Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Low-GWP Alternative Refrigerants Evaluation Program (Low-GWP AREP)

TEST REPORT #55

System Soft-optimization Tests of Refrigerant R-32 in a 6-ton Rooftop Packaged Air-Conditioner

Eng. Mohammad Abbadi
Eng.Mohammad Khawaldeh

Zamil Central Air Conditioners
31424 Dammam -2nd Industrial City
Saudi Arabia

September 8, 2015

This report has been made available to the public as part of the author company's participation in the AHRI's Low-GWP AREP.

AHRI
Air-Conditioning, Heating, and Refrigeration Institute
2111 Wilson Boulevard, Suite 500
Arlington VA 22201
(703) 524-8800
www.ahrinet.org

Low-GWP AREP SOFT-OPTIMIZED SYSTEM TEST

1. Introduction:

A R410A 6 ton (6T) rooftop packaged air conditioner (PTH006) was selected for the soft-optimization test of R-32 in Ikhtebar lab (Climate Control Lab Testing Co.) Which is located in Saudi Arabia at Dammam-1st industrial area, from 3/1/2015 -4/30/2015.

2. Details of Test Setup:

a. Description of Baseline System

PTH006 (Serial # LLABP0006M) is a rooftop packaged air conditioner unit with R410A refrigerant is selected for the soft-optimization test. The baseline tested capacity of this unit is 71,848 BTU/HR (5.98 Ton).Model PTH006 includes ZP61K5E compressor from Copeland along with POE original oil and 6.5 Ton TXV were installed in the baseline system with optimization of charge and valve opening in order to keep proper subcooling and superheat values (Subcooling =15~17 º F ,Super heat = 11~15 º F).

Figure 1: PTH006

Table 1: Specification of Baseline System

Nominal Cooling Capacity BTU/HR (Ton)	Compressor Model	Refrigerant & Charge	Lubrication, Viscosity & Charge	Superheat & Subcooling	TXV Model & Size	Volts-Hz-Phases
71,848 BTU/HR (5.98 Ton)	ZP61K5E	R410A /295 Oz	POE Oil /96cSt /42 OZ	12.83 º F /16.54 º F	TGEL 6.5T	460-3-60

b. Description of Modifications to System

For R32 refrigerant test, the compressor was changed to ZP61KCE-R32 (Prototype) from Copeland along with POE oil (56 Oz), while TXV was changed to TGEL4.5 model due to low refrigerant flow rate as well as the refrigerant charge was optimized with 260 Oz in order to keep proper subcooling and superheat values (Subcooling =15~17º F ,Super heat = 11~15 º F). The prototype compressor has a slightly larger displacement volume (~1.7% larger) than the baseline compressor (7.18 ft^3/min Vs 7.06 ft^3/min).

Table 2: Specification of Modified System

Nominal Cooling Capacity BTU/HR (Ton)	Compressor Model	Refrigerant & Charge	Lubrication, Viscosity & Charge	Superheat & Subcooling	TXV Model & Size	Volts-Hz-Phases
78,343 BTU/HR (6.52 Ton)	ZP61KCE-Prototype	R32 /260 Oz	POE Oil /96cSt /56 OZ	11.28 º F /16.97 º F	TGEL 4.5T	460-3-60

c. Description of Tests Conducted

The baseline R410A test and R32 test have been accomplished as per AHRI 340/360 standard in Ikhtebar lab (Climate Control Lab Testing Co.) – Founded in 2006, Ikhtebar is the first independent laboratory for testing climate control solutions in the Middle East. Ikhtebar, which was constructed by Intertek Testing Services (ITS) as per ASHRAE 37.1 standard and calibrated by Intertek.

Figure 2: PTH006 inside Ikhtebar Lab

d. Instrumentation and Measurement

The lab testing accuracy for all interments are listed as below tables.

Table 3: Thermocouples for Temperature Measurement

Manufacturer	Omega / Yokogawa
Model No.	T-Type (+Blue Copper -Red Constantan /Darwin DS600
Temperature range	0 ~ 300 º F
Accuracy	±0.5 º F

Table 4: Pressure Transducers for Refrigerant Pressure Measurement

Manufacturer	Setra
Model No.	204
Temperature range	0 ~ 1000 Psig
Accuracy	±0.25% Full Scale

Table 5: Pressure Transducers for Air Pressure Measurement

Manufacturer	Setra
Model No.	239
Temperature range	0 ~ 5 inch WC
Accuracy	± 0.14% Full Scale

Table 6: Humidity Sensors for Relative Humidity Measurement

Manufacturer	Rosemount
Model No.	78N0N00N040B3
Range	32 º F ~ 140 º F
RH accuracy	±1% Measured
Temperature accuracy	±0.09 º F

Table 7: AC Watt Transducer for Power Consumption and Line Voltage Measurements

Manufacturer	Yokogawa
Model No.	WT130
Range	15 ~ 600 Volts, Current 1 ~ 100 Amps
Accuracy	±0.5%

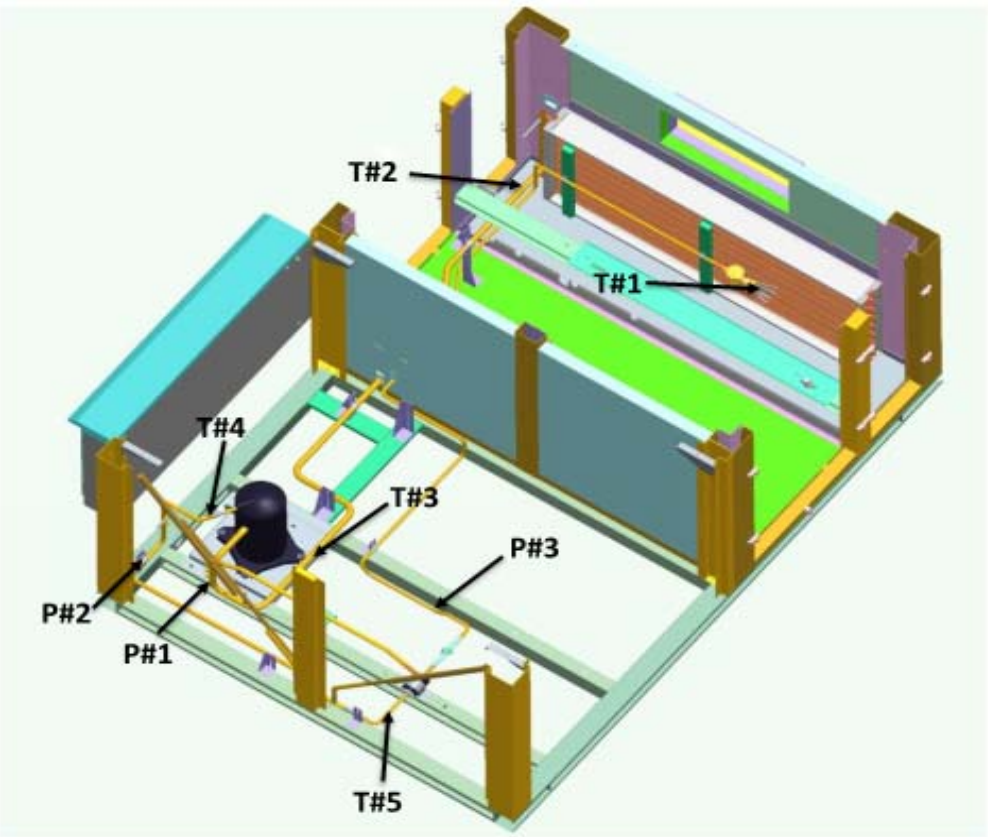

Figure 3: Schematic of soft-optimized system test setup

Table 8: Data measurement locations

Temperature Data Locations		Pressure Data Locations	
T#1	Evaporator Inlet Temperature	P#1	Compressor Suction Pressure
T#2	Evaporator Outlet Temperature	P#2	Compressor Discharge Pressure
T#3	Compressor Suction Temperature	P#3	Condenser Outlet Pressure
T#4	Compressor Discharge Temperature		
T#5	Condenser outlet Temperature		
Total	5	Total	3

Table 9: Extra measurement

1-Evaporator Air Inlet Temperature	4-Condenser Air Inlet Temperature
2-Evaporator Air Outlet Temperature	5-Condenser Air Outlet Temperature
3-Evaporator Air flow	6-Condenser Air flow

3. Results

a. Data Form

Please see the data forms of steady state test A/B/C/D/E /F/G &H in the next pages. The R32 properties are based on ASHARE Handbook, 2013.

b. Conclusions

- R32 refrigerant is compatible to the existing of R410A system, including the extreme conditions (no change was made to the system except the size of the TXV and compressor serial number).
- R32 prototype compressor has slightly lager displacement volume than R410A compressor (7.18 ft^3/min Vs 7.06 ft^3/min).
- Unit has been tested up to 130 ºF ambient without any fault or tripping at high pressure switch due to optimized condenser coil design.
- R32 charge is 12% lower than R410A charge.

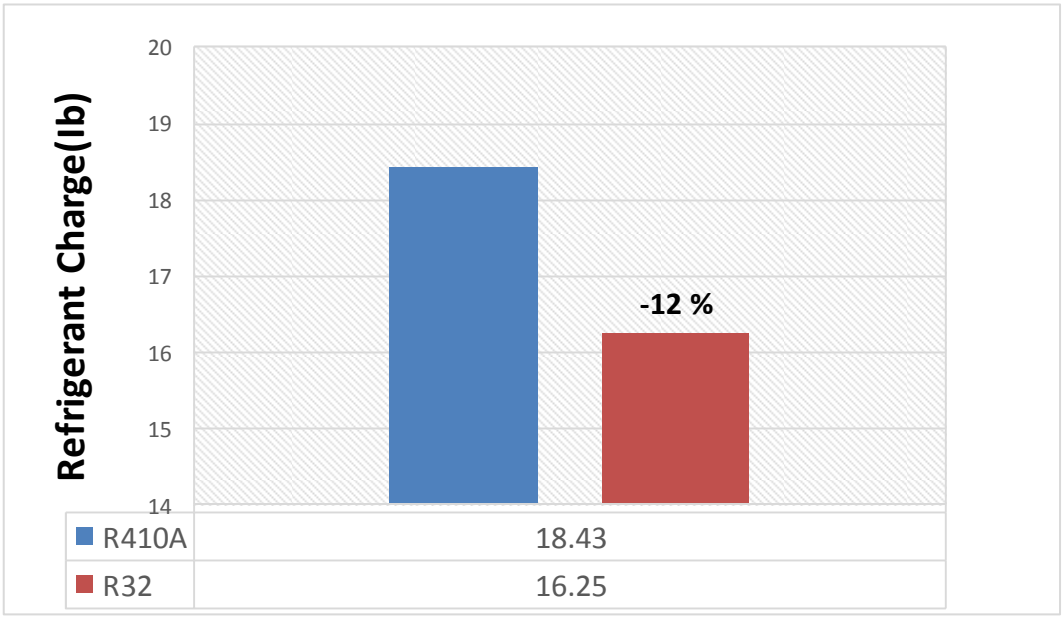

Figure 4: Refrigerant Charge Comparison

- R32 lubricant charge is 34% more than R410A lubricant charge as per Compressor manufacture's recommendation.

