

## CHAPTER 8. SURFACE TREATMENT WORK

### 8.1 GENERAL

This section specifies the general requirements for the surface treatment of fuel Piping and the storage tanks. The scope shall include the material, procedures and or tests described thereunder, but not limited to those only. Any items not specifically stated, but considered necessary for safe and efficient operation of the facilities shall be included.

### 8.2 SPECIFICATION

#### 8.2.1 GENERAL

The contractor shall submit a formal quality certificate of paint materials prior to the commencement of the works. The paints shall be delivered before five days using.

The contractor shall not paint for the following conditions.

Dusty condition.

At the rainfall

The humidity is 85% or more

#### 8.2.2 FUEL STORAGE TANKAGE

##### 8.2.2.1 INTERNAL SURFACE

All internal faces of the fuel storage tanks shall be protected by an epoxy resin coating in accordance with the specification mentioned below. Internal coatings shall be applied in accordance with the manufactures recommendations and to the Engineers approval. The sheets for tankages shall be delivered with a protective coat of rust-inhibiting paint (shall not contain any trace of Zinc) such that they are ready to receive final coats on the inside and outside surfaces.

##### (a) Number of Coats

Number of coats shall be 3 coats, each coat having a minimum dry film thickness (DFT) as following :

1st coat : 70 micron DFT

2nd coat : 90 micron DTF

3rd coat : 90 micron DFT

Total thickness of coating necessary shall be 250 micron minimum  
(Tank bottom :5coats;420micron minimum)

(b) Coating Paint

The product shall be a two-component high solids coating based on amine cured high solids epoxy resins approved by the Engineer.

The products shall be applied strictly in accordance with manufacturer's recommendations and to the approval of the Engineer.

(c) Surface Preparation before Sand Blasting

The internal surface of tanks shall be free of all grease oil etc. Excessive rust or scale shall be removed using cleaning tools.

(d) Blast Cleaning

The internal surfaces shall be cleaned all over to "white metal finish" using an abrasive with maximum particle size 0.7 mm and with no particles smaller than 0.17 mm. Furnace slags or copper slags are not accepted abrasives.

After blast cleaning, the maximum allowed degree of roughness is 75 microns. Dry blast cleaning operations shall not be conducted on surfaces that will be wet after blasting and before painting.

(e) Paint Application

Paint application shall be by airless spray or as approved by the Engineer. One coat of epoxy coating paint shall be applied using an airless spray to give a dry film thickness of 70 microns minimum.

The spray shall be applied automatically and the rate of spray, and speed of spray traverse shall be calculated to ensure an even and complete coverage of the surface.

The coating shall be smooth and even and free from runs, sags, cracks and other effects.

The first coat shall be allowed to dry for a minimum of 6 hours and shall receive a second coat of paint within 20 hours. Intermittent blowing with air to remove solvent vapors would be desirable.

The finished dry film thickness of the three coats shall be 250 microns minimum dry film thickness and shall be smooth and even and free from runs, sags and other defects.

The Contractor shall provide adequate facilities for ventilation and vapor extraction.

(f) Inspection

All surfaces shall be inspected and approved by the Engineer prior to the commencement of painting works.

The first two paint coatings shall be inspected and approved by the Engineer prior to the commencement of the following coat.

The final coat shall also be inspected and approved by the Engineer.

Coatings shall be inspected as well as internal surface coating inspection for pipe.

- Visual
- Thickness : Tested by an electrical thickness meter.
- Pinhole : Tested by a holiday detector
- Ketone : As shown herein

### 8.2.2.2 EXTERNAL SURFACE

External paintings shall be applied in accordance with the manufactures recommendations and the Engineers approval.

#### (a) Number of coats and paints

Number of paints are as follows:

(Shell plate and Roof plate)

Brast cleaning and primer:	By manufacture
Prime coat:	Anticorrosive paint 35 micron x 2 coats
	Middle coat: O.P. 30 micron x 1 coat
Finish coat:	O.P. 25 micron x 1 coat

(Bottom plate)

Brast cleaning and primer :	by manufacture
Prime coat:	Tar epoxy paint 50 micron x 1

### 8.2.2.3 TANK BOTTOM PLATE SEAL TAPE

The rainwater proofing shall be provided in accordance with the manufactures recommendations and Engineers approval for tank bottom plate.  
Refer to Drawing F-24.

### 8.2.3 PIPING

#### 8.2.3.1 INTERNAL SURFACE

Internal surface shall be lined with epoxy resin in the factory.

#### (a) Surface preparation

The internal surface of the pipe shall be sandblasted and cleaned according to manufacture's standards and to the Engineer's approval using abrasive particles sized between 0.17 to 0.7 mm

The abrasive shall not be furnace slag or copper slag.

- The maximum degree of roughness shall be 75 microns.
- The internal surface shall be cleaned of any rust, scale, dust and any trace of water, grease and oil prior to application of coating.

Dry blast cleaning operations shall not be conducted on surfaces that will be wet after blasting and before painting.

**(b) Coating paint**

Products used for internal coating shall not contain any trace of zinc. The product shall be a two-component high solids coating based on amine cured high solids epoxy resins approved by the Engineer. The products shall be applied strictly in accordance with the manufacturer's recommendations and to the Engineers approval.

**(c) Application**

Paint application shall be by air spray or as approved by the Engineer. All coating materials shall be thoroughly mixed and applied in strict conformance with manufacturer's recommended procedure. All coating material containers shall be adequately labeled. After the surface preparation operation, one coat of epoxy paint with a Dry Film Thickness of 350 microns (Minimum) shall be applied by airless spray.

The splice area at both pipe ends shall not be coated for a distance of 10 cm. This area shall be included in the sandblasting operation but shall be properly masked-off prior to application of coating.

Masking shall remain on the pipe ends to protect splice area from rust and other contaminations until field splice is made.

The finished paint film shall be smooth and glossy and free from drips and rusts.

Lining shall be stopped ten centimeter from each end of each pipe by tape masking; the welding bevel shall also be tape masked during the application of the lining.

(d) Inspection

The following test's shall be performed on each pipe length in the presence of the Engineer :

- Ketone test

The coating is rubbed for one minute with a clean white rag soaked in Methyl Ethyl Ketone (M.E.K) after which the lining must not be softened as indicated by scratching with the fingernail, and the rag must not show substantial staining of cloth.

- Stripping test

Following the M.E.K Test, application of a sharp blade to the surface of the cured coating shall not result in strips of the coating being removed. Instead, flakes shall result which, when rolled between the thumb and forefinger shall produce powder-like particles.

- Adhesion test

Adhesion can be tested by cutting with a sharp knife a grid pattern of approximate square side dimension of two millimeters. A strip of sticky tape is pressed down on the grid pattern and then ripped off. The tape shall not remove the coating film.

- Inspection

The lining process shall be witnessed by the Engineer's representative throughout application and each pipeline

The lining process shall tested in accordance with the above procedure by an Inspector before the lined pipe is accepted.

Any lining which fails the curing and or adhesion test shall be blasted off to bare metal and made good.

Lining which is too thin may be built up provided that full inter coat adhesion is achieved to the approval of the Engineer.

- (e) **Repair of defective or insufficient coating** Repair of defective areas shall be accomplished in the same manner as the original coating in regard to surface preparation prior to recoating. Where a completely coated surface is found to have insufficient thickness, such surface shall receive an additional coat or coats until minimum thickness is achieved.

Surface to receive additional coating shall be properly cleaned of all foreign matter or contaminants.

- (f) **End Closures**

The ends of each lined pipe shall be firmly closed with metal or plastic closures, so as to prevent the ingress of foreign matter during shipping and handling of the pipe.

Before closing, the beveled ends shall be protected from rusting.

- (g) **Field Repairs**

Where the shop applied coating has been damaged or in cases where coverage is not complete, the area to be coated shall be cleaned of grease, oil, dirt, and rust by use of approved solvents and either wire brushing or grit blasting to "white metal", as required. Epoxy spray coating shall then be applied in accordance with the recommended shop procedure.

For internal carbon steel pipe surfaces, where pipe jointed by field welding, epoxy coating shall be repaired as follows.

Prior to welding, the previously unpainted pipe surface in the area of the weld shall be cleaned of grease, oil, dirt, and rust by the use of approved solvents or wire brushing or as required. After welding each pipe joint, the unpainted pipe surface shall be entirely coated with one coat of epoxy paint as far as practical. The method of application shall be submitted for approval.

### 8.2.3.2 EXTERNAL SURFACE

- (a) **Specification**

- 1) **External surfaces of straight pipe and fitting** External surfaces shall be lined with polyethylene in the factory. Japanese Industrial standards (JIS) G-3459-1986 or equivalent shall apply to Polyethylene coated steel pipes.

2) Shrink cover

External protection for welded joint, elbow, tee and reducer shall be provided by shrink cover to underground pipe(fuel and HSD)line. Shrink cover size shall be pided from 1/2" to 30".

(b) Field Repairs

There are three methods of field repairs according to extent of damage.

1) Polyethylene stick method

This method is applied to damage which is short of reaching the steel surface. In the case of shallow damage penetrating more than 40% of the thickness of the coating, this part is to be welded with a polyethylene stick using hot jet air.

2) Patch method

This method is applied to small damage (less than 70 cm<sup>2</sup>) which has reached the steel surface and also to small damage which is difficult to repair by stick method.

In this case of damage where steel surface is exposed and no stick method is possible, then apply the patch method. This method needs a polyethylene patch sheet, sealant and an aluminum foil.

3) Joint cover method

This method is applied to large damage (over 70 cm<sup>2</sup>) which has reached the steel surface and to such areas where several small damages are concentrated.

4) Inspection

Before the lines are buried a search for defects in the lining should be made using an electrical device known as a "holiday detector", which applies a minimum voltage of 10,000 Volts across the coating tape. If there is a flaw, a spark jumps from the pipe to the detector electrode, giving an audible signal. The flaw should then be repaired by hand and the line retested.



## CHAPTER 9. WELDING AND INSPECTION

### 9.1 WELDING AND INSPECTION

#### 9.1.1 GENERAL

This section covers welding, and inspection for fuel piping and fuel storage tank in the field.

#### 9.1.2 WELDER'S COMPETENCE QUALIFICATION

Before starting the pipe welding and plate welding works, the Contractor should submit for Engineer's approval a "welded performance tests" certificate as specified in American Petroleum Institute API Std. 5,L Appendix B and API std. 1104 section 3.0 which gives the test to be carried out for welding qualifications :

#### 9.1.3 FUEL STORAGE TANK

##### 9.1.3.1 ERECTION AND WELDING

###### (a) General

Erection welded joints and welding of the tanks shall be in accordance with API 650 with modifications as specified herein.

The weld surface shall merge smoothly, not flush, into plate surface. Welds shall be ground where necessary to achieve this condition.

###### (b) Weld Joint

Annular plate shall be joined by butt welding. Bottom plates shall be joined by single-welded full-fillet lap joints. Undersides of plate shall not be coated. Horizontal and vertical connections between shell plates shall be full-penetration double-welded butt joints. At changes of plate thickness, the tank exterior surfaces shall remain plane. The roof plates shall be joined on the top side with a continuous full fillet-welded lap joint on all seams.

The shell-to-top angle or knuckle connection shall be a full-penetration double-welded butt joint. The roof plate-to-top angle or knuckle connection shall be a continuous fillet weld on the top side only.

(c) Removal of Temporary Attachments

Temporary attachments made to the interior and exterior of tank shall be removed by burning and grinding flush so that no portion of the temporary attachment remains and no undercutting of the parent metal occurs. Where removal of temporary attachments reduces the plate thickness below the minimum specified, the area so reduce in thickness shall be repaired by welding and reground as required.

9.1.3.2 FIELD INSPECTION

(a) Radiography

All horizontal and vertical butt welds shall be 100 percent inspected by radiographic methods as specified in API 650. Surfaces of weld areas to be radiographed shall be ground where necessary to achieve a surface condition suitable for proper interpretation of the radiographic film. If the inspection reveals unacceptable weld defects, such defects shall be repaired as specified in API 650 and such repairs shall be re-examined by the same method as before. This procedure shall continue until all welds examined are determined by the Engineer to be acceptable.

(b) Liquid Penetrant and Magnetic Particle Testing

Where it is determined that the geometry or differential thickness does not lend itself to acceptable radiographic interpretation, welds shall be examined by the liquid-penetrant method in accordance with ASME Code Section VIII, Division 1, Appendix VIII, or the magnetic particle method in accordance with ASME Code Section VIII, Division 1, Appendix VI.

(c) Inspection Procedure

Fillet welds at shell-to-bottom plate connections shall be examined by the liquid-penetrant or magnetic particle methods as specified above. Spot examinations shall be made every 3 m around the perimeter of the tanks. If a section of the weld shows an unacceptable defect, a 150 mm length of weld on each side of the defect shall be examined. If the two additional areas are acceptable, only the defective area revealed by the first examination shall be removed and rewelded. If either of two additional area examined shows unacceptable weld metal, the previous 3 m length shall be examined. All unacceptable welds shall be removed and the area rewelded. Nozzle-to-tank welds shall be 100 percent examined by either the liquid-penetrant or the magnetic particle method. The acceptance

standards shall be as specified in Section VIII of ASME Code, Appendix VI or Appendix VIII as applicable.

### 9.1.3.3 FIELD TEST

#### (a) Vacuum Box

After completion of the welding of the tank bottom, all bottom plate welds shall be 100 percent vacuum box tested in accordance with API 650. Vacuum box testing shall be performed using a metal box with a window at the Top. The bottom shall be open, and shall have a rubber gasket. The weld seam to be tested shall be brushed for the length of the box with a specially prepared solution as approved. The box shall be placed over the seam and a partial vacuum of at least 20.7 kpa below atmospheric pressure shall be applied. A defective weld will be indicated by bubbling or foaming. The bubble-forming properties of the solution shall be checked on a test plate with known leaks at least every four hour during testing.

#### (b) Water Test

After completion of vacuum box testing and before internal Coating is applied, the tank shall be filled with water to the level of the lip of the overflow. All defective joints revealed by leaks shall be repaired as specified and retested by refilling the tank to a elevation 600 mm above the elevation of the highest leak.

- Test water as required will be furnished and disposed of by the Contractor, as approved by Engineer.

The Contractor shall provide all piping and connections required for the tank except as otherwise indicated.

### 9.1.3.4 ROUNDNESS AND VOLUME TESTS

After welding and testing is complete but prior to sandblasting, epoxy coating and external painting, the tanks shall be strapped and checked for roundness and volumetric accuracy.

#### 9.1.3.5 WELD REPAIR AND RETESTING

All defective welds shall be repaired as specified in API 650. Repairs inspections, tests and retests shall be at expense of the Contractor.

#### 9.1.4 FUEL PIPING

##### 9.1.4.1 GENERAL

All welding shall conform to the latest edition of API standard 1104, "Standards for welding pipe lines and related facilities".

##### 9.1.4.2 QUALIFICATION OF WELDING PROCEDURES

Before production welding starts, the Contractor shall establish with the Engineer the welding procedure to be used as prescribed by section 2.0 of API standard 1104.

##### 9.1.4.3 QUALIFICATION OF WELDERS

Each welder employed by the Contractor shall pass a qualifying test as described by section 3.0 of API standard 1104, under the Engineer's supervision and subject to the Engineer's approval before being allowed to weld on the lines.

Welders shall use vertical downhand position welding. The Contractor shall furnish all welding materials and equipment, test equipment, etc. The quality of the qualifying welds shall be determined by destructive testing. The Engineer will promptly notify the Contractor as to the qualification or disqualification of each welder.

##### 9.1.4.4 LINE-UP AND WELDING

The joint of pipe shall be aligned and welded together into a continuous pipeline, and all welds in the pipeline shall be of strength equal to that of the pipe and of the quality set forth in these specification and welds shall have the same hardness as the base material. All welding procedure shall conform to the API Std 1104. Standard for welding pipe lines and Related Facilities. General terms used herein conform to API Std 1104 definitions.

(a) Swabbing, pipe beveling and cleaning joints.

No dirt or debris shall be permitted in the pipeline. Prior to alignment, the inside of each joint shall be adequately swabbed either by use of leather or canvas bolt disc of proper diameter or approved other method.

