



Evaluation of Pall Coralon™ Filter Elements and Competitor* Filter Elements

Pall Coralon filter elements allow users to benefit from the performance advantages of Stress-Resistant Technology filtration without having to change filter housings. The result: Systems stay cleaner, longer, for a greater value.

Coralon Filters

Representative competitors' filter elements were obtained and evaluated against equivalent Pall Coralon filter elements using international standards, where applicable. In addition, the physical construction and materials of each manufacturer's filter elements were analyzed.

Performance and Filter Construction

Performance Criteria	Procedure	Coralon Upgrade 'CN' Filter Element	Ultipor® III 'KN' Filter Element	Hydac ¹ Betamicron 4 Filter Element P/N:0240R005BN4HC	HyPro ² G8 Filter Element P/N:HP60L8-6MB	Parker ³ Filter Element P/N:926843Q	Donaldson ⁴ Filter Element P/N: P566211
Ratings							
Manufacturer's Rating, μm(c)	-	7	7	5	7	7	8
Beta (Filtration) Ratio @ 7 μm(c)	ISO 16889	1000	1000	600	540	200	436
Filter rating, μm(c) @ Beta = 1000	ISO 16889	7	7	8	8	12	8
CST Filter Rating	SAE ARP 4205	14/11/6	15/12/4	16/13/2	16/14/7	17/15/5	18/15/1

Performance

Fluid Cleanliness and performance consistency ¹ (particles per ml > 6 μm(c))	SAE ARP 4205	12	2X dirtier	5X dirtier	9X dirtier	15X dirtier	17X dirtier
Clean Pressure Drop (psid) ²	ISO 3968	0.102	30% higher	330% higher	90% higher	50% higher	220% higher
Cost of energy usage (\$/year) ³	-	\$727	2% higher	12% higher	6% higher	3% higher	7% higher

Construction

Effective Filtration Area (ft ²)	Pall LH002	3.7	3.6	3.5	2.9	3.1	3.52
Dirt holding capacity (DHC), (Retained) grams	ISO 16889 (Retained)	39.6	39.6	37.7	43.6	40.9	41.1

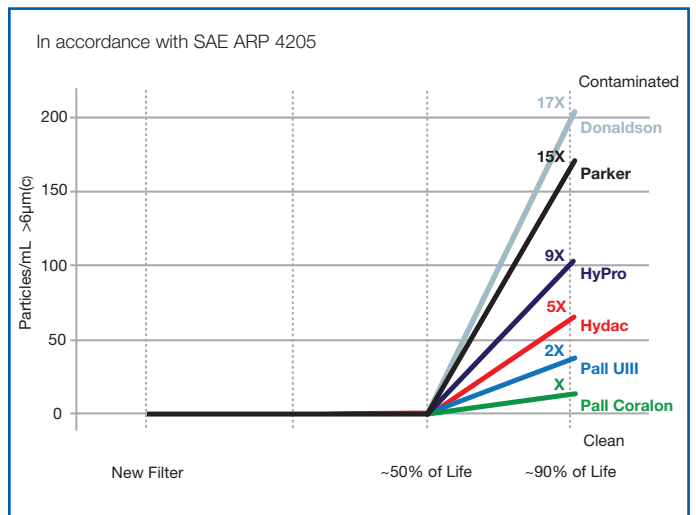
Notes

- Based on the number of >6μm(c) particles in the fluid at end of service life
- Measured @ 35 gpm in 32cSt fluid
- Calculation of energy consumed to drive flow through the filter based on element dirt loading curve, assuming equal service life and energy cost rate @ 0.191 US\$/kWh

* Performance data for competitor filter elements are from one element tested per P/N, and may not be representative of typical performance.

= best performer

A critical measure of a filter's performance is its ability to sustain fluid cleanliness throughout its service life. This graph compares a Coralon 7μm(c) rated filter to an Ultipor III and competitors' products with equivalent ratings. While all filters provide good fluid cleanliness early in service life, **only Coralon filters produce sustained fluid cleanliness over the life of the filter.**



Test Procedures

Manufacturer's rating: Filtration rating provided by the manufacturer. Filter elements are usually rated according to the ISO16889 standard. While this standard does not specify any guidelines for nomenclature of filter elements, many filter manufacturers publish filtration performance ratios ('Beta values') for their filter elements (e.g., $\beta = 75$, $\beta = 200$, or $\beta = 1000$) at a $\mu\text{m}(c)$ (ISO 11171) or μm (ISO 4402) particle size and specify this in their part numbers and product brochures accordingly. If a filtration ratio is not provided, the manufacturer's rating is not meaningful.

