

7-16 EXTERIOR CONSTRUCTION WORK

7-16-1 Scope of Work

(1) Extent

The work specified under this paragraph consists of all exterior construction work indicated in drawings and described in specifications.

(2) Work not included

following items of related work are not included in this paragraph and specified in other paragraphs of this specification.

- 1) Work related to building equipment work, excluding work described herein.
- 2) Supply of manhole covers and frames for miscellaneous constructions
- 3) Rainwater drainage work, excluding work described herein.

(3) Work to be executed on access roads, footways, and other public areas outside the site shall not be stipulated in this specification.

7-16-2 Shop Drawings

Shop drawings related to the work stipulated in this paragraph such as gate doors, shall be submitted to the Engineer for approval. The approval for the drawings shall be gained prior to the commencement of the work. These shop drawings shall indicate details of processing, assembly, erection, etc., and shall clearly state the dimensions of all materials, supporting materials, anchors, connections with other items of work, etc.

7-16-3 Samples

Samples of the following materials shall be submitted to the Engineer for approval. The approval shall be gained before carrying in these materials.

Padlocks and terrazzo blocks

7-16-4 General

- (1) The requirements for earth work, reinforced concrete work, and other items of related work described in other paragraphs of this specification shall also be applicable to the work set out in this paragraph.
- (2) All steel portions excluding stainless steel, galvanized surfaces, and unpainting castings shall properly be pre-processed and given a coat of rust-proofing paint at the factory. Hardware to be embedded into concrete shall not be painted, unless otherwise stated. Hot-dipped galvanized and galvanized surfaces shall not be shop painted, unless otherwise stated. Painting shall be performed in accordance with the requirements of Paragraph 7-13 "PAINTING."

7-16-5 Materials

- (1) For filling under pavements, suitable soil obtained by excavation or carried in from outside the site shall be used.
- (2) For concrete materials, materials meeting the requirement of Paragraph 7-3 "REINFORCED CONCRETE WORK" or equivalent shall be used.
- (3) For shape steel, materials that meet the requirement of JIS G 3101 and SS41 or equivalent shall be used.

- (4) For painting, materials that meet the requirements of Paragraph 7-13 "PAINTING" shall be used.

7-16-6 Roads/Asphalt Pavements

(1) General

roads and asphalt pavements shall be constructed as per design drawings and specifications given hereunder, unless specifically directed by the Engineer. Various types of excavation and trimming shall be executed so that each work can be performed to line and inclination indicated in design drawings.

(2) Subsurface

- 1) In order to form the required height, the existing ground shall be excavated, banked, and consolidated.
- 2) Portions below the required level, such as holes, soft portions, and hollows as specified by the Engineer shall be excavated, filled with crushed stone and consolidated at every thickness of 15cm while spraying water.
- 3) Specified places shall be laid with an approved filling material, sufficiently sprayed with water, and consolidated in layers of 15cm thick to be filled to the required height.
- 4) Cut portions shall be sprayed with sufficient water, tampered to the required height, and approved by the Engineer.
- 5) Slopes, cross falls, and other necessary items shall be formed on subgrade surfaces. Unless otherwise stated, the slope shall be at a ratio of 1cm/2m toward the catch basin.

(3) Crushed stone base course

- 1) Crushed stone shall be less than 50mm in nominal dimension and shall have been approved by the Engineer.
- 2) Crushed stone base course shall be constructed by laying crushed stone at a thickness of 15cm with the specified slope and cross fall. After sufficiently spraying water, compact the surface with a roller approved by the Engineer to achieve a firm surface with uniform bearing capacity.

(4) Asphalt pavement

1) Materials

- a) Straight asphalt in conformity to JIS K2207 (Petroleum asphalt) shall be used. The quality certificate of the manufacturer shall be submitted to the Engineer for approval.
- b) Crushed stone to be used shall be less than 25mm in dimension.
- c) For the stone powder, one produced by crushing limestone and having a water content of less than 1% but without aggregated structure of fine particles shall be used. The standard grading range of the stone powder shall be as given in Table 7-16-1.

Table 7-16-1 Grading of Stone Powder

Nominal of Diameter of Sieve Opening (mm)	Percentage of Sieved Weight (%/wt)
0.6	100
0.15	90 ~ 100
0.074	70 ~ 100

2) Mix proportion and others

- a) The mix proportion of asphalt concrete shall be as given in Table 7-16-2. Aggregate, stone powder, and asphalt shall be heated and mixed at the plant.

Table 7-16-2 Standard Mixture Rate of Hot-Laid Asphalt

Type		Coarse Graded Asphaltic Concrete	Dense Graded Asphaltic Concrete		Modified Topeka
Use		Binder Course	Surface Course		Surface Course
Nominal Diameter of Opening (mm)	Finished Depth (mm)	40 ~ 60	50 ~ 60	40 ~ 50	30 ~ 50
	Percentage of Sieved Weight(°/wt)				
	25	100	100	-	-
	20	95 ~ 100	95 ~ 100	100	100
	13	70 ~ 90	75 ~ 90	95 ~ 100	95 ~ 100
	5	35 ~ 55	45 ~ 65	55 ~ 75	65 ~ 80
	2.5	20 ~ 35	35 ~ 50		50 ~ 65
	0.6	10 ~ 22	18 ~ 29		25 ~ 40
	0.3	6 ~ 16	13 ~ 23		-
	0.15	4 ~ 12	6 ~ 16		8 ~ 20
	0.074	2 ~ 6	4 ~ 8		3 ~ 8
Amount of Asphalt(°/wt)		4.5 ~ 6.5	5.0 ~ 7.0		6.0 ~ 8.0
Penetration		60 ~ 80	80 ~ 100		100 ~ 120

Note: Amount of asphalt is shown as percentage of weight to all of mixture.

- b) Prior to commencing the work, prepare test spacen of the mixture and perform indoor test (Marshall Stability Test) of the test spacen. By obtaining the amount of asphalt by using Table 7-16-3, determine the mixing

rate to be employed actually and report the result to the Engineer. When there is a proper data or reference for the identical materials and mix proportion or when the object to be paved is a footway or an unimportant one, the test can be dispensed with by receiving the Engineer's approval.

Table 7-16-3 Standard Value of Marshall Stability Test-

Type	Coarse Graded Asphaltic Concrete	Dense Graded Asphaltic Concrete	Modified Topeka
Use	Binder Course	Surface Course	Surface Course
Time impact compaction	50		
Stability(kg)	More than 500		
Flow value (1/100 cm)	20 ~ 40		
Percentage of void (%)	3 ~ 7	3 ~ 6	3 ~ 7
Degree of saturation(%)	65 ~ 80	75 ~ 85	70 ~ 85

- c) The aggregate shall be heated to 130~180°C and dried up with a drier. Asphalt shall have a temperature at which a suitable viscosity is provided for mixing.
- d) For mixing the materials, aggregate and stone powder shall be thrown into a mixer and, after mixing the aggregate and stone powder for about 5 seconds, pour melted asphalt. Then, mix for about 50 seconds.
- e) The mixture thus produced shall be carried out from the plant by using a cleaned dump truck. The mixture shall be covered with a sheet or the like for keeping the temperature.

- f) The temperature of the mixture arriving at the construction site shall not be 15°C below the temperature of the mixture at the plant.

2) Paving

- a) In principle, the mixture shall be laid by using a finisher. However, when the object to be paved is not important, the mixture can be laid by hand with the Engineer's approval.
- b) The laying temperature of the mixture shall be more than 110°C as standard. After completion of laying the mixture, confirm that the surface of the pavement is uniform, and commence rolling. When the temperature falls below 5°C, pave by adjustment of penetration or the mixture depending on the situation.
- c) Such mixture that is not suitable because of the separation of aggregate or lowering of temperature shall not be used.
- d) On the base course or binder course, prime coat or tack coat shall be applied.
- e) When it begins to rain while laying the mixture for pavement, interrupt the work and promptly finish by rolling over those portions having been paved. When it rains or snows, paving shall not be made.
- f) In rolling, sufficiently tamp the pavement or whatever to be paved until the trace of the roller disappears and the required density is obtained. For those portions on which rolling is unachievable, apply a tamper for tamping and finish by a smoother.
- g) Footways or whatever not important shall be tamped by a vibration roller, a tandem roller, or a tamper having a tamping effect equivalent to these roller.

h) Traffic shall not be allowed before the finish of the surface layer is complete and the temperature of the surface layer has not lowered to the atmospheric temperature.

3) Cutting test

a) Three cores shall be taken out for every 1000m² or its fractions of completed pavement and must pass the following cutting test, although this cutting test can be dispensed with in the case of footways and unimportant pavements with the Engineer's approval.

i) Pavement thickness allowance shall be $\pm 15\%$ of design thickness.

ii) Specific gravity shall be more than 95% of the design value.

b) Sampling of asphalt mixture shall be conducted as specifically noted. The difference between the result of sampling and design mixing shall be within $\pm 0.5\%$ in the amount of asphalt and within $\pm 12\%$ in grading by 2.5mm sieves and within $\pm 5\%$ by 0.074mm sieves.

c) Test data shall be submitted to the Engineer.

In paving work, due consideration shall be given to standard specifications established in Sri Lanka.

7-16-7 Laying Concrete Blocks and Terrazzo Blocks

(1) Laying concrete blocks

Concrete blocks shall be made of precast concrete slabs each measuring 29.5cm wide, 29.5cm deep, and 6cm thick. Blocks shall be laid with a joint width of 5mm on a 3cm thick bed of consolidated sand course. And the joints shall be filled with sand.

The subsurface shall be as specified in Paragraph 7-16-6, item (2).

(2) Laying terrazzo blocks

1) The materials of terrazzo blocks and their method of production are as specified in Paragraph 7-11-4.

2) When terrazzo blocks are to be laid on consolidated sand course:

The thickness, dimensions, and laying method of terrazzo blocks shall be as specified in Paragraph 7-16-7, item (1).

3) When terrazzo blocks are to be laid on concrete slabs:

Hard mixed cement plaster of cement 1 : sand 3 mix proportion shall be laid to a thickness of 3cm and then terrazzo blocks of 3cm thick shall be laid with a joint width of 5mm on the cement plaster.

Joints shall be filled with a cement plaster of cement 1 : sand 2 mix proportion by using a joint trowel.

7-16-8 Curbstone

Curbstone shall be made of precast concrete with dimensions indicated in drawings. The standard length of curbstone shall be 59cm. Curbstone shall be laid on a plain concrete foundation of 5cm thick with joints of cement plaster (1:3). Curbstone shall be haunched up on both sides by using cement plaster of the same mix proportion. The joint width shall be 1cm. For curbstone on curbs, cast-in-place concrete may be used. Curbstone shall be laid on edges of all areas where concrete blocks, terrazzo blocks, or crushed stones are laid.

7-16-9 Drain

Drains shall be provided in parking areas, garages, and on roadway portions of Colombo Studio Center as indicated in drawings.

For drain grating, ready-made steel grating finished by hot-dipped galvanization shall be used. Frames shall be made of steel, and finished with coal tar.

7-16-10 Boundary Fence

Colombo Studio Center shall be surrounded by a steel net fence with a height of 2m and a brick wall finished with cement plaster to have a height of 1m.

Kokavil, Candy, and Madukanda Stations shall be surrounded by a barbed wire fence of 2m high and a brick wall finished with cement plaster, as indicated in design drawings.

7-16-11 Steel Gate

Colombo Studio Center, Kokavil and Candy Transmitting Stations, and Madukanda Repeater Station shall be furnished with steel gates as shown in design drawings. For rust proofing, minium rust resisting paint specified in JIS K 5622 shall be used. To be finished by SOP coating.

7-16-12 Flag Pole

Colombo Studio Center shall be furnished with 3 ready-made aluminum flag poles of 10m high as indicated in design drawings.

7-16-13 Manhole Cover

The covers of manholes to be provided in areas where asphalt pavement, concrete blocks, or terrazzo blocks are laid shall be such dressed manhole covers finished in the same way as the surrounding.

7-16-14 Crushed Stone Laying

(1) Scope of work

Crushed stone shall be laid in the cooling tower and oil tank spaces of Colombo Studio Center and around the buildings of the respective transmitting and repeater stations, as shown in drawings.

- (2) After sufficiently tamping the ground bed with a tamper or the like, lay crushed stone at a thickness of 5cm. Crushed stone shall be less than 40mm in size.

7-16-15 Planting

(1) Scope of work

Planting shall be made in the area specified in design drawings (Colombo Studio Center only). The warranty period for the planting shall be one year counted from the date of hand-over. Of the whole area of planting, 70% shall be turfed and 30% shall be group planting (5 plants/m²) with low shrubs.

(2) Trees

- 1) Such trees that provide good style, grow well, are free from damage by blight and harmful insects, and produced in Sri Lanka shall be planted. In order to withstand replanting, such cultivated trees that have experienced transplantation or digging around roots and that have many fine roots shall be planted. However, non-cultivated trees with equivalent properties as mentioned above may be planted if approved by the Engineer.

2) Planting

- a) For planting trees, holes shall be excavated to

be sufficiently large for the roots of trees to be planted and unsuitable soil, rubbish and other foreign matter harmful to the growth of plants shall be removed.

- b) Lay suitable soil to a proper height on the bottom of the hole, let the tree to be planted stand in the hole, confirm the direction and depth of the tree, effect throating or soil filling, and lightly stamp the soil to grade it.
- c) Trees shall be planted as promptly as possible after carrying in to the site. In case planting of trees is not achievable by some reason or other, temporarily plant them or cure them completely under instructions of the Engineer.
- d) When planting is complete, take proper measures for pruning, style arrangement, curing, etc., of the trees planted.
- e) The intervals of trees to be planted shall be determined by type of tree, place of plantation, and purpose of plantation.

(3) Lawn and others

- 1) Such lawn that is free from damage by blight and harmful insects, that involves less weeds, that provides luxuriant leafage, and that is produced in Sri Lanka shall be adopted.
- 2) Laying and planting
 - a) Prior to laying lawn, cultivate the soil to a depth of 120mm~150mm, crush clods, remove rubbish, weeds, etc., and level the land.
 - b) In laying lawn on a flat soil, planting with soil joints of 30mm as standard shall be employed.
 - c) After laying lawn in place, lay the required amount

of top-dressing uniformly and carefully sprinkle water. When necessary, use a roller for rolling (about 250kg in weight).

- d) On slopes lawn shall be laid by planting with soil joints of 30mm in standard width.

Four bamboo spits shall be used for a piece of lawn.

These spits shall be driven in with their hooks downward.

After laying the top-dressing, finish by means of a board with a grip or a like.

7-16-16 Retaining Wall

(1) Scope of work

To be provided at Mt. Pidurutalagala and Kandy Transmitting Stations, as indicated in design drawings.

(2) Materials

- 1) Such rocks that have nearly flat surfaces, that provide joint surfaces of about 300mm, and that are produced in Sri Lanka shall be used.
- 2) Concrete and rubble shall be as specified in Paragraph 7-3 "REINFORCED CONCRETE WORK" and Paragraph 7-2 "EARTHWORK."
- 3) Mortar shall be mixed at a 1-2 cement sand mix proportion.

(3) Method

- 1) For masonry stone, dirt and filth on stone shall be cleaned prior to commencing the work.
- 2) Rubble wet masonry shall be used. By fixing stones with props, place back filling concrete and compact sufficiently not to cause large gaps near joints.
- 3) Masonry stone shall in principle be piled while keeping height equal.

- 4) Back form shall in principle be used in the back of backing concrete for wet masonry so as to keep the thickness from the front of the masonry stone to the back of the concrete. In this case, the back form shall not be left embedded but shall be removed after use.
- 5) In wet masonry, the height achievable per day shall be 1.2m to 1.5m as standard and masonry shall be accomplished in form of steps.
- 6) Expansion joint in wet masonry shall be made over the entire design crosssection at points selected from among points with varied masonry height, starting and ending points of curved portions, etc., at intervals of 10 to 15m by using cryptmeria plates of more than 12mm thick or the equivalent.
- 7) One drain hole per 2m² of wet masonry shall be provided as standard. Hard PVC pipes of 75mm in internal diameter shall be passed from the surface to the back filling.
- 8) Wet masonry shall be sufficiently cured by covering with straw mats or the like and no harmful shock or vibration shall be given until concrete sets.
- 9) Cement plaster shall not be applied to the joints in wet masonry unless approved by the Engineer.

7-16-17 Retaining Wall around Plantation

Retaining wall shall be provided around plantation at Colombo Studio Center. The wall shall be made of brick masonry to be finished with cement plaster. Coping shall be made by terrazzo blocks. The dimensions and shape shall be indicated in design drawings.

7-17 TOWER WORK

7-17-1 Scope of Work

(1) Extent

The work specified under this paragraph consists of the fabrication and erection of all steel towers, foundations, anchors, feeder racks, etc., and related items of work necessary to complete the work indicated in drawings and described in specifications.

(2) Items to be approved by the Engineer

The contractor shall in advance submit instruction manuals for fabrication, work plan, construction schedule, etc., to the Engineer for approval. The contractor shall also submit the historical record or, scale, of shop facilities of shop or shops, etc., of the manufacturer or manufacturers to the Engineer for approval.

(3) Work not included

The following items of related work are not included herein.

- a) Feeder and electric wiring work
- b) Fabrication and mounting of parabolic antenna mounting frame for Madukanda Repeater Station
- c) Fabrication and mounting of dipole antenna mounting frames for each station

7-17-2 Materials and Parts

(1) Specifications of materials

Unless specifically noted, materials shall be those that meet the requirement of JIS standards given in Table 7-17-1. The types of materials to be selected shall be as shown in design drawings.

Table 7-17-1 Standards of Quality of Materials

Material	Standards
Section steel, steel plate and steel bar	SS41 and SS55, prescribed in JIS G 3101 (Rolled Steel for General Structure) SM41A and SM50B, prescribed in JIS G 3106 (Rolled Steel for Welded Structure)
Steel pipe	STK41, prescribed in JIS G 3444 (Carbon Steel Tubes for General Structural Purposes) SGP, Black pipe, prescribed in JIS G 3452 (Carbon Steel Pipes for Ordinary Piping)
Light gauge steel	SSC41, prescribed in JIS G 3350 (Light Gauge for General Structure)
Expanded metal	XG, prescribed in JIS G 3351 (Expanded Metal)
Malleable steel	SF45 and SF50, prescribed in JIS G 3201 (Carbon Steel Forgings)
Cast steel	SC46, prescribed in JIS G 5101 (Carbon Steel Castings)
Locked coil rope	Type C, prescribed in JSS-11 (JSSC* Standards for Structural Cables (Locked Coil Ropes))
Welding materials	JIS Z 3211 (Covered Electrodes for Mild Steel) JIS Z 3212 (Covered Electrodes for High Tensile Strength Steel) JIS Z 3311 (Steel Wires and Fluxes for Submerged Arc Welding) <u>Note:</u> The type of welding rod to be used shall be approved by the Engineer in advance.

* JSSC: Society of Steel Construction of Japan

(2) Shapes and dimensions of materials

All materials shall have proper shapes, good quality, have no harmful flaws, cracks or extreme rust, have smooth surfaces, and meet the requirements given in Table 7-17-2.

Table 7-17-2 Standards of Dimensions

Material	Standards
Steel bar	JIS G 3191 (Dimension, Weight and Permissible Variations of Hot Rolled Steel Bars and Bar in Coil)
Section steel	JIS G 3192 (Dimension, Weight and Permissible Variations of Hot Rolled Steel Sections)
Steel plate and steel strip	JIS G 3193 (Dimension, Weight and Permissible Variations of Hot Rolled Plates, Sheets and Strip)
Flat steel	JIS G 3194 (Dimension, Weight and Permissible Variation of Hot Rolled Steel Flats)

Materials not specified in Table 7-17-1 shall conform to relevant JIS standards.

(3) Material test

- 1) For steel materials, test pieces shall be sampled for every 10 tons and its fractions for each shape and dimension. Those steel materials that are to be used but not to construct main structure may be dispensed with this test with the Engineer's approval.

- 2) Specimens shall be sampled in the presence of the Engineer. Test shall be conducted by a test organization approved by the Engineer and the results of test shall be submitted to the Engineer for judgement. When test can be performed at the shop, specimens may be tested at the shop with the approval of and in the presence of the Engineer.
- 3) Specimens shall be manufactured as per JIS G 0303 (Test specifications of steel materials), JIS Z 2201 (Metal material tension test pieces), and JIS Z 2204 (Metal material Bending test piece).
- 4) Test items and test methods shall be as given in Table 7-17-3.

Table 7-17-3 Items and Methods for Testing Materials

Material	Items and Methods for Tests
Steel plate and Section steel	Tension test (JIS Z 2241) ° Bending test (JIS Z 2248)
Steel pipe	do. ° Bending or flatting test (JIS Z 3444)
Gas pipe	do. ° do.
Malleable steel	do. ° Bending test (JIS Z 2248)
Cast steel	do. ° do.
Locked coil rope	JSS 11-1978
Welding rod	JIS Z 3211

- 5) Those standardized products which are furnished with certificates for compliance to the relevant standards and of which quality can be warranted sufficiently may dispense with material test with Engineer's approval.

(4) Component parts (bolts, nuts, and washers)

1) Materials

Unless otherwise specified, the quality of materials shall be as given in Table 7-17-4.

Table 7-17-4 Standards of Quality of Materials

Material	Standard
Bolt and nut	SS41B-D, prescribed in JIS G 3123 (Cold Finished Carbon Steel Bars)
Spring washer	SWRH72B, prescribed in JIS G 3506 (High Carbon Steel Wire Rods)
Plain washer	SS41, prescribed in JIS G 3101 (Rolled Steel for General Structure)

2) Shape, dimensions, specifications and mechanical properties

- a) Shape, dimensions, and specifications of bolts, nuts, and washers shall be as given in Table 7-17-5 unless otherwise stated. Bolts shall be average finished products with regular, hexagon, forged heads. Nuts shall be hexagon forged nuts with a height equal to the bolt diameter.

