MATERIAL AND EQUIPMENT STANDARD

FOR

GENERAL HVAC&R EQUIPMENT

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0. INTRODUCTION

This Standard provides material specification for various mechanical related equipment used in HVAC&R systems which have not been covered in other IPS material standards. The first nine parts consists of material standards and can be used as separate standards for the equipment covered, with the part covering the general administrative and procedural requirements shall be common for all equipment. Reference publications and standards plus definitions and terminology used throughout this Standard are in accordance with 1991 edition of ASHRAE terminology of HVAC&R and other authoritative international body.

The body of the specifications allows the use of any equipment meeting the performance specifications. The specifications are intended to be inclusive of many components which may not be required, hence it is up to the discretion of the design or procurement engineer to eliminate those added items that may not be required for the specific needs of the project being addressed.

Since the type of controls are of several different standards used in the industry, recommendations by acceptable and approved manufacturers shall be used to meet differing requirements of the codes or the equipment.

1. SCOPE

This Standard covers the material specification of HVAC&R related equipment covering minimum requirements for design, construction material standard, inspection, testing and delivery of relevant equipment as specified herein and indicated in the data sheets. In view of various applications involved with different type of equipment, this Standard is divided into following parts:

PART 1	Drinking Water Coolers
PART 2	Ice Cube Making Machines
PART 3	Refrigerators and Freezers
PART 4	Steam Specialty Items
PART 5	Heating Terminal Units
PART 6	Piping Protection Devices
PART 7	Measuring and Monitoring Devices (Flow-Pressure-Level-Temperature)
PART 8	Centrifugal Water Pumps
PART 9	Refrigeration Equipment and System for Pre-Fabricated Cold Stores
PART 10	General Administrative and Procedural Requirements
PART 11	Data Sheets

2. REFERENCES

Throughout this Standard the following standards and codes are referred to. The editions of these standards and codes that are in effect at the time of publication of this Standard shall, to the extent specified herein, form a part of this Standard. The applicability of changes in standards and codes that occur after the date of this Standard shall be mutually agreed upon by the Company and the Vendors.

ANSI (AMERICAN NATIONAL STANDARDS INSTITUTE)

ANSI/ARI 360-86	"Commercial and Industrial Unitary Air Conditioning Equipment"
ANSI/ARI 810-91	"Method of Testing Automatic Commercial Ice Makers"
ANSI/ARI 820-88	"Testing and Ratings of Ice Storage Bins"
ANSI/ARI 1010-84	"Drinking Fountains and Self-Contained Mechanically Refrigerated Drinking Water Coolers"
ANSI/ASHRAE 15-1992	"Safety Code for Mechanical Refrigeration"
ANSI/ASHRAE 34-1992	"Number Designation and Safety Classifications of Refrigerants"
ANSI/UL 1025-80	"Electric Air Heaters"
ANSI/UL 250-1983	"Current Leakage Test"
ANSI/UL 399-86	"Testing Method of Drinking Water Coolers"
ANSI/Z 21-10-1(1984)	"Gas Unit Heaters"

ARI (AIR CONDITIONING AND REFRIGERATION INSTITUTE)

ARI 420-89	"Unit Coolers for Refrigeration"
ARI 750-87	"Testing and Ratings of Thermostatic Refrigerant Expansion Valves"
ARI 810-91	"Testing Method for Standard Ratings of Ice Cube Machines"

ASHRAE (AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR CONDITIONING ENGINEERS, INC.)

ASHRAE 29-78	"Automatic Commercial Ice Makers"
ASHRAE 18-86	"Methods of Testing for Rating Drinking Water Coolers with Self Contained Mechanical Refrigeration System"

AHAM (ASSOCIATION OF HOME APPLIANCE MANUFACTURERS)

ANSI/AHAM HRF-1-11986 "Performance Test Procedures for Household Refrigerators, Combination Refrigerator-Freezers, and Household Freezers"

AIA (THE AMERICAN INSTITUTE OF ARCHITECTS)

Section 15135 "Masterspec Copyright 1984 for Meters and Gages"

MSS (MANUFACTURER'S STANDARDIZATION SOCIETY)

MSS-1992 "Refrigerators and Freezers Specification Sheets" (AHAM Published)

3. DEFINITIONS AND TERMINOLOGY

3.1 Bellows

The flexible portion of an expansion joint consisting of one or more convolutions/corrugations, generally including collars at each end for attachment to end fittings.

3.2 Cabinet Breaker Strip

A separate insulating element or integral insulating extension of the cabinet interior surfaces around the periphery of the cabinet door or drawer opening(s) which functions as a thermal barrier to minimize heat flow to the interior of the cabinet.

3.3 Combination Refrigerator-Freezer

A cabinet which consists of two or more compartments, with at least one of the compartments designed for the refrigerated storage of foods at temperatures above 0°C (32°F) and with at least one of the compartments designed for the freezing and storage of frozen foods at temperatures of -13.3°C (8°F) average or below and typically capable of being adjusted by the user to a temperature of 0°C (32°F) or below.

3.4 Drinking Water Cooler, Bottled

One which employs a bottle for storing the supply of water to be cooled and which utilizes a faucet for filling glasses or cups.

3.5 Drinking Water Cooler, Bubbler-Type

One which is equipped to use water under pressure from a piped system as a supply to the cooler and which employs a valve in the drinking water line for controlling the flow of water to a bubbler or open flowing stream so that the water may be drunk without utilizing glasses or cups.

3.6 Fresh Food Compartment

In a household refrigerator, that compartment(s) designed for the refrigerated storage of food at an average temperature above 0°C (32°F). Special compartments designed for the storage of fresh foods at temperatures near 0°C shall be considered part of the fresh food compartment. Special compartments of combination refrigerator-freezers operating at average temperatures between -13.3°C (8°F) and 0°C (32°F) shall be considered part of the fresh food compartment.

3.7 Freezer Compartment

In a basic refrigerator, the compartment designed for short-term storage of food at temperatures below 0°C in a combination refrigerator-freezer, the compartment(s) designed for extended storage of frozen foods at an average temperature of -17.8°C (0°F) or below and having inherent capability for freezing of food.

3.8 Fan Shroud

A protective housing which surrounds the fan and which may also direct the flow of air.

3.9 Household Refrigerators

A cabinet or any part of a cabinet which is designed for the refrigerated storage of food at temperatures above 0°C which has a source of refrigeration and which is intended for household use. It may include a compartment for the freezing and storage of ice and/or for storage of food at temperatures below 0°C (32°F).

3.10 Household Freezers

A cabinet which is designed for the extended storage of frozen food at an average temperature of -17.8°C (0°F) or below and with inherent capability for freezing of food, which has a source of refrigeration and which is intended for household use.

3.11 Tie Rods

A device used to prevent over traversing an expansion joint and capable of withstanding full pressure loading.

3.12 Unitary Coolers

Unitary coolers or drinking water coolers with mechanical refrigerating system are self-contained and factory assembled in one structure.

3.13 Unit Heaters

A direct-heating, factory-made, encased assembly including a heating element, fan and motor, and directional outlet.

4. UNITS

This Standard is based on International System of Units (SI), except where otherwise specified.

5. CONFLICTING REQUIREMENTS

In case of conflict between documents relating to the inquiry or purchase order the following priority of documents shall apply:

First Priority: Purchase order (including attachments) and variations thereon.
Second Priority: Data-requisition sheets and drawings referred to.
Third Priority: This Standard specification.

All conflicting requirements shall be referred to the company in writing. The company will issue confirmation documents if needed for clarification.

PART 1
DRINKING WATER COOLERS

6. DRINKING WATER COOLERS

6.1 General

This Standard covers the specifications requirements of drinking water coolers as required per job demand. The certification by manufacturers of drinking water cooler covered under ARI standard shall also be applied to this Standard, complying to ANSI/ARI 1010-84 and shall include the following requirements:

a) That the units will operate continuously without damage for four hours under the adverse maximum operating conditions as indicated in Standard ARI rating table.

b) That no condensed water will drip or run from the water cooler under the conditions specified for the Insula--tion Efficiency Test.

c) That the units will operate satisfactorily as specified for the High and Low Voltage Tests.

Note:

This Standard does not apply to individual refrigerating system assemblies such as compressors, condensing units or condensers for separate use.

6.2 Classification

6.2.1 The self-contained drinking water cooler is classified into following types:

a) Bottle water cooler

Employs a bottle or reservoir for storing the quantity of water to be cooled and a faucet or similar means for filling glasses or cups or other containers. It also includes a waste water receptacle.

b) Pressure type water cooler

Supplied with potable water under pressure including a waste water receptacle or means for disposing water to a plumbing drainage system. These coolers can be provided with the following dispensing means:

- Bubler type (without utilizing glasses or cups)
- Faucet type (utilizing a faucet or other suitable means for filling glasses cups or other containers).

c) Compartment type water cooler

Which also include a refrigerated compartment with or without provisions for making ice.

d) Hot and cold type water cooler

Which also include means for heating and dispensing potable water for making instant hot beverages and soups.

e) Remote type water cooler

Function of cooling potable water employed for delivery to remotely installed dispensing means.

6.2.2 Based on performance requirements of ARI standard the following symbols shall be considered for type (style) of installations:

F	Free Standing
FW	Flush-to-Wall
W	Wall Hung
WS	Wall Hung-semi recessed
R	Remote
RE	Recessed

6.3 Design Criteria

Each unit shall be capable of meeting the following design criteria.

6.3.1 Operating conditions

In tropical climate of humid and dusty conditions for maximum dry bulb 50°C (120°F), wet bulb 27°C (80°F) and radiation temperature of 82°C (180°F).

6.3.2 Capacity limitation

The capacity limitation of the water cooler shall preferably be rated in the following three classifications:

- Low capacity within, 4 to 40 liters/hr
- Medium capacity within, 40 to 80 liters/hr
- High capacity within, 80 to 120 liters/hr.

6.4 Central Systems

6.4.1 General

The central circulating drinking water systems can be used for big buildings such as multi-story office building, hospitals etc., commonly consisting of central water chiller, distribution pipings and individual drinking fountains.

Note:

The material specification for the central system is not included in this Standard.

6.5 Unitary Coolers (Self-Contained)

6.5.1 General

6.5.1.1 These units shall be factory assembled free-standing in one structure, suitable for various type of institutional and industrial application.

6.5.1.2 The enclosure shall cover risk of internal parts and equipment damage as specified by National Electric Code, NFPA-70 and bonding for grounding parts in accordance with UL 399. The rating condition standard shall be in accordance to ANSI/ARI 1010-84 and method of testing shall conform to ANSI/UL 399-86.

6.5.1.3 The self-contained refrigeration system shall be electrically operated by hermetic compressor up to 80 L/hr and semi-hermetic motor for up to 120 liter per hour cooling capacity. The electrical characteristics shall be as mentioned in the data sheet. The method of testing shall conform to ASHRAE 18-86.

6.5.2 Component specification

The self-contained unitary cooler units shall include minimum requirements of the following components:

1) Cabinet constructed of 1.3 mm (18 gage) corrosion proof, finish in enamel or stainless steel.

2) Sink top heavy gage 1.22 mm (18 gage) stainless steel, fitted with suitable outlet arrangement, in one piece stamping.

3) Tank heavy gage 1.22 mm (18 gage) stainless steel, pressure shall be tested to 10 bar (150 psi) with high density fibreglass or polyurethane external insulation 25 mm (1 in) thickness and galvanized sheet jacket as vapor barrier.

4) Evaporator, seamless copper suitable for refrigeration quality with electric tinned externally. The evaporator unit shall be inclusive of expansion valve, thermostat range (4°C to 21°C) and freeze control, as required.

5) Hermetic motor compressor operating preferably with R12 refrigerant gas, suitable for small and medium size. The large size unit shall be with hermetic or semi-hermetic motor compressor operating preferably with R22 refrigerant gas.

6) Dispensing arrangement shall be fitted with hygienic guard complete with relevant automatic flow control, made of good quality cast brass chromium plated material or approved equal. The type of dispensing (outlet) arrangements shall be bubbler type or faucet type as mentioned in the data sheet.

Note:

The style of installation of these water coolers shall depend on job requirements and design engineer's discretion, either of which shall be conveyed to the manufacturer.

PART 2
ICE CUBE MAKING MACHINES

7. ICE CUBE MAKING MACHINE

7.1 General

7.1.1 The automatic ice cube making machine (batch type) shall be suitable for commercial and institutional purposes inclusive of the following major items:

1) Water circuit
2) Ice removal assembly
3) Ice storage bins
4) Refrigeration circuit
5) Electrical devices.

7.1.2 The unit may not necessarily be shipped in one package. It may be either self contained (ice-making mechanisms and storage compartment in an integral compartment) or it may be split system ice maker (ice making mechanism and condenser or condensing units in separate sections).

7.1.3 The certification by manufacturers as covered under ARI standard is also applied to this Standard. The automatic commercial ice maker shall comply to ARI 810-91 and Ice storage bins shall comply to ARI 820-88 standards.

