

SECTION 15
INTERIOR FURNISHING

15.1 **SCOPE OF WORK:**

15.1.1 **Extent:** The work required under this section consists of all interior furnishings and related items necessary to complete the work indicated on drawings and described in specifications.

15.2 **SHOP DRAWINGS:**

15.2.1 Submit shop drawings to the Supervisor for approval of all items of interior furnishing. Obtain approval of drawings prior to proceeding with fabrication.

15.3 **SAMPLES:**

15.3.1 Submit samples in duplicate of the following materials or assemblies to the Engineer for approval. Approval must be obtained prior to delivery or fabrication.

(a) Curtains and curtain rails including accessories.

(b) Vertical blinds including accessories.

15.4 **MATERIALS AND WORKMANSHIP:**

15.4.1 **General:** When materials and workmanship specified in other section of this specification are applicable to works included in this section, the works shall conform to those specifications.

15.5 **CURTAINS AND CURTAIN RAILS:**

15.5.1 **Curtains:** The quality, color, pattern and accessories of curtain materials shall be determined by the Supervisor by samples to be submitted.

15.5.2 Curtains for shower spaces shall be of vinyl cloth of more than 0.2 mm thick or of waterproof treated cloth.

15.5.3 Curtain rails shall be of stainless steel or aluminum alloy fur-

nished with runners and other necessary accessories, and shall be the product determined by sample.

15.5.4 Furnish wood curtain boxes at locations indicated on drawing as detailed.

15.6 CABINET WORK AND OTHER SIMILAR FURNISHINGS:

15.6.1 General Requirements:

- (a) As to materials and workmanship, see joinery items in "CARPENTRY AND JOINERY".
- (b) Doors of them shall be provided with proper and adequate hardware including cabinet hinges, pulls, cabinet spring/magnetic catches or latch and cabinet locks (if required).
- (c) The furnishings shall be steady and durable, and finished with paint indicated on drawings and as specified in "PAINTING".
- (d) Provide adequate anchor bolts or other fixing devices to install the cabinet work onto walls and on floors. Provide cleats or battens, and where indicated or required concrete block or concrete in situ shall be installed in masonry.
- (e) All the works shall be executed as shown on shop drawings approved by the Supervisor.

15.6.2 Cupboard/Wallcabinet: Cupboard/wallcabinet shall be provided where indicated on drawings. Provide hinged doors and shelfboards where indicated. Height of shelfboards shall be adjustable at two or three levels.

15.6.3 Store shelves:

Store shelves shall be provided where indicated on drawings and shall be fixed to wall to prevent falling.

15.7 MAKE-UP TABLES:

15.7.1 Make-up tiles with marble counter tops shall be installed in Make-Up Rooms as shown on drawings.

15.7.2 Terrazzo block counter shall be reinforced with wire mesh and/or steel pencil rods properly.

15.8 WASH TABLES:

15.8.1 Wash tables with marble counter tops shall be installed in Make-Up

Room as shown on drawings.

- 15.8.2 Marble counter shall be reinforced with wire mesh and/or steel pencil rods properly, and provided with opening to receive wash basin by "PLUMBING".

15.9 SINKS:

- 15.9.1 Terrazzo sink with wood undercabinet shall be installed in the corner of the side stage as shown on drawings.

(a) Terrazzo sink shall be prefabricated by a compression and vibratory process in accurately constructed watertight mould. It shall be reinforced with wire meshes and steel pencil rods to prevent cracks and fractures.

15.10 RECEPTIONIST'S COUNTER:

The counter shall be of wooden base, as indicated by the drawing, with melamine-dressed ply-wood top board and with vinyl-leather pasted waincoting. Drawers and shelves shall be fitted inside the counter.

15.11 MIRROR:

- 15.11.1 Mirrors shall be installed at the places indicated on drawings. Mirror plate shall be similar to "Hi-Mirror" manufactured by Nihon Sheet Glass Co., Ltd. or products of Toto Kikei Co., Ltd. Mirrors shall in principle be fixed securely to mortar finished walls. The fixing shall be done by screwing the metal frames or fittings to the wood bricks embedded in the wall or in such a manner as may be approved by the Supervisor.

15.12 CARPET:

Carpets shall be jute carpets as manufactured locally. The apparent thickness of carpets shall be approximately 8 mm and colors, designs and quality shall be decided on submission of samples. The underlay shall be low felt having a thickness of 10 mm.

15.13 ROOMNAME PLATES:

15.13.1 Provide and install roomname plates as indicated on drawings and as directed by the Supervisor. The plates shall be of plastic plate of 8 cm x 20 cm. Roomnames shall be painted on by enamel both in Bengalese and English under the directions of the Supervisor.

15.14 GAUZE LAYING WORK:

Refer to 16.2.9

15.15 INSECT SCREEN:

Unless otherwise directed by Supervisor, the insect screen to be fitted shall be 16-mesh 0.19 mm dia. stainless steel wire nets.

15.16 MINERAL ACOUSTICAL TILE CEILING:

15.16.1 Mineral acoustical tiles shall be bonded onto gypsum plaster boards screwed to wood furring of suspended ceiling system, with the adhesives approved by the manufacturer of the tiles and nails. As shown on tiles are available in two types: one having travertin surface and the other having ribbed surface.

15.16.2 Install acoustical tiles in a true and even plane, in a straight courses laid out symmetrically about centre lines of ceiling.

15.16.3 Ceiling access and openings with frames for lighting fixtures shall be installed as shown on shop drawings.

15.17 WOOD CEMENT PANELS:

Wood cement panels complying with JIS A 5417 shall be provided for heat insulation and sound absorption. Wood cement panels to be used in the walls of the passage under the stage shall be 80 mm in thickness and reinforced with D-10 ϕ deformed bars arranged at the rate of five per panel (500 x 3,000) and they shall be fixed

securely as indicated on drawings.

Wood cement panels for use in other places shall have a thickness of 50 mm and be driven into concrete bases where these are provided. When the panels are to be used in the base of brick wall, they shall be fixed in accordance with drawings.

15.18 BLIND:

Blinds shall be fitted to windows as shown on drawings.

The blind shall be of the vertical type made of an aluminum alloy and its opening-closing motion shall be controlled by gearing.

Slats shall be C-shaped with finished width of 34 mm and thickness of 0.15 mm.

Attachment brackets shall be fixed at both ends of a head box if the blind width is up to 1.8 m, and more than one additional brackets shall be fixed at the center of the head box, if the width is greater than 1.8 m. The blinds shall be fixed securely with screws or other suitable means.

15.19 SPRAY-TILE WORK:

- (a) Refer to 16.2.14.

15.20 DRILLING IN CIELING:

- (a) This architectural practice which is also adapted in the interior finishing of auditoriums in modern times.

- (b) Drilling of holes for installation of electrical appliance, fixtures for air-conditioning system, and other fixtures in ceiling shall be included in the ceiling beam work.

As illustrated in the figure, cut shall be made properly at specified position and reinforcing members for ceiling strips and supports shall be securely attached.

Installation of fixture shall be inspected by the supervisor.

SECTION 16

AUDITORIUM INTERIOR FINISH WORK

16.1 GENERAL DESCRIPTION:

The work shall cover the whole interior finish work for the auditorium, stage (including side stage), sound lock, sub-control room and projection room. This auditorium shall be built as the multi-purpose hall to be used for broadcasting as well. Since it is designed with particular care for acoustic treatment such as sound insulation and absorption, the work shall have to be performed with full understanding and utmost caution in line with this principle.

16.1.1 Auditorium:

For the auditorium to be used for multi-purposes the first consideration shall be given to complete insulation of sound coming from outside. The sound lock shall therefore be provided, in all instances, for the doorways leading to the other parts of the building. The partition wall and slab shall be added with brick work or plaster board in duplex layers for improved sound-proof. Doors and windows shall be equipped with sound-proof fittings. Since the interior work is designed on the basis of acoustic calculation, the work shall have to be performed precisely by full understanding of drawings and specifications.

16.1.2 Stage:

The stage shall be the important part to display its effect. It shall be zoned into front stage (including apron), main stage, and side stage. Though each of those may have its own function, the floor shall be finished same for all such stages. The stage floor shall naturally be important in construction. Particularly, since it shall be bearable against frequent movements of the set scenes and TV cameras, the floor shall have to be finished with sufficient solidity and smoothness as shown in the drawings.

The wall shall be covered with the cemented chip board to insure sound absorbing effect. The ceiling shall be of sound-proof with duplex plaster board under the slab. The open space shall be provided with the grid, hurdle-floor and gallery for suspension and lighting. Same as is the case of the auditorium, full care shall be paid to sound insulation from outside.

16.1.3 Orchestra Pit:

The orchestra pit shall be capable of accomodating about 40 members. When it will not be used as the pit, it shall be converted into the audience seats by use of the prefabricated wooden floor. The inner wall of the pit shall provide sufficient space for accomodation of the prefabricated floor and the members' chairs, being partitioned with the sliding wall. Since the orchestra pit and underpass will be below ground water level in the rainy season, particular care shall be required for water proof.

16.1.4 Projection, sub-control and rack rooms:

The sound-absorbing interior wall shall be provided on the inner side of the structure. Doors and windows shall be equipped with sound-proof fittings with full care for security of sufficient sound insulation. The sub-control and rack rooms shall be provided with wiring channels for broadcasting. The ceiling shall be laid with the sound insulating layer over its bare with the suspending beam of vibration-proof structure.

16.1.5 Curing and Security:

Since the auditorium and its associated rooms have very limited number of openings direct to open air, curing shall be required, to the fullest extent, for removal of moisture from material for interior finish. Prior to start of the interior work, the temporary ventilating unit and moisture remover shall be used to insure drying effect of the interior work surface.

Particular care shall be required for preservation of the worker's safety and sanitation during performance of the main and associated installation works.

16.2

ASSOCIATED WORKS:

The interior finish work shall be associated with many kinds of general construction work. Normally, each of such associated works shall be done by application of its own specialized specification. Besides that, however, the following specification shall apply to each of those works.

16.2.1 Concrete Work:

Honeycombs, which may be produced on the concrete walls of the auditorium, stage, sound lock, sub-control room and projection room, shall be removed and pressed with hard mortar; since such honeycombs will affect the sound-proof effect on both sides of the wall. Likewise, any other faulty holes and defective points shall be filled and patched up with mortar. Required thickness for concrete placing shall be as shown in the drawing.

16.2.2 Brick Work:

The brick wall (both new and existing portions) shall be filled up with joint-mortar; particularly at each end on both sides and at top and bottom ends. In case where the brick wall may constitute the double wall with the main structure, the use of the support leg from the structural wall shall be restrained.

16.2.3 Plaster Work:

The brick wall for plastering shall be mortar-finished over its surface. Thickness of plastered mortar shall be limited strictly to 20 mm and the work shall be done so carefully as to eliminate possible creation of crack and peel-off. The surface shall be finished with evenness by use of the trowel.

16.2.4 Carpentry Work:

Timber material to be used for interior work shall be dried wood of designated size and correct shape. Surface shall be of plane finish. The water content ratio shall be kept below 15 percent. Timber shall be stored under proper air ventilation, being fully protected from moisture, wind and rain. All the framework shall

normally be of shiprap. The stud shall be of stub tenon at the top and of dado joint at the bottom, each being pegged with two nails. Each joint shall be strengthened with metal stiffeners if and when deemed necessary.

16.2.5 Sound-Proof Plaster Board Work:

The plaster board shall be provided for sound insulation, being laid over the ceiling base of the auditorium, stage, sub-control room and rack room.

Material to be used shall be the plaster board specified by JIS A6901. It shall be used in its full standard size or its halved size, if possible, without being cut into small sizes. It shall be laid in doubled and staggered way. Each seam shall be of butt splice and shall be raised so as to be set at the center of the stud, to avoid overlapping of seams on each layer.

Nails shall be zinc-plated with 25 m/m length for the 1st layer only and 30 ~ 32 m/m for the 2nd layer and shall be nailed down at a pitch of 150 m/m or so.

Each gap between surface levels shall be filled up with coking material sufficiently as shown in the drawing. This shall be done after approval of the supervisor upon the sampling of coking material to be used. Coking material shall be pressed in thoroughly by use of a coking gun after cleaning of the portion to be filled and shall be forced down evenly by use of a spatula or the like.

16.2.6 Surface Board Laying Work:

(a) Auditorium wall

The board shall be of calcium silicate board, as shown in the drawing, in accordance with JIS A5418. The 24 m/m laminated board shall be comprised of two (2) layers each of 12 m/m board adhered together by use of epoxy resin adhesives. The board shall be laid with either stainless-steel nails (length of nail to be more than 2.5 times of board thickness) or stainless-steel bolts, spaced at about 150 m-m from one to the other.

The side wall shall be finished with spray tile. Prior to start of the work, the wooden frame and boarding surface shall be corrected regularly. Gaps shall be filled up with coking putty for evenly finished surface.

(b) Auditorium ceiling

The ceiling shall be of asbestos cement boarding, as shown in the drawing, in accordance with JIS-A5403. The board shall be laid by use of zinc-plated countersunk bolts, each spaced at about 150 m/m. After full adjustment for correction of irregularity and gap, the underlaid cloth shall be pasted up and finished by the VP roller after application of putty.

(c) Subcontrol, rack and projection rooms

As shown in the drawing, the water-proof plywood of 6 m/m thickness with partial use of the perforated panels shall be provided. Panels shall be standardized at a size of either 450 x 600 m/m or 455 x 605 m/m and shop-fabricated without such field processing as molding or drilling in normal instances. Diameter and pitch of holes on the perforated panels shall be as specified in the drawing.

16.2.7 Sound-absorbing Glass Wool Work:

Material shall comply with the requirement provided by JIS-A6306 glass wool sound absorbing felt No. 2 24K and its thickness shall be as specified in the drawing. Material shall be cut into fitted size and shape of the framework indicated in the drawing and inserted into the frame. The framework shall be provided with board and wooden lath, as instructed by the drawing, in order to settle the material at the required position. The cloth-covered surface shall be wrinkled with polyethylene film of 0.02 m/m between cloth and glass wool.

16.2.8 Polyethylene Film:

A sample of the product of Sekisui Chemical Industry Co., Ltd. or an equivalent shall be submitted for approval of the Supervisor.

16.2.9 Gauze Laying Work:

Gauze dyed in black or gray shall be used between glasswool and perforated plywood. It shall be laid with tensile force to be free from wrinkles.

16.2.10 Vinyl Sheet Laying Work:

(a) Material: Kind and color of vinyl sheet shall be determined as instructed by the Supervisor. Thickness shall accord with that indicated in the drawing and shall require approval of the Supervisor upon presentation of the sample.

Adhesives shall be the product of the same manufacturer as vinyl sheet to be used and shall be subjected to approval of the Supervisor.

(b) Bed surface

Bed surface for mortaring shall be finished with evenness leaving no ripples after handling of the trowel and shall be dried up.

(c) Temporary laying shall be provided if and when necessary.

The sheet shall be cut out to longer length than its allocated length and laid down for 10 days on so until full expansion can be obtained after complete removal of curls.

(d) Final laying and pastering

(1) Locations of joints and seams shall be subjected to approval of the Supervisor.

(2) Prior to start of pastering, the bed surface shall be cleaned thoroughly and nails shall be driven to fill up any gap at joints, seams, doorway edges and around column.

(3) For pastering of sheets adhesives shall be spread evenly over the bed surface and, if necessary, over the back surface of sheets so as to eliminate irregularities and discrepancies.

(4) After pastering, extra surplus of adhesives on the surface

shall be wiped out. Sheets shall be pressed by roller or some other appropriate means so as not to leave air on the contact surface and, if necessary, battened for curing.

- (e) For final surface finish the whole surface shall be washed out at appropriate time when adhesives will become hardened. After drying of the washed surface water soluble wax shall be applied for polishing.

16.2.11 Ceiling Grid and Other Metallic Works:

For fitting of the metallic material to the wall anchor bolts shall be used for fixture to the concrete wall and beam, as shown in the drawing. For the bed wall of structural steel at the upper proscenium the metallic fixture shall be affixed tightly to the structural steel bed after penetrating the finished board surface. It shall be set correctly at the horizontal position by use of hanging bolts. Hanging bolts shall not be sagged perpendicularly. After adjustment in length the nut shall be tack-welded to serve as detent. For rust prevention coating on the member components reference shall be made to the relevant items in (13) Metallic Work and (14) Coating Work.

16.2.12 Stage Floor:

As shown in the drawing, the stage floor shall be finished evenly without irregularities and gaps. For the foundation material wood dried up with particular care shall be used. Each joint shall be of such structure that it can transmit required load and,, besides, can bear stress. The level gauge shall be checked every-time the sleeper, floor joist and slab floor may be set in place. Finished flooring material shall be the laminated Japanese oak wood. Prior to boarding work, allotment of boards shall begin with staggered alignment of seams. Then, flooring boards shall be regularly arranged with full care not to damage tongue or groove of butt end and shall be fixed by combined use of adhesives and nails. After finish of boarding work, the surface shall be cleared of unevenness and irregularity by use of the deck sander.

16.2.13 Audience Chairs:

The chair for audience shall be as illustrated and shall be the product at the factory of the manufacturer authorized by the supervisor. The sample of material for the chair shall be submitted to the Supervisor for his approval.

The movable chair shall be affixed to the floor as illustrated. Careful adjustment shall be required to insure stability.

16.2.14 Spray Tile Works:

Spray tile shall be used for the interior wall of the auditorium. It shall be made of organic epoxy resin. With regard to final specification for finish including surface finish, color and gloss, the sample shall be submitted to the Supervisor for his approval. The bed wall panel surface shall be adjusted sufficiently to eliminate irregularities and gaps. Especially, the wooden frame of the panels and the butt of the boards shall be finished with seamless evenness.

Spray tile shall be the product of Bon Tile Co., Ltd., Fujimori Sangyo Co., Ltd. and Shinetsu Unit Co., Ltd. or its equivalence. The sample shall be presented to the Supervisor for his approval.

16.2.15 (a) Sound-proof window

The window shall be of aluminium and fabricated as illustrated. Glass shall be of 10 m/m thick transparent polished plate and shall be affixed to the window sash by use of H-rubber.

The sample of H-rubber manufactured by Meiki Industry Co., Ltd. shall be determined upon presentation to the Supervisor.

(b) Sound-proof door

Doors to be provided for the auditorium, sound lock, sub-control room, rack room, projection room shall be specified correspondingly same as provided by Section 10 'Steel Door', and shall be characteristic of a high sound insulating degree with particular care for preservation of accuracy in manufacture and installation.

16.2.16 Sliding Wall:

The sliding wall shall be provided within the orchestra pit. It shall be the product of Nichi-bei Blind Industry Co., Ltd. Type C-60 or any other equivalent thereto.

(a) Sliding Wall under stage

In order to make the wall surface reflective, the finished panel on the pit side shall be of VP finish, 12 m/m plywood.

(b) Sliding wall under audience seats

In order to give sound-absorbing characteristic to the surface of wall, the finished panel on the pit side shall be of 6 m/m plywood perforated with $6 \phi \sim 20$, VP finish. Victoria lawn dyed in black color shall be covered between the sliding wall and the inner lock wall.

(c) Hanger rail shall be installed correctly and rigidly as instructed by the drawing. The floor surface under the sliding wall shall be finished at exactly horizontal level with smoothness.

(d) Full adjustment shall be made after installation so as to eliminate any possible slackness, distortion or warp at the closed position.

16.2.17 Vinyl Floor Tile:

Floor tile shall be laid over the floors of the subcontrol and rack rooms. Tile shall be used in compliance with JIS A5705. Thickness shall be 3 m/m and grade and color of tile shall be decided as instructed by the Supervisor. The bed prepared for laying of tile shall be fully dried up and epoxy resin shall be used as adhesives. Surface finish shall be as specified in 16.2.10 (e).

16.3

NOISE PROOFING:

The wiring channel existing between the auditorium and its neighboring rooms will be apt to cause sound leakage. Therefore, after inspection of each part involved the channel shall be filled up

with glass wool from both ends for prevention of sound leakage after finish of all the associated works.

16.4

ACOUSTIC TEST:

Acoustic test shall be conducted as part of the work completion test. All contractors involved in this construction work shall be requested to extend their cooperation in conducting the measuring test.

(a) Purpose

The test purpose shall be to determine acceptability of the completed work from the acoustic viewpoint.