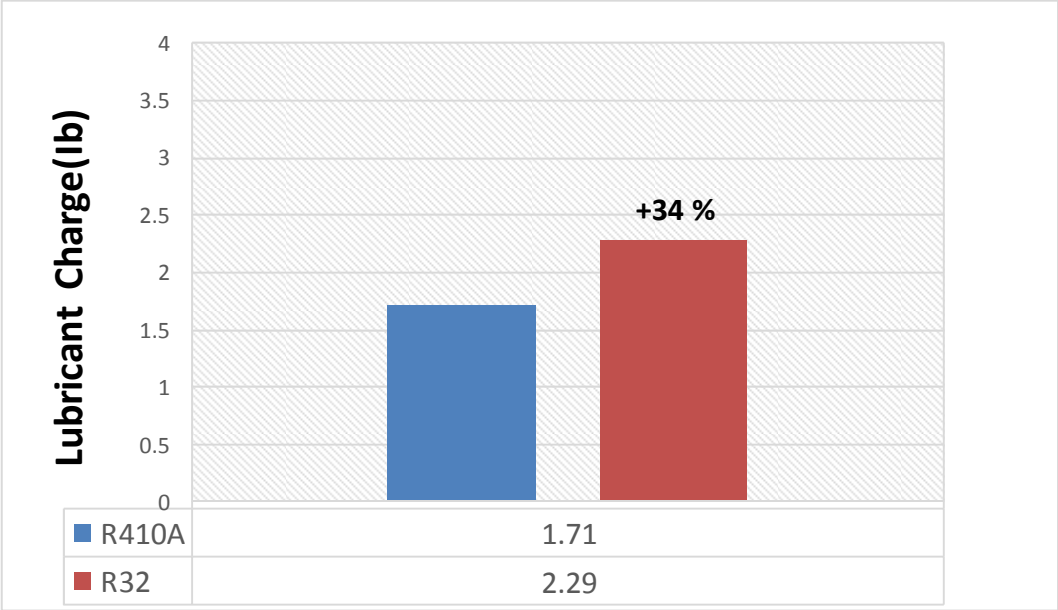

Figure 5: Lubricant Charge Comparison

- R410A has capacity reduction by 10% at 115 ºF ambient and 25% at 130º F ambient.

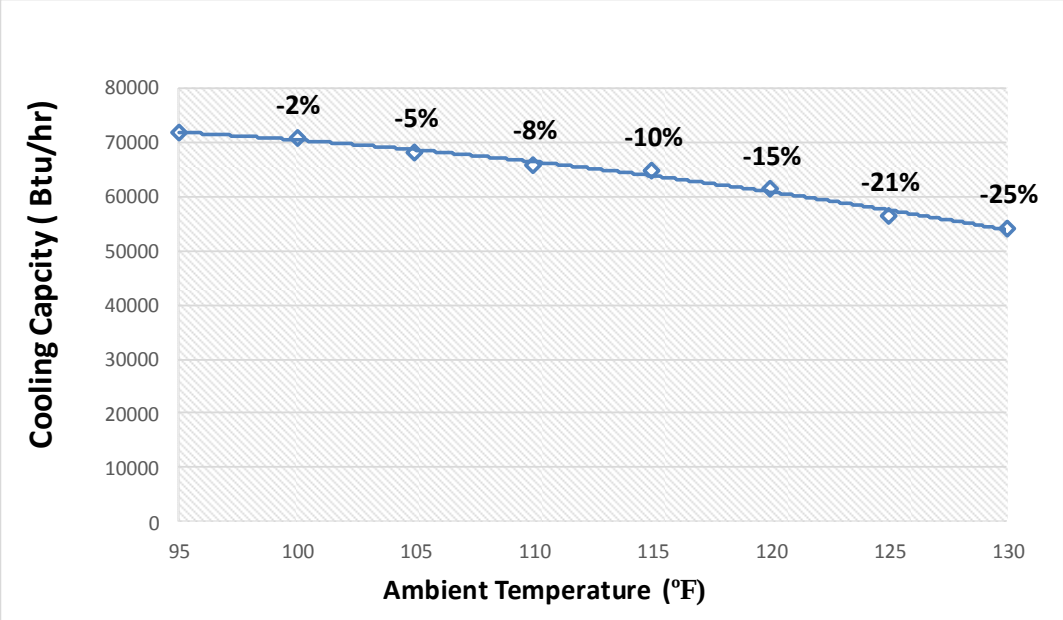

Figure 6: R410A Capacity Reduction Variations

- R32 has capacity reduction by 9% at 115 ºF ambient and 22% at 130º F ambient.

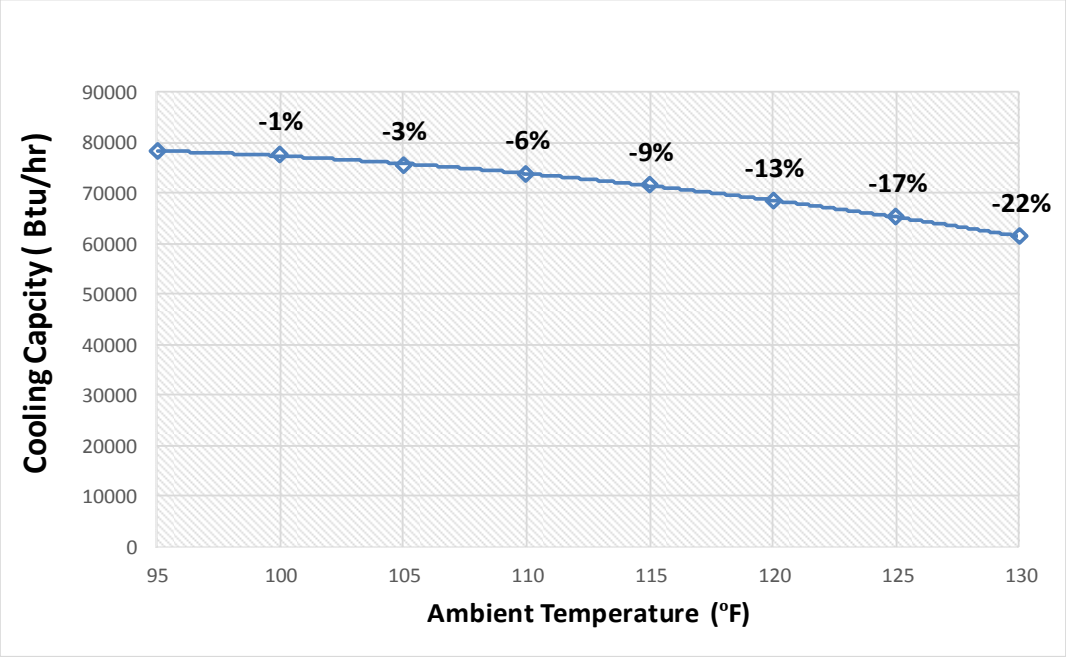

Figure 7: R32 Capacity Reduction Variations

- R32 has higher capacity by 12% (Avg.) than R410A .However, at high ambient condition, R32 shows higher capacity (up to 16 %).

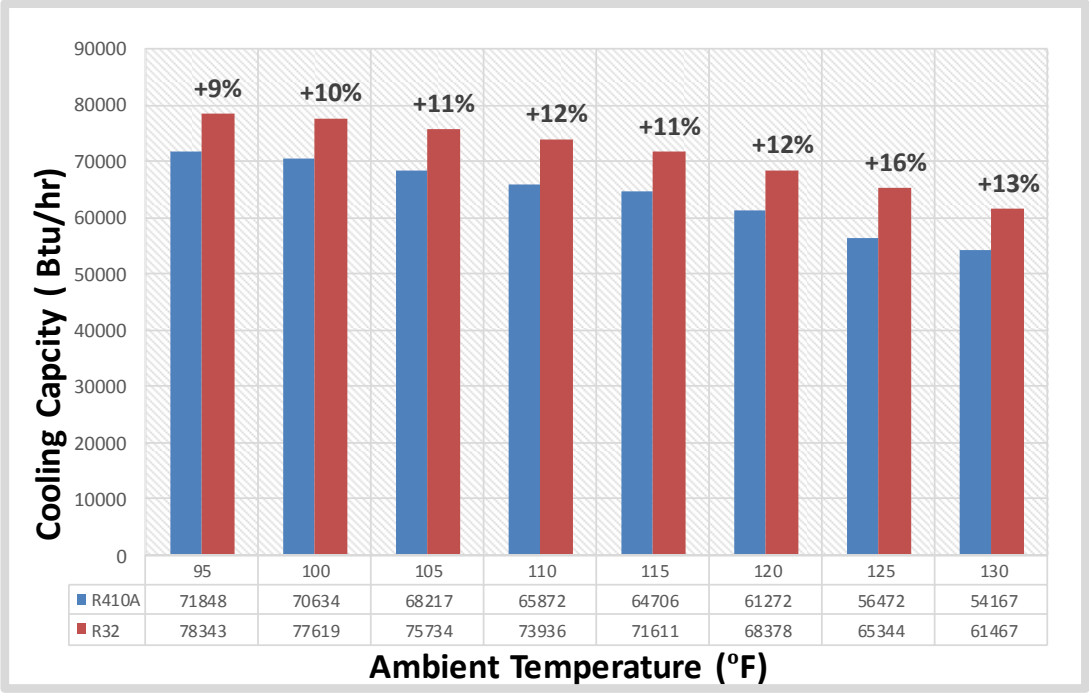

Figure 8: Air Side Capacity

- R32 has higher energy efficiency ratio by 5% (Avg.) than R410A .However, at high ambient condition, R32 shows higher EER (up to 10 %).

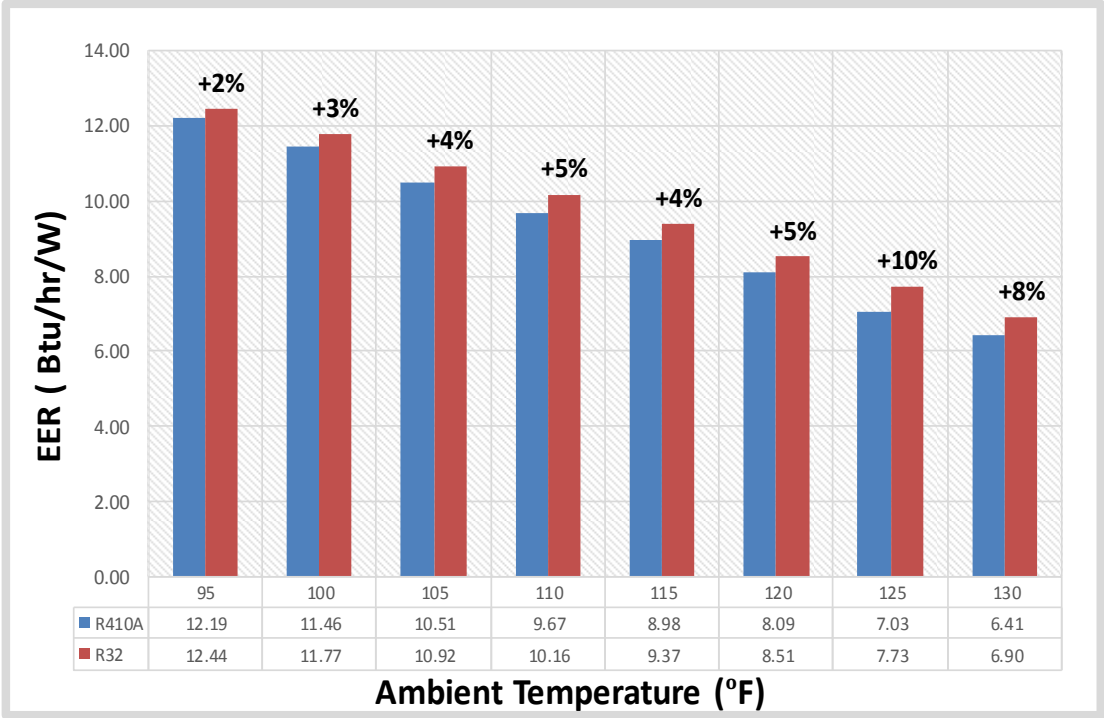

Figure 9: Air Side System Efficiency

- R410A has better integrated energy efficiency ratio (IEER) by 4% than R32.
- The test results for calculating IEER are listed in the data form I, J, and K tables.

