CB SERIES

CONDENSING UNITS

INSTALLATION, OPERATION & MAINTENANCE

⚠ WARNING

If the information in this manual is not followed exactly, a fire or explosion may result causing property damage, personal injury or loss of life.

⚠ WARNING

FOR YOUR SAFETY
Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.

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Owner should pay particular attention to the words: NOTE, CAUTION AND WARNING. NOTES are intended to clarify or make the installation easier. CAUTIONS are given to prevent equipment damage. WARNINGS are given to alert owner that personal injury and/or equipment damage may result if installation procedure is not handled properly.

It is the intent of AAON to provide accurate and current product information. However, in the interest of product improvement, AAON, Inc. reserves the right to change pricing, specifications, and/or design of its products without notice, obligation or liability

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(ACP 29023)

GENERAL DESCRIPTION

All AAON CB Series condensing units are factory assembled and wired, including a full charge of R-410A refrigerant for up to 25' of line set. Refrigeration systems are factory installed with a liquid line filter drier provided for field installation and a fully hermetic scroll compressor. Compressors are equipped with a positive pressure forced lubrication system. The air-cooled condenser coil is constructed of copper tubes with aluminum fins (copper fins optional).

Note: Systems with the modulating hot gas reheat option will require refrigerant to be field added because of the additional refrigerant components and piping associated with the system

Unpacking:
When received, remove all shipping packages and dispose of properly. Check the unit for damage that might have occurred in transit. If damage is found it should be noted on the carrier's Freight Bill. A request for inspection by carrier's agent should be made in writing at once. Check the unit nameplate to ensure that the correct model, size and voltage have been received to match the job requirements.

OWNER'S INFORMATION

⚠ WARNING

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

Warning:
• Failure to observe the following instructions will result in premature failure of your system, and possible voiding of the product warranty.
• Never cut 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. Since the compressor is designed to pump refrigerant gas, damage may occur when power is restored.
• 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 thermostat, and never from the main power supply (except for emergency or for complete shutdown of the system).
• 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 qualified installer or service agency. Refer to installation instructions included in this manual.
• The compressor must be **off** for a minimum of 5 minutes after any power interruption.
• If the unit has been off for over an hour, restore power to the unit and wait two hours before turning the thermostat on.

⚠ WARNING

Scroll compressors will be damaged by operation with the wrong rotation.
THE SUCTION PRESSURE TRANSDUCER HAS BEEN DISCONNECTED AFTER TESTING AT THE FACTORY.
The wiring must be reconnected and proper rotation determined at the time of start-up by a qualified service technician using suction and discharge pressure gauges.
Any alteration should be made at the unit power connection.

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

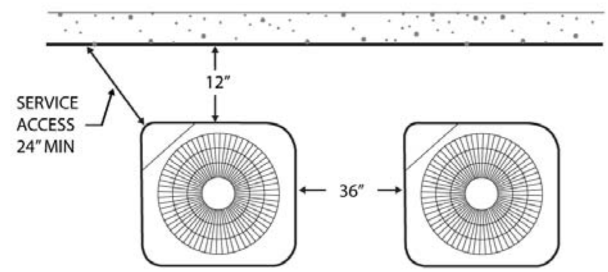
Wiring Diagrams:
• A complete set of unit specific wiring diagrams are laminated in plastic and located inside the control compartment cover.

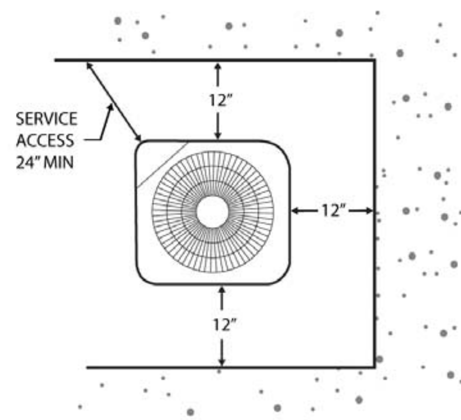
General Maintenance:
After the initial unit startup and on a periodic schedule during operation, it is necessary to perform routine service checks on the performance of the condensing unit. This includes reading and recording suction pressures and checking for normal sub-cooling and superheat. The ECM condenser fan motor is factory preprogrammed and requires no maintenance.

INSTALLATION

Lifting and Handling:
• You are encouraged to use dollies and/or carts to lift and place the unit to prevent damage to the equipment or injury to the installer.
• Care should be taken if using spreader bars, blocking, or other lifting devices to prevent any damage to the coil or the cabinet of the condensing unit.
• Before lifting unit, be sure that all shipping material has been removed from unit.
• All CB Series condensing units have channels underneath the base to provide lifting access to the underside of the equipment and allow moving and placement without physical damage.
• Hoist unit to a point directly above the pad, and lower unit into the proper place (unit may also be positioned with a dolly). When the unit is in place, remove the dolly or lifting device. Make sure the unit is properly seated and level.

Condensing Unit Placement:
• The AAON 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 rooftop mounted, a steel frame must be provided that will support the unit above the roof itself. When installed at ground level, a one-piece concrete slab should be used with footings that extend below the frost line (a substantial base that will not settle).
• With ground level installation, care must be taken to protect the coil fins from damage due to vandalism or other hazards.
• The placement relative to the building air intakes and other structures must be carefully selected. Airflow to and from the condensing unit must not be restricted. Obstruction to air flow will result in decreased performance and efficiency.
• The installation position must provide at least one (1) foot of clearance from the wall for proper air flow to the coils. When units are mounted adjacent to each other, the clearance required between them is three (3) feet.
• Condensing units should not be installed in an enclosure or pit that is deeper than the height of the unit. When recessed installation is necessary, the clearance to maintain proper airflow is at least three (3) feet.





• CB-024 through CB-060 are all single circuit models with vertical air discharge. There must be no obstruction above the equipment. Do not place the unit under an overhang.
• Condenser coils and fans must be free of any obstructions in order to start and operate properly with a correct amount of airflow.
• For proper unit operation, the immediate area around condenser must remain free of debris or grass 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.

Additional Placement Considerations:
Consider the affect of outdoor fan noise on conditioned space and any adjacent occupied space. It is recommended that the unit be placed so that discharge does not blow toward windows less than 25 feet away.

The outdoor unit should be set on a solid, level foundation - preferably a concrete slab at least 4 inches thick. The slab should be above ground level and surrounded by a graveled area for good drainage. Any slab used as a unit's foundation should not adjoin the building as it is possible that sound and vibration may be transmitted to the structure. For rooftop installation, steel or treated wood beams should be used as unit support for load distribution.

Heat pumps require special location consideration in areas of heavy snow accumulation and/or areas with prolonged continuous subfreezing temperatures. Heat pump unit bases are cutout under the outdoor coil to permit drainage of frost accumulation. The unit must be situated to permit free unobstructed drainage of the defrost water and ice. A minimum 3" clearance under the outdoor coil is required in the milder climates. In more severe weather locations, it is recommended that the unit be elevated to allow unobstructed drainage and airflow. The following elevation minimums are recommended:

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

Service Clearance:
An access panel is provided to the electrical service compartment. The CB Series condensing unit service compartment must be accessible for periodic servicing of controls, safety devices, and refrigerant service/shutoff valves. At least two (2) feet of clearance on this corner of the unit is recommended for service.

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

Low Ambient Operation:
• The AAON low ambient (condenser fan cycling) system is used to operate a refrigerant system down to 35°F outside air temperature. As the ambient temperature drops, the condenser becomes more effective therefore lowering the head pressure. When the head pressure gets too low there will be insufficient pressure to operate the expansion valve properly. During low ambient temperatures, it is difficult to start a system because the refrigerant will migrate to the cold part of the system (condenser) and make it difficult for refrigerant to flow.
• The AAON zero degree ambient system maintains normal head pressure during periods of low ambient by effectively reducing the heat transfer surface area, reducing capacity and increasing condensing pressure, allowing the system to operate properly. During periods with higher ambient temperatures the entire condenser is required to condense refrigerant.

Electrical:
• The single point electrical power connections are made in the electrical control compartment.
• Check the unit name plate to make sure it agrees with the power supply. Connect power to the unit according to the wiring diagram provided with the unit.
• The power and control wiring may be brought in through the utility entry. Protect the branch circuit in accordance with code requirements. If the control wires are to run inside the same conduit, 600 volt wires should be used, or as required by applicable codes. The unit must be electrically grounded in accordance with the National Electric Code.
• Units are factory wired for 230V 1 ph. 60Hz application. For 208V applications, the transformer wire taps should be changed for 208V operation.
• Power wiring is to the unit terminal block or compressor contactor. All wiring beyond this point has been done by the manufacturer and

cannot be modified without effecting the unit's agency/safety certification.

⚠ WARNING

Electric shock hazard. Can cause injury or death. Before attempting to perform any service or maintenance, turn the electrical power to unit to OFF at disconnect switch(es). Unit may have multiple power supplies.

Note: Startup technician must check motor amperage to ensure that the amperage listed on the motor nameplate is not exceeded.

Thermostat:
Units without the neutral air dehumidification feature will operate with most common thermostats. Units with the neutral air dehumidification feature must use thermostats with a normally closed (NC) dehumidification option. The following stats have been approved for usage with the dehumidification feature.

Robertshaw	Honeywell
9825i2	VisionPRO®IAQ

STARTUP

Pre Startup:
NOTE: Crankcase Heater Operation
All units are equipped with a crankcase heater, which should be energized at least 24 hours prior to setting the thermostat for cooling operation with the compressor.

After the installation and immediately before the startup of the condensing unit be sure that these items have been checked.

