

# INTERNALS FOR RADIAL FLOW REACTORS



# THE PROCESS



## WHEN CLEAN, HIGH-VOLUME FLOW WITH MINIMAL PRESSURE DROP IS NEEDED, RADIAL FLOW SYSTEMS ARE YOUR BEST CHOICE.

The direction of your process flow can have a lot to do with your overall process efficiency. Radial flow systems produce far less pressure drop across the bed – a controlling process parameter for some applications. Not only does this produce a higher yield, it's more energy efficient as well. Radial flow systems increase contact efficiency between the process stream and catalyst bed. Because of this, vessel size can be dramatically reduced. Given equal vessel diameters, for example, a 20 ft / 6.1m tall radial flow system can handle the same flow as a 40 ft / 12.2m long horizontal bed. Processors can save on vessel capital cost and the equipment operating costs needed to push the flow through it.

Some processes achieve the highest production rate of desired product by operating with very low pressure drops across the screen and bed. Johnson Screens is the premier supplier of screen sets requiring tight annulus tolerances.

Performance, economy and efficiency make radial flow systems especially well suited for such processes as:

- Catalytic reforming (fixed bed and continuous/regenerative)
- Styrene dehydrogenation
- NO<sub>x</sub> removal systems
- Solvent recovery
- Hydrodesulphurizing units
- Tertiary recovery
- Ammonia converters
- Isomerization systems
- Other thin bed annulus systems

Johnson's® expertise with radial flow processes, earned in hundreds of installations, enables us to provide you with superior reactor internal designs and products.



The outer screen may either be a basket or an arrangement of scallops — either Vee-Wire<sup>®</sup> screen, perforated sheet or OptiMiser<sup>™</sup>.



In downflow radial flow systems the process stream passes through the outer basket, across the catalyst and is collected in a center screen where it passes out the vessel bottom.

# THE DESIGN



## THE SYSTEM EFFICIENCY AND ITS COST-EFFECTIVENESS ARE STRONGLY INFLUENCED BY THE SCREEN DESIGN.

We've supplied critical components for hundreds of radial flow systems around the world.

This experience has made us the industry leader in radial flow vessel internal design. In designing and manufacturing these internals, we draw from a full range of options. We can offer Vee-Wire® screens – the top-of-the-line product in vessel screen internals. These screens are fabricated by attaching Vee-shaped profile wire to an array of support rods, welding each intersection of wire and rod. This forms an extremely robust screen with continuous slot openings of very close tolerance.

The benefits to radial flow processors are substantial:

- A stable screen/catalyst interface is created. The rigid, smooth surface of the Johnson® screen eliminates catalyst attrition caused by flexing of wire mesh.
- Screens have vertical slots to allow easier movement of the catalyst vertically, reducing catalyst damage during operation and under upset.

- Because the catalyst beads are not abraded or broken, the bed permeability remains high. Even flow distribution is maintained.
- Strong all-welded screen provides excellent resistance to high temperatures and pressures for long service life, less downtime.
- The interface between the catalyst and screen does not become a plugged surface inducing high pressure drops. Two-point contact with catalyst does not entrap the pills, allowing full movement and complete regeneration in continuously replenished units. If a pill becomes fractured during operation, the outwardly enlarging slot allows the fragments (or fines) to move clear of the interface virtually eliminating slot blinding.