Recutting and rebeveling may be necessary to maintain correct alignment.

All bevels on line pipe shall be made with a beveling machine and oxyacetylene torch. Hand beveling shall not be permitted.

b) Alignment of pipes

All joint shall be aligned with an external line up clamp unless otherwise approval by the Engineer. Spacing of joints and allowable maximum high-low shall be API St 1104. Pipes shall not be hammer marked. When lining-up seamed pipe, in normal, straight alignment laying of successive joints, the seam shall be staggered to right and left so as to offset the seams of adjoining sections by at least 60°.

c) Welding procedure

(1) Welding method

All field welding shall be done by using shield metal-arc process. Multiple joint welding shall be performed either manually or by automatic process, providing the process is in accordance with a qualified procedure approved by the Engineer.

(2) Electrodes

Electrodes shall be selected in accordance with AWS A.5 for each weld layer and approval by the Engineer.

(3) Stringer bead

The stringer bead shall be deposited so as to completely fuse the abutting pipe ends.

The pipes shall not be removed until the stringer beads are completed.

(4) Hot pass

Time interval between stringer bead and hot pass shall be selected in accordance with the material specification and approved by the Engineer. At least, two passes shall be completed on any weld that is left overnight.

**(5) Filler pass**

Each filler pass shall be completed before the next pass is started. The start of filler passes shall be staggered-with complete overlapping of the previous bead.

**(6) Cover pass**

The completed weld shall be thoroughly brushed and cleaned for inspection. The width of the completed weld shall extend no more than 3.2 mm wider than the original groove.

**d) Cleaning welds**

All slag, knots of filler metal, and surface defects shall be removed between passes. Cleaning shall be done with either hand or power tools. Flame gouging shall not be permitted.

**e) Preheating and welding in inclement weather**

Considering the material of pipe and ambient conditions, preheating may be unnecessary. However, welding shall not be carried out when the quality of the completed weld would be likely to be impaired by the prevailing weather conditions, including, but not limited to, airborne moisture, low temperature, blowing sand or heavy wind. Wind breakers and tents shall be provided for the welding work.

**f) Quality and Protection of Welding Rod**

All welding electrodes shall be of quality suitable for the pipeline welding and maintained as per the manufacturer's recommendations.

All welding electrodes found to be deteriorated, defective, or otherwise damaged shall be rejected and prohibited from use on the welding.

**9.1.4.5 INSPECTION FOR WELDING POINT**

In principle, 100 % of the underground pipe weld and 20 % of the above ground pipe weld shall be inspected by using radiograph. The detail method of inspection shall be subject to the Engineer's approval.

Authorization for repair of welds, removal and repair of weld defects, and testing of weld repair shall be strictly in accordance with API 1104.

## CHAPTER 10. PIPE CLEANING AND TEST

### 10.1 PIPE CLEANING

The inside of the piping shall be cleaned in accordance with the procedure indicated below.

#### 10.1.1 TRANSPORTATION AND CUSTODY OF PIPES USED

Pipes used shall be capped at both ends prior to and during transportation and custody, thus shutting out dust, water or other foreign matter.

#### 10.1.2 PIPING INSTALLATION

During piping installation work, utmost care shall be taken to prevent soil, sand or water entering pipes. Should such foreign matter get into the piping, it shall be removed by air blowing, or other manual means approved by the Engineer.

At the end of daily piping installation work, both ends of the piping shall be capped, thereby preventing soil, sand, rainwater or other foreign matter from entering.

#### 10.1.3 PIG CLEANING

Upon completion of the piping installation or prior to the piping flushing, pigs shall be passed through the installed piping for removal of any foreign matter. Pigs used shall be of soft type; otherwise, the inside lining of the piping could be damaged.

### 10.2 LEAK AND PRESSURE TEST

10.2.1 After completion of the piping installation work, the piping shall be subjected to pressure tests and leak tests. Pressure test and leak tests shall be conducted with reference to the pertinent test flow sheet which specifies the following items :

- Test pressure and test fluid
- Scope of tests
- Location of blinds to be inserted
- Valves to be opened or closed in the tests
- Locations of vents and drains

- Locations of in-line instruments and whether these are to be dismantled or left installed.

- Locations of test pressure gauges and pressure inlets

10.2.2 All joints of piping, including welds, shall not be painted before completion of the leak and pressure tests.

10.2.3 The test shall be conducted by dividing items into several blocks.

10.2.4 The leak test shall be conducted with air at 1.1 times of design pressure .

10.2.5 The pressure test shall to be conducted with Jet fuel. The test shall be conducted when small variation of ambient temperature is expected. When the pressure reaches 1.5 times the design pressure or the specified value approved by the Engineer, stop pressurizing and maintain the condition in accordance with API's test standard (API-1110) or a condition approved by the Engineer.

### 10.3 FLUSHING OF PIPE

10.3.1 After erection of all facilities and after preliminary checking under no-load conditions of instrumentation, correct operation, sealing effectiveness etc., a flushing test shall be carried out by filling of the delivery line with JET FUEL provided by contractor.

10.3.2 The Contractor shall submit a test procedure prior to starting the test, for the approval of the Engineer.

10.3.3 The Contractor shall supply all necessary materials include temporary strainer, temporary pipes. The contractor must remove the above materials from the depot within two (2) week after finish of flushing test.



### 10.3.4 FLUSHING PROCEDURE

Basic Flushing procedure are follows refer to the attached Flushing Flow Diagram.

a) 1st Step

All piping and equipment shall be thoroughly flushed to move foreign matter and water.

b) 2nd Step

with Fuel by gravity for flushing from storage tank.

c) 3rd Step

Fuel Hydrant Pumps shall be operated at maximum flow rate 2,000m<sup>3</sup>/h. The following items regarding flushing oil shall be checked.

Item	Base of check	Procedure
Appearance	No solids, free water, color and strange smell.	Visual
Water	30 PPM below	SHELL Type water measurement

d) 4th Step

Laboratory check shall be carried out by the Contractor. The Contractor shall submit a test procedure for approval of the Engineer.

f) 5th Step

Waste disposal procedure for flushing oil shall be instructed by the Engineer.

#### **10.4 TESTING OF PUMP UNIT**

##### **10.4.1 WORKING INSPECTION AND TEST**

The Contractor shall inspect and test the pump units accordance with API-Standard 610 Section IV: shop inspection and testing.

##### **10.4.2 SITE TEST**

The pump trial shall be carried out with the actual fluid of service to ensure that the system actually operates as it was designed to do.

The Contractor shall submit a test procedure before starting the test, for the approval of the Engineer.

## CHAPTER 11. TRAINING, SPARE PARTS, TOOLS AND TEST EQUIPMENT

### 11.1 TRAINING

The Contractor shall provide training for the Employer's staff at the place of manufacture and on site. The Contractor's proposals for training shall be submitted to the Engineer for approval.

#### 11.1.1 FACTORY TRAINING

Factory training shall be provided for the Employer's operation and maintenance staff on selected equipment and systems. The course shall take place at the place of manufacture and or assembly point and shall cover both theory and practical operating and maintenance training on the equipment to be installed in the Works or identical equipment. The courses shall be conducted by competent staff of the manufacturer who are experienced teachers. The courses shall be conducted by competent staff of the manufacturer who are experienced teachers. The courses shall be conducted in the English language. Comprehensive technical literature shall be provided for the trainees at least one month prior to the commencement of each course. Testing of the trainee's knowledge of the equipment shall be carried out at the end of each course.

The duration of each course and the number of trainees is given in Para. 11.1.3: Program of Training.

#### 11.1.2 SITE TRAINING

Site training shall be provided for the Employer's operation and maintenance staff on all equipment, systems, and the like, supplied and installed under this Contract.

The Contractor shall allow in his prices for the provision within his staff of properly qualified tradesmen, technicians and engineers who are experienced in training others. The Contractor shall not allow for the costs involved in bringing trainees to site, housing, feeding or paying them. However, classroom work will be required and the Contractor shall make a suitable room available for this purpose.

The contractor is to ensure that trainees have acquired sufficient knowledge of the equipment or system by testing the trainees.

All courses of training shall be in the English language and the Contractor is to ensure that sufficient technical literature is available at least one month before each course starts.

### 11.1.3 PROGRAM OF TRAINING

When the Contractor's Program to construct the works are drawn up and approved, the Contractor shall draft a comprehensive training schedule for the Engineer's approval. Once the schedule has been agreed on by the Engineer and the Employer no deviation from it shall be permitted except for unavoidable reasons. The Engineer shall be the sole judge of what constitutes an unavoidable reason.

#### a) Factory Training

The length of course shown is only indicative of the Employer's requirements. The exact length of the course will be agreed at the time the Contractor submits his proposals.

System or Equipment	No. of Men	Duration (weeks)	Total Man Weeks
Hydrant Pump System	2	1	2
Controls and software	3	2	6

b) Site Training

The exact length of a course depends on the Contractor's Program of Works. The items given below are only an indication of the lengths of the Courses.

System or Equipment	No. of Men	Duration (Days)	Total Man Days
Storage facilities, Pumping System and Fuel Hydrant system	5	10	50
Controls, instrumentation and software	3	20	60

c) Spare Parts

Spare parts and consumable items for two year's operation after completion are to be supplied under this Contract. In this respect, Sub-Contractors supplying spares must give guarantees that suitable spares will be available for 10 years from the date the Defect Liability Certificate is issued.

d) Special Tools

Any tools which are made purposely to operate or maintain any pieces of equipment supplied are to be provided by the Contractor. Two complete sets of such tools, in suitable containers adequate for the purpose, for each piece of equipment are to be supplied. The cost of special tools and containers are to be included in the rates for the equipment.

## CHAPTER 12. COMMISSIONING

### **12.1 COMMISSIONING**

- 12.1.1 When line flushing and pump tests have been satisfactorily completed the fuel hydrant system is ready for normal operation. This activity is referred to as "Test on completion"; Commissioning.
- 12.1.2 The results of testing and commissioning shall be recorded and signed by the authorized representatives of the Employer, the Engineer and Contractor.
- 12.1.3 Tests on completion shall be referred to "Condition of Contract".

## CHAPTER 13. CIVIL WORK

### **13.1 DESCRIPTION**

This item shall consist of various civil engineering works related to the oil supply system in accordance with these Specifications, at the specified locations and conforming to the lines, grades, cross sections, and dimensions shown on the Drawings or instructed by the Engineer.

### **13.2 MATERIALS**

- a. Materials for sand bedding or cushion or backfilling shall meet the requirements of Section 2.3.2 of the Special Provision of Specification for Airside Civil Works.
- b. Crushed stone base course shall meet the requirements of Section 3.1.1.2 of the Special Provision of Specification for Airside Civil Works.
- c. Materials for cement concrete pavement shall meet the requirements of Section 3.2.2 of the Special Provision of Specification for Airside Civil Works.
- d. Materials for in-situ reinforced concrete structures shall meet the requirements of Section 4.2.2 of the Special Provision of Specification for Airside Civil Works.
- e. Materials for stone masonry work shall meet the requirements of Section 4.1.2 of the Special Provision of Specification for Airside Civil Works.
- f. Materials for brick work shall meet the requirements of Section 6.2.2 of the Special Provision of Specification for Airside Civil Works.
- g. Materials for sodding shall meet the requirements of Section 2.5 of the Special Provision of Specification for Airside Civil Works.

### **13.3 CONSTRUCTION REQUIREMENTS**

- a. Excavation and embankment shall conform to Section 2.2 of the Special Provision of Specification for Airside Civil Works.
- b. Backfilling for concrete structures shall conform to Section 4.2.3.5 of the Special Provision of Specification for Airside Civil Works.

- c. Sand bedding or cushion shall conform to Section 2.3.2 of the Special Provision of Specification for Airside Civil Works.
- d. Crushed stone bedding shall conform to Section 3.1.1.3 of the Special Provision of Specification for Airside Civil Works.
- e. Cement concrete pavement shall conform to Sections 3.2.3 to 3.2.6 of the Special Provision of Specification for Airside Civil Works.
- f. In-situ reinforced concrete structures shall conform to Section 4.2.3 of the Special Provision of Specification for Airside Civil Works.
- g. Stone masonry work shall conform to Section 4.1.3 of the Special Provision of Specification for Airside Civil Works.
- h. Brick work shall conform to Section 6.2.3 of the Special Provision of Specification for Airside Civil Works.
- i. Sodding shall conform to Section 2.5 of the Special Provision of Specification for Airside Civil Works.

#### 13.4 MEASUREMENT AND PAYMENT

- a. Each work item shall be measured in the unit for each Item No. as shown in the Bill of Quantities. The work quantities shall be calculated in conformity with the lines, grades, grading sections, cross sections, and dimensions as shown in the Drawings or as directed by the Engineer.
- b. Payment for each item shall be made at the Contract unit price or the Contract lump sum price as indicated in the Bill of Quantities. These prices shall be full compensation for furnishing all materials, labor, equipment, tools, supplies and incidentals necessary to complete the item in accordance with the Drawings, the Specification, and the terms of Contract.
- c. Payment will be made under:

<u>Item No.</u>	<u>Description of Work</u>	<u>Unit of Measurement</u>
	Supply of borrow materials	cubic metre
	Hauling of borrow materials	cubic metre
	Excavation	square metre
	Backfilling	square metre



Cement concrete pavement (t = 22 cm)	square metre
Fine sand bedding (t = 2 cm)	square metre
Medium coarse sand bedding	square metre
Crushed stone bedding (t = 15 cm)	square metre
Stone masonry foundation (t = cm)	square metre
Brick foundation (t = cm)	square metre
Sodding (full-face)	square metre
Reinforcement steel	ton

## CHAPTER 14. BUILDING WORK

### 14.1 Description

This item shall consist of Building constructed and equipped in accordance with these specifications, at the specified locations and conforming to the lines, grades, and dimensions shown on the Drawings or required by the Engineer.

### 14.2 Materials

- (a) **STONE BEDDING MATERIALS.** Macadam stone bedding materials shall conform to the requirements of Section 3.1.1 of the Special Provision of Specification for Airside Civil Works.
- (b) **CONCRETE.** Reinforced concrete shall meet the requirements of Section 4.2 of the Special Provision of Specification for Airside Civil Works.
- (c) **ARCHITECTURAL WORKS.** Materials for architectural works shall meet the requirements of of the Specifications for the Fire Fighting and Rescue Facilities.
- (d) **BUILDING** This item shall consist of the following buildings:
  - a. Main office Building(Fuel Storage Depot)
  - b. Main office Building(Fuel Storage Depot)
  - c. Fuel Pump Shed
  - d. Fire Pump House
  - e. Electric Room and Control Room
  - f. Dining Hall
  - g. Laboratory
  - h. Maintenance Building
  - i. Warehouse for Flammable material
  - j. Servicer and Refueler Parking

### 14.3 Construction Methods

- (a) **UNCLASSIFIED EXCAVATION.**

- a. Foundations for building shall be excavated to the lines and grades or elevations shown on the Drawings. The excavation shall be of sufficient size to permit the placing of the full width and length of the structure or structure footings shown.
  - b. The foundation base upon which the item is to be built shall be compacted to a firm uniform grade. All soft and unsuitable material shall be removed and replaced with suitable approved material. When required, a layer of approved granular material, compacted to the thickness indicated on the Drawings, shall be placed to form a foundation base.
  - c. When using equipment to excavate the building foundation, care must be taken to ensure that no damage is caused to the soil structure for the bottom of the ditch. If it is difficult to accurately level or smooth the ditch based on the height of the bottom of the drain ditch, the equipment shall be used to excavate only to a depth that is 20 cm above the planned ditch height, and the remaining excavation must be performed manually.
  - d. Boulders, logs, or any other objectionable material encountered in excavation shall be removed. All satisfactory materials shall be hauled and placed in fills, and unsuitable materials shall be placed in spoil areas or as directed by the Engineer.
- (b) **MACADAM STONE BEDDING.** Macadam stone bedding work shall conform to Section 3.1.1 of the Special Provision of Specification for Airside Civil Works.
  - (c) **CONCRETE WORK.** The forms for and the mixing, placing, finishing, and curing of concrete and placement of reinforcement shall conform to the requirements of Section 4.2 of the Special Provision of Specification for Airside Civil Works.
  - (d) **ARCHITECTURAL WORK.** Architectural work (exterior and interior finishes, etc.) shall meet the requirements of the Specifications for the Fire Fighting and Rescue Facilities.
  - (e) **EQUIPMENT INSTALLATION.** Each piece of equipment shall be installed at the locations and positions shown on the Drawings.
  - (f) **BACKFILLING.** After the concrete has set sufficiently, the spaces adjacent to the structure shall be refilled to the required elevation with material specified on the Drawings and compacted by mechanical equipment to at least 90% of the maximum density as determined by ASTM D 698 or JTJ 051-93. The in-

place density shall be determined in accordance with ASTM D 1556 or ASTM D 2167 or JTJ 051-93.

