Automated Verification Systems

John Whinery, VP Product Management – Lennox International

Start Up Procedure

Electrical Checks

Check wiring connections are tight

Check correct supply voltage

ELECTRICAL RATING/ CARACTERISTIQUE ELECTRIQUE					
VOLTS	HERTZ	PHASE	MAX AMPS/ AMP MAX	INDOOR BLOWER MOTOR	
				FLA	HP
120	60	1	12.0	8.4	3/4

Check for correct polarity of supply voltage

External Static Pressure

1. Set supply-side probe between outlet and evaporator coil.
2. Set return-side probe between furnace inlet and filter.
3. Run the Blower at cooling speed.
4. Measure and compare the measured ESP value to the Blower table.

External Static Pressure

Too High ESP

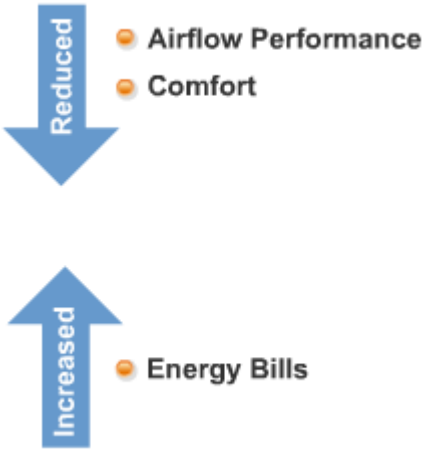
Check the following:

- Dirty A-coil,
- Dirty Filter
- Closed or blocked Registers
- Blocked Return Grilles
- Closed Dampers
- Undersized Duct System

Industry-Approved Standards

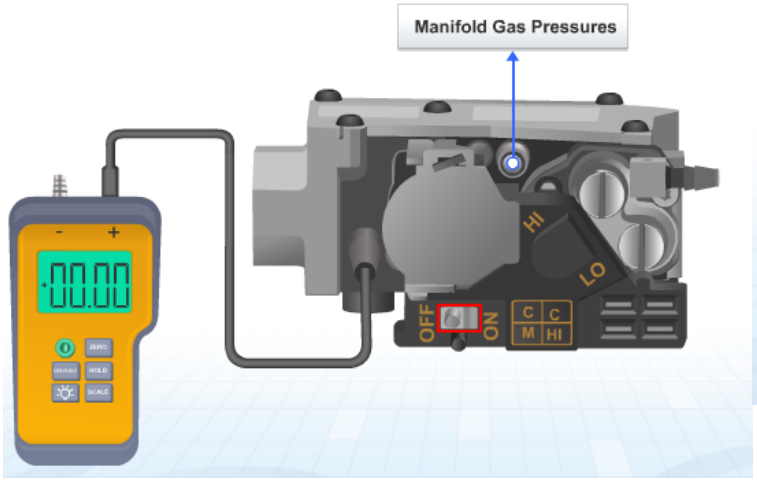
ACCA

System Performance



LENNOX

Measuring Gas Supply Pressure



HEATING DATA

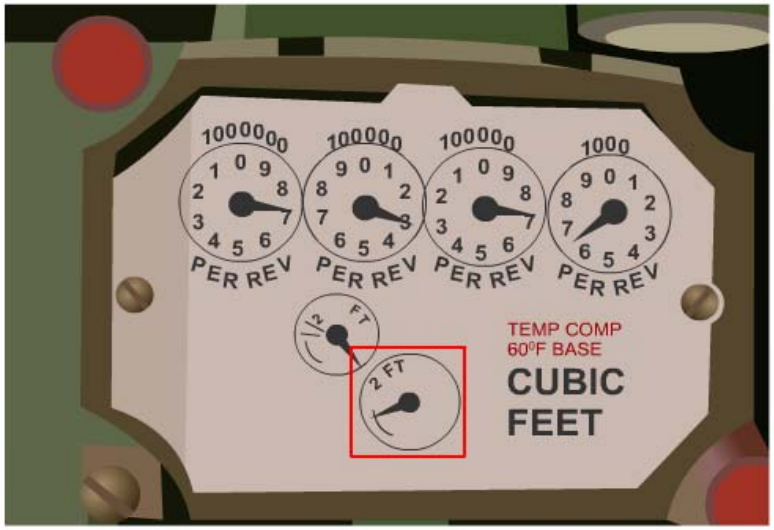
EQUIPPED FOR USE WITH NATURAL GAS

INPUT (BTUH)	88,000/57,200
OUTPUT (BTUH)	70,400/45,760
MANIFOLD PRESSURE (IN. W.C.)	3.5/1.7
GAS SUPPLY LINE PRESS (MAX/MIN/ IN. W.C.)	13.0/4.5

Gas	Min	Max
Natural	4.5	10.5
LP/propane	11.0	13.0

Checking Firing Rate

- Determine time in seconds for two revolutions of gas through the meter.
- Divide by two and compare to time on the Gas Meter Clocking Chart table.



GAS METER CLOCKING CHART

	Seconds for One Revolution			
	Natural		LP	
	1 cu ft Dial	2 cu ft Dial	1 cu ft Dial	2 cu ft Dial
-045	80	160	200	400
-070	55	110	136	272
-090	41	82	102	204
-110	33	66	82	164
-135	27	54	68	136
Natural - 1000 btu/cu ft		LP - 2500 btu/cu ft		

Measuring CO and CO_2 in Exhaust

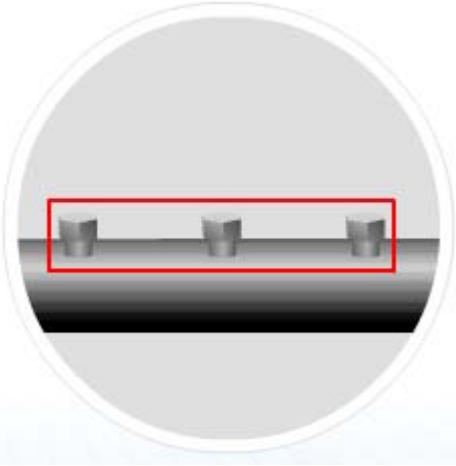
	CO_2% For Nat		CO_2% For LPG	
	Low Fire	High Fire	Low Fire	High Fire
045	5.4 – 6.4	7.5 – 8.5	6.4 – 7.4	8.8 – 9.8
070	5.3 – 6.3	7.4 – 8.4	6.3 – 7.3	8.7 – 9.7
090	5.8 – 6.8	7.6 – 8.6	6.8 – 7.8	8.9 – 9.9
110	6.1 – 7.1	8.0 – 9.0	7.1 – 8.1	9.3 – 10.3
135	6.1 – 7.1	7.8 – 8.8	7.1 – 8.2	9.1 – 10.1

The maximum carbon monoxide reading should not exceed 50 ppm.

