Product

Encapsulated seals were primarily designed to solve the growing problems of sealing corrosive fluids in industry. This development provided designers and engineers with a seal that combined the chemical resistance of Teflon® with the resilience of rubber.

A seamless Teflon® jacket surrounds the elastomer core providing the chemical inertness, whilst the memory in the elastomer core energises the seal.

Encapsulated seals are available with two types of Teflon® jacket – FEP which is standard, and PFA for more demanding applications.

The energising core is available in Viton®, Silicone or EPDM.

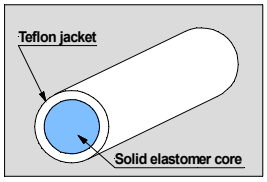
Viton® is offered as the standard because of its superior compression set. For low-temperature applications, or where lower closure forces are required a Silicone core is specified.

The design variations available, together with combined performance characteristics of both the jacket material and elastomer core , ensures that encapsulated seals will be an effective solution for many troublesome applications.

Applications

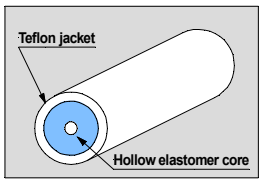
- Chemical Processing
- Petrochemical
- Refineries
- Pharmaceutical
- Manufacturing
- Food & Drinks
- Paints & Dies
- Refrigeration
- Cosmetics
- Pumps
- Filters
- Mechanical seals

Design Types



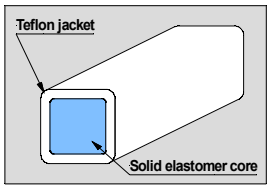
The Standard Design

This design of encapsulated 'O' ring combines a Teflon® jacket with a ***solid*** elastomer core. The ***solid*** core ensures that the preferred 'low compression-set' is achieved. Available with a Teflon® FEP or PFA jacket and an energising core of Viton®, Silicone or EPDM.



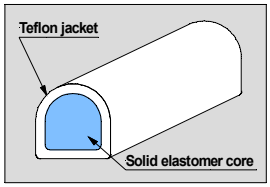
Hollow Core Design

For those sealing applications where more flexible or easier squeeze is required, hollow core designs are available. Manufactured with a Teflon® FEP or PFA jacket and a hollow core energising core of either Silicone or Viton.



Square and Rectangular Design

Behaving as a gasket rather than as an 'O' ring, this design offers total protection of the energising core by the Teflon® FEP or PFA jacket – offering obvious advantages over the common envelope gasket. Sections of square and rectangular design are manufactured to special order.



Milk Coupling Gaskets to DIN 11851

This design is used in Milk coupling gaskets complies with DIN 11851. The materials used for both the jacket and energising core are FDA compliant and USDA 3-A approved.

Material Types

Teflon Jacket

Teflon® FEP is the standard grade of jacket material and is the most readily available. Teflon® FEP (Fluorinated-ethylene-propylene) is manufactured by DuPont and is overall the most versatile jacket material. It is resilient to most chemicals, has a wide temperature range, excellent flex fatigue resistance, superbly low coefficient of friction and complies with FDA 21 CFR 177.1550 and 3-A Sanitary Standards.

Teflon® PFA offers certain advantages over FEP that are desirable in some applications. Teflon® PFA is also a fluorocarbon copolymer, but has improved mechanical and creep properties, and an elevated operating temperature.

Elastomer Core

Viton® Fluoroelastomer cores offer the best recovery from deformation (compression set) and is therefore recommended when high resilience is required.

Silicone elastomer cores offer a wider operating temperature range. This makes it more suitable than Viton®, particularly in low temperature applications. Hollow core Silicone is recommended for housings where the seal needs to be deformed under a light closing force.

EPDM cores are used in specific applications only, and where the end-user requires the core to be compatible with the media being sealed.

Available sizes

O-rings

Encapsulated 'O' rings require no special moulds or tooling, however there are limitations on how small the inside diameters can be, but there is no upper limit. The table below lists the standard cross-sections available, together with the corresponding minimum inside diameters that can be manufactured.