7.1.4 The water flow through the unit during the freezing process shall be free of air bubbles, sparkles etc.

7.1.5 The ice cube size shall preferably not exceed 40 mm and recommended meet to within following requirements.

ICE TYPE	SHAPE	WEIGHT (APPROX.)	
Super cubers	Round	Large Medium Small	30 grams 20 grams 8 grams
Cubers	Square	Standard Half-Dice	13 grams 7 grams
Contour	Flat	Standard	7 grams
Nuggets	Flak (compacted)	Standard	1 grams

Note:

Flake, fragmented, scale and crushed ice are not covered in this Standard.

7.2 Design Limitations

The approved units shall conform to ANSI/AHAM Standard HRF-1-1986 and designed to following parameters:

a) The unit shall be suitable to operate for the following maximum outside operating conditions:

1) Dry-bulb temperature up to 45°C (113°F)
2) Wet-bulb temperature up to 29°C (85°F)
3) Sunrate temperature up to 82°C (180°F).

b) The capacity range of the ice maker shall be available from minimum 10 kg (22 lbs) to maximum 1950 kg (4290 lbs) of cube ice per 24 hours.

7.3 Standard Rating Conditions

Based on ARI standard 810-91, the conditions of testing for standard ratings shall be considered as follows:

- Ambient temperature: 32.2°C (90°F)
- Water inlet temperature: 21.1°C (70°F)
- Water inlet pressure: 207±21 kPa (30±3 psig)

7.4 Construction and Materials

7.4.1 The water pan shall be able to hold large quantity of water in stainless steel bins to insure sufficient water available at the beginning of each freeze cycle.

7.4.2 The internal parts shall be easily removable for servicing. "Wet" parts shall be either stainless steel or bronze for maximum rust corrosive resistance.

7.4.3 The outer shell shall be stainless steel or heavy gauge galvanized with rust resistant coating on outside and inside insulated with high density fibreglass or foamed urethane insulation.

7.4.4 The units shall conform to ASHRAE 29-78 and be factory wired, piped and tested, and mounted on metal skids.

7.5 Harvesting

The ice cube machines shall be in batch-process units using hot gas for melting the bond between ice and evaporator coil. The harvesting shall be through automatic operation functional by a pre-set timing device.

7.6 Storage Bin

The storage bin shall be able to store up to minimum 50% of the daily production of sanitary type of solid hygienic and long lasting ice.

7.7 Refrigeration Unit

7.7.1 The refrigeration unit shall be self-contained either air cooled or water cooled suitable for either R22 or R12 Ozone Depletion Potential free refrigerant gas. All compressor motors shall be tropicalized for up to maximum ambient temperature of 46°C (113°F). The compressors shall be open or semi-open type, suitable for direct drive as mentioned in the data sheet.

7.7.2 The hot gas process shall be provided with automatic hot gas defrost or electric defrost arrangement as indicated in the data sheet.

PART 3
REFRIGERATORS AND FREEZERS

8. REFRIGERATORS AND FREEZERS

8.1 Classification

The classification shall apply to following configurations of contemporary packaged refrigerators and freezers:

1) Refrigerators and combination refrigerators and freezers

a) Single door refrigerator
b) Side-by side combination
c) Top-mount combination
d) Under counter refrigerator
e) Compact refrigerator.

2) Freezers

a) Upright freezer
b) Chest freezer (deep freezer).

8.2 Design Criteria

Unless otherwise provided or the operation facilities necessitates, the following design criteria shall comply:

a) The refrigerators and freezers shall be suitable for indoor installation against side wall or in line-up providing adequate (per manufacturer's recommendation) air clearance space on side, top and back of each unit.

b) The under the counter unit shall be suitable for exposed or recessed mount.

c) All units shall be fully charged with ODP-free blended refrigerants conforming to ANSI/ASHRAE 34-1992.

d) The electric cord shall be with 3-wire 3-pin plug for phase; neutral and earthing connections to current rating of 220 V single phase -50 Hz AC supply.

e) For dissipation of heat, refrigerators up to 424 liters (15 cuft) shall be equipped with naturally (air) cooled condenser and those larger shall be with AHAM-approved mechanically (fan) cooled condenser.

f) For circulation of cold energy, the freezer compartment of top-mount combination refrigerators 424 liters (15 cuft) and larger shall be equipped with AHAM-approved evaporator fan.

g) Refrigerators 225 liters (9 cuft) and larger shall be provided with one or two full width equally sized crispers (drawers) in the bottom storage compartment.

h) Under the counter compact refrigerators shall be single door with manual defrost and capacity limited to size 170 liters (6 cuft).

i) The overall unit capacity shall be in the range of 142 liters to 708 liters or 0.14 m^3 to 0.708 m^3 (5 cuft to 25 cuft) and the cabinet shall be non-sectional type with vapor-compression refrigerating machinery compartment located under the storage area for accommodating the compressor or the condensing unit.

8.3 Standard Specification

8.3.1 General

8.3.1.1 The Standard appliance shall be electrically powered suitable for operation under arduous and humid conditions from minimum ambient of 23.9°C (75°F) to maximum 43°C (110°F) dry bulb temperature and wet bulb temperature of 27°C (80°F).

8.3.1.2 The relevant unit shall be capable to maintain storage (cabinet) temperature between 0°C and 4°C (32°F and 39°F) for preservation of fresh food.

8.3.1.3 The sealed refrigerating system shall include a compressor with maximum copper winding and heavy iron core, evaporator, condenser, drier strainer, capillary tube and connecting tubing.

8.3.1.4 The compressor unit shall be capable to withstand to operate without hindrance on voltage fluctuations of ±10% on standard rating. Should the voltage rating be other than specified, for safety purposes, a transformer shall preferably be built into the equipment (and not supplied as a separate item).

8.3.2 Cabinet

8.3.2.1 The cabinet shall preferably be lined with Acrylonitril-Butadiene-Styrene (ABS) polymer liner and shall be fully vapor sealed designed for specific requirements of its refrigerating system.

8.3.2.2 The cabinet material shall be single fabricated steel structure and its inner and outer walls insulated with high density insulation material.

8.3.2.3 The outer shell shall be coated with synthetic enamel or baked enamel and the finish coating shall be as mentioned in the data sheet.

8.3.2.4 The shelves shall be adjustable and moveable, with material and type as mentioned in the data sheet.

8.3.2.5 The interior lighting on each door shall be with automatic micro-switch activated by the opening of the unit door.

8.3.2.6 On single-door models the frozen food storage shall be top mount, that is the freezing compartment located on the top of the general food storage compartment.

8.3.2.7 On side-by-side models the frozen food compartment shall be provided with separate exterior door, that is a two-door cabinet with separate inner liners fully housed in a single outer shell.

8.3.2.8 The cabinet of chest freezers and upright freezers shall be provided with a suitable lock and key and an exterior indicator light to indicate operation and alarm status.

8.3.2.9 Gaskets shall be heavy-duty one piece vinyl with magnetic insert, vulcanized corners, thermal barrier channel without use of screws or clips.

8.3.2.10 The breaker strip shall preferably be non-conductive, smooth extruded vinyl snap-in type, without use of exposed screws.

8.3.3 Doors

8.3.3.1 Latching of doors shall be accomplished by mechanical or magnetic latches that compress relatively soft compression gaskets for positive seals.

8.3.3.2 Gaskets shall be similar to clause 8.3.2.9. and made of either extruded rubber, vinyl compounds or with magnetic materials embedded.

8.3.3.3 The insulation shall be fiberglass or foamed-in-place polyurethane material bonded to door covering as one rigid section.

8.3.3.4 The door openings shall be right hand swing, fully accessible to 90 degrees within cabinet dimensions and provided with door stops at 150° (to prevent hitting nearby items).

8.3.3.5 The inner door area shall preferably have space for dairy and other items with deep door shelves.

8.3.3.6 Doors and its hardvares shall be durable to withstand the open and shut frequency for over 300000 times during its lifetime.

8.3.4 Hardwares

8.3.4.1 The handle shall be contour edge mounted, made of extruded aluminum with modern and decorative insert as mentioned in the data sheet.

8.3.4.2 The hinges shall be chrome plated cam lift with automatic door closer and stay open position.

8.3.5 Refrigerating system

8.3.5.1 Air cooled condensing unit with bottom vented hermetically sealed high torque permanently lubricated compressor shall be self-contained and thermostatically controlled.

8.3.5.2 Unless otherwise mentioned, the evaporator shall be plate type, incorporating an approximately 13 mm (½") OD copper tube coil on stainless plates fitted behind the centre mullion and (suitable for ice making) capable to produce a minimum of four ice trays of ice cubes per 12 hours. (Manufacturer's alternate design shall be given due consideration subject to the company's approval.)

8.3.6 Defrosting

8.3.6.1 The refrigerator shall be equipped with defrosting which can be accomplished either by manually turning off the switch or by manually initiating a forced heat defrost cycle as indicated in the data sheet.

8.3.6.2 The overall defrost shall be based on manufacturer's standard design, including where required defrost drain pan. The frost-free units shall be equipped with electric strip heaters per ASHRAE requirements.

8.4 Material Selection

Special advantages of the comparable units, for which preference shall be given (when specified) during selection of units, are considered as follows:

a) Humidity controls (to maximize storage life of fresh fruits and vegetable).

b) Extra-cold compartments, keeping temperature above freezing (to maximize storage of meat and fish).

c) Deep dairy compartments (to keep large cheese and tubs of butter away from odor).

d) Door cuddlier (to keep jars and bottles from sliding).

e) Adjustable front wheels with leveling system.

f) Door lock with pop-out (self-ejecting) key for freezers.

g) Adjustable full width cabinet and door shelves moving up or down for easy storage.

h) Minimum insulation thickness for upright and chest freezer with 2½" urethane or fibreglass or combination of both. The foam insulation shall be chemically engineered to contain half the CFCs (weight per volume).

i) Complying with following ASHRAE requirements:

- The total heat load in the cabinet shall be equal to or less than 6% for fan motor and 4% for defrost heater.
- Materials and manufacturing method for the cabinet.

j) Epoxy-coated adjustable slide-out or cantilevered white wire shelves or tempered glass shelves, free of tarnish or chip.

k) Counterbalanced and self aligning lid of the chest freezers.

l) Temperature control panel, to adjust two independent settings, one each for the refrigerator and freezer compartment both with safety automatic control arrangements.

m) Coil (condenser) free back.

n) Reversible textured steel doors.

o) Recessed or decorative door handle and similar color to toe grille.

p) Glass-lidded vegetable food compartment.

q) Dispenser for producing either chilled water or cubed/crushed ice.

8.5 Ratings and Safety Requirements

8.5.1 The method of computing storage volume and shelf area shall comply with ANSI/AHAM Standard HRF-1-1986.

8.5.2 To protect the unit from electrical shocks, fire dangers, and hazards under normal and abnormal conditions, all refrigerators and freezers shall comply with Underwriter's Laboratory Standard UL-250.

8.5.3 Cabinet material and manufacturing method shall comply beyond the version required by ASHRAE.

8.5.4 Safety codes for Mechanical Refrigeration ANSI/ASHRAE 15-1992 and Number Designation and Safety Classification of Refrigerants ANSI/ASHRAE 34-1992 shall be referenced and applied wherever deemed essential.

Note:

Safety provisions as addressed by relevant codes of OSHA, NFPA, ISO, ARI and Authoritative international bodies shall be acceptable and applied to this Standard.

PART 4
STEAM SPECIALTY ITEMS

9. STEAM SPECIALTY ITEMS

9.1 Steam Traps

9.1.1 The steam traps shall meet the conditions of ISO 6552 (where applicable) and designed and constructed for use with saturated steam, and capable to withstand water hammer. The end connections of steam traps shall conform and be suitable to the piping specifications. (Unless otherwise mentioned all traps are arranged for horizontal positions.)

9.1.2 The net ratings shall be in accordance with recommended standards established by the Steam Heating Equipment Manufacturers Association (SHEMA) or authoritative international bodies.

9.1.3 The end connections shall be available in BSP, NPT, DIN and ANSI standards as addressed in the specification.

9.2 Types of Steam Traps

The following types of steam traps (excluding liquid expansion) are represented in this Standard:

1) Thermostatic

a) Balanced pressure;
b) fixed temperature liquid expansion;
c) bimetalic types.

2) Thermodynamic

Generally used on applications up to 42 bars (600 psi) pressure.

3) Mechanical

a) Ball float and thermostatic;
b) inverted bucket or open top bucket.

Note:

Since the liquid expansion steam traps are not used in the HVAC industry, hence its material description is not covered in this Standard.

9.2.1 Balanced pressure steam traps

9.2.1.1 Design parameters

The pressure and temperature range of the steam traps shall be as listed below:

a) The maximum pressure shall be maintained at any ranges from 7 bar (101 psi) to 30 bar (435 psi).

b) The maximum design conditions for the body shall be 25 bar (362 psi) and maximum allowable temperature 285°C (545°F).

9.2.1.2 Sizes and connections

Sizes shall be available from ¼" to 1½" in screwed, socket weld or flanged connections (the size and connections shall be suitable to the operating condition and piping specification) arranged for straight and/or angle positions.

