

O-ring Cords

Mantek's premium quality O-ring cords are extruded from low compression set compounds. Low compression set is one of the most desirable physical properties when selecting a material for seals. Seal materials with a high compression set can fail after only a few hours of use.

Quality

Our range of O-ring cords were developed for their low compression set and suitability for the method of manufacture used. The manufacturing system employs a 'closed loop' control system where laser micrometers feed-back to a computer which controls the extruder.

Usually, the end user will be fitting O-Ring cord into standard design grooves and these grooves will be calculated on squeeze factors designed for moulded O-Rings, therefore cord tolerance will determine how well a seal will perform.

For example, if the user obtains a cord which has been controlled to E2 tolerances and it falls on bottom tolerance, the result could be no squeeze resulting in leakage. If the cord falls on top tolerance the result will be over-squeeze and this will cause 'chopping' on compression due to overflow of the groove.

The following chart shows our standard price list sizes and details our standard and ground cord tolerance together with E1 and E2 ranges.

Cross section	Mantek Extrusion Tolerances	Mantek Ground cord tolerances	ISO3301-1 E1	ISO3301-1 E2
1.78	±0.10	±0.05	±0.20	±0.35
2.00	±0.10	±0.05	±0.20	±0.35
2.40	±0.12	±0.05	±0.20	±0.35
2.62	±0.12	±0.05	±0.25	±0.40
3.00	±0.12	±0.05	±0.25	±0.40
3.18	±0.15	±0.05	±0.25	±0.40
3.53	±0.15	±0.05	±0.25	±0.40
4.00	±0.15	±0.05	±0.25	±0.40
4.50	±0.20	±0.05	±0.35	±0.50
4.80	±0.20	±0.05	±0.35	±0.50
5.00	±0.20	±0.05	±0.35	±0.50
5.34	±0.20	±0.05	±0.35	±0.50
5.50	±0.25	±0.05	±0.35	±0.50
5.70	±0.25	±0.05	±0.35	±0.50
6.00	±0.25	±0.05	±0.35	±0.50
6.35	±0.25	±0.05	±0.40	±0.70
6.50	±0.25	±0.05	±0.40	±0.70
6.99	±0.25	±0.05	±0.40	±0.70
7.50	±0.25	±0.05	±0.40	±0.70
8.00	±0.25	±0.05	±0.40	±0.70
8.40	±0.25	±0.10	±0.40	±0.70
9.00	±0.25	±0.10	±0.40	±0.70
9.52	±0.25	±0.10	±0.40	±0.70
10.00	±0.33	±0.10	±0.40	±0.70
11.10	±0.38	±0.10	±0.50	±0.80
12.00	±0.45	±0.10	±0.50	±0.80
12.70	±0.45	±0.10	±0.50	±0.80
13.00	±0.45	±0.10	±0.50	±0.80
14.00	±0.50	±0.10	±0.50	±0.80
14.30	±0.50	±0.10	±0.50	±0.80

Cross section	Mantek Extrusion Tolerances	Mantek Ground cord tolerances	ISO3301-1 E1	ISO3301-1 E2
15.00	±0.50	±0.10	±0.50	±0.80
15.90	±0.50	±0.10	±0.50	±0.80
18.00	±0.70	Enquire	±0.70	±1.00
19.05	±0.76	Enquire	±0.70	±1.00
20.00	±0.76	Enquire	±0.70	±1.00
20.63	±0.76	Enquire	±0.70	±1.00
22.00	±0.76	Enquire	±0.70	±1.00
25.40	±0.86	Enquire	±0.80	±1.30

Non-standard sizes up to Ø35mm are available on request.

Table 1: Standard cord tolerances

Where cord tolerance is critical our standard ground tolerances are tighter than ISO 3601-1 moulded O-ring tolerances. Ground cords can only be supplied in maximum lengths of 6 metres.

Put our tolerances together with low compression set materials and our premium cords outperform standard industry cords.