1. Verify that electrical power is available to the unit.
2. Verify that the thermostat is in the cooling mode and the "fan" switch is in the **ON** position.

While performing the Startup, use the CB Startup Form at the back of this booklet to record motor amps and any other comments.

Startup:
• Use the General Check List at the top of the Startup Form to make a last check that all the components are in place and the power supply is energized.

• CHECK COMPRESSOR FOR PROPER ROTATION BY STARTING UNIT ONLY AFTER CONNECTING PRESSURE GAUGES TO SUCTION AND DISCHARGE VALVES. THE COMPRESSOR WILL FAIL IF OPERATED IN THE WRONG DIRECTION.

• Turn cooling on – check to see that the compressor(s) is operating within tolerance.
• When unit is running, observe the system for a complete operation cycle to verify that all systems are functioning properly.

⚠ CAUTION

On three phase units the rototation must be checked on ALL MOTORS AND COMPRESSORS. SCROLL COMPRESSORS ARE DIRECTIONAL. Rotation must be checked on start-up by a qualified service technician using suction and discharge gauges. Scroll compressors will FAIL if run in the wrong direction. Condenser fan rotation should be checked and only be altered if necessary at the power connection.

• While performing the check, use the CB Startup Form to record observations of amps and refrigerant pressures.

⚠ CAUTION

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

SERVICING AND 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 (see *Charging Refrigerant* section).

Compressors:
Scroll compressors are fully hermetic and require no maintenance except for keeping the shell clean.

Refrigerant Filter Driers:
Each refrigerant circuit should contain a built in liquid line filter drier that is shipped loose with the unit for field installation. The unit does not include a liquid line solenoid valve. This must be field furnished and installed if required by job conditions.

Charging Refrigerant:
• The unit comes with full charge based on a 25 foot line set. Charging 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.

⚠ IMPORTANT

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:
• The unit being charged must be at or near full load conditions before adjusting the charge.
• Units equipped with hot gas reheat must have the hot gas reheat valves closed to get the proper charge.
• Units equipped with hot gas reheat must be charged with the hot gas valve closed while the unit is in cooling mode.
• After adding or removing charge the system must be allowed to stabilize, typically 10-15 minutes, before making any other adjustments.
• The type of unit and options determine the ranges for liquid sub-cooling and evaporator superheat. Refer to **TABLE 1** when determining the proper sub-cooling.
• The vertical rise of the liquid line must be known in order to adjust the sub-cooling range for proper charge.

Checking Liquid Sub-cooling:
1. Measure the temperature of the **liquid line** as it leaves the condenser coil.
2. Read the gauge pressure reading of 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.
3. Convert the pressure obtained in Step 2 to a saturated temperature using the refrigerant temperature-pressure chart at the back of this manual.
4. Subtract the measured liquid line temperature in Step 1 from the saturated temperature in Step 3 to determine the liquid sub-cooling.
5. Compare calculated sub-cooling to **TABLE 1** for the appropriate unit type and options.

Checking Evaporator Superheat:
1. Measure the temperature of the **suction line** close to the compressor.
2. Read gauge pressure at the **suction line** close to the compressor.
3. Convert the pressure obtained in Step 2 to a saturated temperature using the appropriate refrigerant temperature-pressure chart.
4. Subtract the saturated temperature in Step 3 from the measured suction line temperature in Step 1 to determine the evaporator superheat.
5. Compare calculated superheat to **TABLE 1** for the appropriate unit type and options.

Adjusting Sub-cooling and Superheat Temperatures:
The system is **overcharged** if:
1. the sub-cooling temperature is too high **and**
2. the evaporator is fully loaded (low loads on the evaporator result in increased sub-cooling) **and**
3. the evaporator superheat is within the temperature range as shown in **TABLE 1** (high superheat results in increased sub-cooling)

TABLE 1			
	Sub-cooling (°F)	Superheat (°F)	Sub-cooling W/Hot Gas Reheat (°F)
Air-Cooled Condenser	12-18*	8-15**	15-22*

* Sub-cooling must be increased by 2°F per 20 feet of vertical liquid line rise for R- 410A
** Superheat will increase with long suction line runs.

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

CAUTION

Refigerant overcharging leads to excess refrigerant in condenser coils resulting in elevated compressor discharge pressure. DO NOT OVERCHARGE !

The system is **undercharged** if:
1. the superheat is too high **and**
2. 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.

Lubrication:
• All original motors and bearings are furnished with factory lubrication. They require no lubrication.

Condenser Coil:
• The air-cooled condenser rejects heat by passing outdoor air over the fin tube coils for cooling of the hot refrigerant gas from the compressors. The heated air will discharge from the unit through the axial flow fans.
• The condenser coils should be inspected yearly to ensure unrestricted airflow. If the installation has a large amount of airborne dust or other material, the condenser coils should be cleaned with a water spray in a direction opposite to airflow. Care must be taken to prevent bending of the aluminum fins on the copper tube.
• Before attempting to clean the coils; set thermostat to the "OFF" position; turn the electrical power to the unit to the "OFF" position at the disconnect switch outside by the unit. The condenser coil can be thoroughly cleaned by washing from the inside out with water and a coil cleaner. If coil is extremely dirty with clogged fins, a service professional specializing in coil cleaning should be called.

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

Note: Service technician must provide the model and serial number of the unit in all correspondence with AAON.

• Replacement parts for AAON equipment may be obtained from AAON. When ordering parts, always reference the unit model number, serial number and part number.

To order parts from the AAON parts store online go to www.aaonparts.com.

REFRIGERANT PIPING FOR THE CB SERIES

Note: 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 condensing unit and air handling equipment. AAON is not responsible for interconnecting refrigerant piping. Consult ASHRAE Handbook – Refrigeration and ASME Standards.

General:

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

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

• All CB series condensing units have factory furnished liquid and suction line shutoff valves.

• The pipe sizes must be selected to meet the actual installation conditions and not simply based on the connection sizes at the evaporator and/or condensing unit.

• Condensing units are provided with in-line shutoff valves on both the liquid and suction lines. These should remain closed until the system is ready for start-up after piping and vacuuming.

• Piping should conform to generally accepted practices and codes.

• Upon completion of piping connection, the interconnecting piping and air handler MUST BE evacuated to 500 microns or less; leak checked and charged with R-410A refrigerant.

Determining Refrigerant Line size:

The piping between the condenser and low side must assure:

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 narrow, pressure-reducing frictional forces increase.

• 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 expansion valve 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.

The pipe sizes must be selected to meet the actual installation conditions, and not simply based on the connection sizes at the evaporator and/or condensing unit. Refer to TABLE RP-1 for connection size information.

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 run underground, up vertical risers, or in excessively long line runs.

Liquid line sizing:

• 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 section is below the condenser, and the liquid line does not include risers, 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 should 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 should 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, in the direction of the compressor to minimize the complexity of the configuration.

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

Liquid Line Guidelines:
• In order to ensure liquid at the TXV, frictional losses must not exceed available sub-cooling. A commonly used guideline to consider is a system design with pressure losses due to friction through the line not to exceed a corresponding 1-2°F change in saturation temperature.
• If the velocity of refrigerant in the liquid line is too great, it could cause excessive noise or piping erosion. The recommended maximum velocities for liquid lines are 100 fpm from the condenser to a receiver tank when used, to discourage fluid backup, and 300 fpm from receiver tank to the evaporator to minimize valve induced liquid hammer.

Liquid Line Accessories:
Liquid line shut off valves are factory installed while filter drier is shipped loose for field installation. 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.

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

Suction Line Routing:
• Pitch the suction line in the direction of flow (about 1 ft. per 100 ft of length) to maintain oil flow towards the compressor, and keep it from flooding back into the evaporator. 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. A double suction riser can be applied in this situation. The double suction riser is designed to return oil at minimum load while not incurring excessive frictional losses at full load. The 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 should be sized to return oil at minimum load, while the larger diameter pipe should be sized so that flow through both pipes provides acceptable pressure drop at full load.

Suction Line Insulation:
The entire suction line should be insulated. 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.

Suction Line Guidelines:
• For proper performance, suction line velocities less than a 4000 fpm maximum are recommended. The minimum velocity required to return oil is dependent on the pipe diameter, however a general guideline of 1000 fpm minimum may be applied.
• In a fashion similar to the liquid line, a common guideline to consider is a system design with pressure losses due to friction through the line not to exceed a corresponding 1-2°F change in saturation temperature.
• At points where small pipe size can be used to provide sufficient velocity to return oil in vertical risers at part loads, greater pressure losses are incurred at full loads. This can be compensated for by over sizing the horizontal runs and vertical drop sections. This will however require additional refrigerant charge.

Suction Line Accessories:
If the job requirements specify suction accumulators, they must be separately purchased and installed.

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 for Evaporator Above Condensing Unit:
• Pitch the hot gas bypass line downward in the direction of refrigerant flow, toward the evaporator.
• When installing hot gas bypass risers, a drain leg must be provided at the lowest point in the system. The drain leg must be vertical, its diameter should be the same as the diameter of the riser, and it should be 1 foot long. Install a sight glass in the drain leg for observation. Run an oil return line, using 1/8 inch capillary tube, 10 feet in length, from the drain leg to the suction line. Connect the oil return line below the sight glass, 1 inch above the bottom of the drain leg.
• HGBP valves are adjustable. Factory HGBP valve settings will be sufficient for most applications, but may require slight adjustments for some make up air or other process cooling applications.
• Insulate the entire length of the HGBP line with a minimum 1 inch thick Armaflex insulation.

