Data Sheet

Infra-red Temperature Measurement

RS stock nos. 254-112, 290-2526,238-4451, 288-9518, 263-9688, 264-6579, 330-7679, 341-3493, 344-3488, 331-7468, 341-5411,341-5427, 315-3422, 373-8461, 373-8483, 373-8499, 373-8506, 358-8474, 358-8496,358-8503, 358-8519, 358-8430, 358-8446, 358-8452, 358-8468

Method of operation

Infra-red energy is emitted by all objects having a temperature above absolute zero. The emitted energy increases as the object increases in temperature.

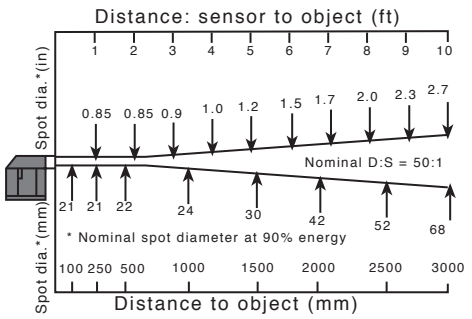
The optical system of the instrument focuses this infra-red energy onto a thermopile. The resulting signal is amplified and then linearised.

Advantages of non-contact temperature measurement over contact

- There is no heat abstraction, therefore the material being measured doesn't have its temperature influenced by the measurement.
- Because there is no direct contact there is no risk of contamination . (i.e. ideal for the food industry)
- Higher temperature measurement is made easier, because measurements can be made from a distance.
- IR thermometers themselves are suitable for applications that are difficult or dangerous to access by hand; i.e. moving parts in machinery, live power cables/distribution panels, inaccessible HVAC vents.
- IR thermometers are ideal in applications where the material being measured is fragile or delicate.

Measurement area

Figure 1



The diagram above details an example measurement area (PM30.**RS** stock no. 263-9688). If a high temperature is to be measured, the instrument should not be less than 1 metre from the heat source as the reading may be distorted and thermal damage may occur to the instrument. Temperature measurement of very hot objects should be taken quickly without allowing the front face of the instrument to become warm. This has a negligible effect when measuring high temperatures but increases the time taken for the reading to return to ambient. When measuring low temperatures the instrument can be as close as is practical.

Emissivity

Emissivity (ε) is defined as the ratio of the energy radiated by an object at a given temperature to the energy emitted by a perfect radiator, or 'black body' at the same temperature. The emissivity of a black body is 1.0, whilst a highly polished metal surface (poor radiator) has an emissivity of typically 0.1 or less. All values of emissivity fall between 0.0 and 1.0.

The 'poor radiator' type of object can result in serious measurement accuracy problems because most IR thermometers mathematically translate measured IR energy into temperature. As an object with an emissivity of 0.6 emits only 60% of the available energy, this would cause the indicated temperature to read lower than actual. This problem can be overcome by including an emissivity potentiometer. This is a gain adjustment to increase the amplification of the detected signal to compensate for the energy lost due to an emissivity less than 1.0. Therefore for applications measuring materials with low emissivity, i.e. metals, an instrument with adjustable emissivity is required.

As emissivity is a function of temperature and subject to variation due to the surface condition of the material the table overleaf should be used as a guide only.

Determination of an unknown emissivity

The emissivity of most organic materials (e.g. cloth, wood, plastics, most paints) equals approximately .95. Metals with polished surfaces can have emissivities which are very low. Typical values of emissivity for some common materials are shown in the following table. If the emissivity of a material is questionable, determine its value by using one of the following methods:

Method A

1. Heat a sample of the material on a hotplate to a known temperature as measured with a calibrated, precision sensor. The surroundings should be at ambient temperature, except for the hotplate.
2. Measure the surface temperature of the sample with the infrared thermometer. Press the emissivity adjustment arrows up or down during the measurement until the display indicates the sample's actual temperature. Note and record the corresponding emissivity value as shown on the display. Use this value whenever the same material is measured again.

Method B

1. For temperatures up to approximately 260°C (500°F), place a piece of common masking tape on the object to be measured.
2. Allow sufficient time for the masking tape to reach thermal equilibrium with the object.
3. With emissivity set to .95, measure and note the temperature of the masking tape. This process establishes the actual temperature of the object.
4. Proceed as in step 2 in METHOD A, above.

