



# ADVISORY CIRCULAR

**CAA-AC-AGA302**

**March 2023**

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## AERODROME SURVEYS

### 1.0 GENERAL

This Advisory Circular (AC) details survey requirements and presentation required by the Uganda Civil Aviation Authority (UCAA) to ensure Aerodrome Operators comply with their legal obligations under the applicable Civil Aviation (Aerodromes) Regulations.

The primary purpose of these general guidelines and specifications is to list the requirements for aeronautical surveys conducted at aerodromes in support of the Civil Aviation (Aerodromes) Regulations. The surveys covered in this circular provide critical information to the operation and safety of the aerodrome and Airspace, and are classified as critical by the International Civil Aviation Organization (ICAO). The information furnished under these standards includes runway and stopway data, navigational aid (NAVAID) data, obstruction data, and data on various aerodrome features, including taxiways, aprons, and landmark features.

### 2.0 PURPOSE

The purpose of aerodrome survey advisory circular is to provide the specifications for the collection of aerodrome survey data through field and office methodologies in support of aeronautical information and aerodrome engineering surveys to enable Aerodrome Operators meet their safety responsibilities and provide the data required by the UCAA to enable it to:

- a) consider aerodrome certification/licensing issues;
- b) design and develop operational flight procedures;
- c) prepare charts; and
- d) conduct safety evaluations.

This AC is structured to assist the following logical steps:

- a) Choosing the relevant aerodrome survey classification.
- b) Determining the areas to be surveyed.
- c) Surveying the areas required.
- d) Populating Aerodrome Facilities and Obstacle data lists.
- e) Producing plans and filtering obstacle data as required.
- f) Producing a survey report.
- g) Distributing relevant data and information.

Following these processes, selected information shall be published in the Aeronautical Information Publication (AIP) and other associated documents.

This Advisory Circular also explains how to submit data to the UCAA.

### 3.0 REFERENCE DOCUMENTS

- a) Civil Aviation (Aerodromes) Regulations
- b) Civil Aviation (Aeronautical Charts) Regulations
- c) Civil Aviation (Aeronautical Information Services) Regulations
- d) Civil Aviation (Units of Measurement to be Used in Air and Ground Operations) Regulations
- e) ICAO DOC 9674 (WGS-84 Manual)
- f) ICAO Annex 4 (Aeronautical Charts)
- g) ICAO Annex 5 (Units of Measurement to be Used in Air and Ground Operations)
- h) ICAO Annex 14 (Aerodromes)
- i) ICAO Annex 15 (Aeronautical Information Services)
- j) ICAO DOC 8168 (PANS OPS)
- k) ICAO DOC 9981 (PANS – Aerodromes)
- l) ICAO DOC 10066 (PANS – AIM)

### 4.0 GLOSSARY OF TERMS

<b>Above Mean Sea Level (AMSL)</b>	Orthometric Height
<b>Accelerate-Stop Distance Available (ASDA)</b>	The length of the take-off run available plus the length of the stopway, if provided.
<b>Aerodrome Elevation</b>	The elevation of the highest point of the landing area.
<b>Aerodrome Reference Point (ARP)</b>	The designated geographical location of an aerodrome.
<b>AGA</b>	Aerodromes, Air Routes and Ground Aids
<b>Cyclic Redundancy Check (CRC)</b>	A mathematical algorithm applied to the digital expression of data that provides a level of assurance against loss or alteration of data.
<b>Ellipsoid Height</b>	The height related to the reference ellipsoid, measured along the ellipsoidal outer normal through the point in question.
<b>Geoid</b>	The equipotential surface in the gravity field of the Earth which coincides with the undisturbed mean sea level (MSL) extended continuously through the continents.
<b>IFP</b>	Instrument Flight Procedure
<b>Landing Area</b>	That part of a movement area intended for the landing or take-off of aircraft.
<b>Landing Distance Available (LDA)</b>	The length of landing distance available
<b>Obstacle</b>	All fixed (whether temporary or permanent) and mobile objects, or parts thereof, that are located on an area intended for the surface movement of aircraft or that extend above a defined surface intended to protect aircraft in flight.

<b>Orthometric Height</b>	Height of a point related to the geoid, generally presented as a MSL elevation.
<b>Reference Ellipsoid</b>	A geometric figure, usually determined by rotating an ellipse about its shorter (polar) axis, used as a surface of reference for geodetic surveys. The reference ellipsoid closely approximates to the dimensions of the geoid, with certain ellipsoids fitting the geoid more closely for various areas of the earth.
<b>Survey Date</b>	The date that fieldwork was carried out to obtain data for the survey. Where fieldwork was completed over more than one day the end date of fieldwork shall be used.
<b>Take-off Distance Available (TODA)</b>	The length of the take-off run available plus the length of the clearway if provided.
<b>Take off Run Available (TORA)</b>	The length of the take-off run available.
<b>Threshold</b>	The beginning of that portion of the runway usable for landing.

## 5.0 INTRODUCTION

5.1 The basic survey philosophy applied in this AC is to provide lists of all aerodrome facilities (i.e. runways, navigation aids, etc.) and features identified as obstacles for each Aerodrome constrained by the appropriate area of interest. These lists form the basis for all charting, obstacle filtering (using obstacle identification surfaces) and analysis for Instrument Flight Procedures design.

5.2 The challenge placed upon surveying companies is to identify appropriate features to survey. It is important for surveying companies to understand the tasks and challenges faced by the end user, i.e. UCAA Aeronautical Charts and information/Data, IFP designers, Aerodrome Inspectors and Aerodrome operators (with regard to Safeguarding aerodromes), in achieving their individual objectives. From an IFP design perspective the appropriate surveyed area and “real world” obstacle representation (“Obstacle list”) forms the critical baseline for successful IFP design.

