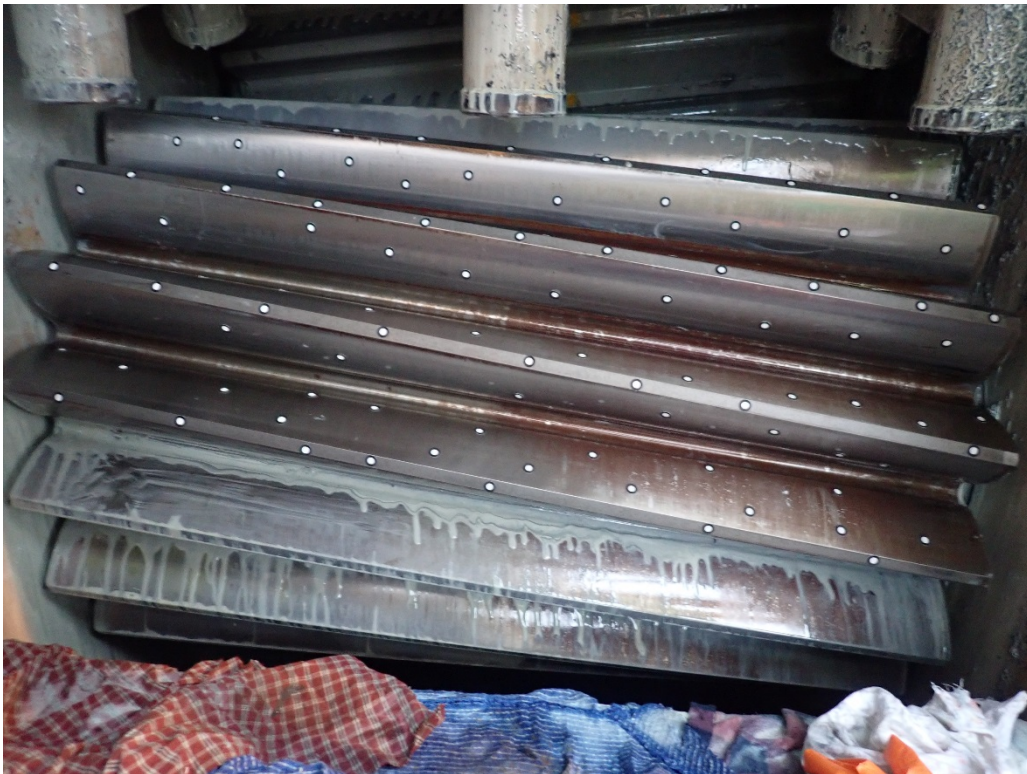


A MINING COMPANY Minesite SAG Mill 3-D DIMENSIONAL SCANNING



Equipment Name	A MINING COMPANY Minesite SAG Mill
Part Name	Girth Gear West Pinion East Pinion
Inspector	Justin Marwick
Date	



Scope:

Make a 3-D Mesh of the Minesite SAG mill gear and pinion teeth using a Metrology grade 3-D scanner in this case a Creafom Handyscan Black Elite. Scanner details are attached in Appendix A. Compare scanned mesh with CAD model of the part or in the case there is no CAD model available, compare currently loaded side with the unloaded side – if it is unused. Once the initial 3-D scan is taken, subsequent scans will be compared with the original benchmark scan.

Method:

Pinions: Access to the pinions on the SAG Mill was somewhat limited. The resultant meshes appeared to be consistent with the original part scanned. A Solidworks CAD model had been used for comparisons of the Spare pinions- It appears that the pinion design currently installed has corrections applied that were not used when generating the CAD model . For the sake of comparison, the 3-D scans were compared with each other. That is to say that the West pinion loaded side was compared with the East pinion. As the East pinion is almost brand new: the loaded and unloaded sides were compared to produce a colour map of the comparison.

Girthgear: Access to the girth gear for scanning was good and complete meshes for 3 gear teeth were available. Currently there is no comparative 3-D mesh for the Minesite SAG girth gear teeth.