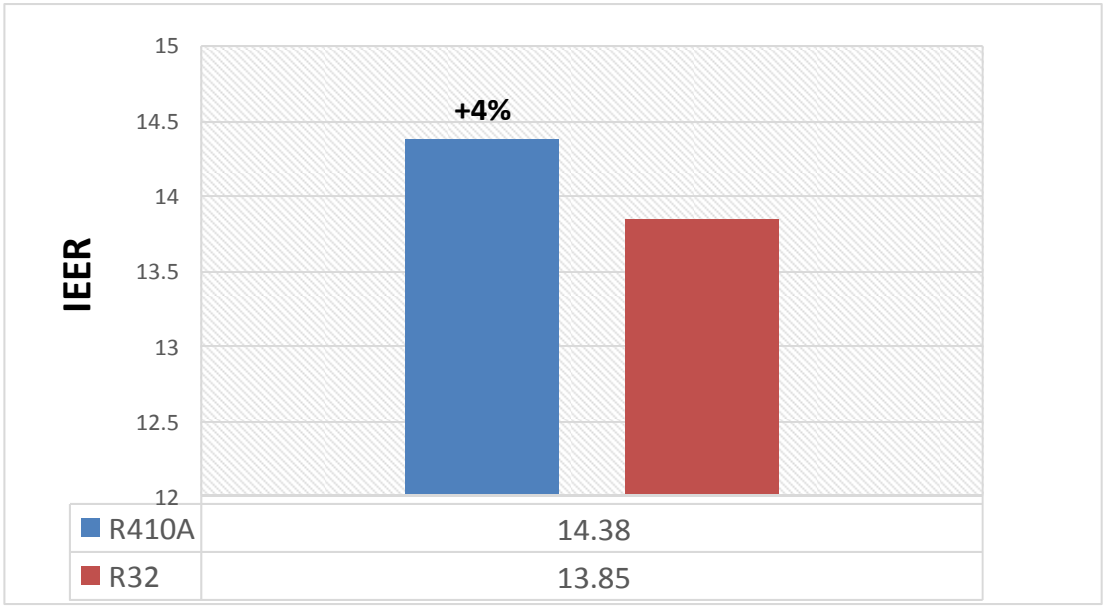

Figure 10: IEER

- R32 has higher suction pressure by +4 Psi (Avg.) than R410A.

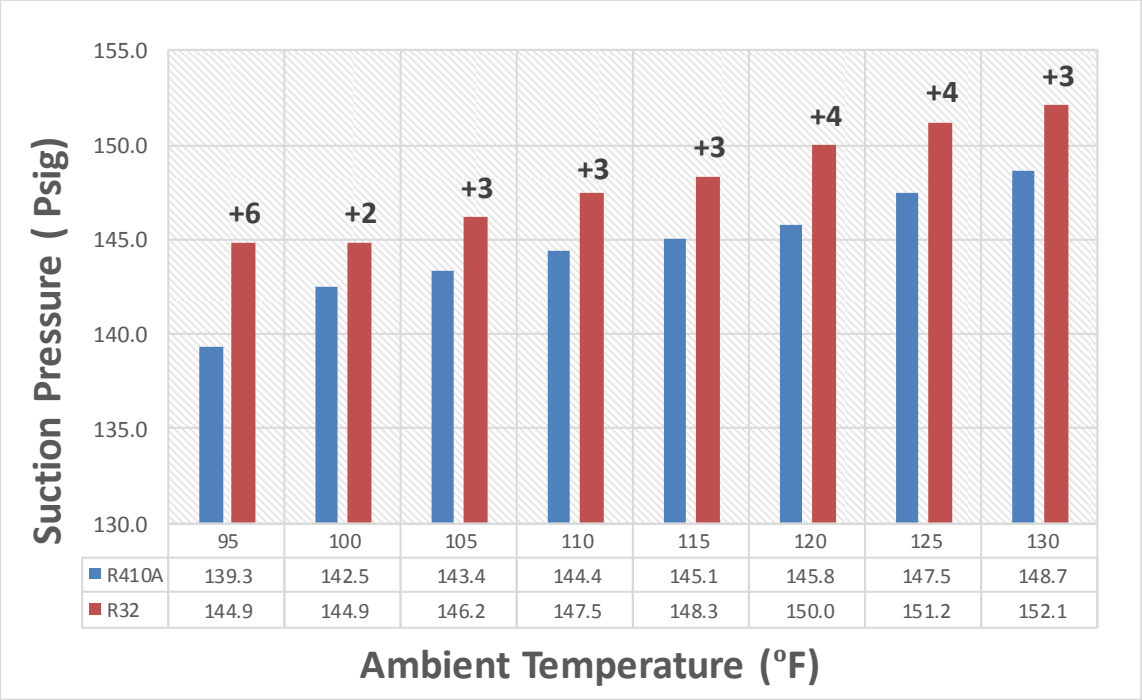

Figure 11: Suction Pressure

- R32 has higher discharge pressure by +26 Psi (Avg.) than R410A.
- At 130 °F ambient, R32 discharge pressure is +32 Psi higher than R410A.

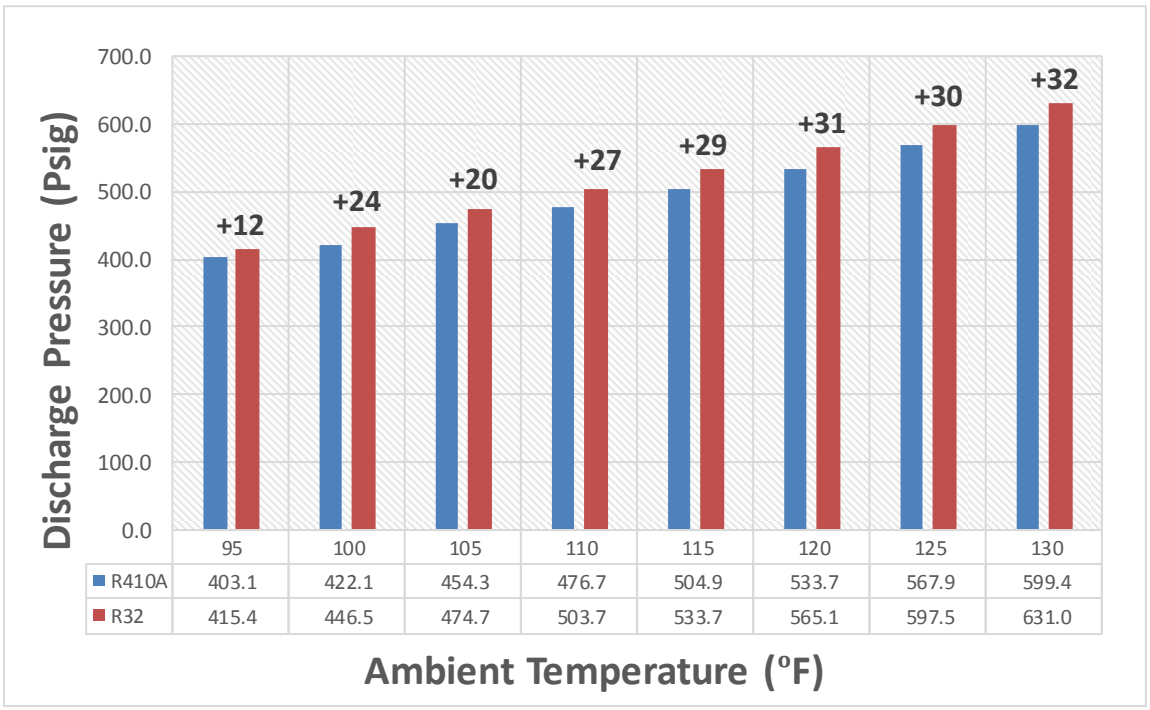

Figure 12: Discharge Pressure

- R32 has higher discharge temperature by +35 ºF (Avg.) than R410A.
- At 130 ºF ambient, R32 discharge temperature is +44 ºF higher than R410A.
- The prototype compressor of R32 from Copeland includes POE oil was tested well at high ambient conditions and no fault because of high discharge temperature.

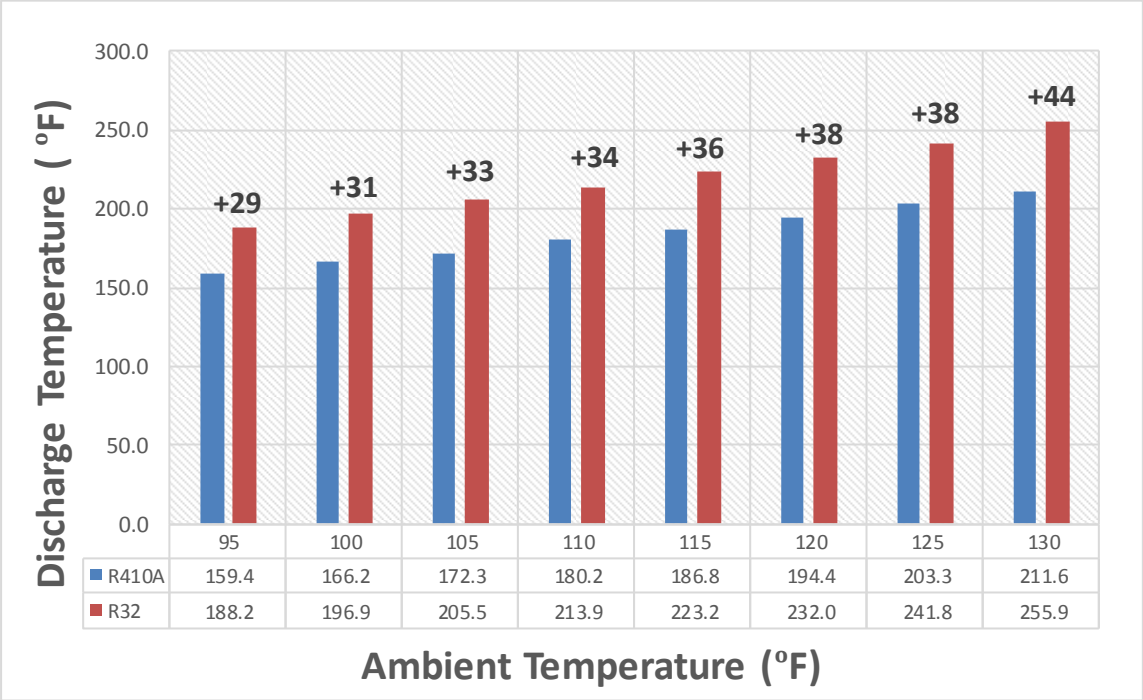

Figure 13: Discharge Temperature

Low-GWP AREP SOFT – OPTIMIZED SYSTEM TEST DATA FORM

Manufacturer: Zamil Central Air Conditioners Manufacturer's Notation: A (95° F Ambient)

