Product Catalog

Large Commercial Split System

Model RAUP - TTV
250 - 620 MBH
5000 - 21000 CFM
50 Hz (R22 & R407C)

August 2015

MUL-PRC004-E4

TRANE

RAUP - TTV
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TRANE

Model Number Description (RAUP - TTV)

Unit Model Number Description

The product is identified by a multiple-character model number that precisely identifies a particular type of unit. An explanation is shown below it will enable the owner or Service Engineer to define operation, components and applicable accessories for a specific unit.

Standard Product Model Nomenclature

R	A	U	P	2	5	0	D	1	C	X	A	S	X	G
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

DIGIT 1,2,3 — Remote Condensing Unit / Air-Cooled / Up-Flow

DIGIT 4 — Development Sequence

DIGIT 5,6,7 — Nominal Cooling Capacity [MBH]

250 = 250	400 = 400	600 = 600
300 = 300	500 = 500	

DIGIT 8 — Electrical Rating / Utilization Range
D = 380-415V / 3Phase / 50Hz

DIGIT 9 — Factory Mounted Control
- 1 = DOL(4w) Starter (UC2c / UC4c)
- 4 = DOL (4w) Starter (UC2c / UC4c) c/w Low Ambient Controls.
- 5 = DOL(4w) Starter (Carel-mCH3)
- 6 = DOL (4w)Starter (Carel-mCH3) c/w Low Ambient Controls.

DIGIT 10 — Minor Design Sequence
C = Modular RAUP Design

DIGIT 11 — Factory Installed Options
- X = None
- 1 = Corrosion Resistant Coated Fin

DIGIT 12 — Refrigerant Type
- A =R22
- B =R407C

DIGIT 13 — Operating Ambient
- S= Standard Ambient (R22 Only)
- H= High Ambient Option (R22, R407C)

DIGIT 14 — Design Special - LIQUID LINE ACCESSORIES
- X = None. (c/w Non-Serviceable Filter Drier Only
- D= Serviceable Filter Drier + Shut-Off Valve Sight Glass + Ship Loose Solenoid Valve

DIGIT 15 — Service Indicator
G = Introduction of Carel Controller & Design Special-A

T	T	V	2	5	0	Q	D	1	I	0	0	0	A	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

DIGIT 1,2 — Indoor Unit / Cooling Only

DIGIT 3 — Air Flow Configuration
V = Vertical Discharge

DIGIT 4,5,6 — Nominal Cooling Capacity [MBH]

250 = 250	400 = 400	600 = 600
300 = 300	500 = 500	

DIGIT 7 — Development Sequence

DIGIT 8 — Electrical Rating / Utilization Range
D = 380-415V / 3Phase / 50Hz

DIGIT 9 — Factory Mounted Control
1 = DOL Starter (less Controls)

DIGIT 10 — Installed Motor kW

	Mtr , kW	
Models	Std.	O/ Size
TTV 250	I = 3.7	L = 7.5
TTV 300 / 400	K = 5.5	M = 11
TTV 500	L = 7.5	N = 15
TTV 600	M = 11	N = 15

DIGIT 11 — Future Use

DIGIT 12 — Future Use

DIGIT 13 — Future Use

DIGIT 14 — Minor Design Sequence

DIGIT 15 — Service Indicator

General Data 250 - 620 MBH Condensing Units

Table 1 - General Data 250 - 620 MBH Condensing Units

		RAUP 250	RAUP 300	RAUP 400	RAUP 500	RAUP 600
Performances (1)						
Gross Cooling Capacity [R22] [1]	(kW) / (MBH)	77 / 262	91 / 311	116 / 396	153 / 524	182 / 621
Gross Cooling Capacity [R407C]	(kW) / (MBH)	73 / 248	86 / 295	110 / 376	146 / 498	173 / 590
Unit Capacity Steps (%)		100 - 50	100 - 50	100 - 75 - 50 - 25	100 - 75 - 50 - 25	100 - 75 - 50 - 25
Total Compressor Power Input [1] STD AMBIENT	(kW)	23.0	28.0	36.0	47.0	55.0
Total Compressor Power Input [1] HIGH AMBIENT	(kW)	29.0	34.0	45.0	58.0	67.0
Main Power Supply		400Vac +/- 10% / 3Ph / 50Hz				
Sound Power Level	(dB(A)	87	89	89	90	92
Compressor						
Compressor Qty		2	2	4	4	4
Type		Scroll				
Model		2 x 13T	2 x 15T	2 x (10T + 10T)	2 x (13T + 13T)	2 x (15T + 15T)
Speeds Number (RPM)		1 (2900 RPM)				
Unit MCA Amps [4] STD AMBIENT	(A)	49	58	75	93	110
Unit MCA Amps [4] HIGH AMBIENT	(A)	58	67	87	110	127
RLA / LRA [2] STD AMBIENT	(A)	20.5 / 145	24.5 / 175	16.5 / 130	20.5 / 145	24.5 / 175
RLA / LRA [2] HIGH AMBIENT	(A)	22.9 / 145	24.2 / 175	20.7 / 130	22.9 / 145	24.2 / 175
Sump Heater (High-Low Amb, option) per Compressor	(W)	65W - 240Vac	75W - 240Vac	65W - 240Vac	65W - 240Vac	75W - 240Vac
Liquid and Suction connection						
Suction Connection	brazed	2 1/8" OD	2 1/8" OD	1 5/8" OD	2 1/8" OD	2 1/8" OD
Liquid Connection	brazed	7/8" OD	7/8" OD	7/8" OD	7/8" OD	7/8" OD
Condensing Coil						
Type		High Efficiency Plate Fin (SLIT) and Tube				
Tube Size / TYPE	(mm)	9.52mm (3/8") OD / SMOOTH BORE				
Height	(mm)	1860	1860	1860	1860	1860
Length	(mm)	1782	1782	1782	1782	1782
Quantity		1	1	2	2	2
Face Area	(m^2)	3.3	3.3	6.6	6.6	6.6
Rows STD AMBIENT		2.5	3	2	2.5	3
Rows HIGH AMBIENT		3	4	3	4	4
Fins Per Foot (fpf)		144	144	144	144	144
Fan / Motor						
Fan Type / Drive Type		Propeller / Direct Drive				
Fan / Motor Qty		2	2	3	4	4
Fan Diameter	(mm) / (in)	711 / 28"				
Speeds Number		1				
Motors kW [2]	kW / hp	0.60kW / 0.8HP				
Motors FLA / LRA [2]	(A)	1.5 / 5.7				
Motor RPM	(rpm)	900				
Unit Dimensions						
Height	(mm)	1911	1911	1911	1911	1911
Width	(mm)	1002	1002	1992	1992	1992
Length	(mm)	2264	2264	2264	2264	2264
Weight Uncrated	(kg)	583	593	990	1153	1177
Weight Crated	(kg)	603	613	1025	1188	1212
System Data						
Refrigerant Circuit		1	1	2	2	2
Refrigerant Charge Limit per Circuit	(kg)	25.0	27.0	20.0	25.0	27.0
Minimum Outdoor Air Temperature for Mechanical Cooling						
Standard Ambient Operating Range [5]	F / (C)	59-109 F / (15 - 43C)				
High Ambient Option, Max	F / (C)	115F / (46 C)				

Notes:

[1] at 7deg C SST and 35 deg C Ambient, 400V, Subcooling 8.3K, Superheat 11.1K

[2] Per Motor @ 400V

[3] Per Circuit

[4] Minimum Circuit Ampacity (MCA) is 125% of the largest compressor RLA plus 100% of the other compressor RLA plus the sum of the condenser fan FLA.

[5] High Ambient and Low Ambient Options Available.

[6] Caution advised for high pressure and low pressure trips [5] where the system performance is outside the operating envelope.

General Data 250-620MBH TTV Evaporator Prematched Air Handler

General Data Blower Coil Units 250 - 620 MBH Evaporator Prematched Air Handler

		TTV 250	TTV 300	TTV 400	TTV 500	TTV 600
Evaporator Coil	Rows / FPF	3 / 144	3 / 144	3 / 144	4 / 144	4 / 144
Evaporator Rated Air Flow	Cfm	7760	9240	12120	15130	18080
	Cmh	13180	15700	20590	25700	30720
Configuration				Vertical with fan discharge configurations		
Face Area	Sq.ft / m^2	16.7 / 1.55	19.2 / 1.78	26.2 / 2.44	34.8 / 3.24	37.9 / 3.53
Tube Material				Copper		
Tube Type				Smooth		
Tube Size (OD)	in / mm	3/8 / 9.5	3/8 / 9.5	3/8 / 9.5	0.5 / 12.7	0.5 / 12.7
No. Of Circuits		1	1	2	2	2
Refrigerant Flow Control				TXV		
Drain Connection Size	in	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4
Evaporator Fan/Motor						
Drive Type				Belt		
RLA / LRA (each) [2]		8 / 42	12 / 82	12 / 82	16 / 104	23 / 153
No of Motors	Std. HP (kw)	1-5 (3.7kw)	1-7.5 (5.5kw)	1-7.5 (5.5kw)	1-10 (7.5kw)	1-15 (11kw)
	Hi Static	10(7.5)	15(11)	15(11)	20(15)	20(15)
Diameter of Fan	in / mm	15.7 / 400	15.7 / 400	15.4 / 390	17.7 / 450	17.7 / 450
Width of Fan	in / mm	12.6 / 320	12.6 / 320	15.4 / 390	14.2 / 360	14.2 / 360
No of Fans		1	1	2	2	2
Indoor Fan Type				Centrifugal FC		
Fan Pulley Pitch Diameter	mm	224	224	224	250	250
Air Qty. - Max	cfm	8900	10600	13800	16700	21800
- Min	cfm	5900	7000	9100	11000	14400
Fan Motor Type				TEFC 400V / 3P / 50Hz		
Std. Fan Speed (Std. Factory Set)		850	900	900	760	760
@ ESP including filters in / Pa		1.1 / 275	1 / 250	0.9 / 225	1.5 / 375	1.1 / 275
Max. Allowable Fan RPM		1100	1100	1200	1000	1000
Motor Pulley Pitch Diameter	mm	140.0	140.0	140.0	132	132
Filter						
Size	(Qty) in	(8) 16" x 20"	(4) 15" x 20"	(6) 16" x 25"	(2) 16" x 20"	(3) 20" x 20"
	(Qty) in		(2) 15" x 25"	(3) 20" x 25"	(6) 16" x 25"	(9) 20" x 25"
	(Qty) in		(2) 16" x 20"		(1) 20" x 25"	
	(Qty) in		(1) 16" x 25"		(3) 25" x 25"	
Std. 2" Washable			(1) 16 x 25, (2) 5 x 25	(3) 20 x 25, (6) 16 x 25, (3) 25 x 25		(6) 20 x 25
Suction Line OD	in	2 1/8"	2 1/8"	1 5/8"	2 1/8"	2 1/8"
Liquid Line OD	in	7/8"	7/8"	7/8"	7/8"	7/8"
Approx. Operating Weight	lbs/kg	778 / 353	928 / 421	1073 / 487	1510 / 685	1651 / 749
Unit Dimensions	HxWxD mm	1219x1808x1040	1372x1808x1040	1520x2088x1040	1653x2596x1275	1777x2596x1275

Trane double walled Quantum Climate Changer Air Handlers are available for semi custom configurations and specialized indoor conditions.

System Performance Matrix

System Performance Matrix									
R22								Condenser	Indoor
MODEL		Evaporator Airflow		Total Capacity		Sensible Capacity		Fan Motor	Fan Motor
Outdoor	Indoor	CFM	CMH	MBH	kW	MBH	kW	kW x Qty	kW
RAUP 250	TTV 250	7760	13184	278	81	197	58	0.60 x 2	3.7
RAUP 300	TTV 300	9240	15699	333	98	237	69	0.60 x 2	5.5
RAUP 400	TTV 400	12120	20592	421	123	303	89	0.60 x 3	5.5
RAUP 500	TTV 500	15130	25706	541	159	395	116	0.60 x 4	7.5
RAUP 600	TTV 600	18080	30718	658	193	493	144	0.60 x 4	11

System Performance Matrix									
R407C								Condenser	Indoor
MODEL		Evaporator Airflow		Total Capacity		Sensible Capacity		Fan Motor	Fan Motor
Outdoor	Indoor	CFM	CMH	MBH	kW	MBH	kW	kW x Qty	kW
RAUP 250	TTV 250	7760	13184	264	77	187	55	0.60 x 2	3.7
RAUP 300	TTV 300	9240	15699	316	93	225	66	0.60 x 2	5.5
RAUP 400	TTV 400	12120	20592	400	117	288	84	0.60 x 3	5.5
RAUP 500	TTV 500	15130	25706	514	151	375	110	0.60 x 4	7.5
RAUP 600	TTV 600	18080	30718	625	183	468	137	0.60 x 4	11

Capacities based on ambient temperature of 95 F [35 c]. Coil on coil temperature of 80 / 67 F [26 /19 c] EDB/EWB.
Rated at 400V / 3P / 50Hz
Capacities are gross and do not include the evaporator fan motor heat deduction
Custom Matches & configuration are available with the Trane Quantum Climate Changer air handler.

Features Summary

Features Summary

Features	Benefits	

Scroll Compressors

- Less vibration and a Quiter Operation
- Durability / Extended Life Built in dirt saperator to prevent dirt reaching the bearings High volume oil sump prevents excessive oil loss.
- Comprehensive Compressor Protection for added reliability.
- Tandem Capability Achieves high part load efficiencies and additional part load control.
- High emergenc y efficiency ratio and outstanding endurance
- Advanced & reliable refrigerant & oil management technology for large scroll compressors.
- Low friction and high volumetric efficiency achieved by ensuring orbiting scrolls, orbit on an oil film that minimizes friction & wear and at the same time ensuring absolute radial tightness. Radial contact is minimized via opposing floating seals.

Smart Controls

- Simple but sophistacated control using microprocessor technology enables:
  - * Temperature setpoints and zone temperatures to be fed to the controller for optimized comfort cooling with minimum installation downtime.
  - * Diagnose problems accurately and swiftly minimizing downtime.
  - * Preprogrammed compressor sequencing ensures maximum compressor protection against cycling.
  - * Fully factory packaged starters enable the installer to power up, charge pipe and run the system with minimum site electrical installation.

Safeties & Protection

- All condensing units come standard with:
- High and low pressure safety switches to protect the system against operations outside recommended pressure limits.
- Reverse rotation protection on compressors through safeties that trip the system on high temperature (indirect).
- Compressor time delays and on-off sequencing logic that is built into the microprocessor algorithm for maximum protection.

Robust Casing

- Stainless Steel & Corossion Resistant Coated external bolts.
- High efficiency Trane slit fin coils.
- Weather resisant baked matt polyester powder painted GI panels.
- Heavy gauge welded steel base with mounting holes.
- Corossion resistant coated coils as an option.

Modular Installation

- Modular designs allow for side by side installation to save valuable space.
- Small footprint saves valuable footprint and castly transportation.

Wide Application Envelope

- High and Low ambient options are available for wider operational envelops.

Standard ambient 15-43C. Hi ambient up to 46C

Pre Matched Compact Air Handlers

- Small foot print
- Multiple fan arrangements. Vertical or horizontal discharge configurations.
- Up to 2.5” [625Pa] ESP
- Baked polyester Powder Painted GI panels for an attractive long lasting finish.
- Closed cell PE insulation.
- Double Inlet DoubleWidth Forward curved fans
- Standard 50mm washable air filters
- Oversized motor options for higher static operation.

Custom Matched Quantum Climate Changer

- High flexible double walled 25mm or 50mm indoor or outdoor Quantum Climate Changes Air Handler (QCC)
- 100% fresh air selections possible with the QCC
- Suitable for back up cooling with chilled water systems.

* Some items are optional and not standard.

Outdoor Unit Application Considerations

Certain application constraints should be considered when sizing, selecting and installing Trane air-cooled condensing units. Unit reliability is dependent upon these considerations. Where your application varies from the guidelines presented, it should be reviewed with the local Trane sales engineer.

Unit Sizing

Intentionally oversizing a unit to assure adequate capacity is not recommended. Erratic system operationand excessive compressor cycling are often a direct result of an oversized condensing unit. In addition, oversized units are ussually more expensive to purchase, install and operate. If oversizing is desired, consider using two units.

Under sized units have nuisance high pressure tripping. Hence it is critical that RAUP installations, have a system matching done on all on coil AHU and RAUP ambient conditions. As ambient conditions and on coil (AHU) conditions impact the system, both extremes need to be modeled to minimise risk. The system matching is even more critical with EBS jobs with unknown AHU loads.

Unit Placement

A base or foundation is not required if the selected unit location is level and strong enough to support the unit's operating weight.

Isolation and Sound Emission

The most effective form of isolation is to locate the unit away from any sound sensitive area. Structurally transmitted sound can be reduced by using spring or rubber isolators. The isolators are effective in reducing the low frequency sound generated by compressors and therefore are recommended for sound sensitive installations. An acoustical engineer should always be consulated on critical applications. For maximum isolation effect the refrigeration lines and electrical conduct should also be isolated. Use flexible electrical conduit. State and local codes on sound emissions should always be considered. Since the environment in which a sound source is located affects sound pressure, unit placement must be carefully evaluated.

Unit Location

Unobstructed flow of condenser air is essential for maintaining condensing unit capacity and operating efficiency. When determining unit placement careful consideration must be given to assure proper air flow across the condenser heat transfer surface. Failure to heed these considerations will result in warm air recirculation and coil air flow starvation, resulting in a high pressure compressor cut-off.

Warm air recirculation occurs when discharge air from the condenser fans is recycled back at the condenser coil inlet. Coil starvation occurs when free air flow to the condenser is restricted.

Both warm air recirculation and coil starvation causes reductions in unit efficiency and capacity. In addition in more severe cases nuisance unit shutdowns will result from excessive head pressures. Accurate estimates of the degree of efficiency and capacity reduction are not possible due to the unpredictable effect of varying winds, temperatures and coil conditions.

In addition, wind tends to further reduce head pressure. Therefore, it is advisable to protect the air-cooled condensing unit from continuous direct winds exceeding 10 miles per hour.

Debris, trash, supplies, etc., should not be allowed to accumulate in the vicinity of the air-cooled condensing unit. Supply air movement may draw debris between coil fins and cause coil starvation. Special consideration should be given to units operating in low ambient temperatures. Condenser coils and fan discharge must be kept free of snow and other obstructions to permit adequate air flow for satisfactory unit operation.

Effect of Altitude On Capacity

Condensing unit capacities given in the performance data tables. At elevations substantially above sea level, the decreased air density will decrease condenser capacity and efficiency. The adjustment factors in Page 10 can be applied directly to the catalog performance data to determine the unit's adjusted performance.

Ambient Considerations

Start up and operation at lower ambients requires sufficient head pressure be maintained for proper expansion valve operation.

At higher ambients, excessive head pressure may result. Standard operating ambients are 15-43^{0}C [15-46^{0}C at High Ambient Mode]. With a low ambient comprising crank case heaters and frequency inverters, operation below 15^{0}C is achievable. Minimum ambient condition are based on still conditions.

Refrigerant Piping

Special consideration must always be given to oil return. Minimum suction gas velocities must always be maintained for proper oil return. Utilize appropriate piping tools lines sizing such as the CDS refrigerant piping program.

Stay within the limits of the recommendations in CDS Refrigerant pipi sizing software.

Equipment Selection

SYSTEM COMPONENTS

To correctly match a condensing unit with a DX coil, it is important to understand the components of the refrigeration system and their functions. A refrigerant syatem consists of four major major components: the compressor, condenser, expansion device and evaporator. Each of these components shown in Fig.1 must be properly sized and installed in order to operate together and perform correctly.

COMPRESSOR

The function of a comprerssor is to raise the pressure of the refrigerant gas to a point where the temperature at which the gas will condense is higher than the ambient temperature of the air being used to condense it. For example, if the ambient design air temperature is 100°F, the refrigerant gas will typically be compressed to a pressure where the condensing, or saturation, temperature is 120 - 130°F.

In scroll compressors, the refrigerant gas is compressed between the faces of two interlocking scrolls, one of which orbits while the other remains stationary.

CONDENSER

An air-cooled condenser typically has one or more heat transfer coils and one or more fans. The fans draw ambient air through the coils, which causes the hot refrigerant gas inside the tubes to condense. The capacity of an aircooled condenser depends upon the temperature and flow rate of the ambient air and the surface area of the coil.

As the high-pressure refrigerant flows through the coil, it begins to condense,but remains at a steady temperature and pressure (for R22) while for R407C the temperature and pressure will change due to the glide of the refrigerant. The ondenser coils are sized such that the refrigerant gas has completely condensed and more heat will be removed from it. This process is known as sub-cooling. Sub-cooling the liquid refrigerant prevents it from flashing back to its vapor state as its pressure drops between the condenser and the expansion device. Sub-cooling also improves the cooling capability of the refrigerant.

