Installation guide
M-9537-9016-01-D

RENISHAW
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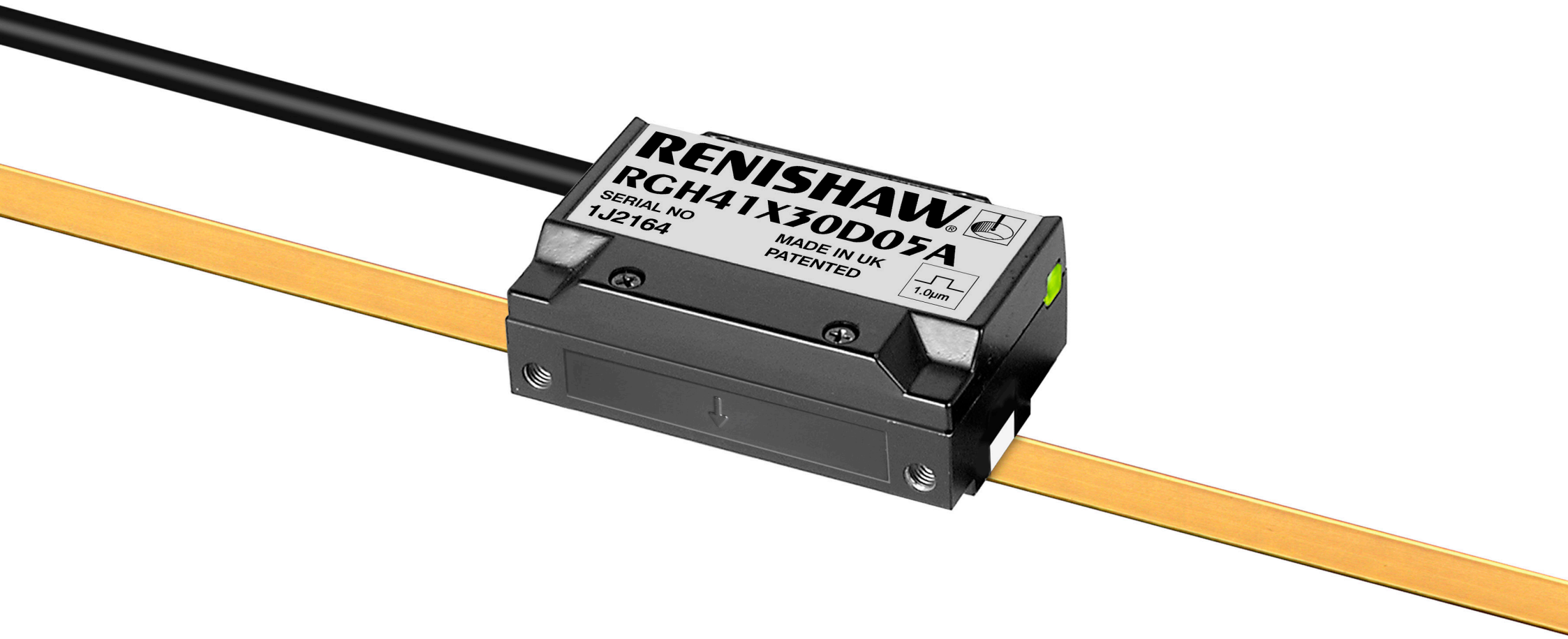
RGH41 RGS40 linear encoder system



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Product compliance

CE

Renishaw plc declares that RGH41 complies with the applicable standards and regulations. A copy of the EU Declaration of Conformity is available from our website at www.renishaw.com/productcompliance

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.

Patents

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

EP 1147377 JP 4571768 US 6588333

Further information

Further information relating to the RGH41 encoder range can be found in the *RGH41 encoder system* Data sheet (Renishaw part no. L-9517-9713). This can be downloaded from our website at www.renishaw.com/opticalencoders 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.

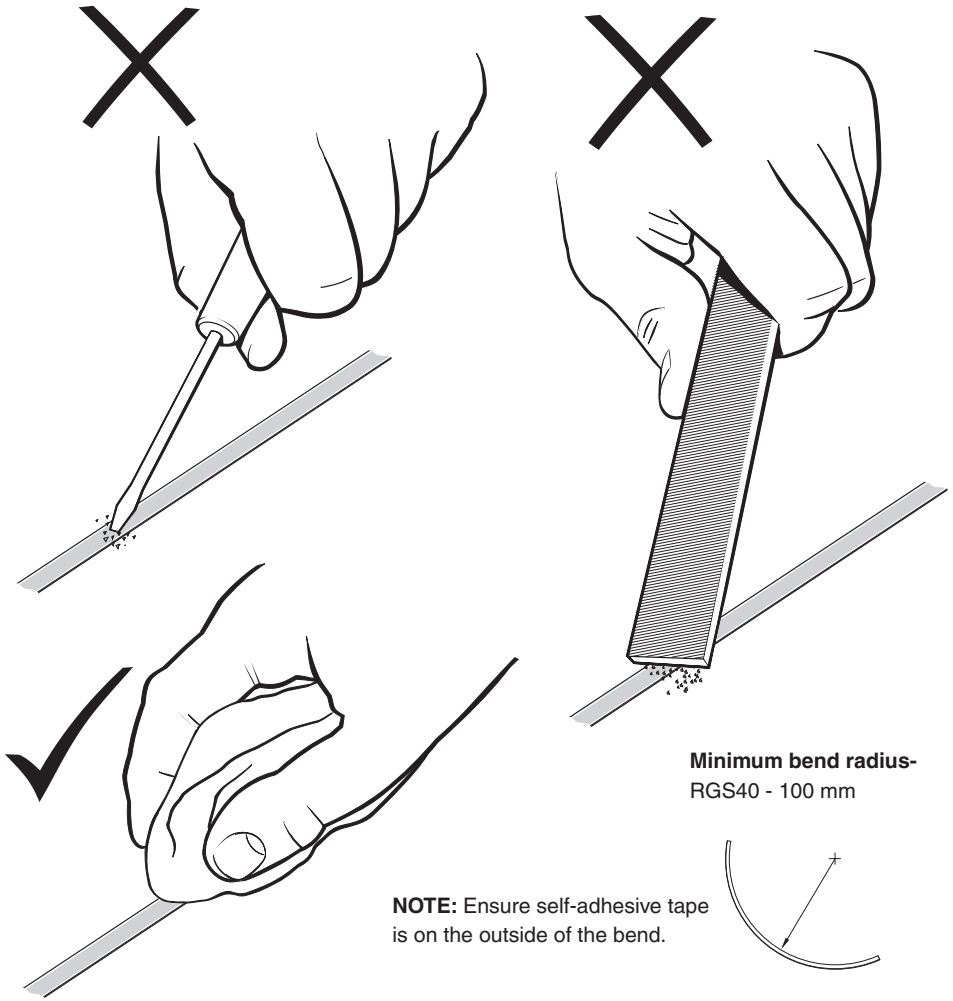
Packaging Component	Material	ISO 11469	Recycling Guidance
Outer box	Cardboard	Not applicable	Recyclable
	Polypropylene	PP	Recyclable
Inserts	Low Density Polyethylene Foam	LDPE	Recyclable
	Cardboard	Not applicable	Recyclable
Bags	High Density Polyethylene Bag	HDPE	Recyclable
	Metalised Polyethylene	PE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

