MATERIAL AND EQUIPMENT STANDARD

FOR

FIELD ERECTED REFRIGERATION SYSTEM

AND

ICE PLANT

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PAGE No.

APPENDICES:

0. INTRODUCTION

Each refrigeration system are required to be engineered to meet job requirements, wherein the equipment shall be custom-built or modified to suit specific applications. In view of the presence of various refrigeration equipment and ice plant, this Standard is divided into following parts:

Part I : General Specifications for Refrigeration Equipment
Part II : General Specifications for Ice Plant
Part III : General Requirements
Part IV : Data Sheets

1. SCOPE

This standard represents the field erected refrigeration system and ice plant suitable for indoor and stationary mount covering the refrigeration, compression equipment and accessories required for cold stores and ice plants engineered and designed as industrial refrigeration system.

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 Vendor:

ARI (AIR CONDITIONING AND REFRIGERATION INSTITUTE)

ARI 510-87	"Ammonia Compressor Units"
ANSI/ARI 520-90	"Positive Displacement Refrigerant Compressors and Condensing Units"
ARI 420-89	"Unit Cooler for Refrigeration"

ASTM (AMERICAN SOCIETY FOR TESTING AND MATERIALS)

ASTM-A525	"Zinc Deposits on Galvanized Mild Sheet Both Sides"

NFPA (NATIONAL FIRE PROTECTION ASSOCIATION)

ANSI/NFPA 214-1988	"Water Cooling Towers"

ANSI (AMERICAN NATIONAL STANDARDS)

ANSI-B16.34-81	"Valves Flanged and Butt Welding Ends"
ANSI/ASME B31.5-1987	"The Pressure Codes for Refrigeration Piping"
ANSI/ASHRAE 15-1989	"Safety Code for Mechanical Refrigeration"
ANSI/ASHRAE 83-1985	"Capacity Measurement of Field-Erected Compression-Type Refrigeration and Air Conditioning Systems"

ASME (AMERICAN SOCIETY OF MECHANICAL ENGINEERS)

ASME Section VIII, Div. 1	"Boiler and Pressure Vessel Code"

3. DEFINITIONS AND TERMINOLOGY

3.1 Accumulator

A storage chamber for low-side liquid refrigerant, also known as surge drum, also a pressure vessel whose volume is used in a refrigerant circuit to reduce pulsation, also a pressure vessel connected to more than one circuit of a pneumatic system to obtain the average pressure of the connected circuits.

3.2 Compressor, Compound

A compressor in which compression is accomplished by stages, as in two or more cylinders.

3.3 Compressor, Booster

A compressor for very low pressure, usually discharging into the suction line of another compressor.

3.4 Compressor, Double-Acting

Compressor which has two compression strokes per revolution of crank shaft per cylinder, i.e. both faces of the piston are working faces.

3.5 Compressor, Reciprocating

A positive displacement compressor in which the change in internal volume of the compression chamber(s) is accomplished by the reciprocating motion of one or more pistons.

3.6 Compressor, Rotary

A positive displacement compressor which changes internal volume of the compression chamber(s) accomplished by the rotary motion of a positive displacement member.

3.7 Compressor, Single-Acting

A compressor having a single compression stroke per revolution of the crank for each cylinder.

3.8 Condenser, Air-Cooled Refrigerant

A refrigerant condenser in which heat rejection is accomplished entirely by raising the temperature of the air used as a cooling medium.

3.9 Condenser, Evaporative Refrigerant

A refrigerant condenser in which part of the heat rejection may be accomplished by raising the temperature of an air stream passing over a heat exchange surface and the remainder by water sprayed or otherwise distributed over the heat exchange surface.

3.10 Evaporator

The part of the refrigerating system that is designed to vaporize liquid refrigerant to produce refrigeration.

3.11 Evaporator Coil

An evaporator constructed of pipe or tubing, not enclosed in a pressure vessel.

3.12 Liquid Receiver

A vessel, permanently connected to a refrigerating system by inlet and outlet pipes, for storage of liquid refrigerant.

3.13 Refrigerating System

A combination of interconnected parts forming a closed circuit in which refrigerant is circulated for the purpose of extracting, then rejecting, heat.

3.14 Self-Contained System

A complete, factory -assembled and tested system that is shipped in one or more sections and has no refrigerant-containing parts that are joined in the field by other than companion or block valves.

3.15 Unloader

A device on or in a compressor for equalizing the high and low side pressures for a brief period during starting in order to decrease the starting load on the motor, also a device for controlling compressor capacity by rendering one or more cylinders inaffective.

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.
- Third Priority : This specification.

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

6. CLASSIFICATION

6.1 General

The following classification shall apply to the field erected industrial refrigerating system:

a) Single stage compression system.
b) Multi-stage compression system comprising of;

I) Compound System employing either:

1) Booster system with a low stage compressor and high-stage compressor.
2) Internally-compounded two-stage compressors.

II) Cascade system, wherein one refrigerant is used as the cooling media to condense the other refrigerant.

6.2 Design Parameters

6.2.1 General

6.2.1.1 As mentioned in ANSI/ASHRAE Standard 83-1985, the standard procedures for determining the capacity under operating conditions of field erected, compression-type refrigeration (and air-conditioning) systems are classified as a standard practice.

6.2.1.2 The ASHRAE Standard 83 is one in which it is impossible to specify explicitly every detail, and where significant judgement due to large variations must be left to the user.

6.2.1.3 The limits and conditions specified are often such that experienced judgement is necessary in order that the intended result be obtained.

6.2.2 Limitations

6.2.2.1 This Standard shall not apply to refrigeration systems employing compressors whose brake horsepower requirements are smaller than 5.6 kW (7.5 Hp) or whose driving motor is NEMA-rated at less than 7.5 kW (10 Hp) or whose rated ampere for the electrical characteristics of the motor are less than the amperage for 10 Hp motors set forth in the 1984 National Electric Code, tables 430-147 through 430-150.

6.2.2.2 Based on user's discretion and final judgement, the use of minimum compressor capacities shall preferably be limited to the following temperature conditions:

a) Reciprocating compressors at 1200 RPM and 50 Hz operation:

i) For high stage at -10°C (14°F) saturated suction and 40°C (104°F) condensing temperature:

R 717, 24 TR (Ton of Refrigeration)
R 22, 22 TR
R 12, 14 TR
R 502, 20 TR

ii) For low stage (booster) at -40°C (-40°F) saturated suction and -10°C intermediate discharge temperature:

R 717, 7 TR
R 22, 9 TR
R 12, 5 TR
R 502, 10 TR

b) Screw compressors at 2950 RPM at 50 Hz operation:

i) For high stage at -6.7°C (20°F) saturated suction and 35°C (95°F) condensing temperature:

R 717, 26 TR
R 22, 23 TR
R 12, 30 TR

ii) For low stage (booster) at -40°C (-40°F) and -10°C intermediate discharge temperature:

R 717, 8 TR
R 22, 8 TR

Note:

The manufacturer's unit shall have the capability to withstand maximum 60°C (140°F) condensing temperature.

PART 1
GENERAL SPECIFICATIONS FOR REFRIGERATION EQUIPMENT

7. DESIGN CRITERIA

7.1 General Guidlines

7.1.1 Ammonia compressor units shall conform to ARI-510-87 and the positive displacement compressors shall be in accordance with ANSI/ARI 520-90.

7.1.2 The compressor equipment covered shall be either Reciprocating, Rotary or Screw Compressor designed and constructed per job requirements to provide for minimum three years of trouble free operation meeting exact requirements of the heavy-duty Industrial Refrigeration.

7.1.3 All compressor components shall be selected and arranged, to assure reliability, accessibility and ease of service.

7.1.4 The compressors and other refrigeration equipment shall be suitable for ammonia, R12 and R22 gasses as specified in the data sheet. Deviations to meet environmental control requirements suggested by vendor shall be subject to approval of the Company.

7.1.5 Compressors shall be equipped to provide well-engineered means of silencing, environmental noise and pulsation suppression to meet following requirements, unless otherwise specified:

SOUND PRESSURE LIMIT IN db re 20 MPa

COMPRESSOR	**87 db**
COMPRESSOR+DRIVER	**90 db**

The above Figures are based on location one meter from the equipment. A 5dB lower limits shall be considered where equipment produces impulsive noise.

7.1.6 Unless otherwise mentioned, standard electrical power supply shall be 380V-3 Phase-50 Hz supply. Wherever required necessary auxiliary contacts shall be provided.

7.1.7 Control panel mounted on units shall be designed to conform to the applicable relevant codes of NEMA, UL, or IEC.

7.1.8 Units that are driven by V-belt operation shall be OSHA approved equipped with slide tension rails and its supporting bolts.

7.2 Limitations

7.2.1 The number of compressor cylinders shall be limited from minimum two to maximum twelve.

7.2.2 Use of non-casted body compressors (welded) are not acceptable.

7.2.3 Use of compressors in tandem arrangements are not acceptable.

7.2.4 Use of internally compounded screw compressors are not acceptable.

Note:

Compressors suitable for hydrocarbon gasses are not covered in this Standard.

8. MAIN REFRIGERATION EQUIPMENT

8.1 Refrigeration Compressors

8.1.1 Reciprocating compressors

8.1.1.1 The open type reciprocating compressor shall be suitable for heavy duty industrial refrigeration application, arranged for V-belt or direct drive capable to be used for both high stage and booster duty and designed for application with commonly used ammonia, R12 and R22 or other approved refrigerants.

