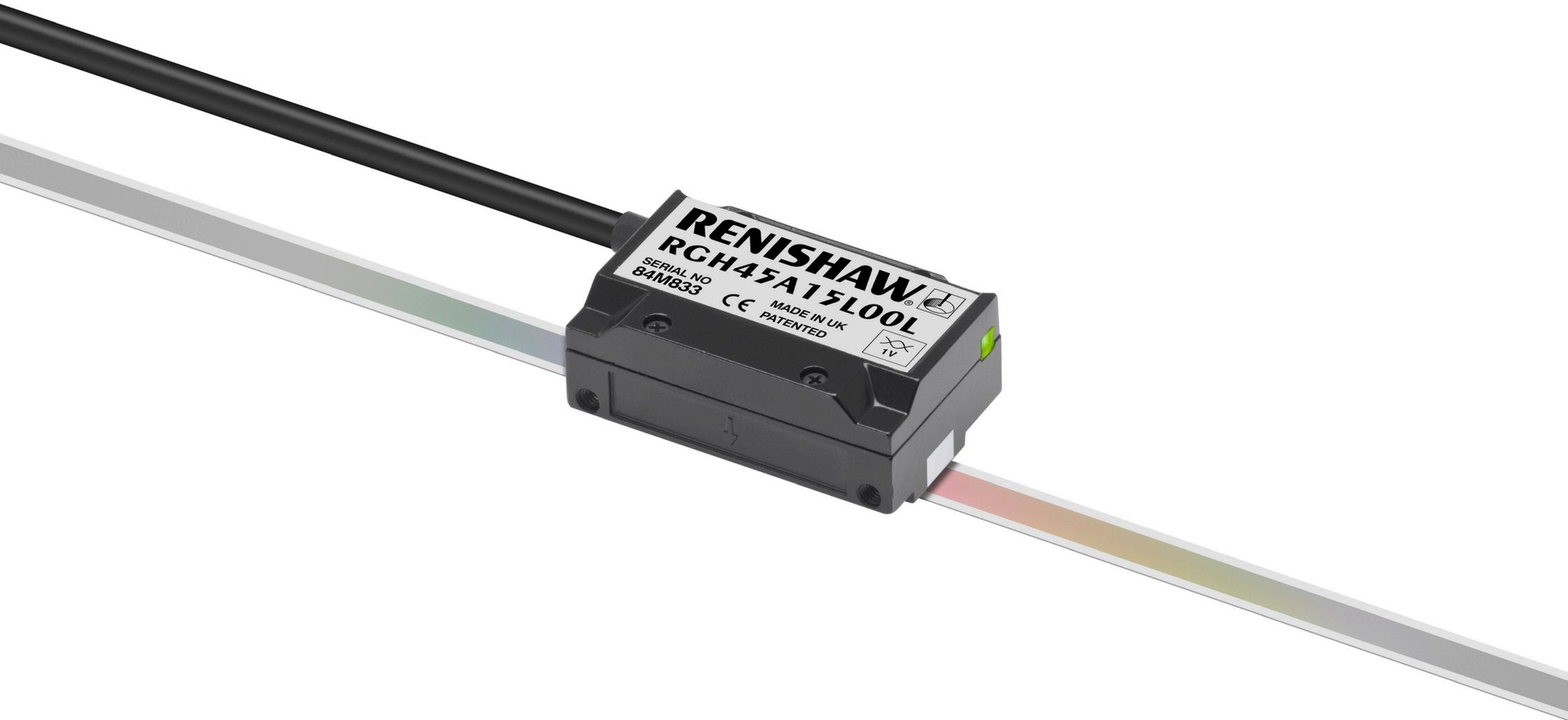


RGH45 RTL40-S linear encoder system



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Product compliance



Renishaw plc declares that RGH45 complies with the applicable standards and regulations. A copy of the EC Declaration of Conformity is available on request.

FCC compliance

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

The user is cautioned that any changes or modifications not expressly approved by Renishaw plc or authorised representative could void the user's authority to operate the equipment.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment.

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

NOTE: This unit was tested with shielded cables on the peripheral devices. Shielded cables must be used with the unit to ensure compliance.

RoHS compliance

Compliant with EC directive 2011/65/EU (RoHS)

Patents

Features of Renishaw's encoder systems and similar products are the subjects of the following patents and patent applications:

EP0748436	US5861953	EP826138	JP3676819	US6051971
CN1314511	EP1469969	JP5002559	US2005045586	

Further information

Further information relating to the RGH45 encoder range can be found in the RGH45 Data sheet (L-9517-9537). This can be downloaded from our website www.renishaw.com/encoder and is also available from your local representative. This document may not be copied or reproduced in whole or in part, or transferred to any other media or language, by any means without the written prior permission of Renishaw. The publication of material within this document does not imply freedom from the patent rights of Renishaw plc.

