



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

TEST REPORT #43

System Drop-in Tests of Refrigerants L-41-1, L-41-2, and R-32 in Water-to- Water Heat Pump

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List of Tested Refrigerant's Compositions (Mass %)

R-32	R-32 (100)
L-41-1	R-32/R-1234ze/R-600 (68.8/28.2/3)
L-41-2	R-32/R-1234ze/R-125 (68/28.6/3.4)

Low-GWP AREP SYSTEM DROP-IN TEST

1. Introduction

This report describes the performance evaluation of three alternative refrigerants with low global warming potential (hereafter defined as a GWP), and then various feasibilities are investigated through performance comparisons of the alternative working fluids and R410A that is a widely used refrigerant of residential and commercial air-conditioning system. Especially, a inverter-driven variable speed compressor is adopted for varying capacity of the heat pump unit in this experimental work. Test conditions and standard rated conditions are based on ISO 13256-2 and reference to the European standard certification criterion, EN14511-2, and these conditions are summarized at Table 1 and 2, respectively. This experimental work is accomplished in order to evaluate the rated and partial capacity in accordance with the test standard. Alternative low GWP refrigerants are considered as R32, L41-1 and L41-2 and the thermophysical performances are experimentally investigated and analyzed.

Table 1: Test Conditions per ISO 13256-2

	Water Loop Heat Pump (WLHP)		Ground Water Heat Pump (GWHP)		Ground Loop Heat Pump (GLHP)	
	Cooling	Heating	Cooling	Heating	Cooling	Heating
Liquid entering indoor side heat exchanger (load side)[°F]	53.6	104	53.6	104	53.6	104
Liquid entering outdoor side heat exchanger (source side) [°F]	86	68	59	50	77	32
Air surrounding unit, Tdb (°F)	59-86	59-86	59-86	59-86	59-86	59-86
Fluid flow rate (gpm)	Rated	Rated	Rated	Rated	Rated	Rated

Table 2: Standard rated condition at EN14511-2

Standard rating conditions	Outdoor heat exchanger		Indoor heat exchanger	
	Inlet temperature	Outlet temperature	Inlet temperature	Outlet temperature
Heating [°C]	10	7a	40	45
Cooling [°C]	30	35	12	7
a The test is performed at the flow rate obtained during the test at the corresponding standard rating conditions.				

2. Details of Test Setup:

a. Description of System

The following is a brief description of the system used for drop-in test.

- Name and model number of the tested system: Designed water-to-water heat pump unit.
- Nominal capacity of the system: 3.5kW (12,000 Btu/hr)
- Baseline refrigerant, charge, flow rate, and lubricant type: R410A, 900g, PVE oil



The heat pump unit tested was a R410A 3.5 kW (12,000 Btu/hr) water-to-water heat pump and it consists of a single rotary compressor, two plated heat exchangers, and an EEV. The schematic of the refrigeration cycle is shown in Fig 1. (Red arrow: Heating, Blue arrow: Cooling)

b. Description of Tests Conducted

Figure 1 is a schematic of tested heat pump system and Table 3 is a component specification of the experimental apparatus. As shown in Fig. 1, an inverter-driven variable speed compressor is adopted for varying capacity of the heat pump unit, and an electronic expansion valve (EEV) with 1-2 phase excitation stepping motor is installed in the experimental device to regulate high and low pressure balance, and moderate refrigerant circulation flow rate was adjusted by the EEV. Plate type indoor and outdoor heat exchangers are employed for exchanging thermal energy between refrigerant and water. The liquid receiver between the condenser and the expansion device prevent performance degradation for rapid ambient air temperature changes or operation mode changes. The accumulator is installed at the compressor inlet to avoid a wet compression.

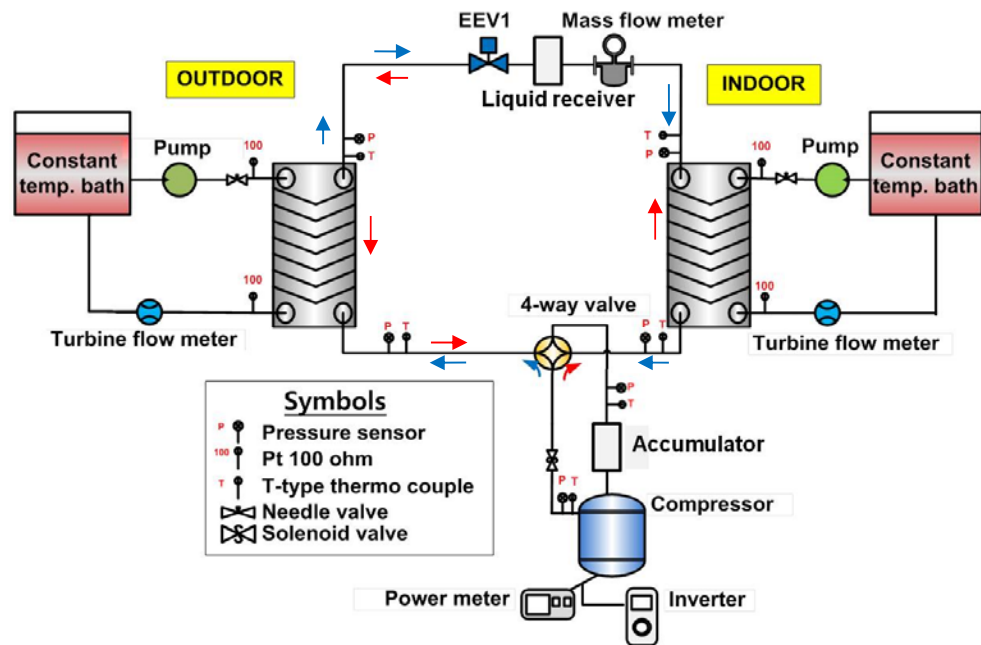


Fig.1: Schematic of the heat pump system

Table 3: Specification of major components

Indoor Heat Exchanger	Manufacturer: Danfoss Model No.: B30-20-3.0-HQ Type: Brazed plate type heat exchanger
Outdoor Heat Exchanger	Manufacturer: Danfoss Model No.: B30-20-3.0-HQ Type: Brazed plate type heat exchanger
Compressor	Manufacturer: LG Model No.: GA102MFB Type: Rotary (R410A) Displacement: 10.2cc Frequency range: 39-100Hz
EEV(Electric expansion valve)	Manufacturer: Sanhua, Model No. DPF(o) 1.3 Step (pulse) : 2000 Orifice diameter: 1.3mm

b.1 Constant temperature water bath

To replicate the heat source and the load, the constant temperature water bath was placed to maintain the secondary fluids' set-point temperature. Constant temperature water bath for the implementation of indoor and outdoor load consists of an electric heater, refrigerator, a temperature sensor, a digital temperature controller (temperature indicating controller, TIC), a power controller (thyristor type power control unit, SCR) and a circulation pump. The antifreeze fluid in the circulating water bath was applied at the outdoor heat exchanger loop and water is applied at the indoor heat exchanger loop. Fig. 2 shows a schematic diagram of the constant temperature water bath.

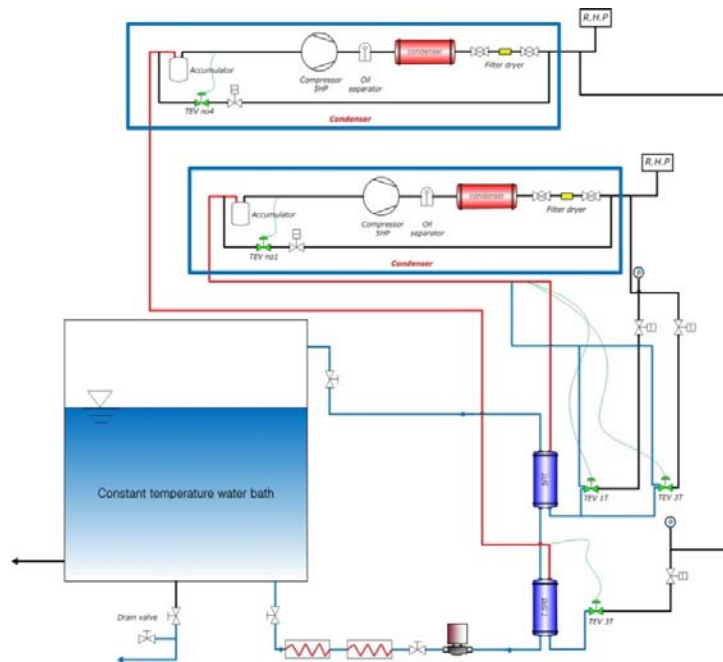


Fig.2: Schematic diagram of the constant temperature water bath

b.2 Temperature measuring device

RTD sensor has been mainly used for measuring temperature of the secondary fluid and a thermocouple was used to measure the refrigerant pipe temperature of the main portion of the refrigerant cycle. Table 4 shows the specification of the thermocouple and RTD sensors.

Table 4: Specification of Thermocouple and RTD

Item	Specification	
	Thermocouple	RTD
Type	T-type	Pt 100Ω
Temperature range	-200 °C ~ 200 °C	-200 °C ~ 650 °C
Accuracy	±0.2 °C	±0.15 °C
Alloy combination	Copper/constant	Pt 100Ω

b.3 Pressure measuring device

To find the pressure-temperature relationship, the pressure of the refrigerant is measured using a pressure transducer was placed in the same position as the temperature measurement position. Table 5 shows the specification of the pressure transducer.

Table 5: Specification of Pressure transducer

Item	Specification
Manufacturer	Sensys.
Pressure range	0 to 50bar _g
Accuracy	±0.13% full scale
Output	0 to 5V
Excitation	24 VDC

b.4 Flow measuring device

To find the flow rate of the refrigerant heat pump was used with a Coriolis effect mass flow meter. Table 6 shows the specifications of the mass flow meter for measuring the flow rate of the refrigerant. Using a turbine volumetric flow meter, the flow rate of the secondary fluid of the heat source and the load side was measured and Table 7 shows the specifications of the volumetric flow meter.

Table 6: Specification of mass flow meter

Item	Specification
Manufacturer	Oval
Maximum flow range	0 to 10 kg/min
Maximum pressure	19 MPa
Transmitter model	CT9401
Analog output	4 to 20mA
Accuracy	±0.1%
Input voltage	220 V

Table 7: Specification of volumetric flow meter

Item	Specification
Manufacturer	SikA
Maximum flow range	0 to 2.2m ³ /hr
Analog output	4 to 20mA
Accuracy	±0.1%
Input voltage	220 V

b.5 Power measuring device

To measure the power consumption of the heat pump was used as the integrating wattmeter of Yokogawa Co. WT230 and Table 8 shows the specifications of the power meter.

Table 8: Specification of power meter

Item	Specification
Manufacturer	Yokogawa electric Co.
Model	WT230
Voltage range	0 to 600 V
Current range	0 to 20 A
Accuracy	±0.2% of full range
Excitation	220V, 60 Hz

Drop-in test procedure:

There are purposes of these experimental works in analysis and comparisons of the performances among refrigerants to investigate possibility for alternative refrigerant with low global warming potential (here in after denoted GWP) to replace R410A which is widely used in various air-conditioning systems. The alternative refrigerants are considered as R32, L41-1, and L41-2 fluids. Experimental work is conducted in focus on ensuring optimum system efficiency. To observe effects according to refrigerant charge variation, the compressor frequency is manually controlled to obtain cooling capacity of 3.5 kW (1RT). Drop-in test was done to compare and analyze performance among refrigerants in room air condition and optimum refrigerant charge ratio, and then the performance evaluation was performed at part-load adjusting to cooling and heating capacity. The performance differences among refrigerants are investigable through series of these experimental works. The temperature, pressure, and mass flow rate were continuously recorded and stored from data acquisition system per two seconds during 40 minutes. The cooling capacity can be expressed as function of the outlet and inlet of the water temperature difference, specific heat, and volume flow rate of the water.

Test summary

1. The optimum refrigerant charge test of R410A and alternative refrigerant
2. Drop-in test in EN 14511-2 condition and capacity matching test in Table 9

Table 9: Capacity matching test conditions

	Cooling mode		Heating mode	
	Rated	Part-load	Rated	Part-load
Capacity (W)	3500	1800	4000	2200
Ratio	100%	51%	100%	55%

Appendix

1. Drop-in test in ISO 13256-2 condition: R-410A, R-32, L-41-1, L-41-2

3. Results

1) The optimum refrigerant charge test of R410A and alternative refrigerant

The refrigerant properties of 100%R32 and R410A were obtained from NIST REFPROP 8.0 and the refrigerant properties of L41-1 and L41-2 were obtained from Honeywell. Figure 6 shows optimum refrigerant charge test result according to various refrigerants on cooling test conditions. This experimental result is obtained at European standard certification criterion of EN14511-2 test condition. An optimum refrigerant charge is defined as fluid amount which can achieve maximum EER. Compressor frequency have been manually decided to target cooling capacity (3.5 kW), and adding refrigerant has increased by 100g at each test. Especially, this test data is obtained at cooling operation mode since effects of refrigerant charge ratio is insignificant from the viewpoint of operating mode for the heat pump system installing a liquid receiver. Generally, compressor volume efficiency could be decreased by temperature increment of compressor inlet in the low refrigerant charge condition. Furthermore, there can be high decrement of the cooling capacity from the decrement of refrigerant mass flow rate. Otherwise, condensing and evaporating pressure could be increased by refrigerant overcharge with pure liquid in the high pressure side. These results lead to lower evaporating temperature and further temperature difference decrement between refrigerant and secondary fluid. However, there may be various problems in that thermal capacity and COP changes are lower than case of the low fill charge condition. As shown in Fig. 3, optimum refrigerant charge of the alternative refrigerants used in the test is considerably smaller than that of R410A because these fluids have further liquid density and latent heat at the cooling operation, EWT (30°C) of cond. and EWT (30°C) of evaporator. Optimum refrigerant charge on the R410A, L41-1, L41-2 and R32 are measured as 900g, 800g, 800g, and 700g, respectively. Optimum refrigerant charge of the L41-1 and L41-2 is reduced to maximum 11% based on the R410A, on the other hand, that of R32 is reduced to maximum 22%. Therefore, optimum refrigerant charge of R32 is the smallest.

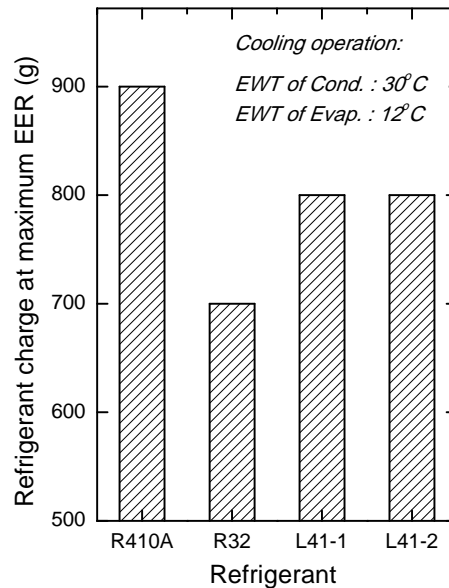


Fig. 3: Refrigerant charge amount at maximum with respect to refrigerant

2) Drop-in test in EN 14511-2 condition and capacity matching test
-Cooling operation mode

Figure 4 shows cooling capacity versus refrigerants under compressor frequency of 55 Hz in Drop-In test condition. Also, in the constant capacity test based on the 3500 W and 1800 W are presented for the refrigerants. In constant capacity test, compressor frequencies have been manually adjusted to meet at the target cooling capacity (3.5 kW and 1.8 kW). As shown in Fig. 4, the cooling capacities for the R410A, R32, L41-1 and L41-2 are measured as 3636 W, 3832 W, 3472 W, and 3423 W, respectively. The cooling capacity of the R32 is 5.4% greater than R410A, on the other hand, the cooling capacity of L41-1 and L41-2 are maximum 4% and 6% smaller than R410A, respectively.

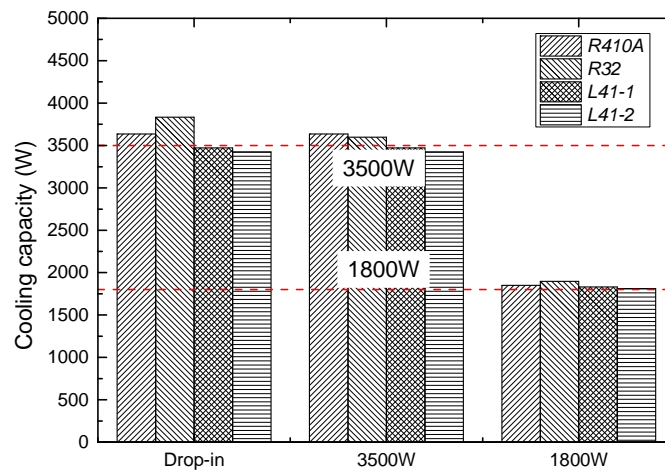


Fig. 4: Cooling capacity with respect to Drop-in test, 3500W and 1800W for cooling operating mode

Figure 5 and 6 shows power consumption of the compressor and COP versus refrigerants under the Drop-in test and the constant capacity test, respectively. As previously stated in Fig. 4, the compressor frequency is fixed on the 55 Hz under the Drop-in test. As shown in Fig. 5, power consumption of the R410A, R32, L41-1 and L41-2 are measured as 857 W, 909 W, 752 W, and 765 W, respectively. The power consumption of the R32 is increased to 5.4% in comparison with R410A, on the other hand, those of L41-1 and L41-2 are decreased to maximum 12% and 11% in comparison with R410A, respectively, and this caused the COP increase of the L41-1 and L41-2. The COPs of the L41-1 and L41-2 are improved in comparison with R410A. For the case of R32, the cooling capacity is relatively high compared to R410A, but the COP is slightly low from increment of the power consumption. However, in the case of constant capacity test (3500 W), the COP was same level in comparison with R410A because the power consumption decrement of 6.6%. As shown in Fig. 6, in low part load (1800 W) of the constant capacity test, the COPs of the alternative refrigerants are measured with 4.8%, 16%, and 13% higher than that of the R410A.

