

# Linear measuring technology

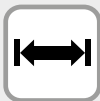
<b>Draw-wire encoder D120</b>	<b>Robust-Line</b>	<b>Measuring length max. 10 m</b>
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With their extremely robust construction, their high IP69k protection level and their wide temperature range up to -40 °C ... +85 °C the D120 draw-wire encoders are specially developed for outdoor applications.

Their flexibility and adaptability reflects in the wide range of housing and wire types, the long measuring range and the various interfaces. The possibility of redundancy must be particularly pointed out.

Analog  
output
CANopen



Long service life



-40° ... +85°C



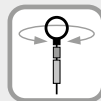
IP69k



Redundancy



V4A  
1.4404



Integrated swivel



For outdoor applications



3 housing types

## Robust

- Protection level up to IP69k and wide temperature range up to -40 °C ... +85 °C.
- The titanium-anodized aluminum housing and the stainless steel wires allow using the mechanics even in harsh conditions.
- Wire diameter (stainless steel, V4A) up to  $\varnothing$  1.5 mm - ideal for outdoor applications.

## Versatile

- Measuring length up to 10 m.
- Redundant outputs (mA, V, R, CANopen).
- The right measuring wire and the right wire fastening for every application.
- Linearity up to  $\pm 0.1$  % of the measuring range.
- Various constructions: open, closed housing or housing with perforated plate cover.

**Draw-wire encoder D120**     **Robust-Line**     **Measuring length max. 10 m**

**Order code**     **D8.D120** . **XXXXX** . **XXX** X . **0000** . **XXXX**

Type     **a** **b** **c** **d**     **e** **f**     **g**

**a** *Measuring length*

- 3 = 3 m
- 4 = 4 m
- 5 = 5 m
- 6 = 6 m
- 7 = 7 m
- 8 = 8 m
- 9 = 9 m
- A = 10 m

**b** *Wire types (stainless steel V4A)*

- 1 = ø 0.5 mm
- 2 = ø 1.0 mm (not for measuring length 9 ... 10 m)
- 3 = ø 1.5 mm (not for measuring length 7 ... 10 m)

**c** *Linearity*

- 1 = standard linearity 0.5 %
- 2 = improved linearity 0.25 %
- 3 = improved linearity 0.1 %

**d** *Housing*

- 1 = open housing, open wire guide
- 3 = with perforated plate cover, open wire guide
- 4 = with perforated plate cover, closed wire guide
- 6 = closed housing, closed wire guide

**e** *Single sensor / supply voltage*

- A11 = 4 ... 20 mA / 12 ... 30 V DC
- A22 = 0 ... 10 V / 12 ... 30 V DC
- A33 = 1 kΩ / max. 30 V DC
- A44 = 0.5 ... 4.5 V / 8 ... 30 V DC
- A55 = 0 ... 5 V / 8 ... 30 V DC
- CC1 = CANopen / 8 ... 30 V DC

*Redundant sensor / supply voltage*

- R11 = 2 x 4 ... 20 mA / 12 ... 30 V DC
- R22 = 2 x 0 ... 10 V / 12 ... 30 V DC
- R33 = 2 x 1 kΩ / max. 30 V DC
- R44 = 2 x 0.5 ... 4.5 V / 8 ... 30 V DC
- R55 = 2 x 0 ... 5 V / 8 ... 30 V DC
- RC1 = 2 x CANopen / 8 ... 30 V DC

**f** *Type of connection / protection level sensor*

*Cable connection, standard lengths<sup>1)</sup>*

- 1 = radial cable, 2 m [6.56'] TPE / IP69k
- 2 = radial cable, 2 m [6.56'] TPE / IP67
- C = radial cable, 5 m [16.40'] TPE / IP69k
- E = radial cable, 5 m [16.40'] TPE / IP67
- D = radial cable, 10 m [32.81'] TPE / IP69k
- F = radial cable, 10 m [32.81'] TPE / IP67

*Connector*

- 3 = radial M12 connector / IP67
- 4-pin for sensor type A11 ... A55
- 5-pin for sensor type CC1 ... RC1
- 8-pin for sensor type R11 ... R55

**g** *Extended order options (optional)*

*Wire fastenings (standard = carabiner ring)*

- V001 = M4 thread<sup>2)</sup>
- V002 = eyelet
- V007 = clip

*Extended temperature range -40 °C ... +85 °C*

*(only in combination with the standard linearity 0.5 %, **c** = 1)*

- V003 = with carabiner ring
- V004 = with M4 thread<sup>2)</sup>
- V005 = with eyelet
- V008 = with clip

