



Flexcoat™ Friction-free Running



Your Partner for Sealing Technology

Optimized solutions for individual requirements

30 years of coating expertise

Trelleborg Sealing Solutions offers a wide range of surface treatments. Their primary function is to improve the friction characteristics of elastomer seals within production processes or their application. By doing this, assembly forces are reduced, seals are prevented from sticking together and permanent friction reduction is provided without the use of lubricants. In addition, the treatments contribute to the efficiency of the total production process, with UV-indicators and colors that aid quality checks and avoid mix-up of similar components during storage or assembly.

Combining 30 years of experience in coating of elastomer seals with research studies and the latest technologies, our surface treatments are tailored to individual manufacturing requirements and the properties of the sealing materials. Taking into account the need to make manufacturing processes as green as possible, we support our customers with environmentally friendly products.



Improved capabilities, through technical innovations

Easy component assembly, low breakaway forces and longer service life cannot, in most cases, be achieved through the development of elastomer materials alone. Properties of the sealing elements, in particular their surface finish, need to be optimized to broaden their application range. This requirement is being driven by manufacturers' need to save time, for safe and secure assembly, cleanliness and the shift of manual processes to automation.

Three Levels of working

Providing the optimum solution for individual requirements, surface treatments from Trelleborg Sealing Solutions are the ideal choice; whether it is simply to improve handling, facilitate assembly or enhance overall performance.

Simple and economical handling aids meet requirements, such as easy separation of parts while more advanced coatings and surface treatments are for specific applications. Micro-thin high-performance coatings and surface modification provide the ultimate choice, maximizing friction characteristics during assembly and in dynamic applications.

With our three levels of surface treatment technology – handling aids, assembly professionals and application professionals – Trelleborg Sealing Solutions can offer individual solutions for a wide range of critical applications.

The Application Professionals combine their advanced benefits with those of the Assembly Professionals, while all surface treatments perform well as Handling Aids.

The Application Professionals

dry surface finishes
for permanent reduction
of friction and wear

The Assembly Professionals

dry coating solutions
for automated assembly
and reduced assembly forces

Handling Aids

low-cost powders, waxes and oils
for ease of separation
and simple handling

From the original seal to the coated solution

The Process flow

Depending on the coating or surface treatment, the seals will pass through different production steps. For Handling Aids these include control, packaging and labeling.

To ensure a high quality result, the micro-thin coatings of the Assembly and Application Professionals are applied in a numerically controlled process. This has two additional cleaning stages followed by plasma activation, which guarantees a firm and permanent surface bond for the elastic coating.

Series production and sampling

For the automated coating process a minimum quantity is required, dependent on the seal's size and material.

Small quantities of seals up to 100 pieces can be coated manually for samples. This excludes Flexcoat™ LF color and CF color. However to get a reliable comparison, it is recommended to test samples from an automated near-series production coating process.

Diagram shows the process flow for Handling Aids, Assembly Professionals and Application Professionals:

