

Feedthroughs

ISO-KF, ISO-K, CF

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Feedthroughs

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Feedthroughs

Current Feedthroughs

General

Current feedthroughs for vacuum applications, as well as their corresponding connectors, comply with the German VDE Regulations 0100, 0660 and 0110 Section 1. The latter refers to air gaps and leakage paths.

- All current feedthroughs are tested according to VDE Regulations

Important

The special regional safety regulations must be observed! These may differ from the regulations which apply in Germany! The voltages stated on the following pages apply to atmospheric pressure and the right connector from Leybold. The voltage specifications apply also to that part of the feedthrough which is exposed to the vacuum, provided the pressure in these areas is less than 10^{-1} mbar (0.75×10^{-1} Torr).

At pressures over 10^{-1} mbar (0.75×10^{-1} Torr) voltage breakdowns may occur depending on the distance between the electrodes, the type of rarefied gas, the type of contamination, the distribution of the electric field, etc.

Operators are advised to check each application individually or to get in touch with Leybold for advice.

In applications where VDE regulations need not be applied, higher operating voltages are permissible. Please contact us for further information regarding your particular application.

The test and operating voltages refer to a vacuum pressure of $< 1 \times 10^{-4}$ mbar ($< 0.75 \times 10^{-4}$ mbar) and when using the connectors recommended by Leybold. Electrical power may only be applied via the external plugs.

Abbreviations used in connection with feedthroughs:

F	Feedthrough
E	Current
L	Liquid
N	Normal
P	Precision
F	Frequency
HC	Current
HV	Voltage
L	Linear
R	Rotary

Current Feedthroughs

Technical Data

FE 16 / 9S

FE 16 / 9

Vacuum connection	DN	16 ISO-KF	16 ISO-KF
Number of feedthroughs		9	9
Voltage per pole ¹⁾	V	50	50
Current per pole ¹⁾	A	2	2
Connection			
Vacuum side		solder connection	connector
Air side		connector	connector
Diameter of connecting wire	mm (in.)	0.8 (0.03) / 1.2 (0.05)	-
Test voltage	V / Hz	1 x 10 ⁻⁹	1 x 10 ⁻⁹
Pressure (absolute)		1 x 10 ⁻⁸ mbar to 2.5 bar (0.75 x 10 ⁻⁸ Torr to 1875 Torr)	1 x 10 ⁻⁸ mbar to 2.5 bar (0.75 x 10 ⁻⁸ Torr to 1875 Torr)
Bakeout temperature (feedthrough, connector)	°C (°F)	130 (266)	130 (266)
Housing		Stainless steel	Stainless steel
Insulator		PEEK / Araldit	PEEK / Araldit
Seal		FPM (FKM)	FPM (FKM)
Contact (feedthrough, connector)		gold-plated brass	gold-plated brass

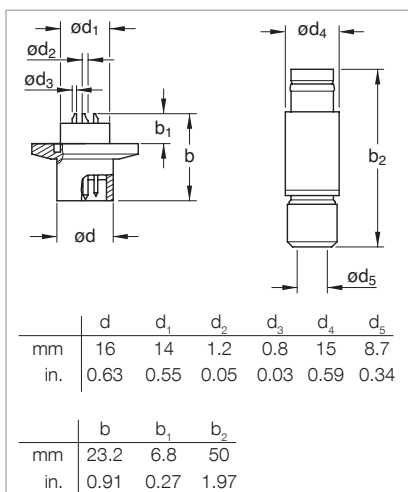
Ordering Information

FE 16 / 9S

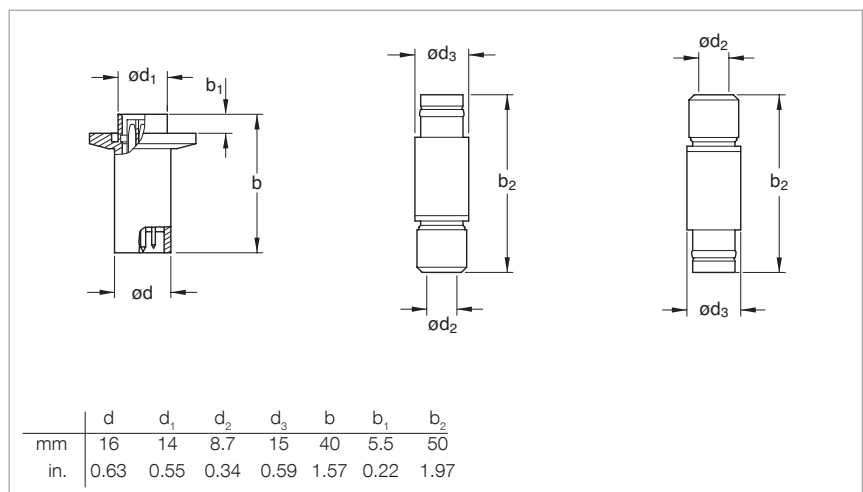
FE 16 / 9

	Part No.	Part No.
Current feedthroughs	210 302	210 304
Connector: vacuum side	-	210 305
Connector: air side	210 303	210 303

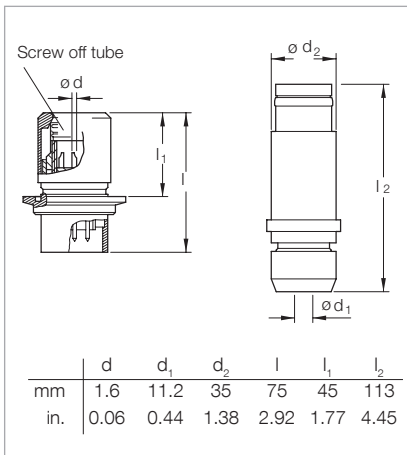
¹⁾ Local regulations concerning use must be followed



