

SPECIFICATION

of

TRANSCRITICAL REFRIGERATION
R744

for

BANNER X INC
(TBA)

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PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

- .A In addition to codes, ordinances, rules, regulations, orders, and other legal requirements with which compliance is required by other consulting divisions or by governing authorities, industry standards published by the following organizations may apply:
 - .1 CSA
 - .2 TSSA
 - .3 UL Standard 471
 - .4 ANSI/NSF Standard 7
 - .5 ASHRAE Standard 72
 - .6 ASTM E-84
 - .7 National Building Code,
 - .8 Canada Labour Code, Regulations, Guidelines and Codes of Practice
 - .9 Canadian Construction Safety Code
 - .10 Occupational Health and Safety Act
 - .11 Workers Compensation Board
 - .12 Municipal Statutes and authorities
 - .13 B52 building code for Ventilation

1.02 RELATED SECTIONS AND WORK

- .A Energy Monitoring and Controls System.
- .B National Accounts.
- .C Electrical Work.
- .D Heating Ventilation and Air Conditioning.
- .E Plumbing.
- .F Comply with all Division 22, Division 23 and Division 26 Sections, as applicable. Refer to other Divisions for co-ordination of work.

1.03 DEFINITIONS

- .A In this Section, the term “Contractor” means the Refrigeration Installing and service Contractor plus their sub-contractors; “EOR” refers to the Refrigeration Engineer of Record and indicated the organization having design liability for the refrigeration system; “Owner” shall mean Banner x Inc or authorized agents or representatives as designated by Banner x Inc; “approved or approval” shall specifically mean approval by the Owner, “AHJ” refers to the Authority Having Jurisdiction; R744 means refrigerant grade carbon dioxide with a minimum purity of 99.9%.

1.04 SUMMARY

- .A The Contractor shall be responsible for receiving, handling, installing and making completely operational/functional all Owners furnished refrigeration equipment as specified herein and so noted on the drawings.
- .B The Contractor shall include the cost to provide warranty for one year from date of store opening as specified in the service and maintenance section in this specification.
- .C Items Furnished by Owner:
 - .1 Cooler and freezer boxes will be procured and delivered by Owner, but unloaded and installed by the Contractor employed to install the walk in boxes.
 - .2 Medium and low temperature cases will be procured and delivered by Owner but unloaded and installed by the Contractor.
 - .3 Refrigeration racks, evaporator coils, gas coolers and heat reclaim coils will be procured and delivered by Owner. Contractor to receive, offload and install. Contractor to schedule a crane and/or mechanical lifting equipment to install units in position. No additional extras for overtime or crane will be allowed. Follow manufacturer's instructions for lifting equipment in place. Coordinate with building contractor for seals and any sheet metal work involved with setting the units.
 - .4 Plumbing, electrical, control systems, heat reclaim, seismic restraints etc will be by others. Seismic restraints are done by the contractor of each trade.

1.05 SCOPE OF WORK

- .A These Specifications are intended to cover the installation and complete operation of Racks, gas coolers, heat reclaim, coils, refrigerated cases, cold rooms and other parts and accessories required to complete the refrigerated system as shown in the following:
 - .1 Refrigeration layout drawings.
 - .2 Architectural drawings and specifications.
 - .3 Mechanical, Electrical, Structural, Civil, Controls drawings and specifications.
 - .4 Banner x merchandising layouts.
- .B The Contractor shall furnish and install refrigerant tubing, fittings, hand shut-off valves, refrigerant, oil, and all other installation materials required together with all labour and permits required to complete the installation and perform the service detailed in these Specifications.
- .C The Contractor shall install all materials and equipment in the scope of work as requested in the construction phasing.
- .D The Contractor shall inform the Owner, prior to commencement of works, the names of the sub-contractors they propose to work on the project. The Contractor will be held fully responsible for the acts and omissions of the sub-contractor. The Contractor will bind every sub-contractor by the terms of the General Conditions, drawings and specifications. The sub-contractor will have no contractual relationship with the Owner.

1.06 PERMITS AND FEES

- .A The Contractor shall obtain all permits required by local, provincial and national jurisdictions, and shall install all equipment in strict compliance with all local, provincial, national codes and regulations as required.

1.07 SUBMITTALS

- .A Product Data – Submit manufacturer’s specifications and cut sheet information to Architect and Owner showing that the refrigeration system configuration complies with the requirements of the refrigeration system.
- .B Substitutions, modifications or changes from the bid equipment and accessories shall be submitted to the Architect and Owner for review and acceptance.
- .C Submit pressure test, electrical certification letters and all mandatory documentation signed off by the Authority having jurisdiction.
- .D Submit the Defrost Schedule to EMS contractor.
- .E Submit documentation confirming refrigeration alarms are being received by store monitoring.
- .F Submit five (5) copies of all Shop Drawings and three (3) copies of As-Built Drawings showing all piping layouts including pipe sizes and riser locations.
- .G Submit Control Data Sheet Submittals and updated Refrigeration Schedule.
- .H Deliver all specified binders, schedules, and test reports, operation diagrams, parts and maintenance procedures of each piece of equipment received and/or installed by the Contractor; including all mounting details.
- .I Rack Submittals
 - .1 Rack Manufacturer shall submit the following in accordance with Conditions of Contract. Submittals shall include the following as a minimum:
 - .a System design information sheet.
 - .b Description of system operation.
 - .c Rack dimension and general arrangement drawing.
 - .d Electrical power and control wiring diagram.
 - .e Material and construction drawing.
 - .f Catalog information on valves, strainers and control components.
 - .g Name and address of factory trained service company.
 - .h Piping schematic of system components, showing all pipe sizes, location of reducers, components, specialties and instrumentation.
 - .i Drawings for structural base and frame.
 - .j Test procedures.
 - .k Letter of Certification.
 - .l Letter of Warranty.
 - .2 Submittals which are generic and not specifically designed shall not be acceptable.
 - .3 Operation and Maintenance Manuals shall include the following as a minimum:

- .a System design information sheet.
 - .b Description of system operation.
 - .c System dimension and general arrangement drawing.
 - .d Piping schematic of Rack or system components, including valve positions and indication if valve is normally open or closed.
 - .e Control panel drawing with list of operator interfaces.
 - .f Electrical power and control wiring diagram.
 - .g Bill of material.
 - .h Operation and maintenance instructions.
 - .i Special electrical component operation instructions.
 - .j Recommended spare parts list.
 - .k Refrigeration control system.
 - .l Name, address, telephone number of all factory trained representatives and emergency contact personnel for all equipment furnished as part of this contract.
- .4 Submittals and Operation Manuals shall be assembled in a neat and orderly manner. Submittals and Operation Manuals shall be bound in booklet form and shall include a front and back cover and a title page with appropriate job name, location and equipment title.
- .5 Certification, Startup, and Warranty: The Equipment manufacturer shall include, as part of the submittals, all required Certificates and Reports as included herein
- .6 All documentation shall also be available in an electronic PDF format in additio.
- .J Refrigeration Cases Submittals
- .1 Manufacturer shall submit specifications and cut sheet information to Architect, and Owners Representative substantiating that cases comply with layout and performance requirements.
 - .2 Upon request from Owner or Third Party , the manufacturer is to submit lab test data in accordance with NSF 7, ASHRAE 72 and Owner's specifications containing refrigerated zone, coil surface temperature, saturated suction temperature (SST), discharge air temperature, return air temperature, air velocity, core product temperature profiles, coil surface temperature for defrost termination and exiting refrigerant temperature.
 - .3 Substitutions, modifications or changes from the bid equipment and accessories shall be submitted to the architect and Owner for approval.
 - .4 The owner will pay for crating and shipping costs of cases that are exchanged or returned after delivery, inspection and acceptance.
- .K Walk-in Freezers and Coolers Submittals
- .1 Product Data - Submit manufacturer's specifications and cut sheet information to the architect and Third Party substantiating that panels comply with layout and performance requirements.
 - .2 Substitutions, modifications or changes from the bid equipment and accessories shall be submitted to the architect and Owner for approval.
 - .3 CSA, NFPA, ASTM, ANSI/NSF requirements.

1.08 QUALITY ASSURANCE

- .A Contractor must show proof of typical refrigeration installations for the past five (5) years. The Contractor must show experience with R744 installations or at the very least industry training.
- .B The refrigeration system manufacturer shall be responsible for reviewing each project's drawing changes and specifications and providing a manufactured system to the job site that accurately represents the latest drawings and specifications. All drawings and specification changes will be issued by the Owner.
- .C The refrigeration system manufacturer shall be responsible for submitting one set of equipment system diagrams to the Owner and Contractor, within two weeks of equipment delivery.
- .D All refrigeration systems shall be labeled in accordance with the construction drawings, and applicable codes and specifications.
- .E The Contractor shall have a qualified technician on the job site on the date the equipment is delivered to inspect all the equipment and verify all manufacturer's equipment is delivered with a nitrogen pressure charge on the sealed equipment. All equipment identified without a nitrogen charge shall be pressure tested on the job site. The Contractor shall resolve with the manufacturer all equipment discrepancies, transportation damages and material re-order.
- .F The refrigeration system manufacturer shall have a qualified field service representative on the job site during the startup of each refrigeration system.
- .G Refrigeration systems shall conform to applicable codes, and shall be CSA/UL/ETL listed.
- .H Rack and Systems:
 - .1 The Rack manufacturer shall provide a system that is coordinated with the manufacturer of the control logic panel, which shall be factory mounted, wired and tested.
 - .2 The Rack manufacturer shall be listed by CSA/UL/ETL as an approved manufacturer. The equipment shall bear the listing and label before shipment from the factory. This listing must cover the entire system as fabricated and assembled at the manufacturer's factory. A separate listing for just the individual components is unacceptable.
 - .3 Testing and Commissioning: Testing and Commissioning of the system shall be required, to the standard laid out by the manufacturer and contained within this specification.
 - .4 Delivery: The entire Rack shall be factory assembled and shipped as a complete unit (s) to the site.
 - .5 Warranty: Rack manufacturer shall submit a written warranty signed by manufacturer agreeing to furnish parts for failures within warranty period. Contractor shall submit warranty agreeing to provide labour for failures and defects in workmanship during installation of Owner-furnished equipment within special warranty period.
 - .6 All the circuits must have isolation valves (Ball valves) in order that service contractors perform maintenance.
- .I Refrigerated Cases

- .1 The case manufacturer shall be responsible for reviewing each project's bid drawings and specifications for proper application and operation of their equipment.
- .2 All refrigerated cases and accessories shall conform to all applicable codes, CSA listings and be NSF certified and labeled.
- .3 The installing contractor shall verify that case evaporators still maintain a pressure charge after delivery. All evaporators identified without a nitrogen charge shall be pressure tested on the job site at the manufacturer's expense.
- .4 The case manufacturer shall have a capable field service representative on the job site during the week, as required, scheduled for the startup of the refrigeration system, to support the installing contractor on equipment, accessories and case performance validation.
- .5 All refrigerated cases and accessories shall conform to all applicable codes, CSA listings and be NSF certified and labeled.
- .J Walk-in Freezers and Coolers
 - .1 Contractor must show proof of typical walk in installations during the past five (5) years.
 - .2 The panel manufacturer shall be responsible for reviewing each project's drawing changes and specifications for proper location, size, layout, application and provide a bill of materials to the job site that accurately represent the latest layout drawings and specifications.
 - .3 The installing Contractor will confirm that the manufacturers submittal aligns with the latest store layout drawing and current site conditions.
 - .4 The panel manufacturer shall be responsible for submitting one set of panel construction drawings each to the architect and the general contractor, respectively, within one week of equipment delivery.
 - .5 All panel sections shall come labeled in accordance with the manufacturer's construction drawings.
 - .6 The insulated panel systems shall be installed in accordance with the latest drawings and specifications.
 - .7 All insulated panels and accessories shall conform to all applicable codes, ULC listings and be NSF certified and shall bear the NSF seal on exterior door panel.

