

# ICS100 IN-CYLINDER LINEAR POSITION SENSORS



## **Removable contact slider assembly**

The ICS100 is designed for easy integration into either hydraulic or pneumatic actuators and is supplied with a contact slider ring that can be easily removed from the sensor when installing in the actuator/cylinder rod. The slider ring is color coded for easy identification of the application type - hydraulic (H) option is blue; pneumatic (P) option is black. Mounting hardware is supplied with each sensor to ensure simple, quick installation.

## **Total reliability**

The ICS100 provides a highly reliable solution for absolute position sensing in hydraulic/pneumatic actuators. The self-cleaning, long life contact design and stable, predictable output of the hybrid track improves service life and reduces the need for regular maintenance or re-calibration of the control system.

## **World leading availability**

The ICS100 sensor has been 'designed for manufacture' which enables assembly in a state-of-the-art manufacturing cell. This means that we can supply any one of 125 different lengths, three different flange styles, two different slider ring styles and two cable lengths in three to five days from ordering.

**This combination of options equates to 1500 different sensors - all available faster than our competitors.**

For that really urgent project, we are flexible enough to be able to despatch the same day as ordered.

## **Operating fluids - caution**

The hydraulic fluid (H) version of the ICS100 has been tested for use in mineral oils only. We do not recommend this sensor for use:-

**In systems containing water based fluids (e.g. water glycol)**

**In systems containing oil with zinc additives present**

**Where system filtration allows particles greater than 10 microns in size**

Information provided in this brochure on product applications should be used by customers for guidance only. Customers should satisfy themselves of the actual performance requirements and subsequently the suitability for any particular design application and the environment in which the ICS100 is to be used.

If you have any doubt about the content, cleanliness or filtration levels of your fluid, we recommend the use of the Penny + Giles contactless in-cylinder transducer range - see our separate brochure on the ICT series.



# ICS100 IN-CYLINDER LINEAR POSITION SENSORS

## PERFORMANCE

<b>Electrical length E</b>	<b>mm</b>	25 to 200 in 5mm increments 210 to 1100 in 10mm increments (Up to 1600mm can be specified. See options)
<b>Resistance ±10%</b>	<b>kΩ</b>	1 per 25mm length
<b>Independent linearity</b>	<b>±%</b>	0.25 for 25 to 70mm lengths 0.15 for 75 to 1600mm lengths
<b>Power dissipation at 20°C</b>	<b>W</b>	0.5 per 25mm length
<b>Applied voltage - maximum Vdc</b>		22 per 25mm length (maximum 74Vdc)
<b>Resolution</b>		Virtually infinite
<b>Hysteresis (repeatability)</b>		Less than 0.01mm
<b>Operational temperature</b>	<b>°C</b>	-30 to +100
<b>Output smoothness</b>		To MIL-R-39023 grade C 0.1%
<b>Insulation resistance</b>		Greater than 50MΩ at 250Vdc
<b>Operating mode</b>		Voltage divider only - see Circuit Recommendation below
<b>Wiper circuit impedance</b>		Minimum of 100 x track resistance or 0.5MΩ, (whichever is greater)
<b>Slider operating force - max. gf</b>		60
<b>Life</b>		Typically greater than 100 million operations (50 x 10 <sup>6</sup> cycles) at 25mm stroke length
<b>Dither life</b>		200 million operations (100 x 10 <sup>6</sup> cycles) at ±0.5mm 60Hz
<b>Slider velocity - maximum</b>	<b>m/s</b>	10 in pneumatic applications 4 in hydraulic applications (ISO VG 32 mineral oil)
<b>Vibration</b>		RTCA/DO-160D 10Hz to 2000Hz, 4.12g (rms) - all axes
<b>Shock</b>		40g, 6.0mS, half sine profile - all axes
<b>Pressure - working</b>	<b>Bar</b>	500 maximum
<b>burst</b>	<b>Bar</b>	> 700
<b>pulsed</b>	<b>Bar</b>	0 to 500 in 1 second (tested to 25,000 cycles)
<b>Working fluid</b>		Tested for mineral oils only. Not recommended for water based fluids or systems containing zinc additives. See cautionary note on page 3.