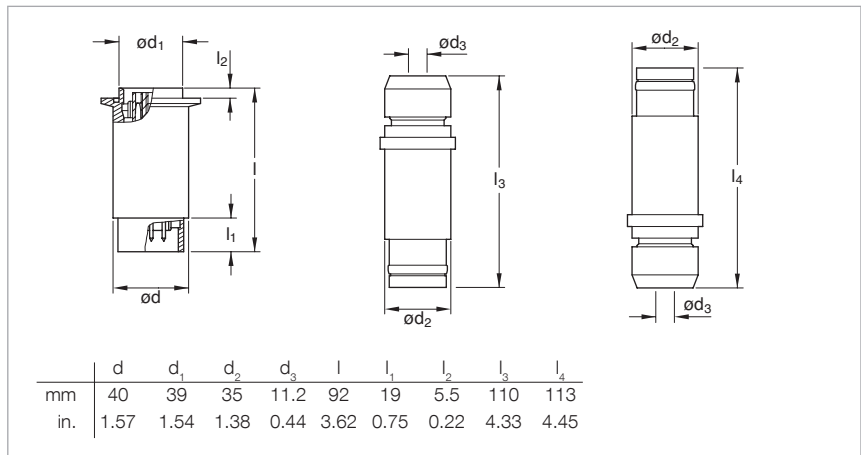
Dimensional drawing for the feedthrough FE 16/9S (left) and the connector for air side (right)



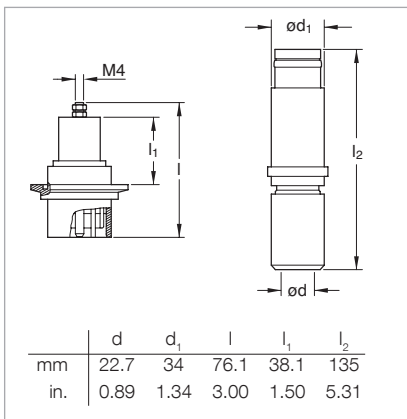
Dimensional drawing for the feedthrough FE 16/9 (left), the connector for vacuum side (middle) and the connector for air side (right)



Dimensional drawing for the feedthrough FE 40/7S (left) and the connector for air side (right)



Dimensional drawing for the feedthrough FE 40/7 (left), the connector for vacuum side (middle) and the connector for air side (right)



Dimensional drawing for the feedthrough FEHV 40/1 (left) and the connector for air side (right)



Technical Data**FE 40 / 7S****FE 40 / 7****FEHV 40 / 1**

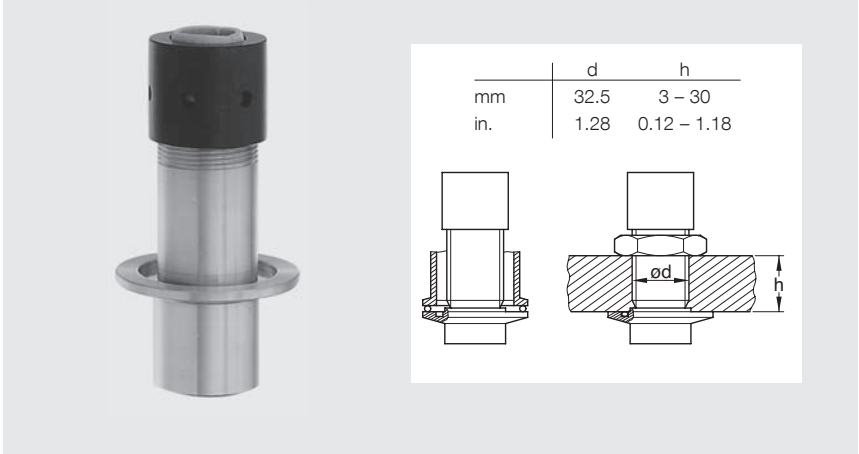
Vacuum connection	DN	40 ISO-KF	40 ISO-KF	40 ISO-KF
Number of feedthroughs		7	7	1
Voltage per pole ¹⁾	V	380	380	6000
Current per pole ¹⁾	A	16	16	25
Connection				
Vacuum side		solder connection	connector	screw coupling
Air side		connector	connector	connector
Diameter of connecting wire	mm (in.)	dia. 1.8 (0.07)	–	–
Test voltage	kV / Hz	–	–	15 / 50
Tightness	mbar x l/s	1 x 10 ⁻⁹	1 x 10 ⁻⁹	1 x 10 ⁻⁹
Pressure (absolute)		1 x 10 ⁻⁸ mbar x l/s to 2.5 bar	1 x 10 ⁻⁸ mbar x l/s to 2.5 bar	1 x 10 ⁻⁸ mbar x l/s to 2.5 bar
Bakeout temperature (feedthrough, connector)	°C (°F)	130 (266)	130 (266)	130 (266)
Housing		chrom-plated steel	chrom-plated steel	chrom-plated steel
Insulator		PTFE / Araldit	PTFE / Araldit	PTFE
Seal		FPM (FKM)	FPM (FKM)	FPM (FKM)
Contact (feedthrough, connector)		gold-plated stainless steel	gold-plated stainless steel	nickel-plated brass