- (g) **CLEANING AND RESTORATION OF SITE.** After the backfill is completed, the Contractor shall dispose of all surplus material, dirt, and rubbish from the site. Surplus dirt may be deposited in embankment, shoulders, or as ordered by the Engineer. The Contractor shall restore all disturbed areas to their original condition.

After all work is completed, the Contractor shall remove all tools and equipment, leaving the entire site free, clear, and in good condition.

#### 14.4 Method of Measurement

- (a) The quantity of unclassified excavation to be paid for shall be the number of cubic meters, measured in original position, of material excavated and disposed in accordance with the Drawings, or as directed by the Engineer.
- (b) Concrete shall be measured by the number of cubic meters in accordance with the dimensions shown on the Drawings or ordered by the Engineer. No deductions shall be made for the volumes occupied by reinforcing steel, anchors, conduits, weep holes, or embedded items.
- (c) Formwork shall be measured by the number of square meters in accordance with the dimensions shown on the Drawings or ordered by the Engineer. No measurements or other allowances shall be made for falsework, bracing, or finishing of the concrete.
- (d) Macadam stone bedding or backfilling shall be measured by the number of cubic meters of materials compacted in place and accepted.
- (e) Architectural finish work shall be measured by the number of square meters of materials in place, completed, and accepted.
- (f) Reinforcing steel shall be measured by the calculated theoretical number of tons placed, as shown on the Drawings, complete in place and accepted. The unit weight used for deformed bars shall be the weight of plain square or round bars of equal nominal size.
- (g) The equipment shall be measured in lump sum.

14.5 Basis of Payment

- (a) Payment for excavation shall be made at the Contract unit price per cubic meter separately either for machine excavation, or manual excavation, or disposal of materials. These prices shall be full compensation for furnishing all labor, equipment, tools, and incidentals necessary to complete the item.
- (b) Payment shall be made at the Contract unit price per cubic meter for in-situ concrete, or macadam stone bedding or backfilling; at the Contract unit price per square meter for formwork or architectural finish work; and at the Contract unit price per ton for reinforcing steel. These prices shall be full compensation for furnishing all materials and for all preparation, delivering, placing and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.
- (c) The accepted quantities of the equipment will be paid for at the contract unit price in lump sum, complete and in place. This price shall be full compensation for fabrication, testing, delivery, and installation and for all labor, materials, tools, equipment and incidentals necessary to complete the works.

Payment will be made under:

<u>Item No.</u>	<u>Description of Work</u>	<u>Unit of Measurement</u>
	Machine excavation	cubic metre
	Manual excavation	cubic metre
	Disposal of residual Materials	cubic metre
	In-situ concrete (C20)	cubic metre
	Leveling concrete (C15)	cubic metre
	Formwork (foundation)	square metre
	Formwork (floor)	square metre
	Formwork (wall)	square metre
	Macadam stone bedding	cubic metre
	Backfilling with ordinary soil	cubic metre
	Reinforcement bar	ton
	Exterior finish	
	1) Wall	square metre
	2) Roof	square metre
	3) Fittings and fixtures	square metre
	Interior finish	
	1) Wall	square metre
	2) Roof	square metre

3) Ceiling	square metre
Electrical equipment	
1) Telephone facilities	Lump Sum
2) Automatic fire alarm facilities	Lump Sum
3) Lighting equipment	Lump Sum
Ventilation equipment	Lump Sum
Fire extinguishing equipment	Lump Sum

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

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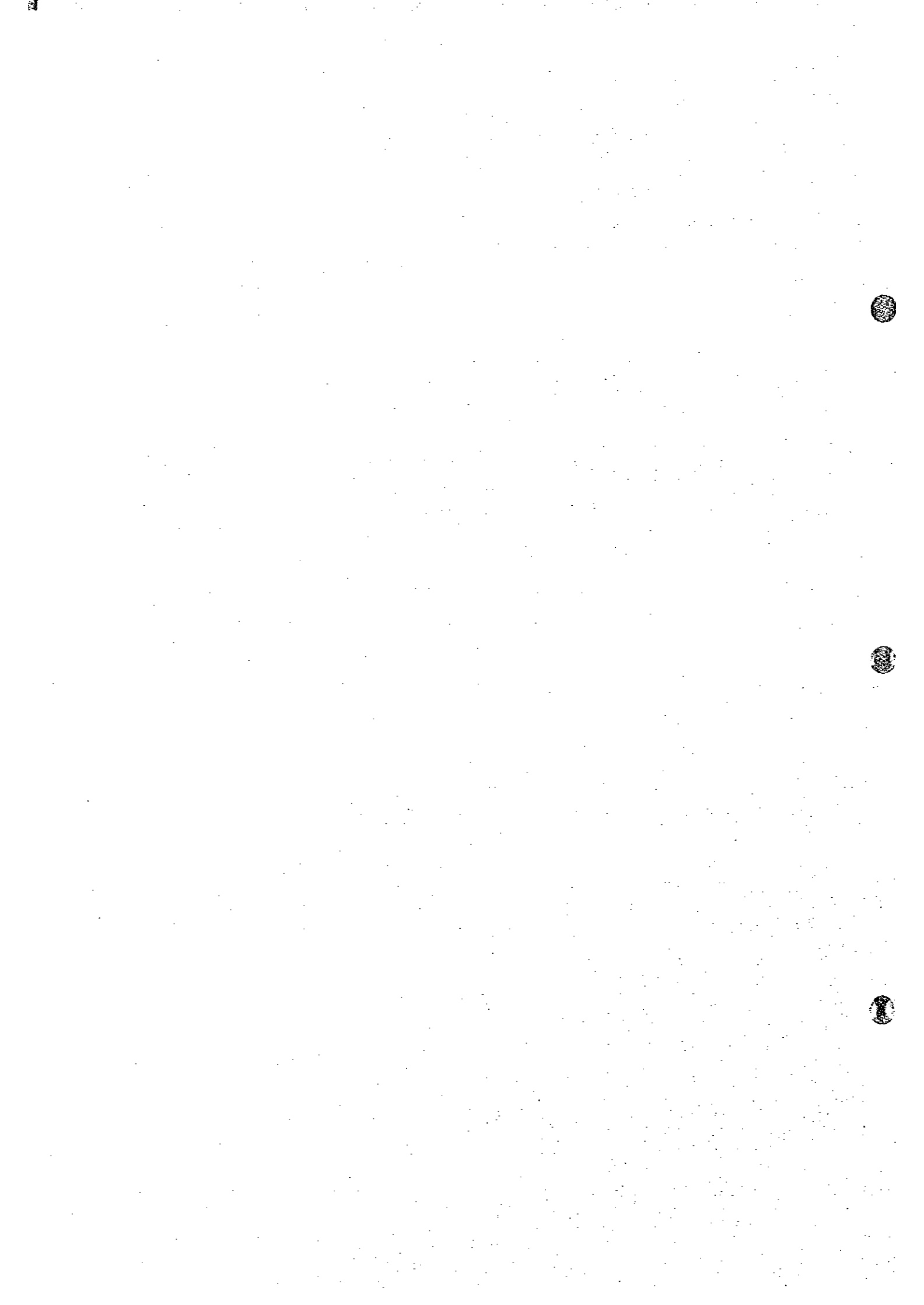
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**VOLUME III  
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**PART IV-4  
SPECIFICATION  
FOR  
FIRE FIGHTING AND RESCUE FACILITIES**

SEPTEMBER 1997

**NIPPON KOEI CO., LTD.  
NIKKEN SEKKEI LTD.**





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SHANHAI MUNICIPAL PEOPLE'S GOVERNMENT

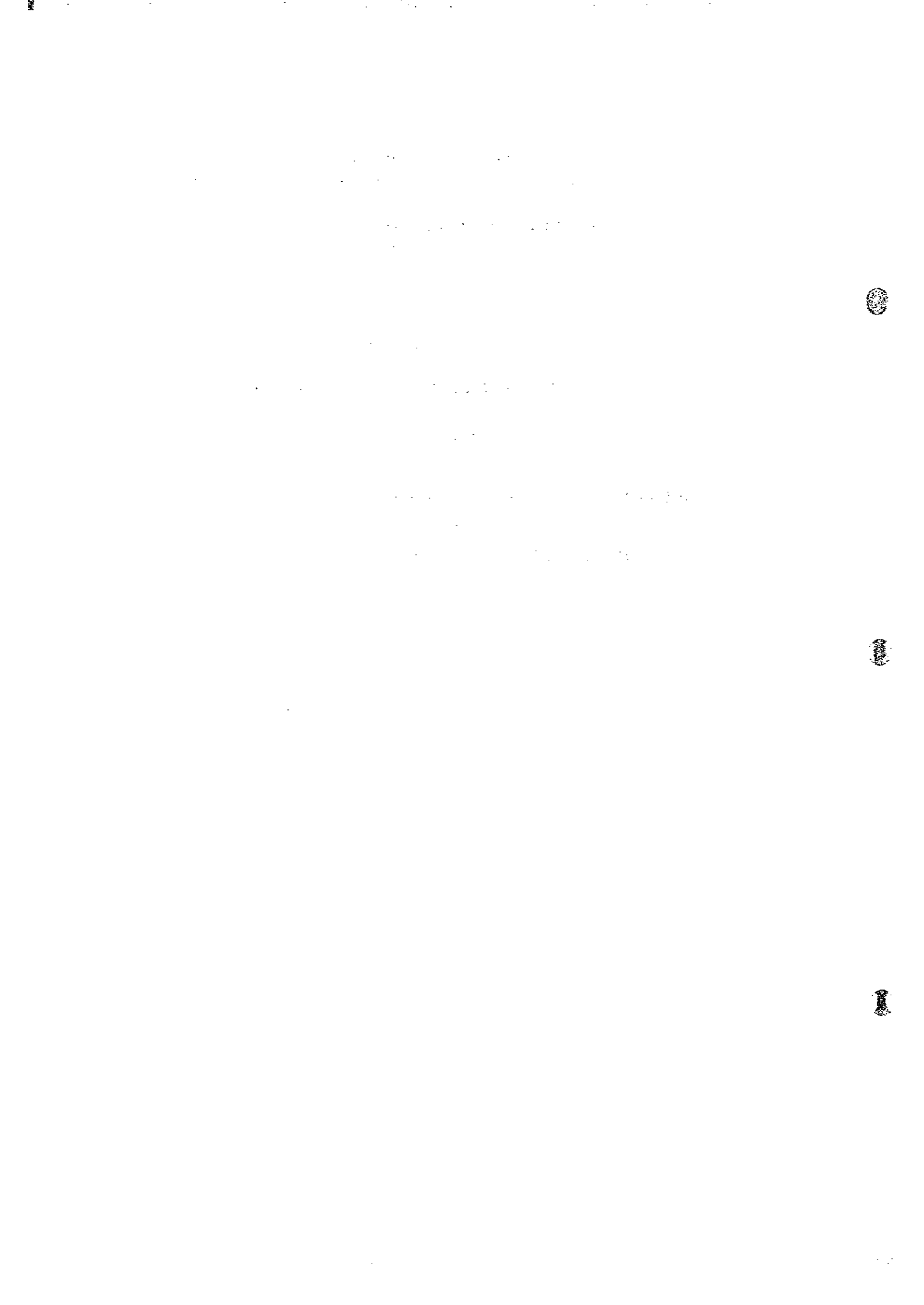
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**SECTION 1**  
**GENERAL PROVISION**



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## CHAPTER 1. GENERAL

### 1.1 GENERAL

The work shall be complete in every respect including supply of all labor, materials, tools and equipment and testing. The work shall be constructed and completed in accordance with the drawings and Specifications and as directed by the Engineer.

### 1.2 SCOPE OF WORKS

The works in this Section shall comprise the complete construction of buildings and related architectural works as listed below including architectural finishing paving of building area, ventilation and air conditioning, plumbing, and electrical facilities for the buildings.

	Buildings	Floor Area	Total
1.	Main Fire Station		3,888.50 m <sup>2</sup>
	First Floor	2,088.02 m <sup>2</sup>	
	Second Floor	1,800.48 m <sup>2</sup>	
2.	Sub Fire Station		1,146.86 m <sup>2</sup>
	First Floor	620.23 m <sup>2</sup>	
	Second Floor	526.63 m <sup>2</sup>	
3.	First Aid Garage		323.80 m <sup>2</sup>
4.	Fire Hydrant Pump Room		294.74 m <sup>2</sup>

Building construction shall include structural works such as earth works and concrete works with all architectural finishing works.

### **1.3 CONDITIONS OF UTILITIES**

#### **1.3.1 WATER SUPPLY**

Directly supplied from water main of facility.

#### **1.3.2 WASTE WATER AND SANITARY SEWAGE**

Combining of waste water and miscellaneous drain water.  
Directly carried out to the sewer main pipe.

#### **1.3.3 STORM WATER**

Directly carried out to the storm water drain pipe or storm drainage ditch of Civil Work.

#### **1.3.4 HOT AND CHILLED WATER FOR AIRCONDITONING**

##### **a) Main Fire Station.**

The hot water and chilled water supply shall be received from the heat exchanger room.(in First Air Garage)

#### **1.3.5 COMMERCIAL POWER SUPPLY**

##### **a) Main Fire Station**

3  $\phi$  4W 0.4KV two-line service system from the Airport secondary sub station.

##### **b) First Aid Garage**

Power shall be received from the Main Fire Station with low voltage.

##### **c) Sub Fire Station**

3  $\phi$  4W 0.4KV two-line service system from the Fire Pump Room.

##### **d) Fire Pump Room**

10KV two-line service system from the Airport Main substation.



#### 1.4 MEASUREMENT AND PAYMENT

Each work item shall be measured in the unit for each Item No. as shown in the Bill of Quantities. The work quantities shall be calculated in conformity with the lines, grades, grading sections, cross sections, and dimensions as shown in the Drawings or as directed by the Engineer.

Measurement for payment for the lump sum payment items shall be by the lump sum for the full set of the subject equipment and machinery. Lump sum payment items are indicated by the abbreviation "LS" in the Unit column of the Bill of Quantities.

Payment for each item shall be made at the contract unit price or the contract lump sum price as indicated in the Bill of Quantities. This price shall be full compensation for furnishing all materials, labor, equipment, tools, supplies and incidentals necessary to complete the item in accordance with the Drawings, the Specification, and the terms of Contract.

The works items to be covered by the section of the Specification are as shown in the Bill of Quantities.

## **CHAPTER 2. PRELIMINARY WORK**

### **2.1 SITE**

The site shall be surveyed and confirmed before the start of work. The Contractor shall submit the survey drawing of the site and report the existing electricity wires, telephone wires and other public utilities to the Engineer.

### **2.2 SAFEGUARD**

The works, material and temporary facilities shall be guarded against damage or theft. All necessary watching and lighting shall be provided.

### **2.3 BOUNDARY OF THE WORKS SITE**

All areas not affected by the works shall be kept clear of workers, materials, etc.

### **2.4 PROTECTION**

The works and any adjoining properties shall be protected from inclement weather. Any loss or damage caused by weather, the carelessness or lack of skill of the workers, accident or otherwise shall be repaired by the Contractor to the satisfaction of the Engineer and the Owners of such adjoining property that are affected.

The work shall be suspended for such time as may be directed and/or approved by the Engineer if the specified quality of work is difficult to maintain during inclement weather.

### **2.5 SIGN BOARD**

Construction sign board shall be provided as directed by the Engineer. The names and addresses of the Project, Client, the Donor, the Consultant and the Contractor shall be indicated on the board.

