



Case No.: 12-2588-EL-EEC

Mercantile Customer: Oak Hills Local School District

Electric Utility: Duke Energy

**Program Title or
Description: Chiller Tune-ups**

Rule 4901:1-39-05(F), Ohio Administrative Code (O.A.C.), permits a mercantile customer to file, either individually or jointly with an electric utility, an application to commit the customer's existing demand reduction, demand response, and energy efficiency programs for integration with the electric utility's programs. The following application form is to be used by mercantile customers, either individually or jointly with their electric utility, to apply for commitment of such programs in accordance with the Commission's pilot program established in Case No. [10-834-EL-POR](#)

Completed applications requesting the cash rebate reasonable arrangement option (Option 1) in lieu of an exemption from the electric utility's energy efficiency and demand reduction (EEDR) rider will be automatically approved on the sixty-first calendar day after filing, unless the Commission, or an attorney examiner, suspends or denies the application prior to that time. Completed applications requesting the exemption from the EEDR rider (Option 2) will also qualify for the 60-day automatic approval so long as the exemption period does not exceed 24 months. Rider exemptions for periods of more than 24 months will be reviewed by the Commission Staff and are only approved up the issuance of a Commission order.

Complete a separate application for each customer program. Projects undertaken by a customer as a single program at a single location or at various locations within the same service territory should be submitted together as a single program filing, when possible. Check all boxes that are applicable to your program. For each box checked, be sure to complete all subparts of the question, and provide all requested additional information. Submittal of incomplete applications may result in a suspension of the automatic approval process or denial of the application.

Any confidential or trade secret information may be submitted to Staff on disc or via email at ee-pdr@puc.state.oh.us.

Section 1: Mercantile Customer Information

Name: **Oak Hills Local School District**

Principal address: **3200 Ebenzer Road Cincinnati, Ohio 45248**

Address of facility for which this energy efficiency program applies:

6325 Rapid Run Road Cincinnati, Oh 45233 (Rapid Run School)
4402 Glenhaven Road Cincinnati, Ohio 45233 (Delshire School)

Name and telephone number for responses to questions:

Grady Reid Jr, 513-287-1038

Electricity use by the customer (check the box(es) that apply):

- The customer uses more than seven hundred thousand kilowatt hours per year at the above facility. (Refer to Appendix A.)**

Section 2: Application Information

A) The customer is filing this application (choose which applies):

- Individually, without electric utility participation.
- Jointly with the electric utility.**

B) The electric utility is: **Duke Energy**

C) The customer is offering to commit (check any that apply):

- Energy savings from the customer's energy efficiency program. (Complete Sections 3, 5, 6, and 7.)
- Capacity savings from the customer's demand response/demand reduction program. (Complete Sections 4, 5, 6, and 7.)
- Both the energy savings and the capacity savings from the customer's energy efficiency program. (Complete all sections of the Application.)**

Section 3: Energy Efficiency Programs

A) The customer's energy efficiency program involves (check those that apply):

- Early replacement of fully functioning equipment with new equipment. (Provide the date on which the customer replaced fully functioning equipment, and the date on which the customer would have replaced such equipment if it had not been replaced early. Please include a brief explanation for how the customer determined this future replacement date (or, if not known, please explain why this is not known)).
- Installation of new equipment to replace equipment that needed to be replaced. The customer installed new equipment on the following date(s):
- Installation of new equipment for new construction or facility expansion. The customer installed new equipment on the following date(s):
_____.

Behavioral or operational improvement.

B) Energy savings achieved/to be achieved by the energy efficiency program:

- 1) If you checked the box indicating that the project involves the early replacement of fully functioning equipment replaced with new equipment, then calculate the annual savings [(kWh used by the original equipment) - (kWh used by new equipment) = (kWh per year saved)]. Please attach your calculations and record the results below:

Annual savings: _____kWh

- 2) If you checked the box indicating that the customer installed new equipment to replace equipment that needed to be replaced, then calculate the annual savings [(kWh used by less efficient new equipment) - (kWh used by the higher efficiency new equipment) = (kWh per year saved)]. Please attach your calculations and record the results below:

Annual savings: _____kWh

Please describe any less efficient new equipment that was rejected in favor of the more efficient new equipment.

- 3) If you checked the box indicating that the project involves equipment for new construction or facility expansion, then calculate the annual savings [(kWh used by less efficient new equipment) - (kWh used by higher efficiency new equipment) = (kWh per year saved)]. Please attach your calculations and record the results below:

Annual savings: _____kWh

Please describe the less efficient new equipment that was rejected in favor of the more efficient new equipment.

- 4) If you checked the box indicating that the project involves behavioral or operational improvements, provide a description of how the annual savings were determined. **Chiller tune-ups - preventative maintenance performed resulting in energy savings.**
-

Section 4: Demand Reduction/Demand Response Programs

- A) The customer's program involves (check the one that applies):
- Coincident peak-demand savings from the customer's energy efficiency program.**
 - Actual peak-demand reduction. (Attach a description and documentation of the peak-demand reduction.)
 - Potential peak-demand reduction (check the one that applies):
 - The customer's peak-demand reduction program meets the requirements to be counted as a capacity resource under a tariff of a regional transmission organization (RTO) approved by the Federal Energy Regulatory Commission.
 - The customer's peak-demand reduction program meets the requirements to be counted as a capacity resource under a program that is equivalent to an RTO program, which has been approved by the Public Utilities Commission of Ohio.

- B) On what date did the customer initiate its demand reduction program?

April 2009, May 2009, April 2010, March 2011 and April 2011

- C) What is the peak demand reduction achieved or capable of being achieved (show calculations through which this was determined):

40.35 KW (See Attachment 1 - Appendix 2)

Section 5: Request for Cash Rebate Reasonable Arrangement (Option 1) or Exemption from Rider (Option 2)

Under this section, check the box that applies and fill in all blanks relating to that choice.

Note: If Option 2 is selected, the application will not qualify for the 60-day automatic approval. All applications, however, will be considered on a timely basis by the Commission.

A) The customer is applying for:

Option 1: A cash rebate reasonable arrangement.

OR

Option 2: An exemption from the energy efficiency cost recovery mechanism implemented by the electric utility.

OR

Commitment payment

B) The value of the option that the customer is seeking is:

Option 1: A cash rebate reasonable arrangement, which is the lesser of (show both amounts):

A cash rebate of **\$1100.50 (See Attachment 1 - Appendix 3).**

Option 2: An exemption from payment of the electric utility's energy efficiency/peak demand reduction rider.

An exemption from payment of the electric utility's energy efficiency/peak demand reduction rider for ___ months (not to exceed 24 months). (Attach calculations showing how this time period was determined.)

OR

A commitment payment valued at no more than \$_____. (Attach documentation and calculations showing how this payment amount was determined.)

OR

- Ongoing exemption from payment of the electric utility's energy efficiency/peak demand reduction rider for an initial period of 24 months because this program is part of the customer's ongoing efficiency program. (Attach documentation that establishes the ongoing nature of the program.) In order to continue the exemption beyond the initial 24 month period, the customer will need to provide a future application establishing additional energy savings and the continuance of the organization's energy efficiency program.)

Section 6: Cost Effectiveness

The program is cost effective because it has a benefit/cost ratio greater than 1 using the (choose which applies):

- Total Resource Cost (TRC) Test. The calculated TRC value is: _____
(Continue to Subsection 1, then skip Subsection 2)
- ✓ Utility Cost Test (UCT). The calculated UCT value is **(See Attachment 1 - Appendix 4)**

Subsection 1: TRC Test Used (please fill in all blanks).

The TRC value of the program is calculated by dividing the value of our avoided supply costs (generation capacity, energy, and any transmission or distribution) by the sum of our program overhead and installation costs and any incremental measure costs paid by either the customer or the electric utility.

The electric utility's avoided supply costs were _____.

Our program costs were _____.

The incremental measure costs were _____.

Subsection 2: UCT Used (please fill in all blanks).

We calculated the UCT value of our program by dividing the value of our avoided supply costs (capacity and energy) by the costs to our electric utility (including administrative costs and incentives paid or rider exemption costs) to obtain our commitment.

Our avoided supply costs were **\$13,395 (See Attachment 1 - Appendix 5).**

The utility's program costs were **\$1,929(See Attachment 1 - Appendix 6).**

The utility's incentive costs/rebate costs were **\$1100.50 (See Attachment 1 - Appendix 3).**

Section 7: Additional Information

Please attach the following supporting documentation to this application:

Narrative description of the program including, but not limited to, make, model, and year of any installed and replaced equipment.

A copy of the formal declaration or agreement that commits the program or measure to the electric utility, including:

- 1) any confidentiality requirements associated with the agreement;
- 2) a description of any consequences of noncompliance with the terms of the commitment;
- 3) a description of coordination requirements between the customer and the electric utility with regard to peak demand reduction;
- 4) permission by the customer to the electric utility and Commission staff and consultants to measure and verify energy savings and/or peak-demand reductions resulting from your program; and,
- 5) a commitment by the customer to provide an annual report on your energy savings and electric utility peak-demand reductions achieved.

Refer to Offer Letter following this application

A description of all methodologies, protocols, and practices used or proposed to be used in measuring and verifying program results. Additionally, identify and explain all deviations from any program measurement and verification guidelines that may be published by the Commission.



DUKE ENERGY
Mercantile Self Direct Program
139 East Fourth Street
Cincinnati, OH 45202
513 629 5572 fax

September 7, 2012

Mr. John Beckemeyer
Oak Hills Local Schools District – **Delshire and Rapid Run**
6325 Rapid Run Road
Cincinnati, Ohio 45233

Subject: Your **(PRESCRIPTIVE)** Application for a Duke Energy Mercantile Self-Direct Rebate

Dear Mr. Beckemeyer:

Thank you for your Duke Energy Mercantile Self Direct **(PRESCRIPTIVE)** rebate application. As noted in the Energy Conservation Measure (ECM) chart on page two, a total rebate of \$1150.00 has been proposed for your **chiller tune-up projects** completed in the 2009, 2010 and 2011 calendar years. **All Self Direct Rebates are contingent upon approval by the Public Utilities Commission of Ohio (PUCO).**

At your earliest convenience, please indicate if you accept this rebate by

- providing your signature on page two
- completing the PUCO-required affidavit on page three.

Please return the documents to my attention via fax at 513-629-5572 or e-mail to SelfDirect@Duke-Energy.com. Upon receipt, Duke Energy will submit the necessary documentation to PUCO. Following PUCO's approval, Duke Energy will remit payment.

At Duke Energy, we value your business and look forward to working with you on this and future energy efficiency projects. We hope you will consider our Smart Saver® incentives, when applicable. Please contact me if you have any questions.

Sincerely,

Grady Reid, Jr
Product Manager
Mercantile Self Direct Rebates

cc: Michelle Kolb, Duke Energy
Rob Jung, WECC
Ms. Cory Feldkamp, Feldkamp Enterprises, Inc

Please indicate your response to this rebate offer within 30 days of receipt.

Rebate is accepted.

Rebate is declined.

By accepting this rebate, Oak Hills Schools affirms its intention to commit and integrate the energy efficiency projects listed on the following pages into Duke Energy's peak demand reduction, demand response and/or energy efficiency programs.

Additionally, Oaks Hills Schools also agrees to serve as joint applicant in any future filings necessary to secure approval of this arrangement as required by PUCO and to comply with any information and reporting requirements imposed by rule or as part of that approval.

Finally, Oaks Hills Schools affirms that all application information submitted to Duke Energy pursuant to this rebate offer is true and accurate. Information in question would include, but not be limited to, project scope, equipment specifications, equipment operational details, project costs, project completion dates, and the quantity of energy conservation measures installed.

If rebate is accepted, will you use the monies to fund future energy efficiency and/or demand reduction projects?

YES

NO

If rebate is declined, please indicate reason (optional):



Customer Signature

Todd Yohey

Printed Name

9/10/12

Date

Proposed Rebate Amounts

Measure ID	Energy Conservation Measure (ECM)	Proposed Rebate Amount
ECM-1	Delshire – Air Cooled Chiller Tune ups (2009, 2010, 2011)	\$563.00
ECM-2	Rapid Run - Water Cooled Chiller Tune ups (2009, 2010, 2011)	\$537.50
Total		\$1100.50



**Public Utilities
Commission**

**Application to Commit
Energy Efficiency/Peak
Demand Reduction
Programs
(Mercantile Customers
Only)**

Case No.: ____ - ____ -EL-EEC

State of Ohio :

Todd Yohey, Affiant, being duly sworn according to law, deposes and says that:

1. I am the duly authorized representative of:

Oak Hills Local School District

[insert customer or EDU company name and any applicable name(s) doing business as]

2. I have personally examined all the information contained in the foregoing application, including any exhibits and attachments. Based upon my examination and inquiry of those persons immediately responsible for obtaining the information contained in the application, I believe that the information is true, accurate and complete.

3. I am aware of fines and penalties which may be imposed under Ohio Revised Code Sections 2921.11, 2921.31, 4903.02, 4903.03, and 4903.99 for submitting false information.

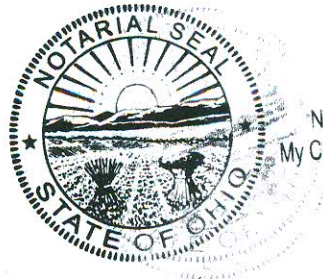
MT Yohey, Superintendent
Signature of Affiant & Title

Sworn and subscribed before me this 10th day of September,
2012 Month/Year

Lisa M. Hauser
Signature of official administering oath

Lisa Hauser, Notary Public
Print Name and Title

My commission expires on 7-22-2017



LISA M. HAUSER
Notary Public, State of Ohio
My Commission Expires 07/22/2017

Attachment 1 –Oak Hills Schools (Rapid Run and Delshire)

Appendix 1 – Electric History

OAK HILLS SCHOOL DISTRICT		
3200 EBENEZER RD		
CINCINNATI, OH 45248		
Date	Days	Actual KWH
8/9/2012	29	307,777
7/11/2012	30	303,536
6/11/2012	32	429,396
5/10/2012	29	378,536
4/11/2012	30	386,763
3/12/2012	31	354,526
2/10/2012	29	329,744
1/12/2012	31	336,868
12/12/2011	33	375,955
11/9/2011	29	359,521
10/11/2011	29	385,917
9/12/2011	32	411,399
Total		4,359,938

Appendix 2 – Annual kWh losses and annual KW losses

Measure	Annual kWh Gross with losses	Upload Amount	TOTAL Annual kWh losses	KW Per Measure	Total KW Savings
Air Cooled Chiller Tune Up	128.92	291	37,516	0.05	14.55
Water Cooled Chiller Tune Up	64.46	1290	83,153	0.02	25.8
Totals		1581	120,669		40.35

Appendix 3 – Cash Rebate

Measure	Amount
Air Cooled Chiller Tune Up	\$563.00
Water Cooled Chiller Tune Up	\$537.50
Totals	\$1,100.50

Appendix 4 – Utility Cost Test

Measure	UCT
Air Cooled Chiller Tune Up	4.41
Water Cooled Chiller Tune Up	2.21

Appendix 5 – Avoided Supply Costs

Measure	T&D	Production	Capacity	Quantity	Total Avoided Costs
Air Cooled Chiller Tune Up	\$2.00	\$8.00	\$5.00	291	\$4,365
Water Cooled Chiller Tune Up	\$1.00	\$4.00	\$2.00	1290	\$9,030
Totals					\$13,395

Appendix 6 – Utility Program Costs

Measure	Qty	Admin Costs	Total Costs
Air Cooled Chiller Tune Up	291	\$1.22	\$355
Water Cooled Chiller Tune Up	1290	\$1.22	\$1,574
Totals	1581		\$1,929

Ohio Mercantile Self Direct Program

Application Guide & Cover Sheet

Questions? Call 1-866-380-9580 or visit www.duke-energy.com.

Email this form along with completed Mercantile Self Direct Prescriptive or Custom applications, proof of payment, energy savings calculations and spec sheets to SelfDirect@Duke-Energy.com. You may also fax to 1-513-629-5572.

Mercantile customers, defined as using at least 700,000 kWh annually are eligible for the Mercantile Self Direct program. Please indicate mercantile qualification:

- a single Duke Energy Ohio account
- multiple accounts in Ohio (energy usage with other utilities may be counted toward the total)

Please list Duke Energy account numbers below (attach listing of multiple accounts and/or billing history for other utilities as required):

Account Number	Annual Usage	Account Number	Annual Usage
00402046 01	400,000 kWh	20302153 01	4,000,000 kWh

Self Direct rebates are available for completed Custom projects that have not previously received a Duke Energy Smart \$aver® Custom Incentive. Self Direct incentives are applicable to Prescriptive measures that were installed more than 90 days prior to submission to Duke Energy and have not previously received a Duke Energy Prescriptive rebate.

Self Direct Program requirements dictate that certain projects that may be Prescriptive in nature under the Smart \$aver program must be evaluated using the Custom process. Use the table on page two as a guide to determine which Self Direct program fits your project(s). Apply for Self Direct projects using the appropriate application forms in conjunction with this cover sheet. Where Mercantile Self Direct Prescriptive applications are listed, please refer to the measure list on that application. If your measure is not listed, you may be eligible for a Self Direct Custom rebate. Self Direct Custom applications, like Smart \$aver Custom applications, should include detailed analysis of pre-project and post-project energy usage and project costs. Please indicate which type of rebate applications are included in the table provided on page two.

Please check each box to indicate completion of the following program requirements:

<input checked="" type="checkbox"/> All sections of appropriate application(s) are completed	<input checked="" type="checkbox"/> Proof of payment.*	<input checked="" type="checkbox"/> Manufacturer's Spec sheets	<input checked="" type="checkbox"/> Energy model/calculations and detailed inputs for Custom applications
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* If a single payment record is intended to demonstrate the costs of both Prescriptive & Custom projects, please include an additional document with an estimated breakout of costs for each Prescriptive and Custom energy conservation measure.

Application Type	Replaced equipment at end of lifetime or because equipment failed**	Replaced fully operational equipment to improve efficiency***	New Construction
Lighting	MSD Custom Part 1 <input type="checkbox"/> Custom Lighting Worksheet <input type="checkbox"/>	MSD Prescriptive Lighting <input type="checkbox"/>	MSD Prescriptive Lighting <input type="checkbox"/>
		MSD Custom Part 1 <input type="checkbox"/> Custom Lighting Worksheet <input type="checkbox"/>	MSD Custom Part 1 <input type="checkbox"/> Custom Lighting Worksheet <input type="checkbox"/>
Heating & Cooling	MSD Custom Part 1 <input type="checkbox"/> MSD Custom General Worksheet <input type="checkbox"/>	MSD Custom Part 1 <input type="checkbox"/> MSD Custom General Worksheet <input type="checkbox"/>	MSD Prescriptive Heating & Cooling <input type="checkbox"/>
			MSD Custom Part 1 <input type="checkbox"/> MSD Custom General Worksheet <input type="checkbox"/>
Window Films, Programmable Thermostats, & Guest Room Energy Management Systems	MSD Custom Part 1 <input type="checkbox"/> MSD Custom General and/or EMS Worksheet(s) <input type="checkbox"/>	MSD Prescriptive Heating & Cooling <input type="checkbox"/>	MSD Custom Part 1 <input type="checkbox"/> MSD Custom General and/or EMS Worksheet(s) <input type="checkbox"/>
Chillers & Thermal Storage	MSD Custom Part 1 <input type="checkbox"/> MSD Custom General Worksheet <input type="checkbox"/>	MSD Custom Part 1 <input type="checkbox"/> MSD Custom General Worksheet <input type="checkbox"/>	MSD Prescriptive Chillers & Thermal Storage <input type="checkbox"/>
			MSD Custom Part 1 <input type="checkbox"/> MSD Custom General Worksheet <input type="checkbox"/>
Chiller Tune-ups	MSD Prescriptive Chiller Tune-ups <input type="checkbox"/>	MSD Prescriptive Chiller Tune-ups <input checked="" type="checkbox"/>	MSD Prescriptive Chiller Tune-ups <input type="checkbox"/>
Motors & Pumps	MSD Custom Part 1 <input type="checkbox"/> MSD Custom General Worksheet <input type="checkbox"/>	MSD Custom Part 1 <input type="checkbox"/> MSD Custom General Worksheet <input type="checkbox"/>	MSD Prescriptive Motors, Pumps & Drives <input type="checkbox"/>
			MSD Custom Part 1 <input type="checkbox"/> MSD Custom General Worksheet <input type="checkbox"/>
VFDs	Not Applicable	MSD Prescriptive Motors, Pumps & Drives <input type="checkbox"/>	MSD Custom Part 1 <input type="checkbox"/> MSD Custom VFD Worksheet <input type="checkbox"/>
		MSD Custom Part 1 <input type="checkbox"/> MSD Custom VFD Worksheet <input type="checkbox"/>	
Food Service	MSD Custom Part 1 <input type="checkbox"/> MSD Custom General Worksheet <input type="checkbox"/>	MSD Custom Part 1 <input type="checkbox"/> MSD Custom General Worksheet <input type="checkbox"/>	MSD Prescriptive Food Service <input type="checkbox"/>
			MSD Custom Part 1 <input type="checkbox"/> MSD Custom General Worksheet <input type="checkbox"/>
Air Compressors	MSD Custom Part 1 <input type="checkbox"/> MSD Custom Compressed Air Worksheet <input type="checkbox"/>	MSD Custom Part 1 <input type="checkbox"/> MSD Custom Compressed Air Worksheet <input type="checkbox"/>	MSD Prescriptive Process <input type="checkbox"/>
			MSD Custom Part 1 <input type="checkbox"/> MSD Custom Compressed Air Worksheet <input type="checkbox"/>
Process	MSD Custom Part 1 <input type="checkbox"/> MSD Custom General Worksheet <input type="checkbox"/>	MSD Prescriptive Process <input type="checkbox"/>	MSD Custom Part 1 <input type="checkbox"/> MSD Custom General Worksheet <input type="checkbox"/>
		MSD Custom Part 1 <input type="checkbox"/> MSD Custom General Worksheet <input type="checkbox"/>	
Energy Management Systems	MSD Custom Part 1 <input type="checkbox"/> MSD Custom EMS Worksheet <input type="checkbox"/>	MSD Custom Part 1 <input type="checkbox"/> MSD Custom EMS Worksheet <input type="checkbox"/>	MSD Custom Part 1 <input type="checkbox"/> MSD Custom EMS Worksheet <input type="checkbox"/>
Behavioral*** & No/Low Cost	MSD Custom Part 1 <input type="checkbox"/> MSD Custom General Worksheet <input type="checkbox"/>		

** Under the Self Direct program, failed equipment and equipment at the end of its useful life are evaluated differently than early replacement of fully functioning equipment. All equipment replacements due to failure or old age will be evaluated via the Custom program.

*** Please ensure that you include the age of the replaced equipment for measures classified as "Early Replacement" in your application as well as the estimated date that you would have otherwise replaced the existing equipment if you had not chosen a more energy efficient option.

**** Behavioral energy efficiency and demand reduction projects must be both measurable and verifiable. Provide justification with your application.



MERCANTILE SELF DIRECT Ohio Chiller Tune-up Service Application

Questions? Call 1-866-380-9580 or visit www.duke-energy.com.

Email the complete, signed application with all required documents to SelfDirect@duke-energy.com or fax to 513-629-5572.

Is this application: NEW (original) or REVISED (changes made to original application)

Building Type – Required (check one)		
<input type="checkbox"/> Data Centers	<input type="checkbox"/> Full Service Restaurant	<input type="checkbox"/> Office
<input checked="" type="checkbox"/> Education/K-12	<input type="checkbox"/> Healthcare	<input type="checkbox"/> Public Assembly
<input type="checkbox"/> Education Other	<input type="checkbox"/> Industrial	<input type="checkbox"/> Public Order/Safety
<input type="checkbox"/> Elder Care/Nursing Home	<input type="checkbox"/> Lodging	<input type="checkbox"/> Religious Worship/Church
<input type="checkbox"/> Food Sales/Grocery	<input type="checkbox"/> Retail (Small Box)	<input type="checkbox"/> Service
<input type="checkbox"/> Fast Food Restaurant	<input type="checkbox"/> Retail (Big Box)	<input type="checkbox"/> Warehouse
<input type="checkbox"/> Other:		
How did you hear about the program? (check one)		
<input checked="" type="checkbox"/> Duke Energy Representative	<input type="checkbox"/> Web Site	<input type="checkbox"/> Radio
<input type="checkbox"/> Contractor / Vendor	<input type="checkbox"/> Other _____	

Please check each box to indicate completion of the following program requirements:

<input checked="" type="checkbox"/> All sections of application	<input checked="" type="checkbox"/> Invoice with make, model number, quantity and equipment manufacturer	<input checked="" type="checkbox"/> Tax ID number for payee	<input checked="" type="checkbox"/> Customer/vendor agree to Terms and Conditions
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Customer Information					
Customer/Business	Oak Hills Local School District	Contact	John Beckemeyer		
Phone	513-598-2941	Account Number	00402046015		
Street Address (Where incentive should be mailed)		6325 Rapid Run Rd.			
City	Cincinnati	State	OH	Zip Code	45233
Installation Street Address		4402 Glenhaven Rd.			
City	Cincinnati	State	OH	Zip Code	45238
E-mail Address	beckemeyer_j@ohlsd.org				

*Failure to provide the account number associated with the location where the installation took place will result in rejection of the application.

Vendor Information					
Vendor	Feldkamp Enterprises, Inc.	Contact	Cory Feldkamp		
Phone	513-347-4500	Fax	513-347-4506		
Street Address		3642 Muddy Creek Rd.			
City	Cincinnati	State	OH	Zip Code	45238
E-mail Address	cory@feldkamphvac.com				

If Duke Energy has questions about this application, who should we contact? Customer Vendor

Payment Information		
Who should receive incentive payment?	<input checked="" type="checkbox"/> Customer	<input type="checkbox"/> Vendor (Customer must sign below)
I hereby authorize payment of incentive directly to the vendor:	Customer Signature (written signature)	
	Date	
Provide Tax ID Number for Payee	Customer Tax ID #	316000742
	Vendor Tax ID #	

Terms and Conditions			
I have read and hereby agree to the Terms & Conditions and Program Requirements.			
Customer Signature		Vendor Signature	
Date	8/18/12	Date	8/15/12
Title	Operations Coordinator	Title	Director of Service

Incentives are subject to change and may be discontinued at the sole discretion of Duke Energy. Equipment must be installed and operable to be eligible for incentives. As Federal Energy Policy Law changes, equipment efficiency requirements are subject to change.



Air Cooled and Water Cooled Chiller Tune-ups						
Manufacturer and Model #	# of Units	Tons Per unit*	Total Project Cost	Current Service Date	Previous Service Date	Total Incentive
York YLAA0101YE17	1	101	\$500.00	4/28/09		
York YLAA0101YE17	1	101	\$500.00	4/14/10		
York YLAA0101YE17	1	101	\$350.00	4/22/11		
*Provide manufacturer's spec sheet documenting the size of the unit						

To Calculate your tune-up incentive*	
A. Add up equipment capacity of all units serviced (in tons) and multiply by \$2/ton =	\$606.00
B. Cost of service = \$1,350.00 x 50% of total service cost =	\$675.00
Total Incentive (lesser amount of row A or row B)=	\$606.00
*Incentives cannot exceed 50% of total service invoice (external labor and equipment).	

