AAON® CB Series

Condensing Units

Installation, Operation & Maintenance

⚠ WARNING

FIRE OR EXPLOSION HAZARD

Failure to follow safety warnings exactly could result in serious injury, death or property damage.

Be sure to read and understand the installation, operation and service instructions in this manual.

Improper installation, adjustment, alteration, service or maintenance can cause serious injury, death or property damage.

Keep a copy of this IOM with the unit.

⚠ WARNING

- Do not store gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance
- WHAT TO DO IF YOU SMELL GAS
  - Do not try to light any appliance.
  - Do not touch any electrical switch; do not use any phone in your building.
  - Leave the building immediately.
  - Immediately call your gas supplier from a phone remote from the building. Follow the gas supplier's instructions.
  - If you cannot reach your gas supplier, call the fire department.
- Startup and service must be performed by a Factory Trained Service Technician.

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(ACP J00187)

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Safety

Attention must be paid to the following statements:

NOTE - Notes are intended to clarify the unit installation, operation and maintenance.

⚠ **CAUTION -** Caution statements are given to prevent actions that may result in equipment damage, property damage, or personal injury.

⚠ **WARNING -** Warning statements are given to prevent actions that could result in equipment damage, property damage, personal injury or death.

⚠ **DANGER -** Danger statements are given to prevent actions that will result in equipment damage, property damage, severe personal injury or death.

⚠ WARNING

ELECTRIC SHOCK, FIRE OR EXPLOSION HAZARD

Failure to follow safety warnings exactly could result in dangerous operation, serious injury, death or property damage.

Improper servicing could result in dangerous operation, serious injury, death, or property damage.

- When servicing controls, label all wires prior to disconnecting. Reconnect wires correctly.
- Verify proper operation after servicing. Secure all doors with key-lock or nut and bolt.

⚠ WARNING

ELECTRIC SHOCK

Electric shock hazard. Before servicing, shut off all electrical power to the unit, including remote disconnects, to avoid shock hazard or injury from rotating parts. Follow proper Lockout-Tagout procedures.

⚠ WARNING

QUALIFIED INSTALLER

Improper installation, adjustment, alteration, service or maintenance can cause property damage, personal injury or loss of life. Startup and service must be performed by a Factory Trained Service Technician. A copy of this IOM must be kept with the unit.

⚠ WARNING

FIRE, EXPLOSION OR CARBON MONOXIDE POISONING HAZARD

Failure to replace proper controls could result in fire, explosion or carbon monoxide poisoning. Failure to follow safety warnings exactly could result in serious injury, death or property damage. Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this appliance.

⚠ WARNING

LIVE ELECTRICAL

During installation, testing, servicing, and troubleshooting of the equipment it may be necessary to work with live electrical components. Only a qualified licensed electrician or individual properly trained in handling live electrical components shall perform these tasks.

Standard NFPA-70E, an OSHA regulation requiring an Arc Flash Boundary to be field established and marked for identification of where appropriate Personal Protective Equipment (PPE) be worn, must be followed.

⚠ WARNING

GROUNDING REQUIRED

All field installed wiring must be completed by qualified personnel. Field installed wiring must comply with NEC/CEC, local and state electrical code requirements. Failure to follow code requirements could result in serious injury or death. Provide proper unit ground in accordance with these code requirements.

⚠ WARNING

ROTATING COMPONENTS

Unit contains fans with moving parts that can cause serious injury. Do not remove grill containing fans until the power to the unit has been disconnected and fan has stopped rotating.

⚠ CAUTION

3-PHASE ROTATION

Rotation must be checked on all MOTORS AND COMPRESSORS of 3 phase units at startup by a qualified service technician. Scroll compressors are directional and can be damaged if rotated in the wrong direction. Compressor rotation must be checked using suction and discharge gauges. Fan motor rotation must be checked for proper operation. Alterations must only be made at the unit power connection

⚠ WARNING

UNIT HANDLING

To prevent injury or death lifting equipment capacity shall exceed unit weight by an adequate safety factor. Always test-lift unit not more than 24 inches high to verify proper center of gravity lift point to avoid unit damage, injury or death.

⚠ CAUTION

Compartments containing hazardous voltage or rotating parts are equipped with a panel requiring tooled access. Always re-install screws on the panel after installation or service is completed.

⚠ WARNING

LEAK TESTING

Do not use oxygen, acetylene or air in place of refrigerant and dry nitrogen for leak testing. A violent explosion may result causing injury or death.

⚠ CAUTION

COMPRESSOR LUBRICANT

Polyolester (POE) and Polyvinylether (PVE) oils are two types of lubricants used in hydrofluorocarbon (HFC) refrigeration systems. Refer to the compressor label for the proper compressor lubricant type.

⚠ CAUTION

PVC PIPING

PVC (Polyvinyl Chloride) and CPVC (Chlorinated Polyvinyl Chloride) are vulnerable to attack by certain chemicals. Polyolester (POE) oils used with R-410A and other refrigerants, even in trace amounts, in a PVC or CPVC piping system will result in stress cracking of the piping and fittings and complete piping system failure.

⚠ CAUTION

COIL CLEANERS

To prevent damage to the unit, do not use acidic chemical coil cleaners. Do not use alkaline chemical coil cleaners with a pH value greater than 8.5, after mixing, without first using an aluminum corrosion inhibitor in the cleaning solution.

⚠ WARNING

COIL CLEANERS

Some chemical coil cleaning compounds are caustic or toxic. Use these substances only in accordance with the manufacturer’s usage instructions. Failure to follow instructions may result in equipment damage, injury or death.

CAUTION

COIL CLEANING

Do not clean DX refrigerant coils with hot water or steam. The use of hot water or steam on refrigerant coils will cause high pressure inside the coil tubing and damage to the coil.

WARNING

ENCLOSED AREA

Do not work in an enclosed area where refrigerant or nitrogen gases may be leaking. A sufficient quantity of vapors may be present and cause injury or death.

WARNING

COMPRESSOR CYCLING

3 MINUTE MINIMUM OFF TIME
To prevent motor overheating compressors must cycle off for a minimum of 3 minutes.

5 MINUTE MINIMUM ON TIME
To maintain the proper oil level compressors must cycle on for a minimum of 5 minutes.

The cycle rate must not exceed 7 starts per hour.

1. Startup and service must be performed by a Factory Trained Service Technician.

2. The unit is for outdoor use only. See General Information section for more unit information.

3. Every unit has a unique equipment nameplate with electrical, operational and unit clearance specifications. Always refer to the unit nameplate for specific ratings unique to the model you have purchased.

4. READ THE ENTIRE INSTALLATION, OPERATION AND MAINTENANCE MANUAL. OTHER IMPORTANT SAFETY PRECAUTIONS ARE PROVIDED THROUGHOUT THIS MANUAL.

5. Keep this manual and all literature safeguarded near or on the unit.

CB Series Feature String Nomenclature

Model Options						:	Unit Feature Options						
GEN	MJREV	UNIT SIZE	VLT	COMP	CKTS		1	2	3	4	5	6	7
CB -	**B -**	**060 -**	**3 -**	**B -**	**1**	**:**	**D**	**D**	**0**	**0**	**D**	**A**	**0**

BASE MODEL

SERIES AND GENERATION

CB

REVISION

B = Design Sequence

UNIT SIZE

024 = 24 MBH - 2 Ton - Vertical Discharge
036 = 36 MBH - 3 Ton - Vertical Discharge
048 = 48 MBH - 4 Ton - Vertical Discharge
060 = 60 MBH - 5 Ton - Vertical Discharge

VOLTAGE

1 = 230V/1Φ/60Hz
2 = 230V/3Φ/60Hz
3 = 460V/3Φ/60Hz
4 = 575V/3Φ/60Hz
8 = 208V/3Φ/60Hz
9 = 208V/1Φ/60Hz

COMPRESSOR TYPE

B = R-410A Two Step Scroll Compressor
D = R-410A Variable Capacity Scroll Compressor
F = R-410A Two Step Scroll Compressor with Sound Blanket
H = R-410A Variable Capacity Scroll Compressor with Sound Blanket

NUMBER OF CIRCUITS

1 = One Circuit

FEATURE 1: AMBIENT CONTROL

0 = Standard (55°F Ambient)
B = Adjustable Fan Cycling (35°F Ambient)
D = Modulating Fan Pressure Control (35°F Ambient)
F = Flooded Condenser Ambient Controls (0°F) + Option B
G = Flooded Condenser Ambient Controls (0°F) + Option D

FEATURE 2: REFRIGERATION OPTIONS

0 = Standard - Split System Air Conditioner
A = External Hot Gas Bypass
B = Split System Heat Pump
D = Modulating Hot Gas Reheat
F = Options A + D
G = Options B + D

FEATURE 3: CONTROLS

0 = Standard - Terminal Block
A = Suction Pressure Transducer (F1- Orion Reheat)
H = Control Circuit Transformer
K = Orion VCCX2 + H + S
L = AAON Touchscreen Controller + H
M = AAON Touchscreen Controller + H + S
S = Suction Pressure Transducer (Not F1 - Orion Reheat)
T = Control Circuit Transformer + Suction Pressure Transducer

FEATURE 4: COIL PROTECTION

0 = Standard
A = Polymer E-Coated Coil

FEATURE 5: CABINET OPTIONS

D = Standard – Louvered Panels + 2500 Hour Salt-Spray Tested Exterior Paint
G = Wire Grille + 2500 Hour Salt-Spray Tested Exterior Paint

FEATURE 6: WARRANTY

0 = Standard
A = Second to Fifth Year Extended Compressor Warranty

FEATURE 7: TYPE

0 = Standard
X = Special Pricing Authorization

General Information

AAON CB Series condensing units have been designed for outdoor installation only. Startup and service must be performed by a Factory Trained Service Technician.

WARNING

QUALIFIED INSTALLER

Improper installation, adjustment, alteration, service or maintenance can cause property damage, personal injury or loss of life. Installation and service must be performed by a Factory Trained Service Technician.

Codes and Ordinances

CB Series units have been tested and certified, by ETL, in accordance with UL Safety Standard 1995/CSA C22.2 No. 236.

System must be sized in accordance with the American Society of Heating, Refrigeration and Air Conditioning Engineers Handbook.

Installation of CB Series units must conform to the ICC standards of the International Mechanical Code, the International Building Code, and local building, plumbing and waste water codes. All appliances must be electrically grounded in accordance with local codes, or in the absence of local codes, the current National Electric Code, ANSI/NFPA 70 or the current Canadian Electrical Code CSA C22.1.

CAUTION

The Clean Air Act of 1990 bans the intentional venting of refrigerant as of July 1, 1992. Approved methods of recovery, recycling, or reclaiming must be followed.

WARNING

SHARP EDGES

Coils and sheet metal surfaces present sharp edges and care must be taken when working with equipment.

WARNING

Failure to observe the following instructions will result in premature failure of your system and possible voiding of the warranty.

Receiving Unit

When received, the unit must be checked for damage that might have occurred in transit. If damage is found it must be noted on the carrier's Freight Bill. A request for inspection by carrier's agent must be made in writing at once.

Check the nameplate to ensure the correct model sizes and voltages have been received to match the job requirements.

If repairs must be made to damaged goods, then the factory must be notified before any repair action is taken in order to protect the warranty. Certain equipment alteration, repair, and manipulation of equipment without the manufacturer's consent may void the product warranty. Contact AAON Technical Support for assistance with handling damaged goods, repairs, and freight claims: (918) 382-6450.

NOTE: Upon receipt check shipment for items that ship loose. Consult order and shipment documentation to identify potential loose-shipped items. Loose-shipped items may have been placed inside the unit cabinet for security.

The warranty card must be completed in full and returned to AAON not more than 3 months after the unit is delivered.

Storage
If installation will not occur immediately following delivery, store equipment in a dry protected area away from construction traffic and in the proper orientation as marked on the packaging with all internal packaging in place. Secure all loose-shipped items.

Direct Expansion (DX) Condensing Units
CB Series condensing units are factory assembled and wired, including a full charge of R-410A refrigerant for up to 25 feet of line set. Systems with the modulating hot gas reheat option will require refrigerant to be field added because of the additional refrigerant components and piping associated with the system.

Failure to observe the following instructions may result in premature failure of your system, and possible voiding of the warranty.

⚠ CAUTION

CRANKCASE HEATER OPERATION

Units are equipped with compressor crankcase heaters, which must be energized at least 24 hours prior to cooling operation, to clear any liquid refrigerant from the compressors.

Never cut off the main power supply to the unit, except for servicing, emergency, or complete shutdown of the unit. When power is cut off from the unit, compressors using crankcase heaters cannot prevent refrigerant migration. This means the compressor may cool down and liquid refrigerant may accumulate in the compressor. Since the compressor is designed to pump refrigerant gas, damage may occur when power is restored.

⚠ CAUTION

3-PHASE ROTATION

Rotation must be checked on all MOTORS AND COMPRESSORS of three phase units. All motors, to include and not be limited to pump motors and condenser fan motors, must all be checked by a qualified service technician at startup and any wiring alteration must only be made at the unit power connection.

If power to the unit must be off for more than an hour, turn the thermostat system switch to “Off”, or turn the unit off at the control panel, and then cut off the main power supply. Leave the unit off until the main power supply has been turned on again for at least 24 hours. This will give the crankcase heater time to clear any liquid accumulation out of the compressor before it is required to run.

Always control the system from the thermostat, or control panel, never at the main power supply, except for servicing, emergency, or complete shutdown of the unit.

The compressor life will be seriously shortened by reduced lubrication, and the pumping of excessive amounts of liquid oil and liquid refrigerant.

⚠ CAUTION

COMPRESSOR ROTATION

Scroll compressors are directional and will be damaged by operation in the wrong direction. Low pressure switches on compressors have been disconnected after factory testing. Rotation must be checked by a qualified service technician at startup using suction and discharge pressure gauges and any wiring alteration must only be made at the unit power connection.

The standard compressors must be on a minimum of 5 minutes and off for a minimum of 3 minutes. The cycle rate must be no more than 7 starts per hour.

⚠ WARNING

COMPRESSOR CYCLING

3 MINUTE MINIMUM OFF TIME
To prevent motor overheating compressors must cycle off for a minimum of 3 minutes.

5 MINUTE MINIMUM ON TIME
To maintain the proper oil level compressors must cycle on for a minimum of 5 minutes.

The cycle rate must not exceed 7 starts per hour.

Note: Low Ambient Operation
Units without a low ambient option, such as condenser fan cycling or the 0°F low ambient option, will not operate in the cooling mode of operation properly when the outdoor temperature is below 55°F. Low ambient and/or air handling unit economizer options are recommended if cooling operation below 55°F is expected.

Note: Multiple Systems with Multiple Thermostats:

When several heating and cooling split systems are used to condition a space all thermostat switches must be set in either heating mode, cooling mode or off. Do not leave part of the systems switched to the opposite mode. Cooling only systems should be switched off at the thermostat during the heating season.

Wiring Diagrams
Unit specific wiring diagram is laminated in plastic and located inside the controls compartment door.

General Maintenance
When the initial startup is made, and on a periodic schedule during operation, it is necessary to perform routine service checks on the performance of the condensing unit. This includes reading and recording suction pressures and checking for normal sub-cooling and superheat.

Installation

AAON equipment has been designed for quick and easy installation.

Lifting the Unit
CB Series condensing units have channels underneath the base which provide lifting access to the underside of the equipment and allow moving and placement without physical damage.

Figure 1 - Forklift Channels & Access Panel

Use dollies and/or carts to lift and place the unit to prevent damage to the equipment and injury to the installer.

⚠ CAUTION

Incorrect lifting can cause damage to the unit.

Use care if using spreader bars, blocking, or other lifting devices to prevent any damage to the cabinet, coil or condensing fans.

Before lifting unit, be sure that all shipping material has been removed from unit.

Hoist unit to a point directly above the condenser pad, and lower unit into the proper place. Unit may also be positioned with a dolly. When the unit is in place, remove the dolly or lifting device. Make sure the unit is properly seated and level.

Locating Unit
CB Series condensing units are designed for outdoor application and placement at ground level or on a rooftop. Units must be placed on a level and solid foundation that can support the unit's weight.

When rooftop mounted, a steel frame must be provided that will support the unit above the roof itself for load distribution.

When installed at ground level, a one-piece concrete slab or composite condenser pad must be used with footings that extend below the frost line (a substantial base that will not settle). Surround the slab by a graveled area for proper drainage. Do not adjoin the condensing unit to the building as sound and vibration may be transmitted to the structure. Care must also be taken to protect the coils and fins from damage due to vandalism or other hazards.

Airflow to and from the condensing unit must not be restricted. Coils and fans must be free of any obstructions and debris in order to start and operate properly with a correct amount of airflow. Obstruction to air flow will result in decreased performance and efficiency.

The installation position must provide at least one foot of clearance from the wall for proper air flow to the coils. When multiple units are mounted adjacent to each other, the clearance required between them is three feet.

Service compartment must be accessible for periodic servicing of controls, safety devices, and refrigerant service/shutoff valves. At least two feet of clearance on this corner of the unit is required for service.

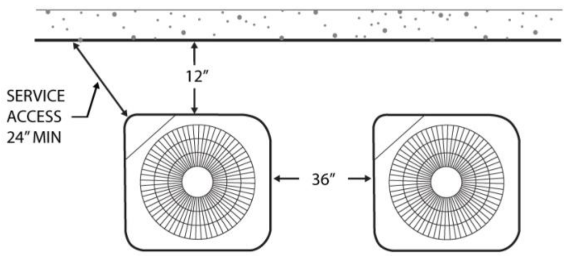

Figure 2 - Condensing Unit Clearances

Condensing units must not be installed in an enclosure or pit that is deeper than the height of the unit. When recessed installation is necessary, the clearance to maintain proper airflow is at least three feet.

CB Series condensing units are single circuited with vertical air discharge. There must be no obstruction above the equipment. Do not place the unit under an overhang.

Placement relative to the building air intakes and other structures must be carefully selected. Consider the effects of outdoor fan noise on conditioned space and any adjacent occupied space. Locate the unit so that discharge does not blow toward windows less than 25 feet away.

Heat pumps require special location consideration in areas where snow accumulation can become an obstruction and in areas with prolonged continuous subfreezing temperatures. Heat pump unit bases are cutout under the outdoor coil to permit drainage of frost accumulation. The unit must be situated to permit free unobstructed drainage of the defrost water and ice. A minimum 3 inches clearance under the outdoor coil is required in the milder climates. In more severe weather locations, elevate the unit to allow unobstructed drainage and airflow.

Table 1 - Elevation Minimums

Design Temperature	Minimum Elevation
+15° F and above	3"
-5° F to +17° F	8"
Below -5° F	12"

Mounting Isolation
For roof mounted applications or anytime vibration transmission is a factor, vibration isolators may be used.

Access Panel
Access panel is provided to electrical compartment. To remove the panel, unscrew the four screws

⚠ CAUTION

PVC PIPING

PVC (Polyvinyl Chloride) and CPVC (Chlorinated Polyvinyl Chloride) are vulnerable to attack by certain chemicals. Polyolester (POE) oils used with R-410A and other refrigerants, even in trace amounts, in a PVC or CPVC piping system will result in stress cracking of the piping and fittings and complete piping system failure.

Standard Evacuation Instructions:

Proper system evacuation is critical to remove moisture and non-condensables from the system before charging the system with refrigerant. A newly installed AAON CB condensing unit has already been evacuated and ships with a full charge based on a 25 foot line set. When evacuating a new system, keep the condensing unit service valves closed and evacuate the suction line, liquid line, and the air handling unit. If an existing system must be evacuated, use the following procedure to ensure the entire system is pulled into a good vacuum.

1. System evacuation must be performed anytime a system is open to atmospheric pressure. The POE oils used with R-410A are extremely hydroscopic in nature and immediately begin pulling in moisture once the system is opened to the atmosphere.

2. Before starting to evacuate the system, you MUST ensure that there are no leaks by pressurizing the system with 400 psig of dry nitrogen and verifying no pressure loss after one hour.

3. Four valve manifold gauge sets are more effective than standard manifold gauge sets due to the extra hose port in combination with a 3/8'' evacuation port. The larger diameter evacuation port will expedite system evacuation.

4. Connect the manifold set to the condensing unit with one hose on the suction line service valve , one hose on the liquid line service valve and if an extra Schrader valve is field installed on the suction line, connect a third hose (not shown). Connect the vacuum pump to the manifold set using a 3/8" vacuum rated hose.

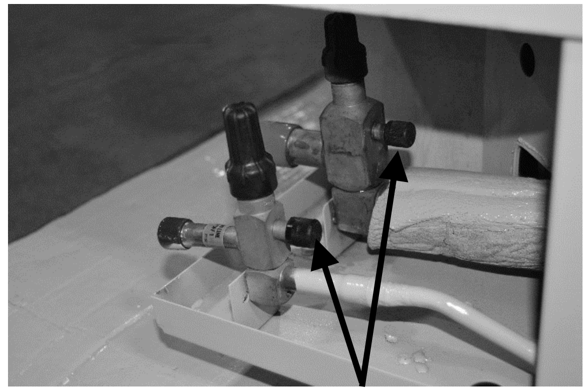

Figure 3 - CU evacuation connections

5. An accurate micron gauge must be used and checked by pulling a vacuum on the gauge by itself and verify a rapid drop to less than 100 microns within a few minutes.

6. The micron gauge must not be attached to the system until the gauge manifold is reading 28'' of vacuum to ensure the micron gauge does not see pressure and is thus damaged. MICRON GAUGES WILL BE DAMAGED BY PRESSURE!!!

7. It is a good practice to replace the vacuum pump oil after one hour of the evacuation process. The oil can be broken down in the pump in the initial first hour causing system evacuation to take longer than it should.

8. The minimum micron level required by AAON is 350 microns for systems using POE oils.

9. The system must then be isolated and the pump turned off to check for vacuum rise due to leaks or moisture in the system. The micron gauge must not rise above 500 microns after 30 minutes of wait time.

Low Ambient & Modulating Reheat System Evacuation Instructions:

Proper system evacuation is critical to remove moisture and non-condensables from the system before charging the system with refrigerant. Systems with low ambient flooded condenser option require the following procedure to ensure the entire system is pulled into a good vacuum.

1. System evacuation must be performed anytime a system is open to atmospheric pressure. The POE oils used with R-410A are extremely hydroscopic in nature and immediately begin pulling in moisture once the system is opened to the atmosphere.

2. Open the reheat valve to 50% when evacuating.

3. Before starting to evacuate the system, you MUST ensure that there are no leaks by pressurizing the system with 400 psig of dry nitrogen and verifying no pressure loss after one hour.

4. Four valve manifold gauge sets are more effective than standard manifold gauge sets due to the extra hose port in combination with a 3/8'' evacuation port. The larger diameter evacuation port will expedite system evacuation.

5. Connect the manifold set to the condensing unit with one hose on the suction line service valve (Item 4 in Figure 4), one hose on the liquid line service valve (Item 16 in Figure 4) and a third hose on the reheat line service valve (Item 3 in Figure 4). Connect the vacuum pump to the manifold set using a 3/8" vacuum rated hose.

