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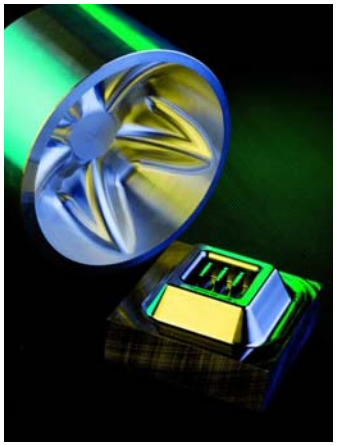
Encoder feed back systems for the print Industry



Ian Oliver
Business Manager encoder products
UK & Row Sales Division

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Encoder feed back systems for the print Industry

- Introduction
- Who are Renishaw plc
- Renishaw in India
- Encoder feed back systems for the print industry
  - Flat bed applications
  - Continuous print
- Encoder technology
- Machine structure calibration

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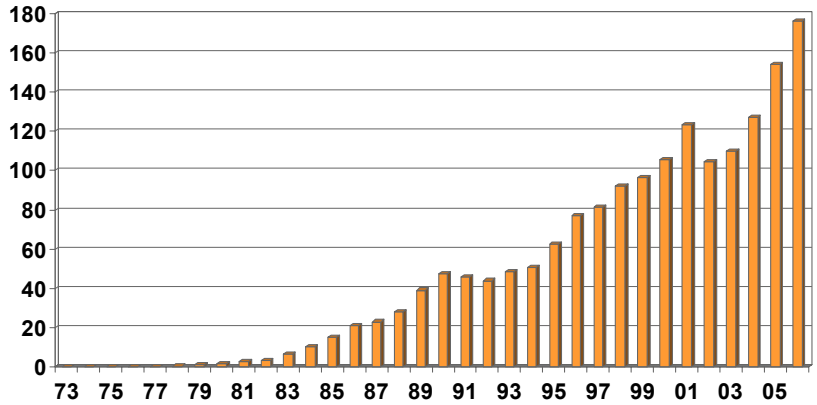
Who is Renishaw plc

- A UK Engineering Company listed on the London stock exchange.
- 2000 employees world wide
- 51 locations in 31 countries + 61 distributors in 45 countries
- 5 manufacturing sites in the UK and one in Pune India
- Turnover £175 million



12 Queens Awards
5 for export
3 for technology
4 for enterprise

THE QUEEN'S AWARDS FOR ENTERPRISE 2006

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Renishaw product lines

Renishaw have developed metrology based products to serve a diverse market place

Co ordinate measurement systems

Machine tool probe systems

Dental systems

Encoders

Spectroscopy products

Laser Measurement systems

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Renishaw in India

- Renishaw have been actively selling in India since 1980
- Renishaw PVt Ltd established 2000, now with 90 employees
- 3 sales offices with a factory in Pune manufacturing cables and tool setting arms