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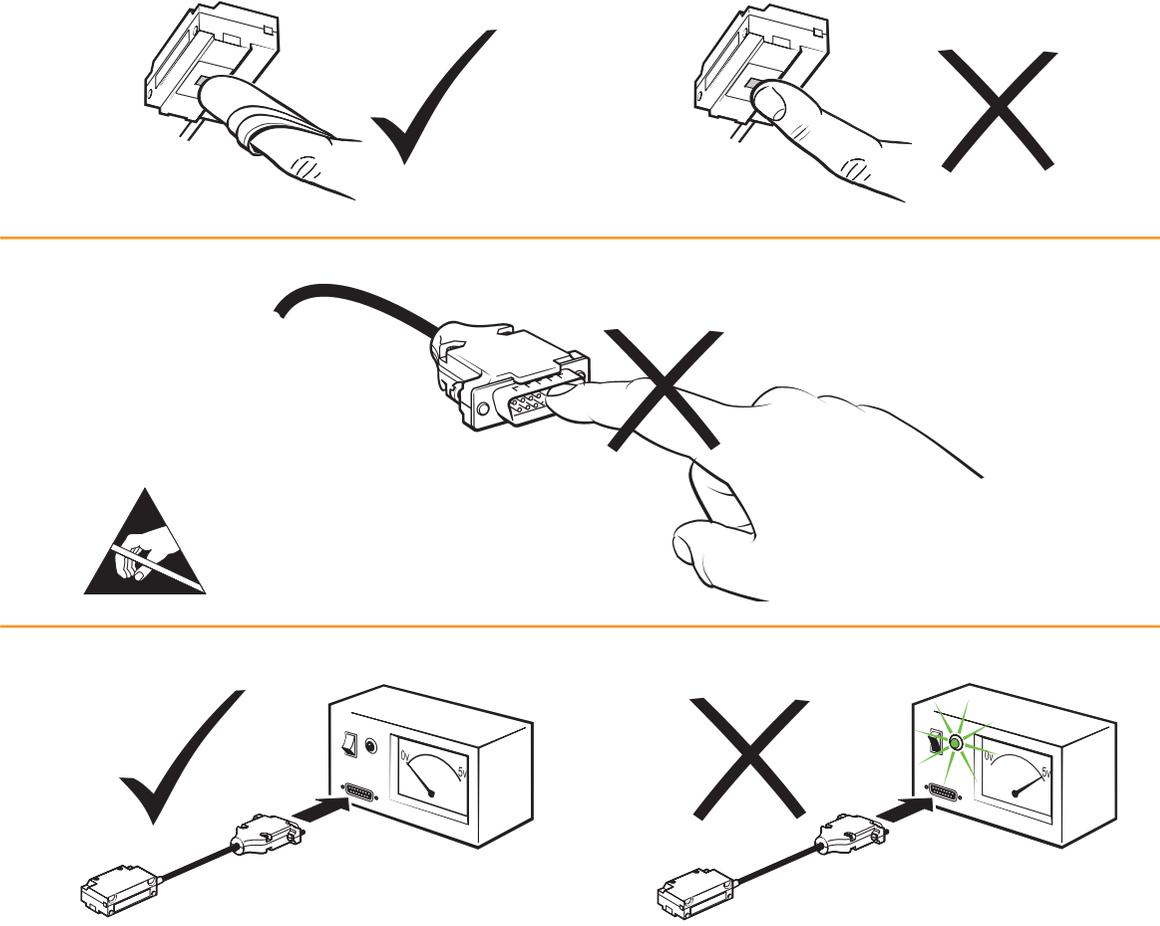
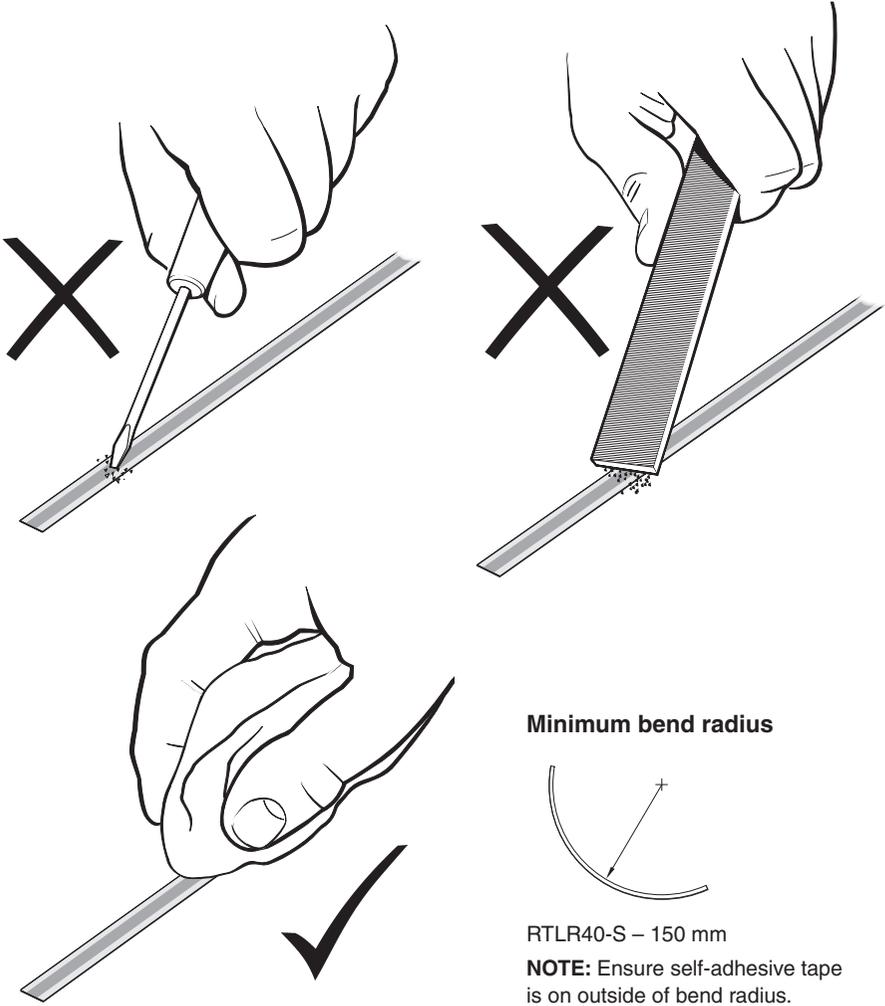
The packaging of our products contains the following materials and can be recycled.

Packaging Component	Material	ISO 11469	Recycling Guidance
Outer box	Cardboard	Not applicable	Recyclable
	Polypropylene	PP	Recyclable
Inserts	Low Density Polyethylene Foam	LDPE	Recyclable
	Cardboard	Not applicable	Recyclable
Bags	High Density Polyethylene Bag	HDPE	Recyclable
	Metalised Polyethylene	PE	Recyclable



The use of this symbol on Renishaw products and/or accompanying documentation indicates that the product should not be mixed with general household waste upon disposal. It is the responsibility of the end user to dispose of this product at a designated collection point for waste electrical and electronic equipment (WEEE) to enable reuse or recycling. Correct disposal of this product will help to save valuable resources and prevent potential negative effects on the environment. For more information, please contact your local waste disposal service or Renishaw distributor.