REACH regulation

Information required by Article 33(1) of Regulation (EC) No. 1907/2006 ("REACH") relating to products containing substances of very high concern (SVHCs) is available at: www.renishaw.com/REACH

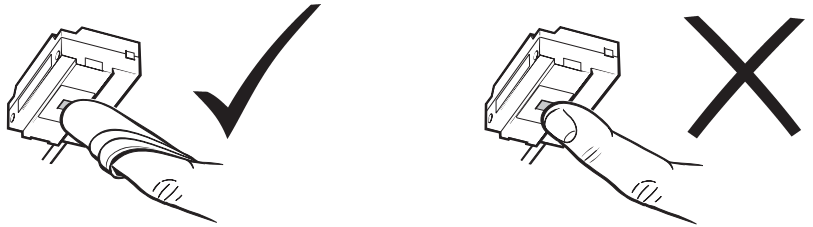
The use of this symbol on Renishaw products and/or accompanying documentation indicates that the product should not be mixed with general household waste upon disposal. It is the responsibility of the end user to dispose of this product at a designated collection point for waste electrical and electronic 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.

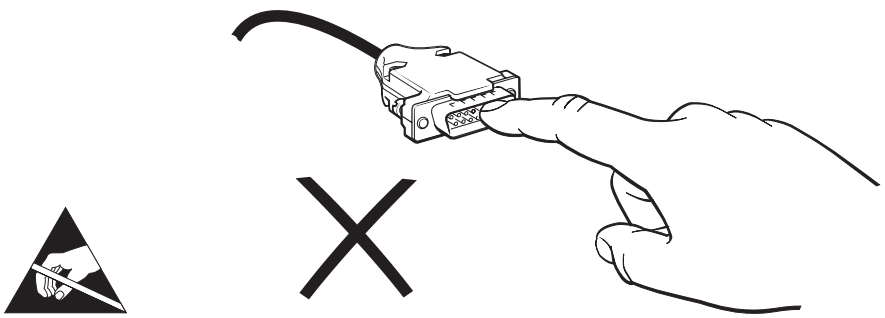
Storage and handling

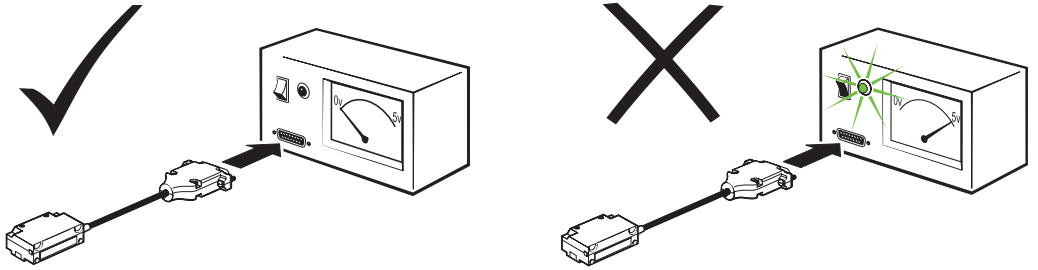


Minimum bend radius-
RGS40 - 100 mm

NOTE: Ensure self-adhesive tape is on the outside of the bend.

