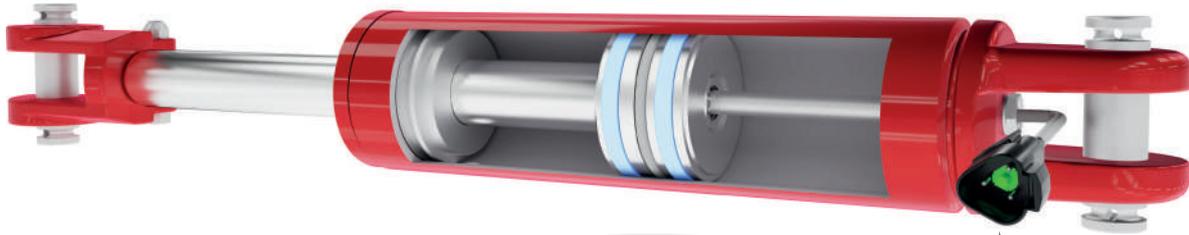




# LA LINEAR TRANSDUCER CATALOGUE



Pioneered. Patented.  
Relentlessly improved.

## NEW FOR v4.2

- New patented high accuracy magnets for long strokes
- IP69K unmated Deutsch DT connectors
- UN ECE Reg. 10.05: October 2014 (AUTOMOTIVE) rating as standard
- 0.05mm resolution CANbus signal option

IP69K Unmated  
Deutsch DT Connector  
Options Available



Ⓔ<sub>11</sub> 10 R

- Cylinder mounting pin to pin length not increased
- Extremely compact
- Very robust solid state/zero wear design
- Industry leading random and sinusoidal vibration ratings, including resonant frequencies!
- Absolute signal
- OEM/Field replaceable design options



Rota Transducers used in all featured photographs



## RELIABLE OPERATION TOUGH APPLICATION

Rota Limited, Manchester UK

[www.rota-ltd.com](http://www.rota-ltd.com)

LACAT V4.2.01.01

## Introduction

Hall Effect Transducers  
 Compact Solution  
 Advanced Features  
 Customer Applications

Page 3  
 Page 4  
 Page 5  
 Page 6

Please consider which electrical connector you may have to use, this will impact what transducer mounting head you can select.

## Transducer Selection Criteria

Wire, Cable, and Metal M12 Connector Options  
 Cable Mounted Plastic Connectors  
 Compact Eye Mounted Cylinders - ie with special bearing, crosstube etc.  
 Thread Mounted - No Cyl. Eye - ie cylinders with Wide Clevis, Trunnion Mounts etc.  
 Integral M12 Connector Options  
 Internal Magnet Options for Cylinders - magnet choice dictates signal resolution  
 Remote Magnet Options for Moving Structures

Page 7  
 Page 8  
 Page 9 - Page 11  
 Page 12 - Page 13  
 Page 14 - Page 15  
 Page 16 - Page 17  
 Page 18

## Hydraulic Cylinder Machining Details

End Cap Machining for LAB, LAC, & LAD  
 End Cap Machining for Thread Mounted  
 M12 Connector Machining Details  
 Magnet Cavity Machining Details

Page 19  
 Page 20  
 Page 21  
 Page 22 - Page 23

LA Standard Performance Data

Page 24 - Page 25

How to Order

Page 26

Rota offers the most compact linear transducers on the market. The left photo shows the mating M12 connector - just seen behind the hydraulic port. In the right picture, our grey cable can be seen coming between the clevis.



## ABOUT ROTA

Based in Manchester UK, Rota Ltd was established in 1964. Since then we have developed our core competencies within quality, robust position technology, tank level sensors, and ex-connectors. Focusing on design and manufacture, Rota's first linear transducer was produced in 1993; today we offer a range of highly accomplished transducers for mobile, industrial, and explosive atmosphere applications.



# HALL EFFECT TRANSDUCERS

## INTRODUCTION

Rota introduced Hall effect linear transducers to the hydraulic market in 2004. The Hall Effect transducers incorporate well proven solid state electronics in a high pressure tube; when installed in the cylinder the only moving part is the magnet being driven by the piston. This has proven to be particularly reliable in many applications, and for this reason Rota transducers are now being used by some of the largest OEM's in hydraulics, construction equipment, farm machinery, forestry equipment, road and military vehicles, mining and oilfield equipment etc.

Over 200 different hydraulic cylinder manufacturers have bought and successfully fitted our Hall Effect transducers. Many of the applications have seen diverse combinations of shock, vibration, temperature, pressure spikes, E.M.C etc.

## QUALITY

Designing and building transducers and connectors for explosive atmospheres requires an obsession with quality. Rota's quality systems were originally approved to BS 5750 in 1986 and are now certified to ISO 9001-2015. The Q.A. system is also approved and regularly audited by Baseefa and C.S.A. (Canadian Standards Association) for the manufacture of transducers and electrical connectors for use in explosive atmospheres.

Rota's environmental management system has achieved ISO 14001:2015 certification.

## MOBILE HYDRAULIC CYLINDER RANGE

Rota offer a range of internally mounted transducer series, all comprising different qualities while utilising our well proven Hall Effect technology.

The 350 bar aluminium LA-series and the 375 bar 304 stainless steel LB option satisfy the most essential requirements.

The LV-series offers an additional array of Hall Effect sensors guaranteeing a verification signal while the sensor dimensions are kept at an absolute minimum.

The LR-series incorporates two fully separate sensing circuits, ensuring a redundant signal while keeping the design compact.

The TL-series liquid level transducer has been specifically designed for tank level measurement in the mobile market to withstand both physical abuse and exposure to dust, water, chemicals, etc.. It is ideally suited for chemical, ADBLue and brine tanks of mobile machines. Also available with temperature indication (TLT version).

For applications where mounting the transducer on the hydraulic cylinder is preferable, Rota offer the patented ELC/ELV series for carbon steel cylinders. If the carbon steel cylinder is particularly long, Rota has designed the modular ML-series which can accommodate cylinders up to 30 metres (100ft) in length.

Our independent pin mounted transducer offers another option. Choose between the ultra-heavy duty LU-series, the normal duty LN-series, and the light duty LL-series.

For explosive atmospheres and industrial applications, Rota also manufacture separate ranges of linear transducers.



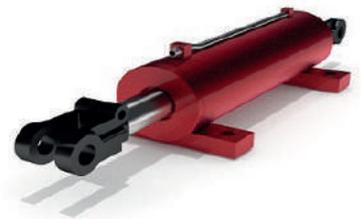
LV SENSOR



LR SENSOR



TL SENSOR



ELC STEERING CYLINDER TRANSDUCER



MLC JOINT ILLUSTRATION



LL SENSOR



**RELIABLE OPERATION TOUGH APPLICATION**

Rota Limited, Manchester UK

[www.rota-ltd.com](http://www.rota-ltd.com)

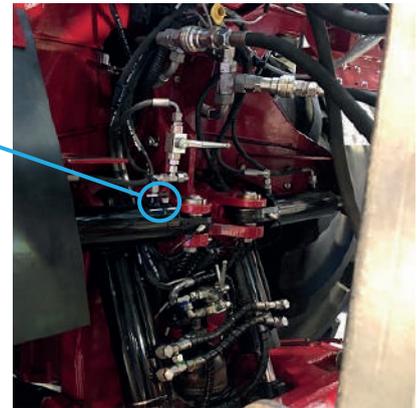
LACAT V4.2.03.01

Modern mobile machinery is often short of space as size is confined by road traffic safety regulations. Compact components purposely designed to meet the tough requirements of mobile equipment are therefore crucial. Rota's LA sensor range has been designed specifically with this in mind.

Rota's advanced technology has allowed for the design and development of very compact smart cylinder designs. The distance between the cylinder base port and the LA transducer connector can be reduced to millimetres, allowing the connector to be fitted without increasing the pin to pin dimensions.



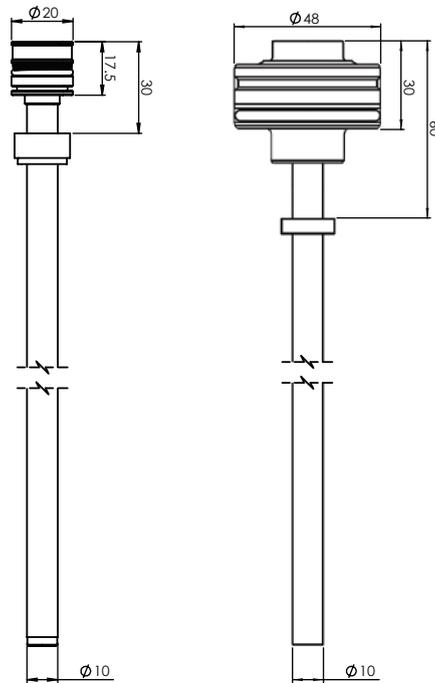
Crowded hydraulic cylinders & valves often found on advanced mobile vehicles.



### Rota Solution

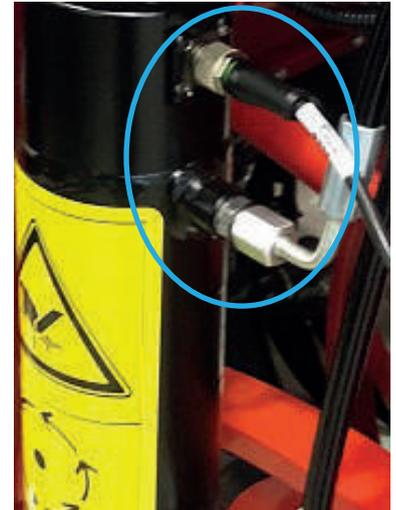


Rota small mounting heads allow an extremely compact distance between hydraulic port and connector.



Rota's LAD transducer vs average competitive transducer.

### Average Magnetostrictive Solution



Integrating bulky magnetostrictive transducer head keeps a considerable distance between electrical connector and hydraulic port, increasing pin to pin dimension.



# ADVANCED FEATURES



Please contact Rota for more information

## 20G RMS VIBRATION RESISTANCE

To assure an extended life for our products, Rota is one of only a few companies that exceed standard requirements during vibration testing. In particular, Rota sensors are tested at 20g (RMS) from 10-2000Hz (including resonant frequencies) and additionally held at 1g for one hour at resonant frequencies.

Rota sensors comply, and in all cases, exceed the requirements of the following IEC Standards:

- IEC 60068-2-64 (Vibration, Broadband Random & Guidance) at 20g 10-2000Hz (RMS) in all 3 axes
- IEC 60068-2-6 (Vibration, Sinusoidal) at 20g 10-2000Hz in all 3 axes
- IEC 60068-2-27 (Shock) Total of 6000 shocks at 50g over all 3 axes
- Resonant Frequency Search and Dwell Test - 10-2000Hz up to 7 found and each held @1g for 1 Hour

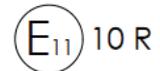


Customer application subject to high vibration

## OUTSTANDING EMC PERFORMANCE

Rota LA transducers meet some of the highest EMC standards worldwide, enabling safe and secure operation in electromagnetic environments whilst ensuring superior and reliable performance. All Rota LA sensors are designed to meet and exceed the compliance requirements in the standards listed below.

- UN ECE Reg. 10.05: October 2014 (AUTOMOTIVE)
- EN ISO 14982:2009 (AGRICULTURAL AND FORESTRY MACHINERY)
- ISO 13766:2018 (EARTH-MOVING AND BUILDING CONSTRUCTION MACHINERY)



## CALIBRATABLE OPTION

It's possible to order customer calibratable. It will then be delivered in calibration mode where the "end of stroke" signal positions must be set after the transducer has been installed in the cylinder/actuator.

Benefits:

- One transducer model can cater for multiple stroke lengths
- Cost efficient - can bulk buy sensors with undetermined strokes
- Signal positions can be tailored to the mechanical tolerances of cylinder/actuator

Available with voltage and current output as normal and reverse signal. Sensors come supplied with approximately 5 mm of extra stroke at each end to allow for tolerance stack up and mechanical wear.

Ordering code:

- L - transducer supplied with requested signal positions factory set at Rota
- Q - transducer supplied in calibration mode ready to be quick set to required piston stroke

## SELECTABLE OUTPUT

Rota now offer our transducers with a 'BU' signal output. The sensors come equipped with both a current output (4-20mA) and a voltage output (1.0-5.0V), allowing the cylinder manufacturer to decide signal output at a later stage. This enables the possibility for hydraulic cylinder manufacturers to build up stock and cut costs even when the output signal is unassigned at point of purchase.

Subject to reasonable modifications due to technical advances



# RELIABLE OPERATION TOUGH APPLICATION

Rota Limited, Manchester UK

www.rota-ltd.com

LACAT V4.2.05.01



# CUSTOMER APPLICATIONS



Terex Roadmaster uses the LA Series transducers in the compact cylinders that swing out the four stabilisers. They previously employed a rotary sensor with a complex bracketry, extensive assembly time and wiring issues. Rota replaced this with a simple plug and play solution.



Komatsu's Comfort Ride employ four Rota Transducers in the cab suspension to reduce vibration and improve operative comfort. To ensure resistance to the extensive vibration the transducers were tested over two million cycles for this application.