Results:

SAG Mill

Pinions: The west pinion has been in service for a considerably longer time than the Eastern pinion. As the current geometry as scanned did not agree well with the CAD model on file (CAD model was generated from the original FALK pinion data) The West pinion was compared with the East pinion. The results confirm that the West pinion is showing some signs of wear.

Girthgear teeth 64-66: The girthgear sample of teeth do not have a CAD reference or previous scans for this piece of equipment. We will develop a library with this section as a reference for future measurements.

Ball mill 1

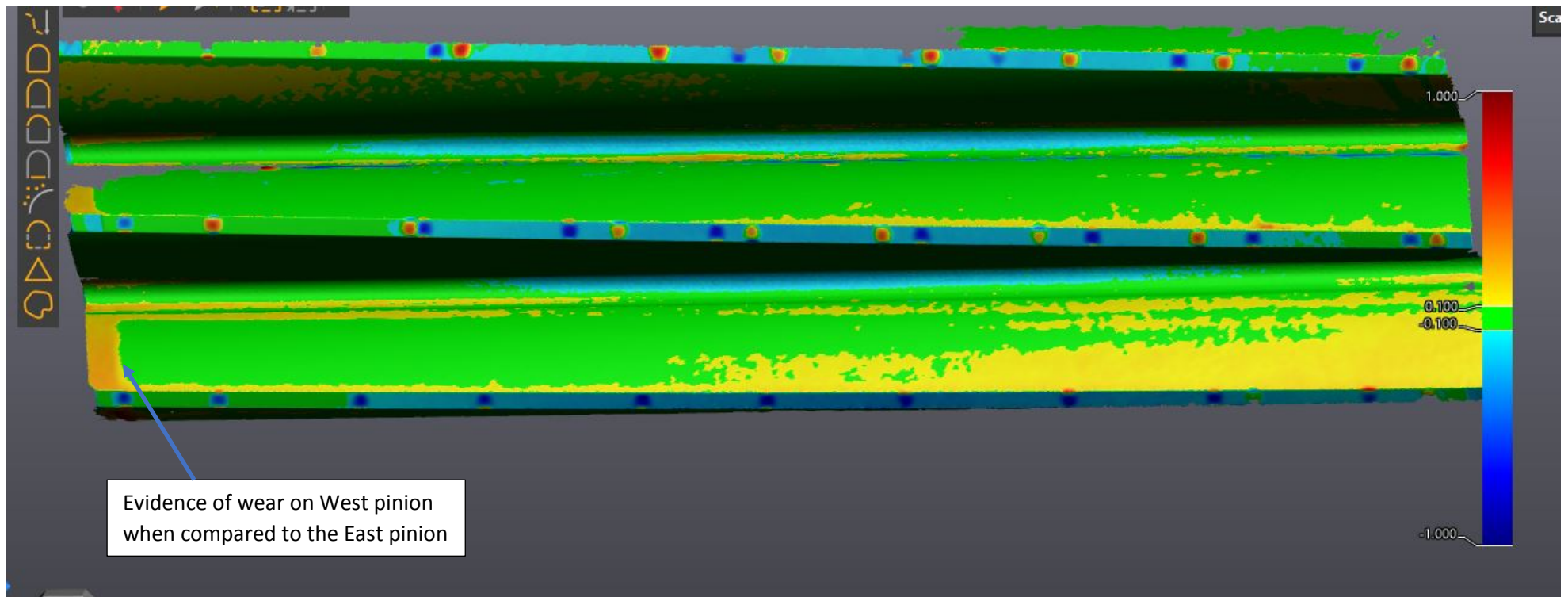
Pinion: as access is somewhat limited for scanning through the pinion inspection hatch, the pinion only was scanned. The results are shown in the following section. The scan is mapped for the sake of measurement against measurements taken of the spare pinion in the warehouse. The 3-D mesh taken demonstrates that the ball mill pinion is also exhibiting signs of wear.

