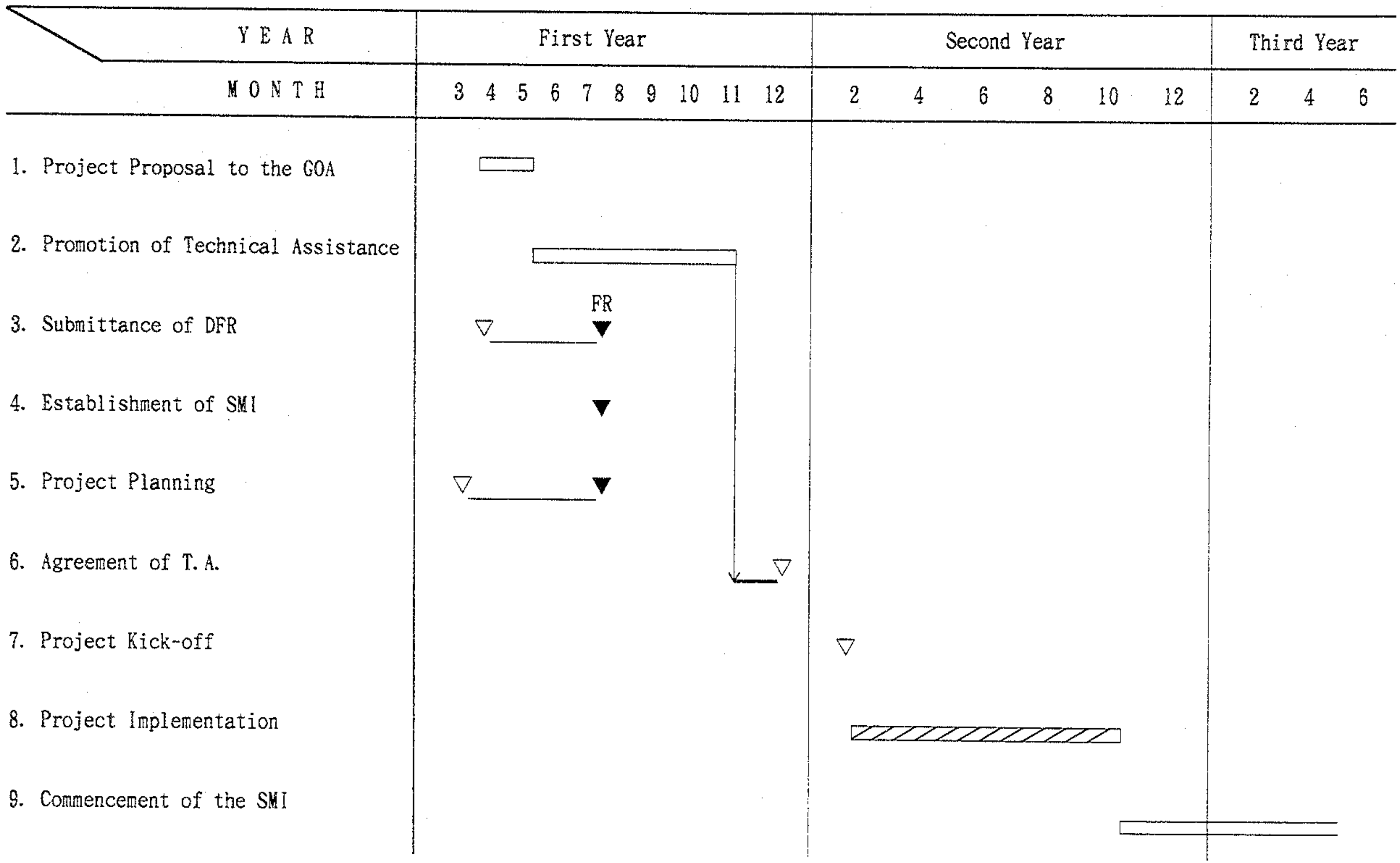


Figure 6-1 IMPLEMENTATION SCHEDULE FOR ESTABLISHMENT OF FLUE GAS MONITERING STATION

Chapter 7 COST AND BENEFIT ASSESSEMENT ON AIR POLLUTION CONTROL

Chapter 7 Cost and Benefit Assessment on Air Pollution Control

7.1 Introduction

In the past decades, the administrative bodies of national government or provincial government in the area, where the issues in relation to the environmental protection are exists, experienced lots of difficulty to find-out the adequate decision, which can maintain desirable environment without disturbing economic development of the nation and/or the area.

In another word, the cost required for the development of a region by construction of infrastructure or development of industries normally increase to the unacceptable level when extremely stringent regulation is imposed on such project for protection of social and natural environment.

Therefore, the administrative bodies must determine the appropriate regulation to be imposed to such development project to maintain the condition of environment in the area without jeopardizing the project. The assessment of required cost and benefit of maintaining environmental standard at desired level should be the basis of such decision making. There have been consistent effort to establish the method to conduct such assessment in the similar way as the benefit analysis on increases in agricultural productivity induced by water resource projects or analysis of road improvement project by time saving and cost saving of vehicles use the improved road.

The history of Cost-Benefit assessment on environmental issues is relatively recent origin and the widely accepted method, which is actual acceptable for decision-making of administrative body, are not established.

However, the benefit analysis based on economic assessment of cost and benefit of environment protection measures expressed in the monetary value have been developed in these years, and in many countries such assessments were conducted and applied to the several practical cases already.

According to a survey conducted by OECD in 1990 on the current status of utilization of "Monetary Valuation Benefit Assessment on Environmental Policy", this method has been used in many cases as shown by Table below;

Table 7-1-1 AREAS OF APPLICATION OF BDE

	SWE	NETH	NOR	FIN	G	UK	AUS	USA	POR	ITA	JAP
National Damage Estimates	-	X	-		X	-	(*)	X	(*)	-	
Specific Pollution Damage											
- air	(*)	X	X	*	X	-	-	X	*	-	X
- water	(*)	X	X	X	X	X	-	X	*	X	-
- soil/land	-	-	-	(*)	X	(*)	-	X	*	X	-
- toxics	(*)	(X)	-	*	-	-	-	X	(*)	-	-
- noise	-	X	X	(*)	X	(*)	-	(X)	-	X	-
- waste	-	X[1]	-	(*)	-	-	-	X	*	X	-
- oils spils	-	-	-	(X)	-	-	-	X	*	-	-
- other	-	-	-		sea defense	-	-	-	-	-	-
Resource Concerns:											
- wetlands	-	-	-	*	-	X	*	X	-	-	-
- forests	X	-	-[2]	(X)	X	(X)	X	X	*	X	-
- coastal zones	-	-	-	(X)	-	-	-	X	(X)	X	-
- wildlife/nature	*	-	X	*	X[3]	(*)	(X)	X	-	X	-
- fish stocks	(*)	-	X	(X)	*	-	-	-	-	-	-
- recycling	-	X	-	*	-	X	(X)	-	(*)	X	X
Risks:											
- 'life'	-	-	-	(*)	-	X	-	X	-	-	
- pollution	-	-	-	*	-	-	-	X	-	-	
- ecological	-	-	-	(*)	-	(*)	-	X	(*)	-	

Source: OECD

1. agricultural waste
2. under way
3. in the near future

Source: Benefit Estimates and Environmental Decision - Making OECD 1992.

OECD Servey also indicated the nature of assessment conducted.

Response from member country of OECD in relation to the way of utilization of "Monetary valuation of Benefit" are analyzed, and results shown as Table bellow:-

Inquiry sent to member country
* Stimulation of environmental awareness
* Influencing decisions
* Identiting what type of decision should be made
* Justification of decision

Table 7-1-2 FUNCTIONS AND LEVELS OF BENEFIT ESTIMATION

Function Level	Simulates Awareness	Influence Decisions	Identify Decisions	Justify Decisions
Policy	Yes	Possible	Unlikely	Unlikely
Regulation	Yes	Likely	Possible	Possible
Project	No	Yes	Likely	Likely

7.2 The outline of "Benefit Damage Estimation of Pollution Control with Monetary Valuation" method.

There are several methods have been developed and being used.

In the followings, the method applicable to assess the benefit of air pollution control in monetary value are described:-

(1) Revealed preference approach

To measure the value of non-market goods, such as the environment, from the market for goods or services which are affected by the changes in the environment. A primary example is real estate transaction which is found to be affected by the quality of air in and around a particular site. Thus, improvement (deterioration) of the environment in a particular area can be expressed in monetary value by assessing environmental impacts on land price. Another indicator is the cost of travels to be made by people in an area under air pollution to other area with clean air at weekend or vacation.

(2) Stated/expressed preference approach

To estimate the price which an affected party is willing to pay (or receive) for improvement (deterioration) of the environment, on the basis of direct interview with the party. (also called contingent valuation)

(3) Dose-response data linkage

To measure the effect of environmental improvement (deterioration) in monetary value by identifying the relationship in which the effect of unit change in environmental quality can be established.

(4) Others

7.3 Preliminary Assessment of Cost Benefit

(On the introduction of "Air Pollution Control Measure" in Argentine.)

In the following the preliminary Cost-Benefit of Air Pollution Control in Grand Buenos Aires based on some of the methods in preceding chapter are shown. The data and information used in this preliminary assessment, the information in the report of OECD are applied, may not same that of present Grand Buenos Aires but it will be useful to indicate the order of magnitute.
(Ref: OECD Environmental Policy Benefits; Monetary Valuation)

7.3.1 Travel Cost Valuation

The method is based on the assumption that, if air pollution becomes a serious problem in an area, people living in the area travel to other area with clean air at least several times a year, so that the cost of travel is considered to be the monetary value representing the quality of the environment. The method is difficult to estimate how many people actually decide to travel. At the same time, the method is known to produce the results close to those obtained by other contingent valuation method. For the purpose of this study, assuming that 3 million population in Capital Federal (600,000 households) earn US$20,000/year on average, and approximately one half of them travel twice a year, one week long each, and spend 10% of their income for the trips, the total travel cost is estimated as 600,000 x 2,000 x 0.5 = US$600 million.

Adding income which would have been earned by the households during the trips, namely 2 weeks, 1/24 x 20,000 x 600,000 x 0.5 = US$250 million, a total of US$850 million is obtained.

7.3.2 Building Corrosion Damage

It is well known that when SOx, NOx and other acidic substances increase in the air due to air pollution, damage to the building surface and corrosion on metal surface progress at an accelerated pace.

According to surveys conducted in the Netherlands, Germany, and the U.S., pollution levels at the 1980s, in the 1983 dollar, are as follows:

EC team estimate 3-14 $/capta/Year			Level of Air Pollution		
			1975	1985	1980-1984
			SOx($\mu g/M^3$)	SOx	NOx($\mu g/M^3$)
Netherlands	8-15$/capt/Y	Amsterdam	34	16	45
Germany	15 $/capt/Y	Berlin	95	67	60
U.S.	28 $/capt/Y	New York	43	37	65

If US$15/capt/year is assumed, 3 million x US$15 x 10 = US$450 million are estimated as the total damage to the building for 10 years in the Buenos Aires area.

7.3.3 Impact of Air Pollution on Property Values

Generally, it is difficult to evaluate the effect of air pollution separately from that of other factors which work together to cause environmental dilapidation (e.g., noise and road congestion). The results of studies conducted in the U.S. are summarized below.

Table 7-3-1 IMPACT OF AIR POLLUTION ON PROPERTY VALUES

City	Year of: a)Property data b)Pollution measure	Pollution	%Fall in property value per %Increase in pollution
St-Louis	1960	Sulfation	0.06-0.10
	1963	Particulates	0.12-0.14
Chicago	1964-67	Particulates and sulphation	0.20-0.50
	1964-67		
Washington	1970	Particulates	0.05-0.12
	1967-68	Oxidants	0.01-0.02
Toronto-Hamilton	1961	Sulfation	0.06-0.12
Philadelphia	1960	Sulfation	0.10
	1969	Particulates	0.12
Pittsburgh[1]	1970	Dustfall and sulphation	0.09-0.15
	1969		
Los Angeles[1]	1977-78	Particulates and oxidants	0.22
	1977-78		

1. In these studies it is clear that part of the elasticity that is estimated is due to the form of pollution that is not included in the analysis, or if included has an insignificant impact. This problem of multicollinearity has been discussed in the text.

Sources: Freeman (1979b), Brookshire et al. (1982)
(1.0% pollution increase cause above fall)

Generally, land value falls at a rate equivalent to 1/20 - 1/10 the rate of increase in SOx or suspended particulate. According to the 1991 census the residential area in Capital Federal and Gran Bs As is about 10^6 acres. Further assuming that the residential land price is US$10,000/acre, the total value of residential land is US$10 billion. If the pollution level increases 100%, the decline in land value is estimated at US$0.5 ~ 1.0 billion.

7.3.4 Conclusion

The benefit of air pollution control estimated in the monetary value result maximum 850 million US$ annually through travel cost method and minimum 45 million US$ annually through building corrosion damage.

However, when the damage of cultural heritage such as historical monument in Grand Buenos Aires is considered the building/status damage will be much more significant than the 45 million dollar/Y.

