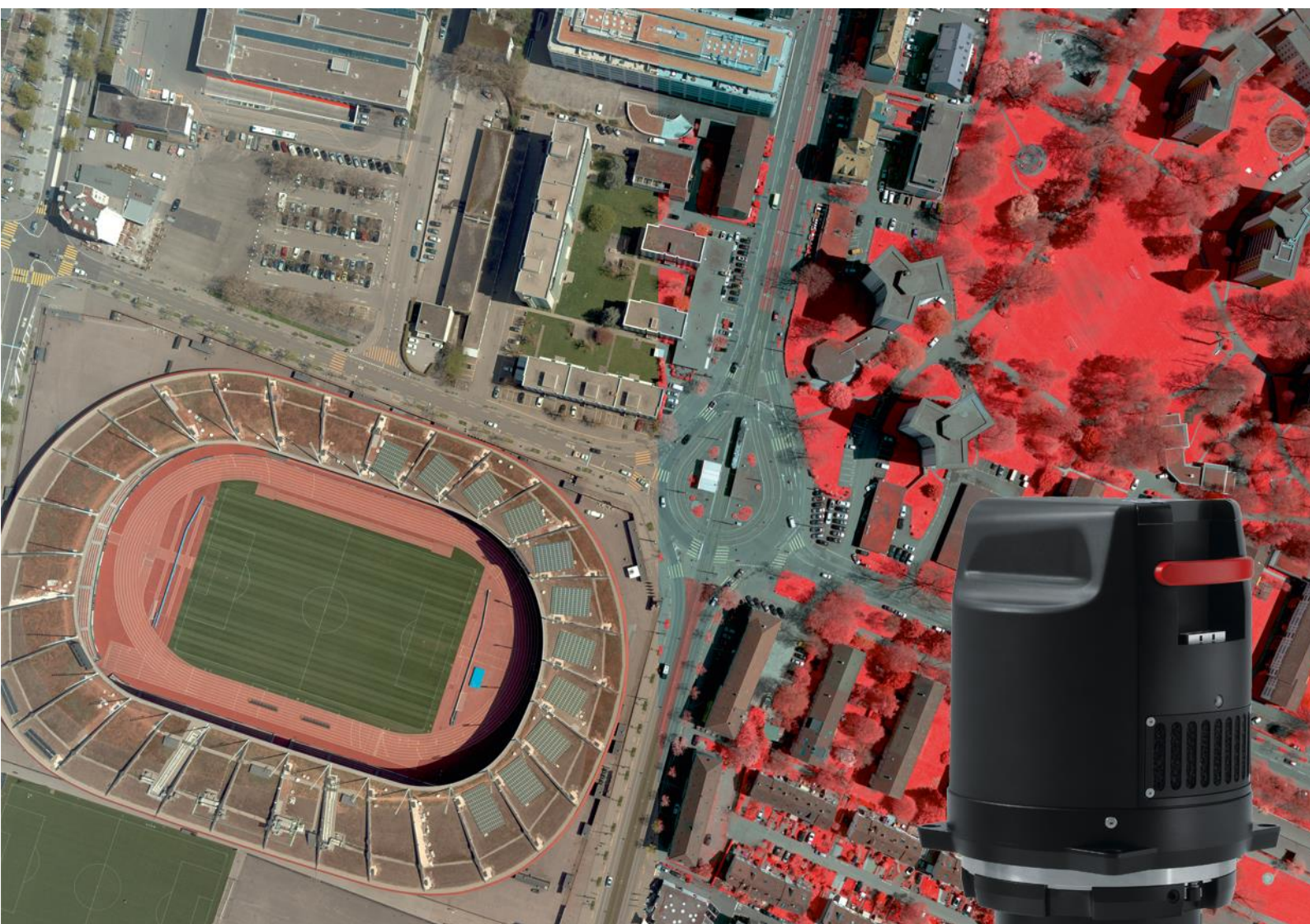


- when it has to be **right**



# Leica Geosystems Leica RCD30 Calibration Certificate

**Product** Leica RCD30  
**Serial Number** 82557  
**Date** 05 September 2022  
**Inspector** Xu Wang




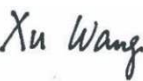
# 1. System Components

Component	Type	Serial Number
GNSS/IMU	Litef LCI-100C 500 Hz	1159-001
Camera Head	CH82	82557
Lens	NAG-D 4.0/50	50098

