ARCHOIL AR9100 FRICTION MODIFIER

Technical Information, Test Results & Additional Benefits

Are oil additives necessary?

Motor oil is critical to the overall function of your engine and provides much more than just lubrication. Wear, sludge and varnish build-up, engine overheating and premature failure of components can all be prevented or managed by the flow of oil through your engine.

However, motor oil will not achieve all of this preventative maintenance by itself and this is where oil additives become important. You have most likely been using oil additives since you first owned a vehicle as most motor oil you can find in the store contains oil additives to carry out its essential functions, although usually not to the level necessary to extend the life of your engine and maintain performance.

While all engines will suffer from wear and tear over time, it is crucial to find the right oil additive for your vehicle in order to be proactive in reducing wear and corrosion on engine parts and maximize the life of your motor. Even for older engines, oil additives will slow down wear and clean the system, resulting in improved engine performance and fuel economy.

Oil additives will benefit vehicles of any age but if you have an older vehicle, high mileage or signs of performance loss, you should be considering using one at every oil change.

Archoil AR9100 Friction Modifier was developed for use in all diesel and gasoline engines to improve performance and protect engines, gearboxes and hydraulic systems. AR9100 utilizes nanoborate technology suspended in an ester complex to reduce friction and provide extreme pressure, wear and corrosion protection.

AR9100 also extends oil life and keeps components clean.

↓ The test results on the following pages demonstrate the benefits of adding AR9100 to your oil.

Anti-wear test results

The Four-Ball Wear Test results below demonstrate AR9100's anti-wear properties. Adding AR9100 to a branded lubricant reduced the average ball scar diameter by 0.337mm (43%).

The Falex Four-Ball Wear Tester determines the relative wear-preventive properties of lubricating fluids and greases in sliding and rolling applications. It is the only test machine proven through cooperative inter-laboratory testing to meet requirements of ASTM D2266 and D4172. The machine compares lubricants using the average size of the scar diameters worn on three, lubricant-covered, 1/2 inch diameter steel balls that are clamped together, with a fourth ball seated within the cavity. (eu.falex.com)

BRANDED LUBRICANT

TEST PARAMETERS	
Speed (rpm):	1200 (±50)
Temperature (°C):	75 (±1.7)
Load (kgf):	40 (±0.2)
Duration (min):	60 (±1.0)

TEST SPECIMENS	
Ball Material:	AISI-E52100
Hardness (HRc):	64-66
Grade:	25EP
Falex Lot No.	230
Falex TL No.	7043

TEST LUBRICANT	
Lubricant ID:	
Falex TL No.	7062

TEST RESULTS

WEAR DATA			
Ball Scar Diameter (mm)			
Axis	Ball 1	Ball 2	Ball 3
X	0.767	0.779	0.723
Y	0.773	0.806	0.830
AVERAGE BALL SCAR DIAMETER:			0.780

FRICTION DATA		
Time (min)	Friction (g)	CoF
0	150.7	0.064
15	238.7	0.101
30	212.9	0.091
45	190.8	0.810
60	194.1	0.082
AVERAGE CoF:		0.230

BRANDED LUBRICANT WITH AR9100

TEST PARAMETERS	
Speed (rpm):	1200 (±50)
Temperature (°C):	75 (±1.7)
Load (kgf):	40 (±0.2)
Duration (min):	60 (±1.0)

