

## **CHAPTER 5 PROJECT IMPLEMENTATION PLAN**



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### 5-1 Project Implementation System

This project will be implemented within the framework of a grant aid to be provided by the Japanese Government. The grant aid will start formally after the signing of the Exchange of Notes between the Thai Government and the Japanese Government following its approval in a cabinet meeting of the Japanese Government.

Two Thai government agencies will be responsible for the implementation of this project. It has been decided that the Thai Industrial Standards Institute(TISI) and the Thailand Institute of Scientific and Technological Research (TISTR) will be responsible for operation and maintenance of the Industrial Standardization, Testing and Training Centre and the Industrial Metrology Testing Service Centre respectively.

After the signing of the Exchange of Notes, the Thai Government will conclude a contract with a Japanese consultant firm to draw up detail design, to conduct tender for the selection of contractors and to supervise the prospective construction works. Construction of the facilities, and procurement and installation of the equipment will be done by Japanese contractors who prove to be successful tenderers.

## 5-2 Scope of Work

The scope of works for both Governments are as follows:

### 5-2-1 Work by the Japanese Government

#### 1. Facilities

- Construction of the buildings
- Construction of the electrical, air-conditioning and plumbing facilities

#### 2. Testing equipment

- Supply of the testing equipment
- Installation of the testing equipment

#### 3. Infrastructure

- Substations (24kV/380-220V)
- Water supply facilities within the site
- Telephone exchange equipment

#### 4. Exterior works

- Construction of internal roads and parking lots within the site
- Drainage facilities within the site
- Neutralization tank
- Exterior lighting

#### 5. Related works and application

- Transport of construction materials and equipment exported to Thailand from Japan

- Inland transport of construction materials and equipment from the unloading port to the site in Thailand

#### 5-2-2 Work by the Thai Government

##### 1. Site and exterior work

- To secure the site necessary for construction of the Centres
- Removal of existing structure, plants and other obstacles in the site and site preparation including banking and leveling of the site
- Construction of the open ditches between surrounding roads and the site and the access to the site over the ditch
- Construction of the fence, gate, garage and guardhouse
- Plantation, detention pond and outdoor facilities

##### 2. Infrastructure

- Electric power service (24kV) and telephone COL to the site
- Water service and drainage service to the site

##### 3. Preparation for construction

- Provision of land for the temporary site office, workshop and stock yard
- Temporary electricity service (380V-220V), telephone COL and water service

##### 4. Utensils, fixtures and furniture

- Utensils, fixtures, furniture, etc. which are not included in the scope of work by the Japanese Government

5. Applications and expenses necessary for the project

- Expenses necessary for bank arrangement
- Expenses necessary for tax exemption
- Prompt arrangement for customs clearance and inland transport
- Exemption procedure from custom duties, government taxes and other government surcharges on concerned Japanese personnel to the project under the verified contracts
- According convenience necessary for Japanese personnel's entry into and stay in Thailand to implement the project
- Maintenance of the Centre facilities for the sound and effective operation
- Necessary expenses for the building permit procedure, etc.

### 5-3 Execution Plan

#### 5-3-1 Execution Guideline

Judging from the scale of the facilities to be constructed and the types of the testing equipment to be installed in the facilities, it is necessary to implement the construction project in two phases. Phase 1 will include construction of the facilities and procurement and installation of some pieces of testing equipment which are closely related to the building construction work. Phase 2 will include procurement and installation of the other pieces of equipment. After the signing of the Exchange of Notes, the Thai Government will conclude the consultant contract with a Japanese consultant firm, and in compliance with the provisions of the contract, detail design of the buildings and the equipment will be conducted. After completion of the detail design documents, tenders for both Phase 1 and Phase 2 will be invited. The Japanese contractors who turn out to be successful tenderers will be responsible for construction of the facilities and procurement and installation of the equipment.

#### 5-3-2 Factors to Note in Execution of the Construction and Installation Work

##### (1) Facilities

Judging from the scale and content of the project, local construction situation and the local climatic conditions, it will be necessary to take note of the following factors in execution of the construction work.

1. Of the work to be included in the scope of work by the Thai side, banking and leveling of the construction site, temporary supply of water, electricity and telephone lines for the construction work and

the transaction of official procedures necessary for commencement of the construction work must be completed before the construction work start.

2. In Thailand the rainy season lasts for about 6 months, from May through October. Accordingly, it is essential to carry out the work strictly in accordance with the execution schedule to avoid delays in work. For example, the foundation work should be completed before the rainy season sets in. On the other hand, the roofing work should start after the rainy season is over.
3. Two agencies, TISI and TISTR, will be responsible for the work to be carried out by the Thai side. Moreover, construction of the two buildings will be implemented simultaneously. In this context, it is essential to settle an approval and decision system for matters common to the two agencies. It is also desirable for the two agencies to establish a project execution committee jointly.
4. Although building materials required for the construction work by the Japanese side will primarily be procured locally, some building materials which are not available in Thailand will need to be imported from Japan. Therefore, a project execution system for customs clearance will have to be established by the Thai side.

## (2) Equipment and Material

The careful planning in coordination with the building construction schedule is essential to ensure adequate time. It will be necessary to take note of the following factors for planning.

1. Equipment should be ordered with lead times calculated so as to have early delivery of equipment that should more conveniently be transferred into the building before other equipment. The equipment



arrangement should be carefully studied in advance for determining the sequence most convenient for the transfer operations.

2. Equipment made to order generally demand long lead times, and should be marked for early ordering.
3. Precise coordination with building schedule is particularly critical in the case of equipment requiring to be built into the structure and calling for wall and other external finishing after installation of the equipment.
4. Heavy equipment also requires transfer into the building before internal finish, to avoid risk of damaging floor surface.
5. Metrological and other equipment of high precision call for particular care in shipment, transfer, storing and installation. Every attention requires to be directed toward conserving equipment accuracy, and delivery to the site and installation should be ensured under contract providing with guarantee of installed equipment accuracy.
6. A warehouse should be provided close to the site for storage against weather, and large equipment should be kept packed until immediately before assembly and installation.
7. Equipment requiring to be timed with technical cooperation activities should have their timing for transfer into building precisely prescribed room by room.

It should also be necessary to establish at the construction site an independent temporary office, to permit smooth performance of administrative operations relevant to handling of incoming equipment, including coordination with the building construction work, communication with and coordination among site work supervisors, as well as reception and installation of the equipment.

### 5-3-3 Construction Supervision Plan

The Japanese consultant firm will conclude the consultant contract with the Thai Government in accordance with the framework of the grant aid to be provided by the Japanese Government. The objectives of the supervision work to be conducted by the Japanese consultant firm are; to make sure that the construction work is properly carried out in compliance with the design drawings and specifications; to give instructions and advice; to coordinate construction work from an objective and fair standpoint in order to enhance the quality of the construction work; to ensure appropriate execution of the provisions of the construction contract.

The design and supervision work will include the followings;

1. Cooperation in inviting tenders and in concluding construction contract and equipment contracts

The consultant will prepare tender documents required for inviting tenders for construction of the buildings and procurement of testing equipment offered by Japanese contractors. And the contract documents to be concluded between the Thai side and the successful tenderers will also be prepared by the consultant. The consultant will provide advice regarding conclusion of the contracts.

2. Instructions, advice and coordination for the contractors

The Consultant will review the execution schedule, the execution plan, the equipment procurement plan, etc. and provide instructions, advice and coordination for the contractors.

3. Review and approval of shop drawings, manufacturing drawings, etc.

The Consultant will review and approve shop drawings, manufacturing drawings, etc. submitted by the contractors.

#### 4. Confirmation and approval of building materials and equipment

The consultant will approve building materials submitted by the contractor and testing equipment submitted by suppliers after confirming their compliance with the provisions of the contracts.

#### 5. Reporting on the progress of the construction work

The consultant will keep track of the progress of the construction work and the condition of the construction site, and will report to the Governments of Thailand and Japan on the progress of the construction work.

#### 6. On-the-spot inspection

Whenever necessary from the start to the end of the construction work, the consultant will make on-the-spot inspections of the facilities and equipment to ensure their high quality and performance.

Judging from the scale of this project, in carrying out the above-mentioned responsibilities, the consultant will assign one Japanese resident engineer to supervise the construction project in Thailand throughout the period of the construction work.

In addition, in keeping with the progress of the project, the consultant will dispatch the necessary number of engineers to Thailand to conduct necessary inspections, guidance and coordination. At the same time, the consultant will assign staff members in Japan with the responsibility for keeping contacts with the contractor and for reporting to the Japanese Government on the progress of the project, the payment procedures, the completion and delivery of the facilities and so on.

## 5-3-4 Procurement Plan

### (1) Procurement of Building Materials

In Thailand, the construction industry is growing rapidly and production of building materials is brisk. The quality of Thai-made building materials is high. Accordingly, most of the building materials required for implementation of this project will be procured primarily in Thailand. However, some materials which cannot be procured locally will be imported from Japan. Materials originating in third countries can be procured only when there is enough justification for it. Procurement of materials from third countries will be decided after detailed research is completed on the technical level and price situation in the country, and also when prior approval is given by the Governments of both Thailand and Japan. Of the materials to be procured locally, reinforcing bars are in short supply and their prices are unstable in Thailand. It will be necessary to take such special measures against possible shortages of the materials as securing required quantities of them well in advance.