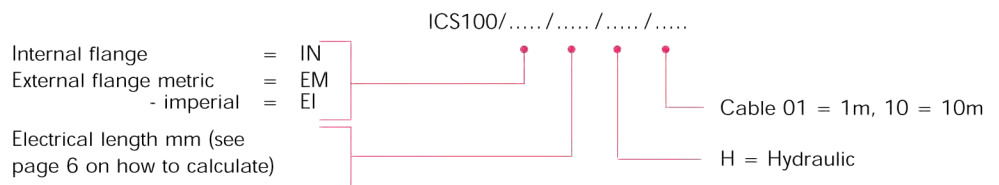
## OPTIONS

<b>Electrical length</b>	Length from 1110mm up to 1600mm can also be supplied in 10mm increments. Please discuss your application with our sales team before ordering.
<b>Mounting</b>	Internal or external flange styles can be specified
<b>Cylinder environment</b>	Hydraulic (H)
<b>Extended cable length</b>	1m or 10m output cable can be specified

## AVAILABILITY

All standard configurations can be supplied rapidly from the factory - check with your local supplier for more details

## ORDERING CODES



Pneumatic version no longer available

## INSTALLATION

An installation kit is provided comprising: O rings, wave washers, shims and circlips. Full details on recommendations for cylinder designers are shown on pages 6 & 7

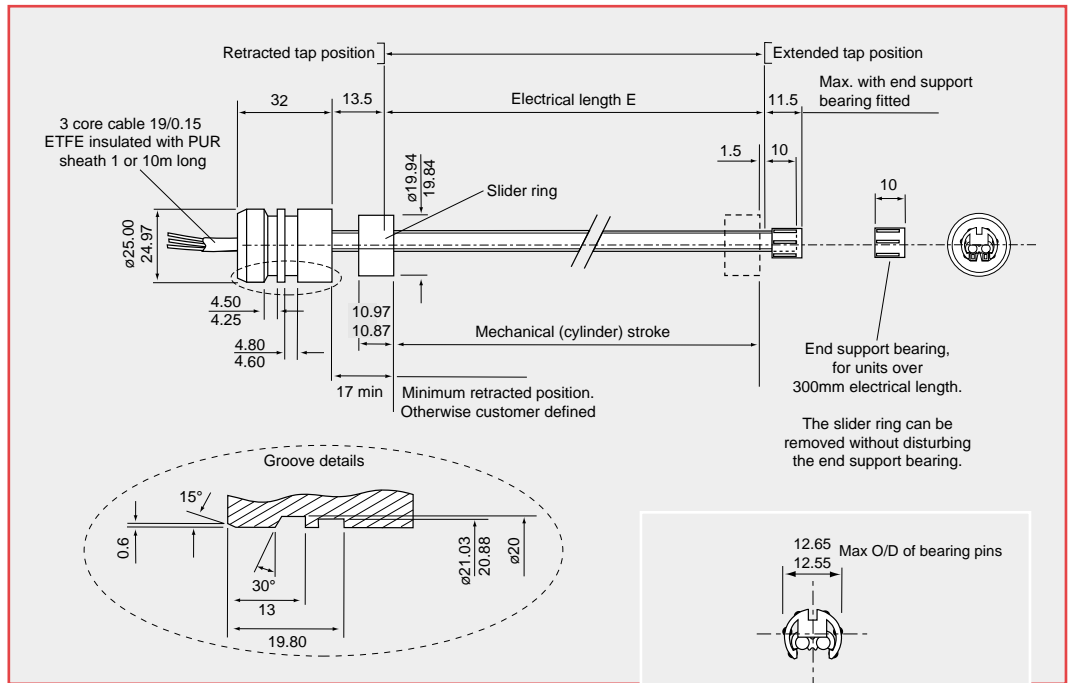
## CIRCUIT RECOMMENDATION

Hybrid track potentiometers feature a high wiper contact resistance, therefore operational checks should be carried out only in the voltage divider mode. Hybrid track potentiometers should be used only as voltage dividers, with a minimum wiper circuit impedance of 100 x track resistance or 0.5MΩ (whichever is greater). Operation with wiper circuits of lower impedance will degrade the output smoothness and affect the linearity.

