



SEC DAVAO EXTENSION OFFICE (DAVEO)

SEC Davao Extension Office, University Avenue, Juna Subdivision,
Matina, Davao City, Davao del Sur

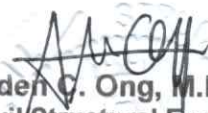


SEC - SEC EXTENSION OFFICE (DAVAO)

Matina, Davao City

Technical Specifications - Mechanical

SEPTEMBER 2024


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PART 1: GENERAL

1.1 SECTION INCLUDES:

- 1.1.1. Submittal procedures
- 1.1.2 Construction progress schedules
- 1.1.3 Proposed Products list
- 1.1.4 Product Data
- 1.1.5 Shop Drawings
- 1.1.6 Samples
- 1.1.7 Design data
- 1.1.8 Test reports
- 1.1.9 Certificates
- 1.1.10 Manufacturer's instructions
- 1.1.11 Manufacturer's field reports
- 1.1.12 Erection drawings
- 1.1.13 Construction photographs

1.2 RELATED SECTIONS

- A. Section 01700 - Contract Closeout: Contract closeout submittals.

1.3 REFERENCES

- A. AGC (Associated General Contractors of America) publication "The Use of CPM in Construction - A Manual for General Contractors and the Construction Industry".

1.1.1 SUBMITTAL PROCEDURES

- A. Transmit each submittal with Architect/Engineer accepted form.
- B. Sequentially number the transmittal form. Revise submittals with original number and a sequential alphabetic suffix.
- C. Identify Project, Contractor, Subcontractor or supplier; pertinent drawing and detail number, and specification section number, as appropriate.
- D. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of Products required, field dimensions, adjacent

construction Work, and coordination of information is in accordance with the requirements of the Work and Contract Documents.

- E. Schedule submittals to expedite the Project, and deliver to Architect/Engineer at business address. Coordinate submission of related items.
- F. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.
- G. Identify variations from Contract Documents and Product or system limitations which may be detrimental to successful performance of the completed Work.
- H. Provide space for Contractor and Architect/Engineer review stamps.
- I. When revised for resubmission, identify all changes made since previous submission.
- J. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report any inability to comply with requirements.
- K. Submittals not requested will not be recognized or processed.

1.1.2 CONSTRUCTION PROGRESS SCHEDULES

- A. Submit initial schedule in duplicate within 15 days after date established in Notice to Proceed.
- B. Revise and resubmit as required.
- C. Submit revised schedules with each Application for Payment, identifying changes since previous version.
- D. Submit network analysis diagram using the critical path method, as outlined in AGC - The Use of CPM in Construction.
- E. Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities. Indicate the early and late start, early and late finish, float dates, and duration.
- F. Indicate estimated percentage of completion for each item of Work at each submission.
- G. Indicate submittal dates required for shop drawings, product data, samples, and product delivery dates, including those furnished by Owner and required by Allowances.

1.1.3 PROPOSED PRODUCTS LIST

- A. Within 15 days after date of Notice to Proceed, submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.
- B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

1.1.4 PRODUCT DATA

A. Product Data for Review:

- 1. Submitted to Architect/Engineer for review for the limited purpose of checking for conformance with information given and the design concept expressed in the contract documents.
- 2. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article above and for record documents purposes described in Section 01700 - CONTRACT CLOSEOUT.

B. Product Data for Information:

- 1. Submitted for the Architect/Engineer's knowledge as contract administrator or for the Owner.

C. Product Data for Project Close-out:

- 1. Submitted for the Owner's benefit during and after project completion.

D. Submit the number of copies which the Contractor requires, plus three (3) copies which will be retained by the Architect/Engineer.

E. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.

F. Indicate Product utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

G. After review distribute in accordance with the Submittal Procedures article above and provide copies for record documents described in Section 01700 - CONTRACT CLOSEOUT.

1.1.5 SHOP DRAWINGS

A. Shop Drawings For Review:

- 1. Submitted to Architect/Engineer for review for the limited purpose of checking for conformance with information given and the design concept expressed in the contract documents.

2. After review, produce copies and distribute in accordance with SUBMITTAL PROCEDURES article above and for record documents purposes described in Section 01700 - CONTRACT CLOSEOUT.

B. Shop Drawings For Information:

1. Submitted for the Architect/Engineer's knowledge as contract administrator or for the Owner.

C. Shop Drawings For Project Close-out:

1. Submitted for the Owner's benefit during and after project completion.
2. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
3. Submit in the form of one reproducible transparency and one opaque reproduction.

1.1.6 SAMPLES

A. Samples For Review:

2. Submitted to Architect/Engineer for review for the limited purpose of checking for conformance with information given and the design concept expressed in the contract documents.
3. After review, produce duplicates and distribute in accordance with SUBMITTAL PROCEDURES article above and for record documents purposes described in Section 01700 - CONTRACT CLOSEOUT.

B. Samples For Information:

1. Submitted for the Architect/Engineer's knowledge as contract administrator or for the Owner.

C. Samples For Selection:

1. Submitted to Architect/Engineer for aesthetic, color, or finish selection.
2. Submit samples of finishes in custom colors selected, textures, and patterns for Architect/Engineer selection.
3. After review, produce duplicates and distribute in accordance with SUBMITTAL PROCEDURES article above and for record

documents purposes described in Section 01700 - CONTRACT CLOSEOUT.

- D. Submit samples to illustrate functional and aesthetic characteristics of the Product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
- E. Include identification on each sample, with full Project information.
- F. Submit the number of samples specified in individual specification sections; two of which will be retained by Architect/Engineer.
- G. Reviewed samples which may be used in the Work are indicated in individual specification sections.
- H. Samples will not be used for testing purposes unless specifically stated in the specification section.

1.1.7 DESIGN DATA

- A. Submit for the Architect/Engineer's knowledge as contract administrator or for the Owner.
- B. Submit for information for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents.

1.1.8 TEST REPORTS

- A. Submit for the Architect/Engineer's knowledge as contract administrator or for the Owner.
- B. Submit test reports for information for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents.

1.1.9 CERTIFICATES

- A. When specified in individual specification sections, submit certification by the manufacturer, installation/application Subcontractor, or the Contractor to Architect/Engineer, in quantities specified for Product Data.
- B. Indicate material or Product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
- C. Certificates may be recent or previous test results on material or Product, but must be acceptable to Architect/Engineer.

1.1.10 MANUFACTURER'S INSTRUCTIONS

- A. When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, to Architect/Engineer for delivery to Owner in quantities specified for Product Data.
- B. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

1.1.11 MANUFACTURER'S FIELD REPORTS

- A. Submit reports for the Architect/Engineer's benefit as contract administrator or for the Owner.
- B. Submit report in duplicate within 30 days of observation to Architect/Engineer for information.
- C. Submit for information for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents.

1.1.12 ERECTION DRAWINGS

- A. Submit drawings for the Architect/Engineer's benefit as contract administrator or for the Owner.
- B. Submit for information for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents.
- C. Data indicating inappropriate or unacceptable Work may be subject to action by the Architect/Engineer or Owner.

1.1.13 CONSTRUCTION PHOTOGRAPHS

- A. Photographs taken during the construction and progress reports submit by the contractor.

CONTRACT CLOSEOUT

PART 1: GENERAL

1.1 SECTION INCLUDES

- 1.1.1 Closeout procedures.
- 1.1.2 Final cleaning.
- 1.1.3 Adjusting.
- 1.1.4 Project record documents.
- 1.1.5 Operation and maintenance data.
- 1.1.6 Spare parts and maintenance Products.
- 1.1.7 Warranties and bonds.
- 1.1.8 Maintenance service.

1.2 RELATED SECTIONS

- A. Section 01500 - Construction Facilities and Temporary Controls: Progress cleaning.
- B. Section 01650 - Starting of Systems: System start-up, testing, adjusting, and balancing.

1.1.1 CLOSEOUT PROCEDURES

- A. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Architect/Engineer's review.
- B. Provide submittals to Architect/Engineer that are required by governing or other authorities.
- C. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due.

1.1.2 FINAL CLEANING

- A. Execute final cleaning prior to final project assessment.
- B. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
- C. Replace filters of operating equipment.

- D. Clean debris from roofs, gutters, downspouts, and drainage systems.
- E. Clean site; sweep paved areas, rake clean landscaped surfaces.
- F. Remove waste and surplus materials, rubbish, and construction facilities from the site.