Hot Gas Bypass Piping Considerations for Evaporator Below Condensing Unit:
• The line must slope downward from the hot gas bypass valve toward the evaporator.

Hot Gas Bypass Line Guidelines:
• Choose a small size line to ensure oil return, and minimize refrigerant charge.
• Maintain velocities below a maximum of 4000 fpm. A general minimum velocity guideline to use is approximately 1000 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 evaporator 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 should 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 hot gas reheat risers, a drip leg must be provided at the lowest point in the system. The drip leg must be vertical, its diameter should be the same as the diameter of the riser, and it should be 1 foot long. Run a drip line, using 1/8 inch capillary tube, 10 feet in length, from the drip leg to the suction line. Connect the drip line a minimum of 1-inch above the bottom of the drain leg.

• 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 3500 fpm. A general minimum velocity guideline is 2000 fpm.

Predetermined Line Sizes:

• To aid in line sizing and selection, AAON has predetermined line sizes for the liquid and suction lines in comfort cooling applications.

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

• The liquid lines have been chosen to maintain velocities between 100 and 350 fpm. The suction line diameters are selected to limit velocities to a 4000 fpm maximum, while a minimum velocity restriction is imposed by the ability to entrain oil up vertical suction risers (ASHRAE Handbook - Refrigeration).

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

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

When to use predetermined line sizing:

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

How to use predetermined line sizing:

• First, read the previous section entitled *(When to use predetermined line sizing)* to decide if this method is applicable.

• Next, consult TABLE RP-1 for pipe diameters.

• Examine Figure RP-1 to determine the acceptable line dimensions associated with the pipe diameters determined in TABLE RP-1. The figure is shown as total available riser height versus total equivalent line length for the liquid line. This curve identifies a region of acceptable piping configuration when the predetermined line sizes are selected for any model in the table. A piping configuration above the curve falls outside the assumptions used to determine the line size and will result in a loss of sub-cooling, and additional pressure losses in the suction and hot gas bypass lines.

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

• Figure RP-1 is presented in terms of the liquid line, but it assumes that the line lengths for the suction and hot gas bypass are similar, as these lines will commonly be routed together to minimize the space and cost required for split system installation.

TABLE RP-1: Predetermined Line sizes for CB units with two step compressors and R-410A

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

* Hot Gas Bypass line
** Hot Gas Reheat line

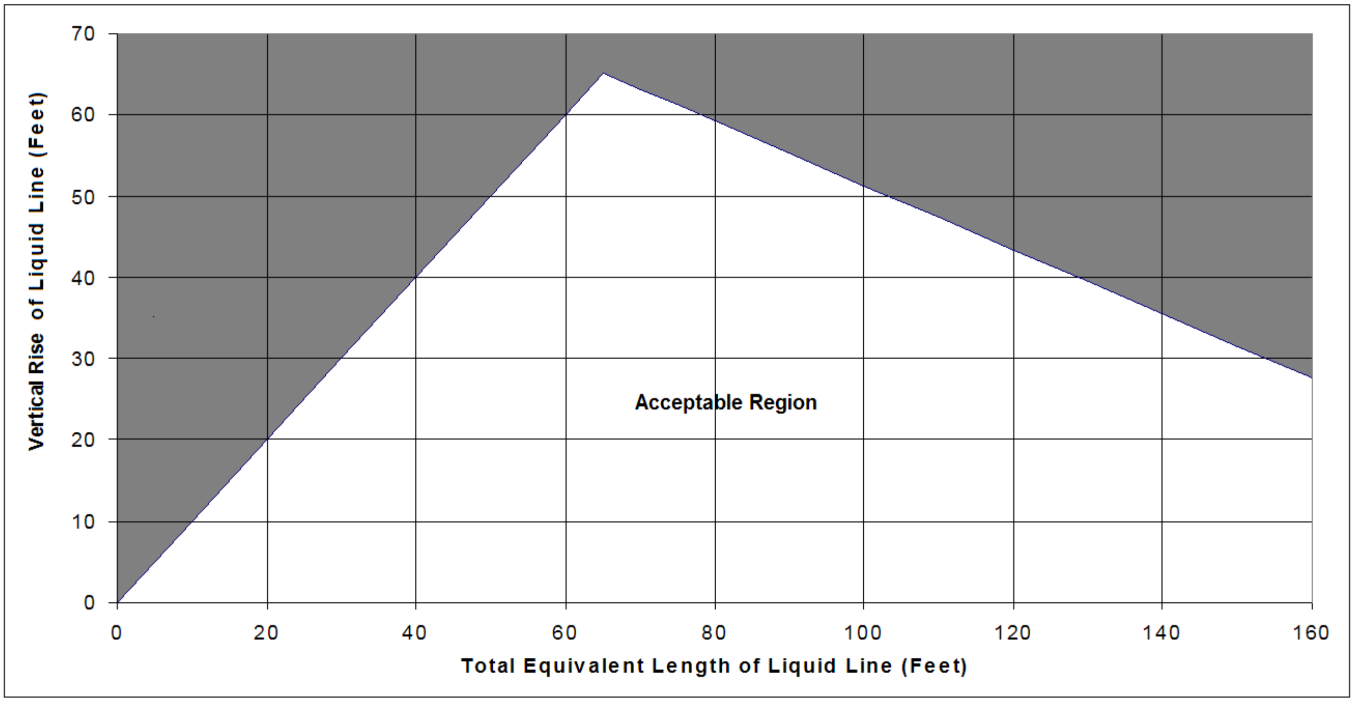


FIGURE RP-1. Riser height versus total equivalent line length for R-410A split system applications with two-step compressor CB-024 through CB-060 units. The region of acceptable riser height is the lighter area. Select the corresponding predetermined line size from TABLE RP-1 above.

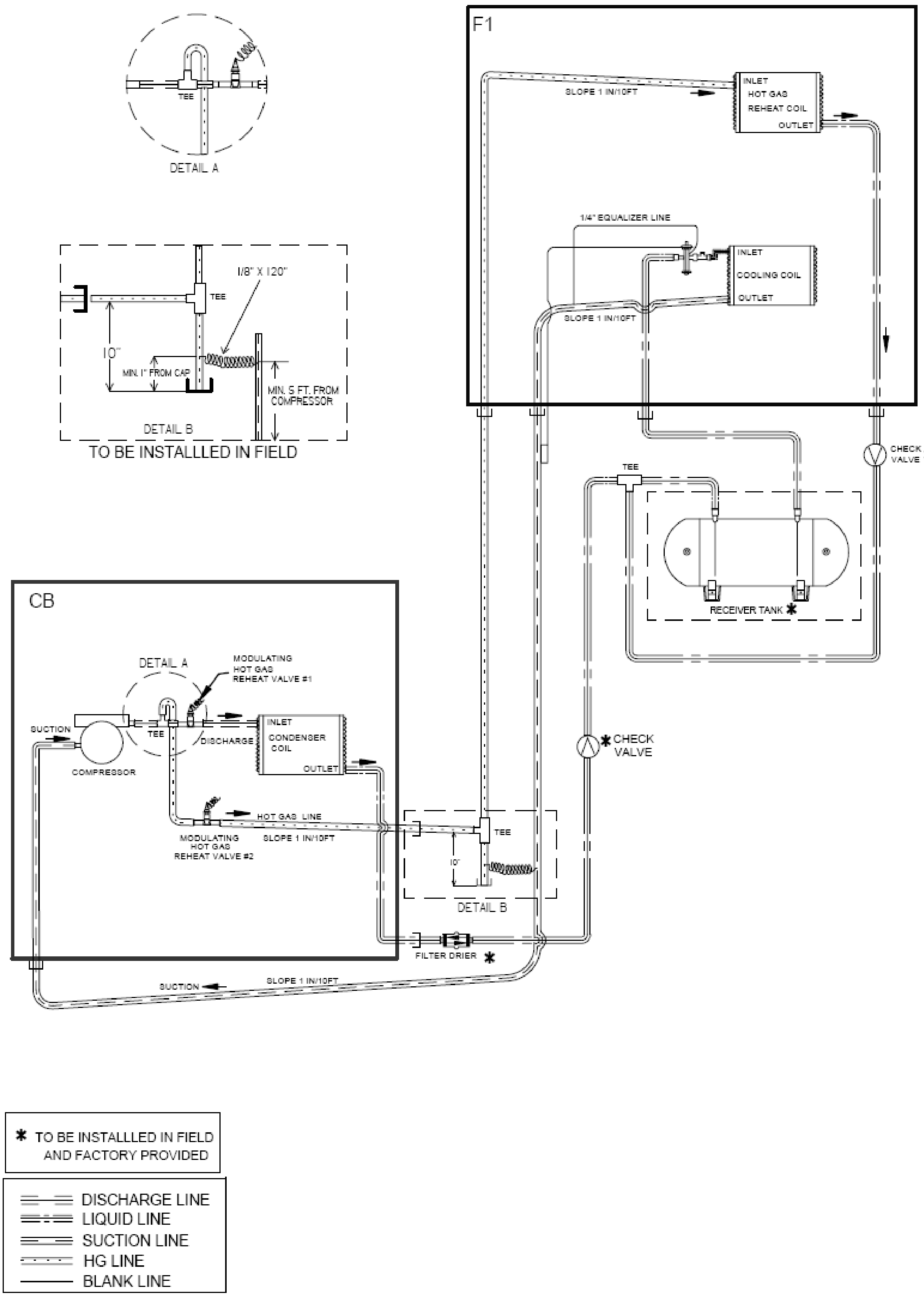


FIGURE RP-2. HOT GAS REHEAT PIPING DIAGRAM WITH AIR HANDLER ABOVE CONDENSING UNIT.