## DIMENSIONS

### INTERNAL FLANGE

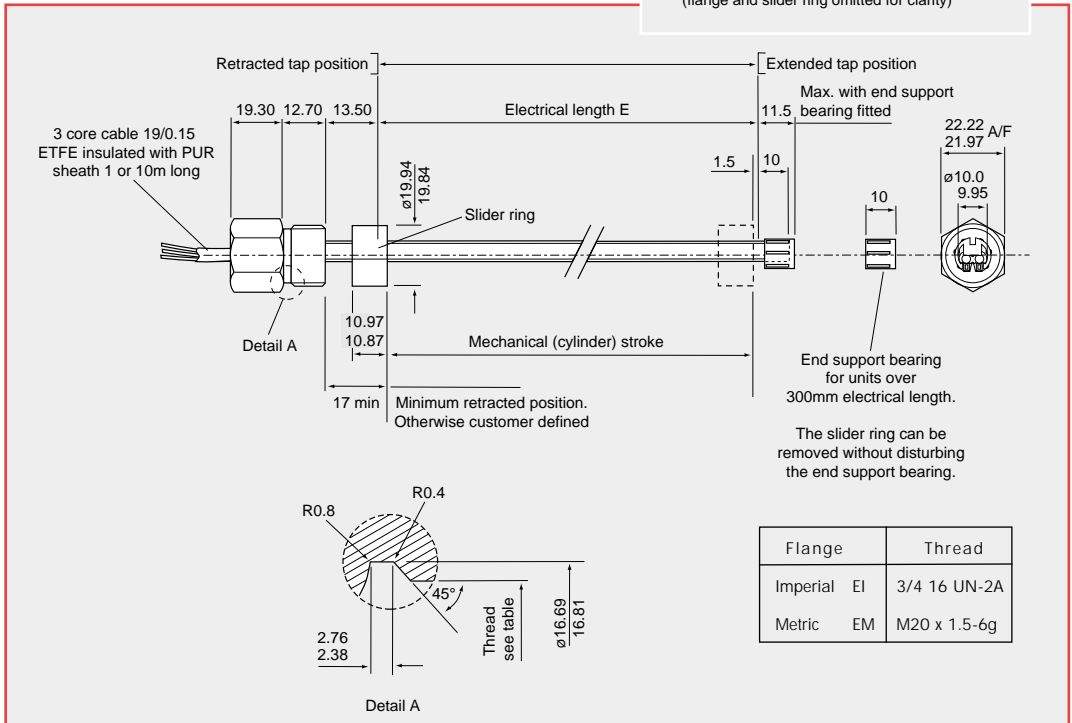
ICS100/IN



View with end support bearing fitted (flange and slider ring omitted for clarity)

### EXTERNAL FLANGE

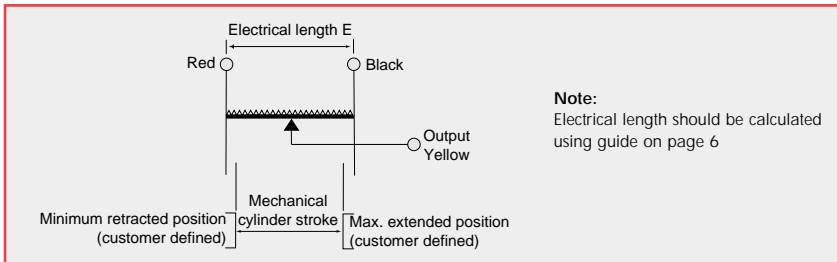
ICS100/EI or EM



Flange	Thread
Imperial EI	3/4 16 UN-2A
Metric EM	M20 x 1.5-6g

### ELECTRICAL CONNECTIONS

3 core cable: PUR sheathed  
1m or 10m long with ETFE  
insulated 19/0.15 cores



# ICS100 DESIGNERS GUIDE FOR ORDERING AND INSTALLATION

The ICS100 sensor is designed for use inside hydraulic or pneumatic actuators and to ensure the correct calculation of the electrical length for ordering purposes, these notes have been developed to assist cylinder designers determine the key dimensions. If you encounter any difficulty with these instructions, please use the contact details on the rear cover to ask for assistance.

In most applications, the designer will need answers to the following questions:

- What length of sensor do I need to order to match my cylinder stroke? - see STEP 1
- How deep should I bore the cylinder rod? - see STEP 2
- What is the machining detail for the sensor attachment? - see STEP 3

## STEP 1 - Calculate electrical length - E This is part of the ordering code

The sensor can only be ordered by **electrical length** - not mechanical stroke of the actuator / cylinder. (Refer to fig.1 and 2)

The formula to use is  $E = a + b - 1.03\text{mm}$

Where

- a** = Maximum mechanical stroke of actuator/cylinder in mm\*
- b** = user defined dead length\*

**-1.03mm constant** =  $c_1 + c_2 - c_3$  (including maximum tolerances)

Select a sensor from the range that has a value for **E** equal to or greater than the calculated length. Note that the ICS100 can be ordered in increments of 5mm for 25mm to 200mm lengths, and increments of 10mm for 210mm to 1600mm lengths.

