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SPECIFICATIONS FOR AIR SURVEY FLIGHT MISSIONS

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Notes on Air Photo Specifications

A specification is basically a description of what is required. It is not a club with which the client beats a Survey company, or vice versa.

It is of fundamental importance that the writer of a specification clearly understands what the end user requires from the photography. Without this understanding the requirement will invariably be under or over stated.

The danger here is that if understated the photography will not be adequate; if overstated the costs involved in acquiring the photography may well be greater than strictly necessary. We would observe, in the Commercial Survey sector, this latter circumstance is a frequent occurrence.

It often appears as though the person writing the specification has got together documents from different sources, extracted the bits from each of them that he likes, and finally put them all together. This procedure does not always make sense, and it very often leads to over specifying.

The group responsible for producing the BASA/RICS specification concentrated on the acquisition of aerial photography for conventional topographic line mapping. Their work involved the aim of ensuring that the client got photography adequate for this purpose, and that any reputable Survey company could, in a practical sense, obtain the photography at a reasonable cost. Before publication of the document there was a very thorough International examination by map users, photogrammetrists, equipment manufacturers, flyers and members of the photographic fraternity. Several useful comments were incorporated in the final version.

In writing a specification the first task is to set out the individual items that need to be specified. The second task is to quantify each of these items, where appropriate or practical, setting values with sensible tolerances around the values stated.

Stated like this, the task appears simple, and it should be, providing common sense prevails. For example, much research has been carried out into the quantification of haze, without any satisfactory answer emerging. In considering this item, the BASA/RICS group expended a great deal of time and thought before concluding that photography shall only be flown in conditions when the visibility does not materially impair the tone reproduction in the negative - "Does not materially impair", really means "does not seriously detract from its intended use". Although this is still far from ideal, in many cases the client has the ultimate protection in that the Company acquiring the photography subsequently does the mapping.

A further example of the requirement for common sense is illustrated by the need for mapping in notoriously poor weather areas. If the specification states that the photography shall be free of all cloud and cloud shadows the operator may collect demurrage money, and the client may get no photography - Maps with gaps are better than no map !

Other examples -

Tips and tilts - within the capabilities of the plotting instrument.
Image movement - large scale photography demands greater leeway, from which mapping can still be carried out adequately.
Residual radial distortion - must be compatible with camera manufacturers specifications.

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It must always be remembered that there is no such thing as all purpose photography. Although a variety of products may be made for varying purposes from any given film, there can never be an all-embracing specification.

Obviously, it would not be possible to do 1:2500 mapping from 1:50,000 scale photography, with any degree of accuracy; and to do 1:50,000 mapping from 1:2,500 scale photography would be very expensive.

More subtle problems than this can arise. For example 1:50,000 scale SWA photography obtained for topographic line mapping might be entirely adequate for this purpose. But due to the S.W.A. accentuation of haze its use in orthophotography would produce a less than satisfactory result.

Photography showing cloud shadow might be used in line mapping, but its presence would substantially impair the quality of product, where the photo image is present, e.g. enlargement, mosaics, orthophotos.

As stated at the outset a specification should be a clear description of what is required. It should enable the operator to perform the work to his client's satisfaction, without putting unnecessary obstacles in the way of completing the work.

SPECIFICATION FOR VERTICAL AIR PHOTOGRAPHY

(MARCH 1980)

This Specification for vertical air photography, taken on contract, is intended for general use worldwide. It aims to define standards which can be achieved in practice rather than ideal standards which can only be achieved in exceptional conditions or by using special procedures at higher cost.

The Specification is designed to satisfy the needs of most clients for black and white photography and includes, therefore, some optional and alternative clauses, printed in italics, which may be selected as required. Also clients may wish to make their own additions and deletions to suit their particular requirements.

This Specification was originated by the British Air Survey Association but has been approved and published by The Royal Institution of Chartered Surveyors. Comments of this edition should be sent to the RICS (Land Surveyors Division) at the address given below and will be taken into consideration in the preparation of future editions.

