

10. EI-II Electronic instrumentation engineering

Cost of equipment:

Price Thousand Yen : 232,824

Price US \$: 1,193,969

10-1 Block gauge

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
-	1,000	2	2,000

Specifications:

A set of 103 pcs.

Accuracy: JIS class A

Accessories:

- 1. Block gauge case**
- 2. Block gauge accessories: a set of 14 kinds (holder, base block, center point, etc.) in a case**
- 3. Maintenance tools in a case**

10-2 Measuring machine

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
-	2,000	1	2,000

Specifications:

Maximum measurable length: more than 500 m/m

Measuring power: 1kg, 0.5 kg, 0.1 kg

Minimum graduations: 0.001 m/m

Weight: about 100 kg

Dimensions: about 1000 (L) x 250 (W) x 400 (H)

Remarks:

For the practice of fundamental measurement

With necessary accessories for measurement

10-3 Automatic collimeter

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
-	400	1	400

Specifications:

Objective:

Focusing distance: 400 mm

Effective diameter: 40 mm

Minimum graduations: about 0.5"

Length: 245 mm

Support stand

**Accessories: reflector1
for measurement**

10-4 Universal projector

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Mitutoyo	800	1	800

Specifications:

Projection screen: ϕ 300 mm, fixed screen

Stage: 50 x 50 mm, differential

Magnification: 10 - 100 x (10, 20, 50, 100)

Lense interchange: single type

Portable type

Weight: about 70 kg

Standard accessories

Spare parts: light source lamp 3 pcs.

10-5 Precision surface plate

Room No. & name of facilities	—		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Mitutoyo Graplate type 517- 103	400	2	800

Specifications:

Dimensions: 600 x 600 x 130 m/m

Accuracy: JIS class A

Granite plate

Accessories:

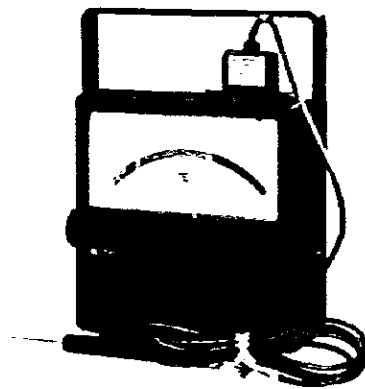
- 1. Precision surface plate stand: 600 x 600 m/m**
- 2. Cleaner 2 pcs.**

10-6 Resistance thermometer

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Yokogawa Electric Works Portable thermistor thermometer type 2672	45	2	90

Specifications:

1. Measuring range: 0° - 100° / 100° - 200°
2. Accuracy: 0.5 %
3. Power source: Two 9V dry cells (JIS C 8501 type 006P)
4. Thermistor probe:
Glass tube with protection tube, round tip-injection needle
Injection needle, surface temperature sensor
5. Spare parts: Thermistors for experiment 10



Type 2672
170 x 158 x 87 mm 1.9 kg
(6-3/4 x 7-3/8 x 3-1/2" 4.2 lbs)

10-7 Thermocouple thermometer

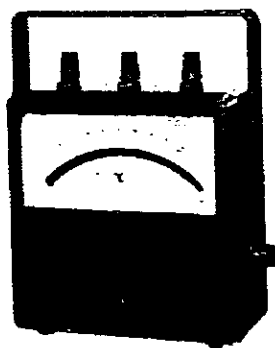
Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Yokogawa Electric Works Portable thermocouple thermometer type 2671	70	2	140

Specifications:

1. Measuring range: 0 - 1,200°C
2. Thermocouple: of chromel-illumel, in a protective tube
3. Scale range: 0 - 1,200°C/0 - 50 mV
4. Accuracy: 0.5 % of full scale

Spare parts: materials for

Thermocouple 10 m for each (JIS C 1601)



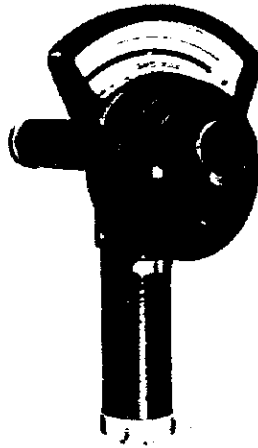
Type 2671
 195 x 185 x 87 mm 1.7 kg
 (7-3/4 x 7-1/4 x 3-1/2" 3.8 lbs)

10-8 Pyrometer

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Yokogawa Electric Works Type 2674	120	2	240

Specifications:

1. Measuring range: 700 - 1,500°C / 1,200 - 2,000°C
2. Min. one division: 10°C / 20°C
3. Accuracy: $\pm 10^\circ\text{C}$ / $\pm 20^\circ\text{C}$
4. Power source: SUM-1 x 2 dry cells



2674

F: 20x152x234mm 1/1.7g

10-9 Manometer

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Yokogawa Electric Works YJ-285H(for mercury column) YJ-285A(for water column)	200	2	400

Specifications:

1. Pressure range: 0 - 15,000 mm
2. For mercury column 1 set
 For water column 1
3. Accessory: mercury 4 kg

Remarks:

For standard pressure measurement

10-10 Electric furnace

Room No. & name of facilities	--		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
--	300	2	600

Specifications:

Dimensions within furnace: 100 (W) x 100 (H) x 200 (D) m/m

Temperature: 100 - 1,000°C

Control: manual control by transformer

Power capacity: 1 kW

Remarks:

- 1. The safety shall be considered since it is used as high-temperature source for practice.**
- 2. Direct viewing of the heater from the opening door.**
- 3. Power source: AC 220V 60 Hz**

10-11 Experimental differential transformer arrangement

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
-	200	8	1,600

Specifications:

1. Differential transformer 4 sets
2. Displacement measuring instrument (with micrometer) 1
3. Stand for 1. and 2 1
4. Power source generator:
 Frequency: 50 - 10 kHz 1
5. Electronic voltmeter for (output) measurement 1

The above instruments shall be contained in a case.
 Differential transformer can be interchanged according to the characteristics.

10-12 Electric micrometer

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
-	300	3	900

Specifications:

Electronic comparator:

1. Indicator:

1) Measurement range: $\pm 15 / \pm 30 / \pm 150 / \pm 300 \mu m$

2) Meter response speed: within 1 sec.

2. Detector:

1) Plunger type detector 1

2) Lever type detector 1

3) Detector stand 1

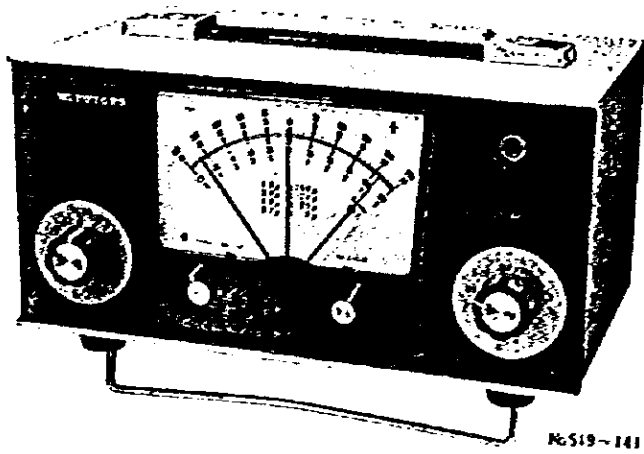
3. Accessories:

1) Supply valve for air condition (including air cleaner)

2) High-pressure hose and connection unit for connecting experimental device with supply valve, and supply valve with air-pressure source.

Remarks:

1. For the fundamental practice of industrial measurement.
2. Two kinds of detectors can be used various kinds of measurement.
3. Supply air-pressure source shall be arranged near the worktable. Connection unit shall be easily operated.



Indicator

No 519-141

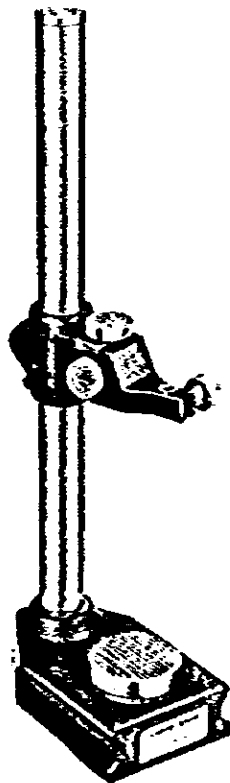


No 519-106



No 519-105

Detector



Detector Stand

10-13 Experimental nozzle flapper arrangement

Room No. & name of facilities	-			
Name of manufacturer & type for reference	Unit price	Q'ty	Amount	
Shimazdu Scientific Instrument Type NFRT-1A	250	8	2,000	

Specifications:

Nozzle caliber and primary stop : variable (interchangeable)

Flapper : differential displacement setting mechanism

Air-pressure measurement: Bourdon's tube pressure meter with setting valve for air-pressure reduction

Air-pressure source shall be provided near the worktable.

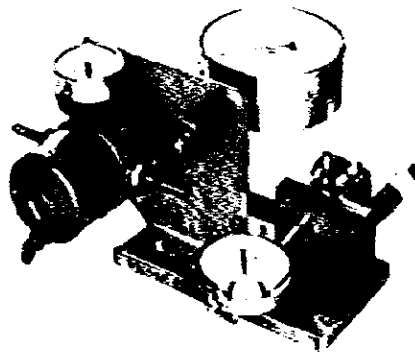
Remarks:

1. For the experiment for element of Air-pressure automatic control system.

Flapper displacement can be set up accurately by using micrometer type adjustment mechanism.

2. Air-pressure source: 5 kg/cm² of high pressure

Air-pressure for the experiment : 1.4 kg/cm² (standard air-pressure) shall be used by air-pressure reduction.



10-14 Pneumatic micrometer

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Air gauge	300	3	900

Specifications:

1. Display of pressure: 1) flow type 2) dial type
2. Indication range: 70 - 100 #
3. Object of measurement: 1) plane 2) outside diameter 3) inside diameter
4. Accessories: each kind of parts for the air micrometer
regulating valve of supplied air

Remarks:

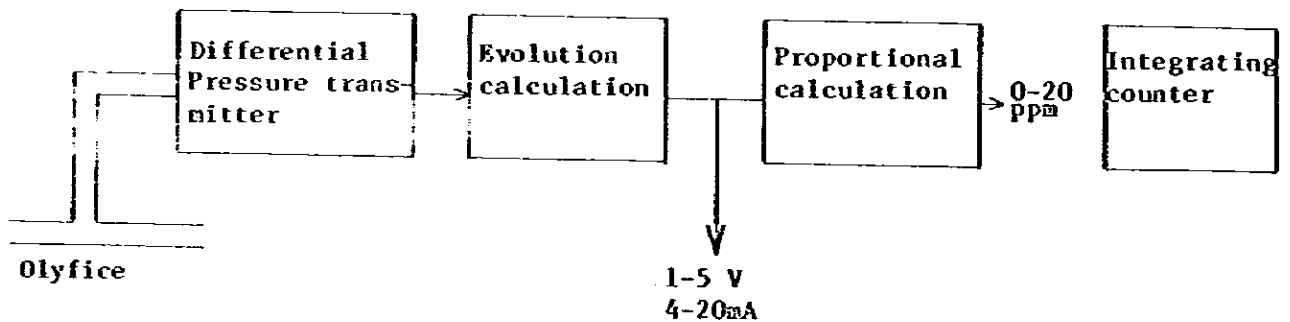
1. For learning pneumatic precision measurement.
To completer accessories for various kind of measurements.
2. The compressed air shall be supplied in high pressure and reduced into the required pressure by the reducing valve attached.

10-15 Flow integrating meter

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Hokushin Electric Works	250	3	750

Specifications:

1. Flow measurement section: orlyfice + differential pressure transmitter
2. Integrating & operating section:



3. Integrating counter: of six figures
Integrating ratio: 100 count/inch at maximum input.
4. Installation pipe size: 15 m/m

10-16 Resistance wire strain gauge

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
-	500	3	1,500

Specifications:

1. Strain meter:

Measurement range: $-29 \sim +30 \times 10^{-6}$) minimum strain
 reading : 5×10^{-6}
 Usable gauge: $60 \Omega - 1,000 \Omega$
 Bridge voltage: 1.6 V AC
 Gauge ratio: 2.00
 Accuracy: less than 1% at every range
 Power source: dry cell (UM-1)

2. Strain gauge for testing 2 pcs.

Remarks:

For measuring strain by using a strain gauge

10-17 Magnetic flowmeter

Room No. & name of facilities	--		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Hokushin Electric Works	1,200	1	1,200

Specifications:

1. Size: 15 m/m

2. Detector:

Pipe: SUS 27

Color plate: Pt-Ir

Measurement range: more than 0.19 m²/V

3. Conversion amplifier

Measurement range: 0 - 1 mV / 0 - 10 mV AC

Output: 4 - 20 mA & 1 - 5V DC

pulse: 0 - 20 ppm

4. Accessories:

Connection cables

10-18 Experimental frequency response testing arrangement

Room No. & name of facilities	Dc 309 Workshop-2 EM		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Yokogawa Electric Works	1,000	3	3,000

Specifications:

1. Signal output system

Frequency range:

Output waveform: sine wave

Signal output: 0 - 5 Vp-p MAX

Frequency: 01 C/M - 128 C/M (double system gear combination transformation system)

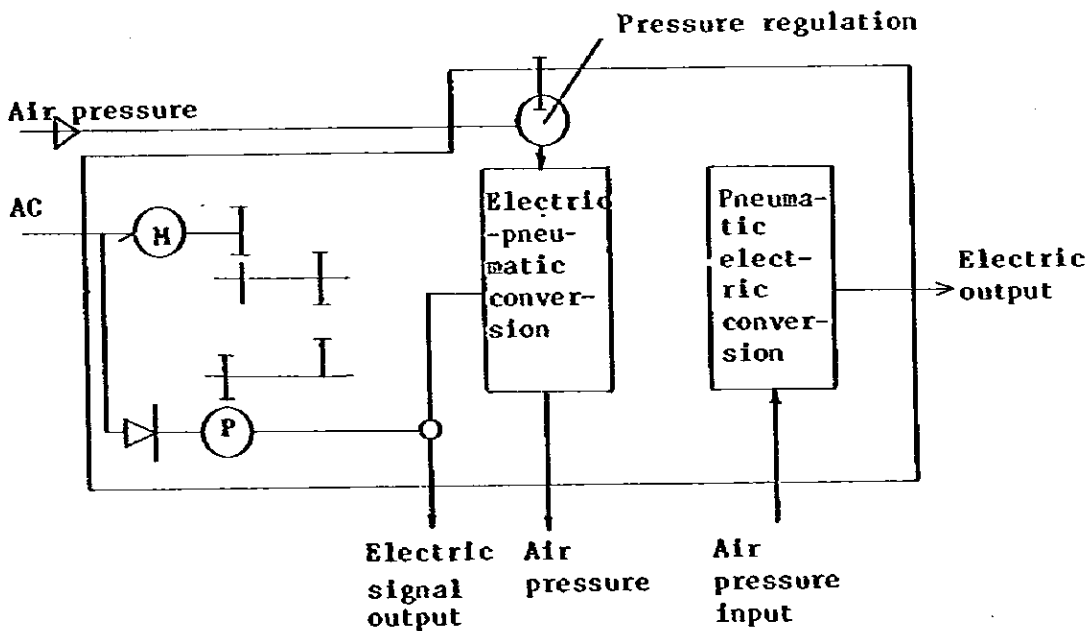
2. Signal conversion section

Electric ———> pneumatic converting section

Pneumatic ———> electric converting section

Current ———> voltage converting section

3. Measurement recording section: 2-pen recorder



Remarks:

Shall be equipped with sine wave output (0 - 5V, 0.2 - 1 Kg) for testing electric and pneumatic automatic control system and a pneumatic-electric converter for recording.

10-19 Electronic controller

Room No. & name of facilities	--		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Hokushin Electric Works Electronic recording controller type EKR-53	500	3	1,500

Specifications:

Input signal: 1 - 5 VDC

Indication: input and set point

Control mode: PID

Output: 4 - 20 mA

With a year's worth of consumables

10-20 Pneumatic controller

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Hokushin Electric Works	500	3	1,500

Specifications:

Input and output signal: 0.2 - 1.0 kgf/cm² of pneumatic pressure

Control mode: PID,

Manual regulator:

Output indicator: 0 100%

Supply air: 1.4 ±0.1 kgf/cm² of pneumatic pressure

Recording: circular - type 8 Hh/rotation

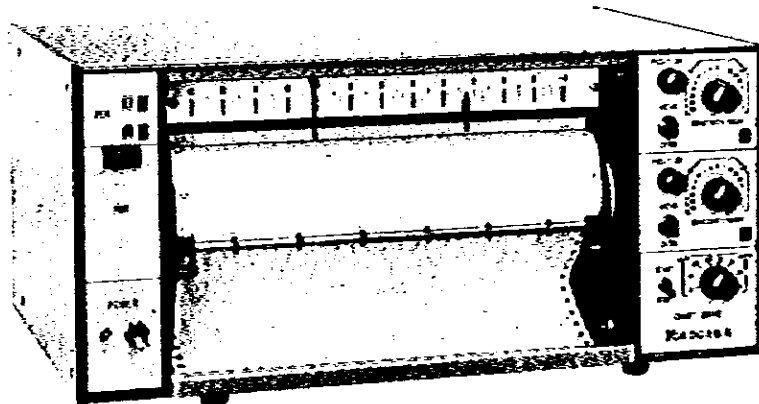
10-21 2-pen recorder

Room No. & name of facilities	—		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Yokogawa Electric Works Pen recorder type 3047	500	3	1,500

Specifications:

Electronic balancing 2-pen recorder:

1. Measurement range: 0.5 mV - 100 V, 17 ranges
2. Chart drive speed: 2 - 60 cm/min
3. Pen: cartridge type
4. Portable type
5. Recording paper: 250 W m/m x 15 m



10-22 Pneumatic recorder

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Yokogawa Electric Works	300	3	900

Specifications:

Measurement range: 0.2 - 1.0 kg/cm²

Three pen type

**Recording paper: 102 m/m x 7.5 m
Z-fold chart**

Chart drive speed: 19 m/h and 19 mm/min. (with change-over switch)

Chart drive power: AC 220V, 60 Hz

10-23 Pneumoelectric transducer

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Hokushin Electric Works	150	3	450

Specifications:

For converting pneumatic pressure signal into electric signal.

Pneumatic pressure signal: 0.2 - 1 kg/cm²

Electric signal: 4 - 20 mA and 1 - 5 V

10-24 Electropneumatic transducer

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Hokushin Electric Works	200	3	600

Specifications:

Input: 4 - 20 mA

Output: 0.2 - 1 kg/cm²

Supply air pressure: 1.4 kg/cm²

With supply/output air pressure indicator

Manual operation: possible

10-25 Positioner

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Hokushin Electric Works Current to pneumatic Converter type ALT-001	150	3	450

Specifications:

Accepts a DC current signal from an electronic transmitter and converts it into a 0.2 to 1.0 kgf/cm² pneumatic signal.

