



**INFRARED ANALYSIS
OF THE
ELECTRIC SERVICE PANELS**

[REDACTED]

[REDACTED]

[REDACTED]

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I. ABSTRACT

An infrared, electrical component analysis was conducted at [REDACTED], by **Spectrum Infrared**. The survey was made on June 27, 2016, for the purpose of locating and defining increases in surface temperatures within power supply panels. All circuit breakers panels, and fuses in electric service panels were scanned.

The basic tool of the **Spectrum Infrared Electrical Survey** is the **Fluke TiR-32** Thermal Measurement and Imaging System. The camera operates using a Focal Plane Array (Uncooled Microbolometer) Infrared Thermal Measurement and Imaging System. Electromagnetic thermal energy radiating from an object is converted into electronic video signals, and displayed on a field monitor. The camera senses the intensity of thermal radiation from a surface, and displays a monochrome image whose density corresponds to the radiation intensity. The radiant energy levels are interpreted as surface temperatures.

Connections of electric service panels generate heat when the circuit is in operation. If there is a malfunction in the circuit, the level of heat generated will become elevated. It is this elevated temperature above normal operating or ambient temperatures that the infrared camera detects and records.

The digital thermal information recorded within the camera is colorized and analyzed using the Smartview 4 software, enabling various color palettes to assist in visible differentiation between temperatures.

The hot spots identified during the scan are indicated as lighter colors. Each panel was opened and analyzed for ambient surface temperature, then the temperatures were taken of each hot spot using the in-camera temperature measuring devices. The actual temperatures are indicated in the Thermographic Documentation Section of this report. The temperature increases or thermal anomalies are also listed in the Infrared Analysis Summary.

Panels without elevated heat are either assumed to be functioning normal or were not in use at the time of the scan. Readings taken at panels that were not in operation will not produce measurable thermal images.

Elevated temperatures do not always indicate a problem with the circuit or fuse, for example: Hallway or exterior lighting panels typically run much warmer than other circuits. Only abnormal anomalies are considered to be issues that may require further attention.

Included in this report are the following:

Evaluation - Offers information as to the possible causes of major problems seen during the survey.

Infrared Analysis Summary - Outlines the findings of the survey.

Thermographic Documentation - Details the findings of the survey, including temperature increases, illustrated through infrared thermograms.

Recommendations and Corrective Action - Basic guidelines for remedial action on identified problem areas.

It is suggested to conduct a second infrared analysis of all items six months after the initial survey, in order to obtain thermal data for comparison. Changes in electrical load due to repairs, and differences in exterior temperatures as well as additional electrical usage, may give different thermal readings, which would be useful in a comparison study.

II. ELECTRICAL SURVEY EVALUATION

The infrared survey for [REDACTED] was conducted during a one-day period, on [REDACTED]. Building personnel identified the panels evaluated. Possible problems that may cause increased surface temperatures of circuits include faulty manufacturing, loose or dirty connections, loose wiring, insufficient fuses or wiring, old or deteriorated parts, and overloaded circuits.

In circuit panels (low voltage equipment- under 600 volts), slight temperature increases of about 10° F. to 20° F. may indicate a possible deficiency, but not one of immediate concern. These temperature increases may also be normal operational temperatures for the loads being used through indicated circuits or fuses. Only through subsequent surveys can these anomalies be confirmed problems areas. Temperature increases exceeding this value and particularly those in excess of 50° F are considered to be moderate to serious deficiencies, and should be attended to as soon as possible.

This temperature criterion is intended to assist your determination of repair priority. These standards have been developed through many years of customer interaction and response to their repairs and findings. These standards are only intended to be a guide for prioritization, and are by no means the final standard.

Departures from normal temperatures expected in fuses and circuits are an indicator of a defect in materials, overloaded circuits, or connections on current carrying positions. Abnormalities such as these are due to installation techniques, or long term expected deterioration. Suspect faults can eventually result in general degradation of switchboard components.

