MasterFlex

act in time
MECHATRONIC COMPONENTS & SOLUTIONS

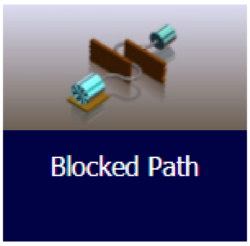
What are flexible shafts?

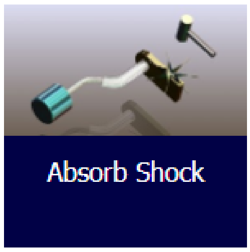
A flexible shaft transmits rotary motion much like a solid shaft. But, it can be routed over, under, and around obstacles that would make using a solid shaft impractical. A “Flexible Shaft Assembly” consists of a rotating shaft (sometimes called a core) with metal end fittings for attachment to mating parts. A protective outer casing is used when necessary. This casing has its own fittings (called ferrules) that keep it stationary during use.

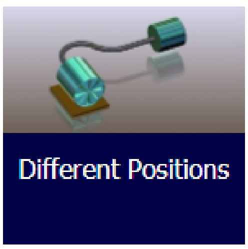
A flexible shaft is a highly effective means of transmitting rotary motion and is more efficient than universal joints, gears, sprockets and chains, or belts and pulleys. It is typically lower in cost than these other devices and offers the added benefit of compensating for misalignment’s in your system that can greatly reduce cost and assembly time.

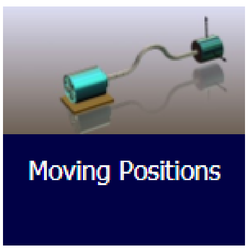
Advantages of flexible shafts:

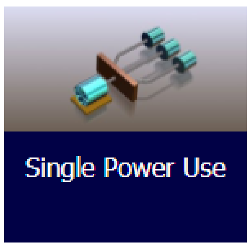
- **Eliminate alignment problems:** Flexible shafts have no need for the tight tolerance that solid shafts require.
- **Have Higher efficiency:** Flexible shafts are 90 %-95% efficient. Gears, U-joints, belts and pulleys have much lower efficiencies due to greater frictional losses.
- **Are Light weight and powerful:** Flexible shafts have a 3:1 weight advantage over other design solutions while transmitting greater power loads.
- **Reduced parts cost:** Bearings and housings for solid shafts and gears require precise machining operations. Flexible shafts eliminate the need for such demanding tolerance and their excessive costs.
- **Are Not affected by Vibration:** Vibrations do not affect flexible shafts performance.
- **Are Easy to Install:** No need for special installation tools
- **Provide Greater design freedom:** Limitless possibilities in position motor and driven components
- **Allow Large off-sets:** Flexible couplings allow only 5 degrees of off-set and U-Joints 30 degrees, but with a 40%-50% decline in efficiency. Flexible shafts permit a full 180 degree off-set while maintaining their high efficiency.
- **Have Lower installation cost:** Flexible shafts install in minutes without special tools or skills. Solid shafts, gears, pulleys, and universal joints require precise alignment and skilled mechanics for their installations.
- **Can Be Designed At The Latter Stages Of A Project:** Unlike other rotary motion devices that need to be designed around because of their rigidness, defined configurations, and large mass. Flexible Shafts allow greater design freedom since engineers have only one piece to work on, eliminating complex coordination of multiple pieces