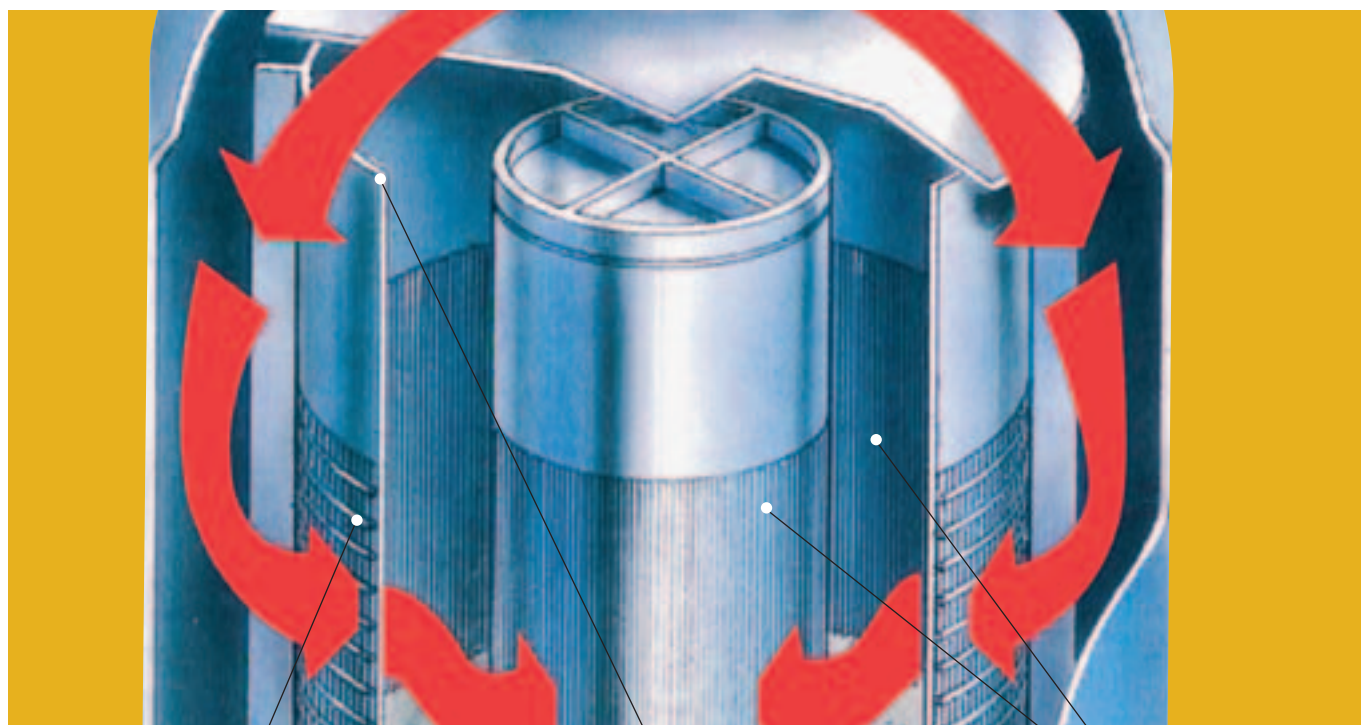
In addition to these general advantages, we can apply our design and fabricating expertise to special areas to give you even better results: we choose the size and shape of the wires and rods to arrive at the best combination of open area and mechanical strength.

We can treat our screens during or after fabrication by pickling and passivation, annealing or other metallurgical processes to further enhance corrosion resistance and mechanical strength.

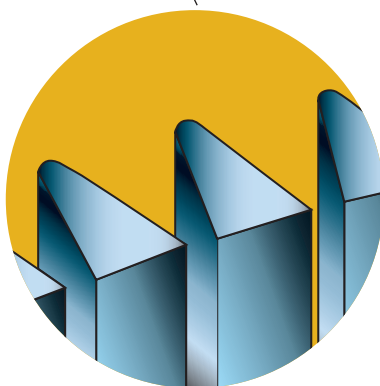
The results of these efforts can be impressive. For example we can build a 24 ft / 7.3 m diameter screen, 40 ft / 12.2 m high with a slot width tolerance of  $\pm 0.004$  in. / 0.1 mm, using heavy wires.

If your process doesn't demand the high performance characteristics of Vee-Wire® screen construction, we can find the solution with the right combination of wire mesh and perforated plate to produce satisfactory results.

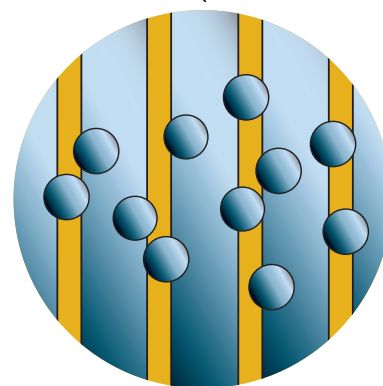
Whether for new installations or retrofits, the goal of all our efforts is to give you the best product for your process.



Each intersection of Vee-wire and support bar is welded to produce an extremely strong structure.



Vee-Wire® screens have outwardly enlarging slots which allow only two-point particle contact. Smaller particles pass freely through without plugging.



Smooth wire surface and vertical slot orientation allow the catalyst to move vertically against the screen face without being abraded.

# THE PRODUCTS



## JOHNSON OFFERS ALL THE SCREEN INTERNALS AND RELATED ASSEMBLIES NEEDED TO PRODUCE A RADIAL FLOW SYSTEM THAT OPERATES AT PEAK EFFICIENCY.

Johnson® fabricates the centerpipes, scallops, outer baskets and other assemblies required in a radial flow reactor vessel.