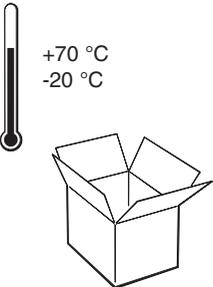
Storage and handling



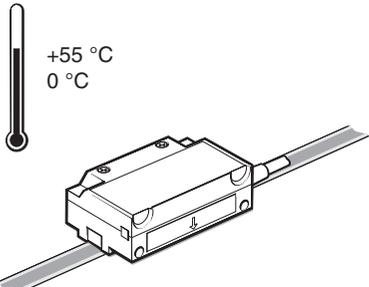
Scale and readhead



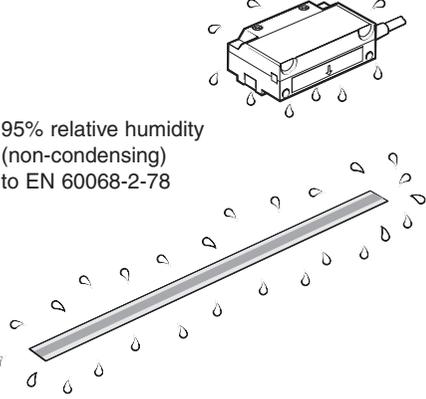
Storage



Operating

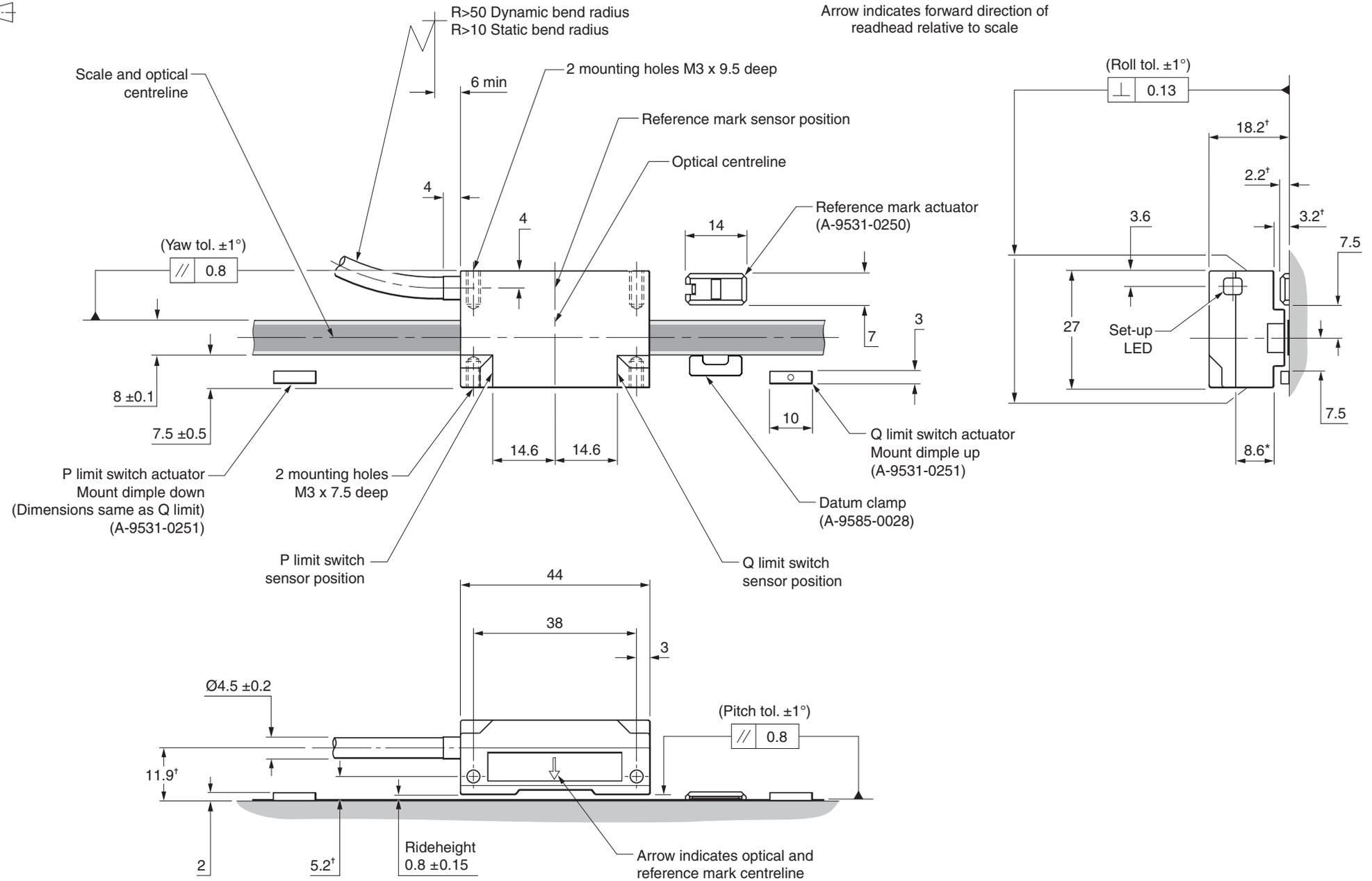


Humidity



RGH45 readhead installation drawing

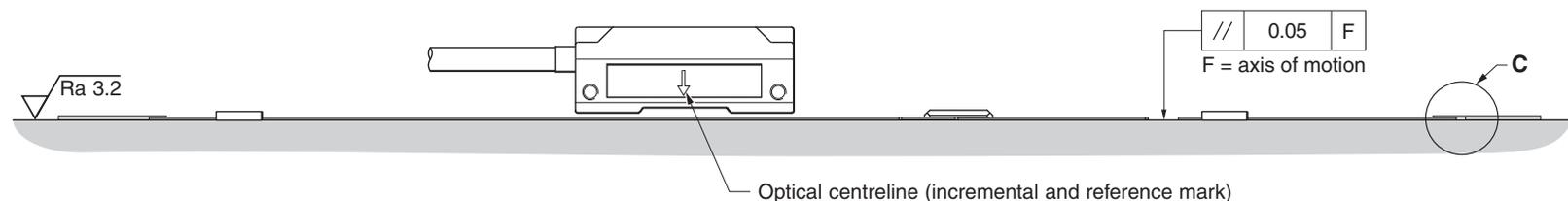
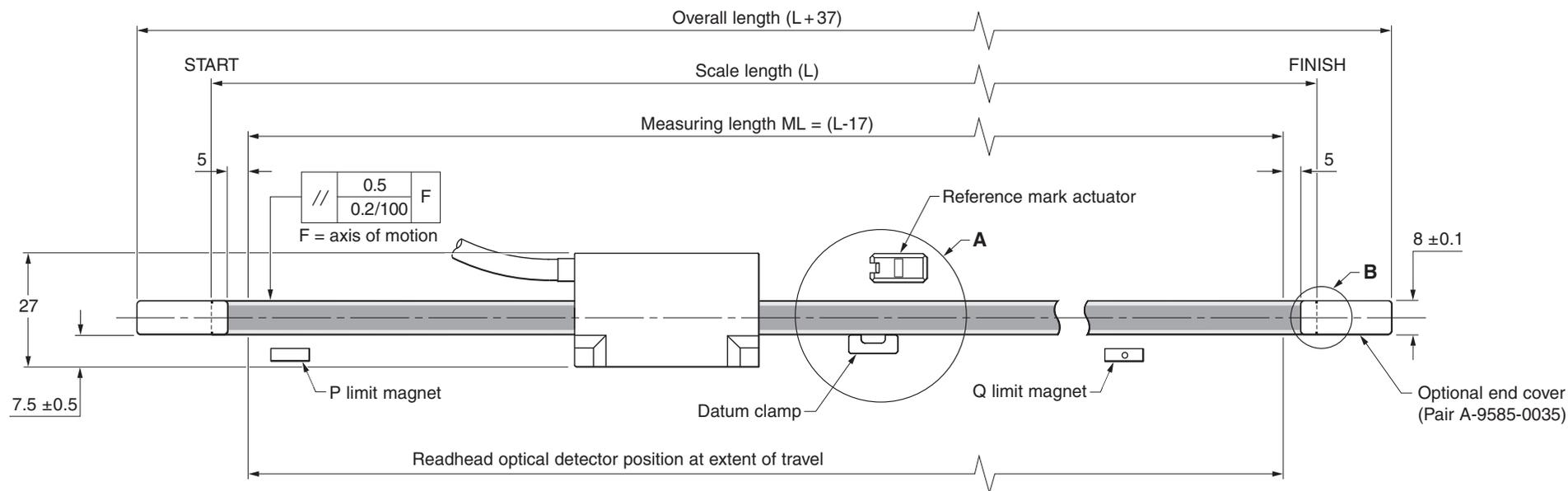
Dimensions and tolerances in mm