Table 7-17-5 Standards of Dimensions of Bolts, Nuts and Washers

Material	Standards
Bolt	JIS B 1180 (Hexagon Head Bolts) The grade of finish: average. The precision of screw: grade 2

(Continued)

Material	Standards
Nut	JIS B 1181 (Hexagon Nuts). The grade of finish: average The precision of screw: grade 2
Screw	JIS B 0205 (Metric Coarse Screw Threads). The precision shall be equivalent to grade 2, prescribed in JIS B 0209 (Limits of Sizes and Tolerances for Metric Coarse Screw Threads) and the screw shall be able to be driven easily by fingers.
Spring washer	No.2, prescribed in JIS B 1251 (Spring Lock Washers)
Plain washer	Cold finished, round washer, prescribed in JIS B 1256 (Plain Washers). Dimensions shall be those shown on the drawings.

- b) In principle, threading on bolts shall be made mainly before plating and slightly after plating. Threading of nuts shall be performed after plating.
- c) Bolts and nuts shall have interchangeability among those with identical diameters.
- d) Unless otherwise specified, the bolt length is equal to the bolting length (the entire thickness of the material to be coupled) plus the applicable value given in Table 7-17-6. As less kinds of bolt length as practicable shall be employed.

Table 7-17-6 Bolt Length

Nominal Diameter of Bolt	Length to Be Added to Bolting Length (mm)
M16	26 ~ 30
M20	33 ~ 42
M22	35 ~ 44
M24	37 ~ 46

e) The effective thread length shall be equal to the bolt length subtracted by the bolting length and the washer thickness, as standard.

f) Sockets, turnbuckles, pins, pinplates, etc., shall be as indicated in design drawings.

3) The abbreviation or symbol of the manufacturer of the bolt shall be embossed or carved on the top of the bolt head.

(5) Split pins

Unless otherwise, split pins shall meet the requirements of JIS B 1351 (split pins) and shall be galvanized.

1) Unless otherwise, split pins shall be Class 1 or Class 2 specified in JIS H 3521 (brass wires).

2) Shape and dimensions

Shall meet the requirements of relevant JIS standards. Suitable sizes shall be selected for corresponding bolt diameters, unless specifically noted.

3) Testing

Appearance inspection and bending test as per the relevant JIS standard shall be performed.

7-17-3 Work

(1) Manufacture drawings

Manufacture drawings shall be prepared in consideration of connections between sections and others on the basis of design drawings and submitted to the Engineer for approval.

(2) Full-size drawings

- 1) Prepare full-size drawings from manufacture drawings and, when necessary, make templates and/or scales and submit them to the Engineer for inspection. However, when the Engineer approves that it is not necessary to provide full-size drawings, they need not necessarily be prepared.
- 2) For scale tape to be used for the preparation of full-size drawings and fabrication, JIS Class 1 tape shall be used and, when necessary, by applying a proper tension specified. Scale tape for full-size drawings and scale tape for use in the field shall be checked for discrepancy.

(3) Identification of steel materials

When steel materials with different qualities are used together, colour identification or other proper means of identification shall be employed for easy identification of different steel materials.

(4) Marking-off

- 1) Marking-off shall be made accurately and elaborately. Necessary items shall be laid out as required from design drawings, manufacture drawings, or full-size template or scales.
- 2) When marking off on high-strength steel, no chisel shall be used in principle.
- 3) When marking off upon bending, the external surface to be bent shall not be notched by a punch or chisel.

(5) Cutting

- 1) For cutting materials, ensure to keep accurate perpendicularity, included angle, and straight forwardness as required and the roughness of the section obtained by cutting shall meet the requirements of surface roughness 50S of JIS B 0601.

- 2) For gas cutting, use an automatic gas cutter. In an avoidable case, a hand gas cutter may be employed with Engineer's approval. When the cutting edge is not normal, finish it smooth by a grinder.
- 3) Steel plates of less than 6mm thick and angle steel may be cut by a cutter.
- 4) Members (materials) to be welded shall be cut by an automatic gas cutter or a saw, into dimensions determined in consideration of shrink and deformation to be caused by welding.

(6) Punching

- 1) Holes shall be so bored that their centers coincide when members are combined. Where particularly high accuracy is required, holes shall be made after temporary assembling.
- 2) Holes shall be bored by a drill or by a combination of a sub punch and a reamer. When the thickness of the material piece is less than 6mm, holes may be bored by a punch to finishing dimensions.
- 3) The hole diameter shall be slightly larger than the bolt diameter: It shall be 1.0mm larger in the case of holes of less than 16mm and 1.5mm larger in the case of holes of 20 24mm in diameter, at standard.
Anchor bolt bolt holes shall be as shown in design drawings.
- 4) Burr and strain around bolt holes shall be removed.

(7) Correction of strain

- 1) Strain on materials shall be corrected.
- 2) Strain caused upon cutting shall be corrected.
- 3) Strain produced upon welding, heating or others shall be corrected to meet the purpose.
- 4) Correction of strain by heating shall be performed at such temperature that shall not damage the material.

5) Steel materials caused pronounced distortion shall not be used.

(8) Processing by bending

Steel materials requiring processing by bending shall be bent at room temperature in principle. However, materials to be bent with small curvatures may be processed heated.

(9) Processing by planing

- 1) Surfaces which receive pressure, such as post joint, shall be plane-finished to have a metal touch.
- 2) When specifically indicated in drawings, metal fittings, parts, etc., shall be plane-finished as specified.

(10) Finish

- 1) Metal fittings, parts, etc., shall be finished as required for their purposes.
- 2) Welded portions having irregular shapes shall be finished adequately.

(11) Partial assembly

- 1) When necessary materials are arranged, partially assemble them as required and effect hole alignment or temporary fastening for welding.
- 2) When it is complicated or difficult to combine material by partial assembly before welding, assemble them by using jigs for assembly and fixing. Sufficient adjustment shall be effected in assembly dimensions, angles, and twist prior to the commencement of welding.

(12) Temporary assembly

- 1) When the arrangement of component materials is complete,

temporarily assemble the whole construction. Check and adjust overall dimensions, bending, twist, straight-forwardness, etc.

- 2) During temporary assembly, check the connection of all component materials and hole alignment on materials to be connected and correct when necessary.
- 3) Galvanized materials shall in principle be assembled temporarily after galvanization and removing strain.

(13) Cast steel

- 1) Casting shall be performed at shop so as to produce complete products through thorough examination of cast form, method, etc.
- 2) Cast steel shall be free from casting fin, flaws, and other defects. Light defects may be corrected by welding with Engineer's approval. After correction proper heat treatment shall be effected.
- 3) For cast steel, finish forging materials and removal of strain shall in principle be effected by heat treatment and other methods. For those cast steel for which high accuracy is not required, finish forging and removal of strain may be dispensed with by obtaining the Engineer's approval.
- 4) Finish of cast steel shall in principle be performed after heat treatment.

(14) Forged steel

- 1) Forging shall be effected so as to achieve complete products through thorough examination of the method of forging and others.
- 2) The forging ratio of forged steel shall in principle meet the requirements of JIS.

- 3) Forged steel shall in principle be heat treated.
- 4) The dimensions, shapes, etc., of forged steel shall be as indicated in design drawings.

(15) Guy-wire fittings

- 1) Guy-wire fittings shall in principle have rounded corners.
- 2) Split pins to be used for guy-wire fittings shall be made of brass.

(16) Base fittings

- 1) Supporting portions of base fittings shall be such that achieve their purposes sufficiently.
- 2) Accessories and attachments shall be such that achieve their purposes sufficiently.

7-17-4 Welding

(1) General

- 1) Welding shall be performed completely and as required.
- 2) Welding of major portions of structures shall be made by manual arc welding. When employing automatic welding or other means of welding, the contractor shall receive the approval of the Engineer.
- 3) Welding work shall be planned so that flat welding shall be achieved as much as practicable and that strain and contraction stress to be caused by welding shall be minimized.

(2) Welders

- 1) Welders for manual welding shall have qualifications specified separately among JIS Z 3801 (test method and judgement criteria for welding technique qualifications), have experience

of being engaged in welding of structures for more than 6 months, and have passed additional tests specified separately for respective items of welding. However, additional tests shall not be performed unless particularly specified.

- 2) Welders to be engaged in welding shall in advance submit their photographs, a copy of certificate for their qualifications, and personnel history to the Engineer for approval, and shall identify themselves as authorized welders by armbands or a like.
- 3) When there is a doubt in working attitude or workmanship of welding of a welder who has already approved by the Engineer, the welder may be retested or disqualified.
- 4) When so directed by the Engineer, the welder shall enter by painting his name or symbol on portions welded by him.

(3) Welding rods (electrodes)

- 1) Welding rods shall meet the requirements of JIS Z 3211 (coated electrodes for mild steel) and JIS Z 3212 (coated electrodes for high strength steel) and shall be suitable for the types, dimensions, and welding conditions of base metals.
- 2) Welding rods shall be handled elaborately. Welding rods with removed, spoiled, or deteriorated coating shall not be used.
- 3) Welding rods shall be stored not to absorb moisture. When there is a fear of absorbing moisture use them after drying them up sufficiently with a drying furnace.

(4) Assembly of material (member) pieces

- 1) Assembly of material pieces shall be made accurately by using proper jigs and others. For filled welding, material pieces shall be jointed as firmly as practicable. In butt welding, the shape of groove shall strictly meet design drawings and assembly shall be made not to cause discrepancy in groove angle, interval, and member pieces. When errors caused in assembly can not be corrected, instructions from the Engineer shall be received.
- 2) In assembly, counter-strain or proper constraint method shall be adopted in order to minimize constraint for deformation to be presumed on the basis of the structure, welding type and welding procedure and produce structure with accurate form after completion of welding.
- 3) Proper temporary fastening or temporary welding shall be effected in order to maintain members securely and not to give excessive constraint. Temporary welding shall be limited to minimum. When temporary welding becomes part of the final welding, the welding shall be performed without any fault.

(5) Welding machine and tools

- 1) Welding machine to be used shall have a construction and functions suitable for the materials, dimensions, and joint shapes of materials to be welded and shall allow stable welding performance. When current can not be adjusted easily near the welding position, the welding machine shall be furnished with a remote control equipment.
- 2) Jigs to be used for welding shall have ample performance and meet the requirements of the relevant JIS standards.

(6) Cleaning of base metals

Prior to welding, clean the surface of the base metal to be welded by elaborately removing slug, water, rubbish, oil, paint, and other foreign matter on the surface.

(7) Welding operation

- 1) Welding shall be performed with proper current and voltage depending on the type and thickness of the welding rod and working attitude. In the case of using a DC welder, the performance characteristics of the welder should also be considered depending on to the type of the welding rod and other conditions.
- 2) The methods and procedure of welding shall be so selected as to minimize strain and residual stress. The welding rod shall be held to keep a proper arc length and angle, maintain sufficient penetration through adequate weaving, and prevent the mixture of blowholes and slag, undercut, unevenness in leg length, overlap, and other defects. The width of weaving shall be less than 3 times as large as the diameter of the welding rod.
- 3) Welded surfaces shall be as much smooth and correctly waved. Welding shall in no case undersize the design dimensions. A slight oversizing of design dimensions may be allowed. Excessive overwelding or pronounced irregularities on surfaces shall not be allowed.
- 4) When the steel material to be welded is large in carbon equivalent and in plate thickness, the workability of welding shall be improved by selecting adequate welding rod and adding pre-heating and post-heating.
- 5) Butt welding
 - a) Unless specifically noted, butt welding shall be made with minimum reinforcement. The thickness of reinforcement shall not exceed 3mm.

- b) When welding is to be made from both sides, perform first back chipping and then back run. Back chipping shall be effected until the first layer on the surface shall be removed or a good welded metal portion shall appear. The thickness and width of back chipping shall be as much uniform as practicable.
- c) When welding is not made on both sides, particularly confirm by applying a backing strip that the root portion is as required. When it is necessary to remove the backing strip, take due care not to damage the base metal and deposit material upon removing the backing strip. The welded portion shall form a slightly convex surface and provide a complete section.
- d) When there is a difference in surface level between plates or materials to be welded by butt welding excluding butt welding of T type joints, weld metal shall be deposited so that a smooth run of deposit shall be formed from the low surface to the high surface. When the difference in level exceeds 3mm, the higher material shall be on a level at the groove portion with the lower material and, in addition, the surface shall be so formed as to provide a moderate slope of less than 1:5 in inclination.
- 6) In isosceles fillet welding, no remarkable difference shall be left between the two sides. When non-isosceles condition is indicated specifically, due care shall be taken to maintain the required dimensions and as much smooth surface of weld as possible. The length of intermittent weld shall be more than 2 times as large as the effective dimension of the fillet. The thickness of reinforcement in fillet weld shall be $0.1S + 1\text{mm}$ or less (S is the specified leg length).

- 7) When the welder is directed to make an important butt weld and fillet weld, deposit an end tab of the same shape as the joint at the both edges and, after completing welding on the weld line extended by more than 25mm at the respective edges, remove the reinforcing plate and finish the welded portion, unless it is approved to prevent the occurrence of defects at the edges of weld by using return or boxing weld on fillet weld joints.
- 8) When shutting off arc, sufficiently embed the end of weld with a sound deposited metal.
- 9) When replacing the electrode or welding next layer in multi-layer welding, completely remove slag and other obstacles which may prevent welding operation on the surface.
- 10) After completion of welding, insure to remove slag without fail.
- 11) When boring temporary bolt holes on members to be welded for assembly, the approval of the Engineer shall be obtained.

(8) Weather

When the surface of the base metal is wet because of rain, snow, etc., or when a high wind blows, welding shall not be performed, unless welders and welds are sufficiently protected and proper measures are taken for the base metal.

(9) Temperature

Welding shall not be performed at temperatures below 0°C. However, if the temperature is in a 0°C to -15°C range and the temperature of the base metal located within 100mm from the welding start portion is maintained above 36°C by heating, welding may be performed.

(10) Disaster prevention

The welding facilities shall be free from hazard, such as electric leakage and electric shock, shall be provided with ample protective means against fall of weld metal and others and fire by arc, and shall prevent harm being given by arc light.

(11) Correction of faulty weld

- 1) Blow holes and porous portions, inclusion of slag, overlap, or ill-merged portions on welded joints, shall be chipped off by a chipping grinder or gas gauging not to damage other welded metal or base metals and then re-welded. When a weld metal involves a crack, re-weld over the whole welded metal. When the base metal involves a crack due to welding, consult with the Engineer to take a proper measure.
- 2) For undercut or insufficiency in the size of weld, add weld metal to obtain the required dimensions. The electrode to be used for correction of defects shall be one with a small diameter.

(12) Correction of members or materials

- 1) Strain caused by welding heat shall be corrected by a mechanical or heating method without damaging the property of the material, under instructions from the Engineer.
- 2) When a member or material is warped in shape or dimensions, correct elaborately it with approval of the Engineer. Materials with excessive warp shall be abandoned.

7-17-5 Rustproofing

(1) Galvanization (Shop plating)

1) Galvanization

Members and materials except portions to be embedded in concrete shall be hot-dip galvanized, unless otherwise specified.

2) The standard process and standards of galvanization are given in Table 7-17-7.

Table 7-17-7 Standard Process and Standards of Zinc Coating

Hot-dipped zinc coating	JIS H 0401 (Methods of Test for Zinc Coating (Hot-Dipped) on Iron or Steel) JIS H 8641 (Zinc Coating (Hot-Dipped) on Iron or Steel) JIS H 9124 (Standard Process of Zinc Coating (Hot-Dipped) on Iron or Steel)
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3) The standards of weight and uniformity of zinc in galvanization shall be as given in Table 7-17-8.

Table 7-17-8 Standards of Zinc Weight

Classification	Zinc Weight (g/sq.m)	Test by Sulfate of Copper
Section steel, steel plate, etc.	More than 550	More than 6 times
Bolt, etc.	More than 450	More than 5 times

4) Galvanized members and materials shall be corrected in strain and inspected in appearance for defects in quality. Defective members and materials shall be rejected.

5) Zinc weight and uniformity test shall be performed as per JIS H 0401 and the results of test shall be filed and submitted to the Engineer.

(2) Painting (to be worked in the field)

1) Types of painting :

The types of painting to be accomplished in the construction field shall be as given in Table 7-17-9.

Table 7-17-9 Classification of Painting

Classification	Shop Treatment for Rustproof	Preparation of Surfaces for Painting	First Coat	Second Coat	Finish Coat
A	Zinc coating	Dust, dirt and oil shall be wiped off with benzine. Rust shall be removed.	Rubber chloride paint 1 coat (180g/sq.m)	The same as the left. (170g/sq.m)	The same as the left. (150g/sq.m)

Note: Values in brackets () are coat weights given for reference's sake.

2) Materials

- a) Materials of painting shall meet the requirements of JIS.
- b) Painting materials shall in principles be procured from a paint maker selected with Engineer's approval.
- c) Auxiliary materials other than paints shall be those specified by the maker of the paint to be used.
- d) Every paint shall have full description of data on the paint and shall be carried in to the construction in the sealed condition. Upon carrying in a

paint or paints, confirm the name of the maker, date of manufacture, the type, colour, and quantity of the paint or paints. When painting work is complete, check the remaining volumes of respective types of paints to confirm the amount used.

3) Painting methods and procedures

- a) The contractor shall consult sufficiently with the subcontractor or subcontractors on the painting methods and procedures to be employed, prior to commencing painting. In each stage, inspection shall be performed for the entire surfaces.
- b) In preparing bed surfaces for painting and in adjusting the preceding layer, completely remove harmful attachments on the surfaces to be painted as specified for respective types of paints.
- c) Painting shall be made by a method suitable for the paint to be applied.
- d) The amount of paint to be used shall be determined from the painting area and painting material to be used as specified for respective types of paints and shall meet the specified amount.
- e) Exercise care for the thickness of coating particularly on projections and corners where paint may not be easily applicable because of construction. The thickness of coating shall meet the required value on all portions.
- f) Painting shall be effected uniformly in consideration of property of the paint in use, performance of the painting tools, condition of the surface to be painted, and weather, not to cause standing, patches, runs, brush marks, wrinkles, and other defects.
- g) The ratio of dilution, drying time intervals between coats, maturing time, and working life shall meet the specified values.

- h) Paint shall be stirred sufficiently. In particular, rustproofing paint shall be stirred sufficiently.
- i) When abnormality is encountered on the coat because of abrupt change of weather, re-clean the surface and re-paint as required. Portions where coating is not uniform or the amount of paint is not sufficient shall be re-painted.

4) Prohibition of painting

When the weather becomes any of the following items, painting shall not be performed.

- a) When the temperature is below 5°C.
- b) two hours before sunrise or after sunset.
- c) When the relative humidity exceeds 85%.
- d) In case of rain or snow or in case it is feared that it will rain or snow after starting or finishing painting work.
- e) When a high or dusty wind blows.
- f) When it is feared that bubbles may be caused on painted surfaces because of high temperature of steel materials exposed to the scorching heat of the sun.
- g) When the weather condition is expected to become worse during the drying process to be followed after painting.

5) Curing and safety control

- a) During painting operation, take sufficient care not to apply soil or damage to the surface to be painted, surfaces already painted, surroundings of the surface to be painted, and other objects. In particular, proper curing or protection shall be effected for the surroundings and other objects as required.
- b) Use and control of paints and thinners shall be made in compliance with relevant laws and regulations to prevent disasters from occurring.

- c) Painting operations at high positions shall be made by skilled painters who shall have ample safety education and provide proper dressing, equipment, and scaffolding for safety.

6) Painting colours

Painting of aviation obstruction markings

- a) For guy-wire type tower (Kokavil Transmitting Station), red (Munsell 5R 4/13) or yellowish red (Munsell 2.5YR 6/13) and white (Munsell N9 or more) shall be used alternately to form stripes with the top and bottom stripes being coloured in red or yellowish red.
- b) Guy-wires and selfsupporting towers shall be coloured in white (Munsell N9 or more).

7-17-6 Steel Tower

All reinforced concrete work excluding the following items shall be executed as specified in Paragraph 7-3 of this specification.

- 1) Standard design strength $F_c = 180\text{kg/cm}^2$
(Reinforced concrete structure)
- 2) Slump: 8cm ~ 13cm
- 3) For exposed concrete above the ground, fair-faced concrete with smooth and minute surfaces free from bubbles and blurs shall be employed. When found necessary through Engineer's inspection, correction shall be made under instructions from the Engineer. A triangular wood strip of 3cm shall be applied to internal and external corners.
- 4) Concrete test
As per Paragraph 7-3 "REINFORCED CONCRETE WORK," unless

specifically directed by the Engineer.

5) Method

- a) Leg interval shall be measured accurately according to the drawings. For embedding anchorbolts, bolts interval, neck length and length margin shall be kept accurately as indicated in drawings. Fix anchor bolts into concrete by using gauge plates on the basis of work drawings. Due care shall be taken not to move the bolts during the work.
- b) The concrete surface to be contacted by the bottom of the base plate shall be, immediately after being placed, finished with a trowel flush and level so that respective leg bases shall be on a level with each other. When the concrete surface becomes lower than the required height, add pea gravel concrete of the proper mix proportion and finish as stated before. Determine the center of the steel tower for use as the reference in plumbing test on tower erection, relocate the center on two or more places outside the steel tower, and protect these centers from deviation.

7-17-7 Laying Anchor Blocks and Anchor Frames

(1) Survey

Prior to commencing the work, accurately measure the positions of the main pole foundation and guy-wire anchor blocks and their positional relationship (in horizontal and vertical directions) on the basis of design drawings and fix their positions. Relocate the centers of the foundation and anchor blocks to places other than on batter board, and cure until these centers shall not move before completion of the work.

(2) Plain concrete work

As per Paragraph 7-3 "REINFORCED CONCRETE WORK," except the following items.