When we take the fall of land value as the benefit of future investment to be made to prevent deterioration of the quality of atmospheric environment in the Grand Buenos Aires, 500~1,000 million US$ investment will be justified because there is possibility of increase of emission level of pollutant almost two times of present level within 15 years as the rapid economic development, which is normally accompany increase of energy consumption as well, is now envisaged.

Chapter 8 CONCLUSION AND RECOMMENDATION

Chapter 8 Conclusion and Recommendation

(1) Present Atmospheric Pollution

There is no serious air pollution problem in the country caused by the emission from the thermal power plant.

However, part of Buenos Aires suffer air pollution problem which mainly caused by emission from vehicles and minor contribution from industrial emission including from the thermal power plant, and part of Mendoza also suffer sometime deteriorated atmospheric condition particularly by particulate material which caused by several industrial facilities including thermal power plant.

These observation made by the JICA study team indicates that immediate introduction of costly pollution abatement facilities to the thermal power plant are not necessary.

It is strongly felt that the present actions taken by S.E. and E.N.R.E. in relation to the management of atmospheric environment need to be integrated with the activities of the other government agencies and state/municipal government to establish the national air pollution management systems.

The technology, which is proposed in this report and being developed by S.E. and its associated institution for inspection and monitoring the atmospheric environment, should be established immedeately and fully utilized by the other institutions in charge of atmospheric environment management.

(2) Establishing the system for the inspection and monitoring system

Although the present air pollution problem in the country is not serious, the present international concern on the global environment preservation together with the current regional and global movement to have common standard for environment preservation as the basis of free trade and common economic community necessitate every country to establish national monitoring system to obtain reliable information on the present environmental conditions in the country, which is collected and assessed by the internationally acceptable methods.

It is recommended that the system proposed in this report for the undertaking by SE and being developed by S.E. for monitoring and inspection of the atmospheric management of the thermal power plant should be expanded to the national level through positive cooperation among other related government agencies.

(3) Future environment management for the thermal power plant

As the results of the fundamental restructuring of the economy and industries being proceeded in the country, the future development of energy sector including the electricity generation will be proceeded based on market economy mechanism.

According to the government economic development program "Growing Argentine 1993-1995", it is now clear that the economy of Argentine will continue rapid development up to next century.

This means the energy requirement including electricity supply will increase rapidly, and the requirement of energy and electricity will be almost doubled from present by AD 2010 as projected by the Ministry of Economy and SE.

Under such circumstance, the supply of clean energy such as hydroelectricity and natural gas might not be sufficient to meet such large additional demand.

This condition may results large scale use of high sulfur fuel oil and coal for requirement of industries and the thermal power plant.

If no adequate measures are taken to avoid the possible air pollution by the emission from such fuel, there is high possibility of serious air pollution in the area, where heavy industries are locating, as it was experienced by industrialized countries during rapid expansion of manufacturing activities.

Since the future development of majority of manufacturing sector including energy sector are in the hand of private sector, maintaing the harmony between environment preservation and cost saving will be complicated.

It is recommended that well prepared guidance by the related authority should be provided in time for leading the activities of private enterprises to prevent environmental pollution without harming the positive development of the economy of the country, which will be supported by the private enterprises.

The guidance should be prepared based on long range energy supply demand master plan, national plan for siting industrial projects in the country and the national regulatory system to adjust the emission standards to be imposed to the emission sources in accordance with the systematic monitoring system.

(4) International Cooperation

It is understood that the Government of Argentine is positively participating international activities for global environment preservation program such as Montreal treaty. As the current open trade policy are adopted world wide, any country will have to maintain international standard for protection of global environment as a member of international society.

It is recommended that the technical cooperation between Argentine and Japan in relation to environment preservation shoul be considered positively to develop international cooperation to accelerate global environment preservation activities.

APPENDIX

APPENDIX 1 List of Equipment Supplied to Argentina

Appendix 1 List of Equipment Supplied to Argentina

LIST OF EQUPMENT SUPPLIED TO ARGENTINA

	ITEM No.	EQUIPMENT [MODEL]	MANUFACTURE	QUANTITY (set)		SPECIFICATION	User
	1.	Portable Analyzer for Flue Gas					
1	1.1	Gas Analyzer[MSI 2000]	MSI	2		O_2, CO, NO, SO_2	O_2, CO, NO, SO_2
	1.1-1	Measuring Probe					
2	1.2	NOx-02 Analyzer for Conbustion Exhaust[NOA-7000]	SHIMADZU Co.	2		NOx:Chemiluminescence O_2:Zirconia Method	NOx, O_2
	1.2-1	Standard Gas					
		1)NO(240ppm:3.6 liter)		2			
		2)NO(996ppm:3.6 liter)		2			
		3)O_2(0.1ppm:3.6 liter)		2			
		4)N_2(Research:3.6 liter)		4			
	1.2-2	Gas Sampling Probe[GSR 100]		4			
	1.2-3	Gas Sampling Unit(Pretreatment Set)[CFP-301]		2			
	1.2-4	Recorder[US-211]		2			
		1)Recording Paper(3pcs.)[No.1008Z40]		22	21		
		2)Ink Set(6colors)[SA100p:4T55568]		8			
		3)Ink Pad[100791]		12			
	1.2-5	IC Memory Card[630-04358-01]		2			
	1.2-6	Step Down Transformer[B-2]		2			
	1.2-7	SO_2 Absorbent(185g)[630-00731-01]		10			
	1.2-8	NH_3 Absorbent Set(6pcs.)[638-52383]		10			
	1.2-9	Ozone Deactivator Catalyst[638-65232]		2			
	1.2-10	Reaction Tube(NO_2 →NO)[638-52842-01]		2			
	1.2-11	Drain Separator Set[638-93092]		2			
3	1.3	Infrared Continuous Gas Analyzer[IRA-107]	SHIMADZU Co.	2		SO_2:Infrared Absorption Method(Ratio Method)	SO_2
	1.3-1	Standard Gas					
		1)SO_2(200ppm:3.6 liter)		2			
		2)SO_2(490ppm:3.6 liter)		2			
	1.3-2	Gas Sampling Unit(Pretreatment Set)[CFP-301]*(1.2-2)					
	1.3-3	Gas Sampling Probe[GSR 100]*(1.2-3)					
	1.3-4	Recorder[US-211]*(1.2-4)					
		1)Recording Paper(3pcs.)[No.1008Z40]					
		2)Ink Set(6colors)[SA100p:4T55568]					
		3)Ink Pad[100791]					
4	1.4	Portable Dust Particle Monitor[AP-710N]	SHIBATA SCIENTIFIC TECHNOLOGY Ltd.	2		Dust:Light Scattering of Near Infrared Ray	Dust
	1.4-1	Hand-held Computer[EPSON HC-45]		2			
	1.4-2	Compact Printer[EPSON C-40]		2			
	1.4-3	Recorder		2			
	1.4-4	Down Transformer for Computer(HC-45)[300AE]		2			
	1.4-5	Down Transformer for Printer[SE-100]		2			

LIST OF EQUPMENT SUPPLIED TO ARGENTINA

	ITEM No.	EQUIPMENT [MODEL]	MANUFACTURE	QUANTITY (set)		SPECIFICATION	User
	1.4-6	Ribon Cassette		8			
	1.4-7	Roll Paper		3			
	1.2-8	Paper for Recorder(2 ×3pcs.)[E9653BQ]		8			
5	1.5	Automatic Equal-Velocity Flue Gas Suction Device	SHIBATA	2		Practical Equal-Velocity	Dust
		[DUSTAC SAMPLER:ESA-302CT-20N]	SCIENTIFIC			Suction Quantity of Flow	
	1.5-1	Wet Gas Meter [Model W-NK De-5A]	TECHNOLOGY	2		:1.0-50 liter/min	
	1.5-2	Moisture Absorption Tube Set[EW-32A]	Ltd.	2			
	1.5-3	Thimble Case Set[EG-4]		4			
	1.5-4	Gas Sampling Tube	OKANO WORKS	2			
		1)Sampling Tube 1,000mm[ES-302S]	Ltd.	2			
		2)Connector Pipe[ES-LS-10]		6			
		3)Connector Pipe[EP-1]		4			
		4)Pitot Tube Western-type 8 φ[EWK-1S]		4			
		5)Pitot Tube L-type 8 φ[EL-1S]		4			
	1.5-5	Sampling Tube for Moisture with Heater		2			
	1.5-6	Dust Collecting Tube		2			
	1.5-7	Suction Nozzle Set[EP-25N]		2			
	1.5-8	Sliy Flange(for 4B,SS)		2			
	1.5-9	Handy Vise(100mm)		5			
	1.5-10	K-Thermocouple					
		1)K-Thermocouple(3.2 φ×1,100mm)[ESK-10]		2			
		2)K-Thermocouple(3.2 φ×3,100mm)[ESK-30]		4			
	1.5-11	Holder for Clindrical Filter-Paper[ESP-25H]		2			
	1.5-12	Packing of Holder for Clindrical Filter-Paper(3pcs.)		40			
	1.5-13	Ribbon Heater		2			
	1.5-14	Slide Regulator(for Ribbon Heater)[SD-242]		2			
	1.5-15	Tool & Tool Box		2			
	1.5-16	Recording Paper(Roll Paper)[NR-440]		4			
	1.5-17	Ink Ribbon(Ribbon Cassette)[ERC-05]		?			
	1.5-18	Vacuum Hose(6 φ×18mm×10m)		1			
	1.5-19	Pretreatment Set		2			
	1.5-20	Cooling Water Bath with Clumps		2			

LIST OF EQUPMENT SUPPLIED TO ARGENTINA

	ITEM No.	EQUIPMENT [MODEL]	MANUFACTURE	QUANTITY (set)		SPECIFICATION	User
	2.	Air Pollution Monitoring Analyzer					
6	2.1	β-Ray Attenuation Mass Monitor[BAM-102S]	SHIBATA	1		Dust Particle Concentration	SPM
	2.1-1	Filter Paper	SCIENTIFIC	30		: β-Ray Absorption	
	2.1-2	Recording Paper for BAM-102S	TECHNOLOGY	14	13		
	2.1-3	Tape Cores	Ltd.	1			
	2.1-4	Ink Ribbon		2			
	2.1-5	Sampling Tube(φ14×10.5mm, 5m)		1			
7	2.2	High Volume Air Sampler[HVC-1000N]	SHIBATA	5		500-1,200 liter/min with	SPM
	2.2-1	Filter Paper(50pcs., 203 ×253mm)	SCIENTIFIC	20	19	Automatic Constant Flow	
	2.2-2	Particle Separator	TECHNOLOGY	2			
	2.2-3	Filter Paper(50pcs., 126 ×166mm with slit)	Ltd.	10			
	2.2-4	Motor Brush for Repair		40			
	2.2-5	Paint for Maintenance		1			
	2.2-6	Carrier(300kg Use)		5			
	2.2-7	Orifice Meter		1			
	2.2-8	Electric Cord with Socket(20m)	Argentina:	5			
8	2.3	Stand Sampler[S-601]	SHIBATA	10		Double Diaphragm System	Sampling of
	2.3-1	SPC Midget Impinger G-1 Set(10pcs.)	SCIENTIFIC	2		Air Sampler	ambient air
	2.3-2	Dry Battery(200pcs.)	TECHNOLOGY	1			
	2.3-3	AC/DC Adaptor[Model:1462](1,000mA-18W)	Ltd.	10			
	2.3-4	Electric Cord(2m)	Argentina:	5			
	2.3-5	Plastic Funnel	Argentina:	10			
	2.3-6	Three-way Socket	Argentina:	6			
	2.3-7	Steel Parts	Argentina:	6			
9	2.4	Impinger Set(6pcs.)[8003-2]	SHIBATA S.T.	22			
10	2.5	Shelter (for Stand Sampler)	Argentina:	6			
11	2.6	Ambient NOx Monitor[APNA-350E]	HORIBA Ltd.	1		NOx:Chemiluminescence	NOx
		UV-Lamp					
		Silica Gel					
12	2.7	Ambient SO2 Monitor[APSA-350E]	HORIBA Ltd.	1		SO2:Ultraviolet Fluorescence	SO2
		Lamp Unit					
13	2.8	Ambient SPM Monitor[APDA-350E]	HORIBA Ltd.	1		Dust: β-Ray Absorption	Dust
		Diaphragm Pump [ULVAC]					
		Filter Paper (for Ambient SPM Monitor)					

