


# Jacobs “Oil Pharmacy” helps transition Kennedy launch facility into the 21st Century

**An Award-Winning,  
DIY Success Story  
at the Home of the  
U.S. Space Program**

Jacobs Engineering Group, Inc. is one of the world’s largest and most diverse providers of technical, professional and engineering consulting services, including all aspects of a physical facility’s engineering, operations, and maintenance.

As the primary contractor for NASA’s Test and Operations Support Contract (TOSC) at Kennedy Space Center (KSC) in Florida, Jacobs is responsible for overall management and implementation of ground systems capabilities, flight hardware processing, and launch operations. This work supports NASA’s International Space Station, Exploration Ground Systems, Space Launch System, Orion Multi-Purpose Crew Vehicle, and Launch Services Programs.

In 2017, Jacobs earned the International Council for Machinery Lubrication’s (ICML) Augustus H. Gill Award for



Oil Analysis Excellence on the TOSC contract at KSC. In an impressive display of resourcefulness, Jacobs developed a centralized oil analysis program entirely on its own, without hiring professional consultants, choosing instead to capitalize on independent training and ICML certifications. The resulting program and facility are jointly known as the TOSC Oil Pharmacy, and its story reflects a DIY approach to excellence.

### Oil Pharmacy Beginnings

Today, the Jacobs Maintenance & Reliability (M&R) Group at KSC is a world-class operation with leading-edge lubrication and oil analysis practices that utilize precision lab equipment and certified personnel to provide on-demand results for real-time analysis and decision making. Since 2013, eight TOSC engineers and technicians have earned MLT-I and/or MLA-I certifications through ICML, and six secured their MLA-II certifications during summer 2018.

In early 2013, TOSC was awarded to Jacobs to help KSC transition to a 21st-century launch facility that could process various spacecraft for both private and government entities. The TOSC management team had experienced the benefits of a comprehensive oil analysis program on a separate Jacobs contract with another client in the aerospace industry. While assessing the TOSC infrastructure and procedures available to them, Jacobs readily concluded it would be beneficial to implement a similar program at Kennedy, as well.

TOSC personnel anticipated that some simple changes would not only make their jobs easier but would also improve efficiency and machine maintainability. A condition-based monitoring (CBM) program was already established and had achieved success within engineering groups supporting the

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Shuttle Program. The Jacobs team decided that its new oil analysis program would build on that effort.

Jacobs envisioned improvements to the way lubricants were received, stored, transported, tested, and analyzed, while anticipating that implementing best practices would align to all customers' needs. However, some system engineers were skeptical of the value to be gained by such a program, expressing concern about kitting, delivery changes, and whether test results would really depict an accurate health of the system. Jacobs knew that oil analysis would provide the necessary insight on all TOSC assets to optimize the maintenance program of the Ground

Support Equipment, and that champions would need to be identified to make it happen.


Therefore, Jacobs management selected two engineers and two technicians to form the M&R Group, and they started to work on an implementation plan. Without the need for an outside consultant, they opted to develop everything in-house by seeking training, attending conferences, acquiring front-line user feedback, and studying resources in order to educate themselves and adapt what they were learning to their specific needs and priorities.

### How It Works

The M&R Group named its new program the



*The Jacobs oil analysis program at Kennedy Space Center earned the 2017 Augustus H. Gill Award, presented by ICML Executive Director Leslie Fish (center) at Reliable Plant 2018. Reliability Engineer Sean Hollis, MLA-II (right), accepted the award on behalf of the Jacobs TOSC team, accompanied by Jacobs Aerospace Engineering Technician Jose "Joe" Atencio, MLA-II (left).*



*“ICML certification ensured that team members could expand their knowledge and continue improvements in new ways.”*

Oil Pharmacy because it established an easy, accessible, one-stop-shop offering solutions for just about every ailment connected to proper storage practices, lubricant consolidation, distribution, testing, analysis, and employee training.

Within the first two years, the team executed changes involving matters of storage and distribution, including inventory consolidation, air conditioned co-location, procedural documentation, and the introduction of lubrication codes. The team piloted its program with one group of system engineers—the Cranes, Doors, and Platforms Group—with the intention of expanding to other groups as new procedures were validated. Once the system engineers witnessed the insights provided by oil analysis, and once they realized they were receiving cleaner lubricants more quickly and with greater confidence in their suitability, they became advocates of the program. The development of the program was further validated as ICML certifications were introduced in 2016.

A major component of the Oil Pharmacy is the oil analysis lab. Designed in-house and based on best practices, the lab is conveniently co-located with the storage area and is equipped to diagnose fully the health of lubricants and assets. The Oil Pharmacy lab receives oil samples from all TOSC system engineering groups requiring machine lubrication, analyzes each lubricant for wear, contamination, and chemistry composition, and then provides reports to the system engineers with recommendations on how to act on the results. In addition, the lab analyzes oils upstream of service: newly arrived from a supplier, sitting in storage for other contracts, or upon delivery to large, critical machines.

Oil samples are collected in new, clean, compatible containers with proper labeling. All technicians have been trained through the Oil Pharmacy on how to take proper samples from the specific hardware configurations where they work.

Analysis employs a combination of particle counting (ISO codes), elemental spectroscopy (individual metals in parts per million), and wear density (wear particle concentration, percent ferrous, micrograms per ml, wear index, etc.) to ensure all large and small particles are recognized.