Section	Minimum possible ID		
	Solid	Hollow Silicone	Hollow Viton
1.60	5.0	N/A	N/A
1.78	5.3	8.0	N/A
2.00	6.8	10.0	10.0
2.40	7.4	12.0	12.0
2.50	7.4	12.0	12.0
2.62	7.6	16.0	16.0
3.00	12.0	20.0	20.0
3.40	12.5	23.0	23.0
3.53	13.0	24.0	24.0
3.60	13.0	24.0	24.0
4.00	14.0	28.0	28.0
4.25	14.5	32.0	32.0
4.50	15.0	35.0	35.0
5.00	20.0	42.0	42.0

Section	Minimum possible ID		
	Solid	Hollow Silicone	Hollow Viton
5.34	22.0	48.0	48.0
5.50	23.0	50.0	50.0
5.70	24.0	60.0	60.0
6.00	27.0	75.0	75.0
6.35	38.0	90.0	90.0
6.50	45.0	95.0	95.0
6.99	48.0	100.0	100.0
8.00	72.0	150.0	150.0
8.40	76.0	160.0	160.0
9.00	95.0	175.0	175.0
9.52	120.0	200.0	200.0
10.00	110.0	230.0	230.0
10.50	112.0	240.0	240.0
11.10	115.0	250.0	250.0

Section	Minimum possible ID		
	Solid	Hollow Silicone	Hollow Viton
12.00	120.0	300.0	300.0
12.70	130.0	350.0	350.0
14.00	180.0	390.0	390.0
14.30	180.0	390.0	390.0
15.00	250.0	400.0	400.0
15.90	280.0	450.0	450.0
18.00	325.0	475.0	475.0
19.05	350.0	500.0	500.0
20.63	400.0	550.0	550.0
25.40	425.0	600.0	600.0

Other sections available to special order.

Milk Coupling Gaskets to DIN 11851

NB Size	Outside Diameter	Inside diameter	Thick -ness
10	20.0	12.0	4.5
15	26.0	18.0	4.5
20	33.0	23.0	4.5
25	40.0	30.0	5.0
32	46.0	36.0	5.0
40	52.0	42.0	5.0
50	64.0	54.0	5.0
65	81.0	71.0	5.0
3”	88.0	78.0	5.0
80	95.0	85.0	5.0
90	104.0	94.0	5.0
100	114.0	104.0	6.0
125	142.0	130.0	7.0
150	167.0	155.0	7.0

Cam & groove gaskets

NB Size		Outside Diameter	Inside diameter	Thick -ness
12.7	(½”)	26.0	17.0	4.30
19.05	(¾”)	35.0	22.5	5.70
25.4	(1”)	39.6	26.0	6.65
31.8	(1 ¼”)	49.0	34.5	6.65
38.	(1 ½”)	55.5	41.0	6.65
50.8	(2”)	66.5	52.0	6.65
63.5	(2 ½”)	78.0	60.0	6.65
76.2	(3”)	95.0	76.0	6.65
101.6	(4”)	123.0	101.0	6.65
127.0	(5”)	150.0	124.0	6.65
152.4	(6”)	179.4	152.4	6.65

Mantek's encapsulated seals are manufactured in the United Kingdom and are made with the highest quality materials. Where an item is not in stock, lead time from order placement is usually less than 10-12 working days.

We offer a break down service for an extra charge which can reduce the lead-time to 48 hours – further information on this service is available from our sales office.

Temperature range

Combination	Minimum Temperature	Maximum Temperature
FEP/Viton	-20°C	+205°C
PFA/Viton	-20°C	+205°C
FEP/Silicone	-62°C	+205°C
PFA/Silicone	-62°C	+260°C
FEP/EPDM	-40°C	+70°C
PFA/EPDM	-40°C	+70°C

Encapsulated Seals from Mantek

Chemical resistance

Teflon® resins can be subject to attack by a few chemicals, such as Molten alkaline metals, halogen compounds, and under certain conditions Fluorine, but are resistant to the following:

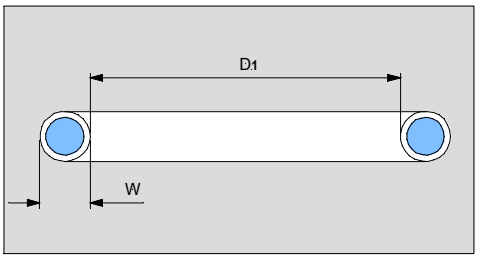
Abietic acid
Acetic acid
Acetic anhydride
Acetone
Acetophenone
Acrylic anhydride
Allyl acetate
Allyl methacrylate
Aluminum chloride
Ammonia, liquid
Ammonium chloride
Aniline
Benzonitrile
Benzoyl chloride
Benzyl alcohol
Borax
Boric acid
Bromine
n-Butyl amine
Butyl acetate
Butyl methacrylate
Calcium chloride
Carbon disulfide
Cetane
Chlorine
Chloroform
Chlorosulfonic acid
Chromic acid
Cyclohexane
Cyclohexanone
Dibutyl phthalate
Dibutyl sebacate
Diethyl carbonate
Dimethyl ether
Dimethyl formamide
Di-isobutyl adipate
Dimethylformamide
Dimethyl hydrazine, unsymmetrical
Dioxane
Ethyl acetate
Ethyl alcohol
Ethyl ether
Ethyl hexoate
Ethylene bromide
Ethylene glycol
Ferric chloride
Ferric phosphate
Fluoronaphthalene
Fluoronitrobenzene
Formaldehyde
Formic acid
Furane
Gasoline
Hexachloroethane
Hexane
Hydrazine
Hydrochloric acid
Hydrofluoric acid
Hydrogen peroxide
Lead
Magnesium chloride
Mercury
Methyl ethyl ketone
Methacrylic acid
Methanol
Methyl methacrylate
Naphthalene
Naphthols
Nitric acid
Nitrobenzene
2-Nitro-butanol
Nitromethane
Nitrogen tetroxide
2-Nitro-2 methyl propanol
n-Octadecyl alcohol
Oils,animal and vegetable
Ozone
Perchlorethylene
Pentachlorobenzamide
Perfluoroxylene
Phenol
Phosphoric acid
Phosphorus pentachloride
Phthalic acid
Pinene
Piperidene
Polyacrylonitrile
Potassium acetate
Potassium hydroxide
Potassium permanganate
Pyridine
Soap and detergents
Sodium hydroxide
Sodium hypochlorite
Sodium peroxide
Solvents, aliphatic and aromatic
Stannous chloride
Sulfur
Sulfuric acid
Tetrabromoethane
Tetrachloroethylene
Trichloroacetic acid
Trichlorethylene
Tricresyl phosphate
Triethanolamine
Vinyl methacrylate
Water
Xylene
Zinc chloride

Please contact our technical department for the suitability of chemicals not listed here.

Manufacturing tolerances

Internal diameter (D_1)

Teflon® FEP/PFA encapsulated seals are manufactured and controlled to conform to DIN 7715 M2F.

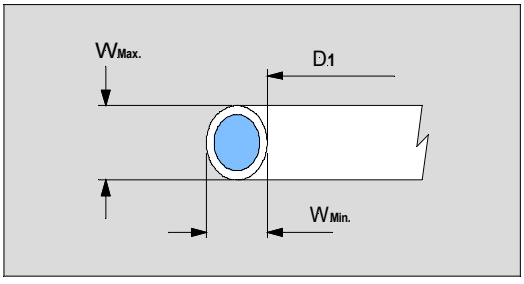


The table below details the internal diameter tolerances:

Internal Diameter D_1		*I.D. Tolerance*
From	*To*	
25mm	40mm	±0.35mm
40.1mm	63mm	±0.40mm
63.1mm	100mm	±0.50mm
100.1mm	160mm	±0.70mm
Thereafter		±0.5% of nominal I.D.

Cross section

The illustration below shows the cross section *W* having alternative values of W_{max} and $W_{min.}$ For small internal diameters the tight bend radius causes both the Teflon® jacket and the elastomer core to become oval. Tolerances on cross section are therefore wider when the O-profile is oval:



The following table shows the cross sectional tolerances taking into account the effect of the O-profile becoming oval for smaller inside diameters.