## 6.0 MANDATORY REQUIREMENTS

6.1 This AC aims to provide means for aerodromes to achieve the minimum prescribed safety standards and requirements. The UCAA fully recognises that each Aerodrome has its own operational needs and therefore the level of survey required should be appropriate to the type of operation intended for its purpose.

6.2 Aerodrome Operator shall provide accurate survey information of their aerodrome and environs according to the type of operation identified by aerodrome survey classification and survey areas required as prescribed in Table 1 and shall be carried out to measure any changes at the periodic intervals as set out in Table 2.

## 7.0 SURVEY AREAS

The Survey Areas required for a particular Aerodrome Survey Classification are prescribed in Table 1 below.

**Table 1 Aerodrome Survey Classification and Survey Areas Required**

Type of Operation	Survey Area
Aerodrome with no Instrument Flight Procedures (IFP)	<ul style="list-style-type: none"> <li>• Aerodrome Plan</li> <li>• AGA</li> </ul>
Aerodrome with Non-precision IFP	<ul style="list-style-type: none"> <li>• Aerodrome Plan</li> <li>• AGA</li> <li>• Non-precision Instrument Approach (*)</li> <li>• Visual Manoeuvring (Circling)</li> <li>• Departure (**)</li> <li>• Aerodrome Obstacle Chart - Type A (***)</li> </ul>
Aerodrome with Precision ILS CAT I or equivalent IFP	<ul style="list-style-type: none"> <li>• Aerodrome Plan</li> <li>• AGA</li> <li>• Non-precision Instrument Approach (*)</li> <li>• Visual Manoeuvring (Circling)</li> <li>• Departure (**)</li> <li>• Aerodrome Obstacle Chart - Type A (***)</li> <li>• Precision Approach Procedure</li> </ul>
Aerodrome with Precision ILS CAT II/III or equivalent IFP	<ul style="list-style-type: none"> <li>• Aerodrome Plan</li> <li>• AGA</li> <li>• Non-precision Instrument Approach (*)</li> <li>• Visual Manoeuvring (Circling)</li> <li>• Departure (**)</li> <li>• Aerodrome Obstacle Chart - Type A (***)</li> <li>• Precision Approach Procedure</li> <li>• Precision Approach Terrain Chart</li> </ul>
<p>(*) Only required for aerodrome classification 3 and 4 if runways have additional Non-precision IFP.</p> <p>(**) Only applicable to runways from which IFR departures take place.</p> <p>(***) Only required if runways used by Performance A aeroplanes engaged in Public Transport flights.</p>	

## 8.0 SURVEY PERIODS

Surveys shall be undertaken for all Survey Areas required to measure any changes at the periodic intervals prescribed in Table 2.

**Table 2: Survey Periods**

Survey Type	When
Geodetic Connection	<ol style="list-style-type: none"> <li>1. Together with an initial full survey.</li> <li>2. When a more accurate reference frame for WGS-84 becomes available.</li> </ol> <p><b>Note:</b> Requirement applies to all aerodromes except for aerodromes with no Instrument Flight Procedures (IFP).</p>

Full Survey	1. Initial survey. 2. If any doubt exists as to the validity of a previous survey.
Check Survey	As and when recommended by the UCAA or as required by the aerodrome operator.

## 9.0 SURVEY PROCEDURES

### 9.1 Geodetic Connection

The procedures for a geodetic connection are detailed in Paragraph 16. The geodetic connection date shall be included with the submission of a Survey Declaration Form (see Appendix A).

### 9.2 Full Survey

The procedures for a full survey are detailed in paragraph 16 and all full surveys shall be notified by the submission of a Survey Declaration Form (see Appendix A).

### 9.3 Check Survey

The check survey is to identify any changes, including significant tree growth or reduction, since the previous survey. Any change shall be surveyed to the specifications detailed in this publication. All check surveys shall be notified by the submission of a Survey Declaration Form (see Appendix A)

## 10.0 DATA MANAGEMENT

**10.1** Proper data management is crucial during the entire survey and subsequent declaration process. Survey companies are urged to implement rigorous data handling processes and practices to eliminate erroneous data submission. Each surveyed entity and associated attributes shall be dealt with as a single data record stream. Any change to an existing data record stream identified during a subsequent annual check survey shall necessitate a re-issue of the entire data record with a new unique record number and the deletion of the old record number.

**10.2** For example: If a check survey is carried out on an existing mast and is found to be higher or lower than previously declared, previous data record will be deleted and a new data record declared together with a new unique data record number. The surveyor shall declare the deleted and new record and the reason(s) for change. The old record shall be deleted irrespective if the new record is the same mast located at the same position.

**10.3** If no changes were found to all attributes in an existing record the record shall retain its original record number and survey date.

**10.4** If a later full survey is submitted following an initial full survey, all previous data records shall be declared as obsolete and a new list of survey data records shall be declared with new record numbers and new survey dates.

## 11.0 SURVEY DECLARATION FORM

A “Survey Declaration Form” (see Appendix A) shall accompany all full and check survey submissions. Completion of this Form confirms that the survey information submitted to the Uganda Civil Aviation Authority meets the requirements and accuracies detailed in this AC. The Aerodrome Operator should state the survey areas appropriate to their operational requirements and the type of survey undertaken, i.e. full or annual check survey. The surveyor is required to state the change or no change status for each survey area.

## 12.0 QUALIFYING SURVEYING COMPANIES

The Aerodrome Operator shall satisfy itself as to the competence of the surveyors it employs for aerodrome surveys. The following is a list of characteristics that should be considered:

- a) Accredited to an ISO 9001:2015 standard or operate an equivalent quality control system.
- b) Professionally qualified surveyors and project managers to oversee the survey.
- c) Field survey staff competent in aerodrome surveying techniques and experienced at working in an operational aerodrome environment.
- d) Professional indemnity cover.

