Report No. 12150
Date: 03/16/06

Fuel Reduction Pilot Program

CONDUCTED AT

HARVARD UNIVERSITY
LOEB DRAMA CENTER

FOR

Northland Group

TEST RESULTS
FOR
HOT-WATER BOILERS
AND
DOMESTIC HOT-WATER HEATER

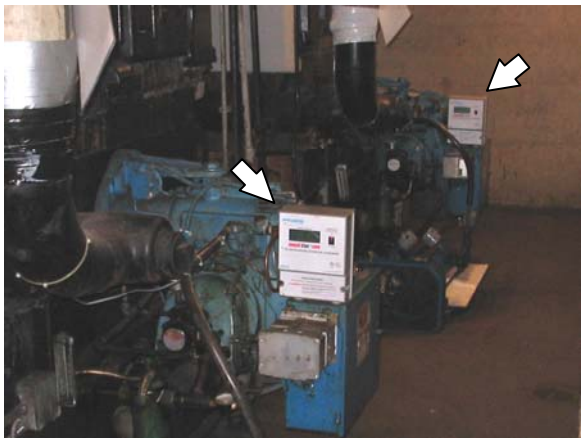
A Confidential Report
Prepared by
Intellidyne LLC

March 2006

EXECUTIVE SUMMARY

LOEB DRAMA CENTER
HARVARD UNIVERSITY

The attached technical report summarizes the Energy Saving Performance of the ***IntelliCon***® "HW" and "CHW" energy saving controls which were installed on 2 oil-fueled HB Smith hydronic boilers with 2.867mbh input and 1 gas-fueled A.O. Smith hot water heater with 190,000 BTU input.



The ***IntelliCon***® units were installed at the Loeb Drama Center located at 64 Brattle St., Cambridge, MA and the validation data was collected from February 8, 2006 to March 7, 2006. The test data was collected using "alternating day" methodology which is further describe later in this report. Detailed data on solar load, outdoor temperature and indoor temperature was also collected and is part of this final report.

The Pilot period data in this report reflects a reduction in run time and a significant reduction in cycling on both the heating system and the Domestic Hot Water System. The two HB Smith boilers achieved a reduction in total run time of **11.93%** and a dramatic reduction in cycling of **58.3**% with the ***IntelliCon***® controls installed. The A.O. Smith water heater also realized a reduction in total run time of **7.13%** and a reduction in cycling of **51.6%** with the ***IntelliCon***® control installed.

The individual reports contain the documentation that supports the summary results and further details the specific length of the Pilot Test as well as documenting the overall temperature performance and predictability of the two systems ***after the IntelliCon® affect.***

Based on the results of this Pilot and using the burner firing rates for the equipment. We have calculated what the financial impact would be if the Intellidyne controls would have been in full operation during the Pilot period. The calculation is as follows

Boilers Without ***IntelliCon***® Controls

Total Hours of Boiler consumption during the pilot period = 293 hrs, 40 min, 22 sec
Fuel consumption for Boilers = 2,867,000 BTU per hour
#4 Heating Oil = 142,500 BTU per Gallon
Calculated fuel consumption = 293.67 Hr x 2,867,000 BTU / 142,500 = 5908 Gal
Calculated cost of fuel consumed = 5980 x $1.60gal = $9,452.80

Boilers With ***IntelliCon***® Controls

Total Hours of Boiler consumption during the pilot period = 258 hrs, 37 min., 50 sec
Fuel consumption for Boilers = 2.867,000 BTU per hour.
#4 Heating Oil = 142,500 BTU per Gallon
Calculated fuel consumption = 258.63 Hr. x 2,867,000 BTU / 142,500 = 5203 Gal
Calculated cost of fuel consumed = 5203 x $1.60gal = $8,324.80

Fuel cost savings with ***IntelliCon***® controls = **$1,128.00 for (28 days)**

Water Heater Without ***IntelliCon***® Controls

Total Hours of Water Heater consumption during pilot period = 72 hrs, 51 min, 34 sec
Fuel consumption for Water Heater = 190,000 BTU per hour
Nat. Gas = 100,000 BTU per Therm
Calculated fuel consumption = 72.86 hr x 190,000 BTU / 100,000 = 138.4 Therms
Calculated cost of fuel consumed = 138.4 x $1.70/thm = $235.28

Water Heater With ***IntelliCon***® Controls

Total Hours of Water Heater consumption during pilot period = 67 hrs, 40 min, 0 sec
Fuel consumption for Water Heater = 190,000 BTU per hour
Nat. Gas = 100,000 BTU per Therm
Calculated fuel consumption = 67.66 hr x 190,000 BTU / 100,000 = 128.5 Therms
Calculated cost of fuel consumed = 128.5 x $1.60/thm = $205.60

Fuel cost savings with ***IntelliCon***® controls = **$29.68** for **(28 days**)

TOTAL SAVINGS FOR 28 DAY PILOT PERIOD = $1,157.68

These results present a compelling financial benefit resulting from the implementation of the ***IntelliCon***® Energy Saving Controls.

Addition cost benefit can be realized from the significant reduction in cycles which reduces wear and tear on equipment and environmental benefits are achieved by reducing the pollutants vented into the atmosphere

The ***IntelliCon***® Energy Saving Controls will deliver the following benefits to the owner and come with a 15 year warranty against manufacturing defects.