When comparing filter elements one should do so at the same Beta value. Otherwise the filter rating could be misleading (e.g., a '5 μm ' filter element with a Beta value = 10 will not deliver the same filtration performance as a '5 μm ' filter element with a Beta value = 1000).

Beta (Filtration) Ratio (ISO 16889:2008 Multi-pass method for evaluating filtration performance of a filter element):

This standard specifies a test method to determine filtration performance under conditions that simulate recirculating (multi-pass) operating conditions, with continuous contaminant injection. The procedure measures filtration efficiency in terms of particle removal efficiency (β ratio) and dirt holding capacity.

A higher β rating (β ratio) for a given particle size range indicates higher particle removal efficiency for that size range.

Cyclic Stabilization Test (CST) Filter Rating (SAE ARP 4205): CST measures the fluid cleanliness achieved by a filter under cyclic flow and dirt loading conditions. The CST rating, reported as an ISO Cleanliness Code, is more representative of performance under actual field conditions. Since CST ratings are reported as filter's performance at the end of a filter's service life, the CST provides a good measure of the filter's performance consistency.

Generally, filters perform well at removing particles to low ISO cleanliness levels at the beginning of their service life. A lower end of service life ISO Code for the target particle size indicates that a filter controls contamination more consistently throughout its life. Studies have shown that keeping fluids cleaner throughout a filter's service life can reduce the mean time between failure (MTBF) for components in hydraulic and lube systems.

Fluid Cleanliness and performance consistency (particles per ml > 6 $\mu\text{m}(c)$)

"Fluid cleanliness and performance consistency" is the ability of a filter element to maintain its level of performance over the service life of the filter element.

Clean Pressure Drop (ISO 3968:2001 Evaluation of differential pressure versus flow characteristics): The procedure specifies the method of measuring the differential

pressure across a fluid filter element under various conditions of flow. Two standards of measurement are specified: class A - for accurate evaluation for reference purposes - requiring laboratory conditions; class B - for evaluation for general purposes - requiring test facilities less stringent than laboratory conditions. The present class for this evaluation was class A.

A lower differential pressure indicates lower energy consumption to pass a given volume of fluid across the filter.

Dirt Holding Capacity

Dirt holding capacity from the multi-pass test is often used as an indicator of filter service life. Unfortunately, dirt capacity alone is of little value in estimating filter service life or in relative service life of filter elements from different manufacturers. Realistic estimates and comparisons can be made only when test conditions, filter efficiency ratings, and details of field operating conditions where the filter will be applied are known. Coarser filters are typically expected to have a higher dirt holding capacity than finer filters.

Effective Cost of Filtration

Effective cost of filtration assesses the cost of using a filter in a system based on energy usage. For this analysis, the calculations assume that the competitor's filter delivers the same service life as the Coralon filter and that the competitor's filter has a customer price 50% of the Coralon filter.

Effective Filtration Area (Pall LH002): This procedure is used to measure the effective filtration area of filter cartridges. The area is calculated by measuring the length of the medium between the end caps of the filter element, the depth of the pleat and the number of pleats in the filter element, accounting for the side seal.

A filter element with a larger effective filtration area typically has more filtration medium and hence, a longer filter element service life.

Filter Element Construction and Medium Analysis: The filter element is dissected and the construction in terms of the filtration medium pack and core is evaluated. Optical and Scanning Electron Microscopes (SEM) are used to characterize the filtration medium and its construction. Organic fibers are characterized by Infrared Spectroscopy (FTIR).

A filter element designed with Stress-Resistant Technology filter medium typically will provide more consistent cleanliness under system stresses compared to a filter element with uniform pore construction. In addition, a filter designed with tapered pore construction typically has greater dirt holding capacity (at the same micron rating) compared to a filter with uniform pore construction. A filter element constructed with polymeric support meshes is environmentally friendlier and has more disposal options compared to a filter element containing metal support meshes.



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