Input signal : 4 - 20 mA

Output signal: 0.2 - 1.0 kgf/cm²

Air supply: 1.4 ± 0.1 kgf/cm²



ALT 001

10-26 Diaphragm valve

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
-	150	3	450

Specifications:

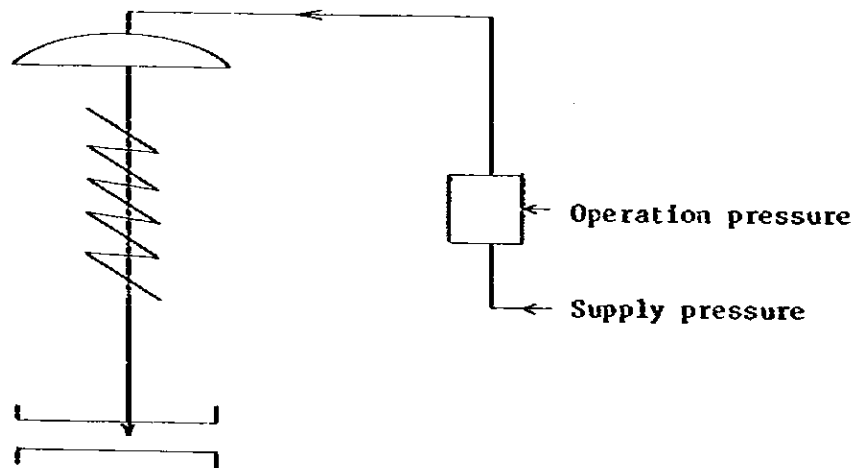
Pipe size: 15 m/m (1/2 - inch) with flange

Operation pressure: 0.2 - 1 kg

With pilot relay

Supply air pressure: 1.4 kg

Action: positive



For reference: general use

10-27-1 Control simulator

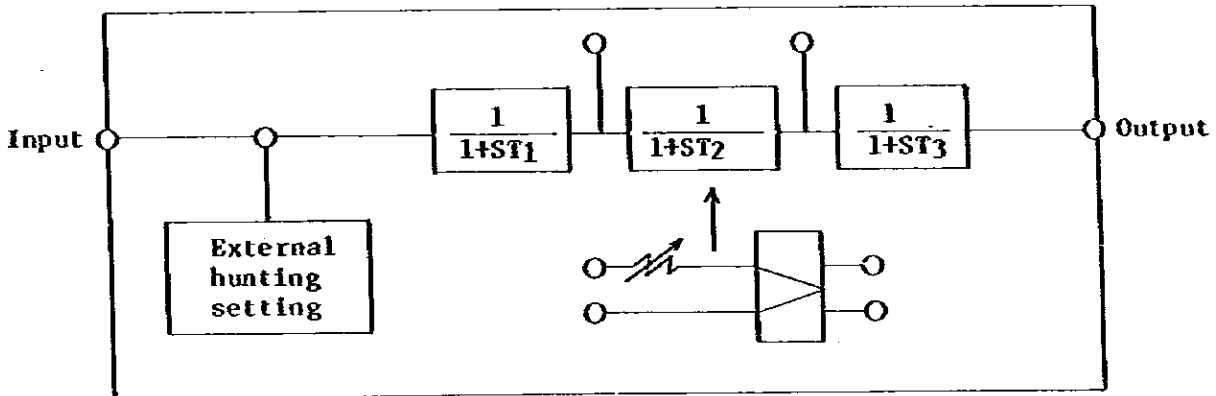
Room No. & name of facilities	Dc 309 Workshop-2 EM		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
-	700	3	2,100

Specifications:

Control model: primary, secondary and third lateness

Time constant: 10 M ~ 1 H, variable

External hunting: step



Input/output: correspond to IEC controller

Desk-type

10-27-2 Transfer function measuring system

Room No. & name of facilities	Dc 309 Workshop-2 EM		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Japan Radio type NJZ-224B	2,000	3	6,000

Specifications:

1. Signal generation section:

Frequency: 0.005 - 1,000 Hz

Waveform: sine-wave, rectangle-wave, etc.

Output level: 1 mV - 3 V rms

Reference signal: same as signal frequency, phase:variable

2. Response wave measurement section:

Input impedance: more than 100 k Ω

Measurement level: 10 mV - 300 V rms

Measurement waveform: sine-wave, rectangle-wave

Output display: X, Y element electric current display

Output terminal: output for recorder

Remarks:

For measuring the amplitude and phase of system against the input frequency (0.005 - 1,000 Hz) and analyzing the response.

10-28 Experimental servo mechanism arrangement

Room No. & name of facilities	Dc 309 Workshop-2 EM			
Name of manufacturer & type for reference	Unit price	Q'ty	Amount	
Ando Electric Automatic control technique trainer type MO-2	800	8	6,400	

Specifications:

1. electronic balancing type control system

For the fundamental experiments of

2. Construction:

Anticipated value setting potentiometer

Servo amplifier (amplification and amplification characteristics: variable)

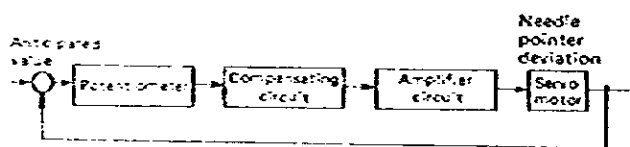
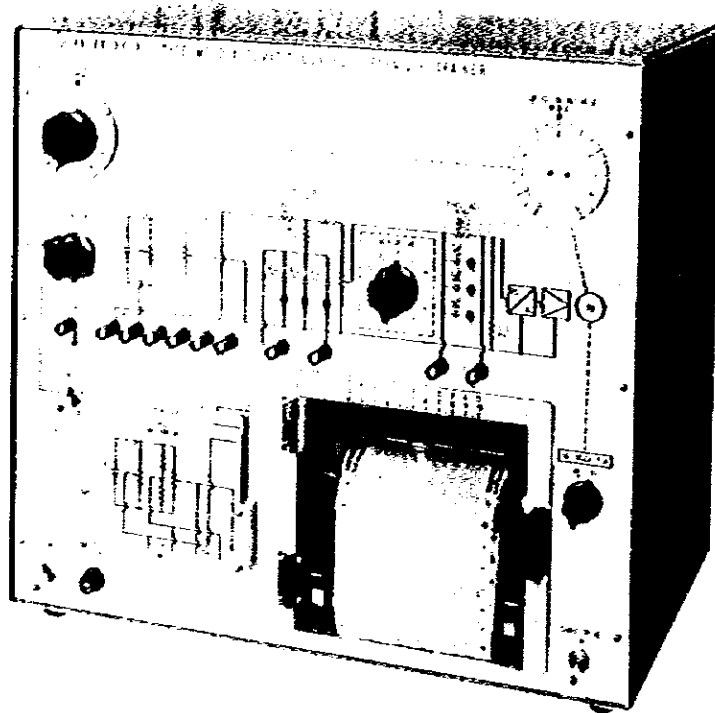
Servo motor

Feed-back potentiometer recorder, etc.

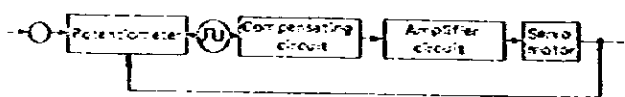
Shall contain in a case.

Remarks:

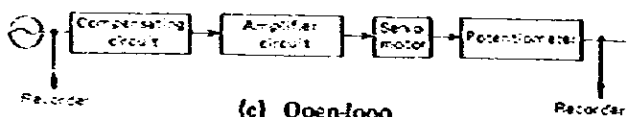
1. Each section of parts is easy to handle and have a solid structure.
2. Power source: AC 220 V 60 Hz
Can be used for converting the power source, voltage and characteristics for the experiments.



(a) Servomechanism



(b) Closed-loop



(c) Open-loop

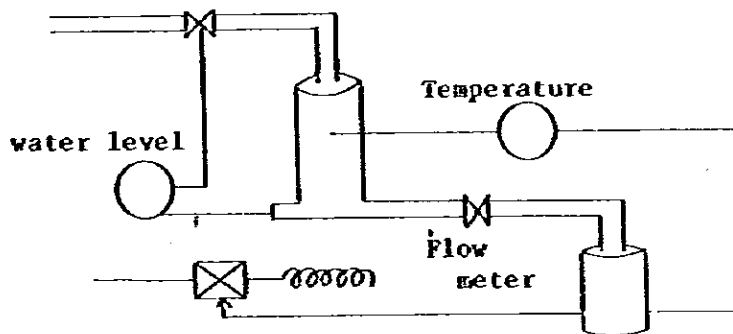
Fig. 2 Typical circuits

10-29 Experimental temperature control system

Room No. & name of facilities	Dc 309 Workshop-2 EM		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Yokogawa Electric Works	1,000	2	2,000
Hokushin Electric Works			

Specifications:

1. The system shall be incorporated into an instrumentation panel of a desk type.



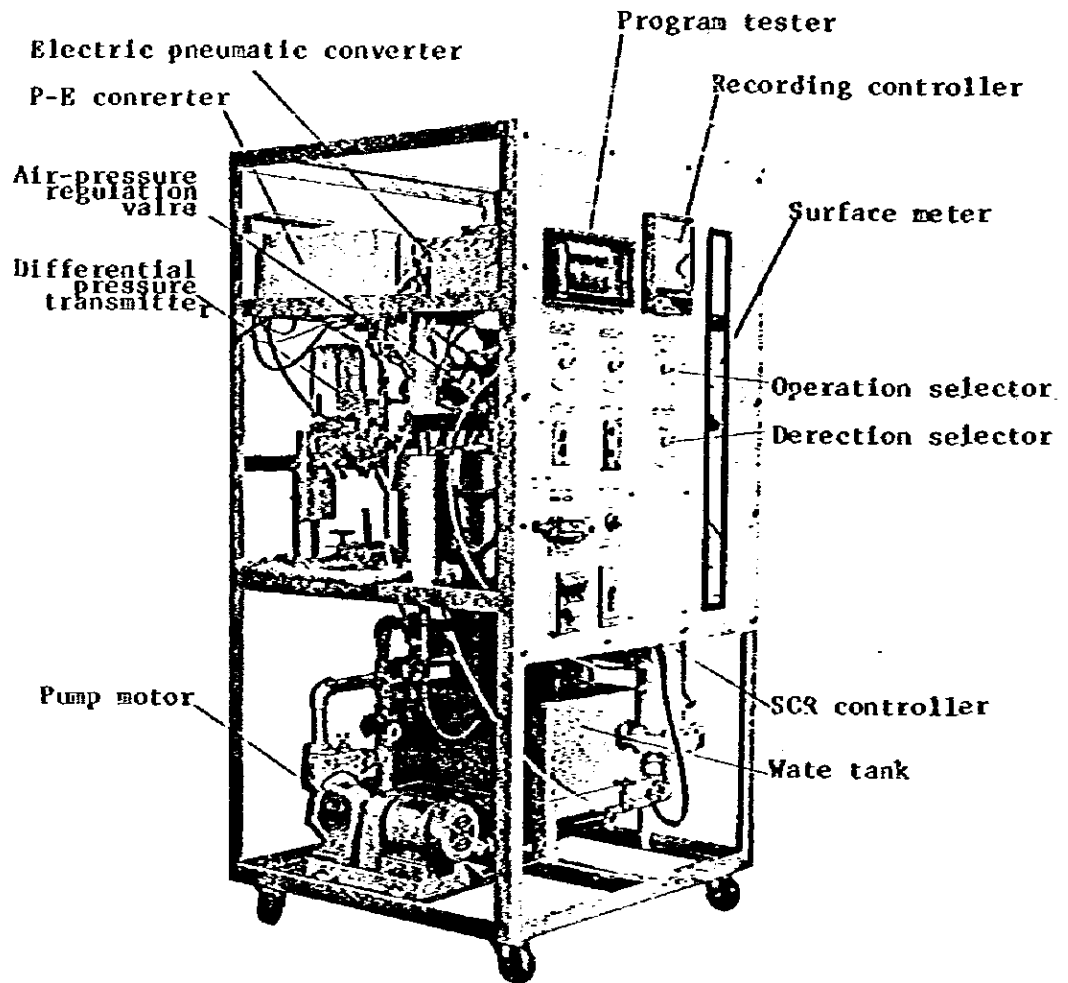
2. Constant value control and program control of temperature shall be the main subject, although water level control and measurement shall be included.

3. Control system shall be electric

Temperature control: ON-OFF control and PI control
 Water level control: PI control

4. Water supply pump shall be included with attachment of a fail-safe circuit for prevention of heating the empty tank.

5. The apparatus shall be assembled on an independent frame as is shown by the reference figure to be used readily for experiment by connecting power source and hoses for supply and drain of water.

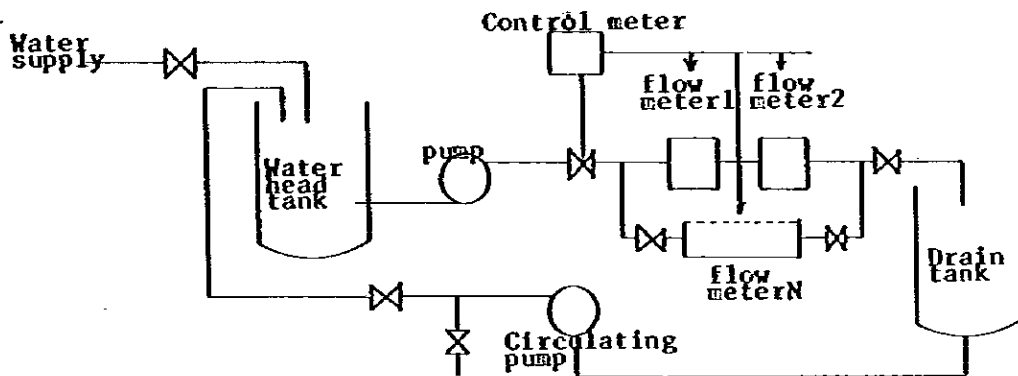


10-30 Experimental flow control system

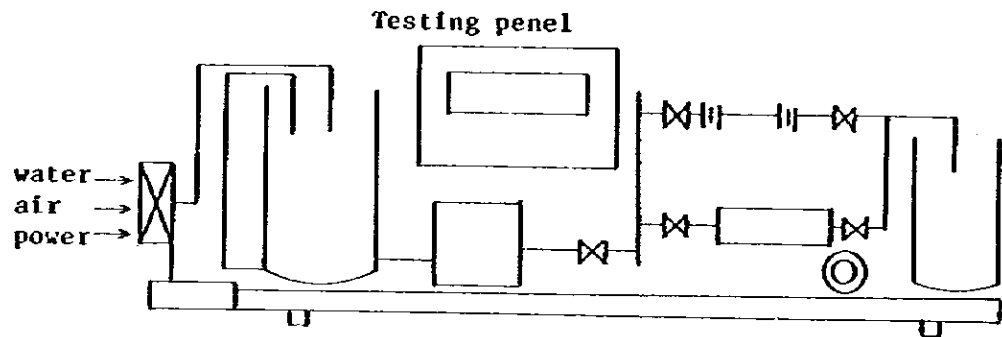
Room No. & name of facilities	Dc 309 Workshop-2	EM	
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Yokogawa Electric Works Hokushin Electric Works	1,000	2	2,000

Specifications:

1. Control system:



2. Plant section and instrumentation section shall be of an easily understandable arrangement.
3. Independent desk type
4. The part of flow meter N can be exchanged and connected from outside.
5. The control system shall be electric and contain PID regulation meter and various flow meter.
6. The circulating pump system shall be sequentially controlled to enable emergency action.
7. Shall be an incorporated structure as shown in the reference figure, and water, air and power can be connected by hose or cable via connecting plug.



10-31 Experimental hydraulic control system

Room No. & name of facilities	Dc 309 Workshop-2 EM		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
-	1,000	2	2,000

Specifications:

The structure components shall include those needed for practicing on the following subjects.

1. Sequential performance circuit by sequence valve
2. Two-speed circuit
3. Automatic reciprocating circuit
4. No-load circuit
5. Meter-in circuit
6. Make-out circuit
7. Differential circuit
8. Bleed-off circuit
9. Measurement of pump efficiency
10. Oil hydraulic servo-mechanism
11. Copying control, etc.

Remarks:

The apparatus shall be constructed with consideration for enabling various experiments for learning foundation of oil hydraulic system and its application for automatic control, etc.

10-32 Experimental sequence control system

Room No. & name of facilities	Dc 309 Workshop-2 EM		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Ando Electric	400	8	3,200

Specifications:

1. Construction:

- Auxiliary relay: 2ab, 4ab 2 for each
- Time limit relay: 0 30 sec./0 10M
- Power relay: 3 10A 2
- Control circuit voltage: 24 V (small voltage circuit is available.)

2. Appearance: portable box-type

Accessories: connection cord (lead of plug-to-plug) 1 lot

Remarks:

- 1. For the sequence control experiment by relay elements
- 2. Each terminal of elements shall be arranged on the graphic panel for easy understanding.

10-33 Experimental logic arrangement

Room No. & name of facilities	Dc 309 Workshop-2 EM		
Name of manufacturer & type for reference	Unit price	Qty	Amount
Yokogawa Electric Works Ando Electric	500	8	4,000

Specifications:

1. Structure:

TTL logic element

NAND

FF

Clock circuit

2. Of desk-type

Remarks:

1. For fundamental experiments

Miss-connection has no influence on the apparatus.

2. Each section shall have a auxiliary TTL logic circuit.

10-34 Experimental logic arrangement

Room No. & name of facilities	Dc 309 Workshop-2 EM		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
--	500	3	1,500

Specifications:

1. Structure:

- Air fluid operation element**
- Air pressure regulating circuit**
- Air pressure detection and display circuit**

2. The apparatus shall be for practicing and facilitating understanding of fundamental experiments on air fluid circuit. Shall be of desk-type.

Remarks:

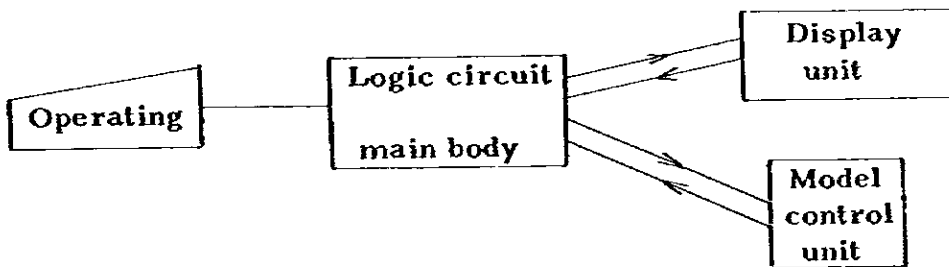
- 1. The apparatus is for fundamental experiment on pneumatic control element.**
- 2. The apparatus shall be for practicing model performance of a system composed of various performances.**
- 3. The air pressure shall be supplied in high pressure to be reduced in the experimental apparatus as required.**

10-35 Sequence control arrangement

Room No. & name of facilities	Dc 309 Workshop-2 EM		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Omuron Yokogawa Electric Works	2,000	3	6,000

Specifications:

1. Structure:



2. For experiment of sequence control by software

- (1) The input of the program is performed by the key of the operating set.
- (2) Controlling output and input: have a capacity enough for controlling 6 FL 2 cage elevator.
- (3) The control model shall be composed of various relays.
- (4) Program check and condition of performance shall be displayed.

Remarks:

1. A model for a large scale sequence control
2. Shall have built-in microcomputer.

10-36 Computer system

Room No. & name of facilities	Dc 309 Workshop-2 EM		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Yokogawa Electric Works Hokushin Electric Works	50,000	1	50,000

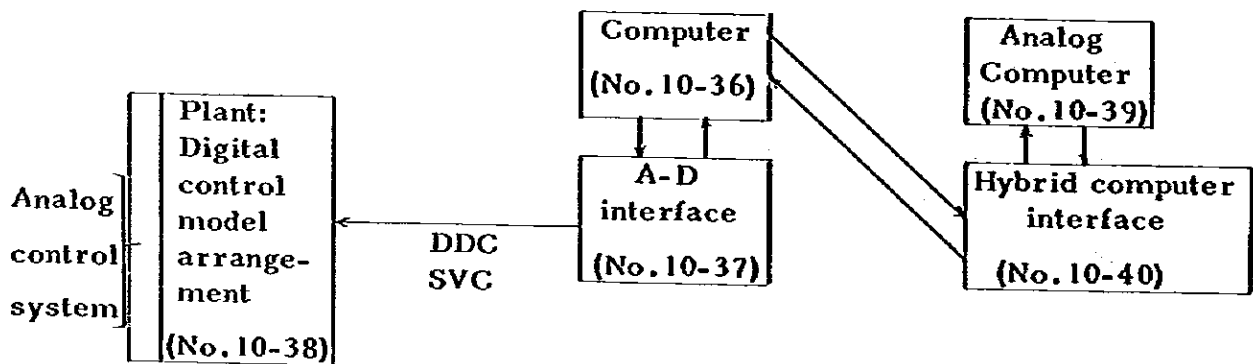
Specifications:

1. Contents of training

- 1) Program of computer control system
- 2) Characteristics analysis of computer control system
- 3) Simulation by analog computer
- 4) Hybrid operation by analog computer ↔ digital computer
- 5) Operation of plant, analog system, SPC, DDC etc.

