105mm Howitzer Recoil Upgrade

CASE STUDY

The U.S. Army, Rock Island Arsenal, requested our help in solving performance and logistics issues associated with an antiquated chevron packing seal used on the M119 105mm Towed Howitzers. The chevron packing provided sealing between the open end of the recoil buffer cylinder and the buffer rod. The packing occasionally leaked upon installation, resulting in additional downtime and expense. In addition, the packing's limited availability made it difficult to obtain.

CHALLENGE

Because the rest of the gun's recoil mechanism was working smoothly, the U.S. Army required replacement seals that would drop into place without modifying any other components. The new system needed to provide for high-pressure sealing for the buffer rod during its high acceleration and must be able to withstand a wide range of temperature fluctuation. Some details of the M119A1's environment follow below:

- Operational Temperature Range: -50°F to 200°F (-46°C to 93°C)
- Hydraulic Fluid: MIL-PRF-6083 or MIL-PRF-46170
- Pressure Range: 0 psi to 3000 psi (2064 bar)
- Buffer Rod Stroke: 24 in. (61 cm) (approximately)

RECOMMENDATION

We recommended a thermoplastic seal carrier assembly with static and dynamic seals. The seal carrier, manufactured from Greene, Tweed's exclusive Arlon® 1555, consisted of an AGT® piston seal (1) to act as a static seal on the carrier's OD and a pair of tandem rod seals on its ID. An Ener-Cap® II HP (3) was selected for the pressure side while an AGT rod seal (4) was chosen as a secondary seal. Arlon 1555 provided strength and low friction qualities. The new carrier (2) will not only hold the seals in place but will also act as a bearing.

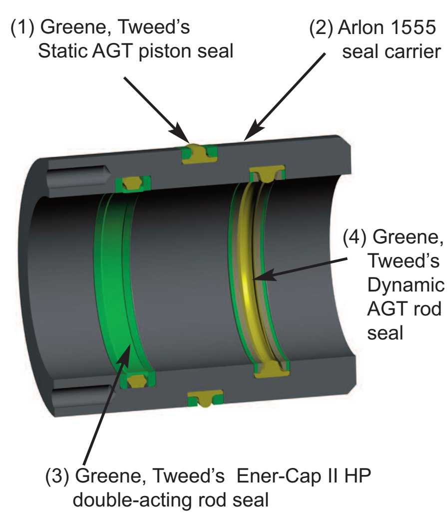
SOLUTION COMPONENTS

Ener-Cap II HP Rod Seal

Greene, Tweed's Ener-Cap II cap sealing system, a self-actuating, pressure-activated seal, offers improved geometric stability for low breakout, running friction and minimal leakage over an extended service life.

The Ener-Cap II consists of a wear-resistant PTFE sealing element and an advanced elastomeric energizer that provides optimum radial squeeze, evenly distributed radial loading and a high degree of seal stability throughout its effective life. Depending on the selected materials, the sealing system can perform in temperature ranges from 85°F to 450°F (-60°C to 260°C), with pressures up to 4000 psig (276 bar).

Thermoplastic Seal Carrier Assembly



LANCER SYSTEMS

AGT® Rod Seal/Piston Seal
Greene, Tweed's AGT ring handles many difficult sealing challenges—from landing gear and flight controls, to hydraulic acutator applications. A bi-directional rod or piston seal, the AGT ring offers an outstanding combination of easy installation, low leakage and long service life.

The AGT ring is constructed of high-grade elastomers and thermoplastics selected to withstand the toughest fluid and service conditions. Because of it's design, O-ring roll and spiral failure are no longer a problem. The AGT ring offers excellent sealability, broad fluid and temperature resistance, and an extended service life that goes beyond that of standard
O-ring seals.

Arlon® 1555 Seal Carrier
The seal carrier, constructed of Arlon® 1555, is ideally suited for dynamic applications where high pressures and high temperatures prevail. Arlon 1555 is a custom blend of carbon filled, lubricated polyetheretherketoone and can withstand temperatures -100°F to 532°F (-73°C to 278°C).

Arlon 1555 Typical Properties

Physical Properties	ASTM Method	Typical Value
Color		Black
Specific Gravity	D792	1.46
Hardness, Shore D, Points	D2240	87
Hardness, Rockwell M, Points	D785	98
Elongation, %	D638	2.2
Tensile Break Strength, psi	D638	21,200
Tensile 0.5% Secant Modulus, psi	D638	1,650,000
Compressive Strength @ Break, psi	D695	24,600
Deformation Under Load, %	D621	0.10
Flexural Strength, psi	D790	33,000
Flexural 0.5% Secant Modulus, psi	D790	1,400,000
Shear Strength, Axial, psi	D732	13,000
Shear Strength, Transverse, psi	D732	10,000
Heat Deflection Temperature @ 264 psi, ºF	D648	>600
Coefficient of Thermal Expansion < 300ºF, 10^{-6} in./(inºF)	D696	8
Coefficient of Thermal Expansion > 300ºF, 10^{-6} in./(inºF)	D696	17
Coefficient of Dynamic Friction, PV = 12,600 psi-ft/min	G77	0.17
Wear Factor, 10^{-10} in.3-min./(lb.-ft.-hr.)	G77	65

RESULTS

The new design exceeded the requirements set by the U.S. Army. The Arlon 1555 based carrier proved successful under the demanding conditions common to the M119A1. This success has propelled the U.S. Army to incorporate the new seal carrier and sealing system on to the recently completed M119A1 LASIP Block II improvement program. Because of this, the high-performance sealing system will now be on all M119A1s, allowing the U.S. army to spend less time fixing leaks and more time fully mission capable.

Lancer Systems is a world-class team of engineers and manufacturing experts committed to providing engineered lightweight and harsh environment solutions to our customers. We support our customers by developing and delivering innovative designs that enable them to effectively complete their missions.

Note: Properties of Arlon 1555 are anisotropic. The published properties, unless otherwise noted, are measured in the axial flow direction of molded test specimens. Strength and stiffness, therefore, are at a maximum, while elongation and thermal coefficient of expansion are at a minimum.

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