agriculture, land reform & rural development

Department:
Agriculture, Land Reform and Rural Development
REPUBLIC OF SOUTH AFRICA

Chief Directorate:
National Geo –spatial Information

Standard for Image Exterior Orientation

Document Reference: QLAS.SD. 13_EXOR
Version: v3

SECTION A

Preliminary Informative Elements

A 1 Document Control

Version Schedule

Version No.	Version Date	Versioned By
v1	16 November 2012	S. Kay
v2	26 March 2018	M. Poole
v3	06 December 2021	M. Poole

Approval and Control Schedule

Version No.	Approved By	Designation	Signature	Date Approved	Copy Status
v1	Derek Clarke	Chief Director	Signed on the original	16 November 2012	*Master Copy*
v2	Derek Clarke	Chief Director	Signed on the original	26 March 2018	*Master Copy*
v3	Bulelwa Semoli	Director (In absent of ACD)		07 December 2021	*Master Copy*

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A 3 **Foreword**

This standard covers the Image Exterior Orientation standard produced by the Chief Directorate: National Gee-spatial Information (CD: NGI), Department of Rural Development and Land Reform. The CD: NGI is mandated by the Land Survey Act, Act 8 of 1997 to provide mapping and related spatial information that covers the extent of the Republic of South Africa.

Image Exterior Orientation forms the basis in the photogrammetric processes that leads to the producing of the various maps as mandated.

Acknowledgement

This standard was developed by the following members of the Standards Committee:

Cameron Williams (Convenor)
Belinda Domingo
Vuyo Makele
Raoul Duesimi
Sumayyah Patel
Shaun Aimes (Quality Assurance Staff Member)
Michelle Poole (Quality Assurance Manager)

A 4 Terms and Definitions

Refer to Glossary

A 5 Symbols and Abbreviations

Refer to Glossary

A 6 Introduction

A 6.1 General

Name of the Standard

The standard described in this document shall be known as the Standard for Image Exterior Orientation.

The shortened name, Image Exterior Orientation Standard, may be used.

A 6.2 Scope and Purpose

The Standard for Image Exterior Orientation comprises all the specifications required for the provision of exterior orientation for imagery as required by the CD: NGI for its production processes which is mandatory. This document outlines the requirements for doing aerial triangulation.

The purpose of this document is to outline the requirements to be met by the CD: NGI and Contractors for producing exterior orientation parameters for imagery to be used in the production processes of the CD: NGI for national mapping purposes.

A 6.3 Audience

The primary audience of this document is the CD: NGI. The secondary audience of this document are contractors.

A 6.4 Applicability

This document is applicable to all role players, activities and processes involved in the production of topographical data, ortho-imagery and maps of the National Series within the CD: NGI.

A 6.5 Assumptions

It is assumed that the provisions of this document may be the applied by users outside CD: NGI for producing of exterior orientation for photogrammetric purposes.

A 6.6 Normative References, other standards and related documents

- The document Recommended Practice for the Structure and Drafting of Standards and Related documents is used to guide the format and structure of this document.
- Refer to C 1 for document references.

A 6.7 Maintenance Authority

Maintenance of the Standard for Image Exterior Orientation is the responsibility of the Division: Quality Assurance of CD: NGI. Changes to this Standard will be instructed by the Chief Director as improvements or amendments become necessary, or as required. Any request for amendments to this Standard may be submitted by any institution, body or individual to the Chief Director for consideration. All such requests and any other comments on the Standard must be addressed to:

Chief Director: National Geo -spatial Information
Private Bag X 10
Mowbray
7705

and be referenced as: Amendment- Standard for Image Exterior Orientation

The Division: Quality Assurance shall maintain the provisions and structure of this document through amendment and revision activities.

A 6.8 Roles and Responsibilities

The roles and responsibilities of the main role players as it pertains to the drafting and maintenance of this document are stated below.

A 6.8.1 Quality Assurance Division

- To maintain the provisions of this document.
- Keeping track of all amendments to this document
- Providing assistance and guidance to the Standards Development Committees and CD: NGI Management in interpreting the provisions of this document
- Provisionally approving a proposed revision of this standard with respect to its structure and format.
- Ensuring that the use and purpose of this document is communicated effectively.

A 6.8.2 Standards Development Committee- Image Exterior Orientation

- To draft revised specifications to the provisions of this document
- To make recommendations on the update and amendment of the provisions of this document.
- Refer to the relevant section in the Terms of Reference of the Standards Development Committee for more details in this regard.

A 6.8.3 Geomatics Manager: Quality Assurance

- Evaluate proposed amendments and revisions of this Standard.
- Provisionally approving proposed amendments to this Standard.
- Refer to the relevant section in the Terms of Reference pertaining to the Geomatics Manager: Quality Assurance for more details in this regard.