- Guaranteed Energy Consumption Reductions
- Reduced Wear and Tear from excessive on/off cycling
- Reduced Environmental Pollution
- Consistent Temperature Performance
- No Maintenance or Programming
- Low Upfront Cost and High ROI

90 Pratt Oval
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Test Report

Report No. 12150-1

Date: 03/16/06

Customer:

Northland Group
593 New Park Avenue
West Hartford, Ct 06110

Contact: Jerry Breen

Test Site Location:

Harvard Loeb Drama Center
64 Brattle Street, Cambridge, MA

Test Type: ☑ HEATING ☐ AIR CONDITIONING ☐ REFRIGERATION ☐ OTHER:

Product Tested: ☐ HW ☐ LCH ☐ LCS ☑ CHW ☐ CHS ☐ AC ☐ CAC ☐ RU ☐ OTHER:

Type of Equipment:

Manufacturer:	HB Smith
Model:	16 Section, Porkchop Style, Brickset
Capacity / SetPt:	2,867,000 Btu Input / 190 F.
Fuel Type:	#4 Oil
Application:	Hydronic Heating
Area Served:	Entire Building
Misc.	

Test Start Date: 02/08/06

Test End Date: 03/07/06

No. of Days in Test: 28

BURNER RUN-TIME: ☑ in HRS. ☐ in MIN.

IntelliCon **ON-DAYS:** 129:18:55

IntelliCon **OFF-DAYS:** 146:50:11

RUN-TIME was reduced by: **11.93%**

BURNER USAGE FACTOR:

IntelliCon **On-Days:** **19%**

IntelliCon **Off-Days:** **22%**

HEATING DEGREE-DAYS (FOR TEST PERIOD)

IntelliCon ON-DAYS: 461

IntelliCon OFF-DAYS: 468

Total Degree-Days: 930

It was **1.5%** **Warmer on the On-Days.**

USAGE PER DEGREE-DAY

ON-DAYS: 0:16:49

OFF-DAYS: 0:18:49

SOLAR LOAD COMPENSATION: (Lumens/Sq. Ft.)

IntelliCon ON-DAYS: 38914

IntelliCon OFF-DAYS: 36420

It was **6.85%** **Sunnier on the On-Days.**

BURNER CYCLING REDUCTION:

IntelliCon ON-DAYS: 369

IntelliCon OFF-DAYS: 885

Cycling was reduced by: **58.3%**

Individual Runtimes

ON-Day	Boiler #1	Boiler #2
Runtime	62:15:22	67:03:33
Cycles	169	200

OFF-Day	Boiler #1	Boiler #2
Runtime	75:49:44	71:00:27
Cycles	460	425

Savings = 11.93%

COMMENTS:

Note: Boiler Runtimes are an aggregate of Boilers #1 and #2. Equipment for Boilers #1 and #2 were the same. The effects of Heating Degree-Day differences of less than 2% are not significant enough to be compensated for. Space temperature excursion occurred on 2/11/06.. Logged data revealed that both boilers were off from 2322 hrs on 2/10 through 1538 hrs on 2/11. The outside temperature during this time period averaged 30 degrees F.

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Test Report

Report No. 12150-2

Date: 03/16/06

Customer:

Northland Group
593 New Park Avenue
West Hartford, Ct 06110

Contact: Jerry Breen

Test Site Location:

Harvard Loeb Drama Center
64 Brattle Street, Cambridge, MA

Test Type: ☑ HEATING ☐ AIR CONDITIONING ☐ REFRIGERATION ☐ OTHER: _____

Product Tested: ☑ HW ☐ LCH ☐ LCS ☐ CHW ☐ CHS ☐ AC ☐ CAC ☐ RU ☐ OTHER: _____

Type of Equipment:

Manufacturer:	AO Smith
Model:	MasterHot
Capacity / SetPt:	190,000 BTU Input / 145 F.
Fuel Type:	Natural Gas
Application:	Domestic Hot Water
Area Served:	Entire Building
Misc.	

Test Start Date: 02/08/06

Test End Date: 03/07/06

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No. of Days in Test: 28

BURNER RUN-TIME:

☑ in HRS. ☐ in MIN.

***IntelliCon* ON-DAYS:** 33:50:00

***IntelliCon* OFF-DAYS:** 36:25:47

RUN-TIME was reduced by: **7.13%**

BURNER USAGE FACTOR:

***IntelliCon* On-Days:** **10%**

***IntelliCon* Off-Days:** **11%**

BURNER CYCLING REDUCTION:

IntelliCon ON-DAYS: 296

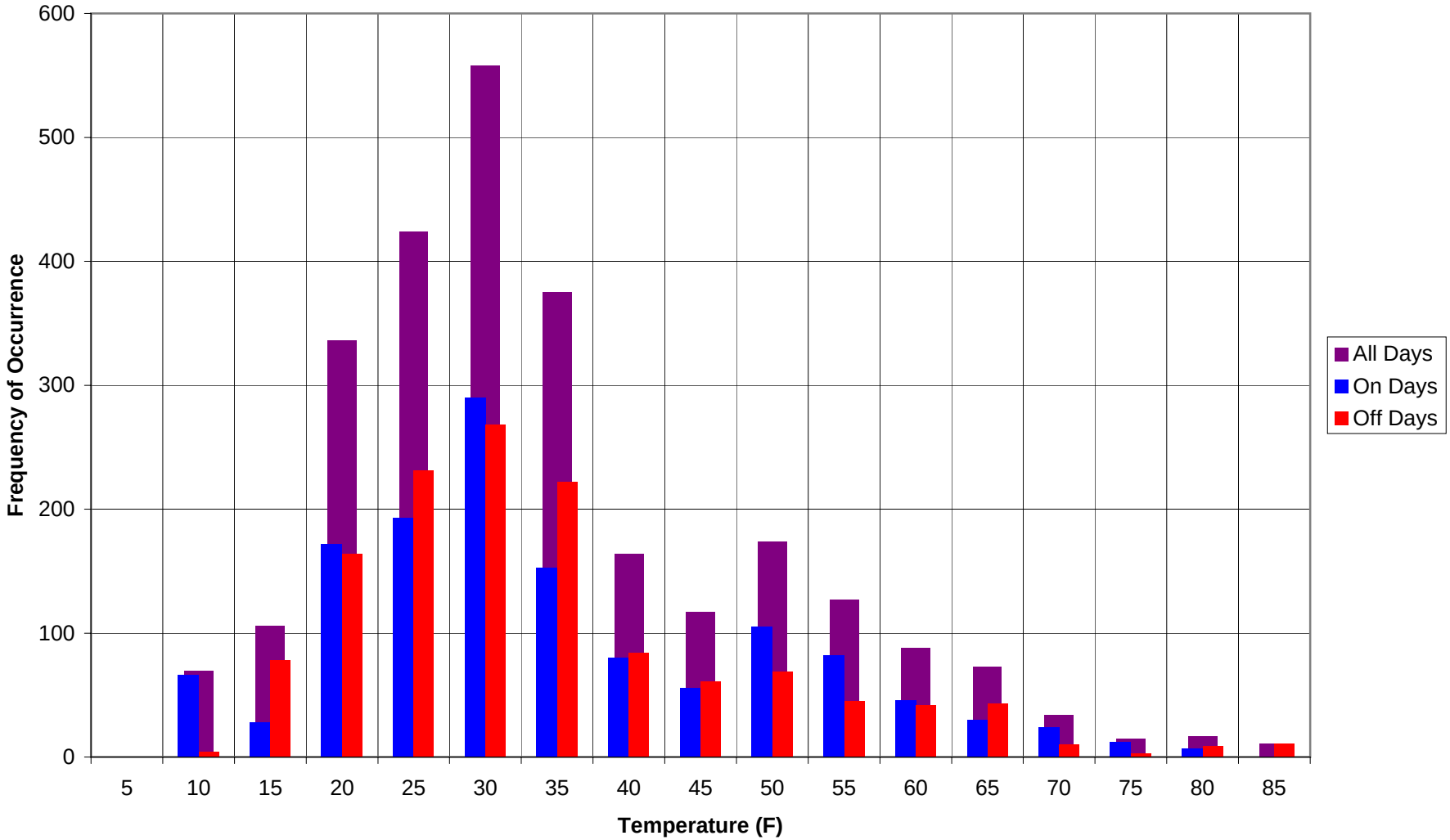
IntelliCon OFF-DAYS: 612

Cycling was reduced by: **51.6%**

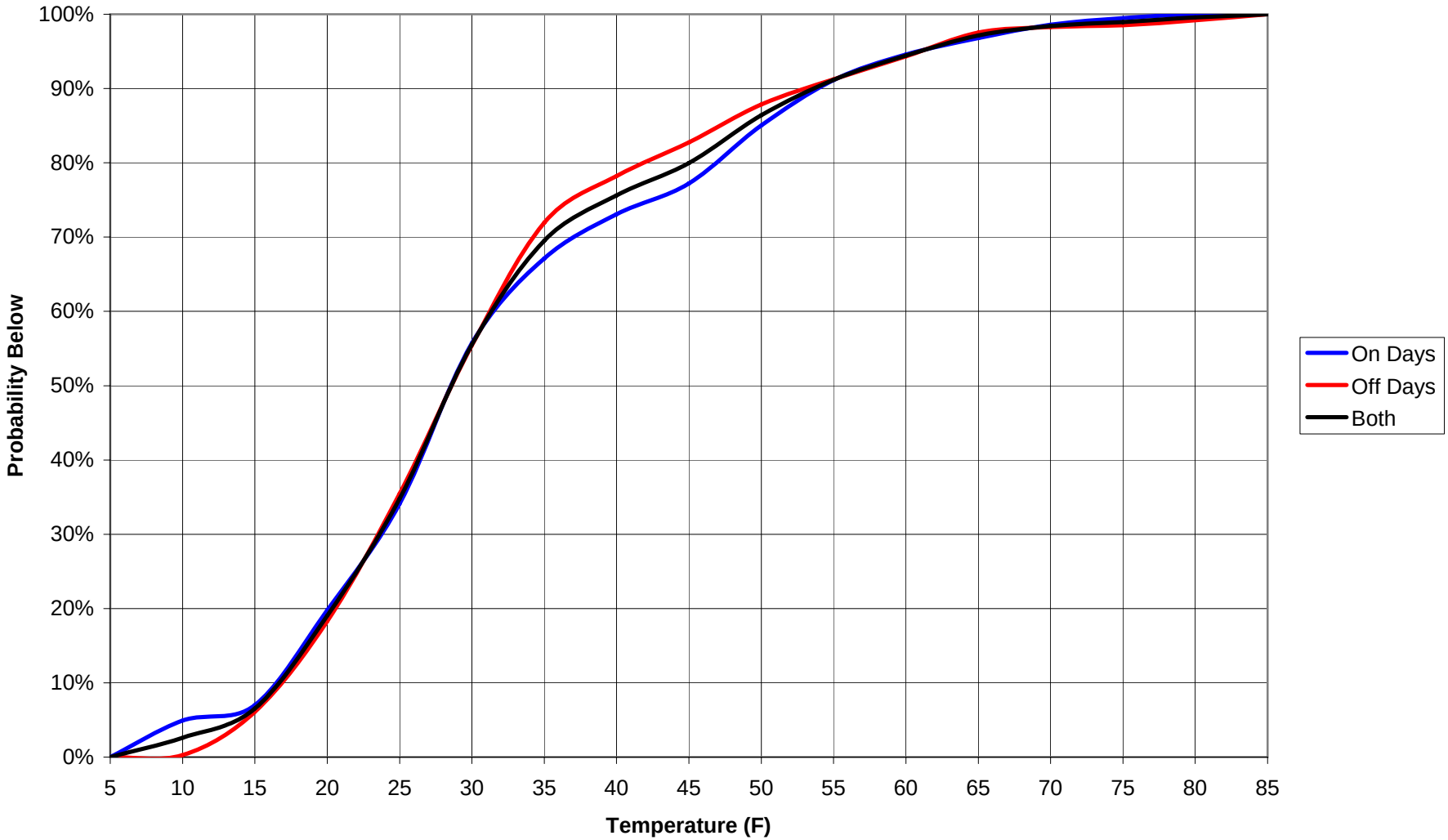
Savings = 7.13%

COMMENTS:

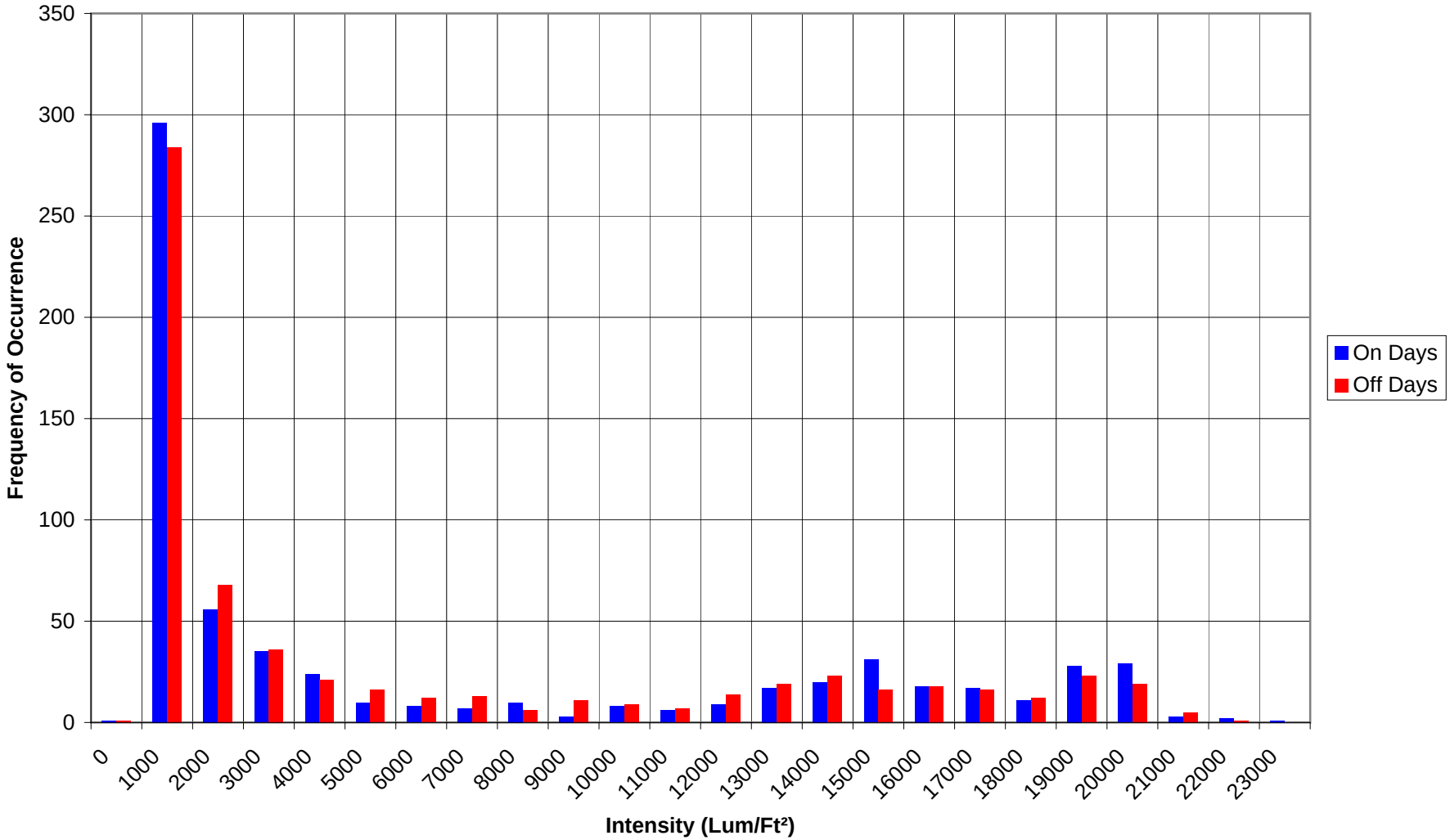
Harvard Loeb Drama Center
Outside Air Temp Histogram (02/08/06--03/07/06)