(b) Test items

- (1) Reverberation characteristics
- (2) Sound insulating characteristics
- (3) Noise pressure spectre
- (4) Noise level

(c) Acoustic revamping

In case where any defective points in the acoustic condition may be discovered from the test result, the Supervisor shall proceed with necessary investigation to find the cause. If such defect comes from deficiency in the construction method, the contractor shall take prompt action for revamping of the defective part(s), as directed by the Supervisor.

If the defect comes from any other cause than stated above, the necessary measures shall be taken as instructed by the Supervisor.

SECTION 17
MISCELLANEOUS WORK

17.1 SEALING:

17.1.1 Scope of Work:

This paragraph shall apply to the filling for connection and joint of component parts and the padding for glass by use of irregular-form elastic sealing material (hereinafter referred to as sealing material) and oilness coking material.

A general term for sealing material and oilness coking material shall be called 'material for sealing'.

17.1.2 Material:

(a) Sealing material shall be specified as follows.

(1) Material shall be the product to be supplied from the specially designated factory as specified in the following Table 17.1.2.

(2) Material shall indicate its compliance with the performance condition requisited by JIS A5757 (performance character by uses of sealing material for building construction), being accompanied by the official test record issued from the authorized laboratory.

Table 17.1.2 Standard and Durability of Sealing Material

Material	Standard	Durability
Silicone sealing material	JIS A5755 (Silicone sealing material for building construction)	1st class
Polysulfide sealing material	JIS A5754 (Polysulfide sealing material for building construction)	1st class
Urethane sealing material	-	1st class 2nd class
Water acryl sealing material	-	2nd class

(3) Base and hardening agent for the binary system sealing material shall be of such compounding as designated by the factory.

(4) Auxiliary material

(i) Primer shall be the product of the main material production factory and shall be suited for the adherent (the paint if used for coating).

(ii) Back-up material shall be made of either synthetic resin or synthetic rubber to be in no contact with sealing material. It shall be shaped suitably for the place of use and sized 2 mm wider than the width of joint.

(iii) Bond breaker shall be either polyethylene tape or polyethylene-applied paper tape.

(b) Oilness coking material shall be of such standard as may satisfy the requirement set forth by JIS A5751 (oilness coking material for building construction).

17.1.3 Storage:

(a) Material shall be sealed tightly in the place protected from direct sun-beam or rain, being kept away from the place of high temperature and humidity.

The storage time at the job site shall be restrained to possible minimum.

(b) Primer and solvent shall be handled with serious caution against fire.

17.1.4 Material Classification and Joint Size:

Classification and kind of sealing material shall be as specified in Table 17.1.4 and classification versus joint size shall be as specified in the special provision.

Table 17.1.4 Classification and Kind of Sealing Material

Classification	Kind
Grade A	Silicone sealing material (Unified system)
Grade B	Silicone sealing material (Binary system)
Grade C	Urethane sealing material (Binary system) Water acryl sealing material (Binary system)
Grade D	Oilness coking material

17.1.5 Joint Shape and Bed Treatment:

- (a) Each joint shall be of proper width, neither excessively broaden nor extremely narrowed, without any unevenness.
- (b) Joint bed shall be fully dried up and carefully cleared of oilness, dust particles, adhered mortar, paint and metal rust.
- (c) If joint depth is deeper than the corresponding depth of sealing material, back-up material shall be first filled to the required depth.
- (d) If joint depth is exactly same as required for urethane sealing materials of Grades A, B and C to be used, bond breaker shall be used at joint bottom.

17.1.6 Filling Method:

- (a) Each joint shall be filled up normally prior to finish of spraying. If the joint is filled after finish of spraying, filled material shall be fully cured by use of tape or the like so as to prevent overfilling out of the joint.
- (b) Work shall be suspended if dew is anticipated from rainfall or humidity.
- (c) Filling
 - (1) General matters
 - (i) The coking gun nozzle for filling shall be slightly undersized from the width of joint. It shall be pressurized for complete filling of material into every corner of the joint.

(ii) Filled material shall be fully pressed down by use of a trowel. Filled surface shall be finished evenly and smoothly for tight contact at its bottom with joint bed.

(iii) Each joint shall be covered with the curing tape, if and when necessary, and the tape shall be removed immediately after being pressed with a trowelling.

(iv) If material is adhered to any other parts than the joint to be filled, such adherence shall be removed instantly.

(2) Special provisions for sealing material

(i) Besides those sub-items specified in the foregoing Item (1), the following provisions shall apply to the filling method.

(ii) Prior to material filling, primer shall apply to each joint after such treatment for joint bed as specified in 17.1.5 (b), (c) and (d). However, no primer shall apply to either back-up material or bond breaker.

(iii) Filling shall start immediately after setting to touch for 30 to 60 minutes of primer.

(iv) In either case where any refuse or dust particles may be adhered to the primer-coated surface or the situation may not permit the filling work to be performed on the same scheduled day, primer shall apply again to the joint after re-cleaning of the said portion.

(v) Sealing material of binary system shall be used for filling after full kneading, at such compounding ratio as designated by the factory, in appropriate quantity to be required for the time of filling.

(vi) In the case where temperature of the adherent may fall below 5°C or rise above 50°C at the time of

filling or within 12 hours after filling, the work shall be suspended. If the work has to continue for inevitable reason, wooden panels or sheet covers shall be provided for heat insulation or break.

17.1.7 Curing:

- (a) Final finish over the filled surface shall be done after hardening of the surface fill.
- (b) Curing shall be provided, if and when necessary, in the case where dust adherence, soilage or hurt may be anticipated.

17.2 CORNER BEAD, NON-SLIP AND OTHERS:

17.2.1 Corner Bead:

Material for corner bead shall be of vinyl chloride, whose sample shall be presented. Corner bead shall be provided to the height of 1.8 m or so from the floor level. Metallic adapter leg shall be sized at about 25 mm and spaced at about 300 mm each from the end to be held down.

17.2.2 Non-slip for Stairway:

- (a) Kind, type and size of non-slip shall be as shown in the drawing.
- (b) Fitting method
 - (1) In the case where foot metal may be embedded into concrete, such metal shall be fitted rigidly at a space of about 300 mm each from both ends to be held down.
 - (2) In the case where the adhesion method may be used, metal shall be fitted with adhesives of epoxy resin after thorough cleaning of the dried foundation.

17.2.3 Door Mat:

Door mat shall be laid at the front doorway as shown in the drawing and shall be made of stainless steel including its frame.

17.2.4 Foam Resin Board:

Foam resin board shall be provided for the expansion joint with the existing building. It shall be made of polyethylene in thickness of 50 mm and shall finally be decided for use upon presentation of the sample.

17.2.5 Cut-off Board:

Cut-off board shall be provided for waterproof at the expansion joint with the existing building. It shall be made of synthetic rubber and sized at 200 mm in width and 6 mm in thickness.

As shown in the arrangement drawing, the construction scheme drawing shall be prepared for effective tightness to insure waterproof.

17.2.6 Conduit Pipe:

(a) Conduit pipe and other accessories shall be as specified in Table 17.2.6(a) and their material shall be as designated in the special provisions.

Table 17.2.6(a) Conduit Pipe and Other Accessories

Material	Standard	Quality and Others
Steel pipe	JIS G3442 (Galvanized sheet iron pipe for water supply)	
Drain pipe joint	JIS B2303 (Screw-type drain pipe joint) standard	Galvanized
Hard vinyl chloride pipe	JIS K6741 (Hard vinyl chloride pipe) standard	VP (pipe) Not to be used indoors.
Drain-use hard vinyl chloride pipe joint	JIS K6739 (Drain-use vinyl chloride pipe) standard	
Roof drain	Made of cast iron	To be treated for rust prevention by such measures as refined-tar baking and bituminous rust-proof painting.
Hard vinyl chloride eaves-gutter	JIS A5706 (Hard vinyl chloride gutter) standard	Gutter and its adhesives to be supplied from same manufacturing factory.
Galvanized iron sheet	JIS G3312 (Colored) JIS G3302 (Non-colored)	-
Fastening copper wire for gutter	-	1.2 mm diameter

- (b) Bracket for gutter shall be of galvanized steel and shall comply with Tables 17.2.6(b) and 17.2.6(c) for its size and other specifications.

Table 17.2.6(b) Bracket for Gutter

Pipe & Gutter	Vertical and Horizontal-run Conduit		Eaves Gutter of Galvanized Iron		Gutter of Hard Vinyl Chloride
	100 and below	Exceeding 100	120 and below	Exceeding 120	
Diameter (mm)	100 and below	Exceeding 100	120 and below	Exceeding 120	-
Bracket size (mm)	Larger than and including 25x2.8 (on market sale)	Larger than and including 25x4.5	Larger than and including 25x2.8 (on market sale)	Larger than and including 25x4.5	On market sale

Table 17.2.6(c) Required Space between Gutter Brackets

Pipe or Gutter	Steel Pipe and Hard Vinyl Chloride Pipe	Gutter of Hard Vinyl Chloride and Galvanized Iron	
	Vertical and Horizontal-run Conduit Pipe	Vertical and Horizontal	Eaves Gutter
Space	To be spaced at about 2m. However, the bracket shall be fitted into each individual floor slab if the pipe is installed indoors and the floor slab is at normal height.	1.2 m	0.9 m

17.2.7 Method for Installation of Gutter Supporting Bracket:

- (a) The bracket for vertical conduit support shall normally be of such type that the ring-shaped iron of hinge type shall be fastened to the foot iron by use of 2 small bolts.
- (b) The bracket for vertical conduit support shall be embedded to the depth of 60 mm of the reinforced concrete structure by splitting and folding the foot iron. It shall be either welded or bolted to the steel-fabricated structure.

- (c) In the case where the bracket for eaves gutter support may be affixed directly to the corrugated asbestos roof slate, it shall be fastened up with 2 small bolts through the liner and washer.
- (d) The bracket for eaves gutter support shall be affixed to the wooden structure by driving two nails into the side face of the rafter or directly nailed into the rafter.
- (e) The eaves gutter shall be fastened tightly to the gutter bracket by use of copper wire.

17.2.8 Method for Installation of Steel Conduit Pipe:

- (a) The joint shall be of drain pipe joint. However, for the pipe with a diameter exceeding 80 mm it may be of weld joint, if so required under the inevitable circumstance, by approval of the site supervisor.

The thread and weld portions after jointing of pipe shall be coated with paint for rust prevention.

- (b) Anti-sweat covering

- (1) Anti-sweat covering shall be provided as specified in the special provisions. However, if not specifying provided, it shall be provided, as specified in Table 17.2.6(d), for wherever deemed necessary.

- (2) The insulating tube shall be 20 mm in thickness for the diameter of less than 150 mm and 30 mm for the diameter larger than that, as set forth by JIS A9511 (Form polystyrene insulating material).

- (3) Adhesive tape shall be as specified in JIS Z1525 (Vinyl adhesive tape).

Table 17.2.6(d) Anti-sweat Covering for Steel Conduit Pipe

Place of Conduit Laying	Covering Material and Work Sequence
Ordinary indoor exposure	Insulation tube setting, adhesive tape winding, paper winding, cotton fabrics winding and seal coating.
Inside of ceiling and wall	Insulation tube setting, adhesive tape winding, vinyl tape winding.
Exposure in bath room and kitchen	Insulation tube setting, adhesive tape winding, asphalt roofing (galvanized iron wire) winding, galvanized iron sheet winding (0.3 mm thickness) and paint coating.
Inside of pipe shaft in R.C. structure	No covering.
Outdoor exposure	No covering but coating only.

(c) In the case where the conduit pipe may go through the concrete or brick wall, the gap to be created around the pipe to the wall shall be filled with mortar.

(d) Two metal fittings of 6 mm in thickness shall be provided to hold up the pipe.

17.2.9 Method for Installation of Hard Vinyl Chloride Pipe:

(a) Each joint shall be cold-spliced and fixed together by use of adhesives.

(b) The same as board as gutter shall be used to support the pipe from possible sagging and fixed by use of adhesives (2) for each bracket.

17.2.10 Method for Installation of Hard Vinyl Chloride Gutter:

The method shall be as instructed by the manufacturing factory.

17.2.11 Method for Installation of Roof Drain Pipe:

(a) The roof drain pipe shall normally be laid prior to placing of concrete, at the position lower than the floor level and of good drainage. If necessary, the pipe route shall be supplemented with additional concrete.

- (b) If the pipe is laid after concrete placing, its circumferential gap shall be filled up with mortar mixed at a ratio (in volume) of cement 1 versus sand 3.

17.2.12 Cleaning Hole:

The opening for cleaning shall be provided at curved or bent portions of the pipe most likely to be fallen into clogging trouble, if the pipe runs horizontally for a long span.

17.2.13 Cleaning and Admission Test:

After finish of roof drain and gutter installation, they shall be cleaned and shall undergo hydraulic test.

SECTION 18

REMOVAL WORK OF EXISTING BUILDING

18.1 GENERAL DESCRIPTION:

This section shall describe the method of destruction work for partial removal of the existing building which shall be required with development of the proposed expansion work. In as much as destruction may partially affect the structure of the existing building and may have direct bearing to the method of work covered by Section 18, precise plan shall be formulated prior to start of the work and the work shall be carried out with utmost care.

18.2 SCOPE:

The scope of work shall be indicated as shown in the drawing.

18.3 METHOD:

The method shall be detailed as shown in the drawing. However, should any discrepancy be discovered between the present condition and the design drawing, the method shall be decided after consultation with the supervisor in charge.

18.4 OTHERS:

Full care shall be taken to protect the existing broadcasting facility from noise, vibration and dust which may arise from the destruction work.

The scheme drawing and time schedule shall be prepared prior to start of the work and submitted to the supervisor for his approval.

SECTION 19
EXPANSION WORK AT CONNECTION
WITH EXISTING BUILDING
LIST OF FIXTURES AND RESERVE STOCKS
IN CONSTRUCTION WORKS

19.1 GENERAL DESCRIPTION:

This section shall provide design, specification and work method for the connection between the existing building and the newly proposed building for expansion. The connection between the two buildings shall be jointed together appropriately by expansion to insure structural strength and waterproof tightness. To achieve this purpose the work shall be performed with comprehensive understanding and utmost care.

19.2 CONSTRUCTION WORK DRAWING:

All drawings pertaining to the work shall be submitted to the supervisor, prior to start of the work, for his approval.

19.3 SAMPLES:

A complete set of samples extracted from the following items shall be presented to the supervisor in advance for his approval.

- (a) Coking material
- (b) Water stop
- (c) Foam resin board
- (d) Stainless metal (processed as per drawing)
- (e) Waterproof mortar
- (f) Joiners (as shown in the drawing)

19.4 WORK METHOD:

In line with the principle stated in Section 18.1, the work shall be performed with full care as shown in the drawing and as instructed by the supervisor.

**Construction Work; List of Fixtures and Reserve Stocks
in Construction Works**

Items	Quantity	Remarks
Tower Lift	1	Nakao Kinzoku Hashigo Co., Ltd. High-Checker NHC-820
Calcium silicate unperforated board	9φ-45 {9φ-15 unperforated board 50% of each quantity used	
Asbestos cement board	10% of the quantity used	
Cemented Chips board	-ditto-	50mm, 80mm, (each 50%)
Rock wool sound Absorbing board	-ditto-	Ribbed rock wool sound absorbing board each 50% Rock wool sound absorbing board
Vinyl Sheet	-ditto-	including adhesives
Vinyl Tile	20% of the quantity used	-ditto-
Vinyl skirting	-ditto-	-ditto-
Glass wool	10% of the quantity used	
Mirror	600x1,300 3 plates 600x900 3 plates	Full-length mirror Dressing table
Glass	1,800x2,400 5 plates 800x2,000 5 plates	Transparent wire glass (vertical wire) 6.8m/m
Sheeling Material	more or less 10kg	3kg canned. Caulking gun set
Non-Slip	10% of the quantity used	
Hard ware	-ditto-	hinge, flush bolt, door check, etc.
Neo prene	100% of the quantity used	Airtight sash, Sound-proof sash
Seat	25 seats	

Items	Quantity	Remarks
Stopper of re-movable	10% of the quantity used	
Foot light cover and lamp	-ditto-	
Wiring-pit lid	-ditto-	Used on the stage floor and sub-control room floor
Chain block	for 1 ton 1	KITO Co., Ltd. 1-7-20, Yaesu, Chuo-ku, Tokyo TEL 272-8471
Clean out Opener	3	Used to be attached to seats

SECTION 20
ELECTRICAL INSTALLATION WORK

20.1 **SCOPE OF WORK**

20.1.1 **Items of Work**

- (1) Power Supply Wiring
- (2) Power Supply System
- (3) Lighting Fixture and Plug Socket System
- (4) Power Control System
- (5) Earthing
- (6) Piping for Telephone System
- (7) Clock System
- (8) Opening Buzzer System
- (9) Alarm System
- (10) Piping for Broadcasting
- (11) Piping for Simultaneous Interpretation System

20.1.2 **Classification of Works**

- (1) Power Supply Wiring (BTV Works)
- (2) Power Supply Wiring Hand Hole (Construction Work)
- (3) Manufacture and Installation of Broadcasting Equipment and Related Wiring (Broadcasting Equipment Works)
- (4) Manufacture and Installation of Distribution Board for Stage Hangers (Broadcasting Equipment Works)
- (5) Manufacture and Installation of Telephones (BTV Works)
- (6) Manufacture and Installation of Secondary Clocks for Use in Places Other than Foyer, Canteens and Gallery (Broadcasting Equipment Works)
- (7) Manufacture and Installation of Connector Box Plate for Broadcasting Equipments; Cameras, Microphones, Speaker, Monitor, etc. (Broadcasting Equipment Works)
- (8) Floor Pits in Rack Room and Control Room (Construction Works)
- (9) Stage Floor Pits for communication Equipment for Broadcasting

Equipments; Cameras, Microphones, Speakers, Monitors, etc.
(Construction Works)

- (10) Wiring Ducts for Stage Lighting Equipment and Power Supply for Stage Hangers (Electrical Installation Works)
- (11) Manufacture and Installation of Stage Lighting Equipment and Related Wiring (Broadcasting Equipment Works)
- (12) Manufacture and Installation of Foot Lights Except Piping and Wiring for Foot Lights in Gallery (Construction Works)
- (13) Riser Ducts for connection with Broadcasting Distribution Board inside the Subcontrol Room (Construction Works)
- (14) Manufacture and Installation of Control Panel Box for Suspend Microphones (Electrical Installation Works)
- (15) Piping, Wiring and Equipment Installation for Secondary of Automatic Control for Airconditioning System (Airconditioning Installation Works)
- (16) Manufacture and Installation of Switch and Pilot Lamp in Fire Hydrant Cabinet and Related Wiring except Manufacture and Installation of Fire Hydrant Cabinet (Electrical Installation Works)
- (17) Manufacture and Installation of Water Level Gauge in Catch Pit (Electrical Installation Works)
- (18) Bore and Reinforcement of Holes for Ceiling Lighting Fixtures and Air Inlets and Outlets for Airconditioning System and Provision of Inspection Hole (Construction Works)
- (19) Exterior Piping and Wiring Except Piping and Wiring for Fire Pump (BTV Works)

20.1.3 Spare Parts

Spare Parts as specified in 20.4 shall be provided at the time of completion.

20.1.4 Inspection and Test

All necessary inspections and tests, such as the measurement of insulation resistance, earthing resistance and luminous intensity, and running tests of the equipment shall be carried out and recorded before the final inspection of the work completed.

20.2 EQUIPMENT AND MATERIALS

20.2.1 Conduit Tubes and Accessories

All conduit tubes and accessories to be used in the work shall be of steel. Their shapes and sizes shall be indicated on design drawings and their specification shall comply with those of J.I.S. (Japan Industrial Standard) or more than equals.

20.2.2 Pull Boxes and Wiring Ducts

The pull boxes and wiring ducts, used in this work shall be made of steel plate with the thickness of more than 1.6 mm. Both interior and exterior of them shall be applied with rust preventive agent. Furthermore, the exterior shall be applied with paint with the designated color. The pull boxes and wiring ducts shall be reinforced with the use of angles or the like and shall be of such a construction as will allow easy wiring and easy access for a check. The interior of these pull boxes and ducts shall have burrs removed from their joint parts. It is by no means by permissible that the head of setscrews is left extruded beyond the interior surface. Binding plates shall be provided at the specified locations inside the riser duct.

20.2.3 Wires and Cables

Wires and cables used in the work shall have the sizes indicated on design drawings and their specifications shall comply with those of JIS or more than equals.