A 6.8.4 CD: NGI Senior Management

- To provide inputs into and recommend approval of this Standard.

A 6.8.5 Contractors

- To determine image exterior orientation according to the provisions of this Standard.

A 6.8.6 Chief Director CD: NGI

- To approve this Standard.
- To authorise revision of this Standard.

SECTION 8

Normative Elements

B 1 Aerial Triangulation

B 1.1 General

(a) A minimum of six Photo Control (Tie) Points (PCP's) per model shall be measured and co-ordinated and each image shall have a minimum of nine PCP's.
(b) A maximum of five trigonometrical beacons, if available, evenly distributed per 1:50 000 sheet area shall be observed as height check points.
(c) The aerial triangulation shall be done by bundle adjustment method, with self-calibration and GNSS and INS assisted air-stations processing capabilities.
(d) Statistical information of the calculated accuracies shall be provided for analysis.

B 1.2 The input shall consist of:

B 1.2.1 Images:

(a) Shall be in accordance with the Standard for the Acquisition of Digital Imagery.

B 1.2.2 Camera calibration certificate:

(a) Shall be in accordance with the Standard for the Acquisition of Digital Imagery.

B 1.2.3 Inertial Navigational System (INS) data:

(a) Shall be in accordance with the Standard for the Acquisition of Digital Imagery.

B 1.2.4 Photo Ground Control Points (PGC points):

(a) Positions of PGC points shall be fixed horizontally and vertically relative to the National Control Survey Network (NCSN).
(b) PGC shall have an absolute accuracy of better than or equal to 0.30 metres in position and elevation.

B 1.2.5 Trigonometrical beacon co-ordinates:

(a) Shall be in accordance with the Standard for the National Control Survey Network (Geospatial Reference Frame)

B 1.2.6 Flight Plan:

(a) Shall be in accordance with the Standard for the Acquisition of Digital Imagery.

B 1.3 The output of the Aerial Triangulation process shall consist of:

B 1.3.1 Final adjusted PCP co-ordinates:

(a) PCP co-ordinates (y, x, H) shall be on the South African co-ordinate system.
(b) PCP co-ordinates shall be displayed to one decimal place of a metre.

B 1.3.2 Exterior orientation (EO) parameters of the images:

(a) The co-ordinates of the EO of an image shall be on the South African co-ordinate system.
(b) The co-ordinates of the EO shall be displayed to one decimal place of a metre.
(c) The rotation angles of the EO, (Omega, Phi, Kappa), shall be displayed to six decimal places of a degree.

B 1.3.3 Aerial Triangulation Plan (ATP):

(a) The ATP shall be created digitally, and a hard copy plotted.

B 1.3.3.1 The ATP shall contain the following information:

B 1.3.3.1.1 The heading, which shall include:

- The name of the job.
- Area covered.
- Scale of the plan.
- Lo number.
- Reference ellipsoid.

B 1.3.3.1.2 Information legend, which shall include:

- Camera name.
- Camera number.
- Focallength.
- Calibration date.
- Ground Sample Distance (GSD) of imagery.
- Date of imagery.
- Entity which carried out Aerial Triangulation (AT).
- Date of AT.

B 1.3.3.1.3 Symbol legend, which shall indicate the description of the symbol utilised:

- PGC points.
- Height control.
- Check points.
- Trigonometrical beacons used as:
  - Control points.
  - Check points.
  - Height only.
- Tie/Pass-points.
- Photo numbers.
- Coast line/Border demarcation/ large water features.

8 1.3.3.2 Information that shall be clearly indicated on the ATP:

(a) The strip numbers
(b) Photo numbers
(c) PGC
(d) Tie/Pass-points
(e) Check points e . g . Trigonometrical beacons, photography field ground control check points and height only control points (symbol and number)
(f) Geographical grid per orthophoto sheet
(g) 1:10 000 orthophoto sheet reference numbers
(h) True north
(i) Approximate coastline/Border/large water features
U) Image numbers to be displayed in different colours for cross/coastal/border/dam strips.

B 1.4 Output accuracies of observations.

(a) The photogrammetric measuring precision of image co-ordinates shall be less than or equal to 10 microns (m).
(b) The horizontal accuracy, in the y and x, of the adjusted Photo Control Points (PCP's), shall not exceed 1. 5m at the 95% confidence level.
(c) The vertical accuracy, in the H, of the adjusted PCP's shall not exceed 1. 8 m at the 95% confidence level.
(d) The vertical accuracy, in the H, of the check points (e. g. trigonometrical beacons) shall not exceed 1.8 m at the 95% confidence level.

SECTION C

Supplementary Informative Elements

C 1 References

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