**Relationship measuring length – wire types – linearity**


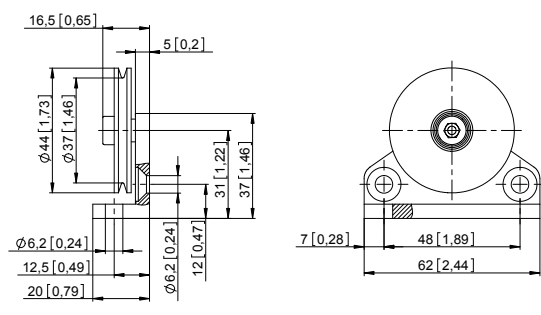
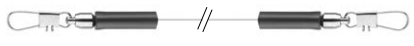
Measuring length	[m] order code <b>a</b>	3 / 4 / 5 / 6			7 / 8			9 / 10		
		<b>3</b> / <b>4</b> / <b>5</b> / <b>6</b>			<b>7</b> / <b>8</b>			<b>9</b> / <b>A</b>		
Wire type	ø [mm] order code <b>b</b>	0.5 <b>1</b>	1.0 <b>2</b>	1.5 <b>3</b>	0.5 <b>1</b>	1.0 <b>2</b>	–	0.5 <b>1</b>	1.0 –	1.5 –
Standard linearity ±0.5 %	order code <b>c</b> = 1	✓	✓	✓	✓	✓	–	✓	–	–
Improved linearity ±0.25 %	order code <b>c</b> = 2	✓	✓	✓	✓	✓	–	✓	–	–
Improved linearity ±0.1 %	order code <b>c</b> = 3	✓	✓	✓	✓	✓	–	✓	–	–

✓ feasible / – not feasible

1) Other cable length on request.

2) Not available with wire type V4A ø 1.5 mm – order option **b** = 3.

# Linear measuring technology

Draw-wire encoder D120	Robust-Line	Measuring length max. 10 m
<b>Accessories for draw-wire encoder</b>		
<b>Guide pulley for wire type 1</b> (0.5 mm)	Dimensions in mm [inch]  Technical data: - mounting bracket (anodized alum.) - guide pulley (plastic POM) - ball bearing (type 696-2R5)	Scope of delivery: - 2 x countersunk screws for lateral fixing - 2 x hexagonal screws for fixing on a flat surface
		<b>8.0000.7000.0045</b>
<b>Extension cable</b> (further on request)		0.5 m with clip 1.0 m with clip 2.0 m with clip
<b>Cables and connectors</b>	<b>Preassembled cables</b>	Order no.  M12 female connector with coupling nut, 4-pin, A coded, straight single ended 2 m [6.56'] PUR cable <b>05.00.6061.6211.002M</b>  M12 female connector with coupling nut, 5-pin, A coded, straight single ended 2 m [6.56'] PVC cable <b>05.00.6081.2211.002M</b>  M12 female connector with coupling nut, 8-pin, A coded, straight single ended 2 m [6.56'] PVC cable <b>05.00.6041.8211.002M</b>
<b>Connectors</b>	M12 female connector with coupling nut, 4-pin, A coded, straight (plastic) M12 female connector with coupling nut, 5-pin, A coded, straight (metal/plastic) M12 female connector with coupling nut, 8-pin, A coded, straight (metal)	<b>05.B8141-0</b> <b>05.B-8151-0/9</b> <b>05.CMB 8181-0</b>

Further Kübler cables and connectors can be found at: [kuebler.com/connection-technology](http://kuebler.com/connection-technology)

# Linear measuring technology

<b>Draw-wire encoder D120</b>	<b>Robust-Line</b>	<b>Measuring length max. 10 m</b>
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## Technical data