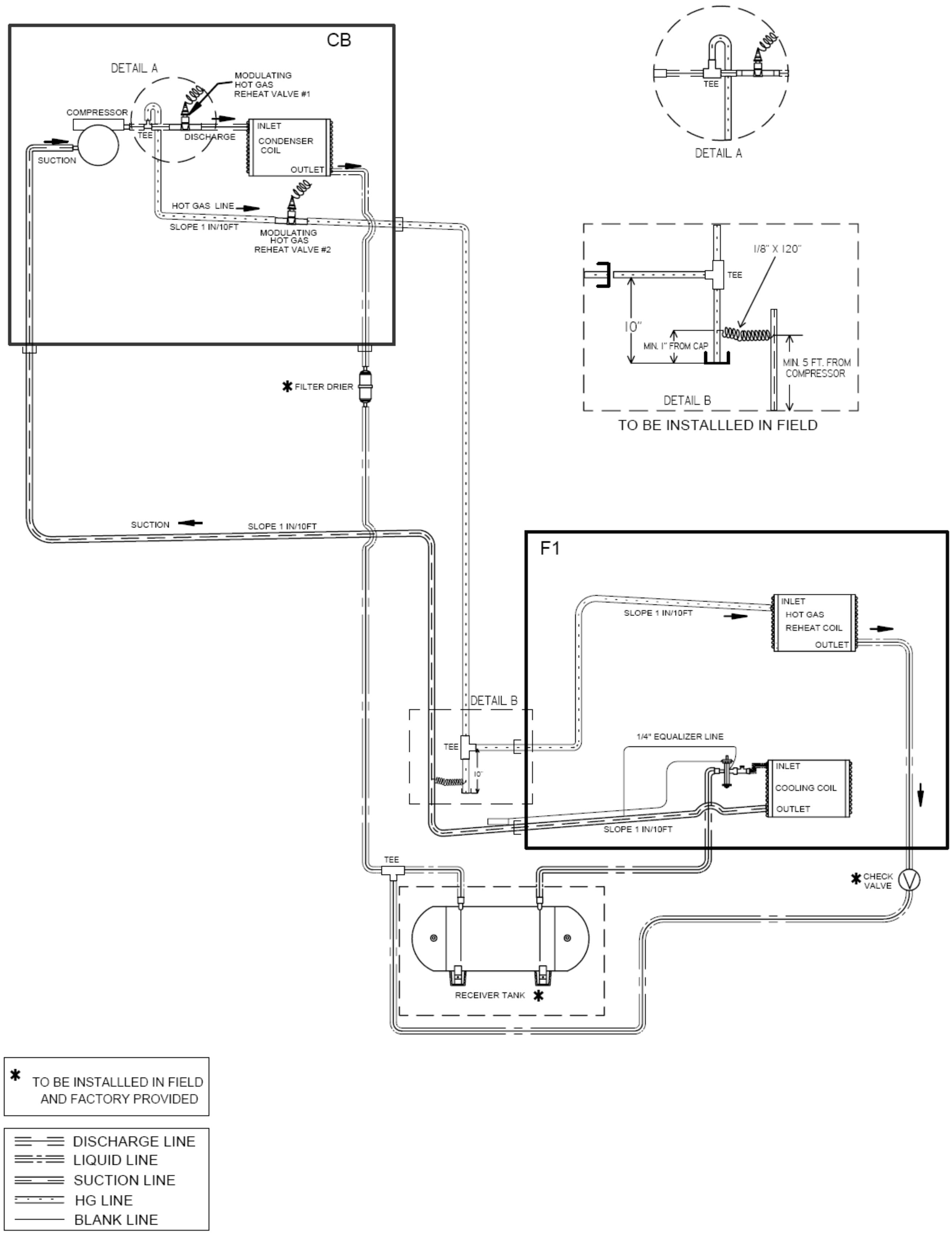


FIGURE RP-3. HOT GAS REHEAT PIPING DIAGRAM WITH AIR HANDLER BELOW CONDENSING UNIT.

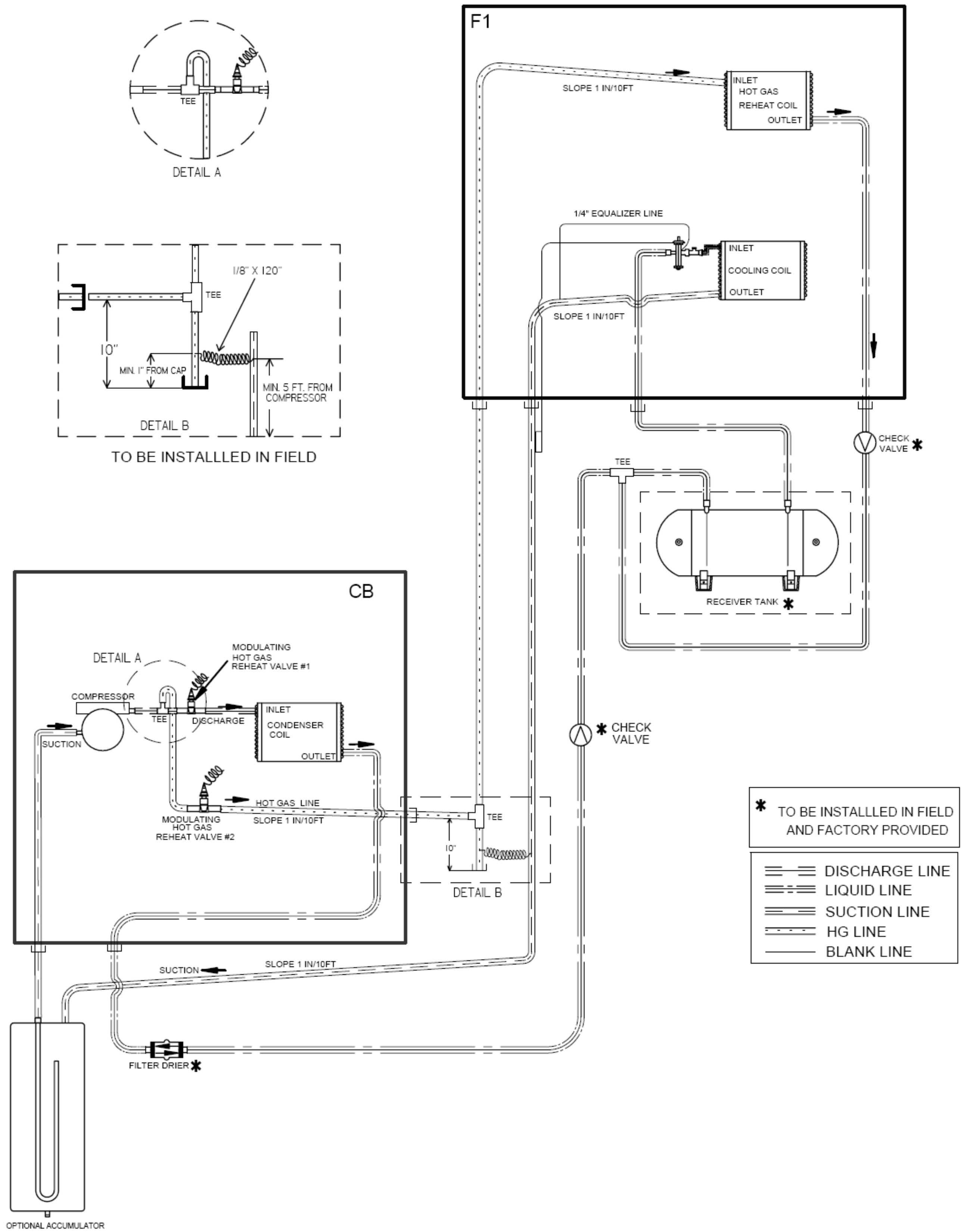


FIGURE RP-4. HOT GAS REHEAT PIPING DIAGRAM WITH AIR HANDLER ABOVE CONDENSING UNIT & OPTIONAL ACCUMULATOR.