20.2.4 Boards

1) Cabinet Panel

- (a) The construction and dimensions of the cabinet panel shall be indicated on the design drawings.
- (b) Unless otherwise specified, the internal equipment, such as the main switch and branch switches shall, in principle, be electromagnetic type no-fuse circuit breakers.
- (c) A box earthing terminal shall be provided in the cabinet.

(d) The contractor shall submit to the Supervisor, manufacturing drawings, wiring diagrams and details of each section for his approval before the manufacture of the items to be used for the work.

(e) Unless otherwise specified, the cabinet panel shall be applied with paint and shall be finished in accordance with the instructions by the Supervisor.

2) Terminal Board

(a) The construction and dimensions of the terminal board shall be indicated on the design drawings.

(b) A box earthing terminal shall be provided inside the terminal board.

(c) The terminal board shall be painted and finished in the same manner as the finishing for the cabinet panel.

3) Power Control Board

(a) The power control board of the self-standing type shall be of the enclosed frame type made of steel plate, and unless otherwise specified, it shall be of the front door type. The dimensions of the board shall be indicated on the design drawings.

(b) The required meters, operation push buttons, changeover switches, etc. shall be mounted on the front door of the board while the board interior shall be furnished with the no-fuse circuit breaker, electromagnetic contact maker, relays, and so forth, in addition to the box earthing terminal.

(c) The board shall be of such a construction and shall have the said equipment or devices arranged in such a manner as will allow easy check of the interior and ready repair, and a group of terminals for the exterior wiring shall be mounted at such a location as shall be suitable to the purpose.

- (d) Unified terminal symbol marks shall be provided for all wirings. The terminal board and wire ends shall have the terminal symbol mark.
- (e) The switching box shall be of the exposed wall mount type or wall flush mount type. A power pilot lamp shall be mounted on the front door of the switching box, and switches (MCB without the tripping mechanism) shall be installed inside the box.
- (f) The switching box shall be painted and finished in the same manner as the finishing for the cabinet panel.
- (g) The contractor shall submit to the Supervisor, manufacturing drawings wiring diagrams, and details of each section for his approval before the manufacture of the items to be used for the work.

20.2.5 WIRING FIXTURES AND PLATES

1) Small-Sized Switches

- (a) The type and capacity of the switches shall be as shown on the design drawing.

2) Plug Sockets

- (a) The type and capacity of the plug sockets shall be as shown on the design drawing.

- 3) Plates: Unless otherwise specified, the plates to be used shall be the metal flush plates and shall have the thickness of more than 0.6 mm.

20.2.6 Lighting Equipment

1) Fluorescent Lamp

- (a) The shape and type of the fluorescent lamp fixtures shall be as shown on the design drawing.
- (b) The fluorescent lamp to be used shall meet the requirements given in JIS C7601, 7602 and 8106.
- (c) Unless otherwise specified, the fluorescent lamp shall be

of high-power factor type; 40W straight fluorescent lamp shall be of the quick lighting type, and a double-fluorescent lamp, type lighting fixtures shall be of the flickerless design. The fluorescent lamps rated for less than 20W shall be of the glow lamp type.

- (d) Care shall be taken for the lighting fixtures with a cover made of acrylic resin so that the cover may not be deformed with heat, not resulting in producing breakage.
- (e) Every fluorescent lamp fixture shall be earthed.
- (f) The contractor shall submit to the Supervisor, manufacturing drawings for his approval before manufacture.

2) Incandescent Lamp

- (a) The shape and type of the incandescent lamp fixture shall be as shown on the design drawing.
- (b) The incandescent lamps to be used shall comply with JIS requirements.
- (c) The contractor shall submit to the Supervisor, manufacturing drawings for his approval before manufacture.
- (d) The lamp fixtures for use in the hall shall be of such type as will permit replacement of lamp from within the ceiling.

20.3 INSTALLATION WORKS

20.3.1 Piping and Duct Work

1) Conduit Tube Installation Work

- (a) Unless otherwise specified, the conduit tubes to be employed shall be steel conduit tubes, and the tube size shall be as shown on the design drawing.
- (b) The tube bending radius shall be 6 times as much as the tube diameter or more, and the tube bend shall not be below 90°. The number of tube bends between boxes, shall

be within 3.

(c) Normal tube bend shall not be used for the tube with the diameter of less than 25 mm.

(d) The tube end shall be cut smooth in such a manner that the wire or cable coverings will not be damaged.

2) Pull Boxes and Joint Boxes

(a) In case the total tube length measures more than 30m or if inevitable to keep the number of tube bends within 3, a pull box or a joint box shall be provided even when nothing is specified on the drawing.

(b) When required to mount the plate for the pull box or the joint box to a wall, it shall be installed on the finished surface a good appearance and shall then be painted in the color harmonious to the surroundings.

3) Position Boxes

(a) An outlet box, a switch box or a similar item shall be installed at a location specified for mounting a lighting equipment, plug socket, and switch, and at other designated locations.

(b) The position box for the lighting equipment and a ventilator shall be furnished with lock bolts to fix the equipment and device to their positions.

(c) The position box shall not have conduit tubes of more than 5, in principle.

4) Connection Between Conduit Tubes or Between a Conduit Tube and a Box or the Like

(a) One conduit tube shall be connected to another, using a coupling of the screw type or non-screw type. Firmly tighten the tube joint so that no clearance may be left at the tube butt joint.

(b) A connection between a conduit tube and the box or a

connection between a conduit tube and a duct shall be made in such a way that the conduit tube may be jointed to the box at a right angle or in such a manner that the tube may be jointed to the duct also at a right angle.

The conduit tube shall be tightened to the box or duct, using the lock nuts applied to their interior to exterior, and a bushing shall be provided at the tube end. The tube end inside the box or duct shall not be left to the length more than the required.

(c) The joint between conduit tubes or between a conduit tube and a box shall have earthing bond. Two tube ends fitted to two different sides of the box shall have a linkage to one another, using a bond wire located outside.

(d) After thoroughly polishing the tube-copper wire joint parts, soft copper wire of a diameter over 2mm shall be wound around each joint, and thereafter, the copper wire shall be soldered to the tube for conduit tube bonding. Or, the joint parts shall be clip-tightened, using a copper plate with the thickness of more than 0.5mm, or they shall be bonded tightly in a similar manner.

(e) In case the diameter of a knocked out hole is different from the tube outside diameter, a reducer shall be used without fail.

5) Conduit Tube Installation

(a) When it is required to install a conduit tube embedded in or penetrating through some structure, the installation location shall be selected at such a point where no adverse influence will be brought about to the structure with regard to strength.

(b) If embedding the conduit tube in the structure, such as reinforced concrete, it shall be located on the upper reinforcement or between the upper and lower reinforcements. Further, the tube shall then be fixed to the reinforcement

at points deemed to be necessary.

In addition, the box shall be fixed firmly to the mould.

- (c) The conduit tube shall be laid at a depth of more than 30mm from its finished surface.
- (d) In case conduit tubes are installed penetrating through the wall lined with a wire net (metal lath or wire lath), or when they are installed along the metal screen on the wall, these conduit tubes and the boxes mounted on the wall shall be insulated from the metal screen.
- (e) An exposed piping or a concealed piping shall be installed while being fixed firmly to position and in good order with the use of pipe hangers or the like. The space between pipe hangers or between saddles shall be within 2m.
- (f) When required to fix saddles to the surface of concrete structure, curl plugs or anchor bolts shall be used.

6) Treatments to be Taken for Tube Ends

- (a) The end of the conduit tubes installed while being embedded in some structure shall have a blind cap with the aim of not letting water or dust get into the interior of the tubes.
- (b) The cut end of the conduit tubes, which is led to the interior of various boxes, such as a pull box and so forth, shall be held in place by means of a lock nut and a bushing.

7) Painting and Others

- (a) The pipe joint, thread cut part on a tube, and such section as has plated metal peeled off the tube surface, shall be applied with rust preventive agent, such as zinc chromate primer.
- (b) The boxes, embedded in some concrete structure, shall be cleaned after removing the mould.
- (c) An exposed piping shall be applied in two coats, with paint

of the specified color.

8) Duct Work

- (a) When a duct is installed while being suspended from the ceiling, the space between hangers or similar items shall be less than 2.0m, and the joint part of the duct shall have earthing bond with the use of a copper band. The duct for stage lighting equipment shall be insulated with such materials as rubber at intervals of less than 2.0m and earthing bond shall be provided between ducts.
- (b) In principle, the floor duct work shall be covered by the construction work.

20.3.2 Wiring Work

1) Passing Wires or Cables through Conduit Tubes

- (a) Before passing the wires or cables through the conduit tubes, clean the interior of the tubes. When they are passed through the tubes, care shall be used so that the ceiling and walls may not be stained.
- (b) The wires or the cables to be installed inside the tubes shall have a sufficient length so that the lighting equipment mounting fixtures and other fixtures may be pulled as required while being connected to the wire or cable.
- (c) When installing an auxiliary piping or when a piping is installed with no wire, the contractor is required to pass an order wire (vinyl cord or the like) through the tube. The contractor will be responsible for making corrections at his expense even after completion of the work, if it becomes difficult to pass a wire or a cable through the tube because of defective installation of a conduit line.
- (d) It is by no means allowed that a wire is installed inside a conduit tube while being connected to another.
- (e) The wiring to be made inside the pull box or in the duct

otherwise specified shall have an identification tag indicating the power supply voltage and the destination.

- 2) **Wiring Inside the Duct:** Wirings shall be made in good order inside the duct, and the wires installed shall be bound properly for one circuit.

In principle, no connection is allowed between the wires inside the duct.

- 3) **Wire Connection**

- (a) Both ends of the wires to be connected to one another shall be polished sufficiently and they shall then be solder-connected or pressure-connected. Each point shall have adhesive vinyl tape wound around 4 times or more.

- (b) When connecting a wire to a terminal, the applicable type of the terminal shall be of the pressure connection type or the copper tube type.

- 4) **Color Identification for Wirings**

- (a) When applying vinyl-sheathed wires, the color of vinyl sheath shall be such as is instructed by the Supervisor for wire identification.

- 5) **Gauge Size of Branch Wire**

- (a) Refer to the drawing for the gauge size of branch wire.

20.3.3 Equipment and Fixture Installation Work

- 1) **Installation of Equipment**

- (a) Various equipment shall be installed in accordance with the mounting procedures and the installation locations specified on the design drawing. The contractor shall submit to the Supervisor, manufacturing drawings, assembly drawings, installation layouts, mounting drawings, and others for his approval which have been studied and confirmed through negotiations with the Supervisor, construction contractor and other contractors.

- (b) In the installation, the equipment shall be adjusted for

level and verticality so that they will be connected correctly to their corresponding piping or duct.

- (c) The operation board and so forth of the self-standing type shall be mounted on the channel base, which shall be fixed to the floor, using anchor bolts.

2) Mounting of Lighting Fixture

- (a) The mounting locations shown in the design drawing are not final; therefore, for actual installation, the contractor shall prepare a ceiling plan with due consideration taken for selecting the installation locations, and he shall then submit the plan to the Supervisor for his approval.

In this way, the lighting fixture can thus be mounted to their places using inserts bolts.

- (b) In principle, they shall be suspended directly from the Building Frame. The number of hangers suspending the fluorescent lamp fixture from the ceiling shall be two while the number of those for the incandescent lamp fixture shall be limited to one.

- (c) At the time of installation, due care shall be taken for heat radiation by providing an air vent with the aim of not increasing the temperature inside the lighting equipment. Otherwise, the lamp is unable to function normally and the service life will be reduced.

- (d) The lighting fixture which require water proofness and moisture proofness, shall be provided with rubber packing or putty; the packing and putty shall be applied in such a manner that they will be provided with sufficient water proofness and moisture proofness.

3) Mounting of the Wiring Fixtures

- (a) Unless otherwise specified, the plug sockets and switches to be employed shall be mounted to the following standard requirements.

(To the center of wiring fixture)

Switch mounting height	1,300mm above the floor
Wall mount type plug socket installation height	300mm above the floor
Mounting height of the outlet for the telephone, monitor, and other systems	300mm above the floor
Box (Type B) for broadcasting equipment	Baseboard or indicated drawings

- (b) The mounting height of the box for slave clocks shall be as shown in the drawing.
- (c) When connecting a wire to a wiring fixture, the setscrews and similar items shall be tightened thoroughly so that the joint between the wire and fixture may not be subject to defective contact.

20.3.4 Earthing Work

1) Earthing Work

- (a) In principle, an earthing rod of the joint driven type shall be applied for the earthing work. When the specified earthing resistance is not available, appropriate measures shall be taken according to the instructions by the Supervisor viz., an earthing mesh shall be employed additionally.
- (b) The thickness of the earthing wire shall be as shown on the design drawing, and the connecting point of the wire shall be insulated sufficiently, using vinyl tape or the like. At this time, care shall be taken so that the copper wire may not be contacted directly to the earth.
- (c) Earthing wires for Power Line shall be branch wires from the substation.

2) Setting of the Earthing Rod and Other Works

- (a) All earthing rods shall be driven in position in the presence of the Supervisor. The earthing resistance of the rod shall be measured at the time of installation, and

after the specified earthing resistance is estimated to be available, the hole excavated for driving the earthing rod shall be back-filled.

- (b) After installing the rod, measured earthing resistance, date of measurement, application particulars, and type of the rod shall be entered in the earthing base inside the floor duct of the control room.
- (c) When connecting the earthing cable to the control board, cabinet panel, motor, lighting fixture, and other electrical appliances, it shall be tightened firmly to them so that connections may be made perfectly both in the electrical and mechanical aspects.

3) Earthing Resistance

- (a) The earthing resistance of the wire which will be connected to the broadcasting equipment is desired to be less than 5Ω .

20.3.5 Alarm System Installation Work

1) System

- (a) The alarm system shall be as shown on the design drawing.

20.3.6 Outdoors Work

1) General

- (a) Though the outline of the outdoors work is indicated on the design drawing, the contractor shall study and examine the physical conditions at the construction site and he shall check if there are something embedded in the ground so that the existing items installed underground may not be impaired nor damaged.

2) Underground Piping

- (a) The conduit pipes installed directly underground shall have polyethylene lining and otherwise they shall be covered with concrete.

(b) The pipes shall be installed underground at a depth of more than 1,200mm where vehicles pass over the installation area. At other installation areas, they shall be set at a depth of more than 600mm from the ground surface. The pipe line shall have a concrete mark block above ground at a point over its bend and it shall also have the mark blocks above ground at points over the straight portion at an interval of less than 5m. An arrow mark shall be provided on top of these blocks to show the direction of the pipe line.

3) Cable Wiring and Connections

- (a) Cable connections shall be made in the presence of the Supervisor.
- (b) Cable core connections shall be made by means of the pressure terminals or by applying the soldering. Prior to the connections, the insulating material or the armor shall be cut off in a manner similarly to that of pencil cutting, and thereafter, proper measures shall be taken so that moisture may not get inside the armor of cables from their joint part.
- (c) In principle, cable connections shall not be made inside the handhole. If unable to do so, a taping or a water proofing treatment shall be properly provided. Care shall be taken that the cable joint parts will not be laid submerged in water.
- (d) Cable ends shall have terminating material. Care shall be taken so that water will not get inside the cables even during the installation work.

20.4 SPARES

Item	Type	Quantity
Fluorescent lamp	40W, straight tube	100% of consumption
	20W, "	"
	40W, "	"
	30W, "	"
Glow-starter		"
Sterilamp	15W, straight u	"
Incandescent lamp	200W	"
	100W	"
	60W	"
	40W	"
	10W	"
	5W	"
Ballast for fluorescent lamp	42-RH-220V-50Hz	20% of consumption
	41-RH-220V-50Hz	"
	41-ZY-220V-50Hz	6 ea.
	31-GH-220V-50Hz	6 ea.
	21-GH-220V-50Hz	20% of consumption
Lighting fixture	G41e4	100% of consumption
	H151	"
	K31	50% of consumption
	L4131	"
	X21	100% of consumption
	Y21	"
	f11	"
	105	"
	J05	"
	k41c	50% of consumption
h101	"	

Item	Type	Quantity
Cover for lighting fixture	For Type B46	100% of consumption
	" 141	"
	" 142	"
	" J21	"
	" J41	"
	" K31	"
	" L4131	"
	" X21	"
	" y21	"
" e61	"	
Plug Socket	2P-15A	20 ea.
Tumbler switch	1P-10A	10 ea.
	3 circuits	5 ea.
	4 "	5 ea.
		3 ea.
Neon lamp		3 ea.
Water level relay		1 ea.
Molded case type circuit breaker	4P225AF	1 ea.
	4P100AF	1 ea.
	4P50AF	2 ea.
	2P30AF	10 ea.
Molded case type circuit breaker for motor	For 3P0.2KW	2 ea.
	" 3P0.75KW	2 ea.
	" 3P1.5KW	2 ea.
	" 3P2.2KW	1 ea.
	" 3P3.7KW	1 ea.
	" 3P5.5KW	1 ea.
	" 3P11KW	1 ea.
	" 3P30KW	1 ea.
	" 3P37KW	1 ea.
Magnetic contactor	5.5KW20A	3 ea.
	11KW 48A	2 ea.
	37KW100A	2 ea.

Item	Type	Quantity
Push button switch for power control panel		50% of consumption
Lamp globe for power control panel		100% of consumption
Ammeter	5A	2 ea.
	15A	2 ea.
	100A	1 ea.
Changeover switch for power control panel		10 ea.
Current transformer	30/5A	1 ea.
	100/5A	1 ea.
Relay for power control panel		10% of consumption
Fuse for control circuit		100% of consumption
Transformer 220V/100V		1 ea.
Pilot lamp for power control panel		200% of consumption
Earth leakage breaker	2P30AF	2 ea.
Temperature detector	Spot type	50% of consumption
Manual alarm box	Type P	1 ea.
Alarm bell		1 ea.
Opening buzzer		2 ea.
Alarm buzzer for power control panel		1 ea.
Solar switch		2 ea.
Timer		1 ea.
Automatic Voltage Regulator	Input Volt 170V~230V Output Volt 200V +0.5%	1 ea.

SECTION 21

PLUMBING

21.1 GENERAL

21.1.1 Scope of Works:

- (1) Water supply & hot water supply work
- (2) Fire extinguishing work
- (3) Drainage, sewage and vent piping work
- (4) Gas supply work
- (5) Sanitary fixture work
- (6) Kitchen fixture work

21.1.2 Separate Works:

- (1) Electrical work
- (2) Outdoor installation work
- (3) Built-in sink
- (4) Manhole for piping inspection
- (5) Gutter
- (6) Kitchen drain pit
- (7) Embedded washstand
- (8) Full-length mirror
- (9) Fire extinguisher

21.1.3 Spare Parts:

Consumable material, such as lubrication oil for all rotating machines, etc., necessary for continuous one year operation, shall be supplied.

21.1.4 Inspection:

During installation work and after completion of work, apparatus, piping and accessories shall be hydraulically tested to ensure no leakage and functional operation. Also running test of pumps shall be performed.

21.2 WATER SUPPLY & HOT WATER SUPPLY WORK

Water shall be supplied to each terminal of consumption through the lateral pipeline to be branched off from the existing supply pipeline system 50 mm x 2.

21.2.1 Piping Material:

21.2.1.1 Pipes and joints

(1) Steel pipe

Galvanized steel pipe specified in JIS G3452 (Steel pipe for piping) should be used. The joint shall be finished with the galvanized screw-type joint of malleable cast iron. The pipe flange shall be of galvanized 10 kg/cm² steel.

(2) Lead pipe

The lead pipe shall be that to be used for water supply.

21.2.1.2 Valves

(1) Sluice valves

Valves with a diameter less than 50 mm shall be made of bronze and be of the screw-in type. Those over 65 mm in diameter shall be, with their valve bodies being made of cast iron and spindle and valve seat being bronze. They must be of the flange type and withstand pressures up to 10 kg/cm².

(2) Check valves

The check valve at the pump outlet shall be of the anti-shock type. Others, smaller than 50 mm in diameter, shall be bronze, screw-in swing type valves.

Those over 65 mm in diameter shall have their valve bodies being made of cast iron, and spindle and valve seat being bronze.

They must be of the flange type and withstand pressures up to 10 kg/cm².

(3) Faucets

The faucet shall be provided with the totally chrome-plated handle and shall have been accepted by the hydraulic pressure test at 17.5 kg per cm². The faucet to be used for the booth in the toilet shall be set at FL +300.

