

THE **3DS-SHAPER** SERIES

HiR - ULTRA-PRECISE 3D LASER PROFILOMETRY

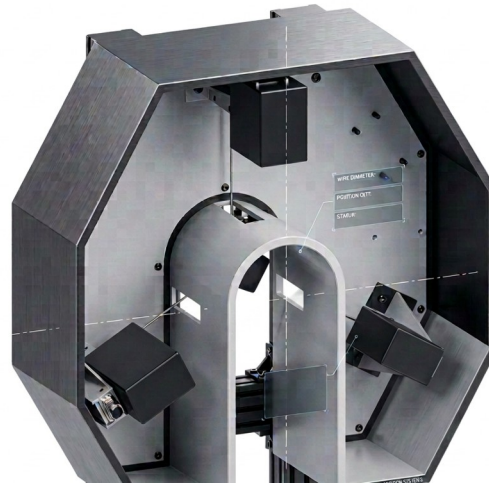
FAQ's

Base Model 3DShaper-HiR

The **HiR** is an a High Range model of the 3DShaper based on wide arrays of 2D Laser Profilometers, suitable to cover pipes and profiles dimensions up to **400 × 200 mm** square profile and big diameter's round pipes.

Guiding Principle

To ensure dimensional compatibility, accuracy, and budget alignment, the starting point is the user's **minimum acceptable requirement**. The objective is to avoid over-dimensioning the system while meeting all functional requirements.



Installation Preference

Systems are preferably installed at the **end of the production line**, where the part is guided and before the cutting stage. This allows reconstruction of:

- Cross-section profile
- Longitudinal profile along the length (capturing **straightness**, often critical for long products)

3. Dimensional Coverage and 360° Inspection



The HiR system can measure:

- Round pipes: **OD 110.0 mm to 400.0 mm**
- Square/rectangular profiles: **100 × 100 mm to 200 × 400 mm**

with the same hardware's system configuration.

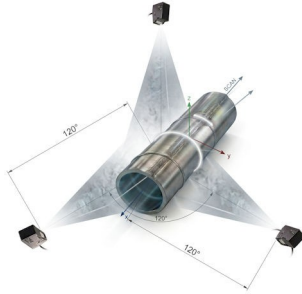
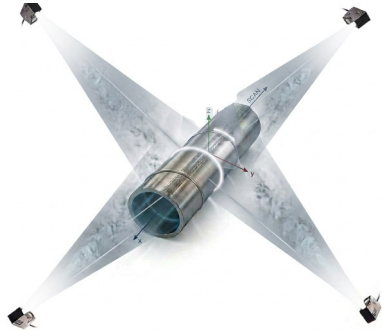
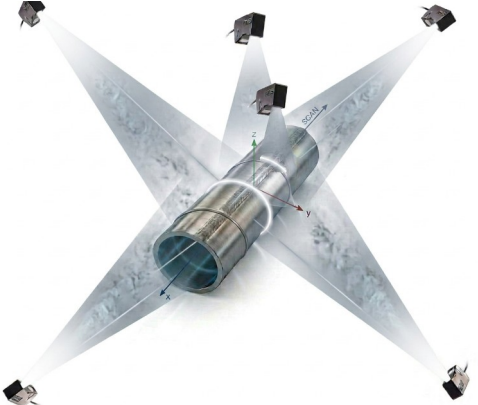
All HiR systems can cover the extended range of different shapes.

The laser beams cover:

- Minimum round shape
- Maximum round shape
- Minimum square shape
- Maximum square shape

Models for shape

Based on weld seam accuracy requirements, the suitable model can be selected among

