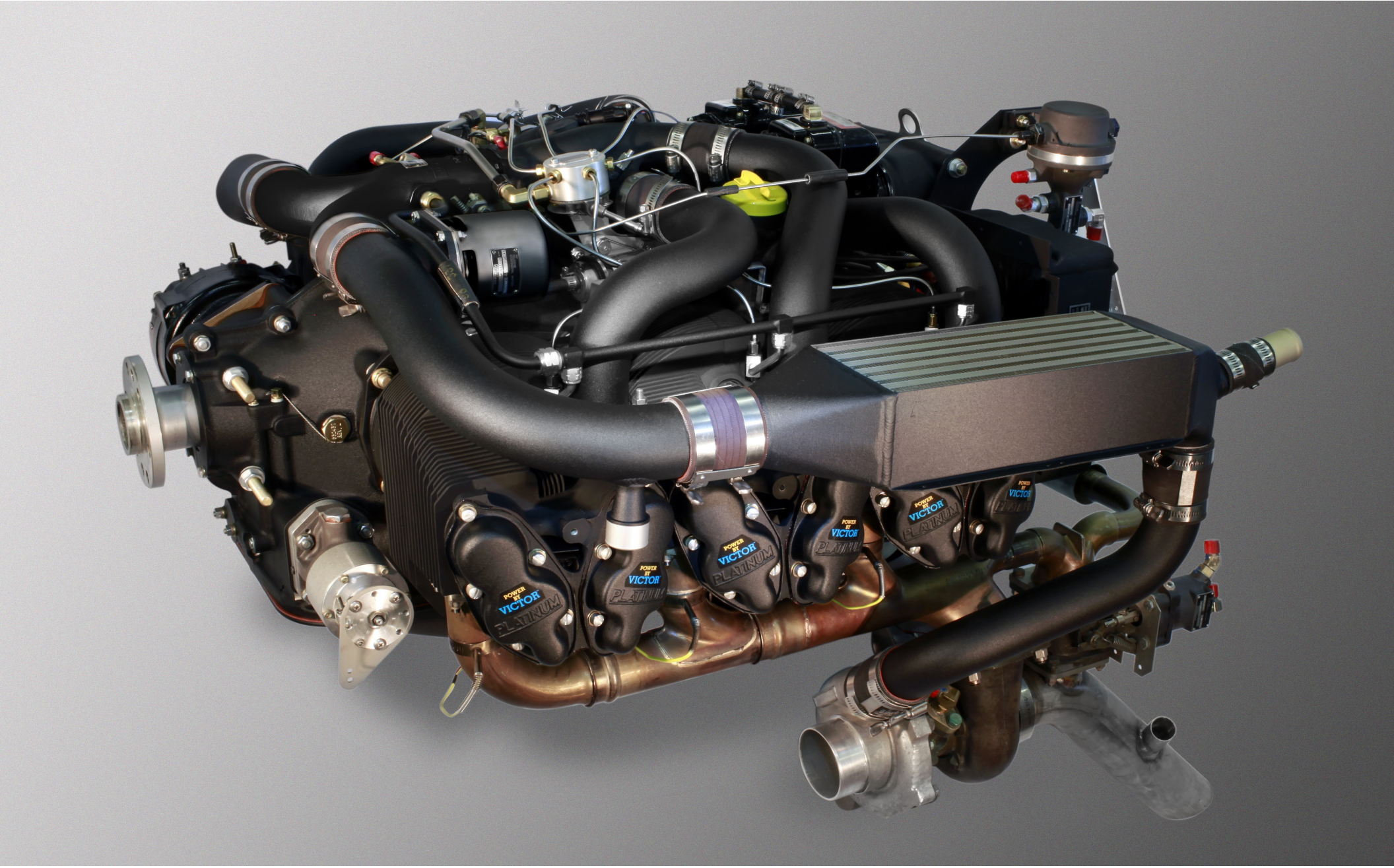


XR BLACK EDITION® VII

Demanding Maximum Performance & Longevity

Victor Aviation™

Legendary Quality

For many years, the words “Power-By-Victor” on the cowling of an aircraft have come to represent the ultimate in quality, the best in aviation piston engine technology. Victor Aviation’s unique, down-to-earth attention to personal service, meticulous detail and reliable high performance have become recognized across the U.S. and around the world as the standard by which other overhaul facilities and manufacturers are measured.

Since 1977 the Victor organization has earned a worldwide reputation for quality and excellence, utilizing innovative design techniques to improve performance and advance the state of the art of piston engine technology.

Pilots from around the world including former Legendary Air Show Pilot Bob Hoover and X-15 Research NACA Rocket Test Pilot Scott Crossfield, relied on Victor’s **BLACK EDITION®** engines throughout their flight careers.