Further copies of this document are obtainable from:-

Land Surveyors Division,
The Royal Institution of Chartered Surveyors,
12 Great George Street, Parliament Square,
London SW1P 3AD Tel: 01 222 7000 ext. 226

SPECIFICATION FOR VERTICAL AIR PHOTOGRAPHY

SECTION ONE

SUMMARY OF REQUIREMENTS AND MATERIALS TO BE DELIVERED

1.1 Area

1.1.1 The area, route or sites to be photographed stereoscopically is/are defined on the Contract map or photomosaic or Landsat imagery forming Annexure ..... of the specification document and measure approximately ..... line km/km^2 in total.

1.1.2 The geographical/grid coordinates defining the area/route are as follows: .....

1.1.3 For the purpose of the contract any stated coordinates shall take preference over the map features in defining the area limits.

1.2 Scale and Type of Camera

1.2.1 The approximate scale of the photography (i.e. negative contact scale) shall be 1: .....

OR The photography shall be flown from an approximate height of ..... metres above sea-level.

1.2.2 The camera shall have a lens of nominal focal length ..... mm and negative format 230 x 230 mm.

1.3 Type of Photography

1.3.1 Black and white panchromatic photography shall be flown for full stereoscopic coverage.

OR Photography shall be flown with infra red or colour or false colour film.

1.3.2 The photographs shall be of a quality and precision suitable for photogrammetric mapping and/or production of orthophotos/mosaics and/or resource interpretation.

1.4 Materials to be Delivered

1.4.1 ..... set(s) of contact prints made on an electronic printer on double-weight fibre-based paper or medium weight resin-coated paper, on which ink, pencil and other commonly employed markers can be used on both sides.

Sets of contact prints required to be produced away from the contractor's laboratory may be produced on a conventional printer.

1.4.2 Copies of an index plot/print-laydown at a scale sufficient to show the position of each flight line and to indicate the approximate relationship of individual photographs.

1.4.3 One copy of all documentation which may include flight and progress reports, and camera calibration certificate.

1.5 Film Negatives

1.5.1 All films exposed on the contract shall be retained by the contractor.

OR All accepted negatives exposed on contract shall be delivered to the client.

OR All films exposed on the contract shall be delivered to the client.

SECTION TWO

CAMERA AND ASSOCIATED EQUIPMENT

2.1 Camera

2.1.1 The camera used shall be of a survey type fitted with a lens that is designed to give a residual radial distortion that does not exceed 15 micrometres except in the corners of the format. The film shall be held flat during exposure to maintain sharp focus and minimise image distortion.

2.1.2 The format of the negative shall be 230 x 230 mm and the focal length of the lens(es) used shall be as follows:

.....

.....

2.1.3 When films other than black and white panchromatic type are used the lens system must be corrected for the extended spectral range required.

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2.2 Calibration

2.2.1 Each camera optical unit to be used on the survey shall have been calibrated without a filter and shall have been tested and certified by a calibration centre approved by the camera manufacturer. This certificate shall be considered as valid for a period of one year and the camera may only be used beyond this period at the contractor's risk.

2.2.2 A valid calibration certificate shall be held by the contractor before commencement of flying and shall be available to the client on request.

2.2.3 The certificate shall contain the following data:

(a) The name of the calibration centre and the date of calibration.

(b) The camera manufacturer's serial number of the lens unit.

(c) The calibrated focal length of the lens.

(d) The radial distortion in micrometres referred to the axis of best symmetry. This shall be measured by goniometer with a grid-plate engraved at 10 mm intervals and approved by the lens manufacturer. Other methods of calibration may be used only by agreement between the client and the contractor before commencement of flying. The residual measurable distortion must fall within the limits laid down by the lens manufacturer.

(e) The radial and tangential resolution figures for the lens issued by the lens manufacturer at the time of manufacture or after optical readjustment of the lens.

(f) The distance between fiducial marks both with regard to sides and diagonals.