LIST OF EQUPMENT SUPPLIED TO ARGENTINA

	ITEM No.	EQUIPMENT [MODEL]	MANUFACTURE	QUANTITY (set)			SPECIFICATION	User
	3.	Chemical Analysis Apparatus						
14	3.1	Chemical Reagent for Salzman Method					NO2:Ambient Air	NOx
	3.1.1	N-1-Naphtylethylenediamine	Japan:WAKO	1g×10×	5			
	3.1.2	Sulfanilic Acid	Japan:WAKO	500g×	5			
		〃	Argentina:MERK	250g×	1			
	3.1.3	Acetic Acid	Argentina:	1,000ml×	3	2.5		
	3.1.4	Sodium Nitrite	Argentina:MERK	500g×	2			
	3.1.5	Potassium Permanganate	Japan:	500g×	1			
15	3.2	Chemical Reagent for Pararosaniline Method					SO2:Ambient Air	SO2
	3.2.1	Mercury (II) Chloride	Japan:WAKO	500g×	3			
		〃	Argentina:MERK	250g×	5			
	3.2.2	Potassium Chloride	Japan:WAKO	500g×	3			
	3.2.3	Ethylendiamine Tetra Acetic Acid Disoium Salt	Japan:WAKO	25g×	2			
	3.2.4	Pararosaniline Hydrochloride	Japan:WAKO	10g×	10			
	3.2.5	Hydrochloric Acid	Argentina:	1,000ml×	3	2.7		
	3.2.6	Formaldehyde (Formalin)	Argentina:	1,000ml×	2			
	3.2.7	Sodium Hydrogen Sulfite	Argentina:	500g×	1			
	3.2.8	Iodine	Japan:WAKO	500g×	3			
	3.2.9	N/10 Sodium Thiosulfate Solution	Japan:WAKO	500ml×	3	2.5		
	3.2.9'	Sodium Thiosulfate	Argentina:	250g×	2			
	3.2.10	Sulfamic Acid	Argentina:	1,000g×	1			
	3.2.11	Potassium Iodine	Japan:WAKO	500g×	1			
	3.2.12	Sotuble Starch	Japan:WAKO	500g×	1			
	3.2.13	Phosphoric Acid	Japan:WAKO	1,000ml×	1			
		〃	Argentina:	1,000ml×	1			
16	3.2'	Chemical Reagent for Zn-NEDA Method					NOx:Flue Gas	
	3.2'.1	Sulfuric Acid	Argentina:	1,000ml×	1			
	3.2'.2	Sulfanilamide	Argentina:	500g×	1			
	3.2'.3	Hydrochloric Acid*(3.2.5)						
	3.2'.4	Sodium Acetate Trihydate	Argentina:MERK	250g×	2	1		
	3.2'.5	Sodium Hydroxide	Argentina:MERK	250g×	2			
	3.2'.6	Acetic Acid*(3.1.3)						
	3.2'.7	Zinc, Powder	Japan:WAKO	100g×	2			
		〃	Argentina:	500g×	1			
	3.2'.8	N-1-Naphtylethylenediamine*(3.1.1)						
	3.2'.9	Potassium Nitrate	Argentina:MERK	500g×	1			
	3.2'.10	Potassium Nitrite			—			
	3.2'.11	Sodium Nitrite*(3.1.4)						

LIST OF EQUPMENT SUPPLIED TO ARGENTINA

	ITEM No.	EQUIPMENT [MODEL]	MANUFACTURE	QUANTITY (set)			SPECIFICATION	User
17	3.2"	Chemical Reagent for Orsat-Apparatus					O2, CO2, CO:Flue Gas	
	3.2".1	Potassium Hydroxide	Argentina:MERK	500g×	2	1		
	3.2".2	Ammonia	Argentina:	1,000ml ×	1			
	3.2".3	Pyrogallol	Argentina:	100g×	1			
	3.2".4	Sodium Chloride	Argentina:	500g×	2			
	3.2".5	Hydrochloric Acid*(3.2.5)						
	3.2".6	Methyl Orange	Argentina:	25g×	1			
	3.2".7	Cuprous Chloride	Argentina:	500g×	1			
	3.2".8	Ammonium Chloride	Argentina:	500g×	2			
18	3.2"'	Chemical Reagent for Analyzer						
	3.2"'.1	Calcium Chloride	Argentina:	500g×	8			
		〃	SHIBATA, OKANO	500g×	18			
	3.2"'.2	Silica Gel	Argentina:	500g×	3	2		
		〃	SHIBATA, OKANO	500g×	20	17		
		〃	Argentina:	1,000g×	1			
19	3.3	Chemical Analysis Glass Ware						
	3.3.1	Mess Flask(1,000m liter)	Argentina:		2			
	3.3.2	Mess Flask(500m liter)	Argentina:		2			
	3.3.3	Mess Flask(250m liter)	Argentina:		2			
	3.3.4	Mess Flask(100m liter)	Argentina:		2			
	3.3.5	Test Tube for Spectrometer	Argentina:		100			
	3.3.6	Stand for Test Tube for Spectrometer	Argentina:		10			
	3.3.7	Volumetric Pipet(10m liter)	Argentina:		10			
	3.3.8	Volumetric Pipet(5m liter)	Argentina:		10			
	3.3.9	Volumetric Pipet(2m liter)	Argentina:		10			
	3.3.10	Volumetric Pipet(1m liter)	Argentina:		10			
	3.3.11	Volumetric Pipet(0.5m liter)	Argentina:		10			
	3.3.12	Pipet Stand	Argentina:		3			
	3.3.13	Washing Bottle(500m liter)	Argentina:		8			
	3.3.14	Coloured Glass Bottle(1,000m liter)	Argentina:		8			
	3.3.15	Coloured Glass Bottle(500m liter)	Argentina:		8			
	3.3.16	Magnet Stirrer for 1,000m liter Beaker[10nomex AA22]	Ar.:ISBA S.A.		3			
	3.3.16'	Magnet Stirrer Chip	Argentina:		5			
	3.3.17	Bottle Top Dispenser(5m liter)[Socorex 511]	Ar.:Socorex		5			
	3.3.18	Sampling Tube	SHIBATA, OKANO		2			
	3.3.19	Sher-field Tube			—			
	3.3.20	Water Bath[Masson]	Ar.:Vicking		2			
	3.3.20'	Immersion Circulator[Model 730]	Ar.:KERNCO INS.CO.		4			
	3.3.21	Oil Circulation Pump[IP-30L]	SHIBATA		5			
		1)Element for Pomp	SHIBATA		6			

LIST OF EQUPMENT SUPPLIED TO ARGENTINA

ITEM No.	EQUIPMENT [MODEL]	MANUFACTURE	QUANTITY (set)		SPECIFICATION	User
	2)Blade	SHIBATA	12			
	3)Maintenance Set	SHIBATA	1			
3.3.21'	Flow Meter[IP-62]	SHIBATA	5			
3.3.22	Gas Meter(Wet Type)		--			
3.3.23	Gas Washing Bottle Set					
3.3.24	Pressure Gas Hose(9 × 21mm, 1m)	SHIBATA	6			
3.3.25	Electronic Balance[FX-3000]	A&D	2			
3.3.26	Slidac					
3.3.27	Transformer	Argentina:	1			
3.3.28	Plug Set	SHIBATA	10			
3.3.29	Storage Case for Equipment					
	1)54L case	SHIBATA	5			
	2)30L case	SHIBATA	10			
3.3.30	Protector Sets					
	1)Helmet(hard resinous)	SHIBATA	10			
	2)Safety Glasses(MM-85A)	SHIBATA	10			
	3)Safety Goggle(X-9305)	SHIBATA	10			
	4)Dust Protective Mask(1121R)	SHIBATA	10			
	5)Safety Belt(Midori B-1)	SHIBATA	5			
	6)Glove(MK-250)	SHIBATA	5	0		
	7)Ear Muffle	SHIBATA	5			
	8)Ear Plug(No.10)	SHIBATA	30	25		
	9)Seal Tape(0.1mm × 13mm × 15mm)	SHIBATA	20			
3.3.31	Miscellaneous					
	1)Heat-resisting Cloth	SHIBATA	5			
	2)Thimble Filter [88RH:25 × 90mm, 10pcs.]	SHIBATA	50			
	3)Teflon Tube	SHIBATA	1			
	4)Silicon Tube	SHIBATA	2			
	5)Paper Wiper(Kim Wipe, 72pcs.)	SHIBATA	2			
	6)Paper Wiper(Kim Towel, 24pcs.]	SHIBATA	3			
	7)Plastics Sheet(3 × 3m)	SHIBATA	3			
	8)Carrier(150kg Use)	SHIBATA	3			
	9)Lope(20m)	SHIBATA	3			
3.3.32	Plastic Bottle(1,000m liter)	Argentina:	4			
3.3.33	Plastic Bottle(250m liter)	Argentina:	5			
3.3.34	Washing Brush					
	1)Washing Brush(Large size)	Argentina:	2			
	2)Washing Brush(Middle size)	Argentina:	2			
	3)Washing Brush(Small size)	Argentina:	2			
3.3.35	Washing Tub	Argentina:	1			

LIST OF EQUPMENT SUPPLIED TO ARGENTINA

	ITEM No.	EQUIPMENT [MODEL]	MANUFACTURE	QUANTITY (set)		SPECIFICATION	User
	3.3.36	Tupperware					
		1)Tupperware(shallow type)	Argentina:	2			
		2)Tupperware(deep type)	Argentina:	1			
	3.3.37	Syringe					
		1)Syringe(100m liter)	Argentina:	2			
		2)Syringe(50m liter)	Argentina:	2			
	3.3.38	Safety Pipetter	SHIBATA	3			
	3.3.39	Glass Funnel	SHIBATA	5			
	3.3.40	Oxygen Cylinder(O2:100%)	Argentina:	1			
	3.3.41	Regulator for Oxygen Cylinder	Argentina:	1			
	3.3.42	Filter Paper					
		1)Filter Paper(5B: φ110mm)	Japan:	2			
		2)Filter Paper(5C: φ110mm)	Japan:	1			
	3.3.43	Powder Paper(500pcs.)	Japan:	1			
	3.3.44	Vcuume Grease(50g)	SHIBATA	50g× 3			
	3.3.45	Gas Cylinder Holder(2pcs. Use)	SHIMADZU	8			
20	3.4	JIS Precipitation Titration Apparatus				SOx:Flue Gas	
	3.4.1	Flask(300m liter, Triangular)	SHIBATA	300m liter × 24			
	3.4.2	N/100 Barium Acetate Solution	Japan:KANTO	500m liter × 1			
	3.4.2'	Barium Acetate	Japan:KANTO	500g× 1			
	3.4.3	Acetic Acid*(3.1.3)					
	3.4.4	2-Propanol	Argentina:	7.000m liter × 1	0.6		
	3.4.5	Hydrogen Peroxide	Argentina:MERK	1.000m liter × 1	0.5		
	3.4.6	Arsenazo Ⅲ	Argentina:MERK	5g× 1			
	〃	〃	Japan:DOTAITO	5g× 5			
	3.4.7	Filter Paper(5B: φ 90mm)	SHIBATA	3			
	3.4.8	Buret(10m liter)	SHIBATA	3			
	3.4.9	Stand for Buret	SHIBATA	3			
	3.4.10	Sulfuric Acid*(3.2'.1)		—			
		Sodium Carbonate		—			
		Bromophenol Blue		—			

LIST OF EQUPMENT SUPPLIED TO ARGENTINA

	ITEM No.	EQUIPMENT [MODEL]	MANUFACTURE	QUANTITY (set)		SPECIFICATION	User
	4.	Miscellaneous Supporting Equipment					
21	4.1	Analyzer Transportation Vehicle[Trafic TA1C]	Ar:Renault	1		Max Capacity:1,410kg	
22	4.2	Incubator(300 liter)[32/2.L32/2]	Ar:Peabody	3		Volume:300 liter	Cold storage of Sample/Reegent
23	4.3	Wind System[OSK-15038]	OTAKEIKI	1			Meteorological observations
	4.3-1	Recording Paper	OTAKEIKI	12			
	4.3-2	Recording Pen(Red, Green 5pcs.)	OTAKEIKI	1			
24	4.4	Personal Computer[AT 80486-33Dx]	Ar:(COMPU CENTER)	1			PC
	4.4-1	Mother Board	Ar:(QUANTUM)				
	4.4-2	Monitor[14"VGA]	Ar:(Samsung)	1			Colour Monitor
	4.4-3	Printer[Deskjet HP550C]	Ar:(Hewlette Packard)	1			Colour Printer
	4.4-4	Plotter[Hiplot 7200 Summgraphics]	Ar:(Houston Instrument)	1			Plotter
	4.4-5	Hard Disk Drive(240Mb)[240ATLPS QUANTUM]	Ar:(QUANTUM)	1			Software
	4.4-6	Software[MS-DOS v.6.0, Windows v.3 etc.]	Argentina:	1			Software
25	4.5	Orsat-Apparatus	Ar:Stouffer	1		O_2, CO_2, CO:Flue Gas	
	〃	〃	SHIBATA	2			
26	4.6	Tool Set	Argentina:	1			
27	4.7	Reel of Electric Cord	Argentina:	2			
	〃	〃 (100V Use)	SHIBATA	1			