In 2017 Victor Aviation was awarded the Highest Honor in Aviation by the Smithsonian Institution by including the “Power-By-Victor” **BLACK EDITION®** engine in the Air and Space Museum, along side Bob Hoover’s Shrike Commander aircraft.

On View Exhibition

Smithsonian Institution
National Air and Space Museum
STEVEN F. UDVAR-HAZY CENTER

CMI **360-470-520-550** Cubic-Inch Displacement
LYCOMING **360-540-541-720** Cubic-Inch Displacement

An Iconic Status

XR BLACK EDITION® VII

Victor Aviation's **XR BLACK EDITION® VII** state-of-the art engines have earned an Iconic Status as the most valued aircraft engines in the world. With the introduction of the **XR BLACK EDITION® VII** engine Victor Aviation has set new standards for the industry for excellence and innovative engine performance. Designed for superior dependability and performance and can handle the toughest and most extreme environmental conditions.

XR BLACK EDITION® VII engines achieve their high performance standards with 21 industry unique "Power-By Victor" comprehensive processes.

- ✓ Real-Time Reciprocating and Rotational Engine Balancing
- ✓ Corrosive and Harsh Environment Protection
- ✓ Cryogenic Liquid Nitrogen Stress Relieving
- ✓ Multiple-Angle Valve and Seat Machining
- ✓ Textured Matte Black Thermally Emissive Powder-Coat
- ✓ High Temperature Ceramics
- ✓ Isotropic Metal Surface Finishing

- ✓ Inertia Supercharging Airflow Optimization
- ✓ Metal Surface Shot Peening
- ✓ Precision Three-Axis Crankcase Machining
- ✓ Enhanced Valve Train Geometry
- ✓ Iron Manganese Phosphate Internal Corrosion Coating
- ✓ Matched Camshaft and Hydraulic Lifters
- ✓ Diamond Cut and Matched Piston Rings

- ✓ Cylinder Chamber Cubic Centimeter Testing
- ✓ Vibratory Stress Relief Testing
- ✓ Eddy Current Electromagnetic Induction Testing
- ✓ Ultrasonic High Speed Velocity Testing
- ✓ Full Domain Frequency Vibration Testing
- ✓ Engine Thrust Velocity Load Cell Testing
- ✓ Cylinder Volumetric Efficiency Balancing and Flow Testing

Cryogenic Non-Destructive Testing & Material Treatment Patent Approved Number: US 2014/8,920,023 December 30, 2014

Cryogenic Transition Detection Patent Approved Number: US 2014/8,894,279 November 25, 2014

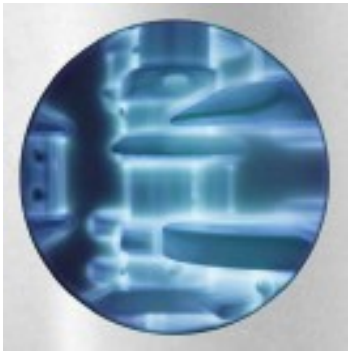
UNIQUE **XR BLACK EDITION® VII** ENGINE OVERHAUL PROCESSES

Cryogenic Liquid Nitrogen Stress Relieving

To reduce residual parts stress and improve engine performance, Victor Aviation has a unique FAA accepted patent approved process to test parts over a 600 degree range in temperature from -300 to +300 degrees Fahrenheit. This non-destructive testing process is performed on **XR BLACK EDITION® VII** engines in a computer controlled vacuum insulated Cryogenic processing chamber over several days, in a Liquid Nitrogen atmosphere with real-time ultrasound material monitoring.

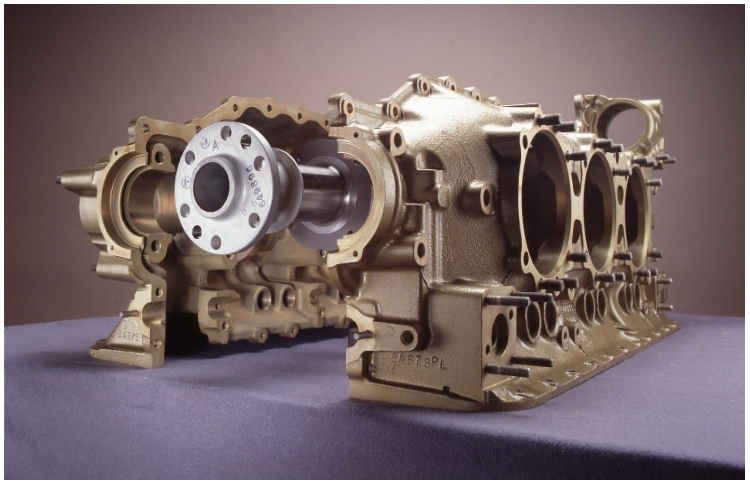
When metal castings cool and solidify during manufacturing, compressive stresses develop in lower volume areas, which cool first and tensile stresses develop in areas of greater volume, which are last to cool. Shear stresses can develop between the different volume areas. The surface cools first and the core last. In such cases, residual stresses develop because of the phase volume change between those layers that transform first and the center portion which transforms last. This Cryogenic testing process can relieve residual stresses and detect for improper machining or heat treating of parts. By measuring material volume changes this patented process can provide for longer engine life, better fuel efficiency, and improve engine performance. Cryogenics is widely used by the NASA Space Program, Aerospace Industry, and other High Performance Industries to improve parts durability and performance.