1.09 DELIVERY, STORAGE, AND HANDLING

- .A The refrigeration system manufacturer shall be responsible for the on time delivery of equipment to the job site. If there is a delay in the shipment, the manufacturer shall notify the Owner's Project Manager, Procurement Manager and Contractor within 10 days prior to the scheduled delivery date and negotiate a new delivery date.
- .B The Contractor shall include in the Bid Form costs incurred for receiving, storage, and labor. Contractor shall be responsible for costs arising when replacement materials must be reshipped due to loss or damage on job site after acceptance of original shipment. Immediately upon award of Contract, coordinate release of units for delivery to site with contacts specified in this Section. Provide crane service to hoist units directly from truck to ground or roof as applicable.
- .C All unloading and handling of such equipment shall be the responsibility of the installing

contractor.

- .D Handle, deliver, and store in manufacturer's original packaging, following manufacturer's recommendations.
- .E Provide labor and equipment to unload, uncrate, set and assemble equipment and supplies.
- .F The Contractor shall check each piece of refrigeration equipment as it arrives at the store and if any of it arrives in damaged condition or shortages, the Contractor shall:
 - .1 Note damages on the bill of lading and obtain legible signature from the carrier.
 - .2 Notify Owner immediately and include photographic evidence.
 - .3 Make no repairs until authorized to do so.
- .G Contractor shall be responsible for failure to note freight damage and shortages at time of receipt of equipment. Concealed damage to equipment within undamaged packaging shall be notified to the Supplier and Owner within 15 days of receipt of delivery
- .H All contractors shall provide all appropriate measures for safekeeping of all refrigeration equipment; however responsibility for site security is with the General Contractor.

ITEM	SUPPLIED BY	DELIVERED BY	DELIVERY COORDINATION	INSTALLER	NOTES
Rack	Owner / Rack OEM	Rack OEM	Refrigeration Contractor / General Contractor	Refrigeration Contractor	
Gas Cooler	Owner / Gas Cooler OEM	Gas Cooler OEM	Refrigeration Contractor / General Contractor	Refrigeration Contractor	Roof curbs and penetrations by General Contractor.
Walk In Evaporators	Owner / Evaporator OEM	Evaporator OEM	Refrigeration Contractor	Refrigeration Contractor	
Walk In Box	Owner / Walk In OEM	Walk In OEM	Walk In Contractor / General Contractor	Walk In Contractor	Floor preparation by General Contractor

Walk In lights	Electrical Contractor	Electrical Contractor	Refrigeration Contractor / Electrical Contractor	Electrical Contractor	
Rack back up condensing unit	Owner / Rack OEM	Rack OEM	Refrigeration Contractor (if remote)	Refrigeration Contractor (if remote)	Factory installation is preferable. Rack OEM to clarify at time of bid if this is not possible. Condensing unit shall provide power to solenoid valve (installed on rack). Condensing unit will be field-installed and field-charged with refrigerant.
Rack back up CU generator	Owner / Rack OEM	Rack OEM	Refrigeration Contractor	Refrigeration Contractor / Electrical Contractor	Roof curb and penetration by General Contractor. Electrical Contractor to install all wiring,
Refrigerated Display Fixtures	Owner / Case Manufacturer	Case Manufacturer	Refrigeration Contractor / General Contractor	Refrigeration Contractor	
Heat reclaim coil	AHU manufacturer	AHU manufacturer	AHU manufacturer	AHU Manufacturer	Refrigeration Contractor to connect tails to rack connections. Coil to be factory installed in AHU.
DHW heat exchanger	Rack OEM	Rack OEM	Rack OEM	Rack OEM	Mechanical contractor to connect to DHW system. Exchanger is to be factory installed on rack by Rack OEM;
Copper pipe	Refrigeration Contractor	Refrigeration Contractor	Refrigeration Contractor	Refrigeration Contractor	
Steel pipe	Refrigeration Contractor	Refrigeration Contractor	Refrigeration Contractor	Refrigeration Contractor	

EMS	EMS Contractor	EMS Contractor	Refrigeration Contractor	EMS Contractor	EMS contractor is to supply controls to case and rack manufacturers for installation prior to site delivery.
Refrigeration electrical	Electrical Contractor	Electrical Contractor	Electrical Contractor	Electrical Contractor	

1.10 INSPECTION OF WORK

- .A The Owner or Owners Representatives shall have access to the work at all times for purpose of inspection.
- .B If specifications, instructions, ordinances, rules, regulations or any public authority require a portion of the work to be tested, approved or inspected, Contractor shall give the Owner timely notice of its readiness for inspection.
- .C In order to verify use of dry nitrogen during brazing operations as specified, Banner x representative may require Contractor to cut out five randomly selected joints. Joints will be inspected for oxidation and braze / weld penetration. For each joint which shows evidence of oxidation and non-compliance, another joint will be cut out. If four fittings are found oxidized, it will be assumed that all joints are defective; therefore all joints will be reworked. Rework joints removed for inspection.

1.11 OPENING DAY

- .A Keep one qualified refrigeration technician on site to handle emergencies connected with the refrigeration system from the time start-up begins through 'Opening Day.' The Owner reserves the right to have the contractor replace the technician if the Owner feels that present technician is failing to respond or is unqualified. The contractor will recheck all fixture temperatures immediately prior to store opening and make all necessary adjustments to provide the specified temperatures (see section 3.07).
- .B Upon start-up, submit to the Owner the name of the local refrigeration service company that will be authorized to handle warranty service

1.12 OWNERS INSTRUCTIONS

- .A Identification of Systems.
 - .1 Each refrigerated case and evaporator shall be identified with the system number. The number for each system will be as shown on the "Refrigeration Schedule" drawing. The Contractor shall provide a decal which will be attached to the case or evaporator with ½" lettering
 - .2 Each rack will be identified by a securely fixed decal detailing system number, which

refrigerated fixture that rack operates, refrigerant type, refrigerant charge, type of refrigerant oil, start up date and the installing contractor.

- .3 The Contractor shall furnish and install a corrected laminated 42"x 30" as built drawings showing the store refrigeration layout including pipework, valve positions, system numbers and refrigeration schedules as a minimum. The drawings shall be to a minimum scale of 1/8" = 1' and be mounted in the compressor room under PMMA.
- .B The Contractor shall furnish and install laminated copies of the Defrost Schedule (note if on demand defrosting is applicable there will be no schedule) and Valve Schedule. These schedules should be posted in the machine room permanently fastened on a wall as directed. Also provide a copy to Store Manager and Third Party if required.

1.13 WARRANTY

- .A The Contractor shall provide all necessary labour, materials and incidental expenses to maintain the temperatures listed in the Refrigeration Schedule for a period of one (1) year from the store opening date without additional cost to Owner for all refrigerated equipment including self contained units and ice machines.
- .B Temperature rises caused by improper stocking, abnormal air currents or plugged drain lines shall not be the responsibility of the Contractor.
- .C It shall be the responsibility of the Contractor to obtain from the manufacturer any necessary replacements without charge to Owner. Owner will not pay additional costs associated with repair or replacement of materials and parts during the warranty period. Additional costs attributed to equipment failures shall be handled directly with the manufacturer. Disputes and issues in procurement of defective parts, between the Contractor and Supplier may be brought to the attention of the Owner for assistance with resolution.
- .D The first year warranty shall include at least four complete services (at approximately three-month intervals) of each system including any gas coolers, and other parts of the system requiring servicing. The service will include a full leak test and analysis of refrigeration operation.
- .E The owner has the option to request an oil acid test during this period, with 3rd party fees being at the owners cost. On request the Contractor will remove an oil sample from the crank case and compare with the colour of a fresh oil sample and perform an oil acid test. If the oil does not meet accepted standards it must be replaced and the drier cores changed at no cost to the Owner. The oil must be rechecked within 90 days and the procedure repeated if the problem persists.
- .F When the final inspection is made, approximately 11 months after store opening or start of warranty (whichever is later), the Contractor shall certify that all equipment and materials installed or connected by the contractor are functioning properly and free of leaks and are maintaining satisfied temperature set-points at normal control adjustments. At this period an inspection will be made by the Owner and their representatives to prepare a final deficiency list for the Contractor who will complete the deficiencies within the warranty period.
- .G The Contractor shall not be responsible for repairs or replacements due to damage by fire, earthquake, tornado, the elements, or "acts of God", power failure, low voltage, overloaded power circuits, broken glass or lighting

- .H The Warranty contractor shall be required to use Banner x work order system and to have signed Banner x Standard Maintenance Agreement.

