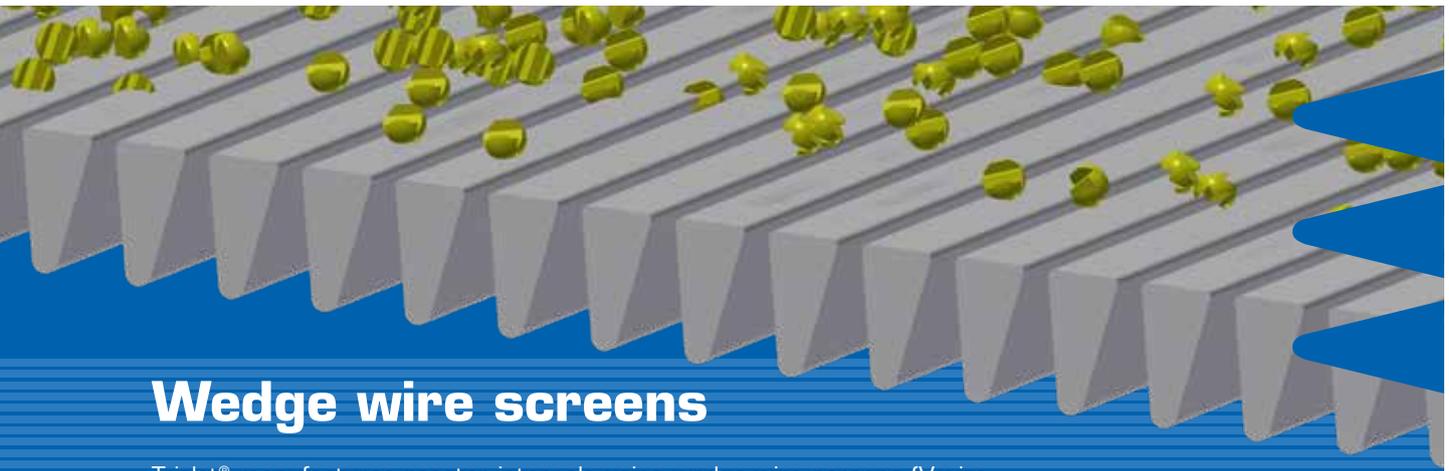




Reactor Internals and solid/liquid filtration
for the Refining & Petrochemical Industry





Wedge wire screens

Trislot® manufactures reactor internals using wedge wire screens (V-wire screens). Such a screen consists of surface wires that are welded onto support profiles. The distance between the surface profiles is controlled very accurately, as it forms the continuous slot opening (aperture) through which the process liquid or gas flows and by which the media (catalyst or resin) is retained in its position.

Compared with conventional wire mesh internals, the wedge wire reactor internals have the following advantages:

- ▶ **Strong Self-Supporting Construction**
In many applications the wedge wire screen is self-supporting due to a strong weld at each surface wire to support profile intersection. Mesh tends to tear, especially when changing the catalyst.
- ▶ **Non-Clogging**
The continuous slot opening formed by the triangular-shaped ('V') surface wires ensures a two-point contact between particles and the slot, which minimises clogging.
- ▶ **High-Precision Slot Sizes**
Precise slot sizes are available to meet customer's requirements. Slot openings down to 25µm.
- ▶ **Low Pressure Drop and High Open Area**
To optimise your process output.
- ▶ **Smooth Screen Interface**
The low friction between the screen and expensive medium is a result of the smooth continuous slot openings, which run in one direction allowing the media to move in that direction with a low friction force.