2. System structure:

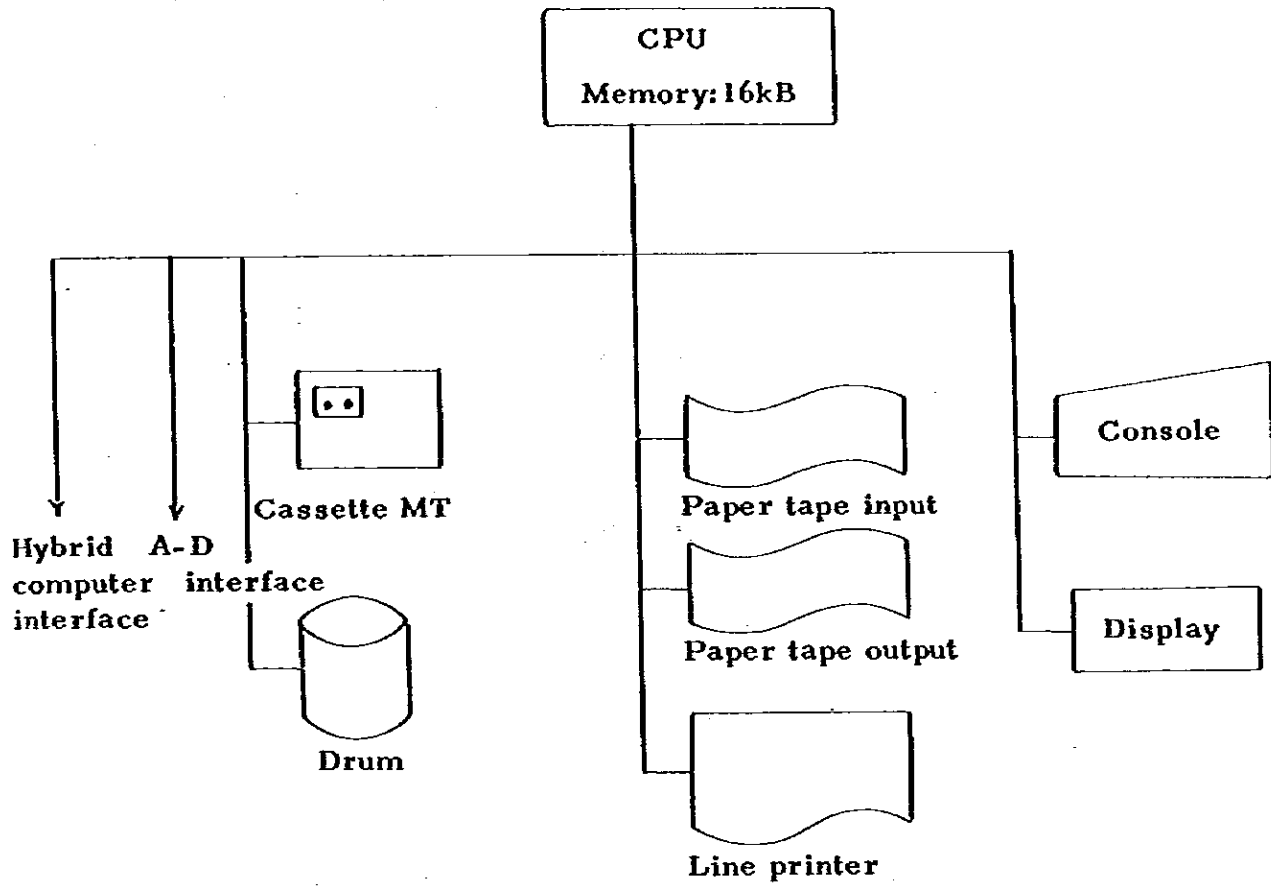
The total system of computer control shall be composed as follows:



3. Specifications of computer

- 1) To be one for controlling
- 2) Memory capacity: more than 16 kB
- 3) OS for controlling being attached
- 4) Program language: assembler and BASIC or FORTRAN

For reference:



10-37 Analog interface

Room No. & name of facilities	Dc 309 Workshop-2 EM		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
-	10,000	1	10,000

Specifications:

Construction:

Analog side: input more than 20 points
output - ditto -

Digital side: input - ditto -
output - ditto -

Control signal: according as required by computer

Remarks:

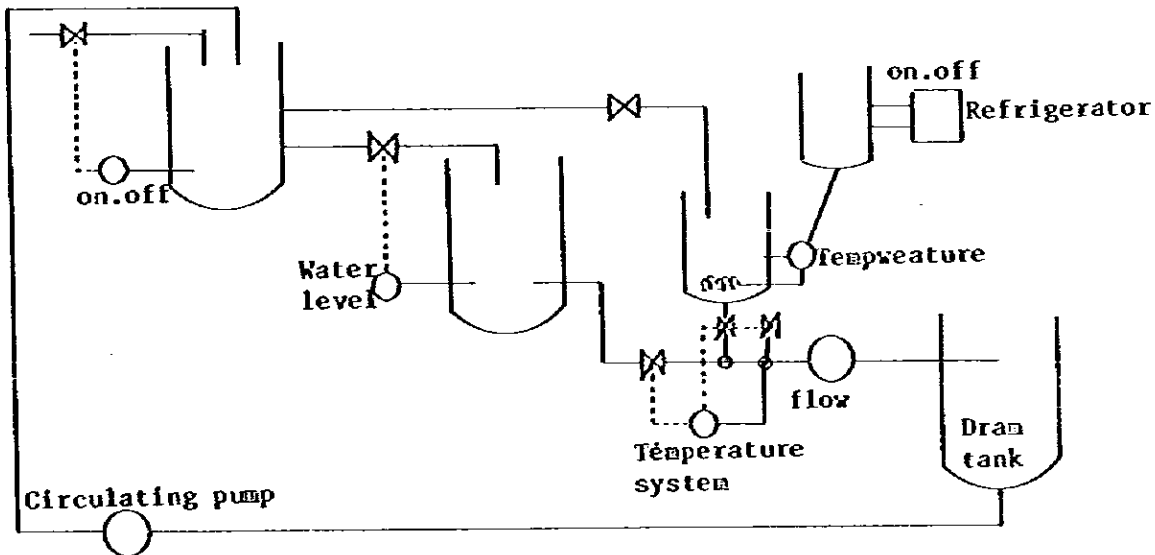
The apparatus takes charge of conversion of analog digital among computer controlling apparatus (No. 10-36~40), and the analog value shall correspond to each of the converter output and the digital side to computer (No. 10-36).

10-38 Digital control model arrangement

Room No. & name of facilities	Dc 309 Workshop-2 EM		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Yokogawa Electric Works	20,000	1	20,000

Specifications:

1. Model construction:



2. Instrumentation

- (1) Each detecting terminal shall be for analog output and digital output. Operation mechanism shall be analog input.
- (2) SVC control circuit shall be attached to regulating meter circuit to be able to compose an independent control loop and to operate independently from computer.
- (3) The plant section and instrumentation section shall be separated, and instrumentation panel and control desk shall be installed.

3. Structure

Each section shall be mounted on an independent frame with connecting devices for power, water and air and input-output terminal board for controlling.

4. Analog control panel

The plant can be operated independently by a desk-type analog instrumentation panel installed separately from the plant. Switching from computer control can be made if needed.

Remarks:

1. The present apparatus is the control object of computer control system (No. 10-36 ~ 40).
2. It is a model for a comprehensive experiment from fundamental experiment of computer control to DAC.
3. Experiment for analog control (and SVC) can also be made.

10-39 Analog computer

Room No. & name of facilities	Dc 309 Workshop-2 EM		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Yokogawa Electric Works Ando Electric	5,000	1	5,000

Specifications:

Construction:

The computer shall have a sufficient capacity as an analog computer and at the same time be capable of mixed computation in combination with the digital computer as the simulator of the plant.

- (1) Operational amplifier of various kind
- (2) Computing speed: high speed and low speed
- (3) Computing output: cathode-ray tube oscillograph and X-Y recorder

Remarks:

One of the constituent elements of computer control system
(No. 10-36 ~ 40)

10-40 Hybrid computer interface

Room No. & name of facilities	Dc 309 Workshop-2 EM		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Ando Electric	5,000	1	5,000

Specifications:

Construction:

**Interval timer
A/D converter
D/A converter
Digital potentiometer**

Appearance:

Control desk type

Remarks:

- 1. One of the components of computer control system (No. 10-36 ~ 40)**

10-41 NC machine tool

Room No. & name of facilities	Dc 305 Workshop-4 EM		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Fujitsu FUNUC Rokuroku sangyo	4,000	1	4,000

Specifications:

1. NC position setting drilling machine:

For drilling many holes on the flat plate such as chassis and printing board.

Shall have a table for thin plate processing.

2. Shall prepare the cab tire cable from the power source distributing board for motor to the machine.

10-42 Electric power unit

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
-	250	8	2,000

Specifications:

Same as No. 3-47.

10-43 Air compressor

Room No. & name of facilities	Dc 309 Workshop-2 EM		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
-	1,500	1	1,500

Specifications:

1. The machine is for supplying compressed air for the practice on electronic instrumentation to each part of experimental stations through piping in a large amount and with stable pressure.
2. Compressor:
 - (1) Motor capacity: more than 15 kW
 - (2) Displacement of compressor: 2 m³/min.
 - (3) Maximum pressure: 8 kg/cm²
 - (4) Number of rotation: 1,000 - 1,400 rpm
 - (5) Cooling system: air-cooling
 - (6) Air reservoir capacity: more than 300 L
 - (7) Weight: about 700 - 1,000 kg

Remarks:

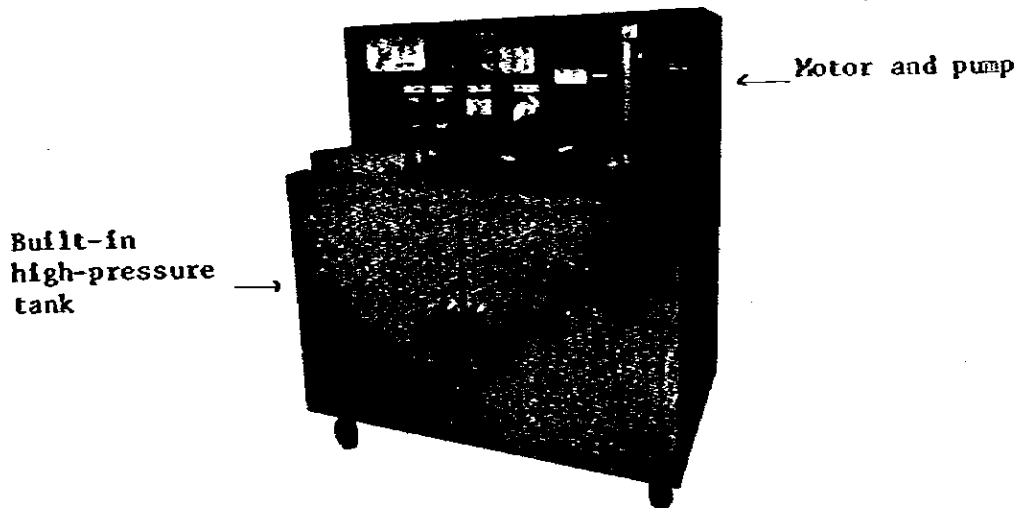
1. Shall be installed with considerable isolation from the workshop rooms during operation for the arrest of noises.
2. The necessity of air-cooling operation in the high-temperated area.

10-44 Hydraulic pump

Room No. & name of facilities	Dc 309 Workshop-2 EM		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Tokyo meter	3,000	1	3,000

Specifications:

1. Maximum supply: 20 L/min.
2. Supply pressure: 5 - 10 kg/cm²
3. Coil cooling: air-cooling
4. Pump power: 3 d 3.3 kW motor



10-45 Water tank

Room No. & name of facilities	Dc 309 Workshop-2 EM		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
--	500	1	500

Specifications:

1. Tank capacity: 2 - 3 m³
2. Tank material: reinforced plastic, closed type
3. Water head to workshop room
4. Auxiliary circuit: lifting pump (including controlling circuit)

Remarks:

1. Industrial water can be used also.
2. A supply tank for computer control system (No. 10-36 ~ 40)

10-48 AC voltmeter

Room No. & name of facilities	-			
Name of manufacturer & type for reference	Unit price	Q'ty	Amount	
Yokogawa Electric Works type 2013	16	25	400	
Shimazdu Scientific Instrument type HA-150	7	20	140	
	(Total)		540	

Specifications:

Same as No. 4-25

Class: JIS C 1102 0.5 class 25 sets
 2.5 class 20

10-49 AC ammeter

Room No. & name of facilities	-			
Name of manufacturer & type for reference	Unit price	Q'ty	Amount	
Yokogawa Electric Works type 2013	16	25	400	
Shimazdu Scientific Instrument type HQ-10	7	20	140	
	(Total)		540	

Specifications:

Same as No. 4-24

Class: JIS C1102 0.5 class25 sets
 2.5 class20 sets

10-50 Electronic circuit tester

Room No. & name of facilities	—		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
—	50	8	400

Specifications:

Same as No. 6-4

10-51 Digital circuit tester

Room No. & name of facilities	—			
Name of manufacturer & type for reference	Unit price	Q'ty	Amount	
Yokogawa Electric Works	Digital multimeter type 2807	180	8	1,440
	Current unit type 2811 (accessory unit for type 2807)	55	8	440
	(Total)			1,880

Specifications:

Display: 4-digit display (0 to 1999)

Range selection: manual

DC voltage ranges: ± 19 mV / 190 mV / 1.9V / 19V / 190V / 1,000V

Polarity sign: automatically displayed

AC voltage ranges: 1.9V / 19V / 190V / 600V

DC current ranges: 19 μ A / 190 μ A / 1.9mA / 19mA / 190mA / 1.9A / 19A

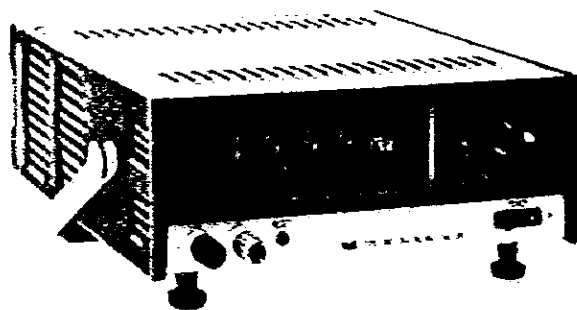
AC current ranges: 190 μ A / 1.9mA / 19mA / 190mA / 1.9A / 19A

Resistance: 190 Ω / 1.9k Ω / 19k Ω / 190k Ω / 1.9M Ω / 19M Ω

Power source: AC 220V, 60 Hz

Accessories:

1. Carrying bag 1 pc.
2. Measurement lead 1 set
3. Fuses (0.5 A) 2 pcs.



Type 2807
77 x 210 x 252 mm 2.5 kg
(3 x 8-1/4 x 9-7/8" 5.5 lbs)

10-52 Digital voltmeter

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
-	400	8	3,200

Specifications:

Same as No. 6-3

10-53 Basic pulse circuit experimental arrangement

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
(1) Iwatsu Electric type ITf-03	300	8	2,400

Specifications:

Same as No. 4-19

10-54 Logic circuit testing arrangement

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
-	400	8	3,200

Specifications:

Same as No. 5-18

10-55 Basic operational circuit experimental arrangement

Room No. & name of facilities	-			
Name of manufacturer & type for reference	Unit price	Q'ty	Amount	
Iwatsu Electric Arithmetic calculator circuits trainer type ITf-07	1,000	8	8,000	

Specifications:

Contentsts of Training.

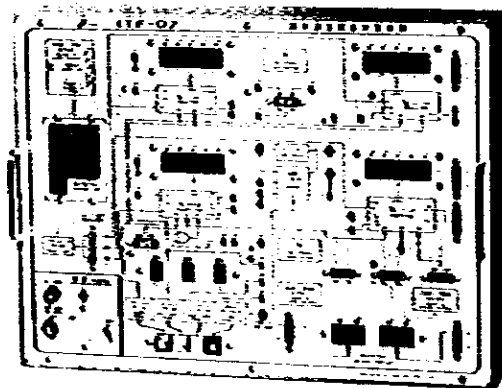
1. Training of adding calculator
2. Training of subtracting calculator
3. Training of multiplying calculator
4. Training of dividing calculator

Power source: AC 220 V, 60 Hz

Portable type

Remarks:

Establishment of input is performed by decimal and calculated by binary, but its result can be indicated by decimal also as well as binary.



10-56 AD, DA experimental arrangement

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Ando Electric A-D converter type AD-51 and D-A converter type DA-51	1,000	1	1,000

Specifications:

1. A-D converter:

Type: Successive comparison type

Input: 0 to +5 V DC, 2 sets of AC terminals for PCM communication simulation.

Output: Code "1" (approx. +5V); code "0" (approx. 0 V).

Output code: Binary 5 bits.

Converting speed: Approx. 80 μ s.

Power requirements: 220 V AC, 50/60 Hz.

Accessories supplied: 5 connecting cords (1 m long each), 1 fuse (0.5 A), 1 operation manual.

2. D-A converter:

Type: Feed-back comparison type

Input: Code "1" (approx. +5V); code "0" (approx. 0V)

Input code: Binary 5 bits

Output: 0 to +5 V DC. 2 sets of AC terminals for PCM communication simulation.

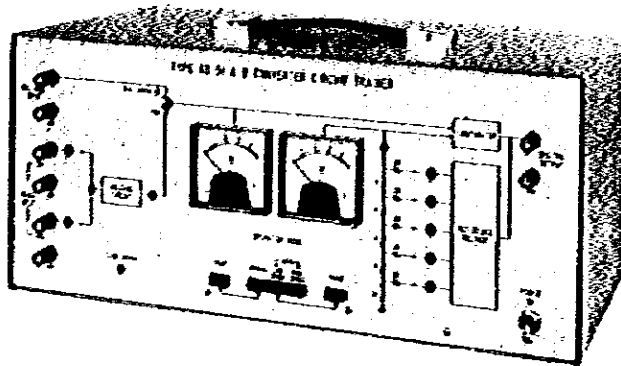
Converting speed: Approx. 80 μ s.

Power requirements: 220 V AC, 50/60 Hz.

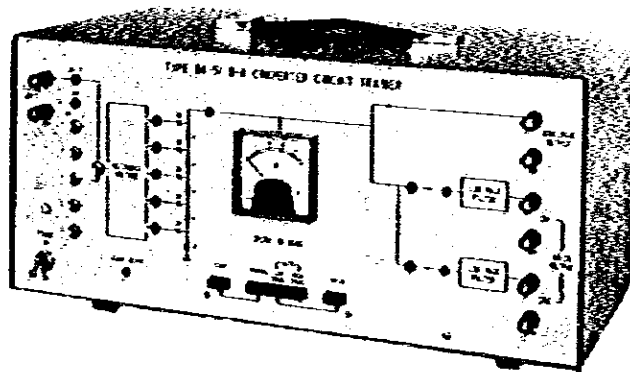
Accessories supplied: 4 connecting cords (1 m long each), 1 fuse (0.5 A), 1 operation manual.

