



mm **X100**

## APPLICATION

- Intrinsically safe for Gas to: Ex II 1G
- Non-contacting inductive technology to eliminate wear
- Travel set to customer's requirement
- High durability and reliability
- High accuracy and stability
- Sealing to IP65/IP67 as required



As a leading designer and manufacturer of linear, rotary, tilt and intrinsically safe position sensors, Althen has the expertise to supply a sensor to suit a wide variety of applications. Our intrinsically safe X100 incorporates electronics system EX07 which is ATEX / IECEx / UKEX approved for use in potentially explosive **gas/vapour** atmospheres. The X100 is designed for demanding hydraulic or pneumatic cylinder position feedback applications where service life, environmental resistance and cost are important and is ideal for OEMs seeking good sensor performance for arduous applications in hazardous areas.

Overall performance, repeatability and stability are outstanding over a wide temperature range. The unit is highly compact and space-efficient, being responsive along almost its entire length. Like all Althen sensors, the X100 provides a linear output proportional to travel. Each unit is supplied with the output calibrated to the travel required by the customer, any stroke from 0-5mm to 0-800mm and with full EMC protection built in. The sensor is very rugged, being made of stainless steel with an inert fluoropolymer-sheathed probe with a stainless steel target tube. The sensor is easy to install in cylinders and has a range of mechanical options. Environmental sealing is to IP65 or IP67 depending on selected cable or connector options.

## SPECIFICATIONS

<b>Dimensions<sup>1</sup></b> Body diameter Body Length (to seal face) Probe Length (from seal face) Target Tube Length	35 mm 43 mm calibrated travel + 58 mm calibrated travel + 30 mm
<b>Independent Linearity</b>	$\leq \pm 0.25\% \text{ FSO @ } 20^\circ\text{C}$ - up to 450 mm $\leq \pm 0.5\% \text{ FSO @ } 20^\circ\text{C}$ - over 450 mm
<b>Temperature Coefficients</b>	$< \pm 0.01\%/^\circ\text{C}$ Gain & $< \pm 0.01\%\text{FS}/^\circ\text{C}$ Offset
<b>Frequency Response</b>	$> 10 \text{ kHz}$ (-3dB)
<b>Resolution</b>	Infinite
<b>Noise</b>	$< 0.02\% \text{ FSO}$
<b>Intrinsic Safety<sup>2</sup></b>	Ex II 1G Ex ia IIC T4 Ga (Ta= -40°C to 80°C)
<b>Sensor Input Parameters (connector option/s) (cable option/s)</b>	Ui: 11.4V, Ii: 0.20A, Pi: 0.51W. Ci: 1.16µF, Li: 50µH Ci: 1.36µF, Li: 860µH with 1km max. cable
<b>Environmental Temperature Limits</b> Operating Storage	-40°C to +80°C -40°C to +125°C
<b>Sealing</b>	IP65/IP67 depending on connector / cable option
<b>Hydraulic Pressure</b>	350Bar
<b>EMC Performance</b>	EN 61000-6-2, EN 61000-6-3

SPECIFICATIONS (CONTINUED)

Vibration	IEC 68-2-6: 10 g
Shock	IEC 68-2-29: 40 g
MTBF	350,000 hrs 40°C Gf
Drawing List <sup>3</sup> X100-11 P100-12 P100-15 TG24-11	Sensor Outline Typical Target Installation details Mounting Thread details Optional Target Tube Flange details
<sup>1</sup> For full mechanical details see drawings X100-11 <sup>2</sup> Approval only applies to the specified ambient temperature range and atmospheric conditions in the range 0.80 to 1.10 Bar, oxygen ≤ 21% <sup>3</sup> 3D models, step or .igs format, available on request	

INTRINSICALLY SAFE EQUIPMENT

Intrinsically safe equipment is defined as “equipment which is incapable of releasing sufficient electrical or thermal energy under normal or abnormal conditions to cause ignition of a specific hazardous atmosphere mixture in its most easily ignited concentration.”  
ATEX / IECEx / UKEX approved to;

Ex II 1G  
Ex ia IIC T4 Ga (Ta= -40°C to 80°C)

Designates the sensor as belonging to; Group II: suitable for all areas **except mining**, Category 1 G: can be used in areas with continuous, long or frequent periods of exposure to hazardous gas / vapour (Zones 2 to 0).

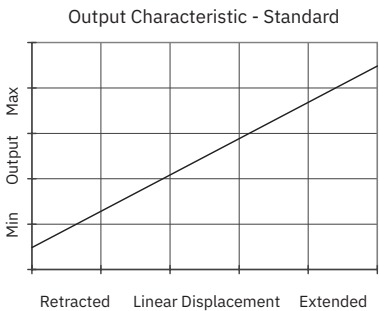
Gas / Vapour:

Protection class ia, denotes intrinsically safe for all zones  
Apparatus group IIC: suitable for IIA, IIB and IIC explosive gas / vapour.  
Temperature class T4: maximum surface temperature under fault conditions 135°C.  
Ambient temperature range extended to -40°C to +80°C.