8.1.1.2 Components

Each reciprocating compressor component shall be provided with, but not limited to, the following:

a) Compressor housing

Shall be close-grained cast iron designed to withstand high pressure and low temperature. Covers on each side of the crankcase shall permit easy access and inspection of the compressor interior. Full and low level sight glasses permit observation of oil level in the crankcase.

b) Crankshaft

The crankshaft shall be forged steel or high tensile ductile iron drilled for oil distribution statically and dynamically balanced.

c) Cylinder liners

Shall be high grade cast alloy iron and interchangeable, with a cross-hatched, honed finish for superior ring seating.

d) Pistons

Shall be treated cast iron furnished with two compression rings and one oil ring for cylinder gas and oil control devices. The compression rings shall be designed for equalized pressure against ring surface to minimize blow back. The oil ring shall have a double scraper edge with ventilated inner circle.

e) Connecting rods

Cast iron steel backed or die-forged aluminum alloy with integral bearings on both ends.

f) Piston pins

Precision ground, case-hardened steel, locked in place with internal retaining rings.

g) Suction and discharge valves

Shall be high performance stainless steel designed for minimum inertia and lift. The valves shall be capable to eliminate clatter and guided on their internal and external diameters.

h) Internal safety valves

Integral and factory set to establish a quick safety relief between discharge and suction manifold above the preset differential pressure limit. The safety valve shall have a steel disc against a steel seat.

i) Safety head and safety head springs

Shall be spring-loaded provided to protect the compressor from liquid slug.

j) Shaft seal

Bellows type or equal with lapped carbon ring sealing against lapped surface of seal cover plate.

k) External discharge manifold

Gas shall be discharged through an external manifold having minimum exposure to suction gas and the body of the compressor.

l) Oil thermometer

Mounted in the compressor crankcase inspection plate allowing monitoring of the oil temperature.

m) Crankcase oil heater

Electric resistance cartridge type, 220 volt shall be replaceable without removing the charge.

n) Lubrication

An internal gear pump driven by the crankshaft shall feed oil to all bearing surfaces and the shaft seal. Shaft seal flow and pressure shall be regulated by a valve on the seal end bearing housing.

o) Oil filter

The oil filter shall be externally mounted having efficient filtering to protect bearing and other vital points of lubrication. It shall be a full-flow-type filter with a replaceable element.

p) Suction strainer

Shall include a removable and cleanable fine mesh screen.

q) Compressor connections

Suction and discharge service valves with connections as required.

r) Compressor cooling

Ammonia gas shall be supplied with water-cooled cylinder heads, water-cooled oil cooler, and interconnecting piping between heads. For R12 and R22 refrigerant an external direct expansion heat exchanger, water-cooled oil cooled, and liquid injection shall be available.

s) Base

Rugged one-piece compressor and motor base of welded structural steel. Motor rails shall be included for V-belt drive arrangement. Foundation bolts and nuts to be included.

t) Control center

The compressor unit shall include either a factory mounted gaged control board or a microprocessor control center with all safety and operating controls described below, as required per job application:

- Gaged control board

Shall be factory mounted and include high and low pressure cutout, oil pressure cutout, capacity control pressurestats, and gages for high pressure, low pressure, and oil pressure (in Metric/English scales), with high oil temperature and high discharge temperature controls.

- Microprocessor control

Shall include all necessary safety, operating, and monitoring controls plus the added features of prealarm and first out annunciator, automatic low pressure control, and remote communications capability.

8.1.2 Internally compounded compressors

8.1.2.1 The internally compounded reciprocating compressors, in addition to those mentioned in item 8.1.1, shall be integrated with suitable safety devices operating as a two stage machine on a single steel base.

8.1.2.2 The standard unit shall be inclusive of mounted high pressure discharge oil separator and intercooler to provide both second stage suction de-superheating and liquid sub-cooling. The partitions within the frame shall separate booster and second stage sections.

8.1.3 Rotary vane compressors

8.1.3.1 The rotary vane compressor shall operate for booster application, V-belt driven with mounted combined oil separator reservoir assembly. The housing shall be steel casting with cylindrical rotor slotted longitudinally for sliding blades.

8.1.3.2 The multiple sliding blades shall be woven fabric impregnated with melamine resin for maximum durability and noise free operation.

8.1.3.3 The bearing and seals shall be pressure lubricated by oil from an internal rotary gear pump directly driven by the compressor shaft.

8.1.3.4 Oil cooling shall be accomplished by recirculated oil continuously chilled by an external shell & tube oil cooler using the refrigerant liquid gas, regulated by operating controls.

8.1.4 Rotary screw compressors

8.1.4.1 General

The rotary screw compressor units shall be engineered and manufactured to meet exact requirements of the industrial refrigeration market. All components shall be designed and arranged to assure reliability, accessibility, and ease of service. Units shall be designed for use as booster or high stage machines on ammonia or halocarbon refrigerants and shipped completely assembled to meet the requirements of clause 7.1.5.

8.1.4.2 Components

Each screw compressor components shall be incorporated with, but not limited to, the following:

a) Rotary Compressor

The compressor shall incorporate the latest technology to bring large screw reliability and efficiency to small screw sizes. The ASTM A-48, Class 40 gray-iron compressor casings are designed and tested in accordance with the requirements of ANSI/ASHRAE 15-1989 safety code, at 2310 kPa (335 psig working pressure). The steel rotors in combination with an integral gear drive shall be capable to increase rotor tip speed, bringing unprecedented efficiency to the unit. The compressor shall incorporate a complete antifriction bearing design for reduced power consumption, improved efficiency, and reduced maintenance. The bearing shall be selected to provide expected life in excess of 100,000 hours at design conditions. The male-and female rotors shall be of steel forgings conforming to SAE 1035 or similar approved standard.

b) Capacity control

The compressor shall incorporate a slide valve for capacity control, allowing infinite capacity adjustment in four steps from 100% to 25% of full load. The slide valve control shall also be available for part load operation.

c) Volume ratio control (Vi)

The compressor shall incorporate a simple mechanism which adjusts the compressor volume ratio during operation to the most efficient of four possible volume ratios, depending on system requirements. This minimizes the power penalty associated with over or under compression, reducing excess bearing load caused by running a machine at a less efficient Vi.

d) Lubrication system

The compressor shall be designed specifically for operation without an oil pump for high-stage service. All oil required for main oil injection and lubrication shall be provided by positive gas differential pressure passing through a 15 micron filter.

Boosters and some low-differential-pressure applications will require the full-lube oil pump option. In low stage, oil pressure shall be regulated with an external, pilot operated regulating valve.

e) Oil separator/reservoir

The oil separator shall be horizontal or vertical, stage design with integral sump. The separator shall be designed and constructed in accordance with ASME Section VIII, Div. 1 for a maximum design allowable working pressure of 2068.2 kPa (300 psig). Replaceable coalescent separator elements shall be provided for final gas/oil separation of particles down to less than 1 micron.

f) Oil cooling

Compressor oil cooling shall be activated by either liquid-refrigerant injection oil cooling or by the use of water or thermosyphon oil cooling. Water cooled and thermosyphon oil cooler shall be supplied with ASME shell and tube heat exchangers mounted on the unit.

g) Control center

The compressor unit shall include a factory mounted and wired electromechanical or microprocessor control center with all required safety, operating and monitoring controls described below for minimum requirement per job application:

- Electromechanical

The safety controls of NEMA 1 gasketed panel shall include high- and low-pressure cutouts, oil-pressure cutout and high-discharge temperature cutout. Operating controls shall include control power switch, manual/remote selector switch, start/stop push button, safety reset button, remote/auto/manual capacity control switch, manual capacity control switch, liquid-injection temperature control (for Liquid Injection Oil Cooling-LIOC only), automatic capacity control pressure switches, with solenoids and four step volume ratio control. Manual reset shall be provided for all safety cutouts. Monitoring device shall include suction pressure, discharge pressure, and oil pressure liquid filled gages and relevant temperature indicators.

- Microprocessor

All safety, operating and monitoring functions as described for the electromechanical control shall be included in the NEMA 4 gasketed panel plus the added features of ammeter/motor load limiter, auto cycle, antirecycling timer, automatic Vi control, automatic liquidinjection, dual-port changeover (for LIOC only), time proportioning capacity control, first-out annunciation, for prealarms, real-time clock control and access code protection. All major operating conditions shall be continuously displayed. All operating conditions prior to a compressor cutout shutdown shall be stored in memory and shown on the freeze display.

h) Thermometers

The suction, discharge, and oil temperature thermometers shall be mounted on the units.

i) Valves

The unit's discharge shall have a mounted combination check and stop valve. The suction shall include an integral suction strainer with mounted or unmounted check valve and stop valve assembly.

8.1.4.3 Sequencing control

Sequence control shall be made available in the event of operating two or more compressor units.

8.2 Heat Rejection Units

Different types of heat rejection unit are as follows:

a) Evaporative condensers
b) Cooling towers (type A and type B)
c) Shell and tube condensers
d) Air-cooled condensers

8.2.1 Evaporative condensers

8.2.1.1 General

8.2.1.1.1 The evaporative condenser shall be complete factory assembled suitable for all refrigerant and shall be of blow-through design.

8.2.1.1.2 The centrifugal or vane-axial fan assemblies built into the pan with all moving parts shall be factory mounted and aligned, internally baffled to permit independent operation of individual fan section assemblies.

8.2.1.2 Pan/fan section

8.2.1.2.1 The combination blower/pan assembly within single heavy duty hot dip galvanized steel housing consisting of forward curved centrifugal (or vane-axial) blowers, motors, V-belt drives, water pan with outlet to pump, pump suction screens, drain, overflow, bleed line, float valve assembly and circular access door.

8.2.1.2.2 The fan shall be statically and dynamically balanced, and the drive shall be OSHA-approved.

8.2.1.3 Fan/motor drive

8.2.1.3.1 The TEFC (totally enclosed fan cooled) ball-bearing fan motor with 1.15 service factor designed for not less than 150% motor nameplate horsepower. Fan ,motor protection class shall be as specified in the data sheet.

8.2.1.3.2 The motor shall be located under pan for protection and provided with adjustable base for V-belt drive. Each motor lead shall be wired to terminals in a junction box or control panel.

8.2.1.4 Coil section

The condensing coils shall be prime surface steel pipe hot dip galvanized after fabrication and pitched to facilitate complete drainage of refrigerant. The coils shall be tested at 23.8 kg/cm^2 air pressure under water. A tapping connection shall be provided at each coil end for installation of pressure gage. The coils for halocarbon gasses shall be of high quality copper type.