West Pinion photograph

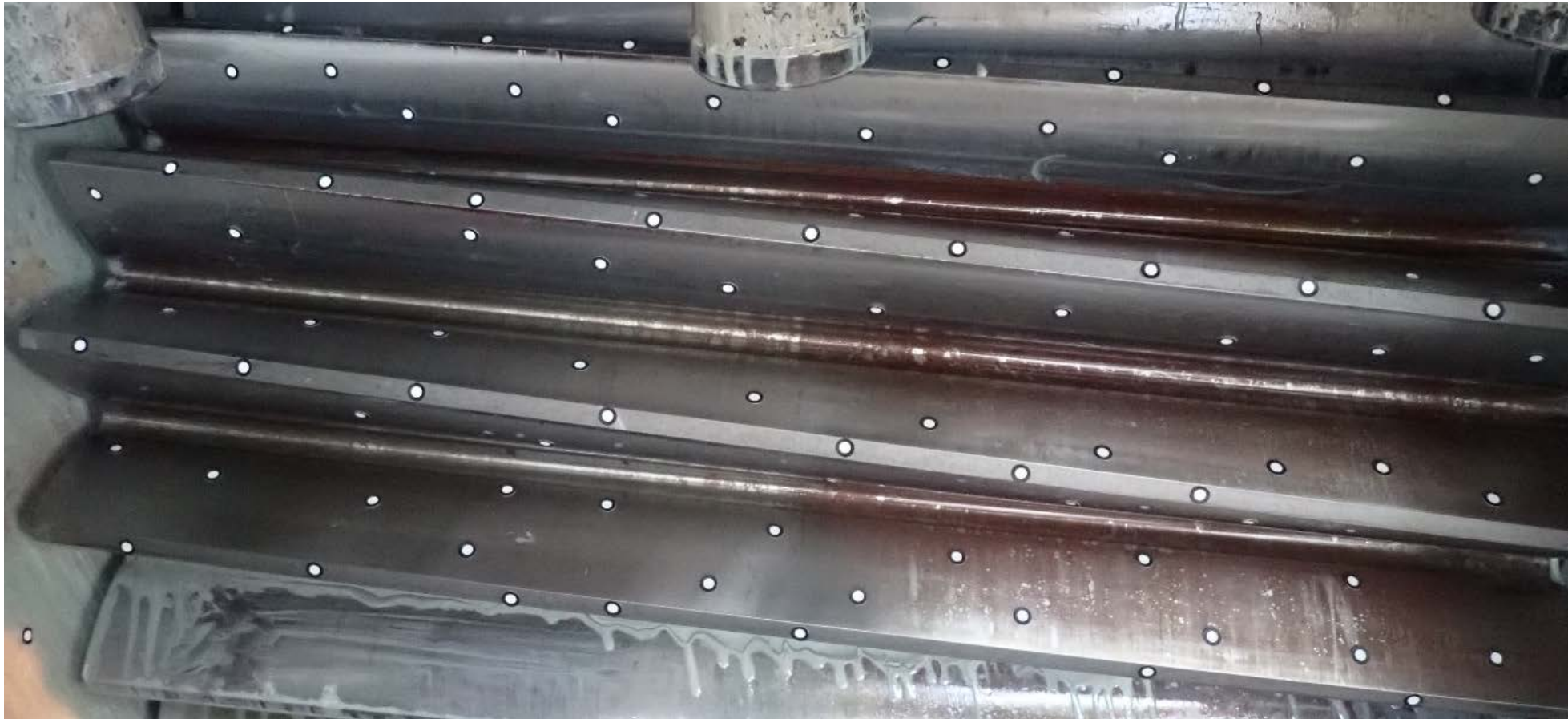


West Pinion Colour Map

1.00 Maximum deviation and acceptance of 0.01mm (green)

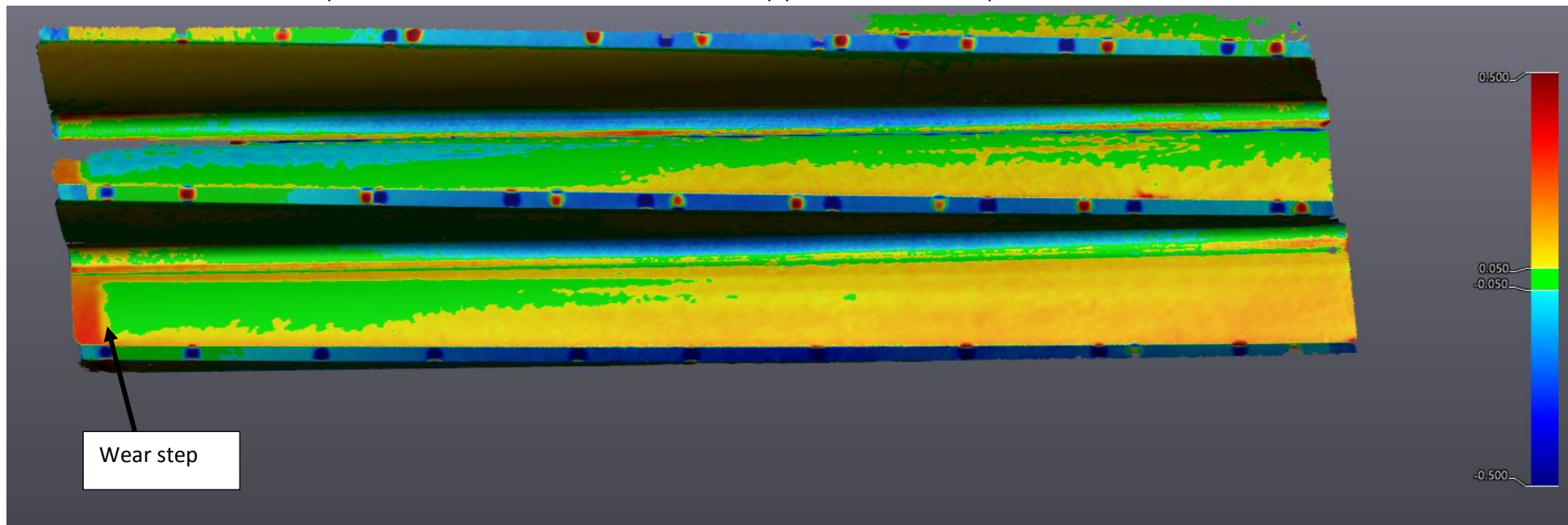