General technical data	
<b>Linearity</b>	±0.5 %
<b>Improved linearity</b>	±0.25 % or ±0.1 %
<b>Resolution</b>	see electrical characteristics
<b>Sensor element</b>	potentiometer
<b>Output signal</b> (others on request)	4 ... 20 mA 0 ... 10 V, 0.5 ... 4.5 V, 0 ... 5 V Potentiometer CANopen
<b>Connection</b>	radial M12 connector or radial cable outlet (TPE cable), standard length 2, 5, 10 m
<b>Protection</b>	M12 connector IP67 cable IP67, IP69k
<b>Humidity</b>	max. 90 % relative, no condensing
<b>Working temperature</b>	standard -20 °C ... +85 °C [-4 °F ... +185 °F] as extended order option (s.page 6) -40 °C ... +85 °C [-40 °F ... +185 °F]
<b>Speed max.</b>	3.0 m/s
<b>Acceleration max.</b>	50 m/s <sup>2</sup>
<b>Weight</b>	1300 ... 1600 g [45.87 ... 56.44 oz] depending on measuring range
<b>Housing</b>	aluminum, spring housing PA6
<b>Spring force</b>	min. 7 N / max. 13 N <sup>1)</sup>

Interface characteristics CANopen – Sensor type CC1, RC1	
<b>CAN specification</b>	Full CAN 2.0B (ISO11898)
<b>Communication profile</b>	CANopen CiA 301 V 4.2.0
<b>Device profile</b>	encoder, absolute linear; CiA 406 V 3.2.0
<b>Error monitoring</b>	Producer Heartbeat, Emergency Message, Node Guarding
<b>Node ID</b>	default: 7, adjustable via SDO
<b>PDO</b>	1 x TPDO, static mapping
<b>PDO functions</b>	event-triggered, time-triggered, Sync-cyclic, Sync-acyclic
<b>Transmission rate</b>	Default 250 kbit/s, 1 Mbps, 800, 500, 250, 125, 50, 20 kbps adjustable via SDO
<b>Bus connection</b>	M12 connector, 5-pin or axial cable outlet (TPE cable), standard length 2 m
<b>Integrated bus terminating resistor</b>	120 ohms ready-to-activate via SDO
<b>Bus, galvanic isolation</b>	no
<b>Supply voltage</b>	8 ... 30 V DC
<b>Current consumption</b>	typ. 10 mA at 24 V, typ. 20 mA at 12 V
<b>Measuring rate</b>	1 kHz with 16 bit resolution
<b>Resolution</b>	0.002 % of the measuring range
<b>Electrical protection</b>	reverse polarity protection

## Electrical characteristics (analog sensor, scaled to measuring range)

Sensor type	A11 / R11 Current output	A22, R22	A44, R44 Voltage outputs	A55, R55	A33 / R33 Potentiometer
<b>Output</b>	4 ... 20 mA	0 ... 10 V	0.5 ... 4.5 V	0 ... 5 V	1 kΩ
<b>Supply voltage</b>	12 ... 30 V DC	12 ... 30 V DC	8 ... 30 V DC	8 ... 30 V DC	max. 30 V DC
<b>Recommended slider current</b>	–	–	–	–	< 1 μA
<b>Current consumption</b>	–	–	25 mA (non load)	–	–
<b>Output current</b>	max. 50 mA in case of a failure	–	max. 10 mA, min. load 10 kΩ	–	–
<b>Response time</b>	< 1 ms from 0 ... 100 % and 100 ... 0 %	–	< 3 ms from 0 ... 100 % and 100 ... 0 %	–	–
<b>Resolution</b>	theoretically unlimited, limited by the noise				
<b>Noise</b>	1.6 mA <sub>eff</sub>	–	0.5 mV <sub>eff</sub>	–	depending on the supply voltage
<b>Reverse polarity protection</b>	–	–	ja	–	–
<b>Short circuit proof</b>	–	–	ja	–	–
<b>Temperature coefficient</b>	0.0079 %/K	–	0.0037 %/K	–	±0.0025 %/K

Characteristics measuring wire	
<b>Material</b>	stainless steel V4A (1.4401)
<b>Measuring range</b>	∅ 0.5 mm 3 ... 10 m ∅ 1.0 mm 3 ... 8 m ∅ 1.5 mm 3 ... 6 m
<b>Breaking force</b>	∅ 0.5 mm 262 N ∅ 1.0 mm 942 N ∅ 1.5 mm 1.890 N
<b>Temperature coefficient</b>	16 x 10 <sup>-6</sup> K <sup>-1</sup>

Approvals	
<b>Electromagnetic compatibility</b>	acc. to EN 61326-1, EN 61326-3-1
<b>CE compliant</b> in accordance with	
EMC Directive	2014/30/EU
RoHS Directive	2011/65/EU

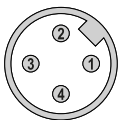
1) Depends on the measuring length.