In the case of a system upgrade or retrofit, we custom build to use existing vessel hardware wherever feasible to minimize or eliminate welding to the vessel envelop.

Every design option is carefully engineered in all radial flow vessel internals we supply including:

- Centerpipes
- Scallops
- Outer Baskets
- Coverplates
- Ventilation Screens
- Expansion Bellows
- Catalyst Placement Pipes
- Thermowell Guides
- Access Doors and Others Manway Arrangements

To assure consistent quality for Johnson products, our manufacturing facilities follow a structured quality control program which is reviewed and updated on a continuous basis. We operate under the ISO 9001 standard in Asia-Pacific, Europe and the USA - your assurance that reactor screen internals from Johnson will always meet your specifications.

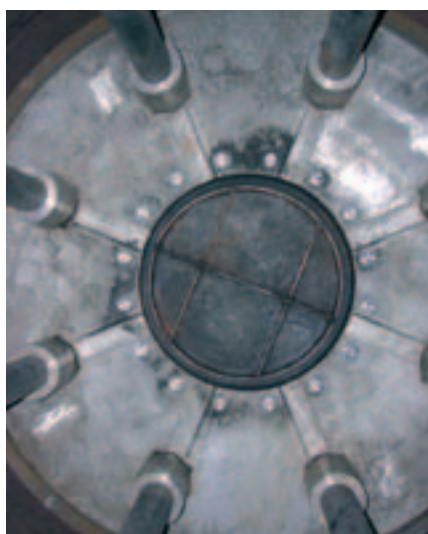
Our radial flow internals are most often made of 321 and 347 stainless steel but 304, 316, 410S, alloys 600 and 800 or other metals may also be used.

Johnson follows ASME code requirements for carbon content on material operating at elevated temperatures.

Field service is readily available from experienced crews. This can include on-site technical supervision, analysis of product condition, labor during installation/repair or engineering consultation on difficult process issues.



Many coverplate designs are available. This segmented coverplate is designed to accommodate catalyst transfer pipes.



Ultrasonic device allows on-site inspection of annulus between inner and outer screens.



Our engineering staff is available for technical consultation at any point in the process from product design to fabrication to installation and start-up.



## CENTERPIPES AND OUTER BASKETS

## How to increase flow rates and decrease vessel size

In its simplest form, a radial flow system consists of two concentric screens with an annulus filled with catalyst or sieve.

The system efficiency is a direct result of the effectiveness of the screen internals. Made of welded wires and rods, they offer exceptional strength and resistance to collapse, buckling or breaking. Equally important, their plug-resistant slot design and high open area percentage provides dependable media retention, high volume flow and long service life. As a further refinement, slots on both the center screen and outer basket are oriented vertically to allow media to slide against the screen surface during processing without becoming abraded by the slot edges.

Screen dimensions are readily adaptable to any new built or retrofitted vessel.

- Cover plates, manways and other options may be provided as needed.
- Screen baskets and centerpipes may be any height and diameter.
- Slots are as small as 0.010 in. / 0.25 mm and up in 0.001 in. / 0.025 mm increments.
- Screen wire & rod shapes and sizes will be determined based on operating conditions.
- Quality documentation is available including statistical process control charts, mill certificates, welding procedure specifications and various other reports and certifications.
- Screens can be made in sections to facilitate installation through the manway ID.



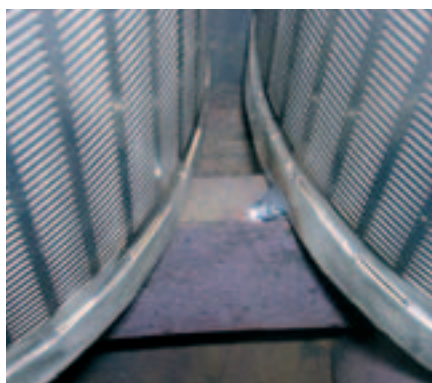




## VEE WIRE SCALLOPS

## For maximum efficiency in radial flow systems

Perforated sheet scallops are the standard in the industry. They are light, easy to install and a low cost product.