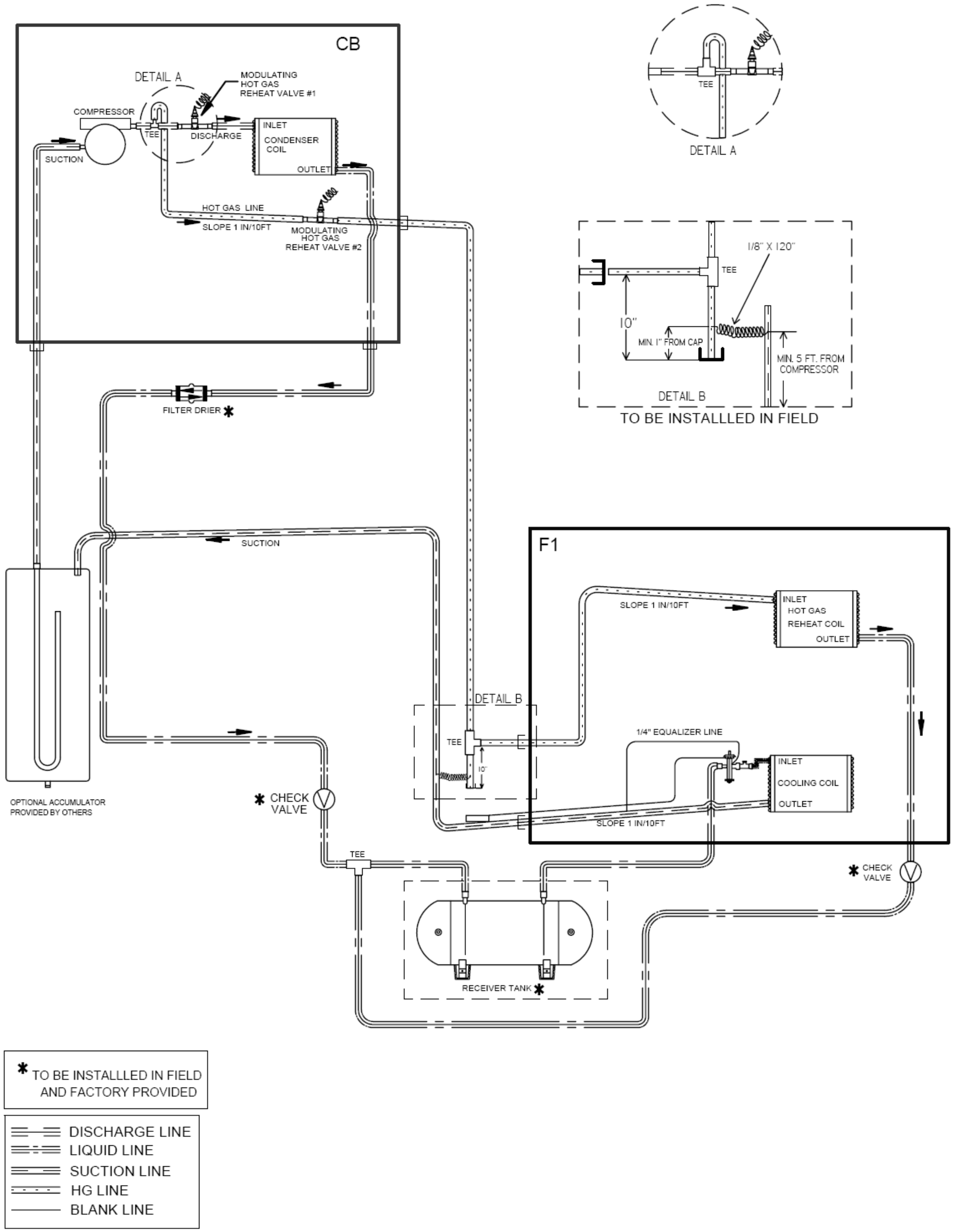


FIGURE RP-5. HOT GAS REHEAT PIPING DIAGRAM WITH AIR HANDLER BELOW CONDENSING UNIT & OPTIONAL ACCUMULATOR.

