CF Series

Condenser and Condensing Units

UL-60335

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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Energy Efficiency
- Two-Stage, 10-100% Variable Capacity, or Tandem R-410A Scroll Compressors
- Air-Source Heat Pump
- VFD Controlled and ECM Driven Condenser Fans

Humidity Control
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- Makeup Air Applications up to 100% Outside Air

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- Adjustable Compressor Lockout

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- Liquid Line Sight Glass
- Compressor Isolation Valves

System Integration
- Complete Split System with AAON DX Air Handling Units
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- Flooded Condenser 0°F Low Ambient Controls
- Terminal Block for Thermostat with Isolation Relays
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Environmentally Friendly
- R-410A Refrigerant

Extended Life
- Optional 5 Year Compressor Warranty
- G90 Galvanized Steel Construction
- 2,500 Hour Salt Spray Tested Exterior Corrosion Protection
- 10,000 Hour Salt Spray Tested Polymer E-Coated Condenser Coils
- Condenser Coil Guards
- Custom Color Paint Options

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.

- Before servicing, disconnect all electrical power to the furnace. More than one disconnect may be provided.
- 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

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

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

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.

⚠ WARNING

VARIABLE FREQUENCY DRIVES

Do not leave VFDs unattended in hand mode or manual bypass. Damage to personnel or equipment can occur if left unattended. When in hand mode or manual bypass mode VFDs will not respond to controls or alarms.

CAUTION

VARIABLE FREQUENCY DRIVES

Electric motor over-current protection and overload protection may be a function of the Variable Frequency Drive to which the motors are wired. Never defeat the VFD motor overload feature. The overload ampere setting must not exceed 115% of the electric motors FLA rating as shown on the motor nameplate.

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

DOOR LATCHES

Door compartments containing hazardous voltage or rotating parts are equipped with door latches that allow locks. Door latches are shipped with a nut and bolt requiring tooled access. If the shipping hardware is not replaced with a pad lock, always re-install the nut and bolt after closing the door to maintain tooled access.

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

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

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

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

CONVENIENCE OUTLETS

Factory installed convenience outlets are not intended for use while the unit is operating.

CAUTION

Unit power supply wire must be only copper or aluminum.

CAUTION

In order to avoid a hazard due to inadvertent resetting of the THERMAL CUT-OUT, this appliance must not be supplied through an external switching device, such as a timer, or connected to a circuit that is regularly switched on and off by the utility.

⚠ WARNING

This appliance is not intended for use by persons with reduced physical, sensory or mental capabilities, or lack of experience and knowledge, unless they have been given supervision or instruction concerning use of the appliance by a person responsible for their safety. Children must be supervised to ensure they do not play with this appliance.

⚠ WARNING

Units with VFD driven motors/compressors have adjustable overload settings. These are set by the AAON factory for the protection of these motors/compressors and must not be adjusted over this factory setpoint or bypassed.

⚠ 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 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 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.

CF Series Feature String Nomenclature

Model Options **:** Unit Feature Options

GEN MJREV SIZE SERIES MNREV VLT A1 A2 A3 A4 A5 : 1 2A 2B 3A 3B 4 5 6A 6B 6C 7 8A 8B 8C 8D 9 10 11 12 13 14 15

CF A - 015 - A - 0 - 3 - D A 0 0 K : 0 - A 0 - E 0 - C 0 - A J 0 - D - B A 0 0 - 0 0 A 0 E 0 0

0 0 0 0 0 D B

16 17 18 19 20 21 22

MODEL OPTIONS

Series and Generation
CF

Major Revision
A

Unit Size
002 = 2 ton Capacity
003 = 3 ton Capacity
004 = 4 ton Capacity
005 = 5 ton Capacity
006 = 6 ton Capacity (Obsolete)
007 = 7 ton Capacity
009 = 9 ton Capacity
011 = 11 ton Capacity
013 = 13 ton Capacity
015 = 15 ton Capacity
016 = 16 ton Capacity
018 = 18 ton Capacity
020 = 20 ton Capacity
025 = 25 ton Capacity
026 = 26 ton Capacity
030 = 30 ton Capacity
031 = 31 ton Capacity
040 = 40 ton Capacity
050 = 50 ton Capacity
060 = 60 ton Capacity
070 = 70 ton Capacity

Series
A = 2-7 ton units
B = 9-15 ton units
C = 16-25 & 30 ton units
D = 26 & 31-70 ton units

Minor Revision
A

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

A1: Compressor Style
0 = Air-Cooled Condenser - No Compressors (1 Circuit)
A = R-410A Scroll Compressors
B = R-410A Two-Stage Capacity Scroll Compressors
D = R-410A Variable Capacity Scroll Compressors
E = R-410A Tandem Scroll Compressors
G = R-410A Tandem Variable Capacity Scroll Compressors
P = Air-Cooled Condenser - No Compressors (2 Circuits)
Q = Air-Cooled Condenser - No Compressors (4 Circuits)

A2: Condenser Style
A = Air-Cooled Microchannel Condenser
C = Air-Cooled Condenser (Fin and Tube) (Obsolete)
J = Air-Source Heat Pump (Fin and Tube)

A3: Configuration
0 = Standard

A4: Coating
0 = Standard
E = Polymer E-Coated Condenser Coil
F = Stainless Steel Casing (Obsolete)
G = Copper Fin + Stainless Steel Casing (Obsolete)
H = Option E + F (Obsolete)

A5: Staging
0 = No Cooling
G = 1 On/Off Refrigeration System
H = 1 Variable Capacity Refrigeration System
J = 2 On/Off Refrigeration Systems
K = 1 Variable Capacity Refrigeration System + 1 On/Off Refrigeration System
L = 2 Variable Capacity Refrigeration System
M = 2 Two-Stage Refrigeration System
N = 1 Variable Capacity Refrigeration System + 1 Two-Stage Refrigeration System
R = 4 On/Off Refrigeration Systems
T = 2 Variable Capacity Refrigeration Systems + 2 On/Off Refrigeration Systems
U = 4 Variable Capacity Refrigeration Systems

CF Series Feature String Nomenclature

Model Options : Unit Feature Options

GEN	MJREV		SIZE		SERIES		MNREV		VLT		A1	A2	A3	A4	A5		1		2A	2B		3A	3B		4	5		6A	6B	6C		7		8A	8B	8C	8D		9	10	11	12	13	14	15
CF	A	-	015	-	B	-	0	-	3	-	D	A	0	0	K	:	0	-	A	0	-	E	0	-	C	0	-	A	N	0	-	B	-	D	E	0	0	-	0	0	A	0	E	0	0

16	17	18	19	20	21	22
0	0	0	0	0	D	B

UNIT FEATURE OPTIONS

1: Unit Orientation

0 = Vertical Condenser Discharge - Standard Access
A = Horizontal Condenser Discharge - Standard Access

2A: Refrigeration Control

0 = Standard
A = 5 Minute Compressor Off Timer + 20 Second Compressor Stage Delay
B = Fan Cycling (Obsolete)
C = Adjustable Fan Cycling
D = Adjustable Compressor Lockout
E = Freeze Stats (each circuit) (Obsolete)
F = Option A + B (Obsolete)
G = Option A + C
H = Option A + D
J = Option A + E (Obsolete)
K = Option B + D (Obsolete)
L = Option B + E (Obsolete)
M = Option C + D
N = Option C + E (Obsolete)
P = Option D + E (Obsolete)
Q = Option A + B + D (Obsolete)
R = Option A + B + E (Obsolete)
S = Option B + D + E (Obsolete)
T = Option C + D + E (Obsolete)
U = Option A + B + D + E (Obsolete)
V = Option A + C + D + E (Obsolete)
W = Option A + C + D

2B: Blank

0 = Standard

3A: Refrigeration Options

0 = Standard
A = Hot Gas Bypass Lead Stage [HGB]
B = HGB Lead + HGB Lag
C = On/Off Hot Gas Reheat [HGR] (Obsolete)
D = Hot Gas Bypass Non-Variable Capacity Refrigeration Systems [HGBNV]
E = Modulating Hot Gas Reheat [MHGR]
F = HGB Lead + HGR (Obsolete)
G = HGB Lead + HGB Lag + HGR (Obsolete)
H = HGB + MHGR
J = HGB Lead + HGB Lag + MHGR

3A: Refrigeration Options Continued

K = HGBNV + HGR (Obsolete)
L = HGBNV + MHGR
M = HGB Lag (Obsolete)
N = HGB Lag + MHGR (Obsolete)

3B: Blank

0 = Standard

4: Refrigeration Accessories

0 = Standard
A = Sight Glass
B = Compressor Isolation Valves
C = Options A + B
D = Flooded Condenser 0°F Low Ambient Controls – One Circuit
E = Options A + D
F = Options B + D
G = Options A + B + D
H = Flooded Condenser 0°F Low Ambient Controls- Two Circuits
J = Options A + H
K = Options B + H
L = Options A + B + H
R = Flooded Condenser 0°F Low Ambient Controls – Four Circuits
S = Options A + R
T = Options B + R
U = Options A + B + R

5: Blank

0 = Standard

6A: Unit Disconnect Type

0 = Single Point Power Block
A = Single Point Power Non-Fused Disconnect

6B: Disconnect 1 Size

0 = Standard
N = 100 amps
R = 150 amps
V = 250 amps
Z = 400 amps

6C: Blank

0 = Standard

CF Series Feature String Nomenclature

Model Options : Unit Feature Options

GEN MJREV SIZE SERIES MNREV VLT A1 A2 A3 A4 A5 **1 2A 2B 3A 3B 4 5 6A 6B 6C** 7 8A 8B 8C 8D 9 10 11 12 13 14 15

CF A - 015 - B - A - 3 - D A 0 0 K **: 0 - A 0 - E 0 - C0 - AN0 -** B - D E 0 0 - 0 0 A 0 E 0 0

0 0 0 0 0 D B

16 17 18 19 20 21 22

7: Accessories
0 = Standard
A = Suction Pressure Transducer on Lead Refrigeration Circuit (Obsolete)
B = Phase & Brown Out Protection
D = Suction Pressure Transducer on Each Refrigeration Circuit
E = Compressor Sound Blanket
F = Options A + B (Obsolete)
J = Options A + E (Obsolete)
L = Options B + D
M = Options B + E
Q = Options D + E
T = Options A + B + E (Obsolete)
1 = Options B + D + E

8A: Control Sequence
A = Terminal Block for Thermostat w/ Isolation Relays
D = VAV Unit Controller - VAV Cool + CAV Heat
E = CAV Unit Controller
F = Makeup Air Unit Controller - CAV Cool + CAV Heat
H = Constant Volume HP Unit Controller - CAV Cool + CAV Heat
J = Makeup Air HP Unit Controller - CAV Cool + CAV Heat
N = Field Installed DDC Controls by Others with Isolation Relays

8B: Control Suppliers
0 = Standard Terminal Block
C = Orion VCM-X (Main Controller in Air Handling Unit) (Obsolete)
E = Orion VCC-X (Main Controller in Air Handling Unit)
H = AAON Touchscreen Controller (Main Controller in Air Handling Unit) (Obsolete)
J = AAON Refrigeration System Supervisory Controls

8C: Control Supplier Options
0 = Standard

8D: BMS Connection & Diagnostics
0 = Standard

9: Blank
0 = Standard

10: Blank
0 = Standard

11: Maintenance Accessories
0 = Standard
A = Factory Wired 115VAC Convenience Outlet
B = Field Wired 115VAC Convenience Outlet
C = Service Lights
E = Remote Unit Start/Stop Terminals
F = Options A + C
H = Options A + E
J = Options B + C
L = Options B + E
N = Options C + E
R = Options A + C + E
U = Options B + C + E

12: Code Options
0 = Standard ETL USA Listing
B = ETL USA + Canada Listing

13: Air-Cooled Condenser Accessories
0 = Standard
A = Condenser Coil Guard
C = ECM Condenser Fan Head Pressure Control
E = VFD Condenser Fan Head Pressure Control
G = Options A + C
J = Options A + E
K = Low Sound Condenser Fan (Obsolete)
L = Options A + K (Obsolete)
N = Options C + K (Obsolete)
S = Options A + C + K (Obsolete)

14: Blank
0 = Standard

15: Blank
0 = Standard

16: Electrical Options
0 = Standard 5 kAIC
C = 10 kAIC

CF Series Feature String Nomenclature

Model Options : Unit Feature Options

GEN MJREV SIZE SERIES MNREV VLT A1 A2 A3 A4 A5 1 2A 2B 3A 3B 4 5 6A 6B 6C 7 **8A 8B 8C 8D 9 10 11 12 13 14 15**

CF A - 015 - B - A - 3 - D C 0 0 K : 0 - A 0 - E 0 - C 0 - A N 0 - B - **DE0 0 - 0 0 A0E0 0**

0 0 0 0 0DB

16 17 18 19 20 21 22

17: Shipping Options
0 = Standard
A = Crating
B = Export Crating

18: Blank
0 = Standard

19: Blank
0 = Standard

20: Cabinet Material
0 = Galvanized Steel Cabinet

21: Warranty
0 = Standard
D = Compressor Warranty - Years 2-5

22: Type
B = Premium AAON Gray Paint Exterior
E = Premium AAON Gray Paint Ext + Shrink Wrap
X = SPA + Premium AAON Gray Paint Exterior
1 = SPA + Premium AAON Gray Paint Exterior + Shrink Wrap

General Information

AAON CF Series air-cooled condensers and condensing units have been designed for outdoor use only. They are factory assembled, wired, charged, and run-tested.

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.

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.

Codes and Ordinances

CF Series units have been tested and certified, by ETL, in accordance with UL Safety Standard 60335-2-40 4th Edition, ANSI Safety Standard Z21.47-2016.

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

Installation of CF Series units must conform to the ICC standards of the International Mechanical Code, the International Building Code, and local building, plumbing and electrical 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.

Receiving Unit

When received, check the unit 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.

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.

⚠ CAUTION

CLEAN AIR ACT

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.

Failure to observe the following instructions will 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 turn off the main power supply to the unit, except for complete shutdown. When power is cut off from the unit, any compressors using crankcase heaters cannot prevent refrigerant migration. This means the compressor will cool down, and liquid refrigerant may accumulate in the compressor. The compressor is designed to pump refrigerant gas and damage may occur if liquid enters the compressor 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.

Before unit operation, the main power switch must be turned on for at least twenty-four hours for units with compressor crankcase heaters. 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 control panel, never at the main power supply (except for emergency or for complete shutdown of the system).

⚠ 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.

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

Wiring Diagrams
Unit specific wiring diagrams are laminated and affixed 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

Forklifting the Unit
CF Series condensing unit sizes 2-25 & 30 tons can be lifted using a forklift. 2-7 ton units must have forks at least 1.2 m (48”) in length. 9-25 & 30 ton units must have forks 1.8 m (72”) in length, or the forks must have 1.8 m (72”) fork extensions. Standard units can be lifted from all sides except the condenser coil side. CF Series condensing unit sizes 26 & 31-70 tons cannot be lifted using a forklift. They can be lifted as shown in Figure 3.

Forks must be perpendicular to the unit and they must be in far enough that the back of the forks are no more than 15.25 cm (6”) away from the edge of the unit.

⚠ CAUTION

FORKLIFTING
2-7 TON UNITS

Forks or Fork Extensions must be at least 1.2 m (48”) in length.

⚠ CAUTION

FORKLIFTING
9-25 & 30 TON UNITS

Forks or Fork Extensions must be at least 1.8 m (72”) in length.

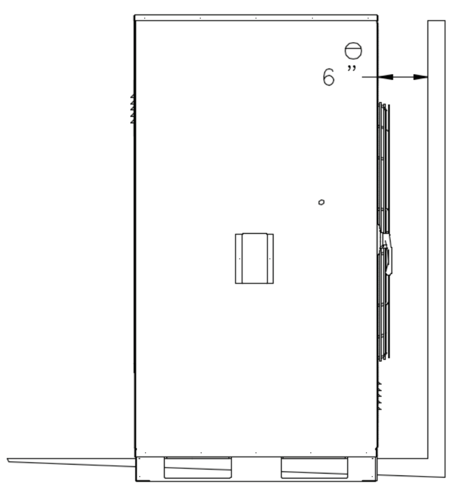

Figure 1 - Forklifting a CF Series A Cabinet

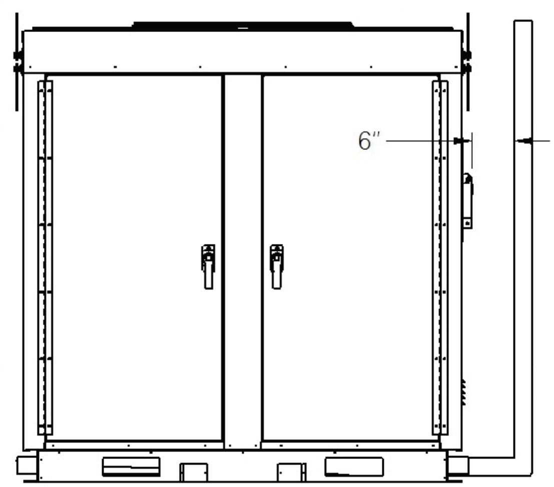

Figure 2 - Forklifting a CF Series B and C Cabinet

Lifting the Unit

If cables or chains are used to hoist the unit they must be the same length. Minimum cable length is 251.5 cm (99”) for CF Series 9-70 ton units. CF Series 2-7 ton units do not include factory installed lifting lugs and must be lifted by forklift only. Care must be taken to prevent damage to the cabinet, coils, and condenser fans.

Before lifting unit, be sure that all shipping material has been removed from unit. Secure hooks and cables at all lifting points / lugs provided on the unit.

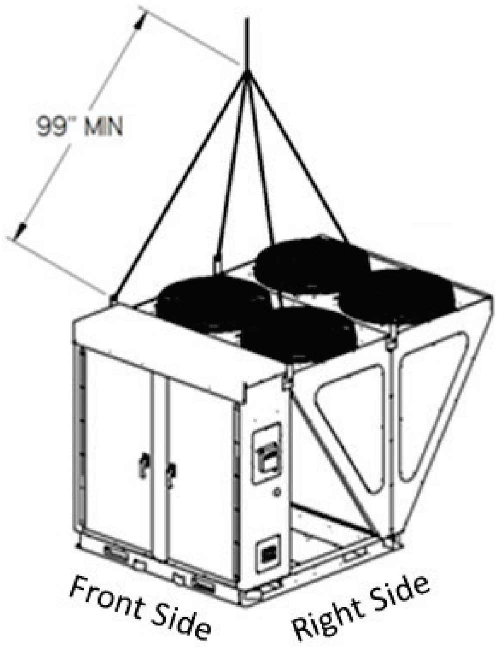

Figure 3 - Lifting Details and Orientation of a CF Series 9-70 ton Condensing Unit

Locating the Unit

The CF Series condenser and condensing unit is designed for outdoor applications and mounting at ground level or on a rooftop. It must be placed on a level and solid foundation that has been prepared to support its weight. When installed at ground level, a one-piece concrete slab must be used with footings that extend below the frost line. Also with ground level installation, care must be taken to protect the coil fins from damage due to vandalism or other causes.

The first clearance table below gives the clearance values for proper unit operation. The second clearance table gives the clearance necessary for removing the coil without disassembling a large part of the condensing unit. For ease of removing the condenser coil, use the second table clearances for the right hand side of the unit.

Table 1 - Clearances for Proper Operation

Location	Unit Size	
	2-7 tons cm (in.)	9-70 tons cm (in.)
Front - (Controls Side)	Unobstructed	91.4 (36)
Left Side	15.25 (6)	76.2 (30)
Right Side	15.25 (6)	91.4 (36)
Top	7.6 (3)	Unobstructed
Back	45.7 (18)	15.25 (6)

Table 2 - Clearances for Coil Pull

Unit Size	Right Hand Side cm (in.)
2-7 tons	106.7 (42)
9-15 tons	106.7 (42)
16-25 & 30 tons	137.2 (54)
26 & 31-70 tons	167.6 (66)

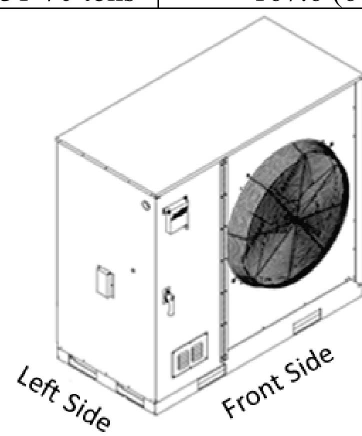

Figure 4 - Orientation of Series 2-7 ton Condensing Unit

The placement relative to the building air intakes and other structures must be carefully selected. Airflow to and from the condenser or condensing unit must not be restricted to prevent a decrease in performance and efficiency.

The installation position for 9-70 ton units must provide at least 76.2 cm (30”) of left and right side clearance for proper airflow to the condenser coils. When units are mounted adjacent to each other, the minimum right and left side clearance required between the units is 152.4 cm (60”) or 1.5 meters (5 feet). Similarly, when 2-7 ton units are mounted adjacent to each other, the minimum clearance required between the back side of the units is 91.4 cm (36”) or 0.9 meters (3 feet).

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 1.5 meters (5 feet) (0.9 meters [3 feet] for 2-7tons).

CF Series condensers and condensing units that have a vertical air discharge must have no obstruction above the equipment. Do not place the unit under an overhang. CF Series condensers and condensing units that have a horizontal discharge must have no obstruction in front of the unit.