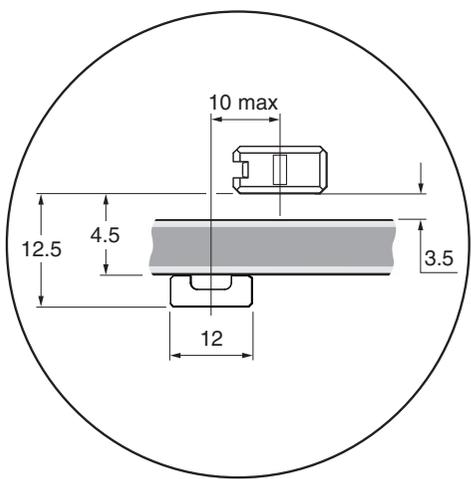
*Extent of mounting faces. †Dimensions from substrate.

RTL40-S installation drawing (adhesive datum clamp)

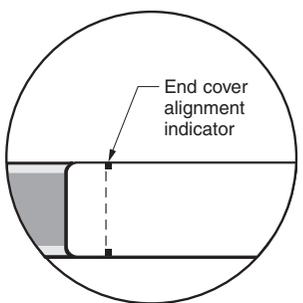
Dimensions and tolerances in mm



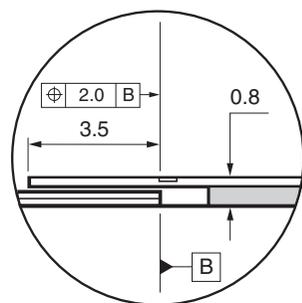
Detail A



Detail B



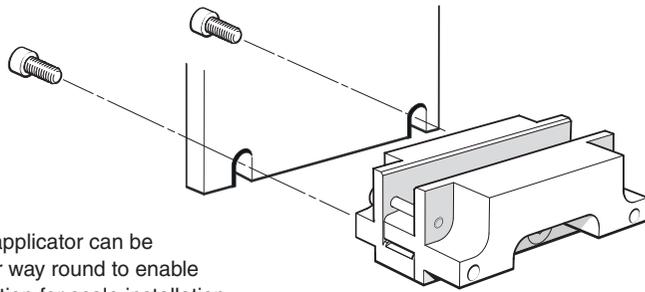
Detail C



Scale application

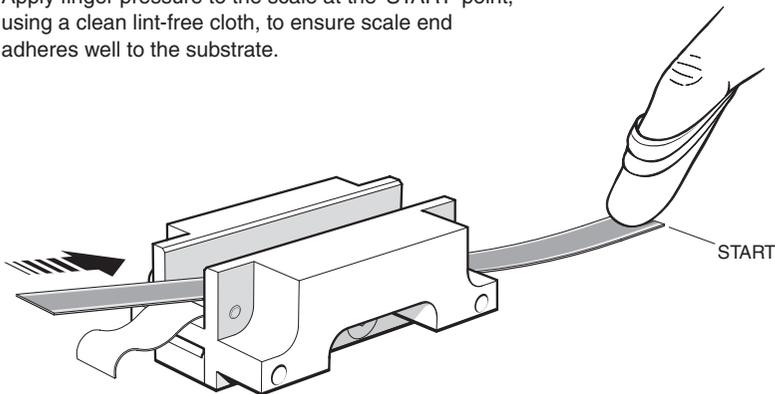
The scale applicator A-9787-0006 is designed specifically for use with RGH45 readheads and RTLR40-S scale.

- 1 Allow scale to acclimatize to installation environment prior to installation.
- 2 Mark out the 'START' and 'FINISH' points for the scale on the axis substrate. Ensure that there is room for the optional end covers if required (see 'RTL40-S installation drawing').
- 3 Thoroughly clean and degrease the substrate using recommended solvents (see 'Storage and handling'). Allow substrate to dry before applying scale.
- 4 Mount the scale applicator to the readhead mounting bracket using M3 screws. Place the shim supplied with the readhead between the applicator and substrate to set the nominal height.

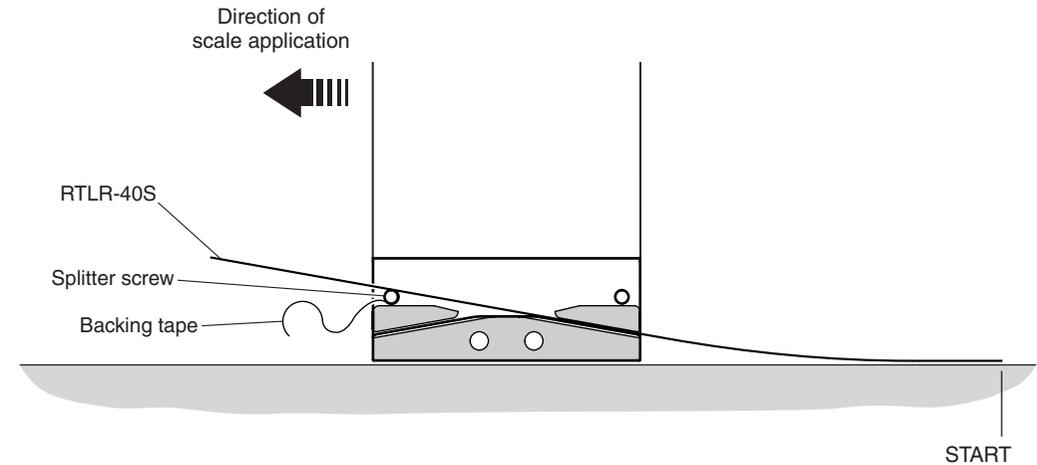


NOTE: Scale applicator can be mounted either way round to enable easiest orientation for scale installation.

