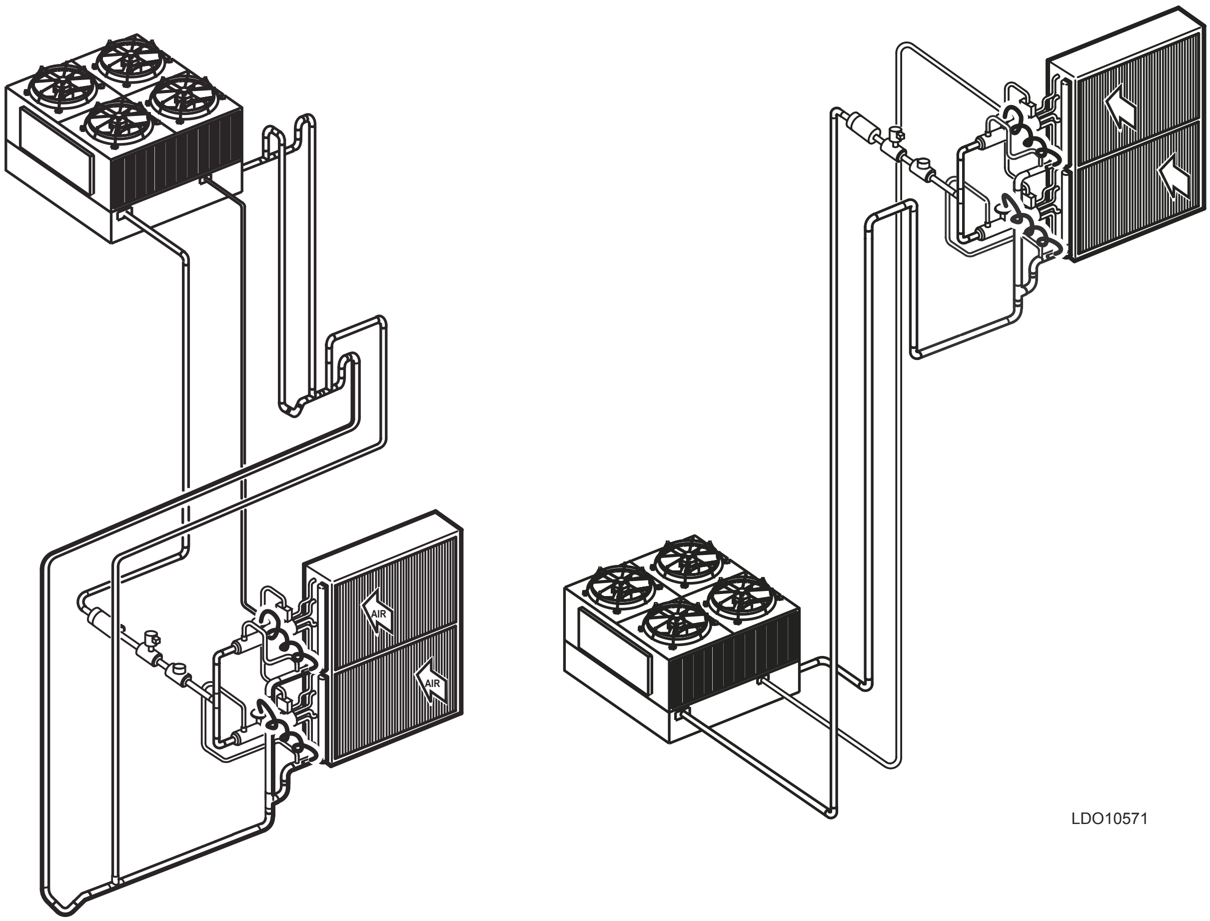
YORK®	SPLIT-SYSTEM TROUBLESHOOTING GUIDE	
TROUBLESHOOTING	Supersedes: Nothing	Form 050.40-TS1 (205)

TROUBLESHOOTING GUIDE FOR YCUL SPLIT-SYSTEMS



LDO10571

"Finding and Solving the Problem"

IMPORTANT!

READ BEFORE PROCEEDING!

GENERAL SAFETY GUIDELINES

This equipment is a relatively complicated apparatus. During installation, operation maintenance or service, individuals may be exposed to certain components or conditions including, but not limited to: refrigerants, oils, materials under pressure, rotating components, and both high and low voltage. Each of these items has the potential, if misused or handled improperly, to cause bodily injury or death. It is the obligation and responsibility of operating/service personnel to identify and recognize these inherent hazards, protect themselves, and proceed safely in completing their tasks. Failure to comply with any of these requirements could result in serious damage to the equipment and the property in which it is situated, as well as severe personal injury or death to themselves and people at the site.

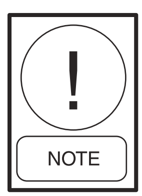
This document is intended for use by owner-authorized operating/service personnel. It is expected that this individual posseses independent training that will enable them to perform their assigned tasks properly and safely. It is essential that, prior to performing any task on this equipment, this individual shall have read and understood this document and any referenced materials. This individual shall also be familiar with and comply with all applicable governmental standards and regulations pertaining to the task in question.

SAFETY SYMBOLS

The following symbol is used in this document to alert the reader to areas of potential hazard:

WARNING indicates a potentially hazardous situation, which if not avoided, could result in death or serious injury.

CAUTION identifies a hazard which could lead to damage to the machine, damage to other equipment and/or environmental pollution. Usually an instruction will be given, together with a brief explanation.



NOTE is used to highlight additional information that may be helpful to you.

CHANGEABILITY OF THIS DOCUMENT

In complying with YORK's policy for continuous product improvement, the information contained in this document is subject to change without notice. While YORK makes no commitment to update or provide current information automatically to the manual owner, that information, if applicable, can be obtained by contacting the nearest YORK Applied Systems Service office.

It is the responsibility of operating/service personnel to verify the applicability of these documents to the equipment in question. If there is any question in the mind of operating/service personnel as to the applicability of these documents, then prior to working on the equipment, they should verify with the owner whether the equipment has been modified and if current literature is available.

TABLE OF CONTENTS

TABLE OF CONTENTS - CON'D

SECTION 1
SPLIT-SYSTEM INTRODUCTION

1.1 Introduction to Split-Systems

This publication offers guidelines for troubleshooting YCUL split-system problems. It is not the intent of this publication to direct IOM, Application or Installation requirements, but to provide a means of troubleshooting YCUL Split-Systems as they are installed in the field. However, the IOM, Application and Installation publications are referenced herein for use in troubleshooting specific products and components (i.e. Reference Section 3.1).

Split-Systems are comprised of three basic components:

1. **Air Cooled Condensing Unit** (ACCU) Package
2. Air Handling Unit (AHU) Package with **Evaporator Coil**
3. **Field Split-System Piping** Package

The ACCU is generally furnished by YORK as a YCUL Hermetic Compressor Package which includes hermetic scroll compressors, an air cooled condenser, and a microprocessor control center, all furnished as an integral package.

The AHU, generally furnished by YORK, can be a custom or commercial package including the essential split-system evaporator coil(s), along with other various integral parts (i.e. fans, filters, economizer, electrical, controls, etc.).

The ACCU typically is located adjacent to or above the AHU on the roof, but can also be located below the AHU at ground level, or at the same level. The distance between the two is generally limited to 150 equivalent feet of piping run with vertical risers not exceeding 40 feet. Installations with equivalent runs less than 30 feet on the same level are termed close-coupled split-systems.

Field split-system piping is virtually always done outside the scope and responsibility of YORK. The customer and his sub-contractor are responsible for reviewing the installation needs and selecting the proper line sizes including field accessories and specialties. *With exception, YORK may provide line sizing and general outline drawings if requested*. YORK provides an Installation Guide and Checklist (Form 50.40-CL1 (604) with every YCUL Air Cooled Condensing Unit (From 9/31/04) for the customer's review and use when installing YORK split-system YCUL air cooled condensing units. This guide is also part of the YORK Sales Submittal and is a required piping practice of YORK. **Warranty issues must be addressed and handled in accordance with publication Form 50.40-CL1 (604) as well as Application Guide Form 050.40-ES3. YORK assumes no warranty responsibility for poor operation or failures due to improper field piping, its design or application.**

1.2 Understanding Product Warranty

YORK has warranty ownership on what YORK provides under contract. YORK supplies Installation, Operating, and Maintenance instructions (IOM's) with all YORK furnished equipment. It is the customer's responsibility to follow and adhere to the installation requirements and IOM obligations. Any shortcomings by the installer could have an impact on warranty coverage.

Obviously, on product (ACCU or AHU) not provided by YORK, YORK assumes no liability or warranty exposure on product outside YORK's scope of work.

1.3 Understanding Field Piping Warranty

Field piping is generally outside YORK's scope of work and is installed by the customer or his sub-contractor (installer). Responsibility for field piping is addressed in greater detail in YORK Installation Guide/Checklist Form 50.40-CL1 (604) and is furnished with every YCUL shipped (beginning 9/31/04). This Form is also available on the YORK Intra/Extranet.

1.4 Getting Started

This guide basically covers (3) areas:

1. Section 1 - Understanding Warranty responsibility, which we've just covered
2. Section 2 - Troubleshooting Table 'Plus': This is the "Troubleshooting Toolbox" which provides an insight to problems and symptoms encountered, and offers possible causes as well as possible solutions
3. Section 3 thru 6 – This is the technical body which supports the troubleshooting table references and offers a more in-depth explanation of problematic split-system findings

SECTION 2
SPLIT-SYSTEM TROUBLESHOOTING

2.1 Troubleshooting Matrix

The following Troubleshooting tables offer possible solutions to typical symptoms and problems detected on split-systems, as well as their possible causes. The troubleshooting table contains five basic categories:

1. Compressor Troubleshooting
2. Condenser System Troubleshooting
3. Evaporator Coil Troubleshooting
4. Refrigerant Accessories and Specialties Troubleshooting
5. Refrigerant Field Piping Troubleshooting

NOTE

Symptoms, Solutions and Causes listed in the troubleshooting table are non-specific to each other, unless accompanied with a < Symbol. (See example below)

Useful reference information relating to fact gathering, air stratification, piping layout and arrangements, and a temperature pressure chart is provided for in the back of this guide, along with a reference index and technical contacts.

2

< Indicates Solution Is Specific to Immediate Left Cause

< Indicates Cause Is Specific to Immediate Left Symptom

References to Section, Figure or Other

Item	Problem	Symptom/Detection	Possible Cause	Possible Solution
1	Example Problem	Example Symptom	< Example Cause	< Example Solution (ref. 3.8)
2		Example Symptom	Example Cause	Example Solution

Generally Stated (non-specific) Cause & Solution to Problem

Troubleshooting Tables for Analyzing Split-System Refrigeration Problems

1. COMPRESSOR TROUBLESHOOTING TABLE

Item	Problem	Symptom/detection	Possible Causes	Possible Solutions
1a	**Liquid slugging - refrigerant or oil**	Noisy compressor/sys operation	Oversized thermal expansion valve	<Review TXV selection (ref Appl Guide form 050.40-ES3)
		Excessive vibration	TXV bulb not installed correctly	<Review TXV bulb & equalizer install. (Ref 4.4, Fig 8)
		Overheating of compressor	TXV equalizer line not install. Corr.	Check valves required on HGBP (ref 5.7 & 4.4 Fig 3)
		High compressor kW draw	Erratic TXV operation	Blockage in TXV or ice formation (sect. 4.5)
		Loss of system capacity	Head pressure control inadequate	Review system charge (sect. 4.9; 6.10)
		High saturated suction temp.	Liquid flashing ahead of TXV	Addition of DX coil isolation dmprs (contact Prod Tech Supt)
		Loss of suction gas superheat	System overcharged	Addition of HGBP (sect. 4.6,5; 4.7; 5.5 and 5.7)
		Compressor failure	Vel. over DX coil below 350 FPM or 300 FPM on close-coupled	Review pumpdown control (ref sect. 4.6, 10; and 6.5)
		Excessive swings in head pr.	Compressor flooded at start	<Review compr. crankcase heater (sect. 3.3, 2; 6.4 and 6.16,2)
		W/compr on - apparent if oil sump temperature is less than 20 °F above the measured SST.	Evaporator frosted	<Add frost control and/or HGBP (sect. 4.6, 5, 5.6, 5.7)
		W/compr off - apparent if oil sump temperature is less than 18 °F above the LP saturated temp.	DX coil split-face circuiting	<Retrofit full-face circuiting (sect. 5.4; and 2.2, Item 10)
		W/compr off - apparent if oil sump temperature is less than 18 °F above the LP saturated temp.	Faulty piping design or sizing	<Review installation form 50.40-CL1 (604).
		W/compr off - apparent if oil sump temperature is less than 18 °F above the LP saturated temp.	Faulty piping design or sizing	Review liq. line system PD (sect. 4.5, 4; and 2.2, Item 4)
		W/compr off - apparent if oil sump temperature is less than 18 °F above the LP saturated temp.	Faulty piping design or sizing	Review addition of a suction line accumulator (sect. 4.3,7; 4.6, 7).
		W/compr off - apparent if oil sump temperature is less than 18 °F above the LP saturated temp.	Faulty piping design or sizing	Review superheat settings reference section 5.8
1b	**Flooded starts**	Reference item 1 “symptoms”	Liquid line sol. valve failed open	<Review LLSV control function (repair or replace)
			Liq. line sol. valve leaking	<Repair leaks in sys. or parts (sect. 4.8)
			Compr. crankcase htr. not operable	<Review crankcase heater oper. (sect 3.3, 2; 6.4 and 6.16,2)
			Faulty piping design or sizing	Review pumpdown control oper. (4.6, 10; and 6.5)
			Pumpdown control not operable	Rev. Install. (Form 50.40-CL1)
			Liquid flood back during compressor operation	Review addition of a suction line accumulator (sect. 4.3, 7; 4.6,7)
			Liquid migration during off-cycle	<Review or add check valves to discharge of compressor

1. COMPRESSOR TROUBLESHOOTING TABLE, Continued

Item	Problem	Symptom/detection	Possible Causes	Possible Solutions
1c	Overheating of compressor	Compr. thermal safety trips	Condenser coil is dirty	<Clean condenser coil
		High compressor kW draw	Running exc. high head pressures	Check compressor rotation (sect. 6.8)
		Compr. casing temp. excessive	Head pressure control inadequate	<Review cond. fan operation (ref. IOM “unit controls, tables 27-31)
		Compr. doesn’t pump properly	Cond. fan or motor failure	<Add improved head pressure control (sect. 3.3, 1; 4.6, 9)
			System over or under charged	<Review system charge (sect. 4.9; and 6.10)
			Low refrigerant flow	Review superheat settings reference section 5.8
			Superheat running too high	
			Excessive HGBP temperatures	
			Incorrect motor rotation	
			Air and/or moisture in system	
1d	Loss of lubricant	Compressor overheating	Flooded starts	Review install. Form 50.40-CL1(604)
		Mechanical seizure	Liquid refrigerant flood back	Review item 1b “Flooded Starts” above
		High compressor kW draw	Oil trapped in system piping	
		Compressor won’t start		
		Noisy operation		
		Compr. thermal safety trips		
1e	Contamination of mechanical refrigeration piping system	Refrigerant valves stick	Improper evacuation/dehydration	<Check system for leaks (sect. 4.8)
		Compr. doesn’t pump properly	System leaks	Replace filter drier (sect. 4.5, 4 & 4.6, 1 & 2; 2.2, item 4)
		Compressor overheats	Filter/drier loaded	
		High compressor kW draw	Overheating of compressor promoting breakdown of oil, refrigerant, and system materials	<Correct overheating of compressor. see item 1c above
		Yellow or chartreuse color in site glass	Sludged system	Clean condenser coils and comb any damaged fins
		Compressor failure	Dirty condensers contributing to intermittent excessive head pressures	Adjust superheat to correct settings (typically 12 to 18 °F for R-22 comfort cooling). Reference section 5.8
		Acid test kit	Non-condensable gases in condenser coil	<Pull refrigerant from system and re-evacuate & re-charge system (sect. 4.9; 6.10)

2

1. COMPRESSOR TROUBLESHOOTING TABLE, Continued

Item	Problem	Symptom/detection	Possible Causes	Possible Solutions
1e (Continued)	**Contamination of mechanical refrigeration piping system**		Excessive superheat at compressor	With compressor burnout, install a suction line filter drier. Always include a trap/valve for collecting oil test samples following cleanup (sect. 4.6, 1 & 2; and 2.2, Item 4)
			Holes drilled in pipe-work following installation	If system has a history of contamination reoccurrence, install **replaceable** core filter driers (include on all burnouts) (sect. 4.6, 1 & 2; and 2.2, Item 4)
1f	**Early failure of compressor in new system or newly replaced compressor (as well as perceived compressor failure)**	Compressor failure (seized or slugging). Bearing washout or mechanical damage.	<Crankcase oil temperature in question. Review superheat at full & low loads (reference section 5.8 and 6.4)	<Always energize heaters for **24 hours minimum before starting compressors** for any reason (or apply 500 Watt heat lamps to compressor body to speed up process) (sect. 3.3, 2; and 6.4)
		Compressor running hot with high Amp draw	<Incorrect discharge superheat: [disch. line temp. - discharge press converted to temp. = SH]. Note that discharge gas flow is required to cool the compressor windings.	**<Maintain a 50 min, 60 °F max. discharge superheat.** Below 50 °F will form liquid and slug the compressor, and above 60 °F can overheat the compressor windings and cause a burnout
		Very low current draw from specified	<Compressors operated in reverse rotation	<Operating compressors in reverse for more than **one hr can cause damage (sect. 6.8)**
		Immediate compressor failure. Determined to be excessively low charge and suction temps below 7 psig	<Compressors operated with insufficient charge at under 25 psig suction pressure **for just 3 seconds can cause failure**	**<Always verify system charge is correct and monitor suction pressure** on startup of compr. If less than 25 psig for 2 seconds, shut compressor down immediately (sect. 6.10)
		Compressor running but not pumping **(don't assume it's a bad compressor!)**	<One or more of the 2 or 3 compressors in one system has a defective internal check valve and is short circuiting its discharge pressure through the bad valve.	<Determine which compressor has the defective check valve, and replace that compressor

1. COMPRESSOR TROUBLESHOOTING TABLE, Continued

Item	Problem	Symptom/detection	Possible Causes	Possible Solutions
1f (continued)	**Early failure of compressor in new system or newly replaced compressor (as well as perceived compressor failure) (continued)**	Compressor electrical and/or control failures **Do not hi-pot test! Reference section 6.11 and “concern #1”**	<Hi-pot testing performed under compressor vacuum **Do not hi-pot test!**	**<Never** perform hi-pot test under compressor vacuum, otherwise damage will result to electronic components (sect. 6.11) **Do not hi-pot test!**
		Required hi-pot test failed control module **Do not hi-pot test!**	<Sensor leads attached to module during hi-pot test **Do not hi-pot test!**	<If sensors require hi-pot testing, always remove leads from compressor and short together (replace when test is completed) (sect. 6.11) **Do not hi-pot test!**
		High levels of current leakage indicate a failed compressor. Is this compressor failed? **Do not hi-pot test!**	<Not necessarily. Hi-pot tests on scrolls can show higher levels of current leakage due to liquid refrigerant being present in the shell (this is not a safety issue) **Do not hi-pot test!**	<Test system with a resistance meter. If no short to ground, run system for a period of time to redistribute the refrigerant and hi-pot the system again. (Sect 6.11) **Do not hi-pot test!**

2. CONDENSING COIL TROUBLESHOOTING TABLE

Item	Problem	Symptom/detection	Possible Causes	Possible Solutions
2a	**High head pressure (including saturated condensing or saturated discharge temp.)**	Intermittent compressor cycling on high head pressure sw. on call for cooling	Faulty head pressure control or component	<Review head pressure control and operation (sect. 3.3, 1; 4.6, 9)
		Intermittent compressor cycling on comp motor protection switch	Dirty or damaged fins on condenser coil	<Review condenser coil for fouling or damage and clean or repair
		High saturated condensing temp	Faulty condenser fan motor	<Review motor for rpm/operation
		High discharge gas superheat	Damaged condenser fan blades	<Inspect condenser fan and repair or replace if damaged
		Compressor overheats	Condenser air recirculation/clearances	<Review condenser fan blade clearances. Reference section 2.1 “IOM, dimensions, note”. Discuss with York Technical Support if in question.

2

2. CONDENSING COIL TROUBLESHOOTING TABLE - CON'T

Item	Problem	Symptom/detection	Possible Causes	Possible Solutions
2a (continued)	**High head pressure (including saturated condensing or saturated discharge temp.) (Continued)**	Compressor seizure	Blocked condenser airflow or improper clearances	<Review condenser coil clearance to any obstruction. Discuss with Product Technical Support. Reference sect. 3.1; "IOM, sect. 1, dimension, note".
		Compressor motor burnout		
		High compressor kW draw	System overcharged	<Remove overcharge as required (sect. 4.9 & 6.10)
		Loss of system capacity	Loose belts (if applicable)	Non-condensable gases in the condenser coil may indicate system leaks or poor evacuation. Check for leaks first and repair. (Sect 4.8)
		Saturated suction temperature normal to high	Condenser fan wrong rotation	High head pressure means high temps and possible acid formation. Perform an acid test on the system & install any necessary filter/driers to correct (sect. 4.5, 4; 4.6,1 & 2; 6.14, Fig 28)
			Non condensable gas present in condenser coil (air & moisture)	<Following the above, it may be necessary to pull the refrigerant and evacuate and recharge the system (sect. 4.9 & 6.10)
2b	**Low head pressure**	Low saturated condensing temperature	Faulty head pressure control	<Review head pressure control operation and correct (sect. 3.3,1 & 4.6,9)
		Low system capacity	Undercharged system	<Check system for leaks and correct (sect. 4.8)
		Low saturated suction temperature	Refrigerant leak	<It may be necessary to pull the refrigerant and evacuate and recharge the system (sect. 4.9 & 6.10)
		Low compressor kW draw	Prevailing winds induce airflow	<Add condensing unit louvers to dampen winds (generally needed if under 5 °F low ambient operation). Standard York part item.
2c	**Refrigerant charge - re-estimates show system is <u>undercharged</u>**	Low head pressure	System leaks	< Check for refrigerant leaks & repair (sect. 4.8)
		Low saturated suction pressure	Air or other non-combustables may be in condenser coil system	<It may be necessary to pull the refrigerant and evacuate and recharge the system (sect. 4.9 & 6.10)
		Low system capacity	Mis estimate on initial charge	<Add charge until sub-cooling reaches 15 °F (sect. 4.9)
		Low liquid subcooling		Do not overcharge system (sect. 4.9)
		Gas flashing at TXV inlet		
2d	**Refrigerant charge - re-estimates show system is <u>overcharged</u>**	High head pressure	Mis-estimate on initial charge	<Remove charge to acceptable level (ref 4.9 & 6.10)
		High saturated suction pressure		
		High liquid subcooling		
		High compressor kW draw		
		Compr. thermal safety trips intermittently		
		Low system capacity		

3. EVAPORATOR COIL TROUBLESHOOTING TABLE

Item	Problem	Symptom/detection	Possible Causes	Possible Solutions
3a	Low airflow	Low discharge air temperature	Dirty evaporator coils	<Inspect and clean evaporator coil
		Low system capacity	Damaged evaporator fin surface	<Comb fin surface and/or repair
		Low saturated suction temp.	Excessive filter loading	<Replace dirty filters
		Low suction gas superheat	Incorrect (low) supply fan rpm	<Install correct sheave rpm
		Low saturated cond. temp.	VSD control problem	<Review VSD control & setpoints
		Low compressor kW draw	System or ductwork obstruction	<Clear obstruction
		Coil frost buildup	System or ductwork excessive leakage	<Seal air leakage points
		High building space temps.	System static pressure is outside design	<Review static pressure across supply fan
		Compressor liquid slugging	Incorrect fan	<Review fan selection
		Failed compressor	Supply fan flex connection leaks	<Repair flex connection
			External ductwork flex connection is drawn “into” the ductwork increasing external static pressure	Inspect external duct flex connections and re-position flex material to “exterior” of duct
3b	Excessive airflow	High saturated suction temp.	Filters missing (or blown out) causing a decrease in Static pressure	<Replace any missing filter media as well as defective or missing clips
		High compressor kW draw	Incorrect (high) supply fan rpm	<Install correct sheave rpm
		High discharge air temperature	VSD control problem	<Review VSD control & setpoints
		Air system noise	System static pressure is outside design	<Review static pressure across supply fan
		Condensate moisture carryover	Incorrect fan	<Review fan selection
3c	Un-uniform airflow over coil(s)	Loss of capacity	Poor partition wall/other design	<Add baffling to achieve even distr.
		Low saturated suction temp.	Fan inlet too close to coil	<Redesign partition if practical
		Uneven condensate carryover	Fan orientation to coil poor	<Reposition fan if practical
		Uneven coil surface temperature	Coil placement	<Move coil if practical
		Compressor liquid slugging	Internal (piping, etc.) restrictions	<Relocate or correct piping restrictions
		Failed compressor	Obstruction on or at coil	<Remove obstruction
			Coil is split-face circuited	<Re-pipe coil for full face (sect. 5.4)

2

3. EVAPORATOR COIL TROUBLESHOOTING TABLE, Continued

Item	Problem	Symptom/detection	Possible Cause	Possible Solution
3d	Low refrigerant supply	Low system capacity	Low system charge	<Add correct charge to system (sect. 4.9; and 6.10)
		Low saturated suction temp	Liq line kinked or crushed	<Repair damaged lines
		Low saturated condensing temp	Return or evap tubes crushed	<Repair damaged tubes/bends
		Low compressor kW draw	System refrigerant leak	<Repair leaks (sect. 4.8)
		High suction gas superheat	TXV damaged/blockage	<Repair or replace TXV/icing (sect. 4.5, 1)
		High discharge air temperature	TXV undersized for load	<Rev. TXV sel (form 050.40-ES3)
		High disch. gas superheat	TXV power element low on charge	<Install new power head element
		Measurable TD in liquid line	TXV equal. line not piped properly	<Review equal. line and correct (sect. 5.5; 2.2, Item 7 & 10)
		Bubbles at liq. line sight glass	TXV bulb not installed properly	<Review bulb and correct (sect. 4.4, Figure 8)
		Evap coil frost buildup	Undersized distributor nozzle	<Review w/York Coils Support
			Undersized distributor	<Review w/York Coils Support
			Evaporator miss-circuiting	<Review w/York Coils Support
3e	Uneven refrigerant distribution to evaporator circuits	Low system capacity	Plugged evap. distributor tubes	<Review w/York Coils Support; also reference sect. 5.5
		Low saturated suction temp	Kinked or crushed distr. tubes	<Repair or replace crushed tubes
		Low suction gas superheat	Oversized distributor (low load)	<Review w/York Coils Support
		Hunting of TXV	Oversized distributor nozzles (low load)	<Review w/York Coils Support
		Uneven coil surface temperature	Crushed evap tubes or U-bends	<Repair tubes or replace coil
		Uneven condensate formation on evap	Plugged evaporator circuit	<Review and correct (sect. 5.5)
		Uneven frost formation on evap	Evaporator mis-circuiting	<Review w/York Coils Support
		Compressor liquid flooding		Review return side suction bends for excessive temperature variances (i.e. 2 or 3 °F variance)