1.1.3 ADJUSTING

- A. Adjust operating Products and equipment to ensure smooth and unhindered operation.

1.1.4 PROJECT RECORD DOCUMENTS

- A. Maintain on site one set of the following record documents; record actual revisions to the Work:
 - 1. Drawings
 - 2. Specifications
 - 3. Addenda
 - 4. Change Orders and other modifications to the Contract
 - 5. Reviewed Shop Drawings, Product Data, and Samples
 - 6. Manufacturer's instruction for assembly, installation, and adjusting
- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress.
- E. Specifications: Legibly mark and record at each Product section description of actual Products installed, including the following:
 - 1. Manufacturer's name and product model and number
 - 2. Product substitutions or alternates utilized.
 - 3. Changes made by Addenda and modifications.
- F. Record Drawings and Shop Drawings : Legibly mark each item to record actual construction including:
 - 1. Measured depths of foundations in relation to finish first floor datum.

2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
 4. Field changes of dimension and detail.
 5. Details not on original Contract drawings.
- G. Submit documents to Architect/Engineer with claim for final Application for Payment.

1.1.5 OPERATION AND MAINTENANCE DATA

- A. Submit data bound in 8-1/2 x 11 inch (A4) text pages, three D side ring binders with durable plastic covers.
- B. Prepare binder cover with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS", title of project, and subject matter of binder when multiple binders are required.
- C. Internally subdivide the binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
- D. Contents: Prepare a Table of Contents for each volume, with each Product or system description identified, typed on 20 pound white paper, in three parts as follows:
 1. Part 1: Directory, listing names, addresses, and telephone numbers of Architect/Engineer, Contractor, Subcontractors, and major equipment suppliers.
 2. Part 2: Operation and maintenance instructions, arranged by process flow and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
 - A. Significant design criteria.
 - B. List of equipment.
 - C. Parts list for each component.
 - D. Operating instructions.
 - E. Maintenance instructions for equipment and systems.

- F. Maintenance instructions for finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.

3. Part 3: Project documents and certificates, including the following:

- A. Shop drawings and product data.
- B. Air and water balance reports.
- C. Certificates.
- D. Originals of warranties
- E. Submit
- F. Submit one (1) draft copy of completed volumes 30 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Architect/Engineer comments. Revise content of all document sets as required prior to final submission.
- E. Submit three sets of revised final volumes, within 15 days after final inspection.

1.1.6 SPARE PARTS AND MAINTENANCE PRODUCTS

- A. Provide spare parts, maintenance, and extra Products in quantities specified in individual specification sections.
- B. Deliver to Project site and place in location as directed; obtain receipt prior to final payment.

1.1.7 WARRANTIES AND BONDS

- A. Provide notarized copies.
- B. Execute and assemble transferable warranty documents from Subcontractors, suppliers, and manufacturers.
- C. Provide Table of Contents and assemble in three D side ring binder with durable plastic cover.
- D. Submit prior to final Application for Payment.
- E. For items of Work delayed beyond date of Substantial Completion, provide updated submittal within days after acceptance, listing date of acceptance as start of warranty period.

1.1.8 MAINTENANCE SERVICE

- A. Furnish service and maintenance of components indicated in specification sections for two year from date of Substantial Completion.
- B. Examine system components at a frequency consistent with reliable operation. Clean, adjust, and lubricate as required.
- C. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.
- D. Maintenance service shall not be assigned or transferred to any agent or Subcontractor without prior written consent of the Owner.

TESTING, ADJUSTING, AND BALANCING

PART 1: GENERAL

1.1 SECTION INCLUDES

- A. Testing, adjustment, and balancing of air systems.
- B. Testing, adjustment, and balancing of hydronic refrigerating systems.
- C. Measurement of final operating condition of HVAC systems.
- D. Sound measurement of equipment operating conditions.
- E. Vibration measurement of equipment operating conditions.

1.2 REFERENCES

- A. ASHRAE 111 - Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-conditioning, and Refrigeration Systems.
- B. SMACNA - HVAC Systems Testing, Adjusting, and Balancing.

1.3 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Submit name of adjusting and balancing agency for approval within 30 days after award of Contract.
- C. Prior to commencing work, submit report forms or outlines indicating adjusting, balancing, and equipment data required.

- D. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect/Engineer and for inclusion in operating and maintenance manuals.
- E. Provide reports in soft cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.
- F. Include detailed procedures, agenda, sample report forms prior to commencing system balance.
- G. Test Reports: Indicate data on forms prepared following ASHRAE 111 . Submit data in S.I. Metric units.

1.4 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01700.

1.5 QUALITY ASSURANCE

- A. Perform total system balance in accordance with ASHRAE 111.
- B. Maintain two copies of each document on site.

1.6 QUALIFICATIONS

- A. Agency: Company specializing in the testing, adjusting, and balancing of systems specified in this Section with minimum three years documented experience.
- B. Perform Work under supervision of registered Professional Engineer experienced in performance of this Work and licensed at the place where the Project is located.

1.7 PRE-BALANCING CONFERENCE

- A. Convene one week prior to commencing work of this section.

1.7 DUCT LEAKAGE TEST

Submit test procedure will done by the contractor for approval

- A. Pressure Test
- B. Smoke Test
- C. Light Test

PART 2: EXECUTION

2.1 EXAMINATION

- A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
 - 1. Systems are started and operating in a safe and normal condition.
 - 2. Temperature control systems are installed complete and operable.
 - 3. Proper thermal overload protection is in place for electrical equipment.
 - 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 - 5. Duct systems are clean of debris.
 - 6. Fans are rotating correctly.
 - 7. Fire and volume dampers are in place and open.
 - 8. Air coil fins are cleaned and combed.
 - 9. Access doors are closed and duct end caps are in place.
 - 10. Air outlets are installed and connected.
 - 11. Duct system leakage is minimized.
 - 12. Hydronic systems are flushed, filled, and vented.
 - 13. Pumps are rotating correctly.
 - 14. Proper strainer baskets are clean and in place.
 - 15. Service and balance valves are open.
 - 16.
- B. Submit field reports. Report defects and deficiencies noted during performance of services which prevent system balance.
- C. Beginning of work means acceptance of existing conditions.

2.2 PREPARATION

- A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect/Engineer to facilitate spot checks during testing.
- B. Provide additional balancing devices as required.

2.3 INSTALLATION TOLERANCES

- A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.
- B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.
- C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

2.4 ADJUSTING

- A. Ensure recorded data represents actual measured or observed conditions.
- B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- E. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.
- F. Check and adjust systems approximately six months after final acceptance and submit report.

2.5 AIR SYSTEM PROCEDURE

- A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities .
- B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
- C. Measure air quantities at air inlets and outlets.
- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
- E. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
- F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
- G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.
- I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.

- J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- K. Where modulating dampers are provided, take measurements and balance at extreme conditions.
- L. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches (12.5 Pa) positive static pressure in clean rooms.
- M. Check multi-zone units for motorized damper leakage. Adjust air quantities with mixing dampers set first for cooling, then heating, then modulating.
- N. For variable air volume system powered units set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.

2.7 SCHEDULES

A. Equipment Requiring Testing, Adjusting, and Balancing

Split Units
Fans
Air Filters
Air Inlets and Outlets
Controls Compressor
Duct Branches

B. Report Forms

1. Title Page:

- a. Name of Testing, Adjusting, and Balancing Agency
- b. Address of Testing, Adjusting, and Balancing Agency
- c. Telephone number of Testing, Adjusting, and Balancing Agency
- d. Project name
- e. Project location
- f. Project Architect
- g. Project Engineer
- h. Project Contractor
- i. Project altitude
- j. Report date

2. Summary Comments:

- a. Design versus final performance

- b. Notable characteristics of system
- c. Description of systems operation sequence
- d. Summary of outdoor and exhaust flows to indicate amount of building pressurization
- e. Nomenclature used throughout report
- f. Test conditions

3. Instrument List:

- a. Instrument
- b. Manufacturer
- c. Model number
- d. Serial number
- e. Range
- f. Calibration date

4. Electric Motors:

- a. Manufacturer
- b. Model/Frame
- c. HP/BHP
- d. Phase, voltage, amperage; nameplate, actual, no load
- e. RPM
- f. Service factor
- g. Starter size, rating, heater elements
- h. Sheave Make/Size/Bore