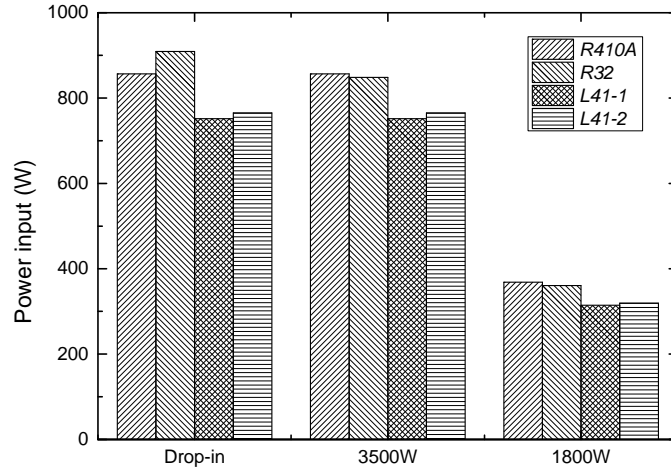


Fig. 5: Power consumption with respect to Drop-in test, 3500W and 1800W for cooling operating mode

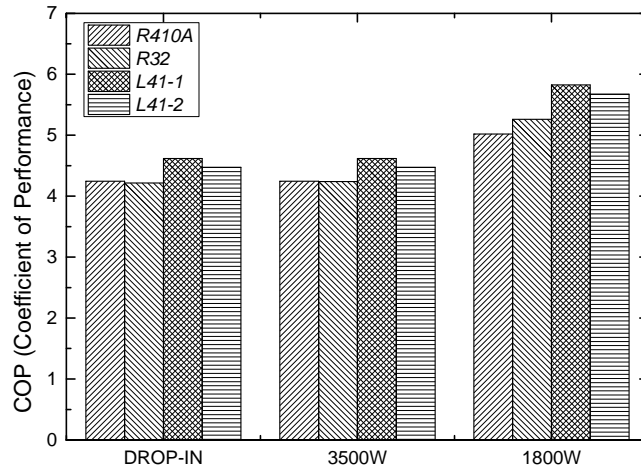


Fig. 6: COP with respect to Drop-in test, 3500W and 1800W for cooling operating mode

Figure 7 shows mass flow rate versus refrigerants with respect to the Drop-in test and the constant capacity test (3500 W and 1800 W) for cooling operating mode. As shown in Fig. 7, for the case of the Drop-in test, mass flow rates on the R410A, R32, L41-1 and L41-2 are measured as 83 kg/h, 55 kg/h, 58 kg/h, and 58 kg/h, respectively. Generally, R32 have the lowest density among refrigerants, and this caused mass flow rate decrement of 33% in comparison with R410A. The mass flow rates of other alternative refrigerants are decreased to maximum 30% in comparison with R410A. For the case of the constant capacity (3500 W), mass flow rate of the R32 is decreased further than Drop-in test and is reduced to maximum 38% as comparison with R410A since compressor frequency is lowly controlled. For the case of the constant capacity test (1800 W), the mass flow rates of the alternative refrigerants are lowly measured in comparison with R410A, and decreased to 32%, 27% and 25% on the R32, L41-1 and L4-2, respectively.

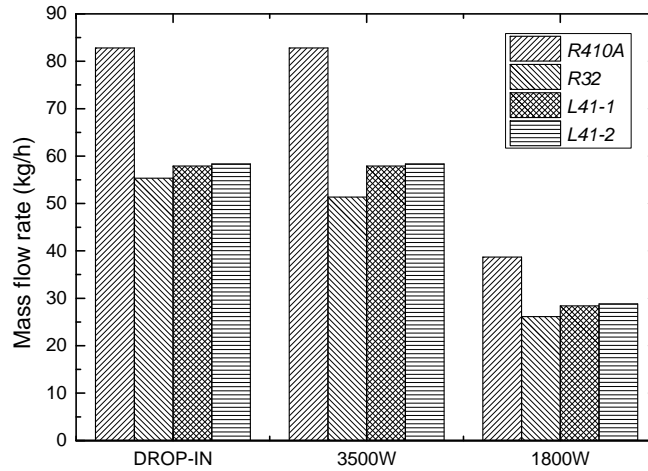


Fig. 7: Mass flow rate with respect to Drop-in test, 3500W and 1800W for cooling operating mode

Figure 8 shows compressor discharge temperature subjecting to cooling operating mode for the each refrigerant on the Drop-in test and the constant capacity test. Discharge temperature of the R32 is the highest in all test case conditions including a Drop-in test and the constant capacity tests (3500 W and 1800 W). In the case of Drop-in test and the constant capacity test (1800 W), the discharge temperatures of the R32 are 20°C and 6°C higher than the R410A, respectively. In the case of Drop-in test and the constant capacity test (3500 W), the discharge temperatures of the L41-1 and L41-2 are 4°C higher than the R410A in both cases but has no difference in the constant capacity (1800 W) test in comparison with R410A.

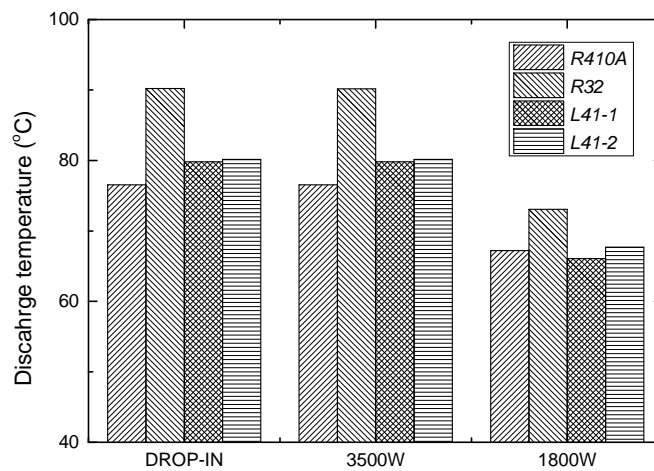


Fig. 8: Discharge temperature with respect to Drop-in test, 3500W and 1800W for cooling operating mode

-Heating operation mode

Figure 9 shows heating capacity versus refrigerants in the Drop-in test and the constant capacity (4000 W and 2200 W) test. Especially, the Drop-in test is accomplished under a constant compressor frequency of 70 Hz. In the case of the R32, the heating capacity is observed as nearly same level with the R410A, while those of L41-1 and L41-2 are 21%, 25% lower than the R410A, respectively. In the constant capacity test (4000 W), the compressor frequency is manually adjusted to 85 Hz to meet the target capacity of 4000 W for the L41-1 and L41-2. In the constant test (2200 W), the compressor frequencies of the R410A, R32, L41-1 and L41-2 are adjusted to 39 Hz, 35 Hz, 45 Hz and 50 Hz to meet target capacity of 2200 W.

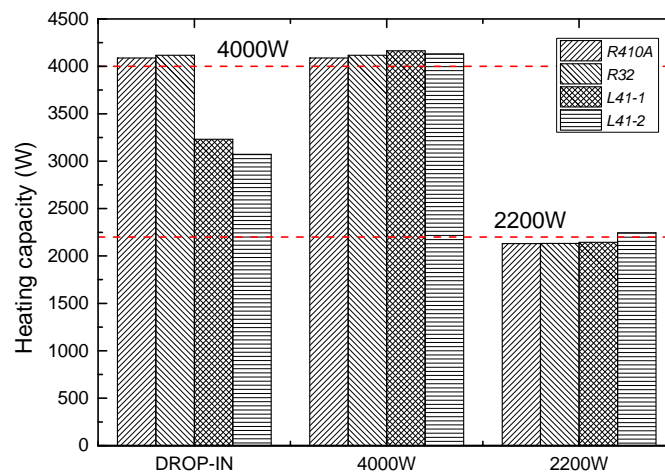


Fig. 9: Heating capacity respect to Drop-in test, 4000W and 2200W for heating operating mode

Figure 10 shows the power consumption (Fig. 10(a)) and COP (Fig. 10(b)) versus refrigerants in the Drop-in test and the constant capacity test (4000 W and 2200 W). In the case of Drop-in test, the power consumptions of the R410A, R32, L41-1, and L41-2 are measured as 1033 W, 1043 W, 857 W, and 877 W, respectively. The power consumption of R32 is measured as nearly same level with the R410A, however, those of L41-1 and L41-2 are 17% and, 15% lower than that of the R410A, respectively. In the case of constant capacity (4000 W) test, the power consumptions of the L41-1 and L41-2 are 6% and, 12.5% higher than the R410A and this was caused the compressor frequency change from 70 Hz to 85 Hz. In the case of constant capacity test (2200 W), the power consumption of R32 is measured as nearly same level with the R410A but the power consumptions of the L41-1 and L41-2 are 9% and, 25% higher than those of the R410A, respectively. As shown in Fig. 10(b), the COPs of the L41-1 and L41-2 are measured lower than other refrigerants in the all test conditions because these refrigerants have lower heat capacity than other refrigerants. Generally, the high power consumption brings, the lower COP in the refrigerant systems. In the case of Drop-in test, the COPs on these refrigerants (L41-1 and L41-2) are measured 5% and, 10% lower than that of the R410A. In the case of constant capacity (4000W) test, the COPs on these refrigerants are measured 8% and, 10% lower than that of the R410A. In the case of the R32, the COP is observed as nearly same level with the 410A but is increased to maximum to 9% for the case of constant capacity test (2200 W) compared to that of the R410A.

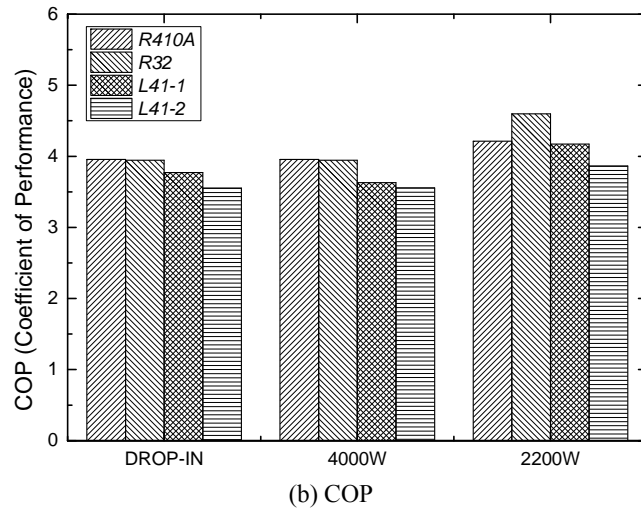
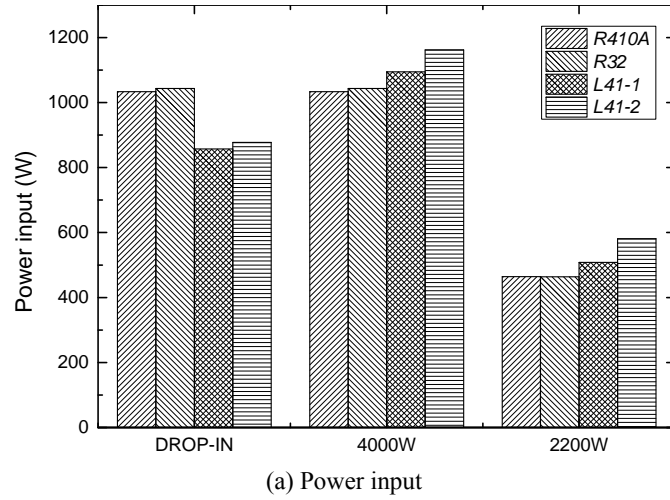


Fig. 10: Power input (a) and COP (b) with respect to Drop-in test, 4000W and 2200W for heating operating mode

Figure 11 shows mass flow rate versus refrigerants according to the Drop-in test and the constant capacity test (4000 W and 2200 W). Alternative refrigerants have lower mass flow rate in comparison with R410A since densities of these alternative refrigerants are low relatively. As shown as in Fig. 11, the mass flow rates of the alternative refrigerants are measured 37% lower than that of the R410A in the Drop-in test. Although the R32 has a lower density than L41-1 and L41-2, the mass flow rate of R32 is equivalently measured because of high suction pressure of the R32. In the case of constant capacity test (4000 W), mass flow rates of L41-1 and L41-2 are measured as 53 kg/h and 56 kg/h, respectively, and this was caused the compressor frequency change from 70 Hz to 85 Hz. In the case of the constant capacity test (2200 W), the mass flow rate of the R32 is 33% lower than that of R410A and those of the L41-1 and L41-2 are 17% and, 11% lower in comparison with R410A.

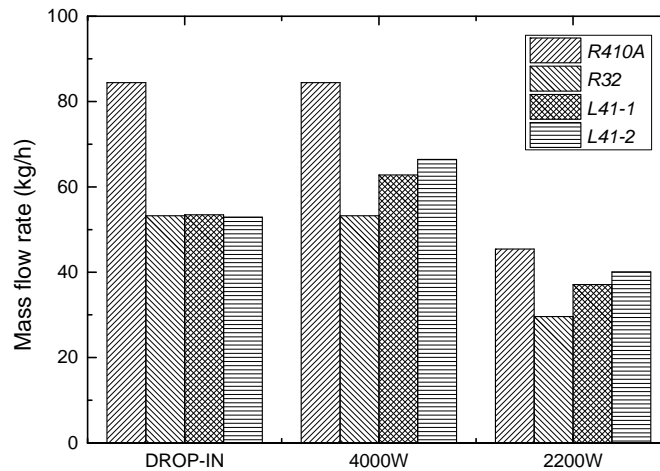


Fig. 11: Mass flow rate with respect to Drop-in test, 4000W and 2200W for operating mode

Figure 12 shows compressor discharge temperature versus refrigerants in the Drop-in test and the constant capacity test (4000 W and 2200 W). As shown in Fig. 12, the discharge temperatures of alternative refrigerants are higher R410A temperature. Particularly, temperature of the R32 is the highest among all refrigerants and is high as maximum 20°C in comparison with R410A. In the Drop-in test, the discharge temperatures of the L41-1 and L41-2 are 4°C and, 7°C higher than the discharge temperature of the R410A. In the case of the constant capacity test (4000 W), the discharge temperatures of the L41-1 and L41-2 are 9°C and, 11°C higher than that of R410A. In the case of constant capacity test (2200 W), the discharge temperature of R32 is 8°C higher than that of the R410A and is measured as 76°C, and then the discharge temperatures of the L41-1 and L41-2 are measured as 71°C and 74°C, respectively.

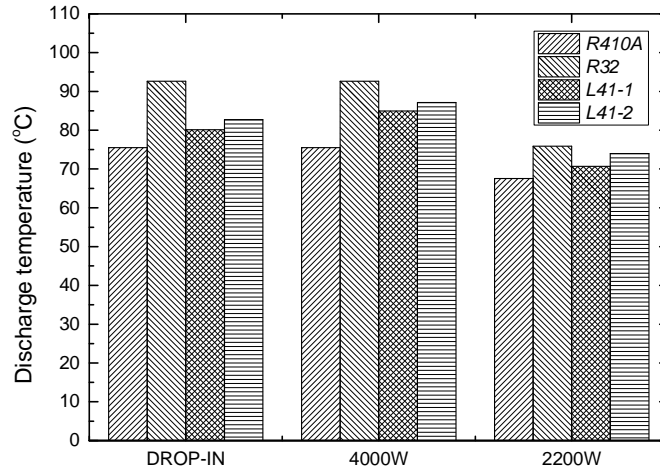


Fig. 12: Discharge temperature with respect to Drop-in test, 4000W and 2200W for heating operating mode

Figure 13 and 14 shows compressor frequency versus refrigerants in the Drop-in test and the constant capacity test (Cooling and Heating operation).

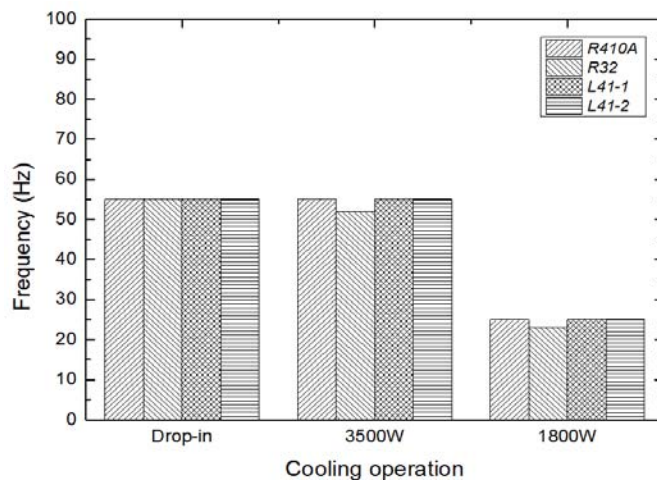


Fig. 13: Compressor frequency with respect to Drop-in test, 3500W and 1800W for cooling operating mode

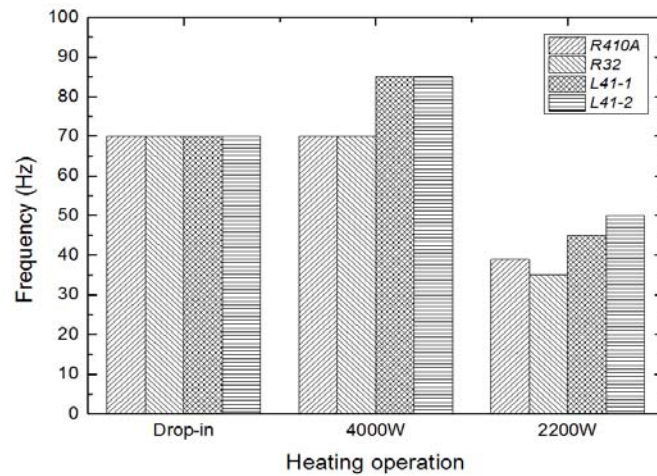


Fig. 14: Compressor frequency with respect to Drop-in test, 4000W and 2200W for heating operating mode

Appendix.

1) Drop-in test in ISO 13256-2: R-410A, R-32, L-41-1, L-41-2

A series of the performance evaluation for the various refrigerants was experimentally accomplished adjusting to ISO 13256-2 test condition in the basis of R410A. This experimental work for the all refrigerants has done based on R410A at same condition. In this report, performances of the alternative refrigerants are compared with R410A to establish baseline performance, and criteria of the performance are selected as COP, Power consumption, discharge temperature and capacity in the cooling-and heating operating modes. In the case of the R32, power consumption of inverter compressor is increased from 8% to 14%, and then thermal capacity is increased from 4% to 10%. Therefore, the COP of the R32 is 6% lower than that of the R410A. In heating operating mode of the L41-1 and L41-2, power consumption is decreased to maximum 12% in comparison with the R410A, but capacity and the COP is decreased to maximum 20% and 10%, respectively. In cooling operating mode of the L41-1 and L41-2, the COP was increased to maximum 5% compared to that of the R410A. On the whole, EER and COP of the alternative refrigerants were low in comparison with R410A and the reasons of results are assumed because experimental system was not optimized alternative refrigerants. An optimum refrigerant charge test will be progressed in future, and then Drop-in test will be accomplished in the standard condition again later.