<b>Draw-wire encoder D120</b>	<b>Robust-Line</b>	<b>Measuring length max. 10 m</b>
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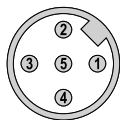
## Terminal assignment

<b>Analog sensor</b> <b>A11</b> (4 ... 20 mA)			R/I converter									
	Signal:	+V	n.c.	I <sub>out</sub>	n.c.							
	Cable <sup>1)</sup>	Core color:	BN	WH	BU	BK						
	M12 connector, 4-pin	Pin:	1	2	3	4						
<b>Analog sensor</b> <b>redundant</b> <b>R11</b> (2 x 4 ... 20 mA)			R/I converter 1		R/I converter 2							
	Signal:	+V <sub>1</sub>	I <sub>out 1</sub>	+V <sub>2</sub>	I <sub>out 2</sub>	n.c.	n.c.	n.c.	n.c.			
	Cable <sup>1)</sup>	Core color:	WH	GN	GY	BU	BN	YE	PK	RD		
	M12 connector, 8-pin	Pin:	1	3	5	7	2	4	6	8		
<b>Analog sensor</b> <b>A22</b> (0 ... 10 V DC) <b>A44</b> (0.5 ... 4.5 V) <b>A55</b> (0 ... 5 V)			R/U converter									
	Signal:	+V	U <sub>out</sub>	0 V	0 V <sub>out</sub>							
	Cable <sup>1)</sup>	Core color:	BN	WH	BU	BK						
	M12 connector, 4-pin	Pin:	1	2	3	4						
<b>Analog sensor</b> <b>redundant</b> <b>R22</b> (2 x 0 ... 10 V DC) <b>R44</b> (2 x 0.5 ... 4.5 V) <b>R55</b> (2 x 0 ... 5 V)			R/U converter 1				R/U converter 2					
	Signal:	+V <sub>1</sub>	U <sub>out 1</sub>	0 V <sub>1</sub>	0 V <sub>out 1</sub>	+V <sub>2</sub>	U <sub>out 2</sub>	0 V <sub>2</sub>	0 V <sub>out 2</sub>			
	Cable <sup>1)</sup>	Core color:	WH	BN	GN	YE	GY	PK	BU	RD		
	M12 connector, 8-pin	Pin:	1	2	3	4	5	6	7	8		
<b>Analog sensor</b> <b>A33</b> (potentiometer 1 kΩ)			Potentiometer									
	Signal:	+V	Out	0 V	n.c.							
	Cable <sup>1)</sup>	Core color:	BN	WH	BU	BK						
	M12 connector, 4-pin	Pin:	1	2	3	4						
<b>Analog sensor</b> <b>redundant</b> <b>R33</b> (2 x potentiometer 1 kΩ)			Potentiometer 1				Potentiometer 2					
	Signal:	+V <sub>1</sub>	Out <sub>1</sub>	0 V <sub>1</sub>	n.c.	+V <sub>2</sub>	Out <sub>2</sub>	0 V <sub>2</sub>	n.c.			
	Cable <sup>1)</sup>	Core color:	WH	BN	GN	YE	GY	PK	BU	RD		
	M12 connector, 8-pin	Pin:	1	2	3	4	5	6	7	8		
<b>Digital sensor</b> <b>CC1</b> (CANopen)			CANopen									
	Signal:	+V	0 V	CAN_GND	CAN_H	CAN_L						
	Cable <sup>1)</sup>	Core color:	WH	BU	BN	BK	GY					
	M12 connector, 5-pin	Pin:	2	3	1	4	5					
<b>Digital sensor</b> <b>redundant</b> <b>RC1</b> (2 x CANopen)			CANopen 1 + CANopen 2									
	Signal:	+V	0 V	CAN_GND	CAN_H	CAN_L						
	Cable <sup>1)</sup>	Core color:	WH	BU	BN	BK	GY					
	M12 connector, 5-pin	Pin:	2	3	1	4	5					

### Top view of mating side, male contact base



M12 connector, 4-pin



M12 connector, 5-pin

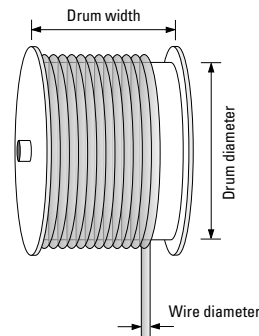


M12 connector, 8-pin

1) Isolate unused cores individually before initial start-up.