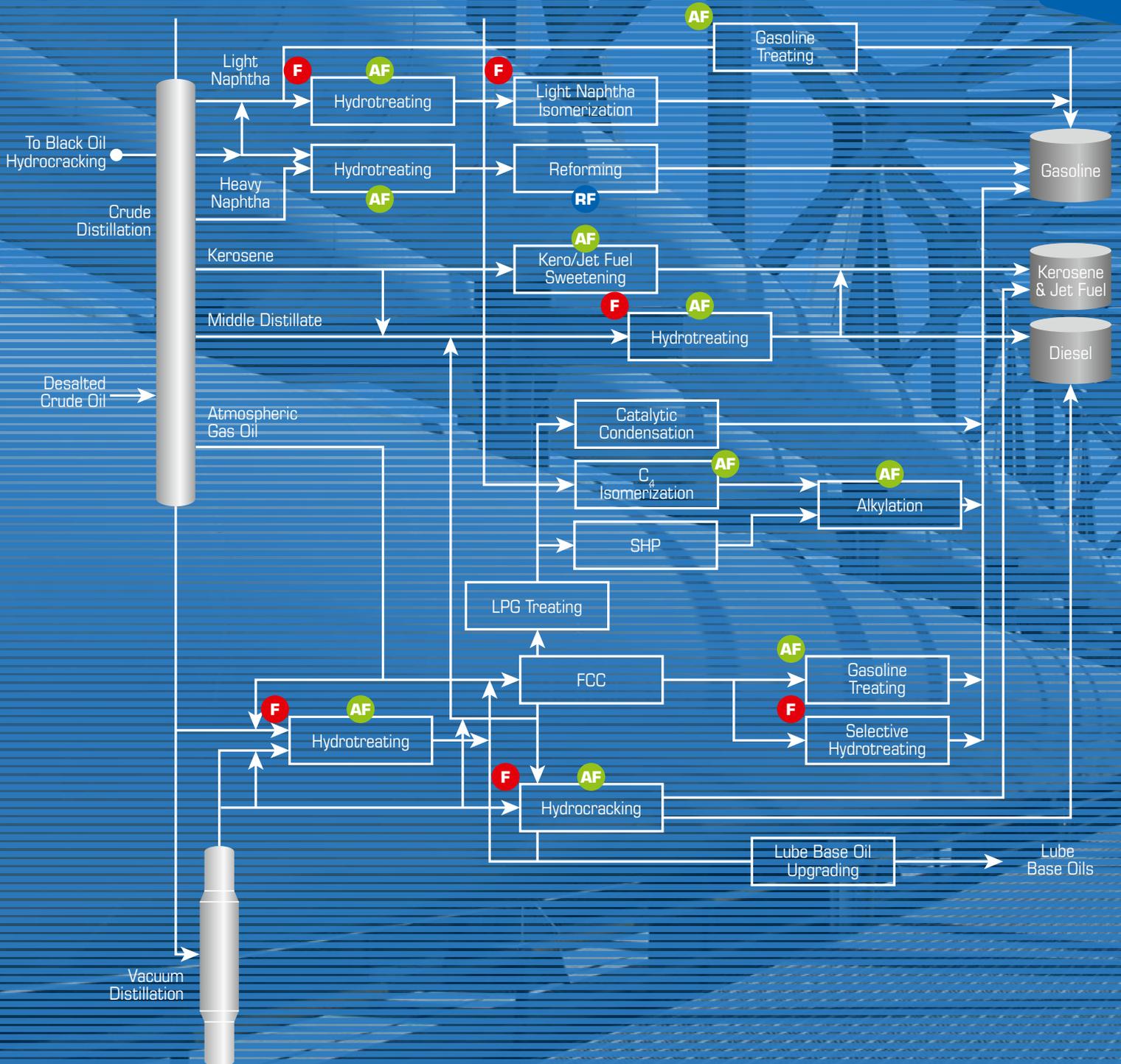
All these advantages result in a low maintenance cost and a minimal operational cost for the petrochemical and refining plants.

Trislot® has many different profiles available in most stainless steel alloys, Duplex and Super Duplex alloys, Inconel 600, Titanium, Hastelloy C-276, AISI 310, 347, etc.

For available profiles and materials, please refer to the end of this brochure or our website www.trislot.be

The refining process

- F** feedstock filtration
- AF** axial flow internals
- RF** radial flow internals



Typical Applications in the refining and petrochemical process



Trislot® has a wide range of wedge wire reactor internals available for your media retention and solid-liquid separation processes that have been used in many types of vessels and reactors. The wedge wire reactor internals are mainly used in two types of reactor processes.

- ▶ **Axial flow** (down or up) reactors, whereby the flow of the process liquid/gas through the catalyst is from top to bottom.
- ▶ **Radial flow** reactors, whereby the flow of the process liquid/gas through the catalyst is from outside to the centre of the reactor and vice versa.
- ▶ **Bubble column** reactors, where the catalyst freely moves in the reactor. Catalyst is retained by means of slot tubes.

