Spring Retainer Application Note

Racing Division of Anatech

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Carbon Raptor – Hard Carbon Coating

Overview of the Process:

Spring retainer wear decreases valve lift, which results in a gradual power decrease during a race. Excessive wear can be catastrophic, as the retainer weakens enough to break, and the valve drops into the cylinder. Carbon Raptor®, a hard carbon coating used successfully in many applications, has proven its value in preserving titanium valve spring retainers under race conditions.

Maintaining retainer integrity necessary under maximum performance conditions is critical when using parts that gall readily to mating surfaces. Carbon Raptor provides intake and exhaust retainer longevity in engines that exceed 10,000 rpm's over several hundred miles at up to 650 pounds of spring pressure without loss of spring retainer thickness.

Figure 1. Titanium intake valve spring retainers with two microns of Carbon Raptor, shown after the Homestead 400. Carbon Raptor is intact on the spring loading surfaces. Coating breakthrough and some wear occurred on the damper contact surface.

Figure 2. Titanium exhaust valve spring retainers with two microns of Carbon Raptor, shown after the Homestead 400. Breakthrough of the coating was seen on the outer spring flat, and with no loss of dimension. No damage to the Carbon Raptor coating occurred on the inner flat. Some wear occurred on the damper contact surface.

Spring Retainers

Higher spring pressures are needed for greater valve lift, and higher spring pressures increase the probability of excessive wear on the retainer. Use of titanium spring retainers to reduce valve train weight further increases the probability of wear due to the soft and gummy nature of titanium. Four microns of Carbon Raptor provides the needed protection to these critical surfaces without exceeding dimensional clearances. Spring retainers can, therefore, maintain their dimensions for the duration of the race.

Carbon Raptor is a smooth, low friction coating that facilitates free rotation between mating surfaces. The Carbon Raptor coated intake valve spring retainer shown in Figure 1 survived the Homestead 400 with no wear on the spring loading surfaces. The Carbon Raptor is intact, and there was no loss of dimension on the flats. Some wear was evident at the dampener contact surface, but thickness loss at these

locations was not sufficient to cause diminished performance on the track.

Carbon Raptor® coated exhaust valve spring retainers in Figure 2, also from the Homestead 400, show some wear of the Carbon Raptor coating on the outer spring loading surface, but no damage to the metal and no change in retainer dimensions. In this case, Carbon Raptor provided the insurance needed for the exhaust valve retainer to function throughout the race.

Tight fits between the retainer and the springs results in restricted relative rotation, and can produce repeated point loading on the spring load surfaces that may prematurely wear the coating. Breakthrough can occur under these conditions with some subsequent loss of Carbon Raptor.

The key to improved performance when using Carbon Raptor coated parts is manufacture and surface preparation of the mating parts to be coated. Spring surfaces need to be flat, radiused, deburred and polished where they contact the spring retainer. Mating surfaces need to be parallel, and a six microinch, or better, finish on the retainer surfaces is critical.

Valve Locks

When the inside diameter of the retainer and the valve locks are Carbon Raptor coated, parts disassemble quickly and easily for critical valve spring changes between rounds or practice, qualifying and the main event. Anatech has tailored its Carbon Raptor family of films for this demanding application. The inner, softer layer has been decreased somewhat in thickness, and the outer, harder layer has been increased in thickness to make a film that is four microns thick to withstand ever increasing spring pressures.

State-of-the-art electronic technology assures reliable consistency and reliability.

Unique Properties

A unique set of properties combines for this success:

High Hardness – Surface hardness is more than 35 percent greater than R_C 60 equivalent.

Low Friction – Testing demonstrated that Carbon Raptor reduces friction by more than 70 percent when compared to uncoated, similar steel components.

High Adhesion and Flexibility – Chemical and physical bonding to the pin and thin film flexibility ensure that Carbon Raptor will not delaminate or flake.

High Surface Conformance – Highly finished wrist pins retain their finish with Carbon Raptor, with no post-processing steps. Surface measurements on a polished surface with an average roughness (R_a) of 0.5 µin (microinches) increased by only 0.05 µin after Carbon Raptor was applied.

Heat Transfer – Unlike other coatings, Carbon Raptor is a good thermal conductor.

Conclusion:

Carbon Raptor coatings on high quality flat smooth surfaces extend the life of retainers in use and drives performance improvement by allowing valuable reductions in valve train weight. High quality parts make possible the highest quality Carbon Raptor coating, which yields the maximum possible increases in engine power without part degradation.

Proven Experience

Join the racers and engine builders who have used tens of thousands of Carbon Raptor coated wrist pins and are pulling ahead of the competition!

Carbon Raptor® – Successful on more than a dozen engine parts!

Demand Carbon Raptor for demanding conditions!

extremeion®
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