3. Portable type

4. Can be used in various types of experiment with the principles of A-D and D-A conversion.



TYPE AD-51



TYPE DA-51

10-57 Electronic circuit testing arrangement

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
-	280	8	2,240

Specifications:

Same as No. 5-3

10-58 Pulse generator

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
-	450	8	3,600

Specifications:

Same as No. 9-71

10-59 Function generator

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Iwatsu Electric Type FG-121B	400	6	2,400

Specifications:

Same as No. 4-61

10-60 Oscilloscope

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Iwatsu Electric Type SS-5510	600	8	4,800

Specifications:

Portable type

Cathode ray tube: 6-inch

Vertical deflection system:

Deflection factor: 1mV/div - 5V/div

Frequency response: DC - 50 MHz

Horizontal deflection system:

Sweep rate: 0.1 μ s/div. - 0.2 s/div.

Others: single sweep, delay sweep, Sweep magnification (10 times), X - Y operation, etc.

10-61 Resistance attenuator

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Anritsu Electric Type MN31A	100	8	800

Specifications:

Frequency: DC to 1MHz

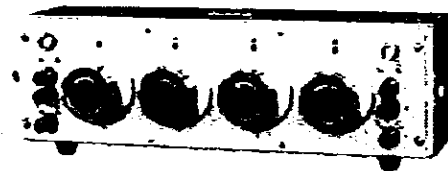
Attenuation step: 0.1 dB

Maximum attenuation: 111 dB

Variable dials: 3

Impedance: 600Ω , balanced

Maximum input: 0.5 W



10-62 LCR meter

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Yokogawa Hewlett-Packard Type 4332A	300	8	2,400

Specifications:

1. Measurement range:

- 1) Inductance L: 2 μ H - 1 H
 - 2) Capacitance C: 3pF - 1 μ F
 - 3) Resistance R: 3 Ω - 1 M Ω
- } 1 - 3 steps, 12 ranges

2. Measurement frequency: 100 kHz or 1 kHz (changeable)

3. Indication system: analogical indicator

4. Output: 1VAC for recorder (full scale)

5. Power source: AC 220V, 60 Hz

10-63 Counter

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
-	400	8	3,200

Specifications:

Same as No. 3-27

10-64 Amplifier for measuring instruments

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Iwatsu Electric DC amplifier type DA-2B	200	8	1,600

Specifications:

Frequency band width: DC ~ 2MHz -3dB

Sensitivity: 0.5 mV - 100 V/FULL

Output voltage: ± 0.5 V or 0 ~ -5V

Output current: Max. 20mA

Power source: AC 220 V, 60 Hz

10-65 X-Y recorder

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
-	550	8	4,400

Specifications:

Same as No. 4-63

10-66 Power transducer

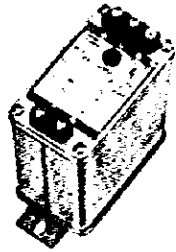
Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Yokogawa Electric Works Power line transducers type 2271 - 2276	-	11	484

Specifications:

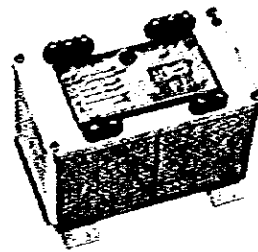
1. AC current transducer 2 pcs. x 21,000 = 42,000
Rated AC input: 5A
2. AC voltage transducer 2 pcs. x 21,000 = 42,000
Rated AC input: 150 V
3. Watt transducer
 - (1) Single phase 1 pc. x 55,000 = 55,000
 - (2) 3-phase, 3-wire 1 pc. x 55,000 = 55,000
 Rated AC input: 100 V/5A
4. Power factor transducer
 - (1) Single phase 1 pc. x 65,000 = 65,000
 - (2) 3-phase, 3-wire 1 pc. x 65,000 = 65,000
 Rated AC input: 100 V/5A
5. Reactive power transducer
 - (1) Single phase 1 pc. x 65,000 = 65,000
 - (2) 3-phase, 3-wire 1 pc. x 65,000 = 65,000
 Rated AC input: 100 V/5A
6. Frequency transducer 1 pc. x 30,000 = 30,000
Rated AC input: 60 ±5 Hz

Remarks:

1. For transducing AC electrical quantities to proportional DC voltages.
2. Insulation resistance: more than 100 MΩ at 500 V DC
Dielectric strength: 2,000 V or 1,000 V AC
Impulse voltage strength: 4,500 V
3. For 5V DC max, output.



Type 2271
AC Current Transducer
95 x 55 x 115 mm 1.0 kg
(3-3/4 x 2-1/8 x 4-1/2" 2.2 lbs)



Type 2272
Watt Transducer (3-phase 3-wire)
95 x 165 x 115 mm 3.0 kg
(3-3/4 x 6-1/2 x 4-1/2" 6.6 lbs)

10-67 Oscillograph

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
-	620	3	1,860

Specifications:

Same as No. 4-62

10-68 Geiger counter

Room No. & name of facilities	-			
Name of manufacturer & type for reference	Unit price	Q'ty	Amount	
Shimazdu Scientific Instrument Radiation detector type GM- B3	400	3	1,200	

Specifications:

The GM tube used is for both beta and gamma rays

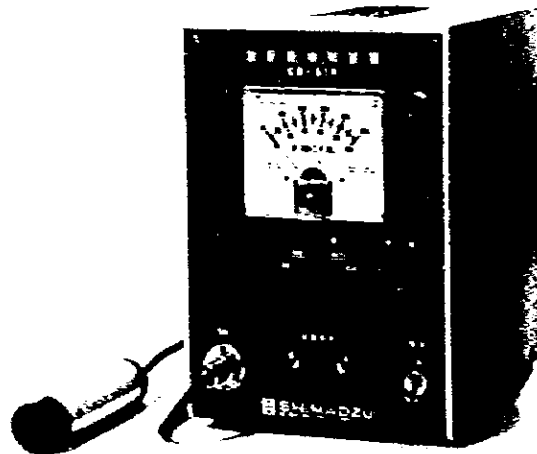
Counting ratemeter: 1,000/5,000/10,000/50,000 cpm
four-stage

With ammeter and speaker

Power source: AC 220 V 60 Hz

With GM probe stand

Portable type

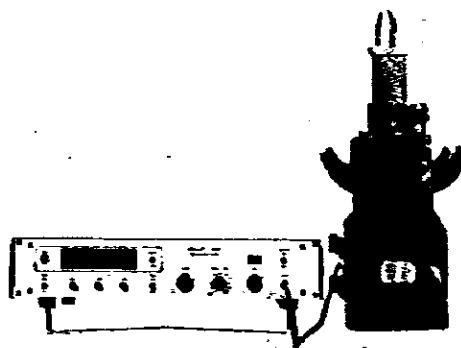


10-69 Scintillation counter

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Nakamura Scientific Type CN-125	1,000	3	3,000

Specifications:

1. Scintillator: NaI (Tl)
2. Counting range: 10 - 300 kepm
3. Dose range: 0.05 - 5mr/h
4. Natural counting: less than 1,600 cpm
5. Counting display: digital system



10-70 γ -ray spectrometer

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
-	3,000	2	6,000

Specifications:

1. γ -ray detection:

Detector: NaI (Tl) crystal scintillator 51 ϕ - 76 ϕ

Amplifier: photomultiplier, same specifications as RCA 6342 output-prepositional amplifier.

High-tention power source: for photomultiplier with stabilizer for prepositional amplification

Stand for measurement

2. Spectrum analyzer:

Memory channel: more than 1024

Memory capacity: more than 10^6-1

Memory division: 2/4 div.

Analog-digital conversion

Differential and integral linear response: better than 0.1/0.75%

Display: cathode ray tube, more than 3-inch

Output: output terminal for X-Y recorder

3. Standard radioactive substance: sealed-type, long-term stable (137Cs, etc.)

4. Standard accessories: for measurement

10-71 Radiation equipment

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
-	500	3	1,500

Specifications:

1. Voltage detector (pocket dosimeter) with charger 9
2. Radiation absorption plate set 3
3. Lead block (brick size) 30
4. Sealed radioactive substance power (various kinds) 9

Remarks:

Various experimental instruments for radiation measurement
 Should not have a harmful effect on the human body.

10-72 Radioactive substance safe

Room No. & name of facilities	Dc 319 Storage EM		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
-	500	1	500

Specifications:

- 1. Inside dimensions: 300 x 300 x 200 m/m (approx.)**
- 2. Lock system: electronic key and figure-combination key**
- 3. Fron display: RI display**

**The radialtion should not be escaped from the safe.
(the inside of the safe is made of lead plate.**

Remarks:

- 1. The function of air-tight condition shall be required for keeping the sealed RI.**
- 2. RI display on the front.**

10-73 Desks and chairs

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
- Desk	30	30	900
- Chair	5	60	300
	(Total)		1,200

Specifications:

Desks: 1,500 x 500 x H. 30 sets x 30,000 yen = 900,000 yen

Chair: same as No. 2-32 60 sets x 5,000 yen = 300,000 yen

10-74 Workbench

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Worktable	-	14	1,140
Chair	5	56	280
	(Total)		1,420

Specifications:

Same as No. 2-32 and 6-43.

Workbench:

1. 2,000 x 1,200 x 760 H m/m	10 sets x	100,000
		= 1,000,000 yen
2. 1,500 x 750 x 760 H m/m	2 sets x	40,000
		= 80,000 yen
3. 1,500 x 500 x 760 H m/m	2 sets x	30,000
		= 60,000
(Total)		14 sets 1,140,000 yen
Chair	56 sets x	5,000
		= 280,000 yen

10-75 Movable blackboard

Room No. & name of facilities	Dc 310, 311 Lec. EM Dc 307, 308, 309 Workshop EM		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
-	50	5	250

Specifications:

Same as No. 2-34

10-76 Locker

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
- Shelf	60	10	600

Specifications:

Same as No. 2-33

10-77 Copier

Room No. & name of facilities	Dc 306 Instructor's Office		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
-	400	1	400

Specifications:

Same as No. 1-4

10-78 Overhead projector

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
-	150	2	300

Specifications:

Same as No. 1-11

10-79 Movie projector

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
-	750	1	750

Specifications:

Same as No. 1-12

10-80 Slide projector

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
-	120	2	240

Specifications:

Same as No. 2-35-3

10-81 VTR unit

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
-	1,000	1	1,000

Specifications:

Same as No. 1-15

10-82 Amplifier for lecture

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
-	150	1	150

Specifications:

Same as No. 1-8

10-83 Taperecorder

Room No. & name of facilities	-			
Name of manufacturer & type for reference	Unit price	Q'ty	Amount	
-	Cassette recorder	60	4	240
	Tape eraser	20	4	80
	Cassette tape (C-60)	0.5	120	60
	(Total)			380

Specifications:

Same as No. 3-57

10-84 Wiring materials for practice

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
-	-	-	350

Specifications:

Parallel vinyl code: 0.75 mm² 50 turns
 1.25 mm² 20 turns

Round vinyl code: 1.25 mm² 20

Vinyl lead for instruments: 0.75 mm² 100 turns (5 colour x 20m)
 0.5 mm² 100 turns (5 colour x 20m)

Heat compression tube: 10 mm (diameter) 200 m

Curl band: 10 mm (diameter) 200 m

10-85 Electrical parts for practice

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
-	-	-	350

Specifications:

- 1. Plug 20 G
- 2. Consent 5 G
- 3. Table tape (3-out let) 10 G
- 4. Switch 5 G
- 5. Vinyl tape 500 turns (5 colors x 100 t.)

10-86 Others for practice

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
-	-	-	140

Specifications:

- Fixed resistance box: 1/4 W 22 kinds x 1G
- Mylar condenser: 50 WV 22 kinds x 1G
- Variable resistance box: metallic 22 kinds x 20 pcs.
- Universal IC printing board: for micro computer 100 sheets
- Electric lapping tools (for N 28) 1 set
- Lapping wiring materials 5 colour x 200 m
- IC socket for lapping 1G for each

11. Computer centre

Cost of equipment:

Price Thousand Yen: 95,990

Price US \$: 492,256

11-1 Electronic computer system

Room No. & name of facilities	C111 Computer		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
IBM Fujitsu Hitach NEC	60,000	1	60,000

Specifications:

1. Component instruments of the system

- (1) CPU: capacity of medium size or more
main memory - 500 MB or more
- (2) Auxiliary memory: a) disc apparatus - 5 MB or more x 2 pack or more
b) magnetic tape apparatus - full/half reel, 2 or more
- (3) Console: display and typewriter
- (4) Card reader: 1,000 cards/min or more
- (5) Line printer: number of letters 63 - 132
130 letters/line 1,000 letters/min or more
- (6) XY plotter: high speed type of A3 or higher
- (7) Paper tape: reading 1,000 c/s, punch 200 c/s or more

2. Software

- (1) System control program (DOS type)
- (2) Language processing program: COBOL, FORTRAN, PL/I, ALGOL, etc.
- (3) Application: APT, for plotter, numerical calculation, education information system, etc.

3. Spare:

- Disc pack: present number x 3
- magnetic tape: present number x 5
- paper tape, card, LP form, 1 year amount

4. Weight of machine (approximate)

Voltage stabilizer: assuming at 20 KVA 1,5 t

Line printer: It

CPU, disc, magnetic tape, etc.: 0.5 t max.

Others: 0.2 - 0.3 t

5. Power consumption (approximate)

3φ 20 KVA

Single phase 3 - 5 KVA inclusive

Stability within 5%, consideration on noise

6. Input and output in Arabic letters to be incorporated as far as possible.

7. Processing capacity

(1) Educating information processing: 40 students

at a time, several hundred jobs

(2) School education information processing: To be of a large enough scale capable of future 5 - 6 years' use under estimated future expansion.

8. Installation works

1) Carrying in electronic computer system

2) Wiring power line from the distributing board of computer room. (voltage stabilizer inclusive)

3) Adjusting and testing electronic computer system

Remarks:

1. The electronic computer system is used as computing center of the high school by the teachers and for management of the school.

2. Separate consideration shall be given for a proper operation of the system for a long period. (periodical preventive maintenance)

3. Sufficient equipment shall be arranged for the environmental conditions.

4. Voltage stabilizer shall be included.

11-3 Paper tape punch

Room No. & name of facilities	CIII Computer		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Fujitsu NEC	1,000	1	1,000

Specifications:

Paper tape: 8 units

Punching speed: 20 c/s

Printing function: 120 letters/line, 1,200 letters/min.

Kind of letters: alphabet, numeral, mark, (Arabic)

Keyboard arrangement: ISO

Code: ISO

Power required: 300 VA

Weight: 150 kg

Remarks:

1. To be arranged in the computer center of the school, and the code specification shall be in accord with those of other workshop rooms.
2. Power source: specified in situ

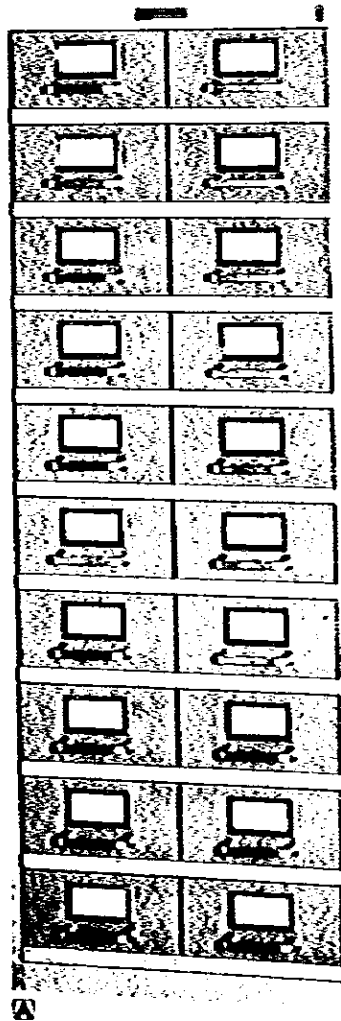
11-4 Cabinet

Room No. & name of facilities	C115 ST.		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
PLUS	100	10	1,000

Specifications:

Cabinet for 80-measure standard punching cards: with 10 drawers

**Drawer: dimensions - 190 (W) x 690 (D) x 94 (H)
number - 20 pcs (two rows)**



11-5 Cabinet

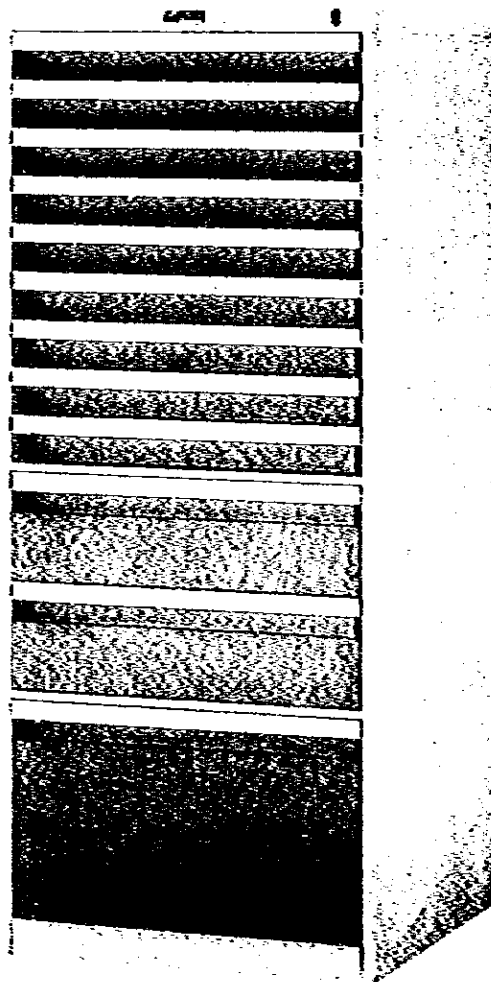
Room No. & name of facilities	C115 ST.		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
PLUS	120	1	120

Specifications:

Cabinet for 8-unit paper tapes:

Drawer:

- 1. Partitioned drawer: 478(W) x 577(D) x 300(H) 9 pcs.
- 2. Non-partitioned drawer: 478(W) x 577(D) x 138(H) 2
- 3. Large-sized drawer: 478(W) x 577(D) x 278(H) 1



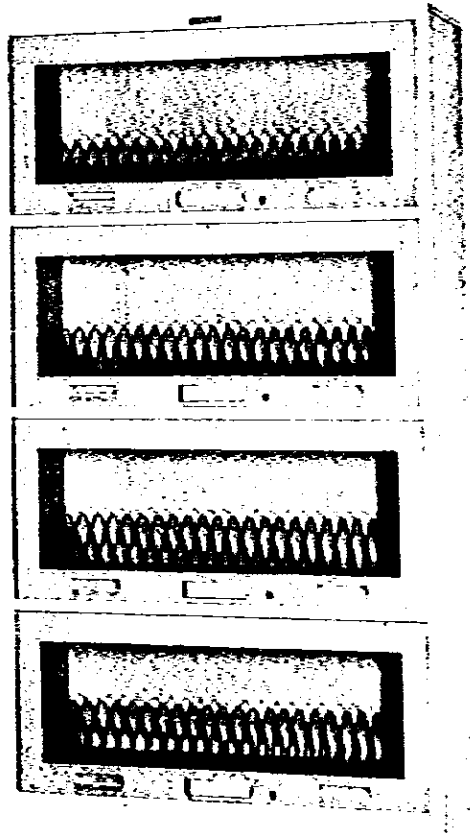
11-6 Cabinet

Room No. & name of facilities	C114 ST.		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
PLUS	200	2	400

Specifications:

Cabinet for magnetic tape:

1. Capacity: 100 reels of thin-type (2,400 ft)25 reels x 4 drawers
2. Kendon type cabinet: of steel, with glass-door



11-7 Data filing desk

Room No. & name of facilities	--		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
-- Desk	50	15	750
Chair	5	30	150
	(Total)		900

Specifications:

Desk: type D, 1,500 x 500 15 sets

Chair 30 pcs.

