



Ministry of Agriculture and Lands

Integrated Land Management Bureau

**Crown Registry and
Geographic Base Branch**

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for
Aerial Photography**

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Province of British Columbia
Ministry of Agriculture and Lands
Crown Registry and Geographic Base Branch

SPECIFICATIONS FOR AERIAL PHOTOGRAPHY

April, 2008

2.0 GENERAL:

These specifications supersede all previous specifications.

The term "Branch" when used herein shall mean Crown Registry and Geographic Base Branch (CRGB) of the Ministry of Agriculture and Lands in the Province of British Columbia.

For the purpose of these specifications, the word "shall" indicates a mandatory requirement and "should" indicates a desirable requirement.

The Branch shall be the final authority on acceptance or rejection of submitted imagery.

Where specifications are not achieved, the Branch may apply penalties as appended, rather than reject the photography.

All references to I.C.A.S. Specifications refer to the current version of the "Specifications for Aerial Survey Photography" produced by the Interdepartmental Committee on Air Surveys, Earth Sciences Sector, Natural Resources Canada.

For the purposes of these and the associated specifications the term "Roll" shall indicate a series of images either film based or digital with similar attributes. A

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“Roll” should be limited to a Maximum of 250 images. A “Roll” may be referred to as a “Filmroll” in some cases.

All aerial photography delivered to the Branch shall meet or exceed the following specifications.

3.0 PRE-ACQUISITION INFORMATION

The Airborne Remote Sensing Unit of BMGS must be notified of the planned acquisition parameters in order to facilitate archival of the Aerial Photography deliverables. The necessary information is:

1. Operation Name
2. Photo scale and/or Ground Sample Distance (GSD)
3. Focal Length
4. Emulsion or Sensor bands
5. Line kilometres
6. Number of photos
7. Number of lines
8. An operation boundary described below in order of submission preference
 - a. File Boundary File in the Branch format.
 - b. A boundary file in a format usable by the Branch.
 - c. An outline on a map with a fixed scale and edge coordinates suitable for digitizing.
9. Special Requirements

Note: The above information is to be submitted progressively during the planning stage of the project.

See Appendix A for a copy of the Submission form.

4.0 EQUIPMENT STANDARDS:

4.1 Calibration

Mapping systems consisting of camera, magazine, filter, and camera port glass shall be tested and calibrated, and unless otherwise stated shall meet standards for Topographic Mapping in the I.C.A.S. Specifications for Aerial Survey Photography. The operation of the camera shall be in accordance with the I.C.A.S. specifications. Alternately, Small & Medium Format Digital

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Cameras shall be calibrated and meet the standards in the current version of the Branch Small & Medium Format Digital Cameras Specifications. Calibration tests, as required, shall be made on the camera, magazine or sensor, and filter before the system is utilized for aerial photography. Copies of the current calibration report for all cameras, filters, film platens or sensors, and glass ports shall be submitted to the Branch – preferably in digital format - prior to the undertaking of the photographic project.

4.2 Camera Recording Equipment:

4.2.1 Annotation Block

- A) Film based Imagery - The camera cone must have a film annotation block situated so as to provide a clear film portion, measuring 50 mm X 7 mm, in the forward corner of the left side of the negative (film transport in direction of flight). The longer measurement shall be along the left side.
- B) Digitally Based Imagery – See the current version of the Small & Medium Format Digital Cameras Specifications.

4.2.2 Recording instruments

- A) Film based Imagery - Level bubble (where available), statoscope (where requested), altimeter, exposure counter, date, fiducial marks, cone number, and time (PST) shall be legibly recorded photographically at the instant of each exposure (see 6.1 for density requirements).

The date recorded on the film shall indicate year, month, and day of exposure. The format shall be **YY-MM-DD**.

The recording altimeter shall be set to agree with the calibrated altimeter which shall be set to the station pressure nearest the aerial photographic

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Operation.

B) Digitally Based Imagery - See the current version of the Small & Medium Format Digital Cameras Specifications

The exposure counter should agree with the field numbers on the film record.

All instruments shall be correctly set and adjusted.

4.2.3 Fiducial Marks:

General

The fiducial marks shall produce precise registration on every negative and shall provide a record of two fixed mutually perpendicular calibrated camera distances.

The lines joining opposite fiducial marks shall intersect at 90 ± 1 .

The lines joining opposite fiducial marks shall intersect at the fiducial centre.

For General, non-mapping photography, neither the principal point of autocollimation nor the centre of best symmetry shall be further from the fiducial centre than 0.10mm.

Topographic Mapping

Fiducial marks shall contain a central dot $80 \mu\text{m} + 30 \mu\text{m}$ in diameter.

For Mapping photography, neither the principal point of autocollimation nor the centre of best symmetry shall be further from the fiducial centre than 0.05 mm.