## 13.0 ACCURACY

Appropriate survey methods shall be applied to qualify the accuracy and integrity of the data provided. Survey methodology shall be clearly demonstrated in the Survey Report. Requirements are stated in ICAO DOC 9674 (WGS-84 Manual) and the most stringent survey accuracy shall apply for Aerodrome as prescribed in Table 3.

**Table 3 Minimum Survey Accuracy and Integrity Requirements**

	Horizontal Accuracy	Vertical Accuracy	Integrity Classification
Aerodrome Control Network	1.0 m (*)	1.0 m (*)	1 x 10 <sup>-8</sup>
Aerodrome Facilities	0.5 m (**)	0.25 m (**)	1 x 10 <sup>-8</sup>
Obstacles and Off Aerodrome Facilities	3.0 m (**)	0.3 m (**)	1 x 10 <sup>-5</sup>
(*) Accuracy with respect to the appropriate geodetic reference frame			
(**) Accuracy relative to the aerodrome control network			

## 14.0 SURVEY PACKAGE

**14.1** The completed survey package for submission to the Authority shall consist of the following:

- a) Two electronic copies on CD-ROM to include the Survey Report and Survey Plans in Adobe PDF format and accompanying Digital Data.
- b) One original signed copy of completed Survey Declaration Form.

**14.2** For Aerodrome Classification 1 the survey package, comprising report, plans, data and declaration form may be submitted in hard copy format.

**14.3** The Aerodrome Operator is responsible for ensuring that copies of all survey information and Survey Declaration Form are forwarded within 60 days of the survey date to: Director Safety, Security and Economic Regulation, Uganda Civil Aviation Authority.

**14.4** Surveys that fail to conform to the requirements stated in this AC will be rejected and returned to the Aerodrome Operator.

**14.5** Ownership and copyright of survey data resides with the Aerodrome Operator.

## 15.0 CONVERSION FACTORS

The Civil Aviation (Aeronautical Units of measurements) Regulations is used as the standard for the application of all conversion factors.

Non-SI Units	SI Units
1 Nautical Mile (nm)	1.852 kilometres (km)
0.54 nm	1 km
1 Foot (ft)	0.3048 metres (m)
3.2808 ft	1 m
1nm = 6076.04 ft	

## 16.0 SURVEY PROCEDURE

### 16.1 General

- a) The accuracy and integrity requirements for the geodetic connection and surveyed data are stated in Table 3.
- b) Surveyed data that does not meet the accuracy and integrity requirements is unacceptable for IFP design and will be published in the AIP with an asterisk. Aerodromes without Instrument Flight Procedures do NOT need to undertake surveys to the accuracy and quality assurance requirements stated in the ICAO DOC 9674 (WGS-84 Manual). The Aerodrome Operator is responsible for ensuring the accuracy of information required for Aerodrome Plan and AGA survey areas. It is recommended that a surveyor or suitably experienced person provide the plans and data.

### 16.2 Horizontal Control

- a) Co-ordinates will be required in WGS-84 format (required format for published data) and appropriate National Grid (for plotting and design on topographical charts).
- b) Survey control points shall conform to the ICAO DOC 9674 (WGS-84 Manual).
- c) WGS-84 geodetic control and format requires that the methods deployed must prove that the accuracy for the various surveys has been met. Survey companies undertaking these surveys shall be responsible for the accuracy of the control data and any transformation sets used. An analysis of the accumulated error, evidence confirming the required accuracies have been met and the transformation parameters used shall be included in the Survey Report.

### 16.3 Vertical Control

- a) Orthometric and ellipsoidal elevations are required.
- b) The variable separation between the geoid and the reference ellipsoid may give rise to inaccuracies greater than the allowable specified. For the computation to transform ellipsoidal to orthometric elevations a geoid model should be used. If a geoid model is not available extra

care must be taken to ensure good geometry of the initial control points. In all cases appropriate survey checks shall be applied to prove the quality of vertical control. These checks shall be included within the survey report.

- c) Standard survey practice shall be used to produce the elevation to the required specification accuracy and the integrity of the control points used shall be proved.

#### **16.4 Instrumentation**

All survey equipment shall have a current calibration certificate and be able to perform to the accuracy appropriate to the requirements of the surveys.

