

Use of hydrophobic HEPA filters may double time between aero-engine overhauls

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Alliance Pipeline's evaluation of hydrophobic high-efficiency particulate air filters, now in its fifth year, continues to support the company's confidence in the [W L Gore & Associates'](#) product. The integrated Canadian/US high-pressure natural-gas transmission system had more than 500,000 hours of Gore HEPA experience at the time of the WTUI 25th anniversary meeting in Long Beach, Mar 15-18, 2015.

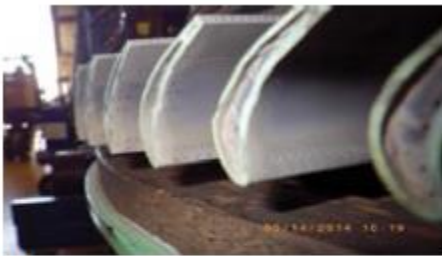
Alliance Pipeline's Rob McMahon and his company have generously shared the results of the long-term evaluation program with [Western Turbine Users](#) and CCJ readers annually. Coverage began in 2011, a year after HEPA filters were installed on the LM2500+G4 serving the Windfall pumping station at the start of the Alliance system and a midstream LM2500 at Kerrobert in west-central Saskatchewan. In 2012, the company equipped its entire fleet with Gore filters.



1. LM2500 first-stage nozzles have operated for 43,000 hours; the last 18,000 hours the engine was protected by hydrophobic HEPA filters. Cooling ports in the leading edge (left) are clear and there are no burn marks on the airfoils. Trailing edges at right are clean and exhibit no erosion, cracking, or platform deformation

McMahon was scheduled to make one of the six special technical presentations on Tuesday afternoon of the Western Turbine meeting to update users on the last year's results but had to cancel at the last moment. Co-author Ryder Pingry of Gore handled the assignment. The first half of the presentation, discussing the HEPA value proposition and the pipeline's early experience with the Gore filters, is summarized in [articles published previously by CCJ ONsite](#).

Highlights, recent history. The filters installed on the Windfall G4 in April 2010 were changed out in November 2013—as a precaution. Some delta-p spiking had occurred and not having first-hand experience on how HEPA filters fail, Alliance erred on the side of caution going into the winter peak run season. Interestingly, this was the only engine in the fleet using HEPA filters without coalescer wraps and the only one reported as experiencing delta-p spiking. The replacement filters have coalescer wraps. Pingry said the original Kerrobert filters would be replaced this year.



2. First-stage rotating blades show some heat erosion, but tip caps still are in good condition. Experts recommend a shop visit when heat erosion gets close to, or into, the cooling holes

The last third of the McMahon/Pingry presentation focused on a hot-section maintenance-extension experiment involving Alliance Pipeline's Unit 671059 and included a summary of the company's HEPA experience to date. This well-traveled LM2500 began its career at the Manchester compressor station near the delivery end of the pipeline.

The engine was removed from Manchester when its No. 4 bearing failed. After repairs, the unit was installed at Fairmount, three compressor stations upstream. It operated there until the second-stage high-pressure-compressor blade issue that affected the fleet dictated its removal. At this point the LM2500 had operated for 25,000 hours with standard filters.

Important to note is that the hot section was inspected during both shop visits for repairs, but never touched. The unit was reinstalled at Olivia, one station downstream from Fairmount, in 2012 but with the HEPA filters being deployed fleet-wide. The goal was to see if extending the maintenance interval beyond 25,000 hours would have any adverse effects on the unit and its performance.

Engine 671059 was sent to a depot in May 2014 for its 25,000-hr overhaul—at 43,000 hours. The very positive results are evident in Figs 1-4. First question many experienced users likely would ask: If the

engine ran 25,000 hours without HEPA filters, where did the fouling and/or water-wash residue from that period go? The assumption is that it burned off during the last 18,000 hours; no more fouling was added during this period because of the HEPA filters.



3. Second-stage nozzles look almost new—leading edges at left, trailing edges at right

Engine experts agreed that the hardware from this hot section (43,000 hours) looks similar to that for an engine after 25,000 service hours. The takeaway for owner is obvious: There doesn't seem to be a reason why the typical hot-section exchange at 25,000 hours couldn't be extended to 50,000 hours—as long as Alliance Pipeline's operational profile remains the same.



4. Looking at the tip and tip cap of this second-stage rotating blade you might think it new, certainly not an airfoil with 43,000 hours of service

Payback. McMahon's slides indicated the short-term benefits of HEPA filters include virtually no degradation in compressor efficiency and shaft power over the run period, and better heat rate. The use of hydrophobic HEPA filters saves Alliance Pipeline considerable resources. The environment surrounding these compressor drivers dictated water washing each spring, summer, and fall pre-HEPA. Annually, engine

washing took more than 1000 man-hours and consumed more than 2250 gal of demineralized water and more than 20 gal of soap, which required disposal in an environmentally acceptable manner.

Long term, HEPA filters save big bucks for Alliance. McMahon figures the ability to operate its engines for six years between overhauls reduces expenses in the neighborhood of eight figures. Hot parts last longer because they run cooler.