# 2. Estimation Process

		Passed	Date	Inspector
Image Flight	completed	ok	26.08.2022	Phung Nguyen
Image Quality Check	checked	ok	30.08.2022	Fatih Kaya
Image Calibration	completed	ok	05.09.2022	Xu Wang
Image Misalignment Update	completed			

# 3. Inspectors

<b>Name</b>	Bernhard Riedl	05.09.2022	
<b>Position</b>	Production Manager		
<b>Name</b>	Xu Wang	05.09.2022	
<b>Position</b>	Support Engineer		

# 4. Remarks

## 5. Imaging Sensors Estimation Results

The estimation results for the camera head and lens combination are only valid for:

- Camera Head, lens and specified position as listed in the Estimation Results sections.

### 5.1 Camera Model of distortion free images

All factory calibration results contain fixed nominal focal lengths and zero principal point offsets. Leica HxMap applies the grid to create distortion-free images of nominal focal length and pixel size.

#### 5.1.1 CH8x Model

<b>Camera Head</b>		<b>Component</b>	
<b>Lens</b>		CH82	
		NAG-D 4.0/50	
<b>Camera Model</b>			
<b>Focal Length</b>		<b>Distance [mm]</b>	
	c		53.00
<b>Radial Symmetric Distorsion</b>		<b>Distance [mm]</b>	
	k <sub>0</sub>		0.0000
	k <sub>1</sub>		0.0000
	k <sub>2</sub>		0.0000
<b>Decentering Distortion</b>		<b>Distance [mm]</b>	
	p <sub>1</sub>		0.0000
	p <sub>2</sub>		0.0000
<b>Non-Orthogonality Distortion</b>		<b>Distance [mm]</b>	
	b <sub>1</sub>		0.0000
	b <sub>2</sub>		0.0000
<b>Pixel Size (Height and Width)</b>		<b>Distance [mm]</b>	
	RGB		0.0052
	NIR		0.0120
<b>Rows and Columns</b>		<b>Rows</b>	<b>Columns</b>
	Raw RGB	7788	10336
	Raw NIR	3366	4500

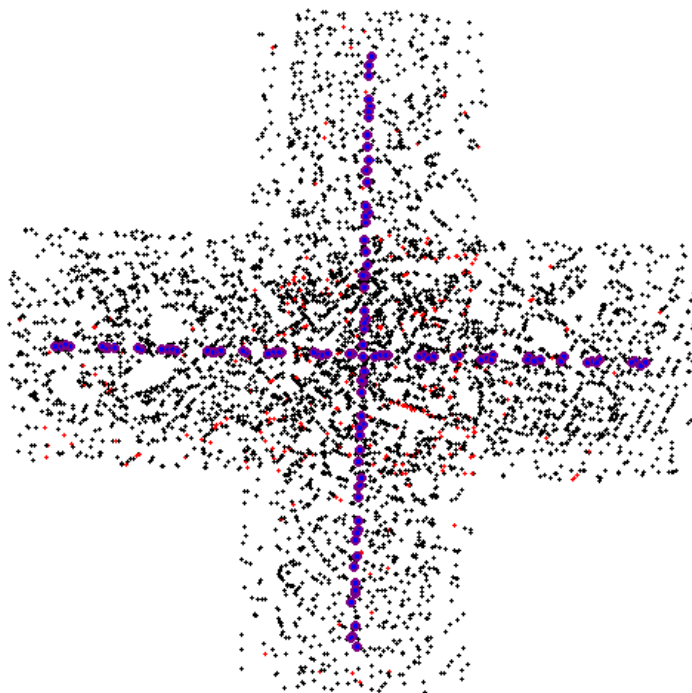
## 5.2 Results of Geometric Calibration

### 5.2.1 Calibration method for Green Reference Band

Estimation of additional parameters (focal length, principal point, radial symmetric distortion, correction grid) and IMU misalignment in simultaneous bundle adjustment