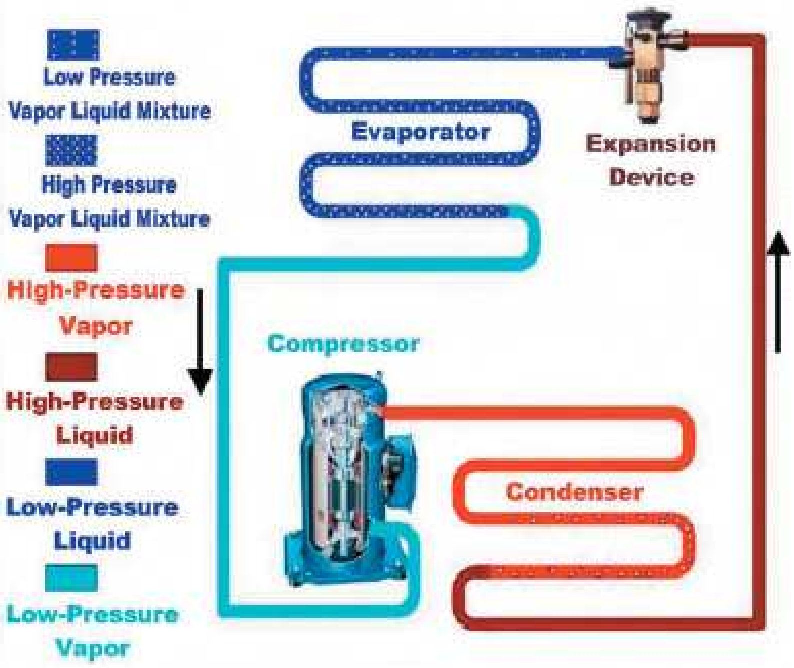


FIG. 1 -MAJOR SYSTEM COMPONENTS

Equipment Selection

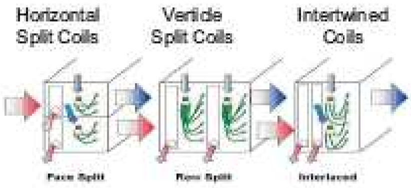


FIG. 2 -EVAPORATOR COIL TYPES

EVAPORATOR

The evaporator coil removes heat from the supply air-stream, cooling the supply air in the process. The evaporator coil generally consists of several rows of copper tubing mechanically bonded to aluminum 9or copper0 heat transfer fins. Depending on the size and capacity of the coil it may consist of one, or several refrigerant circuits (see Fig 2).

A refrigerant distributor on each DX evaporator coil circuit feeds low pressure. low temperature liquid refrigerant to the coil tubes. It is critical that all the distributor tubes are the same length ao the pressure drop across them will be equal and the refrigerant will be evenly distributed to the coil tubes.

As the liquid refrigerant passes through the coil tubes, heat is tranferred from the supply air stream to the refrigerant. As heat is added to the liquid refrigerant, it begind to evaporate much like water boiling on a stove. The liquid-vapor mixture remains at a constant temperature and pressure until it completely vaporizes (for R22), while for R407C the temperature and pressure will drop slightly due to the glide of the refrigerant. the coil capacity is determined by the type and amount of refrigerant used, the temperature difference between the air and the liquid refrigerant, and the amount of air passing over the coil.

Once the refrigerant has completely evaporated, its ability to cool the air decrease dramatically. If too little refrigerant is fed to the coil, it will evaporate quickly and the air will not be adequately cooled. If too much refrigerant is fed to the coil it will not evaporate at all and liquid refrigerant will return to the compressor. Direct expansion (DX) evaporator coils are designed to evaporate all refrigerant in the cil and then “superheat” the refrigerant gas in the last row or two of the coil tubes. The refrigerant gas is superheated to ensure it does not condense back to its liquid state in the suction line. Superheat is also used to control the expansion device.

EXPANSION DEVICE

The expansion device controls the flow of liquid refrigerant to the evaporator coil. Trane uses temperature controlled, (thermostatic) expansion valves (TXVs) as shown in Fig. 3. The TXV has two primary components: the valve body and the sensing bulb.

The valve regulates the flow of refrigerant to the evaporator coil. As refrigerant passes through the valve it is adiabatically expanded (that is, without the addition of enegry). This causes the pressure and temperature of the liquid refrigerant to drop, making it suitable for cooling the air.

The amount of refrigerant fed to the coil is based on the cooling load of the supply air and the resultant amount

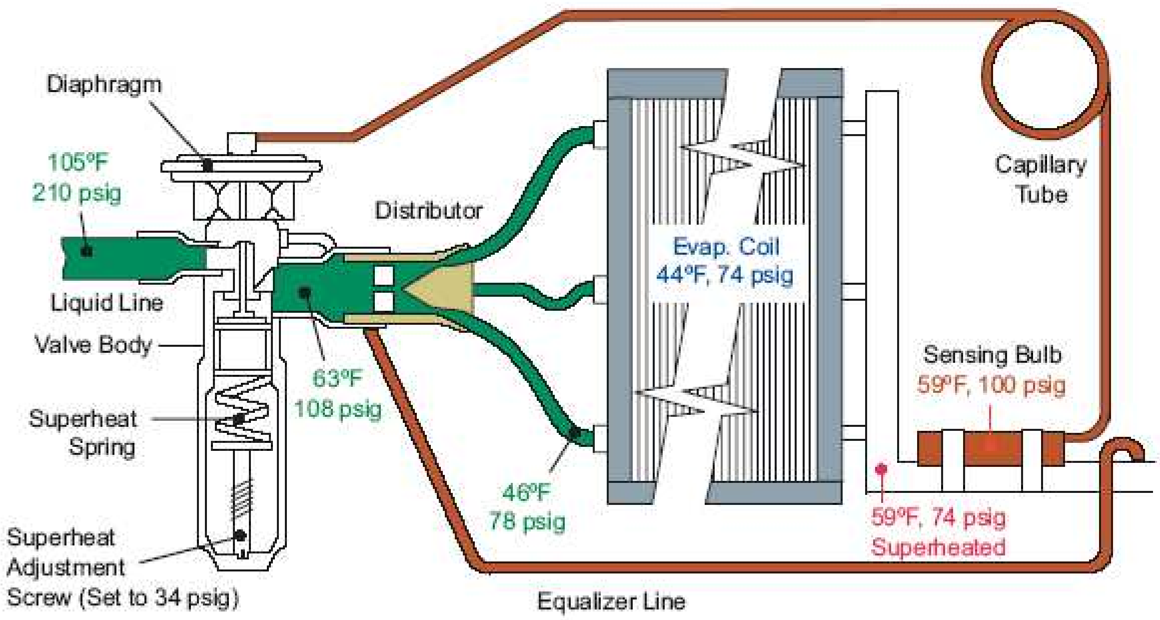


FIG. 3 -THERMAL REXPANSION VALVE (TXV) COMPONENTS

Equipment Selection

of superheat created. As the cooling load increases, the liquid refrigerant absorbs more heat and evaporates more quickly. This means that more of the evaporator coil is available to superheat the refrigerant vapor and it leaves the coil at a higher temperature. Conversely as the cooling load decreases, the liquid refrigerant does not evaporate as quickly so less superheating occurs nd the refrigerant leaves the coil at a lower temperature.

The sensing bulb attached to tthe valve is charged with a mix of liquid and vapor refrigerant. this refrigerant must be the same type as that in the system. The refrigerant vapor in the sensing bulb exerts pressure on a diaphragm in the valve body, which causes the valve to open or close.

As the temperature of the superheated suction gas leaving the evaporator rises due to an increase in the cooling load, refrigerant in the sensing bulb evaporates increasing the pressure on the valve diaphragm. The increased pressure causes the valve to open and allows more refrigerant to flow into the coil to meet the higher cooling demand. When the temperature of the suction gas drops due to a decrease in the cooling load the gas in the sensing bulb condenses reducing its pressure on the valve diaphragm. This allows the valve to restrict the flow of refrigerant into the coil until the lowet cooling demand is adequately met.

The valve body contains a superheat spring that keeps everything in balance. By turning a screw in the bottom of the valve the spring can be set for a certain amount of superheat. For example, if the superheat spring is set for 15^{0}F of superheat it will exert a pressure on the valve equal to the pressure the vaporized gas in the sensing bulb will xert on the valve diaphragm when the suction gas is superheated by 15^{0}F. The equalizer line is used to prevent the pressure drop that occurs across the distributor and DX coil from affecting the operation of the expansion valve.

APPLICATION DESIGN CONDITIONS

Before selecting equipment, you must first establish these basic working parameters:

- The design cooling load
- The design outdoor air temperature
- The refrigerant saturated suction temperature

The design-cooling load is typically found on the job schedule. The design outdoor air temperature may also be listed on the job schedule. If the satured suction temperature (SST) is not known, assume it is in the range of 40^{0}F to 45^{0}F. This represents the standard industry approach.

However, if actual systems operate beyond the recommended SST, high or low pressure cutouts will be activated and point to possible misapplication

RAUP Condensing Unit Performance Information

When using a pre-engineered condensing unit, you can use ratings such as those shown in Fig. (RAUP R22), R407C Performance Data) to determine which condensing unit size will satisfy the cooling capacity of the system.

Choose a TXV that matches the tonnage of the evaporator coil it serves

It is recommended to and install one TXV per distributor.

For larger coil capacities, refer to the quantity of circuits in the AHU and total AHU tonnage to determine the number and tonnage & quantity of the TXV

TXV Qty. listed here is based on the assumption that the Evaporator has similar circuits to the RAUP

TXV Selection when matched with an AHU, should be based primarily on the final system capacity

It is critical that the RAUP circuts are equal or less than the AHU circuits

Correction Factor
Altitude Correction Multiplier For Capacity

Altitude (Ft.)	2,000	4,000	6,000	8,000	10,000
Condensing Unit Only	0.982	0.960	0.933	0.902	0.866
Condensing Unit / Air Handling Unit Combination	0.983	0.963	0.939	0.911	0.881
Condensing Unit With Evaporator	0.986	0.968	0.947	0.921	0.891

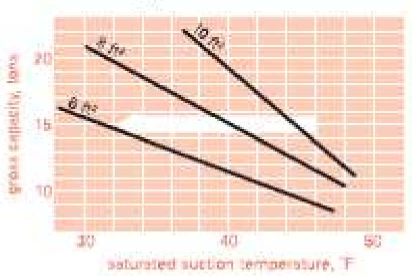
Cooling Capacity Correction Factor for CFM/CMH, other than standard

%CFM.CFM Variation From Rated	-20	-10	Rated	+10	+20
Total Cooling Capacity Multiplier	0.96	0.98	1.00	1.02	1.03
Sensible Heat Multiplier	0.91	0.96	1.00	1.04	1.08

Note: Calculate total nd sensible capacities in MBH and multiply by above factors to determine revised capacities.

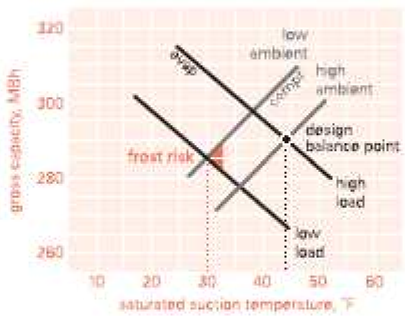
Equipment Selection

Figure 1. Effect of coil face area on cooling capacity (6-row coil, 500 fpm face velocity)



smaller coil face = lower balance points, more instability

Figure 2. Effect of ambient conditions and load on an air handler and condensing unit



DX Coil Performance Information

The direct expansion (DX) evaporator coil can be selected using the CLCP DX TOPSS program. To select the DX coil, you enter the cooling capacity or the leaving air temperature, and the saturated suction temperature (SST)

SSTs up to 50⁰F may be be acceptable for certain applicatons but humidity control becomes difficult at these higher SSTs. Likewise design SSTs below 34⁰F, SST can result in ice building up on the evaporator during periods of reduced load and should be avoided unless provisions are made for periodic coil defrost.

System max SST recommended is 48⁰F to reduce high pressure risk.

BALANCE POINT CROSS PLOT ILLUSTRATION

A precise system balance point can be obtained by plotting the capacity of the DX coil versus the capacity of the condensing unit ay various saturated temperatures. The point at which the two capacity lines intersect is the system balance point.

The intitial balance point of the system occurs where the saturated temperature of the evaporator, intersects with the condensing unit's capacity. Thus, the condensing unit SST and the DX coil SST are equal at this initial balance point without any consideration for suction line penalty.

Missized air handler. It's common pratice to base the selection of the air handler for a split DX system is at a coil face velocity of 500 fpm and then to match coil capacity (with face area now limited by the size of the air-handler cabinet) with the required load. With the trend towards applications that require less airflow per cooling ton, this sizing method leads to the selection of smaller air handlers. Providing the required cooling capacity with a smaller air handler demands colder suction temperature (Figure 1).

As the cooling load decreases and/or the ambient temperature drops the capacities of the compressor and evaporator balance at ever lower suction pressures and temperatures. At such conditions, system operation can become unstable and may eventually result in coil frosting and compressor flooding (Figure 2).

When choosing a DX air handler, it's critical to first determine a coil size that allows the evaporator and compressor capacities to balance at an appropriate suction temperature and pressure. You can then pick an air handler that fits the coil. This approach may appear to result in an oversized air handler, but it achieves a match of indoor and outdoor DX components that can operate more reliably at part-load conditions.

By contrast, when choosing an air handler for a chilled water system, the initial objective is to pick the smallest possible air handler that won't caause water carryover.

Table 1 demonstrates an outcome of these sizing strategies: For comparable systems, the chilled-water air handler usually is smaller-and therefore less costly-than the DX air handler.

Equipment Selection

General Selection Guide for CLCP DX Coil

Standard Mixed Air Application, where the On-Coil sees a constant air temperature.

1. Determine the available condensing unit (CU) capacities the required design capacity. [do not immediately start selecting the Evaporator on CLCP-TOPSS, as direct expansion refrigerant systems are limited to available CU capacity modules, unlike CW AHUs].
2. Select the **closest** CU model/s that match the **system** design capacity, after reviewing the CU capacity curves at the design ambient.
3. Select a capacity that corresponds to the closest design capacity that **falls within an acceptable SST of 36F to 48F.**
4. Input this capacity and the SST into CLCP TOPSS to get your Evaporator coil selection.
5. This method allows you to run selections more efficiently to get actual system capacity available w/o the need to plot the evaporator curve, that would required 2 or more plots to form the evaporator plot.

100% Fresh Air Application, in tropical climates.

1. Same steps needed as above, EXCEPT that <u>2 selections are required to ensure design and lower ambient temperatures are catered for.</u>
2. As the evaporator capacity is now dynamic, subject to ambient condi tions, 2 selections on the same coil is needed. One for design ambient and another for the lowest ambient the evaporator will experience. [eg. 35/29C, and 27/25C]
3. The higher/design ambient on the evaporator needs to be plotted against the design ambient condensing curve.
4. The lower ambient temperature on the evaporator, needs to be plotted against the CU lowest ambient the region experiences [same db temp at the evaporator], using the selected coil rows/fpf output in the design capacity selection output.
5. Same SST ranges need to be considered to ensure no high pressure or frosting/liquid refrigerant flood back issues.

100% FA Selections in 4 season climates.

1. Where the system experiences high ambient over 40C and/or low ambient below 15C, there is a need for high ambient options and low ambient options.

R407C Selections

1. CLCP's TOPSS Software is now equipped with R407C data for you to select R407C coils.

PIPING CONNECTIONS

It is extremely important to know the quantity of FD coil refrigerant distributor units available once the selection is made to ensure yo have the right number of piping connections to the condensing units. Many unnecessary, coil replacements has been initiated due to wrong coil selections on the evaporator that was incompatible with the condensing unit circuits.

1. The number of refrigerant distributor units on the evaporator (indoor coil) MUST BE EQUAL OR MORE than the CU circuits. Standard AHU FD Coils have the distributor quantity input in TOPSS.
2. For special casing sizes, check with the factory for distributor quantity.
3. Manifolding of CU's circuits NOT ALLOWED
4. Manifolding of the indoor unit's circuits to match up with a smaller number of condenser unit circuits is permitted.
5. One TXV per Distributor unit is recommended, for field installed TXV systems.

<u>Design Special for CLCP-DX Coil:</u>

1. FD Coil fitted with TXV by factory (called as DX Coil in CLCP Topss), are available as Design Special.
2. Distributor/TXV qty shall be optimized by factory under design special process, to simplify the connection between CLCP and CU, (RAUP/TTA), in field.
3. Sizing of the TXV should be based on the system capacity per capacity per condensing unit circuit,**.**
4. TXV qty MUST equal or double that of that of the Condensing Unit's circuit number.
5. The R22/R407C TXVs used in CLCP are based on a nominal RT, and the modulation range is between 40% - 120%. For example, a nominal 15RT TXV will be able to operate between 6RT and 15RT capacities.
6. Always specify the following in the Factory Order Report for CLCP Design Special:
   1. CLCP's matching CU model & qty, [eg. 2xRAUP400 to CLCP 030]
   2. TXV Size and qty, need to specified in the FOR as a design special.
   3. Refer to CLCP Price Book for available TXV sizes.

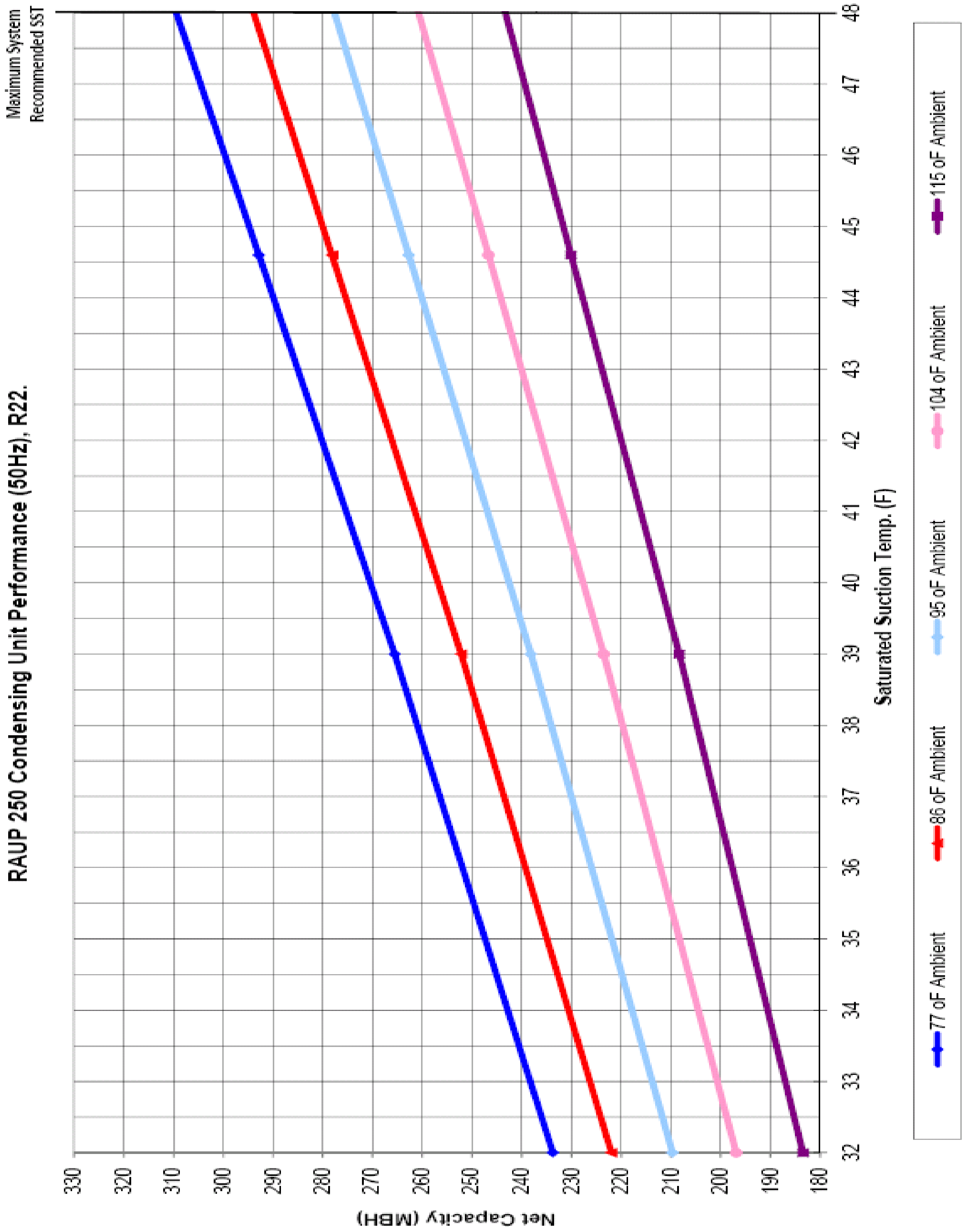
NOTE : As these are customized units, superheat setting is recommended during T&C on TXVs.