- 5 Move axis close to scale start position, leaving enough room for the scale to be inserted through the applicator, as shown below.
- 6 Begin to remove the backing paper from the scale and insert scale into the applicator up to the 'START' point (as shown). Ensure backing tape is routed under the splitter screw.
- 7 Apply finger pressure to the scale at the 'START' point, using a clean lint-free cloth, to ensure scale end adheres well to the substrate.



- 8 Slowly and smoothly move the applicator through the entire axis of travel, ensuring the backing paper is pulled manually from the scale and does not catch under the applicator.



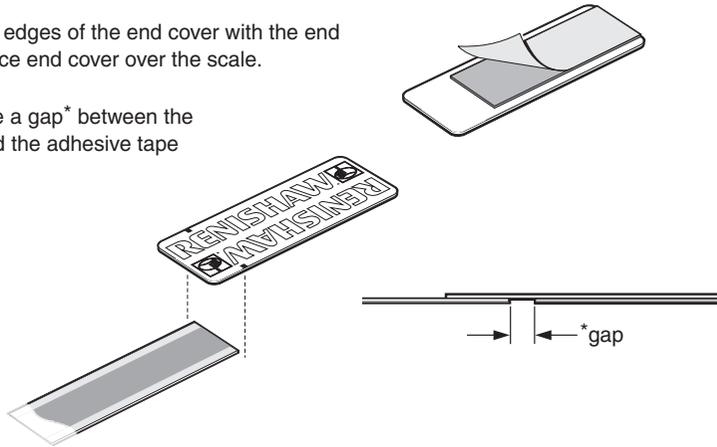
- 9 Remove applicator and, if necessary, adhere the remaining scale manually. Apply firm finger pressure via a clean lint-free cloth along the length of the scale after application to ensure complete adhesion.
- 10 Clean scale using Renishaw scale cleaning wipes (A-9523-4040) or a clean, dry, lint-free cloth.
- 11 Fit end covers.
- 12 Allow 24 hours for complete adhesion of scale before fitting reference mark selector magnet, limits and datum clamps.

End covers

NOTE: End covers are optional and can be fitted before or after readhead installation.

- 1 Remove the backing tape from the adhesive tape on the back of the end cover.
- 2 Align marker on the edges of the end cover with the end of the scale and place end cover over the scale.

NOTE: There will be a gap* between the end of the scale and the adhesive tape on the end cover.

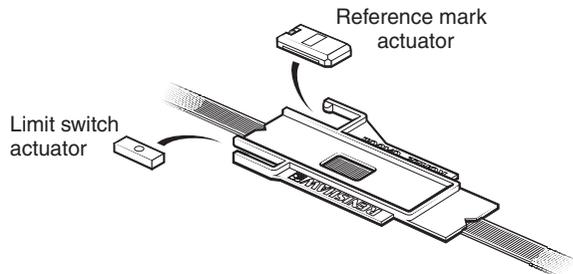


Reference mark and limit switch installation

Mix up a sachet of glue (A-9531-0342) and apply a small amount to the underside of the reference mark and limit switches. Fit the reference mark and limit switches with the aid of the shim (M-9787-0004) as shown.

IMPORTANT: Ensure that the glue does not enter the reference mark adjuster screw.

The reference mark and limit switches can be mounted independently of each other but within the limits specified on the installation drawing.



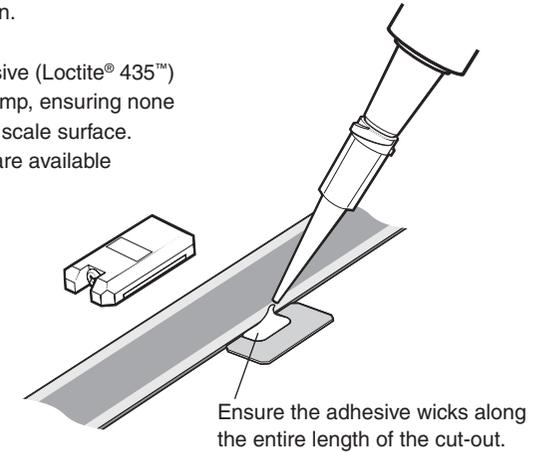
Datum clamp (A-9585-0028)

The datum clamp fixes the RTL40-S scale rigidly to the substrate at the chosen location.

IMPORTANT: The metrology of the system may be compromised if the datum clamp is not used.

The datum clamp does not need to be fitted adjacent to a reference mark. It can be positioned anywhere along the axis depending upon the customers' requirements.

- 1 Place the datum clamp with cut-out against the scale at the chosen location.
- 2 Place a small amount of adhesive (Loctite® 435™) in the cut-out on the datum clamp, ensuring none of the adhesive wicks onto the scale surface. Dispensing tips P-TL50-0209 are available