3. EVAPORATOR COIL TROUBLESHOOTING TABLE, Continued

Item	Problem	Symptom/Detection	Possible Causes	Possible Solutions
3f	Evaporator overfeed (flooding)	Low suction gas superheat	Excessive refrigerant charge	<Remove refrig. to correct charge (sect. 4.9; and 6.10)
		TXV hunting	Oversized TXV	<Review TXV sel (form 050.40-ES3)
		Liquid floodback to compressor	TXV stuck open (ice or sludge)	<Clean or replace (sect. 4.5, 1)
		Compressor slugging	TXV superheat set too low (with one compressor on)	<Adj superheat to correct setting (i.e. 12-18 °F SH range). Reference section 5.8
		Compressor overheats	TXV charge incorrect (non migrating may be required)	<Review need for non-migrating charge (sect. 4.5, 1)
		High compressor kW draw	TXV bulb not insul from ambient	<Correct bulb installation per (sect. 4.4, Figure 8). Also review installation , form 50.40-CL1.
		Compressor doesn't pump properly	TXV loose sensing bulb	<Correct bulb installation per (sect. 4.4, Figure 8). Also review install. Form 50.40-CL1
		Compressor failure	TXV bulb bridges a gap (coupling)	<Correct bulb installation per (sect. 4.4, Figure 8). Also review install. Form 50.40-CL1
			TXV bulb is installed on a coupling	<Reposition bulb to pipe (sect. 4.4, Figure 8) (2.2, Item 6)
			TXV bulb is installed in/after trap	<Review sect. 4.4, Figure 8; 2.2, Item 6). Also reference install. Form 50.40-CL1, item 4
			TXV bulb is insulated by oil logging at the DX tailpipe	<Relocate to better location (sect. 4.4, Figure 8) (2.2, Item 6)
			TXV equal. line not properly installed	<Review sect. 2.2, Item 7. Also review installation form 50.40-CL1
			Wrong TXV for refrigerant in sys.	<Review TXV for refrig. type
			Very low load/cfm present	<Review HGBP installation needs (sect. 4.6, 5 and 5.5). Also, review with product tech. support
3g	Evaporator underfeed (starving)	Low saturated suction temp.	System undercharged	<Add refrig. to system (sect. 4.9; and 6.10)
		High suction gas superheat	TXV undersized	<Review TXV sel (form 050.40-ES3)
		Low system capacity	TXV stuck closed (ice or sludge)	<Clean or replace (sect. 4.5, 1)
		Low compressor kW draw	TXV superheat setting too high	<Adj superheat to correct setting (i.e 12-18 °F SH). Reference section 5.8
		Low saturated condensing temp	Undersized distributor	<Review w/York Coils Support

2

3. EVAPORATOR COIL TROUBLESHOOTING TABLE, Continued

Item	Problem	Symptom/Detection	Possible Causes	Possible Solutions
3g (continued)	Evaporator underfeed (starving)) (continued)	Evap coil frost buildup	Undersized orifice	<Review w/York Coils Support
		High discharge gas superheat	Kinked or crushed capillary tube	<Repair or replace crushed tubes
		High supply air temperature	TXV charge incorrect (non migrating may be required)	<Review need for non-migrating charge (sect. 4.5, 1)
			TXV power elem low on charge	<Install new power head element
			Crushed equalizer line	<Repair or replace crushed line
			Low head pressure	<Rev. need for better hp control (sect. 3.3, 1; and 4.6, 9)
			Faulty head pressure control	<Review control and correct (IOM)
			Wrong TXV for refrigerant in sys.	<Review TXV for refrig. type
			Higher than design load present	<Rev. with cust. & product tech support
				Review load limiting control feature on YCUL for low mid-range duty (ref. IOM "Unit Controls – Load Limiting")
3h	TXV hunting	Saturated suction temperature oscillates high to low in a cyclical condition	Oversized TXV	<Rev. TXV selection & replace (Application Guide form 050-40-ES3)
		Suction gas superheat oscillates high to low in a cyclical condition	Airflow and/or cooling load very low	<Low airflows/loads - discuss with Product Technical Support
			HGBP check valves required	<Check valve required on multiple HGBP circuits (sect. 5.7; and 4.4, Figure 3)
			Non-uniform load on evap. coil	<Rev. upstream mixing and air stratification and baffle as needed
3i	VAV airflow ramp up and ramp down	Unstable control of system; fluctuations in zone temperature; compressor cycling and liquid slugging	VAV ramp up or ramp down rate is faster than the 3% per minute rate required to match compressor cycle timing	<Requires adjustment of the **VAV boxes and unit supply fan VFD** to the 3% per minute rate necessary (ref form 050.40-ES3, section 3 "VAV Systems")

4. REFRIGERATION ACCESSORIES AND SPECIALTIES TROUBLESHOOTING TABLE

Item	Problem	Symptom/Detection	Possible Causes	Possible Solutions
4a	Plugged filter drier (liquid line)	See 3g starved evaporator above	Dirty refrigeration system	<Previous compr. burnouts may have contaminated the system. Review with acid test kit.
		Compressor cycles on low pressure switch	Improper evacuation and/or dehydration of system	<Evacuate, clean system, dehydrate & install new filter driers and charge to correct level (sect. 4.9; and 6.10)
4b	Wet filter drier	Liq. line sight glass shows wet (yellow) - verify not damaged	System refrigerant leak	<Correct any leaks (sect. 4.8)
		Valves stick intermittently and system cycles off on low suction	Improper evacuation and/or dehydration of system	<Evacuate, dehydrate and install new filter driers (sect. 4.9; 6.10; 4.5, 4; 4.6, 1&2)

4. REFRIGERATION ACCESSORIES AND SPECIALTIES TROUBLESHOOTING TABLE , Continued

Item	Problem	Symptom/Detection	Possible Causes	Possible Solutions
4b (continued)	Wet filter drier (continued)	Flash gas ahead of TXV	Loaded filter drier	<Leak test system and charge to correct level (sect. 4.8; 4.9; 6.10)
				Verify sight glass is normal (sect. 4.5, 2)
4c	Undersized filter drier	Reference item 18 above “plugged filter drier”	Incorrect field installed component	<Select correct component size and replace the undersized part
		Gas flashing ahead of TXV	Undersized liquid line	Review liquid line size for correct size (ref form 050.40-ES3)
4d	Crankcase oil heater inoperative	Flooded starts	Not switched on	<Verify switch is on and heater is energized with compressor off
		High compressor kW draw	Failed heater element	<Replace failed heater element
		Compressor overheating	Failed control circuit	<Rev. & correct control circuit
		Noisy system operation	Bad wiring connection	<Clean & tighten wiring conn.
		Excessive compressor vibration	Heater kW undersized	<Rev. - Heater must provide a min. crankcase temp. of 20°F above operating SAT. suction temperature (sect. 3.3, 2; 6.4 and 6.16)
		Foaming in compr. sight glass		
4e	Oil separator trapping oil	Oil level low on compressor sight glass	Sludge blocking oil separator float valve orifice	<Clean and/or replace oil separator (sect. 4.6, 8)
		High compressor kW draw	Oil separator float ass’y. faulty	
		Compressor overheating		
		Noisy system operation		
4f	Oil separator float valve stuck open	High saturated suction temp	Debris at orifice creating poor seal at float valve seat	<Clean and/or replace oil separator (sect. 4.6, 8)
		High saturated condensing temp	Faulty float assembly	<Inspect float, repair or replace
		High compressor kW draw	Liq. refr. migrates through separator to compressor oil sump at shutdown.	
		Foaming in compr. sight glass at startup		
		Flooded startup of compressor		

2

5. REFRIGERANT FIELD PIPING TROUBLESHOOTING TABLE

5a	**Suction line undersized or damaged**	Low system capacity	Undersized suction line	An obvious indication is a change in temp. at the damaged point.
		Low saturated suction temp	Crushed or kinked suction line	You may have to remove insul.
		High compression ratio	Obstruction in suction line	Repair or replace affected area
5b	**Suction line oversized**	Compressor overheats	Oversized suction line	<Rev size w/form 050.40-ES3
		Compressor is noisy	Piping arrangement harbors oil	Change-out pipe size
		High compressor kW draw	Suction riser not sized properly	<Verify size (reference application form 050.40-ES3)
		Compressor trips on motor prot.	Double suction risers required	<Add double suction risers (sect. 4.4, Figure 6)
		Compressor won't start	Traps used long radius elbows	<Correct or add traps (sect. 4.4, Figure 7)
		Compressor seizure	Missing traps (bottom & top inverted)	< Add missing traps (sect. 4.4, Figure 6)
			Suction line not pitched towards compressor or sags	<Direct pitch towards compressor (sect. 4.4, Figure 7)
5c	**Suction line insulation**	Suction line sweating	Insulation missing on suction line	<Inspect, repair or replace
		Excessive suction gas superheat	Vapor barrier missing on suction line insulation	<Add asj insulation or replace with armaflex or equivalent. Coat for UV exposure where applicable using latex paint.
		High discharge gas superheat	Damaged insulation	
			Insulation moisture laden	
5d	**Discharge line arrangement and liquid migration**	Compressor noise at startup following shutdown period	Liquid refrigerant lays on head or discharge port of compressor and/or migrates to crankcase	<Add an external discharge check valve to the system
		Flooded start after shutdown period	HGBP pressure regulating valve stuck open at shutdown	Review discharge piping concerns with Installation Guide form 050.40-CL1
		Compressor vibrates on startup after shutdown period	Scroll compressor check valve has a low leakage rate - re-cycling pumpdown may need to be considered.	<Incorporate recycling pumpdown if not currently installed (sect. 4.6, 10; 6.5). However, note drawbacks to recycling pumpdown. (Discuss with Product Technical Support).
		High compressor kW at startup after shutdown period	Excessive check valve leakage	<Repair or replace compressor check valve and/or add external "true" check valve to discharge line (sect. 4.6, 10; and 6.5) (Discuss with Product Technical Support).
		Compressor pumps inadequate		

5. REFRIGERANT FIELD PIPING TROUBLESHOOTING TABLE, Continued

Item	Problem	Symptom/Detection	Possible Causes	Possible Solutions
5e	**Liquid line undersized (or excessive pressure loss including flash gas problems)**	Loss in capacity	Undersized liquid line	<Review liquid line piping concerns with application guide (form 050.40-ES3, sect. 4 “selecting liquid lines”)
		Excessive pressure loss	Sized in excess of 1 or 2 °F loss	<Review capacity needs. Is there a capacity problem? Discuss with product tech support.
		Inadequate subcooling	Two solenoids in series used	<Rev. & Remove double solenoid
		Flashing gas at TXV inlet	Kinked or crushed line	<Repair crushed lines
			Line exposed to direct sun light	<Insulate portion exposed to direct sunlight
			Line passes through 95 °F + space temperature	<Insulate if exposed to 95 °F plus temp. conditions in spaces
			Bubbles formed in sight glass (sect. 3.5, 2; and 3.6, 4)	<Excessive vertical risers & eqiv. pipe length must be reviewed with Product Technical Support. (Review form 050.40-ES3, sect. 4 “Liquid Lines”)
			Excessive vertical “riser” length	Some intermittent flashing is acceptable
			Excessive equiv. length of pipe	
5f	**Hot gas bypass line**	Compressor cycles excessively	External equalizer line pinched or not installed	Verify control function schematic
		HGBP solenoid not energizing	Failure of pilot solenoid	<Inspect, clean, repair or replace solenoid/valve assembly
		Passing hot gas at saturated suction temperatures above 32 °F.	Hot gas diverting valve operating piston sticking	<Inspect, clean, repair or replace diverting valve assembly
		Hot gas bypass not passing below 32 °F. SST	Hot gas diverting valve pilot solenoid port or valve blocked with foreign material	Verify HGBP setting is set for 32 °F or adjust for “special” conditions at lower DAT’s.
		HGBP appears to not function properly	Excessive low load or airflow	Install/relocate equalizer line to TXV equalizer location
		Excessively low saturated suction pressure	Low head pressures	<Retrofit pressure switch or VSD head pressure control
		Space high humidity	Low ambient operation	Add missing HGBP check valves on “multiple distributor circuits
		Poor comfort level in space	Check valves not installed at ASC inlet (multiple circuit system)	Review application guide form 050.40-ES3 regarding HGBP
		Erratic TXV operation	ASC HGBP side port is at a right angle or pointing down incorrectly	Review installation guide form 50.40-CL1 for recommended HGBP line sizes.
		Evaporator coil frosting	Incorrect “tee” installed where an ASC is required	Replace tee’s with properly located/sized ASC’s

2

2.2 Do's and Don'ts of Split-Systems

The following offers ten important "Do's & Don'ts" in troubleshooting Split-Systems that are vital in determining warranty ownership and validating system essentials are in place:

Item	DO'S	DON'T
1	On arrival always review the problems and symptoms with the owner first.	Never assume responsibility for work outside Yorks scope and contract (Only report the facts).

LD10429

- PROMPTS -

Review the system history (past problems and solutions), including any process, design or control changes that may have taken place. Verify the system is being reviewed per approved submittal design or agreed to conditions. "Out of design" YORK equipment should be discussed with your YORK Area Service Manager for direction prior to proceeding.

Item	Do's	Don't's
2	Diagnose the system problems with regard to proper Application and Installation guidelines.	Don't allow improper piping practices to exist (discuss, report, and make recommendations as required).

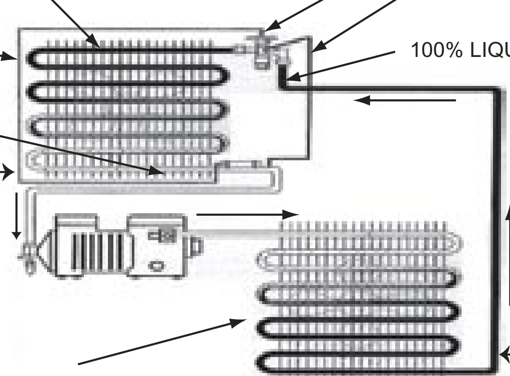
LD10430

- PROMPTS -

When in question, three primary reference guides are available on the YORK Intra & Extranet for your information:
- Application Guide: Form 050.40-ES3 (204)
- Installation Guide: Form 50.40-CL1 (704)
- IOM Guide: Form 150.63-NM5 (303)
- Troubleshooting Guide: Form 50.10-NM1 (105)

Item	Do's	Don't's
3	Verify all "system" and refrigerant charges are in acceptable range, especially subcooling and superheat (Also reference Section 5.2 of this guide).	Do not rely on the sight-glass for system charge and don't overlook the possibility of refrigerant leaks *(Correcting the Charge without fixing the problem is only a temporary fix).*

- PROMPTS -



- Superheat Example -
(R-22 Refrigerant)

Temperature at Bulb . . . = 52° F
Suction Pressure at
Equalizer Point
Equals 68 psig . . . . . . = 40° F

Superheat (Difference)= 12° F

- Subcooling Example -
(R-22 Refrigerant)

Saturation Pressure at
Condenser Coil Outlet
Equals 196 psig . . . . . = 100° F
Refrig. Temp at Outlet . . = 85° F

Subcooling (Difference)= 15° F

LD10431a

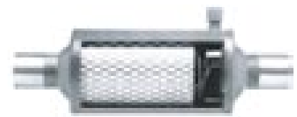
Item	DO'S	DON'T
4	Check pressure drop's on filter/driers to assure acceptable levels of loading to prevent potential gas-flashing at TXV.	Don't forget to install suction line filter/driers when replacing compressor burnouts.

- PROMPTS -

LD10432

R-22 & R407C AC Systems:
Temporary Installation = 8 psi
Permanent Install = 3 psi

R134a AC Systems:
Temporary Installation = 6 psi
Permanent Install = 2 psi



Always **reference and follow** manufacturer's compressor burnout procedure for installation.

Item	DO'S	DON'T
5	Verify crankcase heaters are energized when the compressor is cycled **"off"**.	**Do not** run a new compressor unless the crankcase heater has been energized for at least 24 hours.

- PROMPTS -

LD10433

Crankcase Heater: Must be mounted below the oil removal sight glass and/or oil removal valve.

"This will assure all the liquid refrigerant has been boiled off in the compressor shell and that the compressor can now be safely started".

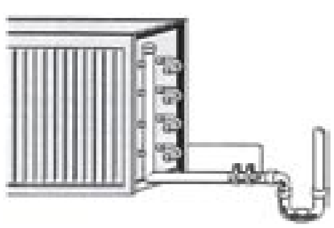
Alternate means of heating the crankcase include:

1. Directing a 500 watt heat lamp or other safe heat source (do not use a torch) at the lower shell of the compressor for a minimum of 30 minutes.
2. *Only as a last resort* - Bump start the compressor by manually energizing the compressor contactor for about one second. Wait 5 seconds and again manually bump the compressor. Repeat this cycle several times.

Item	DO'S	DON'T
6	Verify the TXV sensing bulb is secured with two straps on a clean coil tailpipe, and located at 4 o'clock or 8 o'clock and is insulated vapor tight.	Never allow the sensing bulb to be located in or after an oil trap (drops acceptable), or be positioned on a thicker surface coupling, or straddled on a coupling edge.

- PROMPTS -

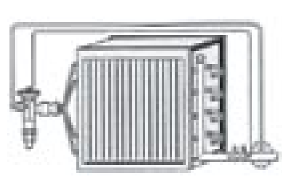
LD10434a

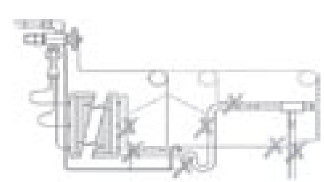


Locating a bulb in the trap area or even after the trap, including vertical risers, can produce false temperatures due to the oil "insulating" the true temperature from the bulb. The warmer bulb sensed temperatures will result in the TXV producing more refrigerant flow to an evaporator that doesn't have the load. The refrigerant will not evaporate, and will return to the compressor as a liquid slug.

Item	DO'S	DON'T
7	Verify the TXV equalizer line is properly located at the suction tailpipe, just after the TXV bulb.	Never allow the equalizer line to be located in the trap or after the trap or in a remote area.

- PROMPTS -





In order for the TXV to control true "Superheat" at the DX Suction outlet, the Equalizer Line must be located where it can sense the saturated suction pressure "at the bulb". Locating the Equalizer Line remote from the bulb will indicate lower pressure and temperatures that will present "falsely" higher Superheats than actual. This condition can produce liquid return with what otherwise appears to be normal Superheat.

Item	DO'S	DON'T
8	When soldering (or sweating off fittings) always direct the flame away from the TEV (or other components) and pass dry nitrogen through the pipe while soldering. As an added precaution, a wet cloth should be wrapped around the component during soldering.	Never apply excessive heat or direct the flame towards the component. Excessive heat can destroy the TEV diaphram.

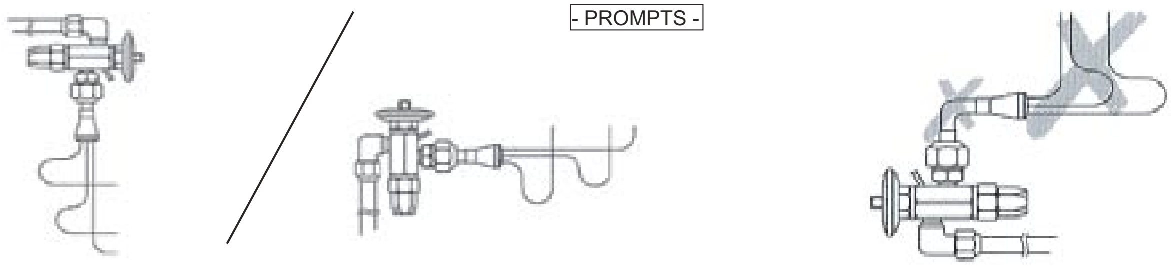
- PROMPTS -

LD10436

9	TEV's can be mounted in the vertical or horizontal positions. Vertical is actually preferred due to the inherent uniform refrigerant/gas distribution tubes. When mounted horizontal, keep the power head upright as shown.	Never install elbows between the TEV and distributor or reduce down just before the distributor. This hinders uniform refrigerant/gas distribution into the distributor tubes and promotes unstable TEV operation which can lead to liquid slugging.

- PROMPTS -

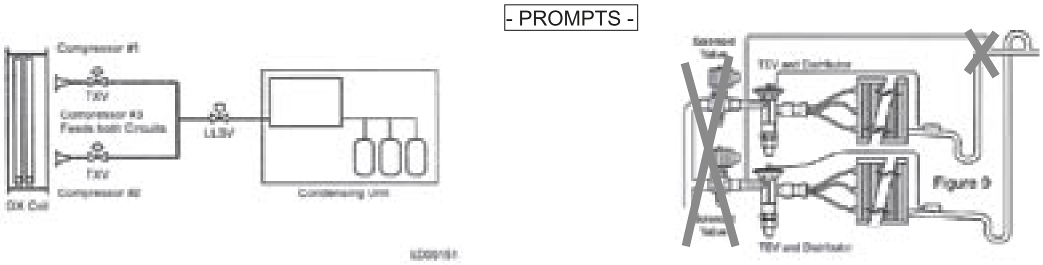
LD10437



10	Always verify evaporator coils are circuited for full-face coverage and the minimum airflow is not below 350 FPM FV (300 FPM on close coupled systems.	**Do not** allow split face circuiting of DX coils or equalizer lines that are only piped to one circuit.

- PROMPTS -

LD10438a



2.3 Tools and Instruments

Having the proper tools for analyzing and diagnosing a problematic system is essential to the service technician's success. The following covers a number of the tools and instruments specific to troubleshooting an air-cooled split-system (This is not meant to cover all tools and instruments necessary, but is a general overview of some key items):

50027

VACUUM PUMP - Vacuum pumps are essential in pulling a vacuum on the refrigeration system prior to charging the system.

50030

SUPERHEAT & SUBCOOLING DIGITAL GAUGE - This instrument is invaluable in measuring superheat and subcooling which are two essential factors in troubleshooting any system.

50028

VACUUM GAUGE - Vacuum gauges are used to assure proper evacuation of the refrigerant system has taken place.

50031

REFRIGERANT CHARGING TANK W/300 WATT HEATER BLANKET - The heater blanket offers a safe means of charging vapor into the low side of a refrigerant system.

50029

DIAGNOSTIC GAUGE MANIFOLD - A diagnostic gauge manifold is essential in charging a system and in diagnosing system pressures.

50032

REFRIGERANT LEAK DETECTOR - Digital leak detectors generally offer the fastest way to finding a leak. Be sure to verify refrigerant compatibility prior to the service call.

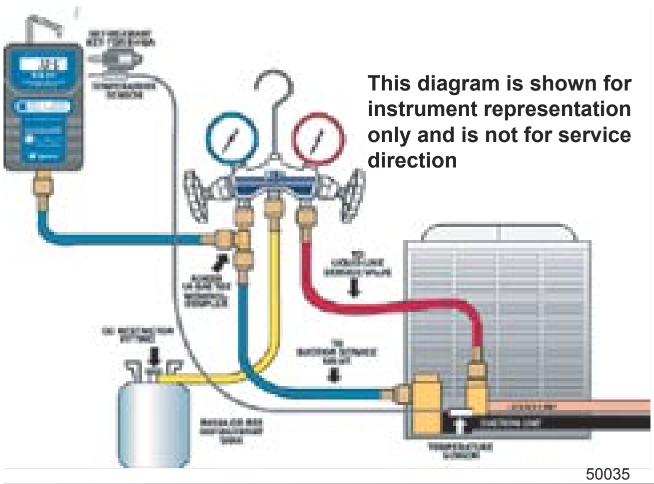
2

50033

INFRARED DIGITAL LASER THERMOMETER - Laser thermometers can be used to measure surface temperatures on the compressor and piping as well as grid testing the DX coil surface temperature and DX coil return bends. Note that when a greater accuracy is required, instruments with thermocouples and probes must be available and used.

50034

HAND HELD VELOMETER - Airflow measuring hand held velometers are necessary to quantify the amount of airflow over the DX coil.