East Pinion (outward running).



Colour map of loaded sided West Vs East

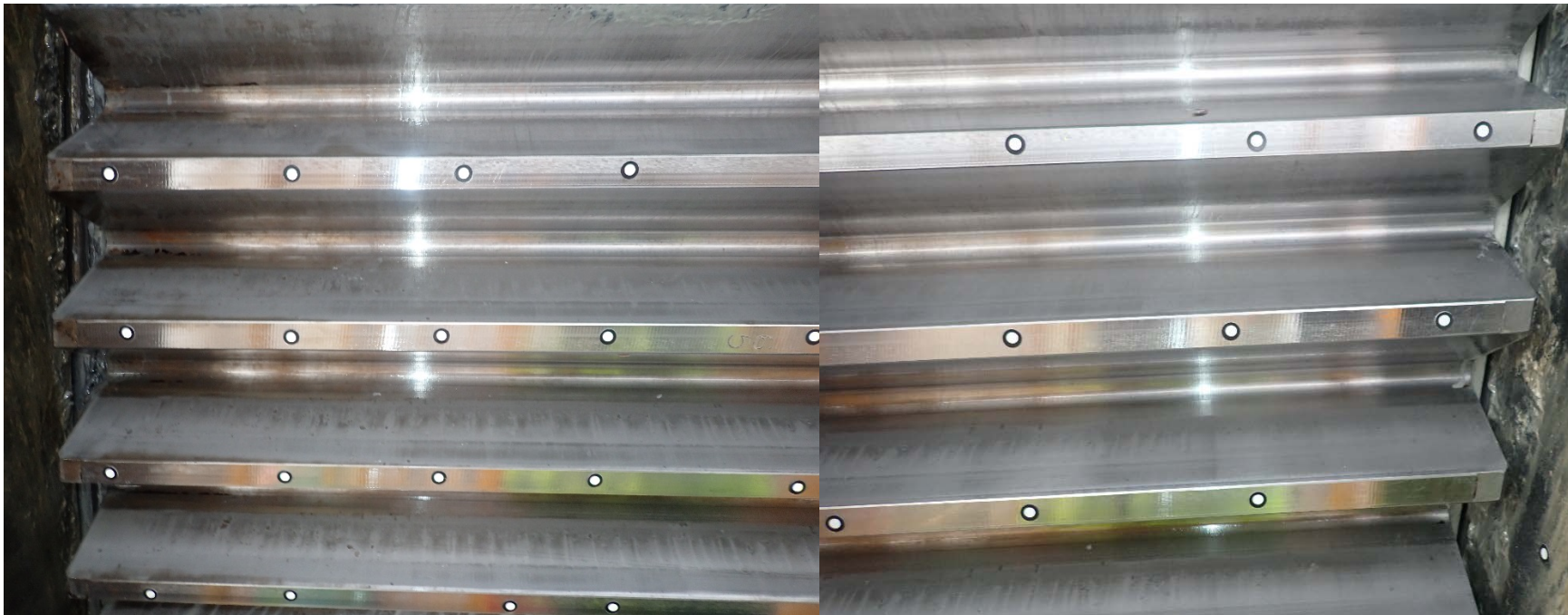
Maximum deviation 0.5 mm acceptance 0.05mm Shows evidence of a wear step present on the West pinion.