Ordering Information**FE 40 / 7S****FE 40 / 7****FEHV 40 / 1**

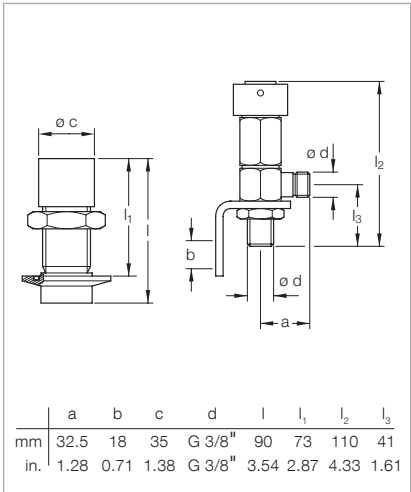
	Part No.	Part No.	Part No.
Current feedthroughs	210 325	210 326	210 350
Connector: vacuum side	–	210 328	–
Connector: air side	210 327	210 327	210 351

¹⁾ Local regulations concerning use must be followed

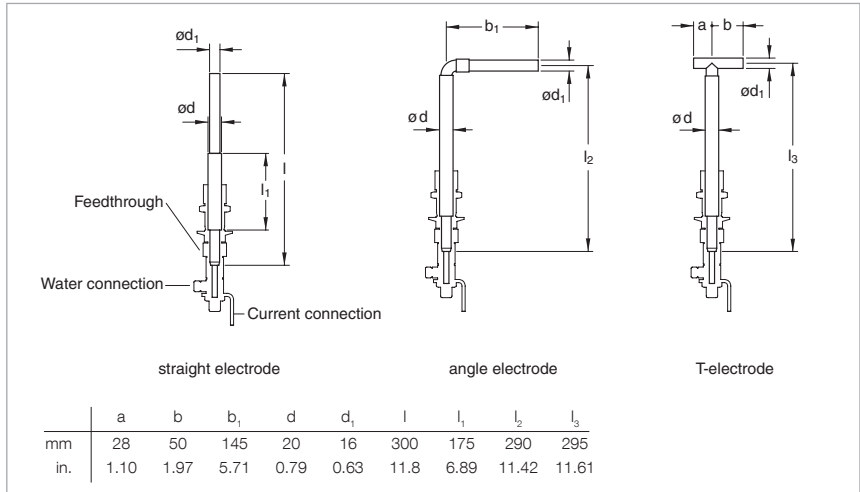
High Current Feedthroughs



- Selection of electrodes
- Slide into mounted feedthrough
- Current connection with water cooling



Dimensional drawing for the feedthrough FEHC 40/1 (left) and current connection with water cooling (right)



Dimensional drawings for the copper electrodes for the feedthrough FEHC 40/1

Technical Data**FEHC 40/1**

Vacuum connection	DN	40 ISO-KF
Number of feedthroughs		1
Voltage	V	50
Current	A	250
with water cooling	A	1500
Tightness	mbar x l/s	1×10^{-9}
Pressure (absolute)		1×10^{-8} mbar to 2.5 bar (max. 10 bar with external centering ring)
Bakeout temperature	°C (°F)	110 (230)
Housing		aluminum
Insulator		thermoplast and thermoset
Seal		FPM (FKM)

Ordering Information**FEHC 40/1**

	Part No.
High current feedthroughs	210 352
Current connection with water cooling ¹⁾	210 356
Straight electrode	210 353
Angle electrode	210 354
T-electrode	210 355

¹⁾ Not insulated

Rotary Feedthroughs

- ISO-KF / ISO-K
- For transmitting high torque
- With FPM (FKM) shaft seal and ball bearings

Technical Data

FR 25/50 N

FR 63/100 N

Vacuum connection	DN	25 ISO-KF	63 ISO-K
Feedthrough / seal		FPM (FKM)	FPM (FKM)
Shaft connection	mm (in.)	dia. 8 (0.31)	dia. 20 (0.79)
Transferable torque	Nm	6	100
Rotational speed ¹⁾	1/min	1000	500
Shaft load			
Radial	N	150	500
Axial	N	50	100
Service life (revolutions)		20 000 000	10 000 000
Tightness, static	mbar x l/s	1 x 10 ⁻⁹	1 x 10 ⁻⁹
Pressure (absolute)		1 x 10 ⁻⁹ mbar to 1 bar	1 x 10 ⁻⁹ mbar to 1 bar
Operating temperature, max.	°C (°F)	50 (122)	50 (122)
Bakeout temperature	°C (°F)	110 (230)	110 (230)
Materials exposed to process media		Stainless steel, aluminum, FPM (FKM)	Stainless steel, aluminum, FPM (FKM)
Weight	kg (lbs)	0.2 (0.44)	2 (4.42)