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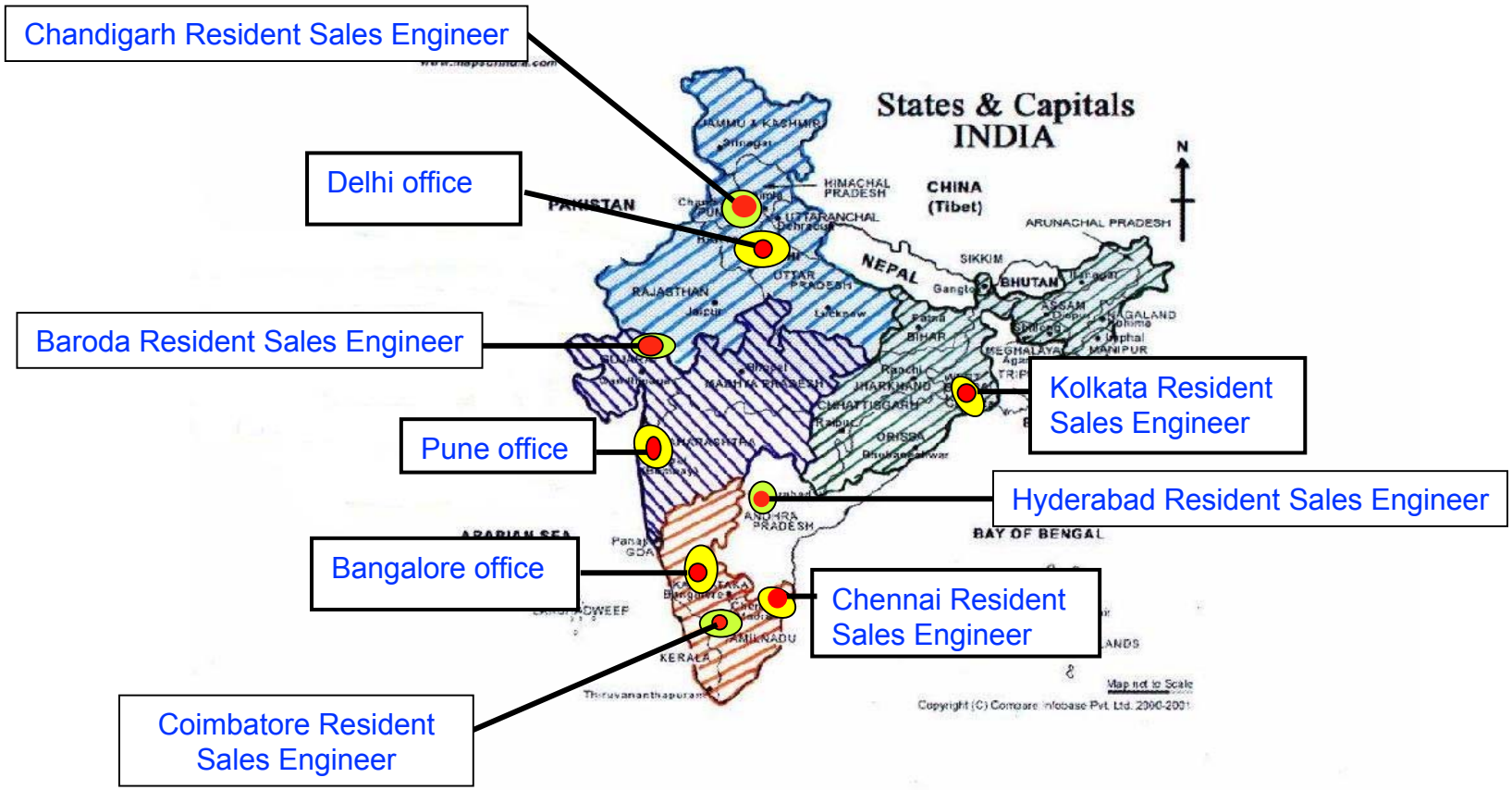
Renishaw in India