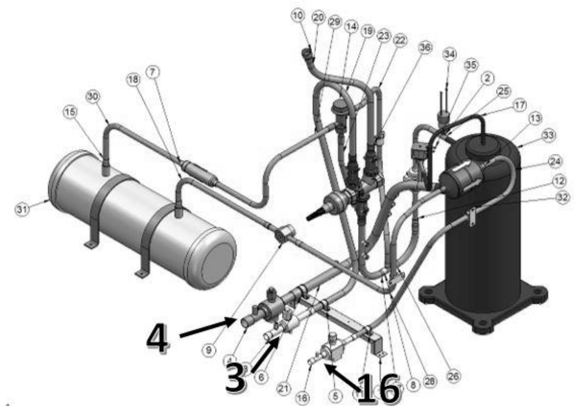

Figure 4 - CU evacuation connections

6. FAILURE to connect to the liquid line service valve will result in the receiver tank not being fully evacuated and most likely lead to non-condensables in the system.

7. An accurate micron gauge must be used and checked by pulling a vacuum on the gauge by itself and verify a rapid drop to less than 100 microns within a few minutes.

8. The micron gauge must not be attached to the system until the gauge manifold is reading 28'' of vacuum to ensure the micron gauge does not see pressure and is thus damaged. MICRON GAUGES WILL BE DAMAGED BY PRESSURE!!!

9. It is a good practice to replace the vacuum pump oil after one hour of the evacuation process. The oil can be broken down in the pump in the initial first hour causing system evacuation to take longer than it should.

10. The minimum micron level required by AAON is 350 microns for systems using POE oils.

11. The system must then be isolated and the pump turned off to check for vacuum rise due to leaks or moisture in the system. The micron gauge must not rise above 500 microns after 30 minutes of wait time.

Adjusting Refrigerant Charge

The CB unit comes with full charge based on a 25 foot line set. If refrigerant lines are longer than 25 foot, adjusting the charge of the system will be required during installation. Systems with the modulating hot gas reheat option will require refrigerant to be field added because of the additional refrigerant components and piping associated with the system.

Charging a system in the field must be based on determination of liquid sub-cooling and evaporator superheat. On a system with a TXV, liquid sub-cooling is more representative of the charge than evaporator superheat but both measurements must be taken.

⚠ CAUTION

COMPRESSOR LUBRICANT

Polyolester (POE) and Polyvinylether (PVE) oils are two types of lubricants used in hydrofluorocarbon (HFC) refrigeration systems. Refer to the compressor label for the proper compressor lubricant type.

⚠ CAUTION

CLEAN AIR ACT

The Clean Air Act of 1990 bans the intentional venting of refrigerant (CFC's and HCFC's) as of July 1, 1992. Approved methods of recovery, recycling or reclaiming must be followed. Fines and/or incarceration may be levied for non-compliance.

Before Charging

Refer to the Unit Nameplate to determine which refrigerant must be used to charge the system.

Unit being charged must be at or near full load conditions before adjusting the charge.

Units equipped with hot gas bypass must have the hot gas bypass valve closed to get the proper charge.

Units equipped with hot gas reheat must be charged with the hot gas valve closed while the unit is in cooling mode. After charging, operate the unit in reheat (dehumidification) mode to check for correct operation.

Units equipped with heat pump options must be charged in cooling mode to get the proper charge. After charging, operate the unit in heating mode to check for correct charge. Charge may need to be adjusted for heating mode. If adjustments are made in the heating mode, cooling mode must be rerun to verify proper operation.

After adding or removing charge the system must be allowed to stabilize, typically 10-15 minutes, before making any other adjustments.

The type of unit and options determine the ranges for liquid sub-cooling and evaporator superheat. Refer to Table 2 when determining the proper sub-cooling.

For units equipped with low ambient (0°F) option see the special charging instructions at the end of this section.

Checking Liquid Sub-cooling

Measure the temperature of the liquid line as it leaves the condenser coil.

Read the gauge pressure at the liquid line close to the point where the temperature was taken. You must use liquid line pressure as it will vary from discharge pressure due to condenser coil pressure drop.

Convert the pressure obtained to a saturated temperature using the appropriate refrigerant temperature-pressure chart.

Subtract the measured liquid line temperature from the saturated temperature to determine the liquid sub-cooling.

Compare calculated sub-cooling to Table 2 for the appropriate unit type and options.

Table 2 - Acceptable Refrigeration Circuit Values

	Cooling Mode Liquid Sub-Cooling Values
Cooling Only Unit[4]	8-15°F
Cooling Only Unit with Hot Gas Reheat[1,4]	5-15°F
Heat PumpUnit[2,4]	2-4°F
Heat Pump Unit with Hot Gas Reheat[3,4]	2-6°F
Cooling Only Unit with LAC[4]	8-15°F
Cooling Only Unit with Hot Gas Reheat & LAC[4]	8-15°F

Notes:

1. Must be charged with the hot gas valve closed. After charging, operate the unit in reheat (dehumidification) mode to check for correct operation.
2. The sub-cooling value in this table is for the unit running in cooling mode of operation. After charging, operate the unit in heating mode to check for correct operation.
3. The sub-cooling value in this table is for the unit running in cooling mode of operation and the hot gas valve closed. After charging, operate the unit in reheat (dehumidification) mode to check for correct operation and then in heating mode to check for correct operation.
4. Sub-cooling must be increased by 1°F per 10 feet of vertical liquid line rise for R-410A (AHU above CU). For example, a cooling only unit with hot gas reheat and a vertical liquid drop can charge to a sub-cooling value of 5-15°F, but a cooling only unit with hot gas reheat and a vertical liquid rise of 30 ft must charge to a sub-cooling value of at least 8-15°F. DO NOT OVERCHARGE. Refrigerant overcharging leads to excess refrigerant in the condenser coils resulting in elevated compressor discharge pressure.

Checking Evaporator Superheat

Measure the temperature of the suction line close to the evaporator.

Read gauge pressure at the suction line close to the evaporator.

Convert the pressure obtained to a saturated temperature using the appropriate refrigerant temperature-pressure chart.

Subtract the saturated temperature from the measured suction line temperature to determine the evaporator superheat.

For refrigeration systems with tandem compressors, it is critical that the suction superheat setpoint on the TXV is set with one compressor running. The suction superheat range is 10-13°F with one compressor running. The suction superheat will increase with both compressors in a tandem running. Inadequate suction superheat can allow liquid refrigerant to return to the compressors which will wash the oil out of the compressor. Lack of oil lubrication will destroy a compressor. Measure liquid sub-cooling with both compressors in a refrigeration system running.

Compare calculated superheat to the acceptable cooling mode superheat values of 8-15°F for all system types. Superheat will increase with long suction line runs.

⚠ CAUTION

EXPANSION VALVE ADJUSTMENT

Thermal expansion valves must be adjusted to approximately 8-15°F of suction superheat. Failure to have sufficient superheat will damage the compressor and void the warranty.

Adjusting Sub-cooling and Superheat Temperatures

The system is overcharged if the sub-cooling temperature is too high compared to Table 2 and the evaporator is fully loaded (low loads on the evaporator result in increased sub-cooling) and the evaporator superheat is within the temperature range of 8-15°F (high superheat results in increased sub-cooling)

Correct an overcharged system by reducing the amount of refrigerant in the system to lower the sub-cooling.

⚠ CAUTION

DO NOT OVERCHARGE!

Refrigerant overcharging leads to excess refrigerant in the condenser coils resulting in elevated compressor discharge pressure.

The system is undercharged if the superheat is too high and the sub-cooling is too low.

Correct an undercharged system by adding refrigerant to the system to reduce superheat and raise sub-cooling.

If the sub-cooling is correct and the superheat is too high, the TXV may need adjustment to correct the superheat.

Special Low Ambient Option Charging Instructions

For units equipped with low ambient refrigerant flood back option **being charged in the summer when the ambient temperature is warm**:

If the ambient is **above** 70°F, charge to approximately 1-2°F of sub-cooling measured at the inlet to the expansion valve. Once enough charge has been added to get the evaporator superheat and sub-cooling values to the correct setting, more charge must be added. Use Table 3 to find the additional charge amount required.

Table 3 - Charge to Flood Condenser Coil for Ambient Above 70°F

CB Size	# of circuits	Per Circuit Charge (lbs)
CB 024, 036	1	9.0
CB 048, 060	1	11.1

For units equipped with low ambient refrigerant flood back option **being charged in the winter when the ambient temperature is cold**:

1. If the ambient is **below** 70°F, charge to approximately 1-2°F of sub-cooling measured at the inlet to the expansion valve. Once enough charge has been added to get the evaporator superheat and sub-cooling values to the correct setting more charge may need to be added. If the ambient temperature is 0°F no more charge is required. Ambient temperatures above 0°F will require a percentage of the per circuit charge values from Table 3. Using your ambient temperature, find the percentage value from Table 4, and multiply the Per Circuit Charge value from Table 3 and the % value to determine the additional charge amount.

Table 4 - % Charge to Flood Condenser Coil for Ambient Below 70°F

Condenser Ambient Temperature ˚F	Percentage Per Circuit Charge from Table 3
60	60%
50	37%
40	24%
30	15%
20	8%
0	0%

2. Check the unit for proper operation once the ambient temperature is above 80°F.

Example: CB size 036 where the ambient temperature is 40°F
From Table 3 – 9 lbs refrigerant charge
From Table 4 – 24% of Table 3 charge
Additional charge needed for a unit with low ambient flooded condenser controls = 9 lbs * 0.24 = 2.16 lbs additional refrigerant charge

Low Ambient Operation

During low ambient temperatures, the vapor refrigerant will migrate to the cold part of the system and condense into liquid. All CB Series compressors are provided with factory installed crankcase heaters to help prevent liquid refrigerant from slugging the compressors during startup in low ambient conditions. The condenser or condensing unit must have continuous power 24 hours prior to startup. This ensures the compressor will receive sufficient refrigerant vapor at startup. Standard units can operate down to 55°F ambient temperature.

AAON condenser fan head pressure control units can operate down to 35°F ambient temperature. The two different condenser fan head pressure control options available are adjustable fan cycling and modulating ECM condenser fan. See detailed information following.

The AAON low ambient (condenser flood-back) system is used to operate a refrigerant system down to 0°F outside air temperature. See detailed information following.

Fan Cycling Low Ambient

Adjustable fan cycling is a low ambient head pressure control option that cycles the condenser fans to maintain refrigerant circuit head pressures at acceptable levels during cooling operation. The head pressure set point (100-470 psi) and pressure differential (35-200 psi) can be field adjusted using a flathead screwdriver. For example, if the head pressure is set to 300psi, and the differential is set to 100psi, then fans will cut in at 300psi and cut out at 200psi. Fan cycling and variable speed condenser fan head pressure control options allow mechanical cooling with ambient temperatures down to 35°F.

Figure 5 - Adjustable Fan Cycling Switch

Variable Speed Low Ambient

Variable speed condenser fan head pressure control is a low ambient head pressure control option that sends a variable signal in relation to the refrigerant circuit head pressure of the system to an electronically commutated motor (ECM). The motor either speeds up or slows down air flow accordingly in order to maintain constant head pressure. Fan cycling and variable speed condenser fan head pressure control options allow mechanical cooling with ambient temperatures down to 35°F.

Flooded Condenser Low Ambient

Flooded condenser low ambient control maintains normal head pressure during periods of low ambient. When the ambient temperature drops, the condensing temperature and therefore pressure drops. Without ambient control, the system would shut down on low discharge pressure. The flooded condenser method of low ambient control fills the condenser coil with liquid refrigerant, decreasing the heat transfer capacity of the coil, which allows the coil to operate at an acceptable discharge pressure.

The condenser coil will not be flooded during summer ambient temperatures, so a receiver is included to store the additional liquid refrigerant required to flood the condenser coil in low ambient. The receiver is factory-sized to contain all of the flooded volume. Without a receiver there would be high head pressures during higher ambient conditions.

The low ambient system maintains normal head pressure during periods of low ambient by restricting liquid flow from the condenser to the receiver, and at the same time bypassing hot gas around the condenser to the inlet of the receiver. This reduces liquid refrigerant flow from the condenser, reducing its effective surface area, which in turn increases the condensing pressure. At the same time the bypassed hot gas raises liquid pressure in the receiver, allowing the system to operate properly. CB Series condensers and condensing units use an LAC valve for low ambient operation.

LAC Valve

The Low Ambient Control (LAC) valve is a non-adjustable three way valve that modulates to maintain receiver pressure. As the receiver pressure drops below the valve setting (295 psig for R-410A), the valve modulates to bypass discharge gas around the condenser. The discharge gas warms the liquid in the receiver and raises the pressure to the valve setting. The following schematic shows an example system using the LAC valve.

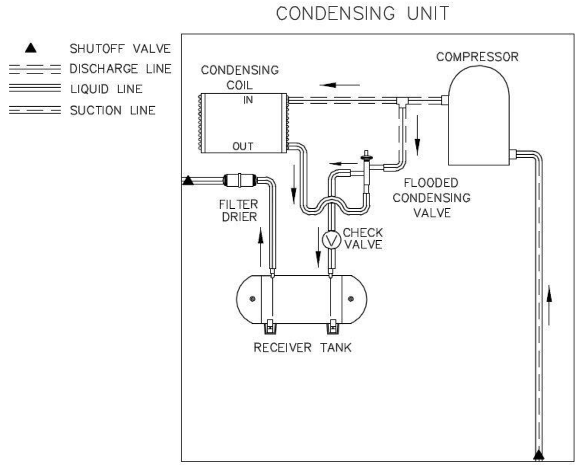

Figure 6 - LAC Piping Example

Electrical

Verify the unit nameplate agrees with the power supply. Connect power and control field wiring as shown on the unit wiring diagram provided with the unit.

Table 5 - Nameplate Voltage Markings & Tolerances

Hz	Nameplate Voltage	Nominal System Voltage	Operating Voltage Range [1]		Acceptable Performance Range[2]	
			Min	Max	Min	Max
60	115	120	104	127	108	126
	208/230	208/240	187	254	187	252
	208	208	187	228	187	228
	230	240	208	254	216	252
	265	277	240	293	249	291
	460	480	416	508	432	504
	575	600	520	635	540	630
50	230	230	198	254	208	254
	400	400	344	440	360	440

Notes:

1. Operating voltage is the min and max voltage for which the unit can function. Never operate outside of this min and max voltage.
2. The Acceptable Performance Range is the min and max voltage for which the unit performance is designed and rated to give acceptable performance.

⚠ WARNING

ELECTRIC SHOCK

Electric shock hazard. Before attempting to perform any installation, service, or maintenance, shut off all electrical power to the unit at the disconnect switches. Unit may have multiple power supplies. Failure to disconnect power could result in dangerous operation, serious injury, death or property damage.

Route power and control wiring, separately, through the utility entry right above the service valves. Do not run power and signal wires in the same conduit.

Size supply conductors based on the unit MCA rating. Supply conductors must be rated a minimum of 75°C.

Protect the branch circuit in accordance with code requirements. The unit must be electrically grounded in accordance with local codes, or in the absence of local codes, the current National Electric Code, ANSI/NFPA 70 or the current Canadian Electrical Code CSA C22.1.

Note: Units are factory wired for 208V, 230V, 460V or 575V. In some units, the 208V and 230V options may also be provided in single or three phase configurations. The transformer configuration must be checked by a qualified technician prior to startup.

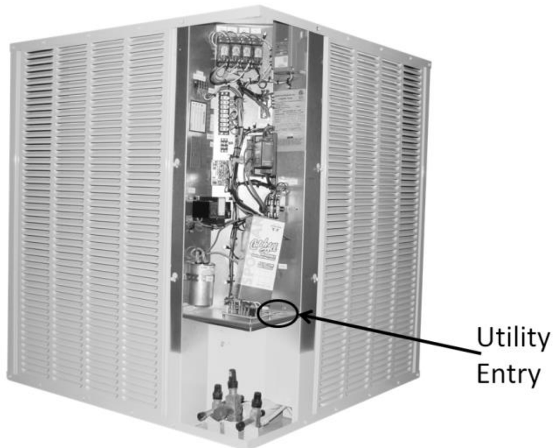

Figure 7 - Utility Entry

CAUTION

3-PHASE ROTATION

Rotation must be checked on all MOTORS AND COMPRESSORS of three phase units. Condenser fan motors must be checked by a qualified service technician at startup and any wiring alteration must only be made at the unit power connection.

Wire power leads to the unit terminal block. All wiring beyond this point has been done by the manufacturer and cannot be modified without affecting the unit's agency/safety certification.

All units require field supplied electrical overcurrent and short circuit protection. Device must not be sized larger than the Maximum Overcurrent Protection (MOP) shown on the unit nameplate.

Codes may require a disconnect switch be within sight of the unit.

Do not install the field installed overcurrent protection or disconnect switch on the unit.

Supply voltage must be within the min/max range shown on the unit nameplate. Available short circuit current must not exceed the short circuit current rating (SCCR) shown on the unit nameplate.

Three phase voltage imbalance will cause motor overheating and premature failure. The maximum allowable imbalance is 2%.

Voltage imbalance is defined as 100 times the maximum deviation from the average voltage divided by the average voltage.

Example:
(221V+230V+227V)/3 = 226V, then 100*(226V-221V)/226V = 2.2%, which exceeds the allowable imbalance.

Check voltage imbalance at the unit disconnect switch and at the compressor terminal. Contact your local power company for line voltage corrections.

Installing contractor must check for proper motor rotation and check blower motor amperage listed on the motor nameplate is not exceeded.

CAUTION

Three phase voltage imbalance will cause motor overheating and premature failure.

Wire control signals to the unit's low voltage terminal block located in the controls compartment.

Thermostat

If a thermostat is used for unit control, locate it on an inside wall 4-5 feet above the floor where it will not be subjected to drafts, sun exposure, or heat from electrical fixtures or appliances. Follow thermostat manufacturer's instructions for general installation procedure.

Thermostat control wiring size must be large enough to prevent excess voltage drop and ensure proper operation.

All external devices must be powered via a separate external power supply.

Units with the modulating hot gas reheat dehumidification feature must use a humidistat or a thermostat with a dehumidification option.

Refrigerant Piping
(See back of the manual for refrigerant piping diagrams.)

⚠ CAUTION

REFRIGERANT PIPING

This section is for information only and is not intended to provide all details required by the designer or installer of the refrigerant piping between the condenser or condensing unit and the air handling unit. AAON, Inc. is not responsible for interconnecting refrigerant piping. Consult ASHRAE Handbook – Refrigeration and ASME Standards.

General
Piping from the condensing unit to the air handler is the responsibility of the installing contractor.

Use only clean type "ACR" copper tubing that has been joined with high temperature brazing alloy.

The pipe or line sizes must be selected to meet the actual installation conditions and NOT simply based on the connection sizes at the condensing unit or air handler.

All CB Series condensing units are provided with in-line shutoff valves on both the liquid and suction lines. These must remain closed until the system is ready for start-up after installation.

Piping must conform to generally accepted practices and codes.

Upon completion of piping connection, the interconnecting piping and air handler MUST BE evacuated to 500 microns or less; leak checked and charged with refrigerant.

Determining Refrigerant Line Size

⚠ CAUTION

REFRIGERANT PIPING

Line sizes must be selected to meet actual installation conditions, not simply based on the connection sizes at the condensing unit or air handling unit.

The piping between the condenser and low side must ensure:

1. Minimum pressure drop, **and**
2. Continuous oil return, **and**
3. Prevention of liquid refrigerant slugging, or carryover

Minimizing the refrigerant line size is favorable from an economic perspective, reducing installation costs, and reducing the potential for leakage. However, as pipe diameters decrease, pressure drop increases.

Excessive suction line pressure drop causes loss of compressor capacity and increased power usage resulting in reduced system efficiency. Excessive pressure drops in the liquid line can cause the liquid refrigerant to flash, resulting in faulty TXV operation and improper system performance. In order to operate efficiently and cost effectively, while avoiding malfunction, refrigeration systems must be designed to minimize both cost and pressure loss.

Equivalent Line Length

All line lengths discussed in this manual, unless specifically stated otherwise, are Equivalent Line Lengths. The frictional pressure drop through valves, fittings, and accessories is determined by establishing the equivalent length of straight pipe of the same diameter. **Always use equivalent line lengths when calculating pressure drop**. Special piping provisions must be taken when lines are up vertical risers or in excessively long line runs. **Do not run underground refrigerant lines.**

Liquid Line

When sizing the liquid line, it is important to minimize the refrigerant charge to reduce installation costs and improve system reliability. This can be achieved by minimizing the liquid line diameter. However, reducing the pipe diameter will increase the velocity of the liquid refrigerant which increases the frictional pressure drop in the liquid line, and causes other undesirable effects such as noise.

Maintaining the pressure in the liquid line is critical to ensuring sufficient saturation temperature, avoiding flashing upstream of the TXV, and maintaining system efficiency. Pressure losses through the liquid line due to frictional contact, installed accessories, and vertical risers are inevitable. Maintaining adequate sub-cooling at the condenser to overcome these losses is the only method to ensure that liquid refrigerant reaches the TXV.

Liquid refrigerant traveling upwards in a riser loses head pressure. If the evaporator is below the condenser, with the liquid line flowing down, the gravitational force will increase the pressure of the liquid refrigerant. This will allow the refrigerant to withstand greater frictional losses without the occurrence of flashing prior to the TXV.

A moisture-indicating sight glass may be field installed in the liquid line to indicate the occurrence of premature flashing or moisture in the line. The sight glass must not be used to determine if the system is properly charged. **Use temperature and pressure measurements to determine liquid sub-cooling, not the sight glass.**

Liquid Line Routing

Care must be taken with vertical risers. When the system is shut down, gravity will pull liquid down the vertical column, and back to the condenser when it is below the evaporator. This could potentially result in compressor flooding. A check valve can be installed in the liquid line where the liquid column rises above the condenser to prevent this. The liquid line is typically pitched along with the suction line, or hot gas line, to minimize the complexity of the configuration.

Liquid Line Insulation

When the liquid line is routed through regions where temperature losses are expected, no insulation is required, as this may provide additional sub-cooling to the refrigerant. When routing the liquid line through high temperature areas, insulation of the line is appropriate to avoid loss of sub-cooling through heat gain.

In heat pump systems, when the liquid line is routed through regions where temperature losses are expected (all lines exposed to outside air conditions), insulate with a minimum 1 inch thick Armaflex insulation, as this will prevent capacity loss during heating mode of operation.

Liquid Line Guidelines

In order to ensure liquid at the TXV, the sum of frictional losses and pressure loss due to vertical rise must not exceed available sub-cooling. A commonly used guideline to consider is a system design with pressure losses due to friction through the line not to exceed a corresponding 1-2°F change in saturation temperature. Additionally, the sum of frictional losses (including valve losses, filter drier losses, other accessories, and line losses) and pressure loss due to vertical rise must not exceed 8°F if the available sub-cooling is 10°F.