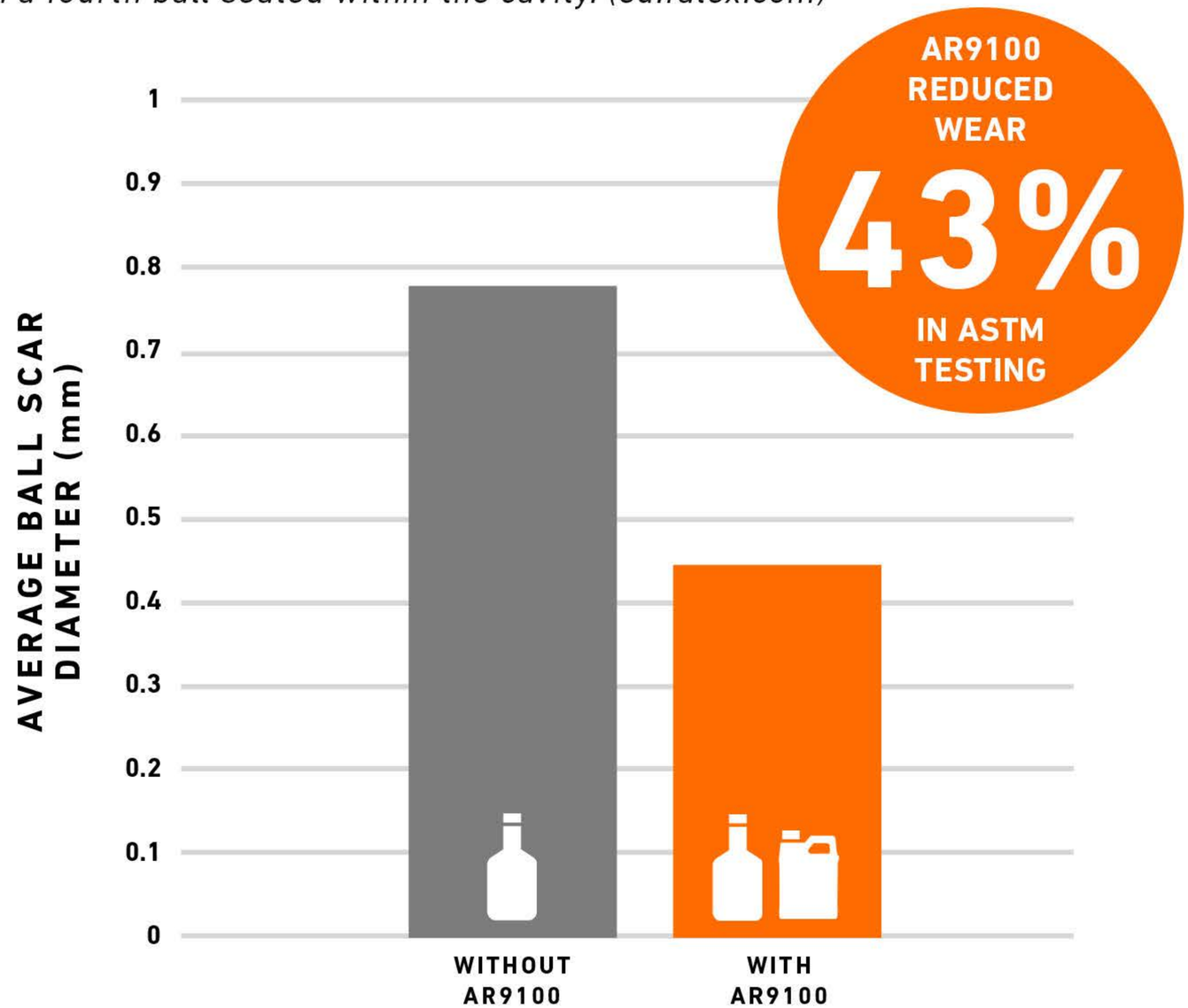
TEST SPECIMENS	
Ball Material:	AISI-E52100
Hardness (HRc):	64-66
Grade:	25EP
Falex Lot No.	230
Falex TL No.	7043