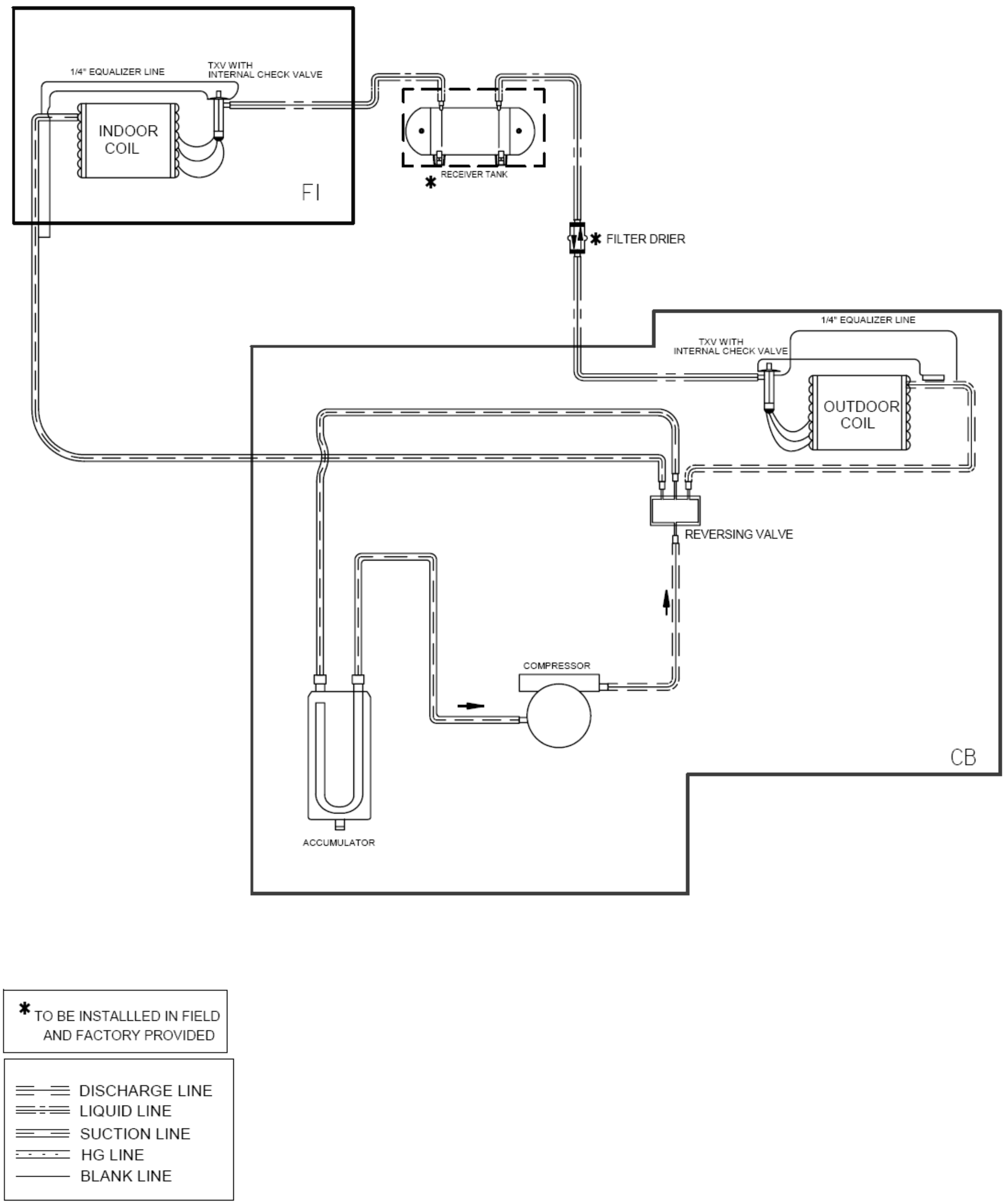


FIGURE RP-6. HEAT PUMP PIPING WITH INDOOR UNIT ABOVE OUTDOOR UNIT

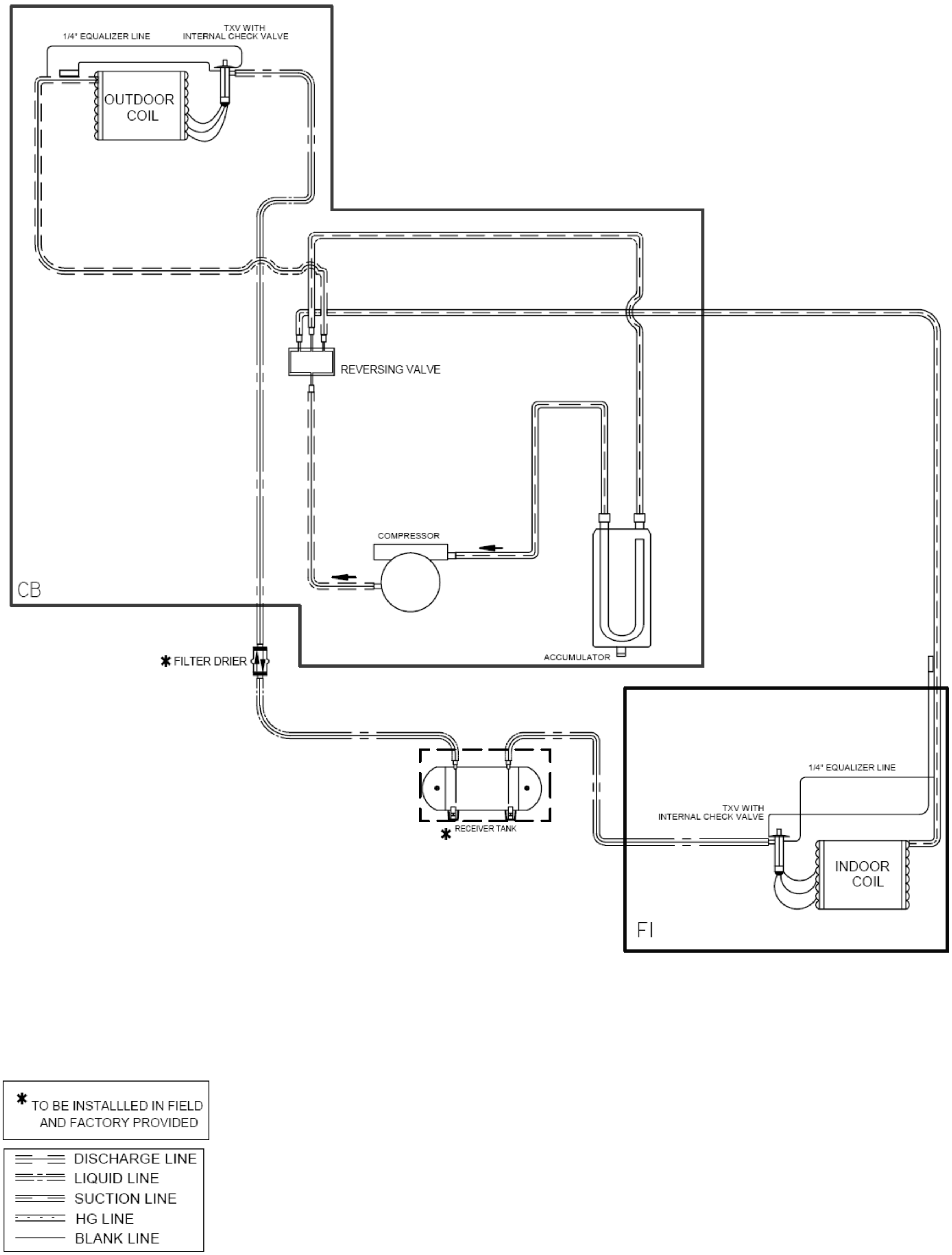


FIGURE RP-7. HEAT PUMP PIPING WITH OUTDOOR UNIT ABOVE INDOOR UNIT

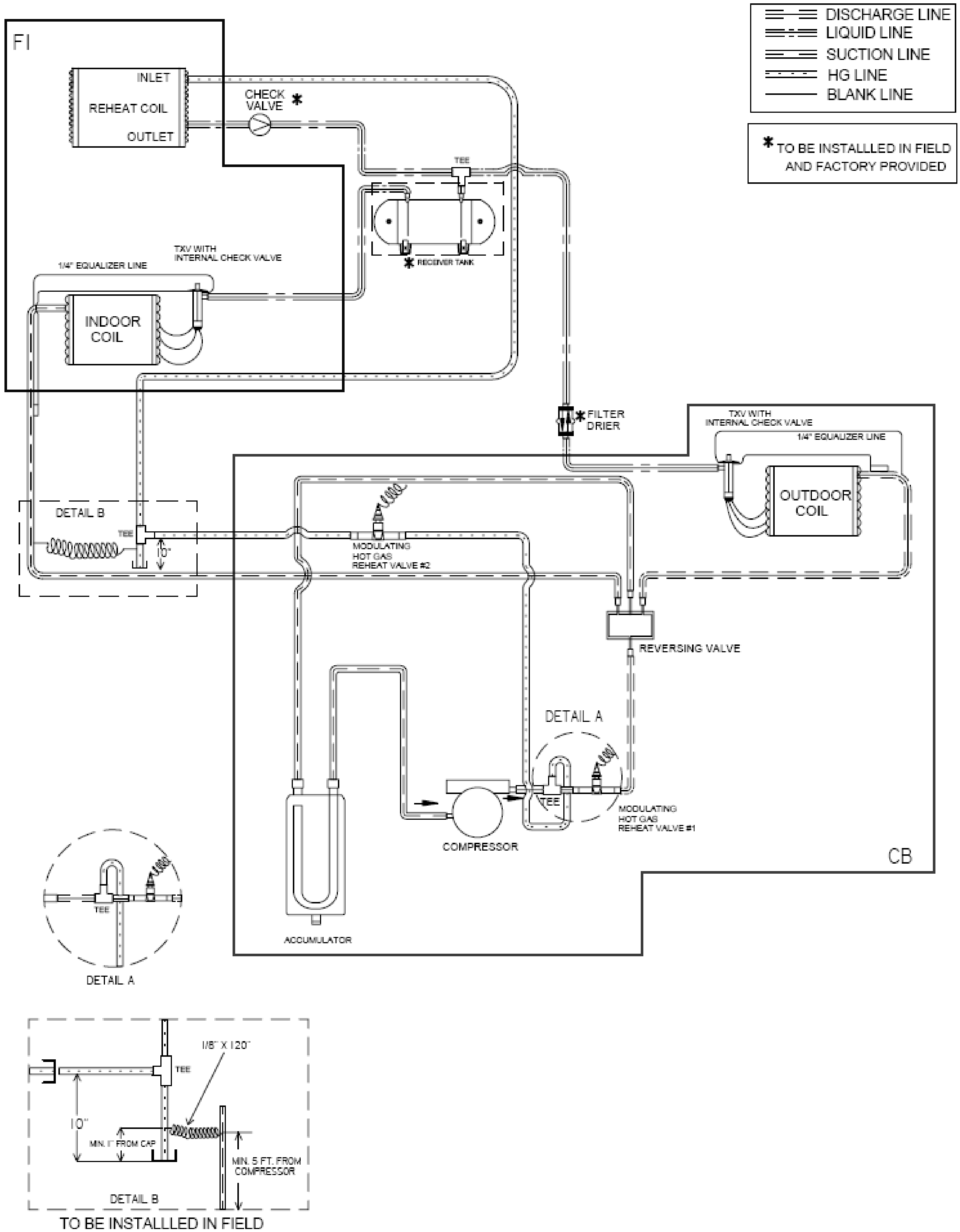


FIGURE RP-8. HEAT PUMP PIPING WITH REHEAT & INDOOR UNIT ABOVE OUTDOOR UNIT

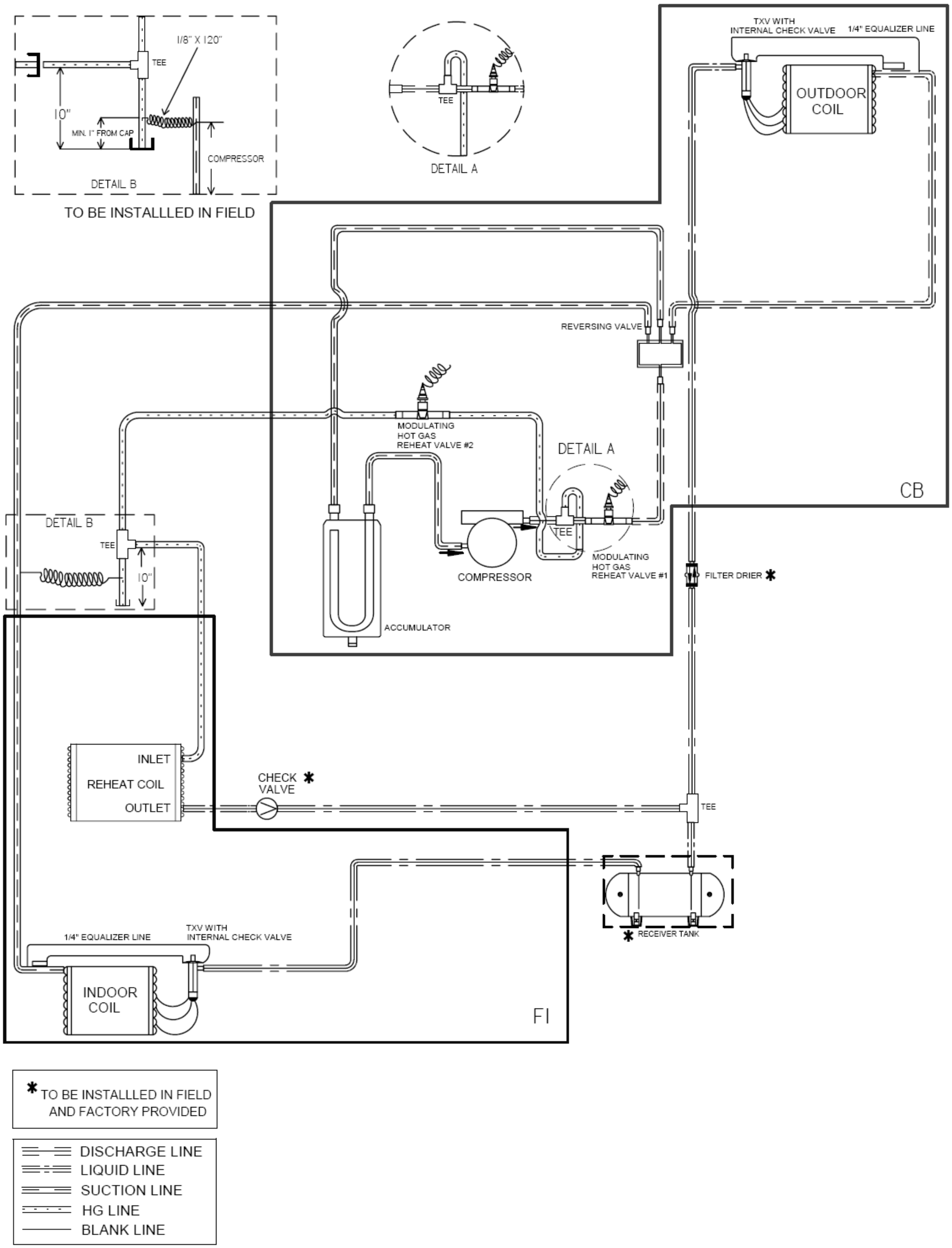


FIGURE RP-9. HEAT PUMP PIPING WITH REHEAT & OUTDOOR UNIT ABOVE INDOOR UNIT

