



Technical Bulletin

Issue Date: January 2008

extremeion®
Carbon Raptor® – Hard Carbon Coating

Application Note Subject: Titanium Intake valves

Customers and Applications:

NASCAR® and other endurance or longevity critical engines that use titanium valves.

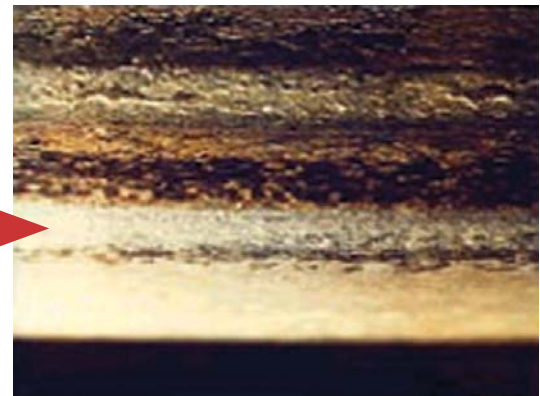
Overview: Identical intake valves, one coated with Carbon Raptor® and one coated by Diamonex, were analyzed at their seat surfaces after similar testing in a NASCAR engine. Scanning Electron Microscopy and X-Ray Photoelectron Spectroscopy (XPS) analyses were conducted to determine comparative performance.

Analyses:

Copper transfer: Carbon Raptor and Diamonex coated seat surfaces are presented below at 28 magnification. The wear surface with the Diamonex coating showed more copper color than the Carbon Raptor coating. The source of copper is the copper alloy insert in the cylinder head. XPS analysis verified that the Diamonex coated valve had twice the amount of copper as the Carbon Raptor coated valve. Also, the upper part of the seat surface with the Diamonex coating also has collected more debris than the Carbon Raptor coating.



Carbon Raptor seat surface



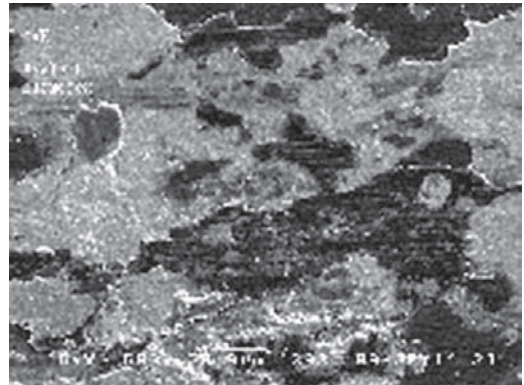
Diamonex shows greater copper buildup.

Carbon Raptor Results and Benefits: More contaminating materials from debris were deposited on the Diamonex coated seat surface, including twice the amount of copper seat material transferred from the cylinder head, than on the Carbon Raptor coated seat surface. Carbon Raptor results in better seat preservation between the valve and the cylinder head.

Debris buildup: Typical regions of Carbon Raptor® and Diamonex coated seat surfaces are shown below. Machining and grinding marks and the dark areas represent the original coated valve seat surface. Light colored regions show the original coating has been removed or that some material has been deposited on the surface. Diamonex coated surfaces have more copper, beryllium, silicon, phosphorous, lead and calcium than do Carbon Raptor coated surfaces. This is consistent with the visual observation of more deposits on the Diamonex coating as compared to Carbon Raptor. Much of the deposits appear to be products of incomplete combustion of gasoline components and copper transfer from the cylinder head.

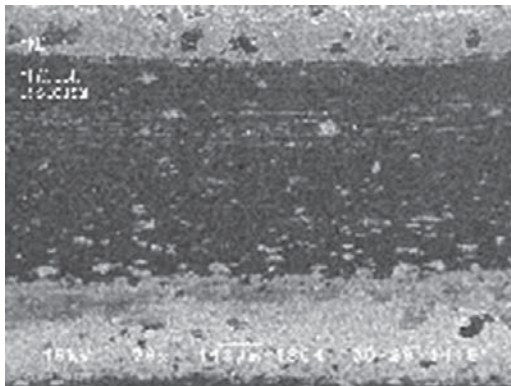


Carbon Raptor seat surface

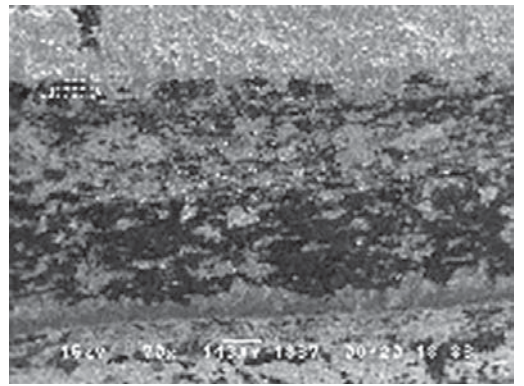


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Coating wear. The lower parts of the seat surfaces in the photos above indicate longer breaks in the Diamonex coating than on the Carbon Raptor coating. Entire grains pull out of the surface of the Diamonex coating, whereas Carbon Raptor wears in a planar fashion, layer by layer.



Carbon Raptor seat surface



Diamonex shows heavier wear debris buildup.

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