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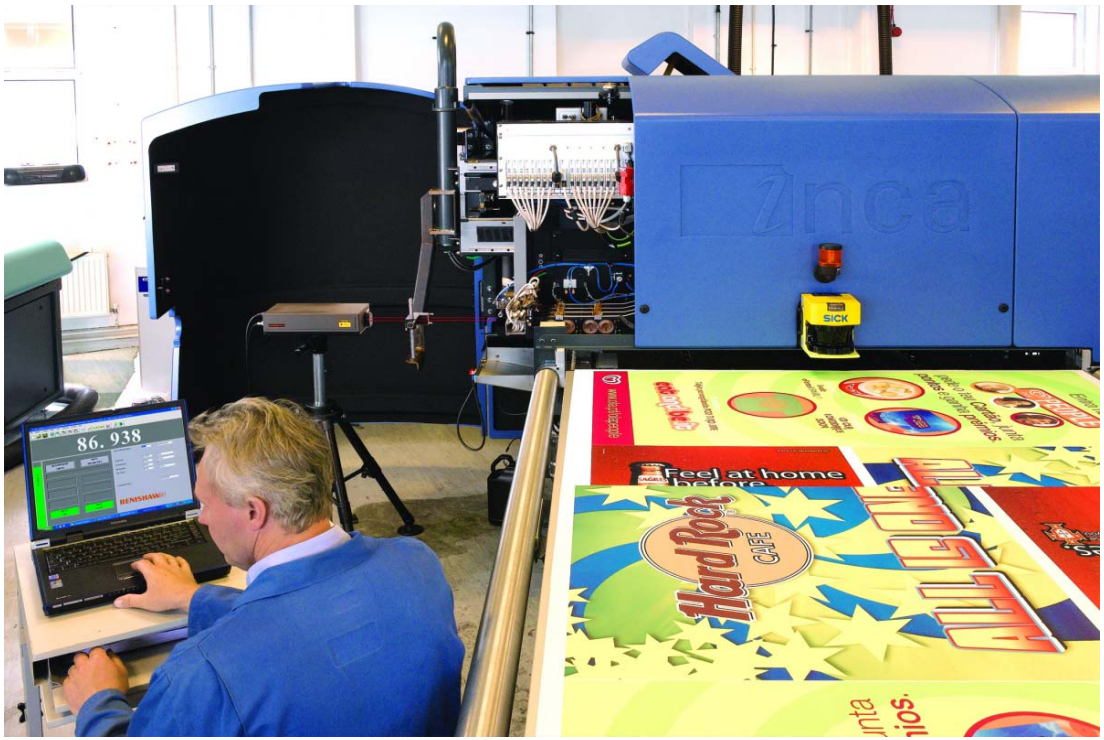
Encoder feed back systems for the print Industry

- The need for high speed motion control in the print industry is fundamental to the production of high quality images.
- Control of the moving axes of the print head or the medium to be printed on is essential were multipass image build up is required.



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Flatbed UV Ink jet printers

- **Typical performance requirements**
  - 1.6m wide stripe in less than 0.8 seconds
  - Bed lengths can exceed 6 meters
  - Reverse motions accelerate in excess of 20m/sec²
  - Typical Ink Droplet radius of 20 microns
  - Axis must have a step accuracy to better than the droplet radius.
- **Position repeatability is essential as the build up of ink drops takes place**