Slowing down the rate that atoms vibrate in a Cryogenic atmosphere with Liquid Nitrogen result in tougher and more durable lasting engine parts.



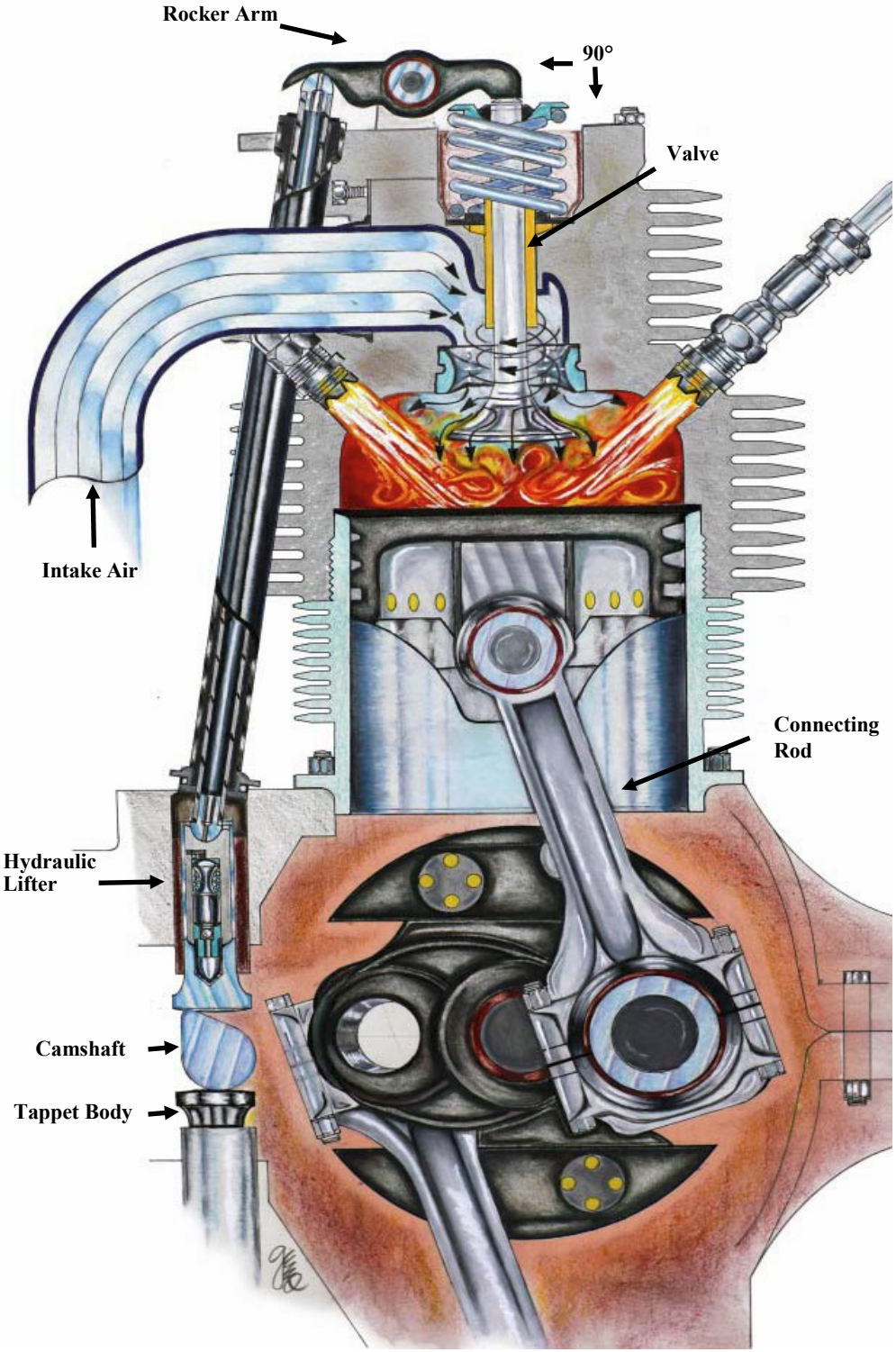
Enhanced Valve Train Geometry

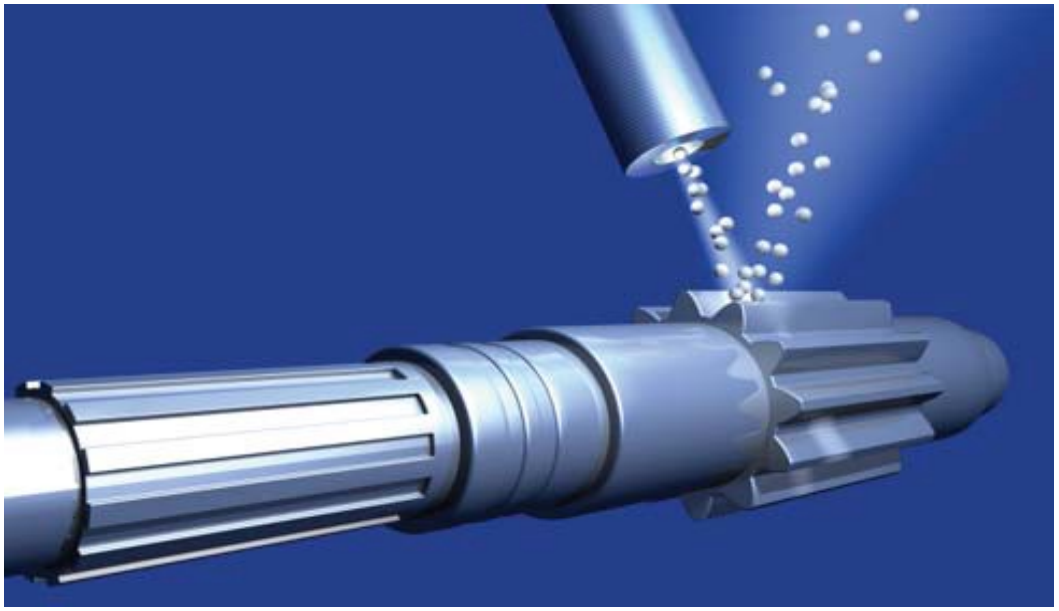
Extracting maximum performance from the engine's valve train is essential for best power, smoothness and longevity. As an engine's valves open and close, the contact angle between the valve and the rocker arm becomes critical to proper valve operation and engine performance. Any valve side loading can decrease cylinder efficiency and reduce available horsepower. Victor's **XR BLACK EDITION® VII** Engines are precision machined for minimum valve side loading for better power, performance and reliability. To help achieve consistency, valve spring pressures and heights are matched for more efficient engine operation. Similarly, hydraulic lifters are matched for identical bleed down rates to assure uniformity of independent valve overlap timing and maximum throttle response. Valve clearances are also set to consistent "Power-By-Victor" specifications. The camshaft is precision ground or replaced with matched tappet bodies for optimum fuel efficiency.



Precision Three-Axis Crankcase Machining

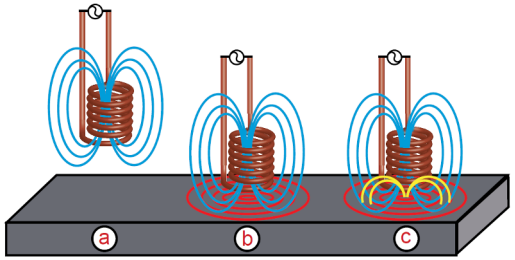