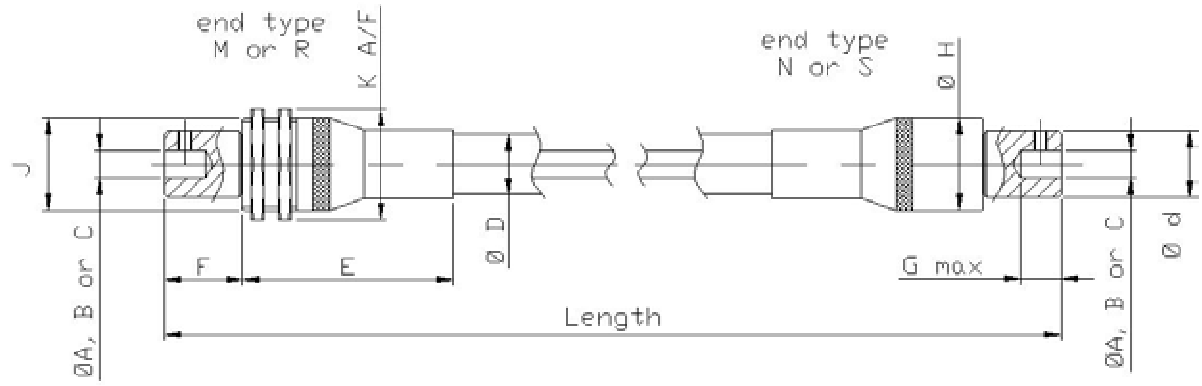


Masterflex dimensions for normal & high duty

Normal Duty (Oilite bearing) assemblies can be used for any application where the running speed does not exceed 2000 rpm and the duty cycle is low. Applications include; Remote operation of valves, potentiometers, gears, rollers etc…

High Duty (Ball bearing) assemblies can be used for any applications where the running speed does not exceed the values given in the MasterFlex performance table. Applications include; Hand held tools (drills, lapping discs etc…), connection of a motor to an appliance where the motor (for safety, noise, or cleanliness reasons) needs to be mounted at a distance from the appliance.

It is normal to have at least one type M or R end (with locknuts – see dimensions figure and coding) to prevent the casing from rotating during operation. End connectors are available in a choice of bore sizes and are fitted with grub screws as standard. If you require other types of end connector, e.g. Square, Keyway, Alternative bore sizes etc… then please contact our sales office who will be happy to advise.



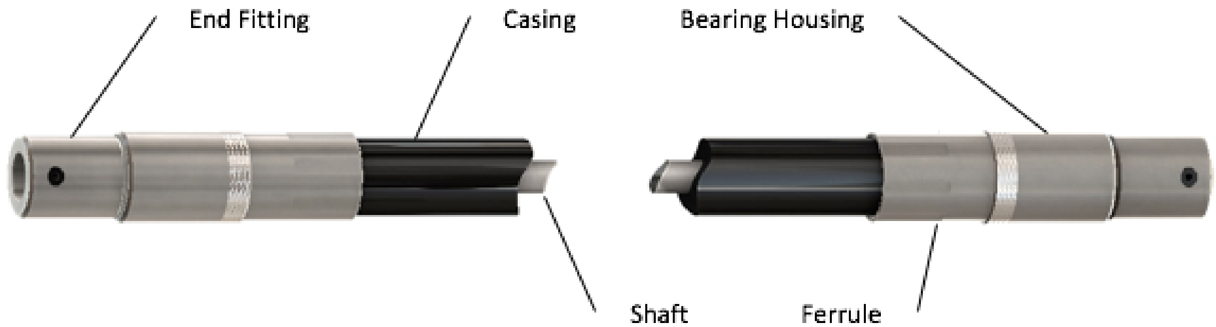
Dimension Table for **NORMAL DUTY** (Oilite Bearings – End Type Codes R & S). All dimensions in mm

Shaft Ø	Connector Bores			d	D	E	F	G max	H	J	K
	A	B	C								
04	4	5	-	12.5	10.5	43	10	8	15	M15 x 1	22
05	5	6	8	15.5	14	50	16	12	18	M18 x 1	24
06	6	8	9	18.5	17	59	17	14	21	M21 x 1	27
08	8	11	12	18.5	17.5	63	23	17	22	M22 x 1.5	30
09	10	14	-	23	22.5	69	25	20	26.5	M26.5 x 1.5	35
13	15	16	-	26	25	84	31	24	29.5	M29.5 x 1.5	36