Method C

1. For very high temperatures and if practical, drill a hole approximately 35mm (1.5 in) in diameter and approximately 100mm (4 in) deep in a sample of the object. This hole will act as a blackbody with emissivity of approximately .97.
2. Set emissivity to .97 and measure the temperature of the blackbody hole.
3. Proceed as in step 2 in METHOD A, above.

Emissivity table

Metals

Material	ε Emissivity
Alloys	
20-Ni, 24-CR, 55Fe, oxidised	0.90
80-Ni, 20-0Cr, oxidised	0.87
Aluminium	
at ambient	0.10
at 100°C and above	0.10
Oxidised	0.11
Heavily oxidised	0.20
Highly polished	0.10
Roughly polished	0.18
Commercial sheet	0.10
Highly polished plate	0.10
Bright rolled plate	0.10
Alloy 1100-0	0.10
Alloy 24ST	0.10
Alloy 75ST	0.11
Alloy polished	0.10
Bismuth	
Bright	0.34
Unoxidised (ambient)	0.10
100°C and above	0.10
Brass	
73%Cu, 27%Zn polished	0.10
62%Cu, 37%Zn polished	0.10
83%Cu, 17%Zn polished	0.10
Matte	0.10
Burnished to a brown colour	0.40
Cu-Zn oxidised	0.61
Cu-Zn unoxidised	0.10
Cadmium	0.10
Carbon	
Lampblack	0.95
Unoxidised	0.81
Filament	0.95
Graphitised	0.76
Chromium	0.10
Polished	0.10
Copper	
Cuprous oxide	0.87
Black oxidised	0.78
Etched	0.10
Matte	0.22

Material	ε Emissivity
Nickel	
Polished	0.10
Oxidised (+37°C-+260°C)	0.31-0.46
Unoxidised	0.10
Electrolytic	0.10
Platinum	0.10
Silver	0.10
Steel	
Cold rolled	0.75-0.85
Polished sheet	0.10
Mild steel polished	0.10
Smooth	0.12
Oxidised steel	0.80
Unoxidised	0.10
Tin	0.10
Gold	
Enamel	0.37
Plate	0.10
Iron	
Oxidised	0.74
Unoxidised	0.10
Red rust	0.70
Rusted	0.65
Cast iron	
Oxidised	0.64
Unoxidised	0.21
Wrought iron	
Dull	0.94
Smooth	0.35
Polished	0.35
Lead	
Polished	0.10
Rough or oxidised	0.43
Magnesium	0.10
Oxide	0.20
Mercury	0.1
Molybdenum	0.1
Oxidised	0.80
Titanium	0.10
Tungsten	0.10
Filament	0.10
Zinc	
Bright galvanised	0.23
Galvanised	0.28
Oxidised	0.11
Polished	0.10

Non-metallic materials

Material	ε Emissivity
Adobe	0.90
Asbestos	
Board	0.96
Cement	0.96
Cement red	0.67
Cement white	0.65
Cloth	0.90
Paper	0.93
Slate	0.97
Asphalt	0.93
Basalt	0.72
Brick	0.93
Ceramic	0.90
Clay	
Fired	0.91
Shale	0.69
Concrete	0.94
Cotton cloth	0.77
Glass	0.80
Paints	
All colours	0.92-0.96
Red lead	0.93
Rubber	
Hard	0.94
Soft, grey	0.86
Sand	0.76
Sandstone	0.67
Red	0.60-0.83
Sawdust	0.75
Shale	0.69

Material	ε Emissivity
Silk cloth	0.78
Slate	0.67-0.80
Snow	
Fine	0.82
Granular	0.89
Soil	
Surface	0.38
Black loam	0.66
Ploughed field	0.38
Soot	
Acetylene	0.97
Camphor	0.94
Candle	0.95
Coal	0.95
Stonework	0.93
Water	0.67
Wood	0.80-0.90
Beech planed	0.94
Oak planed	0.91
Spruce sanded	0.89
Granite	0.45
Gravel	0.28
Ice	
Smooth	0.97
Rough	0.98
Lacquer	
Clear on:	
Aluminium foil	0.10
Bright copper	0.66
Limestone	0.95
Mica	0.75
Human skin	0.92

Alternative methods of measuring the surface emissivity

a. Measure the surface temperature using a thermocouple and then adjust the emissivity setting on the IR Thermometer to give the same temperature reading.
b. Apply black tape or paint to part of the surface. Measure the temperature of the blackened area using an emissivity of 0.95. Then adjust the emissivity setting when measuring an adjoining area until the same temperature reading is obtained.