9.2.1.3 Material specification

a) The body shall be in brass, bronze steel or stainless steel depending on the working pressure, temperature and corrosive operating condition as mentioned in the data sheet.

b) The capsule (thermal element) shall be stainless steel supplied with various standard commodity to operate on either 6°C (11°F), 10°C (18°F), 13°C (25°F), 20°C (36°F) or 24°C (43°F) below steam temperature. The capsules shall be suitable for various operating condition and condensate velocity.

c) The integral strainer shall be of stainless steel material with 1.2 mm (3/64") screen according to BS. 1449-304 S16, or a 'Y' type shape in the body construction in accordance with the manufacturer's standard design. The strainer gasket shall preferably be in stainless steel.

9.2.2 Bimetalic steam traps

9.2.2.1 Design parameters

The pressure and temperature range of the steam traps shall be as listed below:

a) The maximum pressure shall be maintained at any ranges from zero to 42 bar (650 psi).

b) Maximum operating temperature shall be up to 350°C (662°F) and for 4560 kPa (45 bar) pressure up to 450°C (842°F).

9.2.2.2 Sizes and connections

Sizes up to ½" shall be screwed and from ¾" to 1½" shall be screwed, socket weld, butt weld or flanged connections (the size and connections shall be suitable to the operating condition and piping specification).

9.2.2.3 Material specification

a) The body and cover shall be in steel and the internal components in stainless steel suitable to the working pressure and operating condition as indicated in the data sheet.

b) The thermostatic element shall be of corrosion resistant or stainless steel material.

c) For description of strainer type and material, Clause 9.2.1.3 shall apply.

9.2.3 Thermodynamic (or thermodisc) steam traps

9.2.3.1 Design parameters

The pressure and temperature range of the steam traps shall be as listed below:

a) The maximum pressure shall be capable to withstand up to 42 bar (600 psi).
b) The maximum operating temperature shall be capable to withstand up to 425°C (800°F).

9.2.3.2 Sizes and connections

Sizes shall be available in ½" to 1" screwed, socket weld, butt weld or flanged connections.

9.2.3.2 Material specification

a) The body, disc and cap shall be stainless steel material suitable to the working pressure and operating conditions.

b) The seat shall be stainless steel or chromium steel subject to operating condition mentioned in the data sheet.

c) The strainer cap can be fitted with a blowdown cock valve and integrated with 'Y' type strainer with ½ mm (3/64") mesh screen in stainless steel BS 1449-304 S16 or approved equal.

9.2.4 Ball float and thermostatic steam traps

9.2.4.1 Design parameters

The pressure and temperature range of the steam traps shall be as listed below:

a) The maximum pressure shall be maintained at any ranges from zero to 32 bar (465 psi):
b) The operating temperature shall be from 150°C (300°F) to 400°C (752°F) in coordination with relevant operating pressure and type of unit.

9.2.4.2 Sizes and connections

Sizes shall be available from ½" to 2" in screwed, socket weld or flanged connections. (The size and connections shall be on suitable to the operating condition and piping specification). For double ball float type steam trap and high capacity traps a 4" size with flanged ends shall be used.

9.2.4.3 Material specification

a) The body shall be in gray iron cast iron, cast steel or stainless steel depending on the working pressure and operating condition.

b) The float ball and lever shall be in stainless steel material according to the BS 1449-304 S16. The main valve and air vent assembly shall also be in stainless steel.

c) The trap shall be available with thermostatic air vent or with steam lock release or both as desired per job requirements.

9.2.5 Inverted bucket steam traps

9.2.5.1 Design parameters

The pressure and temperature range of the steam traps shall be as listed below:

a) The maximum pressure shall be maintained at any ranges from zero to 60 bar (1000 psi).
b) The operating temperature shall be from 210°C (410°F) to 454°C (849°F) in coordination with the relevant operating pressure and type of unit.

9.2.5.2 Sizes and connections

Sizes shall be available from ½" to 2" screwed, socket weld or flanged connections. The size and connections shall be suitable to the operating condition, piping specification and type of unit.

9.2.5.3 Material specification

a) The body and cover shall be available in cast iron, forged steel, cast steel or ductile iron suitable to the working pressure and operating conditions.

b) The bucket, valve, valve guide plate, valve seat and valve lever shall be in stainless steel material.

c) For description of strainer type and material, Clause 9.2.1.3 shall apply. The strainer cap can be in cast iron or steel.

9.3 Control Valves (Temperature Regulators)

9.3.1 General

The control valves shall be normally open (direct acting) or in normally closed position (reverse acting) with single or double seat, in stainless steel trim, activated by pressure balancing bellows.

9.3.2 Limiting conditions

9.3.2.1 A minimum differential pressure shall be adapted between operating condition and manufacturer's specifications. The operating design pressure shall be limited up to 20 bar (300 psi).

9.3.2.2 The test pressure in cold condition of the body shall be tested at 38 bar (550 psi), and fluid temperature at 232°C (450°F) when fitted directly to the control system.

9.3.3 Sizes and connections

Sizes shall be available from ½" to 2" in screwed or flanged types suitable for operating capacity pressure conditions.

9.3.4 Material specification

The materials specification shall include, but not limited to, the following parts:

a) The valve body and bonnet material shall be gunmetal, cast iron or steel according to the BS 1400 LG2, DIN 1691 GG20 and DIN 17245 GSC 25 respectively.

b) The valve closure member, valve seating and return spring shall be stainless steel complying to BS 970-431 S29 Standard.

c) The bellows shall be preferably in phosphor bronze material.

9.3.5 Auxiliary options

Based on job requirements, the valve manufacturers shall have the following options available:

a) Electrical actuators
b) Electronic controllers
c) Temperature sensors
d) Pneumatic actuators
e) Pilot positioners
f) Self-contained controls.

9.4 Temperature Control Systems (Self Acting)

9.4.1 General

9.4.1.1 It shall be suitable for air and/or fluid sensor, used with two or three port valves and immersion or wall mounting types, adjustment at sensor. The sensors for immersion shall be provided with union or pocket, for walls with wall brackets and for air ducts with duct fixing adaptors.

9.4.1.2 The temperature ranges shall be from -20°C (0°F) to 190°C (374°F) set to individual manufacturer's operating range suitable for adjustment on each type of operation conditions. The maximum differential pressure for relevant control valves shall not exceed manufacturer's design condition.

9.4.2 Size and connections

Sizes shall be available for relevant valve two port or three port sizes from ½" to 4" in screwed or flanged connections.

9.4.3 Capillary tubes

The capillary tube shall be PVC covered copper in lengths of 2 M, suitable for extension up to 20 meters (as desired per job requirements).

9.4.4 Material specification

9.4.4.1 The materials for outside air, on-off duct air, fluid immersion sensor, and actuator shall be in brass, the capillary tube in copper with PVC covered. The integrated pocket for immersion sensor shall be in mild steel, copper, brass or stainless steel material in lengths from 0.5 m (20") to 1 meter (36 inches).

9.4.4.2 The temperature control ancillaries shall contain twin sensor, spacer and manual actuators specified as follows:

a) Twin sensor adaptor body in brass material, shall be coupled to a 2-Port or 3-Port valve allowing the valve to be operated by either actuators.

b) Spacer case shall be in brass material, and belows in stainless steel, suitable to be coupled between 2-Port or 3-Port valves and the actuator to enable the system to operate at higher temperatures 350°C (662°F).

c) Manual actuator shall be in brass material with plastic adjustment head, and coupled to a 2-Port or 3-Port valve to enable the valve for manual operation. A lockable head shall be provided to prevent unauthorized tampering with the setting.

PART 5
HEATING TERMINAL UNITS

10. HEATING TERMINAL UNITS

10.1 General

10.1.1 For ease of identification the various hot water or steam type terminal units are classified as follows:

a) Radiators (steel, cast Iron, or aluminum types)
b) Convectors
c) Heating ventilation unit
d) Unit heaters, which are further divided into:

1) Hot water or steam unit heater
2) Direct fired unit heaters which are further subdivided into:

i) Gas fired unit heaters
ii) Electrical unit heaters
iii) Oil fired unit heaters

e) Gas-fired duct furnaces
f) Heating coils (steam and hot water)
g) Electric duct heaters.

10.1.2 All ceiling suspended units shall be provided with adequate hanger rod arrangements.

10.1.3 Where units are to be packaged, it shall be factory engineered and assembled, including power and control wiring, piping and temperature controls.

10.1.4 All units shall be adequately supplied with drain and air vent connections.

10.1.5 Unless otherwise mentioned, proper weatherproofing of all outdoor units shall be to the responsibility of the manufacturer.

10.1.6 Unless otherwise mentioned, the manufacturers shall provide adequate freeze-protection controls and arrangements.

10.2 Design Criteria

10.2.1 For limitation on hot water and low pressure steam system the following operating range shall be considered.

1) For hot water system where:

a) Low temperature shall be below 121°C (250°F).
b) Medium temperature shall be between 121°C (250°F) to 177°C (350°F).
c) High temperature shall be between 177°C (350°F) to 232°C (450°F).
d) The overall maximum operating pressure range shall be between minimum 414 kPa (60 psi) and 1103 kPa (160 psi).

2) For steam system where:

a) The minimum low pressure and temperature range shall be between 6.9 kPa (1 psi) to 34 kPa (5 psi) and 121°C (250°F) to 232°C (450°F).

b) The medium pressure and temperature range shall be between 34 kPa (5 psi) to 103 kPa (15 psi) and 177°C (350°F) to 232°C (450°F).

c) The maximum high pressure and temperature range shall be between 103 kPa (15 psi) to 517 kPa (75 psi) and 232°C (450°F) to 326°C (650°F).

10.2.2 Where areas are used with personnel occupancy of eight hours per day, the sound pressure shall be maintained at 'A' scale (below 90 db).

10.3 Radiators

10.3.1 General description

10.3.1.1 Radiators shall be used with hot water or steam to deliver heat to the room space by convection. It shall be supplied preferably from upper right hand side and drained from lower left hand side. Every standard radiator shall be equipped with radiator manual valve, key operated air vent, radiator plugs with capped connections including radiator supports and anchors (each unit shall be applied with factory prime coat of heat resistant paint, and finish coat shall be applied at site after installation is completed).

10.3.1.2 The radiators shall be guaranteed against leakage and breakage durable for over 20 years of operation. It shall be fabricated without sharp edges and projections shall be without any irregularities and warps on their body dies.

10.3.1.3 Radiator valve sizes shall be full bore designed to have minimum resistance to flow, suitable for pumped and gravity system. The valve shall be capable to operate and regulate efficiently and shall be water-tight to ensure positive isolation.

10.3.1.4 The extent of radiator supply for hot water covering valves and union shall comform to BS 2767, 1972.

10.3.2 Steel radiators

It shall be fabricated from cold rolled heat treated steel of 1.25 mm thickness and 15 cm wide tested for rated pressure up to 10 atmosphere, capable of handling hot water up to 773 kPa (7.5 atmospheric pressure) and water temperature of 82°C (180°F).

10.3.3 Cast iron radiators

It shall be either column type or plate type (column type preferred) and constructed of high grade cast iron with long durable surfaces, smooth with round edges, compact plain lines and suitable for hot water up to 8 atmospheric pressure (117.6 psi) and temperature up to 82°C (180°F).

10.3.4 Aluminum radiators

It shall be manufactured from corrosive resistant aluminum alloys with high thermal conductivity, high heat surface and high output. The aluminum radiator's thermal output test shall be in accordance with ISO 3147.

Note:

Adequate protective coating on above radiators shall be provided to withstand shipment and possible storage period at building site.

10.4 Convectors

10.4.1 It shall be constructed of steel finned tube or small cast iron heating element enclosed by metal cabinet in various depths, sizes and lengths suitable for safe location under windows, for recessed or wall hung installation.

10.4.2 The cabinet shall be able to fit the unit firmly with provisions for minimum by-pass through the heating element.

10.4.3 For hot water or steam services the testing and rating procedure shall comform to authoritative international standard.

10.5 Heating Ventilating Units

10.5.1 It shall be available in draw-through or blow through configuration complete with galvanized casing, floor or ceiling mounted single zone unit. It shall comprise of centrifugal fan, hot water or steam coil with seperate coil removable section, drain pan, fan section, mixing box and permanent filter section complete with inlet parallel damper fully accessible for ease of service and inspection. Units shall be suitable for indoor application, truss mount, floor mount or wall-mounted. (Special weatherproofing arrangements shall be made by the manufacturer for outdoor applications.)

10.5.2 An adequately designed forced draft fan and environmental control system shall be furnished for provision of contaminant free heated air introduced into space.

10.5.3 Subject to job requirement the units shall be available for addition of sections to accommodate humidifiers and other accessories as specified in the data sheet.