Service Requirements:

1. This incentive is available only once per unit in a 12 month period.
2. An individual chiller is considered one unit.
3. Copy of paid invoice must be included with this application
4. Self serviced (internal) labor should not be included as part of the total service cost. Only external labor will be considered as part of the total service invoice.
5. Cooling service must include the following normal maintenance items (please check if completed):

<input checked="" type="checkbox"/> Air cooled condenser coil cleaning	<input checked="" type="checkbox"/> Compressor amp draw	<input checked="" type="checkbox"/> Low Pressure controls
<input checked="" type="checkbox"/> System Pressure check and adjust	<input checked="" type="checkbox"/> Supply motor amp draw	<input checked="" type="checkbox"/> High Pressure controls
<input checked="" type="checkbox"/> Filter inspect or replace	<input checked="" type="checkbox"/> Condenser fan(s) amp draw	<input checked="" type="checkbox"/> Crankcase heater operation
<input checked="" type="checkbox"/> Belt inspect or replace	<input checked="" type="checkbox"/> Liquid line temperature	<input type="checkbox"/> Water cooled chiller condenser tube cleaning
<input checked="" type="checkbox"/> Contactors condition	<input checked="" type="checkbox"/> Suction pressure & temperature	<input type="checkbox"/> Water cooled chiller evaporator tube cleaning
<input checked="" type="checkbox"/> Evaporator condition	<input checked="" type="checkbox"/> Oil level & pressure	

Incentive Eligibility

- Incentives are only available to customers on Duke Energy Ohio non-residential rate.
- Duke Energy Customers who purchase electric generation from an alternative supplier are eligible to participate.
- Incentive will not be paid until eligible equipment has been installed, is available to operate, and verification has been completed by Duke Energy staff as noted in the Term & Conditions stated below.
- Duke Energy reserves the right to revise incentive levels and/or qualifying efficiency levels at anytime.
- Customer may assign the incentive to the vendor who installed/supplied the equipment. The customer's signature is required in the appropriate places on this form to assign the incentive to the vendor. Customer agrees that such an action constitutes an irrevocable assignment of the incentive. This assigned incentive must reduce the purchase price paid for the equipment by an equivalent amount.
- Any equipment which, either separately or as part of a project, has or will receive an incentive from any other Duke Energy program
- In no case will Duke Energy pay an incentive above the actual cost of the service.
- Incentive recipient assumes all responsibilities for any tax consequences resulting from Duke Energy incentive payment.
- To qualify for Duke Energy incentives, applicants who provide their social security number as their federal tax identification number for tax purposes must sign and return the "Customer consent to release personal information" form ("Consent Form") along with the application. Incentive applications are processed by a 3rd party vendor. The 3rd party vendor is responsible for mailing the 1099 form at the end of the calendar year for tax filing. Duke Energy and the 3rd party vendor have signed a confidentiality agreement to protect your personal information. If your social security number is your federal tax ID number and you elect not to sign the Consent Form, please do not send Duke Energy the application, as you will not be qualified to participate in the incentive program.



Terms and Conditions

I certify that this premise is served by Duke Energy (or an affiliate of Duke Energy), that the information provided herein is accurate and complete, and that I have purchased and installed the high efficiency equipment (indicated herein) for the business facility listed herein and not for resale. Attached is an itemized invoice for the indicated installed equipment. I understand that the proposed incentive payment from Duke Energy is subject to change based on verification and Duke Energy approval. I agree to Duke Energy verification of both the sales transaction and equipment installation which may include a site inspection from a Duke Energy representative or Duke Energy agent. I understand that I am not allowed to receive more than one incentive from Duke Energy on any piece of equipment. I also understand that my participation in the program may be taxable and that my company is solely responsible for paying all such taxes. I hereby agree to indemnify, hold harmless and release Duke Energy and its affiliates from any actions or claims in regards to the installation, operation and disposal of equipment (and related materials) covered herein including liability from an incidental or consequential damages. Duke Energy does not endorse any particular manufacturer, product or system design within these programs; does not expressly or implicitly warrant the performance of installed equipment (Contact your contractor for details regarding equipment warranties), and is not liable for any damage caused by the installation of the equipment or for any damage cause by the malfunction of the installed equipment.



Incentive Application Instructions

IMPORTANT NOTICE

Delays in processing incentive payments will occur if required documentation is not included with completed application(s).

1. Contact Duke Energy toll free at 866-380-9580 to confirm customer eligibility. Applications are available for download at www.duke-energy.com.
2. Review program and equipment requirements on the incentive application. (Page7)
3. Purchase and install eligible energy-efficient equipment.
4. Complete and submit application for equipment that was installed after 1/1/2008.
5. The following items must be included to verify projects. If they are not included, it will delay payment of incentive.
 - A. Itemized invoice for all equipment installed to include:
 - a. Equipment cost
 - b. Quantity per equipment type installed
 - c. Model # for each equipment type
 - d. Manufacturer's data sheet for each equipment model #.
 - B. Make sure the account number provided on the cover page (customer information section) is associated with the location where the equipment was installed. If the account # does not match the address where the equipment was installed, the application will be rejected as ineligible.
 - C. Provide required tax ID# for payee.
 - D. Customer must sign and date the application after reviewing the Terms and Conditions. If customer wishes to assign payment of the incentive directly to the vendor, the customer should circle the appropriate payee in the Payment Information section of the application and sign their name to authorize payment.
6. Duke Energy may require site verification of projects that have been self-installed, prior to payment of incentive.
8. Email the complete, signed application with all required documents to SelfDirect@duke-energy.com or fax to 513-629-5572.
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Mercantile Self Direct Incentive Program Requirements for Vendor Participation

Program Overview

- Duke Energy offers its eligible non-residential customers the opportunity to increase profitability through energy cost savings and contribute to a cleaner environment by participating in our Mercantile Self Direct Incentive Program.
- Under the Duke Energy Mercantile Self Direct Incentive Program, Vendor is defined as any third party who:
 - Promotes the sale and installation of the high efficiency equipment for the customer. The Vendor will ensure that the eligible equipment is installed and operating before submitting the application or assisting the customer in completing the application.
 - Is responsible for the product sale only and is not required to ensure installation of the eligible equipment.
- All license requirements, if any, are solely the Vendor's responsibility. Participating Vendors include equipment contractors, equipment Vendors, equipment manufacturers and distributors, energy service companies, etc. The typical Vendor role is to contact/solicit eligible customers building new or retrofitting existing facilities and encourage the installation of the energy-efficient equipment offered in Duke Energy's program.
- Incentives are paid directly to customers unless the customer assigns the incentive to the Vendor. The assigned incentive must reduce the purchase price paid for the equipment by an equivalent amount. Incentives are taxable to the entity who receives the rebate check. Rebates greater than \$600 will be reported to the IRS unless documentation of tax exempt status is provided.
- Vendors can sign up to be on Duke Energy's Web site as a participating Vendor and be added to Duke Energy's e-mail distribution by emailing the Vendor Participation Agreement (VPA) to SelfDirect@duke-energy.com or faxing to 513-629-5572.
- Vendors may not represent to customers that Duke Energy endorses their specific products or services. Duke Energy does not endorse specific products, services, or companies – only energy-efficient technologies.
- Vendors may advise customers of their option to have Duke Energy make their rebate check(s) payable to the Vendor if the customer's rebate amount is being deducted from the total sale price in advance. The customer must complete and sign the Payment Release Authorization section of the Mercantile Self Direct Incentive Program Application.
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- Vendors shall provide customers with applicable equipment warranty information for all measures installed. Vendors shall provide the required documentation for customers to apply for the rebate (invoices with model numbers and quantities, specification sheets for installed equipment, etc.) and assist customers in filling out the application.
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For more information, call 1-866.380.9580 or visit www.duke-energy.com.



Mercantile Self Direct Rebate Program

Technology	Responsible for sales and not installs*	Responsible for sales and Installation*	Technology	Responsible for sales and not installs*	Responsible for sales and Installation*
Lighting	<input type="checkbox"/>	<input type="checkbox"/>	Thermal Storage	<input type="checkbox"/>	<input type="checkbox"/>
Heating Ventilation & Cooling	<input type="checkbox"/>	<input type="checkbox"/>	Pumps/Motors/VFD's	<input type="checkbox"/>	<input type="checkbox"/>
Food Service	<input type="checkbox"/>	<input type="checkbox"/>	Chillers	<input type="checkbox"/>	<input type="checkbox"/>
Water Heating	<input type="checkbox"/>	<input type="checkbox"/>	Refrigeration	<input type="checkbox"/>	<input type="checkbox"/>
Process Equipment (air compressors, injection molding, etc.)	<input type="checkbox"/>	<input type="checkbox"/>	Window Film	<input type="checkbox"/>	<input type="checkbox"/>

* Check all that apply

Vendors who wish to be listed as a Mercantile Self Direct Incentive Program participating Vendor shall complete this form. A signed copy of this form must be on file at Duke Energy in order for the Vendor to receive incentive payments. Fax form to **513-629-5572** or email to SelfDirect@duke-energy.com.

I have read and understand the Mercantile Self Direct Incentive Program Requirements for Vendor Participation, and I agree to comply with all requirements set forth therein. By signing this agreement, I agree to provide my customers with information and documentation that is true and accurate to the best of my knowledge. I hereby represent and warrant that the Tax ID and Vendor Tax Status provided below are true and accurate. I agree that any confidential information concerning my customer, including but not limited to Duke Energy service account information, will be used for the sole purpose of facilitating the customer's participation in the Mercantile Self Direct Incentive Program. Further, I understand that I am responsible for making sure everyone working for me understands the requirements prior to soliciting customer participation.

Vendor Federal Tax ID Number	
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To qualify for Duke Energy incentives, applicants who provide their social security number as their federal tax identification number for tax purposes must sign and return the "Customer consent to release personal information" form ("Consent Form") along with the application. Incentive applications are processed by a third-party vendor. The third-party vendor is responsible for mailing the 1099 form at the end of the calendar year for tax filing. Duke Energy and the third-party vendor have signed confidentiality agreement to protect your personal information. If your social security number is your federal tax ID number and you elect not to sign the Consent Form, please do not send Duke Energy the application. As you will not be qualified to participate in the incentive program.

Vendor Tax Status	<input type="checkbox"/> Corporation	<input type="checkbox"/> Individual/Sole Proprietor	<input type="checkbox"/> Partnership	<input type="checkbox"/> Other
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Contact me via	<input type="checkbox"/> Phone	<input type="checkbox"/> E-Mail	<input type="checkbox"/> Mail	
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Company Name	
Mailing Address	
City, State, Zip	
Phone/Fax	
Primary E-mail Address	
Secondary E-mail Address	
Vendor Signature	
Title	
Print Name	
Date	

For more information, call 1-866-380-9580 or visit www.duke-energy.com.

Ohio Mercantile Self Direct Program

Application Guide & Cover Sheet

Questions? Call 1-866-380-9580 or visit www.duke-energy.com.

Email this form along with completed Mercantile Self Direct Prescriptive or Custom applications, proof of payment, energy savings calculations and spec sheets to SelfDirect@Duke-Energy.com. You may also fax to 1-513-629-5572.

Mercantile customers, defined as using at least 700,000 kWh annually are eligible for the Mercantile Self Direct program. Please indicate mercantile qualification:

- a single Duke Energy Ohio account
- multiple accounts in Ohio (energy usage with other utilities may be counted toward the total)

Please list Duke Energy account numbers below (attach listing of multiple accounts and/or billing history for other utilities as required):

Account Number	Annual Usage	Account Number	Annual Usage
88602153015	1,300,000 kWh		

Self Direct rebates are available for completed Custom projects that have not previously received a Duke Energy Smart Saver® Custom Incentive. Self Direct incentives are applicable to Prescriptive measures that were installed more than 90 days prior to submission to Duke Energy and have not previously received a Duke Energy Prescriptive rebate.

Self Direct Program requirements dictate that certain projects that may be Prescriptive in nature under the Smart Saver program must be evaluated using the Custom process. Use the table on page two as a guide to determine which Self Direct program fits your project(s). Apply for Self Direct projects using the appropriate application forms in conjunction with this cover sheet. Where Mercantile Self Direct Prescriptive applications are listed, please refer to the measure list on that application. If your measure is not listed, you may be eligible for a Self Direct Custom rebate. Self Direct Custom applications, like Smart Saver Custom applications, should include detailed analysis of pre-project and post-project energy usage and project costs. Please indicate which type of rebate applications are included in the table provided on page two.

Please check each box to indicate completion of the following program requirements:

<input checked="" type="checkbox"/> All sections of appropriate application(s) are completed	<input checked="" type="checkbox"/> Proof of payment.*	<input checked="" type="checkbox"/> Manufacturer's Spec sheets	<input checked="" type="checkbox"/> Energy model/calculations and detailed inputs for Custom applications
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* If a single payment record is intended to demonstrate the costs of both Prescriptive & Custom projects, please include an additional document with an estimated breakout of costs for each Prescriptive and Custom energy conservation measure.

Application Type	Replaced equipment at end of lifetime or because equipment failed**	Replaced fully operational equipment to improve efficiency***	New Construction
Lighting	MSD Custom Part 1 <input type="checkbox"/> Custom Lighting Worksheet <input type="checkbox"/>	MSD Prescriptive Lighting <input type="checkbox"/>	MSD Prescriptive Lighting <input type="checkbox"/>
		MSD Custom Part 1 <input type="checkbox"/> Custom Lighting Worksheet <input type="checkbox"/>	MSD Custom Part 1 <input type="checkbox"/> Custom Lighting Worksheet <input type="checkbox"/>
Heating & Cooling	MSD Custom Part 1 <input type="checkbox"/> MSD Custom General Worksheet <input type="checkbox"/>	MSD Custom Part 1 <input type="checkbox"/> MSD Custom General Worksheet <input type="checkbox"/>	MSD Prescriptive Heating & Cooling <input type="checkbox"/>
			MSD Custom Part 1 <input type="checkbox"/> MSD Custom General Worksheet <input type="checkbox"/>
Window Films, Programmable Thermostats, & Guest Room Energy Management Systems	MSD Custom Part 1 <input type="checkbox"/> MSD Custom General and/or EMS Worksheet(s) <input type="checkbox"/>	MSD Prescriptive Heating & Cooling <input type="checkbox"/>	MSD Custom Part 1 <input type="checkbox"/> MSD Custom General and/or EMS Worksheet(s) <input type="checkbox"/>
Chillers & Thermal Storage	MSD Custom Part 1 <input type="checkbox"/> MSD Custom General Worksheet <input type="checkbox"/>	MSD Custom Part 1 <input type="checkbox"/> MSD Custom General Worksheet <input type="checkbox"/>	MSD Prescriptive Chillers & Thermal Storage <input type="checkbox"/>
			MSD Custom Part 1 <input type="checkbox"/> MSD Custom General Worksheet <input type="checkbox"/>
Chiller Tune-ups	MSD Prescriptive Chiller Tune-ups <input type="checkbox"/>	MSD Prescriptive Chiller Tune-ups <input checked="" type="checkbox"/>	MSD Prescriptive Chiller Tune-ups <input type="checkbox"/>
Motors & Pumps	MSD Custom Part 1 <input type="checkbox"/> MSD Custom General Worksheet <input type="checkbox"/>	MSD Custom Part 1 <input type="checkbox"/> MSD Custom General Worksheet <input type="checkbox"/>	MSD Prescriptive Motors, Pumps & Drives <input type="checkbox"/>
			MSD Custom Part 1 <input type="checkbox"/> MSD Custom General Worksheet <input type="checkbox"/>
VFDs	Not Applicable	MSD Prescriptive Motors, Pumps & Drives <input type="checkbox"/>	MSD Custom Part 1 <input type="checkbox"/> MSD Custom VFD Worksheet <input type="checkbox"/>
		MSD Custom Part 1 <input type="checkbox"/> MSD Custom VFD Worksheet <input type="checkbox"/>	
Food Service	MSD Custom Part 1 <input type="checkbox"/> MSD Custom General Worksheet <input type="checkbox"/>	MSD Custom Part 1 <input type="checkbox"/> MSD Custom General Worksheet <input type="checkbox"/>	MSD Prescriptive Food Service <input type="checkbox"/>
			MSD Custom Part 1 <input type="checkbox"/> MSD Custom General Worksheet <input type="checkbox"/>
Air Compressors	MSD Custom Part 1 <input type="checkbox"/> MSD Custom Compressed Air Worksheet <input type="checkbox"/>	MSD Custom Part 1 <input type="checkbox"/> MSD Custom Compressed Air Worksheet <input type="checkbox"/>	MSD Prescriptive Process <input type="checkbox"/>
			MSD Custom Part 1 <input type="checkbox"/> MSD Custom Compressed Air Worksheet <input type="checkbox"/>
Process	MSD Custom Part 1 <input type="checkbox"/> MSD Custom General Worksheet <input type="checkbox"/>	MSD Prescriptive Process <input type="checkbox"/>	MSD Custom Part 1 <input type="checkbox"/> MSD Custom General Worksheet <input type="checkbox"/>
		MSD Custom Part 1 <input type="checkbox"/> MSD Custom General Worksheet <input type="checkbox"/>	
Energy Management Systems	MSD Custom Part 1 <input type="checkbox"/> MSD Custom EMS Worksheet <input type="checkbox"/>	MSD Custom Part 1 <input type="checkbox"/> MSD Custom EMS Worksheet <input type="checkbox"/>	MSD Custom Part 1 <input type="checkbox"/> MSD Custom EMS Worksheet <input type="checkbox"/>
Behavioral*** & No/Low Cost	MSD Custom Part 1 <input type="checkbox"/> MSD Custom General Worksheet <input type="checkbox"/>		

** Under the Self Direct program, failed equipment and equipment at the end of its useful life are evaluated differently than early replacement of fully functioning equipment. All equipment replacements due to failure or old age will be evaluated via the Custom program.

*** Please ensure that you include the age of the replaced equipment for measures classified as "Early Replacement" in your application as well as the estimated date that you would have otherwise replaced the existing equipment if you had not chosen a more energy efficient option.

**** Behavioral energy efficiency and demand reduction projects must be both measurable and verifiable. Provide justification with your application.



MERCANTILE SELF DIRECT Ohio Chiller Tune-up Service Application

Questions? Call 1-866-380-9580 or visit www.duke-energy.com.

Email the complete, signed application with all required documents to SelfDirect@duke-energy.com or fax to 513-629-5572.

Is this application: NEW (original) or REVISED (changes made to original application)

Building Type – Required (check one)		
<input type="checkbox"/> Data Centers	<input type="checkbox"/> Full Service Restaurant	<input type="checkbox"/> Office
<input checked="" type="checkbox"/> Education/K-12	<input type="checkbox"/> Healthcare	<input type="checkbox"/> Public Assembly
<input type="checkbox"/> Education Other	<input type="checkbox"/> Industrial	<input type="checkbox"/> Public Order/Safety
<input type="checkbox"/> Elder Care/Nursing Home	<input type="checkbox"/> Lodging	<input type="checkbox"/> Religious Worship/Church
<input type="checkbox"/> Food Sales/Grocery	<input type="checkbox"/> Retail (Small Box)	<input type="checkbox"/> Service
<input type="checkbox"/> Fast Food Restaurant	<input type="checkbox"/> Retail (Big Box)	<input type="checkbox"/> Warehouse
<input type="checkbox"/> Other:		
How did you hear about the program? (check one)		
<input checked="" type="checkbox"/> Duke Energy Representative	<input type="checkbox"/> Web Site	<input type="checkbox"/> Radio
<input type="checkbox"/> Contractor / Vendor	<input type="checkbox"/> Other _____	

Please check each box to indicate completion of the following program requirements:

<input checked="" type="checkbox"/> All sections of application	<input checked="" type="checkbox"/> Invoice with make, model number, quantity and equipment manufacturer	<input checked="" type="checkbox"/> Tax ID number for payee	<input checked="" type="checkbox"/> Customer/vendor agree to Terms and Conditions
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Customer Information					
Customer/Business	Oak Hills Local School District	Contact	John Beckemeyer		
Phone	513-598-2941	Account Number	00402046015		
Street Address (Where incentive should be mailed)		6325 Rapid Run Rd.			
City	Cincinnati	State	OH	Zip Code	45233
Installation Street Address		6325 Rapid Run Rd.			
City	Cincinnati	State	OH	Zip Code	45233
E-mail Address	beckemeyer_j@ohlsd.org				

*Failure to provide the account number associated with the location where the installation took place will result in rejection of the application.

Vendor Information					
Vendor	Feldkamp Enterprises, Inc.	Contact	Cory Feldkamp		
Phone	513-347-4500	Fax	513-347-4506		
Street Address		3642 Muddy Creek Rd.			
City	Cincinnati	State	OH	Zip Code	45238
E-mail Address	cory@feldkamphvac.com				

If Duke Energy has questions about this application, who should we contact? Customer Vendor

Payment Information		
Who should receive incentive payment?	<input checked="" type="checkbox"/> Customer	<input type="checkbox"/> Vendor (Customer must sign below)
I hereby authorize payment of incentive directly to the vendor:	Customer Signature (written signature)	
	Date	
Provide Tax ID Number for Payee	Customer Tax ID #	316000742
	Vendor Tax ID #	

Terms and Conditions			
I have read and hereby agree to the Terms & Conditions and Program Requirements.			
Customer Signature		Vendor Signature	
Date	8/15/12	Date	8/15/12
Title	Operations Coordinator	Title	Director of Service

Incentives are subject to change and may be discontinued at the sole discretion of Duke Energy. Equipment must be installed and operable to be eligible for incentives. As Federal Energy Policy Law changes, equipment efficiency requirements are subject to change.

Air Cooled and Water Cooled Chiller Tune-ups						
Manufacturer and Model #	# of Units	Tons Per unit*	Total Project Cost	Current Service Date	Previous Service Date	Total Incentive
Trane RTHB215FLF00EWP000	2	215	\$375.00	5/4/09		\$860.00
Trane RTHB215FLF00EWP000	2	215	\$450.00	4/30/10		\$860.00
Trane RTHB215FLF00EWP000	2	215	\$250.00	3/18/11		\$860.00

*Provide manufacturer's spec sheet documenting the size of the unit

To Calculate your tune-up incentive*:	
A. Add up equipment capacity of all units serviced (in tons) and multiply by \$2/ton =	\$2,580.00
B. Cost of service = \$1,075.00 x 50% of total service cost =	\$537.50
Total Incentive (lesser amount of row A or row B)=	\$537.50

*Incentives cannot exceed 50% of total service invoice (external labor and equipment).

Service Requirements:

1. This incentive is available only once per unit in a 12 month period.
2. An individual chiller is considered one unit.
3. Copy of paid invoice must be included with this application
4. Self serviced (internal) labor should not be included as part of the total service cost. Only external labor will be considered as part of the total service invoice.
5. Cooling service must include the following normal maintenance items (please check if completed):

<input type="checkbox"/> Air cooled condenser coil cleaning	<input checked="" type="checkbox"/> Compressor amp draw	<input checked="" type="checkbox"/> Low Pressure controls
<input checked="" type="checkbox"/> System Pressure check and adjust	<input checked="" type="checkbox"/> Supply motor amp draw	<input checked="" type="checkbox"/> High Pressure controls
<input checked="" type="checkbox"/> Filter inspect or replace	<input checked="" type="checkbox"/> Condenser fan(s) amp draw	<input checked="" type="checkbox"/> Crankcase heater operation
<input checked="" type="checkbox"/> Belt inspect or replace	<input checked="" type="checkbox"/> Liquid line temperature	<input checked="" type="checkbox"/> Water cooled chiller condenser tube cleaning
<input checked="" type="checkbox"/> Contactors condition	<input checked="" type="checkbox"/> Suction pressure & temperature	<input checked="" type="checkbox"/> Water cooled chiller evaporator tube cleaning
<input checked="" type="checkbox"/> Evaporator condition	<input checked="" type="checkbox"/> Oil level & pressure	

Incentive Eligibility

- Incentives are only available to customers on Duke Energy Ohio non-residential rate.
- Duke Energy Customers who purchase electric generation from an alternative supplier are eligible to participate.
- Incentive will not be paid until eligible equipment has been installed, is available to operate, and verification has been completed by Duke Energy staff as noted in the Term & Conditions stated below.
- Duke Energy reserves the right to revise incentive levels and/or qualifying efficiency levels at anytime.
- Customer may assign the incentive to the vendor who installed/supplied the equipment. The customer's signature is required in the appropriate places on this form to assign the incentive to the vendor. Customer agrees that such an action constitutes an irrevocable assignment of the incentive. This assigned incentive must reduce the purchase price paid for the equipment by an equivalent amount.
- Any equipment which, either separately or as part of a project, has or will receive an incentive from any other Duke Energy program
- In no case will Duke Energy pay an incentive above the actual cost of the service.
- Incentive recipient assumes all responsibilities for any tax consequences resulting from Duke Energy incentive payment.
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- Mercantile Self Direct Incentive Program offerings may be modified or terminated without prior notice. Check Duke Energy's Web site for current program status.

For more information, call 1-866.380.9580 or visit www.duke-energy.com.



Mercantile Self Direct Rebate Program

Technology	Responsible for sales and not installs*	Responsible for sales and Installation*	Technology	Responsible for sales and not installs*	Responsible for sales and Installation*
Lighting	<input type="checkbox"/>	<input type="checkbox"/>	Thermal Storage	<input type="checkbox"/>	<input type="checkbox"/>
Heating Ventilation & Cooling	<input type="checkbox"/>	<input type="checkbox"/>	Pumps/Motors/VFD's	<input type="checkbox"/>	<input type="checkbox"/>
Food Service	<input type="checkbox"/>	<input type="checkbox"/>	Chillers	<input type="checkbox"/>	<input type="checkbox"/>
Water Heating	<input type="checkbox"/>	<input type="checkbox"/>	Refrigeration	<input type="checkbox"/>	<input type="checkbox"/>
Process Equipment (air compressors, injection molding, etc.)	<input type="checkbox"/>	<input type="checkbox"/>	Window Film	<input type="checkbox"/>	<input type="checkbox"/>

* Check all that apply

Vendors who wish to be listed as a Mercantile Self Direct Incentive Program participating Vendor shall complete this form. A signed copy of this form must be on file at Duke Energy in order for the Vendor to receive incentive payments. Fax form to **513-629-5572** or email to SelfDirect@duke-energy.com.

I have read and understand the Mercantile Self Direct Incentive Program Requirements for Vendor Participation, and I agree to comply with all requirements set forth therein. By signing this agreement, I agree to provide my customers with information and documentation that is true and accurate to the best of my knowledge. I hereby represent and warrant that the Tax ID and Vendor Tax Status provided below are true and accurate. I agree that any confidential information concerning my customer, including but not limited to Duke Energy service account information, will be used for the sole purpose of facilitating the customer's participation in the Mercantile Self Direct Incentive Program. Further, I understand that I am responsible for making sure everyone working for me understands the requirements prior to soliciting customer participation.

Vendor Federal Tax ID Number	
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To qualify for Duke Energy incentives, applicants who provide their social security number as their federal tax identification number for tax purposes must sign and return the "Customer consent to release personal information" form ("Consent Form") along with the application. Incentive applications are processed by a third-party vendor. The third-party vendor is responsible for mailing the 1099 form at the end of the calendar year for tax filing. Duke Energy and the third-party vendor have signed confidentiality agreement to protect your personal information. If your social security number is your federal tax ID number and you elect not to sign the Consent Form, please do not send Duke Energy the application, As you will not be qualified to participate in the incentive program.

