

# Rosemount™ 2521 Solids Level Switch

## Vibrating Fork



- Very high sensitivity (<5 g/l)
- Reliable, simple and maintenance free measurement principle
- Suitable for process pressures up to 232 psi (16 bar)
- Temperature range from -40 to 302 °F (-40 to 150 °C)
- Extremely robust short-fork versions

# Introduction

## Measurement principles

The Rosemount™ 2521 uses the principle of a tuning fork and a piezo-electric crystal to oscillate the forks at their natural frequency. Changes to the oscillation frequency are continuously monitored by electronics which varies depending on whether the fork is covered or uncovered by a solids medium.

When the solids medium in the vessel (silo) falls away from the fork, it causes a change of oscillation frequency that is detected by the electronics and the output switches to indicate an 'uncovered' state.

When the solids medium in the vessel (silo) rises and covers the fork, it causes a change of oscillation frequency that is detected by the electronics and the output switches to indicate a 'covered' state.

The electrical output will vary depending on the electronics selected.

## Key features and benefits

- Enhanced version of the vibrating fork with extra sensitivity options
- Available as a standard fork length and tube/cable extended fork lengths
- Ideal for use on bulk solids - particularly suitable for use in fine-grained and powdered materials
- Suitable for hygienic applications - polished forks and wetted parts made from stainless steel
- Short fork design allows mounting in small pipes or process vessels with very limited space
- Versatile installation, may be installed in vertical, horizontal, or angled positions
- Modular and simple design
- Available with separate electronic housing
- Reliable, simple, and maintenance-free measurement principle
- Robust aluminum die-cast housing with IP66 protection
- Adjustable signal output time delay
- Handles mechanical vibrations in process
- Approvals for hazardous locations (gas and dust)

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## Applications

- Materials with very light product density, <math> < 0.3 \text{ lb/ft}^3 < /math> (5 \text{ g/l})</li>- Applications requiring pneumatic filling
- Silos/vessels with limited space
- Vibration within the vessel
- High reliability requirements



## Ordering information

**Table 1: Rosemount 2521 Ordering Information**

The starred offerings (★) represent the most common options and should be selected for best delivery. The non-starred offerings are subject to additional delivery lead time.

Model	Product description	
2521	Level Switch - Enhanced Vibrating Fork	★
<b>Fork profile<sup>(1)</sup></b>		
S	Standard sensitivity, 3 lb/ft <sup>3</sup> (50 g/l), dry and wet applications	★
H	High sensitivity, 1.2 lb/ft <sup>3</sup> (20 g/l)	★
<b>Thermal profile</b>		
M	Without extension tube (up to T <sub>proc</sub> = 302 °F (150 °C) at T <sub>amb</sub> ≤ 104 °F (40 °C))	★
E <sup>(2)</sup>	With extension tube (up to T <sub>proc</sub> = 302 °F (150 °C) at T <sub>amb</sub> > 104 °F (40 °C))	★
R <sup>(2)</sup>	With remote housing cable 59-in. (1500 mm) long (up to T <sub>proc</sub> = 302 °F (150 °C))	★
S <sup>(2)</sup>	With remote housing cable 157-in. (4000 mm) long (up to T <sub>proc</sub> = 302 °F (150 °C))	★
C	With cable extension (T <sub>proc</sub> : -13 to 176 °F (-25 to 80 °C), T <sub>amb</sub> : -13 to 140 °F (-25 to 60 °C))	★
<b>Materials of construction: process connection/process extension tube</b>		
D	304/321 Stainless steel (1.4301/1.4541)	★
S <sup>(3)</sup>	316L Stainless steel (1.4404)	★
<b>Conduit entry/cable threads</b>		
1 <sup>(4)</sup>	M20 x 1.5, 1 off screwed cable gland + 1 off blind plug for CE, ATEX, and IECEx	★
2 <sup>(5)</sup>	M20 x 1.5, 2 off screwed cable glands	★
4 <sup>(6)</sup>	½-in. NPT tapered ANSI B1.20.1 (1 off conduit + 1 off Ex-d blind plug)	★
6 <sup>(7)</sup>	M20 x 1.5 (1 off conduit + 1 off Ex-d blind plug)	
<b>Process connection size</b>		
5	1½ in./40 mm (DN40)/40A	★
2 <sup>(8)</sup>	2 in./50 mm (DN50)/50A	★
3	3 in./80 mm (DN80)/80A	★
4	4 in./100 mm (DN100)/100A	★
<b>Process connection rating</b>		<b>Sizes</b>
AA	ASME B16.5 Class 150 flange	All except 5
DZ	EN 1092-1 PN6 flange	4
DA	EN 1092-1 PN16 flange	4
NN <sup>(8)</sup>	For use with non-flange process connection type	2 and 5
<b>Process connection type</b>		<b>Ratings</b>
F	Flat-face flange	DZ and DA
R	Raised-face flange	AA

**Table 1: Rosemount 2521 Ordering Information (continued)**

B	BSPT (R) thread	NN		★
G <sup>(8)</sup>	BSPP (G) thread	NN		★
N <sup>(8)</sup>	NPT thread	NN		★
C <sup>(3)</sup>	Tri Clamp	NN		★
<b>Electronic type</b>		<b>Fork profile</b>	<b>Product certifications</b>	
T	Direct load switching (mains 2-wire) 19 to 230 Vac, without contact, ac/dc	All	All except IJ and IL	★
G	PNP 18 to 50 Vdc	All	All except IJ and IL	★
V	Relay DPDT, 19 to 230 Vac	All	All except IJ and IL	★
E	Relay SPDT, 19 to 230 Vac	All	All except IJ and IL	★
K <sup>(9)</sup>	NAMUR	All except S	All	★
<b>Fork length</b>			<b>Fork profiles</b>	
A <sup>(3)</sup>	Standard length 6.47 in. (165 mm)		S	★
B <sup>(3)</sup>	Standard length 9.25 in. (235 mm), or 10.24-in (260 mm) for Fork Sensitivity V2/V3		H	★
E <sup>(3)(10)</sup>	Extended tube, customer-specified length in tenths of inches		All	★
M <sup>(3)(10)</sup>	Extended tube, customer-specified length in millimeters		All	★
F <sup>(11)(10)</sup>	Extended cable, customer-specified length in tenths of inches		All	★
N <sup>(11)(10)</sup>	Extended cable, customer-specified length in millimeters		All	★
<b>Specific extended fork length</b>				
00000	Factory default length (only if fork length A or B is selected)			★
XXXXX	Specific customer-specified tube/cable length in tenths of inches (XXXX.X inches) or millimeters (XXXXX mm)			★
<b>Product certifications</b>			<b>Conduit entry</b>	
NA	No hazardous locations certifications		1, 2, and 4	★
ND	ATEX, Dust Certification (DIP)		1, 2, and 4	★
NK	IECEX, Dust Certification (DIP)		1, 2, and 4	★
GM	Technical Regulations Customs Union (EAC), Ordinary Locations		1, 2, and 4	★
E7	IECEX, Flameproof / Dust Certification (DIP)		4 and 6	★
E8	ATEX, Flameproof / Dust Certification (DIP)		4 and 6	★
IJ	ATEX, Intrinsically Safe, Dust Certification (DIP)		1, 2, and 4	★
IL	IECEX, Intrinsically Safe, Dust Certification (DIP)		1, 2, and 4	★
K1	ATEX, Increased Safety, Flameproof / Dust Certification (DIP)		1, 2, and 4	★
K7	IECEX, Increased Safety, Flameproof / Dust Certification (DIP)		1, 2, and 4	★
KB	American and Canadian, Dust Certification (DIP)		4 only	★
KE	American and Canadian, Intrinsically Safe, Dust Certification (DIP)		4 only	★
KT	American and Canadian, Increased Safety, Flameproof / Dust Certification (DIP)		4 only	★
KY	American and Canadian, Explosion-proof / Dust Certification (DIP)		4 only	★

**Table 1: Rosemount 2521 Ordering Information (continued)**

KZ	American and Canadian Ordinary Location (unclassified, safe area)	4 only	★
<b>Options (include with selected model number)</b>			
<b>Calibration data certification</b>			
Q4	Certificate of functional test		★
<b>Weather protection</b>			
P2	Weather protection cover		★
<b>Fork sensitivity</b>		<b>Thermal profiles</b>	
V1 <sup>(12)</sup>	Enhanced (> 0.3 lb/ft <sup>3</sup> (5 g/l))	M, E, and C	★
V2 <sup>(12)</sup> (13)	Enhanced (< 0.3 lb/ft <sup>3</sup> (5 g/l)) with increased vibrating surface (aluminum)	M, E, and C	★
V3 <sup>(12)</sup>	Enhanced (< 0.3 lb/ft <sup>3</sup> (5 g/l))	M, E, and C	★
V4 <sup>(14)</sup>	Adjustable sensitivity for interface applications	M, E, and C	★
<b>Sliding sleeve</b>		<b>Thermal profiles</b>	
S2 <sup>(8)</sup> <sup>(15)</sup> (16)	Sliding sleeve, maximum 232 psi (16 bar), maximum 302 °F (150 °C)	M, E, R, and S	★
<b>Extended product warranty</b>			
WR5	5-year limited warranty		★
<b>Tag plate</b>			
WT	Wired tag plate		★
<b>Typical model number: 2521 S M D 1 5 N N B E A 00000 NA</b>			