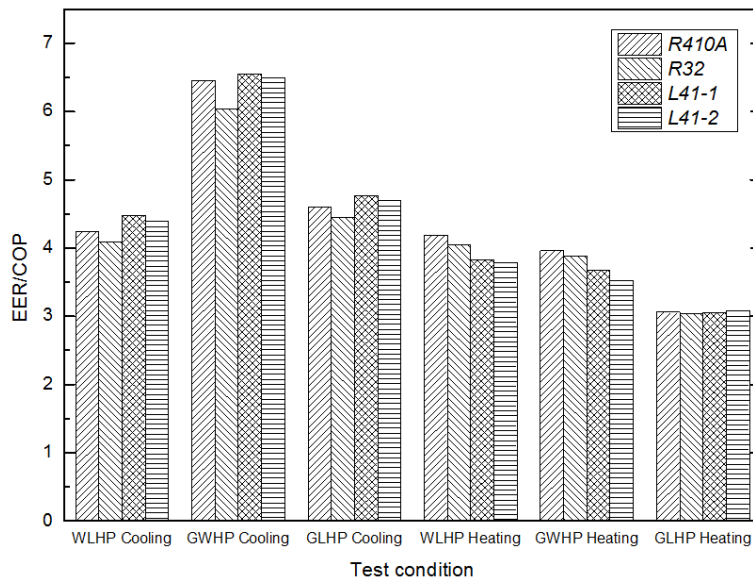


Fig. 15: EER and COP

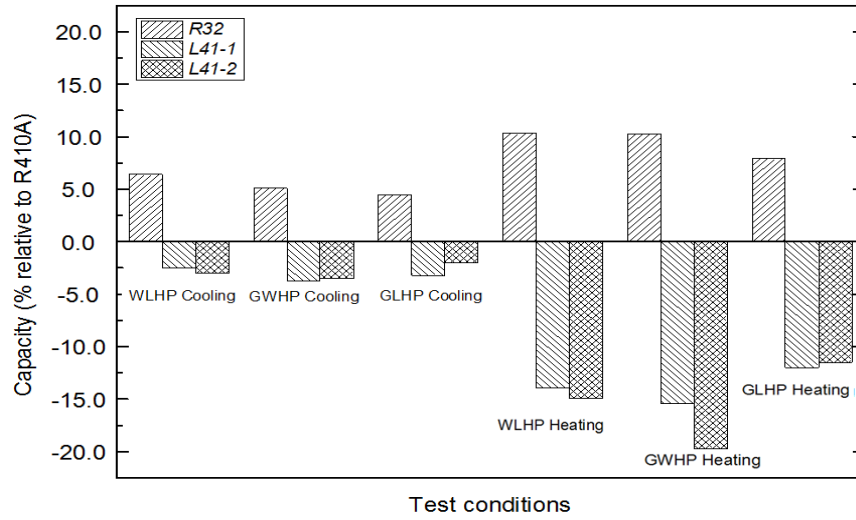


Fig. 16: Capacity relative to R410A baseline

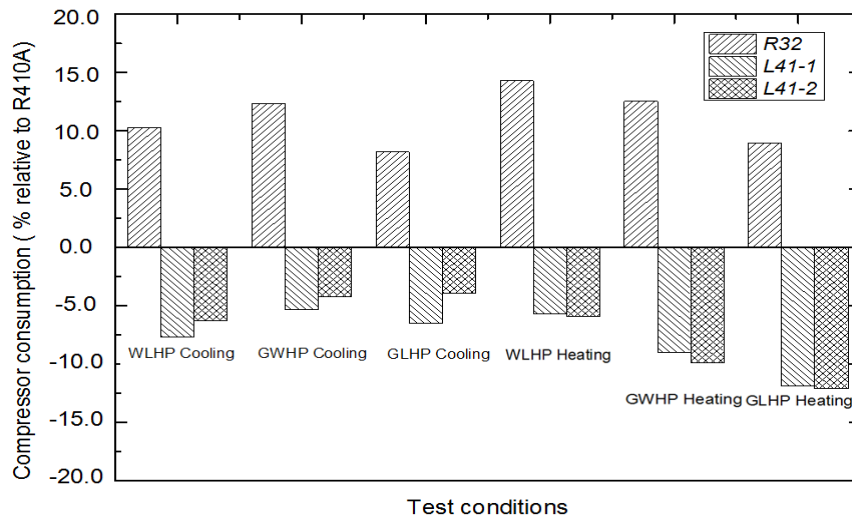


Fig. 17: Compressor Power Consumption relative to R410A baseline

Low_GWP AREP SYSTEM DROP-IN TEST DATA FORM

Manufacturer: LG Electronics

Manufacturer's Notation: MKS

Basic Information	
Alternative Refrigerant (If not proprietary, composition as Charged, % wt)	100% R32
Alternative Lubricant Type and ISO Viscosity	RM68 (VG 68), POE oil
Baseline Refrigerant and Lubricant	FVC68D (VG 68), PVE oil
Make and Model of System	LG electronics
Nominal Capacity and Type of System	3.5kW / Water to Water system

Comparison Data			Base.	Alt.	SI Units	Base.	Alt.	IP UNits	Ratio
Mode (Heating/Cooling)			Cooling WLHP						
Compressor Type			Rotary	Rotary					
Compressor Displacement			0.0337	0.0337	m ³ /min				
Nominal Motor Size			-	-	hp				
Motor Speed			3300	3300	rpm				
Expansion Device Type			Electric Expansion Valve	Electric Expansion Valve					
Lubricant Charge			0.31	0.31	kg	0.68	0.68	lb	
Refrigerant Charge			0.9	0.9	kg	1.98	1.98	lb	
Refrigerant Mass Flow Rate			N/A	N/A	kg/min	N/A	N/A	lb/min	
Composition, at compr. inlet if applicable				-	% wt				
Ambient Temps.	Indoor	db	21.2	21.9	C	70.16	71.42	F	
		Wb	-	-	C	-	-	F	
	Outdoor	db	-	-	C	-	-	F	
		wb	-	-	C	-	-	F	
Total Capacity			3636	3869	W	12406	13201	Btu/hr	1.06
Sensible Capacity			N/A	N/A	W	N/A	N/A	Btu/hr	
Total System Power Input			N/A	N/A	W	N/A	N/A	W	
Compressor Power Input			857	945	W	857	945	W	1.10
Energy Efficiency Ratio (EER)			4.24	4.09	W/W	14.47	13.97	Btuh/W	0.96
Coeff. Of Performance (COP)									

Other System Changes

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

Low-GWP AREP SYSTEM DROP-IN TEST DATA FORM

Type of System: Water-to-water heat pump Alternate Refrigerant: 100% R32
 (e.g., SSHP, window RAC, chiller, etc.) (and composition as charged, % weight, if not proprietary)

Water Side Data	Base.	Alt.	SI Units	Base.	Alt.	IP UNits	Ratio
Evaporator							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ /min	
Flow Rate (liquid)	11.01	11.00	L/min	2.64	2.64	gal/min	
Inlet Temperature	12.0	12.0	C	53.6	53.6	F	
Outlet Temperature	7.55	7.31	C	44.87	44.56	F	
Condenser							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ /min	
Flow Rate (liquid)	11.21	11.20	L/min	2.96	2.96	gal/min	
Inlet Temperature	29.97	30.02	C	85.95	86.04	F	
Outlet Temperature	34.43	34.62	C	93.97	94.32	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	13.64	1003	14.11	1094	56.55	145	57.40	159
Compressor Discharge	76.55	2916	84.24	2984	169.79	423	183.63	433
Condenser Inlet	72.45	2897	81.65	2978	162.41	420	178.97	432
Condenser Outlet	46.82	-	39.21		116.28		102.58	
Expansion Device Inlet	44.97	-	37.11		112.95		98.80	
Subcooling, at expan. device	-		-					
Evaporator Inlet	8.77	-	8.99		47.79		48.18	
Evaporator Outlet	11.23	1005	13.21	1095	52.21	146	55.78	159
Evaporator Superheat	0.47		0.32		0.85		0.58	

Data Source(s) for Refrigerant Properties

Additional Notes

Submitted by: _____

Low_GWP AREP SYSTEM DROP-IN TEST DATA FORM

Manufacturer: LG Electronics

Manufacturer's Notation: MKS

Basic Information	
Alternative Refrigerant (If not proprietary, composition as Charged, % wt)	100% R32
Alternative Lubricant Type and ISO Viscosity	RM68 (VG 68), POE oil
Baseline Refrigerant and Lubricant	FVC68D (VG 68), PVE oil
Make and Model of System	LG electronics
Nominal Capacity and Type of System	3.5kW / Water to Water system

Comparison Data			Base.	Alt.	SI Units	Base.	Alt.	IP UNits	Ratio
Mode (Heating/Cooling)			Cooling GWHP						
Compressor Type			Rotary	Rotary					
Compressor Displacement			0.0337	0.0337	m ³ /min				
Nominal Motor Size			-	-	hp				
Motor Speed			3300	3300	rpm				
Expansion Device Type			Electric Expansion Valve	Electric Expansion Valve					
Lubricant Charge			0.31	0.31	kg	0.68	0.68	lb	
Refrigerant Charge			0.9	0.9	kg	1.98	1.98	lb	
Refrigerant Mass Flow Rate			N/A	N/A	kg/min	N/A	N/A	lb/min	
Composition, at compr. inlet if applicable				-	% wt				
Ambient Temps.	Indoor	db	22.2	21.6	C	71.96	70.88	F	
		Wb	-	-	C	-	-	F	
	Outdoor	db	-	-	C	-	-	F	
		wb	-	-	C	-	-	F	
Total Capacity			4145	4356	W	14143	14863	Btu/hr	1.05
Sensible Capacity			N/A	N/A	W	N/A	N/A	Btu/hr	
Total System Power Input			N/A	N/A	W	N/A	N/A	W	
Compressor Power Input			643	722	W	643	722	W	1.12
Energy Efficiency Ratio (EER)			6.45	6.03	W/W	21.99	20.58	Btuh/W	0.93
Coeff. Of Performance (COP)									

Other System Changes

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

Low-GWP AREP SYSTEM DROP-IN TEST DATA FORM

Type of System: Water-to-water heat pump Alternate Refrigerant: 100% R32
 (e.g., SSHP, window RAC, chiller, etc.) (and composition as charged, % weight, if not proprietary)

Water Side Data	Base.	Alt.	SI Units	Base.	Alt.	IP Units	Ratio
Evaporator							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ /min	
Flow Rate (liquid)	11.01	11.00	L/min	2.64	2.64	gal/min	
Inlet Temperature	12.0	12.0	C	53.60	53.60	F	
Outlet Temperature	7.02	6.75	C	43.75	43.20	F	
Condenser							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ /min	
Flow Rate (liquid)	11.21	11.20	L/min	2.96	2.96	gal/min	
Inlet Temperature	15.02	15.11	C	59.04	59.20	F	
Outlet Temperature	20.12	20.68	C	68.22	69.22	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	9.25	838	9.24	913	48.65	122	48.63	132
Compressor Discharge	50.12	1865	68.11	2250	122.22	270	154.60	326
Condenser Inlet	48.22	1859	66.24	2239	118.80	270	151.23	325
Condenser Outlet	15.75	-	18.74		60.35		65.73	
Expansion Device Inlet	15.64	-	18.56		60.15		65.41	
Subcooling, at expan. device	-		-					
Evaporator Inlet	5.63	-	5.84		42.13		42.51	
Evaporator Outlet	8.84	841	9.02	914	47.91	122	48.24	133
Evaporator Superheat	3.45		1.59		6.21		2.86	

Data Source(s) for Refrigerant Properties

Additional Notes

Submitted by: _____

Low_GWP AREP SYSTEM DROP-IN TEST DATA FORM

Manufacturer: LG Electronics

Manufacturer's Notation: MKS

Basic Information	
Alternative Refrigerant (If not proprietary, composition as Charged, % wt)	100% R32
Alternative Lubricant Type and ISO Viscosity	RM68 (VG 68), POE oil
Baseline Refrigerant and Lubricant	FVC68D (VG 68), PVE oil
Make and Model of System	LG electronics
Nominal Capacity and Type of System	3.5kW / Water to Water system

Comparison Data		Base.	Alt.	SI Units	Base.	Alt.	IP UNits	Ratio	
Mode (Heating/Cooling)		Cooling GLHP							
Compressor Type		Rotary	Rotary						
Compressor Displacement		0.0337	0.0337	m ³ /min					
Nominal Motor Size		-	-	hp					
Motor Speed		3300	3300	rpm					
Expansion Device Type		Electric Expansion Valve	Electric Expansion Valve						
Lubricant Charge		0.31	0.31	kg	0.68	0.68	lb		
Refrigerant Charge		0.9	0.9	kg	1.98	1.98	lb		
Refrigerant Mass Flow Rate		N/A	N/A	kg/min	N/A	N/A	lb/min		
Composition, at compr. inlet if applicable			-	% wt					
Ambient Temps.	Indoor	db	20.1	19.5	C	68.18	67.10	F	
		Wb	-	-	C	-	-	F	
	Outdoor	db	-	-	C	-	-	F	
		wb	-	-	C	-	-	F	
Total Capacity		3795	3965	W	12949	13529	Btu/hr	1.04	
Sensible Capacity		N/A	N/A	W	N/A	N/A	Btu/hr		
Total System Power Input		N/A	N/A	W	N/A	N/A	W		
Compressor Power Input		824	892	W	824	892	W	1.08	
Energy Efficiency Ratio (EER)		4.60	4.45	W/W	15.71	15.16	Btuh/W	0.96	
Coeff. Of Performance (COP)									

Other System Changes

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

Low-GWP AREP SYSTEM DROP-IN TEST DATA FORM

Type of System: Water-to-water heat pump Alternate Refrigerant: 100% R32
 (e.g., SSHP, window RAC, chiller, etc.) (and composition as charged, % weight, if not proprietary)

Water Side Data	Base.	Alt.	SI Units	Base.	Alt.	IP UNits	Ratio
Evaporator							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ /min	
Flow Rate (liquid)	11.02	11.02	L/min	2.65	2.65	gal/min	
Inlet Temperature	12.02	12.01	C	53.64	53.62	F	
Outlet Temperature	7.46	7.24	C	44.65	44.20	F	
Condenser							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ /min	
Flow Rate (liquid)	11.01	11.10	L/min	2.91	2.93	gal/min	
Inlet Temperature	25.05	25.01	C	77.09	77.02	F	
Outlet Temperature	30.22	30.47	C	86.40	86.85	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	10.14	868	12.24	1008	50.25	126	54.03	146
Compressor Discharge	67.34	2111	79.11	2563	153.21	306	174.40	372
Condenser Inlet	65.78	2108	78.22	2555	150.40	306	172.80	371
Condenser Outlet	25.95	-	25.22		78.71		77.40	
Expansion Device Inlet	25.84	-	25.19		78.51		77.34	
Subcooling, at expan. device	-		-					
Evaporator Inlet	6.73	-	7.84		44.11		46.11	
Evaporator Outlet	9.98	872	12.11	1011	49.96	126	53.80	147
Evaporator Superheat	3.52		1.87		6.34		3.37	

Data Source(s) for Refrigerant Properties

Additional Notes

Submitted by: _____

Low_GWP AREP SYSTEM DROP-IN TEST DATA FORM

Manufacturer: LG Electronics

Manufacturer's Notation: MKS

Basic Information	
Alternative Refrigerant (If not proprietary, composition as Charged, % wt)	100% R32
Alternative Lubricant Type and ISO Viscosity	RM68 (VG 68), POE oil
Baseline Refrigerant and Lubricant	FVC68D (VG 68), PVE oil
Make and Model of System	LG electronics
Nominal Capacity and Type of System	3.5kW / Water to Water system

Comparison Data		Base.	Alt.	SI Units	Base.	Alt.	IP UNits	Ratio	
Mode (Heating/Cooling)		Heating WLHP							
Compressor Type		Rotary	Rotary						
Compressor Displacement		0.0337	0.0337	m ³ /min					
Nominal Motor Size		-	-	hp					
Motor Speed		4200	4200	rpm					
Expansion Device Type		Electric Expansion Valve	Electric Expansion Valve						
Lubricant Charge		0.31	0.31	kg	0.68	0.68	lb		
Refrigerant Charge		0.9	0.9	kg	1.98	1.98	lb		
Refrigerant Mass Flow Rate		N/A	N/A	kg/min	N/A	N/A	lb/min		
Composition, at compr. inlet if applicable			-	% wt					
Ambient Temps.	Indoor	db	22.56	20.17	C	72.61	68.31	F	
		Wb	-	-	C	-	-	F	
	Outdoor	db	-	-	C	-	-	F	
		wb	-	-	C	-	-	F	
Total Capacity		4498	4961	W	15348	16928	Btu/hr	1.10	
Sensible Capacity		N/A	N/A	W	N/A	N/A	Btu/hr		
Total System Power Input		N/A	N/A	W	N/A	N/A	W		
Compressor Power Input		1074	1228	W	1074	1228	W	1.14	
Energy Efficiency Ratio (EER)		-	-	W/W	-	-	Btuh/W		
Coeff. Of Performance (COP)		4.19	4.04					0.96	

Other System Changes

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

Low-GWP AREP SYSTEM DROP-IN TEST DATA FORM

Type of System: Water-to-water heat pump Alternate Refrigerant: 100% R32
 (e.g., SSHP, window RAC, chiller, etc.) (and composition as charged, % weight, if not proprietary)

Water Side Data	Base.	Alt.	SI Units	Base.	Alt.	IP Units	Ratio
Evaporator							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ /min	
Flow Rate (liquid)	11.12	11.11	L/min	2.67	2.67	gal/min	
Inlet Temperature	20.01	19.98	C	68.02	67.96	F	
Outlet Temperature	15.24	15.10	C	59.43	59.18	F	
Condenser							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ /min	
Flow Rate (liquid)	11.01	11.64	L/min	2.91	3.07	gal/min	
Inlet Temperature	40.05	40.00	C	104.09	104.00	F	
Outlet Temperature	45.57	45.65	C	114.03	114.17	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	1052	16.22	1110	61.02	153	61.20	161
Compressor Discharge	75.22	2856	97.21	3250	167.40	414	206.98	471
Condenser Inlet	66.88	2855	90.36	3248	152.38	414	194.65	471
Condenser Outlet	44.12	-	42.11		111.42		109.60	
Expansion Device Inlet	44.10	-	41.97		111.38		109.35	
Subcooling, at expan. device	-		-					
Evaporator Inlet	9.25	-	14.22		48.65		57.60	
Evaporator Outlet	14.22	1053	15.01	1115	57.60	153	59.02	162
Evaporator Superheat	2.02		1.55		3.64		2.79	