If the velocity of refrigerant in the liquid line is too great, it could cause excessive noise or piping erosion. The maximum velocities for liquid lines are 100 fpm from the condenser to a receiver to discourage fluid backup, and 500 fpm from receiver tank to the evaporator (300 fpm if the line includes an electric valve to minimize valve induced liquid hammer).

Liquid Line Accessories

Liquid line shut off valves and filter driers are factory provided. The total length equivalent of pressure losses through valves, elbows and fittings must be considered when adding additional components in the field. It is a good practice to utilize the fewest elbows that will allow the mating units to be successfully joined.

A liquid line receiver is factory installed on units with modulating hot gas reheat, units with low ambient control flooded condenser, and units with heat pump.

Suction Line

The suction line is more critical than the liquid line from a design and construction standpoint. More care must be taken to ensure that adequate velocity is achieved to return oil to the compressor at minimum loading conditions. However, reducing the piping diameter to increase the velocity at minimal load can result in excessive pressure losses, capacity reduction, and noise at full load.

Suction Line Routing

For cooling only systems, pitch the suction line in the direction of flow (about 1 inch per 20 feet of length) to maintain oil flow towards the compressor, and keep it from flooding back into the evaporator.

For heat pump systems, do not pitch lines since they will be flowing in one direction in cooling mode and the opposite direction in heating mode.

Crankcase heaters are provided to keep any condensed refrigerant that collects in the compressor from causing damage or wear. Make sure to provide support to maintain suction line positioning, and insulate completely between the evaporator and condensing unit.

It is important to consider part load operation when sizing suction lines. At minimum capacity, refrigerant velocity may not be adequate to return oil up the vertical riser. Decreasing the diameter of the vertical riser will increase the velocity, but also the frictional loss.

For difficult line routing applications, a double suction riser can be applied to the situation of part load operation with a suction riser. A double suction riser is designed to return oil at minimum load while not incurring excessive frictional losses at full load. A double suction riser consists of a small diameter riser in parallel with a larger diameter riser, and a trap at the base of the large riser. At minimum capacity, refrigerant velocity is not sufficient to carry oil up both risers, and it collects in the trap, effectively closing off the larger diameter riser, and diverting refrigerant up the small riser where velocity of the refrigerant is sufficient to maintain oil flow. At full load, the mass flow clears the trap of oil, and refrigerant is carried through both risers. Size the smaller diameter pipe to return oil at minimum load, and size the larger diameter pipe so that flow through both pipes provides acceptable pressure drop at full load.

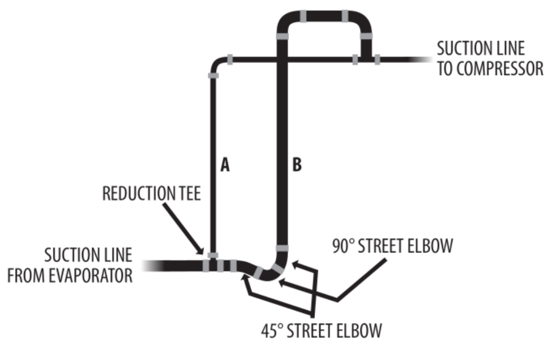

Figure 8 - Double Suction Riser Construction

A double riser can also be used for heat pump operation. The specific volume (ft^3/lb) of refrigerant at the discharge temperature and pressure (heating mode line conditions) is significantly lower than the specific volume at the suction temperature and pressure (cooling mode line conditions). To compound the issue, the capacity in heating mode is lower than the capacity in cooling mode. The discharge velocity in the riser during heating mode is much lower than the suction velocity during cooling mode. Often, a double riser is necessary to get acceptable velocities for the discharge mode and acceptable velocities for the suction mode. In the example diagrams (see heat pump piping schematic figures in the following *Discharge Line Routing* section), the cooling mode will use both lines, and the heating mode will use only one.

Suction Line Traps

Include a trap immediately after the evaporator coil outlet to protect the TXV bulb from liquid refrigerant.

Include traps every 20 feet in vertical suction riser sections for cooling only systems and every 12 feet for heat pump systems.

Suction Line Insulation

The entire suction line must be insulated with a minimum 1 inch thick Armaflex insulation. This prevents condensation from forming on the line, and reduces any potential loss in capacity associated with heat gain placing additional load on the system. This line must still be insulated in heat pump systems even though it acts as both a discharge and suction line.

Suction Line Guidelines

For proper performance, suction line velocities less than a 4,000 fpm maximum are required. The minimum velocity required to return oil is dependent on the pipe diameter, however, a general guideline of 1,000 fpm minimum may be applied.

When suction flow is up, variable capacity compressors require a minimum velocity of 1,500 fpm at full load.

Two-stage compressors must be considered for full load operation and at partial load (67%). The velocity at partial load must be greater than the minimum velocity required to return oil.

Heat pump vapor lines must be checked for suction flow (cooling mode operation) and discharge flow (heating mode operation) at full and partial loads. The same line must be used for both modes of operation.

In a fashion similar to the liquid line, a common guideline to consider is a system design with pressure losses due to friction through the line not to exceed a corresponding 1-2°F change in saturation temperature.

For split system piping with long horizontal runs and short vertical risers, a smaller pipe size can be used to provide sufficient velocity to return oil in vertical risers at part loads, and a larger size pipe can be used on the horizontal runs and vertical drop sections. This helps with oil return, yet keeps the pressure drop to a minimum.

⚠ CAUTION

SUCTION RISER TRAPS

Circuits require suction riser traps every 20 feet. (every 12 feet for heat pumps)

Suction Line Accessories

If the job requirements specify suction accumulators, they must be separately purchased and field installed. Heat pump units will include a factory installed suction accumulator.

Discharge Line

The discharge line is similar to the suction line from a design and construction standpoint. Care must be taken to ensure that adequate velocity is achieved to return oil to the compressor at minimum loading conditions. However, reducing the piping diameter to increase the velocity at minimal load can result in excessive pressure losses, capacity reduction, and noise at full load. Pressure loss in the discharge line has less of an impact on capacity than pressure loss in the suction line. Pressure loss in the discharge line causes the compressors to work harder and thus use more power.

Discharge Line Routing

In a heat pump system, the field installed suction line is also used as a discharge line in the heating mode of operation so the line must be sized to meet both the suction line conditions in cooling mode and the discharge line conditions in heating mode.

Because it is used in both directions for a heat pump unit, the line must be installed level, not pitched, to facilitate oil return in both modes of operation.

It is important to consider part load operation when sizing discharge lines. At minimum capacity, refrigerant velocity may not be adequate to return oil up the vertical riser. Decreasing the diameter of the vertical riser will increase the velocity, but also the frictional loss.

For difficult line routing applications, a double discharge riser can be applied to the situation of part load operation with a discharge riser. A double discharge riser is designed to return oil at minimum load while not incurring excessive frictional losses at full load. A double discharge riser consists of a small diameter riser in parallel with a larger diameter riser, and a trap at the base of the large riser. At minimum capacity, refrigerant velocity is not sufficient to carry oil up both risers, and it collects in the trap, effectively closing off the larger diameter riser, and diverting refrigerant up the small riser where velocity of the refrigerant is sufficient to maintain oil flow. At full load, the mass flow clears the trap of oil, and refrigerant is carried through both risers. Size the smaller diameter pipe to return oil at minimum load, and size the larger diameter pipe so that flow through both pipes provides acceptable pressure drop at full load. (See the Double Suction Riser Construction figure in the *Suction Line Routing* Section)

A double riser can also be used for heat pump operation. The specific volume (ft^3/lb) of refrigerant at the discharge temperature and pressure (heating mode line conditions) is significantly lower than the specific volume at the suction temperature and pressure (cooling mode line conditions). To compound the issue, the capacity in heating mode is lower than the capacity in cooling mode. The discharge velocity in the riser during heating mode is much lower than the suction velocity during cooling mode. Often, a double riser is necessary to get acceptable velocities for the discharge mode and acceptable velocities for the suction mode. In the example diagrams, the cooling mode will use both lines, and the heating mode will use only one. See the following schematics that illustrate how the double discharge riser can work for heat pump applications.

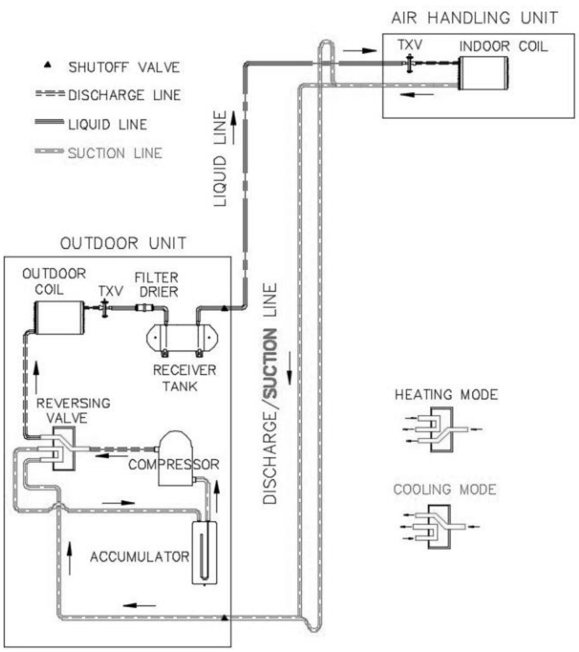

Figure 9 - Heat Pump Piping Schematic of Cooling Mode in Double Riser

Discharge Line Traps
Include traps every 12 feet in vertical discharge riser sections.

Discharge Line Insulation
Although a typical discharge line does not need to be insulated, the suction line does. Since the same line is used for both, the line must be insulated as described in the *Suction Line Insulation* section.

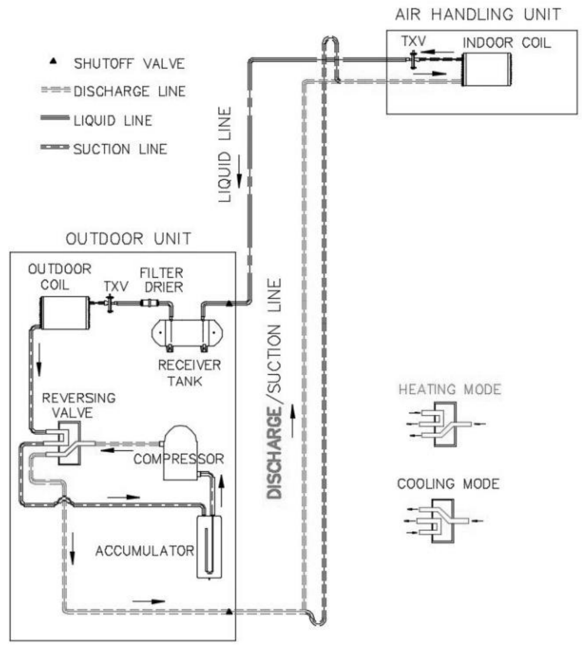

Figure 10 - Heat Pump Piping Schematic of Heating Mode in Double Riser

Discharge Line Guidelines
For proper performance, discharge line velocities less than a 3,500 fpm maximum are required. The minimum velocity required to return oil is dependent on the pipe diameter, however, a general guideline of 900 fpm minimum may be applied.

When discharge flow is up, variable capacity compressors require a minimum velocity of 900 fpm at full load.

Heat pump vapor lines must be checked for suction flow (cooling mode operation) and discharge flow (heating mode operation). The same line must be used for both modes of operation.

In a fashion similar to the suction line, a common guideline to consider is a system design with pressure losses due to friction through the line not to exceed a corresponding 1-2°F change in saturation temperature.

For split system piping with long horizontal runs and short vertical risers, a smaller pipe size can be used to provide sufficient velocity to return oil in vertical risers at part loads, and a larger size pipe can be used on the horizontal runs and vertical drop sections. This helps with oil return, yet keeps the pressure drop to a minimum.

⚠ CAUTION

DISCHARGE RISER TRAPS

Circuits require discharge riser traps every 12 feet.

Hot Gas Bypass Line

Hot Gas Bypass is available for use with DX systems that may experience low suction pressure during the operating cycle. This may be due to varying load conditions associated with VAV applications or units supplying a large percentage of outside air. The system is designed to divert refrigerant from the compressor discharge to the low pressure side of the system in order to keep the evaporator from freezing and to maintain adequate refrigerant velocity for oil return at minimum load.

Hot discharge gas is redirected to the evaporator inlet via an auxiliary side connector (ASC) to false load the evaporator when reduced suction pressure is sensed. **Field piping between the condensing unit and the evaporator is required.**

Hot Gas Bypass Piping Considerations

Pitch the hot gas bypass (HGB) line downward in the direction of refrigerant flow, toward the evaporator.

When installing vertical hot gas bypass lines, an oil drip line must be provided at the lowest point in the system. The oil drip line must be vertical, its diameter must be the same as the diameter of the riser, and a maximum of 10” long. Install a sight glass in the oil drip line for observation. Run an oil return line, using 1/8 inch capillary tube, 10 feet in length, from the hot gas bypass line oil drip line to the suction line. Connect the oil return line below the sight glass and 1 inch above the bottom of the oil drip line.

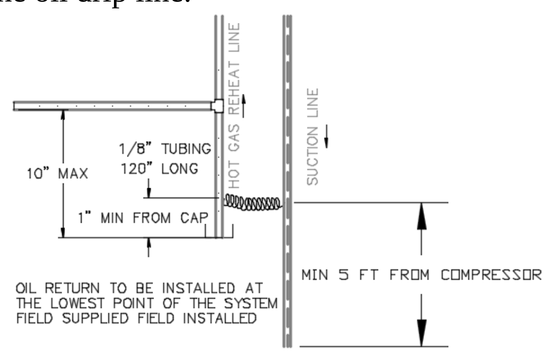

Figure 11 - Oil Return Line

HGB valves are adjustable. Factory HGB valve settings will be sufficient for most applications, but may require slight adjustments for some applications, including some make up air applications.

Insulate the entire length of the HGB line with a minimum 1 inch thick Armaflex insulation.

Hot Gas Bypass Line Guidelines

Choose a small size line to ensure oil return, and minimize refrigerant charge.

Maintain velocities below a maximum of 3,500 fpm. A general minimum velocity guideline to use is approximately 2,000 fpm.

Hot Gas Reheat
The AAON modulating hot gas reheat system diverts hot discharge gas from the condenser to the air handling unit through the hot gas line. **Field piping between the condensing unit and the air handler is required.**

The line delivers the hot discharge gas to the reheat coil and/or the hot gas bypass valve, so it is sized as a discharge line.

Size discharge lines to ensure adequate velocity of refrigerant for oil return, to avoid excessive noise associated with velocities that are too high, and to minimize efficiency losses associated with friction.

Pitch the hot gas line in the direction of flow for oil return.

When installing vertical hot gas reheat lines, an oil drip line must be provided at the lowest point in the system. The oil drip line must be vertical, its diameter must be the same as the diameter of the riser, and a maximum of 10" long. Run an oil return line, using 1/8 inch capillary tube, 10 feet in length, from the hot gas reheat line oil drip line to the suction line. Connect the oil return line below the sight glass and 1 inch above the bottom of the oil drip line. (See Oil Return Line figure in *Hot Gas Bypass Piping Considerations*)

Insulate the entire length of the hot gas line with a minimum 1 inch thick Armaflex insulation.

Hot Gas Reheat Guidelines
Maintain velocities below a maximum of 3,500 fpm. A general minimum velocity guideline is 2,000 fpm.

Predetermined Line Sizes
To aid in line sizing and selection, AAON has predetermined line sizes for the liquid, suction, and hot gas lines in comfort cooling applications.

In order to generate this information, the following cycle assumptions are made: Saturated suction temperature = 50°F, Saturated condensing temperature = 125°F, Sub-cooling = 10°F, Superheat = 15°F.

The liquid lines have been chosen to maintain velocities between 100 and 350 fpm. The suction line diameters are selected to limit velocities to a 4,000 fpm maximum, while a minimum velocity restriction is imposed by the ability to entrain oil up vertical suction risers (ASHRAE Handbook - Refrigeration).

Acceptable pressure loss criteria are applied to each of the lines: The total equivalent length of the liquid line available is determined such that 3°F of liquid sub-cooling remain at the TXV. This includes the pressure losses in horizontal and vertical sections, accessories, elbows, etc.

Recall that the available sub-cooling for the cycle is assumed as 10°F. To maintain at least 3°F sub-cooling as a factor of safety to avoid flashing at the TXV, we consider a maximum pressure loss equivalent to a 7°F change in saturation temperature. Pressure losses in the suction line are not to exceed 2°F.

<u>When to Use Predetermined Line Sizing</u>

The line sizes presented are not the only acceptable pipe diameters, they are however appropriate for general comfort cooling applications, and satisfy common job requirements. Examine the conditions, assumptions, and constraints used in the generation of the predetermined pipe diameters to ensure that this method is applicable to a particular case. Do not assume that these line sizes are appropriate for every case. Consult ASHRAE Handbook – Refrigeration for generally accepted system piping practices.

<u>How to Use Predetermined Line Sizing</u>

First, read the previous section, *When to Use Predetermined Line Sizing*, to decide if this method is applicable. Next, consult Table 6 below for pipe diameters.

Examine Figure 12 below to determine the acceptable line dimensions associated with the pipe diameters determined in Table 6 below. The figure is shown as total available riser height versus total equivalent line length for the liquid line. The curve identifies a region of acceptable piping configuration when the predetermined line sizes are selected for any model in the table. A piping configuration above the curve falls outside the assumptions used to determine the line size and will result in a loss of sub-cooling, and additional pressure losses in the suction and hot gas lines.

The total equivalent line length definition includes the height of vertical rise, pressure drop through elbows and accessories, and horizontal line length, so elbows, accessories, and vertical rise must be considered when determining horizontal length available from the total equivalent line length.

Figure 12 - Riser height versus total equivalent line length is presented in terms of the liquid line, but it assumes that the suction line length is similar, as these lines are commonly routed together to minimize the space and cost required for split system installation.

⚠ CAUTION

Before using this table read the *When to Use Predetermined Line Sizes* section. Do not assume that these line sizes are appropriate for every case. Consult ASHRAE Handbook – Refrigeration for generally accepted system piping practices. The AAON *Refrigerant Piping Calculator* in Ecat32 can be used for job specific line sizing.

Table 6 - Predetermined Line sizes for CB units with two step compressors and R-410A

Model	Connection Sizes			Predetermined Line Size			
	Liquid	Suction	Hot Gas	Liquid	Suction	HGBP*	HGRH**
CB-024	3/8”	3/4”	3/8”	3/8”	3/4”	3/8”	3/8”
CB-036	3/8”	3/4”	3/8”	3/8”	3/4”	3/8”	1/2”
CB-048	3/8”	7/8”	1/2”	1/2”	7/8”	1/2”	1/2”
CB-060	3/8”	7/8”	1/2”	1/2”	7/8”	1/2”	1/2”

* Hot Gas Bypass line
** Hot Gas Reheat line

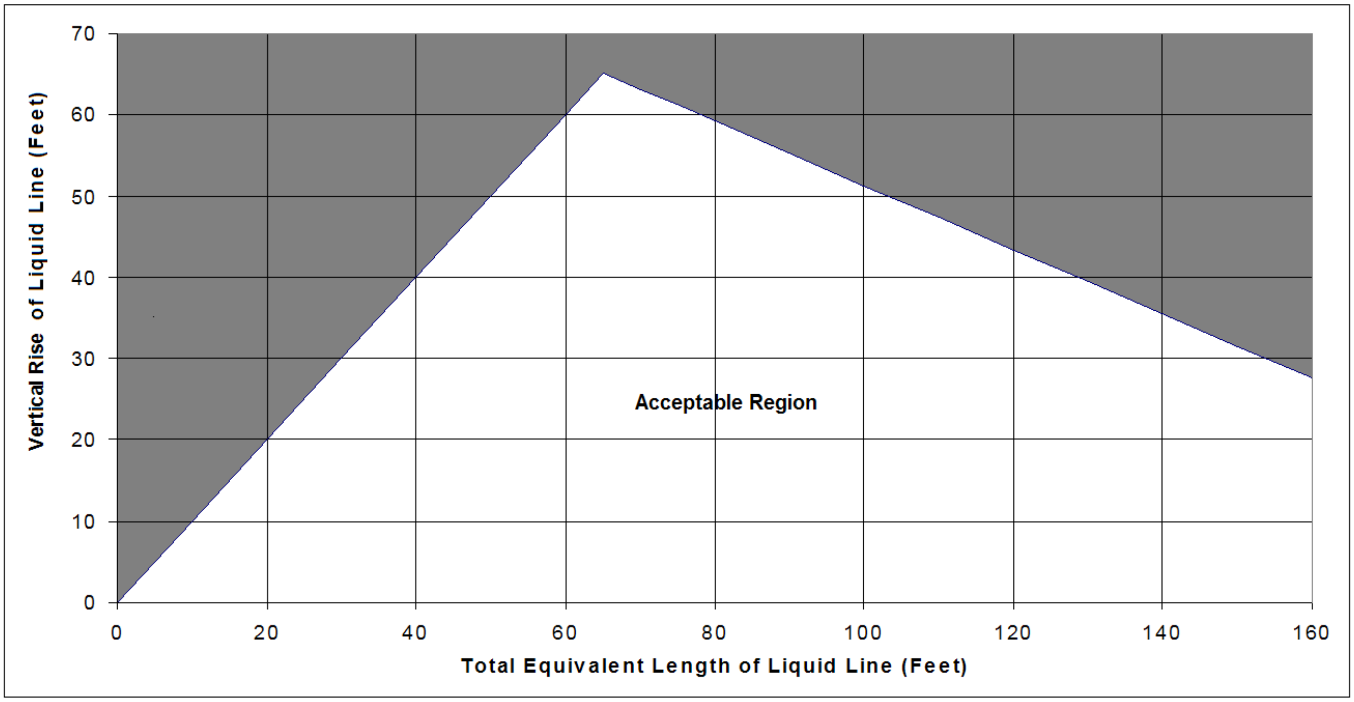

Figure 12 - Riser height versus total equivalent line length

Note: Figure 12 is for R-410A split system applications with two step compressor CB-024 through CB-060 units. The region of acceptable riser height is the lighter area. Select the corresponding predetermined line size from Table 6 above.

CAUTION

Total Equivalent Line Length in this figure is limited to 160 equivalent feet.

Startup

(See back of the manual for startup form.)

⚠ WARNING

ELECTRIC SHOCK

Electric shock hazard. Shut off all electrical power to the unit to avoid shock hazard or injury from rotating parts.

⚠ WARNING

QUALIFIED INSTALLER

Improper installation, adjustment, alteration, service or maintenance can cause property damage, personal injury or loss of life. Startup and service must be performed by a Factory Trained Service Technician.

Before startup of the condenser or condensing unit, make sure that the following items have been checked.

1. Verify that electrical power is available to the unit.
2. Verify that any remote stop/start device connected to the unit controller is requesting the unit to start.

Confirm the compressor is operating within tolerance.

While performing the check, use the startup form to record observations of amps and refrigerant pressures.