8.2.1.5 Water distribution system

Full coverage spray distribution system shall be provided using non-clogging orifice, corrosion and rust resistant plastic or plastic lined spray nozzles.

Where open galvanized troughs are used, it shall be arranged for uniform flooding and complete wetting of coils, preventing accumulation of foreign particles.

A recommended minimum of cooling water per square meters of unit cross section shall be circulated to ensure complete wetting of condenser coil.

8.2.1.6 Water pump

The water pump shall be bronze or cast iron fitted close-coupled centrifugal type with mechanical seal or packing seal as specified in the data sheet. The pump shall be pan mounted completely piped to the suction strainer and water distribution system.

8.2.1.7 Eliminators

The eliminators shall be removable type and constructed of either non-combustible rigid vinyl or heavy coated hot dipped galvanized steel or durable alloy.

8.2.1.8 Accessories

Necessary accessories such as galvanized or stainless steel ladder, two speed motor, pan heater kit, electric level control, discharge hood with dampers, sound attenuator, vibration isolators, electrical sequencing etc. shall be specified per job requirements.

8.2.2 Cooling towers-type A

8.2.2.1 General

The cooling tower shall be, blow-through (forced draft) or draw-through (induced draft) with axial or centrifugal fan assemblies with all moving parts factory tested and aligned, conforming to relevant requirements of ANSI/NFPA 214-1988. Zinc deposits on galvanized sheet both sides shall be twice the quantity mentioned in ASTM A525.

8.2.2.2 Pan/fan section

Items mentioned in clause 8.2.1.2 shall apply.

8.2.2.3 Fan/motor drive

8.2.2.3.1 Items mentioned in clause 8.2.1.3 shall apply.

8.2.2.3.2 A suitable reducing gear box shall be provided where required.

8.2.2.4 Heat transfer section

8.2.2.4.1 The heat transfer sections shall be removable type. Each section including wet deck surface below the spray-type water distribution system shall be encased by hot dip galvanized steel panels with removable eliminators.

8.2.2.4.2 The wet deck surface material shall be non-combustible and impervious to rot, decay, fungus or biological attack.

8.2.2.5 Water distribution system

8.2.2.5.1 The water shall be evenly distributed over a tower fill area by a water distribution system consisting of hot dip galvanized steel header and spray branches with plastic or copper alloy nozzles, held in place.

8.2.2.5.2 The header shall include provisions for measuring spray pressure externally.

8.2.2.5.3 All areas shall be accessible for service and inspection purposes.

8.2.2.5.4 The water basin shall be suitable for minimum hold up, fabricated of hot dip galvanized sheets.

8.2.2.6 Eliminators

Items mentioned in clause 8.2.1.7 shall apply.

8.2.2.7 Accessories

Items mentioned in clause 8.2.1.8 shall apply.

8.2.3 Cooling towers-type B

8.2.3.1 General

8.2.3.1.1 The heavy-duty cylindrical cooling tower shall be induced draft constructed in a pattern of bell mouth and side panel with casing of Fiberglass Reinforced Polyester (FRP) material, one-piece or multi-segment for easy access to fill media, capable to withstand chemical resistance against corrosion, ultra-violet radiation and thermal shock.

8.2.3.1.2 All galvanized steel components such as ladder, fan guard, motor support, tension bar, filling support, etc. shall be corrosion protected, pretreated in hot dip process according to BS 729. Bolts & nuts and suction strainer shall be of stainless steel.

8.2.3.2 Description

8.2.3.2.1 The fan motor shall be TEFC vertical mount direct or V-belt drive with multi-blade propeller or axial flow fan. The fan shaft shall be with reducing gear box and supported by ball-bearings with moisture proof seals. Motor protection shall be as specified in data sheet.

8.2.3.2.2 The bearings shall be designed for a minimum life of 40,000 hrs. The inlet louvers shall be FRP, fan of ABS or Aluminum alloy, the rotating or stationery sprinkler system of durable alloy, the in-fill in circular configuration with material of rigid PVC per ASTM E-84. The float valve shall be of copper alloy.

8.2.3.2.3 The basin shall be provided with connection for water inlet, water outlet, water make-up, quick-fill, overflow and drain.

8.2.3.2.4 The suction tank to be of FRP galvanized steel or concrete. The FRP basin shall be one-piece either rectangular or cylindrical type.

8.2.4 Horizontal or vertical shell & tube condensers

8.2.4.1 General

8.2.4.1.1 The water cooled condensers shall be of the straight tube construction with removable multi-pass heads at both ends. They shall include gas inlets with impingement plates, liquid outlet and vortex plates and relief connections on the shell, and water inlet and outlet drain connections on the heads. It shall be complete with dual relief valve assembly set at 10% above maximum allowable working pressure, sized to code requirements.

8.2.4.1.2 Depending upon the application, the quantity and temperature of water system, design pressure and refrigerant used, condenser tubes shall be of steel or copper of the plain or extended surface type.

8.2.4.1.3 The condenser heads shall be carefully proportioned and baffled to distribute the circulating water through the tubes in such a way as to provide equal velocities through tube areas.

8.2.4.2 Shells

The shells shall be constructed of steel pipe conforming to ASME specification SA-53 Grade B, seamless or resistance welded; or rolled steel plate to ASME SA-516 Grade 70 with electric fusion welds conforming to ASME Boiler and Pressure Vessel Code Section VIII, Division 1.

8.2.4.3 Tubesheets

Constructed to ASME specification. SA-516 Grade 70, the cylindrical grooves shall be precision machined in each reamed tube opening counter bored to flaring end of the tube in the sheet. Sheets shall be machine submerged arc-welded to the condenser shell.

8.2.4.4 Heads

Constructed of fabricated carbon steel or cast iron with integral baffles to provide the proper number of water, brine or refrigerant passes through the tubes. Air vents shall be provided on condenser head with hand valves for manual purging.

8.2.4.5 Tubes

Constructed of steel, copper or alloy tubes of various diameter and gages. Extended surface copper tubes shall be used for halocarbon refrigerant. All tubes shall be fastened securely into the tube plate, by expansion into multiple groove holes with an electronically controlled tube rollers, to form a leak-proof joint. The multipass condensers with ammonia shall conform to ASME specification SA-214 and with halocarbon refrigerant shall conform to SB-359.

8.2.4.6 Supports

Depending on the type of mounting, the structural steel supports shall be accordingly constructed of welded pipe for verticle type and with cast iron or steel saddles suitable for single or multiple shell arrangements for horizontal type.

8.2.5 Air cooled condensers

8.2.5.1 General

8.2.5.1.1 The units shall be arranged for vertical or horizontal air discharge, suitable for halocarbon refrigerants with multi-fan sections compartmented to allow individual fan cycling.

8.2.5.1.2 The housing, fan sections, coil side baffles, leg supports and fan guards shall be provided with corrosion resistant coating such as textured aluminum vinyl coating or hot dip galvanized after fabrication.

8.2.5.1.3 The fins shall be copper or polyester or vinyl coated aluminum as specified on data sheet.

8.2.5.1.4 When necessary, access doors shall be provided for coil cleaning, inspection and service.

8.2.5.1.5 Necessary protection from headwinds, winter operation etc. shall be provided as required to fulfill maximum safety requirements.

8.2.5.2 Condenser coil

8.2.5.2.1 The condenser coil shall be of copper tubes mechanically expanded into corrugated full collared (aluminum plate) fins spaced either 8/10/12 fins per inch.

8.2.5.2.2 Tube sheets shall be aluminum alloy with tube collar preventing tube wear due to uneven thermal expansion.

8.2.5.2.3 Arrangement for liquid sub-cooling shall be provided when temperature difference between liquid outlet temperature and entering air temperature is higher than 8.33°C (15°F).

8.2.5.3 Fans/fan motor

8.2.5.3.1 The fans shall be multi-blade propeller type with fan guards, direct drive with precision for uniform air distribution through the coil.

8.2.5.3.2 For optimum efficiency venturi-fan orifices shall be provided.

8.2.5.3.3 The TEFC fan motors shall be weather resistant and storm proof, sealed ball bearing type with inherent overheat protection in each phase, shaft slingers, enclosure, hardware and insulation for all weather conditions.

8.2.5.3.4 Each motor lead shall be wired to terminals in a junction box or control panel. For fan motor starter type, reference is made to clause 8.9.3.3 of this Standard.

8.2.5.4 Controls

Automatic head pressure control (for maintaining the condensing pressure), fan cycle control and refrigerant flooding control methods shall be provided as required by UL standards, complete with fuses and circuit breakers housed in a weather-proof panel.

8.3 Evaporators

Different types of evaporators and air cooler units shall be as follows:

1) Air cooling units.
2) Ceiling mounted cooling coils.
3) Shell & tube evaporators.
4) Freezing units.

8.3.1 Air cooling units

8.3.1.1 Grouping

Due to its wide range and type, the air cooling unit shall be divided into three specific group:

GROUP A:

Ceiling suspended direct driven with propeller fans, low silhouette air coolers suitable for reach-in and walk-in coolers and freezers to operate with halocarbons refrigerant through direct expansion feed. The air flow shall either be blow-through or draw-through. The defrost arrangements shall be air, electric or hot gas system. Each unit shall operate with single or double fans.

GROUP B:

Ceiling suspended direct driven with propeller fans, draw-through or blow-through air flow. The unit shall be suitable for all refrigerant, operating through any feed, with any type of defrost arrangement, having relatively low noise level on the 'A' scale (67 to 77 dB). Each unit shall operate with single or multi-fans.

GROUP C:

Ceiling suspended or floor mount centrifugal or axial fans, draw through or blow-through units for heavy duty high air volume application, direct drive or V-belt arrangement, designed for medium temperature coolers, freezers and blast freezers. These units shall be capable of accommodating when required, flat filter section and motorized damper with linkage.