CNH New Holland Combine uses Rota external linear transducers on the double ended steering cylinder. Rota's sensors were chosen because Case New Holland needed a robust easily serviceable sensor mounted away from debris.



AGCO RoGator use Rota LA transducers on axle widening cylinders. This was a consequence of AGCO needing a small size sensor to maintain their cylinder pin to pin dimension.



Genie use Rota Hall Effect transducer in their Z 60 Boom lift steering system. Rota's smart cylinder design was deemed the superior option as the design provides best protection to the sensor while enabling integration into the small and restricted space inside the cylinder.



Manitowoc use Rota External Hall Effect transducer on National Crane Models. It was necessary for Manitowoc to employ a robust sensor which would withstand harsh external conditions.



## RELIABLE OPERATION TOUGH APPLICATION



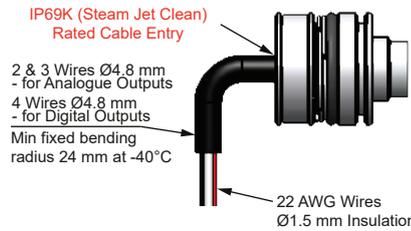
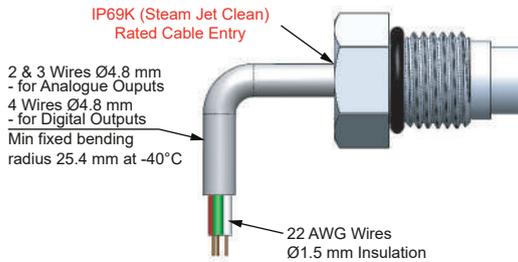
# CABLE AND CONNECTOR OPTIONS

## Cables & Wires

Cable can be fitted with Deutsch, AMP, and M12 connectors. See page 8 for more details.

All cables and individual wires have IP69K rated cable/wire entries (steam jet clean up to 150 bar at 99°C).

**N - Unscreened PVC Cable**   **U - Unscreened PUR Cable**   **W - Individual Wires**  
 -55°C to +105°C (-67°F to +221°F)                      -40°C to +90°C (-40°F to +194°F)                      -40°C to +105°C (-40°F to +221°F)

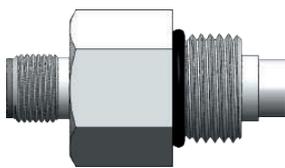


## RELIABLE M12 CONNECTORS - IP69K RATED - OPEN FACE AND UNPLUGGED



Steam Jet Clean  
Up to 150 bar (2180 psi)  
at 85°C (185°F)  
Open Face - even with  
cap/connector not fitted  
Independent UKAS Test  
(IAF MLA)

### J - M12 Integral Connector



(LAA, LAE, LAL, LAM, & LAU Types Only)

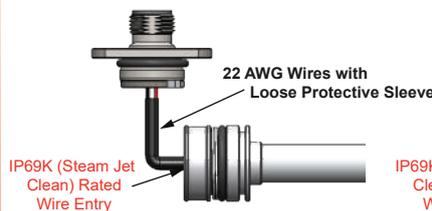
### Rotatable M12 Integral Connector



(LAAR, LAER, LALR, Types Only)

Operating temperature (all M12 connectors):  
-40°C to +105°C (-40°F to +221°F)  
M12 x 1 A Coding (All M12 connectors)

### K - M12 Connector 2 Holes Flange Mount (304 Stainless Steel) 8 Orientations



(LAD Type Only)

### L - M12 Connector 4 Holes Flange Mount (304 Stainless Steel) - ideal for small cylinders 8 Orientations



(LAB, LAC, LAH & LAK Types Only)

To eliminate soldering by the cylinder manufacturer the transducer is delivered with the wires and the M12 connector pre-soldered.

The wire length is mainly dependent on the cylinder bore (Øx) and can be selected as follows:

- Øx < Ø070, wire length = 80 mm
- Ø070 ≤ Øx < Ø110, wire length = 100 mm
- Ø110 ≤ Øx < Ø150, wire length = 120 mm
- Ø150 ≤ Øx < Ø210, wire length = 150 mm
- Øx ≥ Ø210, wire length = 200 mm

If you have a special designed cylinder without a compact mounting or with a valve block etc., you will need to consider altering the individual wire length.

Subject to reasonable modifications due to technical advances



# RELIABLE OPERATION TOUGH APPLICATION



# CABLE MOUNTED PLASTIC CONNECTORS

Threaded transducers are available with complete male connector pre-fitted. Others are supplied with pins only pre-fitted, or with all connector parts loose. See mounting options for details. The connectors can be paired with either the PVC (N) or PUR (U) cable.

Connector Model	Rota Order Code*	Connector Model	Rota Order Code*	Connector Model	Rota Order Code*	Connector Model	Rota Order Code*	Connector Model	Rota Order Code
Deutsch DT		Rota pins for DT		Deutsch DTM		AMP Superseal		M12	
DT04 2 pin	2DT	DT04 2 pin	2RT	DTM04 2 pin	2TM	282104-1	2UP	M12 4 pin	4MH
DT04 3 pin	3DT	DT04 3 pin	3RT	DTM04 3 pin	3TM	282105-1	3UP	M12 5 pin	5MH
DT04 4 pin	4DT	DT04 4 pin	4RT	DTM04 4 pin	4TM	282106-1	4UP	M12 90° 4 pin	4M9
DT04 6 pin	6DT	DT04 6 pin	6RT	DTM04 6 pin	6TM	282107-1	5UP	M12 90° 5 pin	5M9
DT04 8 pin	8DT	DT04 8 pin	8RT	DTM04 8 pin	8TM	282108-1	6UP		

\* For pre-fitted pins/contacts only (no connector body), replace the last letter of the Rota order code with 'C', eg '3DT' becomes '3DC', '4RT' becomes '4RC' etc.

## Deutsch DT - Series \*\*

Operating Temperature:  
-55°C to +125°C  
IP68 rated when mated

## Rota/Deutsch RT - Superior Sealing \*\*

Deutsch connector with Rota machined male contacts  
**IP69k unmated (Steam Jet Clean 99°C at 150 Bar)**  
Enables transducer's Deutsch connector to be left safely unmated



## Deutsch DTM - Series \*\*

Miniature contacts for smaller wire gauge applications  
Operating Temperature:  
-55°C to +125°C  
IP68 rated when mated



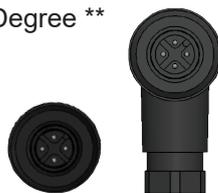
## AMP Superseal 1.5 - Series \*\*

Operating Temperature:  
-40°C to +125°C  
IP67 rated when mated



## M12 Connector - Straight or 90 Degree \*\*

With screw terminals  
M12 A connector male contacts  
Operating Temperature:  
-40°C to +85°C  
IP67 rated when mated



Extended clevis shows cable mounted connector. Installed to be easily removable.

\*\*LAB, LAC, LAD, LAH, & LAK supplied with loose heatshrink and connector body for customer assembly as connector body cannot fit through end cap. For Deutsch/AMP connectors, pins will be fitted to cable.

See page 24 for all connector pin outs

Subject to reasonable modifications due to technical advances



# RELIABLE OPERATION TOUGH APPLICATION

Rota Limited, Manchester UK

www.rota-ltd.com

LACAT V4.2.08.01



# FOR COMPACT EYE MOUNTED CYLINDERS

## ADVANTAGES

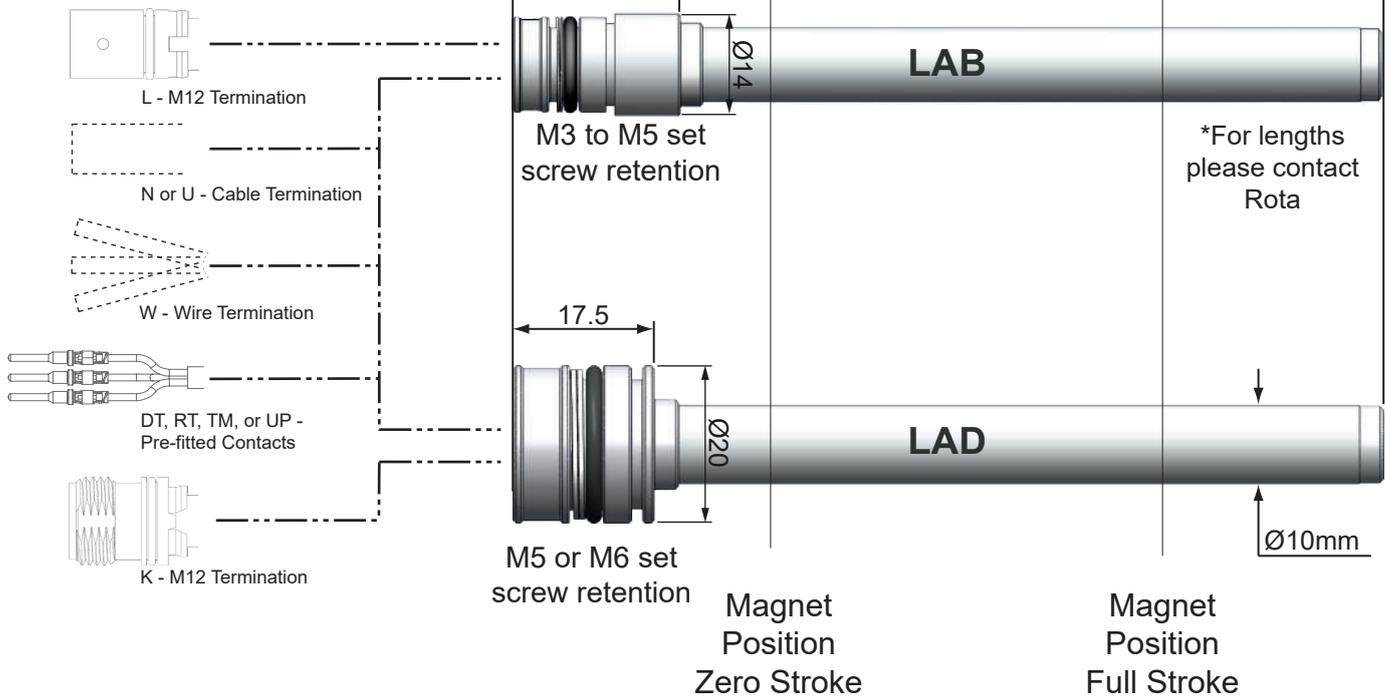
- Fits into all cylinders easily
- LAB particularly suited for small cylinders
- LAD optimised design for 2 hole M12 K-connector
  - Can be supplied with Rota/Deutsch contacts pre-fitted by Rota

## DISADVANTAGES

- Not as easy to install/remove as threaded type fitting

Standard Start of Stroke	Magnet
35 mm**	M, H
40 mm	T
42 mm	CT
45 mm	AT, ET
65 mm	AW, CW

\*\* 33 mm for strokes under 208 mm



## Compact Mounting Configurations



LAB transducer with L connector installed on a clevis mounted welded cylinder



LAD transducer and K connector.



LAD transducer and K connector installed on a rod eye mounted bolted cylinder

Subject to reasonable modifications due to technical advances



RELIABLE OPERATION TOUGH APPLICATION

Rota Limited, Manchester UK

[www.rota-ltd.com](http://www.rota-ltd.com)

LACAT V4.2.09.01



# FOR COMPACT EYE MOUNTED CYLINDERS

## ADVANTAGES

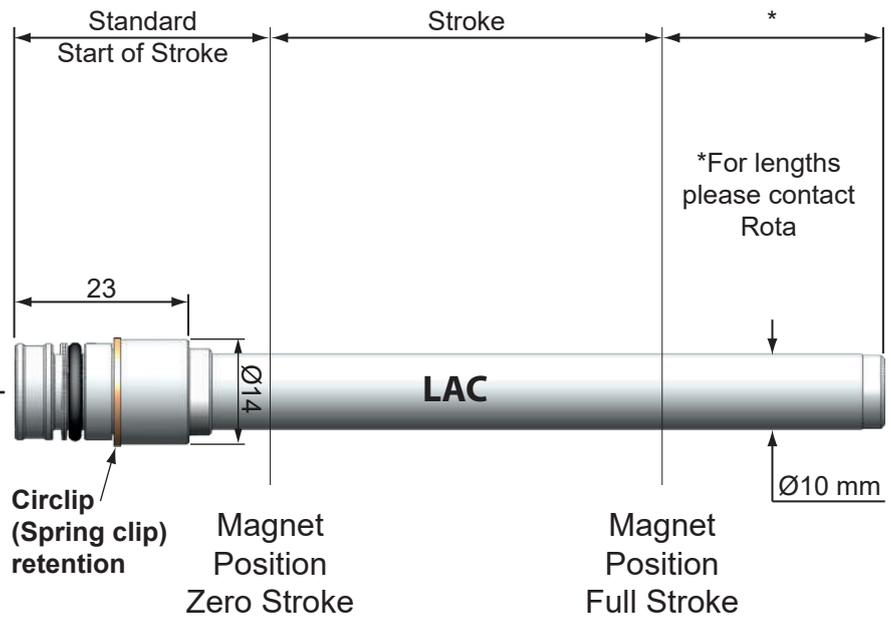
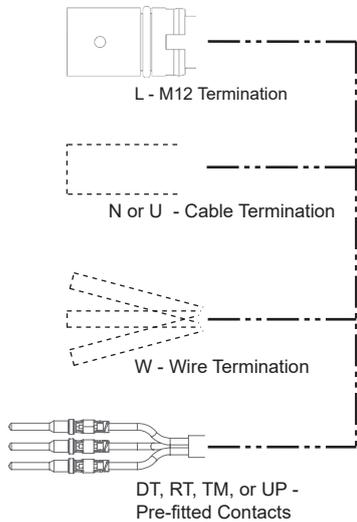
- LAC- clip in design
- Fast assembly
- Reduced cylinder machining cost
- No set screw required (no sealing of the setscrew required)

## DISADVANTAGES

- Not designed to be easily removed
- Cannot use 2 hole flange M12 K - connector

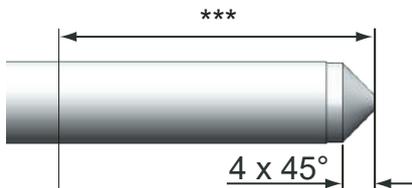
Standard Start of Stroke	Magnet
35 mm**	M, H
40 mm	T
42 mm	CT
45 mm	AT, ET
65 mm	AW, CW

\*\* 33 mm for strokes under 208 mm, M magnet only.