**Technology in detail**
**Operating principle**
**Construction**

The core of a draw-wire device is a drum mounted on bearings, onto which a wire is wound. Winding takes place via a spring-loaded device. The single-layer wire winding ensuring the best linearity possible is a specific feature of Kübler draw-wire encoders.


**Note**

Exceeding the maximum extension length of the draw-wire will lead to damage to the wire and the mechanics. In addition, snapping of the cable during installation must imperatively be avoided, as this can also lead to damages.

**Wire fastenings**

Carabiner ring  
D8.D120.xxx.xxx.V003

M4 thread <sup>1)</sup>  
D8.D120.xxx.xxx.V001

Eyelet  
D8.D120.xxx.xxx.V002

Clip  
D8.D120.xxx.xxx.V007



ball-bearing swivel  
(no torsion of the measuring wire during installation)

rubber stopper

measuring wire

**Wire types**

- Stainless steel V4A,  $\varnothing$  0.5 mm, order option **b** = 1
- Stainless steel V4A,  $\varnothing$  1.0 mm, order option **b** = 2
- Stainless steel V4A,  $\varnothing$  1.5 mm, order option **b** = 3



Ideally suited for long-term outdoor use.

**Extension wire**

For optimum use of the measuring range by extending the wire length, e. g. to allow realizing a pre-extension in the application. Especially combined with analog interfaces (options A11 ... A55 and R11 ... R55).


**Extended temperature range -40 °C ... +85 °C**

(only in combination with the standard linearity 0.5 %, **G** = 1)

By using special components.

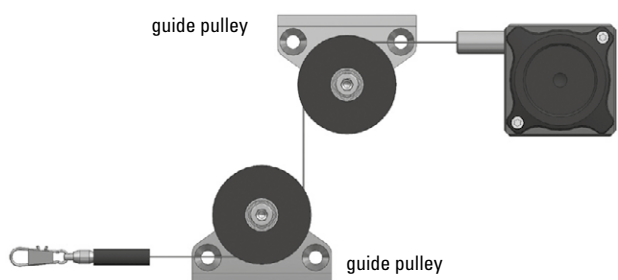
Order code extensions for the extended temperature range:

With carabiner ring: D8.D120.xxx.xxx.V003

With M4 thread <sup>1)</sup>: D8.D120.xxx.xxx.V004

With eyelet: D8.D120.xxx.xxx.V005

With clip: D8.D120.xxx.xxx.V008

**Application-specific installation possibilities**


<sup>1)</sup> Not available with wire type V4A,  $\varnothing$  1.5 mm – order option **b** = 3.

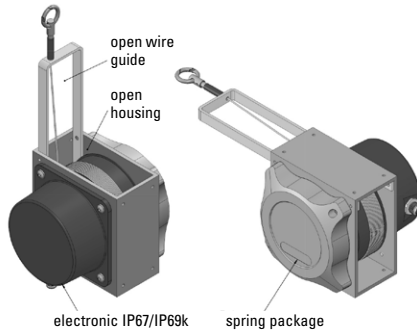
**Draw-wire encoder D120**     **Robust-Line**     **Measuring length max. 10 m**

**Technology in detail**

**Housing types** (the suitable housing type for every application)

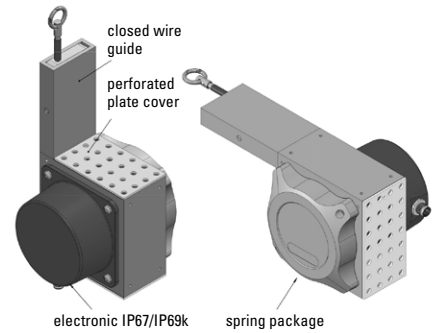
**Open housing, open wire guide**

For use in the presence of fine dust and liquids.



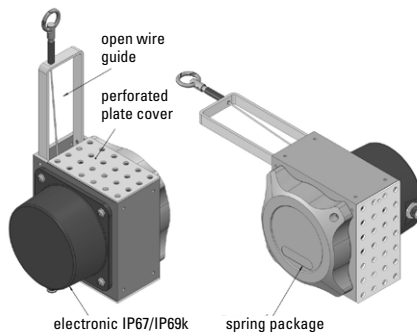
**Housing with perforated plate cover, closed wire guide**

For use in the presence of dirt, particles size > 2 mm and liquids. Shock protection, wire cleaning device (in preparation).