It is imperative Althen intrinsically safe sensors be used in conjunction with a galvanic barrier to meet the requirements of the product certification. The Althen X005 Galvanic Isolation Amplifier is purpose made for Althen IS sensors making it the perfect choice. Refer to the X005 datasheet for product specification and output configuration options.

For cable lengths exceeding 10 metres a five wire connection is recommended to eliminate errors introduced by cable resistance and associated temperature coefficients.

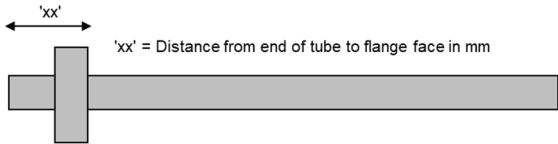
ATEX / IECEx / UKEX approved sensors suitable for dust (E series) and mining (M series) applications, are also available from Althen.



X100	a	b	c	d	e	f	g	h
	Displacement	A	Adjustments	Connections	Option	R	Option	Z000

a Displacement		Value
Factory set to any length from 0-5 mm to 0-800 mm (e.g. 0- 254 mm)		254
b Output		
Supply V <sub>dc</sub> (tolerance)	Output	Code
+5V (4.5 - 5.5V)	0.5 - 4.5V (ratiometric with supply)	A
Supply Current: 10mA nominal, 12mA max.		
c Calibration Adjustments		Code
Accessible default		blank
Sealed		Y
d Connections		Code
Connector IP65 4 pin (3+earth) DIN 43650 'C'		J
Connector IP65 4 pin (3+earth) DIN 43650 'C', pre-wired 3-core cable		Jxx
Connector IP65 4 pin (3+earth) DIN 43650 'C', pre-wired 5-core cable		JQxx
Cable gland IP67 M12, nylon, 3-core cable		Lxx
Cable gland IP67 M12, nylon, 5-core cable		LQxx
Cable gland, short† IP67, metal, 3-core cable		Mxx
Cable gland, short† IP67, metal, 5-core cable		MQxx
Specify required cable length 'xx' in cm. e.g. L2000 specifies axial cable gland with 20 m of cable, 50 cm supplied as standard. <b>Note!</b> maximum length supplied 15000cm. <b>†Nb:</b> restricted cable pull strength.		
e Mounting Thread		Code
M20 x 1.5		N
3/4 16 UNF	Hex. 30 mm A/F, Ø 30 mm seal face. Supplied with O-ring seal.	P
M18 x 1.5		T
See P100-15 Drawing for Mating Thread Details.		

f Target Tube		Code
Stainless Steel 316 O.D.: 9.45 mm		R
See P100-12 Drawing for Typical Target Installation details.		
g Target Tube Mounting Flange		Code
None		U
Penny & Giles HLP100		Vxx
Temposonics (M4 fixing)	Please specify flange position in mm. eg. W17.5 specifies a Tempo style flange fitted 17.5 mm from the front face	Wxx
Parker Hannifin		Xxx
See TG24-11 Drawing for Target Details.		
h Z-code		Code
Calibration to suit X005 required		Z000
IP67 M12 IEC 61076-2-101 conn. No access to cal. Adjustments, must include option 'Y'		Z600
IP67 M12 IEC 61076-2-101 conn. with access to cal. adjustments		Z601
Tighter Independent Linearity; $\pm$ xx% FSO @20°C $\leq \pm 0.1\%$ 0 - 10 mm min. to 0 - 450 mm $\leq \pm 0.25\%$ 0 - 451 mm to 0 - 600 mm $\leq \pm 0.5\%$ 0 - 601 mm to 0- 800 mm max.		Z650



THREE OR FIVE-WIRE MODE CONNECTION

The aim of this document is to help readers who do not understand what is meant by three or five wire modes of connection between the galvanic isolation amplifier and sensor, and the factors behind them. It is by no means an in-depth technical analysis of the subject.

Whether opting for a pre-wired Althen Intrinsically Safe sensor or one with a connector, choosing the right mode of connection and cable to suit the application requires careful consideration.

Interconnecting cables are not perfect conductors and offer resistance to current flow, the magnitude of resistance<sup>†</sup> depends on conductors resistivity, which changes with temperature, cross sectional area<sup>†</sup> and length. If the voltage were to be measured at both ends of a length of wire it would be found they are different, this is known as volts drop. Volts drop changes with current flow and can be calculated using Ohm's law, it should be noted that volts drop occurs in both positive and negative conductors. The effects of volts drop can be reduced by increasing the conductors cross sectional area, this does not however eliminate the effects due to temperature variation. There are instances where large cross-section cables are not practical; for example most standard industrial connectors of the type used for sensors have a maximum conductor capacity of 0.75mm<sup>2</sup>, copper prices and ease of installation are other considerations.