Vendor Tax Status	<input type="checkbox"/> Corporation	<input type="checkbox"/> Individual/Sole Proprietor	<input type="checkbox"/> Partnership	<input type="checkbox"/> Other
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Contact me via	<input type="checkbox"/> Phone	<input type="checkbox"/> E-Mail	<input type="checkbox"/> Mail	
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Company Name	
Mailing Address	
City, State, Zip	
Phone/Fax	
Primary E-mail Address	
Secondary E-mail Address	
Vendor Signature	
Title	
Print Name	
Date	

For more information, call 1-866-380-9580 or visit www.duke-energy.com.



INVOICE

INVOICE NO.

13751-4A

3642 MUDDY CREEK • CINCINNATI, OHIO 45238 • (513) 347-4500
 FAX NO. (513) 347-4506

BILL TO: Oak Hills School District
 6325 Rapid Run Road
 Cincinnati, OH 45233

JOB: DELSHIRE
 4402 GLENHAVEN ROAD
 CINCINNATI, OH 45238

CUSTOMER	PURCHASE ORDER NO.	BILL THRU	TERMS	INVOICE DATE	PAGE
OAKHILLS			Net 30	4/28/09	1

Labor/Material for Annual Chiller Maintenance:
 (1) YLAA0101YE17 Air Cooled York Chiller

	1	Material	200.00	200.00
		Total Material and Other		200.00
LABOR	4.00	Total Hours	75.00	300.00
		Total Labor		300.00

TERMS - NET 30 DAYS

A FINANCE CHARGE OF 1 1/2%, WHICH IS AN ANNUAL PERCENTAGE RATE OF 18%, IS CHARGED ON ACCOUNTS PAST DUE.

SALE AMOUNT	500.00
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TOTAL	\$500.00
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An E E O Company



INVOICE

INVOICE NO.

15330-4A

3642 MUDDY CREEK • CINCINNATI, OHIO 45238 • (513) 347-4500
 FAX NO. (513) 347-4506

BILL TO: Oak Hills School District
 6325 Rapid Run Road
 Cincinnati, OH 45233

JOB: DELSHIRE
 4402 GLENHAVEN ROAD
 CINCINNATI, OH 45238

CUSTOMER	PURCHASE ORDER NO.				BILL THRU	TERMS	INVOICE DATE	PAGE
AKHILLS						Net 30	4/14/10	1

Labor/Material for Annual Chiller Maintenance
 (1) YLAA0101YE17 Air Cooled York Chiller

	1	Material	200.00	200.00
		Total Material and Other		200.00
LABOR	4.00	Total Hours	75.00	300.00
		Total Labor		300.00

TERMS - NET 30 DAYS

A FINANCE CHARGE OF 1 1/2%, WHICH IS AN ANNUAL PERCENTAGE RATE OF 18%, IS CHARGED ON ACCOUNTS PAST DUE.



An E E O Company

SALE AMOUNT	500.00
TOTAL	\$500.00



INVOICE

INVOICE NO.

17066-4A

3642 MUDDY CREEK • CINCINNATI, OHIO 45238 • (513) 347-4500
 FAX NO. (513) 347-4506

BILL TO Oak Hills School District
 6325 Rapid Run Road
 Cincinnati, OH 45233

JOB DELSHIRE
 4402 GLENHAVEN ROAD
 CINCINNATI, OH 45238

CUSTOMER	PURCHASE ORDER NO.	BILL THRU	TERMS	INVOICE DATE	PAGE
OAK HILLS			Net 30	4/22/11 1	

Labor/Material for Annual Chiller Maintenance:
 (1) YLAA0101YE17 Air Cooled York Chiller

	1	Material	125.00	125.00
		Total Material and Other		125.00
LABOR	3.00	Total Hours	75.00	225.00
		Total Labor		225.00

TERMS - NET 30 DAYS

A FINANCE CHARGE OF 1 1/2%, WHICH IS AN ANNUAL PERCENTAGE RATE OF 18%, IS CHARGED ON ACCOUNTS PAST DUE.



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SALE AMOUNT	350.00
TOTAL	\$350.00



INVOICE

INVOICE NO.

13752-4A

3642 MUDDY CREEK • CINCINNATI, OHIO 45238 • (513) 347-4500
 FAX NO. (513) 347-4506

BILL TO: Oak Hills School District
 6325 Rapid Run Road
 Cincinnati, OH 45233

JOB: RAPID RUN MIDDLE SCHOOL
 6345 RAPID RUN ROAD
 CINCINNATI, OH 45233

CUSTOMER	PURCHASE ORDER NO.	BILL THRU	TERMS	INVOICE DATE	PAGE
AKHILLS			Net 30	5/4/09	1

Labor/Material for Annual Chiller Maintenance
 (2) RTHB215 Water Cooled Rotary Chillers
 Serial #: U98J03161, U98K03162

1	Material	75.00	75.00
	Total Material and Other		75.00
LABOR	4.00 Labor Hours	75.00	300.00
	Total Labor		300.00

TERMS - NET 30 DAYS

A FINANCE CHARGE OF 1 1/2%, WHICH IS AN ANNUAL PERCENTAGE RATE OF 18%, IS CHARGED ON ACCOUNTS PAST DUE.

SALE AMOUNT	375.00
TOTAL	\$375.00



An E E O Company



INVOICE

INVOICE NO.

15389-4A

3642 MUDDY CREEK • CINCINNATI, OHIO 45238 • (513) 347-4500
 FAX NO. (513) 347-4506


BILL TO: Oak Hills School District
 6325 Rapid Run Road
 Cincinnati, OH 45233

JOB: RAPID RUN MIDDLE SCHOOL
 6345 RAPID RUN ROAD
 CINCINNATI, OH 45233

CUSTOMER	PURCHASE ORDER NO.	BILL THRU	TERMS	INVOICE DATE	PAGE
AKHILLS			Net 30	4/30/10 1	

Labor/Material for Annual Chiller Maintenance:
 (2) RTHB215 Water Cooled Rotary Chillers
 Serial #: U9BJ03161, U9BK03162

	1	Material	75.00	75.00
		Total Material and Other		75.00
LABOR	5.00	Total Hours	75.00	375.00
		Total Labor		375.00

<p>TERMS - NET 30 DAYS</p> <p>A FINANCE CHARGE OF 1 1/2%, WHICH IS AN ANNUAL PERCENTAGE RATE OF 18%, IS CHARGED ON ACCOUNTS PAST DUE.</p>  <p>An E E O Company</p>	SALE AMOUNT	450.00
	TOTAL	\$450.00



INVOICE

INVOICE NO.

17164-4A

3642 MUDDY CREEK • CINCINNATI, OHIO 45238 • (513) 347-4500
 FAX NO. (513) 347-4506

BILL TO: Oak Hills School District
 6325 Rapid Run Road
 Cincinnati, OH 45233

JOB: RAPID RUN MIDDLE SCHOOL
 6345 RAPID RUN ROAD
 CINCINNATI, OH 45233

CUSTOMER	PURCHASE ORDER NO.	BILL THRU	TERMS	INVOICE DATE	PAGE
AKHILLS			Net 30	3/18/11	1

Labor/Material for Annual Chiller Maintenance:
 (2) RTHB215 Water Cooled Rotary Chillers
 Serial #: U9BJ03161, U9BK03162

	1	Material	25.00	25.00
		Total Material and Other		25.00
LABOR	3.00	Total Hours	75.00	225.00
		Total Labor		225.00

TERMS - NET 30 DAYS

A FINANCE CHARGE OF 1 1/2%, WHICH IS AN ANNUAL PERCENTAGE RATE OF 18%, IS CHARGED ON ACCOUNTS PAST DUE.



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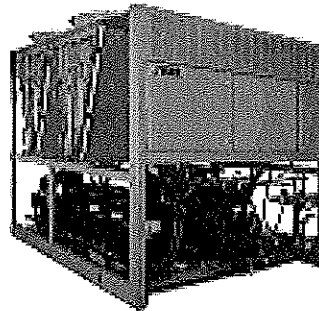
SALE AMOUNT	250.00
TOTAL	\$250.00



Equipment Submittal For Approval

Project:
OAK HILLS SCHOOL DISTRICT
DELSHIRE CHILLER

AIR COOLED SCROLL CHILLER w/ REMOTE EVAPORATOR BARRELL (TAG:CH-1)



SUBMITTED TO:
HAWA INCORPORATED
980 OLD HENDERSON ROAD
COLUMBUS, OHIO 43220

Attn: JIM LOCKARD

DATE:
May 21, 2010

SUBMITTED BY:

DAVID HAMPTON
PROJECT ENGINEER
JOHNSON CONTROLS
8918 BECKETT ROAD
WEST CHESTER, OHIO 45069

TABLE OF CONTENTS

AIR COOLED SCROLL CHILLER (TAG:CH-1)

- Unit Submittal Notes
- Unit Options
- Unit Specification Text
- Unit Drawing
- Unit Performance
- DX Piping Guide
- Start Up Request Form
- Warranty

UNIT SUBMITTAL NOTES

1. A strainer, preferably 40 mesh, should be installed in the cooler and condenser inlet lines, and located where it will protect the circulating pump and the heat exchanger tube bundles. Provide and installed by others.
2. A Differential Pressure switch will be provided (BY YORK) and need to be installed in the piping and wired back to the control panel (BY OTHERS) to prove flow through the chiller.
3. The chiller will be provided with a 200/3/60 voltage code.
4. Please note that the following items will NOT be included by York: rigging, field wiring, controls, valves and piping. Proper rigging must be present upon receiving of equipment. Detention Charges will be applied if shipment is refused upon arrival or not unloaded within the allowable (3) hour time slot.
5. Mechanical Contractor shall complete the entire pre-startup checklist included in this submittal and send it to the local York Service group two (2) weeks prior to desired startup date. Please feel free to contact Randy Weekley at 513-616-3775 to coordinate. A second year startup has been added per specs, please allow (2) weeks prior notice to when startup should occur.
6. York International/JCI will provide a (24) month Parts and Labor warranty for the entire unit. Warranty is effective from date of shipment. An additional 5 year (66) months compressor parts warranty is also included.
7. The current lead-time for a York YLAA chiller is ten (10) weeks after the receipt of approved submittals. An additional (1-2) weeks will be added to the current lead time for the remote evaporator configuration of the chiller.
8. York International/JCI will provide a BACnet Micro Gateway for the Non-Opt view chiller panel
9. With the current application, Hot Gas Bypass is advised by JCI but not specified. Please advise prior to returned submittals if this selection is needed.
10. JCI to provide and install refrigerant during commissioning and start up. Installing contractor to advise JCI two weeks prior to needing the refrigerant as the current lead time is two weeks for R-410a.
11. Please be advised that the JCI chiller does not have as many circuits, compressors or fans as TRANE's BOD does. If you have any questions or concerns, please feel free to contact D.J. Hampton
12. As mentioned in the previous note, JCI will provide a YLAA chiller per the selection provide at time of quote in lieu of Division 2.5, Section B that references the need for 3 compressors per circuit. The selected JCI chiller has two circuits with 2 compressors per each circuit required to meet the design conditions.
13. JCI will not be providing a remote control panel with the remote evaporator. Remote evaporator will be provided with standard JCI controls interface for connection to the control panel on the outdoor

condenser. All functionality and control will be at the control panel on the outdoor unit. No additional interface or control sensors are being provided

14. JCI will be providing the standard YORK compressor housing as mentioned in the Division 2.7, Section 3. If additional items of attenuation are needed, please advise prior to returned submittal.
15. Please read and follow all of the DX piping Guide information. See attached Form 50.40-ES2.
16. If the design of the piping layout is altered from the original layout in reference to the existing piping layout on drawing H2.00 plot dated 5/14/10 (11:53AM) then a new piping layout design must be resubmitted to the York factory for approval. Failure to do so may void factory warranties. Design intent to reuse same path as existing piping layout (hashed lines) and NOT preferred piping layout (solid lines). If this is incorrect please note upon return submittals.
17. Chiller unit drawings are preliminary drawings and may change slightly after final production drawings configured for remote evaporator application. HVAC contractor to coordinate all piping connections with York Manufacture Project Engineer.

UNIT OPTIONS

AIR COOLED SCROLL CHILLER, WITH THE FOLLOWING OPTIONS:

- High Efficiency
- Copper Tube/ Aluminum fin condenser coils
- Voltage Code-(200/3/60)
- Across-the-Line Start
- SP Supply TB
- Control Transformer(factory)
- Both Low & High Ambient Kits (2 Circuits)
- Discharge Pressure Readout Kit
- BAS/EMS Temperature Reset/Offset
- Suction Pressure Readout
- N. American Safety Code (cETL)
- Motor Current Module
- Compressor Crankcase Heater
- Victaulic Flange Kit (150 psig Cooler)
- 1 Differential Pressure switch in lieu of Paddle Flow switch
- ASME Pressure Vessel & Associated Codes
- Wire/ Louvered Enclosure Panels (factory)
- Acoustic Sound Blankets
- Special Quotes- Remote Evaporator option for model YLAA0101YE
- Shipped on Truck From Monterrey to Customer- W/Bag
- 30 Months Parts and Labor (2year) (entire unit) Warranty
- 66 Months Parts (5year) (Compressor only) Warranty
- Initial Factory Start-Up w/ Second Year Start-Up included

UNIT SPECIFICATION TEXT

AIR COOLED SCROLL LIQUID CHILLER YORK YLAA 60 HZ GUIDE SPECIFICATIONS

PART 1 — GENERAL

1.01 SCOPE

- A. The requirements of the General Conditions, Supplementary Conditions, Division 1, and Drawings apply to all work herein.
- B. Provide Microprocessor controlled, multiple-scroll compressor, air-cooled, liquid chillers of the scheduled capacities as shown and indicated on the Drawings, including but not limited to:
 - 1. Chiller package with ZERO Ozone Depletion Potential Refrigerant R-410A
 - 2. Electrical power and control connections
 - 3. Chilled water connections
 - 4. Factory start-up

1.02 QUALITY ASSURANCE

- A. Products shall be Designed, Tested, Rated and Certified in accordance with, and installed in compliance with applicable sections of the following Standards and Codes:
 - 1. ANSI/ASHRAE Standard 15 – Safety Code for Mechanical Refrigeration
 - 2. ASHRAE 90.1 – Energy Efficiency compliance.
 - 3. ANSI/NFPA Standard 70 – *National Electrical Code (NEC)*.
 - 4. ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.
 - 5. ARI Standard 550/590 – Positive Displacement Compressors and Air Cooled Rotary Screw Water-Chilling Packages.
 - 6. Conform to Intertek Testing Services, formerly ETL, for construction of chillers and provide ETL/cETL Listing label.
 - 7. Manufactured in facility registered to ISO 9002.
 - 8. OSHA – Occupational Safety and Health Act
- B. Factory Test: Chiller shall be pressure-tested, evacuated and fully charged with refrigerant and oil, and shall be factory operational run tested with water flowing through the vessel.
- C. Chiller manufacturer shall have a factory trained and supported service organization that is within a 50 mile radius of the site.
- D. Warranty: Manufacturer shall Warrant all equipment and material of its manufacture against defects in workmanship and material for a period of one year from date of initial start-up or eighteen (18) months from date of shipment, whichever occurs first.

1.03 Delivery and Handling

- A. Unit shall be delivered to job site with a Nitrogen holding charge
- B. Unit shall be stored and handled per Manufacturer's instructions.
- C. Protect the chiller and its accessories from the weather and dirt exposure during shipment.
- D. During shipment, provide protective covering over vulnerable components. Fit nozzles and open ends with plastic enclosures.

PART 2 — PRODUCTS

2.01 CHILLER MATERIALS AND COMPONENTS

- A. General: Install and commission, as shown on the schedules and plans, factory assembled, charged, and tested air

AIR COOLED SCROLL LIQUID CHILLER YORK YLAA 60 HZ GUIDE SPECIFICATIONS

cooled scroll compressor chiller(s) as specified herein. Chiller shall be designed, selected, and constructed using a refrigerant with Flammability rating of "1", as defined by ANSI/ASHRAE STANDARD - 34 Number Designation and Safety Classification of Refrigerants. Chiller shall include, but is not limited to: a complete system with a single refrigerant circuit 35 tons (123kW) and below, and not less than two refrigerant circuits above 35 tons (123kW), scroll compressors, direct expansion type evaporator, air-cooled condenser, refrigerant, lubrication system, interconnecting wiring, safety and operating controls including capacity controller, control center, motor starting components, and special features as specified herein or required for safe, automatic operation.

- B. Cabinet: External structural members shall be constructed of heavy gage, galvanized steel coated with baked on powder paint which, when subjected to ASTM B117, 1000 hour 5% salt spray test, yields minimum ASTM 1654 rating of "6".
- C. Service Isolation valves: Service discharge (ball type) isolation valves are added to unit per system. This option also includes a system high-pressure relief valve in compliance with ASHRAE15. (Factory-mounted.)
- D. Pressure Transducers and Readout Capability
 - 1. Discharge Pressure Transducers: Permits unit to sense and display discharge pressure.
 - 2. Suction Pressure Transducers: Permits unit to sense and display suction pressure.

2.02 COMPRESSORS

Compressors: Shall be hermetic, scroll-type, including:

- 1. Compliant design for axial and radial sealing
- 2. Refrigerant flow through the compressor with 100% suction cooled motor.
- 3. Large suction side free volume and oil sump to provide liquid handling capability.
- 4. Compressor crankcase heaters to provide extra liquid migration protection.
- 5. Annular discharge check valve and reverse vent assembly to provide low-pressure drop, silent shutdown and reverse rotation protection.
- 6. Initial Oil charge.
- 7. Oil Level sightglass.
- 8. Vibration isolator mounts for compressors.
- 9. Brazed-type connections for fully hermetic refrigerant circuits.
- 10. Compressor Motor overloads capable of monitoring compressor motor current. Provides extra protection against compressor reverse rotation, phase-loss and phase imbalance

2.03 REFRIGERANT CIRCUIT COMPONENTS

Each refrigerant circuit shall include: liquid line shutoff valve with charging port, low side pressure relief device, filter-drier, solenoid valve, sight glass with moisture indicator, thermostatic expansion valves, and flexible, closed-cell foam insulated suction line and suction pressure transducer.

2.04 HEAT EXCHANGERS

A. Evaporator: YLAA

- 1. Direct expansion type with refrigerant inside high efficiency copper tubes, chilled liquid forced over the tubes by galvanized steel baffles.
- 2. Constructed, tested, and stamped in accordance with applicable sections of ASME pressure vessel code for minimum 450 psig (3103 kPa) refrigerant side design working pressure and 150 PSIG (1034 kPa) water side design working pressure.
- 3. Shell covered with ¾" (19mm), flexible, closed cell insulation, thermal conductivity of 0.26k ([BTU/HR-Ft²-°F]/in.) maximum. Water nozzles with grooves for mechanical couplings, and insulated by Contactor after pipe installation.
- 4. Provide vent and drain fittings, and thermostatically controlled heaters to protect to -20°F (29°C) ambient in off-cycle.

B. Air Cooled Condenser

AIR COOLED SCROLL LIQUID CHILLER YORK YLAA 60 HZ GUIDE SPECIFICATIONS

1. Coils. Condenser coils are made of a single material to avoid galvanic corrosion due to dissimilar metals. Coils and headers are brazed as one piece. Integral sub cooling is included. The design working pressure of the coil is 650 PSIG(45 bar).
2. Low Sound Fans Shall be dynamically and statically balanced, direct drive, corrosion resistant glass fiber reinforced composite blades molded into a low noise, full-airfoil cross section, providing vertical air discharge and low sound. Each fan in its own compartment to prevent cross flow during fan cycling. Guards of heavy gage, PVC (polyvinylchloride) coated or galvanized steel.
3. Fan Motors: High efficiency, direct drive, 6 pole, 3 phase, insulation class "F", current protected, Totally enclosed Air-Over (TEAO), rigid mounted, with double sealed, permanently lubricated, ball bearings.

2.05 CONTROLS

- A. General: Automatic start, stop, operating, and protection sequences across the range of scheduled conditions and transients.
- B. Microprocessor Enclosure: Rain and dust tight NEMA 3R/12 (IP55) powder painted steel cabinet with hinged, latched, and gasket sealed door.
- C. Microprocessor Control Center:
 1. Automatic control of compressor start/stop, anti-coincidence and anti-recycle timers, automatic pumpdown shutdown, condenser fans, evaporator pump, evaporator heater, unit alarm contacts, and chiller operation from 0°F to 125°F (-18°C to 52°C) ambient. Automatic reset to normal chiller operation after power failure.
 2. Software stored in non-volatile memory, with programmed setpoints retained in lithium battery backed real time clock (RTC) memory for minimum 5 years.
 3. Forty character liquid crystal display, descriptions in English (or Spanish, French, Italian, or German), numeric data in English (or Metric) units. Sealed keypad with sections for Setpoints, Display/Print, Entry, Unit Options & clock, and On/Off Switch.
 4. Programmable Setpoints (within Manufacturer limits): display language; chilled liquid temperature setpoint and range, remote reset temperature range, set daily schedule/holiday for start/stop, manual override for servicing, low and high ambient cutouts, number of compressors, low liquid temperature cutout, low suction pressure cutout, high discharge pressure cutout, anti-recycle timer (compressor start cycle time), and anti-coincident timer (delay compressor starts).
 5. Display Data: Return and leaving liquid temperatures, low leaving liquid temperature cutout setting, low ambient temperature cutout setting, outdoor air temperature, English or metric data, suction pressure cutout setting, each system suction pressure, discharge pressure (optional), liquid temperature reset via a YORK ISN DDC or Building Automation System (by others) via a 4-20milliamp or 0-10 VDC input with optional BAS interface, anti-recycle timer status for each compressor, anti-coincident system start timer condition, compressor run status, no cooling load condition, day, date and time, daily start/stop times, holiday status, automatic or manual system lead/lag control, lead system definition, compressor starts/operating hours (each), status of hot gas valves, evaporator heater and fan operation, run permissive status, number of compressors running, liquid solenoid valve status, load & unload timer status, water pump status.
 6. System Safeties: Shall cause individual compressor systems to perform auto shut down; manual reset required after the third trip in 90 minutes. Includes: high discharge pressure, low suction pressure, high pressure switch, and motor protector. Compressor motor protector shall protect against damage due to high input current or thermal overload of windings.
 7. Unit Safeties: Shall be automatic reset and cause compressors to shut down if low ambient, low leaving chilled liquid temperature, under voltage, and flow switch operation. Contractor shall provide flow switch and wiring per chiller manufacturer requirements.
 8. Alarm Contacts: Low ambient, low leaving chilled liquid temperature, low voltage, low battery, and (per compressor circuit): high discharge pressure, and low suction pressure.
- D. Manufacturer shall provide any controls not listed above, necessary for automatic chiller operation. Mechanical Contractor shall provide field control wiring necessary to interface sensors to the chiller control system.

AIR COOLED SCROLL LIQUID CHILLER YORK YLAA 60 HZ GUIDE SPECIFICATIONS

2.06 POWER CONNECTION AND DISTRIBUTION

A. Power Panels:

1. NEMA 3R/12 (IP55) rain/dust tight, powder painted steel cabinets with hinged, latched, and gasket sealed outer doors. Provide main power connection(s), control power connections, compressor and fan motor start contactors, current overloads, and factory wiring.
2. Power supply shall enter unit at a single location, be 3 phase of scheduled voltage, and connect to individual terminal blocks per compressor. Separate disconnecting means and/or external branch circuit protection (by Contractor) required per applicable local or national codes.

B. Compressor, control and fan motor power wiring shall be located in and enclosed panel or routed through liquid tight conduit.

2.07 ACCESSORIES and OPTIONS

Some accessories and options supersede standard product features. Your YORK representative will be pleased to provide assistance.

A. Microprocessor controlled, Factory installed Across the-Line type compressor motor starters as standard.

B. Outdoor Ambient Temperature Control

Low Ambient Control (Factory mounted):

Permits unit operation to 0°F ambient. Standard unit controls to 25°F ambient.

High Ambient Control (Factory Mounted):

Permits unit operation above 115°F ambient.

C. Power Supply Connections:

Single Point Power Supply: Single point Terminal Block for field connection and interconnecting wiring to the compressors. Separate external protection must be supplied, by others, in the incoming power wiring, which must comply with the National Electric Code and/or local codes.

D. Control Power Transformer:

Converts unit power voltage to 120-1-60 (500 VA capacity). Factory-mounting includes primary and secondary wiring between the transformer and the control panel.

E. Protective Chiller Panels (Factory or Field Mounted)

1. Louvered/Wire Panels: Louvered steel panels on external condenser coils painted as per remainder of unit cabinet. Heavy gauge, welded wire-mesh, coated to resist corrosion, around base of machine to restrict unauthorized access.

F. Flow Switch (Field-mounted): Vapor proof SPDT, NEMA 4X switch (___ 150 PSIG or ___ 300 PSIG), -20°F to 250°F.

G. Service Isolation valves: Service suction and discharge (ball type) isolation valves are added to unit per system. This option also includes a system high pressure relief valve in compliance with ASHRAE15. (Factory-mounted.)

H. Hot Gas By-Pass: Permits continuous, stable operation at capacities below the minimum step of unloading to as low as 5% capacity (depending on both the unit & operating conditions) by introducing an artificial load on the cooler. Hot gas by-pass is installed on only one refrigerant circuit.

I. Thermal Storage: Leaving chilled liquid setpoint range for charge cycle from 25° F to 20° F minimum with automatic reset of the leaving brine temperature up to 40° F above the set point.

J. Low Temperature Process Brine: Leaving chilled liquid setpoint range 20° F to 50° F.

AIR COOLED SCROLL LIQUID CHILLER YORK YLAA 60 HZ GUIDE SPECIFICATIONS

K. Building Automation System (EMS) Reset Interface: Chiller to accept 4 to 20mA, 0 to 10 VDC, input to reset the leaving chilled liquid temperature.

L. Vibration Isolation (Field-mounted): 1. Elastomeric (Neoprene) Pad Isolators.

M. Sound Reduction (Factory-mounted):

1. Provide the following options as required to meet scheduled sound performance data at all load points.
 - a. Low speed, reduce noise fans (Factory-mounted).
 - b. Compressor Sound Blankets (Factory-mounted).