- (1) There are two adjustable settings, A and B on the electronics board. See [Operating conditions](#) for how the minimum density requirements are affected by the Fork Profile option codes.
- (2) A thermal extension cable or tube (temperature-extended shaft) moves the electronics further away from high process temperatures. Select this extension when ambient temperatures are greater than 104 °F (40 °C). See [Operating conditions](#) and [Dimensional drawings](#) for further information.
- (3) Not available when Thermal Profile code C is selected.
- (4) Code 1 is for selecting a solid switch with M20 x 1.5-in threaded conduit/cable entries. The switch will be provided with 1 screwed cable gland and 1 blind plug. This option is valid with the following product certifications: CE, ATEX and IECEx, except flameproof versions.
- (5) Code 2 is for selecting a solid switch with two screwed M20 x 1.5-in cable glands. Available for all product certification options, except flameproof versions.
- (6) Code 4 is for selecting a solid switch with NPT 1/5-in threaded conduit/cable entries. The switch will be provided with 1 conduit entry adaptor and one Ex-d rated blind plug. It is available for ordering with all product certifications.
- (7) Code 6 is for selecting a solid switch with M20 x 1.5-in threaded conduit/cable entries. The switch will be provided with 1 conduit entry adaptor and one Ex-d rated blanking/stopping plug. This option is valid with the following product certifications: FM and CSA, except flameproof versions.
- (8) When selecting Process connection size code 2 together with Process connection rating code NN, and Process connection type code G or N, the Sliding sleeve code S2 is required.
- (9) Not available when Fork Profile code S is selected.
- (10) Please refer to [Dimensional drawings](#) for minimum and maximum length.
- (11) Available only when Thermal Profile code C is selected.
- (12) Available only when Fork Profile code H is selected (for high sensitivity).
- (13) This option requires a 4-in. flanged process connection to be selected.
- (14) Available only when Fork Profile code S is selected (for standard sensitivity in wet and dry applications) and Product Certification code NA is selected. The potentiometer on the electronics board may then be used to fine-tune the sensitivity.
- (15) The Sliding sleeve option requires an extended fork length.
- (16) Not available when Process connection size code 5 is selected. Available only when Process connection type code F, R, G, or N is selected.

## Spares and accessories

The specification and selection of product materials, options, or components must be made by the purchaser of the equipment. See [Material selection](#) for more information.

The starred offerings (★) represent the most common options and should be selected for best delivery. The non-starred offerings are subject to additional delivery lead time.

**Table 2: Spares**

Part number	Description	
02500-1000-0069	Electronics board: Relay SPDT 19 to 230 Vac, 19 to 55 Vdc, Fork Profile code S	★
02500-1000-0070	Electronic module: Relay SPDT 19 to 230 Vac, 19 to 55 Vdc, intrinsic safe	★
02500-1000-0071	Electronic module: Relay SPDT 19 to 230 Vac, 19 to 55 Vdc, intrinsic safe	★
02500-1000-0072	Electronic module: Relay (DPDT) 19 to 230 Vac, 19 to 36 Vdc, intrinsic safe	★
02500-1000-0073	Electronic module: PNP 18 to 50 Vdc	★
02500-1000-0074	Electronic module: PNP 18 to 50 Vdc, intrinsic safe	★
02500-1000-0075	Electronic module: 2-wire without contact 19 to 230 Vac/Vdc	★
02500-1000-0077	Electronic module: 8/16 mA 2-wire, intrinsic safe	★
02500-1000-0078	Electronic module: 8/16 mA or 4-20 mA 2-wire, intrinsic safe	★
02500-1000-0079	Electronic module: 8/16 mA or 4-20 mA 2-wire	★
02500-1000-0080	Electronics board: Relay SPDT 19 to 230 Vac, 19 to 55 Vdc, Fork Profile code H	★
02500-1000-0081	Electronics board: Relay SPDT 19 to 230 Vac, 19 to 55 Vdc, Fork Sensitivity code V1	★
02500-1000-0082	Electronics board: Relay SPDT 19 to 230 Vac, 19 to 55 Vdc, Fork Sensitivity code V3	★
02500-1000-0083	Electronics board: Relay SPDT 19 to 230 Vac, 19 to 55 Vdc, Fork Sensitivity code V2	★
02500-1000-0084	Electronic module: Relay SPDT 19 to 230 Vac, 19 to 55 Vdc, 0,3 lb/ft <sup>3</sup> (5 g/l), intrinsic safe	★
02500-1000-0085	Electronic module: Relay SPDT 19 to 230 Vac, 19 to 55 Vdc, 0,3 lb/ft <sup>3</sup> (5 g/l), intrinsic safe	★
02500-1000-0086	Electronic module: Relay DPDT 19 to 230 Vac, 19 to 55 Vdc	★
02500-1000-0087	Electronic module: Relay DPDT 19 to 230 Vac, 19 to 55 Vdc, 0,3 lb/ft <sup>3</sup> (5 g/l)	★
02500-1000-0088	Electronic module: Relay DPDT 19 to 230 Vac, 19 to 36 Vdc	★
02500-1000-0089	Electronic module: Relay (DPDT) 19 to 230 Vac, 19 to 36 Vdc, 0,3 lb/ft <sup>3</sup> (5 g/l)	★
02500-1000-0090	Electronic module: VN2000 PNP 18 to 50 Vdc	★
02500-1000-0091	Electronic module: PNP 18 to 50 Vdc, 0,3 lb/ft <sup>3</sup> (5 g/l)	★
02500-1000-0092	Electronic module: PNP 18 to 50 Vdc, 1,2 lb/ft <sup>3</sup> (20 g/l), intrinsic safe	★
02500-1000-0093	Electronic module: PNP 18 to 50 Vdc, 0,3 lb/ft <sup>3</sup> (5 g/l), intrinsic safe	★
02500-1000-0094	Electronic module: 2-wire without contact 19 to 230 Vac/Vdc, 1,2 lb/ft <sup>3</sup> (20 g/l)	★
02500-1000-0095	Electronic module: 2-wire without contact 19 to 230 Vac/Vdc, 0,3 lb/ft <sup>3</sup> (5 g/l)	★
02500-1000-0098	Electronic module: NAMUR 2-wire intrinsic safe	★
02500-1000-0099	Electronic module: NAMUR 2-wire, 0,3 lb/ft <sup>3</sup> (5 g/l), intrinsic safe	★
02500-1000-0100	Electronic module: 8/16 mA 2-wire, 1,2 lb/ft <sup>3</sup> (20 g/l), intrinsic safe	★
02500-1000-0102	Electronic module: 8/16 mA or 4-20 mA, 1,2 lb/ft <sup>3</sup> (20 g/l)	★

**Table 2: Spares (continued)**

Part number	Description	
02500-1000-0103	Electronic module: 8/16 mA or 4-20 mA 0,3 lb/ft <sup>3</sup> (5 g/l)	★
02500-1000-0104	Electronic module: VN2000/6000 8/16 mA or 4-20 mA, 2-wire, 1,2 lb/ft <sup>3</sup> (20 g/l), intrinsic safe	★
02500-1000-0105	Electronic module: VN2000/6000 8/16 mA or 4-20 mA, 2-wire, 0,3 lb/ft <sup>3</sup> (5 g/l), intrinsic safe	★
02500-1000-0107	Remote version: Remote cable (special Triaxial cable), price per 1000 mm (39.4")	★
02500-1000-0108	Remote version: Angle bracket 1.4301 (304)	★

**Table 3: Accessories**

Part number	Description	
02500-7500-0002	Mounting kit 1 for DN100 PN6 and EN1092-1 flange with ø18 mm holes, containing: 4 off M16 x 60 mm screws (A2-grade stainless steel) 4 off M16 nuts 4 off washers 1 off seal (non-food grade) for up to 464 °F (240 °C)	★
02500-7500-0005	Mounting kit 2 for DN100 PN6 and EN1092-1 flange with M16 threaded holes, containing: 4 off M16 x 40 mm screws (A2-grade stainless steel) 4 off washers 1 off seal (non-food grade) for up to 464 °F (240 °C)	★
02500-7500-0008	Mounting kit 3 for DN100 PN16 and EN1092-1 flange with ø18 mm holes, containing: 8 off M16 x 60 mm screws (A2-grade stainless steel) 8 off M16 nuts 8 off washers 1 off seal (non-food grade) for up to 464 °F (240 °C)	★
02500-7500-0011	Mounting kit 4 for DN100 PN16 and EN1092-1 flange with M16 threaded holes, containing: 8 off M16 x 40 mm screws (A2-grade stainless steel) 8 off washers 1 off seal (non-food grade) for up to 464 °F (240 °C)	★
02500-7502-0001	Angle bracket, Aluminium for remote housing cable	★



# Specifications

## Electrical data

Connection terminals	4 mm <sup>2</sup> (AWG 12), maximum
Cable entry options	M20 × 1.5 or ½-in. NPT threaded cable/conduit entry Clamping range (diameter) of the factory provided cable glands: 0.24 to 0.47 in. (6 to 12 mm) for M20 × 1.5
Signal output delay	1 second for uncovered-to-covered switchover 1 to 2 seconds for covered-to-uncovered switchover
Safety operation (FSL,FSH)	Configurable switches for each signal output. Select Fail Safe High (FSH) or Fail Safe Low (FSL) depending on application.
Sensitivity	Adjustable, two settings (A or B)
Vibration frequency	Rosemount 2521S: 350 Hz Rosemount 2521H: 125 Hz (standard) or 90 Hz (enhanced sensitive options V2 to V3)
Installation category	II
Pollution degree	2 (inside housing)

## Electronics

Table 4: Electronics (1/2)

	SPDT relay (universal voltage)	Relay DPDT (universal voltage)	3-wire PNP
Power supply	19 to 230 Vac 50/60 Hz ±10%	19 to 230 Vac 50/60 Hz ±10%	
	19 to 55 Vdc ±10%	19 to 55 Vdc (36 Vdc <sup>(1)</sup> ) ±10%	18 to 50 Vdc ±10%
Maximum ripple of dc supply	7 V <sub>SS</sub>	7 V <sub>SS</sub>	7 V <sub>SS</sub>
Maximum load	8 VA, 1.5 W	18 VA, 2 W	1.5 W
Signal output	SPDT relay	SPDT relay	Open collector: Permanent load maximum is 0.4 A. Short-circuit and overload protected. Maximum power-on voltage is 50 V (reverse protected)
	Maximum 250 Vac, 8 A (non-inductive) Maximum 30 Vdc, 5 A (non-inductive)	Maximum 250 Vac, 8 A (non-inductive) Maximum 30 Vdc, 5 A (non-inductive)	
Intrinsically Safe (IS) ratings	Not applicable		
Indicating LED	Status of signal output is indicated.		
Isolation	Power supply to signal output: 2225 Vrms	Power supply to signal output: 2225 Vrms Signal output to signal output (DPDT): 2225 Vrms	Not applicable
Protection class	I	I	III

(1) Versions of the Rosemount 2521 with an Intrinsically Safe approval are restricted to a maximum supply of 36 Vdc.