For proper unit operation, the immediate area around condenser must remain free of debris that may be drawn in and obstruct airflow in the condensing section.

Consideration must be given to obstruction caused by snow accumulation when placing the unit.

Mounting Isolation

For roof mounted applications or anytime vibration transmission is a factor, vibration isolators may be used. When vibration isolators are used, the CF Series unit must be directly mounted either on a flat platform or on support rails running front to back and at least 2.5 cm (1”) wider than the unit base rail. If the CF is mounted on the support rails, the additional width of the support rail must be on the inside of the unit such that the support rail fully covers the corner connections of the unit base rail. Any isolation must be applied to the platform or support rails. DO NOT put spring isolation on the base of the CF Series Condensing Unit.

Access Doors

Access doors are provided to the compressor and electrical compartment.

⚠ 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 condensing unit has already been evacuated and charged with some refrigerant at the factory. When evacuating a new system, keep the condensing unit service valves closed and evacuate the suction and liquid lines and the air handling unit. If the entire 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 2758 kpa (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 9.5 mm (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). The vacuum pump must be connected to the manifold set using a 9.5 mm (3/8") vacuum rated hose. Figure 5 shows two circuits. Both circuits must be evacuated separately.

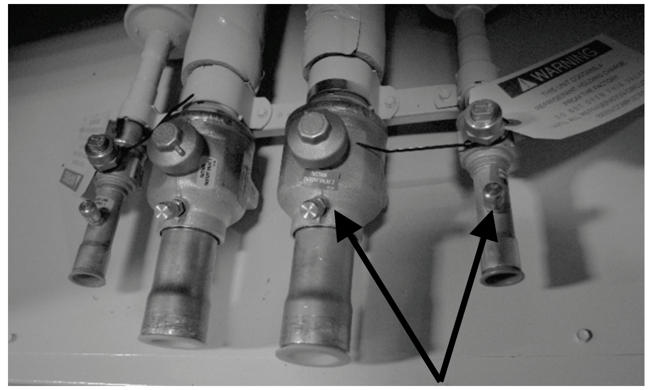

Figure 5 - CU evacuation connections

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. Do not attach the micron gauge to the system until the gauge manifold is reading 71 cm (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 2758 kPa (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 9.5 mm (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, one hose on the liquid line service valve and a third hose on the reheat line service valve. The vacuum pump must be connected to the manifold set using a 9.5 mm (3/8") vacuum rated hose. Figure 6 shows two circuits. The first circuit has a reheat line, the second circuit is just the suction and liquid line. Both circuits must be evacuated separately.

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.

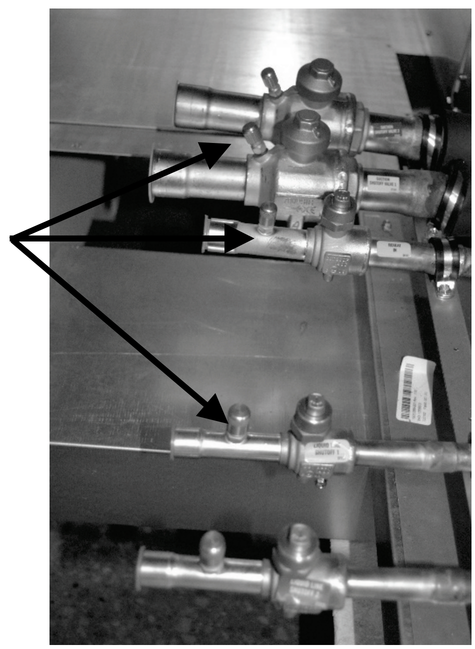

Figure 6 - CU evacuation connections

8. Do not attach the micron gauge to the system until the gauge manifold is reading 71 cm (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

All AAON CF Series condensers and condensing units are shipped with a factory holding charge. The factory charge is different depending on the unit size and system (heat pump, modulating hot gas reheat, LAC). The factory charge per circuit is shown on the unit nameplate. Adjusting the charge of the system will be required during installation.

Adjusting the charge of a system in the field must be based on determination of liquid sub-cooling and evaporator superheat. On a system with a thermostatic expansion valve 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 reheat 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.

Table 3 - Acceptable Fin & Tube Refrigeration Circuit Values

	Cooling Mode Liquid Sub-Cooling Values (°C)	Cooling Mode Liquid Sub-Cooling Values (°F)
Cooling Only Unit[4]	4.4 - 8.3	8-15
Cooling Only Unit with Hot Gas Reheat[1,4]	2.8 - 8.3	5-15
Heat PumpUnit[2,4]	1.1 - 2.2	2-4
Heat Pump Unit with Hot Gas Reheat[3,4]	1.1 - 3.3	2-6
Cooling Only Unit with LAC[4]	4.4 - 8.3	8-15
Cooling Only Unit with Hot Gas Reheat & LAC[4]	4.4 - 8.3	8-15

The type of unit and options determine the ranges for liquid sub-cooling and evaporator superheat. Refer to Table 3 when determining the proper sub-cooling.

For units equipped with low ambient (-17.2°C [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 3 for the appropriate unit type and options.

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 -17.2°C (1°F) per 3 meters (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 2.8 - 8.3°C (5-15°F), but a cooling only unit with hot gas reheat and a vertical liquid rise of 9.1 m (30 ft) must charge to a sub-cooling value of at least 4.4 - 8.3°C (8-15°F). DO NOT OVERCHARGE. Refrigerant overcharging leads to excess refrigerant in the condenser coils resulting in elevated compressor discharge pressure.

Table 4 - Acceptable Microchannel Air-Cooled Condenser Coil Liquid Sub-Cooling Values (Metric)

	Cooling Mode Liquid Sub-Cooling Values(°C)				
Ambient (°C)	Evaporator Coil Saturation Temperature (°C)				
	4.4	7.2	8.9	10.0	12.8
19.4	5.0 - 7.8	4.4 - 7.2	4.4 - 7.2	3.9 - 6.7	2.8 - 5.6
22.2	5.6 - 8.3	5.0 - 7.8	5.0 - 7.8	4.4 - 7.2	3.9 - 6.7
27.8	5.6 - 8.3	5.6 - 8.3	5.6 - 8.3	5.0 - 7.8	3.9 - 6.7
35.0	5.6 - 8.3	5.6 - 8.3	5.6 - 8.3	5.0 - 7.8	4.4 - 7.2
40.6	6.1 - 8.9	6.1 - 8.9	5.6 - 8.3	5.6 - 8.3	4.4 - 7.2
46.1	5.6 - 8.3	6.1 - 8.9	6.1 - 8.9	6.1 - 8.9	5.0 - 7.8

Table 5 - Acceptable Microchannel Air-Cooled Condenser Coil Liquid Sub-Cooling Values (Imperial)

	Cooling Mode Liquid Sub-Cooling Values(°F)				
Ambient (°F)	Evaporator Coil Saturation Temperature (°F)				
	40	45	48	50	55
67	9 - 14	8 - 13	8 - 13	7 - 12	5 - 10
72	10 - 15	9 - 14	9 - 14	8 - 13	7 - 12
82	10 - 15	10 - 15	10 - 15	9 - 14	7 - 12
95	10 - 15	10 - 15	10 - 15	9 - 14	8 - 13
105	11 - 16	11 - 16	10 - 15	10 - 15	8 - 13
115	10 - 15	11 - 16	11 - 16	11 - 16	9 - 14

Notes:

1. Microchannel condenser coils are more sensitive to charge. The system must be running in cooling mode with compressor, supply airflow & condenser fan speed at full load. The sub-cooling value changes depending on the ambient temperature reading and the evaporator coil saturation temperature. To find the correct sub-cooling value, find the ambient temperature on the first column and follow that across to the SST (4.4-12.8°C [40-55°F]).
2. Superheat for Microchannel condenser coils must be between 4.4 and 8.3°C (8 - 15°F)

<u>*Checking Evaporator Superheat*</u>

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 must be 5.6-7.2°C (10-13-) 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. Liquid sub-cooling must be measured with both compressors in a refrigeration system running.

Compare calculated superheat to the acceptable cooling mode superheat values of 4.4-8.3°C (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 4.4-8.3°C (8-15°F) of suction superheat. Failure to have sufficient superheat will damage the compressor and void the

Adjusting Sub-cooling and Superheat Temperatures

The system is overcharged if the sub-cooling temperature is too high compared to Table 3 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 4.4-8.3°C (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.

Table 6 - R-410A Refrigerant Temperature-Pressure Chart (Metric)

°C	KPA	°C	KPA	°C	KPA	°C	KPA	°C	KPA
-6.7	539.9	**8.3**	928.8	**23.3**	1473.5	**38.3**	2213.3	**53.3**	3193.8
-6.1	551.6	**8.9**	946.0	**23.9**	1496.9	**38.9**	2245.0	**53.9**	3235.8
-5.6	564.0	**9.4**	963.2	**24.4**	1521.0	**39.4**	2276.7	**54.4**	3277.9
-5.0	576.4	**10.0**	980.5	**25.0**	1545.2	**40.0**	2309.1	**55.0**	3320.6
-4.4	588.8	**10.6**	998.4	**25.6**	1570.0	**40.6**	2341.5	**55.6**	3363.4
-3.9	601.2	**11.1**	1016.3	**26.1**	1594.8	**41.1**	2374.6	**56.1**	3406.8
-3.3	614.3	**11.7**	1034.9	**26.7**	1619.6	**41.7**	2408.4	**56.7**	3450.9
-2.8	627.4	**12.2**	1053.6	**27.2**	1645.1	**42.2**	2442.2	**57.2**	3495.1
-2.2	640.5	**12.8**	1072.2	**27.8**	1670.7	**42.8**	2476.0	**57.8**	3539.9
-1.7	654.3	**13.3**	1090.8	**28.3**	1696.2	**43.3**	2510.5	**58.3**	3585.4
-1.1	667.4	**13.9**	1110.1	**28.9**	1722.4	**43.9**	2544.9	**58.9**	3630.9
-0.6	681.2	**14.4**	1129.4	**29.4**	1749.3	**44.4**	2580.1	**59.4**	3677.1
0.0	695.7	**15.0**	1149.4	**30.0**	1775.5	**45.0**	2616.0	**60.0**	3724.0
0.6	709.5	**15.6**	1169.4	**30.6**	1802.4	**45.6**	2651.8	**60.6**	3771.6
1.1	724.0	**16.1**	1189.4	**31.1**	1829.9	**46.1**	2688.4	**61.1**	3819.1
1.7	738.5	**16.7**	1209.4	**31.7**	1857.5	**46.7**	2724.9	**61.7**	3867.4
2.2	752.9	**17.2**	1230.1	**32.2**	1885.8	**47.2**	2761.4	**62.2**	3915.7
2.8	768.1	**17.8**	1251.4	**32.8**	1914.1	**47.8**	2798.7	**62.8**	3965.3
3.3	783.3	**18.3**	1272.1	**33.3**	1942.3	**48.3**	2836.6	**63.3**	4015.0
3.9	798.4	**18.9**	1293.5	**33.9**	1971.3	**48.9**	2874.5	**63.9**	4065.3
4.4	814.3	**19.4**	1314.9	**34.4**	2000.2	**49.4**	2913.1	**64.4**	4115.6
5.0	829.5	**20.0**	1336.9	**35.0**	2029.9	**50.0**	2952.4	**65.0**	4167.3
5.6	846.0	**20.6**	1359.0	**35.6**	2059.5	**50.6**	2991.7	**65.6**	4219.1
6.1	861.9	**21.1**	1381.8	**36.1**	2089.2	**51.1**	3031.0		
6.7	878.4	**21.7**	1403.8	**36.7**	2120.2	**51.7**	3071.0		
7.2	895.0	**22.2**	1427.3	**37.2**	2150.6	**52.2**	3111.7		
7.8	911.5	**22.8**	1450.0	**37.8**	2181.6	**52.8**	3153.1		

Table 7 - R-410A Refrigerant Temperature-Pressure Chart (Imperial)

°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		

Table 8 - R-454B Refrigerant Temperature-Pressure Chart (Metric)

°C	KPA	°C	KPA	°C	KPA	°C	KPA	°C	KPA
-6.7	484.5	**8.3**	843.3	**23.3**	1348.0	**38.3**	2034.6	**53.3**	2946.9
-6.1	495.6	**8.9**	859.3	**23.9**	1370.0	**38.9**	2064.1	**53.9**	2985.7
-5.6	506.9	**9.4**	875.3	**24.4**	1392.2	**39.4**	2093.9	**54.4**	3024.9
-5.0	518.2	**10.0**	891.6	**25.0**	1414.6	**40.0**	2123.9	**55.0**	3064.5
-4.4	529.7	**10.6**	908.1	**25.6**	1437.3	**40.6**	2154.3	**55.6**	3104.5
-3.9	541.5	**11.1**	924.8	**26.1**	1460.3	**41.1**	2185.0	**56.1**	3144.9
-3.3	553.3	**11.7**	941.7	**26.7**	1483.5	**41.7**	2216.1	**56.7**	3185.8
-2.8	565.4	**12.2**	958.8	**27.2**	1507.0	**42.2**	2247.4	**57.2**	3227.0
-2.2	577.6	**12.8**	976.2	**27.8**	1530.8	**42.8**	2279.1	**57.8**	3268.6
-1.7	589.9	**13.3**	993.7	**28.3**	1554.8	**43.3**	2311.1	**58.3**	3310.7
-1.1	602.5	**13.9**	1011.5	**28.9**	1579.0	**43.9**	2343.5	**58.9**	3353.2
-0.6	615.2	**14.4**	1029.4	**29.4**	1603.6	**44.4**	2376.2	**59.4**	3396.1
0.0	628.1	**15.0**	1047.6	**30.0**	1628.4	**45.0**	2409.2	**60.0**	3439.5
0.6	641.2	**15.6**	1066.0	**30.6**	1653.5	**45.6**	2442.6	**60.6**	3483.3
1.1	654.4	**16.1**	1084.7	**31.1**	1678.8	**46.1**	2476.2	**61.1**	3527.6
1.7	667.8	**16.7**	1103.5	**31.7**	1704.4	**46.7**	2510.3	**61.7**	3572.3
2.2	681.4	**17.2**	1122.6	**32.2**	1730.4	**47.2**	2544.7	**62.2**	3617.4
2.8	695.2	**17.8**	1141.9	**32.8**	1756.6	**47.8**	2579.4	**62.8**	3663.0
3.3	709.2	**18.3**	1161.5	**33.3**	1783.0	**48.3**	2614.5	**63.3**	3709.2
3.9	723.3	**18.9**	1181.3	**33.9**	1809.9	**48.9**	2650.0	**63.9**	3755.7
4.4	737.6	**19.4**	1201.3	**34.4**	1836.9	**49.4**	2685.7	**64.4**	3802.7
5.0	752.2	**20.0**	1221.5	**35.0**	1864.3	**50.0**	2721.9	**65.0**	3850.3
5.6	766.9	**20.6**	1242.0	**35.6**	1891.9	**50.6**	2758.5	**65.6**	3898.4
6.1	781.8	**21.1**	1262.8	**36.1**	1919.8	**51.1**	2795.4		
6.7	796.9	**21.7**	1283.7	**36.7**	1948.1	**51.7**	2832.7		
7.2	812.2	**22.2**	1304.9	**37.2**	1976.7	**52.2**	2870.4		
7.8	827.7	**22.8**	1326.3	**37.8**	2005.5	**52.8**	2908.4		

Table 9 - R-454B Refrigerant Temperature-Pressure Chart (Imperial)

°F	PSIG	°F	PSIG	°F	PSIG	°F	PSIG	°F	PSIG
20	70.3	**47**	122.3	**74**	195.5	**101**	295.1	**128**	427.4
21	71.9	**48**	124.6	**75**	198.7	**102**	299.4	**129**	433.0
22	73.5	**49**	127.0	**76**	201.9	**103**	303.7	**130**	438.7
23	75.2	**50**	129.3	**77**	205.2	**104**	308.0	**131**	444.5
24	76.8	**51**	131.7	**78**	208.5	**105**	312.5	**132**	450.3
25	78.5	**52**	134.1	**79**	211.8	**106**	316.9	**133**	456.1
26	80.3	**53**	136.6	**80**	215.2	**107**	321.4	**134**	462.0
27	82.0	**54**	139.1	**81**	218.6	**108**	326.0	**135**	468.0
28	83.8	**55**	141.6	**82**	222.0	**109**	330.6	**136**	474.1
29	85.6	**56**	144.1	**83**	225.5	**110**	335.2	**137**	480.2
30	87.4	**57**	146.7	**84**	229.0	**111**	339.9	**138**	486.3
31	89.2	**58**	149.3	**85**	232.6	**112**	344.6	**139**	492.6
32	91.1	**59**	151.9	**86**	236.2	**113**	349.4	**140**	498.8
33	93.0	**60**	154.6	**87**	239.8	**114**	354.3	**141**	505.2
34	94.9	**61**	157.3	**88**	243.5	**115**	359.1	**142**	511.6
35	96.9	**62**	160.1	**89**	247.2	**116**	364.1	**143**	518.1
36	98.8	**63**	162.8	**90**	251.0	**117**	369.1	**144**	524.6
37	100.8	**64**	165.6	**91**	254.8	**118**	374.1	**145**	531.3
38	102.9	**65**	168.5	**92**	258.6	**119**	379.2	**146**	538.0
39	104.9	**66**	171.3	**93**	262.5	**120**	384.3	**147**	544.7
40	107.0	**67**	174.2	**94**	266.4	**121**	389.5	**148**	551.5
41	109.1	**68**	177.2	**95**	270.4	**122**	394.8	**149**	558.4
42	111.2	**69**	180.1	**96**	274.4	**123**	400.1	**150**	565.4
43	113.4	**70**	183.1	**97**	278.4	**124**	405.4		
44	115.6	**71**	186.2	**98**	282.5	**125**	410.8		
45	117.8	**72**	189.3	**99**	286.7	**126**	416.3		
46	120.0	**73**	192.4	**100**	290.9	**127**	421.8		

The following table is available to help with estimating the initial charge to add based on refrigerant line lengths, however, final refrigerant charge must be based on the sub-cooling and superheat values as discussed in the prior section.

Table 10 - Estimated R410A Refrigerant Charge per 1.5 meters

Liquid Line (mm) od	Additional R410A charge per 1.5m of line (oz)*	Suction Line (mm) od	Additional R410A charge per 1.5m of line (oz)*	Reheat Line (mm) od	Additional R410A charge per 1.5m of line (oz)*	Hot Gas Bypass Line (mm) od	Additional R410A charge per 1.5m of line (oz)*
9.5	2.58	9.5	0.1	9.5	0.24	9.5	0.17
12.7	5.08	12.7	0.19	12.7	0.48	12.7	0.34
15.9	8.23	15.9	0.31	15.9	0.77	15.9	0.55
19.1	11.85	19.1	0.44	19.1	1.12	19.1	0.8
22.2	16.46	22.2	0.62	22.2	1.55	22.2	1.11
28.6	28.06	28.6	1.05	28.6	2.64	28.6	1.88
34.9		34.9	1.56	34.9	3.9	34.9	2.78

*at SCT = 35°C & Subcooling = 5.6°C,SST = 13.7°C & Superheat=5.6°C

Table 11 - Estimated R410A Refrigerant Charge per 5 ft

Liquid Line	Additional R410A charge per 5 ft of line (oz)*	Suction Line	Additional R410A charge per 5 ft of line (oz)*	Reheat Line	Additional R410A charge per 5 ft of line (oz)*	Hot Gas Bypass Line	Additional R410A charge per 5 ft of line (oz)*
3/8od	2.58	3/8od	0.10	3/8od	0.24	3/8od	0.17
1/2od	5.08	1/2od	0.19	1/2od	0.48	1/2od	0.34
5/8od	8.23	5/8od	0.31	5/8od	0.77	5/8od	0.55
3/4od	11.85	3/4od	0.44	3/4od	1.12	3/4od	0.80
7/8od	16.46	7/8od	0.62	7/8od	1.55	7/8od	1.11
1-1/8od	28.06	1-1/8od	1.05	1-1/8od	2.64	1-1/8od	1.88
1-3/8od		1-3/8od	1.56	1-3/8od	3.90	1-3/8od	2.78

* at SCT = 115ºF & Subcooling = 10ºF, SST = 45ºF & Superheat=10ºF

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** 21°C (70°F), charge to approximately 0.6-1.1°C (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. For units with **Fin & Tube Condenser coils**, use Table to find the additional charge amount required for the system when running in cold ambient conditions. For units with **Microchannel Condenser coils**, use Table 12 to find the additional charge amount required for the system when running in cold ambient conditions.

Table 12 - Charge to Flood Fin and Tube Condenser Coil for Ambient Above 21.3°C (70°F)

CF Size	# of circuits	Per Circuit Charge (lbs)
CF 2, 3	1	4.9
CF 4, 5, 6, 7	1	6.2
CF 9, 11	2	9.1
CF 13, 15	2	12.1
CF 16, 18	2	13.1
CF 20, 25, 30	2	17.5
CF 26, 31, 40	2	18.0
	4	9.1
CF 50, 60, 70	2	43.8
	4	22.1

Table 13 - Charge to Flood Microchannel Condenser Coil for Ambient Above 21.3°C (70°F)

CF Size	# of circuits	Per Circuit Charge (lbs)
CF 2, 3, 4	1	5.6
CF 5, 6, 7	1	10.2
CF 9, 11	2	5.6
CF 13, 15	2	10.2
CF 16, 18	2	13.3
CF 20, 25, 30	2	13.3
CF 26, 31, 40	2	19.5
	4	9.7
CF 50, 60, 70	2	29.8
	4	14.9

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** 21°C (70°F), charge to approximately 0.6-1.1°C (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 -17.8°C (0°F) no more charge is required. Ambient temperatures above -17.8°C (0°F) will require a percentage of the per circuit charge values from Table 6 (for fin and tube condenser coils) or Table 7 (for microchannel condenser coils). Using your ambient temperature, find the percentage value from Table 8, and multiply the Per Circuit Charge value from Table 6 (for fin and tube condenser coils) or Table 7 (for microchannel condenser coils) and the % value to determine the additional charge amount.