1) Standard design strength: $F_c = 150\text{kg/cm}^2$

2) Concrete mixing

a) Slump: 8 ~ 13cm

b) Maximum coarse aggregate diameter: less than 40mm

c) Minimum unit weight of cement: 250kg/m^3

(2) Laying anchor frame

The position to lay the anchor frame at shall be determined accurately by drawings and shall not be relocated upon work.

(3) Precise re-surveying of the positions of the main pole foundation and guy-wire anchor blocks

After placing concrete for the main pole foundation and guy-wire anchor blocks, accurate survey shall be made again in order to estimate the initial guy-wire tension and guy-wire lengths. The results of this survey shall be reported to the Engineer.

7-17-8 Guy-Wire Composition Work

Stranded steel wire (End socketing)

1) Dimensions of guy-wires

In order to accurately measure the dimensions of guy-wires, measure guy-wire dimensions by adding a tension of about 10% of the guy-wire rupture stress upon applying pretension to the guy-wires in the guy-wire shop, and enter markings.

2) Cutting of guy-wires

a) The initial tension and lengths of guy-wire shall be determined by calculation on the basis of the survey drawings of anchor block distances and shall be approved by the Engineer.

b) The length of a guy-wire to be cut shall be equal to the distance between the specified sockets measured

with the above-mentioned tension being applied plus the length necessary for socketing.

- c) Stranded steel wire cut end shall be bound firmly by winding a galvanized steel wire over a length 3 to 4 times as large as the stranded wire diameter so as to prevent return of strand.
- d) Stranded steel wire shall be cut by a saw or cutter. When stranded steel wire is cut by gas cutter as required by the circumstances, cut the wire at a position more than 5cm from the end by a saw or cutter.

3) Socketing work

- a) Socketing shall be performed at the shop.
- b) Socket fittings

For socket fittings, Type 1 distillation zinc specified in JIS H 2107 shall be used. Authorized test data issued by relevant bureau or government office shall be submitted.

c) Socketing procedure

- i) Effect sufficiently firm seizing of the guy-wire over a length 3 to 6 times as large as the stranded wire diameter excluding the guy-wire edge section to enter into the socket so as to prevent return of strand. Ensure that the seized portion shall enter into the socket by about 20mm.
- ii) After passing a guy-wire, unravel the strand wire into a tea whisk form, and eliminate twist and overlap. Stranded of each wire may be kept as it is.
- iii) By impregnating the tea whisk portion of the strand wire into scouring oil (light oil heated up to about 50°C), wash out oil and impurities attached on the wire.
- iv) Wash the tea whisk portion with hot water and, after drying, pull the tea whisk portion into the socket, and determine the fixing point. The seized portion of about 20mm shall remain within the socket and the tip of the wire shall not come out of the socket.

- v) Heat the socket to a 150 to 200°C. In particular, heat the bottom and opening of the socket sufficiently. Gas burner, torch lamp or the like shall be used for this heating, without affecting materials.
- vi) Coincide the axis of the socket with that of the guy-wire, fix the socket on a vice or work bench so that the center line shall become plumb, fill the opening of the socket with clay, asbestos, etc., so that metal poured shall not leak out.

The fixation shall be so made that the guy-wire under the socket opening shall become plumb in a length equal to 30 to 40 times as large as the wire diameter. Leakage of the poured metal may cause honeycomb and thus shall not be caused. Take due care so that the guy-wire shall not contact with the inside of the socket. Only the upper end should desirably contact with the socket.

- vii) Promptly pour melt metal into the socket at a stretch. The pouring temperature shall be 480°C. After pouring, dent will appear on the upper surface, and then pour additionally.
- viii) Leave the socket fixed as it is for about 30 to 40 minutes, then take it out and after painting apply caulking to the hollow in the opening to prevent rainwater from staying there.

7-17-9 Steel Tower/Steel Pole Erection and Guy-Wire Laying

- 1) Erection shall be made as indicated in working and assembly drawings.
Erection shall be executed according to the erection numbers of members.
- 2) For erection, proceed with assembling members of 4 legs while keeping pace with each other, gradually go up in

erection, and inspect leveling and plumbing in each section of tower with minor errors to be adjusted upon fitting horizontal and diagonal members.

- 3) Clamping bolts shall be used definitely identified in shop drawings to be prepared separately. Clamping nuts shall in principle be located outside in the case of vertical members and on the upper side in the case of horizontal members.
- 4) When the erection is complete, inspect the plumbing of the whole structure for normality prior to final tightening of bolts, then finally tighten the bolts with bolting torques given in Table 7-17-10 by using torque wrench and set detents securely to screws and nuts at more than 3 places by using a roundhead punch.

Table 7-17-10 Bolting Torque

Bolt Diameter	M16	M20	M22
Torque (kg - cm)	570 ~ 610	1000 ~ 1100	1650 ~ 1800

- 5) Take proper measures to prevent objects from being dropped from heights as much as possible and prevent disasters and hazard from occurring by accidental drop.
- 6) Members shall not be damaged or spoiled by any means during transportation and work. In case any damage or loss is given, measures shall be taken under instructions from the Engineer.
- 7) Take due care in replacing erector or temporary stay on the basis of the erection plan. When necessary, use temporary reinforcements.

- 8) Temporary reinforcement shall, when necessary, be employed for wind pressure and other loads during erection.
- 9) Split pins to be used on guy-wire fittings and pin bolts shall be bent sufficiently and wound around pins.
- 10) Guy-wire with guy-wire fittings assembled completely and finished by painting as required shall be laid on a stage, cleaned and fitted to the tower structure.
- 11) When the erection of the steel pole and the fitting of guy-wires to the steel pole are complete and the plumbing of the entire steel tower is maintained in normal condition, finally tighten bolts on steel pole joints at the required torques.
Then, apply detents on bolts and nuts at 3 places.
- 12) Each guy-wire shall be given the required initial tension. Initial tension shall be measured accurately by using a proper instrument.
- 13) The erection error of a steel tower shall be within $\pm 10\text{mm}$.
- 14) The erection error of the steel pole shall fall within $1/5000$ of the length of the steel pole and shall be within $1/50$ of the outside diameter of the pole between supporting points.
- 15) The threaded portions of the guy-wire turnbuckles shall be greased sufficiently after specified painting.
- 16) All lock nuts shall be tightened completely.

7-17-10 Accompanied Items of Work

(1) Feeder lead-in rack

The contractor shall fabricate and install feeder lead-in racks and bases to be laid between each steel tower and the inlet hole of the station building.
The racks and bases shall be galvanized for rustproofing.
The construction and dimensions of feeder lead-in racks and bases shall be as indicated in design drawings.

(2) Aviation obstruction light work

- 1) Aviation obstruction lights shall be furnished at the required positions as per design drawings.
- 2) Pippings and wirings are not included in this work.

7-17-11 Inspection

(1) Inspection of full-size drawings

When full-size drawings are prepared, inspect major dimensions, member arrangements, assembled condition, etc., by referring to the manufacture drawings for comparison.

(2) Inspection of component parts

1) Bolts, nuts and washers

Inspect bolts, nuts, and washers for appearance, shape, dimensions, threading accuracy, and mechanical properties by referring to the relevant JIS standards.

2) Guy-wire fittings

- a) When major parts have been arranged, inspect them for appearance, shape, dimensions, finish, and mechanical properties.
- b) Inspect guy-wire dimensions.
- c) Inspect guy-wires for composition, sockets for assembly condition, assembly bolts for tightening condition and split pins for normality.
- d) Inspect socketing condition

3) Cast steel and forged steel

When major parts have been arranged, inspect cast

and forged steel for appearance, shape, dimensions, finish, mechanical properties. When directed by the Engineer, perform inspection by using a supersonic wave detector and/or X-ray photograph equipment.

(3) Inspection of finished products

1) Inspection of temporary assembly

After completion of parts, assemble them temporarily into a structure with attachments as required, sufficiently correct strain caused by galvanization, and inspect the temporarily assembled structure in a cleaned condition for appearance, major dimensions, shape, accuracy, finish, member arrangement, etc.

2) Inspection of welds

When the major structures are welded ones, inspect the welded portions by means of a supersonic wave detector, X-ray photograph equipment, etc., by the method specified in JIS Z 2344 and JIS Z 3104.

3) Inspection of galvanization

a) Perform zinc weight test and copper sulfate test for galvanized test specimens as well as for major members.

b) Inspect members for galvanizing condition.

4) Inspection of painting

a) Inspect paints for their composition and performance. However, maker's test data will be used for this inspection, unless specifically directed by the Engineer.

b) For those portions of which bed adjustment has been completed, inspect to determine whether bed adjustment is complete or not.

- c) In each painting process, inspect the amount of paint and finish.
- d) After completion of painting, inspect tone, finish, amount of paint, and coating thickness. Inspect also corrected portions.

5) Inspect of erection

- a) Inspect, appearance of members, assembly procedures and methods in each stage of the work.
- b) Whenever occasion cause during the erection work and before final tightening bolts, inspect the steel towers and steel pole for perpendicularity from two orthogonal directions and record the results of inspection. When the perpendicularity is out of the tolerance, correct it. When an erector or/and other facilities are mounted, their influence shall be considered.
- c) When bolting is complete, inspect bolting torque, punched portions, and washer conditions.
- d) Inspect the levelness of steel tower base plates and the condition of the base concrete.
- e) Inspect damage and loss on the base and tightening condition of anchor bolts.
- f) Inspect distances between the steel pole and anchor blocks and directions, angles, and dimensions of anchor blocks.
- g) Inspect finished condition of anchor block concrete.
- h) While adjusting force applied to obtain the specified initial stress of guy-wires, inspect to determine whether the force is applied in good balance.
- i) Inspect lock nut tightening of turnbuckles, greasing on split pins and threaded portions (after painting) and protective measures.

- j) Inspect the mounting position of aviation obstruction light and mounting dimensions and finish of the feeder lead-in rack.

7-18 ELECTRICAL WORK

7-18-1 Scope of Work

(1) Extent

The work specified under this paragraph consists of the following items of work.

- 1) Main line installation
- 2) Power
- 3) Earthing
- 4) Lighting fixture and receptacle mounting
- 5) Conduit piping for telephone system
- 6) Conduit piping for monitor system
- 7) Conduit piping for interphone system
- 8) Conduit piping and wiring for clock system
- 9) Fire alarm system installation
- 10) Conduit piping for broadcasting equipment
- 11) Alarm system installation

(2) Work not included

The following items of related work are not included herein.

- 1) Fabrication, installation, and related wiring of power receiving and distribution apparatus
- 2) Fabrication, installation and related wiring of emergency engine generator facilities
- 3) Fabrication, installation and related wiring of battery facilities
- 4) Extension of earthing wire in floor duct and connection of earthing wire with equipment
- 5) Apply and installation of airconditioners and motors

- 6) Mounting of aviation obstruction light on steel towers and related wiring
- 7) Connection of lightning rod and lightning wire to steel tower
- 8) Wiring of feeders to steel tower and supply and installation of outdoor ladder
- 9) Fabrication and installation of telephone exchanger and telephone sets
- 10) Fabrication and installation of battery facilities for telephone exchanger
- 11) Wiring for telephone system and mounting and connection of low-power terminals
- 12) Supply, installation and related wiring of interphone facilities
- 13) Supply, installation and related wiring of common TV antenna facilities (antenna, booster amplifier, distributor, divider and matching unit)
- 14) Fabrication and installation of master and slave clocks
- 15) Fabrication and installation of battery facilities for clocks
- 16) Fabrication and installation of broadcasting equipment and wiring between equipment
- 17) Fabrication and installation of connectors and plates for microphones and cameras
- 18) Piping and wiring on grid pipes, and fabrication and installation of wiring ducts on grid pipes
- 19) Wiring for ON AIR lamp (for control circuit use)
- 20) Fabrication and installation of lighting fixtures for broadcasting use in studios
- 21) Fabrication and installation of light control apparatus and main board for lighting for broadcasting in studios

(3) Work to be accomplished by Sri Lanka side

- 1) Power lead-in work and outdoor conduit piping
- 2) Telephone lead-in work and outdoor conduit piping

(4) General

1) Main line installation

Piping and wiring from terminals on the secondary side of the power distribution board (work not included) in the power room to each distribution board for lighting fixtures, distribution board for broadcasting equipment, and power control panel and supply and installation of cable racks for high and low powers shall be carried out by the contractor. For each penetrating portion on walls and floors, opening portion shall be filled with a sound absorbing or heat insulating material after passing wires.

2) Power installation

Fabrication and installation of the power control panel to be installed in the equipment room, piping and wiring from terminals on the secondary side of the panel to the respective loads such as a motor, and piping and wiring between the power control panel and manual control panel shall be accomplished by the contractor. The starting of the motor shall be made either automatically or manually and the operating condition is monitored in the equipment room.

3) Earthing

Earthing for high power, low power, broadcasting equipment, and lightning shall be accomplished.

4) Lighting fixture and plug socket mounting

Fabrication and installation of respective distribution

boards for lighting fixtures, piping and wiring from terminals on the secondary side of the board to lighting and wiring fixtures, and supply and installation of lighting and wiring fixtures shall be carried out by the contractor.

5) Conduit piping for telephone system

Supply and installation of terminal board for low power, piping to respective receptacles, and installation of metal nozzle plates shall be accomplished by the contractor. Telephone exchange and associated equipment, telephone sets, related wiring and terminals shall not be included.

6) Conduit piping for monitor system

Piping to respective receptacles and installation of metal blind plates shall be accomplished.

Supply and installation of equipment and wiring are not included.

7) Conduit piping for interphone system

Piping to respective receptacles and installation of metal nozzle plate shall be accomplished by the contractor.

Supply and installation of equipment and wiring are not included.

8) Conduit piping and wiring for clock system

Piping and wiring to respective receptacles and installation of metal plates furnished with 2P and 3P receptacles. The manufacture and installation of master and slave clocks shall not be included.

9) Fire alarm system installation

Supply and installation of receivers and sensors and related piping and wiring shall be accomplished by the contractor.

10) Conduit piping for broadcasting equipment

Piping for broadcasting equipment of the respective studios, subcontrol rooms, and master control installation of wiring ducts, and fabrication and installation of boxes for cameras and shall be accomplished by the contractor. Broadcasting equipment, connectors, plates, and wiring shall not be included.

11) Alarm system installation

This alarm system, in which a magnet switch is provided on the door or window outside and when the door or window is opened, an alarm signal is issued, shall be provided only at Mt. Pidurutalagala Station. Piping and wiring from the magnet switch to the receiver shall also be included.

(5) Spares

Spares specified in Paragraph 7-18-12 shall be supplied at the time of transfer of the facilities.

(6) Inspection and test

Wiring insulation resistance and earthing resistance measurements, operation test of respective equipment, illumination measurement, and all other measurements and tests shall be accomplished and their records shall be taken prior to the completion test.

7-18-2 Piping and Wiring materials

(1) Conduits

- 1) For metal pipes, thin-wall steel conduits specified in JIS C 8305 shall be used in principle.
- 2) Hard PVC conduits shall meet the requirements of JIS C 8430.
- 3) Flexible conduits shall be such that meet the requirements of JIS C 8309 or equivalent.

(2) Accessories to conduits

- 1) Coupling shall meet the requirements of JIS C 8330 and union couplings and unthreaded couplings shall meet the requirements of JIS C 8357.
- 2) Normal bends shall meet the requirements of JIS C 8331.
- 3) Bushings shall meet the requirements of JIS C and insulation bushings shall meet the requirements of JIS C 8347.
- 4) Lock nuts shall meet the requirements of JIS C 8333.
- 5) Saddles shall meet the requirements of JIS C 8334 and insulation saddles shall be such that shall meet the requirements of the same JIS standard or equivalent.
- 6) Universals shall meet the requirements of JIS C 8335.

(3) Boxes

- 1) Outlet boxes shall meet the requirements of JIS C 8336 and switch boxes the requirements of JIS C 8337. Box covers shall meet the requirement JIS C 8339. For switches and receptacles, applicable BS boxes shall be used.
- 2) Concrete boxes shall meet the requirements of JIS C 8338.
- 3) Round exposed type boxes shall meet the requirements of JIS C 8340.
- 4) Accessories for hard PVC conduits shall meet the requirements of JIS C 8432 through JIS C 8435.
- 5) The specified pull boxes and wiring ducts shall be made of steel sheets of more than 1.6mm thick coated with rustproofing paint over both inside and outside surfaces with the outside surface being coated in the specified colour. In construction, the pull boxes and wiring ducts shall be reinforced with angles, have construction

suitable for wiring and inspection, and provide an inside surface free from burr on connecting portions and containing no projected screws.

For rising ducts, wiring bands shall be provided at specified positions.

- 6) Joint frames shall be made of steel sheets and meet the requirements for boxes which joint frames shall be applied.

(4) Wires and cables

Wires to be used in this work shall meet the requirements of the relevant JIS standards, unless otherwise stated.

600V thermoplastic-covered wires (1V) shall meet the requirements of JIS C 3307 and 600V thermoplastic-covered cables shall meet the requirements of JIS C 3342 (VVF, VVR), 3605 (CV), and 3401 (CVV).

(5) Cords

Cords for apparatus shall meet the requirements JIS C 3306.

7-18-3 Boards/Panels

(1) Distribution boards

- 1) The construction and dimensions of each distribution board shall be as indicated in design drawings.
- 2) Built-in equipment shall be as particularly specified and MCB (Magnetic Circuit Breaker) shall be used in principle for main and branch switches.
- 3) The neutral conductor of one circuit shall be separated from that of another and insulation resistance measurement shall be facilitated. Box earthing terminals shall also be provided.

- 4) Prior to manufacture, the contractor shall submit manufacture drawings, connection diagrams, and detailed drawings to the Engineer for approval.
- 5) Painting colours and finish shall be as directed by the Engineer, unless otherwise specified.

(2) Terminal boards

- 1) The construction and dimensions of each terminal board shall be as indicated in design drawings.
- 2) Box earthing terminals shall be incorporated without fail.
- 3) Prior to manufacture, the contractor shall submit manufacture drawings, connection diagrams, and detailed drawings to the Engineer for approval.
- 5) Painting and finish shall be as those of distribution boards.

(3) Power control panels

- 1) Selfsupporting power control panel shall be an enclosed frame type made of steel plate and shall be, unless otherwise stated, of front door type. The dimensions of a selfsupporting power control panel shall be as indicated in design drawings.
- 2) Meters, operational pushbuttons, selection switches, etc., shall be provided on the front door and magnetic circuit breaker magnetic contactor, and relays shall be incorporated within. Box earthing terminals shall be provided without fail.
- 3) Each power control panel shall have a construction and equipment arrangement to assure ease of inspection and repair of the built-in equipment. Terminals for exterior wiring shall be provided at locations convenient for exterior wiring.

- 4) Common terminal symbols shall be employed, which shall be described on all terminal boards and wire ends.
- 5) For switching boxes, either exposed wall mount type or wall flush mount type shall be employed. On the front door an operation pilot lamp, control pushbuttons, etc., shall be provided. Inside the switching box a hand switch (MCB without trip) shall be provided.
- 6) Painting and finish shall be as those of distribution boards.
- 7) Prior to manufacture, the contractor shall submit manufacture drawings, connection diagrams, and detailed drawings to the Engineer for approval.

(4) Power stabilizer boxes

- 1) The construction and dimensions of each power stabilizer box shall be as indicated in design drawings.
- 2) Inside each power stabilizer box shall have stabilizer fittings and terminals with neat wiring arrangement.
- 3) Prior to manufacture, the contractor shall submit manufacture drawings, connection diagrams, and detailed drawings to the Engineer for approval.
- 4) Painting and finish shall be as those of distribution boards.

7-18-4 Wiring Fixture and Plates

(1) Compact switches

The types and capacities of switches shall be as indicated in design drawings and shall meet the requirements of relevant BS specifications.

(2) Receptacles

The types and capacities of receptacles shall be as indicated in design drawings and shall meet the requirements of relevant BS specifications.

(3) Plates

Unless otherwise stated, plates shall be made of metal and have thicknesses of more than 0.6mm.

7-18-5 Lighting Fixtures

(1) Fluorescent lamps

- 1) The construction and types of fluorescent lamps shall be as indicated in design drawings.
- 2) Fluorescent lamps shall meet the requirements of JIS C 7601, 7602, and 8106.
- 3) Unless otherwise specified, fluorescent lamps shall be of high power factor type. Straight fluorescent lamps of 40W shall be of instantaneously turn-on type. Fluorescent lamps incorporating double lamps shall be of flickerless type. Fluorescent lamps of less than 20W shall be of glow type.
- 4) Appliances using acrylic covers shall be such that will not cause noise due to expansion of the cover by heat.
- 5) All fluorescent lamp appliances shall be earthed.
- 6) Prior to manufacturing, the contractor shall submit manufacturer drawings to the Engineer for approval.

(21) Mercury-arc lamps

- 1) The construction and types of mercury-arc lamps shall be as indicated in design drawings.

- 2) Mercury-arc lamps shall meet the specifications of JIS C 7604 and 8110.
 - 3) Unless otherwise specified, mercury-arc lamps shall be of high power factor, constant power type.
 - 4) Prior to manufacture of mercury-arc lamps, the contractor shall submit manufacture drawings to the Engineer for approval.
 - 5) The construction and dimensions of pole foundation of outdoor lamp shall be as indicated in design drawings.
- (3) Incandescent lamps
- 1) The construction and types of incandescent lamp shall be as indicated in design drawings.
 - 2) Incandescent lamps shall meet the requirements of JIS C 7501.
 - 3) Prior to manufacture of incandescent lamps the contractor shall submit manufacture drawings to the Engineer for approval.

7-18-6 Piping and Duct Work

- (1) Conduit piping
- 1) Unless otherwise specified, conduits shall be thin-wall steel conduit with diameters indicated in design drawings.
 - 2) The curvature of a conduit shall be more than 6 times as large as the conduit diameter and the bending angle shall not be less than 90°. The number of curves between boxes shall not exceed 3.
 - 3) Conduits less than 25mm shall not use normal bend.
 - 4) Ends of conduits shall be finished to be smoothed not to damage the covering of wires.