10.6 Hot Water or Steam Unit Heaters

The unit heater shall be ceiling suspended factory fabricated and include, but not limited to, the following:

a) Heavy gage sheet steel zinc-coated inside and out painted with one coat of high grade primer, complete with vertical or horizontal adjustable louver and fin tube coil for downblow or horizontal blow applications.

b) The propeller or cabinet type fan with fan guard and electrical motor of suitable horse power rating at 1.15 service factor shall be suitable for hot water up to 163°C (325°F), 1550 kPa (225 psi), and steam from 414 kPa (60 psi) to 517 kPa (75 psi). (The safety electric protection shall be in accordance with NEC Standard.)

c) The heating capacity (with propeller or cabinet type forced draft fan) shall be limited to 70000 kcal/hr output.

d) Manufacturer's instructions shall be followed as a guideline for arrangements, mounting height, heat coverage, final temperature, and connection outlets.

10.7 Direct Fired Unit Heaters

10.7.1 Gas fired unit heaters

It shall be AGA rated, factory assembled, round or rectangular type, ceiling suspended combination of natural gas-fired burner with blower fan and stainless steel heat exchanger suitable for high heating capacity, capable to operate either with propeller or cabinet type fan (blower) representing, but not limited to, the following components.

a) The burner material shall be aluminized steel (stainless steel) with non-clogging, slotted ports designed for good lighting characteristics without noise of extinction.

b) The casing shall be heavy gage steel with rounded corners and baked enamel coat, with vertical or horizontal adjustable louvre. The casing shall also include a hinged bottom panel for easy access to the burner compartment.

c) The propeller or centrifugal blower model fan and motor shall be for low dB noise level to minimize vibration and noise; suitable for maximum throw of 20 m (65 ft). The blowers shall be statically and dynamically balanced. The propeller shall be statically balanced equipped with a 360 degrees safety fan guard.

d) Primary heat exchanger tubes shall be direct-fired in aluminized steel (stainless steel as option) machine-welded and stress free to provide optimum efficiency. The secondary heat exchanger plate shall be preferably made of type 409 stainless steel.

e) Gas control valve for automatic operation of pilot ignition with or without lockout, established only on call for heat and turned off after thermostat is satisfied as mentioned in the data sheet. All safety control shall be designed for operation with natural or propane gas in accordance with UL-372.

f) The unit shall have a factory mounted and wired integral power exhauster directly connected to the unit collector box assembly. It shall also include safety pressure switch designed to prevent pilot and main burner ignition until positive venting has been proved.

g) The unit shall be provided with a factory designed blower enclosure and filter rack assembly, and meet existing OSHA sound requirements.

10.7.2 Electrical unit heaters

10.7.2.1 The unit shall comply with UL standard designed for classified hazardous or rugged industrial location and applicable under UL temperature code of 260°C (500°F) for Class I and for 165°C (329°F) for Class II indicating maximum operating surface temperature.

10.7.2.2 It shall be completely factory assembled for horizontal or vertical air delivery, suitable for commercial and industrial applications, and comprising of following major features:

a) Constructed of minimum 2 mm (14 gage) steel cabinet with adjustable louvers (air deflectors) allowing directional control of air and safety fan guard to shield moving parts.

b) Copper conductor enclosed in steel conduit to carry all the electrical power.

c) AMCA-rated propeller type fan of suitable capacity driven by high performance TEFC electric motor with thermal overhead protection.

d) Stainless steel pressure relief-valve (to prevent over-pressure or excessive ambient temperature).

e) Automatic reset capillary type high limit temperature regulator.

f) Heating coil elements for open or close system. The closed system shall be able to use ethylene glycol to water mixture as the heat transfer fluid in the heater core, providing -45°C (-49°F) freeze damage protection.

10.7.2.3 The following performance limitations are recommended:

a) Heating capacity range from 2500 kcal/hr to 50000 kcal/hr.
b) Maximum mounting height location up to 3 m (10 ft).
c) Heat throw shall be anywhere between 7.5 m (24 ft) and 12 m (40 ft).
d) Air temperature rise shall be not more than 22°C (40°F).
e) Electrical power shall be direct single phase or three phase in pure 50 Hz without requiring any deration multiplier.

Note:

Air flow must not be interrupted or decreased at any point of the element when coils are energized.

10.7.3 Oil fired unit heaters

10.7.3.1 It shall be direct-fired units, able to provide air on horizontal delivery for optimum heating efficiency. The unit in draw-formed steel casing shall be inclusive of centrifugal fan, heat exchanger, resilient ceramic fibre fire pot, pressure atomized gun-type burner equipped with a stainless steel flame retention head and housed inside a heavy gage metal cabinet.

10.7.3.2 The unit capacity limitation shall preferably be between 25000 kcal/hr to 50000 kcal/hr, with minimum temperature rise of 35°C with about 15 m (50 ft) heat throw and located at maximum height of 3.5 m (12 ft).

10.7.3.3 The unit shall be equipped with safe and automatic operation, including safety shut-off system, electric spark ignition, fan and limit control with OSHA-approved fan guard.

10.7.3.4 The heat exchanger shall be equipped with an inspection port, accessible clean out ports and ample sized service door.

10.8 Gas Fired Duct Furnaces

10.8.1 These shall be AGA ratings free standing unit comprising of combination of natural gas fired burner with blower fan and exchanger as a heat source.

10.8.2 It shall be suitable for central duct-type air conditioning systems (installed down stream from cooling coil), comprising minimum requirements of the following components:

a) Heat exchanger preferably stainless steel, with warranty for 10 years against failure.

b) Gas burner suitable for any gas pilot arrangement.

c) Control system together with interlock between pilot and thermostat shall be two position ranging between 50% and 70% of full capacity operation. Also inclusive shall be the interlock between gas valve and system blower. Intermittent pilot ignition single stage,two-stage or modulating gas controls shall be provided, where applicable.

d) The maximum and minimum output/input performance shall preferably meet the following data:

INPUT	
Minimum	18750 kcal/hr (75000 BTU/hr)
Maximum	100000 kcal/hr (400000 BTU/hr)
OUTPUT	
Minimum	15000 kcal/hr (60000 BTU/hr)
Maximum	75000 kcal/hr (300000 BTU/hr)

Note:

The gas fired duct furnaces can be used as reheat unit for tempering make-up air or for straight heating or in process drying operations.

10.9 Heating Coils (Steam and Hot Water)

10.9.1 It shall preferably be one or two row type for hot water and steam heating services, with serpentined copper tubing with supply and return connections preferably on the same side.

10.9.2 The unit design temperature limit shall be up to 205°C (400°F) for steam coil and 160°C (326°F) for hot water coil.

10.9.3 The common type of coils depending on heating media and capacity, can be any one of the following:

a) A 16 mm (5/8") "U" tube copper bonded with aluminum finned, inlet and outlet connections shall be externally threaded in seamless copper tube material. The heaters shall be constructed of high strength close-grained cast iron corrosion resistance coils.

b) A 25.4 mm (1") seamless carbon steel tube bonded with aluminum finned, inlet and outlet connections, internally threaded in seamless carbon steel material.

10.10 Electric Duct Heaters

10.10.1 It shall be in various step controls, factory assembled units with either of the following frame type configurations as mentioned in the data sheet:

a) Slip-in, suitable for ducts up to 1829 mm wide and 915 mm high (72" wide and 36" high).
b) Flanged type, ducts larger than the above.

10.10.2 The frame and terminal box material shall be from heavy gage corrosion resistant steel suitable for humidity and corrosive environments. The steel plate thickness shall be UL listed with rigid and suitable insulation.

10.10.3 The open coil staggered heating elements shall be high grade nickel chrome alloy resistance (capable to convert 100% electrical energy to heat energy), mechanically staked and heliarc welded to corrosion resistant terminals. Each heater shall meet all requirements of the National Electric Codes (NEC).

10.10.4 Terminal box shall be NEMA 1 construction, designed per UL standard 1096.

10.10.5 Thermal safety devices shall include a disc type automatic reset thermal cutout for primary overtemperature protection and thermal links for secondary thermal protection. All safety devices shall be accessible through the terminal box without removing the heater from the duct.

10.10.6 The built-in control compartment shall not be limited to the following items:

a) Pilot lights, visually indicated.

b) Removable knockout or conduit holes located adjacent to the high voltage and control voltage terminal boards.

c) Durable steatite insulators or ceramic bushings.

d) Where necessary, relevant step-down transformer and pressure switches (to convert pneumatic signal to electric signal).

e) The primary automatic high limit device sensitive to both radiant and convected heat by bimetallic disc type action.

f) Built-in fuses and primary contactors (for switching and step control).

g) Fan interlock relay with equipment grounding lugs.

h) Hinged access door with latch and lock. As an option a door interlock disconnect switch shall be available.

i) Wiring diagram.

PART 6
PIPING PROTECTION DEVICES

11. PIPING PROTECTION DEVICES

11.1 General

The type of pipe protection devices are classified as follows:

1) Flexible pump connectors.
2) Expansion joints, which are further divided into:

a) Single axial (flanged or screwed).
b) Copper ended.
c) Articulated hinged single, hinged double and gimbal type.
d) Rubber type.

3) Expansion compensators.
4) Slip joints.
5) Flexible ball pipe joints.
6) Expansion joints for grooved piping.

11.2 Flexible Pump Connectors

11.2.1 General

11.2.1.1 It shall be available for sizes 50 mm to 610 mm (2" to 24") and installed between mechanical equipment and pressure-line piping designed to compensate for multi-plane axial, lateral, and angular movement absorbing stress, off-setting misalignment, reducing sound and thermal expansion in non-tortional applications.

11.2.1.2 The outer shield of flexible pump connectors shall be available in following three styles:

a) Stainless steel laminated bellows.

b) Corrugated inner tubing (of either tin bronze or 321 stainless steel) with outer shield of wire braid of same alloy.

c) High grade flexible rubber reinforced with neoprene.

11.2.1.3 The flexible braided connectors shall be either in bronze or stainless steel hose and braiding fitted for following ends:

a) For bronze core: it shall be either with tapered male nipples, female copper tube ends, carbon steel stub ends or threaded on flanges.

b) For stainless steel core: (similar to item a) but with carbon steel weld ends (instead of copper ends).

11.2.2 Material specification

11.2.2.1 It shall be EJMA approved (Expansion Joint Manufacturer's Association) constructed of flanged ends with or without carbon steel tie rods, pressed asbestos sealing gasket in corrugated and laminated bellows, elongated bolt holes, 347 or 321 stainless steel bellow material with forged steel flanges, suitable to withstand maximum working pressure of 2068 kPa (3000 psi) and 450°C (842°F) fluid temperature.

11.2.2.2 It shall be designed for a total axial traverse of 16 mm (5/8") that is (½" compression, 1/8" extension), a total lateral movement of 3 mm (1/8") that is (1/16" each side of centerline) and an angular offset of 3½ degrees maximum. The overall length (measured from face to face of flanges) shall be as specified in the data sheet.

11.2.2.3 The wire braided type shall be with single axial bellows, with nominal piping diameter preferably from 15 mm to 150 mm, bellows overbraid material conforming to BS 1449 304 S16 or 321 S31. The end fittings shall be flanged carbon steel, suitable to offset lateral movement and anti-vibration, capable to withstand maximum temperature up to 300°C (572°F) and working pressure up to 1013 kPa (10 bar).

11.3 Expansion Joints

The type and design criteria of expansion joints are considered as follows:

11.3.1 Single axial expansion joint

11.3.1.1 It shall be flanged ends or screwed ends, bellows type suitable for heavy duty application with bellow length anywhere between 32 mm (1¼ in) to 600 mm (24") conforming to BS 1449 and bellows material conforming to 304 Sl6 or 321 S31.

11.3.1.2 The end fittings shall be of carbon steel or stainless steel as specified in the data sheet. The flexible movement shall be from 25 mm (1" in) to 80 mm (3 in). The maximum operating temperature up to 300°C (572°F) and working pressure shall be from 10 bar up to full vacuum as specified in the data sheet.

11.3.2 Expansion joint with copper ends

It shall be bellows type with tubing diameter preferably from 15 mm Nominal Bore (NB) to 50 mm (NB), bellows materials conforming to BS 1449 304 S16 or 321 S31. The end fittings shall be copper, with up to 25 mm movements, and capable to withstand maximum temperature up to 100°C (212°F) and working pressure from 608 kPa (6 bar) up to full vacuum as specified in the data sheet.

11.3.3 Articulated, hinged single, hinged double, and gimbal expansion joints

11.3.3.1 General

These are various types of expansion joints suitable for operating with steam, condensate, oil, compressed air from 1013 kPa (10 bars) to full vacuum as indicated in the data sheet.

11.3.3.2 Material specification

The overall length shall preferably be anywhere from 50 mm to 600 mm conforming to BS 1449 and bellows materials comforming to 304 S16, or 321 S31. The movement shall be from 25.4 mm (1 in) to 150 mm (6 in) for articulated and double hinged types and 5° to 20° for single hinge and gimbal types. It shall be capable to withstand maximum temperature up to 300°C (572°F) and working pressure up to 1013 kPa (10 bar).

11.3.4 Rubber expansion joints

11.3.4.1 It shall be constructed of duck and butyl rubber with fullfaced integral flanges, internally reinfored with steel retaining rings, provided over entire surface of flanges, drilled to match flange bolt holes, and equipped with external control rods. The packless product shall be suitable for system temperatures up to 204°C (400°F).