⚠ CAUTION

COMPRESSOR ROTATION

Scroll compressors are directional and will be damaged by operation in the wrong direction. Low pressure switches on compressors have been disconnected after factory testing. Rotation must be checked by a qualified service technician at startup using suction and discharge pressure gauges and any wiring alteration must only be made at the unit power connection.

When all is running properly, place the controller in the Run mode and observe the system until it reaches a steady state of operation.

⚠ CAUTION

Before completing startup and leaving the unit a complete operating cycle must be observed to verify that all components are functioning properly.

Compressors

All compressors are equipped with crankcase heaters, which must be energized at least 24 hours prior to cooling operation of the compressor.

⚠ CAUTION

3-PHASE ROTATION

Rotation must be checked on all MOTORS AND COMPRESSORS of three phase units. Condenser fan motors must all be checked by a qualified service technician at startup and any wiring alteration must only be made at the unit power connection.

Air Flow

Table 7 - Performance Testing Air Flow Setpoints

Model	Cooling Stage 2 (cfm)	Cooling Stage 1 (cfm)	Heating Stage 2 (cfm)	Heating Stage 1 (cfm)
CB-B-024-*-*-1	885	665	885	795
CB-B-036-*-*-1	1250	940	1250	1125
CB-B-048-*-*-1	1500	1125	1500	1350
CB-B-060-*-*-1	1545	1160	1545	1390

Table 8 - R-410A Refrigerant Temperature-Pressure Chart

°F	PSIG	°F	PSIG	°F	PSIG	°F	PSIG	°F	PSIG
20	78.3	**47**	134.7	**74**	213.7	**101**	321.0	**128**	463.2
21	80.0	**48**	137.2	**75**	217.1	**102**	325.6	**129**	469.3
22	81.8	**49**	139.7	**76**	220.6	**103**	330.2	**130**	475.4
23	83.6	**50**	142.2	**77**	224.1	**104**	334.9	**131**	481.6
24	85.4	**51**	144.8	**78**	227.7	**105**	339.6	**132**	487.8
25	87.2	**52**	147.4	**79**	231.3	**106**	344.4	**133**	494.1
26	89.1	**53**	150.1	**80**	234.9	**107**	349.3	**134**	500.5
27	91.0	**54**	152.8	**81**	238.6	**108**	354.2	**135**	506.9
28	92.9	**55**	155.5	**82**	242.3	**109**	359.1	**136**	513.4
29	94.9	**56**	158.2	**83**	246.0	**110**	364.1	**137**	520.0
30	96.8	**57**	161.0	**84**	249.8	**111**	369.1	**138**	526.6
31	98.8	**58**	163.8	**85**	253.7	**112**	374.2	**139**	533.3
32	100.9	**59**	166.7	**86**	257.5	**113**	379.4	**140**	540.1
33	102.9	**60**	169.6	**87**	261.4	**114**	384.6	**141**	547.0
34	105.0	**61**	172.5	**88**	265.4	**115**	389.9	**142**	553.9
35	107.1	**62**	175.4	**89**	269.4	**116**	395.2	**143**	560.9
36	109.2	**63**	178.4	**90**	273.5	**117**	400.5	**144**	567.9
37	111.4	**64**	181.5	**91**	277.6	**118**	405.9	**145**	575.1
38	113.6	**65**	184.5	**92**	281.7	**119**	411.4	**146**	582.3
39	115.8	**66**	187.6	**93**	285.9	**120**	416.9	**147**	589.6
40	118.1	**67**	190.7	**94**	290.1	**121**	422.5	**148**	596.9
41	120.3	**68**	193.9	**95**	294.4	**122**	428.2	**149**	604.4
42	122.7	**69**	197.1	**96**	298.7	**123**	433.9	**150**	611.9
43	125.0	**70**	200.4	**97**	303.0	**124**	439.6		
44	127.4	**71**	203.6	**98**	307.5	**125**	445.4		
45	129.8	**72**	207.0	**99**	311.9	**126**	451.3		
46	132.2	**73**	210.3	**100**	316.4	**127**	457.3		

Operation

Unit operations must be controlled with thermostat, or unit controller, never at the main power supply, except for emergency, servicing, or complete shutdown of the unit.

Thermostat Operation

Heating

Thermostat system switch - "Heat"
Thermostat fan switch - "Auto" or "On"
Thermostat temperature set to desired point.

Cooling

Thermostat system switch - "Cool"
Thermostat fan switch - "Auto" or "On"
Thermostat temperature set to desired point.

Air Circulation

Thermostat system switch - "Off"
Thermostat fan switch - "Auto" or "On"
No change of the thermostat temperature.
With these settings, the air handler's supply fan will run continuously but the supply air will not be heated, cooled, or dehumidified.

System Off

Thermostat system switch - "Off"
Thermostat fan switch - "Auto"
No change of the thermostat temperature.
With these settings, the system is shut down, with the exception of the control system power (24 VAC), and the crankcase heaters (about 60 watts/compressor).

Night and Weekend Unoccupied Operation

To reduce the operating time of the unit when the space is unoccupied, such as nights and weekends, it is recommended that the temperature setting be raised about 5°F while unoccupied during the cooling season and lowered about 10°F during the heating season.

Compressor

The compressors must be **off** for a minimum of 3 minutes and **on** for a minimum of 5 minutes. Short cycling of the compressors can causes undue stress and wear.

⚠ WARNING

COMPRESSOR CYCLING

3 MINUTE MINIMUM OFF TIME
To prevent motor overheating compressors must cycle off for a minimum of 3 minutes.

5 MINUTE MINIMUM ON TIME
To maintain the proper oil level compressors must cycle on for a minimum of 5 minutes.

The cycle rate must not exceed 7 starts per hour.

Variable Capacity Compressor Controller

Units with variable capacity scroll compressors may include variable capacity compressor controller. The following is an explanation of the terminals and troubleshooting of the alert flash codes on the controller. For more information on the compressor controller, see Emerson Climate Bulletin AE8-1328.

Figure 13 - Variable Capacity Compressor Controller

Low Voltage Terminals

24COM	Module Common
24VAC	Module Power
C1 & C2	Demand Input
P1	Pressure Common
P2	Pressure Input
P3	Pressure Power 5VDC
P4	Pressure Shield
P5 & P6	Pressure Output
T1 & T2	Discharge Temperature Sensor

High Voltage Terminals

A1 & A2	Alarm Relay Out
M1 & M2	Contactor
L1	Control Voltage N
L2	Control Voltage L
U1 & U2	Digital Unloader Solenoid
V1 & V2	Vapor Injection Solenoid

⚠ WARNING

To avoid damaging the compressor controller, DO NOT connect wires to terminals C3, C4, T3, T4, T5, or T6.

The compressor controller modulates the compressor unloader solenoid in an on/off pattern according the capacity demand signal of the system. The following table shows the linear relationship between the demand signal and compressor capacity modulation. The compressor controller also protects the compressor against high discharge temperature. Refer to Table 10 for the relationship between thermistor temperature readings and resistance values.

Table 9 - Demand Signal vs. Compressor Capacity Modulation

Demand Signal (VDC)	Loaded %	Unloaded %	Time Loaded	Time Unloaded	% Compressor Capacity
1.00	Off	Off	Off	Off	0%
1.44	10%	90%	1.5 sec	13.5 sec	10%
3.00	50%	50%	7.5 sec	7.5 sec	50%
4.20	80%	20%	12 sec	3 sec	80%
5.00	100%	0%	15 sec	0 sec	100%

LED Descriptions

Green LED - 24VAC Power
Yellow LED - Unloader Solenoid On
Red LED - ALERT Flash Code

- Flashing Green LED indicates anti-short cycle timer active
- All LEDs flashing at same rate indicates 24VAC supply too low for operation
- All LEDs solid at same time indicates controller failure
- Reset ALERT code or lockout by removing 24VAC supply to module
- All ALERTs close alarm relay contacts
- All ALERTs deenergize contactor and solenoids except Code 6
- Compressor always unloads for 0.1 second at startup
- Compressor only starts when Demand signal input is above 1.45 VDC and no ALERTs are present

Troubleshooting ALERT Flash Codes

Code 1 Reserved for future use

Code 2 High Discharge Temperature
Discharge thermistor above trip set point or thermistor short circuited.
Resets after 30 minutes and motor cools down.
If 5 events occur within 4 hours, the compressor is locked out.

Code 3 Compressor Protector Trip
No compressor current is detected when compressor should be running.
Resets when compressor current is detected.

Code 4 Locked Rotor
Locked rotor condition is detected. Compressor is locked out.

Code 5 Demand Signal Loss
Demand input signal is below 0.5VDC. Resets after demand input signal rises above 1.0VDC.

Code 6 Discharge Thermistor Fault
Thermistor is not connected. Reset by reconnecting thermistor.

Code 7 Reserved for future use

Code 8 Compressor Contactor Fault
Compressor current is detected when compressor should be off. Resets when current is no longer detected.

Code 9 Low 24VAC Supply
Supply voltage to module has dropped below 18.5VAC. Resets after voltage rise above 19.5VAC.

Figure 14 - Compressor Controller Flash Code Details

Table 10 - Thermistor Temperature vs. Resistance Values

°C	°F	kΩ	°C	°F	kΩ
-40	-40	2889.60	75	167	12.73
-35	-31	2087.22	80	176	10.79
-30	-22	1522.20	85	185	9.20
-25	-13	1121.44	90	194	7.87
-20	-4	834.72	95	203	6.77
-15	5	627.28	100	212	5.85
-10	14	475.74	105	221	5.09
-5	23	363.99	110	230	4.45
0	32	280.82	115	239	3.87
5	41	218.41	120	248	3.35
10	50	171.17	125	257	2.92
15	59	135.14	130	266	2.58
20	68	107.44	135	275	2.28
25	77	86.00	140	284	2.02
30	86	69.28	145	293	1.80
35	95	56.16	150	302	1.59
40	104	45.81	155	311	1.39
45	113	37.58	160	320	1.25
50	122	30.99	165	329	1.12
55	131	25.68	170	338	1.01
60	140	21.40	175	347	0.92
65	149	17.91	180	356	0.83
70	158	15.07			

Compressor Lockouts

Some units include adjustable compressor lockouts. The compressor lockout in the picture below can be set to any temperature between -10°F and 70°F. The ambient temperature sensor hangs right outside the unit with a cover.

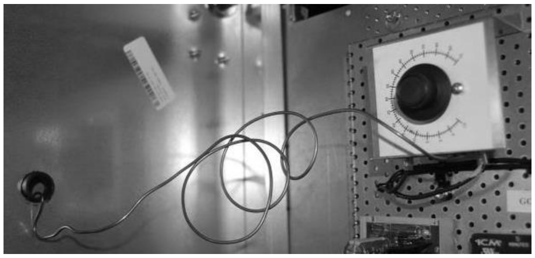

Figure 15 - Adjustable compressor lockout

Heat pump units include a non-adjustable compressor lockout for the cooling mode set to 55°F, and an adjustable compressor lockout for the heating mode that can be set between 20°F to 95°F. If a heat pump is selected with the compressor lockout feature, the adjustable compressor lockout will change to the -10°F to 70°F range.

Maintenance

(See back of the manual for maintenance log.)

At least once each year, a qualified service technician must check out the unit. This includes reading and recording suction pressures and checking for normal sub-cooling and superheat.

⚠ WARNING

Improper installation, adjustment, alteration, service or maintenance can cause property damage, personal injury or loss of life. Installation and service must be performed by a trained, qualified installer.

Only trained and qualified service technicians experienced in both condensing units and air conditioning are permitted to service the CB Series units to keep warranties in effect.

Coils

The condenser coils must be inspected yearly to ensure unrestricted airflow. If the coils contain a large amount of airborne dust or other material, they must be cleaned. Care must be taken to prevent bending of the aluminum fins on the coils.

Before attempting to clean the coils; set thermostat to the "OFF" position; turn the electrical power to the unit to the "OFF" position at the disconnect switch. The condenser coil can be cleaned by washing from the inside out with water and a coil cleaner. If coil is extremely dirty with clogged fins, a service professional specializing in coil cleaning must be called.

E-Coated Coil Cleaning

Documented routine cleaning of e-coated coils is required to maintain coating warranty coverage for condenser coils. E-Coated Coil Maintenance Record sheet is provided in this document.

⚠ WARNING

ELECTRIC SHOCK

Electric shock hazard. Shut off all electrical power to the unit to avoid shock hazard or injury from rotating parts.

Remove surface loaded fibers or dirt prior to water rinse to prevent restriction of airflow. If unable to back wash the side of the coil opposite of the coils entering air side, then surface loaded fibers or dirt must be removed with a vacuum cleaner. If a vacuum cleaner is not available, a ***soft non-metallic*** bristle brush may be used. In either case, the tool must be applied in the direction of the fins. Coil surfaces can be easily damaged (fin edges bent over) if the tool is applied across the fins.

Use of a water stream, such as a garden hose, against a surface loaded coil will drive the fibers and dirt into the coil. This will make cleaning efforts more difficult. Surface loaded fibers must be completely removed prior to using low velocity clean water rinse.

A ***monthly*** clean water rinse is recommended for coils that are applied in coastal or industrial environments to help to remove chlorides, dirt, and debris. It is very important when rinsing, that water temperature is less than 130°F and pressure is less than 100 psig to avoid damaging the fin edges. An elevated water temperature (not to exceed 130°F) will reduce surface tension, increasing the ability to remove chlorides and dirt.

CAUTION

High velocity water from a pressure washer or compressed air must only be used at a very low pressure to prevent fin and/or coil damages. The force of the water or air jet may bend the fin edges and increase airside pressure drop. Reduced unit performance or nuisance unit shutdowns may occur.

Quarterly cleaning is essential to extend the life of an e-coated coil and is required to maintain coating warranty coverage.

Coil cleaning must be part of the unit's regularly scheduled maintenance procedures. Failure to clean an e-coated coil will void the warranty and may result in reduced efficiency and durability.

CAUTION

Harsh chemicals, household bleach, or acid cleaners must not be used to clean outdoor or indoor e-coated coils. These cleaners can be very difficult to rinse out of the coil and can accelerate corrosion and attack the E-coating. If there is dirt below the surface of the coil, use the recommended coil cleaners.

For routine quarterly cleaning, first clean the coil with the below approved coil cleaner. After cleaning the coils with the approved cleaning agent, use the approved chloride remover to remove soluble salts and revitalize the unit.

Recommended Coil Cleaner

The following cleaning agent, when used in accordance with the manufacturer's directions on the container for proper mixing and cleaning, has been approved for use on e-coated coils to remove mold, mildew, dust, soot, greasy residue, lint, and other particulate:

Enviro-Coil Cleaner: AAON PN: V82540

GulfClean ™ Coil Cleaner; AAON PN: G074480

Recommended Chloride Remover

GulfClean Salt Reducer™ ; AAON PN: G074490

GulfClean Salt Reducer™ is used to remove soluble salts from the e-coated coil, follow the manufacturer's instructions. This product is not intended for use as a degreaser. Any grease or oil film must first be removed with GulfClean ™ Coil Cleaner.

Remove Barrier - First ensure the power to the unit is off and locked out. Clean the area around the unit if needed to ensure leaves, grass or loose debris will not be blown into the coil. Soluble salts adhere themselves to the substrate. For the effective use of this product, the product must be able to come in contact with the salts. These salts may be beneath any soils, grease or dirt; therefore, these barriers must be removed prior to application of this product. As in all surface preparation, the best work yields the best results.

Application- Apply GulfClean ™ Coil Cleaner directly onto the substrate. Sufficient product must be applied uniformly across the substrate to thoroughly wet out surface, with no areas missed. This may be accomplished by use of a pump-up sprayer or conventional spray gun. Apply the cleaner to unit interior air exiting side coil surfaces first. Work in sections/panels moving side to side and from top to bottom. Allow the cleaning solution to soak for 5 to 10 minutes. Then move on to the exterior using the same method.

Rinse - Using pressurized potable water such as a garden hose, (< 100 psi), rinse the coils and continue to always work in sections/panels.

Continue until all coil areas on the inside of the unit have been rinsed. ***Note: Coils must always be cleaned / back flushed, opposite of airflow to prevent impacting the dirt into the coil.***

Repeat these steps with GulfClean ™ Salt Reducer. When finished replace all panels and tops that were removed.

DX Cooling
Set unit controls to cooling mode of operation with supply fans on. Check compressor operation, rotation, amperage and voltage to the unit nameplate (check the amperage on the load side of the compressor contactor).

The scroll compressors are fully hermetic and require no maintenance except for keeping the shell clean.

Refrigerant circuit includes factory provided and field installed line filter drier. The unit does not include a liquid line solenoid valve. This must be field furnished and installed if required by job conditions.

Condenser Fan Motor
All original motors and bearings are furnished with factory lubrication. They require no lubrication.

The electrically commutated condenser fan motor (ECM) is factory preprogrammed and requires no maintenance.

Replacement Parts
Parts for AAON equipment may be obtained from your local AAON representative.

Reference the unit serial number and part number when ordering parts.

AAON Technical Support
203 Gum Springs Rd.
Longview, TX 75602
Ph: (918) 382-6450
techsupport@AAON.com
www.AAON.com

Note: Before calling, technician must have model and serial number of the unit available for the service department to help answer questions regarding the unit.