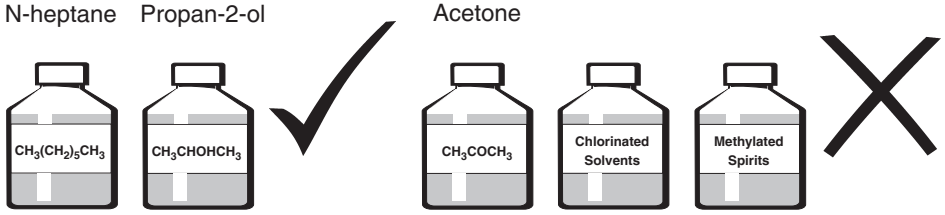






N-heptane Propan-2-ol

Acetone

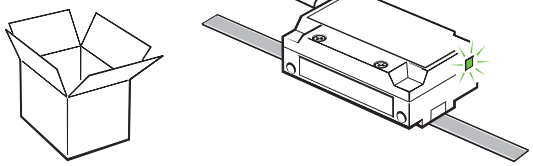


Storage

System
+70 °C
–20 °C

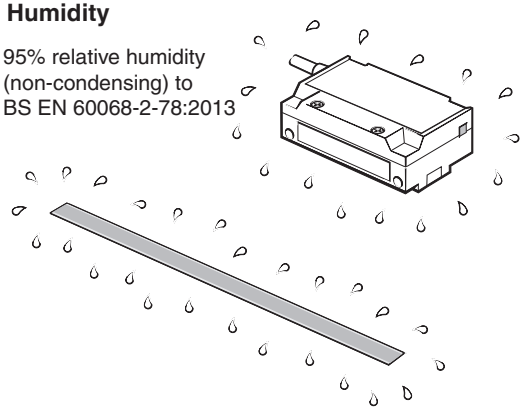
Operating

System
+55 °C
0 °C



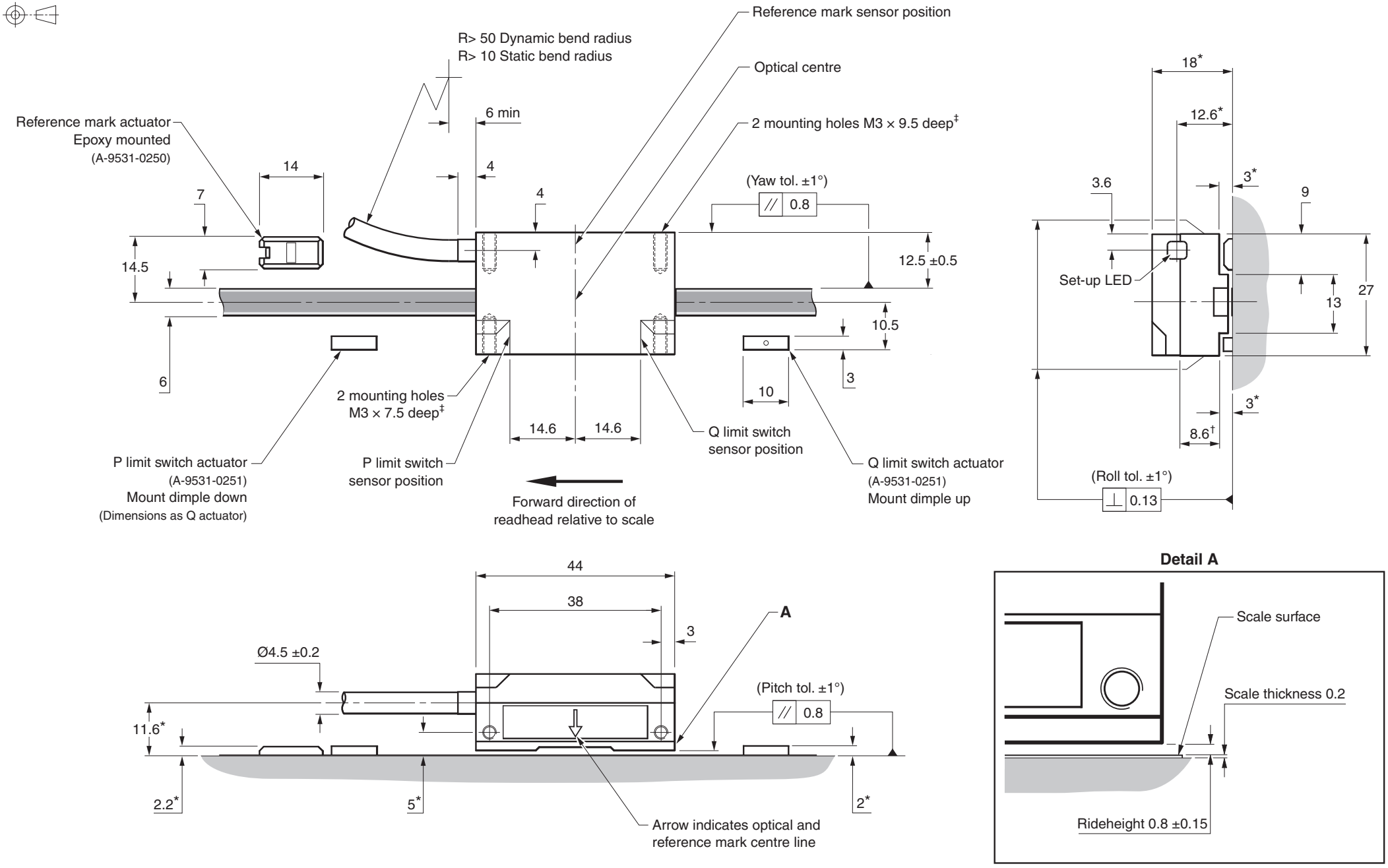
Humidity

95% relative humidity
(non-condensing) to
BS EN 60068-2-78:2013



RGH41 readhead installation drawing

Dimensions and tolerances in mm



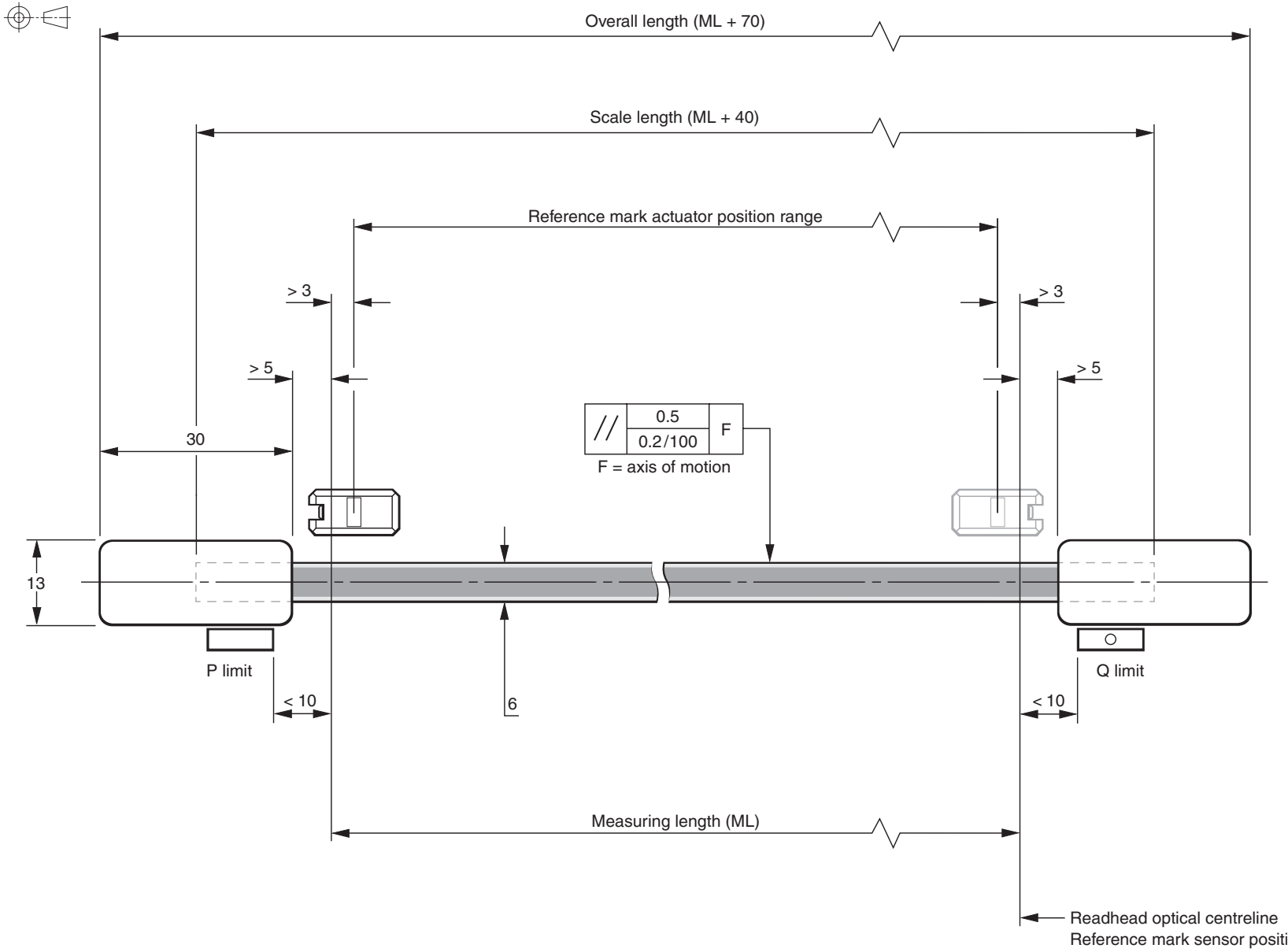
Detail A

*Dimension measured from substrate †Extent of mounting faces

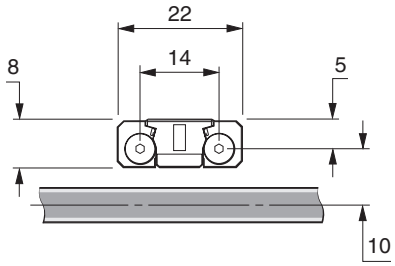
‡The recommended thread engagement is 5 mm. The recommended tightening torque is between 0.5 and 0.7 Nm.

RGS40 scale installation drawing

Dimensions and tolerances in mm



Optional bolted reference mark actuator (A-9531-0287)



NOTE: The surface roughness of the scale mounting surface must be ≤ 3.2 Ra.
The parallelism of the scale surface to the axis of motion (readhead rideheight variation) must be within 0.05 mm.

Scale application

RGA22 - scale applicator (recommended for longer axes)

