

CASE STUDY

Monitoring Cutting Fluid Health and Tramp-Oil Ingression in CNC Machining

Multi-parameter cutting fluid condition monitoring with FluidInspectIR® BenchPro at a Honeywell Aerospace CNC machining facility, Chihuahua, Mexico

Spectrolytic FluidInspectIR® BenchPro is deployed across the CNC machining floor to test the condition of the neat oil cutting fluids used in metal cutting and grinding operations. Cutting fluids degrade in service through oxidation, water dilution, additive depletion and, critically, contamination by tramp hydraulic and slideway oils that leak from the machine tools themselves. Left undetected, this degradation and cross-contamination shortens fluid life, increases tool wear, and can affect surface finish and part quality.

This case study describes how BenchPro is used to quantify fluid condition across multiple parameters and to detect tramp-oil ingression that conventional fluid checks cannot see.

5 Metrics

Water, oxidation, KV40C,
TAN & particle count

Minutes

At-line result,
no external lab

Tramp-Oil ID

Detects hydraulic & slideway
oil ingression

The Challenge

Honeywell's CNC machining operation in Chihuahua runs a large fleet of turning, milling and grinding centres, each with its own cutting fluid sump. Cutting fluid condition had traditionally been assessed on a periodic sampling schedule using only a limited number of key parameters such as Viscosity.

- Degradation (oxidation, water dilution, acid build-up) between sampling rounds went undetected until it affected tool life, surface finish, or fluid odour/stability
- Hydraulic and slideway (way) lubricant leaking into cutting fluid sumps is a common failure mode on CNC machines, but tramp-oil ingression is not visible in standard bulk fluid tests
- No fast, at-line way to confirm fluid condition and cross-contamination at the point of use

The Solution

Spectrolytic FluidInspectIR® BenchPro provides rapid, at-line multi-parameter analysis of the cutting fluids in use across the machining floor, using a bench-mounted sensor unit connected directly to Honeywell's own condition-monitoring workflow. A single sample measurement quantifies:

- Water content
- Oxidation
- Kinematic viscosity at 40°C (KV40C)
- Total Acid Number (TAN)
- Particle count, per ASTM D4406 optical particle counting

The key innovation is in how the full sensor response is used, not just the individual bulk parameters above. Spectrolytic developed proprietary algorithms that use the combined sensor responses to detect and quantify the **ingression of hydraulic and slideway oils into each cutting fluid** — a form of cross-contamination that is essentially invisible to conventional, single-parameter fluid checks, but which BenchPro can flag and quantify directly from the same measurement.

This turns a single, minutes-long bench measurement into both a fluid-health check and a machine-tool health check.

Implementation

- Installation of a FluidInspectIR® BenchPro bench unit for at-line testing of the cutting fluid grades in routine use across the CNC machining floor
- Development of calibration models for water, oxidation, KV40C, TAN and ASTM D4406 particle count
- Development and validation of dedicated algorithms to detect and quantify hydraulic-oil and slideway-oil ingression, using reference-blended and field samples
- Training Honeywell technicians to run routine sampling and interpret results directly against clear normal/abnormal thresholds
- Integration into a simple, standardised results workflow, giving operators an immediate accept/investigate decision at the machine

Results

The deployment delivered clear, measurable outcomes:

- **Rapid, at-line testing** of five key condition parameters without external lab turnaround
- Early detection of hydraulic and slideway oil ingression before it affected fluid performance
- Consistent, standardised accept/investigate decisions across machines and shifts
- A preventive, condition-based approach to cutting fluid management, in place of fixed-interval sampling and reactive changeouts
- **Approximately one actionable event per month** — typically early tramp-oil ingression or fluid degradation — flagged early enough for preventive action

Next Phase: Expanding the Measurement Portfolio

Building on these results, Honeywell is now adding further oils and applications to the BenchPro measurement portfolio, beyond the cutting fluids covered in the initial deployment. Because the same bench unit, sampling routine and accept/investigate workflow are used, each new application extends early-detection coverage across more of the site.