SOUND POWER LEVELS (In Accordance with ARI 370) – Octave Band Center Frequency, Hz										
YLAA0101YE17 (Equipped with Acoustic Sound Blanket kit)										
Load %	Ambient (°F)	63	125	250	500	1K	2K	4K	8K	LWA
100.0	95.0	102.0	99.0	96.0	95.0	90.0	87.0	83.0	81.0	96.0
86.1	89.3	101.0	98.0	96.0	94.0	90.0	87.0	83.0	80.0	96.0
57.0	75.2	101.0	98.0	95.0	94.0	90.0	86.0	83.0	80.0	96.0
43.0	65.7	98.0	95.0	93.0	91.0	87.0	84.0	80.0	77.0	93.0
13.9	55.0	95.0	91.0	89.0	87.0	82.0	79.0	76.0	73.0	89.0

SOUND PRESSURE LEVELS in dB at 30.0 (ft.) **										
YLAA0101YE17 (Equipped with Acoustic Sound Blanket kit)										
Load %	Ambient (°F)	63	125	250	500	1K	2K	4K	8K	dBA
100.0	95.0	75.0	72.0	69.0	68.0	63.0	60.0	56.0	54.0	69.0
86.1	89.3	74.0	71.0	69.0	67.0	63.0	60.0	56.0	53.0	69.0
57.0	75.2	74.0	71.0	68.0	67.0	63.0	59.0	56.0	53.0	69.0
43.0	65.7	71.0	68.0	*** UNASS IGNED ***	64.0	60.0	57.0	53.0	50.0	66.0
13.9	55.0	68.0	64.0	62.0	60.0	55.0	52.0	49.0	46.0	62.0

** Chiller is assumed to be a point source on a reflecting (hemispherical radiation)

PART 3 — EXECUTION

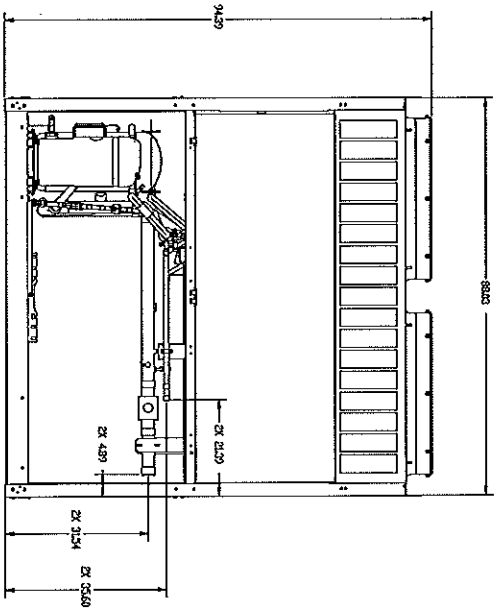
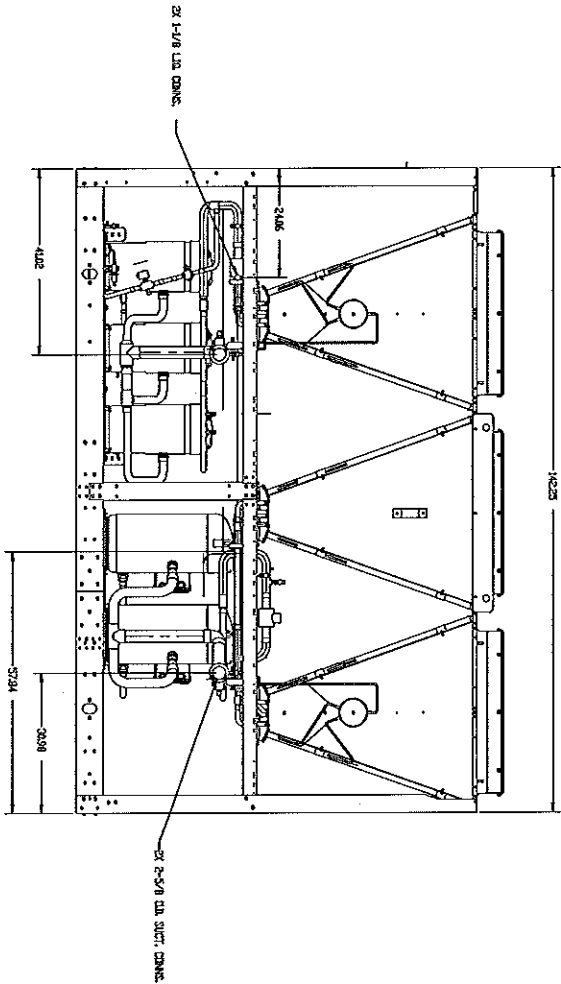
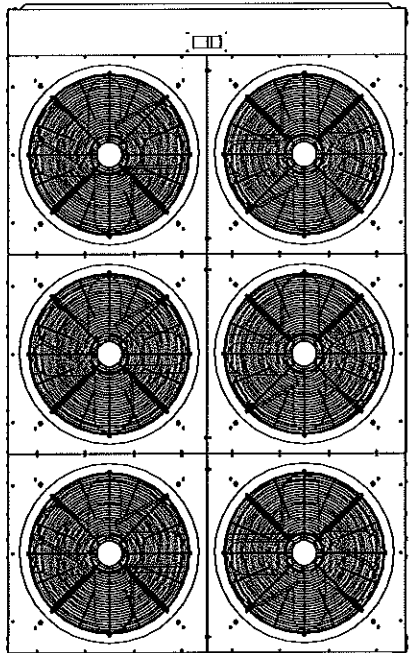
3.01 INSTALLATION

- A. General: Rig and Install in full accordance with Manufacturer's requirements, Project drawings, and Contract documents.
- B. Location: Locate chiller as indicated on drawings, including cleaning and service maintenance clearance per Manufacturer instructions. Adjust and level chiller on support structure. If equipment provided exceeds height of scheduled chiller, installing contractor is responsible for additional costs associated with extending the height of parapet or screening walls/enclosures.
- C. Components: Installing Contractor shall provide and install all auxiliary devices and accessories for fully operational chiller.
- D. Electrical: Coordinate electrical requirements and connections for all power feeds with Electrical Contractor (Division 16).

**AIR COOLED SCROLL LIQUID CHILLER
YORK YLAA 60 HZ GUIDE SPECIFICATIONS**

- E. Controls: Coordinate all control requirements and connections with Controls Contractor.
- F. Finish: Installing Contractor shall paint damaged and abraded factory finish with touch-up paint matching factory finish.

UNIT DRAWING



REVISION

REV.	DATE	BY	CHK.	DESCRIPTION

CONTINUED

REV.	DATE	BY	CHK.	DESCRIPTION

ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED. DIMENSIONS FOR THE COIL SHALL BE AS SHOWN IN THIS DRAWING. THE COIL SHALL BE ASSEMBLED AND TESTED IN ACCORDANCE WITH THE YORK INTERNATIONAL STANDARD SPECIFICATION FOR COILS.

YORK INTERNATIONAL
 YORK INTERNATIONAL CORPORATION
 YORK, PA. 17402

PROJECT NO. 56935
 DRAWING NO. YIAA003

DATE: 11/15/50

BY: [Signature]

CHK: [Signature]

SCALE: AS SHOWN

UNIT PERFORMANCE



A JOHNSON CONTROLS COMPANY

Air Cooled Scroll Chiller Performance Specification

Unit Tag	Qty	Model No.	Capacity (Tons)	Volts/Ph/Hz	Refrigerant
CH-1	1	YLAA0101YE17	97.3	200/3/60	R410A
Pin No: YLAA0101YE17XBASXTXATXBLXCXX44SXXXXXHXXVSAQXXXX3BXXXXNOXXXX					

Evaporator Data		Condenser Data		Performance Data	
EWT (°F)	54.0	Ambient Temp. (°F)	95.0	EER / COP	10.0 / 2.9
LWT (°F)	44.0	Altitude (ft.)	0	EER IPLV/COP IPLV	14.9 / 4.4
Design Flow Rate (gpm)	233.2	Physical Data			
Pressure Drop (ft.)	12.0	Rigging Wt. (lbs.)	6539		
Fluid	Water	Operating Wt. (lbs.)	6967		
Fouling Factor	0.00010				
Water Volume. (gal)	51.0				

Electrical Data				
Circuit	1	2	3	4
Compressor RLA	55.8/55.8/55.8	109.6/109.6		
Compressor Start Current (LRA)	425.0/425.0/425.0	599.0/599.0		
Fan QTY/FLA (each)	2/7.6	4/7.6		

Single Point				
Min. Circuit Ampacity	459.6			
Min. Non-Fused Disconnect (Amps)	600			
Min. Dual Element Fuse Size (Amps)	500			
Max. Dual Element Fuse Size (Amps)	500			
Min. Circuit Breaker (Amps)	500			
Max. Circuit Breaker (Amps)	500			
Wire Lugs Per Phase*	1			
Wire Range (Lug Size)	(1)#4 - 500			
Total Amps	432.2	Operating Condition Electrical Data		
Inrush (PW) Amps	599.0	Compressor kW	106.6	
Starter Type	Across the Line	Total Fan kW	10.1	
		Total kW	116.7	

Notes:	RATED AND CERTIFIED IN ACCORDANCE WITH ARI STANDARD 550/590. * Use Copper Conductors only
--------	--

Part Load Rating Data				
Load %	Ambient (°F)	Capacity (Tons)	Compressor kW	Unit Efficiency
100.0	95.0	97.3	106.6	10.0 / 2.9
86.1	89.3	88.1	84.0	11.2 / 3.3
57.0	75.2	65.2	45.2	14.1 / 4.1
43.0	65.7	49.8	32.1	16.1 / 4.7
13.9	55.0	15.9	9.2	17.5 / 5.1



A JOHNSON CONTROLS COMPANY

Air Cooled Scroll Chiller Performance Specification

SOUND POWER LEVELS (In Accordance with ARI 370) – Octave Band Center Frequency, Hz YLAA0101YE17 (Equipped with Low Sound Fans and Acoustic Sound Blanket kit)										
Load %	Ambient (°F)	63	125	250	500	1K	2K	4K	8K	LWA
100.0	95.0	102.0	99.0	96.0	95.0	90.0	87.0	83.0	81.0	96.0
86.1	89.3	101.0	98.0	96.0	94.0	90.0	87.0	83.0	80.0	96.0
57.0	75.2	101.0	98.0	95.0	94.0	90.0	86.0	83.0	80.0	96.0
43.0	65.7	98.0	95.0	93.0	91.0	87.0	84.0	80.0	77.0	93.0
13.9	55.0	95.0	91.0	89.0	87.0	82.0	79.0	76.0	73.0	89.0

SOUND PRESSURE LEVELS in dB at 30.0 (ft.) ** YLAA0101YE17 (Equipped with Low Sound Fans and Acoustic Sound Blanket kit)										
Load %	Ambient (°F)	63	125	250	500	1K	2K	4K	8K	dBa
100.0	95.0	75.0	72.0	69.0	68.0	63.0	60.0	56.0	54.0	69.0
86.1	89.3	74.0	71.0	69.0	67.0	63.0	60.0	56.0	53.0	69.0
57.0	75.2	74.0	71.0	68.0	67.0	63.0	59.0	56.0	53.0	69.0
43.0	65.7	71.0	68.0	66.0	64.0	60.0	57.0	53.0	50.0	66.0
13.9	55.0	68.0	64.0	62.0	60.0	55.0	52.0	49.0	46.0	62.0

** Chiller is assumed to be a point source on a reflecting surface (hemispherical radiation)

YLAA0101YE17 Performance at AHRI Conditions					
Evaporator Data		Condenser Data		Performance Data	
EWT (°F)	54.0	Ambient Temp. (°F)	95.0	EER / COP	10.0 / 2.9
LWT (°F)	44.0	Altitude (ft.)	0	EER IPLV/COP IPLV	14.9 / 4.4
Flow Rate (gpm)	233.2			Capacity (Tons)	97.3
Pressure Drop (ft.)	12.0				
Fluid	Water				
Fouling Factor	0.00010				
Water Volume (gal)	51.0				

DX PIPING GUIDE



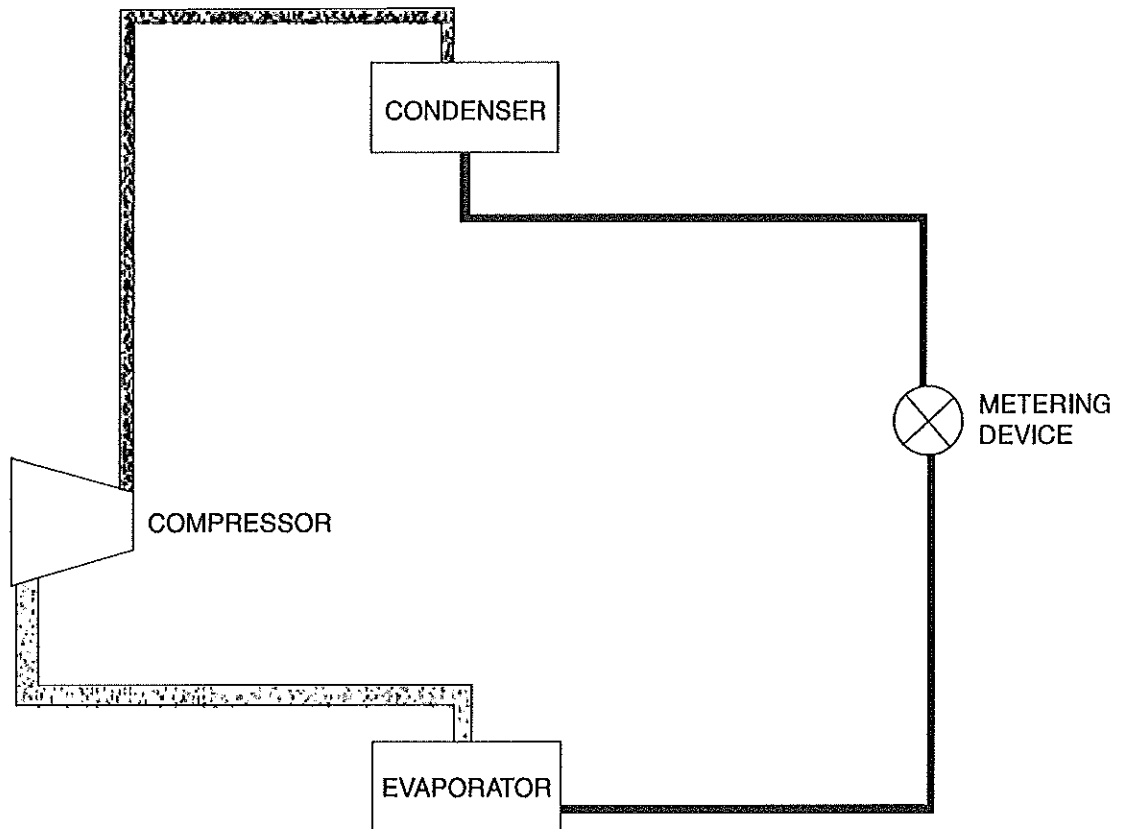
DX PIPING GUIDE

ENGINEERING SUPPLEMENT

New Release

Form No. 050.40-ES2 (102)

DX PIPING GUIDE



LD07428

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1.0 OVERVIEW

The current best practices for DX system piping are outlined in this document for systems using R-22, R-134a and R-407C refrigerants.

The objectives that influence the design of piping systems for refrigeration systems are to:

- Ensure proper refrigerant feed to evaporators
- Provide economical pipe sizes without excessive pressure drop
- Ensure lubricating oil return to the compressor by preventing excessive amounts of oil from being trapped in the system
- Minimize the loss of oil from the compressors
- Prevent liquid refrigerant or excessive amounts of oil from entering the compressor either during operation or during idle time

Improper design and sizing of refrigerant piping may result in loss of system efficiency and/or eventual failure of the system. Factors that must be considered in a piping design are the inter-relationships between velocity, pressure, friction, as well as, economics. Economics favor the use of the smallest possible line sizes. However, high suction and discharge line pressure drops will cause loss in capacity and increased power consumption. Another important design criterion is oil return to the compressor. The refrigerant line velocities have to be sufficiently high to carry oil up suction or hot gas risers at all operating capacities.

Sections 2.0 and 3.0 deal with refrigerant line sizing from a frictional pressure drop and oil return point of view. Section 5.0 discusses hot gas bypass arrangements. Losses in valves and fittings are discussed in Section 6.0. Multiple compressor piping recommendations are covered in Section 7.0. Tables are provided with factors for proper refrigerant line sizing.

2.0 REFRIGERANT LINE SIZING

The pressure drops (line losses) are typically presented as a given change in the corresponding saturation temperature. The effect of line losses on the capacity and energy consumption (kW/ton) is illustrated in Figure 1. Line sizing is a balance between pressure drop (reflected in system performance) and oil return (for system reliability).

Pressure drop issues are addressed in Section 3.1 while oil return considerations are dealt with in Section 4.0.

3.0 PRESSURE DROP CONSIDERATIONS

As mentioned previously, pressure drop calculations are determined as pressure changes associated with a change in saturation temperature of the refrigerant. Systems are typically sized for pressure losses of 2°F or less for the discharge, suction and liquid lines. This is the conventional method for sizing and is accepted practice throughout the industry (ASHRAE).

Tables 1 through 6 show capacities for R-22, R-134a and R-407C at specified pressure drops for the various refrigerant lines.

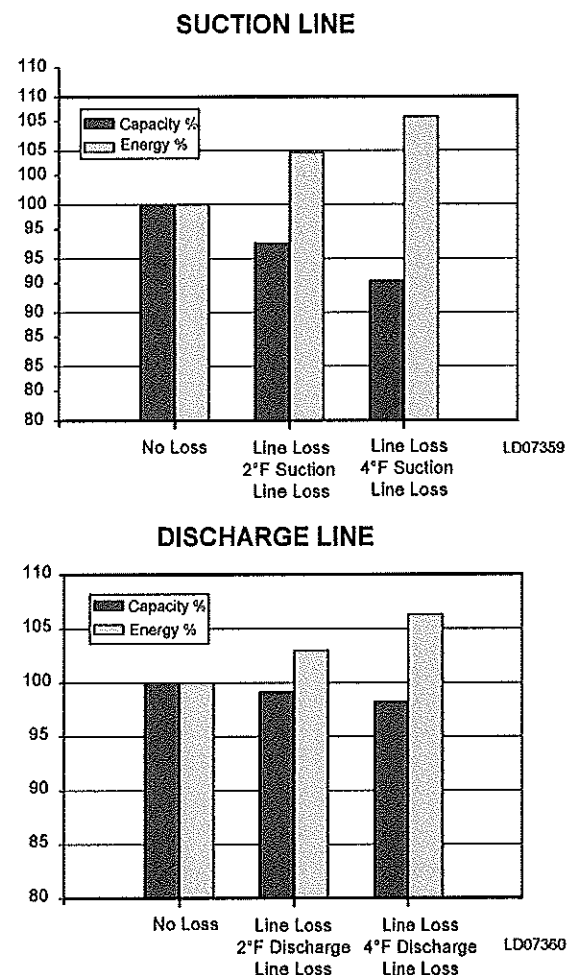


FIG. 1 – EFFECT OF SUCTION AND DISCHARGE LINE PRESSURE DROP ON CAPACITY AND POWER (ASHRAE). (R-22 system operating at 100°F saturated condensing and 40°F saturated evaporating temperature. Energy percentage is rated at kW/ton.)

Section 3.1 will address suction line sizing while discharge and liquid line sizing will be discussed in Sections 3.2 and 3.3, respectively.

3.1 SUCTION LINES

Pressure drop in the suction line reduces a system's capacity by forcing the compressor to operate at a lower suction pressure in order to maintain the desired temperature in the evaporator. The suction line is normally designed to have pressure drop no more than 2°F change in saturation temperature due to friction. Tables 1, 3 and 5 contain suction line sizing data for refrigerants 22, 134a and 407C, respectively. Capacities for Type L copper and steel tubes at three different pressure drops of 2, 1 and 0.5°F at various saturated suction temperatures and condensing temperature of 105°F are provided. Correction factors for capacity for condensing temperatures other than 105°F is given in the notes at the bottom of Tables 2, 4 and 6 for the above mentioned refrigerants.

For low pressure drops, the suction riser must be properly sized to ensure oil entrainment up the riser thereby assuring oil is always returned to the compressor. This is dealt with in detail in Section 4.0. When pipe size needs to be reduced to ensure sufficient velocities for oil return at partial loads, the pressure drops may get excessive at full load. This can be compensated for by over sizing the horizontal and down run lines.

3.2 DISCHARGE LINES

Pressure loss in the discharge line increases the power to capacity ratio (kW/ton) of the system and decreases the compressor capacity. This is illustrated in Figure 1. ASHRAE recommends a saturation temperature change of 1°F based on frictional pressure drop for discharge line sizing. Tables 2, 4 and 6 contain discharge line sizing data for refrigerants 22, 134a and 407C, respectively. Capacities are for a condensing temperature of 105°F and correction factors are given at the bottom of the tables for other condensing temperatures.

3.3 LIQUID LINES

Pressure drop in liquid lines causes flashing of the refrigerant and reduction in pressure at the liquid feed device. ASHRAE recommends that systems be designed so that the pressure drop be no more than 1 to 2°F change in saturation temperature. Tables 2, 4 and 6 contain liquid line sizing data for refrigerants 22, 134a and 407C, respectively, based on frictional pressure drop causing a 1°F change in saturation temperature. Liquid subcooling is the only means of over-

coming the liquid line pressure loss to ensure liquid entering the expansion device. Insufficient subcooling may lead to flashing of liquid refrigerant in the liquid line, which may result in degradation of system performance. Liquid line risers are an additional source of pressure loss. The loss in the risers is approximately 0.5 psi per foot of liquid lift (ASHRAE). Other losses include those caused by accessories like solenoid valves, filter driers, hand valves, etc.

Liquid lines from the condensers to the receivers should be sized for a refrigerant velocity of 100 fpm or less to ensure positive gravity flow without backup of liquid flow (ASHRAE). Sizing data is provided in Tables 2, 4 and 6.

4.0 OIL CIRCULATION CONSIDERATIONS

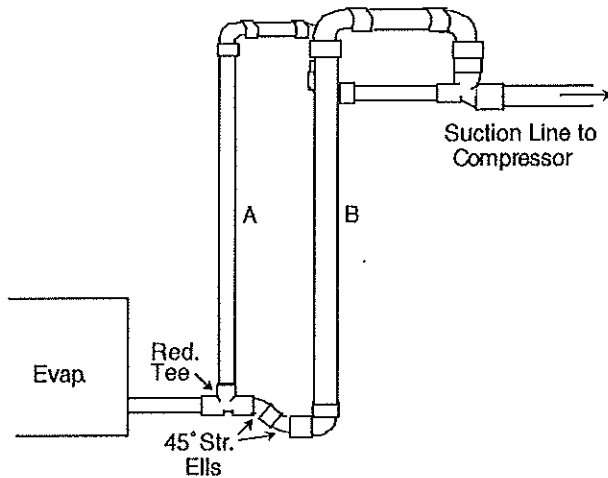
All compressors inevitably lose some oil during normal operation. The oil leaving the condenser is dissolved in the liquid refrigerant and oil return through the liquid line to the evaporator usually poses no problem. The oil separated in the evaporator returns to the compressor by gravity or by shear forces induced by the suction vapor. Some systems utilize oil separators, but they are not 100% effective, and hence the oil that finds its way into the system needs to be returned to the compressor. In systems where the capacity can be modulated, the system piping needs to be designed to return oil at the lowest load condition, while not imposing excessive pressure drop at full load.

Section 4.1 describes the methodology used for sizing of single and multiple suction risers as well as their construction. Suction piping at multiple evaporator coils is illustrated in Figures 3 and 4 of Section 4.2. Hot gas riser sizing details are addressed in Section 4.3.

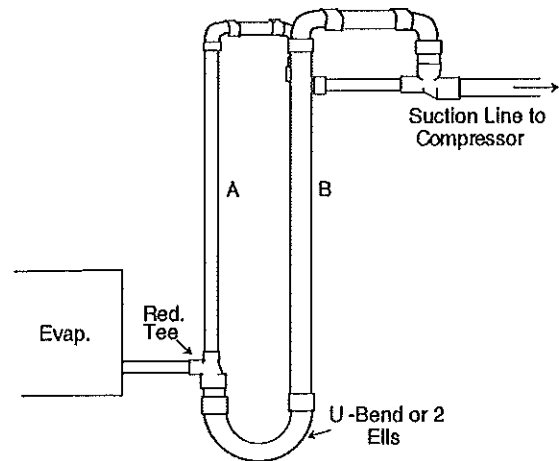
4.1 SUCTION LINE SIZING

Many systems contain a suction riser because the evaporator is located at a lower level than the compressor. Oil circulating in the system returns up the suction riser with the returning gas. The principal factors that govern the transport of oil by refrigerant vapor are the vapor velocity, vapor density, and inside pipe diameter.

Suction risers must be sized for the minimum capacity. Table 7 lists minimum refrigeration capacity for various pipe sizes at various saturated suction and suction gas temperatures for refrigerants 22, 134a and 407C.



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Method A

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Method B**FIG. 2A – DOUBLE SUCTION RISER DESIGN**

When a suction riser is sized to allow oil return at minimum load condition, the pressure drop in this line may be too high when operating at full load. If a correctly sized suction riser causes excessive pressure drop at full load, a double riser should be used. Figures 2A and 2B shows two methods of riser construction. The operation of the double riser is as follows:

Riser A is designed for the minimum load possible.

Riser B is sized for satisfactory pressure drop through both risers at full load. Riser B is sized such that the combined cross sectional area of A and B is equal to or slightly greater than that of a single pipe sized for an acceptable pressure drop at full load without any consideration for oil return at minimum load. The combined cross sectional area, however, should not exceed that of a single pipe that would return oil in an upflow riser under maximum load conditions.

During minimum operation, the gas velocity is not sufficient to carry oil up both the risers. Oil tends to accumulate in the trap between the two risers until riser B is completely sealed off. The gas velocity is now sufficient to carry oil along riser A.

The trap capacity should be maintained to a minimum by close coupling fittings otherwise the oil hold-up could lower the oil level in the compressor crankcase,

FIG. 2B – DOUBLE SUCTION RISER DESIGN

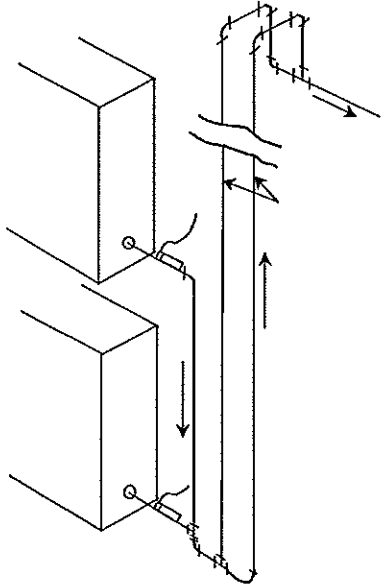
thereby impairing compressor operation. The two risers form an inverted loop and enter the horizontal line. This prevents oil drainage into risers that may be idle during part load operation. Another situation that warrants the use of double suction risers is when multiple compressors are used in a circuit. In this case, one continues to operate while the others may shut down, and the ratio of maximum to minimum capacity becomes large.

4.2 MULTIPLE EVAPORATOR COILS

Suction lines should be designed such that oil from the active evaporator does not drain into an idle one. Figures 3A through 3D show the recommended piping construction for multiple evaporators and their relative positions with respect to the compressor. Figure 4 shows the typical piping for evaporators above and below a common suction line. All horizontal runs should be level or pitched approximately 1/4" per linear foot toward the compressor to ensure oil return.

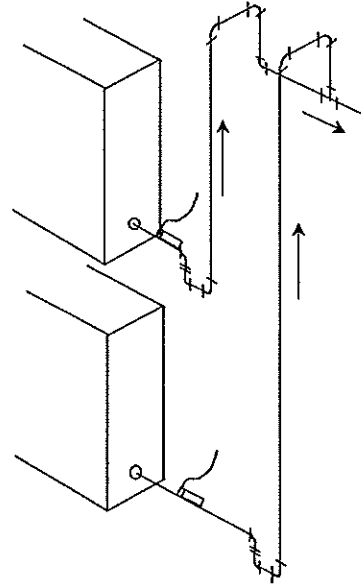
The traps after the evaporator suction outlets are recommended to prevent erratic functioning of the thermal expansion valve. The expansion valve bulbs are located on the suction lines between the evaporator and these traps. The traps serve as drains for refrigerant and helps prevent accumulation of liquid under the valve bulbs during compressor off cycles.