How far away can I be and still take a reading?

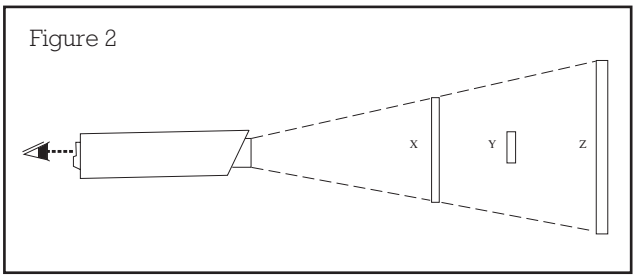
The models listed are general purpose thermometers which measure infra-red radiation in the wavelength region 6-18 microns. The atmosphere is transparent to radiation in this waveband so the target can be many metres away (30 or 40, say) and the thermometer will still receive its radiation.

However in measuring objects at a distance, it is important that the target surface is sufficiently large to fill the field of view of the IR Thermometer otherwise the instrument will receive radiation from the background.

Optics

Target sizes and distance are critical to accuracy for most IR thermometers. Every instrument has a field of view, an angle of vision in which it will average all of the temperatures it sees.

Figure 2



In the diagram above object x fills the field of view. The only temperature seen will be that of object x and therefore will be accurately indicated. However if object x is removed object y and object z will share the field of view. The indicated temperature will be somewhere between that of objects y and z dependent on the relative areas of each filling the circular field of view. To compensate for this such that object y only is measured, either increase the size of object y or move the pyrometer closer.

Combination Thermometers

There are circumstances under which a non-contact IR reading and a core or surface temperature reading must be taken. Core readings may be necessary for foods, surface readings for shiny surfaces or materials of unknown emissivity.

Combination thermometers affer 2 instruments in 1, refer to the selection tables

Applications for portable IR

Main areas of application for the handheld units are in test, inspection maintenance, and general troubleshooting activities. Some industries are:

Food

Food manufacturers and retailers
Hotels
Restaurants
Shops etc
Distribution
E.H.O.S.

Electronics

PCB testing for overheated components
Wave soldering
Semi-conductor wafer polishing.

Automotive

Engine maintenance/diagnostics radiators
Tyres
Brakes
Road surfaces (asphalt, tar mix)

Glass

Annealing/tempering
Furnace exteriors for hotspots
Vacuum flask checking.

Metals

Heat treating
Casting mould temperatures
Annealing
Induction heating

Maintenance

Boiler hot spots
Electrical connections
Motors compressors
Water/Oil cooling equipment
Energy auditing
Thermal insulation
Heat exchangers

Ovens & Dryers

Paint curing
Coating/laminating

Paper & Textiles

Web monitoring
Heating rollers
Laminating
Curing
Leather forming

Chemical

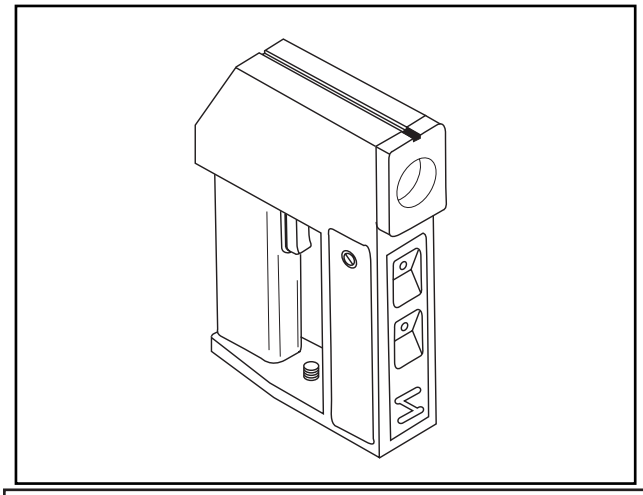
Powers/liquids
Sintering
Product flow
Refractory & Insulation