#### **16.5 Methodology**

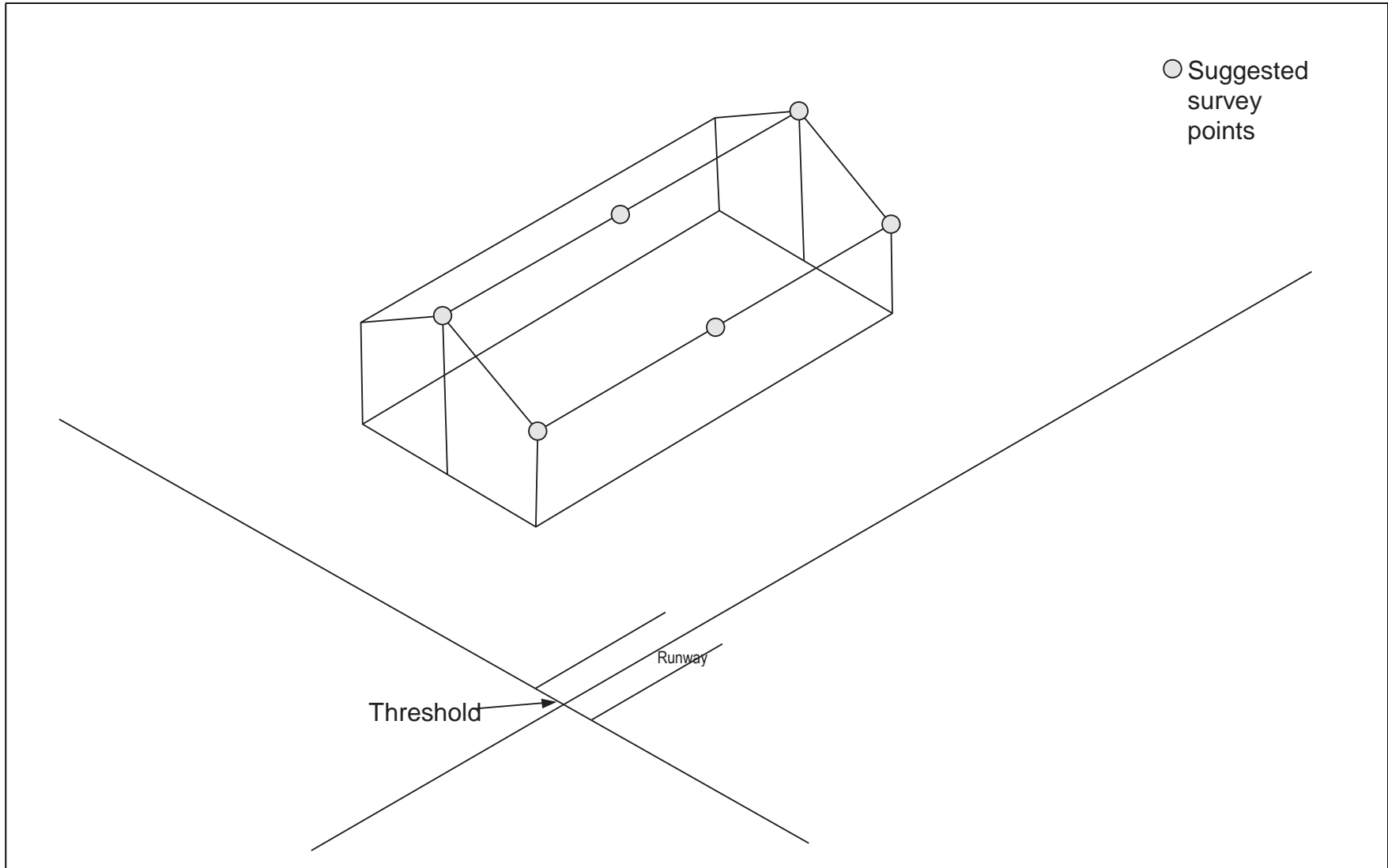
- a) All permanent controls that are established within the aerodrome boundary shall be documented and traceable.
- b) Office appreciation using contour maps can aid in the process of defining the probable extent of the survey and the likely position of obstacles. Local scale factor adjustment to ground distances shall be considered, and the effects of curvature and refraction.
- c) New obstacle data shall be proved by two independent measurements and their resultant elevations and positions shall satisfy the appropriate survey criteria.
- d) Obstacles heighted on previous surveys need only to be checked to confirm their height and position without the rigor afforded to new obstacles. Particular attention should be paid to structures and trees whose height may change. An appreciation of the effects of vertical angles over variable distances is necessary to give good height accuracies. It is recommended that observations taken without corrections for curvature and refraction should be limited to a maximum of 1 km.

#### **16.6 Obstacles to be Heighted**

- a) Surveying companies should take note that when surveying a prescribed area, a situation might arise where the highest obstacle within that area might not necessarily be the dominant obstacle for that particular phase of flight. Therefore, surveyors should always declare an obstacle in the Obstacle list if any doubt exists to its validity as an obstacle.
- b) Obstacles include terrain, vegetation and structures.
- c) Where there are a large number of obstacles to be heighted it will be impractical to survey, for example, every tree in a wooded area and therefore the surveyor should consult with the Aerodrome Operator and the Instrument Flight Procedure (IFP) designers where necessary.
- d) Due consideration must be taken when observing transverse and longitudinal obstacles in close proximity to the runway because their leading edge may have greater significance than the highest point. (It must be appreciated that the highest object might not be the most important for consideration, see Figure 1.)
- e) Fine obstacles such as lightning conductors or aerials that surmount the object may not be visible over a distance. Therefore, care must be taken when observing distant obstacles to ensure that the highest point is heighted.



- f) Temporary obstacles encountered at the time of survey should be included and identified as temporary. A statement should be included in the Survey Report stating the temporal extent of all such obstacles.
- g) When submitting the report, the surveyor should include details of all obstacles surveyed, whether they penetrate the relevant surfaces or not.



**Figure 1 Transverse and Longitudinal Obstacles**

## **17.0 PRESENTATION**

### **17.1 Plans**

- a) The format of the base mapping for the Aerodrome Plan is at the discretion of the Aerodrome Operator. Listed below are the formats accepted by UCAA:
- Digital mapping;
  - Hard copy mapping compilations;
  - Published mapping sheets; or
  - Approved equivalent.
- b) Surveyors shall ensure the following:
- The most recent mapping shall be used.
  - National Grid reference system shall be shown with grid values along the plan edge at convenient intervals.
  - Data reference source and revision data shall be shown on the plan.
  - Copyright license requirements shall be met when required.

### **17.2 Plan Sheet Size**

It is recommended that the sheet size should be limited to A0 size for easy storage and handling. Where this is not practical due to the extent of the survey area, out-size and adjoining sheets may be used. When using an adjoining sheet system, it should be capable of being abutted and orientated to give the best possible coverage.