In consideration of the above, the outline of the procurement plan for this project should be as follows:

#### 1) Materials to be procured locally

Concrete	Reinforced bar	Steel
Brick	Concrete block	Timber
Plywood	Ceramic tile	Paint
Plastic paint	Plastic tile	Vinyl sheet
Terrazzo tile	Steel door	Aluminum sashes
Wooden door	Glass	
Light gauge ceiling bed	Ceiling materials	Pile (PC pile)
Asphalt waterproofing membrane		

2) Materials to be imported

Hardware

Soundproof removable partition

Soundproof door

Free access floor

(2) Equipment and Materials

Office equipment such as photo copying machine and typewriter, and furniture such as desk and chair, should be procured locally, and the others should be imported.

#### 5-4 Project Implementation Schedule

Implementation of this project will be divided into two phases, namely Phase 1 (construction of the buildings and procurement of part of the equipment) and Phase 2 (equipment). Phase 1 will start after the Governments of the two countries sign the Exchange of Notes regarding the grant aid to be provided by the Japanese Government. After the signing of the Exchange of Notes, the Thai Government will select a Japanese consultant firm and the consultant contract will be concluded between the Thai Government and the Japanese consultant firm. The project implementation schedule after this stage will be divided into three stages, namely detail design, inviting tenders and construction. In Phase 2, after the signing of the Exchange of Notes, the project will be implemented in the order of inviting tenders, procurement and installation of equipment.

##### 1. Detail Design

After the Japanese Government verifies the the consultant contract, the detail design stage will start. In the detail design stage, a set of tender documents, including detail design drawings, specifications and a tender requirement, for which tenders will be offered, will be prepared. Meanwhile, consultations on the contents of the facilities and equipment will be held with the Thai side and finally the tender documents will be submitted to the Thai side for approval.

##### 2. Inviting Tenders for Phase 1

Selection of the construction contractor and the supplier of equipment will be done by tender, in the order of public announcement for tender, screening of prequalifications of the tenderers (Japanese corporations), tender offer, evaluation of the tender prices, selection of the contractor

and the supplier of equipment and conclusion of contracts. This procedure will take approximately 1.5 months.

### 3. Construction

When the Japanese Government verifies the construction contract after signing, the construction work will start. Judging from the scale of the project, the local weather conditions and local construction situations, the work period for Phase 1 (including procurement and installation of equipment) is estimated at 14.5 months.

### 4. Inviting Tender for Phase 2

After the signing of the Exchange of Notes regarding Phase 2, the suppliers of equipment will be selected through tender, in the same order as in Phase 1.

### 5. Procurement and Installation of Equipment

The work will start after the contract is verified by the Japanese Government. The period of time (including the time for explanation by supplier about the operation method of the equipment installed) required for procurement and installation of the equipment for the construction work is estimated at about 10 months.

The outline of the above process is as illustrated below.

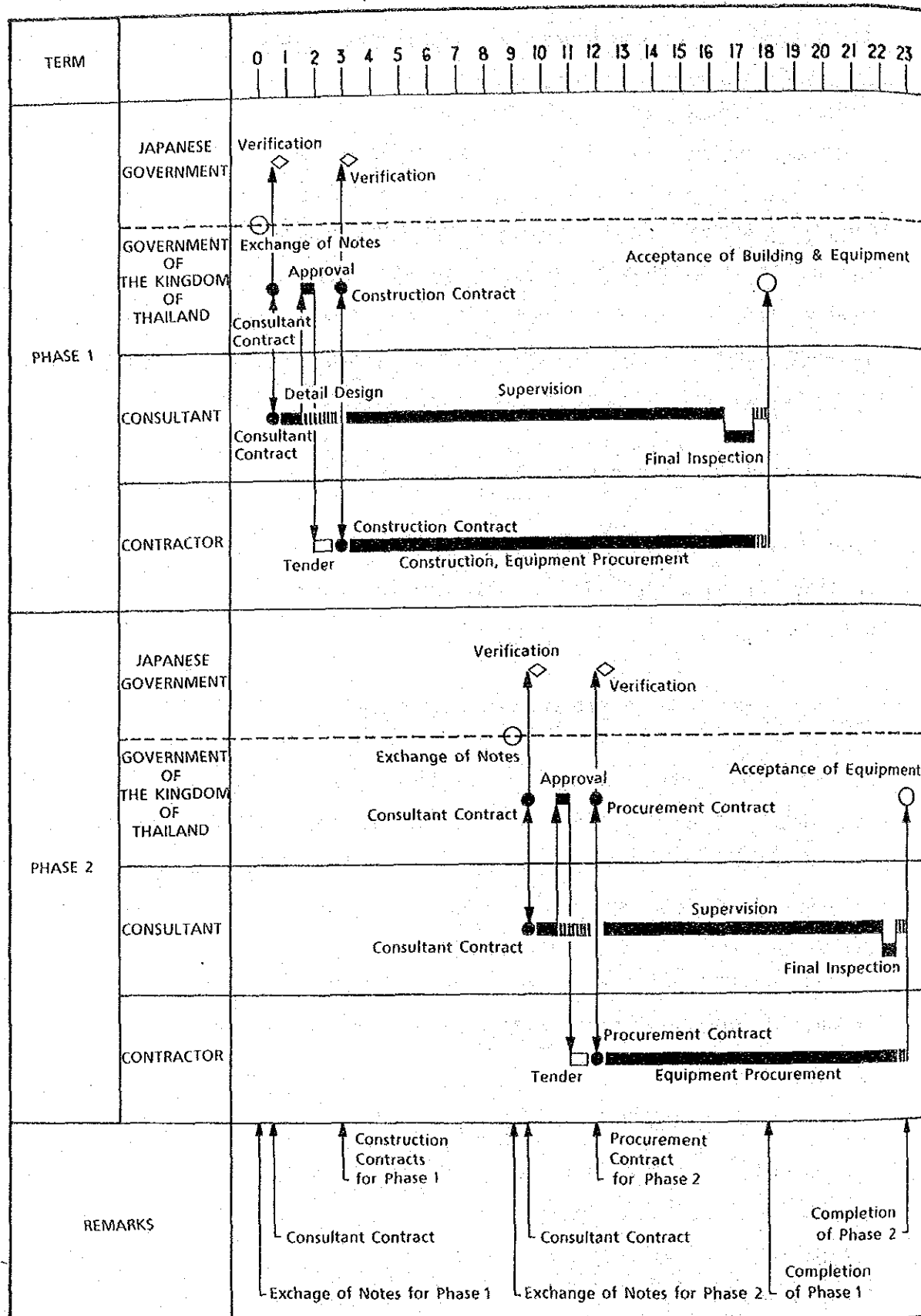


Fig.5.4-1 Project Implementation Schedule



## 5-5 Maintenance and Operation Plan

### 5-5-1 System for Maintenance and Operation of the Facilities and Equipment

Although the facilities and equipment will be designed with the utmost emphasis on ease of maintenance and operation, it will be advisable to establish a system for efficient maintenance of the facilities and equipment as shown below.

1. Thai side staff responsible for maintenance and operation of the facilities and equipment in each field should be assigned before the construction work is completed.
2. The Japanese consultant firm and the Japanese contractors should give on-the-job training in operation, maintenance and inspection of equipment to the above mentioned Thai side staff, and at the same time provide instruction manuals on maintenance and operation of the facilities and equipment.
3. The Thai government agencies which implement this project should prepare the budget for necessary maintenance and operation expenses and ensure effective and continuous use of the facilities and equipment.
4. Daily or weekly reports on maintenance and inspection of the facilities and equipment should be prepared to make it easy to have a clear grasp of the status of the facilities. Also, a system for stock control of expendables and spare parts and for efficient procurement of replacement parts should be established.
5. The staff responsible for maintenance and operation of the facilities and equipment should maintain the most efficient possible communications with individual equipment operators concerning the

method of maintaining and operating the facilities and equipment. When some of such staff are to be replaced, it must be assured that such information is transferred internally to the successors.

6. Lists of suppliers which will take care of problems for facilities and equipment should be clarified.

#### 5-5-2 Maintenance and Operation Plan

The main points to be noted in maintaining and operating the facilities and equipment are as shown below:

##### (1) Facilities

##### 1. Roofs

- Highly durable materials will be selected for waterproofing of the roof. When water leaks occur within the contractors' guarantee period, however, they should be reported to the contractor for prompt repair works.
- Gutters and drain pipes should be inspected and cleared about twice a year since they are likely to be filled with dust.

##### 2. Exterior

- When an exterior tile has peeled off, it should be replaced with a spare tile.
- When an exterior metal has rusted, the rust should be removed and then the metal should be painted to prevent the spread of rust.