### **2.6 STAKING-OUT, LAY-OUT, AND BENCH MARK**

The Building position shall be confirmed by staking-outs with attendance of the Engineer.

The stake-boards shall be erected at designated position to indicate the accurate lines and levels during the progress of construction.

The bench marks shall be placed firmly and secured.

## **2.7 SCAFFOLDING**

All scaffolding necessary for the proper execution of the works shall be provided. The scaffolds shall be erected safe and convenient for the execution and supervision of the work and maintained and inspected periodically for safety. The materials and structures shall conform to the law and regulation concerned.

## **2.8 TEMPORARY BUILDINGS**

### **2.8.1 TEMPORARY OFFICE**

Engineer's Field Office, temporary office for the Contractor, storage for materials, goods, etc. shall be provided and maintained as directed. These temporary buildings shall be erected in the premises according to the law and regulation concerned, unless otherwise specified.

The plan and structural design of the above office shall be submitted for approval of the Engineer.

### **2.8.2 STORAGE**

Flammable and combustible liquids storage shall be isolated from other buildings and erected in accordance with Chinese law and regulation concerned. Its structural design and finishes shall be fire-protected and all the doors shall be provided with locks. Fire-extinguishers shall be furnished.

## **2.9 TEMPORARY SERVICE**

Temporary services, such as water supply, drainage, sanitary, light, power, telephone, etc. shall be provided and maintained.

## **2.10 PROTECTIVE OUTFITS**

Helmets shall be provided for the use of the Client and other visitors.

## **2.11 CONSTRUCTION MACHINE**

Construction machine shall be provided and maintained.

## **2.12 SAFETY PRECAUTION**

Safety precaution for explosion, fire, pollution, noise, windstorm, etc. in and out of the premises shall be taken in accordance with law and regulation concerned. The Contractor shall be responsible for any damages to adjacent properties and the public.

**2.13 DISMANTLING OF TEMPORARY FACILITY**

All temporary facilities shall be dismantled and removed from premises as directed by the Engineer before completion. Temporary facility areas should be leveled and cleaned.

**2.14 PAYMENT**

Cost for all items listed in preliminary work shall be borne by the Contractor.

**2.15 FILL**

Suitable excavated soils or other materials approved by the Supervisor shall be used for filling and compacted by hand or other mechanical means to the required density, unless otherwise specified. Level of fill shall be shown on the drawings unless otherwise directed the Engineer.

**2.16 GRADING**

Surrounding area of buildings shall be cleared and leveled with suitable materials unless otherwise specified.

**2.17 SURPLUS EARTH**

Surplus earth shall be disposed in the premises with direction of the Engineer, unless otherwise specified.

**2.18 LOAD TEST**

Field load test shall be performed to confirm required bearing capacity of soil in accordance with direction of the Engineer. Test shall be conducted at two different locations for building and levels designated by the Engineer.  
Maximum load to be applied for this test to secure 90Kpa bearing capacity of soil.

**SECTION 2**  
**SPECIAL PROVISION**



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## **CHAPTER 1      ARCHITECTURAL WORKS**

### **1.1      EXCAVATIONS AND EMBANKMENT**

#### **1.1.1    GENERAL**

Except as otherwise provided herein or directed by the Engineer, excavations embankments works shall conform to Section 2.2 of the Special Provision of Specification for Airside Civil Works.

### **1.2      BACKFILLING**

#### **1.2.1    GENERAL**

Except as otherwise provided herein or directed by the Engineer backfills works shall conform to Section 4.2.3.5 of Special Provision of Specification for Airside Civil Works.

### **1.3      SAND AND CRUSH STONE BED**

#### **1.3.1.   GENERAL**

Except as otherwise provided herein or directed by the Engineer, sand and crushed stone beds shall conform to section 2.3.2 and 3.1.1.3 of the Special Provision of Specification for Airside Civil Works.

Sand and crushed stone beds shall be provided under slab and footing on grade and other portions as shown on the drawings.

### **1.4      CONCRETE WORKS**

#### **1.4.1    GENERAL**

Except as otherwise provided herein or directed by the Engineer, the concrete, reinforcing steel bars and formworks shall be performed in accordance with the provisions of concrete works as stipulated in Section 3 of these Specifications.

The class of concrete to be used for the building and other structures shall be of C20, and levelling concrete shall be of C10. All concrete shall be made with ordinary Portland cement specified hereto.

#### **1.4.2    TRANSPORTING AND PLACING**

##### **a)    General**

Concrete placement shall be in accordance with Chinese Standards.

The contractor shall establish manner and schedule for transporting and placing of concrete and obtain approval of the Engineer. Concrete shall be transported in a manner to minimize segregation, spillage and other changes in quality thereof. Concrete shall be placed and consolidated in a manner to insure uniformity and optimum density.

In case of rain or other conditions which may affect the quality of concrete during concreting, the Contractor shall take necessary measures as instructed by the Engineer.

- b) **Time Limit**  
The time limit from start of mixing to completion of placing of a batch, as a general rule, shall be 90 minutes.
- c) **Preparation Prior to Placing**  
The place where concrete is to be deposited shall be cleaned and sheathing shall be sprinkled with water. Subsequently, water accumulated in the form shall be removed.
- d) **Construction Joint**  
Joint surfaces shall be cleaned, made free of laitance and other foreign matters, and wetted prior to concreting. Joint surface shall be roughened if directed by the Engineer.

The locations and shapes of construction joints shall be discussed with and approved by the Engineer.

- e) **Concrete Placing.**
  - 1) **Placing**  
Concrete placing shall be done in a manner as to keep the surface of placed concrete as horizontal as possible. Concrete shall be continuously poured to complete the portion as planned. Concrete shall be properly placed and compacted around reinforcing bars and corners of form work.

The maximum time interval between placements of continuous concreting shall not exceed 90 minutes. However, when special measures are taken this time limit may be changed according to instruction or approval of the Engineer.

2) **Horizontal Movement**

Movement may be by means of suitable clean chutes, troughs or pipes. Do not use water to facilitate the movement.

3) **Vertical Movement**

In vertical elements, limit the free fall of concrete to 1500 mm per 100 mm element thickness, up to a maximum free fall of 3000 mm, by means such as enclosed chutes, access hatches in forms, and the like. As far as practicable keep chutes vertical and full of concrete during placement, with ends immersed in the placed concrete.

f) **Consolidation**

Vibrating of concrete and tapping of form work shall be performed to wall, column and other places difficult for concrete to fill. Proper number of workers for placing and compacting concrete shall be arranged.

Vibrator shall be operated for concrete calling for water tightness, difficult portion for concrete to fill and other cases as directed by the Engineer. However, vibrator shall not touch reinforcing bars and shall not be operated for more than 30 seconds at the same spot.

Concrete shall be placed 0.3 - 6 m in thickness at once in case vibrator is performing. In case flexible-insert-vibrator is called for, concrete shall not be placed thicker than the length of the insert or vibrator at one pouring.

g) **Placing Speed**

Concrete shall be placed at a speed suitable for the workability of the concrete and condition of the place of placement, which insures proper consolidation of concrete.

h) **Hot Weather Placing**

The provisions of this clause shall apply to concreting when the surrounding shade outdoor temperature is greater than 32°C.

Do not mix concrete when the outdoor shade temperature on the site exceeds 38°C, unless otherwise approved and then only subject to such conditions as may be imposed.

Take precautions to prevent premature stiffening of the fresh mix and to reduce water absorption and evaporation losses. Mix, transport, place and compact the concrete as rapidly as possible.

Before and during placing maintain the formwork and reinforcement at a

temperature not greater than 32°C by protection, cold water spraying, or other effective means. When placed in the forms, the temperature of the concrete shall not exceed the following:

<u>Concrete element:</u>	<u>Temperature limit:</u>
Normal concrete in footings, beams columns, walls and slabs:	35°C
Concrete in large mass concrete sections; or Concrete of strength 40 Mpa or greater, in sections exceeding 600 mm in thickness:	27°C

Submit for approval the proposed method or methods of maintaining the specified temperature of the placed concrete, which may include:

- using chilled mixing water; or
- spraying the coarse aggregate with cold water; or
- a combination of these methods.

#### 1.4.3 INSPECTIONS.

a) Notice

Give minimum of 24 hours notice so that inspection by the Engineer may be made of the following:

- base or subgrade prior to covering;
- film underlay or membrane installed on the base;
- completed formwork;
- reinforcement and tendons fixed in place;
- cores and embedments fixed in place;
- placing of concrete;

#### 1.4.4 EMBEDMENTS, FIXINGS, JOINTS.

a) Embedments and Fixings

Location of embedments and fixings shall not cut or displace reinforcement, or cut hardened concrete unless prior approval has been obtained from the Engineer.

b) Joints

Make construction joints as shown on the drawings in accordance with Chinese Standards

Before fresh concrete is placed at a construction joint, roughen and clean the hardened concrete surface of the joint, so that all loose or soft material, free water, foreign matter and laitance is removed. Just prior to placement, dampen the hardened concrete surface, without leaving free water.

Unless otherwise shown on the Drawings or specified, butt joint the surfaces of adjoining pours. In visually important surfaces make the joint straight and true, and free from impermissible blemishes relevant to its surface finish class.

c) Monolithic Finish

Floor slabs to be finished with polyvinyl sheet flooring or permanently exposed shall be monolithic finish. When preliminary floated finish has hardened sufficiently to prevent an excess of fine material from being drawn to the surface, steel trowelling shall be commenced, steel trowelling shall be performed by mechanical trowelling machine. The finished surface shall be a dense uniform surface, free from blemishes and trowel marks. Spinkling of the surface with dry cement or any other material will not be permitted.

## **1.5 BRICK AND CONCRETE HOLLOW BLOCK MASONRY**

### **1.5.1 GENERAL**

- a) **Materials and Workmanship**  
Materials and workmanship shall comply with one or more of the current edition of the following Chinese standards.
- b) **Execution Drawing**  
Work shall comply with this specification unless otherwise stated on the drawings. Any work not specified shall be discussed and directed by the Engineer. Execution drawing of block alignment (inclusive of indication for hanging bolt, wood-plug and conduit pipe), detail reinforcement, window opening, door opening, and other requirements shall be prepared and submitted for approval by the Engineer.
- c) **Stake-Board**  
Stake-board shall be provided at each 5 m in length and shall be inspected by the Engineer for accuracy, firmness and secureness. However, suitable ruler, plumb-bob and hand leveler shall be provided for minor performance of concrete block and bricks.
- d) **Transportation and Storing**  
Care shall be taken to prevent damage during transportation of material. Defects of natural finished concrete blocks or bricks shall be rejected. Different size of material shall be stored separately and protected from dirt and other impurities.
- e) **Curing**  
No shock or load shall be applied until concrete mortar or other fills have hardened. Corner, projection and top of concrete block or brick work shall be protected from rain, dryness, cold, damage and stain by covering. Void between blocks shall not be intruded by rain water.
- f) **Cleaning**  
The block work shall be cleaned down on completion by removing all surplus mortar to the satisfaction of the Engineer.

## 1.6 TILE WORK

### 1.6.1 GENERAL

#### a) Materials

Samples of material shall be submitted and approved for manufacture, product name by areas of use, class, shape and size, color tone, body, glaze and quality in accordance with the drawing.

Portland cement shall conform to the requirements of Chinese Standard. Mortar shall be used adding water to machine mixed dry grout. Mortar that has been standing for over an hour after water was added shall not be used. Mixing volume ratio of mortar shall be as follows:

Areas of Use	<u>Cement</u>	<u>Sand</u>
Setting and Paying Mortar(for Floor )	1	4
Setting Mortar for Tile of High Permeability(for wall )	1	2.5
Joint Filler	1	1

Pure cement shall be used in case of joint width less than 3 mm. For use of white cement for joint filler, color hue, mixing ratio, etc., shall be in accordance with the direction of the Engineer.

#### b) Tile Layout

Layout plan shall be made in accordance with the design drawings and as approved by the Engineer.

#### c) Tile Preparation

Color tone, distortion, size, etc., shall be checked and sorted out before preparing tile, and areas of use shall be decided. Tiles with uniform thickness shall be selected for bond setting. Tiles with high permeability shall be soaked without fail before setting.

#### d) Setting

##### 1) Standard Tile.

Preparation of setting bed-leveling mortar shall be applied and scratched. Mortar shall be applied in several separate layers where leveling is needed.

However, foreign objects such as debris of brick or tile shall not be spread. Tile shall be set after mortar has been set for more than 5 days.

Setting bed shall be cleaned and wetted. Leveling string shall be provided in accordance with joint layout, and tiles are set after checking for distortion, joint widths, etc. Backfilling mortar shall be spread into every corner, but care shall be taken not to sprinkle fresh cement. Raking shall be done out to the depth of 5 mm after tile has been set for 3 hours, and tile surface shall be cleaned with cloth or equivalent. Care shall be taken not to apply external force or vibration for 7 days after tile has been set.

The use of waterproofing agent, admixture or special joint filler for joint fill after setting mortar has been hardened shall be in compliance with the specification.

2) Mosaic Tile.

Preparation of setting bed shall comply with that of standard tile.

Setting bed shall be cleaned and wetted. Dry mortar shall be spread to a thickness of 10 mm and tapped with wood trowel until the surface becomes wetted and then screeded to get a level surface. Water pitch shall be provided as necessary. After dry mortar has been set for more than 24 hours, wet mortar with mixing ratio of cement 1 to sand 1 shall be spread to a thickness of 4 mm, and tiles shall be laid after leveling strings have been provided in accordance with joint layout.

Tile top shall be tapped with wood trowel until mortar shows up in joints and then papers shall be taken off after wetting the surface. Tile joint shall be aligned. Glue shall not be used on the above mortar.

Wet neat cement shall be applied to joint after tiles have been set for more than 24 hours. Tile surface shall be cleaned with cloth, etc., and further washed with water after more than 24 hours have passed.

e) Curing

Tile setting work shall be properly cured or stopped temporarily in conditions of direct sunlight, wind, rain, etc., which are injurious to work. Work already executed shall be properly cured depending on place and weather.

f) Cleaning

Tiled surface shall be cleaned as a rule with water after joint has been filled for more than a week. When acid solution is used to clean the surface, tiles already



watered shall be washed with approval of the Engineer by thinner thinned 20 times and soon thereafter washed with water so that there is no acid left in joints. In acid washing, care shall be taken not to leave acid on adjacent finishes such as sash, terrazzo, accessories on sanitary equipment, etc.

## **1.7 CARPENTRY**

### **1.7.1 GENERAL.**

- a) **Scope**  
Carpentry work shall conform to this specification unless otherwise specified.
- b) **Shop Drawing**  
Samples, shop drawings, full scale drawing and other required drawings shall be submitted for the approval of the Engineer according to the drawings.
- c) **Standard of Material**  
Material shall be suitably dried and conform to required standard and requirement concerned.
- d) **Material.**

- 1) **Lumber**  
Material for fixture shall not be center of wood. All timber shall be well-seasoned and shall be free from large knots, flaws, shakes or blemishes of any kind. Timber with loose, rotten or dead knots will not be accepted.

Dimension specified shall be size of sawn lumber, however dimension specified for fixture shall be size actually finished. Twisted or warped materials shall not be used.

- 2) **Plywood**  
Plywood shall conform to;

### **1.7.2 WALL AND CEILING FRAMING.**

- a) **Material**  
Material shall be as otherwise specified or as directed by the Engineer.
- b) **Performance**  
Performance shall conform to the following items unless otherwise specified on the drawings. Furring strips and studs directly covered by finishing board and other finishing material shall be planned with planner machine.

Wall furring strip and stud shall have size and interval of 75 x 50 mm @450 mm centers.

Nogging for plywood, gypsum and Fiber cement board shall be butted and nailed between studs.

Size of furring strips for ceiling shall be as shown on drawings or as approved by the Engineer. Furring strips shall be provided at all ceiling joint. Interval shall approximately @450 mm centers.

## **1.8 WATER PROOFING WORK**

### **1.8.1 GENERAL**

#### **a) Scope**

This chapter covers the requirements for providing all the waterproofing work. The work shall include furnishing all labor materials, equipment, tools and transportation necessary to complete the waterproofing work indicated on the drawings and specified herein.