50035

Having the right tool or test instrument is essential to solving problematic refrigerant systems to minimize warranty exposure and regaining compressor and system reliability for the customer. *Always go to the jobsite prepared.*

2.4 Temperature/Pressure Chart

The following is a copy of a Temperature/Pressure Chart used in analyzing Refrigeration Systems. This covers R-22 and R407C available on YCUL Air Cooled Condensing Units as well as some additional Refrigerants *(see end of Guide for larger copy of this Chart).*

TEMPERATURE PRESSURE CHART

Vacuum-Inches of Mercury—*Italic Figures*

Pressure-Pounds Per Square Inch Gage **Bold Figures**

TEMPERATURE °F	R-22(V)	R-410A(Z)	R-407C(N)	R-12(F)	R-134a(J)
-60	*11.9*	*0.9*	*16.0*	*19.0*	*21.6*
-55	*9.2*	1.8	*13.7*	*17.3*	*20.2*
-50	*6.1*	4.3	*11.1*	*15.4*	*18.6*
-45	*2.7*	7.0	*8.1*	*13.3*	*16.7*
-40	0.6	10.1	*4.8*	*11.0*	*14.7*
-35	2.6	13.5	*1.1*	*8.4*	*12.3*
-30	4.9	17.2	1.5	*5.5*	*9.7*
-25	7.5	21.4	3.7	*2.3*	*6.8*
-20	10.2	25.9	6.2	0.6	*3.6*
-18	11.4	27.8	7.2	1.3	*2.2*
-16	12.6	29.7	8.4	2.1	*0.7*
-14	13.9	31.8	9.5	2.8	0.4
-12	15.2	33.9	10.7	3.7	1.2
-10	16.5	36.1	11.9	4.5	2.0
-8	17.9	38.4	13.2	5.4	2.8
-6	19.4	40.7	14.6	6.3	3.7
-4	20.9	43.1	15.9	7.2	4.6
-2	22.4	45.6	17.4	8.2	5.5
0	24.0	48.2	18.9	9.2	6.5
1	24.8	49.5	19.6	9.7	7.0
2	25.7	50.9	20.4	10.2	7.5
3	26.5	52.2	21.2	10.7	8.0
4	27.4	53.6	22.0	11.3	8.6
5	28.3	55.0	22.8	11.8	9.1
6	29.1	56.4	23.7	12.4	9.7
7	30.0	57.9	24.5	12.9	10.2
8	31.0	59.3	25.4	13.5	10.8
9	31.9	60.8	26.2	14.1	11.4
10	32.8	62.3	27.1	14.7	12.0
11	33.8	63.9	28.0	15.3	12.6

TEMPERATURE °F	R-22(V)	R-410A(Z)	R-407C(N)	R-12(F)	R-134a(J)
12	34.8	65.4	29.0	15.9	13.2
13	35.8	67.0	29.9	16.5	13.8
14	36.8	68.6	30.9	17.1	14.4
15	37.8	70.2	31.8	17.7	15.1
16	38.8	71.9	32.8	18.4	15.7
17	39.9	73.5	33.8	19.0	16.4
18	40.9	75.2	34.8	19.7	17.1
19	42.0	77.0	35.9	20.4	17.7
20	43.1	78.7	36.9	21.1	18.4
21	44.2	80.5	38.0	21.8	19.2
22	45.3	82.3	39.1	22.5	19.9
23	46.5	84.1	40.2	23.2	20.6
24	47.6	85.9	41.3	23.9	21.4
25	48.8	87.8	42.4	24.6	22.1
26	50.0	89.7	43.6	25.4	22.9
27	51.2	91.6	44.7	26.1	23.7
28	52.4	93.5	45.9	26.9	24.5
29	53.7	95.5	47.1	27.7	25.3
30	54.9	97.5	48.4	28.5	26.1
31	56.2	99.5	49.6	29.3	26.9
32	57.5	101.6	50.9	30.1	27.8
33	58.8	103.6	52.1	30.9	28.6
34	60.2	105.7	53.4	31.8	29.5
35	61.5	107.9	54.8	32.6	30.4
36	62.9	110.0	56.1	33.5	31.3
37	64.3	112.2	57.5	34.3	32.2
38	65.7	114.4	58.9	35.2	33.1
39	67.1	116.7	60.3	36.1	34.1
40	68.6	118.9	61.7	37.0	35.0
41	70.0	121.2	63.1	37.9	36.0

TEMPERATURE °F	R-22(V)	R-410A(Z)	R-407C(N)	R-12(F)	R-134a(J)
42	71.5	123.6	64.6	38.9	37.0
43	73.0	125.9	66.1	39.8	38.0
44	74.5	128.3	67.6	40.8	39.0
45	76.1	130.7	69.1	41.7	40.0
46	77.6	133.2	70.6	42.7	41.1
47	79.2	135.6	72.2	43.7	42.2
48	80.8	138.2	73.8	44.7	43.2
49	82.4	140.7	75.4	45.7	44.3
50	84.1	143.3	77.1	46.7	45.4
55	92.6	156.6	106.0	52.1	51.2
60	101.6	170.7	116.2	57.8	57.4
65	111.3	185.7	127.0	63.8	64.0
70	121.5	201.5	138.5	70.2	71.1
75	132.2	218.2	150.5	77.0	78.6
80	143.7	235.9	163.5	84.2	86.7
85	155.7	254.6	177.0	91.7	95.2
90	168.4	274.3	191.3	99.7	104.3
95	181.9	295.0	206.4	108.2	113.9
100	196.0	316.9	222.3	117.0	124.1
105	210.8	339.9	239.0	126.4	134.9
110	226.4	364.1	256.5	136.2	146.3
115	242.8	389.6	274.9	146.5	158.4
120	260.0	416.4	294.2	157.3	171.1
125	278.1	444.5	314.5	168.6	184.5
130	297.0	474.0	335.7	180.5	198.7
135	316.7	505.0	357.8	192.9	213.5
140	337.4	537.6	380.9	205.9	229.2
145	359.1	571.7	405.1	219.5	245.6
150	381.7	607.6	430.3	233.7	262.8
155	405.4	645.2	456.6	248.6	281.0

To determine **subcooling** for refrigerant R-407C use BUBBLE POINT values (Temperatures above 50°F — Gray Background); to determine **superheat** R-407C, use DEW POINT values (Temperatures 50°F and below).

50037

2.5 Troubleshooting Space Humidity Problems

Controlling space humidity on constant volume DX systems can be a challenge. A typical DX system utilizes a space thermostat that enables the DX cooling, and cycles compressors on and off within a preset throttling range. When the space sensible load is satisfied, the thermostat de-energizes DX cooling. VAV systems are seldom a problem.

Space humidity or latent load is determined by two factors:

- The latent content of the outside air being introduced to the space, and
- The latent load the space produces.

Both of these loads must be de-humidified (moisture removed) to a reasonable relative humidity that will satisfy comfort levels in the occupied space (generally 50 – 60% RH).

With a properly sized ACCU, the “design” load of a system will produce the desired space sensible and relative humidity for occupied comfort levels. However, when outdoor ambient temperatures drop, the resultant reduced load creates an oversized ACCU that typically produces natural yet unwanted compressor cycling that can interfere with moisture removal. YCUL’s provide a means to compensate reduced capacity by compressor staging. Capacity reduction “steps” or “stages” can range from 15% on larger YCUL’s to as little as 50% on the smallest systems. Larger numbers of compressors can lessen the natural cycling that occurs, but is limited to the specific YCUL sized for the load at design. The first step is **DO NOT** oversize ACCU’s at design.

The “steps or stages” provide the cycling of the compressors, which satisfies the sensible space thermostat (or discharge air sensor). **This compressor cycling is where humidity problems occur.**

First we need to realize that moisture removal is based primarily on the surface temperature of the DX coil and the DX coil having an adequate number of rows and fin surface. Cycling the compressor allows the coil surface to warm and actually re-evaporate the condensate that adheres to the fin surface and doesn’t fall to the drain pan. In the off cycle the RH can actually increase well beyond comfort levels producing surges of excess humidity to the space.

Three humidity control improvements are mentioned here for your review and consideration in troubleshooting:

1. **HGBP** can be added to mitigate or minimize compressor cycling and maintain low SST’s.

NOTE

HGBP maintains adequate load control to prevent frosting on the coil, low suction faults, and provides safe, low saturated suction temperatures for improved moisture removal).

2. **Auto Fan Speed Control** - This requires a space humidistat that reduces the system CFM at a space RH set point. Reduced airflow can be through either a 2-speed motor or a variable speed drive. The lower airflow will produce lower LAT’s to handle the same reduced building load. This lower coil temperature will also remove greater amounts of moisture condensate and prevent re-evaporation.
3. **Wrap-around Heat Pipe** that will pre-cool and dehumidify the entering air; post cool and dehumidify at a lower LAT using the DX Coil; and reheat the air.

NOTE

Any of the above approaches must be thoroughly reviewed by Product Technical Support prior to presenting to the Customer.

SECTION 3
SPLIT-SYSTEM OVERVIEW

3.1 Referenced Related YORK Publications

The following related Split-System Guides are available on the Intra/Extranet, offering greater detail with regard to the product packages and/or field piping requirements:

- YCUL Air Cooled Condensing – DX Coil Split - System Applications & Piping Guidelines – Form 050.40-ES3 (204)
- Split-Systems Installation Guide/Checklist – Form 50.40-CL1 (604)
- IOM YCUL0016-0130, 60 Hz Style C Air Cooled Condensing Units R-22/HFC407C – Form 150.63-NM5
- Literature Supplement - YCUL0140, Updated Electrical & Physical Data, Isolator Selection – Form 150.63-NM5 (LS01)
- Split-Systems Troubleshooting Guide – Form 050.40.TS1 (105)

Other related Forms and Parts Lists are also available on the YORK Intra/Extranet Publications Library.

3.2 Equipment Locations

The location of the installation is important to note and review. There are five essential factors associated with properly locating both the AHU and the ACCU:

1. **Wind** – When ACCU's are located where the condenser coils are subject to high winds, condenser coil head pressures can be compromised along with system performance and reliability. This is especially a factor when ACCU's operate at low ambient temperatures below 25° F. Louvers installed over the ACCU condenser coils can help lessen this problem. Parapet walls can also be installed to impede wind problems.

2. **Refrigerant Line-Loss** – Installing liquid line vertical risers (see note below) in excess of 40 feet (risers minus drops) can develop pressure drops in the liquid line that cause gas flashing just ahead of the Thermal Expansion Valve (TXV).

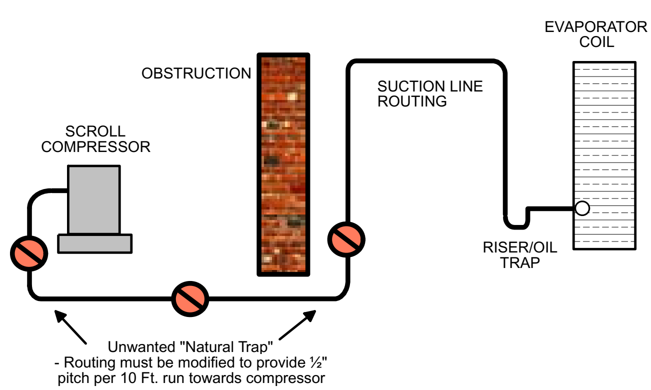
   This flashing will result in a loss of system capacity and reliability. Any vertical riser exceeding these recommended lengths, with detectable flashing at the TXV, should be discussed with Product Technical Support for split-systems.

NOTE: ***The term "riser" applies to refrigerant flow up the vertical pipe. The term "Drop" applies to refrigerant flow down the vertical pipe.***

3. **Equivalent Length of Pipe** – The equivalent length of pipe from the AHU evaporator coil to the ACCU should not exceed 150 equivalent feet of pipe (length plus elbows, valves, etc.). Exceeding this guideline can result in loss of capacity and system reliability. Where this guideline is exceeded and system problems are present, contact Product Technical Support for split-systems.

4. **Traps** – When routing suction line piping, it is critical to minimize any large formed "traps" within the piping arrangement. The only traps that should be incorporated are the operating traps using short radius elbows at the bottom or top of vertical suction risers. Natural* traps between the evaporator and compressor will only harbor oil and liquid refrigerant during the compressor off cycle that will on startup, slug the compressor. Even small slugs over a period of time can fail a compressor *(Reference Section 4.4, Figure 6 and 7).*

   *Natural traps are unwanted traps formed in the general routing of the refrigerant piping. Natural traps in suction lines can cause liquid build-up in the off cycle and create liquid slugging when the compressor is started. Note the following example that would require field modifications:



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5. **Underground Piping** – Location of equipment requiring the use of underground piping should never be allowed. A number of problems can occur either at the initial startup, or in the future. The initial problem is eliminating suction gases from condensing during intermittent shutdown or cycling, where liquid refrigerant forms in the line and is returned to the compressor. It is also evident that underground piping is subject to moisture or water around (or even in) the PVC conduit that can freeze, fracture and shift PVC conduit in time. This can lead to refrigerant line fractures, leaks, non-condensable gases infiltrating, dirt, kinks and system failure due to underground piping. Furthermore, the problems are difficult to detect as well as correct. If a problem job is found to have underground piping, contact Product Technical Support for split-systems *(Also Reference Section 4.3 Underground Piping).*

3.3 Ambient Concerns

Ambient concerns related to split-systems encompass two areas. Both, if not addressed properly, will impact performance and fail compressors.

1. **Head Pressure Control** – High ambient as well as low ambient operation of the ACCU can greatly affect the system head pressure. Low operation (down to 25° F or lower) offer challenges in maintaining adequate head pressure for the **Hot Gas Bypass** option to function. Low ambient temperatures mean low condensing temperatures, which cause Hot Gas Bypass temperatures to be inadequate for low capacity control and preventing compressor cycling. The addition of optional head pressure packages can help this (i.e. pressure switches, variable speed drives, or as a last resort, receivers) (*Also reference Section 4.6, Item 9 that covers this in greater detail).*

2. **Compressor Oil Dilution** – The hermetic scroll compressors utilized on the ACCU's require crankcase oil heaters that protect against off-cycle migration of liquid refrigerant to the compressor crankcase (Note that liquid refrigerant migrates to the coldest spot in the system).

Higher Saturated Suction Temperatures require higher crankcase oil temperatures and higher KW Heaters **(i.e. During compressor operation the crankcase oil temperature MUST maintain 20° F above the saturated suction temperature to prevent oil dilution in the system. Generally, maintaining a minimum of 10°F superheat <u>at the compressor</u> assures the 20° F difference).** Getting an accurate field reading of the oil temperature is virtually impossible without adding a thermal couple to the crankcase.

This TD assures the oil temperature is higher than other parts of the system, minimizing the absorption of refrigerant by the oil while in the off-cycle. Oil dilution takes place when the liquid refrigerant that makes its way to the compressor crankcase, during the off-cycle or through light liquid flood back during operation, is absorbed by the oil.

This dilution promotes oil washout of the compressor bearings as well as loss of oil from the sump. This loss of oil from the sump ends up in the system where it can log* coil tubes or suction tailpipes causing a loss in coil heat transfer or worst, the TXV bulb not sensing the true line temperature. This WILL lead to poor TXV control and more cyclical liquid flooding to the compressor with more oil placed in the system until the compressor seizes and fails. **Keep in mind as well, that higher ambient temperatures can affect heater capacity** *(Also reference Section 6.4 and 6.16 for additional information on crankcase heaters).*

NOTE

**** Logging is a term used for either filling a tube (or tubes) with oil or coating the inner surface of the tube with oil.***

CAUTION

The rate at which "oil" leaves the compressor is the rate at which it must return to the compressor to achieve maximum oil management and compressor reliability.

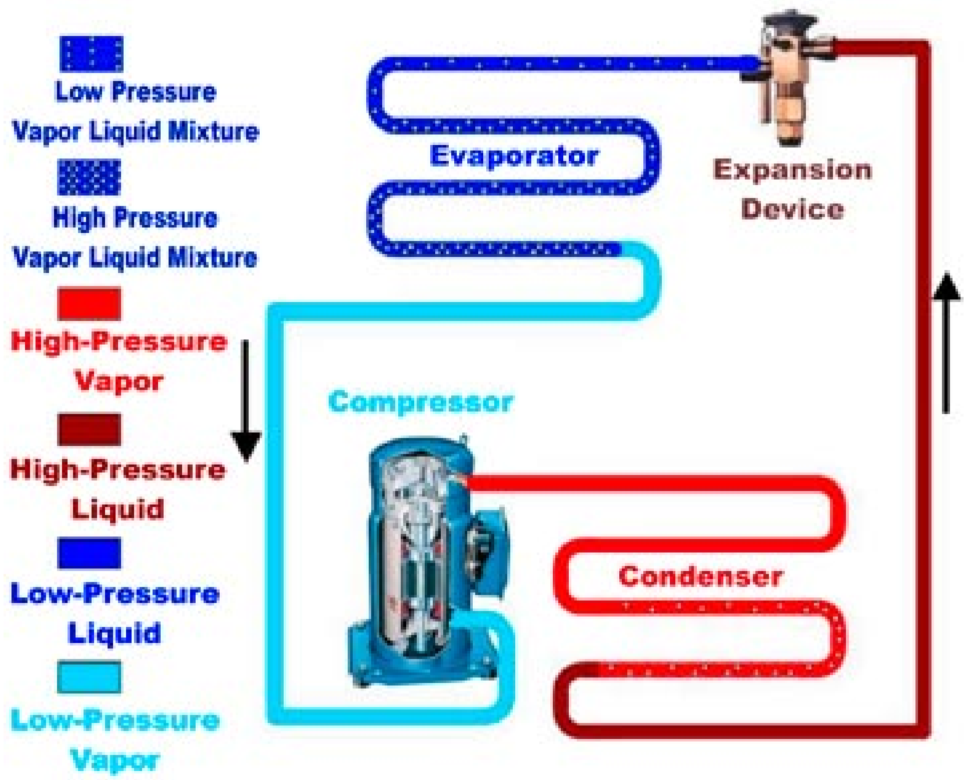

FIG. 1 - BASIC REFRIGERANT SYSTEM COMPONENTS AND FLOW

3.4 Refrigeration Basics

Operating principals have been well established and/or documented by societies like ASHRAE, as well as the HVAC/R manufacturing environment we work in. The application of these principals is what makes or breaks systems.

Figure 1 shows a basic overview of a refrigeration cycle. The essential "basic" parts include:

1. Compressor for pumping the refrigerant
2. Condenser coil for extracting/rejecting heat
3. Expansion Device for converting a high pressure/ temperature liquid to a low pressure/temperature vapor/liquid
4. The evaporator coil which removes heat from the supply air stream

The heart of the system is the compressor since it pumps the refrigerant. Its function is to receive a low pressure and temperature refrigerant vapor from the evaporator and compress it into a high-pressure and temperature refrigerant vapor. The high-pressure vapor is then converted into a liquid state in the condenser coil.

The condenser coil removes heat from the vapor and rejects that heat to the ambient air. The liquid, which remains in a high-pressure state, passes through the TXV, experiences a pressure drop, and becomes a low pressure, two phase (liquid and vapor) mixture. This refrigerant mixture returns to the vapor phase in the evaporator coil by absorbing heat from the supply airstream. The low pressure, low temperature vapor then returns to the compressor, and the cycle begins again.

It's a proven process that works. However, it is the piping practices and arrangements between these parts, the sizing of the piping and accessories, and the overall control that determines the success of a field installed split-system.

SECTION 4
SPLIT-SYSTEM FIELD PIPING REQUIREMENTS

4.1 Refrigerant Types

Refrigerant types currently used in YCUL product are R-22 and R-407C. When R-407C refrigerant is utilized, note that subcooling is determined using bubble point values and superheat using dew point values *(Reference Section 2.4)*.

4.2 Piping Layout and Design

Field piping layout and design is generally the responsibility of the installing contractor. To support the contractor in the field piping, YORK has available, detailed guides (Application Form 050.40-ES3) to be used through our sales force to support layout and design prior to, during, or following the bid stage of the project. Installation Form 50.40-CL1 is furnished at time of submission for approval and is furnished with the YCUL at time of shipment to direct the installer on YORK field piping requirements.

Figure 5 in the following pages depicts a refrigeration flow diagram for a typical split-system. This is representative of a YCUL with a “single” system* and “single” circuit* having three scroll compressors and evaporator with the hot gas bypass option.

NOTE

The term "system" applies to the number of independent refrigerant suction & liquid lines leaving the YCUL. The term "circuit" applies to the number of evaporator distributors/TXV’s used per system.

Note in Figure 5 the solid line piping is integral with the YCUL as shipped. The dashed piping lines represent the required field piping by the installing contractor. The YCUL can be set up for either discharge control or suction pressure control. Field piping includes the following customer supplied items:

1. Thermostatic Expansion Valve (Equalizer Line not shown, but is required)
2. Sight Glass/Moisture Indicator (shipped with YCUL)
3. Liquid Line Solenoid Valve
4. Liquid Line Filter/Drier (shipped with YCUL)
5. Suction, Liquid Line and optional Hot Gas Bypass Piping

Specialties (i.e. oil separator, suction line accumulator, etc.) are not shown. These items may be a project requirement and would be outlined in the YORK submittal, or may be required by the installing contractor due to system installation needs he has determined necessary.

4.3 Underground Piping

Underground piping is always considered a last resort in piping layout and design. **YORK does not recommend installing refrigerant piping underground.**

NOTE

Underground piping can expose the customer to potential reliability problems due to unwanted refrigerant condensation as well as major integrity breakdown of the underground piping system due to temperatures and thermal shifting, etc.

YORK reserves this option as a last resort design and limits its compressor warranty to 1st year parts only, and requires YORK startup supervision and field inspection of the system.

This provides sufficient time to prove the YORK components, as well as prove the integrity of the contractor installed underground field piping. Beyond this warranty period, a strict preventative maintenance program by the owner is recommended and considered essential in maintaining correct system pressures, refrigerant charge, and underground piping integrity that otherwise can contribute to unwanted system condensation and migration to the compressor, bearing wash out, liquid slugging, and eventual compressor failure.

Proper underground piping design and installation follow through are essential in minimizing risk to the owner. Figure 2 depicts a general underground piping arrangement **required** for Underground Installations.

Review of the field underground piping installation is necessary in troubleshooting systemic problems. Underground piping must consist of the following as a minimum:

1. Schedule 80 PVC Piping Conduit – This should extend at least 12” above the ground and must form a vapor tight and waterproof seal. Conduit must be

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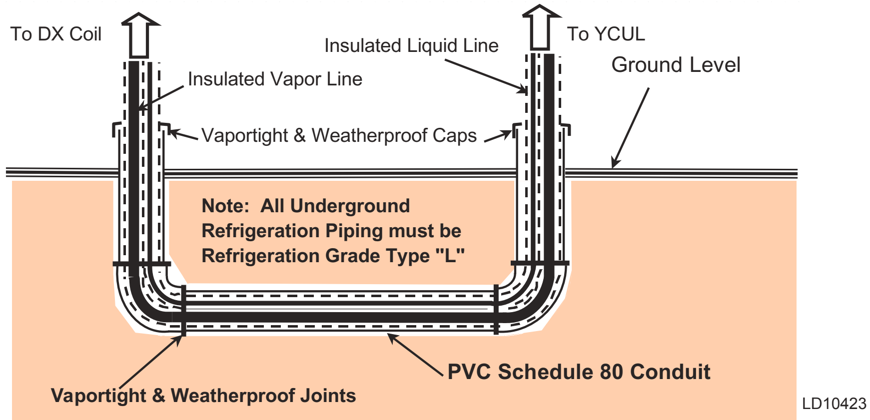

FIG. 2 - TYPICAL UNDERGROUND PIPING ARRANGEMENT

sized to allow for pipe diameters, insulation thickness, and a recommended ½" minimum clearance to the ID wall.

2. Conduit lines must be protected from surface damage (in the case of the stub outs), as well as underground damage where water, freezing or even tree root growth can shift the conduit, and above ground traffic that can crush the conduit **(Above ground traffic includes vehicles, roadways, cart paths, side walks, etc.).**
3. Where PVC conduit runs join (especially at elbows), it is recommended to "pack" Armaflex or equal foam insulation tightly around the refrigeration lines at the joint perimeters to help support lines and reduce vibration as well as eliminate wear points.
4. All suction lines, liquid lines, and HGBP lines must be individually insulated with ½" minimum wall thickness Armaflex or equal foam insulation. Insulation must be installed providing a vapor tight and waterproof seal (Do not compress insulation).
5. Heat trace must be run on all lines carrying refrigerant vapor, to help prevent refrigerant condensation and mitigate liquid refrigerant return to the compressor. **The heat trace is energized in the off-cycle.**
6. Caps can be foamed in place, but must not allow water or vapor to enter the underground conduit system. Care must be taken not to crack the conduit while foaming.
7. The horizontal underground suction line must be pitched ½" for every 10 ft of run minimum (up to a ¼" per foot maximum) in the direction of the compressor.

   - All PVC conduits with **suction lines MUST include a suction line accumulator** *(Reference Section 4.6 Item 7)* located as close as possible to the compressor

NOTE

Always follow accumulator manufacturers sizing and installation recommendations including heat bands or heat trace provisions.

NOTE

In lieu of burying the piping in PVC conduit, an alternate provision of running the piping in a concrete trough with the refrigerant piping Insulated and supported a minimum of 12" up* from the bottom of the trough will provide better serviceability. Piping must be pitched ½" per 10 feet in direction of refrigerant flow. A suitable protective walk grate would be provided a minimum of 6" above* the piping. Item 2 above applies as well. Also, keep in mind that concrete troughs or basins can shift as well and must be suitably anchored.
****Always factor in piping pitch.***

8. Always provide above ground trapping and arrangements as shown in Figures 3 & 4 of this guide.

4.4 Pipe Sizing, Traps and Risers

Pipe sizing, traps and risers are extremely important to system performance and oil management. It is the installing contractors responsibility* to provide the proper line sizes with regard to acceptable system pressure drops associated with the equivalent feet of pipe run and the number of fittings in the line. Normal pressure line losses are as follows:

- Suction Line – 2° F
- Liquid Line – 1° F
- Hot Gas Bypass Line – as outlined in Form 50.40-CL1

NOTE

**** The installing contractor may have also received direction from YORK in supporting recommended line sizes. This can be verified through the YORK sales office.***

Reference YORK Application Guide Form 050.40-ES3 (shown below) for specifics as well as examples on proper line sizing including the use of double suction risers and oil traps.

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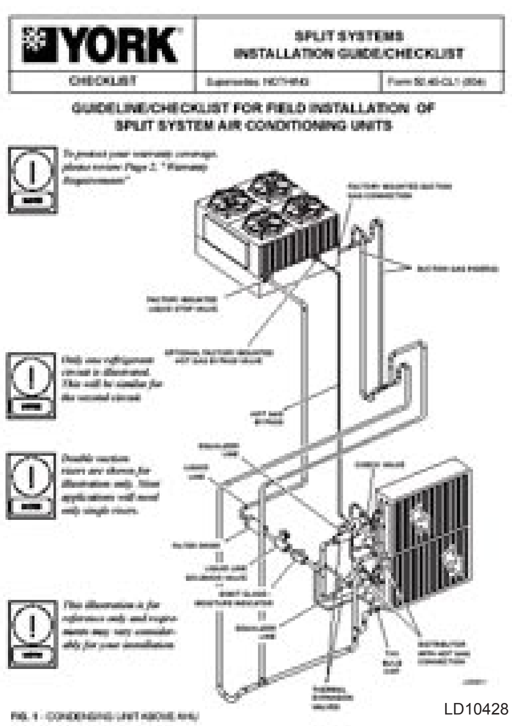
The previously mentioned guide as well as the Installation Guide Form 50.40-CL1 (shown below) should always be referred to if a question comes up on the installation and/or accessory sizing.