Refrigerant Piping Diagrams

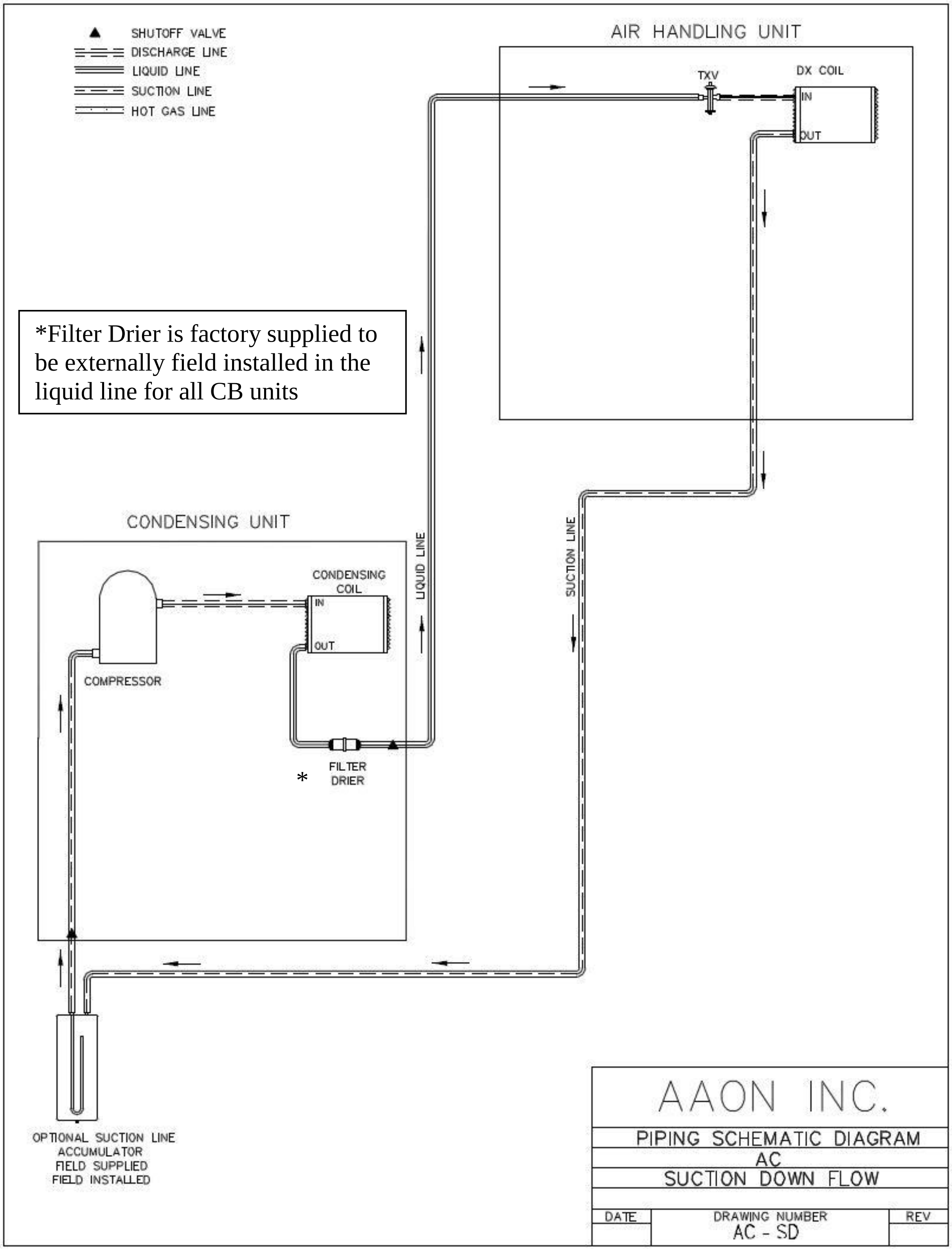

Figure 16 - A/C Split System Piping, Suction Down

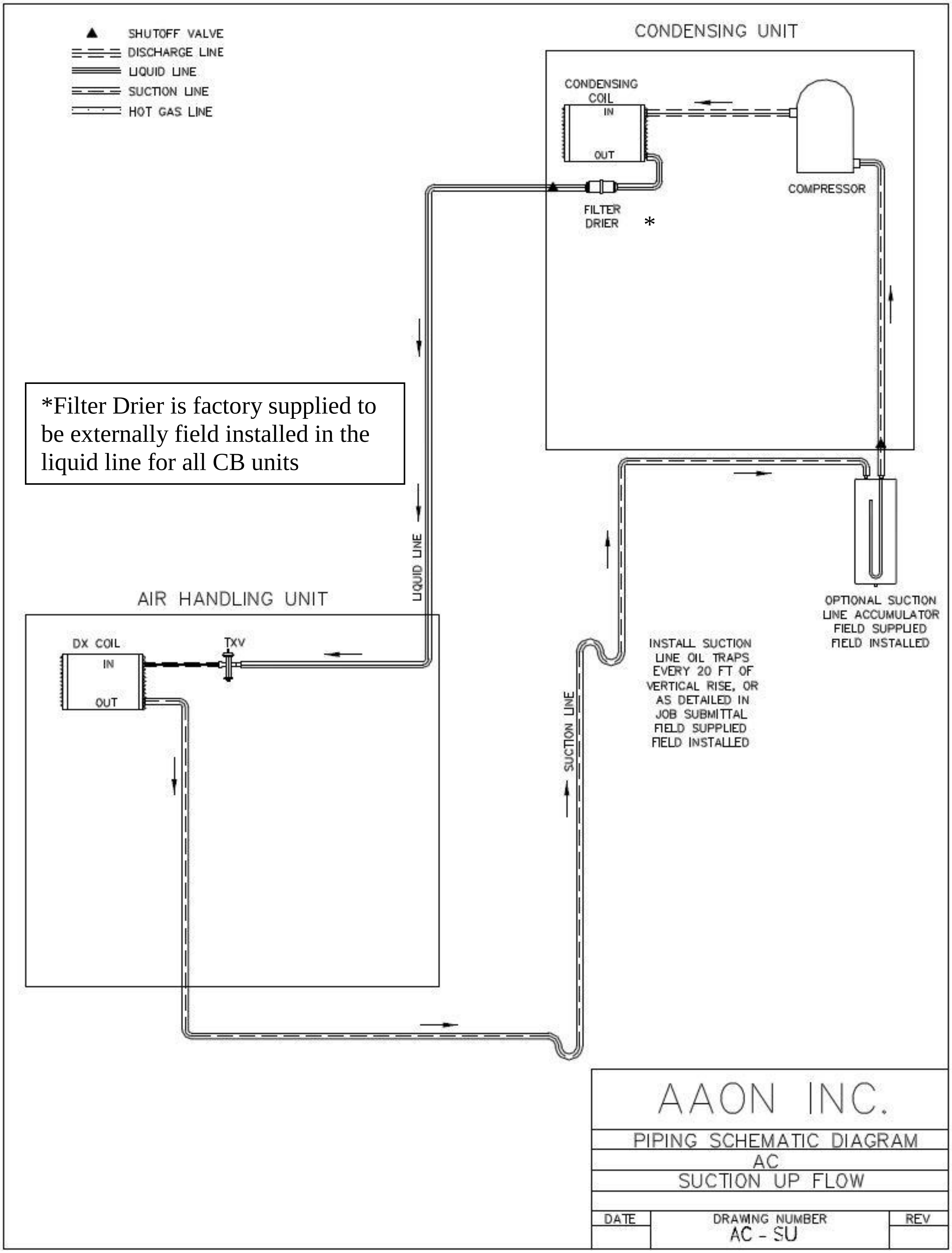

Figure 17 - A/C Split System Piping, Suction Up

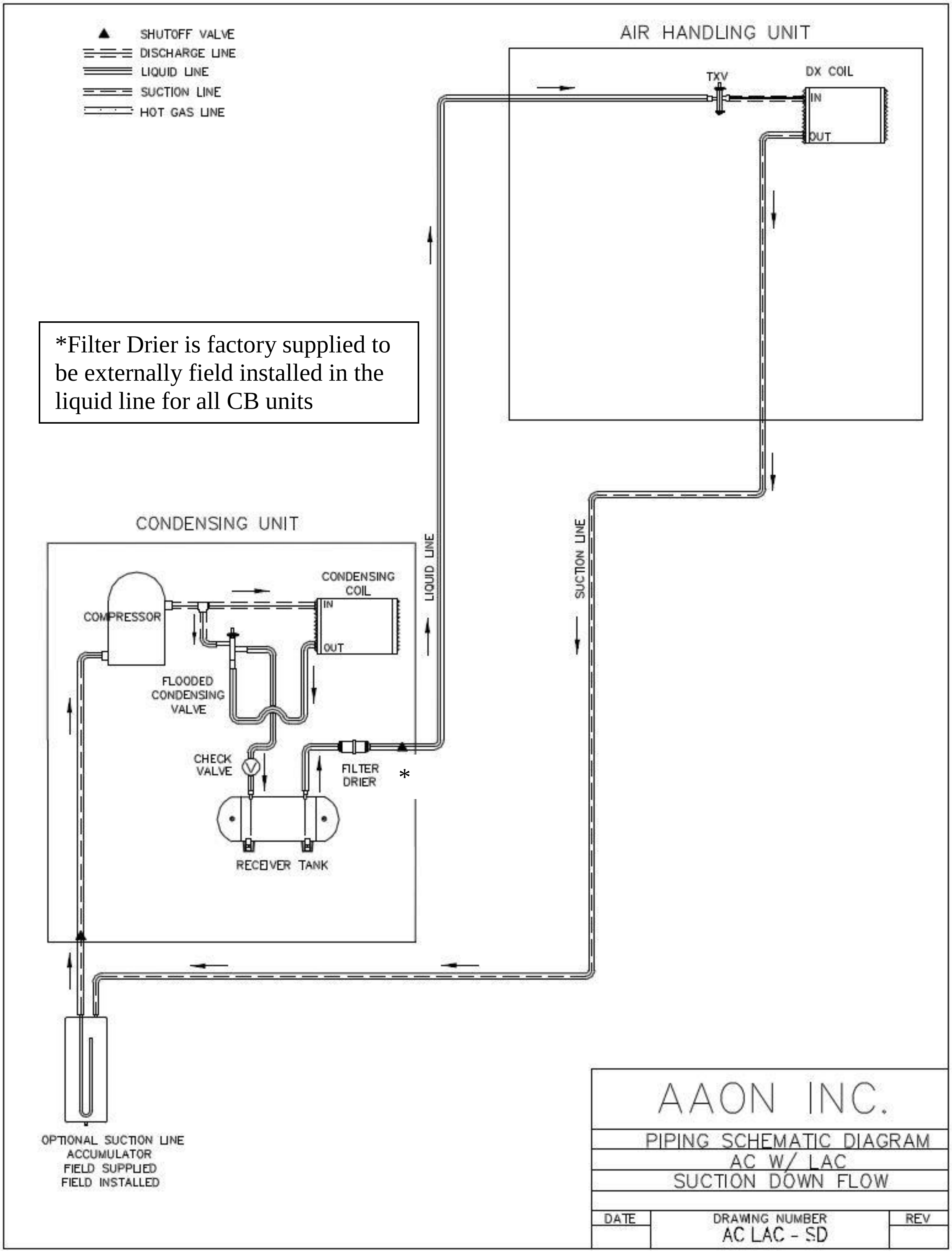

Figure 18 - A/C with LAC Split System Piping, Suction Down

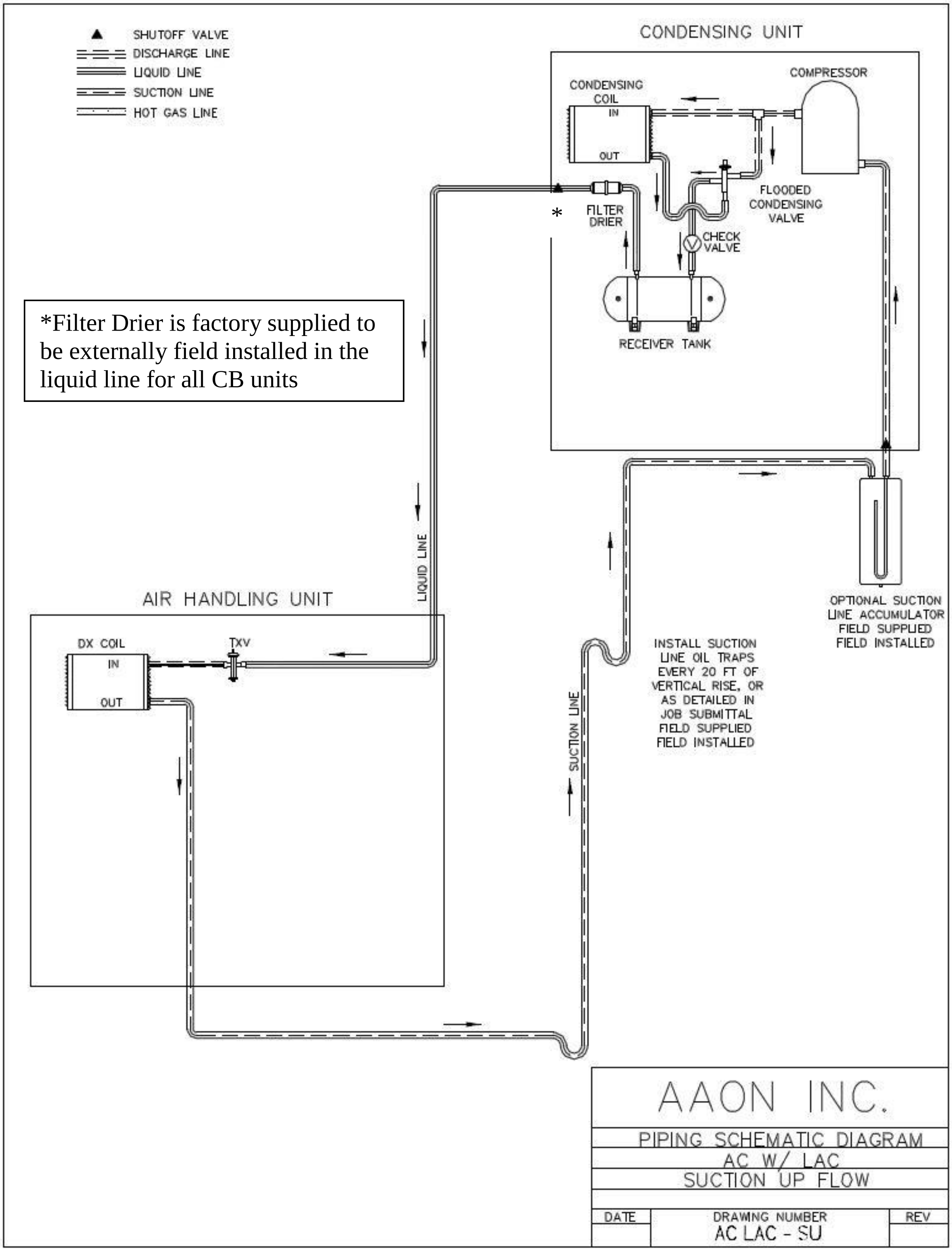

Figure 19 - A/C with LAC Split System Piping, Suction Up

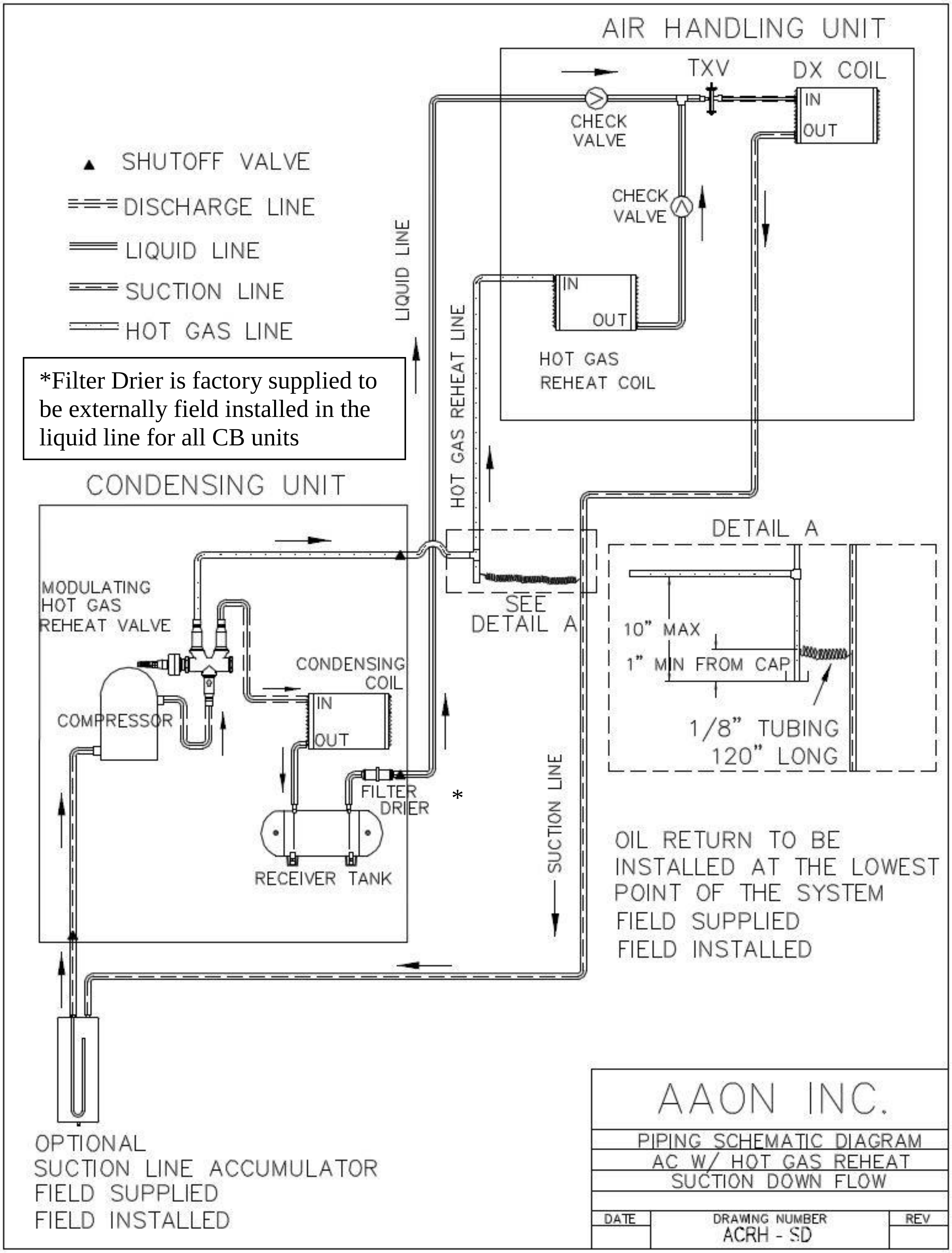

Figure 20 - A/C with Modulating Hot Gas Reheat Split System Piping, Suction Down

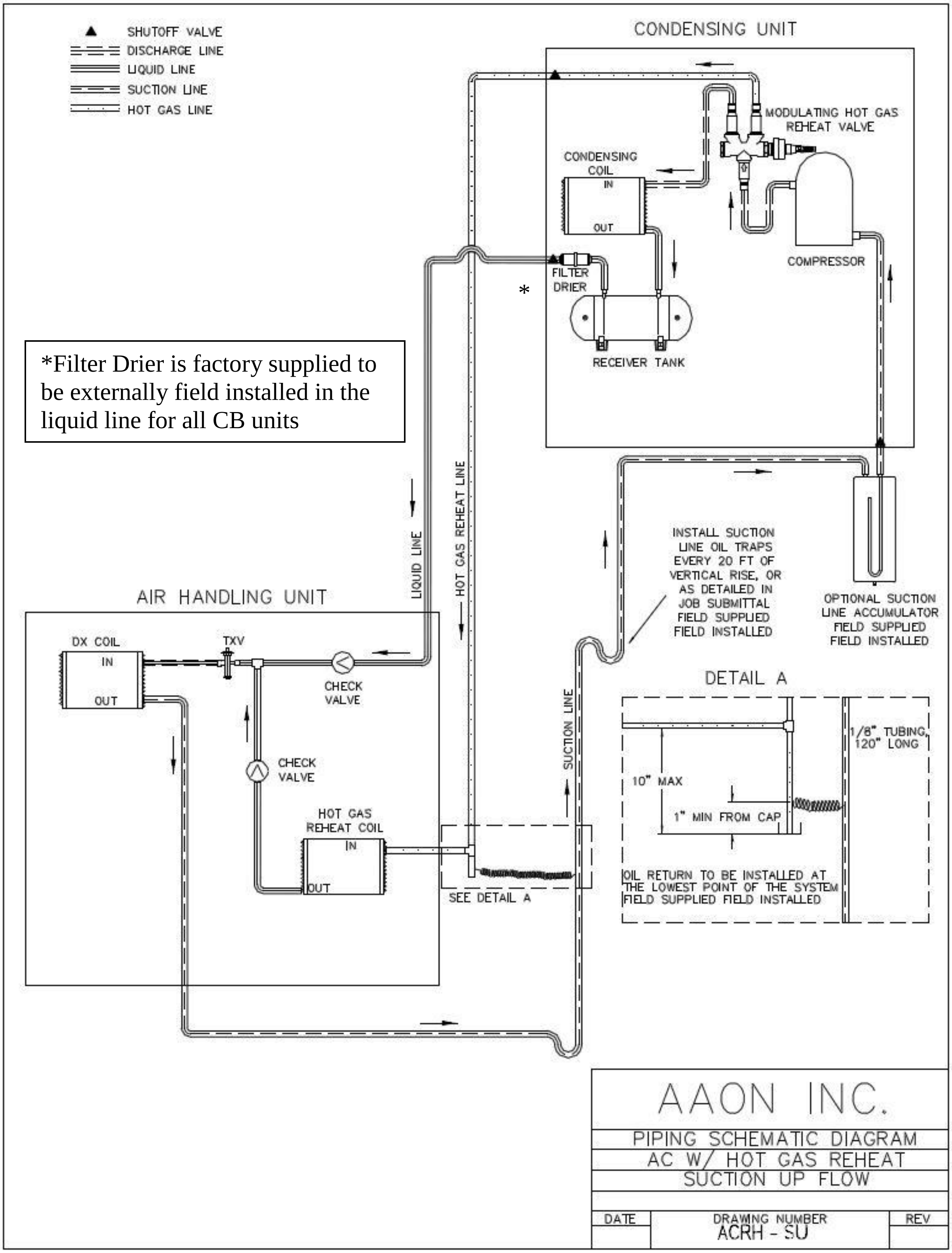

Figure 21 - A/C with Modulating Hot Gas Reheat Split System Piping, Suction Up

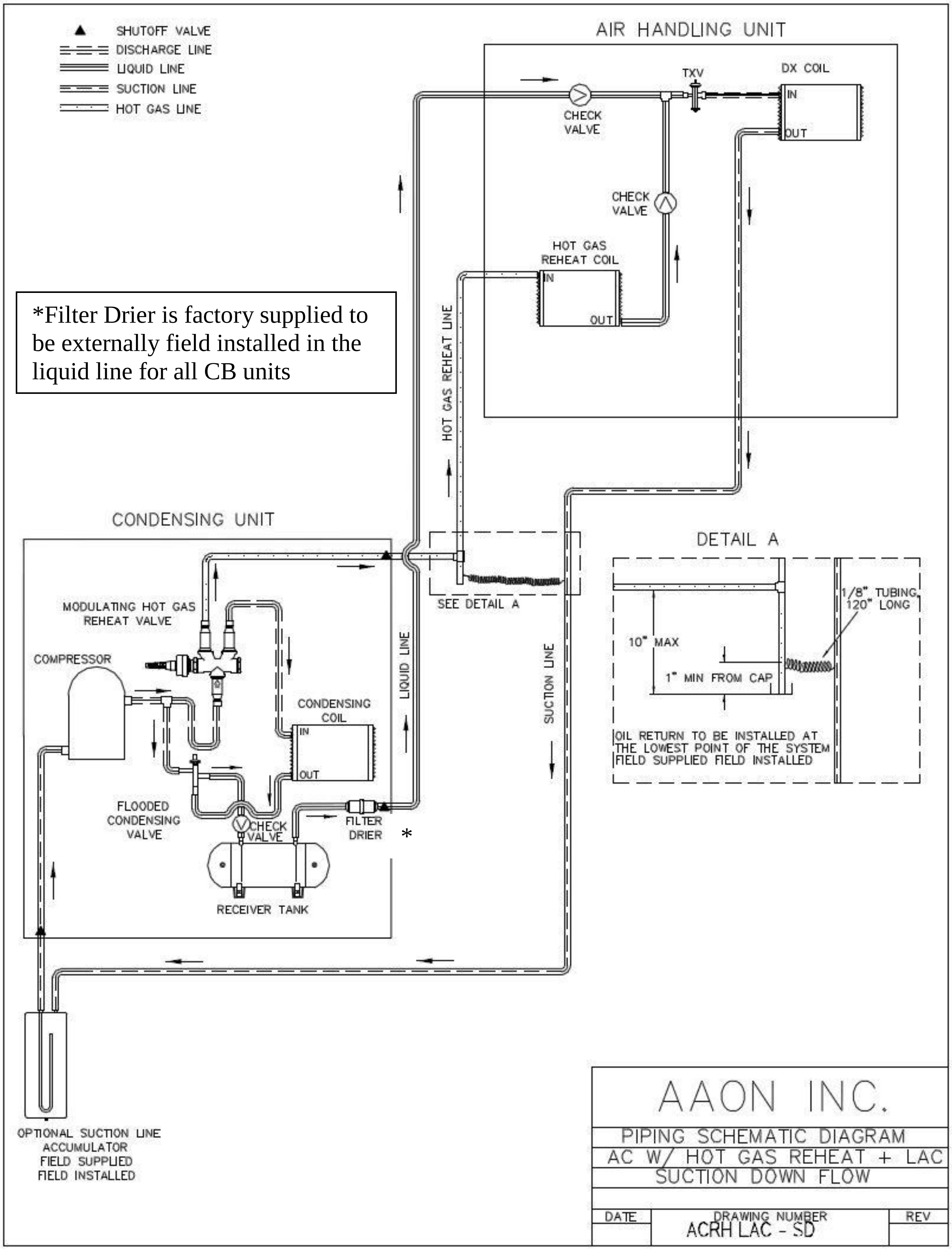

Figure 22 - A/C with Modulating Hot Gas Reheat Split + LAC System Piping, Suction Down

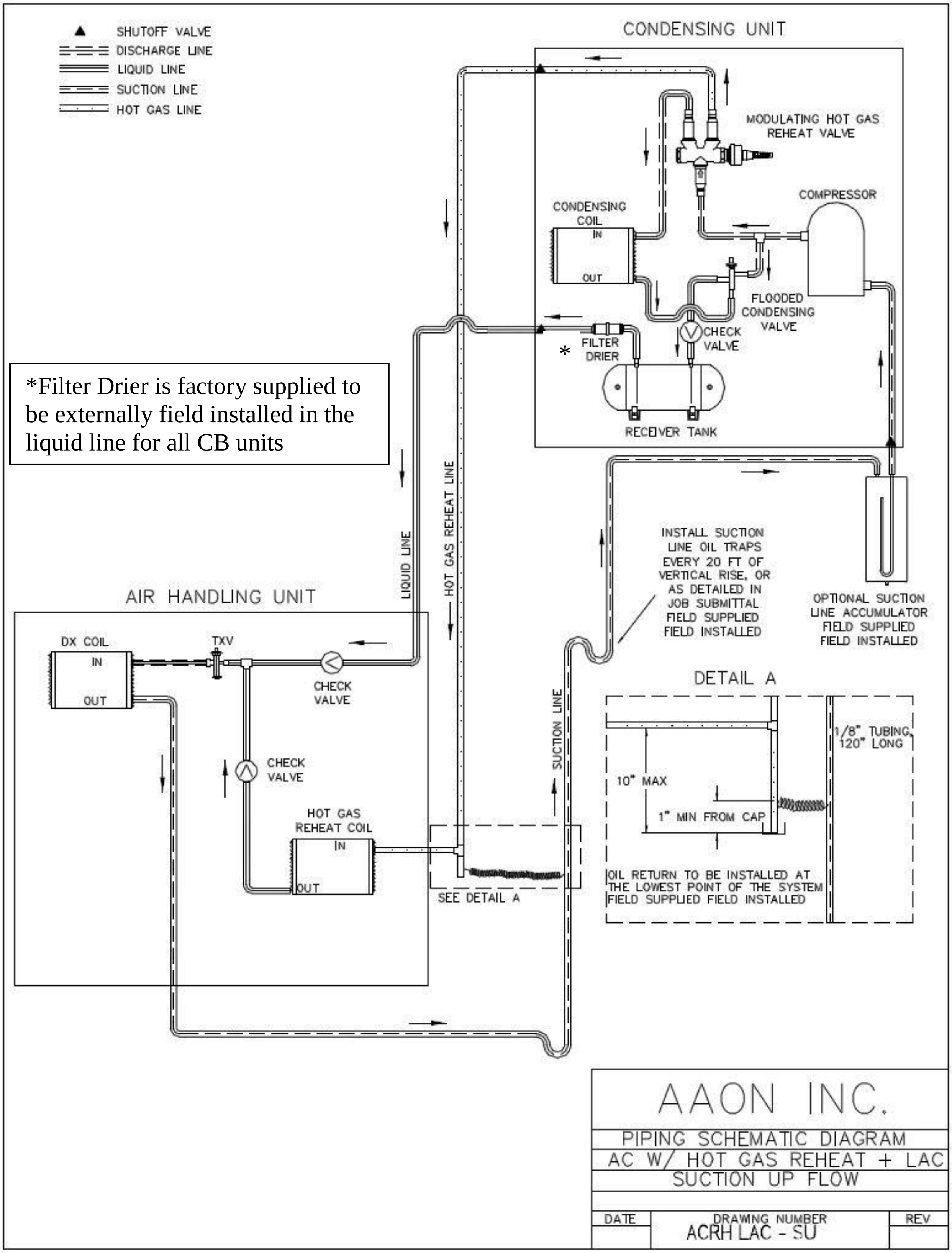

Figure 23 - A/C with Modulating Hot Gas Reheat Split + LAC System Piping, Suction Up