Reducing CO and CO_2 Levels in Exhaust

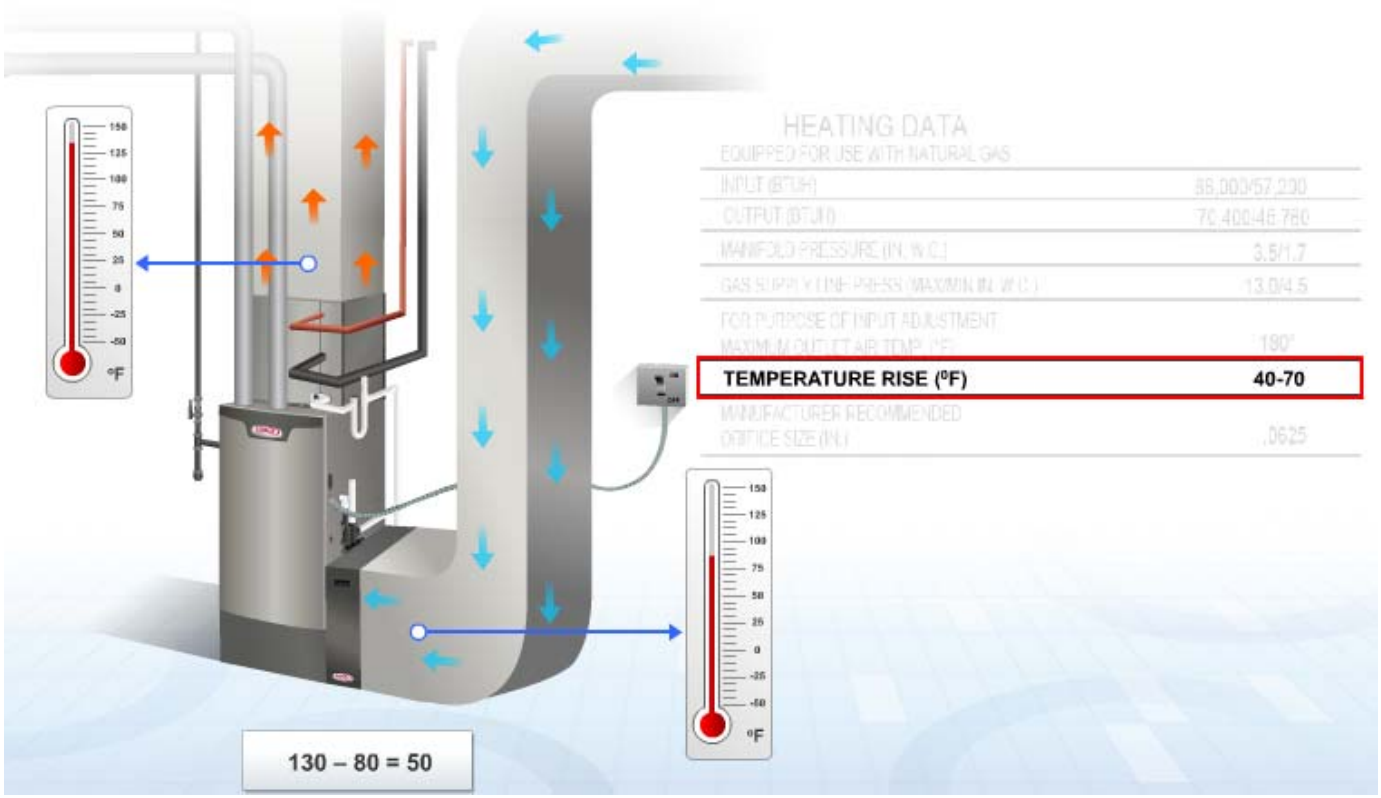
Flame impingement

Over firing



Oversized gas orifices

Temperature Rise Measurement



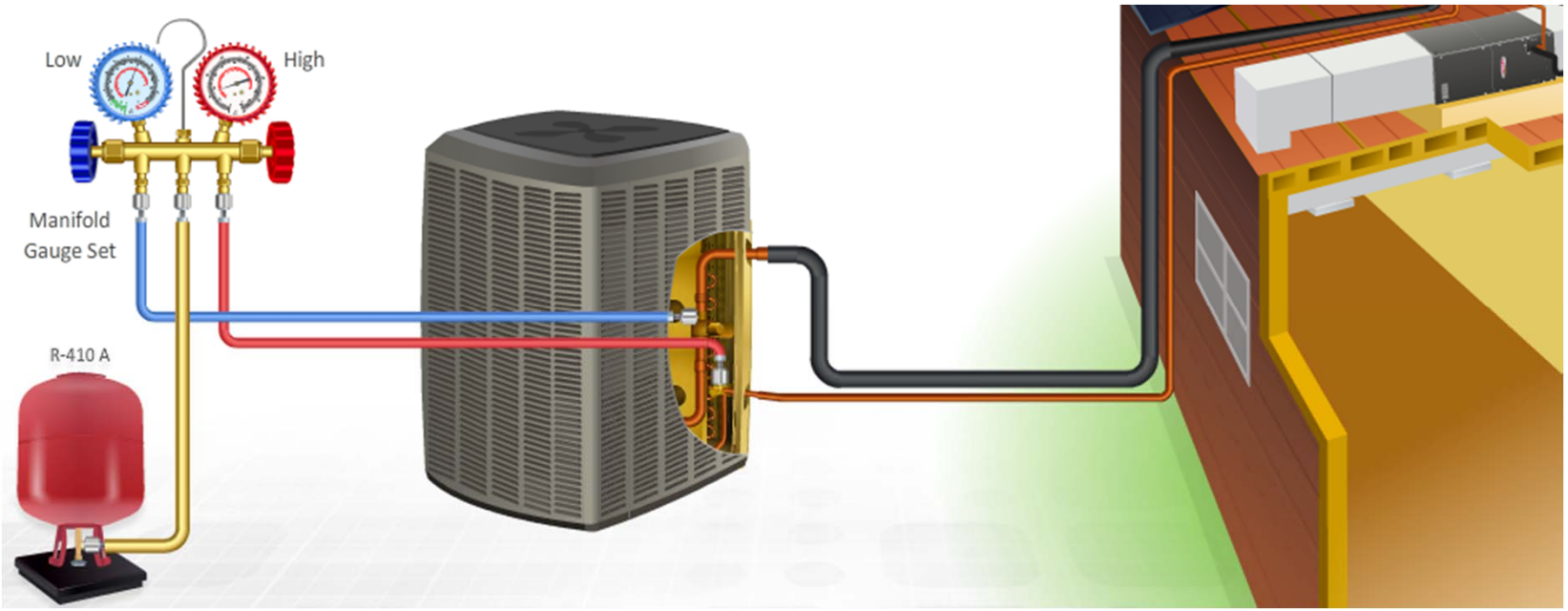
Charging Methods

Weigh In

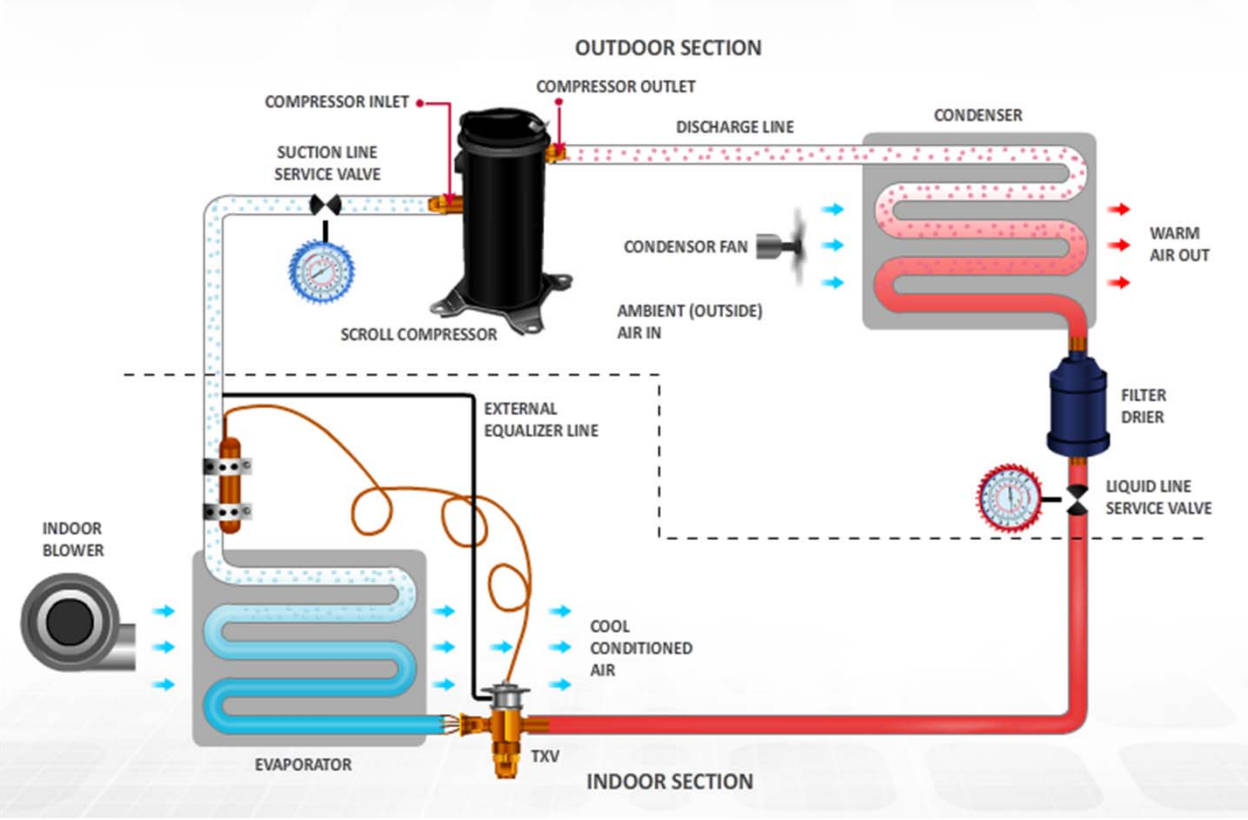
Subcooling and Superheat

Temperature °F	°C	R22	R407C Liquid Press	R407C Vapor Press	R410A
-40	-40.0	0.5	3.0	4.4	11.6
-35	-37.2	2.6	5.4	0.6	14.9
-30	-34.4	4.9	8.0	1.8	18.5
-25	-31.7	7.4	10.9	4.1	22.5
-20	-28.9	10.1	14.1	6.6	26.9
-15	-26.1	13.2	17.6	9.4	31.7
-10	-23.3	16.5	21.3	12.5	36.8
-5	-20.6	20.1	25.4	15.9	42.5
0	-17.8	24.0	29.9	19.6	48.6
5	-15.0	28.2	34.7	23.6	55.2
10	-12.2	32.8	39.9	28.0	62.3
15	-9.4	37.7	45.6	32.8	70.0
20	-6.7	43.0	51.6	38.0	78.3
25	-3.9	48.8	58.2	43.6	87.3
30	-1.1	54.9	65.2	49.6	96.8
35	1.7	61.5	72.6	56.1	107
40	4.4	68.5	80.7	63.1	118
45	7.2	76.0	89.2	70.6	130
50	10.0	84.0	98.3	78.7	142
55	12.8	92.6	108	87.3	155
60	15.6	102	118	96.8	170
65	18.3	111	129	106	185
70	21.1	121	141	117	201
75	23.9	132	153	128	217
80	26.7	144	166	140	235
85	29.4	156	180	153	254
90	32.2	168	195	166	274
95	35.0	182	210	181	295
100	37.8	196	226	196	317
105	40.6	211	243	211	340
110	43.3	226	261	229	365
115	46.1	243	280	247	391
120	48.9	260	300	266	418
125	51.7	278	321	286	446
130	54.4	297	342	307	476
135	57.2	317	365	329	507
140	60.0	337	389	353	539
145	62.8	359	–	–	573
150	65.6	382	–	–	608