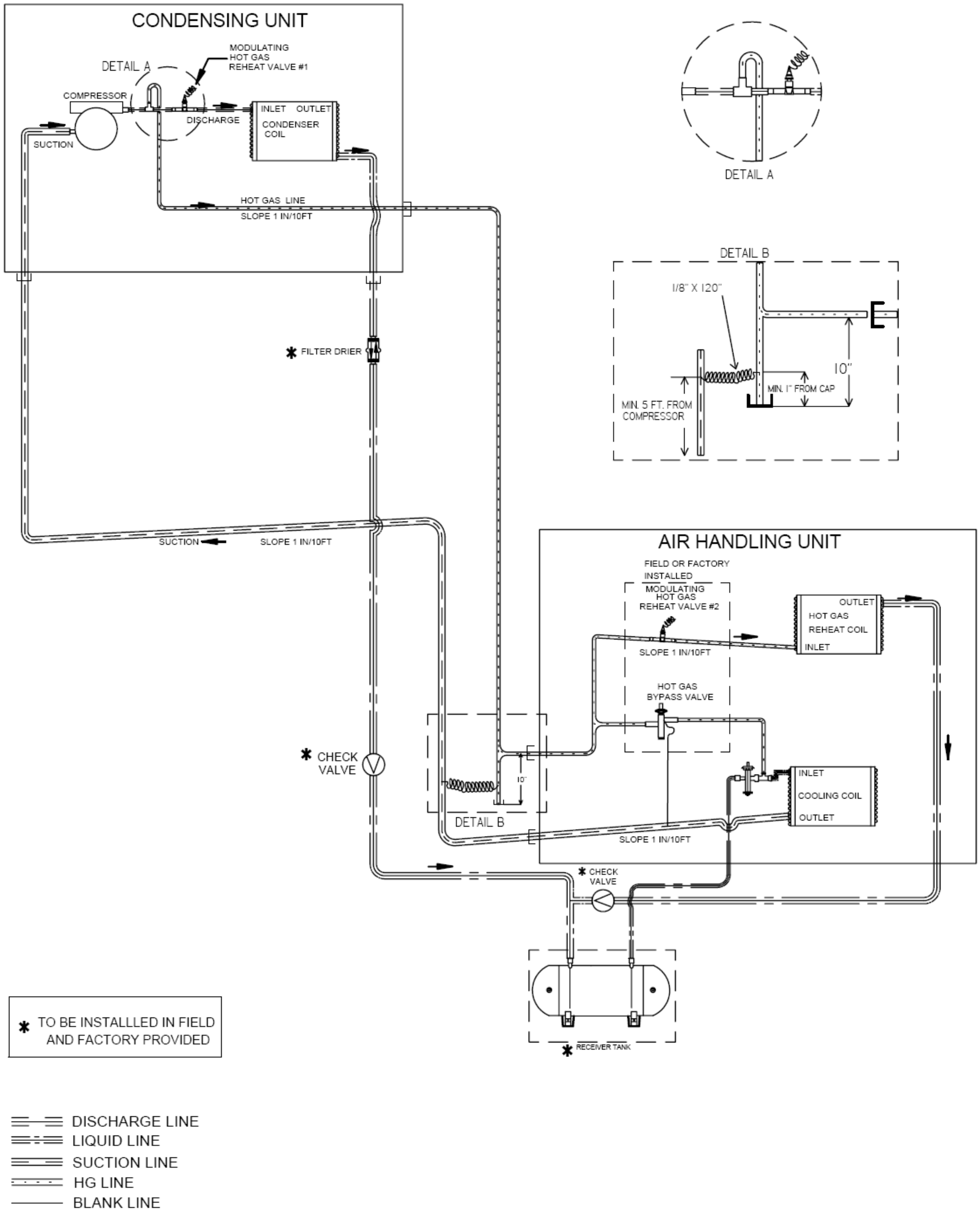


FIGURE RP-10. HOT GAS REHEAT PIPING DIAGRAM WITH HOT GAS BYPASS & AIR HANDLER BELOW CONDENSING UNIT.

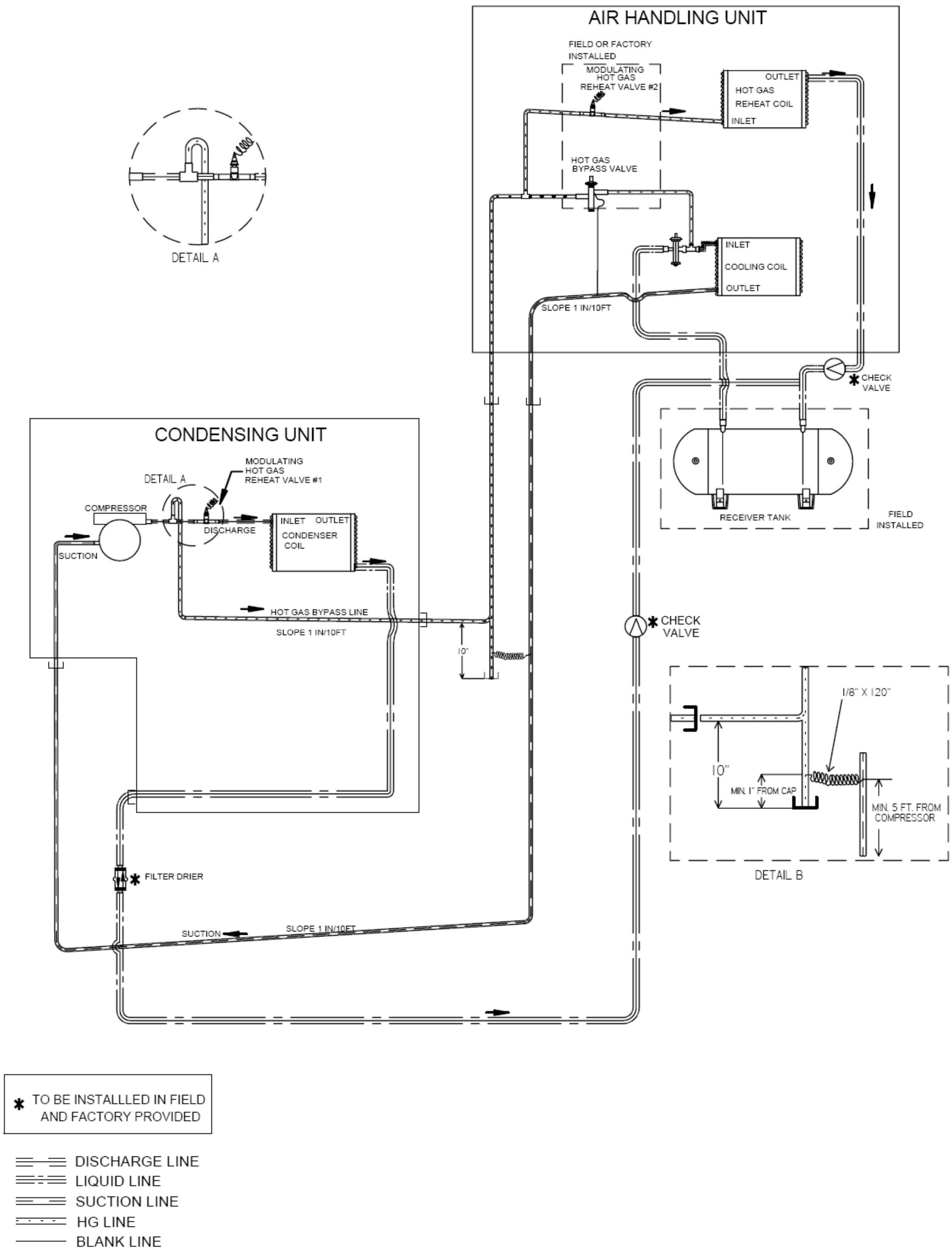


FIGURE RP-11. HOT GAS REHEAT PIPING DIAGRAM WITH HOT GAS BYPASS & AIR HANDLER ABOVE CONDENSING UNIT.

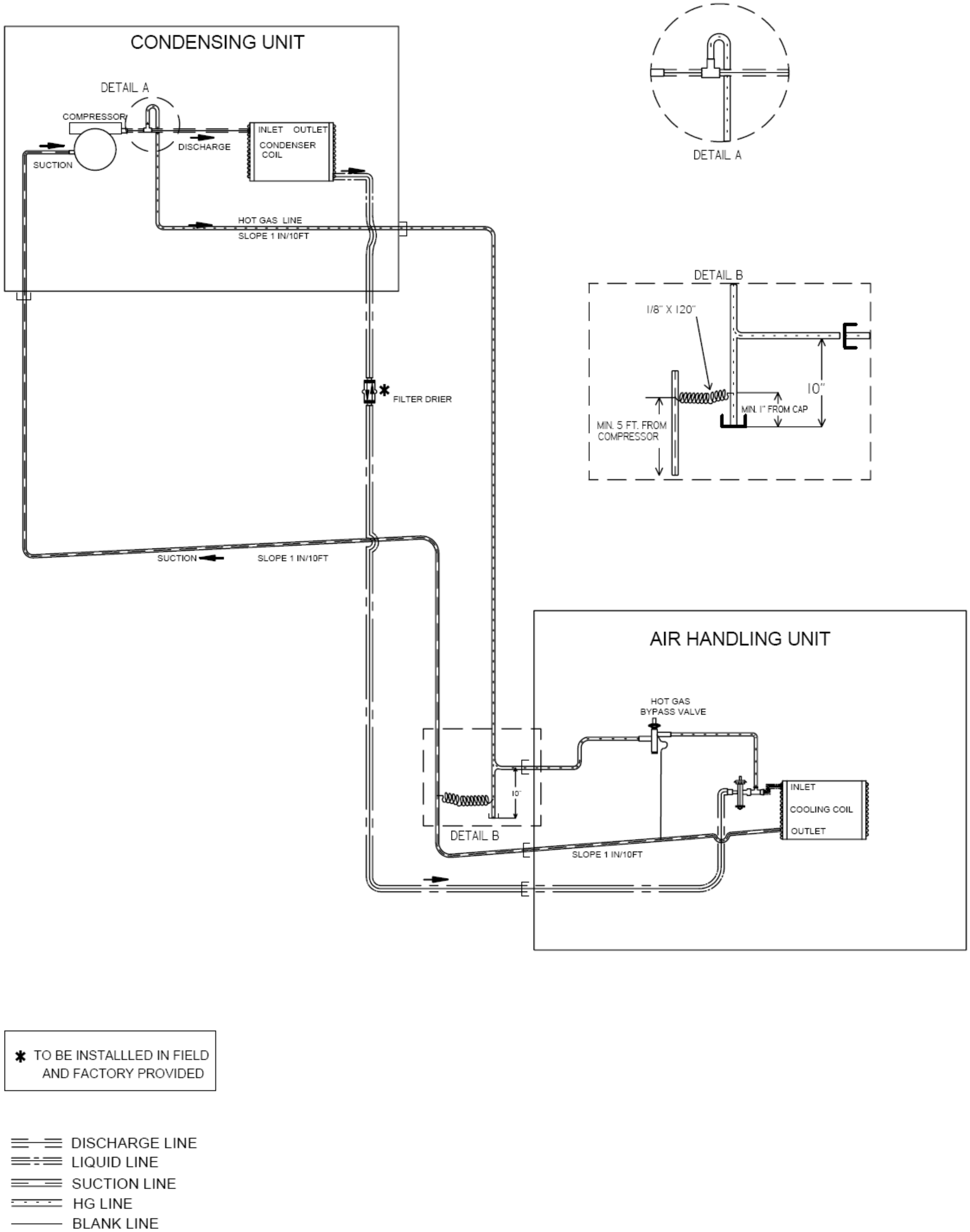


FIGURE RP-12. HOT GAS BYPASS PIPING DIAGRAM WITH AIR HANDLER BELOW CONDENSING UNIT.