Table 14 - % Charge to Flood Condenser Coil for Ambient Below 21.3°C (70°F)

Condenser Ambient Temperature °C (°F)	Percentage Per Circuit Charge from Table 6 or
15.6 (60)	60%
10.0 (50)	37%
4.4 (40)	24%
-1.1 (30)	15%
-6.7 (20)	8%
-17.8 (0)	0%

2. Check the unit for proper operation once the ambient temperature is above 26.7°C (80°F).

Example: A **CF size 31** with **tandem compressors and Fin and Tube Condenser Coils** where the ambient temperature is 4.4°C (40°F).

From Table 12 - 18 lbs refrigerant charge per circuit (tandem compressors would have 2 circuits in this size of CF).

From Table 14 - 24% of Table 12 charge
Additional charge needed for a unit with low ambient flooded condenser controls = 18 lbs * 0.24 = 4.32 lbs additional refrigerant charge per circuit

Low Ambient Operation
During low ambient temperatures, the vapor refrigerant will migrate to the cold part of the system and condense into liquid. All CF 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 12.8°C (55°F) ambient temperature.

AAON condenser fan head pressure control units can operate down to 1.7°C (35°F) ambient temperature. Three different condenser fan head pressure control options available are adjustable fan cycling, ECM condenser fan, or VFD controlled condenser fans. See detailed information following.

The AAON low ambient (condenser flood-back) system is used to operate a refrigerant system down to -17.8°C (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 (689.5 – 3240.5 kPa [100-470 psi]) and pressure differential (241.3 – 1379 kPa [35-200 psi]) can be field adjusted using a flathead screwdriver. For example, if the head pressure is set to 2068.4 kPa (300psi), and the differential is set to 689.5 kPa (100psi), then fans will cut in at 2068.4 kPa (300psi) and cut out at 1379 kPa (200psi). Fan cycling and variable speed condenser fan head pressure control options allow mechanical cooling with ambient temperatures down to 1.7°C (35°F).

Figure 7 - 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) or VFD. 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 10.6°C (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. CF Series condensers and condensing units use an LAC valve for low ambient operation.

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.

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 (2034 kPa [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.

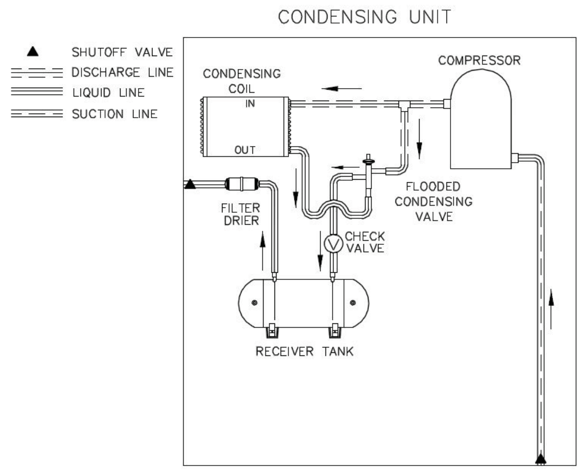

Figure 8 - LAC Piping Example

⚠ 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.

General

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

Use only clean type “ACR” rigid 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 CF 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.

Care must be taken not to cross the circuits on multiple circuit systems.

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

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

In cooling only systems, 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 -17.2 to -16.7°C (1-2°F) change in saturation temperature. 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 -13.3°C (8°F) if the available sub-cooling is -12.2°C (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.

<u>*Suction Line Routing*</u>

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. The smaller diameter pipe must be sized to return oil at minimum load, while the larger diameter pipe must be sized so that flow through both pipes provides acceptable pressure drop at full load.

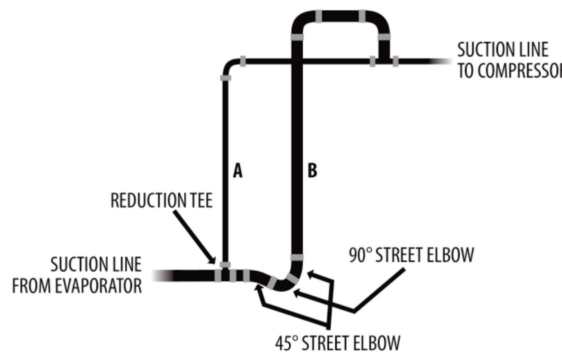

Figure 9 - Double Suction Riser Construction

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 Figure 10 & Figure 11), the cooling mode will use both lines, and the heating mode will use only one.

Suction Line Traps
Include traps every 6.1 meters (20 feet) in vertical suction riser sections for cooling only systems and every 3.7 meters (12 feet) for heat pump systems. Include a trap at the bottom of the vertical run.

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, keep suction line velocities less than a 4,000 fpm. 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.

Tandem compressors must be considered for full load operation (both compressors operating) and at partial load (only one compressor operating). When suction flow is up, and the tandem has a variable capacity compressor, the velocity for only one compressor in operation must be greater than 1,500 fpm. For on/off compressors, the velocity 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). 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 -17.2 to -16.7°C (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

For cooling only remote condenser systems, pitch the discharge line in the direction of flow (about 1 inch per 20 feet of length) to maintain oil flow towards the compressor.

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. The smaller diameter pipe must be sized to return oil at minimum load, while the larger diameter pipe must be sized so that flow through both pipes provides acceptable pressure drop at full load. (See the Double Suction Riser Construction Figure 9)

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.

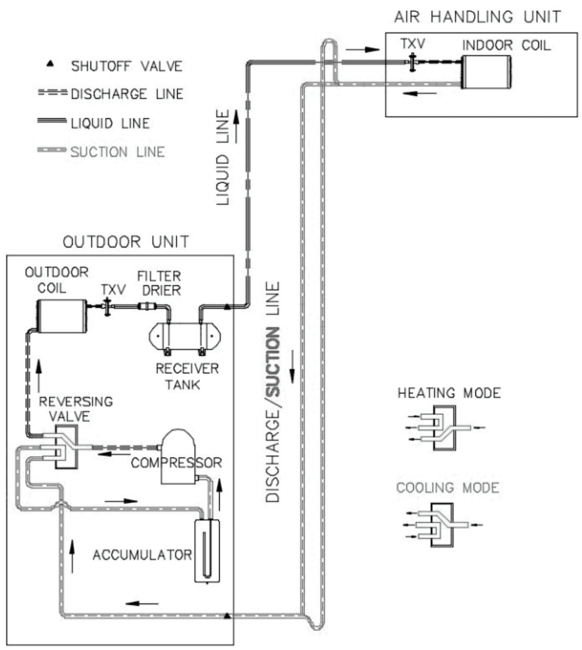

Figure 10 - Heat Pump Piping Schematic of Cooling Mode in Double Riser

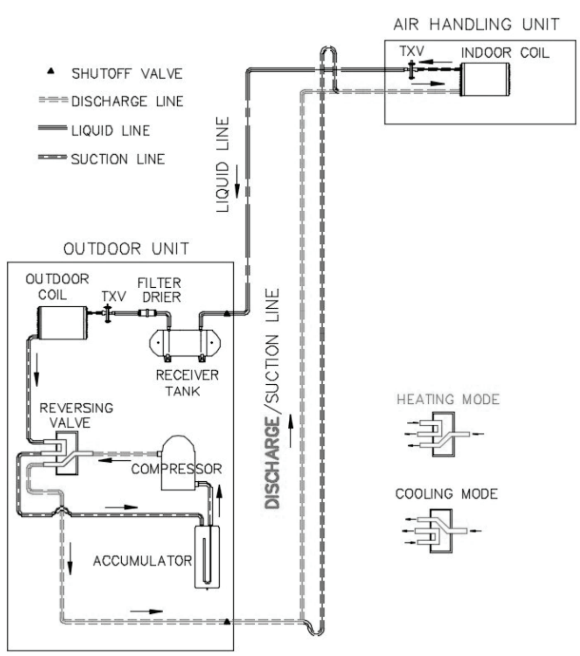

Figure 11 - Heat Pump Piping Schematic of Heating Mode in Double Riser

Discharge Line Traps

Include traps every 3.7 meters (12 feet) in vertical discharge riser sections. Include a trap at the bottom of the vertical run.

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.

Discharge Line Guidelines

For proper performance, keep discharge line velocities less than a 17.8 m/s (3,500 fpm). The minimum velocity required to return oil is dependent on the pipe diameter, however, a general guideline of 4.6 m/s (900 fpm) minimum may be applied.

When discharge flow is up, variable capacity compressors require a minimum velocity of 4.6 m/s (900 fpm) at full load.

Tandem compressors must be considered for full load operation (both compressors operating) and at partial load (only one compressor operating). When discharge flow is up, and the tandem has a variable capacity compressor, the velocity for only one compressor in operation must be greater than 4.6 m/s (900 fpm). For on/off compressors, the velocity 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). 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 -17.2 to -16.7°C (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 25.4 cm (10") long. Install a sight glass in the oil drip line for observation. Run an oil return line, using 3.2 mm (1/8 inch) capillary tube, 3 meters (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.

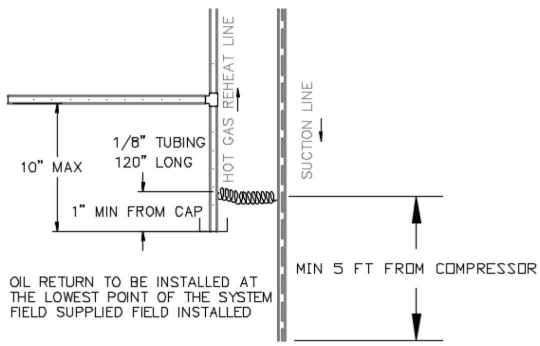

Figure 12 - Oil Return Line

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 2.5 cm (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 17.8 m/s (3,500 fpm). A general minimum velocity guideline to use is approximately 10.2 m/s (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.

Discharge lines must be sized to ensure adequate velocity of refrigerant to ensure oil return, 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 25.4 cm (10") long. Install a sight glass in the oil drip line for observation. Run an oil return line, using 3.2 mm (1/8 inch) capillary tube, 3 meters (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 12)

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 17.8 m/s (3,500 fpm). A general minimum velocity guideline to use is approximately 10.2 m/s (2,000 fpm).

Electrical

The single point electrical power connections are made in the electrical control compartment.

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 15 - 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. 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 (167°F).

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.

⚠ 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. Variable frequency drives are programmed to automatically rotate the fan in the correct rotation. Do not rely on fans with variable frequency drives for compressor rotation.

Power wiring is to the unit terminal block or main disconnect. 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.

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.

⚠ CAUTION

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

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.

⚠ CAUTION

SEALING ELECTRICAL ENTRIES

Installing Contractor is responsible for proper sealing of the electrical entries into the unit. Failure to seal the entries may result in damage to the unit and property.

NOTE: A qualified technician must check for proper motor rotation and check fan motor amperage listed on the motor nameplate is not exceeded. Motor overload protection may be a function of the variable frequency drive and must not be bypassed.

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

If any factory installed wiring must be replaced, use a minimum 105°C (221°F) type AWM insulated conductors.

Fuses and Circuit Breakers
The interrupting rating of fuses and circuit breakers is to be determined based on the KAIC rating of the unit. Refer to the wiring diagram for fuse sizing.

Table 16 – 35 KAIC Fuse Sizing

35 KAIC Construction		
Component	**Description**	**Interrupting Rating (kA)**
Fuse	Class CC, 600V, 0.5A - 30A	200
Fuse	Class J, 600V, 35A - 600A	200
Disconnect	3P, 600V, 15A - 600A	35

Table 17 – 65 KAIC Fuse Sizing

65 KAIC Construction		
Component	**Description**	**Interrupting Rating (kA)**
Fuse	Class CC, 600V, 0.5A - 30A	200
Fuse	Class J, 600V, 35A - 600A	200
Disconnect	3P, 600V, 15A - 600A	65

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.

Cycle through all the compressors to confirm that all are operating within tolerance.

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

⚠ 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. Variable frequency drives are programmed to automatically rotate the fan in the correct rotation. Do not rely on fans with variable frequency drives for compressor rotation.

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 installation, a complete operating cycle must be observed to verify that all components are functioning properly.

Compressor Operation

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 cause 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.

Microchannel Unit Restart Sequence

Units with microchannel condenser coils include a sequence of controls to allow additional compressor restarts without locking out the high pressure switch on the compressors. This helps with the startup process when the microchannel coil is cold. The sequence allows four high pressure trips with auto reset within the first 15 minutes after a compressor call, but will lock out the compressors on the fifth high pressure trip. After the first 15 minutes of operation, one more restart is allowed, but the compressors will lockout if another fault occurs within 2 hours.

Variable Capacity Compressor Controller

Units with variable capacity scroll compressors may include a 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

Note: When using field controls any variable capacity compressors must run at 100% for 1 minute when starting.

Low Voltage Terminals

24COM	Module Common
24VAC	Module Power
C1	Demand Input -
C2	Demand Input +
P1	Pressure Common
P2	Pressure Input
P3	Pressure Power 5VDC
P4	Pressure Shield
P5	Pressure Output -

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	Variable Capacity Unloader Solenoid
V1 & V2	Vapor Injection Solenoid

⚠ WARNING

COMPRESSOR CONTROLLER

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 19** for the relationship between thermistor temperature readings and resistance values.

Table 18 - 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 19 - 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 -23.3°C and 21.1°C (-10°F and 70°F). The ambient temperature sensor hangs right outside the unit with a cover.

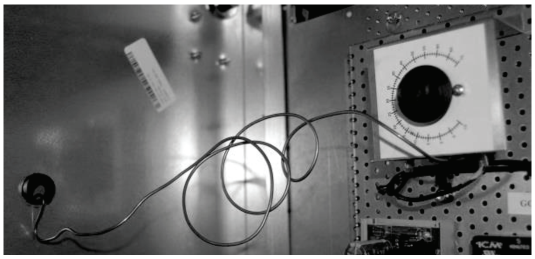

Figure 15 - Adjustable compressor lockout

Heat pump units include a non-adjustable compressor lockout for the cooling mode set to 12.8°C (55°F), and an adjustable compressor lockout for the heating mode that can be set between -6.7°C (20°F) to 35°C (95°F). If a heat pump is selected with the compressor lockout feature, the adjustable compressor lockout will change to the -23.3°C and 21.1°C (-10°F and 70°F) range.

Figure 16 - Ambient sensor cover

Maintenance

General
Qualified technicians must perform routine service checks and maintenance. This includes reading and recording the condensing and suction pressures and checking for normal sub-cooling and superheat.

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

Refrigerant Filter Driers
Each refrigerant circuit contains a filter drier. Replace when there is excessive pressure drop across the assembly or moisture is indicated in a liquid line sight glass.

Table 20 - Max Filter Drier Pressure Drops

Circuit Loading	Max. Pressure Drop
100%	69 kPa (10 psig)
50%	34.5 kPa (5 psig)

Oil Level

It is critical that the refrigerant line piping is designed to maintain proper oil return to the compressors. Some systems may require oil to be added in addition to what is provided in the compressors. The oil is a POE type and is available from your AAON Representative under part number R63681.

Proper oil level must be observed under minimum load conditions. On units equipped with tandem compressors, all oil is returned to the lead compressor in each tandem pair. When only the lead compressor is running, the oil level must be a minimum of ⅜ from the bottom of the sight glass. With both compressors running, the level in the lead compressor will drop to the bottom of the sight glass and the level in the second compressor must be a minimum of ⅜, from the bottom of its sight glass. Do not allow the oil level in the sight glass to exceed ¾ full level.

Lubrication

All original motors and bearings are furnished with an original factory charge of lubrication. Certain applications require bearings be re-lubricated periodically. The schedule will vary depending on operating duty, temperature variations, or severe atmospheric conditions.

Bearings must be re-lubricated at normal operating temperatures, but not when running.

Condenser Coil Inspection

The coils are leak tested at 4482 kPa (650 psig), before shipment. AAON will not be responsible for loss of refrigerant. It is the responsibility of the installer to verify that the system is sealed before charging with refrigerant.

Maintenance Requirements

Fan Motor Maintenance

Cleaning - Remove oil, dust, water, and chemicals from exterior of motor. Keep motor air inlet and outlet open. Blow out interior of open motors with clean compressed air at low pressure.

Labeled Motors - It is imperative for repair of a motor with Underwriters' Laboratories label that original clearances be held; that all plugs, screws, other hardware be fastened securely, and that parts replacements be exact duplicates or approved equals. Violation of any of the above invalidates Underwriters' Label.

Access Doors

If scale deposits or water is found around the access doors, adjust door for tightness. Adjust as necessary until leaking stops when door is closed.

Propeller Fans and Motors

The fans are directly mounted on the motor shafts and the assemblies require minimal maintenance except to assure they are clear of dirt or debris that would impede the airflow.

Required Annual Inspection

In addition to the above maintenance activities, a general inspection of the unit surface must be completed at least once a year.

Air-Cooled Condenser

The air-cooled condenser section rejects heat by passing outdoor air over the condenser coils for cooling of the hot refrigerant gas from the compressors.

Inspect the condenser coils annually to ensure unrestricted airflow. If the installation has a large amount of airborne dust or other material, clean the condenser coils with a water spray in a direction opposite to airflow. Care must be taken to prevent damage to the coils.

Microchannel Coil Cleaning

Cleaning microchannel coils is necessary in all locations. In some locations it may be necessary to clean the coils more or less often than recommended. Condenser coil must be cleaned at a minimum of once a year. In locations where there is commonly debris or a condition that causes dirt/grease build up it may be necessary to clean the coils more often. Proper procedure must be followed at every cleaning interval. Using improper cleaning technique or incorrect chemicals will result in coil damage, system performance fall off, and potentially leaks requiring coil replacement.

Documented routine cleaning of microchannel coils with factory provided e-coating is required to maintain coating warranty coverage. Use the E-Coated Coil Cleaning section for details on cleaning e-coated coils.

Field applied coil coatings are not recommended with microchannel coils.

Allowed Chemical Cleaners and Procedures

AAON recommends certain chemicals that can be used to remove buildup of grime and debris on the surface of microchannel coils. These chemicals have been tested for performance and safety and are the only chemicals that AAON will warrant as correct for cleaning microchannel coils.

There are two procedures that are outlined below that will clean the coils effectively without damage to the coils. Use of any other procedure or chemical may void the warranty to the unit where the coil is installed. **With all procedures make sure the unit is off before starting.**

⚠ WARNING ⚠

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

The water pressure used to clean must not exceed 689.5 kPa (100 psi), from no closer than 15.25 centimeters (6 inches) from the coils, and with the water aimed perpendicular to the coils.

#1 Simple Green

Simple Green is available from AAON Parts and Supply (Part# T10701) and is biodegradable with a neutral 6.5 pH A 4 to 1 solution is recommended. Use the following procedure.

1. Rinse the coil completely with water. Use a hard spray but be careful not to bend or damage the fins. A spray that is too hard will bend the fins. Spray from the fan side of the coil.
2. With a pump sprayer filled with a mix of 4 parts water to one part Simple Green spray the air inlet face of the coil. Be sure to cover all areas of the face of the coil.
3. Allow the coil to soak for 10-15 minutes.
4. Rinse the coil with water as in step one.
5. Repeat as necessary.

#2 Water Flush

This procedure can be used when the only material to cause the coil to need cleaning is debris from plant material that has impinged the coil face.

1. Rinse the coil completely with water. Use a hard spray but be careful not to bend or damage the fins. A spray that is too hard will bend the fins. Spray from the fan side of the coil.
2. Spray and rinse the coil from the face.

⚠ CAUTION

Use pressurized clean water, with pressure not to exceed 689.5 kPa (100 psi). Nozzle must be 15.25 cm (6”) and perpendicular to the coil face. Failure to do so could result in coil

Application Examples

The two procedures can be used to clean microchannel coils. They will fit with the application depending on the area. In some areas where the spring/summer has a large cottonwood bloom #2 might work fine if the unit is installed on an office building and no other environmental factors apply.

Generally the best and broadest based procedure is #1. The grease cutting effect of the Simple Green is good for restaurant applications.

Other Coil Cleaners

There are many cleaners on the market for condenser coils. Before using any cleaner that is not covered in this section you must get written approval from the AAON warranty and service department. Use of unapproved chemicals will void the warranty.

AAON testing has determined that unless a chemical has a neutral pH (6-8) it must not be used.

Beware of any product that claims to be a foaming cleaner. The foam that is generated is caused by a chemical reaction to the aluminum fin material on tube and fin coils and with the fin, tube, and coating material on microchannel coils.

Microchannel coils are robust in many ways, but like any component they must be treated correctly. This includes cleaning the coils correctly to give optimal performance over many years.