Weigh in Charge



Subcooling & Superheat Charging Method



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-25	-31.7	7.4	10.9	4.1	22.5
-20	-28.9	10.1	14.1	6.6	26.9
-15	-26.1	13.2	17.6	9.4	31.7
-10	-23.3	16.5	21.3	12.5	36.8
-5	-20.6	20.1	25.4	15.9	42.5
0	-17.8	24.0	29.9	19.6	48.6
5	-15.0	28.2	34.7	23.6	55.2
10	-12.2	32.8	39.9	28.0	62.3
15	-9.4	37.7	45.6	32.8	70.0
20	-6.7	43.0	51.6	38.0	78.3
25	-3.9	48.8	58.2	43.6	87.3
30	-1.1	54.9	65.2	49.6	96.8
35	1.7	61.5	72.6	56.1	107
40	4.4	68.5	80.7	63.1	118
45	7.2	76.0	89.2	70.6	130
50	10.0	84.0	98.3	78.7	142
55	12.8	92.6	108	87.3	155
60	15.6	102	118	96.8	170
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70	21.1	121	141	117	201
75	23.9	132	153	128	217
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135	57.2	317	365	329	507
140	60.0	337	389	353	539
145	62.8	359	–	–	573
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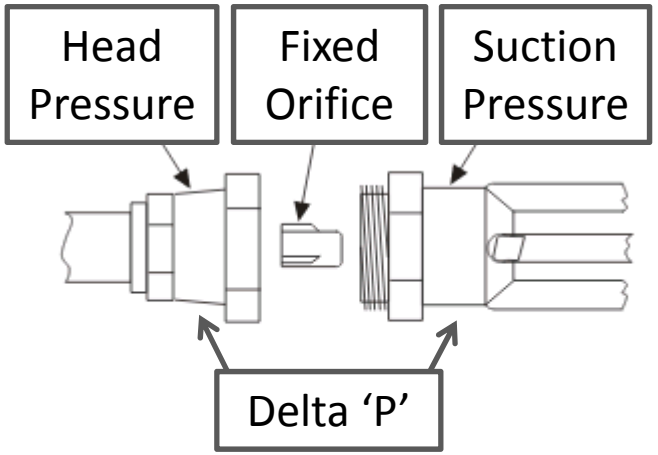
Superheat Calculation - RFC

- Outdoor Dry Bulb
- Indoor Wet Bulb

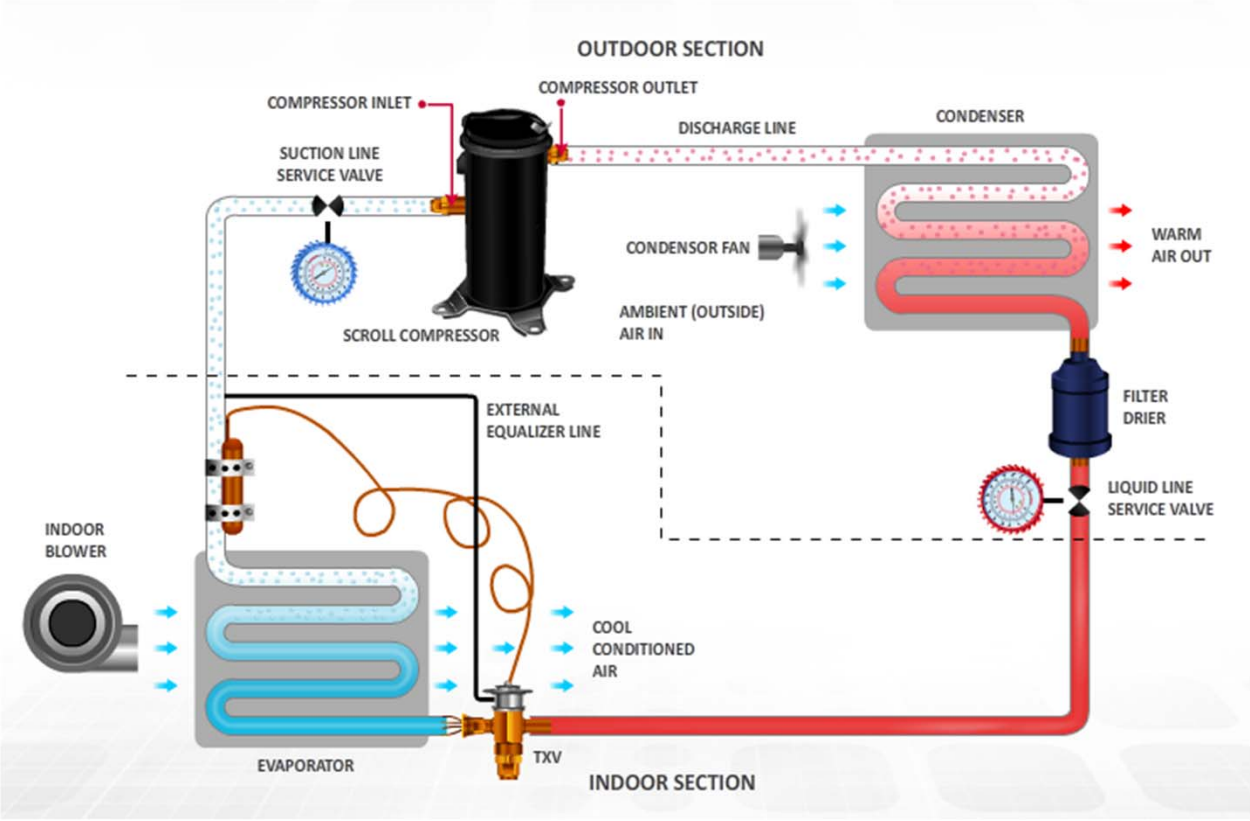


Dry bulb temperature of ambient air entering outdoor unit (°F)