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Figures 3 and 4 below depict two typical field-piping arrangements for YCUL ACCU's, showing above and below the evaporator coil configurations (single system shown). *Reference Fig. 30 & 31 for larger view.*

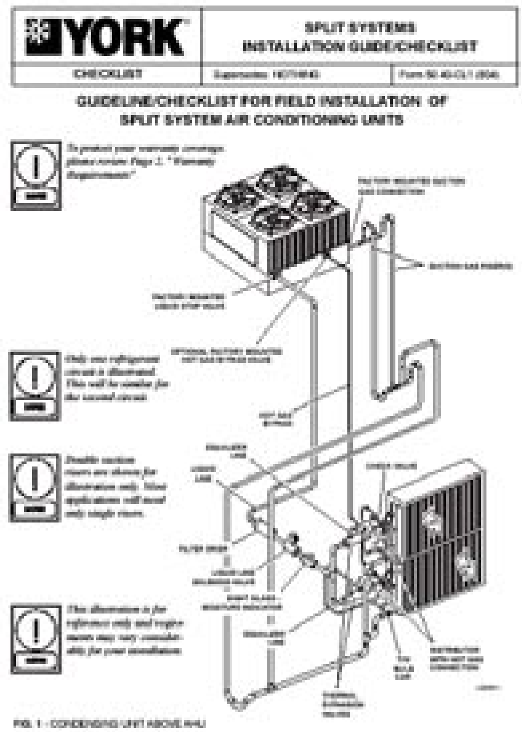

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FIG. 3 - YCUL ABOVE EVAPORATOR COIL

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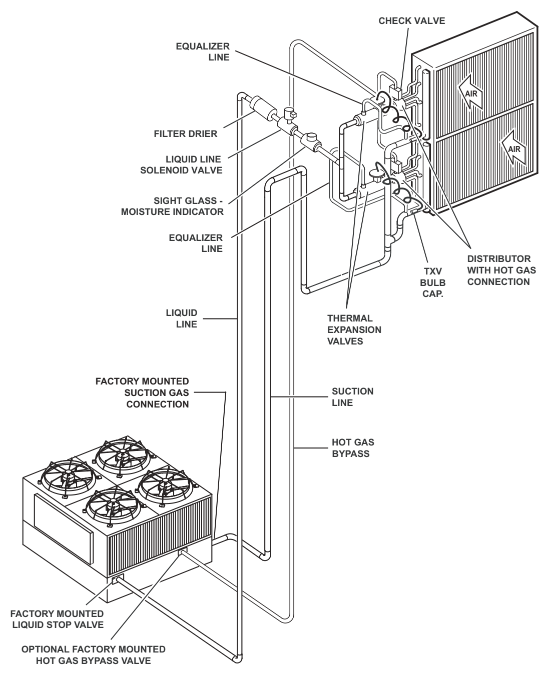

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FIG. 4 - YCUL BELOW EVAPORATOR COIL

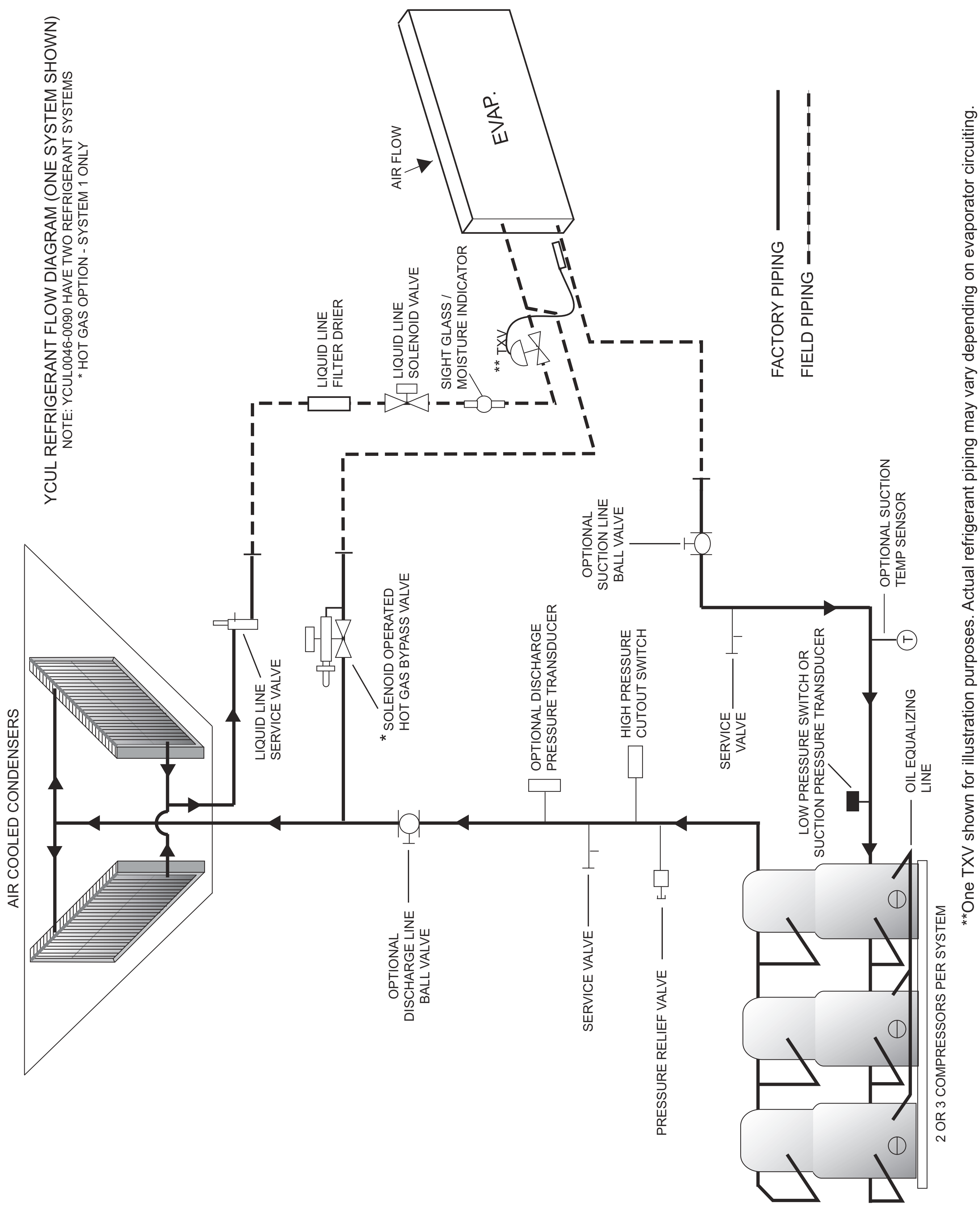

FIG. 5 – REFRIGERANT FLOW DIAGRAM OUTLINES A TYPICAL YCUL AIR COOLED CONDENSER REFRIGERANT FLOW ARRANGEMENT (A SINGLE SYSTEM IS SHOWN).

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Pipe Sizing, Traps and Risers . . . continued

Properly sized and installed Traps and Risers are essential in oil management, and proper TXV bulb installation is essential for maintaining proper superheat. The following (3) Figures (6, 7 & 8) depict the proper arrangements for systems requiring double suction risers, trapping and the correct installation of the TXV bulb. Sizing is further outlined in the Application Guide Form 050.40-ES3.

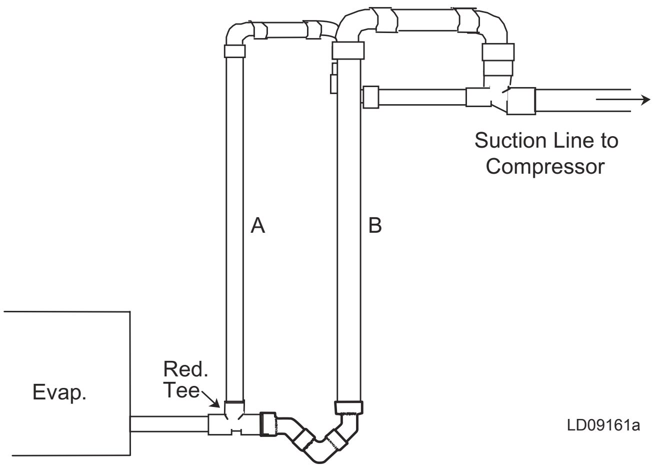

FIG. 6 –OIL TRAP INSTALLATION ON DOUBLE SUCTION RISER

Where traps and risers tie into overhead suction lines, "inverted" traps must be utilized at the top of the vertical riser to prevent oil "logging" of the bottom suction line. This is also important when multiple suction line circuits are teed together.

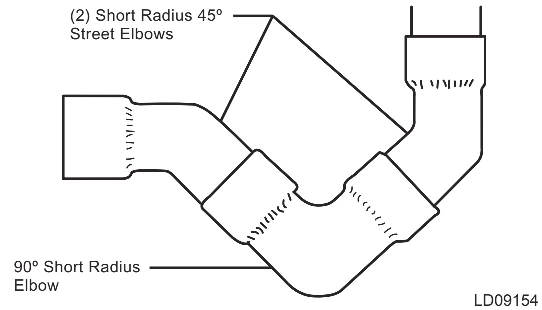

FIG. 7 –OIL TRAP PIPING

Oil traps must utilize short radius elbows in order to promote good oil return. Use traps on any vertical riser over 3 ft. Any riser in excess or 20 ft. must include an intermediate trap (mid-point). If risers exceed 40 ft., contact Product Technical Support.

4.5 Piping Accessories and Selection

The selection and sizing of piping accessories is essential for proper system performance and compressor reliability. The following are required system accessories that are typically selected, furnished and installed by the installing contractor:

1. **Thermostatic Expansion Valve**

   Take care to NOT oversize the TXV and assure it is designed to function at the low load condition (minimum step of unloading of the compressor system). TXV's can provide a 30% turndown in capacity without any adverse affects to superheat control. Indication of an oversized TXV is low superheat and liquid flooding the compressor.

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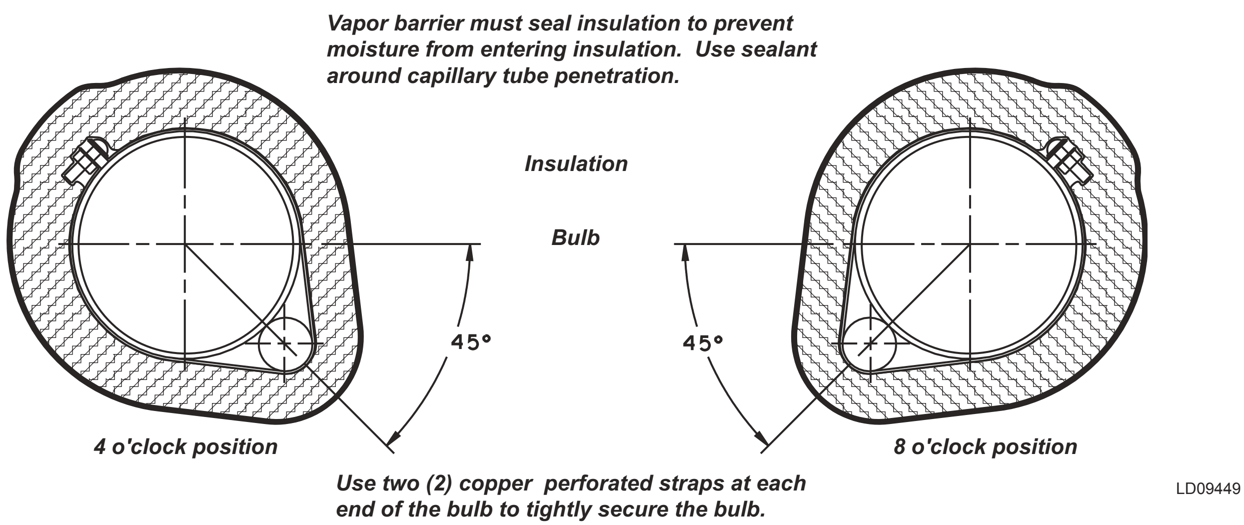

FIG. 8 –TXV BULB INSTALLATION - .*(Also reference Section 2.2, Items 6 & 7 on other critical bulb installation practices)*

Verify the valve type is equal to a Sporlan OVE with external equalizer line properly piped. The bulb charge is typically a VGA charge, but some installations may require a VCP100 charge to meet specific MOP (maximum operating pressure) limits, or an adsorption type "N" charge to prevent liquid migration of the bulb refrigerant to the TXV. (Refer to Fig. 9). Adsorption type charges are typically required when the TXV is located outdoors and the operating TXV can see lower temperatures than that of the suction line temperature.

Also, note that TXV's can form ice at the valve seat port or collect dirt that can hinder valve performance. Ice blockage can be verified by placing a rag soaked with hot water over the TXV. This will dissolve the blockage and return the TXV to normal operation. Moisture would indicate a need to replace filter/driers and/or evacuate and clean the system. Dirt in the TXV will require cleaning, or replacement if worn parts are present. Reference the troubleshooting table in Section 2.1 (3d through 3h) of this guide for other problem/solution direction.

2. Sight Glass/Moisture Indicator

The sight glass should be the same size as the liquid line. Normally pressure drop is minimal and not a concern, unless undersized. An undersized sight glass can act as a restriction and cause flash gas at the TXV.

A sight glass element has two purposes:

- *It indicates moisture in the line* (i.e. Green "OK" and Yellow "Wet"). A wet condition generally means poor system evacuation or leaks in the system. Moisture is a non-condensable element and will displace refrigerant in the condenser coil and consequently increase the head pressure, exhibit high compressor KW, and normal to high SST's, as well as erratic TXV operation. However, remember an overcharged system may exhibit the same symptoms.
- *A refrigerant liquid indicator* – As a liquid indication a clear column of refrigerant indicates, no gas flashing is present just ahead of the TXV. Note that some occasional intermit-

Thermostatic Expansion Valve Bulb Charge Overview:

#	Type	VGA	VCP100	VN	Comments
1	For Air Conditioning Use	X	X	X~	~N Charge is typically used on Chiller Applications, but can be used on AC systems for its non-migrating characteristics.
2	Standard Charge Offering	X			The Base AC Charge
3	Standard Alternate Charge Offering		X		Use VCP100 charge when more defined MOP characteristics are desired (See note 3)
4	Pressure-Limiting Charge	Above 64 dF Only	X		Gas-Cross Charge element (See note 3)
5	TXV Response (**Slow to Open**)	X	X	X	Typical Response for all Charges
6	TXV Response (**Fast to Close**)	X	X		**Fast to Close** could create Low Suction Pressures, but is Good for Catching a Flood.
7	TXV Response (**Slow to Close**)			X	**Slow to Close** can create Liquid Return to Compressor
8	Gas-Cross Charge	X	X		"Possible" Charge migration (See note 2)
9	Adsorption Charge			X	Use only when TXV Diaphram can be colder than bulb
10	Anti-Hunting Characteristics	X	X		VGA charge is the recommended charge for Anti-Hunting **w/limited MOP**. The VGA bulb thermal ballast helps stabilize TXV control.
11	MOP* (Max Oper Pressure) Defined	Limited	X		If a defined MOP is not required, the VGA charge can be used
12	More Constant Superheat	X	X		Generally desired on systems operating at a significant range in evaporating temperature
13	Possible Migration (See note 2)	X	X		Both the VGA and VCP100 with a properly sized Distributor will guard against migration (See note 2)
14	Non-Migrating Type			X	Generally applied to Chillers where the TXV is located outdoors and extreme ambient temperatures.
Note 1	* MOP feature causes the TXV to close above a predetermined evaporator pressure, thereby restricting flow to the evaporator and limiting the maximum operating evaporator pressure.				
Note 2	A properly selected and applied pressure drop Distributor/Orifice (35 psi) is effective in preventing charge migration by keeping the TXV outlet pressure and temperature higher than the suction gas temperature. However, "IF" the operable TXV will sense colder OA temperatures than the sensing bulb you should consider using the "N" charge type, noting that there will be other compromises associated with this charge (I.e. No MOP, No Anti-Hunting, and Less Constant Superheat characteristics).				
Note 3	Superheat Characteristic Curves Graph (Far Right): The curve to the right shows the flat superheat curves associated with both the VGA and VCP100 Bulb Charges. At the far right of each curve line the pressure is limited (hence pressure-limiting charge) and the superheat line jumps upward sharply. Note that the pressure limit for VCP100 charge is well defined starting at 34 degrees F, while the VGA is somewhat limited with a gradual pressure limit starting around 40 dF.				

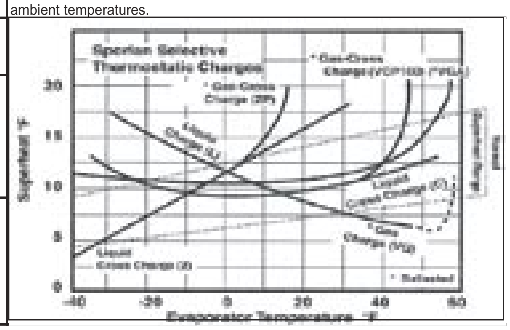

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FIG. 9–TXV BULB CHARGE OVERVIEW)

tent gas flashing may occur during system operation, and should generally be considered normal. However, if erratic TXV operation and low suction pressures are prevalent, don't discount gas flashing as a problem. Super Heat that "hunts" is an indication of an erratic TXV. However, also note this as well could be an undercharged system. **"Don't rule anything out until the problem is resolved".**

NOTE

1- A newly installed sight glass should operate for 12 hours to allow equilibrium of the sight glass element with the system and provide a more accurate indication of the system.

2- Sight glass paper indicating elements will remain yellow or turn white if they come in contact with water and must be replaced (Some sight glass' have paper replacement kits, but a complete change-out is generally recommended).

3. **Liquid line Solenoid Valve**

   Liquid Line solenoid valves are selected based on refrigerant type, maximum circuit capacity, and the maximum operating pressure differential (MOPD) where installed. Selections are typically based on a pressure drop of 3 psi. Generally, sizes match that of the liquid line. Keep in mind, undersized lines and/or valves can cause excessive pressure drops and promote gas flashing ahead of the TXV, which can damage the TXV and compromise system performance and ultimately compressor reliability by liquid slugging.

4. **Liquid Line Filter/Drier**

   Filter driers are used to "collect" and remove moisture, dirt, acids and varnish or sludge, and keep them from circulating through the system where contamination can compromise or damage vital parts, especially compressor bearings, solenoid valve, and TXV's. The key word here is "collect". Filter/driers that are loaded to holding capacity (dirty) can also generate excessive pressure drops that cause gas flashing at the TXV.

   Determining when a filter/drier is dirty can be a challenge. One indication of a dirty filter/drier is bubbles present in the sight glass. However, bubbles could also indicate a low charge. Detecting the temperature difference across the filter/drier can also indicate a loaded filter/drier. The third and more accurate approach is to measure the PD across the device. A PD of 4 to 5 psi across the filter/drier generally would signal a need for change-out *(Reference section 2.2, item 4)*. The cause can stem from a poor initial evacuation of the system or leaks in the system. In addition, systems generating even cyclical or intermittent high discharge pressures can create temperatures (above 300° F) that form sludge or varnish that will cause filter/drier loading and ultimately compressor failure.

5. ***Reference Section 5.7 covering hot gas bypass & ASC's (selection and review).***

4.6 Piping Specialties and Selection

Piping specialties are accessories outside YORK's normal offerings. Included are:

1. **Suction Line Filter-Driers**

   Suction line filters are typically not installed on new systems, but are specifically designed for installation following a compressor burnout (Reference Sporlan "Clean-up Procedure" Bulletin 40-10; and Sect 6.14, Figure 28). The filter-drier can be installed directly in the suction line by removing a portion of the line.

   A hermetic motor burnout produces large amounts of acid, moisture, sludge and various types of lubricant decomposition materials. Always utilize a charcoal core in removing these contaminants. After clean up the filter-drier is generally left in the line **(It is highly recommended to use a replaceable-core filter drier)**. Following clean up, the cores in the replaceable model must be replaced with standard filter elements to obtain the lowest possible pressure drop.

NOTE

Crankcase oil acts as a scavenger collecting acid, sludge and other contaminants, therefore it is vital to check color and acid content of the lubricant with an acid test kit, before the job is finished.

2. **Replaceable Core Liquid Line Filter-Driers with bypass valves**

   Normally, liquid line filter-driers can be serviced by pumping the system down. However, some installations may not permit shutdown during filter-drier servicing. In this case, a bypass arrangement is necessary.

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When a bypass installation is used, isolation valves "A", "B" and "C" (Reference Figure 10) is used. Closing of Valve "A" and opening of "B" and "C" allow full flow through the Filter-Drier. During servicing, valve "A" is open and valves "B" and "C" is closed. The bypass line must be kept as short as possible. A pressure relief valve is required due to potentially dangerous hydraulic pressures between the two isolation valves.

WARNING

Dangerous hydraulic pressures may develop between closed valves "B" and "C". A pressure relief valve is required as a safety device (always vent pressure relief valve to the outside).

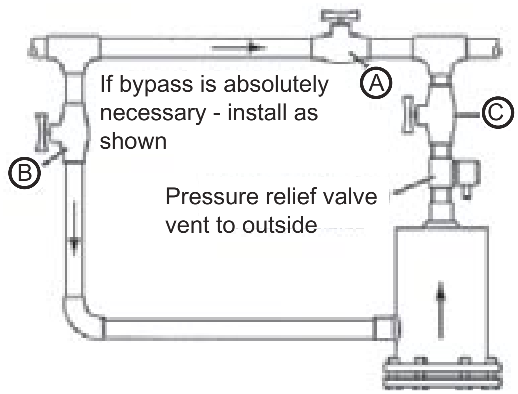

FIG. 10 – FILTER/DRIER WITH BYPASS PIPING

3. **Schraeder Valves**

   Schraeder valves are used on refrigeration lines for taking pressure readings between devices. They are typically added in the field to measure pressure drops across devices and in trouble shooting problematic systems. It is recommended you install Schraeder valves as an assembled item (see Figure 11) with coupled ends for brazing into the system.

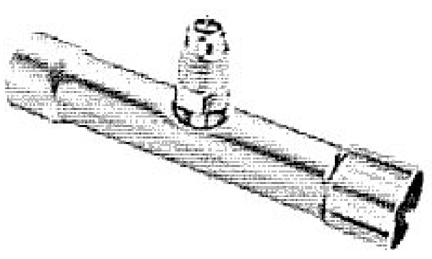

FIG. 11 – SCHRADER VALVE (ASSEMBLED)

CAUTION

DO NOT just drill a hole in the line! Drilling a hole allows the introduction of copper drillings into the system that can contribute to system contamination and even cause a restriction hindering uniform flow of refrigerant at the Distributor orifice or worse yet, make its way to the compressor where greater damage can occur.

4. **Individual Circuit Sight-Glasses**

   Most multi-circuit systems come with a single sight-glass located prior to any distribution tee on the liquid line. Although this offers reliable indication of moisture, it doesn't always offer full-proof indication of liquid at the TXV. Flashing could take place between the "single" sight-glass and the TXV that may be missed in your analysis of the system. Individual sight-glasses located after the filter-drier but just before the TXV offer foolproof analysis of gas flashing at the TXV.

5. **Hot Gas Bypass Valves on both Systems**

   Standard HGBP includes a single HGBP pressure -regulating valve for the "lead" system only. Although this supports low load conditions, it prevents automatic lead-lag capability of the systems and compromises humidity control at loads above 50% capacity. The addition of "full time" HGBP on the secondary system can assure lead-lag as well as humidity control at all loads. This add-on will promote better room comfort and increase system reliability. Installation and insulation requirements are the same as for the lead system.

6. **Electric Expansion Valves**

   Electric expansion valves (EEV) are an alternate means of controlling the refrigerant flow to the evaporator coil over the normal thermal expansion valve (TXV). This type of expansion valve utilizes a controller, which typically measures discharge air temperature via a sensor. Another unique attribute of this type of control is a temperature sensor and pressure transducer that can measure super-heat, providing data to the controller that can be used to throttle the expansion valve under low superheat conditions to prevent liquid flood-back at the compressor.

Given the above, this type of control is primarily suited for chiller (chilled water) applications or integral packaged air-cooled systems. Its use on split-systems actually compromises system operation and reliability and is considered not suitable for split-systems. This type of control should be considered a last resort in troubleshooting split-system problems.

NOTE

EEV's require extensive review by the Product Technical Support Team to see if this type of control is acceptable for your application. Contact York Product Technical Support when considering EEV's in your problem solving.

Reference Figure's 12 & 13, showing an EEV as well as a typical controller wiring schematic.

7. Suction Line Accumulators

Suction line accumulators are often considered in troubleshooting liquid refrigerant return in the suction line. However, before considering suction line accumulators, all other deficiencies **must** be corrected first (i.e. pitch of suction line to compressor, line sizing, traps, TXV bulb, etc.). Accumulators should never be required on properly piped systems. Suction line accumulators are typically reserved where suction lines are run underground (a last resort) and require a means of controlling liquid flood-back and avoiding reliability/warranty issues.

Suction line accumulators are selected and sized so that the accumulators can hold approximately 50% of the system refrigerant charge. Additionally the accumulator must not exceed the minimum/maximum capacity rating outlined in the suppliers published data (minimum applies to **minimum unloaded capability**). On large capacity systems, it may take two accumulators in series to meet certain volume requirements (If two different size accumulators are used in series, the larger accumulator is 1st and the smaller second in direction of flow). And all accumulators must include a heat band or heat trace at the bottom of the vertical accumulator to help boil off liquid and aid in oil return. The heat band KW can be sized the same as that recommended for scroll compressors.

CAUTION

Over-sizing the heat band can cause excessive temperatures at the compressor and reduce compressor reliability.