It should be noted that the infrared analysis records instantaneous data on energized suspect areas; therefore, the "rate" of deterioration cannot be determined. A yearly maintenance program including an infrared study would substantially reduce the risk of low voltage burndowns.

Each panel box is labeled, and the departure from ambient temperature is listed in this report.

One circuit showed a Priority One temperature increase (over 50 degrees F), located at the Laundry Room Service Disconnect, AC Unit #2 Phase 2. The issue noted there (loose connection) was addressed during the scan (by [REDACTED]).

III. THERMOGRAPHIC DOCUMENTATION

The following sets of thermograms depict thermal anomalies seen during the electrical survey. The information available on each page is as follows:

1. Location
2. Photo Set Number
3. Panel Designation
4. Circuit Number or Fuse Designation
5. Ambient Temperature
6. Anomaly Temperature
7. Temperature Increase over Ambient T.
8. Priority Scale

Panel Designation is based on the labels seen on panels at the time of the survey. For panels without labels, a letter designation was drawn onto the panels.

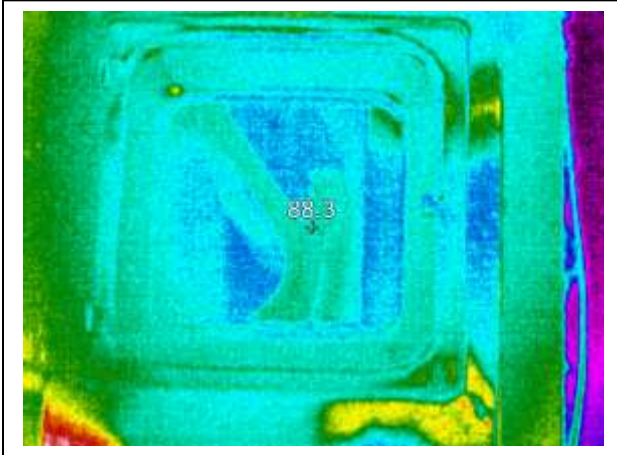
Circuit numbers and/or fuses listed in this section were confirmed with the infrared camera imagery and identified visually (as marked on the panel boxes).

Priority Scale can be interpreted as follows: All identified anomalies require attenuation in some form or another. The greater the temperature increase, the greater the importance of identifying the cause. Temperature increases seen at 10° or less are not within the Priority Scale, as they can be assumed to be within a normal operational range.

Increases that are seen as 10° F to 19° F are marked as PRIORITY 3. These circuits may or may not have a problem, as the temperature increases may be normal for those circuits. It is suggested, however, to evaluate the circuits for potential problems as time and materials permit. Parts are usually repairable.

Increases that are seen as 20° F to 49° F are marked as PRIORITY 2, indicating a greater possibility of circuitry problems. Try to correct the problems soon. Parts are still usually repairable, but may become permanently damaged soon.

Circuits listed with temperature increases of 50° F and higher are marked as PRIORITY 1 and should take top priority in electrical repair service. Parts will often require replacement due to thermal stress. Attempts to simply tighten connections will probably not offer permanent repair.