Basic Information	
Alternative Refrigerant (Composition as Charged, % wt, if not proprietary)	R32
Alternative Lubricant Type and ISO Viscosity	POE
Refrigerant and Lubricant of Baseline System	R410A/POE
Make and Model of Baseline System	PTH006
Nominal Capacity and Type of Baseline System	6T Rooftop Air Conditioner Unit

Comparison Data			**Base.**	**Alt.**	**SI Units**	**Base.**	**Alt.**	**IP UNits**	**Ratio**
Mode (Heating/Cooling)			Cooling						
Compressor Type			Scroll	Scroll					
Compressor Displacement			0.199	0.203	M^3/min	7.06	7.18	Ft ^3/min	
Nominal Motor Size			5	5	hp				
Motor Speed			3500	3500	rpm				
Expansion Device Type			6.5 TXV	4.5 TXV					
Lubricant Charge			0.78	1.04	kg	1.71	2.29	lb	
Refrigerant Charge			8.36	7.37	kg	18.43	16.25	lb	
Refrigerant Mass Flow Rate			XXX	XXX	kg/min	XXX	XXX	lb/min	
Composition, at compr. Inlet if applicable				XXX	% wt				
Evaporator Face Area			0.74	0.74	m ^ 2	8.0	8.0	ft ^2	
Condenser Face Area			2.37	2.37	m ^2	25.6	25.6	ft ^2	
Ambient Temps.	Indoor	db	26.68	26.66	C	80.03	79.99	F	
		wb	19.45	19.42	C	67.02	66.97	F	
	Outdoor	db	34.99	35.0	C	94.99	95.0	F	
		wb	20.71	20.28	C	69.29	68.51	F	
Total Capacity			21037.8	22939.6	W	71848	78343.0	Btu/hr	
Sensible Capacity			15869.1	16732.3	W	54196	57144.0	Btu/hr	
Total System Power Input			5891.5	6299.70	W	5891.5	6299.70	W	
Compressor Power Input			4782.5	5224.09	W	4782.5	5224.09	W	
Energy Efficiency Ratio (EER)			3.571	3.641	W/W	12.196	12.436	Btuh/W	
Coeff. Of Performance (COP)			XXX	XXX					

Other System Changes (eg: llsl-hx, flow control, hx fins and circuiting, vapor/liquid injection, etc.)
* Compressor was changed from ZP61KCE to ZP61KCE-R32(prototype)
* TXV was changed from TGEL6.5 to TGEL4.5 model
* Filter drier was changed to new one

System Data	**Base.**	**Alt.**	**Ratio**
Degradation Coefficient – Cd	XXX	XXX	XXX
Seasonal Energy Efficiency Ratio - SEER	XXX	XXX	XXX
Heating Seasonal Performance Factor - HSPF	XXX	XXX	XXX

Low-GWP AREP SOFT – OPTIMIZED SYSTEM TEST DATA FORM

Type of System: Rooftop Packaged Unit (e.g., SSHP, window RAC, chiller, etc.)

Alternate Refrigerant: R32 (and composition as charged, % weight, if not proprietary)

Air/Water Side Data	Base.	Alt.	SI Units	Base.	Alt.	IP Units	Ratio
Evaporator							
Heat Exchange Fluid	Air	Air					
Flow Rate (gas)	70.79	70.79	m ^3/min	2500.2	2500.1	ft^3/min	
Flow Rate (liquid)	XXX	XXX	L/min	XXX	XXX	gal/min	
Inlet Temperature	26.68	26.66	C	80.03	79.99	F	
Outlet Temperature	15.68	15.01	C	60.23	59.02	F	
Condenser							
Heat Exchange Fluid	Air	Air					
Flow Rate (gas)	183.29	183.34	m ^3/min	6473	6474.7	ft^3/min	
Flow Rate (liquid)	XXX	XXX	L/min	XXX	XXX	gal/min	
Inlet Temperature	34.99	35.0	C	94.99	95.0	F	
Outlet Temperature	42.53	43.31	C	108.57	109.96	F	

Refrigerant Side Data Temperatures & Pressures	Baseline		Alternative		Baseline		Alternative	
	T (C)	P [kPa]	T (C)	P [kPa]	T [F]	P [psia]	T [F]	P [psia]
Compressor Suction	16.39	1061.79	16.1	1100.05	61.51	154.0	60.98	159.55
Compressor Discharge	70.77	2880.69	86.76	2965.57	159.39	417.81	188.18	430.12
Condenser Inlet	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
Condenser Outlet	37.53	2839.33	37.51	2929.37	99.57	411.81	99.53	424.87
Expansion Device Inlet	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
Subcooling, at expan. device	9.18		9.42		16.54		16.97	
Evaporator Inlet	11.42	XXX	11.34	XXX	52.56	XXX	52.42	XXX
Evaporator Outlet	15.40	XXX	15.41	XXX	59.72	XXX	59.74	XXX
Suction Superheat	7.12		6.26		12.83		11.28	

Data Source(s) for Refrigerant Properties
ASHRAE Handbook,2013

Additional Notes

Submitted by: Mohammad Abbadi

Low-GWP AREP SOFT – OPTIMIZED SYSTEM TEST DATA FORM

Manufacturer: Zamil Central Air Conditioners Manufacturer's Notation: B (100° F Ambient)

Basic Information	
Alternative Refrigerant (Composition as Charged, % wt, if not proprietary)	R32
Alternative Lubricant Type and ISO Viscosity	POE
Refrigerant and Lubricant of Baseline System	R410A/POE
Make and Model of Baseline System	PTH006
Nominal Capacity and Type of Baseline System	6T Rooftop Air Conditioner Unit

Comparison Data			**Base.**	**Alt.**	**SI Units**	**Base.**	**Alt.**	**IP UNits**	**Ratio**
Mode (Heating/Cooling)			Cooling						
Compressor Type			Scroll	Scroll					
Compressor Displacement			0.199	0.203	M^3/min	7.06	7.18	Ft ^3/min	
Nominal Motor Size			5	5	hp				
Motor Speed			3500	3500	rpm				
Expansion Device Type			6.5 TXV	4.5 TXV					
Lubricant Charge			0.78	1.04	kg	1.71	2.29	lb	
Refrigerant Charge			8.36	7.37	kg	18.43	16.25	lb	
Refrigerant Mass Flow Rate			XXX	XXX	kg/min	XXX	XXX	lb/min	
Composition, at compr. Inlet if applicable				XXX	% wt				
Evaporator Face Area			0.74	0.74	m ^ 2	8.0	8.0	ft ^2	
Condenser Face Area			2.37	2.37	m ^2	25.60	25.6	ft ^2	
Ambient Temps.	Indoor	db	26.67	26.66	C	80.01	79.99	F	
		wb	19.44	19.43	C	67.0	66.99	F	
	Outdoor	db	37.77	37.78	C	100.0	100.01	F	
		wb	21.15	21.85	C	70.08	71.34	F	
Total Capacity			20682.3	22727.6	W	70634.0	77619.0	Btu/hr	
Sensible Capacity			15818.5	16605.5	W	54023.0	56711.0	Btu/hr	
Total System Power Input			6161.1	6596.5	W	6161.1	6596.5	W	
Compressor Power Input			5060.6	5518.95	W	5060.6	5518.95	W	
Energy Efficiency Ratio (EER)			3.356	3.445	W/W	11.464	11.766	Btuh/W	
Coeff. Of Performance (COP)			XXX	XXX					

Other System Changes (eg: llsl-hx, flow control, hx fins and circuiting, vapor/liquid injection, etc.)
* Compressor was changed from ZP61KCE to ZP61KCE-R32(prototype)
* TXV was changed from TGEL6.5 to TGEL4.5 model
* Filter drier was changed to new one

System Data	**Base.**	**Alt.**	**Ratio**
Degradation Coefficient – Cd	XXX	XXX	XXX
Seasonal Energy Efficiency Ratio - SEER	XXX	XXX	XXX
Heating Seasonal Performance Factor - HSPF	XXX	XXX	XXX

Low-GWP AREP SOFT – OPTIMIZED SYSTEM TEST DATA FORM

Type of System: Rooftop Packaged Unit (e.g., SSHP, window RAC, chiller, etc.)

Alternate Refrigerant: R32 (and composition as charged, % weight, if not proprietary)

Air/Water Side Data	Base.	Alt.	SI Units	Base.	Alt.	IP Units	Ratio
Evaporator							
Heat Exchange Fluid	Air	Air					
Flow Rate (gas)	70.79	70.78	m ^3/min	2500	2499.9	ft^3/min	
Flow Rate (liquid)	XXX	XXX	L/min	XXX	XXX	gal/min	
Inlet Temperature	26.67	26.66	C	80.01	79.99	F	
Outlet Temperature	15.68	15.11	C	60.24	59.21	F	
Condenser							
Heat Exchange Fluid	Air	Air					
Flow Rate (gas)	183.32	183.54	m ^3/min	6474	6481.9	ft^3/min	
Flow Rate (liquid)	XXX	XXX	L/min	XXX	XXX	gal/min	
Inlet Temperature	37.77	37.78	C	100.0	100.01	F	
Outlet Temperature	45.46	46.09	C	113.83	114.97	F	

Refrigerant Side Data Temperatures & Pressures	Baseline		Alternative		Baseline		Alternative	
	T (C)	P [kPa]	T (C)	P [kPa]	T [F]	P [psia]	T [F]	P [psia]
Compressor Suction	17.12	1083.99	16.06	1100.12	62.83	157.22	60.91	159.56
Compressor Discharge	74.54	3011.90	91.58	3179.72	166.18	436.84	196.86	461.18
Condenser Inlet	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
Condenser Outlet	40.43	2970.53	40.13	3143.52	104.78	430.84	104.24	455.93
Expansion Device Inlet	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
Subcooling, at expan. device	8.22		9.86		14.81		17.76	
Evaporator Inlet	12.13	XXX	11.33	XXX	53.84	XXX	52.41	XXX
Evaporator Outlet	17.03	XXX	15.45	XXX	62.66	XXX	59.82	XXX
Suction Superheat	7.16		6.22		12.90		11.21	

Data Source(s) for Refrigerant Properties
ASHRAE Handbook,2013

Additional Notes

Submitted by: Mohammad Abbadi

Low-GWP AREP SOFT – OPTIMIZED SYSTEM TEST DATA FORM

Manufacturer: Zamil Central Air Conditioners Manufacturer's Notation: C (105^{o} F Ambient)

Basic Information	
Alternative Refrigerant (Composition as Charged, % wt, if not proprietary)	R32
Alternative Lubricant Type and ISO Viscosity	POE
Refrigerant and Lubricant of Baseline System	R410A/POE
Make and Model of Baseline System	PTH006
Nominal Capacity and Type of Baseline System	6T Rooftop Air Conditioner Unit