While accumulators can provide flood back control in certain situations, accumulators can actually contribute to system problems if not installed or

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FIG. 12 – EEV

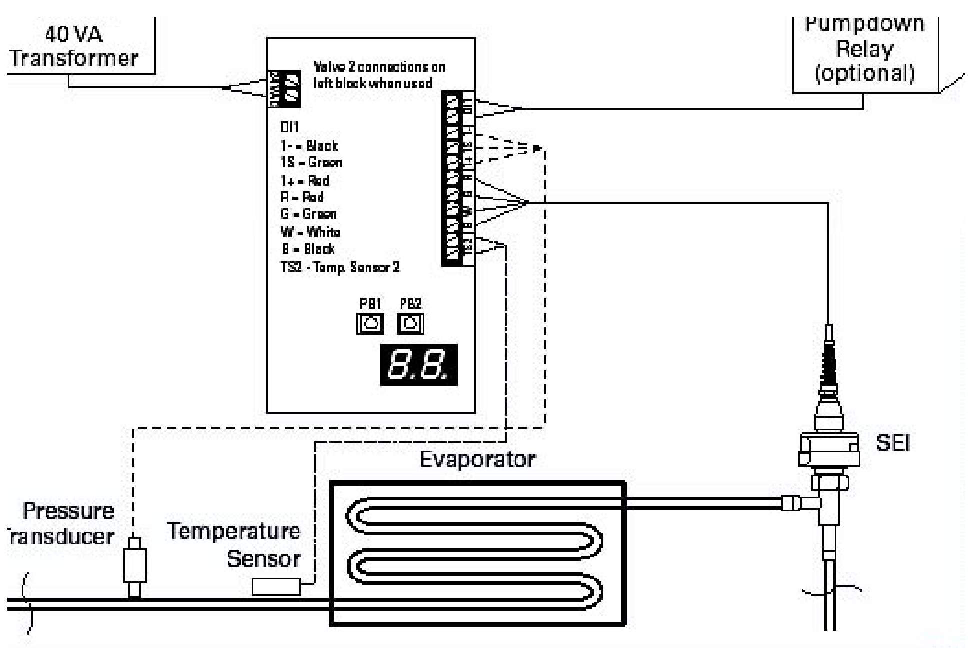

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FIG. 13 – TYPICAL CONTROLLER WIRING SCHEMATIC

maintained properly. Accumulators are susceptible to wax and debris build-up, which can clog the orifice of the accumulator, that can also lead to oil return problems and excessive pressure drops. If an accumulator is found necessary, it is suggested a suction line filter be installed just ahead of it.

CAUTION

Keep in mind that when coils, piping and accessories are brought into proper design, selection and installation . . . accumulators are not necessary.

8. **Oil Separators**

Like accumulators, oil separators are to be considered a last resort. When systems and components are brought to within proper design, oil separators are not required. Note must be made when applying separators, that while they can reduce the amount of oil being pumped into the system, they are **not** 100% efficient. Even with oil separators in place, oil can still be eventually pumped into, and harbored in a system where proper piping practices where not followed.

NOTE

"Always address and correct piping problems first, before considering oil separators".

9. **Head Pressure Control**

Standard head pressure control on YCUL systems is adequate for most applications *(reference IOM form 150.63-NM5 "Condenser Fan Control" under the Unit Controls section)*. York YCUL Air Cooled Condensing Units offer three (3) head pressure control packages:

- Standard with outside ambient temperature, and discharge control (optional)
- Discharge pressure only (requires discharge transducer) – recommended setpoints are as follows (R-22):

  Stage 1 @ 250 psig on & 200 psig off (adjust to 50 psig differential) – This differential will maintain reasonable low-end head pressure for proper HGBP operation, if HGBP is used. If HGBP is not used an 80 psig differential will offer less cycling of the condenser fans.

  Stage 2 @ 290 psig on & 240 psig off (adjust to 50 psig differential)

- Low ambient with reversing fan feature – For ACU operation down to 0°F ambient (optional)

However, occasionally head pressure problems surface despite an otherwise properly designed system with correct charge; and adequate head pressure control using standard selectable options may be inadequate in maintaining proper TXV operation. Some applications require a more precise and/or controllable means of discharge head pressure control for HGBP control during low ambient operation and to prevent erratic TEV operation and/or fault shutdowns where critical room and humidity control is essential (i.e. labs, surgical suites, etc.). The following offers three ways of stabilizing head pressure control:

- Pressure switches
- Variable speed drives (always consult with Product Technical Support)
- Floodout receivers (always consult with Product Technical Support)

Pressure Switch Control

Offers an "inexpensive" approach to controlling tighter head pressure needs over the standard or VFD offering. The use of Penn #P70AA118C or equal pressure switches are utilized. The pressure switches are wired in parallel (contact Product Technical Support for wiring and interface directions).

Variable Speed Drive (VSD) with Pressure Sensing Transducers and Controller.

One important thing to remember here is that the condenser fan motors must be approved for "speed control duty". Motors should include ball bearings and carry a minimum 1.25 SF for reliable operation (review all application's with Product Technical Support).

General Overview of Required Components:

1. Variable speed drive
2. Controller
3. Pressure transducer
4. Power supply

Special Requirements:

1. Enclosure location must be reviewed for NEC compliance.

2. Enclosure must be suitable for the environment installed (i.e. NEMA 3 R minimum for weatherproof installations if outdoors).

3. Enclosure must have proper environmental heat source or ventilation as needed (review needs based on geographic area and other influence). (See "VSD ventilation needs" below).

4. Review desired cycling sequence (i.e. normally the VSD will throttle both condenser fans in unison). **Do not exceed total FLA rating of drive**

NOTE

Consult Product Technical Support for specifics on part numbers and other interfacing requirements. A complete plan must be established before approval or implementation can take place.

VSD Ventilation Needs

VSD's located at the YCUL may require heating and/or cooling depending on the ambient design they are located in. Cold weather typically is not a problem unless you operate below –10°F, however, hot summer conditions can exceed the 104°F limitation of most VSD's depending on where they are located (i.e. roof tops, design ambient over 104°F, etc). One common way of tempering a VSD is to pump conditioned air from the AHU to the VSD. This generally involves running a 2" minimum size Conduit from the pressurized segment of the AHU

NOTE

DO NOT use this air if it is humidified.

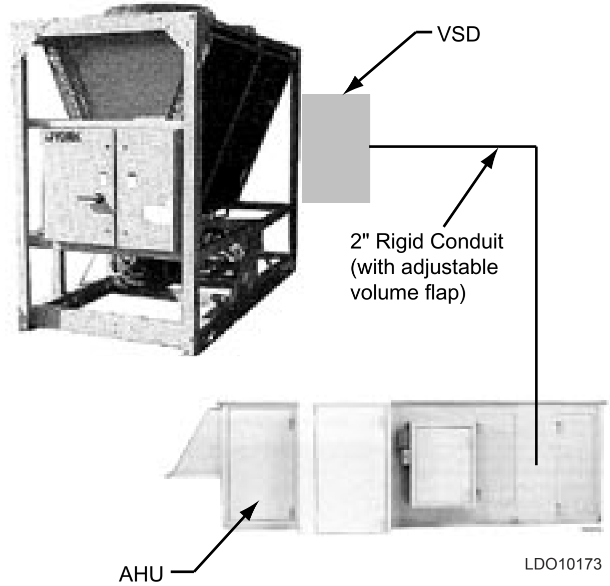

FIG. 14 – VSD VENTILATION

VSD Ventilation *(reference Figure 14).*

Run 2" rigid wall conduit from pressurized "dry" AHU discharge to VSD and vent to atmosphere. Consult with Product Technical Support on any questions or concerns

NOTE

This ventilation arrangement is generally suited for close-coupled split-systems only.

4

Floodout Receivers

Used primarily on low ambient design applications when even cycling all the condenser fans off, the air-cooled condenser is so efficient that excessively low head pressures result in erratic TXV operation and liquid refrigerant return

NOTE

Flood-out receivers are rarely necessary and are only covered here as another alternative in troubleshooting split-systems. Furthermore, this method takes in a critical charge method, which must be serviced, adjusted and maintained by a knowledgeable refrigeration technician.

Figure 16 illustrates a typical system using Flood-out receivers and the necessary ORI/ORD pressure regulating valves associated with this system. The operation of the system offers a constant receiver pressure for normal system operation. The ORI valve is adjustable over a range of 65 to 225 psig. Note that each “system” requires its own receiver package.

During periods of low ambient temperatures, as the drop in condensing pressure approaches the setting of the ORI valve, the valve throttles restricting liquid refrigerant flow, causing it to back up into the condenser coil, thus reducing the active condenser surface and raising the head pressure. As the pressure differential between the condensing pressure and receiver pressure exceed the ORD set point, the ORD valves opens providing a tempering of hot gas with the liquid being passed by the ORI valve. This allows the liquid to reach the receiver in a warm state and with sufficient head pressure to properly operate the TXV.

As long as sufficient refrigerant charge is in the system, the two valves modulate to maintain proper receiver pressure regardless of the outside air temperature.

10. Recycling Pumpdown

The YCUL compressor integral discharge check valve is by design a low leak back valve. When the compressor is idle for an extended period, the refrigerant pumped down into the high side can leak back into the compressor. If allowed to remain in the compressor, oil dilution can occur. A crank-case heater usually is adequate for preventing oil dilution in the off-cycle, but if oil dilution remains a problem, recycling pumpdown may need to be considered. Standard with all YCUL product is a one-time pumpdown with compressor crankcase heaters.

An inherent problem with recycling pumpdown is that continuous pumpdown can pump oil from the compressor and harbor this oil in the piping system. This can eventually create lubrication problems that can lead to bearing failure.

Always consult Product Technical Support if this is a consideration *(reference Section 6.5 for further pumpdown related topics).*

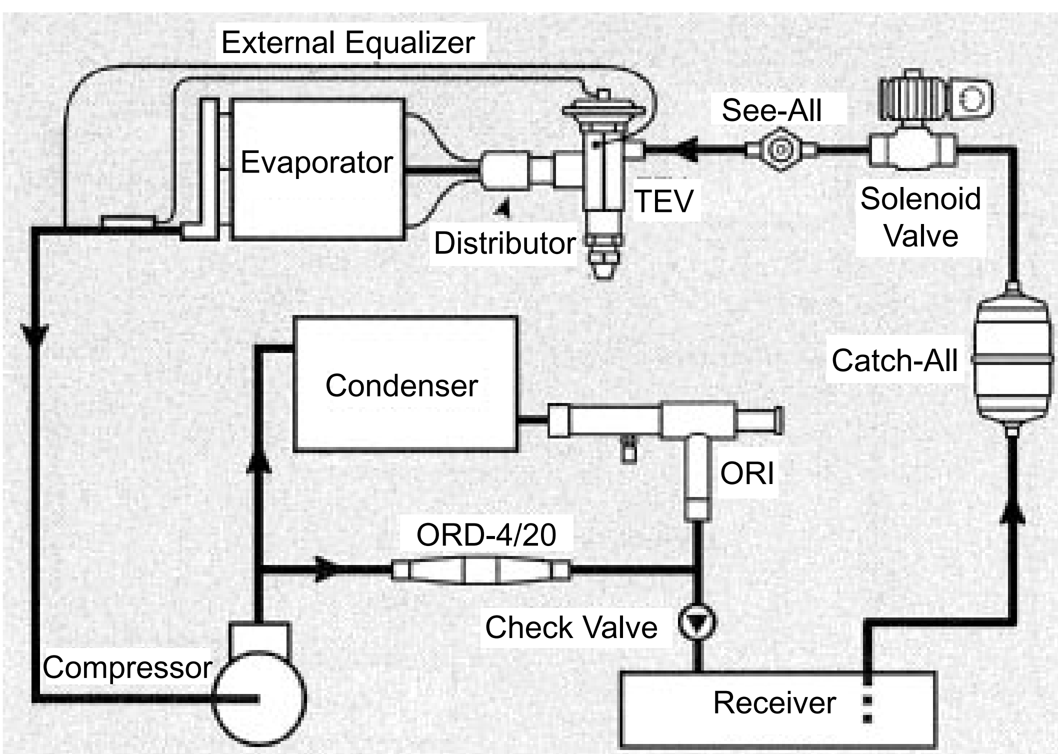

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FIG. 16 – FLOODOUT RECEIVERS - TYPICAL SYSTEM (COURTESY OF SPORLAN VALVE)

4.7 Piping Insulation

Piping insulation of any refrigerant line carrying "vapor" is necessary (excluding discharge lines). This includes the suction line and the hot gas bypass lines associated with split-system piping.

Suction Line Insulation prevents:

1. **Loss of capacity at the Air Cooled Condensing Unit (ACCU)** – Un-insulated lines produce heat gains that increase the line loss temperature beyond those calculated. This can reflect a loss of building control at design conditions.
2. **Liquid slugging of the compressor** – Un-insulated lines will condense refrigerant vapor in the suction line during lower ambient temperatures or in the off-cycle, producing liquid slugging of the compressor or liquid migration during the off-cycle.

CAUTION

Liquid refrigerant surging or slugging as well as bearing washout will ultimately fail the compressor.

Hot Gas Bypass Insulation prevents:

1. **Refrigerant condensation in the HGBP line during the off cycle** - Any refrigerant gas that condenses to a liquid is eventually pumped into the system and adds more liquid refrigerant to the DX coil than can be evaporated. This liquid returns to the compressor in small surges that **can** wash out the oil in the compressor bearings.
2. **Heat loss of the HGBP during low load ambient is a problem** - Low ambient temperature operation of the HGBP typically means low head pressures in the neighborhood of 200 psi or 102°F for R-22. HGBP essentially doesn't work well below this temperature, and the compressors will cycle uncontrollably. As we know, cycling has a tendency of robbing oil from the compressor and harboring it in the piping system, thus compromising compressor oil management. Oil must return to the compressor at the same rate at which it leaves

CAUTION

The above promoted liquid slugging, washed out bearings, and oil displacement will ultimately fail the compressor.

Although some insulation techniques incur the use of Fiberglas insulation with an all service jacket (ASJ), this type of insulation, when not vapor sealed or water tight, can get soaked and compromise the insulation values as well as system operation due to influenced TXV bulb and thermistor sensing. Wet insulation is difficult and costly to repair or replace as well.

Armaflex or equivalent thermal refrigerant insulation on the other hand offers better weatherproofing characteristics than fiberglass and is less costly and easier to install. One caution with Armaflex or equivalent insulation is its affect with UV rays. Foam insulation can break down over time if not properly protected with a coating suitable for UV exposure.

4.8 Leak Testing

Refrigerant leaks contribute to three problems:

1. Pollution of the ozone
2. Added expense in replacing refrigerant
3. Contaminants and non-condensable in the system that promotes poor operation and compromises compressor and other component reliability

4

Leak detection should be a primary review with systems appearing undercharged. The following offers leak detection procedures that must be adhered to:

1. Lock out the supply fan operation.
2. Temporarily disable the system.
3. Verify "all" valves in the system are open.
4. Jumper the liquid line solenoid valve to power the valve to the open position.
5. At the YCUL liquid line service valve, pull a vacuum on the system to 500 microns and hold for a minimum of 10 minutes.
6. If in 10 minutes the vacuum exceeds plus 100 microns, pull the vacuum and pressurize the system with 325# dry nitrogen and check for leaks at elbows, fittings and other components. **This may involve removing some insulation.**

7. Mark leak points and relieve the test pressure. **This may involve removing insulation at elbows and fittings**
8. Run dry nitrogen through the leak point portion and repair leak. Evacuate refrigerant charge where necessary.
9. Repeat testing 5 – 9 until the plus 100 microns is held for 10 minutes minimum
10. Re-insulate elbows and fittings where required
11. Reposition all valves to their correct setting and remove LLSV jumper.

4.9 Charging the System

The following will cover new system charging as well as field replacement system charging, and charging following major field piping modifications.

System charging at design ambient temperatures and building loads can be very straight forward, yet charging a system at even 70°F ambient with a building load at 75% of capacity or less requires some creativity on the part of the technician. In the case of the later, a required system-check follow-up by the startup technician or the owners facilities technician will be required (reference Section 6.10 for additional refrigerant charging cautions.

Split-System charging must follow the guidelines below:

1. YCUL's come with a holding charge of 5 pounds of dry nitrogen
2. Complete all interconnecting field piping and/or modifications (reference Installation Guide Form 50.40-CL1)
3. Insulate all required field piping "except the elbows and other to-be insulated fittings"
4. Review estimated refrigerant charge (reference Installation Guide Form 50.40-CL1, page 10, Par. 11 "Charging the System"). This will be your initial targeted charge ___________.
5. Testing System #1 (disable and lock-out System #2 if applicable)
6. Lock out the supply fan operation
7. Temporarily, disable System #1
8. Verify "all" valves in the system are open
9. Jumper the liquid line solenoid valve to power the valve to the open position
10. At the YCUL liquid line service valve, pull a vacuum on the system to 500 microns and hold for a minimum of 10 minutes.
11. If in 10 minutes the vacuum exceeds plus 100 microns, pull the vacuum and pressurize the system with 325# dry nitrogen and check for leaks at elbows, fittings and other components.
12. Mark leak points and relieve the test pressure.
13. Run dry nitrogen through the leak point portion and repair leak.
14. Repeat testing 10 – 14 until the plus 100 microns is held for 10 minutes minimum.
15. Insulate elbows and fittings where required.
16. Re-verify all lines are open and the LLSV is still open.
17. Connect refrigerant jug lines to the liquid line service valve at the YCUL.
18. Make sure the condenser fans are **not** running.
19. Invert the jug to allow liquid to flow into the system.

NOTE

Jugs with two valves have an internal siphon tube that can feed liquid with the Jug in the upright position

20. Eventually the jug will reach the same pressure as the high side pressure.
21. At this pressure equilibrium, now run the condenser fans only to lower the high side pressure and allow more liquid refrigerant to flow.
22. Compare the amount of refrigerant added vs. the estimated charge in pounds *(see item 4 above)*. This generally will make 70% of the charge required.

NOTE

23. An electrical heated blanket (reference Section 2.3) can be wrapped around the jug to develop some additional refrigerant flow (or other acceptable heat means can be used).

NOTE

24. A 70% charge is required prior to running the compressor

25. When you have charged to 70% or more, remove jug hoses.
26. Allow the system charge to stabilize for 15 minutes minimum before running the YCUL System #1 compressors.
27. Verify all service valves are open to the system.
28. Remove LLSV jumper and allow LLSV normal control through the YCUL ISN.
29. Enable supply fan and YCUL System #1.
30. All compressors in the system must be running.

    If a load isn't present to run all compressors, develop an artificial load to keep all compressors in operation by providing some preheat if available or adjust the economizer dampers to take in the larger system load).
31. The ambient temperature should be above 75°F to accomplish a first time startup.

NOTE

If ambient is 75°F or below, a second visit "system check "should be planned either by York or the facilities people when the ambient is at least 80°F.

32. Remove the refrigerant jug from the liquid line service valve and connect it to the low side suction line service valve.
33. With System #1 running all compressors (The discharge air or suction pressure control may need to be temporarily lowered to ensure **all** compressors cycle on), and with the jug in the upright position, deliver refrigerant **gas only** charging to the low side of the system. **Assure this is refrigerant gas and not liquid.**
34. Closely monitor the amount of refrigerant added vs the estimated charge in pounds refrigerant required for the System #1 *(reference 4 above).*
35. Again, an electrical heated blanket can be wrapped around the jug to develop some additional refrigerant flow (or other acceptable heat means can be used).
36. Closely monitor the subcooling temperature, and top off the system charge as required providing 15°F subcooling. This will offer the correct charge at full load and design ambient with a system installed per Form 50.40-CL1.

NOTE

If loads are low during charging, 12°F sub-cooling may be more satisfactory.

CAUTION

37. DO NOT overcharge or undercharge the system. Overcharging WILL cause excessive heat at the compressors as well as liquid slugging and eventually fail the compressors. Excessive undercharging can cause high leaving air temperatures and coil frosting.

38. Remove jug from System #1 and proceed to System #2 (if applicable).
39. Repeat System #2 as outlined in the above 1 through 37.

NOTE

40. System #2 may have a different tonnage capacity than System #1. Always verify and calculate to the correct system tons & pipe volume.

41. When 1 through 37 are completed successfully, remove jug from System #2.
42. Charging completed.
43. Document and date charge in pounds at the compressor system and in your paperwork. Make note on the paperwork if a follow-up visit is required, by York or the facilities people at a closer design day (i.e. 80°F ambient or above).

4.10 Controls and Interface

York Air Cooled Condensing Units (ACCU's) are controlled by either discharge air temperature control or RA/space enabling using suction pressure control. Either control method can produce staging control, but certain system effects and/or customer demands on comfort and stable control may make one more suitable than the other.

NOTE

On two system YCUL's, RA/space enabling using suction pressure control requires (2) individual thermostats, one for each YCUL system. The return air thermostat range should be adjustable between 70 and 80°F. Any dual system YCUL found to be wired to a "single" thermostat MUST be corrected to dual thermostats.

Where Variable Air Volume (VAV) systems generally maintain a constant discharge air temperature and vary the CFM to satisfy room conditions, constant volume control promotes room comfort by providing a fixed CFM while varying the leaving air temperature.

Additionally, when VAV or Constant Volume (CV) systems are utilized on buildings, a combination of outdoor air economizer and mechanical cooling is incorporated to satisfy room comfort. ASHRAE 90.1 requires that mechanical cooling be available, while the economizer is operating above 25% load. The mechanical cooling must be locked out when the economizer load is below 25%. This is necessary in preventing coil frosting and liquid slugging at low loads.

Variable Air Volume (VAV):

Using discharge air temperature control (DAT) – While discharge control works well on chilled water systems with an infinite control media, discharge control on DX systems, where control is based on limited steps of compressor staging, leaves a lot to be desired.

Potential problems with discharge air temperature stratification off the DX coil to the sensor – un-uniform DX coil EAT's generally mean un-uniform LAT's. This stratified air temperature can stratify right through the supply fan and produce unstable control in the form of compressor cycling as well as poor humidity control. Hot Gas Bypass (HGBP) can partly reduce the compressor cycling, but stratification can still be a big a problem. What compounds the air temperature stratification is varying the air volume (VAV). Varying the air volume has varying effects on air patterns over the sensing bulb. Averaging sensors can help with stratification, but are costly and the outcome can be questionable. RA sensing and enabling with suction pressure control on VAV systems is a more stable way of controlling the building for comfort and stable temperature and humidity control. Problems associated with DAT control must either be corrected, or RA Enabling with suction pressure control must be reviewed with the owners facilities engineer and BAS group.

CAUTION

Unstable systems can lead to more than unacceptable comfort levels, in the form of system reliability and premature compressor failure.

CAUTION

Never allow substitution of a field-supplied signal, over the discharge sensor that is furnished with the York unit. This voids warranty (reference Form 050.40-ES3 "Controls" Capacity Control Approaches).

Constant Volume Control (CV)

CV applications generally have building loads that change gradually, providing more stable control and minimized compressor cycling.

Reference Application Guide, Form 050.40-ES3, Section 5 "Controls" for additional information on this item.

4.11 Commissioning and Validation Folder (Fact Finding)

On systems initially started in the field, a system validation or commissioning folder or report should have been generated and kept on file by the owner, contractor, as well as the York startup office. The commissioning report will validate the system was operating within acceptable design performance criteria at startup. Any variances or deficiencies should also be noted on this report, including any corrective actions necessary. A copy of this report should be made available for review prior to servicing a problematic split-system. This validation report can consist of numerous documents:

- **YCUL & AHU Approved Submittal Documents** This can be acquired from York Sales and will support York's warranty ownership and include wiring, control and piping diagrams and/or information. The **key** here is **"Approved"** Submittals with stamp. It should also identify who owns the DX coil (evaporator coil). **Remember to acquire both the YCUL and AHU approved submittals.**

- Field **Air Balance Report -** Unless acquired by York Service at startup, this should be on file with the customer. This will offer invaluable information on whether the system is performing to specified design duty (airflow CFM and static pressure) or is operating at an interim CFM and static pressure pending building or ductwork completion.
- A Building Automation System **(BAS) Controls Validation Report** should be held by the Owner's facilities personnel. This will validate the control system operation and assist you in understanding how the system is controlled (i.e. discharge, space or return air; BAS safety lockouts such as air flow, freezestats, hi-limits, time-clocks, smoke or fire dampers, etc.; possibly timing of the VAV boxes (3% max. airflow per minute required by York); any remote set points or reset points; how the economizer is controlled and minimum outside air content; and if the system functioned correctly when validated by the BAS and customer.
- **Information Outside York's Scope of Work** – This could be an existing Air Handling Unit (AHU) and evaporator coil, or another manufacturers AHU. This information should have been acquired by the York Sales office and on file with them. Or, the owner should have the information on file. The bottom line here is, you need to know the AHU evaporator coil design data and circuiting arrangement (face, row, interlaced or split-faced) as well as number of coils involved and how they are controlled. Keep in mind any split-faced coil "bank" found **must** be changed to allow full-face control. Also, acquire the nozzle and distributor selection if possible. This is invaluable information when troubleshooting a problematic system.
- **Previous Service Reports** – This may identify any previous modifications to the equipment being serviced, as well as by the owner or by York. If current information is kept up to date, this should be reflected in the information acquired, but the likely hood is very remote. Talk to the owners facilities people as well as visit the York Service file. Do customer modifications void any warranties?

NOTE

Always keep a clear picture of warranty ownership and what may be voided. Always document your findings.

If the information is not readily available or can't be acquired, the back of this guide provides a (3) page "System Troubleshooting – Fact Gathering Checklist". This will prompt the service technician on important information that should be acquired and/or reviewed during his service call. This information should offer sufficient information to the technician as well as Product Technical Support Team for troubleshooting purposes.

Fact-finding should be developed prior to, or in parallel with the service call(s). This should establish the boundaries and responsibilities for York. Obviously, recommendations by York can go beyond these boundaries, but would require a purchase order or approval by the York Area Service Manager.

NOTE

Collecting all the facts surrounding an installation will be found invaluable when it comes to troubleshooting and addressing warranty responsibility. Fact-finding must also cover information about others equipment that interfaces with York' scope of work and product responsibility (i.e. DX coil performance, circuiting, etc.).