8.3.1.2 General description

The following general description shall comply:

a) For flooded ammonia operation with hot gas defrost an ASME stamped surge drum shall be fitted with internal level float.

b) The defrost arrangement shall be either through air (off cycle), hot gas (coil & drain pan) electric (coil & drain pan) and water defrost.

c) Suitable access doors shall be provided for inspection and motor removal and/or for easy installation and service of different feed valves and connections.

d) Fin spacings shall be for 8.5, 6.3 or 4.2 mm (3,4 or 6 fins per inch) and coil connections available for either left or right hand.

e) TEFC or totally enclosed air over (TEAO) motors shall be available with either single speed or two speed.

f) The casing (housing) shall be fabricated of hot dip galvanized sheets. Air coolers with stainless steel casings shall be made available as specified in data sheet.

g) The air coolers shall have space provisions for heating element with thermostat for re-heating, pre-heating or fruit (banana) ripening arrangements, as required per job application.

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

8.3.1.3 Explosion proof units

8.3.1.3.1 The explosion proof units shall be available with following features:

I) The housing and drain pan shall be of aluminum, circuited for halocarbon refrigerant.
II) NEC class 1, group C or D in divisions.
III) Insulated drain pan with liquid line heat tracing for hot gas defrost.
IV) Explosion proof temperature controllers.
V) Spark-proof fans.
VI) Chemical resistant coils.

8.3.2 Ceiling mounted cooling coils (for ammonia and brine)

8.3.2.1 Coils

The coils shall be fabricated in sections, hot dip galvanized after fabrication (in the case of threaded ends these shall be capped before galvanizing). The coil assembly shall be duly shot blasted inside.

8.3.2.2 Fins

The fins shall be square 177.8 × 177.8 mm (7" × 7") from 1.6 mm or 2 mm (16 or 14 gage) galvanized steel with rounded corners, spaced at 25.4 mm or 38 mm (1" or 1½") centers as required.

8.3.2.3 Accessories

8.3.2.3.1 A double decked polystyrene or galvanized drip trough fabricated from suitable material, shall be provided to prevent flow of condensate below.

8.3.2.3.2 Trough hanger shall be provided with hanger bolts formed to fit external dia of pipes or tubing.

8.3.2.3.3 The hot gas defrosting arrangement shall be automatic and thermal valve shall be provided for day or seasonal storage.

8.3.2.4 Manufacturers shall quote, as alternate, their standard up-to-date products designed according to latest technology which shall be subject to the final approval of the customer.

8.3.3 Shell & tube evaporators (coolers & chillers)

8.3.3.1 General

The shell and tube cooler shall be used when refrigeration must be fed to various parts of the building by cold brine or water cooling as secondary medium through ammonia or halocarbon refrigerants. Pertinent contents of Clause 8.2.4.1 shall apply.

8.3.3.2 Description

8.3.3.2.1 The liquid coolers for halocarbons shall be direct expansion and flooded type with refrigerant in the tubes and water or brine in the shell.

8.3.3.2.2 The pipes for water coolers shall be plain or internal finned copper tubes and those for brine coolers shall be of steel tubes.

8.3.3.2.3 The ammonia liquid cooler shall be connected with flooded accumulator through different risers and stub section outlets and sampling connections.

8.3.3.2.4 The brine medium cooler, operating with either ammonia or halocarbon refrigerant shall include, but not limited to, the following:

a) Reflex glass lense type gage glass with frost shield and valves.

b) Freeze protection thermostat & flow switch.

c) Automatic oil bleed system consisting of oil still with heater, thermostat, solenoid valve, level gage, relays, light, control etc.

d) Liquid feed system consisting of collecting drum with two float switches and liquid line solenoid valve with strainer.

e) Liquid reservoir for refrigerant.

f) Oil receiver.

8.3.3.3 Shells

Clause 8.2.4.2 shall apply for evaporator application only.

8.3.3.4 Tubesheet

Clause 8.2.4.3 shall apply but for evaporator application only.

8.3.3.5 Heads

Clause 8.2.4.4 shall apply but for evaporator application only.

8.3.3.6 Tubes

Clause 8.2.4.5 shall apply for evaporator application only.

8.3.3.7 Supports

Clause 8.2.4.9 shall apply for evaporator application only.

8.3.4 Freezing units

8.3.4.1 General

The factory assembled industrial quick freezing packaged system shall be so designed to prevent dehydration, shrinkage, weight loss or discoloration of perishable food.

Common freezing units are briefly described, the detailed description of which shall be the responsibility of reputed suppliers.

8.3.4.2 Description

8.3.4.2.1 Continuous automatic freezer with single or twin belt design offering simultaneous freezing of two products requiring different freezing time. The belts shall operate spirally to freeze packaged portion of fruits & vegetables, pies, meat, prepared dinner tray-pack protein items, ice cream novelties and bakery products.

8.3.4.2.2 Air blast freezer for the freezer tunnels shall be individually designed with wide fin spacing. In such applications hipowered blower motors shall be available for hi-external static air pressures. The blast freezers shall be floor mount or suspended type designed for delivering between 3050 to 3400 m^3/hr (1800 to 2000 CFM) per ton of refrigeration.

Notes:

1) Above items shall be capable of operating automatically and economically through any suitable defrost arrangements (hot gas preferred) complete with safety components and indicating switches.

2) For other methods of freezing namely brine immersion and contact plate freezing refer to manufacturer's standard equipment.

8.4 Refrigeration Related Equipment

The refrigeration related equipment commonly used in typical cold store and ice plant application are as follows:

a) Horizontal liquid receiver (high-pressure);
b) Oil separator;
c) Gas & liquid intercooler (coil & flash type);
d) Liquid sub-cooler;
e) Suction accumulator or surge drum or suction trap;
f) Air purger (non-condensibles);
g) Recirculation package (low-side).

8.4.1 Liquid receiver

8.4.1.1 General

The liquid receiver shall be adequately sized to accommodate for the fluctuating charge in the low side, provide pump-down storage capacity and capable to handle as back-up about 30% extra charge for future plant expansion program.

8.4.1.2 Description

8.4.1.2.1 It shall be cylindrical design for horizontal mount complying to ASME Code Section 8 Division 1. All connections shall comply to ANSI/ASME B 31.5 1985. It shall be hydrostatically tested at 1.5 times design pressure. After testing and cleaning, connections and tappings shall be plugged, or capped accordingly.

8.4.1.2.2 The unit shall be equipped with standard accessory package as required per job application, including, but not limited to, the following:

a) Hot gas connection (for hot gas defrost);
b) ANSI flanged valves with companion flanges and bolts and nuts;
c) Connections for purge, equalizing (gas/liquid) and drain, charging valve plus dual safety valves;
d) Liquid level armored gage glass or magnetic/electronic level indicator type.

8.4.2 Oil separator

8.4.2.1 General

A properly sized oil separator shall be mounted and suspended as far from the compressor as possible and capable to accomplish these desirable objectives:

a) Assure adequate compressor lubrication.
b) Reduce sound level created by pulsation.
c) Reduce running time and minimize power consumption.
d) Allow expansion device to operate at peak regulating efficiency.
e) Assure continued maximum heat transfer of the evaporator.
f) Separate entrained oil from the discharge gas automatically returned to the compressor crankcase.

8.4.2.2 Description

8.4.2.2.1 The oil separator shall be scrubber or coalescent type consisting of a cylindrical shell containing an oil separation pad of interlocking type, 304 class stainless steel (s/s) mesh conforming to relevant codes.

8.4.2.2.2 The unit shall be complete with gas inlet & outlet connection, filter on the down stream, baffle pad, oil connection with oil float for automatic oil return to crankcase, safety valve and drain valve, and (subject to site ambient temperature) with 220 V oil heater & thermostat.

8.4.3 Gas & liquid intercooler

8.4.3.1 General

8.4.3.1.1 Designed for installation in the booster discharge line (high-stage suction) it subcools liquid ammonia from the receiver for the low stage load while desuperheating booster discharge gas to the high stage compressor. Desuperheating of booster discharge gas is necessary to prevent over heating of the hi-stage compressor.

8.4.3.1.2 Sub-cooling of liquid refrigerant for the low stage load is essential to obtain economical thermodynamic efficiency of the refrigeration cycle.

8.4.3.1.3 Per job application either the vertical type shell & coil intercooler or horizontal flash intercooler may be used.

8.4.3.2 Description

8.4.3.2.1 The gas & liquid cooler shall consist of a vertical shell containing a stainless steel mist separator pad and liquid cooling coil.

8.4.3.2.2 It shall be ASME designed and furnished with standard connections including, but not limited to, the following:

a) Float control valve.
b) Safety valve & oil drain valve.
c) Vapor in, vapor out connection, vapor and liquid equalising connection, etc.

8.4.4 Liquid subcooler

8.4.4.1 General

8.4.4.1.1 In a two-stage halocarbon compression system, liquid refrigerant sub-cooling is essential for maximum efficiency. The shell and tube sub-cooler, shall be designed to cool liquid refrigerant for the low temperature load, by passing the liquid through the baffled shell (sub cooler circuit) while the refrigerant gas is expanded in tubes of the evaporator circuit.

8.4.4.1.2 It is also called the "liquid-suction heat exchanger" that is, it sub-cools the liquid refrigerant and superheats the suction gas.

8.4.4.2 Description

8.4.4.2.1 The subcooler shall be designed for 1379 kPa (200 psig) with segmental baffles precision machined to the inside diameter of the shell.

8.4.4.2.2 The copper tubes shall be brazed into brass tube sheets and inner fins on tube shall be provided for increased heat transfer.

8.4.4.2.3 The unit shall be ASME designed and have liquid outlet & inlet connection, suction connection, expansion device connection and drain connection.

8.4.5 Suction accumulator

8.4.5.1 General

8.4.5.1.1 Primarily used with flooded evaporators, the suction accumulator is also called surge drum, knock-out drum, liquid separator and suction trap; designed for installation in the main suction line between the evaporator and the compressor to provide positive compressor protection from liquid slugging. Separation of entrained liquid from the suction gas stream is accomplished by heat, velocity reduction, flow directional change and impingement of the suction gas against baffles or S/S mist eliminator pad.