Ordering Information

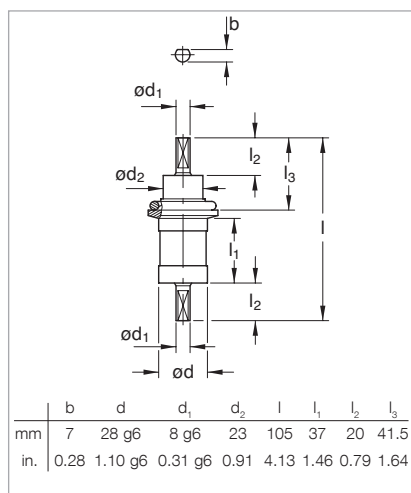
FR 25/50 N

FR 63/100 N

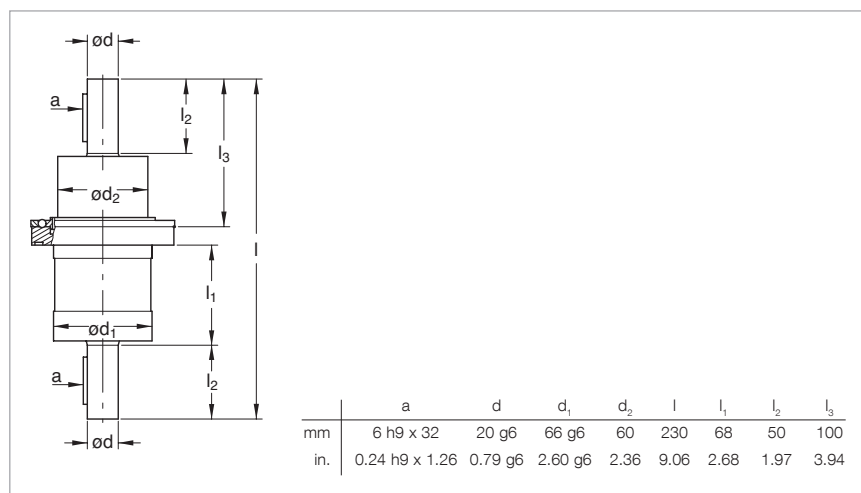
	Part No.	Part No.
Rotary feedthrough	210 151	210 153 ²⁾

¹⁾ When a reduced service life is acceptable, the rotational speed can be increased by up to a factor of two

²⁾ Centering ring, CR/aluminum Part No. 268 05, FPM (FKM)/stainless steel Part No. 887 03



Dimensional drawing
for the feedthrough FR 25/50 N



Dimensional drawing for the feedthrough FR 63/100 N

Liquid Feedthroughs

- For H₂O and LN₂
- Thermally insulated
- Especially suited for very hot and very cold applications

Technical Data

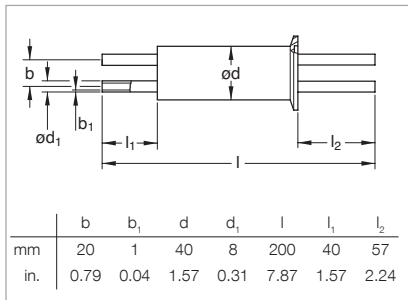
FL 40K/2

Vacuum connection	DN	40 ISO-KF
Feedthrough / seal		welded
Connection	mm (in.)	dia. 8 x 1 (0.31 x 0.04)
Number of tubes		2
Tightness	mbar x l/s	1 x 10 ⁻⁹
Pressure (absolute)		1 x 10 ⁻⁹ mbar to 2.5 bar (max. 10 bar with external centering ring)
Temperature range	°C (°F)	-200 to +150 (-328 to +302)
Material		Stainless steel
Weight	kg (lbs)	0.3 (0.66)

Ordering Information

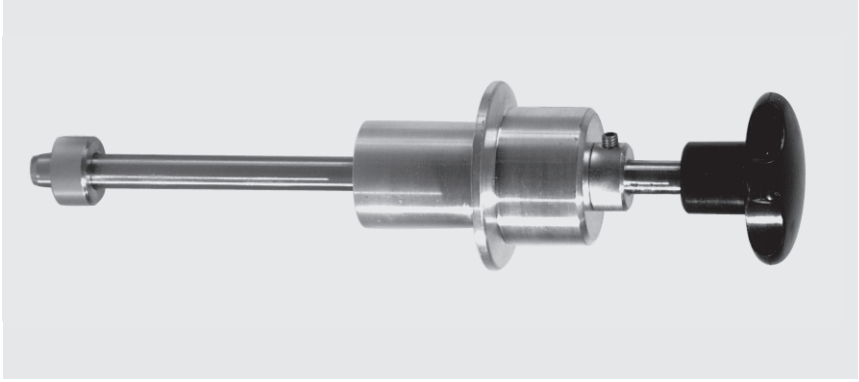
FL 40K/2

	Part No.
Liquid feedthrough	210 275

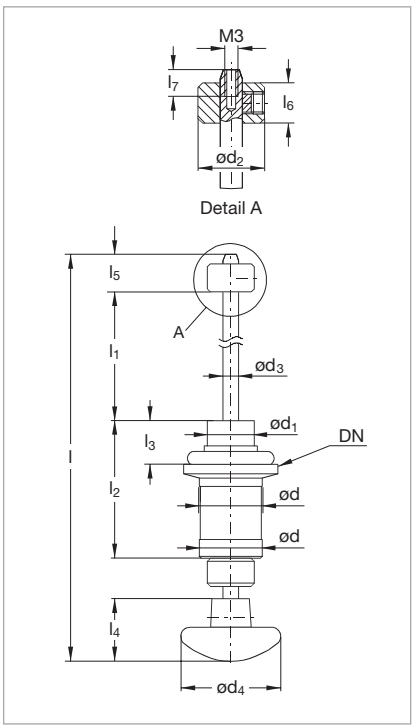


Dimensional drawing for the liquid feedthrough
FL 40K/2

Rotary / Linear Motion Feedthroughs



- Two FPM (FKM) shaft seals
- Direct push/pull and rotary actuation
- With locking ring



Dimensional drawing for the feedthroughs FNRL

Dimension Table

Feedthroughs	DN	d	d ₁	d ₂	d ₃	
FNRL 16/50	16	20g6	15	15	5 ^{+0.03} _{-0.05}	
	mm	0.79g6	0.59	0.59	0.20	
FNRL 25/100	25	25g6	23	22	8 ^{-0.06} _{-0.08}	
	mm	0.98g6	0.91	0.87	0.31	
		d ₄	l	l ₁ max.	l ₂	l ₃
FNRL 16/50	32	134	50	44	14	
	mm	1.26	5.28	1.97	1.73	0.55
FNRL 25/100	50	210	100	58	24	
	mm	1.97	8.27	3.94	2.28	0.94
		l ₄	l ₅	l ₆	l ₇	
FNRL 16/50	20	10.5	8	6		
	mm	0.79	0.41	0.31	0.24	
FNRL 25/100	32	11	9	8		
	mm	1.26	0.43	0.35	0.31	