Tolerances for sections between 19.05mm and 25.4mm are 60 micron bigger than E1 tolerances. These sections suffer from collapse under their own weight before curing can take place. Cords may be slightly oval and the wider tolerance accounts for this ovality.

The type of extrusion line used depends very much upon the material. For instance, Silicone cannot be produced on the same type of extruder as Viton®. This is due to screw design and the curing system being different.

All extrusion lines have been designed to give accuracy rather than volume. As the compound travels down the length of the extruder screw, air is drawn out by the use of vacuum. This vacuum extrusion method is critical in removing gas/air from in the extrudate which would later appear as 'porosity' in a cord making it useless.



On leaving the screw the extrudate is sized by a die and it then passes through a 'laser gauge' which records the diameter.

The laser gauge then feeds back this information to a computer which makes any necessary adjustments to the extruder settings and thus the diameter of the extrudate is permanently 'closed loop' controlled.



From here the extrudate is coiled onto circular trays to cool before being passed to the next process which is steam vulcanising (curing).

Steam Curing

Steam curing or vulcanising is one of the most important aspects of producing high quality extrusions.

Some extruded materials can only be cured by steam such as Viton® and Aflas®. All our extrusions are cured by steam (with the exception of silicones and fluorosilicones which are cured by hot air) to achieve the best mechanical characteristics.

The extruded and still uncured profiles are loaded with their trays into a large vessel known as an autoclave.



Once closed the autoclave is filled with high pressure steam. This raises the temperature of the extrudates and begins the vulcanising/curing process.

In addition to the steam providing the temperature required to activate the curing process, its pressure also serves to stop rapid expansion of the extrudate.

This desire to expand is termed 'blowing' and occurs as a result of the curing agents in the compound (volatiles) attempting to exit the extrudate too rapidly.

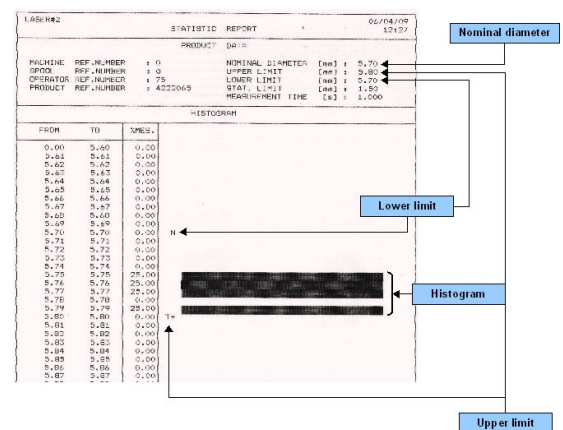
These volatiles must be allowed to exit the compound, but in a controlled manner and steam provides a perfect medium for this process.

After a steam cure time of approximately 1 hour the load is removed from the autoclave and allowed to cool. Once cool, the extrudate is then washed (to remove steam residue) and sent for dimensional inspection as changes may occur during the curing process due to thermal expansion.

Inspection



The cord is passed through an inspection gauge and the laser beam measures the diameter 250 times per second. It then produces a report which is stored with the cord showing the maximum, minimum and average diameters together with a histogram showing the distribution of the tolerance. These special inspection lasers have dual axis technology which looks for ovality in addition to diameter and is the only method which can allow 100% inspection.



Once inspected, cord up to 9.52mm is placed on spools (if requested) carrying the report, batch number and cure date.



Other Profiles



In addition to O Ring Cord we are able to produce custom profiles and tubes, however the size and complexity of profiles which can be cured in steam is limited.

During the long cure cycle, temperatures can reach as high as 180° C and this makes the profiles very soft and subject to collapse.

This means that complex or hollow profiles lose their shape during this 'soft zone' and therefore should be avoided.

The same problem occurs with low shore hardness. Even solid cord below 70 shore will collect a longitudinal 'flat' caused by soft zone collapsing.