The lab's testing equipment was physically arranged to accommodate frequency of use. Reflecting the DIY nature of the Oil Pharmacy's growth, all lab equipment was selected for purchase based on self-guided research, vendor tutorials, accuracy preferences, and ease-of-use suggestions gleaned at conferences. All assets were

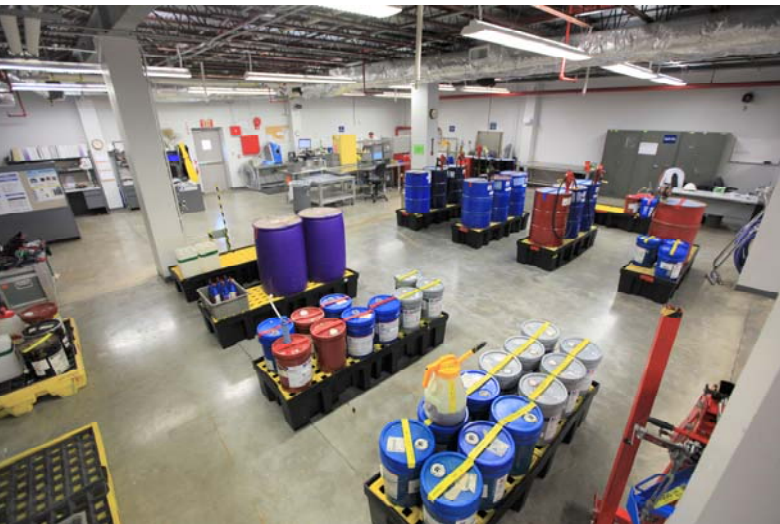
loaded into Emerson's OilView software, with limits applied consensually by system engineers, OEM direction, and drawing requirements. The team uses Maximo to track asset hierarchy, baseline asset information, condition assessments, labor time, and material cost, along with details on oil sampling routes, grease caddy inspections, etc.

Jacobs M&R Group runs the oil analysis program in conjunction with a broader reliability team that includes vibration analysis, thermography, and other condition monitoring technologies and tactics.

"We recognize that it takes a suite of tools to get the job done," says Sean Hollis, MLA-II, Jacobs TOSC Reliability Engineer. "Routine oil analysis and static motor analysis are performed independently, but in all other maintenance and troubleshooting situations, other technologies are utilized to corroborate findings as necessary."

### Elements of Success

It is worth noting that the overall success of Jacobs' program was buoyed by these key elements:



*The full TOSC Oil Pharmacy showing the lab and storage best practices, emphasizing Six Sigma, secondary containment, and color coding.*

**LUBRICATION MANUAL:** The Jacobs team collected and documented all starting data from relevant KSC shops and made modifications as they validated new procedures, drew new schematics, and established lubrication codes. After managing this information briefly in standard office documents and spreadsheets, Jacobs compiled all information into a single, controlled document with formalized revision procedures. This “lubrication manual” has undergone three revisions since 2015, and it is readily available on the company intranet.

**MANAGEMENT SUPPORT:** Jacobs management presented the Oil Pharmacy’s benefits to system engineer groups in monthly meetings, in addition to visiting


shops and joining team meetings as the program matured.

**ICML CERTIFICATIONS:** Because the team did not utilize an outside consultant service, preferring instead to become their own subject matter experts, they knew they would eventually require some training and certification to take the Oil Pharmacy to its next level of optimization, to move beyond the “low-hanging fruit” opportunities.

The M&R Group’s implementation plan had always included the eventual procurement of funds for training and certification. By 2016, six personnel had achieved MLT-I certification, following formal training by Ken Kizer of Lubrication Training & Consulting (LTC), and several practitioners followed up with MLA-I certification in 2017.



*The TOSC Oil Pharmacy Lab emphasizes Six Sigma best practices and an assembly line for oil analysis.*



In 2018, six TOSC personnel earned MLA-II certification.

ICML certification ensured that team members could expand their knowledge and continue improvements in new ways, e.g., adding greases to the program. Certified personnel also perform on-the-job training for system engineers and technicians outside the M&R Group.

“The education provided us with the knowledge and the tools to expand the program, and provides additional credibility with the System Engineers and our NASA customer,” says Hollis.

MLT-I certification is now required for all new hires, and MLA-I is required for anyone regularly involved with oil analysis. Routine training for certification upgrades is now budgeted yearly.

### The CBM Solution

The procedural changes implemented through the Oil Pharmacy have enabled the M&R Group to switch from a time-based maintenance schedule to a proactive CBM schedule. This conversion has significantly optimized the TOSC maintenance program.

Hollis has noted additional positive achievements of the Oil Pharmacy, all of which indicate that management’s anticipation of streamlining machine efficiency, control, and reliability was well-placed:

- Fewer mix of oil brands in use
- Drastically lower volume of oil in storage
- Significantly lower maintenance costs
- Greater confidence among system engineers that proper lubricants are in use
- More precise and accurate monitoring of machine health
- Fewer spill prevention, control, & countermeasure (SPCC) sites
- Drastic reduction of disposal costs through the use of a re-refiner
- Stronger brain trust with multiple ICML-certified practitioners on crew

The Oil Pharmacy has made it possible for analytical findings to be used in data-driven, cost-cutting, proactive decisions on the planning and scheduling of maintenance work orders.

Hollis notes, “Oil analysis has provided the largest return on investment and, therefore, has become the example of the reliability culture at Kennedy Space Center on TOSC.”

**ICML**