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SECTION 5 – SPLIT-SYSTEM AHU EVAPORATOR COIL REQUIREMENTS

5.1 Interfacing YCUL Refrigeration Tonnages

It is important to interface YCUL "system" tonnage with that of the evaporator DX coil in the air handler. YCUL packages above YCUL0040 offer dual systems that can have varying capacity loads per system (i.e. YCUL0076 has 40 & 31 tons respectively for System #1 & #2). It is important to verify if the design interface has considered this. Problems associated with this example could include:

- A 50/50 split DX coil coupled with a 40 ton System #1 serving a 35.5 Ton DX coil circuit(s), and 31 tons System #2 serving a 35.5 ton DX circuit(s). The problem developed on System #1 is low suction gas superheat, TXV hunting, flooding and compressor thermal faults, loss in capacity, due to an undersized DX coil, and on System #2 high suction gas superheat, DX coil frosting, faults on low suction cut-out, and potential high compressor return temperatures/trips not to mention a loss in capacity due to a miss-matched system/circuit.

NOTE

The system/circuiting interface MUST be corrected! Contact Product Technical Support for review (also, reference Section 6.1)

5.2 Evaporator Coil and Uniform Airflow

Poor air distribution over a DX coil is generally due to compromised or poor upstream or downstream component arrangements. This can take in offset damper walls being too close upstream, to Fan inlets offset too far from the center of the coil downstream, as well as internal piping restrictions across the face of the coil.

Airflow distribution (as well as CFM) can be estimated by the use of a hand held portable Velometer (reference Section 2.3 "Tools and Instruments - Velometer"). A rough grid or traverse is established over the face of the DX coil (or coils), usually on 1 or 2 foot centers both up and down the coil. During system operation, Velometer readings are taken at these established points and recorded on a grid outline sheet (reference the end of this guide for the "Airflow Traverse Readings Sheet"). The following is an example:

AIRFLOW TRAVERSE READINGS SHEET

Project: ANY JOB
Contract No: 04XXX123
AHU Designation: AHU-1
Serial No: SN # XXXX
Test No: 1
Test Date/Time: 12/1/04 , 3:00 PM
By: BEL

Record Grid (Traverse) Coil Face Velocities (FPM) Below using a Hand Held Velometer

Grid	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	270	280	280	280	280	280	270	270										
2	270	300	300	300	300	290	280	280										
3	280	320	320	320	330	330	300	290										
4	300	340	340	340	350	360	340	310										
5	320	360	370	370	380	390	370	320										
6	340	380	390	390	400	420	400	350										
7	300	340	350	350	360	360	350	320										
8	280	300	300	300	300	290	280	270										
9																		
10																		
11																		
12																		

Total Addition of FPM Recorded:	20,700	
Total Number of Grids taken:	64	
Average Face Velocity of Coil Bank:	323	(Divide Total FPM Recorded by Number of Grids)
Total Face Area (Ft2) All Coils:	60	
Total Operating CFM:	19,380	(Average Face Velocity times Total Face Area (Ft2) of All Coils)
Total Design CFM:	30,000	(All Coils - From Approved Submittals)
Design Face Velocity, FPM:	500	(From Approved Submittals)

LDO10180

5

The problem associated with the above example can be two fold *(reference Figure 17 below)*:

- Non-uniform airflow distribution (uneven loads on the DX coil)
- Air Temperature stratification (again, uneven loads on the DX coil). A similar grid could be run profiling the DX Coil Entering or Leaving Air Temperatures.

Non-uniform airflow as well as temperature stratification, individually or together have an undesirable effect on system performance as well as reliability. First, understand that DX coils are selected to evaporate refrigerant uniformly over the face of the coil and maintain a superheat generally between 12 and 18 °F (i.e. 1 System compressor on = 12 °F SH; 2 System compressors on = 15 °F SH; and 3 System compressors on = 18 °F SH).

NOTE

Keep in mind these numbers can vary depending on actual system requirements, but generally speaking, operating much below 12 °F SH and above 18 °F SH can cause problem (also reference Section 5.8 "TXV Adjustment and Superheat".

Coils given unequal face velocities exhibit varying loads as well as varying superheat properties per coil circuit. Coil circuits with inherently higher than design loads generally aren't a problem, but do generate higher than normal superheats. However, coil circuits with inherently lighter than design loads can't evaporate the liquid refrigerant called for by the TXV bulb, and may exhibit "0" superheat for that circuit. This "0" superheat allows liquid refrigerant to pass through the suction line, pass the TXV bulb, to the compressor. The reason here is, the "combined circuits and superheat" at the suction bulb show a need for additional cooling and pass more refrigerant through the TXV. Imagine how this problem is compounded with the addition of "air temperature stratification".

The problem must be corrected. The following offers suggested changes to lessen the problem to an acceptable level:

- Add perforated air baffles upstream or downstream to somewhat shift the air pattern and make it more uniform.
- Add air blenders upstream. Generally, air blenders take up addition unit length and are not possible.
- Add air diverters that will provide a convergent mixing action of the outside air and return air streams.
- Add a high velocity prop mixing fan within the outside air stream to direct the outside air into the return air stream providing a convergent mixing pattern (This Fan could also be located in the RA stream converging into the OA).
- Relocate OA and/or RA dampers for better mixing (i.e. blade action as well as damper velocities should be considered).
- Consult with Product Technical Support.

As with any change in component arrangement or additions, system pressure drop must also be considered and reviewed along with supply fan BHP requirements and fan class. Part of the fix may be speeding up the fan, which could lead to other problems.

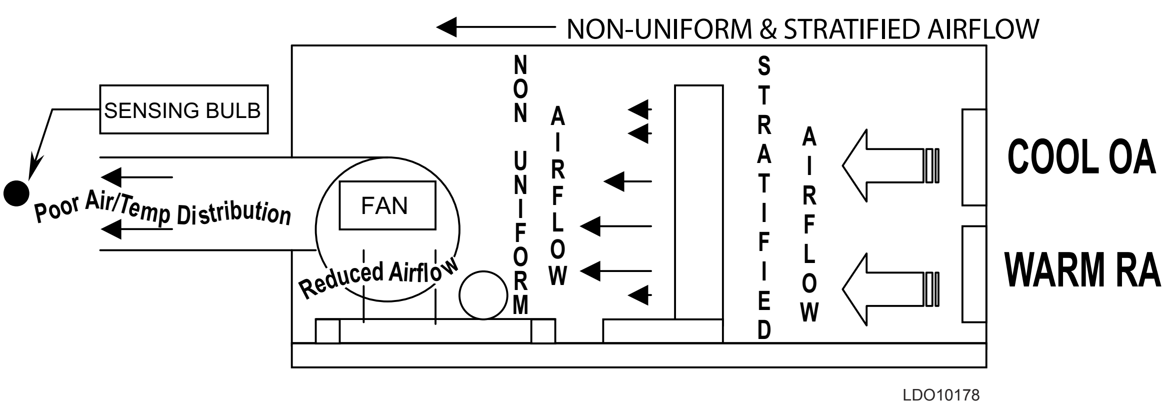

FIG. 17 – POOR AIR/TEMPERATURE DISTRIBUTION

5.3 Evaporator Coil Minimum Velocities

Reasonable coil velocities are essential to DX system performance and reliability. DX coil face velocities are generally selected between 400 to 550 FPM as a norm. On constant volume systems, this range is satisfactory. However, on variable air volume systems with a typical 35% system turndown can spell "disaster" delivering 140 FPM across the face of a DX coil at low loads (i.e. 400 x .35 = 140).

On air-cooled split-systems, York limits the minimum DX coil operating velocity at 350 FPM (close coupled systems can be 300 FPM with review by application engineering). Operating compressors at DX coil velocities below 350 FPM can cause system faults and eventual compressor failure due to exceeding the systems unloading capability. Low airflow equates to low capacity (tons), and when you exceed the turndown of system unloading (compressor cycling) and the inherent TXV weak low-end dampening capability, the result is TXV hunting with excess refrigerant in the evaporator and not enough load to evaporate the liquid refrigerant. The results are disastrous:

- Low suction gas superheat
- DX coil frost buildup – The frost buildup on the tube also hinders heat transfer and refrigerant boil off and further degrades the superheat and promotes added liquid slugging.
- Excessive compressor cycling and oil return problems.
- Compressor liquid slugging
- System low suction pressure cut-out faults.
- Low unit discharge air temperature
- And eventually failed compressor(s)

What compounds this problem is the development of poor air distribution and temperature stratification inherent with low unit velocities during CFM turndown *(reference Section 5.2 "Evaporator Coil and Uniform Airflow", as well as Figure 17).*

Combating this situation is a challenge to say the least. The following offers some suggestions that can lessen the problem:

1. Have the BAS install a low-end limit to prevent compressor operation below 350 FPM or equivalent airflow (300 FPM on close coupled systems).
2. If not already installed, HGBP can offer artificial loading that can raise the saturated suction temperature to handle the exceeded low load condition. This will also promote an increased "safe" superheat.
3. A froststat *(reference Section 5.6)* can be added that will cycle the compressor when frost buildup is detected on the coil. Although this protects the coil, and frosting problems, it's cycling effect on the compressors can pump oil from the compressor into the system creating yet another problem of poor oil return.
4. Isolation dampers can be added to the DX coils (depending on face circuiting arrangement). This is a proven fix for low airflow problems, but a means of identifying CFM and/or load to operate the 2-position dampers is necessary.
5. Down sizing of the distributor orifice and TXV, may also benefit *(reference Sect. 5.5).*
6. Using suction pressure space sensing control vs. discharge control

NOTE

"Discuss this with Product Technical Support prior to attempting major modifications".

5.4 Evaporator Coil Circuiting Configurations

The general purpose of any DX Coil is to cool and dehumidify the entering air temperature to a desired ***stable*** leaving air temperature and humidity for comfort or process needs. To maintain the desired stable leaving air temperatures/RH to accomplish this, it is essential that the full face be actively cooling. Systems without full-face coverage (split-face) **will** be problematic in two ways:

1. Space temperature and humidity control
2. Compressor reliability

Space Temperature and Humidity Control

Control stability is compromised when excessive cycling of the compressors takes place. When a compressor is off, it is not dehumidifying or cooling, and space temperature and humidity instability takes place. In addition, with split-face coils, warm air is bypassed through the inactive coil. This requires the active coil to run lower saturated suction temperatures (SST), driving the active coil LAT to a lower temperature than design due to the warmer bypass air 'mixing' *(much like Gas Heating with bypass)*. The 'mixing' of the two

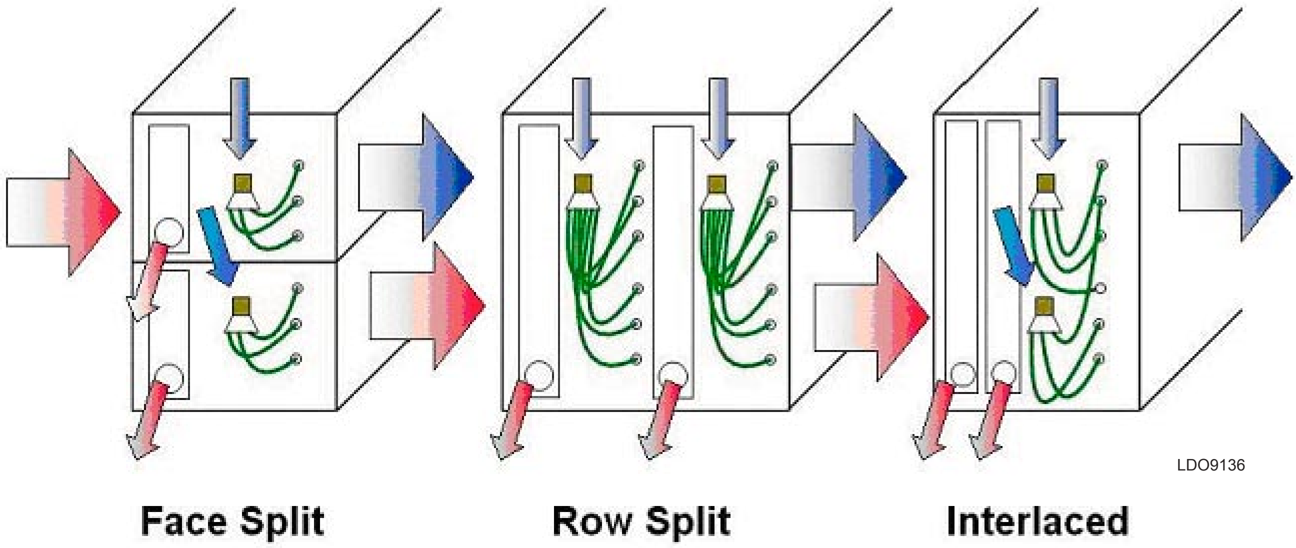

FIG. 18 – EVAPORATOR COIL TYPES

coil LAT's can also stratify promoting false mixed air temperatures at the sensor *(if discharge air control is used)*, promoting even lower SST's as well as stratified air to the space, producing both cold and hot spots.

Compressor Reliability

In part, compressor life is determined by the number of starts and strops it encounters. Starting and stopping a compressor in short cycles can also pump oil into the piping system, and return it at a slower rate than what goes out. This causes a number of problems:

- A shortage of oil in the crankcase
- Greater oil dilution by the refrigerant
- Oil logging in the piping and its components, which can create TXV hunting and liquid refrigerant return to the compressor.

All three of the above will have a negative effect on compressor reliability.

Evaporator Coil Types

There are essentially three types of coil arrangements to be found in York *(or other)* Air Handling Units *(reference Figure 18):*

- Face Split
- Row Split
- Interlaced

Full-Face Circuited is a term used to identify any given system providing circuiting that assures equal full face cooling. **All coils must be field piped for full-face circuiting** or compressor reliability will be compromised in short order. All face split, row split and interlaced coils can be circuited for full face cooling given a proper upfront interface between the AHU and YCUL.

Coil circuiting problems will occur when one compressor system is piped to the top coil(s) and the other compressor system is piped to the bottom coil(s) – this could also be in the reverse. This establishes what is termed a "split-face circuited coil" arrangement. Split-face circuited coils can surface on any project with face split, as well as stacked *(or side-by-side)* row split, or interlaced coils given an incorrect interface between the AHU and YCUL

NOTE

Any AHU found to have DX coils split-face circuited, would rarely, if ever be found acceptable. All coils must be full-face circuited! Discuss all coil circuiting found to be split-face with Product Technical Support.

"Split-Face" Coil Problem Explanation

The problem with "split-face" circuited coils occurs when the top coil system is off, producing a dry top coil bank. The wet bottom coil bank now operating creates a higher-pressure drop (wet coil). With the higher PD, the airflow is now biased towards the top coil bank (dry coil with less PD). The now lower airflow through the operating system produces a lower tonnage than the expected 50% (given a 50/50% split YCUL). The air bypassing through the top coil now mixes with the cooled bottom air causing a rise in discharge air as well as space temperatures. This requires a lower LAT off the bottom coil to compensate for the warm air mixing. The lower LAT now creates excessive lower suction temperatures and pressures outside the normal design of the coil and system. This will cause the following to occur:

1. Frosting on the coil
2. Cold/warm temperature stratification at the discharge air sensing bulb
3. Excessive compressor cycling
4. Liquid migration back to the compressor and inevitable compressor failure

Another related problem is holding acceptable space humidity levels and meeting customer expectations *(also reference Section 2.5)*. Bypassed warmer moist air is not dehumidified by the cooling operation of just the bottom coil. A number of things will take place:

1. Moisture can condense and fall out in the AHU, final filters or ductwork with a potential of water damage
2. Final filter damage can occur (where final filters are utilized, especially with HEPA media)
3. Space humidity will rise to uncomfortable, if not unacceptable levels
4. Sweating can form on space furnishings causing damage
5. Moisture in the space can cause the formation of fungus, algae or bacteria, compromising indoor air quality and causing potential health risks.

Additionally, if the staging of the coils were reversed (top on and bottom off as in the case of lead/lag) further problems can now exist with the added airflow through the now dry bottom coil, where condensate from the now top operating coil crosses the face of the bottom coil, which is now operating at much higher velocities. The condensate will blow off into the airstream and onto the floor of the AHU (missing the condensate pan) creating potential internal AHU corrosion, potential leaks to the building, and the possibility of microbial growth.

Row-Split Coils – System Lead-Lag Restriction Note

Any unit posing a Row split coil arrangement **cannot** have system lead-lag. The reason being, row-split coils have rows split unequally (i.e. an 8 row coil is split 3 & 5 respectively in direction of airflow). This split is determined based on an approximate percentage of work performed by successive coil rows. Figure 19 shows the approximate percentage of work done by successive coil rows.

Reversing this split with Lead-Lag would essentially provide one coil oversized that could run excessive superheat, and one coil undersized which can run low superheat promoting liquid return to the compressor and eventual compressor failure.

NOTE

If a Row-Split Coil System is encountered, verify Lead-Lag is disabled.

Approximate Percentage of Work Done by Successive Coil Rows

Coil Rows >	2	3	4	5	6	8	10
1st Row	57	42	35	31	28	23	19
1st 2 Rows	100	74	61	**54**	**49**	39	33
1st 3 Rows		100	83	73	66	**53**	45
1st 4 Rows			100	88	80	65	**53**
1st 5 Rows				100	91	75	66
1st 6 Rows					100	86	77
1st 7 Rows						95	85
1st 8 Rows						100	92
1st 9 Rows							98
1st 10 Rows							100

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FIG. 19 – WORK DONE BY SUCCESSIVE COIL ROW (Row-Split Coils)

Interlaced Coils are usually the preferred coil arrangement and support lead-lag.

5.5 Distributors and Orifices (Selection Review)

Proper selection of the distributor and orifice are essential for trouble-free evaporator coil performance as well as compressor reliability. The purpose of a distributor is to provide a "uniform and equal" flow of refrigerant and hot gas (if HGBP is utilized) into each circuit of the multi-circuited evaporator coil.

York utilizes orifice type distributors on all of its current DX coils. Venturi type distributors may have been used before the year 2000, and will not be discussed here.

NOTE

Contact York Product Technical Support if you encounter Venturi type distributor troubleshooting.

Combined distributor tubes and nozzle orifice selections provide a 35-psi pressure drop (i.e. 10 psi tube and 25 psi orifice). This practice is used satisfactory at "Full Load Design".

Problems can surface on applications where capacity is reduced (unloaded). A recommended practice on virtually all applications is to select a distributor tube and orifice pressure drop that is 10 psi greater than the normal 35 psi. However, this practice is seldom if ever used upfront given lack of turndown knowledge. To the point, **pressure drop must be a consideration when troubleshooting poor superheat** and/or liquid return problems in split-systems (either in total retrofit or just the orifice itself can make a big difference).

NOTE

For both the distributor and nozzle (orifice), the percentage of loading should fall between 50% and 200% at all system operating conditions.

Proving the need to increase distributor and/or orifice PD can be accomplished by first reviewing the minimum load on the distributor circuit. If the unloaded capacity is less than 50%, the orifice, and/or distribution, should be reviewed for an increased pressure drop. Generally, this can be accomplished by reducing the orifice size (but review with Product Technical Support if not sure).

NOTE

Caution here is that circuit loading greater than 200% results in a high-pressure drop across the distributor, making proper TEV sizing difficult.

NOTE

Always review TEV selections in parallel with increasing distributor pressure drops. Even dropping one orifice size can affect the TEV selection. It is also crucial that the orifice (nozzle) be located tight to the distributor (Figure 20):

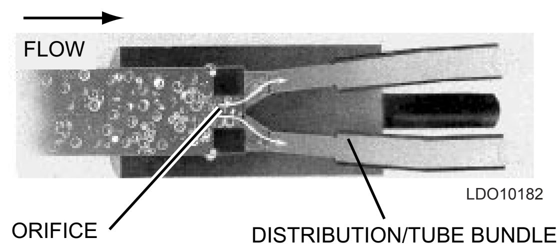

FIG. 20 – NOZZLE (ORIFICE) LOCATION

Locating the orifice close to the mouth of the distribution tubes better assures even distribution of the refrigerant/gas mixture.

Systems incorporating hot gas bypass should utilize the auxiliary-side-port in the distributor if possible. This allows the TEV to be mounted direct to the distributor in most cases and provides the best possible situation of even refrigerant distribution at the mouth of the distribution tubes *(see Figure 21)*.

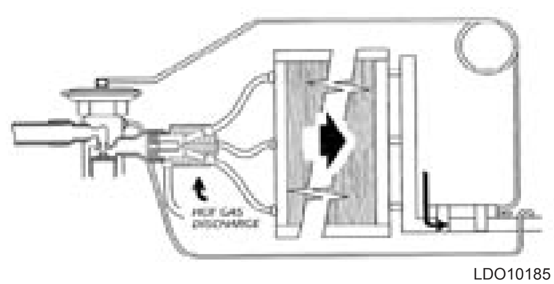

FIG. 21 – HGBP/NOZZLE LOCATION

Always install the TEV directly to the distributor wherever possible. If this cannot be accomplished, do not exceed 24", and transition at the TEV allowing full line size to the distributor. **Do not** allow any elbows or fittings between the TEV and distributor. This will assure even refrigerant distribution.

Problems associated with oversized distributors or orifices; or locating the hot gas bypass remote in an add-on ASC (Reference Section 5.7) are poor refrigerant feed and poor distribution to the mouth of the distributor tube bundle. Given liquid refrigerant is heavier than the refrigerant gas vapor, the consequences are refrigerant vapor or hot gas at the upper tubes and liquid refrigerant at the lower tube portion. The projected uniform load across the DX coil isn't sufficient to evaporate the excessive refrigerant in the lower tubes due to the refrigerant overfeed *(Reference Figure 22)*.

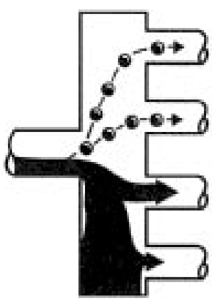

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FIG. 22 – POOR REFRIGERANT/VAPOR DISTRIBUTION

The upper vapor tube distribution becomes starved of refrigerant and results in excessive superheat (i.e. 20 °F plus), while the lower liquid refrigerant tube distribution overfeeds resulting in a loss of superheat (i.e. to as low as 0 °F). This "combined" superheat however, may give an indication of 10 °F + superheat at the equalizer line, but continues returning liquid refrigerant to the compressor due to improper piping and/or excessive low load conditions.

Blocked Tubes can also create poor refrigerant/gas distribution in the evaporator coil due to initial poor evacuation of the system or other debris that enters the system (i.e. drillings, compressor burnout, sludge, kinked tubes, etc.). If in trouble shooting the above scenario, the distributor becomes exposed, it is a good practice to inspect the tubes for blockage.

NOTE

Troubleshooting may also warrant exposing the distributor for inspection even if all else seems OK. Do a temperature traverse over the face of the DX coil. If the surface temperature varies more than 3 or 4 degrees, you may have blocked or damaged tubes (but this may also indicate face velocity/temperature stratification).

Feeling and comparing the distributor tube temperatures will also give an indication of blockage or poor distribution. In addition, measuring the temperature of the suction return bends (outlet side) can give some indication.

NOTE

If blockage is evident, correction is necessary!

Figure 23 offers typical practices on inspecting by visual, wire probe, or pressurizing the tube "circuit" with dry nitrogen to verify the tube circuit is not restricted.

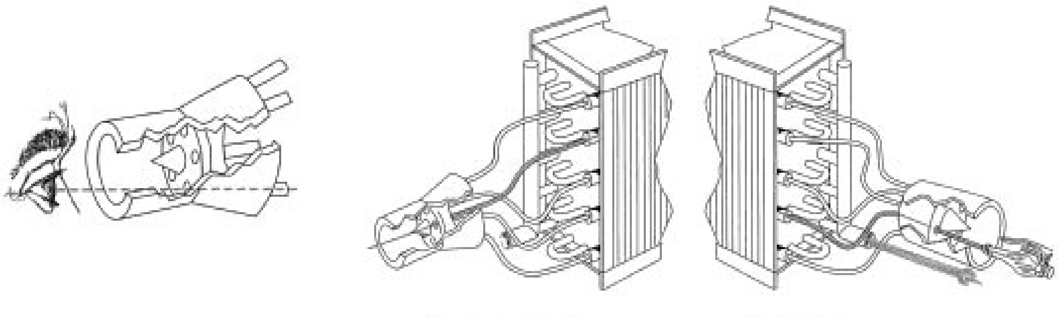

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FIG. 23 – DISTRIBUTOR VISUAL INSPECTION

5.6 Frost stat Control

Frosting (or icing) of the evaporator coil takes place when the saturated suction temperature drops to a point where condensate, formed on the tubes and fins, freezes. This condition is also related to DX coil face velocity. Velocities above 500 FPM could frost at 24 or 26 °F, while lower velocities below 500 FPM (VAV) could frost at 28 °F.

One device that protects the system from frost buildup is a frost-stat. This application generally requires suction pressure control and York frost stat PN #025 36119 001 (one per system).

One argument with this approach is **excessive cycling** of the compressors. **Hot gas bypass** *(Reference 5.7)* is generally a better approach to minimizing cycling and provides Frost control.

NOTE

Always contact Product Technical Support if considering Frost stat control.

5.7 Hot Gas Bypass and ASC's (Selection Review)

Hot gas bypass is utilized for two purposes with regard to reliability; to prevent compressor cycling and to prevent coil frosting and low suction pressure faults

Split-system Hot Gas Bypass (HGBP) line sizes and installation guidelines can be reviewed by referencing the Installation Guide Form 50.40-CL1. The HGBP pressure regulating valve is typically a combined valve housing the solenoid as well (SHGBE style). The SHGBE style is standard on all YCUL product after the year 2000. Pre 2000 systems may include the ADRHE style, which incorporates the solenoid as a separate item.

NOTE

Most HGBP Valve connections are smaller than the HGBP line size. Reducing in and out of the valve is acceptable, however, if a separate solenoid is utilized, the solenoid should be full line size to minimize the system pressure drop.

Most current HGBP applied systems have an Auxiliary Side Connector incorporated directly into the DX Coil Distributor. Systems with single circuits can tie directly into the Distributor auxiliary side connector.

NOTE

If the System has multiple distributors (circuits), a Check Valve (Reference Section 4.4 Figure 3) is required on each distributor circuit to prevent short circuiting of system pressures that can falsely influence TXV operation and promote liquid refrigerant overfeed in the suction line and ultimately compromise compressor reliability.

NOTE

Check Valves by the Installer were not a direct requirement by York for Split-Systems until 9/31/04.