2.3 Filters

2.3.1 Only optical filters provided by the lens manufacturer or meeting the same optical specifications shall be used.

2.4 Camera Windows

2.4.1 Prior to photography any camera window used shall be checked by the calibration centre to ensure that it will not adversely affect lens resolution and distortion and that it is substantially free of veins, striations and other inhomogeneities.

2.4.2 Camera windows shall be mounted in vibration damping material in order to avoid mechanical stress to the window.

2.5 Camera Mounting

2.5.1 The camera shall be installed in a mounting which damps the effects of aircraft vibration.

SECTION THREE

FLYING AND PHOTOGRAPHIC COVER

3.1 Flight Altitude and Direction

3.1.1 The flying height(s) above mean sea level in metres for the block(s) and/or tie strip(s) to be photographed shall be as follows:

Block(s) .....
Block(s) .....
Block(s) .....
Tie Strip(s) .....

OR Flying height shall be selected by the contractor to achieve the approximate scale of photography specified in Section One para 1.2.1.

3.1.2 The direction of flight lines and/or tie strips shall be at the discretion of the contractor. On request the contractor shall supply a copy of the flight plan to the Client for information.

OR The direction of flight lines and/or tie strip(s) shall be as shown on diagram ..... forming Annexure ..... of the specification document.

3.2 Photographic Cover

3.2.1 The area(s) shall be covered by approximately straight strips of vertical photographs taken from the flying height(s) specified in para 3.1.1 above.

3.2.2 The fore and aft overlap between successive exposures in each strip shall be between 55 and 65 per cent. The lateral overlap between adjacent strips of photography shall be:

(a) Below 1,500 m ..... between 20 and 40 per cent.

(b) 1,500 m and above ..... between 15 and 35 per cent.

When ground heights within the area of overlap vary by more than ten per cent of the flying height a reasonable variation in the stated overlaps shall be permitted, provided always that the fore and aft overlap does not fall below 55 per cent and the lateral overlap does not fall below 10 per cent or exceed 45 per cent.

In extreme terrain relief where the foregoing overlap conditions are impossible to maintain in straight and parallel flight lines, the 'gaps' created by excessive relief shall be filled by short strips flown between the main flight lines and parallel to them.

3.2.3 Where a strip crosses a shoreline at right angles, or obliquely, the overlap shall be increased to a nominal 90 per cent subject to the constraints imposed by the camera cycle time.

3.2.4 Strips which run parallel to a shoreline may be repositioned to reduce the proportion of water covered, provided the coverage extends beyond the limit of any land feature by at least 10 per cent of the strip width.

3.2.5 Where the end of strips of photography join the ends of other strips or blocks flown in the same general direction, there shall be an overlap of at least two stereoscopic models which, if the scales of photography are different, shall be at the smaller photo-scale.

3.2.6 Crab shall not exceed 5° when measured between the base line and a line parallel to the frame of the negative, nor create stereoscopic gaps in the photography.

3.2.7 Tilt shall not normally exceed 2°. Isolated exposures with up to 4° shall be permitted in turbulent conditions.

3.3 Conditions of Photographic Flying

3.3.1 Cloud, dense cloud shadow or smoke shall not lie over the principal point of any photograph or its homologues in adjacent photographs. Nor shall any single mass of cloud, dense cloud shadow, or smoke, obscure more than three per cent of the total area of any negative. Nor shall the aggregate of cloud, dense cloud shadow and smoke obscure more than five per cent of the total area of negative.

OR Photography shall be free of all cloud, cloud shadow and smoke.

OR Isolated clouds shall not be cause for rejection of the photography.

3.3.2 Photography shall only be flown in conditions when the visibility does not materially impair the tone reproduction in the negative.

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SECTION FOUR

AERIAL FILM AND NEGATIVE QUALITY (Black and White panchromatic film only)

4.1 Aerial Film

4.1.1 The type(s) of aerial film to be used on the contract shall be:
..... (to be completed by the contractor).

4.1.2 The thickness of the base shall not be less than 0.1 mm.

4.1.3 The dimensional stability of the base shall be such that in any negative the length and width between fiducials shall not vary by more than 0.3 per cent from the same measurements taken on the camera, and that the differential between these measurements shall not exceed 0.04 per cent.