40	15	18	20	23	26	29	32	34	38	41	43	46	48	51
45	13	16	18	21	24	27	30	33	36	39	41	44	46	49
50	11	14	16	19	22	25	28	31	34	37	39	42	44	47
55	9	12	14	17	20	23	27	30	33	36	38	40	42	44
66	7	10	12	15	18	21	24	27	30	33	35	38	40	43
65	-	6	10	13	16	19	21	24	27	30	33	36	38	41
70	-	-	7	10	13	16	19	21	24	27	30	33	36	39
75	-	-	-	6	9	12	15	18	21	24	28	31	34	37
80	-	-	-	-	5	8	12	15	18	21	25	28	31	35
85	-	-	-	-	-	-	8	11	15	19	22	26	30	33
90	-	-	-	-	-	-	5	9	13	16	20	24	27	31
95	-	-	-	-	-	-	-	6	10	14	18	22	25	29
100	-	-	-	-	-	-	-	-	8	12	16	21	24	28
105	-	-	-	-	-	-	-	-	5	9	13	17	22	26
110	-	-	-	-	-	-	-	-	-	6	11	15	20	25
115	-	-	-	-	-	-	-	-	-	-	8	14	18	24
°F	50	52	54	56	58	60	62	64	66	68	70	72	74	76

[Wet bulb temperature of air entering indoor coil]

Superheat - RFC



Head Pressure

Super Heat

Installation Check List

14ACX Start-Up and Performance Checklist

Customer _____ Address _____

Indoor Unit Model _____ Serial _____

Outdoor Unit Model _____ Serial _____

Notes: _____

_____

START UP CHECKS

Refrigerant Type: _____

Rated Load Amps: _____ Actual Amps____ Rated Volts_____ Actual Volts_____

Condenser Fan Full Load Amps_____ Actual Amps:___

COOLING MODE

Suction Pressure: _____ **Liquid Pressure:**_____

Supply Air **Temperature:**_____ Ambient **Temperature:**__ Return Air: **Temperature:**_____

System Refrigerant Charge (Refer to manufacturer's information on unit or installation instructions for required subcooling and approach temperatures.)

Subcooling: Saturated Condensing Temperature (A) *minus* Liquid Line Temperature (B)	A	—	B	=	SUBCOOLING
Approach: Liquid Line Temperature (A) *minus* Outdoor Air Temperature (B)	A	—	B	=	APPROACH
Indoor Coil Temperature Drop (18 to 22°F) Return Air Temperature (A) *minus* Supply Air Temperature (B)	A	—	B	=	COIL TEMP DROP


LENNOX
Automated Start Up

Technologies Available

- ✓ Voltage measurement
- ✓ Air flow measurement
- ✓ Gas pressure measurement
- ✓ Combustion measurement
- ✓ Temperature rise measurement
- ✓ Refrigerant temperature & pressure measurement
- ✓ Communicating controls
- ✓ Cloud connectivity

Monitoring Operation

Available Technologies

- Self Monitoring by Homeowner
  - Thermostat alerts or reports
  - Smart phones alerts or reports via Wi-Fi thermostat
  - Email alerts or reports via Wi-Fi thermostat
  - Alerts or reports via Home Automation System

- Professional Monitoring by Dealer
  - Include in homeowner alerts
  - Web portal


LENNOX
Systems Today

Lennox Example

iComfort®
So simple. So smart. So comfortable.

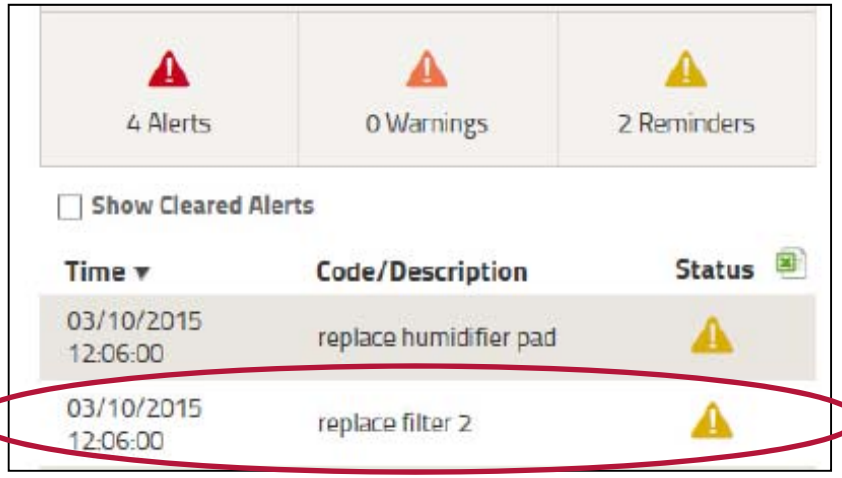
LENNOX
DAVE LENNOX signature® COLLECTION