Dimension Table for **HIGH DUTY** (Ball Bearings – End Type Codes M & N). All dimensions in mm

Shaft Ø	Connector Bores			d	D	E	F	G max	H	J	K
	A	B	C								
04	4	5	-	10.75	10.5	48	11	8	18	M18 x 1	24
05	5	6	8	14	14	59	14.5	12	21	M21 x 1	27
06	6	8	9	18	17	66.5	19.5	14	27	M27 x 1	35
08	8	11	12	20	17.5	68.5	24	17	30	M30 x 1.5	36
09	10	14	-	24.5	22.5	78.5	25	20	34	M34 x 1.5	41
13	15	16	-	28	25	85.5	28	24	38	M38 x 1.5	46
16	16	19.05	20	31	32	108.5	30	25	44	M44 x 1.5	55
19	16	17	20	36.5	31	114	31	25	50	M50 x 1.5	60

Masterflex performance characteristics for normal and high duty



Shaft Code	Shaft Ø	Direction	Min Operating Rad (mm)	Torsional Deflection (°)		Speed (rpm)		Max Torque (Nm) vs Bend Radius (mm)											
				Wind	Unwind	Normal Duty	High Duty	75	100	125	150	175	200	250	300	350	400	500	600
04	3.80	B	75	28	56	2000	3000	0.65	1.20	1.50	1.70	1.80	1.85	1.95	2.00	2.03	2.05	2.10	
05	4.75	B	100	7.5	17	2000	3000		1.30	1.70	2.05	2.17	2.25	2.34	2.40	2.45	2.50	2.60	
06	6.35	B	125	1.5	3.25	2000	3000			4.0	5.0	6.0	7.0	8.0	9.0	9.4	9.8	10.5	
08	8.00	B	200	0.5	0.8	2000	2000						10.0	12.5	14.4	15.8	16.5	17.6	18.5

Shaft Code	Shaft Ø	Direction	Min Operating Rad (mm)	Torsional Deflection (°)		Speed (rpm)		Max Torque (Nm) vs Bend Radius (mm)											
				Wind	Unwind	Normal Duty	High Duty	200	250	300	350	400	500	600	650	750	800	1000	1500
09	9.52	B	200	0.3	0.63	2000	2000	13.0	17.0	20.0	23.0	24.4	26.0	27.2	28.0				
13	12.7	B	250	0.11	0.20	2000	2000		23	32	41	45	49	51	51.5	53	53.5	56	
16	16	B	300	0.06	0.13		1500			20	28	31.5	36.5	40	41.2	43.8	45	50	
19	19.05	B	400	0.01	0.01		1500					40	50	60	62.5	65	66.2	70	75

Figures for torsional deflections are in Degrees for a load of 0.1 Nm load at 1 metre along the shaft.

Casing and ferrules

What is a casing?

A Casing is a tube or conduit the flexible shaft rotates within. It is part of the overall flexible shaft assembly and has its own end fittings, called ferrules, which attach the casing to the stationary mounting points at either end of the drive system.

What purpose does a casing serve?

A Casing serves several purposes depending on the application:

- Retaining lubricant
- Protection from moisture, dust, dirt and other environmental factors
- Limiting the phenomenon of helixing or “corkscrewing” a shaft may experience in high torque applications
- Prevent injury to the operator by contact with unprotected rotating shaft at high speed
- Controls the bending of the enclosed shaft by guiding it through natural and gradual bends while limiting how tight of a bend radius it can achieve

What types of ferrules are typically used?

Ferrules are used to attach the casing to its mounting points. They are typically made of metal or plastic and have mounting features allowing them to be securely attached to a mating surface.

Ferrules give axial and torsional support to the casing. Without the ferrule the casing would just float on top of the rotating shaft, being free to rotate somewhat with the shaft due to the friction between the shaft and casing. The ferrule prevents this from happening. Also, the ferrules can be used to create and environmental seal, keeping moisture, dirt, and dust out of the inside of the casing and away from the flexible shaft. Ferrules can be simple slip fits or more involved machined parts that screw into their mating points.