11-8 Movable blackboard

Room No. & name of facilities	C112 Briefing, C113 Prep.		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
--	50	2	100

Specifications:

Same as No. 2-34

11-9 Locker

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
- Shelf	60	4	240

Specifications:

Same as No. 2-33

11-10 Overhead projector

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
-	150	2	300

Specifications:

Same as No. 1-11

11-11 Individual study trainer

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Ricoh My teacher	250	3	750

Specifications:

Interlocked operation of slide and magnetic tape: hearing type

Automatic recording adjustment circuit

S/N ratio: 30 dB

Wow and flutter: less than 0.8 %

Speaker: ellipse-type, 16x 6cm (8 Ω)

Maximum output: 450 mW

Power source: AC 220 V 60 Hz

Power requirement: 10 W

Dimensions: about 380 (W) x 270 (D) x 150 (H) Weight: about 6 kg

Accessories:

1. Microphone
2. Headphone
3. Radio cord
4. Magnetic sheets as teaching materials 500 sheets

11-12 Slide projector

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
-	120	2	240

Specifications:

Same as No. 2-35-3

11-13 Amplifier for lecture

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
-	150	2	300

Specifications:

Same as No. 1-8

11-14 Taperecorder

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Cassette recorder	60	2	120
Head cleaning liquid	1	20	20
	(Total)		140

Specifications:

Same as No. 3-57, but the following accessories are included.

Accessories:

1. Head cleaning liquid: 20 sets
: for head and rubber
2. AC power source cord 2

11-15 Copier

Room No. & name of facilities	C113 Prep.		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Canon Type NP-5000	1,500	1	1,500

Specifications:

Electronic dry copier:

Copying size: B5, B4, A4, A3

Copying speed: 10 sheets/min.

Paper driving: cassette type (400 sheets x 2)

Continuous copying mechanism: 1 - 99 sheets setting system

Remarks:

- 1. The regular checking, adjustment and maintenance shall be required.**
- 2. The articles of consumption shall be provided regularly.**

11-16 Coding sheets

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
-	-	-	1,500

Specifications:

Coding sheets for computer: standard type

1. FORTRAN2000 volumes
2. COBOL1000
3. PL/I..... 1000
4. ASSEMBLERA 1000

11-17 Tin plate

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
-	1	500	500

Specifications:

JIS: about 25 x 13 cm, of plastic,
name of the Insitute (English) shall be included.

12. Teaching materials center

Cost of equipment:

1. Price Thousand Yen : 117,514

2. Price US \$: 602,636

12-1~13 Teaching materials center studio equipment

Room No. & name of facilities	C105 Monitor, C106 Recording C107 Announce, C108 Studio		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
AVCC Studio system	-	-	60,900

Specifications:

The studio shall aim at preparation of video teaching materials and communication of information to the school facilities, and two systems of CCTV and school broadcasting shall be introduced as a means of communicating information.

CCTV system is composed of three sections: studio, control room and classroom or practice room. Studio shall prepare VTR teaching materials and provide professors, officers and students with information through television broadcast.

A sufficient illumination is indispensable for a good picture in using camera, especially color camera, and due considerations shall be given to the illuminating equipment.

The control room shall be capable of sending out (1) direct broadcast from the studio through camera, (2) pictures already prepared through videotape, (3) 16 m/m movie, (4) slide picture, (5) 8 m/m movie, and (6) on-air national broadcast, etc. to respective section concerned. The sending-out shall be in three series of audio and visual. Various kinds of equipment (wiper, for example) shall be arranged to enable editing of VTR tape.

Classrooms and workshop rooms shall be equipped with television receivers as the console units to receive the pictures from the studio and control room. CCTV with classroom as a unit shall be possible by switching.

The in-school broadcasting system shall aim mainly at broadcasting within the school building, school ground and workshop rooms, etc. while being utilized for call, time chime and delivery of information requiring no picture, and the equipment shall be placed in the control room. The sending channel shall be so divided that separate items can be handled for each school year.

In order that the broadcast is more effective, an announcing room for voice shall be arranged and equipped, similarly to studio system, with instruments, such as player and tape recorder for sending out vocal

teaching materials, so that the equipment can be operated conveniently.

Instruments construction:

Studio:

1. Color camera (with tripod and lens): 2 sets	7,500 yen
2. Monochrome camera (- ditto -): 2	1,500
3. Monitor television set: 2	1,000
4. Speaker (for talk back): 1	100
5. Microphone: 3 - 4	500
6. Illuminating apparatus: 1	1,500
7. Connection box and cables: 1	1,500
8. Service parts: 1 set	1,500
<hr/>	
Total:	15,100 yen

Control room:

1. Picture control console (for color AV): 1 set	15,000
2. Voice control console (for broadcasting): 1	2,500
3. Tape recorder and player: 1	1,500
4. Video tape recorder: 1	1,500
5. Video corder console for editing: 2	3,500
6. Tape recorder console for editing voice: 1	500
7. Color telecine apparatus including projector: 1	4,000
8. Projecting instrument storing frame: 2	3,800
9. Amplifier for voice (360W x 2): 2	3,200
10. Monitor TV storing rack: 1	1,300
11. A set of service parts and small articles	4,000
12. Light control console: 1	2,500
13. Recorded voice mixer console with 3 microphones: 1 ...	2,500
<hr/>	
Total:	45,800 yen
<hr/>	
Grand Total:	60,900 yen

Remarks:

The equipment shall be designed with an object to use it mainly for preparation of video teaching materials and in-school broadcasting system so that it can be used for students' practice, that each instrument is provided with a remote control device, and that it can be operated by a small number of people.

Although specifications for constituting items are shown, it should function better as a whole system and special attention shall be paid to make the most of its basic function.

12-1 ITV studio camera

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
SONY	750	2	1,500

Specifications:

Specifications similar to No. 8-9.

Monochrome camera for studio

Horizontal resolution: 250 lines or above

Can operate at control console in control room.

With a tripod (mobile stand)

Scanning system: according to the specification in situ

With zoom lens, finder, cables and a set of other accessories.

Remarks:

Auxiliary camera of remote control and zooming type to be used in the studio of the school.

Used in semi-fixed position.

12-2 ITV colour camera

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
SONY	3,750	2	7,500

Specifications:

Specifications similar to No. 8-10.

Colour camera for studio

Horizontal resolution: more than 300 lines

Can operate at control console in the control room.

Manual and remote control

A set of color camera, with a tripod (mobile stand) and remote control

Scanning system: as specified in situ, SECAM system.

With zoom lens and finder

Small adjusting items and easy handling

With microphone

With a contacting telephone between control console.

Remarks:

Camera for color television to be used in the studio of the school. Should function under a low illumination and suitable for practice by students and preparation of teaching materials.

12-3 Studio control console

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
SONY Colour AV control console	1,500	1	1,500

Specifications:

Capable of operating two monochrome cameras and two color cameras.

Built-in monitors: specifications in situ 4 sets

Have various controlling circuits.

Includes telecine, pattern (external), telop circuits, etc.

Capable of receiving broadcast in situ, voice and picture.

Includes instruments for voice such as record, tape and voice circuit.

Includes 2 microphones for studio with stand.

Capable of connecting with recording VTR.

Includes various mixer circuits and switches.

Capable of utilizing remote control microphones.

Television system output: picture and voice3 circuits for each

Capable of sending to each classroom.

and preparing teaching materials and recording by (built-in cassette video tape recorder) video recorder.

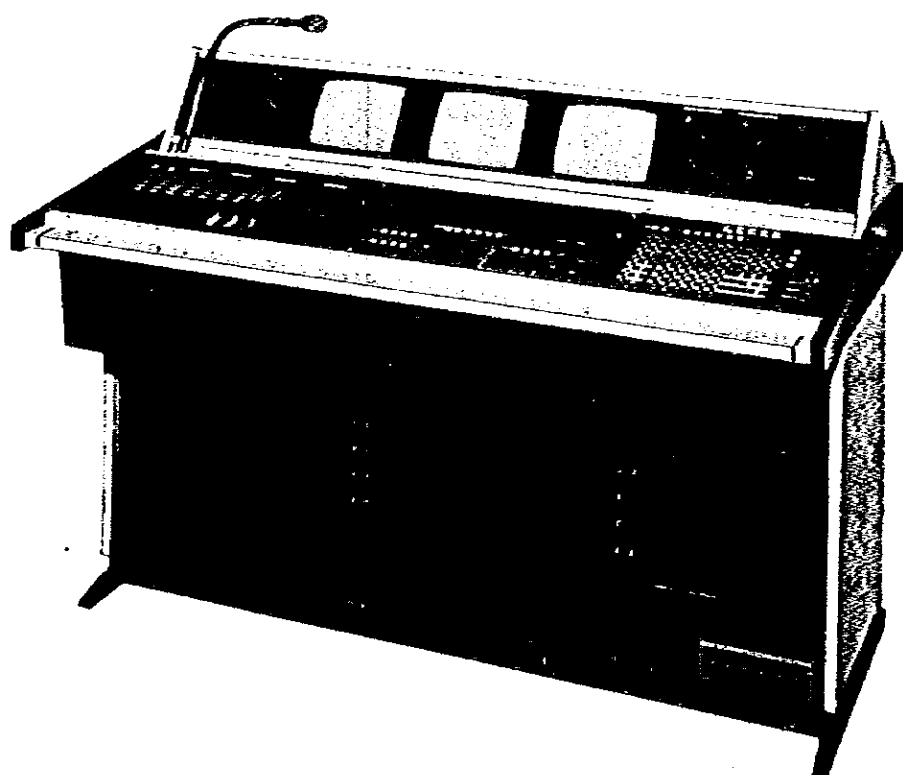
Remarks:

A television control console for teaching materials center studio

For operating cameras (No. 12-1 and 12-2) and has mixing, change-over, and wiping mechanisms.

The voice circuit can be used in combination with No. 12-4.

For reference:



12-4 Hall broadcast system

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
SONY	2,500	1	2,500

Specifications:

Three-way broadcast system of desk type: 203 (W) x 48 (D) x 87.5 (H) cm (approx.)

Rated output: 40 (W) x 4 or above

Speaker: more than 160 pcs.

Record player desk (for stereo)

Tape recorder desk (for open reel and cassette tapes)

With wireless amplifier and 4 sets of wireless microphones

Capable of broadcasting in connection with the desk lines

Speakers:

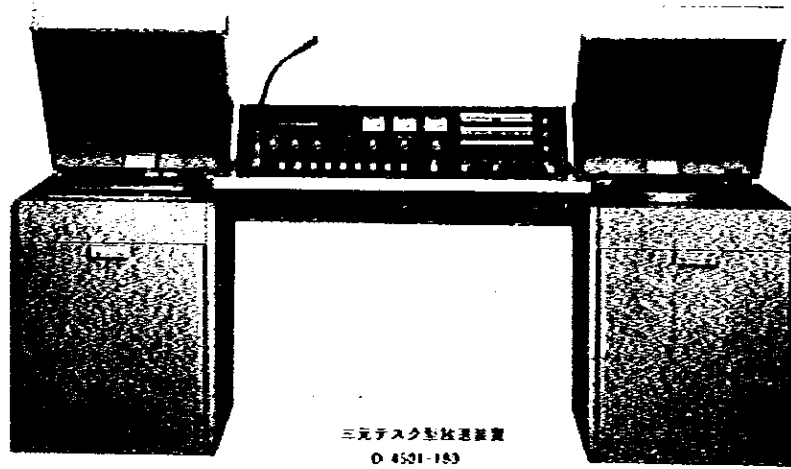
- Speaker for classrooms, workshop rooms and others: 3W, 16cm, dynamic type with box 160 pcs.
- Speaker for large classrooms: 10W, dynamic type with box 30
- Trampt speaker: 15W, dynamic type with box 6
- Movable microphone with stand and cables 4
- Pre-amplifier for controlling and mixing 1 set
- Bell timer: for setting 4 kinds of timer 1
- Music chime 1

Remarks:

Broadcast system: for notifying time and announcing generally or partly.

Easy handling

Capable of controlling, mixing and sending out of voice signal in combination with No. 12-3.



3 - way broad cast system

12-5 Film continuity equipment

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
EIKI Type UST-3	500	1	500

Specifications:

Projector: 16 m/m optical and magnetic recording and playback type

Lense: can be closed to TV camera

Lamp life: 900 LX at minimum

Projecting speed: 24 frames

Rewinding: high speed automatic

A set of film cutting tools: for 16 m/m and 8 m/m

Film cement: 10 bottles.

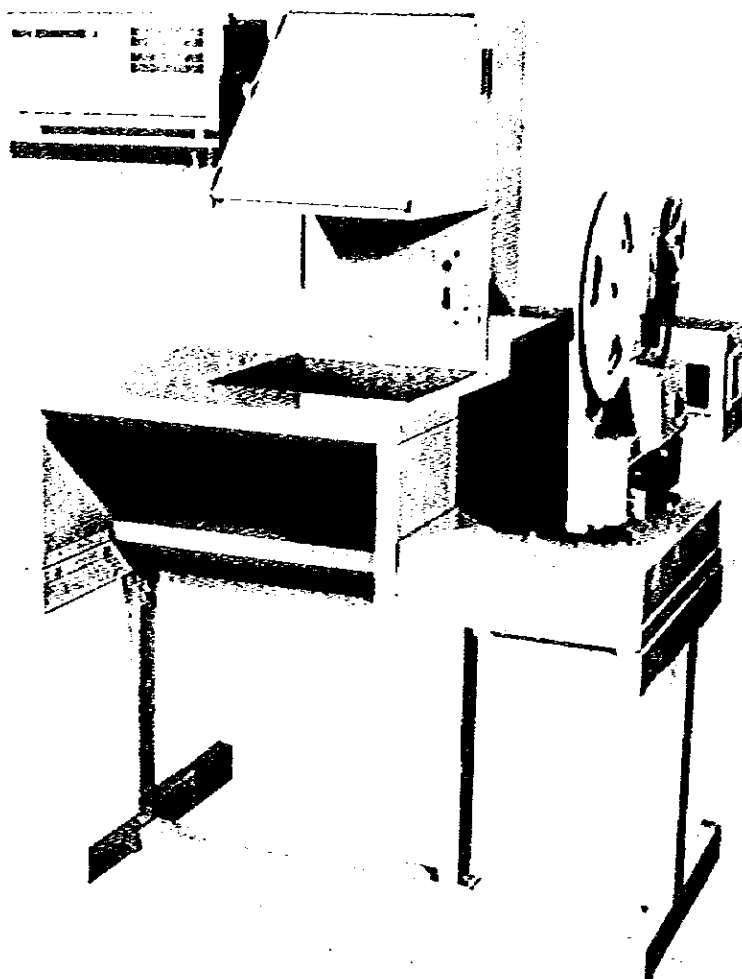
Remarks:

Automatic 16 m/m projector for studio use

Film is automatically fed from reel to reel and rooled up.

A set of projector and cutting tools

For reference:



12-6 Film video transmitter

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
SONY Colour telecine apparatus	4,000	1	4,000

Specifications:

A teaching materials presenting apparatus including 16 mm, and 8 mm projector, video camera, telecine attachment

Capable of converting a picture of a size from the visiting card to A4 into a full image in television receiver by just placing the picture on the picture board.

Illumination: 150 W x 2 lamps

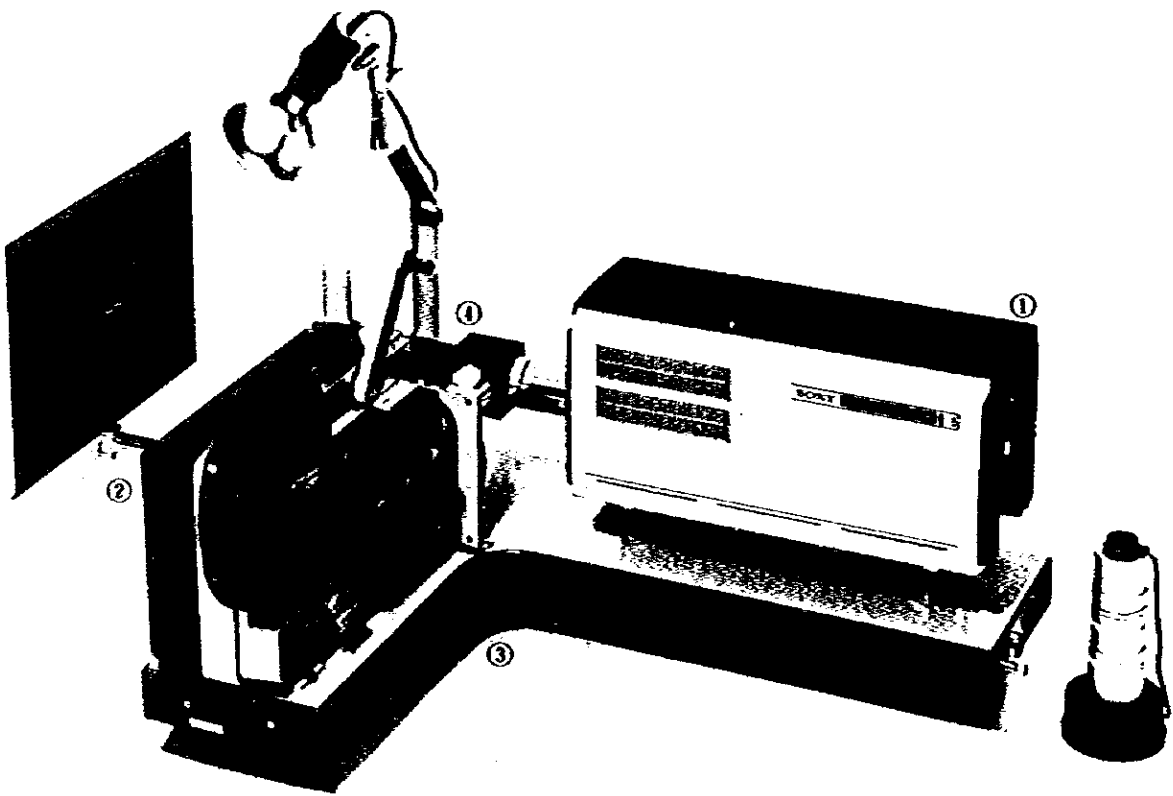
Component parts: a set of field lens, multipressor, TV camera, projector, etc.

Divided for connection with studio control console (No. 12-3), convenient use in preparation of teaching materials, and VTR picture recording.

Remarks:

Installed in teaching materials center

Capable of converting film, slide or other materials into image, and convenient for preparing teaching materials.



12-7 VTR unit, w/monitor

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Qty	Amount
SONY	1,500	2	3,000

Specifications:

VTR unit for editing: capable of video recording and editing simple operation

Video tape recording apparatus: capable of play back for more than one hour

Horizontal resolution: more than 250 lines

Suitable for school broadcasting in combination with the control console.

Color system and others: specified in situ, SECAM, CCIR system

Contained or interlocked with the studio control console (No. 12-3)
Specially considered for recording with a cassette tape recorder.

Accessories:

1. Tape 10
2. Connector 1 set
3. Cleaner 1 set
4. Tools 1 set

Remarks:

VTR unit for studio: simple operation of edition, video recording, and playback

12-8 Taperecorder

Room No. & name of facilities		-		
Name of manufacturer & type for reference		Unit price	Q'ty	Amount
SONY	Type TCR 7-2	218	4	872
	DP-30	5	4	20
	Super A A7-120	1	20	20
-	Others	20	4	80
		(Total)		992

Specifications:

Same as No. 9-82, but the following accessories are included.

Cutting tools:

1. Dermatograph (yellow): 12 for each x 4 48
2. Tape splicer: one for each x 4 4
3. Splicing tape: 30 cm for each x 4 120 cm
4. Timing tape: 300 m for three types x 4 3,600 m

12-9 Small-sized portable recording machine

Room No. & name of facilities		-		
Name of manufacturer & type for reference		Unit price	Q'ty	Amount
SONY	Type TC 3000 SD	70	2	140
	Type BP-8H	8	2	16
	B 301	20	2	40
TDK	Type D (C-60)	0.5	20	10
		(Total)		206

Specifications:

Same as No. 7-55, but the following accessories are included.