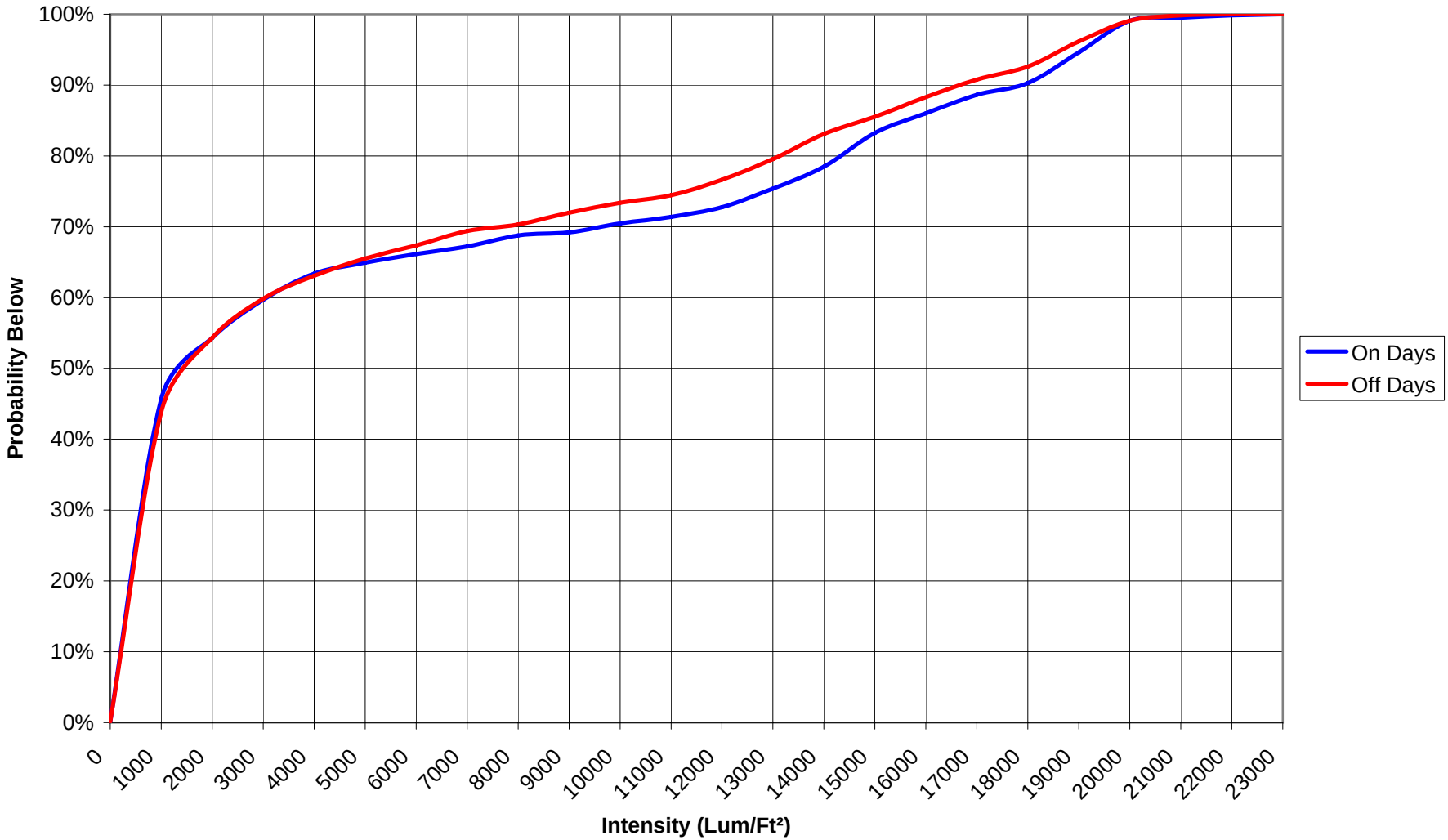
Harvard Loeb Drama Center
Outside Air Temperature Probabilities (02/08/06--03/07/06)



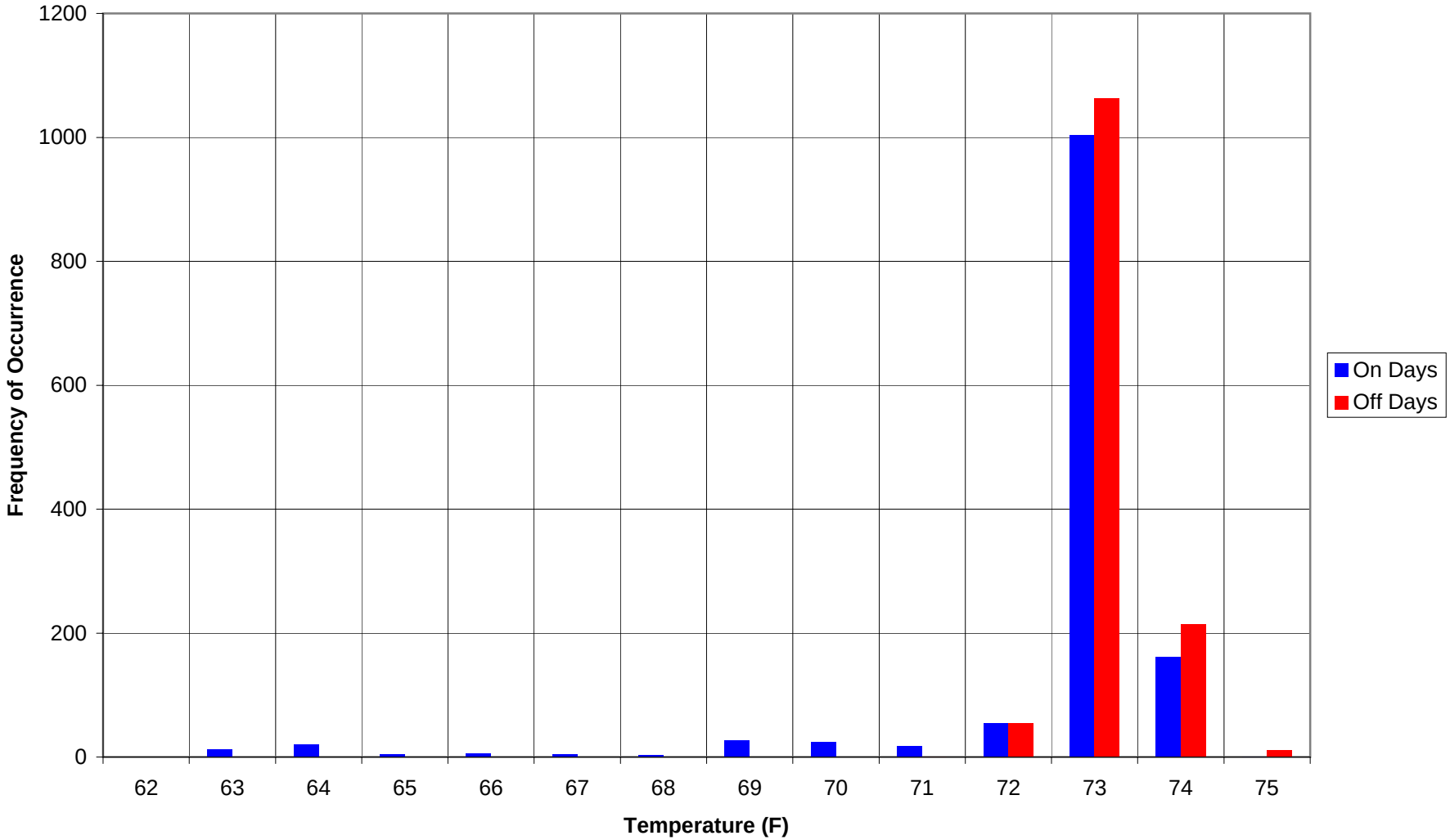
Harvard Loeb Drama Center
Solar Load Histogram (02/08/06--03/07/06)