4.1.4 The net value of fog shall not exceed D 0.2 or D 0.4 above the density of the support when processed in full strength D 19 developer at 20°C for 10 minutes with continuous agitation. The density of 0,4 applies only with film nominally rated at a speed in excess of 250 ASA (Effective Aerial Film Speed).

4.1.5 The processed negatives shall be free of stains, discolouration, or brittleness that can be attributed to ageing.

4.2 Exposure

4.2.1 A shutter speed shall be chosen that meets the combined requirements of minimal image movement and optimum lens aperture for the prevailing illumination conditions.

4.2.2 Image movement shall not normally exceed 30 micrometres, but in cases of low subject luminance and/or photography at scales 1:5,000 and larger, up to 90 micrometres image movement shall be acceptable.

4.3 Filter

4.3.1 The filter(s) used shall provide optimum tone reproduction.

OR The filter type(s) used shall be: .....

4.4 Processing

4.4.1 Equipment used for processing shall be either Rewind Spool-tank or Continuous Processing Machine, and must be capable of achieving consistent negative quality specified under 4.5 below without causing distortion of the film.

4.4.2 The residual thiosulphate content of processed film shall not exceed 2.0 microgrammes per square centimetre.

4.4.3 Drying of the film shall be carried out without affecting its dimensional stability.

4.4.4 All processed negatives shall be substantially free of blisters, bubbles, inclusions, coating lines, stress or static marks, bar marks, pin holes, abrasions, streaks, stains and drying marks. Some tolerance in this respect shall be allowable where processing has to be carried out in sub-standard conditions, provided the intended purpose of the negatives is not impaired.

4.5 Quality of Negatives

4.5.1 The density, contrast and freedom from fog of all negatives shall be such that commercially available grades of paper (covering Log E ranges of 0.6 - 1.6) can be used in printing to give detail in significant areas of highlight and shadow.

4.5.2 The fog level of negatives shall not normally exceed a net density of D 0.2 when measured in an area clear of any image detail. A net density of fog up to D 0.4 shall be acceptable for fast films having a nominal speed rating in excess of 250 ASA (Effective Aerial Film Speed).

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4.5.3 Useful minimum shadow detail shall be not normally less than a net density of D 0.2 above the base plus fog value as defined in 4.5.2 above. In no circumstances shall the minimum density fall below D 0.1 above the base plus fog value.

4.5.4 The maximum density in useful areas of the negative shall not exceed D 1.5 above base, other than in areas of high reflectance where a maximum density of D 2.0 shall be permissible.

4.5.5 All fiducial marks shall be clearly visible on every negative.

4.5.6 The camera panel of instruments should be clearly legible on all processed negatives. Failure of instrument illumination during a sortie shall/shall not be cause for rejection of the photography.

4.5.7 Sensitometric wedges shall be printed on one end of all films. In the case of rewind spool-tank processing the wedge must be printed at least five metres distant from the start or end of the film and at least three separate wedges exposed.

4.5.8 Contrast limits shall be kept within ±20 per cent in the case of Rewind Spool-Tank processing (±12 per cent in the case of continuous processing) of the average gradient (G) of the D/Log E characteristic curve when measured over a Log E range 1.0 from a density of 0.4 above base plus fog.

SECTION FIVE

DOCUMENTATION AND ANNOTATION

5.1 Film Annotation

5.1.1 The following information shall be supplied as leaders at the start and the end of each film:-

START or END (as appropriate)
Contract Number and/or designation (if any).
Film Number.
Date of photography.
Effective negative numbers and run numbers.
Approximate scale(s) of photography.
The calibrated focal length of the lens unit.
Contractor's name.

5.2 Negative Numbering and Annotation

5.2.1 Numbering of negatives shall be carried out using heat-foil or indelible ink. The numbers shall be printed in a neat and clearly legible type.