The RGA22 scale applicator kit (A-9531-0265) is designed specifically for installing RGS40-S scale for use with the RGH41 readhead.

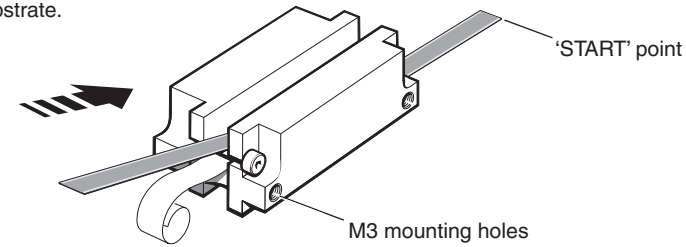
For instructions on how to use the RGA22 please refer to 'RGA22 scale applicator User's guide' (M-9531-0297).

RGA22G - scale applicator (recommended for shorter axes or where space is limited)

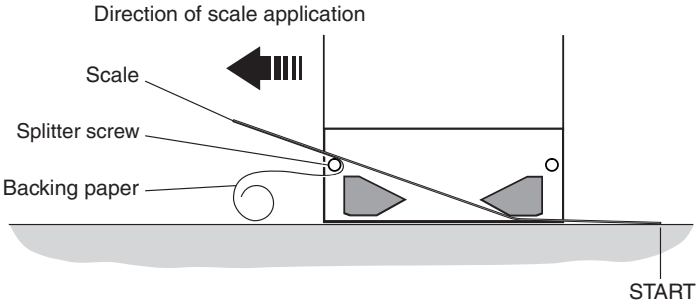
The RGA22G scale applicator (A-9531-0239) is designed specifically for installing RGS40-S scale for use with the RGH41 readhead.

1. Allow scale to acclimatize to installation environment prior to installation.
2. Mark out 'START' and 'FINISH' points for the scale on the axis substrate. Ensure that there is room for the end clamps (see 'RGS40 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 clamps (see 'End clamps' section).
12. Allow 24 hours for complete adhesion of scale before fitting reference mark and limit magnets.

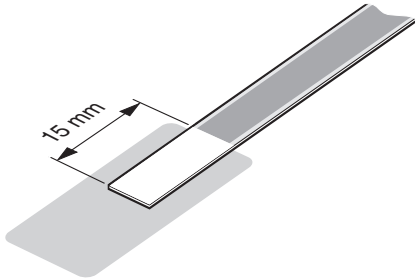
End clamps

A-9523-4015 is an end clamp kit designed to be used with RGS40 scale.