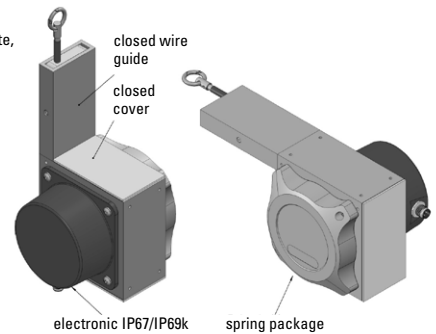
**Housing with perforated plate cover, open wire guide**

For use in the presence of dirt, particles size > 2 mm and liquids



**Closed housing, closed wire guide**

For use in the presence of sticky dust, cement, concrete, clay. Shock protection, wire cleaning device (in preparation).



## Draw-wire encoder D120

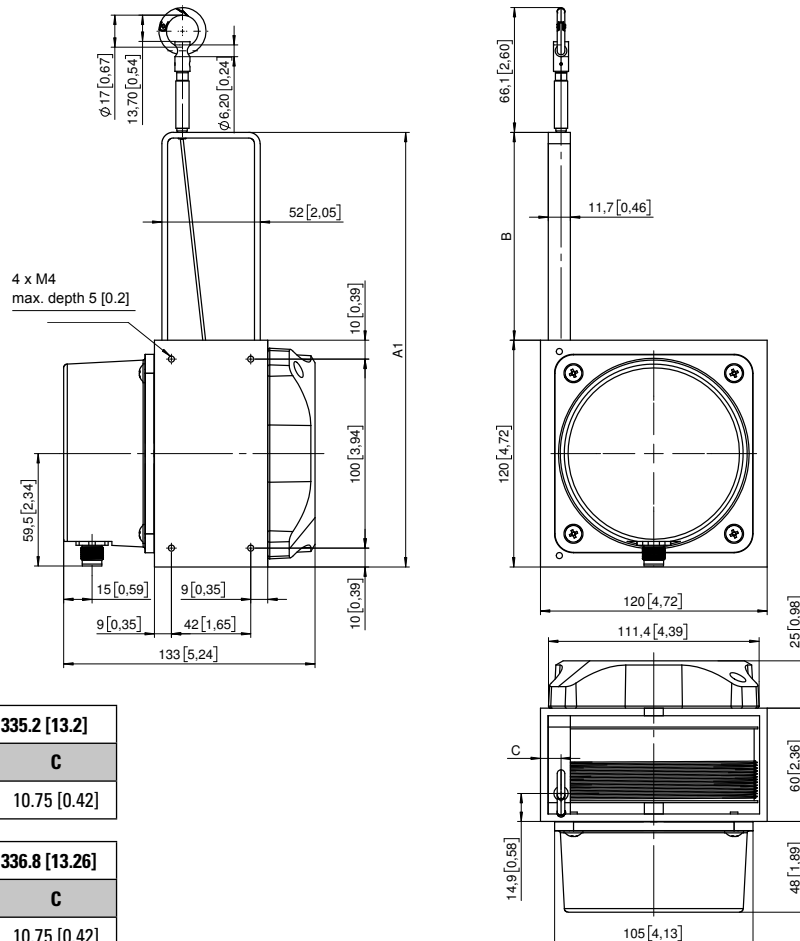
Robust-Line

Measuring length max. 10 m

### Dimensions

Dimensions in mm [inch]

Open housing,  
open wire guide



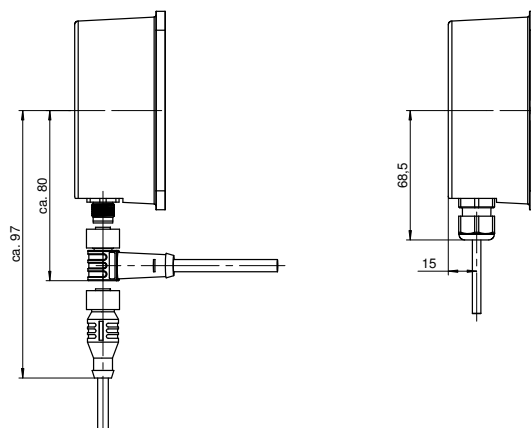
Wire diameter $\varnothing$ 0.5 mm – drum pitch circumference: 335.2 [13.2]			
Measuring length	A1	B	C
3 ... 10 m	230 [9.06]	110 [4.33]	10.75 [0.42]