5. V-Belt Drive:

- a. Identification/location
- b. Required driven RPM
- c. Driven sheave, diameter and RPM
- d. Belt, size and quantity
- e. Motor sheave diameter and RPM
- f. Center to center distance, maximum, minimum, and actual

6. Air Moving Equipment

- a. Location
- b. Manufacturer
- c. Model number
- d. Serial number
- e. Arrangement/Class/Discharge
- f. Air flow, specified and actual
- g. Return air flow, specified and actual
- h. Outside air flow, specified and actual
- i. Total static pressure (total external), specified and actual
- j. Inlet pressure
- k. Discharge pressure
- l. Sheave Make/Size/Bore
- m. Number of Belts/Make/Size
- n. Fan RPM

7. Return Air/Outside Air Data
 - a. Identification/location
 - b. Design air flow
 - c. Actual air flow
 - d. Design return air flow
 - e. Actual return air flow
 - f. Design outside air flow
 - g. Actual outside air flow
 - h. Return air temperature
 - i. Outside air temperature
 - j. Required mixed air temperature
 - k. Actual mixed air temperature
 - l. Design outside/return air ratio
 - m. Actual outside/return air ratio
8. Exhaust Fan Data:
 - a. Location
 - b. Manufacturer
 - c. Model number
 - d. Serial number
 - e. Air flow, specified and actual
 - f. Total static pressure (total external), specified and actual
 - g. Inlet pressure
 - h. Discharge pressure
 - i. Sheave Make/Size/Bore
 - j. Number of Belts/Make/Size
 - k. Fan RPM
9. Duct Traverse:
 - a. System zone/branch
 - b. Duct size
 - c. Area
 - d. Design velocity
 - e. Design air flow
 - f. Test velocity
 - g. Test air flow
 - h. Duct static pressure
 - i. Air temperature
 - j. Air correction factor
11. Duct Leak Test:
 - a. Description of ductwork under test
 - b. Duct design operating pressure
 - c. Duct design test static pressure
 - d. Duct capacity, air flow
 - e. Maximum allowable leakage duct capacity times leak factor
 - f. Test apparatus
 1. Blower

2. Orifice, tube size
3. orifice size
4. Calibrated
5. Test static pressure
6. Test orifice differential pressure
7. Leakage

12. Flow Measuring Station:

- a. Identification/number
- b. Location
- c. Size
- d. Manufacturer
- e. Model number
- f. Serial number
- g. Design Flow rate
- h. Design pressure drop
- i. Actual/final pressure drop
- j. Actual/final flow rate
- k. Station calibrated setting

13. Air Distribution Test Sheet:

- a. Air terminal number
- b. Room number/location
- c. Terminal type
- d. Terminal size
- e. Area factor
- f. Design velocity
- g. Design air flow
- h. Test (final) velocity
- i. Test (final) air flow
- j. Percent of design air flow

14. Sound Level Report:

- a. Location
- b. Octave bands - equipment off
- c. Octave bands - equipment on

15. Vibration Test:

- a. Location of points:
 1. Fan bearing, drive end
 2. Fan bearing, opposite end
 3. Motor bearing, center (if applicable)
 4. Motor bearing, drive end
 5. Motor bearing, opposite end
 6. Casing (bottom or top)
 7. Casing (side)
 8. Duct after flexible connection (discharge)

9. Duct after flexible connection (suction)

b. Test readings:

1. Horizontal, velocity and displacement
2. Vertical, velocity and displacement
3. Axial, velocity and displacement

c. Normally acceptable readings, velocity and acceleration

d. Unusual conditions at time of test

e. Vibration source (if non-complying)

AIR CONDITIONING SYSTEMS

PART 1: GENERAL

1.1 APPLICABLE PUBLICATIONS:

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1.1.1 Air Conditioning and Refrigeration Institute (ARI) Publications:

210-81	Unitary Air Conditioning Equipment
260-75	Application, Installation and Servicing of Unitary Systems
360 -83	Commercial and Industrial Unitary Air-Conditioning Equipment
410-72	Forced Circulation Air-cooling and Air- heating Coils
520-78 Units	Positive Displacement Refrigerant Compressor and Condensing Unit

1.1.2 Air Moving and Conditioning Association (AMCA) Publications:

210-74	Laboratory Methods of Testing Fans for Rating
99-83	Standard Handbooks
210-74	Laboratory Methods of Testing Fans for Rating

1.1.3 American Society of Heating, Refrigerating, and Air- Conditioning Engineers (ASHRAE) Inc. Publications:

1983	Equipment, Handbook and Product Directory
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1980 Systems, Handbook and Product Directory

15-78 Safety Code for Mechanical Refrigeration

1.1.4 American Society for Testing and Materials (ASTM) Publications:

A386-78 Zinc-Coating (Hot-Dip) on Assembled Steel Products

B117-85 Salt Spray (Fog) Testing

B209-83 Aluminum-Alloy Sheet and Plate

B280-83 Seamless Copper Tube for Air Conditioning and Refrigeration
Field Service

F 872-84 Filter Units, Air Conditioning: Viscous-Impingement Type
Cleanable

1.1.5 National Electrical Manufacturer's Association (NEMA) Publications:

MG-1-1978 Motors and Generators (Rev. 82)

ICS-1978 Industrial Controls, Devices, Controllers and Assemblies
(Rev. 83)

1.1.6 National Fire Protection Association (NFPA) Publications:

70-81 National Electrical Code

90A-81 Air Conditioning and Ventilating Systems

91-04 Exhaust System for Air Conveying of Gases, etc.

1.1.7 Underwriters Laboratories (UL) Publications:

109-78 Tube Fittings for Flammable and Combustible Fluid Refrigeration
Services and Marine Use

873-79 Temperature Indicating and Regulating Equipment

900-77 Air Filters

1.2 GENERAL REQUIREMENTS:

Section 15011, "Mechanical General Requirements", with the following
additions and modifications, applies.

1.3 DESCRIPTION OF WORK:

The work includes the following:

1.4 SUBMITTALS:

The contractor shall submit all other items for approval.

1.4.1 Manufacturer's Data:

- a. Split type A/C Units (Indoor and Outdoor)
- b. Refrigeration piping & accessories

1.4.2 Certified Test Reports

- a. Split Type Units (Indoor and Outdoor Unit)
- b. Fans / Blower data

1.4.3 Operation and Maintenance Manuals

- a. Split type Units (Indoor and Outdoor Unit)

1.4.4 Posted Operating Instructions:

- a. Split type Units (Indoor and Outdoor Unit)

1.4.5 Manufacturer's Recommended Procedures:

- a. Installation, including evacuation and charging procedures
- b. Start-up and initial operation

1.4.6 Report of Start-Up and Initial Readings

1.5 CORROSION PREVENTION: Unless specified otherwise, equipment fabricated from ferrous metals that do not have a zinc coating conforming to ASTM A386 or a duplex coating of zinc and paint shall be treated for prevention of rust with a factory coating or paint system that will withstand 125 hours in a salt-spray fog test except that equipment located outdoors shall be tested for 500 hours. The salt spray fog test shall be in accordance with ASTM B 117 using a 20 percent sodium chloride solution. Immediately after completion of the test, the coating shall show no signs of blistering, wrinkling or cracking, no loss of adhesion, and the specimen shall show no signs of rust creepage beyond 3 mm on either side of the scratch mark. The film thickness of the factory coating or paint system applied on the equipment shall be not less than film thickness used on the test specimen.

1.6 SAFETY STANDARDS:

1.6.1 Design, Manufacture and Installation of Mechanical Refrigeration Equipment: ASHRAE 15-78.

1.6.2 Machinery Guards: Fully guard drives mechanisms, or other moving parts in Accordance with ANSI B15.1. Provide guards fabricated of steel and expanded

Metal, rigidly mounted, and readily removed without disassembly.

PART 2: PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

Trane
Daikin
Samsung
Mitsubishi
Carrier
Hitachi
LG

2.1 General: The air conditioning system shall be designed, constructed, and rating tested in accordance with ARI Standard 430. Units shall be ARI certified.

2.2 Performance Rating: Cooling capacity of unit shall meet the total heat requirements indicated. Submittal shall include catalog selection data, which accounts for entering air conditions at evaporator, and condenser air conditions.