### Typical working example:

Cylinder mechanical stroke <b>a</b>	= 321.0 ±1.0mm
User defined dead length <b>b</b>	= 6.70 ±0.5mm
Constant	= -1.03mm
Sensor	= External flange, metric thread; hydraulic use; 1m cable

Maximum electrical length (including positive tolerances) =  $322 + 7.2 - 1.03 = 328.17\text{mm}$

From the available range, the next closest length to 328.17mm is **330mm**, so select this in the ordering code. Full ordering code for this selection would be: **ICS100/EM/0330/H/01**

### Calculating the sensor body length

For reference, the maximum sensor body length (see dimension **d** on figs.1 & 2) can be calculated using the following formula once **E** has been determined. Use datum **X** of the sensor pressure flange.

- i) For sensors below 300mm electrical length (without the end support bearing fitted)  $d = E + 24.0\text{mm}$   
(24.0mm constant is calculated\* as  $c_3 + g = [13.5 + 0.25] + [10.0 + 0.25]$ )

\*Including maximum tolerances

- ii) For sensors 300mm electrical length and above (with the end support bearing fitted)  $d = E + 25.5\text{mm}$   
(25.5mm constant is calculated\* as  $c_3 + h = [13.5 + 0.25] + [11.5 + 0.25]$ )

### Working example for ICS100/EM/0330/H/01

This sensor with a 330mm electrical length will be supplied with an end support bearing, so use calculation ii) Maximum sensor body length **d** (including positive tolerances) =  $330 + 25.5 = 355.5\text{mm}$

## STEP 2 - Calculate full diameter drill depth of cylinder rod

Calculate the full diameter drill depth from counter bore spot face (see dimension **f** on figs. 1 & 2)

The following calculation assumes that the cylinder rod is in the fully retracted position against a mechanical stop and that the slider ring is fully located against the spot face of the slider ring location bore. This position is shown as datum **Y** in figs. 1 and 2.

- iii) For sensors below 300mm electrical length (without the end support bearing fitted)  $f = E - b + 18.03$   
(18.03mm constant is calculated as  $c_3 - c_2 + g + 5\text{mm [clearance]} = [13.5 + 0.25] - [10.97] + [10.0 + 0.25] + 5$ )

**Suggested cylinder rod bore diameter is 11.0mm minimum.**

- iv) For sensors 300mm electrical length and above (with the end support bearing fitted)  $f = E - b + 19.53$   
(end support bearing adds 1.5mm to sensor length)  
**Suggested cylinder rod bore diameter is 13.0mm minimum.**

### Working example for ICS100/EM/0330/H/01

This sensor with a 330mm electrical length will be supplied with an end support bearing, so use calculation iv)  
 $f = E - b + 19.53 = 330 - 6.2 + 19.53 = 343.33\text{mm}$

In this working example, we suggest the full diameter bore depth from datum **Y** is 344mm (rounded up to the nearest mm)

In these calculations, we have suggested a 5mm clearance to eliminate any chance of the sensor hitting the limit of the cylinder rod bore at the fully retracted position.

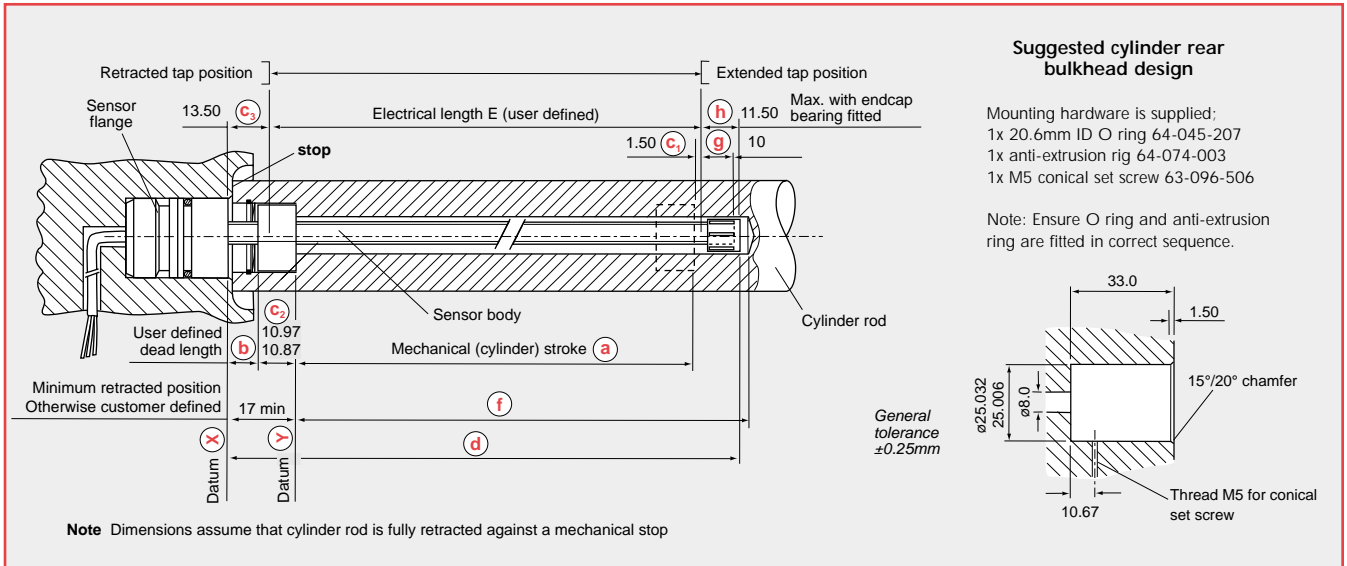
## STEP 3 - Machine cylinder rod and rear bulkhead