#### **b) Item of Work**

Item of the work shall include but not be limited to the following:

- a. Cement mixed waterproofing finishes
- b. Asphalt Waterproofing
- c. Synthetic high polymer-based roofing sheet waterproofing
- d. Urethane-based Film waterproofing
- e. Sealing work

### **1.8.2 MATERIALS**

a) The Contractor shall submit a certificate and samples of the materials to the Engineer for his approval before use.

b) All waterproofing materials shall be properly protected so as to prevent damage before use.

### **1.8.3 GENERAL REQUIREMENTS**

#### **a) Climatic conditions**

The Contractor shall be responsible for determining in consultation with the Engineer whether or not the waterproofing work shall be carried out when rain is expected or base surfaces are wet due to rain or under such adverse climatic conditions as strong winds or high humidity.

#### **b) Base Preparation**

- 1) All cement rendered and or concrete surfaces to receive the waterproofing work shall be cleaned and be free from dust, staining, oil and laitance.
- 2) All base surfaces shall be finished true to slope as specified and well drained, especially around drain outlets.

#### **c) Waterproofing Test**

When the Engineer deems necessary to inspect the performance of waterproofing work, the Contractor shall test in accordance with the instruction of the Engineer.

#### 1.8.4 APPLICATION

- a) Cement Mixed Waterproofing
  - 1) Mixing shall be conducted in accordance with Manufacture's Instructions.
  - 2) The waterproofing mortar shall be applied to have thickness of 25-30 mm and three coat work.
  
- b) Asphalt Waterproofing
  - 1) Asphalt waterproofing shall be applied to the roof area where indicated on the drawings.
  - 2) Asphalt waterproofing shall be complied as followings.
    1. Primer
    2. Asphalt roofing, Asphalt flow coating
    3. Strech roofing, Asphalt flow coating
    4. Asphalt roofing, Asphalt flow coating
    5. Asphalt brushing
    6. Covering concrete on mortar
  - 3) Application shall be conducted in accordance with the Manufacture's Instructions
  
- c) Synthetic highpolimer-based roofing sheet Waterproofing
  - 1) Synthetic highpolymer-based roofing sheet waterproofing shall be applied to the roof area where indicated on the drawings.
  - 2) Waterproofing layers shallbe complied as followings.
    1. Primer
    2. Adhesive coating
    3. Roofing sheet
    4. Finish paint coating
  - 3) Application shall be conducted in accordance with the Manufacture's Instructions.
  
- d) Urethane-based Film Waterproofing
  - 1) Film waterproofing shall be applied to the roof area where indicated on the drawings.
  - 2) Waterproofing layers shall be complied as followings.
    1. Primer coating
    2. Urethan waterproofing materials, reinforcing cloth.
    3. Urethan waterproofing materials.
    4. Urethan waterproofing materials.
    5. Finish paint.

#### 1.8.5 CURING AND PROTECTION

- a) Cement Mixed Waterproofing

Applied surface shall be properly protected to prevent overrapid drying and be

allowed to harden completely before supporting traffics.

- b) Asphalt Waterproofing, Synthetic highpolymer-based roofing sheet waterproofing, Urethan-based Film waterproofing  
Curing and protection shall be done on accordance with Manufacture's Instruction.

#### 1.8.6 SEALING WORK

- a) Materials

Sealing materials used shall be conform to Chinese Standards or JIS A 5758 "Sealing compounds for Sealing and Glazing in Buildings" and as following or approved equivalent.

- 1) Silicone sealing compounds
- 2) Modified silicone sealing compounds
- 3) Polysulfide sealing compounds
- 4) Other materials such as primer, back-up bond breaker or curing tape shall be necessary and in accordance with manufacturer's instructions.

**b) Application**

- 1) silicone sealing shall be filled for metal-metal joints, glass-glass joints and metal-glass joints as indicated on the drawings.
- 2) Modified silicone sealing shall be filled for metal-concrete or tiles joints and concrete-precast concrete or tiles joints as indicated on the drawings.
- 3) Polysulfide sealing shall be filled for all exterior construction joints, around exterior door and windows and other joints as indicated on the drawings.

**1.8.7 WARRANTY PERIOD**

Warranty period of Asphalt waterproofing shall be 10 years after the date of delivery of the buildings.

## **1.9 METAL**

### **1.9.1 GENERAL**

**a) Scope**

This chapter applies to steel, iron, non-ferrous metal, ready-made products made of these metals and order-made products as specified in drawings.

**b) Material**

All materials to be used for the metal works shall conform to Chinese Standards, unless otherwise specified on the Drawings.

Shop drawing of order-made product shall be submitted for approval of the Engineer (ready-made product excluded). Take and confirm dimensions on site, before preparing Shop Drawings where possible.

Quality analysis, strength and other required tests of material shall be performed if directed by the Engineer.

**c) Anti-Corrosion Treatment**

Anti-corrosion coating for steel products shall be as approved by the Engineer unless otherwise specified, and portion inserted in concrete or exposed outdoor and placed in moisture shall be hot dip galvanized to JISK5621 or equivalent or applied with rust-proof paint unless otherwise specified.

Anti-corrosion coating shall be applied to portion of non-ferrous metal product in contact with other corrosive material according to direction of the Engineer.

Damage to anti-corrosion coating shall be remedied immediately.

**d) Protection and Cleaning**

Proper protection shall be provided after installation according to direction of the Engineer. At the time of completion, protection shall be removed and product shall be cleaned with care.

### **1.9.2 INSTALLATION.**

**a) Installation Before Concreting**

Position of product or material shall be accurately marked and properly supported according to dimension and weight without obstructing other works such as form work. Level shall be checked and welded, bolted, riveted or other means of securing. Proper attention shall be paid for displacement during concreting.



b) **Installation After Concreting**

Fastener and other jointers shall be placed in position and at intervals strictly according to drawing and suitable for installation. Product shall be firmly installed in designated position by wedging, supporting-packing and other means. Inserted portion of fastener and other jointers shall be packed with mortar 1:3 volume mixture.

1.9.3 **OTHER PRODUCTS.**

a) **Hand-Rail**

Quality and dimension shall conform to drawings. Hand-rail shall be produced from one piece of material and if joint of material is unavoidable, joint shall be firmly welded, brazed or reinforced with additional plate and bolted.

Baluster shall be provided in accordance with drawing. Baluster shall be welded, solder, brazed or bolted to handrail or bottom-rail, and in case bottom-rail is not provided, baluster shall be firmly secured to structural member. Bottom-rail shall be firmly assembled and welded, brazed, screwed or bolted to baluster.

Exposed surface of welding and brazing shall be grinded or sanded even.

1.9.4 **LATH.**

a) **Metal-Lath (Mortar Bedding)**

Metal wire lath shall be of galvanized expanded metal with diamond mesh having a metal sheet thickness of not less than 0.3 mm. Joint of metal-lath shall be lapped more than 50 mm and zigzag stapled at approximately every 300 mm of 150 mm for ceiling.

1.9.5 **LIGHT-WEIGHT GAUGE STEEL.**

a) **Suspended Ceiling Frame**

Light-weight gauge steel for ceiling frame shall conform to drawing and sample or catalog shall be submitted and approved by the Engineer for quality and dimension. Execution drawing of lay-out shall be prepared, according to drawing for approval of the Engineer. Insert-fastener shall be secured to a structural member at every 900 mm. Bolt-hanger shall be 9 mm diameter unless otherwise specified. Main-frame shall be provided at every 600 mm and jointed to bolt-hanger. Sub-frame shall be provided at approximately every 1200 mm and jointed to main-frame. Ceiling frame shall be reinforced at opening.

## 1.10 PLASTER AND CEMENT WORKS

### 1.10.1 GENERAL

- a) **Storage of Materials**  
Plaster materials already inspected shall be stored in order to avoid stain, etc. Pigments shall be especially handled with care. Those materials which are affected by moisture such as plaster and cement shall be stored properly.
- b) **Preparation of Setting Bed**  
Deformation, unevenness on wall or floor of concrete, brick or concrete block shall be corrected. Concrete surface which is too smooth to plaster shall be roughened with chisel, etc. Base coat for plaster board backing shall be plaster board base coat.
- c) **Cleaning and Wetting of Backing and Base Coat**  
Dry backing of concrete, brick or concrete block or dry base coat of cement mortar or plaster shall be properly wetted. Backing and base coat shall be cleaned thoroughly before plastering. Looseness on backing or plastering face shall be immediately corrected.
- d) **Protection Against Cracks**  
Around grooves of casing, base board, coping, stile, etc. shall be left unfilled by thickness of a trowel. Those places likely to be cracked such as corners at opening joints of lath, excelsior plate, plaster board shall be applied with cloth in plastering and metal lath inclement mortar. Protection against cracking at joints of concrete and wood, brick or concrete block shall be properly dealt with under the direction of the Engineer.
- e) **Sample Application**  
Sample shall be submitted or sample application shall be conducted and approved by the Engineer for those finishes requiring samples for color tone and special surface finish.

### 1.10.2 CEMENT MORTAR PLASTERING

- a) **Scope**  
This section shall apply to cement mortar made principally of cement, sand and water for application to building.

b) Materials

Cements, sand and water shall conform to those of concrete work. Grading of sand, however, shall be as following:

<u>Grading of Sand</u>	<u>Mortar Plastering</u>	<u>Plaster</u>
5 mm Those Sifting Through 100%		
0.15 mm Those Sifting Less Than 10%	For First and Second Coat	For First Coat and Dubbing Out
2.5 mm Those Sifting Through 100%		
0.15 mm Those Sifting Less Than 10%	For Finish Coat	For Second Coat

White cement shall conform to the requirements of Portland cement, GB175 JISR5210 or equivalent. Pigment shall be alkali-proof and inorganic and one which does not go through noticeable color change under direct sunshine or temperature below 100°C and which does not rust metals by dissolving in the water.

The use of admixture shall be approved by the Engineer before its use. The amount of admixture shall be such that mortar strength is affected very little. Waterproof agent shall be best quality.

c) Mixing Ratio

Mixing volume ratio of mortar shall be as following:

<u>Base</u>	<u>Area of Application</u>	<u>First Coat on</u>		<u>Finish Coat Cement:: Sand Admixture</u>
		<u>Lath Cement: Sand</u>	<u>Dubbing Out Cement: Sand</u>	
	Floor	-	-	1:2.5
Concrete/Concrete Block	Interior Wall/ Exterior Wall/	1:2.5	1:3	1:3 : 0.1
Brick	Others	1:2.5	1:3	1:3
Metal Lath	Interior Wall	1:3	1:3	1:3 : 0.1
Rib Lath	Exterior Wall/			
Wire Lath	Others	1:2.5	1:3	1:3

Note: (1) One part of coarse sand of 3-5 mm shall be allowed to be added to first coat

on wire lath

(2) Fiber shall be mixed for first coat on lath if work calls for it.

d) Application

The surfaces which are to receive scratch coat shall be free from all laitance, scum, loose carbonate scale, loose aggregate, dirt and other foreign matters. In case of cement mortar or brick surface, they shall be sufficiently and uniformly dampened immediately before the application of mortar. Concrete surfaces shall be kept wet for 24 hours prior to the application of mortar.

Where shown on the Drawings or directed by the Engineer, metal wire lath shall be fixed to the brick, brick or concrete walls before applying cement mortar plaster. The metal wire lath shall be fixed to the structure with staples.

Cement mortar shall be used within 90 minutes from the time of mixing. Retempering shall not be permitted.

The rendering for tile works shall be made in 2 coats to 18 mm thick and its surface shall be cross scratched. In case of cement mortar finish, mortar shall be applied in 3 coats making the total thickness of 30 mm for floors and 20 mm for other areas. Concrete floors may be plastered in one coat if the surface are smooth and level upon approval of the Engineer. Reduction of number of coats and total thickness in other areas if proposed by the Contractor shall be subject to approval of the Engineer. Cement mortar finish shall be metal trowel finished unless otherwise specified. When the finish coat is applied, the entire surface or a bay of floor, wall or ceiling shall be finished in one operation in order to minimize joint marks.

Where expansion and control joints exist in the base structure, provision shall be made to prevent cracking of the cement mortar by inserting metal expansion beads within the coating thickness in a manner approved by the Engineer.

The finished surface shall be perfectly plumb or level as the case may be except otherwise specified without any bulging runs, bruises or stains.

Scratch coat shall be applied as soon as possible after construction of the base structure to allow at least 1 week drying time until the finish coat.

After application of each coat, the surfaces shall be kept continuously damp for not less than 48 hours, and then allowed to become thoroughly dry. Moistening shall be started as soon as the surface has hardened sufficiently not to cause displacement or damage.

## 1.11 METAL DOORS AND WINDOWS

### 1.11.1 GENERAL.

a) **Applicable Scope**

This chapter shall apply to aluminum doors, windows, steel doors, and their frames.

b) **Common Matters**

Material, type, shape, dimension, finish, etc., of doors and windows and hardwares shall be as indicated in the drawing. Prior to fabrication and installation, shop drawing shall be prepared and submitted to the Engineer for his approval. The shop drawings shall indicate materials, types, dimensions, jointing methods, installing methods, flashings, connection with other works, etc.

If instructed by the Engineer, a sample shall be submitted with regard to type, surface finish, connection of frame corner, other special connections, etc., for approval.

c) **Performance Conditions**

Doors and windows including hardware shall be of a construction sufficient to withstand the various loads, including weight, operation and wind pressure, and, if necessary, their safety shall be verified by strength calculation and testing. Aluminum doors and windows shall conform to Chinese Standards or approved equivalent industrial standard.

The louver facing exterior shall be provided with windbreak, flashing, etc., for weatherproofing.

### 1.11.2 ALUMINUM DOORS AND WINDOWS

a) **Material**

Frame, mullion, fitting and other main-members shall be fabricated of extruded aluminum section and aluminum plates.

b) **Accessory**

Hardware for aluminum sash and door shall be aluminum alloy, galvanized alloy or stainless steel and surface properly treated. Fastening devices such as screws, bolts, nuts, rivets, etc., shall be of aluminum or stainless steel. Runner shall be hard-nylon product with bearing. Stainless steel runner shall be as otherwise specified. Door-stopper shall be aluminum and hard-rubber or vinyl bumper equipped. Washers shall be neoprene rubber, aluminum or stainless steel.

Anchor shall be mild-steel isolated with electro-galvanized plating or varnish-galvanize-plating.

c) **Production**

Manufacturer shall be approved by the Engineer. Full-scale shop drawing shall be prepared in accordance with sash and door drawing and list and submitted for approval of the Engineer. Prior to fabrication, a complete system description with the following information shall be submitted to the Engineer for approval.

1) Complete system description including the following information :

Names of manufactures of products.

Names, addresses and telephone numbers of local representatives for products.

Types, model numbers and names of products, and indication whether products are "off the shelf" or custom fabricated. Include specific information on finishes - thickness, patented process name, process description and test data.

Detailed information on products manufactured specifically for this project.

Detailed system description including standard details and manufacturer's literature; and large-scale details of specially fabricated products.

2) Statement that the proposed system meet(s) the regularity requirements, thermal, aesthetic and water proofing criteria and wind loading, construction, glazing and warranty requirements specified; noting in detail exceptions.

Sash-bar shall not be defective or deformed. Sash and door shall be accurately produced and tolerance shall be less than 1.5 mm for width and height and less than 2.0 mm for diagonal dimension.

Joint and corner of frame shall be properly and firmly riveted, screwed or welded and caulking shall be provided from back.

d) **Surface**

Surface shall be provided with anodized coating to JISH8602 Aluminium and Aluminium alloys. Coating thickness shall be not less than 20 microns or as otherwise specified. Anodized coating shall be applied to processed members or treated otherwise as approved by the Engineer. In case powder coating is required, material shall be high durability polyester powder coat. Sample of coating shall be submitted and approved by the Engineer for thickness and color.

e) **Insulation**

Where aluminum faces come in contact with steel, masonry, or other materials, they shall be treated with a coat of zinc chromate or alkali-resistant bituminous paint before installation.

f) **Transportation**

All external faces of aluminum shall be applied with peelable protection film or the like before dispatching from the factory.

