



Geometric Verification
DMC lie_230 23536



Camera Geometric Verification Certificate
No: DMC lie_230 23536



For

Keystone Aerial Survey
467 Aviation Way
Frederick, MD 21701

United States

DMC lie_230 23536
Geometric Verification

Camera: DMC lie_230 23536
Manufacturer: Leica Geosystems Technologies, D-73430 Aalen, Germany
Reference: PAN
Serial Number: 00120741 (PAN Head)
Date of Calibration: 22 December 2016
Date of Report: 30 June 2023
Number of Pages: 5

This camera system is certified by Leica Geosystems Technologies and is fully functional within its specifications and tolerances.

Date of Calibration: December 2016

Date of Certification: June 2023



Dipl.Ing. Christian Müller, Product Manager

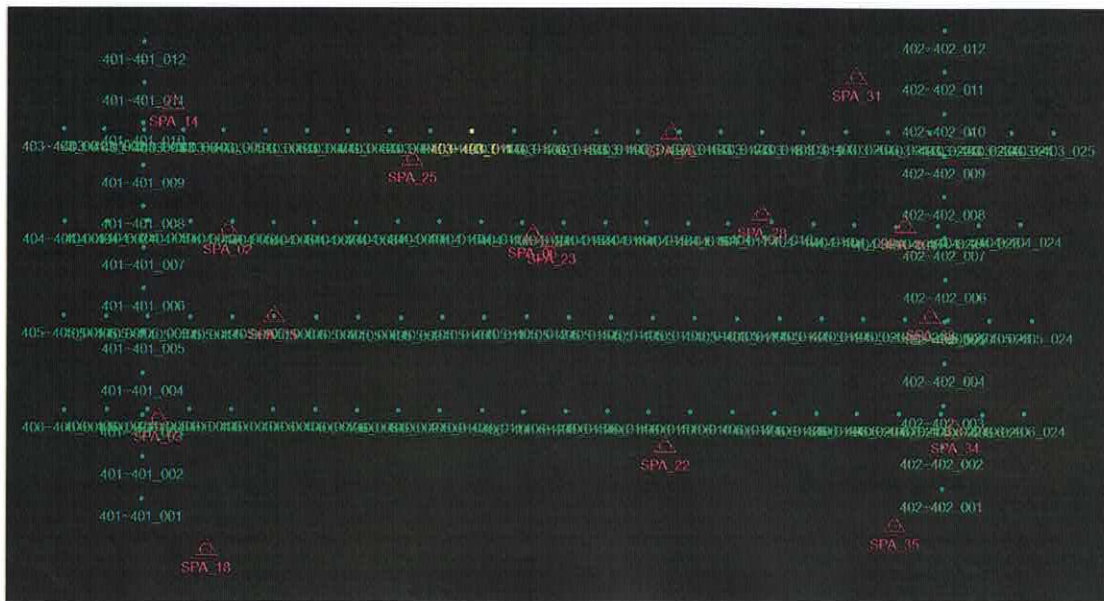
Michael Reading, Senior Support Analyst

Camera Serial Numbers and Burn-In flight

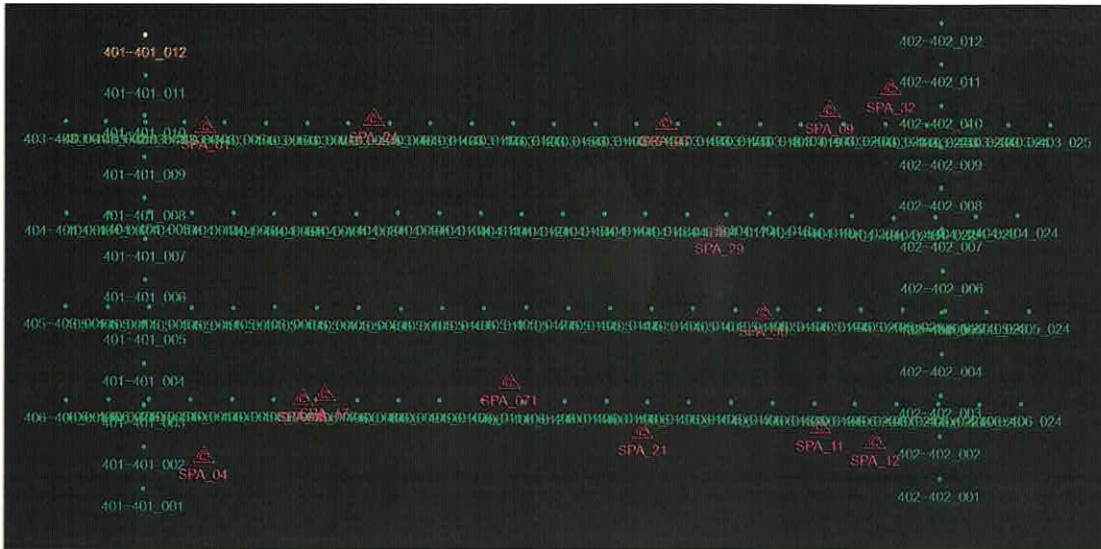
Camera Head	Serial Number	Calib. Date
PAN (reference)	00120741	22.12.2016
MS1 (NIR)	00121884	22.12.2016
MS2 (Blue)	00125498	22.12.2016
MS3 (Red)	00118779	22.12.2016
MS4 (Green)	00122307	22.12.2016

Verification flight performed: 17 June 2023

Flight parameters of 5 cm Verification Flight – Control Points



Flight parameters of 5 cm Verification Flight – Check Points



Parameter	Validation Flight
GSD (cm)	5
End-lap (%)	70
Side-Lap (%)	40
Number of Exposures	121
Number of Flight Lines	4
Number of Cross Flight Lines	2
Number of Control Points	16
Number of Check Points	14
GNSS / INS	Yes

Application

Parameter	Validation Flight
Weighting for manual measured image points (um)	3.0