11.3.4.2 The strength (spherical or global shape), flexibility (precision mold of neoprenes with nylon) and durability shall be addressed by application requirements as mentioned in the data sheet.

Note:

The fabric expansion joints (of ceramic fibre, PTFE, silicon, or rypalon materials) used with fans, exhaust ducts, chimney stack and process system are not covered in this Standard.

11.4 Expansion Compensators

11.4.1 The expansion compensators designed up to 10 cm (4") ID shall be multi-ply of laminated or corrugated two-ply one piece or tandem bellows of type 321 stainless steel suitable to operate at maximum temperature 315.6°C (600°F) and maximum pressure of 2068 kPa (300 psi) with traverse movement (80% compression 20% extension) range between 50-100 mm (2" to 4"). It shall be suitable for both vertical and horizontal installation.

11.4.2 The ends shall be available for any of the following, as mentioned in the data sheet.

a) Female tapered pipe threads.
b) Square brass ends.
c) Copper tube solder sweat ends.
d) Carbon steel weld ends (schedule 40 or 80).
e) Carbon steel plate flange ends (schedule 40 or 80).

11.4.3 The shroud of compensators shall be square or cylindrical either in brass telescopic or carbon steel type slided over a square guide to provide positive protection against torsion, squirm and external damage.

11.4.4 Each unit shall be provided with removable screw (set for the indicated traverse), and with adequate length traveling nipple. The cylindrical housing shall be one-piece with removable retaining clip.

Notes:

1) To assure maximum cycle life, manufacturers shall be advised on provision for adequate anchoring for perfectly aligned and concentracally guided pipe lines.

2) The low pressure compensators shall be used on applications where convectors and fin tube baseboard radiation units are used.

11.4.5 Slip joints

The slip joints shall be provided where indicated for piping system, with materials and pressure/temperature ratings selected to provide 200% absorption capacity of piping expansion between anchors. These shall be designed for repacking under pressure with drip connections for steam piping systems, and ends to mate with piping system.

11.4.6 Flexible ball pipe joints

11.4.6.1 These joints shall be designed for 360 degrees rotation, and with minimum of 30 degrees angular flexing movement for sizes 6.35 to 152.4 mm (¼" to 6") and 15 degrees for sizes 203 to 762 mm (8" to 30"). Each joint shall be provided with suitable composition gaskets.

11.4.6.2 For environmental shock testing, the carbon steel joints shall be in accordance with MIL-S-4456 or MIL-S-90IC.

11.4.6.3 The pressure piping for materials and design of pressure containing parts and bolting shall comply with Section 11 of ASME Boiler and Pressure Vessel Code and ASME B31.

11.4.6.4 Each assembly shall be tested with steam at working pressure of piping system for zero leaks before shipment.

11.4.7 Expansion joints for grooved piping

These shall be used on applications where piping systems are fabricated from cut grooved pipe and couplings: one of the following two methods shall be considered for expansion compensation:

a) Combination couplings and nipples

It shall be designed to suit intended service with provisions for removable ties to hold joint compressed or expanded during piping fabrication, depending on application. The couplings and gaskets shall be selected to match balance of piping system.

b) Slip-type expansion joints

The slip-type expansion joints shall be constructed of carbon steel pipe and couplings, designed to suit intended service. The couplings and gaskets shall be selected to match balance of piping system.

PART 7
MEASURING AND MONITORING DEVICES

12. MEASURING AND MONITORING DEVICES

12.1 General

Each device shall be based on capacities and ranges indicated, designed and constructed for use in service specified. Subject to compliance with requirements, the manufacturers can offer their closest equivalent.

12.2 Types

The following types and extent of meters and gages are specified in this Standard:

1) Temperature Gages and Fittings

a) Glass Thermometers
b) Direct Mount Dial Thermometers
c) Remote Reading Dial Thermometers
d) Dial Type Insertion Thermometers
e) Industrial Thermometers
f) Thermometer Wells
g) Temperature Gage Connector Plugs.

2) Pressure Gages and Fittings

a) Pressure Gages
b) Pressure Gage Cocks
c) Pressure Gage Connector Plugs.

3) Flow Measuring Meters

a) Wafer-Type Flow Meters
b) Calibrated Balance Valves
c) Window Flow Meters
d) BTU Meters.

4) Level Indicating Meters

Note:

The digital temperature indicator designed for high accuracy, continuous indication in-plant use are not covered in this Standard.

12.2.1 Glass thermometers

12.2.1.1 Case

It shall be die cast aluminum finished in baked epoxy enamel, glass front, spring secured approximately 230 mm (9") long. Cases can also be constructed of glass reinforced molded black nylon. The front can also be clear acrylic plastic.

12.2.1.2 Adjustable joint

It shall be die cast aluminum, finished to match case, 180 degrees adjustment in vertical plane, 360 degrees adjustment in horizontal plane, with locking device.

12.2.1.3 Stem

It shall be copper-plated steel or brass, for separable socket, length to suit installation.

12.2.1.4 Tube and capillary

It shall be mercury filled, magnifying lens 1% scale range accuracy, shock mounted.

12.2.1.5 Scale and range

The scale shall be satin faced, non-reflective aluminum with permanently etched marking. The range shall conform to those specified in the data sheet but with 1°C scale divisions (2°F scale divisions).

12.2.2 Direct mount dial thermometer

It shall be vapor tension universal angle type in brass precision geared movement and constructed as follows:

12.2.2.1 Case

The case shall be drawn steel or brass, glass lens, preferably 114 mm (4½") diameter. The case can also be constructed of molded brass, aluminum, or phenolic plastic. The lens can also be clear acrylic plastic.

12.2.2.2 Adjustable joint

It shall be die cast aluminum, 180 degrees adjustment in vertical plane, 360 degree adjustment in horizontal plane, with locking device.

12.2.2.3 Thermal bulb

The thermal bulb shall be copper with phosphor bronze bourdon pressure tube, at one scale division accuracy.

12.2.2.4 Stem

The stem shall be copper plated steel or brass suitable for separable socket, length to (suit installation) be as specified in the data sheet.

12.2.2.5 Scale and range

The scale shall be satin faced, non-reflective aluminum with permanently etched markings. The range shall conform to those specified in the data sheet.

12.2.3 Remote reading dial thermometers

12.2.3.1 It shall be vapor actuated, accuracy to plus or minus one scale division, dial type, flushed or surface mount suitable for remote reading with aluminum alloy black coated pointer. The stem of direct type shall be either fixed or adjustable, the movement shall be brass precision geared.

12.2.3.2 Scale and range

It shall be satin faced, non-reflective aluminum with permanently etched marking, featuring english/metric scale with the English scale in F located on the inner arc and the metric scale in °C on the outer arc. The temperature range shall be as mentioned in the data sheet. The operating accuracy shall be ±10% over first 20% of scale, ±3% over next 30% of scale, ±2% over remaining 50% of scale.

12.2.3.3 Case material

The case shall be drawn steel or brass with glass lens. The case connection location can be in bottom, back or adjustable form. Cases can also be constructed of molded brass, aluminum or phenolic plastic. The lens can also be clear acrylic-plastic. Depending on dial sizes the case material shall preferably be any of the following:

a) For 90 mm (3½") dial chrome plated brass case.
b) For 114 mm (4½") dial cast aluminum case with a black enameled finish.
c) For 50 mm (2") and 64 mm (2½") dial drawn steel case phosphatized for rust resistance.

12.2.3.4 Window and ring

Depending on the dial size it shall be any one of the following:

a) Convex acrylic window secured to the case by a steel ring.
b) Glass crystal or cast hinged style aluminum ring.

12.2.3.5 Capillary

Capillary shall be provided for remote-reading and protected by double-braided copper or bronze armor available in 1½ meter increments lengths from 2 meters to 15 meters (50 ft), as indicated in the data sheet.

12.2.3.6 Sensing bulb

Bulb shall be nickel plated copper alloy with ½" nominal type threaded (NPT), swivel union connection. Also it can be of copper with separable socket for liquids, averaging element of air.

12.2.3.7 Bourdon tube assembly

The bourdon tube shall preferably be of phospher-bronze, soft soldered to a brass socket.

Note:

The remote reading dial thermometer, when required, shall be suitable for installation on control panels with tube run between panel and thermometer bulb, adequately supported to prevent kinks.

12.2.4 Dial type insertion thermometers

It shall be bi-metal with stainless steel case and stem, 25 mm (1") diameter dial dust and leak proof, 3.2 mm (1/8") diameter stem with nominal length of 127 mm (5"). The accuracy shall be 0.5% of dial range. (It shall be suitable for measurement applicable to equipment such as, air heating and cooling duct).

12.2.5 Industrial thermometers

The mercury-in-glass thermometer in rigid (straight form or 90° back angle form)or adjustable angle case styles shall be considered for heavy duty application.

12.2.5.1 Scale

The scale length shall be within 180 mm (7") to 225 mm (9") linear type, preferably black printed on white coated aluminum with both Celsius and corresponding Fahrenheit ranges.

12.2.5.2 Case material

It shall be in cast aluminum with baked black enamel finish and include the following:

a) **Window:** It shall be high clarity glass.
b) **Bulb chamber:** It shall be brass 50 mm (2") insertion length.
c) **Accuracy:** It shall be 1% of scale range.
d) **Separable socket:** May be brass with ¼" internal and ½" external NPT connections.

12.2.6 Thermometer wells

Installed in piping tee in vertical upright position, the thermometer wells shall be constructed of brass or stainless steel, pressure rated to match piping system design pressure. On insulated piping a 50 mm (2") extension shall be made available. A suitable cap unit with chain fastened permanently to thermometer well shall also be furnished. (The well shall be filled with oil or graphite.)

12.2.7 Temperature gage connector plugs

12.2.7.1 Where required on piping tee, a temperature gage connector plug installed at most readable position shall be provided for pressure rated at 3447 kPa (500 psi) and temperature rated at 93°C (200°F).

12.2.7.2 These shall be constructed of brass and finish in nickelplate, equipped with ½" NPT fitting, with self-sealing valve core type neoprene gasketed orifice suitable for inserting a 1/8" OD probe assembly from dial type insertion thermometer. The orifice shall be provided with gasketed screw cap and chain. Necessary extension, length equal to insulation thickness shall be provided for insulated piping.

12.3 Pressure Gages and Fittings

12.3.1 Pressure gages

12.3.1.1 Type

The pressure gage shall be for general use, 1% accuracy to conform to ANSI B40.1 Grade A, phospher bronze bourdon tube with bottom connection.

12.3.1.2 Case

The case shall be drawn steel or brass, glass lens, 114 mm (4½") diameter. The case can also be constructed of molded aluminum and phenolic plastic. The lens can also be clear acrylic plastic.

12.3.1.3 Connector

It shall be brass with 6.35 mm (¼") male NPT. A protective syphon shall be provided for steam service.

12.3.1.4 Scale and range

The scale shall be white coated aluminum with permanently etched markings both in kPa and psi scale. The range shall be as specified in the data sheet, but for water and steam it shall be from minimum zero psi and for vacuum from 30" Hg (408" water column).

Note:

When selecting pressure gages, mid-range shall be considered as operating point.

12.3.2 Pressure gage cocks

12.3.2.1 Cocks

Pressure gage cocks shall be provided between pressure gages and gage tees on piping systems. The gage cock shall be of brass construction with ¼" female NPT on each end, and "T" handle brass plug.

12.3.2.2 Syphon

It shall be ¼" straight coil constructed of brass tubing with ¼" male NPT on each end.

12.3.2.3 Snubber

A 6.35 mm (¼") brass bushing shall be provided with corrosion resistant porous metal disc, through which pressure fluid is filtered. Selection of disc material shall be for fluid served and pressure rating.

12.3.3 Pressure gage connector plugs

The pressure gage connector plugs shall be pressure rated for 3447 kPa (500 psi) and 93°C (200°F). It shall be constructed of brass and finish in nickel-plate, equipped with ½" NPS fitting, with self-sealing valve core type neoprene gasketed orifice suitable for inserting 1/8" OD probe assembly from dial type insertion pressure gage. The orifice shall be equipped with gasketed screw cap and chain. Necessary extension length equal to insulation thickness shall be provided for insulated piping.

12.4 Flow Measuring Meters

12.4.1 Wafer-type flow meters

It shall be cast-iron wafer-type equipped with read-out valves to facilitate connecting of differential pressure meter to flow meter. Each read-out valve shall be equipped with integral *EPT check valve designed to minimize system fluid loss during monitoring process. The calibrated nameplate shall be with flow meter detailing its flow range through range of differential head pressures.

*** Ethylene-Propylene Terpolymer**

12.4.2 Calibrated balance valves

The calibrated balance valves shall be equipped with read-out valves to facilitate connecting of differential pressure meter to balance valves. Each read-out valve shall be provided with integral EPT check valve designed to minimize system fluid loss during monitoring process. The calibrated nameplate shall indicate degree of closure of precision machined orifice. Balancing valve shall be with internal EPT O-ring seals to prevent leakage around rotating element. (The balance valves shall preferably be provided with preformed polyurethane insulation used on heating and cooling systems, for protecting balance valves during shipment.)