### **17.3 Plan Sheet Layout**

- a) Where multi-sheets are used, full reference shall be given to the total number in the series.
- b) Each sheet shall have a title panel. The information shown should consist of the following:
- ✓ Aerodrome
  - ✓ Drawing Title
  - ✓ Drawing number or reference number including current amendment status.
  - ✓ Date of survey
  - ✓ Scale
  - ✓ Survey company name and address including telephone number
  - ✓ Surveyed by
  - ✓ Checked by
  - ✓ Sheet number
  - ✓ Sheet lay-out and diagram, if applicable

- ✓ Abbreviations used
- ✓ A reference to the appropriate survey report
- ✓ Statement of vested copyright.

#### **17.4 Survey Reports**

a) Geodetic Connection Report (if required) Shall include the following:

- ✓ Quality Records as par Paragraph 18
- ✓ Details of the connection of the aerodrome control network to the geodetic network
- ✓ Aerodrome control network plan
- ✓ Survey stations descriptions
- ✓ Transformation parameters

b) Full Survey Report

Shall include the following:

- ✓ Quality Records as per paragraph 18
- ✓ Survey Declaration Form

c) Check Survey Report

Shall include the following:

- ✓ Abbreviated Quality Records that refer back to the previous Full Survey with regard to surveying methodology
- ✓ Survey Declaration Form
- ✓ Schedules listing all obstacles that have been added or deleted since the last survey.

d) For traceability purposes the complete documentation shall be reissued on every occasion that a check survey amends the preceding full or check survey.

e) Format of the schedules listing changes shall be at the discretion of the surveyor or as agreed with the Aerodrome Operator. It is recommended that schedules are prepared as digital spreadsheets. To enable users to track changes where an obstacle has been given a new feature number the old number shall be referenced against it.

#### **17.5 Digital Data**

a) The following files of all surveyed obstacles and aerodrome facilities shall be created and supplied:

- ✓ Obstacles file, including all features identified as obstacles.
- ✓ Aerodrome facilities file, including all facilities surveyed for the purposes of the Aerodrome Plan survey area.

b) The integrity of the survey information supplied in digital format shall be protected against

third party corruption by wrapping with a Cyclic Redundancy Check (CRC).

## **18.0 QUALITY ASSURANCE**

### **18.1 Quality Records**

- a) All data elements for aerodromes with Instrument Flight Procedures shall be traceable to their source of production by an unbroken audit trail. The surveying company, following guidance given in the WGS-84 Quality Assurance Manual, shall provide information on the source of production in the form of Quality Records.
- b) Quality Records shall include:
  - ✓ Surveying organisation
  - ✓ Name of surveyor(s)
  - ✓ Date and purpose of survey
  - ✓ Method of survey and equipment used
  - ✓ Equipment calibration information and method of checking the survey
  - ✓ Evidence that the accuracy requirements have been met including details of the error budget analysis.

### **18.2 Methodology**

The surveying company shall maintain an effective checking system to ensure that the data collected conforms to the accuracy standard and shall present proof of that conformity within the Survey Report.

## **19.0 AERODROME PLAN SURVEY AREA**

### **19.1 Purpose**

The Aerodrome Plan is part of the Aerodrome Manual which Aerodrome Operators are required to maintain for certification/licensing and safeguarding purposes. The Aerodrome Plan is a working document that gives an accurate picture of the aerodrome configuration and integral facilities.

### **19.2 Survey Specification**

- a) The survey specifications for the Aerodrome Plan is covered in ICAO DOC 9674 (WGS-84 Manual).
- b) All features listed in paragraph 19.3.5 below shall be surveyed.

### **19.3 Plan Content**

- a) The scale shall be 1:2500. The accepted format of the plan is covered in paragraph 17.1
- b) The area of the plan shall show the limits of the aerodrome boundary and the locations of

installations that are considered integral to the operational procedures of the aerodrome. Insets may be required to show off-site facilities.

- c) All aerodrome characteristics as described in Civil Aviation (Aerodromes) Regulations and relevant buildings shall be shown on the plan. Surveyed features shall be represented by an appropriate symbol and labelled by survey identification number. The operational runway(s) shall be shown by a solid line, the runway markings and approach lighting arrays shall be shown true to scale.
- d) The height above local ground level (AGL) and elevation AMSL to the highest point of the feature in metres and feet are required for all features surveyed that are greater than 0.9m above local ground level within the runway strip.
- e) WGS 84 and OSGB36 co-ordinates and orthometric elevation AMSL and height AGL (where applicable) shall be shown on the plan for the following features.
  - ✓ Aerodrome Beacon (Identification or Location)
  - ✓ Aerodrome Elevation
  - ✓ Aircraft stand points
  - ✓ Anemometer(s)
  - ✓ ARP
  - ✓ ATC tower
  - ✓ DME
  - ✓ End of ASDA
  - ✓ End of LDA
  - ✓ End of TODA
  - ✓ End of TORA
  - ✓ ILS Localizer and Glidepath antennae
  - ✓ ILS Middle and Outer Markers (where applicable show as inset on plan)
  - ✓ IRVR
  - ✓ MLS Azimuth and Elevation antennae
  - ✓ NDB(Locator)
  - ✓ PAPI/APAPI
  - ✓ Radar antenna
  - ✓ Runway Observing Position
  - ✓ Runway centre-line elevation points
  - ✓ Runway edge lights if human observed RVR is in use
  - ✓ Start of TORA
  - ✓ Taxi-Holding positions

- ✓ Thresholds
  - ✓ TLOF
  - ✓ UHF and VHF transmitters
  - ✓ VDF
  - ✓ VOR
  - ✓ Windsleeve(s)
- f) The co-ordinates and associated data shall be in a schedule format within the margin of the plan.
- g) Additional information may be required; this shall be at the request of the Aerodrome Operator and may include the following:
- ✓ Fire service accommodation
  - ✓ Emergency access/egress gates and routes
  - ✓ Emergency water supply tanks
  - ✓ Facility safeguarding (fences)
  - ✓ Runway Observing Position to runway edge lights distances
  - ✓ Human Observed RVR Conversion Table

#### **19.4 Digital Data**

All surveyed features shall form part of the Aerodrome Facilities list.