Trislot® wedge wire reactor internals are commonly found in the following processes:

Refining

- ▶ Hydrotreating
- ▶ Hydrocracking
- ▶ Hydrodesulphurisation (HDS)
- ▶ Molecular Sieve
- ▶ Sulphur Recovery Units
- ▶ Alkylation
- ▶ Continuous Catalyst Regeneration (CCR)

Petrochemical

- ▶ Purified Terephthalic Acid (PTA)
- ▶ Styrene Monomer Dehydrogenation
- ▶ Ammonia Conversion
- ▶ Mercury Removal
- ▶ Sulphur Recovery
- ▶ Ethylene
- ▶ Merox
- ▶ Gas Dehydration

Natural Gas

- ▶ Molecular Sieves (Hydrogen)
- ▶ Activated Carbon
- ▶ Silica Gel
- ▶ Amine
- ▶ Mercury Removal



Trislot® has been working with worldwide Process Licensors including the following:

- ▶ Shell Global Solutions (SGS)
- ▶ UOP
- ▶ IFP / Axens
- ▶ Haldor Topsoe (HTAS)
- ▶ ABB Lummus
- ▶ Uhde
- ▶ Thyssenkrupp Industrial Solutions AG
- ▶ Snamprogetti
- ▶ Air Products
- ▶ Chevron
- ▶ BOC
- ▶ Sasol

Wedge wire advantages

Needless to say that the maintenance cost and risk of defects need to be minimised in refining & petrochemical applications.

Wedge wire holds the advantages that have a larger return on investment than any other filter medium:

- ▶ Strong mechanical construction
- ▶ Non-clogging surface
- ▶ **No maintenance or replacement costs**

Axial Flow Reactor Internals

These reactor internals are employed for their high ability to safely retain your expensive catalyst media from migration. Wedge wire screens allow the collection of process flow across the entire reactor/vessel diameter or length.

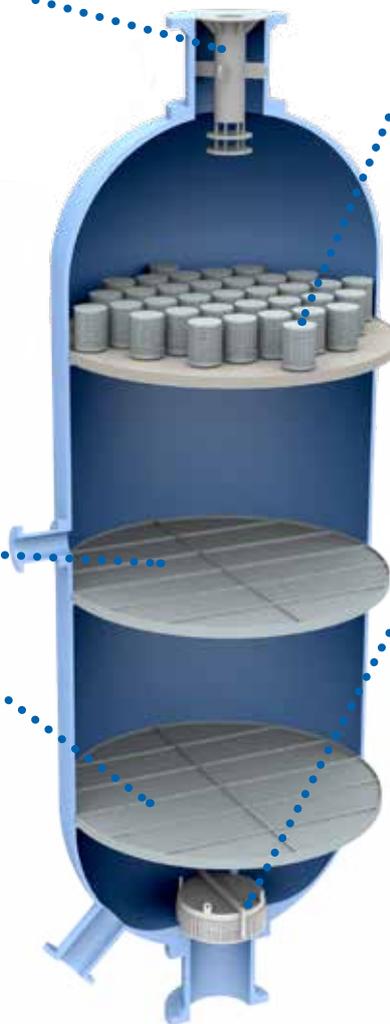
Employing the advantages of wedge wire, Trislot® offers a wide range of reactor internals designed by our engineers to your specific requirements. All screen internals are designed to fit through the reactor manway and are commonly manufactured from Stainless Steel AISI 304 / 304L / 316L / 321 / 347 / 310.

Inlet Distributors

- ▶ Manufactured from either wedge wire screen or from plate.
- ▶ Used to evenly distribute the process flow over the top surface of the catalyst bed or onto the adjacent reactor internal (e.g. distribution tray).
- ▶ Designs vary depending on the Process Licensor.

Support Grids

- ▶ A welded flat screen with or without additional support bars.
- ▶ Used for supporting and directly retaining media.
- ▶ Made in several sections to pass through the vessel manway.
- ▶ Designed to a calculated design load, which includes the bed weight and pressure drop through a catalyst/resin bed.
- ▶ Can be easily accommodated with vessel support beams.
- ▶ Common slot openings: 0.25 – 1.0 mm.



Filter Elements

- ▶ A series of cylindrical screens arrayed at the top of the upper catalyst bed.
- ▶ Used to collect metallic contaminants or scale from plugging the top surface of the upper catalyst bed.
- ▶ Will also increase the total surface area of the upper catalyst bed to extend the bed's useful life.
- ▶ Common slot openings: 0.5 – 1.5 mm.