Trane CU Models Reference:

Trane Penang CU Model	Nos of Circuits per unit	Refrigerant Type, available
RAUP250/300	1	R22 / R407c
RAUP400/500/600	2	R22 / R407c

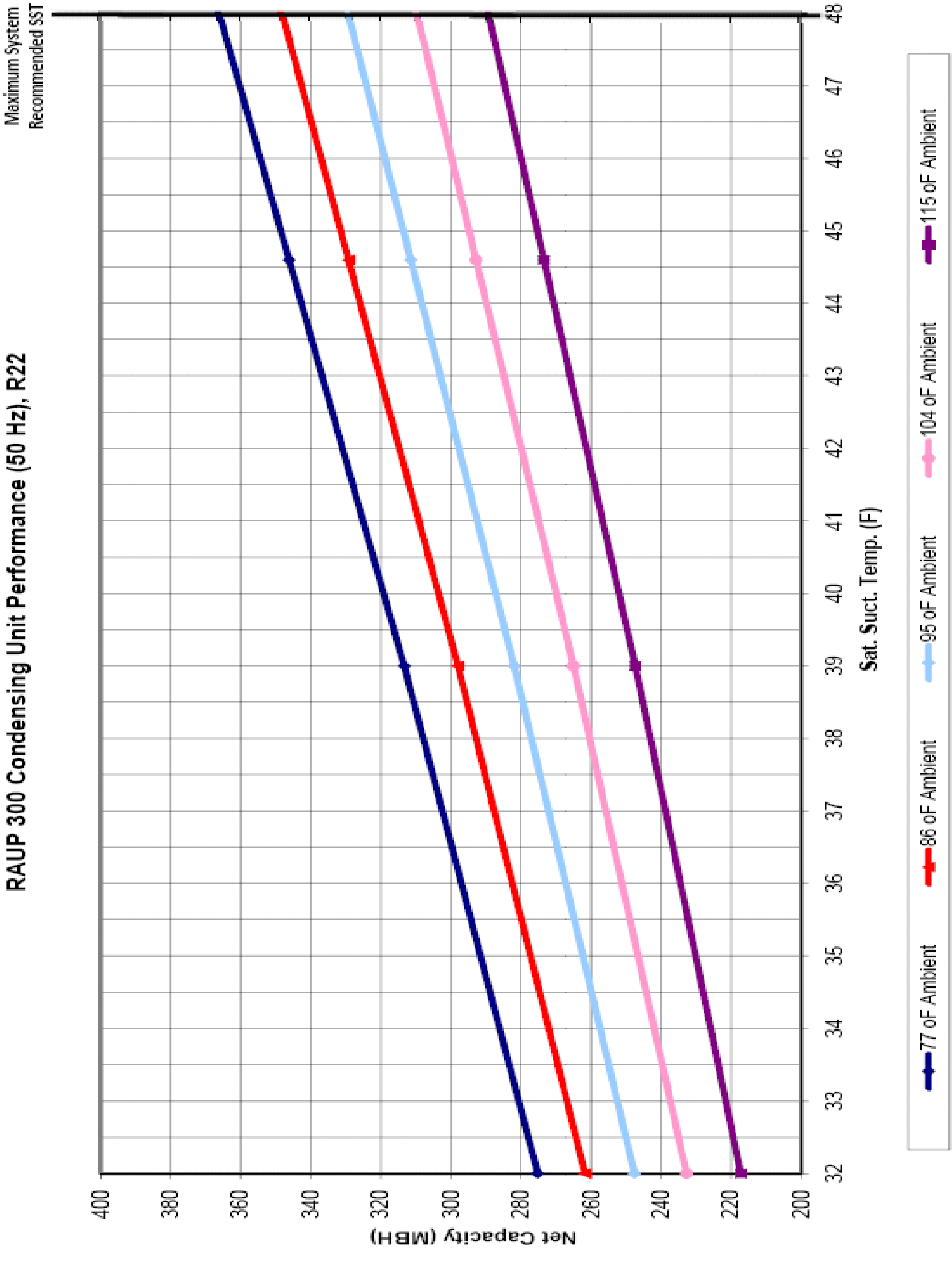
TRANE®

RAUP 250 Condensing Unit Performance R22 (50Hz)

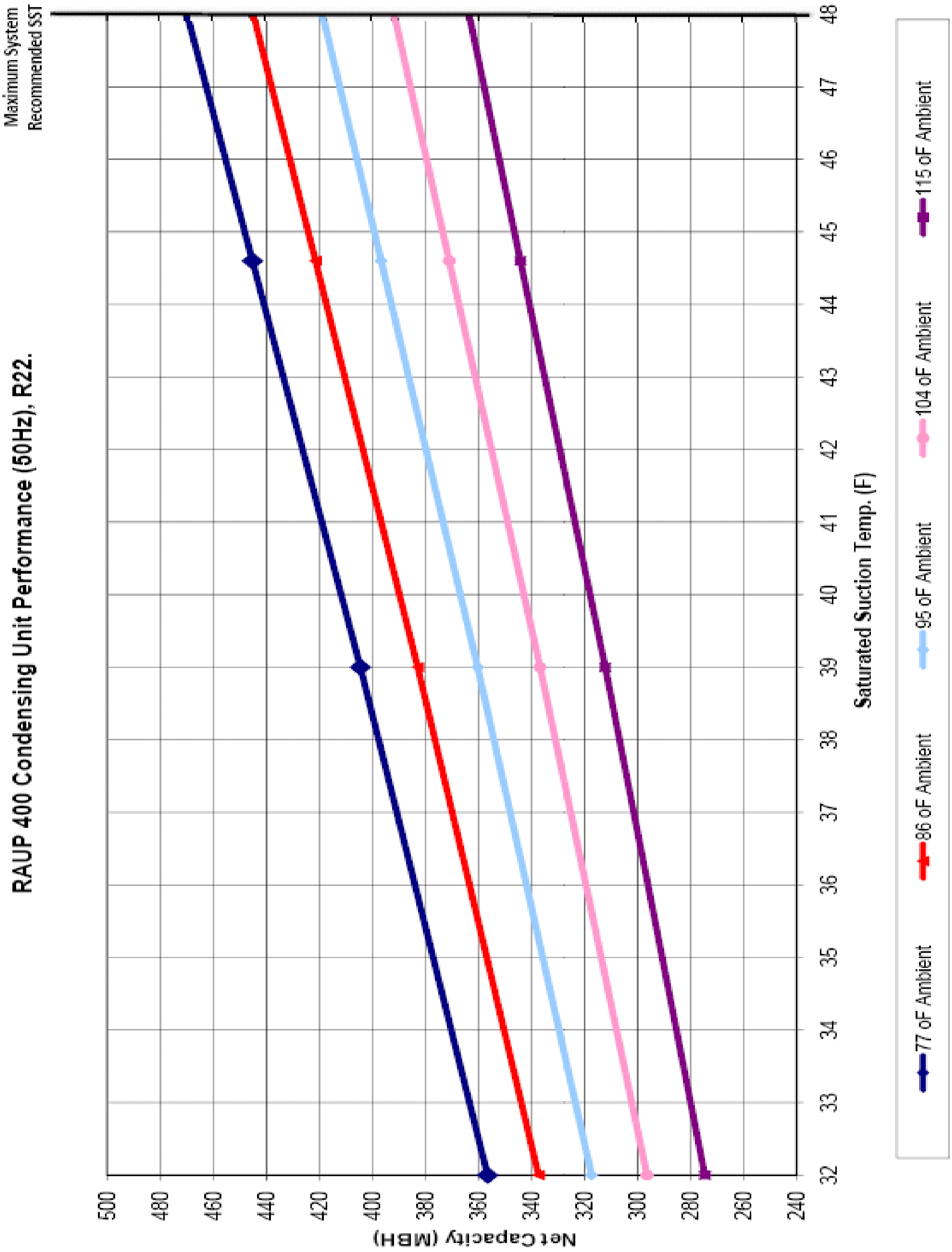


TRANE

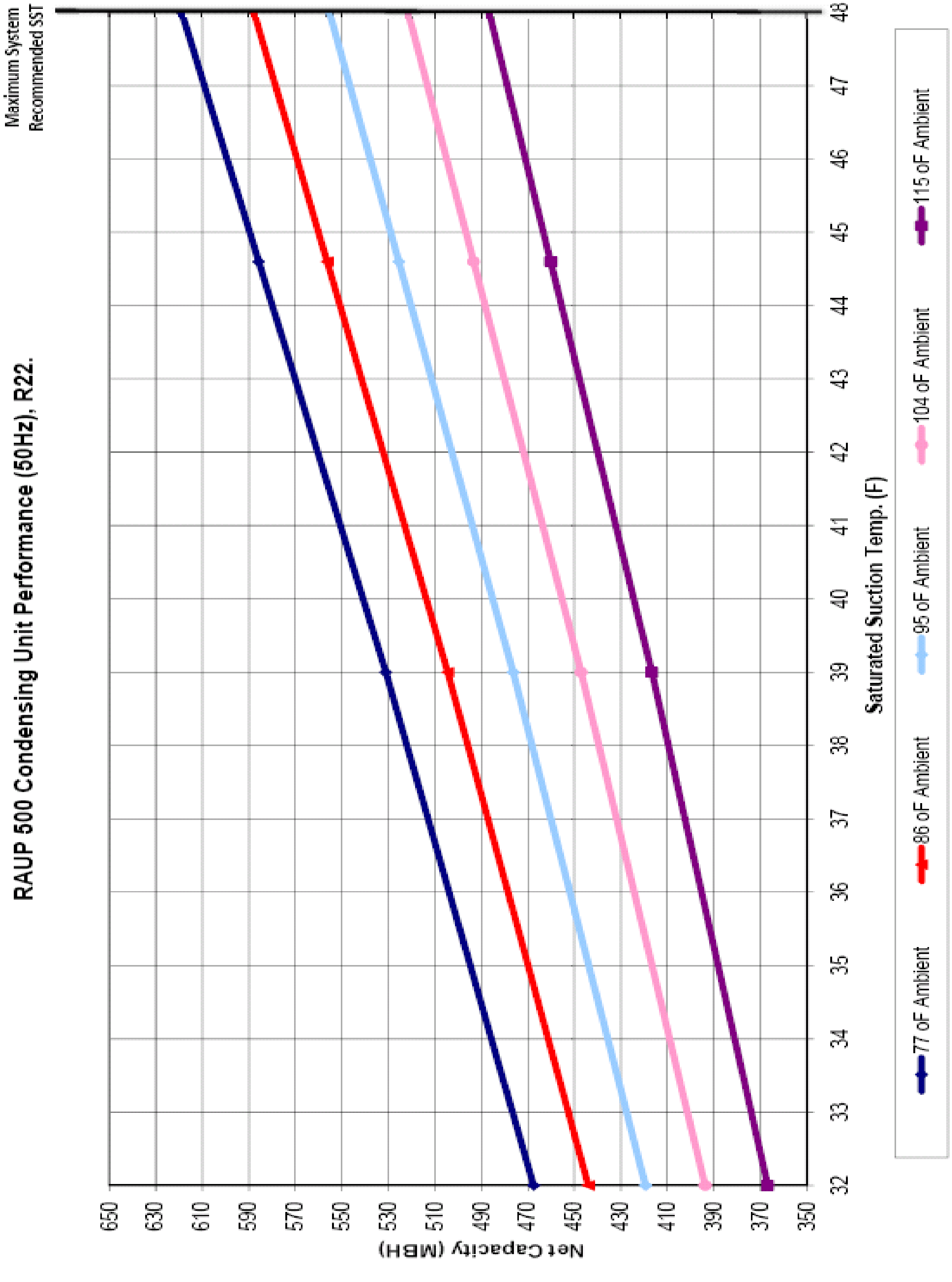
RAUP 300 Condensing Unit Performance R22 (50Hz)



RAUP 400 Condensing Unit Performance R22 (50Hz)

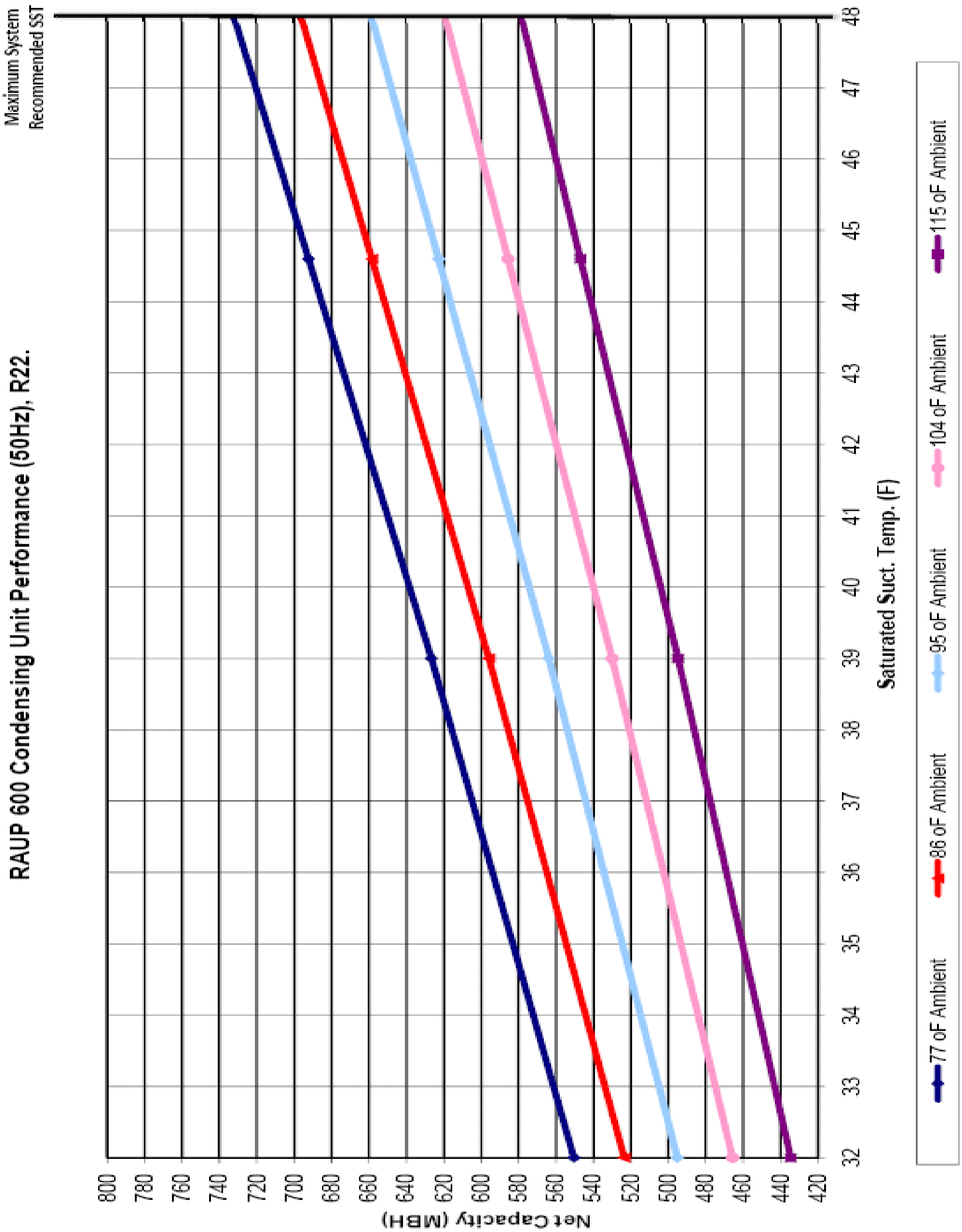


RAUP 500 Condensing Unit Performance R22 (50Hz)

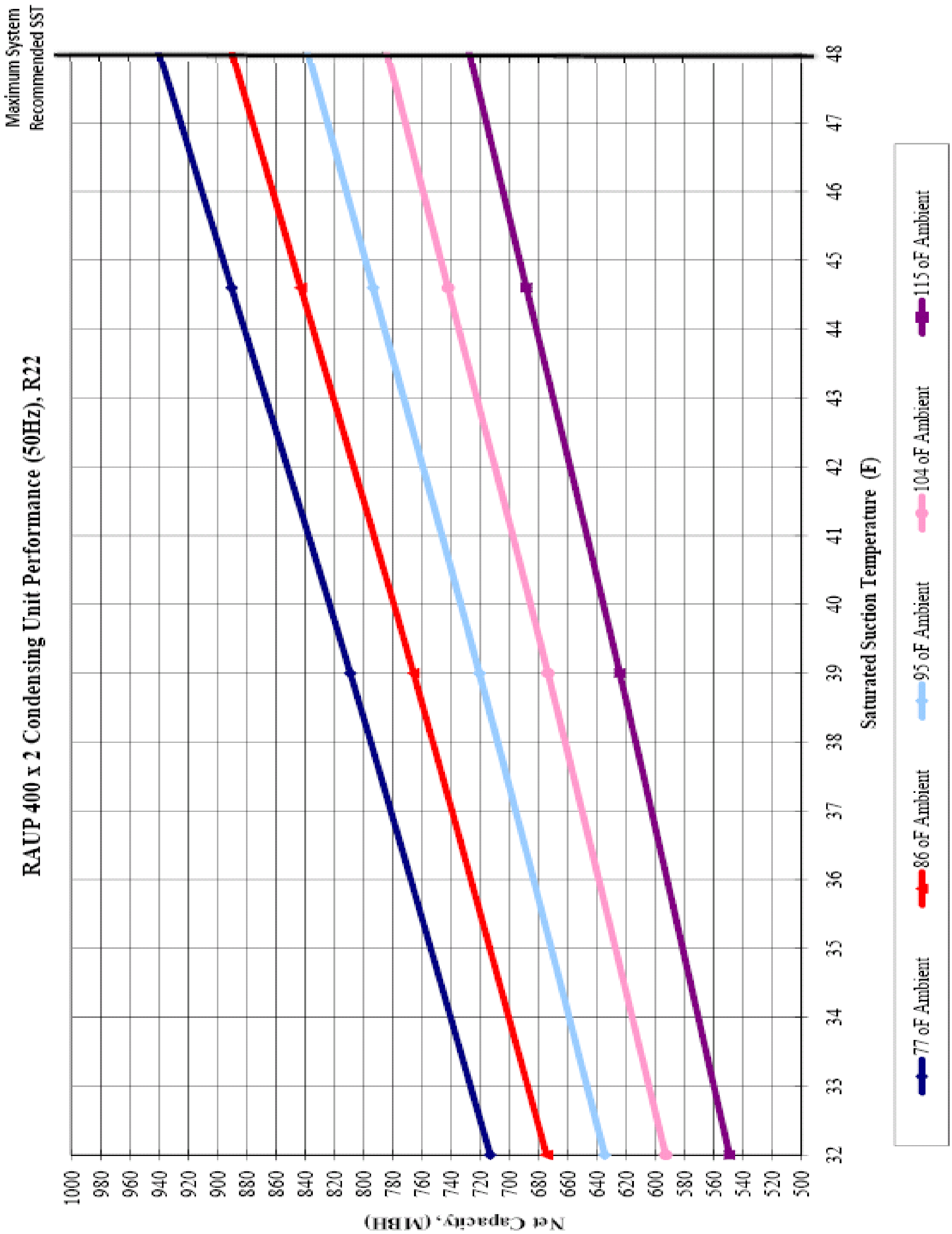


TRANE®

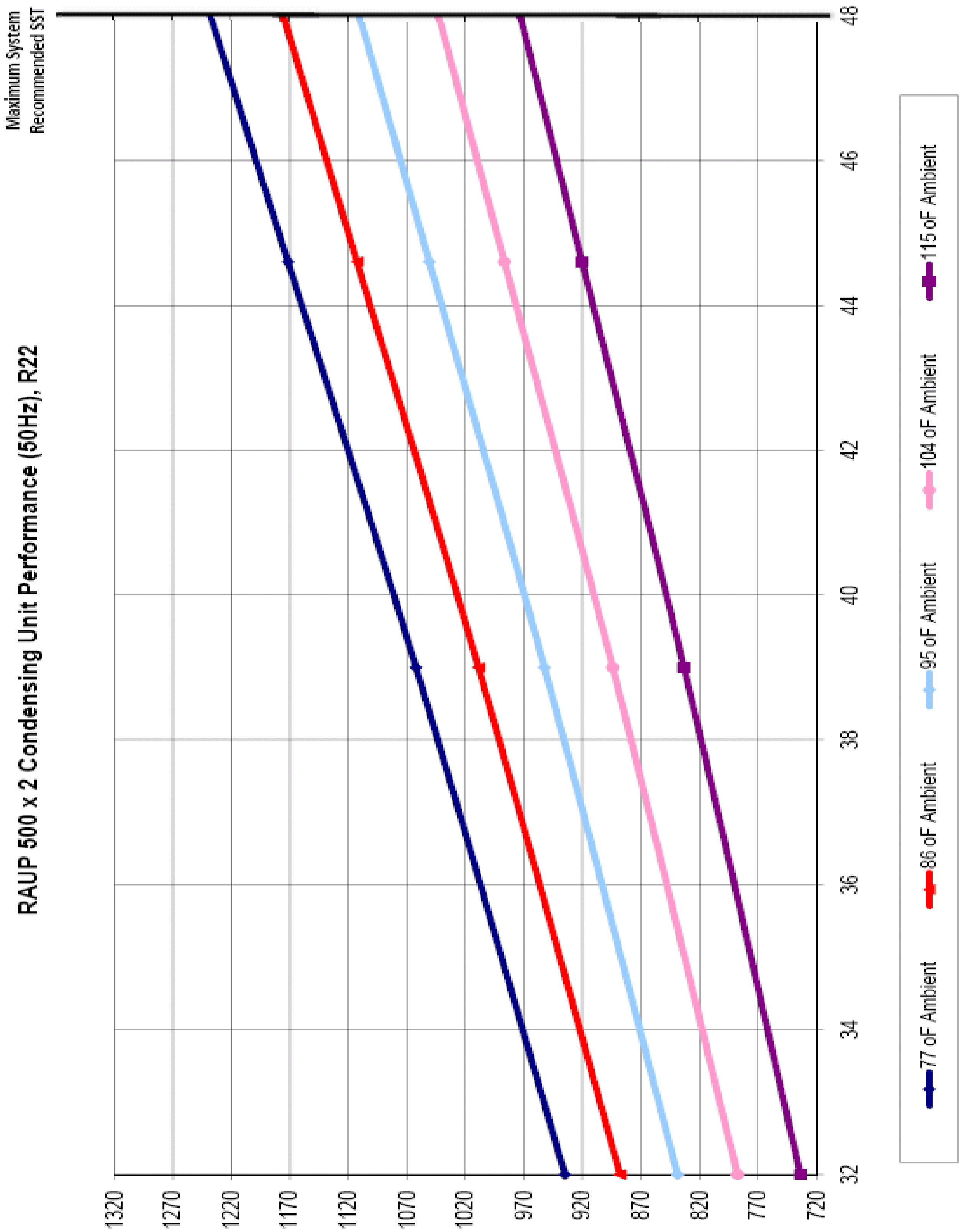
RAUP 600 Condensing Unit Performance R22 (50Hz)