### **20.0 AGA SURVEY AREA**

#### **20.1 Purpose**

- a) The purpose of the AGA survey is to identify all obstacles that infringe the prescribed Aerodrome obstacle limitation surfaces appropriate to the existing or proposed runway coding.
- b) The survey data enables the Aerodrome Operator to make safety evaluations and assists the UCAA to make assessments for the grant, retention or modification of an Aerodrome certificate/Licence.
- c) It is the Aerodrome Operators' responsibility to promulgate selected significant obstacles within the aerodrome approach, take-off climb and circling areas in the Aeronautical Information Publication (AIP). To aid this selection it is recommended that Aerodrome Operators ensure the surveyor provides a list of obstacles that infringe the surfaces, including extent of infringement. For guidance, identify and report the following:
- ✓ First obstacles in the Take-Off Climb Surfaces
  - ✓ Lines of trees/pylons close to the aerodrome in the Approach/Take-Off Climb Surfaces

- ✓ High ground that may affect the circuit height
- ✓ Obstacles (chimney, mast, etc.) within the circling area that are significantly higher than the aerodrome elevation.
- ✓ Lit aerodrome features or large single objects that may not necessarily be infringements.

## 20.2 Survey Specification

- a) The AGA obstacle limitation surfaces are listed below:
- ✓ 1:10 surface from the runway centreline
  - ✓ Runway Strip
  - ✓ Clearway (when applicable)
  - ✓ Transitional Surface
  - ✓ Take-Off Climb Surface
  - ✓ Approach Surface
  - ✓ Inner Horizontal Surface
  - ✓ Conical Surface
  - ✓ Outer Horizontal Surface
  - ✓ Obstacle Free Zone Surface, comprising the inner approach, inner transitional and landing surfaces (precision approach only).
- b) Aerodrome Operators of airfields that have visual runways only without Instrument Flight Procedures (IFP) may limit their survey to the asterisked items at paragraph 20.2.1, within the remit of abbreviated requirements given in paragraph 16.
- c) The Aerodrome Operator before the start of work will give the origin of each surface, relative to a particular runway, to the surveyor.
- d) The dimensions and slopes of the various surfaces are defined and illustrated in Civil Aviation (aerodromes) Regulations.
- e) The survey requirement is to height all obstacles within the AGA obstacle limitation surfaces area that infringe the limitation surfaces.
- f) Special care must be exercised in the near environs of the approach and take-off climb area to ensure complete obstacle coverage.

## 20.3 Digital Data

All surveyed obstacles shall form part of the “Obstacles list”.

## 21.0 DOMINANT OBSTACLE SURVEY AREAS

### 21.1 Purpose

The purpose is to provide obstacle information for the applications listed below:



- ✓ Non-Precision Instrument Approach Procedures as follows: Surveillance Radar - termination range 0.5, 1 and 2 nautical miles NDB (Non-Directional Radio Beacon)
- ✓ VOR (VHF Omni directional Radio Range) ILS Localiser / MLS Azimuth only
- ✓ Visual Manoeuvring (Circling) Areas.
- ✓ Departure Areas 1 and 2.

## 21.2 Survey Specification

### a) Non-Precision Instrument Approach Area

- (i) The survey area is divided into a mosaic of tiles. The optimum tile size is 0.5kmx1km. However, the Aerodrome Operator may select a tile dimension larger than the optimum after consultation with TA, DAP. The total area has been designed to allow the IFP designer the flexibility to adjust the approach and missed-approach path to gain the best operational advantage in terms of OCH with regard to the local terrain and/or airspace restrictions, against the design criteria laid down in PANSOPS Volume II.
- (ii) The optimum requirement is to height the three highest obstacles in each tile, thus allowing the IFP designer to calculate the most advantageous Minimum Descent Altitude/Height (MDA/H). However, in analysing the three highest obstacles in any one tile, consideration must be given to other obstacles within the same tile where such additional obstacles are located closer to the nominal flight path of an aircraft approaching or departing an aerodrome. For example, if there were three chimneys adjacent to each other near the outer edge of the tile furthest from the nominal flight path and there was an office building located within the same tile closer to the nominal flight path but marginally lower than the three chimneys, then all four obstacles should be declared. Situations may exist where more than three, four or five obstacles are declared within any one tile.
- (iii) If it is apparent that there are significant obstacles beyond the 10 km limit, the survey area shall be extended longitudinally to 30 km to take account of such obstacles. A significant obstacle is one that is not shielded by an obstacle closer to the runway.

### b) Visual Manoeuvring (Circling) Areas

- (i) Applicable only at aerodromes with Instrument Flight Procedures.
- (ii) The number of runways in use and the Approach Category of aircraft using the aerodrome shall determine the VM areas.
- (iii) The survey areas for consideration are constructed by describing arcs of the appropriate radius as detailed below, centered on the thresholds, and joined by common tangents to form an enclosed area.