To use this table, look up the cross section of the O-ring and read off either column ***ID ≤ D_1*** or ***ID > D_1*** depending on the nominal ID (***D_1***) of the ring being inspected:

Tolerances on cross section

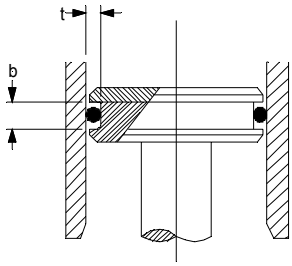
Section W	*Nominal ID (D_1)*	*ID ≤ D_1 W±*	*ID > D_1 W±*
1.60	10.0	0.12	0.10
1.78	12.0	0.12	0.10
2.00	15.0	0.12	0.10
2.40	17.0	0.15	0.12
2.50	17.0	0.15	0.12
2.62	18.0	0.15	0.12
3.00	20.0	0.20	0.15
3.40	22.5	0.20	0.15
3.53	25.0	0.20	0.15
3.60	25.0	0.20	0.15
4.00	30.0	0.30	0.25
4.25	35.0	0.30	0.25
4.50	40.0	0.30	0.25
5.00	45.0	0.30	0.25
5.34	50.0	0.30	0.25
5.50	52.0	0.30	0.25
5.70	54.0	0.30	0.25
6.00	56.0	0.35	0.30
6.35	58.0	0.35	0.30
6.50	60.0	0.35	0.30
6.99	60.0	0.35	0.30
8.00	90.0	0.45	0.40
8.40	100.0	0.45	0.40
9.00	125.0	0.45	0.40
9.52	150.0	0.45	0.40
10.00	170.0	0.60	0.50
10.50	200.0	0.60	0.50
11.10	200.0	0.60	0.50
12.00	250.0	0.60	0.50
12.70	300.0	0.60	0.50
14.00	400.0	0.60	0.50
14.30	400.0	0.75	0.60
15.00	450.0	0.75	0.60
15.90	500.0	0.85	0.70
18.00	750.0	1.00	0.80
19.05	750.0	1.00	0.80
20.63	875.0	1.00	0.90
25.40	1000.0	1.25	0.90

Housing Design

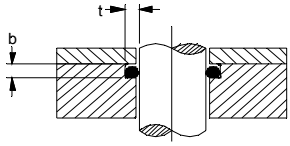
Where possible we recommend the use of the housing designs shown below, followed by the dimension tables.

Radial Sealing

Radial Piston sealing
(note split design)

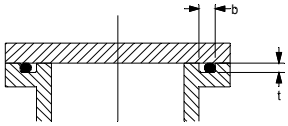


Radial gland sealing
(note split design)

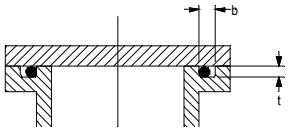


Axial sealing

Internal pressure



External pressure



W	*'t'*	*+/-*	*'b'*	*+/-*
1.60	1.20	0.05	2.10	0.20
1.78	1.30	0.05	2.30	0.20
2.00	1.50	0.05	2.60	0.20
2.50	1.90	0.05	3.20	0.20
2.62	2.00	0.05	3.40	0.20
3.00	2.30	0.05	3.90	0.20
3.40	2.50	0.05	4.30	0.20
3.53	2.75	0.05	4.50	0.20
4.00	3.15	0.05	5.20	0.20
4.25	3.38	0.05	5.50	0.20
4.50	3.60	0.05	5.80	0.20
5.00	4.00	0.05	6.50	0.20
5.34	4.30	0.05	6.90	0.20
5.50	4.50	0.05	7.10	0.20
5.70	4.65	0.05	7.40	0.20
6.00	4.95	0.05	7.80	0.20
6.35	5.25	0.05	8.20	0.20
6.99	5.85	0.05	9.10	0.20
8.00	6.75	0.10	10.40	0.20
8.40	7.15	0.10	10.90	0.20
9.00	7.70	0.10	11370	0.20
9.52	8.20	0.10	12.30	0.20
10.00	8.65	0.10	13.00	0.20
11.10	9.70	0.10	14.30	0.20
12.00	10.60	0.10	15.60	0.20
12.70	11.40	0.10	16.70	0.20
14.30	12.50	0.10	18.80	0.20
15.00	13.00	0.10	19.80	0.20