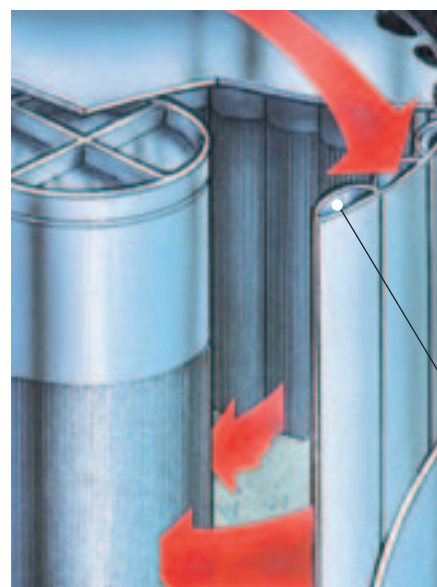


Compared to a single large outer basket, installation and repair can be much faster and simpler with individual scallop screens. Made of welded Vee-Wire and rods or perforated sheet, Johnson® screen scallops have exceptional resistance to bending, twisting or collapsing – all essential qualities when faced with extreme loads caused by expansion or contraction during temperature cycling operations.

Buckling - a common problem in tall reactors- is virtually eliminated, as is damage caused during installation.

Once installed, the screens are easily maintained. Their special slot design virtually eliminates plugging.

Johnson Vee-Wire screen scallops have distinct operating advantages. Vertical slots, for example, allow the catalyst to slide up and down smoothly during operation without abrading. Slots can be as narrow as 0.010 in. / 0.25 mm to retain small size catalyst.



Vee-Wire screens have inwardly enlarging slots which allow only two-point particle contact. Smaller particles pass freely through without plugging.



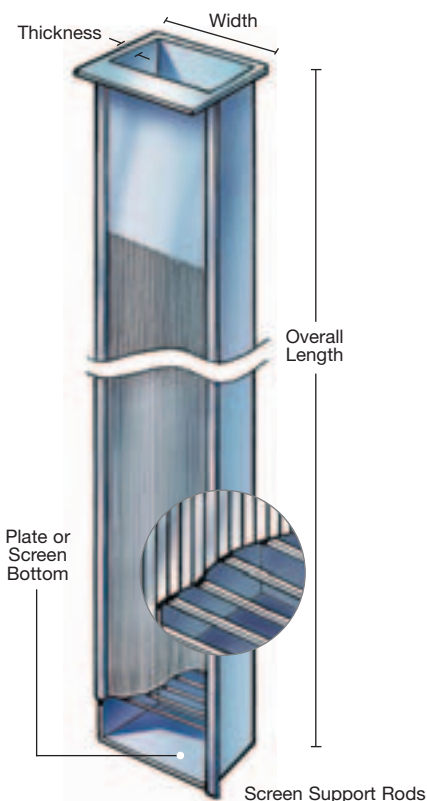
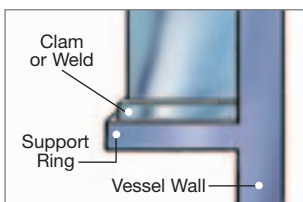
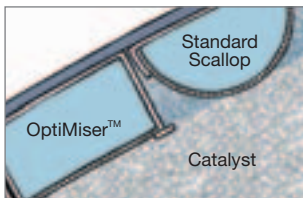
Despite the narrowness of individual slots, the Johnson Vee-Wire scallop arrangement has a much higher total open area than a single large outer basket or perforated sheet scallops of the same size. This increased open area translates directly into reduced pressure drop and enhanced process efficiency.

Standard Johnson screen scallops are available in any width or length, and in a wide variety of metal alloys.

- Scallop size is determined by process engineers.
- The upper section of the scallops (and the centerpipe) is a length of blank material equal in height to the horizontal thickness of the bed. This prevents short circuiting flow if the catalyst beads settle.
- Cover plates are available and can be easily attached to the top of the scallops and/or centerpipe.
- Scallops are provided with expander rings on request.

# OPTIMISER™ SCALLOPS

## Johnson OptiMiser™ scallops enhance process efficiency



Johnson® has developed a new screen system that combines the process efficiencies of an outer basket with the installation and maintenance advantages of standard scallops. Called the OptiMiser system, it maintains a uniform bed thickness in order to make maximum use of the bed. Among the many advantages of this new Johnson OptiMiser scallops:

- Install easily.
- Create high flow capacity.
- Make more effective use of catalyst than conventional scallops.
- Adapt to all size vessels.
- Stronger than conventional scallops.
- Create a uniform thickness annulus for predictable process flow and pressure drop.
- Can be made with slots sized 0.010 in. / 0,25 mm up in 0.001 in. / 0,025 mm increment.
- Include system sealing components and coverplate connections.

