

2-18 PLUMBING WORK

2-18-1 Scope of 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) Oil supply 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) Opening of through holes and hole reinforcement
- 5) Roof drainage

(3) Work to be accomplished by Nepal 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 Nepal 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 Nepal side. For rainwater drainage, the portion ranging down to the existing rainwater basins shall be included in this work.

(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.

2-18-2 Water Supply Work

(1) Automatic water supply system and associated facilities

1) Capacity, as per design drawings.

2) Accessories

Sluice valve	.....	2
Check valve (Anti-shock type)	.....	2
Out-put joint pipe	.....	1
Pressure switch	.....	2
Pressure gauge	.....	2
Control panel	.....	1
Blind flange	.....	1
Phase flange	.....	1
Common bed	.....	1
Foundation bolts and wrench	.....	1

3) 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 2-18-7. 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.

4) Tests

Test data shall be submitted to the Engineer.

(2) Water tank and accessories

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.

(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 malleable 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 sanitarly 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/cm² 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/cm² 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.

d) Indoor fire hydrant and box

i) For valves, chrome plated bronze stop valves shall be used. For hose connection sections, bell and spigot joint shall be used.

ii) 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.

iii) Nozzle shall be made of chrome plated bronze and have a tip of 13mm. Bell and spigot joint shall be employed for jointing hoses.

iv) Hose hook shall be of chrome plated bronze comb-shaped capable of mounting 2 hoses of 15m.

v) 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 1.6mm thick.

(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 2-18-1. Bent and branched portions shall be supported as required. Pipe supports shall be made of round steel or/and angle steel.

Table 2-18-1

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.

Water supply pipes shall be supported by vibration proof supports.

8) 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.

9) 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.

10) 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.

For water pumping pipe, the pressure shall be twice as large as the pressure corresponding to the total lift of the applicable lift pump.

11) 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.

12) 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 2-18-2.

Table 2-18-2 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 2-18-3 for the respective types of piping.

Table 2-18-3 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.

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 2-18-4.

Table 2-18-4

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.
- 3) Fire hydrant box shall in principle be given 2 coats of rust proofing paint and finished by melamine baked finish in specified colours.
- 4) Concrete work

See paragraph 2-3.

2-18-3 Hot Water Supply Work

(1) Major equipment

- 1) Hot water steel plate electric boiler

As per design drawings.

(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 2-18-5.

Table 2-18-5 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 2-18-2 "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 2-18-2 "Water Supply Work".

3) Flexible joints

Shall meet the requirements specified in Paragraph 2-18-2 "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 2-18-2 "Water Supply Work".

(5) Heat insulation

1) Material

Shall meet the requirements specified in Paragraph 2-18-2 "Water Supply Work".

2) Thickness of lagging

The thickness of lagging to be employed given in Table 2-18-6.

Table 2-18-6 Thickness of Lagging

Pipe Diameter	Thickness
less than 80mm	20mm
more than 100mm	25mm

3) Lagging work

Shall meet the requirements specified in Paragraph 2-18-2 "Water Supply Work".

(6) Painting

Shall meet the requirements specified in Paragraph 2-18-2 "Water Supply Work".

(7) On-site test and inspection

Shall meet the requirements specified in Paragraph 2-18-2 "Water Supply Work".

2-18-4 Drainage, Sewage and Vent Piping Work

(1) Piping materials

1) Pipes

- a) For straight 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 2-18-2 "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 trap 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 2-18-2 "Water Supply Work".

4) Intervals of pipe supports

- a) Intervals of steel pipe supports shall be as specified in Paragraph 2-18-2 "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 2-18-7.

Table 2-18-7 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 2-18-8 "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 tamp 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 2-18-8

(Unit: mm)

Pipe Bottom Depth	Width Length	Wall Thickness	Rubble Thickness	Bottom Thickness	Manhole Diameter	Manhole Lid Size
Under 450	300x300	100	100	120	300	300 [□]
460 ~ 600	360x360	100	100	120	300	300 [□]
610 ~ 750	450x450	100	100	120	450	450 [□]
760 ~ 900	500x500	120	150	150	450	450 [□]
910 ~ 1300	600x600	120	150	150	600	600 [□]
Over 1310	750x750	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 2-18-9.

Table 2-18-9

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 2-18-2 "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) A clean-out shall be provided at the ends of drainage pipes and at locations specified in drawings or by the Engineer.
- 18) 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.
- 19) 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.
- 20) When making a trap with lead pipe, ensure to make the water seal depth more than 50mm.
- (3) Septic tank (clarification tank)
 - 1) Volume and dimensions
As per design drawings.