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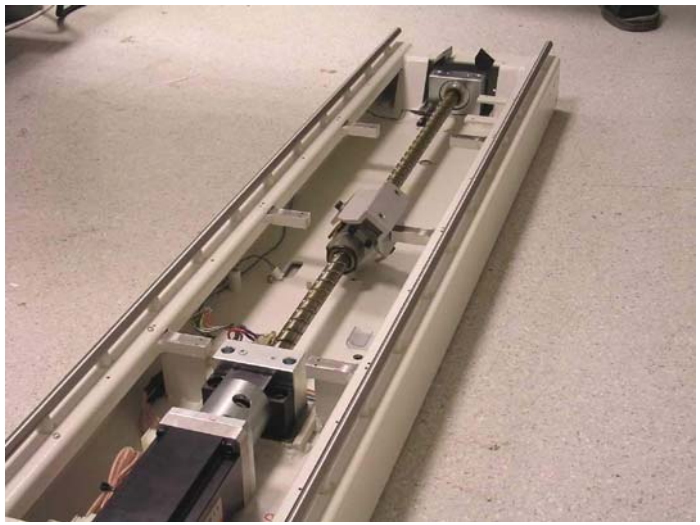
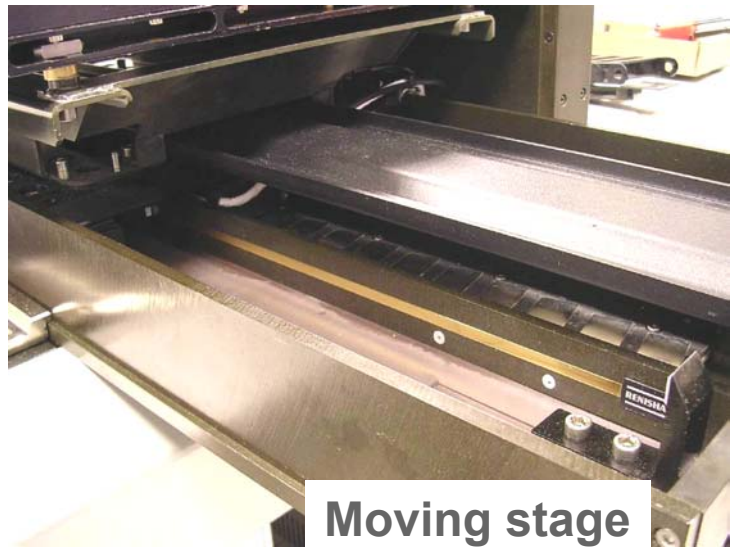
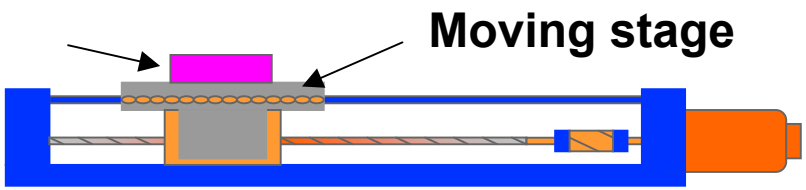
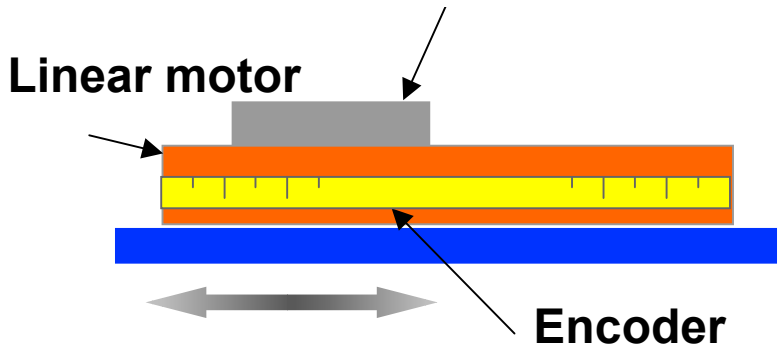
The evolution of encoder feedback

Linear systems have developed from lead screw with rotary Encoders to direct linear feedback and / or integrated linear motors









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Linear carriage with direct encoder feedback

- Moving carriage
  - Both axes are driven by linear motors which form part of the structure
  - Encoder feedback ensure both motor control and position repeatability are maintained
  - Improved position performance - accuracy, repeatability

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Encoder Technology

- Magnetic
  - Scale pitch will dominate errors
  - Environmentally immune

- Optical
  - Fine scale pitch, using steel tape, glass or Invar.
  - Open system high accuracy and flexibility

- Laser
  - Time of flight beam systems, low accuracy
  - Interferometer, high resolution / accuracy