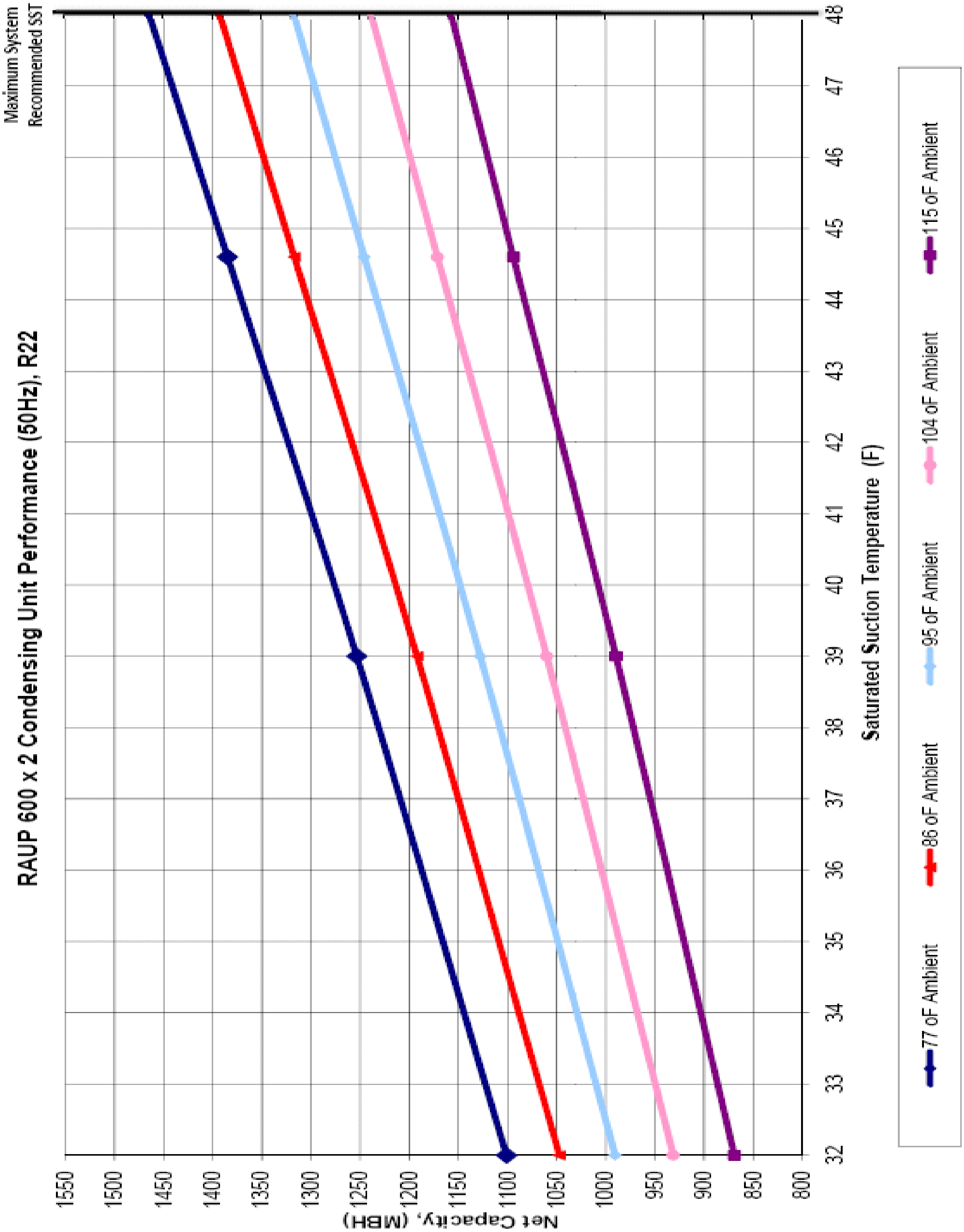
RAUP 400 x 2 Condensing Unit
Unit Performance R22 (50Hz)



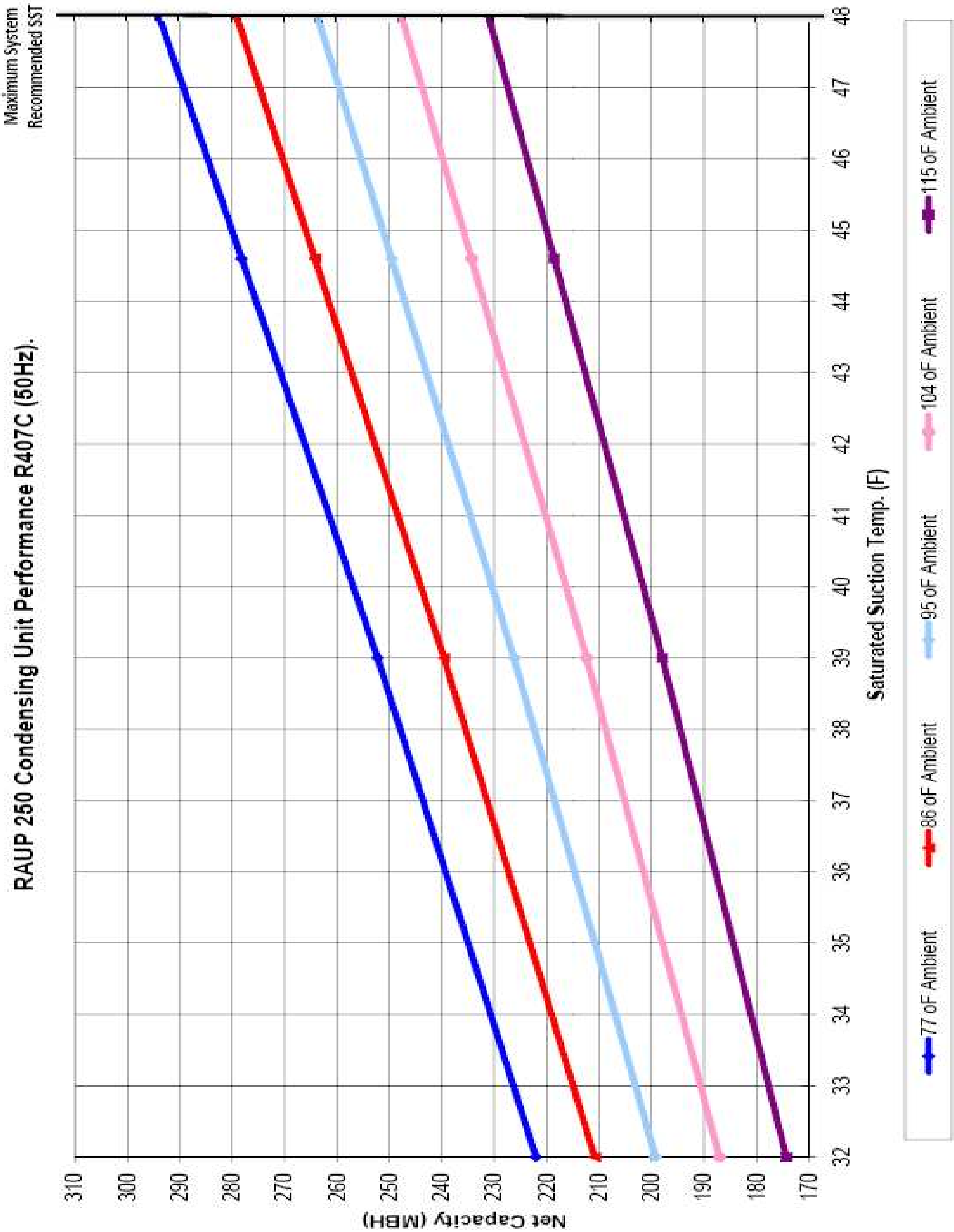
RAUP 500 x 2 Condensing Unit Performance R22 (50Hz)



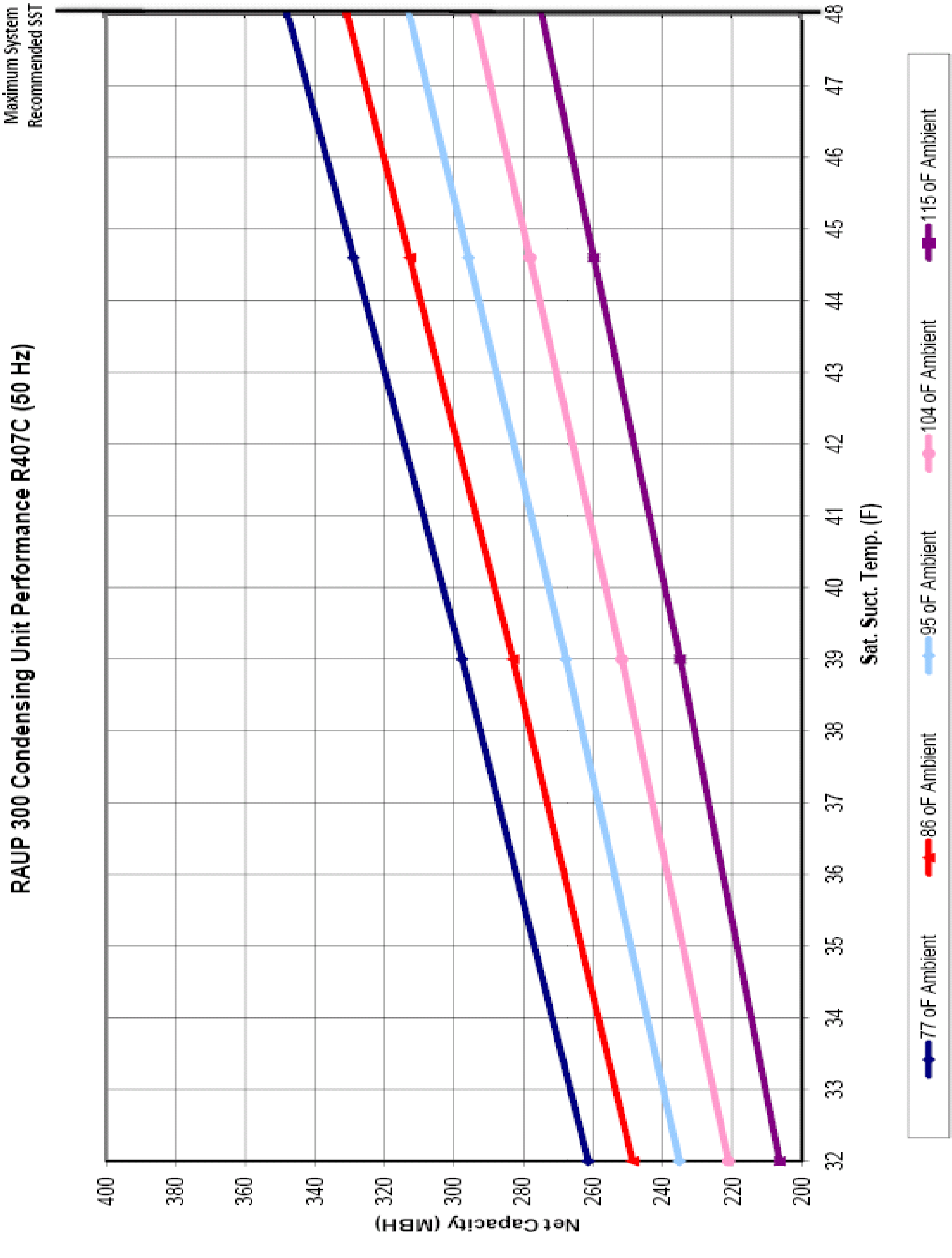
RAUP 600 x 2 Condensing Unit Performance R22 (50Hz)



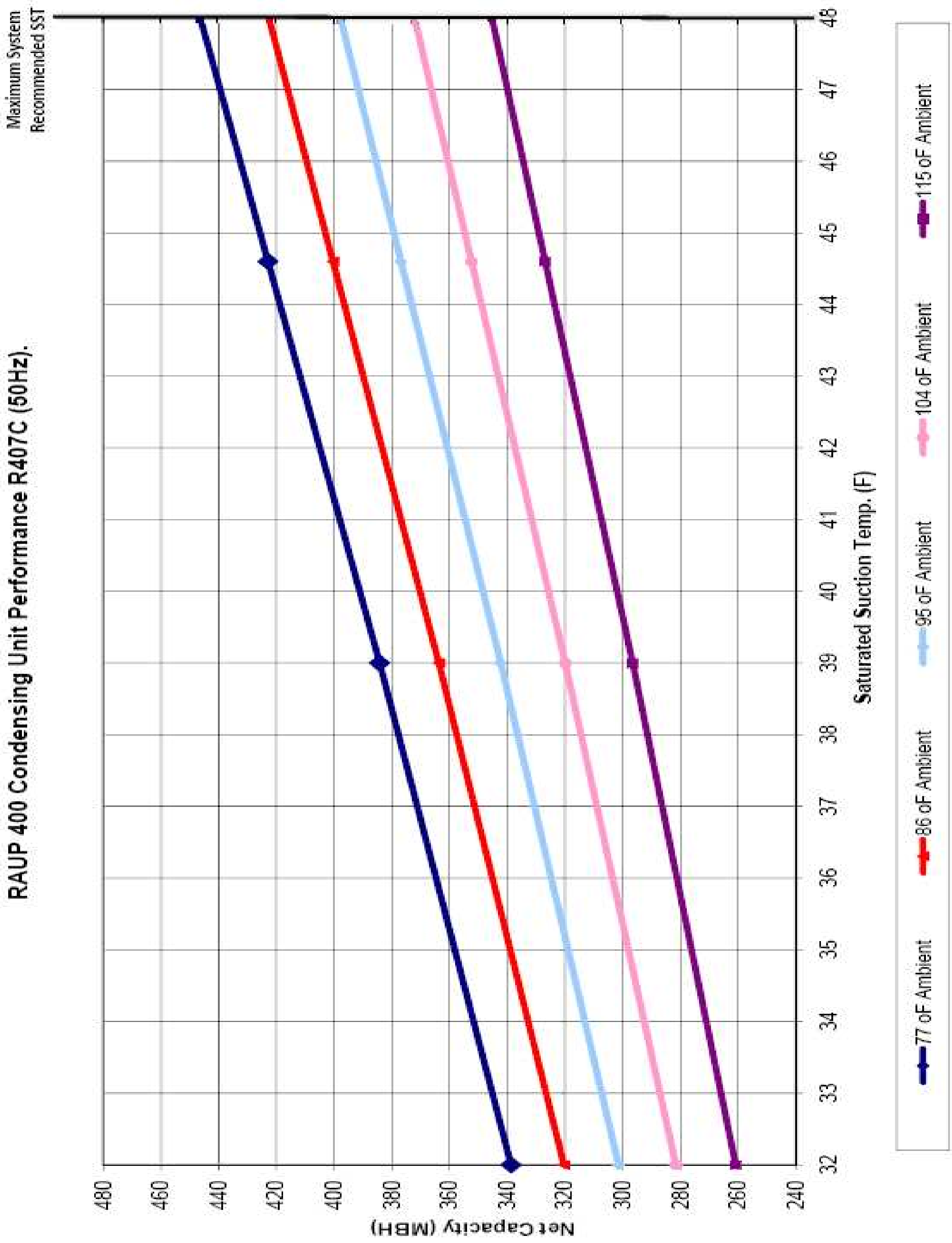
RAUP 250 Condensing Unit Performance R407C (50Hz)



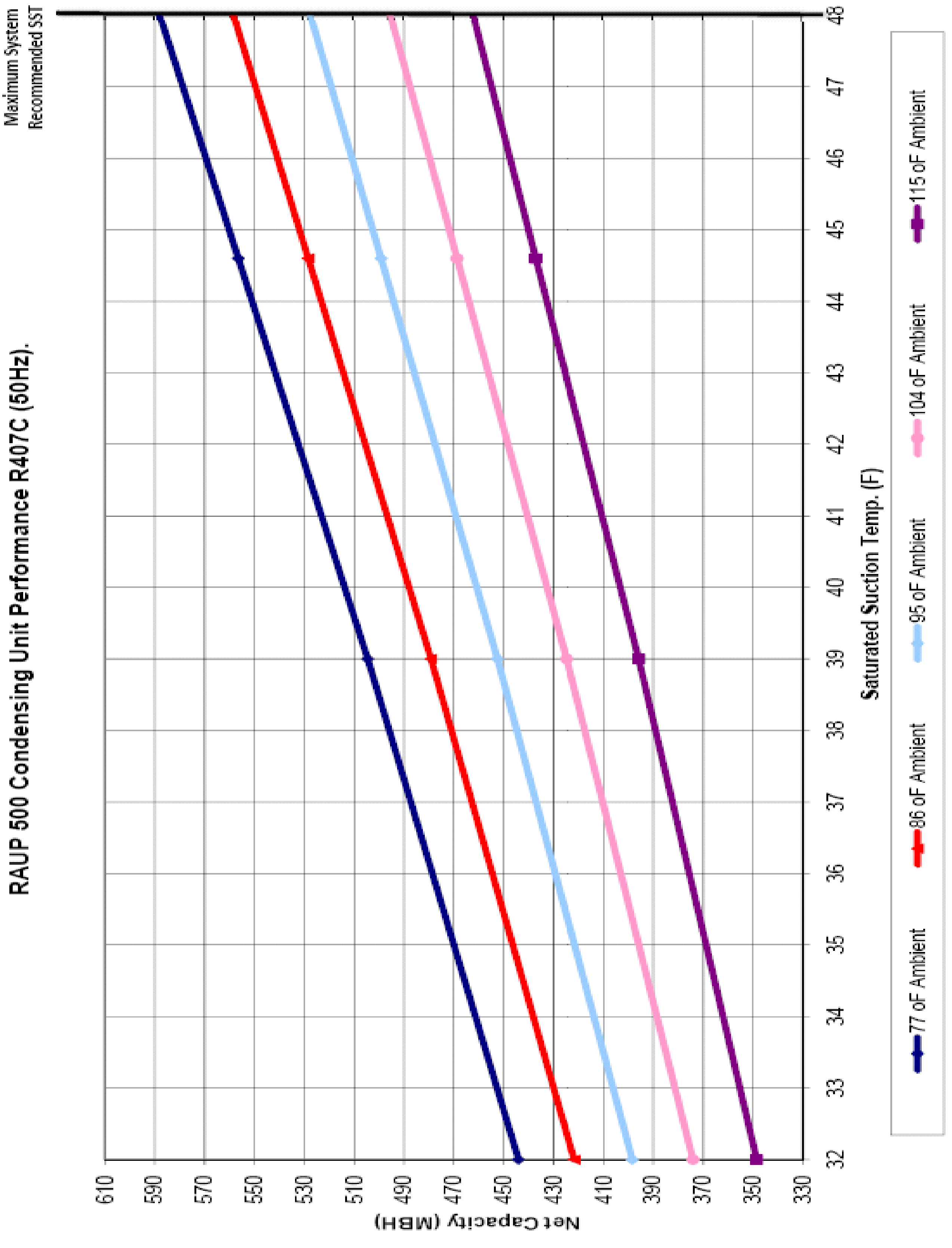
RAUP 300 Condensing Unit Performance R407C (50Hz)