A common misconception is that conventional lapping and line honing alone always results in a properly aligned and sized crankcase. This is untrue as line honing merely follows existing discontinuities and lapping can create uneven thicknesses. Gear mesh and bearing heat transfer problems may also occur. When necessary, crankcases are straightened, then precision milled to avoid high metal loss, and final machine bored utilizing precision boring equipment to assure proper alignment and size. Crankcase journals are finish tested for size and journal geometry by airflow differential procedures to assure proper fit. This minimizes piston side loading, reduces bearing wear and provides equal loading on crankshaft main journals. Unlike line honing which follows or changes the existing axis, line boring reestablishes the centerline of the crankshaft axis, thereby insuring the centerline is parallel and equidistant to the cylinder deck planes for enhanced engine performance.





Metal Surface Shot Peening

Shot peening is a FAA accepted process accomplished by the pneumatic impingement of metallic, glass or plastic shot on critical engine parts. Because of this process part fatigue strength and resistance to stress corrosion cracking is improved by enhancing parts residual surface compressive stress. Nearly all fatigue and stress corrosion failures originate at the surface of a part, but cracks will not initiate or propagate in a compressively stressed zone. Because of this unique process, critical stressed surface areas prone to stress corrosion cracking are shot peened to provide for longer lasting more durable parts life.