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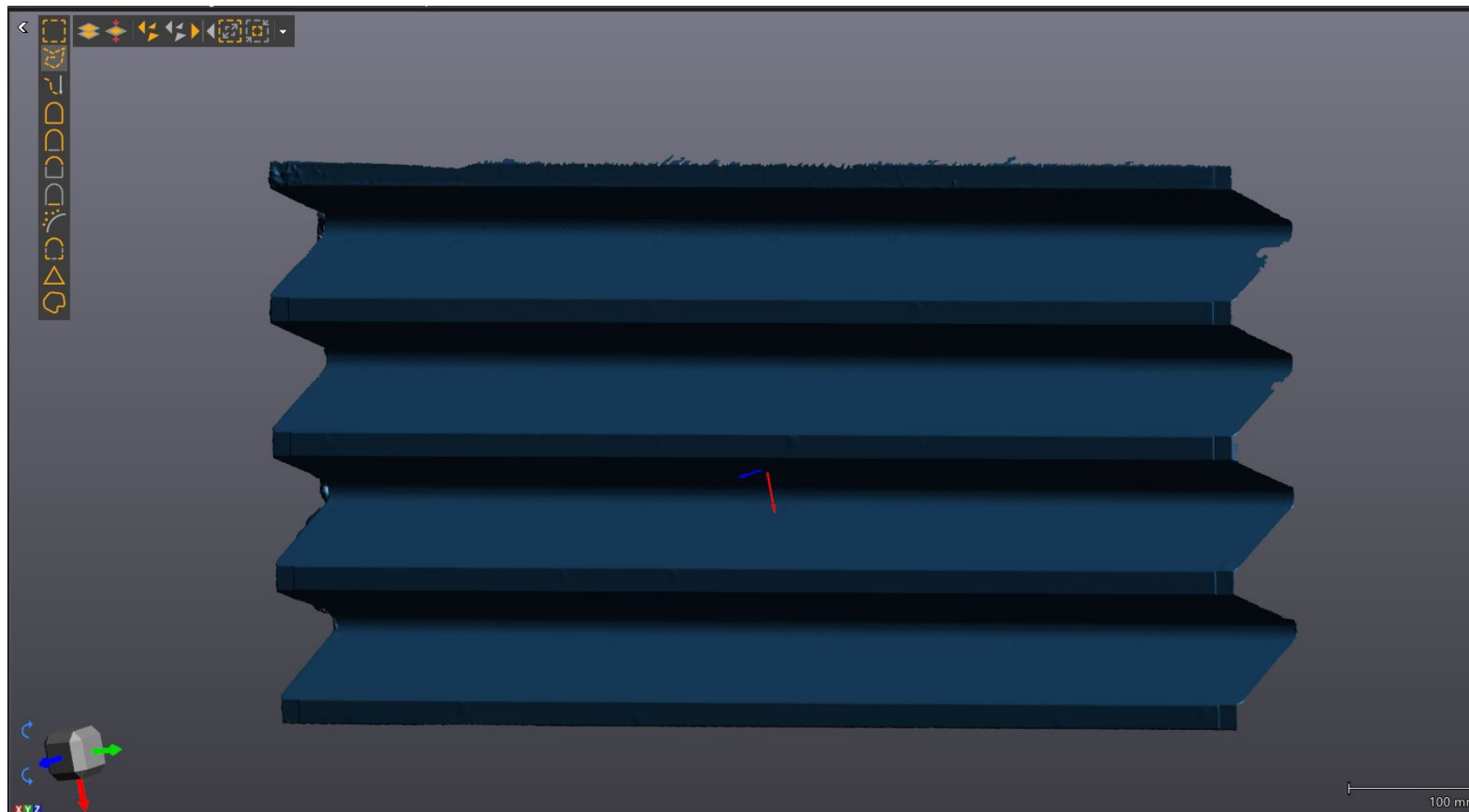