- **More fluids monitored** means more events caught before they escalate into downtime, fluid changeouts or quality issues
- **Every additional event caught** adds an estimated USD 3,200–15,700 in avoided costs (see Estimated Financial Impact)
- **No additional instrument required** — each new application runs on the existing BenchPro unit, so the return on the original investment grows as coverage expands

USE CASE — AEROSPACE CNC MACHINING: CUTTING FLUID HEALTH & TRAMP-OIL INGRESSION



FluidInspectIR® BenchPro in Workflow at Honeywell

Operational Impact

- Rapid, at-line screening of cutting fluids across the machining floor
- Early detection of tramp hydraulic and slideway oil contamination, invisible to conventional fluid checks
- Protection of machine tools and product quality by reducing the risk of fluid-related process issues
- Reduced dependence on external laboratory turnaround for routine decisions
- Standardised, repeatable fluid-condition decisions across machines, shifts and technicians
- A preventive maintenance signal for machine-tool hydraulic and slideway lubrication systems

Key Insight

“BenchPro has not only contributed to significant savings in cutting fluid consumption, but it has also proven to be an excellent preventive tool. By helping us monitor fluid condition, it supports the protection of both our manufacturing equipment and the quality of the products we produce, reducing the risk of potential damage and process-related issues.”

Osiris Angelica Gamez | Technical Field Engineer, Project Lead — Honeywell Aerospace, Chihuahua

FluidInspectIR® BenchPro provides the actionable, quantitative data needed to catch cutting fluid degradation and cross-contamination early — turning fluid condition monitoring from a reactive, lab-dependent task into a fast, preventive check that protects both the fluid and the machine tool it runs in.

Estimated Financial Impact

A missed event typically means unplanned downtime, a premature sump changeout, extra tool wear and, in some cases, scrapped parts or machine-tool damage. Applying typical aerospace machining costs to around 12 events per year at a single site:

Cost of a missed event (USD)	Conservative	Typical	High
Unplanned machine downtime (8–24 h)	1,200	3,200	6,000
Premature sump dump and recharge	1,500	3,000	5,000
Extra tool wear and breakage	500	1,500	3,000
Quality impact (scrap, rework, NCR/MRB)	0	5,000	25,000
Escalation to hydraulic / slideway damage	0	3,000	15,000
Per event	~3,200	~15,700	~54,000
Per year (≈12 events)	~40,000	~190,000	~650,000

Spectrolytic estimate based on industry-typical aerospace machining costs; not Honeywell financial data. Quality and machine-damage figures in the typical column are expected values, as not every event would have escalated.

Estimated Return on Investment

Against a BenchPro investment of around USD 30,000, cutting-fluid monitoring alone pays back the system in under a year on conservative assumptions, and in about two months on typical ones:

Return on investment (USD)	Conservative	Typical
BenchPro investment	\$30,000	\$30,000
Annual avoided cost (≈12 events)	~\$40,000	~\$190,000
Payback period	~9 months	~2 months
First-year ROI	~33%	~530%
Three-year ROI	~300%	~1,800%

This covers cutting fluids only; as further oils and applications are added to the same instrument, more events are caught and ROI rises further.

Assumes a one-off investment of USD 30,000. Excludes running costs such as technician time and consumables. ROI = (cumulative avoided cost – investment) ÷ investment.

Conclusion

Spectrolytic FluidInspectIR® BenchPro enables aerospace manufacturers such as Honeywell to move beyond periodic, lab-dependent fluid sampling and implement fast, quantitative, at-line monitoring of cutting fluid condition — including cross-contamination from hydraulic and slideway oils that conventional testing cannot see.

The result is a measurable combination of **reduced cutting fluid consumption, protected machine tools, and fewer process-related quality issues** — supported by real, actionable analytical data.

When cutting fluid health matters, at-line verification is no longer simply a laboratory function — it is a preventive, cost-saving operational advantage.

Interested in understanding how this can be applied within your operations?

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