Technical Data**FNRL 16/50****FNRL 25/100**

Vacuum connection	DN	16 ISO-KF	25 ISO-KF
Feedthrough / seal		FPM (FKM)	FPM (FKM)
Shaft connection	mm (in.)	M 3 x 6 / dia. 5 (M 3 x 0.24 / dia. 0.20)	M 4 x 8 / dia. 8 (M 4 x 0.31 / dia. 0.31)
Stroke	mm (in.)	50.0 (1.97)	100.0 (3.94)
Shaft load			
Radial, at max. displacement	N	10	15
Torsion	Nm	2	8
Tightness, static	mbar x l/s	1 x 10 ⁻⁹	1 x 10 ⁻⁹
Operating pressure range (absolute)		1 x 10 ⁻⁸ mbar to 1 bar	1 x 10 ⁻⁸ mbar to 1 bar
Operating temperature, max.	°C (°F)	50 (122)	50 (122)
Bakeout temperature	°C (°F)	110 (230)	110 (230)
Materials exposed to process media		Stainless steel, aluminum, FPM (FKM)	Stainless steel, aluminum, FPM (FKM)
Weight	kg (lbs)	0.1 (0.22)	0.2 (0.44)

Ordering Information**FNRL 16/50****FNRL 25/100**

	Part No.	Part No.
Rotary / linear feedthrough	210 200	210 201

CF Feedthroughs

CF feedthroughs are available in a variety of field-proven designs, specifically:

- Linear motion mechanical feedthroughs
- Rotary motion mechanical feedthroughs

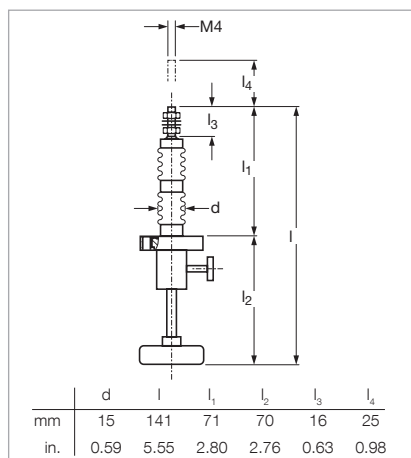
A stainless steel bellows is used to seal off the CF linear and rotary feedthroughs against the atmosphere.

All feedthroughs can be installed in the vacuum systems in any orientation.

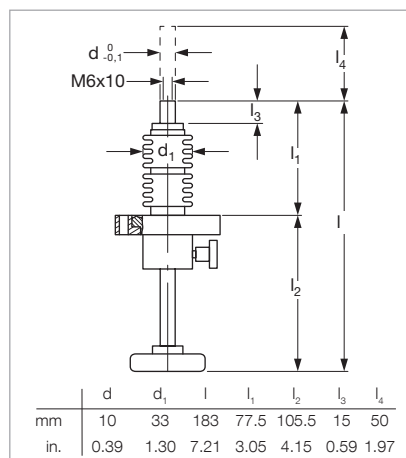
Abbreviations used in connection with feedthroughs:

- F Feedthrough
- E Electric
- L Liquid
- N Normal
- P Precision
- F Frequency
- HC Current
- HV Voltage
- L Linear
- R Rotary

Linear Motion Mechanical Feedthroughs



Dimensional drawing for the FNL 16/25 linear motion feedthrough



Dimensional drawing for the FNL 40/50 linear motion feedthrough

Technical Data

FNL 16/25

FNL 40/50

Nominal width	DN	16 CF-R	40 CF-R
Shaft connection	mm (in.)	M 4 x 16 (M 4 x 0.63)	M 6 x 10, Ø 10 (M 6 x 0.39, Ø 0.39)
Feedthrough / seal		bellows	bellows
Actuator		manually	manually
Travel	mm (in.)	25.0 (0.98)	50.0 (1.97)
Scale division	mm (in.)	5.0 (0.20)	10.0 (0.39)
Shaft load			
Radial at max. displacement	N	20	100
Axial, against vacuum	N	85	140
Axial, against atmosphere	N	100	200
Torsion	Nm (lbf-in)	0.2 (1.77)	0.5 (4.43)
Tightness	mbar x l/s	5 x 10 ⁻¹¹	5 x 10 ⁻¹¹
Pressure absolute		1 x 10 ⁻¹⁰ mbar to 2 bar	1 x 10 ⁻¹⁰ mbar to 2 bar
Bakeout temperature feedthrough	°C (°F)	300 (572)	300 (572)
Weight	kg (lbs)	0.15 (0.33)	0.75 (1.66)
Materials exposed to process media		Stainless steel	Stainless steel