Product shall be packed in wood-frame and transported vertically.

g) **Installation**

The contractor shall be responsible for installation. Position of sash and door shall be confirmed and adjusted by temporary placing before installation.

h) **Protection and Cleaning**

Proper protection shall be provided after installation.

### 1.11.3 STEEL DOOR LEAVES AND FRAMES.

a) **Material**

Hollow steel door leaves shall be fabricated from cold rolled sheet steel. The minimum metal thickness shall be as follows:

Panel	:	1.6 mm
Stiffener plates and anchor plates	:	2.3 mm

The door leaves shall be full flushed seamless panel, 40 mm thick unless otherwise specified. Doors shall be mortised and reinforced for hinges and locks. Doors shall be reinforced for closures and other surfaces supplied hardware where required.

Door frames shall be formed of cold rolled sheet steel. The minimum metal thickness shall be as follows:

Frame	:	2.3 mm
Architrave	:	1.6 mm
Threshold	:	2.3 mm

The frames shall be blanked, reinforced, drilled and tapped to receive template hinges and locust strikes. They shall be reinforced for surface mounted closures where required. All frames shall be prepared with rubber bumpers.

All frames shall be fixed to the structure with welded or snap-in anchors. The frames shall be furnished with a spreader bar attached to the bottom of the jambs; where no floor finish occur to conceal these spread bars, stainless steel channel shall be used, welded to the back of the jambs.

Frames shall be securely caulked with approved caulking material on exterior walls. The frames shall be extended to accommodate transom where they occur.

b) Priming

All steel work shall be thoroughly cleaned of rust, oil, grease and other impurities and then given one shop coat of a primer. Parts inaccessible after assembly shall be primed in the shop before assembly.

All shop primed surfaces damaged in the field shall be cleaned and reprimed with the same paint.

c) Installation

Along the rims of the opening in concrete, brick structures for the door, window and louver anchor metals shall be pre-embedded at boom centers as the works progresses.

Before installing the frames of door, window and louver, the rim of the opening shall be cleaned of all loose and foreign matters and the pre-embedded anchor metals shall be exposed and extended.

The frames shall be set in place with suitable wedge plumb and true to line and then rigidly fixed to the structure through the fixing lugs. Exterior perimeters of the frame shall be sealed with approved caulking compound.

After glazing and painting works have been completed, all movable parts of the door and window shall be adjusted to ensure proper fitting and functioning.

#### 1.11.4 HARDWARE

Hardware shall conform to drawing and Chinese Standards. Sample of all hardware shall be submitted for approval by the Engineer.

Hardware shall conform to the following unless otherwise specified.

a) Locks; Pin for cylinder-lock shall be more than 6 pieces.

Tumbler for bit-key-lock shall be more than 3 pieces and back-set shall be 64 mm.

b) Bolt shall be Chromium plated bronze or stainless steel flush-bolt.

c) Hinge shall be brass or stainless steel and number and dimension as in the following;



<u>Door Fitting Size</u> <u>Width x Height (mm)</u>	<u>Dimension of</u> <u>Hinge (mm)</u>	<u>Thickness of Hinge</u>		<u>Number for</u> <u>Each Fitting</u>
		<u>Brass</u>	<u>Stainless</u> <u>SUS 27</u>	
Larger than 900 x 2,100	125	6	3	3
Smaller than 890 x 2,090	100	6	3	3
Smaller than 770 x 2,040	75	4.5	3	2

- d) Knobs, lever handles shall be stainless steel or chromium plated bronze.
- e) Floor-hinge shall be cast iron body with stainless steel cover, oil and spring activated with 90° stop device.
- f) Pivot for pivot-hinge shall be brass.
- g) Door-stopper shall be wall or floor mounted type brass or gun-metal and provided with door-catch and rubber bumper.
- h) Operating-handle shall be as otherwise specified.

In case master-key is otherwise specified, classification and number shall be determined in accordance with key-plan.

Keys shall be labelled and handed over to Client. Each lock shall be provided with three separate sets keys and master keys to pass all locks shall be provided.

Hardwares for ready-made steel sash and door shall be standard hardware supplied by the approved manufacturer, however, samples shall be submitted to the Engineer for approval.

#### 1.11.5 FIXED STEEL LOUVERS AND FRAMES

Frames for the louver shall be fabricated in the same manner as steel door frames as specified before and as shown in the details.

Louver blades shall be made of cold rolled steel plate of 1.6 mm thick and properly formed to prevent storm water from driving into the interior space and to allow air flow at an acceptable resistance.

### 1.11.6 INSECT SCREENS

Insect screen shall be fabricated of extruded aluminum frames with wire secured in frames to the inner side of windows and louvers by means of spline or galvanized screws. Screen unit shall be removable and rewirable. Screen wire shall be aluminum mesh, or other approved wire.

### 1.11.7 STEEL ROLLING SHUTTER

A steel rolling shutter capable of both electrical and manual operation shall be installed as shown on the Drawings.

All steel plates and angles, welding and riveting shall be performed in accordance with the structural steel works as specified in Paragraph 1.6 of these Specifications.

The shutter shall be rolled-up type composed of slats, guiderails, rolling drum and cover case, with a motor, motor control gear, safety switch and all wiring from the safety switch and all other necessary accessories.

Specifications for the various components shall be as follows:

Slat	Hollow type, steel plates 1.2 mm thick, designed against a wind pressure of 25 m/sec.
Guiderail	2.3 mm thick roll-formed steel plates, depth of 65 mm with safety stop at a height of 2.2 m above the floor. The guiderail shall be anchored securely to the concrete jambs and shall be finished flush with the surrounding surfaces.
Cover case	1.6 mm thick steel plate with adequate reinforcement and inspection hole.
Motor	Electric power source: A.C., 380-volt, 3-phase, 50 Hz, operation speed: 3 to 5 m/min. Motor to be installed in the cover case.
Operation box	Install on the side wall at adequate height and provided with both electric and manual operation devices complete with all necessary accessories and provided with a stainless steel door.

The manual operation device shall be suitably geared to allow operation by one man.

The Contractor shall submit detailed shop drawings prior to fabrication. Fabrication shall not be commenced until shop drawings have been approved by the Engineer. Painting shall be as specified in Paragraph 1.13 hereof.

## 1.12 WOOD DOORS

### 1.12.1 DOORS

a) Scope

Material and performance shall conform to this Paragraph for wood Sash and Door unless otherwise specified.

b) Material

Wood material shall be all side cut timber and dried. Moisture content shall be less than 15%. Species of wood shall be as otherwise specified or as directed by the Engineer. Plywood for internal doors shall be of ordinary plywood to Chinese Standards and of standard quality. Plywood shall be more than 3 layers of veneer and thickness of plywood shall conform to the following:

	<u>Thickness</u>
Panel-plate, wainscot-plate	9 mm
Flush door-panel	4 mm

General adhesive shall be urea-resin adhesive or Vinyl Acetate resin emulsion adhesive for wood and adhesive for moistured portion shall be phenol-adhesive for wood unless otherwise specified.

Other materials shall conform to drawing, or approval of the Engineer.

c) Dimension and General Performance.

Construction

Increase the width of stiles and rails above the standard as necessary for sliding door grooves, door closers, and the like. Provide additional frame members where necessary to take fastenings of hardware such as push and kick plates, or to frame openings for panels. Form rebates if required on edges of doors in solid matching edge strips.

Edge strips:	To Chinese Standards, thickness 12 mm
Door thickness:	35 mm generally, 40 mm where door width exceeds 900 mm.

Provide a sub-frame around openings (e.g. for louvers or glazing) of 30 mm thick (finished) timber.

Internal doors shall be hollow core, flush panel except for WC doors which shall

be solid particleboard 30mm thick faced on both sides and all edge with selected laminated plastic.

Provide an additional horizontal rail, minimum 50 mm wide at 1,800mm above bottom of door.

Frames shall be pressed steel 1.6mm thick single rebated fully welded with floor spreader.

d) Protection

Protection shall be provided to already installed sash and door in accordance with instruction of the Engineer and with other works concerned.

1.12.2 HARDWARE.

a) Quality

Hardware shall be standard quality and approved by the Engineer.

b) Classification

Hardware shall be marked with the manufacturer's name or brands, and sample shall be submitted for approval of the Engineer for color, finish, appearance, dimension, mechanism, quality and other necessary points.

Standard of classification, type and grade shall conform to the following unless otherwise specified.

<u>Type</u>	<u>Hardware</u>	<u>Material</u>	<u>Remarks</u>
Hinged-Door	Hinge	Stainless Steel	
	Spring hinge	Painted iron	
	Lavatory hinge	Stainless Steel	
	Stainless cover hinge	Stainless cover	Cast iron body
	Floor hinge	Stainless Steel	
	Pivot hinge	Cast iron	Two-step adjusting device for oil-pressure type
	Door closer		
	Door-spring	Painted iron	
	Mortise lock	Stainless Steel	Cylinder lock with 6 pins, bar-lock with tumbler

<u>Type</u>	<u>Hardware</u>	<u>Material</u>	<u>Remarks</u>
	Panic lock	Stainless Steel	With cylinder lock
	Indicator lock	Stainless Steel	
	Indicator	Stainless Steel	
	Flush bolt	Stainless Steel	
	Door stopper	Stainless Steel	
	Door holder	Stainless Steel	
	Knob	Stainless Steel	
	Lever handle	Stainless Steel	
	Handle	Stainless Steel	
	Button	Stainless Steel	
	Push plate	Stainless Steel	
	Gate bolt	Stainless Steel	
	Latch bolt	Stainless Steel	
	Latch	Brass	

c) **Installation**

Hardware and other accessories for sash and door shall be correctly and firmly installed with required screw, bolt, rivet or nail. Screw hole shall be drilled and all screw shall be evenly fastened.

All door furniture shall be accurately and neatly fitted to the correct line and levels. Rebates and pockets shall be carefully cut to the correct depths and size.

Erect frames plumb and true. Brace as required until surrounding structure is complete. Install doors in accordance with manufacturer's instructions. Condition doors to average humidity in area prior to hanging. Provide clearance of 3mm at jambs and heads; 3mm at meeting stiles at pairs of doors; 12mm from bottom of door to top of floor finishing and 6mm at thresholds.

Hardware shall be removed and refixed to permit finishing of surround areas to be carried out. Upon completion hardware shall be carefully and properly adjusted and lubricated to ensure smooth efficient operation.

## 1.13 GLASS AND GLAZING

### 1.13.1 GLASS

a) Material

Glass shall be standard quality and approved by the Engineer. Glass type and thickness shall be in accordance with Chinese Standard or approved equivalent industrial standard. Glass shall be free from foam, crack, deformation and other defects. Sample of glass shall be submitted for approval of the Engineer.

b) Maximum dimension of sheet glass

Maximum dimension of sheet glass shall conform to Chinese Standards.

c) Installation

All panes shall be accurately cut to fit in the places with 4 mm clearance all around. All panes shall be sealed with non-structural external weather-proofing sealants of low modulus neutral curing silicone rubber compounds of approved manufacturer using spacer shims, clips, and setting blocks at intervals recommended by the glass manufacturer. Panes for aluminum sashes shall be set evenly in the rebates. Panes for wooden frames shall be fixed with triangular wood stops. All panes shall be cleaned and polished when the building work is completed.

The contractor shall be held fully responsible for any defective glass, curing of glass and all scratched, damaged or broken glass which shall be immediately removed and replaced.

d) Mirror

.Chamfering, edge-polishing, frame, thickness, position, fastener and other accessories shall conform to drawing or as instructed by the Engineer.

Elastic-mould-type sealer shall be provided as cushion, in case mirror is directly installed to concrete, mortar, plaster, plywood and other boards with urea-adhesive.

Back of mirror shall be free from salinity, alkali and acid and agent applied on back shall not be damaged. In case installed in moisturous room, mirror shall be moisture-proof as directed by the Engineer. Detail of installation shall be reported for approval of the Engineer.

### 1.13.2 SEALANTS

a) **Material**

Sealant shall be non-structural external weather-proofing sealant of low modulus neutral curing silicone rubber compound. Color of the compound shall generally match the color of adjacent materials. Primer, joint filler, bond breaker tape and backing rod shall be of types recommended by the manufacturer of sealant for compatibility.

b) **Application**

All sealing shall be done in a manner to completely seal the joints against wind, rain and dust.

Where sealant comes in contact with cement, concrete, brick or other porous material, the latter shall be primed to prevent absorption of oils from the compound.

Sealant shall be applied with a caulking gun. Excessive sealant shall be removed.



## **1.14 PAINTING**

### **1.14.1 MATERIAL AND GENERAL CONDITIONS**

Material shall be product stated in the specification or as approved by the Engineer. Material shall be delivered to the job in the manufacturers' sealed containers for approval of the Engineer. Use of product by the same manufacturer shall be the general rule in each stage of work in this specification. Paint shall be safely stored at storage exclusively for the use of paints. Care shall be given to fire protection. Color, luster, color scheme, finish shall be decided by the Engineer after checking sample paint test. The painting shall be performed by experienced, competent painter approved by the Engineer.

Comply with applicable portions of relevant Chinese Standards.

### **1.14.2 APPLICATION**

All metal surfaces shall be oil painted unless other paints are specified. All steel components other than galvanized steel shall be prepared and primed in the shop and finish painted after erection.

All metal surfaces to be painted shall, prior to application of paint, be prepared in the following manner:

- All soil or other foreign matter (other than grease and oil) shall be removed by brushing or scraping.
- Oil or grease shall be removed by wiping the surface with rags or brushes wetted with an approved solvent.
- Excessive rust scale shall be removed by hand chipping or by power impact tools.
- Rough welds and sharp steel edges shall be ground smooth, and all weld spatter shall be removed.
- The whole surface shall be cleaned by means of sand blast or combination of powered steel scrapers or steel brushes and sand papers.

Immediately after completion of the surface preparation, approved primer shall be applied; two coats for the structural steels and one coat for other steels unless otherwise specified.

All wood surface to receive paint shall be cleaned of all dirt, grease, dust or any other deleterious matters. All surfaces shall be thoroughly sanded and all nail holes, cracks and any other defects shall be puttied, re-sanded to a smooth and flush finish. The putty shall be colored to match the color of the finish paint.

Spray painting equipment shall have suitable air pressure and paint flow controls. Air lines shall be equipped with moisture and dirt traps. The paint shall be continuously stirred during the painting process. The paint shall be mixed and applied in accordance with the manufacturer's recommendations.

**Drying time:** The drying time of double coated paint shall be measured at the temperature of 20°C and humidity of 70%.

**Amount of paint:** The paint amount shall be standard amount of paint itself not including thinner. It shall increase or decrease depending on shape and surface condition in the process of painting.

Drying time of double coated paint and paint amount shall not be listed in coating schedule when they vary with the conditions of surface to be painted.

The finished surface shall show a smooth and uniform finish, free from any stains and shall be uniform in color and shade.

#### 1.14.3 PAINT FINISH SYMBOLS

OP	: Gloss enamel-oil based (Synthetic resin mix) paint finish.
VP	: Durable gloss enamel-two part water based (Solvent-polyvinyl chloride resin) paint finish.
EP	: Low gloss vinyl-water based (Polyvinyl acetate resin emulsion) paint finish.
AEP	: Acrylic-water based (Synthetic resin emulsion) paint finish.
CL	: Clear polyurethane finish.
EXP	: Semi-gloss two part Epoxy enamel (Epoxy resin) paint finish.

#### 1.14.4 GENERAL NOTES ON PAINTING.

##### a) Preparation of Paint

##### 1) Mixing

Paint content with pigment shall be thoroughly stirred to make a uniform consistency.

##### 2) Thinning

Potable water shall be used for thinning of acrylic paint and water-soluble paint. Proper thinner, product of the same manufacturer as paint, as a rule,

shall be used for other types of painting. Percentage of thinning and viscosity shall be conducted in accordance with manufacturer's recommendations.

3) Allowable Period of Use

Paint mixing more than 2 types shall be used as directed by the manufacturer or catalogue, as allowable period of use, mixing ratio and mixing method vary. That paint which has passed allowable period of use shall not be used.

b) Conditions at Painting

1) Work shall not be executed in the following situations.

When humidity is above 85%  
When raining or it is forecast.  
When dust is present.

2) Conditions of surface to be painted:

Work shall not be executed or proper means shall be taken in the following situations.

