CHAPTER 3

EXPERIMENTAL DETAILS

3.1 Equipments and Materials.

3.1.1 Cameras

The following camera were used:-

(1) ASAHI PENTAX SPOTMATIC. This camera has the infrared focusing mark on the focusing scales. Its lens system consists of 7 - element Super - Takumar 50 mm, f/1.4.

(2) CANON, CANONET without infrared focusing mark, with CANON LENS SE 45 mm, f/1.9.

(3) TARON, without infrared focusing mark, 45 mm., f/2.8.

(4) ROLLEICORD, without infrared focusing mark, with Schneider Kreuznach Xenar 75 mm., f/3.5.

3.1.2 Infrared sensitive materials.

The following infrared 35 mm. roll films were used:-

1. Kodak Infrared Film (IR - 135), 20 exposures in magazines
2. Kodak Infrared Film (IR - 401), 50 feet roll.
3. Kodak High Speed Infrared Film (HIR - 421), 100 feet roll.

NOTE.

There is no other products available.

3.1.3 Filters.

The products of the following Kodak Wratten Filters were used:

No. 29	No. 87C
No. 70	No. 88A
No. 87	No. 89B
No. 87B,	

The characteristics of these filters were shown in Chap.

3.2 Taking Infrared Pictures.

3.2.1 Focusing for infrared rays.

Infrared rays, because of their longer wavelenght, in the case of many lenses do not focus in the same plane as visible rays (have been discussed on Chap. I and Chap. 2)

The focusing correction for modern camera is easy, first focus by visual, then turn focusing scale counterclockwise (general modern cameras) to the infrared focusing mark.

For the ordinary camera without infrared focusing mark on the focusing scales, the infrared focusing corrections were recommended by manufacturers. Kodak's recommendation is the photographic focusing tests,[1] a basis for trial is the extension of the lens by 1/4 of 1 percent of the focal length of the lens.

The corrections for CANON and TARON cameras, with 45 mm. focal lengths are as the following example.

1% of 45 mm = 0.45 mm.

1/4 x 0.45 mm = 0.1125 mm.

Hence, the correction is 0.1125 mm. for each camera.

3.2.2 Exposure determination.

The exposure meters commonly used for normal photography do not respond to the infrared. They are not of value for determining exposures by daylight, because there is no fixed relationship between the infrared content of daylight and the intensity of visible light. In the case of artificial light sources, however, it should be possible to infrared radiation is constant. The followings are the method of

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[1] Kodak Co, Medical Infrared Photography, pp. 31 - 32.

exposure determinations.

A. Trial exposure method[1], when the exposure time is unknown for a particular film or plate, and a means is not available for making direct reading of image brightness to determine exposure. Make a series of different exposures. From this series, you can easily find the best exposure. Such a series is often made in definite exposure - time increments to cover a long range and thus ensure is included. Fig 3.1 shows a test strip made with power - of - 2 steps; that is, each exposures is twice as long as the preceding one.

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1 Ibid.