Readhead mounting and alignment

Mounting brackets

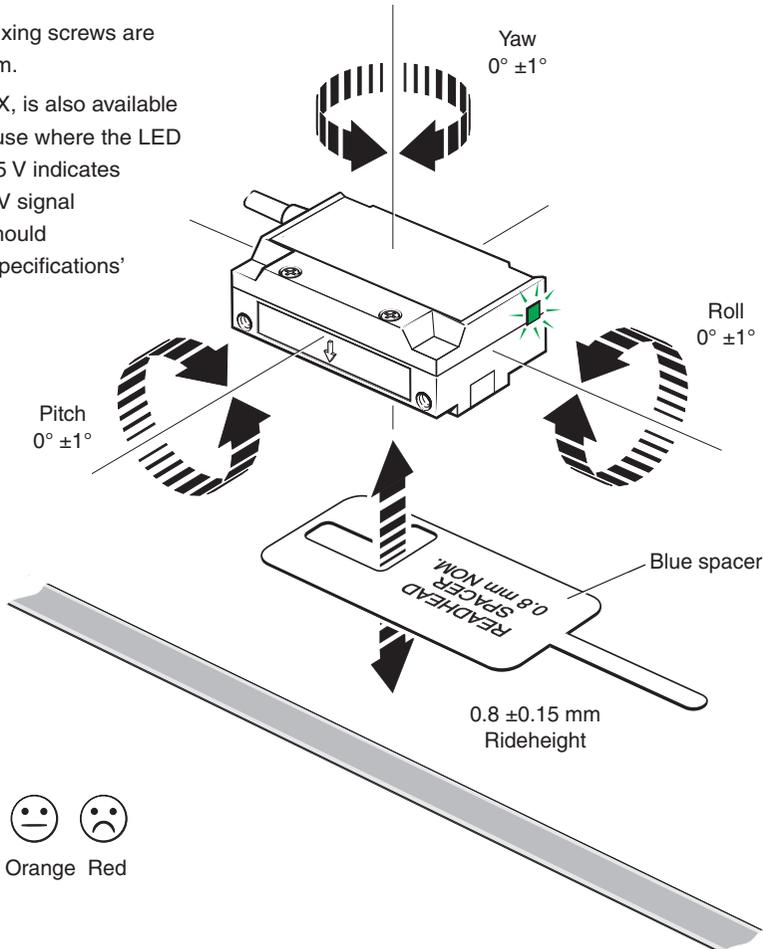
The bracket must have a flat mounting surface, ensure conformance to the installation tolerances, allow adjustment to the rideheight of the readhead, and be sufficiently stiff to prevent deflection of the readhead during operation. For easier installation, the bracket should be adjusted for roll and yaw with respect to the axis of readhead travel before the scale is applied using the appropriate applicator. This can be done with a clock gauge and a precision square.

Readhead set-up

Ensure that the scale, readhead window and mounting face are clean and free from obstructions. To set nominal rideheight, the blue readhead spacer should be positioned with the aperture under the optical centre to allow normal LED function during set-up procedure. The scale, readhead optical window and mounting face should be clean and free from obstructions. When correctly installed, the set-up LED should be Green. The readhead should be moved slowly to ensure the set-up LED remains Green along the full axis of travel.

NOTE: Ensure readhead fixing screws are tightened to 0.5 Nm-0.7 Nm.

An external set-up signal, X, is also available on RGH45 readheads for use where the LED is not visible. In this case, 5 V indicates optimum set-up, while a 0 V signal indicates that the set-up should be adjusted. See 'Output specifications' for further details.



Reference mark set-up

To ensure unidirectional repeatability, the reference mark requires phasing with the scale in the direction of normal datuming operation.

A reference pulse is output in both directions, but repeatability is guaranteed only in the phased direction.

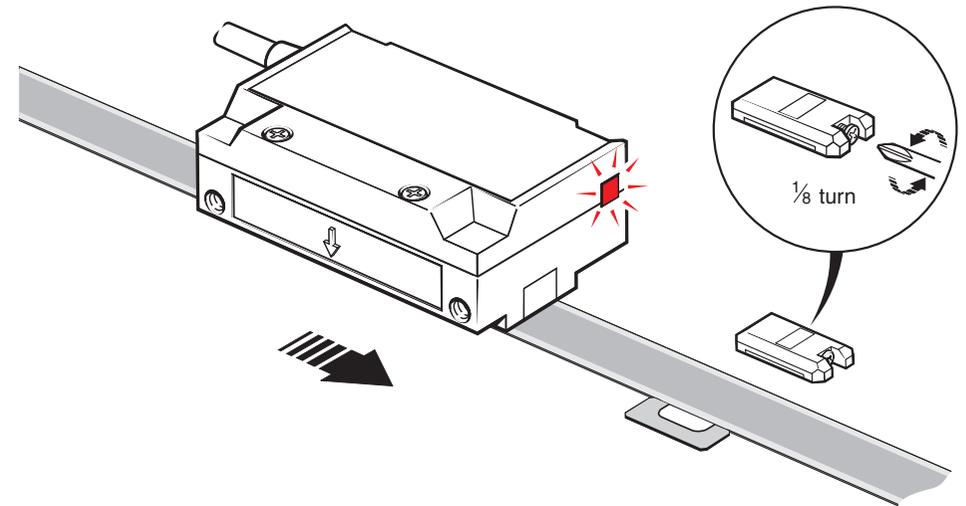
The readhead should be set up correctly ensuring a Green LED indication over the full length of travel. The reference mark actuator should be installed as shown on the installation drawing.

NOTE: It is recommended that a datum procedure is performed as part of any power-up sequence to ensure the correct datum position is recorded.

NOTE: Reference mark output is synchronised with the incremental channels, giving unit of resolution pulse width. For further details see 'General specifications'.

Phasing procedure

The readhead must be moved over the reference mark in the direction to be used for the datuming operation. The reference mark is phased correctly when the set-up LED flashes Red for 0.25 seconds. If it flashes Orange or goes blank, the reference mark adjuster screw should be turned anti-clockwise by $\frac{1}{8}$ turn and the procedure repeated until a Red flash is obtained.



LED flash during reference mark traverse only

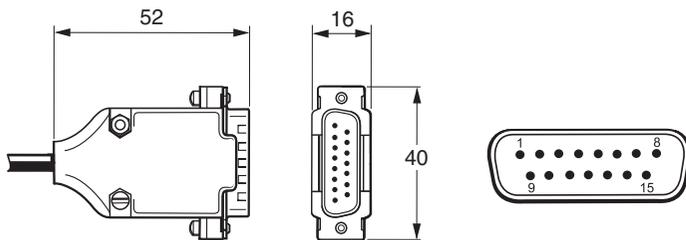


Output signals

RGH45A 1Vpp analogue

Function	Signal		Colour	15 pin D-type (L)
Power	5 V		Brown	4
			Brown (link)	5
	0 V		White	12
			White (link)	13
Incremental signals	V ₁	+	Red	9
		-	Blue	1
	V ₂	+	Yellow	10
		-	Green	2
Reference mark	V ₀	+	Violet	3
		-	Grey	11
Reference mark uni-directional operation*	BID		Black	6
	DIR		Orange	14
Limit switch	V _p		Clear	7
	V _q		Pink	8
Shield	Inner		Green/Yellow	15
	Outer		-	Case

15 pin D-type plug (termination code L)



*Reference mark uni-directional operation

The RGH45 reference mark output is repeatable for one direction of travel only.

Certain controllers will flag an error when they see different reference mark positions in the forward and reverse directions.