Outlet Collectors (Bottom Baskets)

- ▶ A cylindrical screen with or without a screen top section.
- ▶ Used for direct media retention and as a safety screen to prevent migration of catalyst through the outlet nozzle.
- ▶ Designed to a calculated design load, which includes the bed weight and pressure drop through a catalyst/resin bed.
- ▶ Fixed to the reactor/vessel bottom head via bolts; lugs with wedge-pins; or fully welded.
- ▶ Common slot openings: 0.25 – 4.0 mm.

Axial Flow Reactor Internals (cont.)

Trislot® has designed and manufactured axial flow reactor internals to many customers worldwide.



Catalyst Support Grid with Support Beams



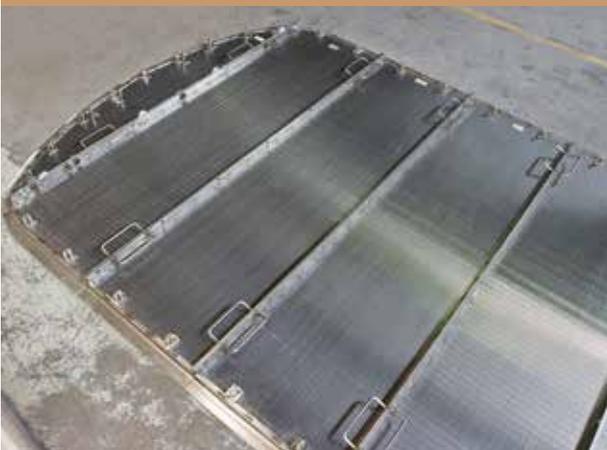
Large Catalyst Support Grid (4000 mm dia.) with Beams and Anti-Buckling Combs



4 sets of Scale Trap Baskets



Outlet Collectors



Molecular Sieve Bed Support Grid for a horizontal vessel



Scale Trap Baskets

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Radial Flow Reactor Internals

These reactor internals are employed for their high-volume flow capacity with minimal pressure drop. Normally arranged with two types of concentric-positioned screens, which create an annulus filled with either static or flowing catalyst media.

Also employing the advantages of wedge wire, Trislot® offers a wide range of screen internals designed by our engineers to your specific requirements. All screen internals are designed to fit through the reactor manway and are commonly manufactured from Stainless Steel AISI 316L and 321/321H / Inconel.

Cover Plates and Riser Plates

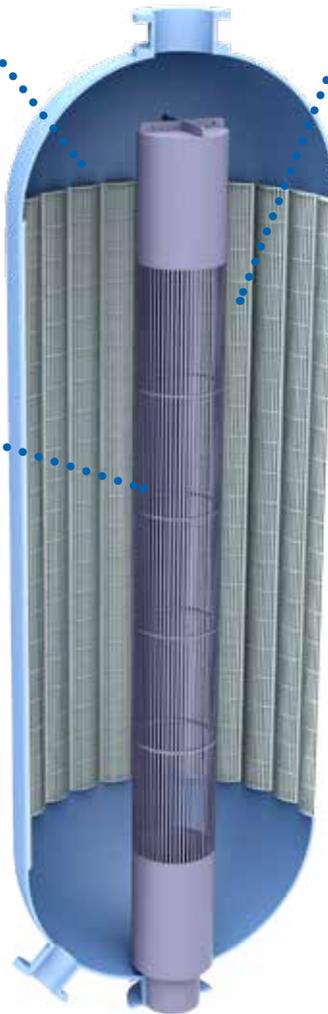
- ▶ Trislot® also offers the centrepipe cover plates and scallop riser seal plates. Other types of internals can also be supplied.

Centrepipes

- ▶ A large cylindrical screen wrapped around a strong perforated tube.
- ▶ The slot openings run in the axial direction (up to down) to provide a smooth interface to eliminate the abrasion of expensive catalyst and thus minimising fines.
- ▶ Centrepipes or centre screens are designed to a calculated design load, which includes the bed load and pressure drop through the catalyst bed.
- ▶ Slot openings vary depending on the Process Licensor. Commonly 0.61 mm.

Scallops

- ▶ 'D'-shaped screens manufactured from either wedge wire screen or perforated plate.
- ▶ Scallops are located around the reactor wall and held into position by expander rings.
- ▶ Provides a higher surface area than a traditional outer basket.
- ▶ Installation and repair can be much faster and simpler with these individual screens.
- ▶ Slot openings/perforation openings vary depending on the Process Licensor. Commonly 1.02 x 12.57 mm perforated slots.
- ▶ Spare Scallops are generally held in stock by many refiners for emergency shutdowns.