Multiple Evaporators Stacked on Same Level – Compressor Above



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**Multiple Evaporators Stacked on Same Level – Compressor Above
Arrangement "A" Preferred**

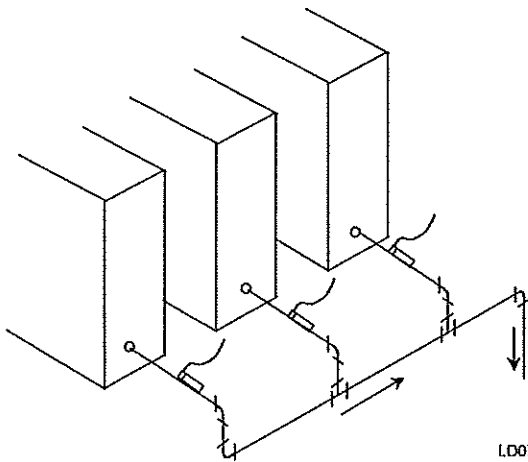


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FIG. 3A – SUCTION LINE PIPING ON MULTIPLE EVAPORATOR

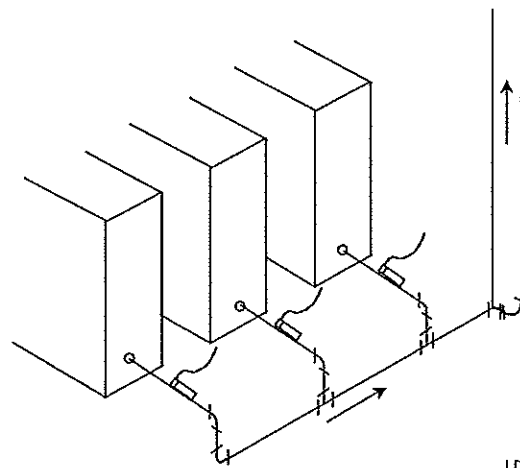
FIG. 3B – SUCTION LINE PIPING ON MULTIPLE EVAPORATOR

Multiple Evaporators on Same Elevation – Compressor Below



LD07364

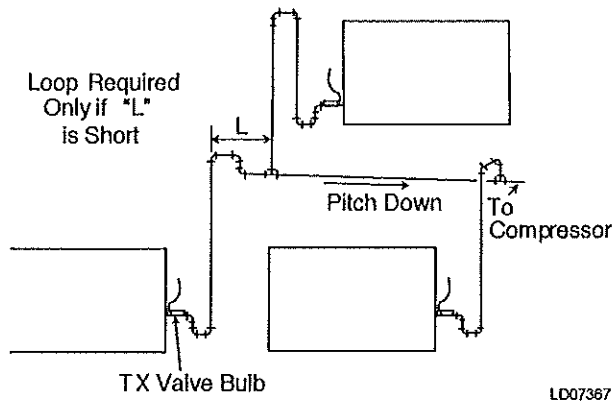
Multiple Evaporators on Same Level – Compressor Above



LD07366

FIG. 3C – SUCTION LINE PIPING ON MULTIPLE EVAPORATOR COILS

FIG. 3D – SUCTION LINE PIPING ON MULTIPLE EVAPORATOR COILS



LD07367

FIG. 4 – TYPICAL PIPING FOR EVAPORATORS LOCATED ABOVE AND BELOW SUCTION LINE

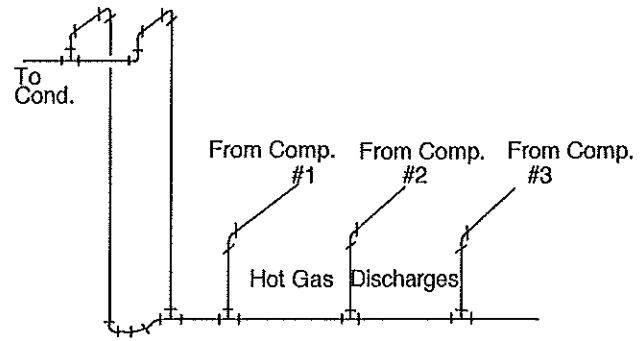
4.3 HOT GAS LINE SIZING

Low pressure drops are desired in hot gas lines. However, oversized lines can reduce gas velocities to the extent that oil is not transported by the refrigerant. Therefore, when using multiple compressors with capacity control, a hot gas riser should be appropriately sized to transport oil at all possible load conditions. Table 8 lists the minimum capacity in tons for oil transport up hot gas risers of different sizes for refrigerants 22, 134a and 407C. The capacities are given for various saturated condensing temperatures and discharge gas temperatures.

In installations with multiple compressors and with capacity control, a vertical hot gas line designed for oil transport at minimum load may cause excessive pressure drop when operating at full load. In such cases, either a double riser or a single riser with an oil separator should be used. A double hot gas riser can be applied similar to the case of the suction line. Figure 5 shows a schematic of a double hot gas riser design. Section 4.1 should be referred to for the operating principle and sizing of the risers.

As an alternative to double risers, a single riser and an oil separator can be used. The separator is located just before the riser so that any oil draining back down the riser accumulates in the oil separator. The oil is then returned to the compressor by feed mechanisms such as a pump, etc. Horizontal lines should be level or pitched approximately 1/4" per linear foot in the direction of gas flow to facilitate transport of oil through the system and back to the compressor. Mufflers are recommended to dampen discharge gas pulsations. Mufflers should

be installed horizontally or in the downflow portion of the hot gas line immediately after the compressor. The gas velocity through the muffler being lower than that through the line, there is a tendency of oil to accumulate within the muffler. The muffler should be installed such that it prevents the accumulation of oil.



LD07368

FIG. 5 – DOUBLE HOT GAS RISERS

5.0 HOT GAS BYPASS ARRANGEMENTS

Most compressors are equipped with unloaders that help the compressor start with a low starting torque and permit capacity control without stopping the compressor. Reduction of starting torque can also be accomplished by using a manual or automatic valve between the compressor discharge and suction lines. To avoid overheating the compressor, the valve is opened only during the start of the compressor and closed when the compressor attains full speed.

Figures 6(a) through 6(d) show various recommended bypass arrangements (ASHRAE). Figure 6(a) shows the simplest configuration. The compressor will overheat when used for long periods of time. The arrangement in Figure 6(b) shows the use of hot gas bypass to the exit of the evaporator. It is recommended that the expansion valve bulb be placed at least 5 feet downstream from the bypass point entrance. In Figure 6(c), the hot gas bypass enters after the thermostatic expansion valve bulb. Another expansion valve provides liquid to the bypass line for desuperheating purposes. The preferable arrangement is shown in Figure 6(d). Here, the bypass is connected into the low side between the expansion valve and the entrance to the evaporator. If a distributor is used, the bypass gas enters between the expansion valve and the distributor. The hot gas bypass line should be sized such that its pressure loss is only a small fraction of the pressure drop across the valve.

6.0 LOSSES IN FITTINGS AND VALVES

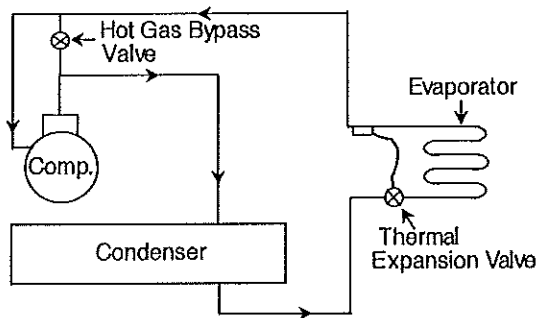
The refrigerant line capacity tables (Tables 1 through 6) are based on pressure drop per 100 equivalent feet of straight pipe, or combination of straight pipe and fittings and valves with friction drop equivalent to 100 feet of straight pipe. Pressure drop through fittings and valves is determined by establishing the equivalent straight length of pipe of the same size. Tables 9, 10 and 11 give the equivalent lengths of straight pipe for various fittings and valves based on nominal pipe sizes (ASHRAE).

7.0 MULTIPLE COMPRESSOR PIPING

Piping design for field-erected multiple compressor systems involves the need for uniform distribution of oil and refrigerant among the compressors. The design must also prevent oil and liquid refrigerant draining back to the heads of idle compressors. Suction, discharge and crankcase equalizing piping arrangements are discussed in Sections 7.1, 7.2 and 7.3, respectively.

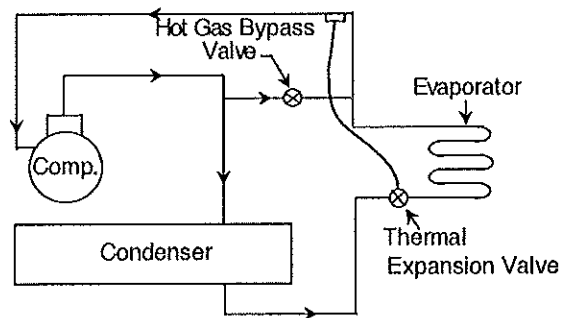
7.1 SUCTION PIPING

Suction piping in multiple compressors operating in parallel should be designed to maintain the same suction pressure and ensure that oil is returned in equal proportions. All suction lines should be brought to a common suction header. The suction header is a means of distributing oil and suction gas as uniformly as possible between the compressors. The header should run above the level of the compressor suction inlets so that oil can return to the compressors by gravity. Figure 7 shows a pyramidal or yoke-type suction header to maximize pressure and flow equalization for three compressors piped in parallel (ASHRAE). In case of two compressors in parallel, a single feed between two compressor take offs is an acceptable configuration. The suction header should be sized such that the suction gas and oil separate. The suction flow for the compressors should be tapped off at the top of the header and devices to feed the oil back to the compressor need to be utilized.



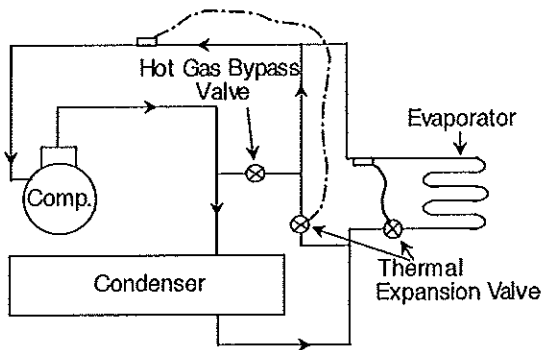
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FIG. 6A – HOT GAS BYPASS ARRANGEMENTS



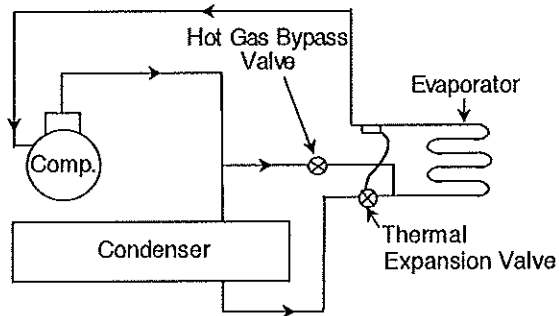
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FIG. 6B – HOT GAS BYPASS ARRANGEMENTS



LD07370

FIG. 6C – HOT GAS BYPASS ARRANGEMENTS



LD07372

FIG. 6D – HOT GAS BYPASS ARRANGEMENTS

7.2 DISCHARGE PIPING

Figure 7 also shows the piping arrangement for the discharge piping. The arrangement is such that liquid refrigerant and oil are prevented from draining back to the heads of idle compressors. A check valve is recommended in the discharge line to prevent refrigerant and oil from migrating to the compressor heads. The piping should be routed to a lower elevation so that a trap is formed for the drainback. An oil separator, if used, may serve as the trap.

7.3 CRANKCASE EQUALIZERS

When two or more compressors are connected, the crankcases should be equalized. The compressors should be placed on foundations and all equalizer tapping locations must be maintained level. An oil equalization line should connect all crankcases to maintain uniform oil levels (refer to Figure 7).

In order to allow the oil equalizer to perform satisfactorily, a gas equalizer should be installed above the oil level (refer Figure 7). It should be piped such that oil or liquid refrigerant will not be trapped.

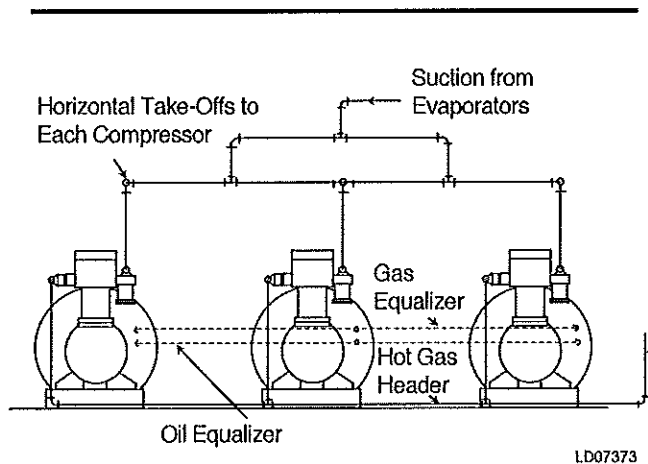


FIG. 7 – CHILLERS WITH REMOTELY INSTALLED DX COOLERS

8.0 CHILLERS WITH REMOTELY INSTALLED DX COOLERS

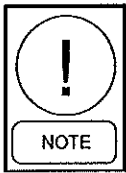
Outdoor chillers with remote DX water cooler applications have grown in popularity. It is prudent practice

to design these systems so that the remote, indoor DX cooler is as close to the outdoor section as possible. This assures optimum performance, reduces piping pressure penalties, and promotes reliability.

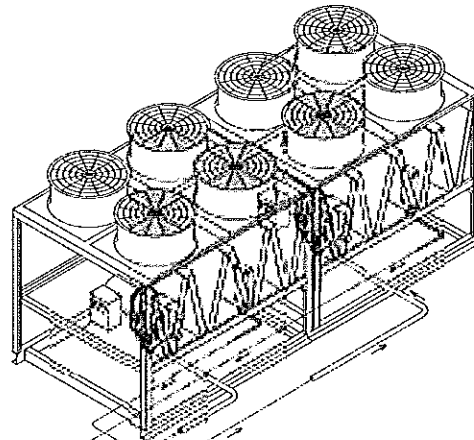
To assure these, the following recommendations should be followed:

- It is suggested that the linear feet of piping be 200 feet or less.
- The total equivalent feet of piping (which includes tees, elbows, fittings, etc.) be 300 feet or less.
- The DX cooler should be no lower than 100 feet below the outdoor section.
- The DX cooler should be no more than 12 to 15 feet above the outdoor section. [The combined friction and static refrigerant liquid column penalty should be no more than 25 psi.]

The design must be based on refrigerant lines (suction and liquid) which will meet full load and provide for proper oil return at the minimum system load condition. These should follow the practices contained in this catalog. See Figure 8A, which illustrates the DX cooler at the same level as the outdoor section. Figure 8B illustrates the DX cooler below the outdoor section. Figure 8C illustrates the DX cooler being above the outdoor section. Regarding Figure 8C, the suction lines should loop up 1 to 2 feet above the DX cooler suction refrigerant connections before they proceed down vertically. This will allow any suction gas which condenses to drain back into cooler. A long radius elbow should be used at the bottom of the vertical drop to transition to the horizontal suction line (pitched approximately 1/4" per linear foot toward the compressor), which should be routed directly to the compressor suction valve connection, without any traps. Thus, any small amount of refrigerant which may condense in the suction line will drain into the compressor where it will be vaporized by the compressor crankcase heater, when the compressor is not operating. It is extremely important that the compressor heater is sized to handle the amount of condensed liquid that may occur in long suction lines and that the heater is allowed to remain energized during the compressor off cycle. Start-up logic should prevent the compressor from restarting if the crankcase temperature has not risen above the saturation temperature corresponding to the pressure of the compressor crankcase. Typically, the crankcase temperature is measured against the ambient and restart is prevented if the crankcase temperature is not at least 25°F above ambient.



Suction lines must rise above the cooler and compressor, then slope to the compressor suction inlet.



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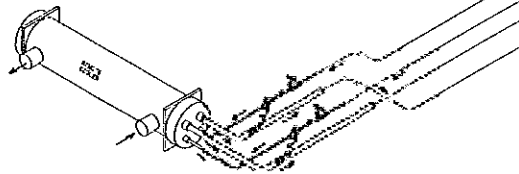
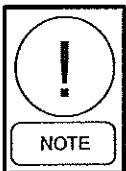
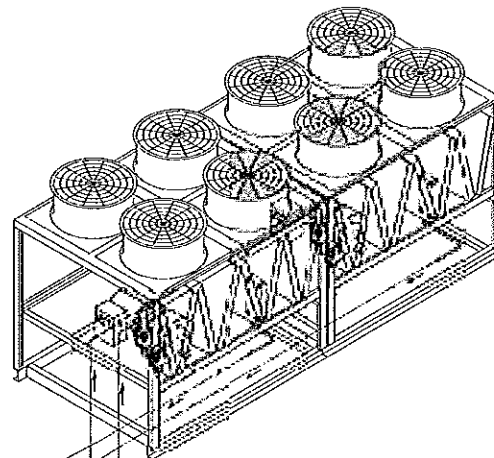


FIG. 8A – REMOTE COOLER LOCATED ON THE SAME LEVEL AS THE CONDENSING UNIT



Suction lines must rise above the cooler and compressor, then slope to the compressor suction inlet.

The horizontal suction lines should be as short as possible.



LD07375

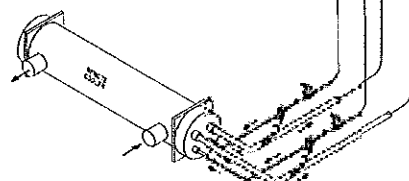
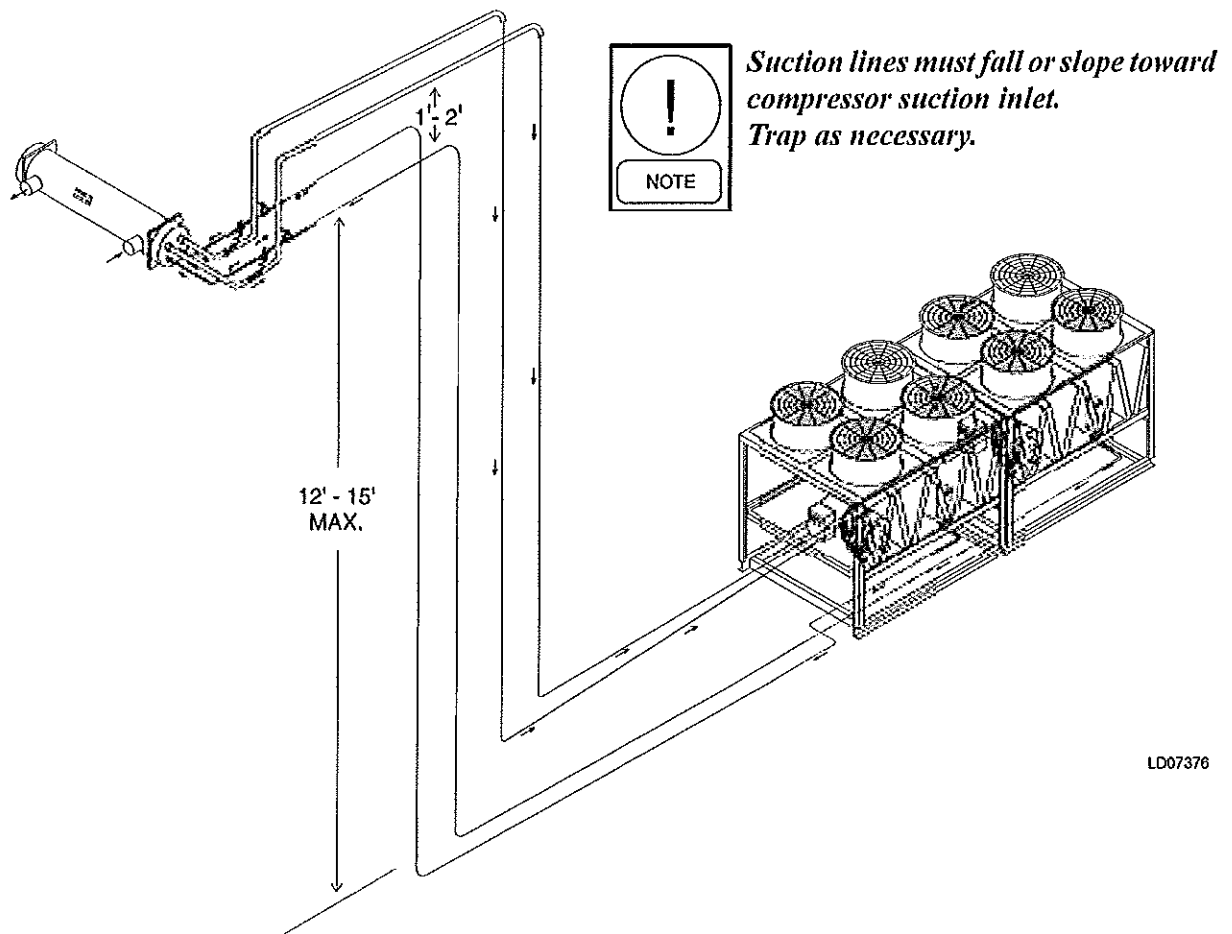


FIG. 8B – REMOTE COOLER LOCATED BELOW THE CONDENSING UNIT



LD07376

FIG. 8C – REMOTE COOLER LOCATED ABOVE THE CONDENSING UNIT

9.0 OTHER PIPING SUGGESTIONS

When vertical suction or discharge lines are greater than 25 feet, an extra oil trap is recommended for each 25 feet of vertical rise.

Suction and hot gas bypass lines must be insulated to help maintain optimum system performance.

Provisions should be made for contraction and expansion of 3/4" per 100 feet of copper piping.

Installing suction and discharge lines underground is not recommended. These have the potential to become liquid traps, which will damage compressors and reduce reliability.

Suction line accumulators may be required in certain instances where large volumes of liquid can periodically return to the compressors.

If there are reliability concerns regarding a proposed piping design, consult YORK Application Engineering personnel for advice.

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10.0 SYSTEM CHARGE REQUIREMENTS

Equipment literature should be reviewed to determine the necessary system charge requirements. There are additional requirements for the suction, discharge and liquid lines. Tables 12, 13, and 14 are included to help the designer determine these piping requirements, which need to be added to the equipment requirements to determine the total operating charge requirements. However, the charge will need to be trimmed during the commissioning process by a certified technician checking both the subcooling and superheat under design conditions.

11.0 EXPANSION VALVE SENSING BULB PLACEMENT

TXV sensing bulb mounting is of extreme importance. The purpose of the bulb is to sense the temperature of the refrigerant flowing through the suction line. Anything that hampers the bulb from doing this accurately will adversely affect the long-term reliability of the system.

The following points must be stressed when considering how and where to mount the TXV bulb (a more detailed explanation for each point mentioned is provided below the list).

You can think of the steps as **Location, Location, Strap-it and Wrap-it!**

1. **Location:** The bulb should be mounted on a horizontal run of piping at the outlet of the evaporator.
2. **Location:** The bulb should be mounted radially on the suction line so that liquid oil returning from the evaporator does not influence the sensing bulb.
3. **Strap-it:** The bulb must be mounted to the suction line using the pair of metal straps normally supplied by the TXV manufacturer in order to provide good thermal contact with the suction line.
4. **Wrap-it:** The sensing bulb and the suction line must be thermally insulated with a vapor barrier¹ so that ambient conditions do not affect the bulb.

A general rule should be to mount the TXV sensing bulb on a horizontal run of suction line close to the outlet of the evaporator for which it is supplying liquid. In cases of multiple evaporators, especially stacked, multiple evaporators, consideration must be given to

the avoidance of bulb locations subject to liquid draining from higher evaporators. Avoid mounting the bulb next to large massive items such as valves or flanges that may act as a heat sink and influence the sensing bulb. Likewise, do not mount the bulb after a suction/liquid line heat exchanger since the suction gas is going to be artificially heated at that point.

The proper radial mounting location on the suction line will vary depending on the diameter of the suction line. Since the objective is to mount the bulb where it will quickly sense liquid refrigerant traveling down the suction line, but not be falsely affected by normal amounts of liquid oil returning from the evaporator, it stands to reason that the bulb should be mounted as close to the bottom of the line as possible, but not so close to the bottom to be affected by any normal oil return through the suction line. Smaller diameter suction lines will require the bulb to be mounted more closely to the top of the line, while large suction lines should have the bulb mounted nearer to the bottom of the suction line. On suction line sizes over 1.5 inches, YORK recommends the bulb to be mounted at 4 or 8 o'clock. Mounting the bulb on sweeping inside or outside bends may also result in false sensing of liquid oil, depending on the piping geometry and consequently those locations should be avoided. The oil will travel in the area of the

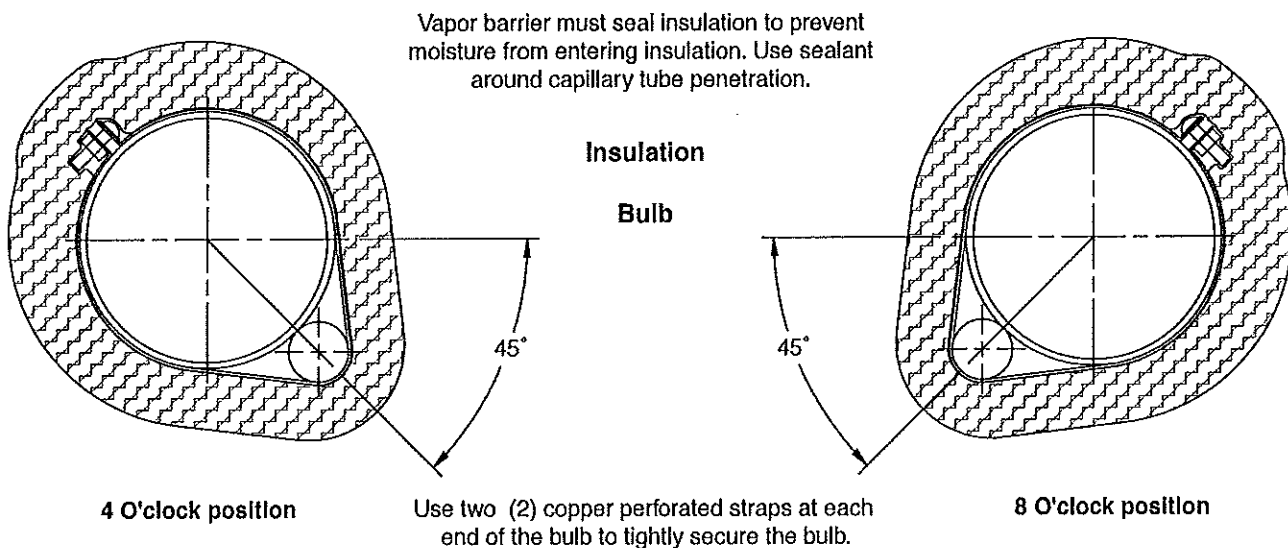


FIG. 9 – THERMAL EXPANSION VALVE BULB MOUNTED RADIALLY ON THE SUCTION PIPING AT THE 4 AND 8 O'CLOCK POSITIONS

pipe that gravity and velocity dictate. On long stretches of horizontal runs, the oil will be in the bottom of the pipe. On bends in the pipe, the oil may be forced along the outside of the piping and it may even tend to swirl around the piping under certain circumstances.

Since the sensing bulb is round and the suction line is normally round, the contact area between the bulb and the pipe is at best one single line of contact for surface mounted sensing bulbs. With that in mind, the method used to position the bulb and clamp it in place is of utmost importance. Good heat transfer between the bulb and outer surface of the suction line is critical to TXV responding quickly to low and high suction gas superheat conditions. On surface-mounted bulbs (not inserted in a thermal well), the bulb must be mounted tightly using the manufacturer's supplied mounting hardware. Normally the mounting straps are made of copper. This is not because copper straps are soft and easy to bend. It is because copper straps provide an additional path for heat transfer to occur between the suction line and the bulb. The straps should be installed tightly but not so tight as to deform the bulb or piping. In addition, if desired, heat conductive compound could be added to further increase the heat transfer. Be careful to install the bulb on a round, straight uninterrupted, section of suction line. Do not straddle braze joints and other irregularities in the piping that would prevent that single line of contact over the length of the bulb-to-pipe mating surface.