12.4.3 Window flow meters

The window flow meters shall be pressure rated for 1034 kPa (150 psig), temperature rated for 116°C (240°F). It shall be constructed of glass calibrated tube with indicator ball, bronze body, bronze impact tube, integral self closing valve. (These are designed to be installed on hydronic piping and measure flow directly with accuracy of plus or minus 5%.)

12.4.4 BTU-meters

The BTU meters shall be pressure rated for 862 kPa (125 psi), consisting of turbine wheel flow meter, bronze housing, solid-state calculator with integral battery pack, 2 temperature sensors (one with 16 m or 5ft cable), integral stop valves on inlet and outlet, strainer, and magnetic trap. Following features shall be considered.

a) Range

The temperature range shall be as specified in the data sheet between 4° to 121°C (40° -250°F).

b) Power input

A 12 month operating life battery pack shall be supplied.

c) Data output

The data output shall be through 6-digit electromechanical counter with read-out in kW or btu.

d) Accuracy

The accuracy shall be ±1% over range of (1-12 gpm); ±1% of temperature difference of 2.8°C (5°F) or greater.

Notes:

1) The flow measuring meters shall be installed on piping systems located in accessible locations at most readible position.

2) Wafer-type flow meters shall be installed between 2 Class 125 pipe flanges, ANSI B16.1 (cast-iron) or ANSI B16.24 (cast-bronze). Minimum straight lengths of pipe upstream and downstream from meter shall be provided in accordance with manufacturer's installation instructions.

3) Calibrated balance valves shall be installed on piping with read-out valves in vertical upright position. Minimum length of straight unrestricted piping equivalent to 3 pipe diameters upstream of valve shall be maintained.

4) Window flow meters shall be installed in vertical upward position with impact tube mounted in bushing centered on pipe with 10 pipe diameters upstream and 5 pipe diameters downstream of straight unrestricted piping for 32 mm (1¼") and smaller, 20 pipe diameters upstream and 10 pipe diameters downstream for 38 mm (1½") and larger. The meter after installation shall be calibrated in accordance with manufacturer's installation instructions.

5) BTU meters shall be installed in piping (where indicated) in hydronic supply line. A thermal well in return line for remote sensor shall be provided. Meter can be mounted on wall if accessible, if not bracket can be provided to support meter.

12.5 Level Indicators or Gage Glasses

12.5.1 Reflex type gage glasses

It shall be suitable for when liquid-gas interface exists.

12.5.2 The maximum pressure rating

It shall be coordinated with the manufacturer's pressure temperature charts and working requirement, using preferably No. 8 glass (300 mm visibility). The body material shall be carbon steel and alloy or 304 stainless steel for construction to wetted parts.

12.5.3 Frost extensions

It shall be applicable where operating temperatures are below 0°C (32°F). Visible length of gage glass shall cover the range of shut down and alarm devices and the multiple gage glasses independent and overlap shall be provided where greater coverage is required.

12.5.4 Connections

It shall be normally with 19 mm (¾") NPT (female) screwed on the top and bottom connected with minimum of pipe fittings.

PART 8
CENTRIFUGAL WATER PUMPS

13. CENTRIFUGAL WATER PUMPS

13.1 Classification

13.1.1 Types

The centrifugal water pump are classified as follows:

a) End suction centrifugal

- Close coupled (without flexible coupling)
- Base or frame mounted (with flexible coupling)

b) Split-case centrifugal (horizontal or vertical)

- Single suction
- Double suction
- Multi-stage

c) In-line centrifugal

- Screwed ends
- Flanged ends

13.1.2 Applicable ranges

The preferred capacity operating ranges are recommended as follows:

a) In-line circulators for "low" system head to 6 meter (3 to 20 ft), "low" flow (1 to 40 gpm) with fractional horse power motors.

b) In-line pumps for "low-to-medium" system head 5 to 15 meter (15 to 50 ft), "low-to-medium" flow 1.26 to 7.6 L/s (20 to 120 gpm) and fractional horse power up to 5 HP motors.

c) End-suction pumps for "medium" system head 6 to 21 meter (20 to 70 ft), "medium" flow 1.9 to 44 L/s (30 to 700 gpm) and fractional horse power up to 20 HP motors.

d) Split-case or double-suction pumps for "medium-to-high" system head 15 to 42 meters (50 to 140 ft), medium-to-high" flow 12.5 to 252.4 L/S (200 to 4000 gpm) and motors up to 156 kW (250 HP).

e) For energy saving, the manufacturer’s shall have available where specified variable-speed drive pumps where horse power requirements are below 15 HP (including secondary pumping for chilledwater systems, hot water systems and most other pumping systems where constant flow is desired).

Note:

The designer shall select a pump that has design flow and head intersecting at a point on the pump curve that is within the "peak efficiency" range of the pump. Intersecting to the left of this area will provide the system with a slightly oversized pump and intersecting to the right of the optimum area will result in a slightly undersized pump.

13.2 End Suction and Split-Case Pumps

13.2.1 General

13.2.1.1 The centrifugal pump shall be self-priming and suitable for circulating water in the HVAC&R system. (submersible pumps, sump pumps and pressure booster system being plumbing pumps are not covered in this Standard).

13.2.1.2 The specification covers for both end-suction and split case pumps and shall be read in conjunction with IPS-M-PM-115 (centrifugal pumps for general services). Manufacturers shall have available bronze fitted, all bronze, all iron and all stainless steel construction pumps.

13.2.1.3 The manufacturers of split case pump shall comply with the closest equivalent of applicable material specification mentioned herein.

13.2.1.4 The end suction pump shall be either close-coupled or base mounted and the split case pump shall be arranged for either horizontal or vertical mount, applicable for the following services:

1) Residential applications.
2) Condenser water for cooling tower applications.
3) Chilled water for comfort cooling application.
4) Hot water heating and for domestic hot water applications.
5) Boiler feed for make-up water applications.

13.2.1.5 The pumps shall be factory-tested thoroughly cleaned, and painted with one coat of machinery enamel prior to shipment. The size, speed, capacity and power input of each pump shall be as listed in the pump schedule.

13.2.1.6 The maximum operating limitation for the temperature range shall be up to 232°C (450°F) and for the pressure range up to 10134 kPa (20 bar).

13.2.2 Material specification

13.2.2.1 Pump casing

a) The pump casing shall be cast iron, bronze fitted.

b) The thickness of casing shall be suitable to withstand stresses and strains at full operating pressures at pumping temperature, with a 3 mm (1/8") minimum corrosion allowance. It shall be subject to a hydrostatic pressure test at 150% of specified duty point. The design stress that are applicable to the cast iron material shall comply to Section VIII "Unfired Pressure Vessel" of the ASME Boiler and Pressure Vessel Code.

c) The relevant ANSI standard shall be applicable to the flanged suction and discharge. Pump attachments such as vent tap, petcock and drain connections shall be with minimum size of 12 mm (½") NPT.

13.2.2.2 Impeller

The impeller shall be enclosed type, statically and dynamically balanced of strong hydraulic design, keyed to the shafts and shall be of bronze material, unless otherwise mentioned.

13.2.2.3 Shaft and shaft sleeve

13.2.2.3.1 It shall be replaceable type to protect the shaft passing through the stuffing box. The shaft or sleeve through the rubbing surface with the stuffing box shall not exceed a roughness of 0.8 μm (32 micro-inches).

13.2.2.3.2 The pump shaft shall be provided with a replaceable sleeve to cover all wetted areas of the shaft under the sleeve.

13.2.2.3.3 Centrifugal movement of the shaft and sleeve measured by dial indicator shall not exceed 0.05 mm (0.002"). Shaft sleeve outside diameter through stuffing boxes shall be not less than 3 mm (1/8") over the shaft diameter.

13.2.2.4 Coupling

13.2.2.4.1 The coupling for base (frame) mounted pumps shall be all metal flexible spacer type for the horizontal pumps. An approved design of rigid type shall be provided for vertical pumps.

13.2.2.4.2 The coupling guard shall be removable, sufficiently heavy and rigid type designed to avoid contact with shaft or coupling.

13.2.2.4.3 The motor and pump shall be connected with a coupler assembly to reduce vibration and allow minor misalignment.

13.2.2.5 Bearing

Bearing housing closures of the labyrinth-slinger type shall be self lubricated with an average life of 250000 hours. It shall be arranged for life time lubrication and comply with thrust bearing for centrifugal pumps, conforming to the "Anti-friction Bearing Manufacturer's Association" requirements.

13.2.2.6 Mechanical seal

13.2.2.6.1 Unless otherwise mentioned the packing of pumps shall be equipped with self-lubricated mechanical sealing arrangement of carbon on ceramic or tungsten carbide, and suitable for the temperature range 0 to 232°C (450°F). (integral type of mechanical seals are not acceptable except for "close coupled" pumps).

13.2.2.6.2 The mechanical seal with all metal parts shall be 303 stainless steel with "Buna-N" elastomers, nickel resistant seal and carbon washer.

13.2.2.6.3 The mechanical seal for horizontal or vertical split case pumps, single or double stage shall be stuffing-box type with impregnated asbestos packing plus lantern ring for flushing.

Note:

Subject to the design engineers discretion use of packing gland can be considered.

13.2.2.7 Motor

13.2.2.7.1 The squirrel cage induction motors shall be heavy duty equipped with extra large shaft and oversized regreasable ball bearing, open drip proof type or with oil lubricated sleeve bearings, supplied and installed by the manufacturer with 1.15 service factor according to the relevant standards suitable for capacity rating of the pump without causing overheat or burn, operating at a speed and power input no greater than that shown.

13.2.2.7.2 The motor shall be guaranteed to deliver full power at the rated capacity and at a voltage fluctuation of ±5%. The motor shall be provided with a magnetic starter with thermal overload protection.

13.2.2.8 Mounting frame

13.2.2.8.1 It shall be of heavy fabricated cast iron with drip rim, formed steel or rigid steel baseplate furnished for base-mounted pumps, suitable for proper alignment of pump, motor and all accessories. (For double suction pump the bearing section may be overhung.)

13.2.2.8.2 The under section of the base shall have suitable grout holes minimum 100 mm (4") diameter for protection of the pump unit from undue vibration.

13.3 In-Line Pumps

13.3.1 General

13.3.1.1 The recirculation in-line pumps shall be single stage vertical close coupled of bronze fitted, all bronze or cast iron construction designed for 1033 kPa (150 psi) working pressure and 121°C (250°F) continuous water temperature. The pump body for domestic water services shall be all bronze.

13.3.1.2 The suction and discharge ends shall be threaded or flanged of the same size located on a common centerline 180° apart, designed for mounting in the pipeline system.

13.3.2 Material of construction

13.3.2.1 The construction of material shall meet the closest equivalent of the following:

COMPONENT	BRONZE FITTED	ALL BRONZE	ALL IRON
Casing	Cast iron ASTM A-48	Bronze ASTM B-62	Cast iron ASTM A-48
Impeller (case) wearing ring	Bronze ASTM B-62	Bronze ASTM B-62	Cast iron ASTM A-48
Impeller	Bronze ASTM B-62	Bronze ASTM B-62	Cast iron ASTM A-48
Shaft	Steel AISI C1045	Steel AISI C1045	Steel AISI C1045
Sleeve	Bronze ASTM B-62	Bronze ASTM B-62	Stainless steel AISI 316

13.3.2.2 The mechanical seal of pumps with all metal parts shall be 303 stainless steel with "Buna-N" elastomers, nickel resistance seat and carbon washer. The shaft shall be oil-lubricated polished steel with integral thrust collar.

13.3.2.3 The impellers shall be vacuum cast, dynamically balanced and keylocked to the shaft.

13.3.3 Motor

Motor and pump shall be connected with a coupler assembly to reduce vibration and allow minor misalignment. Motor shall be non-overloading open, drip-proof type with oil-lubricated sleeve bearings. Motor shall be mounted in rubber for quiet operation. Motor shall be provided with a magnetic starter with thermal overload protection.

PART 9
REFRIGERATION EQUIPMENT AND SYSTEM
FOR
PRE-FABRICATED COLD STORES

14. REFRIGERATION EQUIPMENT AND SYSTEM FOR PRE-FABRICATED COLD STORES

14.1 General

The prefabricated cold stores can be divided into following types:

a) The reach-in (installed indoors and may be stationary or portable)

The reach-in or step-in type size shall be packaged and limited to small capacity up to 5 m^3 space.

b) The walk-in (installed indoors and/or outdoors)

The pre-fabricated walk-in type shall be limited to 1500 m^3 space and suitable for locations that call for low population dwellings in rural areas, camp sites, drilling rigs, rest houses, commercial kitchen, hotels and motels etc., coast to coast. The selection of water-cooled or air cooled condensers shall depend on ambient temperatures and the design engineers discretion.

Note:

The system shall be with single or multi-refrigeration circuit and shall depend on job requirements and design engineer's discretion.

