#107255

ERL MAINTENANCE SUPPORT SDN BHD

(Company No. 498574-T)

E-MAS

Your Railway Operations & Maintenance Specialist

ROLLING STOCK DEPARTMENT

IN-HOUSE TECHNICAL INSTRUCTION

INFRARED THERMOGRAPHY OPERATING INSTRUCTION

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Certified to ISO 9001 : 2008
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Release

	Name	Dept./Position	Date	Signature
Released:	Ham MW	MTN HoD	15-01-2010	
Checked:	Mohd Jamil	RST HoD	13-01-2010	
Checked:	Mohamad	RST QMR	13.01.10	
Author:	Azerul Fahmi	RST Tech. Exec.	12.01.10	

Amendments or additions to this procedure must be indicated with a vertical black line in the adjacent left margin.

Change Record and Configuration Control

Revision	Date	Modification	Name
A	12/01/10	New	Azerul

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Page

1 Purpose

The purpose of this document is to provide the user the basic information on

a) Infrared thermal Imager – Model Fluke Ti25
b) Work frequency
c) Reporting

2 Scope, Distribution & Access

The scope of this work falls under maintenance. The distribution is open to all Maintenance staffs. The access to this document will be made available to all RST personnel via E-MAS Documentation Management System or RST Portal at http:/express50/E-MAS_Portal/RST.html.

3 Infrared Thermal Imager Camera

Below are the images of our Infra-red Thermal imager. The Thermal Imager is kept in locked shelf in the Material Management "Goods issuing counter".

Side view of camera

Back view of camera

Location of camera: MMT issuance area

4 Thermal Image

4.1 Camera Setting

The below settings would only need to be carried out once and it will remain as a default setting

No	Description	Remarks
1	Power ON Press on hold the F2 button until a beep sound is heard.	Camera turns on
2	Press F2 button again for menu selection At the bottom of the screen, the below message pops up Memory | Menu | IRFusion	
2a	Memory Memory selection would display captured images.	Use the up and down displayed button to scroll the captured images.
2b	IRFusion IRFusion selection would display IR screen coverage in the camera display.	Recommended selection **Full screen max IR**.
3	Press again the F2 button for menu At the bottom of the screen, the previous message changes to Palette | Menu | Range	
3a	Pallete Pallete selection would display the desired colours to be selected for capturing the thermal image.	Recommended selection **High Contrast**
3b	Range	

	Range refers to the temperature range selection on the capturing thermal image. Selection either manual or auto. Manual is usually used for focusing or capturing specific item.	Recommended selection **Auto**
4	Press again the F2 button for menu At the bottom of the screen, the previous message changes to Backlight | Menu | Spot Temp	
4a	Backlight Background light for the capturing the thermal image	Recommended selection **Full Bright**
4B	Spot temperature Selection for cursor indicator during thermal image capturing	Recommended selection **On**
5	Press again the F2 button for menu At the bottom of the screen, the previous message changes to Language | Menu | Units	
5a	Language For selecting the desired language of use with the IR thermal camera	Recommended selection **English**
5b	Units For selecting temperature units.	Recommended selection **Celsius (C)**
6	Press again the F2 button for menu At the bottom of the screen, the previous message changes to Date | Menu | Time	
6a	Date For selecting the date format and inserting the correct	Recommended selection

	date	**DD/MM/YY**
6b	Time For selecting the time format and inserting the correct time	Recommended selection **12 hrs**
7	Press again the F2 button for menu At the bottom of the screen, the previous message changes to Emissivity | Menu | File Format	
7a	Emissivity Selection on emissivity is based on the equipment that is being thermal imaged. Adjusting the emissivity according to the equipment will give an accurate thermal reading.	
7b	File Format For selecting the file format	Recommended selection **IS2**

4.2 Downloading the Image

Image capture in the camera are saved in the SD card.

These images are transferred to PC via a card reader. The editing software is known as "Smartview"

4.3 Software Setting

Smartview software allows you to perform adjustment and fine tuning to the individual thermal image.

All the above camera settings can be adjusted through the software on individual image. The fine tuning to the captured thermal would be based on thermographers experience and preference.

5 Frequency of Work

The thermography work is scheduled for a minimum once in 6 month. However, the thermography work would be carried out on monthly basis covering different location with Maintenance Department.