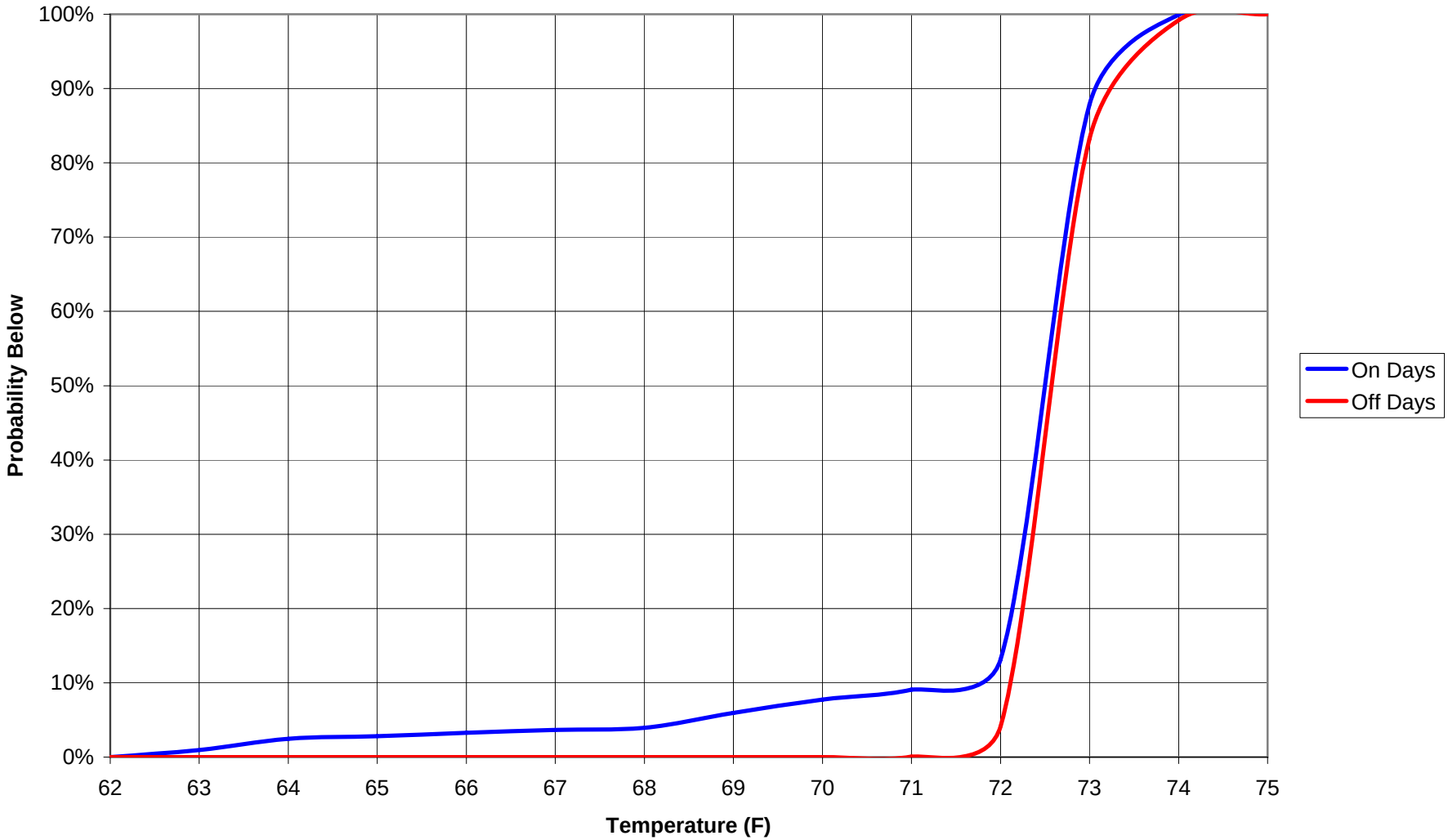
Harvard Loeb Drama Center
Solar Load Probabilities (02/08/06--03/07/06)