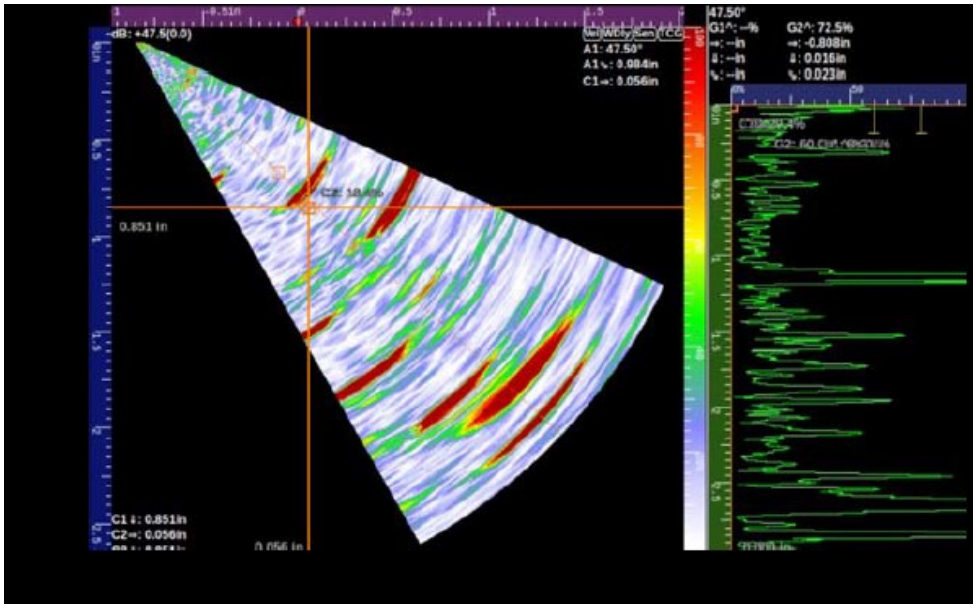
a - The alternating current flowing through the coil at a chosen frequency generates a magnetic field around the coil.

b - When the coil is placed close to an electrically conductive material, eddy current is included in the material.

c - If a flaw in the conductive material disturbs the eddy current circulation, the magnetic coupling with the probe is changed and a defect signal can be read by measuring the coil impedance variation.