**Table 5: Electronics (2/2)**

	<b>2-wire without contact</b>	<b>NAMUR (IEC 60947-5-6)</b>
Power supply	19 to 230 Vac 50/60 Hz ±10%	7 to 9 Vdc
Maximum ripple of dc supply	7 V <sub>ss</sub>	Not applicable
Maximum load	1.5 VA, 1 W	30 mA (for non intrinsically safe application)
Signal output	Load current: Minimum 10 mA Maximum 500 mA permanent Maximum 2 A <200 ms Maximum 5 A <50 ms Voltage drop on the electronic module: Maximum 7 V with closed electric circuit. Cut-off current with open electric circuit: Maximum 5 mA <sup>(1)</sup> Short-circuit- and overload-protected.	<1 mA or >2.2 mA (spec. IEC 60947-5-6)
Intrinsically Safe (IS) ratings	Not applicable	U <sub>i</sub> = 20 V I <sub>i</sub> = 67 mA P <sub>i</sub> = 0.17 W C <sub>i</sub> = negligible L <sub>i</sub> = negligible
Indicating LED	Status of signal output is indicated.	Status of signal output and diagnostics are indicated.
Protection class	I	III

(1) For safety, the cut-off current will be set for some milliseconds to 0 when the electric circuit is open.

## Mechanical data

<b>Housing</b>	Aluminum housing, powder coated Seal between housing and lid: NBR Seal between housing and process connection: NBR Nameplate: polyester film
<b>Cable of separate housing</b>	Silicone elastomer, ø10 mm (ø0.39 in.), surface resistance < 10 <sup>9</sup> Ohm, UV-resistant, minimum bend radius of 1.97 in. (50 mm)
<b>Ingress Protection (IP)</b>	NEMA® Type 4X, IP66 (IEC/EN 60529)
<b>Process connection and extension</b>	Materials: 1.4301/1.4404 stainless steel (304/316L) Flanges: 1.4541 stainless steel (321). Other higher quality or corrosion-resistant materials may be used as alternatives. Cable-extended fork length: PUR with black carbon (not food grade) Thread: R 1½-in. tapered (EN 10226) or 1½-in. NPT tapered (ANSI B 1.20.1) Tri Clamp: 1.4301/1.4404 stainless steel (304/316L), 2-in. (DN50) ISO 2852
<b>Fork</b>	1.4404 (316L) stainless steel, food grade Surface finish: polished, Ra < 0.75 µm; PTFE (on request)

Maximum noise level 50 dBA  
 Overall weight (approximated) See Table 6

**Table 6: Overall Weights**

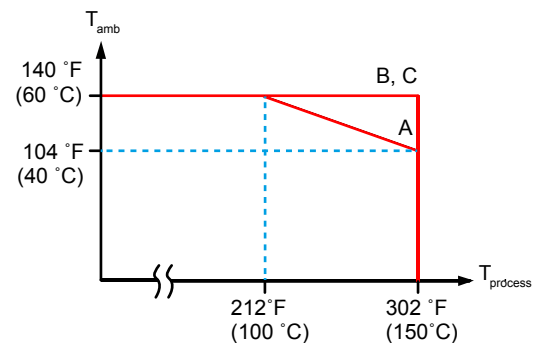
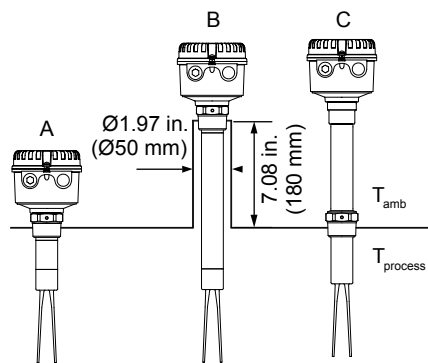
	Standard housing	Type DE-housing	Type D-housing	Extension
Standard length version:	4.6 lbs (2.1 kg)	7 lbs (3.2 kg)	6.2 lbs (2.8 kg)	-
Tube/shaft extended length version:	4.6 lbs (2.1 kg)	7 lbs (3.2 kg)	6.2 lbs (2.8 kg)	+ 5.5 lbs per 39.3 in. (+2.5 kg per m)
Cable extended length version:	9.9 lbs (4.5 kg)	12.3 lbs (5.6 kg)	11.4 lbs (5.2 kg)	+ 1.1 lbs per 39.3 in. (+0.5 kg per m)

### Material selection

Emerson provides a variety of Rosemount products with various product options and configurations including materials of construction that can be expected to perform well in a wide range of applications. The Rosemount product information presented is intended as a guide for the purchaser to make an appropriate selection for the application. It is the purchaser’s sole responsibility to make a careful analysis of all process parameters (such as all chemical components, temperature, pressure, flow rate, abrasives, contaminants, etc.), when specifying product, materials, options, and components for the particular application. Emerson is not in a position to evaluate or guarantee the compatibility of the process fluid or other process parameters with the product, options, configuration or materials of construction selected.

### Operating conditions

<b>Ambient temperature (housing)</b>	-40 to +140 °F (-40 to +60 °C)	All except cable-extended versions
	-13 to +140 °F (-25 to +60 °C)	Cable-extended versions
<b>Process temperature</b>	-40 to +302 °F (-40 to +150 °C)	All except cable-extended versions
		Mounting for process temperature up to 150 °C (302 °F): see graph
	-40 to +230 °F (-40 to +110 °C)	Rosemount 2521 with the standard fork length and the tube-extended fork length with Ex approval and separate housing
	-13 to +176 °F (-25 to +80 °C)	Cable-extended versions



<b>Ventilation</b>	Ventilation is not required.		
<b>Minimum powder density requirements</b>		<b>Setting B:</b>	<b>Setting A:</b>
	Rosemount 2521S	3 lb/ft <sup>3</sup> (50 g/l)	9 lb/ft <sup>3</sup> (150 g/l)
	Rosemount 2521H	1.2 lb/ft <sup>3</sup> (20 g/l) 0.3 lb/ft <sup>3</sup> (5 g/l), V1 < 0.3 lb/ft <sup>3</sup> (5 g/l), V2/V3 <sup>(1)</sup>	4.5 lb/ft <sup>3</sup> (75 g/l) 1.2 lb/ft <sup>3</sup> (20 g/l), V1 < 1.2 lb/ft <sup>3</sup> (20 g/l), V2/V3 <sup>(1)</sup>
<b>Bulk material requirements</b>	No strong tendency to cake or deposit. Maximum 0.39 in. (10 mm) grain size.		
<b>Maximum mechanical load</b>	600 N laterally (on the forks)  Fit a protective angled (reverse-V shaped) shield to the vessel, directly above the level switch, when mechanical loads are high.		
<b>Maximum mechanical torque</b>	300 Nm	Tube/shaft-extended versions	
<b>Maximum tractive force</b>	2 kN	Cable-extended versions	
<b>Maximum process pressure</b>	-14.5 to 232 psi (-1 to +16 bar) -14.5 to 87 psi (-1 to +6 bar)	Standard length and tube/shaft extended versions Cable-extended versions	
	The maximum overall process pressure may be reduced, depending on the selected flange. Refer to the flange standards for pressure ratings and pressure de-ratings at higher temperatures.		
<b>Vibration</b>	1.5 (m/s <sup>2</sup> ) <sup>2</sup> /Hz according to EN 60068-2-64		
<b>Relative Humidity</b>	0 to 100%, suitable for outdoor use		
<b>Maximum altitude</b>	6562 ft. (2000 m)		
<b>Expected product lifetime</b>	The following parameters have a negative influence on the expected product lifetime: High ambient- and process temperatures, corrosive environments, high plant vibration, and a high flow rate of abrasive bulk material.		

(1) The V2 sensitivity option has an increased surface area on the fork and is more sensitive than the V3 option.

## Transport and storage

<b>Transport</b>	<p>Refer to the instructions as stated on the transport packaging, otherwise the products may get damaged.</p> <p>Transport temperature: -40 to +176 °F (-40 to +80 °C) Transport humidity: 20 to 85%</p> <p>Always inspect the received goods for any damage occurred during shipment from the factory. Notify Emerson of damaged goods as soon as possible.</p>
<b>Storage</b>	<p>Products must be stored at a dry and clean place. They must be protected from influence of corrosive environments, vibrations, and exposure to direct sunlight.</p> <p>Storage temperature: -40 to +176 °F (-40 to +80 °C) Storage humidity: 20 to 85%</p>

# Product certifications

## European Union directive information

A copy of the EU Declaration of Conformity can be found at the end of the Rosemount 2521 [Product Certifications document](#). The most recent revision of the EU Declaration of Conformity can be found at [Emerson.com/Rosemount](https://emerson.com/rosemount).