Wire diameter $\varnothing$ 1.0 mm – drum pitch circumference: 336.8 [13.26]			
Measuring length	A1	B	C
3 ... 5 m	230 [9.06]	110 [4.33]	10.75 [0.42]
6 ... 8 m	320 [12.6]	200 [7.87]	12.25 [0.48]

Wire diameter $\varnothing$ 1.5 mm – drum pitch circumference: 338.3 [13.32]			
Measuring length	A1	B	C
3 ... 4 m	230 [9.06]	110 [4.33]	10.75 [0.42]
5 ... 6 m	320 [12.6]	200 [7.87]	12.25 [0.48]

### Connector output / Cable outlet

The cable must be protected in case of steam and high-pressure cleaning.

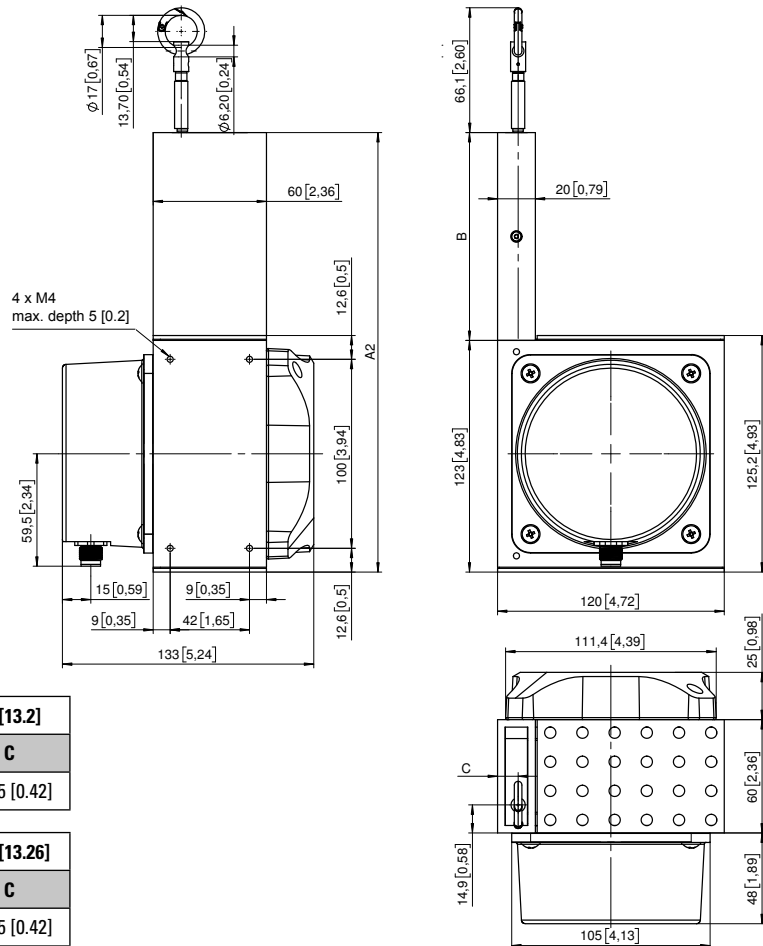


**Draw-wire encoder D120**      **Robust-Line**      **Measuring length max. 10 m**

## Dimensions

Dimensions in mm [inch]

Housing with perforated plate cover,  
closed wire guide



Wire diameter $\varnothing$ 0.5 mm – drum pitch circumference: 335.2 [13.2]			
Measuring length	A2	B	C
3 ... 10 m	233 [9.17]	110 [4.33]	10.75 [0.42]

Wire diameter $\varnothing$ 1.0 mm – drum pitch circumference: 336.8 [13.26]			
Measuring length	A2	B	C
3 ... 5 m	233 [9.17]	110 [4.33]	10.75 [0.42]
6 ... 8 m	323 [12.7]	200 [7.87]	12.25 [0.48]

Wire diameter $\varnothing$ 1.5 mm – drum pitch circumference: 338.3 [13.32]			
Measuring length	A2	B	C
3 ... 4 m	233 [9.17]	110 [4.33]	10.75 [0.42]
5 ... 6 m	323 [12.7]	200 [7.87]	12.25 [0.48]