1. Charging battery: SONY type BP-8H or the equivalent 2
2. Boom stand: SONY type B301 or the equivalent 2
 Thread adjustment: 18 (u 5/16) and 14 (PF1/2) or
 with adapter
3. Cassette tace: TDK C-60 or the equivalent 20
4. AC power source code 2

12-10 Slide video transmitter

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Uchida Yoko	1,700	2	3,400

Specifications:

A set of apparatus for converting picture from 35 ,m/m slide projector into television image

Slide projector: for 35 m/m

TV camera: for color, with lens, specified in situ

With color film change adapter

Includes color control and adjustment apparatus, camera attachment for super-imposing photograph, illuminator, close-up lens, rotatable titler, Telop card holder, and holder attaching fitting.

Remarks:

A slide telecine apparatus : a set of 35 m/m slide TV projector

Can use together with the Film video transmitter (No. 12-6).

12-12 Darkroom equipment

Room No. & name of facilities	C101 Dark RM.		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Olympus Nikon	1,000	1	1,000

Specifications:

Camera: 35 m/m single-lense reflex, with tripod, with a set of interchangeable wide angle, 130 m/m telephoto, and close-up lenses

Enlarger 2 sets
 Developing tray and tank 10
 Chemicals 100
 Other small articles 10
 Film 100 pcs.
 Photographic paper 100 cases x 10

Remarks:

Cameras and a set of developing equipments: for making slides and teaching materials.

12-13 Record player

Room No. & name of facilities		-		
Name of manufacturer & type for reference		Unit price	Q'ty	Amount
Technics	Record player type SL-01	80	4	320
	Cartridge type 270C-II	11	4	44
	Spare stylus type EPS-270 ED	6	8	48
Nagaoka	Cleaner type Whlty II	1	4	4
		(Total)		416

Specifications:

Wow and flutter: less than 0.03 % (WRMS)
 S/N ratio: more than 75dB (DIN-B)
 Turn table diameter: more than 30 cm
 Rotation: 45 rpm, 33-1/3 rpm
 Power source: AC 220 V 60 Hz

Accessories:

1. Cartridge 4 sets
 Power generation method: MM type
 Frequency range: 20 Hz - 25 kHz
 Stylus pressure: 1.5 - 2.5 g
 Output voltage: 3 - 3.5 mV
 Technics type 270C-II or the equivalent
2. Spare stylus 8 pcs.
3. Cleaner 4 pcs.

Remarks:

AC power source shall be used.
 With inside force canceller and arm lifter
 Direct drive phone-motor
 Weight: about 9 kg
 Suitable cartridge weight: 5 - 11 g

12-14 Offset printer

Room No. & name of facilities	C102 Copy		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Ricoh Auto priuter type 1510	1,500	2	3,000
Electronic printer type S-3	700	2	1,400
Etching processor	300	2	600
Printing machine, etc.	500	2	1,000
	(Total)		6,000

Specifications:

Offset printer: can be used for up to B-4 size paper.

Paper quality : fine paper, medium-grade paper, or pulp paper(36Kg-135Kg)

Automatic master loading and ejection

Loaded paper: 85m/m(height)

Printing speed; varoable from 3,600-7,200 copies/hour

Etching method: Molton rooler system

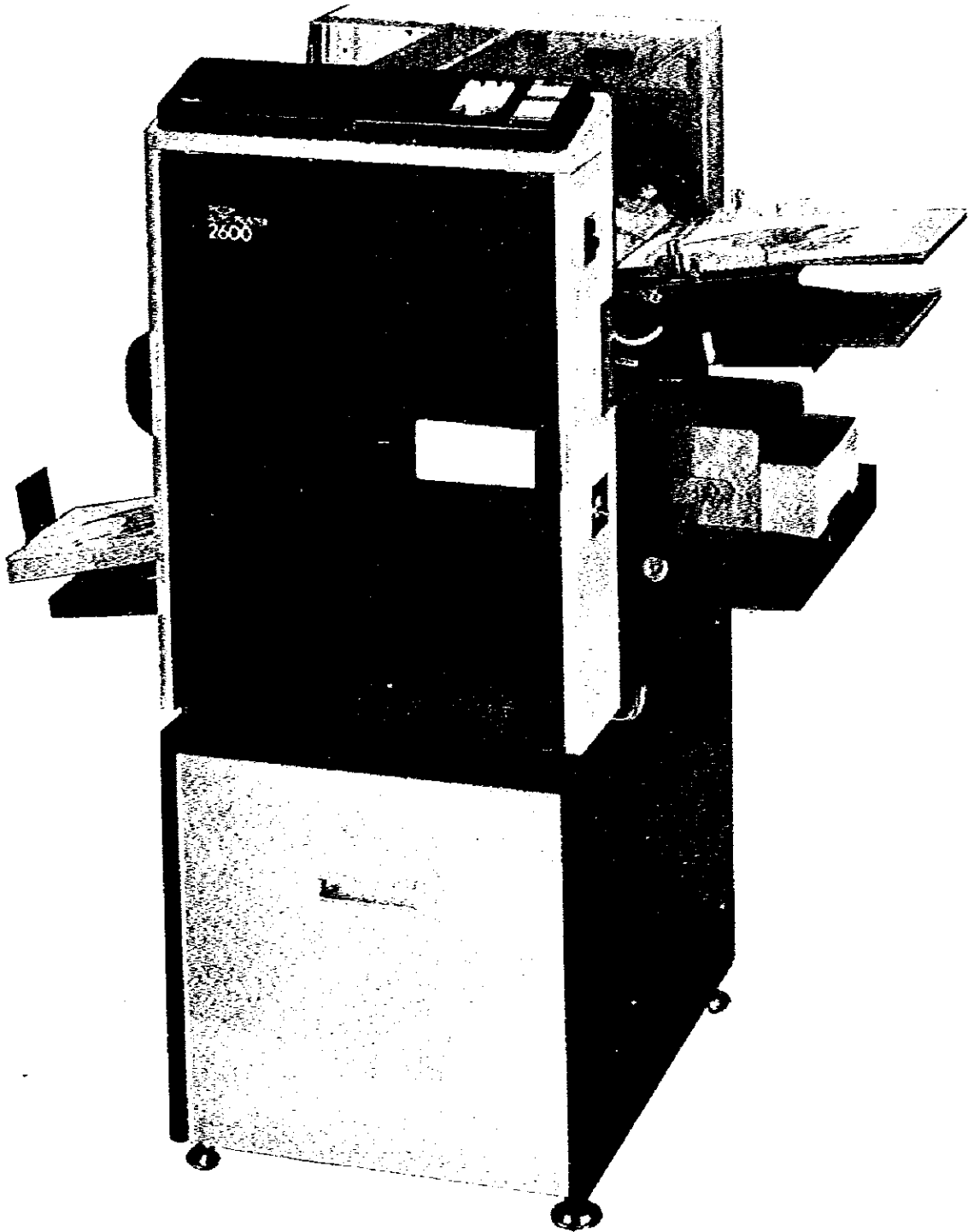
One lever automatic printing system

A set of printing machines such as electronic printer and etching processor, etc.

Accessories:

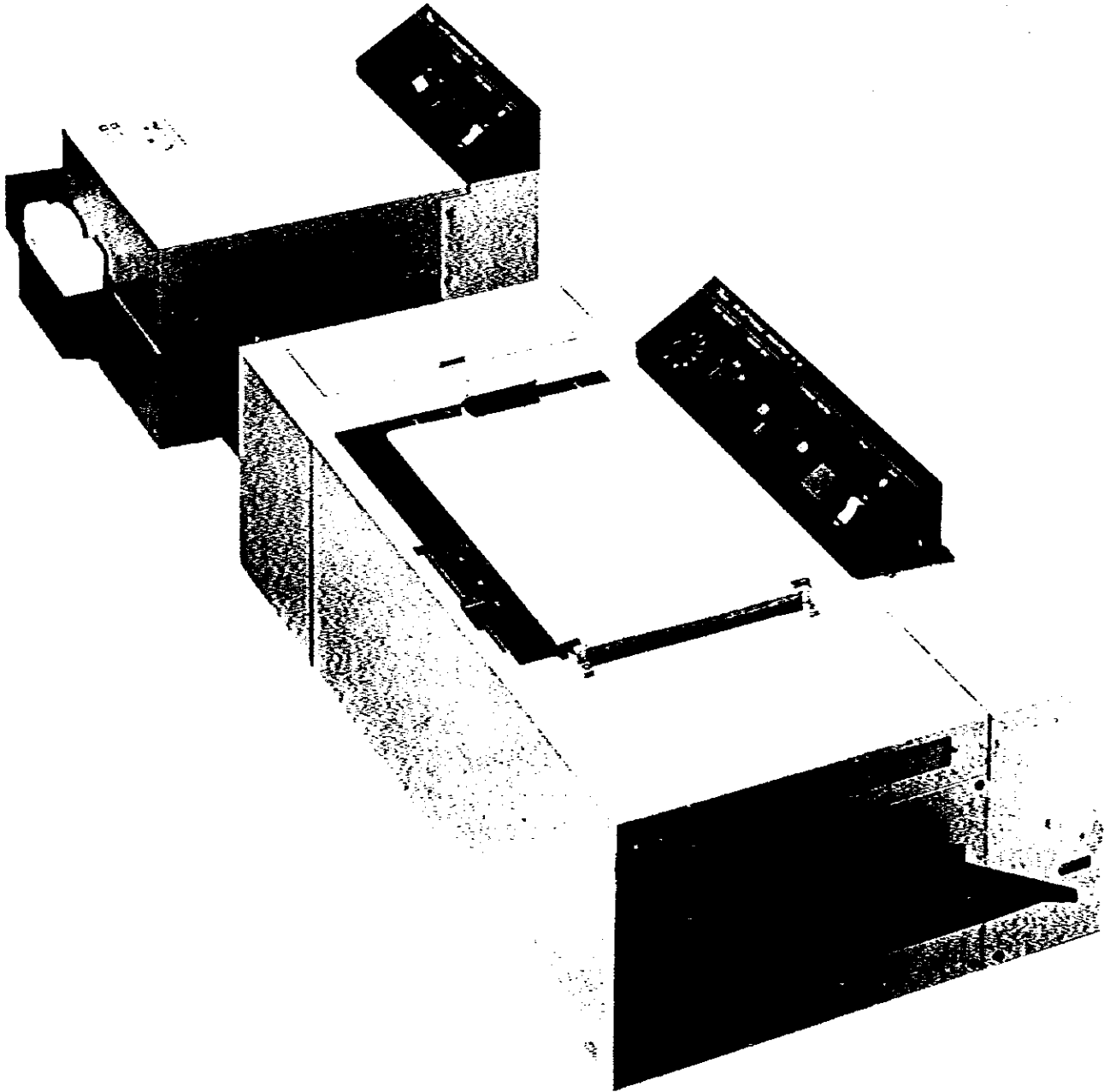
1. Ink, etching fluid: for a half year use
2. Small articles for printing
3. Maintenance tools, oil, cleaner, etc.
4. Printing paper: 1000sheets x 100 package.
5. Spare parts: 2 sets.

For reference:



auto printer

For reference:



Electronic printer and auto processor

12-15 Copier

Room No. & name of facilities	C102 Copy		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
-	400	2	800

Specifications:

Same as No. 1-4

12-16 Book binder

Room No. & name of facilities	C102 Copy		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
-	200	1	200

Specifications:

Paper cutting machine: for more than A3 size
500 papers can be cut at a time.

Book binding machine: for more than B5 size

Stapler, folding machine, and expendable supplies (for 10,000 copies for each): Paper cutter, screwed 2-hole punch, rotary piercer, binding machine for book binding, etc.)

Remarks:

Book binding machine for copy room

Used to prepare teaching materials for B5 or A3.

12-17 Desk & chair

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
-	-	-	2,800

Specifications:

1. Armchair for guest room:	2 sets	x 50,000 yen	= 100,000 yen
2. Sofa for three for guest room:	4	x 100,000	= 400,000
3. Chair for a person for guest room :	10	x 20,000	= 200,000
4. Table for guest room:	1	x 50,000	= 50,000
5. Sofa for guest room:	6	x 150,000	= 900,000
6. Table for library: 1,800(W) x 900(D) x 700(H)	5	x 90,000	= 450,000
Collapsible chair:	20	x 7,500	= 150,000
7. Counter for library with cabinet:	2	x 150,000	= 300,000
Chair for officer:	5	x 10,000	= 50,000
8. Collapsible table for conference:	4	x 30,000	= 120,000
Pipe chair for conference:	16	x 5,000	= 80,000
		(Total)	2,800,000 yen

12-18 Locker

Room No. & name of facilities	~		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Uchida Yoko	--	--	1,860

Specifications:

1. Bookshelf with locker: 2,000(W) x 400(D) x 1,700(H)
2 sets x 100,000 yen = 200,000 yen
2. Sideboard: 2,000(W) x 450(D) x 850 (H)
1 x 60,000 yen = 60,000
3. Cabinet: same as No.3-49:
10 x 60,000 yen = 600,000
4. File locker: 1,550(H) x 520(W) x 760(D) standard type,
4 shelves: 10 x 40,000 yen = 400,000
5. Steel tray cabinet: 1,840(H) x 900(W) x 560(D)
3 rows, 20 shelves B4 type: 3 x 200,000 = 600,000

(Total) 1,860,000 yen

Remarks:

Arranging cabinet and material locker for studio

12-19 Shelf

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Uchida Yoko	-	-	3,120

Specifications:

1. Cabinet for records: 1,760(W) x 400(D) 500(D) x 1,850(H)
of steel 6 sets x 80,000 yen = 480,000
2. Cabinet for films: 1,800(W) x 400(D) 500(D) x 1,800(H)
..... 4 sets x 100,000 = 400,000
3. Cabinet for slides: 1,760(W) x 550(D) x 1,850(H)
..... 4 sets x 100,000 = 400,000
4. Cabinet for OHP: 1,800(W) x 400(D) 500(D) x 1,800(H)
..... 4 sets x 100,000 = 400,000
5. Bookshelf: 1,800(W) x 450(D) 720(D) x 1,800(H)
..... 10 sets x 70,000 = 700,000
6. Arranging rack for printing room:
1,720(W) x 470(D) x 1,383(H)
..... 10 sets x 70,000 = 700,000
7. Magazine rack: 1,888(H) x 1,000(W) x 400(D)
..... 2 sets x 20,000 = 40,000

(Total)

3,120,000 yen

12-20 Stationery

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
-	-	-	10,000

Specifications:

- B4 size paper: for printing and testing 1,000 sheets x 1,000 packages
- Totalizing paper: various kinds 100 sheets for each x
10 kinds
- Envelope: large, middle, and small size 10,000 for each
- Pencil: red and black (HB, H, B) 100,000 pcs.
- Ball-point pen: red and black 1,000 pcs.
- Marking pen: red and black 500 pcs.
- Tube paste, binding thread (a package of 100 pcs.), eraser (with abrasive), blotting paper (a package of 200 sheets), vynil tape, covering paper, packing tape, file (A5, B5 size), clip (a package of 100 pcs.), drawing pin, paper holder, rubber band, vermilion inkpad, vynil patch (a package of 240 pcs.), stamp pad (black and red), cardrring, ink and pen, finger stall, stapler, chalf (white, black yellow, green and blue), pin for stapler, blackboard eraser, marking ink, knife, large-sized clip (a package of 3 pcs.)
..... 1,000 pcs. for each
- Blackboard eraser cleaner 30 sets
- Tape cutter 50 pcs.
- 2-hole punch 30
- Measuring tape: 2 m 30
- Scissors: about 160 m/m 50
- Cutter knife: 9 m/m wide edge 50
- Paper cutter: for B4 size 3
- Clear case: B4 and B5 100 for each
- Paper bond (adhesive) 200
- Clear bond (adhesive) 200
- Stamp case : small size 20
- Copying paper: B5 and A4 50 package for each
- Graph paper: B5, 40 sheets x 100
- Logarythmic coordinate paper: B5 40 sheets x 100
- Logrythmic andlinear coordinate paper: B5, 40 sheets x 100
- Tracing paper: B5, 40 sheets x 100
- Lever file: B5 100 pcs.
- Spring file: B5 100

Clear file: A4100
Form holder 100
Scrape book: H 100
Clear book: B4 100
Note book: No. 6 (size) 100

Remarks:

A set of stationery, papers, expendables, etc. for school.

12-22 Recording tape

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
-	-	-	1,500

Specifications:

Magnetic tape for VTR:

Open reel: for 1 hour 100 pcs.

Cassette: for 1 hour 1,000 pcs.

These tapes shall fit tape recorders used in the school.

Remarks:

Tapes for VTR: suitable for using in the classroom and laboratory.

12-23 Recording tape

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
SONY Super A type A7-120	1	100	100
Type R-7A (empty reel)	0.2	100	20
	(Total)		120

Specifications:

Tape width: 1/4 - inch
 Normal bias and normal equalizer
 Length: more than 370 m
 Thickness: more than 32 μm

Accessories:

Empty reel: No. 7 sized fine
 hub reel, SONY type R-7A or
 the equivalent 100 pcs.

Remarks:

Winded on the No. 7 (size) fine hub reel
 High-grade acoustic tape

12-24 Camera film

Room No. & name of facilities	--		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
-	-	-	500

Specifications:

Color films:

- 16 m/m cinema film: for photographing 50 pcs.
- 35 m/m film: ASA 100 and 400 for photographing ... 500 for each
- 8 m/m cinema film: for photographing 50

Remarks:

For making teaching materials and recording
 Suitable for cameras of item No. 12-12 and 12-21.

12-25 Record

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
-	3	1000	3,000

Specifications:

Educational record

1. General education
2. Music
3. Testing
4. Language study

With 10 copies of list

Remarks:

For library and teaching materials

10-26 Slide film

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
-	30	100	3,000

Specifications:

Educational slide:

1. General education
2. Language study
3. Electricity
4. Electronics
5. Physical education

With 10 copies of list

Remarks:

Slide films for library: suitable for teaching materials.

12-27 Sensitive paper for copying

Room No. & name of facilities			
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
-	-	-	1,000

Specifications:

Paper for electronic copying: B4, B5 and A4 size
 100 sheets x 100 packages

Sensitive paper for recopying: A3 and B4 size
 100 sheets x 20 packages

Remarks:

Electronic copying paper: including A3 size for drafting paper

12-28 Recorded tape

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
-	50	100	5,000

Specifications:

Video tapes as teaching materials: recorded tapes

- 1. General education**
- 2. Physical education**
- 3. Language study**
- 4. Electricity**
- 5. Mechanics**
- 6. Electronics**

Remarks:

Tapes shall be stored in a library and lent for teaching.

12-29 Recorded tape

Room No. & name of facilities	—		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
—	5	300	1,500

Specifications:

Cassette tapes as teaching materials: recorded

1. General education
2. Physical education
3. Language study
4. Electricity
5. Mechanics
6. Electronics

Remarks:

Acoustic tapes: stored in a library and lent for teaching.

13. Solid state physics experiment (Electronics engineering III)

Cost of equipment:

Price Thousand Yen : 18,108

Price US \$: 92,862

13-1 Experimental laser equipment

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
-	127	1	127

Specifications:

Same as No. 5-19

13-3 Planck's constant measuring device

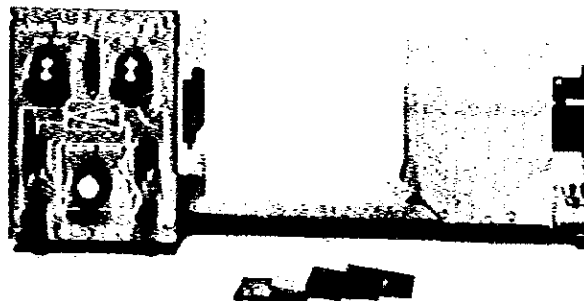
Room No. & name of facilities	-			
Name of manufacturer & type for reference	Unit price	Q'ty	Amount	
Shimazdu Scientific Instrument Planck's constant apparatus type HA-4	62	8	496	

Specifications:

- Light receiver: vacuum photoelectric cell
- Light source: incandescent lamp 220V 100W
- Filter: four kinds (colored acryl plate)
- Amplifier: DC amplifier amplification degree 40 dB
- Accuracy of measurement: approximately 10^{-34} (J. sec)
- Electric power: AC 220V 60 Hz
- dry cell (015) 22.5V two
- (UM-1) 1.5V two

Remarks:

This is used by a student group to impressively grasp the Planck's constant which is one of the fundamental constants used in the modern physics through the mutual reactions between photons and electrons during use of photoelectric effect.