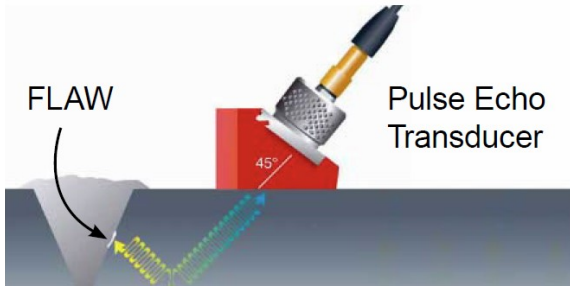
Eddy Current Electromagnetic Induction

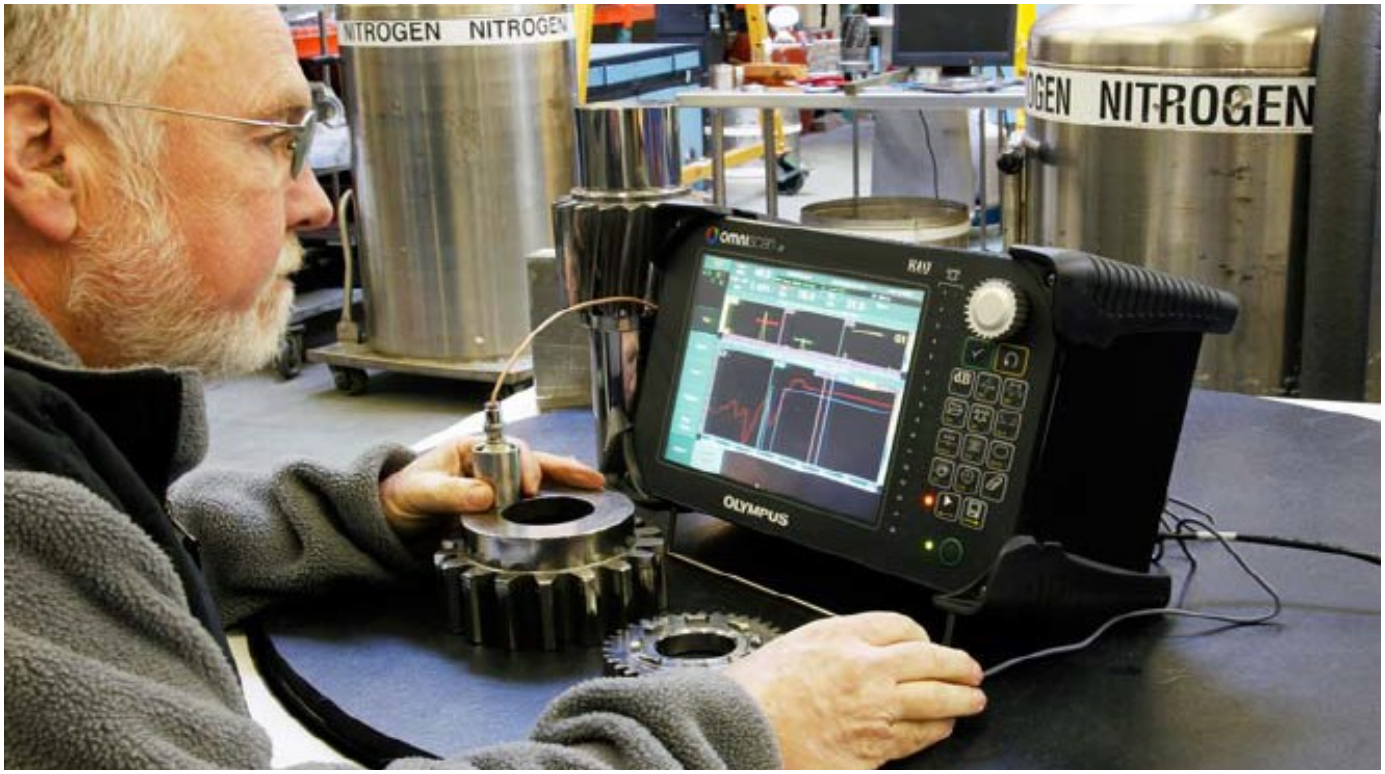
Electrically conductive engine parts are tested using an electromagnetic induction process. This process is very effective especially on aluminum castings such as crankcases and housings. The advantage of this method is that it can detect fractures or porosity problems beneath the surface of the material that are not detectable by surface dye penetrant inspection techniques. Eddy current uses alternating electrical current flowing through a coil at a chosen frequency and generates a magnetic field around a coil or probe. When the coil is placed next to a conductive material, eddy current is included in the material. If a flaw in the conductive material disturbs the eddy current circulation such as a crack or porosity problem, the magnetic coupling with the probe is changed and a defect signal can be read by measuring the coil impedance variation. This process is an advanced parts inspection procedure and can detect hidden flaws in materials before they reveal themselves by structural failure.



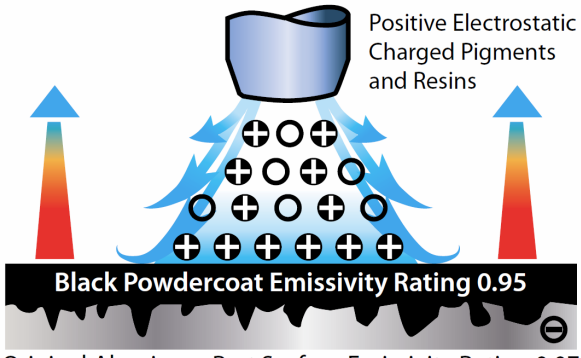
Ultrasonic High Speed Velocity Testing

Using high frequency high speed sound waves, parts are scanned to gauge their integrity, test for flaws and material characterization. A pulse echo ultrasonic measurement can determine the location of a discontinuity within a part or structure by accurately measuring the time required for a short ultrasonic pulse generated by a transducer to travel through a thickness of the material. The pulse then reflects from the back or surface of the discontinuity, is then returned to the transducer and can identify flaws internally in a part. Using ultrasonic high speed velocity testing can significantly improve engine longevity by detecting sub-surface flaws that could have developed into future parts failure.