Comparison Data			**Base.**	**Alt.**	**SI Units**	**Base.**	**Alt.**	**IP UNits**	**Ratio**
Mode (Heating/Cooling)			Cooling						
Compressor Type			Scroll	Scroll					
Compressor Displacement			0.199	0.203	M^3/min	7.06	7.18	Ft ^3/min	
Nominal Motor Size			5	5	hp				
Motor Speed			3500	3500	rpm				
Expansion Device Type			6.5 TXV	4.5 TXV					
Lubricant Charge			0.78	1.04	kg	1.71	2.29	lb	
Refrigerant Charge			8.36	7.37	kg	18.43	16.25	lb	
Refrigerant Mass Flow Rate			XXX	XXX	kg/min	XXX	XXX	lb/min	
Composition, at compr. Inlet if applicable				XXX	% wt				
Evaporator Face Area			0.74	0.74	m ^ 2	8.0	8.0	ft ^2	
Condenser Face Area			2.37	2.37	m ^2	25.6	25.6	ft ^2	
Ambient Temps.	Indoor	db	26.66	26.67	C	80.0	80.01	F	
		wb	19.45	19.44	C	67.01	67.0	F	
	Outdoor	db	40.56	40.56	C	105.01	105.01	F	
		wb	21.48	21.92	C	70.67	71.46	F	
Total Capacity			19974.6	22175.7	W	68217.0	75734.0	Btu/hr	
Sensible Capacity			15586.5	16355.8	W	53231.0	55858.0	Btu/hr	
Total System Power Input			6493.2	6938.50	W	6493.2	6938.50	W	
Compressor Power Input			5385.65	5860.82	W	5385.65	5860.82	W	
Energy Efficiency Ratio (EER)			3.074	3.196	W/W	10.50	10.915	Btuh/W	
Coeff. Of Performance (COP)			XXX	XXX					

Other System Changes (eg: llsl-hx, flow control, hx fins and circuiting, vapor/liquid injection, etc.)
* Compressor was changed from ZP61KCE to ZP61KCE-R32(prototype)
* TXV was changed from TGEL6.5 to TGEL4.5 model
* Filter drier was changed to new one

System Data	**Base.**	**Alt.**	**Ratio**
Degradation Coefficient – Cd	XXX	XXX	XXX
Seasonal Energy Efficiency Ratio - SEER	XXX	XXX	XXX
Heating Seasonal Performance Factor - HSPF	XXX	XXX	XXX

Low-GWP AREP SOFT – OPTIMIZED SYSTEM TEST DATA FORM

Type of System: Rooftop Packaged Unit (e.g., SSHP, window RAC, chiller, etc.)

Alternate Refrigerant: R32 (and composition as charged, % weight, if not proprietary)

Air/Water Side Data	Base.	Alt.	SI Units	Base.	Alt.	IP Units	Ratio
Evaporator							
Heat Exchange Fluid	Air	Air					
Flow Rate (gas)	70.78	70.78	m ^3/min	2499.8	2499.6	ft^3/min	
Flow Rate (liquid)	XXX	XXX	L/min	XXX	XXX	gal/min	
Inlet Temperature	26.66	26.67	C	80.0	80.01	F	
Outlet Temperature	15.87	15.27	C	60.58	59.50	F	
Condenser							
Heat Exchange Fluid	Air	Air					
Flow Rate (gas)	183.07	183.06	m^3/min	6465.3	6464.8	ft^3/min	
Flow Rate (liquid)	XXX	XXX	L/min	XXX	XXX	gal/min	
Inlet Temperature	40.56	40.56	C	105.01	105.01	F	
Outlet Temperature	48.13	48.88	C	118.64	120.0	F	

Refrigerant Side Data	Baseline		Alternative		Baseline		Alternative	
Temperatures & Pressures	T (C)	P [kPa]	T (C)	P [kPa]	T [F]	P [psia]	T [F]	P [psia]
Compressor Suction	17.41	1089.99	16.64	1109.22	63.35	158.09	61.96	160.88
Compressor Discharge	77.92	3233.64	96.37	3374.08	172.26	469.0	205.48	489.37
Condenser Inlet	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
Condenser Outlet	43.19	3192.27	42.95	3337.89	109.75	463.0	109.32	484.12
Expansion Device Inlet	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
Subcooling, at expan. device	8.61		9.65		15.50		17.38	
Evaporator Inlet	12.43	XXX	11.65	XXX	54.39	XXX	52.98	XXX
Evaporator Outlet	17.33	XXX	15.75	XXX	63.20	XXX	60.35	XXX
Suction Superheat	7.25		6.53		13.06		11.76	

Data Source(s) for Refrigerant Properties
ASHRAE Handbook ,2013

Additional Notes

Submitted by: Mohammad Abbadi

Low-GWP AREP SOFT – OPTIMIZED SYSTEM TEST DATA FORM

Manufacturer: Zamil Central Air Conditioners Manufacturer's Notation: D (110^{o} F Ambient)

Basic Information	
Alternative Refrigerant (Composition as Charged, % wt, if not proprietary)	R32
Alternative Lubricant Type and ISO Viscosity	POE
Refrigerant and Lubricant of Baseline System	R410A/POE
Make and Model of Baseline System	PTH006
Nominal Capacity and Type of Baseline System	6T Rooftop Air Conditioner Unit

Comparison Data			**Base.**	**Alt.**	**SI Units**	**Base.**	**Alt.**	**IP UNits**	**Ratio**
Mode (Heating/Cooling)			Cooling						
Compressor Type			Scroll	Scroll					
Compressor Displacement			0.199	0.203	M^3/min	7.06	7.18	Ft ^3/min	
Nominal Motor Size			5	5	hp				
Motor Speed			3500	3500	rpm				
Expansion Device Type			6.5 TXV	4.5 TXV					
Lubricant Charge			0.78	1.04	kg	1.71	2.29	lb	
Refrigerant Charge			8.36	7.37	kg	18.43	16.25	lb	
Refrigerant Mass Flow Rate			XXX	XXX	kg/min	XXX	XXX	lb/min	
Composition, at compr. Inlet if applicable				XXX	% wt				
Evaporator Face Area			0.74	0.74	m ^ 2	8.0	8.0	ft ^2	
Condenser Face Area			2.37	2.37	m ^2	25.6	25.6	ft ^2	
Ambient Temps.	Indoor	db	26.68	26.67	C	80.03	80.02	F	
		wb	19.45	19.45	C	67.02	67.02	F	
	Outdoor	db	43.34	43.33	C	110.02	110.0	F	
		wb	21.69	22.11	C	71.05	71.80	F	
Total Capacity			19288.0	21649.2	W	65872.0	73936.0	Btu/hr	
Sensible Capacity			15125.4	16075.0	W	51656.0	54899.0	Btu/hr	
Total System Power Input			6812.40	7278.20	W	6812.40	7278.20	W	
Compressor Power Input			5711.39	6199.24	W	5711.39	6199.24	W	
Energy Efficiency Ratio (EER)			2.831	2.974	W/W	9.67	10.159	Btuh/W	
Coeff. Of Performance (COP)			XXX	XXX					

Other System Changes (eg: llsl-hx, flow control, hx fins and circuiting, vapor/liquid injection, etc.)
* Compressor was changed from ZP61KCE to ZP61KCE-R32(prototype)
* TXV was changed from TGEL6.5 to TGEL4.5 model
* Filter drier was changed to new one

System Data	**Base.**	**Alt.**	**Ratio**
Degradation Coefficient – Cd	XXX	XXX	XXX
Seasonal Energy Efficiency Ratio - SEER	XXX	XXX	XXX
Heating Seasonal Performance Factor - HSPF	XXX	XXX	XXX

Low-GWP AREP SOFT – OPTIMIZED SYSTEM TEST DATA FORM

Type of System: Rooftop Packaged Unit (e.g., SSHP, window RAC, chiller, etc.)

Alternate Refrigerant: R32 (and composition as charged, % weight, if not proprietary)

Air/Water Side Data	Base.	Alt.	SI Units	Base.	Alt.	IP Units	Ratio
Evaporator							
Heat Exchange Fluid	Air	Air					
Flow Rate (gas)	70.80	70.79	m ^3/min	2500.3	2500.0	ft^3/min	
Flow Rate (liquid)	XXX	XXX	L/min	XXX	XXX	gal/min	
Inlet Temperature	26.68	26.67	C	80.03	80.02	F	
Outlet Temperature	16.13	15.45	C	61.05	59.81	F	
Condenser							
Heat Exchange Fluid	Air	Air					
Flow Rate (gas)	182.98	182.58	m ^3/min	6462.1	6448.1	ft^3/min	
Flow Rate (liquid)	XXX	XXX	L/min	XXX	XXX	gal/min	
Inlet Temperature	43.34	43.33	C	110.02	110.0	F	
Outlet Temperature	50.98	51.67	C	123.77	125.02	F	

Refrigerant Side Data Temperatures & Pressures	Baseline		Alternative		Baseline		Alternative	
	T (C)	P [kPa]	T (C)	P [kPa]	T [F]	P [psia]	T [F]	P [psia]
Compressor Suction	17.60	1096.74	16.93	1117.98	63.69	159.07	62.48	162.15
Compressor Discharge	82.31	3388.01	101.03	3574.10	180.16	491.39	213.87	518.38
Condenser Inlet	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
Condenser Outlet	46.01	3346.64	45.77	3537.90	114.82	485.39	114.40	513.13
Expansion Device Inlet	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
Subcooling, at expan. device	7.86		9.44		14.16		17.0	
Evaporator Inlet	12.66	XXX	11.93	XXX	54.79	XXX	53.49	XXX
Evaporator Outlet	17.45	XXX	16.06	XXX	63.42	XXX	60.91	XXX
Suction Superheat	7.25		5.67		13.06		10.21	

Data Source(s) for Refrigerant Properties
ASHRAE Handbook ,2013

Additional Notes

Submitted by: Mohammad Abbadi

Low-GWP AREP SOFT – OPTIMIZED SYSTEM TEST DATA FORM

Manufacturer: Zamil Central Air Conditioners Manufacturer's Notation: E (115^{o} F Ambient)

Basic Information	
Alternative Refrigerant (Composition as Charged, % wt, if not proprietary)	R32
Alternative Lubricant Type and ISO Viscosity	POE
Refrigerant and Lubricant of Baseline System	R410A/POE
Make and Model of Baseline System	PTH006
Nominal Capacity and Type of Baseline System	6T Rooftop Air Conditioner Unit

Comparison Data			**Base.**	**Alt.**	**SI Units**	**Base.**	**Alt.**	**IP UNits**	**Ratio**
Mode (Heating/Cooling)			Cooling						
Compressor Type			Scroll	Scroll					
Compressor Displacement			0.199	0.203	M^3/min	7.06	7.18	Ft ^3/min	
Nominal Motor Size			5	5	hp				
Motor Speed			3500	3500	rpm				
Expansion Device Type			6.5 TXV	4.5 TXV					
Lubricant Charge			0.78	1.04	kg	1.71	2.29	lb	
Refrigerant Charge			8.36	7.37	kg	18.43	16.25	lb	
Refrigerant Mass Flow Rate			XXX	XXX	kg/min	XXX	XXX	lb/min	
Composition, at compr. Inlet if applicable				XXX	% wt				
Evaporator Face Area			0.74	0.74	m ^ 2	8.0	8.0	ft ^2	
Condenser Face Area			2.37	2.37	m ^2	25.6	25.6	ft ^2	
Ambient Temps.	Indoor	db	26.66	26.66	C	80.0	80.0	F	
		wb	19.45	19.45	C	67.02	67.01	F	
	Outdoor	db	46.12	46.11	C	115.02	115.01	F	
		wb	21.76	22.93	C	71.17	73.29	F	
Total Capacity			18946.5	20968.4	W	64706.0	71611.0	Btu/hr	
Sensible Capacity			15039.6	15736.5	W	51363.0	53743.0	Btu/hr	
Total System Power Input			7202.9	7642.60	W	7202.9	7642.60	W	
Compressor Power Input			6110.84	6566.25	W	6110.84	6566.25	W	
Energy Efficiency Ratio (EER)			2.630	2.743	W/W	8.983	9.370	Btuh/W	
Coeff. Of Performance (COP)			XXX	XXX					

Other System Changes (eg: llsl-hx, flow control, hx fins and circuiting, vapor/liquid injection, etc.)
* Compressor was changed from ZP61KCE to ZP61KCE-R32(prototype)
* TXV was changed from TGEL6.5 to TGEL4.5 model
* Filter drier was changed to new one

System Data	**Base.**	**Alt.**	**Ratio**
Degradation Coefficient – Cd	XXX	XXX	XXX
Seasonal Energy Efficiency Ratio - SEER	XXX	XXX	XXX
Heating Seasonal Performance Factor - HSPF	XXX	XXX	XXX

Low-GWP AREP SOFT – OPTIMIZED SYSTEM TEST DATA FORM

Type of System: Rooftop Packaged Unit (e.g., SSHP, window RAC, chiller, etc.)