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 remove surface loaded fibers or dirt 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, dirt and salts 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 39.5°C (130°F) and pressure is less than 689.5 kPa (100 psi) to avoid damaging the fin edges. An elevated water temperature (not to exceed 39.5°C [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 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, (< 689.5 kPa [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.

Service

If the unit will not operate correctly and a service company is required, only a company with service technicians qualified and experienced in both refrigerant chillers and air conditioning are permitted to service the systems to keep warranties in effect. If assistance is required, the service technician must contact AAON.

Warranties

Please refer to the limitation of warranties in effect at the time of purchase.

Replacement Parts

Parts for AAON equipment may be obtained by contacting your local AAON representative. When ordering parts, reference the serial number and part number located on the external or internal nameplate of the unit.

AAON
Warranty, Service and Parts Department
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.

Warranty: Refer to the Limited Warranty Certificate for the unit warranty details. Contact your AAON representative for a unit specific copy of the certificate for your serial number.

Limited Warranty Certificate

GENERAL CONDITIONS
AAON Coil Products, Inc. (hereinafter referred to as "ACP") warrants this ACP equipment, as identified hereon, to be free of defects in material and workmanship under normal use, service, and maintenance. Our obligations under this warranty must be limited to repairing or replacing the defective part, or parts, which in our judgment show evidence of such defects. ACP is not liable for labor charges and other costs incurred for removing, shipping, handling or transporting defective part, or parts, or for shipping, handling, transporting, or installing repaired or replacement part, or parts.

The limited warranty is effective one (1) year from date of **original installation**, or eighteen (18) months from date of original shipment from the factory, whichever occurs first and covers all parts and components in this ACP equipment excluding air filters, belts, refrigerant moisture driers, and lost refrigerant, which are not included in any part of this limited warranty. The replacement part, or parts, assume only the unused portion of the original limited warranty and are shipped f.o.b. from the factory and freight prepaid by the factory.

The limited warranty is effective for products manufactured at the Tulsa, Oklahoma or Longview, Texas facility.

THIS LIMITED WARRANTY ONLY APPLIES WHEN THE **ORIGINAL MODEL NUMBER AND SERIAL NUMBER** OF THE ACP UNIT ARE GIVEN AT TIME OF REQUEST FOR REPLACEMENT PART, OR PARTS. DEFECTIVE PART, OR PARTS, MUST BE RETURNED **PREPAID**, WITH ITS ASSIGNED RETURN MATERIAL TAG, WITHIN FOURTEEN (14) DAYS OF RECEIPT OF THE REPLACEMENT PART, OR PARTS.

EXTENDED LIMITED WARRANTY ON COMPRESSORS INCLUDED IN SINGLE PACKAGE EQUIPMENT (NOT INCLUDING CHILLERS); OPTIONAL ON OTHER EQUIPMENT
For the second through the fifth year from date of **shipment**, we further agree to repair or replace the fully hermetic compressor, at our option, for the **original purchase-user only**. The repaired or replacement fully hermetic compressor will be supplied f.o.b. the factory, freight **prepaid and add**, providing the defective fully hermetic compressor is returned **prepaid by the customer**, and is proven to be inoperative due to defects in materials or workmanship. This extended limited warranty covers **only** the fully hermetic compressor and **does not include** any labor charges, or other additional costs incurred for removing, shipping, handling, transporting, or replacing the defective fully hermetic compressor. It also **does not include** additional costs incurred for shipping, handling, or transporting of electric controls such as relays, capacitors, pressure controls, or fan-motor assemblies, condensers, receivers, etc, which carry the standard **one-year limited warranty**.

EXTENDED LIMITED WARRANTY OF M2/V3/H3 SERIES GAS FIRED HEAT EXCHANGERS
For the second through the tenth year from date of original installation, we further warrant the steel heat exchanger against failure due to defects in materials and workmanship for the original purchaser-user only, in accordance with the following: For the first five (5) years from date of shipment, we agree to repair or replace the heat exchanger, at our option, for the original purchaser-user only; during the sixth year, we will charge 50% of the current trade price for repaired or replacement steel heat exchanger, as the case may be, during the seventh year, 60%, during the eighth year, 70% during the ninth year, 80% and during the tenth year, 90%.

In all cases, the repaired or replacement heat exchanger will be supplied f.o.b. our factory, freight prepaid, providing the defective heat exchanger is returned **prepaid**, and if it is proved to be inoperative due to defects in materials and workmanship. This extended limited warranty covers **only** the heat exchanger and **does not include** labor charges, or other costs incurred for removing, shipping, handling, transporting, or installing repaired replacement heat exchanger. This extend limited warranty **does not apply** where the furnace has been operated in an atmosphere contaminated by chlorine, fluorine, or any other damaging chemical compounds.

FOR OPTIONAL FIVE YEAR EXTENDED LIMITED WARRANTY OF COIL COATING
For the second through fifth year from date of shipment, we further warrant the coating of e-coated coils on the equipment against failure due to defects in materials and workmanship for the original purchaser-user only. Coil cleaning, maintenance, and record keeping must be followed according to the unit Installation, Operation and Maintenance Manual to maintain warranty.

OTHER CONDITIONS
This warranty **does not cover** any ACP unit or part thereof which has been subject to accident, negligence, damages in transit, misuse or abuse, **or which has been tampered with or altered in any way**, or which has **not** been installed operated serviced and maintained in accordance with our instructions, or which has been installed outside of the Continental United States or Canada, or on which the serial number or identification number has been altered defaced, or removed. ACP will not be responsible for failure of the unit to start due to voltage conditions, blown fuses, open circuit breakers, or other damages due to the inadequacy or interruption of electric service.

This warranty **does not cover** equipment containing a water-to-refrigerant heat exchanger for any damage resulting from freezing, fouling, corrosion or clogging.

ACP must not be liable for any default or delay in performance hereunder, caused by a contingency beyond its control, including governmental restrictions or restraint, strikes, short or reduced supply of raw materials or parts, floods, winds, fire, lightning strikes, or any other acts of God.

Limited Warranty Certificate

DISCLAIMERS OF WARRANTIES

THIS WARRANTY IS EXCLUSIVE AND IS IN LIEU OF ANY WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR OTHER WARRANTY OF QUALITY, WHETHER EXPRESS OR IMPLIED, EXCEPT OF TITLE AND AGAINST PATENT INFRINGEMENT, CORRECTION OF NON-CONFORMITIES ARE LIMITED TO REPAIR OR REPLACEMENT OF THE DEFECTIVE PART OR PARTS, AT SELLER'S OPTION, WHICH MUST CONSTITUTE FULFILLMENT OF ALL TORT OR OTHERWISE IT IS EXPRESSLY UNDERSTOOD THAT ACP MUST NOT BE LIABLE FOR ANY CONSEQUENTIAL OR INCIDENTAL DAMAGES. ACP MUST NOT UNDER ANY CIRCUMSTANCES BE LIABLE FOR SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES, SUCH AS, BUT NOT LIMITED TO DAMAGES OR LOSS OF OTHER PROPERTY OR EQUIPMENT, LOSS OF PROFITS OR REVENUE, COST OF CAPITAL, COST OF PURCHASED OR REPLACEMENT GOODS, OR CLAIMS OF BUYER OR USER FOR SERVICE INTERRUPTIONS. THE REMEDIES OF THE BUYER SET FORTH HEREIN ARE EXCLUSIVE, AND THE LIABILITY OF ACP WITH RESPECT TO ANY CONTRACT, OR ANYTHING DONE IN CONNECTION THEREWITH SUCH AS THE PERFORMANCE OR BREACH THEREFORE, OR FROM THE MANUFACTURE, SALE, DELIVERY, RESALE, INSTALLATION, OR USE OF ANY GOODS COVERED BY OR FURNISHED UNDER THIS CONTRACT WHETHER ARISING OUT OF CONTRACT, NEGLIGENCE, STRICT TORT, OR UNDER ANY WARRANTY, OR OTHERWISE, MUST NOT EXCEPT AS EXPRESSLY PROVIDED HEREIN, EXCEED THE PRICE OF THE GOODS UPON WHICH SUCH LIABILITY IS BASED.

WITH RESPECT TO THE GOODS SOLD, THE BUYER HEREBY WAIVES ALL LIABILITY ARISING FROM STATUTE, LAW, STRICT LIABILITY IN TORT, OR OTHERWISE, INCLUDING WITHOUT LIMITATION ANY OBLIGATION OF ACP WITH RESPECT TO CONSEQUENTIAL OR INCIDENTAL DAMAGES AND WHETHER OR NOT OCCASIONED BY ACP NEGLIGENCE. TIME LIMIT ON COMMENCING LEGAL ACTIONS: AN ACTION FOR BREACH OF THIS CONTRACT FOR GOOD SOLD OR ANY OTHER ACTION OTHERWISE ARISING OUT OF THIS CONTRACT, MUST BE COMMENCED WITHIN ONE (1) YEAR FROM THE DATE, THE RIGHT, CLAIM, DEMAND OR CAUSE OF ACTION MUST FIRST OCCUR, OR BE BARRED FOREVER.

SEVERABILITY

IF ANY PROVISION OR CAUSE OF THIS CONTRACT OR APPLICATION THEREOF TO ANY PERSON OR CIRCUMSTANCES IS HELD INVALID OR UNCONSCIONABLE SUCH INVALIDITY OR UNCONSCIONABILITY MUST NOT AFFECT OTHER PROVISIONS OR APPLICATIONS OF THE CONTRACT WHICH CAN BE GIVEN EFFECT WITHOUT THE INVALID OR UNCONSCIONABLE PROVISIONS OF THE CONTRACT ARE DECLARED BE SEVERABLE.

EQUIPMENT INFORMATION (REQUIRED)

Job Name: Click or tap here to

Sales Order Number: Click or tap here to enter text.

Unit Tag: Click or tap here to enter text

Date of Shipment: Click or tap here to enter text.

Serial Number: Click or tap here to enter text.

Unit Model Number: Click or tap here to enter text.