Radial Flow Reactor Internals (cont.)

Trislot® has designed and manufactured radial flow reactor internals to many customers worldwide.



Scallops and Centrepipe in position



Set of Scallop with perforated liners in AISI 321



Centrepipe (length 10m) in Inconel 600



Segment of Outer Screen



Centrepipe for revamp in 4 sections



Outer Screen mock-up assembly

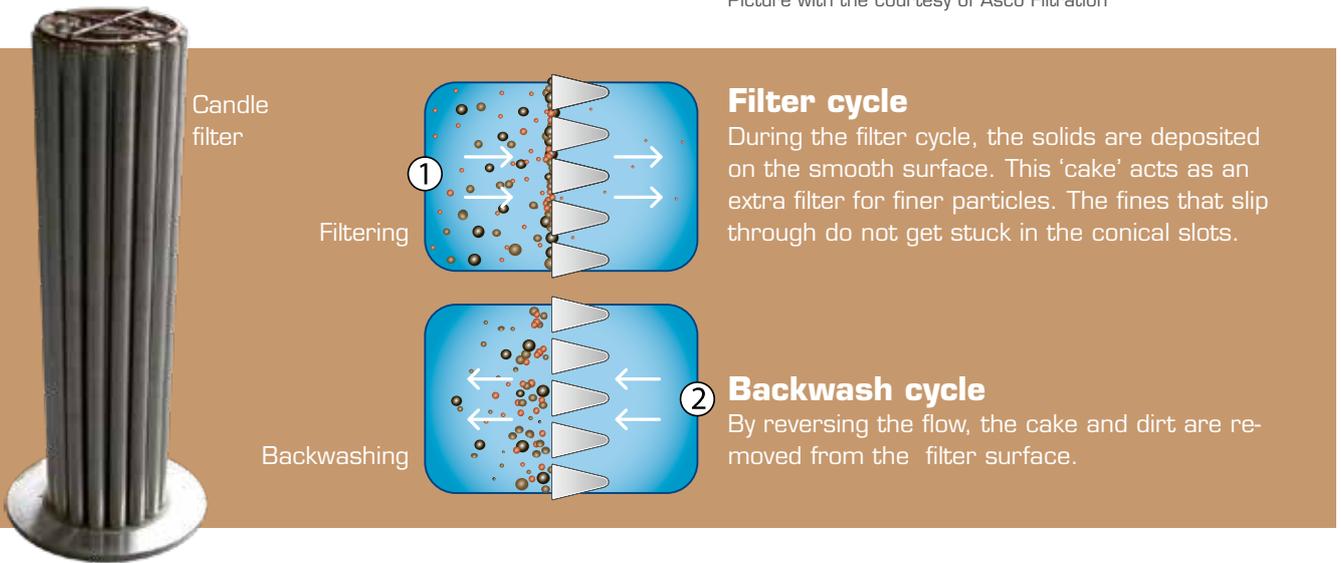
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Feedstock Filtration

- ▶ Wedge wire screen elements are employed in this filtration system to remove contaminants such as coke particles and scale rust from sour water, reactor feeds and hydrocracker feeds.
- ▶ These contaminants from process equipment and pipelines lead to fouling of the catalyst beds.
- ▶ Screen elements will require backwashing to remove the buildup of filter cake.



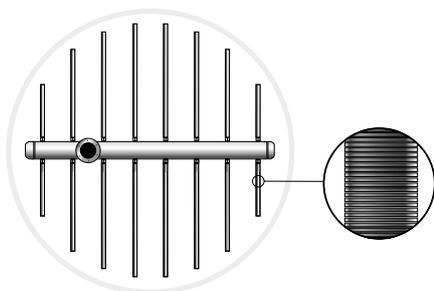
Picture with the courtesy of Asco Filtration



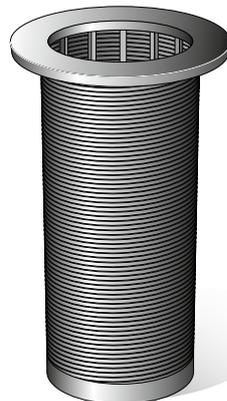
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Other applications in your plant

- ▶ Wedge wire screens are used in Ion Exchange, Water Demineralisers & Softeners, Condensate Polishers, Sand Filters for media retention and thus eliminating the migration of expensive resin out of the vessel.