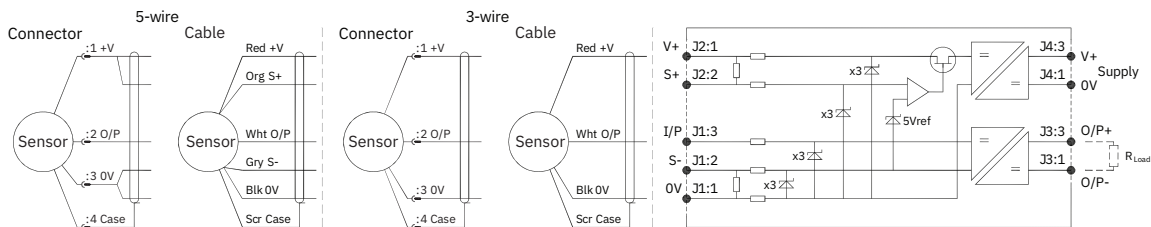
This is important because the effects of volts drop can significantly alter the perceived accuracy of the sensor which is ratiometric i.e. the output signal is directly affected by the voltage across the sensor. Changes in temperature will also be seen as gain variation in the sensor output.

**Three wire mode connections** are common and are suitable in most cases with short or moderate cable runs. Applications that do not require a high degree of accuracy but have cable runs, say in excess of 10m, volts drop can reduced by introducing a terminal box close to the sensor and using a larger cross-section cable for a majority of the cable run. Sensors supplied with three core cable are calibrated with the cable fitted which largely eliminates errors due to conductor resistance at room temperature however, as mentioned above, small gain errors due to temperature fluctuations should be expected.

**Five wire mode connections** have significant benefits as losses in the positive and negative conductors are compensated for by the galvanic isolation amplifier which can ‘sense’ the voltage across the sensor and dynamically adjust the output voltage so that the voltage across the sensor is correct. The effects of cable resistance and associated temperature coefficients are eliminated allowing for smaller conductors than a three wire connection for the same cable run. The amplifier can compensate for up to 15Ω per conductor with a current flow of 15mA, which is more than adequate for 150m of 0.25 mm<sup>2</sup> cable, longer lengths will require larger conductors.

**For this reason Althen recommends five wire connections for cable lengths exceeding 10 metres in 0.25 mm<sup>2</sup> cable to preserve the full accuracy of the sensor.**

See illustrations below for examples of connecting a sensor to the galvanic isolation amplifier.



Cable Length (metres)	Up to 150	150 - 300	300 - 450	450 - 600	600 - 900	900 - 1000
Cross Section (mm <sup>2</sup> )	0.25	0.5	0.75	1.0	1.5	2.0

The table above shows recommended conductor sizes with respect to cable length for both three and five wire connections, based on copper conductors. Three wire connections will introduce a gain reduction of 5% and a ±1% temperature dependence of gain over the range -40°C to +80°C for the cable temperature. (i.e. about -150 ppm/°C for the maximum lengths shown and less pro rata for shorter lengths.)

It should be noted that the maximum cable length, as specified in the sensor certification, takes **precedence** and **must not** be exceeded.

Althen sensors are supplied with three core 0.25 mm<sup>2</sup> cable as standard, however five core 0.25 mm<sup>2</sup> cable can be supplied on request. The galvanic isolation amplifier is available as;

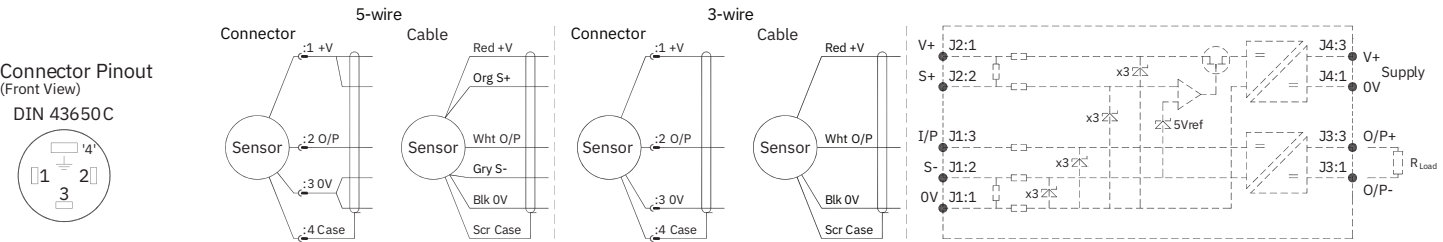
- G005-\*\*\* for ‘G’ and ‘H’ prefix sensors
- X005-\*\*\* for ‘E’, ‘M’ and ‘X’ prefix sensors

<sup>†</sup>  $R = \rho L / A$   $\rho$  is the resistivity of the conductor ( $\Omega m$ )  $L$  is the length of conductor (m)  $A$  is the conductor cross-sectional area (m<sup>2</sup>).  
<sup>‡</sup> It is presumed that direct current flow is uniform across the cross-section of the wire, the galvanic isolation amplifier and sensor are a dc system.

**INSTALLATION INFORMATION**

For certificate number and safety parameters information for product marked EX04, see next page.