(2) Pull box and joint box

- 1) When the length of conduit exceed 30m, or when the conduit is required to be bent at more than 3 positions, pull box or joint box shall be used even if not indicated in drawings.
- 2) When the plate of the pull box or joint box is to be mounted on a wall, it shall be finished to keep harmony with the surrounding.

(3) Position box

- 1) Outlet box or switch box shall be provided at locations where lighting fixture, receptacle, switch, etc., are mounted, and at other designated locations.
- 2) Each position box for lighting fixture shall be provided with bolts and others for mounting lighting fixtures.
- 3) In principle, more than 5 conduits shall not be connected to a position box.
- 4) Box to be used for outlet on the floor shall be furnished with a cover mounting a level-height adjustor.

(4) Connection between conduits and connection between conduit and box

- 1) Connection between conduits shall be made completely by means of a threaded or unthreaded coupling not to cause a gap on the joint.
- 2) For connection of a conduit with the box or duct the conduit shall be fitted perpendicularly to the box or duct, fixed securely to the inside and outside surfaces of the box or duct by using lock nuts, and fit bushing in place. Conduit shall not be projected more than necessary into the box.

- 3) Joints between conduits and joints between conduit and box shall have earthing bonding. Conduits to come on both sides of the box shall have a linkage to one another, using a bond wire located outside.
- 4) For bonding, sufficiently polish the portions to be jointed, wind soft copper wire of more than 2mm in diameter on the joint, and then solder or clip by copper sheets of more than 0.5mm thick, or use an equivalent method for complete bonding.
- 5) When the knock-out of the box does not meet the outside diameter of the conduit to be used, insure to use a reducer.

(5) Conduit laying

- 1) When it is necessary to embed a conduit or pass it through a structure, it should be embedded in or passed through such a portion of the structure that gives no hindrance to the strength of the structure.
- 2) When embedding a conduit into reinforced concrete or the like, pass the conduit above or between reinforcing bars, bind the conduit to the reinforcing bars, and fix the box firmly to the concrete form.
- 3) Conduit shall not be laid by breaking a building structure. When it is necessary to lay a conduit in a groove, gain the approval of the Engineer and the depth from the finished surface to the conduit shall be more than 30mm.
- 4) When passing a conduit through a wall covered with a metal net (such as metal lath and wire lath) or along a metal net, the conduit and the box or the like to be mounted on the metal net shall be completely isolated from the metal net.

- 5) Exposed piping and concealed piping shall be laid in good order by using proper hangers or the like. The intervals of hangers or saddles to be provided shall be less than 2m.
- 6) When a conduit is fixed with saddles to concrete surface, curl plugs or anchor bolts shall be employed.

(6) Treatment of pipe ends

- 1) When conduits are to be embedded, pipe ends of conduits shall be covered with a blind cap not to allow water or rubbish to enter.
- 2) Cut of a conduit in box or others shall be furnished with lock nut and bushing without fail.

(7) Painting and others

- 1) Connecting portions of conduits, threaded portions, and exfoliated galvanized portions caused while piping shall be coated with a rustproofing paint such as zinc chromate primer.
- 2) Boxes and others to be used for concrete work shall be cleaned after removing forms.
- 3) Exposed portions of conduits shall be given more than 2 coats of paint of the specified colour.

(8) Duct work

- 1) When hanging ducts from ceiling slabs, the intervals of hangers shall be less than 2.0mm and connection of ducts shall be earth bonded with a copper band. Hanger bolts shall be fixed to the building structure.
- 2) All floor ducts shall be accomplished in the construction work.

(9) Cable rack work

- 1) Hanger bolts for cable racks shall be fixed to the building structure. The intervals of hanger bolts to be provided shall be less than 2.0m. Connection of racks shall be earth bonded with a copper band or the like.
- 2) When necessary, a support or supports anchored in wall shall be employed.

(10) Vibration proofing and soundproofing

- 1) For vibration proofing of conduit piping, conduits in the dubbing studio shall be fixed to the interior framework not to contact the building structure. Supporting hardware to be used for airconditioning ducts and sanitary pipes shall not be used in combined use with electrical conduits. Conduits to vibration proofed pumps and airconditioners shall not directly be fixed to the pumps or airconditioners. When it is necessary owing to circumstances to directly connect a conduit to a pump or airconditioner, use a flexible conduit at a proper portion to prevent transmission of vibration.

- 2) Sound insulation of pipes

When a conduit or duct is laid into a studio or subcontrol room, a sound absorbing or heat insulating material shall be applied over the opening portion of the room after passing wires, so as to prevent leakage of sound. The same treatment shall be applied for auxiliary piping and piping for broadcasting equipment to be provided on partition walls of respective rooms.

- 3) Sound insulation of through holes

When conduit or conduits is to pass through the building structure near a studio or subcontrol room, fill

the through holes sufficiently with mortar and then extend the conduit or conduits to accomplish the piping work. When a conduit or conduits is to pass through the interior sound insulating layer of a studio, bore a hole elaborately and apply caulking material to the surrounding of the hole after wiring completely for sound insulation.

- 4) Sound insulation on surrounding of lighting fixtures and others

When a hole is bored on the studio soundproofing layer, for fitting a lighting fixture or the like, fill the surrounding of the lighting fixture or the like with caulking material after fitting the fixture.

7-18-7 Wiring

(1) Passing wires through conduits

- 1) For passing wires through a conduit, clean the inside of the conduit prior to passing wires so as to not to soil the ceiling or wall.
- 2) For passing a wire or wires through a conduit, use a wire of sufficient length so that the fixture can be pulled while being connected to the wire or wires.
- 3) In the case of an auxiliary piping or only piping without passing wires (when wire passing work is not included), ensure to pass an orderwire (vinyl covered steel wire of 1.2mm) through the pipe. When it is found difficult to pass a wire or wires through a conduit because of poor installation of a conduit line, even after completion of the work, the contractor shall be responsible for making proper correction.
- 4) Connection of wires shall not be made in any conduit.

5) Wires in pull box and ducts specified by the Engineer shall have identification tags having a description of the type of power, destination of the wires, etc.

(2) Wiring in ducts

1) Wiring shall be performed in good order while binding wires properly for respective circuits. Connection of wires shall not be made in ducts.

(3) Wiring on cable racks

1) Wiring shall be performed in good order. Wires shall be bound and fastened to racks. Wirings shall have identification tags with the description of the types of power, destination of the wires, etc.

2) No other wiring than the earthing wire and cables shall be laid on cable racks.

3) Wires shall not be connected on cable racks.

(4) Connection of wires

1) After polishing wires to be connected sufficiently, connect them by solder or by pressure. Connections shall be given more than 4 rolls of adhesive vinyl tape.

2) Connection of wires with terminals shall be made by using pressure connection type terminals or copper tube type terminals.

(5) Colour identification of wires

When using vinyl covered wires, vinyl cover colours shall be such as specified by the Engineer for different phases for wire identification.

(6) Gauge size of branch wires

- 1) Gauge size of branch wires shall be as indicated in drawings.
- 2) Connection of wires and cables shall be made in boxes or panels and cable terminals shall be processed with terminating material.

7-18-8 Installation of Equipment and Fixtures

(1) Installation of equipment

- 1) For installation of equipment, the method of installation, the location of installation, etc., shall be as indicated in drawings. The contractor shall prepare manufacture drawings, assembly drawings, installation layout drawings, mounting drawings, and other detailed work drawings, consult with the Engineer and related construction contractor, and other contractors, and implement equipment installation with the Engineer's approval.
- 2) On installation of equipment, sufficiently check equipment for being level and plumb and connect conduit or duct with the equipment as required.
- 3) Selfsupporting equipment such as power control panel shall be mounted on channel bases to be fixed securely to the floor with anchor bolts.

(2) Fitting of lighting fixture

- 1) Since design drawings indicate rough positional relationship between lighting fixtures, concrete ceiling plans shall be prepared with due consideration for fixtures layout upon actually fitting lighting fixtures and shall obtain the Engineer's approval for the ceiling plans. Inserts and bolts, etc., for mounting shall also be embedded.

- 2) Hanging of lighting fixtures shall in principle be made from the building structure: at 2 points in the case of a fluorescent lamp and at one position in the case of an incandescent lamp.
- 3) In fitting lighting fixtures, due care shall be taken for heat radiation and ventilation so that the temperature inside each lighting fixture shall not rise and that the functions and service life of bulbs shall not degrade.
- 4) When waterproofing or moistureproofing is required, use rubber packing and putty to assure complete waterproofing and moistureproofing.

(3) Fitting of wiring fixtures

- 1) Receptacles, switches, etc., shall be positioned as followed, unless specifically noted.

<u>Item</u>	<u>Distance to center of fixture</u>
Switch	1300mm from floor surface
Receptacle	300mm from floor surface
Outlet for lowpower	300mm from floor surface

- 2) Height of box for slave clock shall be as indicated in drawings.
- 3) When connecting wires to wiring fixtures, sufficiently tighten screws or the like not to cause poor contact.

7-18-9 Earthing

(1) Earthing

Earthing shall be made as indicated in design drawings. When the specified earthing resistance is not obtained, take proper measures under instructions from the Engineer

until the specified earthing resistance is obtained.

(2) Method

- 1) Driving earthing rods into the ground and laying earthing copper plates shall all be made in the presence of the Engineer. When, by measuring earthing resistance, the specified earthing resistance is to be achievable, back fill as required.
- 2) When earthing work is complete, stick a tag having the description of the measured resistance, date of measurement, type of the rod, etc., to the inside of the earthing relay box.
- 3) Earthing of not only control panels and distribution board but also motors, lighting fixtures, and other electric appliances shall be accomplished securely. Connection of earthing wires shall be made completely both electrically and mechanically.

(3) Earthing resistance

- 1) All earthing resistances except those for broadcasting equipment shall be less than 10 ohms.
- 2) Earthing resistances for broadcasting equipment shall desirably be less than 5 ohms.

7-18-10 Fire Alarm System Installation

The construction and circuit design of the fire alarm system to be employed shall be as indicated in design drawings.

7-18-11 Outdoor Installation

(1) General

Design drawings indicate outlines of the work to be

carried out. Care shall be exercised not to hinder the existing installations buried by examining the conditions of the circumstances and the presence/absence of installations buried upon commencing the work in the field.

(2) Underground piping

- 1) In principle, hard PVC conduits or thick-wall steel conduits coated with polyethylene lining on both inside and outside surfaces shall be used.
- 2) The depth of underground piping shall be more than 1200mm under the ground surface under roads and others involving traffic of automobiles, etc., and more than 600mm under other places. Mark blocks made of concrete shall be provided at locations under which conduits are buried. Above bending portions of conduits buried, mark blocks shall be provided, and above the straight portion mark blocks shall also be provided at intervals of less than 10m. At the top of each mark block an arrow indicated the direction of the conduits buried shall be provided.
- 3) The construction and dimensions of hand holes shall be as indicated in design drawings. A cast iron water-proofed hand hole cover shall be provided on the upper part.
- 4) For back fill river sand or mountain sand shall be used in principle.

(3) Cable laying and splicing

- 1) Cable splicing shall be made in the presence of the Engineer.
- 2) For connecting cores of cables, use pressure connection or solder connection.
Insulators and armors shall be sharpened like pencils

and insulation shall be effected by insulation tape. Due care shall be taken not to allow moisture enter inside.

- 3) Cable splicing shall in principle not be made in hand holes.
- 4) Cable ends shall use termination material. Care shall be exercised not to allow water enter into the cable during the work as well as after completion of the work.

7-18-12 Spares

Spares to be provided at the Colombo Studio Center and transmitting stations shall be as given hereunder.

(1) Spares to be provided at Studio Center

Item	Type	Unit	Quantity
Fluorescent lighting lamp	FL 40W	No.	100
	FL 20W	No.	20
	FL 10W	No.	10
Incandescent lighting lamp	60W	No.	20
	10W DC-24V	No.	10
Mercury lighting lamp	HF 400W	No.	5
Ballast for fluorescent lighting	FL 40W x 2	No.	40
	FL 40W x 1	No.	10
	FL 20W x 1	No.	10
	FL 10W x 1	No.	2
Ballast for mercury lighting	HF 400W x 1	No.	3
Glow-starter for lighting fixture		No.	50

(Continued)

Item	Type	Unit	Quantity
Socket for fluorescent lighting fixture	T18	No.	80
Socket for incandescent lighting fixture	E26	No.	10
Socket for mercury lighting fixture	E39	No.	5
Socket for incandescent lighting	DC-24V	No.	5
Diffuser of fluorescent lighting fixture	I	No.	2
	J ₃	No.	5
Plug socket	2P, 5A with earth	No.	20
Switch	1P, 15A	No.	20
	3-way	No.	5
	4-way	No.	5
	Time switch	No.	1
	Phototube	No.	1
M B	3P 225/102	No.	1
	3P 50/32	No.	1
	3P 50/12	No.	1
	3P 50/5	No.	2
Relay		No.	10
Transformer	400/200V, 50VA	No.	4
Ampere-meter	200/5	No.	1
	30/5	No.	1
	10/5	No.	3

(Continued)

Item	Type	Unit	Quantity
Magnet switch	55kW	No.	1
	15kW	No.	1
	5.5kW	No.	3
Pushbutton for power board		No.	5
Pilot lamp for power board		No.	50
Pilot lamp		No.	50
Changeover switch		No.	2
Fuse for control circuit		No.	50
M C B	3P 225/175	No.	1
	4P 100/75	No.	1
	4P 50/30	No.	1
	2P 100/75	No.	1
	2P 50/30	No.	10
Fire alarm bell		No.	1
Fire alarm lamp		No.	50
Fire alarm pushbutton		No.	1
Fire alarm detector	Constant temperature type	No.	10
Low tension outlet		No.	2

(2) Spares to be provided at respective transmitting stations

Item	Type	Unit	Quantity			
			Piduru-talagala	Kokavil	Kandy	Madukanda
Fluorescent lighting lamp	FL 40W	No.	10	10	2	2
Incandescent lighting lamp	60W	No.	1	1	1	1
	10W DC-24V	No.	2	2	0	0
Mercury lighting lamp	400W	No.	1	2	0	0
	200W	No.	0	0	1	1
Ballast for fluorescent lighting	FL 40W x 2	No.	2	2	0	0
	FL 40W x 1	No.	2	2	1	1
Ballast for mercury lighting	HF 400W x 1	No.	1	1	0	0
	HF 200W x 1	No.	0	0	1	1
Socket for fluorescent	T18	No.	10	10	2	2
Socket for incandescent lighting fixture	E26	No.	1	1	1	1
Socket for mercury lighting fixture	E39	No.	1	1	1	1
Socket for incandescent lighting fixture	DC-24V	No.	1	1	0	0
Plug socket	2P, 5A with earth	No.	1	2	1	1
Switch	1P, 15W	No.	2	3	1	1
	3-way	No.	0	1	1	1
	Phototube	No.	1	1	1	1
M C B	4P 50/30	No.	1	1	0	0
	4P 50/20	No.	0	1	1	1
	3P 50/20	No.	1	1	0	0
	2P 50/20	No.	2	2	1	1

(Continued)

Item	Type	Unit	Qunatity			
			Piduru- talagala	Kokavil	Kandy	Madukanda
Magnet switch	3.7kW	No.	1	1	1	1
Pushbutton for power board		No.	2	2	2	2
Pilot lamp for power board		No.	10	10	10	10
Fire alarm detector	Constant temperature range	No.	2	0	0	0
Magnet switch for alarm		Set	5	0	0	0

7-19 PLUMBING WORK

(1) Extent

The work specified under this paragraph consists of the following items of work necessary to complete the work indicated in drawings and described in specifications.

- 1) Water supply work
- 2) Hot water supply work
- 3) Fire extinguishing work
- 4) Drainage, sewage, and vent piping work
- 5) Plumbing fixtures work
- 6) Gas piping work

(2) Work not included

The following items of related work are not included herein and specified under other paragraphs of this specification.

- 1) Electric work
- 2) Water tank under the floor of equipment room, ladder and manhole cover
- 3) Stainless steel sink
- 4) Manhole cover for inspection of pipes
- 5) Concrete foundation for equipment in building
- 6) Opening of through holes and hole reinforcement
- 7) Roof drainage

(3) Work to be accomplished by Sri Lanka side

1) Water supply

Water supply work to range from the main city water pipe through branches to water meter connecting portions shown in drawings shall be accomplished separately by the Sri Lanka side.

2) Drainage

Sewage and waste water shall be led to trap basins

located at indicated positions and connection to main sewer pipe shall be accomplished separately by the Sri Lanka side. For rainwater drainage, the portion ranging down to the existing rainwater basins shall be included in this work.

3) Gas piping work

The work from the main gas pipe through branches to the gas meter connecting portions indicated in drawings shall be accomplished separately by the Sri Lanka side.

4) Water heaters shall be provided separately by the Sri Lanka side.

(4) Spares

As many such consumable parts necessary for continuous operation over one year as lubricants of pumps, ground packings, coupling rubber, bowl bearings, etc., shall be supplied as spares.

(5) Inspection

During the work and upon completion of the work, water filling test, water reducing test, drainage test, water leakage test, and water discharge test, and boiler and pump operation tests shall be performed in the presence of the Engineer.

7-19-2 Water Supply Work

(1) Pump and associated facilities

1) Lift pump

a) Capacity

Bore x water volume x lift. As per design drawings.

b) Motor

Kilowatts x volts x frequency x number of poles x type.
As per design drawings.

c) Type

As per design drawings.

d) Accessories

Sluice valve	1
Check valve	
Anti-shock type check valve	1
Foot valve (with lever and chain)...	1
Pressure gauge	1
Funnel for priming and cock	1 set
Phase flange	1
Coupling	1 set
Air cock	1 set
Common bed	1
Foundation bolts and wrench	1 set

e) Number of lift pumps to be employed

As per design drawings

f) Construction

A horizontal turbine pump shall be installed directly coupled with a motor on the common bed. A flexible coupling shall be used for the pump casing. The rotary sections shall be completely balanced, not allowing the oil to enter. Less noise and less vibration.

g) Installation

Fix the common bed to a floating base having a proper weight and strength solid and securely, and mount it on a concrete base of 300mm in thickness provided by another work by using the vibration protection method specified in Paragraph 7-19-8. Upon preparing the concrete base, consult with the officer of the construction work on the location of vibration proof rubber anchor bolts and others so as to make complete preparation.

h) Tests

Test data shall be submitted to the Engineer.

(2) Tanks and their accessories

1) Water tank

Underground type made of concrete (to be included in the reinforced concrete work) shall be built. Water tank shall be furnished with piping sleeve, ball-taps and electrodes through consultation with the construction contractor, not to cause any hindrance in the construction work.

2) Elevated water tank

Elevated water tank shall be FRP single-panel tank (2m x 4m x 1m high) to be supplied with accessories of a manhole, a subframe, and tapplings.

3) Rainwater storage tank

FRP Single-panel tank (1m x 1m x 1m high) to be supplied with accessories of manhole, subframe, and tapplings.

(3) Piping materials

1) Materials of pipes and joints

Such a pipe as produced by lining a hard PVC pipe having the quality and thermal expansibility specified in JIS K 6742 (hard PVC covered pipe for waterway use) on the inside surface of a galvanized pipe specified in JIS G 3452 (carbon steel for piping) shall be used for piping. For screw joint, pipe coupling specified in JIS B 2301 (screw-in type melleable cast iron pipe joint) shall be coated with hard PVC resin with a minimum coating thickness of 0.2mm or with epoxy resin with a minimum coating thickness of 0.15mm on both inside and outside surfaces to produce a screw joint with no pinhole. Pipe coupling to be used for water supply piping for drinking water shall use sanitarilly harmless coating material without affecting the water

quality. Flanged joint shall be such that is produced by welding a flange specified in JIS B 2211 or JIS B 2212 to an edge of a steel joint and lining a hard PVC pipe having specifications equivalent to those of the lining steel pipe over the inside surface of the flanged joint.

2) Valves

a) Sluice valve

For sluice valves with diameters of less than 50mm, brass screw-in type sluice valves specified in JIS B 2023 shall be used. For those with diameters exceeding 65mm, valve body cast iron, main portion bronze flange type sluice valve with a pressure resistance of 5kg/cm^2 specified in JIS B 2044 shall be used.

b) Check valve

Anti-shock type check valve shall be used at the outlet of a pump. For check valves with diameters of less than 50mm, brass screw-in swing type check valves specified in JIS B 2025 shall be used.

For check valves of more than 65mm in diameter, valve body cast iron, main portion bronze, flange type check valve with a pressure resistance of 10kg/cm^2 shall be used.

c) Ball tap

The main body of the ball tap shall be made of bronze and the ball of copper plate, which shall be brazed together. For ball taps with diameters exceeding 40mm, double valve seat flange type ball tap shall be used. For ball taps with diameters of less than 32mm, screw in type ball tap shall be used.

(4) Piping

1) Depth of pipe to be buried

The depth of pipe to be buried under the ground shall be more than 450mm in general outdoor areas and more than 750mm under roads with traffic of vehicles. Under roads with traffic of heavy vehicles, the depth shall be more than 1000mm.

2) Cutting of pipe

For cutting a pipe to the required dimension, use a cutter furnished with a saw or cutting tool and such a tool that compresses the pipe diameter shall not be used. After cutting the pipe perpendicularly to the center line of the pipe, remove warps and fine splits on the cut elaborately by a reamer or file. After completion of piping in the required section, apply a cap (plug) to the opening of the pipe to prevent duct and foreign matter from entering during the work. Prior to connecting pipes, inspect the inside of each pipe and if necessary, clean.