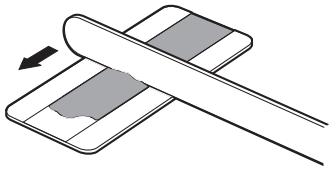
IMPORTANT: End clamps should be used to ensure positional stability of the scale and reference mark repeability.

NOTE: End clamps can be mounted before or after readhead installation.

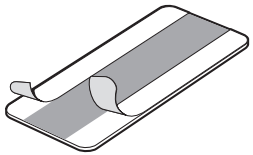
1. Remove the lacquer coating from the last 15 mm of each end of the scale with a knife and clean with one of the recommended solvents (see 'Storage and handling').



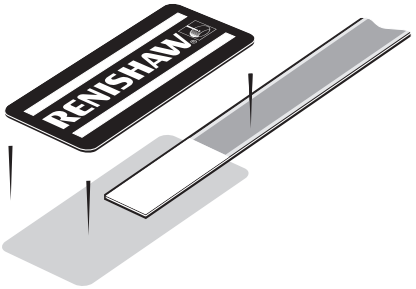
2. Mix up a sachet of glue (A-9531-0342) and apply a small amount to the underside of the end clamp.



3. The end clamp features a small region of contact adhesive. This will temporarily hold the end clamp in position while the glue cures. Remove the backing tape from either side.

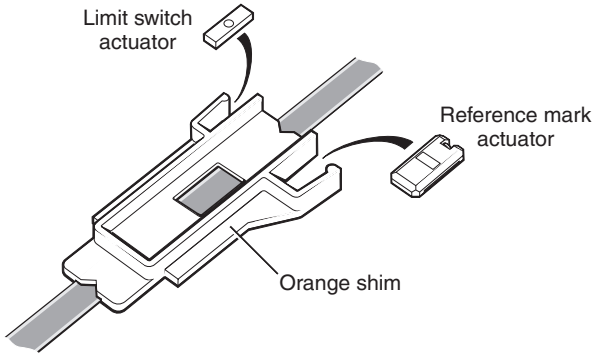


4. Immediately position end clamp over the end of the scale. Allow 24 hours at 20 °C for full cure.



Ensure that excess glue is wiped away from scale as it may affect the readhead signal level.

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. Position with the aid of the Orange shim as shown. Reference mark and limit switch actuators can be mounted independently from each other, but within the limits specified by the relevant installation drawing.

Ensure that the glue does not enter the reference mark actuator adjustment mechanism.

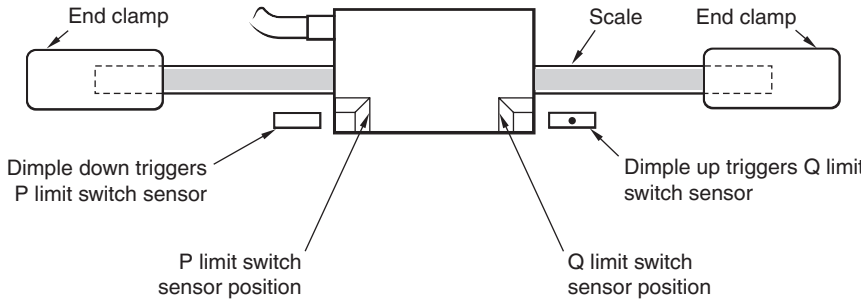
Once the reference mark has been secured it must be phased with the readhead. See 'Reference mark set-up' for details

Single limit switches

For single limit switch detection, limit switch actuator should be mounted with the dimple up.

Dual limit switches

Some versions of the RGH41 (options 05 and 06) are configured to detect dual limit switch actuators.



If in doubt, refer to the *RGH41 encoder system* Data sheet (Renishaw part no. L-9517-9713) to see if single or dual limit switch capability has been specified on the readhead you have purchased.

Readhead mounting and alignment

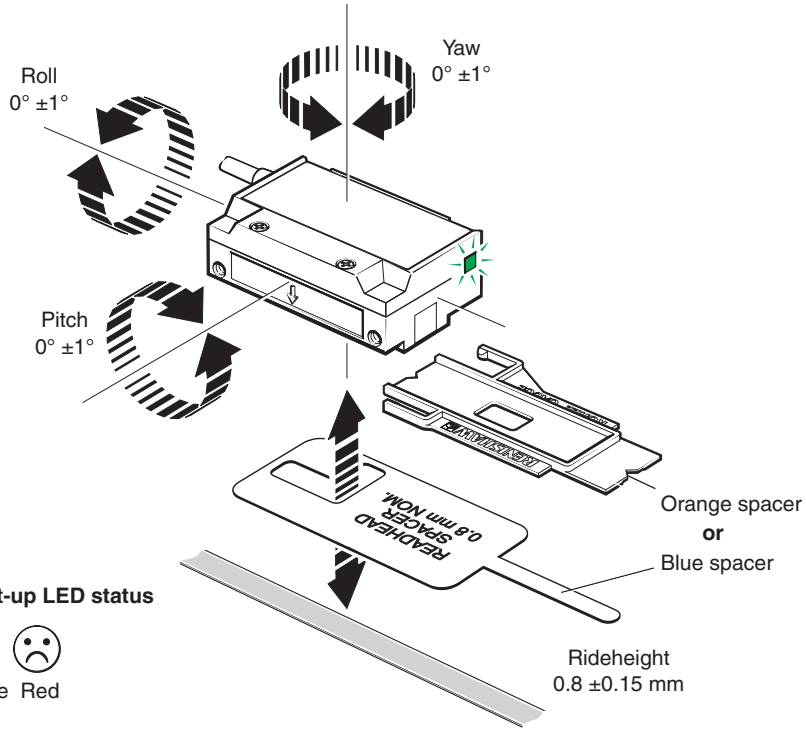
Mounting brackets

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 precision square.