### 3. Interior

- Each room should be kept well ventilated and the finished surfaces of interior walls should be kept clean to prevent them from getting rusty and dirty.
- Since floors finished with plastic tiles or vinyl sheet have the possibility of getting scratched, minute care should be taken when moving a heavy object on such a floor.
- Ceiling finish materials should be handled very carefully since they are badly affected by shocks.

### 4. Building Equipment

- Building equipment should be operated and inspected by engineers with professional knowledge of electricity or machinery in accordance with the instructions listed in instruction manuals.
- When trouble is found in a piece of equipment, operation of it should immediately be stopped to find out the cause and remedial measures should be taken to prevent the trouble from affecting other pieces of equipment.

#### (2) Equipment and Materials

##### 1) Testing Equipment

In both of the Industrial Standardization, Testing and Training Centre and the Industrial Metrology Testing Service Centre, the testing equipment require to be maintained in condition for frequent use at all times, bearing in mind the following points:

1. At regular intervals calibrate the equipment to verify accuracy, record the data upon calibration, and keep the record attached to

the equipment for reference at any time, and proceed with renewal of equipment that cannot ensure requisite accuracy.

2. Take measures to prevent misoperation of equipment overloading, underloading, and in the event of trouble encountered during operation, have the machine clearly marked to prevent use until properly repaired.

3. With equipment using water, take measures to prevent overflowing and leakage, and with those using gas, similarly prevent gas leakage.

4. Draw up a long-term programme for equipment maintenance, renewal and extension, to match equipment capacity to testing demand.

## 2) Equipment for Standardization and for Certification Operations

1. Study the yearly training programme and estimate the annual requirements of consumable supplies used in training activities; plan the issue of replenishment orders with adequate lead time.

2. Regularly inspect and maintain equipment used in training activities, to ensure their being kept in condition for frequent use at all times.

## 3) Metrological Equipment

Perform regular verifications to see that prescribed accuracy is constantly maintained, and establish standing rules for disposition of equipment that fails to ensure prescribed accuracy.

With calibration equipment also, perform accuracy verifications at regular intervals, and repair immediately any affected parts, to ensure their being kept in condition for frequent use at all times.

With primary standards, personnel authorized to manipulate them should be limited to those fully familiarized with traceability to the national metrological system, and others should be permitted to approach the standards only with specific authorization.

### 5-5-3 Maintenance and Operation Cost

The maintenance and operation cost can be broadly divided into facilities operating expenses and equipment maintenance expenses.

#### (1) Operation Cost

##### 1) The Industrial Standardization, Testing and Training Centre

1. Electricity .....	2,100,000 BT/year
2. Telephone .....	40,000 BT/year
3. Water supply .....	47,600 BT/year
4. Sewage .....	38,100 BT/year
5. Gas .....	28,600 BT/year
6. Industrial Estate Management Fee .....	14,000 BT/year
7. Waste .....	12,000 BT/year
8. Maintenance for Building .....	919,700 BT/year
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Total .....	3,200,000 BT/year

##### 2) The Industrial Metrology Testing Service Centre

1. Electricity .....	2,026,000 BT/year
2. Telephone .....	40,000 BT/year
3. Water supply .....	44,900 BT/year
4. Sewage .....	36,000 BT/year
5. Gas .....	2,300 BT/year
6. Industrial Estate Management Fee .....	19,000 BT/year
7. Waste .....	12,000 BT/year
8. Maintenance for Building .....	919,800 BT/year
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Total .....	3,100,000 BT/year

(2) Equipment Maintenance Expenses

1) The Industrial Standardization, Testing and Training Centre

1. Maintenance and repair .....	806,000 BT/year
2. Spare parts and consumable parts .....	1,612,000 BT/year
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Total .....	2,418,000 BT/year

2) The Industrial Metrology Testing Service Centre

1. Maintenance and repair .....	851,000 BT/year
2. Spare parts and consumable parts .....	1,702,000 BT/year
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Total .....	2,553,000 BT/year

The maintenance and operation costs for each Centre are as follows;

The Industrial Standardization, Testing and Training Centre .....	5,618,000 BT/year
The Industrial Metrology Testing Service Centre .....	5,653,000 BT/year
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Total .....	11,271,000 BT/year

## 5-6 Estimated Project Cost to Be Defrayed by the Thai Government

The estimated total project cost to be defrayed by the Thai Government is broken down as follows:

(1) Site Preparation ..... 6,710,000BT

The project site shall be banked and leveled in compliance with the construction regulation of the Bangpoo Industrial Estate.

TISI ..... 3,017,000BT

TISTR ..... 3,693,000BT

(2) Infrastructure ..... 303,000BT

1. Electricity : 198,000BT (TISI - 99,000BT, TISTR - 99,000BT)

2. Telephone : 105,000BT (TISI - 52,500BT, TISTR - 52,500BT)

3. Water supply : (This works will be done by IEAT.)

4. Drainage : (This works will be done by IEAT.)

5. Sewage disposal : (This works will be done by IEAT.)

(3) Buildings ..... 1,972,400BT

1. Garage : 1,320,000BT  
(50m×6m, 2 garages)

2. Gatehouse : 652,400BT  
(4m×2m, 2 gatehouses)

(4) Exterior work ..... 4,227,200BT

1. Fences and gates : 1,485,000BT  
(Net Fence, H=1.8m, 1,100m)
2. Plantation : 1,371,500BT  
(Tree-400ps, Lawn - 6,000m<sup>2</sup>)
3. Sports facility for staff:  
240,000BT
4. Detention pond : 951,900BT  
(800m<sup>2</sup>, 600m<sup>2</sup>)

(5) Furniture ..... 341,000 BT

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Grand Total ..... 13,553,600 BT

The estimated total project cost to be defrayed by the Thai side does not include taxes, fees and personnel expenses.

It is desirable that the Thai Government prepares the budget for this project and conduct design and construction work in a timely manner so that the entire project can be implemented smoothly and the facilities constructed may be utilized effectively.



## **CHAPTER 6 EVALUATION OF THE PROJECT**



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Considering the indispensability of developing industrial standardization, testing and metrology for promoting the industrialization of Thailand, establishment of the Industrial Standardization, Testing and Training Centre and the Industrial Metrology Testing Centre should positively benefit the progress of Thai industrialization through their direct contribution toward development of the foregoing essential factors. The beneficiary effects to be expected of the two Centres should take such forms as described as follows.

### (1) The Industrial Standardization, Testing and Training Centre

1. Enhancement of training function for promoting standardization and for disseminating quality control practice

With the views to alleviating the shortage of proficient personnel to engage in promoting industrial standardization and quality control practice in both public and private organizations, this Centre is envisaged to hold, as an important objective, the training of such personnel. Within 5 years after establishment, it is planned to have training courses organized at the Centre for accepting every year 480 trainees in the domains of industrial standardization and of quality control, and 115 trainees in the domains of testing.

While this number cannot be considered extremely large, if compared with the corresponding number of 20,000 trained annually by the Japanese Standards Association, it should still provide a very effective continuing impetus for about 100 factories already established in and near Bangpoo area where this Centre will be established, as well as about 50 factories projected to be additionally established in the foreseeable future.

## 2. Enhancement of certification testing capacity

The lengthening of the time required between request for certification testing and issue of test results, is a serious impediment to the diffusion of industrial standard certification system.

As explained in 2-3-4, demand of certification testing is expected to increase by nearly 700 each year in addition to the current figure which are being undertaken by the accredited testing laboratories. One of the objectives of establishing this Centre is to cope with this increment by directly conducting testing with the equipment of its own. Testing capacity of this Centre is planned to handle additional 3,500 testing at the end of 5 years. Thus, with proficient testing personnel, the Centre will contribute to shortening the time required for testing. Upon proficient technical staff coming to be trained through technical cooperation, this staff will come to be available for transferring their proficiency to other testing laboratory staff, and contribute to enhancement of the overall capability for testing. The enhanced capability for testing will assist the dissemination of industrial standard certification system and accommodate the request for testing from other organizations.

Consequently, it will be able to contribute to the improvement of industrial product quality. The testing equipment of the Centre will further serve in testing for developing new 150 industrial standards per year optimized for promoting national industrial development.

### (2) The Industrial Metrology Testing Service Centre

#### 1. Establishment of Metrological Standards and Extension of Calibration Services

Establishment of national primary standards verified internationally, and of industrial metrological standards traceable to these primary standards, together with calibration services correctly based on this national metrological system will contribute toward better uniformity and higher level of quality presented by manufactured products. Further, progress of Thai industrialization can be expected to increase demands for various kinds of calibration services. Calibration service is currently undertaken at a rate of around 400 cases per year. In 5 years, extension of the calibration system will permit 1,300 calibration services to be performed with appropriate time required between application for calibration and completion of requested calibration. Management by the Centre of metrological standards, and provision of calibration services in answer to the demands, will contribute to improvement of industrial product quality.

Further, upon creation of proficient personnel to engage in metrological operations, their serving as leaders in training activity should contribute to firm establishment of the metrological system.

## 2. Extension of capacity for testing associated with research and development

In order to accelerate research and development in the field of industry, it is important that their theoretical aspect and experimental aspect organically function together. Although research and development is also conducted by private enterprises for their products, testings conducted by private sector for the development of new products have to be verified by public testing institutions to raise the level of accuracy of their test data, as is evidenced by the fact that TISTR receives nearly 3,500 requests for testing from private sector a year.