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4.3 Vacuum Supply:

- A) Film based Imagery - The vacuum supply to the camera shall be sufficient to provide acceptable image sharpness in every exposure. It is preferable that the camera be automatically rendered inoperable if the vacuum system fails.
- B) Digital Imagery – Not applicable.

4.4 Mounting:

The camera shall be mounted vertically in the aircraft.

Film cameras shall be oriented so that the film transport over the focal plane is in the direction of flight.

The camera shall be isolated from the vibration of the aircraft. Angular vibration of the camera shall be reduced to a level that does not significantly affect resolving power at the shutter speeds used.

4.5 Focal Length:

The Branch shall specify or approve the focal length of the lens to be used for each aerial photographic Operation.

4.6 Camera Port Glass:

The camera shall be mounted behind a camera port glass. Unless otherwise stated, the camera port glass shall meet the deviation requirements of the I.C.A.S. Specifications. The port glass in the aircraft shall be kept clean, free of scratches and other defects.

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4.7 Temperature:

The camera compartment should be maintained at a temperature of 20° C \pm 2° C.

5.0 FILM or FILTERS:

5.1 Films:

The film shall have a dimensionally stable polyester base and shall be stored and handled in accordance with the manufacturer's recommendations. Film emulsion type shall be specified by the Branch. Film manufacturer shall be approved by the Branch.

5.2 Filters:

Camera and filter should be calibrated as an operational unit. Unless otherwise stated, the deviation produced by the filter for collimated light at normal incidence shall not exceed 10 seconds and the change of deviation shall not exceed 2 seconds over the area of the filter. Filter orientation shall be constant. Filters may be specified by the Branch.

6.0 EXPOSURE:

6.1 Film Speed vs. Development:

The exposure shall produce an image that results in most of the densities in that image falling on the straight-line portion of the characteristic curve of the film.

6.2 Resolution:

Exposure shall be made at the aperture setting and shutter speed setting for maximum resolution and minimum image motion. Image motion on the film shall be held to less than 20 μ m.

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Project requirements may specify full Image Motion Compensation be set.

7.0 PHOTOGRAPHIC FLIGHT TOLERANCES:

7.1 Scale of Photography:

Average scale or ground sample distance (GSD) of photography shall be the scale as specified at datum ($\pm 3\%$).

7.2 Forward Overlap:

Unless otherwise specified, forward overlap shall be 60% ($\pm 4\%$). Isolated deviations from specified forward overlap up to three consecutive exposures will be acceptable except where it exceeds 68% or is less than 54%. Overlap over mountainous terrain shall be such that the highest ground within the photo image shall be covered by not more than 60% or less than 55% forward overlap.

7.3 Lateral Overlap:

Unless otherwise specified by the Branch, lateral overlap should be 30%.

In no case shall lateral overlap be less than 15%. For single line photography, deviation from the flight line shall not be greater than 10% of the gross photo cover at datum.

7.4 Course Correction:

Course correction shall not exceed 3 degrees between successive exposures.

7.5 Crab:

Crab shall not exceed 3 degrees between successive exposures.

7.6 Verticality:

The lens axis shall not be allowed to depart from the vertical at the time of any

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exposure by an angle greater than 2.5 degrees.

7.7 Combined Crab / Verticality:

The apparent crab caused by the combined effects of course correction, crab, and lack of verticality, shall not exceed 5 degrees in successive exposures and shall not average more than 3 degrees on any flightline.

7.8 Atmospheric Conditions:

Photography shall be taken under a clear sky or under thin cirrus with minimum interference from smoke or haze.

Colour or infrared photography shall be taken in clear conditions only.

A combination of cloud and cloud shadow shall be less than 5% on any photograph.

Orthophoto photography shall be cloud free.

7.9 Area Coverage:

Photography shall extend far enough beyond the borders of the specified area to ensure full stereoscopic coverage of the entire area included within the borders.

Block area shall mean an area comprising a minimum of 1,500 square kilometres and more than 5 parallel lines.

Photography within block areas shall be continuous from at least one block boundary.

7.10 Solar Angle:

The solar angle limitations shall be specified by the Branch. Unless otherwise specified, the minimum solar angle shall be 38°.

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7.11 Snow Cover:

Unless otherwise specified, aerial photography shall be taken only during the absence of seasonal snow cover.

7.12 Broken Flight Lines:

Flight lines shorter than 25 kilometres shall be flown as unbroken lines. Lines longer than 25 kilometres may have more than 1 break with minimum lengths specified by the Branch. Where breaks occur there shall be an overlap of at least three photographs.

8.0 PHOTOGRAPHIC PROCESSING

(For Digital Imagery see the current edition of the Branch Specifications for Digital Aerial Photographic Images):

8.1 Density Requirements:

Exposure shall be such that, within a 10 cm. radius of the fiducial centre, the minimum net density is not below .2 or over .5. Nowhere on the image shall the density be less than 0.1 above base plus fog.