Regardless of how well the bulb is mounted, adequate insulation must cover the bulb and surrounding suction line to prevent the ambient conditions from influencing the sensing bulb. Insulation must not only be thick enough to prevent the bulb from sensing ambient temperatures, but also include a vapor barrier sufficient to prevent any moisture from condensing on or around the bulb mounting area. If the vapor barrier is compromised, moisture may condense and form a pocket under the insulation that eventually will damage the insulation as well as cause erratic TXV operation. In low ambient applications, the moisture may freeze which will further hamper TXV operation and may cause eventual damage to the piping and/or insulation system. Since the capillary line attached to the bulb will penetrate the

vapor barrier, some method of sealing, such as a waterproof caulking compound, around the capillary tube should be used to keep the vapor barrier intact.

12.0 SUMMARY

Design recommendations have been provided for the design and sizing of connecting piping in DX systems.

This information is compiled for refrigerants 22, 134a and 407C, for all sizes of piping and range of capacities that encompasses all of YORK's current DX products and are consistent with the industry practices of ASHRAE. Following these recommendations will result in optimal system performance and reliability.

13.0 REFERENCES

ASHRAE Refrigeration and Fundamentals Handbooks, American Society of Heating, Refrigerating and Air Conditioning Engineers, Atlanta, GA.

York International, 1960, Refrigerant-12 Piping, Form 215.05-TM1 (R-12).

York International, 1960, Refrigerant-22 Piping, Form 215.05-TM1 (R-22).

York International, Refrigerant Piping – Compressors, Form 215.05-TM11.

York International, Refrigerant Piping – Suction Lines, Form 215.05-TM09.

York International, Refrigerant Piping – Suction Lines, Form 215.05-TM12.

¹ A vapor barrier consists of a moisture proof material such as aluminum foil, plastic tape, etc. that will prevent water vapor from passing through the insulation material around the suction line. The vapor barrier must be installed on the outside (warm side) of the insulation material and must be sealed so that water vapor cannot go around it.

TABLE 1 - SUCTION LINE CAPACITIES IN TONS FOR REFRIGERANT 22

LINE SIZE	SATURATED SUCTION TEMPERATURE, °F																			
	-40				-20				0				20				40			
	t = 2 F p = 0.77	t = 1 F p = 0.39	t = 0.5 F p = 0.19		t = 2 F p = 1.13	t = 1 F p = 0.57	t = 0.5 F p = 0.29		t = 2 F p = 1.60	t = 1 F p = 0.81	t = 0.5 F p = 0.40		t = 2 F p = 2.18	t = 1 F p = 1.1	t = 0.5 F p = 0.55		t = 2 F p = 2.87	t = 1 F p = 1.45	t = 0.5 F p = 0.73	
COPPER	0.10	0.07	0.05	0.17	0.12	0.08	0.27	0.18	0.12	0.40	0.27	0.40	0.19	0.19	0.58	0.40	0.58	0.40	0.27	
O.D.	0.19	0.13	0.09	0.32	0.22	0.15	0.50	0.34	0.23	0.75	0.52	0.75	0.35	0.35	1.10	0.74	1.10	0.74	0.51	
1/2	0.33	0.23	0.15	0.55	0.38	0.26	0.86	0.59	0.40	1.30	0.88	1.30	0.60	0.60	1.80	1.30	1.80	1.30	0.87	
5/8	0.52	0.35	0.24	0.85	0.58	0.40	1.30	0.91	0.62	2.00	1.40	2.00	0.93	0.93	2.90	2.00	2.90	2.00	1.30	
3/4	1.10	0.72	0.49	1.70	1.20	0.80	2.70	1.90	1.30	4.00	2.80	4.00	1.90	1.90	5.80	4.00	5.80	4.00	2.70	
7/8	1.80	1.30	0.90	3.00	2.10	1.40	4.70	3.20	2.20	7.00	4.80	7.00	3.30	3.30	10.00	6.90	10.00	6.90	4.80	
1-1/8	2.90	2.00	1.40	4.80	3.30	2.30	7.40	5.10	3.50	11.10	7.60	11.10	5.30	5.30	15.90	11.00	15.90	11.00	7.60	
1-3/8	6.10	4.20	2.90	10.00	6.90	4.70	15.40	10.70	7.30	22.90	15.90	22.90	10.90	10.90	32.80	22.80	32.80	22.80	15.70	
1-5/8	10.80	7.50	5.10	17.70	12.20	8.40	27.30	18.90	13.00	40.50	28.10	40.50	19.40	19.40	58.00	40.30	58.00	40.30	27.80	
2-1/8	17.30	12.00	8.20	28.20	19.50	13.40	43.60	30.20	20.80	64.60	44.80	64.60	31.00	31.00	92.30	64.20	92.30	64.20	44.40	
2-5/8	25.80	17.80	12.30	42.00	29.10	20.00	64.80	44.90	31.00	96.00	66.70	96.00	46.10	46.10	137.00	95.40	137.00	95.40	66.10	
3-1/8	36.50	25.20	17.40	59.30	41.10	28.30	91.40	63.40	43.80	135.20	94.00	135.20	65.10	65.10	193.00	134.40	193.00	134.40	93.20	
3-5/8	65.30	45.20	31.20	106.10	73.60	50.80	163.30	113.50	78.50	241.50	168.10	241.50	116.50	116.50	344.40	240.20	344.40	240.20	166.70	
4-1/8	105.20	72.93	50.30	170.70	118.50	81.90	262.50	182.60	126.40	387.90	270.30	387.90	187.50	187.50	552.70	385.80	552.70	385.80	268.10	
STEEL																				
1/2	0.24	0.16	0.11	0.38	0.27	0.19	0.58	0.41	0.29	0.84	0.60	0.84	0.42	0.42	1.20	0.84	1.20	0.84	0.59	
3/4	0.50	0.35	0.24	0.80	0.56	0.39	1.20	0.86	0.60	1.80	1.30	1.80	0.88	0.88	2.50	1.80	2.50	1.80	1.20	
1	0.95	0.66	0.46	1.50	1.10	0.75	2.30	1.60	1.10	3.40	2.40	3.40	1.70	1.70	4.80	3.40	4.80	3.40	2.40	
1-1/4	2.00	1.40	1.00	3.10	2.20	1.50	4.80	3.40	2.40	6.90	4.90	6.90	3.40	3.40	9.80	6.90	9.80	6.90	4.90	
1-1/2	2.90	2.10	1.40	4.70	3.30	2.30	7.10	5.00	3.60	10.40	7.40	10.40	5.20	5.20	14.70	10.40	14.70	10.40	7.30	
2	5.70	4.00	2.80	9.10	6.40	4.50	13.80	9.70	6.90	20.10	14.20	20.10	10.00	10.00	28.30	20.00	28.30	20.00	14.10	
2-1/2	9.10	6.40	4.50	14.50	10.20	7.20	22.00	15.50	10.90	32.00	22.60	32.00	16.00	16.00	45.10	31.90	45.10	31.90	22.50	
3	16.10	11.30	8.00	25.60	18.10	12.70	38.80	27.50	19.40	56.50	40.00	56.50	28.20	28.20	79.60	56.40	79.60	56.40	39.80	
3-1/2	23.50	16.60	11.70	37.40	26.50	18.60	56.80	40.20	28.30	82.70	58.50	82.70	41.30	41.30	116.50	82.50	116.50	82.50	58.30	
4	32.70	23.10	16.30	52.10	36.90	26.00	79.00	55.90	39.50	115.00	81.40	115.00	57.50	57.50	162.10	114.80	162.10	114.80	81.10	
5	59.20	41.80	29.40	94.10	66.60	47.00	142.60	101.00	71.30	207.60	147.00	207.60	103.80	103.80	292.60	207.20	292.60	207.20	146.40	
6	95.70	67.70	47.60	152.00	107.60	76.00	230.40	163.20	115.30	335.40	237.60	335.40	167.80	167.80	472.50	334.70	472.50	334.70	236.60	

NOTES:
 Capacities are in tons of refrigeration.
 Δp = pressure drop due to line friction, psi per 100 feet equivalent length.
 Δt = change in saturation temperature corresponding to pressure drop, °F per 100 feet.
 All steel pipe sizes are nominal and are for schedule 40.
 See notes at the bottom of Table 2.

TABLE 2 – DISCHARGE AND LIQUID LINE CAPACITIES IN TONS FOR REFRIGERANT 22

LINE SIZE		DISCHARGE LINES (Δt = 1°F, Δp = 3.03 PSI)					LINE SIZE		LIQUID LINES	
TYPE L		SATURATED SUCTION TEMPERATURE, °F					TYPE L		VEL. = 100	Δt = 1°F
COPPER, O.D.		-40	-20	0	20	40	COPPER, O.D.		FPM	Δp = 3.03
1/2		0.75	0.78	0.8	0.83	0.85	1/2		2.4	3.7
5/8		1.4	1.5	1.5	1.6	1.6	5/8		3.8	7.0
3/4		2.4	2.5	2.6	2.6	2.7	3/4		5.7	12.0
7/8		3.7	3.8	4.0	4.1	4.2	7/8		8.0	18.6
1-1/8		7.5	7.8	8.0	8.3	8.5	1-1/8		13.6	37.8
1-3/8		13.1	13.5	14.0	14.4	14.8	1-3/8		20.7	66.1
1-5/8		20.6	21.4	22.1	22.8	23.4	1-5/8		29.3	104.7
2-1/8		42.7	44.2	45.7	47.1	48.4	2-1/8		51.0	217.5
2-5/8		75.3	78.0	80.6	83.1	85.3	2-5/8		78.7	385.0
3-1/8		119.9	124.3	128.4	132.3	135.9	3-1/8		112.3	615.0
3-5/8		177.9	184.4	190.6	196.3	201.6	3-5/8		151.8	914.6
4-1/8		250.6	259.7	268.4	276.5	283.9	4-1/8		197.4	1291.0
5-1/8		447.0	463.3	478.7	493.2	506.4	5-1/8		307.6	—
6-1/8		717.1	743.2	768.0	791.2	812.5	6-1/8		442.2	—

STEEL										
IPS	SCH						IPS	SCH		
1/2	40	1.5	1.6	1.7	1.7	1.8	1/2	80	3.9	5.8
3/4	40	3.3	3.4	3.5	3.6	3.7	3/4	80	7.1	13.1
1	40	6.1	6.4	6.6	6.8	7.0	1	80	11.9	25.8
1-1/4	40	12.7	13.1	13.6	14.0	14.3	1-1/4	80	21.1	55.4
1-1/2	40	19.0	19.7	20.3	21.0	21.5	1-1/2	80	29.1	84.5
2	40	36.6	37.9	39.2	40.4	41.5	2	40	55.3	196.5
2-1/2	40	58.3	60.4	62.5	64.3	66.1	2-1/2	40	78.9	313.4
3	40	103.0	106.7	110.3	113.6	116.7	3	40	121.8	554.0
4	40	209.6	217.3	224.5	231.3	237.5	4	40	209.8	1129.0
5	40	378.3	392.1	405.2	417.4	428.6	5	40	329.7	2039.0
6	40	611.1	633.3	654.4	674.1	692.3	6	40	476.2	3294.0

Capacities are in tons of refrigeration.

Δp = Pressure drop due to line friction, psi per 100 feet equivalent length.

Δt = Change in saturation temperature corresponding to pressure drop, °F per 100 feet.

Line capacity for other saturation temperatures Δt and equivalent lengths L.

$$\text{Line capacity} = \text{Table capacity} \left(\frac{\text{Table } L_e}{\text{Actual } L_e} \right) \times \left(\frac{\text{Actual } \Delta t}{\text{Table } \Delta t} \right)^{0.55}$$

Saturation temperature Δt for other capacities and equivalent lengths L_e.

$$\Delta t = \text{Table } \Delta t \left(\frac{\text{Actual } L_e}{\text{Table } L_e} \right) \left(\frac{\text{Actual Capacity}}{\text{Table Capacity}} \right)^{1.8}$$

The refrigerant cycle for determining capacity is based on saturated gas leaving the evaporator and no subcooling in the condenser. Discharge superheat is 105°F. The saturated suction temperature is 40°F for liquid line sizing.

Multiply table capacities by the following factors for condensing temperatures other than 105°F.

CONDENSING TEMPERATURE, °F	SUCTION LINE	DISCHARGE LINE
80	1.12	0.82
90	1.07	0.89
100	1.03	0.96
110	0.97	1.03
120	0.92	1.10
130	0.87	1.16
140	0.82	1.22

TABLE 3 – SUCTION LINE CAPACITIES IN TONS FOR REFRIGERANT 134a

LINE SIZE		SATURATED SUCTION TEMPERATURE, °F																
		-40			-20			0			20			40				
		t = 2 F p = 0.98	t = 1 F p = 0.49	t = 0.5 F p = 0.25	t = 2 F p = 1.17	t = 1 F p = 0.59	t = 0.5 F p = 0.30	t = 2 F p = 1.39	t = 1 F p = 0.70	t = 0.5 F p = 0.35	t = 2 F p = 1.63	t = 1 F p = 0.82	t = 0.5 F p = 0.41	t = 2 F p = 1.90	t = 1 F p = 0.96	t = 0.5 F p = 0.48		
COPPER, O.D.		1/2	0.14	0.10	0.07	0.18	0.12	0.08	0.23	0.16	0.11	0.28	0.19	0.13	0.35	0.24	0.16	
		5/8	0.27	0.18	0.12	0.34	0.23	0.16	0.43	0.29	0.20	0.53	0.37	0.25	0.66	0.45	0.31	
		3/4	0.46	0.31	0.21	0.58	0.40	0.27	0.73	0.50	0.34	0.91	0.62	0.43	1.1	0.77	0.53	
		7/8	0.71	0.48	0.33	0.90	0.62	0.42	1.1	0.78	0.53	1.4	1.0	0.66	1.7	1.2	0.82	
		1-1/8	1.4	1.0	0.67	1.8	1.3	0.86	2.3	1.6	1.1	2.9	2.0	1.3	3.5	2.4	1.7	
		1-3/8	2.5	1.7	1.2	3.2	2.2	1.5	4.0	2.8	1.9	5.0	3.4	2.4	6.1	4.2	2.9	
		1-5/8	4.0	2.7	1.9	5.1	3.5	2.4	6.4	4.4	3.0	7.9	5.4	3.7	9.7	6.7	4.6	
		2-1/8	8.3	5.7	3.9	10.5	7.3	5.0	13.2	9.1	6.3	16.4	11.3	7.8	20.1	13.9	9.6	
		2-5/8	14.7	10.1	7.0	18.6	12.9	8.8	23.3	16.1	11.1	28.9	20.0	13.8	35.5	24.6	17.0	
		3-1/8	23.4	16.2	11.2	29.7	20.6	14.2	37.2	25.8	17.8	46.1	32.0	22.1	56.6	39.3	27.1	
		3-5/8	34.9	24.1	16.6	44.2	30.6	21.1	55.3	38.4	26.5	68.6	47.6	32.9	84.1	58.4	40.4	
		4-1/8	49.2	34.1	23.5	62.4	43.2	29.8	78.1	54.2	37.4	96.7	67.1	46.4	118.5	82.4	57.0	
		5-1/8	88.2	61.1	42.2	111.6	77.4	53.5	139.6	97.0	67.1	172.7	120.1	83.1	211.6	147.3	102.1	
		6-1/8	141.8	98.5	68.0	179.4	124.7	86.2	224.4	156.0	108.0	277.5	193.2	133.9	339.9	236.8	164.2	
STEEL		IPS																
SCH		1/2	80	0.22	0.16	0.11	0.28	0.20	0.14	0.35	0.25	0.17	0.43	0.30	0.21	0.52	0.37	0.26
		3/4	80	0.50	0.35	0.25	0.63	0.45	0.31	0.79	0.56	0.39	0.97	0.68	0.48	1.2	0.83	0.59
		1	80	1.0	0.70	0.49	1.2	0.88	0.61	1.5	1.1	0.76	1.90	1.3	0.94	2.3	1.6	1.1
		1-1/4	40	2.6	1.8	1.3	3.3	2.3	1.6	4.1	2.9	2.0	5.0	3.5	2.5	6.1	4.3	3.0
		1-1/2	40	3.9	2.8	1.9	4.9	3.5	2.4	6.1	4.3	3.0	7.5	5.3	3.7	9.1	6.4	4.5
		2	40	7.6	5.3	3.7	9.5	6.7	4.7	11.8	8.3	5.9	14.5	10.2	7.2	17.6	12.4	8.8
		2-1/2	40	12.1	8.5	6.0	15.1	10.7	7.5	18.8	13.3	9.3	23.1	16.3	11.5	28.0	19.8	14.0
		3	40	21.3	15.1	10.6	26.7	18.9	13.3	33.2	23.5	16.5	40.7	28.8	20.3	49.6	35.1	24.7
		3-1/2	40	31.2	22.1	15.5	39.1	27.7	19.5	48.5	34.3	24.2	59.6	42.2	29.8	72.5	51.3	36.2
		4	40	43.5	30.7	21.7	54.5	38.5	27.2	67.6	47.8	33.7	82.9	58.7	41.4	100.9	71.4	50.4
		5	40	78.5	55.5	39.2	98.4	69.6	49.1	122.0	86.4	60.9	149.7	106.0	74.9	182.1	129.0	91.1
		6	40	126.9	89.8	63.3	159.0	112.6	79.4	197.1	139.6	98.5	241.9	171.3	121.0	294.2	208.4	147.2

NOTES:
 Capacities are in tons of refrigeration.
 Δp = pressure drop due to line friction, psi per 100 feet equivalent length.
 Δt = change in saturation temperature corresponding to pressure drop, °F per 100 feet.
 All steel pipe sizes are nominal and are for schedule 40.
 See notes at the bottom of Table 4.

TABLE 4 – DISCHARGE AND LIQUID LINE CAPACITIES IN TONS FOR REFRIGERANT 134a

LINE SIZE		DISCHARGE LINES ($\Delta t = 1^\circ\text{F}$, $\Delta p = 2.2 \text{ PSI}$)			LINE SIZE		LIQUID LINES	
TYPE L		SATURATED SUCTION TEMPERATURE, $^\circ\text{F}$			TYPE L		VEL. = 100	$\Delta t = 1^\circ\text{F}$
COPPER, O.D.		0	20	40	COPPER, O.D.		FPM	$\Delta p = 2.2$
1/2		0.54	0.57	0.59	1/2		2.4	3.7
5/8		1.0	1.1	1.1	5/8		3.8	7.0
3/4		1.7	1.8	1.9	3/4		5.7	12.0
7/8		2.7	2.8	2.9	7/8		8.0	18.6
1-1/8		5.4	5.7	5.9	1-1/8		13.6	37.8
1-3/8		9.4	9.9	10.4	1-3/8		20.7	66.1
1-5/8		14.9	15.6	6.4	1-5/8		29.3	104.7
2-1/8		30.8	32.4	33.9	2-1/8		51.0	217.5
2-5/8		54.4	57.1	59.8	2-5/8		78.7	385.0
3-1/8		86.7	91.0	95.2	3-1/8		112.3	615.0
3-5/8		128.7	135.1	141.4	3-5/8		151.8	914.6
4-1/8		181.3	190.4	199.1	4-1/8		197.4	–
5-1/8		323.5	339.7	355.4	5-1/8		307.6	–
6-1/8		519.2	545.2	570.3	6-1/8		442.2	–

STEEL STEEL									
IPS					IPS				
IPS	SCH				IPS	SCH			
1/2	80	0.80	0.83	0.87	1/2	80	3.2	5.6	
3/4	80	1.8	1.9	2.0	3/4	80	7.1	16.0	
1	80	3.5	3.7	3.9	1	80	11.9	31.5	
1-1/4	40	9.2	9.7	10.1	1-1/4	80	21.1	67.9	
1-1/2	40	13.8	14.5	5.2	1-1/2	80	29.1	103.7	
2	40	26.6	28.0	29.2	2	40	55.3	242.0	
2-1/2	40	42.4	44.6	46.6	2-1/2	40	78.9	386.7	
3	40	75.0	78.7	82.3	3	40	121.8	684.8	
4	40	152.6	160.2	167.6	4	40	209.8	–	
5	40	275.4	289.2	02.5	5	40	329.7	–	
6	40	444.8	467.1	488.5	6	40	476.2	–	

Capacities are in tons of refrigeration.

Δp = Pressure drop due to line friction, psi per 100 feet equivalent length.

Δt = Change in saturation temperature corresponding to pressure drop, $^\circ\text{F}$ per 100 feet.

Line capacity for other saturation temperatures Δt and equivalent lengths L_e .

$$\text{Line capacity} = \text{Table capacity} \left(\frac{\text{Table } L_e}{\text{Actual } L_e} \right) \times \left(\frac{\text{Actual } \Delta t}{\text{Table } \Delta t} \right)^{0.55}$$

Saturation temperature Δt for other capacities and equivalent lengths L_e .

$$\Delta t = \text{Table } \Delta t \left(\frac{\text{Actual } L_e}{\text{Table } L_e} \right) \left(\frac{\text{Actual Capacity}}{\text{Table Capacity}} \right)^{1.8}$$

The refrigerant cycle for determining capacity is based on saturated gas leaving the evaporator and no subcooling in the condenser. Discharge superheat is 105°F . The saturated suction temperature is 40°F for liquid line sizing.

Multiply table capacities by the following factors for condensing temperatures other than 105°F .

CONDENSING TEMPERATURE, $^\circ\text{F}$	SUCTION LINE	DISCHARGE LINE
80	1.14	0.81
90	1.09	0.89
100	1.03	0.96
110	0.97	1.03
120	0.91	1.10
130	0.84	1.16
140	0.78	1.20

TABLE 5 - SUCTION LINE CAPACITIES IN TONS FOR REFRIGERANT 407C

LINE SIZE	SATURATED SUCTION TEMPERATURE, °F																			
	-40				-20				0				20				40			
	t = 2 F p = 0.69	t = 1 F p = 0.35	t = 0.5 F p = 0.18	t = 2 F p = 1.04	t = 1 F p = 0.53	t = 0.5 F p = 0.26	t = 2 F p = 1.50	t = 1 F p = 0.76	t = 0.5 F p = 0.38	t = 2 F p = 2.08	t = 1 F p = 1.05	t = 0.5 F p = 0.53	t = 2 F p = 2.81	t = 1 F p = 1.41	t = 0.5 F p = 0.71					
COPPER, O.D.																				
1/2	0.08	0.05	0.04	0.14	0.09	0.06	0.22	0.15	0.10	0.35	0.24	0.53	0.36	0.25						
5/8	0.15	0.10	0.07	0.26	0.18	0.12	0.42	0.29	0.20	0.66	0.45	0.99	0.68	0.46						
3/4	0.25	0.17	0.12	0.44	0.30	0.20	0.72	0.49	0.34	1.1	0.77	3.7	1.2	0.79						
7/8	0.39	0.27	0.18	0.68	0.47	0.32	1.1	0.77	0.52	1.7	1.2	2.6	1.8	1.2						
1-1/8	0.80	0.55	0.37	1.4	1.0	0.6	5.3	1.6	1.1	3.5	2.4	5.3	3.6	2.5						
1-3/8	1.4	1.0	0.66	2.4	1.7	1.1	4.0	2.7	1.9	6.1	4.2	9.2	6.3	4.4						
1-5/8	2.2	1.5	1.0	3.9	2.7	1.8	6.3	4.3	3.0	9.7	6.7	14.5	10.0	6.9						
2-1/8	4.6	3.2	2.2	8.0	5.5	3.8	13.0	9.0	6.2	20.1	13.9	29.9	20.8	14.3						
2-5/8	8.2	5.7	3.9	14.2	9.8	6.7	23.0	15.9	11.0	35.6	24.6	52.8	36.7	25.4						
3-1/8	13.2	9.1	6.2	22.7	15.7	10.8	36.8	25.5	17.5	56.7	39.4	84.2	58.5	40.5						
3-5/8	19.6	13.6	9.3	33.8	23.4	16.1	54.6	37.9	26.1	84.2	58.5	124.9	87.0	60.2						
4-1/8	27.7	19.2	13.2	47.7	33.0	22.7	77.1	53.5	36.9	118.7	82.5	176.0	122.6	85.0						
5-1/8	49.7	34.4	23.7	85.3	59.2	40.8	137.8	95.7	66.2	212.1	147.6	314.1	219.0	152.0						
6-1/8	80.1	55.5	38.3	137.3	95.3	65.8	221.5	154.1	106.6	340.6	237.3	504.0	351.8	244.5						
STEEL																				
1/2	0.18	0.13	0.09	0.31	0.21	0.15	0.49	0.34	0.24	0.74	0.52	1.1	0.77	0.54						
3/4	0.38	0.27	0.19	0.65	0.45	0.32	1.0	0.72	0.51	1.6	1.1	2.3	1.6	1.1						
1	0.73	0.51	0.36	1.2	0.86	0.60	1.9	1.4	1.0	3.0	2.1	4.3	3.1	2.2						
1-1/4	1.5	1.1	0.74	2.5	1.8	1.2	4.0	2.8	2.0	6.1	4.3	8.9	6.3	4.5						
1-1/2	2.3	1.6	1.1	3.8	2.7	1.9	6.0	4.3	3.0	9.2	6.5	13.4	9.5	6.7						
2	4.4	3.1	2.2	7.3	5.2	3.6	11.6	8.2	5.8	17.7	12.5	25.8	18.3	12.9						
2-1/2	7.0	4.9	3.4	11.7	8.3	5.8	18.6	13.1	9.2	28.1	19.9	41.2	29.1	20.6						
3	12.3	8.7	6.1	20.7	14.6	10.3	32.8	23.2	16.4	49.7	35.2	72.7	51.5	36.3						
3-1/2	18.1	12.8	9.0	30.3	21.4	15.1	48.0	34.0	24.0	72.7	51.5	106.3	75.3	53.2						
4	25.2	17.8	12.5	42.2	29.8	21.0	66.8	47.3	33.4	101.2	71.7	148.0	104.8	74.0						
5	45.5	32.2	22.6	76.2	53.9	38.0	120.7	85.4	60.3	182.7	129.4	267.1	189.2	133.7						
6	73.6	52.0	36.6	123.2	87.2	61.5	195.0	138.1	97.5	295.1	209.1	431.4	305.6	216.0						

NOTES:
 Capacities are in tons of refrigeration.
 Δp = pressure drop due to line friction, psi per 100 feet equivalent length.
 Δt = change in saturation temperature corresponding to pressure drop, °F per 100 feet.
 All steel pipe sizes are nominal and are for schedule 40. The saturated condensing and suction conditions are referenced to the dewpoint.
 See notes at the bottom of Table 6.