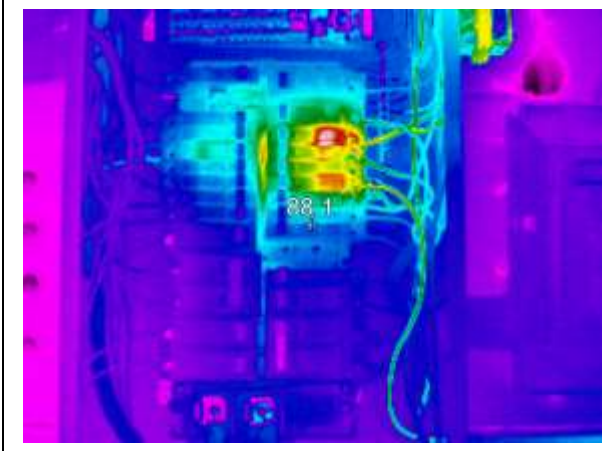
Infrared Image



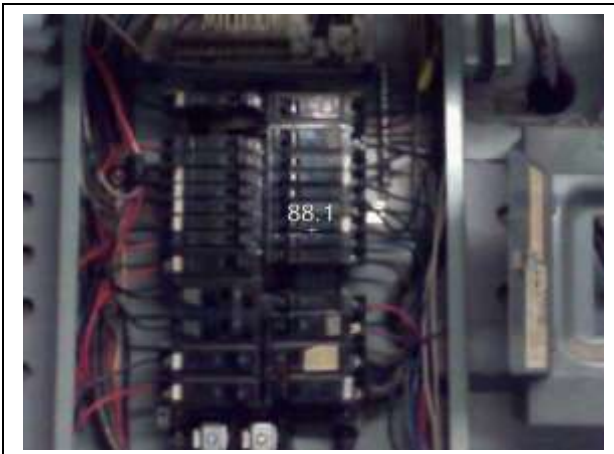
Visible Light Photo

Thermographic Set #: 1
Location: Laundry Room
Panel: Junction Box
Circuit/Fuse Designation: Wires
Anomaly Temp: --
Ambient Temp: 88 F
Temperature Differential: --
Priority Scale: x

Comments: No increases in surface temperatures noted within this junction box.



Infrared Image



Visible Light Photo

Thermographic Set #: 2

Location: Laundry Room

Panel: Main Lighting

Circuit/Fuse Designation: #6, #12

Anomaly Temp: 100.7 and 97 F

Ambient Temp: 86 F

Temperature Differentials:

#6- 14.7 F

#12- 11 F

Priority Scale: 3

Comments: Minor increases at lighting panels.



Infrared Image



Visible Light Photo

Thermographic Set #: 3

Location: Laundry Room

Panel: Main Disconnect

Circuit/Fuse Designation: Kitchen
Breaker

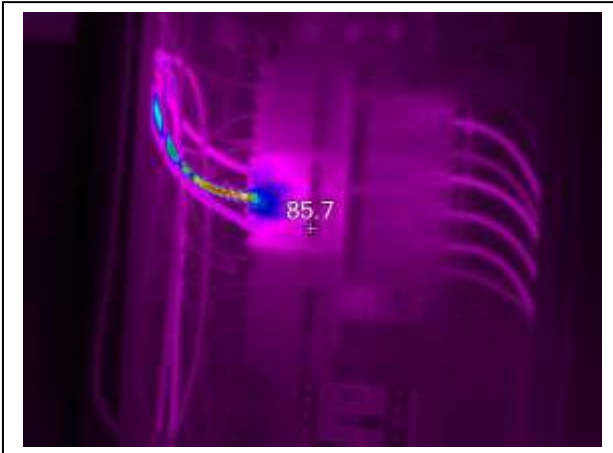
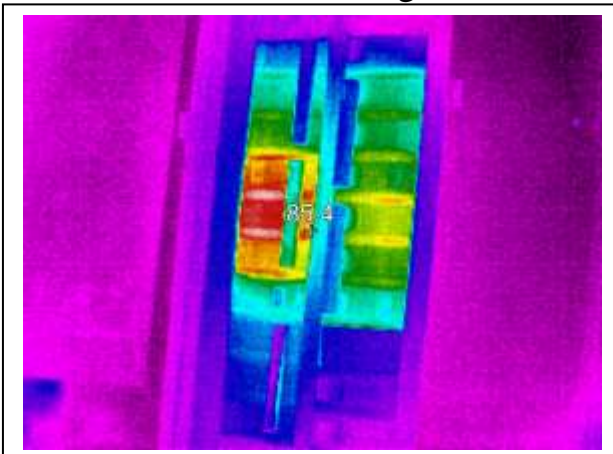
Anomaly Temp: 103.7 F

Ambient Temp: 82 F

Temperature Differential: 21.7 F

Priority Scale: 2

Comments: Increased loads with normal kitchen use.