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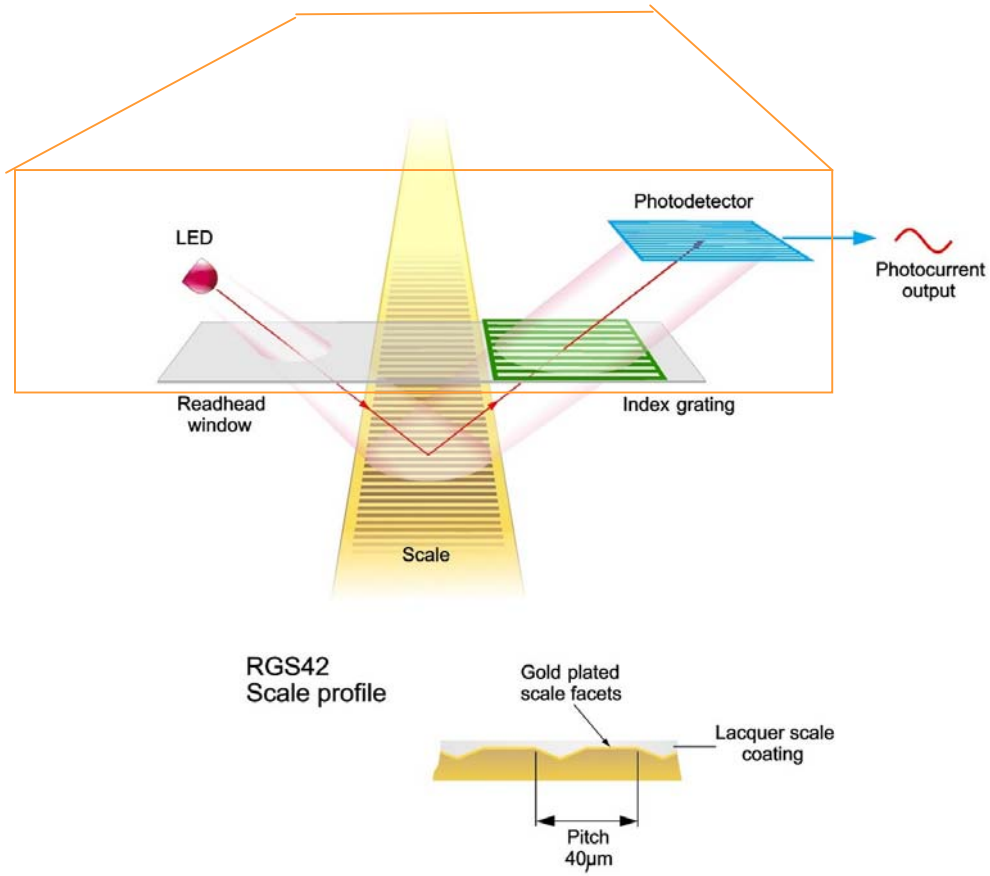
How does the Renishaw readhead work ?



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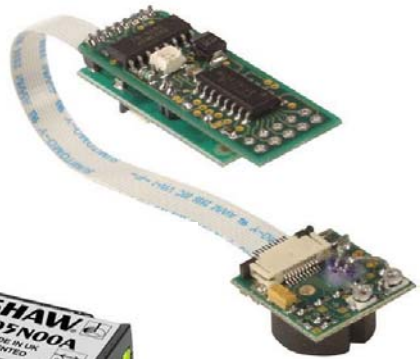
Renishaw linear optical encoders

- Renishaw readheads are now available in 20 µm and 40 µm pitch versions, with tape scale, glass, Invar
- Available with 1Vpp, digital A-Quad-B and serial outputs
- Resolutions to 10 nm
- UHV compatible options
- Component readheads also available



Rotary axes also require controlling

- **Continuous film type applications.**
  - In addition to control of the print head, the rate at which the medium is fed and thus the control of the drum or roller, is essential.
  - Drums require accurate rotary motion combined with linear feed back of the print head

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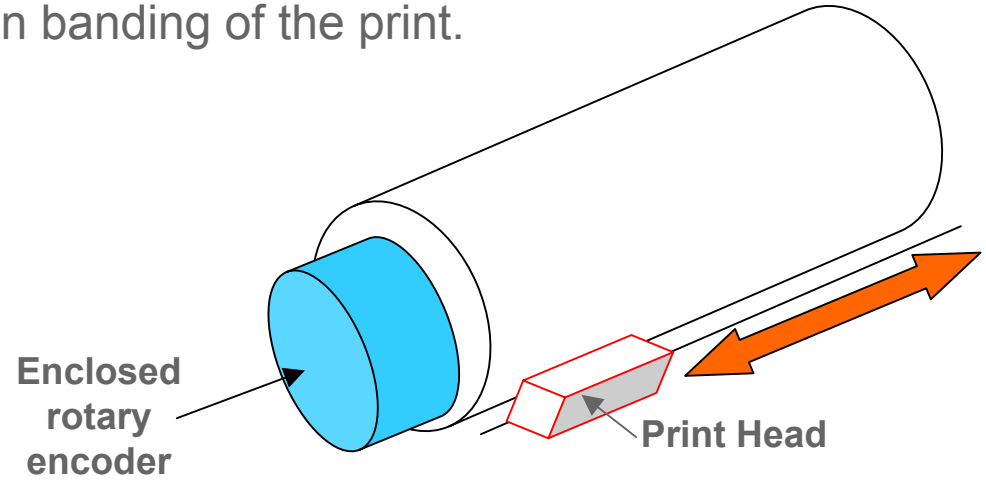
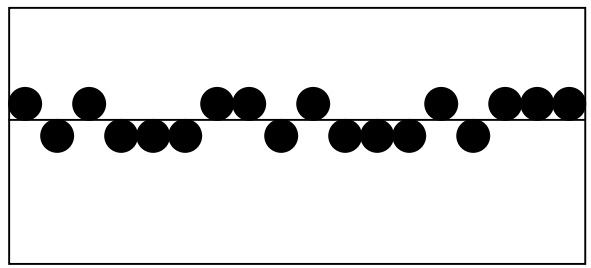
Repeatability in print industry