## Installing equipment in North America

The US National Electrical Code® (NEC) and the Canadian Electrical Code (CEC) permit the use of Division marked equipment in Zones and Zone marked equipment in Divisions. The markings must be suitable for the area classification, gas, and temperature class. This information is clearly defined in the respective codes.

## U.S.A.

### U.S.A. Ordinary Location certification

#### KZ

##### Summary of product certification:

Protection	Ordinary location (unclassified, safe area)
Certificate	FM20US0086X
Standards	FM Class 3810:2018 ANSI/NEMA® 250: 1991 ANSI/IEC 60529:2004
Markings	Type 4X and IP66

As standard, the level switch has been examined and tested to determine that the design meets the basic electrical, mechanical, and fire protection requirements by a nationally recognized test laboratory (NRTL) as accredited by the Federal Occupational Safety and Health Administration (OSHA).

**U.S.A. Dust certification****KB****Summary of product certification:**

<b>Protection</b>	Dust ignition-proof
<b>Certificate</b>	FM20US0086X
<b>Standards</b>	FM Class 3600:2018 FM Class 3810:2018 ANSI/ISA 512.0.01:2002 ANSI/NEMA 250:1991 ANSI/ISA 60079-0:2009
<b>Markings</b>	DIP Class II/III, Division 1, Groups E, F, and G T* T* (See control drawings and safety instructions) Type 4X, IP66
<b>Control drawing</b>	D7000006/345 (Remote housing) D7000006/346 (NAMUR electronics) (See Rosemount 2521 <a href="#">Product Certifications document</a> )
<b>Safety instructions</b>	See Rosemount 2521 <a href="#">Product Certifications document</a>

**Special Condition for Safe Use (X)**

The apparatus enclosure contains aluminum and is considered to constitute a potential risk of ignition by impact or friction. Care must be taken into account during installation and use to prevent impact or friction.

## U.S.A. Intrinsically Safe (IS) and Dust (DIP) certification

### KE

#### Summary of product certification

<b>Protections</b>	Intrinsic safety Dust ignition-proof
<b>Certificate</b>	FM20US0086X
<b>Standards</b>	FM Class 3600:2018 FM Class 3610:2010 FM Class 3810:2018 ANSI/ISA 512.0.01:2002 ANSI/NEMA 250:1991 ANSI/IEC 60529:2004 ANSI/ISA 60079-0:2009 ANSI/ISA 60079-11:2009
<b>Markings</b>	IS: Class I, Division 1, Groups A, B, C, and D Class I, Zone 0 and 0/1, AEx ia IIC DIP: Class II, III, Division 1, Groups E,F, and G T* (See control drawings and safety instructions) T* (See Rosemount 2521 <a href="#">Product Certifications document</a> ) Type 4X, IP66
<b>Control drawing</b>	D7000006/345 (Remote housing) D7000006/346 (NAMUR electronics) (See Rosemount 2521 <a href="#">Product Certifications document</a> )
<b>Safety instructions</b>	See Rosemount 2521 <a href="#">Product Certifications document</a>

**U.S.A. Explosion-proof (XP) and Dust (DIP) certification****KY****Summary of product certification:**

<b>Protections</b>	Explosion proof Dust ignition-proof
<b>Certificate</b>	FM20US0086X
<b>Standards</b>	FM Class 3600:2018 FM Class 3615:2018 FM Class 3616:2011 FM Class 3810:2018 ANSI/NEMA 250:1991 ANSI/IEC 60529:2004
<b>Markings</b>	XP: Class I, Division 1, Groups B, C, and D T* Class I, Zone 1, AEx d [ia] IIC T* DIP: Class II/III, Division 1, Groups E, F, and G T* T* (See control drawings and safety instructions) Type 4X, IP66
<b>Control drawing</b>	D7000006/345 (Remote housing) D7000006/346 (NAMUR electronics) (See Rosemount 2521 <a href="#">Product Certifications document</a> )
<b>Safety instructions</b>	See Rosemount 2521 <a href="#">Product Certifications document</a>



## U.S.A. Increased Safety (IS), Flameproof (XP) and Dust (DIP) certification

### KT

#### Summary of product certification:

<b>Protections</b>	Increased safety Flameproof Dust ignition-proof
<b>Certificate</b>	FM20US0086X
<b>Standards</b>	FM Class 3600:2018 FM Class 3610:2010 FM Class 3615:2018 FM Class 3810:2018 ANSI/ISA S12.0.01:2002 ANSI/ISA S12.22.01:2002 ANSI/NEMA 250:1991 ANSI/IEC 60529:2004 ANSI/ISA 60079-0:2009 ANSI/ISA 60079-0:2009
<b>Markings</b>	XP-IS: Class I, Division 1, Groups B, C, and D T* Class I, Zone 1, AEx d e [ia] IIC T* DIP: Class II, III, Division 1, Groups E, F and G T* T* (See control drawings and safety instructions) Type 4X, IP66
<b>Control drawing</b>	D7000006/345 (Remote housing) D7000006/346 (NAMUR electronics) (See Rosemount 2521 <a href="#">Product Certifications document</a> )
<b>Safety instructions</b>	See Rosemount 2521 <a href="#">Product Certifications document</a>

## Canada

### Canada Ordinary Location certification

#### KZ

##### Summary of product certification

Protection	Ordinary location (unclassified, safe area)
Certificate	80046076
Standards	CAN/CSA-C22.2 No. 61010-1-04 UL Std. No. 61010-1 (2nd Edition) IEC 61010-1 (2nd Edition)
Markings	Type 4X, IP67

As standard, the level switch has been examined and tested to determine that the design meets the basic electrical, mechanical, and fire protection requirements by a nationally recognized test laboratory (NRTL) as accredited by the Federal Occupational Safety and Health Administration (OSHA).

### Canada Dust certification

#### KB

##### Summary of product certification

Protection	Dust-ignition proof
Certificate	80049993
Standards	CAN/CSA C22-2 No. 25-1966 CAN/CSA-C22.2 No.94-M91 CAN/CSA C22.2 No. 61010-1-2004 CAN/CSA-E60079-0-02 IEC 60529: 1989
Markings	Class II/III, Division 1, Groups E, F, and G Ex DIP A20/21 T* (See safety instructions) Type 4X, IP66
Safety instructions	See Rosemount 2521 <a href="#">Product Certifications document</a>

## Canada Intrinsically Safe (IS) and Dust (DIP) certification

### KE

#### Summary of product certification:

<b>Protections</b>	Intrinsic safety Dust ignition-proof
<b>Certificate</b>	80049993
<b>Standards</b>	CSA Std C22.2 No.25-1966 CAN/CSA-C22.2 No.94-M91 CSA Std C22.2 No. 157-M1992 CAN/CSA C22.2 No. 61010-1-2004 CAN/CSA-E60079-0-02 CAN/CSA-E60079-11-02 IEC 60529: 1989
<b>Markings</b>	IS: Class I, Division 1, Groups A, B, C, and D Class I, Zone 0 and 0/1, Ex ia IIC DIP: Class II, III, Division 1, Groups E,F, and G Ex DIP A20 and A20/21 T* (See certificate)(See Rosemount 2521 <a href="#">Product Certifications document</a> )
<b>Safety instructions</b>	See Rosemount 2521 <a href="#">Product Certifications document</a>

## Canada Explosion-proof (XP) and Dust (DIP) certification

### KY

#### Summary of product certification

<b>Protections</b>	Explosion proof Dust ignition-proof
<b>Certificate</b>	80049993
<b>Standards</b>	CAN/CSA C22-2 No. 25-1966 CSA Std C22.2 No.30-M1986 CAN/CSA-C22.2 No.94-M91 CSA Std C22.2 No. 157-M1992 CAN/CSA C22.2 No. 61010-1-2004 CAN/CSA-E60079-0-02 CAN/CSA-E60079-1-02 CAN/CSA-E60079-11-02 IEC 60529: 1989
<b>Markings</b>	XP: Class I, Division 1, Groups B, C, and D Class I, Zone 0, Ex d IIC DIP: Class II, III, Division 1, Groups E,F, and G Ex DIP A20/21 T* (See certificate) Type 4X, IP66
<b>Safety instructions</b>	See Rosemount 2521 <a href="#">Product Certifications document</a>

## Canada Increased Safety (IS), Flameproof (XP) and Dust (DIP) certification

### KT

#### Summary of product certification:

<b>Protections</b>	Increased safety Flameproof Dust ignition-proof
<b>Certificate</b>	80049993
<b>Standards</b>	CSA Std C22.2 No.25-1966 CSA Std C22.2 No.30-M1986 CAN/CSA-C22.2 No.94-M91 CSA Std C22.2 No. 157-M1992 CAN/CSA C22.2 No. 61010-1-2004 CAN/CSA-E60079-0-02 CAN/CSA-E60079-1-02 CAN/CSA-E60079-7-02 CAN/CSA-E60079-11-02 IEC 60529: 1989
<b>Markings</b>	XP-IS: Class I, Zone 1, Ex de [ia] IIC DIP: Class II, III, Division 1, Groups E,F, and G Ex DIP A20/21  Type 4X, IP66
<b>Safety instructions</b>	See Rosemount 2521 <a href="#">Product Certifications document</a>