1.14 SERVICE AND MAINTENANCE AGREEMENT

- .A All costs for a one (1) year service and maintenance agreement associated with this contract shall be included in the bid. The Contractor shall agree to the terms of this Agreement for a period of one (1) year after the store officially opens.
- .B Contractor agrees to maintain all the new refrigeration equipment.
- .C Contractor agrees:
 - .1 To furnish all labour and materials as specified in this agreement for equipment installed by this contractor.
 - .2 To perform four (4) preventative maintenance inspections on the refrigeration systems.
 - .3 If, at the owners approval, the Contractor sub-contracts the warranty work, the warranty responsibility remains with the primary Contractor. The sub contractor must be approved by the Owner prior to the primary contractor employing their services. The contractor shall resolve all payments between the two parties. The Owner will not involve itself in resolving payment issues. If the service contractor discontinues or drops their service level because the Contractor has failed to make payment on completed warranty work, the Owner will remove that Contractor from the Store Bid List until such time when all disputes or claims are settled.
 - .4 The 24 hour per day emergency service will be provided 365 days per year.
 - .5 Contractor will make every reasonable effort to respond to all service calls as detailed within the table in this section. Contractor is aware of the need for a timely response in situations involving safety, and potential product loss. In the event that contractor is unable to have a mechanic in the store as per the table, and product, customer, or employee safety are at risk, Banner x may call a licensed refrigeration contractor to make any emergency repairs. Said repairs will be paid by Banner x and reimbursed by Contractor.
 - .6 The self-contained refrigeration units installed by the Contractor will be covered under the terms of this agreement to include clearing of evaporators and condensers and all parts and labour necessary to make repairs including repairs or replacements of the compressors.
 - .7 Under the terms of this agreement, Contractor will provide maintenance and repair or replacement service on installed gas coolers and heat reclaim system including piping, equipment and controls, other than units directly related to HVAC air movement.
 - .8 The Contractor will provide the following services should they result in the poor operation of the system. If the cause of the issue is shown to be due to store operations then the cost will be additional to the contracted fees.
 - .a Cleaning and clearing plugged refrigeration or drain lines and floor sinks (above ground only).
 - .b De-icing refrigerated cases.
 - .c De-icing and cleaning walk-in box coils.
 - .d Cleaning honey combs and airways of refrigerated cases.

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- .9 Contractor will provide the following services at all times; however, these services will be additional to the contracted fees.
 - .a Repair or replacement of case components such as trim, thermometers, reach-in door gaskets, door handles, kick plates, and other case hardware that may be needed due to normal wear and tear. Contractor is not required to repair or reset shelving.
 - .b Restart or shutdown of refrigeration equipment for planned or unplanned power and/or water supply interruptions of any kind.
 - .c Repairs to refrigeration equipment caused by power and/or water interruptions of any kind.
 - .10 All refrigeration systems will at all times maintain a refrigerant and oil charge of a sufficient level so that the equipment operates according to manufacturers' specifications.
 - .11 Contractor will provide a written refrigerant usage and service activity report to Banner x upon request or agreed time scale.
 - .12 Contractor to supply all refrigerant (at no cost to Banner x) required for maintaining the equipment included in the contract including the entire warranty period.
 - .13 Contractor shall be responsible for communicating with store Energy Management System (EMS) equipment for the purpose of modifying refrigeration program as required to maintain the efficient operation of the related equipment covered under the terms of this agreement.
- .D Contractor's services hereunder will not include:
- .1 Repair or replacement of:
 - .a HVAC and other mechanical systems not directly related to refrigeration or heat reclaim.
 - .b Electrical wiring and components between power supplies and connection points of refrigeration equipment and components.
 - .c Waste or water supply lines (excluding evaporator condensate drain lines from covered equipment).
 - .d EMS system components. (Other than refrigeration controllers on racks, cases, walk ins etc.)
 - .2 Labour and parts for repair necessary because of accident, abuse, vandalism, fire, water, or other casualty loss as "act of God".
 - .3 Cleaning of case or walk-in box components except at hand over.
 - .4 Removal, replacement, or alteration to any part of the building in performance of this agreement.
- .E Other Terms and Conditions.
- .1 Replacement compressors will be supplied by *compressor manufacturer through coordination with rack OEM* to Banner x.
 - .2 Replacement compressors will be warranted for the remainder of the warranty period agreed with the manufacturer. Rebuilt compressors are not permitted without Banner x Maintenance Department approval only.

- .3 Contractor shall not be liable for repairs and cost of repairs by others unless approved prior to work being performed.
- .4 When requested, Banner x will be allowed access to Contractor's books for actual documentation regarding Banner x service work.
- .5 Should Contractor fail to perform its obligations hereunder, this Agreement may be terminated immediately by Banner x upon written or verbal notification to Contractor.

PRIORITY	ACCEPT SLA	RESPOND ON-SITE SLA	DESCRIPTION
Level 1: Emergency 2 hour response	0.25 hours (15 mins)	2 hours	Respond ASAP Includes after hour service
Level 2: Urgent 4 hour response	0.5 hours (30 mins)	4 hours	Same day service O/T is a possibility
Level 3: Within 24 Hrs No O/T M-F	8 hours	24 hours	24 hour service No O/T without approval
Level 4: Standard 72 hour response	24 hours	72 hours	Regular service No O/T without approval
Level 5: Next Visit (no travel charges)	n/a	n/a	Extra hours No O/T or trip charge
Level 6: Next Budget	As specified in Work Order	As specified in Work Order	Planned repairs

PART 2 PRODUCTS

2.01 REFRIGERANT PIPING

- .A All system components will be selected to operate with R744 within the limits of the pressure extremes which the system operates.
- .B The piping shall be planned and arranged to keep the number of fittings at a minimum and to keep the runs as short as possible. Arrange the piping so that normal inspection and servicing of the compressors and other equipment is not hindered. Do not obstruct the view of the crankcase oil sight glass or run piping so it interferes with removal of the compressor, cylinder heads, end bells, access plates, fans, fan motor, or other parts. Do not run tubing from one system through a case connected to another system. All pipe routes are to be reviewed and approved by Banner x Project Manager and GC.
- .C Field piping to/from refrigerated cases and walk-ins shall be designed for a max one degree equiv pressure drop. Piping to/from a dehumidification coil in AHU supplied with CO2 gas direct and gas cooler shall be designed for a maximum of 5 psi pressure drop.
- .D Sandpaper or steel wool shall not be used to clean the inside or outside of the tubing. Use a tubing wire brush internal and external, the brush must be suitable for the pipe in question.
- .E Size refrigeration piping in accordance with drawings and as specified by the Manufacturer.
- .F Perform cutting of tubing with wheel-type cutter where possible, and reamed to original bore. Where necessary to saw cut, drag tubing clean after reaming. Before using, drag clean tubing left open on job after cutting.
- .G Slope all suction lines at least 1 inch in 20 feet towards the compressor. At the bottom of each riser in a suction line, install a "P" trap, as per rack manufacturers recommendations. All sloped lines shall be constant - no bellies.
- .H Provide branch liquid and suction line ball valves for isolation purposes as indicated on refrigeration piping plans. Coordinate location with Banner x Construction Manager. Install valves at fully accessible location. Do not conceal by walls, fixtures, or other equipment.
- .I Piping runs require an offset every 80 Ft, all piping lines are 20 feet long.
- .J Copper tubing shall be ACR Type L, Type K or stainless steel as required by system design pressure and Code requirements.
- .K Systems shall be purged with OFN during brazing process to prevent scaling and oxidation.
- .L Pressure controls shall use 1/4" seamless steel tubing or high pressure hoses. Steel tubing shall be clear coated/*ainted* to prevent corrosion.
- .M Vent lines, transducers, check valves and oil filters shall have brass "front seat to close" service valves or capped Schraeder valves with isolation ball brass valves.
- .N Refrigeration piping shall be secured by the use of hydro-sorb type clamps and saddles which lock onto unistrut (*or pipe hangers*).

- .O Suction and liquid manifolds shall contain a pressure port valve.
- .P Gas Cooler piping - Assume 150 FT of 1 ½ IN unless otherwise specified.
- .Q HVAC Reheat Coil piping - Assume 4 lines at 400 FT of 1 ½ IN unless otherwise specified.
- .R Relief Headers – Refer to rack manufacturers specifications and piping drawings. Relief piping accored to gas cooler and relief to an elevation of 7 FT. Relief valves and relief manifolds are to be supplied by the Rack OEM. All pressure relief lines are to be clamped with approved clamps for there entire run. Relief line piping must be clearly marked with yellow labels. A maximum of 24" of straight pipe is to be used from any relief valve outlet. No directional fittings are permissible on relief valve

2.02 REFRIGERANT PIPING MATERIALS

- .A Unless otherwise specified, all materials shall be new and of the best quality. Materials or work described which have a well-known technical or trade meaning shall be held to refer to such recognized standards.
- .B Materials that are not satisfactory shall be removed from the premises at once upon being condemned by the Architect or Owner.
- .C Refrigeration Piping Materials (Copper).
 - .1 Provide refrigeration copper piping of a type that is suitable for the maximum allowable working pressure of the selected Rack Manufacturer. Generally type L for under 5/8" and Type K for over 5/8" hard drawn copper tubing for the installation. Contractor must have a procedure in place (to be approved by the Owner) to guarantee that the correct pipe is being used for the different pressure constraints. All copper refrigerant piping shall be refrigeration grade ACR hard drawn, degreased, deoxidized, sealed-at-the-mill copper tubing (use only sealed tubing). Soft drawn copper piping is not accepted.
 - .2 Type K or L copper is satisfactory for field-installed lines to/from rack to auxiliary condensing unit, cases, coolers, and freezers. Stainless Steel is required for Interconnecting piping to gas cooler and heat reclaim coil using CO2.
 - .3 All sweat-type copper fittings shall be suitable for R744 refrigerant and the associated pressures which will be dependant on the rack manufacturer. All elbows and return bends shall be 90-degree long radius type, 45 degree fittings are not allowed. Traps in risers shall be factory fabricated traps such as Mueller Brass Co. "P" traps, as per manufacturers recommendations. No crimping or stuffing of copper fittings or pipe is acceptable. Use only approved pipe reducing fittings.
 - .4 Liquid line "Tee" fittings are not to be "bull headed" to insure least possible pressure drop. Flare nuts are not allowed.
 - .5 All hand shut-off valves shall be the same port size as the lines in which they are installed. They shall be nonferrous ball valves with seal cap or angle valves. Any ball valves added to a CO2 refrigeration system which are not factory installed on the refrigeration unit are to have check valves installed around them to allow "trapped refrigerant" to relief into main lines.
 - .6 Pulling Tees (Swagging) is not acceptable "on site" as thinning of the pipe material cannot be controlled. The Manufacturer may machine pull Tees during Rack build.