Data Source(s) for Refrigerant Properties

Additional Notes

Submitted by: _____

Low_GWP AREP SYSTEM DROP-IN TEST DATA FORM

Manufacturer: LG Electronics

Manufacturer's Notation: MKS

Basic Information	
Alternative Refrigerant (If not proprietary, composition as Charged, % wt)	100% R32
Alternative Lubricant Type and ISO Viscosity	RM68 (VG 68), POE oil
Baseline Refrigerant and Lubricant	FVC68D (VG 68), PVE oil
Make and Model of System	LG electronics
Nominal Capacity and Type of System	3.5kW / Water to Water system

Comparison Data		Base.	Alt.	SI Units	Base.	Alt.	IP UNits	Ratio	
Mode (Heating/Cooling)		Heating							
Compressor Type		Rotary	Rotary						
Compressor Displacement		0.0337	0.0337	m ³ /min					
Nominal Motor Size		-	-	hp					
Motor Speed		4200	4200	rpm					
Expansion Device Type		Electric Expansion Valve	Electric Expansion Valve						
Lubricant Charge		0.31	0.31	kg	0.68	0.68	lb		
Refrigerant Charge		0.9	0.9	kg	1.98	1.98	lb		
Refrigerant Mass Flow Rate		N/A	N/A	kg/min	N/A	N/A	lb/min		
Composition, at compr. inlet if applicable			-	% wt					
Ambient Temps.	Indoor	db	21.12	22.54	C	70.02	72.57	F	
		Wb	-	-	C	-	-	F	
	Outdoor	db	-	-	C	-	-	F	
		wb	-	-	C	-	-	F	
Total Capacity		4088	4507	W	13949	15379	Btu/hr	1.10	
Sensible Capacity		N/A	N/A	W	N/A	N/A	Btu/hr		
Total System Power Input		N/A	N/A	W	N/A	N/A	W		
Compressor Power Input		1033	1162	W	1074	1228	W	1.12	
Energy Efficiency Ratio (EER)		-	-	W/W	-	-	Btuh/W		
Coeff. Of Performance (COP)		3.96	3.88					0.98	

Other System Changes

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

Low-GWP AREP SYSTEM DROP-IN TEST DATA FORM

Type of System: Water-to-water heat pump Alternate Refrigerant: 100% R32
 (e.g., SSHP, window RAC, chiller, etc.) (and composition as charged, % weight, if not proprietary)

Water Side Data	Base.	Alt.	SI Units	Base.	Alt.	IP UNits	Ratio
Evaporator							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ /min	
Flow Rate (liquid)	11.08	11.15	L/min	2.66	2.68	gal/min	
Inlet Temperature	10.05	10.13	C	50.09	50.23	F	
Outlet Temperature	6.44	6.29	C	43.59	43.32	F	
Condenser							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ /min	
Flow Rate (liquid)	11.11	11.44	L/min	2.93	3.02	gal/min	
Inlet Temperature	40.01	40.03	C	104.02	104.05	F	
Outlet Temperature	44.88	45.26	C	112.78	113.47	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	8.22	802	7.94	846	46.80	116	46.29	123
Compressor Discharge	71.87	2681	94.11	2911	161.37	389	201.40	422
Condenser Inlet	64.24	2678	87.63	2899	147.63	388	189.73	420
Condenser Outlet	43.06	-	41.97		109.51		107.55	
Expansion Device Inlet	43.01	-	41.91		109.42		107.44	
Subcooling, at expan. device	-		-					
Evaporator Inlet	4.85	-	3.61		40.73		38.50	
Evaporator Outlet	5.42	806	6.91	850	41.76	117	44.44	123
Evaporator Superheat	1.27		1.81		2.29		3.26	

Data Source(s) for Refrigerant Properties

Additional Notes

Submitted by: _____

Low_GWP AREP SYSTEM DROP-IN TEST DATA FORM

Manufacturer: LG Electronics

Manufacturer's Notation: MKS

Basic Information	
Alternative Refrigerant (If not proprietary, composition as Charged, % wt)	100% R32
Alternative Lubricant Type and ISO Viscosity	RM68 (VG 68), POE oil
Baseline Refrigerant and Lubricant	FVC68D (VG 68), PVE oil
Make and Model of System	LG electronics
Nominal Capacity and Type of System	3.5kW / Water to Water system

Comparison Data		Base.	Alt.	SI Units	Base.	Alt.	IP UNits	Ratio
Mode (Heating/Cooling)		Heating						
Compressor Type		GLHP						
Compressor Displacement		Rotary	Rotary					
Nominal Motor Size		0.0337	0.0337	m ³ /min				
Motor Speed		-	-	hp				
Expansion Device Type		4200	4200	rpm				
Lubricant Charge		Electric Expansion Valve	Electric Expansion Valve					
Refrigerant Charge		0.31	0.31	kg	0.68	0.68	lb	
Refrigerant Mass Flow Rate		0.9	0.9	kg	1.98	1.98	lb	
Composition, at compr. inlet if applicable		N/A	N/A	kg/min	N/A	N/A	lb/min	
Ambient Temps.			-	% wt				
Indoor	db	22.72	23.54	C	72.90	74.37	F	
		-	-	C	-	-	F	
	Wb	-	-	C	-	-	F	
		-	-	C	-	-	F	
Total Capacity		3066	3309	W	10462	11291	Btu/hr	1.08
Sensible Capacity		N/A	N/A	W	N/A	N/A	Btu/hr	
Total System Power Input		N/A	N/A	W	N/A	N/A	W	
Compressor Power Input		1002	1092	W	1002	1092	W	1.09
Energy Efficiency Ratio (EER)		-	-	W/W	-	-	Btuh/W	
Coeff. Of Performance (COP)		3.06	3.03					0.99

Other System Changes

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

Low-GWP AREP SYSTEM DROP-IN TEST DATA FORM

Type of System: Water-to-water heat pump Alternate Refrigerant: 100% R32
 (e.g., SSHP, window RAC, chiller, etc.) (and composition as charged, % weight, if not proprietary)

Water Side Data	Base.	Alt.	SI Units	Base.	Alt.	IP Units	Ratio
Evaporator							
Heat Exchange Fluid	50% of Ethanol	50% of Ethanol					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ /min	
Flow Rate (liquid)	11.18	11.16	L/min	2.93	2.95	gal/min	
Inlet Temperature	0.05	0.03	C	32.09	32.05	F	
Outlet Temperature	-4.23	-3.98	C	24.39	24.84	F	
Condenser							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ /min	
Flow Rate (liquid)	11.21	11.14	L/min	2.96	2.94	gal/min	
Inlet Temperature	40.06	40.13	C	104.11	104.23	F	
Outlet Temperature	43.71	44.12	C	110.68	111.42	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	-0.63	607	-1.22	640	30.87	88	29.80	93
Compressor Discharge	74.36	2701	99.29	2981	165.85	392	210.72	432
Condenser Inlet	67.82	2692	89.74	2974	154.08	390	193.53	431
Condenser Outlet	41.28	-	40.06		106.30		104.11	
Expansion Device Inlet	41.19	-	39.91		106.14		103.84	
Subcooling, at expan. device	-		-					
Evaporator Inlet	-3.56	-	0.25		25.59		32.45	
Evaporator Outlet	-3.12	609	-4.23	643	26.38	88	24.39	93
Evaporator Superheat	0.44		-1.47		0.79		-2.65	

Data Source(s) for Refrigerant Properties

Additional Notes

Submitted by: _____

Low_GWP AREP SYSTEM DROP-IN TEST DATA FORM

Manufacturer: LG Electronics

Manufacturer's Notation: MKS

Basic Information	
Alternative Refrigerant (If not proprietary, composition as Charged, % wt)	L41-1
Alternative Lubricant Type and ISO Viscosity	FVC68D (VG 68), PVE oil
Baseline Refrigerant and Lubricant	FVC68D (VG 68), PVE oil
Make and Model of System	LG electronics
Nominal Capacity and Type of System	3.5kW / Water to Water system

Comparison Data		Base.	Alt.	SI Units	Base.	Alt.	IP UNits	Ratio	
Mode (Heating/Cooling)		Cooling WLHP							
Compressor Type		Rotary	Rotary						
Compressor Displacement		0.0337	0.0337	m ³ /min					
Nominal Motor Size		-	-	hp					
Motor Speed		3300	3300	rpm					
Expansion Device Type		Electric Expansion Valve	Electric Expansion Valve						
Lubricant Charge		0.31	0.31	kg	0.68	0.68	lb		
Refrigerant Charge		0.9	0.9	kg	1.98	1.98	lb		
Refrigerant Mass Flow Rate		N/A	N/A	kg/min	N/A	N/A	lb/min		
Composition, at compr. inlet if applicable			-	% wt					
Ambient Temps.	Indoor	db	21.2	21.8	C	70.16	71.24	F	
		Wb	-	-	C	-	-	F	
	Outdoor	db	-	-	C	-	-	F	
		wb	-	-	C	-	-	F	
Total Capacity		3636	3545	W	12407	12096	Btu/hr	0.97	
Sensible Capacity		N/A	N/A	W	N/A	N/A	Btu/hr		
Total System Power Input		N/A	N/A	W	N/A	N/A	W		
Compressor Power Input		857	791	W	857	791	W	0.92	
Energy Efficiency Ratio (EER)		4.24	4.48	W/W	14.47	15.29	Btuh/W	1.05	
Coeff. Of Performance (COP)									

Other System Changes

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

Low-GWP AREP SYSTEM DROP-IN TEST DATA FORM

Type of System: Water-to-water heat pump Alternate Refrigerant: L41-1
 (e.g., SSHP, window RAC, chiller, etc.) (and composition as charged, % weight, if not proprietary)

Water Side Data	Base.	Alt.	SI Units	Base.	Alt.	IP UNits	Ratio
Evaporator							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ min	
Flow Rate (liquid)	11.01	11.09	L/min	2.64	2.93	gal/min	
Inlet Temperature	12.0	12.04	C	53.6	53.67	F	
Outlet Temperature	7.55	7.78	C	44.87	46.00	F	
Condenser							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ min	
Flow Rate (liquid)	11.21	11.12	L/min	2.96	2.94	gal/min	
Inlet Temperature	29.97	30.12	C	85.95	86.22	F	
Outlet Temperature	34.43	34.52	C	93.97	94.14	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	13.64	1003	13.98	951	56.55	145	57.16	138
Compressor Discharge	76.55	2916	77.25	2615	169.79	423	171.05	379
Condenser Inlet	72.45	2897	75.20	2612	162.41	420	167.36	379
Condenser Outlet	46.82	-	36.17		116.28		97.11	
Expansion Device Inlet	44.97	-	36.11		112.95		97.00	
Subcooling, at expan. device	-		-					
Evaporator Inlet	8.77	-	5.23		47.79		41.41	
Evaporator Outlet	11.23	1005	13.11	955	52.21	146	55.60	139
Evaporator Superheat	0.47		0.36		0.85		0.65	

Data Source(s) for Refrigerant Properties

Additional Notes

Submitted by: _____

Low_GWP AREP SYSTEM DROP-IN TEST DATA FORM

Manufacturer: LG Electronics

Manufacturer's Notation: MKS

Basic Information	
Alternative Refrigerant (If not proprietary, composition as Charged, % wt)	L41-1
Alternative Lubricant Type and ISO Viscosity	FVC68D (VG 68), PVE oil
Baseline Refrigerant and Lubricant	FVC68D (VG 68), PVE oil
Make and Model of System	LG electronics
Nominal Capacity and Type of System	3.5kW / Water to Water system

Comparison Data		Base.	Alt.	SI Units	Base.	Alt.	IP UNits	Ratio	
Mode (Heating/Cooling)		Cooling GWHP							
Compressor Type		Rotary	Rotary						
Compressor Displacement		0.0337	0.0337	m ³ /min					
Nominal Motor Size		-	-	hp					
Motor Speed		3300	3300	rpm					
Expansion Device Type		Electric Expansion Valve	Electric Expansion Valve						
Lubricant Charge		0.31	0.31	kg	0.68	0.68	lb		
Refrigerant Charge		0.9	0.9	kg	1.98	1.98	lb		
Refrigerant Mass Flow Rate		N/A	N/A	kg/min	N/A	N/A	lb/min		
Composition, at compr. inlet if applicable			-	% wt					
Ambient Temps.	Indoor	db	22.2	20.6	C	71.96	69.08	F	
		Wb	-	-	C	-	-	F	
	Outdoor	db	-	-	C	-	-	F	
		wb	-	-	C	-	-	F	
Total Capacity		4145	3989	W	14143	13611	Btu/hr	0.96	
Sensible Capacity		N/A	N/A	W	N/A	N/A	Btu/hr		
Total System Power Input		N/A	N/A	W	N/A	N/A	W		
Compressor Power Input		643	609	W	643	609	W	0.95	
Energy Efficiency Ratio (EER)		6.45	6.55	W/W	21.99	22.35	Btuh/W	1.02	
Coeff. Of Performance (COP)									

Other System Changes

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

Low-GWP AREP SYSTEM DROP-IN TEST DATA FORM

Type of System: Water-to-water heat pump Alternate Refrigerant: L41-1
 (e.g., SSHP, window RAC, chiller, etc.) (and composition as charged, % weight, if not proprietary)

Water Side Data	Base.	Alt.	SI Units	Base.	Alt.	IP UNits	Ratio
Evaporator							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ /min	
Flow Rate (liquid)	11.01	11.12	L/min	2.64	2.94	gal/min	
Inlet Temperature	12.0	11.95	C	53.60	53.51	F	
Outlet Temperature	7.02	7.21	C	43.75	44.98	F	
Condenser							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ /min	
Flow Rate (liquid)	11.21	10.94	L/min	2.96	2.89	gal/min	
Inlet Temperature	15.02	15.08	C	59.04	59.14	F	
Outlet Temperature	20.12	20.87	C	68.22	69.57	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	9.25	838	8.96	798	48.65	122	48.13	116
Compressor Discharge	50.12	1865	55.61	1762	122.22	270	132.10	256
Condenser Inlet	48.22	1859	53.21	1758	118.80	270	127.78	255
Condenser Outlet	15.75	-	15.45		60.35		59.81	
Expansion Device Inlet	15.64	-	15.40		60.15		59.72	
Subcooling, at expan. device	-		-					
Evaporator Inlet	5.63	-	4.29		42.13		39.72	
Evaporator Outlet	8.84	841	8.04	799	47.91	122	46.47	116
Evaporator Superheat	3.45		0.83		6.21		1.50	

Data Source(s) for Refrigerant Properties

Additional Notes

Submitted by: _____

Low_GWP AREP SYSTEM DROP-IN TEST DATA FORM

Manufacturer: LG Electronics

Manufacturer's Notation: MKS

Basic Information	
Alternative Refrigerant (If not proprietary, composition as Charged, % wt)	L41-1
Alternative Lubricant Type and ISO Viscosity	FVC68D (VG 68), PVE oil
Baseline Refrigerant and Lubricant	FVC68D (VG 68), PVE oil
Make and Model of System	LG electronics
Nominal Capacity and Type of System	3.5kW / Water to Water system

Comparison Data			Base.	Alt.	SI Units	Base.	Alt.	IP UNits	Ratio
Mode (Heating/Cooling)			Cooling GLHP						
Compressor Type			Rotary	Rotary					
Compressor Displacement			0.0337	0.0337	m ³ /min				
Nominal Motor Size			-	-	hp				
Motor Speed			3300	3300	rpm				
Expansion Device Type			Electric Expansion Valve	Electric Expansion Valve					
Lubricant Charge			0.31	0.31	kg	0.68	0.68	lb	
Refrigerant Charge			0.9	0.9	kg	1.98	1.98	lb	
Refrigerant Mass Flow Rate			N/A	N/A	kg/min	N/A	N/A	lb/min	
Composition, at compr. inlet if applicable				-	% wt				
Ambient Temps.	Indoor	db	20.1	21.2	C	68.18	70.16	F	
		Wb	-	-	C	-	-	F	
	Outdoor	db	-	-	C	-	-	F	
		wb	-	-	C	-	-	F	
Total Capacity			3795	3673	W	12949	13529	Btu/hr	0.97
Sensible Capacity			N/A	N/A	W	N/A	N/A	Btu/hr	
Total System Power Input			N/A	N/A	W	N/A	N/A	W	
Compressor Power Input			824	771	W	824	771	W	0.94
Energy Efficiency Ratio (EER)			4.60	4.77	W/W	15.71	17.55	Btuh/W	1.04
Coeff. Of Performance (COP)									

Other System Changes

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

Low-GWP AREP SYSTEM DROP-IN TEST DATA FORM

Type of System: Water-to-water heat pump Alternate Refrigerant: L41-1
 (e.g., SSHP, window RAC, chiller, etc.) (and composition as charged, % weight, if not proprietary)

Water Side Data	Base.	Alt.	SI Units	Base.	Alt.	IP UNits	Ratio
Evaporator							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ min	
Flow Rate (liquid)	11.02	11.12	L/min	2.65	2.94	gal/min	
Inlet Temperature	12.02	12.01	C	53.64	53.62	F	
Outlet Temperature	7.46	7.61	C	44.65	45.70	F	
Condenser							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ min	
Flow Rate (liquid)	11.01	11.03	L/min	2.91	2.91	gal/min	
Inlet Temperature	25.05	25.11	C	77.09	77.20	F	
Outlet Temperature	30.22	30.98	C	86.40	87.76	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	10.14	868	11.04	822	50.25	126	51.87	119
Compressor Discharge	67.34	2111	71.21	2011	153.21	306	160.18	292
Condenser Inlet	65.78	2108	69.54	2009	150.40	306	157.17	291
Condenser Outlet	25.95	-	25.65		78.71		78.17	
Expansion Device Inlet	25.84	-	25.61		78.51		78.10	
Subcooling, at expan. device	-		-					
Evaporator Inlet	6.73	-	6.22		44.11		43.20	
Evaporator Outlet	9.98	872	9.92	827	49.96	126	49.86	120
Evaporator Superheat	3.52		1.62		6.34		2.92	