## Europe

### ATEX Dust certification

### ND



#### Summary of product certification:

<b>Protection</b>	By enclosure
<b>Certificate</b>	BVS 20 ATEX E 077X
<b>Standards</b>	EN IEC 60079-0:2018 EN 60079-31:2014
<b>Markings</b>	⊕ II 1/2D Ex ta/tb IIIC T*°C Da/Db
<b>Temperature*</b>	See <a href="#">Table 9</a> or <a href="#">Table 10</a>
<b>Safety instructions</b>	See Rosemount 2521 <a href="#">Product Certifications document</a>

## ATEX Flameproof and Dust certification

### E8




#### Summary of product certification:

Protections	Flameproof By enclosure
Certificate	BVS 20 ATEX E 077X
Standards	EN IEC 60079-0:2018 EN 60079-1:2014 EN 60079-31:2014 EN 60079-11:2012
Markings	 II 1/2D Ex ta/tb IIIC T°C Da/Db  II 2G Ex db IIC T* Gb  II 2G Ex db ia IIC T* Gb
Temperature*	See <a href="#">Table 9</a> or <a href="#">Table 10</a>
Safety instructions	See Rosemount 2521 <a href="#">Product Certifications document</a>

## ATEX Increased Safety, Flameproof and Dust certification

### K1

#### Summary of product certification:

Protections	Increased safety Flameproof By enclosure
Certificate	BVS 20 ATEX E 077X
Standards	EN IEC 60079-0:2018 EN 60079-1:2014 EN IEC 60079-7:2015 + A1:2018 EN 60079-31:2014 EN 60079-11:2012
Markings	 II 1/2D Ex ta/tb IIIC T*°C Da/Db  II 2G Ex db eb IIC T* Gb  II 2G Ex db eb ia IIC T* Gb
Temperature*	See <a href="#">Table 9</a> or <a href="#">Table 10</a>
Safety instructions	See Rosemount 2521 <a href="#">Product Certifications document</a>

## ATEX Intrinsically Safe (IS) and Dust (DIP) certification

### IJ

#### Summary of product certification

Protections	Intrinsic safety By enclosure
Certificate	BVS 20 ATEX E 077X
Standards	EN IEC 60079-0:2018 EN 60079-11:2012 EN 60079-31:2014
Markings	⊕ II 1/2D Ex ta/tb IIIC T* °C Da/Db ⊕ II 1/2G Ex ia IIC T* Ga/Gb ⊕ II 1G Ex ia IIC T* Ga
Temperature	See <a href="#">Table 9</a> or <a href="#">Table 10</a>
Safety instructions	See Rosemount 2521 <a href="#">Product Certifications document</a>

## International

### IECEx Dust certification

### NK

#### Summary of product certification:

Protection	By enclosure
Certificate	IECEx BVS 20.0064X
Standards	IEC 60079-0:2017 IEC 60079-31:2013
Markings	Ex ta/tb IIIC T* °C Da/Db
Temperature*	See <a href="#">Table 9</a> or <a href="#">Table 10</a>
Safety instructions	See Rosemount 2521 <a href="#">Product Certifications document</a>

**IECEX Flameproof and Dust certification****E7**

## Summary of product certification:

Protections	Flameproof By enclosure
Certificate	IECEX BVS 20.0064X
Standards	IEC 60079-0:2017 IEC 60079-1:2014-06 IEC 60079-31:2013
Markings	Ex ta/tb IIIC T* °C Da/Db Ex db IIIC T* Gb Ex db ia IIIC T* Gb
Temperature*	See <a href="#">Table 9</a> or <a href="#">Table 10</a>
Safety instructions	See Rosemount 2521 <a href="#">Product Certifications document</a>

**IECEX Increased Safety, Flameproof, and Dust certification****K7**

## Summary of product certification:

Protections	Increased safety Flameproof/explosion-proof By enclosure
Certificate	IECEX BVS 20.0064X
Standards	IEC 60079-0:2017 IEC 60079-1:2014-06 IEC 60079-31:2013 IEC 60079-7:2017
Markings	Ex ta/tb IIIC T* °C Da/Db Ex db eb IIIC T* Gb Ex db eb ia IIIC T* Gb
Temperature*	See <a href="#">Table 9</a> or <a href="#">Table 10</a>
Safety instructions	See Rosemount 2521 <a href="#">Product Certifications document</a>



## IECEX Intrinsically Safe and Dust certification

### IL

#### Summary of product certification:

<b>Protections</b>	Intrinsic safety By enclosure
<b>Certificate</b>	IECEX BVS 20.0064X
<b>Standards</b>	IEC 60079-0:2017 IEC 60079-11:2011 IEC 60079-31:2013
<b>Markings</b>	Ex ta/tb IIIC T* °C Da/Db Ex ia IIC T* Ga/Gb Ex ia IIC T* Ga
<b>Temperature*</b>	See <a href="#">Table 9</a> or <a href="#">Table 10</a>
<b>Safety instructions</b>	See Rosemount 2521 <a href="#">Product Certifications document</a>

## Technical Regulations Customs Union (TR-CU)

### EAC

### GM

TR CU 020/2011 “Electromagnetic Compatibility of Technical Products”

TR CU 004/2011 “On safety of low-voltage equipment”

## FM and CSA thermal data

**Table 7: Maximum temperatures (IS approvals)**

Versions of electronics modules that are intrinsically safe:

- NAMUR (IEC 60947-5-6), 8/16 mA, and 4-20 mA

Max. ambient air temperature (T <sub>a</sub> )	Max. process temperature (T <sub>p</sub> )	Max. surface temperature (T)	Temperature class (division)	Temperature class (zone)
122 °F (50 °C)	158 °F (70 °C)	176 °F (80 °C)	T6	T6
140 °F (60 °C)	176 °F (80 °C)	185 °F (85 °C)	T6	T5
	194 °F (90 °C)	194 °F (90 °C)	T5	T5
	212 °F (100 °C)	212 °F (100 °C)	T5	T4
	230 °F (110 °C)	230 °F (110 °C)	T4A	T4
	248 °F (120 °C)	248 °F (120 °C)	T4A	T4
	266 °F (130 °C)	266 °F (130 °C)	T4	T4
	284 °F (140 °C)	284 °F (140 °C)	T3C	T3
	302 °F (150 °C)	302 °F (150 °C)	T3C	T3

**Table 8: Maximum temperatures (non-IS approvals)**

Versions of electronics modules that are not intrinsically safe:

- Universal voltage Relay SPDT and Relay DPDT
- 3-wire PNP
- 2-wire without contact (8/16 mA or 4-20 mA)

Max. ambient air temperature (T <sub>a</sub> )	Max. process temperature (T <sub>p</sub> )	Max. surface temperature (T)	Temperature class (division)	Temperature class (zone)
140 °F (60 °C)	176 °F (80 °C)	248 °F (120 °C)	T4A	T4
	194 °F (90 °C)	248 °F (120 °C)	T4A	T4
	212 °F (100 °C)	248 °F (120 °C)	T4A	T4
	230 °F (110 °C)	248 °F (120 °C)	T4A	T4
	248 °F (120 °C)	248 °F (120 °C)	T4A	T4
	266 °F (130 °C)	266 °F (130 °C)	T4	T4
	284 °F (140 °C)	284 °F (140 °C)	T3C	T3
	302 °F (150 °C)	302 °F (150 °C)	T3C	T3

## ATEX and IECEx thermal data

**Table 9: Temperatures (electronic module types A and B)**

Max. ambient air temperature ( $T_a$ )	Max. process temperature ( $T_p$ )	Max. surface temperature (T)	Temperature class
140 °F (60 °C)	176 °F (80 °C)	248 °F (120 °C)	T4
140 °F (60 °C)	194 °F (90 °C)	248 °F (120 °C)	T4
140 °F (60 °C)	212 °F (100 °C)	248 °F (120 °C)	T4
140 °F (60 °C)	230 °F (110 °C)	248 °F (120 °C)	T4
140 °F (60 °C)	248 °F (120 °C)	248 °F (120 °C)	T4
140 °F (60 °C)	266 °F (130 °C)	266 °F (130 °C)	T4
140 °F (60 °C)	284 °F (140 °C)	284 °F (140 °C)	T3
140 °F (60 °C)	302 °F (150 °C)	302 °F (150 °C)	T3