137-400 プランク定数測定器 HA-4E

13-4 Frank-Hertz's experimental arrangement

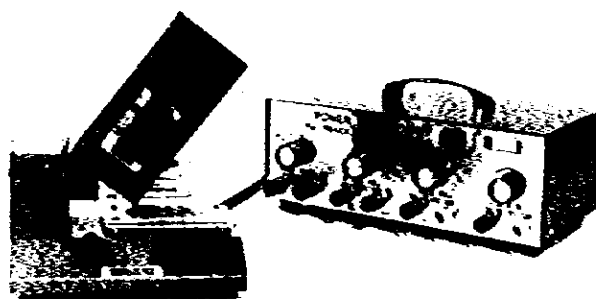
Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Shimazdu Scientific Instrument Franck-Hertz apparatus type FH-100	85	8	680

Specifications:

Power source: AC 220 V 60 Hz
 Voltage for acceleration: DC 0 - 20V
 Capacity of electric furnace: 220V 80W
 Thermometer: 0° - 150°C

Remarks:

Experiments on resonance potential of water vapor, that is, measurement of critical voltage by irradiating accelerated electrons onto mercury atoms were carried out by Frank and Hertz. This apparatus has been manufactured to make this experiment on school level. A tetrode containing mercury is used and inelastic collision between electrons and mercury atoms is confirmed directly by experiments. Can understand theory of atomic structure.



137-4D フランクヘルツ装置 FH-100

13-5 Solar battery experimental arrangement

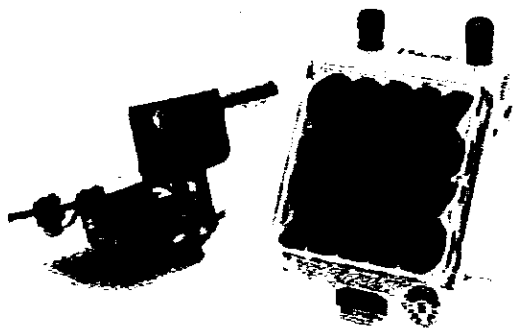
Room No. & name of facilities	--		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Shimazdu Scientific Instrument Solar battery demonstrator type SO-12	23	8	184

Specifications:

Solar battery elements: 20 with inclined bench
Accessories: motor with a gear head for hang up

Remarks:

20 solar battery elements are connected in parallel and series. This is set on a inclined bench with outlet terminals. Light energy is converted into the electric energy and various experiments are carried out. For the light source, the sun is used when it is fine and also commercial 100W electric bulb can be used.



128-471 太陽電池実験器 SO-12E

13-6 Electric heater

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Shimazdu Scientific Instrument Type HH-2	6	8	48

Specifications:

Electric power: AC 220 V 200/400W

Dimensions: 260 (W) x 190 (D) x 50 (H) mm (approx.)

Accessories:

Heating wires: 200 W 2

Remarks:

Used for various kinds of scientific experiments such as observations of way of releasing heat by electricity, thermotype, experiments on thermal radiations, etc.

Can be switched to 200 W and 400W.

13-7 Electric heater

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Shimazdu Scientific Instrument Type HD-35	100	1	100

Specifications:

With hot air cycle type thermostat (Drier)

Dimensions: 350 (W) x 300(D) x 300 (H) m/m (approx.)

Power used: 1 kW - 1.5 kW

Setting temperature: 20 - 200°C ±0.5 deg.

13-8 Spectroscope

Room No. & name of facilities		-		
Name of manufacturer & type for reference		Unit price	Q'ty	Amount
Shimazdu Scientific Instrument	Spectrum tubes type SH	50	8	400
	Spectrum tube stand type SH-SA	10	8	80
	Induction coil type IK-100	100	8	800
	GS Alkali storage battery type AP	50	8	400
	(Total)			1,680

Specifications:

Spectrum tubes: H, He, N, O, Ne, Cl, Ar, Hg one for each

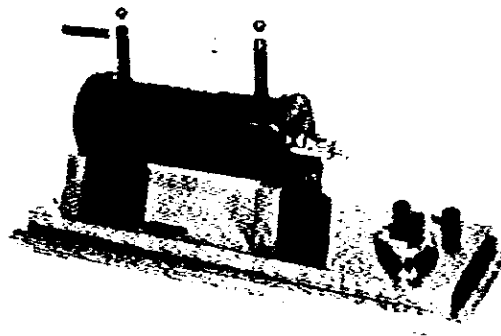
Spectrum tube stand: the height can be adjusted, and two terminals are provided.

Induction coil: spark gap-60 - 100 mm

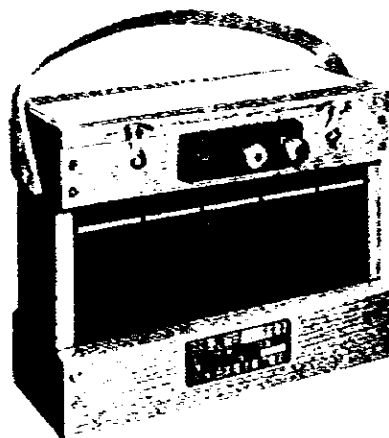
Alkaline battery: capacity-6V, 7.5 AH



Spectra tube and stand



Induction coil



GS Alkali storage battery

13-9 Discharge tube experimental device

Room No. & name of facilities		--		
Name of manufacturer & type for reference		Unit price	Q'ty	Amount
Shimazdu Scientific Instrument	Vacuum discharge tubes	90	8	720
	Rotay vacuum pump	80	8	640
	Induction coil	80	8	640
	(Total)			2,000

Specifications:

1. Vacuum discharge tube one for each
 - 1) Crookers' tube with rotating wheel
 - 2) Crookes' tube with cross
 - 3) Crookes' tube showing magnetic field effect
 - 4) Crookes' tube deflection effect
 - 5) Vacuum discharge tube
 - 6) Cross vacuum scales: set of four
2. Rotary vacuum pump 8 sets
3. Induction coil (spark gap: more than 60 mm) .. 8 sets

13-10 Electron specific charge measuring device

f:

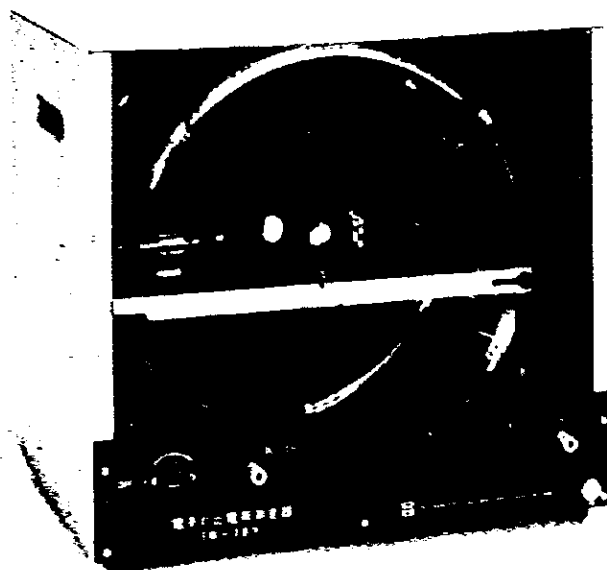
Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Shimazdu Scientific Instrument e/m Measuring apparatus type EM-30	100	8	800

Specifications:

Bulb: hydrogen gas sealed in
 Hermholtz coil: diameter about 30cm 130 turns
 With coil current adjusting resistor, coil holder, bulb holder,
 scale and dark box

Remarks:

e/m measurement can be made through deflection of electron rays.



13-11 X-ray equipment

Room No. & name of facilities			
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Shimazdu Scientific Instrument Demonstration super-soft X-ray apparatus type LN-2	240	8	1,920

Specifications:

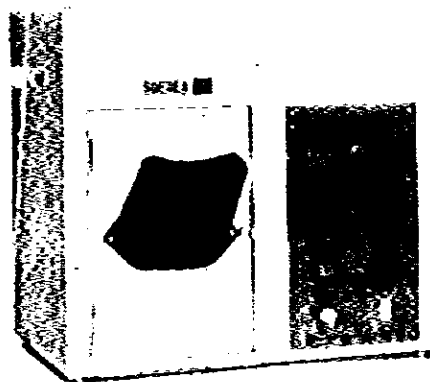
Thermionic X-ray tube
 Fluorescent screen,
 Stand
 Power source (high-voltage transformer)
 viewing box

Perfect rayproof construction

Power source: AC 220 V 60 Hz
 Secondary voltage: 15/16.5/18 kV
 Tube current: 4 - 6 mA
 With Laue spot photographing kit

Remarks:

There is a built-in transformer and an X-ray proof cover. It is also possible to use is equipment in carrying out Laue spot photography and in carrying out experiments on characteristics of Coolidge tube. By means of a push-button control, X-ray screening and photographing of soft bodies of fish, insects, flowers, etc., can be made easily.



13-11 XRAY LN-2B

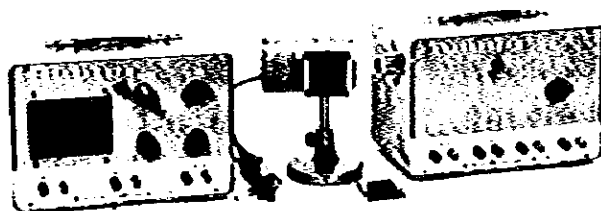
13-12 Photoelectric current experimental arrangement

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Shimazdu Scientific Instrument Photoelectric demonstration set type PC-B	80	8	640

Specifications:

The set is made up of transmitter, phototube apparatus, and receiver.

Power source: AC 220 V 60 Hz



136-580 光電流實驗裝置 PC-B型

13-13 Fog box

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Shimazdu Scientific Instrument Diffusion cloud chamber type WH-10	55	8	440

Specifications:

Diffusion type (high temperature)

Capacity of heater: AC 220 V about 100W

Ionization chamber: 100 mm in diameter

Electric power: AC 220 V 60 Hz

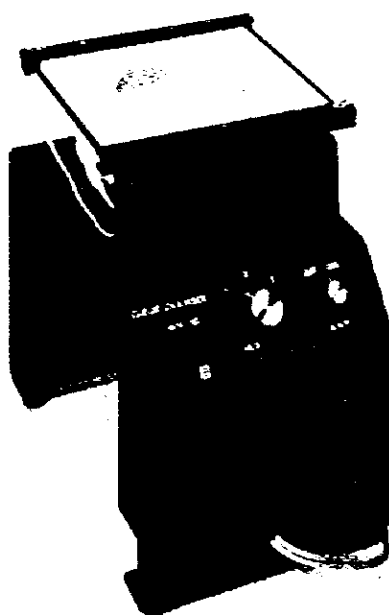
Dimensions: about 140(W) x 200(D) x 200(H) m/m

Radiation source: α - ray, β - ray with protection case

DC power equipment, heater, temperature adjuster, light source are provided.

Remarks:

No mechanical handling is required. Just by adjusting the temperature of the heater placed top of the chamber, the tracks of radiation can be continuously observed. In addition by using an electromagnet the track of β - rays can be deflected.



135-500 RD WHITE

13-14 Radioactivity detector

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
-	150	8	1,200

Specifications:

Same as No. 10-68

13-16 Peltier's experimental cooling device

Room No. & name of facilities			
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Shimazdu Scientific Instrument Electronic cooling demonstrator type SR-2	95	8	760

Specifications:

Power input: AC 220V 60 Hz

Output: DC 1.15/1.5/1.95V 19A

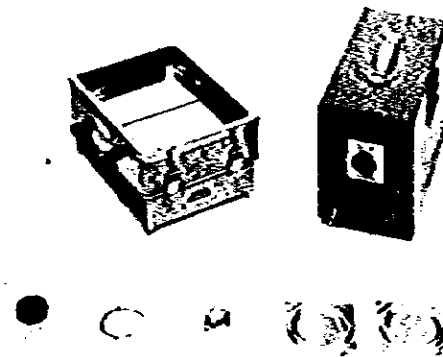
Ripple content: 10% rms

Size of tray: 220(W) x 170(D) x 32 (H) mm (approx.)

2 cooling units and a storing case

Remarks:

Designed for experiments on Peltier effect and Seebeck effect which are the basic theory of thermionic phenomena, this vessel can make a variety of experiments such as cooling and heating experiments, temperature difference and endothermic measurements, experiments on dew-point hygrometer, thermostatic developing tray, etc. Consisting of the main body and the power supply, this vessel demonstrates the use of semi-conductor element and serves also as a photographic cooling tray.



137-220 電冷装置 SR-2B

13-17 Electromagnetic wave testing arrangement

Room No. & name of facilities		-		
Name of manufacturer & type for reference		Unit price	Q'ty	Amount
Shimazdu Scientific Instrument	Radio wave experiment apparatus type EU-60	60	8	480
	Simple radio wave experiment apparatus type YE U-25	26	8	208
	(Total)			688

Specifications:

Radio wave experiment apparatus (type EU-60) 8 sets

Wavelength: approximately 600 mm

Oscillator: input AC 220 V

with external modulation terminal, parabolic mirror and oscillator antenna

Receiver: input AC 220 V

with speaker and receiver antenna

With a metal plate and a wooden board for experiments on radio wave reflection and transmittance, and a screen for wave inclination experiments as well as a Lecher wire for wavelength measurement.

Remarks: Experiments on various aspects of the physical characteristics of radio waves are possible, including the principle of the ultra-high frequency (ultra-short wave) communication and the principle of operation of the radio wave detector, fairly advanced work on these being possible. Used together with a record player and microphone, it is possible to carry out experiments with voice and music, both sending and receiving the oscillations.

Simple radio wave experiment apparatus (type YEU-25) 8 sets

Electrostatic induction oscillation type

Electrostatic induction spark oscillator

Oscillation wavelength: approx. 25 cm

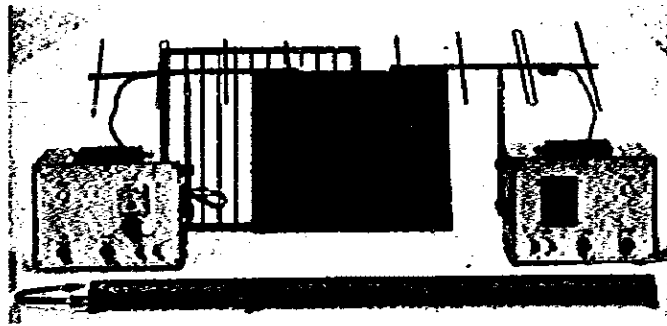
Electric field antenna: half-wave length dipole type

Magnetic field antenna: of microwave magnetic material

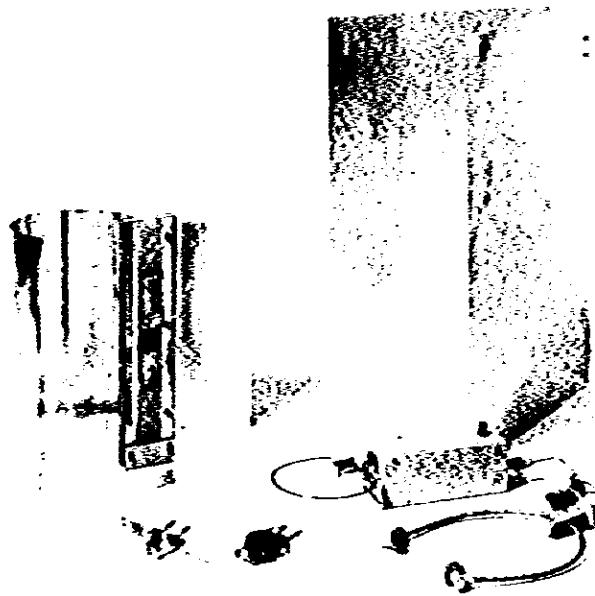
Receiver, amplifier, built-in luminous indicator, cylindrical resonator and reflector are provided.

Remarks:

A simple apparatus generating radio waves by spark discharge, making it possible to readily understand electromagnetic waves.



Radio wave experiment apparatus



Simple radio wave experiment apparatus

13-18 Plasma testing arrangement

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
-	900	1	900

Specifications:

Display model kit for the principle of plasma generation: using a lamp

13-19-1 Wave and oscillation experimental arrangement

Room No. & name of facilities		-		
Name of manufacturer & type for reference		Unit price	Q'ty	Amount
Shimazdu Scientific Instrument	Shive's wave machine type WM-70N	70	1	70
	Supplementary equipment for Shive's wave machine type WMK-70	90	1	90
	(Total)			160

Specifications:

Shive's wave machine:

Total length of device: approx. 930 mm

Number of cross arms: 70

Wave transmission speed: about 0.4 m/sec.

Motor-equipped wave maker: operates on DC 6V power variable speed

Holding clamp, vibration control plate, counterweights and two pendulums (period adjusting type) provided

Remarks: it is possible to observe wave wave forms and how they are transmitted, wave damping, reflection, lapping, stationary waves, resonance experiments, measure wave speed and carry out many other experiments.

Since waves are transmitted steadily, it is possible to have adequate time for observation of momentary phenomena and to readily understand them.

Supplementary equipment for Shive's wave machine:

No. 2 Machine:

Total length: approx. 930 mm

With 70 cross arms (each 230 mm in length)

Wave transmission speed: approx. 1.2 m/s

With fixing for use when storing away

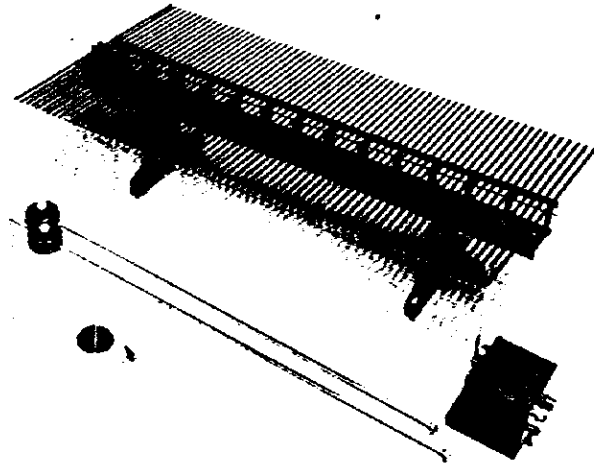
Attached outfit:

Total length: approx. 230 mm

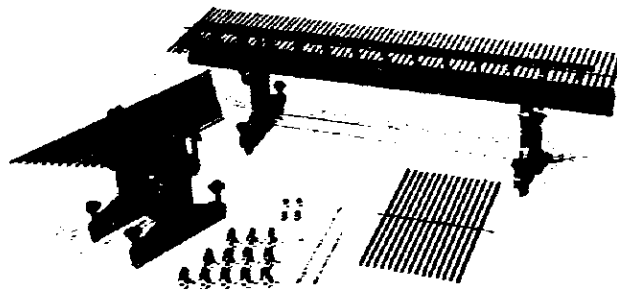
With 15 cross arms of two types: length 230 - 460 mm (tapered)
length 325 mm ($1/4 \lambda$)

Balancing weights, connectors, connecting bar and cylinder for damping plate also provided.

Remarks: can be used in experiments developed from and more advanced than those with Shive's wave machine and when connected to that machine the range of experiments on wave motions is greatly extended.