Here are some of the most popular configurations:

Flange 3 holes

Quick disconnect

Threaded external

Flange 2 holes

Threaded nut internal

Panel mount

Fittings and shaft ends

Formed square, on flexible shaft

A Formed Square end is created when the ends of a round flexible shaft are mechanically formed into a square shape.

Pro:
- Most economical
- High torque capacity
- Allows axial movement
- Smalles OD profile

Con:
- Some radial backlash
- Wear on formed wires

Formed Tube Square, over shaft

A Formed Tube Square is when a close fitting round metal tube is mechanically formed over the round section of a flexible shaft.

Pro:
- Low wear on formed end
- Economical
- High torque capacity
- Allows axial movement
- Small OD profile

Con:
- Radial backlash - a few degrees

Round fitting (Female)

Round Female Fittings are made up of a round female hole on one end, which slips over the flexible shaft to be formed, and another round female hole which will interface with the driving or driven device. Typically uses set screws.

Pro:
- Moderate Cost
- Moderate torque capacity
- Fits directly to many motor shafts
- Low radial backlash

Con:
- Large OD profile
- No axial movement of shaft

Round fitting (Male)

Round Male Fittings are made up of a round female hole on one end, which is formed over the flexible shaft, and a round male tip which will unify with the driving or driven device.

Pro:
- Moderate Cost
- Moderate torque capacity
- Fits directly to many couplings
- Low radial backlash

Con:
- Large OD profile
- No axial movement of shaft

Square Fitting (Female)

Square Female Fittings are made up of a round female hole on one end, which slips over the flexible shaft to be formed, and a square female hole which will interface with the driving or driven device.

Pro:
- Allows axial movement
- High torque loads

Con:
- High cost
- Radial backlash – a few degrees
- Some radial backlash

Square Fitting (Male)

Square male Fittings are made up of a female round hole on one end, which slips over the flexible shaft to be formed, and a square male tip which will interface with the driving or driven device.

Pro:
- Allows axial movement
- Most commonly used fitting
- High torque loads

Con:
- Moderate cost
- Some radial backlash

Fittings and shaft ends

Hex Fitting (Female)

Hex Female fittings are made up of a round female hole on one end, which slips over the flexible shaft to be formed, and a hex female hole which will interface with the driving or driven device.

Pro:
- Low radial backlash
- Easier installation than a square for radial alignment
- Allows axial movement
- High/Moderate torque capacity

Con:
- High cost

Hex Fitting (Male)

Hex male fittings are made up of a female round hole on one end, which slips over the flexible shaft to be formed, and a hex male tip which will interface with the driving or driven device.

Pro:
- Low radial backlash
- Easier installation than a square for radial alignment
- Allows axial movement
- High/Moderate torque capacity

Con:
- Moderate cost

Spline Fitting (Female)

Splined female fittings are made up of a round female hole on one end, which slips over the flexible shaft to be formed, and a splined female hole which will interface with the driving or driven device.

Pro:
- Lowest radial backlash
- Highest torque loads
- Easiest installation for radial alignment
- Allows axial movement

Con:
- Higher cost

Spline Fitting (Male)

Splined male fittings are made up of a female round hole on one end, which slips over the flexible shaft to be formed, and a splined male tip which will interface with the driving or driven device.

Pro:
- Low radial backlash
- High torque loads
- Easiest installation for radial alignment
- Allows axial movement

Con:
- Increased cost

Panel Mount

Panel mount is a tip designed to fit on a plate in such a way that rotary motion of the shaft assembly is unhindered while axial motion is constrained.

Pro:
- Easy installation on a panel

Con:
- Low speed applications only
- Low torque loads typically

Custom

Custom fittings are available and built to spec.

Contact us for more information.