Alternate Refrigerant: R32 (and composition as charged, % weight, if not proprietary)

Air/Water Side Data	Base.	Alt.	SI Units	Base.	Alt.	IP Units	Ratio
Evaporator							
Heat Exchange Fluid	Air	Air					
Flow Rate (gas)	70.79	70.79	m ^3/min	2500	2500.1	ft^3/min	
Flow Rate (liquid)	XXX	XXX	L/min	XXX	XXX	gal/min	
Inlet Temperature	26.66	26.66	C	80.0	80.0	F	
Outlet Temperature	16.26	15.66	C	61.28	60.20	F	
Condenser							
Heat Exchange Fluid	Air	Air					
Flow Rate (gas)	183.77	184.20	m ^3/min	6489.8	6505	ft^3/min	
Flow Rate (liquid)	XXX	XXX	L/min	XXX	XXX	gal/min	
Inlet Temperature	46.12	46.11	C	115.02	115.01	F	
Outlet Temperature	53.68	54.41	C	128.64	129.94	F	

Refrigerant Side Data	Baseline		Alternative		Baseline		Alternative	
Temperatures & Pressures	T (C)	P [kPa]	T (C)	P [kPa]	T [F]	P [psia]	T [F]	P [psia]
Compressor Suction	17.67	1101.71	17.25	1124.05	63.81	159.79	63.05	163.03
Compressor Discharge	85.98	3582.79	106.22	3781.01	186.77	519.64	223.21	548.39
Condenser Inlet	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
Condenser Outlet	48.65	3541.42	48.51	3744.81	119.58	513.64	119.32	543.14
Expansion Device Inlet	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
Subcooling, at expan. device	7.75		9.32		13.96		16.78	
Evaporator Inlet	12.82	XXX	12.13	XXX	55.09	XXX	53.85	XXX
Evaporator Outlet	17.52	XXX	15.98	XXX	63.55	XXX	60.78	XXX
Suction Superheat	7.13		6.69		12.85		12.05	

Data Source(s) for Refrigerant Properties
ASHRAE Handbook ,2013

Additional Notes

Submitted by: Mohammad Abbadi

Low-GWP AREP SOFT – OPTIMIZED SYSTEM TEST DATA FORM

Manufacturer: Zamil Central Air Conditioners Manufacturer's Notation: F (120^{o} F Ambient)

Basic Information	
Alternative Refrigerant (Composition as Charged, % wt, if not proprietary)	R32
Alternative Lubricant Type and ISO Viscosity	POE
Refrigerant and Lubricant of Baseline System	R410A/POE
Make and Model of Baseline System	PTH006
Nominal Capacity and Type of Baseline System	6T Rooftop Air Conditioner Unit

Comparison Data			**Base.**	**Alt.**	**SI Units**	**Base.**	**Alt.**	**IP UNits**	**Ratio**
Mode (Heating/Cooling)			Cooling						
Compressor Type			Scroll	Scroll					
Compressor Displacement			0.199	0.203	M^3/min	7.06	7.18	Ft ^3/min	
Nominal Motor Size			5	5	hp				
Motor Speed			3500	3500	rpm				
Expansion Device Type			6.5 TXV	4.5 TXV					
Lubricant Charge			0.78	1.04	kg	1.71	2.29	lb	
Refrigerant Charge			8.36	7.37	kg	18.43	16.25	lb	
Refrigerant Mass Flow Rate			XXX	XXX	kg/min	XXX	XXX	lb/min	
Composition, at compr. Inlet if applicable				XXX	% wt				
Evaporator Face Area			0.74	0.74	m ^ 2	8.0	8.0	ft ^2	
Condenser Face Area			2.37	2.37	m ^2	25.6	25.6	ft ^2	
Ambient Temps.	Indoor	db	26.66	26.66	C	80.0	80.0	F	
		wb	19.45	19.45	C	67.01	67.01	F	
	Outdoor	db	48.89	48.89	C	120.01	120.01	F	
		wb	24.61	23.75	C	76.30	74.76	F	
Total Capacity			17941.0	20021.7	W	61272.0	68378.0	Btu/hr	
Sensible Capacity			14582.2	15439.8	W	49801.0	52730.0	Btu/hr	
Total System Power Input			7567.80	8038.10	W	7567.80	8038.10	W	
Compressor Power Input			6463.71	6959.15	W	6463.71	6959.15	W	
Energy Efficiency Ratio (EER)			2.370	2.490	W/W	8.096	8.507	Btuh/W	
Coeff. Of Performance (COP)			XXX	XXX					

Other System Changes (eg: llsl-hx, flow control, hx fins and circuiting, vapor/liquid injection, etc.)
* Compressor was changed from ZP61KCE to ZP61KCE-R32(prototype)
* TXV was changed from TGEL6.5 to TGEL4.5 model
* Filter drier was changed to new one

System Data	**Base.**	**Alt.**	**Ratio**
Degradation Coefficient – Cd	XXX	XXX	XXX
Seasonal Energy Efficiency Ratio - SEER	XXX	XXX	XXX
Heating Seasonal Performance Factor - HSPF	XXX	XXX	XXX

Low-GWP AREP SOFT – OPTIMIZED SYSTEM TEST DATA FORM

Type of System: Rooftop Packaged Unit (e.g., SSHP, window RAC, chiller, etc.)

Alternate Refrigerant: R32 (and composition as charged, % weight, if not proprietary)

Air/Water Side Data	Base.	Alt.	SI Units	Base.	Alt.	IP Units	Ratio
Evaporator							
Heat Exchange Fluid	Air	Air					
Flow Rate (gas)	70.79	70.80	m ^3/min	2500	2500.5	ft^3/min	
Flow Rate (liquid)	XXX	XXX	L/min	XXX	XXX	gal/min	
Inlet Temperature	26.66	26.66	C	80.0	80.0	F	
Outlet Temperature	16.52	15.97	C	61.75	60.75	F	
Condenser							
Heat Exchange Fluid	Air	Air					
Flow Rate (gas)	183.09	183.63	m ^3/min	6466.1	6485.1	ft^3/min	
Flow Rate (liquid)	XXX	XXX	L/min	XXX	XXX	gal/min	
Inlet Temperature	48.89	48.89	C	120.01	120.01	F	
Outlet Temperature	56.27	57.11	C	133.30	134.81	F	

Refrigerant Side Data	Baseline		Alternative		Baseline		Alternative	
Temperatures & Pressures	T (C)	P [kPa]	T (C)	P [kPa]	T [F]	P [psia]	T [F]	P [psia]
Compressor Suction	17.97	1106.33	17.50	1135.49	64.35	160.46	63.51	164.69
Compressor Discharge	90.22	3781.01	111.1	3997.85	194.40	548.39	231.98	579.84
Condenser Inlet	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
Condenser Outlet	51.40	3739.64	51.13	3961.65	124.53	542.39	124.05	574.59
Expansion Device Inlet	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
Subcooling, at expan. device	7.45		9.25		13.42		16.65	
Evaporator Inlet	13.06	XXX	12.48	XXX	55.51	XXX	54.47	XXX
Evaporator Outlet	17.69	XXX	16.59	XXX	63.85	XXX	61.87	XXX
Suction Superheat	7.31		6.61		13.16		11.91	

Data Source(s) for Refrigerant Properties
ASHRAE Handbook,2013

Additional Notes

Submitted by: Mohammad Abbadi

Low-GWP AREP SOFT – OPTIMIZED SYSTEM TEST DATA FORM

Manufacturer: Zamil Central Air Conditioners Manufacturer's Notation: G (125° F Ambient)

Basic Information	
Alternative Refrigerant (Composition as Charged, % wt, if not proprietary)	R32
Alternative Lubricant Type and ISO Viscosity	POE
Refrigerant and Lubricant of Baseline System	R410A/POE
Make and Model of Baseline System	PTH006
Nominal Capacity and Type of Baseline System	6T Rooftop Air Conditioner Unit

Comparison Data			**Base.**	**Alt.**	**SI Units**	**Base.**	**Alt.**	**IP UNits**	**Ratio**
Mode (Heating/Cooling)			Cooling						
Compressor Type			Scroll	Scroll					
Compressor Displacement			0.199	0.203	M^3/min	7.06	7.18	Ft ^3/min	
Nominal Motor Size			5	5	hp				
Motor Speed			3500	3500	rpm				
Expansion Device Type			6.5 TXV	4.5 TXV					
Lubricant Charge			0.78	1.04	kg	1.71	2.29	lb	
Refrigerant Charge			8.36	7.37	kg	18.43	16.25	lb	
Refrigerant Mass Flow Rate			XXX	XXX	kg/min	XXX	XXX	lb/min	
Composition, at compr. Inlet if applicable				XXX	% wt				
Evaporator Face Area			0.74	0.74	m ^ 2	8.0	8.0	ft ^2	
Condenser Face Area			2.37	2.37	m ^2	25.6	25.6	ft ^2	
Ambient Temps.	Indoor	db	26.66	26.66	C	80.0	79.99	F	
		wb	19.44	19.42	C	67.0	66.97	F	
	Outdoor	db	51.67	51.66	C	125.01	125.0	F	
		wb	26.31	23.82	C	79.36	74.89	F	
Total Capacity			16535.5	19133.4	W	56472.0	65344.0	Btu/hr	
Sensible Capacity			14078.3	15061.2	W	48080.0	51437.0	Btu/hr	
Total System Power Input			8033.40	8457.10	W	8033.40	8457.10	W	
Compressor Power Input			6932.27	7377.39	W	6932.27	7377.39	W	
Energy Efficiency Ratio (EER)			2.058	2.262	W/W	7.03	7.726	Btuh/W	
Coeff. Of Performance (COP)			XXX	XXX					

Other System Changes (eg: llsl-hx, flow control, hx fins and circuiting, vapor/liquid injection, etc.)
* Compressor was changed from ZP61KCE to ZP61KCE-R32(prototype)
* TXV was changed from TGEL6.5 to TGEL4.5 model
* Filter drier was changed to new one

System Data	**Base.**	**Alt.**	**Ratio**
Degradation Coefficient – Cd	XXX	XXX	XXX
Seasonal Energy Efficiency Ratio - SEER	XXX	XXX	XXX
Heating Seasonal Performance Factor - HSPF	XXX	XXX	XXX

Low-GWP AREP SOFT – OPTIMIZED SYSTEM TEST DATA FORM

Type of System: Rooftop Packaged Unit (e.g., SSHP, window RAC, chiller, etc.)