2) Concrete work

As per paragraph 2-3 "Concrete Work"

3) Crushed gravel

Granite, Liparite or other stone which can bring up a aerobic bacteria film shall be used.

The gravel shall not be flat or long and slender, shall be square form having many corners.

The gravels shall be 50mm diameter for upper part and 75 ~ 100mm diameter for lower part of tank.

4) Concrete bar for gravel receiving

A bar shall be made of reinforced concrete which is mixed small gravel. (less than 15mm in diameter)

In any case the bar shall not be loaded less than 28 days after making.

5) Sprincler gutter

Sprincler gutter shall be made of reinforced concrete which is mixed pea gravel (less than 10mm in diameter).

The section of a gutter shall be V-Type, and the both sides of a gutter has water-drop-notchs which shall be arranged zigzag and to spray uniformly the sanitary sewage for gravels.

The surface of a gutter shall be finished by brash.

6) Vent pipe and vent cap

a) Normal hume pipe (JIS A 5303) shall be adopted at the part of underground, and hard polyvinyl-chloride pipe shall be adopted at the part of above the ground.

b) Vent pipe shall be more than 3,500mm above ground level in case of self-standing, and more than 600mm above roof-slab in case of mounting to Building. In case of self-standing, vent pipe shall be reinforced by steel or concrete. In case of mounting to

Building, it shall be fixed solidly to Building at two points (less than 3,000mm).

7) Submersible pump for sanitary sewage.

Capacity: As per design drawings

8) Disinfection material

It shall be high quality tablet, and the chief ingredient shall be calcium hypochloride.

The tablet shall contain the active chlorine more than 75%.

(4) Anti-sweat work

Shall meet the requirements specified in Paragraph 2-18-2 "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.

(5) Painting

Shall meet the requirements specified in Paragraph 2-18-2 "Water Supply Work".

(6) 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 compressure 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/cm² 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 25mmAq.

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.

2-18-5 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 2-18-2 "Water Supply Work".

2) Valves, faucets, and joints

Shall meet the requirement specified in Paragraph 2-18-2 "Water Supply Work" and 2-18-4 "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.

(2) 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 slop sink:

705mm from floor face to top of apron

(3) 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 of cocks.

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

(4) Curing

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

2-18-6 Fuel Oil Supply Work

(1) Fuel oil tank

1) Volume and steel plate thickness

As per design 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.

(2) 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) For piping, steel gas pipe conforming to JIS G 3452 shall be used.

(3) 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.

(4) Testing

Water pressure test of pipes shall be performed at 5kg/cm²

2-18-7 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 2-18-10.

Table 2-18-10

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

Expansion joint portion shall meet the requirements specified in Paragraph 2-18-2 "Water Supply Work".

(2) Vibration proofed support of piping

All pipes in the area specifically noted in Paragraph 2-18-4, (2), 5) 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 2-18-2, 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 2-18-2, 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.

2-19 AIRCONDITIONING AND VENTILATION WORK

2-19-1 Scope of Work

(1) Extent

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

- 1) Air handling unit, packaged air conditioner and air duct work.
 - a) Air handling unit and packaged air conditioner
 - b) Air Duct
- 2) Ventilation work
 - a) Ventilating fan
 - b) Air duct
- 3) 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
 - 2) Plumbing work
 - 3) Door grill
 - 4) Louver on external wall
 - 5) Making holes on structure and reinforcement for them
 - 6) Reinforcement for opening on suspended ceiling
- (3) Spares

For Air Filters, as many frames as equal to 19% 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) Nameplate

Each unit shall have nameplate specifying the name of manufacturer type and serial number of the unit, specifications and date of manufacture.

(5) Inspection

Water-fill, water reducing, drainage, water leakage, water discharge, and air sending tests and operation of packaged air conditioner, air handling unit, pump, and fan shall be performed during the work and upon completion of the work.

2-19-2 Air Handling Unit, Air Duct and Piping Work

1) Air handling unit

The air handling unit shall incorporate a blower, an electric heater, a humidifier and an eliminator with a motor mounted outside its casing.

a) Capacity & Dimensions

As per design drawings

b) 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 2-19-4, Item (1) 1) d) (a). The noise level of the blower shall be less than 60dBA at a position 1m apart from the side of the casing.

c) Humidifier

Capacity; as per design drawings.