Intelligent comfort backed by professional service

LENNOX

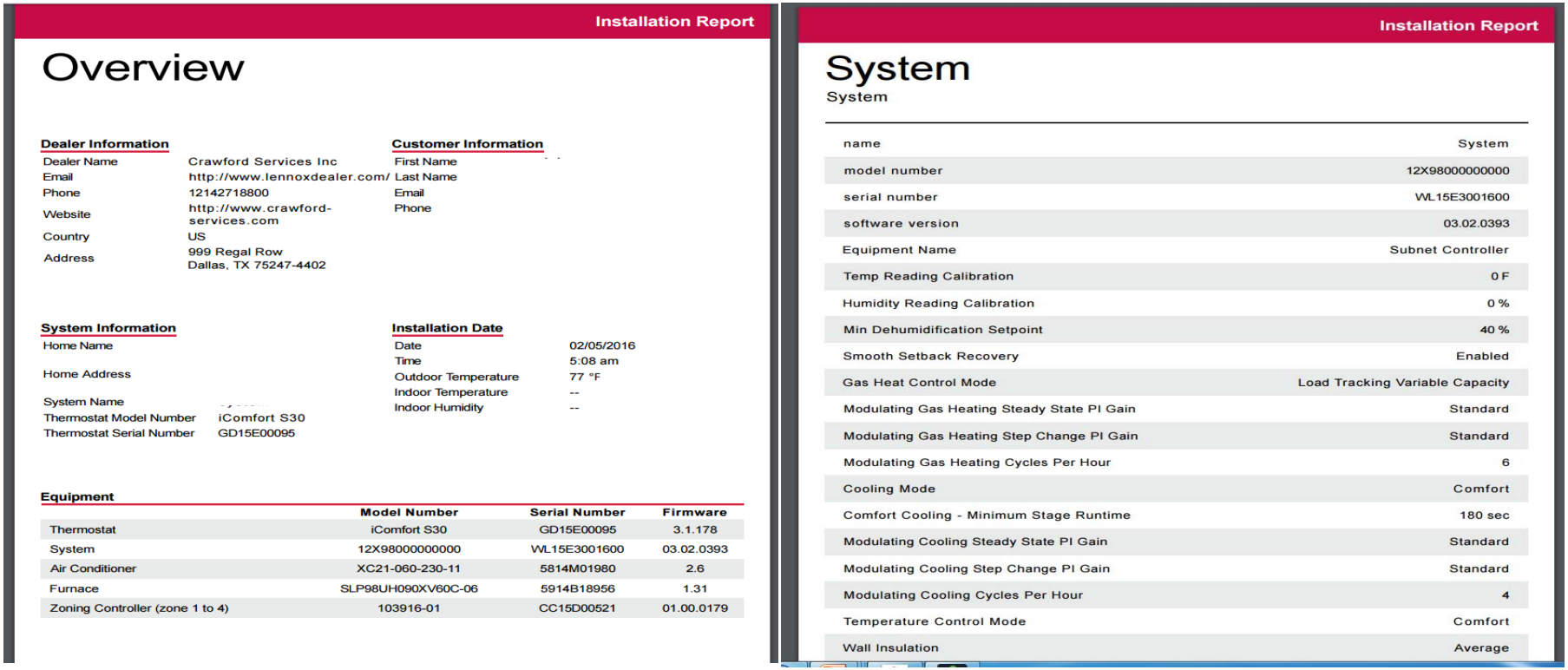
Information for the Homeowner

Intuitive User Interface



Know When Their System Needs Service

Installation Report



Installation Report

Overview

Dealer Information

Dealer Name	Crawford Services Inc
Email	http://www.lennoxdealer.com/
Phone	12142718800
Website	http://www.crawford-services.com
Country	US
Address	999 Regal Row Dallas, TX 75247-4402

Customer Information

First Name	
Last Name	
Email	
Phone	

System Information

Home Name	
Home Address	
System Name	
Thermostat Model Number	iComfort S30
Thermostat Serial Number	GD15E00095

Installation Date

Date	02/05/2016
Time	5:08 am
Outdoor Temperature	77 °F
Indoor Temperature	--
Indoor Humidity	--

Equipment

	Model Number	Serial Number	Firmware
Thermostat	iComfort S30	GD15E00095	3.1.178
System	12X98000000000	WL15E3001600	03.02.0393
Air Conditioner	XC21-060-230-11	5814M01980	2.6
Furnace	SLP98UH090XV60C-06	5914B18956	1.31
Zoning Controller (zone 1 to 4)	103916-01	CC15D00521	01.00.0179