Further, TISTR is aggressively carrying out many national research and development projects based upon requests from public organizations.

In this way, this Centre is strongly expected to play active role in

experimental aspect as well as theoretical aspect of research and development. This Centre will be able to conduct highly reliable testing for research and development based upon requests from both of public and private sectors. The current capacity for undertaking nearly 3,500 testing per year will be increased to around 5,000.

Further, upon creation of proficient personnel to engage in testing operations, nearly 20 engineers from other testing institutions will be able to receive training by the above mentioned proficient personnel annually. Technology transfer made in this manner should contribute to enhancement of testing capability, and promotion of exchange of test data among laboratories.

It may be concluded from the foregoing that the present project will, upon attainment of the level of activity envisaged for the two Centres, effectively contribute to enhancement of industrial product quality. The consequent capability that will be acquired by Thai industry to manufacture products of quality competitive in the international market will contribute directly to promotion of exports.

Upon establishment, the Industrial Standardization, Testing and Training Centre is to be operated as a department of TISI. The personnel is envisaged to number 107 in 5 years from establishment, and regular yearly recruitment is planned to this end. These personnel will be able to use equipment to be installed in this Centre after enhancement of their technical ability by the technical cooperation. The Industrial Metrology Testing Service Centre is to be operated under TISTR, with personnel numbering 96 in 5 years from establishment, to be similarly acquired through regular yearly recruitment. These personnel will be able to use equipment to be installed in this Centre, after enhancement of their technical ability by the technical cooperation and in-house training.

The operation and maintenance costs are arranged to be made available. TISI plans 5.6 million Baht as operation and maintenance cost for the Industrial Standardization, Testing and Training Centre, and TISTR plans 6.1 million Baht for the Industrial Metrology Testing Service Centre.

On the other hand, operation and maintenance cost is estimated 5.62 million Baht for the Industrial Standardization, Testing and Training Centre and 5.65 million Baht for the Industrial Metrology Testing Service Centre. As the estimated costs are very closed to the planned costs by TISI and TISTR respectively, there is no administrative impediments for the operation of the Centres.

In conclusion, the two Centres can contribute to the development of Thai industry, and the administration and management is promised upon their establishment with the assistance of Thai Government. The project for establishing the Centres through grant aid provided by the Japanese Government can be judged feasible and justifiable.





## **CHAPTER 7 CONCLUSION AND RECOMMENDATIONS**



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This project is going to be implemented for the purpose of promotion of industrial standardization and firm establishment of metrological system in Thailand. More directly, this project aims at improving capabilities of training and testing for coping with the increase of basic and urgent need of bringing up necessary human resources for promotion of standardization and quality control, and of testing in the following five years. And this will contribute to solving restrictions in the sound development of the Thai industry. In other words, the implementation of the project is to consolidate one of the necessary conditions for sound development of the Thai industry and is judged to be meaningful. The project site has no serious problems for the construction of the Centres in terms of shape, ground condition and infrastructure. The system for operating and managing the prospective facilities and personnel plans prepared by the Thai side are also appropriate.

Thus, it is judged to be quite reasonable and advisable for the Japanese Government to provide a grant aid for implementation of the project.

To ensure prompt implementation of the project and accomplishment of the initial objective with smooth operation of the facilities after completion of the construction work, the following recommendations are presented.

### 1. Smooth Implementation of the Works by the Thai Side

It is necessary for the Thai side to draw up a budget for this project timely in conjunction with the Thai Government's fiscal year so that the works by the Thai side will be implemented smoothly. Particularly, the site preparation work, including banking and leveling of the site and the

temporary power supply for the construction work are important and need to be completed before the commencement of the Japanese side work.

## 2. Personnel Recruitment

The key to the success of this project lies in improving the technical capabilities of the two Centres' staff. Technologies developed and mastered at the two Centres will be transferred to both public and private sectors through various training programs offered by the Centres, which in turn will help broaden the industrial base of Thailand. In this context, it is important to develop human resources required for operating and managing both Centres' facilities in accordance with the projected personnel assignment plan.

## 3. Sufficient Budget for Operating and Managing the Facilities

It is necessary to secure a sufficient budget for sound and smooth operation and management of the Centres. For the two Centres to be operated soundly on the backing of a general understanding of the significance of this project, it is desirable that sufficient budgets be appropriated for operation and management of this project each year successively.

## 4. Renewing and Upgrading the Equipment

The equipment plan for this project was worked out with an eye to five years ahead. To cope with increases, quantitative and qualitative, in the needs of Thai industry as a result of its upgrading, it will be necessary to continually renew and upgrade the equipment installed in both Centres. For this reason, there is a need to begin, as early as this point of time, taking all necessary steps, including budgetary measures for renewal and upgrading of the equipment, to cope with such future increases in the needs of Thai industry.

## 5. Technical Cooperation

The Japanese Government is going to provide a technical assistance to the "Industrial Standardization, Testing and Training Centre" as the project-type technical cooperation related to this project. It is desirable that close cooperation be maintained between both Governments towards the implementation of the technical cooperation programme. It is also hoped that if the technical cooperation be implemented for the "Industrial Metrology Testing Service Centre" the effects of the grant aid may be maximized.



**ATTACHMENT 1**

**LIST OF EQUIPMENT**





**Equipment for**

**The Industrial Standardization, Testing and Training Centre**



Equipment	Quantity	Note
TESTING		
MECHANICAL		
BASIC EQUIPMENT		
Steel long tape	14	
Vernier caliper	29	
Liner hight	1	
Digimatic caliper	2	
Vernier microscope	2	
Toolmakers microscope	1	
Monitor TV set	1	
A-counter	1	
Polaroid photographic attachment	1	
Digimatic Head	2	
Micrometer	10	
Digital bench micrometer	2	
Outside micrometer	19	
Tublar inside micrometer	9	
Micrometer stand	2	
Groove micrometer	1	
Dial indicator	10	
Magnetic stand	10	
Layout machine	1	
Roundness measuring machine	1	
Digital roughness tester	1	
Granite table	3	
H,V-block	2	
Transfer stand	1	
Magnetic chuck	2	
Thread gauge	10	
Radius gauge	1	
Dial snap gauge w/dial indicator	4	
Filler gauge	1	
Metallurgical microscope	1	
Universal bevel protractor	1	
Profile projector	1	
Protector screen	1	

Equipment	Quantity	Note
Cross travel stage	1	
Overlay chart	1	
Electronic balance	1	
Balance table	1	
Top load balance	1	
Balance table	1	
Hygrometer	3	
Thermo-hydrometer	1	
Automatic densimeter	1	
Multi-layer coating thickness analyzer	1	
Specimen punching press	1	
Tension gauge	1	
Desiccator	1	
<b>TENSILE PROPERTIES</b>		
Universal tensile testing machine	1	
Calibration device for extensometer	1	
Autograph	1	
Tension test device for use in thermostatic chamber	1	
Thermostatic chamber	1	
Schopper tensile testing w/dumbell grip	1	
<b>IMPACT</b>		
Drop tester	1	
Pendulum impact tester	1	
Pendulum impact tester (Charpy)	1	
Impact tester for head rest	1	
<b>HARDNESS</b>		
Hardness tester (Vickers)	1	
Hardness tester (Brinell)	1	
Hardness tester (Rockwell)	1	
Hardness tester (30-95IRHD)	1	
<b>COMPRESSION</b>		
Compression set apparatus	1	
Hydraulic test press	1	
<b>TORSION</b>		
Torque wrench	6	
Torque meter	10	

Equipment	Quantity	Note
<b>CREEP</b>		
Creep testing machine(Bending tester)	1	
<b>VIBRATION</b>		
Vibro tester	1	
Vibration measuring instrument	1	
<b>SPRING CHARACTERISTIC</b>		
Leaf spring testing machine	1	
Automatic spring testing machine	1	
Digital system coil spring testing machine(max.200kgf)	1	
Digital system coil spring testing machine(max.10kgf)	1	
<b>FRICITION &amp; WEAR RESISTANCE</b>		
Friction testing machine	1	
Abrasion resistance tester	1	
<b>SPECIFIC EQUIPMENT</b>		
Three dimensional manikins	1	
Standard head form	1	
Shock absorption test equipment for helmet	1	
Penetration test equipment	1	
Endurance tester for head rest	1	
Damping force tester	1	
Seat frame testing machine	1	
V-belt length measurement stand	1	
Cylinder for flexibility test	1	
Fasten belt strength test equipment	1	
<b>NON DISTRUCTIVE EXAMINATION</b>		
X-ray projector(crack weld test)	1	
Ultrasonic flaw detector	1	
Angle probe	6	
Straight probe	2	
Standard test block set	13	
Crack inspection equipment	1	
Densitometer	1	
Shaukasten(film-viewer)	1	