- .D Refrigeration Piping Materials (Steel).
 - .1 For pipe-work systems operating above the maximum allowable working pressures of copper only stainless steel is acceptable. This will typically be the case for pipe systems on the discharge side of the systems such as to/from gas cooler and heat reclaim systems.
 - .2 All high side refrigeration piping (gas cooler/heat reclaim) shall be in stainless steel ASTM A312 schedule 40 pipe or stainless seamless steel tube ASTM A213. If stainless pipe is used all fittings shall be in stainless steel ASTM A182. Carbon steel piping of any kind **WILL NOT** be accepted. Stainless tubing or piping to be welded by approved pressure ticketed welder or automated welding system according to local code using approved procedures..
 - .3 For gas cooler piping assume 1-1/2" and 150 ft unless stated otherwise stated.
 - .4 Stainless steel will be as per ASTM A312 or ANSI/ASME B36.19. Carbon Steel is not acceptable .
 - .5 Welded joints will be used wherever practicable to reduce the probability of leaks
 - .6 Different types of steel shall not be mixed within the refrigeration systems.
- .E Condensate Piping Materials (Walk Ins)
 - .1 Run ¾ inch copper condensate line from evaporator directly to outside of walk-in walls into floor hubs. When more evaporators are installed in the same walk-in box, run ¾ inch copper condensate line from evaporator and adapt to 1 ½" header. Run 1 ½" header to outside of walk-in walls into floor hubs exiting the box as directly as possible using a single penetration.
 - .2 Provide drain-line heaters for Walk In Freezers. Provide self-regulating type (no thermostat) such as Raychem or equal. Ensure drain line heater are operating properly. Heater tape is to be covered with 1/2-inch insulation. Refrigeration contractor to terminate both ends of heat trace according to local code. Supply power termination to be located outside refrigerated space to a owner supplied GFI receptacle or breaker.
 - .3 Install unions on condensate drains in walk-ins close to drain pan; allow clearance for pans to hinge open. Drain lines shall be supported by hangers to avoid damage to the drain pan.
 - .4 All condensate drain lines must be trapped and run to an open drain. Never connect the drain line directly to the sewer system. Traps in the drain line must be located in a warm environment.
 - .5 Refrigeration contractor to install ¾" drain line for meat open preparation room evaporator coils. Lines shall PVC and trapped before entering hub drain location. Install a "T" in each drain for clean-out purposes. Printed labeling on pipe to be faced towards wall or ceiling so not visible from customers or staff. Care to be taken to minimize the amount of exposed glue at each pipe joint for aesthetics.
- .F Piping Insulation
 - .1 Provide insulation of appropriate thickness to ensure that heat pick up by the system and condensation on the insulation is prevented. Confirmation by the manufacturer that the insulation thickness is adequate will be required. Provide 1/2" wall thickness

insulation on services to protect sub-cooled services and high temperature services which employees could touch and burn themselves.

- 1/2" on all liquid lines (3/4" Advansor Rack)
- 1/2" on all medium temperature suction lines (3/4" Advansor Rack)
- 3/4" on all low temperature suction lines
- 3/4" on all heat reclaim lines
- 3/4" on all suction lines that are above drywall or suspended ceiling tile.
- Underground piping, completely insulated from box to box. Same thickness rules as above, 3/4" liquid, 1/2" medium temp suction and 3/4" low temp suction.

- .2 Slip insulation over pipe before making joints. Split type insulation is acceptable on fittings only. Install insulation in conformance with manufacturer's recommendations including glued joints. Provide WB Armaflex finish on insulation. Apply finish in accordance with manufacturer's recommendations. At Contractor's option, Arma-Check Armaflex insulation may be provided in lieu of AP Armaflex.
- .3 Apply insulation to piping only after tests have been made and systems accepted. Apply insulation and insulation finish so finished product is smooth in finish, with the longitudinal seams concealed from view. Apply piping insulation materials, accessories and finishes in accordance with manufacturer's recommendations

.G Hangers - Unistrut System.

- .1 Support overhead refrigeration lines at 8'-0" feet maximum intervals on Unistrut hung on galvanized all-thread rod. Pipe support hangers to be fastened to steel roof decking using approved "Q-deck" hangers or beam clamps. Flat ceiling flanges are not permitted for use on steel roof decking. If beam clamps are used, clamps should be affixed to the upper most flange of the roof truss. Support suction and liquid lines at each hanger with individual "INSUGUARD" type pipe protectors with an I.D. equal to insulation O.D. surrounding pipe insulation. Hanger supports to have the two most outside "Insuguard saddles" fastened in place with screws to prevent the saddles from moving or sliding laterally on the hanger support. All hangers to have double nuts or nylon insert lock nuts "Nyloc" on hanger support rods to prevent the nuts from loosening over time.
- .2 Secure vertical piping to Unistrut fastening system with Cush-a-Clamps. Fasten clamps directly to copper pipe, not to outside of insulation. Butt insulation tightly against clamp and insulate uncovered areas to prevent sweating. Cover exterior refrigerant pipe insulation (including heat reclaim lines) and interior prep room lines with 0.030 inch thickness PVC jacketing and fitting covers, Proto or Zeston. Jacketing shall be vapour and weather sealed. Support shall not be soldered or brazed to the refrigerant piping. Piping shall not be tied in bundles or left in contact with other tubing.
- .3 Install trapeze hangers no farther than two feet on each side of 90 degree turns.

2.03 VALVES

- .A Manufacturers: Subject to compliance with requirements, approved refrigeration control valve manufacturers include:
 - .1 Danfoss

- .2 Emerson
- .3 Henry
- .4 Parker / Sporlan

- .B Solenoid valve(s) on compressor rack shall be normally-closed and controlled from the rack control system. The control voltage will be 208/1, 120/1, or 24/1. Valves with manual lift stems are discouraged due to leaks at the stems. Where solenoid valves are provided without manual lift stems, the rack OEM shall provide one solenoid valve operating magnet (Refco or equivalent) per rack, capable of opening the pilot port on the valve. Valves shall be installed with braze type connections, care must be taken to prevent heat damage to internal components. Ensure that heat damage is prevented to valve body and motor assembly during installation

- .C Electric Discharge Bypass Valves. Shall be normally closed with a tight shut off when closed. The control voltage will match that of the rack. The valve shall have a proven field reliability, manufactured from corrosion resistant materials and have a low power consumption.

- .D Evaporator Pressure Regulators (EPRs) shall be stepper type Electric Evaporator Pressure Regulators (EEPRs) and controlled from the rack control system. EEPRs shall have a 1/4" male flare access port with Schraeder valve located on the valve inlet, or installed in the piping upstream of the valve. The valves selected shall have proven field reliability, manufactured from self lubricating materials and have a low power consumption.

- .E Expansion Valves shall be EEVs. Each expansion valve shall have a serviceable strainer or filter/drier mounted directly upstream of the valve. In the case of hot gas defrost a check valve must be installed to avoid hot gas flow through the expansion valve.

- .F A full port ball valve and check valve shall be provided for each one of the refrigeration circuit's suction control valves and liquid control valves or as per rack manufacturers requirements.

- .G Isolation valves shall be provided such that the following components may be serviced by removing the refrigerant from only the component and the adjacent pipe sections. These components include: Compressors, Oil System Components, Condensers, 2-Way and 3-Way Solenoid Valves, Pressure Regulating Valves, Receiver, Liquid Line Filter Driers, Expansion Valves, Heat Exchangers, Pressure Sensing Devices and Check Valves.

- .H Access ports shall be provided for servicing such that refrigerant can be removed from piping sections and components located between isolation valves.

- .I Valves shall be suitable for operation with R744. All valves shall have name and pressure rating marked on body.

- .J Relief valves on the rack relieve vapor to a common manifold which is to be piped outside. There shall be three main discharge/relief lines from the machine room to the outside of the building as follows;

High pressure (Discharge of the transcritical compressor stainless),
Receiver relief copper.
Liquid line, Suction line, defrost return copper.

Pressure relief valves shall be installed outside. No piping is necessary after the relief valve.

The PRVs must be securely attached to the structure to prevent-valve movement during relief. The relief valves will be of the twin body type; (two way discharge) so that changing a valve on relief will not result in system pump down.

The pressure setting shall not exceed the maximum working pressure of the vessel.

Each valve shall have a unique serialization number for tagging requirements.

It is very important that a slope of 1 inch per 20 feet be respected as per OEM piping spec. The relief piping must be over all the other overhead piping.

The relief valves shall be installed such that if venting occurs there is no risk to public safety or property damage. If the rack manufacturer has an alternate (improved) way of achieving the same results at no additional cost this will be considered and must be preapproved by the owner.

2.04 REFRIGERATION EQUIPMENT

.01 Trans Critical Rack

- .A Racks must be installed as per manufacturer's recommendations
- .B Assume all components are rack mounted including the emergency condensing units unless otherwise specified. Advansor locates their condensing unit and discharge headers on separate frames adjacent to the rack(s). Shut off valves for each circuits must be installed on the headers.
- .C Vendor shall implement an internal process whereby any changes or process improvements shall be documented and an internal bulletin signed off on. Vendor shall confirm the process is in place and provide their policy and procedures. Vendor shall have an electronic documented and controlled procedure. Additionally, production standards and engineering standards are also controlled documents.
- .D Vendor shall be familiar with all Provincial rules and regulations and coordinate with Banner x Project Managers to ensure all expectations are met. Particular attention must be noted to compressor BHP limitations within each provincial jurisdiction.
- .E See Fixture Layout and Refrigeration Schedule for Refrigeration load.
- .F The Contractor shall thoroughly review the Fixture Layout, refrigeration plans and specifications and Refrigeration Schedule to determine the scope of work required to provide a complete operating system. Any questions, clarifications, omissions, etc., shall be brought to the attention of the Banner x Project Manager for resolution prior to submitting bid.
- .G Rack Construction
 - .1 Component spacing within the compressor room shall be per NEC requirements. Manufacturer to ensure that room and rack dimensions do not compromise codes.