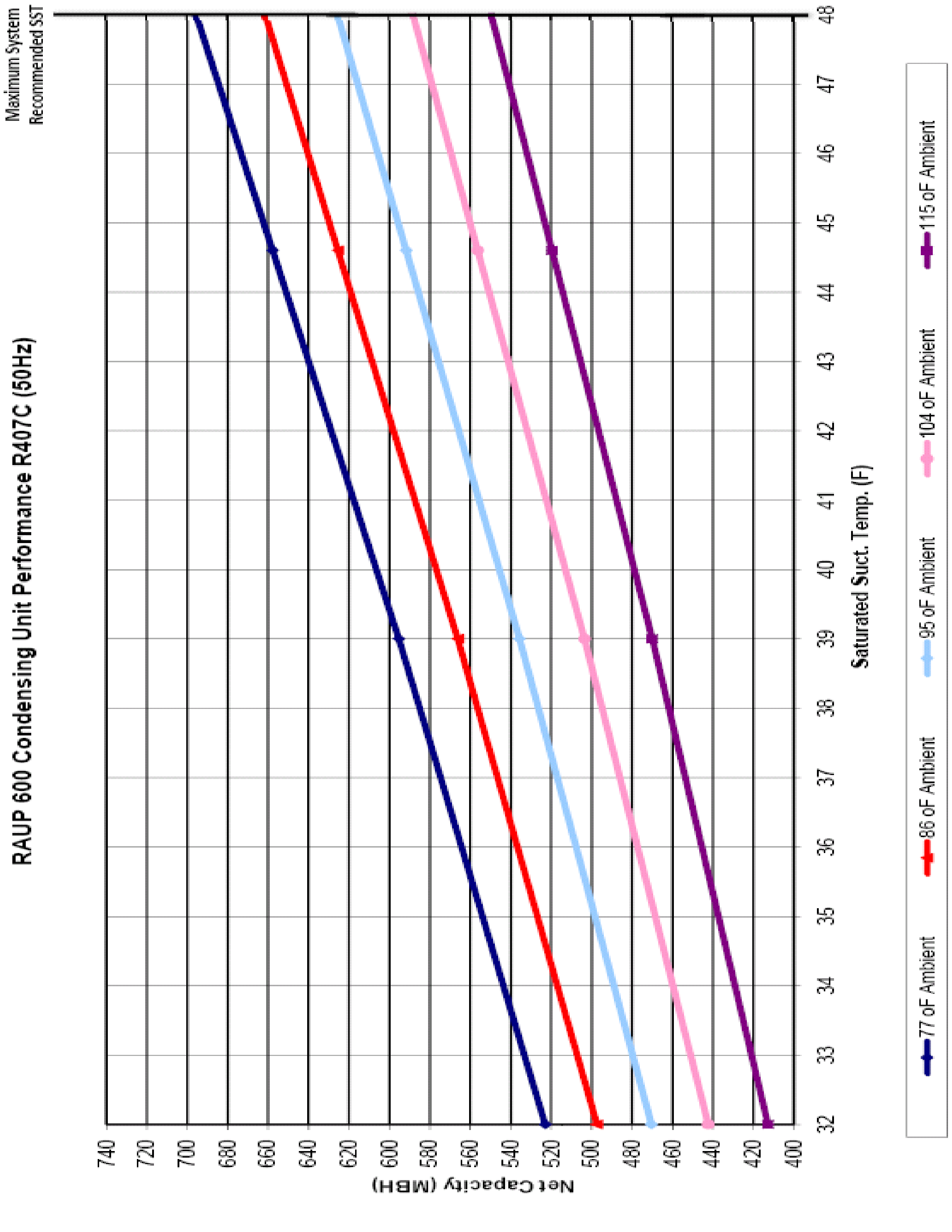
RAUP 400 Condensing Unit Performance R407C (50Hz)



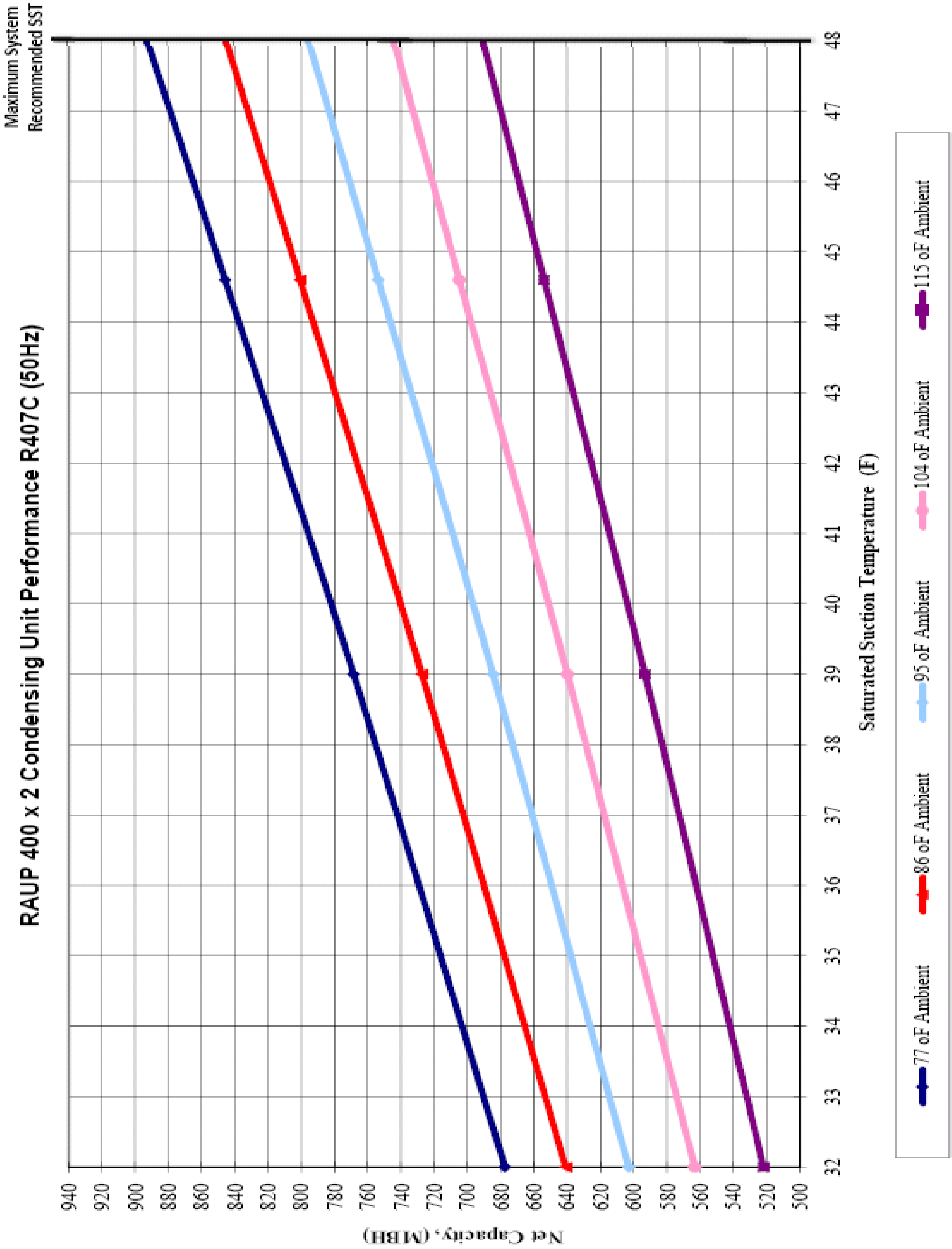
RAUP 500 Condensing Unit Performance R407C (50Hz)



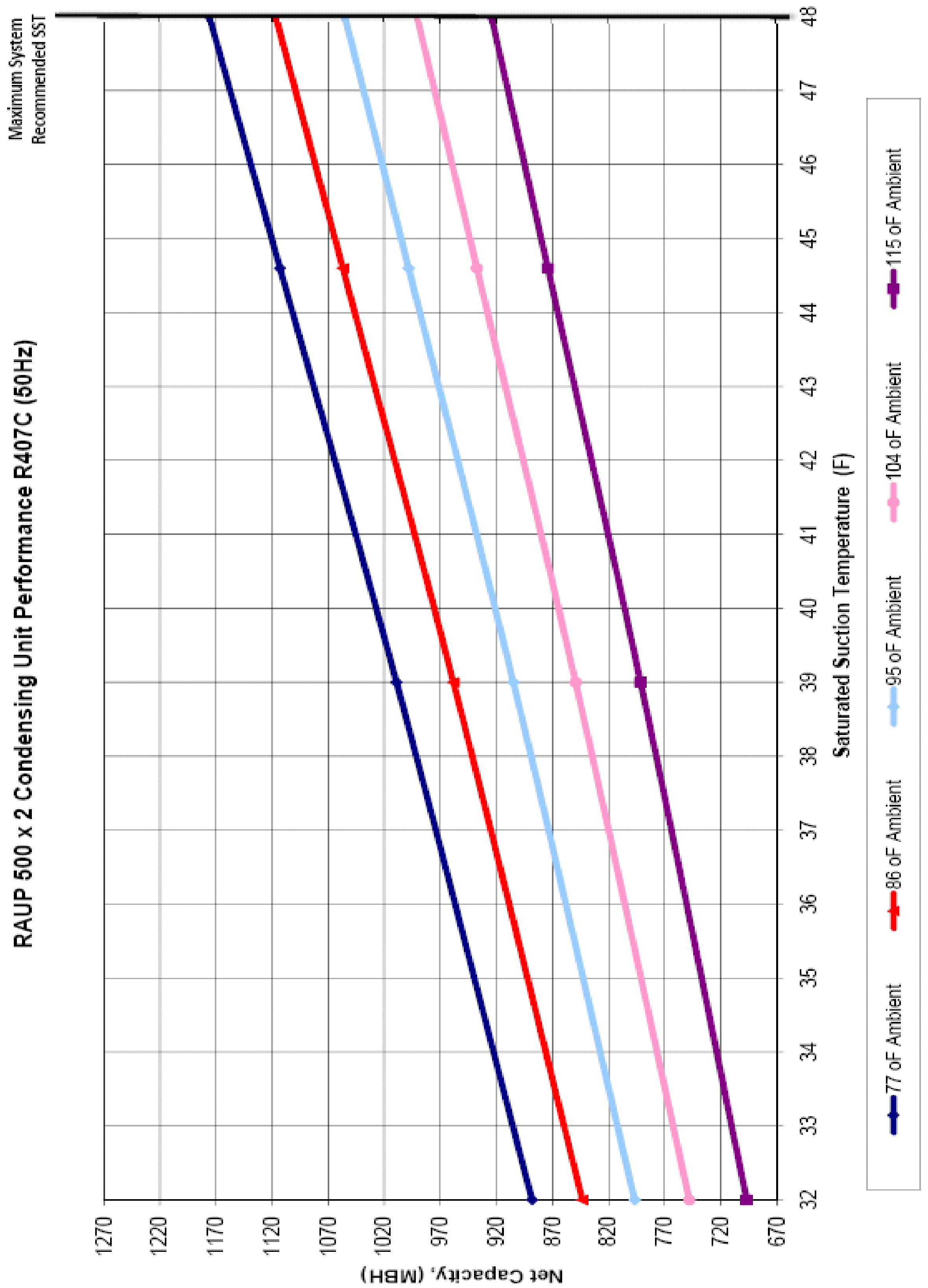
RAUP 600 Condensing Unit Performance R407C (50Hz)



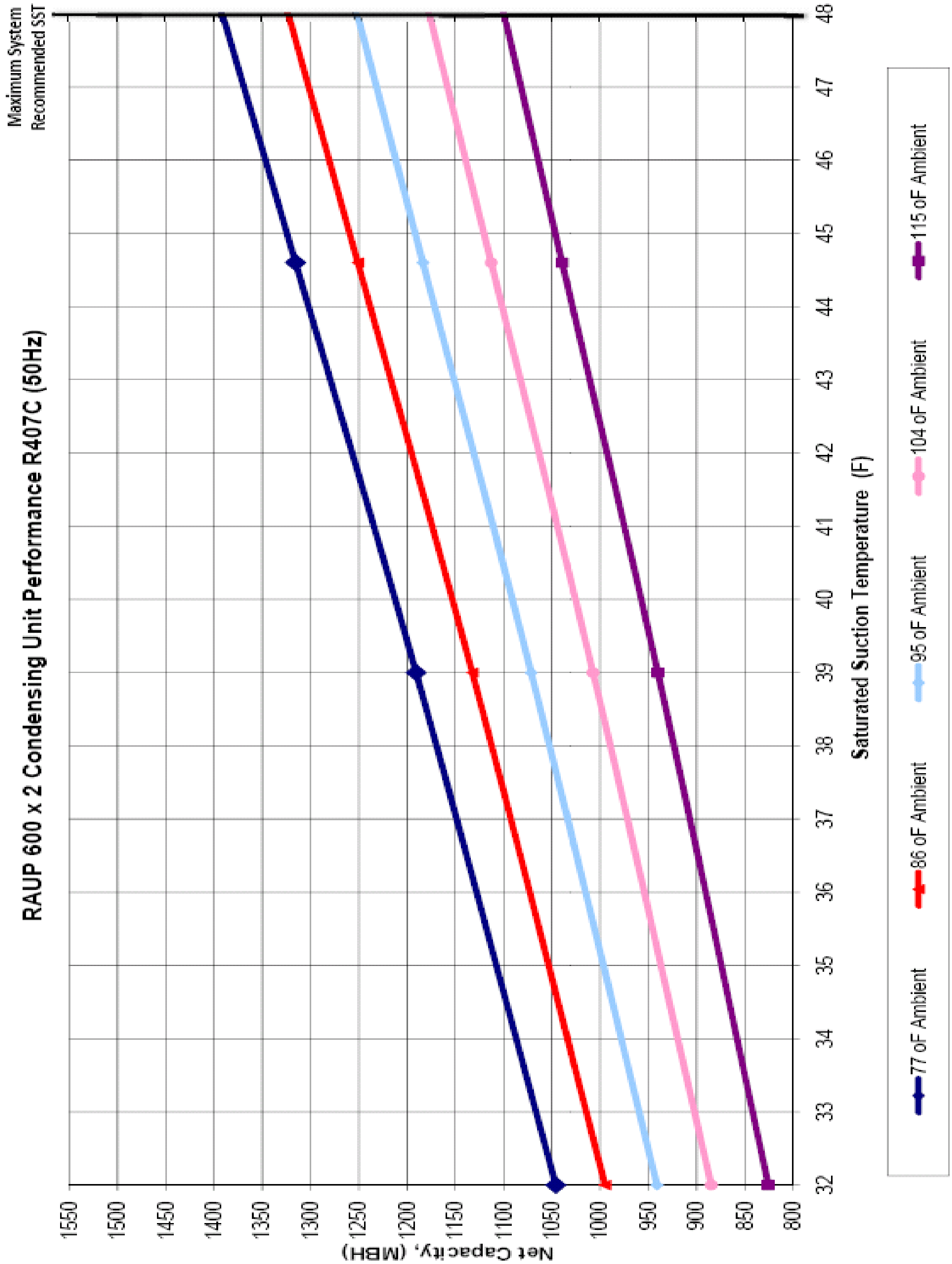
RAUP 400 x 2 Condensing Unit Performance R407C (50Hz)



RAUP 500 x 2 Condensing Unit Performance R407C (50Hz)



RAUP 600 x 2 Condensing Unit Performance R407C (50Hz)



RAUP Performance Data - R22 (50Hz)

Gross Cooling Capacities - RAUP 250 R22 Refrigerant 46 C (115 F)

		Outdoor Ambient Temperature									
Saturated Suction		25 C (77 F)		30 C (86 F)		35 C (95 F)		40 C (104 F)		46 C (115 F)	
Temperature		Capacity		Capacity		Capacity		Capacity		Capacity	
C	F	(kw)	(MBH)	(kw)	(MBH)	(kw)	(MBH)	(kw)	(MBH)	(kw)	(MBH)
0	32	68.4	234	65.0	222	61.4	210	57.6	197	53.7	183
2	36	73.7	252	70.0	239	66.1	226	62.0	212	57.8	197
4	39	77.8	266	73.9	252	69.7	238	65.6	224	61.0	208
6	43	83.3	285	79.1	270	74.7	255	70.2	240	65.4	223
8	46	87.6	299	83.2	284	78.6	268	73.8	252	68.8	235
10	50	93.5	319	88.8	303	83.9	286	78.8	269	73.5	251

7C SST / 35C Amb. 76.7 261.8175 25.25

Gross Cooling Capacities - RAUP 300 R22 Refrigerant 46 C (115 F)

		Outdoor Ambient Temperature									
Saturated Suction		25 C (77 F)		30 C (86 F)		35 C (95 F)		40 C (104 F)		46 C (115 F)	
Temperature		Capacity		Capacity		Capacity		Capacity		Capacity	
C	F	(kw)	(MBH)	(kw)	(MBH)	(kw)	(MBH)	(kw)	(MBH)	(kw)	(MBH)
0	32	80.6	275	76.6	262	72.5	248	68.2	233	63.6	217
2	36	86.9	297	82.6	282	78.2	267	73.5	251	68.6	234
4	39	91.7	313	87.3	298	82.6	282	77.6	265	72.4	247
6	43	98.4	336	93.6	320	88.6	303	83.0	284	77.8	266
8	46	103.6	354	98.5	336	93.2	318	87.6	299	81.8	280
10	50	110.7	378	105.2	359	99.5	340	93.6	320	87.4	299

7C SST / 35C Amb. 90.9 310.38 28.9

Gross Cooling Capacities - RAUP 400 R22 Refrigerant 46 C (115 F)

		Outdoor Ambient Temperature									
Saturated Suction		25 C (77 F)		30 C (86 F)		35 C (95 F)		40 C (104 F)		46 C (115 F)	
Temperature		Capacity		Capacity		Capacity		Capacity		Capacity	
C	F	(kw)	(MBH)	(kw)	(MBH)	(kw)	(MBH)	(kw)	(MBH)	(kw)	(MBH)
0	32	104.4	357	98.8	337	92.9	317	86.8	296	80.4	275
2	36	112.3	384	106.3	363	100.0	342	93.5	319	86.6	296
4	39	118.4	405	112.1	383	105.5	362	98.6	337	91.4	312
6	43	126.8	433	120.0	410	113.0	386	105.6	361	98.0	335
8	46	133.2	455	126.1	431	118.7	405	111.0	379	103.0	352
10	50	141.8	484	134.3	459	126.4	432	118.3	404	109.8	375

7C SST / 35C Amb. 115.8 395.535 39.5

Gross Cooling Capacities - RAUP 500 R22 Refrigerant 46 C (115 F)

		Outdoor Ambient Temperature									
Saturated Suction		25 C (77 F)		30 C (86 F)		35 C (95 F)		40 C (104 F)		46 C (115 F)	
Temperature		Capacity		Capacity		Capacity		Capacity		Capacity	
C	F	(kw)	(MBH)	(kw)	(MBH)	(kw)	(MBH)	(kw)	(MBH)	(kw)	(MBH)
0	32	136.9	468	130.0	444	122.8	419	115.3	394	107.4	367
2	36	147.4	503	140.0	478	132.2	452	124.1	424	115.6	395
4	39	155.5	531	147.7	504	139.5	476	130.9	447	122.0	417
6	43	166.6	569	158.3	541	149.5	511	140.3	479	130.9	447
8	46	175.2	599	166.4	568	157.2	537	147.6	504	137.6	470
10	50	186.9	638	177.5	606	167.7	573	157.5	538	147.0	502

7C SST / 35C Amb. 153.3 523.635 50.5

Gross Cooling Capacities - RAUP 600 R22 Refrigerant 46 C (115 F)

		Outdoor Ambient Temperature									
Saturated Suction		25 C (77 F)		30 C (86 F)		35 C (95 F)		40 C (104 F)		45 C (113 F)	
Temperature		Capacity		Capacity		Capacity		Capacity		Capacity	
C	F	(kw)	(MBH)	(kw)	(MBH)	(kw)	(MBH)	(kw)	(MBH)	(kw)	(MBH)
0	32	161.2	550	153.3	524	145.0	495	136.3	466	127.2	435
2	36	173.8	594	165.2	564	156.3	534	147.0	502	137.2	469
4	39	183.5	627	174.5	596	165.1	564	155.2	530	144.9	495
6	43	196.9	672	187.2	640	177.2	605	166.0	567	155.5	531
8	46	207.2	708	197.0	673	180.4	637	175.2	599	163.7	559
10	50	221.3	756	210.4	719	199.0	680	187.2	639	174.9	597

7C SST / 35C Amb. 181.8 620.76 57.8

Capacity = Grosss Total Capacity
P.I. = Compressor Power Input rated at 400V/50Hz
HP = High Pressure Gauge
LP = Low Pressure Gauge
Pressures and power output here are calculated and subject to variation depending on site conditions.