3) Jointing of pipes

In general, pipes with nominal diameters of less than 100mm shall be jointed by screw joint and those with diameters of more than 125mm shall be jointed by flange joint. In the case of screw joint, tapered male screws for pipes specified in JIS B 0203 (tapered screw for pipe) shall be used and, when necessary, screw jointing material may be used. Epoxy resin or synthetic rubber rustproofing agent shall be applied sufficiently to the tip of the screw and into the depth of the threaded portion. The rustproofing material to be used for piping for drinking water shall be harmful to man and shall not affect the water quality. In the case of flange joint, bolts shall be tightened uniformly through packings of a proper thickness. When connecting flanges in the field, welding shall be employed for jointing the lining coat. Plastering which causes

steps inside and the method in which a PVC board is applied to the flange face and the portion in contact perpendicularly with the lining coat of pipe is welded shall not be employed. When it is necessary to dismount the joint at times, use in principle flange joint and not union joint. High-quality rubber packing shall be used for flange and union joints.

4) Installation location of sluice valve

Valves shall be set at locations to facilitate operation on the basis of drawings. Sluice valves shall be provided at the locations of taking out branch pipes to the respective floors, at toilets, and at other branching points.

5) Piping embedded in concrete

Those portions of pipes to be embedded in concrete shall be completed before placing concrete and shall undergo water pressure test. Piping by chipping the portion where the pipe is to be embedded after placing concrete shall not be allowed. Pipes shall not be embedded into structural portions such as floor, ceiling, and walls of studios and subcontrol rooms. Pipes of outside diameters exceeding $1/3$ of the thickness of the floor slab shall not be embedded into the floor slab.

6) Inclination of piping

In the case of horizontal pipes, give an upward gradient to up-feed water supply piping and a downward gradient to down-feed supply system with the gradient being in principle $1/250$ in both cases. Where dead air space is produced in the pipe, provide an air vent. Where sediment accumulates, provide a mud discharge plug.

7) Supporting of piping

The supporting intervals of horizontal pipes shall in principle be as given in Table 7-19-1. Bent and branched portions shall be supported as required. Pipe supports shall be made of round steel or/and angle steel.

Table 7-19-1

Type of Piping	Pipe Diameter	Interval of Supporting Fixture
Horizontal pipe	Under 50mm	Within 1,800mm
	65~200mm	Within 3,600mm
	Over 250mm	Within 5,400mm
Rising pipe	More than one spot on each floor	

In concrete ceilings inserts shall be embedded in advance and when a number of pipes are passed in parallel, one piece of angle steel may be used to support them. When pipes are passed through a wall or floor, pipes shall be supported just before or after the wall or floor and shall not be supported by the wall structure or floor slabs.

8) Water supply and water lift pipes in those portions particularly specified shall be supported by vibration proof supports, as indicated in drawings. For vibration proofing, the requirements specified in Paragraph 7-19-8 "Vibration Proofing" shall be applied.

9) Sleeve

Proper sleeve (ribbed steel pipe) shall be provided on the side walls and floors of a concrete water tank or portions required to be particularly watertight.

Space between the sleeve and pipe shall be filled with yarn and lead to achieve sufficient watertightness. For all other types of piping through walls and floors, sleeves shall be provided in advance in the wall or floor through which pipes are to pass and removed after placing concrete. Cover the pipe with fiberglass lagging pipe (JIS A 9505, No.2). After winding up a steel plate with a rib on the outside of the fiberglass lagging pipe, apply mortar sufficiently from both sides to secure solid. In the case of embedded piping, asphalt jute shall be wound instead of the above-mentioned steel plate with rib. For sleeve insertion, marking shall be made prior to arranging reinforcing bars and necessary procedure shall be taken through the officer of the construction work so that reinforcement, cutting, etc., shall be made by the reinforcing bar contractor. Reinforcing bars and steel frames shall not be processed or changed without permission.

10) Sealing plate, decorated cover and band

Piping shall in principle be concealed piping. When pipes are exposed indoors, chrome plated brass sealing plates shall be used on the through holes of ceilings, floors, and walls.

For the ends of anti-sweat covering of pipings, chrome plated brass decorated covers shall be used. A chrome plated brass band of 2cm wide shall be wound, neat and tidy, at intervals of 2m in the straightforward portions and at every branched and bent portion.

11) Testing

Each piping shall be subjected to water pressure test for one hour at the test pressure given hereunder in the presence of the Engineer at a proper time during piping, before concealing or back filling and after completion of all piping but before application

of anti-sweat covering. In case water leakage is found, promptly replace the defective material. Repair by caulking shall not be made in any case.

- a) For water pumping pipe, the pressure shall be twice as large as the pressure corresponding to the total lift of the applicable lift pump.
- b) For pipes below elevated water tank and water service pipe the pressure shall be 10kg/cm².

12) Flexible joints

All flexible joints except those indicated in drawings shall be of bellows type in which bellows and its protective steel band shall be made of stainless steel (SUS 304) and provide sufficient flexibility and pressure resistance.

13) Vibration proofed joints

All vibration proofed joints shall be of bellows type made of either resin or stainless steel (SUS 304) which shall consist of a bellows portion and a spherical or cylindrical reinforced synthetic rubber portion and provide sufficient flexibility, heat resistance, and pressure resistance. Vibration proofed joint shall be used at those locations indicated in drawings.

(5) Anti-sweat and anti-corrosion work

1) Materials

Main materials and others shall be as follows.

- a) Rock wool lagging pipe and fiberglass lagging pipe
JIS A 9504, No.2
JIS A 9505, No.2
- b) Cotton
Cotton to be used shall weigh more than 115g/m².

c) Asphalt jute cloth

Jute cloth obtained by applying blown asphalt (penetration: 10 to 20) specified in JIS K 2207 (petroleum asphalt) on one side of hessian cloth No.7 (270g/m²) specified in JIS L 3405 (hessian cloth).

d) Galvanized steel sheets

Type 2 specified in JIS G 3302 shall be used.
Thickness: 0.397mm (No.28).

e) Galvanized steel wires

BWG No.20

f) Thick paper shall weigh more than 370g/m².

2) Thicknesses of anti-sweat material

The thicknesses of anti-sweat coating shall be as given in Table 7-19-2.

Table 7-19-2 Thicknesses of Anti-Sweat Covering

Pipe Diameter	Thickness of Anti-Sweat Covering
20 ~ 80m	20mm
Over 100m	25mm

3) Procedures for application of anti-sweat covering

The procedures for the application of anti-sweat covering shall be as given in Table 7-19-3 for the respective types of piping.

Table 7-19-3 Procedures for Application of
Anti-Sweat Covering

Type of Piping	Procedure for Applying Anti-sweat Covering
Exposed pipe outdoors	<ol style="list-style-type: none"> 1. Fiberglass lagging pipe 2. Steel wire 3. Asphalt roofing 4. Galvanized steel sheet #28
Exposed pipe indoors	<ol style="list-style-type: none"> 1. Fiberglass lagging pipe 2. Steel wire 3. Asphalt roofing 4. Thick paper 5. Cotton cloth
Concealed pipe indoors	Same as the above
Pipe embedded in concrete, Pipe buried underground	Asphalt jute
Pipe at place where humidity is high, such as, under floor, under drain, etc.	<ol style="list-style-type: none"> 1. Fiberglass lagging pipe 2. Steel wire 3. Asphalt roofing 4. Waterproof cotton cloth

4) Application of anti-sweat material

The thickness of lagging shall not include the thickness of armoring material but shall be the thickness of the lagging proper. Joints of lagging shall be connected close to each other. Steel sheets to the wound shall have seem and lock groove joints with curving portions being bent like a prawn.

be used for joints, and bents shall be rounded. Lagging shall be bound by galvanized steel wire of BGW No.20 or more. For piping passed through floors, the pipe portion of 150mm from the floor surface shall be covered with a galvanized steel sheet or stainless steel sheet. Cotton cloth shall be wound spirally with its end overlapped by more than 15mm.

(6) Painting

Painting shall be made as per Table 7-19-4.

Table 7-19-4

Part to Be Painted	Surface and State	Type of Paint and No. of Coat			
		Under Coat	No.	Middle & Top Coat	No.
Surface of insulation covering	Cotton cloth (exposed portion)	Filler	1	Ready mixed paint	2
	Cotton cloth (concealed portion)	Filler	1	Ready mixed paint	1
	Galvanized steel sheet (exposed portion)	Rust preventive paint	1	Ready mixed paint	2
Conduit tube	Exposed portion	Ready mixed paint	1	Ready mixed paint	1
Naked pipe and support metal part	Ferrous metal surface (exposed portion)	Rust preventive paint (for general use)	2	Ready mixed paint or aluminum paint	2
	Ferrous metal surface (concealed portion)	Rust preventive paint (for general use)	2		
	Zinc-coated surface (exposed portion)	Zinc dust paint	1	Ready mixed paint or aluminum paint	2

(7) Identification mark on piping

Every pipe shall have an identification mark to be given by the method directed by the Engineer.

(8) Others

- 1) In addition, about 2 coats of specified colour shall be applied to pumps, valves, handles, etc.
- 2) Anti-sweat covering need not be employed on underground pipes, pipes embedded in concrete (although asphalt jute tape shall be applied for rustproof purpose), flanges, expansion joints and flexible joints.

7-19-3 Hot Water Supply Work

(1) Major equipment

- 1) Hot water storage type steel plate gas boiler
 - a) Capacity:
As per design drawings.
 - b) Amount of hot water stored:
As per design drawings.
 - c) Accessories
Safety valve, hot water inlet and outlet valves, blow-off cock, pressure gauge, high temperature alarm set, check window, control panel, anchor bolts, and maintenance tools.
- 2) Hot water circulation pump

In compliance to the requirements specified in the paragraph on water supply work.

(2) Piping materials

- 1) Pipes and joints

For hot water supply pipe, phosphorus-deoxidized copper seamless pipe Type M (hard) specified in JBMA0002) shall be used. For copper pipe joints, copper and copper alloy pipe joints for piping specified in JCDA0001 shall be used.

2) Hangers and supports

Supports shall have sufficient ruggedness in construction and shall use shape steel specified in JIS G 3192 and round steel specified in JIS G 3191.

3) Intervals of supports to be provided

Supporting fixtures shall be used at intervals given in Table 7-19-5

Table 7-19-5 Intervals of Supporting Fixtures

Type of Piping	Pipe Diameter	Interval of Supporting Fixture
Horizontal pipe	less than 20mm	within 1,000mm
	25 ~ 40mm	within 1,500mm
	50mm	within 2,000mm
	65 ~ 100mm	within 2,500mm
	more than 125mm	within 3,000mm
Rising pipe		within 1,200mm

(3) Piping and supporting

1) Common items

All piping and supporting work shall be made in consideration of expansion/contraction due to temperature variation of the pipe, not to hinder circulation by dead air space or the like.

2) Jointing of copper pipe and valve

Copper pipes shall be jointed by, in principle, brazing using a proper hard solder among copper phosphorus brazing filler metals specified in JIS Z 3264, silver brazing filler metal specified in JIS Z 3261, or brass brazing filler metal specified in JIS Z 3262, whichever most suitable.

(4) Valves

1) Sluice valve

Sluice valves shall meet the relevant JIS standards indicated in Paragraph 7-19-2 "Water Supply Work." Solder end type joints shall be employed for diameters of less than 50mm.

2) Check valve

Anti-water hammering type check valve shall be employed. Check valve shall meet the requirements specified in Paragraph 7-19-2 "Water Supply Work."

3) Flexible joints

Shall meet the requirements specified in Paragraph 7-19-2 "Water Supply Work."

4) Expansion joints

Bellows type expansion joint specified in JIS B 2352 shall be used. This joint body shall be made of cast iron and its main portion of stainless steel or bronze.

For the material of the bellows, bronze plate (Type 1) specified in JIS G 4305, SUS 304 or JIS H 3731 shall be used. This joint shall not cause leakage upon expansion/contraction, provide secure operating capability, and when used in double provide a fixed mount with a sufficient ruggedness. Connection with pipes shall be made by flange type, and joint shall be used at locations indicated in drawings.

5) Vibration proofed joint

As stated in paragraph 7-19-2 "Water Supply Work."

(5) Installation of hot water supply facilities

1) Boiler

The contractor shall in advance submit the installation specification of the manufacturer, assembly and installation drawing, and layout drawings to the Engineer, prior to assembly and installation.

Installation shall be accomplished in conformity with JIS B 8201-18 (installation of steel plate boiler).

2) Pump

Shall meet the requirements specified in Paragraph 7-19-2 "Water Supply Work."

(6) Heat insulation

1) Material

Shall meet the requirements specified in Paragraph 7-19-2 "Water Supply Work."

2) Thickness of lagging

The thickness of lagging to be employed given in Table 7-19-6.

Table 7-19-6 Thickness of Lagging

Pipe Diameter	Thickness
less than 40mm	40mm
more than 50mm	50mm

3) Procedure for application of lagging
Shall meet the requirements specified in Paragraph
7-19-2 "Water Supply Work."

4) Lagging work
Shall meet the requirements specified in Paragraph
7-19-2 "Water Supply Work."

(7) Painting
Shall meet the requirements specified in Paragraph 7-19-2
"Water Supply Work."

(8) On-site test and inspection
Shall meet the requirements specified in Paragraph 7-19-2
"Water Supply Work."

(9) Others
For spares for use with the boiler, various packings,
fuses meeting the specifications of those used on the
boiler control panel, electric bulbs, etc., shall be
supplied.

2-19-4 Fire Extinguishing Work

(1) Major equipment

1) Fire pump

a) Capacity

Bore x water volume x lift (as per design drawings)

b) Motor

Kilowatts x volts x frequency x number of poles x type
(as per design drawings)

c) Accessories

As per Paragraph 7-19-2 "Water Supply Work."

- d) Number of pumps to be used
As indicated in design drawings.
- e) Construction
As per Paragraph 7-19-2 "Water Supply Work."
- f) Installation
As per Paragraph 7-19-2 "Water Supply Work."
- g) Testing
As per Paragraph 7-19-2 "Water Supply Work."

2) Priming tank for fire pump

- a) Dimensions
500mm x 500mm x 500mm high
- b) Effective water volume
100 litres
- c) Plate thicknesses
The thicknesses of side and bottom plates shall all be 3.2t.
- d) Accessory
Bracket

(2) Fire hydrant

- 1) Indoor fire hydrant and box
 - a) For valves, chrome plated bronze stop valves shall be used. For hose connection sections, bell and spigot joint shall be used.
 - b) For hemp hoses, 2 first-class hoses with a diameter of 40mm and a length of 15m shall be used. Bell and spigot joint made of chrome plated bronze shall be used.
 - c) nozzle shall be made of chrome plated bronze and have a tip of 13mm. Bell and spigot joint shall be employed for jointing hoses.
 - d) Hose hook shall be of chrome plated bronze comb-shaped capable of mounting 2 hoses of 15m.

e) Fire hydrant box

Fire hydrant box shall be made of bonderized steel plate of more than 1.2mm thick with its frame being made of steel plate of 1.6mm thick. The contractor shall in advance submit manufacture drawings to the Engineer for approval.

The dimensions of the box and items to be incorporated shall be as shown in drawings.

(3) Piping materials

1) Pipe and joint

a) Steel pipe

Galvanized steel pipe specified in JIS G 3452 (steel pipe for piping) shall be used.

b) Joint

Joint shall be galvanized one specified in JIS B 2301 and 2302. Pipe flange shall be as specified in JIS B 2212.

(4) Piping

- 1) Unless otherwise specified, those requirements set out in Paragraph 7-19-2 "Water Supply Work" shall apply.
- 2) Water pressure test and water discharge test of fire hydrant shall be performed.

(5) Anti-sweat and anti-corrosion work

As specified in Paragraph 7-19-2 "Water Supply work." For the anti-corrosion of the inside of the priming tank for fire hydrant use, more than 3 coats of epoxy resin coating (more than 0.4mm thick) shall be applied. The epoxy resin coating material to be used shall be such that can be obtained by adding hardner and filler to such liquid epoxy resin that is obtained as a condensation

product of epichlorohydrine and bisphenol A, that has more than 2 epoxy radicals, and that provides epoxy equivalent of 175 to 290. The hardner and filler shall not affect the water quality. In this work, pre-treatment shall be made first, then coating and heating for complete hardening.

(6) Painting

- 1) For painting on pipes and others, the requirements specified in Paragraph 7-19-2 "Water Supply Work" shall apply.
- 2) Fire hydrant box shall in principle be given 2 coats of rust proofing paint and finished by melamine baked finish in specified colours.

7-19-5 Drainage, Sewage and Vent Piping Work

(1) Piping materials

1) pipes

- a) For staight pipes for sewage and drainage, rubber joint type drainage cast steel pipe (mechanical joint) specified in HASS 210 shall be used.
- b) For waste water pipe, carbon steel pipe for piping (galvanized steel pipe) specified in JIS G 3452 shall be used.
- c) For vent pipe, identical types of pipes for waste water pipe shall be used.
- d) For lead pipe, lead pipe for waste water, vent, and cleaning pipes specified in HASS 203 shall be used.
- e) For outdoor waste water pipe, centrifugal reinforced concrete pipe (Hume pipe) shall be used.
- f) Hard PVC pipe shall meet the requirements of JIS K 6741.

2) Joints and special pipes

- a) For special cast steel pipe, special mechanical joint cast steel pipe shall be used.
- b) For pipes for waste water, galvanized drainage joint shall be used.
- c) For vent pipe, screw-in type drainage fittings specified in JIS B 2301 shall be used.
- d) For PVC pipes with PVC fittings, fittings produced by the manufacturer of PVC pipes and adhesives specified by the manufacturer shall be used.

3) Valves

As specified in Paragraph 7-19-2 "Water Supply Work."

4) Drainage fittings

a) Floor drainage fittings

Cast steel floor drainage fittings shall be used and strainer shall be of chrome plated brass.

b) Floor drainage trap

Floor drainage dtap shall be made of cast steel with strainer of brass. Minimum water seal depth shall be 50mm.

c) Clean-out fittings

Cast steel clean-out shall be flanged bolt tightening type or of bronze screw-in type. Clean-out steel and lead pipes shall be of bronze screw-in type. Exposed portions shall be chrome plated. For floor with waterproofing layer, use waterproof type clean-out.

(2) Piping

- 1) Pipes and joints shall be used as follows.

<u>Use</u>	<u>Indoors/Outdoors</u>	<u>Type of Pipe</u>
Near fixture	Lead pipe	(Use of this pipe shall be limited to minimum)
Waste water	Indoors	Galvanized steel pipe and drainage fittings
	Outdoors	Hume pipe
Sewage	Indoors	Drainage cast steel pipe
	Outdoors	Hume pipe
Vent pipe	Galvanized steel pipe (galvanized steel pipe joint)	

2) Gradient of piping

For indoor horizontal pipes for sewage and waste water, the gradient shall in principle be minimum 1/50 for diameters of less than 80mm and minimum 1/100 for diameters of more than 100mm.

For outdoor horizontal main pipes in the site, the gradient shall in principle be in a 1/100 to 1/200 range on the assumption that flow speed shall not exceed 0.6m/s.

3) Pipe support metals

As specified in Paragraph 7-19-2 "Water Supply Work."

4) Intervals of pipe supports

a) Intervals of steel pipe supports shall be as specified in Paragraph 7-19-2 "Water Supply Work." Horizontal pipes using cast iron flexible joints shall be supported at one position per joint in addition to the above-mentioned supporting.

b) Horizontal running pipes of cast iron for drainage shall be supported at one position for every interval of 1.6m or less and, when connected with specials,

at one position for every interval of 0.6m or less.
Vertical pipes shall be supported at one point on each floor.

- c) Horizontal pipes of lead for drainage shall, when the pipe length exceeds 1.0m, be mounted on semi-circle gutters of galvanized steel sheets (more than 0.6mm in standard thickness of original sheets) and supported at intervals of less than 1.5m.
- d) Horizontal PVC pipes shall in principle be supported as specified in Table 7-19-7.

Table 7-19-7 Intervals of Support Metals

Pipe Diameter	Interval of Support Metals
32 ~ 40mm	within 1m
50 ~ 100mm	within 2m
more than 125mm	within 2.5m

- e) Cast iron inserts or anchor bolts shall be fitted for the hangers of horizontal main pipes prior to placing concrete.
 - f) Where the falling pipe for drainage is connected to a horizontal pipe above the ground, provide a brick or concrete foundation and surround the bending portion with concrete. Other positions shall be supported securely by hangers.
- 5) Where pipes for drainage are to be supported by such building structures as walls, ceilings, and floors of studios, subcontrol rooms, and master control rooms, vibration proofed supporting shall be effected as

specified in Paragraph 7-19-8 "Vibration Proofing and Sound Proofing."

6) Jointing of cast steel pipes

In the case of mechanical joint. push the pipe to be jointed until its spigot end contacts the bottom of the hub of the other pipe, insert the rubber ring having been put in near the spigot end so that no twist shall be caused in gaps between the hub and spigot end, then push the rubber ring with a push ring, and fasten the rubber ring uniformly with bolts and nuts so as to cause the rubber ring to attach the pipe closely.

7) Protection of lead pipes

Lead pipes to be embedded or concealed shall be covered with asphalt jute and after burying under the ground, apply fill of soil or sand.

8) Solder to be used for connecting lead pipes shall be a pure alloy of lead and tin with the following standard composition.

Lead: 60%

Tin: 40% (by weight)

9) In piping outdoor pipes for drainage, due consideration shall be given to the condition of the site (such as standing trees) and the gradient of land.

10) Prior to laying outdoor pipes for drainage, prepare and submit to the Engineer a section by surveying at the site for approval.

11) For laying outdoor pipes for drainage, excavate the land, lay rubble when necessary and compact sufficiently, fix joints on concrete bases, perform water passing test in the presence of the Engineer, and tapm and back fill not to produce gaps under the pipe.

12) Pits shall be made of concrete by a mix proportion of 1:2:4. Pits of more than 1m deep shall be constructed by using reinforcing bars. The inside of each pit shall be finished with waterproofing mortar at a thickness of 25mm by using a trowel. Catch pits shall have gravel basin of 150mm high from the bottom of the pipe and shall be fitted with cast iron manhole covers (with theft-proof iron chains).