**Table 10: Temperatures (electronic module type C)**

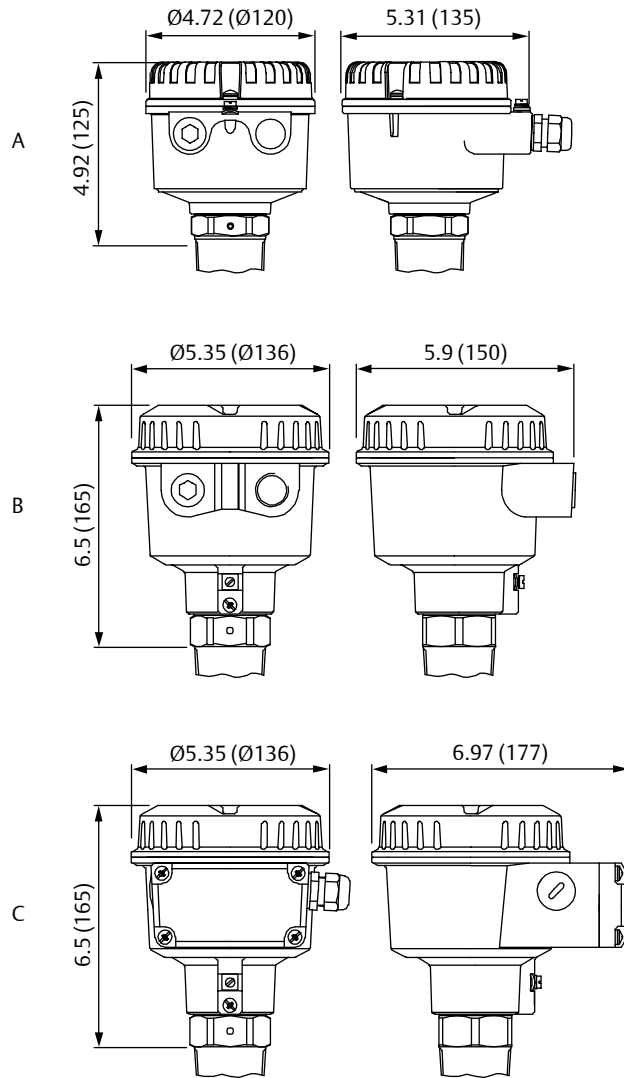
Max. ambient air temperature (T <sub>a</sub> )	Max. process temperature (T <sub>p</sub> )	Max. surface temperature (T)	Temperature class
122 °F (50 °C)	158 °F (70 °C)	176 °F (80 °C)	T6
140 °F (60 °C)	176 °F (80 °C)	185 °F (85 °C)	T5
140 °F (60 °C)	194 °F (90 °C)	194 °F (90 °C)	T5
140 °F (60 °C)	212 °F (100 °C)	212 °F (100 °C)	T4
140 °F (60 °C)	230 °F (110 °C)	230 °F (110 °C)	T4
140 °F (60 °C)	248 °F (120 °C)	248 °F (120 °C)	T4
140 °F (60 °C)	266 °F (130 °C)	266 °F (130 °C)	T4
140 °F (60 °C)	284 °F (140 °C)	284 °F (140 °C)	T3
140 °F (60 °C)	302 °F (150 °C)	302 °F (150 °C)	T3

**Note**

The maximum surface temperature of the electronic enclosure with a thermal fuse is limited to 242.6 °F (117 °C).

# Dimensional drawings

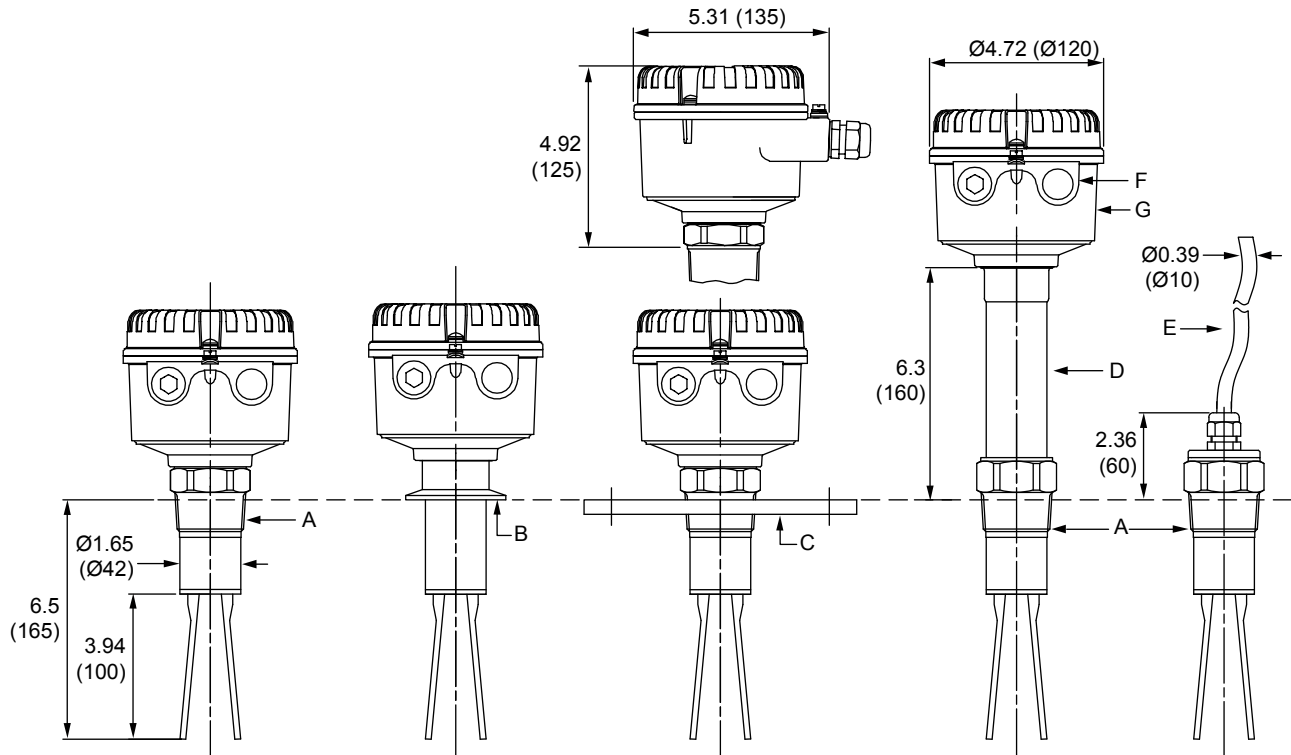
Figure 1: Rosemount 2521 Housing Options



- A. Standard housing
- B. Type D flameproof/explosion-proof housing
- C. Type DE explosion-proof housing with increased safety terminal box

Dimensions are in inches (millimeters).

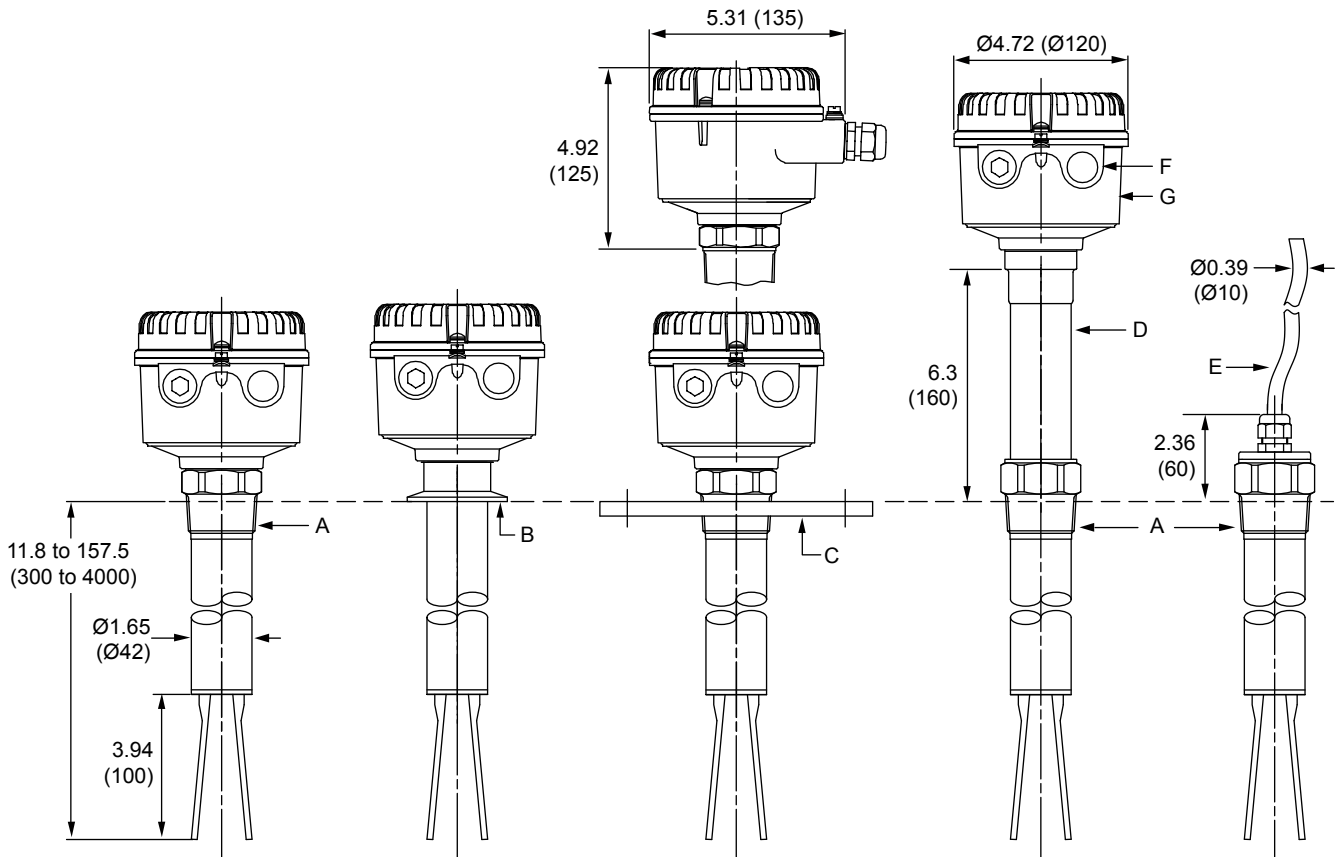
Figure 2: Rosemount 2521S Vibrating Fork Level Switch (Standard Length, Standard Fork Sensitivity)



- A. Thread
- B. Tri Clamp
- C. Flange
- D. Thermal extension tube (temperature-extended shaft)
- E. Separate housing option
- F. Conduit/cable entries
- G. Aluminum standard housing. See [Figure 1](#) for dimensions of housing types D and DE.

Dimensions are in inches (millimeters).