- .2 R744 Transcritical racks shall meet all local and national codes.
- .3 Rack frame shall support lifting weight according to the manufacturer's drawings and operating weight when positioned in compressor room. Manufacturer shall detail lifting methodology to move rack. Lifting points for craneage and fork lifting into position are to be considered and detailed for the installing contractor.
- .H Compressors
 - .1 Manufacturers: Subject to compliance with requirements, approved compressor manufacturers (or approved equals) include:
 - .a Bitzer
 - .2 Subject to compliance with requirements, approved compressor technologies will be suitable for transcritical operation with R744.
 - .3 The lead compressor on each suction group shall have variable capacity (i.e. Bitzer Vari-speed) control and provide continuous compressor unloading from 100% down to 30% of the total group capacity.
 - .4 Compressors shall have a wide application range being capable of operating both sub and transcritically.
 - .5 The net refrigeration effect of the system shall be designed to meet 110% of the required evaporator load at design conditions (provided 100 horsepower limitation does necessitate reducing safety factor). The net refrigeration effect shall be calculated at the evaporator and not include superheat gained in the suction line.
 - .6 The maximum compressor size shall be limited to 25% of the suction group requirement, or as approved by the Owner. Any deviation to this specification must be discussed and approved by the owner in advance. Multiple compressors are required for excess capacity, redundancy and multiple stages of cooling capacity. If any compressor fails on either the MT or LT circuits the operation of the store must not be compromised.
 - .7 Each compressor selected by the manufacturer must be available locally within a reasonable distance from the store or available within 24hrs.
 - .8 All compressors shall be equipped with 100% shut-off service valves and access pressure port valves.
 - .9 Each system shall have a single high pressure transducer piped to each main suction header and wired to shut down all compressors on the system.
 - .10 Each compressor shall be piped in such a way that no pipework will require cutting should a compressor be removed from the rack for service.
 - .11 Compressors shall be mounted on a structural frame with vibration isolation. Vibration isolators shall be high density rubber/plastic or spring isolators.
 - .12 Each reciprocating compressor shall have a fused crank case heater, interlocked with the compressor motor auxiliary contactor.
- .I Receiver / Flash Tank
 - .1 Flash Tanks may be oriented horizontally or vertically as deemed appropriate by the

OEM. Horizontal receivers shall include a liquid level (dial) indicator and a separate liquid level float alarm. The float alarm shall activate a low-level alarm to the refrigeration control system. Digital level indicators be installed and monitored. Vertical receivers may also include sight glasses..

- .2 A system must be in place by the manufacturer to ensure that in the event of a store electrical failure the R744 charge of the system is not vented due to expansion when the temperature of the R744 rises. The recommendation for the manufacturer is to provide an integrated cooling system to ensure that the R744 in the flash tank remains at a stable condition, is for a remote condensing unit powered by a roof mounted generator. The generator will be operated by natural gas and come complete with remote monitor, cold weather kit and maintenance kit. Control and power wiring for the generator will be supplied and installed by the electrical contractor.
 - .3 The OEM shall be responsible for properly sizing the flash tank to handle expected refrigerant level fluctuations from normal operation and service. The EOR shall communicate an approximate store piping refrigerant charge to the OEM for use in sizing the receiver
 - .4 Receiver high pressure relief shall be accomplished in accordance with ASHRAE Standard 15. Upon high pressure relief, the unit shall alarm to the control system.
 - .5 The flash tank shall include inlet and outlet isolation valves.
 - .6 The refrigerant used shall be designated on the side of the receiver. When required by the local authority having jurisdiction the receiver's ASME tag shall be accessible and readable.
- .J Oil System
- .1 The main oil supply line shall be equipped with an isolation valve between the separator and reservoir. An oil reservoir shall be equipped with a sight glass
 - .2 Discharge oil separators shall be coalescing type.
 - .3 The quantity of oil in the system shall be sufficient to ensure correct compressor lubrication.
 - .4 Oil shall be supplied by installation contractor.
 - .5 The oil must be as recommended by the Compressor manufacturer. The oil will be specifically formulated for use in transcritical applications.
- .K Filters
- .1 Medium temperature suction line to have a removable element, steel shell, suction filter with stainless steel bolts sized for minimum pressure drop at design load conditions, with element in place. To ensure the filter drier has ample contaminant removal ability the selection must be based on flow capacities and the amount of desiccant required for system clean up. The filter drier must be large enough to adequately remove acid, moisture and solid contaminants without causing nuisance plug ups.
 - .2 The suction line of rack shall have a replaceable core suction filter sized per the manufacturer's recommendations. The drier shell shall be isolated with ball valves located approximately 18" from inlet and outlet with a bypass for service. This is necessary to service the drier without shutting down the system. Banner x will entertain alternative solutions that allow for servicing the dryer providing there is no increased

cost to install or maintain.

- .3 A 10-micron (or less) rated oil filter, with replaceable cartridges, shall be installed in the main oil supply line to the compressors.
- .4 Rack manufacturer shall supply filters specifically to the rack including turn over set. Case manufacturer to furnish driers upstream of EEVs

.L Input Control Devices

- .1 Each compressor suction header shall have a dedicated suction pressure transducer, rated for the operating limits of the system.
- .2 Each compressor suction header shall have a dedicated temperature sensor securely mounted and not affected by ambient air.
- .3 The system discharge line shall have a dedicated discharge pressure transducer, located after the oil separator, rated for the operating limits of the system.
- .4 The system gas cooler return shall have a pressure transducer, located prior to the holdback valve, rated for the operating limits of the system.
- .5 The system gas cooler return shall have a dedicated temperature sensor securely mounted, not affected by ambient air and located prior to the holdback valve.
- .6 Each subcooled liquid header shall have a dedicated temperature securely mounted and not affected by ambient air.
- .7 Ambient temperature sensors are required per gas cooler and shall be mounted in a shaded location out of the direct sun light.

.M Controls

- .1 The refrigeration control system will be specified as a site-specific item by Banner x.
- .2 The refrigeration control system will be part of the overall store BMS system.
- .3 The micro processor shall have a dedicated power source
- .4 The refrigeration control system shall control the following:
 - .a Cases and Walk Ins. Control of Electronic Expansion Valves for evaporator refrigerant flow with consistent superheat, Electronic Evaporator Pressure Regulator for control of evaporator back pressure control, controllers for local temperature control plus anti sweats, defrost , lighting fans, door opening etc
 - .b Gas Cooler. Control of variable fan speed, condensing temperature control of fan staging and options for control of evaporative assisted cooling.
 - .c Rack / Compressors. Variable capacity compressor per suction group, float on suction pressure, control to maximize COP (controlling transcritical operation). The rack controller shall be factory installed by the rack OEM
 - .d Control of mechanical sub cooling (if applicable).
 - .e Leak detection with in compressor room. The system will be supplied and installed by the EMS contractor and will control room ventilation and rack shut down in the case of a major refrigerant leak.
 - .f Heat reclaim. Control of operation between refrigeration rejected heat sources and auxiliary electric and natural gas options.

- .5 Compressor rooms shall have exhaust fans sized as required by code. Exhaust fans in compressor rooms requiring leak detection shall be wired through the EMCS for temperature activation or for refrigerant leak evacuation. The exhaust fans shall be hardwired through two-position (on/auto) override switches for manual control.
 - .6 The equipment manufacturer shall supply a fully downloaded, tested, and operable refrigeration control system, upon delivery of equipment at the job site. The equipment shall be fully tested before final installation. Final adjustments and set-up shall be performed by the Contractor.
- .N Electrical Panels and Power Distribution
- .1 Refer to Division 26 - Electrical.
- .02 Gas Coolers**
- .A Variable capacity control for gas coolers shall be submitted.
 - .B Manufacturers: Subject to compliance with requirements, approved gas cooler manufacturers (or approved equals) include:
 - .1 Gunter
 - .2 Heatcraft
 - .3 Luvata
 - .4 Ref Plus
 - .C Selection Criteria:
 - .1 Refrigerant R744.
 - .2 THR = Evaporator load and suction line heat gains plus 100% of compressor energy input at design conditions. THR may also include desuperheating, and/or subcooling loads from internally compounded systems.
 - .3 Altitude correction factor = Calculated on a site-specific basis.
 - .4 Fin spacing = 10 FPI
 - .5 Fan RPM in 800 – 850 range.
 - .D Variable capacity condenser fan motors shall be direct drive ECM (brushless DC) or VFD controlled motors and conform to local noise restrictions. The motors shall meet the following criteria: ISR insulation rating, weather proof, grounded, permanently lubricated ball bearings, and internal overload protection.
 - .E Gas cooler housing shall be aluminum with galvanized legs and tube sheets. Fan guards to be coated against corrosion and OSHA approved. Fan sections shall be compartmentalized and fully baffled for structural strength and to prevent wind-milling in the off cycle.
 - .F Coils being installed within 80 km radius from any salt water coast line to be coated against corrosion (Poly-vinyl Fin Coating).

- .G Gas coolers Electrical Specifications:
 - .1 Gas coolers/ condensers to be line voltage 3 phase.
 - .2 575/3/60 power supply or 208/3/60 variable speed EC fans.
 - .3 Each gas cooler shall be factory wired to an outdoor rain-tight type, non-fused disconnect switch.
 - .4 Each gas cooler fan shall be supplied with separate fuses and 3 pole contactors.
 - .5 Each fan motor shall be energy efficient, with thermal overload protection, permanently lubricated ball bearings and ground strap installed to motor frame.
 - .6 All fan motor leads shall be wired to a weatherproof electrical enclosure for single-point field wiring.
 - .7 All fans shall have cycling controls and all controls shall be factory mounted and wired.

.03 Heat Reclaim Coils/Heat Exchangers

.A Heat Exchangers for DHW

- .1 Heat exchangers shall be of the plate packaged type. Heat exchangers shall be made of corrugated channel plates between front and rear cover-plate packages. The cover plate packages shall consist of sealing plates, blind rings and cover plates.
- .2 Select plate packaged heat exchangers that withstand the design pressure range and be suitable for applications utilizing R744.
- .3 Plate heat exchanger shall be designed by Rack OEM and Mechanical consultant such that the maximum heat rejection capability of the rack is directed to give high quality hot water with the minimum requirement for auxiliary heating of the DHW. Control shall be by the store EMS system.
- .4 Rack OEM shall supply heat exchanger as a preinstalled item on the rack. The refrigeration connections to the heat exchanger will be factory installed.
- .5 Mechanical contractor will connect DHW pipework to the connections on the heat exchanger. The mechanical contractor shall coordinate the pipework route with refrigeration contractor.

.B Heat Reclaim Coil

- .1 The heat reclaim coil will be installed within the main store AHU. The coil will be installed by the AHU manufacturer during factory build. The coils will be designed to work with R744 at its discharge pressures and come with steel tails for connection by the refrigeration contractors specialist welder.
- .2 Heat reclaim coil will be designed by rack OEM and AHU manufacturer.
- .3 Heat reclaim coil will be supplied by the AHU manufacturer.
- .4 The store EMS system will control the space heating within the store including operation of the heat reclaim.