ASC (Add-on Auxiliary Side Connectors)

ASC's are utilized where distributors **do not** have the integral auxiliary side connector built in or where HGBP is retrofit in the field. ASC's **must** be installed directly into the distributor and be of the same line size **(do not use reducers).** Prior to installing the ASC, the distributor nozzle and retaining ring must be removed and relocated to the inlet of the ASC *(reference Figure 24).*

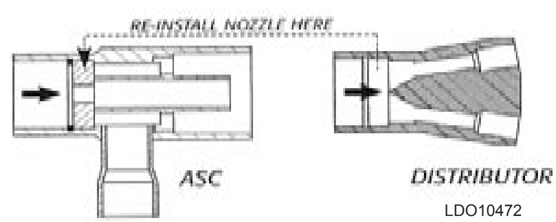

FIG. 24 – ASC/NOZZLE LOCATION

NOTE

Where AHU's have the distributor piped to the AHU exterior and the field addition of an ASC is required, the ASC "must" be installed direct* to the distributor. Field modification of the distributor liquid line may be required to accomplish this.

****A two inch or three inch spacer may be used in some cases. Consult Product Technical Support.***

Hot Gas Bypass Operation and Selection Procedures

1. Hot gas bypass is recommended when the evaporator load drops below the last stage of unloading and cycling of compressor is undesirable.
   - *Typically, cycling of the compressors' as the specific means of capacity control is undesirable due to poor space, humidity and microbial growth control; it reduces equipment life; and in many cases compressor cycling is not economical because of peak load demand charges.*
2. When wired in parallel with the LLSV, HGBP is enabled with the first stage of compressor control and is operable through the entire full load capacity range. The term used here is "full time HGBP". This mitigates second and 3rd compressor cycling as well.

NOTE

Always review and modify HGBP systems for full time HGBP if excessive compressor cycling is a problem.

3. Where condensing units utilize (2) systems, with HGBP only on the lead system, lead-lag is not permitted. However, compressor sequencing can take place to equalize each compressors run hours, within each system.

NOTE

Adding HGBP to both systems will allow lead lag control. Full time HGBP on both systems is recommended to prevent excessive cycling of "all" compressors.

4. York generally sizes the HGBP regulating valve to operate down to 0% capacity for split-systems. The HGBP regulating valve must be sized to pass the minimum compressor load in tons

NOTE

This is based on the "largest" compressor offering in that system.

5. York currently utilizes the Sporlan SHGBE series HGBP valve with integral solenoid. The SHGBE-8-0/75 is used on 7.5 and 10-ton nominal HP compressors, while the SHBGE-15-0/75 is used on the larger sizes through 25 tons capacity. Valve capacities are 12.1 & 47.4 tons respectively at 26 °F minimum evaporator temperature & 80 °F condensing temperature. Both Valves have an adjustable spring range from 0 to 100 psig. They are installed with the factory setting of 60 psig (SHBGE-8) and 69 psig (SHGBE-15). Either valve spring range can and should be field adjusted to the recommended setting of 32 °F by turning the adjustment screw on the pilot valve. Clockwise will increase the valves setting and counterclockwise will decrease the valves setting.
6. Generally, the valve setting is field calibrated at 32 °F. The 6 °F "standard throttling range" puts the operating "wide open point" at 26 °F (full capacity point). 26 °F is generally the accepted minimum where frost will not form with DX Coil Face Velocities down to 350 FPM (split-systems) or 300 FPM for Integral or close-coupled systems. Constant volume systems can generally tolerate 20 to 25°F Evaporating temperatures.
   - *Adjusting the valves can be complicated because the load must be varied during the setting procedure. The load must first be decreased to lower the suction pressure to detect control (pass hot gas). The system load should then be increased to raise the suction pressure above the valve setting to close the valve. Once this is accomplished, the valve setting can be checked by slowly decreasing the load until the valve begins to open (a hissing sound will be detected, or an accompanying pressure rise (temperature rise) at the outlet connection will indicate that the bypass valve has opened).*
7. The condensing temperature, is generally selected based on low ambient temperatures, and is typically 85 °F for air-cooled applications. This is considered the minimum allowable temperature for satisfactory system operation.
8. Liquid temperatures are generally around 5 degrees below the condensing temperature for selection purposes or 80 °F (adjusted for line loss).

9. Selection can be verified with the following information (example):
   - Refrigerant type = R-22
   - HGBP valve setting = 32 °F (desired evaporator temperature). This is the saturated suction temperature that starts to open the bypass valve.
   - Condensing temperature = 85 °F (based on low ambient worst case allowed)
   - Liquid temperature = 80 °F
   - Largest single compressor capacity = 25 tons
   - The Sporlan selection program will offer an SHGBE-15-0/75 in this example.

10. Given the actual design, the HGBP valve selection can be run by any dealer with the Sporlan selection program, or contact York Product Technical Support split-systems.
11. Obviously, if the DX coil LAT is say 42 °F by design, this could pose a 32 °F SST which now conflicts with the normal regulator valve setting of 32 °F. In this case the regulating valve would have to be adjusted to a 30 °F setting, with a tighter throttling range of 4 °F or even 2 °F to achieve acceptable operation, keeping in mind that the tighter throttling range will also decrease regulator valve capacity. Contact Product Technical Support on conditions outside the norm

5.8 Thermostatic Expansion Valves (Selection Review)

Thermal Expansion Valves (TXV's) are the metering device that maintains the superheat required for safe and reliable operation. Undersized TXV's can "starve" the evaporator coil causing high suction gas superheat, low SST's and DX coil frosting, and nuisance low suction cutout trips. Oversized TXV's can promote "overfeeding" the evaporator coil with liquid refrigerant, causing low suction gas superheat, flooding, and compromise compressor reliability.

Selection of the TXV can be checked, by referring to the York Application Guide, Form 050.40-ES3, located on the Intra/Extranet. Selection can also be made using Sporlans TXV selection program at your local distributor, or contact Product Technical Support Split-Systems. Always review TXV selections at both full load and minimum load capacity. Note the nozzle and distribution pressure drops will be lower at reduced load.

Reference Section 4.5, Figure 9 for additional information and specifics on TXV charge selection. In addition, reference Section 5.5 for other TXV related topics.

CAUTION

The key is to not oversize the TXV, due to probable flooding at low loads and compromised compressor reliability.

TXV Adjustment and Superheat

Thermostatic expansion valves operate under various system pressure variables as well as valve manufacturing inconsistencies in component tolerances, including field installation practices. Factoring in variable system flow rates along with systems that contain two or even three compressors manifold together present a challenge for setting superheat that will offer a safe operating range at low loads as well as design or full loads.

Aside from dynamics, TXV bulb charges can also affect the system superheat settings. While VGA and VCP100 bulb charges offer a quick response closure of the TXV, they can still present an interim time where the valve overfeeds the reduced load on the evaporator, and liquid refrigerant can return to the compressor and chance diluting the oil. This is especially true with the VN charge, which is slower to close. Keep in mind refrigerant in its liquid state is excellent at removing oil from bearings.

The challenge with superheat is to not drop below the minimum 8 °F superheat (SH) at the compressor suction inlet during all system dynamics that take place. The 8 °F SH is considered a safe number, again, as measured at the compressor.

Typically most SH settings are measured at the evaporator. Split-system valve settings of 10-12°F suction superheat at the evaporator provide optimum capacity for single compressor operation, while valve settings adjusted for 15-18 °F suction superheat with all compressors running on its system, generally provides sufficient line loss safety in maintaining the 8 °F SH at the compressor when cycled to one compressor.

However, given the dynamics and bulb charges mentioned above, it may be necessary to set the SH at 20 or even 24 °F to offer safe reliable operation at reduced or low loads. **Do not** increase the SH to a point where suction line return temperatures at the compressor trip internal temperature overloads. If higher than normal SH is set, it must be monitored over 48 hours of operation including full load operation of the system.

The following parameters offer safe reliable operation on YCUL compressors:

- 8 °F min. superheat at the compressor inlet (min. at all loads).
- 10 – 12 °F SH min. with (1) compressor running.
- 13 – 15 °F SH with (2) compressors running.
- 16 – 18 °F SH with (3) compressors running.
- Optional if 8 °F min SH can't be held: 18 – 24 °F SH with all compressors running and suction "line" temperature at compressor not above 85 °F

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SECTION 6 –
YCUL AIR COOLED CONDENSING UNIT REQUIREMENTS

6.1 Interfacing with the AHU Evaporator Coil

Interfacing the YCUL "system" loads (which can be different) with the AHU evaporator coil (which must match YCUL closely), requires a field review when troubleshooting either performance or reliability related problems. In Addition, mix-matching the YCUL system to the evaporator coil (crossover) can lead to additional problems.

Mix-matched interfaces can surface in two problematic areas (example – YCUL0106 with 59 tons on System #1 and 50 tons on System #2 requiring a nominal 55/45% split respectively):

1. The DX coil could be the wrong % split (i.e. 60/40% or 50/50%)
2. System #1 (55% load) could be cross-piped to the 45% evaporator

Either of the situations above spell disaster in terms of performance and compressor reliability, and must be corrected. Either situation will starve one evaporator circuit while overfeeding the other resulting in high superheats on one system and low superheat on the other. This will promote liquid refrigerant overfeed in the suction line and liquid slugging of the compressor.

6.2 YCUL Safety Controls

Standard YCUL product offers the following operating safety controls that provide system safety when IOM cautions are followed (i.e. fix the problem when the fault arises).

The following only offers a general overview of this topic. *Reference the York IOM Form 150.63-NM5 "Controls" for more in-depth information.*

YCUL Safeties include:
(This does not cover normal operating controls)

1. **Compressor motor temperature trip** – auto reset after 30 minutes.
2. **Compressor motor current trip** – auto reset after 30 minutes.
3. **Low ambient cutout** (cooling is generally locked out before this occurs) – auto reset
4. **Low suction pressure cutout** – *reference IOM cutout routine:*

   Standard "mechanical low suction switch" faults generally occur at 23 psig (+/- 5 psig), and reset at 35 psig (+/- 5 psig). If the system includes a suction pressure transducer, the system provides a software cutout generally set for 44 psig. On system start, the software cutout is set to 10% of the programmed value. During the next three minutes, the cutout point is ramped up to the program cutout point. If at any time during the 3 minutes the suction pressure falls below the ramped cutout point, the system will stop. (This cutout is ignored for the first 30 seconds of run time.)
5. **High discharge pressure cutout** (if transducer option is taken) – auto reset.
6. **Micro-board 115 V under voltage cutout** – restart of system required.
7. **Unit high motor current trip** (programmed to trip if the unit RLA's are exceeded) – Auto reset.
8. **Low battery in micro-panel** (warning on startup only). – Manual reset (program values **will** go to default on the next startup & systems must be reprogrammed).

Faults generally occur, but are not limited to, the following:

1. The system is operating outside its design limits (system pressures & temperatures, and DX coil velocities).
2. Incorrect set-points on the micro-board.
3. Failed micro-board
4. Improper charge
5. Improper field piping and/or accessory selections.
6. Field airstream control/safety interface
7. Field building automation interface

External faults or control generally cover field furnished and/or interfaced items:

1. Remote controlled shutdown (Building Automation System – BAS).
2. Daily schedule shutdown (BAS)
3. Air proving switch and/or supply fan interlock (AHU)
4. Remote zone thermostats open (suction pressure control only).

Operating Data Printout

With optional printer connected, pressing the "print key" and then the "operating data key" will printout the current system operating parameters. This can be found useful in reviewing overall system operation.

History Printout

With the optional printer connected, pressing the "print key" and then the "history key" will printout the last six safety shutdowns. The information is stored at the exact time of the safety fault. This information can be found invaluable in troubleshooting system faults and reliability problems.

Reference the unit "Controls" portion of the IOM Form 150.63-NM5 for additional information on the controls and safeties with York YCUL product.

6.3 Compressor Motor Protection Control

Compressor motor protection consists of an electronic control module located on the compressor exterior. This module is connected to a number of thermistors embedded in the motor winding and one in the discharge port of the compressor. The module will trip and remain off for a minimum of 30 minutes if either the motor or the discharge temperatures exceed a preset "protection" limit, allowing the compressor to cool down

NOTE

Turning off power to the module will reset it immediately).

CAUTION

Restarting the compressor sooner than the minimum 30 minute time-delay will cause damage to the compressor. Additionally, it could take as long as two hours for the motor to cool down before the protector resets.

6.4 Crankcase Heaters

Crankcase heaters are furnished as standard on all YCUL product. Oil and refrigerant both exist in the compressor crankcase raising concerns, especially during the "off" compressor cycle. Crankcase oil heaters maintain the crankcase oil at a temperature higher than that of the other parts of the system during the off cycle, minimizing the absorption of the refrigerant by the oil.

General Heater Operation and Guidelines:

1. The heater is energized when the compressor is off.
2. Element band is located **below** the oil removal valve located on the bottom shell.
3. The element is sized sufficiently to maintain the crankcase oil at a temperature 20 °F above the low-pressure saturated suction temperature, at **all** ambient temperatures, including design **(This cannot be field measured with any reasonable accuracy but is generally assumed if the superheat is above 10 °F) at the compressor.**

NOTE

4. Crankcase heaters DO NOT protect against uncontrolled liquid floodback during any running or starting conditions.

NOTE

5. Cold air blowing over the crankcase shell can make the oil heaters ineffective (see Section 6.5 "Pumpdown Requirements").

On initial startup of the YCUL or after power has been off for several days, the crankcase heater must be turned on 24 hours prior to starting the compressor. In lieu of this, you can direct a 500-watt heat lamp or equivalent electric heat blanket for approximately 30 minutes. A last resort means would be to bump the compressor manually by energizing the contactor for one second. Wait 5 seconds and again, manually bump the compressor for one second. Repeat this cycle several times until the refrigerant in the shell has been boiled off (feeling the shell and visually inspecting the compressor site glass should give sufficient indication).

6.5 Pumpdown at Shutdown Feature

Pumpdown is also used as standard to control refrigerant migration (in addition to crankcase heaters). This is especially effective where cold air blowing over the compressor makes the crankcase heater ineffective.

Pumpdown sequence is initiated when the last compressor cycles off. The liquid line solenoid valve closes, and the compressor will continue to run; down to the suction pressure cutout point or 180 seconds, whichever occurs first.

Note that the "Copeland" compressor integral discharge check valve is designed for low leak back and may also require the use of recycling pumpdown, or the addition of a discharge line "true" check valve if liquid refrigerant migration is a problem. Also note that "Danfoss" scrolls integral check valve only prevents the compressor from back spinning due to system pressures in the off cycle.

CAUTION

Recycling pumpdown is not generally recommended because the recycling operation of the compressor during long periods of shutdown can rob oil from the crankcase and harbor it in the system. This is especially compounded on split-systems where long runs are encountered.

Reference Section 4.6, Item 10 for Pumpdown related topics.

6.6 Sound Control

Scroll compressors can exhibit vibration characteristics in three manners:

1. **Low level beat frequency** – The result in a low level "beat" frequency may be detected as noise coming along the suction line to the building.
2. **A rocking and torsion motion** – This motion of the Scroll Compressor can transmit vibration to piping runs and other structures.
3. **Normal rotational starting action** – This action of the scroll compressor can transmit and "impact" noise along the suction line.

NOTE

Electrical Conduit (rigidly connected to the compressor) can also be a factor.

York takes normal precautions in isolating these sound phenomena with the use of vibration isolator mounts on the compressors, and annular discharge check valves, etc. Field piping must take into account tubing shock loops, swing joints, expansion joints, typical for any split-system application *(reference Installation Guide Form 50.40-CL1, Item 2).*

Other vibration and noise control solutions can be offered:

1. Lower speed reduced noise fans can be retrofitted.
2. Compressor acoustical blanket can be offered where compressor noise is a concern.
3. YCUL pad or spring isolation can be retrofitted (if not included in the installation).
4. An acoustical barrier can be added between the YCUL and the noise sensitive area *(reference Figure 25).*

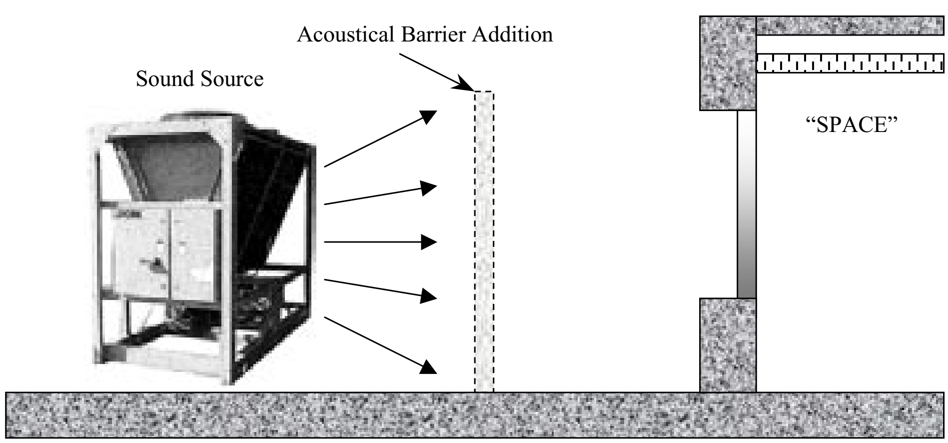

FIG. 25 – ACOUSTICAL BARRIER

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NOTE

With any noise problem, it is recommended a field evaluation take place by an authorized York acoustical consultant prior to any retrofit direction.

6.7 YCUL Scroll Compressor Safe Operating Temperatures

This section covers two areas of temperature safety precautions:

1. Compressor safe operating envelope
2. Compressor shell temperature

Compressor Safe Operating Envelope

The scroll compressor's used in YCUL product are subject to damage if operated beyond certain limits. Operating below a –10 °F saturated suction temperature generally is an indication of an extremely low refrigerant charge. This low charge, in just a few seconds, can overheat the scroll windings and cause early drive bearing damage.

On the other hand, excessively high super heat temperatures and/or head pressures can cause high, saturated suction temperatures. Suction "line" temperatures above 85 °F can cause damage to the compressor by overheating the compressor windings

NOTE

Internal winding sensors can shut the compressor down as low as 220 °F, and at discharge temperatures over 250 °F.

Figure 26 outlines the safe zone for Copeland scroll compressor operation for R407C, as well as R22 (dashed line reduced operating zone).

Compressor Shell Temperature

Damaged wiring or other material that is evident at the compressor shell could be due to compressor shell temperatures. The top shell and discharge line could briefly but repeatedly reach temperatures of 350 °F as the compressor cycles on its internal protection. Additionally, crankcase heaters can hold a surface temperature of over 300 °F when properly installed and with the proper torque ratings.

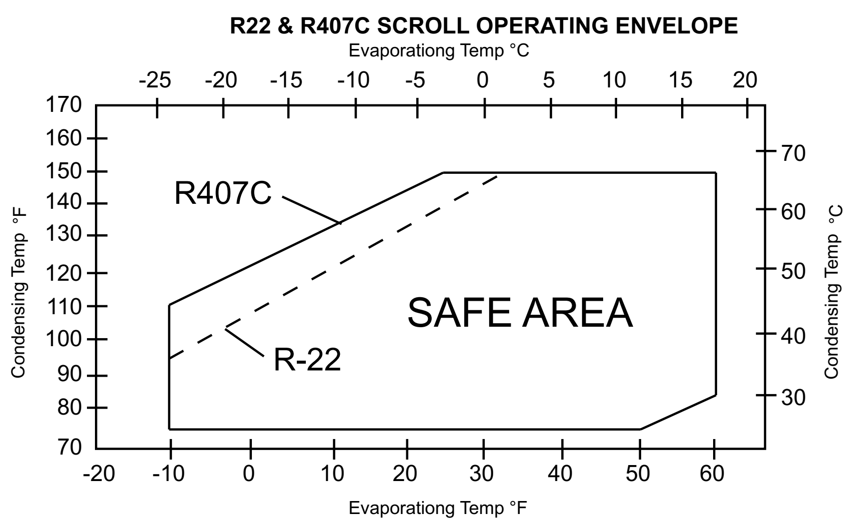
Correct any damaged wiring or material and make sure the items **do not** come in contact with the compressor shell.

6.8 Compressor Rotation

Scroll compressors can be mis-wired and run in reverse due to incorrect phasing. If left to run in reverse, the compressor's protection system will trip, and if left uncorrected will repeatedly restart.

CAUTION

After an hour of running in reverse in this manner, the compressor will be damaged.



Full operating envelope is for ZR90K3E to ZR19M3E and ZR250KCE and ZR300KCE with R407C at dew point. Dashed line indicates reduced operating envelope required for ZR90K3 to ZR19M3 and ZR250KC to ZR300KC with R22.

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FIG. 26 – FOR COPELAND COMPRESSORS – DANFOSS HAS A SLIGHTLY SMALLER REDUCED OPERATING ZONE

Verification and proper compressor rotation is made by observing an immediate drop in suction pressure and a rise in discharge pressure.

6.9 Compressor Oil Type and Removal

Always review the compressor nameplate for oil type. There are two types of oil used on York YCUL scroll compressors:

1. R-22 (HCFC) refrigerants utilize York type "F" mineral oil.

3GS mineral oil may be added in the field.

2. R407C (HFC) refrigerants utilize York type "T" polyol ester (POE) oil (YCUL0016 thru 0090); and type "V" polyol ester (POE) oil (YCUL0096 thru 0140).

Either Copeland Ultra 22 CC, Mobil Arctic EAL22CC, or ICI Emkarate RL32CF may be added in the field.

Occasionally a condition will form on R407C systems, where the refrigerant in the site glass appears "chalky-white" in color. This condition means the system was diluted with mineral oil, either by adding mineral oil or the compressor was replaced with an R-22 scroll. The system must be cleaned and replaced with the correct POE oil.

Removing Oil

After replacing failed compressors in the field, it is probable that a major portion of the oil is still in the system piping. To remove any excess oil, follow this procedure **(specific to Copeland – contact Product Technical Support for Danfoss):**

1. Run the compressor for 10 minutes.
2. Shut compressor down.
3. Remove excess oil via the "access valve" at the bottom of the compressor shell.
4. When the oil is between ¼ and 1/3 of the site glass, close the valve.
5. Repeat 1 through 4 above.

In tandem applications where site glasses are not available, a Schrader valve may be added to the lower portion of the common oil/gas equalizer line. Run the compressor for 10 minutes, shut down, and open the access valve until no oil flows. Repeat procedure.

6.10 Refrigerant Charging Cautions

System charging is critical to compressor reliability. Systems not charged correctly can lead to premature compressor failure. Note the following:

1. Do not operate scroll compressors without enough system charge to maintain at least 25psig suction pressure. Lower temperatures can damage scroll compressors and/or cause premature bearing failure by overheating.
2. Do not operate with low-pressure cutout jumpered.
3. Do not use compressor to test the trip point of high-pressure cutout.
4. Bearings are susceptible to premature damage before they have had several hours of normal operation.
5. Maintain a minimum of 70% charge prior to starting any compressor.
6. *Reference Section 4.9 "Refrigerant Charge".*

Compressor reliability will be established during the first few hours of run-in time, following a properly charged, piped, and commissioned system.

6.11 "Hi-pot" (Hi-Potential) Testing

Hi-Pot or Hi-Potential testing is never recommended on field-installed systems and should not be performed by the owner or York technician. Virtually all compressors furnished in YCUL product pass U.L. required tests using Hi-Potential current leakage testers (Hi-Pot) at the point of compressor manufacture. Scroll compressors have the motor immersed in the oil at the bottom of the shell.

Concerns with Field Hi-Pot Testing:

1. When scroll compressors are "Hi-Pot" tested with liquid refrigerant in the shell, they can show higher levels of leakage current than top mounted motors. The level of current leakage does not present any safety issue but can mislead those doing the testing.
2. A Hi-Pot test performed while the compressor is under a vacuum will damage the compressor.
3. A Hi-Pot test made on the sensors with the sensor leads attached to the module will damage the sensor and module.

6.12 Scroll Compressor Functional Check

One way of determining if a compressor functions properly is to execute a functional diagnostic check. **Do not close the suction service valve** to see how low the suction pressure can go. **This will fail the compressor.** The correct diagnostic procedure is as follows:

1. Verify the correct voltage is applied to the unit.
2. Check the motor winding continuity as well as short to ground. If the internal thermal protector has tripped, the compressor must be allowed to cool down until it has sufficient time to reset (30 minutes minimum must be allowed).
3. Verify the supply fan functions and that you have 300 to 350 FPM minimum across the DX coil.
4. Connect service gauges to the suction and discharge service valves and start the compressor. If the suction pressure falls below the normal level, the system is either low in charge or there is a restriction in the system (reference the Troubleshooting Matrix, Section 2.1, Item 3d, "Low Refrigerant Supply").
5. If the suction pressure does not drop and the discharge pressure does not rise to normal levels, there could be two possible problems:
   a. The compressor is operating in reverse. This can be verified by reversing any two of the compressor power leads. If no change is noticed, reconnect the compressor leads as originally configured.
   b. The compressor is faulty.
6. To test if the compressor is pumping properly, compare the compressor current draw to the published compressor performance curves using the operating pressures and voltage of the system. If the average measured current deviates more than + or – 15% from the published values, you may have a faulty compressor. A current imbalance exceeding 15% of the average on the three phases may indicate a voltage imbalance and should be investigated further. Discuss with York Product Technical Support personnel.
7. Note that if a compressor is on a system of 2 or 3 compressor, a "good" compressor can be running and appear not to be pumping due to a faulty internal check valve on one of the inoperative compressors (an external discharge line check valve could be added in this case).
8. Before replacing a compressor be certain the compressor is actually defective!

6.13 Equalizer Line Oil Return

Multiple compressor staging is utilized on all YCUL systems to provide capacity control at low loads. Either two or three compressors generally run in a system. A common discharge and suction manifold is used linking all system compressors together. In order to ensure oil is returned and distributed evenly, an oil equalizer line is installed between each compressor. It is important to note that **all compressors in this system must be located at the same level** to prevent oil from migrating to the lowest level compressor through the equalizer line. This is especially important when replacing a compressor.

6.14 Compressor Replacement

Identify the reason for the replacement. If a compressor is replaced due to a motor burnout, it is necessary to install a 100% activated alumina suction line filter-drier just ahead of the compressor. This is essential in removing acid, moisture and solid contaminants, which are formed during the burnout. Follow the "Burnout Procedure" in Figure 28 on the following page.