Profiles which are suitable for steam curing are tubes, rectangles/squares and quad's, particularly in Viton®.

The Silicone cure system being different, allows production of the most complex profiles.

Alternatives to Steam Cure

There are cure systems other than steam and we feel we should mention these.

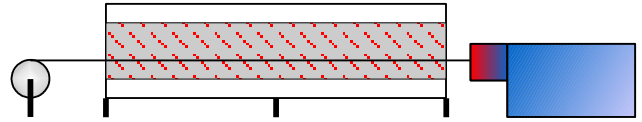
Salt Bath System

A salt bath system employs an extruder in the normal manner but when the profile exits the die it goes immediately into a very long bath which is full of liquid salts. These salts are elevated in temperature to approx 240 degrees C and the profile is pulled through the salt bath at the same speed as the extruder. The temperature of the salts cures the profile. Once out of the bath the process is complete and the profile can be spooled or bagged ready for shipping.



Microwave System

Similar to the salt bath system, microwave curing utilises a standard extruder but in place of a bath, the profile is pulled through a tunnel. Within the tunnel the profile is bombarded with microwaves and these activate special curatives in the compound resulting in vulcanisation.



With both salt bath and microwave cure systems, very high through put speeds can be achieved resulting in low running costs.

However, both systems are not really suitable for producing high quality grades for use in the O Ring industry.

They are serious competitors when it comes to the complex profile market.

It is worth noting that neither of these systems are capable of curing Viton's®.

Steam Cure Disadvantages

- Higher running costs compared to Salt bath or microwave cured.
- Only short lengths are possible due to the limited amount of extrudate which a curing tray can hold.
- Soft compounds and some tubes will collapse during steam cure, particularly in larger sections.
- White compounds may dull in steam cure.
- Peroxide cured compounds have poor surface finish, although this can be overcome by having a ground finish.
- Complex profiles deform in steam cure.

Steam Cure Advantages

- Steam curing gives the best result for compression set with the extrudate.
- Porosity is minimised due to our vacuum technology and this is important when permeability resistance of a seal is critical.
- Accuracy of cord diameter due to 'closed loop' control is the most accurate and consistent in the industry.
- Steam cure is suited to smaller volumes.
- Viton® extrusions can only be cured by steam!

Material availability

Our standard grades of Nitrile, EPDM, Neoprene, Silicone and Viton® are premium grades all offering exceptional application performance, however some applications will have more demanding conditions.

For these applications we offer a range of speciality materials which are made to the same high quality as our everyday grades.

Listed below are the grades we currently offer. Cord shown as a price list item is our standard compound grade. Please ask if the grade you need is not listed.

We can also offer lengths of our standard FEP/PFA jacketed Viton, Silicone or EPDM.