2.3 Air Conditioner;

Split type A/C: The unit shall be a combination of multi-split system and split type A/C. The indoor units shall be constructed for indoor installation and the outdoor unit shall be completely weather- proofed for outdoor installation. Both indoor and outdoor units shall be properly assembled, internally piped and wired, thoroughly tested, and charged with R410A refrigerant at the factory.

Cooling capacity - The total capacity of the multi-system full inverter controlled compressor (KW) shall be as shown on the equipment schedule.

2.3.1 Indoor Units:

Units shall have capacities at the operating conditions specified. They shall include an evaporator coil, expansion valve, centrifugal type air circulation blower, permanent type air filter, condensate drip pan and insulated decorative cabinet with discharge plenum, supply and return air grilles.

- a. Refrigeration Cycle – The refrigeration cycle shall be equipped with heat exchanger, an electronic expansion valve, solenoid valves and flare connections.
- b. Indoor Fan and Fan Motor – The indoor fan shall be the multi-blade centrifugal type, statically and dynamically balanced and direct driven by an electric motor. The motor bearing shall be permanently lubricated. The fan shall deliver air flow indicated on the schedule, nominal air flow for the model selected. They shall be provided with a combination fan switch and thermostat. Three operating positions can be selected according to the required conditions. Fan motor shall be equipped

with overload protection.

- c. Indoor Heat Exchanger – The heat exchanger shall be multi-pass, cross-finned tube type, equipped with highly-efficient aluminum fins, mechanically bonded to seamless, oxygen free copper tubes. The fins shall be spaced at no more than 12 fins per 25.4 mm. The face area shall not be less than the manufacturer's recommendation. The coil shall be cleaned, dehydrated and tested for leakage at the factory.

2.3.2 Outdoor Unit:

For Split type Units: It consist of fully inverter one condensing unit supplying one fan coil unit.

- a. Split type Outdoor units, full Inverter controlled compressor shall be capable of changing the speed linearly to follow variations in cooling and heating load. Outdoor unit shall be suitable for mix-match connection of the following type of indoor units.

- Cassette Type
- Ceiling Suspended Type
- Wall Mounted Type
- Floor Mounted
- Ceiling Concealed Mounted type

- b. Capacity

Unit shall have a total capacity as shown on the equipment schedule of the plans.

- c. Refrigerant circuit

- The refrigerant circuit shall include an accumulator, plural electronic expansion valves, one or two oil separators, a receiver and liquid and gas shut off valves. Filter drier and crankcase heaters shall be furnished.
- The outdoor unit shall either have one scroll type conventional compressors and multiple inverter type compressors. The indoor unit shall be equipped with an electronic control valve to control refrigerant flow individually.
- Refrigerant shall be R410a or R32 whichever is available

- d. Safety Devices

The following safety devices shall be part of the outdoor unit; high pressure switch, fused crankcase heater, fusible plug, thermal protectors for compressor and fan motor, over current protection for inverter, short recycling protection timer.

- e. Oil Recovery System

Unit shall be equipped with an oil recovery system to ensure stable operation with long refrigerant piping

f. Oil Equalize System

The outdoor unit with 2 or 3 compressors shall be equipped with an oil equalize system to avoid unbalance between 2 or 3 compressors.

g. Controls

- Unit shall be equipped with a self diagnosis circuit for easy maintenance and service
- The indoor unit shall be operated individually and each having a remote controller with an ON/OFF switch, a fan speed selector, a timer, a thermostat setting button and LCD which indicates temperature setting, operation mode, malfunction code and filter cleaning timing etc.
- The remote controller shall memorize the latest malfunction code for easy maintenance.

2.3.3 Related Accessories

a. The following accessories shall be provided:

- Piping branches and headers with insulation for quick work and smooth refrigerant flow
- Remote control devices for operation and monitoring of indoor unit from remote
- Multi-function centralized controller

b. The monitoring function shall be capable of indicating operation and trouble signals of the indoor and outdoor unit to the remote

2.3.4 Outdoor unit shall be provided with anti-corrosion treatment. Cabinet shall be constructed of galvanized steel sheet, baked with synthetic paint. The service panel shall be easily removable for service access to the electrical components and the compressor.

2.3.5 Fans: Statically and dynamically balanced, with air capacities horsepower, fan types, fan arrangement, and pressure ratings as indicated. Fan bearing life shall be minimum 200,000 hours at operating conditions. Provide guard (bird) screens for outdoor inlets and outlets. Equip with automatic back-draft damper where indicated. Housing and fan wheel shall be aluminum or steel.

- a. 4-Way Cassette Type - shall be design for quiet operation and shall match any interior design with a wide air flow wing installed turning to both sides of the air outlet to allow the air distribution in every four corners of the panel. The unit shall be provided with shutter to conceal the air outlet with the louvers when the operation is stopped. The louvers shall cover the air outlet horizontally providing a neat appearance. There shall be provision for fresh air duct connection. Install drain to meet local sanitation codes. Unit shall be provided with condensate pump installed as standard from the factory.

- b. Floor Mounted Type Indoor Unit - shall be design for quiet operation, slim compact and highly performance diagonal flow cone type fan to minimize the noise. A long life filter (mildew-proof) shall be fitted as a standard with no maintenance for 2,500 hours of operation for ordinary offices.
- c. Wall Mounted Type Indoor Unit - shall be design for quiet operation, slim compact and highly performance diagonal flow cone type fan to minimize the noise. A long life filter (mildew-proof) shall be fitted as a standard with no maintenance for 2,500 hours of operation for ordinary offices.

2.4 CLEANING, PAINTING, AND IDENTIFICATION: Cleaning, painting, and identification of piping shall be as specified under Section entitled "Painting of Building (Field Painting)".

2.5 IDENTIFICATION TAGS AND PLATES: Provide equipment, gages, thermometers, valves, and controllers with tags numbered and stamped for their use. Plates and tags shall be of brass or suitable nonferrous material, securely mounted or attached. Minimum letter and numeral size shall be 3 mm.

PART 3: EXECUTION

3.1 INSTALLATION: Application and installation practices for unitary air-conditioning systems shall conform to the requirements of ARI 260.

3.1.1 General: Install equipment and components in a manner to insure proper and sequential operation of the equipment and its control. Installation of the system should strictly comply with the manufacturer's recommended installation practice. Manufacturer's representative should check and verify the installation to ensure it is in accordance with their recommendations. Preliminary refrigerant pipe sizes are depicted in the plan and requires to make necessary final pipe sizing that conform to their recommendation. Installation of equipment not covered herein or in the manufacturer's representative. Provide proper foundations for mounting of equipment, accessories, appurtenances, piping and controls including, but not limited to, supported vibration isolators, stands, guides, anchors, clamps and brackets. Foundations for equipment shall conform to equipment manufacturer's recommendation, unless otherwise shown on the drawings. Set anchor bolts and sleeves accurately using properly constructed templates. Anchor bolts shall be of adequate length and provided with welded-on plates on the head end embedded in the concrete. Level equipment base, using jacks or steel wedges, and neatly grouted-in with a non-shrinking type of mortar grout. Locate equipment so that working space is available for all necessary servicing such as shaft removal, disassembling compressor cylinders and pistons, replacing or adjusting drives, motors, or shaft seals, access to water valves and head of shell and tube equipment, tube cleaning or replacement, access to automatic controls, refrigerant charging, lubricator, oil draining and working clearance under overhead lines. Provide electric isolation between dissimilar metals for the purpose of minimizing galvanic corrosion.

3.1.2 Air Conditioning System: Install system as indicated, in accordance with the requirements of ASHRAE 15-78, and as recommended in the manufacturer's installation and operational instructions. All electrical control devices shall be enclosed in the indoor and outdoor units. The refrigeration cycle shall be equipped with solenoid valves and flare connections to changeover the cycle in mediating between outdoor unit and indoor unit.

3.1.3 Electrical Work: Electric motor driven equipment specified herein shall be provided complete with motors, motor starters, and controls. Electrical equipment and wiring shall be provided with complete "Interior Wiring Systems". Motor starters shall be provided complete with properly sized thermal overload protection and other appurtenances necessary for the motor control specified. Provide manual or automatic control and protective devices required for the operation, herein specified and any control wiring required for controls and devices but not indicated.