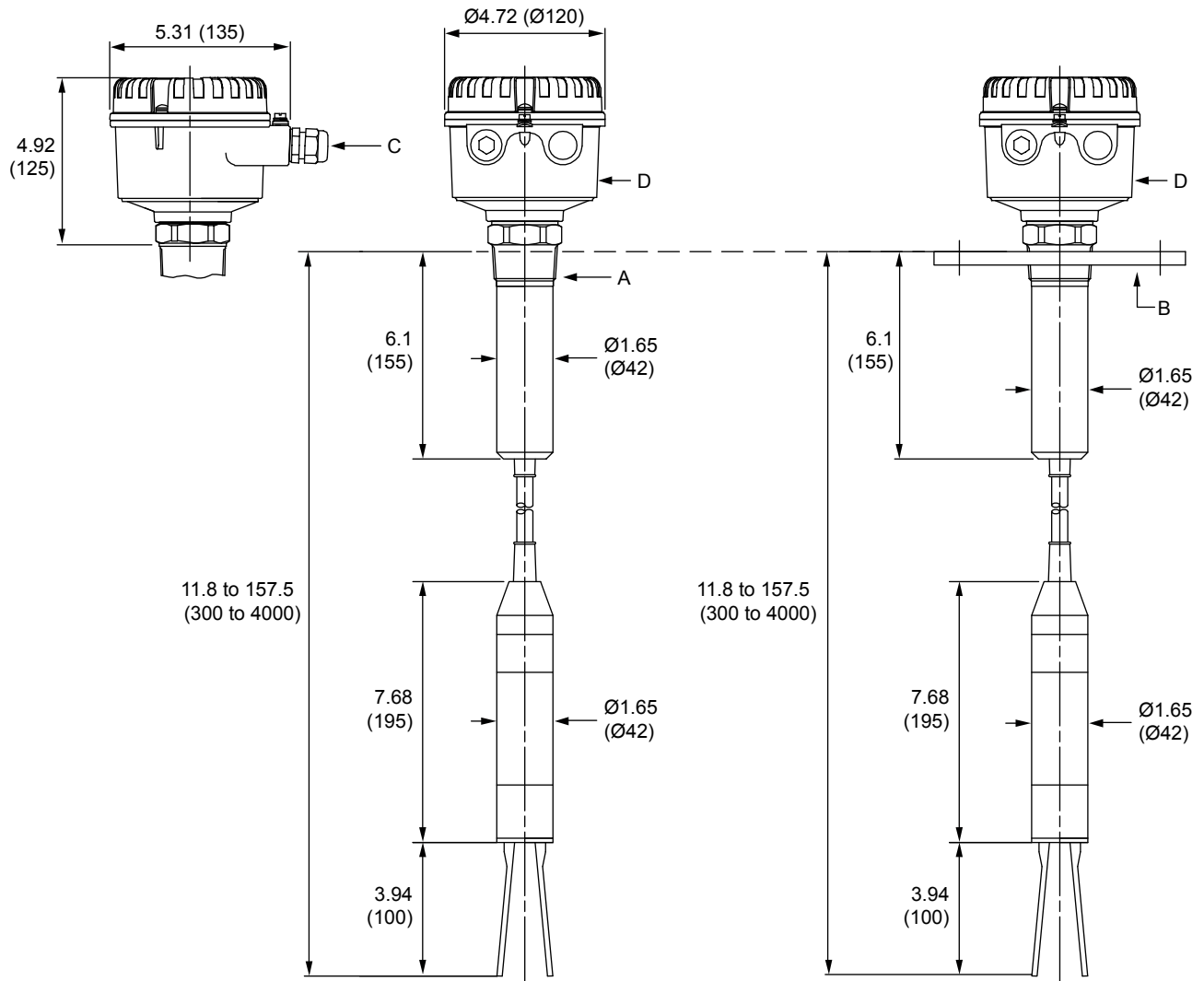
**Figure 3: Rosemount 2521S Vibrating Fork Level Switch (Tube-extended Length, Standard Fork Sensitivity)**



- A. Thread
- B. Flange
- C. Tri Clamp
- D. Thermal extension tube (temperature-extended shaft)
- E. Separate housing option
- F. Conduit/cable entries
- G. Aluminum standard housing. See [Figure 1](#) for dimensions of housing types D and DE.

Dimensions are in inches (millimeters).

Figure 4: Rosemount 2521S Vibrating Fork Level Switch (Cable Extension, Standard Fork Sensitivity)

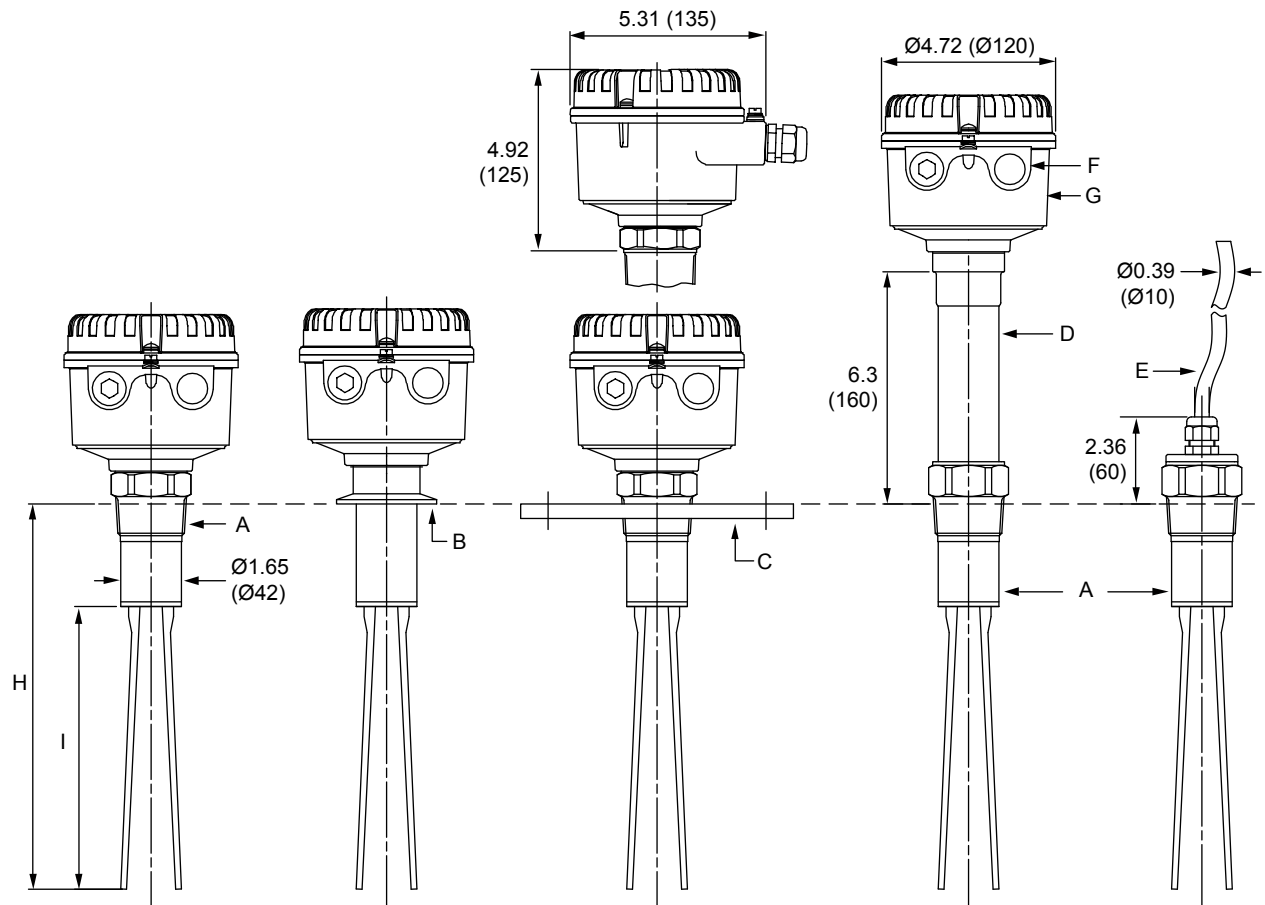


- A. Thread
- B. Flange
- C. Conduit/cable entries
- D. Aluminum standard housing. See Figure 1 for dimensions of housing types D and DE.

Dimensions are in inches (millimeters).