Shire's wave machine



Supplementary equipment
for shive's wave machine

13-19-2 Wave and oscillation experimental arrangement

Room No. & name of facilities		-		
Name of manufacturer & type for reference		Unit price	Q'ty	Amount
Shimazdu Scientific Instrument	Wave motion demonstrator Hayashida's type HB-24	30	1	30
	Flat wire coil for wave demonstrator	3	1	3
	Melde's apparatus for stationary transverse waves type MV-100	35	1	35
		(Total)		68

Specifications:

Wave motion demonstrator: Hayashida's type

Total length: 1,100 mm (approx.)
With Otsuka's spring and weight

Remarks: designed to make possible, under natural conditions, the observation of wave transmission and reflection, and the formation of stationary waves.

Flat wire coil for wave demonstrator:

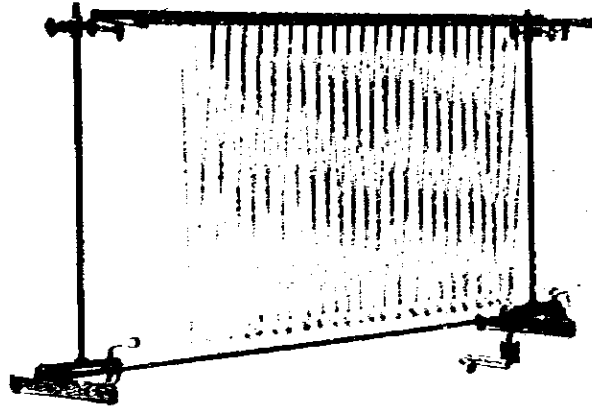
Plain wire helical spring
Diameter: 75 mm finely coiled (170 turns)
Length: 110 mm

Remarks: Observation of waves at comparatively low velocity for experiments on their velocity, overlap and reflection can be made by extending this spring over a smooth floor and applying pulses to it from either end.

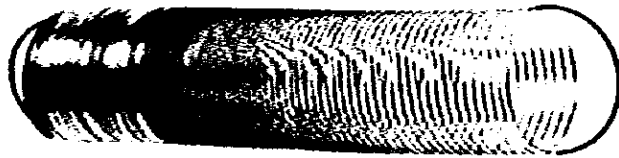
Melde's apparatus for stationary transverse waves:

For both horizontal and vertical use
Length of the arm: 1 m
Electromagnetic tuning fork, weights and pan are included.

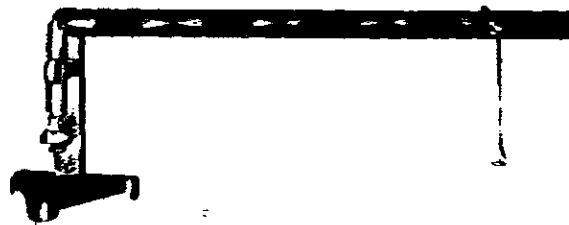
Remarks: With the electromagnetic tuning fork, stationary vibrations are induced in the string, and then, by using the weights to adjust the tension, it is possible to cause, in the string which has a fixed length, the appearance of one or more nodes and loops.



Wave motion demonstrator



Flat wire coil



Helde's apparatus for
stationary transverse

13-20 Optical testing arrangement

Room No. & name of facilities		-		
Name of manufacturer & type for reference		Unit price	Q'ty	Amount
Shimazdu	Lenses and prisms kit type OH-7	5	1	5
Scientific	GS universal optical disc	85	1	85
Instrument	Optics experimental bench	83	1	83
	Spectrometry attachment for above	38	1	38
	Photometry attachment for above	9	1	9
	Optical slit type OS-27	18	1	18
	Biprism for interference of light type BK-30	15	1	15
	Newton's ring apparatus	9	1	9
			(Total)	

Specifications:

Lenses and prisms kit:

- Large convex lens: 50 mm in diameter $f=90$ mm
- Small convex lens: 40 mm in diameter $f=90$ mm
- Prism: regular triangle 25(side) x 50 (long) mm
- Cylindrical lens: about 25 mm in diameter, 50 mm long
- Semicircular convex lens: 60 mm in diameter $f=150$ mm
- Trapezoidal glass: 70(W) x 40(H) x 15(D) mm
- Round glass: 50 mm in diameter, about 10 mm thick

Remarks: seven kinds of lenses and prisms are contained to be used for the experiments on refraction of rays
Set in a case

GS universal optical disc:

- Diameter of disc: 300 mm
- Illumination: AC 100V 80W
- Included: lens holder, slit, lens, prism, plane mirror, water trough and case

Remarks: a spring device holds the lenses onto the disc, and clamping on and removal of the lenses is quite easy to do. The disc is used in various fundamental optical experiments.
Possible to alter the position of the disc from horizontal to vertical.

Optics experimental bench:

- Graduated rotary base: 360° divisions each one degree mounted on a metal tripod
- Scale plates (two): each with a 500 mm scale
- Rotary stage and six carriers provided

Remarks: the accessories (spectrometry attachment, photometry attachment) are used together with this optical bench in carrying out experiments on spectrometry, measurement of light intensity, and other optical experiments. Two metal scale plates, fitted horizontally, can be lined up straight or set at an angle of up to 50 degrees to each other.

Spectrometry attachment:

Includes a slit, collimating lens, prism, telescope objective lens, eyepiece and grating holder

Photometry attachment:

Consists of Joly's photometer, two lamp sockets and two diaphragm screens and are used in measuring luminosity.

Optical slit:

Slit: 20 mm long made of stainless steel

With fine adjuster screw, adjustable stand, and A-shaped base

Remarks: by using the slit in combination with Biprism, it is possible to carry out light interference experiments easily.

Biprism for interference of light:

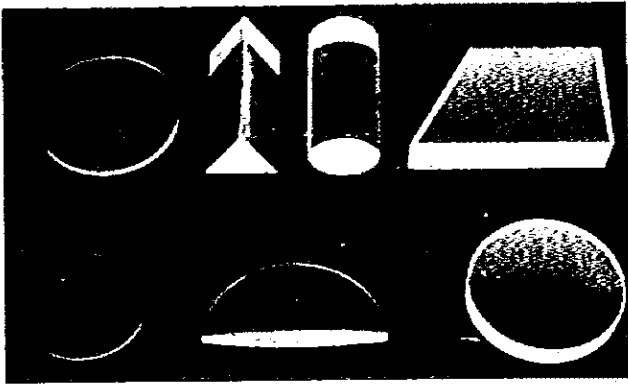
Length of prism side : approx. 30 mm

Adjustable metal stand and A-shaped base included

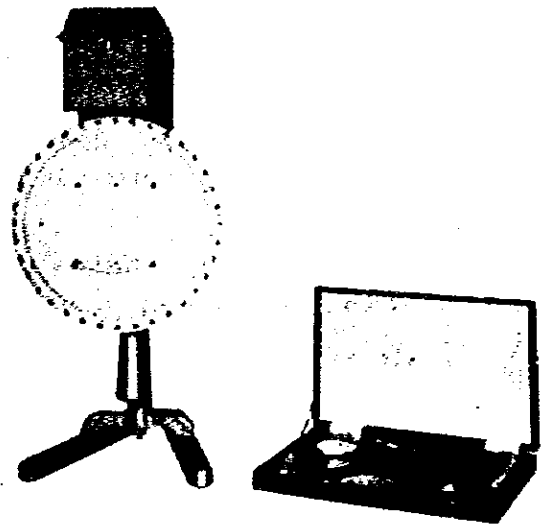
Remarks: light passing through the slit is directed to the side of the prism and interference fringes projected and observed.

Newton's ring apparatus:

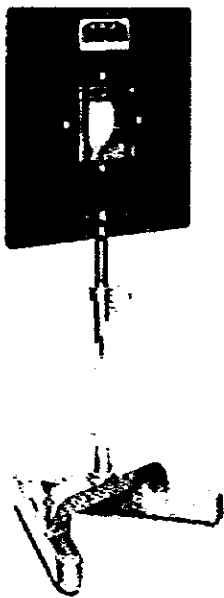
A plain glass plate and a slightly curved glass are used in combination. Consists of a glass portion, 85 mm in diameter, frame and adjusting screws.



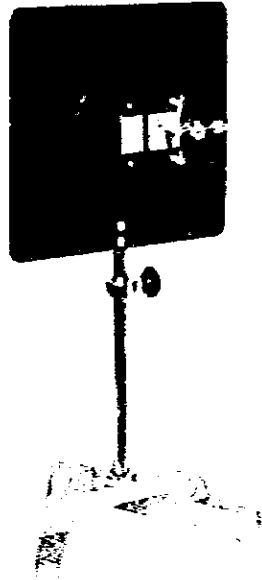
Lenses and prisms kit



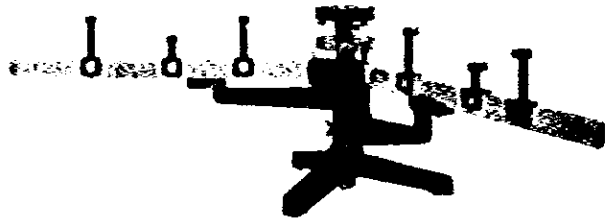
GS Universal optical disc



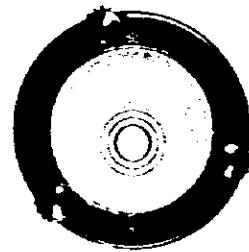
Biprism



Optical slit



Optics experimental bench



Newton's ring apparatus

13-21 Acoustic testing arrangement

Room No. & name of facilities		--		
Name of manufacturer & type for reference		Unit price	Q'ty	Amount
Shimazdu	Tuning fork type TF-10	7	1	7
Scientific	Sympathetic tuning fork type TF-100	15	1	15
Instrument	Electromagnetic tuning fork type MF-100	34	1	34
	Rotary drum type RD-160	30	1	30
	Organ pipe(one octave scale) type B	11	1	11
	Sonometer type MK-T	29	1	29
	Sonometer type MK-S	8	1	8
	Sound experiment apparatus	150	1	150
	Kundt's apparatus type KA-80	17	1	17
	Specifications:	(Total)		

Tuning Fork:

Of steel

With resonance box and rubber hammer

Remarks: forged out of special steel and with an anticorrosive finish, the tuning fork is very durable, and care has been taken in designing the resonance box to make sure that it suitable for this particular type of tuning fork.
A tone is maintained for more than ten seconds.

Sympathetic tuning fork:

A pair of steel tuning forks, a resonance box and a rubber hammer

Metal accessory used in beat experiments

Remarks: the tuning forks will sympathize when set up at a distance of more than a meter apart.

Electromagnetic tuning fork:

Of steel, with platinum contacts and iron supporting stand

Frequency: 100 c/s

Accuracy: within 0.2 c/s

Remarks: draws oscillation waveforms through Rotary Drum to be used for measurement of seconds in decimal unit.

Rotary drum:

Diameter of drum: 160 mm

Length: 180 mm

Feed screw, support and base included.

Remarks: to record on smoked paper, which has been placed over the surface of the cylinder, the vibration waves of Electro-magnetic tuning fork, etc. A square thread is used in the feed screw so as to avoid wobbling during rotation, and to minimize wear.

Organ pipe:

With temperature compensating scale
C' 256 c/s physically tuned harmonic rhythm

Remarks: the sliding portion allows the length to be varied and one octave is produced from the one organ pipe.

Sonometer:

1. For demonstration 1 set

With two strings

Dimensions: 1,080(L) x 150(W) x 70(H) mm

Two bridges, a spare set of strings, two weight receivers which each weight 1 kg, eight 1kg tension increasing weights also included

Remarks: used to determine the relationship between the length, mass, and tension of the strings and the number of vibrations. The tension of the two strings is adjusted by the weights.

2. For students 1 set

With two strings

Dimensions: 600(L) x 100 (W) x 55 (H) mm

Resonance box, two bridges and a spare set of strings also included.

Remarks: used in determining the relationship between the length, thickness and tension of the strings and the number of vibrations. One string is twice as thick as the other, and the sonometer is provided with a mechanism to tighten both strings equally at all times, and since this mechanism incorporates a worm gear, there need be no fear that the strings will become slack while an experiment is being carried out.

Sound experiment apparatus:

Power source: AC 220 V 60 Hz

Frequency: pulse waves 2 - 20 Hz one range

sinusoidal wave 30 Hz - 30 kHz 4 ranges

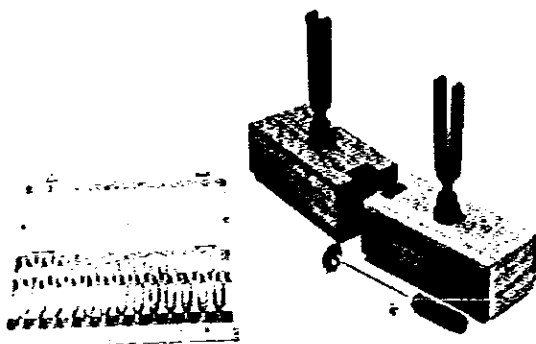
Equipment includes one 8" speaker, one 5" speaker, two crystal receivers, a wave source apparatus for water experiments, Kundt's Apparatus and lead wire

Remarks: a CR oscillator, a pulse oscillator, and a double amplifier are housed in a single case, so that sound vibrations and interference which were formerly observed on an oscilloscope, are able to be heard as sounds on this apparatus by amplifying on one of the amplifiers.

Kundt's apparatus:

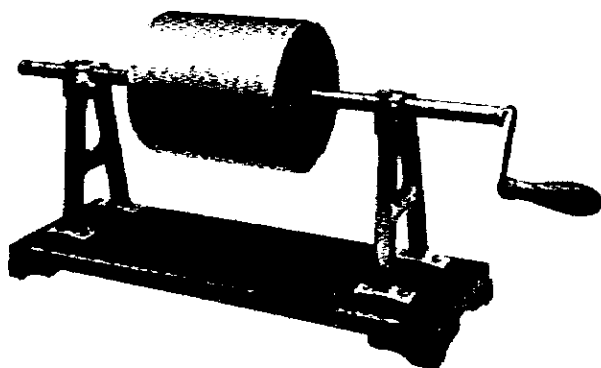
Glass tube: approx 30 mm in diameter x 800 mm length

Remarks: by using the vice and metal rod provided, it is possible to carry out Kundt's experiment on the speed of sound. The nichrome wire inside the glass tube is heated with a 60 - 100V current until red hot, and then, when a whistle is blown close to the mouth of the tube, dark and light stripes appear in the resistance wire, and this phenomenon is used in the measurement of wavelength.

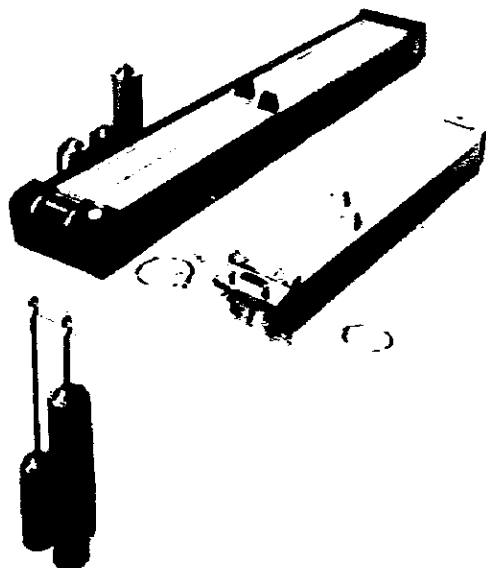


Tuning fork

Electromagnetic tuning fork



Rotary drum



Sonometers

13-22. Structural model of molecule

Room No. & name of facilities	-			
Name of manufacturer & type for reference	Unit price	Q'ty	Amount	
Shimazdu Scientific Instrument	Crystal model kit type HGS-C5	48	10	480
	HGS-E3	45	10	450
	Atom model kit type HGS-15	22	10	220
	Crystal structure model	140	10	1,400
	(Total)			2,550

Specifications:

1. Crystal model kit:

**Beads(for atoms): polyhedrons made of ABS resin (different colors)
169 in all**

**Bonds(for chemical bonds): made of polyacetal resin
286 in all**

With wooden case for storage

**Remarks: designed mainly for chemistry course studies.
Silicate crystals, hexagonal close packed crystals, cubic close packed crystals, etc., are constructed.**

2. Crystal model kit:

**Beads(for atoms): polyhedrons made of ABS resin (different colors)
194 in all**

**Bonds(for chemical bonds): made of polyacetal resin
253 in all**

With wooden case for storage

**Remarks: designed mainly for earth science course studies.
Silicate crystals, diamond, graphite, rock salt, etc., are constructed.**

3. Atom model kit:

**Beads(for atoms): polyhedrons made of ABS resin (different colors)
106 in all**

**Bonds(for chemical bonds): made of polyacetal resin
122 in all**

**Electron orbit plate: PVC plate with different colors
12 pieces in all**

With wooden box for storage

Remarks: Simple organic compounds are constructed and the relation between nucleus and electron cloud is explained.

4. Crystal structure model:

**Salt, iron, diamond, copper, sphalerite, calcite, graphite, zinc,
cuprite, chalcopyrite**

13-23 Electron configuration model of atomic structure

Room No. & name of facilities	-		
Name of manufacturer & type for reference	Unit price	Q'ty	Amount
Shimadzu Scientific Instrument	120	10	1,200

Specifications:

Atomic structure model kit:

Electron configuration board (transparent resin type): 45 x 55 cm
Atom nucleus ball(with magnet) and other accessories

Valence model kit:

For understanding the theory of covalent bond, ionic bond and coordinate bond

Element - named balls : 34 pcs.

Connector

With case

Atomic and molecular structure demonstration model kit:

Demonstration board (of steel): used on the desk and on the wall,
60 x 46 cm

Atom nucleus circle board: 21

Atom nucleus hemisphere: 2

Electron hemisphere: 36

Electron nucleus circle board: 6

} Of synthetic resin
With magnet

Molecule model kit:

Large ball (35 mm): 10

Small ball (19 mm): 8

Connection bar: 20

} Of synthetic resin

For demonstration of the structure of hydrogen, carbon, chlorine, oxygen and nitrogen molecules

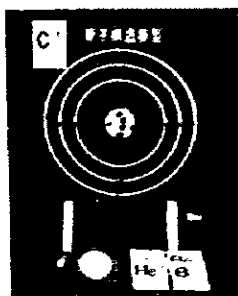
Movable atom model kit:

Manual rotation type: with handle

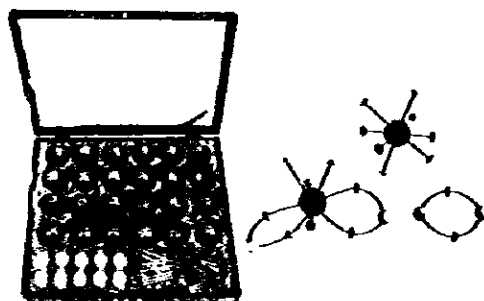
Height: about 110 cm

Arrange in three dimensions the coloured balls of proton, neutron and electron on the axis of rotation, and each ball rotates and revolves.

Each ball can set and remove freely, and can make any atom model

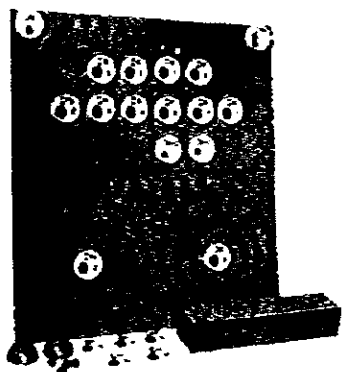


Atomic structure model kit



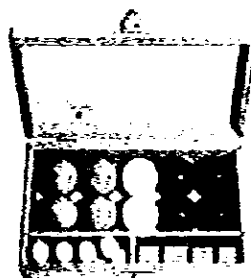
22-753 原子價模型

Valence model kit



22-754 原子-分子構造說明器七、十

Atomic and molecular
structure demonstration
model kit



22-755 分子模型 R形

molecule model kit



Movable atom model kit