8.4.5.1.2 Sizing shall allow proper separation of liquid from the gas, and also to provide surge space for temporary storage of liquid during hot gas defrost period.

8.4.5.2 Description

8.4.5.2.1 The suction coil accumulator shall consist of a vertical shell or horizontal type as specified with heating coil and eliminator pad.

8.4.5.2.2 The unit shall be provided with standard fittings and connections, including oil bleed connection with oil drain valve, high level control with shut-off valves, dual safety valves, welded or threaded connections, built to meet ASME code.

8.4.6 Air purger

8.4.6.1 General

Suitable for all refrigerants and of either automatic or manual type. An air purger is required to purge the non-condensable gasses to the atmosphere in order to maintain a normal condensing pressure.

8.4.6.2 Description

8.4.6.2.1 The air purger shall consist of cylindrical steel shell of high carbon steel and cooling coil of spiral shaped or similar.

8.4.6.2.2 The vessel shall be complete with inlet and outlet connections, operational valves, liquid level sight gage glass, relief valve and mounting support.

8.4.6.2.3 It shall be tested upto minimum 30 kg/cm^2 hydrostatically duly ASME designed with all tappings capped.

8.4.8 Recirculation package

The recirculation package shall be factory piped wired and tested complete with liquid separator (accumulator assembly) necessary controls and indicators, ammonia pump (for recirculation) together with valves, pipes and fittings. The ammonia pump shall be mounted on a common steel base with one pump as 100% stand-by.

8.5 Automatic Control System

8.5.1 General

8.5.1.1 Complete system of automatic temperature and refrigerant control for the refrigeration plant shall be designed per project application, strictly maintaining the concept of energy management.

8.5.1.2 For remote readings, tappings and adjustings, heads of all instruments shall be placed at convenient eye-level points, employing wherever necessary, armored tubing to accomplish this arrangement.

8.5.1.3 For motors, motor starters, disconnect switches, relays wiring, control panel etc. reference is made to IPS-M-EL-142 and to Clause 8.9 of this Standard.

8.5.2 Refrigerant control valves

8.5.2.1 General

8.5.2.1.1 All valves and devices are used to start, stop, direct and modulate the flow of refrigerant to satisfy the system requirements in accordance with load and design application.

8.5.2.1.2 The valves and devices shall be selected from approved manufacturer's tables, capacity ratings supported by timing chart, electrical diagram.

8.5.2.2 Solenoid valves

8.5.2.2.1 Solenoid valves (direct acting) with pilot light assembly self-contained allowing for visual observation of valve operation shall be provided such that when the solenoid coil is energized the pilot is lit and when de-energized the pilot is off.

8.5.2.2.2 The piston powered (through condenser gas) heavy duty (indirect acting) solenoid valve shall be suitable for low pressure drop and low temperature suction lines, designed to fully open or close under conditions which at times make conventional solenoid valves unreliable. This valve shall be two-position hermetically sealed using condenser gas pressure acting upon a piston for opening motive power and a strong spring for closing motive power.

8.5.2.2.3 The solenoid valve shall be heavy duty direct acting or pilot-operated positive lift, held open electrically, controlling flow of refrigerant liquid or gas, designed for halocarbon or ammonia liquid line, suction line, gas line, brine and water line application. It shall be packless, quick in operation with powerful moisture resistant coil, corrosion resistant materials, come-apart construction for easy cleaning and service. It shall be mounted on horizontal line with solenoid coil on top. For safety it is advisable to furnish a 100 micron S/S screen strainer, upstream of each valve. The body shall be cadmium-plated, steel alloy or semi-steel.

8.5.2.3 Expansion valves

8.5.2.3.1 The thermal expansion valve shall be externally adjustable designed for all refrigerant, rugged in construction and come-apart features with body of corrosion resistant, complete with internal equilizer, sufficient remote bulbing and superheat connections.

8.5.2.3.2 The Electronic expansion valve with body of steel shall be externally adjustable capable of handling refrigerants of different pressure and temperature.

8.5.2.4 Back pressure regulators

8.5.2.4.1 The back pressure regulator shall be available in all standard voltages so that when electric voltages or pneumatic pressure are cut-off, the evaporator pressure at regulator inlet will continue to be controlled at the evaporator pressure which existed when power failure occurred.

8.5.2.4.2 The electrically or pneumatically compensated back pressure regulator controls evaporator temperature in response to the electrical signal of a remote potentiometer type bulb of a temperature controller. In response to the air pressure received from a thermostat or humidistat it shall control product cooling where load fluctuations are great or where load is fairly constant but very close temperature control are desired.

8.5.2.4.3 The pilot operated back pressure regulator shall conform to ARI-770-84 handling constant pressure for control of lower limit of evaporation pressure.

8.5.2.5 Liquid level controls

8.5.2.5.1 The liquid level control shall be electric or electronic type, suitable for level controlling designed for ammonia refrigeration plants in flooded evaporators. These controls shall be used on various applications of liquid return system.

8.5.2.5.2 The level control shall consist of a float housing of gas tight rugged construction, with a ball float, water proof pilot coil, control relay, etc. The control shall be able to withstand direct liquid temperature of -45°C and yet able to operate on 45°C dry bulb ambient conditions.

8.5.3 Float control regulators

The float control regulator shall consist of needle or piston steel valve mounted on a cast semi-steel head attached to a hollow semi-steel body containing float ball valve and valve seat. It shall be stamped, steel welded with welded tapped lug for float rod, tested at 50 kPa pressure. The two common types shall be as follows.

a) Designed for ammonia refrigerant the float control valve (or low pressure float) shall be used as an evaporator liquid level control of air coolers, brine coolers or where the float valve is located at a height corresponding to the desired evaporator liquid level.

b) Float expansion valve (or high pressure float) are recommended for systems containing one evaporator to maintain a liquid seal between the high & low side of the system. Evaporator liquid level is dependent upon correct charging of the system.

8.5.4 Control accessories

8.5.4.1 The Thermostatic water valve shall be bronze-trimmed for controlling of cooling water for the compressor cylinders.

8.5.4.2 The room thermostat shall be either on-off or modulating, single or dual acting, integrated with humidity control of chambers, designed for wall(with sub-base) or unit mount suitable for interlocking with fan, solenoid valves, as per job requirements.

8.5.4.3 The moisture indicator and sight glass shall be provided on all halocarbon circuit liquid lines.

8.5.4.4 The filter drier shall be suitable for all halocarbon refrigerants, either molecular sieve or silica gel dessicants and for large plants shall be with replaceable core and removable filter element type.

8.5.4.5 The low pressure control, high pressure control, dual & differential controls plus other standard safety components and switches shall be integral part of the compressor manufacturer's product.

8.6 Defrost Kit

8.6.1 General

Whether for hot gas, electric, air and water defrosting, the air cooler manufacturer shall be responsible to provide the complete defrost kit as required per standard upto-date items, operating automatically in sequence of design requirements. It shall be supported by a typical piping hook-up and electrical diagram.

8.6.2 Description

8.6.2.1 The defrost kit shall be provided with standard items together with an electronic frost sensor (efs) to intimate a defrost cycle only after pre-set volume of frost has been accumulated on a given fin tube air cooler.

8.6.2.2 The defrost kit shall be inclusive of adjustable delay timer for delaying the closing of a solenoid valve and temporarily unload compressor discharge during motor starting.

Notes:

Standard defrost kits which meet requirements of plant operation and approved by air cooler manufacturer, shall be accepted as approved alternative.

8.7 Energy Management & Automation System (EMAS)

8.7.1 For sophisticated yet simple installations,arrangements in compressor panels and other control panels, shall be such that system customization through direct digital control (ddc) type shall be provided.

8.7.2 Through digital signal it shall be able to monitor and display temperature, pressure, humidity, flow , malfunction, operation, status maintenance and preventive maintenance.

8.7.3 All datas on system such as fire alarms, lighting circuits, emergency generators, conveyer belting, security doors, clock, etc. shall also be capable of being integrated with the EMAS System.

Note:

1) The EMAS design and quality control shall work in close coordination between the consultant and the manufacturer.

2) A customized engineered design and well-trained operating personnel shall be required to deliver the correct system for the site at correct price.

3) For proper EMAS approach a special software shall be documented and submitted by the supplier.

8.8 Probes and Setpoints

The manufacturer of compressor, air cooler and other system shall provide, where required, arrangements for inserting multiple highly sensitive thermistor or other upto-date probes for automatic detection of equipment malfunction.

8.9 Electrical Equipment

8.9.1 General

8.9.1.1 The selection of motors for high stage applications shall be based on design operating conditions complying to IPS-M-EL-132.

8.9.1.2 Motors for booster applications shall be sized for start-up and pull-down duty as well as for the design condition.

8.9.1.3 Motors for screw and reciprocating compressors shall be factory tested, wired and mounted.

8.9.1.4 The starter packages for screw compressors shall be inclusive of all necessary interlocks prewired to terminals numbered for direct connection to the unit's junction box.

8.9.1.5 The manufacturer is responsible for careful analysis of compressor (particularly screw) torque requirements versus the available motor starting torque. (At worst portion of this curve, the motor torque should exceed the compressor torque requirement by a minimum of 20%.)

8.9.2 Motors

Motor shall be integrated squirrel cage induction AC motors, normal torque 4-pole construction, minimum protection class IP 23 suitable for over 20% of compressor torque requirements and applicable starter package as indicated in the data sheet.

8.9.3 Starters

8.9.3.1 For reciprocating and rotary vane compressors the starters shall be star-delta combination open circuit transition type, NEMA type 1, general purpose enclosure with 3-pole contactor and overload protection, 220 V holding coils, overload element and built-in H-O-A mounted selector switch.