Split System Refrigerant Piping Diagrams

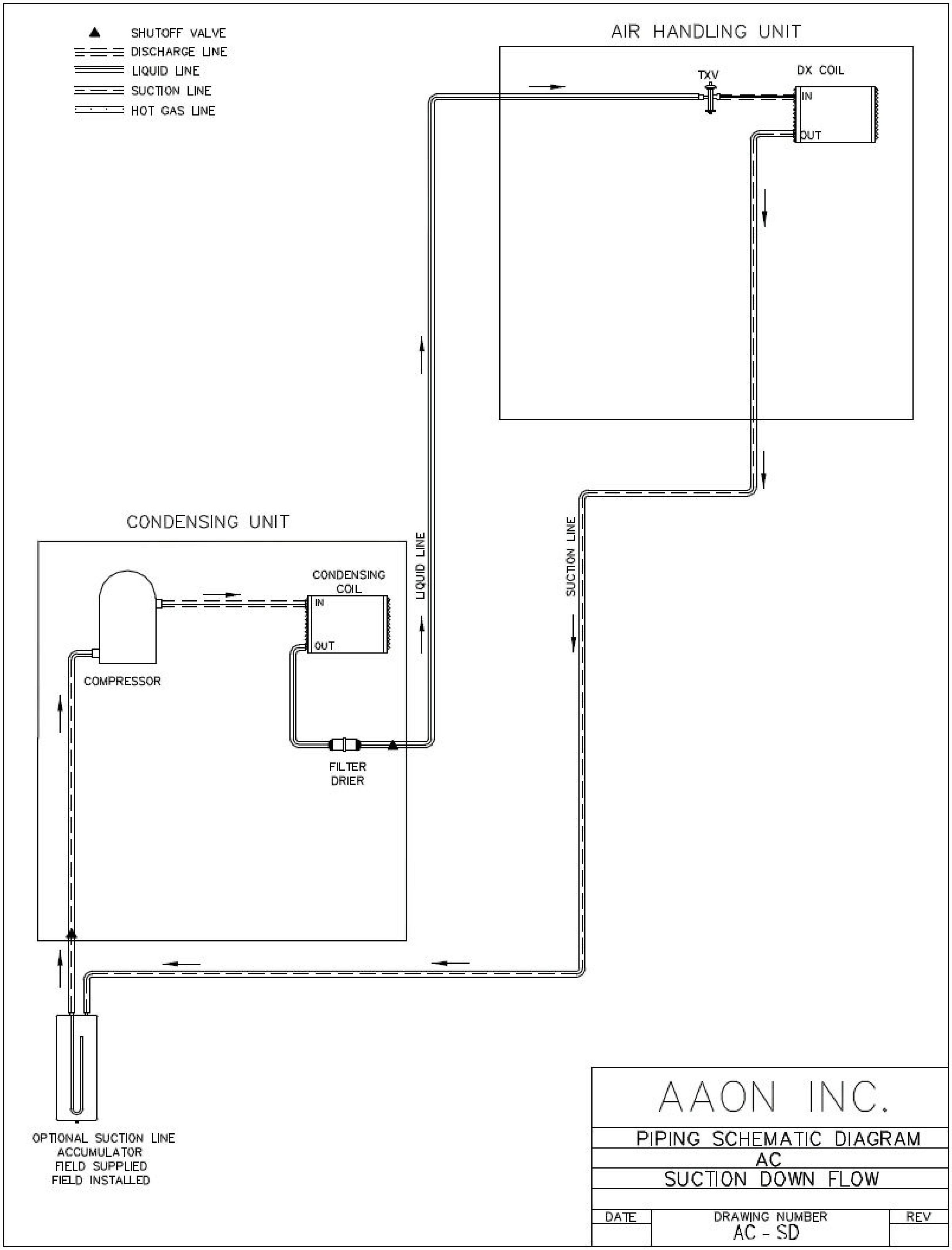

Figure 17 - A/C Split System Piping, Suction Down

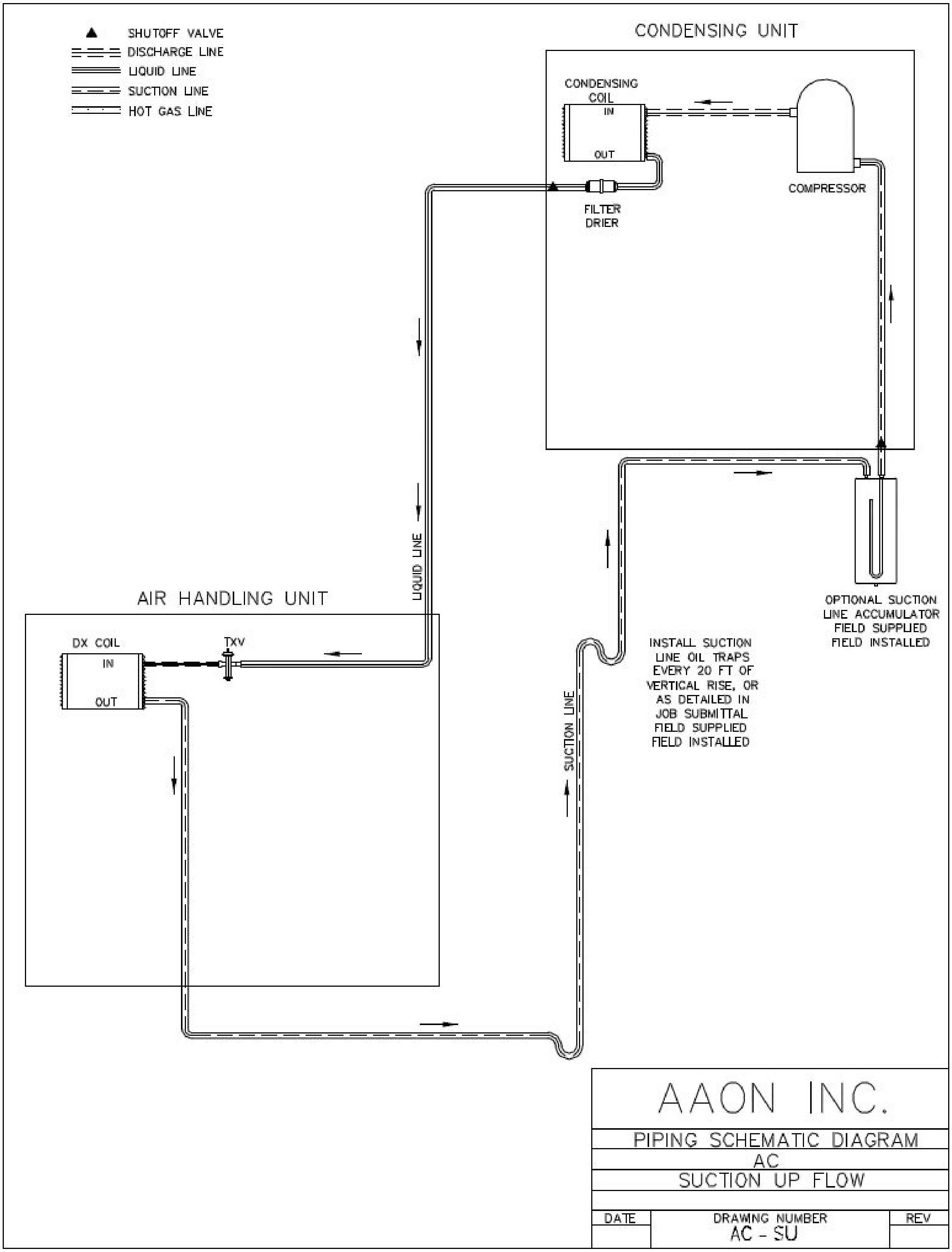

Figure 18 - A/C Split System Piping, Suction Up

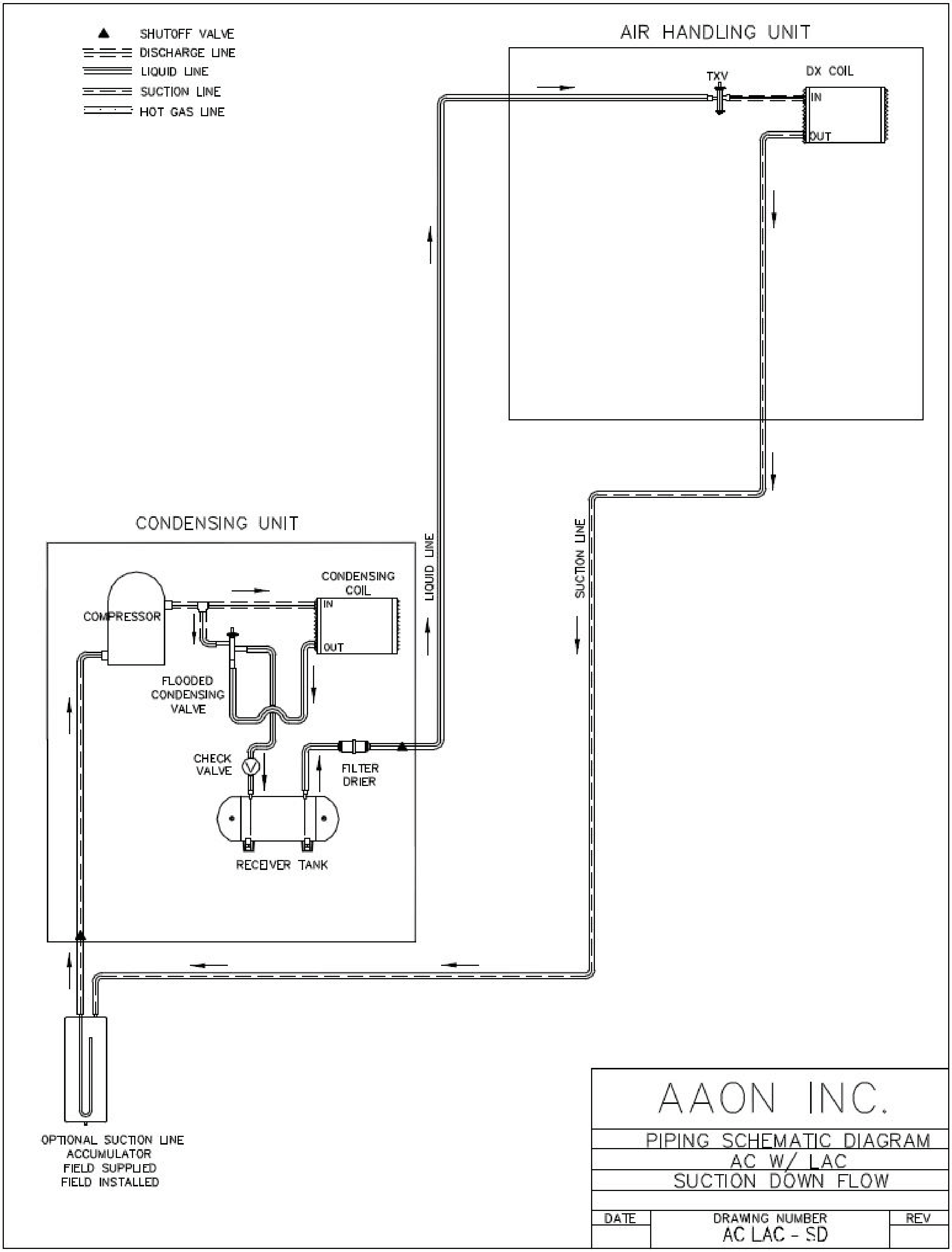

Figure 19 - A/C with LAC Split System Piping, Suction Down

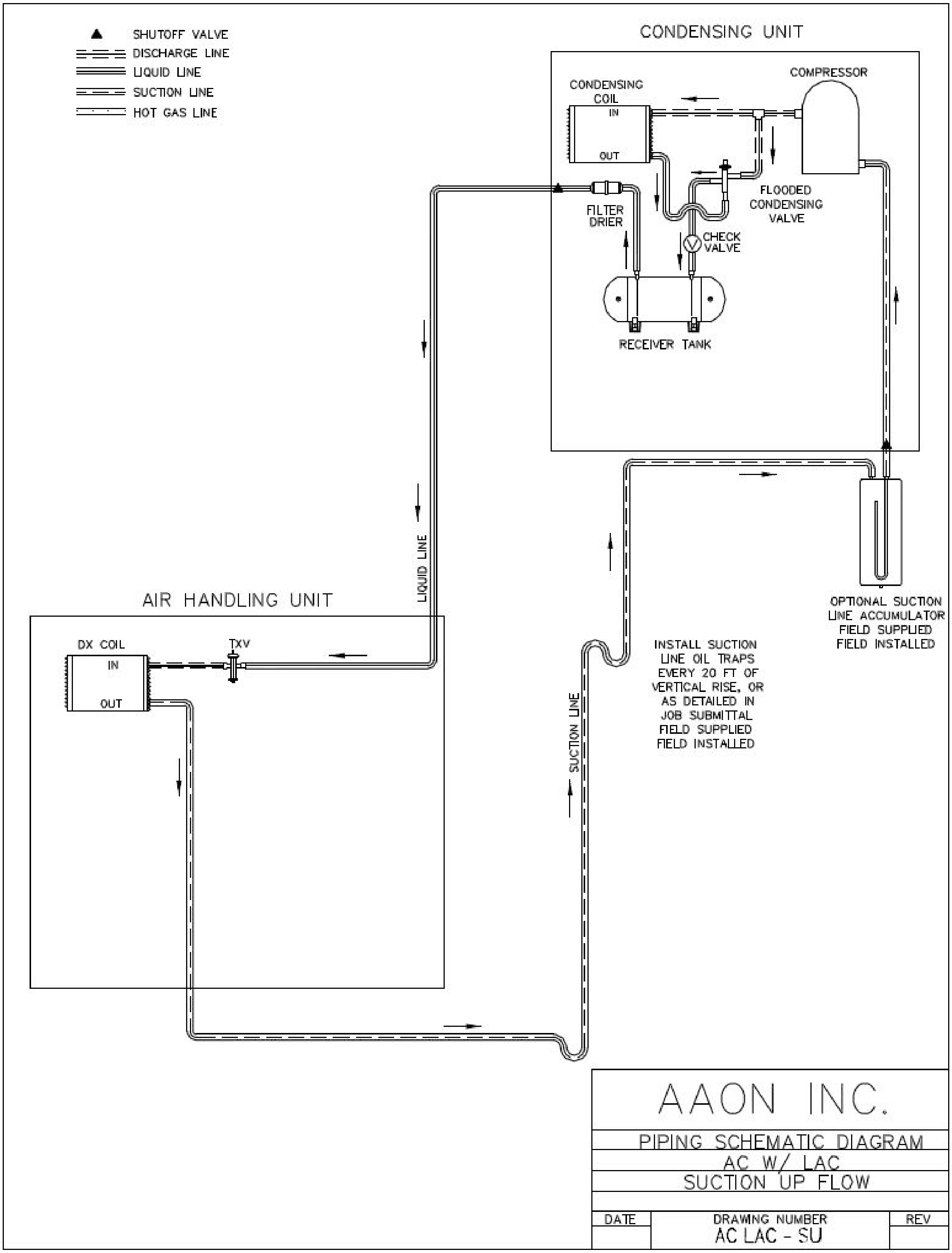

Figure 20 - A/C with LAC Split System Piping, Suction Up

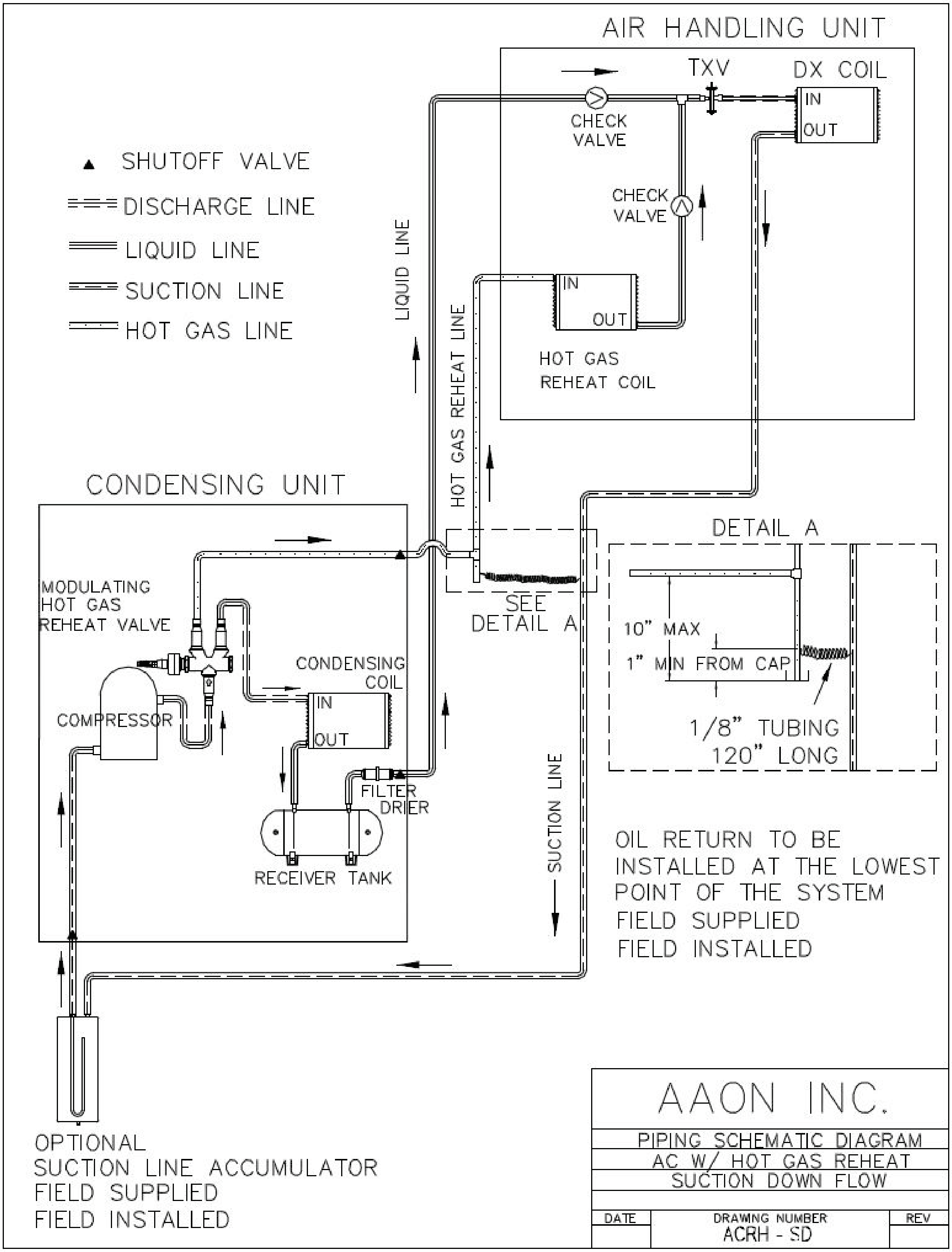

Figure 21 - A/C with Modulating Hot Gas Reheat Split System Piping, Suction Down

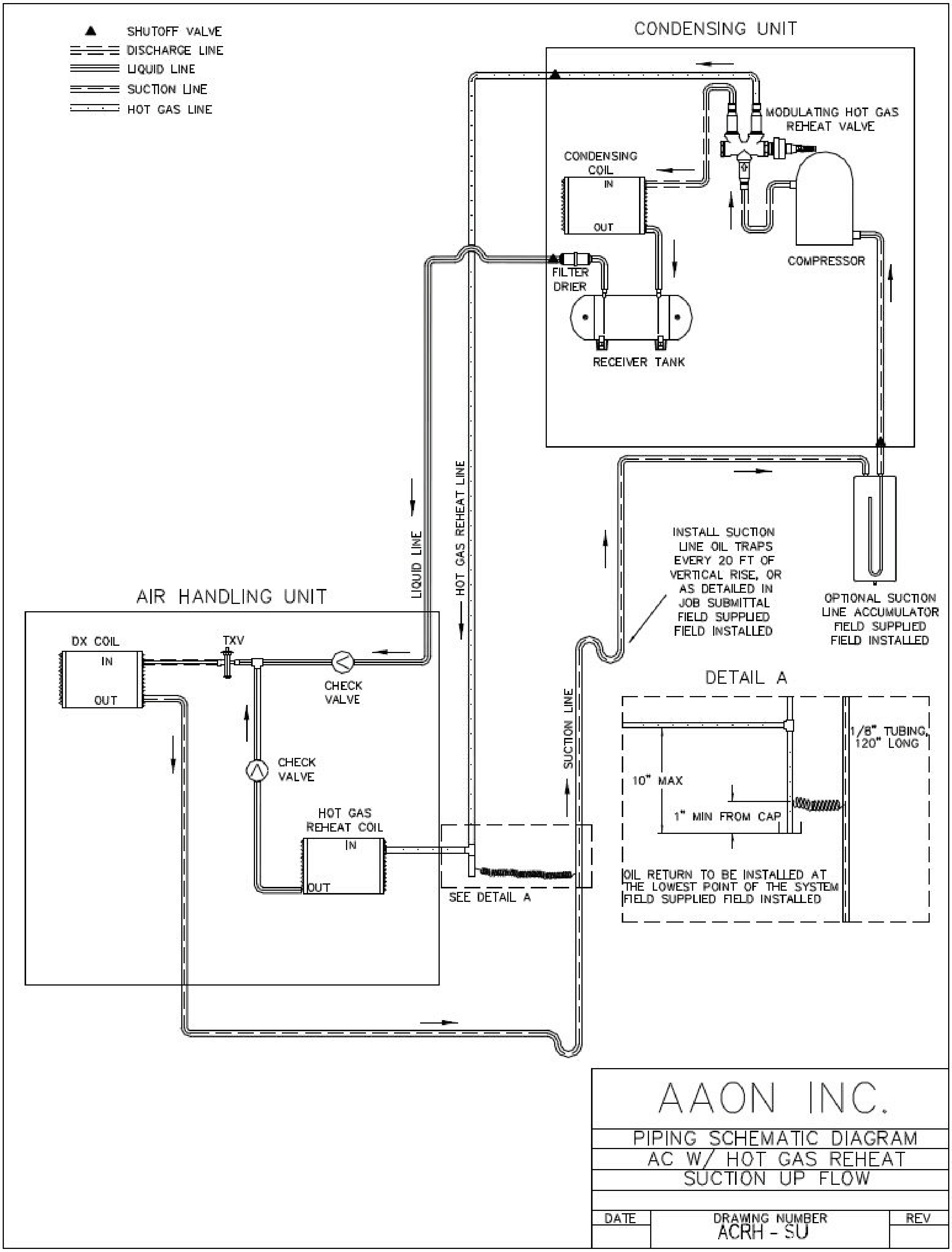

Figure 22 - A/C with Modulating Hot Gas Reheat Split System Piping, Suction Up

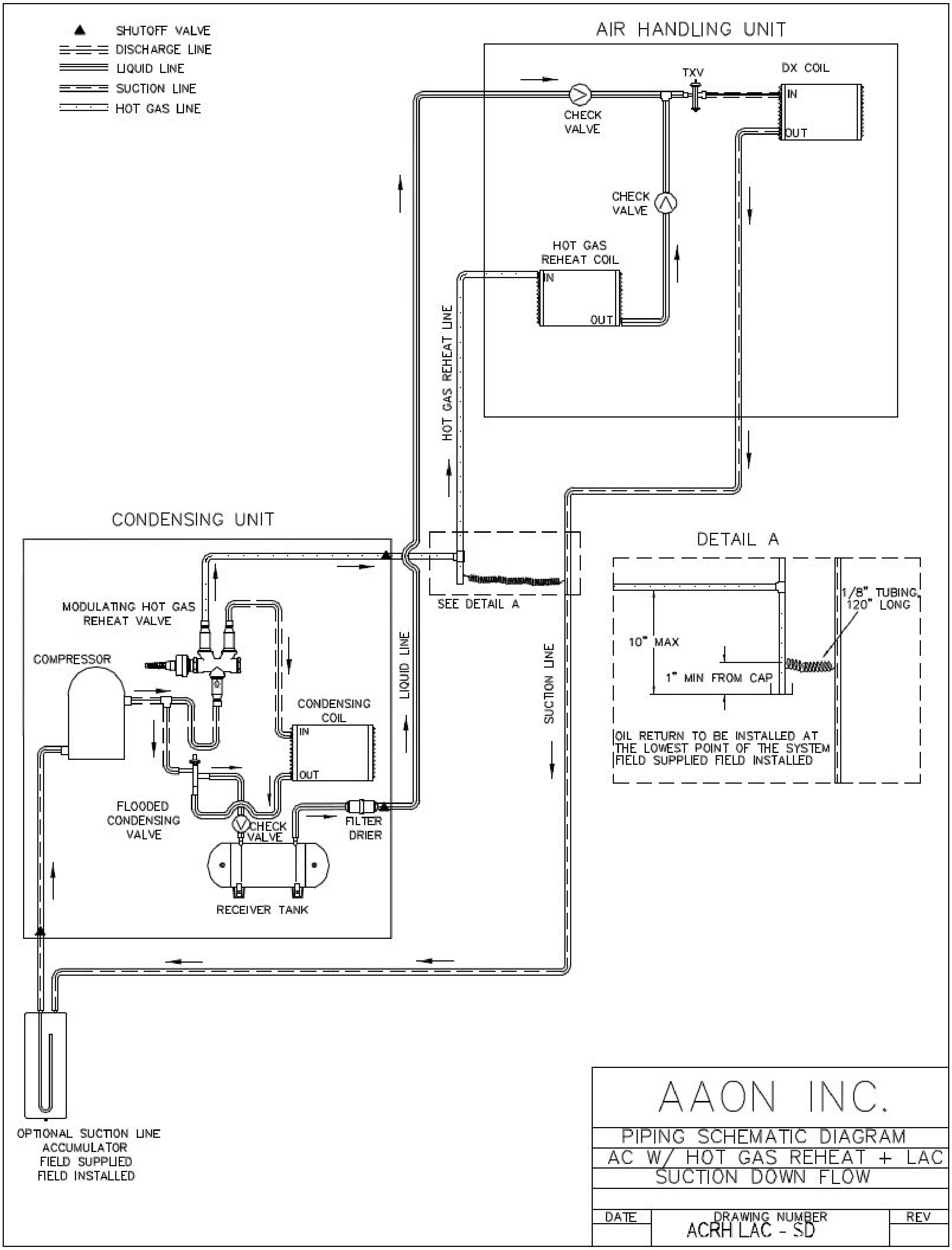

Figure 23 - A/C with Modulating Hot Gas Reheat Split + LAC System Piping, Suction Down

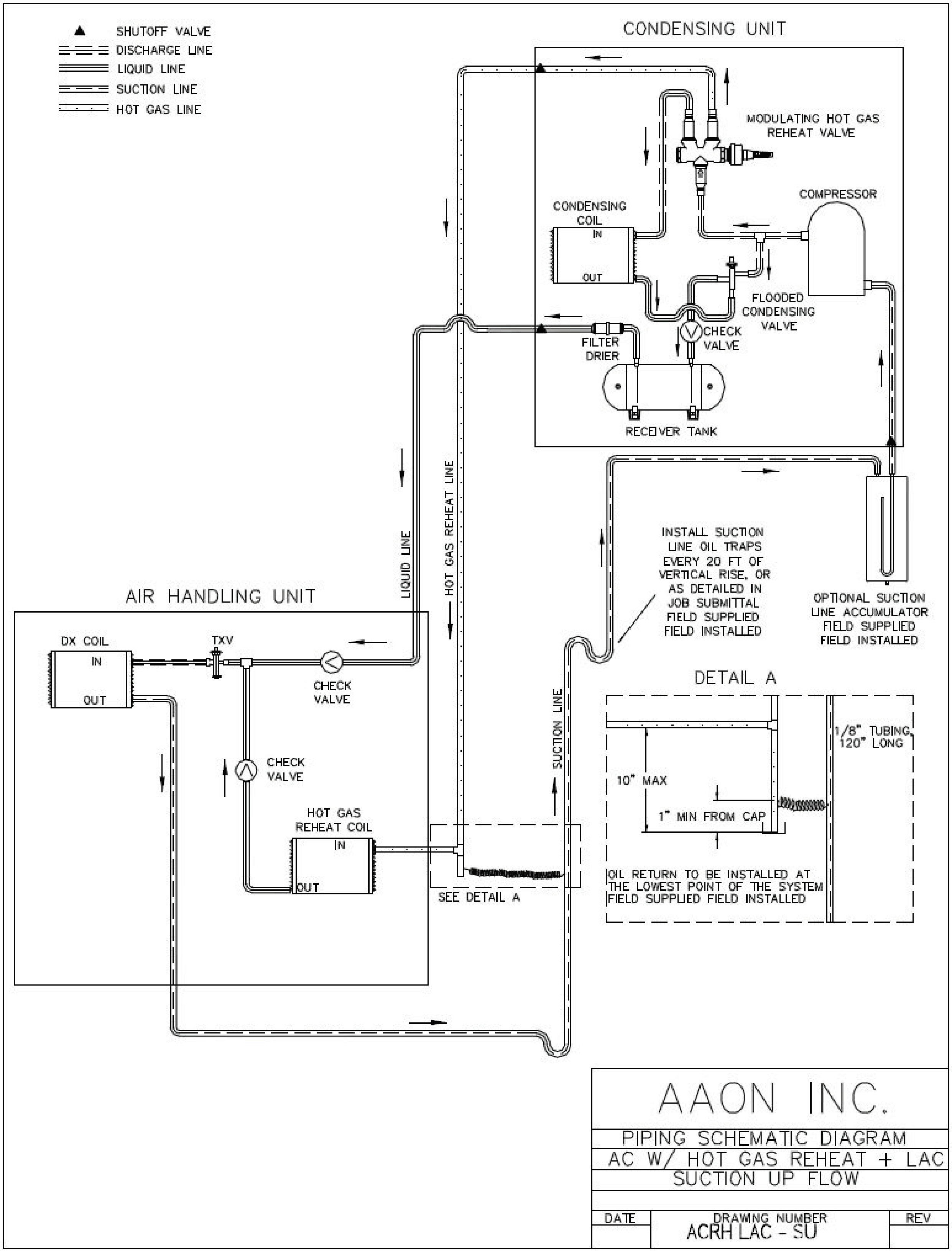

Figure 24 - A/C with Modulating Hot Gas Reheat Split + LAC System Piping, Suction Up