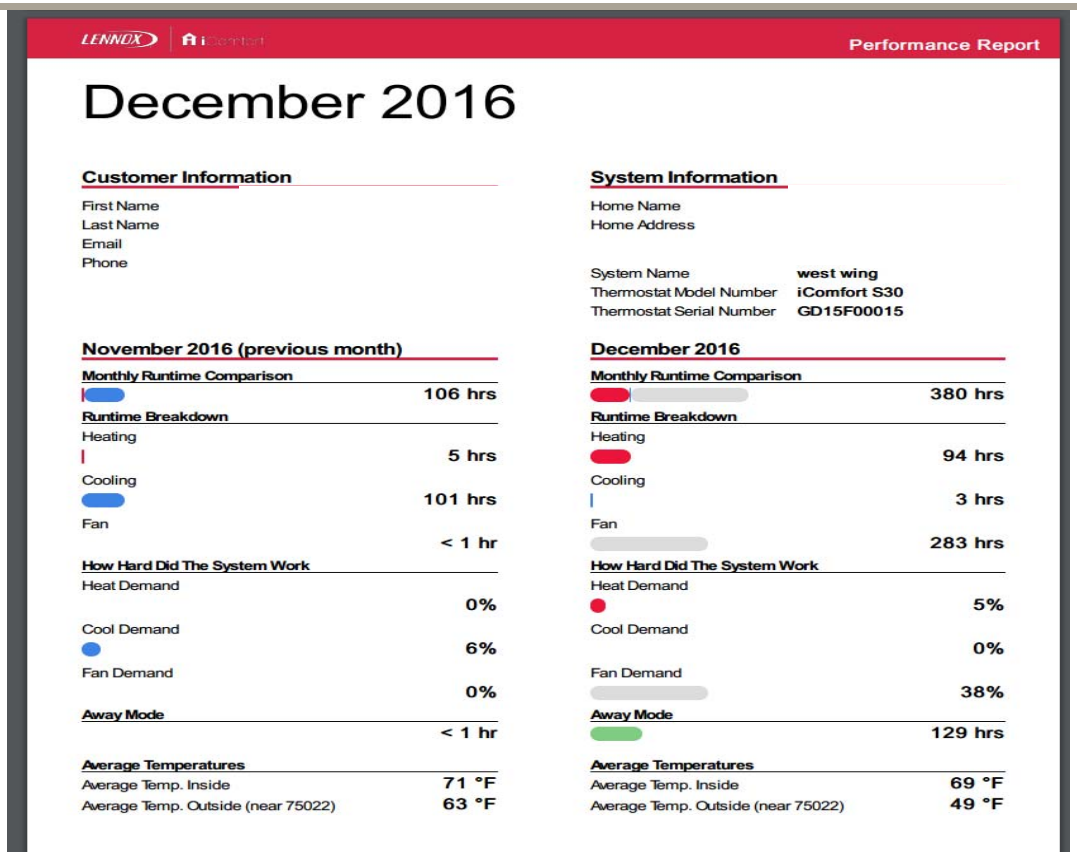
Installation Report

System

System

name	System
model number	12X98000000000
serial number	WL15E3001600
software version	03.02.0393
Equipment Name	Subnet Controller
Temp Reading Calibration	0 F
Humidity Reading Calibration	0 %
Min Dehumidification Setpoint	40 %
Smooth Setback Recovery	Enabled
Gas Heat Control Mode	Load Tracking Variable Capacity
Modulating Gas Heating Steady State PI Gain	Standard
Modulating Gas Heating Step Change PI Gain	Standard
Modulating Gas Heating Cycles Per Hour	6
Cooling Mode	Comfort
Comfort Cooling - Minimum Stage Runtime	180 sec
Modulating Cooling Steady State PI Gain	Standard
Modulating Cooling Step Change PI Gain	Standard
Modulating Cooling Cycles Per Hour	4
Temperature Control Mode	Comfort
Wall Insulation	Average

Homeowner Monthly Performance Report



LENNOX | iComfort

Performance Report

December 2016

Customer Information

First Name
Last Name
Email
Phone

System Information

Home Name
Home Address

System Name	**west wing**
Thermostat Model Number	**iComfort S30**
Thermostat Serial Number	**GD15F00015**

November 2016 (previous month)