Table 7-19-8

(Unit: mm)

Pipe Bottom Depth	Width Length	Wall Thickness	Rubble thickness	Bottom Thickness	Manhole Diameter	Manhole Lid Size
Under 450	300 x 300	100	100	120	300	300
460 ~ 600	360 x 360	100	100	120	300	300
610 ~ 750	450 x 450	100	100	120	450	450
760 ~ 900	500 x 500	120	150	150	450	450
910 ~ 1300	600 x 600	120	150	150	600	600
Over 1310	750 x 750	150	150	200	600	600

All swage pits shall be furnished with inverts. A stench proof lid (with theft-proof iron chains) shall be put on each swage pit. The constructions of swage pits shall be similar to those of catch pits with their dimensions as given in Table 7-19-9.

Table 7-19-9

Pipe diameter	Under 150	450 x 450
	Over 180	600 x 600
Depth	Over 1,000	600 x 600

Each cast iron manhole cover shall be cor-tar baked over its entire surface. Manhole covers to be laid on roadways with traffic of automobiles and others shall be of load resistance type.

- 13) A concrete pit shall be provided at places where outdoor pipes for drainage meet with each other, where the length of the straight pipe is large, and where the pipe bend.
- 14) Processing of hard PVC pipes
 - a) Cut of a straight pipe shall be perpendicular to the access of the pipe. Inclined cut will cause concave portions on joints and thus shall be avoided.
 - b) Bend pipes with large radii may be bent directly in straight pipe portions without using elbows.
- 15) For pipes to pass through walls or embedded, the requirements specified in Paragraph 7-19-2 "Water Supply Work" shall apply.
- 16) Unless otherwise stated, louver of copper plate or ventilation strainer of chrome plated bronze shall be provided on the openings of bent pipes to the atmosphere.
- 17) Raise the pipe for drainage to the uppermost floor and connect it with the vertical bent pipe for discharge to the atmosphere. The vertical vent pipe shall be connected with the vertical drainage pipe on the lowermost floor.
- 18) A clean-out shall be provided at the ends of drainage pipes and at locations specified in drawings or by the Engineer.
- 19) When raising a vent pipe from a horizontal pipe for drainage, joint the vent pipe so that the angle to be formed by the horizontal pipe for drainage and the

vent pipe shall become more than 45° and that the vent pipe shall come to have an angle of either 45° or 90° to the upstream relative to the gradient of the horizontal pipe.

- 20) Lead pipes shall when necessary be bent to form round bends. Branch pipes shall when necessary be connected to straight pipe portions. Do not insert branch pipes to exceed the inside of the main lead pipe.
- 21) When making a trap with lead pipe, ensure to make the water seal depth more than 50mm.
- 22) Unless otherwise stated, the depth of outdoor underground pipes shall be 600mm in general and more than 1000mm under roadways.

(3) Anti-sweat work

Shall meet the requirements specified in Paragraph 7-19-2 "Water Supply Work" except that anti-sweat work will not be effected to vent pipes but over 100mm portions around branches from drainage pipes and anti-sweat work shall not be made on hume pipes.

(4) Painting

Shall meet the requirements specified in Paragraph 7-19-2 "Water Supply Work."

(5) Tests

- 1) Water pressure test of indoor pipes for drainage

Tightly close all connections with fixtures except the highest opening of the pipe portion to be tested pour water to fill the pipe, and perform water leakage inspection at a water pressure of 0.3kg/cm².

- 2) Air pressure test of indoor pipes for drainage

Connect an air compressor or tester to an opening of the drainage pipe, tightly close other openings of the pipe, send air by pressure through the opening into the system of the pipe, and inspect the pipe for leakage by measuring the air pressure and comparing it with the reference value of 0.35kg/cm^2 or 250mmHg.

3) Smoke test of indoor vent pipes

After water sealing of all pipes and traps to be tested, send a stimulative concentrated smoke produced by one or several smoke candles into the piping system and, in 15 minutes, inspect the pipes, traps, and connections with fixtures for leakage while maintaining a test water height of 25mAq.

4) Test of drainage pipes in site

By tightly closing the drainage pipe to the pit immediately before being connected to the public sewer system, fill the drainage pipe with water and, in 30 minutes, inspect the drainage pipe for leakage. Partial water-fill test may be performed depending on the condition of the site.

5) Others

Tests shall be performed in the presence of the Engineer.

7-19-6 Plumbing Fixtures Work

(1) Materials

1) Pipes

- a) Pipes to be attached to sanitary wares shall be chrome plated.
- b) Others shall meet the requirements specified in Paragraph 7-19-2 "Water Supply Work."

2) Valves, faucets, and joints

Shall meet the requirement specified in Paragraph 7-19-2 "Water Supply Work" and 7-19-4 "Drainage, Sewage and Vent Piping Work."

3) Sanitary wares and accessories

- a) Sanitary wares shall meet the requirements specified in JIS A 5207 (sanitary ware).
- b) Details of sanitary ware and accessories shall be indicated in drawings. Exposed portions of accessories shall all be chrome plated.
- c) Wood screws and others to be used on sanitary ware and accessories shall be of brass and their exposed portions shall be chrome plated.
- d) Water closets for urinals shall be of flush valve type.
- e) Water closets for bowls shall be flush valve type.
- f) Traps to be used for wash bowls and wash basins shall be chrome plated.
- g) Paper holder shall be attached to each bowl and shall be hard chrome plated.
- h) Mirror shall have dimensions indicated in drawings. Rear of the mirror shall have undergone anti-acid treatment. The mirror fixed firmly to the wall by means of 4 chrome plated fittings through rubber packings.
- i) Liquid soap pot shall be 0.35ℓ in capacity.

(4) Installation

- 1) For fitting sanitary ware, centering shall be accomplished by using detailed drawings in the presence of the Engineer.

- 2) When fitting sanitary wares to concrete or brick wall, use anchor bolts to be in good appearance.
- 3) When using wood bricks for fitting sanitary wares to a brick wall, apply preservative to the wood bricks and fix them firmly to the wall.
- 4) When a portion of a sanitary ware is to be embedded into concrete, apply an asphalt coating of more than 3mm thick on the contact surface of sanitary ware and concrete or mortar and joint so as to prevent the sanitary ware from being in contact directly with concrete or mortar. Bowls and urinals shall be installed with their bottom contact surfaces being put on sand for protection.
- 5) Mounting of bowls
Every bowl shall be installed securely after accurate centering, with its top of apron being level without leaving any shake.
- 6) Mounting of urinal
Every urinal shall be mounted securely at the required location to the required height.
- 7) Flush pipe and water supply pipe
Galvanized gas pipe shall be used for flush pipe to be embedded and water supply (to the sanitary ware) pipe portion to be embedded in the wall. Exposed water supply pipe and flush pipes of more than 32mm in diameter shall have a minimum thickness of 0.8mm and flush pipes of less than 25mm in diameter shall have a minimum thickness of 0.6mm, all to be made of brass.
- 8) Heights of sanitary wares to be mounted
The standard heights of sanitary wares to be mounted shall be as follows.

- a) Height of urinal:
650mm from floor face to top of apron
- b) Height of flush valve for urinal:
1360mm from floor face to center of flush valve
- c) Height of basin:
780mm from floor face to top of apron
- d) Height of low tank for cleaning:
100mm from top of apron to bottom of tank
- e) Height of slop sink:
705mm from floor face to top of apron

(5) Tests

1) Installation inspection

To inspect to determine sanitary wares are fitted securely as required.

2) Water passing test

After completion of the work, promptly perform water passing test to check wares and accessories for water leakage.

3) Performance test

Flow water volume adjustment shall be made by passing water through the flush valve, cocks, and other valves or cocks.

Temperature adjustment shall be made for mixing valve and mixed water cock.

(6) Curing

After installation, sanitary wares and fittings shall be properly cured for protection from damage and soil before service-in.

7-19-7 Gas Piping Work

(1) Piping materials

1) Pipes

Pipes to be used shall be as given in Table 7-19-10. Steel pipes and screw-in steel pipe joints shall be approved as JIS marked products.

Table 7-19-10

Material	Standards		Remarks
	JIS Number	Name	
Steel pipe	JIS G 3452	Galvanized steel pipe for piping	
Steep pipe joint	JIS B 2301	Malleable cast iron pipe joint, screw-in type	Hot-dipped galvanized

2) Valves, cocks and stopcocks

- a) Iron cocks and meter cocks shall consists of main bodies of cast iron and major parts of bronze or brass. Gun metal valves and cocks shall be made of bronze.
- b) Gas cocks shall be made of nickel-chrome plated bronze or brass, fitted in principle with safety springs.

(2) Gas meter and others

Gas meter and others to be used shall be as given in Table 7-19-11.

Table 7-19-11

Item	Specifications
Gas meter	Dry type gas meter
Draw off apparatus	Cast iron or steel made
Location mark for pipe embedded	Cast iron or concrete made

(3) Others

Miscellaneous materials to be used shall be as given in Table 7-19-12.

Table 7-19-12

Material		Specifications
Joiner	Gasket	1st class listed in JIS R 3453 (Asbestos joint sheet)
	Gasket, liquid type	Synthetic resin or oil type. Product approved by the gas supplier
	Welding rod	Product with JIS mark, conforming to JIS Z 3211 (Coated electrode for mild steel)

(4) Mounting of fixtures

1) Gas cock

Through centering to be made in consideration of the surrounding and ease of the gas cock, fix the gas cock securely and in a good style not to cause a gap or warp between the gas cock and the surface to which the cock is to be fitted. When the gas cock

is to be located near as electric installation, ensure to separate the cock sufficiently from the electric installation.

2) Gas meter

Gas meter shall be installed at such a position that shall facilitate meter reading, conforming to the requirements of the gas supplier.

When gas meter is to be installed near electric installation, ensure to provide necessary separation from the electric insulation.

(5) Jointing of steel pipes

- 1) When necessary, cut a pipe so that the cut surface shall become perpendicular to the axis of the pipe without transformation of the cut surface. The cut shall be finished smooth.
- 2) Prior to jointing pipes, inspect inside of the pipes to determine that no foreign matter is left inside and after cleaning off cut chips and rubbish, joint the pipes.
- 3) When piping is suspended temporary, cure the pipe, while preventing any foreign matter to enter into the pipe.
- 4) For screws to be used for joints, tapered male screws for pipe use specified in JIS B 0203 (tapered screws for pipes) shall be used. When necessary for joints, apply a small amount of sealer on the male screw portion, and joint pipes securely.

(6) Piping

- 1) Prior to piping, examine relationship with other pipes facilities and equipment to be installed in detail, and determine the accurate layout of the piping in consideration of

its gradient. When piping within a building, fit pipe supports and embed pipe sleeve without delay as the work progresses.

- 2) Supply pipe shall go down to the first rising or falling point toward the main pipe. When a reverse gradient is to be employed owing to unavoidable circumstances and it is feared that water may stay, a water catch shall be provided at the lowest portion of the pipe.
- 3) When there is a fear of corrosion on underground pipe or others, apply anti-corrosion tape or the like for protection against corrosion.
- 4) Exposed portions of pipes passing through ceiling, floors, walls, etc., shall use washers.

Table 7-19-13

Anti-corrosive tape	Product conforming to JIS Z 1901 (Anti-corrosive vinyl tape), or approved by the gas supplier.
Pipe washer	Nickel-chromium plating brass or stainless steel made
Pipe sleeve	Made of steel pipe or steel plate with thickness of more than 0.4mm (more than 0.7mm in case of nominal diameter of more than 200mm). In an unavoidable case and if there is no possibility that the building structure and piping work are damaged, use of paper sleeve will be permitted instead of steel one. A sleeve penetrating a waterproof layer shall have a structure harmless to washerproofing.

(Continued)

Support metal parts for pipes	They shall have a structure with sufficient supporting capacity according to a diameter of pipe, and steel materials to be used shall conform to JIS G 3101 (Rolled steel for general structures). Insert metal parts, pressed type made of cast iron, or malleable cast iron, or steel sheet, shall have sufficient strength to support pipes, and shall be convenient for connection with a hanger, etc. Support metal parts shall be coated with hot-dipped zinc (refer to Chapter 12 Metal Work) or paint (refer to Chapter 13 Painting).
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5) In piping, keep sufficient separation from chimney and any fire.

(7) Gradient

Horizontal pipes shall be inclined upward toward fixture or equipment with a standard gradient of 1/250.

(8) Intervals of supports

1) Indoor horizontal pipes shall in principle be supported at intervals specified in Table 7-19-14. Bending portions and branches shall be supported as required.

Table 7-19-14

Nominal Diameter	Under 20	25 ~ 40	50 ~ 80	100 ~ 150	Over 200
Interval	1,800	2,000	3,000	4,000	5,000

2) Vertical pipes shall be fitted with more than one bracing at each floor and fixed to the floor at one point on the lowest floor and for every 3 stories or less.

(9) Depth of pipe to be buried

The depth of pipe to be buried under the ground is more than 300mm in general and more than 750mm under roadways with traffic of automobiles.

(10) Painting

- 1) After completion of airtightness test, paint all pipes excluding those to be embedded.
- 2) Painting shall be carried out as specified in Paragraph 7-19-2 "Water Supply Work."

(11) Tests

Airtightness test and ignition test shall be made. Airtightness test shall be conformed prior to painting and during piping, before concealing or back filling or after completion of piping. The test value shall in principle be more than 1.1 times as large as the maximum operating pressure. Ignition test shall be performed after mounting the gas meter by eliminating air within the pipe.

7-19-8 Vibration Proofing and Soundproofing

(1) Vibration proofed installation of pump

Pump to be installed in the equipment room shall be installed through 2 standard pads (of about 10mm thick) produced by an approved manufacturer.

1) Vibration proofing rubber pads

For vibration proofing rubber pads, channeled vibration proofing rubber pads with properties in conformity to JIS K 6385 and 6386 and definite natural frequency, etc., shall be selected among ready-made products.

2) Vibration proofing joint (flexible joint)

Rubber flexible joint or rubber expansion joint shall be used around pump. Vibration proofing joint shall be used on joint between piping and pump and in principle in the vertical direction. The length of flexible joint to be used shall be as given in Table 7-19-15.

Table 7-19-15

Nominal Pipe Diameter	Length
20 ~ 25A	more than 200mm
32 ~ 80A	more than 300mm
100 ~ 125A	more than 400mm
over 150A	more than 500m

Expansion joint portion shall meet the requirements specified in Paragraph 7-19-2 "Water Supply Work."

(2) Vibration proofed support of piping

All pipes in the area specifically noted in Paragraph 7-19-2, item (4), 8) shall be supported by vibration proofed supports.

1) Vibration proofing rubber

Vibration proofing rubber in conformity to JIS K 6385 and 6386 and furnished with fitting screws on both sides or suspended vibration proofing rubber having a construction allowing compressive load to receive shall be employed. The hardness, dimensions, and number of pieces of rubber shall be determined from the supporting weight so that the natural frequency of the system to be vibration proof supported shall become about 10Hz (600c/m). Vibration proofing rubber shall be selected from among standard products produced by an approved manufacturer. Supporting positions shall be determined so that every piece of vibration proofing rubber shall support a given weight. Vibration proofing rubber shall be used at intervals given in Paragraph 7-19-2, item (4), 7). For horizontal pipes, turnbuckle type hangers and suspension type vibration proofing rubber shall be used in principle. For a single pipe, hangers and vibration proofing rubber shall be fitted together to suspension bolts. For vertical pipes, round type vibration proofing rubber with screws on both sides shall be used in principle. For both cases of a singly running pipe and parallel running pipes, vibration proofing rubber shall be used between bracket fitted to the pipe or pipes and support fitted to the building structure. The methods of suspension and supporting shall be as specified in Paragraph 7-19-2, item (4), and it shall be prohibited to support both vibration proofed pipe and non-vibration proofed pipe in common. Care shall be exercised so that vibration proof supported portion shall not contact with the building structure or non-vibration proofed portions. Care shall also be taken in determining the positions of suspension bolts and supports so that the load

shall apply perpendicularly to vibration proofing rubber.

(3) Vibration proofing joints for pipes

Pipes to pass expansion of the building structure shall employ expansion joints. Although in principle pipes shall not be passed through the building structure around studios such as walls and ceilings, pipes may, owing to unavoidable circumstances, be passed through such structure by using flexible joint outside the through hole and on the studio side.

7-20 AIRCONDITIONING AND VENTILATION WORK

7-20-1 Scope of Work

(1) Extent

The work specified under this paragraph consists of the following items of work.

- 1) Cooling and heating source equipment installation work
 - a) Water chilling unit
 - b) Pump
- 2) Air handling unit, air duct and piping work
 - a) Air handling unit
 - b) Air duct
 - c) Piping
- 3) Ventilation work
 - a) Ventilating fan
 - b) Air duct
- 4) Fuel oil supply work
- 5) Automatic control equipment work

(2) Work not included

The following items of related work are not included herein and specified in other paragraphs of this specification.

- 1) Electrical work (except piping and wiring on secondary side of water chilling unit to be included in this paragraph)
- 2) Plumbing work
- 3) Heat storage tanks, manholes, vents, drainage holes, ladders and manhole covers
- 4) Door grill
- 5) Louver on external wall

- 6) Equipment concrete base (except outdoor equipment base to be included in the work specified in this paragraph)
- 7) Making holes on structure and reinforcement for them
- 8) Reinforcement for opening on suspended ceiling
- 9) Oil service tank

(3) Spares

For such consumables as refrigerant and lubricant (for all rotating machines), spares to allow for continuous operation over one year shall be supplied. For air filters, as many frames as equal to 10% of the number of units in service and as many filters as equal to 100% of the number of units in service shall be supplied for spares.

(4) Inspection

Water-fill, water reducing, drainage, water leakage, water discharge, and air sending tests and operation of water chilling unit, air handling unit, pump, and fan shall be performed during the work and upon completion of the work. Each unit shall have nameplate specifying the name of manufacturer, type and serial number of the unit, specifications, and date of manufacture.

7-20-2 Cooling and Heating Source Equipment Installation Work

(1) Water chilling unit

Water chilling unit shall meet the following requirements.

- a) Cooling capacity: as per design drawings.
- b) Refrigerant: as per design drawings.
- c) Chiller inlet temperature: as per design drawings.

- d) Chiller output temperature: as per design drawings.
- e) Condenser inlet temperature: as per design drawings.
- f) Condenser outlet temperature: as per design drawings.
- g) Circulating chilled water volume: as per design drawings.
- h) Circulating condenser water volume: as per design drawings.
- i) Main motor
 - Applicable standard: JIS C 4201 (Three-phase induction motor)
 - Type: as per design drawings.
 - Rated output: as per design drawings.
 - Power supply: Frequency x Number of phases x Voltage, as per design drawings
 - Starting device: as per design drawings.

1) Reciprocating water chilling unit

a) General

i) Reciprocating water chilling unit shall incorporate reciprocating compressor, condenser, chiller, motor, oil cooler and heater, oil separator, safety device, automatic capacity control device, and other necessary accessories.

ii) In performance the reciprocating water chilling unit shall have sufficient capabilities and a safety factor for meeting the requirements of design specifications and allow for capacity control at more than 3 stages.

b) Capacity control system

Capacity control shall be achieved by using an unloader. The capacity control system shall allow for light load starting and automatic operation at the rated capacity.

c) Automatic control system

i) Start and stop

Start shall be made automatically by a thermostat in the heat storage tank.

Stop shall be made automatically by a thermostat in the heat storage tank.

ii) For automatic safety devices, the following items shall be provided.

High-low pressure switch

High-low oil pressure switch

Chilled water temperature switch

High pressure liquid pipe shut-out switch

Switch for water supply cut off

Motor overload relay switch

d) Interlock with evaporator pump and condenser pump shall be made.

e) This unit shall incorporate the following components.

i) Receptrocating compressor	1
ii) Chiller	1
iii) Condenser	1
iv) Main motor	1
v) High and low pressure controller	
vi) Enclosure type steel plate cubicle board	1
vii) Gauge board	1
viii) Oil pump	1
ix) Oil filter	1
x) Temperature control device	1
xi) Automatic safety device	1
xii) Accessories	
Thermometer	
Vibration proofing device	
Water piping for oil cooling and piping for pressure gauge	

Anchor bolts

Maintenance tools

Refrigerant: Specified amount shall be poured
(Guaranteed for 3 years)

Lubricant: Specified amount shall be poured
(Guaranteed for 3 years)

In addition, such electrical parts as lamps,
fuses, and auxiliary relays shall be provided
as spares.

f) Construction

- i) Special alloys, special steel, and cast iron shall be used for materials. All of which shall be robust, free from cracks and flaw, abrasion-proofed, high tensile, free from loss due to friction resistance inside, and finished by galvanization or the like for corrosion prevention from refrigerant.
- ii) The rotating section shall be designed with particular consideration for weight balance, not to cause unbalance and vibration during operation and to facilitate inspection and cleaning with covers at the ends being removable or opened/closed easily.
- iii) The evaporator shall be of cylindrical, multi-pipe flooded type having a welded steel plate body with a water chamber and water chamber cover made of steel plate or welded steel plate. Water chamber cover shall allow opening/closing without removing piping. Pipe is furnished with fins made of copper or other anti-corrosive metal and shall be fitted securely to pipe plates at the ends. In order to eliminate liquid drip to be caused from refrigerant vapor to be sucked into the compressor, anti-corrosive inner eliminator

shall be provided.

- iv) The construction of the condenser shall be similar to that of the evaporator.
- v) The vibration proofing device shall have vibration proofing rubber conforming to JIS K 6385 and 6386 and a metal spring or vibration proofing rubber with a brake and shall be suitable for attenuating the minimum natural frequency vibration of the supporting equipment by more than 10dB. Even when the condenser and evaporator are to be installed separate from the compressor and motor, similar vibration proofing device shall be used. The contractor shall in advance submit vibration proofing design specification of the vibration proofing device to the Engineer for approval.
- vi) This unit shall be such that causes less vibration and no abnormal sound with its noise level at a distance of 1m being less than 80dBA.

2) Installation of water chilling unit, heat insulation and painting

a) Installation

The water chilling unit shall be installed as follows.