Weighting for automatic measured image points (um)	3.0
Weighting for Control Points (m)	0.080 / 0.080 / 0.080
Weighting for GPS (m)	0.050 / 0.050 / 0.050
Weighting for INS (deg)	0.010 / 0.010 / 0.050
Modeling of GPS systematic residuals	YES
Bore Sight Alignment (YES/NO)	YES
Camera Self Calibration (YES/NO)	NO

Statistics –Bundle Block Adjustment

Parameter	Validation Flight
Sigma0 [µm]	0.82379
Mean Std Dev Photo Position [m]	0.01512 / .02039 / 0.01417
Mean Std Dev Photo Attitude [deg]	0.00118 / 0.00094 / 0.00049
Mean Std Dev Control Points [m]	0.00977 / 0.00996 / 0.01966
Mean Std Dev Check Points [m]	0.009898 / 0.01549 / 0.042099
RMS Photo Position [m]	0.01590 / 0.01018 / 0.02868
RMS Photo Attitude [deg]	0.00142 / 0.00149 / 0.00045

Statistics – Results From Independent Reference Measurements

Parameter	Validation Flight
RMS of Control Points – horizontal [m]	0.03094 / 0.02991
Max Ground Residual of Control Points – horizontal [m]	0.06958 / 0.05372
RMS of Control Points – vertical [m]	0.04367
Max Ground Residual of Control Points – vertical [m]	0.09437
RMS of Check Points – horizontal [m]	0.01634 / 0.02247
Max Ground Residual of Check Points – horizontal [m]	0.04105 / .04846
RMS of Check Points – vertical [m]	0.04196
Max Ground Residual of Check Points – vertical [m]	0.08344

The results of the aerial triangulation were generated with ImageStation Automatic Triangulation (ISAT), 2022, Version 16.7.0, Build 573 from Hexagon Geospatial.

Aerial Triangulation performed by


Michael Reading

06.30.2023
Date