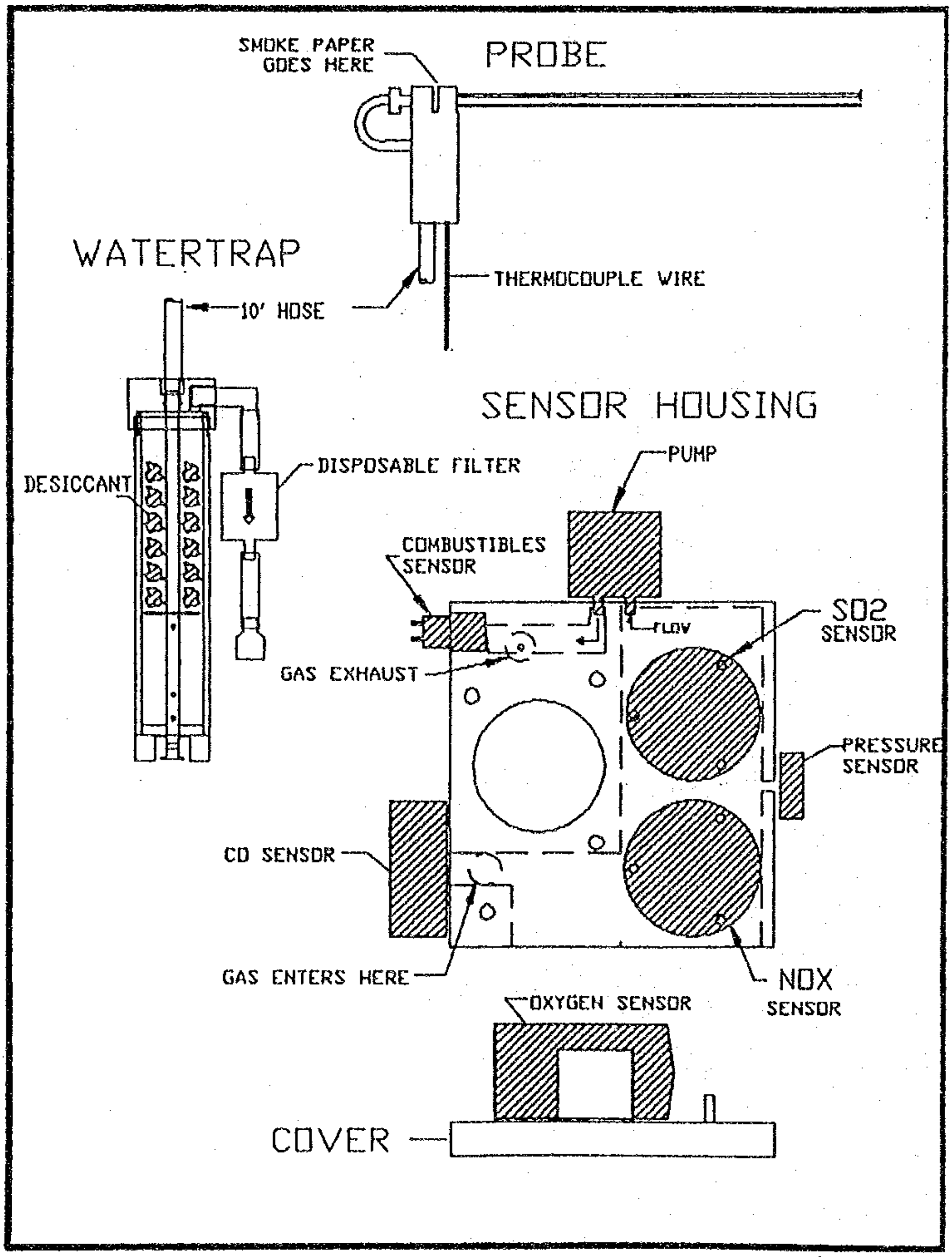
Attached Table 1 (1)　　SYSTEM OUTLINE OF PROVIDED EQUIPMENT

EQUIPMENT	1.1 Gas Analyzer [MSI-2000]

MEASUREMENT PRINCIPLE

O_2 : Electrochemical Method
NO : Electrochemical Method
SO_2 : Electrochemical Method

FLOW DIAGRAM



Attached Table 1 (2) SYSTEM OUTLINE OF PROVIDED EQUIPMENT

EQUIPMENT	1.2 NO_x and O_2 Analyzer for Combution Exhaust Gas [NOA-7000]

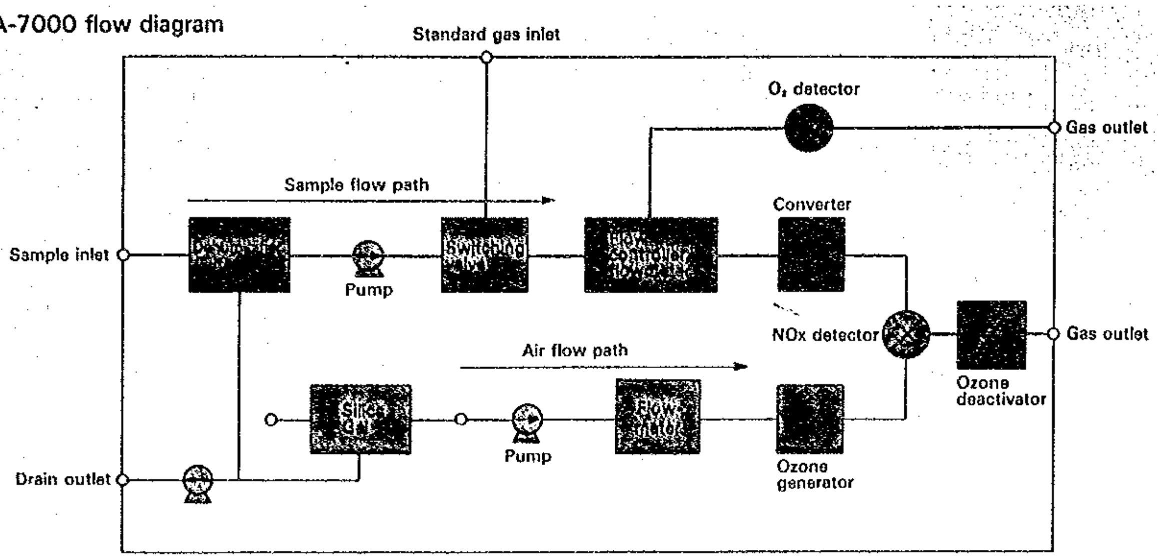
MEASUREMENT PRINCIPLE

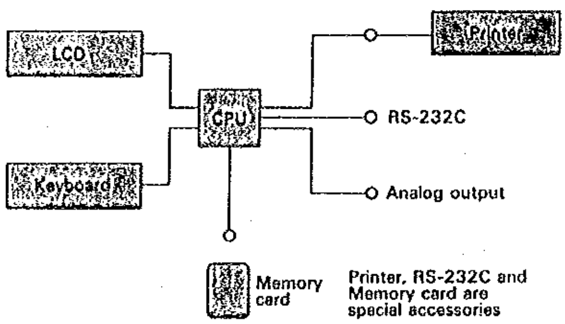
NO_x : Atomospheric Pressure Chemiluminescence
Ozone(O_3) which generated internally from atmospheric air is mixed in the reaction chamber with the NO in the sample. Part of the product becomes excited state NO_2. When the NO_2 returns to the ground state, it emits light. The light intensity is measured by a silicon photodiode at the opening of the NO_x detector and is expressed as the NO concentration.

O_2 : Zirconia Method
The concentration of O_2 in the sample gas is measured as the difference in the O_2 concentration at the electrodes. Electrodes are attached at each end of zirconia in high-temperature environment.

FLOW DIAGRAM

NOA-7000 flow diagram





Attached Table 1 (3) SYSTEM OUTLINE OF PROVIDED EQUIPMENT

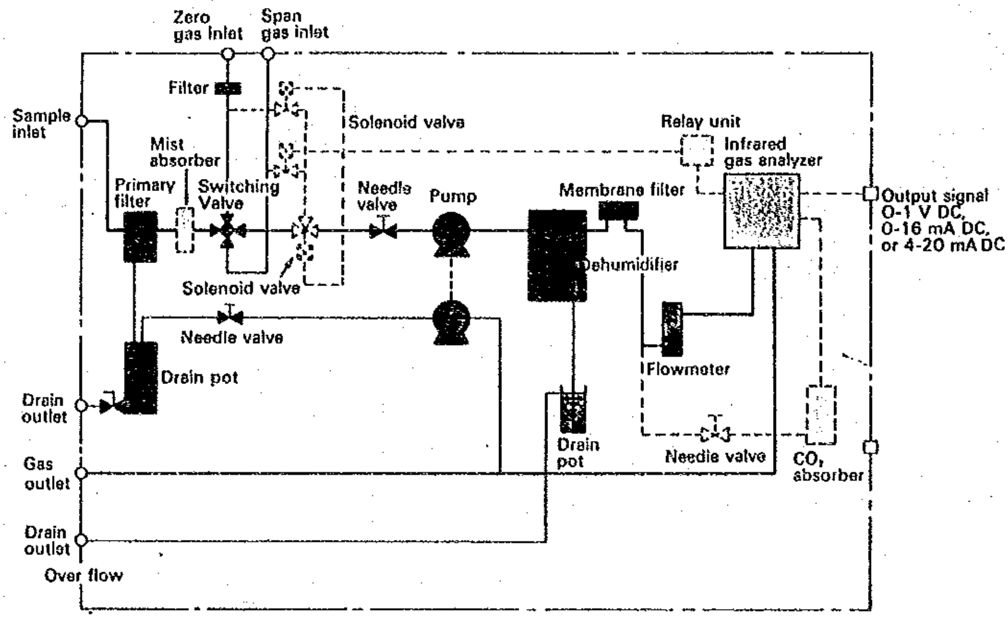
EQUIPMENT	1.3 Infrared Continuous Gas Analyzer [IRA-107]

MEASUREMENT PRINCIPLE

SO_2 : Non-Dispersive Infrared Absorption Method (Ratio Photometry Method)
The cocentration of SO_2 in a sample gas is continuously measured by utilizing the selective infrared absorption of the gas molecules.

FLOW DIAGRAM

IRA-107 flow diagram



The analyzer purge circuit (needle valve and CO_2 absorber) is used for analyzers with a CO_2 range that does not exceed 1,000 ppm.
Relay unit and solenold valves are used for Automatic Calibration (optional accessory).
Mist absorber is required when the sample contains SO_3 (special accessory).

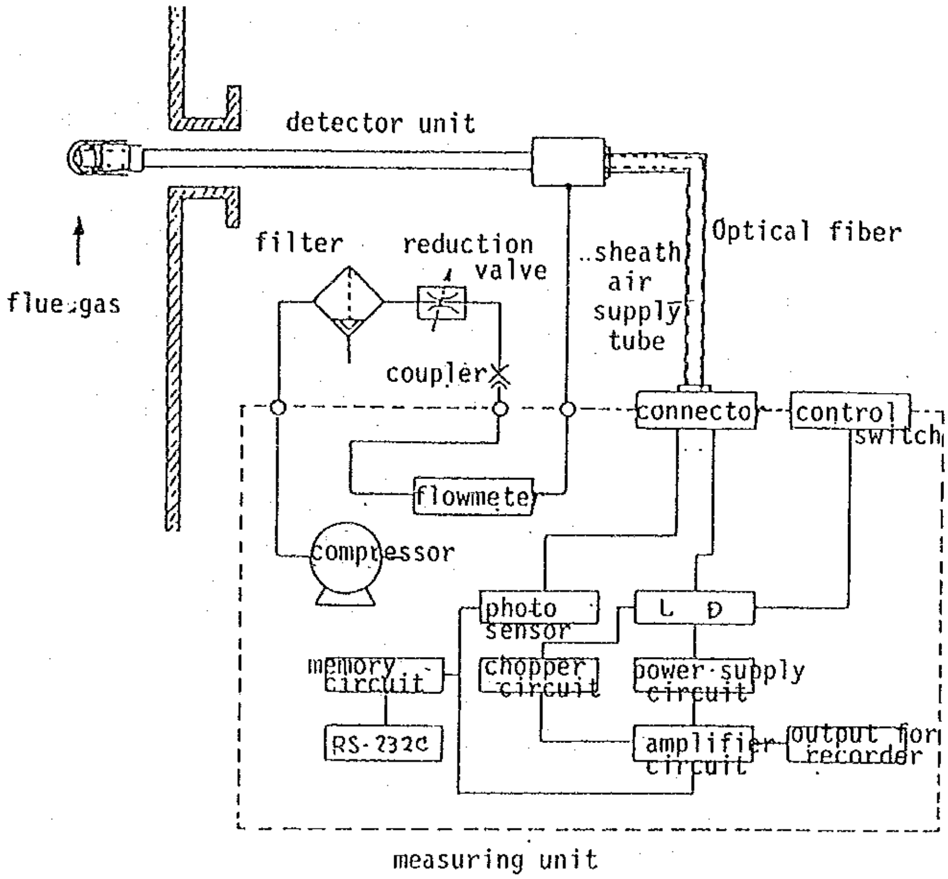
EQUIPMENT	1.4 Portable Dust Particle Monitor [AP-710N]

MEASUREMENT PRINCIPLE

Dust Particle: Light Scattering of Near Infrared Ray

Amount of the light scattered by dust particles of the same physical property illuminated from a light source is proportional to the mass concentration of dust particles.