When surface to be painted is damp and wet.

When condensation is likely to develop on the surface.

All nail holes on veneer, board, etc. shall be covered with proper rust-proof paint before the subsequent painting is applied in accordance with this specifications.

c) Performance

Paint shall be evenly and uniformly applied on the surface. Areas of difficult application such as painted part, internal angle, welded part, etc. shall be thoroughly painted and double coated as necessary to keep uniform coating thickness. Painting shall be properly done by carefully selecting the painting method for the shape of surface and types of paint.

d) Delivery, Handling and Storage

Store materials in designated spaces in a manner which meets the requirements of applicable codes and fire regulations. When not in use, such spaces shall be kept locked and inaccessible to those not employed under this Section. Provide each space with a fire extinguisher of carbon dioxide or dry chemical type bearing a tag of recent inspection.

Bring materials to the building and store in manufacturer's original sealed containers, bearing the manufacturer's standard label, indicating type and color. Deliver materials in sufficient quantities in advance of the time needed in order that work will not be delayed in any way.

### 1.14.5 PROCEDURE OF PAINTING.

a) Exterior-Surface of Mortar, Concrete, Brick and Concrete Block.

AEP: All weather full gloss acrylic (Synthetic resin emulsion paint)

	<u>Coating Process</u>	<u>No. of Coats</u>	<u>Type of Paint</u>	<u>Drying Time</u>	<u>Amount m<sup>2</sup>/Lt</u>
1	Surface preparation		Dry, clean and free from impurities		
2	Surface sealing	1	Sealer for acrylic paint	Longer than 2 hrs	16
3.	Puttying		Putty for acrylic paint		
4.	Sanding		Sand with proper tool		
5.	Spot painting		Acrylic paint		
6.	Second coating	1	Acrylic paint	Longer than 2 hrs	16
7.	Finish coating	2	Acrylic paint	Longer than 2 hrs	16

- Note:
- 1 Degree of dryness on the surface to be painted shall be kept under 6% in water content and below pH 9.5.
  - 2 Puttying and sanding processes shall be allowed to be omitted depending on the conditions of the surface.
  3. Drying time of puttying shall be long enough for sanding to proceed.
  4. Amount of sealer for surface sealing shall be adjusted under the direction of the Engineer as it varies with the surface conditions.

b) Exterior - Steel Surface

OP: Gloss enamel (Synthetic resin mix paint)

	<u>Coating Process</u>	<u>No. of Coats</u>	<u>Type of Paint</u>	<u>Drying Time</u>	<u>Amount m<sup>2</sup>/Lt</u>
1	Surface preparation		Completely remove rust, moisture, oil and other impurities by sander, cleaner and scraper on by sand-blasting		
2	Primer	1	Zinc-rich organic priming paint	Longer than 24 hrs	16
3.	Touch-up		same as above		
4.	First coating	1	All purpose undercoat	Longer than 16 hrs	16
5.	Second coating	1	Enamel paint	Longer than 16 hrs	16
6.	Finish coating	1	Enamel paint	Longer than 16 hrs	16

Note: Paint for touch-up painting shall be the same as used for process No. 5.

c) Exterior - Wood Surface

OP: Gloss enamel (Synthetic resin mix paint finish)

	<u>Coating Process</u>	<u>No. of Coats</u>	<u>Type of Paint</u>	<u>Drying Time</u>	<u>Amount m<sup>2</sup>/Lt</u>
1	Surface preparation		Clean and sand to plane surface		
2	Primer	1	Wood primer	Longer than 24 hrs	12
3.	First coating	1	All purpose undercoat	Longer than 16 hrs	16
4.	Second coating	1	Oil mix paint	Longer than 16 hrs	16
5.	Finish coating	1	Oil mix paint	Longer than 16 hrs	16

Note: Puttying and sanding shall be done after process No. 3. When there are cracks, etc., on the surface, putty shall be oil-putty, but drying time shall vary depending on conditions.

d) Interior - Mortar, Board, etc

(EP): Vinyl (Polyvinyl acetate resin emulsion paint finish)

	<u>Coating Process</u>	<u>No. of Coats</u>	<u>Type of Paint</u>	<u>Drying Time</u>	<u>Amount m<sup>2</sup>/Lt</u>
1	Surface preparation		Dry, clean and free from impurities		
2	Surface sealing	1	Ultraprep sealer	Longer than 4 hrs	12
3.	Filling		Filler for Vinyl paint		
4.	Sanding		Sand with proper tool		
5.	Spot painting		Ultraprep sealer		
6.	First coating	2	Vinyl paint	Longer than 2 hrs	16
7.	Finish coating	1	Vinyl paint	Longer than 2 hrs	16

- Note: 1 Degree of dryness on the surface to be painted shall be kept under 6% in water content and below pH 9.5
- 2 Puttying and sanding processes shall be allowed to be omitted depending on the conditions of the surface.
3. Drying time of puttying shall be long enough for sanding to proceed.
4. Amount of sealer for surface sealing shall be adjusted under the direction of the Engineer as it varies with the conditions of the surface.

e) Interior - Render, Plaster, Concrete, Brick or Concrete Block, etc.

(EP): Vinyl (Polyvinyl acetate resin emulsion paint finish)

	<u>Coating Process</u>	<u>No. of Coats</u>	<u>Type of Paint</u>	<u>Drying Time</u>	<u>Amount m<sup>2</sup>/Lt</u>
1	Surface preparation		Dry, clean and free from impurities		
2	Surface sealing	1	Ultraprep sealer	Longer than 16 hrs	16
3.	Filling		Filler for emulsion paint		
4.	Sanding		Sand with proper tool		
5.	Spot prime painting		Ultraprep sealer		
6.	First coating	1	Vinyl paint	Longer than 2 hrs	16
7.	Finish coating	1	Vinyl paint	Longer than 2 hrs	16

- Note: 1 Degree of dryness on the surface to be painted shall be kept under 6% and below pH 9.5.  
 2 Puttying and sanding processes shall be allowed to be omitted depending on the conditions of the surface.  
 3. Drying time of puttying shall be long enough for sanding to proceed.  
 4. Amount of sealer for surface sealing shall be adjusted under the direction of the Engineer as it varies with the surface conditions.

f) Interior - Iron Products, Steel

OP: Gloss enamel (Synthetic resin mix paint finish)

	<u>Coating Process</u>	<u>No. of Coats</u>	<u>Type of Paint</u>	<u>Drying Time</u>	<u>Amount m<sup>2</sup>/Lt</u>
1	Surface preparation		Completely remove rust, moisture, oil and other impurities by sander, cleaner and scraper		
2	Primer	1	Inorganic zinc silicate paint	Longer than 24 hrs	16
3.	Touch-up		Same as above		
4.	First coating	1	All purpose undercoat	Longer than 16 hrs	16
5.	Second coating	1	Enamel paint	Longer than 16 hrs	16
6.	Finish coating	1	Enamel paint	Longer than 16 hrs	16

- Note: Paint for touch-up painting shall be the same as used for first coat in process No. 2

g) Interior - Wood Products in Clear Finish

CL: (Clear Polyurethane Finish)

	<u>Coating Process</u>	<u>No. of Coats</u>	<u>Type of Paint</u>	<u>Drying Time</u>	<u>Amount m<sup>2</sup>/Lt</u>
1	Surface preparation		Clean and sand to plane surface		
2	Putting		Putty of similar color to timber		
3.	Sealer	1	Sanding sealer	Longer than 16 hrs	16
4.	Sanding		Sand with proper tool		
5.	Finish coating	2	Clear polyurethane	Between 16 hrs	16
6.	Sanding		Sand lightly		
7.	Finish coating	1	Clear polyurethane	Longer than 16 hrs	16

h) Steel Sash

OP: Gloss enamel (Synthetic resin mix paint finish)

	<u>Coating Process</u>	<u>No. of Coats</u>	<u>Type of Paint</u>	<u>Drying Time</u>	<u>Amount m<sup>2</sup>/Lt</u>
1	Surface preparation		Phosphoric acid chemical coat treatment by metal surface treating agent		
2	Priming	1	Wash-primer		
3.	Under coating	1	Zinc-rich organic priming paint	Longer than 24 hrs	16
4.	Touch-up		Touch-up primer		
5.	First coating	1	All purpose undercoat	Longer than 16 hrs	16
6.	Second coating	1	Enamel paint	Longer than 16 hrs	16
7.	Finish coating	2	Enamel paint	Longer than 16 hrs	16

- Note: 1 Wash-primer shall be omitted when surface is treated by phosphoric acid in process No. 1  
 2 Paint for processes No. 4 and No. 5 shall be of similar paint used for under coat in process No. 3 or that recommended by the manufacturer.



## 1.15 INTERIOR FINISH

### 1.15.1 FIBRE CEMENT BOARD, GYPSUM PLASTER BOARD AND PLYWOOD

#### a) Material

Fiber cement board, gypsum plaster board, and plywood shall be of standard quality. Types, shapes and size shall be in accordance with the drawing unless otherwise specified.

Wood screw and nail nail for each type of board shall be as set forth in the following. Nail spacing shall be about 120 mm with approval of the Engineer.

- 1) Plywood, hard fiber board, particle board - Brass or stainless nail.
- 2) Gypsum plaster board - Stainless staple
- 3) Fiber cement board - Galvanized Steel or brass wood screw.

#### b) Method of Installation

Backing shall comply with Paragraph 1.6 Carpentry. Material shall be cut in size and planned as indicated in the drawing and as directed by the Engineer. Material shall be installed flat with joints in line by nailing, screwing or adhesive.

Except where otherwise specified or on drawing, gypsum plaster board and fiber cement board shall have flush set joints to manufacturers directions.

#### c) Sus Gyp Ceiling

Sus gyp ceiling shall be a prefinished suspension grid system with moulded gypsum plaster panels with vinyl surface 1200(900) mm x 3000 mm x 9 mm in size. The susgyp ceiling shall include the complete metal suspending ceiling system including suspending bolts, hangers, clips, main runners and furring strips. The gypsum board shall conform to Chinese Standards or approved equivalent. The method of installation shall strictly comply with the manufacturer's specifications.

The entire suspended ceiling shall be installed to the level and lines as shown on the Drawings and the completed surface shall not have a deviation on level or lines of more than 3 mm in 4 m. The suspending bolts shall be fixed to the roof structural members, so that the suspending bolts are systematically and vertically installed.

Main runners shall be provided at intervals as recommended by manufacturer, installed with allowance for adequate camber. They shall be designed for ceiling loads of 60 kgf/m<sup>2</sup>.

Furring strips shall be provided at intervals according to the ceiling material manufacturer's requirement. Adequate reinforcing and metal framing shall be provided for mounting lighting fixtures, air diffusers and ceiling access holes.

Gypsum board shall be securely fixed to the furring strips with the galvanized screws true to level and line.

Ceiling trims shall be of hard wood and fixed to the wall as shown on the Drawings.

d) **Acoustic Boards**

Acoustic boards shall be of first grade conforming to JIS A 6307 "Dressed Rockwool Boards for Acoustic Use" or approved equivalent.

## **1.16 MISCELLANEOUS WORKS**

### **1.16.1 ROOM NAME PLATES**

Where shown on the Drawing or as directed by the Engineer, room name plates shall be provided on the external surfaces of entrance door of each room. The name plates shall be made of acrylic resin plates having approximately 80 mm x 350 mm x 6 mm thick in size and fixed with chromium plated screws to the doors. On the plate shall be engraved the name of the room as directed by the Engineer.

### **1.16.2 INSPECTION-HATCH CEILING**

Inspection-hatch locations shall conform to drawing. Inspection-hatch shall be 450 mm square unless otherwise indicated.

### **1.16.3 DOOR SILLS**

Door sill for steel flush door shall be made of 2 mm thick stainless steel plate with a dimension of 40 mm wide. Door sill shall be provided for in the joint between different floor finishing and installed with steel anchor lugs the full width of each door width.

### **1.16.4 FLOOR DIVIDERS**

Floor dividers shall be provided in the joint between different floor finishes. Floor divider shall be of brass or stainless strips having 4 mm x 12 mm in dimensions.

### **1.16.5 DOWNSPOUT**

Downspouts shall be of bell-end type PVC pipe for heavy use, solvent cement connected and provided with adaptable vent for effective water flow. Downspouts shall be strongly secured to concrete columns and walls with 3.0 mm galvanized wall brackets and 2.3 mm metal straps attached by galvanized lug screws and expansion anchors. Wall brackets shall be provided for within 1,500 mm spacing.

### **1.16.6 KITCHENETTE UNITS**

Kitchenette sink unit shall be of composite of a sink unit, cooking table and wood cupboard in the dimensions as shown on the Drawings. The sink unit shall consist of stainless steel sink top, stainless steel strainer and melamine resin or polyester faced

plywood cabinet. Stainless steel sink top shall be drawn from one-sheet of more than 0.8 mm in thickness. The cooking table shall be made of stainless steel sheet top and melamine resin or polyester faced plywood cabinet.

Wood cupboards shall be framed with dovetailed, housed, rebated or locked joints and shall be accurately finished to the dimensions as shown on the Drawings.

Shelves and bench tops shall be 25 mm thick. Bench tops and exposed edges shall be covered with melamine of approved color and securely glued in place.

Each cupboard shall be fitted with 25 mm thick solid core door, which shall be hung on a pair of steel butt hinges and fitted with an approved push button catch and circular fly-proof ventilator.

Drawer shall be dovetailed, glued and housed with a 20 mm thick front and 12 mm thick sides and back with a 5 mm plywood bottom. Drawer shall be fitted on tallow wood runners and shall have approved handles.

The Contractor may propose ready-made market products to suit the dimensions of the kitchen by submitting catalogues to the Engineer and obtaining his approval.

#### 1.16.7 STEEL HOIST AND RAIL

Steel hoist and hoist rail having the 1.00 ton in suspension capacities shall be provided in the D.E.G. room as shown on the Drawings or directed by the Engineer.

#### 1.16.8 TOILET PARTITION

The toilet partition shall consist of doors and panels with miscellaneous fittings. The doors and panels shall be 40 mm thick panel surfaced with plastic laminated plywoods. The panel and door shall be installed in accordance with the provisions of Paragraph 1-11 Wooden Doors, in these Specifications. The panels shall be firmly supported and fixed to the wall and floor with chromium plated or stainless steel plate supporting hardware and clamps. Each panel shall be securely connected together with stainless steel channels. Each shall be equipped with complete fittings consisting of door stop, latch, and combination coat hook and rubber bumper.

## CHAPTER 2 AIR CONDITIONING AND VENTILATION

### 2.1 GENERAL

#### 2.1.1 SCOPE

The Contractor's works covered by this Specification comprises the supply, installation, commissioning, testing, placing into service and maintenance of the Air-conditioning and mechanical services including:

(1) Air Conditioning

Packaged air conditioners consisting of indoor evaporators and fans with outdoor condensing units and single package air conditioning units. Located as shown on the contract drawings.

(2) Ventilation

Mechanical exhaust systems shall be installed to garage, electrical room and kitchen space where shown on the contract drawings.

#### 2.1.2 ASSOCIATED BUILDING WORK

The Contractor will provide the following items of work for the Mechanical Contractor.

- Opening or fixing of sleeves to openings in external and internal walls, floors, walls and ceilings, etc. to accommodate ducts, pipes, etc...
- Built in fixing inserts required for the attachment of brackets, etc...
- Concrete ducts for the piping and cables of outdoor condensing units.
- Concrete pads for mounting external equipment.
- Carriers and risers for passage of refrigerant pipework and cables.
- Access panels to concealed equipment.
- Flashing upstands for all roof penetrations, including primary support members for roof mounted equipment.

#### 2.1.3 DESIGN CONDITIONS

The packaged air conditioning units and FCU (Fan Coil Unit) have been sized to the following limits at full load. No control of RH (Room Humidity) is required to be installed.

(1) External

Summer	34°C	DB	28.2°C	WB
Winter	-2°C	DB	-3°C	WB

(2) Internal

Summer	26°C		DB+2°C	
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Winter

22°C

DB+2°C

(3) **Supply Air**

Supply air quantities on the drawings are nominal only and dependent on the final packaged equipment selected and the manufacturer.