3.1.4 Refrigerant Piping: Piping and fitting installation shall conform to the requirements of ASME B31.1. Pipe shall be cut accurately to measurements established at the jobsite, and worked into place without springing or forcing, completely clearing all windows, doors, and other openings. Cutting or other weakening of the building structure to facilitate piping installation will not be permitted without written approval. Pipe or tubing shall be cut square, shall have burrs removed by reaming, and shall permit free expansion and contraction without causing damage to the building structure, pipe, joints, or hangers. Changes in direction shall be made with fittings, except that bending of pipe 100 mm (4 inches) and smaller will be permitted, provided a pipe bender is used and wide weep bends are formed. Mitering or notching pipe or other similar construction to form elbows or tees will not be permitted. The centerline radius of bends shall not be less than 6 diameters of the pipe. Bent pipe showing kinks wrinkles, flattening, or other malformations will not be accepted. Piping shall be installed 4 mm per m (1/2 inch per 10 feet) of pipe in the direction of flow to ensure adequate oil drainage. Open ends of refrigerant lines or equipment shall be properly capped or plugged during installation to keep moisture, dirt, or other foreign material out of the system. Piping shall remain capped until installation. Equipment piping shall be in accordance with the equipment manufacturer's recommendations and the contract drawings. Equipment and piping arrangements shall fit into space allotted and allow adequate acceptable clearances for installation, replacement, entry, servicing, and maintenance.

3.1.5 FANS: Installation shall conform to NFPA 91, and SMACNA Round Industrial Duct Construction Standards, and SMACNA Rectangular Industrial Duct Construction Standards. Provide mounting and supports for equipment and accessories, including structural supports, hangers, vibration isolators, stands, clamps and brackets, access doors, and dampers. Install accessories in accordance with manufacturer's instructions.

3.1.5.1 Installation of Supports:

3.1.5.1.1 Selection: Selection of equipment support system shall take into account the best practice recommendations and requirements of SMACNA Round Industrial Duct Construction Standards, SMACNA Rectangular Industrial Duct Construction Standards, and NFPA 91; location and precedence of work under other sections; interferences of various piping and electrical work; facility equipment; building configuration; structural and safety factor requirements; vibrations and imposed loads under normal and abnormal service conditions. Indicated support sizes, configurations,

and spacing are the minimal type of supporting component required for normal loads. Where installed loads are excessive for the normal support spacing, provide heavier duty components or reduce the element spacing. After system start-up, replace or correct support elements, which vibrate and cause noise or possible fatigue failure.

3.2 FIELD TESTS AND INSPECTIONS

3.2.1 Tests: All tests shall be performed and the Contractor shall furnish materials and equipment required for test. Tests after installation and prior to acceptance shall be performed in the presence of the Engineer and subject to his approval. Equipment and material certified as having been successfully tested by the manufacturer in accordance with referenced specifications and standards will not require retesting before installation. Equipment and materials not tested at the place of manufacturer will be tested before or after installation, as applicable, where necessary to determine compliance with referenced specifications and standards.

3.2.1.1 Leak Testing: Upon completion of installation of the air conditioning equipment, test all factories as well as field refrigerant piping with an electronic-type leak detector to acquire leak tight refrigerant systems. If leaks are detected at the time of installation or during the guarantee period, remove the entire refrigerant charge from the system, correct the leaks and retest the system.

3.2.1.2 Evacuation, Dehydration, and Charging: After system is found to be without leaks, evacuate the system using a reliable gage and a vacuum pump capable of pulling a vacuum of at least 1 mm Hg absolute. Evacuate system in strict accordance with the triple-evacuation and blotter method or in strict accordance with equipment manufacturer's printed instructions. System leak testing, evacuation, dehydration, and charging with refrigerant shall comply with the requirements contained in ARI Standard 260.

3.2.1.3 Start-Up and Operation Tests: Follow the manufacturer's start-up and initial operation procedures and place the system under all modes of operation to ensure that it is functioning correctly. Adjust safety and automatic control instruments as necessary to ensure proper operation and sequence. Initial operation period shall be not less than 8 hours. The air conditioner manufacturer/vendor shall perform the start-up and should verify and confirm the complete installation. Manufacturer should issue acceptance of the installed system that the system is fully functional and operational according to the need of the project.

3.2.1.4 Performance Tests: Upon completion of evacuation, charging, start-up, final leak testing, and proper adjustment of controls, the system shall be performance tested to demonstrate that it complies with the performance and capacity requirements of the specifications and plans. Test the system for not less than 8 hours, during which time hourly readings shall be recorder. At the end of the test period, the readings shall be averaged and the average shall be considered to be the system performance.

REFRIGERANT PIPING AND SPECIALTIES

PART 1: GENERAL

1.1 SECTION INCLUDES

- A. Piping.
- B. Refrigerant.
- C. Moisture and liquid indicators.
- D. Valves.
- E. Strainers.
- F. Check valves.
- G. Pressure relief valves.
- H. Filter-driers.
- I. Solenoid valves.
- J. Expansion valves.
- K. Receivers.
- L. Flexible connections.

1.2 REFERENCES

- A. ARI 495 - Refrigerant Liquid Receivers.
- B. ARI 710 - Liquid Line Dryers.
- C. ARI 730 - Flow-Capacity Rating and Application of Suction-Line Filters and Filter-Driers
- D. ARI 750 - Thermostatic Refrigerant Expansion Valves.
- E. ARI 760 - Solenoid Valves for Use With Volatile Refrigerants.
- F. ASHRAE 15 - Safety Code for Mechanical Refrigeration.
- G. ASHRAE 34 - Number Designation of Refrigerants.
- H. ASME - Boiler and Pressure Vessel Codes, SEC 9 - Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.

- I. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- J. ASME B16.26 - Cast Copper Alloy Fittings For Flared Copper Tubes.
- K. ASME B31.5 - Refrigeration Piping.
- L. ASME B31.9 - Building Services Piping.
- M. ASME SEC 8D - Boilers and Pressure Vessels Code, Rules for Construction of Pressure Vessels.
- N. ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- O. ASTM A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
- P. ASTM B88 - Seamless Copper Water Tube.
- Q. ASTM B280 - Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
- R. ASTM F708 - Design and Installation of Rigid Pipe Hangers.
- S. AWS A5.8 - Brazing Filler Metal.
- T. AWS D1.1 - Structural Welding Code, Steel.
- U. MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
- V. MSS SP69 - Pipe Hangers and Supports - Selection and Application.
- W. MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

1.4 SYSTEM DESCRIPTION

- A. Where more than one piping system material is specified ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.
- B. Provide pipe hangers and supports in accordance with ASTM B31.5 MSS SP69 unless indicated otherwise.
- C. Liquid Indicators:
 - 1. Use line size liquid indicators in main liquid line leaving condenser.
 - 2. If receiver is provided, install in liquid line leaving receiver.

3. Use line size on leaving side of liquid solenoid valves.

D. Valves

1. Use service valves on suction and discharge of compressors.
2. Use gage taps at compressor inlet and outlet.
3. Use gage taps at hot gas bypass regulators, inlet and outlet.
4. Use check valves on compressor discharge.
5. Use check valves on condenser liquid lines on multiple condenser systems.

E. Refrigerant Charging Packed Angle Valve: Use in liquid line between receiver shutoff valve and expansion valve.

F. Strainers:

1. Use line size strainer upstream of each automatic valve.
2. Where multiple expansion valves with integral strainers are used, use single main liquid line strainer.
3. On steel piping systems, use strainer in suction line.
4. Use shutoff valve on each side of strainer.

G. Pressure Relief Valves: Use on ASME receivers and pipe to outdoors.

F. Permanent Filter Driers:

1. Use in low temperature systems.
2. Use in systems utilizing hermetic compressors.
3. Use filter driers for each solenoid valve.

I. Replaceable Cartridge Filter Driers:

1. Use vertically in liquid line adjacent to receivers.
2. Use filter driers for each solenoid valve.

J. Solenoid Valves:

1. Use in liquid line of systems operating with single pump out or pump down compressor control.
2. Use in liquid line of single or multiple evaporator systems.
3. Use in oil bleeder lines from flooded evaporators to stop flow of oil and refrigerant into the suction line when system shuts down.

K. Receivers:

1. Use on systems 10 tons, 36 kW and larger, sized to accommodate pump down charge.
2. Use on systems with long piping runs.

L. Flexible Connectors: Utilize at or near compressors where piping configuration does not absorb vibration.

1.5 PROJECT RECORD DOCUMENTS

Record exact locations of equipment and refrigeration accessories on record drawings.