FLOW DIAGRAM



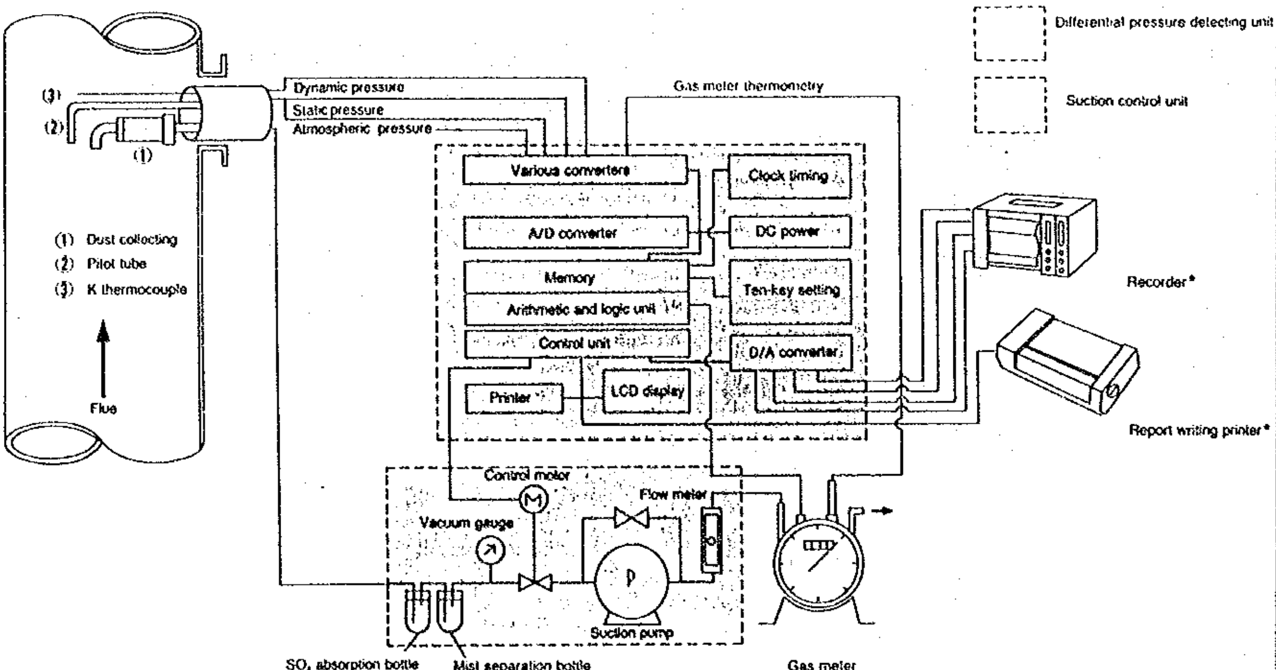
EQUIPMENT	1.5 Automatic Equal-Velocity Flue Gas Suction Device [DUSTAC SAMPLER:ESA-302CT-20N]

MEASUREMENT PRINCIPLE

Practical Equal-Velocity Suction Quantity of Flow:

This equipment detects both the variation in the velocity of flow within a flue by means of a pitot tube and the variation in the temperature of flue gas by means of a thermocouple, and then calculates the equal-velocity suction quantity of flow(qm1) from various conditions, such as coefficient of pitot tube, water content and the like, which are inputted beforehand by by means of the ten-key, and the results of the above detection, and further automatically controls the quantity of flow(qm2) measured by a pulse oscillation type gas meter so that (qm2) is equal to (qm1).

FLOW DIAGRAM



*Optional parts

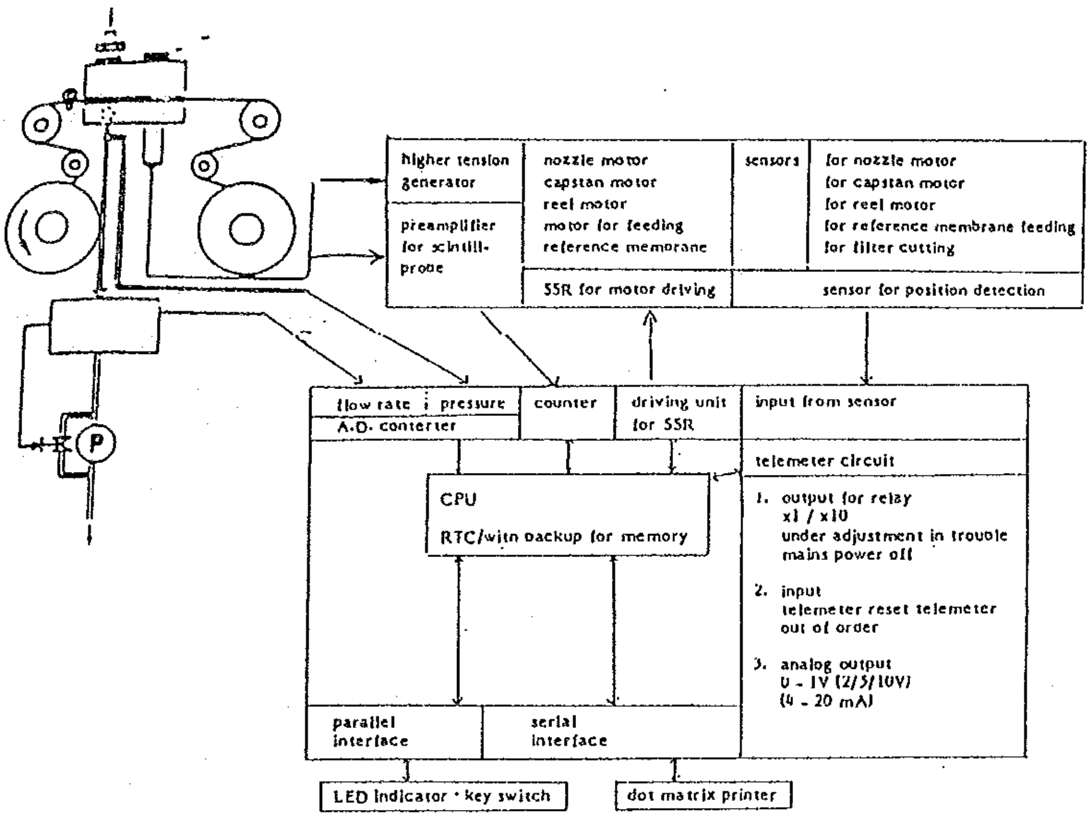
EQUIPMENT	2.1 β-Ray Attenuation Mass Monitor [BAM-102S]

MEASUREMENT PRINCIPLE

Dust : β-Ray Absorption Method

β-ray radioactive rays consisting of a stream of electrons are scattered and absorbed by the electrons in a substance when passing through it. If the energy of β-ray is assumed constant, the amount of absorption is proportional to the mass of the substance and not influenced by its size, composition and color. By means of the above principle, this equipment is an instrument designed to measure the weight of dust particles collected on a filter and indicates this weight in concentration per unit air volume expressed mg/m^3.

FLOW DIAGRAM



Attached Table 1 (7)　　SYSTEM OUTLINE OF PROVIDED EQUIPMENT

EQUIPMENT	2.2 High Volume Air Sampler [HVC-1000N]

SPECIFICATION

Suction pump : Double blower directly connected to commutator motor

This instrument is a air sampler, that can colllect Suspended Particulate Matter (SPM) in ambient air by filter paper.

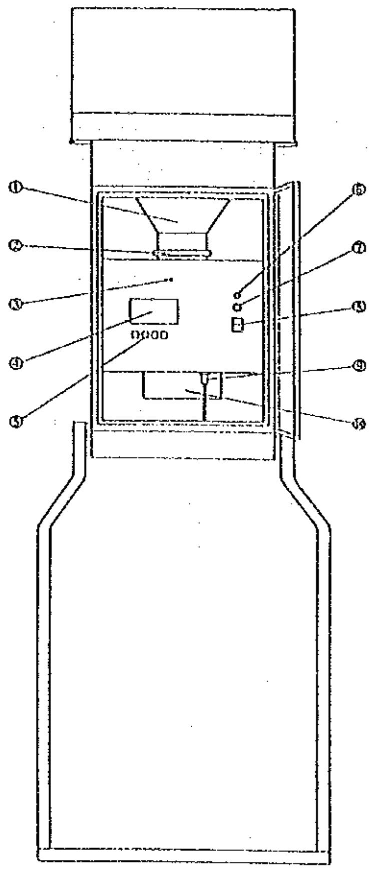
The concentration of SPM in ambient air is calculated from the weigt of filter paper.

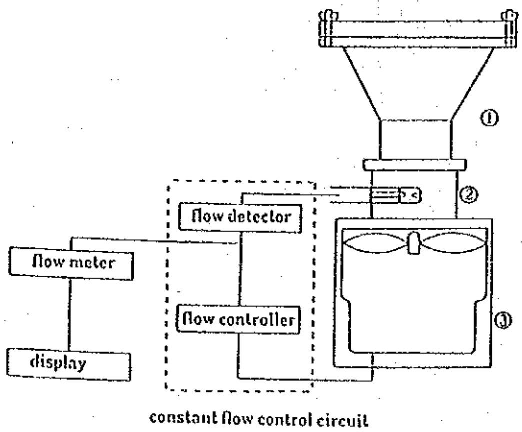
This instrument ensures stable amount of sucked air due to adopted automatic constant flow system minimizing loss in sucked air flow by increase in pressure drop caused by SPM settled on filter.

This instrument has functions "instantaneous flow rate indication", "integrated flow rate indication", "automatic sampling", "power failure measure".

A particle separator (10μm or more and less than that) can be attached.

FLOW DIAGRAM





Block diagram of constant flow device

① filter paper
② detector
③ motor of pump

Name of components

① filter holder
② adapter for assembly
③ potentiometer
④ display
⑤ control switches
⑥ potentiometer
⑦ fuse holder
⑧ main switch
⑨ plug for power supply
⑩ pump unit

Attached Table 1 (8)　　　SYSTEM OUTLINE OF PROVIDED EQUIPMENT

EQUIPMENT	2.3 Stand Sampler [S-601]

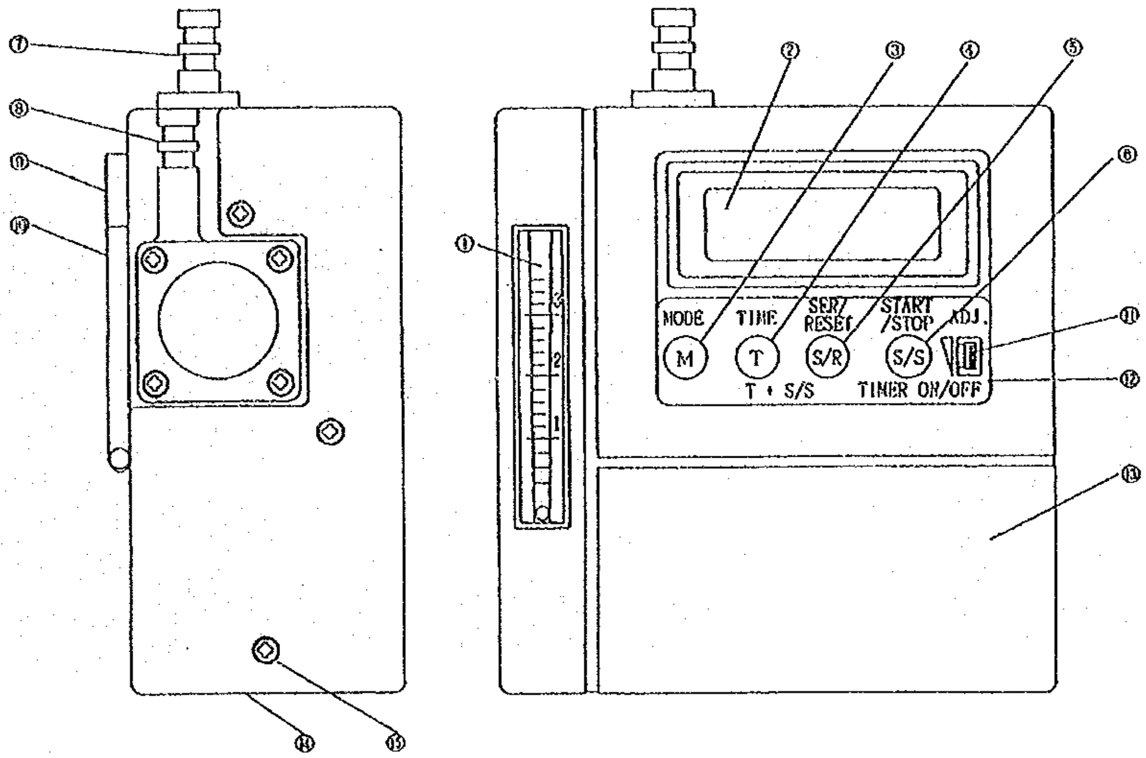
SPECIFICATION

Suction pump : Double Diaphragm System

This is a sampler for liquid collection of harmful particulate or gaseous substances.