- i) For the fixed foundation, a floor foundation with a height of 150mm shall be used.
- ii) Common bed of compressor and motor
The condenser and evaporator shall be installed through the vibration proofing device in accordance with the instructions of the manufacturer.
Installation shall be elaborated not to diminish the vibration proofing effect by improper tightening.
- iii) After completion of assembly at the site, perform airtight test, noise test, and vibration test in

the presence of the Engineer.

b) Heat insulation work

i) Materials

Rock wool insulation material: as specified in JIS A 9507.
Galvanized steel wire: as specified in JIS G 3505
and 3506. Class 3, 1.2mmφ.
Galvanized steel sheet: as specified in JIS G 3302.
#28, 0.397mm

ii) For evaporator and gas suction tube, heat insulation shall be effected as follows.

Clean the surface to which insulation material is to be applied, lay insulation boards with rivets, roll asphalt roofing on the insulation boards, apply wire lath of a diamond or square shaped pattern for reinforcement, cover with galvanized steel sheet, and apply biting joint.

iii) Heat insulation of the condenser is not necessary.

c) Painting

i) The portion to be covered with galvanized steel sheet shall be finished with 2 coats of oil paint of the specified colour.

ii) Iron portion shall be given 2 coats of rustproofing paint and finished by 2 coats of oil paint of the specified colour.

iii) Cubical boards and gauge board shall be shop finished by melamin baked painting in the predetermined colour.

iv) Pipes shall be given 2 coats of rust proofing paint and finished by 2 coats of oil paint of the specified colours which shall work also for identification marking.

d) After completion of assembly in the shop, the water chilling unit shall be subjected to trial operation to perform performance, airtightness, noise, and vibration tests prior to carrying in to the site. This work shall include operational adjustment.

(2) Pumps

1) Various types of pumps to be used

a) Primary chilled water pump

i) Capacity: Bore x water volume x lift.
as per design drawings.

ii) Motor: Power (kW) x voltage (V) x frequency
x number of poles x type.
as per design drawings.

iii) Type: as per design drawings.

iv) Accessories

Foot valve (with strainer, lever and chains)	1
Sluice valve	1
Check valve	1
Pressure gauge	1
Common floor bed	1
Funnel and cock for priming	1 set
Phase flange	1 set
Coupling	1 set
Anchor bolts and wrench	1 set

v) Number of pumps: as per design drawings.

vi) Construction

The pump and motor shall be installed, directly coupled with each other, on the common floor bed. The casing of the pump shall be of cast steel and the fins of bronze. The coupling shall be flexible coupling. The rotating section shall be completely balanced, with oil and others not mixed in. Less noise and vibration.

vii) Installation

The pump shall be mounted on the common floor bed on doubled vibration proofing rubber pads (8t) and, after accurate centering, fixed well-balanced to the common floor bed by tightening nuts.

viii) Tests

After finishing the relevant tests, the contractor shall submit test data to the Engineer for approval.

ix) Operating mode

This pump to be interlocked with the water chilling unit shall start automatically and also allows for manual start and stop.

b) Condensing water pump

- i) Capacity: Bore x water volume x lift.
as per design drawings.
- ii) Motor: Power (kW) x voltage (V) x frequency
x number of poles x type.
as per design drawings.
- iii) Type: as per design drawings.
- iv) Accessories: as per Paragraph 7-20-2, item (2),
1) a) iv).
- v) Number of pumps: as per design drawings.
- vi) Construction: as per Paragraph 7-20-2, item (2),
1) a) vi).
- vii) Installation: as per Paragraph 7-20-2, item (2),
1) a) vii).
- viii) Tests: as per Paragraph 7-20-2, item (2),
1) a) viii).
- ix) Operation mode: as per Paragraph 7-20-2, item (2),
1) a) ix).

c) Secondary chilled water pump

- i) Capacity: Bore x water volume x lift.
as per design drawings.
- ii) Motor: Power (kW) x voltage (V) x frequency
x number of poles x type.
as per design drawings.
- iii) Type: as per design drawings.
- iv) Accessories: as per Paragraph 7-20-2, item (2),
1) a) iv).
- v) Number of pumps: as per design drawings.
- vi) Construction: as per Paragraph 7-20-2, item (2),
1) a) vi).
- vii) Installation: as per Paragraph 7-20-2, item (2),
1) a) vii).
- viii) Tests: as per Paragraph 7-20-2, item (2),
1) a) viii).

ix) Operation mode:

The first pump shall be started manually and then as many pumps as necessary shall be started automatically by means of the flow meter. Manual start/stop shall also be allowed.

2) Heat insulation and painting of pumps

- a) First apply rock wool lagging to the pump proper, lay asphalt roofing on the lagging, apply wire lath for reinforcement, then cover with galvanized steel sheet, and apply biting joint.
- b) The portion covered with galvanized steel sheet shall be given 2 coats of oil paint of the specified colour.
- c) The iron portion shall be given 2 coats of rustproofing paint and 2 coats of oil paint of specified colour.

3) Noise of pumps

When mounted on the common floor bed together with the motor, each pump shall have a noise level not exceeding 65dBA at a point 1m apart from the main axis of the pump.

20-3 Air Handling Unit, Air Duct and Piping Work

(1) Air handling unit, duct and piping

1) Air handling unit

The air handling unit shall incorporate a blower, and a cooling coil with a motor mounted outside its casing.

- a) The blower shall run well-balanced without causing any rolling. The blower shall use good materials free from strain, deformation, and any other defect. In particular, the bearing shall be such that has been selected strictly among good products. Rotation shall be transmitted to drive V belt by motor and the fabrication shall be elaborated to cause less vibration and less noise. Noise to be caused by the blower shall meet the requirements set out in Paragraph 7-20-5, item (1), 1) d) i).

The noise level of the blower shall be less than 60dBA at a position 1m apart from the side of the casing.

b) Cooling coil

i) Construction

The coil shall provide sufficient strength against inside water pressure and have a small air resistance.

Fins shall be of plate type and shall be so connected to the coil mechanically or by galvanization that the heat transmission resistance of the contact portion shall become minimum.

The material of coil shall conform to JIS H 3603 (Phosphorus-deoxidized copper seamless pipes) or JIS H 3606 (Tough pitch copper seamless pipes) and shall be about 16mm in outside diameter and more than 0.6mm in thickness.

Fins shall conform to JIS H 4000 (Aluminum and aluminum alloy plates and wires), shall have aluminum content of more than 99%, and shall be more than 0.2mm thick. Header shall in principle be of pipe form. Between pipes, return bend of copper pipe shall be brazed or welded. On the header taps for piping and an air vent valve shall be provided.

After assembly at the shop, water pressure test shall be performed by applying water pressure of more than $5\text{kg}/\text{cm}^2$.

ii) Installation

The air cooling coil shall be mounted horizontally on a rack framed firmly with shape steels.

c) Drain pan

A drain pan shall be made of steel sheet (more than 1.6mm thick) conforming to JIS G 3141. The drain pan shall be completely watertight, shall have a sufficient gradient, and be provided with taps for drainage pipe of more than 32mm in diameter on the downstream side. The inside of the drain pan is rustproofed by epoxy resin coating or equivalent.

d) Casing

The outer casing shall be made of a framework reinforced sufficiently with shape steel conforming to JIS G 3101 and JIS G 3192 and steel plate conforming to JIS G 3141 and having a thickness of more than 1.2mm and shall be lacquer spray finished. The inside of the casing shall be coated by a rustproofing paint on which glass wool insulation boards of more than 25mm thick shall be pasted for the purposes of heat insulation and sound absorption in compliance with the requirement of the vibration proofing and sound insulation work.

e) Installation

This unit shall be installed on a concrete foundation of 150mm high by the method specified in paragraph 7-20-8 "Vibration Proofing and Sound Insulation Work." Aluminum canvas connection shall be used between the coil and fan sections.

2) Air filter

Air filter shall provide a high dust collection efficiency with a small passing resistance. The performance of air filter shall be as indicated in drawings.

a) Unit type air filter

Unit type air filter shall be such that incorporates a filter in a rustproofed framework made of steel sheet and aluminum plate while using a filter support to prevent the filter from being easily deformed by air pressure.

3) Fan coil unit

This unit is a compact air handling unit

incorporating a blower directly coupled to the motor, a cooling coil, and a filter.

a) Blower

The blower shall be of air foil type made of aluminum, run well balanced and without causing rolling when in operation, use good materials free from strain and other defects and, in particular, use a bearing selected strictly from among good products.

Noise of the blower shall meet the requirements set out in Paragraph 7-20-5, item (1) 1) d) i).

The noise level at a point 1m apart from the side of the casing shall be less than 35dBA.

b) Cooling coil

As per Paragraph 7-20-3, item (1) 1) b).

c) Air filter

Air filter shall allow dismounting, cleaning, and remounting for use.

d) Casing

The casing shall use steel sheet of more than 0.8mm thick of which the outside surface shall be finished by melamine baked painting of the specified colour and the inside shall be coated by a rustproofing paint and then pasted with glass wool insulation board of more than 24kg/cm^3 in density and more than 13mm in thickness.

e) Accessories

Speed control switch and reactor box

f) Vibration proofing

Shall be vibration proofed as Paragraph 7-20-8 "Vibration Proofing and Sound Insulation Work."

7-20-4 Air Duct Work

(1) Ducts

1) Materials

a) Galvanized steel sheet

Galvanized steel sheet shall conform to JIS G 3302 and have the standard zinc weight given in Table 7-20-1.

Table 7-20-1 Standard Zinc Weight per Unit Area

Thickness of sheet (mm)	0.5	0.6 ~ 1.0	1.2 ~ 1.6
Weight of zinc per unit area (g/m ²)	244	305	381

b) Shape steel and bar steel

Shape steel shall conform to JIS G 3192 and bar steel to JIS G 3191.

c) Rivets, bolts and nuts

Rivets shall conform to JIS B 1213 and JIS B 1214 and bolts and nuts to JIS B 1180 and JIS B 1181.

d) Packing for flanges

For packing for flanges, asbestos tape of 3mm thick using asbestos string conforming to JIS R 3450 and packing of 3mm thick using asbestos board conforming to JIS R 3454 shall be used.

2) Work

a) Rectangular duct

Rectangular duct shall be fabricated from galvanized

steel sheet, as follows.

i) Sheet thicknesses and joints

As given in Table 7-20-2. Care shall be exercised so that joints shall not be located in pass-through portions.

Table 7-20-2 Thickness and Joints of Rectangular Ducts

Length of Long Side (mm)	Sheet Thickness (mm)	Connecting Flange		Rivet 4.5φ Pitch	Bolt 7.5φ Pitch
		Standard	Maximum Interval		
less than 450	0.6	L-25x25x3	3.6 ^(m)	65 ^(mm)	100 ^(mm)
460 1,000	0.8	L-30x30x3	2.7	65	100
1,010 1,750	1.0	L-40x40x3	1.8	65	100
1,760 2,500	1.2	L-40x40x5	1.8	65	100
more than 2,510	1.6	L-50x50x4	1.5	65	100

ii) Reinforcement

As per Table 7-20-3. When the length of the long side is less than 300mm, reinforcement by standing seam may be used.

Table 7-20-3 Reinforcement

Sheet Thickness (mm)	Reinforcement Angle		Rivet 45φ Pitch
	Standard	Maximum Interval	
less than 0.6	L-25x25x3	1.8 ^(m)	65 ^(mm)
0.8	L-30x30x3	0.9	65
1.0	L-40x40x3	0.9	65
1.2	L-40x40x5	0.9	65
1.6	L-50x50x4	0.9	65

Table 7-20-4

Height of Standing Seam	Interval of Standing Seam	Diameter of Rivet	Rivet Pitch
25mm	0.9mm	4.5mm	65mm

iii) Metal parts and supports

As per Table 7-20-5.

Table 7-20-5 Metal Parts and Supports

Duct Thickness (mm)	Support Angle	Metal Part		Support Maximum Interval
		Steel Bar	Maximum Interval	
less than 0.6	L-25x25x3	9 (mm ϕ)	2.7 (m)	3.6 (m)
0.8	L-30x30x3	9	2.7	3.6
1.0	L-40x40x3	9	2.7	3.6
1.2	L-40x40x5	12	2.7	3.6
1.6	L-50x50x4	12	2.7	3.6

b) Round steel sheet duct to be fabricated at site

i) Sheet thicknesses and joint

As per Table 7-20-6. Care shall be exercised so that joints shall not be located in pass-through portions.

Table 7-20-6

Diameter (mm)	Thickness (mm)	Connecting Flange		Rivet 4.5 ϕ Pitch	Bolt 7.5 ϕ Pitch
		Standard	Maximum Interval		
less than 300	0.5	L-25x25x3	3.6 (mm)	65 (mm)	100 (mm)
310 ~ 600	0.6	L-25x25x3	3.6	65	100
610 ~ 900	0.8	L-30x30x3	2.7	65	100
910 ~ 1,250	1.0	L-40x40x3	1.8	65	100

ii) Reinforcement

As per Table 7-20-7.

Table 7-20-7

Diameter	Reinforcement Angle	Maximum Interval
610 900 ^(mm)	L-30x30x3	2.4 ^(m)
910 1,250	L-30x30x3	1.8

iii) Hangers and supports

As per Table 7-20-8.

Table 7-20-8 Hangers and Supports

Diameter	Flat Bar	Metal Part	Maximum Interval of Supports
less than 1,500 ^{mm}	25x3 ^{mm}	9 ^{mm} φ	3.6 ^{mm}

c) Vibration proofing and sound insulation

i) Vibration proofing hangers

Air ducts to pass studios, subcontrol rooms, and master control room and ducts to be provided in the duct space specifically noted in drawings shall be suspended by vibration proofing hangers or supported by vibration proofing supports.

ii) Vibration proofed and sound insulated ducts

Ducts to pass the walls, floors, and ceilings of the studios, subcontrol rooms, master control room, and equipment room shall be vibration proofed and sound insulated ducts specified in Paragraph 7-20-8.

The ducts to be provided in the duct space shown in drawings shall also be sound insulated.

When ducts to be heat insulated pass through concrete structure other than those mentioned above, the outside of the heat insulating material shall be covered with galvanized steel sheet with a brim of 25mm and then filled with mortar from both sides. When ducts not to be heat insulated pass through concrete structure other than those mentioned above, heat insulating material shall be applied on the duct surface at the pass-through portions and then covered with galvanized sheet with a brim of 25mm and filled with sufficient amount of mortar from both sides. The pass-through portions of duct shall be as much short as possible and the ends of such short pipe shall be flange jointed.

iii) Vibration proofing of duct

Rubber flexible joint of about 100mm long or double canvas connection shall be applied to the duct inside the room in pass-through portions of the studio structure. When double canvas connection is to be employed, heat insulation treatment shall be effected as per Paragraph 7-20-4, item (3). The above-mentioned vibration proofing treatment shall be effected to blowers and circulators in ducts and joints with air handling unit.

(2) Duct accessories

1) Air flow control damper

a) Damper casing shall be made of steel sheet of more than 1.2mm thick and be furnished with a flange on both ends. Blades shall be made into a spindle shape by using galvanized steel sheet of more than 0.6mm thick.

- b) Damper shall function well without vibration and involve minimum air resistance when open.
- c) The damper shaft shall be made of galvanized steel bar and its bearing shall be of bronze or brass and be fitted to the casting.
- d) Manual operated large sized dampers shall be operated by means of a handle. Interlock mechanism shall function smoothly with no difficulty. Manual operated dampers shall be furnished with cast iron or bronze open-shut indicators.
- e) Automatic dampers for proportional control shall all be opposed blade type multi-blade dampers.

2) Fireproof damper

- a) Damper casing and moovable blade shall be made of steel sheet of more than 1.6mm thick. Flange shall be provided at the ends.
- b) The damper shall be interlocked with a temperature fuse to automatically shut off and involves less air resistance when open, with reliable fireproofing function.
- c) The shaft and bearing of the damper shall be as those of the above-mentioned air flow control damper.
- d) Fuse shall be such that can easily be replaced from outside. The operating temperature of fuse shall in principle be 72°C. Inspection hole shall be provided to allow open-shut and operating condition of blade to be observed.

3) Supply air grille and return air grille

- a) Supply air grille

- i) Supply air grille made of punched steel plate
Shall have the required effective area.
 - ii) Air supply resistor with movable blade
Blade shall be made of steel sheet as specified in JIS G 3141, brass sheet, or aluminum sheet.
 - iii) Ceiling air diffuser
Shall use steel sheet as specified in JIS G 3141, brass sheet, or aluminum sheet.
 - iv) Mounting of supply air grille
The surrounding of supply air grille shall be formed to make a good appearance without air leakage. Shutters and others shall not be provided around studios, subcontrol rooms and any other specified place.
 - v) Fabrication of supply air grille
Prior to fabrication of supply air grille, the contractor shall submit shop drawings to the Engineer for approval.
- b) Return air grille
- i) Return air grille
Shall have the required effective area.
 - ii) Mounting of return air grille
A shutter shall be fitted on the back of the portion to which return air grille shall be mounted. Air shall not leak from the surrounding the return air grille. Shutters and others shall not be provided around studios, subcontrol rooms and other specified place.
 - iii) Fabrication of return air grille
For the fabrication of return air grille, the contractor shall submit shop drawings to the Engineer for approval.

c) Hood

Hood shall be made of galvanized steel sheet conforming to JIS G 3302 with important portions reinforced by shape steel conforming to JIS G 3192. Hood shall have such construction and dimensions that allows for effective suction of exhaust gas.

4) Sound absorbing

a) Sound absorbing

Shall be made of galvanized steel sheet. The outside form shall be rectangular and the inside form circular. Sound acoustic material of 50mm thick shall be lined as per Paragraph 7-20-8. The inner size of duct after application of the lining shall be used as nominal duct size. In the case of rectangular duct, the length on both sides of the elbow shall be more than twice as large as the width. Unless otherwise specified, guide vane shall not be provided.

b) Sound absorbing chamber

shall be made of galvanized steel sheet and have the required dimensions. Inner acoustic lining shall be effected as per a) above. Unless otherwise noted, the crosssectional dimension of the sound absorbing chamber shall be more than 1.5 times as large as the corsssectional dimension of the duct or more than 1.5 times as large as the diameter. The length of the sound absorbing chamber shall be more than 1.5 times as large as the diagonal line or diameter of the duct. The inner size after application of the acoustic lining shall make the nominal size of the sound absorbing chamber. The duct opening on the supply air side and that on the return air side shall not be opposed to each other.

(3) Heat insulation work

The air supply and return ducts of each air handling unit system shall be heat insulated as follows.

1) Material

Rock wool lagging (JIS A 9504) or glass wool lagging (JIS A 9503, No.2, c or d) shall be used.

2) Work

a) Thickness of lagging

Shall be more than 25mm for both supply and return ducts.

b) Mounting of lagging

For indoor exposed duct, heat insulation shall be achieved by means of copper rivets, lagging (24K), steel frame or wood frame, plaster board, joiner and corner bead.

For indoor concealed duct, heat insulation shall be achieved by using copper rivets, lagging (24K) with aluminum foil, aluminum adhesive tape, (for joints) and hexagonal pattern wire net.

c) Sound proofing and outer covering

Sound proofing and outer covering shall be effected for ducts to pass the airconditioning equipment room and wherever specified, by means of copper rivets, lagging (24K), hexagonal pattern wire net, framework, plaster board (9t, double sticking by staggering), and corner bead.

d) Others

When acoustic lining is provided inside the duct, lagging needs not be applied. Where lagging and acoustic lining connect, an overlap of 100mm shall be provided with the overlapped end to be

fastened by adhesive tape and attached to the duct steel sheet.

(4) Painting

1) Ducts

- a) Exposed portions, of lagged, sound insulated, and unlagged ducts shall be finished by 2 coats of oil paint of the specified colour.
- b) The inside of duct to be connected to supply or return grille shall be finished by flat black paint.

2) Duct accessories

a) Dampers

Damper casing shall be given 2 coats of rustproofing paint. Exposed portions of damper casing shall be given 2 coats of oil paint of the specified colour.

b) Supply and return air grilles

- i) Supply and return air grilles made of steel sheet shall be finished by melamine baked painting of the specified colour.
- ii) Supply and air grilles of aluminum shall be almite finished.
- iii) Shutters of supply and return air grilles shall be finished by flat black paint.
- iv) Hangers and supports after chipping off rust, apply 2 coats of rustproofing paint.
Exposed portions shall be given another 2 coats of oil paint of specified colour to finish.

(5) Piping

1) Materials

a) Pipes and joints

i) Steel pipe

Galvanized steel pipe specified in JIS G 3452 (steel pipes for piping and gas pipes) shall be used.

ii) Joints

Malleable cast iron pipe joints or steel pipe joints specified in JIS B 2301 and JIS B 2302 shall be used. Flange joints shall be used at places where dismounting shall be allowed. In principle, union joints shall not be used. For flanges, 10kg/cm² flanges specified in JIS B 2212 shall be used.

iii) Vibration proofed joint

As per Paragraph 7-20-8.

b) Valves

i) Sluice valves

Sluice valves of less than 50mm in diameter shall be of bronze screw-in type specified in JIS B 2013. Those of more than 65mm shall have valve bodies of cast iron with operating portions being bronze flange type. More than 5kg/cm². In principle, sluice valves shall be of outer screw type.

ii) Check valves

Check valves for use at pump outlets shall be of anti-shock type. Check valves with diameters of less than 50mm shall be of bronze screw-in swing type conforming to JIS B 3025. Check valves of more than 65mm shall have valve bodies of cast

iron with operating portions of bronze flange type.
10kg/cm².

2) Piping

a) Jointing of pipes

Pipes shall be jointed by screw joint, flange joint, or welded joint.

i) For screws, tapered screws conforming to JIS B 0203 shall be used. When application of jointing agent is necessary, apply it to male screws only.