1.6 QUALIFICATIONS

- A. Installer: Company specializing in performing the work of this section with minimum three (3) years documented experience.
- G. Design piping system under direct supervision of a Professional Engineer experienced in design of this work and licensed at the place where the Project is located.
- H.

1.7 REGULATORY REQUIREMENTS

- A. Conform to ASME B31.9 for installation of piping system.
- B. Products Requiring Electrical Connection: Listed and classified by UL, as suitable for the purpose indicated.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 01600.
- B. Deliver and store piping and specialties in shipping containers with labelling in place.
- C. Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.
- D. Dehydrate and charge components such as piping and receivers, seal prior to shipment, until connected into system.

PART 2: PRODUCTS

2.1 PIPING

- A. Copper Tubing: ASTM B280, Type ACR hard drawn or annealed.
 - 1. Fittings: ASME B16.22 wrought copper.
 - 2. Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting range 640 to 805 degrees C.
- B. Copper Tubing to 22 mm OD: ASTM B88, Type K, annealed.
 - 1. Fittings: ASME B16.26 cast copper.
 - 2. Joints: Flared.

- C. Steel Pipe: ASTM A53, Schedule 40, 10 mm wall for sizes 300 mm and over, black.
 - 1. Fittings: ASTM A234, forged steel welding type.
 - 2. Joints: AWS D1.1, welded.
- D. Pipe Supports and Anchors:
 - 1. Conform to ASME B31.5 .
 - 2. Hangers for Pipe Sizes 13 to 38 mm: Carbon steel, adjustable swivel, split ring.
 - 3. Hangers for Pipe Sizes 50 mm and Over: Carbon steel, adjustable, clevis.
 - 4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 - 5. Wall Support for Pipe Sizes to 75 mm: Cast iron hook.
 - 6. Wall Support for Pipe Sizes 100 mm and Over: Welded steel bracket and wrought steel clamp.
 - 7. Vertical Support: Steel riser clamp.
 - 8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 - 9. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
 - 10. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
 - 11. Inserts: Malleable iron case of steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

PART 3 : EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.2 INSTALLATION

- A. Install refrigeration specialties in accordance with manufacturer's instructions.
- B. Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.
- C. Install piping to conserve building space and not interfere with use of space.

- D. Group piping whenever practical at common elevations and locations. Slope piping one percent in direction of oil return.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Inserts:
 - 1. Provide inserts for placement in concrete formwork.
 - 2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 - 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 100 mm.
 - 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 - 5. Where inserts are omitted, drill through concrete slab from below and provide through bolt with recessed square steel plate and nut recessed into and grouted flush with slab.
- G. Pipe Hangers and Supports:
 - 1. Install in accordance with ASTM B31.5.
 - 2. Support horizontal piping as scheduled.
 - 3. Install hangers to provide minimum 13 mm space between finished covering and adjacent work.
 - 4. Place hangers within 300 mm of each horizontal elbow.
 - 5. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
 - 6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- H. Arrange piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required. Slope horizontal piping 0.40 percent in direction of flow.
- I. Provide clearance for installation of insulation and access to valves and fittings.
- J. Provide access to concealed valves and fittings.
- K. Flood piping system with nitrogen when brazing.
- L. Where pipe support members are welded to structural building frame, brush clean, and apply one coat of zinc rich primer to welding.
- M. Prepare unfinished pipe, fittings, supports, and accessories ready for finish painting. Refer to Section 09900.
- N. Insulate piping.
- O. Follow ASHRAE 15 procedures for charging and purging of systems and for disposal of refrigerant.

- P. Provide replaceable cartridge filter driers, with isolation valves and valved bypass.
- Q. Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.
- R. Provide external equalizer piping on expansion valves with refrigerant distributor connected to evaporator.
- S. Install flexible connectors at right angles to axial movement of compressor, parallel to crankshaft.
- T. Fully charge completed system with refrigerant after testing.
- U. Provide electrical connection to solenoid valves. Refer to Section 16180.

3.3 FIELD QUALITY CONTROL

- A. Test refrigeration system in accordance with ASME B31.5.
- B. Pressure test system with dry nitrogen to 1470 kPa. Perform final tests at 92 kPa vacuum and 1470 kPa using halide torch. Test to no leakage.

3.4 SCHEDULES

- A. Pipe Hanger Spacing

Pipe Size, mm	Maximum Hanger Spacing, m	Hanger Rod, mm
12 to 32	2	9
38 to 50	3	9
62 to 75	3	13
100 to 150	3	15
200 to 300	4.25	22

THERMAL INSULATION FOR MECHANICAL SYSTEMS

PART 1: GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only. At the discretion of the Government, the manufacturer of any material supplied will be required to furnish test reports pertaining to any of the tests necessary to assure compliance with the standard or standards referenced in this specification.

ASHRAE 90.1 - IP	(2007; Supplement 2008; Errata 2009; Errata 2009) Energy Standard for Buildings Except Low-Rise Residential Buildings, I-P Edition
ASHRAE 90.2	(2007) Energy Efficient Design of Low-Rise Residential Buildings
ASTM A 167	(1999; R 2004) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM B 209	(2007) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM C 1126	(2004) Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation
ASTM C 1136	(2008) Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation
ASTM C 1290	(2006e1) Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts
ASTM C 1427	(2007) Specification for Preformed Flexible Cellular Polyolefin Thermal Insulation in Sheet and Tubular Form
ASTM C 533	(2007) Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation
ASTM C 534/C 534M	(2008) Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form

MSS SP-69	(2003; R 2004) Standard for Pipe Hangers and Supports - Selection and Application
MICA Insulation Stds	(1999) National Commercial & Industrial Insulation Standards
NFPA 96	(2007) Ventilation Control and Fire Protection of Commercial Cooking Operations

1.2 SYSTEM DESCRIPTION

1.2.1 General

Provide field-applied insulation and accessories on mechanical systems as specified herein; factory-applied insulation is specified under the piping. Field applied insulation materials required for use on Government-furnished items as listed in the SPECIAL CONTRACT REQUIREMENTS shall be furnished and installed by the Contractor.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval/information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01300 SUBMITTAL PROCEDURES:

Submit the three SD types, SD-02 Shop Drawings, SD-03 Product Data, and SD-08 Manufacturer's Instructions at the same time for each system.

SD-02 Shop Drawings

Pipe Insulation Systems and Associated Accessories
Equipment Insulation Systems and Associated Accessories

A booklet containing completed MICA Insulation Stds plates detailing each insulating system for each pipe, duct, or equipment insulating system, after approval of materials and prior to applying insulation.

a. The MICA plates shall detail the materials to be installed and the specific insulation application. Submit all MICA plates required showing the entire insulating system, including plates required to show insulation penetrations, vessel bottom and top heads, legs, and skirt insulation as applicable. The MICA plates shall present all variations of insulation systems including locations, materials, vapor proofing, jackets and insulation accessories.

b. If the Contractor elects to submit detailed drawings instead of edited MICA Plates, the detail drawings shall be technically equivalent to the edited MICA Plate submittal.

SD-03 Product Data

Pipe Insulation Systems Equipment Insulation Systems

A complete list of materials, including manufacturer's descriptive technical literature, performance data, catalog cuts, and installation instructions. The product number, k-value, thickness and furnished accessories including adhesives, sealants and jackets for each mechanical system requiring insulation shall be included. The product data must be copywrited, have an identifying or publication number, and shall have been published prior to the issuance date of this solicitation. Materials furnished under this section of the specification shall be submitted together in a booklet and in conjunction with the MICA plates booklet (SD-02). Annotate the product data to indicate which MICA plate is applicable.

SD-04 Samples

Thermal Insulation

After approval of materials, actual sections of installed systems, properly insulated in accordance with the specification requirements, shall be displayed. Such actual sections must remain accessible to inspection throughout the job and will be reviewed from time to time for controlling the quality of the work throughout the construction site. Each material used shall be identified, by indicating on an attached sheet the specification requirement for the material and the material by each manufacturer intended to meet the requirement. The Contracting Officer will inspect display sample sections at the jobsite. Approved display sample sections shall remain on display at the jobsite during the construction period. Upon completion of construction, the display sample sections will be closed and sealed.

Pipe Insulation Display Sections: Display sample sections shall include as a minimum an elbow or tee, a valve, dielectric waterways and flanges, a hanger with protection shield and insulation insert, or dowel as required, at support point, method of fastening and sealing insulation at longitudinal lap, circumferential lap, butt joints at fittings and on pipe runs, and terminating points for each type of pipe insulation used on the job, and for hot pipelines and cold pipelines, both interior and exterior, even when the same type of insulation is used for these services.