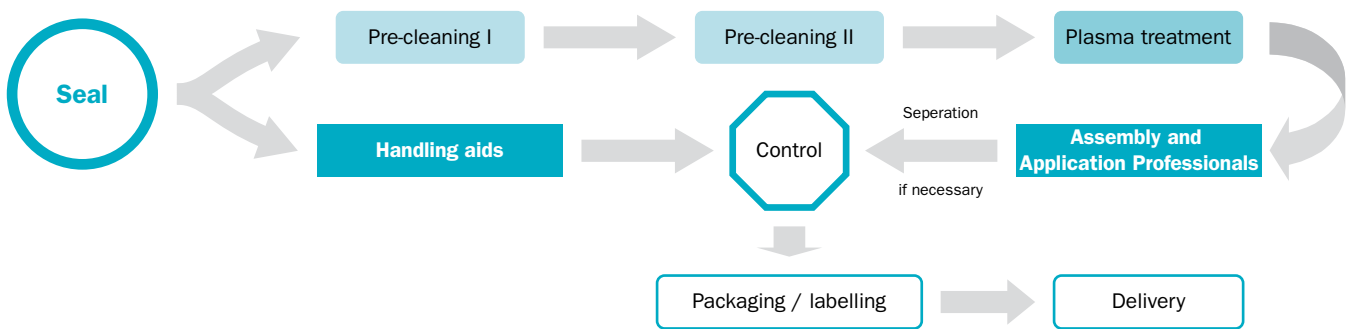
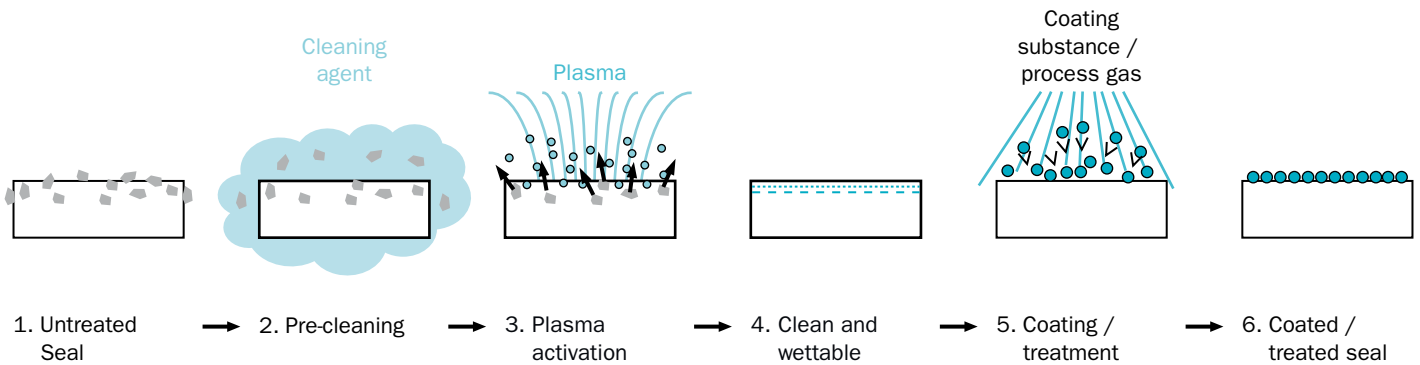


Diagram of the coating process for Assembly Professionals and Application Professionals



The Application Professionals

Micro-thin high-performance coatings and surface modification provide the ultimate choice, maximizing friction characteristics during assembly and in dynamic applications.

Flexcoat™ PF

– Friction reduction polysiloxane –

For the first time, this coating provides engineers with a true alternative to oil lubrication. Black pigment dots ensure that with non-black seal materials, the transparent coating can easily be seen. In addition our proven UV-indicator allows detection of the coating during the production process.

Flexcoat™ LF transparent

– Dynamic friction reduction –

The primary aim of using LF coating is to reduce friction in dynamic applications while assembly forces are significantly reduced. With the use of the transparent LF coating, the color of the sealing material is preserved.

Flexcoat™ LF color

With the same performance characteristics as the transparent version, colored LF coatings allow differentiation of similar seals, preventing mix-up during the production process. Colors available: yellow, orange, red, blue, white, brown and green.

Flexcoat™ SF

– High-performance friction reduction –

SF coating is characterized by its outstanding level of resistance to wear and excellent friction properties in dynamic applications.

Flexcoat™ DF

– Surface modification –

In this process, the surface of the elastomer seals is modified in the micrometer range. There is only a very slight effect on the physical properties of the elastomer.

Application examples

- Automated assembly
- Reduction of assembly forces particularly where there are frequent assembly and dismantling operations
- Seals in plug-fit or quick-release couplings
- Seals in valves
- Seals in push buttons
- Seals in dynamic applications at low speeds and with short stroke lengths.

Application Professionals	Type	Color	Detection	Coating thickness ¹	Temperature range ²	Approvals / guidelines	Hardness (surface)	Appearance
Flexcoat™ PF	coating, Polysiloxane	transparent, with black pigments	UV-indicator, reference samples	2–10 µm 78.74–393.1 µin	-45°C to +175°C -49°F to +347°F	no substances requiring declaration according to VDA 232-100	up to +4 IRHD	dry
Flexcoat™ LF transparent	coating, PTFE	transparent	UV-indicator	2–10 µm 78.74–393.1 µin	-40°C to +150°C -40°F to +302°F	no substances requiring declaration according to VDA 232-100	up to +4 IRHD	dry
Flexcoat™ LF color ⁴	coating, PTFE	yellow, orange, red, blue, white, brown, green	UV-indicator	2–10 µm 78.74–393.1 µin	-40°C to +150°C -40°F to +302°F	no substances requiring declaration according to VDA 232-100	up to +4 IRHD	dry
Flexcoat™ SF	coating, PTFE	black	UV-indicator	2–10 µm 78.74–393.1 µin	-40°C to +150°C -40°F to +302°F	no substances requiring declaration according to VDA 232-100	up to +4 IRHD	dry
Flexcoat™ DF	chemical modification	—	reference samples	—	like NBR	KTW possible	up to +4 IRHD	dry