For the jointing agent, lead red mixed firmly with vegetable oil shall be used.

ii) Welding shall be carried out by authorized welder.

iii) Prior to jointing, clean out the inside of the pipes to be jointed. After completion of piping, properly cap pipe ends to prevent foreign matter from entering during the work.

b) Supporting of pipes

Where specifically noted in drawings, pipes to pass duct space shall be suspended by vibration proofed hangers or supported by vibration supports. Vibration proofing shall be accomplished as per Paragraph 7-20-8 "Vibration Proofing and Sound Insulation."

When using expansion joint, provide fixed pipe supports at proper positions of the pipe. Supports shall be provided at intervals given in Table 7-20-9.

Table 7-20-9 Pipe Supports

Diameter of pipe	under 50mm	65 ~ 200mm	over 250mm
Interval	1,800mm	3,600mm	5,400mm

c) Passing of pipe through structure

- i) Insert sleeves in advance, remove the sleeve after placing concrete, apply heat insulating cover right around the pipe, then wind steel sheet with collar, apply mortar from both sides, and seal completely. Sufficiently adjust pipe position prior to filling with mortar so that the load of the pipe shall not be applied to the pass-through portion of the structure and, if necessary, support the pipe at positions immediately before and after the pass-through portion.
- ii) Gap between pipe and sleeve to pass through walls of concrete water tank or pass portions required to be particularly watertight shall be filled with yarn and lead to assure complete watertightness.

d) Flexible joint

- i) For pipes to pass expansion of building structure, flexible joint shall be employed.
- ii) For portions contacting with such equipment that cause vibration, such as water chilling unit and pumps, flexible joint shall be used. Flexible joint shall in principle be made of rubber product with dimensions specified in Table 7-20-10.

Table 7-20-10 Dimensions of Vibration Proofing Joint

Nominal Dimension of Pipe	Length	Nominal Dimension of Pipe	Length
20, 25A	200mm	100, 125A	400mm
32 ~ 80A	300mm	over 150A	500mm

e) Sealing plate and decorated cover

Pipes shall in principle be concealed but where exposed, indoors pipes shall use chrome plated brass sealing plate at pass-through portion of ceiling, floor, and wall. The ends of pipe laggings shall be covered with chrome plated brass decorated covers.

f) Water piping work

i) Jointing of pipes

When using flange, asbestos joint sheet (JIS R 3453) of less than 15mm thick using asbestos as the major material or rubber packing made of high-quality rubber shall be used. The packing surface shall be coated only by a mixture of vegetable oil and lead red or black lead and shall not be coated by hard paint or the like.

ii) Gradient

Pipes shall run horizontally not to cause dead air space and where unavoidable and approved by the Engineer, they will be fitted with automatic air release valve or cock.

iii) Water pressure test

After applying a pressure of $8\text{kg}/\text{cm}^2$ for more than 30 minutes, inspect for water leakage.

3) Heat insulation

a) Lagging of cooling water pipes

i) Material

Rock wool or glass wool heat insulating cover (JIS A 9504, No.2 and JIS A 9505, No.2) shall be used.

ii) Thickness of lagging

Thickness of lagging shall as given in Table 7-20-11.

Table 7-20-11 Thickness of Lagging Material

Pipe diameter	less than 32mm	40 ~ 125mm	more than 150mm
Thickness of insulation material	30mm	40mm	50mm

iii) Mounting of lagging

After laying lagging of the required thickness around pipe, wind the lagging by galvanized steel wire of BWG No.20 or thicker, roll thick paper No.33 (roofing thick paper) over the lagging, then roll cotton cloth spirally around the pipe covered with lagging, thick paper, etc., with one end of the cloth being folded to have a lap of more than 15mm, and give 2 coats of filling paint. Lagging of pipes in under-floor heat storage tank shall not be made.

iv) Lagging of flanges, valves, etc.

Flanges, valves, etc., shall be lagged and finished in the same way as straight pipes.

v) Outdoor piping

Outdoor pipes shall be covered with asphalt jute instead of the above-mentioned cotton cloth and, after baking the piled portion, finished by No.28 galvanized steel sheet with joints soldered.

b) Anti-sweating of drain pipes

Anti-sweating shall be effected as follows.

i) Material

As per Paragraph 7-20-4, item (5), 3) a) i).

ii) Thickness of anti-sweat material

Thickness of anti-sweat material shall be as given in Table 7-20-12.

Table 7-20-12 Thickness of Anti-Sweat Material

Pipe Diameter	Thickness of Anti-Sweat Material
32A~150A	20mm

iii) Mounting of anti-sweat material

As per Paragraph 7-20-4, item (5), 3) a) iii).

iv) Anti-sweating of flanges, valves, etc.

Flanges, valves, etc., shall be anti-sweated in the same manner as straight pipes.

c) Application of band

Heat insulated pipes shall be rolled with chrome plated brass bands to a good style at intervals of 2m in straight portions and at branches and bends. The ends of heat insulating material shall be rolled with yellow bands of the same material.

4) Painting

a) Pipes and others not heat insulated

Exposed portions shall be given 2 coats of rustproofing paint and finished by 2 coats of oil paint of the specified colour.

b) Heat insulated pipes and others

Exposed portions shall be finished by 2 coats of oil paint of the specified colour.

7-20-5 Ventilation Work

(1) Work for blower

1) Multi-blade blower

- a) Type: Sirocco type
- b) Motor: Enclosed drip-proofed type
- c) Accessories: Pulley, V belt, belt cover, anchor bolts, common floor bed, companion flange (with bolts), each one set

d) Construction

i) This machine shall incorporate a blade wheel and casing both fabricated to be robust by using steel plate and other materials with high strength. This machine shall provide excellent static and dynamic balance and involve less vibration when in operation. For the noise of this machine, the total power level on both inlet and outlet sides shall be less than $(91.25 + 10 \log_{10} KW)$ and the frequency response relative to the total power level shall not exceed the value given in Table 7-20-13. KW denotes the capacity of the motor.

Table 7-20-13

Octave Band (Hz)	63	125	250	500	1k	2k	4k	8k
Noise of Blower less than 2kW	-1	-6	-11	-16	-21	-26	-31	-36
Noise of blower more than 2kW	-5	-6	-7	-8	-10	-13	-18	-23

ii) The motor shall be used for driving the V belt and shall allow for adjustment of belt tension by means of a sliding motor base or other proper method.

e) Installation

- i) The blower and motor shall be mounted securely on a robust common floor bed fixed to the concrete foundation to be constructed separately, by using the vibration proofing method specified in Paragraph 7-20-8. Prior to constructing the fixed concrete foundation, thoroughly consult with the officer of construction work as to vibration proofing rubber anchor bolt position and others so as not to constitute any hindrance.
- ii) Double canvas connection shall be employed for connection between the blower outlet and casing or between blower outlet/inlet and duct.
- iii) Blower shall be subjected to performance test at the shop in the presence of the Engineer and test data shall be submitted to the Engineer.

2) Pressure fan

Type: as per design drawings.
Motor: as per design drawings.
Accessories: as per design drawings.

3) Ventilating fan

Type: as per design drawings.
Motor: as per design drawings.
Accessories: as per design drawings.

2) Installation

a) Installation of multi-blade blower

Multi-blade blower shall be installed together with the motor on the common floor bed, as indicated in design drawings.

- i) Common floor bed

Channel steel base and suspension bolts shall
as given in Table 7-20-14.

Table 7-20-14 Common Floor Bed, Channel Steel Base
and Suspension Bolts

Common of Fan		Common Floor Foundation	Channel Steel	Suspension Bolt
Single Suction	Dual Suction			
under 1 3/4 [#]	under 1 1/2 [#]	45 (mm)	L-175x40x5	9 (mmφ)
2 ~ 3 1/2	1 3/4 ~ 3	60	L-100x50x5	13
4	3 1/2	90	L-125x65x6	16

oii) Vibration proofing

As per Paragraph 7-20-8 "Vibration Proofing and
Sound Insulation."

iii) Painting

Two coats of rustproofing paint shall be applied.
Exposed portions shall still be coated by oil paint
of the specified colour.

b) Mounting of pressure and ventilating fans shall be
as per Paragraph 7-20-8 "Vibration Proofing and
Sound Insulation."

(3) Ducts

1) Duct work

a) Materials

As per Paragraph 7-20-4, item (1) 1).

b) Method

As per Paragraph 7-20-4, item (1) 2).

c) Painting

As per Paragraph 7-20-4, item (4) 1).

2) Accessories of duct

i) Air control damper

ii) Fireproof damper

iii) Air supply and return grilles

iv) Sound absorbing duct

These accessories as specified in Paragraph 7-20-4, item (2).

7-20-6 Fuel Oil Supply Work

(1) General

The tank shall be provided with strict regard for design drawings. Tank gauge, tap for oiling, oil supply pipe, air vent pipe, waste oil output, and manhole shall be provided. Oil supply and return pipes shall be, where indicated in drawings, connected to the service tank to be constructed separately in this project. Purge pipe shall be provided as indicated in drawings so that oil volume can be inspected in the equipment room by means of oil purge. The tank shall be subjected to 5kg/cm^2 water pressure test at the shop after fabrication so as to check for water leakage, etc., prior to carrying in.

(2) Scope of work

In this work the following items of work shall be elaborated.

i) Tank proper and ventilating device

ii) Tank manhole cover

- iii) Piping and related fittings
- iv) Concrete structure such as tank base, bottom and upper floor, and supports
- v) Anti-corrosion coating and other painting and testing
- vi) Others to be accomplished as per drawings.

(3) Methods

1) Tank proper

The tank proper shall be of steel plate with plate thickness as specified in detailed drawings.

2) Painting

The inside surface of the tank shall be given 2 coats of oil-proof paint. The outside surface of the tank shall be, after sufficient chipping of rust, given 2 coats of rustproofing paint. When the tank is of embedded type, asphalt primer and asphalt roofing shall be applied alternately to provide a finish thickness of more than 10mm. In the case of outdoor exposed type tank, 2 coats of oil paint of the specified colour shall be employed.

3) Tapping

As indicated in detailed drawings.

(4) Piping

- 1) For cutting pipes, use a saw or such a tool that shall not diminish the diameter of the pipe. After cutting the pipe, remove burr on the cut by using a reamer.
- 2) For jointing pipes, welded joint shall be employed.
- 3) Welding of pipes shall be done by authorized welder.

- 4) Prior to jointing pipes, clean out inside of the pipes. After piping, ends of pipes shall be capped by a proper method to prevent foreign matter from entering into pipes during the work.
- 5) A check valve (swing type) of screw-in type made of bronze conforming to JIS B 2025 shall be provided in the upper portion of the supply port.
- 6) For piping, steel gas pipe conforming to JIS G 3452 shall be used.

(5) Painting and covering

Pipes to be embedded under ground shall be rolled spirally with asphalt jute using coal-tar and sufficiently baked. Outdoor exposed pipes shall be coated by rustproofing paint and then finished by 2 coats of oil paint.

(6) Testing

Water pressure test of pipes shall be performed at 5kg/cm^2 .

7-20-7 Automatic Control Equipment Work

(1) Construction

Every equipment shall function securely and be constructed to assure ease of installation and maintenance. Equipment to be installed in general rooms shall have a good style and rugged construction.

(2) Control equipment

a) Thermostat

- i) Dual position control type
- ii) Proportional control type

b) Humidistat

Double position control type

- c) Automatic valve
 - i) Proportional control 2-way valve
 - ii) Proportional control 3-way valve
- d) Automatic damper
 - Proportional control type
- e) Automatic/manual mode selector
- f) Manual controller

(3) Fitting

- 1) Motor-driven damper and motor-driven valve shall be mounted to be directed as specified and with due consideration for the position of the balancing relay.
- 2) Damper gauge shall be mounted in consideration of the relationship between the operating angle of the damper and that of the motor. Where minimum operating angle to be maintained, maintain the specified air flow under the inspections from the Engineer.
- 3) Motor-driven valve shall employ a bypass valve unless otherwise stated. When a operating angle meter is provided, piping shall be effected to assure ease of reading on the meter.
- 4) Thermostat and humidistat shall be mounted at such locations that their required functions can fully be achieved.
- 5) Orifice shall be mounted in horizontal pipe, with a straight pipe length of more than 10d to be provided before the orifice and that of more than 5d after the orifice.

(4) Tests

After being mounted, each equipment shall be subjected to the required tests for its operating condition.

7-20-8 Vibration Proofing and Sound Insulation

(1) Vibration proofed installation of rotating equipment

1) Equipment to be vibration proofed.

As indicated in drawings.

2) Vibration proofing material

Vibration proofing rubber conforming to JIS K 6385 and JIS K 6386 or metal vibration proofing spring with a proper brake shall be used with a compressing load being applied. The hardness, dimensions, and the required number of vibration proofing rubber or vibration proofing springs shall be determined by calculation from the weight of the vibration proofing support system so that the natural frequency of the vibration proofing support system shall become as given in Table 7-20-15 and thus applicable product shall be selected from among standard product of manufacturers.

Table 7-20-5

Classification of equipment		Natural vibration	Vibration proofing material
Equipment with rotation over 1200 r.p.m.		600	Rubber
Equipment with rotation of 1200 ~ 850 r.p.m.		r.p.m. x 1/2	Rubber
Equipment with rotation of 850 ~ 400 r.p.m.	Equipment installed in next room or on upper floor of studio and subcontrol room	r.p.m. x 1/2	Spring
	Other equipment	360	Rubber
Equipment with rotation under 400 r.p.m.	Equipment installed in next room or on upper floor of studio and sub-control room	r.p.m. x 1/2	Spring
	Other equipment with power over 2.1kW	r.p.m. x 1/1.5	Spring
	Other equipment with power under 2.0kW	600	Rubber

When the weight of the equipment is insufficient, increase the weight of the support system by a basic or additional weighting method.

For the rubber material, neoprene shall be used in principle.

Vibration proofing supports shall be determined so that a uniform weight shall apply at all points. The contractor shall submit vibration proofing design drawings and supporting point location drawings to the Engineer for approval in advance.

3) Method

a) Installation on floor

Vibration proofing band, vibration proofing rubber and vibration proofing spring in a shape of mounting seat shall be mounted between the concrete foundation bed and free foundation bed or equipment floor foundation. These vibration proofing materials shall be mounted by embedding their fitting screws directly in mortar or by embedding fitting metals or anchor bolts into the concrete foundation bed. These vibration proofing materials shall be mounted accurately in place and plumb by using jigs. After fixing vibration proofing rubber or spring securely, set free foundation bed or equipment floor foundation to the vibration proofing rubber or spring. Care shall be exercised so that electrical and plumbing pipes and non-vibration proofing supports shall not contact the vibration proofing support system. Temporary support and others to be employed upon installation shall all be removed without fail upon completion of installation.

b) Suspension from ceiling

Suspension type vibration proofing rubber and turnbuckle

type hangers shall be employed at upper intermediate positions on the hanger bolts of the equipment. Fix the hangers firmly to the anchor bolts embedded in concrete slabs. The distance between concrete slab face and upper ends of the hangers shall in principle be less than 30mm. By fitting hanger bolts through vibration proofing rubber to the hangers, suspend the equipment. The vibration proofing rubber shall be set securely at the required positions so that load shall be applied perpendicularly to the vibration proofing rubber. Care shall be exercised so that hanger bolts or suspended equipment shall not contact the ceiling, sound absorbing box, etc.

4) Insulation from pipes

Flexible joints shall be employed to insulate vibration between pump and water supply pipe, between blower and air duct, and airconditioner and air duct, as specified in Paragraph 7-20-8, item (3) 4). For electric pipes, the transmission of vibration shall be prevented by using flexible pipe or rubber hose.

(2) Vibration proofing of water pipes

1) Pipes to be vibration proofed

Such water pipes as specified in Paragraph 7-20-4, item (5) 2)a) ii) shall be suspended or supported with vibration proofing work.

2) Vibration proofing rubber

Suspension type or mounting seat type vibration proofing rubber conforming to JIS K 6381 or 6386 shall be employed in such a way that compressing load shall be applied. The hardness and dimensions of rubber

to be used shall be calculated from the weight to be supported (including weight of water in the pipe) so that the natural frequency of the system to be vibration proofing supported shall become as given in Table 7-20-15 and thus shall be selected from among standard products of relevant manufacturers. Supporting intervals shall be as specified in Paragraph 7-20-4, item (5) 2) b). The type of rubber to be used shall in principle be neoprene. The contractor shall submit vibration proofing design drawings to the Engineer for approval in advance.

3) Method

For horizontal pipes, turnbuckle type hanger and suspension type vibration proofing rubber shall be used in principle. In the case of a single pipe, vibration proofing material shall be used at an intermediate position on the hang bolt as specified in Paragraph 7-20-8, item (1) 3) b). In the case of more than 2 pipes to run in parallel, vibration proofing material shall be set at an intermediate position on the hanger bolts of the common fixtures as specified in Paragraph 7-20-8, item (1) 3) b).

For vertical types, mounting seat type vibration proofing rubber shall be employed in principle. For both single pipe and prural pipes to run in parallel, vibration proofing rubber shall be put between the fixture used for fixing the pipe or pipes and the wall of the building structure or post fixed to the floor of the building structure. Care shall be exercised so that vibration proofing rubber shall not be inclined and that load shall not be applied obliquely to the vibration proofing rubber. A pipe to be supported by vibration proofing supports and

a pipe to be supported by non-vibration proofing supports shall not be supported by common fixture or rack. Care shall also be exercised so that vibration proofing supports shall not contact the building structure or other non-vibration proofing materials. All pieces of vibration proofing rubber used on one fixture shall receive an equal load.

4) Vibration proofed joint of pipes

When connecting a pipe to a rotary equipment, flexible joint shall be used. Pipes to pass through the wall of the studio structure shall employ flexible joint on the studio side. For the flexible joint, the so-called rubber flexible joint or rubber expansion joint shall in principle be used at the point of joint. Standard length of flexible joint shall be as given in Table 7-20-16.

Table 7-20-16 Length of Flexible Joint

Nominal Diameter of Pipe	Length	Nominal Diameter of Pipe	Length
20, 25A	200mm	100, 125A	400mm
32 80A	300mm	over 150A	500mm

Expansion joint with as many troughs and crests as suitable for the diameter of the pipe shall be used. For hot water piping, heat resisting pipe suitable for the temperature of the hot water to run shall be used.

(3) Vibration proofing of air ducts

1) Air ducts to be vibration proofed

All air ducts specified in Paragraph 7-20-4, item (1)

2) c) i) shall be suspended or supported with vibration proofing work. Vibration proofed joint shall be used in pass-through portions of soundproofed wall, connection with blower, etc.

2) Vibration proofing material

In principle, suspension type or mounting seat type vibration proofing rubber conforming to JIS K 6385 and 6386 shall be used.

The hardness and dimensions of vibration proofing rubber shall be selected as per Paragraph 7-20-8, item (2) 2) and supporting intervals as per Paragraph 7-20-4, item (1) 2) a) iii). For the type of rubber, neoprene rubber shall be used in principle. The contractor shall submit vibration proofing design drawings to the Engineer for approval in advance.

3) Method

As per Paragraph 7-20-8, item (2) 3).

Glass wool lagging band shall be when used inserted between duct support or duct support ring and duct. The width of glass wool lagging band shall be about 1.5 times as large as the width of the duct support or duct support ring.

4) Vibration proofed joint

For vibration proofed joint, flexible joint made of soft rubber film, canvas joint, or double canvas joint shall be used. The length of joint shall be 100 to 300mm depending on the dimensions of the air duct. Where lagging or anti-sweating is required, apply lagging around the outside surface. In the case of an air duct to be heat insulated or sound insulated,

mortar or other covering shall not be applied to the vibration proofed joint portion either.

(4) Inner sound insulation (absorption) lining

1) Where to apply inner sound insulation or absorption lining

Inner sound insulation or absorption lining shall be applied to sound absorbing chamber or casing to accommodate blower and sound absorbing box, sound absorbing curved air duct, sound absorbing straight air duct, etc., specified in design drawings.

2) Sound absorbing material

Sound absorbing glass wool board (No.2, 24K) conforming to JIS A 6306 shall be used. The thickness of the sound absorbing material shall be in principle be 50mm or 25mm, doubled.

3) Method

Solder a copper rivet for every 200mm square inside the side boards of a chamber or air duct, support sound absorbing material of the required thickness with glass cloth, and fit the sound absorbing material securely through washers of about 25mm in diameter. Care shall be exercised so that the tip of the rivet will not float to be loose and that the sound absorbing material shall not be compressed to less than the required thickness.

(5) Vibration proofed and sound insulated air ducts

1) Air ducts to be vibration proofed and sound insulated.

Those portions specified in Paragraph 7-20-4, item (1)

2) c) i) shall be vibration proofed and sound insulated.

2) Method

a) Fabrication

Fabricate a short pipe with a proper length depending on the thickness of the pass-through portion (thickness of the structure plus finish covering) as per Paragraph 7-20-4, item (1) 2) a) and b), and cover the central portion of the pipe (thickness of pass-through portion plus 100mm) with heat insulation material at a thickness 2 times as large as the required thickness (in the case of rock wool heat insulating material) or 3 times as large as the required thickness (in the case of glass wool heat insulating material). Wrap firmly the outside surface with galvanized steel sheet with ribs of 25mm so that the thickness of the heat insulating material shall become as required. The short pipe shall be as much short as practicable. On both ends of the sound insulating and vibration proofing covering, concealed portions shall not be processed any more and exposed portions shall be finished or else under instructions from the Engineer. The heat insulating material of the sound proofed and vibration proofed portion shall be, after application of the steel plate covering, cut in flush with the steel plate covering.

b) Installation

First temporarily set the vibration proofed and sound insulated duct at the required position, connect air ducts from both sides, and adjust the position of the vibration proofed and sound insulated air duct so that the entire air duct system shall come to the required position, and apply a sufficient amount of mortar from both sides of the pass-through portion so as to fix the air duct securely and assure sound insulation. In adjusting the position of the vibration proofed and sound insulated air duct, care shall be exercised so that the vibration proofing and sound insulating covering

shall not separate from the pass-through portion
(including inner finished portion).

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