Sampling for arbitrary time with a built-in timer is possible.

FLOW DIAGRAM



① Flowmeter
② LED
③ Mode switch
④ Time set switch
⑤ Time set, action time reset switch
⑥ Start/Stop switch
⑦ Vent port
⑧ Suction port
⑨ Fixed position of inpinger
⑩ Belt hook
⑪ ADJ. trimmer
⑫ Sliding cover
⑬ Battery case
⑭ Fitting screw
⑮ Fixing screw

Attached Table 1 (9) SYSTEM OUTLINE OF PROVIDED EQUIPMENT

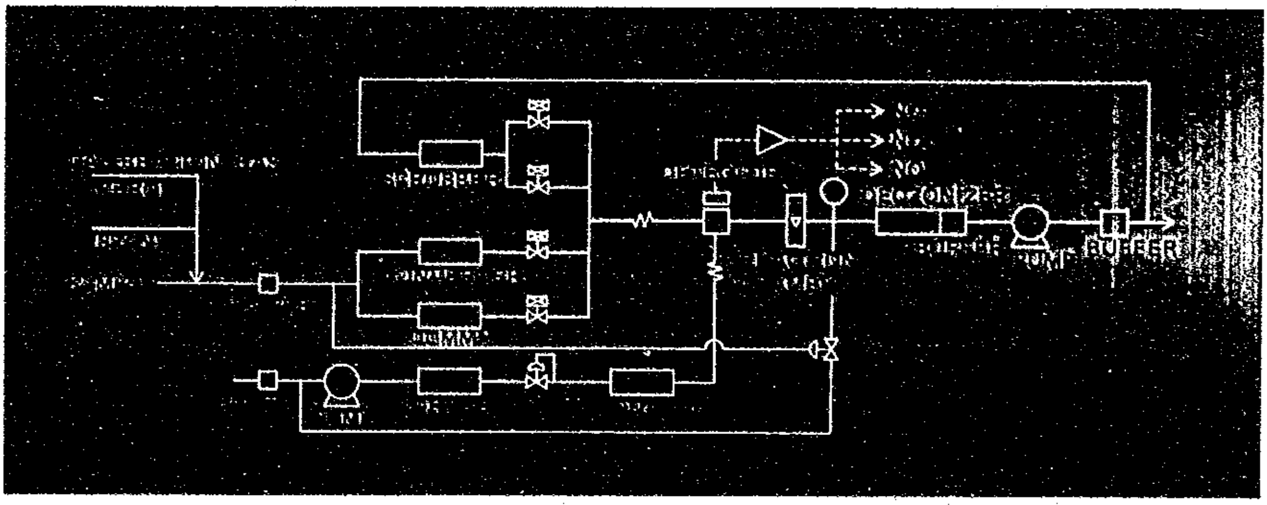
EQUIPMENT	2.6 Ambient NO_x Monitor [APNA-350E]

MEASUREMENT PRINCIPLE

NO_x : Chemiluminescence (CLD)

Inside the reaction chamber, NO reacts with ozone(O_3) to from NO_2. A portion of the NO_2 is excited to a higher electron state, and detectable chemiluminescence is emitted as these molecules return to the ground state. This chemiluminescence is measured through an optical filter by a sensitive solid detector. The output of the solid detector is linearly proportional to the NO_x concentration when line-1 flow is measured, and the NO concentration when line-2 flow is measuerd. The NO_2 concentration is determined by an electronic subtraction circuit which subtracts the NO signal from the NO_x signal.

FLOW DIAGRAM



Attached Table 1 (10)   SYSTEM OUTLINE OF PROVIDED EQUIPMENT

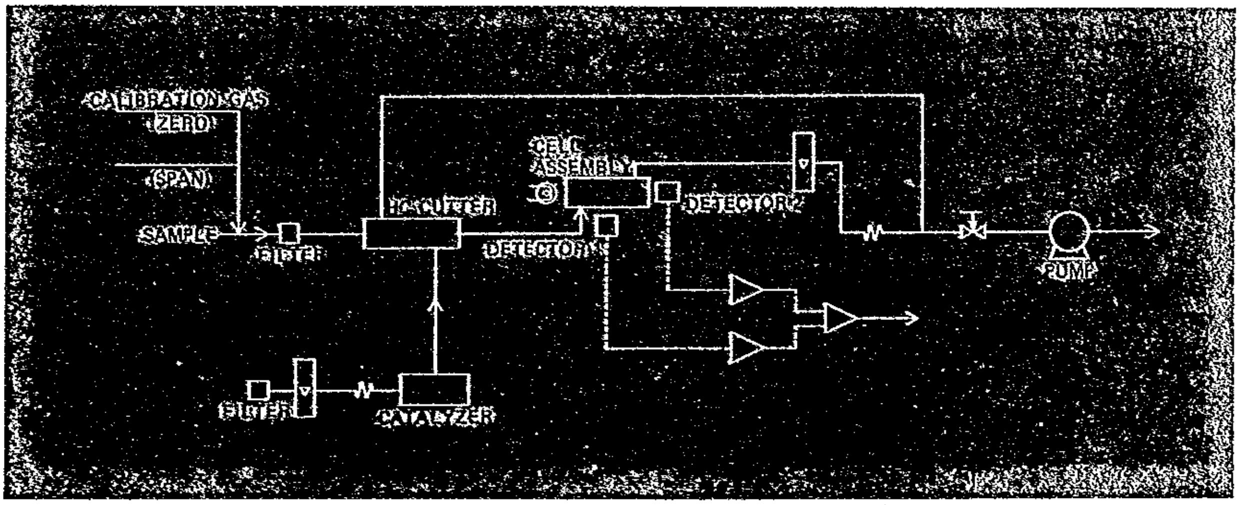
EQUIPMENT	2.7 Ambient SO_2 Monitor [APSA-350E]

MEASUREMENT PRINCIPLE

SO_2 : Ultraviolet Fluorescence (UVF)

SO_2 in the sample gas is monitored by the fluorescent analyzer, which exploits the ability of this gas to emit light of a specific wavelength when subjected to UV irradiation.

FLOW DIAGRAM



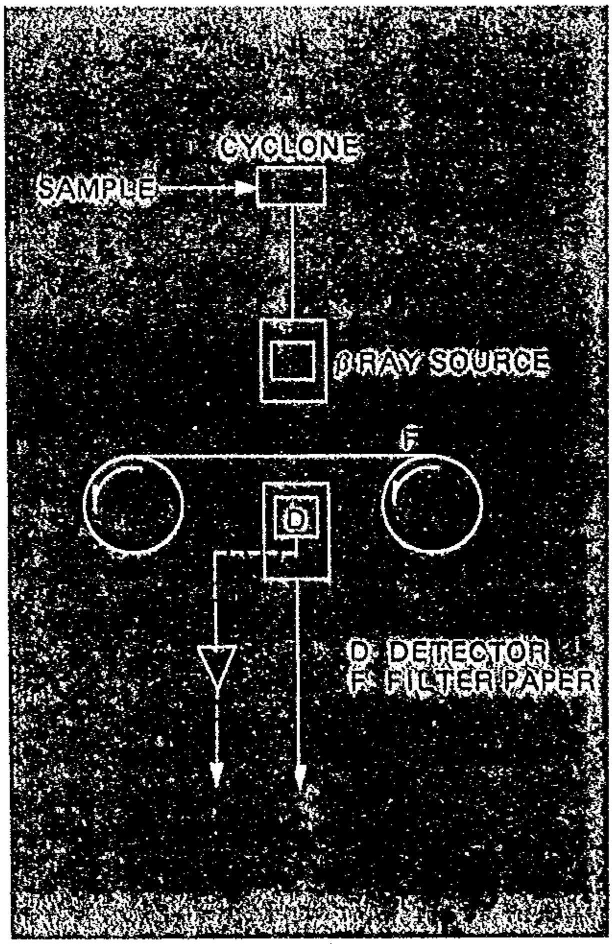
EQUIPMENT	2.8 Ambient SPM Monitor [APDA-350E]

MEASUREMENT PRINCIPLE

Dust : β-Ray Absorption

Absorption of β-Ray passing through matter depends on upon the mass of the matter.
The sample tape background is measured for each measurement cycle.
A constant volume of ambient air is collected during the measurement cycle and the particulates suspended in the collected air are at a spot on the sample tape.
The intensity of β-ray after they have passed through the particulates on the sample tape is measured by a plastic scintillator.
These data are processed by an integral microprocessor to give the concentration of particulates in the ambient air.

FLOW DIAGRAM



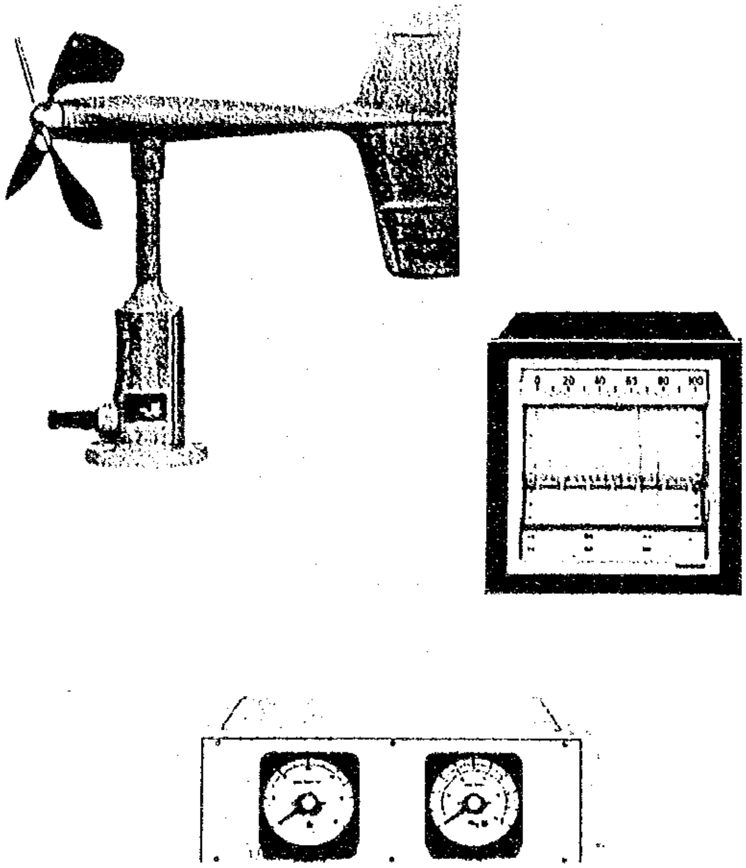
Attached Table 1 (12)   SYSTEM OUTLINE OF PROVIDED EQUIPMENT

EQUIPMENT	4.3 Wind System [OSK-15038E]

MEASUREMENT PRINCIPLE

Wind direction sensor : Tail synchronized control
Wind speed transmitter : DC generator

FLOW DIAGRAM



OSK 15038

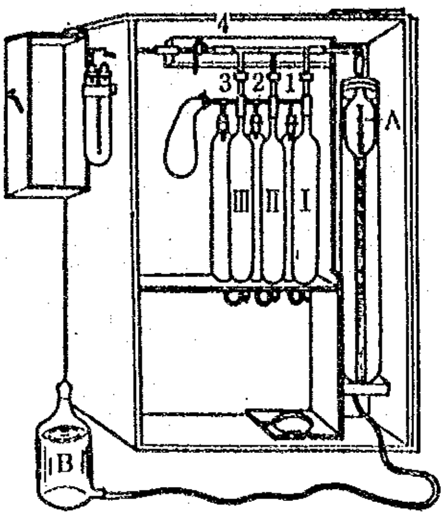
EQUIPMENT	4.5 Orsat-Apparatus

MEASUREMENT PRINCIPLE

CO, CO_2, O_2: Absorption Method

CO, CO_2 and O_2 gases of flue gas are absorbed into the absorption reagents in three pipets and determined from the absorption quantity using the gas buret.
CO absorption reagent is ammoniac Copper (I) Chloride Solution.
CO_2 absorption reagent is Potassium Hydroxide Solution.
O_2 absorption reagent is alkaline Pyrogallol Solution.

FLOW DIAGRAM



Orsat-apparatus

APPENDIX 2 Standard Analysis Procedure for the Related Pollutants

Appendix 2 Standard Analysis Procedure for the Related Pollutants

Following documents were handed over to SE.