Equipment	Quantity	Note
<b>ELECTROMECHANICAL</b>		
Anemometer w/tripod	2	
Calorimeter room	1	
Heating efficiency test stand	1	
Air delivery testing room	2	
Mechanical endurance test for speed regulator (rotary type)	1	
Mechanical endurance test for speed regulator (push type)	1	
Tachometer (noncontact type)	2	
Tachometer (contact type)	2	
Endurance tester for ignition coil	1	
Performance test equipment for starter motor	1	
Endurance test equipment for SW mag. assembly	1	
Durability test equipment for wiper motor	1	
<b>FLUID PRESSURE</b>		
High pressure water pump w/pressure gauge	1	
Air pump/pressure gauge	10	
Flow meter	10	
Water jacket cylinder w/expansion gauge	1	
Air leak tester	1	
Air leakage test equipment for spark plug	1	
<b>LIGHT &amp; SOUND</b>		
<b>LIGHT</b>		
Light projection test apparatus	1	
Projection device	1	
Specimen holder (capable of moving & turning)	1	
Projection screen	1	
Light stability test apparatus	1	
Optical deviation test equipment	1	
Distortion of vision test apparatus	1	
Uniformity test apparatus	1	
Flux meter (20,000lumen)	1	
Lux meter	1	
Photometric Integrating sphere 2m dia. w/photo receiver	1	

Equipment	Quantity	Note
Photometric bench 3.5m length w/photo receiver	1	
Standard lamps of flux	3	
Standard lamps of intensity	2	
Standard lamps of colour temp.	1	
Standard fluorescent lamps	6	
Photometric measuring system	1	
Digital illumination meter	1	
Chromameter	1	
Reference ballast (20W)	2	
Reference ballast (32W)	2	
Reference ballast (40W)	2	
Lamp chamber tester w/lamp holder	1	
Life test rack for incandescent lamp	1	
Life test rack for fluorescent lamp	1	
Testing circuits for fluorescent lamp	1	
Testing circuit for incandescent lamp	1	

#### TYRE & RIM

Balancing machine for tyre & wheel	1	
Endurance tester for tyre & wheel	1	
Holographic tyre test unit (NDT)	1	
Bead unseating fixture	1	

#### WORK SHOP & MAINTENANCE

Universal thread-cutting lathe	1	
Universal milling machine	1	
Cylindrical grinder	1	
Universal tool milling and boring machine	1	
Precision surface grinder	1	
Welding machine	1	
Soldering equipment	1	
Electric saw	1	
Polishing machine	1	
Molding	1	
Overhead monorail crane with hoist	1	
Fork lift	1	

Equipment	Quantity	Note
Jack	1	
Punching press (bar-shaped)	1	
Circle cutter	1	
Strip cutter	1	
<b>ELECTRICAL</b>		
<b>BASIC EQUIPMENT</b>		
Portable watt-meter	8	
Digital Watt-meter	3	
Watt meter (3-phase, 20A, 500V)	2	
Watt-hour meter (single-phase, 15A, 250V)	5	
Recorder for watt-hour meter	5	
Digital power factor meter	2	
Portable AC voltmeter	13	
Electro-static voltmeter	1	
Portable DC voltmeter	10	
Portable DC volt-ammeter	4	
Portable AC volt-ammeter	4	
Portable AC ammeter	25	
Portable DC ammeter	20	
Thermo-couple type am-meter	1	
Thermo-couple type milli am-meter	2	
Thermo-couple type voltmeter	2	
Thermo-couple for ammeter	3	
Digital AC meter	2	
Precision digital multimeter	2	
Digital multimeter	2	
Clamp multimeter	2	
Digital circuit tester	10	
Capacitance meter	1	
<b>RESISTANCE</b>		
Precision wheatstone bridge	1	
Precision double bridge	1	
Electronic galvanometer	1	
Decade resistance boxes (Low Z)	4	
Decade resistance box (High Z)	4	



Equipment	Quantity	Note
Resistors for discharge test	1	
Rheostat	2	
Switch resistance tester(contact resistance tester)	2	
Shunt resistor	2	
WAVE FORM, FREQUENCY		
Oscilloscope w/probe	6	
Strage oscilloscope	2	
Frequency meter	4	
TIME, ROTATION		
Line counter (Magnetic counter)	20	
Time sequencer	5	
Timer (minute)	20	
Timer (Hour)	20	
Precise stop clock	5	
Digital stroboscope	2	
TEMPERETURE MEASURING		
Digital thermometer w/analog output	2	
30point selector for digital thermometer	2	
Thermo-couple (sheath)	60	
Thermo-couple (coil)	1	
Hybrid recorder	2	
Hybrid recorder	6	
Temperature controller	2	
Pocket thermometer	10	
Temp. probe	5	
Thermo-couple	15	
Rod type glass thermometer	3	
RECORDER		
Flat bed recorder(3-pen)	4	
X-Y recorder	6	
POWER SUPPLY, TRANSFORMER, VOLT SLIDER		
AC single phase voltage regulator	5	
AC three phase voltage regulator	3	
DC Power supply source	12	
Variable AC source	3	
Variable power supply	1	

Equipment	Quantity	Note
High voltage testing device	1	
High voltage power supply unit	1	
Fuse tester jig	2	
Step-up transformer	1	
Step-down transformer	3	
Insulation transformer	10	
Current transformer	10	
Filament heating transformer	2	
Volt slider	14	
Megohm tester (handy type)	2	
Insulation & breakdown tester	5	
Insulation resistance meter	4	
High frequency breakdown tester	1	
Spark tester w/drum	1	
Tracking resistance tester	1	
Arc resistance tester	1	
Leakage current tester	4	
Earth continuity tester	2	
SPECIFIC EQUIPMENT		
Safety test tool kit	3	
Standard plug for dimension testing	1	
Special cap for twist test for lamp	1	
Mandrels for wrapping test	1	
Enamel wire testing pencil lead scratch	1	
Cable cord flexing tester	1	
Cord bending fatigue tester	1	
Triple parallel plate plastometer	1	
Tumbling barrel	1	
Test table for heating test	1	
Hot mandrel heat resistance tester	1	
Special plugs for dimension bayonet & spring type	1	
V-belt electrical resistance measurement stand	1	
AUTOMOBILE PARTS		
Alternator tester	1	
Starter tester	1	
Regulator tester	1	

Equipment	Quantity	Note
Battery tester	1	
Short circuit tester	1	
High rate tester	1	
Automatic capacity tester	1	
Automatic battery life tester	1	
B.Q. tester (Spark plug tester)	1	
THERMAL		
Temp/Humi oven	1	
High-low temp. and humidity chamber	1	
Temperature oven	4	
Gear type oven	1	
Oil bath w/constant temp. device	2	
Oil bath	2	
Water bath w/thermal control	1	
Flamability tester w/draft chamber	1	
Muffle furnace	1	
Rain test system	1	
Dilatometer	1	
CLIMATIC RESISTANCE		
Water spraying chamber	1	
Ozone aging tester	1	
Dust chamber	1	
Salt spray tester	1	
SOUND		
Microphone 1-inch	2	
Microphone 1/2-inch	2	
Pre-amplifier	2	
Microphone cable	6	
Measuring amplifier	1	
Sine wave generator	1	
Level recorder	1	
Band pass filter	1	
Power amplifier	1	
Sound level meter	4	

Equipment	Quantity	Note
Level recorder	2	
Piston phone	1	
Anechoic room	1	
<b>ELECTRONICS</b>		
AM/FM Signal generator	2	
Stereo signal generator	1	
Audio signal generator	2	
Function generator	1	
Electronic voltmeter	5	
Frequency counter	2	
Audio analyzer	2	
Wow & flutter meter	2	
Oscilloscope	1	
DC power supply	4	
Field strength meter	1	
FM detector (stereo use)	1	
Shield room with line filter	1	
Dummy antenna	1	
<b>CALIBRATION</b>		
Block gauge for dimension measurement	1	
Weight for weighting	1	
Lead calibration device for tensile testing machine	1	
Hardness standard block for hardness testing (Rockwell)	1	
Hardness standard block for hardness testing (Vickers)	1	
Hardness standard block for hardness testing (Brinell)	1	
DC Volt-ammeter	1	
AC Volt-ammeter	1	
Thermo couple type mill-ammeter	3	
Precision wheatstone bridge	1	
Electronic galvanometer	1	
Precision double bridge	1	
Decade resistance box	1	

Equipment	Quantity	Note
DC voltage / current standard	1	
AC voltage / current standard	1	
Rod type glass thermometer	1	
CHEMICAL		
Atomic absorption spectrophotometer	1	
X-ray spectrophotometer	1	
Inductively Coupled Plasma Spec.(ICPS)	1	
UV-VIS spectrophotometer	1	
Shaker w/separatory funnel holder	1	
Fume hood	1	
Table center	4	
Table side	5	
Sink	2	
Cabinet	4	
Storage cabinet	2	
Balance	1	
Balance table	1	
Hot plate	1	
Auto-still	1	
Oven	1	
Water bath	1	
Muffle furnace	1	
TEST DRAINAGE TREATMENT SYSTEM		
Test drainage treatment system	1	