14.2 Condensing Units

14.2.1 Air-cooled condensing units

The air-cooled condensing unit shall include, but not limited to the following:

14.2.1.1 It shall be factory-assembled and tested, consisting of casing, compressors, condenser coils, condenser fans and motors, and unit controls. Capacities and electrical characteristics shall be as scheduled in the data sheet.

14.2.1.2 The unit casings shall be designed for outdoor installation and complete with weather protection for components and controls, and complete with removable panels for required access to compressors, controls, condenser fans, motors, and drives. Additional features shall include:

a) steel, galvanized or zinc-coated, for exposed casing surfaces, treated and finished with manufacturer's standard paint coating;

b) lifting lugs to facilitate rigging of units;

c) factory-installed metal grilles, for protection of condenser coil during shipping, installation, and operation;

d) hinged and gasketed control panel door.

14.2.1.3 Compressor shall be reciprocating semi-hermetic or hermetic type, 1450 RPM, designed for air-cooled condensing, complete with crankcase, sight glass, and backseating service access valves on suction and discharge ports. Capacity shall be controlled through cylinder unloading. Additional features shall include:

a) Crankcase heater in well within crankcase.
b) Capacity steps as scheduled, or greater number.
c) Compressor shall be of same manufacturer as condensing unit.

14.2.1.4 The operating and safety controls shall include high and low pressure cutouts, oil pressure cutout, compressor winding thermostat cutout, 3-leg compressor overload protection, and condenser fan motors with thermal and overload cutouts. Control transformer if required shall be 220-volts, and magnetic contactors for compressor and condenser fan motors shall be provided. Additional features shall include:

a) Reset relay circuit for manual resetting of cutouts from remote thermostat location.
b) Automatic non-recycling pumpdown, and timing device to prevent excessive compressor cycling.
c) Unfused disconnect switch, factory-mounted and wired, for single external electrical power connection.

14.2.1.5 Condensing coil shall be seamless copper tubing mechanically bonded to heavy-duty, configurated aluminum fins, with separate and independent refrigeration circuit for each compressor. Units shall include liquid accumulator and subcooling circuit, and back-seating liquid line service access valve. Condenser coils shall be factory-tested at 3159 kPa (450 psig), vacuum dehydrated, and filled with a holding charge of nitrogen.

14.2.1.6 Condenser fans and drives shall be propeller-type for vertical air discharge; either direct drive or belt drive. Additional features shall include:

a) Permanent lubricated ball bearing condenser fan motors;
b) separate motor for each condenser fan;
c) constant speed condenser fan motors;
d) each fan assembly shall be dynamically and statically balanced.

14.2.1.7 Low ambient control such as, factory-installed low ambient damper assembly, fan speed control, or fan cycling control shall be provided where applicable.

14.2.2 Water-cooled condensing units

14.2.2.1 Factory-assembled and tested water-cooled condensing units, consisting of reciprocating compressor, water-cooled condenser, base, and unit control panel. Capacities and electrical characteristics shall be as specified in the data sheet.

14.2.2.2 The condenser shall be multipass shell-and-tube type having replaceable seamless integral finned copper tubes, positive liquid subcooling circuit, pressure relief device, liquid level test cock, purge connection, liquid line shut-off valve, and 6 mm (¼") flare angle valve for connection of water regulating valve. Unit shall be ASME designed for refrigerant side working pressure of 2700 kPa (385 psig) and water side working pressure of 1750 kPa (250 psig).

14.2.2.3 The compressor shall be reciprocating semi-hermetic or serviceable hermetic type with reversible oil pump, operating oil charge, and suction and discharge shutoff valves. Compressor shall be factory-mounted to base using spring isolators. Additional features shall include:

1) Compressor motor shall use suction gas around motor windings and shall be thermally protected.

2) Compressor shall be equipped with insert type crankcase heater of size required to control oil dilution during shutdown.

3) Capacity control shall be obtained through cylinder unloading, by suction pressure controlled and discharge pressure operated. Designed so that compressor will start with controlled cylinders unloaded.

14.2.2.4 The factory-mounted and wired control panel shall contain the limited requirements of the following controls:

1) positive acting timer to prevent short cycling;
2) high and low pressure controls;
3) power and control circuit terminal blocks;

4) compressor motor starter;
5) control relays;
6) control circuit off-on switch;
7) control circuit fuse.

14.3 Accessories

Accessories with the condensing units shall include the minimum requirements of the following components:

a) discharge line muffler;
b) gage panel containing gages for suction, discharge, and oil pressure;
c) electric solenoid unloading in lieu of suction-pressure unloading;
d) control circuit transformer line to 220-volts AC;
e) pumpdown relay package;
f) crankcase coverplates with equalizer connections.

14.4 Air-Cooling Units

14.4.1 Ceiling suspended direct driven with propeller fans, low silhouette air coolers suitable for reach-in and walk-in coolers and freezers to operate with blended CFC-free halocarbon refrigerants through direct expansion refrigerant feed.

14.4.2 Material specification

Depending on application requirements, the following description shall comply:

a) The casing (housing) shall be fabricated of heavy gage aluminum hot dip galvanized sheets. (Air coolers with stainless steel casings shall be made available when required.)

b) The air flow arrangement shall be draw-through. The defrost arrangements shall be air or electric. Each unit shall operate with single or double fans.

c) Fin spacings shall be for 4, 6 and 8 fins per inch and coil connections available for either left or right hand.

d) The motors shall be totally enclosed air operated (TEAO) with thermal overload protection and available for 2-speed drive, where required for part load operation.

e) The air coolers shall conform to ARI 420-89 representing safety components covered under OSHA/UL requirements.

f) Air throw of each unit shall be anywhere from 4 to 12 meters depending upon discharge air velocity, motor rpm, ceiling height, aisle location and air volume requirement in the storage space.

14.5 Approved Standards

The following approved standards shall apply:

a) Capacity ratings for condensing units shall be in accordance with ARI Standard 360 "Standard for Commercial and Industrial Unitary Air-Conditioning Equipment".

b) Refrigeration system of condensing units shall be constructed in accordance with ANSI/ASHRAE 15-1992 "Safety Code for Mechanical Refrigeration".

14.6 Auxiliary Equipment

14.6.1 Copper tubing and fittings

14.6.1.1 Copper tube types

Refrigerant piping shall be hard drawn type "K" or "L" copper tubing conforming to ANSI B31.1, suitable for SAE flare or solder copper fittings connected in silver alloy, with couplings to join sections.

14.6.1.2 Description of types

a) The type "K" or "L" hard drawn high grade copper tubing suitable for refrigeration application preferably in 3 or 6 meter lengths.

b) It shall be available in various outside diameter size of 3/8" to 71/8" and wall thickness ranging from 0.035" to 0.134".

Note:

Type "M" type copper pipes shall not be applicable to this Standard.

14.6.1.3 Fittings

The fittings shall be high tensile strength, resistant to corrosion and suitable for use with copper tubing for solder or flared coupling connections. The fittings in main pipe lines shall be arranged through eccentric reducing fittings. The suction line shall be provided with a suitable U-trap. (Pipes shall be straight and sloped toward the condensing unit.)

14.6.2 Thermostatic expansion valve

14.6.2.1 The adjustable thermostatic expansion valves suitable for commercial refrigeration shall be in ODF solder or SAE flare type connections, together with expansion bellows and external equalizer to offset superheat.

14.6.2.2 The power element capillary tubing shall be in minimum 1.5 meter length.

14.6.2.3 The testing method, capacity ratings, refrigerant type and evaporator temperature shall conform to ARI-750-87.

14.6.3 Solenoid valves

The liquid line solenoid valves shall be leak-proof suitable for direct acting and pilot operated, normally closed type or normally open type as applicable. Inlet and outlet of the solenoid valve shall be solder or flare type connections, suitable for either horizontal or vertical mount.

14.6.4 Filter driers

14.6.4.1 The filter driers shall be charged with pellotized activated aluminum silica gel or other suitable desiccant with interchangeable drier media, where required.

14.6.4.2 It shall be capable to remove moisture, oil sludge, various organic acids, varnish, and max. produced by low temperature refrigerant up to 5 micron dimension and 5 ppm impurity. The inlet and outlet shall be of SAE flare or ODF solder connections, as specified in the data sheet.

14.6.5 Moisture and liquid indicators

The moisture and liquid indicators shall be package type in ODF (Outside Dia Female) solder or SAE (Socket Annealed Ends) male or female flare connections with indicating element in the center of the sight glass showing different colors when dry or wet. It shall be complete with leak proof gaskets and seal cap installed full size on main liquid refrigerant lines.

PART 10
GENERAL ADMINISTRATIVE
AND
PROCEDURAL REQUIREMENTS

15. GENERAL ADMINISTRATIVE AND PROCEDURAL REQUIREMENTS

15.1 Labeling

15.1.1 All units on order shall be suitably labeled, engraved on non corrosive alloy nameplate, showing all data as called for in the relevant standards and order including the followings:

- Manufacturer's name and the fabrication date
- Type, size and serial number
- Power supply characteristics
- Input/output characteristics
- Rating and class of insulation
- Purchase order number and factory order number and date.

The name plate shall be fixed in an easily visible and non removable part of the frame. A second plate reserved for purchaser, where required, shall be screwed to the unit engraved as following:

For example:

+ NIOC No. ..... +

15.2 Inspection/Quality Control and Quality Records

15.2.1 Inspection/quality control and test

15.2.1.1 The purchaser's inspector, or his authorized representative shall have free access to the manufacturing plant engaged in the manufacture of the equipment, to carry out necessary inspection at any stage of work.

15.2.1.2 Approval by the purchaser's inspector or assigned representative shall not relieve the vendor of his commitments under the terms of this specification or any associated order.

15.2.1.3 The supplier shall make available technical data, test facilities and samples that the purchaser's representative may require for verification in conjunction with pertinent equipment.

15.2.1.4 The equipment should be replaced if measurement, datas and inspection reveal any discrepancies between quoted figures resulting in purchase order and those measured actually.

15.2.1.5 Test certificates and test reports shall refer to the serial number of the equipment tested and bear the purchaser's name, order number and manufacturer's name and seal.

15.2.1.6 The certified performance test data on 50 cycle curves shall consist of head capacity and horse power readings shall be taken over the full operating range of pumps.

15.2.1.7 On centrifugal pumps the following test results shall be provided:

- Hydrostatic test submittal
- Vibration test submittal
- Witness NPSH test.

15.2.2 Quality control records

The supplier shall maintain appropriate inspection and test records to substantiate conformance with specified requirements. Preference shall be given to those ISO-certified suppliers that apply ISO-9000 version of quality management and quality assurance.

15.3 Finish

The unit and relevant equipment exterior shall be primed and then finished with high quality paint per customer's standard IPS-E-TP-100.

15.4 Packing and Shipment

15.4.1 Due attention must be given to protection against corrosion during transit, silica gel or similar dehydrating compound shall be provided.

15.4.2 The method of cleaning, preserving and the details of packing including moisture elimination, cushioning, blocking and crating shall be such to protect the product against all damages or defects which may occur during handling, sea shipment to the port and rough road haulage to site and extended tropical open air storage.

15.4.3 All resilient mounted components such as motors, compressor, etc., shall be secured by wedges of suitable clamps before packing.

15.4.4 Accessory items forming an integral part of the equipment should be packed preferably in separate boxes and shipped loose to prevent damage. Alternatively the ancillary items shall be fixed securely to the equipment and adequate precautions taken to ensure that items do not damage or loosen in transit.

15.4.5 After cleaning, leak test and vacuuming of pressure vessels, its refrigerant side connection ends and tube chamber connections shall be plugged or welded as required.

15.4.6 The pressure and temperature, size and other salient requirements shall be duly casted on the relevant equipment and devices.

15.5 Vendor's Data

15.5.1 Drawings and data

The supplier shall provide the purchaser drawings and datas in the English language at no extra cost to the purchaser.

15.5.2 Technical documents

The technical documents shall be furnished according to following stages:

15.5.2.1 At quotation stage

Comprehensive catalogs, technical data, outline drawings, applicable performance curves, proposed test procedure, service facilities, etc. of equipment and its components offered. All ratings shall preferably be at site conditions.

15.5.2.2 At order stage

a) Piping connections and wiring diagrams, dimensional and installation drawing. Water pipe connections where dispensers are furnished with refrigerators and freezers.

b) Service, operation and maintenance manual.

c) Reference list showing the successful continuous operation for at least three years and the location of the equipment or devices offered in major international installations.

d) Commissioning procedures and two years spare parts list.

Note:

The manufacturer shall identify all proprietary items.

15.6 Guarantee

15.6.1 Clearance of defect

The equipment or devices must carry the manufacturer's following warranty protection period, on all parts and components.

a) Full one-year warranty

Supply of parts, repair and replacements of any item and section of equipment which may fail due to manufacturing defects.

b) Full five-year warranty

Supply of parts, repair and replacement of sealed items such as, compressors, electric motors, trim mounts, structural items etc., which may fail due to manufacturing defects.

15.6.2 Replacement of defective parts

All defective parts shall be replaced by the supplier in shortest possible time free of charge including dismantling, reassembling at site and all transportation cost. The above mentioned period shall not be later than 18 months from the date of dispatch from manufacturer's works.