## Optional Alignment Aid

Available for LAB, LAC, and LAD (A added to end of Order Code See Page 26)



\*\*\*Adds 3mm to length, please contact Rota for this length



LAC transducer with connector installed on a standard NFPA clevis mounted cylinder

Subject to reasonable modifications due to technical advances



**RELIABLE OPERATION TOUGH APPLICATION**



# FOR COMPACT EYE MOUNTED CYLINDERS

## ADVANTAGES

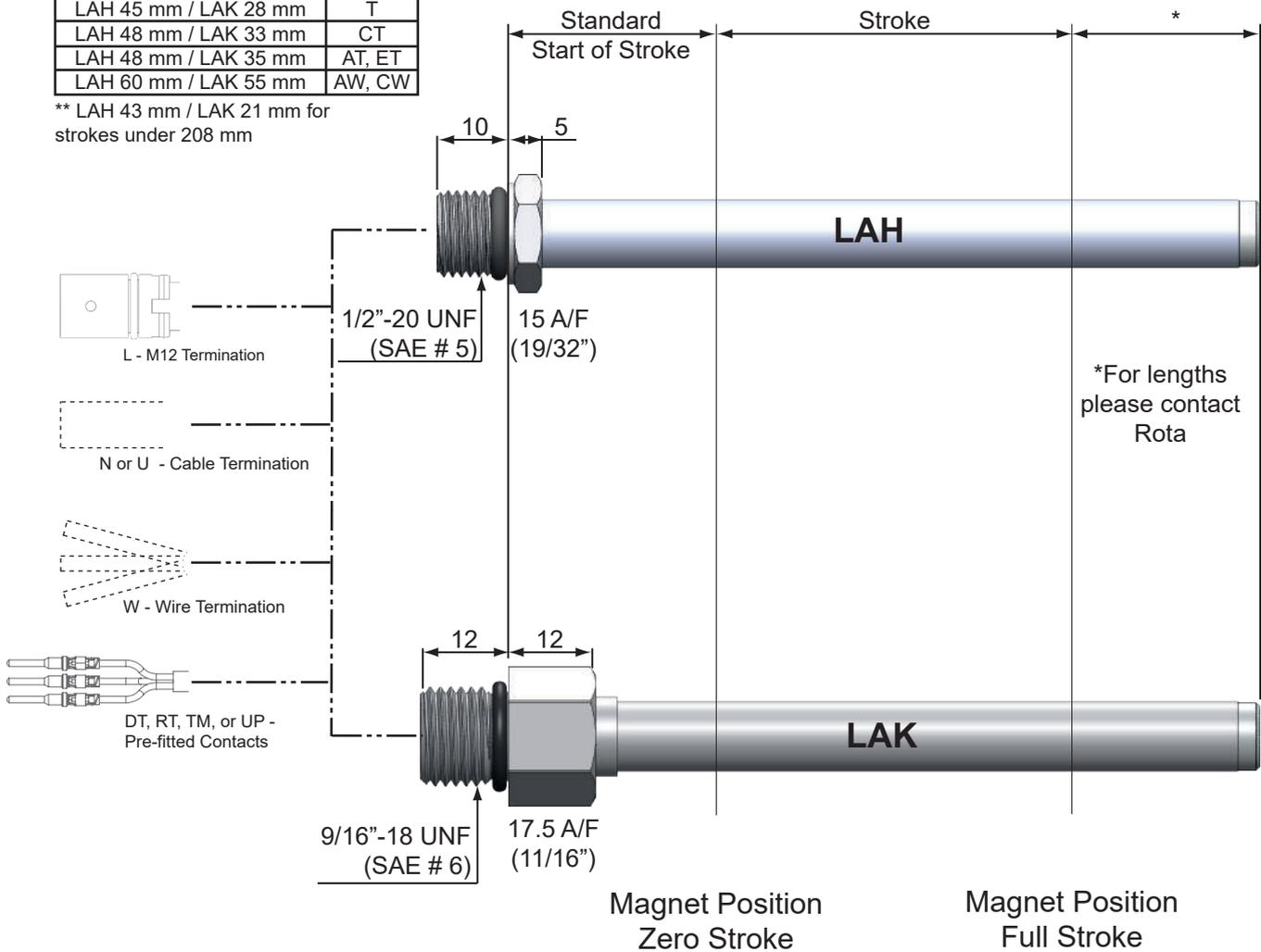
- No circlip or set screw needed
- Very compact
- Low machining cost

## DISADVANTAGES

- Special socket spanner needed
- LAH - max length 1 metre

Standard Start of Stroke	Magnet
LAH 45 mm** / LAK 23** mm	M, H
LAH 45 mm / LAK 28 mm	T
LAH 48 mm / LAK 33 mm	CT
LAH 48 mm / LAK 35 mm	AT, ET
LAH 60 mm / LAK 55 mm	AW, CW

\*\* LAH 43 mm / LAK 21 mm for strokes under 208 mm



\*For lengths please contact Rota

Subject to reasonable modifications due to technical advances



RELIABLE OPERATION TOUGH APPLICATION

Rota Limited, Manchester UK

www.rota-ltd.com

LACAT V4.2.11.01



# SMALL THREAD MOUNTING - NO CYL. EYE

## ADVANTAGES

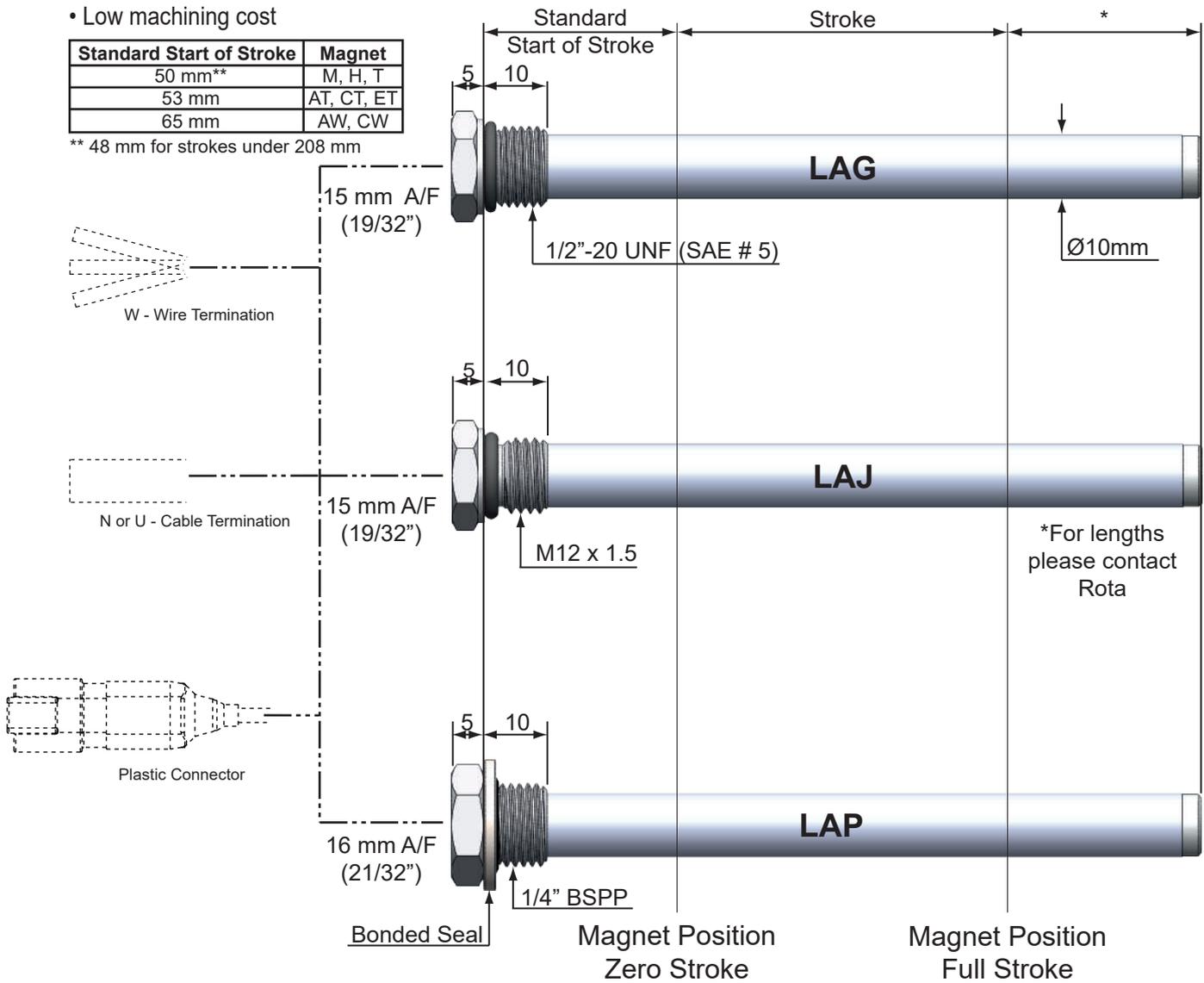
- Ideal for small clevis mounted cylinders
- Easy to fit/remove sensor from the cylinder
- Easy to thread cylinder end cap
- OEM and field replaceable
- Low machining cost

Standard Start of Stroke	Magnet
50 mm**	M, H, T
53 mm	AT, CT, ET
65 mm	AW, CW

\*\* 48 mm for strokes under 208 mm

## DISADVANTAGES

- Max length 1 metre
- Increased dead length at head end



So compact you don't even notice it's there!