SAG Mill Girthgear Non drive and Drive ends





SAG mill Gear reference 3-D mesh scan.



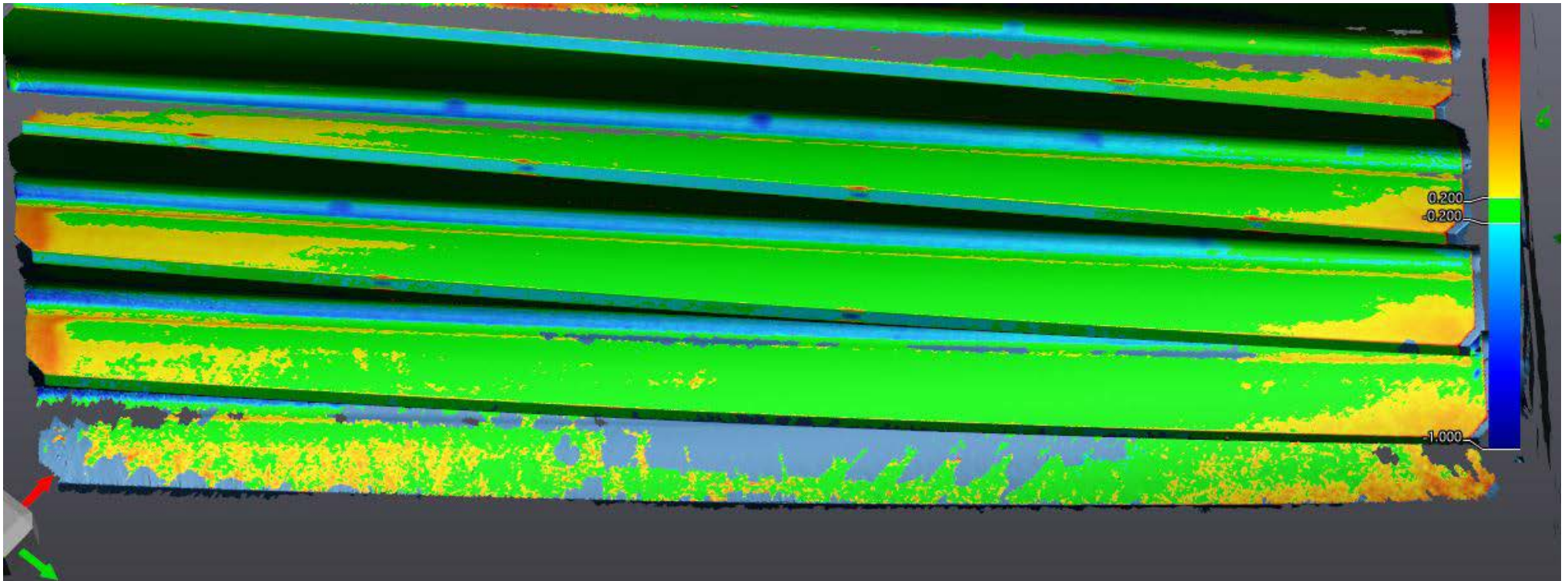
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Bal Mill 1 pinion as scanned



Ball mill 1 pinion comparison with spare pinion on the store



Maximum deviation scale +/- 1mm and acceptance 0.2mm

Evidence of wear at the drive end is apparent.