Data Source(s) for Refrigerant Properties

Additional Notes

Submitted by: _____

Low_GWP AREP SYSTEM DROP-IN TEST DATA FORM

Manufacturer: LG Electronics

Manufacturer's Notation: MKS

Basic Information	
Alternative Refrigerant (If not proprietary, composition as Charged, % wt)	L41-1
Alternative Lubricant Type and ISO Viscosity	FVC68D (VG 68), PVE oil
Baseline Refrigerant and Lubricant	FVC68D (VG 68), PVE oil
Make and Model of System	LG electronics
Nominal Capacity and Type of System	3.5kW / Water to Water system

Comparison Data		Base.	Alt.	SI Units	Base.	Alt.	IP UNits	Ratio	
Mode (Heating/Cooling)		Heating WLHP							
Compressor Type		Rotary	Rotary						
Compressor Displacement		0.0337	0.0337	m ³ /min					
Nominal Motor Size		-	-	hp					
Motor Speed		4200	4200	rpm					
Expansion Device Type		Electric Expansion Valve	Electric Expansion Valve						
Lubricant Charge		0.31	0.31	kg	0.68	0.68	lb		
Refrigerant Charge		0.9	0.9	kg	1.98	1.98	lb		
Refrigerant Mass Flow Rate		N/A	N/A	kg/min	N/A	N/A	lb/min		
Composition, at compr. inlet if applicable			-	% wt					
Ambient Temps.	Indoor	db	22.56	22.17	C	72.61	71.91	F	
		Wb	-	-	C	-	-	F	
	Outdoor	db	-	-	C	-	-	F	
		wb	-	-	C	-	-	F	
Total Capacity		4498	3873	W	15348	16928	Btu/hr	0.86	
Sensible Capacity		N/A	N/A	W	N/A	N/A	Btu/hr		
Total System Power Input		N/A	N/A	W	N/A	N/A	W		
Compressor Power Input		1074	1013	W	1074	1013	W	0.94	
Energy Efficiency Ratio (EER)		-	-	W/W	-	-	Btuh/W		
Coeff. Of Performance (COP)		4.19	3.82					0.91	

Other System Changes	

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

Low-GWP AREP SYSTEM DROP-IN TEST DATA FORM

Type of System: Water-to-water heat pump Alternate Refrigerant: L41-1
 (e.g., SSHP, window RAC, chiller, etc.) (and composition as charged, % weight, if not proprietary)

Water Side Data	Base.	Alt.	SI Units	Base.	Alt.	IP Units	Ratio
Evaporator							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ /min	
Flow Rate (liquid)	11.12	11.01	L/min	2.67	2.91	gal/min	
Inlet Temperature	20.01	20.04	C	68.02	68.07	F	
Outlet Temperature	15.24	15.41	C	59.43	59.74	F	
Condenser							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ /min	
Flow Rate (liquid)	11.01	11.04	L/min	2.91	2.92	gal/min	
Inlet Temperature	40.05	40.01	C	104.09	104.02	F	
Outlet Temperature	45.57	44.68	C	114.03	112.42	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	1052	10.23	845	61.02	153	50.41	123
Compressor Discharge	75.22	2856	77.25	2453	167.40	414	171.05	356
Condenser Inlet	66.88	2855	71.25	2448	152.38	414	160.25	355
Condenser Outlet	44.12	-	40.95		111.42		105.71	
Expansion Device Inlet	44.10	-	40.91		111.38		105.64	
Subcooling, at expan. device	-		-					
Evaporator Inlet	9.25	-	8.12		48.65		46.62	
Evaporator Outlet	14.22	1053	9.64	849	57.60	153	49.35	123
Evaporator Superheat	2.02		0.63		3.64		1.13	

Data Source(s) for Refrigerant Properties

Additional Notes

Submitted by: _____

Low_GWP AREP SYSTEM DROP-IN TEST DATA FORM

Manufacturer: LG Electronics

Manufacturer's Notation: MKS

Basic Information	
Alternative Refrigerant (If not proprietary, composition as Charged, % wt)	L41-1
Alternative Lubricant Type and ISO Viscosity	FVC68D (VG 68), PVE oil
Baseline Refrigerant and Lubricant	FVC68D (VG 68), PVE oil
Make and Model of System	LG electronics
Nominal Capacity and Type of System	3.5kW / Water to Water system

Comparison Data			Base.	Alt.	SI Units	Base.	Alt.	IP UNits	Ratio
Mode (Heating/Cooling)			Heating						
Compressor Type			Rotary	Rotary					
Compressor Displacement			0.0337	0.0337	m ³ /min				
Nominal Motor Size			-	-	hp				
Motor Speed			4200	4200	rpm				
Expansion Device Type			Electric Expansion Valve	Electric Expansion Valve					
Lubricant Charge			0.31	0.31	kg	0.68	0.68	lb	
Refrigerant Charge			0.9	0.9	kg	1.98	1.98	lb	
Refrigerant Mass Flow Rate			N/A	N/A	kg/min	N/A	N/A	lb/min	
Composition, at compr. inlet if applicable				-	% wt				
Ambient Temps.	Indoor	db	21.12	21.61	C	70.02	70.90	F	
		Wb	-	-	C	-	-	F	
	Outdoor	db	-	-	C	-	-	F	
		wb	-	-	C	-	-	F	
Total Capacity			4088	3458	W	13949	15379	Btu/hr	0.85
Sensible Capacity			N/A	N/A	W	N/A	N/A	Btu/hr	
Total System Power Input			N/A	N/A	W	N/A	N/A	W	
Compressor Power Input			1033	940	W	1033	940	W	0.91
Energy Efficiency Ratio (EER)			-	-	W/W	-	-	Btuh/W	
Coeff. Of Performance (COP)			3.96	3.68					0.93

Other System Changes

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

Low-GWP AREP SYSTEM DROP-IN TEST DATA FORM

Type of System: Water-to-water heat pump Alternate Refrigerant: L41-1
 (e.g., SSHP, window RAC, chiller, etc.) (and composition as charged, % weight, if not proprietary)

Water Side Data	Base.	Alt.	SI Units	Base.	Alt.	IP UNits	Ratio
Evaporator							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ min	
Flow Rate (liquid)	11.08	11.16	L/min	2.66	2.95	gal/min	
Inlet Temperature	10.05	10.11	C	50.09	50.20	F	
Outlet Temperature	6.44	6.88	C	43.59	44.38	F	
Condenser							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ min	
Flow Rate (liquid)	11.11	11.21	L/min	2.93	2.96	gal/min	
Inlet Temperature	40.01	39.92	C	104.02	103.86	F	
Outlet Temperature	44.88	44.01	C	112.78	111.22	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	8.22	802	6.12	712	46.80	116	43.02	103
Compressor Discharge	71.87	2681	76.05	2315	161.37	389	168.89	408
Condenser Inlet	64.24	2678	73.58	2311	147.63	388	164.44	408
Condenser Outlet	43.06	-	40.25		109.51		104.45	
Expansion Device Inlet	43.01	-	40.21		109.42		104.38	
Subcooling, at expan. device	-		-					
Evaporator Inlet	4.85	-	6.21		40.73		43.18	
Evaporator Outlet	5.42	806	5.88	715	41.76	117	42.58	104
Evaporator Superheat	1.27		1.72		2.29		3.10	

Data Source(s) for Refrigerant Properties

Additional Notes

Submitted by: _____

Low_GWP AREP SYSTEM DROP-IN TEST DATA FORM

Manufacturer: LG Electronics Manufacturer's Notation: MKS

Basic Information	
Alternative Refrigerant (If not proprietary, composition as Charged, % wt)	L41-1
Alternative Lubricant Type and ISO Viscosity	FVC68D (VG 68), PVE oil
Baseline Refrigerant and Lubricant	FVC68D (VG 68), PVE oil
Make and Model of System	LG electronics
Nominal Capacity and Type of System	3.5kW / Water to Water system

Comparison Data		Base.	Alt.	SI Units	Base.	Alt.	IP UNits	Ratio	
Mode (Heating/Cooling)		Heating							
		GLHP							
Compressor Type		Rotary	Rotary						
Compressor Displacement		0.0337	0.0337	m ³ /min					
Nominal Motor Size		-	-	hp					
Motor Speed		4200	4200	rpm					
Expansion Device Type		Electric Expansion Valve	Electric Expansion Valve						
Lubricant Charge		0.31	0.31	kg	0.68	0.68	lb		
Refrigerant Charge		0.9	0.9	kg	1.98	1.98	lb		
Refrigerant Mass Flow Rate		N/A	N/A	kg/min	N/A	N/A	lb/min		
Composition, at compr. inlet if applicable			-	% wt					
Ambient Temps.	Indoor	db	22.72	21.12	C	72.90	70.02	F	
		Wb	-	-	C	-	-	F	
	Outdoor	db	-	-	C	-	-	F	
		wb	-	-	C	-	-	F	
Total Capacity		3066	2698	W	10462	9206	Btu/hr	0.88	
Sensible Capacity		N/A	N/A	W	N/A	N/A	Btu/hr		
Total System Power Input		N/A	N/A	W	N/A	N/A	W		
Compressor Power Input		1002	883	W	1002	883	W	0.88	
Energy Efficiency Ratio (EER)		-	-	W/W	-	-	Btuh/W		
Coeff. Of Performance (COP)		3.06	3.06					1.00	

Other System Changes

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

Low-GWP AREP SYSTEM DROP-IN TEST DATA FORM

Type of System: Water-to-water heat pump Alternate Refrigerant: L41-1
 (e.g., SSHP, window RAC, chiller, etc.) (and composition as charged, % weight, if not proprietary)

Water Side Data	Base.	Alt.	SI Units	Base.	Alt.	IP Units	Ratio
Evaporator							
Heat Exchange Fluid	50% of Ethanol	50% of Ethanol					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ /min	
Flow Rate (liquid)	11.18	11.16	L/min	2.93	2.95	gal/min	
Inlet Temperature	0.05	0.01	C	32.09	32.02	F	
Outlet Temperature	-4.23	-3.12	C	24.39	26.38	F	
Condenser							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ /min	
Flow Rate (liquid)	11.21	11.04	L/min	2.96	2.92	gal/min	
Inlet Temperature	40.06	40.05	C	104.11	104.09	F	
Outlet Temperature	43.71	43.29	C	110.68	109.92	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	-0.63	607	-3.05	541	30.87	88	26.51	78
Compressor Discharge	74.36	2701	88.21	2455	165.85	392	190.78	356
Condenser Inlet	67.82	2692	80.64	2449	154.08	390	177.15	355
Condenser Outlet	41.28	-	40.08		106.30		104.14	
Expansion Device Inlet	41.19	-	40.06		106.14		104.11	
Subcooling, at expan. device	-		-					
Evaporator Inlet	-3.56	-	-1.25		25.59		29.75	
Evaporator Outlet	-3.12	609	-5.61	548	26.38	88	21.90	79
Evaporator Superheat	0.44		-2.45		0.79		-4.41	

Data Source(s) for Refrigerant Properties

Additional Notes

Submitted by: _____

Low_GWP AREP SYSTEM DROP-IN TEST DATA FORM

Manufacturer: LG Electronics

Manufacturer's Notation: MKS

Basic Information	
Alternative Refrigerant (If not proprietary, composition as Charged, % wt)	L41-2
Alternative Lubricant Type and ISO Viscosity	FVC68D (VG 68), PVE oil
Baseline Refrigerant and Lubricant	FVC68D (VG 68), PVE oil
Make and Model of System	LG electronics
Nominal Capacity and Type of System	3.5kW / Water to Water system

Comparison Data		Base.	Alt.	SI Units	Base.	Alt.	IP UNits	Ratio	
Mode (Heating/Cooling)		Cooling WLHP							
Compressor Type		Rotary	Rotary						
Compressor Displacement		0.0337	0.0337	m ³ /min					
Nominal Motor Size		-	-	hp					
Motor Speed		3300	3300	rpm					
Expansion Device Type		Electric Expansion Valve	Electric Expansion Valve						
Lubricant Charge		0.31	0.31	kg	0.68	0.68	lb		
Refrigerant Charge		0.9	0.9	kg	1.98	1.98	lb		
Refrigerant Mass Flow Rate		N/A	N/A	kg/min	N/A	N/A	lb/min		
Composition, at compr. inlet if applicable			-	% wt					
Ambient Temps.	Indoor	db	21.2	22.8	C	70.16	73.04	F	
		Wb	-	-	C	-	-	F	
	Outdoor	db	-	-	C	-	-	F	
		wb	-	-	C	-	-	F	
Total Capacity		3636	3527	W	12407	12035	Btu/hr	0.97	
Sensible Capacity		N/A	N/A	W	N/A	N/A	Btu/hr		
Total System Power Input		N/A	N/A	W	N/A	N/A	W		
Compressor Power Input		857	803	W	857	803	W	0.94	
Energy Efficiency Ratio (EER)		4.24	4.39	W/W	14.47	14.99	Btuh/W	1.04	
Coeff. Of Performance (COP)									

Other System Changes

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

Low-GWP AREP SYSTEM DROP-IN TEST DATA FORM

Type of System: Water-to-water heat pump Alternate Refrigerant: L41-2
 (e.g., SSHP, window RAC, chiller, etc.) (and composition as charged, % weight, if not proprietary)

Water Side Data	Base.	Alt.	SI Units	Base.	Alt.	IP UNits	Ratio
Evaporator							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ /min	
Flow Rate (liquid)	11.01	11.02	L/min	2.64	2.91	gal/min	
Inlet Temperature	12.0	11.98	C	53.6	53.56	F	
Outlet Temperature	7.55	7.70	C	44.87	45.86	F	
Condenser							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ /min	
Flow Rate (liquid)	11.21	11.11	L/min	2.96	2.93	gal/min	
Inlet Temperature	29.97	30.02	C	85.95	86.04	F	
Outlet Temperature	34.43	34.62	C	93.97	94.32	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	13.64	1003	13.81	943	56.55	145	56.86	137
Compressor Discharge	76.55	2916	78.69	2698	169.79	423	173.64	391
Condenser Inlet	72.45	2897	76.11	2692	162.41	420	169.00	390
Condenser Outlet	46.82	-	36.24		116.28		97.23	
Expansion Device Inlet	44.97	-	36.19		112.95		97.14	
Subcooling, at expan. device	-		-					
Evaporator Inlet	8.77	-	5.89		47.79		42.60	
Evaporator Outlet	11.23	1005	12.98	948	52.21	146	55.36	137
Evaporator Superheat	0.47		0.69		0.85		1.23	

Data Source(s) for Refrigerant Properties

Additional Notes

Submitted by: _____

Low_GWP AREP SYSTEM DROP-IN TEST DATA FORM

Manufacturer: LG Electronics

Manufacturer's Notation: MKS

Basic Information	
Alternative Refrigerant (If not proprietary, composition as Charged, % wt)	L41-2
Alternative Lubricant Type and ISO Viscosity	FVC68D (VG 68), PVE oil
Baseline Refrigerant and Lubricant	FVC68D (VG 68), PVE oil
Make and Model of System	LG electronics
Nominal Capacity and Type of System	3.5kW / Water to Water system

Comparison Data			Base.	Alt.	SI Units	Base.	Alt.	IP UNits	Ratio
Mode (Heating/Cooling)			Cooling GWHP						
Compressor Type			Rotary	Rotary					
Compressor Displacement			0.0337	0.0337	m ³ /min				
Nominal Motor Size			-	-	hp				
Motor Speed			3300	3300	rpm				
Expansion Device Type			Electric Expansion Valve	Electric Expansion Valve					
Lubricant Charge			0.31	0.31	kg	0.68	0.68	lb	
Refrigerant Charge			0.9	0.9	kg	1.98	1.98	lb	
Refrigerant Mass Flow Rate			N/A	N/A	kg/min	N/A	N/A	lb/min	
Composition, at compr. inlet if applicable				-	% wt				
Ambient Temps.	Indoor	db	22.2	22.5	C	71.96	72.50	F	
		Wb	-	-	C	-	-	F	
	Outdoor	db	-	-	C	-	-	F	
		wb	-	-	C	-	-	F	
Total Capacity			4145	4000	W	14143	13649	Btu/hr	0.97
Sensible Capacity			N/A	N/A	W	N/A	N/A	Btu/hr	
Total System Power Input			N/A	N/A	W	N/A	N/A	W	
Compressor Power Input			643	616	W	643	616	W	0.96
Energy Efficiency Ratio (EER)			6.45	6.50	W/W	21.99	22.16	Btuh/W	1.01
Coeff. Of Performance (COP)									

Other System Changes

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

Low-GWP AREP SYSTEM DROP-IN TEST DATA FORM

Type of System: Water-to-water heat pump Alternate Refrigerant: L41-2
 (e.g., SSHP, window RAC, chiller, etc.) (and composition as charged, % weight, if not proprietary)

Water Side Data	Base.	Alt.	SI Units	Base.	Alt.	IP UNits	Ratio
Evaporator							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ min	
Flow Rate (liquid)	11.01	11.08	L/min	2.64	2.93	gal/min	
Inlet Temperature	12.0	12.05	C	53.60	53.69	F	
Outlet Temperature	7.02	7.25	C	43.75	45.05	F	
Condenser							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ min	
Flow Rate (liquid)	11.21	11.05	L/min	2.96	2.92	gal/min	
Inlet Temperature	15.02	15.01	C	59.04	59.02	F	
Outlet Temperature	20.12	20.91	C	68.22	69.64	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	9.25	838	8.96	772	48.65	122	48.13	112
Compressor Discharge	50.12	1865	56.21	1801	122.22	270	133.18	261
Condenser Inlet	48.22	1859	53.88	1792	118.80	270	128.98	260
Condenser Outlet	15.75	-	15.38		60.35		59.68	
Expansion Device Inlet	15.64	-	15.32		60.15		59.58	
Subcooling, at expan. device	-		-					
Evaporator Inlet	5.63	-	5.11		42.13		41.20	
Evaporator Outlet	8.84	841	7.75	778	47.91	122	45.95	113
Evaporator Superheat	3.45		1.39		6.21		2.51	

Data Source(s) for Refrigerant Properties

Additional Notes

Submitted by: _____

Low_GWP AREP SYSTEM DROP-IN TEST DATA FORM

Manufacturer: LG Electronics

Manufacturer's Notation: MKS

Basic Information	
Alternative Refrigerant (If not proprietary, composition as Charged, % wt)	L41-2
Alternative Lubricant Type and ISO Viscosity	FVC68D (VG 68), PVE oil
Baseline Refrigerant and Lubricant	FVC68D (VG 68), PVE oil
Make and Model of System	LG electronics
Nominal Capacity and Type of System	3.5kW / Water to Water system