8.9.3.2 For screw compressor the starters shall be closed transition, star-delta combination starter with control panel transformer, NEMA 1 enclosure, oil pump starter, compressor motor current transformer, main circuit breaker disconnect with motor overcurrent protection with prewired appropriate interlocks.

8.9.3.3 When used with reciprocating compressors for block ice plant (conventional type), reduced voltage autotransformer type shall be used.

8.9.3.4 Type of starters for evaporative condenser fan and motor, ammonia pump motor the air cooler fan motor and all other electric motors, except compressors shall be as follows:

- Direct-on-line for upto 1 HP Motors.
- Across-the-line for 1½ HP and over.

8.9.4 Central control panel

8.9.4.1 Microprocessor control center

System Microprocessor free-standing panel for controlling and monitoring all major equipment, defrosting evaporators, alarm annunciation and shutdown at preset failure conditions shall comprise of, but not limited to, the following:

- 3 sets 8" system gage.
- Time clock.
- Microprocessor screen for display of various functions.
- Head pressure control, condenser fans and pump auto cycling.
- Automatic defrosting of evaporators.
- Compressor status.
- Alarm and shut-down levels of liquid ammonia (based on feeds).
- Temperature of the liquid ammonia in various pipes of the system.
- Room temperature on various areas of the system.

8.9.4.2 Main low voltage panel board (MLVP)

The MLVP shall be metal clad in multicubicles allowing for manual and automatic continuous operation. The MLVP shall be inclusive but not limited to, the following components:

a) Motive power

- Three ammeter
- Transformer
- General voltmeter (0-500 V)
- Voltmetric change-over switch
- Voltmetric pilot lights
- Three-pole automatic general switch, magnetothermal type
- 3 phase bus bars with bus bar for earthing
- Terminal point

b) Main equipment

Compressors, evaporative condensers and unit air coolers shall be protected with:

- Ammeters
- Transformers
- Thermal relays
- Fuses
- Timers (for compressors only)
- Hour meters (for compressors only)
- Multiple position selectors
- Signal lights
- Name plates

c) Automation

Solenoid valves, thermostats, pressure switches on main lines and vessels shall be furnished with:

- Auxiliary relays
- Timers
- Programmers
- Fuses
- Single-stage transformer
- Multiple position selectors
- Signal lights
- Terminal points

PART II
GENERAL SPECIFICATION FOR ICE PLANTS

9. ICE PLANTS

9.1 General

9.1.1 There are various methods of producing clear, hard long lasting ice in various thicknesses and weights. They can be stored in refrigerated rooms, bagged manually, automatically conveyed or blow through loose.

9.1.2 Types

The two common methods of producing ice for industrial or heavy commercial applications are:

a) Block ice
b) Flake (fragmented) ice

9.1.2.1 Block ice can be produced through conventional brine (NaCl or $CaCl_2$) tank method or through the latest version of Packaged System. The latter requires less space, requires less than 2 hours freezing time and the installation and start-up cost are much cheaper than conventional type.

9.1.2.2 Transportation of block ice however are easier as they do not require refrigerated enclosures during transport plus it melts much slower than other forms of ice. The Block ice can be maintained in a -2.8°C storage temperature as compared to -17.7°C for small pieces of ice . They are commonly available in 25 kg and 50 kg blocks, also capable to operate when required with sea water.

9.1.2.3 Flake or fragmented ice is a thin ice generally made on the surface of a cylinder (pipes-tubes) and its thickness is normally limited as the mechanisms tend to chatter and harvesting becomes difficult. These ice are suitable for fish trawlers, packing fresh protein products, dairy products, concrete cooling, chemical processing applications etc.

Note:

1) Other methods of ice producing are the crushed ice, chipped ice, also ice in cubes, ribbons, discs or slabs suitable for commercial and residential application.

9.2 Packaged Flake Ice Plant

9.2.1 General

9.2.1.1 Basically for use with halocarbons and ammonia refrigerant it shall consist of freezing section, harvesting section and control panel. These shall be factory tested and assembled but for ease of handling and installation they may be shipped in various sections.

9.2.1.2 The unit base, motor base and the steel frames shall be hot-dip galvanized; the accumulator, refrigerating piping and gage lines shall be zinc-coated.

9.2.2 Freezing section

9.2.2.1 The freezing section shall consist of refrigeration zone and ice freezing zone separated by oversized stainless steel drip pan.

9.2.2.2 The refrigeration section shall include accumulator and float switch, oil and liquid traps, automatically operated suction, liquid and hot gas valves. Ice freezing zone shall include stainless steel tubes with refrigerant circulating inside and water supply directed to outer surface.

9.2.3 Ice harvesting section

The ice harvesting section shall include stainless steel water collection tank with water float valve and circulating pump, motor driven ice breaker, stainless steel grid for directing ice flow, stainless steel deflector sheets around the ice breaker and lower portion of tubes.

9.2.4 Control panel

The control panel shall include cycling clock, relays & wiring all enclosed in a suitable box. Tube feeler arms shall be connected to the control box to regulate recycling. Magnetic starters shall be furnished for 380V/3 phase/50Hz ice breaker motor and standard pump motor. All external wiring between control panel, solenoid valves, motors & starters shall be available for field erection.

9.3 Block Ice Plant-Conventional Type

9.3.1 General

The block ice plant suitable for flooded operation with ammonia refrigeration shall be supplied in sections described below. All sections shall be provided with drawings and instruction for proper field mount and operation. The sections shall be arranged with clear identification for facilitating transportation and re-assembly at site.

9.3.2 High side system

9.3.2 The high side system shall comprise of the following:

1) Compressor and drive:

a) Heavy-duty industrial type reciprocating compressor complete with all standard controls, complying to clause 8.1.1 of this Standard.

b) The drive shall be direct drive or v-belt drive as mentioned in the data sheet.

c) The motors shall be squirrel cage induction type, complying to clause 8.9.2 of this Standard.

d) The starters shall comply to clause 8.9.3.3 of this Standard.

2) Condenser

The condesnser of suitable capacity shall be shell and tube type complying to clause 8.2.4, or evaporative condenser complying to clause 8.2.1 of this Standard.

3) Liquid Receiver:

The liquid receiver of suitable capacity shall comply to clause 8.4.1 of this Standard.

4) Oil separator:

The discharge line oil separator shall comply to clause 8.4.2 of this Standard.

5) Gas purger

The non-condensible gas purger shall comply to clause 8.4.6 of this Standard.

9.3.3 System piping

Complete set of ammonia pipes and fittings, similar to schedule 40 ASTM A53 grade B or ASTM A120 based on close grouping of equipment and the manufacturer's approved design.

Necessary line control valves shall also be provided for proper system balancing and proper operation. The water piping and fittings shall be similar to BS 1387 medium weight galvanized pipes.

9.3.4 Freezing system

The freezing system and components shall comprise of the following:

a) Freezing tank

Shall be precut of mild steel plate of note less than 6 mm (¼") thick, complete with all necessary cross buffles for arrangements of ice can with suitable raceway along length of tank for submerged brine cooler coil. The tank shall be in sections shipped disassembled for field welding , included with wooden lid and can covers.

The framework shall be rigidly braced and reinforced on top of the tank to form cells for the cans.

b) Evaporator:

The evaporator shall be submerged shell and tube type, fabricated with schedule 40 pipes in serpentine or herring bone design in suitable length and adequate heat transfer surface. The coil shall be complete with accumulator, float control valve and by-pass manifold. The accumulator shall comply to clause 8.4.5 of this Standard. Necessary square front head, circular rear head, supports, safety and other standard components shall also be provided. The coil shall be rigidly braced.

c) Brine agitator

The brine agitator shall be vertical type (mounted on top of the brine tank) arranged for V-belt drive or direct drive (the latter is preferred) with suitable propeller diameter and standard electric motor to maintain exact brine velocity and minimum brine temperature difference throughout the freezing tank.

d) Ice cans

The ice cans shall be in standard 25 kg size fabricated from heavy gage galvanized sheet steel and feature rugged all welded construction. Can bottoms shall be extra heavy for added corrosion resistance and strength. Advanced welding method shall prevent damage to galvanizing inside the can. Cans shall be tapered and the inside seams shall be flat and smooth, permitting easy ice removal with minimum meltage.

A strong steel band (guide) of flat shape and hold-down clip shall be provided at the top for hoisting single can or for attaching cans to grid for a multiple can lift.

e) Can and raceway covers

Can covers, depending on plant size, shall be designed for one or more cans, built to fit snugly and lie uniformly flat on top of the fans or grids.

All covers shall be with edges sealed and built preferably of top quality pine (for sanitation) and durability purposes) with two layers of 1.9 cm (¾") wooden boards separated by a layer of water-proof, furgus resistant material. After fabrication, covers shall be painted with linseed oil for positive moisture protection.

Sectional covers for the brine raceway of the freezing tank shall employ similar fabrication techniques as the can covers.

f) Brine test kit

A brine test kit shall be provided for measuring and maintaining freezing temperature of brine and anti-corrosion treatment.

9.3.5 Harvesting system

The harvesting system shall comprise of the following:

a) Crane and hoist

The overhead electric crane and hoist, sized to match grids and plant capacity, (for removing cans from the freezing tank) shall be provided complete with lift, cross beam assembly, trolley wheels, track rails, wiring and mounting hardware. Depending on plant size it shall be designed to lift 1 to 50 cans. All travelling and traversing shall be driven by suitable electric motors. Each can lift arrangement shall be carefully selected for the most economical operation with the lowest initial investment.

Note:

For plants upto 1½ ton capacity, a hand winch or a chain block, suitable to hoist upto two cans, shall be provided.

b) Steel Grids (baskets)

These shall be provided for plants 25 ton and larger, to permit harvesting a group of 4 or more cans, lifted at intervals of not less than 30 minutes at a time with sufficient weight to insure that cans are properly submerged.