The below table summarise the schedule.

No.	Location	Jan	Feb	Mac	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
1	KL Sentral Station	X						X					
2	Bandar Tasik Selatan Station		X						X				
3	Cross-over Building		X						X				
4	Putrajaya Cyberjaya Station			X						X			
5	Traction Power Sub-Station			X						X			
6	Salak Tinggi Station				X						X		
7	KLIA Station				X						X		
8	Salak Tinggi Station					X						X	
9	Train Equipments						X						X

6 Train Equipments

The thermography imaging works covers and can be extended to varieties of scope and works. However, the below listed equipment are the required and essential equipments for our thermal imaging works. The equipments are:

a) Underfloor equipment box - contactors & circuit breakers
b) Auxiliary terminal box of main transformer
c) Traction motor
d) Side compartment of auxiliary converter

7 Report

A report has to be submitted in 2 weeks time to the maintenance manager upon completion of the work.

The report would be saved as softcopy in the company servers. The cover letter for the report should be addressed to the maintenance manager highlighting on the work completion and any abnormalities discovered during the work. The sample report on the individual item is on the item 8.

Note:
If any critical abnormalities found during thermography activities, thermographers is responsible to notify the RST HoD for corrective measure immediately.

7.1 Report Template

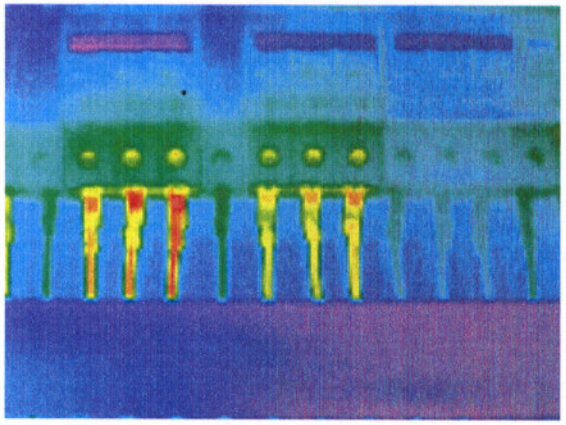
Copy and paste thermal image here	*Copy and paste scale here*	*Copy and paste thermal photo here*
IR000416.IS2	**Scale**	**Visible Light Image**

Image Info

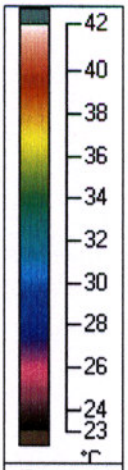
Equipment Name	
Location	
Severity	
Abnormally Description	

Emissivity	
Background	
Average Temperature	
Image Range	
Image Time	

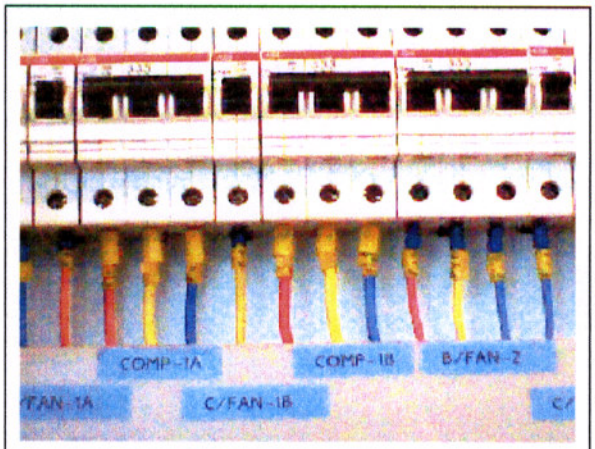
7.2 Report Sample



IR000416.IS2



Scale



Visible Light Image

Image Info

Equipment Name	Breaker for compressor
Location	OCC
Severity	Nil
Abnormally Description	Nil

	Red	Yellow	Blue
Comp. 1A	13A	13.4A	14.5A
Comp. 1B	12.6A	12.9A	14.0A

Emissivity	0.95
Background	22.0 °C
Average Temperature	30.5 °C
Image Range	24.9 °C to 40.2 °C
Image Time	7/29/2009 9:13:44 AM

8 Attachments

Attachment 1 – Emissitivity Table

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Emissivity Tables

We have learned that emissivity varies with material, wavelength and temperature. Therefore the emissivity determined by using an infrared instrument is these three items. Therefore, the emissivity tables below **are to be used only as a guideline.**

To obtain accurate emissivity it is recommended emissivity test is carried out, thereby creating your own tables.