Comparison Data			Base.	Alt.	SI Units	Base.	Alt.	IP UNits	Ratio
Mode (Heating/Cooling)			Cooling GLHP						
Compressor Type			Rotary	Rotary					
Compressor Displacement			0.0337	0.0337	m ³ /min				
Nominal Motor Size			-	-	hp				
Motor Speed			3300	3300	rpm				
Expansion Device Type			Electric Expansion Valve	Electric Expansion Valve					
Lubricant Charge			0.31	0.31	kg	0.68	0.68	lb	
Refrigerant Charge			0.9	0.9	kg	1.98	1.98	lb	
Refrigerant Mass Flow Rate			N/A	N/A	kg/min	N/A	N/A	lb/min	
Composition, at compr. inlet if applicable				-	% wt				
Ambient Temps.	Indoor	db	20.1	21.8	C	68.18	71.24	F	
		Wb	-	-	C	-	-	F	
	Outdoor	db	-	-	C	-	-	F	
		wb	-	-	C	-	-	F	
Total Capacity			3795	3719	W	12949	12690	Btu/hr	0.98
Sensible Capacity			N/A	N/A	W	N/A	N/A	Btu/hr	
Total System Power Input			N/A	N/A	W	N/A	N/A	W	
Compressor Power Input			824	792	W	824	792	W	0.96
Energy Efficiency Ratio (EER)			4.60	4.69	W/W	15.71	16.02	Btuh/W	1.02
Coeff. Of Performance (COP)									

Other System Changes

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

Low-GWP AREP SYSTEM DROP-IN TEST DATA FORM

Type of System: Water-to-water heat pump Alternate Refrigerant: L41-2
 (e.g., SSHP, window RAC, chiller, etc.) (and composition as charged, % weight, if not proprietary)

Water Side Data	Base.	Alt.	SI Units	Base.	Alt.	IP UNits	Ratio
Evaporator							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ /min	
Flow Rate (liquid)	11.02	11.05	L/min	2.65	2.92	gal/min	
Inlet Temperature	12.02	12.08	C	53.64	53.74	F	
Outlet Temperature	7.46	7.59	C	44.65	45.66	F	
Condenser							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ /min	
Flow Rate (liquid)	11.01	11.05	L/min	2.91	2.92	gal/min	
Inlet Temperature	25.05	25.01	C	77.09	77.02	F	
Outlet Temperature	30.22	30.93	C	86.40	87.67	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	10.14	868	10.11	813	50.25	126	50.20	118
Compressor Discharge	67.34	2111	72.89	2045	153.21	306	163.20	297
Condenser Inlet	65.78	2108	69.12	2041	150.40	306	156.42	296
Condenser Outlet	25.95	-	25.25		78.71		77.45	
Expansion Device Inlet	25.84	-	25.22		78.51		77.40	
Subcooling, at expan. device	-		-					
Evaporator Inlet	6.73	-	5.84		44.11		42.51	
Evaporator Outlet	9.98	872	8.11	819	49.96	126	46.60	119
Evaporator Superheat	3.52		0.28		6.34		0.51	

Data Source(s) for Refrigerant Properties

Additional Notes

Submitted by: _____

Low_GWP AREP SYSTEM DROP-IN TEST DATA FORM

Manufacturer: LG Electronics

Manufacturer's Notation: MKS

Basic Information	
Alternative Refrigerant (If not proprietary, composition as Charged, % wt)	L41-2
Alternative Lubricant Type and ISO Viscosity	FVC68D (VG 68), PVE oil
Baseline Refrigerant and Lubricant	FVC68D (VG 68), PVE oil
Make and Model of System	LG electronics
Nominal Capacity and Type of System	3.5kW / Water to Water system

Comparison Data			Base.	Alt.	SI Units	Base.	Alt.	IP UNits	Ratio
Mode (Heating/Cooling)			Heating WLHP						
Compressor Type			Rotary	Rotary					
Compressor Displacement			0.0337	0.0337	m ³ /min				
Nominal Motor Size			-	-	hp				
Motor Speed			4200	4200	rpm				
Expansion Device Type			Electric Expansion Valve	Electric Expansion Valve					
Lubricant Charge			0.31	0.31	kg	0.68	0.68	lb	
Refrigerant Charge			0.9	0.9	kg	1.98	1.98	lb	
Refrigerant Mass Flow Rate			N/A	N/A	kg/min	N/A	N/A	lb/min	
Composition, at compr. inlet if applicable				-	% wt				
Ambient Temps.	Indoor	db	22.56	22.02	C	72.61	71.64	F	
		Wb	-	-	C	-	-	F	
	Outdoor	db	-	-	C	-	-	F	
		wb	-	-	C	-	-	F	
Total Capacity			4498	3828	W	15348	13062	Btu/hr	0.85
Sensible Capacity			N/A	N/A	W	N/A	N/A	Btu/hr	
Total System Power Input			N/A	N/A	W	N/A	N/A	W	
Compressor Power Input			1074	1011	W	1074	1011	W	0.94
Energy Efficiency Ratio (EER)			-	-	W/W	-	-	Btuh/W	
Coeff. Of Performance (COP)			4.19	3.79					0.90

Other System Changes	

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

Low-GWP AREP SYSTEM DROP-IN TEST DATA FORM

Type of System: Water-to-water heat pump Alternate Refrigerant: L41-2
 (e.g., SSHP, window RAC, chiller, etc.) (and composition as charged, % weight, if not proprietary)

Water Side Data	Base.	Alt.	SI Units	Base.	Alt.	IP UNits	Ratio
Evaporator							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ min	
Flow Rate (liquid)	11.12	11.05	L/min	2.67	2.92	gal/min	
Inlet Temperature	20.01	20.12	C	68.02	68.22	F	
Outlet Temperature	15.24	15.51	C	59.43	59.92	F	
Condenser							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ min	
Flow Rate (liquid)	11.01	11.08	L/min	2.91	2.93	gal/min	
Inlet Temperature	40.05	40.06	C	104.09	104.11	F	
Outlet Temperature	45.57	44.67	C	114.03	112.41	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	1052	10.23	832	61.02	153	50.41	121
Compressor Discharge	75.22	2856	77.69	2441	167.40	414	171.84	354
Condenser Inlet	66.88	2855	71.11	2436	152.38	414	160.00	353
Condenser Outlet	44.12	-	40.24		111.42		104.43	
Expansion Device Inlet	44.10	-	40.19		111.38		104.34	
Subcooling, at expan. device	-		-					
Evaporator Inlet	9.25	-	8.12		48.65		46.62	
Evaporator Outlet	14.22	1053	9.56	836	57.60	153	49.21	121
Evaporator Superheat	2.02		1.02		3.64		1.83	

Data Source(s) for Refrigerant Properties

Additional Notes

Submitted by: _____

Low-GWP AREP SYSTEM DROP-IN TEST DATA FORM

Type of System: Water-to-water heat pump Alternate Refrigerant: L41-2
 (e.g., SSHP, window RAC, chiller, etc.) (and composition as charged, % weight, if not proprietary)

Water Side Data	Base.	Alt.	SI Units	Base.	Alt.	IP UNits	Ratio
Evaporator							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ min	
Flow Rate (liquid)	11.08	11.01	L/min	2.66	2.91	gal/min	
Inlet Temperature	10.05	10.13	C	50.09	50.23	F	
Outlet Temperature	6.44	6.98	C	43.59	44.56	F	
Condenser							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ min	
Flow Rate (liquid)	11.11	11.05	L/min	2.93	2.92	gal/min	
Inlet Temperature	40.01	40.08	C	104.02	104.14	F	
Outlet Temperature	44.88	44.03	C	112.78	111.25	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	8.22	802	6.39	701	46.80	116	43.50	102
Compressor Discharge	71.87	2681	75.98	2287	161.37	389	168.76	332
Condenser Inlet	64.24	2678	73.12	2281	147.63	388	163.62	331
Condenser Outlet	43.06	-	40.11		109.51		104.20	
Expansion Device Inlet	43.01	-	40.09		109.42		104.16	
Subcooling, at expan. device	-		-					
Evaporator Inlet	4.85	-	6.56		40.73		43.81	
Evaporator Outlet	5.42	806	5.12	706	41.76	117	41.22	102
Evaporator Superheat	1.27		1.46		2.29		2.63	

Data Source(s) for Refrigerant Properties

Additional Notes

Submitted by: _____

Low_GWP AREP SYSTEM DROP-IN TEST DATA FORM

Manufacturer: LG Electronics

Manufacturer's Notation: MKS

Basic Information	
Alternative Refrigerant (If not proprietary, composition as Charged, % wt)	L41-2
Alternative Lubricant Type and ISO Viscosity	FVC68D (VG 68), PVE oil
Baseline Refrigerant and Lubricant	FVC68D (VG 68), PVE oil
Make and Model of System	LG electronics
Nominal Capacity and Type of System	3.5kW / Water to Water system

Comparison Data		Base.	Alt.	SI Units	Base.	Alt.	IP UNits	Ratio	
Mode (Heating/Cooling)		Heating							
		GLHP							
Compressor Type		Rotary	Rotary						
Compressor Displacement		0.0337	0.0337	m ³ /min					
Nominal Motor Size		-	-	hp					
Motor Speed		4200	4200	rpm					
Expansion Device Type		Electric Expansion Valve	Electric Expansion Valve						
Lubricant Charge		0.31	0.31	kg	0.68	0.68	lb		
Refrigerant Charge		0.9	0.9	kg	1.98	1.98	lb		
Refrigerant Mass Flow Rate		N/A	N/A	kg/min	N/A	N/A	lb/min		
Composition, at compr. inlet if applicable			-	% wt					
Ambient Temps.	Indoor	db	22.72	23.21	C	72.90	73.78	F	
		Wb	-	-	C	-	-	F	
	Outdoor	db	-	-	C	-	-	F	
		wb	-	-	C	-	-	F	
Total Capacity		3066	2713	W	10462	9257	Btu/hr	0.88	
Sensible Capacity		N/A	N/A	W	N/A	N/A	Btu/hr		
Total System Power Input		N/A	N/A	W	N/A	N/A	W		
Compressor Power Input		1002	881	W	1002	881	W	0.88	
Energy Efficiency Ratio (EER)		-	-	W/W	-	-	Btuh/W		
Coeff. Of Performance (COP)		3.06	3.08					1.01	

Other System Changes

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

Low-GWP AREP SYSTEM DROP-IN TEST DATA FORM

Type of System: Water-to-water heat pump Alternate Refrigerant: L41-2
 (e.g., SSHP, window RAC, chiller, etc.) (and composition as charged, % weight, if not proprietary)

Water Side Data	Base.	Alt.	SI Units	Base.	Alt.	IP Units	Ratio
Evaporator							
Heat Exchange Fluid	50% of Ethanol	50% of Ethanol					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ /min	
Flow Rate (liquid)	11.18	11.10	L/min	2.93	2.93	gal/min	
Inlet Temperature	0.05	0.04	C	32.09	32.07	F	
Outlet Temperature	-4.23	-3.02	C	24.39	26.56	F	
Condenser							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ /min	
Flow Rate (liquid)	11.21	11.02	L/min	2.96	2.91	gal/min	
Inlet Temperature	40.06	40.12	C	104.11	104.22	F	
Outlet Temperature	43.71	43.42	C	110.68	110.16	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	-0.63	607	-3.26	530	30.87	88	26.13	77
Compressor Discharge	74.36	2701	88.86	2412	165.85	392	191.95	350
Condenser Inlet	67.82	2692	80.75	2404	154.08	390	177.35	349
Condenser Outlet	41.28	-	40.19		106.30		104.34	
Expansion Device Inlet	41.19	-	40.16		106.14		104.29	
Subcooling, at expan. device	-		-					
Evaporator Inlet	-3.56	-	-1.86		25.59		28.65	
Evaporator Outlet	-3.12	609	-5.12	532	26.38	88	22.78	77
Evaporator Superheat	0.44		-0.93		0.79		-1.68	

Data Source(s) for Refrigerant Properties

Additional Notes

Submitted by: _____

Capacity Matching Test Data Sheet

Low_GWP AREP SYSTEM DROP-IN TEST DATA FORM

Manufacturer: LG Electronics

Manufacturer's Notation: MKS

Basic Information	
Alternative Refrigerant (If not proprietary, composition as Charged, % wt)	100% R32
Alternative Lubricant Type and ISO Viscosity	RM68 (VG 68), POE oil
Baseline Refrigerant and Lubricant	FVC68D (VG 68), PVE oil
Make and Model of System	LG electronics
Nominal Capacity and Type of System	3.5kW / Water to Water system

Comparison Data		Base.	Alt.	SI Units	Base.	Alt.	IP UNits	Ratio	
Mode (Heating/Cooling)		Cooling Matching 3.5kW							
Compressor Type		Rotary	Rotary						
Compressor Displacement		0.0337	0.0337	m ³ /min					
Nominal Motor Size		-	-	hp					
Motor Speed		3300	3120	rpm					
Expansion Device Type		Electric Expansion Valve	Electric Expansion Valve						
Lubricant Charge		0.31	0.31	kg	0.68	0.68	lb		
Refrigerant Charge		0.9	0.7	kg	1.98	1.98	lb		
Refrigerant Mass Flow Rate		N/A	N/A	kg/min	N/A	N/A	lb/min		
Composition, at compr. inlet if applicable			-	% wt					
Ambient Temps.	Indoor	db	21.2	21.1	C	70.16	69.98	F	
		Wb	-	-	C	-	-	F	
	Outdoor	db	-	-	C	-	-	F	
		wb	-	-	C	-	-	F	
Total Capacity		3636	3598	W	12407	12277	Btu/hr	0.99	
Sensible Capacity		N/A	N/A	W	N/A	N/A	Btu/hr		
Total System Power Input		N/A	N/A	W	N/A	N/A	W		
Compressor Power Input		857	849	W	857	849	W	0.99	
Energy Efficiency Ratio (EER)		4.24	4.24	W/W	14.47	14.46	Btuh/W	1.00	
Coeff. Of Performance (COP)									

Other System Changes

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

Low-GWP AREP SYSTEM DROP-IN TEST DATA FORM

Type of System: Water-to-water heat pump Alternate Refrigerant: 100% R32
 (e.g., SSHP, window RAC, chiller, etc.) (and composition as charged, % weight, if not proprietary)

Water Side Data	Base.	Alt.	SI Units	Base.	Alt.	IP Units	Ratio
Evaporator							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ /min	
Flow Rate (liquid)	11.01	11.05	L/min	2.64	2.92	gal/min	
Inlet Temperature	12.0	12.01	C	53.6	53.62	F	
Outlet Temperature	7.55	7.68	C	44.87	45.82	F	
Condenser							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ /min	
Flow Rate (liquid)	11.21	11.20	L/min	2.96	2.96	gal/min	
Inlet Temperature	29.97	30.02	C	85.95	86.04	F	
Outlet Temperature	34.43	34.50	C	93.97	94.10	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	13.64	1003	13.58	1014	56.55	145	56.44	147
Compressor Discharge	76.55	2916	86.25	2884	169.79	423	187.25	418
Condenser Inlet	72.45	2897	82.12	2875	162.41	420	179.82	417
Condenser Outlet	46.82	-	38.24		116.28		100.83	
Expansion Device Inlet	44.97	-	37.11		112.95		98.80	
Subcooling, at expan. device	-		-					
Evaporator Inlet	8.77	-	9.12		47.79		48.42	
Evaporator Outlet	11.23	1005	12.25	1017	52.21	146	54.05	148
Evaporator Superheat	0.47		1.70		0.85		3.06	

Data Source(s) for Refrigerant Properties

Additional Notes

Submitted by: _____

Low_GWP AREP SYSTEM DROP-IN TEST DATA FORM

Manufacturer: LG Electronics

Manufacturer's Notation: MKS

Basic Information	
Alternative Refrigerant (If not proprietary, composition as Charged, % wt)	L41-1
Alternative Lubricant Type and ISO Viscosity	FVC68D (VG 68), PVE oil
Baseline Refrigerant and Lubricant	FVC68D (VG 68), PVE oil
Make and Model of System	LG electronics
Nominal Capacity and Type of System	3.5kW / Water to Water system

Comparison Data			Base.	Alt.	SI Units	Base.	Alt.	IP UNits	Ratio
Mode (Heating/Cooling)			Cooling Matching 3.5kW						
Compressor Type			Rotary	Rotary					
Compressor Displacement			0.0337	0.0337	m ³ /min				
Nominal Motor Size			-	-	hp				
Motor Speed			3300	3300	rpm				
Expansion Device Type			Electric Expansion Valve	Electric Expansion Valve					
Lubricant Charge			0.31	0.31	kg	0.68	0.68	lb	
Refrigerant Charge			0.9	0.8	kg	1.98	1.98	lb	
Refrigerant Mass Flow Rate			N/A	N/A	kg/min	N/A	N/A	lb/min	
Composition, at compr. inlet if applicable				-	% wt				
Ambient Temps.	Indoor	db	21.2	22.17	C	70.16	71.91	F	
		Wb	-	-	C	-	-	F	
	Outdoor	db	-	-	C	-	-	F	
		wb	-	-	C	-	-	F	
Total Capacity			3636	3472	W	12407	11847	Btu/hr	0.95
Sensible Capacity			N/A	N/A	W	N/A	N/A	Btu/hr	
Total System Power Input			N/A	N/A	W	N/A	N/A	W	
Compressor Power Input			857	752	W	857	752	W	0.88
Energy Efficiency Ratio (EER)			4.24	4.62	W/W	14.47	14.46	Btuh/W	1.09
Coeff. Of Performance (COP)									

Other System Changes

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

Low-GWP AREP SYSTEM DROP-IN TEST DATA FORM

Type of System: Water-to-water heat pump Alternate Refrigerant: L41-1
 (e.g., SSHP, window RAC, chiller, etc.) (and composition as charged, % weight, if not proprietary)