Compact LA design fitted in the clevis

Subject to reasonable modifications due to technical advances



# RELIABLE OPERATION TOUGH APPLICATION

Rota Limited, Manchester UK

www.rota-ltd.com

LACAT V4.2.12.01



# LARGE THREAD MOUNTING - NO CYL. EYE

## ADVANTAGES

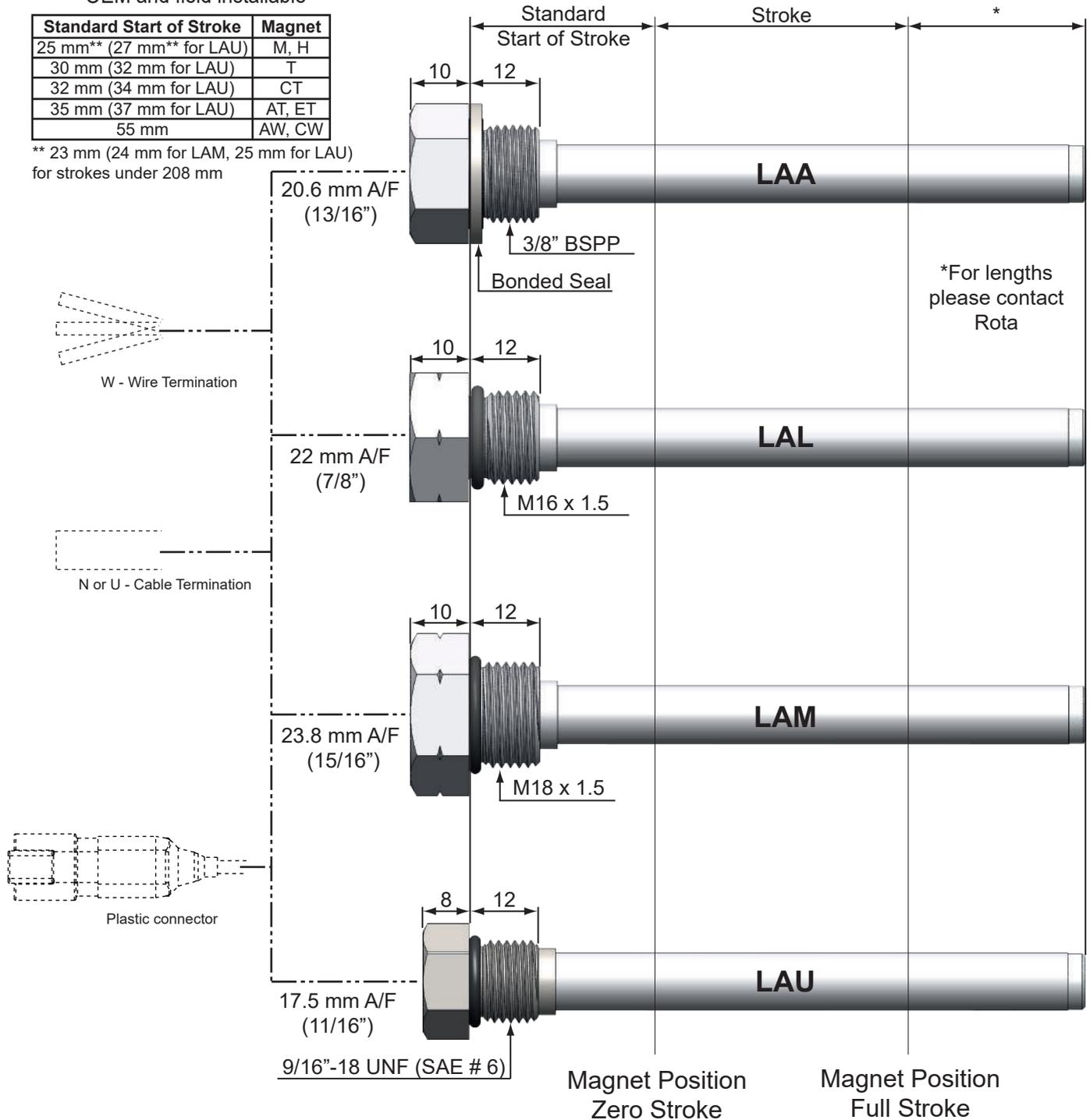
- Easy to thread cylinder end cap
- Easy to fit/remove sensor from the cylinder
- Low cost of machining
- OEM and field installable

## DISADVANTAGES

- Hex head may be too large to fit into clevis mounted cylinders (see page 12 for small thread fittings)

Standard Start of Stroke	Magnet
25 mm** (27 mm** for LAU)	M, H
30 mm (32 mm for LAU)	T
32 mm (34 mm for LAU)	CT
35 mm (37 mm for LAU)	AT, ET
55 mm	AW, CW

\*\* 23 mm (24 mm for LAM, 25 mm for LAU) for strokes under 208 mm



Subject to reasonable modifications due to technical advances



RELIABLE OPERATION TOUGH APPLICATION



# INTEGRAL M12 CONNECTORS - NO CYL. EYE

## ADVANTAGES

- Easy to thread cylinder end cap
- Easy to fit/remove sensor from the cylinder
- Low cost of machining
- OEM and field replaceable

## DISADVANTAGES

- Transducer hex can be difficult to accommodate in small clevis mounted cylinders - alternatively the clevis can be lengthened and/or widened to suit a mounting shown below such as our LAU
- Finishing connector pin orientation unknown - can be problem for 90° Cable Harness (For rotatable option see page 15)

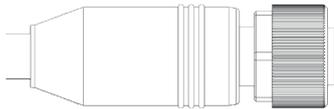
### IP69K

Steam Jet Clean  
Up to 150 bar (2180 psi)  
at 85 °C (185 °F)  
Open face - even with  
cap/connector not fitted  
Independent UKAS Test  
(IAF, MLA)

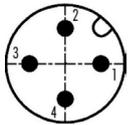


Standard Start of Stroke	Magnet
25 mm**	M, H
30 mm	T
32 mm	CT
35 mm	AT, ET
55 mm	AW, CW

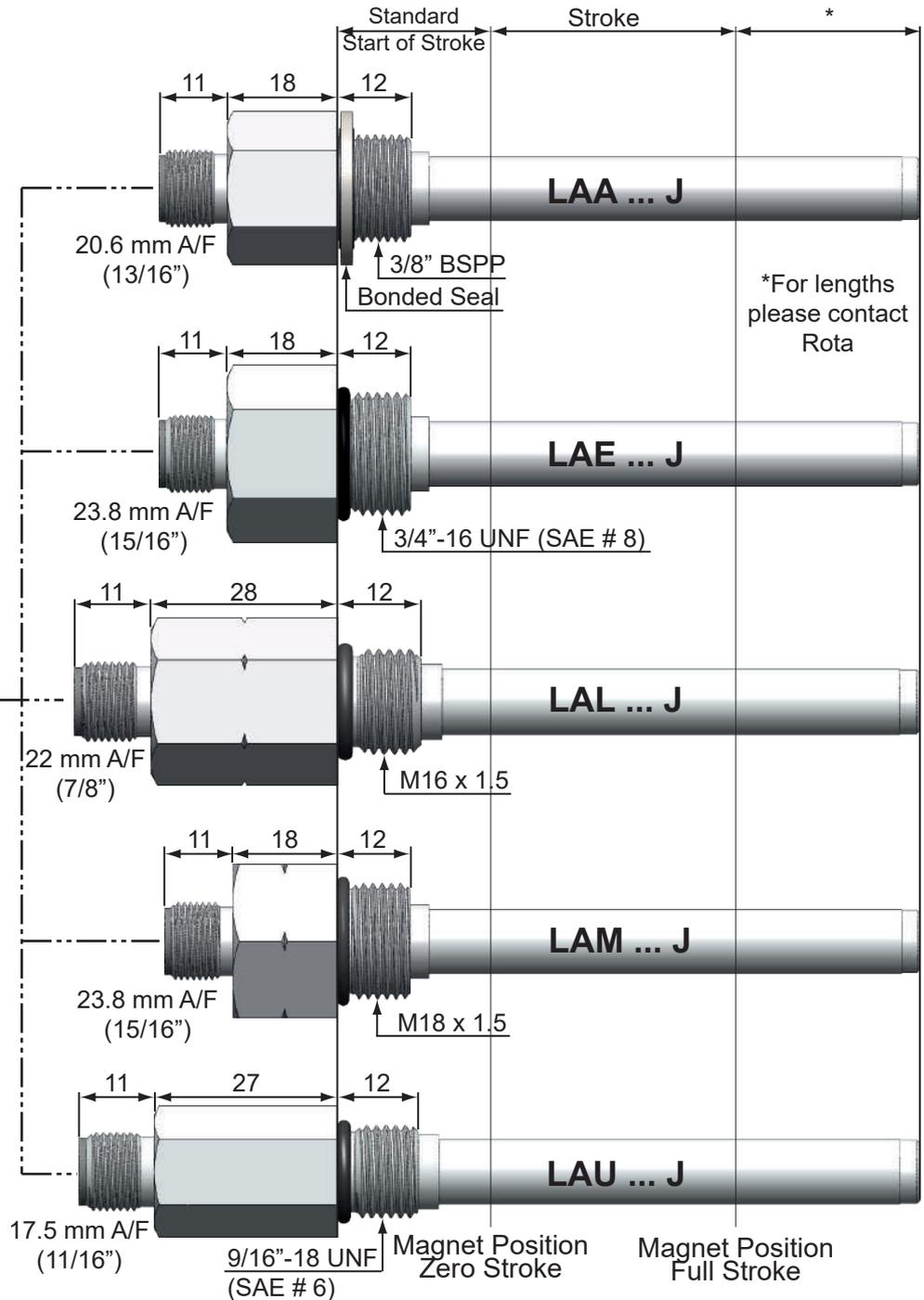
\*\* 23 mm (24 mm for LAE & LAM)  
for strokes under 208 mm



Inline Cable Harness  
Rota standard M12 x 1  
Termination is A Coding



Transducer Face View  
J - Termination  
M12 x 1 Male Pins  
Termination is A Coding



\*For lengths  
please contact  
Rota

Subject to reasonable modifications due to technical advances



RELIABLE OPERATION TOUGH APPLICATION

Rota Limited, Manchester UK

www.rota-ltd.com

LACAT V4.2.14.01



# ROTATABLE INTEGRAL M12 - NO CYL. EYE

## ADVANTAGES

- Allows the fitting of 90° M12 connectors in the preferred orientation
- OEM and field replaceable

## DISADVANTAGES

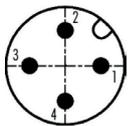
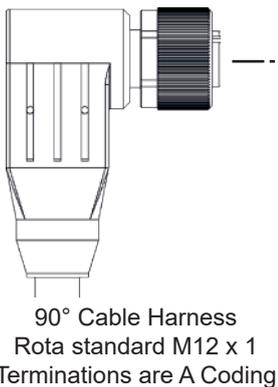
- Hex head can be too large to fit into small clevis mounted cylinders
- Larger than non rotatable head & increased start of stroke
- Head cannot rotate under hydraulic pressure



**IP69K**  
 Steam Jet Clean  
 Up to 150 bar (2180 psi)  
 at 85 °C (185 °F)  
 Open face - even with  
 cap/connector not fitted  
 Independent UKAS Test  
 (IAF, MLA)

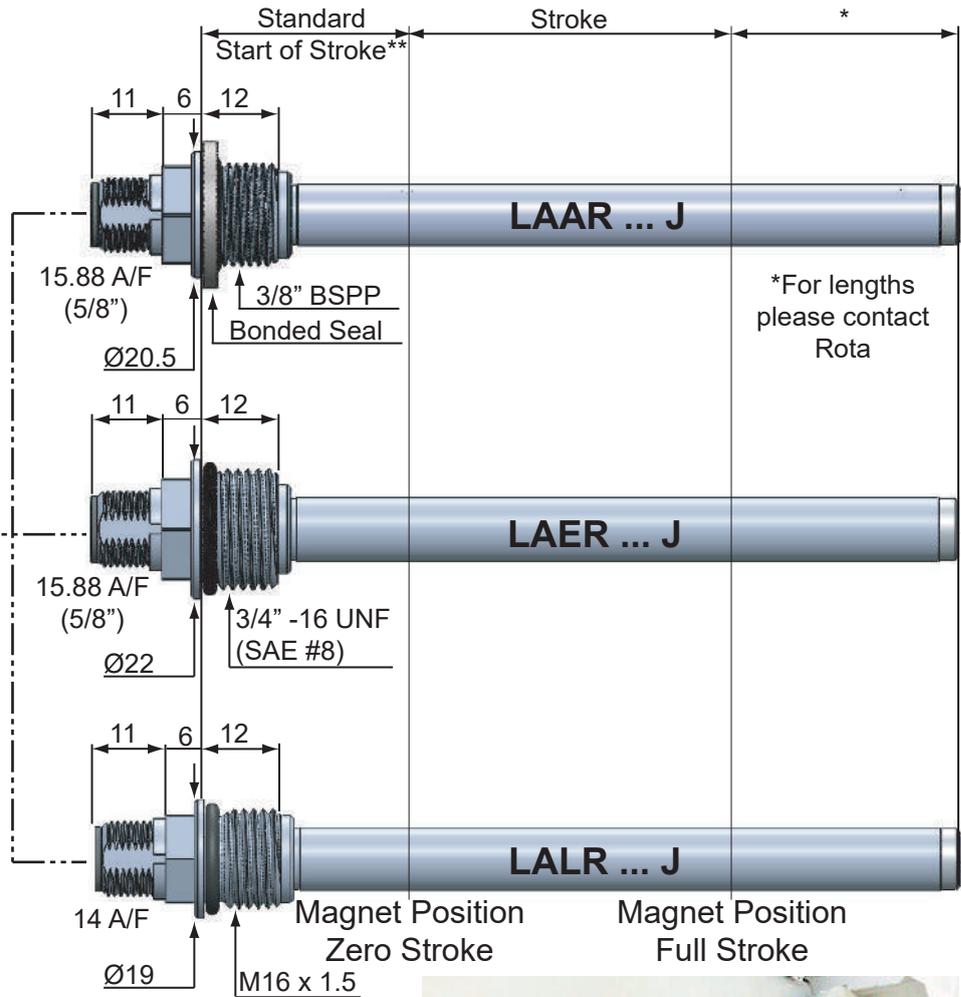
Standard Start of Stroke	Magnet
53 mm***	M, H, T
58 mm	AT, CT, ET
66 mm	AW, CW

\*\*\* 51 mm for strokes under 208 mm



Transducer Face View  
 J - Termination  
 M12 x 1 Male Pins  
 Termination is A Coding

\*\*For shorter start of strokes a welded stainless steel version is available, please contact Rota for more information.



\*For lengths please contact Rota



High vibration setting; Rota LAER sensor installed in Roadtec SX7 cutter cylinder.

Subject to reasonable modifications due to technical advances



RELIABLE OPERATION TOUGH APPLICATION

Rota Limited, Manchester UK

www.rota-ltd.com

LACAT V4.2.15.01



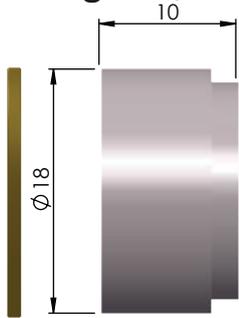
# INTERNAL MAGNETS

Internal magnets must be housed in magnetic material - for housing in non-magnetic material please contact Rota. For machining details please see page 22.