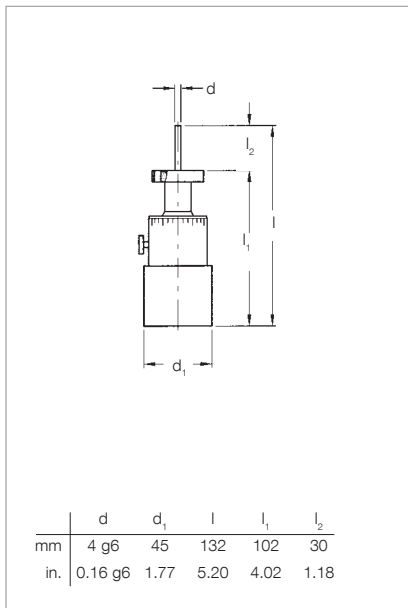
Ordering information

FNL 16/25

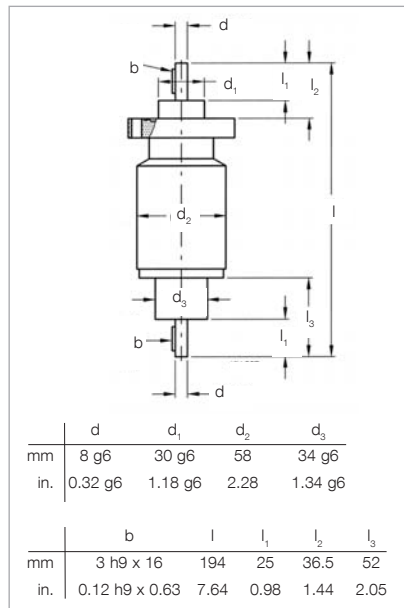
FNL 40/50

	Part No.	Part No.
Linear motion feedthrough	210 250	210 251

Linear Motion Mechanical Feedthroughs



Dimensional drawing for the FPR 16/5 N rotary feedthrough



Dimensional drawing for the FNR 40/20 N rotary feedthrough

The rotation of the drive knob is translated via a gearless drive system to the shaft on the vacuum side. This shaft runs on ball bearings which do not require any maintenance during the entire service life.

Technical Data

FPR 16/5 N

FNR 40/20 N

Nominal width	DN	16 CF-F	40 CF-F
Shaft connection	mm (in.)	dia. 4 (0.16)	dia. 8 (0.32)
Feedthrough / seal		bellow	bellow
Transferable torque			
Dynamic	Nm (lbf-in)	0.4 (3.54)	4.0 (35.40)
Dynamic, at 300 °C (572 °F)	Nm (lbf-in)	0.2 (1.77)	2.0 (17.70)
Static	Nm (lbf-in)	0.2 (1.77)	3.0 (26.55)
Rotational speed	rpm	200	1000
at max. torque	rpm	–	500
Scale division	mm	10°	–
Shaft load			
Radial	N	10	60
Axial	N	5	20
Tightness	mbar x l/s	5 x 10 ⁻¹¹	5 x 10 ⁻¹¹
Pressure absolute		1 x 10 ⁻¹⁰ mbar to 2 bar	1 x 10 ⁻¹⁰ mbar to 2 bar
Bakeout temperature	°C (°F)	300 (572)	300 (572)
Weight	kg (lbs)	0.3 (0.66)	1.5 (3.31)
Materials exposed to process media		Stainless steel	Stainless steel

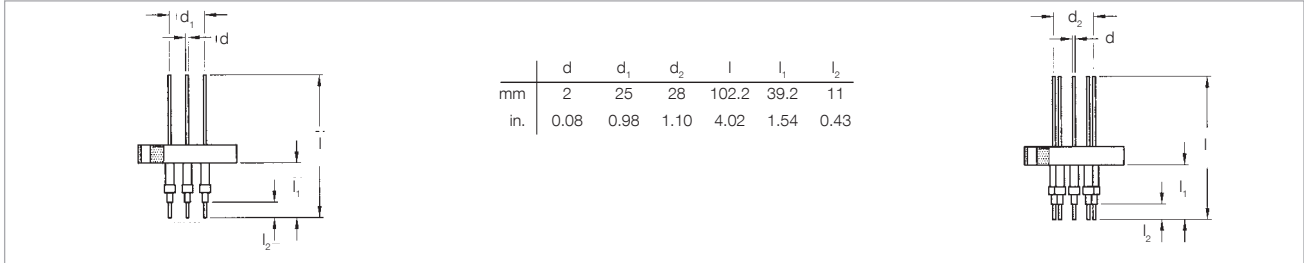
Ordering information

FPR 16/5 N

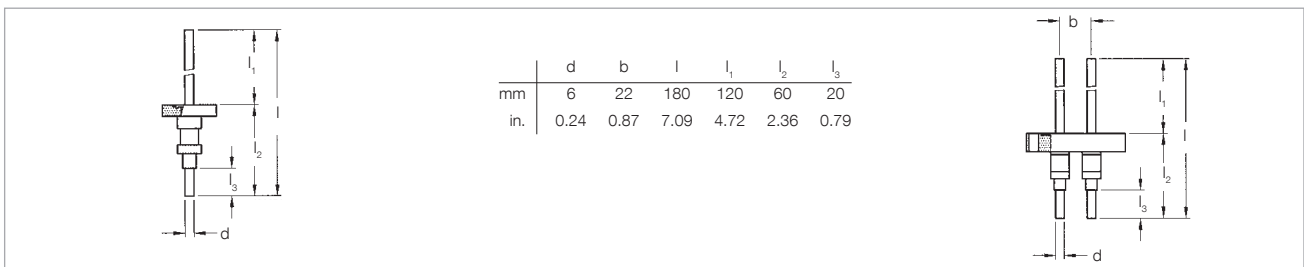
FNR 40/20 N

	Part No.	Part No.
Rotary feedthrough	210 154	210 155

Current Feedthroughs



Dimensional drawing for the current feedthrough FE 40/4 (left) and FE 40/9 (right)



Dimensional drawing for the current feedthrough FEHC 16/1 (left) and FEHC 40/2 (right)