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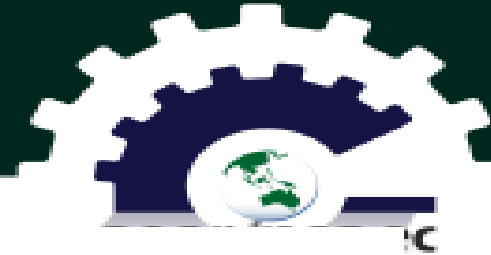
APPENDIX A

Handiscan Black Elite

Specifications

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





HandySCAN3D™

**WHEN ACCURACY
 MEETS VERSATILITY
 AND PORTABILITY**

The HandySCAN 3D™ line-up is a proven and trusted patented metrology-grade 3D scanner. Optimized to meet the needs of design, manufacturing and metrology professionals, it provides the most effective and reliable way to acquire accurate 3D measurements of physical objects anywhere.

Portable, accurate and simple to use, the HandySCAN 3D features unmatched speed that captures high-quality measurements. Since it performs regardless of environment changes or part movement, it represents the ideal tool for quality assurance and product development applications.

-  **ACCURACY OF 0.025 mm (0.0009 in)**
-  **SCAN-TO-MESH IN SECONDS**
-  **CERTIFIED ISO 17025**
-  **WORLDWIDE SUPPORT**
-  **LARGE SCANNING AREA**
-  **PATENTED TECHNOLOGY**



- 1 High-performance optics
Optimal scan quality
- 2 Extra single line
Easy capture of hard-to-reach areas
- 3 Blue laser technology
High resolution capability
- 4 Stand-off distance color indicator
Maximizes scanning performance
- 5 Multifunction buttons
Quick access to frequently used software functionalities
- 6 Highly ergonomic and sleek design
Provides outstanding user experience



ACCURACY & RESOLUTION

The HandySCAN 3D delivers accurate, high-resolution and repeatable results, regardless of the measurement setup quality and no matter the user experience. Featuring dynamic referencing, both the scanner and part can move during measurement and still provide an accurate and high-quality scan.

- Accuracy**
0.025 mm (0.0009 in)
- Volumetric accuracy**
0.020 + 0.040 mm/m (0.0008 in + 0.0016 in/ft)
- Reliable acceptance test**
Based on VDI/VDE 2634 part 3 standard
ISO 17025 accredited laboratory
- High resolution for fine details**



PORTABILITY

This handheld 3D scanner is a stand-alone device that does not require a tripod nor any external tracking device to operate. Fitting in a small suitcase, it can be brought anywhere and used in any environmental conditions without affecting its performance.

- Lightweight**
0.94 kg (2.1 lb)
- Dynamic referencing**
Both the object and scanner can be moved freely while scanning
- Fits into a suitcase**
Take it anywhere you need



SIMPLICITY & VERSATILITY

With its user-friendly interface and ergonomic design, the HandySCAN 3D measurement solution has a short learning curve. Highly versatile, it can be used to scan various object sizes and surface types in real time—all with the same device.

- Plug and play**
Simple user interface and real-time mesh visualization
- Single device fits all needs**
Masters complex and difficult surfaces



SPEED

The HandySCAN 3D scanner features multiple laser crosses and an automatic mesh generation, enabling a faster workflow from the set-up to the scan and then to the file.

- Instant mesh**
Ready-to-use files
- High measurement rate**
Up to 1,300,000 measurements/s
- 11 laser crosses scanning area**
Quick set-up
Up and running in less than 2 minutes

TECHNICAL SPECIFICATIONS

Innovating technology that provides TRUaccuracy™, TRUsimplicity™, TRUportability™ as well as real speed to your metrology-grade applications.