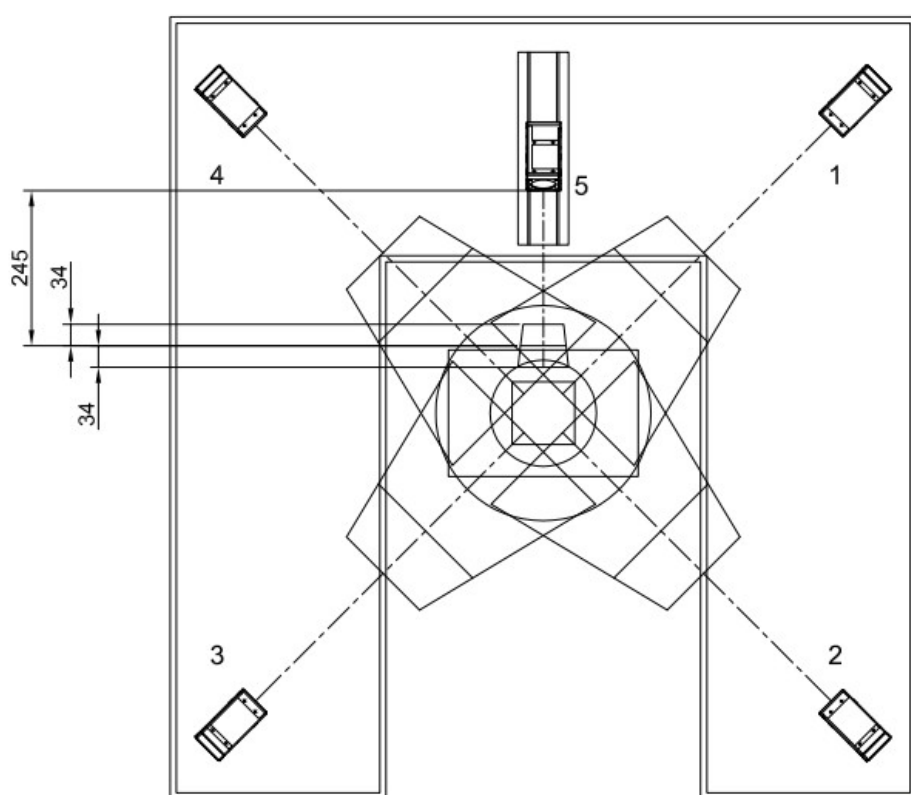
• 3DShaper 980-3 The 3DShaper-980-3 with static heads is the most basic approach to long products 360° profilometry.	
• 3DShaper 380-4 The 3DShaper-380-4 with static heads is the average option, capable of an accuracy of 100 microns on shape.	
• 3DShaper 380-5 • 3DShaper 380.4-245.1 The 3DShaper-380-5 with static heads and the 3DShaper-380.4 / 245.1 are suitable for a more precise external weld detection . The 5th head ensures the best possible view of the weld area and can be more accurate than the others if required.	

Models for weld

- **3DShaper Welda 980**
- **3DShaper Welda 380**
- **3DShaper Welda 245**



Dimensions



✱ **3DShaper 380.4-245.1** ✱

Measurable Features

The system can measure:

Feature	Capability
Ovality	Yes
Corner radius	Yes
Convexity / concavity	Yes
External weld seam geometry	Yes

Model 380

Reference Performance

Parameter	Value
Overall accuracy on external dimensions	± 0.1 mm
Challenging area	External weld inspection (e.g., depression)

The **380 model** is the average solution for the specified dimensions. However, the **seam height tolerance** actually experienced in the customer's lines must be clarified to determine whether a higher-performance model is required. Increasing capability may require additional heads and a corresponding price increase.

Line Speed and Sampling Parameters

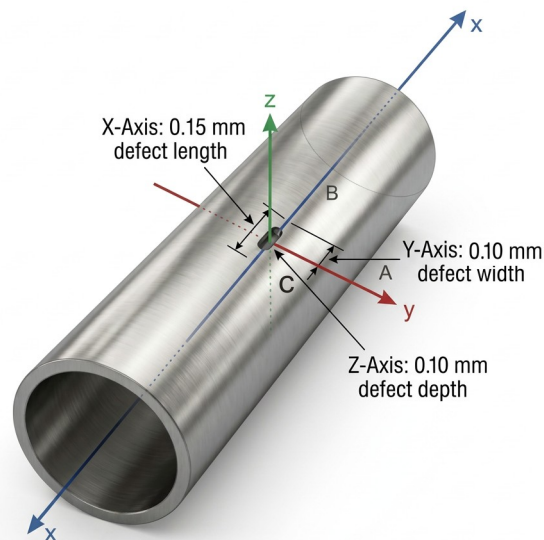
Parameter	Value
Maximum line speed	50 m/min = 833.33 mm/s
Sampling rate	16,000 profiles/s (16 kHz)
Spatial step (X-axis)	$833.33 \div 16,000 \approx 0.052$ mm per profile
Reliable reading (average of ~3 profiles)	Defect length ≥ 152 μm (~0.15 mm)

Defect Width (Y-axis)

- Each profile: **3,200 points**
- Point spacing depends on distance to object: **56 μm to 75 μm per point**
- Worst-case values occur at maximum speed and worst measuring range (very small pipe or very large rectangular profile)

Defect Depth (Z-axis)

- Minimum detectable depth: **0.10 mm**
- Scratches with depth < 0.1 mm cannot be detected
- Speed affects X-axis defect size more than depth



Summary Table – Minimum Detectable Defect

Axis	Parameter	Minimum Detectable
X (length)	Sampling rate + speed	0.15 mm
Y (width)	Points per profile	0.056–0.075 mm
Z (depth)	Sensor accuracy	0.10 mm