## Circlip Design

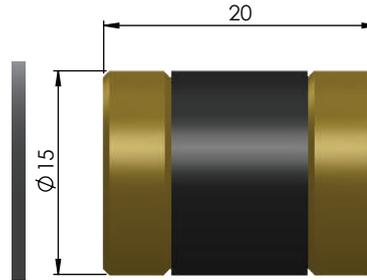
0.3 mm Resolution,  $\leq \pm 1.0$  mm Non-linearity.

### 'M' Magnet (Rota P/N 255194)



- Fitted with a special circlip - eliminating need for spacers  
- Non-magnetic circlip only, supplied by Rota, must be fitted with care

### 'T' Magnet (Rota P/N LA 2484)



- Fitted with a steel circlip  
- Comes with spacers supplied  
- Specifically designed for small bore cylinders

## Clip-in Design

- Clips in by hand\*
- Easy & fast assembly
- No circlip needed
- Non-removable

\*To aid installation, setting tools are available. Please contact Rota for more information.

### Maximum Electronic Speed:

Output	Magnet	H, M, & T	AT, CT & ET	AW & CW***
Analogue**		2.5m/s	5.5m/s	8m/s
J1939		2m/s	3.5m/s	8m/s
CANopen		1.75m/s	3.25m/s	7m/s

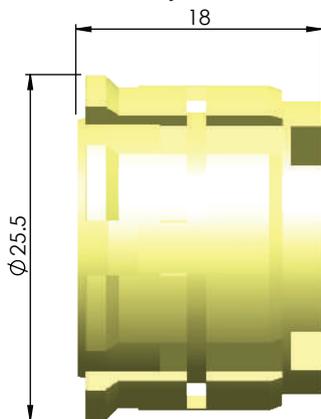
Electronics speed only, mechanical constraints may exist. For longer transducers, particularly when used with certain types of hydraulic oil or in sub-zero temperatures this velocity must be significantly reduced.

\*\*3-wire outputs only, 2-wire output is slower please contact Rota.

\*\*\*For higher speeds please contact Rota.

### 'H' Magnet (Rota P/N LA 2188)

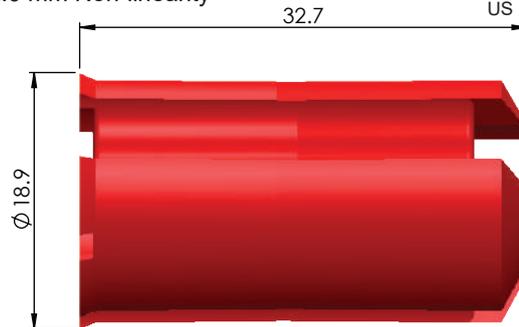
0.05 mm (CAN) or 0.1mm (analogue) Resolution  
 $\leq \pm 0.2$  mm Non-linearity



### 'CT' Magnet (Rota P/N LA 2878)

2.0mm Resolution  
 $\leq \pm 2.0$  mm Non-linearity

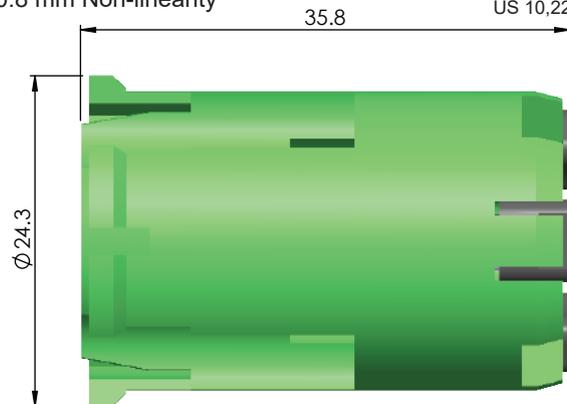
Patents  
CNZL201580063891.8  
EP 3198231  
KR10-1960719  
JP 6713457  
US 10,222,238



### 'AT' Magnet (Rota P/N LA 4909)

0.3 mm Resolution  
 $\leq \pm 0.8$  mm Non-linearity

Patents  
CNZL201580063891.8  
EP 3198231  
KR10-1960719  
JP 6713457  
US 10,222,238



Subject to reasonable modifications due to technical advances



# RELIABLE OPERATION TOUGH APPLICATION



# INTERNAL MAGNETS

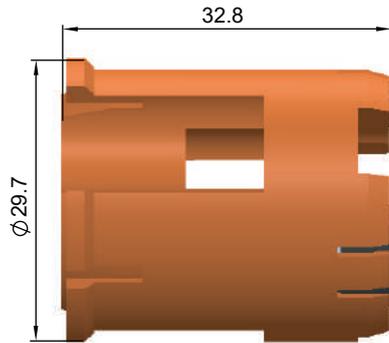
## Clip-in Design Continued

### 'ET' Magnet (Rota P/N LA 5704)

0.3 mm Resolution

<±0.8 mm Non-linearity

Ideal for long strokes and high speed applications



Patents  
CNZL201580063891.8  
EP 3198231  
KR10-1960719  
JP 6713457  
US 10,222,238

## Thread Mounted Design

### 'AW'/'CW' Magnet (AW Rota P/N LA 6065, CW Rota P/N LA 6200)

AW: 0.3 mm Resolution - for approx. ≥ 60 mm I/D magnet cavity\*

CW: 2.0 mm Resolution - for approx. 50 mm I/D magnet cavity\*

< ±0.8 mm Non-linearity

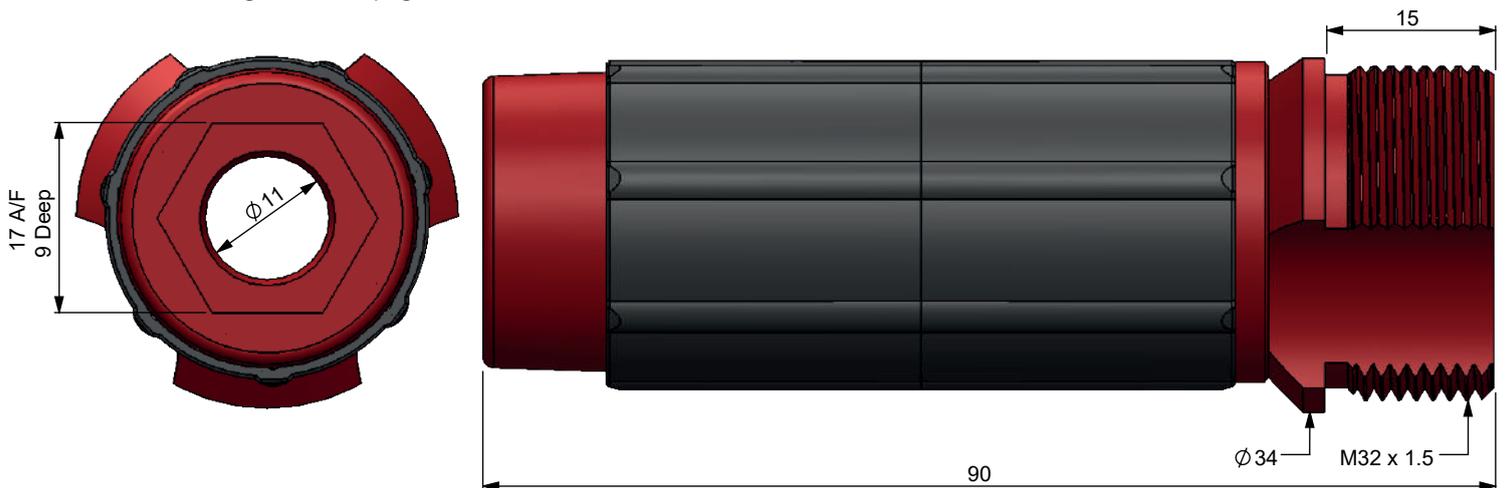
Ideal for long strokes and high speed applications.

Also available with a larger internal diameter to suit larger diameter sensor rods.

Please contact Rota for stroke lengths above 3180mm, or for more information on larger diameter sensors.

\*See machining details on page 23.

Patents  
CNZL201580063891.8  
EP 3198231  
KR10-1960719  
JP 6713457  
US 10,222,238



Internal magnets must be housed in magnetic material - for housing in non-magnetic material please contact Rota. For machining details please see page 23.

Subject to reasonable modifications due to technical advances



# RELIABLE OPERATION TOUGH APPLICATION

Rota Limited, Manchester UK

[www.rota-ltd.com](http://www.rota-ltd.com)

LACAT V4.2.17.01



# REMOTE - 'R' MAGNETS

For mounting on any linear-moving structure where internal hydraulic cylinder mounting is not feasible. Strokes up to 5.9m possible. For strokes up to 30m, see ML modular design.

	ØD (mm)	Lx (mm)	Resolution (mm)	Optimum distance from centre-line of Transducer (mm)**
R1	5	13	0.2	10 ±0.5
R2	10	15	0.2*	22 ±3
R3	4.76	50.8	0.3*	19 ±3
R5	4.76	50.8	0.3*	15 ±3
R6	9.52	50.8	0.3*	26 ±4
R7	11.5	62	0.3*	45 ±4

\*For analogue strokes over 2m: R2 = 0.3mm, R4-R7 = 0.5mm

\*\*For increased distances please contact Rota regarding 'E' magnets

## Note

Correct magnet orientation is critical – North Pole of magnet (indicated with red mark) must be orientated towards connector/cable end of transducer. If the optimum distance between the magnet and the transducer is not maintained the signal will dropout.

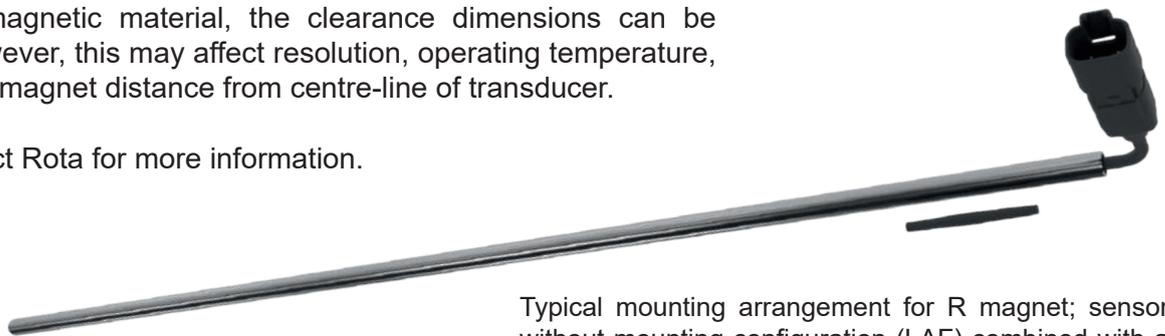
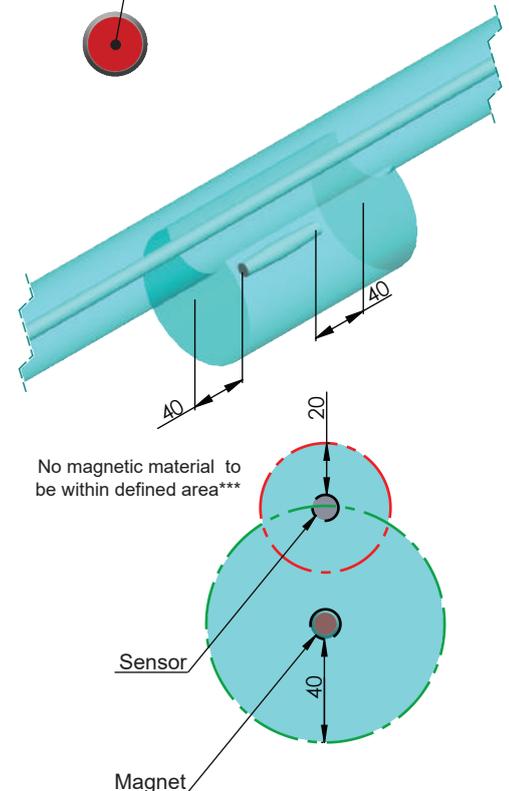
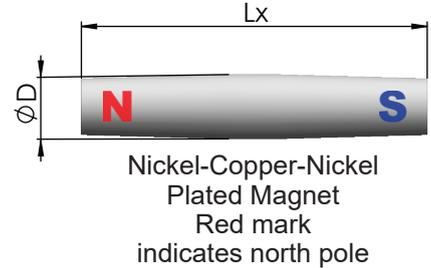
To achieve the above figures, the 'R' magnets must be housed in non-magnetic material, and magnetic fields in close proximity to transducer must be avoided. In addition there must be no magnetic bracket, fixture or structure within 20mm of the stroke sensing zone or within 40mm of the magnet.

Magnet operating temperature: -40 to +70°C (-40 to +158°F)

## \*\*\*Boom Mounting

In nested booms (found in access equipment, telehandlers, etc.) or similar applications where it isn't possible to install the sensor rod away from magnetic material, the clearance dimensions can be reduced. However, this may affect resolution, operating temperature, and optimum magnet distance from centre-line of transducer.