Monthly Runtime Comparison

106 hrs

Runtime Breakdown

Heating — 5 hrs
Cooling — 101 hrs
Fan — < 1 hr

How Hard Did The System Work

Heat Demand — 0%
Cool Demand — 6%
Fan Demand — 0%

Away Mode

< 1 hr

Average Temperatures

Average Temp. Inside	71 °F
Average Temp. Outside (near 75022)	63 °F

December 2016

Monthly Runtime Comparison

380 hrs

Runtime Breakdown

Heating — 94 hrs
Cooling — 3 hrs
Fan — 283 hrs

How Hard Did The System Work

Heat Demand — 5%
Cool Demand — 0%
Fan Demand — 38%

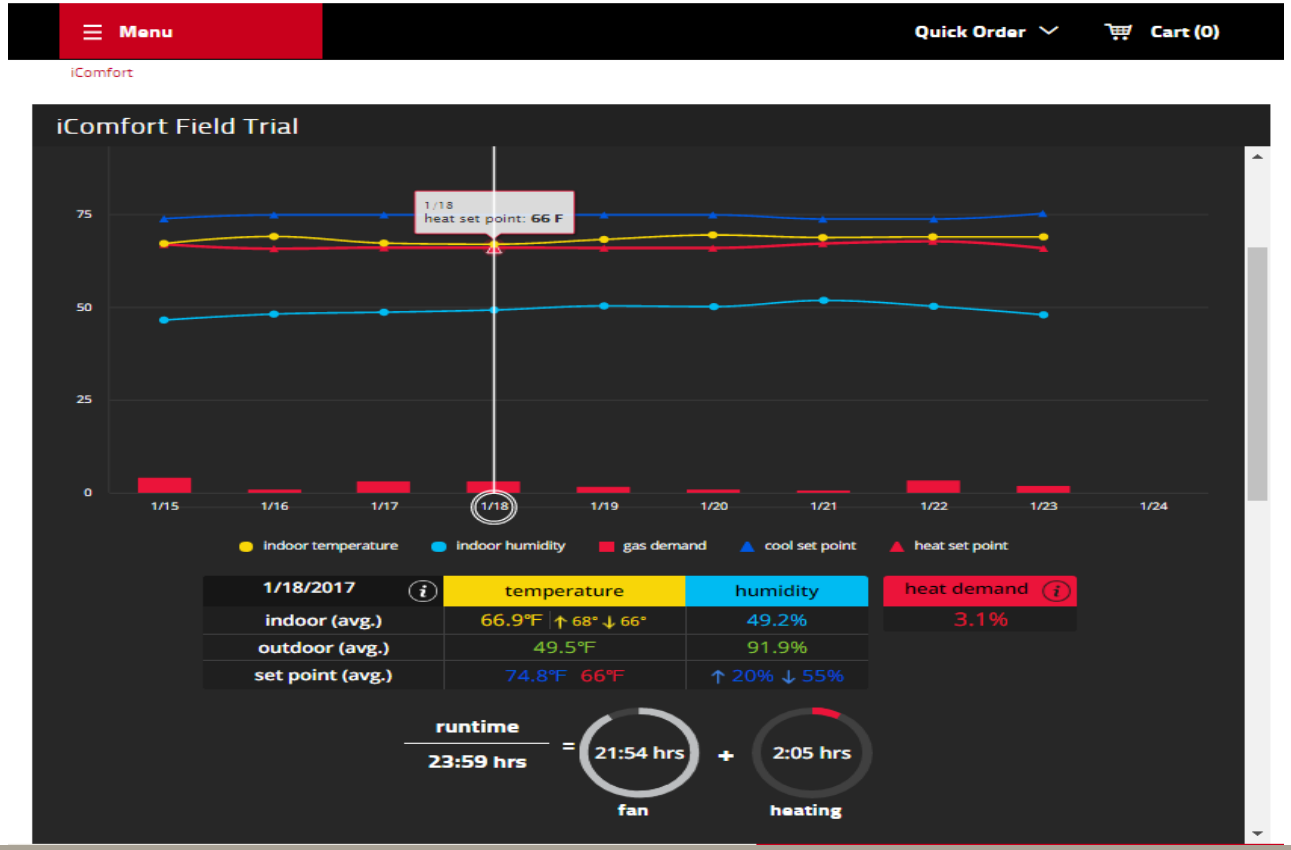
Away Mode

129 hrs

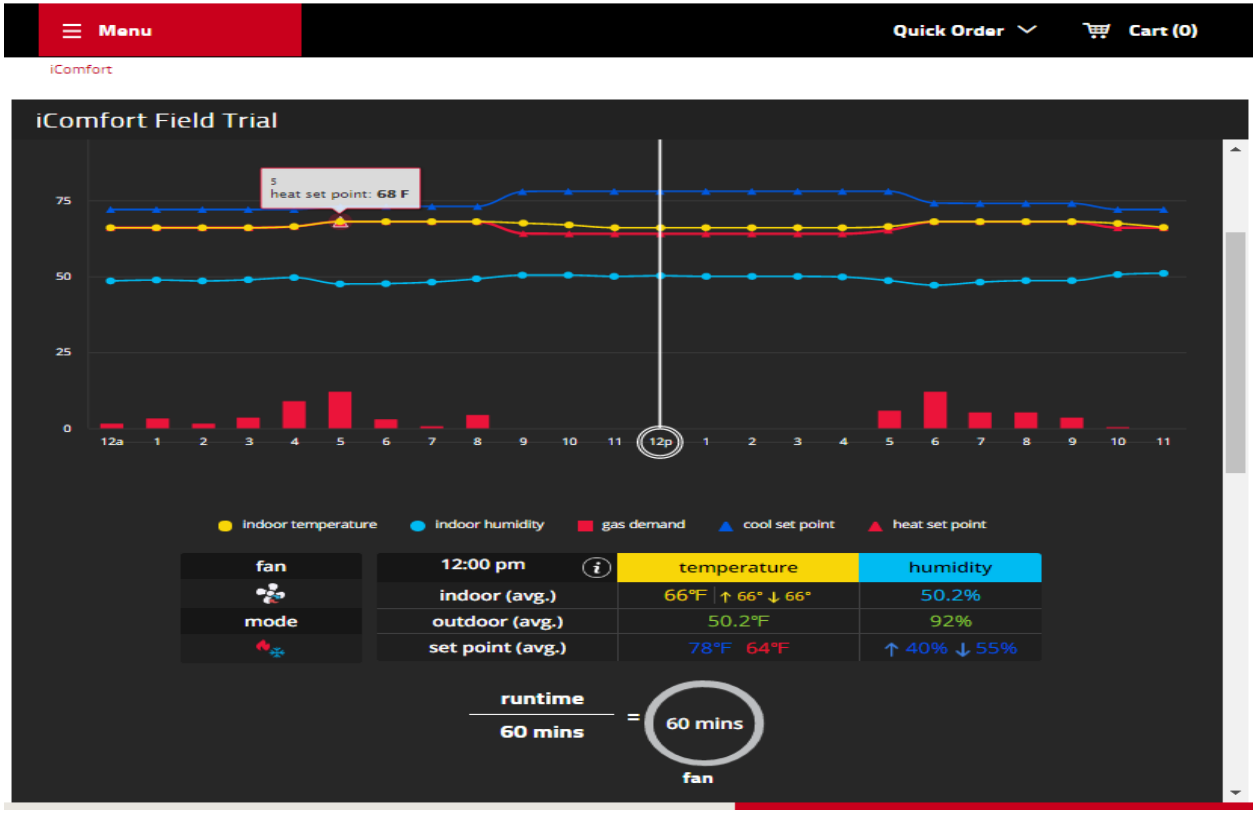
Average Temperatures

Average Temp. Inside	69 °F
Average Temp. Outside (near 75022)	49 °F

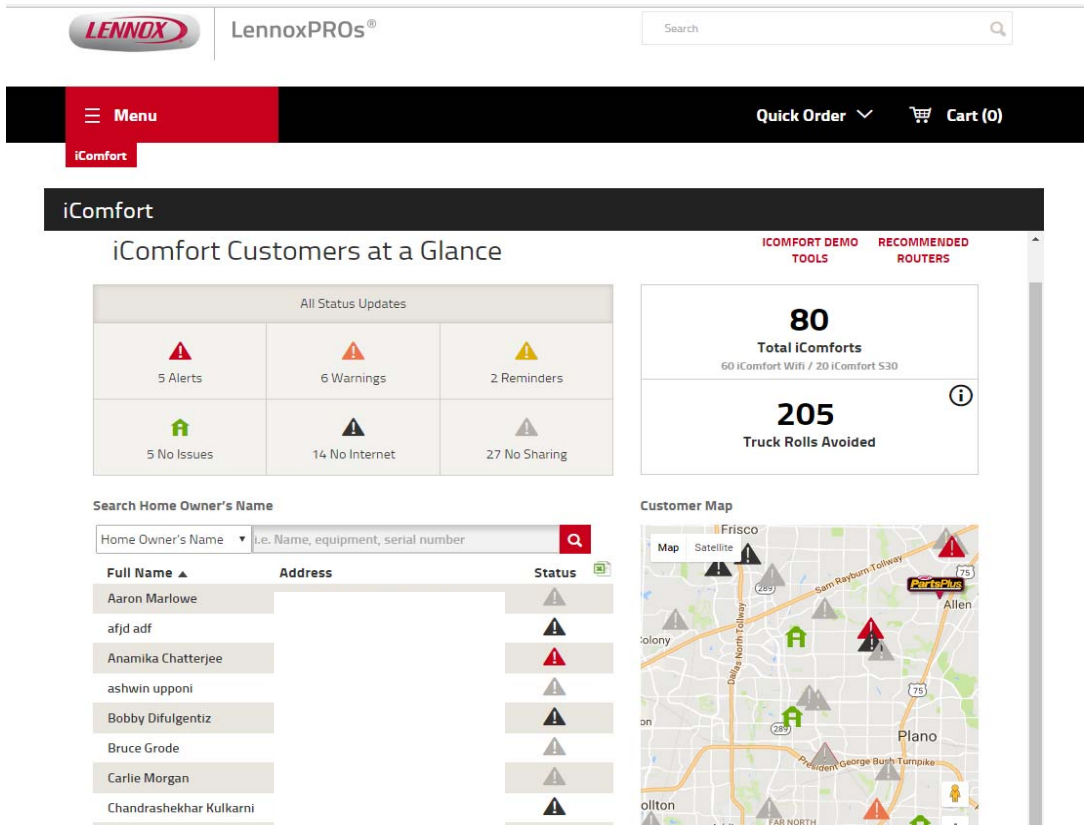
Homeowner Web Portal – Daily Performance Report



Homeowner Web Portal – Hourly Performance Report



Dealer Web Portal Dashboard

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