### JOHNSON PERFORMANCE SOLUTIONS TO RADIAL FLOW REQUIREMENTS

Johnson OptiMiser scallops can be fabricated to nearly any size, all with the following key features:

- Blank interval at screen top prevents “short-circuiting” of flow if the catalyst bed settles.
- Longitudinal and horizontal plates seal spaces between screens. The space between the back of the screen and the vessel wall is also sealed.
- Vertical slots and smooth Vee-wire face prevent abrasion of catalyst beads as the bed moves vertically in operation.
- Rugged welded construction of the OptiMiser scallops creates high column strength.
- Expander rings are not required for maintaining scallop in position, which removes impediments to catalyst movement vertically along the face.



## GLOBAL SERVICE SUPPLIER : FROM EXPERTISE AND INSPECTION TO INSTALLATION AND MAINTENANCE

Our experience with a great variety of industries ranging from refining, petrochemical applications and chemical uses to water well, pulp & paper processing, mining and architecture gives us a wealth of knowledge which we make available to you through our field service teams and in-house technical support groups.

We are experts in major processes including Catalytic Reforming, Styrene Dehydrogenation, LAB, Sulfur Treatment, HDS/HDT, Ammonia Conversion, Mercury Removal, Claus, etc.

We apply this expertise from initial product design through proprietary fabrication to testing, installation and start-up and have the people to solve a problem that may arise at any point in a product life cycle.

### A TEAM OF HIGHLY SKILLED WELDERS

No matter how distant or difficult the problem, we can get a team of experienced welders to your site. Each of them has personal experience in repair and installation of screens and other vessel internals. All have considerable expertise in TIG/MIG and other welding techniques, including work on exotic alloys.

Thanks to their experience, these welders can operate autonomously with little or no supervision under the most demanding conditions, including confined space work in remote sites. These teams need no intermediate contractor to direct their work and typically report directly to our client's on-site management.

For new project installations, we will field a team of experienced fitters, technicians and supervisory engineers to ensure a smooth, trouble-free start-up.



# Innovation and customer satisfaction



AT JOHNSON SCREENS<sup>®</sup>, OUR LARGE RANGE OF PRECISION ENGINEERING EQUIPMENT IS SUITABLE FOR MORE APPLICATIONS THAN EVER.

It is our aim to assist you in maximizing your operational efficiency and supporting you in finding long term trouble-free solutions. Discover our ever expanding range of products, designed with your needs in mind:

#### PETROCHEMICAL AND REFINING

Centrepipes  
Outer Baskets  
Scallops  
Support Grids & Beams  
Outlet Collectors  
Laterals  
Distributor Trays

#### GENERAL INDUSTRIAL

Flat Panels  
Sieve Bends  
Cylindrical Screens  
Architectural Products  
Custom Polyurethane Casting  
Corn Wet Milling (Starch and Sieves)  
Sugar Processing Products

#### WATER PROCESS

Passive Intake Screens  
In-Line Self-Cleaning Filters  
Nozzles  
Triton<sup>®</sup> Underdrain Systems  
Fish Diversion Screens  
Collectors/Distributors  
Vessel Internals

#### MINING

Centrifuge Baskets  
Pipo Two<sup>™</sup> Modular Screening Systems  
Pipo Three<sup>™</sup> Modular Screening Systems  
Polyurethane & Rubber Screen Panels  
Woven Wire  
Vee Wire<sup>™</sup>  
Sieve Bends  
Trommel Mats

#### WATERWELL SCREENS

Well screens  
Riser Pipes  
Environmental Monitoring Screens  
Drilling Fluids  
Rehabilitation Chemicals/Nuwell

#### ARCHITECTURE & CONSTRUCTION

Column covers  
Urban development  
Frontages  
Floor gratings  
Ventilation grids  
Sun control screens  
Custom lighting  
Furniture  
Walls/Wall partitions

**Johnson**screens<sup>®</sup>

A Weatherford Company

#### ASIA PACIFIC

JOHNSON SCREENS - Australia  
Tel. : +61 (0)7 3867 5555  
Fax : +61 (0)7 3265 2768  
salesaus@johnsonscreens.com.au

#### EUROPE - AFRICA - MIDDLE-EAST

JOHNSON SCREENS - France  
Tel. : +33 (0)5 4902 1600  
Fax : +33 (0)5 4902 1616  
jseurope@johnsonscreens.com

#### NORTH & SOUTH AMERICAS

JOHNSON SCREENS - USA  
Tel. : +1 651 636 3900  
Fax : +1 651 638 3132  
sales@johnsonscreens.com

[www.johnsonscreens.com](http://www.johnsonscreens.com)