Reference band (green)	Distance [mm]
Resulting sigma naught of bundle adjustment:	0.0008

Final bundle adjustment results after elimination of tie point blunders:



CAP-A Sigma0 : 0.8  
Control Points  
RMS-X : 0.000  
RMS-Y : 0.000  
RMS-Z : 0.000  
Antenna Centers  
RMS-X : 0.029  
RMS-Y : 0.026  
RMS-Z : 0.020  
Variance Comp.  
X : 1.000  
Y : 1.000  
Z : 1.000  
O : 1.120  
P : 1.023  
K : 0.837

### 5.2.2 Calibration method for Other Spectral Bands

Estimation of additional parameters (correction grid), based on the result for green in simultaneous bundle adjustment

Other Spectral Bands	Distance [mm]
Co-registration to green better than:	0.002

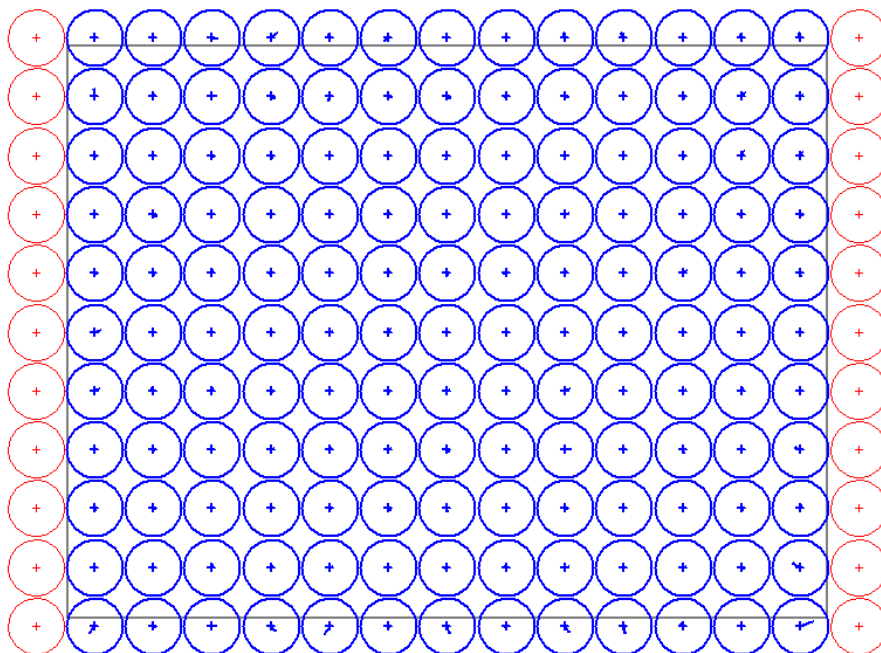
Leica HxMap applies the grid to create distortion-free images of nominal focal length and fixed pixel size of 0.0052 mm.

### 5.3 Estimation Results for Nadir Camera Head and Lens

		Component	Serial Number
<b>Camera Head</b>		CH82	82557
<b>Lens</b>		NAG-D 4.0/50	50098
<b>View Direction in Pod Position</b>		Nadir	
<b>IMU Misalignment</b>		<b>Angle [degree]</b>	
Valid for calibration flight only	$\omega$	0.09209	
	$\phi$	0.03182	
	$\kappa$	0.19233	
<b>Principal Point</b>		<b>Distance [mm]</b>	
	x	0.0000	
	y	0.0000	
<b>Focal Length</b>		<b>Distance [mm]</b>	
	c	53.00	
<b>Geometric Calibration File</b>			
RCD30_Geometry_CameraHead-82557-D-798528_LensSystem-50098-A-785422_DateTime-20220905-132027.xml			
<b>Geometric Calibration Date</b>	Date	05.09.2022	
<b>Radiometric Calibration Date</b>	Date	24.08.2022	
<b>Misalignment Flight</b>	Date	-	
<b>Misalignment Update Completed</b>	Date	-	

Remaining image space residuals after applying the calibration results

RMS-X: 0.08  
RMS-Y: 0.08



Radius of circles is 0.0010 mm