ATEX / IECEx / UKEX Qualified to Intrinsic Safety Standard Certificate numbers SIRA 13ATEX2371X IECEx SIR 13.0154X CSAE 21UKEX2537X			Ex II 1G Ex ia IIC T4 Ga (Ta = -40°C to +80°C)
Electronics Version	Output Description	Supply Voltage: V <sub>s</sub> (tolerance)	Load resistance
EX07	0.5 - 4.5V (ratiometric with supply) [Output code 'A']	+5V (4.5 - 5.5V)	5kΩ min



**PUTTING INTO SERVICE**

The sensor must be used with a galvanic isolation barrier designed to supply the sensor with a nominal 5V and to transmit the sensor output to a safe area. The barrier parameters must not exceed:-

U <sub>i</sub> = 11.4V	I <sub>i</sub> = 0.20A	P <sub>i</sub> = 0.51W
C <sub>i</sub> = 1.36μF*	L <sub>i</sub> = 860μH*	(with maximum cable length)
C <sub>i</sub> = 1.16μF	L <sub>i</sub> = 50μH	(without cable)

\*Figures for 1km cable where: C<sub>i</sub> = 200pF/m & L<sub>i</sub> = 810nH/m

The sensor is certified to be used with up to **1000m** of cable, cable characteristics must not exceed:-

Capacitance: ≤ 200 pF/m or max. total of: 200 nF  
Inductance: ≤ 810 nH/m or max. total of: 810 μH

Approval only applies to specified ambient temperature range and atmospheric conditions in the range: 0.80 to 1.10 Bar, oxygen ≤ 21%.

The performance of the sensor may be affected by voltage drops associated with long cable lengths; For cable lengths exceeding 10 metres a five wire connection is recommended to eliminate errors introduced by cable resistance and associated temperature coefficients.

**SPECIAL CONDITION FOR SAFE USE**

The apparatus does not meet the 500 V r.m.s dielectric strength test between circuit and frame, in accordance with clause 6.3.13 of IEC 60079- 11:2011. This must be taken into consideration on installation.

Under certain extreme circumstances, the non-metallic and isolated metal parts incorporated in the enclosure of this equipment may generate an ignition-capable level of electrostatic charge. Therefore the equipment shall not be installed in a location where the external conditions are conducive to the build-up of electrostatic charge on such surfaces. This is particularly important if the equipment is installed in a zone 0 location. In addition, the equipment shall only be cleaned with a damp cloth.

**Use:** The sensor is designed to measure linear displacement and provide an analogue output signal.

**Assembly and Dismantling:**

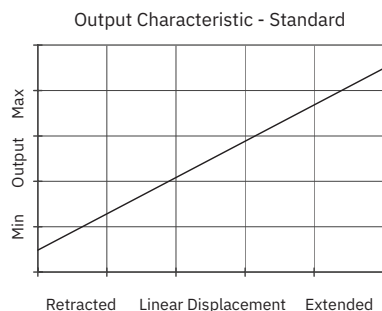
The unit is not to be serviced or dismantled and re-assembled by the user.

**Maintenance:** No maintenance is required.

## OUTPUT CHARACTERISTIC

Target position at start of normal travel is 36.0 mm from seal face.

The output increases as the target is moved away from the sensor body, the calibrated stroke is between 5 mm and 800 mm.



## MECHANICAL MOUNTING

Via mounting thread, maximum tightening torque: 100Nm. See drawing P100-15, Installation Details Mounting Threads & Seals. An O ring seal is provided, size BS908 for M20 & 3/4 UNF thread or 14.3 x 2.4 for M18 thread. Install the target tube using the flange provided or fix directly into the piston rod using adhesive for instance, the end of the target tube can be proud or flush with the piston end face as required see drawing P100-12.

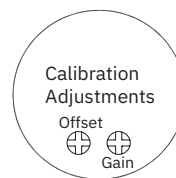
## GAIN AND OFFSET ADJUSTMENT

(Where accessible - Typically  $\pm 10\%$  Min available)

To adjust the gain or offset use a small potentiometer adjuster or screwdriver 2mm across. Do not apply too much force on the potentiometers.

## INCORRECT CONNECTION PROTECTION LEVELS

<b>A</b>	<b>Not protected</b> – the sensor is <b>not</b> protected against either reverse polarity or over-voltage. The risk of damage should be minimal where the supply current is limited to less than 50mA.
----------	--



For certificate number and safety parameters information for product marked EX07, see previous page.

ATEX Qualified to Intrinsic Safety Standard Certificate numbers SIRA 00ATEX2076X			Ex II 1G EEx ia IIC T4 (Ta = -40°C to +80°C)
Electronics Version	Output Description	Supply Voltage: $V_s$ (tolerance)	Load resistance
EX04	0.5 - 4.5V (ratiometric with supply) [Output code 'A']	+5V (4.5 - 5.5V)	5kΩ min