21.2.2 Plumbing:

- (1) For indoor plumbing, galvanized steel gas pipes shall mainly be used. Lead pipes may be used only in portions where they will be connected to various apparatus or where their use will be unavoidable.
- (2) Cut pipes perpendicularly to their center lines using a pipe cutting saw or other tools which shall allow the work to be done without affecting the diameter of the pipes. File off burrs at the cut portions and clean the cut pipes before connecting them to others. Pipe cutters shall never be used.
- (3) Steel pipes shall be screwed together or connected with flanges. They shall have tapered threads.
- (4) To connect lead pipes, the joint wiping method shall be employed. In connecting a galvanized steel gas pipe and a lead pipe, soldering nipples made of bronze shall be used.
- (5) Use flange couplings for portions which need removal. As a rule, union joints should not be used. In flange joints and union joints, use good quality rubber packings.
- (6) Valves should be installed in such a manner that they can be easily operated as per drawings.
- (7) Sluice valves are to be provided in take-outs for branch pipes for various floors, at lavatories and at other branching spots.
- (8) Floor slabs must not have embedded in them any pipe whose diameter exceeds one-third of the floor slab thickness.
- (9) Piping to be buried in concrete should at least partially be completed before being buried, and the completed portions

should undergo a water pressure test. Never dig the concrete for piping work after concrete placement has been completed. No piping may be embedded in the slabs of the floors, ceilings or walls of the auditories and subcontrol room.

- (10) Give an upward gradient to upfeed water supply piping and a downward gradient to downfeed supply systems. Provide air vents at portions in the piping where dead air space exists. Also provide mud discharge plugs at spots where sediment accumulates.
- (11) Piping support brackets are to be made of round steel or angle steel. Concrete ceilings should have inserts embedded in advance. Portions where many pipes are to run in parallel need to be supported with an angle steel. Piping supporting fixtures should be provided at intervals as shown below:

Horizontal pipe	Pipe dia. under 50 mm	Within 1,800 mm
	Over 65 mm	3,600 mm
Rising pipe	More than one spot on each floor	

Branching points must always be supported.

- (12) Pipes to be supported by ceilings or floors of the auditory and sub-control room shall be so designed as to be able to perform the vibration-proof supporting function at their supported portions. 'Vibration and sound proof work' in 21.8 shall apply to vibration protection work.
- (13) Walls and floors through which piping runs must have sleeves built in beforehand. After concrete has been placed, remove these sleeves and wind a fiberglass lagging material around the pipes. Then, wind a ribbed steel plate around its outside and fill in sufficient cement mortar from both sides. In the case of embedded piping, asphalt jute should be wound, instead of a ribbed steel plate. Pipes passing through the expansions of a structure are to employ flexible joints, even though it may not be so specified in the drawing. Pipes running through a wall or a floor should be supported

before or after their penetration. They should not be supported by the wall or the floor slab itself.

- (14) Upon completion of piping, plug all openings and close the ends of lead pipes by soldering, so as to prevent the entry of any foreign matter.
- (15) All pipes should undergo in the presence of the Supervisor one hour of 10 kg/cm² water pressure tests, using pressures given below, at an appropriate time; during piping work, at the time before concealing, or backfilling, or before application of anti-sweat covering after all piping work has been completed. Should any water leakage be found, the necessary replacement or repair must be made immediately, and must never be caulked for repair.
- (16) Sealing plates, decorated cover and bands: Concealed piping should as a rule be adopted. However, for penetrating portions at exposed spots in rooms, that is, in ceilings, floors and in walls, use chrome-plated brass sealing plates. Use chrome-plated brass decorated cover at the end of anti-sweat covering of the piping. Wind chrome-plated brass bands, 2 cm in width, at 2 meter intervals on straight portions and also at branching and bent sections.

21.2.3 Anti-sweat and Anti-corrosion:

21.2.3.1 Materials

Use materials designated below:

- (1) Rock wool and fiberglass lagging pipes
JIS-marked (No. 2)
- (2) Cotton tape
115 g and above per 1 m²
- (3) Asphalt jute
385 g and above per 1 m² with asphalt permeated over both surfaces of linen cloth.
- (4) Galvanized steel sheet
No. 28 (0.397 mm thick) as per JIS G3302.

(5) Galvanized steel wire

0.9 mm

(6) Thick paper

More than 370 g per square meter

21.2.3.2 Thickness of anti-sweat covering

Pipe Diameter	Under 20 mm	25 ~ 40	Over 50
Thickness	15 mm	20	25

21.2.3.3 Installation of anti-sweat covering

Apply an anti-sweat covering material of the specified thickness around a pipe, and bind it with galvanized steel wires of over 0.9 mm. And then wind a thick paper on it. After that, wind cotton cloth on top of it and then apply two coats of filling paint on it.

21.2.3.4 Surface finishing for pipes used in various places

- a. Pipes embedded in internal walls, or concrete, etc. are to be wound with asphalt jute.
- b. No anti-sweat covering shall be provided for pipes exposed outdoors.
- c. Pipes buried underground must be wound with asphalt jute, whose overlapping portions should be stuck close by heating using a trowel.
- d. For piping running above ceilings or through shafts, use linen cloth instead of cotton.

21.2.4 Painting:

21.2.4.1 Surfaces of steel exposed portions of piping

Carefully remove rust and apply two coats of rust preventive paint. Then, apply two coats of oil paint of designated colors.

21.2.4.2 Anti-sweat finished portions

After filling of the cotton cloth wound, apply two coats of oil paint of designated colors.

21.2.4.3 Piping marks

Pipes should be provided with appropriate marks in accordance with instructions given by the Supervisor.

21.2.4.4 Others

Valves, handles, etc. should also be given two coats of paint of designated colors.

21.3 FIRE EXTINGUISHING FACILITIES

21.3.1 Fire Extinguishing Pump;

(1) Capacity

40φ x 150ℓ/min x 38 m

(2) Motor

2.2 kW x 380V x 50 Hz x 3φ

(3) Type

Underwater centrifugal pump

(4) Accessories

Flange (with bolts) 2 sheets

Automatic purge valve 1 pc.

Water-proof cable 10 m

Cable band 3 pc.

Base plate (with bent pipe) 1 sheet

(5) Quantity

1 unit

(6) Construction

As per drawing.

(7) Installation

The pump shall be installed horizontally at the tank bottom and shall be connected with the discharge pipe to be supported with sufficient safety and rigidity so as to avoid direct load upon the pump body. Underwater cable shall be connected to the discharge pipe with full care not to hurt or break its cover. The gap to be created by the discharge pipe penetration through the floor shall be filled completely with mortar.

(8) Test

Shop test shall be conducted for test running of the pump, after which the test record shall be submitted.

21.3.2 Fire Hydrant:

21.3.2.1 Indoor hydrant and box

(1) The valve shall be a chrome-plated bronze stop valve, and the hose connection section is to be a bell and spigot joint.

(2) Use two linen cloth hoses, 40 mm in diameter and 15 meters long. Bell and spigot type joints made of chrome-plated bronze shall be used.

(3) The nozzle is to be made of bronze and chrome-plated. Its tip shall be 13 mm in diameter, and hose connection section shall be of the bell and spigot type joint.

(4) The hose bracket shall be made of chrome-plated bronze and be of the comb type. It must be large enough to hang two 15 meters hoses.

(5) Fire hydrant box

(a) Should be made of bonderized sheet iron with a thickness of more than 1.2 mm. The door and frame shall be made of a steel plate with a thickness of 1.6 mm.

(b) Production drawings shall be submitted in advance and manufacture of the box should be started after the drawings have been approved by the Supervisor.

(c) Dimensions of the box and its contents shall be as per drawings.

21.3.3 Piping Materials:

Material shall be galvanized steel. As per instructions given in "Water supply facilities construction work", unless otherwise specified.

21.3.4 Piping:

(1) As per instructions given in "Water supply facilities construction work" unless otherwise specified.

- (2) Besides pressure tests (17.5 kg/cm²), water discharge tests of the hydrant shall also be conducted.
- (3) The underground pipe shall be buried to the depth of 760 mm or deeper.

21.3.5 Anti-sweat and Anti-corrosion Work:

As per instructions given in "Water supply facilities construction work".

21.3.6 Painting:

- (1) Painting of piping should be done in accordance with "Water supply facilities construction work".
- (2) The hydrant box shall be given two coats of rust preventive paint and then, in principle, be given a melamine baked finish in designated colors.

21.4 DRAINAGE, SEWAGE AND VENT PIPING WORK

The specific gravity drainage system shall apply to the whole, except drainage at the circulation space to the orchestra pit. The drainage system shall be divided into the sewage pipeline and the drain pipeline which shall be led into each separate cesspool to be provided under the separate contract work.

21.4.1 Movable Underwater Drain Pump:

- (1) Capacity 40φ x 100 ℓ/min x 5 m
- (2) Motor 0.25 kW x 220V x 50 Hz x 1φ
- (3) Type Underwater pump
- (4) Accessories Waterproof cable 6 m
Hanging rope 5 m
- (5) Quantity 1 unit
- (6) Construction As per design drawing.
- (7) Test As per requirement provided in 21.3.1(8).

21.4.2 Piping Materials:

21.4.2.1 Pipes

- a. Lead pipes shall be made for drainage use.
- b. Rigid polyvinyl chloride pipe shall be of ordinary standard.

Rigid polyvinyl chloride pipe diameter (unit: mm)

Pipe dia.	Up to 20	Up to 30	Up to 40	Up to 65	Up to 75	Up to 100	Up to 125	Up to 150	Up to 250
Thickness	Over 2.7	Over 3.1	Over 3.6	Over 4.1	Over 5.5	Over 6.6	Over 7.0	Over 8.9	Over 9.2

21.4.2.2 Joints

Vinyl fittings used on polyvinyl chloride pipes must be the products of the same manufacturer of pipes. Adhesives specified by the manufacturer must be used.

21.4.2.3 Valves

Valves defined in "Water supply facilities construction work" shall be used.

21.4.2.4 Waste water fittings

a. Floor drain fittings

These shall be made of cast iron, and the strainer shall be made of chrome-plated brass.

b. Floor drain traps

Floor drain traps shall be made of cast iron. The strainer shall be made of brass and its minimum water seal depth shall be 50 mm.

c. Clean-out fittings

Cast iron clean-out fittings shall be attached with flange bolts, or else be made of bronze and screwed on. Clean-outs for steel and lead pipes shall be made of bronze and be of the screw-on type. The exposed portions are to be chrome-plated. In case of a floor with a waterproof layer, a waterproof type shall be used.

d. Sink drainage fittings and sink traps

These including strainers and plugs shall be made of brass and be chrome-plated. The plug shall be provided with a chain. The sink trap shall be made of cast iron, and the strainer shall be chrome-plated brass.

e. Grease trap shall be made of stainless steel and shall be specified as per design drawing.

21.4.3 Piping:

(1) Pipes and couplings used for different purposes shall be as follows:

- Pipe connected with apparatus : Lead pipe (at minimum length)
- Drain pipe : Rigid polyvinyl chloride pipe and joint for drainage use
- Sewer pipe : Rigid polyvinyl chloride pipe and joint for drainage use
- Ventilation pipe: Rigid polyvinyl chloride pipe and joint for drainage use

(2) Pipe gradient

The gradient of indoor horizontal pipes shall be over 1/50. If impossible, the gradient of the main pipe only may be more than 1/100. Ventilation pipes shall be given a gradient of more than 1/100.

(3) Use piping support fixtures defined below, which must be firmly fixed in place.

a. Horizontal lead piping for drainage

When a lead pipe horizontally runs more than one meter, it must be placed in a semi-circular trough made of a steel plate with a thickness of more than 1.6 mm, and be supported at intervals of 2 meters.

b. Polyvinyl chloride pipes for drainage

Under 40 mmφ	Within 1 m
50φ ~ 100φ	Within 2 m
Over 125φ	Within 2.5 m

c. Hangers for horizontally running main pipes shall be provided with cast iron inserts or embedded bolts before concrete is placed.

d. For portions which connect to a horizontal pipe under a falling pipe, a brick or concrete base should be provided, and the bent section should be wound with concrete. In other cases, the pipe should be firmly supported with hangers.

(4) Drainage pipes, which are supported by the walls, ceilings and floors of auditorium, sub-control room or master control room shall be given vibration protection supporting as defined in 21.8 "Vibration and sound proof work",

(5) For splicing of both rigid polyvinyl chloride pipe and lead pipe, the lead pipe soldered to the outer diameter of the union socket and, on the other hand, the hard vinyl chloride pipe inserted with the vinyl-made socket shall be jointed together and tightened up with cap nuts.

(6) Protection of lead pipes

In burying a lead pipe underground or concrete, or in concealed piping work, pipe shall be wound with asphalt jute. After laying pipe underground, fill the groove with sand.

(7) The wiping solder used in joining lead pipes shall be a good quality lead and tin alloy of the following ratio:

Lead 60%
Tin 40% (weight ratio)

(8) Standards for rigid polyvinyl chloride pipe processing

a. Straight pipe shall be cut perpendicularly to the pipe axis. Cutting at an angle should be avoided because it will cause bend in joining section.

b. Straight pipes may be bent into bend pipes with large radius, without using elbows.

(9) Refer to instructions given in "Water supply facilities construction work" with regard to wall penetrating and embedded pipes.

- (10) Unless otherwise specified, ventilation pipes shall be provided at the top with ventilation louvers made of copper or strainers made of chrome-plated bronze.
- (11) Vertical drainage pipes and vertical ventilation pipes shall be connected on the highest floor. And then vertical drainage pipes shall themselves be vertical ventilation pipes. Vertical ventilation pipes shall be connected to drainage pipes on the lowest floor.
- (12) Vertical ventilation pipes and ventilation pipes on various floors shall be connected above the overflow level of various fixtures.
- (13) Clean-outs should be provided at the ends of drainage pipes specified in drawings and other places instructed by the engineer.
- (14) When raising a ventilation pipe from a horizontal drainage pipe, the angle from the axial line of the horizontal pipe to that of the ventilation pipe at the connection section shall be more than 45 degrees, and an angle of 45 to 90 degrees upward must be maintained from the gradient line of the horizontal pipe to the axial line of the ventilation pipe.
- (15) Lead pipes must be bent in a circle. When connecting a branch pipe, it should be connected to the straight portion of the main pipe. The end of the branch pipe connected to the main pipe shall not protrude from the interior surface of the main pipe.
- (16) When making a trap out of a lead pipe, its water seal depth shall be more than 50 mm.

21.4.4 Tests:

(1) Water filling test

Upon completion of piping work, close all connections between branch pipes and various plumbing fixtures and all other openings, and fill the whole system to the highest point with water. Leave it as it is for more than one

hour and conduct a water filling test in the presence of the Supervisor.

(2) Water-running test

The test shall be conducted in the presence of the Supervisor after connection to the drainage basin.

(3) The pumps must be thoroughly tested in accordance with instructions given in "Water supply facilities construction work".

21.4.5 Anti-sweat Covering and Painting:

(1) Should be carried out in accordance with instructions given in "Water supply facilities construction work".

(2) The thickness of anti-sweat covering shall be as follows:

Pipe diameter	Thickness (mm)
Under 40 mm	10
Over 50 mm	20

21.5 GAS SUPPLY WORK

Gas shall be supplied to each terminal through the lateral pipeline to be laid by the separate work as indicated in the design drawing.

21.5.1 Piping Material:

Steel pipe (galvanized steel) shall be used mainly as the piping material.

21.5.2 Piping Work:

(1) Piping shall comply correspondingly with the requirement provided in each item of this specification.

(2) Piping shall be graded properly. Its bottom and end shall be provided with the drain and the tees to be used for plug-stop as well as cleaning inside the pipe.

- (3) Piping shall be laid at a clearance of 150 mm or larger from the electrical wire. If it has to be laid inevitably within that clearance, the electrical wire shall be covered with the porcelain tube or segregated with the insulating partition.
- (4) Piping shall be cocked off outside the building. Laying work to the indoor terminal shall be carried out by the separate contract.

21.5.3 Cover Coating of Pipeline:

- (1) In case where the pipeline may break through or contact the floor and wall of corrosiveness and in case where it may be buried underground, it shall be covered with anti-corrosive coating.
- (2) The exposed pipeline shall be undercoated by two layers for rust prevention and then finished with color paint by two layers.

21.5.4 Test:

After finish of the pipe laying work, pneumatic pressure test shall be conducted in the presence of the Supervisor by request of the gas supply enterpriser or by instruction of the Supervisor.

21.6 SANITARY FIXTURE WORK

21.6.1 Materials:

21.6.1.1 Pipes

- a. Pipes attached to sanitary pottery shall be chrome-plated.
- b. Refer to "Water supply facilities construction work" for other pipes than the listed above.

21.6.1.2 Valves, bibcocks and couplings

Refer to "Water supply facilities construction work" and "Drainage facilities construction work".

21.6.1.3 Sanitary pottery and accessories

- a. Pottery shall be ordinary white pottery of first grade.
- b. Details of sanitary pottery and accessories shall be in accordance with drawings. All exposed portions of the accessories shall be chrome-plated.
- c. All wood screws used on sanitary pottery and accessories shall be brass screws, whose exposed portions shall be chrome-plated.
- d. The flushing system for urinals shall be provided with the flush valve.
- e. The flushing system for other closet shall be equipped with the flush valve.
- f. Traps used for lavatory bowls and wash basins shall be chrome-plated.
- g. A toilet paper holder shall be attached to each closet, and the holder shall be hard chrome-plated.
- h. The mirror chamfered shall be 450 mm by 600 mm in size and 6 mm thick. Its back shall be given acid proof treatment. The mirror shall be firmly fitted to the wall with two chrome-plated brackets and rubber packings on both upper and lower sides.
- i. Showers
The fixed type chrome-plated shower shall be furnished with the shower valve as its accessory.
- j. Details on water cooler and air towel shall be as specified in the design drawing.

21.6.2 Installation:

- (1) Various apparatus to be installed must be correctly positioned according to detailed architecture drawings, under the supervision of the Supervisor.
- (2) When installing an apparatus on a concrete or brick wall, use anchor bolts to be in good appearance.

- (3) When wood bricks are used, apply preservative on them and attach the bricks firmly to the wall.
- (4) When part of the pottery is embedded in concrete, an asphalt covering with a thickness of more than 3 mm must be provided over the entire contact surface of the pottery with the concrete or the cement mortar so as not to contact directly. Fill the bottom contact portion of the urinal stall pottery with sand before fixing it in place.

(5) Installation of western style closets

In installing a western style closet, position it correctly, keeping the top surface as level as possible without leaving any shake.

(6) Installation of urinals

- a. Urinals with traps shall be attached to the wall at the right position and at the correct height. They should be connected to drainage pipes using wall flanges (for lead pipes) of closet accessory fittings and be bolted together.
- b. For stalls, stall drainage fixtures should be used. The socket fixture must be closely joined to the flared end of the draining pipe.

(7) Heights of various apparatus and fixtures

The standard heights of various apparatus and fixtures are as follows:

a. Height of urinal	From floor to the top of apron	530 mm
b. Height of wash basin	From floor to the top of apron	720 mm
c. Height of lavatory bowl	From floor to the top of apron	760 mm
d. Height of janitor's sink	From floor to the top of apron	683 mm
e. Air towel	From floor to the bottom of apron	1,000mm

21.6.3 Tests:

After completion of the installation of water supply and drainage apparatus, conduct tests, in the presence of the Supervisor, by running water through the system.

21.7 KITCHEN FIXTURE WORK

21.7.1 Material:

Stainless steel shall be SUS304.

21.7.2 Processing:

- (1) All stainless steel joints exceeding 0.8 mm in thickness shall be finished, after argon-arc welding, by grinding with the grinder graded at and above 'grinder-puff #300'.
- (2) Each fixture shall be fixed rigidly and evenly on the floor by use of SUS304 adjusting balls at the base. All fixtures for water and gas supplies and drainage shall be arranged without interference between each other.

21.7.3 Equipment:

As per design drawings.

21.7.4 Fabrication, Installation and Test:

- (1) Each kitchen fixture shall be fabricated after approval of the Supervisor on the fabrication drawing, which shall be prepared in accordance with the design drawing and submitted for his approval.
- (2) The fabricated unit shall undergo tests for performance and finished workmanship at the shop and shall be delivered to the site after acceptance by such tests.
- (3) Prior to installation at the job site, full discussion shall be made with the contractor involved so that all of those fixtures for water supply, drainage and vent may be located nicely without interference and inconvenience.