Except for images of extremely bright spots, such as specular reflections of the sun, the maximum density on the negative shall not exceed 1.7 above base plus fog.

Base plus fog shall not exceed .20 and the difference between maximum and minimum base plus fog shall not exceed .05 across any frame.

An average gradient of development shall be chosen so that the negative density range is as close to 1.0 as possible. Maximum Density - Minimum Density shall not be less than 0.40.

In achieving the aim density range of 1.0, the contractor is expected to use

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low-contrast processing for high brightness range terrain and high-contrast processing for low brightness range terrain. If the density range on a roll is less than 0.7 and its average gradient is less than 1.3

or

If the density range on the roll is over 1.4 and its average gradient is over 1.0

then

It may be assessed that the contractor has not met the requirements of this specification.

Instrument density, including the information block, shall be between .15 and .8 above base fog as read between the numbers of letters on the negative using a Densitometer with a 5 mm aperture.

8.2 Colour Processing:

The average gradient for colour emulsions shall fall in the range as specified by the manufacturer. For true colour emulsions, the gradients of the three dye layers shall be such as to retain colour balance over the exposure range.

Based on the sensitometric exposure and plot sheet for colour I.R. emulsions, the I.R. sensitive layer shall be $.35 \text{ Log } E \pm .05$ less sensitive than the average of the two remaining dye layers measured parallel to the Log E axis at $D = 1.0$.

For all colour and I.R. colour films, a copy of the sensitometric plot shall accompany the film.

8.3 Panchromatic Processing:

All aerial film flown for the Branch shall be processed in a Roller Transport Continuous Processor such as a Kodak Versamat II-C, using Kodak Type 885 chemistry or equivalent.

Films shall be tested for residual hypo content using Kodak Hypo Test solution HT-2. Colour patch 2 of the Kodak Estimator indicates the limit of acceptable

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residual hypo.

Films shall be tested for residual silver using test solution ST-1. The test shall not cause a milky stain on unexposed, processed film.

If for some special reason it seems desirable to use procedures or equipment other than stated above, the suitability shall be established to the satisfaction of the Branch, prior to processing and Branch acceptance or rejection shall be confirmed in writing.

A processing report shall be completed and submitted for every roll of film.

8.4 Sensitometric Exposure:

At least one sensitometric step-wedge shall be exposed on each roll of aerial film prior to processing. The step-wedge shall be exposed in an area of the film that is unexposed, free of fog, and which shall not be subject to anomalous development effects. Density readings from each step wedge must be submitted. A current calibration report for the sensitometer used shall be available for inspection by the Branch.

8.5 Condition of Film:

Film shall be clean and free from stains, scratches, blemishes, air bells, and light or chemical fog.

9.0 PHOTOGRAMMETRIC TOLERANCES:

The geometric properties of the photographic system shall be such that the maximum residual Y-parallax shall not exceed 20 um.

10.0 IMAGE HANDLING, SPLICING, and DELIVERY:

10.1 Handling:

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Each Roll shall contain images exposed with one focal length cone only.

A) Film based Imagery -Each roll of film shall have at least 150 centimetres or six frames of film at the start and end of the roll as leader and trailer.

Unusable frames shall be identified by means of a heavy black line drawn through the length of the annotation space.

More than six continuous unusable frames, excluding leader and trailer, shall be removed from the roll before submitting the roll to the Branch.

B) Digital Imagery – See the current version of “Specifications for Digital Aerial Photographic Images”

10.2 Splicing:

A) Film based Imagery - Segments of usable film, when required to be joined, shall be butt joined with plastic tape equal in serviceability to 3M Scotch Brand Polyester Transparent Tape Type 850 applied to both sides of the film.

B) Digital Imagery – Not applicable.

Shipping:

A) Film based Imagery - Unless the Branch gives prior permission, filmrolls delivered shall measure between 60 metres and 80 metres. Film shall be on spools and in containers measuring not more than 14 centimetres in diameter, similar to Kodak S46 spools and #3000 cans.

B) Digital Imagery – See the current version of “Specifications for Digital Aerial Photographic Images”

10.3 Digital format Film/Roll Records:

A film/roll record in digital form shall accompany every roll delivered.

The film/roll record digital format shall be as specified in the current version of

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The Specifications for Aerial Photography Database Files.

10.4 Annotation of Film:

A) Film based Imagery - Each usable frame of exposed film shall be annotated with a permanent labeling method, depicting the BC Roll number (provided by the Branch), and unique frame number as follows:

Focal Length Code (2 characters), Emulsion or Sensor Code (3 characters), Designated BC Roll Number (5 characters), Unique Frame Number (3 characters)

Sample: 15BCB04001 – 001

Frames must be annotated sequentially from the Start to End of each roll beginning with the first usable frame (final, number one – 001).