Thermal Emissivity Coefficient Improved

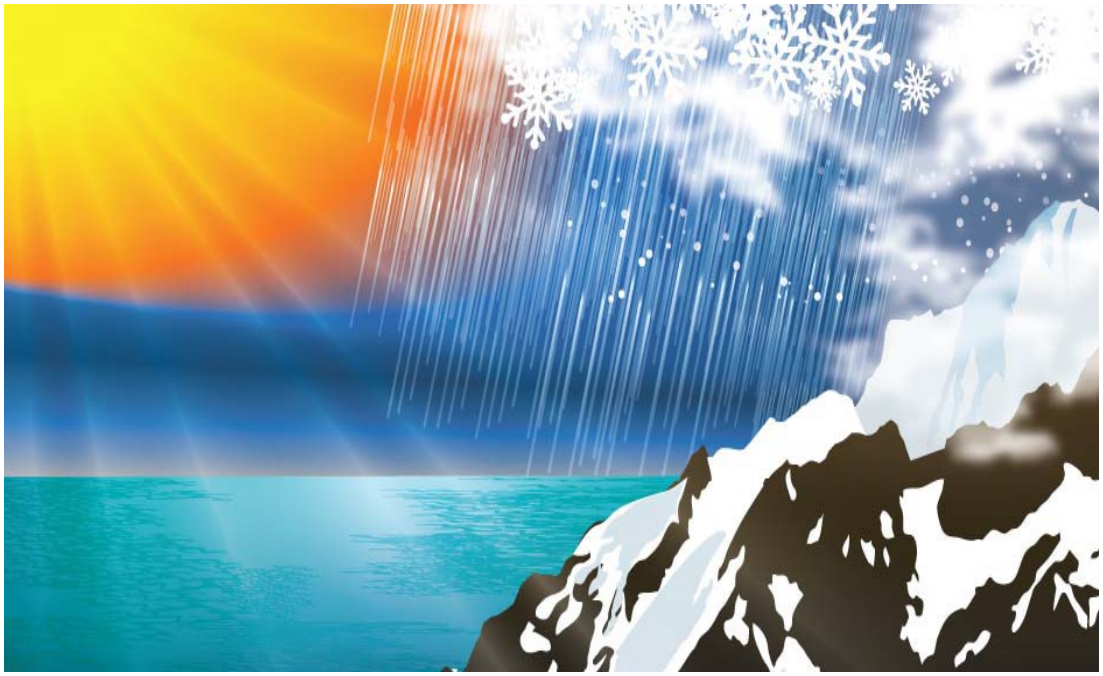


Original Aluminum Part Surface Emissivity Rating 0.07

Thermally Emissive Textured XR Matte Black Powder-Coated

XR BLACK EDITION® VII engines come with the ultimate in electrostatic powder-coat finishing that enhances the durability, corrosion resistance, and heat dispersion of engines. Designed to withstand extreme and the toughest conditions. Victor Aviation has been uniquely applying high quality powder-coat materials for over twenty-five years on aircraft engines and has partnered with a Fortune 500 company to provide a special textured **XR BLACK EDITION® VII** Matte Black finish with exceptional heat dispersion and corrosion protection qualities. Parts are pretreated, pre-baked, electrostatic charged and post baked cured at high temperature. These materials have exceptional ultraviolet, chemical, solvent, salt air and impact resistance while maintaining the high hardness and flexibility needed for optimum performance.

Material specifications meet or exceed salt spray resistance ASTM B- 117/ AAMA 2603.

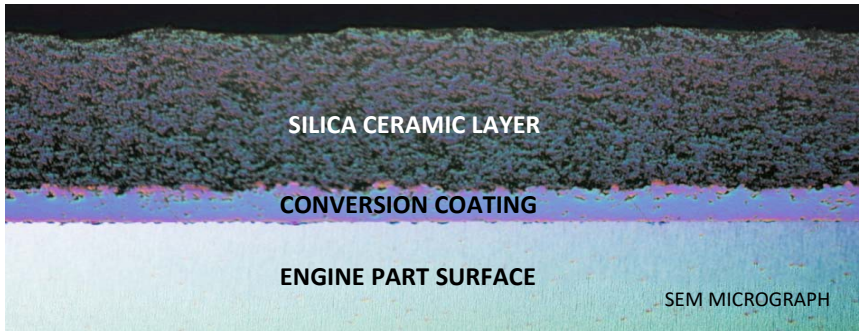


Corrosive and Harsh Environment Protection

Due to thermal changes, moisture conditions, airborne contaminants, and exposure to salt air, aircraft engines can deteriorate quickly and develop premature parts fatigue. To reduce these premature fatigue effects Victor Aviation has developed proprietary formulated Ceramic Silica and Polymer materials for exterior engine and component finishing on **XR BLACK EDITION® VII** engines. These extremely tough and durable high temperature corrosion resistant finishes are applied on the aircraft cylinders crankcase, induction system, housings and other critical parts. Finished parts are oven baked at high temperature and specially cured to make a magnificent textured Black Matte finish on **XR BLACK EDITION® VII** engines, significantly improving parts longevity and performance.

High Temperature Ceramics

Aircraft engine applications involve exposure to oxidizing fuels, heating and corrosive sources. All non-oxide materials used on engines will undergo oxidation and form some combination of solid, liquid or gaseous reaction to these environmental conditions. It is this oxidation behavior that can cause detrimental effects on engine parts. Special high temperature Silica Ceramics with good chemical stability and strength at high temperature oxidizing environments are used on **XR BLACK EDITION® VII** engines to increase heat dispersion and enhance parts performance. Engine parts are pneumatic plastic shot peened, degassed to remove any contaminants, a conversion coating is applied and final coated with specially formulated **XR BLACK EDITION® VII** Black Silica Ceramics. Materials are oil, fuel, and corrosion resistant.