21.8.1 Vibration Protection Support for Piping:

a. Vibration protection rubber

Use vibration proof rubber which meets the specifications given. The rubber should have mounting screws on both sides or else it should be of the suspension type vibration protection rubber both of which receive compression loads. The hardness, size and the number of rubber pieces shall be calculated based on loads supported, with the natural frequency of the vibration protection system set at 10 Hz (600 c/m). The rubber shall be selected from standard products of the manufacture. Their supporting intervals shall be as specified in 21.2.2 (11). For horizontally running piping, turnbuckle type hangers and suspension type vibration protection rubber should normally be used. For independent piping, provide hangers and vibration protection rubber at the middle of the suspension bolts. For vertical pipes, use, in principle, round vibration protection rubber pieces with screws on both sides. In both independent piping and piping laid in parallel with others, provide the pipes with supporting fixtures and place vibration protection rubber pieces between the fixtures and the support fittings fixed to the structure. Suspension and supporting work shall be conducted in accordance with Paragraph 21.2.2. A common support system must not be employed for vibration protection piping and non-vibration protection piping. Exercise care least any vibration protection portion should come into contact with the structure or a non vibration protection portion. Also, full attention must be paid to hanger bolts and the supporting positions, so that load will work vertically to the vibration protection rubber.

21.8.2 Vibration Protection Couplings for Piping:

Use flexible joints for those portions of the piping which pass through the expansion joint of the structure. There should, as a rule, be no piping penetrating through the walls, ceilings or floors of the auditorium structure. If it is unavoidable, however, use flexible joints on the auditorium side of the penetrating portions.

SECTION 22

VENTILATION AND AIR CONDITIONING

22.1 GENERAL

22.1.1 Scope of Works:

- (1) Cooling source equipment installation work
 - (a) Refrigerator (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) Automatic control work

22.1.2 Separate Works:

- (1) All electrical works except secondary wiring for refrigerator
- (2) Plumbing
- (3) Outer louver (For O.A inlet and exhaust)
- (4) Door grille
- (5) Underground ductwork

22.1.3 Spare Parts:

Consumable material necessary for continuous one year operation such as refrigerant and one year operation such as lubrication oil for all rotating machines, etc., shall be supplied.

Necessary spare parts for air filter shall be 10% of framing and 100% of filtering media and fan belt.

22.1.4 Inspection:

During installation work and after completion of work, apparatus, ducting, piping and accessories shall be tested to ensure functional operation.

Running test of refrigerator, air-handling units, fans and pumps shall be performed.

22.2 COOLING SOURCE

22.2.1 Refrigerator:

The existing refrigerator (225USRT) shall be utilized as the cooling source available with chilled water supply from the existing machine room.

For cooling of the sub-control room the air-cooled chilling unit shall be newly installed so as to serve as the stand-by unit, if so required, as well as to provide the separate cooling facilities.

22.2.2 Water Chilling Unit:

(1) Capacity

The refrigerator must have following capacity.

- | | |
|-------------------------------------|-------------------------|
| a. Cooling capacity | 87000 kcal/hr |
| b. Refrigerant | R-22 |
| c. Chiller inlet temperature | 12°C |
| d. Chiller outlet temperature | 7°C |
| e. Condenser inlet temperature | 35°C |
| f. Condenser outlet temperature | 37.9°C |
| g. Chiller circulation water volume | 290 l/min |
| h. Condenser circulation air volume | 680 m ³ /min |
| i. Main motor | |
| (a) Three phases induction motor | |
| (b) Type | As per drawings |
| (c) Rated output | 37 kW |
| (d) Power source | 380V x 3φ x 50 Hz |
| (e) Starting device | Star-delta |

(2) General

- a. A reciprocating type compressor, chiller, condenser, motor, oil heater, refrigerant heat exchanger, safety device, automatic capacity control device and other necessary accessories should be equipped with the machine.
- b. The performance is to have sufficient capacity and to secure safety to satisfactorily realize the designed standards. The capacity controlling must cover over four stages. It shall be operable at outdoor temperature up to and including 52°C.

(3) Capacity control system

Having a structure utilizing unloader device, starting with light load and automatic operation with the rated capacity should be performed.

(4) Automatic control system

a. Method of starting and stopping

- (a) The starting operation should be automatically performed by means of a thermostat provided at the cooler inlet.
- (b) The stopping operation should be automatically performed by means of a thermostat provided at the cooler inlet.

b. Following items should be prepared for the automatic safety device.

- (a) High-low pressure switch
- (b) Oil-pressure relay
- (c) Chilled water temperature switch
- (d) Switch for cut-off water supply
- (e) Over-load relay for motor

(5) The chiller pump should be interlocked.

(6) The machine consists of the following equipment.

- a. Reciprocating type compressor 1 set
- b. Chiller 1 set
- c. Condenser 1 set
- d. Main motor 1 set
- e. High-low pressure controller 1 set
- f. Control box attached to main body 1 set
- g. Fan 1 set
- h. Oil pump 1 set
- i. Oil filter 1 set
- j. Temperature controlling device 1 set
- k. Automatic safety device 1 set
- l. Other accessories
 - (a) Vibration protection device for compressor
 - (b) Piping for pressure gauge
 - (c) Foundation bolts
 - (d) Refrigerant Rated supply quantity
 - (e) Lubricant Rated supply quantity
 - (f) Electrical parts such as a lamp, fuse, etc., will be prepared as the spare parts.

(7) Structure

- a. Special alloy, special steel and cast iron are used as the material, all of which has stiff, anti-abrasion and high extension characteristics, and has no breakage. The inside part has neither frictional resistance nor any other loss, and has zinc plated or equivalent finish to prevent corrosion by refrigerant.
- b. Special care is given to weight balance of the rotating parts to prevent uneven operation or generation of noise. The inside structure facilitates clearing and checking works.
- c. The chiller is multi-tube dry type and its shell is steel plate welded made. The water chamber and cover are cast iron or steel plate welded made. The tube has copper or other anti-corrosion metal made fin, and is mounted firmly at the both ends.

- d. For the condenser shall be of cross-fin coil type or its equivalence.
- e. The vibration protection device shall be of structure using either metallic spring with appropriate brake controller or vibration-proof rubber. In case of that the condenser and chiller is installed independently from the compressor or motor parts, the vibration protection device same with the mentioned above should be employed.
- f. The noise level should be less than 65 phon at the distance of 1 m from the machine. Abnormal sound should not be generated and vibration should be small.

22.2.2.1 Installation, insulation and painting of refrigerator

(1) Installation

The following item should be observed at installation of the refrigerator.

- a. The admixture ratio of concrete foundation (100 mm) to be established on the floor should be 1:2.5:3.5.
- b. Common bed for units
Unit is to be installed with the vibration protection device in accordance with instructions of the manufacturer. At the installation work, special care should be taken not to attenuate the vibration protection effect by importer tightening of the bolts.
- c. Test on the air tightness will be performed after completing the on-site assembly. Tests on noise and vibration will also be performed with attendance of the Supervisor.

(2) Insulation work

As per design drawings.

(3) Painting

As per design drawings.

- (4) After assembling of the refrigerator at the factory, tests on the capacity, air tightness, noise and vibration should be performed at the trial operation. After this procedures, the machine will be delivered to the site. This installation work includes the delivery and operation adjustment.

22.2.3 Pumps:

22.2.3.1 Description of the pump

A. Chiller pump

- a. Capacity : 50 ϕ x 290 l/min x 20 m
- b. Motor : 2.2 kW x 380V x 50 Hz x 3 ϕ
- c. Type : Line pump
- d. Accessories

- Pressure gauge : 1 pc.
- Purge valve : 1 pc.
- Funnel and cock for priming : 1 set
- Coupling flange (with bolts) : 2 sheets

- e. Quantity : 1 unit

f. Structure

The pump shall be of unified structure together with the motor, being equipped with its casing of cast iron and blade of gunmetal. The structure shall be of complete water tightness by use of mechanical seal for the shaft sealed portion and shall be designed for less noise and vibration.

g. Installation work

As per drawings.

h. Test

The test report should be submitted.

i. Operation

Interlocked with the refrigerator, the pump operates automatically. By manual operation, it should also be started and stopped.

B. Water supply pump (For expansion tank)

as per drawing

22.3 AIR CONDITIONING FACILITY

22.3.1 Air Conditioning Facility:

22.3.1.1 Air handling unit

A blower, cooler and air filter are built in the unit, and a motor is normally mounted on the casing. (As per design drawing)

(1) Operation of the blower is required to keep balanced rotating constantly without having any rolling. The material should be fine quality without any fault such as strain. The blower is driven by the motor by means of the V-belt, where vibration and noise to be generated should be weak. The noise generated by the blower should be as specified in 22.5.1.1(1) d(a) and less than 60 phon at the position of 1 m from the casing side.

(2) Cooler

a. Construction

(a) Cooling coil should have enough strength against interior water pressure, and should be required a little air resistance.

(b) Fins are plate type;

The connection of the fins with tube should be made mechanically or by plating method, so that heat transmission resistance of the contact may be minimum.

(c) Copper pipe and aluminum fins are used.

These should be fixed in a steel casing without leaving any bend.

(d) Header should be provided with taps for piping and air bent.

(e) After assembly at factory an air tightness test at 16 kg/cm² should be conducted.

b. Installation

Cooling coil should be mounted horizontally on a rack framed firmly.

(3) Air filter

The filter shall be removable, washable and reusable, using filtration material of chemical fibre of 5mm thickness for the standard type and same of 32 mm thickness for the high-efficiency type.

(4) Casing

The outer casing should be made with steel plate with thickness of more than 1.6 mm, and the outer surface should be melamine resin-baked finished. On the inner surface, 25 mm glass insulation board should be pasted in accordance with the instructions given by 22.7 is applied.

(5) Foundation and installation

In case of a floor installation, the air handling unit should be installed on a 100 mm thickness concrete foundation in accordance with the instructions given in 22.7. Canvas connections should be applied between the air outlet and the duct, and between the return air duct and the filter chamber respectively.

22.3.1.2 Fan coil unit

A fan coil unit is a small sized air handling unit. Fan connected with motor directly, cooler and air filter are built in the unit.

(1) Fan

Steel-plate made multi-blade (Sirocco) should be used. Operation of the fan is required to keep balanced rotating constantly without having any rolling. The material should be fine quality without any fault such as strain. A bearing should be selected specially from fine quality material. The noise generated by the fan should be as specified in 22.5.1.1(1) d (a) and less than 45 phon at the position of 1 m from the casing side.

(2) Cooler

Refer to 22.3.1.1 (2).

(3) Air filter

The air filter should be detached, washed and used repeatedly.

(4) Casing

The outercasing should be made with steel plate with thickness of more than 0.8 mm, and the outer surface should be melamine baked finished as specified cooler.

On the inner surface, 8 mm glass wool insulation board should be pasted is applied.

(5) Accessories

Remote control switch for embedded type.

Speed control switch and reactor box for exposure type.

(6) Vibration protection

The fan coil unit should be installed with vibration protection accordance with 22.7.

22.3.1.3 Enthalpy exchanger (Air to air)

a. Volume:

O.A. 8,400 m³/hr

Ex.A. 9,600 m³/hr

b. Temperature exchange efficiency:

75% and larger

c. Type:

As per design drawing.

d. Installation and others:

Ditto

22.4 DUCT WORK AND PIPING

22.4.1 Duct Work:

(1) Rectangular duct

The duct should be made of galvanized steel sheet (JIS G3302) with the following specifications.

(a) Thickness and joints

Length of Long Side (mm)	Thickness (mm)	Connecting Flange		Rivet 4.5φ Pitch	Bolt 7.5φ Pitch
		Standard	Maximum Interval		
Under 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
Over 2,510	1.4	L-50x50x4	1.5	65	100

Care should be taken not to position the joint at pass-through section of the structure.

(b) Reinforcement

Thickness (mm)	Reinforcement Angle		Rivet 4.5φ Pitch
	Standard	Maximum Interval	
Under 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
1.4	L-50x50x4	0.9	65

In case of that the length of long side is under 300 mm, standing seam may be utilized.

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

(c) Metal parts and support metal parts

Duct Thickness (mm)	Support Angle	Metal Part		Support Metal Part Maximum Interval
		Steel Bar	Maximum Interval	
Under 0.6	L-25x25x3	9 mmφ	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
1.4	L-50x50x4	12	2.7	3.6

(2) Steel sheet round duct

(a) Thickness and joints

Diameter (mm)	Thickness (mm)	Connecting Flange		Rivet 4.5φ	Rivet 7.5φ
		Standard	Maximum Interval	Pitch	Pitch
Under 300	0.5	L-25x25x3	3.6 m	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

Care should be taken not to position the joint at a passthrough section of the structure.

(b) Reinforcement

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

(c) Suspension metal part and support metal part

Diameter	Flat Bar	Metal Part	Support Metal Part Maximum Interval
Under 1,500 mm	25 x 3 m	9 mmφ	3.6 m

(3) Vibration protection and sound proof

(a) Vibration protected suspension

The duct passing through or passing directly under the floor of auditorium, sub-control room and machine rooms for air conditioning or ventilating (including sound attenuation room) should be suspended with vibration protected support at the part in accordance with 22.7. For the duct passing through the parts other than the mentioned above, same vibration protected suspension is required, for the steel sheet duct, of which long side is over 500 mm.

(b) Vibration protection and sound proof duct

The vibration protection and sound proof duct specified in 22.7 should be employed when the ducts pass through walls, floors and ceilings of the auditorium, sub-control room or machine rooms. At the pass-through part other than the above mentioned, the insulation material's surface on the duct should be clamped with galvanized steel sheet with brim (25 mm) and mortar should be filled sufficiently. In case the duct has no insulated covered surface, same procedure should be taken after applying adiabatic material to the pass-through part. The pass-through part should be minimized, and the both ends should be connected with flange.

(c) Vibration protection of duct

For the pass-through part of duct at the inside of auditorium, rubber made flexible joint or double canvas connection with about 100 mm length should be used. In the latter case, insulation work should be applied for it in accordance with 22.4.3.

For the contact part between the duct and the blower or air handling unit, where the duct passes through, the vibration protection work as mentioned above should be performed.

22.4.2 Duct Accessories:

(1) Air control damper

- a. The damper casing should be made of steel plate with thickness of over 2.0 mm having flanges at the both ends. The blade should be made with galvanized steel sheet over 0.6 mm thickness.
- b. Operation of the damper should be precise without vibration. When it is opened, air resistance should be minimum.
- c. At the pass-through part of the damper shaft on the side board of air duct, bearing should be provided.
- d. The manual operated large sized damper should be operated by means of a handle. Smooth operation of the interlocking mechanism should be secured. For the manual operated small sized damper, an open-shut indicator made of cast iron or bronze should be provided.
- e. The damper should not be provided at the pass-through part of the structure.

(2) Supply air grille and return air grille

a. Supply air grille

- (a) The grille should be punched steel plate made or a fixed blade type grille having specified area.
- (b) Air supply resistor
The blade should be made of thick steel plate, brass or aluminium plate.
- (c) Ceiling air diffuser
Steel, brass or aluminium plate should be used.
- (d) Mounting of grille
At the part on which the grille to be mounted, a shutter made of thin steel plate should be provided without spoiling the outside appearance, where air leakage should be prevented.

(e) Manufacturing of grille

The drawing should be approved by the Supervisor in charge.

b. Return air grille

(a) Grille

It should have specified effective area.

(b) Mounting

At backside of the part on which the grille to be mounted, a shutter should be provided and should be prevented air leakage from circumference part of the grille.

(c) Manufacturing

The manufacturing drawing should be approved by the Supervisor in charge.

c. Hood

The hood should be galvanized steel sheet made specified in JIS G3302, and the operating part should be reinforced with shape steel. The hood should have the shape and measurements enabling effective discharge of waste gas.

(3) Sound absorbing duct

a. Sound absorbing elbow

It should be made with galvanized steel sheet, and the outside part should be right angled while the inner part should be arc shaped. The acoustic lining should be applied. See design drawings.

b. Sound absorbing chamber

The chamber should be made with galvanized steel sheet having specified measurements. The acoustic lining should be applied. When the measurement is not specified, the cross sectional measurement should be over two times of cross sectional measurement or diameter of the duct. The length should be over 1.5 times of

diagonal line or diameter of the duct. The nominal size is the inner measurement after applying the lining. See design drawings.

22.4.3 Insulation Work:

Supply, return and air intake ducts in each air conditioning system should be insulated as follows.

(1) Material

Rock wool insulation board or glass wool insulation board should be used.

(2) Works

a. Thickness of insulation material

Supply duct	Over 20 mm
Return duct	Over 20 mm
Air intake duct	Over 20 mm

b. Mounting of insulation material

On the surface of duct, one copper rivet should be soldered for each 200 cm². On them, the insulation material with specified thickness should be placed and be fixed by metal washers. After covering it with cotton cloth, primary painting in two times should be applied.

c. Mortar finish

The duct passing through the specified spaces should be covered by asphalt paper and be finished with 25 mm mortar plaster after applying the above mentioned insulation.

d. Others

For the part applied with acoustic lining, insulation is not required. The connecting part of adiabatic duct and acoustic lining duct should overlapped with the length of 100 mm. The end should be sticked to the duct's steel sheet with adhesive tape.

22.4.4 Painting:

(1) Duct

- a. Duct with insulation, for the exposed part of adiabatic duct, vinyl paint with specified color should be applied in two times and for the concealed part, primary painting should be applied, in two times.
- b. For the mortar finished part, primary painting should be applied, in two times.
- c. Duct without insulation
Oil paint with specified color should be applied in two times.
- d. Flat black paint should be applied on the interior surface of a duct, at the connection portion of the duct with an outlet or an inlet.

(2) Duct accessories

- a. Air control damper
For the damper casing, anti-corrosive paint should be applied in two times. For the exposed part, oil paint with specified color should be additionally applied in two times.
- b. Supply air grille and return air grille
 - (a) For the steel plate, melamine baked finish with specified color should be applied.
 - (b) For the aluminium made, no painting is required.
 - (c) Shutters of the grilles should be painted with flat black paint.
- c. Suspension metal parts and support metal parts
After removing rust, anti-corrosive paint should be applied in two times. For the exposed part, oil paint with specified color should additionally be applied in two times.

22.4.5 Piping:

22.4.5.1 Material

(1) Pipe and joint

- a. The galvanized steel pipe specified in JIS G3452 (Steel pipe for piping) should be used.
- b. The malleable cast iron pipe joints or steel pipe joints should be used. When dismantling is needed, flange joints should be used but union joints should not be used. The flange 10 kg/cm² should be employed.

(2) Valves

a. Sluice valve

For the diameter under 50 mm, bronze made screw type should be employed, while for over 65 mm, flange type having cast iron body and bronze made operating part should be used (10 kg/cm²). Principally, outer screw type should be employed.

b. Check valve

The check valve provided at the pump outlet should be antishock type. For other positions, bronze made screw swing type should be employed for the diameter under 50 mm, while for over 65 mm, flange type having cast iron body and bronze operating part should be employed (10 kg/cm²).

c. Float valve

The body should be bronze made while the ball should be copper plate type. For the diameter over 40 mm, double valve flange type should be employed, while for under 32 mm, screw type should be used.

d. Safety valve

The valve shall be of flange type, steel-made structure except the element part made of bronze.

22.4.5.2 Piping work

(1) General

a. Connection of pipe

Screw connection, flange connection and welding connection should be adopted.

(a) Taper screws should be used. When incassant is required, it should be applied for only a plus screw. Lead red mixed firmly with vegetable oil can be used.

(b) Welding should be performed by a welder.

(c) Before connection work, the inside of pipe should be cleaned. After piping works, the ends of pipes should be temporarily plugged to prevent intrusion of foreign materials.

b. Support of pipe

All piping with over 34 mm diameter except for drainage which is not connected with a pump, should be suspended with vibration protection method or be supported in the same way. However, when pipings are supported by ceilings, floors or walls of the auditorium, sub-control room or machine rooms, the pipings should totally be vibration protected. For the vibration protection, follow the instructions given in 22.7 (Vibration protection . Sound proof works). The intervals of the support metal part are given below.

Diameter of Pipe	Under 50 mm	65 ~ 200 mm	Over 250 mm
Interval	1,800 mm	3,600 mm	5,400 mm

c. Pipe passing through the structure

A sleeve inserted should be removed after concrete work. The pipe should be covered by insulating cover and then be covered by steel sheet with collar. After these procedures, the pass-through section should be sufficiently filled with mortar from the both ends. Before fillings mortar, the position of pipe should be properly adjusted so that the load of pipe will not affect to the pass-through section directly. If necessary, support should be provided.

d. Flexible joint

(a) For expansion jointing parts of building, flexible joints should be employed.