Sensor Specifications

Specification	Value
Repeatability	10 μ m
Linearity	$\pm 0.035\%$ of F.S. (full range)
Profile Data Interval	75 μ m (default, settable down to 50 μ m)
Profile Data Count	3,200 points
Temperature drift	0.0315 mm/ $^{\circ}$ C
Overall accuracy (worst range)	No better than ± 0.100 mm

Temperature and Environmental Considerations

Product Temperature

No issue. A product at 80°C is considered "cold" in this application. Changes begin at **250°C**. Other sensors are used at **800°C**. Measurement above **1000°C** (bright yellow/orange-yellow) is not possible with the HiR series.

Frame Thermal Management

- The 3DShaper frame (typically hexagonal) is fitted with **Peltier cells** for air conditioning (standard Rittal top-mounted thermoelectric cooler).
- Peltier system: no direct contact between outside and inside → keeps dirt and dust out.
- Used on cold materials as well, to stabilize temperature and limit:
 - Sensor temperature drift (0.0315 mm/°C)
 - Thermal expansion of the frame
- For sudden temperature changes >10°C, **carbon fibre plates** (immune to expansion) are normally used — not required in a standard pipe factory.

Surface Oil Contamination

- The pipe/profile should be **air-sprayed**.
- Oil drops are seen by the system as part of the pipe.
- Alternative solutions (e.g., rag) exist but are not preferred.
- All vision and laser-based systems are subject to this problem.
- X-rays are immune but not usable in these applications.
- UT and eddy pulse are immune but performance is far lower than digital profilometry.

Option Analysis

Option 1 – Model 3DS-380-5

- **5 static heads**
- Standard configuration
- 5th head ensures best view of weld area

Option 2 – Model 3DS-380-4/245-1

- **4 static heads + 1 mobile head**
- Mobile head: **3 to 5 times more accurate** than other heads
- Tighter working distance → distance from pipe surface must be adaptable to pipe size
- Mobile head intended **solely for weld area inspection** with greater accuracy
- Automatically positioned via linear slide, descending according to diameter measured by the other 4 heads
- Externally identical to Option 1

Comparison – 380 vs. 245 Sensors

Parameter	380 (Shape Sensor)	245 (Weld Sensor)
Reference distance from pipe	~380 mm	~245 mm
Laser blade width	~280 mm (need up to 320 mm on far side for smallest pipes)	~70 mm
Resolution X (length)	0.15 mm (150 µm)	0.15 mm (150 µm)
Resolution Y (width)	280 mm / 3200 pts ≈ 0.08 mm (80 µm) average; 320/3200 ≈ 0.1 mm (100 µm) far side	70 mm / 3200 pts ≈ 0.03 mm (30 µm)
Resolution Z (depth)	0.1 mm (100 µm)	~0.04 mm (40 µm)

Operational Principle – Round Pipe Example

- Pipe arrives → shape sensors (380) calculate diameter by reading profile
- Communicate with slide drive to move weld sensor (245) up/down
- Weld sensor reaches optimal working distance (245 mm)
- **245 sensor always operates at ideal working distance** → significant advantage
- **380 sensors are static** → blade width and resolution vary with measurement position/shape/size
 - Blade width: (smaller / 3200) points near sensors, (wider / 3200) points far from sensors

Worst-Case Scenarios

- **Shape (380):** Very small pipe, very far from sensors, very high line speed
- **Weld (245):** Only limiting factor is line speed

Cost Impact of Moving Sensors

- Moving sensors add **20% to 25%** to overall architecture cost
- Three moving heads could cover same sizes of 4 statics, but overall system cost would be **far higher** than static heads

Sampling Rate Consideration

- Both sensors have the **same sampling rate**
- Adopting the 245 does **not** provide significant improvement on X-axis
- 245 does deliver improvements in **Y and Z directions**

Key Discussion Points

1. **Seam height tolerance** actually experienced in their lines → determines whether 380 is sufficient or a higher-performance model is needed
 2. **Weld area accuracy** – 0.10 mm is standard for external defects but somewhat coarse for welding area → requires detailed discussion
 3. **Scarfig feature** – currently described as "if possible" → confirm whether mandatory or optional
 4. **Surface oil** – air wiping/cleaning system required before measurement station → advise required surface condition for reliable measurement
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The **3DShaper-HiR** platform, specifically the **3DShaper-380-5** with static heads, is the recommended solution for the specified dimensional range and feature set. For enhanced weld inspection, **3DS-380-4/245-1** offers superior weld area accuracy at a 20–25% cost premium.