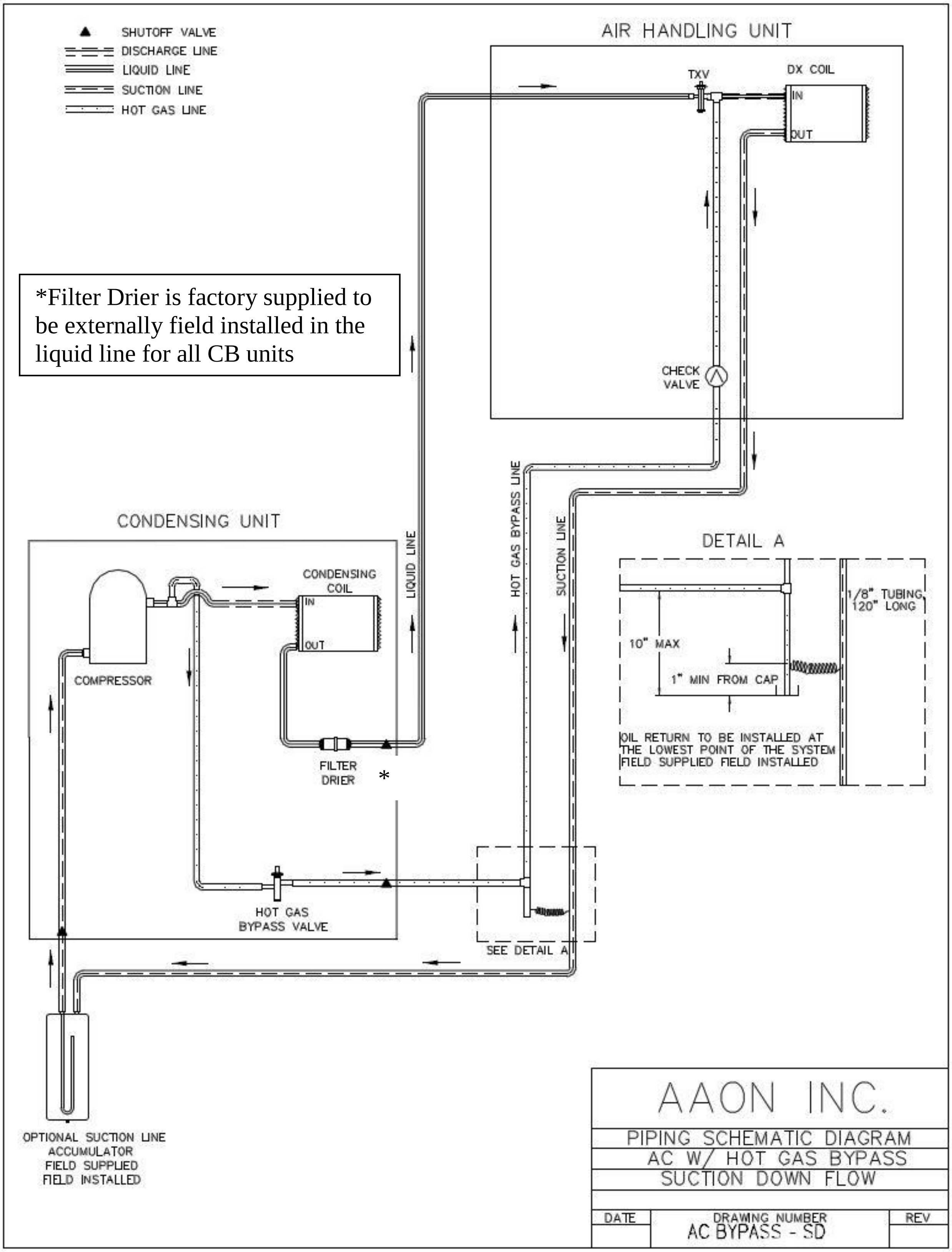

Figure 24 - A/C with Hot Gas Bypass Split System Piping, Suction Down

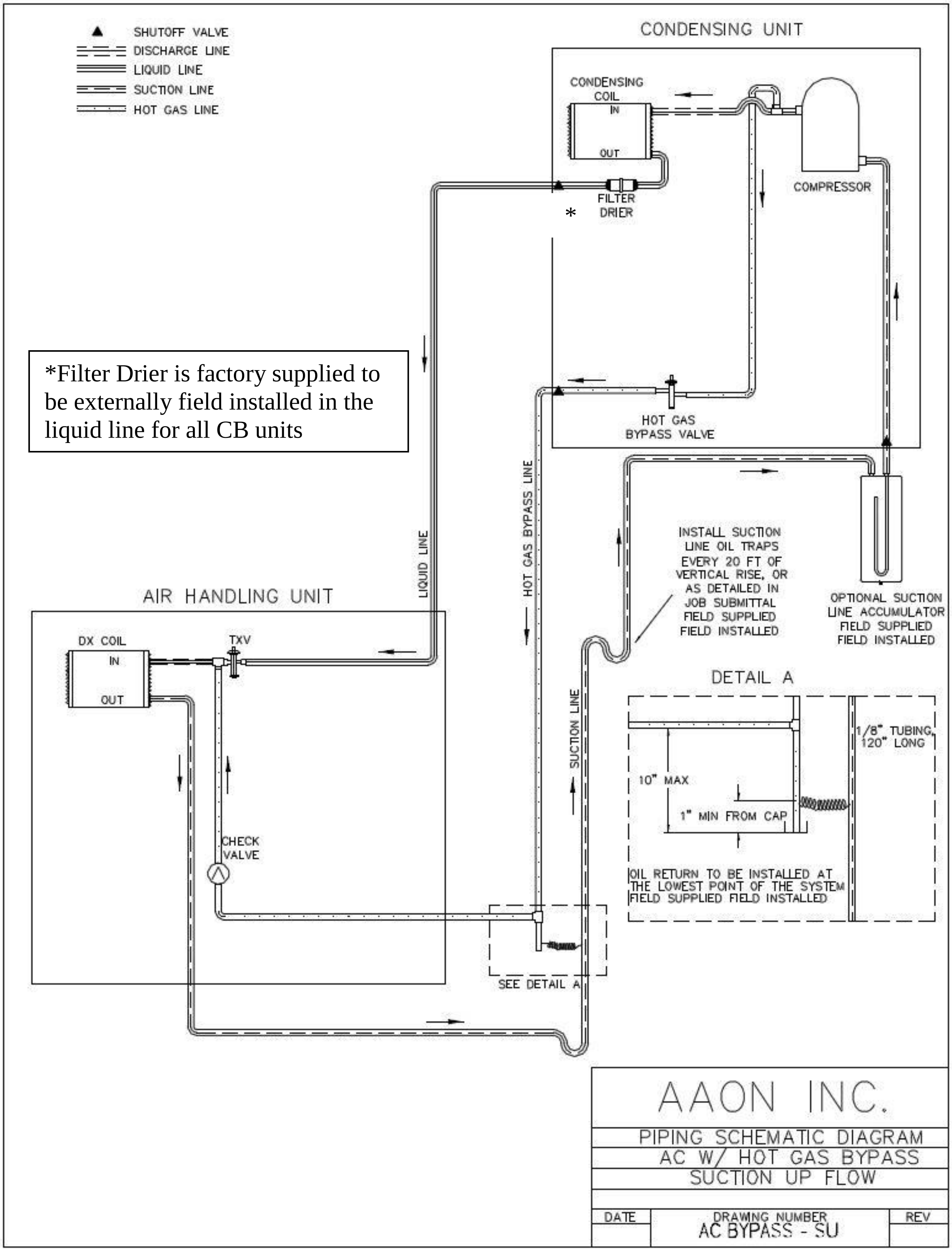

Figure 25 - A/C with Hot Gas Bypass Split System Piping, Suction Up

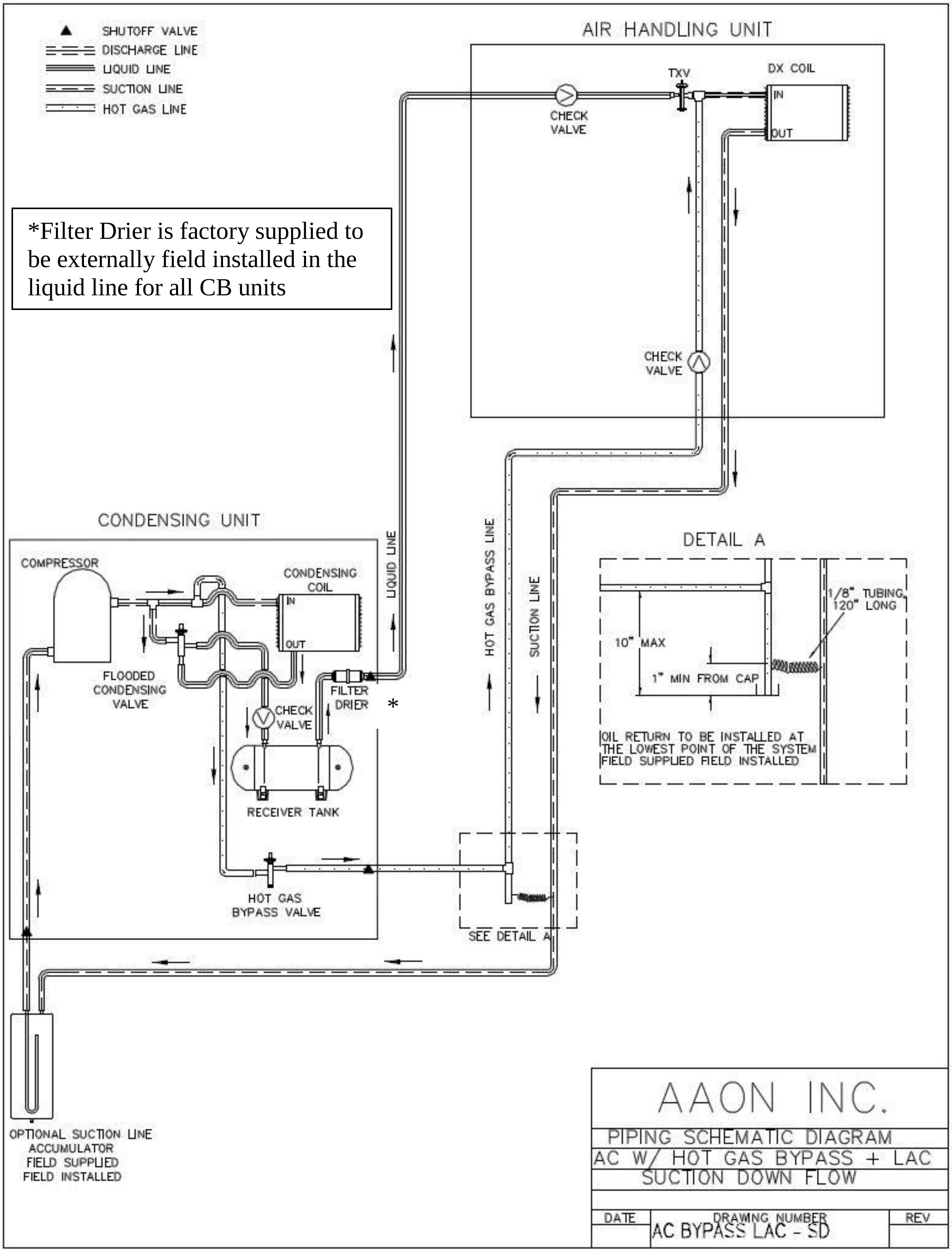

Figure 26 - A/C with Hot Gas Bypass + LAC Split System Piping, Suction Down

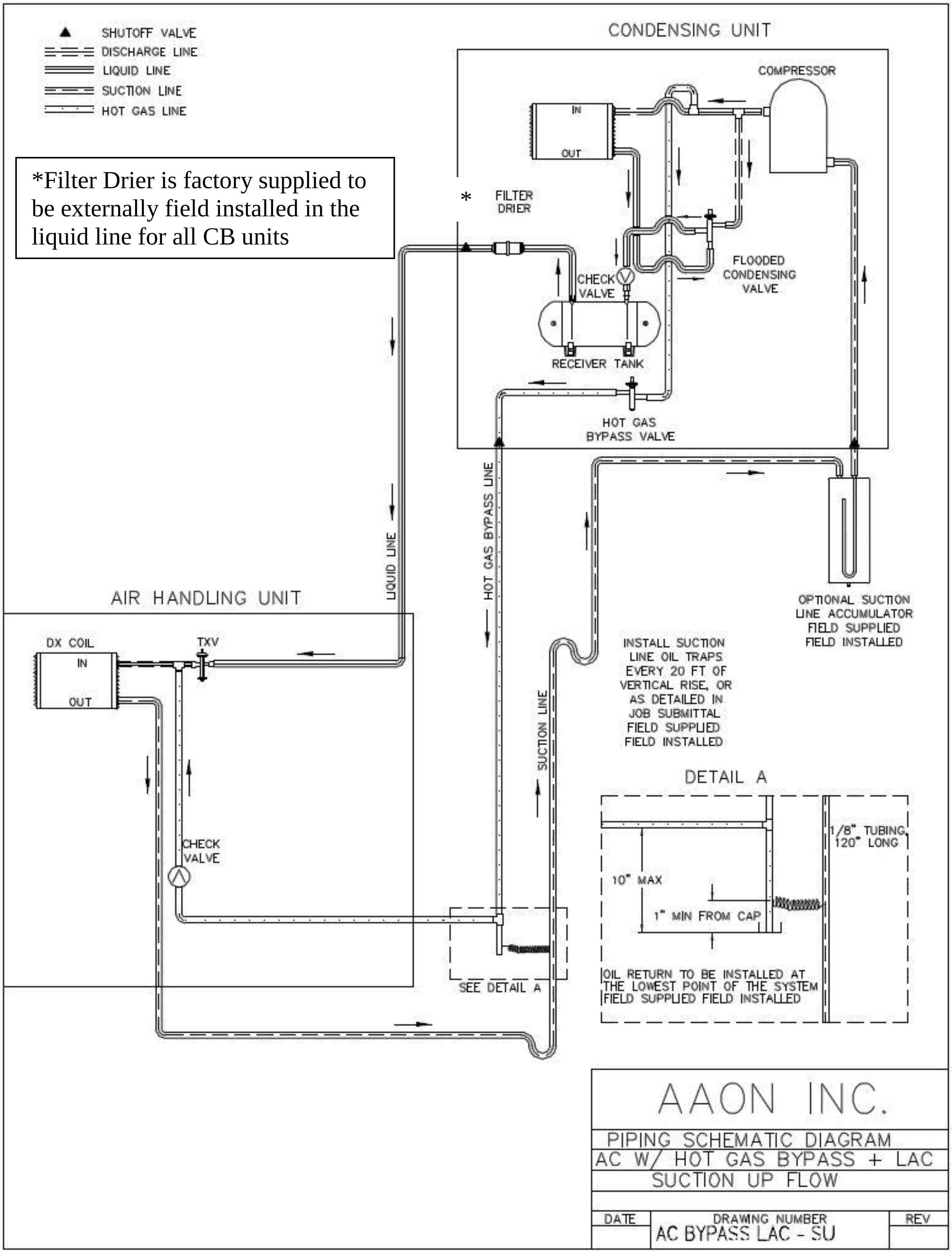

Figure 27 - A/C with Hot Gas Bypass + LAC Split System Piping, Suction Up

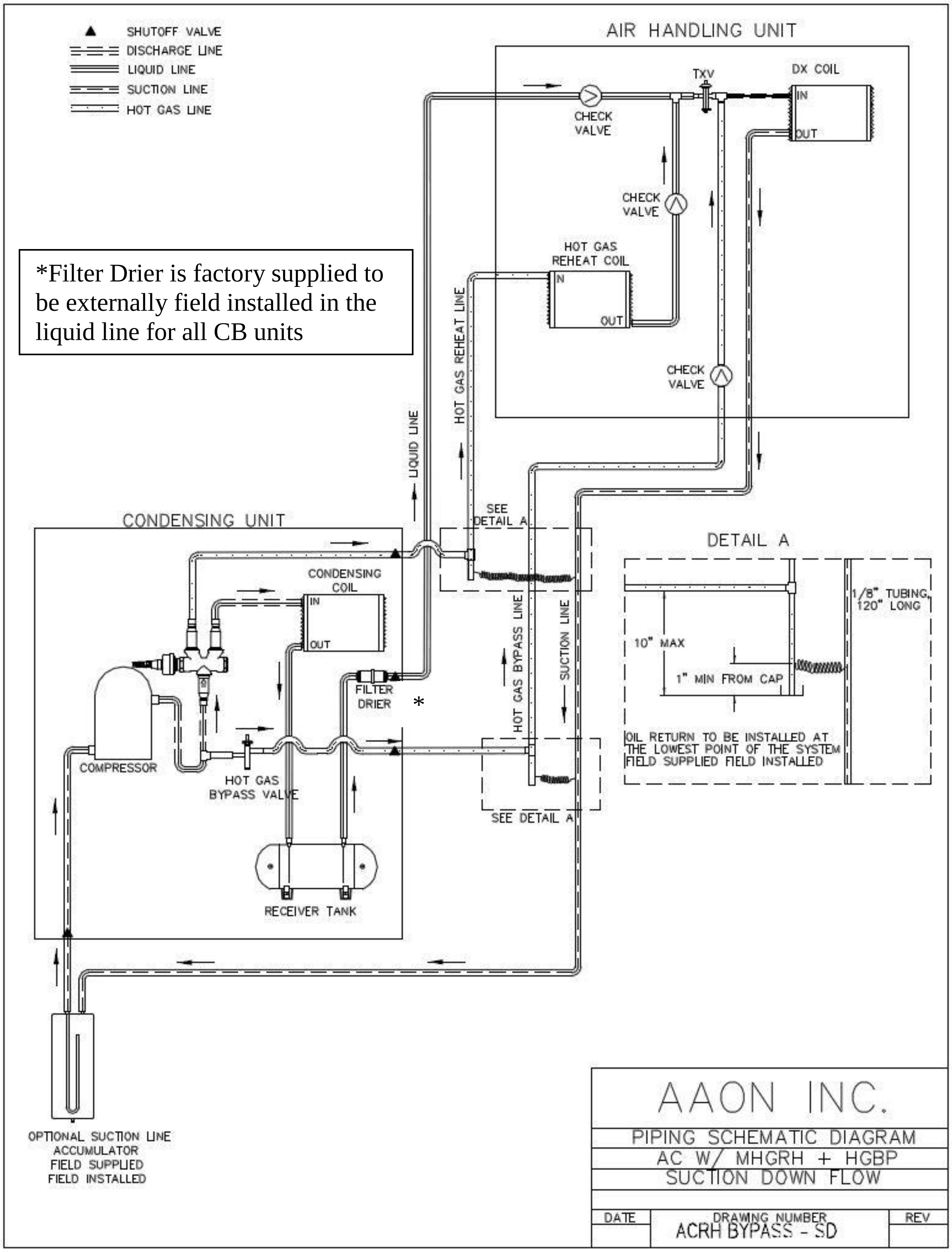

Figure 28 - A/C with Modulating Hot Gas Reheat and Hot Gas Bypass Split System Piping, Suction Down

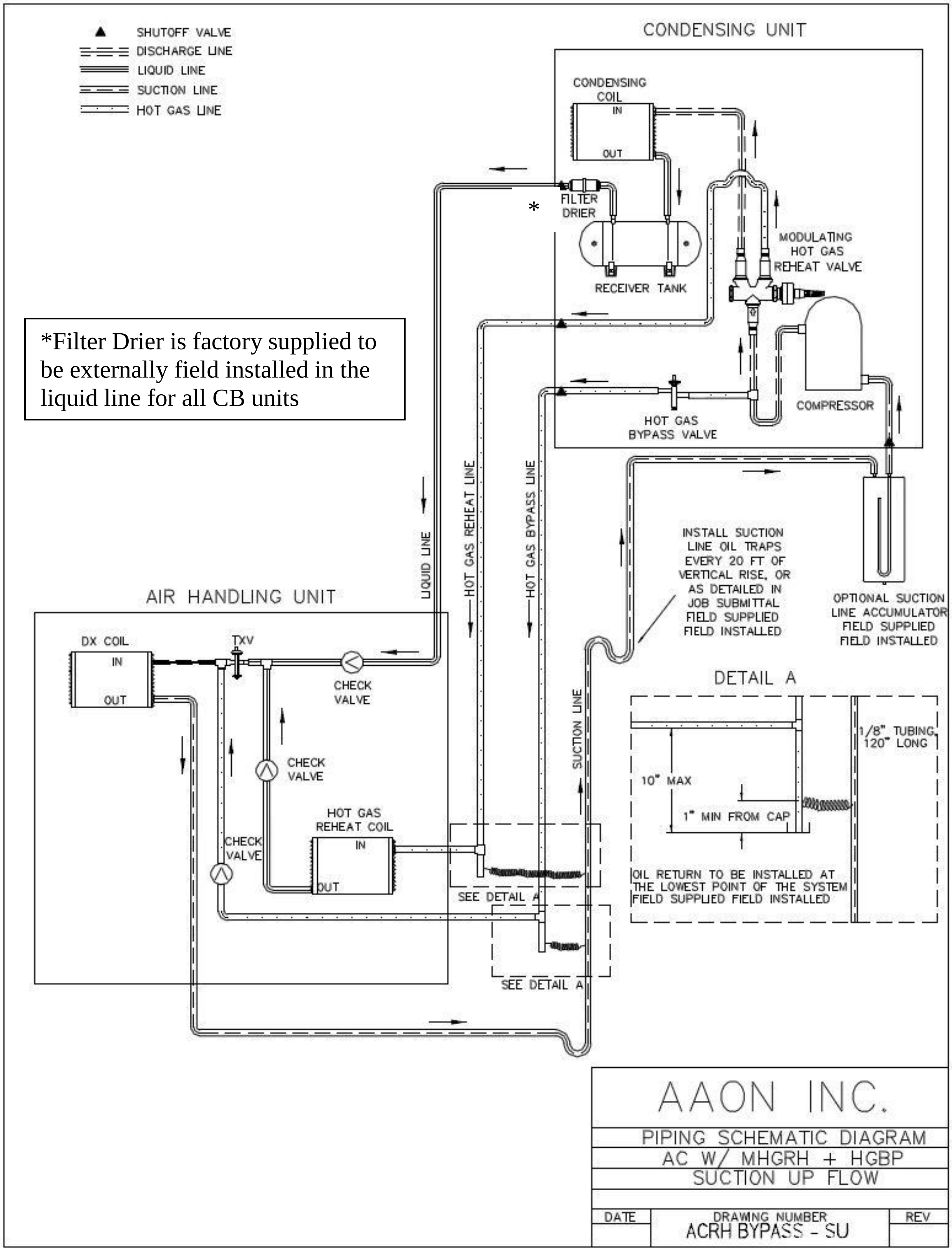

Figure 29 - A/C with Modulating Hot Gas Reheat and Hot Gas Bypass Split System Piping, Suction Up