Note that the majority of the contaminated oil will be removed with the failed compressor. The rest of the oil is cleaned through the liquid line filter-drier and the required addition of the suction line filter-drier (if not already part of the system).

NOTE

The suction line charcoal core must be replaced with standard filter elements and the mesh screen must be removed within 72 hours of operation to obtain the lowest pressure drop.

If a suction line accumulator is in the system, it is highly recommended to replace it. It is more than likely that the oil return orifice and screen have become plugged shortly after the compressor failure. This will result in starving oil return to the compressor and an immediate repeat failure, due to a totally different problem.

When a single or tandem compressor is replaced it is still possible that a major portion of the oil may still be in the system. The extra oil, if not corrected, will add to compressor rotor drag and increase the compressor KW compromising compressor reliability. *Reference Section 6.9, "Compressor Oil Type & Removal" for proper removal of excess oil.*

CAUTION

Wax, sludge, scale, acid, oxides, dirt, grit and moisture are all contaminants that can enter the piping system following a compressor burnout.

Compressor Burnout Procedure

Prior to starting up any new or replacement compressor following a burnout, specific procedures must be followed and completed in cleaning up the contaminated refrigeration system. Failure to follow these procedures will result in a **failure of ALL system compressors** due to a contaminated system.

Always refer to the York "System Clean Up Procedure After Compressor Burnout, SI0095" located on the York Intra/Extranet under "Literature", "Service Bulletins and Service Information Letters". This service instruction will direct you on "minor" burnouts as well as "severe" burnout procedures and requirements *(reference Figure 28).*

6.15 Start-up of a New or Replacement Compressor

Reliability of a compressor starts with how a system is evacuated and charged. Always charge liquid to the high side and vapor to the low side only.

NOTE

Do not start a system while the compressor is in a deep vacuum, as internal arching will occur and compromise compressor reliability.

The system must have at least a 70% charge in place and maintain at least a 25-psig suction pressure during charging. Operating the compressor with a suction pressure below 7 psig for only a few seconds can overheat the scrolls and cause early drive bearing failures. Do not operate the compressor with a restricted suction or the low-pressure cutout jumpered.

When unattended, always lock the system out to prevent someone from accidentally operating the system and running a compressor with no refrigerant flow. This will damage or fail compressors.

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FIG. 28 – SERVICE INFORMATION LETTER - SYSTEM CLEAN UP PROCEDURE

6

System Reliability Check

Following the successful installation and startup of a new or replacement compressor, it is recommended to prove system reliability. Given most compressor problems and failures occur at low loads, it is suggested superheat settings be verified at forced low capacity loads.

This can be accomplished by reducing the airflow over the DX coil to 300 FPM~ and adjusting the mixed air for the minimum expected enthalpy available (or web bulb temperature). If practical, overcharge the system by 15% maximum. And lower the cooling set point to keep the system operating.

NOTE: ***Do not bypass any safeties.***

With the system operating in this manner, verify the superheat setting provides at least a 10 °F SH and that no apparent liquid is returning to the compressor. Review the compressor sight glass for foaming and feel the top of the scroll. The top of the scroll should be warm to the touch.

Also, refer to Section 5.8 “TXV Adjustment and Superheat”.

When satisfied that low load operation provides system reliability, replace all setpoints, economizer, airflow and charge to correct specification numbers, and document your efforts.

System Troubleshooting - Fact Gathering Sheet 1 of 3

Job Name/CN/Location: ____________________/___________/_______________

YCUL Model/Serial Number: ____________________/_______________________

AHU Model/Serial Number: _____________________/_______________________

Timelines:

Ship Date ______/______/_______

Startup Date ______/_______/_______

Refrigeration Design (*Design* information from Submittal if available):

Design Ambient_____________ dF

Design Load ______________ Tons

Design DX Coil SST__________ dF

Design DX Coil LAT____________ dF

Design YCUL Capacity________ Tons

Design YCUL SST______________ dF

Comments - ____

Airside Design (*Design* information from submittal if available):

Design Airflow____________ CFM

Design DX FV_____________ FPM

Measured Min. DX FV______ FPM

VAV____ or Constant Volume____

DX Coil Design_________ Split-Faced*

________ "Full" Face Split

_________Row Split

_________ Interlaced

* Split-Faced Coils allow part of coil face to be active at low loads (this voids warranty)

Comments - ____

____

Hot Gas Bypass (Check if installation is applicable):

ASC_______ or Deadhead Tee_______

ASC Bypass Port "Vertical Up"______

Orifice Relocated to ASC Inlet_______

Number of Distr./HGBP System _____

Check Valve Incl._____, None_______

HGBP Termination Location –

At Distributor ______________

External to AHU ____________

HGBPV Start to Open at _________ dF

HGBPV Fully Open at ___________ dF

Is the HGBP Line fully insulated?____

Where does the equalizer line terminate?____________________________________

Is the HGBP wired for "Full-Time" operation? Yes______, No______

Comments - ____

Type of Compressor Control – Discharge______________ , Zone or RA__________________

Remote Control used____

Ambient HP Control – Standard________, Low Ambient_________, High Ambient_________

System Troubleshooting - Fact Gathering Sheet 2 of 3

Operational Check: Date/Time__________/__________ Ambient______________ dF

System #1 Voltage Check

Voltage – 1 – 2 = _______________

Voltage – 2 – 3 = _______________

Voltage – 1 – 3 = _______________

System #2 Voltage Check

Voltage – 1 – 2 = _______________

Voltage – 2 – 3 = _______________

Voltage – 1 – 3 = _______________

System #1 Compressor Amp Check

Compr. #1, L1_____ L2_____ L3_____

Compr. #2, L1_____ L2_____ L3_____

Compr. #3, L1_____ L2_____ L3_____

System #2 Compressor Amp Check

Compr. #1, L1_____ L2_____ L3_____

Compr. #2, L1_____ L2_____ L3_____

Compr. #3, L1_____ L2_____ L3_____

Comments - ____

____

Oil Level appears –

System #1 - Adequate___________ , Low___________ , Excessive______________

System #2 - Adequate___________ , Low___________ , Excessive______________

Comments - ____

____

System #1 Sub-cooling –

Compressor #1 On____________ dF

Compr. #1 & 2 On____________ dF

Compr. #1, 2 & 3 On__________ dF

System #2 Sub-cooling –

Compressor #1 On____________ dF

Compr. #1 & 2 On____________ dF

Compr. #1, 2 & 3 On__________ dF

System #1 Superheat –

Compressor #1 On – Suction P/T______/______ dF, Suction Temp______, SH_____

Compr. #1 & 2 On – Suction P/T______/______ dF, Suction Temp______, SH_____

Compr. #1, 2 & 3 On – Suct. P/T______/______ dF, Suction Temp______, SH_____

System #2 Superheat –

Compressor #1 On – Sat Suct P/T______/_____ dF, Suction Temp______, SH_____

Compr. #1 & 2 On – Sat Suct P/T______/_____ dF, Suction Temp______, SH_____

Compr. #1, 2, 3 On – Sat Suct. P/T_____/_____ dF, Suction Temp______, SH_____

Comments - ____

____

____

System Troubleshooting - Fact Gathering Sheet 3 of 3

Operational Check, continued

Observation Checks:

1. Are there any apparent Refrigerant Leaks? Yes______, No_______
2. Does Head Pressure seem normal (I.e. Ambient + 30 dF)? Yes____, No____
3. Is Liquid Line Solenoid Valve Sticking? Yes______, No_______
4. Does condensation form on any idle compressors? Yes______, No______
5. Is Loss of Programming Data evident? Yes______, No______
6. Does Compressor Contactor Chatter? Yes______, No______
7. Do Crankcase Heaters function in off position? Yes______, No______
8. Does Oil Crankcase maintain 20 dF above SST? Yes______, No______
9. Are the compressors and equalizer lines level? Yes______, No______
10. Does Oil Odor indicate Acid in the system? Yes______, No______
11. Has an Acid test been performed/results? Yes______, No______
    - ✓ ____
12. Is the PD on all Filter/Driers below 3 psig/comment? Yes______, No______
    - ✓ ____
13. Have any faults occurred during operation/List? Yes______, No______
    - ✓ ____

Accessory/Software Checks:

1. Thermal Expansion Valve Model Number - ___________________________
    - ✓ Is the equalizer line properly piped at bulb? Yes______, No______
    - ✓ Is TXV farther than 24” from Distributor? Yes______, No______
    - ✓ Any elbows between TXV and Distributor? Yes______, No______
    - ✓ Bulb is properly installed & insulated vapor tight? Yes_____, No____
2. Orifice Size/Location - ____________/________________________________
3. Software Version in place - ____

Record any Compressors failed and date/type of failure (Suction Flow):

System #1 –	Compressor #3	Compressor #2	Compressor #1
Date/Type	________/________	________/________	________/________
System #2 –	Compressor #3	Compressor #2	Compressor #1
Date/Type	________/________	________/________	________/________

- End -

Airflow Traverse Readings Sheet (For Analyzing DX Coil Stratification)

AIRFLOW TRAVERSE READINGS SHEET (For Analyzing Stratification)

Project: ______________________________

Contract No: ______________________________ **Test No:** ______________________

AHU Designation: ______________________________ **Test Date/Time:** __________ / ____________

Serial No: ______________________________ **By:** ______________________

Record Grid (Traverse) Coil Face Velocities (FPM) Below using a Hand Held Velometer (Facing Leaving Air Side of Coil)

Grid	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1																		
2																		
3																		
4																		
5																		
6																		
7																		
8																		
9																		
10																		
11																		
12																		

Total Addition of FPM Recorded:		
Total Number of Grids taken:		
Average Face Velocity of Coil Bank:		**(Divide Total FPM Recorded by Number of Grids)**
Total Face Area (Ft2) All Coils:		
Total Operating CFM:		**(Average Face Velocity times Total Face Area (Ft2) of All Coils)**
Total Design CFM:		**(All Coils - From Approved Submittals)**
Design Face Velocity, FPM:		**(From Approved Submittals)**

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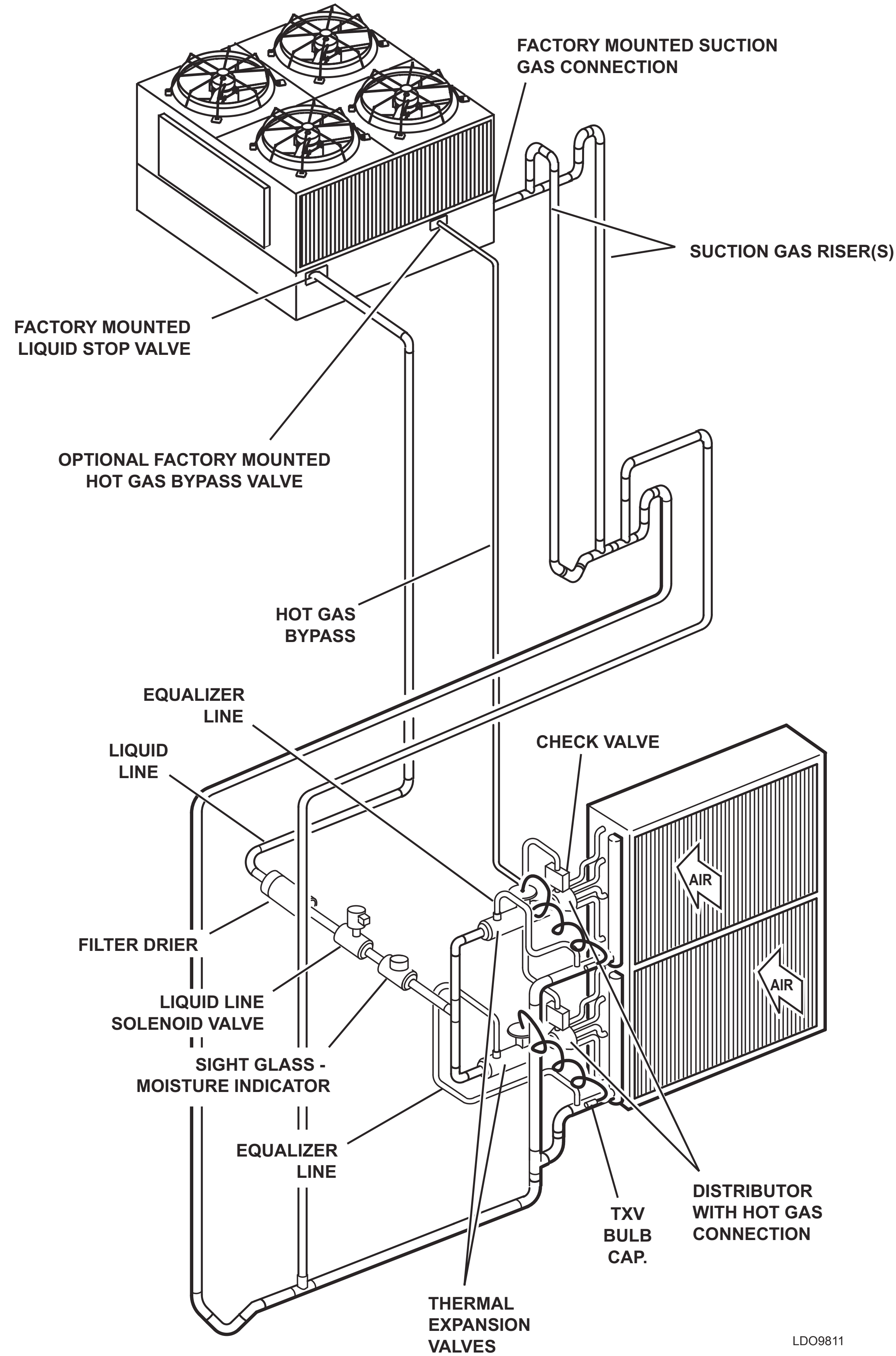

FIG. 30 – REFERENCE DRAWING - FIELD-PIPING LAYOUT (ACCU ABOVE EVAPORATOR)

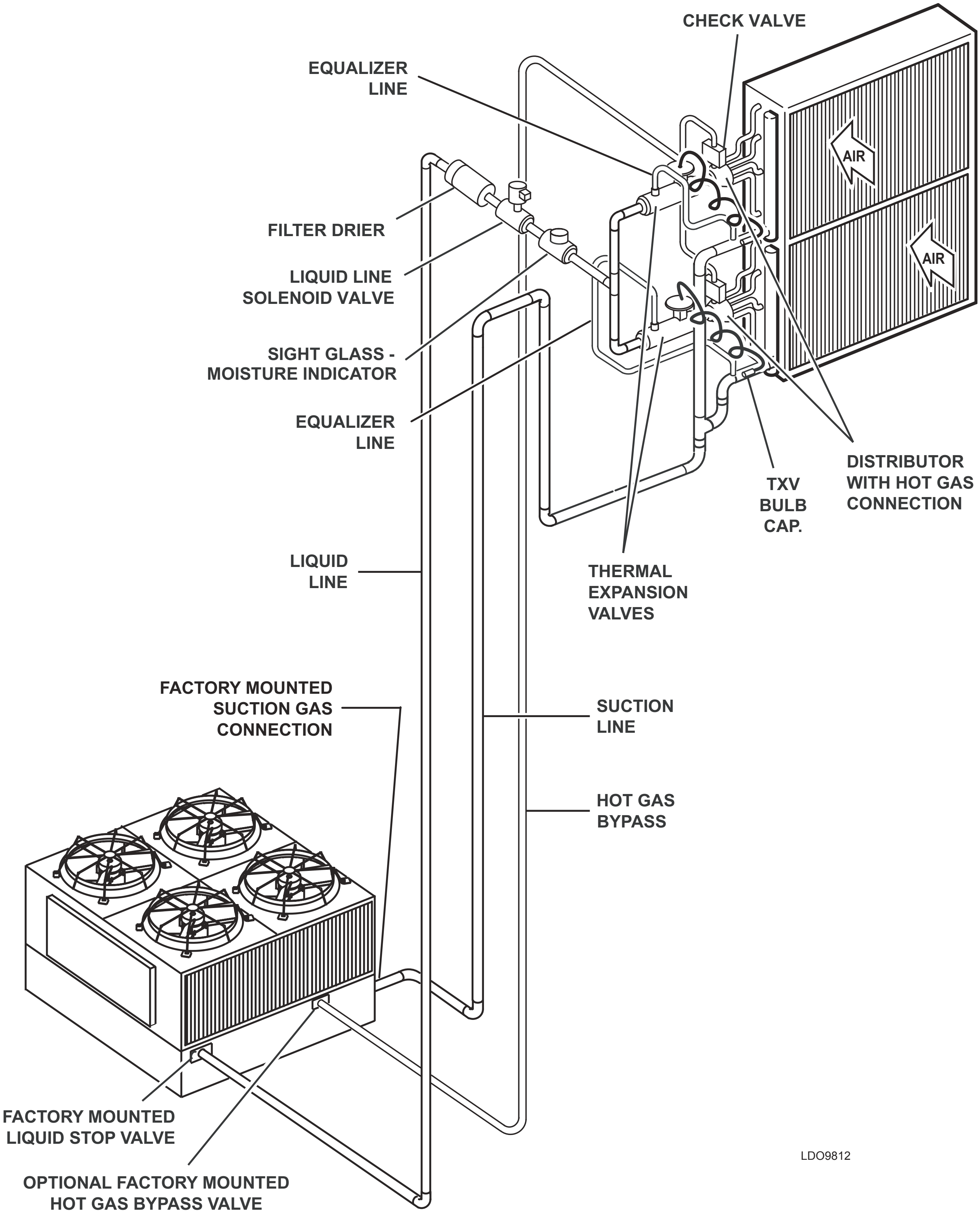

FIG. 31 – REFERENCE DRAWING - FIELD-PIPING LAYOUT (ACCU BELOW EVAPORATOR)

Vacuum-Inches of Mercury—*Italic Figures*

SPORLAN TVT

TEMPERATURE PRESSURE CHART

Pressure-Pounds Per Square Inch Gage **Bold Figures**

TEMPERATURE °F	REFRIGERANT (SPORLAN CODE) R-22(V)	R-410A(Z)	R-407C(N)	R-12(F)	R-134a(J)
-60	*11.9*	*0.9*	*16.0*	*19.0*	*21.6*
-55	*9.2*	1.8	*13.7*	*17.3*	*20.2*
-50	*6.1*	4.3	*11.1*	*15.4*	*18.6*
-45	*2.7*	7.0	*8.1*	*13.3*	*16.7*
-40	0.6	10.1	*4.8*	*11.0*	*14.7*
-35	2.6	13.5	*1.1*	*8.4*	*12.3*
-30	4.9	17.2	1.5	*5.5*	*9.7*
-25	7.5	21.4	3.7	*2.3*	*6.8*
-20	10.2	25.9	6.2	0.6	*3.6*
-18	11.4	27.8	7.2	1.3	*2.2*
-16	12.6	29.7	8.4	2.1	*0.7*
-14	13.9	31.8	9.5	2.8	0.4
-12	15.2	33.9	10.7	3.7	1.2
-10	16.5	36.1	11.9	4.5	2.0
-8	17.9	38.4	13.2	5.4	2.8
-6	19.4	40.7	14.6	6.3	3.7
-4	20.9	43.1	15.9	7.2	4.6
-2	22.4	45.6	17.4	8.2	5.5
0	24.0	48.2	18.9	9.2	6.5
1	24.8	49.5	19.6	9.7	7.0
2	25.7	50.9	20.4	10.2	7.5
3	26.5	52.2	21.2	10.7	8.0
4	27.4	53.6	22.0	11.3	8.6
5	28.3	55.0	22.8	11.8	9.1
6	29.1	56.4	23.7	12.4	9.7
7	30.0	57.9	24.5	12.9	10.2
8	31.0	59.3	25.4	13.5	10.8
9	31.9	60.8	26.2	14.1	11.4
10	32.8	62.3	27.1	14.7	12.0
11	33.8	63.9	28.0	15.3	12.6

TEMPERATURE °F	REFRIGERANT (SPORLAN CODE) R-22(V)	R-410A(Z)	R-407C(N)	R-12(F)	R-134a(J)
12	34.8	65.4	29.0	15.9	13.2
13	35.8	67.0	29.9	16.5	13.8
14	36.8	68.6	30.9	17.1	14.4
15	37.8	70.2	31.8	17.7	15.1
16	38.8	71.9	32.8	18.4	15.7
17	39.9	73.5	33.8	19.0	16.4
18	40.9	75.2	34.8	19.7	17.1
19	42.0	77.0	35.9	20.4	17.7
20	43.1	78.7	36.9	21.1	18.4
21	44.2	80.5	38.0	21.8	19.2
22	45.3	82.3	39.1	22.5	19.9
23	46.5	84.1	40.2	23.2	20.6
24	47.6	85.9	41.3	23.9	21.4
25	48.8	87.8	42.4	24.6	22.1
26	50.0	89.7	43.6	25.4	22.9
27	51.2	91.6	44.7	26.1	23.7
28	52.4	93.5	45.9	26.9	24.5
29	53.7	95.5	47.1	27.7	25.3
30	54.9	97.5	48.4	28.5	26.1
31	56.2	99.5	49.6	29.3	26.9
32	57.5	101.6	50.9	30.1	27.8
33	58.8	103.6	52.1	30.9	28.6
34	60.2	105.7	53.4	31.8	29.5
35	61.5	107.9	54.8	32.6	30.4
36	62.9	110.0	56.1	33.5	31.3
37	64.3	112.2	57.5	34.3	32.2
38	65.7	114.4	58.9	35.2	33.1
39	67.1	116.7	60.3	36.1	34.1
40	68.6	118.9	61.7	37.0	35.0
41	70.0	121.2	63.1	37.9	36.0

TEMPERATURE °F	REFRIGERANT (SPORLAN CODE) R-22(V)	R-410A(Z)	R-407C(N)	R-12(F)	R-134a(J)
42	71.5	123.6	64.6	38.9	37.0
43	73.0	125.9	66.1	39.8	38.0
44	74.5	128.3	67.6	40.8	39.0
45	76.1	130.7	69.1	41.7	40.0
46	77.6	133.2	70.6	42.7	41.1
47	79.2	135.6	72.2	43.7	42.2
48	80.8	138.2	73.8	44.7	43.2
49	82.4	140.7	75.4	45.7	44.3
50	84.1	143.3	77.1	46.7	45.4
55	92.6	156.6	106.0	52.1	51.2
60	101.6	170.7	116.2	57.8	57.4
65	111.3	185.7	127.0	63.8	64.0
70	121.5	201.5	138.5	70.2	71.1
75	132.2	218.2	150.6	77.0	78.6
80	143.7	235.9	163.5	84.2	86.7
85	155.7	254.6	177.0	91.7	95.2
90	168.4	274.3	191.3	99.7	104.3
95	181.9	295.0	206.4	108.2	113.9
100	196.0	316.9	222.3	117.0	124.1
105	210.8	339.9	239.0	126.4	134.9
110	226.4	364.1	256.5	136.2	146.3
115	242.8	389.6	274.9	146.5	158.4
120	260.0	416.4	294.2	157.3	171.1
125	278.1	444.5	314.5	168.6	184.5
130	297.0	474.0	335.7	180.5	198.7
135	316.7	505.0	357.8	192.9	213.5
140	337.4	537.6	380.9	205.9	229.2
145	359.1	571.7	405.1	219.5	245.6
150	381.7	607.6	430.3	233.7	262.8
155	405.4	645.2	456.6	248.6	281.0

To determine **subcooling** for refrigerant R-407C use BUBBLE POINT values (Temperatures above 50°F — Gray Background); to determine **superheat** R-407C, use DEW POINT values (Temperatures 50°F and below).

LDO10467

Index (Section, Item)

For Technical Support - See Page 75

Area Service Manager –

Contact: ______________________________

Phone: ______________________________

Product Technical Support, Split-Systems –

Contact: ______________________________

Phone: ______________________________

York Coils Technical Support –

Contact: ______________________________

Phone: ______________________________

Notes:

Split-System Systemic Analysis

(Superheat and Suction Pressure can point to the real cause)

"POSSIBLE CAUSE OVERVIEW"

FLOOD-BACK

(On System Startup)

1. **Oversized TXV**
2. **TXV Seat Leak (off cycle)**
3. **Low Superheat Adjustment**
4. **Wrong Thermostatic Charge**
5. **Bulb Installation**
   a. **Poor Thermal Contact**
   b. **Warm Location**
6. **Discharge Line Ball Valve Leak**
7. **Solenoid Valve Seat Leak**
8. **Compressor in Cold Location**
9. **Suction Line in Cold Location**
10. **DX Coil Free Draining to Compr**
11. **Interrupted Pumpdown**
12. **Restricted External Equalizer**

Low Suction Pressure / High Super Heat

1. **Moisture, Dirt or Wax**
2. **Undersized TXV**
3. **High Superheat Adjustment**
4. **Gas Charge Condensation**
5. **Dead Thermostatic Element**
6. **Wrong Thermostatic Charge**
7. **Evap PD – No External Equalizer**
8. **External Equalizer Location**
9. **Restricted or Capped Equalizer**
10. **Low Refrigerant Charge**
11. **Liquid Line Vapor – PD Problem**
12. **Low Pressure Drop Across TXV**
   a. **Liq. Line PD Excessive**
   b. **Low Condensing Pressure**
   c. **Undersized Distr. Nozzle**
   d. **See 11 above**

High Suction Pressure / Low Superheat

1. **Oversized TXV**
2. **TXV Seat Leak**
3. **Low Superheat Adjustment**
4. **Bulb Installation**
   a. **Poor Thermal Contact**
   b. **Warm Location**
5. **Wrong Thermostatic Charge**
6. **Bad Compressor – Low Capacity**
7. **Moisture, Dirt or Wax**
8. **Incorrectly Located External Equalizer**

Low Suction Pressure / Low Superheat

1. **Low Load**
   a. **Low Airflow**
   b. **Dirty Air Filters**
   c. **Air Too Cold**
   d. **Coil Icing**
2. **Poor Air Distribution**
3. **Poor Refrigerant Distribution**
4. **Poor Evap/Compressor Balance**
5. **Evaporator Oil Logged**
6. **Multiple TXV's Short Circuiting**
   a. **Missing Check Valve on HGBP**
   b. **One TXV Affecting Another**

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