Material Code	Price list?		Ground finish only?	Material	Colour	Special property	SG g/cm ³	Typical test values			
	Cord	SJV O-ring						Hardness Shore A	Elongation at break %	Tensile strength Mpa	Compression set %
231-312				Nitrile 65	BLACK	FDA/3-A metal detectable	1.47	60	554	6.3	17.4
231-161		Yes		Nitrile 60	BLACK		1.26	64	378	10.7	20.0
231-185		Yes		Nitrile 75	BLACK	FDA	1.37	71	379	11.7	19.6
231-238	Yes	Yes		Nitrile 75	BLACK		1.27	79	310	19.0	18.0
231-241	Yes	Yes		Nitrile 90	BLACK		1.31	86	217	14.6	17.0
231-195			Yes	Carboxylated Nitrile 75	BLACK		1.21	75	349	15.6	29.0
231-153			Yes	Hydrogenated Nitrile 75	BLACK		1.24	72	360	18.0	21.0
231-299		Yes		Chloroprene 60	BLACK	FDA	1.54	62	390	17.0	77.0
231-186		Yes		Chloroprene 75	BLACK	FDA	1.6	74	499	12.8	42.0
231-144		Yes		Chloroprene 75	BLACK		1.55	75	370	9.5	16.5
231-155				EPDM 60	BLACK		1.34	57	537	9.0	16.0
231-251				EPDM 60	BLACK	FDA	1.22	62	280	8.0	9.5
231-278		Yes		EPDM 60	BLACK		1.13	63	831	12.3	36.0
231-311				EPDM 65	BLACK	FDA/3-A metal detectable	1.61	67	285	7.4	15.1
231-309				EPDM 70	BLACK	FDA/3-A/USP Class VI	1.18	68	365	12.5	11.6
231-187		Yes		EPDM 75	BLACK	FDA/3-A	1.31	73	418	11.8	13.9
231-130	Yes	Yes		EPDM 75	BLACK		1.38	73	439	8.9	42.0
231-214	Yes			EPDM 90	BLACK		-	-	-	-	-
231-134	Yes	Yes		Viton® 'A' 60	BLACK		2	65	292	12.0	6.7
231-184	Yes			Viton® 'A' 60	BROWN		2.14	65	476	12.5	5.4
231-327				Viton® 'A' 70	BLUE	FDA/3-A metal detectable	2.25	66	237	12.0	7.7
231-307				Viton® 'A' 70	BLACK	FDA/3-A/USP Class VI	2.17	72	192	15.8	5.3
231-179			Yes	Viton® 'GLT' 75	BLACK		1.78	74	231	19.4	14.5
231-220			Yes	Viton® 'GFLT' 75	BLACK		1.83	75	195	13.0	22.0
231-276				Viton® 'GF-S' 75	BLUE		2.36	76	362	16.4	13.0
231-275				Viton® 'GFLT-S' 75	BLUE		2.37	76	232	12.0	13.0
231-229				Viton® 'A' 75	WHITE	FDA/3-A	2.44	77	335	12.1	6.2
231-172	Yes	Yes		Viton® 'A' 75	BLACK	FDA/3-A	2.32	78	302	13.5	5.8
231-162				Viton® 'A' 70	BLACK		1.95	78	247	12.5	22.0
231-152	Yes	Yes		Viton® 'A' 75	BLACK		2.32	79	233	11.5	4.6
231-170	Yes	Yes		Viton® 'A' 75	BROWN		2.26	79	273	13.5	5.4
231-129				Viton® 'GF' 75	BLACK		1.88	79	328	19.3	14.0
231-150	Yes	Yes		Viton® 'A' 75	GREEN		2.32	80	232	10.2	5.5
231-226	Yes			Viton® 'A' 90	BROWN		2.51	87	129	11.2	9.4
231-204			Yes	Viton® 'B' 90 EDR	BLACK	Explosive decompression	1.87	90	220	12.5	7.0
231-126	Yes	Yes		Viton® 'A' 90	BLACK		1.82	90	193	15.8	5.7
231-167	Yes			Viton® 'A' 90	GREEN		2.51	90	93	15.0	8.4
231-164				Aflas® 75	BLACK		1.73	80	331	14.9	54.5
231-115				Aflas® 90	BLACK		1.6	88	184	21.0	18.0
231-249				Fluorosilicone 80	BLUE		1.77	81	84	7.3	26.0
231-330				Silicone 70	BLUE	FDA/3-A metal detectable	1.33	69	167	4.7	14.8
231-308				Silicone 70	TRANS.	FDA/3-A/USP Class VI	1.19	67	369	9.9	17.8
231-203		Yes		Silicone 75	RED	FDA/3-A	1.58	73	165	7.5	9.2

Ground cord

Certain grades of extruded material do not have a satisfactory surface finish to be used as an O-ring – for example Hydrogenated Nitrile 75°. Compounds such as this are delivered with a ground finish – see *Table 1 Standard cord tolerances* above. Ground finished cords can only be supplied in lengths up to 6 metres.