- Category A aircraft: 3.12 Kilometres (1.68 Nautical Miles)
- Category B aircraft: 4.90 Kilometres (2.66 Nautical Miles)
- Category C aircraft: 7.85 Kilometres (4.20 Nautical Miles)
- Category D aircraft: 9.79 Kilometres (5.28 Nautical Miles)
- Category E aircraft: 12.82 Kilometres (6.94 Nautical Miles)

- (iv) The Aerodrome Operator shall advise on circling Category requirements.
- (v) The survey requirement is to height the three highest obstacles in each segment defined by the extended runway centrelines and aircraft category boundaries, thus allowing the IFP designer to calculate the most advantageous minimum OCA/H.

**c) Departure Areas**

- (i) Applicable to runways from which IFR departures take place.
- (ii) The survey requirement is to height all obstacles in this area that penetrates the 1:40 slope.

**21.3 Digital Data**

All surveyed obstacles shall form part of the Obstacles list.

**22.0 AERODROME OBSTACLE CHART - ICAO TYPE A SURVEY AREA**

**22.1 Purpose**

- a) The Type A chart provides data necessary to enable the aircraft operator to comply with the operating limitations of ICAO Annex 6 - Operation of Aircraft.
- b) Aerodrome Obstacle Charts - ICAO Type A (Operating Limitations) shall be made available as prescribed in the Civil Aviation (Aeronautical Charts) Regulations. Runways that do not have obstacles in the take-off flight path (TOFP) areas shall be recorded as not requiring a Type A chart.
- c) The CAA will undertake the preparation of the Type A chart from the information supplied by the surveyor. The CAA will determine which obstacles are to be shown on the final Type A chart by the application of complex shadowing techniques.

**22.2 Survey Specification**

**a) Aerodrome Area**

- (i) The elevation AMSL, at the start and end of TORA, end of ASDA and end of TODA, and at regular intervals (maximum 200 metres) along the runway and clearway centreline shall be provided.
- (ii) The type of clearway and declared distances for TORA, TODA, ASDA and LDA shall be stated in the Survey Report. If these have not already been agreed with CAA, they must be submitted for verification before the Survey is started. Definitions are stated in Civil Aviation (Aerodromes) Regulations.

**b) Take-Off Flight Path Area**

- (i) The area to be surveyed originates at the end of the TODA. It is 180m wide at origin, symmetrical about the extended centreline and increases uniformly at a rate of 0.25D to a maximum width of 1800m, where D is the distance from origin. At a distance of 6480m it

extends at the maximum width to a distance of 10000m. The elevation of the origin is the elevation declared for the end of TODA.

- (ii) The flight path plane surface has an upward slope of 1.2% from the origin.
- (iii) All objects and terrain within the Take-off flight path area shall be comprehensively analysed. All obstacles that penetrate the Take-off flight path surface shall be surveyed except where such obstacles are in the shadow of others. The shadow of an obstacle is considered to be a plane surface originating at a horizontal line passing through the top of the obstacle at right angles to the centreline of the Take-off flight path, and extended to cover the complete width of the area. Frangible and mobile obstacles shall not shadow other obstacles. If the obstacle creating a shadow is likely to be removed, objects that would become dominant by its removal shall be surveyed. If the surveyor is not sure as to which obstacles are dominant then all obstacles penetrating the surface shall be surveyed.
- (iv) For runways serving aircraft having operational limitations that do not preclude the use of a gradient less than 1.2%, the Take-off flight path area is increased to 12000m and the slope of the plane surface is reduced to 1% or less. Where the plane of the 1% slope does not touch any objects, it is to be reduced until it touches the first object.
- (v) The elevation AMSL of any road, railway track or water feature capable of supporting mobile obstacles greater than 4.8m (for waterways the high and low water marks and the height of shipping) shall be surveyed at a regular interval to its full linear extent, until shadowed by the next dominant obstacle if the combined elevation penetrates the Take-off flight path surface. The combined elevation shall be provided.
- (vi) Where the Take-off flight path is at an offset angle from the runway extended centreline in order to gain an operational advantage, the area to be surveyed shall be determined by consultation between the Aerodrome Operator and aircraft operators concerned, and agreed with UCAA and annotated in the survey report.

### **22.3 Digital Data**

All surveyed obstacles shall form part of the Obstacles list. Positional data, and associated elevations, that determines the extent of the declared distances and runway profile shall be included in the Aerodrome Facilities list.

## **23.0 PRECISION APPROACH PROCEDURE SURVEY AREA**

### **23.1 Purpose**

- a) The survey is to identify obstacles within the Precision Approach area. It provides important data for the safety assessment of Precision Approach procedures and the calculation of obstacle clearance heights.
- b) The survey provides data for use in connection with the following precision approach procedures:
  - ILS (including Offset Localiser facilities)
  - MLS (including Offset Azimuth facilities)

(NOTE: ILS Localiser only and MLS Azimuth only are non-precision approach procedures.)

- c) In the case of offset facilities (where the localizer is not aligned with the extended runway centreline), UCAA should be consulted on the alignment of the survey area required.

### **23.2 Survey Specification**

The survey requirement is to height all obstacles in this area that penetrate the surfaces.

### **23.3 Digital Data**

All surveyed obstacles shall form part of the Obstacles list.

## **24.0 PRECISION APPROACH TERRAIN CHART SURVEY AREA**

### **24.1 Purpose**

- a) The Precision Approach Terrain Chart provides a detailed terrain profile of the final portion of a Precision Approach. It provides information to enable the evaluation of the effects of the terrain on decision height determination using radio altimeters.
- b) It is a mandatory requirement for aerodromes that conduct Cat II, III precision approaches to provide data to the UCAA to enable the preparation and publication of the Precision Approach Terrain Chart.