Equipment	Quantity	Note
STANDATDIZATION, FURNITURE, OTHERS		
TESTING ROOMS		
Testing table	30	
Testing table with out-let	15	
Chair for testing table	45	
Working desk	25	
Chair for working desk	25	
Data cabinet	35	
Tool locker	30	
Blackboard (Data board)	15	
Shelves for equipments & material	30	
STOCK ROOM 1F		
Shelf	24	
ADMINISTRATION OFFICE		
Typewriter	1	
Copy machine	1	
Desk for typewriter	1	
Chair for typist	1	
Desk	9	
Chair	9	
Filing cabinet	10	
Locker	3	
Blackboard	2	
Vacumm cleaner	1	
Floor polisher	1	
RECEPTION		
Counter table	1	
STAFF ROOM 2F		
Desk	35	
Chair	35	

Equipment	Quantity	Note
Filing cabinet	10	
Blackboard	2	
Locker	12	
STAFF ROOM 1F		
Desk	19	
Chair	19	
Filing cabinet	5	
Locker	7	
Blackboard	1	
CPU		
Computer	2	
Desk for computer	2	
Chair for computer	2	
External diskette drive	2	
Printer	2	
Cabinet for computer material	1	
Stencile copying machine	1	
Copy machine	1	
Work table	2	
Blackboard	1	
Facsimile	1	
Table for facimile	1	
LIBRARY		
Book shelf	10	
Reading desk	8	
Chair	16	
Filing cabinet	1	
Blackboard	1	

Equipment	Quantity	Note
Index cabinet	1	
Shelf	4	
DIRECTOR'S ROOM		
Desk	1	
Chair	1	
Locker	1	
Filing cabinet	1	
Reception furniture (Arm chair)	4	
Reception furniture (sofa)	1	
Reception furniture (table)	1	
Reception furniture (center table)	1	
SECRETARY'S ROOM		
Desk	1	
Chair	1	
Typewriter	1	
Typewriter desk	1	
Chair for typist	1	
Blackboard	1	
WAITING CORNER		
Chair	8	
SEMINAR ROOM (1)		
Desk for trainee	16	
Chair for trainee	32	
Desk for teacher	2	
Chair for teacher	2	
Blackboard	2	
Dark curtain	2	
SEMINAR ROOM (2)		
Desk for trainee	16	
Chair for trainee	32	
Desk for teacher	2	



Equipment	Quantity	Note
Chair for teacher	2	
Blackboard	2	
Dark curtain	2	
SEMINAR ROOM (3)		
Desk for trainee	8	
Chair for trainee	16	
Desk for teacher	1	
Chair for teacher	1	
Blackboard	1	
Dark curtain	1	
CONFERENCE ROOM		
Table	17	
Chair	50	
Dark curtain	1	
GUEST CORNER		
Table	2	
MEETING ROOM		
Table	6	
Chair	16	
LECTURER'S ROOM		
Desk	8	
Chair	8	
Locker	4	
SENIOR LECTURER'S ROOM		
Desk	1	
Chair	1	
Locker	3	

Equipment	Quantity	Note
<b>CHIEF LECTURER'S ROOM</b>		
Desk	1	
Chair	1	
Blackboard	1	
Table	2	
Chair	4	
Locker	3	
<b>AUDIO VISUAL SYSTEM FOR SEMINAR ROOM</b>		
Dynamic mic. w/out cable	2	
Microphone boom stand	2	
Mic. extension cable	4	
Speaker system	2	
Mounting bracket	4	
Control power amplifier	2	
Cassette tape deck	2	
Compact disk player	2	
Console rack	2	
Cable	2	
Main power switcher	2	
VTR	2	
Color TV receiver	2	
Console rack	2	
<b>OHP AND OTHERS</b>		
Over head projector w/acc.	3	
Screen	3	
Slide projector	3	
<b>AUDIO VISUAL SYSTEM FOR CONFERENCE ROOM</b>		
Universal video projector	1	
Flat screen	1	
Suspension support	2	
Camera extension cable	1	
Remote control unit	1	

Equipment	Quantity	Note
VTR	2	
Control power amplifier	1	
Speaker system	2	
Speaker stand	4	
Main power switcher	1	
Dynamic mic w/out cable	1	
Microphone boom stand	1	
Mic extension cable	2	
Console rack	1	
A/V cable	1	
Video/audio selector	1	
Control/power unit	1	
Chairman's unit	1	
Delegate's unit	20	
Cassette tape deck	1	
Audio connecting cable	1	
Multi-disc-player	1	

#### AUDIO VISUAL SYSTEM FOR MEETING ROOM

VTR	2	
Control power amplifier	1	
Speaker system	1	
Mounting bracket	2	
Dynamic mic w/out cable	2	
Microphone boom stand	2	
Mic extension cable	2	
Console rack	1	
A/V cable	1	
Color TV receiver	2	
Cassette deck	1	
CD player	1	

#### PORTABLE VTR SYSTEM

3-chip CCD Video camera	1	
Battery adapter	1	
Battery shoe	1	

Equipment	Quantity	Note
Condenser microphone	1	
Camera mic holer	1	
Battery for microphone	20	
Tripod w/dolly	1	
Carrying bag	1	
Portable video cassette recorder	1	
Battery charger	1	
Rechargeable battery pack	20	
Portable battery light	1	
Lamp	10	
Carrying case	1	
Color video monitor	1	
Mic extension cable	1	
Camera cable	1	
Mic extension cable	1	
Dubbing connector cable	1	
Audio cable	1	
Dynamic mic	1	
Carrying handle	1	
AC power adaptor	1	
AC power supply unit	1	

#### COLOR VIDEO STUDIO SYSTEM

3-chip CCD video camera	1	
5-inch monochrome electronic viewfinder	1	
Flexible cable unit	1	
Tripod w/dolly	1	
Camera control unit	1	
AC power adaptor	1	
4-inch monochrome electronic viewfinder	1	
Rack mount metal	1	
Camera cable	1	
Camera control console	1	
Main power switcher	1	
Color video monitor	1	
Compact monitor speaker system	1	

Equipment	Quantity	Note
Monitor stand	1	
Dynamic mic w/out cable	1	
Electret condenser mic	1	
Electret condenser mic	1	
Table microphone stand	1	
Microphone boom stand	1	
Cradle suspension	1	
Mic extension cable	2	
Portable lighting kit	1	
Lamp	2	
AC power supply unit	1	
A/V cable	1	
B/W video camera	1	
AC adaptor	1	
Monochrome video monitor	1	
Manual zoom lens	1	
Close up lens	1	
Stand console	1	
Special effect generator	1	
Color video monitor	2	
Video/audio selector	2	
Video/audio distributor	1	
Connecting cable	7	
Intercomm	4	
Console	1	
Video cassette recorder/editing	1	
Video cassette recorder	1	
Color video monitor	2	
Monitor connecting cable	2	
Rack mount metal	2	
Automatic editing control	1	
Remote control cable	2	
Dubbing connector cable	1	
Time base corrector	1	
Cable	1	
Console box	1	

Equipment	Quantity	Note
Professional 8-ch audio mixer	1	
Stereo headphone	1	
Cassette tape deck	1	
Compact disk player	1	
Amplifier	1	
Compact monitor speaker	2	
Rack mount adapter	1	
Audio console	1	
Genlocker	1	
PAL videotizer	1	
PAL super-imposer	1	
Cache disk unit	1	
PAL video titler (English)	1	
Graphic editor	1	
Q-manager	1	
Disk basic	1	
Color video monitor	1	
Micro floppy disk	5	
System console	1	
Cable	1	
Video cassette tape	30	
Video cassette tape	30	
Video cassette tape	50	
VHS video cassette tape	50	
Low noise audio cassette tape	50	

#### DEVELOPING SYSTEM

Enlarger main unit	1	
Stepdown transformar	1	
105mm lens	1	
90mm lens	1	
75mm lens	1	
Lens board	1	
Lamp	5	
6x6 film carrier	1	

Equipment	Quantity	Note
6x9 film carrier	1	
35mm film carrier	1	
4x5 film carrier	1	
Automatic developing equipment	1	
Stepdown transformer	1	
Washer tank	1	
Developing	4	
SUS hanger	25	
Hanger rack	1	
Photopaper developing vat	1	
Film dryer	1	
Photo paper dryer	1	
Photo paper washer	1	
FG film	10	
Roll film	20	
Photo paper	20	
Dark room kit	1	

#### TRAINING MATERIALS

Slide	12
Statistical Simulators Kit	15
Statistics & Quality Control Exercise Kit	15
Icosahedron (20 faces) DICE	15
QC Template	15
Color Standard Charts	3
Scales for Color Fastness Tests	3