TEST LUBRICANT	
Lubricant ID:	w/Archoil AR9100
Falex TL No.	7063

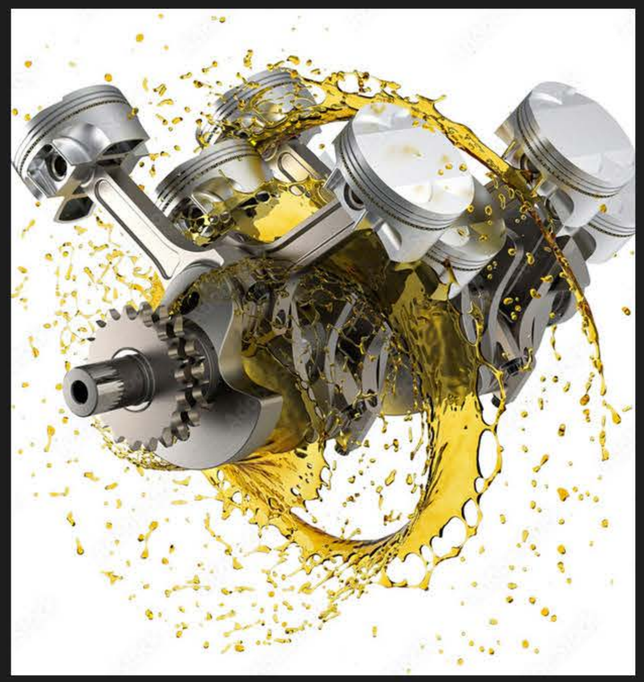
TEST RESULTS

WEAR DATA			
Ball Scar Diameter (mm)			
Axis	Ball 1	Ball 2	Ball 3
X	0.439	0.437	0.437
Y	0.448	0.441	0.455
AVERAGE BALL SCAR DIAMETER:			0.443

FRICTION DATA		
Time (min)	Friction (g)	CoF
0	153.6	0.065
15	212.9	0.090
30	171.6	0.073
45	168.4	0.071
60	183.4	0.078
AVERAGE CoF:		0.075



Reduce friction, wear, noise and heat



Friction can cause a number of problems in a vehicle engine. The most noticeable issues include:

- **Excess heat** - friction between moving parts generates heat, leading to increased wear and tear
- **Power loss** - friction can cause a loss of power in the engine, reducing efficiency and performance
- **Noise and vibration** - driving can be uncomfortable when friction causes noise and vibration
- **Poor fuel efficiency** - the engine has to work harder to overcome resistance caused by friction

Once added to oil, AR9100 Friction Modifier forms a solid boundary lubricating film on surfaces to provide outstanding extreme pressure and wear protection. This film is more resilient than the soft sacrificial films of zinc based anti-wear additives (ZDDP).

The nanoborate film stays on engine components during the oil cycle, meaning the engine is protected and not exposed to excessive wear during extreme operating conditions such as cold starts. Integral parts of the engine such as the camshafts, piston rings, bearings and valves are protected due to reduced friction between moving parts.

As nanoborate has a lower shear strength than the metal it bonds to, surface friction is reduced (CoF .037 @ 3,750 lbs in ATSM D3233 Falex test) which leads to increased power, improved fuel economy and less heat generated through friction. Noise and vibration is reduced and blow-by is also reduced thanks to a better seal on the piston rings.

Extreme pressure test results

The Pin and Vee Test results below demonstrate AR9100's extreme pressure capabilities. Adding AR9100 to a branded lubricant dramatically extended the load-carrying ability to over 4,500 lb.

The Falex Pin and Vee Block Machine is used to evaluate wear, friction, and extreme pressure properties of lubricants, coatings, and materials in a multitude of applications. The equipment rotates a 1/4 inch diameter test pin against two 1/2 inch diameter vee blocks. A four-line contact region is established as load is applied through a mechanical gage by a ratchet wheel and an eccentric arm. (eu.falex.com)