Readhead set-up

Ensure that the scale, readhead optical window and mounting face are clean and free from obstructions. To set nominal rideheight place either the Blue or Orange readhead spacer should be positioned with the aperture under the optical centre of the readhead to allow normal LED function during set-up procedure. The Orange spacer also helps to position readhead with respect to offset and yaw relative to the scale. Adjust the readhead to maximise the signal strength along the full axis travel to achieve a Green set-up LED. An external set-up signal (X or V_x) is also available on RGH41 readheads for use where the LED is not visible. See 'Output specifications' for details.

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



Readhead set-up LED status

Green Orange Red

Reference mark set-up

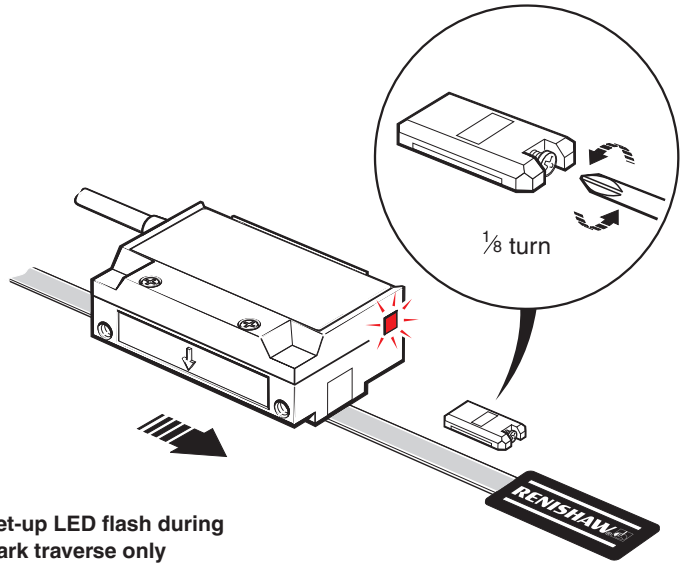
To ensure uni-directional repeatability, the reference mark requires phasing with the scale in the direction of normal datuming operation. A reference pulse is output in both directions, but repeatability is guaranteed only in the phased direction.
The readhead should be set up correctly ensuring a Green 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

Move the readhead 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.



Readhead set-up LED flash during reference mark traverse only

Red Orange Blank

Limit switch

Limit switch detection is entirely independent of other readhead functions - the signal is only output when the readhead is positioned over the limit switch actuator.

Output signals

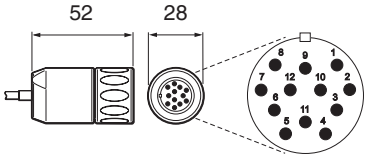
RGH41A, B 1 Vpp analogue

Function	Signal		Colour	15-way D-type plug (L)	12-way circular (V)	12-way circular coupling (W)	16-way in-line connector (X)
Power	5 V		Brown	4	2	2	A
			Brown (link)	5	12	12	M
	0 V		White	12	10	10	B
			White (link)	13	11	11	N
Incremental signals	V_1	+	Red	9	5	5	F
		–	Blue	1	6	6	R
	V_2	+	Yellow	10	8	8	D
		–	Green	2	1	1	G
Reference mark	V_0	+	Violet	3	3	3	K
		–	Grey	11	4	4	O
Limit switch	V_q		Pink	8	N/C	N/C	H
Dual limit / external set-up*	V_p / V_x		Clear	7	N/C	N/C	E
Reference mark uni-directional operation‡	BID		Black	6	9†	9††	I
	DIR		Orange	14	7†	7††	P
Shield	Inner		Green / Yellow	15	11 (link)	11 (link)	L
	Outer		–	Case	Case	Case	Case

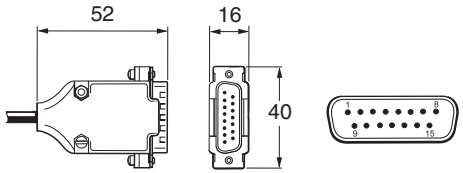
*Dual limit versions (RGH41A) utilise the clear wire for limit switch function 'V_p'. Single limit versions (RGH41B) utilise the clear wire for external set-up function 'V_x'. Please select the preferred readhead version at time of ordering.

†Only connected with option 17 ††Only connected with option 18

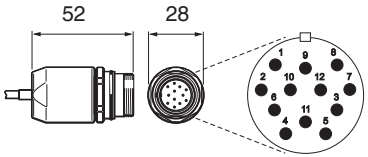
12-way circular plug (termination code V)



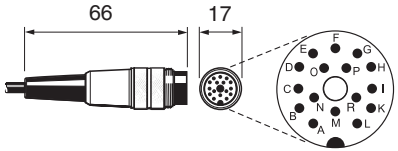
15-way D-type plug (termination code L)



12-way circular coupling (termination code W)



16-way in-line connector plug (termination code X)



‡Reference mark uni-directional operation

The RGH41 reference mark output is repeatable for one direction of travel only.

Certain controllers will flag an error when they detect 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 one direction (see section 'Reference mark set-up').