A humidifier shall be spray nozzle type. Sockets shall be welded on a galvanized steel pipe (JIS G3452), and attach spray nozzle made of brass or other anti-corrosion materials on sockets.

Spray nozzle shall spray small-grained water drop as a mist.

d) Eliminator

Eliminator shall be installed behind a humidifier.

Eliminator shall be made of three-fold galvanized steel sheet (JIS G3302) more than 0.6mm thick, or made of polyvinyl chloride fibre more than 50mm thick.

e) Drain pan

A drain pan shall be made of steel sheet (more than 1.6mm thick) conforming to JIS G3141. 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.

f) Casing

The outer casing shall be made of a framework reinforced sufficiently with shape steel conforming to JIS G3101 and JIS G3192 and steel plate conforming to JIS G3141 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 rust-proofing paint on which glass wool insulation boards of more than 25mm thick shall be pasted for

g) Installation

This unit shall be installed on a concrete foundation of 100mm high by the method specified in Paragraph 2-19-6 "Vibration Proofing and Sound Insulation Work".

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 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) Heat pump type packaged air-conditioner

a) Capacity

As per design drawings.

b) Construction

Standard type of Japanese manufacture.

c) Pipe for refrigerant

Standard type of Japanese manufacture

d) Installation

This unit shall be installed on a concrete foundation of 100mm high by the method specified in paragraph 2-19-6 "Vibration Proofing and Sound Insulation Work".

2-19-3 Air Duct Work

(1) Ducts

1) Materials

- a) Galvanized sheel sheet shall conform to JIS G3302 and have the standard zinc weight given in Table 2-19-1.

Table 2-19-1 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 G3192 and bar steel to JIS G3191.

c) Rivets, bolts and nuts

Rivets shall conform to JIS B1213 and JIS B1214 and bolts and nuts to JIS B1180 and JIS B1181.

d) Packing for flanges

For packing for flanges, asbestos tape of 3mm thick using asbestos string conforming to JIS R3450 and packing of 3mm thick using asbestos board conforming to JIS R3454 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 2-19-2. Care shall be exercised so that joints shall not be located in pass-through portions.

Table 2-19-2 Thickness and Joints of rectangular Ducts

Length of Long Side (mm)	Sheet Thickness (mm)	Connecting Flange		Rivet 4.5φ pitch (mm)	Bolt 7.5φ pitch (mm)
		Standard	Maximum Interval (m)		
less than 450	0.5	L-25x25x3	3.6	65	100
460~750	0.6	L-30x30x3	3.6	65	100
760~1,500	0.8	L-40x40x3	2.7	65	100
1,510~2,200	1.0	L-40x40x5	1.8	65	100
more than 2,210	1.2	L-50x50x4	1.8	65	100

ii) Reinforcement

As per Table 2-19-3. When the length of the long side is less than 300mm, reinforcement by standing seam may be used.

Table 2-19-3 Reinforcement

Sheet Thickness (mm)	Reinforcement Angle		Rivet 4.5φ Pitch
	Standard	Maximum Interval	
less than 0.6	L-25x25x3	1.8 (mm)	65 (mm)
0.8	L-30x30x3	0.9	65
1.0	L-40x40x3	0.9	65
1.2	L-40x40x5	0.9	65

Table 2-19-4

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 2-19-5

Table 2-19-5 Metal Parts and Supports

Duct Thickness (mm)	Support Angle	Metal Part		Support Maximum Interval
		Steel Bar	Maximum Interval	
less than 0.5	L-25x25x3	9 (mm ϕ)	2.7 (m)	3.6 (m)
0.6	L-30x30x3	9	2.7	3.6
0.8	L-30x30x3	9	2.7	3.6
1.0	L-40x40x3	9	2.7	3.6
1.2	L-40x40x5	9	2.7	3.6

b) Round steel sheet duct to be fabricated at site

i) Sheet thicknesses joint

As per Table 2-19-6. Care shall be exercised so that joints shall not be located in pass-through portions.

Table 2-19-6

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 2-19-7.

Table 2-19-7

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 2-19-8

Table 2-19-8 Hangers and Supports

Diameter	Flat Bar	Metal Part	Maximum Interval of Support
less than 1,500mm	25x3mm	9mm ϕ	3.6mm

c) vibration proofing and sound insulation

i) Vibration proofing hangers

Air ducts to pass studios, subcontrol rooms and air-conditioner rooms shall be suspended by vibration proofing supports as per paragraph 2-19-6. Air ducts more than 500mm length of long side to pass other rooms shall be suspended or supported by above-mentioned method.