5.2.2 Each film shall be provided with the following annotation which shall appear on the prints:-

Contractor identification.
Contract Number and/or designation (if any).
Film Number.
Year, month and day of photography.
Height above mean sea level or ground level or nominal scale of photography.
The focal length of the lens unit.

5.3 Processed Film

5.3.1 Each processed film shall be supplied in roll form on a spool and in a metal or plastic container as supplied by the film manufacturer.

5.3.2 The outside of each film container shall show clearly:-

Contract Number and/or designation (if any).
Film Number.
Date of Photography.
Effective negative numbers and run numbers.
Scale(s) of photography.
Contractor's name.
The focal length of the lens unit.

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5.4 Film Report

5.4.1 A report shall be included with each film giving the following information:

Film Number.
Camera type and number, lens number, filter type and number.
Magazine number or cassette and cassette holder unit numbers.
Film type and manufacturer's emulsion number.
Lens aperture and shutter speed.
Run number and flight direction.
Date of photography.
Start and end time for each run in local time.
Negative numbers of all offered photography.
Indicated flying height.
Computed flying height above sea level.
Scale of photography.
Outside air temperature.
Weather conditions - cloud, visibility, turbulence.
Date of processing.
Method of development.
Developer used and dilution.
Time and temperature of development or film transport speed.
Length of film processed.
General comment on quality.

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12 Great George Street,
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Abstract

Following discussions which were held at the International Congress of Photogrammetry in 1976 the British Air Survey Association together with the Royal Institution of Chartered Surveyors has produced a specification for aerial photography which, it is hoped, could become a standard document forming part of every international tender for air survey photography.

This specification was the subject of a paper to the International Congress of Photogrammetry in 1980.

This paper discusses the thinking behind the production of this new specification and examines some of the more important aspects which needed to be considered.

Bildflug-Spezifikationen

Zusammenfassung

Aufgrund von Diskussionen während des Internationalen Kongresses für Photogrammetrie 1976 wurde von der British Air Survey Association (Britische Gesellschaft für Luftbildvermessung) in Zusammenarbeit mit der Royal Institution of Chartered Surveyors (Verband Vereidigter Geometer) eine Spezifikation für das Luftbildwesen erstellt, welche, so hofft man, als Richtlinie zum Bestandteil jeder internationalen Ausschreibung auf dem Gebiet der Luftbildphotographie werden könnte.

Ein Vortrag beim Internationalen Kongress für Photogrammetrie 1980 hatte diese Spezifikation zum Thema.

Der vorliegende Beitrag behandelt die Überlegungen, welche der Erstellung dieser neuen Spezifikation zugrunde lagen und prüft die wichtigsten der dabei zu berücksichtigenden Aspekte.

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Spécifications des missions de prise de vues aériennes

Résumé

Sur le base des discussions soulevées au cours du Congrès International de Photogrammétrie en 1976, la British Air Survey Association (Société britannique de prise de vues aériennes) a établi une spécification en collaboration avec le Royal Institution of Chartered Surveyors (Association de géomètres assermentés) qui pourrait être à la base de chaque appel d'offres dans le domaine de la prise de vues aériennes.

Cette spécification était le thème d'un document présenté à l'occasion du Congrès International de Photogrammétrie 1980.

Le présent exposé traite les réflexions qui ont été à la base de cette nouvelle spécification et il examine les plus importants aspects à prendre en considération.

Especificaciones de vuelos fotogramétricos

Resumen

Tomando como base las cuestiones deliberadas con motivo del Congreso International de Fotogrametría, celebrado en 1976, la British Air Survey Association junto con la Royal Institution of Chartered Surveyors ha reunido una especificación destinada a la aerofotografía. Se espera que la misma podría convertirse en pauta o norma que formará parte integrante de todo concurso público internacional referente a aerofotogrametría.

Esta especificación ha sido el tema de una conferencia dictada con ocasión del Congreso Internacional de Fotogrametría 1980.

La presente conferencia está dedicada a las consideraciones que sirvieron de base al establecimiento de esta nueva espècificación y analiza los aspectos más importantes que había que tener en cuenta para tal fin.

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