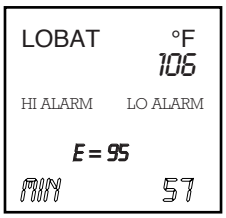
SELECTION TABLE 1									
Features / model	Thermo Check	Sensing head	Pyrometer	TC/K probe	PyroPen E	PyroPen L	PyroPen R	PM30 Pistol	Model 65 thermometer
RS stock number	290-2526	238-4451	254-112	288-9518	330-7679	341-3493	344-3488	263-9688	331-7468
Supplier	Steinel	Digitron	Digitron	Raytek	Calex	Calex	Calex	Calex	Fluke
Temp. Range	-30 to +300°C	-20 to +250°C	-2 to +500°C	-18 to +500°C	-20 to +500°C	-20 to +500°C	-20 to +500°C	-18 to +870°C	-40 to +500°C
Emissivity, ε	0.5 to 1.0	Fixed at 0.95	0.1 to 1.0	Fixed at 0.95	Fixed at 0.95	0.1 to 1.0	0.1 to 1.0	0.1 to 1.0	Fixed at 0.95
Distance: spot ratio	Use @ 40mm	8:1	20:1	3:1	8:1	8:1	8:1	4:1	8:1
Accuracy at 23°C (where % or °C is quoted, the larger value applies)	+/-1°C between 21-40°C or +/-3°C	+/-1% rdg +2°C	+/-1% rdg +1 digit	+/-2% or +/-2°C	+/-0.5% or +/-0.5°C	+/-0.5% or +/-0.5°C	+/-0.5% or +/-0.5°C	+/-1% or +/-1°C	Above 0°C:+/-2°C Below: +/-5°C
Repeatability				+/-1% or +/-1°C	+/-0.5% or +/-0.5°C	+/-0.5% or +/-0.5°C	+/-0.5% or +/-0.5°C	+/-0.5% or +/-0.5°C	+/-1% or +/-1°C
Response time			500ms	1s	500ms	500ms	500ms	350ms	800ms
Resolution	0.1°C	1°C	0.1°C or 1°C	0.1°C	0.1°C	0.1°C	0.1°C	0.1°C or 1°C	0.1°C or 1°C
Spectral response		6-14µm	6-14µm	8-14µm	8-14µm	8-14µm	8-14µm	8-14µm	8-14µm
Laser sighting	No	No	No	No	No	Single beam	Single beam	Single beam	Single beam
Locking trigger	No	No	No	No	Yes	Yes	Yes	Yes	No
Datalogging	No	No	No	No	No	No	Yes	No	No
Output signal	No	No	Linear analogue	Type K T/C	No	No	RS232	RS232+ analogue	No
Display functions	Hold, °C/°F	None	Hold + peak hold, °C/°F	None	Max, min, avg, hold, scan, °C/°F	Max, min, avg, hold, scan, °C/°F	Max, min, avg, hold, scan, °C/°F	Max,min,dif, avg, Alarm, TAM °C/°F	Hold, Min/Max, °C/°F
Backlight	No	Yes	Yes	No	No	No	No	Yes	Yes
Intergral contact probe	No	No	No	No	No	No	No	No	No
External probe input	No	No	No	No	No	No	No	No	No
Ambient temp.	10-40°C	-10 to +50°C	0 - 50°C	0 - 65°C	0 - 50°C	0 - 50°C	0 - 50°C	0 - 50°C	0 - 50°C
IP rating									
Power	PP3 9V	PP3 9V	AA 1.5V	PP3 9V	2 x AAA 1.5V	2 x AAA 1.5V	2 x AAA 1.5V	PP3 9V 9V	2 x AAA 1.5V
Dimentions		140x70 x26mm	150x115 x49mm	180x30 x50mm	163x27 x16mm	163x27 x16mm	163x27 x16mm	140x44 x178mm	38.1x63.5x 184.5mm
Weight		290g	630g	180g	50g	60g	60g	600g	283.5g
Software	No	No	No	No	No	No	No	No	Yes
Tripod mount	No	No	Yes	No	No	No	No	1/4''-20 UNC	No