Alternate Refrigerant: R32 (and composition as charged, % weight, if not proprietary)

Air/Water Side Data	Base.	Alt.	SI Units	Base.	Alt.	IP Units	Ratio
Evaporator							
Heat Exchange Fluid	Air	Air					
Flow Rate (gas)	70.78	70.91	m ^3/min	2499.9	2504.4	ft^3/min	
Flow Rate (liquid)	XXX	XXX	L/min	XXX	XXX	gal/min	
Inlet Temperature	26.66	26.66	C	80.0	79.99	F	
Outlet Temperature	16.86	16.21	C	62.35	61.18	F	
Condenser							
Heat Exchange Fluid	Air	Air					
Flow Rate (gas)	182.53	183.27	m ^3/min	6446.1	6472.3	ft^3/min	
Flow Rate (liquid)	XXX	XXX	L/min	XXX	XXX	gal/min	
Inlet Temperature	51.67	51.66	C	125.01	125.0	F	
Outlet Temperature	59.21	59.82	C	138.59	139.69	F	

Refrigerant Side Data Temperatures & Pressures	Baseline		Alternative		Baseline		Alternative	
	T (C)	P [kPa]	T (C)	P [kPa]	T [F]	P [psia]	T [F]	P [psia]
Compressor Suction	18.57	1118.05	17.90	1143.97	65.43	162.16	64.23	165.92
Compressor Discharge	95.15	4016.67	116.52	4220.83	203.27	582.57	241.75	612.18
Condenser Inlet	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
Condenser Outlet	54.2	3975.31	53.96	4184.63	129.56	576.57	129.13	606.93
Expansion Device Inlet	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
Subcooling, at expan. device	7.44		9.03		13.40		16.27	
Evaporator Inlet	13.45	XXX	12.77	XXX	56.21	XXX	54.99	XXX
Evaporator Outlet	18.12	XXX	16.94	XXX	64.62	XXX	62.50	XXX
Suction Superheat	7.54		6.73		13.58		12.13	

Data Source(s) for Refrigerant Properties
ASHRAE Handbook ,2013

Additional Notes

Submitted by: Mohammad Abbadi

Low-GWP AREP SOFT – OPTIMIZED SYSTEM TEST DATA FORM

Manufacturer: Zamil Central Air Conditioners Manufacturer's Notation: H (130° F Ambient)

Basic Information	
Alternative Refrigerant (Composition as Charged, % wt, if not proprietary)	R32
Alternative Lubricant Type and ISO Viscosity	POE
Refrigerant and Lubricant of Baseline System	R410A/POE
Make and Model of Baseline System	PTH006
Nominal Capacity and Type of Baseline System	6T Rooftop Air Conditioner Unit

Comparison Data			**Base.**	**Alt.**	**SI Units**	**Base.**	**Alt.**	**IP UNits**	**Ratio**
Mode (Heating/Cooling)			Cooling						
Compressor Type			Scroll	Scroll					
Compressor Displacement			0.199	0.203	M^3/min	7.06	7.18	Ft ^3/min	
Nominal Motor Size			5	5	hp				
Motor Speed			3500	3500	rpm				
Expansion Device Type			6.5 TXV	4.5 TXV					
Lubricant Charge			0.78	1.04	kg	1.71	2.29	lb	
Refrigerant Charge			8.36	7.37	kg	18.43	16.25	lb	
Refrigerant Mass Flow Rate			XXX	XXX	kg/min	XXX	XXX	lb/min	
Composition, at compr. Inlet if applicable				XXX	% wt				
Evaporator Face Area			0.74	0.74	m ^ 2	8.0	8.0	ft ^2	
Condenser Face Area			2.37	2.37	m ^2	25.6	25.6	ft ^2	
Ambient Temps.	Indoor	db	26.66	26.66	C	80.0	80.0	F	
		wb	19.45	19.44	C	67.01	67.0	F	
	Outdoor	db	54.45	54.45	C	130.01	130.02	F	
		wb	25.55	25.51	C	78.0	77.92	F	
Total Capacity			15860.6	17998.1	W	54167.0	61467.0	Btu/hr	
Sensible Capacity			13668.9	14294.7	W	46682.0	48819.0	Btu/hr	
Total System Power Input			8446.3	8913.50	W	8446.3	8913.50	W	
Compressor Power Input			7344.4	7836.93	W	7344.4	7836.93	W	
Energy Efficiency Ratio (EER)			1.877	2.019	W/W	6.413	6.896	Btuh/W	
Coeff. Of Performance (COP)			XXX	XXX					

Other System Changes (eg: llsl-hx, flow control, hx fins and circuiting, vapor/liquid injection, etc.)
* Compressor was changed from ZP61KCE to ZP61KCE-R32(prototype)
* TXV was changed from TGEL6.5 to TGEL4.5 model
* Filter drier was changed to new one

System Data	**Base.**	**Alt.**	**Ratio**
Degradation Coefficient – Cd	XXX	XXX	XXX
Seasonal Energy Efficiency Ratio - SEER	XXX	XXX	XXX
Heating Seasonal Performance Factor - HSPF	XXX	XXX	XXX

Low-GWP AREP SOFT – OPTIMIZED SYSTEM TEST DATA FORM

Type of System: Rooftop Packaged Unit (e.g., SSHP, window RAC, chiller, etc.)

Alternate Refrigerant: R32 (and composition as charged, % weight, if not proprietary)

Air/Water Side Data	Base.	Alt.	SI Units	Base.	Alt.	IP Units	Ratio
Evaporator							
Heat Exchange Fluid	Air	Air					
Flow Rate (gas)	70.78	70.79	m ^3/min	2499.7	2500.0	ft^3/min	
Flow Rate (liquid)	XXX	XXX	L/min	XXX	XXX	gal/min	
Inlet Temperature	26.66	26.66	C	80.0	80.0	F	
Outlet Temperature	17.1	16.68	C	62.78	62.03	F	
Condenser							
Heat Exchange Fluid	Air	Air					
Flow Rate (gas)	182.0	182.06	m ^3/min	6427.4	6429.5	ft^3/min	
Flow Rate (liquid)	XXX	XXX	L/min	XXX	XXX	gal/min	
Inlet Temperature	54.45	54.45	C	130.01	130.02	F	
Outlet Temperature	61.83	62.67	C	143.31	144.81	F	

Refrigerant Side Data Temperatures & Pressures	Baseline		Alternative		Baseline		Alternative	
	T (C)	P [kPa]	T (C)	P [kPa]	T [F]	P [psia]	T [F]	P [psia]
Compressor Suction	19.08	1126.32	18.78	1150.04	66.36	163.36	65.81	166.8
Compressor Discharge	99.76	4233.86	124.37	4451.87	211.58	614.07	255.87	645.69
Condenser Inlet	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
Condenser Outlet	56.97	4192.49	56.48	4415.67	134.56	608.07	133.67	640.44
Expansion Device Inlet	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
Subcooling, at expan. device	7.10		9.07		12.79		16.33	
Evaporator Inlet	13.74	XXX	12.52	XXX	56.74	XXX	54.55	XXX
Evaporator Outlet	18.67	XXX	16.70	XXX	65.61	XXX	62.07	XXX
Suction Superheat	7.82		7.45		14.08		13.41	

Data Source(s) for Refrigerant Properties
ASHRAE Handbook,2013

Additional Notes

Submitted by: Mohammad Abbadi

Low-GWP AREP SOFT – OPTIMIZED SYSTEM TEST DATA FORM

Manufacturer: Zamil Air Conditioner Manufacturer's Notation: I (81.5° F Ambient)

Basic Information	
Alternative Refrigerant (Composition as Charged, % wt, if not proprietary)	R32
Alternative Lubricant Type and ISO Viscosity	POE
Refrigerant and Lubricant of Baseline System	R410A/POE
Make and Model of Baseline System	PTH006
Nominal Capacity and Type of Baseline System	6T Rooftop Air Conditioner Unit

Comparison Data			**Base.**	**Alt.**	**SI Units**	**Base.**	**Alt.**	**IP UNits**	**Ratio**
Mode (Heating/Cooling)			Cooling						
Compressor Type			Scroll	Scroll					
Compressor Displacement			0.199	0.203	M^3/min	7.06	7.18	Ft ^3/min	
Nominal Motor Size			5	5	hp				
Motor Speed			3500	3500	rpm				
Expansion Device Type			6.5 TXV	4.5 TXV					
Lubricant Charge			0.78	1.04	kg	1.71	2.29	lb	
Refrigerant Charge			8.36	7.37	kg	18.43	16.25	lb	
Refrigerant Mass Flow Rate			XXX	XXX	kg/min	XXX	XXX	lb/min	
Composition, at compr. Inlet if applicable				XXX	% wt				
Evaporator Face Area			0.74	0.74	m ^ 2	8.0	8.0	ft ^2	
Condenser Face Area			2.37	2.37	m ^2	25.6	25.6	ft ^2	
Ambient Temps.	Indoor	db	26.66	26.66	C	80.0	80.0	F	
		wb	19.44	19.42	C	67.0	66.97	F	
	Outdoor	db	27.49	27.50	C	81.49	81.50	F	
		wb	16.53	18.15	C	61.76	64.67	F	
Total Capacity			23588.5	24160.9	W	80559.0	82514.0	Btu/hr	
Sensible Capacity			17139.9	17399.0	W	58536.0	59421.0	Btu/hr	
Total System Power Input			5137.0	5560.6	W	5137.0	5560.6	W	
Compressor Power Input			4036.1	4478.73	W	4036.1	4478.73	W	
Energy Efficiency Ratio (EER)			4.59	4.34	W/W	15.682	14.839	Btuh/W	
Coeff. Of Performance (COP)			XXX	XXX					

Other System Changes (eg: llsl-hx, flow control, hx fins and circuiting, vapor/liquid injection, etc.)
* Compressor was changed from ZP61KCE to ZP61KCE-R32(prototype)
* TXV was changed from TGEL6.5 to TGEL4.5 model
* Filter drier was changed to new one

System Data	**Base.**	**Alt.**	**Ratio**
Degradation Coefficient – Cd	XXX	XXX	XXX
Seasonal Energy Efficiency Ratio - SEER	XXX	XXX	XXX
Heating Seasonal Performance Factor - HSPF	XXX	XXX	XXX

Low-GWP AREP SOFT – OPTIMIZED SYSTEM TEST DATA FORM

Type of System: Rooftop Packaged Unit (e.g., SSHP, window RAC, chiller, etc.)