	HandySCAN 307™	HandySCAN BLACK™	HandySCAN BLACK™IElite
ACCURACY⁽¹⁾	Up to 0.040 mm (0.0016 in)	0.035 mm (0.0014 in)	0.025 mm (0.0009 in)
VOLUMETRIC ACCURACY⁽²⁾ (based on part size)	0.020 mm + 0.100 mm/m (0.0008 in + 0.0012 in/ft)	0.020 mm + 0.060 mm/m (0.0008 in + 0.0007 in/ft)	0.020 mm + 0.040 mm/m (0.0008 in + 0.0005 in/ft)
VOLUMETRIC ACCURACY WITH MaxSHOT Next™IElite⁽³⁾	0.020 mm + 0.015 mm/m (0.0008 in + 0.00018 in/ft)		
MEASUREMENT RESOLUTION	0.100 mm (0.0039 in)	0.025 mm (0.0009 in)	
MESH RESOLUTION	0.200 mm (0.0078 in)	0.100 mm (0.0039 in)	
MEASUREMENT RATE	480,000 measurements/s	800,000 measurements/s	1,300,000 measurements/s
LIGHT SOURCE	7 red laser crosses	7 blue laser crosses	11 blue laser crosses (+ 1 extra line)
LASER CLASS	2M (eye safe)		
SCANNING AREA	275 x 250 mm (10.8 x 9.8 in)	310 x 350 mm (12.2 x 13.8 in)	
STAND-OFF DISTANCE	300 mm (11.8 in)		
DEPTH OF FIELD	250 mm (9.8 in)		
PART SIZE RANGE (recommended)	0.1–4 m (0.3–13 ft)	0.05–4 m (0.15–13 ft)	
SOFTWARE	VXelements		
OUTPUT FORMATS	.dae, .fbx, .ma, .obj, .ply, .stl, .txt, .wrl, .x3d, .x3dz, .zpr, .3mf		
COMPATIBLE SOFTWARE⁽⁴⁾	3D Systems (Geomagic® Solutions), InnovMetric Software (PolyWorks), Metrolog/c Group (Metrolog X4), New River Kinematics (Spatial Analyzer), Verisurf, Dassault Systèmes (CATIA V5, SOLIDWORKS), PTC (Creo), Siemens (NX, Solid Edge), Autodesk (Inventor, PowerINSPECT)		
WEIGHT	0.85 kg (1.9 lb)	0.94 kg (2.1 lb)	
DIMENSIONS (LxWxH)	77 x 122 x 294 mm (3.0 x 4.8 x 11.6 in)	79 x 142 x 288 mm (3.1 x 5.6 x 11.3 in)	
CONNECTION STANDARD	1 X USB 3.0		
OPERATING TEMPERATURE RANGE	5–40°C (41–104°F)		
OPERATING HUMIDITY RANGE (non-condensing)	10–90%		
CERTIFICATIONS	EC Compliance (Electromagnetic Compatibility Directive, Low Voltage Directive), compatible with rechargeable batteries (when applicable), IP50, WEEE		
PATENTS	CA 2,600,926, CN 200680014069.3, US 7,912,673, CA 2,656,163, EP (FR, UK, DE) 1,877,726, AU 2006222458, US 8,032,327, JP 4,871,352, US 8,140,295, EP (FR, UK, DE) 2,278,271, EP (FR, UK, DE) 2,230,482, IN 266,573, US 7,487,063, CA 2,529,044, EP (FR, UK, DE) 3,102,908, US 15/114,563, CN 201580007340X		

(1) HandySCAN BLACK and HandySCAN BLACKIElite (ISO 17025 accredited): Based on VDI/VDE 2634 part 3 standard. Probing error performance is assessed with diameter measurements on traceable sphere artefacts.
 HandySCAN 307: Typical value for diameter measurement on a calibrated sphere artefact.

(2) HandySCAN BLACK and HandySCAN BLACKIElite (ISO 17025 accredited): Based on VDI/VDE 2634 part 3 standard. Sphere-spacing error is assessed with traceable length artefacts by measuring these at different locations and orientations within the working volume.
 HandySCAN 307: Value for spheres spacing measurement on a calibrated length artefact.

(3) The volumetric accuracy of the system when using a MaxSHOT 3D cannot be superior to the default accuracy for a given model.

(4) Also compatible with all major metrology, CAD, and computer graphic software through mesh and point cloud import.