Please contact Rota for more information.



Typical mounting arrangement for R magnet; sensor without mounting configuration (LAF) combined with a cable mounted plastic connector.

Subject to reasonable modifications due to technical advances



# RELIABLE OPERATION TOUGH APPLICATION

Rota Limited, Manchester UK

www.rota-ltd.com

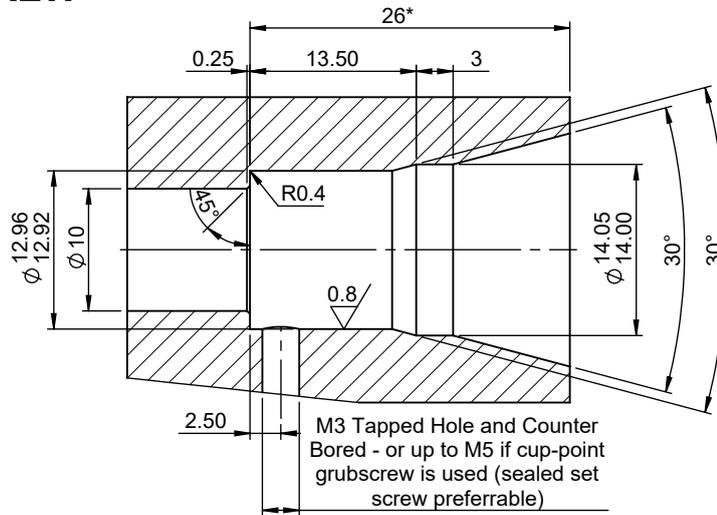
LACAT V4.2.18.01



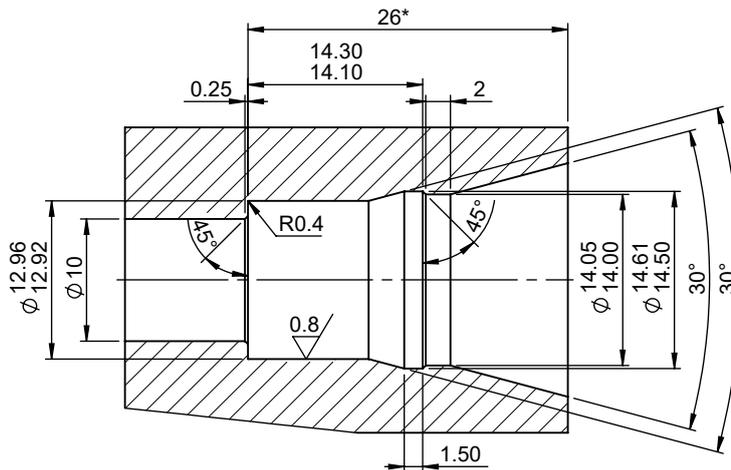
# END CAP MACHINING FOR LAB, LAC & LAD

## GRUB/SET SCREW

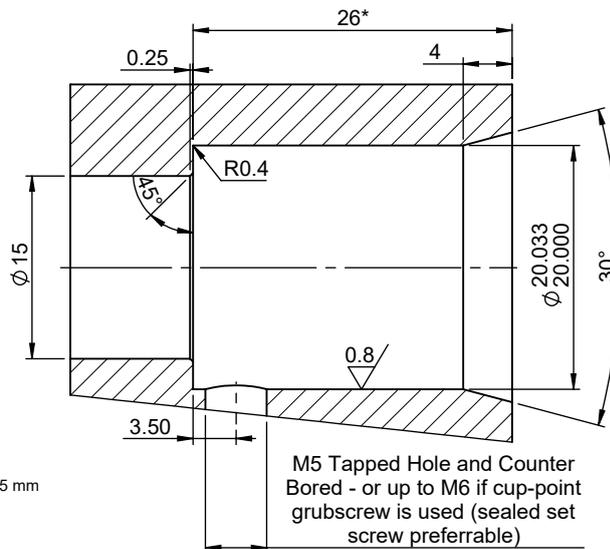
### LAB



### LAC



### LAD



Torque values for set screws:

Thread	Tightening Torque	
	N·m	lbf·ft
M3	1	0.74
M4	2.1	1.55
M5	4.7	3.47
M6	7.7	5.68

PRODUCTION NOTES  
 UNLESS OTHERWISE STATED  
 REMOVE ALL SHARP EDGES  
 MACHINED SURFACE TEXTURE TO BE  $\leq 1.6\mu\text{m Ra}$   
 TOLERANCE ON MACHINED DIMENSIONS  $\pm 0.25\text{ mm}$   
 TOLERANCE ON NON-MACHINED DIMENSIONS  $\pm 0.75\text{ mm}$   
 TOLERANCES ON ANGLES  $\pm 2\text{ DEGREES}$   
 ALL DIMENSIONS IN MILLIMETRES

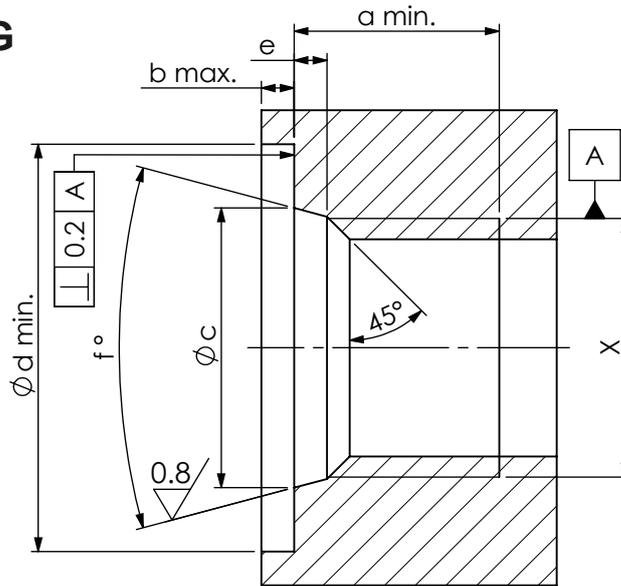
Subject to reasonable modifications due to technical advances



RELIABLE OPERATION TOUGH APPLICATION

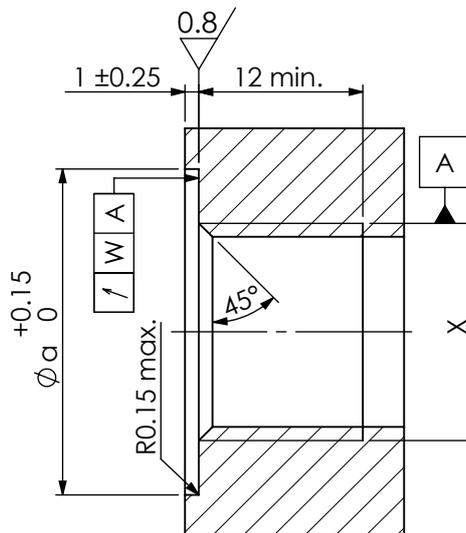
## ORB MACHINING

- LAE
- LAG
- LAH
- LAJ
- LAK
- LAL
- LAM
- LAU



	X	a	b	c	d	e	f	Tightening Torque into Steel End Cap	
								N-m	lbf-ft
LAG & LAH	1/2" - 20 UNF (SAE #5) - 2B	12	1.6	14.00/14.13	19	2.4/2.8	24	30	22.13
LAU & LAK	9/16" - 18 UNF (SAE #6) - 2B	13	1.6	15.60/15.73	22	2.5/2.9			
LAE	3/4" - 16 UNF (SAE #8) - 2B	15	2.4	20.60/20.73	30	2.4/2.8	30	35	25.81
LAJ	M12 x 1.5 6H	12	1.5	13.8/13.9	19			30	22.13
LAL	M16 x 1.5 6H	13	1.5	17.8/17.9	28			35	25.81
LAM	M18 x 1.5 6H	15	2.0	19.8/19.9	30				

- LAA
- LAP



PRODUCTION NOTES  
 UNLESS OTHERWISE STATED  
 REMOVE ALL SHARP EDGES  
 MACHINED SURFACE TEXTURE TO BE  $\leq 1.6 \mu\text{m Ra}$   
 TOLERANCE ON MACHINED DIMENSIONS  $\pm 0.25 \text{ mm}$   
 TOLERANCE ON NON-MACHINED DIMENSIONS  $\pm 0.75 \text{ mm}$   
 TOLERANCES ON ANGLES  $\pm 2$  DEGREES  
 ALL DIMENSIONS IN MILLIMETRES

	X	a	Tightening Torque into Steel End Cap	
			N-m	lbf-ft
LAP	1/4" BSPP	20.70	20	14.75
LAA	3/8" BSPP	23.93	35	25.81

Subject to reasonable modifications due to technical advances

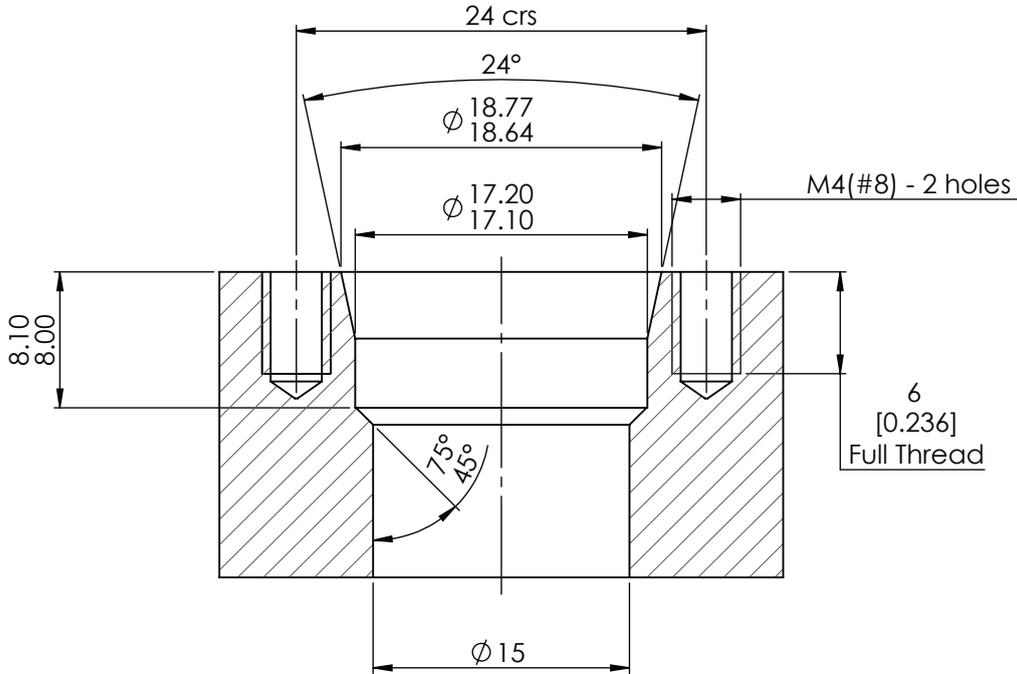


# M12 CONNECTOR MACHINING DETAILS

## K Connector

2 Hole Flange

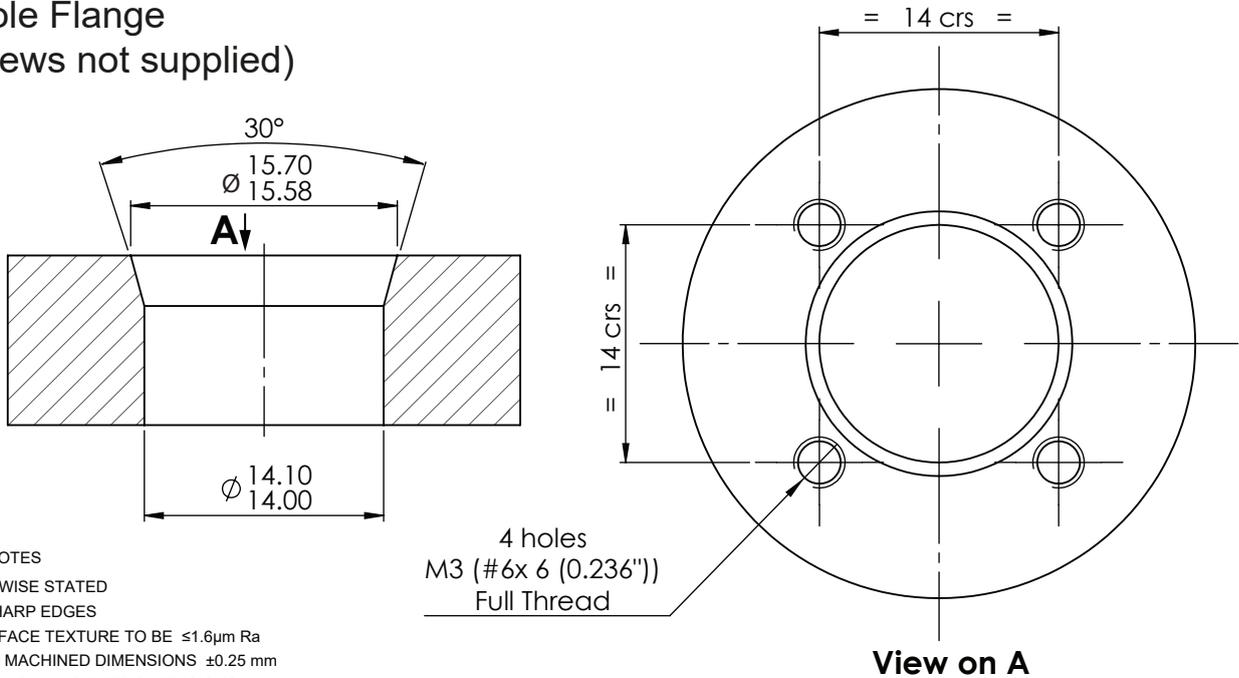
(Supplied with x2 M4x8 screws)