.04 Walk-In Evaporators

- .A Manufacturers: Subject to compliance with requirements, approved evaporator manufacturers (or equals) include:
 - .1 Bohn
 - .2 Keeprite
 - .3 Krack
 - .4 Ref Plus

- .B Selection Criteria:
 - .1 A basis of design selection will be made by system designer. This will include evaporator manufacturer, model, capacity, suction temperature, fan motor amps and voltage and TD required. If OEM chooses to provide another evaporator than listed, the selection will need to be provided on the submittal documents and approved by Owner.
 - .2 The maximum fin spacing shall be 6 fins per inch.
 - .3 Electronic expansion valves for evaporator shall be factory installed with a solid core filter drier brazed directly ahead of it, or as per rack manufacturers recommendations, and shall be sized for the design case load at the refrigeration system's winter and summer operation extremes. Liquid pressure and temperature shall be factored into valve sizing. The EEV shall be controlled via a case controller and respond from inputs from a pressure transducer at the coil outlet and temperature sensors at coil outlet and discharge air. Distributor nozzles shall be factory installed. Reference the "VALVES" section for approved manufacturer list and specific valve requirements.
 - .4 All Electronic Expansion Valves (EEV) shall have sweat connections.
 - .5 Evaporator coils shall be furnished with the EEV factory mounted. Filter and bypass ball valve shall be field installed.

- .C Fan guards shall be plastic or have protective coating to prevent against corrosion.

- .D Fan motors to be permanently lubricated with internal overload protection.

- .E LT evaporators shall have drain pan heating.

- .F The prep rooms, meat/deli, bakery, seafood, and produce cooler evaporators shall be the low velocity types, and have poly-coated fins if they are scheduled for off-cycle defrost application. All other evaporators shall be of the high velocity, horizontal type.

- .G No evaporator shall have a flare connection.

- .05 Refrigerated Cases**
 - .A This section is to be read in conjunction with Banner x refrigerated case product specification.

 - .B Materials
 - .1 The manufacturer shall supply butyl caulking, seam tape, nuts, bolts, screws and shims necessary to install each case according to the layout drawings and specifications.

.C Drains

- .1 All condensate drain final connections shall be by Refrigeration Contractor.
- .2 All cases shall have a drain line and trap. The line shall be the same size as the fixture drain outlet connection but shall not be smaller than $\frac{3}{4}$ ".
- .3 Case drains can be installed with ABS if approved by local codes.
- .4 Any un-used case drain outlets shall be securely sealed and capped. Note that pooling of condensate water in the bottom of the case will not be permitted.
- .5 All drains shall be installed to provide a minimum continuous fall of 1 inch in 8 feet.
- .6 All case drains will terminate by gravity into a main drain hub (provided by others). An air gap must be provided between the case drain pipe and the hub drain
- .7 All case drains shall have screens to prevent product ingress.

.D Coils

- .1 All coils shall be made of copper tubes with aluminum fins and be capable of operating with R744 as a refrigerant, with the increase in pressure associated with its use.
- .2 All coils shall arrive on the job site sealed with an OFN holding charge to manufacturers recommendations.
- .3 All coils shall have a schraeder tee with pressure transducer.
- .4 Cases which have refrigeration services fed from above will have suction and liquid lines factory piped from the coil to the top rear section of the case.

.E Valves and Controls

- .1 Factory installed valves and case controllers shall match the requirement of the rack manufacturer and refrigeration control system, with reference in particular to defrosting.
- .2 The Refrigeration Controls System sensors shall be factory installed. The wire shall run from the raceway to within four inches behind discharge air honeycomb grill. Discharge air temp sensors shall be mounted in the center of the case's supply air stream and shall have a minimum of six inches of sensor cable slack near the sensor.
- .3 All case controllers shall be factory installed. The controllers will be suitable for operation with the stores refrigeration control system.
- .4 All Electronic Expansion Valves (EEV) shall have sweat connections. All EEVs shall be factory installed with a solid core filter drier brazed directly ahead of it, or as per rack manufacturers recommendations, and shall be sized for the design case load at the refrigeration system's winter and summer operation extremes. Liquid pressure and temperature shall be factored into valve sizing. The EEV shall be controlled via a case controller and respond from inputs from a pressure transducer at the coil outlet and temperature sensors at coil outlet and discharge air.

PART 3 EXECUTION

3.01 REFRIGERANT PIPING INSTALLATION.

.A Jointing Procedure

- .1 To eliminate the formation of copper oxide on the inside of the tubing, all air must be flushed from the lines before brazing/weld and a slow stream (2 cubic feet per hour) of OFN must be passed through the tubing while brazing/welding. Suggested method is as follows:
 - .a Make up as many long lengths of piping as possible before beginning a joint. Tape steel pipe joints on butt welds.
 - .b Blow the pipe clean to ensure that any particles in the pipe network are removed.
 - .c Connect a pressure regulator and flow meter to a nitrogen drum.
 - .d Use a tapered rubber stopper as a tube connector. Insert a piece of 1/2" O.D. copper tubing into the stopper and connect the other end to the flow meter.
 - .e First set the regulator to give a quick shot of high pressure OFN to drive all the air out of the tubing. Then set the regulator for about two cubic feet per hour for each line.
 - .f All copper-to-copper joints shall be made with Silfos 15, Silvaloy 15 or equally high melting point brazing alloy. Solder or brazing alloy with less than 15% silver content will not be acceptable.
 - .g All stainless steel pipe is to be traceable and fully documented.
 - .h Stainless steel pipe can be joined using butt or socket welds.
 - .i All copper to brass joints shall be made with minimum 45% silver solder (Silvaloy450 or equivalent).
- .2 Before making the final connections, have dry nitrogen at ½ psi pressure flowing through tubing while joints are being made to avoid internal scale etc. (Special precautions must be taken to keep metal filings out of the tubing during fabrication and not to rely on blowing them out.
- .3 Joining of all special fittings such as vibration eliminators, driers, solenoid valves etc., that may warp, shall be made in such a manner to contain the heat in the immediate area of the joint providing necessary precautions are taken to prevent moisture and steam from being drawn into the joint.
- .4 Painting of copper piping is not allowed.
- .5 Under no condition shall pipes touch each other when necessary to cross pipes. Offset or insulate to insure no metal-to-metal contact. Refrigerant piping shall not come in contact with electrical conduit or other dissimilar grounded metals. Refrigerant lines from one system shall not be run through fixtures of another system.
- .6 Seal and pressure test each individual refrigerant circuit before connecting to condensing unit or refrigerant compressor rack. Line shall hold pressure. Testing shall be verified by AHJ. Repair leaks and repeat test until line is totally leak free.
- .7 Where a branch suction line enters a main suction line, it shall enter at the top, i.e.; inverted traps. Piping shall be arranged so refrigerant or oil cannot drain from the suction line into the coil.
- .8 Where a branch liquid line enters a main liquid line, it shall enter at the bottom. If piping is inside or under case and entering into bottom of main branch is not feasible entering into the side will be permitted. Liquid line branch is not to enter into the top of a main branch in any circumstance.

.B Pipe Insulation.

- .1 No sweating of lines will be allowed in areas where condensation may cause damage or unsafe conditions. This reservation applies to all weather conditions.
 - .2 Provide insulation of adequate thickness and R value to prevent heat pick up and condensation on all suction lines. Liquid lines shall be insulated to protect sub cooling and prevent heat pick up from store ambient conditions. The thickness of the insulation must be in accordance with manufacturer recommendations and all local code requirements.
 - .3 Insulation shall be installed in accordance with the insulation manufacturers recommendations.
 - .4 PVC pipe sleeves shall be provided for all refrigeration lines passing through walls and floors, walk-in box panels and case partitions that do not have pre-fabricated access holes provided. Sleeves and pipe shall be sealed with insulated foam and silicone on both sides of fixtures. Refrigeration piping is to enter refrigerated case through the manufacture intended penetration. Refrigeration piping entering fixture through a case end panel or other penetration not intended by the equipment manufacture is not permitted. Any display case end panel which is altered to allow piping penetration will be replaced at refrigeration contractors expense.
 - .5 All pipe insulation exposed to the exterior elements shall receive aluminized or PVC jacket specifically approved for this type of insulation. The finish shall be applied in accordance with the recommendations of the manufacturer.
- .C Underground lines shall be run in PVC sleeves terminating in a PVC elbow and brought above ground under the fixture with a tee in the riser at the other end. Trenching and backfill floor underground lines by General Contractor, Seal ends prior to setting cases. PVC pipe and lines to be flush with finish concrete. No inaccessible under ground joints in the pipe will be permitted unless accepted by the Owner.
- .D Refrigerant piping shall be run overhead in this store with the exception of the under floor runs as shown on drawings. Installation of expansion joints is recommended to minimize stress on the pipe work system. Most expansion requirements can be accommodated through the normal direction changes of the pipe. Long straight runs of pipe should include an expansion loop. Consideration should be given to the expansion that will be noted in pipe for discharge gas (heat reclaim) when it is compared to ambient conditions during its installation.
- .E All vertical refrigeration piping in the sales area shall be run next to columns, be installed in false columns in line with existing columns, or up a side wall in-line with existing columns.

3.02 INSTALLATION OF EQUIPMENT

- .A Contractor shall coordinate the installation of the Owner-furnished equipment with all affected subcontractors to insure proper provisions for installation of the unit. The coordination shall include as a minimum:
- .1 Structural supports and roof curb for units.
 - .2 Piping size and connection/header locations.
 - .3 Electrical power requirements and interconnection of wires/conduits and over-current protection.
 - .4 Controls and Security Systems requirements for connection to interlocked equipment

and refrigeration control system.

5 All contractor sub contracted trades.

.B Refrigerated Cases.

.1 Unload from trucks, record, handle, and place in building all refrigerated cases and condensing units serving the cases. See Refrigeration Schedule. Contractor to confirm latest fixture positions before cases are placed.

.2 Un-crate, assemble, and install in complete operating condition, refrigerated cases and condensing units serving them.

.3 This Contractor shall clean all normal debris, dirt, dust, etc., out of all cases.

.4 The refrigeration contractor shall remove all stickers/labels and installation debris from all fixtures and vacuum clean inside of fixtures prior to equipment start-up. Any/all shipping tape, blocking and/or packaging inside display fixtures to be removed by refrigeration contractor.

.5 Set cases level and in line with transit. Shim at every vertical support or at maximum 4 foot intervals with galvanized plates where floor condition requires (both front and rear of case).