Alternate Refrigerant: R32 (and composition as charged, % weight, if not proprietary)

Air/Water Side Data	Base.	Alt.	SI Units	Base.	Alt.	IP Units	Ratio
Evaporator							
Heat Exchange Fluid	Air	Air					
Flow Rate (gas)	70.80	70.78	m ^3/min	2500.3	2499.6	ft^3/min	
Flow Rate (liquid)	XXX	XXX	L/min	XXX	XXX	gal/min	
Inlet Temperature	26.66	26.66	C	80.0	80.0	F	
Outlet Temperature	14.83	14.67	C	58.7	58.42	F	
Condenser							
Heat Exchange Fluid	Air	Air					
Flow Rate (gas)	184.79	185.46	m ^3/min	6526.1	6549.5	ft^3/min	
Flow Rate (liquid)	XXX	XXX	L/min	XXX	XXX	gal/min	
Inlet Temperature	27.49	27.50	C	81.49	81.50	F	
Outlet Temperature	35.03	35.52	C	95.06	95.95	F	

Refrigerant Side Data Temperatures & Pressures	Baseline		Alternative		Baseline		Alternative	
	T (C)	P [kPa]	T (C)	P [kPa]	T [F]	P [psia]	T [F]	P [psia]
Compressor Suction	16.16	1056.89	16.26	1077.16	61.09	153.29	61.27	156.23
Compressor Discharge	61.17	2388.20	75.93	2490.24	142.12	346.38	168.68	361.18
Condenser Inlet	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
Condenser Outlet	30.14	2346.83	29.74	2454.05	86.26	340.38	85.54	355.93
Expansion Device Inlet	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
Subcooling, at expan. device	8.61		9.75		15.5		17.56	
Evaporator Inlet	11.0	XXX	10.51	XXX	51.8	XXX	50.92	XXX
Evaporator Outlet	15.93	XXX	13.86	XXX	60.68	XXX	56.95	XXX
Suction Superheat	7.05		7.15		12.69		12.87	

Data Source(s) for Refrigerant Properties
ASHRAE Handbook ,2013

Additional Notes

Submitted by: Mohammad Abbadi

Low-GWP AREP SOFT – OPTIMIZED SYSTEM TEST DATA FORM

Manufacturer: Zamil Air Conditioner Manufacturer's Notation: J (68^{o} F Ambient)

Basic Information	
Alternative Refrigerant (Composition as Charged, % wt, if not proprietary)	R32
Alternative Lubricant Type and ISO Viscosity	POE
Refrigerant and Lubricant of Baseline System	R410A/POE
Make and Model of Baseline System	PTH006
Nominal Capacity and Type of Baseline System	6T Rooftop Air Conditioner Unit

Comparison Data			**Base.**	**Alt.**	**SI Units**	**Base.**	**Alt.**	**IP UNits**	**Ratio**
Mode (Heating/Cooling)			Cooling						
Compressor Type			Scroll	Scroll					
Compressor Displacement			0.199	0.203	M^3/min	7.06	7.18	Ft ^3/min	
Nominal Motor Size			5	5	hp				
Motor Speed			3500	3500	rpm				
Expansion Device Type			6.5 TXV	4.5 TXV					
Lubricant Charge			0.78	1.04	kg	1.71	2.29	lb	
Refrigerant Charge			8.36	7.37	kg	18.43	16.25	lb	
Refrigerant Mass Flow Rate			XXX	XXX	kg/min	XXX	XXX	lb/min	
Composition, at compr. Inlet if applicable				XXX	% wt				
Evaporator Face Area			0.74	0.74	m ^ 2	8.0	8.0	ft ^2	
Condenser Face Area			2.37	2.37	m ^2	25.6	25.6	ft ^2	
Ambient Temps.	Indoor	db	26.67	26.67	C	80.01	80.01	F	
		wb	19.44	19.43	C	67.00	66.99	F	
	Outdoor	db	19.99	19.99	C	67.99	67.99	F	
		wb	14.02	13.81	C	57.25	56.87	F	
Total Capacity			25196.34	25292.67	W	86050.0	86379.0	Btu/hr	
Sensible Capacity			17893.64	17957.48	W	61110.0	61328.0	Btu/hr	
Total System Power Input			4563.0	4961.10	W	4563.0	4961.10	W	
Compressor Power Input			3462.41	3883.38	W	3462.41	3883.38	W	
Energy Efficiency Ratio (EER)			5.522	5.098	W/W	18.858	17.411	Btuh/W	
Coeff. Of Performance (COP)			XXX	XXX					

Other System Changes (eg: llsl-hx, flow control, hx fins and circuiting, vapor/liquid injection, etc.)
* Compressor was changed from ZP61KCE to ZP61KCE-R32(prototype)
* TXV was changed from TGEL6.5 to TGEL4.5 model
* Filter drier was changed to new one

System Data	**Base.**	**Alt.**	**Ratio**
Degradation Coefficient – Cd	XXX	XXX	XXX
Seasonal Energy Efficiency Ratio - SEER	XXX	XXX	XXX
Heating Seasonal Performance Factor - HSPF	XXX	XXX	XXX

Low-GWP AREP SOFT – OPTIMIZED SYSTEM TEST DATA FORM

Type of System: Rooftop Packaged Unit (e.g., SSHP, window RAC, chiller, etc.)

Alternate Refrigerant: R32 (and composition as charged, % weight, if not proprietary)

Air/Water Side Data	Base.	Alt.	SI Units	Base.	Alt.	IP Units	Ratio
Evaporator							
Heat Exchange Fluid	Air	Air					
Flow Rate (gas)	70.78	70.79	m ^3/min	2499.8	2500.1	ft^3/min	
Flow Rate (liquid)	XXX	XXX	L/min	XXX	XXX	gal/min	
Inlet Temperature	26.67	26.67	C	80.01	80.01	F	
Outlet Temperature	14.31	14.30	C	57.77	57.75	F	
Condenser							
Heat Exchange Fluid	Air	Air					
Flow Rate (gas)	185.16	185.02	m ^3/min	6539.2	6534.2	ft^3/min	
Flow Rate (liquid)	XXX	XXX	L/min	XXX	XXX	gal/min	
Inlet Temperature	19.99	19.99	C	67.99	67.99	F	
Outlet Temperature	27.48	27.86	C	81.48	82.16	F	

Refrigerant Side Data Temperatures & Pressures	Baseline		Alternative		Baseline		Alternative	
	T (C)	P [kPa]	T (C)	P [kPa]	T [F]	P [psia]	T [F]	P [psia]
Compressor Suction	16.12	1034.14	16.12	1071.99	61.02	149.99	61.03	155.48
Compressor Discharge	52.97	1999.41	65.56	2071.59	127.36	289.99	150.01	300.46
Condenser Inlet	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
Condenser Outlet	22.36	1958.04	22.40	2035.40	72.25	283.99	72.32	295.21
Expansion Device Inlet	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
Subcooling, at expan. device	8.86		9.65		15.95		17.38	
Evaporator Inlet	10.29	XXX	10.24	XXX	50.53	XXX	50.44	XXX
Evaporator Outlet	15.92	XXX	15.14	XXX	60.66	XXX	59.26	XXX
Suction Superheat	7.75		7.12		13.96		12.83	

Data Source(s) for Refrigerant Properties
ASHRAE Handbook,2013

Additional Notes

Submitted by: Mohammad Abbadi

Low-GWP AREP SOFT – OPTIMIZED SYSTEM TEST DATA FORM

Manufacturer: Zamil Air Conditioner Manufacturer's Notation: K (65° F Ambient)

Basic Information	
Alternative Refrigerant (Composition as Charged, % wt, if not proprietary)	R32
Alternative Lubricant Type and ISO Viscosity	POE
Refrigerant and Lubricant of Baseline System	R410A/POE
Make and Model of Baseline System	PTH006
Nominal Capacity and Type of Baseline System	6T Rooftop Air Conditioner Unit

Comparison Data			**Base.**	**Alt.**	**SI Units**	**Base.**	**Alt.**	**IP UNits**	**Ratio**
Mode (Heating/Cooling)			Cooling						
Compressor Type			Scroll	Scroll					
Compressor Displacement			0.199	0.203	M^3/min	7.06	7.18	Ft ^3/min	
Nominal Motor Size			5	5	hp				
Motor Speed			3500	3500	rpm				
Expansion Device Type			6.5 TXV	4.5 TXV					
Lubricant Charge			0.78	1.04	kg	1.71	2.29	lb	
Refrigerant Charge			8.36	7.37	kg	18.43	16.25	lb	
Refrigerant Mass Flow Rate			XXX	XXX	kg/min	XXX	XXX	lb/min	
Composition, at compr. Inlet if applicable				XXX	% wt				
Evaporator Face Area			0.74	0.74	m ^ 2	8.0	8.0	ft ^2	
Condenser Face Area			2.37	2.37	m ^2	25.6	25.6	ft ^2	
Ambient Temps.	Indoor	db	26.66	26.66	C	80.00	80.0	F	
		wb	19.45	19.46	C	67.02	67.03	F	
	Outdoor	db	18.33	18.32	C	65.00	64.99	F	
		wb	13.17	12.35	C	55.71	54.24	F	
Total Capacity			25613.3	25368.2	W	87474.0	86637.0	Btu/hr	
Sensible Capacity			18090.4	17929.6	W	61782.0	61233.0	Btu/hr	
Total System Power Input			4461.30	4840.10	W	4461.30	4840.10	W	
Compressor Power Input			3360.85	3760.98	W	3360.85	3760.98	W	
Energy Efficiency Ratio (EER)			5.741	5.241	W/W	19.608	17.900	Btuh/W	
Coeff. Of Performance (COP)			XXX	XXX					

Other System Changes (eg: llsl-hx, flow control, hx fins and circuiting, vapor/liquid injection, etc.)
* Compressor was changed from ZP61KCE to ZP61KCE-R32(prototype)
* TXV was changed from TGEL6.5 to TGEL4.5 model
* Filter drier was changed to new one

System Data	**Base.**	**Alt.**	**Ratio**
Degradation Coefficient – Cd	XXX	XXX	XXX
Seasonal Energy Efficiency Ratio - SEER	XXX	XXX	XXX
Heating Seasonal Performance Factor - HSPF	XXX	XXX	XXX

Low-GWP AREP SOFT – OPTIMIZED SYSTEM TEST DATA FORM

Type of System: Rooftop Packaged Unit (e.g., SSHP, window RAC, chiller, etc.)

Alternate Refrigerant: R32 (and composition as charged, % weight, if not proprietary)

Air/Water Side Data	Base.	Alt.	SI Units	Base.	Alt.	IP Units	Ratio
Evaporator							
Heat Exchange Fluid	Air	Air					
Flow Rate (gas)	70.78	70.79	m ^3/min	2499.8	2500.2	ft^3/min	
Flow Rate (liquid)	XXX	XXX	L/min	XXX	XXX	gal/min	
Inlet Temperature	26.66	26.66	C	80.00	80.00	F	
Outlet Temperature	14.20	14.31	C	57.56	57.77	F	
Condenser							
Heat Exchange Fluid	Air	Air					
Flow Rate (gas)	184.81	185.51	m ^3/min	6526.6	6551.3	ft^3/min	
Flow Rate (liquid)	XXX	XXX	L/min	XXX	XXX	gal/min	
Inlet Temperature	18.33	18.32	C	65.0	64.99	F	
Outlet Temperature	25.87	26.11	C	78.58	79.00	F	

Refrigerant Side Data Temperatures & Pressures	Baseline		Alternative		Baseline		Alternative	
	T (C)	P [kPa]	T (C)	P [kPa]	T [F]	P [psia]	T [F]	P [psia]
Compressor Suction	16.23	1029.73	16.18	1064.75	61.22	149.35	61.13	154.43
Compressor Discharge	51.46	1925.49	63.80	1986.44	124.63	279.27	146.85	288.11
Condenser Inlet	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
Condenser Outlet	20.95	1884.13	20.59	1950.25	69.72	273.27	69.07	282.86
Expansion Device Inlet	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
Subcooling, at expan. device	9.04		9.79		16.28		17.63	
Evaporator Inlet	10.07	XXX	10.00	XXX	50.13	XXX	50.01	XXX
Evaporator Outlet	16.03	XXX	14.85	XXX	60.86	XXX	58.73	XXX
Suction Superheat	8.0		7.40		14.40		13.33	

Data Source(s) for Refrigerant Properties
ASHRAE Handbook,2013

Additional Notes

Submitted by: Mohammad Abbadi