The barrier parameters must not exceed:-

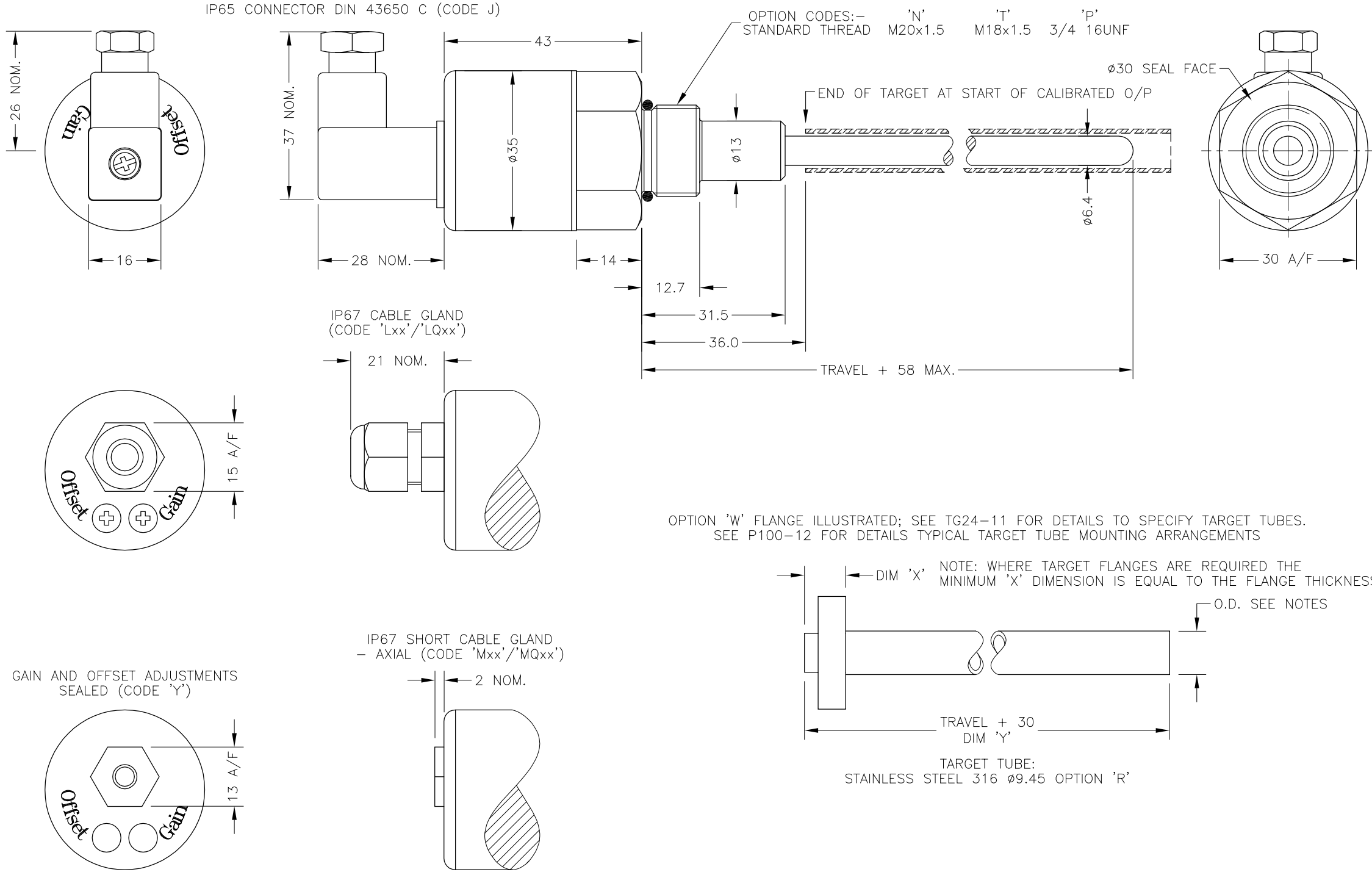
<b>Ui = 11.4V</b>	<b>Ii = 0.20A</b>	<b>Pi = 0.51W</b>
<b>Ci = 1.36μF*</b>	<b>Li = 710μH* ('Lxx' or 'Mxx' options)</b>	*Figures for 1km cable
<b>Ci = 1.16μF</b>	<b>Li = 50μH ('J' option)</b>	

The sensor is certified to be used with up to **1000m** of cable, cable characteristics must not exceed:-

Capacitance: ≤ 200 pF/m or max. total of: 200 nF

Inductance: ≤ 660 nH/m or max. total of: 660 μH

With the exception of the certificate number and safety parameters above, all other notes regarding Putting Into Service, Use, Assembly and Dismantling etc. on previous page apply to sensors marked EX04 or EX07.



ELECTRICAL OPTIONS/ SPECIFICATIONS


OUTPUT	SUPPLY
0.5 TO 4.5V RATIOMETRIC	5V
SUPPLY CURRENT 12mA TYP. 20mA MAX.	
CABLE: 0.2mm <sup>2</sup> , O/A SCREEN, PUR JACKET — SUPPLIED WITH 50cm OR REQUIRED LENGTH IN cm (15000cm MAX).	
STANDARD 3—CORE: JACKET ø4mm BLACK	e.g. 'L50'
OPTIONAL 5—CORE: JACKET ø4.6mm BLUE	e.g. 'LQ50'
CABLE/CONNECTOR* CONNECTIONS;	
3 CORE	5 CORE    CONNECTOR
RED	RED    :1    +Ve
—	ORG    :1    +SENSE (5—WIRE ONLY)
BLACK	BLACK :3    0V
—	GRY    :3    —SENSE (5—WIRE ONLY)
WHITE	WHITE :2    OUTPUT
SCREEN	SCREEN :4    BODY

\*CONNECTORS; MAXIMUM CONDUCTOR CROSS SECTION 0.75mm<sup>2</sup>

RANGE OF DISPLACEMENT FROM 0-5mm TO 0-800mm e.g.76, IN INCREMENTS OF 1mm.

BODY MATERIAL: STAINLESS STEEL.