RAUP Performance Data - R407C (50Hz)

Gross Cooling Capacities - RAUP 250 R407C Refrigerant 46 C (115 F)

		Outdoor Ambient Temperature									
Saturated Suction		25 C (77 F)		30 C (86 F)		35 C (95 F)		40 C (104 F)		46 C (115 F)	
Temperature		Capacity		Capacity		Capacity		Capacity		Capacity	
C	F	(kw)	(MBH)	(kw)	(MBH)	(kw)	(MBH)	(kw)	(MBH)	(kw)	(MBH)
0	32	65.0	222	61.7	211	58.3	199	54.8	187	51.0	174
2	36	70.0	239	66.5	227	62.8	215	58.9	201	54.9	188
4	39	73.9	252	70.2	240	66.2	226	62.2	212	57.9	198
6	43	79.2	270	75.2	257	71.0	243	66.7	228	62.2	212
8	46	83.2	284	79.0	270	74.7	255	70.1	239	65.4	223
10	50	88.8	303	84.3	288	79.7	272	74.8	256	69.8	239

7C SST / 35C Amb. 72.8 248.726625 25.25

Gross Cooling Capacities - RAUP 300 R407C Refrigerant 46 C (115 F)

		Outdoor Ambient Temperature									
Saturated Suction		25 C (77 F)		30 C (86 F)		35 C (95 F)		40 C (104 F)		46 C (115 F)	
Temperature		Capacity		Capacity		Capacity		Capacity		Capacity	
C	F	(kw)	(MBH)	(kw)	(MBH)	(kw)	(MBH)	(kw)	(MBH)	(kw)	(MBH)
0	32	76.6	261	72.8	249	68.9	235	64.8	221	60.4	206
2	36	82.5	282	78.5	268	74.2	254	69.8	238	65.2	223
4	39	87.2	298	82.9	283	78.4	268	73.7	252	68.8	235
6	43	93.5	319	88.9	304	84.1	287	78.9	269	73.9	252
8	46	98.4	336	93.6	320	88.5	302	83.2	284	77.8	266
10	50	105.1	359	100.0	341	94.5	323	88.9	304	83.1	284

7C SST / 35C Amb. 86.3 294.861 28.9

Gross Cooling Capacities - RAUP 400 R407C Refrigerant 46 C (115 F)

		Outdoor Ambient Temperature									
Saturated Suction		25 C (77 F)		30 C (86 F)		35 C (95 F)		40 C (104 F)		46 C (115 F)	
Temperature		Capacity		Capacity		Capacity		Capacity		Capacity	
C	F	(kw)	(MBH)	(kw)	(MBH)	(kw)	(MBH)	(kw)	(MBH)	(kw)	(MBH)
0	32	99.2	339	93.8	320	88.3	301	82.5	282	76.4	261
2	36	106.7	364	101.0	345	95.0	325	88.8	303	82.3	281
4	39	112.5	384	106.5	364	100.2	342	93.7	320	86.8	297
6	43	120.4	411	114.0	389	107.3	367	100.3	343	93.1	318
8	46	126.5	432	119.8	409	112.7	385	105.4	360	97.8	334
10	50	134.7	460	127.6	436	120.1	410	112.4	384	104.3	356

7C SST / 35C Amb. 110.0 375.75825 39.5

Gross Cooling Capacities - RAUP 500 R407C Refrigerant 46 C (115 F)

		Outdoor Ambient Temperature									
Saturated Suction		25 C (77 F)		30 C (86 F)		35 C (95 F)		40 C (104 F)		46 C (115 F)	
Temperature		Capacity		Capacity		Capacity		Capacity		Capacity	
C	F	(kw)	(MBH)	(kw)	(MBH)	(kw)	(MBH)	(kw)	(MBH)	(kw)	(MBH)
0	32	130.0	444	123.5	422	116.7	398	109.5	374	102.1	349
2	36	140.0	478	133.0	454	125.6	429	117.9	403	109.8	375
4	39	147.7	505	140.3	479	132.5	453	124.4	425	115.9	396
6	43	158.3	541	150.4	514	142.0	485	133.3	455	124.3	425
8	46	166.5	569	158.1	540	149.3	510	140.2	479	130.7	447
10	50	177.6	606	168.6	576	159.4	544	149.7	511	139.7	477

7C SST / 35C Amb. 145.7 497.45325 40.5

Gross Cooling Capacities - RAUP 600 R407C Refrigerant 46 C (115 F)

		Outdoor Ambient Temperature									
Saturated Suction		25 C (77 F)		30 C (86 F)		35 C (95 F)		40 C (104 F)		46 C (115 F)	
Temperature		Capacity		Capacity		Capacity		Capacity		Capacity	
C	F	(kw)	(MBH)	(kw)	(MBH)	(kw)	(MBH)	(kw)	(MBH)	(kw)	(MBH)
0	32	153.1	523	145.6	497	137.7	470	129.5	442	120.9	413
2	36	165.1	564	157.0	536	148.5	507	139.6	477	130.3	445
4	39	174.3	595	165.8	566	156.8	536	147.4	504	137.6	470
6	43	187.1	639	177.9	608	168.3	575	157.7	539	147.7	505
8	46	196.9	672	187.2	639	177.1	605	166.5	569	155.5	531
10	50	210.2	718	199.9	683	189.1	646	177.8	607	166.1	567

7C SST / 35C Amb. 172.7 589.722 57.8

Capacity = Grosss Total Capacity
P.I. = Compressor Power Input rated at 400V/50Hz
HP = High Pressure Gauge
LP = Low Pressure Gauge
Pressures and power output here are calculated and subject to variation depending on site conditions.

RAUP - TTV System

For ease of selection, 5 pre selected systems with indoor units TTV are available as in the following performance table

SYSTEM PERFORMANCE DATA R22							Outdoor Ambient F (C)																			
Outdoor Unit	Indoor Unit	Indoor Unit	Evap. On Coil Temp.				75 (24)					86 (30)					95 (35)					104 (40)				
		CFM	EDB		EWB		TC		SCH		PI	TC		SCH		PI	TC		SCH		PI	TC		SCH		PI
		CMS	F	C	F	C	MBH	kW	MBH	kW	kW	MBH	kW	MBH	kW	kW	MBH	kW	MBH	kW	kW	MBH	kW	MBH	kW	kW
RAUP 250	TTV 250	7760	75	24	61	16	276	81	218	64	17	264	77	212	62	19	252	74	206	60	21	239	70	200	59	24
		3.7	77	25	64	18	290	86	209	61	17	278	81	206	60	19	260	76	195	57	21	251	73	193	57	24
			80	27	67	19	304	89	207	61	17	292	86	204	60	19	278	81	197	58	21	262	77	191	56	24
			86	30	71	22	-		-		-	-		-		-	-		-		-	-		-		-
RAUP 300	TTV 300	9240	75	24	61	16	206	60	165	48	14	197	58	251	74	22	301	88	247	72	25	286	84	240	70	28
		4.4	77	25	64	18	217	63	158	46	15	208	61	241	71	22	316	93	237	69	25	299	88	230	67	28
			80	27	67	19	228	67	157	46	15	218	64	240	70	22	333	98	237	69	25	317	93	228	67	28
			86	30	71	22	243	71	165	49	15	233	68	-		-	-		-		-	-		-		-
RAUP 400	TTV 400	12120	75	24	61	16	419	123	335	98	26	399	117	327	96	30	380	111	315	92	34	359	105	309	90	38
		5.7	77	25	64	18	444	130	324	95	26	423	124	313	92	30	401	117	305	89	34	379	111	295	86	38
			80	27	67	19	462	135	319	93	26	442	129	314	92	30	421	123	303	89	34	398	116	294	86	38
			86	30	71	22	-		-		-	-		-		-	-		-		-	-		-		-
RAUP 500	TTV 500	15130	75	24	61	16	536	157	440	129	33	513	160	426	125	37	490	143	416	122	42	464	136	371	109	47
		7.1	77	25	64	18	565	165	418	122	33	540	158	410	120	37	515	151	397	116	42	487	143	385	113	47
			80	27	67	19	592	173	420	123	33	568	166	409	120	37	541	159	395	116	42	514	151	386	113	47
			86	30	71	22	-		-		-	-		-		-	-		-		-	-		-		-
RAUP 600	TTV 600	18080	75	24	61	16	645	189	542	159	40	621	182	528	155	45	594	174	517	151	50	564	165	502	147	56
		8.5	77	25	64	18	682	200	518	152	40	656	192	512	150	45	627	184	496	145	50	595	174	482	141	56
			80	27	67	19	714	209	514	150	40	686	201	508	149	45	658	193	493	144	50	623	182	480	140	56
			86	30	71	22	-		-		-	-		-		-	-		-		-	-		-		-

SYSTEM PERFORMANCE DATA R407C							Outdoor Ambient F (C)																			
Outdoor Unit	Indoor Unit	Indoor Unit	Evap. On Coil Temp.				75 (24)					86 (30)					95 (35)					104 (40)				
		CFM	EDB		EWB		TC		SCH		PI	TC		SCH		PI	TC		SCH		PI	TC		SCH		PI
		CMS	F	C	F	C	MBH	kW	MBH	kW	kW	MBH	kW	MBH	kW	kW	MBH	kW	MBH	kW	kW	MBH	kW	MBH	kW	kW
RAUP 250	TTV 250	7760	75	24	61	16	262	77	207	61	17	251	74	201	59	19	239	70	196	57	21	227	66	190	56	24
		3.7	77	25	64	18	276	81	198	58	17	264	77	195	57	19	247	72	185	54	21	238	70	184	54	24
			80	27	67	19	289	85	197	58	17	277	81	194	57	19	264	77	187	55	21	249	73	182	53	24
			86	30	71	22	-		-		-	-		-		-	-		-		-	-		-		-
RAUP 300	TTV 300	9240	75	24	61	16	195	57	156	46	14	187	55	239	70	22	286	84	234	69	25	271	79	228	67	28
		4.4	77	25	64	18	206	60	150	44	15	197	58	229	67	22	300	88	225	66	25	284	83	219	64	28
			80	27	67	19	216	63	149	44	15	207	61	228	67	22	316	93	225	66	25	301	88	217	63	28
			86	30	71	22	-		-		15	-		-		-	-		-		-	-		-		-
RAUP 400	TTV 400	12120	75	24	61	16	398	117	319	93	26	379	111	311	91	30	361	106	299	88	34	341	100	294	86	38
		5.7	77	25	64	18	421	123	308	90	26	402	118	298	87	30	381	112	289	85	34	360	105	281	82	38
			80	27	67	19	439	129	303	89	26	420	123	298	87	30	400	117	288	84	34	378	111	280	82	38
			86	30	71	22	-		-		-	-		-		-	-		-		-	-		-		-
RAUP 500	TTV 500	15130	75	24	61	16	510	149	418	122	33	488	143	405	119	37	465	136	386	116	42	441	129	352	103	47
		7.1	77	25	64	18	536	157	397	116	33	513	150	390	114	37	489	143	377	110	42	463	136	366	107	47
			80	27	67	19	562	165	399	117	33	540	158	389	114	37	514	151	375	110	42	488	143	366	107	47
			86	30	71	22	-		-		-	-		-		-	-		-		-	-		-		-
RAUP 600	TTV 600	18080	75	24	61	16	613	179	515	151	40	590	173	502	147	45	564	166	491	144	50	536	157	477	140	56
		8.5	77	25	64	18	648	190	493	144	40	624	183	486	142	45	596	175	471	138	50	565	165	458	134	56
			80	27	67	19	678	199	488	143	40	652	191	482	141	45	625	183	468	137	50	592	173	456	133	56
			86	30	71	22	-		-		-	-		-		-	-		-		-	-		-		-

Notes

TC Gross Total Capacity
SC Sensible Capacity
PI Power Imput, kW Compressors

All Capacities are gross and do not include a deduction for evaporator fan motor heat..
Interpolation is allowed. Do not extrapolate.

TRANE

Indoor Unit Fan Performance Data

Evaporator For Performance - TTV 250 — English Unit

External Static Pressure (in. wg)

	0.5		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
CFM	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
6207	634	1.9	661	2.0	713	2.3	764	2.5	812	2.8	860	3.1	907	3.4	953	3.7	999	4.1
6760	662	2.2	687	2.3	736	2.7	784	2.8	831	3.1	876	3.5	919	3.8	961	4.1	1002	4.4
7760	725	3.1	748	3.3	791	3.5	834	4.0	876	4.2	917	4.4	958	4.8	999	5.2	1036	5.5
7880	732	3.2	755	3.4	798	3.6	840	4.1	881	4.3	922	4.6	963	4.9	1003	5.3	1040	5.7
9010	805	4.5	825	4.7	866	5.1	903	5.3	941	5.9	977	6.3	1013	6.5	1049	6.8	1065	7.1
9460	835	5.1	855	5.3	894	5.8	931	6.1	967	6.5	1001	7.0	1036	7.3	1071	7.7	1105	8.0

SI Unit

External Static Pressure (Pa)

	125		149		199		249		299		349		398		448		498	
CMS	RPM	kW	RPM	kW	RPM	kW	RPM	kW	RPM	kW	RPM	kW	RPM	kW	RPM	kW	RPM	kW
2.9	634	1.4	661	1.5	713	1.7	764	1.9	812	2.1	860	2.3	907	2.5	953	2.8	999	3.1
3.2	662	1.6	687	1.7	736	2.0	784	2.1	831	2.3	876	2.6	919	2.8	961	3.1	1002	3.3
3.7	725	2.3	748	2.5	791	2.6	834	3.0	876	3.1	917	3.3	958	3.6	999	3.9	1036	4.1
3.7	732	2.4	755	2.5	798	2.7	840	3.1	881	3.2	922	3.4	963	3.7	1003	4.0	1040	4.3
4.3	805	3.4	825	3.5	866	3.8	903	4.0	941	4.4	977	4.7	1013	4.9	1049	5.1	1065	5.3
4.5	835	3.8	855	4.0	894	4.3	931	4.6	967	4.9	1001	5.2	1036	5.4	1071	5.7	1105	6.0

Std. Motor is 5hp (3.7kW). High Static Option is 10hp (7.5kW)

Evaporator For Performance - TTV 300 — English Unit

External Static Pressure (in. wg)

	0.5		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
CFM	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
7440	692	2.7	717	2.9	762	3.2	807	3.5	851	3.8	894	4.0	936	4.4	976	4.7	1016	5.1
7880	719	3.1	743	3.3	786	3.5	829	4.0	870	4.3	911	4.5	952	4.8	992	5.2	1030	5.6
9000	790	4.4	810	4.5	852	5.0	890	5.2	927	5.6	964	6.2	1000	6.4	1036	6.6	1072	7.0
9240	806	4.7	825	4.9	866	5.3	904	5.6	940	6.0	977	6.5	1012	6.8	1047	7.1	1082	7.4
10130	865	6.0	882	6.1	919	6.5	956	7.0	990	7.3	1023	7.7	1057	8.3	1089	8.8	-	-
11260	924	8.0	958	8.2	990	8.5	1023	9.0	1057	9.6	1088	9.9	1118	10.2	-	-	-	-

SI Unit

External Static Pressure (Pa)

	125		149		199		249		299		349		398		448		498	
CMS	RPM	kW	RPM	kW	RPM	kW	RPM	kW	RPM	kW	RPM	kW	RPM	kW	RPM	kW	RPM	kW
3.5	692	2.0	717	2.2	762	2.4	807	2.6	851	2.8	894	3.0	936	3.3	976	3.5	1016	3.8
3.7	719	2.3	743	2.5	786	2.6	829	3.0	870	3.2	911	3.4	952	3.6	992	3.9	1030	4.2
4.2	790	3.3	810	3.4	852	3.7	890	3.9	927	4.2	964	4.6	1000	4.8	1036	4.9	1072	5.2
4.4	806	3.5	825	3.7	866	4.0	904	4.2	940	4.5	977	4.9	1012	5.1	1047	5.3	1082	5.5
4.8	865	4.5	882	4.6	919	4.9	956	5.2	990	5.4	1023	5.7	1057	6.2	1089	6.6	-	-
5.3	924	6.0	958	6.1	990	6.3	1023	6.7	1057	7.2	1088	7.4	1118	7.6	-	-	-	-

Std. Motor is 7.5hp (5.5kW). High Static Option is 15hp (11kW)

Evaporator For Performance - TTV 400 — English Unit

External Static Pressure (in. wg)

	0.5		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
CFM	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
9680	609	2.9	737	3.2	799	3.6	861	4.0	918	4.4	971	4.8	1021	5.2	1068	5.6	1115	6.2
10140	631	3.3	754	3.5	812	3.9	873	4.4	930	4.8	983	5.2	1032	5.8	1078	6.2	1124	6.6
11260	687	4.3	798	4.6	854	4.9	906	5.4	960	5.9	1014	6.4	1062	6.9	1108	7.4	1152	7.9
12120	730	5.2	835	5.4	887	5.9	937	5.9	986	6.8	1036	7.4	1085	8.0	1131	8.6	1175	8.9
12390	744	5.5	847	5.8	897	6.2	947	6.7	994	7.2	1043	7.8	1093	8.3	1139	8.9	1182	9.4
13520	802	6.8	900	7.1	943	7.6	990	8.2	1035	8.7	1078	9.3	1123	9.8	1169	10.5	1213	11.1
14670	863	8.6	954	8.9	996	9.4	1035	9.9	1079	10.6	1154	11.3	1200	12.1	-	-	-	-

SI Unit

External Static Pressure (Pa)

	125		149		199		249		299		349		398		448		498	
CMS	RPM	kW	RPM	kW	RPM	kW	RPM	kW	RPM	kW	RPM	kW	RPM	kW	RPM	kW	RPM	kW
4.6	609	2.2	737	2.4	799	2.7	861	3.0	918	3.3	971	3.6	1021	3.9	1068	4.2	1115	4.6
4.8	631	2.5	754	2.6	812	2.9	873	3.3	930	3.6	983	3.9	1032	4.3	1078	4.6	1124	4.9
5.3	687	3.2	798	3.4	854	3.7	906	4.0	960	4.4	1014	4.8	1062	5.2	1108	5.5	1152	5.9
5.7	730	3.9	835	4.0	887	4.4	937	4.4	986	5.1	1036	5.5	1085	6.0	1131	6.4	1175	6.6
5.8	744	4.1	847	4.3	897	4.6	947	5.0	994	5.4	1043	5.8	1093	6.2	1139	6.6	1182	7.0
6.4	802	5.1	900	5.3	943	5.7	990	6.1	1035	6.5	1078	6.9	1123	7.3	1169	7.8	1213	8.3
6.9	863	6.4	954	6.6	996	7.0	1035	7.4	1079	7.9	1154	8.4	1200	9.0	-	-	-	-

Std. Motor is 7.5hp (5.5kW). High Static Option is 15hp (11kW)

Indoor Unit Fan Performance Data

Evaporator For Performance - TTV 500																								English Unit
	External Static Pressure (in. wg)																							
	0.5		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0		2.2		2.4		2.5	
CFM	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
12060	479	2.6	509	2.9	570	3.5	638	4.5	698	5.5	745	6.3	787	6.9	826	7.6	865	8.2	904	8.9	943	9.6	963	9.9
12780	489	2.9	516	3.2	574	3.7	634	4.6	702	5.8	754	6.8	796	7.6	834	8.2	871	8.9	907	9.6	944	10.3	963	10.6
13940	511	3.5	536	3.8	587	4.4	638	5.0	695	6.0	758	7.4	808	8.5	849	9.4	885	10.2	920	10.9	953	11.6	970	12.0
15130	532	4.2	556	4.5	602	5.1	651	5.8	697	6.5	751	7.6	810	9.1	859	10.4	899	11.5	934	12.3	967	13.2	983	13.5
16260	553	5.0	577	5.3	622	6.0	664	6.6	710	7.4	753	8.1	802	9.3	858	10.9	907	12.4	947	13.7	982	14.7	998	15.2
17420	577	5.9	601	6.2	642	6.9	682	7.6	722	8.4	766	9.2	805	10.0	850	11.1	902	12.8	951	14.6	992	16.0	1010	16.6
18310	597	6.6	619	7.0	658	7.7	698	8.5	734	9.2	775	10.0	815	10.9	854	11.8	897	13.1	945	14.7	991	16.6	-	-

																								SI Unit
	External Static Pressure (Pa)																							
	125		149		199		249		298.8		348.6		398.4		448.2		498		548		597.6		622.5	
CMS	RPM	kW	RPM	kW	RPM	kW	RPM	kW	RPM	kW	RPM	kW	RPM	kW	RPM	kW	RPM	kW	RPM	kW	RPM	kW	RPM	kW
5.7	479	1.9	509	2.2	570	2.6	638	3.4	698	4.1	745	4.7	787	5.1	826	5.7	865	6.1	904	6.6	943	7.2	963	7.4
6.0	489	2.2	516	2.4	574	2.8	634	3.4	702	4.3	754	5.1	796	5.7	834	6.1	871	6.6	907	7.2	944	7.7	963	7.9
6.6	511	2.6	536	2.8	587	3.3	638	3.7	695	4.5	758	5.5	808	6.3	849	7.0	885	7.6	920	8.1	953	8.7	970	9.0
7.1	532	3.1	556	3.4	602	3.8	651	4.3	697	4.9	751	5.7	810	6.8	859	7.8	899	8.6	934	9.2	967	9.9	983	10.1
7.7	553	3.7	577	4.0	622	4.5	664	4.9	710	5.5	753	6.1	802	6.9	858	8.1	907	9.3	947	10.2	982	11.0	998	11.3
8.2	577	4.4	601	4.6	642	5.2	682	5.7	722	6.3	766	6.9	805	7.5	850	8.3	902	9.6	951	10.9	992	11.9	1010	12.4
8.6	597	4.9	619	5.2	658	5.7	698	6.3	734	6.9	775	7.5	815	8.1	854	8.8	897	9.8	945	11.0	991	12.4	-	-

Std. Motor is 10hp (7.5kW). High Static Option is 20hp (15kW)

Evaporator For Performance - TTV 600																								English Unit
	External Static Pressure (in. wg)																							
	0.5		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0		2.2		2.4		2.5	
CFM	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
14460	569	5.0	592	5.3	635	5.9	682	6.6	728	7.4	777	8.5	832	9.9	882	11.4	923	12.6	959	13.6	992	14.5	1008	14.9
14900	579	5.3	602	5.7	643	6.3	689	7.0	733	7.8	777	8.6	831	10.1	885	11.8	929	13.1	966	14.2	999	15.2	1015	15.7
15960	605	6.3	625	6.6	667	7.3	705	8.0	749	8.9	789	9.6	831	10.6	881	12.1	932	13.9	977	15.5	1014	16.8	-	-
17030	631	7.4	651	7.7	691	8.5	727	9.2	765	10.0	806	10.9	843	11.7	882	12.7	928	14.2	977	16.1	-	-	-	-
18090	658	8.6	677	9.0	714	9.8	751	10.6	785	11.3	821	12.2	860	13.2	895	14.0	931	15.1	973	16.6	-	-	-	-
19160	686	9.9	705	10.4	739	11.2	775	12.1	808	12.9	840	13.7	876	14.7	912	15.7	945	16.6	-	-	-	-	-	-
20220	713	11.4	732	11.9	765	12.8	799	13.7	832	14.6	862	15.4	893	16.3	927	17.4	-	-	-	-	-	-	-	-
21280	740	13.1	759	13.6	792	14.5	823	15.4	856	16.4	886	17.3	-	-	-	-	-	-	-	-	-	-	-	-
21900	756	14.1	775	14.6	808	15.6	838	16.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

																								SI Unit
	External Static Pressure (Pa)																							
	125		149		199		249		298.8		348.6		398.4		448.2		498		548		597.6		622.5	
CMS	RPM	kW	RPM	kW	RPM	kW	RPM	kW	RPM	kW	RPM	kW	RPM	kW	RPM	kW	RPM	kW	RPM	kW	RPM	kW	RPM	kW
6.8	569	3.7	592	4.0	635	4.4	682	4.9	728	5.5	777	6.3	832	7.4	882	8.5	923	9.4	959	10.2	992	10.8	1008	11.1
7.0	579	4.0	602	4.3	643	4.7	689	5.2	733	5.8	777	6.4	831	7.5	885	8.8	929	9.8	966	10.6	999	11.3	1015	11.7
7.5	605	4.7	625	4.9	667	5.4	705	6.0	749	6.6	789	7.2	831	7.9	881	9.0	932	10.4	977	11.6	1014	12.5	-	-
8.0	631	5.5	651	5.7	691	6.3	727	6.9	765	7.5	806	8.1	843	8.7	882	9.5	928	10.6	977	12.0	-	-	-	-
8.5	658	6.4	677	6.7	714	7.3	751	7.9	785	8.4	821	9.1	860	9.9	895	10.4	931	11.3	973	12.4	-	-	-	-
9.0	686	7.4	705	7.8	739	8.4	775	9.0	808	9.6	840	10.2	876	11.0	912	11.7	945	12.4	-	-	-	-	-	-
9.5	713	8.5	732	8.9	765	9.6	799	10.2	832	10.9	862	11.5	893	12.2	927	13.0	-	-	-	-	-	-	-	-
10.1	740	9.8	759	10.2	792	10.8	823	11.5	856	12.2	886	12.9	-	-	-	-	-	-	-	-	-	-	-	-
10.3	756	10.5	775	10.9	808	11.6	838	12.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Std. Motor is 15hp (11kW). High Static Option is 20hp (15kW)

Notes

To determine power of the motor to be installed, the following correction factors have to be applied to the fan Shaft Absorbed hp.