BID / DIR connections

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

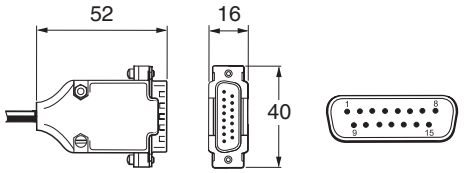
BID / DIR connection For uni-directional operation	To:-	Reference mark output direction
BID	0 V	
DIR	+5 V or not connected	Forward **only**
DIR	0 V	Reverse **only**

Output signals (continued)

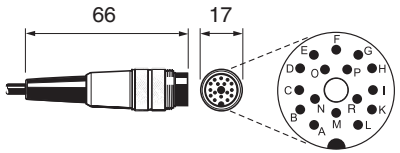
RGH41 T, D, G, X, N, W, Y, H RS422A digital

Function	Signal		Colour	15-way D-type plug (D)	16-way in-line connector (X)
Power	5 V		Brown	7	A
			Brown (link)	8	M
	0 V		White	2	B
			White (link)	9	N
Incremental signals	A	+	Green	14	G
		–	Yellow	6	D
	B	+	Blue	13	R
		–	Red	5	F
Reference mark	Z	+	Violet	12	K
		–	Grey	4	O
Limit switch	Q		Pink	10	H
Alarm / limit*	E+/P		Black	11	I
Alarm	E–		Orange	3	P
External set-up	X		Clear	1	E
Shield	Inner		Green / Yellow	15	L
	Outer		–	Case	Case

*Options 05/06 (dual limit) utilise the black wire for limit switch function 'P'
Options 03/04 (single limit) utilise the black wire for alarm function 'E+'



15-way D-type plug (termination code D)



16-way in-line connector plug (termination code X)

Speed

Digital readheads

Non-clocked output readheads

Head type	Maximum speed (m/s)	Lowest recommended counter input frequency (MHz)
T (10 µm)	15	$\left(\frac{\text{Encoder velocity (m/s)}}{\text{Resolution (µm)}}\right)$ × 4 safety factor
D (5 µm)	12	
G (2 µm)	10	
X (1 µm)	6	

Clocked output readheads

The RGH41N, W, Y, H readheads are available with a variety of different clocked outputs. Customers must ensure they comply with the lowest recommended counter input frequency.

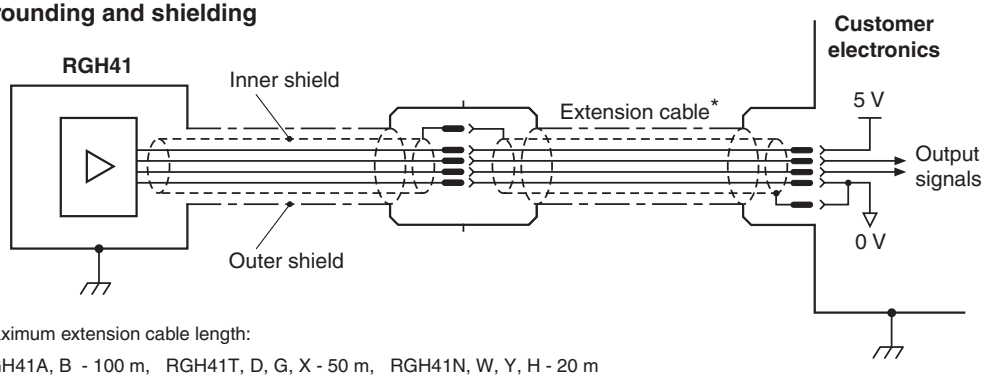
Options	Maximum speed (m/s)				Lowest recommended counter input frequency (MHz)
	Head type				
	N (0.4 µm)	**W** (0.2 µm)	**Y** (0.1 µm)	**H** (50 nm)	
61	3	2.5	1.3	0.6	20
62	2.6	1.3	0.7	0.3	10
63	1.3	0.7	0.35	0.15	5

Analogue readheads

RGH41A and B - 8 m/s (–3dB)

Electrical connections

Grounding and shielding



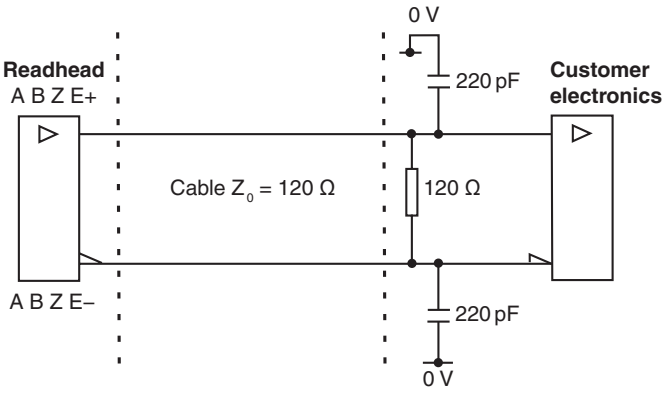
*Maximum extension cable length:

RGH41A, B - 100 m, RGH41T, D, G, X - 50 m, RGH41N, W, Y, H - 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 should 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 terminations

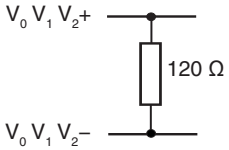
Digital output - RGH41 T, D, G, X, N, W, Y, H



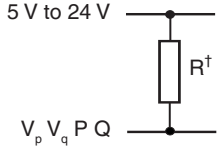
Standard RS422A line receiver circuitry.

Capacitors recommended for improved noise immunity.

Analogue output - RGH41 A, B



Limit termination

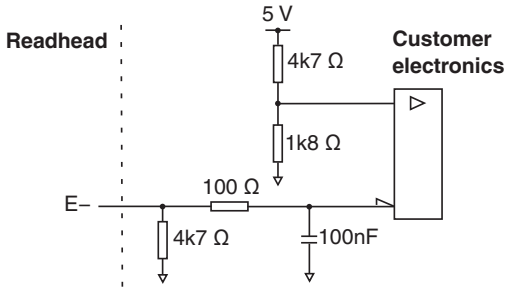


†Select R so that the maximum current does not exceed 20 mA.

Alternatively, use a relay or opto-isolator.