15.6.3 After sale technical services

15.6.3.1 Commissioning

15.6.3.1.1 The supplier shall quote where required for the services of competent engineer(s) and or technician(s) to assist in installation, commissioning and test-run of the equipment and system at site on a per diem basis.

15.6.3.1.2 The quoted rates shall be irrespective of duration and frequency and the supplier shall guarantee to provide the services of the engineer(s) and technician(s) on the specified date within a minimum of four weeks advance notice by the purchaser.

15.7 Spare Parts

15.7.1 The spare parts shall comply with specification and tests of the original equipment and shall be fully interchangeable with the original parts without requiring modification at site.

15.7.2 The Vendor shall guarantee the provision of spare parts for a minimum period of 10 years from the date of despatch of materials and/or equipment.

15.7.3 Spare parts shall be preserved to prevent deterioration during shipment and storage in tropical climate.

15.8 Coordination Responsibility with Others

15.8.1 In case the equipment ordered should be mounted on, aligned, connected, adjusted, or tested with the equipment of other manufacturer(s), the supplier shall coordinate with the participating manufacturer(s) and obtain all dimensional and technical informations allowing for any interconnecting equipment and tests that may be required.

15.8.2 The supplier shall be responsible for correct and timely communication with the participating manufacturer(s) and for any delay and/or cost claims arising from such communications.

15.8.3 Copies of all correspondence, including those with sub-vendors, shall be furnished to the purchaser.

15.9 Languages

All correspondence, submittals, layouts, documents, certificates including testing procedures and edited specifications shall be submitted in English and/or Persian language.

PART 11
DATA SHEETS

16. DATA SHEETS

Data sheets provided herein are carefully prepared with strategic informations inserted. In case additional informations are required to be advised to the customer, the manufacturer shall be responsible to furnish such datas in separate submittals and forwarded as supporting supplement.

The format of the following data sheets are provided for individual equipment:

1) Typical site data sheet.
2) For expansion joints.
3) For refrigerators and freezers.
4) For steam traps.
5) For unit heaters.
6) For electric duct heaters.
7) For dial indicating thermometers.
8) For pressure gages.
9) For centrifugal pumps.

16.1 Site Data Sheet

1) Ambient conditions:

- Summer max..... °C (°F) DB .....°C (°F) WB.
  min..... °C (°F) DB .....°C (°F) WB.
- Winter max. ..... °C (°F) DB .....°C (°F) WB.
  min. ..... °C (°F) DB .....°C (°F) WB.
- Relative humidity% ..... Summer.....Winter.
- Site elevation ..... meter above sea level.
- Sitelatitude.....

2) Wind velocity .... km/h.

3) Environment:

- Dusty .....
- Saliferous .....
- Others .....

4) Available services:

- Power supply.....V..... ph .....Hz.
- Cooling water source:
  - From treated water .....city water .....
  - Max. temperature .....max. pressure .....

5) Area classification .....

6) Job description .....

Note:

Earthquake belt of Iran is located in ubc area of zone 3.

16.2 Data Sheet for Expansion Joints

Project ..... Location .....
Order No. ..... Factory ..... Customer
Manufacturer ..... Model No. .....S/No. .....
Quantity ..... Nominal Diameter.....Type .....
Mounting Position ..... Fabrication Date .....

Media	Medium
	Velocity m/sec (fpm)
	Flow direction
Pressure	Design (bar) kPa
	Test (bar) kPa
Temperature	Design °C (°F) Installation °C (°F)
Design Movement	Axial extension mm (inch)
	Axial compression mm (inch)
	Lateral mm (inch)
	Angulation (deg)
Required Fatigure Life (Standard is 1000 cycles)	
Materials of Manufacture	Bellows
	End fittings
End Fittings	Pipe end (O/D & thk)
	Flange specification
Dimensional Limitations	Overal length mm (inch)
	Outside diameter mm (inch)
Spring Rate Limitations	Axial (N/mm)
	Lateral (N/mm)
	Angular (Nmm/deg)
Quality Assurance Required	X-ray
	Dye penetrant
	Design code

16.3 Data Sheet for Refrigerators and freezers (Side-by-Side and Top Mount Units)

General:

Customer.....Location.....
OrderNo.....Customer.....Factory
Manufacturer ..... Model No. ..... Serial No.....
Refrigerant.....HCFC.....BlendedCFC
Temperature Range (duty) .....°C (°F) Ambient.....°C (°F)
Appliance Type .....Fabrication Date .....
Materialused.....Cabinet.....Door
Auto Dispenser ..... with .....without
Type of Dispenser ..... Crushed ..... Cubed .....Chilled
.....ice.....ice.....water
Gasket Material.....Cabinet.....door

Performance Data:

Compressor..... Type.....HP.....RPM
Condenser..... W/fan.....W/Ofan
Evaporator..... W/fan.....W/Ofan
Coil Type..... Condenser.....Evaporator
UnitBack..... W/Condenser .....W/O Condenser
Defrosting .....Manual ..... Frost Free .....Automatic
(a) NoiseCriteria.....dBa.....Scale
Electrical.....Volt.....Phase.....Hz
Current draw .....Amps (at 220 V/50 Hz)
Weight kg (lbs).....Gross.....Net
ShippingVolume.....m³.....cuft
SalientFeatures.....

Capacity Chart:

TotalVolume.....liter.....cuft
(a) Fresh Food .....Liter (cuft) Freezer .....Liter (cuft)
(a) Shelf Area .....m^2 .....sqft
(a) Door Size .....Fresh Food .....Freezer Section
(a) Interior Lights.....Quantity.....type

Fresh Food Section:

No. of Shelves ..... Cabinet.....Door
Make of shelves ..... White Wire .....Tempered Glass
(b) Type of Shelves ..... Slide-in.....Cantilever
(b) Type of Door Shelves ..... Deep.....Removable
StorageCompartment..... Dairy.....Crispers

a) To be filled by the manufacturer.

b) These shelves are considered adjustable.

Freezer Section:

Shelves.....	Make.....Type
No. of Shelves	Cabinet.....Door
Ice Tray Shelf.....	Quantity.....
Loading Compartment	Slide-out Basket .....Adjustable

Cabinet Features:

Insulation type	Cabinet.....Door
Liner Type[(a)]	Cabinet.....Door
Doors.....	Enamelled.....Textured Steel
Legs.....	Adjustable.....Rollers
Door Opening	Right.....Reversible
Door Swing	W/stop .....W/O stops
Door Handle.....	Exposed.....Recessed

Dimensions: [(a)]

Size mm (inch)	Ht.....W.....D
Depth mm (inch)	W/handle.....W/Ohandle
Cabinet Depth mm (inch).....	W/door.....W/Odoor
Air Clearance mm (inch)	Each.....Top.....Back

16.4 Data Sheet for Steam Traps

General [(a)]

Project.....Location.....
Order No.....Factory.....Customer
[(a)]Manufacturer.....Model No.....
Tag No.....Quantity.....Fabrication.....
Operating Range.....Temperature.....Pressure
Trap Type .....Service .....Size mm (inch) .....

Operating Data: [(b)]

Condensate Load kg/h (lbs/h)	Size mm (inch).....
Press Differential kg/cm^2 (lbs/SQ")	Body.....
End Connections.....	Orifice Size.....
Cover or Cap	Cover Bolts.....
Pin and Seat	Air Vent.....

Float or Bucket.....Brass.....S/S.....Other.....
Gasket.....Graphite.....Teflon.....Fiber.....

a) Indicates information to be completed by manufacturer.

b) Indicates information to be completed by purchaser.

Lever.....ThermElement.....
Built-inStrainer.....ScreenSize.....

Physical Data:[a]

Dimension:mm(inch).....
Weightkg(lbs).....Dry.....Operating

16.5 Data Sheet for Unit Heaters

General: [a]

Project..... Location .....
OrderNo..... Factory.....Customer
[a]Manufacturer..... Model No. ..... S/No. .....
Quantity..... Type .....
Mounting Position ..... Fabrication Date .....

Performance Data: [b][a]

Media.....HotWater.....Steam.....Electric
Heating Capacity kcal/h (BTUH) ..... Input .....Output
Air Volume m³/h(cfm)[a].....Standard.....Range
Delivery.....Vertical.....Horizontal
Firing Fuel .....Oil ..... Electric..... Steam Hot Water .....Nat Gas or Propane
FanType.....Propeller.....Centrifugal
FanMotor.....HP.....Type.....rpm
Outlet Velocity m/s (fpm) .....Top Speed .....rpm
Heat Spread .....W/Deflector .....W/O Deflector
FanDrive.....Direct.....V-Belt
Coil Type.....Copper.....Stainless Steel
CoilConnections.....Size.....Lh/Rh
Coil Capacity.....L/S (gpm).....Rows.....Fins

Physical Data:[a]

Overal Dimensions mm (inch).....L.....W.....H
Operating Weight kg (lbs) .....
Salient Features .....
.....
.....

a) Indicates information to be completed by manufacturer

b) Indicates information to be completed by purchaser.

16.6 Data Sheet for Electric Duct Heaters

General: (a)

Project ..... Location.....
Order No. ..... Factory.....Customer
Manufacturer..... Model No. .....S/No. .....
Duct Size Entry ..... Horizontal.....Vertical
Panel Door ..... Rh.....Lh
Panel Hinging..... Rh.....Lh
Unit Data..... Capacity.....Quantity
Service..... Location.....Position
Dimension..... Duct Width .....Duct Height

Capacity Ratings: (b)

Airflow..... m^3/h(cfm).....Direction
Heater Type.....No. of Stages .....kW/Stages
Control Options..... Remote.....Integral
Mounting..... Flanged.....Slip-in
Voltages..... Main.....Controls
Primary Contactors.....Relay.....Magnetic.....Mercury
Secondary Back-up ..... Magnetic.....Reset
Special Construction ..... Derated Coil .....Watts/sq mm

Built-in Accessories.....
.....

Shipping Weight: (b)

Weight each.....kg (lbs).....Packed in Cartons.....

16.7 Data Sheet for Dial Indicating Thermometers

General: (b)

Project.....Location.....
Order No.....Factory.....Customer
Manufacturer (a).....Model No.....S/No.....
Tag No. ..... Quantity.....Date.....
Service.....Operating Range.....

a) Indicates information to be completed by manufacturer.

b) Indicates information to be completed by purchaser.

Operating Data: (b)

Dial Scale °C (°F)		Accuracy	%
Dial		Size	Color
Mounting		Straight	Angular
From		Fixed	-Adjustable
Capillary		Type	Length
ComponentType	Case		Bulb
Sockets		Dimension	Material
BallorUnionSize	½"		¼"Thread
WellMaterial		Bronze	StainlessSteel
WellConstruction		Built-up	DrilledStock
Accessories			

Shipping Weight: (a)

Each ..... kg (lbs) Packed in Cartons .....

16.8 Data Sheet for Pressure Gages

General: (b)

Project		Location	
OrderNo		Factory	Customer
Manufacturer (a)		ModelNo.	S/No.
Tag No.	Quantity		Fabrication Date
Service	OperatingRange		

Operating Data:(b)

Dial Scale kPa (psi)		Accuracy	%
Dial		Color	Diameter
Type		Indicating	Receiving
Mounting	Surface	Local	Flush
Case Material	Cast Iron	Aluminum	Phenol
Ring Type	Screwed	Hinged	Slip
PressureElement		Bourdon	Bellows
ElementMaterial		Bronze	StainlessSteel
SocketMaterial		Bronze	StainlessSteel
Connections mm (inch)		13 (½")	6.35 (¼")
Accessories			

Shipping Weight: (a)

Each ..... kg (lbs) ..... Packed in Cartons .....

a) Indicates information to be completed by manufacturers.

b) Indicates information to be completed by purchaser.

16.9 Data Sheet for Centrifugal Pumps

General: (b)

Project..... Location.....
Order No..... Factory.....Customer
Manufacturer (b)..... Model No. .....S/No. .....
Service..... Location.....Position.....
Pump Type..... Fabrication Date.....
Starts/Day..... Continuous.....Intermittant
Pump No. or Symbol ..... Quantity.....

Operating Performance & Material: (a)

Capacity L/S (gpm) ..... Normal.....Rated
Total Head M (ft) ..... Dynamic.....NPSH
Pressure kPa (psi) ..... Suction.....Discharge
Main Connections mm (inch) ..... Suction.....Discharge
Other Connections mm (inch) ..... Drain.....Vent.....Gage
Casing.....Mounting.....Split.....Type
Media.....Type.....Termperature.....Viscosity
End Connections.....Flanged.....Threaded
Rated Power kW (BHP). .....Efficiency .....%
Motor Mount.....Horizontal.....Vertical
Motor Type .....Frame ..... Service Factor .....
Rotation (Coupling End) CW .....CCW .....
Bearings.....Radial.....Thrust

Physical Data (a)

Overal Dimensions mm (inch) ..... L.....W .....H
Weight kg (lbs).....Dry.....Operating
Special Features.....
.....