## L Connector

4 Hole Flange

(Screws not supplied)



PRODUCTION NOTES  
 UNLESS OTHERWISE STATED  
 REMOVE ALL SHARP EDGES  
 MACHINED SURFACE TEXTURE TO BE  $\leq 1.6\mu\text{m Ra}$   
 TOLERANCE ON MACHINED DIMENSIONS  $\pm 0.25\text{ mm}$   
 TOLERANCE ON NON-MACHINED DIMENSIONS  $\pm 0.75\text{ mm}$   
 TOLERANCES ON ANGLES  $\pm 2\text{ DEGREES}$   
 ALL DIMENSIONS IN MILLIMETRES

Subject to reasonable modifications due to technical advances



# RELIABLE OPERATION TOUGH APPLICATION

Rota Limited, Manchester UK

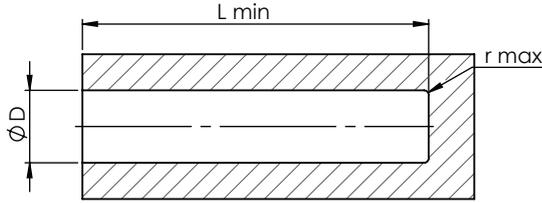
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LACATV4.2.21.01



# MAGNET CAVITY MACHINING DETAILS

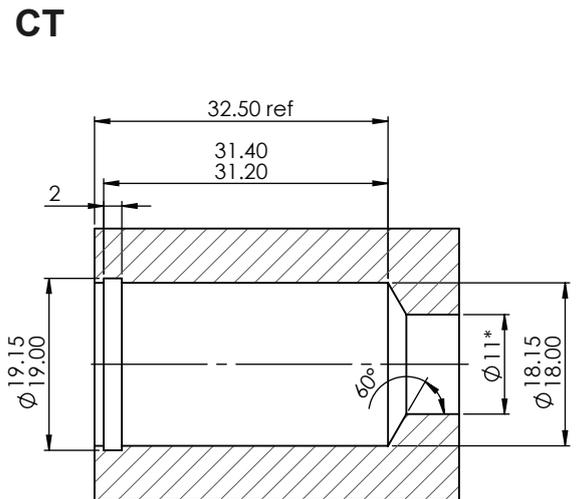
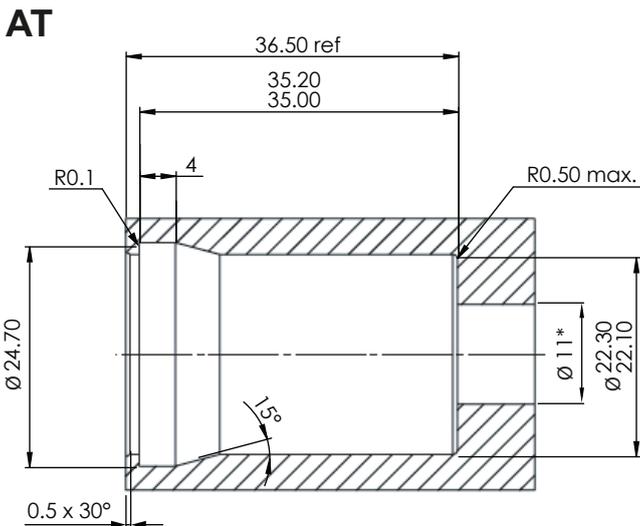
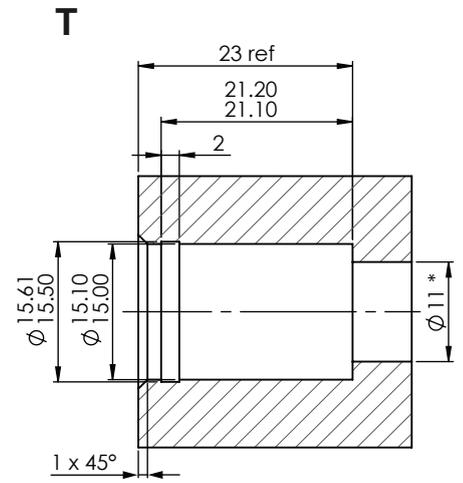
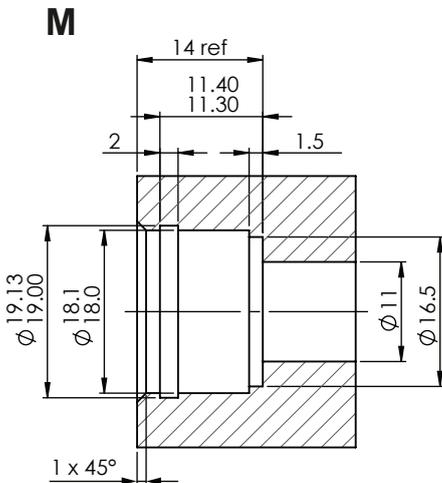
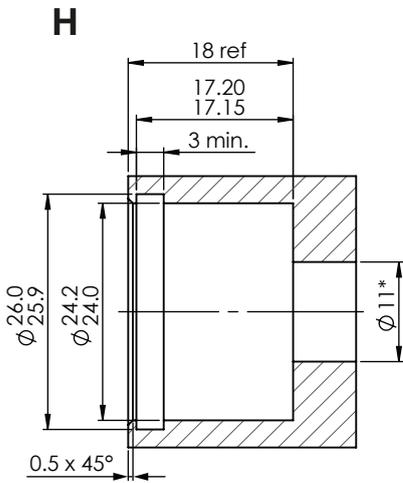
## REMOTE 'R' MAGNETS SEE ALSO PAGE 18



	ØD (mm)	L (mm)	r (mm)
<b>R1</b>	5.1/5.2	13	0.40
<b>R2</b>	10.1/10.2	15	0.85
<b>R3</b>	4.85/4.95	50.8	0.60
<b>R5</b>	4.85/4.95	50.8	0.60
<b>R6</b>	9.6/9.7	50.8	0.60
<b>R7</b>	11.6/11.7	62	1.20

### PRODUCTION NOTES

UNLESS OTHERWISE STATED  
 REMOVE ALL SHARP EDGES  
 MACHINED SURFACE TEXTURE TO BE  $\leq 1.6\mu\text{m Ra}$   
 TOLERANCE ON MACHINED DIMENSIONS  $\pm 0.25\text{ mm}$   
 TOLERANCE ON NON-MACHINED DIMENSIONS  $\pm 0.75\text{ mm}$   
 TOLERANCES ON ANGLES  $\pm 2\text{ DEGREES}$   
 ALL DIMENSIONS IN MILLIMETRES



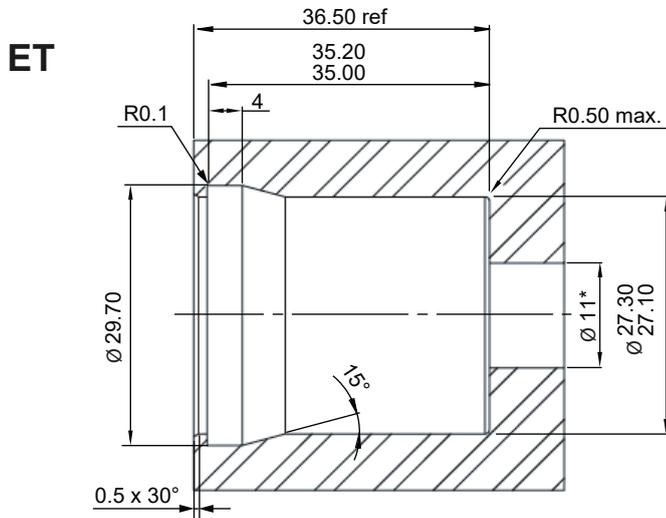
\*Gundrill hole diameter will affect oil flow,  $\phi 11$  is preferable to support the transducer. However, consideration must be given to the pressure created in the gundrilled hole at various stroke lengths, cylinder speeds, oil viscosities, and temperatures. Each magnet has a maximum gundrill hole size. Installation in hollow tubes can also be accommodated - please contact Rota for more information.

Subject to reasonable modifications due to technical advances



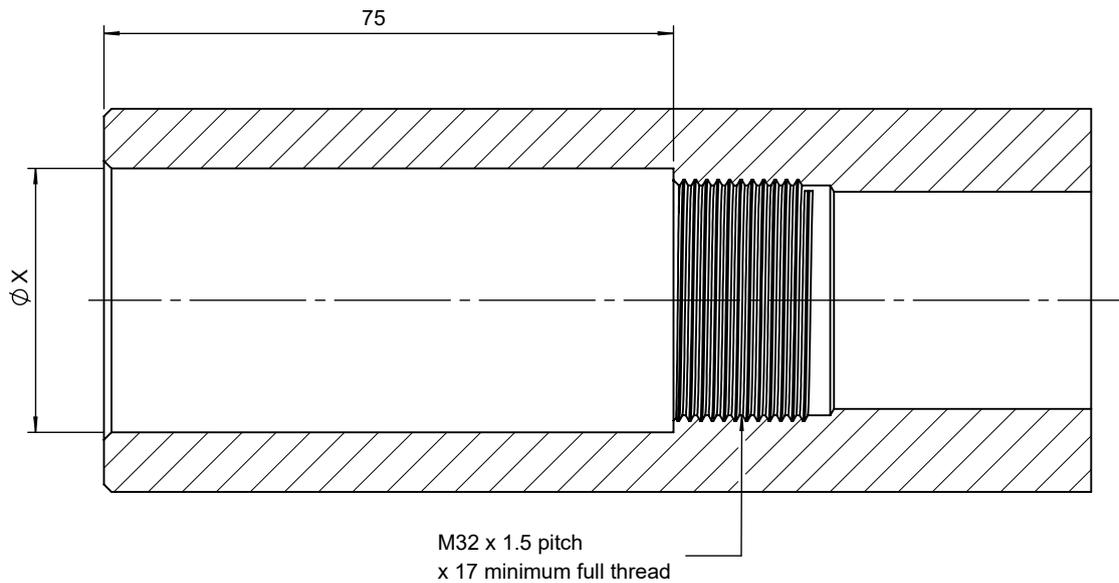
**RELIABLE OPERATION TOUGH APPLICATION**

## Magnet Housing Machining Details Continued



PRODUCTION NOTES  
 UNLESS OTHERWISE STATED  
 REMOVE ALL SHARP EDGES  
 MACHINED SURFACE TEXTURE TO BE  $\leq 1.6\mu\text{m Ra}$   
 TOLERANCE ON MACHINED DIMENSIONS  $\pm 0.25\text{ mm}$   
 TOLERANCE ON NON-MACHINED DIMENSIONS  $\pm 0.75\text{ mm}$   
 TOLERANCES ON ANGLES  $\pm 2\text{ DEGREES}$   
 ALL DIMENSIONS IN MILLIMETRES

### AW/CW



	$\phi X$ (mm)	Resolution (mm)
<b>AW</b>	$\geq 60$	0.3
<b>CW</b>	50	2.0

\*Gundrill hole diameter will affect oil flow,  $\phi 11$  is preferable to support the transducer. However, consideration must be given to the pressure created in the gundrilled hole at various stroke lengths, cylinder speeds, oil viscosities, and temperatures. Each magnet has a maximum gundrill hole size. Installation in hollow tubes can also be accommodated - please contact Rota for more information.