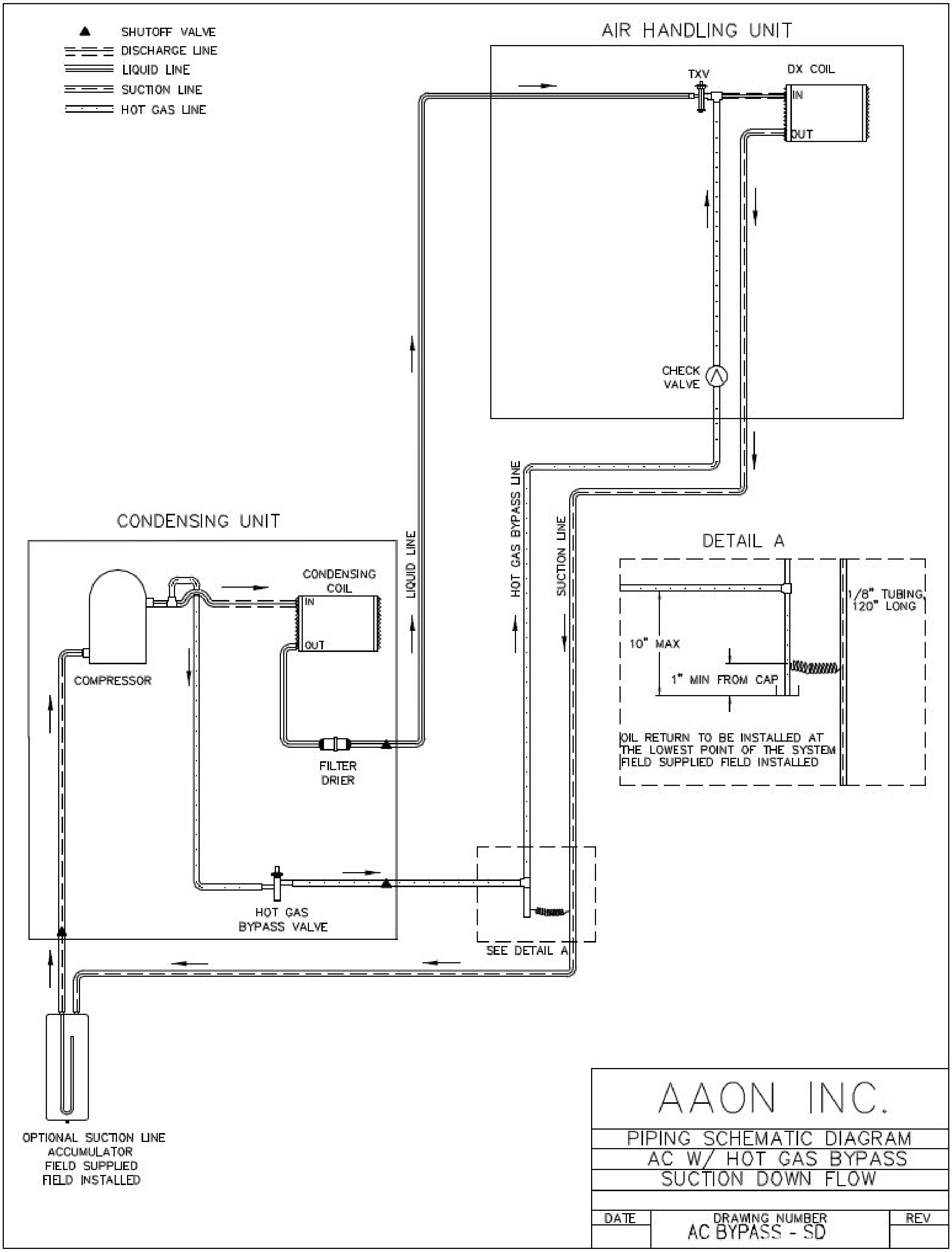

Figure 25 - A/C with Hot Gas Bypass Split System Piping, Suction Down

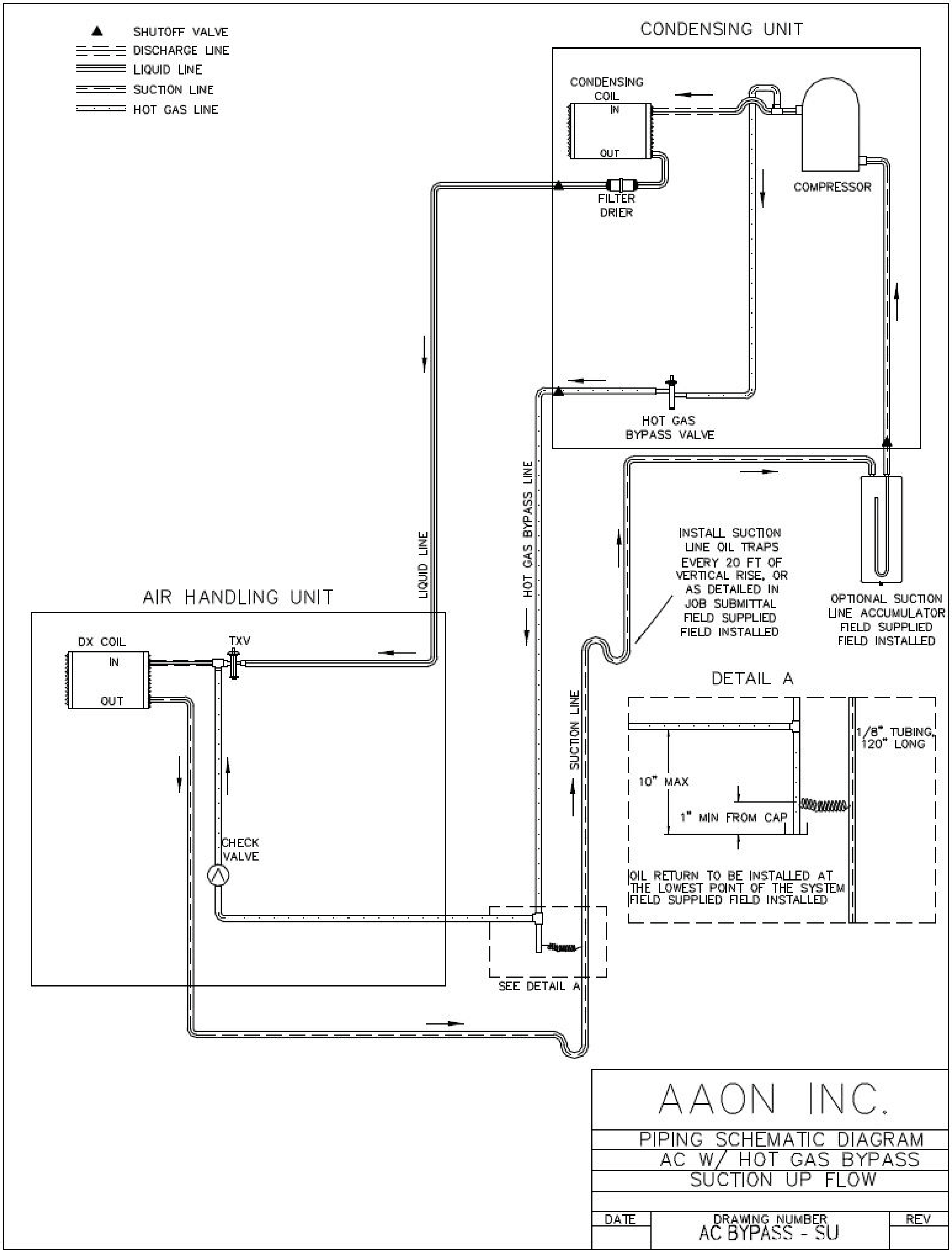

Figure 26 - A/C with Hot Gas Bypass Split System Piping, Suction Up

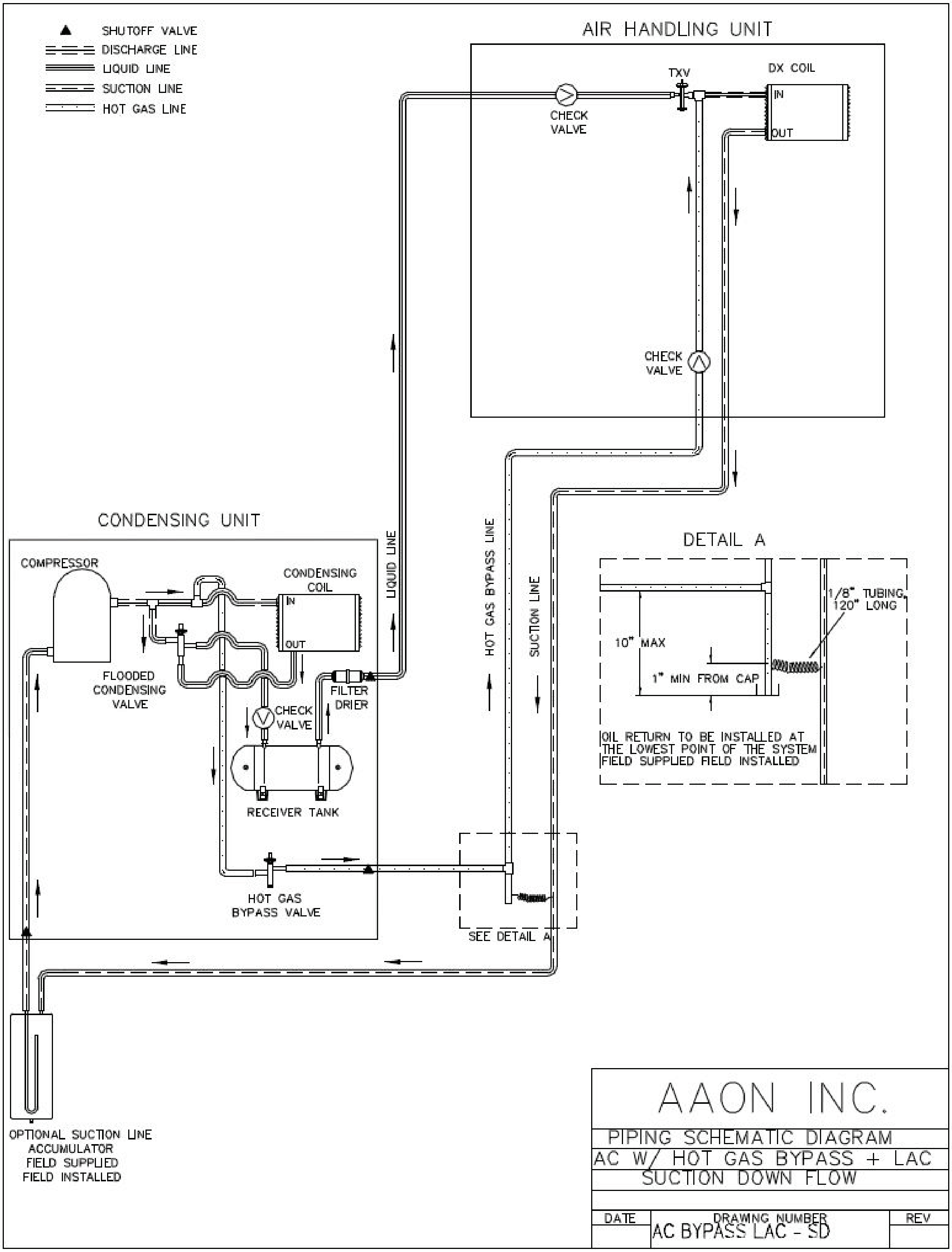

Figure 27 - A/C with Hot Gas Bypass + LAC Split System Piping, Suction Down

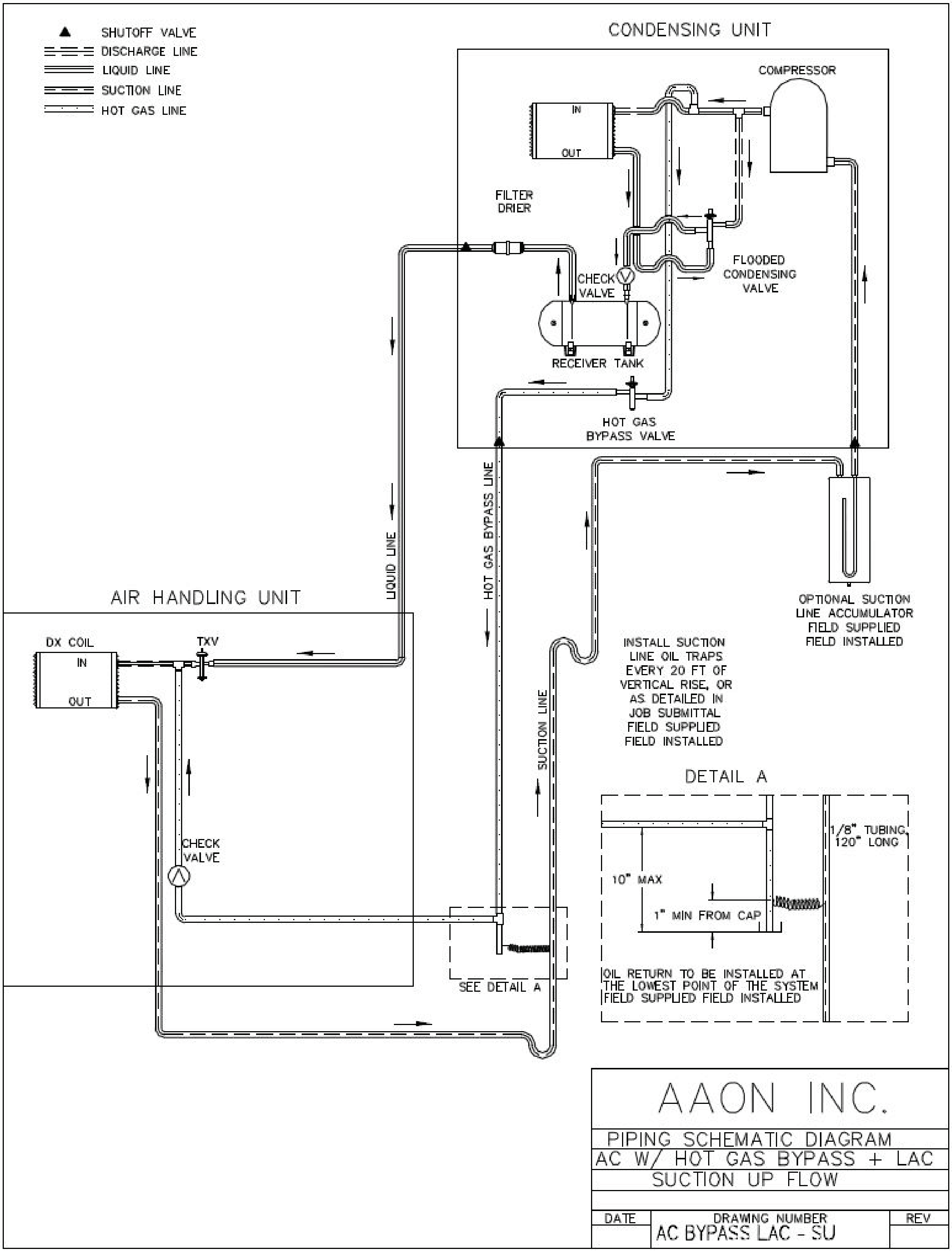

Figure 28 - A/C with Hot Gas Bypass + LAC Split System Piping, Suction Up

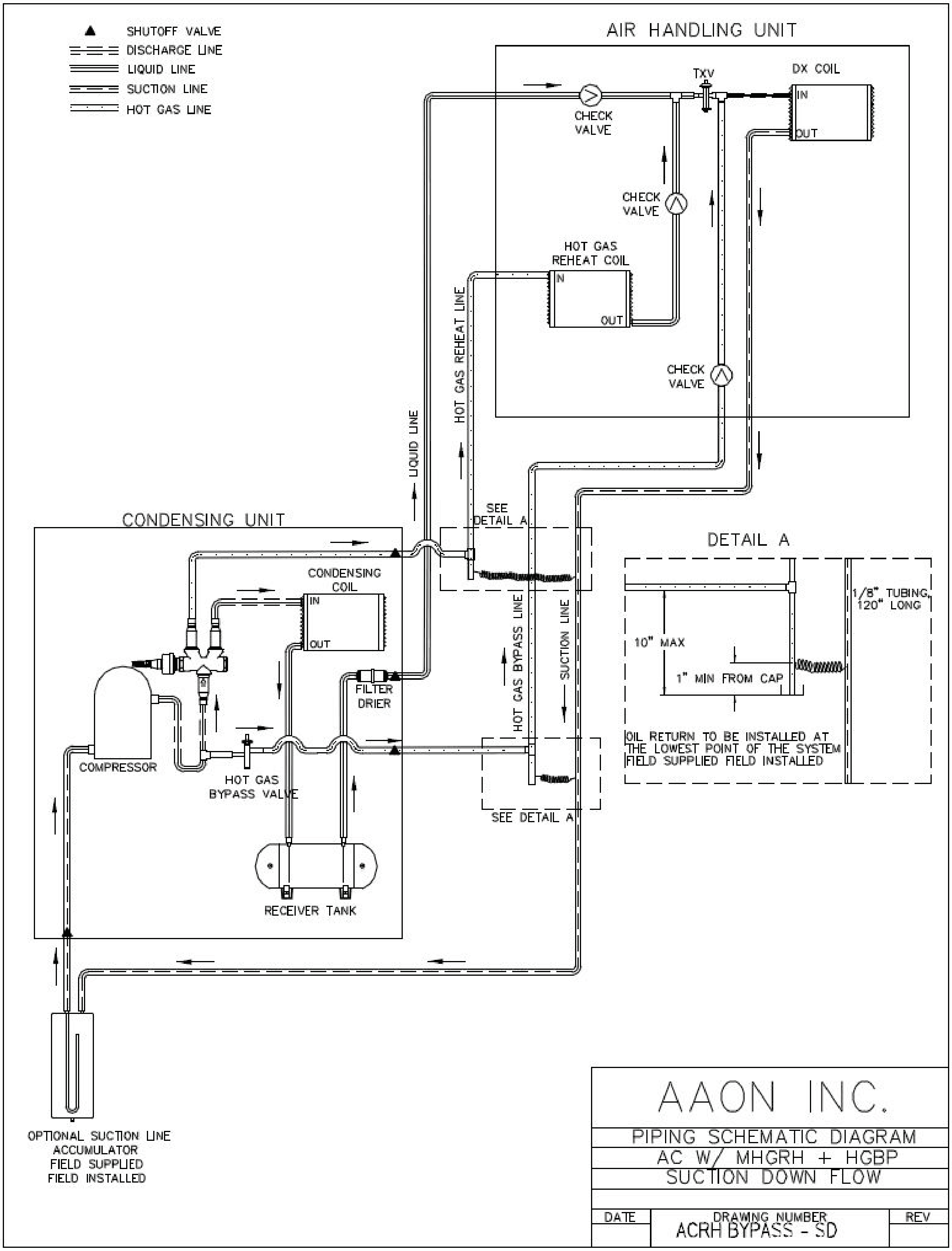

Figure 29 - A/C with Modulating Hot Gas Reheat and Hot Gas Bypass Split System Piping, Suction Down

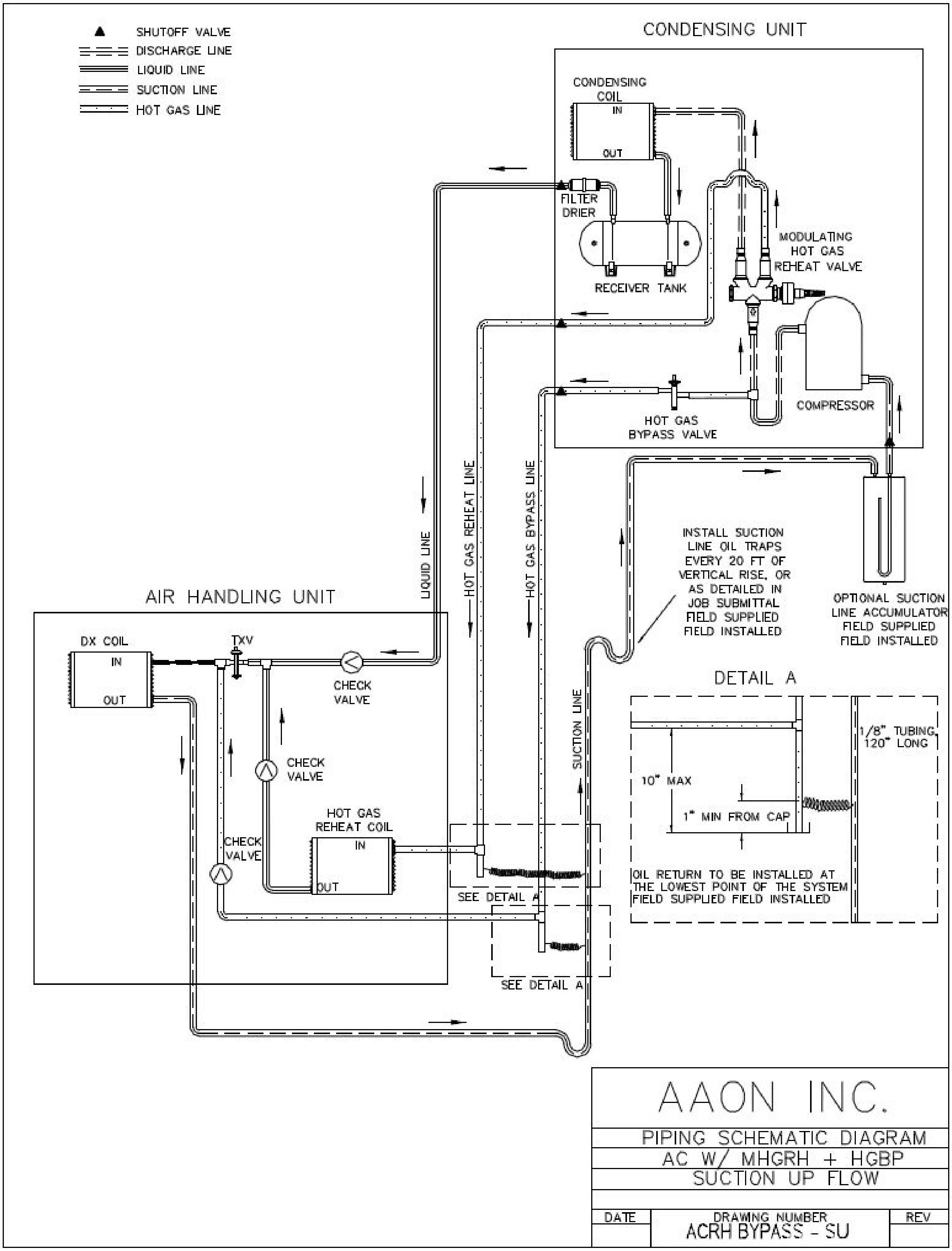

Figure 30 - A/C with Modulating Hot Gas Reheat and Hot Gas Bypass Split System Piping, Suction Up