**2.1.4 DESIGN STANDARDS**

The installation shall be carried out in accordance with Chinese Standard Codes, JIS or equivalent.

Where specific standards or codes are referred to in the Bill of Quantities or the Specifications, or the drawings, other authoritative standards that ensure an equal or higher quality than the standards mentioned will also be acceptable. It will be incumbent on the Contractor to verify the equal or higher quality and to submit comparative standards (both specified and proposed standards) for review.

For any items not included in the above, the Sub-contractor shall use the appropriate Standards.

**2.1.5 DIMENSIONS**

The Contractor shall check all relevant dimensions on site and notify the Engineer of any discrepancies before proceeding with the works.

Under no circumstances shall dimensions be scaled from drawings. Use figured dimensions only.

The layout of equipment as shown on the Drawings shall be taken as diagrammatic only and all measurements and other information required to carry out the works specified shall be obtained by the Sub-contractor on site. No claims for extras arising from failure to obtain measurements and other information on site will be allowed.

Should any dispute arise as to the number of items or interpretation of plans or specification, such disputes shall be referred to the Engineer whose decision shall be final and binding on all parties concerned.

**2.1.6 MATERIALS AND WORKMANSHIP**

Unless otherwise specified, all materials and goods required for the project shall be new, the best of their respective kinds, conforming with the relevant standard specification and codes.

The Engineer reserves the right to inspect the work in progress and all materials to be used and in the event of any dispute regarding the quality of materials or workmanship. The Engineer reserves the right to order the removal or replacement of any material or goods which in his opinion is not satisfactory or does not comply with the specification. The Engineer shall give to the Contractor notice in writing of any defects in the works carried out by the Contractor. The Contractor shall then at his own expense and with all speed make good the defects so specified.

The Contractor shall provide and retain on site at all times copies of the relevant codes. Workmanship shall be the best practices of the trades.

#### 2.1.7 INSURANCE

The Contractor shall take out and maintain during the Contract any insurance as applicable or proportional to this section of the work.

The Contractor shall submit evidence, before commencing work, that the required insurance policies have been effected.

#### 2.1.8 WARRANTY

The Contractor warrants that the completed works and every part thereof and all materials, articles and goods used or incorporated therein, or supplied by the Contractor in performance, or purported performance of this Contract, whether purchased by the contractor under patent or trade name or otherwise, shall comply with the quality, nature, description and conditions specified, or shall otherwise be fit for the purpose for which they are required. The contractor shall be liable for breach of this warranty notwithstanding that the Project Manager or Engineer may have accepted the works, or any part thereof, as satisfactorily executed or otherwise.

#### 2.1.9 GUARANTEES AND MAINTENANCE

The Contractor shall provide a comprehensive guarantee for twelve (12) months from the date of completion against faulty workmanship or materials. The Contractor shall ensure that equipment supplied by the manufacturer is also extended to cover the above period.

#### 2.1.10 CONSTRUCTION DRAWINGS

The Constructor shall prepare and submit for approval prior to manufacture or installation Five (5) complete sets of shop drawings. All drawings shall be prepared generally in accordance with the drawings supplied with this specification, except where variations to the shop drawings are endorsed by the Client.

All shop drawings shall be on the same size drawing sheet and shall be to a scale not less than 1:50 and larger if necessary. All duct sizes shall be drawn overall external airway dimensions.

Construction drawings shall cover the following:-

- All structural penetrations including full dimensions to enable blockout and sleeve placement by others.
- Ductwork and pipework layouts including details of construction, supports, fixings.
- Electrical schematic layout.

Approval of drawings will not in any way relieve the contractor of his responsibility for errors or omissions and interference or from the necessity of furnishing such workmanship or materials as may be required for the completion of these works in accordance with this specification.

#### 2.1.11 AS-BUILT CONSTRUCTED DRAWINGS

Provide (3) three bound sets of "As-Built" drawings and forward to the Engineer within (3) three weeks after completion. Final acceptance of this contract will not be given until receipt of these documents.

The As-Built drawings shall be a true and accurate representation of the actual installation and shall include the following:-

- Complete equipment layout drawings with full identification of each and every item of equipment.
- Complete piping layout showing the actual size and location of all refrigeration pipes applicable to the system.
- Complete control wiring diagram showing all electrical controls, relays cut outs, timing devices, fuses, etc. which shall be clearly identified as to the type of function.

"As-Built" drawings upon final issue by the contractor shall be of a uniform size and neatly bound into sets, with front and back covers. The front cover shall be titled.

#### 2.1.12 MAINTENANCE AND OPERATING INSTRUCTIONS

On completion of a satisfactory performance test the contractor shall supply (3) three copies of Maintenance and Operating instructions bound together in a manual form.

These manuals shall include clear and precise instructions for the operation of the systems as a whole, complete details of recommended preventative maintenance with



recommended lubricants to be used, and the normal running period between applications, and all other information needed to keep the system in good order and condition.

The setting of all controls and protection devices shall be stated. Where proprietary equipment is installed the manufacturer's operating and maintenance instructions shall be included.

One copy of each instruction manual shall be left on site. One instruction manual shall be issued to the Engineer prior to final inspection and commissioning, for inspection.

## **2.2 MATERIALS AND EQUIPMENT**

### **2.2.1 GENERAL**

The Mechanical Services contractor shall supply and install all necessary equipment and components as herein described.

### **2.2.2 AIR CONDITIONING SYSTEM**

The air cooled packaged units shall be of a factory assembled horizontal discharge type, and suitable for outdoor applications.

All condensate shall be drained as shown on contract drawings.

The condensers shall be fully compatible to the fan coil units in refrigerant and capacity.

The compressor shall be a Hermetically sealed compressor operating on R22 refrigerant.

The Condenser fans shall be direct drive, propeller type with blades.

All Condensing units shall be mounted on anti vibration mounts and bolted to the structure in accordance with the Manufacturer's recommendation.

Electrical panel should install loss phase protection.

### **2.2.3 MECHANICAL VENTILATION**

Ventilation shall be provided to garage, electrical room and kitchen space by wall, or roof mounted exhaust fans and duct systems where shown on the contract drawings.

#### **a) Exhaust Fans**

Duct mounted fans shall be of axial flow form suitable for connection to ductwork systems as required.

The roof mounted units shall comprise centrifugal, or axial flow fans housed in a compact base fitted with back draft dampers.

The manufacturer shall ensure that all fans are adequate to withstand the pressures developed by the fan for the specified duty.

All fans shall be fitted with anti vibration mounts between fan and upstand.

#### **b) Connections to ductworks**

Fans shall be isolated from the ductwork system by means of flexible connections, the flexible connection shall be made with fire retardant materials.

Connection shall be such that the fabric can be removed without disturbing fan or ductwork, and the fan and ductwork are separated by not less than 100 mm.

c) Fan Motors

The motor power on a continuous maximum rating shall not be less than the sum of the fan limit load power at the specified speed. The motor shall be suitable for 220 volt and or 380 volt operation as indicated in the equipment schedule.

d) Fan Control

Fan on/off control shall be by switches as where shown on the design drawings.

## 2.2.4 DUCTWORK AND GRILLES

a) General

This part of the specification details the materials to be used and the methods to be employed in the fabrication and installation of ductwork associated with mechanical services.

The drawings indicate the extent and general arrangement of the ducting system. Details of departures from the contract drawings which are deemed necessary by the Sub-contractor shall be submitted to the Engineer for approval.

The drawings indicate the sizes of ducts in millimeters and the manner in which the various systems are to be installed. They do not, however, purport to show off-sets and transitions which must be coordinated with other trades, measured on site or ascertained from Architectural drawings.

All ductwork systems shall be complete with transitions, bends, tees, supports, dampers, offsets, flexible connection, take offs and similar fittings necessary for the full operation of the air ventilation system and shall be fully detailed on the construction drawings.

All ductwork sizes are shown with clear internal dimensions of the air passage. In the case of rectangular ducting the first dimension indicates the size of duct in view on the particular plan or elevation, and the spiral duct in diameters. The fire dampers shall fully comply with relevant Standard.

All sheet metal ductwork shall be fabricated from full size galvanized sheet steel specifically manufactured for roll forming such as "Galvabond" or approved equivalent. Galvanizing shall remain unbroken after fabrication and installation.

**b) General Ductwork Construction (Small Systems)**

Ductwork shall be machine folded and free from waves and buckles. Rectangular ducts shall not have a Long/Short side ratio of greater than 4:1 unless shown otherwise.

Longitudinal corner Joints between two sides shall be made using Pittsburgh or Snap-Lock seams.

Sheet metal joints shall be "drive slip" and "plain slip" type restricted to duct sizes. S-slip sheet metal joints shall not be employed on internally insulated ductwork.

**c) Exhaust Air Grilles**

All exhaust air grilles shall be of an approved type, and selected for efficient air distribution and low noise levels.

All internal parts of outlets, such as volume controllers shall be finished matte black. External finishes shall be colored to match adjacent services.

## 2.3 INSTALLATION

### 2.3.1 DUCTWORK INSTALLATION

a) Ductwork Joints

Sheet metal joints shall be sealed with a liquid or mastic sealant, applied with an injection gun. The use of adhesive tape will not be accepted.

b) Supports

Ductwork or ductwork supports shall not be used for support to other services, ceiling systems, or light fittings.

Supports shall be installed at right angles to the center line of the duct, and generally at transverse joints whenever the specified spacing intervals match the length of duct sections.

At horizontal changes in duct direction one or more supports shall be symmetrically located at the center of the bend.

Supports shall be installed at duct ends, branches, diffusers, and plenums.

Vertical ductwork shall be supported from joints or stiffeners.

c) Hangers

Hangers may be fixed to the building structure by the following:-

Steel - by steel bolts, nuts and washers and with clamps if appropriate.

Concrete or masonry - by steel expanding bolts in drilled holes.

Explosion power fasteners shall not be used.

### 2.3.2 PIPEWORK

a) General

This section of the specification details the materials to be used and methods to be employed in the fabrication and in the installation of piped services associated with the mechanical services.

The Contractor shall install refrigerant pipes chilled and hot water pipes and

condensate pipes for the air cooled condensers and fan coil units, complete with insulation as described in this section of the specification.

All refrigerant pipes shall be located as indicated on the mechanical drawings.

Unless an alternative standard of material is required by the Local and/or Statutory Authority having jurisdiction over installation, the pipework shall comply with the following clauses.

Copper piping shall be hard drawn for pressures up to 1379 kPa. Copper piping shall be used on all liquid and suction pipes.

b) **Pipework Construction**

Unless shown otherwise, all permanent pipe joints shall be brazed or silver soldered. Flared unions, screwed joints, capillary fittings and compression fittings shall be used on non permanent fittings and connection to the unit.

All refrigerant pipes shall be de-hydrated and end capped.

Copper pipe bends shall have a center line radius of not less than 1.5 times the nominal diameter of the pipe.

Branch connections shall be made with factory produced tee-pieces, pipe to pipe branches shall only be employed on the approval of the Engineer.

c) **Pipework Installation**

All pipework shall be installed in workmanship manner. Pipe runs shall be straight, true, aligned and graded as required.

All pipework shall be supported by hangers, clips or rollers in suitable placed steel brackets, so designed and located to prevent any undue stress being applied to connected equipment.

The exact location of supports shall be determined to suit conditions on site but as far as possible they shall be located adjacent to valves, bends, branches, and joints at intervals to meet relevant standard.

Where groups of pipes are suspended from a concrete slab "Unitstrut" or equal inserts shall be used to aid the suspension, and at no time shall suspended pipework be closer than 100 mm to the ceiling over.

All supports and fixings subject to weather, condensation or other moist conditions under normal services shall be painted with a protective coating.

For all pipes passing through walls or floors provide a sleeve. Clearance between pipe or pipe insulation and sleeve shall be adequate for installation and shall be tightly packed with fire retardant material.

**d) Pipework Insulation**

All liquid, suction, chilled and hot water pipes and condensate drain pipes shall be insulated as described in this section. All pipe bends, tees, valves, flare unions and fittings shall be insulated with a similar material to the pipework.

The thickness of the insulation of the pipework, valves and fittings shall be as follows:-

PIPE	PIPE SIZE	INSULATION THICKNESS
Refrigerant, Condensate	0 - 32	25 mm
Chilled and hot water	0 - 25	30 mm
	32 - 200	40 mm

All pipes shall be insulated with rigid molded sectional closed cell expanded polystyrene, or rigid fiberglass. All insulated pipework shall be provided with an approved vapour barrier of "Sisalation 450" adhesive bonded to the insulation. All insulation shall have a Thermal Conductivity of 0.036 W/m deg C and a density of not less than 17.5 KG/M<sup>3</sup>. All insulation joints shall be of the lapped construction with vapour barrier joints lapped a minimum of 25 mm and sealed with tape.

Chilled and hot water pipes shall use glass wool insulation not less than 40 kg/m<sup>3</sup>.

Where pipework is exposed to the weather, install a further sheathing of 0.3 mm thick stainless sheet steel, rolled to diameter of the insulation and lapped 10 mm at the seam, popped riveted with blind rivets to the pipework and fittings. Alternative protection where pipework runs at groups level shall be as shown on the drawings.

**e) Testing of Pipework**

Each pipework system shall be tested as a whole. Care shall be taken to avoid excessive tests pressures. Any equipment or instrument not capable of withstanding the test pressure shall be isolated during such tests.

Any leaks in screwed fittings shall be corrected by re-making the joint. In a welding joint by cutting out and re-welding.

All joints in the system must be tested. The test pressure shall be the gauge

pressure recorded at the highest point of each system. Each system shall satisfactorily withstand test pressure of 1.5 times the design pressure and be absolutely tight and drip-proof or gas leak after 24 hours. The gauges used for the test shall have a current certificate of calibration.

The Contractor shall give a minimum of 48 hours notice to the Engineer that the system is ready for test. Make available to the Engineer facilities to enable him to inspect and test any item of equipment, necessary to ensure procedures are taken.

All valves and fittings shall be the standard products of approved manufacture. All valves shall be entirely suitable and correctly sized for each application and unless otherwise shown shall be of the pipeline size. Valves shall be selected to suit the operating characteristics of the system.

All valves, controls and accessories shall be installed in positions readily accessible for operation and maintenance.

The connection between each valve and adjacent lines shall be made with flare or flange connection to permit the removal of the valve.

### 2.3.3 ASSOCIATED ELECTRICAL WORK

#### a) General

This section of the specification details the material and equipment to be used and the method to be employed in the electrical installation associated with mechanical services.

The Electrical Services Contractor shall provide an isolator switch adjacent to the air cooled condensers to enable the final connection only to be carried out by this sub-contractor. Power supplies for the exhaust and outdoor air fans shall be provided at an isolator adjacent to the fans or as nominated on the design drawings.

The Mechanical Services Contractor shall be responsible for carrying out the field wiring between the air cooled condenser, the fan coil unit and remote control panels.

The remote control switches supplied by the manufacture of the air conditioning units shall be neatly mounted as indicated on the contract drawings.

The controls and power supply cables from the indoor fan coil units to the remote control panels and exhaust fans to switch cables shall be concealed. Remote control panels for the ceiling cassette type units shall be supplied standard with each unit and shall include instantaneous temperature display and adjustment.



**b) Standards**

Certificates or proof of compliance with the relevant standards shall be provided by the contractor within 14 days when requested by the Engineer. The materials and equipment will not be accepted if certificates or proof of compliance are not provided when requested.

**c) Cables and cable installation**

Unless specified otherwise, all wiring shall be carried out with the loop in and loop out system and any intermediate joints shall only be made in enclosed junction boxes. Tee connections shall only be employed at specified terminal blocks and connected to equipment terminals.

Wiring shall generally be concealed under floors, in wall cavities, in false ceilings and roof spaces. Cables directly embedded in concrete, plastic etc. will not be accepted. They shall be enclosed in P.V.C. Conduit at all times.

Wiring installed in false ceilings or roof spaces shall be fixed to the underside of the floor or roof structure above at 100 mm intervals. In the event of this structure not being suitable, cable trays shall be employed to achieve continuity of fixing. Wiring shall not be laid on or supported from the false ceiling.

Wiring to the remote control switches shall be concealed.

The remote control switch location shall be neatly mounted to the wall.