¹ Important: The coating thickness is not quoted as a capability criterion but is for guidance only, deviations are possible depending on part geometry

² Only valid for coating layer

³ Dependent on the part and the material, has to be requested specially

⁴ Available for special materials from Maltese production only



Advantages

- Prevent parts sticking together during packaging or handling
- Improve the automatic supply or separation of seals
- Simplify the assembly and dismantling of seals, in manual or automated assembly
- Reduce insertion forces
- Optimize the dynamic use of elastomer seals
- Decrease the tendency of elastomer seals to stick to mating surfaces even after extended periods of rest
- Reduce “stick-slip” effect
- Increase wear resistance of elastomer seals in dynamic applications

Benefits

- Save time and enhance safety and security of assembly
- Cleaner process reduces associated time and cost for maintenance
- Ensure shorter process-flow times
- Increase opportunities for the use of simple and cost-effective elastomer seals
- Extend service life due to better wear properties and increased assembly safety
- Improve safety and security of elastomer seals used in valves, as they are less likely to seize up

Characteristics	Base material types	Important notice	Available in Labs-free quality ³	Application area	Advantages	Supply / separation	Easier assembly / once-only assembly	Reduced insertion force / repeat assembly	Reduction of stick-slip effects	Low dynamic loadings	General dynamic use (without limit)
computer-controlled, secure process, water-based	all types of elastomers, except Silicones / Fluorosilicones (depending on formulation)	contains Silicone	yes	I + A		•	•	•	•	•	○
computer-controlled, secure process, water-based	all types of elastomers, PU, except Silicones / Fluorosilicones (depending on formulation)	—	yes	I + A		•	•	•	•	•	•
computer-controlled, secure process, water-based	all types of elastomers, except Silicones / Fluorosilicones (depending on formulation)	friction values may differ from LF transparent	no	A		•	•	•	•	•	•
computer-controlled, secure process, water-based	all types of elastomers, except Silicones / Fluorosilicones (depending on formulation)	—	yes	I + A		•	•	•	•	•	•
environmentally-friendly process	only NBR (black)	no coating layer	yes	I + A		•	•	•	•	•	•

I = Industrial applications
 A = Automotive applications, high volume

• = fully capable
 ○ = partly capable
 — = not applicable

The Assembly Professionals

The Assembly Professionals are suited to both manual and automated assembly, ensuring friction-free running of assembly processes.

Flexcoat™ FF

– FDA assembly aid –

Flexcoat™ FF is a coating that has been specifically developed for hygienic processing environments. As required for food and beverage processing, it is FDA compliant. In addition, it complies to the German Lebensmittel- und Bedarfsgegenständegesetzes (LMBG) §5 para. 1, §31 para. 1 and to the standards of the Umweltbundesamtes (UBA) (German Federal Environmental Agency (FEA)) for organic coatings used in potable water valid for the area D2 (seals).

Flexcoat™ CF color

– Colored assembly aid –

Flexcoat™ CF is a dry coating which is used to reduce assembly and plug-in forces. Available in pink and turquoise it is ideal for segregation of similar seals in production processes.

MaxWax®

MaxWax® is a waxy coating which can be used as a substitute for lubricants to ease assembly. Its use is dependent on the material.

Flexcoat™ MF

– For easier assembly –

Flexcoat™ MF is the alternative to lubrication, guaranteeing safety and security within automated assembly processes. Its dry surface improves handling without contaminating the system.

Flexcoat™ AMF

– Automotive assembly aid –

Flexcoat™ AMF is a semi-permanent coating that eases assembly primarily in automotive applications. It is modified dependent on materials.