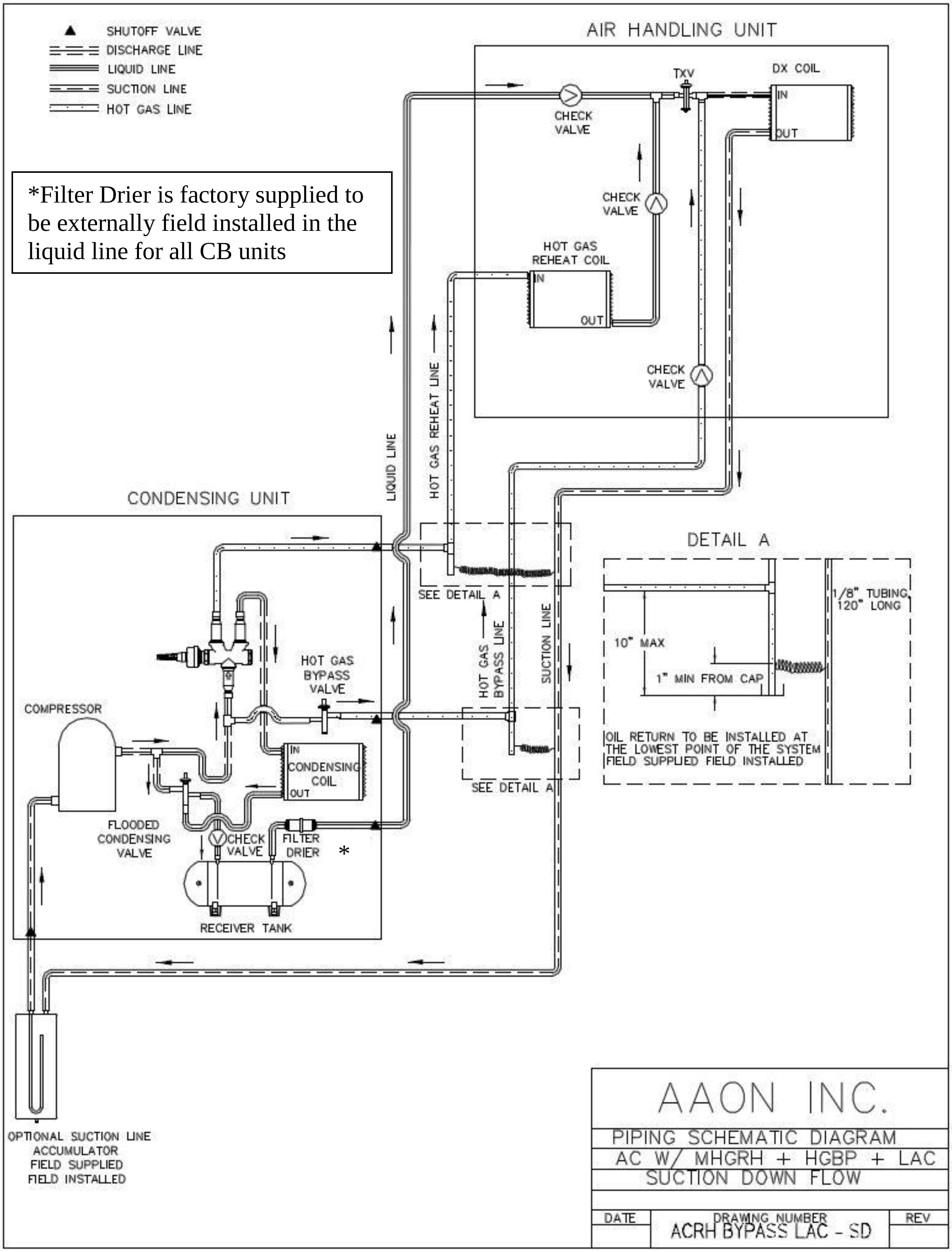

Figure 30 - A/C with Modulating Hot Gas Reheat and Hot Gas Bypass + LAC Split System Piping, Suction Down

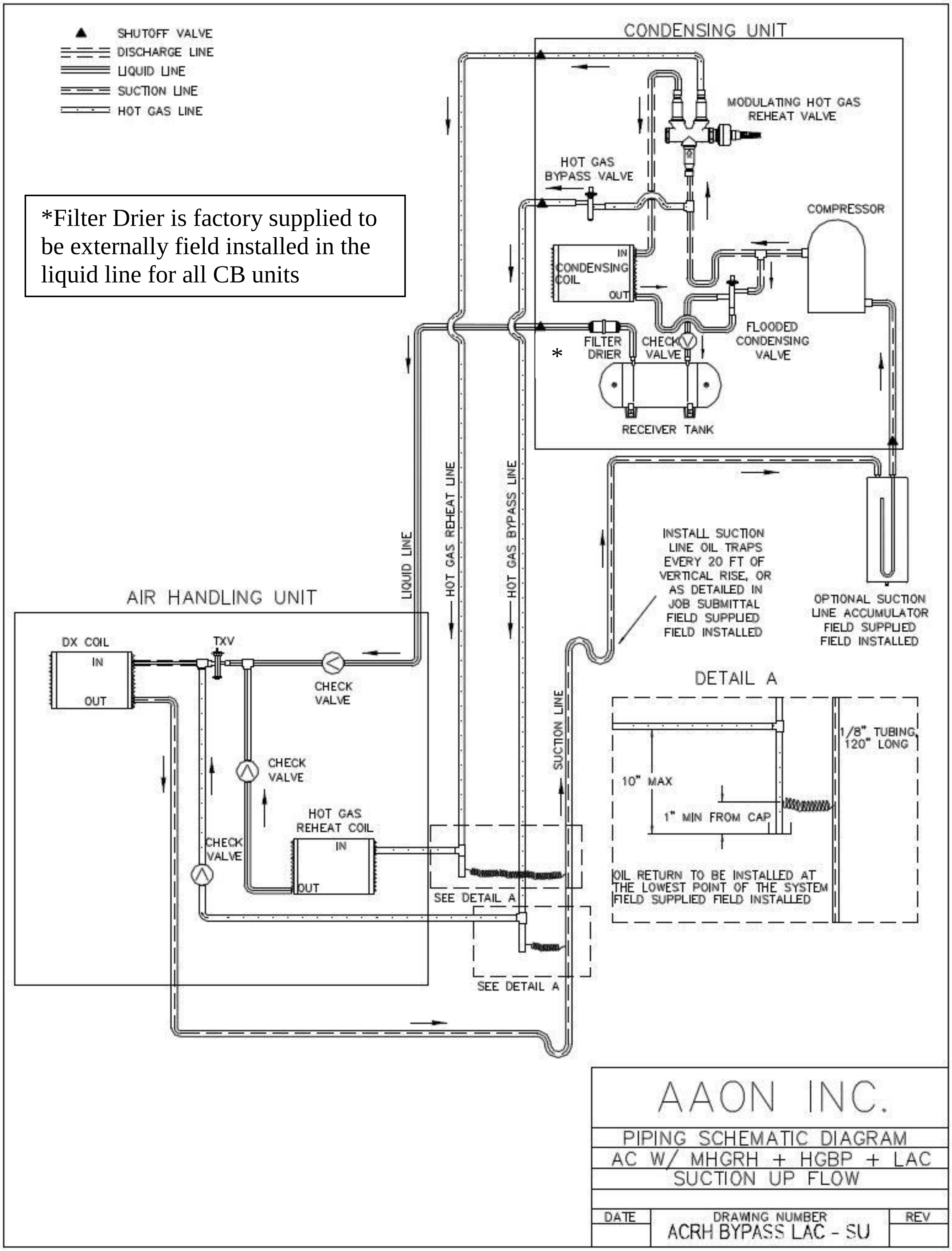

Figure 31 - A/C with Modulating Hot Gas Reheat and Hot Gas Bypass + LAC Split System Piping, Suction Up

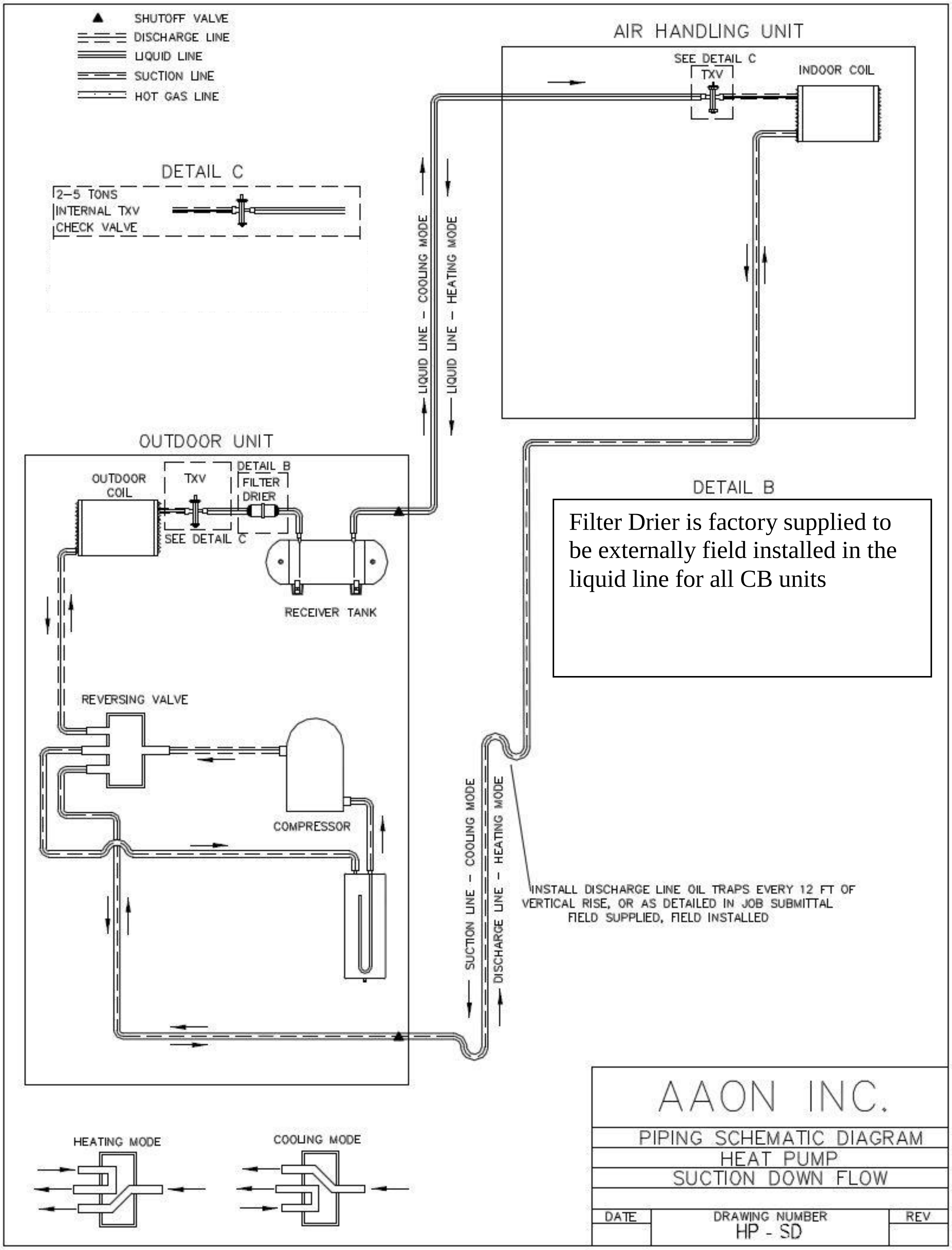

Figure 32 - Heat Pump Split System Piping, Suction Down

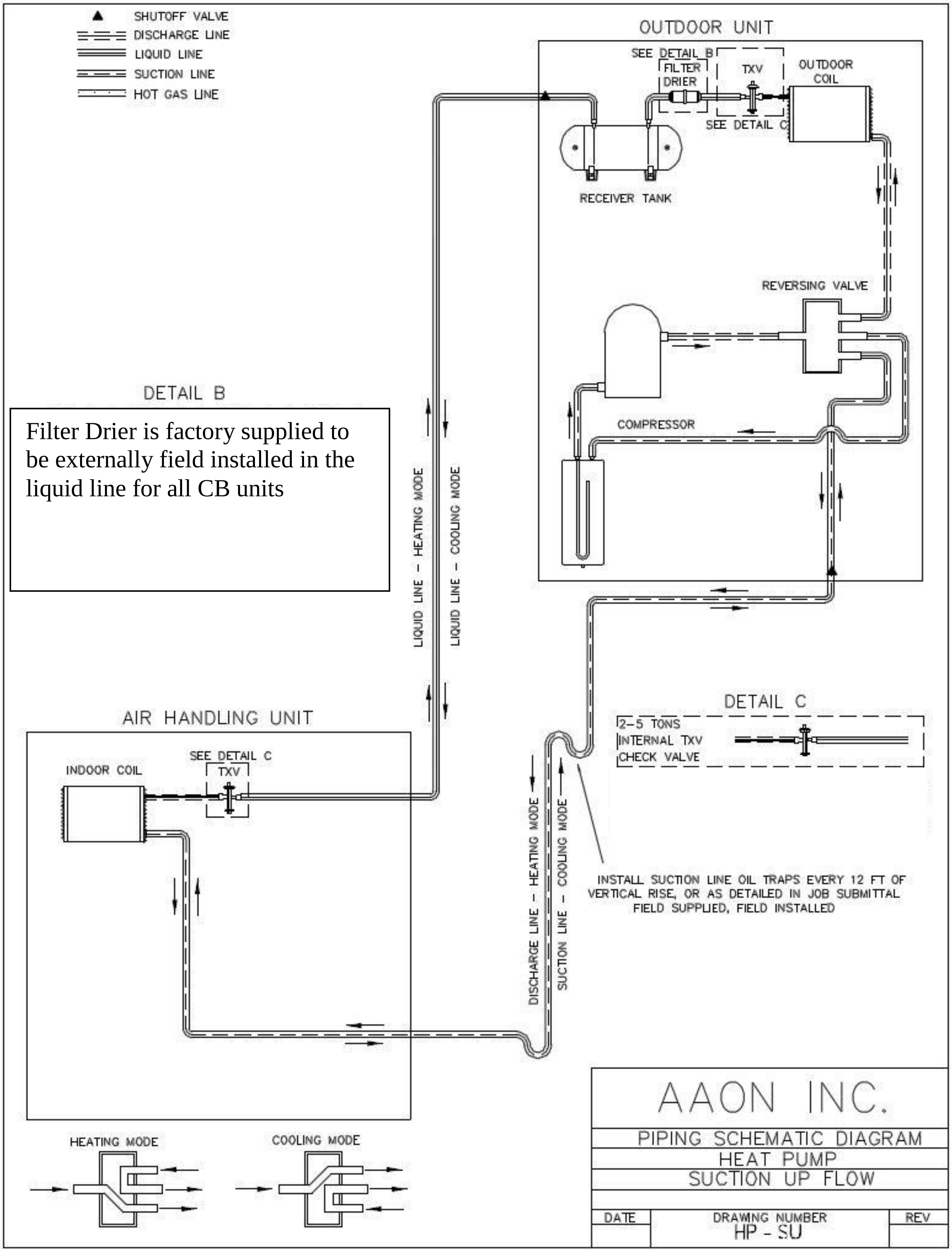

Figure 33 - Heat Pump Split System Piping, Suction Up

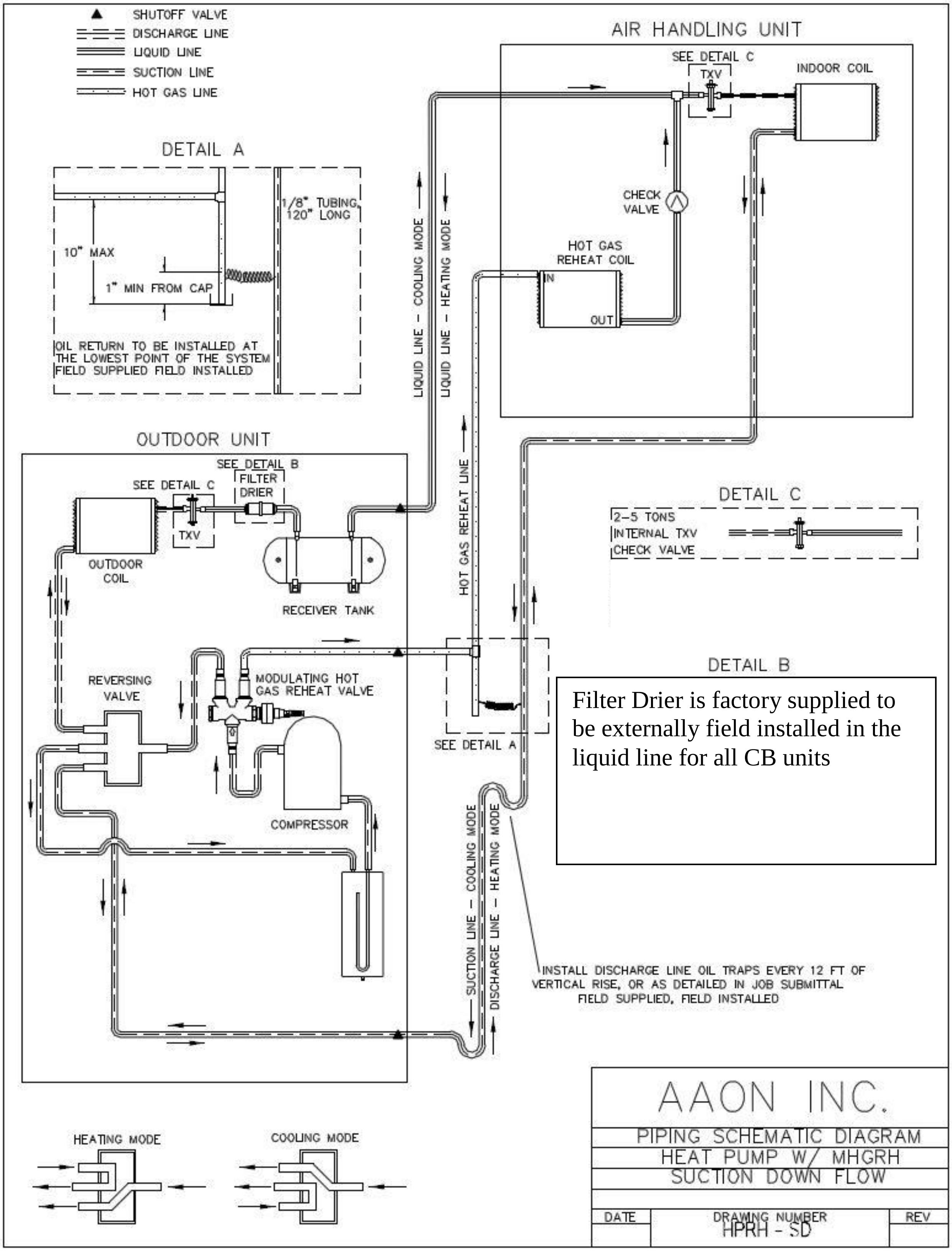

Figure 34 - Heat Pump with Modulating Hot Gas Reheat Split System Piping, Suction Down

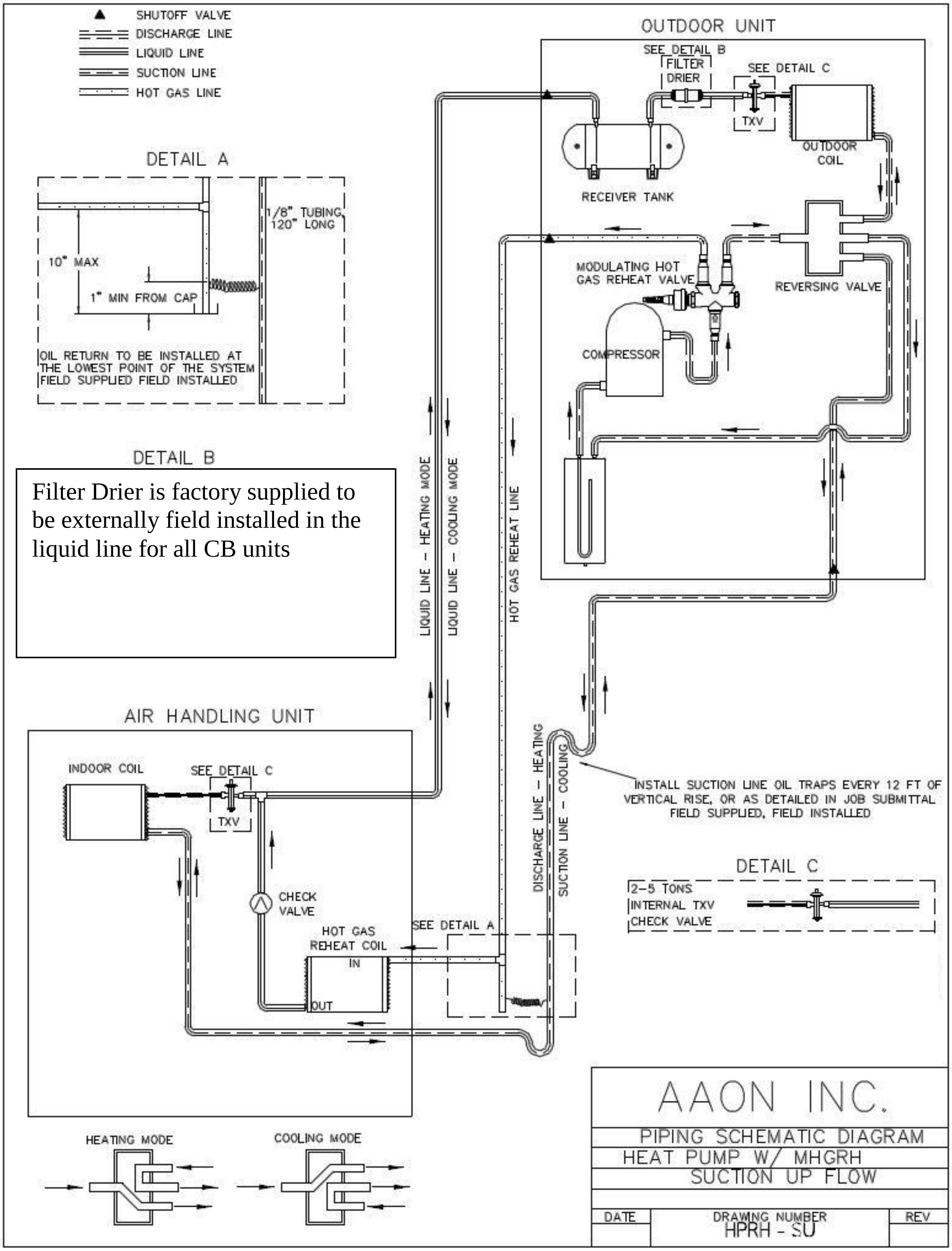

Figure 35 - Heat Pump with Modulating Hot Gas Reheat Split System Piping, Suction Up