(b) For the connecting part with equipment which generates vibration (refrigerator, pump, etc.), a flexible joint should be applied. The size should be used in accordance with 22.7.

e. Sealing plate, decorated cover

Principally, the pipings should be concealed. For the exposed part in a room, chrome plated sealing plate made of brass should be used for the pass-through section of ceiling, floor & wall. For the ends of piping insulation, chrome plated decorated cover made of brass should be used.

(2) Water piping work

a. Connection of pipe

When a flange is used, asbestos joint sheet with thickness under 1.5 mm of which main material is asbestos, or packing made of fine quality rubber should be used. For the surface of packing, vegetable oil mixed with lead red or graphite should be applied, but hard paint should not be applied.

b. Slope

Piping should be horizontally installed to prevent air trap. When it can't be installed horizontally, an automatic air release valve or cock can be provided subject to approval of the Supervisor.

c. Water pressure test

The pressure should be 8 kg/cm² at the checking proceeded after applying the pressure over 30 minutes.

22.4.5.3 Insulation work

(1) Chilled water piping insulation

a. Material

Insulation cover made of rock wool or glass wool should be used.

b. Thickness of insulation material

Pipe Diameter	Under 32 mm	40 ~ 125	Over 150
Thickness of insulation material	30 mm	40	50

c. Mounting of insulation material

Insulation material with specified thickness should be mounted, and it should be fastened with galvanized wire with the count over 0.8 mm and then wind the water proof paper on it. Then it should be bandaged by cotton cloth with the doubled part over 15 mm, and primary painting should be applied in two times.

d. Insulation of flanges and valves

Same insulation with the straight pipe should be applied.

e. Outdoor piping

For outdoor pipings, the cotton cloth as mentioned above should be replaced with asphalt jute. After hardening the piled part by heating, it should be covered by galvanized steel sheet (thickness 0.4 mm) with soldered connection.

(2) Mounting of bands

For the insulated part, brass made chrome plated band should be mounted on the straight pipe with the gap of 2 m, the branching and curved parts. At the ends of insulation material, yellow band with the same material should be mounted.

22.4.5.4 Painting

(1) Non-insulated part

a. Galvanized steel pipe

Oil paint with specified color should be applied in two times.

b. Steel pipe

After removing rust, anti-corrosive paint should be applied in two times, and then oil paint with specified color should be applied in two times. For outdoor exposed pipings, silver paint should be applied instead of oil paint.

(2) Insulated part

a. Galvanized steel pipe

After covering it with cotton cloth, oil paint should be applied in two times.

b. Steel pipe

Before insulation work, anti-corrosive paint should be applied in two times. After insulated covered with cotton cloth, follow to the instruction given above.

c. Galvanized steel sheet covered part

Oil paint with specified color should be applied in two times.

22.5 VENTILATION WORK

22.5.1 Works for Blower:

22.5.1.1 Blower

(1) Multi-blade blower

a. Type

Multi-blade (Sirocco) type

b. Motor

As per drawing.

c. Accessories

Pulley, V belt, belt cover, foundation bolts, common foundation base, flanges with bolts, each 1 set.

d. Structure

(a) The blower should have the blade wheel and casing made of steel plate or other, all of which has stiff. Good weight balance of static and dynamic, the least vibration should be required in operation. The noise level in both side of delivery and suction should be under $91.5 + 10 \log_{10} \text{kW}$ (motor capacity). Frequency distribution is shown the following chart. Total power level should be used as standard,

Octave Band (Hz/s)	20 ~ 75	75 ~ 150	150 ~ 300	300 ~ 600	600 ~ 1,200	1,200 ~ 2,400	2,400 ~ 4,800	4,800 ~ 9,600
Blower noise	-1	-6	-11	-16	-21	-26	-31	-36

Oil filler should be provided at accessible place.

(b) The motor is used for V-belt drive, and should be able to control of belt tension by sliding the motor base.

e. Installation

- (a) The blower and motor should be installed on common floor foundation. And then, they should be installed in accordance with the instruction given in 22.8.
- (b) At the connection of blower and casing, blower and duct, double canvas connection should be provided.
- (c) The blower should be tested at the factory. The test report should be submitted.

22.5.1.2 Installation

(1) Installation of multi-blade blower

In accordance with the instructions given in the drawing, it should be installed with the motor on a common floor foundation or common bed.

- a. Specifications of the common floor foundation, channel type steel bed and suspension bolt are as follows:

Count of Fan		Common Floor Foundation	Channel Type 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

- b. Vibration protection

Refer to 22.7.

- c. Sound absorbing casing

- (a) Structure

See the design drawing.

- (b) Access door

Steel made airtight door should be employed. It should be convenient for checking of the motor, lubrication and replacement of the belt.

(c) Painting

Anti-corrosive paint should be applied in two times.
After the painting, the exposed part should be finish with oil paint with specified color.

22.5.2.1 Duct work

(1) Material

Refer to 22.4.1 (1).

(2) Details of work

Refer to 22.4.1 (1).

(3) Insulation

Insulation is not required unless otherwise specified.

(4) Painting

Refer to 22.4.4 (1).

22.5.2.2 Duct accessories

(1) Air control damper

(2) Air supply and return grille

(3) Hood

} Follow to the relating class in 22.4.2.

a. Material

Galvanized steel sheet with following thickness should be used.

Long Side	Thickness	Reinforcement Angle for Edge
Under 450 mm	0.8 mm	L-25x25x3
460 ~ 1,000	1.0	L-30x30x3
1,010 ~ 1,750	1.2	L-40x40x3
1,760 ~ 2,500	1.4	L-40x40x5

b. Suspension metal part

A hood having the long length over 1,100 mm should be fixed with bolts of 9 mmφ at its four sides.

c. Painting

Oil paint should be applied in two times.

(5) Painting

Refer to 22.4.4 Painting.

22.6 AUTOMATIC CONTROL EQUIPMENT

22.6.1 Structure:

Operation of each equipment to be employed should be sure, and the mounting and maintenance should be easy. The equipment to be provided in a room should have elegant shape and strong structure.

22.6.2 Equipment to be employed:

(1) Thermostat

Proportional control type, insertion type 9 pc.

(2) Automatic valve

a. Dual position control type (Electric valve) 4 pc.

b. Proportional control three-way valve 9 pc.

22.6.3 Mounting:

(1) An electric driven motor should be mounted with the specified directions. Careful attention should be paid to the position of balancing relay at the mounting.

(2) For the electric driven valve, a by-pass valve should be provided unless otherwise specified. When an angle gauge is provided the piping should be arranged to assure the easy reading.

(3) The thermostat should be mounted in a manner to ensure the proper operation.

22.6.4 Test:

Operation of each equipment should be performed after the mounting.

22.6.5 Control System:

As per drawings.

22.7 VIBRATION PROTECTION • SOUND PROOF WORK

22.7.1 Vibration Protected Installation of Rotary Equipment:

(1) Equipment to be vibration protected

Motor, pump, blower and other devices on which the former machines are mounted without vibration protection.

(2) Vibration protection material

Vibration protection rubber, or metal made vibration protection spring with proper damping device should be employed. The material is to be used with compressing load. The hardness, size and number of vibration protection rubber or spring should be obtained through calculation of the weight of vibration protected support system in which the frequency of own vibration should conform with the value given in the following table. In accordance with this method, the material should be selected among the standard products of relative manufacturers. When the weight of equipment is insufficient, the weight of support system should be increased by a basic or additional weighting method. The material of rubber should be Neoplane principally.

Classification of Equipment		Own Vibration	Vibration Protection Material
Equipment with rotation over 1200rpm		600	Rubber
Equipment with rotation of 1,200~850rpm		rpm x 1/2	Rubber
Equipment with rotation of 850~400rpm	Equipment installed at the next room or upper floor of auditorium and sub-control room.	rpm x 1/2	Spring
	Other equipment	360	Rubber
Equipment with rotation under 400rpm	Equipment installed at the next room or upper floor of auditorium and sub-control room.	rpm x 1/2	Spring
	Other equipment with power over 2.1 kW	rpm x 1/1.5	Spring
	Other equipment with power under 2.0 kW	600	Rubber

In case of reciprocating equipment, vibration frequency should be used cpm instead of rpm. The position of vibration protection support should be decided in a manner to have the uniform load on it.

The drawing of vibration protection design and drawing to indicate the supporting positions should be submitted to the Supervisor for approval.

(3) Installation work

a. Floor installation

Vibration protection rubber or springs in the shape of a mounting seat should be installed between the foundation concrete bed and equipment floor foundation. For installation, the mounting screw part should directly be buried into the foundation concrete bed with mortar. Instead of the mounting screw part, metal parts for mounting or a method to bury anchor bolts can be employed. In these cases, installation with correct position keeping right vertical line should be performed by utilizing jigs. After the vibration protection rubber or springs are fixed firmly, equipment floor foundation should be installed on it. At electrical or plumbing work, careful attention should be paid not to make any connection or contact between the vibration protected support system and the non-protection parts. Posts temporarily utilized for the installation should be removed without fail. As per design drawing.

b. Suspensory installation

Suspension type vibration protection rubber and turnbuckle type hanger should be attached to the suspension bolt of equipment. The hanger should be fixed to the insert buried in the specified position on upper slab. The distance between the surface of upper slab and the upper edge of hanger should be approximately under 30 mm principally. The equipment should be suspended after the suspension bolt is mounted to the hanger through the

vibration protection rubber should be provided at the specified position on the hanger, and the hanger should be adjusted to apply the load to the vibration protection rubber vertically. The suspension bolt of equipment suspended should not contact with the ceiling or sound absorbing box.

(4) Vibration protection at connection with pipe

At the connection of pump and water piping, blower and air duct, or air handling unit and air duct, vibration should be protected by utilizing a flexible joint as per 22.7 (4). At electrical piping, vibration should be protected by using a flexible pipe or rubber hose.

(5) Omission by vibration protection

For rotary equipment with proper vibration protection, vibration protected installation can be omitted.

22.7.2 Vibration Protection of Water Piping:

(1) Piping to be vibration protected

For water piping specified in 22.4.5.2 (1) b. and water piping between a flexible joint and pump installed with vibration protection should be suspended or supported with vibration protection work.

(2) Vibration protection rubber

The suspension type or mounting seat type should be used in the structure where compression load is applied. Hardness and size of the rubber should be calculated based on the supporting weight (including the weight of water contained) where own vibration of the supported system will be approximately conform to the Table 22.7.1 (2). In this way, the rubber should be selected among the standard products of relative manufacturers.

For the interval of support to be taken, follow to 22.4.5.2 (1) b. The rubber should principally be Neoprene made. The vibration protection design should be approved by the Supervisor by submitting of the drawing.

(3) Details of work

For horizontal pipings, turnbuckle type hangers and suspension type vibration protection rubber should principally be applied. These parts should be mounted on the suspension bolt in case of single piping, and should be on the suspension bolt of the common receiving part in case of plural pipings in accordance with the instructions given in 22.7.1

(3) b. For vertical pipings, mounting seat type vibration protection rubber should principally be used. Both for the single and plural pipings, the vibration protection rubber should be mounted on the positions between the fixing metal parts of piping and the support post mounted on the structure wall or structure floor. The vibration protection support parts should not be contacted with the structure or other parts having no vibration protection. The loads of each vibration protection rubber provided on a support metal part should be uniform.

(4) Vibration protection joint for piping

For the piping to be connected with rotary equipment, a flexible joint should be applied. For the piping passing through the structure wall of auditorium, a flexible joint should be provided at the auditorium side. The flexible joint to be employed should be a rubber made flexible joint. The flexible joints should be mounted vertically. The length of a flexible joint should be over two times of the diameter of pipe. The standards are given below:

Nominal Diameter of Pipe (mm)	Length (mm)	Nominal Diameter of Pipe (mm)	Length (mm)
20, 25	200	100, 130	400
35 ~ 80	300	160, 180	500

22.7.3 Vibration Protection of Air Duct:

(1) Air duct to be vibration protected

For air ducts specified in 22.4.1 (3) (a), vibration protected suspension or vibration protected support should be applied. For pass-through parts of sound proof walls, and contacting parts with a blower, vibration protection joints should be provided.

(2) Material for vibration protection

Suspension type or mounting seat type vibration protection rubber and should principally be used. However, for specially light weighted air ducts, insulation material in band shape can be utilized. The hardness and size of vibration protection rubber should follow to 22.7.2 (2), and the intervals of supports should follow to 22.4.1 (1) (c). The rubber should principally be Neoprene made, and the design of vibration protection should be approved by the Supervisor by submitting the drawing. When the band insulation material is used, the material specified in 22.4.3 (1) should be cut in the shape of band. The finished thickness of insulation material should be over 10 mm. The parts to be vibration protected should be decided through consultation with the Supervisor.

(3) Detail of work

Refer to 22.7.2 (3).

The band of glass wool should be inserted between duct and support metal part or between duct and duct support ring. The width of band should be required one and half times of width of support metal part or duct support ring.

(4) Vibration protection joint

The vibration protection joint to be employed should be a soft rubber film made flexible connector, canvas joint or double canvas joint. The length of joint should be 100 ~ 300 mm in accordance with the size of air duct.

Even for the air duct which requires insulation or sound proof, mortar or other outer finish should not be provided at the vibration protection joint.

22.7.4 Acoustic Lining:

(1) Part where acoustic lining should be applied.

Acoustic lining should be applied to the sound absorbing chamber or casing containing a blower, sound absorbing box specified in the drawing, sound absorbing curved air duct and sound absorbing straight air duct.

(2) Sound absorbing material

The sound absorbing glass wool board No. 2-24K should be used. The thickness should be 50 mm. Double glass wool board consists of two glass wool boards with each 25 mm thickness can be also acceptable. The board with different color from that of the insulation material to be used for air duct should be employed.

(3) Details of work

One copper rivet should be soldered on the inner surface of side board of chamber or air duct for each 200 mm². The sound absorbing material with specified thickness, the glass cloth should be mounted on it, and should be fastened with washers with approximately 25 mm diameter. At the working, the copper rivet tip should not bread the surface, and the absorbing material should not be compressed to decrease its specified thickness.

22.7.5 Vibration Protection and Sound Proof Air Duct:

(1) Part where vibration protection and sound proof should be applied

The works should be applied for the parts indicated in 22.4.1, (3) (a).

(2) Details of work

a. Manufacturing

Following to the instructions given in 22.4.1 (1), (2)

short tubes with the proper length in consideration of the thickness of pass-through section (the structure and thickness of finish) should be manufactured. The surface of center part of the tube should be covered by insulation material with the thickness of two times (with rock-wool insulation) or three times (with glass wool insulation material) of the specified thickness in the length of the thickness of pass-through section plus 100 mm. Then, the outer surface should be covered and clamped by galvanized steel sheet with collar (25 mm) so that the thickness of insulation material should be the one specified. The length of short tube should be as minimized as possible. For the both ends of sound proof and vibration protection finish, no work is required at the covered part, while proper work should be applied at the exposed part through consultation with the Supervisor. The insulation material of the sound proof and vibration protection part should be cut with same length of the covered steel sheet.

b. Installation work

The vibration protection and sound proof air duct should firstly be installed temporarily. Then, air ducts should be connected with the above mentioned duct at its both ends. The position of vibration protection and sound proof air duct should be adjusted so that the total air duct system can be properly positioned as specified. Then, the air duct should be fixed and the sound proof should be maintained by filling mortar into the pass-through section from its both sides.

At adjustment of the position of the vibration protection and sound proof air duct, the outer finished part of vibration protection and sound proof should not be detached from pass-through section (including the inner finished part).

APPENDIX

APPENDIX I

LIST OF SUPPLIERS FOR PROPRIETARY PRODUCTS REFERRED TO IN THE SPECIFICATION

(1) CONSTRUCTION

MATERIAL OR PRODUCT	COMMERCIAL BRAND, NAME OR NUMBER	SUPPLIER'S OR MANUFACTURE'S NAME & ADDRESS (IN JAPAN)
Asbestos Cement Flexible Board	Flexible Board Flexible Sheet	-Asano Slate Co., Ltd. 2-12, Shibadaimon, Minato-ku, Tokyo TEL (434) 1211 -Nozawa Corp. 15, Namihana-cho, Ikuta-ku, Kobe TEL 078 (391) 7221 -Ashahi Asbestos Co., Ltd. 7-10-6, Ginza, Chuo-ku, Tokyo TEL (573) 5111
Cemented Chip Board	Dorisol	-Nippon Drisol Co., Ltd. 1-16-3, Ginza, Chuo-ku, Tokyo TEL (563) 2731
Rock Wool Sound Absorbing Board	Minerartone Minerartone-Cube Solar-Tone	-Mitto Boseki Co., Ltd. 6-1, Yaesu, Chuo-ku, Tokyo TEL (272) 1211
Plaster Board	Gypsum Board	-Japan Gypsum Board Association 2-13-12, Nishi-shinbashi, Minato-ku, Tokyo TEL (591) 6844
Calcium Silicate Board	Asbest-rax	-Nippon Asbestos Co., Ltd. 1-1-26, Daimon, Minato-ku, Tokyo TEL (433) 7241
Vinyl Sheet	Lon-lium	-Lonseal Corp. 13, Matsumaga-cho, Chiyoda-ku, Tokyo TEL (253) 4941

MATERIAL OR PRODUCT	COMMERCIAL BRAND, NAME OR NUMBER	SUPPLIER'S OR MANUFACTURE'S NAME & ADDRESS (IN JAPAN)
Glass Wool Board	Glass Wool	<ul style="list-style-type: none"> -Asahi Fiber Glass Co., Ltd. 8-1, Ichigaya-hachiman-cho, Shinjuku-ku, Tokyo TEL (268) 1101 -Paramount Glass Mfg. Co., Ltd. 6-1, Yaesu, Chuo-ku, Tokyo TEL (273) 5011 -Nippon Mineral Fiber Mfg. Co., Ltd. 1, Iwamoto-cho, Chiyoda-ku, Tokyo TEL (253) 7781
Special Epoxiresin Spraying Tile	<ul style="list-style-type: none"> Wall Coat Sof-Tile, Epo-Tile Color lock AO Tile 	<ul style="list-style-type: none"> -ABC Trading Co., Ltd. 2-12-14, Nagata-cho, Chiyoda-ku, Tokyo TEL (507) 7111 -Shinto Paint Co., Ltd. 1-7-20, Yaesu, Chuo-ku, Tokyo TEL (272) 4011 -Shinetsu Unit Co., Ltd. 3-19, Sakuma-cho, Chiyoda-ku, Tokyo TEL (861) 2691 -Kikusui Chemical Industry Co., Ltd. 1-38-5, Kamiikebukuro, Toshima-ku, Tokyo TEL (949) 2155 -Fujimori Sangyo Co., Ltd. 1-2-17, Higashi-shinbashi, Minato-ku, Tokyo TEL (574) 0511
Stage Flooring		<ul style="list-style-type: none"> -Takashimaya Kosakusho Co., Ltd. 4-8-8, Shibaura, Minato-ku, Tokyo TEL (453) 4331 -Naigai Mokuzai Kogyo Co., Ltd. 1-14-8, Uchi-kanda, Chiyoda-ku, Tokyo TEL (292) 3841 -Mitsui Mokuzai Kogyo Co., Ltd. 1-5-11, Nishi-shinbashi, Minato-ku, Tokyo TEL (505) 6609

MATERIAL OR PRODUCT	COMMERCIAL BRAND, NAME OR NUMBER	SUPPLIER'S OR MANUFACTURE'S NAME & ADDRESS (IN JAPAN)
Vinyl tile	P-tile Matico-V Vinies-Tile	<ul style="list-style-type: none"> -Tajima Oyokako Co. Ltd. 3-11-13, Iwamoto-cho, Chiyoda-ku, Tokyo TEL (866) 6101 -Toyo Linoleum Mfg. Co., Ltd. 33, Kotohira-cho, Minato-ku, Tokyo TEL (503) 3021 -Nisshin Kogyo Co., Ltd. 2-21-28, Senju-higashi, Adachi-ku, Tokyo TEL (882) 2424
Vinyl Skirting		Ditto
Coloured Aluminium		<ul style="list-style-type: none"> -Morimura Metal Co., Ltd. 2-3-5, Kinshi, Sumida-ku, Tokyo TEL (625) 3991 -Yoshida Kogyo K.K. 1, Kanda-izumi-cho, Chiyoda-ku, Tokyo TEL (866) 7241 -Riken Light Metal Industry Co., Ltd. 1-10-5, Iwamoto-cho, Chiyoda-ku, Tokyo TEL (863) 1901
Access Door		<ul style="list-style-type: none"> -Naka Industry Co., Ltd. 39, Shin-machi, Yashio-city, Saitama Pref. TEL 0489 (36) 3781 -Riken Light Metal Industry Co., Ltd. 1-10-5, Iwamoto-cho, Chiyoda-ku, Tokyo TEL (863) 1901
Vertical Blind		<ul style="list-style-type: none"> -Sasaki Blind Co., Ltd. 4-21-2, Nakanobu, Shinagawa-ku, Tokyo TEL (786) 1141 -Tachikawa Blind Co., Ltd. 4-30-7, Yoyogi, Shibuya-ku, Tokyo TEL (357) 1111 -Nichibei Blind Co., Ltd. 3-15, Nihonbashi, Chuo-ku, Tokyo TEL (272) 2011