#### VEHICLE

Medium bus	1
Wagon	1
Pick up truck	1
Station wagon	1





**Equipment for**

**The Industrial Metrology Testing Service Centre**



Equipment	Quantity	Note
<b>METROLOGY</b>		
<b>LENGTH</b>		
3 co-ordinate measuring machine	1	
Block gauge & accessory set	1	
Block gauge & accessory set	1	
Electronic micrometer	1	
Autocollimeter & Polygon mirror	1	
Standard wedge gauge block	1	
Masters for square	1	
Masters for height(digital)	1	
Checkers for caliper	1	
Checkers for dialgauge	1	
Checkers (depth micrometer)	1	
Checkers (inside micrometer)	1	
Fix gauge (height gauge)	1	
Fix gauge (dial gauge)	5	
Fix gauge (indicator)	2	
Fix gauge (cylinder)	2	
Micrometer(standard)	1	
Micrometer(digital)	1	
Rod inside micrometer sets	1	
Micrometer(indicator)	1	
Electronic micrometer	4	
Micrometer(bench)	1	
Digimatic caliper	3	
Caliper(standard)	3	
Caliper(dial)	2	
Surface roughness tester	1	
Optical parallel	1	
Optical flat	3	
Profile projector	1	
Precision level	1	
Temp/humidity recorder	1	
Base plates	2	
Base plates	1	
Granite plate stand	1	

Equipment	Quantity	Note
Suport stand	2	
Digimatic mini-processor	2	
MASS		
Standard weight set (stainless)	1	
Standard weight set (brass)	1	
Standard weight	25	
High precision hand.operated balance	1	
Direct reading balance (with NRLM report)	1	
Direct reading balance *NRLM	2	
Standard platform scale *NRLM	1	
Electronic floor scale	2	
Electronic balance	1	
Balance table	2	
Barometer	1	
Hygrometer(assman type)	1	
Digital themometer	1	
Temp./Humi. recorder	1	
Desiccator	2	
VOLUME		
Weighing machine	1	
Direct reading balance	1	
Standard flask	6	
Standard flask *NRLM	2	
Standard pipette	4	
Standard burette	8	
Standard tank	3	
Piston prover for Gas	1	
Standard wet Gas meter	3	
Gas meter test equipment	1	
Water master meter	4	
Standard hydrometer	1	
Specific gravity meter for LPG	2	
Barometer	1	
Const. temperature bath	1	

Equipment	Quantity	Note
Thermometer	2	
Water distillation apparatus	1	
Manometer	1	
See-through Gas meter	1	
Plastic tubing	1	
Desiccator	2	
Special gavity balance	1	
Pycnometer	16	
Prefabricated stand	2	
Standard weight set	1	
Dry oven	1	
Experimental desk	1	

#### FORCE

Force standard machine & accessory	1	
Standard proving ring	6	
Standardizing box	1	
Load cell & digital test amplifier	3	
Load cell	1	
Load cell indicater	2	
Wire strain gauge, strain meter	1	
Torque transducer	2	
Barometer	1	
Temp/Humi recorder	1	

#### PRESSURE

Dead weight piston gauge	2	
Precision pressure gauge	3	
Liquid column pressure gauge	2	
Calibration apparatus for vaccume meter	1	
Standard barometer & accessory	1	
Aneroid pressure gauge	24	
Digital pressure gauge	9	
Tool kit	1	
Temp./Humi. recorder	1	
Air tight chamber	1	

Equipment	Quantity	Note
Pressure transducer	4	
Differential pressure transducer	4	
Strain meter	1	
RADIATION		
Standard radiation detector(with Head and Chopper)	1	
Standard source in UV region(with JEMIC)	5	
Standard source in IR region(with JEMIC)	5	
Spectral irradiance	2	
ACOUSTIC		
Anechoic room	1	
Primary standard	1	
Measuring amplifier	1	
Sine generator	1	
Power amplifier	1	
Band pass filter	1	
Multimeter	1	
Programable attenuator	3	
Attenuator	2	
Tone burst generator	1	
Sound level meter	2	
Level recorder	1	
Acoustic calibrator	1	
Oscilloscope	1	
Voltmeter	1	
Frequency counter	1	
Switch	1	
System procceser unit	1	

Equipment	Quantity	Note
<b>ELECTRICAL (LOW FREQUENCY)</b>		
<b>DC VOLTAGE &amp; CURRENT MEASUREMENT</b>		
Standard cell	1	
Channel switch for standard cell	1	
Voltage standard	1	
Standard shunt	1	
Stabilized source	1	
Switch	1	
High voltage source	1	
High voltage standard divider	1	
Differential voltmeter	1	
<b>AC VOLTAGE &amp; CURRENT MEASUREMENT</b>		
AC/DC comparator	1	
AC standard voltage source	1	
Power amplifier	1	
Current shunt	1	
AC/DC voltage & current supply	1	
Power amplifier	1	
<b>RESISTANCE MEASUREMENT</b>		
Standard resistor	17	
Oil bath	2	
<b>RESISTANCE CALIBRATION SYSTEM</b>		
D.C.C.B.	1	
Extender	1	
Switch	1	
Current source	1	
<b>HIGH RESISTANCE CALIBRATION SYSTEM</b>		
High resistance measuring set	1	
Resistance transfer standard (1kohm/step)	2	
Resistance transfer standard (10kohm/step)	2	
Resistance transfer standard (100kohm/step)	2	
<b>VARIABLE RESISTOR</b>		
Variable resistor	10	
<b>ELECTRICAL POWER MEASUREMENT</b>		
AC/DC power comparator	1	
Measuring set for power meter power source	3	

Equipment	Quantity	Note
Measuring set for power meter signal generator	2	
Digital power meter(1 $\emptyset$ )	2	
Digital power meter(3 $\emptyset$ )	2	
Digital multimeter	2	
CAPACITANCE MEASUREMENT		
Standard capacitor	2	
Digital LCR meter	1	
Decade capacitor	1	
ELECTRICAL (HIGH FREQUENCY)		
Measuring receiver	1	
Selective level meter	1	
Impedance transformer	3	
Precision attenuator set	2	
Frequency synthesizer	1	
Standard signal generator	1	
Step attenuator	1	
Spectrum analyzer	1	
Oscilloscope	1	
Step Attenuator	3	
Thermal converter	1	
Frequency synthesizer	1	
LF impedance analyzer	1	
RF impedance analyzer	1	
VSWR bridge	1	
Scalar network analyzer horizontal	1	
Decade trans	1	
Sweep Generator	1	
Rubidium frequency standard	1	
Frequency convertor	1	
Frequency counter	1	
Power unit	2	
RF power level control unit	1	
RF power transfer standard	1	
Synthesized signal generator	1	
RF power transfer standard	2	



Equipment	Quantity	Note
Power meter	1	
Digital voltmeter	1	
Two channel power meter	1	
Power sensor	1	
Calibration generator	1	
Time mark generator	1	
Leveled sine wave generator	1	
Synthesizer	1	
HF voltmeter	1	
Differential voltmeter	1	
Wow flutter meter calibration system	1	
Distortion meter calibration system	1	
Distortion meter	1	
Wow flutter meter	1	
Signal analyzer	1	

#### TEMPERATURE

Comparative calibration equipment for resistance thermometer	1
Thermocouple/resistance thermometer fixed point cal. equip.	1
Salt bath	1
Ice maker	1
Ice crusher	1

Equipment	Quantity	Note
TESTING		
MECHANICAL		
BASIC EQUIPMENT		
Digital roughness tester	1	
Universal tensile testing machine	1	
Pendulum impact tester	1	
Hardness tester (Vickers)	1	
Hardness tester (Brinell)	1	
Hardness tester (Rockwell)	1	
Hardness standard block for hardness testing(Rockwell)	1	
Hardness standard block for hardness testing(Vickers)	1	
Hardness standard block for hardness testing(Brinell)	1	
Torsional testing machine	1	
Microhardness tester (vickers) w/knoop identification	1	
Induction furnace	1	
WORK SHOP		
Lathe	1	
Universal milling machine w/optional acc.	1	
Cylindrical grinding machine	1	
Drilling and boring machine	1	
Welding machine	1	
Automatic band saw	1	
Hydraulic press	1	
Fork lift truck	1	
NDT		
Magnetic particle inspection (magnetic flow method)	1	
Magnetic particle inspection (current flow method)	1	
Liquid penetrant	1	
Eddy current inspection	1	
Ultrasonic inspection	1	
Radiographic examination(Gamma ray projector)	1	
Radiographic examination(X ray projector)	1	

Equipment	Quantity	Note
ELECTRICAL/ELECTRONIC		
ELECTRICAL		
Digital AC meter	1	
Precision digital multimeter	1	
Digital multimeter	1	
Strage oscilloscope	1	
Digital thermometer w/analog output	1	
30point selector for digital thermometer	1	
Hybrid recorder	1	
X-Y recorder(1pen) w/dust cover	1	
DC Power supply source	2	
Insulation & breakdown tester	1	
High frequency breakdown tester	1	
Safety test tool kit	2	
Standard plugs for dimension testing	1	
Special caps for twist test for lamp	1	
Cord bending fatigue tester	1	
Hot mandrel heat resistance tester	1	
Light projection test apparatus (Safty glass)	1	
Projection device	1	
Specimen holder (capable of moving & turning)	1	
Projection screen	1	
Light stability test apparatus	1	
Optical deviation test equipment	1	
Distortion of vision test apparatus	1	
Uniformity test apparatus	1	
Flux meter (20,000 lumen)	1	
Photometric Integrating sphere 2m dia. w/photo receiver	1	
Photometric bench 7m length w/photo receiver	1	
Standard lamps of flux	3	
Standard lamps of intensity	2	
Standard lamps of colour temp.	1	
Standard fluorescent lamps	3	
Luminance meter	1	
Digital illumination meter	1	
Chromameter	1	