NOTE:— READ INSTALLATION SHEET X100-19 FOR FULL INSTRUCTIONS FOR USE.

ATEX / IECEx APPROVED TO	
	II 1G
Ex ia IIC T4 Ga (Ta= -40° to +80°C)	
Ui 11.4V, Ii 0.2A, Pi 0.51W	



APPROVED FOR USE IN CONJUNCTION WITH A GALVANICALLY ISOLATED BARRIER.

NOTE: APPROVAL ONLY APPLIES AT NORMAL ATMOSPHERIC PRESSURE!

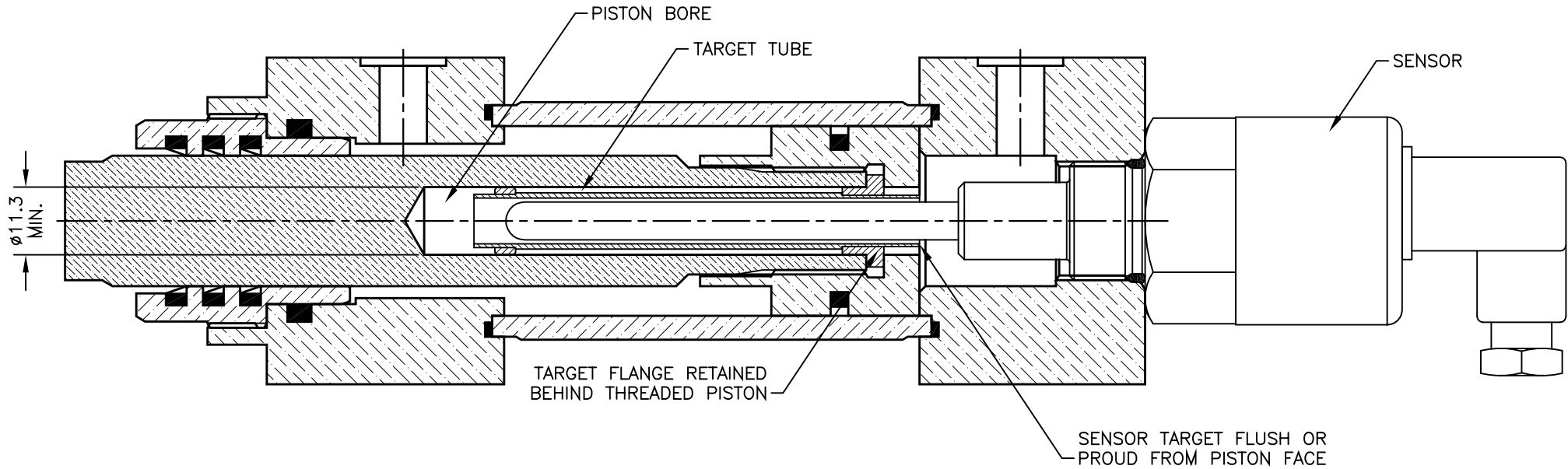
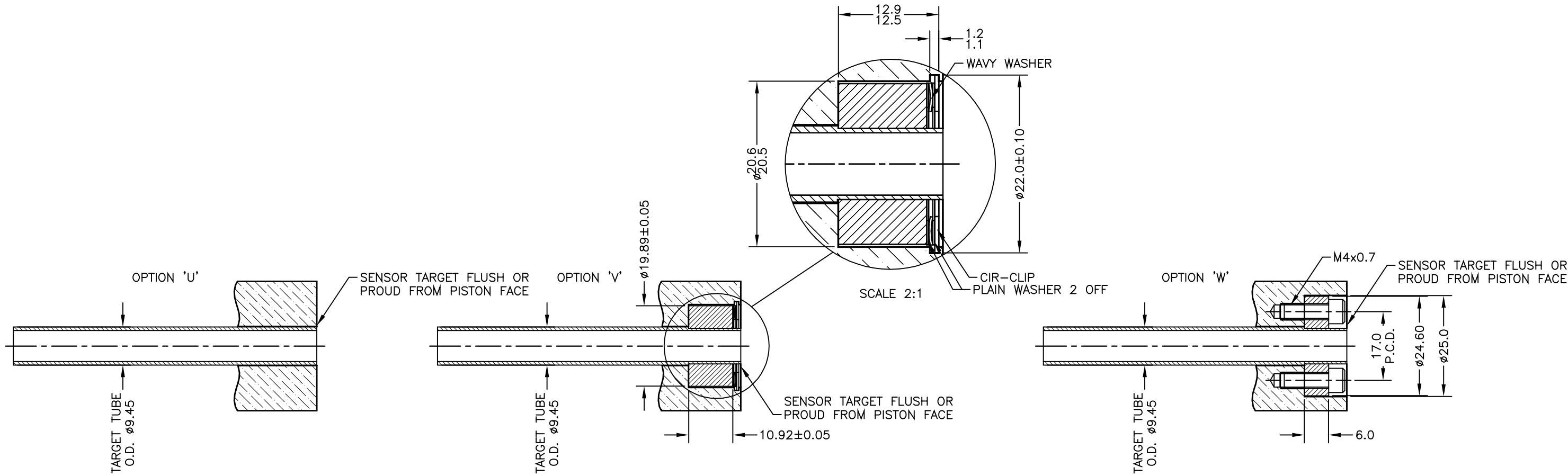
H	OPTION 'S' REMOVED - RAN1035.	PDM
J	RANGE WAS 20-600 RAN1056	RDS
K	TARGET NOTES AMENDED ~ RAN1114	PDM
L	5-CORE OPTION ADDED ~ RAN1102	PDM
M	RANGE NOTE AMENDED ~ RAN1200	PDM
N	HEX. LENGTH 14 WAS 15 ~ RAN1160	PDM