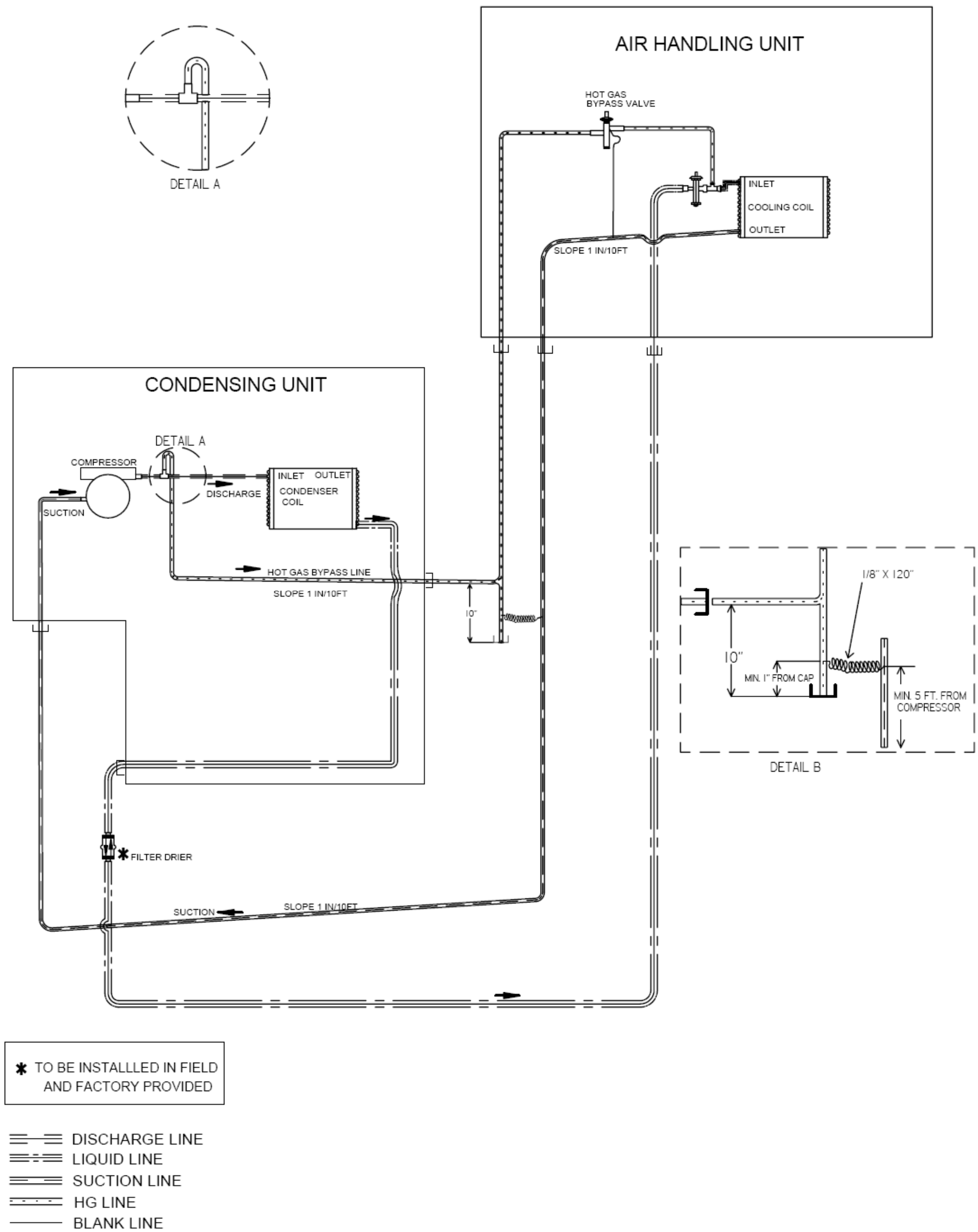


FIGURE RP-13. HOT GAS BYPASS PIPING DIAGRAM WITH AIR HANDLER ABOVE CONDENSING UNIT.

CB STARTUP FORM

DATE:___________________
JOB NAME:____
ADDRESS:____ MODEL No:______________
CITY, STATE:____ SERIAL No:______________
START-UP CONTRACTOR:____________________________________ TAG:____________________

PRE STARTUP CHECKLIST

Installing contractor shall verify the following items (cross out items that do not apply).

1. Is there any visible shipping damage?__________ Yes ☐ No ☐
2. Is the unit installation level?__________ Yes ☐ No ☐
3. Are the unit clearances adequate for service and operation?__________ Yes ☐ No ☐
4. Do all access panels removable freely?__________ 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. Has the over current protection been installed to match unit nameplate requirement?__________ Yes ☐ No ☐
9. Have all set screws on fans (if applicable) been tightened?__________ Yes ☐ No ☐
10. Does condenser fan rotate freely?__________ Yes ☐ No ☐

COOLING TEST

COMPRESSORS					CRANKCASE HEATER AMPS
NUMBER	MODEL #	AMPS L1	AMPS L2	AMPS L3	
1					

AMBIENT TEMPERATURE

AMBIENT DRY BULB TEMP______________°F AMBIENT WET BULB TEMP______________°F

REFRIGERATION SYSTEM #1

	PRESSURE	SATURATED TEMPERATURE	LINE TEMPERATURE	SUB-COOLING	SUPERHEAT
DISCHARGE					
SUCTION					
LIQUID					

CONDENSER FAN AMPS

ALIGNMENT________ ☐ CHECK ROTATION__________ ☐ NAMEPLATE AMPS________ ☐

NUMBER	HP	L1	L2	L3
1				

NOTES:

R-410A Saturation Pressure/Temperature Chart

(°F)	PSIG	(°F)	PSIG	(°F)	PSIG	(°F)	PSIG	(°F)	PSIG
20	78.3	**50**	142.2	**80**	234.9	**110**	364.1	**140**	540.1
21	80	**51**	144.8	**81**	238.6	**111**	369.1	**141**	547
22	81.8	**52**	147.4	**82**	242.3	**112**	374.2	**142**	553.9
23	83.6	**53**	150.1	**83**	246	**113**	379.4	**143**	560.9
24	85.4	**54**	152.8	**84**	249.8	**114**	384.6	**144**	567.9
25	87.2	**55**	155.5	**85**	253.7	**115**	389.9	**145**	575.1
26	89.1	**56**	158.2	**86**	257.5	**116**	395.2	**146**	582.3
27	91	**57**	161	**87**	261.4	**117**	400.5	**147**	589.6
28	92.9	**58**	163.8	**88**	265.4	**118**	405.9	**148**	596.9
29	94.9	**59**	166.7	**89**	269.4	**119**	411.4	**149**	604.4
30	96.8	**60**	169.6	**90**	273.5	**120**	416.9	**150**	611.9
31	98.8	**61**	172.5	**91**	277.6	**121**	422.5		
32	100.9	**62**	175.4	**92**	281.7	**122**	428.2		
33	102.9	**63**	178.4	**93**	285.9	**123**	433.9		
34	105	**64**	181.5	**94**	290.1	**124**	439.6		
35	107.1	**65**	184.5	**95**	294.4	**125**	445.4		
36	109.2	**66**	187.6	**96**	298.7	**126**	451.3		
37	111.4	**67**	190.7	**97**	303	**127**	457.3		
38	113.6	**68**	193.9	**98**	307.5	**128**	463.2		
39	115.8	**69**	197.1	**99**	311.9	**129**	469.3		
40	118.1	**70**	200.4	**100**	316.4	**130**	475.4		
41	120.3	**71**	203.6	**101**	321	**131**	481.6		
42	122.7	**72**	207	**102**	325.6	**132**	487.8		
43	125	**73**	210.3	**103**	330.2	**133**	494.1		
44	127.4	**74**	213.7	**104**	334.9	**134**	500.5		
45	129.8	**75**	217.1	**105**	339.6	**135**	506.9		
46	132.2	**76**	220.6	**106**	344.4	**136**	513.4		
47	134.7	**77**	224.1	**107**	349.3	**137**	520		
48	137.2	**78**	227.7	**108**	354.2	**138**	526.6		
49	139.7	**79**	231.3	**109**	359.1	**139**	533.3		

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