Using the detail from fig.3, machine the cylinder rod to accept the slider ring (same for both styles whether H hydraulic or P - pneumatic). Ensure the slider ring is fitted correctly - as notes on fig.3

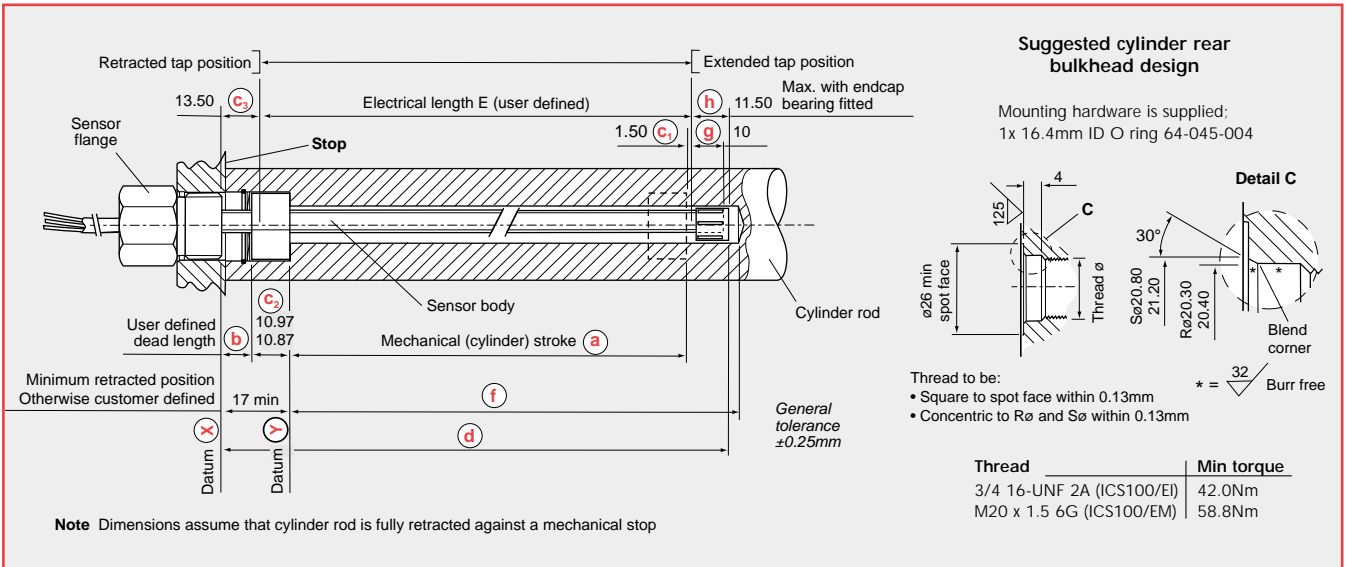
Use the detail in fig.1 or fig.2 (depending on flange style) to machine the rear bulkhead to accept the sensor.

Each sensor is supplied with the mounting hardware to mount the sensor and slider ring assembly. The generic kit includes all components for all types of sensor available. Spare mounting hardware kits can be ordered as part number AI200535

**Fig 1 INTERNAL FLANGE** ICS100/IN



**Fig 2 EXTERNAL FLANGE** ICS100/EI & EM



**Fig 3 SLIDER RING** ICS100 - mounting instructions and dimensions for boring cylinder rod.