DRAWINGS NOT TO BE CHANGED WITHOUT REFERENCE TO THE CHANGE PROCEDURE.  
CHANGES TO PARTS USED IN INTRINSICALLY SAFE PRODUCT MUST BE APPROVED BY THE AUTHORISED PERSON  
THIS IS AN UNCONTROLLED PRINT AND WILL NOT BE UPDATED.

H	29/06/15		CHECKED BY	X	±0.4	
J	9/11/15		RDS	X.X	±0.2	
K	18/10/16			X.XX	±0.1	
L	06/04/17	DESCRIPTION				
M	29/08/17	X100 INTRINSICALLY SAFE				
N	11/10/17	CYLINDER LINEAR POSITION SENSOR				
SCALE		DRAWING NUMBER		REV		
10mm		X100-11		N		
				SHEET		
				1 OF 1		

SEE DRAWING TG24-11 FOR TARGET TUBE FLANGE OPTIONS 'V', 'W' & 'X'.



A	FIRST ISSUE.	RDS
B	REDRAWN.	PDM
C	WORDING AMMENDED	RDS
D	TARGET NOTES AMENDED - RAN1349	PDM

DRAWINGS NOT TO BE CHANGED WITHOUT REFERENCE TO THE CHANGE PROCEDURE.  
CHANGES TO PARTS USED IN INTRINSICALLY SAFE PRODUCT MUST BE APPROVED  
BY THE AUTHORISED PERSON  
THIS IS AN UNCONTROLLED PRINT AND WILL NOT BE UPDATED.

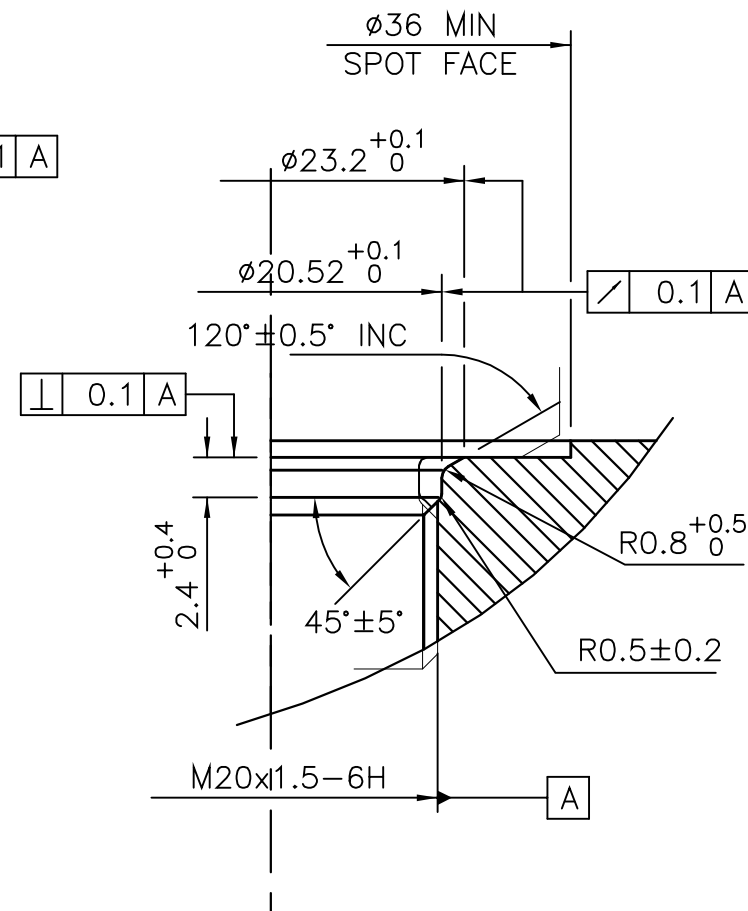
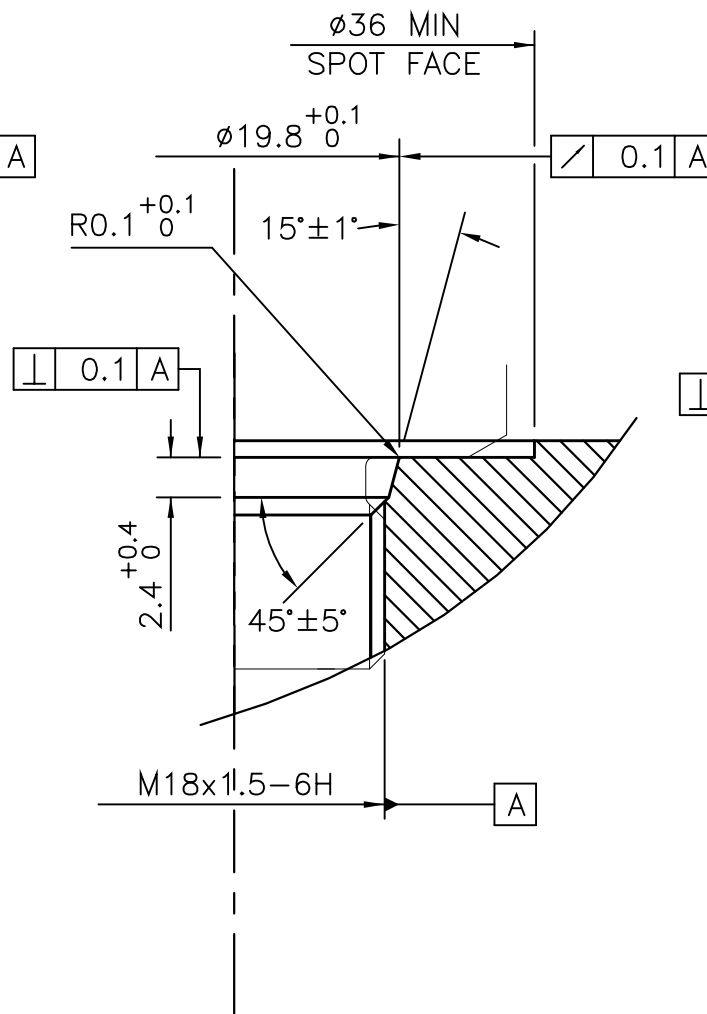
A	28/06/95		CHECKED BY	X	±0.4
B	04/10/11		RDM	X.X	±0.2
C	26/10/17			X.XX	±0.1
D	22/01/21			DIMS	mm
		DESCRIPTION			
		TYPICAL TARGET TUBE FITTING OPTIONS			
	SCALE 10mm	DRAWING NUMBER P100-12		REV	D
				SHEET	1 OF 1