Technical Data

FE 40/4

FE 40/9

FEHC 16/1

FEHC 40/2

Nominal width	DN	CF 40-F	CF 40-F	CF 16-F	CF 40-F
Number of feedthroughs		4	9	1	2
Number of connection pieces					
vacuum side (set)		5	2 x 5	2	2
atmospheric side (set)		5	2 x 5	2	2
Voltage per pole ¹⁾	kV	1	1	4	4
Current per pole ¹⁾	A	8	8	150	150
Bakeout temperature	°C (°F)	400 (752)	400 (752)	400 (752)	400 (752)
Temperature rise at max. current ΔT	°C/min	40	40	50	50
Tightness	mbar x l/s	5 x 10 ⁻¹¹	5 x 10 ⁻¹¹	5 x 10 ⁻¹¹	5 x 10 ⁻¹¹
Pressure absolute		1 x 10 ⁻¹⁰ mbar to 2 bar	1 x 10 ⁻¹⁰ mbar to 2 bar	1 x 10 ⁻¹⁰ mbar to 2 bar	1 x 10 ⁻¹⁰ mbar to 2 bar
Flange		Stainless steel	Stainless steel	Stainless steel	Stainless steel
Conductor		Stainless steel	Stainless steel	Copper	Copper
Insulator		Al ₂ O ₃	Al ₂ O ₃	Al ₂ O ₃	Al ₂ O ₃
Weight	kg (lbs)	0.3 (0.66)	0.4 (0.88)	0.15 (0.33)	0.45 (0.91)

Ordering information

FE 40/4

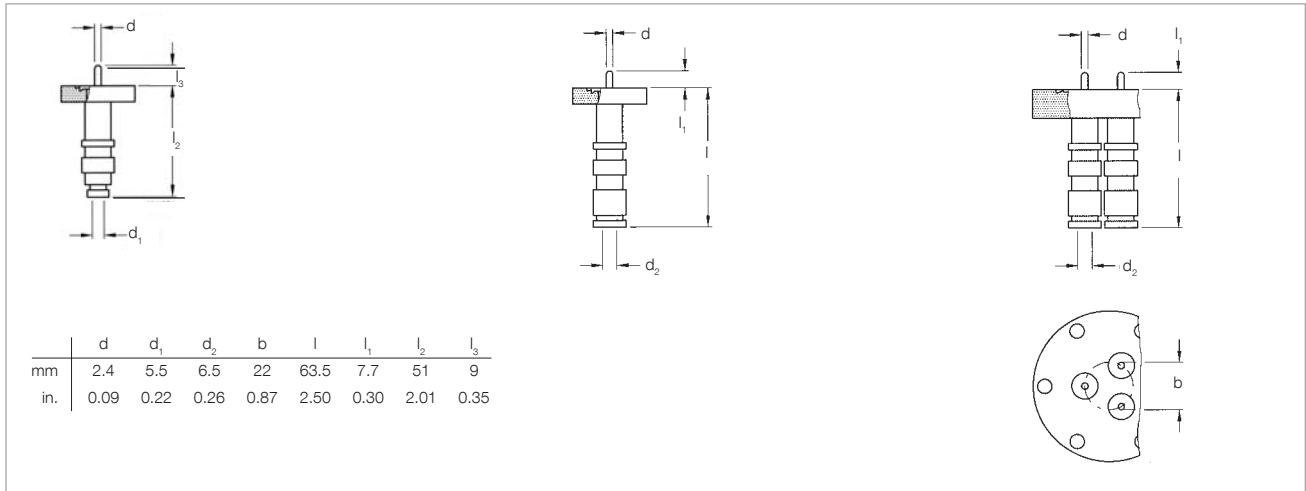
FE 40/9

FEHC 16/1

FEHC 40/2

	Part No.	Part No.	Part No.	Part No.
Current feedthrough	210 310	210 313	210 335	210 342
Connection piece, vacuum side (set)	210 312	2x 210 312	210 337	210 337
Connector, atmospheric side (set)	210 311	2x 210 311	210 336	210 336

¹⁾ Local safety regulations must be met



Dimensional drawing for the current feedthrough FEF 16/1 (left), FEHV 16/1 (middle) and FEHV 40/3 (right)

Technical Data

FEF 16/1

FEHV 16/1

FEHV 40/3

Nominal width	DN	CF 16-F	CF 16-F	CF 40-F
Number of feedthroughs		1	1	3
Voltage				
AC, 50 Hz	kV	0.35	3.5	3.5
DC	kV	0.5	5.0	5.0
Current	A	3	3	3
Frequency	MHz	150	–	–
Impedance	Ω	50 – 60	–	–
Insulation resistance at 20 °C (68 °F)	Ω	10^{+10}	10^{+10}	10^{+10}
Bakeout temperature				
with connector	°C (°F)	50 (122)	50 (122)	50 (122)
without connector	°C (°F)	400 (572) ¹⁾	400 (572) ¹⁾	400 (572) ¹⁾
Tightness	mbar x l/s	1×10^{-10}	1×10^{-10}	1×10^{-10}
Pressure absolute ²⁾		1×10^{-10} mbar to 2.5 bar	1×10^{-10} mbar to 2.5 bar	1×10^{-10} mbar to 2.5 bar
Housing, flange, conductor		Stainless steel	Stainless steel	Stainless steel
Feedthrough, seal		Al ₂ O ₃	Al ₂ O ₃	Al ₂ O ₃
Weight	kg (lbs)	0.14 (0.31)	0.14 (0.31)	0.5 (1.10)