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 2-19-6. 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 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 2-19-3. 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 sheel sheet of more than 0.6mmthick.

- b) Damper shall function well without vibration and involve minimum air resistance when open.
 - c) The damper shaft shall be made of galvanized sheet 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 movable 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 G3141, brass sheet, or aluminum sheet.

iii) Ceiling air diffuser

Shall use steel sheet as specified in JIS G3141, 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.

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 2-19-6. 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 cross-sectional dimension of the sound absorbing chamber shall be more than 1.5 times as large as the cross-sectional 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 A9504) or glass wool lagging (JIS A9503, 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 pipes specified in JIS G3452 (steel pipes for piping and gas pipes) shall be used.

ii) Joints

Malleable cast iron pipe joints or steel pipe joints or steel pipe joints specified in JIS B2301 and JIS B2302 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 B2212 shall be used.

iii) Vibration proofed joint

As per Paragraph 2-19-6.

b) Valves

i) Sluice valves

Sluice valves of less than 50mm in diameter shall be of bronze screw-in type specified in JIS B2013. 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 B3025. 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 B0203 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 2-19-6 "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 2-19-12.

Table 2-19-12 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 tight 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 pumps, flexible joint shall be used. Flexible joint shall in principle be made of rubber product with dimensions specified in Table 2-19-13.

Table 2-19-13 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 R3453) 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 apply 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 A9504, No. 2 and JIS A9505, No. 2) shall be used.

ii) Thickness of lagging

Thickness of lagging shall as given in Table 2-19-14.

Table 2-19-14 Thickness of Lagging Material

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

iii) Mounting to 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.

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 2-19-3, Item (5), 3) a) i).

ii) Thickness of anti-sweat material

Thickness of anti-sweat material shall be as given in Table 2-19-13.

Table 2-19-15 Thickness of Anti-Sweat Material

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

iii) Mounting of anti-sweat material

As per Paragraph 2-19-3, 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.

2-19-4 Ventilation Work

(1) Work for blower

1) Multi-blade blower

- a) Type : Sirocco type
- b) Motor : Enclosed drip-proofed type
- c) Accessories : Pully, 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 2-19-11. KW denotes the capacity of the motor.

Table 2-19-11

Octave Band (Hz)	63	125	250	500	1k	2k	4k	8k
Noise of blower	-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 by using the vibration proofing method specified in Paragraph 2-19-8. 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 2-19-9.

Table 2-19-9 Common Floor Bed, Channel Steel Base and Suspension Bolts

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

ii) Vibration proofing

As per Paragraph 2-19-6 "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 or pressure and ventilating fans shall be as per Paragraph 2-19-6 "Vibration Proofing and Sound Insulation".

(3) Ducts

1) Duct work

a) Materials

A rectangle duct; as per paragraph 2-19-3 (1).

A spiral duct shall be made of galvanized steel sheet (JIS G 3302) which shall be seamed by machine as spiral form.

Dimension of spiral duct shall be inner size in diameter.

Allowance of the inner size shall be less than $0 \sim +2\text{mm}$.

A thickness of the spiral duct shall be 0.5mm for less than 200mm ϕ in diameter.

A space of the seam shall be less than 100mm for duct of less than 100mm ϕ in diameter, and less than 150mm for duct of less than 1,000mm ϕ in diameter.

A joint shall be made of galvanized steel sheet (JIS G 3302) which shall be seamed.

A thickness of the joint shall be 0.6mm for less than 200mm ϕ in diameter.

A overlap length to insert of the joint shall be more than 60mm for the joint of less than 120mm ϕ in diameter, and more than 80mm ϕ for less than 300mm ϕ .

b) Method

As per Paragraph 2-19-3, Item (1) 2).

c) Painting

As per Paragraph 2-19-3, 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 2-19-3, Item (2).

2-19-5 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 damper

Proportional control type

d) Automatic/manual mode selector

e) 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) Thermostat and humidistat shall be mounted at such locations that their required functions can fully be achieved.

(4) Tests

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

2-19-6 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 K6385 and JIS K6386 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 2-19-10 and thus applicable product shall be selected from among standard product of manufacturers.