- The feed drum uses a shaft encoder on the back of the motor
- The print quality is directly effected by any bearing wander
  - Results in banding of the print.

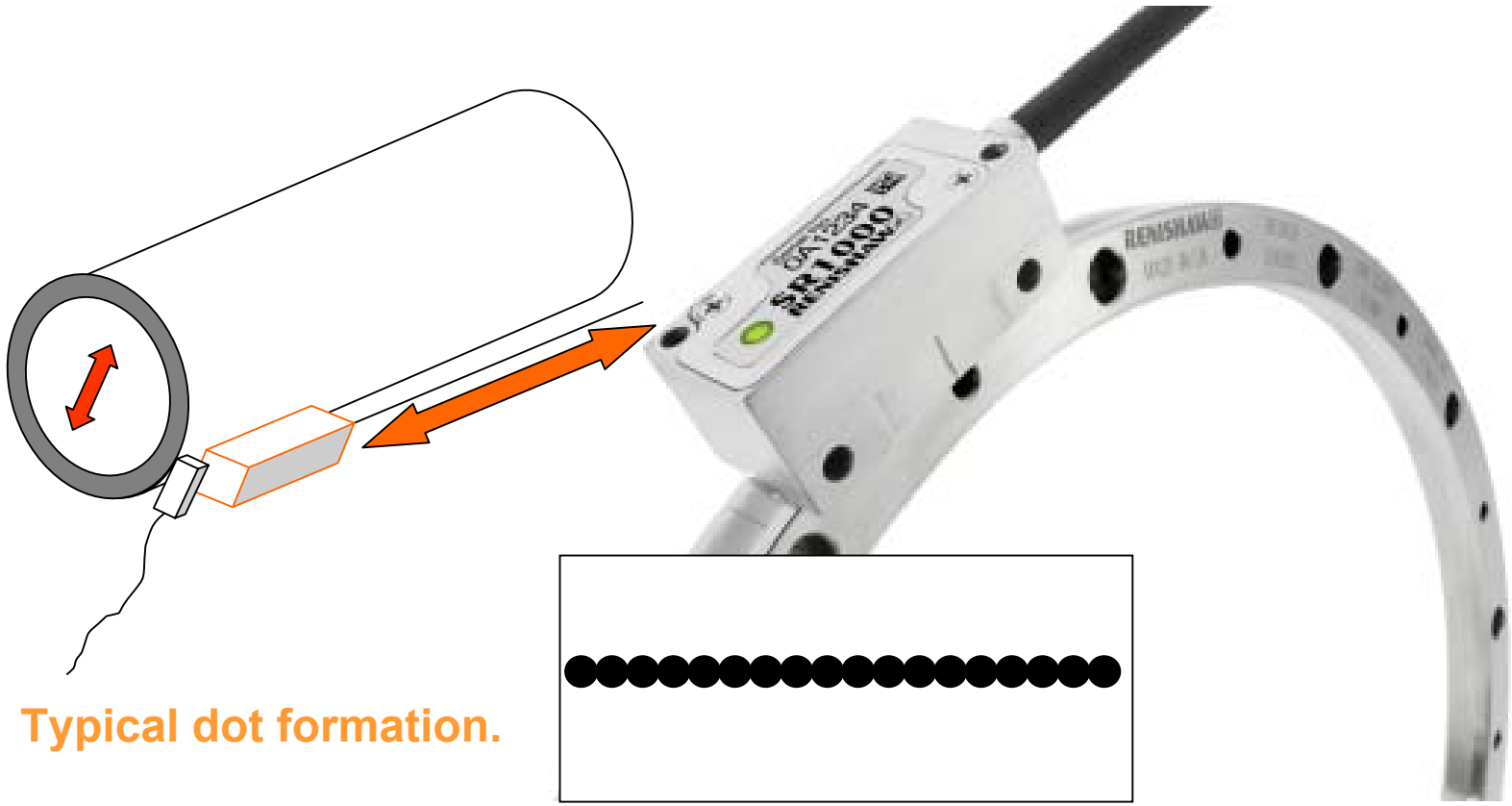


Typical dot formation.



Repeatability in print industry

- Use of a Renishaw Angular ring encoder ensures; Bearing wander is genuinely compensated!



Typical dot formation.

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Renishaw rotary products

- A range high performance Angular encoders which feature *IN-TRAC*™ optical reference mark technology
  - Graduation accuracy to ± 0.38 arc second
  - Resolution and repeatability to 0.02 arc second
  - High operating temperatures, and spindle speeds up to 4500rev/min
  - Ring Diameters up to 550mm
  - Supported with a range of rotary magnetic encoders