Application examples

- Manual and automated assembly
- Once-only and repeated assembly processes
- Reduction of assembly and plug-in forces

Assembly Professionals	Type	Color	Detection	Coating thickness ¹	Temperature range ²	Approvals / guidelines	Hardness (surface)	Appearance
Flexcoat™ FF	coating, PTFE	transparent (milky)	reference samples	2–10 µm 78.74–393.1 µin	-40°C to +150°C -40°F to +302°F	FDA compliant, conform to LMBG, §5 para. 1 and §31 para. 1 and to the standards of UBA	up to +4 IRHD	dry
Flexcoat™ CF color	coating, PTFE	pink, turquoise	reference samples	2–10 µm 78.74–393.1 µin	-30°C to +140°C -22°F to +284°F	—	up to +4 IRHD	dry
MaxWax® ⁵	wax	transparent	reference samples	n/a	-40°C to +150°C -40°F to +302°F	—	like the base material	dry, waxy
Flexcoat™ MF	coating, PTFE	transparent	UV-indicator	2–10 µm 78.74–393.1 µin	up to +175°C +347°F	no substances requiring declaration according to VDA 232-100	up to +4 IRHD	dry
Flexcoat™ AMF ⁵	coating, PTFE	transparent	UV-indicator	2–10 µm 78.74–393.1 µin	-40°C to +150°C -40°F to +302°F	no substances requiring declaration according to VDA 232-100	up to +4 IRHD	dry

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² Only valid for coating layer

³ Dependent on the part and the material, has to be requested specially

⁴ Available for special materials from Maltese production only

⁵ Available for special materials from Swedish production only

Advantages

- Prevent parts sticking together during packaging or handling
- Improve the automatic supply or separation of seals
- Simplify the assembly and dismantling of seals, in manual or automated assembly
- Reduce insertion forces



Benefits

- Save time and increase safety and security in assembly
- Cleaner process reduces associated time and cost for maintenance
- Ensure shorter process-flow times
- Extend service life due to enhanced assembly safety
- Improve friction properties
- Improve safety and security of elastomer seals used in valves, as they are less likely to seize up

Characteristics	Base material types	Important notice	Available in Labs-free quality ³	Application area	Advantages	Supply / separation	Easier assembly / once-only assembly	Reduced insertion force / repeat assembly	Reduction of stick-slip effects	Low dynamic loadings	General dynamic use (without limit)
computer-controlled, secure process, water-based	all types of elastomers (depending on formulation)	—	yes	I + A		●	●	●	●	○	—
computer-controlled, secure process, water-based	all types of elastomers, except Silicones / Fluorosilicones (depending on formulation)	contains Polysiloxane	no	I + A		●	●	●	●	○	—
mixture of paraffins and synthetic waxes	all types of elastomers	contains non migrating Silicone	no	I + A		○	●	●	—	○	—
computer-controlled, secure process, water-based	all types of elastomers, except Silicones / Fluorosilicones (depending on formulation)	not permanent, storage not recommended	yes	I + A		●	●	—	—	—	—
computer-controlled, secure process, water-based	all types of elastomers, except Silicones / Fluorosilicones (depending on formulation)	—	no	A		●	●	—	—	—	—

I = Industrial applications
A = Automotive applications, high volume

● = fully capable
○ = partly capable
— = not applicable

The Handling Aids

The simple and economical handling aids facilitate basic requirements, such as easy separation of parts along with other assembly processes like feeding and insertion.

Talcum powder coating

Applied to the seal as a loose powder coating the talcum prevents parts sticking together during packaging and simplifies handling.

MoS₂ powder coating

A dry lubricating film, MoS₂ is applied by tumbling onto the seal surface. It is primarily used for separation of elastomer seals. Long-term friction reduction can be achieved by deposition of slide-promoting substances in the hollows of mating surfaces.

Graphite powder coating

Graphite powder forms a dry lubricating film and is primarily used to ease separation and assembly of parts.

Elastolub 013

Elastolub 013 is a silicone fluid-based lubricant. The substance is applied to seals in a drum and adheres very well to the elastomer surface. Forming a thin lubricating film it has a tendency to make seals stick together slightly so is not recommended for automated assembly.