BRANDED LUBRICANT

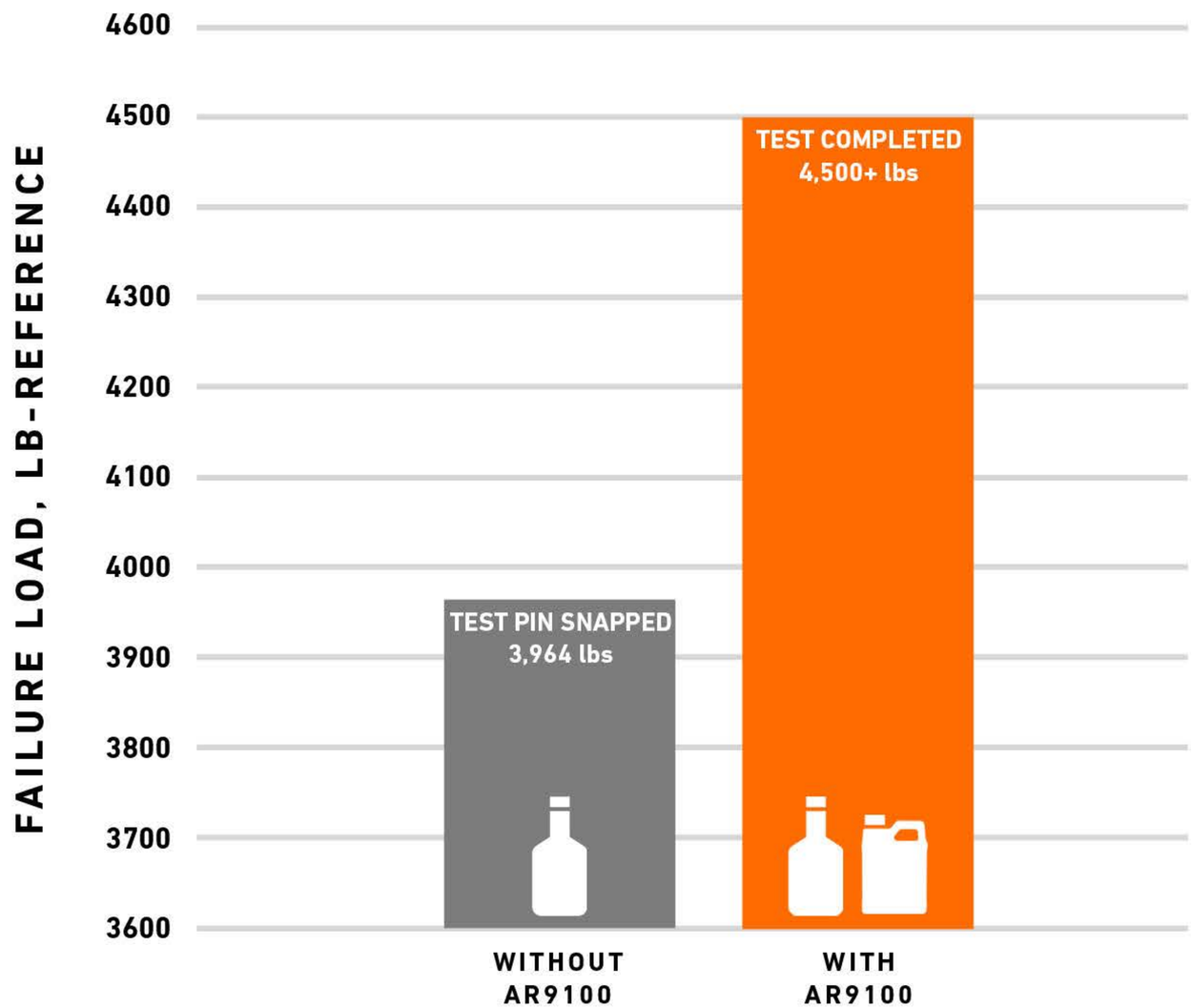
TEST RESULTS				
Load (lb)	Failure Load	Duration (min)	Torque (in-lb)	Temperature (°C)
300		0	10.1	48.7
300		5	7.2	70.8
500		1	9.7	72.9
750		1	14.3	76.1
1000		1	15.3	79.9
1250		1	18.6	84.2
1500		1	19.9	87.9
1750		1	21.4	91.6
2000		1	23.8	95.0
2250		1	23.8	98.8
2500		1	25.6	102.3
2750		1	24.5	105.0
3000		1	26.1	107.7
3250		1	26.5	110.7
3500		1	28.8	114.1
3750		1	30.3	117.5
4000	**3964**	1	74.9	121.5
4250		1		
4500		1		

COMMENTS: The test pin snapped at 3964 lb load.