1st Infrared Image

2nd Infrared Image



Visible Light Photo

Thermographic Set #: 4

Location: Laundry Room

Panel: Service Disconnect

Circuit/Fuse Designation: AC Unit #2, 2nd Phase

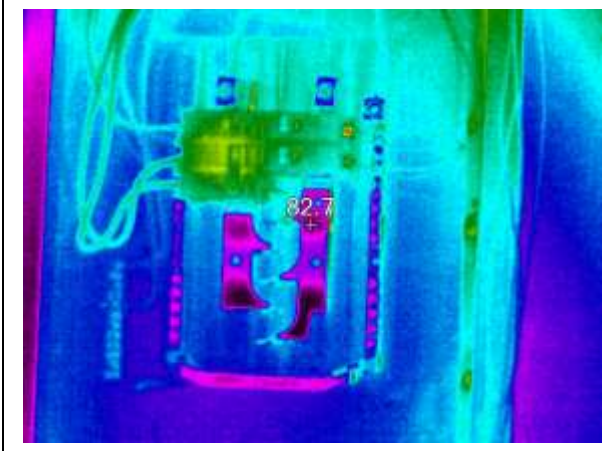
Anomaly Temp: 165 F at wire,
106 F at breaker

Ambient Temp: 80 F

Temperature Differential: 85 F at
wire, 26 F at breaker.

Priority Scale: 1

Comments: 1st Infrared Image depicts an 85 F temperature rise at the wire connection to the breaker. The connection was found to be loose, and tightened by [REDACTED] during the scan. The breaker panel was re-scanned one hour later, noting a significant temperature reduction at the breaker, from 106 F to 86 F.



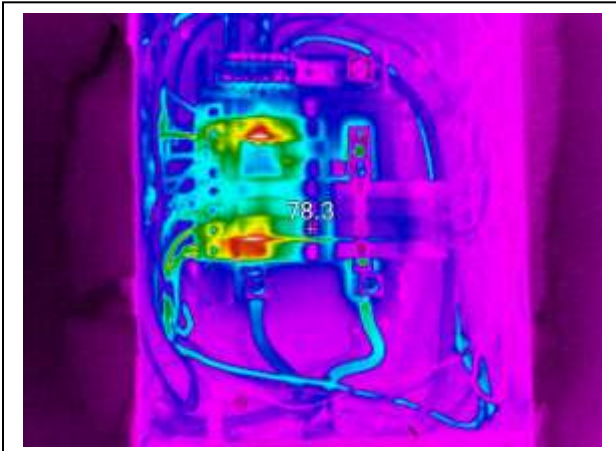
Infrared Image



Visible Light Photo

Thermographic Set #: 5
Location: Food Storage Pantry
Panel: Circuit Panel
Circuit/Fuse Designation: --
Anomaly Temp: --
Ambient Temp: 84 F
Temperature Differential: --
Priority Scale: x

Comments: No increases noted here.



Infrared Image



Visible Light Photo

Thermographic Set #: 6

Location: Nurses Office

Panel: Circuit Panel

Circuit/Fuse Designation: #3 and #9

Anomaly Temp: #3- 94.7 F.
#9- 94.1 F

Ambient Temp: 77 F

Temperature Differential: #3- 17.7 F,
#9- 17.1 F

Priority Scale: 3

Comments: Minor increases seen here.