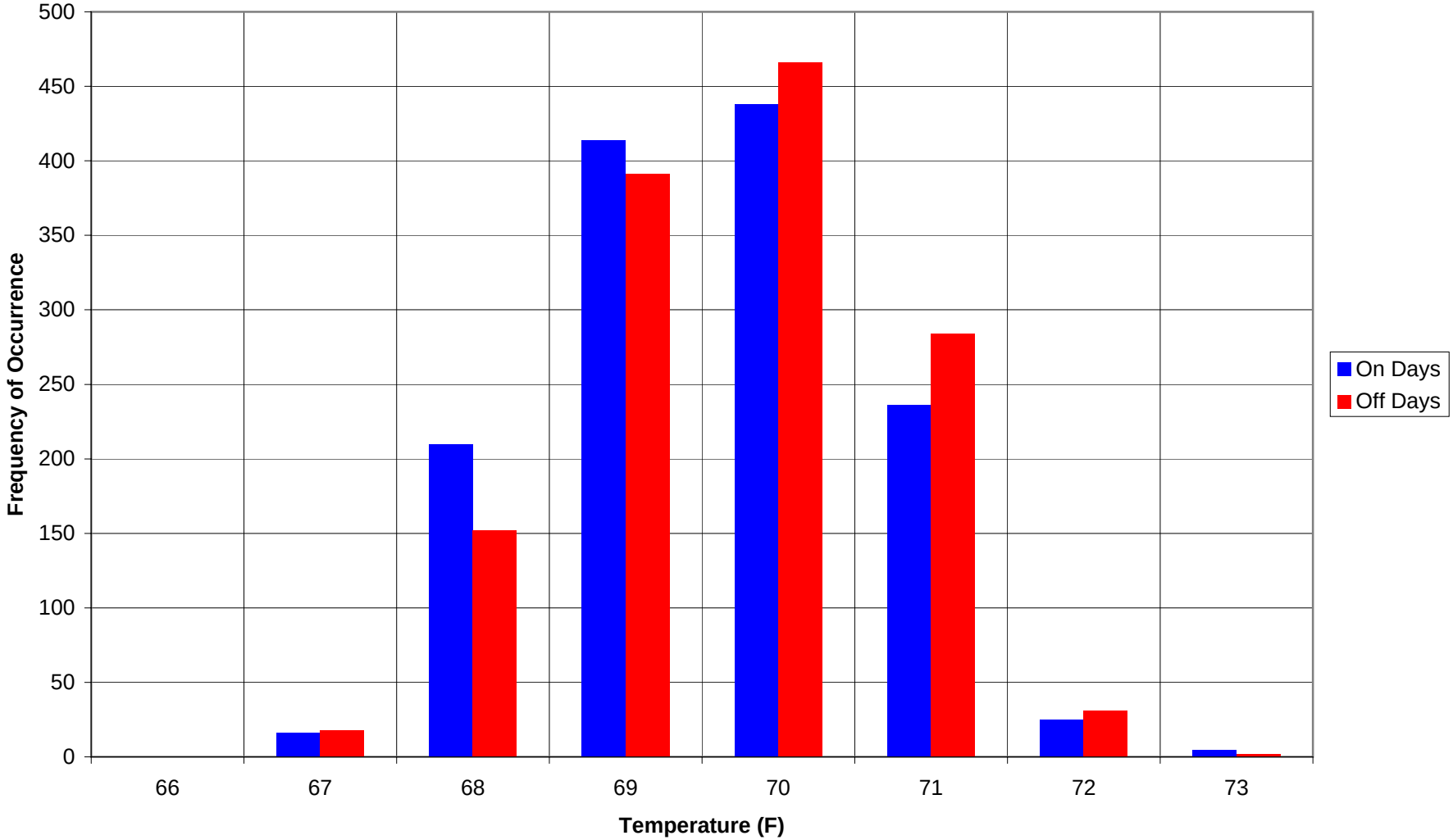
Harvard Loeb Drama Center
Office Area Space Temp Histogram (02/08/06--03/07/06)



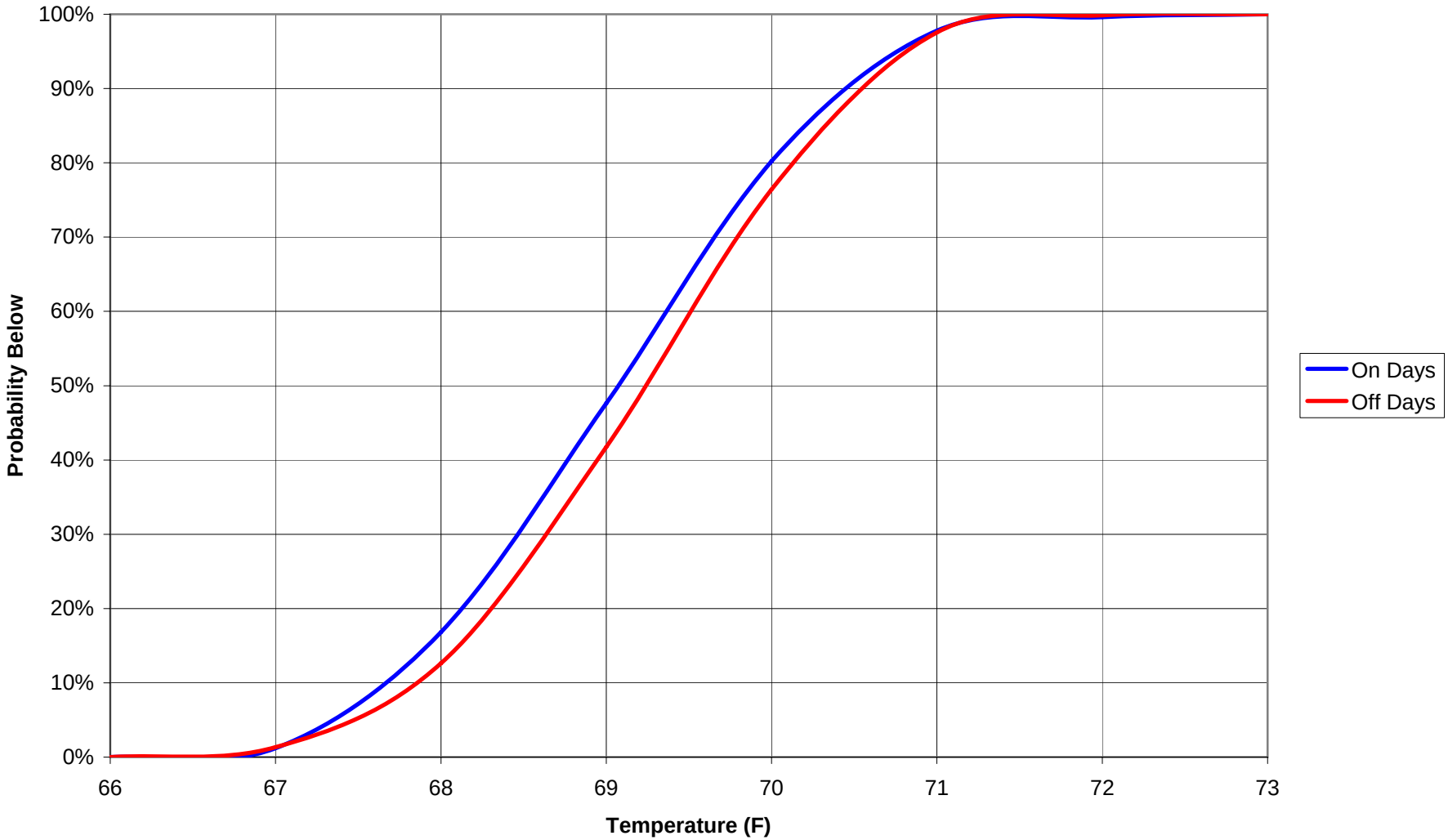
Harvard Loeb Drama Center
Office Area Space Temperature Probabilities (02/08/06--03/07/06)