(1) Standard Analysis Procedure for the Related Pollutants

<u>JIS</u>

1) JIS K0103 : Methods for Determination of Sulfur Oxides in Flue Gas
2) JIS K0104 : Methods for Determination of Oxides of Nitrogen in Flue Gases
3) JIS Z8802 : Methods of Measuring Dust Concentration in Flue Gas

<u>EPA</u>

4) EPA Subchapter C Part 50 Appendix A
   : Reference Method for the Determination of Sulfer Dioxide in the Atmosphere (Pararosaniline Method)
5) EPA Subchapter C Part 50 Appendix B
   : Reference Method for the Determination of Suspended Particulate Matter in The Atmosphere (High-Volume Method)

(2) Related Analytical Procedure of JIS, EPA and WHO

<u>JIS</u>

1) JIS K0050 : General Rules for Chemical Analysis
2) JIS K0095 : Methods for Sampling of Flue Gas
3) JIS K0115 : General Rules for Molecular Absorptiometric Analysis
4) JIS K0301 : Methods for Determination of Oxygen in Flue Gas
5) JIS K0004 : Sulfur Dioxide (Standard Reference Gas)
6) JIS B7952 : Continuous Analyzers for Sulfur Dioxide in Ambient Air
7) JIS B7981 : Continuous Analyzers for Sulfur Dioxide in Flue Gas

8) JIS K0001 : Nitrogen Monoxide (Standard Reference Gas)
9) JIS B7953 : Continuous Analyzers for Oxides of Nitrogen in Ambient Air
10) JIS B7982 : Continuous Analyzers for Oxides of Nitrogen in Flue Gas
11) JIS K0901 : Form, size and performance testing methods of Filtration Media for Collecting Airborne Particulate Matters
12) JIS Z8814 : Low Volume Air Samplers and Methods for Measuring Mass Concentration of Airborne Dust by the Low Volume Air Samplers
13) JIS B7954 : Automatic Monitors for Suspended Particulate Matter in Ambient Air

EPA

15) EPA Subchapter C Part 53 Subpart B
: Procedures for Testing Performance Characteristics of Automated Methods SO_2, CO, O_3 and NO_2
16) EPA Subchapter C Part 50 Appendix F
: Measurement Principle and Calibration Procedure for the Measurement of Nitrogen Dioxide in the Atmosphere (Gas Phase Chemilumineseence)

WHO

17) WHO Chapter 2 : Sulfure Dioxide
18) WHO Chapter 4 : Nitric Oxide and Nitrogen Dioxide
19) WHO Chapter 1 : Suspended Particulate Matter

(3) Instruction Manual of the Analytical Instruments Provided to the Government of Argentina

1) NOx-O_2 Gas Analyzer : NOA-7000
2) Infrared Continuous Gas Analyzer : MODEL IRA-107
3) Infrared Gas Analyzer : MODEL URA-107
4) Portable Dust Particle Monitor : MODEL AP-710N
5) Dust Sampler : MODEL ESA-302CT-20N
6) β-Ray Attenuation Mass Monitor : MODEL BAM-102S
7) High Volume Dust Sampler : MODEL HVC-1000N

8) Stand Sampler : MODEL S-601

9) Ambient NOx Monitor : MODEL APNA-350E

10) Ambient SO_2 Monitor : MODEL APSA-350E

11) Ambient Particulate Monitor : MODEL APDA-350E

12) Wind System : MODEL OSK-15038

APPENDIX 3 Supplementary Instruction Manual for Analysis and Measurement of Pollutants from Flue Gas and in the Ambient Air

Appendix 3 Supplementary Instruction Manual for Analysis and Measurement of Pollutants from Flue Gas and in the Ambient Air

Page

I. SULFUR DIOXIDE

1. **Coverage:** A standard material should not be limited in application to particular measuring instruments, but should be considered for a wide range of applications. This standard gas, therefore, is one that can be used as a standard for the graduation and calibration of measuring equipment, a starting material for the preparation of gas for calibration, and a standard for general chemical analyses.

2. **Definition of Term:** Each is clearly defined in accordance with the concept that a standard material conforms to national standards.

(1) **Sulfur Dioxide Standard Gas:** It is made clear that the sulfur dioxide standard gas prescribed in this specification conforms to national standards based on Certified Reference Material defined in ISO or OIML and is confirmed about its quality by a public organization for examination.

(6) **Sulfur Dioxide Reference Standard Gas of Primary Standards:** The sulfur dioxide reference standard gas of primary standards is prepared by mixing high purity gases of secondary standards by a public organization for examination. It is named the reference standard gas of the primary standards, because its function for mixed gas is similar to that of The Primary Standard for Weights.

3. **Concentration (Code) and Grade:** Twenty different concentrations are selected by taking into account the calibrations specified in JIS K 0055 (Common Rules for Calibration Method of Gas Analyzers), the range of measurement of currently available measuring instruments, and the concentration zone deemed necessary for measurements unrelated to environmental pollution.

Codes numbered greater than SD-P60 have the permissible concentration range of 90-100% of the upper limit, and those smaller than SD-P60 have the range of 80-100% of the limit. SD-P2000, for example, may take values between 1,800 ppm and 2,000 ppm.

The three grades, high purity grade, general first grade, and general second grade, are selected, following the concept of grade in the class of the mass standards. It was duly considered that the gas would be used in a large amount for daily analytical work and the grades would not need to be defined very strictly.

The major applications of each of the grades are shown in the following Explanatory Table:

Explanatory Table Major Applications of Each Grade

Grade	Application
High Purity Standard Gas	Measurements for regulations by local governments Measurements by firms issuing environmental certificates Calibration of densitometers by firms of public nature for clearance with authorities Graduation and calibration of densitometers by manufacturers of instruments Measurements requiring high levels of confidence
General Standard Gas, First Grade	Starting material for preparation of gas for calibration Measuring concentration of gas formed by generators of gas for calibration
General Standard Gas, Second Grade	General applications other than the above

5. **Container for High Pressure Gas and Valve:** The Regulation of High Pressure Gas applies to the standard gas. Containers and valves used must meet the regulation. The containers are usually not made specifically for the standard gas. Treatments of the containers such as grinding the inner surface are necessary for maintaining the gas concentration stably for a long period of time. The regulation does not prescribe the treatments. The aforementioned studies commissioned by Standards Department of Agency of Industrial Sciences and Technology and those (1978-1980) commissioned by Weights and Measurements Division of Ministry of International Trade and Industry have shown that the standard gas of low concentration can be kept relatively stable in the containers that are super-ground, gold-plated, and gas-

treated on the inner surface.

The regulation of high pressure gas was partly revised in 1980 to permit aluminum alloy containers for high pressure gases as manganese steel containers had been. Stainless steel valves of containers for high pressure gases have little effects on the concentration of the standard gas, but they are legally required to be certified prior to use.

6. Preparation and Filling: The preparation procedure of the standard gas is not specified in the standards. They may be prepared the methods of pressure ratio or flow rate ratio. The most important properties of the standard gas are strictly maintained concentration and stability. As prescribed in 8.1(2) Expressed Values of Concentration, concentrations are determined against the reference standard gas. Therefore, its homogeneity in a container is more important than the preparation method. A homogeneous mixture is obtained by:

1. leaving a filled container laid at room temperature for 24-48 hours.
2. keeping a filled container slanted and warming the bottom to about 40°C.
3. laying and rotating a filled container.

7. Quality

7.3 Filled Pressure: It should be within ±10% of a specified pressure. The allowance takes into consideration gas quantity used for tests.

7.5 Effective Period: There are problems in maintaining the standard gas at a constant concentration for long, although it would be ideal to do so. The standard adopts an effective period based on the result of the studies commissioned by Standards Department of Agency of Industrial Sciences and Technology.

Note : The standard instructs against using the standard gas when residual pressure decreases below 15 kgf/cm^2, because the effects of the gas used for the container treatment may manifest when residual pressure is low.

There are opinions favoring a lower pressure as the cutoff point, but no data is available for judgment. 15kgf/cm2 is adopted from past experience.

8. Test Method

8.1(1) Analyzer: Four kinds of analyzers are chosen, which are widely used, quick in response, and good in reproducibility.

8.1(2) Expressed Value of Concentration: The expressed values of concentration are based on the reference standard gas of secondary standards, which is maintained in accordance with JIS K 0055 (Common Rule for Calibration Method of Gas Analyzer) by public organizations for examination, who adopt an analyzer chosen in 8.1 to conform to national standards.

The significant number of the values is three. That for values not greater than 1 ppm is two, considering the accuracy of analyzers and the change of gas over time.

8.2 Note on Test Method of Gas Leakage (3): Foaming solution should be wiped off well, because, if it is left, it might alter the concentration of sample gas.

8.3 Test Method for Filled Pressure: The regulation of high pressure gas adopts the following definition: a gas with pressure not lower than 10 kgf/cm^2 under ordinary temperature is a compressed gas; a compressed gas with pressure not lower than 10 kgf/cm^2 regardless of temperature or a compressed gas with pressure not less than 10 kgf/cm^2 at 35°C is a high pressure gas. Accordingly, values of filled pressure at 35°C should be shown.

9. Test: For the purpose of improving confidence level in the users of chemical standard materials, JIS K 0501 (Common Rule of Chemical Standard Material) requires the name of a third party, operating under the administrative guidance of the national government, who issues certificates for the determined values of concentration.

As mentioned previously, the definition of Certified Reference Material by ISO also states that certificates or other documents issued by a certifying organization should be attached. This standard adopts a provision for test as part of certification. The standard gas is one that passes the test.

9.(1) Deviation of Concentration: A high purity gas should be measured by two analyzers of different principles. Resulting two values must be within ±1.0% of each other.

10. Handling Care: The regulation of high pressure gas applies to the standard gas. On the other hand, it needs to be handled carefully as a standard material.

(1) **Storage Method:** It is desirable to store it in a place where temperature fluctuates little.

Because it is a highly reactive, poisonous gas, careful attention should be paid to leakage after use and ventilation in the storage place. Storage of more than 300 m^3 legally requires a separate storage facility, which satisfies technical standards, and a permit from the prefectural governor.

(2) **Gas Sampling:** The following cautions in addition to those described in the text should be practiced:

1. Provide one pressure regulator specifically for one kind of the standard gas. Clean the installation port when installing it.
2. Substitute gas thoroughly in the pressure-reducing device of the pressure regulator.
3. Make piping as short as possible.
4. Watch residual pressure carefully.

(3) **Handling of Container:** A gas container for 10 liters weighs 15-18 kg; one for 40 or 47 liters weighs 60-70 kg. Appropriate safety measures such as safety shoes need to be provided for handling gas containers.

II. METHODS OF MEASURING DUST CONCENTRATION IN FLUE GAS

4. Measurement Positions, Sampling Nozzle and Measurement Points

4.1 Measurement Positions: Measurement positions should not be mounted in the bent of the duct or other sections where the cross sectional profiles change abruptly. Such sections may involve flow disturbance or even reverse flow that will prevent the accurate measurement of gas flow speed or proper sampling of dust.

Measurement shall be conducted in areas where measurement is safe and easy. Scaffolds or work platform should be provided when the measurement personnel are to work on ducts installed at high elevation.

In many occasions, measurement points that meet the conditions described in section 4.1 in the main body of this standard are not readily available for measurement. In such cases, the following guidelines shall be observed to install the measurement points.

(1) Choose a straight and long duct as much as possible, and also choose a vertical, straight duct rather than horizontal, straight duct as much as possible.

(2) Avoid cross sections close to a bent or to an orifice that chokes the duct abruptly. The measurement points should be as distant as possible from such sections with abrupt changes in the cross sections while being at a distance no less than 1.5 times the duct diameter or no less than 1.5 times the longer side of the rectangular duct from such sections.

The standard issued in 1964 included the statement that the measurement cross sections should be where the flow speed is no less than 5 m/sec. In actual measurement, however, the flow speed was in some occasions less than 5 m/sec at which accurate flow speed measurement was difficult with a Pitot tube. Since a gas flow speed meter, which will be described later, enables accurate flow speed measurement, this statement is eliminated from the latest revision of this standard.

4.2 Measurement Holes: The size, shape and the position of the measurement hole are important factors for measurement. The previous version stated that the inner diameter of the measurement hole should be approximately 100 mm. Too small a measurement hole will make difficult the installation of various measuring devices through this hole. On the other hand, too large a measurement hole will allow external air to enter the duct or flue gas to escape through the hole after installing the measuring devices. Considering measurement on large-scale ducts in addition to the above, the inner diameter of the measurement hole is revised to approximately 100 to 150 mm.

The latest revision of this standard requires that the clearances between the wall of the measurement hole and the measuring devices installed through the measurement hole shall be stuffed with material such as heat insulator to prevent leakage. The measurement hole shall be opened when measuring and shall be covered when not measuring. The measurement hole cover may be bolted to the hole or may have threads and be capped securely. If the flue gas contains corrosive substances, bolted cover should be preferable.

4.3 Measurement Points: After selecting the section of the duct subjected to measurement, the interior surfaces of the duct shall be checked for caked dust. The dust shall be checked if it is caked on the duct surfaces firmly. The geometrical shape of the duct way through which exhaust flue gas runs shall be obtained. Unless otherwise specified, the duct cross section shall be divided into a suitable number of equal sections based on the shape and size of the duct in accordance with the main body of this standard. Measurement points shall be established in each equally divided section.

The concept in determining the measurement points is that the mean flow speed and mean dust concentration should be measured with a minimum number of measurement points and with a minimum measurement error.

The 1963 version of this standard required that the number of the measurement points should depend on the duct cross sectional area. The revision in 1977 defined the maximum number of measurement points as twenty (20). According to this revision, a circular duct the diameter of which exceeds 4.5 m shall have 20 measurement points regardless of the diameter. The circular cross section shall be divided into equal small sections while the number of the measurement points remains 20.