The steel grid system shall replace the tank framework supporting the can and raceway covers directly.

c) Dip tank

A steel dip tank fabricated of welded steel sheet 4 mm thick shall be provided for thawing the peripheral portion of ice loose from the can(s). (The tank is filled with warm water and after dipping the cans shall be transferred to the can dump). The tank shall be coated with rust proof paint.

d) Can dump

In order to allow ice block to spring out of cans, ice cans are lifted into a can dumper and overturned. The type of can dumper shall be any of the following:

i) For loose can plants the can dump shall consist of a steel framework rigidly supported by triangular floor stands. The steel framework shall be lined with lumber for can protection.

ii) For larger plants(over 15 tons) equipped with a grid system, a balance type dump with pivoted base support shall be provided. With this harvesting system the hoist lift hooks shall remain engaged with grid lift pins throughout the harvesting cycle.

e) Can filler:

The can filling steel tank, used for filling raw water into several cans at one time in one operation, shall be furnished with suitable water level control. The type shall be any of the following:

i) In small plants, (made to fit inside the automatic can filler) shall be for direct connection to the water supply line. These shall be designed with a brass float ball to automatically shut-off the supply when the can water level has reached the desired level.

ii) For plants 15 tons and larger, tank type can fillers shall be provided for filling the can at the dump. Cans shall be filled simultaneously and be able to automatically deliver the exact quantity of water to each can. The tanks shall be supported on a steel frame by either wall brackets or floor stands.

9.3.6 Air agitation system

a) Air blower

To produce transparent ice for tens and larger, raw water in ice cans shall be continuously agitated by an air blower. The air blower shall be low pressure rotary or roots type arranged for v-belt drive designed to work at a pressure of 0.15 kg/cm^2. Where required, the air blower shall be equipped with air receiver for eliminating the pulsation of air and for separating oil out of the air discharged from the air blower.

b) Core sucker pump

The core sucker vacuum pump shall be to adequate size and capacity, capable to suck the impurities (foreign matters) concentrated in the center portion of the ice can.

c) Air fittings and thawing needles:

Necessary air fittings with drop tubes, brackets and hose, set of air connections, including air suction and supply headers with laterals together with throwing needle with hose and water connections shall be furnished.

9.3.7 Air cooling units (for storage rooms)

The ceiling mounted air cooling unit shall be provided for flooded operation to maintain an approximate storage temperature of -10°C, complying to clause 8.3.1 of this Standard.

Note:

An ice block stacker may be provided for the storage room. The ice stacker is used for stacking up ice blocks over one another. Although these come in stationary or movable type built the former is normally preferred.

9.3.8 Miscellaneous items

a) Insulation:

i) The freezing tank insulation shall be of expanded polystyrene 10 cm (4") thick, to cover bottom and all sides of tank.

ii) Low pressure gas lines, shall be insulated with pre-formed fibreglass insulation 5 cm (2") thick with vapor proof barrier.

iii) The storage room insulation shall be expanded polystyrene 10 cm (4" thick) at 30 kg/cm^3 density for walls and ceilings and at 40 kg/cm^3 for floor.

b) Electrical

The electrical equipment shall match motor starters for ice block plant, including plant entrance, entrance disconnect, panels, short circuit breaker connection boxes, conduit, galvanized tray for and with wiring and cables, connectors and accessory equipment as required to make complete power installation.

Except for compressors, the type of starters for other relevant electric motors shall comply to clause 8.9.3.3 of this Standard.

c) Testing

The complete refrigeration system including suction and discharge lines and condenser lines shall be tested at 967 m bar (28" Hg) vacuum capable to be held for 24 hours. The system shall be pressure tested at not less than 2068 kPa (300 Psi) without any trace of leaks.

9.4 Block Ice Plant Packaged Type

9.4.1 General

9.4.1.1 These packaged machines represent both high-side and low-side equipment including the freezing tank, heat exchangers, brine circulators, reciprocating or screw low stage compressor with motor, evaporative condenser, all pipes valves & fittings mounted on structural steel base, with first charge of ammonia, salt for brine, control panel, electric starters including safety and automatic controls.

9.4.1.2 The units shall be available for shipment in sections as required per job specifications.

9.4.2 Freezing Method

9.4.2.1 The ice in molds or cans shall form at the bottom of a water container. These molds shall have tubes extending upward from the bottom of the molds to lower freezing time. Upon freezing of block the refrigerant ammonia shall be circulated through these tubes on the outside of molds. The ice shall be thawed loose from the molds and tubes by circulation of warm refrigerants.

9.4.2.2 The floating ice shall be pushed over the side of the water container by an automatic rake. At this point the ice shall be removed either by a conveyer, manually or down a gravity slide to the storage or for other disposal means.

9.4.2.3 Freezing tank and heat exchanger shall be insulated and jacketed by steel sheeting.

Notes:

1) Both the flake ice plant and block ice plant particularly its low side equipment, shall be suitable for indoor mount preferably in an insulated enclosure.

2) Due to economic reasons from one side, some manufacturers may tend to discontinue their products which are hardly 3 years in the market, and from the other side, some may have pending patents on their newly design system which are yet to be officially introduced to the industry - a word of caution is given to the design engineer - incorporate only those system which features not only savings in first cost and power consumption but also the best available upto date system manufactured by reliable manufacturers.

PART III
GENERAL REQUIREMENTS

10. GENERAL CONDITIONS

10.1 Labeling

10.1.1 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
- Type, size and serial number
- Power supply characteristics
- Input/output characteristics
- Rating and class of insulation
- Purchase 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 shall be screwed to the unit engraved as following:

For example:

+ NIOC No. ..... +

10.2 Inspection/Quality Control and Quality Records

10.2.1 Inspection/quality control and test

10.2.1.1 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.

10.2.1.2 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.

10.2.1.3 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.

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

10.2.1.5 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.

10.2.1.6 The cooling tower shall be rated in accordance with CTI test procedures and performance data.

10.2.2 Quality records

The supplier shall maintain appropriate inspection and test records to substantiate conformance with specified requirements.

10.3 Finish

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

10.4 Packing

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

10.4.2 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.

10.4.3 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 the item do not loosen in transit.

10.4.4 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.

10.4.5 The compressors and necessary equipment shall be shipped with holding charge of dry nitrogen gas.

10.4.6 Manufacturers of refrigeration equipment shall be required to supply also special tools and foundation bolts. All tappings shall be duly plugged or capped.

10.4.7 All refrigerant copper coils shall be tested under water 2758 kPa(400 psig) air evacuated to 500 micron and shipped pressurized with dry nitrogen, tapping duly capped.

10.5 Vendor's Data

10.5.1 Drawings and data

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

10.5.2 Technical documents

The technical documents shall be furnished according to following stages:

10.5.2.1 Quotation stage

- Comprehensive catalogs, technical data, outline drawings, applicable performance curves, proposed test procedure, service facilities, etc. of equipment offered and its components.

10.5.2.2 Order stage

a) Piping connections and wiring diagrams, dimensional and installation drawing.

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 offered, in major international installations.

d) Commissioning and two years spare parts list.

10.6 Guarantee

10.6.1 Clearance of defect

The equipment must carry the manufacturer's one year guarantee, on all parts and furthur four years guarantee on compressors.

10.6.2 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.

10.6.3 After sale technical services

10.6.3.1 Commissioning

10.6.3.1.1 The supplier shall quote if 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.

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

10.7 Spare Parts

10.7.1 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.

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

10.8 Coordination Responsibility with Others

10.8.1 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.

10.8.2 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.

10.8.3 Copies of all correspondence shall be furnished to the purchaser.

PART IV
DATA SHEETS

11. DATA SHEETS

11.1 Data sheets provided herein are carefully prepared such that strategic informations are inserted by the project engineer in spaces provided. In case additional informations are required to be advised to the customer, the manufacturer shall be responsible to furnish such datas in a separate submittal and forwarded to the customer as supporting attachments.

The following data sheets are as follows:

- Site Data sheet;
- Data sheet for Compressors;
- Data sheet for Air Coolers;
- Data sheet for Heat Exchangers & Pressure Vessels;
- Data sheet for Cooling Towers & Evaporative Condensers;
- Data sheet for Air-Cooled Condensers.
- Data sheet for block ice plant

11.1.1 Site data sheet

a) AMBIENT TEMPERATURE:

- 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

- SITE ELEVATION ---------- METER ABOVE SEA LEVEL

- SITE LATITUDE ----------

b) WIND VELOCITY ----------km/h

c) ENVIRONMENT:

DUSTY .....
SALIFEROUS .....
OTHERS .....

d) AVAILABLE SERVICES:

- POWER SUPPLY ---------- V ---------- ph ----------Hz

- COOLING WATER SOURCE:

  FROM TREATED WATER
  FROM CITY WATER

e) AREA CLASSIFICATION .....

f) JOB DESCRIPTION .....

Note:

Earthquake belt of Iran is located in zone 3.

11.1.2 Data sheet for compressors

PROJECT ----------LOCATION .....
* ORDER No. ---------- CUSTOMER ---------- FACTORY
* MANUFACTURER ---------- MODEL No. .....
COMPRESSOR TYPE ---------- DUTY .....
* FABRICATION DATE .....
REFRIGERANT .....

- PERFORMANCE DATA:

REFRIGERATING CAPACITY (Min.) ---------- kcal/h (Btuh) ---------- W
COMPRESSOR SWEPT VOLUME ---------- m^3/hr (CFM)
TEMP. FEED ----------°C(°F) EVAPORATING ----------°C(°F) CONDENSING
TYPE OF DRIVE ---------- V-BELT ---------- DIRECT
NR. OF CYLINDERS ----------PISTON LINEAL SPEED ----------m/s
MAX. SPEED ---------- RPM
POWER CONSUMPTION ---------- BHP
CAPACITY CONTROL ----------
TYPE OF CONTROL PANEL ----------
OIL COOLING METHOD----------

- TECHNICAL DATA (PER MOTOR):

OUTPUT ---------- HP
SPEED ---------- RPM ---------- SINGLE ---------- DOUBLE
TYPE ---------- DRIVE .....
STARTER TYPE .....
PROTECTION CLASS ---------- No. OF POLES .....
ELECTRIC CHARACTERISTICS ---------- -VOLTS ---------- Ph ---------- Hz
* OVERALL DIMENSIONS (mm) ---------- L ---------- W ---------- H
* OPERATING WEIGHT ---------- kg (lbs)
* ACCESSORIES .....
SPECIAL FEATURES .....
.....