Harvard Loeb Drama Center
Auditorium Space Temp Histogram (02/08/06--03/07/06)



Harvard Loeb Drama Center
Auditorium Space Temperature Probabilities (02/08/06--03/07/06)



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Testing Methodology

RECOMMENDED EQUIPMENT FOR TESTING PURPOSES

Specific timing and data logging devices are used to gather detailed information about the unit(s) being evaluated. Each device has been carefully selected for its reliability, capability and function. The individual devices INTELLIDYNE uses are explained below.

1. TIME CLOCK:

Manufacturer: Tork Model: 8007V-0

Is used to switch the IntelliCon® product in and out of the circuit. This is done on a 24 hour basis. The result is that the IntelliCon® product is in control ("in" the circuit) one day and not in control ("out" of circuit) the next day. A 14 day time clock was selected so that a complete alternation of days that IntelliCon® is in control would result.

2. CURRENT SWITCH:

Manufacturer: Veris Industries Model: Hawkeye 608/908

The current switch is used to monitor when current is being drawn by the cooling/refrigeration compressor or heating burner. When current is sensed it is "On" when no-current is sensed it is off "OFF". The current switch is used in conjunction with the "Change-of-State" data logger.

3. "CHANGE–OF–STATE" DATA LOGGER:

Manufacturer: Onset Computer Corp. Model: H06-001-02

This device monitors and logs the "change-of-states" (the on / off status) of the unit being tested. It is used in conjunction with the CURRENT SWITCH, above, and time and date-stamps (logs) each change of status. By processing the logged data, the durations for each cycle can be determined.

4. "LIGHT INTENSITY" DATA LOGGER

Manufacturer: Onset Computer Corp. Model: HLI

This data logger is used to monitor and log Light Intensity and is used to determine the solar-load influence on the facility.

5. "T/Rh " DATA LOGGER

Manufacturer: Onset Computer Corp. Model: H08-004-02

This data logger is used to monitor and log the temperature and relative humidity in the conditioned space.

6. "TEMPERATURE" DATA LOGGER

Manufacturer: Onset Computer Corp. Model: H08-001-02

This data logger is used to monitor and log the outdoor air temperature, and is used to determine the degree-day influence on the facility

WHAT DATA IS COLLECTED

Linking all of the above together with the IntelliCon® product being “in” and “out” of the circuit, on alternating days, yields the following data:

How many on/off cycles per day (if applicable).
Total “on time” per cycle, per day.
Total “off time” per cycle, per day.
What the solar conditions of the facility was during the test period (if applicable).
What the relative humidity in the conditioned space was during the test period (if applicable).
What the temperature of the conditioned space was during the test period (if applicable).
What the outdoor air temperature was during the test period (if applicable).

How The Data Is Analyzed

Upon completion of the test, all the data is evaluated to calculate the reduction of consumption (savings).

Short-term testing analysis can only be performed properly by the elimination and reduction of as many variables as possible and through the analysis of the data on a statistical basis. The alternating “in” circuit / “out” of circuit testing has the advantage of minimizing the variations due to time-sensitivity, day-of-week sensitivity, degree-day effects, etc.

In order to properly evaluate the data, the following must be determined:

1. A baseline must be established. Baseline consumption data is the “use” or consumption information that is unaffected by the IntelliCon economizer (“out” of circuit). This may be derived during the test (which is what is done here) or from historical records. The advantage of deriving the base-line during the test is that site specific degree-day and solar data may be determined as opposed to weather-service data that may or may not be indicative of the test site.

2. It is necessary to determine what effects or influences are caused by solar- load and degree-day variations. This is done by performing a statistical analysis on the solar and degree-day data collected during the base-line phase.

3. In order to properly compare the two consumption cases (IntelliCon “in” and “out” of circuit), and determine the savings, it is necessary to adjust (or “normalize”) the data collected during the “in-circuit” phase. The consumption data collected when the IntelliCon economizer was “in-circuit”, is “normalized” by compensating for the effects of the solar and degree-day influences that occurred during the same phase of the test. This is accomplished by applying the statistical analysis results of the solar and degree-day influences (collected during the base-line phase) as a means to compensate for the solar and degree-day variations that occurred during the “in” circuit phase of the test.

4. The normalized consumption data acquired during the “in” circuit phase is compared to the base-line data and the savings determined.