Water Side Data	Base.	Alt.	SI Units	Base.	Alt.	IP UNits	Ratio
Evaporator							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ /min	
Flow Rate (liquid)	11.01	11.03	L/min	2.64	2.91	gal/min	
Inlet Temperature	12.0	12.13	C	53.6	53.83	F	
Outlet Temperature	7.55	7.95	C	44.87	46.31	F	
Condenser							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ /min	
Flow Rate (liquid)	11.21	11.14	L/min	2.96	2.94	gal/min	
Inlet Temperature	29.97	30.06	C	85.95	86.11	F	
Outlet Temperature	34.43	34.56	C	93.97	94.21	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	13.64	1003	13.89	925	56.55	145	57.00	134
Compressor Discharge	76.55	2916	79.81	2534	169.79	423	175.66	368
Condenser Inlet	72.45	2897	77.21	2531	162.41	420	170.98	367
Condenser Outlet	46.82	-	36.11		116.28		97.00	
Expansion Device Inlet	44.97	-	36.01		112.95		96.82	
Subcooling, at expan. device	-		-					
Evaporator Inlet	8.77	-	8.68		47.79		47.62	
Evaporator Outlet	11.23	1005	13.25	928	52.21	146	55.85	135
Evaporator Superheat	0.47		1.49		0.85		2.68	

Data Source(s) for Refrigerant Properties

Additional Notes

Submitted by: _____

Low_GWP AREP SYSTEM DROP-IN TEST DATA FORM

Manufacturer: LG Electronics

Manufacturer's Notation: MKS

Basic Information	
Alternative Refrigerant (If not proprietary, composition as Charged, % wt)	L41-2
Alternative Lubricant Type and ISO Viscosity	FVC68D (VG 68), PVE oil
Baseline Refrigerant and Lubricant	FVC68D (VG 68), PVE oil
Make and Model of System	LG electronics
Nominal Capacity and Type of System	3.5kW / Water to Water system

Comparison Data		Base.	Alt.	SI Units	Base.	Alt.	IP UNits	Ratio	
Mode (Heating/Cooling)		Cooling Matching 3.5kW							
Compressor Type		Rotary	Rotary						
Compressor Displacement		0.0337	0.0337	m ³ /min					
Nominal Motor Size		-	-	hp					
Motor Speed		3300	3300	rpm					
Expansion Device Type		Electric Expansion Valve	Electric Expansion Valve						
Lubricant Charge		0.31	0.31	kg	0.68	0.68	lb		
Refrigerant Charge		0.9	0.8	kg	1.98	1.98	lb		
Refrigerant Mass Flow Rate		N/A	N/A	kg/min	N/A	N/A	lb/min		
Composition, at compr. inlet if applicable			-	% wt					
Ambient Temps.	Indoor	db	21.2	22.15	C	70.16	71.87	F	
		Wb	-	-	C	-	-	F	
	Outdoor	db	-	-	C	-	-	F	
		wb	-	-	C	-	-	F	
Total Capacity		3636	3423	W	12407	11680	Btu/hr	0.94	
Sensible Capacity		N/A	N/A	W	N/A	N/A	Btu/hr		
Total System Power Input		N/A	N/A	W	N/A	N/A	W		
Compressor Power Input		857	765	W	857	765	W	0.89	
Energy Efficiency Ratio (EER)		4.24	4.47	W/W	14.47	15.26	Btuh/W	1.05	
Coeff. Of Performance (COP)									

Other System Changes

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

Low-GWP AREP SYSTEM DROP-IN TEST DATA FORM

Type of System: Water-to-water heat pump Alternate Refrigerant: L41-2
 (e.g., SSHP, window RAC, chiller, etc.) (and composition as charged, % weight, if not proprietary)

Water Side Data	Base.	Alt.	SI Units	Base.	Alt.	IP UNits	Ratio
Evaporator							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ /min	
Flow Rate (liquid)	11.01	11.02	L/min	2.64	2.91	gal/min	
Inlet Temperature	12.0	12.02	C	53.6	53.64	F	
Outlet Temperature	7.55	7.89	C	44.87	46.20	F	
Condenser							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ /min	
Flow Rate (liquid)	11.21	11.11	L/min	2.96	2.93	gal/min	
Inlet Temperature	29.97	30.02	C	85.95	86.04	F	
Outlet Temperature	34.43	34.51	C	93.97	94.12	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	13.64	1003	13.54	921	56.55	145	56.37	134
Compressor Discharge	76.55	2916	79.25	2525	169.79	423	174.65	366
Condenser Inlet	72.45	2897	77.63	2521	162.41	420	171.73	366
Condenser Outlet	46.82	-	36.01		116.28		96.82	
Expansion Device Inlet	44.97	-	35.94		112.95		96.69	
Subcooling, at expan. device	-		-					
Evaporator Inlet	8.77	-	8.21		47.79		46.78	
Evaporator Outlet	11.23	1005	13.11	924	52.21	146	55.60	134
Evaporator Superheat	0.47		1.48		0.85		2.66	

Data Source(s) for Refrigerant Properties

Additional Notes

Submitted by: _____

Low_GWP AREP SYSTEM DROP-IN TEST DATA FORM

Manufacturer: LG Electronics

Manufacturer's Notation: MKS

Basic Information	
Alternative Refrigerant (If not proprietary, composition as Charged, % wt)	100% R32
Alternative Lubricant Type and ISO Viscosity	RM68 (VG 68), POE oil
Baseline Refrigerant and Lubricant	FVC68D (VG 68), PVE oil
Make and Model of System	LG electronics
Nominal Capacity and Type of System	3.5kW / Water to Water system

Comparison Data		Base.	Alt.	SI Units	Base.	Alt.	IP UNits	Ratio	
Mode (Heating/Cooling)		Cooling Matching 1.8kW							
Compressor Type		Rotary	Rotary						
Compressor Displacement		0.0337	0.0337	m ³ /min					
Nominal Motor Size		-	-	hp					
Motor Speed		1500	1380	rpm					
Expansion Device Type		Electric Expansion Valve	Electric Expansion Valve						
Lubricant Charge		0.31	0.31	kg	0.68	0.68	lb		
Refrigerant Charge		0.9	0.7	kg	1.98	1.98	lb		
Refrigerant Mass Flow Rate		N/A	N/A	kg/min	N/A	N/A	lb/min		
Composition, at compr. inlet if applicable			-	% wt					
Ambient Temps.	Indoor	db	21.2	21.5	C	70.16	70.70	F	
		Wb	-	-	C	-	-	F	
	Outdoor	db	-	-	C	-	-	F	
		wb	-	-	C	-	-	F	
Total Capacity		1850	1858	W	6312	6340	Btu/hr	1.00	
Sensible Capacity		N/A	N/A	W	N/A	N/A	Btu/hr		
Total System Power Input		N/A	N/A	W	N/A	N/A	W		
Compressor Power Input		369	361	W	369	361	W	0.98	
Energy Efficiency Ratio (EER)		5.01	5.15	W/W	17.11	17.56	Btuh/W	1.02	
Coeff. Of Performance (COP)									

Other System Changes

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

Low-GWP AREP SYSTEM DROP-IN TEST DATA FORM

Type of System: Water-to-water heat pump Alternate Refrigerant: 100% R32
 (e.g., SSHP, window RAC, chiller, etc.) (and composition as charged, % weight, if not proprietary)

Water Side Data	Base.	Alt.	SI Units	Base.	Alt.	IP Units	Ratio
Evaporator							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ /min	
Flow Rate (liquid)	11.02	11.05	L/min	2.91	2.92	gal/min	
Inlet Temperature	12.0	12.01	C	53.60	53.62	F	
Outlet Temperature	9.75	9.73	C	49.55	49.51	F	
Condenser							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ /min	
Flow Rate (liquid)	11.12	11.10	L/min	2.94	2.93	gal/min	
Inlet Temperature	30.01	30.03	C	86.02	86.05	F	
Outlet Temperature	32.56	32.68	C	90.61	90.82	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	16.64	1150	17.58	1210	61.95	167	63.64	175
Compressor Discharge	67.21	2582	73.07	2612	152.98	374	163.53	379
Condenser Inlet	65.31	2576	70.12	2608	149.56	374	158.22	378
Condenser Outlet	41.11	-	36.21		116.80		97.18	
Expansion Device Inlet	40.97	-	35.87		116.55		96.57	
Subcooling, at expan. device	-		-					
Evaporator Inlet	10.77	-	10.12		51.39		50.22	
Evaporator Outlet	15.26	1156	15.25	1216	59.47	168	59.45	176
Evaporator Superheat	0.08		-0.96		0.14		-1.73	

Data Source(s) for Refrigerant Properties

Additional Notes

Submitted by: _____

Low_GWP AREP SYSTEM DROP-IN TEST DATA FORM

Manufacturer: LG Electronics

Manufacturer's Notation: MKS

Basic Information	
Alternative Refrigerant (If not proprietary, composition as Charged, % wt)	L41-1
Alternative Lubricant Type and ISO Viscosity	FVC68D (VG 68), PVE oil
Baseline Refrigerant and Lubricant	FVC68D (VG 68), PVE oil
Make and Model of System	LG electronics
Nominal Capacity and Type of System	3.5kW / Water to Water system

Comparison Data			Base.	Alt.	SI Units	Base.	Alt.	IP UNits	Ratio
Mode (Heating/Cooling)			Cooling Matching 1.8kW						
Compressor Type			Rotary	Rotary					
Compressor Displacement			0.0337	0.0337	m ³ /min				
Nominal Motor Size			-	-	hp				
Motor Speed			1500	1500	rpm				
Expansion Device Type			Electric Expansion Valve	Electric Expansion Valve					
Lubricant Charge			0.31	0.31	kg	0.68	0.68	lb	
Refrigerant Charge			0.9	0.8	kg	1.98	1.98	lb	
Refrigerant Mass Flow Rate			N/A	N/A	kg/min	N/A	N/A	lb/min	
Composition, at compr. inlet if applicable				-	% wt				
Ambient Temps.	Indoor	db	21.2	22.32	C	70.16	72.18	F	
		Wb	-	-	C	-	-	F	
	Outdoor	db	-	-	C	-	-	F	
		wb	-	-	C	-	-	F	
Total Capacity			1850	1831	W	6312	6248	Btu/hr	0.99
Sensible Capacity			N/A	N/A	W	N/A	N/A	Btu/hr	
Total System Power Input			N/A	N/A	W	N/A	N/A	W	
Compressor Power Input			369	314	W	369	314	W	0.85
Energy Efficiency Ratio (EER)			5.01	5.83	W/W	17.11	19.90	Btuh/W	1.16
Coeff. Of Performance (COP)									

Other System Changes	

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

Low-GWP AREP SYSTEM DROP-IN TEST DATA FORM

Type of System: Water-to-water heat pump Alternate Refrigerant: L41-1
 (e.g., SSHP, window RAC, chiller, etc.) (and composition as charged, % weight, if not proprietary)

Water Side Data	Base.	Alt.	SI Units	Base.	Alt.	IP UNits	Ratio
Evaporator							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ min	
Flow Rate (liquid)	11.02	11.06	L/min	2.91	2.92	gal/min	
Inlet Temperature	12.0	12.02	C	53.60	53.64	F	
Outlet Temperature	9.75	9.78	C	49.55	49.60	F	
Condenser							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ min	
Flow Rate (liquid)	11.12	11.13	L/min	2.94	2.94	gal/min	
Inlet Temperature	30.01	30.05	C	86.02	86.09	F	
Outlet Temperature	32.56	32.48	C	90.61	90.46	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	16.64	1150	18.16	1021	61.95	167	64.69	148
Compressor Discharge	67.21	2582	66.07	2241	152.98	374	150.93	325
Condenser Inlet	65.31	2576	64.89	2238	149.56	374	148.80	325
Condenser Outlet	41.11	-	34.15		106.00		93.47	
Expansion Device Inlet	40.97	-	34.08		105.75		93.34	
Subcooling, at expan. device	-		-					
Evaporator Inlet	10.77	-	9.23		51.39		48.61	
Evaporator Outlet	15.26	1156	16.02	1023	59.47	168	60.84	148
Evaporator Superheat	0.08		1.36		0.14		2.44	

Data Source(s) for Refrigerant Properties

Additional Notes

Submitted by: _____

Low_GWP AREP SYSTEM DROP-IN TEST DATA FORM

Manufacturer: LG Electronics

Manufacturer's Notation: MKS

Basic Information	
Alternative Refrigerant (If not proprietary, composition as Charged, % wt)	L41-2
Alternative Lubricant Type and ISO Viscosity	FVC68D (VG 68), PVE oil
Baseline Refrigerant and Lubricant	FVC68D (VG 68), PVE oil
Make and Model of System	LG electronics
Nominal Capacity and Type of System	3.5kW / Water to Water system

Comparison Data			Base.	Alt.	SI Units	Base.	Alt.	IP UNits	Ratio
Mode (Heating/Cooling)			Cooling Matching 1.8kW						
Compressor Type			Rotary	Rotary					
Compressor Displacement			0.0337	0.0337	m ³ /min				
Nominal Motor Size			-	-	hp				
Motor Speed			1500	1500	rpm				
Expansion Device Type			Electric Expansion Valve	Electric Expansion Valve					
Lubricant Charge			0.31	0.31	kg	0.68	0.68	lb	
Refrigerant Charge			0.9	0.8	kg	1.98	1.98	lb	
Refrigerant Mass Flow Rate			N/A	N/A	kg/min	N/A	N/A	lb/min	
Composition, at compr. inlet if applicable				-	% wt				
Ambient Temps.	Indoor	db	21.2	21.85	C	70.16	71.33	F	
		Wb	-	-	C	-	-	F	
	Outdoor	db	-	-	C	-	-	F	
		wb	-	-	C	-	-	F	
Total Capacity			1850	1811	W	6312	6179	Btu/hr	0.98
Sensible Capacity			N/A	N/A	W	N/A	N/A	Btu/hr	
Total System Power Input			N/A	N/A	W	N/A	N/A	W	
Compressor Power Input			369	319	W	369	319	W	0.86
Energy Efficiency Ratio (EER)			5.01	5.68	W/W	17.11	19.37	Btuh/W	1.13
Coeff. Of Performance (COP)									

Other System Changes

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

Low-GWP AREP SYSTEM DROP-IN TEST DATA FORM

Type of System: Water-to-water heat pump Alternate Refrigerant: L41-2
 (e.g., SSHP, window RAC, chiller, etc.) (and composition as charged, % weight, if not proprietary)

Water Side Data	Base.	Alt.	SI Units	Base.	Alt.	IP UNits	Ratio
Evaporator							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ /min	
Flow Rate (liquid)	11.02	11.04	L/min	2.91	2.92	gal/min	
Inlet Temperature	12.0	12.06	C	53.60	53.71	F	
Outlet Temperature	9.75	9.85	C	49.55	49.73	F	
Condenser							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ /min	
Flow Rate (liquid)	11.12	11.08	L/min	2.94	2.93	gal/min	
Inlet Temperature	30.01	30.05	C	86.02	86.09	F	
Outlet Temperature	32.56	32.68	C	90.61	90.82	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	16.64	1150	18.32	1035	61.95	167	64.98	150
Compressor Discharge	67.21	2582	67.70	2263	152.98	374	153.86	328
Condenser Inlet	65.31	2576	65.12	2257	149.56	374	149.22	327
Condenser Outlet	41.11	-	34.26		106.00		93.67	
Expansion Device Inlet	40.97	-	34.19		105.75		93.54	
Subcooling, at expan. device	-		-					
Evaporator Inlet	10.77	-	8.88		51.39		47.98	
Evaporator Outlet	15.26	1156	15.86	1039	59.47	168	60.55	151
Evaporator Superheat	0.08		0.71		0.14		1.28	

Data Source(s) for Refrigerant Properties

Additional Notes

Submitted by: _____

Low_GWP AREP SYSTEM DROP-IN TEST DATA FORM

Manufacturer: LG Electronics

Manufacturer's Notation: MKS

Basic Information	
Alternative Refrigerant (If not proprietary, composition as Charged, % wt)	100% R32
Alternative Lubricant Type and ISO Viscosity	RM68 (VG 68), POE oil
Baseline Refrigerant and Lubricant	FVC68D (VG 68), PVE oil
Make and Model of System	LG electronics
Nominal Capacity and Type of System	3.5kW / Water to Water system

Comparison Data		Base.	Alt.	SI Units	Base.	Alt.	IP UNits	Ratio	
Mode (Heating/Cooling)		Heating Matching 4.0kW							
Compressor Type		Rotary	Rotary						
Compressor Displacement		0.0337	0.0337	m ³ /min					
Nominal Motor Size		-	-	hp					
Motor Speed		4200	4200	rpm					
Expansion Device Type		Electric Expansion Valve	Electric Expansion Valve						
Lubricant Charge		0.31	0.31	kg	0.68	0.68	lb		
Refrigerant Charge		0.9	0.7	kg	1.98	1.98	lb		
Refrigerant Mass Flow Rate		N/A	N/A	kg/min	N/A	N/A	lb/min		
Composition, at compr. inlet if applicable			-	% wt					
Ambient Temps.	Indoor	db	21.12	22.14	C	70.02	71.85	F	
		Wb	-	-	C	-	-	F	
	Outdoor	db	-	-	C	-	-	F	
		wb	-	-	C	-	-	F	
Total Capacity		4088	4116	W	13949	14044	Btu/hr	1.01	
Sensible Capacity		N/A	N/A	W	N/A	N/A	Btu/hr		
Total System Power Input		N/A	N/A	W	N/A	N/A	W		
Compressor Power Input		1033	1043	W	1033	1043	W	1.01	
Energy Efficiency Ratio (EER)		-	-	W/W	-	-	Btuh/W		
Coeff. Of Performance (COP)		3.96	3.95					1.00	

Other System Changes

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

Low-GWP AREP SYSTEM DROP-IN TEST DATA FORM

Type of System: Water-to-water heat pump Alternate Refrigerant: 100% R32
 (e.g., SSHP, window RAC, chiller, etc.) (and composition as charged, % weight, if not proprietary)

Water Side Data	Base.	Alt.	SI Units	Base.	Alt.	IP UNits	Ratio
Evaporator							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ /min	
Flow Rate (liquid)	11.08	11.11	L/min	2.93	2.93	gal/min	
Inlet Temperature	10.05	10.08	C	50.09	50.14	F	
Outlet Temperature	6.44	6.35	C	43.59	43.43	F	
Condenser							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ /min	
Flow Rate (liquid)	11.11	11.21	L/min	2.93	2.96	gal/min	
Inlet Temperature	40.01	40.01	C	104.02	104.02	F	
Outlet Temperature	44.88	44.89	C	112.78	112.80	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	8.22	802	7.88	800	46.80	116	46.18	116
Compressor Discharge	71.87	2681	93.12	2653	161.37	389	199.62	385
Condenser Inlet	64.24	2678	88.65	2648	147.63	388	191.57	384
Condenser Outlet	43.06	-	41.23		109.51		106.21	
Expansion Device Inlet	43.01	-	41.18		109.42		106.12	
Subcooling, at expan. device	-		-					
Evaporator Inlet	4.85	-	4.15		40.73		39.47	
Evaporator Outlet	5.42	806	7.56	806	41.76	117	45.61	117
Evaporator Superheat	1.27		3.85		2.29		6.93	