W	*'t'*	*+/-*	*'b'*	*+/-*
1.60	1.20	0.02	2.50	0.20
1.78	1.30	0.02	2.70	0.20
2.00	1.40	0.02	3.00	0.20
2.50	1.83	0.03	3.50	0.20
2.62	1.96	0.03	3.75	0.20
3.00	2.25	0.05	4.15	0.20
3.40	2.55	0.05	4.60	0.20
3.53	2.65	0.05	4.95	0.20
4.00	3.05	0.05	5.25	0.20
4.25	3.25	0.05	5.50	0.20
4.50	3.45	0.05	5.80	0.20
5.00	3.85	0.05	6.40	0.20
5.34	4.30	0.05	7.25	0.20
5.50	4.38	0.05	7.30	0.20
5.70	4.45	0.05	7.40	0.20
6.00	4.85	0.05	7.80	0.20
6.35	5.20	0.05	8.20	0.20
6.99	5.75	0.05	9.10	0.20
8.00	6.40	0.07	10.20	0.20
8.40	6.65	0.07	10.90	0.20
9.00	7.30	0.07	11.70	0.20
9.52	7.80	0.10	12.30	0.20
10.00	8.20	0.10	13.00	0.20
11.10	9.20	0.10	14.30	0.20
12.00	10.00	0.10	15.60	0.20
12.70	10.80	0.10	16.70	0.20
14.30	12.00	0.10	19.00	0.20
15.00	12.70	0.12	21.00	0.22

All lead in chamfers should be 30-40 degrees inclusive, rounded, smooth and length no less than 50% of cross section diameter of O Ring. All contact surfaces should be micro inch or better.

The above data is for guidance only and covers general sealing duties only. Before cutting any of the grooves check with our technical department giving full details and conditions of service for final confirmation.

Wall Thickness of Encapsulation

The wall thickness's shown in the table below are the result of many years of manufacturing knowledge and application experience.

The Teflon® jacket provides chemical protection for the elastomer core – if the jacket is too thick it will diminish the resilience of the elastomer core; if it is too thin it will allow chemicals to migrate through the wall to attack the core.

Optimum performance is achieved by balancing the jacket wall thickness in proportion to cross sectional diameter of the seal. For this reason the larger the section becomes, the thicker the jacket wall becomes.

Section W	Wall thickness
1.60	0.22
1.78	0.24
2.00	0.26
2.40	0.32
2.50	0.32
2.62	0.34
3.00	0.34
3.40	0.35

Section W	Wall thickness
3.53	0.35
3.60	0.39
4.00	0.39
4.25	0.40
4.50	0.40
5.00	0.48
5.34	0.50
5.50	0.50

Section W	Wall thickness
5.70	0.50
6.00	0.50
6.35	0.50
6.50	0.52
6.99	0.55
8.00	0.58
8.40	0.58
9.00	0.63

Section W	Wall thickness
9.52	0.70
10.0	0.74
10.5	0.77
11.1	0.77
12.0	0.78
12.7	0.80
14.0	0.80
14.3	0.80

Section W	Wall thickness
15.0	0.84
15.9	0.86
18.0	0.90
19.0	0.90
20.6	0.93
25.4	1.05

When not to use

Dynamic applications: We advise against using Encapsulated seals in dynamic applications as the Teflon® jacket may fail during service.

Abrasive media: The Teflon® jacket does not have good wear resistance, the jacket will easily be damaged by any abrasive liquids, slurries or powders.

Stretching: Excessive stretching of the encapsulated seal could rupture the jacket, or break the elastomer core. The seals may be stretched up to 2 times the cross section, however this should strictly be in accordance with the fitting instructions.

Collapsing: Can occur as a result of forcing the encapsulated seal to collapse into a smaller bore than the seal is designed to fit into. The seal can be severely kinked and the jacket could rupture. It is essential that seals are pre-heated prior to fitting and the fitting instructions adhered to.

High pressures: It is essential that the housing is designed with minimum clearances between metal parts. High pressure with a large clearance will result in the seal failing as the jacket extrudes into the metal parts gaps.

Approvals

FDA Compliance

This data pertains to the U.S. Federal Food and Drug Administration regulations governing the use of fluoropolymers as articles or components of articles intended for use in contact with food.

The Teflon® FEP and PFA used to produce our range of encapsulated seals both comply with FDA regulation 21 CFR 177.1550. This specification includes acceptance by The United States Department of Agriculture (USDA) for direct use in contact with meat or poultry food products and by The Dairy and Food Industries Supply Association Inc for product contact surfaces for dairy equipment.

USP Class VI requirements are met by Teflon® FEP for use in Pharmaceutical Processing.

The following is a summary of the FDA references applicable to the Teflon® FEP and PFA resins used in the manufacturing process.