Fan Motor hp = Absorbed Fan Shaft hp x Correction Factor

Correction Factor = 1.2 for Absorbed Fan Shaft < 10kW (13.4hp)

Correction Factor = 1.15 for Absorbed Fan Shaft > 10kW (13.4hp)

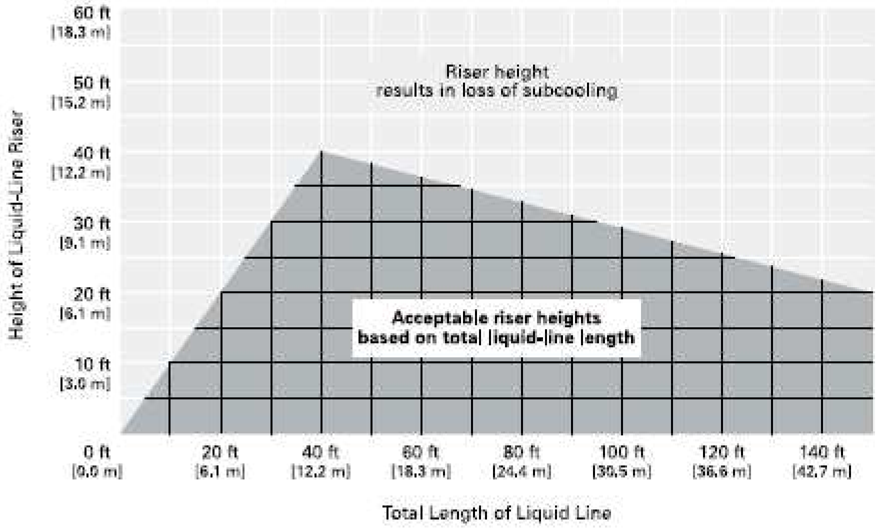
Fan Motor Heat (MBH) = 2.55 x BHP

Data Includes pressure drop due to filters and wet coil.

Line Sizing, Routing and Component Selection

Riser height limitations defined in this chart assume that the liquid line contains 10 elbows. The effect of addittional elbows varies based on the specific characteristics of each installation.

Figure 2. Liquid-Line Riser Limitations for RAUP Condensing Units



Note: Preselected liquid-line diameters independent of line length or rise, within the premissible guidelines, for properly charged RAUP units in normal air-conditioning applications.

Routing. Install the liquid line with a slight slope in the direction of flow so that it can be routed with the suction line.

A height limitation exits for liquid lines that include a liquid riser because of the loss of subcooling that accompanies the pressure loss in the height of the liquid column, Figure 2 depicts the permissible rise in the liquid line (that is, without excessive loss of subcooling). Again, **system designs outside the application envelope of the RAUP unit require Trane review**

Insulation

The liquid line is generally warmer than the surrounding air, so it does not require insulation. In fact, heat loss from the liquid line improves system capacity because it provides additional subcooling.

Components

Liquid-line refrigerant components necessary for a successful job include a filter drier, access port, moisture-indicating sight glass, expansion valve(s), and ball shutoff valves.

Mechanical Specifications

Air Cooled Condensing Unit

- The contractor shall furnish and install a split air cooled condensing unit of size and capacity scheduled at the required working condition.
- The unit shall operate with either a R22 or R407C refrigerant.
- The unit shall be fully wired with starters and controller by the factory.
- All units shall be furnished with hermetic scroll compressors, air cooled condenser and micro-processor control panel.
- Unit shall be able to operate down to 15^{0}C as standard and lower with a low ambient control option.
- Unit shall be able to operate up to 43^{0}C as standard and up to 46^{0}C with a high ambient option,within HPCO limits.
- The airflow through the condenser shall be handled by multiple direct drive fans. Each fan shall be statically and dynamically balanced. Fan motors shall be with permanently lubricated ball bearings, protected by thermal overloads.
- Units shall be designed and manufactured in accordance with the quality insurance ISO 9001.

Unit Construction

- The unit shall be designed for out door application and rust protected with polyester powder paint.
- The unit base, shall be manufactured with GI steel.
- Unit panels shall be removable to facilitate easy service with Allen Key locks.
- Compressor, air intake sections shall be protected with intake grilles as standard.
- Each unit shall be modular in de sign to facilate a modular installation to minimize installed space.

Condenser Coils

- Air cooled condenser coils shall be smooth bore with 3/8” copper tubes mechanically bonded to configured alluminium W3BS slit fins as standard.
- Coils shall be factory leak tested up to 450psig.
- Higher corrosion resistant fins shall be available as an option.

Refrigerant Circuit

- All units shall have 1 or 2 refrigeration circuits with a minimum of 2 manifolded compressors on each circuit for staging control.
- The manifolding piping shall be designed to ensure relable oil return management.
- Each circuit shall be provided with factory set high and low pressure switches.

Electrical

- Electrical panels shall be fully mounted and wired in the factory with full opening access panel.
- The starting mechanism of the fans and compressors shall be provide by the factory.
- A DOL starting mechanism shallbe provided and installed by the factory.

Control System

- Units shall be completely factory wired with microprocessor based controls, starters and terminal block for power wiring.
- Control wiring shall be 230V.
- Compressor overheat, overcurrent and phase loss protection shall be provided. (Phase loss protection is only with the high level control option)
- High and low pressure safety switches to protect the system against operations outside recommended pressure limits.
- Compressor time delays and on-off sequencing logic that is built into the microprocessor algorythm for maximum protection.
- A dry contact shall be available for remote signalling of general faults.
- Segment LED Display shall provide diagnosis for troubleshooting and setpoint temperatures as well as actual size temperatures.
- A zone sensor (measure room temperature to temperature STPT) control shall be standard factory installed.

Indoor Unit Air Handler

Unit Casing

- The unit framework shall be constructed of GI steel. Exterior panels shall be fabricated from galvanized stell sheets, cleaned and coated with a baked polyster powder paint.
- All panels in contact with the air stream shall be insulated with closed cell PE insulation.
- All panels shall be removable to ensure proper access for servicing and maintainence. Removeable panels shall be secured with bolts.

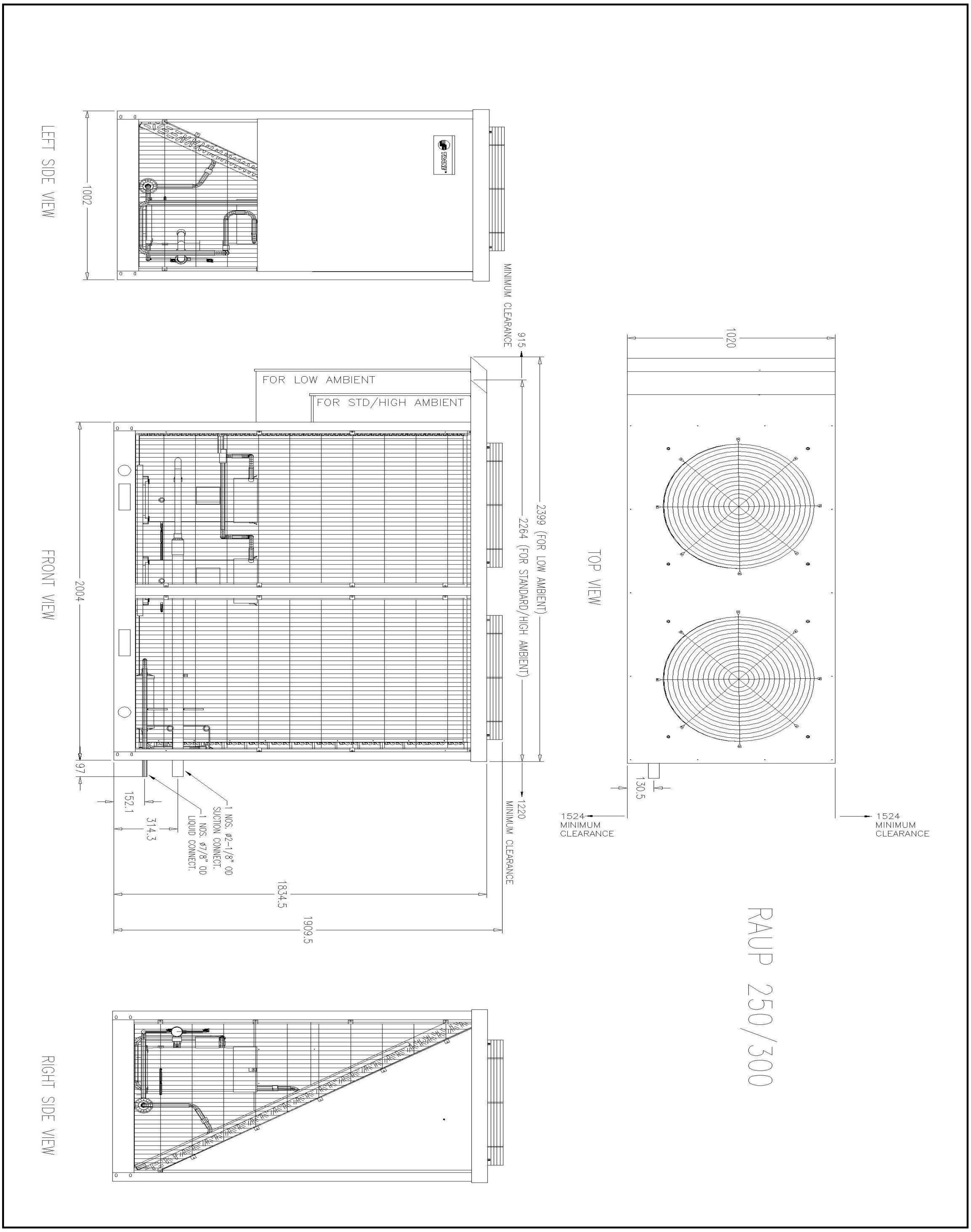
Cooling Coil

- The evaporator coil shall be 1/2 or 3/8” OD seamless copper tubes, mechanically expanded into alluminium fins.
- Coils shall have at least 2 independent circuits for good port load capability (watched with RAUP 400-600)
- Coils shall be leak and proof tested up to 375psig.
- Expansion devices shall be thermal expansion valves.
- Drain pans shall be fabricated of GI, insulated with PE and corossion resistant coated with a corossion resistant coating.

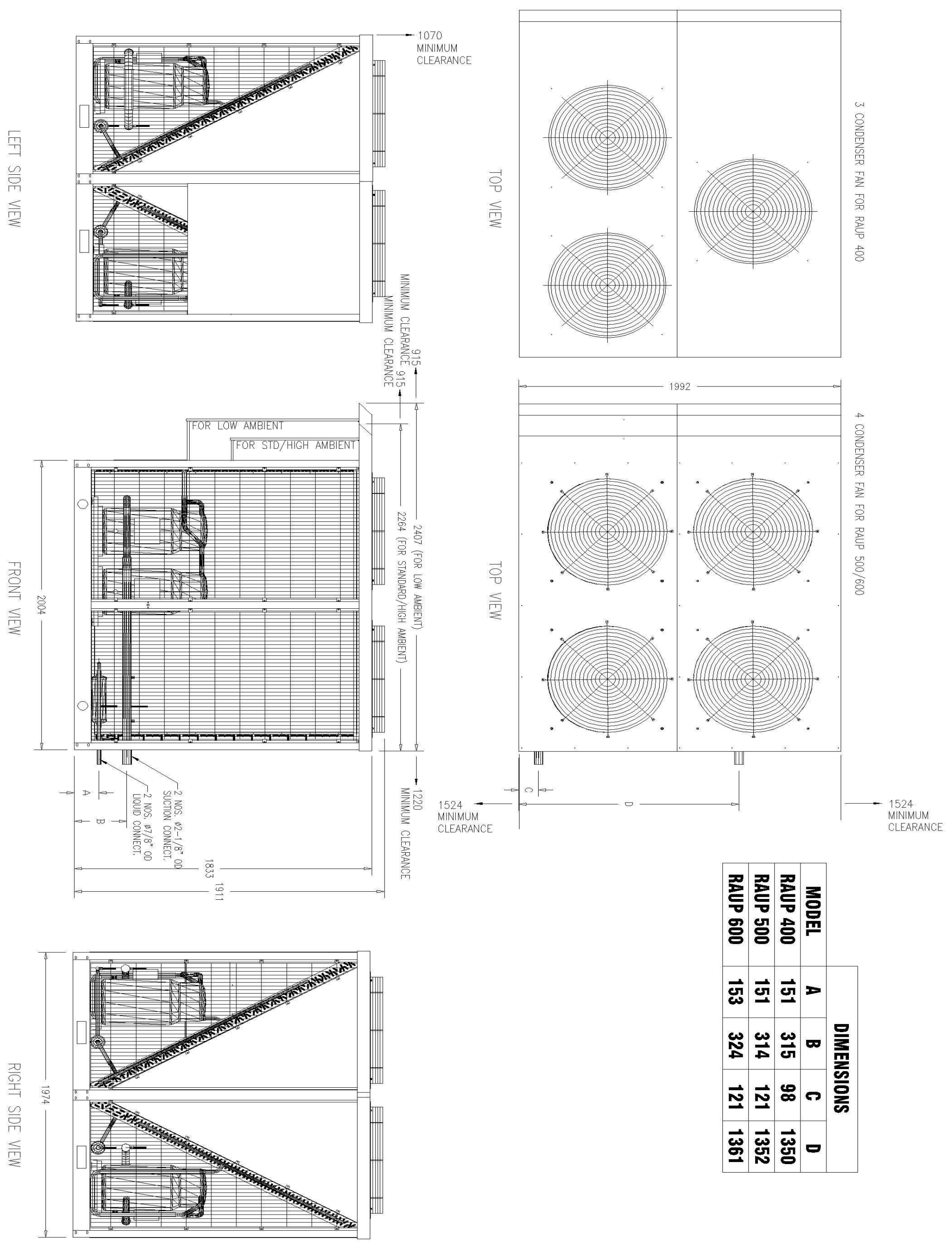
Fans

- Supply fans shall be double width double inlet forward curve centrifugal fans, statically and dynamically balanced.
- The drive components shall be fixed pitch drives with multiple V belts.The supply fan motor shall be of a TEFC type.
- DOL Fan motor starters shall be provided as standard. Thermal overloads shall be provided.

Dimension Drawing
Condensing Unit

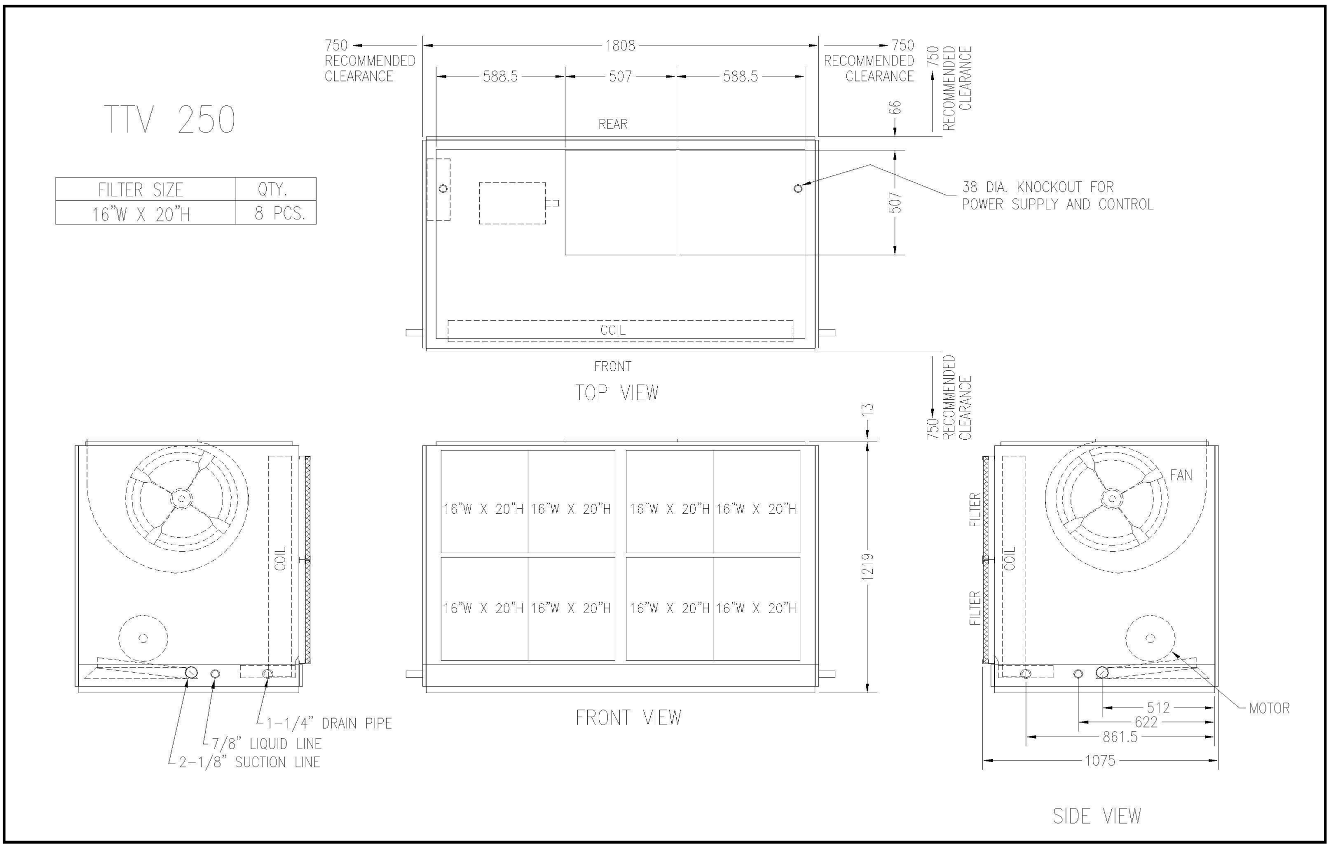


Dimension Drawing
Condensing Unit

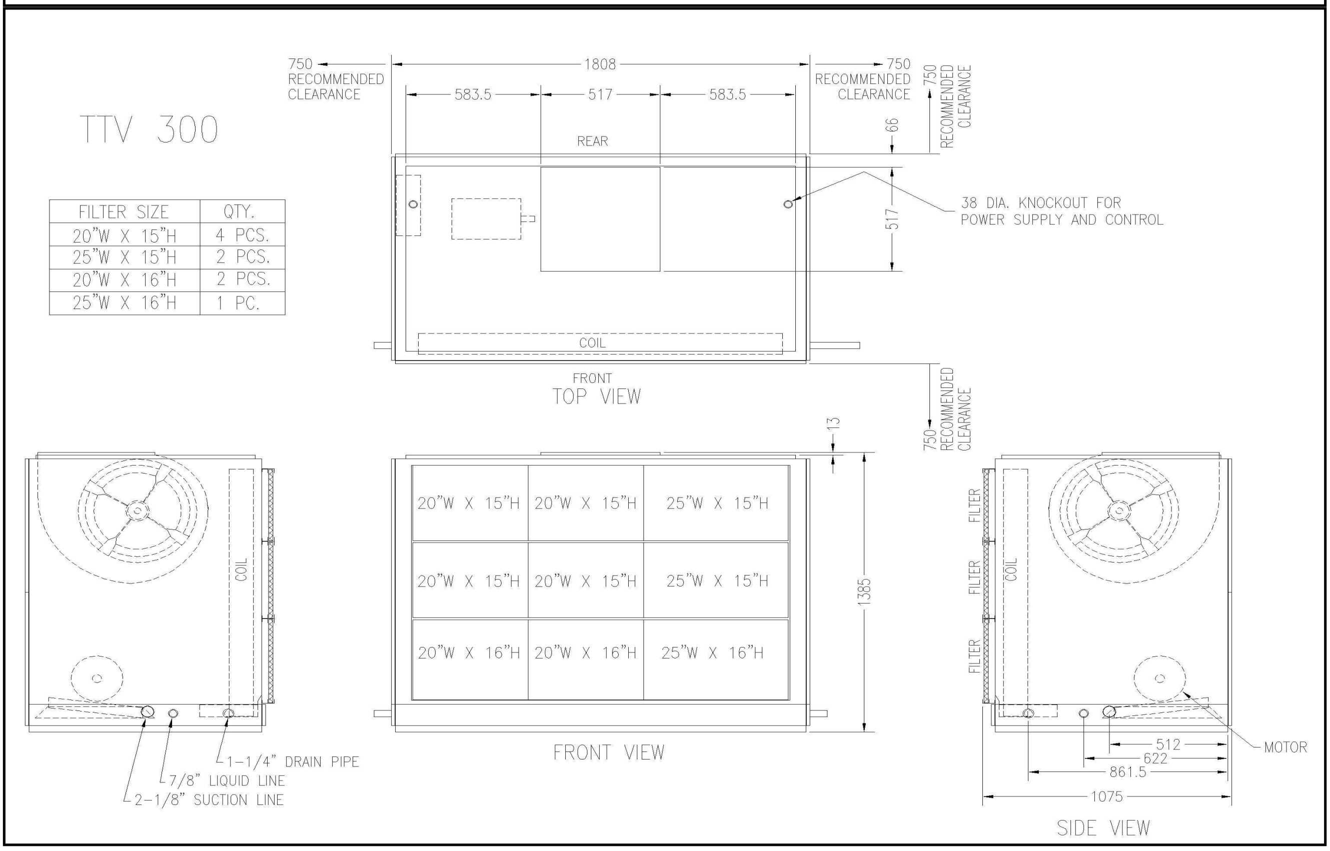


MODEL	DIMENSIONS			
	A	B	C	D
RAUP 400	151	315	98	1350
RAUP 500	151	314	121	1352
RAUP 600	153	324	121	1361

Dimension Drawing
(Evaporating) Unit



FILTER SIZE	QTY.
16"W X 20"H	8 PCS.