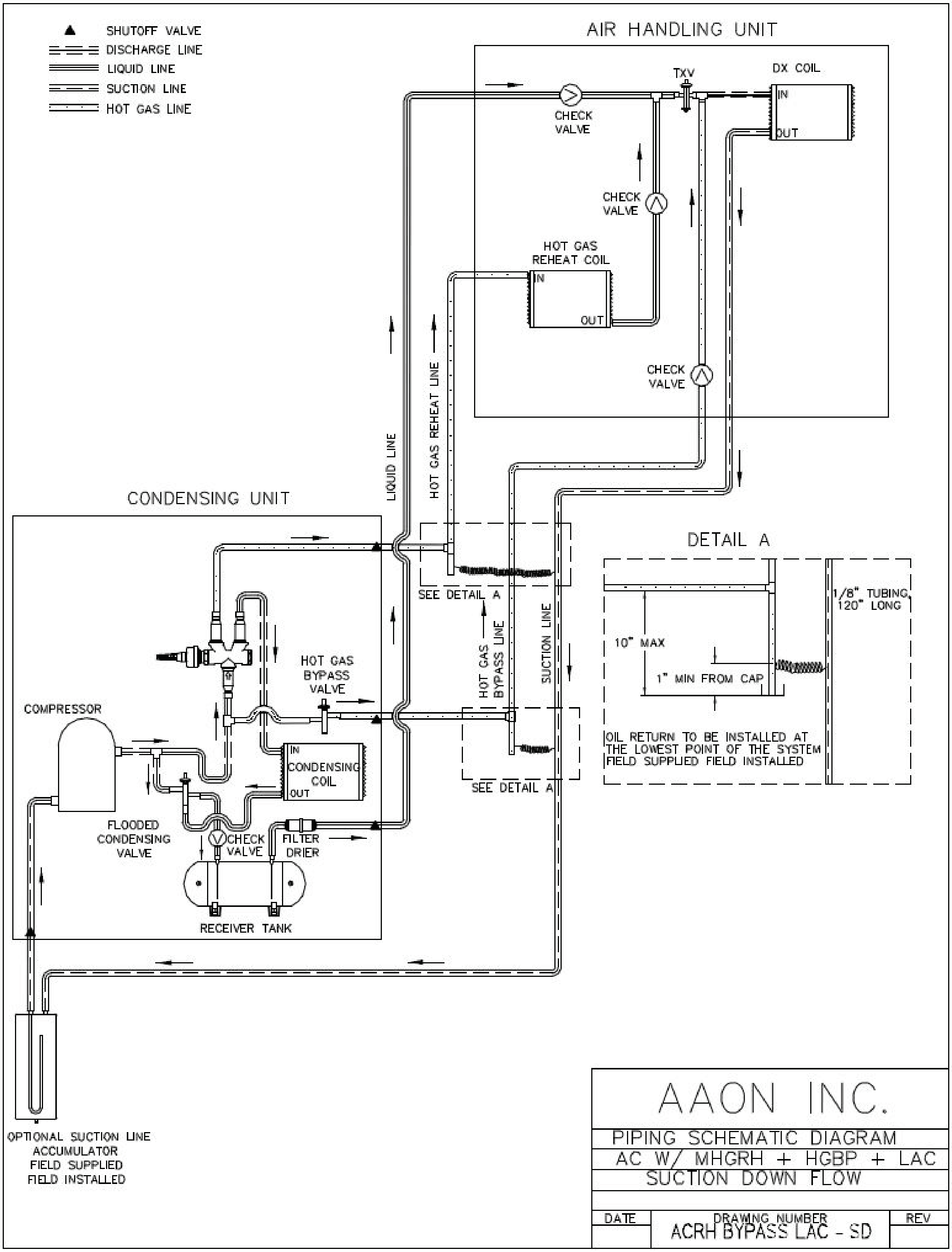

Figure 31 - A/C with Modulating Hot Gas Reheat and Hot Gas Bypass + LAC Split System Piping, Suction Down

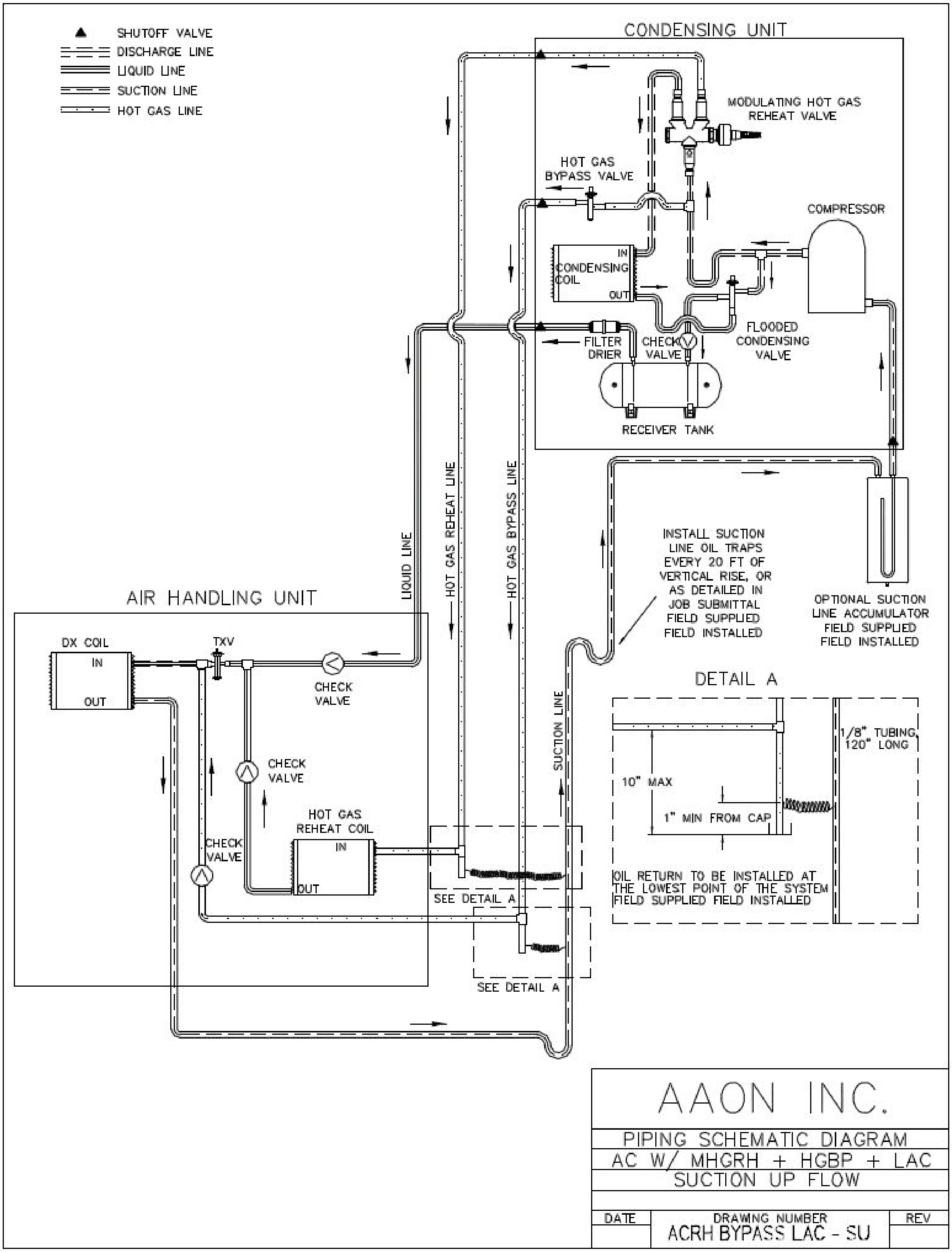

Figure 32 - A/C with Modulating Hot Gas Reheat and Hot Gas Bypass + LAC Split System Piping, Suction Up

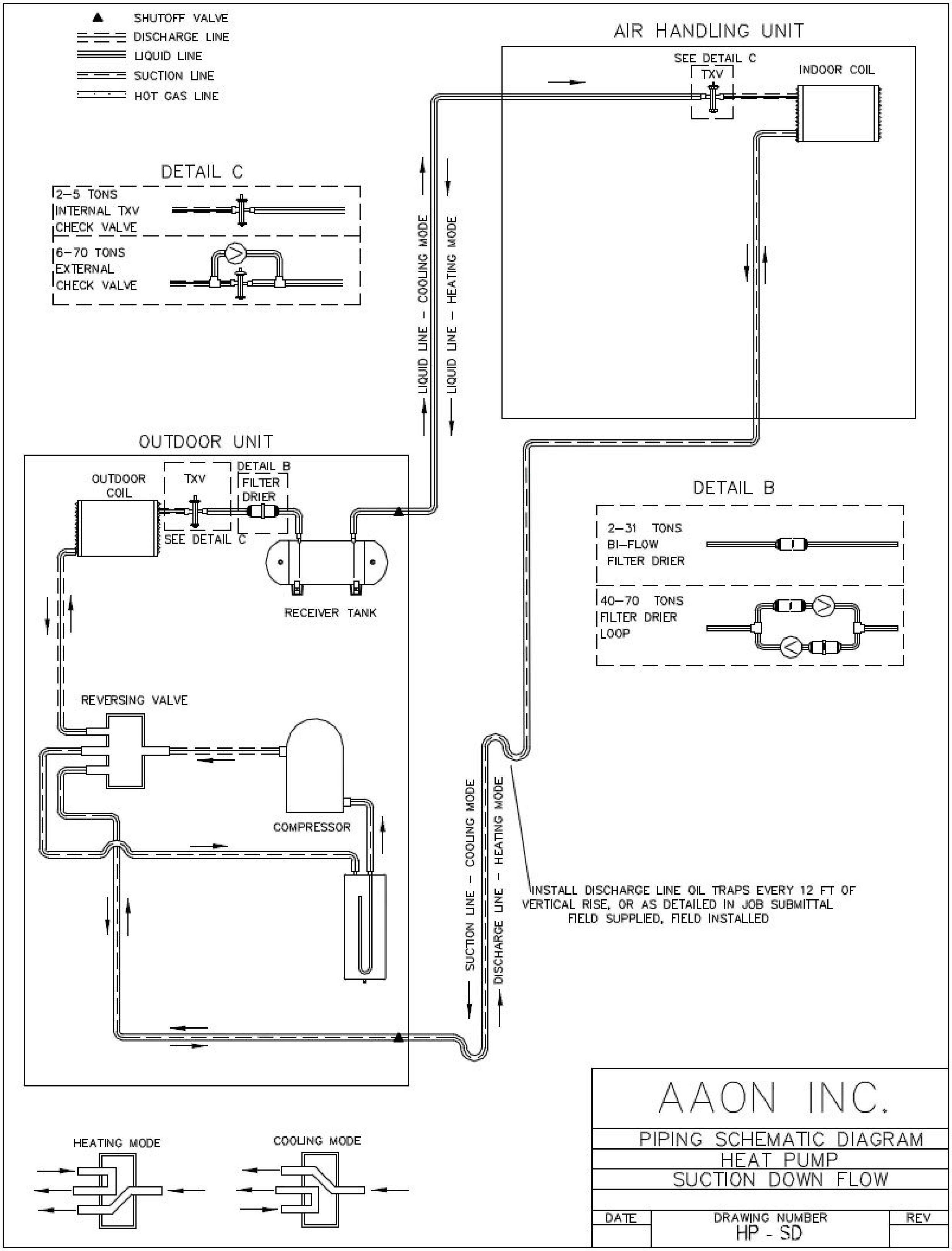

Figure 33 - Heat Pump Split System Piping, Suction Down

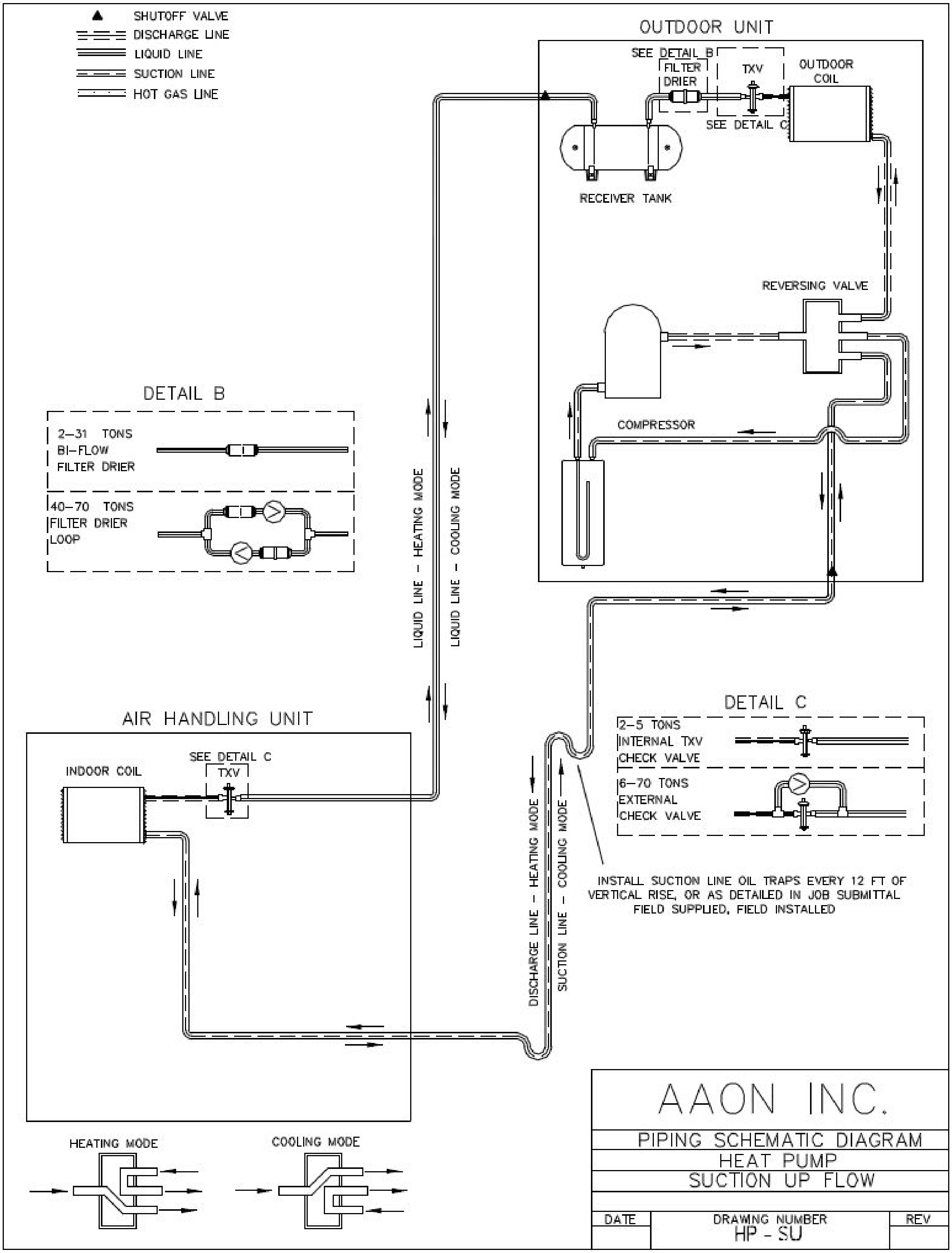

Figure 34 - Heat Pump Split System Piping, Suction Up

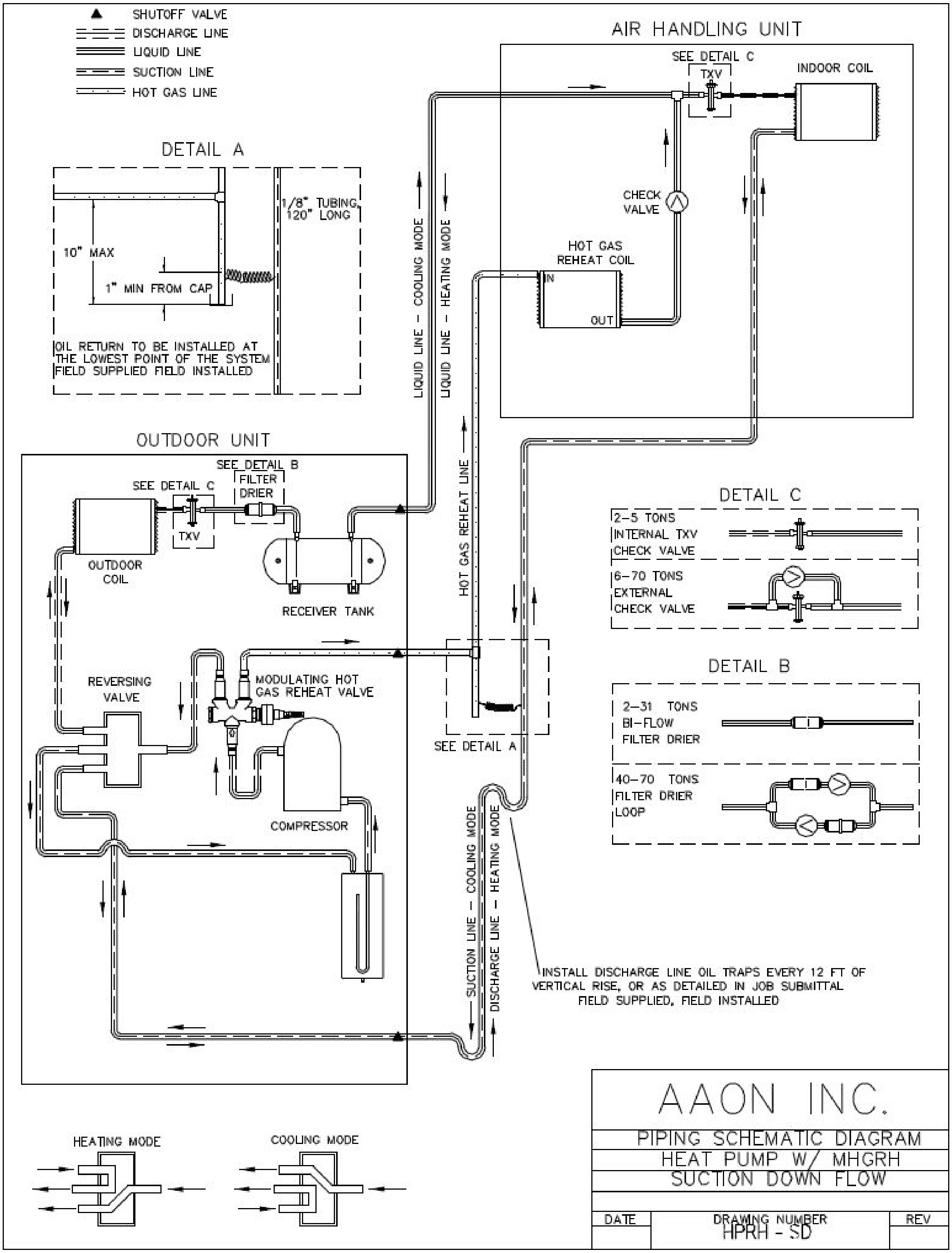

Figure 35 - Heat Pump with Modulating Hot Gas Reheat Split System Piping, Suction Down

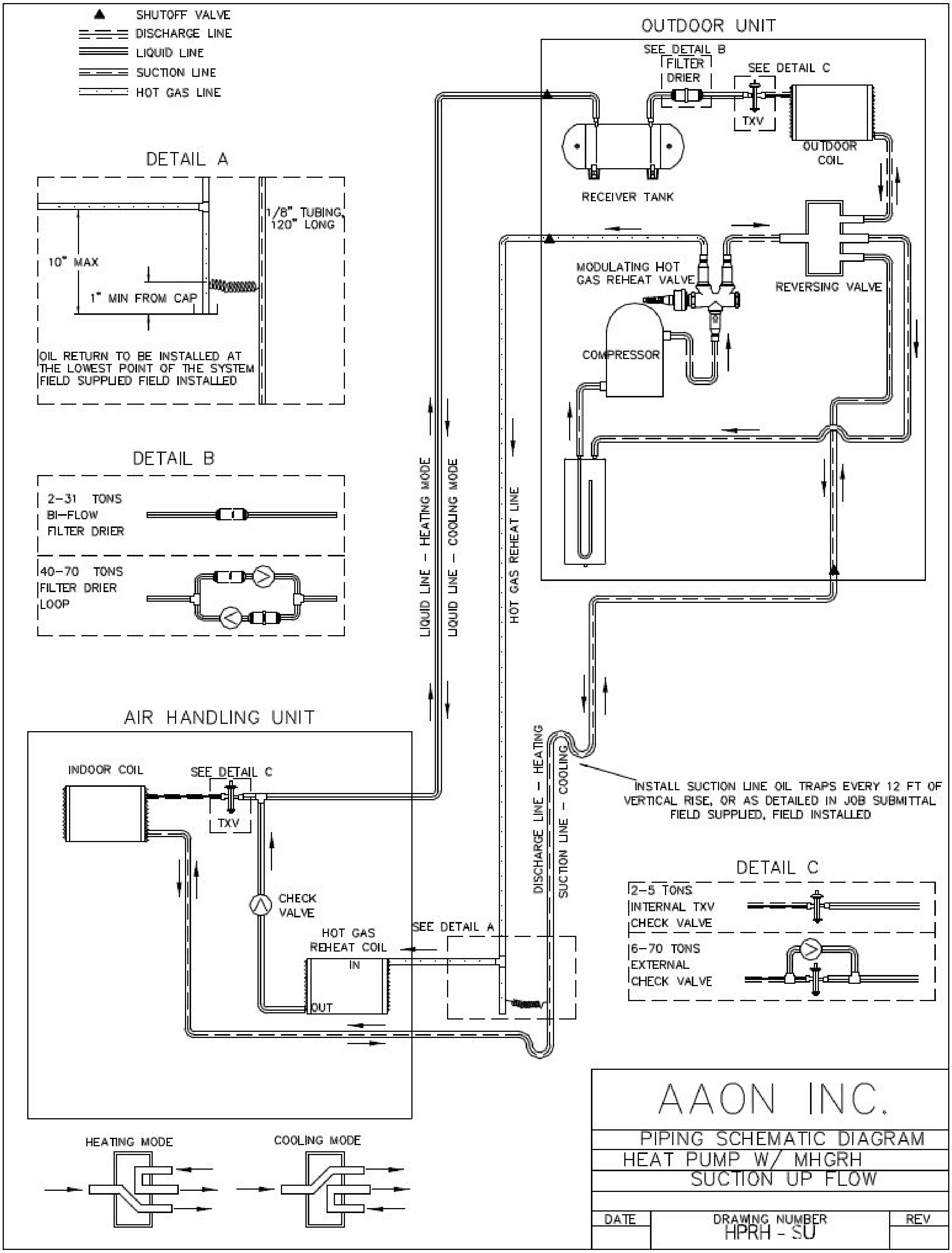

Figure 36 - Heat Pump with Modulating Hot Gas Reheat Split System Piping, Suction Up