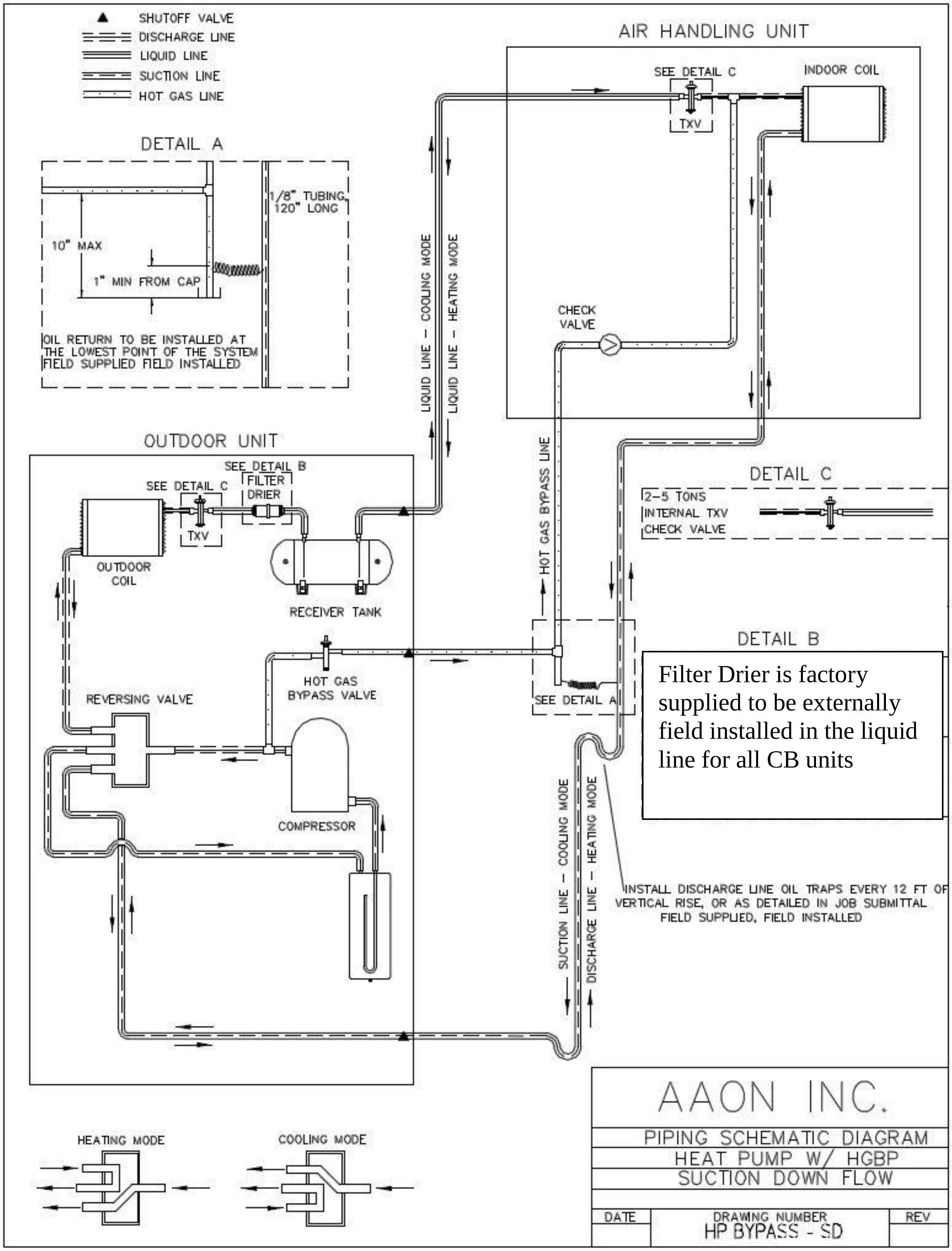

Figure 36 - Heat Pump with Hot Gas Bypass Split System Piping, Suction Down

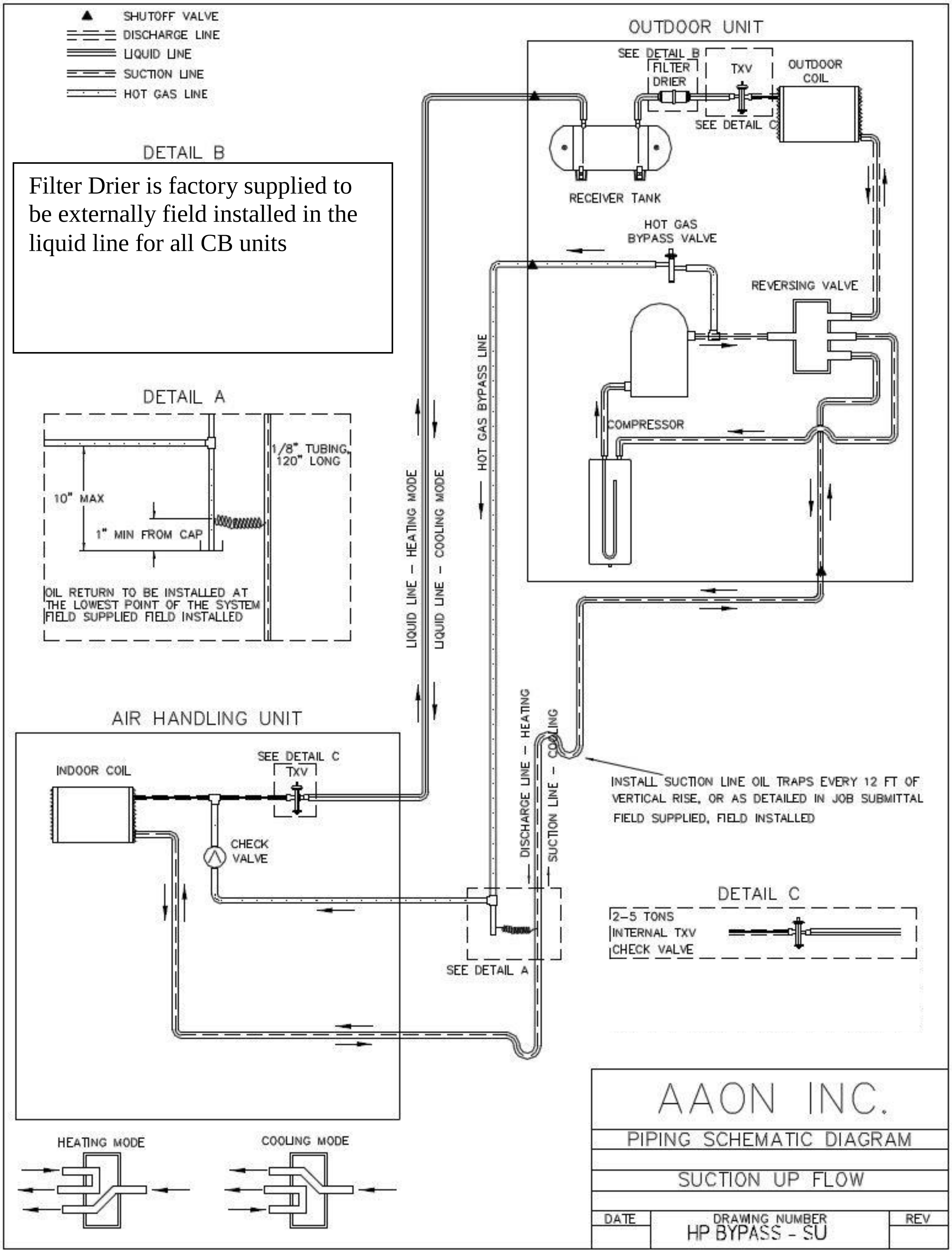

Figure 37 - Heat Pump with Hot Gas Bypass Split System Piping, Suction Up

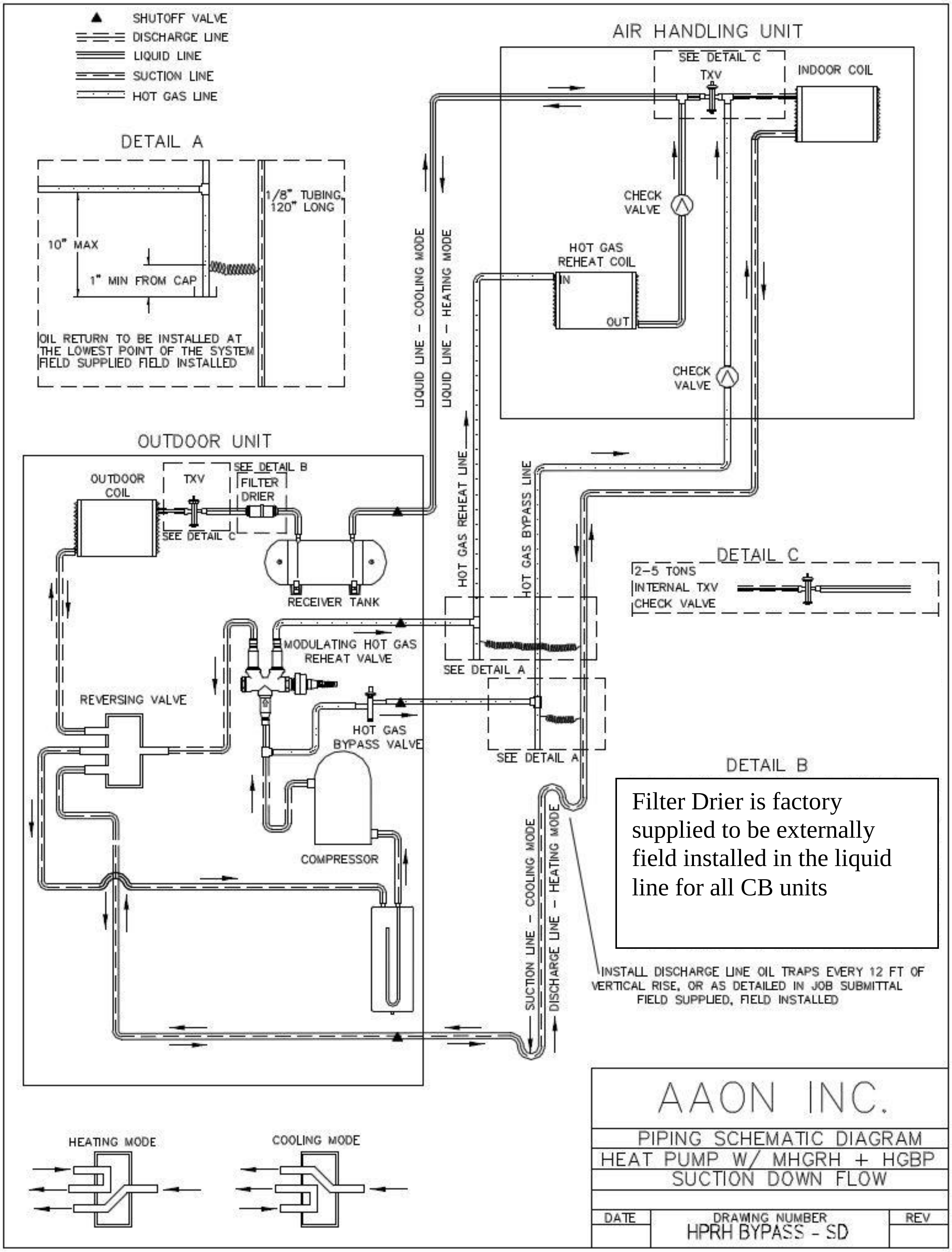

Figure 38 - Heat Pump with Modulating Hot Gas Reheat and Hot Gas Bypass Split System Piping, Suction Down

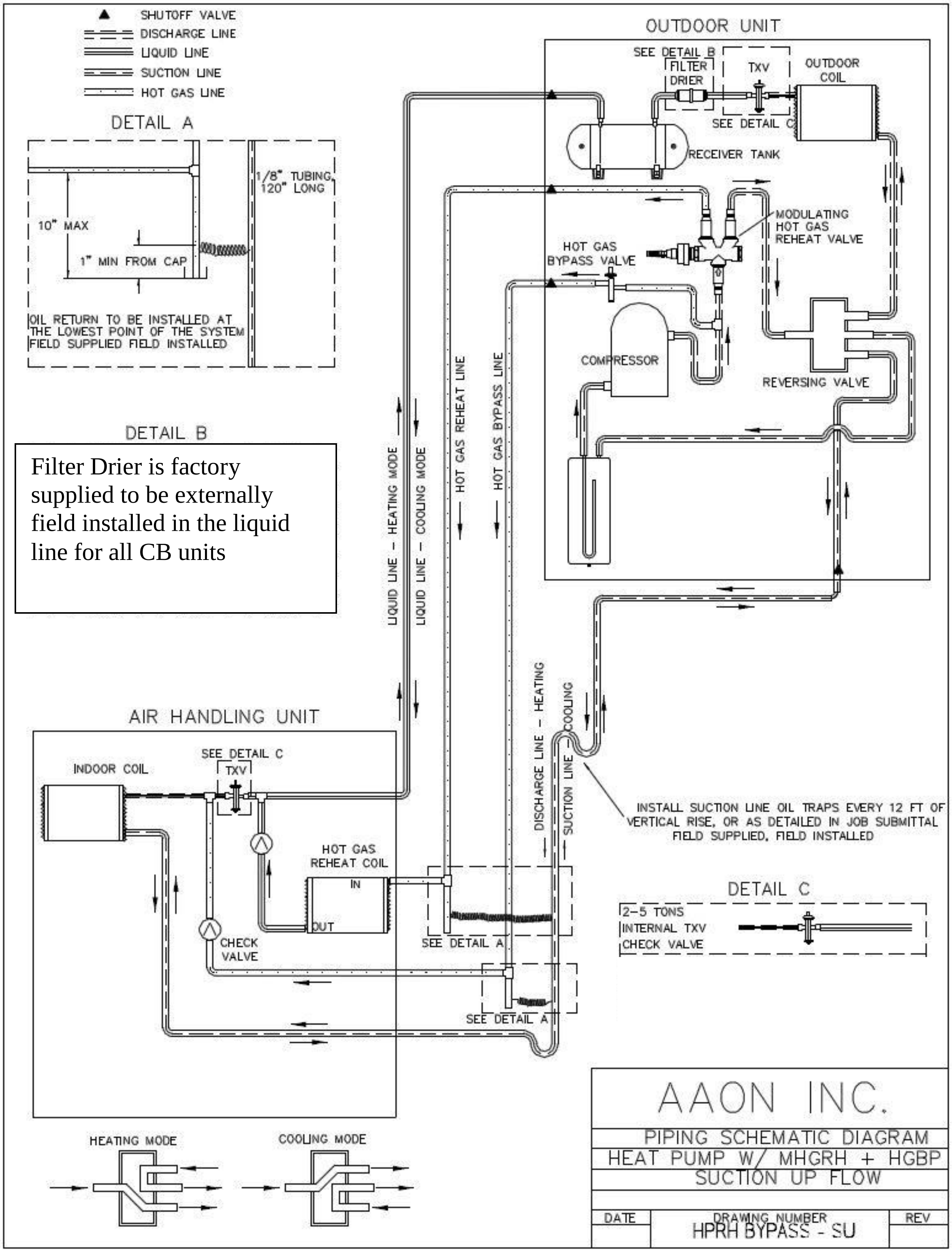

Figure 39 - Heat Pump with Modulating Hot Gas Reheat and Hot Gas Bypass Split System Piping, Suction Up

CB Series Startup Form

Date:_______________
Job Name:____
Address:____
____
Model Number:____
Serial Number:____ Tag:________________
Startup Contractor:____
Contractor Address:______________________________________
____ Phone:____________

Pre Startup Checklist		
Installing contractor must verify the following items.		
1. Is there any visible shipping damage?	Yes ☐	No ☐
2. Is the unit level?	Yes ☐	No ☐
3. Are the unit clearances adequate for service and operation?	Yes ☐	No ☐
4. Do all access doors open freely and are the handles operational?	Yes ☐	No ☐
5. Have all shipping braces been removed?	Yes ☐	No ☐
6. Have all electrical connections been tested for tightness?	Yes ☐	No ☐
7. Does the electrical service correspond to the unit nameplate?	Yes ☐	No ☐
8. On 208/230V units, has transformer tap been checked?	Yes ☐	No ☐
9. Has overcurrent protection been installed to match the unit nameplate requirement?	Yes ☐	No ☐
10. Have all set screws on the fans been tightened?	Yes ☐	No ☐
11. Do all fans and rotate freely?	Yes ☐	No ☐
12. Is all copper tubing isolated so that it does not rub?	Yes ☐	No ☐

Ambient Temperature
Ambient Dry Bulb Temperature _________°F Ambient Wet Bulb Temperature _________°F

Voltage

L1-L2	L2-L3	L1-L3

L1-Ground	L2-Ground	L3-Ground

Compressors

Check Rotation ☐					
Number	L1 Volts/Amps	L2 Volts/Amps	L3 Volts/Amps	Head Pressure PSIG	Suction Pressure PSIG
1 - Full Capacity					
1 - Reduced Capacity					

Refrigeration System 1 - Cooling Mode					
	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge					
Suction					
Liquid					

Refrigeration System 1 - Heating Mode (Heat Pump Only)					
	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge					
Suction					
Liquid					

Air-Cooled Condenser Fan				
Alignment_____ ☐	Check Rotation_____ ☐	Nameplate Amps________		
Number	hp	L1 Volts/Amps	L2 Volts/Amps	L3 Volts/Amps
1				

Maintenance Log

This log must be kept with the unit. It is the responsibility of the owner and/or maintenance/service contractor to document any service, repair or adjustments. AAON Service and Warranty Departments are available to advise and provide phone help for proper operation and replacement parts. The responsibility for proper start-up, maintenance and servicing of the equipment falls to the owner and qualified licensed technician.

Entry Date	Action Taken	Name/Tel.

Maintenance Log (E-Coated Coil)

AAON E-COATED COIL MAINTENANCE RECORD

Installation Site ______________________ Installation Date ______________________
Unit Model # ______________________ Unit Location ______________________
Unit Serial # ______________________ Customer ______________________

Year 20____	Ambient Temp (°F)	Surface Debris Removed	Coil Cleaned	Approved Cleaner Used	Potable Water Backwash Rinse	Potable Water Frontwash Rinse	Chlorides Removed	Comments
Jan								
Feb								
Mar								
Apr								
May								
Jun								
Jul								
Aug								
Sep								
Oct								
Nov								
Dec								

The following cleaning agents have been approved for use on AAON E-Coated Coils to remove mold, mildew, dust, soot, greasy residue, lint and similar particulate without harming the coated surfaces.

CLEANING AGENT	RESELLER	PART NUMBER
GulfClean ™ Coil Cleaner or Enviro-Coil Cleaner	Rectorseal 2601 Spenwick Drive, Houston, Texas 77055 (P): 713-263-8001	G074480 / 80406 or V82540
GulfClean Salt Reducer™	" "	G074490 / 80408

RECOMMENDED CHLORIDE REMOVER
Rectorseal 2601 Spenwick Drive, Houston, Texas 77055 (P): 713-263-8001

Literature Change History

November 2009
Update of manual formatting to match with other IOMs and adding variable capacity scroll compressor information.

April 2012
Added oil drip note below piping diagrams. Updated the Startup Form.

May 2012
Updated the Table of Contents.

March 2013
Update of the manual revising Table S1 - Sub-Cooling and Superheat, adding Table S2 - Performance Testing Air Flow Setpoints, adding information about compressor cycling.

June 2013
Updated piping diagrams to show internal modulating hot gas reheat and hot gas bypass valves. New part number assigned.

July 2014
Updated service clearance drawing.

February 2015
Updated Feature 5 options to reflect standard exterior corrosion protection.

July 2015
Updated Replacement Parts instructions. Added Features and Options section.

August 2016
Added Storage information. Added guidelines for variable capacity compressors in the line sizing section. Added double riser schematics and discussion for heat pump operation. Added a section about oil level under the refrigerant line sizing section. Added a section on compressor lockouts. Included heat pump charging guidelines in the Acceptable Refrigeration Circuit Values Table. Added Special Low Ambient Option Charging Instructions. Changed e-coated coil cleaning to100 psi water pressure.

December 2016
Fixed a reference error.

October 2017
Added option K to feature 3. Updated digital compressor discharge up minimum velocity. Updated phase imbalance example. Added receiver installation section.

May 2018
Updated the technical support contact information. Removed receiver installation section since they are now factory installed. Updated subcooling values for charging. Updated piping diagrams and refrigerant line sizing.

June 2018
Updated E-coated coil cleaning procedure. Added split system evacuation procedure for low ambient and modulating hot gas reheat.

November 2018
Added Standard Evacuation Instructions to the Installation section. Updated Special Low Ambient Option Charging Instructions.

February 2019
Changed WattMaster to Orion. Added Do Not Overcharge note to Acceptable Refrigeration Circuit Values table. Added suction line guideline for two-stage compressors.

May 2019
Added the minimum/maximum voltage range table in the Electrical section.

July 2019
Removed most references to PVE oils except in the caution boxes.

June 2020
Updated nameplate voltage table and tolerances. Updated e-coated coil cleaning instructions. Added E-coating coil maintenance record.

August 2020
Revised compressor cycling to 3 minute minimum off time. Revised measurement of suction line temperature and pressure to be taken at the evaporator. Revised wording for oil return line. Updated phase imbalance example. Added Voltage check to the startup form.

July 2021
Updated the E-coated coil cleaning section.

AAON
203 Gum Springs Rd.
Longview, TX 75602-1721
www.AAON.com

CB Series
Installation, Operation & Maintenance

R57611 · Rev. D · 210709
(ACP J00187)

Factory Technical Support: 918-382-6450

Note: Before calling Technical Support, please have the model and serial number of the unit available.

Parts: For replacement parts, please contact your local AAON Representative.