BID/DIR pins allow the readhead to be configured to ignore the reference pulse output in the unphased direction (see section 'Reference mark set-up').

BID/DIR connections

BID/DIR connection	To:-	Reference mark output direction
For bi-directional operation (normal)		
BID	+5 V or not connected	Forward and reverse
DIR	Do not connect	
For uni-directional operation		
BID	0 V	
DIR	+5 V or not connected	Forward only
DIR	0 V	Reverse only

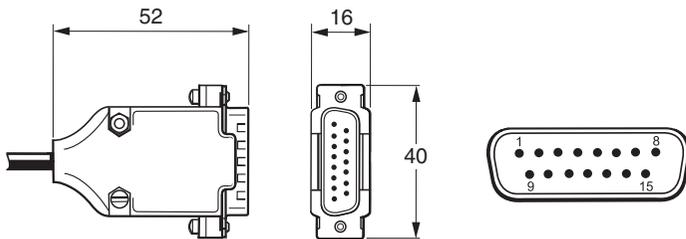
Output signals (continued)

RGH45T, D, G, X, N, W, Y RS422A digital

Function	Signal	Colour	15 pin D-type (D)	
Power	5 V	Brown	7	
		Brown (link)	8	
	0 V	White	2	
		White (link)	9	
Incremental signals	A	+	Green	14
		-	Yellow	6
	B	+	Blue	13
		-	Red	5
Reference mark	Z	+	Violet	12
		-	Grey	4
Limit switch	P	Black	11	
	Q	Pink	10	
Alarm*	E-	Orange	3	
External set-up	X	Clear	1	
Shield	Inner	Green/Yellow	15	
	Outer	-	Case	

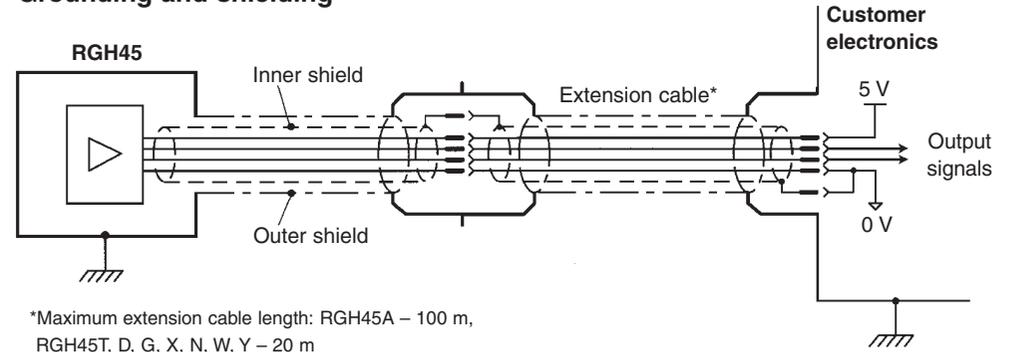
* NOTE: Alarm channel E- (option 05) line driver or 3-state (option 06)

15 pin D-type plug (termination code D)



Electrical connections

Grounding and shielding

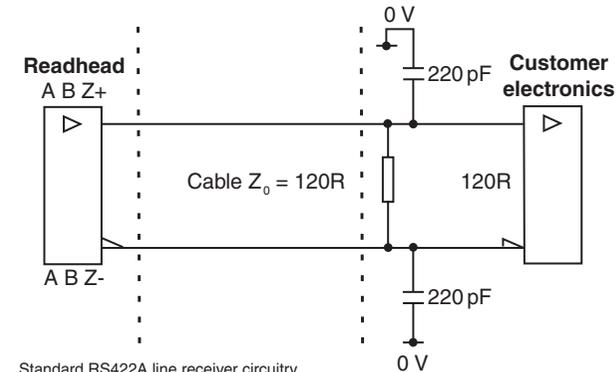


*Maximum extension cable length: RGH45A – 100 m,
RGH45T, D, G, X, N, W, Y – 20 m

IMPORTANT: The outer shield should be connected to the machine earth (Field Ground). The inner shield should be connected to 0 V at receiving electronics only. Care should be taken to ensure that the inner and outer shields are insulated from each other. If the inner and outer shields are connected together, this will cause a short between 0 V and earth, which could cause electrical noise issues.

Recommended signal termination

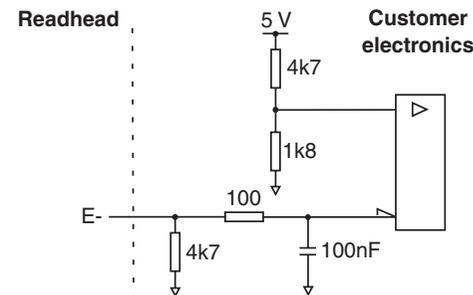
Digital outputs - RGH45T, D, G, X, N, W, Y



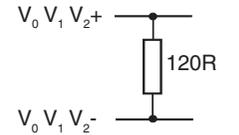
Standard RS422A line receiver circuitry
Capacitors recommended for improved noise immunity

Single ended alarm signal termination

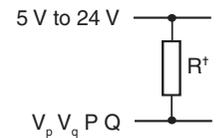
(option 05)



Analogue output - RGH45A



Limit output



*Select R so that the maximum current does not exceed 20 mA.
Alternatively, use a relay or opto-isolator.

General specifications

Readhead

Power supply	5 V ±5%	RGH45A <160 mA RGH45T, D, G, X <125 mA RGH45N, W, Y, H <160 mA
	Ripple	200 mVpp maximum@ frequency up to 500 kHz
		NOTE: Current consumption figures refer to unterminated readheads. For digital outputs, a further 25 mA per channel pair (eg A+, A-) will be drawn when terminated with 120 Ω. For analogue outputs, a further 20 mA in total will be drawn when terminated with 120 Ω. Power from a 5 V dc supply complying with the requirements for SELV of standard IEC BS EN 60950-1.
Sealing		IP50
Acceleration	Non-operating	500 m/s ² , 3 axes
Shock	Operating	500 m/s ² , 11 ms, ½ sine, 3 axes
Vibration	Operating	100 m/s ² max@55 Hz to 2000 Hz, 3 axes
Mass		Readhead 50 g Cable 38 g/m
Cable		12 core, double-shielded, outside diameter 4.5 ±0.2 mm Flex life >20 x 10 ⁶ cycles at 50 mm bend radius

The RGH45 series readheads have been designed to the relevant EMC standards, but must be correctly integrated to achieve EMC compliance. In particular, attention to shielding and earthing arrangements is essential.