MATERIAL OR PRODUCT	COMMERCIAL BRAND, NAME OR NUMBER	SUPPLIER'S OR MANUFACTURE'S NAME & ADDRESS (IN JAPAN)
Door Mat		<ul style="list-style-type: none"> - Teramoto Co., Ltd. 1, Katsuyama-minami, Ikuno-ku, Osaka TEL 06 (717) 3721 - Yamazaki Sangyo Co., Ltd. 5-10-12, Toranomon, Minato-ku, Tokyo TEL (432) 3821
Sealant (Caulking)	<ul style="list-style-type: none"> Better-Seal Weather-Ban Hama Chio-Coak Fine-Sealer 	<ul style="list-style-type: none"> - San-star Chemical Co., Ltd. 1-3-36, Mita, Minato-ku, Tokyo TEL (453) 9301 - Sumitomo 3-M Co., Ltd. 2-33-1, Tamagawa, Setagaya-ku, Tokyo TEL (709) 8111 - Yokohama Rubber Co., Ltd. 6-1-11, Shinbashi, Minato-ku, Tokyo TEL (432) 7111 - ABC Trading Co., Ltd. 2-12-14, Nagata-cho, Chiyoda-ku, Tokyo TEL (507) 7111 - Nippon Tenkazai Kogyo Co., Ltd. 1-21-5, Maeno-cho, Itabashi-ku, Tokyo TEL (960) 8621
Foamed Polystyrene	<ul style="list-style-type: none"> Sulen Board YB Board 	<ul style="list-style-type: none"> - Sekisui Chemical Industry Co., Ltd. 2-1-1, Nishi-shinjuku, Shinjuku-ku, Tokyo (Mitsui Bldg.) TEL (347) 9646 - Sansyo Jushi Co., Ltd. 1-5-4, Nihonbashi, Bakuro-cho, Chuo-ku, Tokyo TEL (283) 5442
Water Stop		<ul style="list-style-type: none"> - Hayakawa Rubber Co., Ltd. 1-16-10, Saga, Koto-ku, Tokyo TEL (642) 9434 - Yokohama Rubber Co., Ltd. 6-1-11, Shinbashi, Minato-ku, Tokyo TEL (432) 7111 - Seibu Polymer Chemical Co., Ltd. 2-5, Kami-ikebururo, Toshima-ku, Tokyo TEL (916) 6121

MATERIAL OR PRODUCT	COMMERCIAL BRAND, NAME OR NUMBER	SUPPLIER'S OR MANUFACTURE'S NAME & ADDRESS (IN JAPAN)
Polyethylene Film		-Sekisui Chemical Co., Ltd. 2-1-1, Nishi-shinjuku, Shinjuku-ku, Tokyo TEL (347) 9111
Corner Bead		-Fukubi Chemical Industry Co., Ltd. Sendagaya, Shibuya-ku, Tokyo TEL (404) 6881
Vibration Isolating Hanger		-Toyo Kenzai Kogyo Co., Ltd. 1-9-14, Kaigan, Minato-ku, Tokyo TEL (437) 0831
Sliding Wall		-Nichibei Partition Co., Ltd. 3-15-4, Nihombashi, Chuo-ku, Tokyo TEL (272) 2011
Seat		-Kotobuki Co., Ltd. 1-2-12, Yuraku-cho, Chiyoda-ku, Tokyo TEL (591) 1311
Vinyl Paint (VP) Oil Paing (OP)		-Nippon Paint Co., Ltd. 4-1-15, Minami-shinagawa, Shinagawa-ku, Tokyo TEL (474) 1111 -Kansai Paint Co., Ltd. 5-27, Fushimi-cho, Higashi-ku, Osaka TEL 06 (203) 5531 -Dainippon Paint Co., Ltd. 6-1, Nishikujo, Konohana-ku, Osaka TEL 06 (461) 5371 -Toa Paint Co., Ltd. 1-3-18, Takami, Konohana-ku, Osaka TEL 06 (461) 7031 -Shinto Paint Co., Ltd. 1-7-20, Yaesu, Chuo-ku, Tokyo TEL (272) 4011

MATERIAL OR PRODUCT	COMMERCIAL BRAND, NAME OR NUMBER	SUPPLIER'S OR MANUFACTURER'S NAME & ADDRESS (IN JAPAN)
Special Porcelain Tile		-Iwao Jiki Co., Ltd. 2-8, Ginza, Chuo-ku, Tokyo TEL (561) 1191 -Ina Seito Co., Ltd. 4-9-8, Hatchobori, Chuo-ku, Tokyo TEL (551) 6371 -Danto Co., Ltd. 3-7-2, Nihonbashi, Hama-cho, Chuo-ku, Tokyo TEL (664) 1621 -Nippon Toshoku Co., Ltd. 2-19-26, Seta, Setagaya-ku, Tokyo TEL (709) 1591
Semi-Porcelain Tile		-Ina Seito Co., Ltd. 2-9-8, Hatchobori, Chuo-ku, Tokyo TEL (551) 6371 -Danto Co., Ltd. 3-7-2, Nihonbashi, Hama-cho, Chuo-ku, Tokyo TEL (664) 1621
Mirror	Mirror 119 AS Series Hi-Mirror	-Toto Kiki Co., Ltd. 1, Toranomon, Minato-ku, Tokyo TEL (503) 6311 -Nippon Sheet Glass Co., Ltd. 4-8, Doshomachi, Higashi-ku, Osaka TEL 06 (202) 1161
Glass		-Central Glass Co., Ltd. 3-7-1, Kanda Nishiki-cho, Chiyoda-ku, Tokyo TEL (296) 7111 -Nippon Sheet Glass Co., Ltd. 1-8-3, Shinbashi, Minato-ku, Tokyo TEL (573) 0121 -Asahi Glass Co., Ltd. 2-1-2, Marunouchi, Chiyoda-ku, Tokyo TEL (218) 5555

MATERIAL OR PRODUCT	COMMERCIAL BRAND, NAME OR NUMBER	SUPPLIER'S OR MANUFACTURE'S NAME & ADDRESS (IN JAPAN)
Water proofing Mortar finished	Rorus Gelka Magna	<p>-Kaijo Chemical Industry Co., Ltd 2-28-7, Akabane, Kita-ku, Tokyo TEL (902) 3181</p> <p>-Yoshida Kensetsu Kogyo Co., Ltd. 5-10-19, Roppongi, Minato-ku, Tokyo TEL (403) 0851</p> <p>-Magna Industry Co., Ltd. 1-31, Xoyogi, Shibuya-ku, Tokyo TEL (370) 2211</p>
Light Gauge Steel Flame (Wall & Cieling)		<p>-Okumura-Jubei Co., Ltd. 22, Ise-machi, Kita-ku, Osaka TEL (312) 4131</p> <p>-Sakata Kentetsu Co., Ltd. 2-23-12, Fukagawa, Koto-ku, Tokyo TEL (642) 0661</p> <p>-Suehiro Tetsumo Co., Ltd. 7-16-8, Nishi-gotanda, Shinagawa-ku, Tokyo</p>
Light Gauge Steel Backing (Wall & Ceiling)		<p>-Nippon Kenko Co., Ltd. 5-29-3, Nishi-gotanda, Shinagawa-ku, Tokyo TEL (492) 4951</p>
Non-Slip		<p>-Naka Industry Ltd. 39 Shin-machi, Yashio-city, Saitama Pref. TEL 0489 (36) 3781</p> <p>-Atras Sangyo Co., Ltd. 2-31-1, Higashi-nippori, Arakawa-ku, Tokyo</p>

MATERIAL OR PRODUCT	COMMERCIAL BRAND, NAME OR NUMBER	SUPPLIER'S OR MANUFACTURE'S NAME & ADDRESS (IN JAPAN)
Aluminium Cast Wall		<p>-Tajima Metal Work Co., Ltd. 6-2-2, Maeno-cho, Itabashi-ku, Tokyo TEL (960) 5131</p> <p>-Fuso Alloy Co., Ltd. 3-19, Kanda Nishiki-cho, Chiyoda-ku, Tokyo TEL (293) 2881</p> <p>-Kubota Ltd. 3-3-2, Nihonbashi, Muro-machi, Chuo-ku, Tokyo TEL (279) 2111</p>
Welded Mesh		<p>-Teikoku Kanaami Co., Ltd. 3-1-30, Imazu, Minami, Tsurumi-ku, Osaka TEL (961) 5171</p>
Roof Drain		<p>-Hasegawa FDY Co., Ltd. 1-2, Kanda, Awaji-cho, Chiyoda-ku, Tokyo TEL (255) 4051</p> <p>-Ito Tekko Co., Ltd. 3, Motogo, Kawaguchi-city, Saitama Pref. TEL 0482 (22) 3176</p> <p>-Daiichi Kizai Co., Ltd. 1-65-4, Akabane, Kita-ku, Tokyo TEL (902) 3141</p>
Cast Iron Insert		<p>-Toyo Kenzai Co., Ltd. 1-9-14, Kaigan, Minato-ku, Tokyo TEL (437) 0831</p> <p>-Marui Sangyo Co., Ltd. 4-16-8, Kogo-naka, Hiroshima-city, Hiroshima Pref. TEL 0822 (72) 0101</p>

MATERIAL OR PRODUCT	COMMERCIAL BRAND, NAME OR NUMBER	SUPPLIER'S OR MANUFACTURE'S NAME & ADDRESS (IN JAPAN)
Steel Sash Aluminium Sash		<p>-Fuji Mfg. Co., Ltd. 1-3, Takara-cho, Chuo-ku, Tokyo TEL (279) 1611</p> <p>-Showa Koki Co., Ltd. 6-1-10, Maeno-cho, Itabashi-ku, Tokyo TEL (969) 1111</p> <p>-Nippon Kentetsu Co., Ltd. 2-6, Ote-machi, Chiyoda-ku, Tokyo TEL (270) 6511</p> <p>-Nittetsu Curtain Wall Co., Ltd. 1, Kanda-nishiki-cho, Chiyoda-ku, Tokyo TEL (295) 4511</p>
Shutter		<p>-Sanwa Shutter Mfg. Co., Ltd. 2-1-1, Nishi-shinjuku, Shinjuku-ku, Tokyo (Mitsui Bldg.) TEL (346) 3011</p> <p>-Omata Shutter Mfg. Co., Ltd. 1-4-1, Higashi-Tabata-machi, Kita-ku, Tokyo TEL (893) 5211</p> <p>-Suzuki Shutter Mfg. Co., Ltd. 1-1-4, Otsuka, Toshima-ku, Tokyo TEL (944) 1111</p>
Hard Ware		<p>-Miwa Lock Mfg. Co., Ltd. 3-1-12, Shiba, Minato-ku, Tokyo TEL (452) 5551</p> <p>-Goal Co., Ltd. 4-30, Tsuya-kitadori, Higashi-yodogawa-ku, Osaka TEL 06 (309) 1271</p> <p>-Showa Lock Co., Ltd. 2-11-50, Nakano-Nakaminami, Yodogawa-ku, Osaka TEL 06 (303) 1121</p>

MATERIAL OR PRODUCT	COMMERCIAL BRAND, NAME OR NUMBER	SUPPLIER'S OR MANUFACTURE'S NAME & ADDRESS (IN JAPAN)
Hard Ware		<p>-Nakanishi Sangyo Co., Ltd. 1-11, Kanda, Izumi-cho, Chiyoda-ku, Tokyo TEL (862) 2211</p> <p>-Hori Lock and Hard Ware Co., Ltd. 2-5-2, Shinbashi, Minato-ku, Tokyo TEL (591) 6301</p>
Door Check Floor Hinge		<p>-Otori Kiko Co., Ltd. 2-2-17, Sotokanda, Chiyoda-ku, Tokyo TEL (255) 7971</p> <p>-Nikkana Co., Ltd. 3-9-12, Kudan-minami, Chiyoda-ku, Tokyo TEL (264) 1381</p> <p>-Nippon Door Check Mfg. Co., Ltd. 2-12, Knada, Ogawa-machi, Chiyoda-ku, Tokyo TEL (293) 4831</p>
Pivot Hinge		<p>-Otori Kiko Co., Ltd. 2-2-17, Sotodanda, Chiyoda-ku, Tokyo TEL (255) 7971</p> <p>-Sugita Kinzoku Co., Ltd. 2-14-15, Midori, Sumida-ku, Tokyo TEL (633) 5151</p> <p>-Nakanishi Sangyo Co., Ltd. 1-11, Izumi-cho, Chiyoda-ku, Tokyo TEL (862) 2211</p> <p>-Nikkana Co., Ltd. 3-9-12, Kudan-minami, Chiyoda-ku, Tokyo TEL (264) 1381</p> <p>-Eiwa Industry Co., Ltd. 3-6-12, Sotokanda, Chiyoda-ku, Tokyo TEL (253) 0317</p>

MATERIAL OR PRODUCT	COMMERCIAL BRAND, NAME OR NUMBER	SUPPLIER'S OR MANUFACTURE'S NAME & ADDRESS (IN JAPAN)
Vinyl Leather		<p>-Moriden Co., Ltd. 3-23-6, Nishi-shinbashi, Minato-ku, Tokyo TEL (433) 4421</p>
Special Hi-tension Bolt (Special-Type)	<p>TC Bolt PI Nut, Bil-ten Shinko Tol-con Bolt SS Bolt</p>	<p>-Nittetsu Bolten Co., Ltd. 980, Fukutomi, Yukubashi-city, Fukuoka Pref. TEL 09302 (3) 2571 -Sankyo Special Steel Bolt & Nut Co., Ltd. 2-4991, Hironedai, Zama-city, Kanagawa Pref. TEL 0462 (51) 2311 -Shinko Bolt Co., Ltd. 17, Futamatashin-machi, Ichikawa-city, Chiba Pref.</p> <p>-Sumitomo Metal Industry's Ltd. 1-3-2, Marunouchi, Chiyoda-ku, Tokyo TEL (282) 6111</p>
Special Hi-tension Bolt (Grip-Type)	Fastac	<p>-Sankyo Special Steel Bolt & Nut Co., Ltd. 2-4991, Hironedai Zama-city, Kanagawa Pref. TEL 0462 (51) 2311</p>
Reinforcing Bar (SD-30, SD-35)		<p>-Kawasaki Steel Corp. 1-1-28, Kitamoto-machi-dori, Fukiai-ku, Kobe TEL 078 (221) 4141 -Kobe Steel Ltd. 1-8-2, Marunouchi, Chiyoda-ku, Tokyo (Daiichi Tekko Bldg.) TEL (218) 7111 -Nippon Steel Corp. 2-6-3, Ote-machi, Chiyoda-ku, Tokyo TEL (242) 4111 -Sumitomo Metal Industry's Ltd. 1-3-2, Marunouchi, Chiyoda-ku, Tokyo TEL (282) 6111</p>

MATERIAL OR PRODUCT	COMMERCIAL BRAND, NAME OR NUMBER	SUPPLIER'S OR MANUFACTURE'S NAME & ADDRESS (IN JAPAN)
Reinforcing Bar (SD-30, SD-35)		<p>-Toshin Seiko Co., Ltd. 1-7-2, Ote-machi, Chiyoda-ku, Tokyo (Sankei New Bldg.) TEL (242)6711</p>
Sign Plate		<p>-Showa Neon Kogyosho Co., Ltd. 1-7-17, Minami-shinagawa, Shinagawa-ku, Tokyo TEL (471) 4141</p>
Gasket		<p>-DIA-ROCK Co., Ltd. 10-2, Gobancho, Chiyoda-ku, Tokyo TEL (230) 3761</p> <p>-IWAKI Shoko Co., Ltd. 4-13-5, Narihira, Sumida-ku, Tokyo TEL (625) 6041</p>
Clean out Opener		<p>-Hasegawa EDY Co., Ltd. 1-2, Kanda, Awaji-cho, Chiyoda-ku, Tokyo TEL (255) 4051</p>

(2) ELECTRICAL INSTALLATION WORKS

MATERIAL OR PRODUCT	COMMERCIAL BRAND, NAME OR NUMBER	SUPPLIER'S OR MANUFACTURE'S NAME & ADDRESS (IN JAPAN)
Wired Cable		-The Furukawa Electric Co., Ltd. 2-6-1, Marunouchi, Chiyoda-ku, Tokyo TEL (286) 3203
Conduit Pipe		-Toshiba Electric Equipment Corporation 1-1-43, Shibaura, Minato-ku, Tokyo TEL (454) 8811
Accessory for Conduit Pipe		Ditto
Power Control Board Terminal Board Cabinet Panel		-Saginomiya Johnson Controls Co., Ltd. 1-1-8, Koraku, Bunkyo-ku, Tokyo TEL (813) 4151
Lighting Fixture		-Hitachi Lighting. Ltd. 1-11, Sakuma-cho, Kanda, Chiyoda-ku, Tokyo TEL (255) 5251
Tumbler, Switch Plug, Socket, etc.		-Matsushita Electric Works. Ltd. Monma-city, Osaka Pref. TEL 06 (908) 1131
Lighting Connection Box		-Ryudensha Co., Ltd. 4-7-2, Shinbashi, Minato-ku, Tokyo TEL (433) 2521

MATERIAL OR PRODUCT	COMMERCIAL BRAND, NAME OR NUMBER	SUPPLIER'S OR MANUFACTURE'S NAME & ADDRESS (IN JAPAN)
Clock		-K. Hattori Co., Ltd. 2-1-10, Kaji-cho, Chiyoda-ku, Tokyo TEL (256) 2111
Fire Control Panel Detector, etc.		-Nohmi Bosai Kogyo Co., Ltd. 4-7-3, Kudan-minami, Chiyoda-ku, Tokyo TEL (265) 0211
Buzzer		-Matsushita Electric Works. Ltd. Monma-city, Osaka Pref. TEL 06 (908) 1131

(3) PLUMBING

MATERIAL OR PRODUCT	COMMERCIAL BRAND, NAME OR NUMBER	SUPPLIER'S OR MANUFACTURE'S NAME & ADDRESS (IN JAPAN)
PVC-Lining Steel Pipe Galvanized Steel Pipe		-Nippon Kokan K.K. 1-1-2, Marunouchi, Chiyoda-ku, Tokyo TEL (212) 7111
Polyvinyl Chloride Pipe	VP	-Sekisui Chemical Co., Ltd. 2-1-1, Nishi-shinjuku, Shinjuku-ku, Tokyo TEL (347) 9111
Pump	BMS DSW	-Ebara Corporation 6-6, Ginza, Chuo-ku, Tokyo TEL (572) 5611
Valve		-Miyoshi Valve Co., Ltd. 5-10-18, Higashi-gotanda, Shinagawa-ku, Tokyo TEL (441) 0191
Sanitary Fixture		-Toto Ltd. 1, Shiba-toranomon, Minato-ku, Tokyo TEL (503) 6311
Kitchen Equipment		-Fuji Chubo Setsubi Co., Ltd. 5-14-5, Shinbashi, Minato-ku, Tokyo TEL (434) 2271
Fire Hydrant		-K.K. Nanboku Seisakujo 2-13, Kayaba-cho, Nihonbashi, Chuo-ku, Tokyo TEL (668) 1231

MATERIAL OR PRODUCT	COMMERCIAL BRAND, NAME OR NUMBER	SUPPLIER'S OR MANUFACTURE'S NAME & ADDRESS (IN JAPAN)
Water Cooler	CE-130P	-Matsushita Electric Co., Ltd. 1-1-2, Shibakoen, Minato-ku, Tokyo TEL (437) 1111
Air Towel	P-15L	-Kashin Electronics, Inc. 1-25-12, Shimotakaido, Suginami-ku, Tokyo TEL (303) 1291
Clean out & Drain Trap		-Hasegawa Foundry Co., Ltd. 1-2, Awagi-cho, Kanda, Chiyoda-ku, Tokyo TEL (255) 4051
Grease-Trap	SK-50M	-Shimoda Kiki Co., Ltd. 4-6-9, Higashi-komagata, Sumida-ku, Tokyo TEL (625) 6025
Vibration Isolating Material		-Syowa Electric Wire & Cable Co. 10, Shiba-toranomon, Minato-ku, Tokyo TEL (503) 1111
Heat Insulation & Antisweat Material		-Nitto Boseki Co., Ltd. 6-1, Yaesu, Chuo-ku, Tokyo TEL (272) 1211