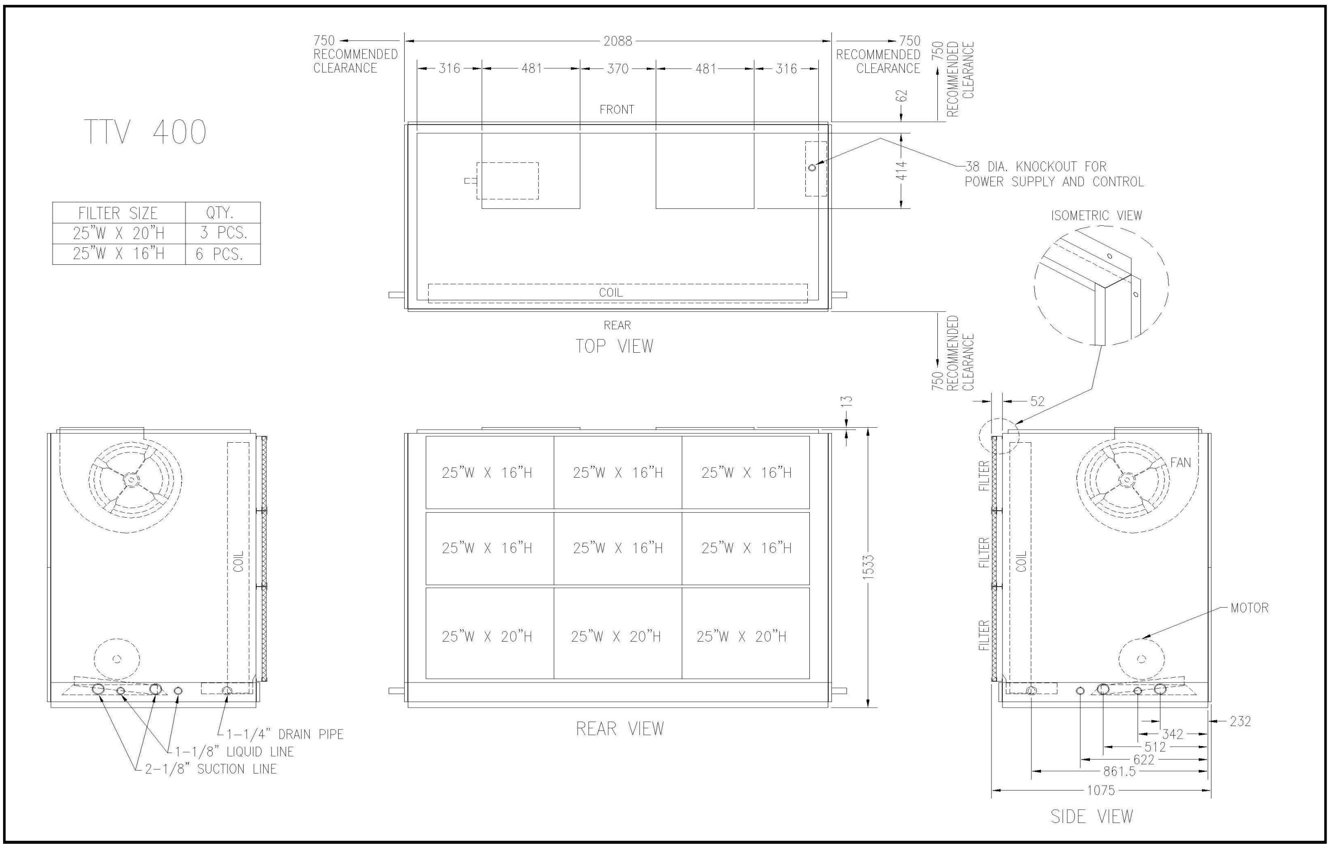


FILTER SIZE	QTY.
20"W X 15"H	4 PCS.
25"W X 15"H	2 PCS.
20"W X 16"H	2 PCS.
25"W X 16"H	1 PC.

Dimension Drawing (Evaporating) Unit

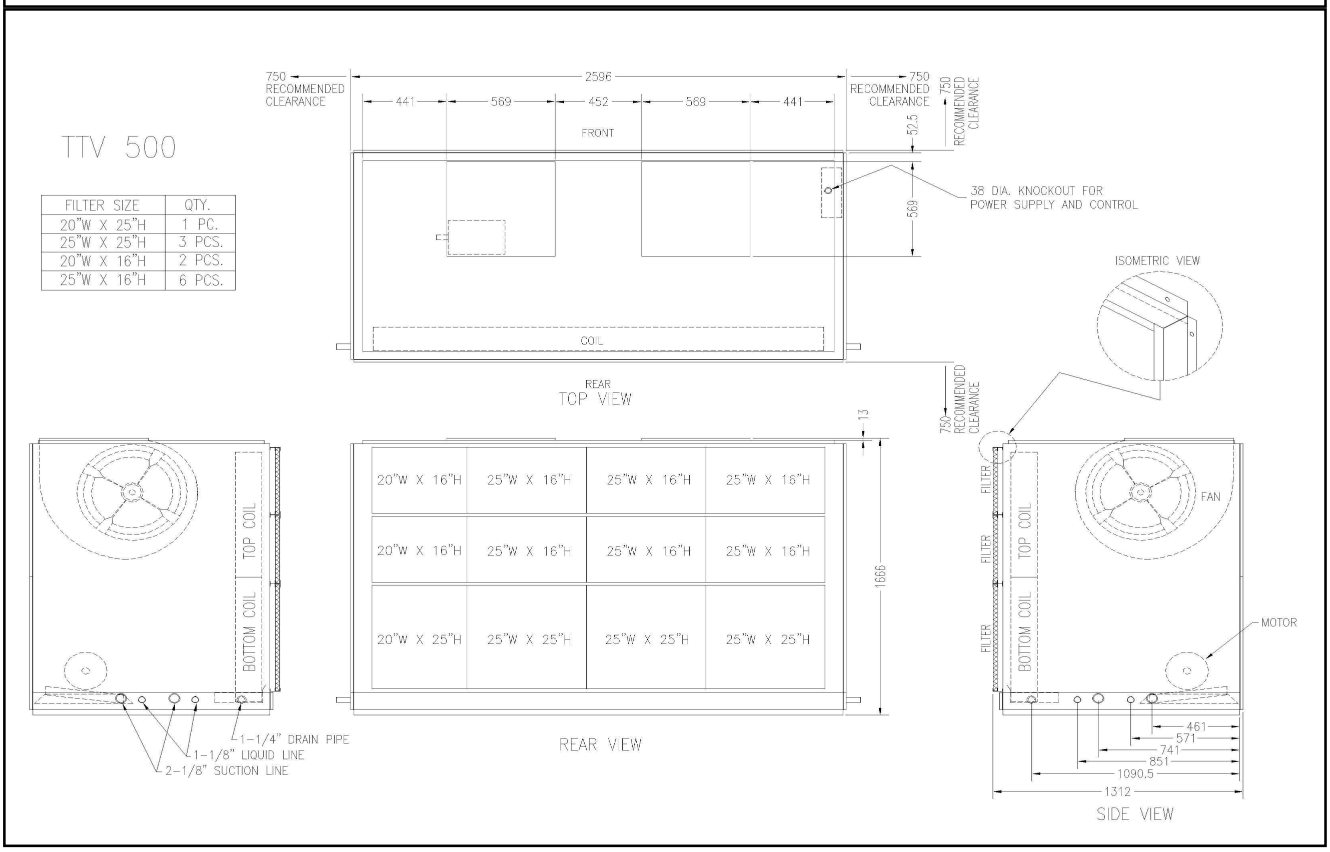
TTV 400

FILTER SIZE	QTY.
25"W X 20"H	3 PCS.
25"W X 16"H	6 PCS.

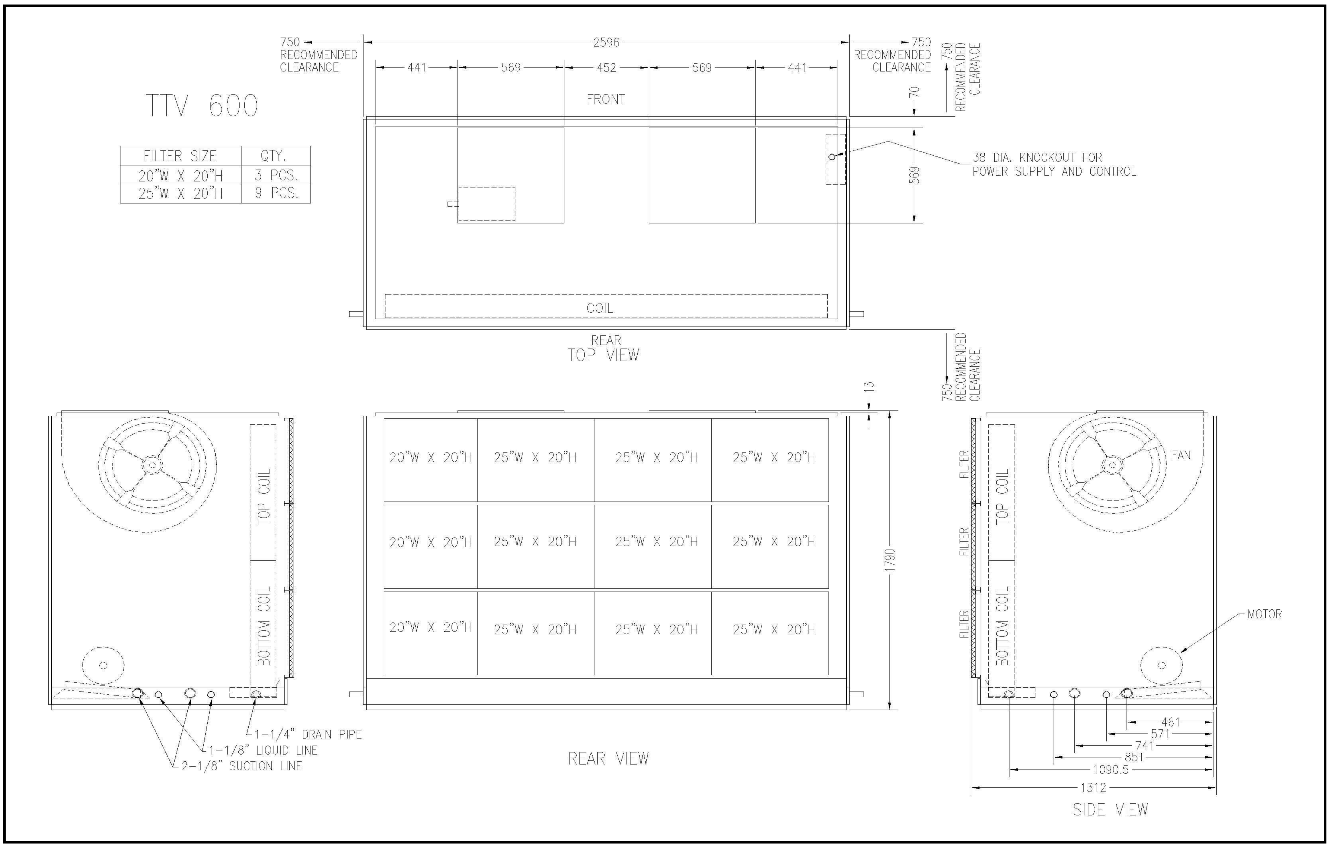


TTV 500

FILTER SIZE	QTY.
20"W X 25"H	1 PC.
25"W X 25"H	3 PCS.
20"W X 16"H	2 PCS.
25"W X 16"H	6 PCS.



Dimension Drawing Indoor (Evaporating) Unit

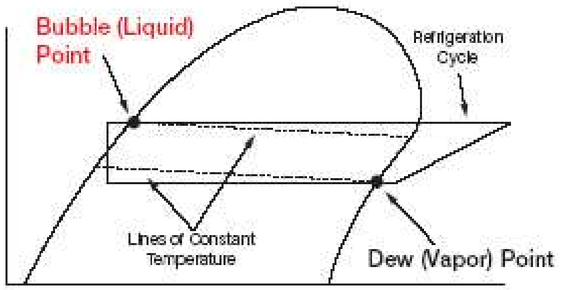


TRANE

Standard Conversion Table

To Convert From	To	Multiply By:
Length		
Feet (ft)	meter (m)	.30481
Inches (In)	millimeters (mm)	25.4
Area		
Square Feet (ft2)	square meter (m2)	.093
Square Inches (In3)	square millimeters (mm2)	645.2
Cubic Feet (ft3)	Cubic Meter (m3)	.0283
Cubic Inches (In3)	Cubic mm (mm3)	16387
Gallons (gal)	litres(l)	3.785
Gallons (gal)	Cubic meter (m3)	.003785
Flow		
Cubic feet/min (cfm)	cubic meters/second (m3/s)	.000472
Cubic feet/min (cfm)	cubic meters/hr (m3/hr)	1.69884
Gallons/minute (GPM)	cubic meter/hr (m3/hr)	.2271
Gallons/minute (GPM)	litres/second (l/s)	.06308
Velocity		
Feet per minute (ft/m)	meters per second (m/s)	.00508
Feet per second (ft/s)	meters per second (m/s)	.3048
Energy and Power and Capacity		
British Thermal Units (Btu/h)	Kilowatt (kW)	.000293
British Thermal Units (Btu/h)	Kcalorie (Kcal)	.252
Tons (refrig. effect)	Kilowatt (refrig. effect)	3.516
Tons (refrig. effect)	Kilocalories-per hour (Kcal/hr)	3024
Horsepower	Kilowatt (kW)	.7457
Pressure		
Feet of water (ftH2O)	Pascals (PA)	2990
Inches of water (inH2O)	Pascals (PA)	249
Pounds per square inch (PSI*)	Pascals (PA)	6895
PSI*	Bar or KG/CM2	0.06895
*PSIG		

P-H DIAGRAM - BLENDS



To determine superheat, use **Dew (Vapor) Point** values.
To determine subcooling, use **Bubble (Liquid) Point** values.

Useful Formulas

Note: 3-phase amps or KVA can be used in single-phase formulas by multiplying average phase leg current times $\sqrt{3}$ or 1.73. Example:

$$KVA = \frac{V \times A \times 1.73}{1000}$$

KW = Real Power; KVA = Apparent Power

$$KW = KVA \times \text{Power Factor} = \frac{V \times A \times \text{Power Factor}}{1000}$$

$$\text{Motor KW} = \frac{HP \times .746}{\text{Efficiency}}; \quad \text{Motor KVA} = \frac{HP \times .746}{\text{Eff.} \times \text{Power Factor}}$$

$$\text{Motor HP} = \frac{KW \times \text{Eff.}}{.746} = \frac{KVA \times \text{Power Factor} \times \text{Eff.}}{.746}$$

$$\text{Pump HP} = \frac{GPM \times \text{Total Heat (Ft. Water)}}{\text{Pump Eff.} \times 3960}$$

$$HP = \frac{\text{Torque (lb.-ft.)} \times RPM}{5250}$$

$$\text{Temperature:} \quad \frac{^{\circ}C}{5} = \frac{^{\circ}F - 32}{9}$$

$$\text{Refrig. Tons} = \frac{Btu/h}{12000} = \frac{GPM \times \Delta t}{24}$$

Standard Conversion Table

Pressure Temperature

Temp °F	R22 Pressure psia	R123 Pressure psia	R134a Pressure psia
0.00	38.728	1.963	21.171
5.00	42.960	2.274	23.777
10.00	47.536	2.625	26.628
15.00	52.475	3.019	29.739
20.00	57.795	3.460	33.124
25.00	63.514	3.952	36.800
30.00	69.651	4.499	40.784
35.00	76.225	5.106	45.092
40.00	83.255	5.778	49.741
45.00	90.761	6.519	54.749
50.00	98.763	7.334	60.134
55.00	107.28	8.229	65.913
60.00	116.33	9.208	72.105
65.00	125.94	10.278	78.729
70.00	136.13	11.445	85.805
75.00	146.92	12.713	93.351
80.00	158.33	14.090	101.39
82.08	-	14.696	-
85.00	170.38	15.580	109.93
90.00	183.09	17.192	119.01
95.00	196.50	18.931	128.65
100.00	210.61	20.804	138.85
105.00	225.46	22.819	149.65
110.00	241.06	24.980	161.07
115.00	257.45	27.297	173.14
120.00	274.65	29.776	185.86
125.00	292.69	32.425	199.28
130.00	311.58	35.251	213.41
135.00	331.37	38.261	228.28
140.00	352.08	41.464	243.92
145.00	373.74	44.868	260.36

* PSIG = PSIA-14.7

Pressure Temperature

Pressure Psia	R407C Temp °F Bubble	Dew	R410A Temp °F Bubble	Dew
44.00	-0.28	11.47	-16.91	-16.79
46.00	1.86	13.56	-14.90	-14.77
48.00	3.92	15.58	-12.95	-12.82
50.00	5.93	17.53	-11.07	-10.94
55.00	10.68	22.18	-6.59	-6.46
60.00	15.11	26.50	-2.42	-2.29
65.00	19.27	30.56	1.49	1.63
70.00	23.19	34.39	5.17	5.32
75.00	26.90	38.01	8.66	8.81
80.00	30.43	41.46	11.98	12.13
85.00	33.80	44.74	15.14	15.30
90.00	37.02	47.88	18.17	18.32
95.00	40.11	50.89	21.06	21.22
100.00	43.08	53.78	23.85	24.01
110.00	48.70	59.24	29.12	29.28
120.00	53.95	64.35	34.03	34.20
130.00	58.87	69.13	38.65	38.82
140.00	63.53	73.65	43.00	43.18
150.00	67.94	77.93	47.13	47.31
160.00	72.13	81.99	51.05	51.23
170.00	76.14	85.87	54.79	54.98
180.00	79.97	89.58	58.37	58.56
190.00	83.65	93.13	61.08	61.99
200.00	87.18	96.55	65.10	65.29
220.00	93.88	103.00	71.34	71.54
240.00	100.14	109.02	77.16	77.36
260.00	106.02	114.67	82.63	82.83
280.00	111.58	119.99	87.79	87.99
300.00	116.85	125.03	92.68	92.88
320.00	121.86	129.81	97.32	97.53
340.00	126.65	134.36	101.75	101.95
360.00	131.23	138.70	105.99	106.19
380.00	135.63	142.86	110.05	110.24
400.00	139.85	146.84	113.94	114.13
450.00	149.77	156.11	123.06	123.24
500.00	158.90	164.54	131.41	131.58
550.00	167.37	172.23	139.12	139.27
600.00	175.31	179.23	146.28	146.40

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