Figure 5: Rosemount 2521H Vibrating Fork Level Switch (Standard Length, Enhanced Fork Sensitivity)



- A. Thread
- B. Flange
- C. Tri Clamp
- D. Thermal extension tube (temperature-extended shaft)
- E. Separate housing option
- F. Conduit/cable entries
- G. Aluminum standard housing. See Figure 1 for dimensions of housing types D and DE.
- H. Dimension L (see Table 11)
- I. Dimension X (see Table 11)

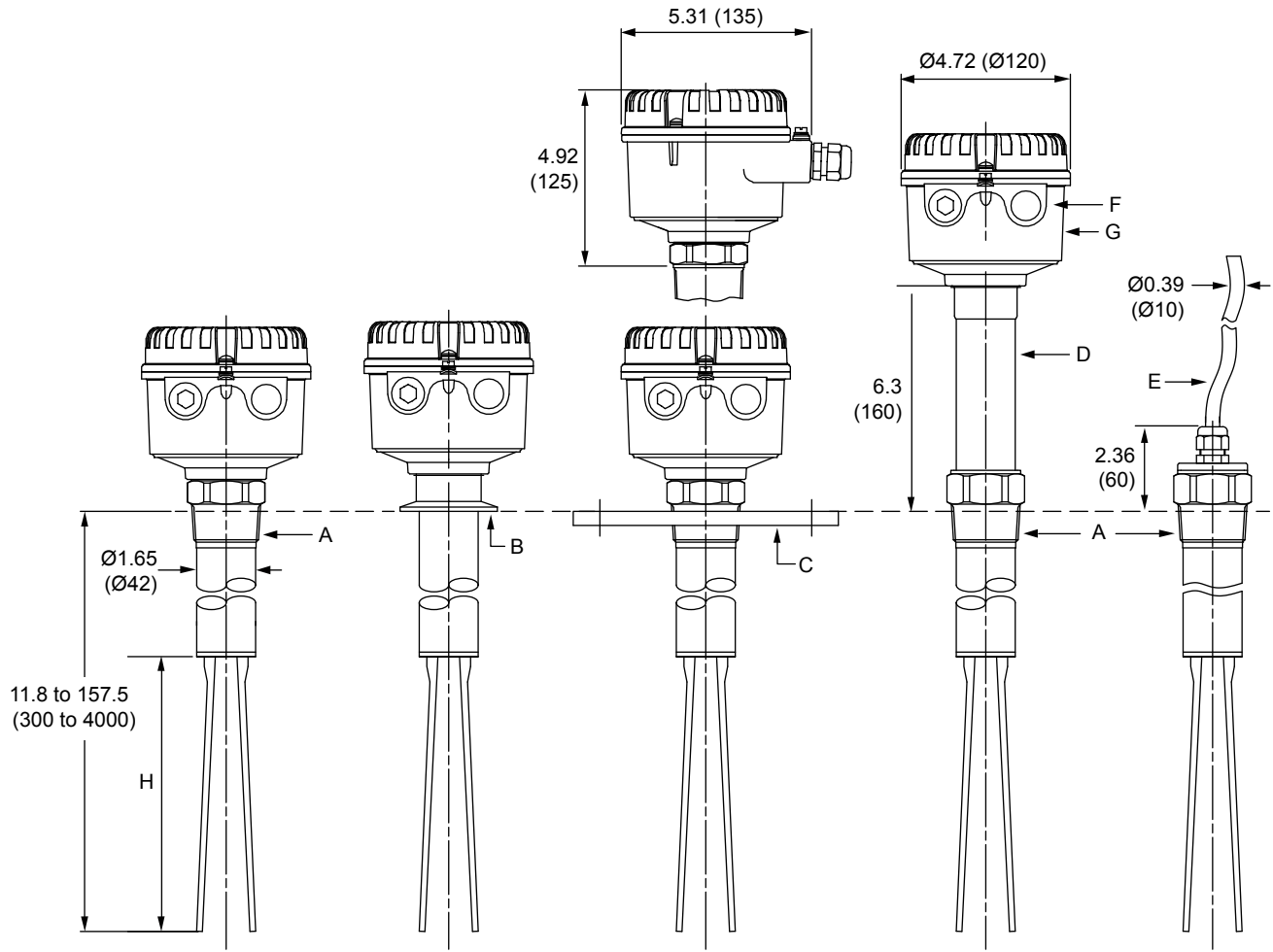
Dimensions are in inches (millimeters).

Table 11: Dimensions L and X

Dimension	Fork sensitivity options	
	Without option	Options (V1, V2 <sup>(1)</sup> and V3)
L	9.25 in. (235 mm)	10.24 in. (260 mm)
X	6.69 in. (170 mm)	7.68 in. (195 mm)

(1) Option V2 is only available on a Rosemount 2521 with a 4-in. DN100 flanged process connection.

Figure 6: Rosemount 2521H Vibrating Fork Level Switch (Tube-extended Length, Enhanced Fork Sensitivity)



- A. Thread
- B. Flange
- C. Tri Clamp
- D. Thermal extension tube (temperature-extended shaft)
- E. Separate housing option
- F. Conduit/cable entries
- G. Aluminum standard housing. See Figure 1 for dimensions of housing types D and DE.
- H. Dimension X (see Table 12)

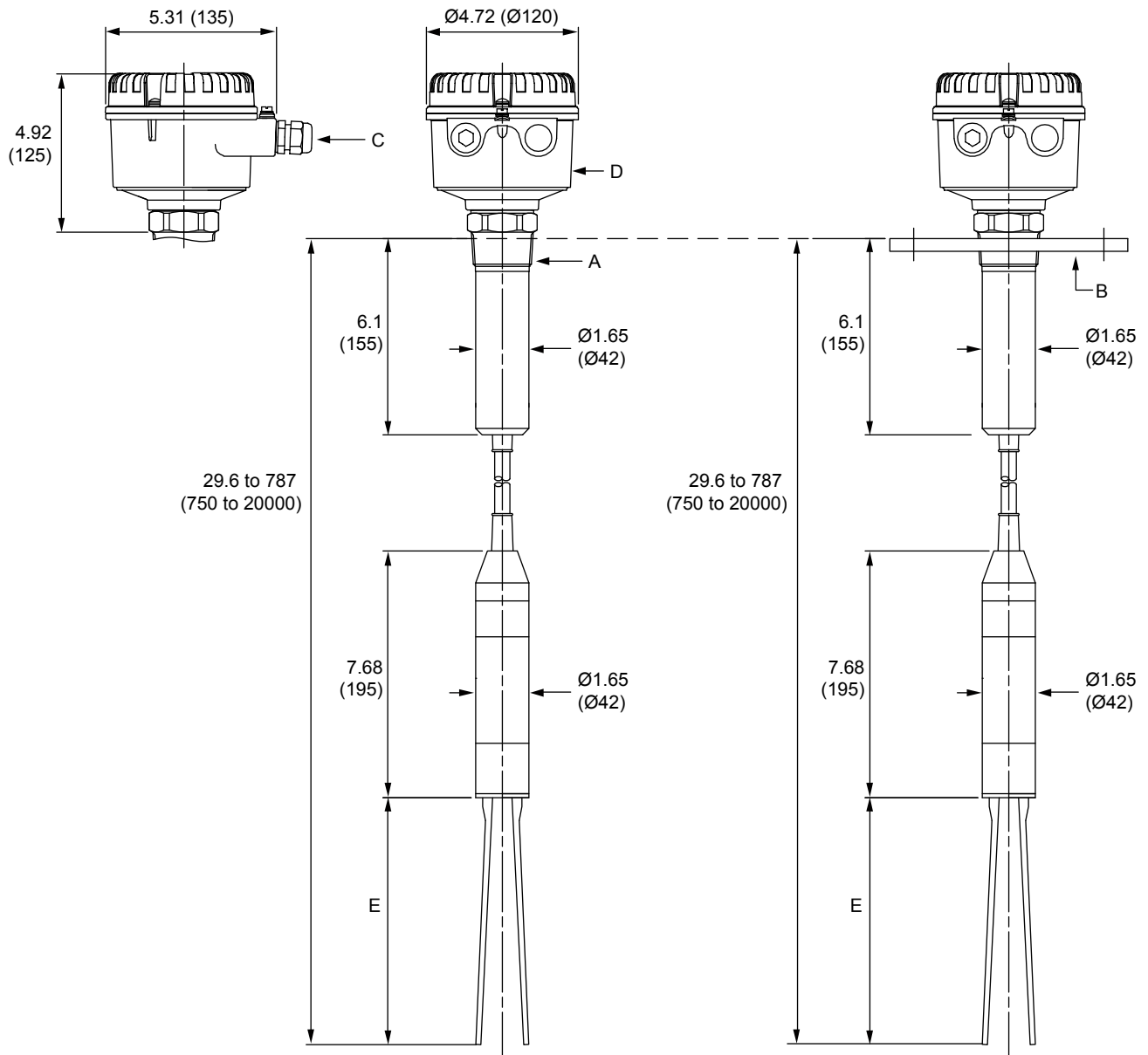
Dimensions are in inches (millimeters).

Table 12: Dimension X

Dimension	Fork sensitivity options	
	Without option	Options V1, V2 <sup>(1)</sup> and V3
X	6.69 in. (170 mm)	7.68 in. (195 mm)

(1) Option V2 is only available on a Rosemount 2521 with a 4-in. DN100 flanged process connection.

Figure 7: Rosemount 2521H Vibrating Fork Level Switch (Cable Extension, Enhanced Fork Sensitivity)



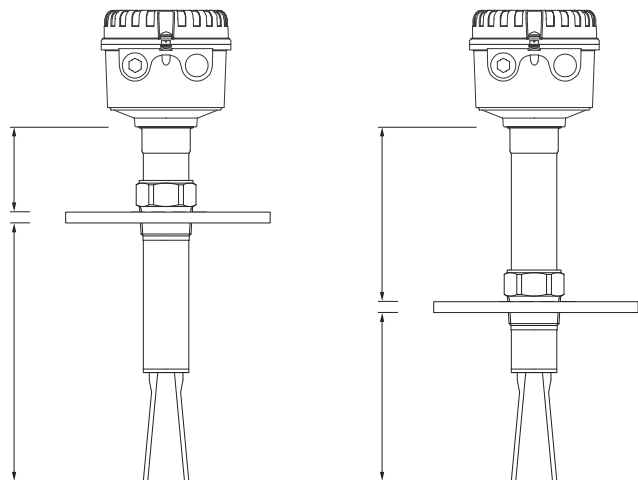
- A. Thread
- B. Flange
- C. Conduit/cable entries
- D. Aluminum standard housing. See Figure 1 for dimensions of housing types D and DE.
- E. Dimension X (see Table 12)

Dimensions are in inches (millimeters).

## Sliding sleeve

Sliding sleeve can be used to adjust the position of the paddle. When using the sliding sleeve the total length of the level switch remains unchanged, make sure that there is sufficient space to allow for these adjustments.

**Figure 8: Sliding Sleeve**









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