SELECTION TABLE 2								
Features / model	MT2 Pistol	MT4 Pistol	MX2 Pistol	MX4 Pistol	ST20 Pistol	ST30 Pistol	ST60 Pistol	ST80 Pistol
RS stock number	341-5411	341-5427	264-6579	315-3422	373-8461	373-8483	373-8499	373-8506
Supplier	Raytek	Raytek	Raytek	Raytek	Raytek	Raytek	Raytek	Raytek
Temp. Range	-18 to +260°C	-18 to +260°C	-30 to +900°C	-30 to +900°C	-32 to +400°C	-32 to +450°C	-32 to +600°C	-32 to +760°C
Emissivity, ε	Fixed at 0.95	Fixed at 0.95	0.1 to 1.0	0.1 to 1.0	Fixed at 0.95	Fixed at 0.95	0.1 to 1.0	0.1 to 1.0
Distance: spot ratio	6:1	6:1	50:1	50:1	12:1	12:1	30:1	50:1
Accuracy at 23°C (where % or °C is quoted, the larger value applies)	+/-2°C or +/-2%	+/-2°C or +/-2%	+/-1% or +/-1°C	+/-1% or +/-1°C	+/-1% or +/-1°C	+/-1% or +/-1°C	+/-1% or +/-1°C	+/-1% or +/-1°C
Repeatability	+/-2% or +/-2°C	+/-2% or +/-2°C	+/-0.5% or +/-1°C	+/-0.5% or +/-1°C	+/-0.5% or +/-1°C	+/-0.5% or +/-1°C	+/-0.5% or +/-1°C	+/-0.5% or +/-1°C
Response time	500ms	500ms	250ms	250ms	500ms	500ms	500ms	500ms
Resolution	0.1°C	0.1°C	0.1°C	0.1°C	0.2°C	0.2°C	0.1°C	0.1°C
Spectral response	8-14µm	8-14µm	8-14µm	8-14µm	8-14µm	8-14µm	8-14µm	8-14µm
Laser sighting	No	Single beam	Circular 8 point	Circular 8 point	Single beam	Circular 8 point	Circular 8 point	Circular 8 point
Locking trigger	No	No	No	No	No	No	Yes	Yes
Datalogging	No	No	No	100 locations	No	No	12 point	12 point
Output signal	No	No	No	No	No	No	No	No
Display functions	Hold, °C/°F	Hold, °C/°F	Hold, Min/max, Alarm graph, °C/°F	Hold, Min/max, Dif/avg, Alarm, graph, ε-table, C/°F	Scan, Hold, Max, °C/°F	Scan, Hold, Max, °C/°F	Scan, Hold, Max,Avg Dif, Hi/Lo, Recall, C/°F	Scan, Hold, Max,Avg Dif, Hi/Lo, Recall, C/°F
Backlight	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Intergral contact probe	No	No	No	No	No	No	No	No
External probe input	No	No	No	Type K/J and NTC	No	No	RTD	RTD
Ambient temp.	0-50°C	0-50°C	0 - 45°C	0 - 45°C	0 - 50°C	0 - 50°C	0 - 50°C	0 - 50°C
IP rating								
Power	PP3 9V	PP3 9V	2 x AA 1.5V	2 x AA 1.5V	PP3 9V	PP3 9V	PP3 9V	PP3 9V
Dimentions	152x101 x38mm	152x101 x38mm	200x170 x50mm	200x170 x50mm	200x150 x50mm	200x150 x50mm	200x150 x50mm	200x150 x50mm
Weight	227g	227g	480g	480g	320g	320g	320g	320g
Software	No	No	No	Yes	No	No	No	No
Tripod mount	No	No	1/4''-20UNC	1/4''-20UNC	1/4''-20UNC	1/4''-20UNC	1/4''-20UNC	1/4''-20UNC