TEFLON® FEP	
21 CFR 177.1500	21 CFR 177.1520
21 CFR 177.2600	21 CFR 175.300
21 CFR 175.105	21 CFR 176.170
21 CFR 176.180	

TEFLON® PFA	
21 CFR 177.1500	21 CFR 175.300
21 CFR 175.105	21 CFR 176.170
21 CFR 176.180	

Potable Water

Teflon® FEP is approved for use with potable water under section 5296 in the WRAS directory, certificate number 0206511.

Please note that the approvals shown above are applicable only to the Teflon® jacket.

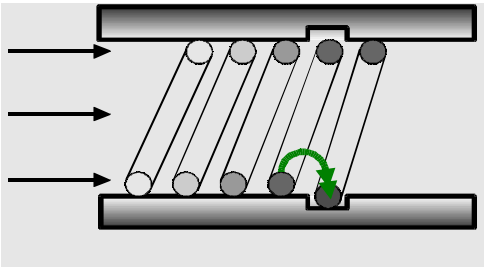
Methods of installation

Correct installation of an encapsulated seal is essential in order to minimise possible damage during installation – 90% of reported seal failures turn out to be either poor installation or housing design problems.

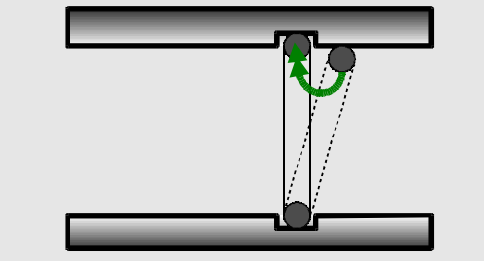
Fitting to an Internal groove

To fit an encapsulated seal to an internal groove can be quite difficult as the seal needs to collapse into a smaller diameter that the gland it is being fitted into. We recommend pre-heating the seal by immersion in hot water (60°C – 70°C) for ten minutes.

Then quickly take the heated ring and insert into the bore guiding the leading edge past the groove and seating the trailing edge firmly into the groove.



Then, pull back the leading edge and snap the ring into the whole groove length. Insert the shaft immediately while the seal is still warm and flexible .

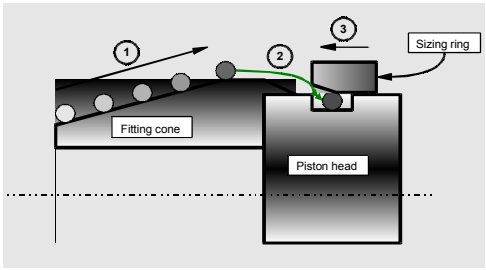


The above approach may be difficult to employ for small seals. Please contact our sales office should you experience difficulty during assembly. We will be able to advise on the use of special fitting tools.

Fitting to an External piston

It is possible to fit encapsulated seals to certain solid piston head type grooves by utilising a fitting cone.

The ring must be pre-heated by immersing in hot water and quickly and evenly pushed until it drops into the groove (steps 1 and 2 below).



It may be necessary to utilise a Sizing ring to help the encapsulated seal to return to its original outside diameter (see 3 above).

The sizing cone is normally made in hard plastic or Brass. It is essential that the fitting cone is made free from sharp corners and burrs otherwise any damage caused during fitting could result in the premature failure of the seal.

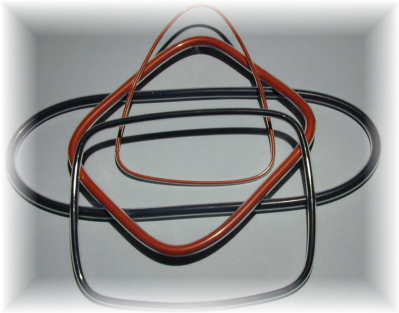
Encapsulated seals will collapse or stretch to a very small degree without some permanent damage being inflicted to the seal. Our advice is to avoid difficult installation issues by designing the housing so it may be split.

Shaped Encapsulated Parts

The most popular style of Teflon® encapsulated seal is as an O-ring, however oval, square and rectangular frame shapes are possible – the only mandatory feature is that the corners are radiused.

This means it is possible to make hand and man hole ovals; and semi-circular heat-exchanger seals.

We can also offer square and rectangular profiles for Pump case seals and Heat exchanger plates.



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