A

RDS

Technical drawing of a mechanical part showing a cross-section with various dimensions and tolerances. The part has a cylindrical top section with a diameter of 36 mm (tolerance 0 to +0.1) and a spot face. Below this is a section with a diameter of 20.6 mm (tolerance 0 to +0.1) and a 15-degree angle. The bottom section has a diameter of 20.6 mm (tolerance 0 to +0.1) and a 45-degree angle. The part is threaded with 3/4 inch - 16 UNF Class 3B. Surface finish requirements are specified as 0.1 A for several surfaces.



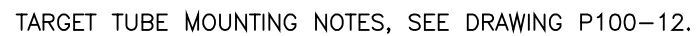
A	FIRST ISSUE	COH/DS
---	-------------	--------

A	29/01/95		MATERIAL	X $\pm 0.4$ X.X $\pm 0.2$ X.XX $\pm 0.1$ ALL DIMS mm
			SEE NOTE 1	
			DESCRIPTION	
			INSTALLATION DETAILS MOUNTING THREADS & SEALS	
SCALE		DRAWING NUMBER	P100-15 REV	A
5mm 				
		SHEET <span style="border: 1px solid black; padding: 2px;">1</span> OF <span style="border: 1px solid black; padding: 2px;">1</span>		

1. SPECIFY TUBE MATERIAL; CODE:-  
'R' STAINLESS STEEL 316  $\phi 9.45$ .  
'S' ALUMINIUM 6063  $\phi 3/8$  (9.2-9.8); NOTE! ONLY AVAILABLE WITH P100 OR P106 VERSIONS.

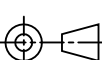

2. SPECIFY FLANGE TYPE; CODE: 'U', 'Vx', 'Wx' OR 'Xx' ~ SEE DETAILS BELOW.

3. SPECIFY DIMENSION 'x' (mm), NOT APPLICABLE CODE 'U' PLAIN TUBE. ← LEN



E	MATERIAL OPTION REMOVED.	PDM
F	MAT'L OPTION REINSTATED RAN221.	PDM
G	X DIM FOR PH FLANGE SHOWN RAN225	RDS
H	9.45 WAS 9.5 RAN396	RDS
J	REDRAWN, PH FLANGE ROTATED RAN507.	PDM
K	NOTE 1 AMENDED ~ RAN1114.	PDM
L	'x' WAS 'n' ~ RAN1309	PDM

DRAWINGS NOT TO BE CHANGED WITHOUT REFERENCE TO THE CHANGE PROCEDURE.  
CHANGES TO PARTS USED IN INTRINSICALLY SAFE PRODUCT MUST BE APPROVED  
BY THE AUTHORISED PERSON  
THIS IS AN UNCONTROLLED PRINT AND WILL NOT BE UPDATED.

E	16/10/06		CHECKED BY	X	±0.4
F	24/09/08		RDM	X.X	±0.2
G	13/11/08			X.XX	±0.1
				DIMS	mm
H	11/12/12	DESCRIPTION			
J	23/07/14	TARGET TUBE AND FLANGE			
K	30/11/16	OPTIONS (LIPS 100/106)			
L	08/11/22				
SCALE		DRAWING NUMBER	TG24-11	REV	L
5mm					
		SHEET			1 OF 1