Infrared Image



Visible Light Photo

Thermographic Set #: 7

Location: Boiler Room 5

Panel: Lighting Panel New Wing

Circuit/Fuse Designation: --

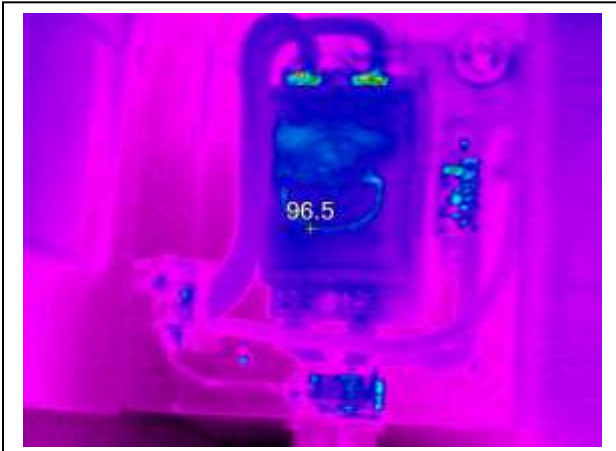
Anomaly Temp: --

Ambient Temp: 93 F

Temperature Differential: --

Priority Scale: x

Comments: All circuits and wiring without temperature increases.



Infrared Image



Visible Light Photo

Thermographic Set #: 8

Location: Boiler Room 5

Panel: Main SW New Wing

Circuit/Fuse Designation: --

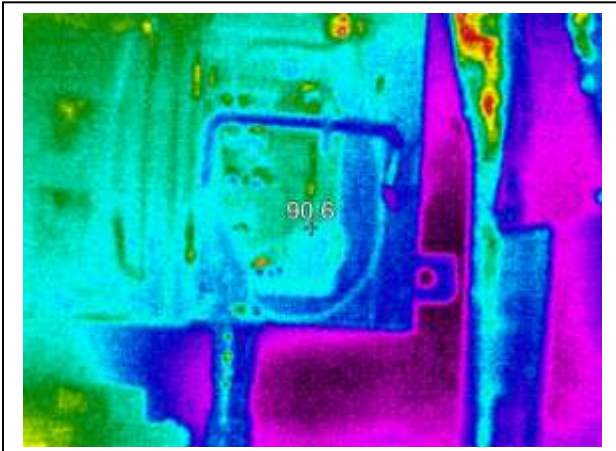
Anomaly Temp: --

Ambient Temp: 94 F

Temperature Differential: --

Priority Scale: x

Comments: No issues noted.



Infrared Image



Visible Light Photo

Thermographic Set #: 9

Location: Boiler Room 5

Panel: 20 Volt Receptacle

Circuit/Fuse Designation: --

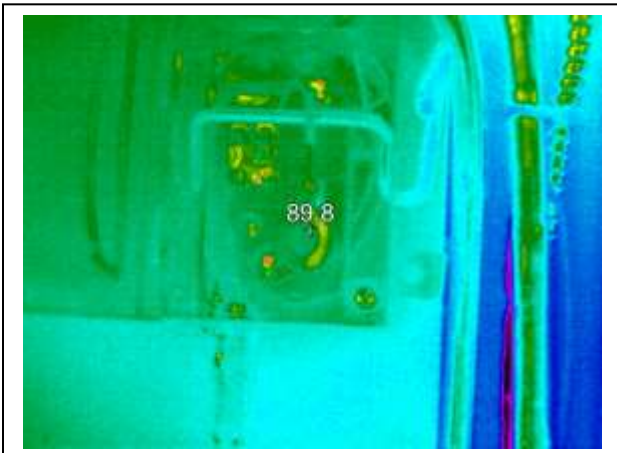
Anomaly Temp: --

Ambient Temp: 90.6 F

Temperature Differential: --

Priority Scale: x

Comments: Box empty, no fuses within box.