Table 2-19-10

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 sub-control 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 turn-

buckle 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 2-19-6, 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 2-19-3, Item (5) 2) 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 K6381 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 2-19-10 and thus shall be selected from among standard products of relevant manufacturers. Supporting intervals shall be as specified in Paragraph 2-19-3, 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 20-19-6, 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 20-19-6, 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 2-19-16.

Table 2-19-16 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 2-19-3, Item (1) 20)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 K6385 and 6386 shall be used.

The hardness and dimensions of vibration proofing rubber shall be selected as per Paragraph 2-19-6, Item (2) 2) and supporting intervals as per Paragraph 2-19-3, 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 2-19-6, 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 joining

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 A6306 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 washer 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 2-19-3, Item (1) 2)c)i) shall be vibration proofed and sound insulated.

2) Method

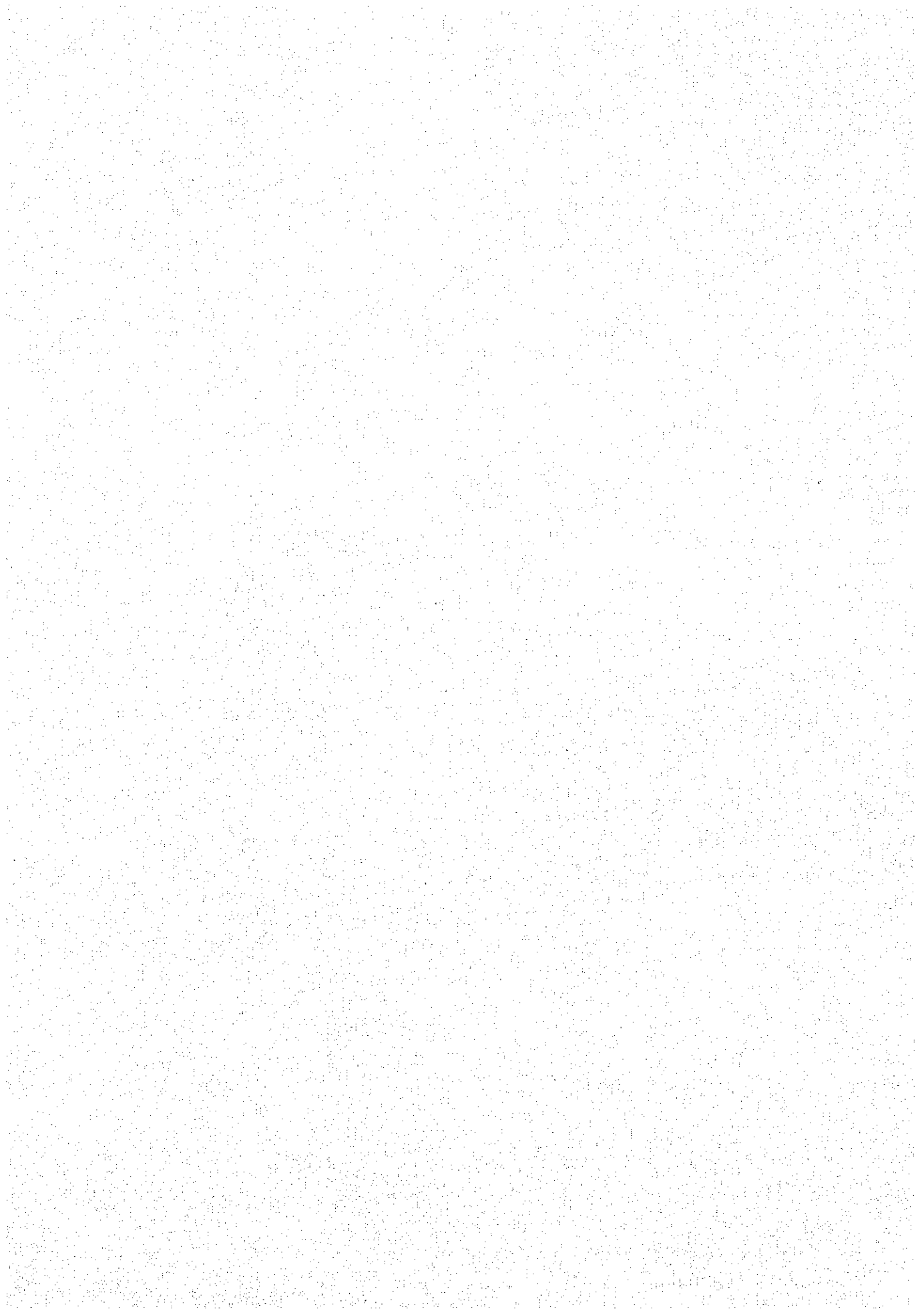
a) Fabrication

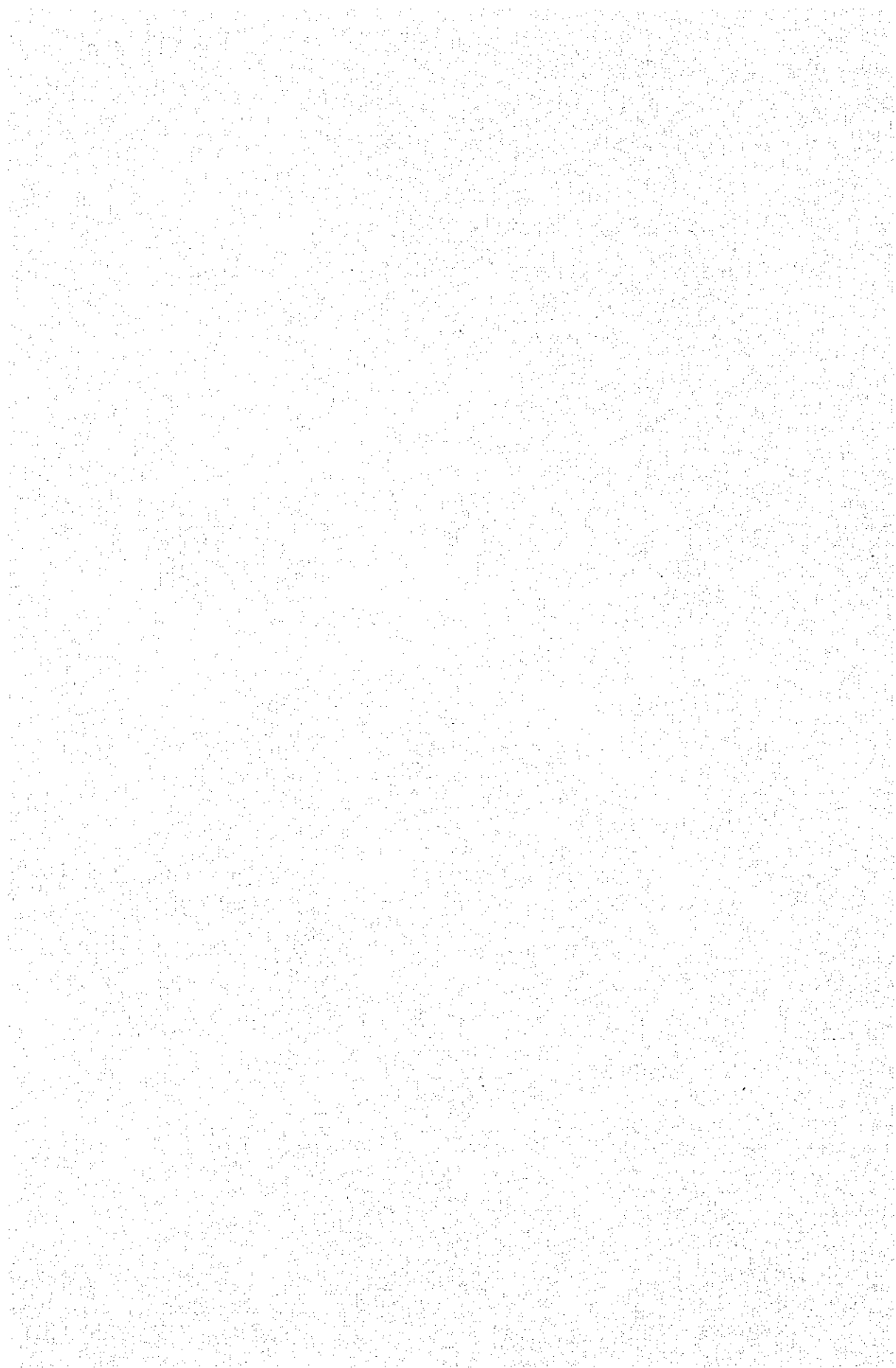
Fabricate a short pipe with a proper length depending on the thickness of the pass-through portion (thickness of the structure plus finish covering) as per Paragraph 2-19-3, Item (1) 2)a) and b), and cover the central portion of the pipe (thickness of

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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