.6 Apply ample amounts of Butyl caulking compound at case joints. Caulking in low temperature and meat cases is especially critical. Manufacturer's seal is not sufficient. Once equipment is jointed, do not shift or move without breaking and resealing joints.

.7 Do not alter any case structural component without approval.

.8 Hang case shelving and place pans in refrigeration cases, including door shelving in Dairy cooler.

.9 Connect water feed stubbed in by the general contractor to service seafood/fish case humidification system. System supplied by owner to be installed by refrigeration contractor.

.10 Connect water feed stubbed in by the general contractor to service gourmet meat case humidification system. System supplied by owner to be installed by refrigeration contractor.

.11 Connect water feed stubbed in by the general contractor to produce "wet wall" misting system. System supplied by owner to be installed by refrigeration contractor. Location of misting spray bar and nozzles to be coordinated confirmed with Banner x produce specialist.

.C Refrigerated Boxes.

.1 Unload from trucks and place in building all coils and boxes shown on Refrigeration Schedule.

.2 Install in complete operating condition coils in walk-in box. See Refrigeration Schedule.

.3 All coils shall be washed clean of all dust and dirt.

.4 The evaporator coils must be separately and adequately supported in such a manner that it will not adversely affect the structural integrity of the cooler/freezer walk-in boxes. Unistrut or equivalent galvanized steel channel is to be used to support/distribute the weight of the evaporator coils. Length of each Unistrut support should at minimum be

equal length to the width of the evaporator coil being supported. Wood or other non water/corrosive resistance materials are not acceptable. Location of evaporator coils must be coordinated with Banner x project manager prior to installation. Coils shall be installed promptly upon receipt so boxes can be locked for safekeeping of Owner's property.

- .5 Where electrical conduit, drain lines and refrigerant lines penetrate box wall panels, properly permagum all points of entry - both sides.
 - .6 EEV and controllers in all boxes for temperature control shall be furnished by controls OEM.
 - .7 Erect all cold rooms, doors etc.
 - .8 Contractor is to coordinate with General Contractors sub-trades to ensure timely installation of curbs, bollard etc.
- .D Remodel Work.
- .1 See the refrigeration drawings to determine which coils are to be replaced, relocated, removed, etc.
- .E Rack.
- .1 Rack Manufacturer shall be responsible for a complete installation, and for delivering the Rack to site, with all mechanical, electrical, and controls connections prepared for external field connections.
 - .2 Contractor shall receive and protect the Rack once delivered to the site and shall install the Rack in accordance with manufacturer's instructions.
 - .3 Provide piping connections from Rack field connection points to equipment as shown on drawings.
- .F Gas Cooler
- .1 This Section is intended to cover the installation of the gas coolers including receiving, un-crating, setting and providing unit in complete operating condition in accordance with the manufacturer's requirements.
 - .2 Set gas cooler as scheduled. Verify exact size with manufacturer and coordinate size and location of roof supports with the building general contractor and structural subcontractor. Verification is to be carried out prior to gas cooler delivery.
 - .3 The Contractor shall coordinate location of weather-proof galvanized sheet metal hood at piping roof penetration with general contractor, as per architectural detail drawings and specifications.

3.03 FIELD QUALITY CONTROL

- .A Pipe Testing and Evacuation.
- .1 Contractor shall notify the Owner 24 hours in advance when one or more systems will be ready to test so the Owner and/or manufacturer's representative may be present for the test, if desired. Failure to notify the Owner will result in having to repeat test.

.B Refrigerant Piping Testing.

- .1 Piping systems should be tested for strength and leaks and should be evacuated before being charged with refrigerant. The relief valves and safety devices should be removed and the connections should be plugged during the test. The system should be pressurized with OFN to 1.1 times the maximum system pressure (relief valve settings) for 2 hours (check with local authorities if different times are required). Once it is determined that the system is free of leaks, all air, water and other non-condensables must be removed from the system before it is charged. Removal of the water is important when polyester oils are used. The system should be allowed to stand with a 1000-micron vacuum for at least three hours before each evacuation is broken with OFN. The third evacuation should run until the pressure is below 500 microns, and the pumps should be stopped for 12 hours. After this, the vacuum should be broken again with OFN and the pressure allowed to rise slightly above 0 psig. At this time the drier cartridges and other devices can be installed and the system can be evacuated below 500 microns and charged with refrigerant.
- .2 Comply with requirements of local codes if higher test pressures are required. Refrigeration piping will not be acceptable unless it is gas tight. If leaks are found, isolate leaks, discharge gas and repair leaks, and then repeat test. When testing has been completed, release pressure using safe procedure.

.C Refrigerant Piping Evacuation.

- .1 Each system must be evacuated with a vacuum pump manufactured for that purpose.
- .2 The vacuum pump shall be connected to the system through a 5/8" O.D. or larger line connected to a flange adapter installed between the suction service valve and the compressor suction port. A second line shall be connected to the three-way valve in the liquid line to allow evacuation from both high and low sides simultaneously. This second line shall be the same size as the liquid line.
- .3 All components that may be damaged under vacuum (eg pressure transducers) shall be isolated.
- .4 Systems are to be triple evacuated for a minimum of 24 hours. The first vacuum shall be broken with OFN and then twice more with R744 vapour. Oil levels should be monitored during this time and additional oil topped up as required. Compressor crankcase heaters should be on during evacuation.

.D Refrigerant Charging.

Refrigeration contractor shall supply complete redundant refrigerant charge as part of scope of work. Only 20 cylinders are permitted to remain on site during warranty period. Remainder of redundant charge is to be stored off site at refrigeration contractors expense for the balance of the 1 year warranty period. Refrigeration contractor to secure all refrigerant cylinders on site to wall using steel chain or other owner approved method. Cylinders of R744 will be stored on site with the final position of the storage point and the number of cylinders to be marked on the drawings as a site specific position. For larger refrigerant losses the R744 supplier shall be required to make available the necessary amount of R744 for a full charge within an agreed time frame.

Accommodations shall be made to pipe R744 from the warehouse receiving area to the machine room and connect to the rack via a flexible hose. Piping and flexible hose connection to be identified on drawings.

- .1 When the system has been successfully evacuated, the contractor shall fit to the system calibrated pressure gauges and thermometers for use during the charging and commissioning procedure.
- .2 After final evacuation, the vacuum should be broken with R744 vapour. Always begin with vapor CO2 only, until the pressure rises above 75 psig. Do not introduce liquid CO2 until pressure across the entire refrigeration system is greater than 75 psig to avoid the formation of dry ice in the refrigeration system. Charging may then continue with liquid refrigerant. When charging the CO2 refrigerant to a new system follow OEM procedures. During refrigerant charging oil heaters on low pressure side vessels should be energised, if fitted. Only one container of refrigerant should be connected to the system at a time. The connecting point will depend on the type of system and the chosen method of charging i.e. gas or liquid charging. Care shall be taken to ensure that liquid refrigerant does not enter the compressor.
- .3 The container for charging the system should be securely supported and located in a position where it will not cause a hazard to other personnel involved on the site and a notice posted to indicate that it is being used for charging.
- .4 When changing containers during the charging procedure, care must be taken not to trap liquid refrigerant between isolating valves.
- .5 When sufficient refrigerant has been charged into the system and there is suitable heat load to maintain operation, the compressor should be started in order to reduce the low side pressure and hence enable the charging process to be completed.
- .6 If the container pressure drops too low for further efficient charging, the pressure may be increased by standing the container in a bath of warm water or by applying some other gentle heat. On no account shall a flame be used, nor shall the container be heated over 40°C.
- .7 During this procedure the operation of the compressor shall be monitored, and details recorded of all its mechanical and electrical operating parameters. It shall be shut off if any signs of abnormal operation are observed or heard. Extra care shall be taken during the initial phase of the charging process as, until there is an adequate charge of refrigerant in the system, the compressor could be operating outside its normal range of temperatures and pressures. The system shall not be left unattended during the charging process.
- .8 The system should be fully charged, taking into account all operating conditions that can exist over the design range of ambient temperatures. When completed, the total weight of refrigerant charged into the system shall be recorded.
- .9 Refrigerant containers should be disconnected as soon as charging is completed. When the system has been fully charged, the protection devices shall be tested to ensure that the system will be protected in the event of it running outside of normal operating conditions.
- .10 The installing Contractor shall supply Coleman Instrument Grade CO2 only for the refrigeration system unless otherwise authorized by Banner x West in writing. Coleman Instrument Grade is 99.99% pure with less than 20ppm of water.

.E Inspections.

- .1 The Contractor shall notify Banner x Project Manager 72 hours in advance of start up of all compressors and equipment. Contractor shall have all equipment running and down to specified temperatures above on the day specified by.
- .2 The inspection day will be set by Owner.
- .3 The Contractor shall notify Owner immediately of any excessive draft conditions over refrigerated cases whether due to air conditioning, heating system, or outside doors both before and after stocking.
- .4 The Contractor shall take an adequate number of velometer readings over all cases to satisfy himself that there are no drafts in excess of 225 f.p.m. and furnish a written report of any location over 25 f.p.m.
- .5 Document and set all defrost times and their duration if on demand defrosting is not utilized.

3.04 CLEANING

- .A The Contractor shall remove from the interior of the building daily crating, packaging and any other debris removed from equipment being installed by him. It shall be placed in a debris container or truck or neatly stacked outside the building and hauled away daily into a GC supplied bin.
- .B For remodels this Contractor shall relocate and render operable all items of Banner x Inc fixtures, cases, and equipment as required and necessary (if even on a temporary basis) to allow for the completion of the work.

3.05 PROTECTION

- .A Protect refrigerant lines and equipment during and after installation. Any damage to the system and fixtures will be replaced at no cost to the Owner.

3.06 SCHEDULES

- .A The Contractor shall provide one copy of all manufacturers' literature furnished with each piece of equipment, and install literature in machine room in three-hole binder secured to wall.
- .B The Contractor shall complete four (4) copies of schedules entitled Refrigeration System Settings. These Schedules shall be completed after the Contractor has commissioned all systems as prescribed in these Specifications. One copy shall be mounted in a see-through protective covering in the compressor room, one copy retained by the Contractor and two copies forwarded to the Owner within seven (7) days after the remodel is completed for business.
- .C Mount on each control panel a plate giving time and length of each defrost.