SD-08 Manufacturer's Instructions

Pipe Insulation Systems Equipment Insulation Systems

Submit a booklet containing manufacturer's published installation instructions for the insulation systems in coordination with the submitted

MICA Insulation Stds plates booklet. Annotate their installation instructions to indicate which product data and which MICA plate are applicable. The instructions must be copywrited, have an identifying or publication number, and shall have been published prior to the issuance date of this solicitation.

1.4 DELIVERY, STORAGE, AND HANDLING

Materials shall be delivered in the manufacturer's unopened containers. Materials delivered and placed in storage shall be provided with protection from weather, humidity, dirt, dust and other contaminants. The Contracting Officer may reject insulation material and supplies that become dirty, dusty, wet, or contaminated by some other means. Packages or standard containers of insulation, jacket material, cements, adhesives, and coatings delivered for use, and samples required for approval shall have manufacturer's stamp or label attached giving the name of the manufacturer and brand, and a description of the material. Insulation packages and containers shall be asbestos free.

PART 2 : PRODUCTS

2.1 STANDARD PRODUCT

Provide materials which are the standard products of manufacturers regularly engaged in the manufacture of such products and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Provide insulation systems in accordance with the approved MICA National Insulation Standards plates as supplemented by this specification. Provide field-applied insulation for heating, ventilating, and cooling (HVAC) air distribution systems and piping systems which are located within, on, under, and adjacent to buildings; and for plumbing systems.

2.2 MATERIALS

Provide insulation that meets or exceed the requirements of ASHRAE 90.1 – IP/ASHRAE 90.2. Insulation exterior shall be cleanable, grease resistant, non-flaking and non-peeling. Materials shall be compatible and shall not contribute to corrosion, soften, or otherwise attack surfaces to which applied in either wet or dry state. Materials to be used on stainless steel surfaces shall meet ASTM C 795 requirements. Materials shall be asbestos free and conform to the following:

2.2.1 Wire

Soft annealed ASTM A 580/A 580M Type 302, 304 or 316 stainless steel, 16 or 18 gauge.

2.2.2 Insulation Bands

Insulation bands shall be 1/2 inch wide; 26 gauge stainless steel.

2.2.3 Sealants

Sealants shall be chosen from the butyl polymer type, the styrene-butadiene rubber type, or the butyl type of sealants. Sealants shall have a maximum moisture vapor transmission of 0.02 perms, and a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E 84.

2.3 PIPE INSULATION SYSTEMS

Insulation materials shall conform to Table 1. Insulation thickness shall be as listed in Table 2 and meet or exceed the requirements of ASHRAE 90.1-IP/ASHRAE 90.2. Insulation thickness shall be ½ to 1 inch. Comply with EPA requirements in accordance with Section 01 62 35 RECYCLED / RECOVERED MATERIALS. Pipe insulation materials shall be limited to those listed herein and shall meet the following requirements:

2.3.1 Aboveground Cold Pipeline (-30 to 60 deg. F)

Insulation for outdoor, indoor, exposed or concealed applications, shall be as follows:

- a. Cellular Glass: ASTM C 552, Type II, and Type III. Supply the insulation with manufacturer's recommended factory-applied jacket/vapor barrier.
- b. Flexible Elastomeric Cellular Insulation: ASTM C 534/C 534M, Grade 1, Type I or II. Type II shall have vapor retarder/vapor barrier skin on one or both sides of the insulation. Insulation with pre-applied adhesive shall not be used.
- c. Phenolic Insulation: ASTM C 1126, Type III. Phenolic insulations shall comply with ASTM C 795 and with the ASTM C 665 paragraph Corrosiveness. Supply the insulation with manufacturer's recommended factory-applied jacket/vapor barrier.
- d. Polyisocyanurate Insulation: ASTM C 591, type I. Supply the insulation with manufacturer's recommended factory-applied vapor retarder/vapor barrier. Insulation with pre-applied adhesive shall not be used.
- e. Flexible Polyolefin Cellular Insulation: ASTM C 1427, Grade 1 Type I or II.
- f. Mineral Fiber Insulation with Integral Wicking Material (MFIWM): ASTM C 547. Install in accordance with manufacturer's instructions.

PART 3: EXECUTION

3.1 APPLICATION - GENERAL

Insulation shall only be applied to unheated and uncooled piping and equipment. Flexible elastomeric cellular insulation shall not be compressed at joists, studs,

columns, ducts, hangers, etc. The insulation shall not pull apart after a one hour period; any insulation found to pull apart after one hour, shall be replaced.

3.1.1 Installation

Except as otherwise specified, material shall be installed in accordance with the manufacturer's written instructions. Insulation materials shall not be applied until [tests] [tests and heat tracing] specified in other sections of this specification are completed. Material such as rust, scale, dirt and moisture shall be removed from surfaces to receive insulation. Insulation shall be kept clean and dry. Insulation shall not be removed from its shipping containers until the day it is ready to use and shall be returned to like containers or equally protected from dirt and moisture at the end of each workday. Insulation that becomes dirty shall be thoroughly cleaned prior to use. If insulation becomes wet or if cleaning does not restore the surfaces to like new condition, the insulation will be rejected, and shall be immediately removed from the jobsite. Joints shall be staggered on multi layer insulation. Mineral fiber thermal insulating cement shall be mixed with demineralized water when used on stainless steel surfaces. Insulation, jacketing and accessories shall be installed in accordance with MICA Insulation Stds plates except where modified herein or on the drawings.

3.2 PIPE INSULATION SYSTEMS INSTALLATION

Install pipe insulation systems in accordance with the approved MICA Insulation Stds plates as supplemented by the manufacturer's published installation instructions.

3.2.1 Pipe Insulation

3.2.1.1 General

Pipe insulation shall be installed on aboveground hot and cold pipeline systems as specified below to form a continuous thermal retarder/barrier, including straight runs, fittings and appurtenances unless specified otherwise. Installation shall be with full length units of insulation and using a single cut piece to complete a run. Cut pieces or scraps abutting each other shall not be used. Pipe insulation shall be omitted on the following:

- a. Pipe used solely for fire protection.
- b. Chromium plated pipe to plumbing fixtures. However, fixtures for use by the physically handicapped shall have the hot water supply and drain, including the trap, insulated where exposed.
- c. Sanitary drain lines.
- d. Air chambers.
- e. Adjacent insulation.
- f. ASME stamps.

g. Access plates of fan housings.

h. Cleanouts or hand holes.

3.2.1.2 Pipes Passing Through Walls, Roofs, and Floors

a. Pipe insulation shall be continuous through the sleeve.

b. An aluminum jacket or vapor barrier/weatherproofing - self adhesive jacket (minimum 2 mils adhesive, 3 mils embossed) less than 0.0000 permeability, greater than 3 ply standard grade, silver, white, black and embossed with factory applied moisture retarder shall be provided over the insulation wherever penetrations require sealing.

c. Where pipes penetrate interior walls, the aluminum jacket or vapor barrier/weatherproofing - self adhesive jacket (minimum 2 mils adhesive, 3 mils embossed) less than 0.0000 permeability, greater than 3 ply standard grade, silver, white, black and embossed shall extend 2 inches beyond either side of the wall and shall be secured on each end with a band.

d. Where penetrating floors, the aluminum jacket shall extend from a point below the backup material to a point 10 inches above the floor with one band at the floor and one not more than 1 inch from the end of the aluminum jacket.

e. Where penetrating waterproofed floors, the aluminum jacket shall extend from below the backup material to a point 2 inches above the flashing with a band 1 inch from the end of the aluminum jacket.