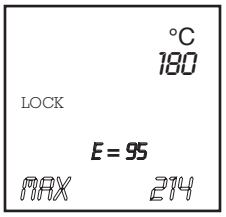
SELECTION TABLE 3								
Features / model	Quick Temp 825-T1	Quick Temp 825-T2	Quick Temp 825-T3	Quick Temp 825-T4	Quick Temp 826-T1	Quick Temp 826-T2	Quick Temp 826-T3	Quick Temp 826-T4
RS stock number	358-8474	358-8496	358-8503	358-8519	358-8430	358-8446	358-8452	358-8468
Supplier	Testo	Testo	Testo	Testo	Testo	Testo	Testo	Testo
Temp. Range	-50 to +400°C	-50 to +400°C	-50 to +400°C	-50 to +400°C	-50 to +400°C	-50 to +400°C	-50 to +400°C	-50 to +400°C
Emissivity, **ε**	0.2 to 1.0	0.2 to 1.0	0.2 to 1.0	0.2 to 1.0	Fixed at 0.95	Fixed at 0.95	Fixed at 0.95	Fixed at 0.95
Distance: spot ratio	3.1	3.1	3.1	3:1	3.1	3.1	3.1	3.1
Accuracy at 23°C (where % or °C is quoted, the larger value applies)	+/-2% or +/-2°C	+/-2% or +/-2°C	+/-2% or +/-2°C	+/-2% or +/-2°C	+/-2% or- +/-2°C	+/-2% or +/-2°C	+/-2% or +/-2°C	+/-2% or +/-2°C
Repeatability	+/-0.5% or +/-1°C	+/-0.5% or +/-1°C	+/-0.5% or +/-1°C	+/-0.5% or +/-1°C	+/-0.5% or +/-1°C	+/-0.5% or +/-1°C	+/-0.5% or +/-1°C	+/-0.5% or +/-1°C
Response time	<2s	<2s	5s contact side	5s contact side	<2s	<2s	10s contact side	10s contact side
Resolution	0.5°C	0.5°C	0.1°C	0.1°C	0.5°C	0.5°C	0.1°C	0.1°C
Spectral response	8-14µm	8-14µm	8-14µm	8-14µm	8-14µm	8-14µm	8-14µm	8-14µm
Laser sighting	No	Single beam	No	Single beam	No	Single beam	No	Single beam
Locking trigger	No	No	No	No	No	No	No	No
Datalogging	No	No	No	No	No	No	No	No
Output signal	No	No	No	No	No	No	No	No
Display functions	Hold+ optical alarm	Hold+ audible alarm	Hold+ optical alarm	Hold+ audible alarm	Hold+ optical alarm	Hold+ audible alarm	Hold+ optical alarm	Hold+ audible alarm
Backlight	No	No	No	No	No	No	No	No
Intergral contact probe	No	No	Type K surface probe	Type K surface probe	No	No	NTC Immersion Food probe	NTC Immersion Food probe
External probe input	No	No	No	No	No	No	No	No
Ambient temp.	0 - 50°C	0 - 50°C	0 - 50°C	0 - 50°C	0 - 50°C	0 - 50°C	0 - 50°C	0 - 50°C
IP rating	IP67	IP67	IP67	IP67	IP67	IP67	IP67	IP67
Power	Lithium 2032 (x 2)	AAA round (x 2)	Lithium 2032 (x 2)	AAA round (x 2)	Lithium 2032 (x 2)	AAA round (x 2)	Lithium 2032 (x 2)	AAA round (x 2)
Dimentions (Excluding probe)	155x32mm	155x32mm	155x32mm	155x32mm	155x32mm	155x32mm	155x32mm	155x32mm
Weight	75g	75g	88g	88g	75g	75g	88g	88g
Software	No	No	No	No	No	No	No	No
Tripod mount	No	No	No	No	No	No	No	No