BRANDED LUBRICANT WITH AR9100

TEST RESULTS				
Load (lb)	Failure Load	Duration (min)	Torque (in-lb)	Temperature (°C)
300		0	8.3	50.7
300		5	8.1	70.1
500		1	10.3	72.3
750		1	14.2	75.9
1000		1	16.1	80.0
1250		1	17.3	84.0
1500		1	20.6	88.2
1750		1	21.5	92.6
2000		1	21.9	96.5
2250		1	22.7	100.6
2500		1	23.3	103.8
2750		1	24.1	107.2
3000		1	25.9	110.9
3250		1	25.4	114.3
3500		1	26.8	117.5
3750		1	27.0	120.4
4000		1	28.3	123.1
4250		1	28.1	126.3
4500	**4500+**	1	31.5	129.5

COMMENTS: The test completed successfully.



Remove harmful sludge and varnish deposits

Sludge and varnish are both types of contaminants that can build up in the oil system of a vehicle. Sludge is a thick, sticky substance, often found in areas with high heat and low oil flow. Varnish is a thin, hard film that can form on the inside of the engine. These contaminants can clog oil passages, reduce the effectiveness of the oil and cause damage to the engine. There can be a number of negative effects on the performance and health of the vehicle. The following areas are likely to be affected by deposits:

- **Mechanical seals**
- **Oil filters**
- **Mechanical surfaces**
- **Thrust-bearing pads**
- **Valves**

Short trip driving, poor maintenance, poor quality oil, high temperatures, contaminated fuel and cooling system problems are common causes for sludge and varnish which can cause a number of problems if they build up in the oil system, leading to reduced engine performance, increased fuel consumption and decreased engine lifespan. In severe cases, they can cause engine failure.

The organic ester package in AR9100 Friction Modifier's formulation dissolves existing deposits safely to restore power, performance, fuel economy and protect the engine from further damage and premature failure.

AR9100 also contains antioxidants which reduce the rate of oil breakdown and help to prevent the oil from oxidizing, which can lead to the formation of sludge and varnish. Removing contaminants with AR9100 also reduces engine heat and noise.

Injector Stiction - Power Stroke & other engines

AR9100 Friction Modifier solves misfire and cold start issues in 6.0L & 7.3L Power Strokes. Other engines, such as the Navistar VT365, use the same HEUI injection system which can suffer from static friction - often called 'stiction'.

Deposits and wear in HEUI injectors cause them to become stuck, preventing the injectors from firing.

The problem most commonly occurs when a cold engine is started with symptoms getting worse in colder weather. On start-up, uneven engine idling, cylinder misfiring, and an engine non-responsive to acceleration are most recognizable. However, fuel injector stiction symptoms, including cylinder misfires, can continue even after the engine warms up with rough idling, bucking, smoking and reduced power.

Engine oil is exposed to very high temperatures and pressures within the spool valve (poppet valve in 7.3L) of HEUI injectors. The oil degrades and forms deposits that cause excessive wear, which can prevent the injector from firing.

AR9100 removes deposits and forms a friction-reducing lubricating film on the bore of the spool valve. By removing deposits and reducing friction, AR9100 eliminates stiction issues.

Money back guarantee

Get your money back if AR9100 does not resolve stiction issues in your 6.0L or 7.3L Power Stroke within 100 miles of driving.

Extended oil cycles

Raising the Total Base Number (TBN) of oil can help extend the oil drain interval by increasing the oil's ability to neutralize acidic byproducts that are produced during the combustion process. The TBN of an oil is a measure of its reserve alkalinity, which is the amount of acid that the oil can neutralize over time. As the oil is used, it comes into contact with acidic byproducts that are produced during the combustion process, and the TBN helps to neutralize these acids, protecting the engine from corrosion and wear.

AR9100 typically extends oil drain intervals by raising the TBN of oil. AR9100 also improves the oxidative stability of engine oil, reducing the rate of degradation. Oil sampling should be used as a toll to determing if extended drain intervals are appropriate for your application.

Fuel with higher detergent content can also raise the TBN. Archoil's fuel treatments include concentrated detergent packages which can also raise the TBN by keeping combustion byproducts suspended in the oil, allowing them to be neutralized more effectively.

Other applications

AR9100 Friction Modifier can be used in hydraulic oil, power steering fluid, manual transmissions, gear oil, limited slip differentials and motorcycle wet clutches. If you have any questions about these applications or use of AR9100 in general, please email tech@archoil.com