### **24.2 Survey Specification**

- a) The area for survey starts at the runway threshold and extends for a distance of 900m into the approach, 60m either side of the extended runway centre line. A longitudinal extension of this area might be required if the terrain undulates significantly. Any such requirement will be identified by UCAA during the initial approval process for Cat II, III operation.
- b) Features to be surveyed:
  - ✓ Runway threshold and elevation.
  - ✓ Extended runway centre line terrain profile.
  - ✓ All features including mobile features that are 10ft, or greater, above or below the extended runway centre line terrain level and with a horizontal dimension of more than 15m measured parallel to the runway centre line.
  - ✓ Terrain contours at 3ft contour intervals related to the runway threshold height.
  - ✓ Roads, railways, river or canal features shall have sufficient levels to show their surface elevation, (in the case of a body of water subject to tides, high and low tidal variations are required) and the height of the highest mobile feature that could be expected on them. The features shall include vegetation, hard, mobile and temporary objects.

### **24.3 Survey Chart Presentation**

- a) The base map shall be at a scale of 1:2500 or where the area has been extended it shall be at 1:5000. The accepted format is listed in paragraph 17.
- b) The chart will show the survey area in plain view at either of the above scales and in cross

section profile at a recommended scale of 1:500. (If the area is flat, a larger profile scale may be used).

- c) The chart shall reflect the position, height and shape of all features that fall in the category as described in paragraph 24.2.

#### 24.4 Published Chart

The survey information shall be issued to the Aerodrome Operator for approval and the data passed to UCAA. The final chart is prepared and published by UCAA.

#### 24.5 Chart Maintenance

- a) It is the responsibility of the Aerodrome Operator to monitor any changes in the approach terrain profile. If significant changes occur the Aerodrome Operator shall notify them by NOTAM and provide appropriate new survey data to the UCAA immediately.
- b) All changes in the profile that exceed the following limits shall be recorded:
- ✓ Changes in slope of 12.5% or more over a distance of 15m or more.
  - ✓ Changes in the contour height of 10ft or more (increase or decrease) and over 15m to the defined approach area.
  - ✓ All features

**NOTE:** It is important that both increases and decreases in elevation are significant.

#### 25.0 PAPI/APAPI Site Survey Area

The survey is required to provide data to assist in the calculation for the siting of PAPI/APAPI units on initial installation. Full details are contained in Civil Aviation (Aerodromes) Regulations. PAPI/APAPI surveys do not form part of the full and check survey procedures.


**Director Safety, Security and Economic Regulation**

### Appendix A: Survey Declaration Form

<b>Aerodrome</b>	
<b>Surveying Company</b>	
<b>Initial/Last Full Survey Date</b>	
<b>Geodetic Connection Date*</b>	
<b>Check Survey Date*</b>	

(\* If applicable)

Survey Area Required		No Change to Previous Survey	Change to Previous Survey
Aerodrome Plan			
AGA			
Non-Precision Instrument Approach			
Visual Manoeuvring (Circling)			
Departure			
Aerodrome Obstacle Chart - Type A			
Precision Approach Procedure			
Precision Approach Terrain Chart			

**Declaration by Aerodrome Operator's Representative**

I certify that information supplied meets the Aerodrome's operational requirements

Name			
Position			
Signature		Date	

**Declaration by Surveyor**

I certify that information supplied is complete and conforms to Civil Aviation (Aerodromes) Regulations

Name			
Signature		Date	

Submit form together with all relevant survey information to: .....

## **Appendix B Methodology of Modelling Obstacles (For information only)**

### **1.0 Introduction**

The ILS Collision Risk Model (CRM) requires position and dimension data for all relevant obstacles. The data can be entered in the co-ordinate system (x, y, z) or converted from other co-ordinate systems to the (x, y, z) system.

### **2.0 Description of Artificial Obstacles**

For processing by the CRM, obstacles must be of a specific form: either as a spike or a wall. For the purposes of the CRM, therefore, obstacles after adjustment have height and width but do not have length.

### **3.0 Simple Obstacle Modelling**

Obstacles are usually of a complex shape, unlikely to be orientated at right angles to the line of approach, and may well extend longitudinally for considerable distance. These can be expressed as a number of simple obstacles as spikes or a series of walls.

In general obstacle modelling should be as simple as possible with conservative dimensions assigned.

### **4.0 Sophisticated Obstacle Modelling**

4.1 If analysis of the CRM results shows that the precise shape of an obstacle is critical with respect to the total risk, a more sophisticated obstacle model may be required as detailed below:

- ✓ Construct lines parallel to the x axis through  $y_1$  and  $y_2$ , the outer edges of the obstacle in the y axis. The perpendicular distances from these lines to the x axis are the lateral boundary dimensions.
- ✓ The height (z) of the obstacle is taken to be that of the highest point above threshold elevation.
- ✓ The range (x) is the perpendicular distance from the obstacle boundary point nearest to the threshold.

4.2 If a solid obstacle is modelled by spike obstacles, lateral spacing should be not more than the wing span of the largest aircraft likely to use the aerodrome.

4.3 If the difference between the most distant point and the nearest point of the obstacle to the threshold exceeds 100m, the obstacle should be partitioned into a series of wall obstacles separated by no more than 100m in range. The height assigned to such a “wall” obstacle should be the highest elevation of the obstacle in the area away from the runway. In cases where the obstacle height varies with distance from the centre line, each wall may be broken up into two or more adjacent walls.

## **5.0 Considerations on Accuracy**

Consideration should be given to the accuracy with which the obstacle data has been collected. Suitable adjustments should be made to take account of inaccuracies in the obstacle data; these should result in a greater height, a smaller (absolute) range, and a smaller (absolute) lateral displacement. If these adjustments lead to unacceptable operational penalties, more accurate surveying may reduce these penalties. In addition, adjustments for such things as tree growth may be taken into account by adding a tolerance to the height.