Application examples

- To prevent parts sticking together
- Manual seal assembly
- Automated seal assembly

Handling Aids	Type	Color	Detection	Coating thickness ¹	Temperature range ²	Approvals / Guidelines	Hardness (surface)	Appearance
Talcum powder coating	powder coating	white	reference samples	n/a	like base material	—	like base material	dry, powder
MoS₂ powder coating	powder coating	anthracite	reference samples	n/a	like base material	—	like base material	dry, powder
Graphite powder coating	powder coating	grey / silvery	reference samples	n/a	like base material	—	like base material	dry, powder
Elastolub 013	lubrication based on oil	transparent	reference samples	n/a	like base material	—	like base material	oily

¹ Important: The coating thickness is not quoted as a capability criterion but is for guidance only, deviations are possible depending on part geometry

² Only valid for coating layer

³ Dependent on the part and the material, has to be requested specially



Benefits

- Provide time savings in assembly
- Ensure shorter process-flow times
- Cost-effective solutions with good performance

Advantages

- Prevent parts sticking together during packaging or handling
- Facilitate the separation of seals
- Improve the gliding properties of seals during manual assembly operations
- Rapid availability due to their simple production process

Characteristics	Base material types	Important notice	Available in Labs-free quality ³	Application area	Advantages	Supply / separation	Easier assembly / once-only assembly	Reduced insertion force / repeat assembly	Reduction of stick-slip effects	Low dynamic loadings	General dynamic use (without limit)
—	all types of elastomers	contamination possible due to wear	no	I + A	●	○	—	—	—	—	—
—	all types of elastomers	contamination possible due to wear, absorption of MoS ₂ through base material possible	no	I + A	●	○	○	○	○	○	—
—	all types of elastomers	contamination possible due to wear	no	I + A	●	○	○	—	—	—	—
Silicone oil with solid lubricants	all types of elastomers, except Silicones	contains Silicone, parts tend to stick, not for automated assembly, absorption through base material possible	no	I + A	○	●	○	—	—	—	—

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Technical Information

Differentiation and detection options

Several options are available to provide evidence of coating or to differentiate between seals that appear to be almost identical.

The UV-indicator

Most of the Assembly and Application Professionals provide a UV-indicator.

This will be highlighted under ultraviolet lamps, the shade and brilliancy varying from white to violet, dependent on the coating and on seal material. This can be used for 100 percent detection of coating.

It is recommended to only use lamps with long wave ultraviolet light as this provides the best brilliancy and protects eyesight.



Uncoated and coated seal under UV-light

Colored coatings

The primary function of any coating is to improve the friction characteristics of an elastomer seal. In addition, colored coatings enable effective differentiation of seals and 100 percent detection in production and assembly process.

Color-coding allows segregation of seals that appear to be similar during assembling or storage. This prevents mix-ups, which can lead to leakage or seal failure. In addition, lighter colors can be more easily detected in a black or dark assembly during end of line quality checks.

Flexcoat™ CF color is available in pink and turquoise. Flexcoat™ LF for dynamic applications is available in yellow, orange, red, blue, white, brown and green. Detailed information regarding the coatings can be found on pages 4 to 7.



Colored coated O-Rings

Cleanliness and residue analysis

Modern sealing technology involves washing, Labs-free cleaning and residue analysis. With coated seals several important issues have to be considered.

Washing

Washing of seals after coating is not usually recommended as depending on the washing method and agent, the coating can be damaged. However, in some cases washing is possible.

Residue analysis

To determine residue on the seal surface we recommend the use of wdk (the trade association of the German rubber industries) guideline number 2111. For coated seals only the sputtering method is applicable. Using an ultrasonic bath may damage the coating.

Labs-free cleaning for automotive lacquering applications

Substances such as processing aids, softeners or similar ingredients within seals can potentially contaminate sensitive automotive lacquering process. Acting similarly to silicone oils, they can cause 'dimples' on the lacquer surface which are not allowed.

A high-tech 'Labs-free' cleaning regime is used to remove these substances from within or on the surface of the seal as specific by the Volkswagen test specification 'Colors and Lacquers' PV 3.10.7.

If seals have been cleaned using the 'Labs-free' method, once packaging has been opened, any unused seals remaining within it should be discarded. For information on suitable packaging, please contact your local Trelleborg Sealing Solutions Marketing Company.