Single ended alarm signal termination

(option 05/06)

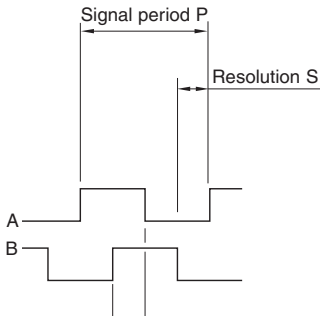


Output specifications

Digital output signals - RGH41T, D, G, X, N, W, Y, H

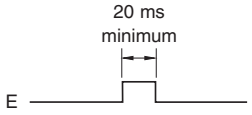
Form - Square wave differential line driver to EIA RS422A (except limit switches P, Q and external set-up signal X)

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



Model	P (µm)	S (µm)
RGH41T	40	10
RGH41D	20	5
RGH41G	8	2
RGH41X	4	1
RGH41N	1.6	0.4
RGH41W	0.8	0.2
RGH41Y	0.4	0.1
RGH41H	0.2	0.05

Alarm† single limit readheads - differential line driven output
dual limit readheads - single ended line driven output



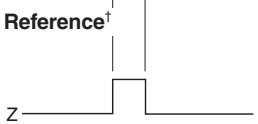
E– only on dual limit readheads (option 05/06)

For RGH41T, G, X alarm asserted for signal amplitude < 15%. Either asynchronous pulse E as shown (options 03/05) or line driver channels 3-state (options 04/06).

For RGH41N, W, Y, H - alarm asserted when:
- Signal amplitude > 150%
- Readhead exceeds specified maximum speed

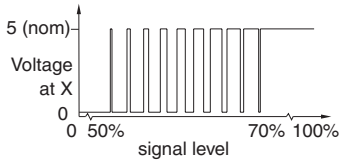
Also, outputs are 3-stated at signal amplitude < 15%

Reference†



Synchronised pulse Z, duration as resolution S. Repeatability of position (uni-directional) maintained within ±20 °C from installation temperature and for speed < 0.5 m/s.
For RGH41W, Y, H only Z pulse re-synchronised at power-up with any one of the quadrature states (00, 01, 11, 10).

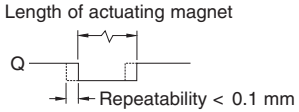
Set-up



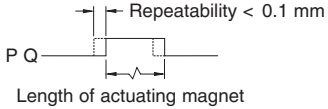
Between 50% and 70% signal level, X is a duty cycle.
Time spent at 5 V increases with signal level.
At > 70% signal level X is nominal 5 V.

Limit open collector output, asynchronous pulse

Single limit (option 03/04)



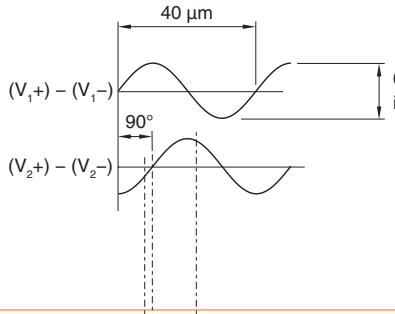
Dual limit (option 05/06)



†Inverse signal not shown for clarity

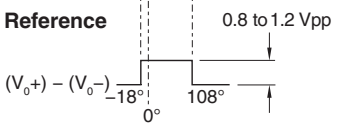
Analogue output signals - RGH41A, B

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



0.6 to 1.2 Vpp with Green LED indication and 120 Ω termination.

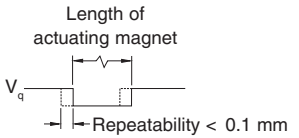
Reference



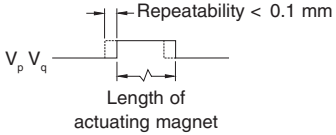
Differential pulse V_0 –18° to 108°. Duration 126° (electrical).
Repeatability of position (uni-directional) maintained within ±20 °C from installation temperature and for speed < 0.5 m/s.

Limit open collector output, asynchronous pulse

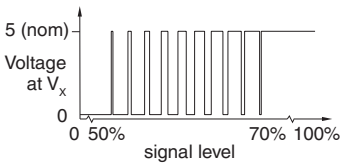
Single limit RGH41B



Dual limit RGH41A



Set-up



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

General specifications

Power supply	5 V ± 5%	RGH41A < 140 mA RGH41B < 120 mA RGH41T, D, G, X < 95 mA RGH41N, W, Y, H < 150 mA **NOTE:** Current consumption figures refer to unterminated readheads. For digital outputs a further 35 mA per channel pair (e.g. A+, A–) will be drawn when terminated with 120 Ω. For analogue outputs a further 20 mA 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.
	Ripple	200 mVpp @ frequency up to 500 kHz maximum.
Temperature	Storage	–20 °C to +70 °C
	Operating	0 °C to +55 °C
Humidity		95% relative humidity (non-condensing) to EN 60068-2-78
Sealing		IP50
Acceleration	Operating	500 m/s², 3 axes
Shock	Non-operating	1000 m/s², 6 ms, ½ sine, 3 axes
Vibration	Operating	100 m/s² 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 × 10⁶ cycles at 50 mm bend radius.

Renishaw encoder systems have been designed to the relevant EMC standards, but must be correctly integrated to achieve EMC compliance. In particular, attention to shielding arrangements is essential.

Scale specifications

Scale type		Reflective gold plated steel tape with protective lacquer coating. Adhesive backing tape allows direct mounting to the machine substrate.
Scale period		40 µm
Linearity		±3 µm/m
Scale length		Up to 50 m (> 50 m by special order)
Form (H × W)		0.2 mm × 6 mm (includes adhesive)
Substrate materials		Metals, ceramics and composites with expansion coefficients between 0 and 22 µm/m/°C (steel, aluminium, Invar, granite, ceramic etc.)
Coefficient of thermal expansion		Matches that of substrate material when scale ends are fixed by epoxy mounted end clamps
End fixing		Epoxy mounted end clamps (A-9523-4015) using 2 part epoxy adhesive (A-9531-0342) Scale end movement typically < 1 up to +40 °C
Temperature	Operating	–10 °C to +120 °C
	Minimum installation	10 °C
	Storage	–20 °C to +70 °C
Humidity		95% relative humidity (non-condensing) to EN 60068-2-78

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