(4) VENTILATION & AIR CONDITIONING

MATERIAL OR PRODUCT	COMMERCIAL BRAND, NAME OR NUMBER	SUPPLIER'S OR MANUFACTURE'S NAME & ADDRESS (IN JAPAN)
Water Chilling Unit Air Handling Unit, Fan-Coil Unit	UWA-GYK AH(V)-EAR FWV(M)	-Daikin Kogyo Co., Ltd. 2-6-1, Nishi-shinjuku, Shinjuku-ku, Tokyo TEL (347) 8111
Pump	LPD	-Ebara Corporation 6-6, Ginza, Chuo-ku, Tokyo TEL (572) 5611
Fan	TFU	-Takebe Manufacturing Co., Ltd. 5-9-39, Kita-shinagawa, Shinagawa-ku, Tokyo TEL (441) 0131
Galvanized Steel Plate		-Nippon Steel Corporation 2-6, Ote-machi, Chiyoda-ku, Tokyo TEL (242) 4111
Galvanized Steel Pipe		-Nippon Kokan K.K. 1-1-2, Marunouchi, Chiyoda-ku, Tokyo TEL (212) 7111
Enthalpy Exchanger	Lossnay	-Mitsubishi Electric Corporation 2-2-3, Marunouchi, Chiyoda-ku, Tokyo TEL (218) 2962
Air Outlet & Inlet Chamber		-Marumitsu Industry Co., Ltd. 4-8-3, Iidabashi, Chiyoda-ku, Tokyo TEL (263) 0551

MATERIAL OR PRODUCT	COMMERCIAL BRAND, NAME OR NUMBER	SUPPLIER'S OR MANUFACTURE'S NAME & ADDRESS (IN JAPAN)
Automatic Control System		<p>-Yamatake-Honey Well Co., Ltd. 2-6-2, Marumouchi, Chiyoda-ku, Tokyo TEL (211) 7261</p>
Vibration Absorber	OS	<p>-Tokyo Kiki Co., Ltd. 1-12-2, Higashi-tabata, Kita-ku, Tokyo TEL (800) 4684</p>
Silencer Elbow		<p>-Takebe Manufacturing Co., Ltd. 5-9-39, Kita-shinagawa, Shinagawa-ku, Tokyo TEL (441) 0131</p>
Circulator	FY	<p>-Mastushita Electric Co., Ltd. 1-1-2, Shibakoen, Minato-ku, Tokyo TEL (437) 1111</p>
Valve		<p>-Miyoshi Valve Co., Ltd. 5-10-18, Higashi-gotanda, Shinagawa-ku, Tokyo TEL (441) 0191</p>
Vibration Isolating Material		<p>-Syowa Electric Wire & Cable Co. 10, Toranomon, Minato-ku, Tokyo TEL (503) 1111</p>
Sound Absorbing Material & Heat Insulating Material	Glass Wool	<p>-Nitto Boseki Co., Ltd. 6-1, Yaesu, Chuo-ku, Tokyo TEL (272) 1211</p>

APPENDIX II

INSTRUCTIONS FOR MEASUREMENT OF BUILDING ACOUSTIC CHARACTERISTICS

1. GENERAL:

1.1 Purpose of Measurement

Acoustic measurement shall be performed as part of completion inspection to insure that the acoustical aspect of the building design meets the design requirements.

1.2 Acoustic Characteristics to be Measured

The following acoustic characteristics shall be measured:

- (1) Reverberation time
- (2) Sound insulation
- (3) Sound pressure level spectrum of noise
- (4) Sound level of noise

1.3 Evaluation of Measurements

If the desired acoustic characteristics are not obtained in measurements, the provisions of Section 16.4 (Acoustical Inspection) of the Specifications for Building Construction shall apply.

2. MEASUREMENT OF REVERBERATION TIME:

2.1 Outline of Method for Measurement

Intermittent sound recorded tape produced by means of the manner described in Section 6.1 hereof are played back and radiated to the test room where they will be accompanied with reverberation. The reverberation sounds will be taperecorded and the tape will be played back. The reverberation time will be measured by means of a 1/3 octave band frequency analyser, high-speed level recorder and other appropriate devices.

2.2 Measuring Instrument to be Used

(1) Tape recording and playback units

Tape recording and playback units to be used shall be of the semi-professional or professional higher class. One playback unit and recording unit are required. The tape speed shall be 19 cm/sec. The tape width shall in principle be full for recording or playback.

(2) Loud speaker for sound source

Transmission frequency band 50 ~ 10,000 Hz
Maximum non-distortion output power Over 10W

The loud speaker for sound source shall produce a sound pressure-level higher than 90 dB over all frequency band in the test room. The cabinet capacity shall be over 5×10^4 cm³. The rear cover and the side panels of the cabinet shall be free from heavy vibration or trembling.

(3) Power amplifier for loudspeaker

The power amplifier in the control room or movable power amplifier, whichever is available, shall be used.

(4) Microphone

Frequency band 50 ~ 10,000 Hz

Omni-directional microphones of the moving coil type or condenser type shall be used.

(5) Monitor

(6) Wet and dry bulb thermometer

(7) 1/3 octave band frequency analyzer

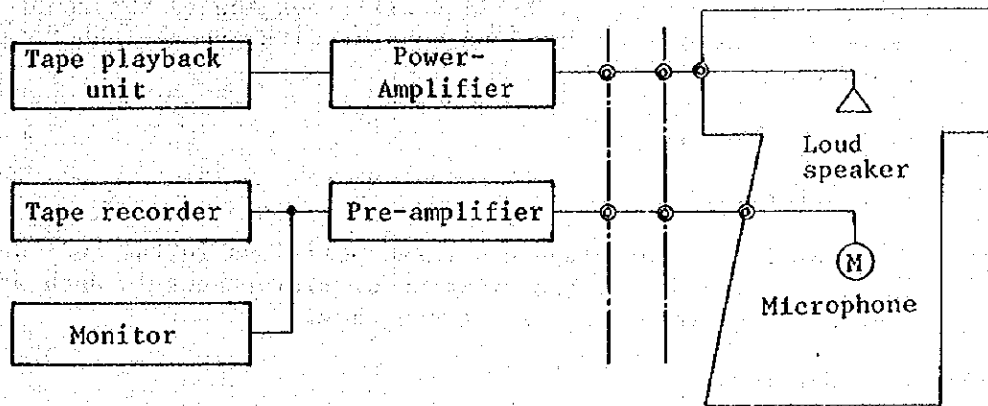
A 1/3 octave band frequency analyzer complying with the IEC Publication which is capable of selecting central frequencies in the 1/3 octave band at intervals of 50, 63, 80, 100, 125, 160 ~ 6,300, 8,000 and 10,000 Hz.

(8) High-speed level recorder

A high-speed level recorder having the characteristics similar to those of level recorders Type 2305 or Type 2307 manufactured by Brüel & Kjær, and capable of measuring a minimum reverberation time of 0.1 sec.

2.3 Circuit Configuration Necessary for Recording Reverberation Sound

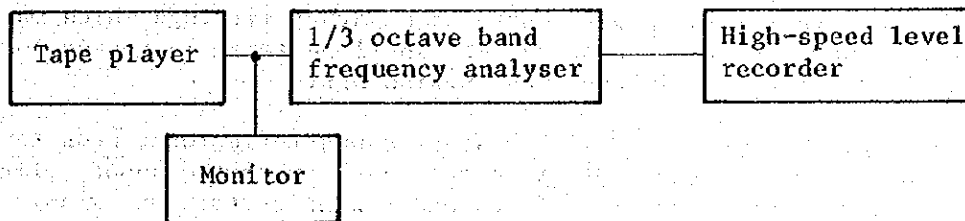
Circuits shall be arranged as illustrated below to permit playback of a sound tape and tape-recording of reverberation sound.



Circuit newly provided in this auditorium shall be used for the microphone and the loud speaker. If no existing circuits are available for this purpose, cables similar to cabtyre cable shall be used for connection.

2.4 Circuit Configuration for Frequency Analysis of Reverberation Time

The circuits required for this purpose shall be arranged as follows:



2.5 Positioning of Loud-speaker

(1) In auditorium

A loud-speaker shall be positioned in the center of the stage floor in such way that it will face to the audience sheet with a diagonal upward inclination. In the case of using inevitably a heavy loud speaker, it may be so positioned as to face full to the audience sheet. In unavoidable case, a procenium loud speaker may be used as a sound source.

(2) In other rooms

The loud-speaker shall be positioned at a room corner where there are no windows, doors, depressions or protrusions near by, in such way that its center axis coincides with a diagonal line of the room and that the back of the cabinet will look toward the room. It is preferable to protect the loud-speaker with sponge rubber against vibration.

2.6 Positioning of Microphone

(1) In auditorium

One position on the stage and three positions in the audience sheet shall be selected for installation of microphones in such way as to provide adequate distances between them.

(2) In other rooms

Microphones shall not be positioned at points of symmetry in a room, but some distances from all the wall surfaces. They shall be installed about 1,500 mm above the floor level in such way that the diaphragm will lie substantially horizontal. It is preferable to protect the microphones with sponge rubber or other suitable materials against vibration transmitted from the floor.

2.7 Interior Conditions of Test Room

The test room shall be kept unoccupied and all doors closed.

If the room is furnished with curtains or other fittings which may affect reverberation time, measurements shall be taken in respect of two situations: with and without such furnishings.

For an auditorium provided with a stage sound-reflectors, measurements shall be taken in respect of two situations; when the sound reflectors are in use and when they are stowed and a wing curtain and middle curtain are used.

In making measurement, all the building equipment shall be kept out of operation and any construction-noise shall not be produced in the neighborhood. Temperature and humidity in the test room shall be measured before and after the measurement of reverberation characteristics and the mean for the measured values shall be recorded. If the values measured before and after measuring reverberation time are wide apart, then it shall be measured again.

3. MEASUREMENT OF SOUND INSULATION:

3.1. Outline of Method for Measurement

Tape-recorded noises of the octave band (sound source produced in the manner described in Section 6.2 hereof) are radiated into the sound source room so as to form a diffused sound field.

The mean sound pressure level L_1 , in the sound source room and the mean sound pressure level L_2 , of the noise transmitting the test room through the test partition or test fittings shall be measured by means of an octave band frequency analyser and a sound level meter.

Frequency characteristics of the noise insulation factor (N.I.F.), or the level difference between L_1 and L_2 , are the sound insulation characteristics of the test partition.

3.2 Measuring Instrument

- (1) Tape Recorder/Playback

Same as in (1), Section 2.2.

- (2) Loud speaker

Same as in (2), Section 2.2.

- (3) Power amplifier

Same as in (3), Section 2.2.

- (4) Sound analyser

A combination of ordinary sound level meter complying with IEC Publication and octave band frequency analyzer. Capable of measuring noise levels by the equalizing curves A and C and of analyzing central frequencies in the octave band at intervals of 63, 125, 250, 500, 1,000, 2,000, 4,000 and 8,000 Hz.

3.3 Fixtures to be Measured

Sound insulation measurement will be performed mainly in respect of doors and windows of the auditorium, control room and the projector room.

The expansion joints in the auditorium, joints between the tiered floors and the walls, and other parts of the structure will be checked for sound leakages.

3.4 Positioning of Loud-speaker

The loud-speaker will be positioned in such way that its back will face the fixtures to be measured. Its position and angle will be adjusted so as to form a diffused sound field uniformly on the surfaces of the test objects in the sound source room.

3.5 Sound Pressure Level of Sound Source Side

A sound pressure level above 90 dB must be obtained in every frequency band under test.

3.6 Positioning of Microphones

In both the sound source room and the sound receiving room, microphones will be installed 1 m apart from the surface of the objects under test, at five different positions distributed over the entire surface of the objects. Microphones will be supported in such way that their diaphragms will remain substantially horizontal.

If the tester is to hold a microphone, he must hold it at least over 60 cm apart and make sure that he does not conceal the sound source.

If the object under test is too high to distribute the microphones all over its surface, they may be positioned within the space ranging 1 m to 2 m above the floor level.

3.7 Surrounding Conditions of Test Object

Of the two rooms adjoining with the test object, the principal room on acoustics or the less noisy room will be selected for sound reception.

In both the sound source and sound-receiving rooms, the operation of air conditioning system will be stopped, and any construction noise will not be produced. If a fluorescent light generates a noise, this must be recorded, and measurement will be taken after turning off the light.

Special care will be taken to check places for heavy sound leaks, and if such places are found, they will be recorded. In spaces such as that between the studio and the sub control room, sound leakage often occurs in wire pipings and cable troughs. All pipings and troughs will be checked beforehand and filled with glass wool at both ends to prevent sound leakage.

3.8 Measurement of Background Noise and Correction of Measured Values

In the receiving room, background noises will be measured during measurement of sound insulation characteristics.

Background noises must be more than 3 dB lower than the mean value L_2 of the pressure level of noises transmitting to the receiving room.

4. MEASUREMENT OF NOISE PRESSURE SPECTRUM:

4.1 Outline of Method for Measurement

With the equipment under test kept in operation, the sound-pressure levels in the octave band will be measured by means of a sound level meter and a frequency analyzer, in respect of the positions and conditions of measurement described below.

All measurements will be taken on the spot and tape-recording will not be employed. Sound levels by the equalizing curves A and C of the sound level meter will also be measured at the measuring points for the sound pressure spectrum.

4.2 Positioning of Microphones

In the auditorium, microphones will be positioned on the stage, in the center, front and rear of the audience sheet, in all cases 1.5 m above the floor level.

In other rooms, microphones will be positioned 1.5 m above the floor level, substantially in the center of the room or in the center of each division of the room as a point of measurement. They will be supported in such way that their diaphragms will remain substantially horizontal.

If the tester is to hold a microphone, he must hold it at least over 60 cm apart and make sure that he does not conceal the direction from which noises will be transmitted.

4.3 Conditions of Measurement

(1) Background noise

Before starting up the building equipment, background noises in the center of the room will be measured.

Noises other than test object to be measured will be prevented from being produced. For this purpose, all equipment other than those producing noises to be measured will be kept out of operation and any construction noise will not be produced. For a room which is affected largely by external noises, measurements shall be taken during the hours that such noises are at the lowest level.

In measuring background noises, the sound levels by the equalizing curves characteristics A and C of the sound level meter as well as the sound pressure spectrum will also be measured.

(2) Equipment noise

In each room, measurements will be taken of noises generated by the whole building equipment when in operation. If the values measured are smaller than the criteria shown in Section 4.4, measurements will not be taken during the operation of individual equipment. If the measured values are larger than the criteria and some equipment are considered to generate specially large noises, noise measurement will be made in respect of individual equipment, such as a ventilator and air exhauster, to trace the air conditioning unit which produces excessive noises.

4.4 Criteria for Evaluation of Sound Pressure Level Measurements of Noise

The criteria for the evaluation of sound pressure level of noise are as follows:

For auditorium, stage and control room : NC-25

Lobby, foyer, VIP room, etc. : NC-30

4.5 Reading of Indicated Values

Noises keep fluctuating over a wide range in a low frequency band. If the range of fluctuation is below 2 dB, the mean of the indicated values will be read and recorded. If the range is above 2 dB, both the mean of the indicated higher values and the mean of the indicated lower values will be read and recorded.

5. MEASUREMENT OF SOUND LEVEL OF NOISE:

5.1 Outline of Method for Measurement

When only noises to be measured occur, the indicated values by the equalizing curves A and C will be measured by means of a sound level meter.

5.2 Other

Instructions of Sections 4.2 through 4.5 are all applicable to the measurement of sound level of noise.

6. PREPARATION OF SOUND SIGNAL RECORDED TAPE AS A SOUND SOURCE:

6.1 A Sound Signal Recorded Tape for Reverberation Time-Measurement

In case of the reverberation time measurement, the sound signal recorded tape mentioned below, shall be used as a sound source. That is a tape on which are recorded intermittent signals of white noises in each of four frequency bands ranging from 50 Hz to 10,000 Hz (Band 1, Band 2, Band 3 and Band 4).

(1) Composition of the recorded tape

Table 6.1 shows the reverberation time measurement program in the recorded tape. The recorded tape is composed of 10 sections. The Interval between sections is about 10 seconds for auditoriums and about 5 seconds for other rooms.

(2) Tape speed : 19 cm/sec.

(3) Equipment and circuit configuration

The equipment and the circuit configuration are as illustrated below.

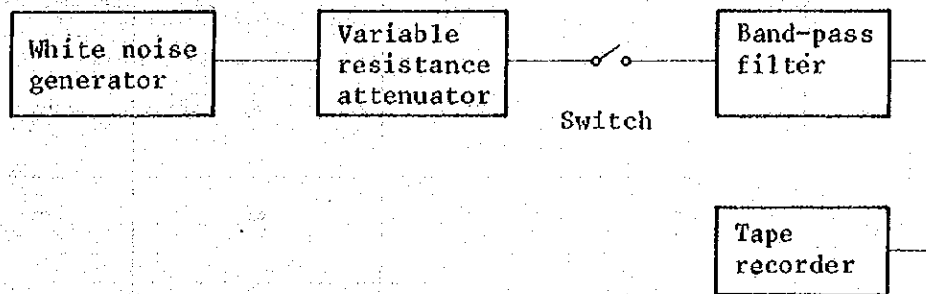


Table 6.1 Reverberation Time Measurement Program on Recorded Tape

Section	Recorded sound	Frequency Band of noise	(1) Hall			(2) Other rooms			Outline of Playback/Recording operation
			Unit time	No. of repetitions	Total time	Unit time	No. of repetitions	Total time	
Section 1	Leader tape announcement for tape identification and level adjustment signal	Band noises (1st, 2nd, 3rd, 4th)	60		240	60		240	Level adjustment of playback and recording systems
Section 2	Signal for level adjustment of the 1st Band (continuous sound)	Band noise of 50-200Hz (1st)	5	1	5	5	1	5	Level adjustment of playback and recording systems
Section 3	Signal for reverberation time measurement of the 1st band (intermittent sound)	"	6	16	96	4	16	64	Recording of reverberation sound
Section 4	Signal for level adjustment of the 2nd band (continuous sound)	Band noise of 150 ~ 1,200 Hz (2nd)	5	1	5	5	1	5	Level adjustment of playback and recording systems

Section	Recorded sound	Frequency Band of noise	(1) Hall			(2) Other rooms			Outline of Playback/Recording operation
			Unit time	No. of repetitions	Total time	Unit time	No. of repetitions	Total time	
Section 5	Signal for reverberation time measurement of the 2nd (intermittent sound)	Band noise of 150 ~ 1,200 Hz (2nd)	6	11	66	4	11	44	Recording of reverberation sound
Section 6	Signal for level adjustment of the 3rd band (continuous sound)	Band noise of 1,100 ~ 4,000 Hz (3rd)	5	1	5	5	1	5	Level adjustment of playback and recording systems
Section 7	Signal for reverberation time measurement of the 3rd band (intermittent sound)	"	6	6	36	4	6	24	Recording of reverberation sound
Section 8	Signal for level adjustment of the 4th band (continuous sound)	Band noise of 3,800 ~ 10,000 Hz (4th)	5	1	5	5	1	5	Level adjustment of playback and recording systems
Section 9	Signal for reverberation time measurement of the 4th band	"	6	6	36	4	6	24	Recording of reverberation sound
Section 10	Sign-off announcement				20			20	

6.2 Sound Signal Recorded Tape for Sound Insulation Measurement

A recorded tape for sound insulation measurement is a tape on which continuous band noises (white noises as grouped in fixed band ranges) are recorded.

(1) Composition of the recorded tape

The tape is composed of recorded noises in four bands: 50 ~ 200 Hz, 150 ~ 1,200 Hz, 1,100 ~ 4,000 Hz and 3,800 ~ 10,000 Hz.

The duration of the continuous sound in each band shall be about 10 minutes.

(2) Tape speed

Tape speed shall be 19 cm/sec.

(3) Equipment and circuit configuration

The equipment and circuit configuration required are the same as for Section 6.1.