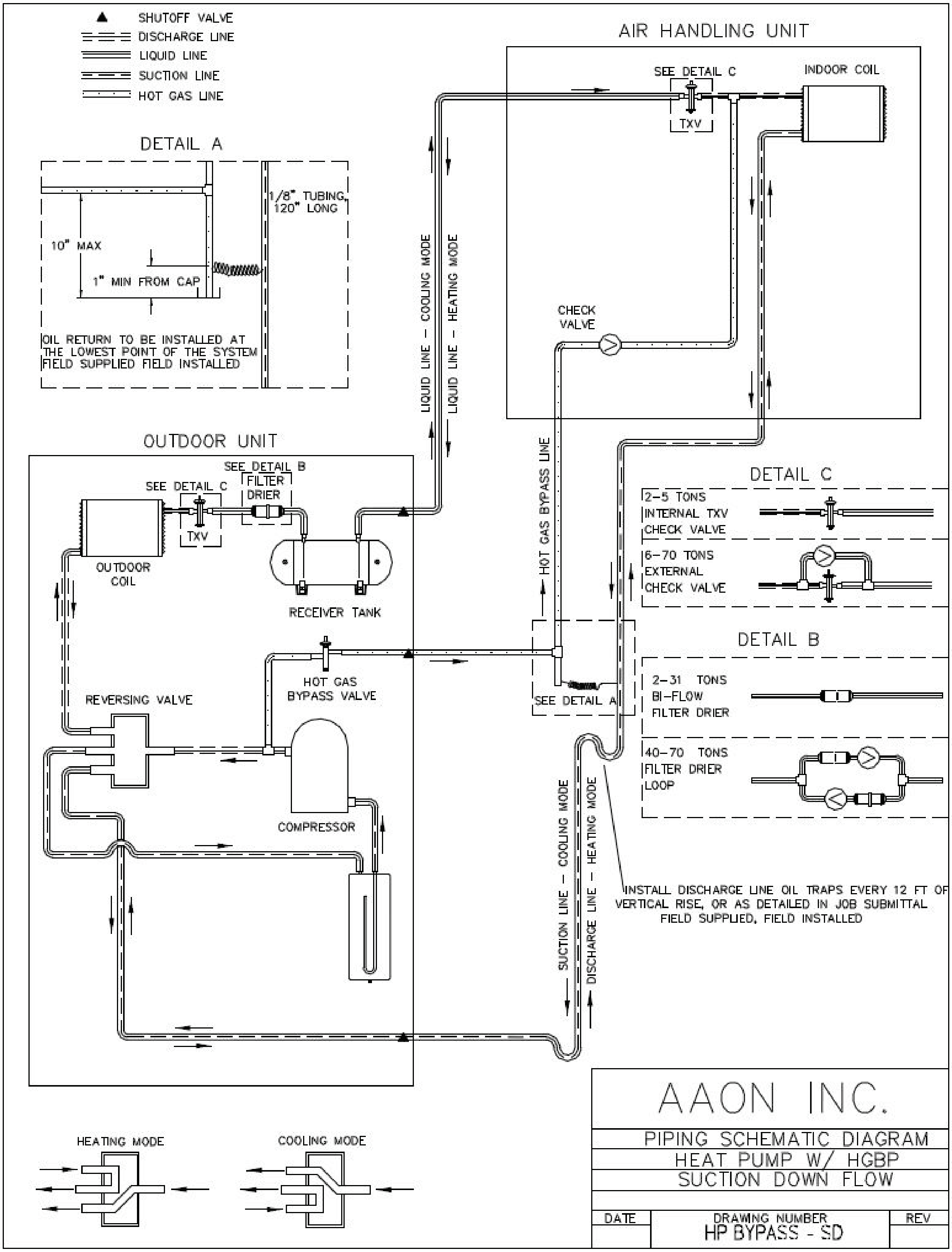

Figure 37 - Heat Pump with Hot Gas Bypass Split System Piping, Suction Down

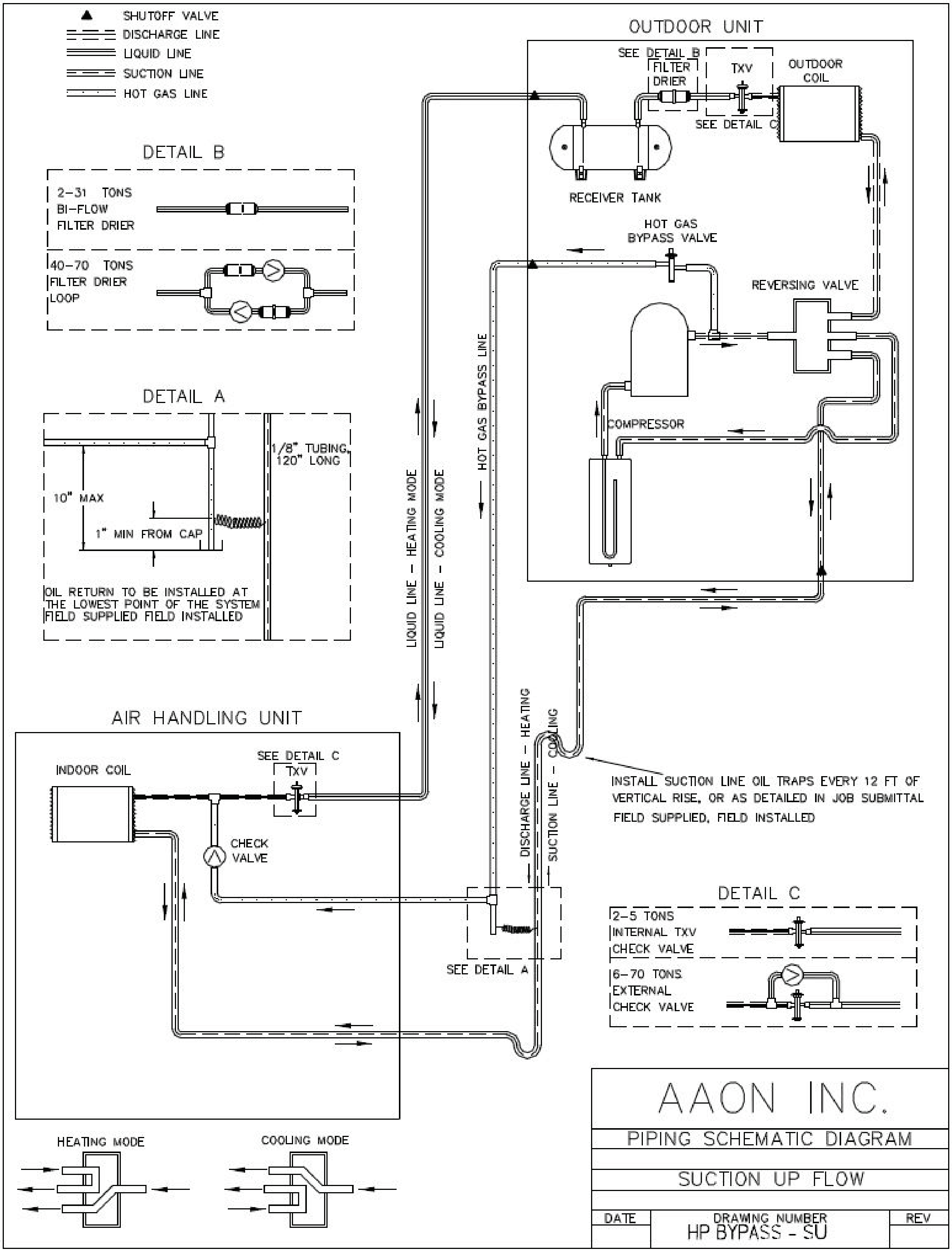

Figure 38 - Heat Pump with Hot Gas Bypass Split System Piping, Suction Up

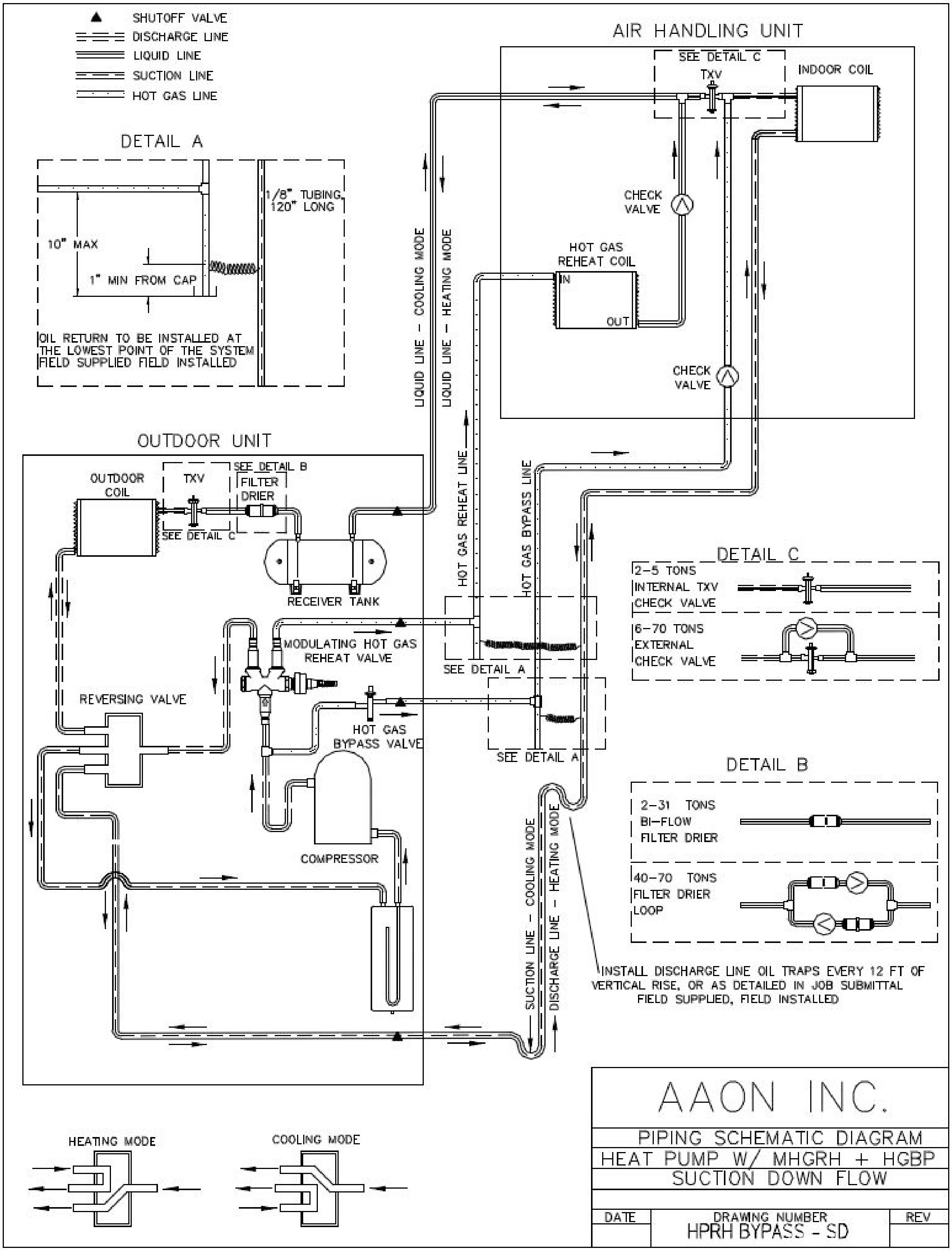

Figure 39 - Heat Pump with Modulating Hot Gas Reheat and Hot Gas Bypass Split System Piping, Suction Down

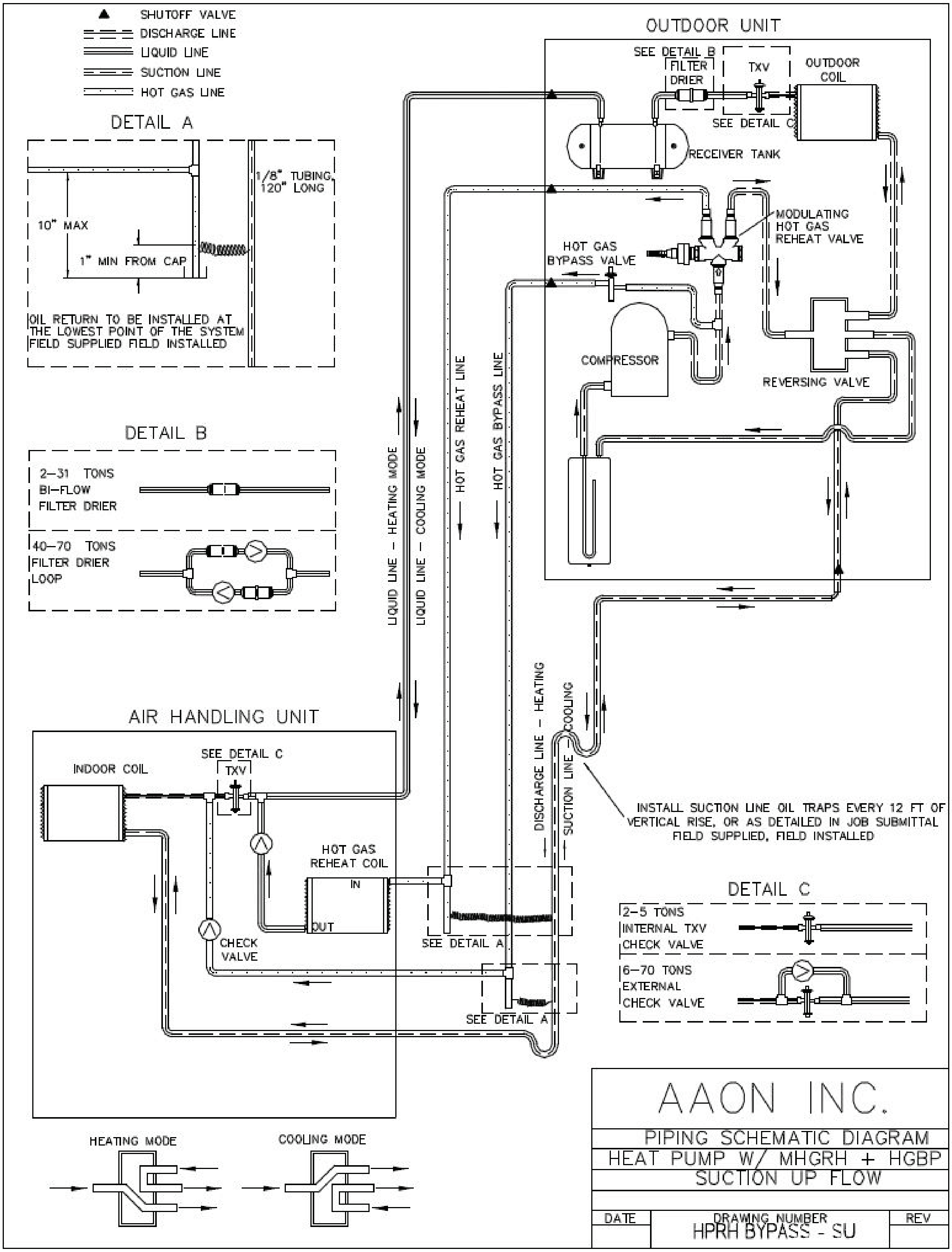

Figure 40 - Heat Pump with Modulating Hot Gas Reheat and Hot Gas Bypass Split System Piping, Suction Up

CF Series Startup Form

Job Name:______________________________________ Date:___________

Address:____

____

Model Number:____

Serial Number:____________________________________ Tag:____________

Startup 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 rotate freely?	☐Yes ☐No

Ambient Temperature

Ambient Dry Bulb Temperature _____°C/°F Ambient Wet Bulb Temperature _____°C/°F

Voltage

L1-L2	L2-L3	L1-L3

L1-Ground	L2-Ground	L3-Ground

Compressors/DX Cooling

Check Rotation ☐							
Number	Model #	L1 Volts/Amps	L2 Volts/Amps	L3 Volts/Amps	Head Pressure	Suction Pressure	Crankcase Heater Amps
1							
2							
3							
4							

Refrigeration System 1 - Cooling Mode

	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A

Refrigeration System 2 - Cooling Mode

	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A

Refrigeration System 3 - Cooling Mode

	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A

Refrigeration System 4 - Cooling Mode

	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A

Refrigeration System 1 - Heating Mode (Heat Pump Only)

	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A

Refrigeration System 2 - Heating Mode (Heat Pump Only)

	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A

Refrigeration System 3 - Heating Mode (Heat Pump Only)

	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A

Refrigeration System 4 - Heating Mode (Heat Pump Only)

	Pressure	Saturated Temperature	Line Temperature	Sub-cooling	Superheat
Discharge				N/A	N/A
Suction				N/A	
Liquid					N/A

Condenser Fans

Alignment ☐ Check Rotation ☐ Nameplate Amps________

Number	hp	L1 Volts/Amps	L2 Volts/Amps	L3 Volts/Amps
1				
2				
3				
4				

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 (ºF)	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

July 2015
Initial version

March 2016
Clarified forklift instructions and removed wording about curb mounting.

June 2016
Updated CF Series Features and Options Introduction. Added Feature 17 Shipping Options in the Feature String Nomenclature. Added Storage information. Added Table for Service Clearances. Clarified Low Ambient section and added a picture of an adjustable fan cycle switch. Added guidelines for variable capacity compressors and tandem compressors in the line sizing section. Added double riser schematics and discussion for heat pump operation. 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. Added A/C with LAC Piping to show low ambient piping which is internal to the condensing unit.

March 2017
Updated Piping Diagrams because receivers are now factory installed in CF 2-7 tons.

April 2017
Updated service clearances tables and added a table for coil pull. Updated orientation of the CF 9-70 ton. Added a note that AAON does not allow underground refrigerant lines. Added clarification to the liquid line solenoid valve recommendation. Added a double suction risers figure. Removed solenoid valve recommendation on the heat pump double risers and updated the figures. Added a suction line traps section. Changed the suction flow minimum velocity for variable compressors. Changed the caution note by removing the variable capacity compressor wording. Added discharge line sizing guidelines. Removed the hot gas bypass piping considerations for evaporator below condensing unit since they are the same as for evaporator above condensing unit. Added a figure for oil return line. Changed the maximum hot gas maximum velocity from 4,000 fpm to 3,500 fpm. Changed the sub-cooling values in the Acceptable Refrigeration Circuit Values table. Updated heat pump piping diagrams to include suction/discharge line traps in suction down diagrams. Added all the LAC piping diagrams.

October 2017
Updated digital compressor discharge up minimum velocity. Updated charge information. Updated phase imbalance example. Added Air Cooled Condenser Option in A1 Compressor Style. Added No Cooling Option in A5 Staging. Added Orion VCCX.

March 2018
Added AAON Touchscreen Controller feature 8B. Updated Refrigerant Piping section to match the DX Handbook. Added note about running variable capacity compressors at 100% for 1 minute when starting. Updated Acceptable Refrigeration Circuit Values Table and notes. Updated piping diagrams with 3-way reheat valve.

May 2018
Updated technical support contact information.

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

November 2018
Added Feature Options N = ECM Condenser Fan Head Pressure Control + Low Sound Condenser Fan & S to Feature 13. Added Standard Evacuation Instructions & Low Ambient & Modulating Reheat System Evacuation Instructions to Installation section. Updated Special Low Ambient Option Charging Instructions and the LAC Valve Piping Schematic figure.

February 2019
Changed WattMaster to Orion. Added Do Not Overcharge note to Acceptable Refrigeration Circuit Values table.

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.

October 2019
Updated mounting section to clarify spring isolation mounting instructions.

April 2020
Minor changes to wording for print.

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 the Nameplate Voltage Markings and Tolerance table. Updated phase imbalance example. Revised the e-coated coil cleaning section. Added Voltage check to the startup form. Added the AAON E-Coated Coil Maintenance Record.

August 2021
Added option J = AAON Refrigeration Systems Supervisory Controls under Feature 8B. Updated the suction line & discharge line traps to include wording for a trap at the bottom of the vertical run. Added Enviro-Coil Cleaner.

December 2021
Added microchannel condenser coil option to Feature A2. Added 10kAIC option to Feature 16. Added Acceptable Microchannel Air-Cooled Condenser Coil Liquid Sub-Cooling Values table. Added microchannel cleaning section. Added Estimated R410A Refrigerant Charge per 5ft table to help with initial charge estimates based on refrigerant line lengths. Updated values in the Charge to Flood Condenser Coil for Ambient Above 70°F table and added a table for microchannel condenser coils.

July 2022
Added the clarification that “ACR” rigid copper tubing must be used for connecting copper.

December 2022
Added obsolete options in the feature string nomenclature for historical reference. Added Two-Stage Refrigeration system options M and N to Model Option A5.

September 2023
Added all information pertaining to UL-60335 standard. Included metric units with all imperial units. Added R-454b P.T. tables.

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

CF Series
Installation, Operation & Maintenance

V04410 · Rev. A · 230927
(ACP J000237)

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.