Metals and their oxides	Temp.(°C)	Wavelength(λ) (measured in μ's)	Emissivity (∈)
Alloys:			
20-Ni, 24-CR, 55-FE, Oxidized	200		0.90
20-Ni, 24-CR, 55-FE, Oxidized	500		0.97
60-Ni, 12-CR, 28-FE, Oxidized	270		0.89
60-Ni, 12-CR, 28-FE, Oxidized	560		0.82
80-NI, 20-CR, Oxidized	100		0.87
80-Ni, 20-CR, Oxidized	600		0.87
Aluminum:			
Disk, roughened	26	3	0.275
Disk, roughened	26	10	0.180
Foil	26	3	0.09
Foil	26	10	0.04
Heavily weathered	17		.83-.94
Polished		2-5.6	0.05
Polished	100	8-14	0.09
Commercial sheet	100		0.09
Electrolytic chrome oxide	100		0.55
Lightly oxidized	25-600		0.10-0.20
Heavily oxidized	25-600		0.20-0.40
Unoxidized	25		.02
Unoxidized	500		.06
Brass:			
Matte	20		.07
Polished	28		0.03
Polished		8-14	0.10
Oxidized	100-600		0.59-0.61
Cast Iron:			
Cast iron polished	200	3-14	0.21
Cast iron finished	20		0.44
Chromium:			
Polished	40-1090		0.08-0.26
Polished		8-14	0.10

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Metals and their oxides	Temp.(°C)	Wavelength(λ) (measured in μ's)	Emissivity(∈)
Copper:			
Mirror face	100		0.03
Heavy oxidation	25		0.78
Cuprous oxide	800-1100		0.66-0.54
Cuprous oxide	38		.87
Molten copper	1080-1280		0.16-0.13
Polished	20	3	0.031
Polished	20	10	0.016
Oxidized		8-14	0.65
Oxidized, heavily	20	3-5	0.78-0.94
Shiny		3.4-5	0.24
Oxidized, slightly dirty		3.4-5	0.50
Xformer plate, slightly oxidized		3.4-5	0.22
Xformer plate, pitted		3.4-5	0.32
Gold:			
Polished	38-260	3-14	.02
Iron:			
Tempering iron polished	40-250		0.28
Steel casting polished	770-1040		0.52-0.56
Ground seal steel	945-1100		0.55-0.61
Hot Rolled		8-14	0.77
Oxidized		8-14	0.74
Oxidized surface:			
Completely rusted surface	20		0.70
Foundry iron (oxidized at	198-600		0.64-0.78
600oC)	125-500		0.78-0.82
Electrolytic oxidized iron	500-1200		0.85-0.89
Iron oxide	925-1120		0.87-0.95
Ingot	25		0.80
Cast Iron:			
Oxidized	199		.64
Strong Oxidation	104		.95
Lead:			
Pure lead (non-oxidized)	125-225	3-14	0.06-0.08
Oxidized		8-14	0.63
Lightly oxidized	25-300		0.43
Magnesium:			
Oxidized	275-825		0.55-0.20
Oxidized	900-1670		0.20
Molybdenum:	38		.06
Oxidized at 1000 F	316		.80

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Metals and their oxides	Temp.(°C)	Wavelength(λ) (measured in μ's)	Emissivity(∈)
Silver:			
Plate (0.0005 on Ni)	93-371		.06-.07
Polished	38		.01
Stainless Steel:			
18-8	25		0.16
18-8 buffed	20		0.16
18-8 oxidized at 800°C	60		0.85
18-8 sandblasted	20		0.440
304 (8 Cr, 18 Ni)	215-490		0.44-0.36
310 (25 Cr, 20 Ni	215-520		0.90-0.97
Steel:			
Cold Rolled	93		.75-.85
Galvanized		8-14	0.28
Polished Sheet	38		.07
Rough Surface		8-14	0.96
Oxidized	25		.80
Unoxidized	100		.08
Tin:			
Commercial tin-plated sheet iron	100		0.07
Heavily oxidized	0-200		0.60
Zinc:			
Bright Galvanized	38		.23