3.2.1.3 Pipes Passing Through Hangers

a. Insulation, whether hot or cold application, shall be continuous through hangers. All horizontal pipes 2 inches and smaller shall be supported on hangers with the addition of a Type 40 protection shield to protect the insulation in accordance with MSS SP-69. Whenever insulation shows signs of being compressed, or when the insulation or jacket shows visible signs of distortion at or near the support shield, insulation inserts as specified below for piping larger than 2 inches shall be installed, or factory insulated hangers (designed with a load bearing core) can be used.

b. Horizontal pipes larger than 2 inches at 60 degrees F and above shall be supported on hangers in accordance with MSS SP-69, and Section 15400 PLUMBING, GENERAL PURPOSE.

c. Horizontal pipes larger than 2 inches and below 60 degrees F shall be supported on hangers with the addition of a Type 40 protection shield in accordance with MSS SP-69. An insulation insert of cellular glass, calcium silicate (or perlite above 80 degrees F), or the necessary strength polyisocyanurate shall be installed above each shield. The insert shall cover not less than the bottom 180-degree arc of the pipe. Inserts shall be the same thickness as the insulation, and shall extend 2 inches on each end beyond the

protection shield. When insulation inserts are required in accordance with the above, and the insulation thickness is less than 1 inch, wooden or cork dowels or blocks may be installed between the pipe and the shield to prevent the weight of the pipe from crushing the insulation, as an option to installing insulation inserts. The insulation jacket shall be continuous over the wooden dowel, wooden block, or insulation insert.

d. Vertical pipes shall be supported with either Type 8 or Type 42 riser clamps with the addition of two Type 40 protection shields in accordance with MSS SP-69 covering the 360-degree arc of the insulation. An insulation insert of cellular glass or calcium silicate shall be installed between each shield and the pipe. The insert shall cover the 360-degree arc of the pipe. Inserts shall be the same thickness as the insulation, and shall extend 2 inches on each end beyond the protection shield. When insulation inserts are required in accordance with the above, and the insulation thickness is less than 1 inch, wooden or cork dowels or blocks may be installed between the pipe and the shield to prevent the hanger from crushing the insulation, as an option instead of installing insulation inserts. The insulation jacket shall be continuous over the wooden dowel, wooden block, or insulation insert. The vertical weight of the pipe shall be supported with hangers located in a horizontal section of the pipe. When the pipe riser is longer than 30 feet, the weight of the pipe shall be additionally supported with hangers in the vertical run of the pipe that are directly clamped to the pipe, penetrating the pipe insulation. These hangers shall be insulated and the insulation jacket sealed as indicated herein for anchors in a similar service.

e. Inserts shall be covered with a jacket material of the same appearance and quality as the adjoining pipe insulation jacket, shall overlap the adjoining pipe jacket 1-1/2 inches, and shall be sealed as required for the pipe jacket. The jacket material used to cover inserts in flexible elastomeric cellular insulation shall conform to ASTM C 1136, Type 1, and is allowed to be of a different material than the adjoining insulation material.

3.2.1.4 Flexible Elastomeric Cellular Pipe Insulation

Flexible elastomeric cellular pipe insulation shall be tubular form for pipe sizes 6 inches and less. Grade 1, Type II sheet insulation used on pipes larger than 6 inches shall not be stretched around the pipe. On pipes larger than 12 inches, the insulation shall be adhered directly to the pipe on the lower 1/3 of the pipe. Seams shall be staggered when applying multiple layers of insulation. Sweat fittings shall be insulated with miter-cut pieces the same size as on adjacent piping. Screwed fittings shall be insulated with sleeved fitting covers fabricated from miter-cut pieces and shall be overlapped and sealed to the adjacent pipe insulation.

FANS & BLOWERS

1.0 PART 1: GENERAL

- 1.1 Fans shall be of the type, size, arrangement and capacity as indicated in the schedule and/or as shown on the drawings.
- 1.2 Unless specify, fans performance rating data shall be tested accordance with AMCA Standard 210-85 (Air Movement and Control Association), ANSI/ASHRAE Standard 51-1985 Laboratory Methods of Testing Fans for Rating". Sound ratings shall conform to AMCA Standard 300-85. "Reverberant Room Method for Sound Testing of Fans".
- 1.3 A computer printout of fan performance rating corresponding to the AMCA licensed data, with corrected ratings for altitude and temperature, fan operating speed, bearing life, etc., shall be submitted for approval.
- 1.4 All fans shall be dynamically trim-balanced to ISO 1940 and AMCA 204/3-G2.5 quality grade after assembly. A computer printout with the vibration spectrum analysis shall be attached to the fans.
- 1.5 Fan motors shall comply in all respects with continuous rating in accordance with IEC34 or equivalent. Motor bearing shall be of ball or roller type, grease or lubricant sealed for life. Fan and drive shall earthed to prevent accumulation of static charge.

2.0 PART 2 : PRODUCTS

2.1 ACCEPTABLE MANUFACATURERS

KRUGER
MORRISON
NIAGARA
NATIONAL
FERRARI
WOODS
BUFFALO.

2.2 CABINET

- 5.1 Fan contained within cabinet shall be licensed to bear the AMCA Air and Sound Certified rating Seal.
- 5.2 Fan shall be of DIDW forward or Backward curved with fan scroll belt drive or direct drive assembled within a cabinet.
- 5.3 Cabinet shall be constructed of Galvanized Steel material with 220 g/m2 coating.

5.4 Cabinet shall be of "Panel Construction" assembled together by means of fasteners for easy of dismantling for service and maintenance. Welded cabinets are not acceptable.

5.5 Cabinet design shall be capable of adding acoustic insulation (i.e. double skin arrangement) if requested for noise reduction.

5.6 DIRECT DRIVE TYPE

A. Fans shall be of DIDW Forward Curved centrifugal type with fan scroll within a Cabinet.

B. Fan speed shall not exceed 1800 RPM.

C. Motor shall be for power supply 220-240 V/60Hz/Single Phase

ELEVATOR

1.0 PART 1: OUTLINE SPECIFICATIONS

The outline specifications are as follows:

TECHNICAL SPECIFICATIONS FOR PASSENGER ELEVATOR		
QUANTITY	1	
FIREMAN'S LIFT	Yes	
RATED CAPACITY (kg)	1000kg (13 Persons)	
SPEED (m/s)	1.0 m/s	
NO. OF STOPS	4	
NO. OF OPENINGS	4 (All front)	
FLOOR DESIGNATION	G, 2, 3, 4	
TRAVEL HEIGHT (m)	9.0 m	
TOTAL SHAFT SIZE	2020 mm x 1900 mm	As per plan
OVER TRAVEL (mm)	4300 mm	Minimum Requirement
PIT DEPTH (mm)	1200 mm	Minimum Requirement
DRIVE SYSTEM	Permanent Magnet Gearless	
CONTROL SYSTEM	Scalable Control (SC)	
OPERATING	1 KS (COLLECTIVE – SELLECTIVE)	
POWER SUPPLY (Main, Light)	380 VAC, 3PH, 60HZ 220 VAC, 1PH, 60HZ	
BUFFER	RUBBER	
LIFT CAR		
CLEAR CAR SIZE (WxDxH)	1400 mm x 1600 mm x 2500 mm	
DOOR TYPE	2 Panel – Center Opening	
DOOR SIZE (WxH)	900 mm x 2100 mm	
DOOR PANEL	Stainless Steel Hairline	
DOOR SILL	Extruded Aluminum	
LANDING DOOR	Stainless Steel Hairline	
CAR DOOR	Stainless Steel Hairline	
FRONT WALL FINISHES	Stainless Steel Hairline	
REAR WALL FINISHES	Stainless Steel Hairline	
SIDE WALL FINISHES	Stainless Steel Hairline	
HANDRAILS	Rear Side Only	
COP BUTTONS	Mechanical Push Button	w/ braille
NO. OF COP'S/LOCATION	1/Side Wall	
PLATFORM DECORATION	Artificial Granite – Black	
CAR CEILING LIGHT	Bracket	
LIFT LOBBY		
Landing Door (Main Floor/s)	Stainless Steel Hairline	
Landing Door (Typical Floors)	Stainless Steel Hairline	
Landing Door Frame	50 mm x 50 mm Box Frame	

Landing Operating Panel (LOP)	Mechanical Push Button	w/ braille
Landing Indicator Panel (LIP)	Mechanical Push Button	
STANDARD FEATURES INCLUDED IN THE PACKAGE		
Alarm		
Car fan & light automatic on/off		
Light curtain sensor		
Emergency light in COP		
Full load by-pass		
Overload measuring with load contacts		
SPECIAL FEATURES INCLUDED IN THE PACKAGE		
Arrival GONG	Yes	
Intercom System	3-way	
Attendant Control	Yes	
Out of Service Switch	Yes	
Fireman's Emergency Operation	Yes	
Car call cancellation	Yes	
CCTV interface	Yes	
Card reader interface	Yes	
AVR/TVSS	Yes	
Automatic Rescue Device	Yes	
Shaft Lighting	Yes	