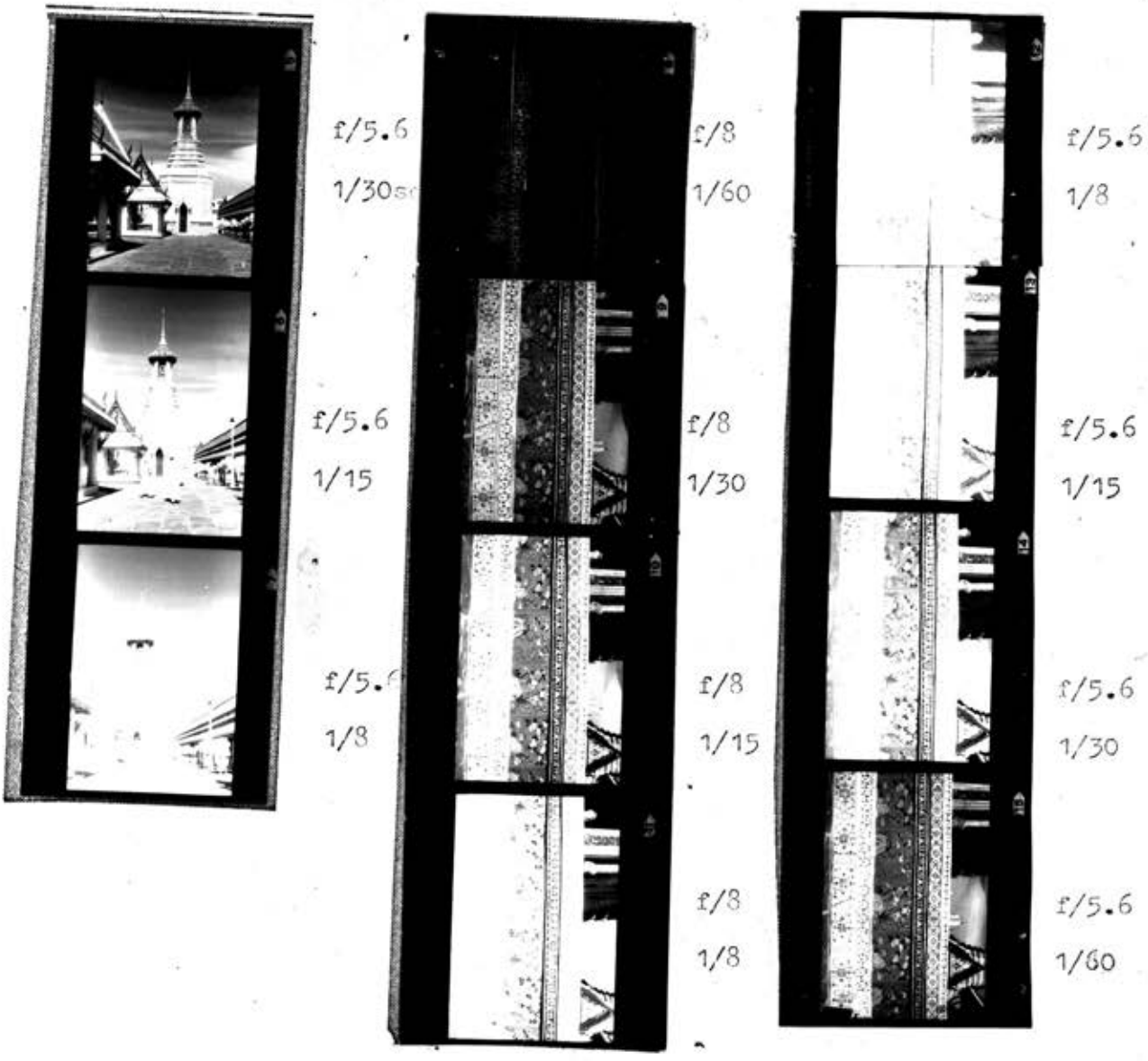

Fig.3.1 Test exposure strips of general infrared photography. HIR421 material, filter No.89B were used, first strip no.5 is the best . The second no.10 is the best. The third, no.15 is the best exposure.

B. Another method of exposure determination is recommended in Data Sheet of each film, for examples:-

1. (from data sheet of Kodak Infrared Film IR - 135)

"For unusual subjects or uncertain light, make a series of different exposures;- first use the aperture recommended then make an exposure using two lens opening smaller, and another exposure using two lens opening larger than the one recommended."

Rec.	2 - stop smaller	2 - stop large
exposed through	f/8,1/30	f/4,1/30
No.88A	sec	sec

f/5.6,1/30.sec.

Fif.3.2 Recommended exposure strip, for IR-135 or IR-401 films.

TAPLE 3.1

Recommended Daylight Exposures

for IR - 135 or IR - 401

Exposure index, Daylight 18 - 19 ASA. Tungsten = 25 ASA

Exposed Through Kodak Wratten Filter No. 25 (A)		No filter for ordinary Rendering
Distant Scenes	Near - by Scenes	Distant Scenes
1/25 sec at f/8	1 sec at f/22 or 1/10 sec at f/6.3	1/50 sec at f/16

2. (from Kodak High Speed Film, HIR - 421)

" The exact exposure index are not possible, since the ratio of infrared to visible light is variable and photoelectric exposure meters respond only to the visible radiations. Similar levels of visible light may be vastly different in the amounts of infrared radiation they contain. It is recommended that trial exposures be made to determine the proper exposure for the conditions under which photographs are to be made. "

If the infrared films were exposed through the red filters. The aperture openings depend on the filter factors, as shown in the following tables:-

TABLE 3.2 [1]

FILTER FACTORS

Light Source	Kodak Wratten Filters					
	No.25	No.29	No.70	No.87	No.88A	No.89B
Daylight	1.5	1.5	1.5	3.0	2.5	2.0
Tungsten	1.2	1.2	1.5	2.5	2.0	1.5

TABLE 3.3 [1]

Aperture Changes With Filter Factors

Filter Factor	1.5	2	3	4	5-6	7-9	10-13	14-18	20-27	30-35
Increase aperture by (stops)	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5

1 - Purves, Federick., The Focal Encyclopedia, p.455

2 - Neblette,C.B., op.cit pp. 187 - 196

3.3 Processing Infrared Materials

3.3.1 Development[1]

The exposed infrared - sensitive mate ials are developed and fixed in exactly the same manner as ordinary films and plates. The detailes of development recommendation will be found in data sheets for each film. The contrast can be varied by developing for longer or shorter time than those specified. Some of the developers mentioned in 3.3.3 are available in several sizes of chemicals packaged, or can prepare them.