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Non-Metals	Temp.(°C)	Wavelength(λ) (measured in μ's)	Emissivity(∈)
Brick:			
Common	17	2-5.6	.81-.86
Firebrick	17	2-5.6	0.68
Fireclay	1000		0.75
Masonry	0	5	0.94
Red Rough	21		.93
Carbon:			
Candle soot	20		0.95
Graphite, filed surface	20		0.98
Cement		8-14	0.54
Clay:			
Fired		8-14	0.91
Concrete:			
Concrete	20		0.92
Concrete: dry	36	5	0.95
Concrete: rough	17	2-5.6	0.92-0.97
Mortar	17	2-5.6	0.87
Mortar: dry	38-260	2-5.6	0.94
Fiberglass	20		0.750
Fibre board:			
Porous, untreated	20	2-5.6	0.85
Glass:		8-14	0.92
Polished plate	20		0.94
Granite:			
Natural Surface	36	5	0.96
Smooth	21		0.45
Gypsum	20	3-14	.80-.90
Ice		3-14	0.97
Limestone	38		.95
Marble:			
White	38		.95
Smooth, white	38		.56
Polished, grey	38		.75
Mica	38		.75
Oil, lubricating			
Nickel base alone	20		0.05
Film thickness = 0.001	20		0.27
Film thickness = 0.002	20		0.46
Film thickness = 0.005	20		0.72
Thick coating	20		0.82
P.V.C.	17	2-5.6	.91-.93

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PAINTS:			
Aluminum	38		.27-.67
Blue, Cu2O3	24		.94
Black, CuO	24		.96
Green	24		.92
White, A12O3	24		.94
White, Y2O3	24		.90
Yellow, PbO	24	3	.90
Red	24	10	.93
Krylon, flat black	50	3	0.95
Krylon, flat black	50	8-14	0.956
Krylon, flat white #1502	40	3-14	0.992
Lacquer: bakelite		8-14	0.93
Lacquer: dull, black			0.97
Lacquer: white			0.87
Lacquer: white	100		0.92
Lacquer: white	200		.95
Lacquer: matte black	100		0.97
Lacquer: shiny,black, on metal		2-5.6	0.87
Oil: average of 16 colors		2-5.6	0.94
Oil, black, flat	100	2-5.6	0.94
Oil, black, gloss	20	2-5.6	0.94
Oil, gray, flat	20	8-14	0.92
Oil, gray, gloss	20	2-5.6	0.97
Oil, various colors	20	2-5.6	0.96
Plastic, black			0.94
Plastic, white	20		0.95
Shellac, black, dull	20		0.84
Shellac, black, shiny, on tin plate		2-5.6	
Varnish: flat	100		0.91
	20		0.82
Radiator Paint:	20		0.93
White			
Cream	100		0.79
Bleaching	100		0.77
	100		0.84
Plastic:	17	2-5.6	0.86
Opacity (all colours)			0.92
Black			
Polyproplene	17	2-5.6	0.97
Porcelain: glazed		8-14	0.92
Rubber		8-14	0.95
Stopper, black	35	5	0.97
Sand	20		.76-.90
Skin, human	32		0.98

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Soil:			
Dry	20		0.92
Frozen		6.5-20	0.93
Saturated with water	20		0.95
Styrofoam: insulation	37	5	0.60
Tape:			
Electrical, insulating, black	35	5	0.95
Masking	36	5	0.92
Textile (all colours)			0.95
Water:		8-14	0.97
Distilled	20		0.96
Ice, Smooth	-10		0.96
Frost crystals	-10		0.98
Snow	-10	3-5	0.85
Snow		8-14	0.80
Wood:			
Chipboard: untreated	20	2-5.6	0.90
Oak, planed	20		0.90
Paneling, light finish	36	5	0.87
Planed		8-14	0.85
Plywood	17	2-5.6	.83-.98
Plywood commercial, smooth dry finish	36	5	0.82
Plywood, untreated	20	2-5.6	0.83
Spruce, polished, dry	36	5	0.86