Ordering information

FEF 16/1

FEHV 16/1

FEHV 40/3

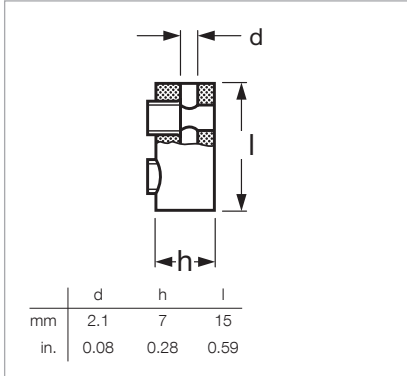
	Part No.	Part No.	Part No.
Current feedthrough	210 404	210 402	210 403
Outside plug (included in delivery)	BNC UG 88/U	MHV UG 932/U	MHV UG 932/U
Cable	RG 58/U	RG 59/U	RG 59/U

¹⁾ With elastomer seal up to 150 °C (302 °F)

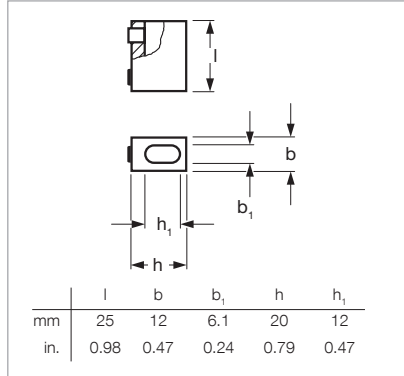
²⁾ Pressure at 400 °C (572 °F) reduced to 2 bar

Accessories for Feedthroughs

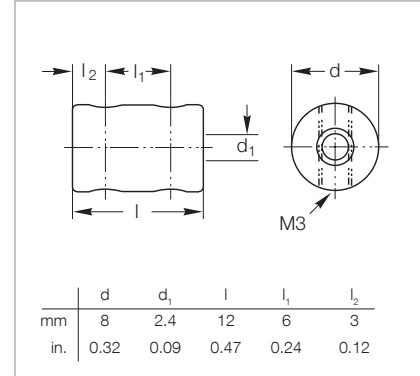
Connectors, vacuum side



Dimensional drawing for the connector used on FE 40/4 / FE 40/9



Dimensional drawing for the connector used on FE 16/1, FEHC 40/2 and FEHC 16/1



Dimensional drawing for the connector used on FEHV 16/1, FEHV 40/3 and FEF 16/1

Technical Data

Connectors Vacuum Side

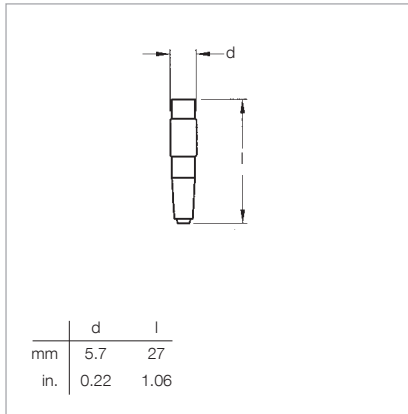
Connector for feedthrough		FE 40/4 / FE 40/9	FEHC 40/2 / FEHC 16/1	FEHV 16/1 / FEHV 40/3 / FEF 16/1
Current max.	A	12	90	13
Bakeout temperature	°C (°F)	400 (752)	400 (752)	350 (662)
Material		Stainless steel	Stainless steel	Copper

Ordering information

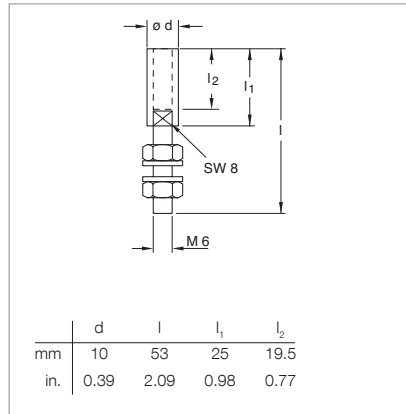
Connectors Vacuum Side

	Part No.	Part No.	Part No.
Connector, vacuum side	-	-	846 47
Connector, vacuum side (Set of 5)	210 312	-	-
Connector, vacuum side (Set of 2)	-	210 337	-

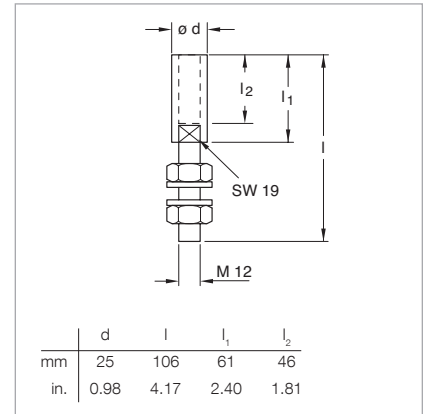
Connectors, atmospheric side



Dimensional drawing for the outside plug used on FE 40 /4 and FE 40/9



Dimensional drawing for the outside plug used on FE 16/1, FEHC 40/2 and FEHC 16/1



Dimensional drawing for the outside plug used on FEHC 40/1

Technical Data

Connectors Atmospheric Side

Connector for feedthrough		FE 40/4 / FE 40/9	FE 16/1 / FEHC 40/2 / FEHC 16/1	FEHC 40/1
Current max.	A	12	90	250
Not insulated, for use up to	V	50	50	50
Bakeout temperature	C (°F)	50 (122)	150 (302)	150 (302)
Material		gold-plated brass	silver-plated brass	silver-plated brass

Ordering information

Connectors Atmospheric Side

	Part No.	Part No.	Part No.
Connector, atmospheric side	-	-	210 339
Connector, atmospheric side (Set of 5)	210 311	-	-
Connector, atmospheric side (Set of 2)	-	210 336	-