Facility Maintenance Checklist

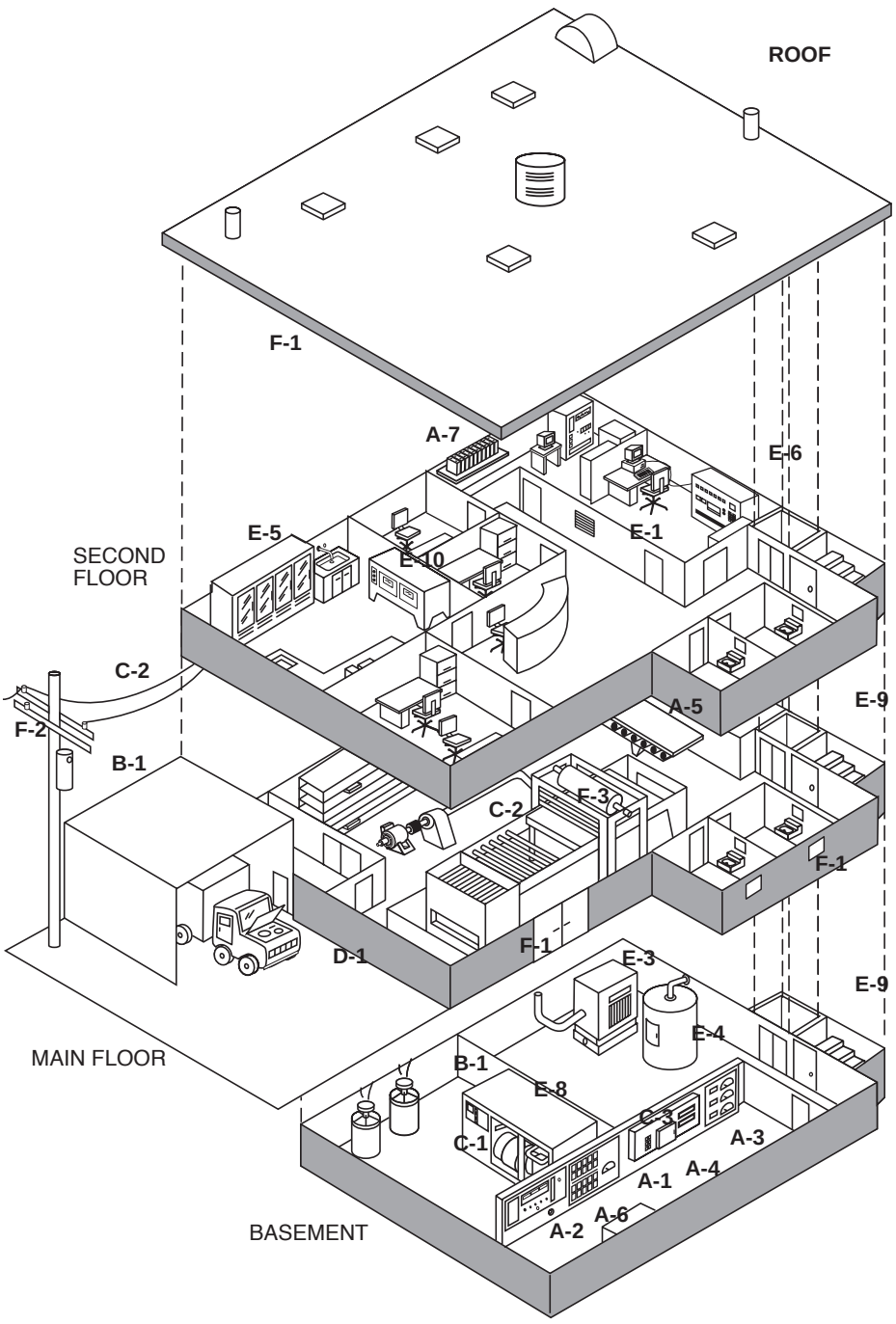




Hi and lo temperature limits may be set and an audible and visible alarm activated when these limits are exceeded. Lo Bat indicates a low battery



The Lock function allows you to lock the trigger in the on position. The PM will also store Last Temperature Read and Max temperature for instant recall.



PLEASE SEE NEXT PAGE FOR CODES

284-3017

Facility Maintenance Checklist

	Benchmark	January	February	March	April	May	June	July	August	September	October	November	December
I. Electric Maintenance Checklist													
A. Connections													
A-1 Circuit Breakers													
A-2 Power Panel Terminators													
A-3 Bus Bars													
A-4 Fuse Connections													
A-5 Ballasts													
A-6 Switch Gear, Wall Switches													
A-7 Battery Bank Terminators													
B. Transformers													
B-1 Cable Terminators													
C. Electric Motors													
C-1 Compressors													
C-2 Cable Terminators													
C-3 Circuit Breakers/Fuses													
II. Vehicle Fleet Maintenance Checklist													
D-1 Engines, Cooling Systems,													
Hydraulics, Tires & Bearings													
III. Equipment Checklist													
E-1 HVAC													
E-2 Rooftop AC & Other Equipment													
E-3 Heater/Furnace													
E-4 Boiler													
E-5 Freezers, Stored Food Temperatures													
E-5 Uninteruptable Power Supply													
E-7 Bearings													
E-8 Diesel Generators													
E-9 Elevators													
E-10 Ovens													
IV. Other Facilitis HotSpots													
F-1 Energy Audit: Insulation, Doors, Windows, Roofs and Steam Traps													
F-2 Power Transmission: Insulators and Transformers													
F-3 Product/Process Temperature													

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