Distributor and collector laterals



Resin trap



Nozzle Screen

Nozzle

Technical Information

The tables below list the most commonly used Trislot® surface and support profiles used in the refining and petrochemical industry.

Trislot® surface profiles

Figure	Name	Width (mm)	Height (mm)
	12S	1	2
	12SL	1	2
	15S	1.2	2.5
	18S	1.5	2.5
	18SC	1.5	2.8
	22S	1.8	3.7
	28S	2.2	4.5
	28SC	2.2	4.5
	28ST	2.28	3.55
	34S	2.8	5.5
	42S	3.4	6.8

Trislot® support profiles

Figure	Name	Width (mm)	Height (mm)
	Q25	2	3
	Q35	3	5
	D45	3.8	5.6
	D56	5	6.5
	10x3	3	10
	12x3	3	12
	15x3	3	15
	25x3	3	25
	50x3	3	50

The open area, Fo, is expressed in % and can be calculated using this formula:

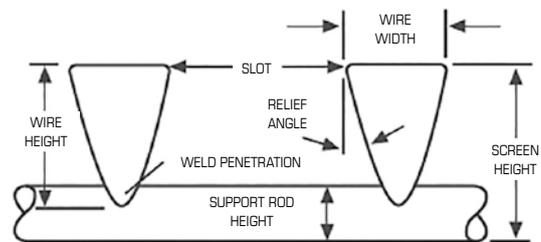
$$F_o = \frac{s}{b + s} \times 100 (\%)$$

s = slot width (mm)
b = width of surface profile

Example:

Surface profile 22S: b = 1.8 mm and Slot width: s = 0.5 mm

$$F_o = \frac{0.5}{1.8 + 0.5} \times 100 \% = 22 \%$$



Quality Assurance

Documentation



- ▶ Drawing for Approval
- ▶ Design Calculations
 - Mechanical strength of screen internals
 - Recommended quantity and size of support beams
- ▶ Mill Certificates
- ▶ Slot Opening Reports
- ▶ Final Inspection Reports
- ▶ WPS and PQR
- ▶ PMI Reports (at request)
- ▶ Dye Penetrant

Mock-Up Test Assembly

- ▶ To ensure there are no sudden and unwanted issues during site installation, we perform an in-house mock-up test assembly of complicated reactor internals to check for correct fitment of adjacent items. For example, catalyst support grids with associated support beams and the HD trays, as pictured below.
- ▶ In all other cases, support grids and outlet collectors are still trial assembled prior to shipment.
- ▶ We welcome our valued customers to visit our factory and carryout a joint inspection of our reactor internals prior to shipment.



Mock-up Test Assembly of Catalyst Support Grid, Support Beams and HD Tray

Trislot® dedicated Sales team



Nico Mercier
Senior Project
Engineer world wide

Agent for Italy
Sergio Butti
buttisergio1@gmail.com

Agent for France
Filtr'ation
info@filtraction.fr



Glenn Vercruyce
Central & South America,
UK, Scandinavia, Portugal,
The Netherlands & Germany
gvc@trislot.be



Christophe Caenepeel
Turkey, Spain,
Switzerland, Austria,
Eastern Europe, Belgium,
Luxembourg & Germany
ccn@trislot.be



Mike Verduyn
Rest of the world
mvm@trislot.be



Corey Brightwell
APAC
crb@trislot.be



Florian Van Assche
North America
fva@trislot.be



Jason Qiu
China
jason@trislot.be

Trislot® Quality Assurance

- ▶ ISO 9001 Certified
- ▶ Trislot® focuses on Total Quality Management

Conclusion

Trislot® offers an extensive range of screen retention and filtration solutions, making us an ideal partner.

References

Trislot® has supplied screen internals to end users worldwide and cooperates with engineering and vessel fabrication companies active in this market. Trislot® is also a qualified screen vendor of Shell Global Solutions (SGS). References can be submitted on request after discussion with our customers.

Production sites:

Trislot nv
Roterijstraat 134 - B-8970 Waregem - Belgium

Trislot Shanghai
Bldg. 2, N°6, Lane 55 - East Shanfu Road - Shanyang Town - Jinshang distr. - 201505 Shanghai - China

www.trislot.be