TABLE 6 – DISCHARGE AND LIQUID LINE CAPACITIES IN TONS FOR REFRIGERANT 407C

LINE SIZE		DISCHARGE LINES ($\Delta t = 1^\circ\text{F}$, $\Delta p = 3.28 \text{ PSI}$)					LINE SIZE		LIQUID LINES	
TYPE L COPPER, O.D.		SATURATED SUCTION TEMPERATURE, $^\circ\text{F}$					TYPE L COPPER, O.D.		VEL. = 100 FPM	$\Delta t = 1^\circ\text{F}$ $\Delta p = 3.43$
		-40	-20	0	20	40				
1/2		0.71	0.75	0.78	0.82	0.86	1/2		2.2	4.0
5/8		1.3	1.4	1.5	1.5	1.6	5/8		3.6	7.5
3/4		2.3	2.4	2.5	2.6	2.7	3/4		5.4	12.9
7/8		3.5	3.7	3.9	4.0	4.2	7/8		7.5	19.9
1-1/8		7.0	7.4	7.8	8.2	8.5	1-1/8		12.7	40.3
1-3/8		12.3	12.9	13.6	14.3	14.9	1-3/8		19.4	70.3
1-5/8		19.3	20.4	21.5	22.5	23.5	1-5/8		27.5	111.2
2-1/8		40.0	42.2	44.4	46.5	48.6	2-1/8		47.8	230.5
2-5/8		70.5	74.5	78.3	82.1	85.6	2-5/8		73.7	407.3
3-1/8		112.3	118.6	124.8	130.7	136.4	3-1/8		105.2	649.6
3-5/8		166.6	176.0	185.1	193.9	202.3	3-5/8		142.3	965.0
4-1/8		234.7	247.8	260.7	273.1	284.9	4-1/8		185.0	1360.0
5-1/8		418.5	441.9	464.9	487.0	508.1	5-1/8		288.3	–
6-1/8		671.3	708.9	745.7	781.2	815.0	6-1/8		414.4	–

STEEL										
IPS	SCH						IPS	SCH		
1/2	40	1.4	1.5	1.6	1.7	1.8	1/2	80	4.7	8.5
3/4	40	3.0	3.2	3.4	3.5	3.7	3/4	80	8.2	17.9
1	40	5.7	6.1	6.4	6.7	7.0	1	80	13.4	34.0
1-1/4	40	11.8	12.5	13.1	13.8	14.4	1-1/4	80	23.1	70.0
1-1/2	40	17.7	18.7	19.7	20.6	21.5	1-1/2	80	31.4	105.0
2	40	34.2	36.1	38.0	39.8	41.5	2	40	51.8	202.4
2-1/2	40	54.5	57.5	60.5	63.4	66.1	2-1/2	40	73.9	322.7
3	40	96.2	101.6	106.9	112.0	116.8	3	40	114.2	570.2
4	40	195.8	206.8	217.5	227.9	237.8	4	40	196.6	1161.0
5	40	353.4	373.2	392.5	411.3	429.0	5	40	309.0	–
6	40	570.8	602.7	634.0	664.2	692.9	6	40	446.2	–

Capacities are in tons of refrigeration.

Δp = Pressure drop due to line friction, psi per 100 feet equivalent length.

Δt = Change in saturation temperature corresponding to pressure drop, $^\circ\text{F}$ per 100 feet.

Line capacity for other saturation temperatures Δt and equivalent lengths L.

$$\text{Line capacity} = \text{Table capacity} \left(\frac{\text{Table } L_e}{\text{Actual } L_e} \right) \times \left(\frac{\text{Actual } \Delta t}{\text{Table } \Delta t} \right)^{0.55}$$

Saturation temperature Δt for other capacities and equivalent lengths L_e .

$$\Delta t = \text{Table } \Delta t \left(\frac{\text{Actual } L_e}{\text{Table } L_e} \right) \left(\frac{\text{Actual Capacity}}{\text{Table Capacity}} \right)^{1.8}$$

The refrigerant cycle for determining capacity is based on saturated gas leaving the evaporator and no subcooling in the condenser. Discharge superheat is 105°F . The saturated suction temperature is 40°F for liquid line sizing.

Multiply table capacities by the following factors for condensing temperatures other than 105°F .

CONDENSING TEMPERATURE, $^\circ\text{F}$	SUCTION LINE	DISCHARGE LINE
80	1.16	0.81
90	1.09	0.89
100	1.03	0.96
110	0.97	1.03
120	0.90	1.10
130	0.83	1.16
140	0.76	1.19

20 TABLE 7 – MINIMUM REFRIGERATION CAPACITY IN TONS FOR OIL ENTRAINMENT UP SUCTION RISERS (TYPE L COPPER TUBING)

REFRIGERANT	SATURATION SUCTION TEMP., °F	SUCTION GAS TEMP., °F	PIPE O.D., IN.												
			1/2	5/8	3/4	7/8	1-1/8	1-3/8	1-5/8	2-1/8	2-5/8	3-1/8	3-5/8	4-1/8	
			AREA, IN ²												
22	-40	-30	0.07	0.12	0.20	0.30	0.484	0.825	1.256	1.780	3.094	4.770	6.812	9.213	11.97
		-10	0.07	0.12	0.20	0.30	0.58	0.97	1.51	3.00	5.16	8.06	11.75	16.30	
		10	0.07	0.12	0.20	0.30	0.58	0.98	1.52	3.02	5.19	8.11	11.82	16.40	
	-20	-10	0.09	0.16	0.26	0.39	0.76	1.28	1.97	3.94	6.77	10.57	15.41	21.38	
		10	0.09	0.15	0.25	0.38	0.74	1.26	1.95	3.89	6.68	10.42	15.20	21.09	
		30	0.09	0.15	0.26	0.39	0.75	1.27	1.96	3.92	6.73	10.51	15.33	21.26	
	0	10	0.11	0.20	0.33	0.49	0.96	1.63	2.52	5.03	8.63	13.48	19.65	27.26	
		30	0.11	0.19	0.32	0.49	0.94	1.60	2.47	4.93	8.47	13.22	19.29	26.75	
		50	0.11	0.20	0.32	0.49	0.95	1.61	2.49	4.97	8.54	13.33	19.44	26.96	
	20	30	0.14	0.25	0.41	0.62	1.20	2.03	3.15	6.28	10.78	16.84	24.56	34.06	
		50	0.14	0.24	0.40	0.61	1.19	2.01	3.11	6.21	10.66	16.65	24.28	33.68	
		70	0.14	0.24	0.40	0.61	1.19	2.01	3.11	6.20	10.65	16.63	24.25	33.64	
40	50	0.17	0.30	0.50	0.76	1.48	2.49	3.86	7.70	13.22	20.64	30.11	41.76		
	70	0.17	0.30	0.49	0.74	1.45	2.45	3.78	7.55	12.96	20.24	29.52	40.94		
	90	0.17	0.30	0.49	0.74	1.45	2.45	3.78	7.55	12.97	20.26	29.54	40.98		
0	10	0.09	0.16	0.26	0.39	0.76	1.29	2.00	3.99	6.86	10.71	15.61	21.66		
	30	0.09	0.15	0.25	0.38	0.75	1.26	1.95	3.90	6.70	10.46	15.26	21.16		
	50	0.09	0.16	0.26	0.39	0.76	1.28	1.98	3.95	6.79	10.60	15.46	21.45		
10	20	0.10	0.17	0.28	0.43	0.84	1.41	2.18	4.36	7.49	11.69	17.05	23.65		
	40	0.10	0.17	0.29	0.43	0.85	1.43	2.21	4.41	7.58	11.84	17.26	23.95		
	60	0.10	0.18	0.29	0.44	0.86	1.45	2.24	4.47	7.68	11.99	17.49	24.26		
20	30	0.11	0.19	0.32	0.49	0.95	1.60	2.48	4.94	8.49	13.25	19.32	26.80		
	50	0.11	0.20	0.33	0.49	0.96	1.62	2.51	5.01	8.61	13.44	19.60	27.19		
	70	0.11	0.20	0.33	0.50	0.97	1.64	2.54	5.06	8.70	13.58	19.81	27.48		
30	40	0.12	0.22	0.37	0.55	1.08	1.82	2.82	5.63	9.67	15.10	22.02	30.55		
	60	0.12	0.22	0.37	0.55	1.08	1.82	2.82	5.62	9.66	15.08	21.99	30.51		
	80	0.13	0.23	0.37	0.56	1.10	1.86	2.87	5.73	9.85	15.38	22.43	31.11		
40	50	0.14	0.25	0.41	0.62	1.20	2.03	3.14	6.26	10.75	16.79	24.49	33.97		
	70	0.14	0.25	0.41	0.62	1.20	2.03	3.14	6.28	10.78	16.83	24.55	34.05		
	90	0.14	0.25	0.42	0.63	1.23	2.08	3.22	6.43	11.04	17.24	25.15	34.88		

TABLE 7 – MINIMUM REFRIGERATION CAPACITY IN TONS FOR OIL ENTRAINMENT UP SUCTION RISERS (TYPE L COPPER TUBING) (CONTINUED)

REFRIGERANT	SATURATION SUCTION TEMP., °F	SUCTION GAS TEMP., °F	PIPE O.D., IN.													
			1/2	5/8	3/4	7/8	1-1/8	1-3/8	1-5/8	2-1/8	2-5/8	3-1/8	3-5/8	4-1/8		
			AREA, IN ²													
407C	-40	-30	0.06	.10	0.17	0.25	0.348	0.484	0.825	1.256	1.780	3.094	4.770	6.812	9.213	11.97
		-10	0.06	0.10	0.17	0.26	0.348	0.484	0.825	1.256	1.780	3.094	4.770	6.812	9.213	11.97
		10	0.06	0.11	0.18	0.27	0.348	0.484	0.825	1.256	1.780	3.094	4.770	6.812	9.213	11.97
	-20	-10	0.08	0.14	0.23	0.34	0.484	0.825	1.256	1.780	3.094	4.770	6.812	9.213	11.97	14.81
		10	0.08	0.14	0.23	0.35	0.484	0.825	1.256	1.780	3.094	4.770	6.812	9.213	11.97	14.81
		30	0.08	0.14	0.24	0.36	0.484	0.825	1.256	1.780	3.094	4.770	6.812	9.213	11.97	14.81
	0	10	0.10	0.18	0.29	0.45	0.67	1.13	1.75	3.49	6.00	9.36	13.65	18.93	24.56	31.79
		0	0.10	0.18	0.30	0.46	0.68	1.15	1.78	3.56	6.11	9.54	13.92	19.30	25.20	
		50	0.10	0.19	0.31	0.47	0.69	1.17	1.83	3.65	6.28	9.80	14.29	19.82	25.82	
	20	30	0.13	0.23	0.38	0.58	0.87	1.47	2.27	4.53	7.78	12.14	17.71	24.56	31.79	
		50	0.13	0.23	0.39	0.59	0.89	1.51	2.33	4.65	7.98	12.46	18.17	25.20		
		70	0.13	0.24	0.39	0.60	0.91	1.54	2.38	4.76	8.17	12.76	18.61	25.82		
40	50	0.16	0.29	0.47	0.71	1.12	1.90	2.94	5.86	10.06	15.71	22.92	32.28			
	70	0.16	0.29	0.48	0.73	1.14	1.93	2.98	5.95	10.22	15.95	23.27	32.85			
	90	0.17	0.30	0.49	0.74	1.16	1.96	3.03	6.05	10.40	16.24	23.68	32.85			

Refrigeration capacity in tons is based on 90°F liquid temperature and superheat as indicated by the temperature in the table. The saturated condensing and suction conditions are referenced to the dewpoint for R-407C. For other liquid line temperatures, use correction factors to the capacity given in the table below.

REFRIGERANT	LIQUID TEMPERATURE, °F											
	50	60	70	80	100	110	120	130	140			
22	1.16	1.12	1.08	1.04	0.96	0.91	0.87	0.82	0.78			
134a	1.19	1.15	1.10	1.05	0.95	0.90	0.84	0.79	0.73			
407C	1.21	1.16	1.11	1.05	0.94	0.89	0.83	0.77	0.70			

23 TABLE 8 - MINIMUM REFRIGERATION CAPACITY IN TONS FOR OIL ENTRAINMENT UP HOT GAS RISERS (TYPE L COPPER TUBING)

REFRIGERANT	SATURATION SUCTION TEMP., °F	SUCTION GAS TEMP., °F	PIPE O.D., IN.											
			1/2	5/8	3/4	7/8	1-1/8	1-3/8	1-5/8	2-1/8	2-5/8	3-1/8	3-5/8	4-1/8
			AREA, IN ²											
22	80	110	1.146	0.233	0.348	0.484	0.825	1.256	1.780	3.094	4.770	6.812	9.213	11.97
		140	0.23	0.42	0.69	1.04	2.02	3.42	5.29	10.56	18.15	28.33	41.32	57.31
		170	0.21	0.38	0.65	0.98	1.91	3.23	5.00	9.98	17.15	26.77	39.04	54.15
	90	120	0.24	0.43	0.71	1.07	2.09	3.53	5.46	10.90	18.72	29.22	42.62	59.12
		150	0.23	0.40	0.67	1.01	1.96	3.32	5.13	10.25	17.60	27.48	40.08	55.60
		180	0.22	0.39	0.64	0.96	1.88	3.17	4.90	9.78	16.81	26.24	38.27	53.09
	100	130	0.25	0.44	0.73	1.11	2.16	3.65	5.64	11.26	19.34	30.20	44.05	61.10
		160	0.23	0.41	0.68	1.03	2.01	3.41	5.27	10.51	18.05	28.18	41.11	57.02
		190	0.22	0.40	0.65	0.99	1.92	3.25	5.02	10.02	17.21	26.86	39.18	54.34
	110	140	0.25	0.45	0.75	1.13	2.21	3.73	5.77	11.52	19.79	30.89	45.06	62.50
		170	0.24	0.42	0.70	1.06	2.06	3.48	5.38	10.73	18.44	28.79	41.99	58.24
		200	0.22	0.40	0.66	0.99	1.93	3.27	5.06	10.09	17.33	27.06	39.46	54.74
120	150	0.26	0.46	0.76	1.15	2.25	3.80	5.87	11.72	20.14	31.44	45.85	63.60	
	180	0.24	0.43	0.70	1.06	2.07	3.50	5.41	10.81	18.56	28.98	42.27	58.63	
	210	0.23	0.41	0.67	1.01	1.97	3.34	5.16	10.30	17.70	27.63	40.30	55.90	
80	110	0.20	0.36	0.59	0.89	1.73	2.93	4.52	9.03	15.51	24.22	35.32	48.99	
	140	0.19	0.33	0.55	0.83	1.62	2.74	4.24	8.47	14.55	22.71	33.13	45.95	
	170	0.18	0.32	0.53	0.80	1.55	2.63	4.06	8.10	13.92	21.73	31.70	43.97	
90	20	0.20	0.37	0.61	0.92	1.79	3.02	4.67	9.32	16.01	24.99	36.45	50.56	
	150	0.19	0.34	0.56	0.85	1.66	2.80	4.33	8.64	14.84	23.17	33.79	46.87	
	180	0.18	0.33	0.54	0.82	1.59	2.69	4.16	8.30	14.26	22.27	32.48	45.05	
100	130	0.21	0.37	0.62	0.93	1.81	3.07	4.74	9.47	16.26	25.39	37.03	51.36	
	160	0.20	0.35	0.58	0.88	1.71	2.90	4.48	8.95	15.37	23.99	34.99	48.54	
	190	0.19	0.34	0.55	0.84	1.63	2.76	4.26	8.50	14.61	22.80	33.26	46.13	
110	140	0.21	0.38	0.63	0.96	1.86	3.15	4.88	9.73	16.71	26.09	38.06	52.79	
	170	0.20	0.36	0.59	0.90	1.75	2.95	4.57	9.11	15.66	24.44	35.65	49.45	
	200	0.19	0.34	0.56	0.85	1.65	2.80	4.32	8.63	14.83	23.15	33.76	46.83	
120	150	0.21	0.38	0.63	0.96	1.87	3.16	4.88	9.74	16.73	26.12	38.10	52.85	
	180	0.20	0.36	0.60	0.90	1.76	2.97	4.60	9.18	15.76	24.61	35.89	49.79	
	210	0.19	0.34	0.57	0.86	1.67	2.83	4.37	8.73	14.99	23.41	34.14	47.36	








TABLE 8 – MINIMUM REFRIGERATION CAPACITY IN TONS FOR OIL ENTRAINMENT UP HOT GAS RISERS (TYPE L COPPER TUBING) (CONTINUED)

REFRIGERANT	SATURATION SUCTION TEMP., °F	SUCTION GAS TEMP., °F	PIPE O.D., IN.											
			1/2	5/8	3/4	7/8	1-1/8	1-3/8	1-5/8	2-1/8	2-5/8	3-1/8	3-5/8	4-1/8
			AREA, IN ²											
407C	80	110	0.146	0.233	0.348	0.484	0.825	1.256	1.780	3.094	4.770	6.812	9.213	11.97
		140	0.23	0.42	0.69	1.05	2.04	3.46	5.34	10.66	18.32	28.60	41.72	57.87
		170	0.22	0.40	0.66	0.99	1.93	3.27	5.05	10.08	17.31	27.02	39.42	54.67
	90	120	0.21	0.38	0.63	0.95	1.85	3.13	4.84	9.66	16.60	25.91	37.79	52.42
		150	0.24	0.43	0.71	1.07	2.07	3.51	5.42	10.83	18.60	29.03	42.35	58.74
		180	0.23	0.41	0.67	1.02	1.98	3.35	5.19	10.35	17.78	27.76	40.49	56.17
	100	130	0.22	0.39	0.65	0.98	1.90	3.22	4.97	9.93	17.06	26.63	38.83	53.87
		160	0.24	0.44	0.72	1.09	2.13	3.60	5.56	11.10	19.07	29.77	43.42	60.23
		190	0.23	0.42	0.69	1.05	2.04	3.44	5.32	10.62	18.25	28.49	41.55	57.63
	110	140	0.22	0.40	0.66	1.00	1.94	3.28	5.07	10.12	17.39	27.15	39.60	54.93
		170	0.25	0.45	0.73	1.11	2.16	3.66	5.65	11.28	19.38	30.25	44.12	61.21
		200	0.24	0.42	0.70	1.06	2.06	3.49	5.39	10.76	18.49	28.86	42.10	58.39
120	150	0.23	0.41	0.67	1.01	1.98	3.34	5.17	10.31	17.71	27.65	40.32	55.93	
	180	0.25	0.45	0.75	1.13	2.20	3.71	5.74	11.45	19.68	30.72	44.80	62.15	
	210	0.24	0.43	0.71	1.07	2.09	3.53	5.46	10.91	18.73	29.25	42.66	59.17	
			0.23	0.41	0.68	1.03	2.01	3.40	5.26	10.49	18.03	28.14	41.04	56.93

Refrigeration capacity in tons is based on a saturated suction temperature of 20°F with 15°F superheat at the indicated saturated condensing temperature with 15°F subcooling. The saturated condensing and suction conditions are referenced to the dewpoint for R-407C. For other saturated suction temperatures with 15°F superheat, use correction factors to the capacity given in the table below.

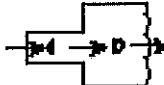

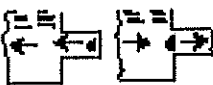

REFRIGERANT	SATURATED SUCTION TEMPERATURE, °F		
	-40	-20	0 40
22	0.91	0.94	0.97 1.03
134a	-	-	0.96 1.04
407C	0.88	0.92	0.96 1.04

TABLE 9 – FITTING LOSSES IN EQUIVALENT FEET OF PIPE (SCREWED, WELDED, FLANGED AND BRAZED CONNECTIONS)

Nominal Pipe or Tube Size, In.	Smooth Bend Elbows							Smooth Bend Tees		
	90° Std.†	90° Long Radius†	90° Street†	45° Std.†	45° Std.†	180° Std.†	Flow Through Branch	Straight-Through Flow		
								No Reflection	Reduced 1/4	Reduced 1/2
3/8	1.4	0.8	2.3	0.7	1.1	2.3	2.7	0.9	1.2	1.4
1/2	1.6	1.0	2.5	0.8	1.3	2.6	3.0	1.0	1.4	1.6
3/4	2.0	1.4	3.2	0.9	1.6	3.2	4.0	1.4	1.9	2.0
1	2.6	1.7	4.1	1.3	2.1	4.1	6.0	1.7	2.2	2.6
1-1/4	3.3	2.3	5.6	1.7	3.0	5.6	7.0	2.3	3.1	3.3
1-1/2	4.0	2.6	6.3	2.1	3.4	6.3	8.0	2.6	3.7	4.0
2	5.0	3.3	8.2	2.8	4.6	8.2	10.0	3.3	4.7	5.0
2-1/2	6.0	4.1	10.0	3.2	6.2	10.0	12.0	4.1	5.6	6.0
3	7.5	5.0	12.0	4.0	6.4	12.0	16.0	5.0	7.0	7.5
3-1/2	9.0	5.9	12.0	4.7	7.3	16.0	18.0	5.9	8.0	9.0
4	10.0	6.7	10.0	6.2	8.6	17.0	21.0	6.7	9.0	10.0
5	15.0	8.2	12.0	6.6	11.0	21.0	26.0	8.2	12.0	15.0
6	18.0	10.0	15.0	7.9	13.0	26.0	30.0	10.0	14.0	18.0

LD07400

TABLE 10 – SPECIAL FITTING LOSSES IN EQUIVALENT FEET OF PIPE (ASHRAE)

Nominal Pipe or Tube Size, In.	Sudden Enlargement, d/D			Sudden Contraction, d/D			Sharp Edge		Pipe Projection	
	1/4	1/2	3/4	1/4	1/2	3/4	Entrance	Exit	Entrance	Exit
										
3/8	1.4	0.8	0.3	0.7	0.5	0.3	1.5	0.8	1.5	1.1
1/2	1.6	1.1	0.4	0.9	0.7	0.4	1.8	1.0	1.8	1.6
3/4	2.5	1.5	0.5	1.2	1.0	0.5	2.4	1.4	2.4	2.2
1	3.2	2.0	0.7	1.9	1.2	0.7	3.7	1.9	3.7	2.7
1-1/8	4.7	3.0	1.0	2.3	1.6	1.0	5.3	2.6	5.3	4.2
1-1/2	6.8	3.8	1.2	2.9	2.2	1.2	6.6	3.3	6.6	5.0
2	8.0	4.8	1.6	4.0	3.0	1.6	8.0	4.4	8.0	6.5
2-1/2	10.0	6.1	2.0	5.0	3.8	2.0	12.0	5.8	12.0	8.7
3	13.0	8.0	2.6	6.5	4.9	2.6	14.0	7.2	14.0	11.0
3-1/2	16.0	9.2	3.0	7.7	6.0	3.0	17.0	8.5	17.0	13.0
4	17.0	11.0	3.8	9.0	6.8	3.8	20.0	10.0	20.0	16.0
5	24.0	16.0	6.0	12.0	9.0	5.0	27.0	14.0	27.0	20.0
6	29.0	22.0	8.0	15.0	11.0	6.0	33.0	18.0	33.0	25.0

LD07401

TABLE 11 – VALVE LOSSES IN EQUIVALENT FEET OF PIPE (ASHRAE)

Nominal Pipe or Tube Size, in.	Globe ^a	60° Wye	45° Wye	Angle ^a	Gate ^b	Swing Check ^c	Lift Check
3/8	17	8	6	6	0.6	5	Globe and vertical lift same as globe valve ^d
1/2	18	9	7	7	0.7	6	
3/4	22	11	9	9	0.9	8	
1	29	15	12	12	1.0	10	
1-1/4	38	20	15	15	1.5	14	
1-1/2	43	24	18	18	1.8	16	
2	55	30	24	24	2.3	20	
2-1/2	69	35	29	29	2.8	25	Angle lift same as angle valve
3	84	43	35	35	3.2	30	
3-1/2	100	50	41	41	4.0	35	
4	12	58	47	47	4.5	40	
5	140	71	58	58	6.0	50	
6	170	88	70	70	7.0	60	

NOTE:

Losses are for valves in fully open position and with screwed, welded, flanged, or flared connections.

^a These losses do not apply to valves with needlepoint seats.

^b Regular and short pattern plug cock valves, when fully open, have the same loss as gate valve.

^c Losses also apply to the in-line, ball-type check valve.

^d For Y pattern globe lift check valve with seat approximately equal to the nominal pipe diameter, use values of 60° Wye valves for loss.

TABLE 12 – REFRIGERANT CHARGE IN POUNDS PER 100 FEET OF SUCTION LINE

Line Size, O.D.	Saturated Suction Temperature, °F								
	R-22			R-134a			R-407C		
	-40	0	40	0	20	40	-40	0	40
1/2	0.03	0.07	0.15	0.05	0.07	0.11	0.02	0.06	0.14
5/8	0.05	0.12	0.25	0.08	0.12	0.17	0.04	0.10	0.22
3/4	0.07	0.18	0.37	0.11	0.17	0.26	0.06	0.15	0.33
7/8	0.10	0.24	0.51	0.16	0.24	0.36	0.08	0.21	0.46
1-1/8	0.17	0.42	0.87	0.27	0.41	0.61	0.14	0.36	0.79
1-3/8	0.26	0.64	1.33	0.41	0.62	0.92	0.21	0.55	1.20
1-5/8	0.37	0.90	1.88	0.58	0.88	1.31	0.30	0.78	1.70
2-1/8	0.65	1.57	3.27	1.00	1.54	2.27	0.53	1.35	2.95
2-5/8	1.01	2.42	5.04	1.55	2.37	3.50	0.81	2.09	4.55
3-1/8	1.44	3.45	7.19	2.21	3.38	5.00	1.16	2.98	6.50
3-5/8	1.94	4.66	9.73	2.99	4.57	6.77	1.57	4.03	8.79
4-1/8	2.52	6.06	12.65	3.88	5.94	8.79	2.04	5.24	11.42
5-1/8	3.93	9.45	19.71	6.05	9.26	13.70	3.17	8.17	17.80
6-1/8	5.65	13.58	28.34	8.69	13.31	19.70	4.56	11.74	25.59

TABLE 13 – REFRIGERANT CHARGE IN POUNDS PER 100 FEET OF DISCHARGE LINE

Line Size, O.D.	Saturated Suction Temperature, °F								
	R-22			R-134a			R-407C		
	-40	0	40	0	20	40	-40	0	40
1/2	0.22	0.33	0.48	0.17	0.27	0.40	0.21	0.33	0.50
5/8	0.35	0.53	0.77	0.27	0.43	0.65	0.34	0.53	0.80
3/4	0.53	0.79	1.15	0.41	0.64	0.97	0.50	0.78	1.19
7/8	0.73	1.10	1.60	0.57	0.89	1.34	0.70	1.09	1.65
1-1/8	1.25	1.87	2.72	0.97	1.52	2.29	1.19	1.86	2.81
1-3/8	1.90	2.85	4.14	1.48	2.31	3.49	1.81	2.83	4.28
1-5/8	2.69	4.04	5.86	2.09	3.28	4.94	2.57	4.01	6.06
2-1/8	4.67	7.02	10.20	3.63	5.70	8.59	4.47	6.97	10.55
2-5/8	7.20	10.83	15.72	5.60	8.79	13.25	6.89	10.74	16.27
3-1/8	10.28	15.45	22.45	8.00	12.54	18.92	9.83	15.34	23.22
3-5/8	13.91	20.90	30.36	10.82	16.96	25.59	13.30	20.74	31.40
4-1/8	18.08	27.17	39.46	14.06	22.05	33.26	17.29	26.96	40.82
5-1/8	28.17	42.34	61.50	21.91	34.37	51.84	26.94	42.02	63.62
6-1/8	40.50	60.87	88.41	31.50	49.40	74.52	38.73	60.41	91.46

Discharge superheat is 105°F for R-22 and R-407C, and 85°F for R-134a.