B) Digitally Based Imagery – See the current version of the Small & Medium Format Digital Cameras Specifications

11.0 Summary of Returns:

11.1 Deliverables:

11.1.1 Annotated aerial photography negatives in sealed canisters
(Digital source photography is exempt from 11.1.1)

11.1.2 Film/Roll Record in digital form

- Must satisfy criteria as described in the current edition of the *Specifications for Aerial Photography Database Files.*

11.1.3 GPS Field Data Return File.

- Must satisfy criteria as described in the current edition of the

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Specifications for Aerial Photography Database Files.

11.1.4 One digital image of each annotated frame

11.1.4.1 One thumbnail Image derived from each Digital Aerial
Photographic Image:

- All digital imagery must satisfy criteria as described in the current edition of the *Specifications for Digital Aerial Photographic Images*.

11.1.5 Copy of the sensitometric plot for all colour negative and infrared colour films

11.1.6 Digital Aerial Photography Indices for each roll / operation submitted.

- Must satisfy criteria as described in the current version of the *Specifications for Aerial Photography Indexing*.

11.1.7 Written confirmation that copyright and moral rights for the submitted aerial photography film and/or products resides exclusively with the province

11.1.8 **NOTE:** For Aerial Photography funded under the Forest Investment Account (FIA) – Land Base Investment Program (LBIP), an additional set of hard copy prints will be delivered to the LBIP recipient.

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AERIAL PHOTOGRAPHY DISCOUNT SCHEDULE - 2008

1.0 Maximum penalties on a per roll basis may be assessed as follows:

		<u>Section</u>
1.1	Film movement not in direction of flight	4.4
	- \$150.00	
1.2	One or more instruments unreadable, incorrectly set, or not within density parameters; incomplete date displayed on the film or in the meta data.	4.2/8.1
	- \$250.00	
1.3	No step wedge	8.4
	- \$200.00	
1.4	Incorrect spool and/or container	10.3
	- \$150.00	
1.5	Unusable negatives not marked	10.1
	- \$100.00	
1.6	Unauthorized delivery or rolls shorter than 60 m.	10.3
	- \$50.00	
1.7	Failure to meet residual hypo and/or silver test requirements - unsuccessful remedial action will result in rejection of roll <u>or</u> penalty.	8.3
	- Remedial Action by Contractor <u>or</u> \$300/Rejection	
1.8	Scratches, abrasions and/or processing marks on film which cause inferior image reproduction.	8.5
	- \$250.00	

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		<u>Section</u>
1.9 Clearing frames less than 6 frames (150 cm) on each end of film.	- \$100.00	10.1
1.10 Film densities outside specifications will be assessed \$35.00 per group of 10 frames.	-	8.1
1.11 Miscellaneous		
1.11.1 Required splicing not performed	- \$100.00 per Splice	10.1/10.2
1.11.2 Incorrect packing slip	- \$50.00 per Occurrence	
1.11.3 No annotation block	- \$300.00/Rejection	4.2
1.11.4 Non-Conforming Annotation	- Remedial action by Contractor/Rejection	10.5

2.0 Maximum penalties on a per line kilometre basis may be assessed as follows:

		<u>Section</u>
2.1 Loss of one or more fiducial marks	- 100%	4.2.3
2.2 Substandard lateral overlap	- 50%	7.3
2.3 Lateral gap	- 100%	7.3
2.4 Substandard forward overlap	- 50%	7.2

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			<u>Section</u>
2.5	Forward overlap less than 52%	- 100%	7.2
2.6	Apparent crab exceeding 5 degrees	- 50%	7.7
2.7	More than 5% cloud or cloud shadow	- 50 to 100%	7.8
2.8	Solar angle outside specifications	- 50 to 100%	7.10
2.9	Block coverage incomplete;		7.9/7.12
	-Accomplished photography discounted	- 10%	
	Isolated line(s) will not be considered for payment.		
2.10	Non-block Operations incomplete;		7.12
	-Accomplished photography discounted	- 50%	
	Isolated line(s) or part line(s) will not be considered for payment.		
2.11	Contractor's GPS equipment not functional - no hard data captured	- 10%	

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12.0 APPENDIX A -

Aerial Photography Pre-Acquisition Information

Operation Name:

Gazetted Geographic Location

Photo Scale or Ground Sample Distance: 1: _____

Lens Focal Length: _____ mm

Emulsion or Sensor(s): _____

Line Kilometres: _____

Number of Photos: _____

Number of Lines: _____

Special Requirements: _____

Requesting Agency:

Company Name:

Contact Name:

Phone: _____ Fax: _____

E-Mail: _____

Outline of Photo Area:

Digital File Attached / Digital File E-mailed / Graphic File E-mailed / Map
Outline Mailed / Other _____

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