



ENSURING OPTIMAL PERFORMANCE & LONGEVITY IN HYDRAULIC CYLINDERS

COMPREHENSIVE TESTING, SEAL QUALITY, AND CONTAMINATION CONTROL

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WHY HYDROSTATIC TESTING, SEAL QUALITY, CONTAMINATION CONTROL, AND PREVENTIVE MAINTENANCE REMAIN THE FOUNDATION OF RELIABLE CYLINDER PERFORMANCE.

Hydraulic cylinders are among the most important components in industrial machinery, quietly converting fluid power into the force and motion that move excavators, presses, aircraft systems, farm equipment, and mining machines. Their work is often taken for granted until something goes wrong, e.g., a leak, a loss of pressure, or a failure that stops production and sends maintenance teams scrambling. Cylinder performance is shaped long before the cylinder reaches service, and it is preserved only when testing, cleanliness, sealing, storage, and maintenance are treated as part of a single system rather than as separate tasks.

The challenge is straightforward: hydraulic cylinders are expected to perform under extreme pressure, in contaminated environments, and often for long service intervals without interruption. That expectation makes quality control essential. Failures rarely happen for a single reason. Instead, they usually begin with small issues, including dirty fluid, a weak seal, poor storage, or a skipped inspection. These

concerns grow into major problems over time. The best cylinder programs are designed to stop that chain before it starts.

TESTING UNDER PRESSURE

Hydrostatic testing remains one of the most important tools for verifying cylinder integrity. By pressurizing a cylinder beyond its normal operating range, manufacturers and maintenance teams can expose weaknesses that would otherwise remain hidden until the cylinder is in the field. The purpose is not simply to prove that a cylinder “works,” but to confirm that it can withstand demanding conditions without leakage, deformation, or structural failure.

In practice, hydrostatic testing is a disciplined process. The cylinder is mounted securely, filled with incompressible fluid, and gradually brought up to a pressure well above its operating level. Engineers then watch for leaks, visible distortion, and seal problems. If a cylinder cannot pass the test, it is repaired or reinforced before it ever reaches the customer. Standards such as ISO 10100 and SAE J1336 help define how these tests are performed and why they matter. For users, hydrostatic testing offers something more valuable than a pass-fail result. It establishes confidence. A cylinder that has already proven

its ability to endure extreme pressure is far less likely to surprise an operator later with premature failure.

CLEAN FLUID, LONGER LIFE

If testing proves strength, filtration preserves it. Contamination is one of the leading causes of hydraulic failure, and cylinders are especially vulnerable because abrasive particles attack seals, surfaces, and internal components over time. Even small amounts of dirt or debris can create wear that eventually shows up as leakage, pressure loss, or rough motion.

That is why fluid cleanliness is not an afterthought. Clean oil protects seals and pistons, reduces wear, and improves the overall efficiency of the system. Many manufacturers now treat filtration as part of the product itself, not just part of the machine. Using highly clean oil during testing and service reduces the chance that a cylinder will begin its life already exposed to damaging particles.

International cleanliness standards such as ISO 4406 give users a common language for measuring contamination, while offline filtration and kidney-loop systems help keep fluid within acceptable limits. In high-performance applications, clean oil is not a luxury. It is one of the simplest and most effective ways to extend service life.

SEALS DO THE QUIET WORK

Cylinder seals rarely get attention until they fail, but they are central to performance. Seals hold pressure, keep fluid where it belongs, and prevent outside contamination from entering the system. When seal quality is poor, the consequences are immediate: leakage, reduced efficiency, heat buildup, and more frequent maintenance.

Material choice matters. High-quality seals made from compatible compounds such as Viton, PTFE, or NBR can better withstand pressure, temperature, and chemical exposure. Low-friction designs also reduce wear on rods and pistons. Just as important are dust wipers and rod seals that keep debris from entering the cylinder in the first place.

Seal selection should always reflect the application. A cylinder working in a dusty mining environment faces different risks than one operating in a controlled industrial setting. The best sealing systems are not just durable; they are matched to the conditions they will face.

STORAGE AND MAINTENANCE MATTER

A cylinder can be built well, tested thoroughly, and filled with clean fluid, and still fail early if it is stored or maintained poorly. Long-term storage can dry out seals, expose surfaces to corrosion, and create problems before the cylinder is even installed. Protective oil films, sealed storage, and periodic rotation help preserve seal integrity and prevent flat spots or deformation.

Preventive maintenance plays the same role once the cylinder is in service. Regular oil analysis, pressure checks, visual inspections, and water testing can reveal early warning signs before they lead to costly failures. Tools such as Karl Fischer testing and contamination monitoring help maintenance teams catch moisture and wear that are otherwise invisible. This kind of discipline pays off because cylinder failures are rarely cheap. They can damage connected equipment, halt production, and create cascading problems throughout a system. Maintenance is not just about keeping cylinders alive; it is about protecting the machine around them.

CONVENTIONAL VALVING STILL COUNTS

Although electronic controls garner industry attention, conventional hydraulic valves still have an important place in fluid power. These mechanically or manually operated valves remain

valuable because they are rugged, reliable, and able to function without electricity. In remote, hazardous, or power-sensitive environments, that simplicity is a major advantage.

Directional control valves, pressure control valves, flow control valves, and check valves continue to support heavy-duty machinery across industrial, mobile, and mining applications. Their broad tolerance for contamination also makes them practical where ultra-clean conditions are difficult to maintain. That said, even conventional valving benefits from proper filtration, compatible materials, and routine inspection.

THE LESSON IS FAMILIAR: RELIABILITY IS NOT ACCIDENTAL. IT COMES FROM MATCHING THE RIGHT COMPONENTS TO THE RIGHT ENVIRONMENT AND SUPPORTING THEM WITH THE RIGHT MAINTENANCE HABITS.

THE BIGGER PICTURE

The most reliable hydraulic cylinders are rarely the result of one breakthrough. They are the product of several good decisions made consistently: testing at the right pressure, keeping fluid clean, selecting seals carefully, storing equipment properly, and maintaining it before problems escalate. Conventional valving follows the same logic. Simplicity and ruggedness only last when they are supported by sound engineering and disciplined care.

For hydraulic users, the takeaway is clear. Cylinder integrity is not a single event; it is a lifecycle strategy. The systems that perform best are the ones that are built, tested, operated, and maintained with the same standard of care from beginning to end. ●



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