TABLE 14 – REFRIGERANT CHARGE IN POUNDS PER 100 FEET OF LIQUID LINE

Line Size, O.D.	Saturated Suction Temperature, °F								
	R-22			R-134a			R-407C		
	-40	0	40	0	20	40	-40	0	40
1/2	7.47	7.03	6.50	7.56	7.13	6.64	7.11	6.64	6.11
5/8	12.01	11.29	10.44	12.15	11.46	10.66	1.42	10.67	9.81
3/4	17.93	16.86	15.59	18.14	17.11	15.92	17.05	15.93	14.65
7/8	24.91	23.42	21.66	25.20	23.78	22.11	23.69	22.14	20.35
1-1/8	42.47	39.93	36.93	42.96	40.54	37.70	40.39	37.74	34.70
1-3/8	64.69	60.82	56.24	65.44	61.74	57.42	61.52	57.49	52.85
1-5/8	91.56	86.09	79.61	92.62	87.39	81.28	87.08	81.37	74.81
2-1/8	159.30	149.80	138.50	161.10	152.00	141.40	151.50	141.60	130.10
2-5/8	245.60	231.00	213.60	248.50	234.40	218.00	233.60	218.30	200.70
3-1/8	350.60	329.70	304.80	354.70	334.60	311.20	333.40	311.60	286.40
3-5/8	474.20	445.90	412.30	479.70	452.60	420.90	451.00	421.40	387.40
4-1/8	616.40	579.60	536.00	623.60	588.40	547.20	586.20	547.80	503.60
5-1/8	960.70	903.30	835.30	971.80	917.00	852.80	913.70	853.80	784.90
6-1/8	1381.00	1299.00	1201.00	1397.00	1318.00	1226.00	1313.00	1227.00	1128.00

Discharge superheat is 105°F for R-22 and R-407C, and 85°F for R-134a.



START UP REQUEST FORM



**CONTRACTORS INSTALLATION CHECKLIST AND REQUEST FOR
START-UP of Air-Cooled Equipment**

TO: _____

JOB NAME: _____

LOCATION: _____

YORK CONTRACT #: _____

PHONE NO.: _____

YORK PHONE NO.: 513-605-6045

FAX NO.: _____

YORK FAX NO.: 513-489-7516

The following work (as checked below) is in progress and will be completed by: _____

Date that you wish for a York Certified Technician to begin the start-up process _____

**THE FOLLOWING WORK MUST BE COMPLETED IN ACCORDANCE WITH INSTALLATION
INSTRUCTIONS AND TWO (2) WEEKS NOTICE IS REQUIRED FOR SCHEDULING OF START-UP.**

A-WATER PIPING:

- Chilled water piping installed between cooler, pumps and cooling coils
- All water piping checked for strain. Piping should not spring when connections are broken at unit
- Water piping leak tested and flushed. Water strainers cleaned after flushing. Piping systems filled with water and trapped air vented
- Chilled water flow available to meet unit design requirements
- Cooling load available
- Pressure taps available on chiller piping (on chiller side of butterfly valves) for technician to verify design flows
- Flow switch set at minimum flow (to be confirmed by York Service technician)

C-ELECTRICAL WIRING:

- Power wiring completed to control panel
- Flow switches piped and wired per York wiring diagram
- Power available

**D-TESTING, DEHYDRATION AND CHARGING FOR SPLIT SYSTEMS (UNDER YORK
SUPERVISION IF SHIPPED LESS REFRIGERANT OR DISMANTLED):**

- Unit and piping pressure tested by contractor
- Unit must be dehydrated to 2000 microns and sit overnight. Vacuum confirmation will be done by York Service technician.
- Refrigerant available by contractor near unit

DATE: _____

CUSTOMER SIGNATURE: _____

Customer Print Name _____

WARRANTY

**OPTIONAL 30 MONTHS (2 YEAR) PARTS & LABOR WARRANTY
FOR THE ENTIRE UNIT
YORK INTERNATIONAL CORPORATION
ENGINEERED SYSTEMS - YORK AMERICAS**

PRODUCT TYPE:	<u>AIR COOLED</u>	COMPRESSOR SERIAL NUMBER(S):	_____
YORK CONTRACT NO.:	_____		_____
UNIT MODEL NUMBER:	<u>YLAA0101YE17</u>		_____
UNIT SERIAL NUMBER:	_____		_____
UNIT TAG ID:	<u>YLAACA</u>		_____
UNIT LOCATION:	_____		_____

PROJECT NAME: OAK HILLS - CHILLER
 INSTALLATION ADDRESS: _____

Shipping Date _____

The term of this agreement is 30 months, commencing _____ and expires _____.

LIMITED WARRANTY

WHEN PROPERLY ENDORSED, THIS PROTECTION PLAN BETWEEN YORK INTERNATIONAL CORPORATION (YORK) AND CUSTOMER, WARRANTS, TO THE CUSTOMER NAMED HEREIN, PARTS AND LABOR FOR THE ENTIRE UNIT. IT DOES NOT COVER REFRIGERANT COST, FREIGHT CHARGES, *** UNASSIGNED ***OR ANY OTHER COSTS.

THIS WARRANTY EXCLUDES IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, AND WE DO NOT ASSUME, OR AUTHORIZE ANY OTHER PERSON TO ASSUME OTHER WARRANTIES FOR US. THIS WARRANTY IS OFFERED AS AN EXTENSION TO THE STANDARD LIMITED WARRANTY (FORM 50.05-NM2) AND IS SUBJECT TO THE SAME LIMITATIONS AND EXCLUSIONS, EXCEPT WHERE NOTED.

THIS PROTECTION PLAN DOES NOT COVER FAILURE OR DAMAGE RESULTING FROM FIRE, FLOOD, ABUSE, OR ACT OF GOD. ALSO EXCLUDED ARE DAMAGES OR FAILURES CAUSED BY INSTALLATION, OPERATION, OR MAINTENANCE CONTRARY TO YORK RECOMMENDATIONS, OR THOSE OF THE MANUFACTURER IF OTHER THAN YORK. IN NO EVENT SHALL YORK BE LIABLE FOR CONSEQUENTIAL, INCIDENTAL, OR INDIRECT DAMAGE, LOSS, OR INJURY. WARRANTY FOR EXCHANGE OR PARTS PROCUREMENT SERVICE SHALL BE AVAILABLE THROUGH THE SERVICER LISTED HEREIN DURING NORMAL WORKING HOURS.

DISTRICT SERVICE OFFICE: _____

OFFERED BY: _____
 York Selling Representative Print/Sign _____ Date _____

APPROVED BY: _____
 York Area Service Manager Print/Sign _____ Date _____

ACCEPTED BY: _____
 Customer Signature _____ Date _____

(Manufacturer's Use Only)

AUTHORIZED BY: Robert D. Halaszynski _____ Date 05/21/2010 AT 15:20
 Manager, Warranty Administration _____ Date _____

**OPTIONAL 66 MONTHS (5 YEAR) PARTS ONLY WARRANTY
FOR THE COMPRESSORS
YORK INTERNATIONAL CORPORATION
ENGINEERED SYSTEMS - YORK AMERICAS**

PRODUCT TYPE:	<u>AIR COOLED</u>	COMPRESSOR SERIAL NUMBER(S):
YORK CONTRACT NO.:	_____	_____
UNIT MODEL NUMBER:	<u>YLAA0101YE17</u>	_____
UNIT SERIAL NUMBER:	_____	_____
UNIT TAG ID:	<u>YLAACA</u>	_____
UNIT LOCATION:	_____	_____

PROJECT NAME: OAK HILLS - CHILLER
 INSTALLATION ADDRESS: _____

Shipping Date _____

The term of this agreement is 66 months, commencing _____ and expires _____.

LIMITED WARRANTY

WHEN PROPERLY ENDORSED, THIS PROTECTION PLAN BETWEEN YORK INTERNATIONAL CORPORATION (YORK) AND CUSTOMER, WARRANTS, TO THE CUSTOMER NAMED HEREIN, PARTS ONLY FOR THE COMPRESSORS. IT DOES NOT COVER REFRIGERANT COST, FREIGHT CHARGES, LABOR COST, OR ANY OTHER COSTS.

THIS WARRANTY EXCLUDES IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, AND WE DO NOT ASSUME, OR AUTHORIZE ANY OTHER PERSON TO ASSUME OTHER WARRANTIES FOR US. THIS WARRANTY IS OFFERED AS AN EXTENSION TO THE STANDARD LIMITED WARRANTY (FORM 50.05-NM2) AND IS SUBJECT TO THE SAME LIMITATIONS AND EXCLUSIONS, EXCEPT WHERE NOTED.

THIS PROTECTION PLAN DOES NOT COVER FAILURE OR DAMAGE RESULTING FROM FIRE, FLOOD, ABUSE, OR ACT OF GOD. ALSO EXCLUDED ARE DAMAGES OR FAILURES CAUSED BY INSTALLATION, OPERATION, OR MAINTENANCE CONTRARY TO YORK RECOMMENDATIONS, OR THOSE OF THE MANUFACTURER IF OTHER THAN YORK. IN NO EVENT SHALL YORK BE LIABLE FOR CONSEQUENTIAL, INCIDENTAL, OR INDIRECT DAMAGE, LOSS, OR INJURY. WARRANTY FOR EXCHANGE OR PARTS PROCUREMENT SERVICE SHALL BE AVAILABLE THROUGH THE SERVICER LISTED HEREIN DURING NORMAL WORKING HOURS.

DISTRICT SERVICE OFFICE: _____

OFFERED BY: _____
 York Selling Representative Print/Sign _____ Date _____

APPROVED BY: _____
 York Area Service Manager Print/Sign _____ Date _____

ACCEPTED BY: _____
 (Manufacturer's Use Only) Customer Signature _____ Date _____

AUTHORIZED BY: *Robert D. Hilday* _____ Date 05/21/2010 AT 15:20
 Manager, Warranty Administration Date



Submittal

The Trane Company
A Division of American Standard Inc.

Date: June 26, 1998

s River City Mechanical

Sold To:

TEEPE'S RIVER CITY MECHANICAL
2105 SCHAPPELLE
CINCINNATI , OH 45240

Job Name:

New Delhi Middle School (Rapid Run Middle)
Pontius Road
CINCINNATI, OH 45202

The Trane Company is pleased to provide the enclosed submittal for your review and approval.

Products Included in this Submittal Package:

Qty	Description
2	Water Cooled Helical Rotary Chillers (Simplex)

Serial #'s U98J03161, U98K03162

Specification Section 15671

NOTES:

- Chillers are in accordance with industry standard ARI Standard 550, ANSI/ASHRAE 15 – 1992 Safety Code for Mechanical Refrigeration, ASME Boiler and Pressure Vessel Code, Section 8, ANSI B31.1 – Power Piping Code, National Electric Code (NFPA No. 70), and ASHRAE Standard 90-75.
- Sound power levels for the chillers are in accordance with industry standard ARI 575.
- Start-up and operator instruction by factory trained service personnel is included.
- The refrigerant monitoring system is not included.
- A complete sound package is standard.
- The following warranties are included: one year parts warranty on the entire unit, five year replacement compressor warranty, and one year labor warranty on the entire unit.

The attached information describes the equipment we propose to furnish for this project, and is submitted for your approval.

Cincinnati - W. Schriener/M. Dangel
1807 Dalton Street
Cincinnati, OH 45214
Phone: 513-621-7126
Fax: 513-621-5299

Table of Contents

Water Cooled Helical Rotary Chillers (Simplex) (Item A1)

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Water Cooled Helical Rotary Chillers (Simplex)	9

Tag Data - Water Cooled Helical Rotary Chillers (Simplex)

Item	Tag(s)	Qty	Description	Model Number
A1	CH-1, CH-2	2	Series R CenTraVac	RTHB215

Product Data

Item: A1 Qty: 2 Tag(s): CH-1, CH-2

- Water-Cooled Series R(TM) CenTraVac(TM)
- 215 Nominal Tons
- Standard Cooling
- UL/CUL Listing
- Factory Insulation
- Extended Length Shells
- 3 Pass Evaporator
- L.H. Evaporator Connection
- 150 psi Evaporator Water Pressure
- Internally Enhanced Evaporator Tubes
- 2 Pass Condenser
- L.H. Condenser Connection
- 150 psi Condenser Water Pressure
- Internally Enhanced Tubes
- Unit Mounted Star Delta Starter
- Standard Electrical Termination
- 460 Volt/60 Hertz/3 Phase
- 145 kW Motor
- 207 Max RLA
- 150 psi NEMA 1 Flow Switch x 2 (Fld)
- CWR - Outdoor Air Sensor (Fld)
- 2-5th Year Replacement Compressor Warranty
- 1st Year Labor Warranty Whole Unit
- Disconnect Switch
- Start-Up

Fld = Furnished by Trane / Installed by Others

Performance Data

Tags	CH-1	CH-2
Item	A1	A1
Capacity (tons)	201.0	201.0
Design (kW)	142.0	142.0
Entering Evap. Water Temp. (F)	55.7	55.7
Leaving Evap. Water Temp. (F)	42.0	42.0
Evaporator Flow (gpm)	351.0	351.0
Evaporator Pressure Drop (ft)	6.0	6.0
Evaporator Fouling Factor (hr-sq ft-deg F/Btu)	0.00025	0.00025
Entering Cond. Water Temp. (F)	85.0	85.0
Leaving Cond. Water Temp. (F)	96.3	96.3
Condenser Flow (gpm)	513.0	513.0
Condenser Pressure Drop (ft)	7.0	7.0
Condenser Fouling Factor (hr-sq ft-deg F/Btu)	0.00025	0.00025
Motor Full Load Amps (A)	206.0	206.0
Motor Locked Rotor Amps (A)	979.0	979.0

Part Load Performance Data (CH-1 & CH-2)

Percent	80%	60%	40%	25%
Capacity (Tons)	161	121	80	50
Entering Evap. Water Temp. (F)	53.0	50.2	47.5	45.4
Leaving Evap. Water Temp. (F)	42.0	42.0	42.0	42.0
Entering Cond. Water Temp. (F)	80.0	75.0	70.0	66.3
Leaving Cond. Water Temp. (F)	88.8	81.6	74.4	69.10
Design (kW)	100.0	69.0	46.0	38.0

Mechanical Specifications - Water Cooled Helical Rotary Chillers (Simplex)

Item(s): A1 Qty: 2 Tag(s): CH-1, CH-2

General

Exposed metal surfaces are painted with an air-dry executive beige primer-finisher prior to shipment. Each unit ships with a full operating charge of refrigerant and oil. Molded neoprene isolation pads are supplied for placement under all support points. Start-up and operator instruction by factory trained service personnel is included.

Compressor - Motor

Semi-hermetic, direct drive, rotary compressor with: capacity control slide valve, integral single-stage economizer with no moving parts, oil sump heater and differential refrigerant pressure oil flow system. Four pressure lubricated rolling element bearing groups support the rotating assembly.

Motor is a liquid refrigerant cooled, hermetically sealed, two-pole, squirrel cage induction motor.

Evaporator

Shells are carbon steel plate. Evaporators are designed, tested and stamped in accordance with ASME Code for refrigerant side working pressure of 300 psig (2068.5 kPa).

All tube sheets are carbon steel. Evaporator tubes are individually replaceable. Tubes are externally finned, internally enhanced seamless copper with lands at all tube sheets. Evaporator tubes are 1 inch (25.40 mm) in diameter. Tubes are mechanically expanded into tube sheets.

Water pass arrangements are flat-faced flange 150 psig (1034.3 kPa) waterside. Connections are left-handed. Waterside is hydrostatically tested at 1 1/2 times design working pressure, but not less than 225 psig (1551.5 kPa).

Condenser

Shells are carbon steel plate. Condensers are designed, tested

and stamped in accordance with ASME Code for refrigerant side working pressure of 300 psig (2068.5 kPa).

All tube sheets are carbon steel. Condenser tubes are individually replaceable. Tubes are externally finned, internally enhanced seamless copper with lands at all tube sheets. Condenser tubes are 3/4" (19.05 mm) in diameter. Condenser tubes are mechanically expanded into tube sheets and mechanically fastened to tube supports. Condenser baffle prevents direct impingement of compressor discharge gas upon the tubes.

Water pass arrangements are flat-faced flange 150 psig (1034.3 kPa) waterside. Connections are left-handed. Waterside is hydrostatically tested at 1 1/2 times design working pressure, but not less than 225 psig (1551.5 kPa).

Refrigerant Circuit

A multiple orifice control system consisting of an electronically controlled expansion valve and a fixed orifice, maintains proper refrigerant flow at all operating conditions.

Control Panel

Factory mounted microprocessor-based control panel. Automatic shutdown protection with manual reset is provided for low evaporator refrigerant temperature and pressure, high condenser refrigerant pressure, loss of condenser water flow, high motor temperature, low oil flow, motor current overload, phase reversal, phase loss, and severe phase imbalance. Automatic shutdown protection with automatic reset when condition is corrected is provided for loss of chilled water flow, high compressor discharge temperature, under/over voltage, and momentary power loss.

The unit control module (UCM) utilizing the Adaptive Control(TM)

microprocessor automatically takes action to prevent unit shutdown due to abnormal operating conditions associated with low evaporator refrigerant temperature, high condensing temperature, and motor current overload. If the abnormal operating condition continues and the protective limit is reached, the machine will be shut down.

Operator Interface: Factory mounted to the door of the control panel, the operator interface has a 16 button keypad for operator input and a 2 line by 40 character display screen. A chiller report, refrigerant report, compressor report, an operator configurable custom report, operator settings, service setting, service tests, and diagnostics may be accessed by pressing the appropriate button. All diagnostics and messages are displayed in "clear language".

Capacity Control

Each packaged chiller shall be equipped with a capacity control system. Capacity control shall be obtained by an electronically initiated hydraulically actuated slide valve within the compressor housing. Capacity reduction shall be of the continuously rebalancing type and shall be fully proportional to the increase or decrease in load with capacity reduction down to 10 percent or full load.

Safety Controls

The control system on the chiller contains the following control and safety devices: Manual controls include control circuit stop and start/reset switches. Safety controls include compressor motor starter (Wye-Delta type) overloads, low oil level float switches, high oil temperature thermostats, high condenser pressure switch, low evaporator pressure switch, compressor motor winding thermostat, chilled water flow switch terminals, under voltage/phase failure protection, and freezestat/chilled water thermostat. Automatic controls

include compressor motor Wye-Delta starters, anti-recycle timer, increment start timer, electronic temperature load controller with motor current draw limiter, and oil sump heater interlock relays. Refrigerant controls include load solenoid valves, and unload solenoid valves. Clear language display alarms include power on, low oil, high pressure,

compressor high motor temperature, anti-recycle, and compressor motor overloads.

Starter

Unit mounted NEMA 1 enclosure with top power wiring access and three-phase solid-state overload protection. Factory installed and wired 1 KVA control power transformer provides all unit

control power (120 volt secondary).

Insulation

All low temperature surfaces are covered with 3/4 inch (19.05 mm) Armaflex II or equal ($k=0.28$), including the evaporator, water boxes and economizer lines.

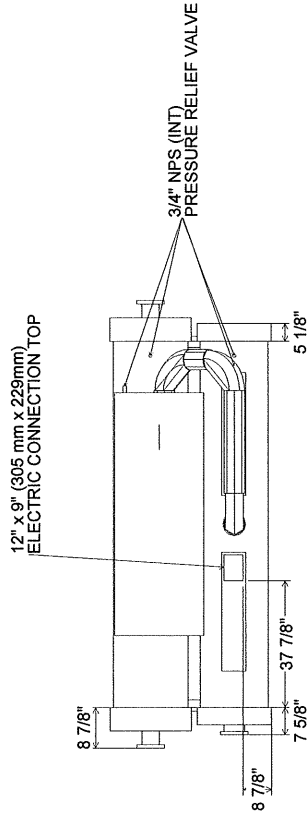
Unit Dimensions - Water Cooled Helical Rotary Chillers (Simplex)
Item: A1 Qty: 2 Tag(s): CH-1, CH-2

STARTER PANEL CONNECTION	SELECTION RLA	LUG SIZE (EACH PHASE)
MAIN LUGS ONLY	000-606	L1-L3 (EACH PHASE) (2) #4-500 MCM
MAIN CIRCUIT BREAKER OR NON - FUSED DISCONNECT SWITCH	000-146	(1) #4-350 MCM
	147-284	(1) 3/0-500 MCM + (1) 3/0-250 MCM
	285-360	(2) 4/0-350 MCM
	361-432	(2) #350-500 MCM
	433-606	(2) #1-500 MCM

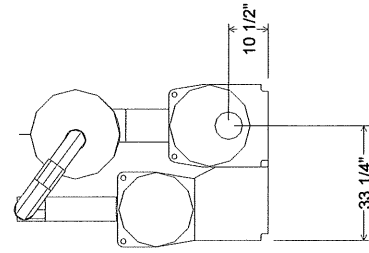
	in
CONDENSER WATER CONNECTION SIZE	6"
EVAPORATOR WATER CONNECTION SIZE	5"

NOTES:

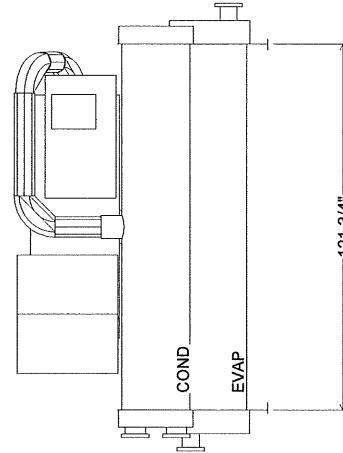
1. DIMENSIONAL TOLERANCE +/- 1/4" (6.35 mm)
2. EVAPORATOR ENTERING IS THE TOP CONNECTION AND EVAPORATOR LEAVING IS THE BOTTOM CONNECTION.
3. CONDENSER ENTERING IS THE BOTTOM CONNECTION AND CONDENSER LEAVING IS THE TOP CONNECTION.



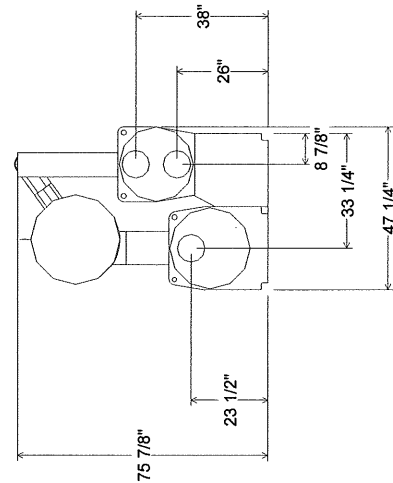
PLAN VIEW



RIGHT END VIEW



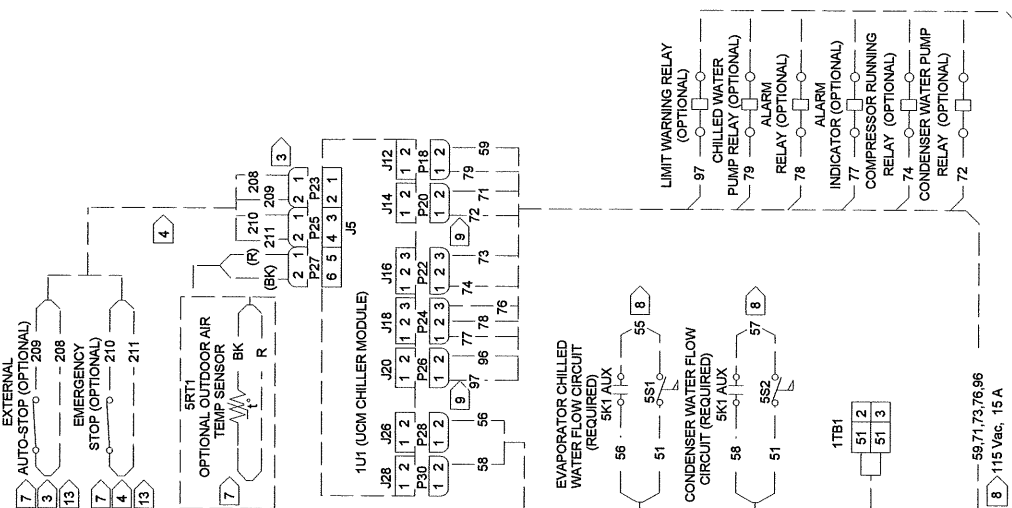
FRONT VIEW



LEFT END VIEW

Field Wiring - Water Cooled Helical Rotary Chillers (Simplex)

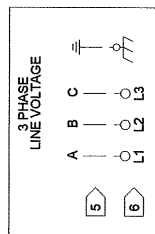
Item: A1 Qty: 2 Tag(s): CH-1, CH-2



- NOTES:
- DASHED LINES INDICATE RECOMMENDED FIELD WIRING BY OTHERS. PHANTOM LINES INDICATE ALTERNATE CONNECTIONS TO AVAILABLE SALES OPTIONS. CHECK SALES ORDER TO DETERMINE IF WIRING IS REQUIRED FOR SPECIFIC OPTIONS.
 - ALL FIELD WIRING MUST BE IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE (NEC), STATE AND LOCAL REQUIREMENTS. OTHER COUNTRIES APPLICABLE NATIONAL AND/OR LOCAL REQUIREMENTS SHALL APPLY.
 - P23 TERMINALS 1 & 2 (1U1-5-1 AND -2) MUST BE JUMPERED IF NOT USED.
 - P25 TERMINALS 1 & 2 (1U1-5-3 AND -4) MUST BE JUMPERED IF NOT USED. DO NOT OVER TIGHTEN.
 - RETTIGHTEN TERMINALS A MINIMUM OF 24 HOURS AFTER INITIAL INSTALLATION.
 - COPPER WIRE, SIZED PER NEC, BASED ON UNIT NAMEPLATE MCA (MINIMUM CIRCUIT AMPACITY), PHASING OF 3 PHASE INPUT; L1 TO A, L2 TO B, L3 TO C WHERE ABC REPRESENTS STANDARD PHASE ROTATION.
 - 30V OR LESS #14-18 AWG 600V WIRE. DO NOT RUN IN CONDUIT WITH HIGHER VOLTAGE WIRE.
 - 115V/AC, #14 AWG 600V WIRE.

460

UNIT MOUNTED STARTER PANEL



9 FIELD WIRING ELECTRICAL LOADS ARE NOT TO EXCEED 120VAC/240V/VA FOR CONNECTIONS AT TERMINALS 1U1J12-1,2; 1U1J14-1,2; 1U1J16-1,3; 1U1J18-1,3; 1U1J20-1,2; 1U5J12-1,2; 1U5J18-1,3; AND 1U5J8-1,2.

13 CONTACTS TO BE SUITABLE FOR USE WITH 24 Vdc, 12ma CIRCUIT.

⚠ WARNING

HAZARDOUS VOLTAGE!
DISCONNECT ALL ELECTRIC POWER FROM THE UNIT BEFORE SERVICING. FAILURE TO DISCONNECT POWER BEFORE SERVICING CAN CAUSE SERIOUS PERSONAL INJURY OR DEATH.

⚠ CAUTION

USE COPPER CONDUCTORS ONLY. UNIT TERMINALS ARE NOT DESIGNED TO ACCEPT OTHER TYPES OF WIRING. FAILURE TO DO SO MAY CAUSE DAMAGE TO THE EQUIPMENT.

IMPORTANT

THE SERVICE PERSONNEL MUST WAIT 5 MINUTE AFTER AN AUTO STOP COMMAND IS GIVEN.

Part/Order Number Summary

Product Family - Water Cooled Helical Rotary Chillers (Simplex)

Item	Tag(s)	Qty	Description	Model Number
A1	CH-1, CH-2	2	Series R CenTraVac	RTHB215

Field Installed Option Description	Part Number/Ordering Number
150 psi NEMA 1 Flow Switch x 2	(2) X13040029
CWR - Outdoor Air Sensor	5715-0666-0100