The exposed films would be processed as the following steps:-

(1) Develop at 68 F (or 20 C) for approximate times given below:-

TABLE 3.4

Type of Infrared Film	Developer	Temperature (F)	Development times (minutes) Small Tank
Kodak infrared film (IR - 135)	D - 76	68	11*
	Microdol - x (full strength)	68	14*
		75	9*
	Microdol - x (1:3)	75	22*
Kodak High Speed infrared film (HIR-417) &-421	D - 19	68	8**
	D - 76	68	11**

1 - Neblette,C.B., op.cit pp. 187 - 196

(2) Rinse in Kodak Indicator Stop Bath or Kodak Stop Bath SB-5 about 30 seconds with agitation at 65 to 70 F. A running water rinse can be used if an acid rinse bath is not available.

(3) Fex 5 to 10 minutes at 65 to 70 F with Kodak Fixer or Kodak Fixing Bath F-5, or 2 to 4 minutes with Kodak Rapid Fixer. Agitate films frequently during fixing.

(4) Wash 20 to 30 minutes in running water. To mininize drying marks, treat in Kodak Photo-Flo Solution after washing, or wipe surfaces carefully with a Kodak Photo Chamois or a soft viscose sponge.

Agotatoin at 30 - second intervals during development.

Agitation at one minute intervals during development.

(5) Dry in a dust - free place.

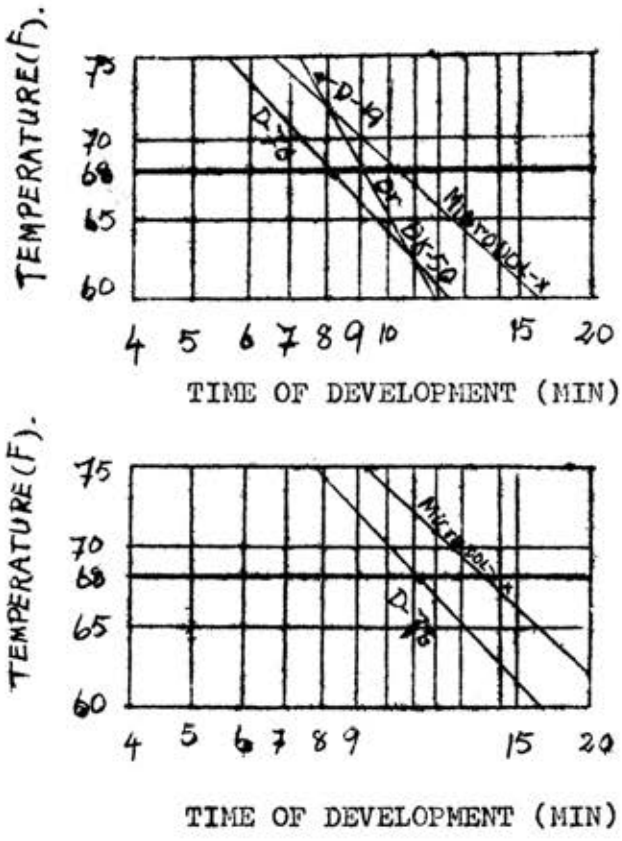

Fig 3.3[1] Showing development times at various temperatures corresponding to certain recommended times at 68 F, additional lines can be drawn parallel to the existing diagonal line for the developer concerned. Best results are obtained at 65 to 70 F,

(A) for Kodak Sheet film (B) for IR - 135 film

When finishing the above steps, the negatives are ready for printing.

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1 - Kodak Co, Infrared And Ultraviolet Photography, pp. 27 - 29.

3.3.2 Printing [1]

The printing process is done easily the same method as black - and - white printing. The writer should like to exclude the printing process.

3.3.3 Developers and Fexers Preparation

The recommended formulas for infrared photography are:-

(1) Developers[2],, formulas No. D-11, D-19, DK-50 and D-76.

(2) Fixers;[3] formulas No. F-5, SB-3, F-16 and SH-1.

1

- Boucher, E. Paul,, Fundamentals of Photography pp. 135-156

- Neblette, C.B., op.cit, pp. 224 - 233

2,3

- Boucher, Paul E., op.cit, pp. x - xxxii