Almost all coatings or treatments from the Assembly and Application Professionals can be delivered in Labs-free quality. Please find further information in the tables on pages four to seven.

Tests and analyses

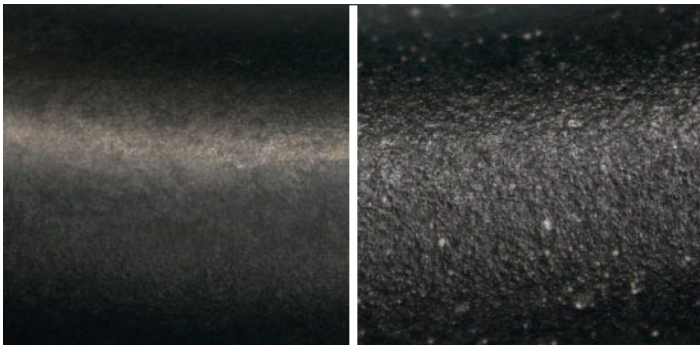
Test results exist on the friction properties of seals with and without surface treatments. Various movement types are simulated, forces measured and surfaces microscopically inspected. These results can only be used as a general guide.

Due to the interaction of parameters influencing friction, customers should preferably undertake their own tests within their specific application. Alternatively the seals should be tested within components that make up the final assembly.

Surface analyses

In general coatings improve the friction coefficient of elastomer seals. A major contribution to this improvement is the change in surface structure caused by coating.

The microscopic examination of the surface of coated and uncoated seals shows significant differences in the structure. In most cases the coated seal will have a rougher texture.



Surface of an uncoated seal (left) and of a seal coated with Flexcoat™ SF (right)

Standard analyses

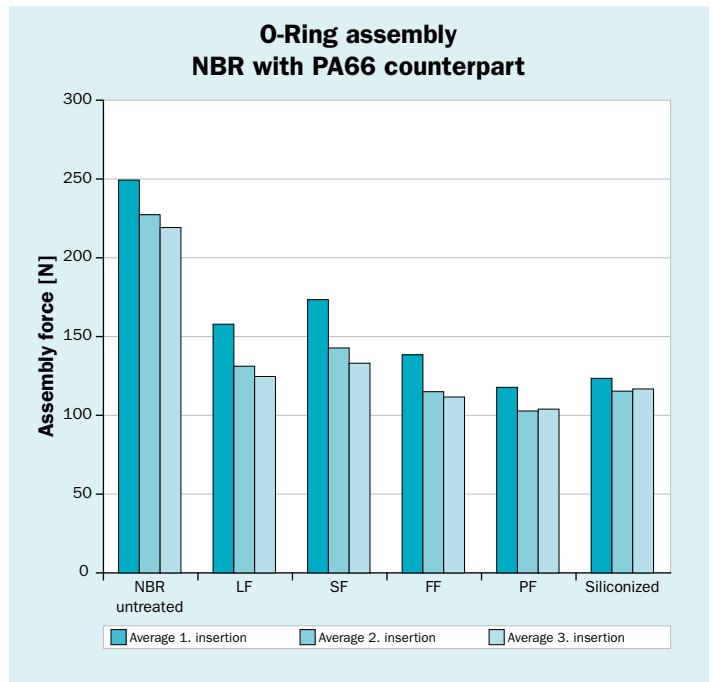
Various standard analyses, always done under the same conditions, allow the comparison of different methods of friction reduction.

Assembly force tests

The following graph shows the necessary plug-in forces for the multiple assembly of O-Rings in a standard application. Tests have been run comparing uncoated O-Rings to coated ones with silicone oil treated parts used as piston seals. The O-Ring size was 20.29 × 2.62 mm / 0.8 × 0.1 inches combined with a compression of approximately 20%.

Local marketing companies at your service

To identify the optimum seal for your application, contact your local marketing company. To locate this see the back cover of this brochure or go to www.tss.trelleborg.com.



Assembly forces of O-Rings

Disclaimer:

The given application limits for temperature are maximum values determined in laboratory conditions. In application, due to inappropriate interaction media the temperature resistance of a coating may be influenced negatively. The application temperature has to be adopted accordingly. Furthermore in all cases, reduction in friction is dependent on the application parameters. This should be tested in conjunction with the surface treatment before specification.

Contact your local marketing company for further information:

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