Note:

1) The relevant motors shall be supplied by the compressor manufacturer but starters may be purchased separately from a starter manufacturer.

2) Items marked with * shall be completed by the relevant manufacturer.

11.1.3 Data sheet for air coolers

PROJECT ----------LOCATION .....
ORDER No. ---------- FACTORY ---------- CUSTOMER
* MANUFACTURER ---------- MODEL No .....
CHAMBER LOCATION ---------- DIMENSIONS ---------- L ---------- B ---------- H
CHAMBER TEMP.----------PRODUCT TEMP.----------°C
QTY OF AIR COOLERS .....
MOUNT ---------- SUSPENDED ---------- FLOOR
AREA CLASSIFICATION .....

REFRIGERANT .....
TYPE OF FEED .....
TYPE OF DEFROST .....
REFRIGERATION CAPACITY ---------- kcal/hr. (Btuh)
----------Watts
EVAPORATING TEMP. ----------°C(°F) DELTA T ---------- °C(°F)
AIR VOLUME ---------- M^3/h (CFM)
FANS ---------- TYPE ---------- QTY ---------- HP
FAN DRIVE ---------- V-BELT ---------- DIRECT
AIR FLOW ---------- BLOW THROUGH ---------- DRAW THROUGH
FIN SPACING ---------- TYPE----------
-
COIL DESCRIPTION ---------- TYPE ----------
CIRCUITING
COIL CONNECTIONS ---------- LH ---------- RH ---------- ROWS
METHOD OF STORAGE ---------- STORAGE HEIGHT ----------
ELECTRIC CHARACTERISTICS ---------- V ---------- Ph---------- Hz
* CORRECTION FACTORS ----------
* OVERALL DIMENSION ---------- L ---------- W ---------- H
* OPERATING WEIGHT ---------- kg(lbs)
SPECIAL FEATURES ----------
-

-

-

Note:

Items marked with * shall be completed by the relevant manufacturer.

11.1.4 Data sheet for heat exchangers & pressure vessels

PROJECT..... LOCATION .....
* ORDER No. ..... CUSTOMER .....FACTORY
* CERTIFICATE No.....* DRAWING No. .....
* MANUFACTURER ..... MODEL No. .....

*** - STRUCTURAL:**

DESIGN ..... PRESSURE..... TEMP.
PRESSURE TEST.....
FRAME ..... TYPE ..... MATERIAL
COIL ..... TYPE ..... MATERIAL
No. OF ..... ROWS..... PASSES
GASKET TYPE.....

- CONNECTION:

WARM FLUID ..... mm (INCH)..... mm (INCH)
COLD FLUID ..... mm (INCH)..... mm (INCH)
DIMENSIONS mm (INCH)..... L ..... W..... H
CONNECTIONS ..... TYPE ..... SIZE

- DESIGN

FLOW..... WARM m^3/h. (GPM)..... COLD m^3/h. (GPM)
MEDIUM .....
WARM FLUID .....°C(°F) LVG ..... °C(°F) ENT
COLD FLUID .....°C(°F) LVG ..... °C(°F) ENT
LMTD .....
DENSITY .....WARM ..... COLD
VISCOSITY..... WARM .....COLD
SPECIFIC HEAT ..... WARM ..... COLD
OPERATING PRESSURE ..... WARM ..... COLD
* PRESSURE DROP .....
* WEIGHT kg(lbs) ..... DRY ..... WET
* ACCESSORIES .....
SPECIAL FEATURES .....
.....
.....

Note:

Items marked with * shall be completed by the relevant manufacturer.

11.1.5 Data sheet for cooling towers & evaporative condensers

PROJECT ---------- LOCATION ----------
ORDER No. ---------- CUSTOMER ---------- FACTORY
* MANUFACTURER ---------- MODEL No. ----------
COOLING TOWER TYPE ----------
REFRIGERANT ----------
* PRESSURE ---------- DESIGN ---------- TEST
* ALTITUDE CORRECTION FACTOR ---------- FF ---------- m^2/kW
* NOISE LEVEL ---------- dBA

- PERFORMANCE DATA:

WATER FLOW ---------- m^3/h. ---------- USGPM
WARM WATER INLET TEMP. ---------- °C (°F)
COOLED WATER INLET TEMP. ---------- °C (°F)
AMBIENT TEMP. ---------- °DB ---------- °WB
RANGE ---------- °C(°F) APPROACH ---------- °C (°F)
CASING ---------- WOOD ---------- GALV ---------- FRP

RATING ----------

INTERNAL ELEMENTS ----------

- PIPE CONNECTION DIA. mm (INCH)

OUTLET ---------- INLET ---------- OVERFLOW ---------- DRAIN ----------
FLOAT VALVE ---------- QUICK FILL ----------

- TECHNICAL DATA :

PUMP MOTOR ---------- KW ---------- PROTECTION CLASS
FAN MOTOR OUTPUT ---------- kW PROTECTION CLASS ----------
TYPE ---------- DRIVE ---------- No. OF POLE ----------
SPEED ---------- RPM ---------- SINGLE ---------- DOUBLE
STARTER TYPE ----------
FAN ---------- DIA ---------- MATERIAL ---------- YIELD m^3/min
ELECTRICAL SUPPLY ---------- V ---------- Ph ---------- Hz
* TOWER DIMENSION (mm) ---------- H ---------- W ---------- L
* WEIGHT kg (lbs) ---------- DRY ---------- WET
* ACCESSORIES ----------
SPECIAL FEATURES ----------

Notes:

1) Items marked with * shall be completed by the relevant manufacturer.

2) The cooling tower shall be rated in accordance with CTI test procedures and performance data.

11.1.6 Data sheet for air-cooled condensers

PROJECT ---------- LOCATION ----------
* ORDER No. ---------- CUSTOMER ---------- FACTORY ----------

* MANUFACTURER ---------- MODEL No. ----------
REFRIGERANT ----------

- STRUCTURAL:

PRESSURE ---------- kPa (Psig) TEST ---------- kPa (INCH wc) HYDROSTATIC
HOUSING ---------- TYPE ---------- MATERIAL
COATING ----------
COIL ---------- TYPE ---------- MATERIAL
No. OF ---------- ROWS ---------- PASSES
FINS ---------- TYPE ----------MATERIAL---------- mm (PER INCH)

- PERFORMANCE DATA:

AIR FLOW ---------- M^3/HR ---------- CFM
AIR INLET TEMP ---------- °C(°F) DB ---------- °C(°F) WB
AIR OUTLET TEMP ---------- °C(°F) DB---------- °C WB(°F)

- TECHNICAL DATA:

FANS ---------- TYPE ---------- QTY ---------- DRIVE
* MOTOR OUTPUT ---------- kW PROTECTION CLASS ----------
* TYPE ---------- NO. OF POLE ----------
-
* SPEED ---------- RPM ---------- SINGLE ---------- DOUBLE
STARTER TYPE ----------
ELECTRICAL SUPPLY ---------- V ---------- PH ----------HZ
* OPERATING WEIGHT ---------- kg (lbs)
* OVERALL DIMENSION ---------- L ---------- W ---------- H
* ACCESSORIES ----------
-
SPECIAL FEATURES ----------

Note:

Items marked with * shall be completed by the relevant manufacturer.

11.1.7 Data sheet for block ice plant (Conventional type)

- GENERAL:

PROJECT ----------LOCATION
* ORDER No. ----------CUSTOMER ---------- FACTORY
* REFRIGERATION MANUFACTURER ----------
REFRIGERANT ----------
TYPE OF FEED ----------

- CAPACITY DATA:

PLANT CAPACITY ----------kg/DAY (lbs/24 HOURS)
CAN SIZE ---------- kg (lbs)
TYPE OF BRINE ---------- $NaCl_2$ ----------$CaCl_2$
TEMPERATURE OF FRESH WATER ----------°C(°F)
TYPE OF ICE----------WHITE ----------CLEAR
SIZE OF STORAGE ROOM ----------
TYPE OF CAN DUMP ----------
TYPE OF CAN FILLER ----------
TYPE OF INSULATION ----------FREEZING TANK ----------STORAGE ROOM

*** TECHNICAL DATA:**

TOTAL ELECTRICAL POWER ---------- kw
TOTAL PERSONNAL REQUIRED ---------- No.
ELECTRICAL CHARACTERISTICS ---------- V ----------PH ----------HZ
OVERAL PLANT DIMENSION ----------L ---------- W ----------H
PLANT DYNAMIC LOAD, kg (lbs) ---------- OPERATING ---------- DRY
SPECIAL FEATURES----------
-

-

-

Note:

Items marked with * shall be completed by the relevant manufacturer.

APPENDICES

APPENDIX A

Although, these items may not form part of the customized refrigeration system yet as expertise items it becomes an integral part of a cold store project. Considering that major part of below listed items are available and can be purchased from Iranian manufacturers, description of these items shall therefore not be mentioned. Their title names are hereby listed as a reminder to design engineers. Based on job applications, the items in general are as follows:

a) Water treatment & corrosion compound;
b) Paints and coatings;
c) Exhaust fans;
d) Air curtains;
e) Diesel generators (with fuel oil storage tank);
f) Forklift and battery charger;
g) Overhead crane;
h) Cooling & freezing cold storage doors;
i) Overhead transport equipment & rails
j) Weighing scale;
k) Pallets;
l) Conveying screw assembly;
m) Loading dock bashers;
n) Fumigation equipment (for grapes);
o) Insulation, whether prefabricated sandwiched panels for rooms, and premoulded or field injected for pipes and vessels. For insulation materials, reference is made to IPS-M-AR-225.