Equipment	Quantity	Note
Illumination meter	1	
Reference ballast (20W)	2	
Reference ballast (32W)	2	
Reference ballast (40W)	2	
Lamp chamber tester w/lamp holder	1	
ELECTRONIC		
AM/FM Signal generator	2	
Stereo signal generator	1	
Audio signal generator	2	
Electronic voltmeter	3	
Frequency counter	1	
Audio analyzer	1	
Wow & flutter meter	2	
Oscilloscope	1	
DC power supply (35V,30A)	1	
DC power supply (35V,5A)	2	
Shield room with line filter	1	
Dummy antenna	1	
THERMAL		
Temp/humi oven	1	
High-low temp. and humidity chamber	1	
Temperature oven	4	
Oil bath	2	
CHEMICAL		
POLIMER & PAINT		
GC/MS	1	
Thermal gravimatic analyzer / differential analyzer	1	
Universal testing machine(500kg)	1	
Impact tester (Drop type)	1	
Gear's rubber aging oven	1	
Abrasion resistance tester	1	
Fume hood	1	
Table	5	
Sink	1	

Equipment	Quantity	Note
Cabinet	1	
Storage cabinet	1	
Melt index	1	
Laboratory plastmill	1	
Acceleration weathering tester	1	
Ozone weathering tester	1	
Balance	2	
Balance table	1	
Colour meter	2	
Liquid chromatograph	1	
Table center	1	
Table side	1	

#### GAS ANALYSIS

Gas chromatograph w/gas analyzer	1	
Toxic gas leak detector	1	
Fume hood	1	
Table side	3	
Sink	1	
Cabinet	1	
Oven	1	
Muffle furnace	1	
Laboratory refrigerated centrifuge	1	

#### BIOCHEMISTRY

Ion chromatograph	1	
Amino acid	1	
Nitrogen analyzer	1	
Fatty extractor	1	
Fibertec system (Digester)	1	
High temperature solvent extractor(Extraction)	1	
Transmission electron microscope	1	
Laboratory refrigerated centrifuge	1	
Cooling shaking bath	1	
Digital pH meter	1	

Equipment	Quantity	Note
Oxygen meter	1	
Deep freezer	1	
Autoclave	1	
Fume hood	2	
Analytical mill	1	
Water bath	1	
Rotary evaporator	1	
Hot plate	1	
Oven	2	
Table center	4	
Table side	7	
Sink	1	
Cabinet	2	
Storage cabinet	2	
Analytical balance	2	
Balance table	1	
Sugar analyzer	1	
Protein system	1	
Vacuum dry oven	1	
Cold room	2	
Ultra filtration system	1	

#### ORGANIC SUBSTANCE

High performance thin layer chromatograph	1	
Gas chromatograph	1	
C.H.N analyzer	1	
Fume hood	2	
Water bath	1	
Rotary evaporator	1	
Hot plate	1	
Oven	2	
Table center	2	
Table side	10	
Sink	2	
Cabinet	3	
Storage cabinet	4	

Equipment	Quantity	Note
Shaker	1	
Auto-still	1	
Water purifier	1	
Distillater	1	
PH meter	1	
GC/FTIR/MS	1	
UV-VIS spectrophotometer	1	
Infrared spectrophotometer	1	
Fluorometer w/data system	1	
Emission spectrophotometer	1	
Atomic absorption spectrophotometer	1	
Test drainage treatment system	1	

Equipment	Quantity	Note
<b>FURNITURE, OTHERS</b>		
<b>TESTING AND STANDARD ROOMS</b>		
Testing table	35	
Testing table with out-let	15	
Chair for testing table	50	
Working desk	30	
Chair for working desk	30	
Data cabinet	45	
Tool locker	30	
Blackboard (Data board)	20	
Shelves for equipments & material	30	
<b>STOCK ROOM (1) (2)</b>		
Shelf	18	
<b>STOCK ROOM 1F</b>		
Shelf	12	
<b>ADMINISTRATION OFFICE</b>		
Typewriter	1	
Copy machine	1	
Desk for typewriter	1	
Chair for typist	1	
Desk	9	
Chair	9	
Filing cabinet	10	
Locker	3	
Blackboard	2	
Vacumm cleaner	1	
Floor polisher	1	



Equipment	Quantity	Note
STAFF ROOM 1F		
Desk	16	
Chair	16	
Filing cabinet	5	
Blackboard	1	
Locker	6	
STAFF ROOM (LEFT)		
Desk	14	
Chair	14	
Filing cabinet	4	
Locker	5	
Blackboard	1	
STAFF ROOM (RIGHT)		
Desk	14	
Chair	14	
Filing cabinet	4	
Locker	5	
Blackboard	1	
RECEPTION		
Counter table	1	

Equipment	Quantity	Note
CPU R		
Computer	2	
Desk for computer	2	
Chair for computer	2	
External diskette drive	2	
Printer	2	
Cabinet for computer material	1	
Stencile copying machine	1	
Copy machine	1	
Work table	2	
Blackboard	1	
Facsimile	1	
Table for facsimile	1	
LIBRARY		
Book shelf	8	
Reading desk	6	
Chair	12	
Filing cabinet	1	
Blackboard	1	
Index cabinet	1	
Shelf	4	
DIRECTOR'S ROOM		
Desk	1	
Chair	1	
Locker	1	
Filing cabinet	1	
Reception furniture (Arm chair)	4	
Reception furniture (sofa)	1	
Reception furniture (table)	1	
Reception furniture (center table)	1	

Equipment	Quantity	Note
<b>SECRETARY'S ROOM</b>		
Desk	1	
Chair	1	
Typewriter	1	
Typewriter desk	1	
Chair for typist	1	
Blackboard	1	
<b>WAITING CORNER</b>		
Chair	8	
<b>SEMINAR ROOM (1) (2)</b>		
Desk for trainee	16	
Chair for trainee	32	
Desk for teacher	2	
Chair for teacher	2	
Blackboard	2	
Dark curtain	2	
<b>CONFERENCE ROOM</b>		
Table	17	
Chair	50	
Dark curtain	1	
<b>MEETING ROOM</b>		
Table	10	
Chair	20	
<b>GUEST ROOM (1) (2)</b>		
Table	4	
Chair	8	

Equipment	Quantity	Note
<b>LECTURER'S ROOM</b>		
Desk	4	
Chair	4	
Locker	4	
<b>AUDIO VISUAL SYSTEM FOR SEMINAR ROOM</b>		
Dynamic mic w/out cable	1	
Microphone boom stand	1	
Mic extension cable	2	
Speaker system	1	
Mounting bracket	2	
Control power amplifier	1	
Cassette tape deck	1	
Compact disk player	1	
Console rack	1	
Cable	1	
Main power switcher	1	
VTR	2	
Color TV receiver	2	
Console rack	1	
<b>OHP AND OTHERS</b>		
Over head projector w/acc.	2	
Screen	2	
Slide projector	2	
<b>AUDIO VISUAL SYSTEM FOR CONFERENCE ROOM</b>		
Universal video projector	1	
Flat screen	1	
Suspension support	2	
Camera extension cable	1	
Remote control unit	1	
VTR	2	
Control power amplifier	1	
Speaker system	2	

Equipment	Quantity	Note
Mounting bracket	4	
Main power switcher	1	
Dynamic mic w/out cable	2	
Microphone boom stand	2	
Mic extension cable	4	
Console rack	1	
A/V cable	1	
Video/audio selector	1	
Control/power unit	1	
Chairman's unit	1	
Delegate's unit	20	
Cassette tape deck	1	
Audio connecting cable	1	
Multi-disc-player	1	

#### AUDIO VISUAL SYSTEM FOR MEETING ROOM

VTR	2	
Control power amplifier	1	
Speaker system	1	
Mounting bracket	2	
Dynamic mic w/out cable	2	
Microphone boom stand	2	
Mic extension cable	2	
Console rack	1	
A/V cable	1	
Color TV receiver	2	
Cassette deck	1	
CD player	1	

#### DEVELOPING SYSTEM

Enlarger main unit	1	
Stepdown transformar	1	
105mm lens	1	
90mm lens	1	
75mm lens	1	
Lens board	1	

Equipment	Quantity	Note
Lamp	5	
6x6 film carrier	1	
6x9 film carrier	1	
35mm film carrier	1	
4x5 film carrier	1	
Automatic developing equipment	1	
Stepdown transformer	1	
Washer tank	1	
Developing	4	
SUS hanger	25	
Hanger rack	1	
Photopaper developing vat	1	
Film dryer	1	
Photo paper dryer	1	
Photo paper washer	1	
FG film	10	
Roll film	20	
Photo paper	10	
Photo paper	10	
Dark room kit	1	
<b>VEHICLE</b>		
Wagon	1	
Pick up truck	1	
Station wagon	1	