Data Source(s) for Refrigerant Properties

Additional Notes

Submitted by: _____

Low_GWP AREP SYSTEM DROP-IN TEST DATA FORM

Manufacturer: LG Electronics

Manufacturer's Notation: MKS

Basic Information	
Alternative Refrigerant (If not proprietary, composition as Charged, % wt)	L41-1
Alternative Lubricant Type and ISO Viscosity	FVC68D (VG 68), PVE oil
Baseline Refrigerant and Lubricant	FVC68D (VG 68), PVE oil
Make and Model of System	LG electronics
Nominal Capacity and Type of System	3.5kW / Water to Water system

Comparison Data			Base.	Alt.	SI Units	Base.	Alt.	IP UNits	Ratio
Mode (Heating/Cooling)			Heating Matching 4.0kW						
Compressor Type			Rotary	Rotary					
Compressor Displacement			0.0337	0.0337	m ³ /min				
Nominal Motor Size			-	-	hp				
Motor Speed			4200	5100	rpm				
Expansion Device Type			Electric Expansion Valve	Electric Expansion Valve					
Lubricant Charge			0.31	0.31	kg	0.68	0.68	lb	
Refrigerant Charge			0.9	0.8	kg	1.98	1.98	lb	
Refrigerant Mass Flow Rate			N/A	N/A	kg/min	N/A	N/A	lb/min	
Composition, at compr. inlet if applicable				-	% wt				
Ambient Temps.	Indoor	db	21.12	22.54	C	70.02	72.57	F	
		Wb	-	-	C	-	-	F	
	Outdoor	db	-	-	C	-	-	F	
		wb	-	-	C	-	-	F	
Total Capacity			4088	4164	W	13949	14208	Btu/hr	1.02
Sensible Capacity			N/A	N/A	W	N/A	N/A	Btu/hr	
Total System Power Input			N/A	N/A	W	N/A	N/A	W	
Compressor Power Input			1033	1095	W	1033	1095	W	1.06
Energy Efficiency Ratio (EER)			-	-	W/W	-	-	Btuh/W	
Coeff. Of Performance (COP)			3.96	3.80					0.96

Other System Changes

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

Low-GWP AREP SYSTEM DROP-IN TEST DATA FORM

Type of System: Water-to-water heat pump Alternate Refrigerant: L41-1
 (e.g., SSHP, window RAC, chiller, etc.) (and composition as charged, % weight, if not proprietary)

Water Side Data	Base.	Alt.	SI Units	Base.	Alt.	IP Units	Ratio
Evaporator							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ /min	
Flow Rate (liquid)	11.08	11.15	L/min	2.93	2.95	gal/min	
Inlet Temperature	10.05	10.01	C	50.09	50.02	F	
Outlet Temperature	6.44	6.29	C	43.59	43.32	F	
Condenser							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ /min	
Flow Rate (liquid)	11.11	11.08	L/min	2.93	2.93	gal/min	
Inlet Temperature	40.01	40.06	C	104.02	104.11	F	
Outlet Temperature	44.88	45.05	C	112.78	113.09	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	8.22	802	3.56	617	46.80	116	38.41	89
Compressor Discharge	71.87	2681	85.13	2324	161.37	389	185.23	337
Condenser Inlet	64.24	2678	79.56	2318	147.63	388	175.21	336
Condenser Outlet	43.06	-	40.85		109.51		105.53	
Expansion Device Inlet	43.01	-	40.78		109.42		105.40	
Subcooling, at expan. device	-		-					
Evaporator Inlet	4.85	-	2.68		40.73		36.82	
Evaporator Outlet	5.42	806	1.85	621	41.76	117	35.33	90
Evaporator Superheat	1.27		1.84		2.29		3.31	

Data Source(s) for Refrigerant Properties

Additional Notes

Submitted by: _____

Low_GWP AREP SYSTEM DROP-IN TEST DATA FORM

Manufacturer: LG Electronics

Manufacturer's Notation: MKS

Basic Information	
Alternative Refrigerant (If not proprietary, composition as Charged, % wt)	L41-2
Alternative Lubricant Type and ISO Viscosity	FVC68D (VG 68), PVE oil
Baseline Refrigerant and Lubricant	FVC68D (VG 68), PVE oil
Make and Model of System	LG electronics
Nominal Capacity and Type of System	3.5kW / Water to Water system

Comparison Data			Base.	Alt.	SI Units	Base.	Alt.	IP UNits	Ratio
Mode (Heating/Cooling)			Heating Matching 4.0kW						
Compressor Type			Rotary	Rotary					
Compressor Displacement			0.0337	0.0337	m ³ /min				
Nominal Motor Size			-	-	hp				
Motor Speed			4200	5100	rpm				
Expansion Device Type			Electric Expansion Valve	Electric Expansion Valve					
Lubricant Charge			0.31	0.31	kg	0.68	0.68	lb	
Refrigerant Charge			0.9	0.8	kg	1.98	1.98	lb	
Refrigerant Mass Flow Rate			N/A	N/A	kg/min	N/A	N/A	lb/min	
Composition, at compr. inlet if applicable				-	% wt				
Ambient Temps.	Indoor	db	21.12	20.63	C	70.02	69.13	F	
		Wb	-	-	C	-	-	F	
	Outdoor	db	-	-	C	-	-	F	
		wb	-	-	C	-	-	F	
Total Capacity			4088	4131	W	13949	14096	Btu/hr	1.01
Sensible Capacity			N/A	N/A	W	N/A	N/A	Btu/hr	
Total System Power Input			N/A	N/A	W	N/A	N/A	W	
Compressor Power Input			1033	1162	W	1033	1162	W	1.12
Energy Efficiency Ratio (EER)			-	-	W/W	-	-	Btuh/W	
Coeff. Of Performance (COP)			3.96	3.56					0.90

Other System Changes	

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

Low-GWP AREP SYSTEM DROP-IN TEST DATA FORM

Type of System: Water-to-water heat pump Alternate Refrigerant: L41-2
 (e.g., SSHP, window RAC, chiller, etc.) (and composition as charged, % weight, if not proprietary)

Water Side Data	Base.	Alt.	SI Units	Base.	Alt.	IP Units	Ratio
Evaporator							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ /min	
Flow Rate (liquid)	11.08	11.12	L/min	2.93	2.94	gal/min	
Inlet Temperature	10.05	10.08	C	50.09	50.14	F	
Outlet Temperature	6.44	6.65	C	43.59	43.97	F	
Condenser							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ /min	
Flow Rate (liquid)	11.11	11.09	L/min	2.93	2.93	gal/min	
Inlet Temperature	40.01	40.02	C	104.02	104.04	F	
Outlet Temperature	44.88	44.96	C	112.78	112.93	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	8.22	802	3.32	629	46.80	116	37.98	91
Compressor Discharge	71.87	2681	87.23	2376	161.37	389	189.01	345
Condenser Inlet	64.24	2678	81.55	2371	147.63	388	178.79	344
Condenser Outlet	43.06	-	40.59		109.51		105.06	
Expansion Device Inlet	43.01	-	40.54		109.42		104.97	
Subcooling, at expan. device	-		-					
Evaporator Inlet	4.85	-	2.11		40.73		35.80	
Evaporator Outlet	5.42	806	1.34	633	41.76	117	34.41	92
Evaporator Superheat	1.27		0.99		2.29		1.78	

Data Source(s) for Refrigerant Properties

Additional Notes

Submitted by: _____

Low_GWP AREP SYSTEM DROP-IN TEST DATA FORM

Manufacturer: LG Electronics

Manufacturer's Notation: MKS

Basic Information	
Alternative Refrigerant (If not proprietary, composition as Charged, % wt)	100% R32
Alternative Lubricant Type and ISO Viscosity	RM68 (VG 68), POE oil
Baseline Refrigerant and Lubricant	FVC68D (VG 68), PVE oil
Make and Model of System	LG electronics
Nominal Capacity and Type of System	3.5kW / Water to Water system

Comparison Data			Base.	Alt.	SI Units	Base.	Alt.	IP UNits	Ratio
Mode (Heating/Cooling)			Heating Matching 2.2kW						
Compressor Type			Rotary	Rotary					
Compressor Displacement			0.0337	0.0337	m ³ /min				
Nominal Motor Size			-	-	hp				
Motor Speed			2340	2100	rpm				
Expansion Device Type			Electric Expansion Valve	Electric Expansion Valve					
Lubricant Charge			0.31	0.31	kg	0.68	0.68	lb	
Refrigerant Charge			0.9	0.7	kg	1.98	1.98	lb	
Refrigerant Mass Flow Rate			N/A	N/A	kg/min	N/A	N/A	lb/min	
Composition, at compr. inlet if applicable				-	% wt				
Ambient Temps.	Indoor	db	21.12	20.52	C	70.02	68.94	F	
		Wb	-	-	C	-	-	F	
	Outdoor	db	-	-	C	-	-	F	
		wb	-	-	C	-	-	F	
Total Capacity			2130	2133	W	7268	7278	Btu/hr	1.00
Sensible Capacity			N/A	N/A	W	N/A	N/A	Btu/hr	
Total System Power Input			N/A	N/A	W	N/A	N/A	W	
Compressor Power Input			464	464	W	464	464	W	1.00
Energy Efficiency Ratio (EER)			-	-	W/W	-	-	Btuh/W	
Coeff. Of Performance (COP)			4.59	4.60					1.00

Other System Changes	

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

Low-GWP AREP SYSTEM DROP-IN TEST DATA FORM

Type of System: Water-to-water heat pump Alternate Refrigerant: 100% R32
 (e.g., SSHP, window RAC, chiller, etc.) (and composition as charged, % weight, if not proprietary)

Water Side Data	Base.	Alt.	SI Units	Base.	Alt.	IP UNits	Ratio
Evaporator							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ /min	
Flow Rate (liquid)	11.08	11.05	L/min	2.93	2.92	gal/min	
Inlet Temperature	10.01	10.08	C	50.02	50.14	F	
Outlet Temperature	8.25	8.24	C	46.85	46.83	F	
Condenser							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ /min	
Flow Rate (liquid)	11.02	11.05	L/min	2.91	2.92	gal/min	
Inlet Temperature	40.03	40.06	C	104.05	104.11	F	
Outlet Temperature	42.62	42.63	C	108.72	108.73	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	9.32	872	7.88	901	48.78	126	46.18	131
Compressor Discharge	68.12	2376	76.58	2336	154.62	345	169.84	339
Condenser Inlet	65.45	2371	71.24	2332	149.81	344	160.23	338
Condenser Outlet	41.22	-	40.56		106.20		105.01	
Expansion Device Inlet	41.19	-	40.52		106.14		104.94	
Subcooling, at expan. device	-		-					
Evaporator Inlet	6.98	-	5.96		44.56		42.73	
Evaporator Outlet	8.65	877	8.54	905	47.57	127	47.37	131
Evaporator Superheat	2.03		1.44		3.65		2.59	

Data Source(s) for Refrigerant Properties

Additional Notes

Submitted by: _____

Low_GWP AREP SYSTEM DROP-IN TEST DATA FORM

Manufacturer: LG Electronics

Manufacturer's Notation: MKS

Basic Information	
Alternative Refrigerant (If not proprietary, composition as Charged, % wt)	L41-1
Alternative Lubricant Type and ISO Viscosity	FVC68D (VG 68), PVE oil
Baseline Refrigerant and Lubricant	FVC68D (VG 68), PVE oil
Make and Model of System	LG electronics
Nominal Capacity and Type of System	3.5kW / Water to Water system

Comparison Data			Base.	Alt.	SI Units	Base.	Alt.	IP UNits	Ratio
Mode (Heating/Cooling)			Heating Matching 2.2kW						
Compressor Type			Rotary	Rotary					
Compressor Displacement			0.0337	0.0337	m ³ /min				
Nominal Motor Size			-	-	hp				
Motor Speed			2340	2700	rpm				
Expansion Device Type			Electric Expansion Valve	Electric Expansion Valve					
Lubricant Charge			0.31	0.31	kg	0.68	0.68	lb	
Refrigerant Charge			0.9	0.8	kg	1.98	1.98	lb	
Refrigerant Mass Flow Rate			N/A	N/A	kg/min	N/A	N/A	lb/min	
Composition, at compr. inlet if applicable				-	% wt				
Ambient Temps.	Indoor	db	21.12	22.24	C	70.02	72.03	F	
		Wb	-	-	C	-	-	F	
	Outdoor	db	-	-	C	-	-	F	
		wb	-	-	C	-	-	F	
Total Capacity			2130	2145	W	7268	7319	Btu/hr	1.01
Sensible Capacity			N/A	N/A	W	N/A	N/A	Btu/hr	
Total System Power Input			N/A	N/A	W	N/A	N/A	W	
Compressor Power Input			464	508	W	464	508	W	1.09
Energy Efficiency Ratio (EER)			-	-	W/W	-	-	Btuh/W	
Coeff. Of Performance (COP)			4.59	4.22					0.92

Other System Changes	

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

Low-GWP AREP SYSTEM DROP-IN TEST DATA FORM

Type of System: Water-to-water heat pump Alternate Refrigerant: L41-1
 (e.g., SSHP, window RAC, chiller, etc.) (and composition as charged, % weight, if not proprietary)

Water Side Data	Base.	Alt.	SI Units	Base.	Alt.	IP UNits	Ratio
Evaporator							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ /min	
Flow Rate (liquid)	11.08	11.05	L/min	2.93	2.92	gal/min	
Inlet Temperature	10.01	10.05	C	50.02	50.09	F	
Outlet Temperature	8.25	8.29	C	46.85	46.92	F	
Condenser							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ /min	
Flow Rate (liquid)	11.02	11.01	L/min	2.91	2.91	gal/min	
Inlet Temperature	40.03	40.03	C	104.05	104.05	F	
Outlet Temperature	42.62	42.67	C	108.72	108.81	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	9.32	872	4.28	712	48.78	126	39.70	103
Compressor Discharge	68.12	2376	71.56	2063	154.62	345	160.81	299
Condenser Inlet	65.45	2371	67.17	2059	149.81	344	152.91	299
Condenser Outlet	41.22	-	40.19		106.20		104.34	
Expansion Device Inlet	41.19	-	40.14		106.14		104.25	
Subcooling, at expan. device	-		-					
Evaporator Inlet	6.98	-	4.21		44.56		39.58	
Evaporator Outlet	8.65	877	2.98	718	47.57	127	37.36	104
Evaporator Superheat	2.03		-1.18		3.65		-2.12	

Data Source(s) for Refrigerant Properties

Additional Notes

Submitted by: _____

Low_GWP AREP SYSTEM DROP-IN TEST DATA FORM

Manufacturer: LG Electronics

Manufacturer's Notation: MKS

Basic Information	
Alternative Refrigerant (If not proprietary, composition as Charged, % wt)	L41-2
Alternative Lubricant Type and ISO Viscosity	FVC68D (VG 68), PVE oil
Baseline Refrigerant and Lubricant	FVC68D (VG 68), PVE oil
Make and Model of System	LG electronics
Nominal Capacity and Type of System	3.5kW / Water to Water system

Comparison Data			Base.	Alt.	SI Units	Base.	Alt.	IP UNits	Ratio
Mode (Heating/Cooling)			Heating Matching 2.2kW						
Compressor Type			Rotary	Rotary					
Compressor Displacement			0.0337	0.0337	m ³ /min				
Nominal Motor Size			-	-	hp				
Motor Speed			2340	3000	rpm				
Expansion Device Type			Electric Expansion Valve	Electric Expansion Valve					
Lubricant Charge			0.31	0.31	kg	0.68	0.68	lb	
Refrigerant Charge			0.9	0.8	kg	1.98	1.98	lb	
Refrigerant Mass Flow Rate			N/A	N/A	kg/min	N/A	N/A	lb/min	
Composition, at compr. inlet if applicable				-	% wt				
Ambient Temps.	Indoor	db	21.12	20.19	C	70.02	68.34	F	
		Wb	-	-	C	-	-	F	
	Outdoor	db	-	-	C	-	-	F	
		wb	-	-	C	-	-	F	
Total Capacity			2130	2244	W	7268	7657	Btu/hr	1.05
Sensible Capacity			N/A	N/A	W	N/A	N/A	Btu/hr	
Total System Power Input			N/A	N/A	W	N/A	N/A	W	
Compressor Power Input			464	581	W	464	581	W	1.25
Energy Efficiency Ratio (EER)			-	-	W/W	-	-	Btuh/W	
Coeff. Of Performance (COP)			4.59	3.86					0.84

Other System Changes	

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

Low-GWP AREP SYSTEM DROP-IN TEST DATA FORM

Type of System: Water-to-water heat pump Alternate Refrigerant: L41-2
 (e.g., SSHP, window RAC, chiller, etc.) (and composition as charged, % weight, if not proprietary)

Water Side Data	Base.	Alt.	SI Units	Base.	Alt.	IP UNits	Ratio
Evaporator							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ /min	
Flow Rate (liquid)	11.08	11.04	L/min	2.93	2.92	gal/min	
Inlet Temperature	10.01	10.05	C	50.02	50.09	F	
Outlet Temperature	8.25	8.21	C	46.85	46.78	F	
Condenser							
Heat Exchange Fluid	water	water					
Flow Rate (gas)	-	-	m ³ /min	-	-	ft ³ /min	
Flow Rate (liquid)	11.02	11.01	L/min	2.91	2.91	gal/min	
Inlet Temperature	40.03	40.06	C	104.05	104.11	F	
Outlet Temperature	42.62	42.79	C	108.72	109.02	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	9.32	872	2.98	687	48.78	126	37.36	100
Compressor Discharge	68.12	2376	74.25	2112	154.62	345	165.65	306
Condenser Inlet	65.45	2371	68.96	2108	149.81	344	156.13	306
Condenser Outlet	41.22	-	40.35		106.20		104.63	
Expansion Device Inlet	41.19	-	40.28		106.14		104.50	
Subcooling, at expan. device	-		-					
Evaporator Inlet	6.98	-	2.28		44.56		36.10	
Evaporator Outlet	8.65	877	2.96	691	47.57	127	37.33	100
Evaporator Superheat	2.03		0.10		3.65		0.18	

Data Source(s) for Refrigerant Properties

Additional Notes

Submitted by: _____