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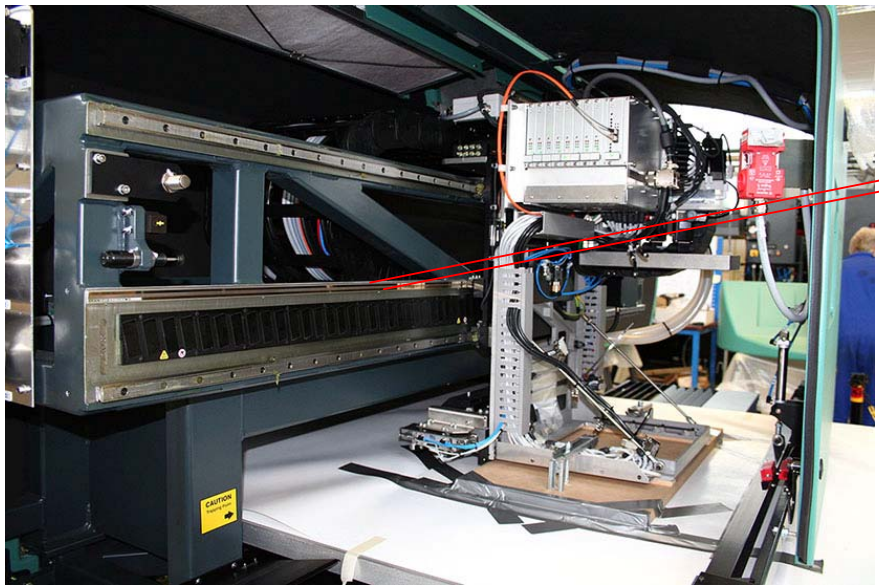
Machine structure compensation

- Print machines are complex technically challenging structures
- The laws of Physics dominate the mechanical stability of the structure
- Choice of materials, tolerance build up, and the Thermal environment will all effect the final image
- Use of a Renishaw calibration laser to map the machine can enhance performance



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Machine structure effects

- Geometric errors
  - Linear accuracy & repeatability
  - Angular (pitch & yaw)
  - Straightness
  - Squareness

- Dynamic errors
  - Positioning accuracy
  - Velocity & acceleration
  - Stability & consistency

- Above are reduced or eliminated through calibration.

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Any questions?