The number of measurement points for a rectangular or a square duct, the cross sectional area of which is 20 m^2 or larger, have 20 measurement points. Unless otherwise specified, the cross section shall be divided into 20 equal sections regardless of the length of one side of the divided section being equal to 1 m or less. The maximum number of the measurement points for ducts having other cross sectional shapes shall also be 20 following the specification above.

The reason for limiting the maximum number of measurement points to 20 is as follows. If the number of measurement points exceeds 20, measurement of exhaust flue gas could take extremely long time. Changes in the exhaust gas condition during this long measurement period could directly affect the measurement results. In addition, past experience proved that the mean flow speed and the mean dust concentration obtained from several dozens of measurement points differ little from those mean values obtained from measurement points limited to 20. Thus, there is no need to increase the number of measurement point above 20, unless extraordinary channelling or drift is involved. The number of measurement points may be more than 20 if the dust collector performance should be measured precisely or the effect of channelling or drift cannot be ignored.

Depending on the type and concentration of the dust, condition of gas flow and the size of the duct, mean gas flow speed and mean dust concentration can be obtained even if the specifications above are not followed in establishing the measurement points. If it is the case, the number of measurement points may be reduced. This can be applied to a situation where the duct is straight, the dust concentration is low and the distribution of gas flow speed is symmetrical about the duct center.

Considering these, the remarks of this standard specify the following.

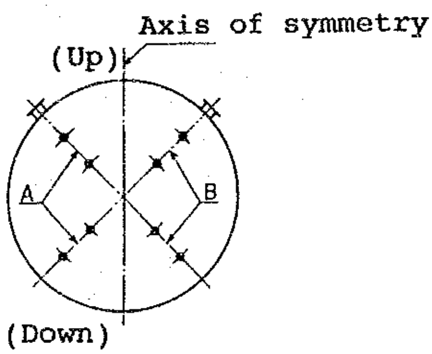
(1) For small size ducts having cross sectional area of no greater than 0.25 m^2, the center of the cross section can be the representative point and can be used as the measurement point. This is applicable to square ducts having the side length no greater than 0.5 m and circular ducts the diameter of which does not exceed 0.56 m, for example. For these small size ducts, past experiences have verified that the measurement values obtained from the center of the duct differ little from the mean value obtained from four measurement points that are established in accordance with this specification. However, data shall be obtained from four measurement points established in accordance with this standard if it is obvious that the data obtained from the center of the duct differs significantly from the mean value obtained from the four measurement points.

(2) If the flow speed distribution measured in accordance with section 7.3 in the main body of this standard is considered reasonably symmetrical, the number of measurement points for the horizontal duct may be reduced to 1/2 by taking either half of the vertical axis of symmetry. The number of measurement points for the vertical duct may be reduced to 1/4 by taking one-fourth of the cross sectional area. The expression "reasonably symmetrical" in this regard means that the differences in gas flow speed values between the comparable points with respect to the axis of symmetry are within approximately 10%.

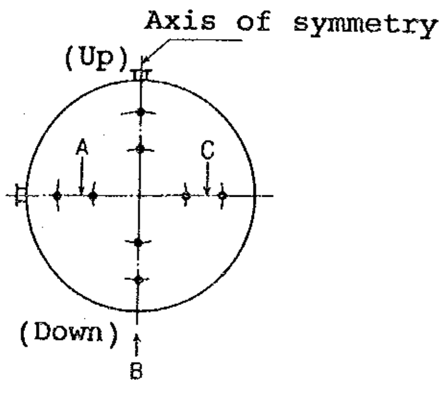
(a) Horizontal ducts:

Either half of the cross section with respect to the vertical axis of symmetry will be taken. Generally, the dust concentration is higher in the lower half of the duct. If the measurement points are established on either of the two perpendicular diameter lines that run 45°C to the horizontal axis, the measurement points are on either line A or line B as shown in Explanatory Figure 3. Thus, the number of the measurement points will be reduced to 1/2. If the measurement points should be on the axis of symmetry, the number of the measurement points will be reduced to 3/4. For rectangular or square ducts, if the number of equally divided sections in the vertical direction is even as shown in Explanatory Figure 4, the measurement points will be reduced to 1/2 and will be established in either side of the axis of symmetry. If the number of the equally divided sections in the vertical direction is odd on the other hand, some measurement points should be established on the axis of symmetry. In this case, the number of the measurement points cannot be reduced to 1/2, but more.

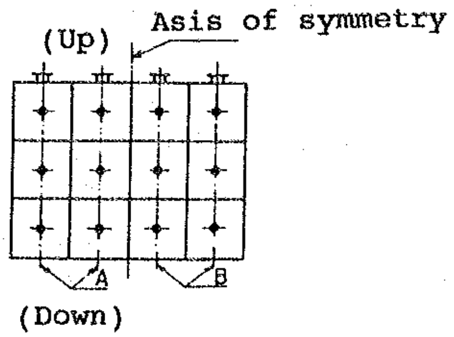
Measuring points are on either line A or line B.



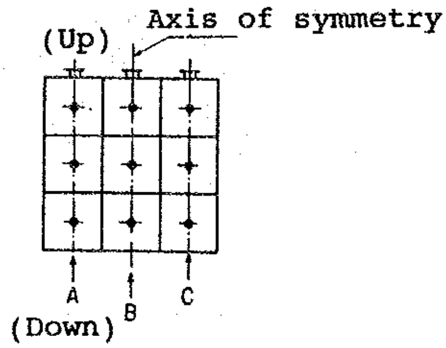
Measuring points are on (either line A or line B) or, (either line C or line B).



Expranatory Figure 3 Example of Circular Sectional Horizontal Duct



(1) In the case the number of equally devided sections are even:
Measuring points are on either line A or line B.

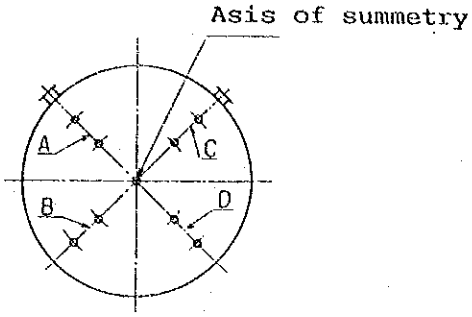


(2) In the case the number of equally devided sections are odd:
Measuring points are on
Measuring points are on
(either line A or line B) or, (either line C or line B).

Expranatory Figure 4 Example of Rectangular or Square Square Sectional Horizontal Duct

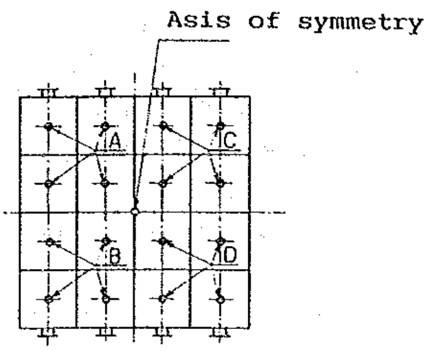
(b) Vertical ducts:

For circular ducts, if the axis of symmetry coincides with the center line of the duct as shown in Explanatory Figure 5, the measurement points will be established on the half length (or radius) of either of the two diameters perpendicular to each other. This reduces the number of the measurement points to 1/4. For rectangular or square ducts, the duct center line may be used as the axis of symmetry as shown in Explanatory Figure 6. If the number of equally divided sections is even, the number of the measurement points will be reduced to 1/4. If the number of equally divided sections on either side of the rectangular is odd on the other hand, the number of the measurement points will be more than that.

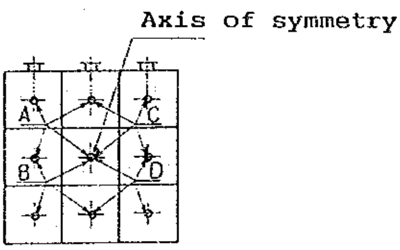


Measuring points are on one of the line A, B, C or D.

Expranatory Figure 5 Example of Circular Sectional Vertical Duct



(1) In the case the number of equally devided sections are even:
Measuring points are on one of A, B, C or D.



(2) In the case the number of equally devided sections are odd:
Measuring points are on one of A, B, C or D.

Expranatory Figure 6 Example for Rectangular or Square Sectional Vertical Duct

(3) If the concentration distribution has been obtained in accordance with this standard and the mean dust concentration has been obtained from one or more measurement points, such measurement points may be used as the representative points for the subsequent measurement.

The representative points should be the points where the measured dust concentrations at these points are the same as the mean dust concentration. These representative points may be used again as the representative points for the following measurement opportunity only if the exhaust flue gas speed, dust concentration and other values differ little from those values measured when the last representative points were established. As a guideline, "Differing little" in the above statement means that the differences in the comparable measurement values are within 10%, the condition of dust caked on the interior surfaces of the duct has not changed significantly and the operating conditions (type and quantity of fuels, type and quantity of material, etc.) of the source of the exhaust flue gas have not changed significantly.

5. **Measurement of Exhaust Flue Gas Temperature:** Exhaust flue gas temperature is necessary to calculate exhaust flue gas density which is in turn used to obtain the exhaust flue gas speed by means of a Pitot tube as well as to calculate the exhaust flue gas flow rate and equal speed aspiration flow rate. The flue gas temperature should be measured in the beginning to select the instruments and devices used for measurement of other particulars.

5.1 **Measurement Points:** Measurement points shall be established in accordance with section 4.3 in the main body of this standard. The number of measurement points may be reduced if the temperature distribution is known to be relatively flat. "Relatively flat" in the above statement means, as a guideline, that adjacent values of the last measurement differ within ±5%.

However, the temperature should be measured at all points as the measurement of the exhaust flue gas itself is simple.

5.2 **Measuring Instruments:** Among various types of thermometers available, liquid-in-glass thermometers and electrical thermometers are used often. Of the liquid-in-glass thermometers, mercury thermometers with sealed inactive gas are used frequently.

Some of them are capable of measuring up to 500°C (the boiling point of mercury is 357°C). Electrical thermometers are classified into two types; thermocouple thermometers and resistance thermometers.

Specific thermocouple thermometers will be selected considering the exhaust flue gas temperature while referring to the specifications defined in JIS C 1602 "Thermocouples". Chromel-alumel (K) thermometers are useful as exhaust flue gas temperatures are generally below 1,000°C. See Explanatory Table 1.

Resistance thermometers use resistances such as platinum line and thermistor. Changes in temperature is measured as the changes in resistance in these materials (temperature factors). Platinum resistance thermometers, nickel resistance thermometers and thermistor thermometers can measure from -180 to 500°C, -50 to 150°C and -100 to 350°C, respectively.

These electrical thermometers should be calibrated before use.

Explanatory Table 1 Use Limit of Thermocouples

Symbol Component Material	Former Symbol (Reference)	Wire Diameter mm	Normal Limit °C *1)	Super Heating Limit °C *2)
B	-	0.50	1 500	1 700
R	-	0.50	1 400	1 600
S				
K	CA	0.65	650	850
		1.00	750	950
		1.60	850	1 050
		2.30	900	1 100
		3.20	1 000	1 200
E	CRC	0.65	450	500
		1.00	750	950
		1.60	850	1 050
		2.30	900	1 100
		3.20	1 000	1 200
J	IC	0.65	400	500
		1.00	450	550
		1.60	500	650
		2.30	550	750
		3.20	600	750
T	CC	0.32	200	250
		0.65	200	250
		1.00	250	300
		1.60	300	350

Notes: 1) Normal limit refers to the limit temperatures at which the thermometer can be used continuously in air.

2) Superheating limit refers to the limit temperatures at which the thermometer can be used for a short period of time.

5.3 Measurement Methods: Measuring devices are installed through the measurement hole. The temperature sensing point of the probe of the measuring instrument shall be at the point of measurement. The clearances between the measuring devices and measurement hole shall be completely plugged with materials such as asbestos or cloth. External air entering through the measurement hole should be avoided because it causes the exhaust gas to be cooled, resulting in low temperature measurement.

If the exhaust flue gas is toxic or inflammable, satisfactory safety measures shall be taken. Attachment for complete gas sealing should be used.

If the exhaust flue gas pressure is positive and high, suitable safety measures shall be taken as blow-out gas causes burn.

These safety measures should also be applicable to all other measurement activities.

Some temperature measurement takes some time to detect actual temperature of the flue gas.

The exhaust flue gas temperature shall be the mean value of the temperatures obtained at the individual measurement points.

6. Measuring Moisture Content in Exhaust Flue Gas: Moisture content in the exhaust flue gas is necessary for calculating exhaust flue gas density (for exhaust flue gas composition analysis and measurement by a density meter), dry exhaust flue gas flow rate and equal speed aspiration flow rate. The measurement of the moisture content generally follows the exhaust flue gas temperature measurement.

The condenser method specified along with the draft tube method in the old version of this standard is eliminated from the latest revision since they are not currently used.

The latest revision newly includes the section for moisture sampling devices to describe the construction and functions of each component of the devices.