Subject to reasonable modifications due to technical advances



# LA STANDARD PERFORMANCE DATA

Termination Options				
Termination Description		M12 Connectors	Deutsch/AMP Connectors	Cables or Wires
Code		J, MH, M9	DT <sup>1</sup> , RT <sup>1</sup> , TM, UP	N, U, W
<b>Analogue (3 wire)</b>				
Terminal Wiring Details	Input	1 (Red)	1 (Red)	Red
	Signal	2 (White)	2 (White)	White
	Common	3 (Black)	3 (Black)	Black
		4 (Not Connected)	N/A	N/A
<b>2 Wire 4-20mA</b>				
Terminal Wiring Details	Input	1 (White)	1 (White)	White
	Common/Signal Return	2 (Black)	2 (Black)	Black
		3, 4 (Not Connected)	N/A	N/A
<b>CAN bus<sup>2</sup></b>				
Terminal Wiring Details		1 (Not Connected)	N/A	N/A
	Input	2 (Red)	1 (Red)	Red
	Common	3 (Black)	2 (Black)	Black
	CAN_H	4 (White)	3 (White)	White
	CAN_L	5 (Green)	4 (Green)	Green
<b>Environmental Performance</b>				
<b>Sensor and Magnet</b>				
Pressure Rating	Maximum Operation = 350 Bar (5075 psi)		(375 Bar (5450 psi) for LB model)	
	Minimum Collapse = 530 Bar (7690 psi)		(530 Bar (7690 psi) for LB model)	
<b>Sensor</b>				
Enclosure	Aluminium 6082 T6 (Stainless Steel 304 for LB model)			
Vibration Tests	IEC 60068-2-64 Random Vibration (including resonant frequencies) - 10-2000Hz @ 20g (all 3 axes) Resonant Frequency Search and Dwell Test - 10-2000Hz up to 7 found and each held @ 1g for 1 Hour			
EMC	Tested and complies to: UN ECE Reg. 10.05: October 2014 (automotive), EN ISO 14982:2009 (agricultural & forestry machinery), ISO 13766:2018 (earth-moving and building construction machinery)			
MTBF <sup>3</sup>	Estimated 44 years for 1 metre (40") stroke length - any output - M, H, T, R1 magnets. Estimated 79 years for 1 metre (40") stroke length - any output - AT, CT, ET, R2 magnets. Estimated 79 years for 0.5 metre (20") stroke length - any output - M, H, T, R1 magnets. Estimated 129 years for 0.5 metre (20") stroke length - any output - AT, CT, ET, R2 magnets. Estimated 129 years for 1 metre (40") stroke length - any output - AW, CW, R4, R5, R6, R7 magnets. Estimated 191 years for 0.5 metre (20") stroke length - any output - AW, CW, R4, R5, R6, R7 magnets.			
<small>1. Deutsch DT/RT 3 pin - Rota ref 3DT/3RT connector pins lettered not numbered, pin 1 - A, pin 2 - B &amp; pin 3 - C.  2. Maximum length for CAN stub cables dependent on Bus network configuration  3. Figures stated are for electronics only, and depend on stroke length and output type. Figures quoted to be used as a guide.</small>				

Subject to reasonable modifications due to technical advances



## RELIABLE OPERATION TOUGH APPLICATION



# LA STANDARD PERFORMANCE DATA

Stroke	Up to 3.180 m (125 ") (Contact Rota for stroke lengths up to 40 m (1600 ")										
Resolution including ripple	0.05, 0.1, 0.2, 0.3, 0.5, and 2.0 mm available - see pages 16 - 18 for further details										
Repeatability	< 0.5 mm standard (0.02 ") or < 0.3 mm (0.012 ") - any length (< 0.1 mm (0.004 ") - any length: Available on request)										
Hysteresis (see pg 16/17)	< 0.5 mm standard (0.02 ") or < 0.3 mm (0.012 ") - any length (< 0.1 mm (0.004 ") - any length: Available on request)										
Non-linearity (see pg 16/17)	< ±0.2 mm (0.008 "), < ±0.8 mm (0.031 "), < ±1.0 mm (0.039 "), or < ±2.0 mm (0.079 ")										
Operating and Storage Temperature	-40°C to + 105°C (-40°F to +221°F)										
Surge Protection	Tranzorb Protection Diode (BS EN 61000-4-5 Compliant)					ISO 7637-2 & ISO 7637-3					
Short Circuit Protection	All types protected to maximum input voltage										
Electrical Protection	All types fully protected against incorrect connection (all wires) to maximum input voltage Supply Reverse polarity protection up to -36V DC										
<b>Analogue Outputs</b>											
Update Frequency	Update Frequency (3 Wire types) 900Hz - any length Update Frequency (2 wire 4-20mA) - 620Hz - any length										
Update Period	3 Wire Types	1.1 ms; any length - gives 1.1 mm (0.043 ") resolution at 1metre/second magnet speed. 1.1 ms; any length - gives 0.55 mm (0.022 ") resolution at 0.5metre/second magnet speed.									
	2 Wire 4-20mA	1.6 ms; any length - gives 1.6 mm (0.063 ") resolution at 1metre/second magnet speed. 1.6 ms; any length - gives 0.80 mm (0.031 ") resolution at 0.5metre/second magnet speed.									
Start-up Time	3 Wire Types	<120 ms									
	2 Wire 4-20mA	<200 ms									
Analogue Outputs <i>(custom output on requests)</i>	0.5 - 3.5V	0.25 - 4.75V	0.5 - 4.5V	0.5 - 10V	0.5 - 4.5V	0.5 - 4.75V	0.5 - 5.0V	4 - 20 mA		4 - 20 mA	
Order Code	C	F	G	H	L	R	V	A <sup>1</sup>	B <sup>2</sup>	T <sup>3</sup>	BU <sup>4</sup>
Input Voltage	4 - 10V	9 - 32V	9 - 32V	13 - 32V	5 - 10V	9 - 32V	9 - 32V	13 - 32V	10 - 18V	11 - 28V	10 - 30V
Current Consumption (~)	8mA	8.5mA	8.5mA	8.5mA	8mA	8.5mA	8.5mA	9.5mA + signal	9.5mA + signal	4 - 20mA	9.5mA + signal
Power Consumption	0.04W (5V)	0.2W (24V)	0.2W (24V)	0.2W (24V)	0.04W (5V)	0.2W (24V)	0.2W (24V)	0.7W (24V)	0.35W (12V)	0.48W (24V)	0.35W (12V)
Magnet off stroke output	~0.2V	~0.2V	~0.2V	~0.36V	~0.2V	~0.2V	~0.2V	0.7mA	0.7mA	3.8mA	0.7mA & 0.2V
<p>1. Three wire current output signal type "A" designed for a 24V Input, 500Ohm load. For other input voltages and load resistances please inform Rota</p> <p>2. Three wire current output signal type "B" designed for a 12V Input, 250Ohm load. For other input voltages and load resistances please inform Rota</p> <p>3. Two wire current output signal type "T" designed for a 12V Input, 250Ohm load. For other input voltages and load resistances please inform Rota</p> <p>4. Three wire current output signal type "BU" designed for a 12V Input, 250Ohm load. For other input voltages and load resistances please inform Rota</p>											
<b>Digital Outputs</b> <sup>5, 6</sup>											
Position Resolution	CAN	0.1mm per bit - any length (Standard)					Higher bit resolution available on request to Rota				
Update Frequency	CAN	J1939 and CANopen - 1100Hz - Any Length									
Update Period	J1939	0.9 millisecond; any length - gives 0.9 mm (0.035 ") resolution at 1metre/second magnet speed									
	CANopen	0.6 millisecond; any length - gives 0.45 mm (0.018 ") resolution at 0.5metre/second magnet speed									
Start-up Time	J1939	<10 ms									
	CANopen	<250 ms									
Digital Output	<b>CANopen (CiA 301)</b>			<b>SAE J1939</b>			<b>ISOBUS</b>		<b>P.W.M</b>		
Order Code	O			J			Z		P		
PWM Frequency				-					500Hz		
Duty Cycle				-					1 - 99%		
Magnet off Stroke Output				Magnet Error Byte					0.5% Duty Cycle		
Input Voltage	9 - 32V										
Temperature Co-Efficient (~)	±15ppm/°C (±0.0008%/°F) + 0.002mm/°C										
Current Consumption (~)				20mA					8mA		
Power Consumption (~)				0.48W (24V) or 0.24W (12V)					0.2W(24V)		
NB! Repeatability, Hysteresis, and Non-linearity data does not apply to the remote 'R' magnet series. Contact Rota for details											
5. Canbus test kit 'LJ 2914' available, please contact Rota											
6. You will be asked to complete a CAN order form with your desired parameters											

Subject to reasonable modifications due to technical advances



## RELIABLE OPERATION TOUGH APPLICATION

Rota Limited, Manchester UK

www.rota-ltd.com

LACAT V4.2.25.01



# HOW TO ORDER

LA A 3180 AT 0.3 A R L 4DT N 0.5 1234

## LA Series Linear Transducer

### Mounting Configuration

- A = 3/8" BSPP
- AR= 3/8" BSPP Rotatable
- B = M3-M5 Grubscrew
- C = Clip in Head
- D = M5-M6 Grubscrew
- E = 3/4" - 16 UNF (SAE#8)
- ER= 3/4" - 16 UNF (SAE#8) Rotatable
- F = Flat - no mounting configuration
- FA = 15° angled
- FP = Parallel Offset
- G = 1/2" - 20 UNF (SAE#5)
- H = 1/2" - 20 UNF (SAE#5) Reverse
- J = M12 x 1.5
- K = 9/16" - 18 UNF (SAE#6) Reverse
- L = M16 x 1.5
- LR= M16 x 1.5 Rotatable
- M = M18 x 1.5
- P = 1/4" BSPP
- U = 9/16" - 18 UNF (SAE#6)

### Stroke

(millimetres - max=3180mm, longer strokes available for remote magnets)

### Magnet\*

- AT = 0.3 mm res - high speed
- AW = 0.3 mm res - very high speed
- CT = 2.0 mm res - high speed
- CW = 2.0 mm res - very high speed
- ET = 0.3 mm res - high speed
- H = 0.05 mm (CANbus) or 0.1 mm (analogue) res
- M = 0.3 mm res
- R = See page 18 for res
- T = 0.3 mm res

\*For non-magnetic housing contact Rota

### Signal Resolution

0.05, 0.1, 0.2, 0.3, 0.5, 2.0 mm

### Output Signal

- A = Current 4 to 20 mA (3 Wire) (13 - 32 V Input)
- B = Current 4 to 20 mA (3 Wire) (10 - 18 V Input)
- BU= Current 4 to 20 mA & Voltage 1.0 to 5.0 V (10 - 30 V Input)
- C = Voltage 0.5 to 3.5 V (4 - 10 V Input)
- F = Voltage 0.25 to 4.75 V (9 - 32 V Input)
- G = Voltage 0.5 to 4.5 V (9 - 32 V Input)
- H = Voltage 0.5 to 10.0 V (13 - 32 V Input)
- J = CANbus SAE J1939 (9 - 32 V Input)
- L = Voltage 0.5 to 4.5 V (5 - 10 V Input)
- O = CANopen (9 - 32 V Input)
- P = P.W.M 500Hz (9 - 32 V Input)
- R = Voltage 0.5 to 4.75 V (9 - 32 V Input)
- T = Current 4 to 20 mA (2 Wire) (11 - 28 V Input)
- V = Voltage 0.5 to 5.0 V (9 - 32 V Input)
- Z = ISOBUS (9 - 32 V Input)

### Optional

R = Reversible Signal (analogue outputs only)

## Unique Transducer Calibration Number

### Optional

A = Alignment aid - for easy fitting  
[LAB, LAC, LAD only]

### Flying Lead Length (m)

**N, U & W Terminations**  
standard lengths\* (approx.): 0.15, 0.3, 0.4, 0.5, 1.0, 1.5, & 2.0 m

### or

### Cylinder Bore (mm)

**K & L Terminations**  
eg 060 = 60 mm bore

\*Lead length is measured to tip of pins or connector where applicable

### Electrical Termination

- J = M12 Integral Connector (6061 Al)  
[LAA, LAAR, LAE, LAER, LAF, LAFA, LAFF, LAL, LALR, LAM, LAU only]
- K = M12 Connector (2 Holes Flange Mount, 304 St Steel [LAD only])
- L = M12 Connector (4 Holes Flange Mount, 304 St Steel) [LAB, LAC & LAK only]
- N = PVC Cable
- U = PUR Cable
- W = Individual Wires

### Optional

- 2DT/2DC = Deutsch DT04-2P
- 3DT/3DC = Deutsch DT04-3P
- 4DT/4DC = Deutsch DT04-4P
- 6DT/6DC = Deutsch DT04-6P
- 8DT/8DC = Deutsch DT04-8P
- 2RT/2RC = Deutsch DT04-2P with IP69K contacts
- 3RT/3RC = Deutsch DT04-3P with IP69K contacts
- 4RT/4RC = Deutsch DT04-4P with IP69K contacts
- 6RT/6RC = Deutsch DT04-6P with IP69K contacts
- 8RT/8RC = Deutsch DT04-8P with IP69K contacts
- 2TM/2TC = Deutsch DTM04-2P
- 3TM/3TC = Deutsch DTM04-3P
- 4TM/4TC = Deutsch DTM04-4P
- 6TM/6TC = Deutsch DTM04-6P
- 8TM/8TC = Deutsch DTM04-8P
- 2UP/2UC = AMP 282104-1
- 3UP/3UC = AMP 282105-1
- 4UP/4UC = AMP 282106-1
- 5UP/5UC = AMP 282107-1
- 6UP/6UC = AMP 282108-1
- 4MH = M12 - 4 pin [LAA, LAB, LAC, LAD, LAF, LAG, LAJ, LAL, LAM, LAP & LAU only]
- 5MH = M12 - 5 pin
- 4M9 = 90° M12 - 4 pin
- 5M9 = 90° M12 - 5 pin

### Optional

L = 'End of stroke' signal positions factory set at Rota  
Q = Quick calibration upon installation

Subject to reasonable modifications due to technical advances



# RELIABLE OPERATION TOUGH APPLICATION

Rota Limited, Manchester UK

www.rota-ltd.com

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