3.07 COMMISSIONING

Commissioning is a series of activities for achieving, verifying and documenting that the performance of the refrigeration system and various sub systems meet the design intent as well as the Owners operational needs. These activities extend through all phases of a project and include:

- .A System Startup
 - .1 The Contractor shall give the Owner or his representative and refrigeration system manufacturer minimum 2 weeks notice prior to scheduled start-up.
 - .2 Refrigeration system start-up shall be in accordance with these Specifications and procedure as laid out by the system manufacturer. Start-up reports will form part of the refrigeration completion documentation which will be issued to Owner by the Contractor.
 - .3 Coordinate Work of this Section with energy management system contractor, refrigeration contractor, mechanical contractor, and rack Manufacturer for installation dates, testing dates, and completion dates.
 - .4 The rack Manufacturer or his representative shall provide assistance for system startup. The Contractor shall perform the startup, which shall include a check of proper installation, system check-out, adjustment, and complete start-up. The startup will occur only when system Manufacturer and Owners representative have signed off that the refrigeration system is complete and ready to start.
 - .5 The Contractor shall complete installation and startup checks according to manufacturer's written instructions and shall include the following as a minimum:
 - .a Shipping, blocking, and bracing removed.
 - .b Inspection for visible damage to all components.
 - .c Clearances have been provided for servicing.
 - .d Electrical connections are tightened.
 - .e Controls are connected and operable.
 - .f Lines purged with OFN.
 - .g Start-up completed according to manufacturer's written instructions.
 - .h Completion of startup sheets.
 - .i Inspection and record of interlocks and protective devices performance; verification of sequences documented.
 - .j Unit operation for run-in period recommended by manufacturer.
 - .k Inspection of control valves for proper operation.
 - .l Inspection of controls for correct sequencing for normal and emergency shutdown.
 - .m Measurement and record of operating conditions, temperatures and amperage.
 - .n Verification of functional performance of system simulating conditions on the sequence of operations.
 - .o Verification of Refrigeration Equipment operation.
 - .6 Notify Equipment Manufacturer of malfunctioning components that do not pass tests and inspections. Equipment Manufacturer shall remove and replace malfunctioning components and retest as specified above.
 - .7 Equipment Manufacturer shall notify Owner on any major issues regarding equipment and startup.
 - .8 After compressors are started, continue charging until system has sufficient refrigerant for proper operation. Do not overcharge. During start-up, do not leave compressor operating unattended and unmatched until system is properly charged with refrigerant and oil.
 - .9 Do not add refrigerant oil while system is short of refrigerant unless oil level is dangerously low. If oil has been added during charging, carefully check compressor

crank case sight glass after reaching normal operating condition to ensure it does not contain excessive amount of oil which can cause slugging or loss of refrigeration capacity.

- .10 The case manufacturer shall provide assistance during the start up of the refrigeration system to support the Contractor with case operation and performance.
- .11 The Contractor shall be responsible for documenting and reporting all case operating problems to the case manufacturer and Owner.

.B Adjusting

.1 Adjusting Controls.

The temperature controls shall be set in accordance with manufacturer's and Owners recommendations called for on refrigeration schedule, so that the following temperatures are maintained:

FIXTURE	DEG F	DEG C
Ice Cream Reach In	-12	-24
Ice Cream Cases	-12	-24
Frozen Food Cases (1 deck)	-3	-19
Frozen Food Cases (5 deck)	-3	-19
Food and Ice Cream Freezer	-12	-24
Meat Freezer	-5	-20
Bakery Freezer	-15	-27
Fresh Meat Cases	28	-2
Deli Cases	34	1
Service Deli Cases	36	2
Dairy or Cheese Cases	36	2
Bakery Cases	38	3
Produce Cases	40	4
Meat Cooler	30	-1
Deli / Fish Cooler	34	1
Dairy / Bakery Cooler	36	2
Produce Cooler	40	4
Meat Cutting Room	55	12

- .2 Contractor shall adjust all controls to maintain the lowest head pressure that is found to give adequate liquid feed to the expansion valves including but not limited to the following:
 - .a Control set points for gas cooler/condenser.
 - .b Control strategy for remote gas coolers.
- .3 The Contractor shall perform the following:
 - .a Adjustments of E.E.P.R valves, EEV valves, solenoid valves, compressor high and low pressure switches;
 - .b Checking electrical load balances;
 - .c Complete refrigerant and oil charge;
 - .d Adjusting oil float levels, replacement of liquid, suction and oil line filter dryers,

- etc;
- .e Checking pressure and temperature gauges for accurate operation;
- .f Controls set point adjustment to ensure system performance as designed.

- .4 The Contractor shall check overload protection devices and report to Owner if size is incorrect.
- .5 The Contractor shall furnish a competent refrigeration service mechanic to make any necessary adjustments to the controls during the time the fixtures are being stocked. The mechanic shall remain at the store eight hours during the first day the equipment is in operation.
- .6 The Contractor shall check oil level, and fill as required, all compressors from 24 to 48 hours after start up (or as directed by the system OEM, whichever is greater). Provide oils samples for each rack.

.C OPERATION AND CHECK OUT

- .1 Refrigeration contractor to verify all fixture control set-points and programming settings have been individually set and checked for proper operation of each fixture as per OEM specifications. Refrigeration contractor to verify all electronic expansion valve superheat and valve base opening settings have been individually set for proper operation of each fixture.
- .2 Verify and reset superheat after cases and walk-ins have been loaded with product, and temperature and humidity levels have been reached.
- .3 Change liquid line filter dryers, oil system dryers and suction filter dryers after 24 hours of run time or as recommended by rack manufacturer. Filters to be rated for wax removal. Refrigeration contractor shall be responsible to change coalescent oil separator cartridges at interval recommended by equipment manufacturer at no cost to owner for 1 year period from grand opening date.
- .4 The refrigeration Contractor shall ensure that all defrost schedules are satisfactory. Refrigeration contractor to verify and adjust any/all defrost termination and fan delay set points. Defrost Schedules must be set in accordance with case/rack manufacturer specifications. The refrigeration Contractor shall confirm that all systems defrost cycles are terminating at proper time or temperatures based on manufacturers recommendations.
- .5 Refrigeration contractor to verify operation and control for emergency condensing unit. Unit to be activated automatically during a store power failure to limit pressure within the system. Condensing unit should also have a manual toggle switch to facilitate manual operation of unit for servicing or emergency situations. Refrigeration contractor to perform store power failure simulation test once refrigeration system is operational but before perishable product arrives at store. Contractor to verify that system performs as designed in this situation. Any issues or concerns need to be documented and presented to the Banner x West project manager and equipment OEM.

.D SYSTEM COMMISSIONING AND VERIFICATION

- .1 Commissioning is a series of activities
- .2 The refrigeration contractor shall be responsible before perishables arrive that proper alarm set points are programmed and active on the EMS as per Banner x West refrigeration alarm specifications. Refrigeration alarms must be tested with the store

- alarm monitoring company (Chubb). If the alarm monitoring company has not completed their work, the refrigeration contractor shall inform Banner x West project manager. The refrigeration contractor shall be sure that all alarms are activated before leaving the store each night.
- .3 The following is a series of events the refrigeration contractor shall follow for alarms occurring prior to store grand opening:
- 1.1.1. Once perishables are in store refrigeration contractor shall submit all after hours emergency contact numbers to Banner x West store managers and project manager. All information shall be given prior to start-up of equipment.
 - 1.1.2. Firstly, Alarm Company shall phone refrigeration contractor; secondly, phone store manager.
 - 1.1.3. After store opening all refrigeration alarms and/or service calls will be sent directly to the Banner x Maintenance Solution Center (MSC). MSC will contact refrigeration contractor.
- .4 The Rack shall be factory tested prior to delivery to site.
- .5 A functional performance test that shall be performed by the Contractor and conducted under the direction of and witnessed Owner.
- .6 The commissioning functional performance test shall not be conducted until the manufacturer provides a letter of certification that all testing, adjusting and balancing of all systems, including controls, have been completed, that all items on the Pre-Functional Checklist, have been completed, and that the system is ready for commissioning.
- .7 The case manufacturer's field service representative shall endorse the commissioning of each case within one week after refrigeration system start up. This commissioning process shall be the responsibility of the installing contractor and the manufacturer's field service representative
- .8 Typical Schedule for Rack Start Up
- Day 1 to 5
Refrigeration Controls Supplier to set up case controllers.
- Day 6 to 8
Verification of all sensors, transducers and valves. Heat Reclaim programming.
- Day 9 to 21
Rack Manufacturer and Refrigeration Contractor. Rack start-up.
- Prior to Rack start up the refrigeration system should be at the following status:
All refrigeration pipework will be installed; fully pressure tested and has gone through a triple vacuum.
- Cases and Walk in evaporators will have all condensate drains connected to the store drainage network, to hub drains specified for the refrigeration condensate. Cases and evaporators will have been tested for water tightness.
- Refrigeration electrical installation will be complete, tested and power will be on.
Refrigeration controls wiring will be complete and tested.

Cold rooms and door must be sealed and be ready for operation. All auxiliary heating systems (condensate trace, threshold, frame, pressure relief vent etc) will be operational.

High-speed Internet should be accessible via modem and router from the mechanical room and connecting to a UPS.

A computer or terminal connected to UPS in the mechanical room with control software for the control system is to be available.

Provide an email address associated to the Internet connection.

The generator must be installed and functional for the Rack emergency condensing unit.

.E TRAINING

- .1 After store opening, the Contractor shall instruct the store personnel on the proper operation, care, and upkeep of all equipment. Training shall include but not be limited to:
 - .a Overview of the system and/or equipment as it relates to the facility as a whole.
 - .b Operation and store actions/re-actions related to the Refrigeration monitoring system.
 - .c Operation and maintenance procedures and schedules related to startup and shutdown, troubleshooting, servicing, preventive maintenance and appropriate operator intervention.
 - .d Back up operation of the rack during power outages.
- .2 The Contractor shall submit to the Owner a certification letter stating that store personnel have been trained as specified herein. Letter shall include date, time, attendees and subject of training. The certification letter shall be signed by the Contractor and the Owner's representative indicating agreement that the training has been provided.
- .3 The Contractor shall ensure that their staff who work within the Owners stores are fully trained and knowledgeable with the trans critical refrigeration system and generally with the use of R744.
- .4 Contractors that have not installed the particular Transcritical system specified in the past are required to have a minimum of 3 staff factory trained. This is at the Contractors own cost. Training usually consists of three days theory and practical training at the manufacturer's facility. Costs include flights and accomodation.
- .5 The Manufacturer will ensure through regular training sessions that the Contractors are fully conversant with the use of R744 and its application within their products.

END OF SECTION