RTL40-S scale technical specifications

Form	0.4 mm x 8 mm (H x W) including adhesive
Datum fixing	Loctite 435
Material	Hardened and tempered martensitic stainless steel fitted with a self-adhesive backing tape
Accuracy (at 20 °C)	±15 µm/m, calibration traceable to International Standards
Thermal expansion (at 20 °C)	10.1 ±0.2 µm/m/°C
Maximum length	20 m
Installation temperature	15 °C to 35 °C
Reference mark	Magnetic actuator Output synchronised with incremental channels Repeatability of position (uni-directional) maintained within these conditions: Temperature ±10 °C from installation temperature, speeds <0.5 m/s, magnetic field steady ±0.02 T or changing ±7.5 T/s
Limit switches	Magnetic actuator at user selected locations Repeatability 0.1 mm

Speed performance

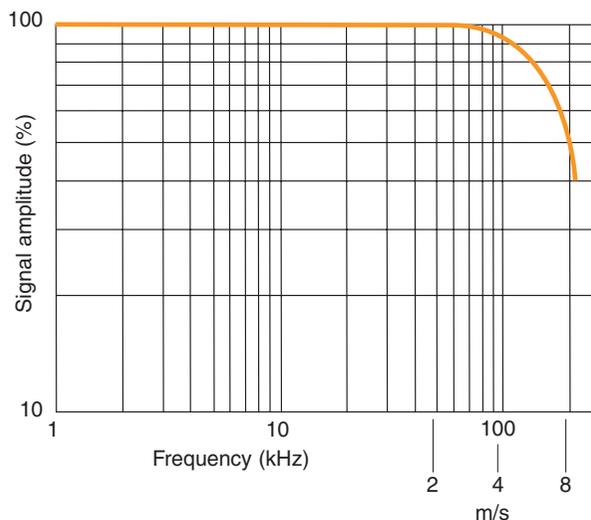
Clocked output readheads

The RGH45N, W, Y readheads are available with a variety of different clocked outputs. The clocked options have been designed to prevent fine edge separations being missed by receiving electronics utilising slower clock speeds.

Depending on the clock frequency chosen, each option has a different maximum speed and associated minimum receiver clock frequency.

Digital readheads				
Head type	Maximum speed (m/s)			Minimum receiver clock frequency (MHz)
T D G X	10			$\left(\frac{\text{Encoder velocity (m/s)}}{\text{Resolution (}\mu\text{m)}} \right) \times 4$ safety factor
N, W, Y option	N	W	Y	
61	3.0	2.5	1.3	20
62	2.6	1.3	0.7	10
63	1.3	0.7	0.35	5

Analogue type RGH45A

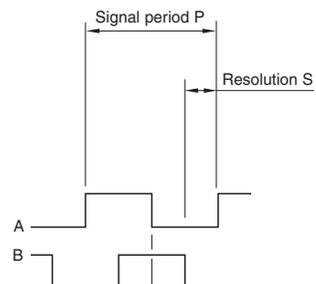


Output specifications

Digital output signals - RGH45T, D, G, X, N, W, Y

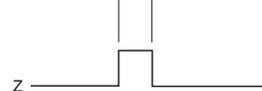
Form - Square wave differential line driver to EIA RS422A (except limit switch P, Q, Alarm E- and external set-up signal, X)

Incremental[†] 2 channels A and B in quadrature (90° phase shifted)



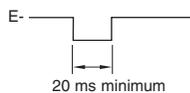
Model	P (μm)	S (μm)
RGH45T	40	10
RGH45D	20	5
RGH45G	8	2
RGH45X	4	1
RGH45N	1.6	0.4
RGH45W	0.8	0.2
RGH45Y	0.4	0.1

Reference[†]



Synchronised pulse Z, duration as resolution S. Repeatability of position (uni-directional) maintained within ±20 °C from temperature at time of phasing and for speeds <0.5 m/s. For RGH45N, W, Y only Z pulse re-synchronised at power-up with any one of the quadrature states (00, 01, 11, 10).

Alarm single ended line driver output

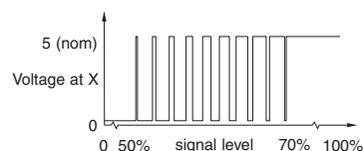


For RGH45T, G, X alarm asserted for signal amplitude <15%. Either asynchronous pulse E- as shown (option 05) or line driver channels 3-state (option 06)

For RGH45N, W, Y - alarm E- asserted when:
 - Signal amplitude >150%
 - Readhead exceeds specified maximum speed

Also, outputs are 3-stated at signal amplitude <15%

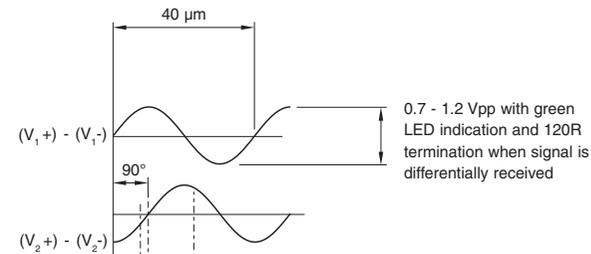
Set-up



Between 50% and 70% signal level X is a duty cycle. Time spent at 5 V increases with signal level. At >70% signal level X is nominal 5V.

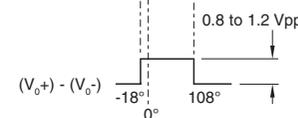
Analogue output signals - RGH45A

Incremental 2 channels V_1 and V_2 differential sinusoids in quadrature (90° phase shifted)



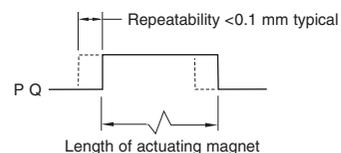
0.7 - 1.2 Vpp with green LED indication and 120R termination when signal is differentially received

Reference



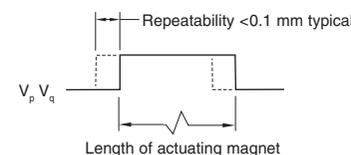
Differential pulse V_0 -18° to 108°. Duration 126° (electrical). Repeatability of position (uni-directional) maintained within ±20 °C from temperature at time of phasing and for speeds <0.5 m/s

Limit open collector output, asynchronous pulse



[†]Inverse signal not shown for clarity

Limit open collector output, asynchronous pulse



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Gloucestershire GL12 8JR
United Kingdom

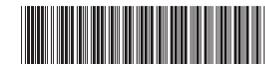
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