Infrared Image



Visible Light Photo

Thermographic Set #: 10

Location: Boiler Room 5

Panel: Transformer Heating System

Circuit/Fuse Designation: --

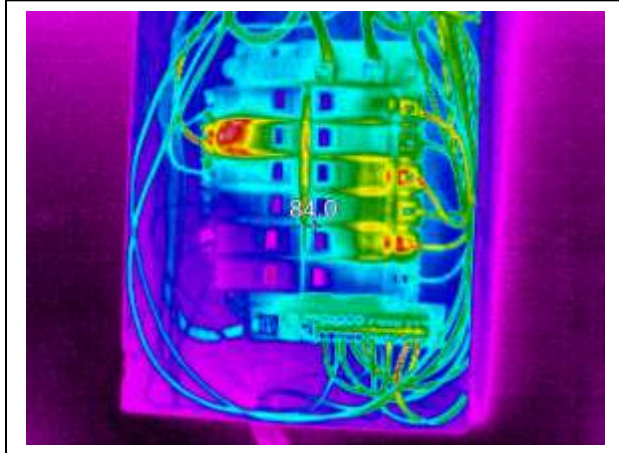
Anomaly Temp: --

Ambient Temp: 88 F

Temperature Differential: --

Priority Scale: x

Comments: No issues noted.



Infrared Image



Visible Light Photo

Thermographic Set #: 11

Location: Boiler Room 5

Panel: Water Heater Box

Circuit/Fuse Designation: #3

Anomaly Temp: 90.5 F

Ambient Temp: 82.1 F

Temperature Differential: 8.4 F

Priority Scale: x

Comments: Slight increase, below criteria for Priority Scale 3. Likely a normal usage increase.

IV. RECOMMENDATIONS AND CORRECTIVE ACTION

At a minimum, a preventative maintenance program should include the following items:

1. Check and clean wiring connection points.
2. Take an amp reading at each identified circuit or fuse.

Special attention should be made at anomalies with temperatures of 20 degrees or more above ambient temperatures. Connections should be tightened and amp readings taken, to be sure the circuit is not overloaded. If an overload is determined, the usage of the circuit should be re-directed.

Thermal anomalies identified at wires may indicate that either the line is being overloaded or the wires are insufficient for the load being used. check wires at identified anomalies to be sure they are the proper size.

Qualified electrical specialists should conduct maintenance repair duties, as working on indicated anomaly areas may be hazardous. For example, the affected circuit should be de-energized due to the high risk to personnel when tightening components in place on live apparatus. This is due to the possibility that insulating materials between conductors or ground have deteriorated or carbonized to a point where torque tightening pressure would cause final breakdown through that insulating medium. The maintenance mechanic should then be in direct contact with a bolted or ground fault condition. Also, connections of hardware or pole pieces may have annealed due to excessive heating causing reduced strength. Torquing pressure might then destroy the connection hardware, again subjecting the mechanic to fault condition hazards.

It should be noted that burrs of foreign material may prevent the seating and surface conductivity of bolts and washers, etc. Torque tightening may then actually be ineffective although tightening is registered. In view of this possibility and in the interest of true cost-effective power continuity, bus bar connections, or circuit breaker pole pieces should be disassembled, cleaned with slow residue solvent and re-silvered.

It is recommended that all deficiencies as described in this report be addressed through proper maintenance and repair, and be rescanned subsequent to their repair. This will insure proper corrective measures were taken.

V. INFRARED CAMERA SPECIFICATIONS

Camera:	FLUKE TiR32
Detector Type:	Uncooled Microbolometer Focal Plan Array (320x240 pixels)
Spectral Band:	8 μ m to 14 μ m (long wave)
Thermal Sensitivity:	0.040°C at 30°C target temp (40mK)
Visible Light Camera:	2 megapixel
Spatial Resolution:	1.25 mRad
Temperature Measurements:	-20° C to 150° C
Accuracy:	\pm 2°C
Measurement Capability:	Full frame
Optics:	Standard- 23°x17° Telephoto- 11.5°x8.7° Wide Angle- 46°x34°
Battery Type:	12-Volt Lithium-ion
Storage Medium:	SD Memory Card
File Formats:	JPEG, JPG, JPE, JFIF, BMP, GIF, DIP, PNG, TIF and TIFF
PC File Formats:	JPEG, TIFF and BMP