UNIQUE **XR BLACK EDITION® VII**

ENGINE OVERHAUL PROCESSES

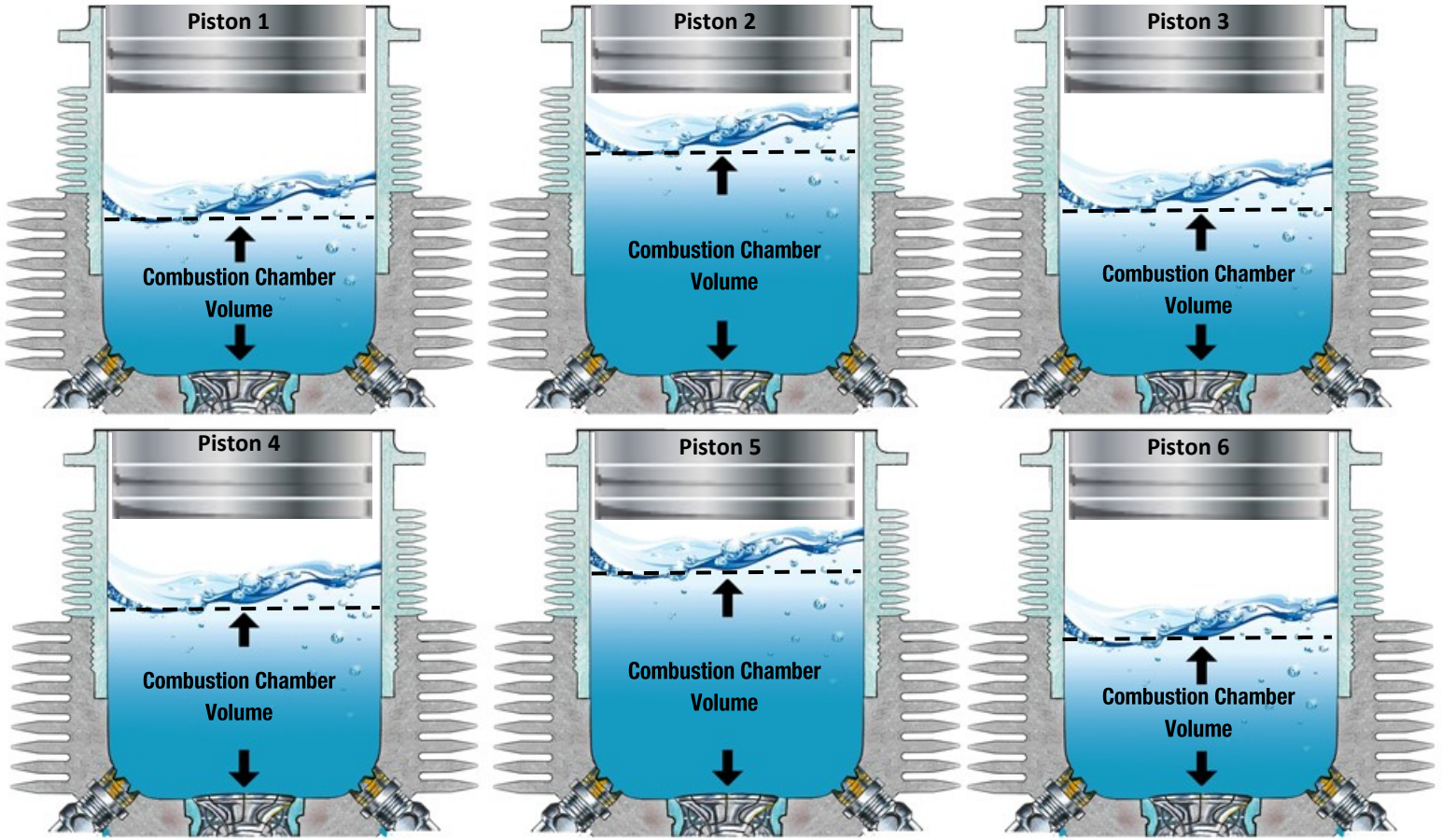
Isotropic Metal Surface Finishing

Engine parts are manufactured using grinding and cutting methods that can cause high surface roughness or irregularities in metal surfaces causing an anisotropic surface. This means that the surface irregularities of the parts all run in the same direction. These grinding marks can also interfere with non-destructive testing of a parts surface. This FAA accepted process enables technicians more reliable test indications when testing parts.

Isotropic surface finishing means that the part has been surface finished, or honed, to obtain a surface that has no discernible pattern thereby reducing friction, heat, noise and reduces contact fatigue. By exposing internal engine parts to a series of improved optional surface finishing techniques utilizing media in a specialized vibratory process, these surface roughness problems are reduced resulting in longer parts life, smoother parts operation, improved lubrication and better fuel efficiency.

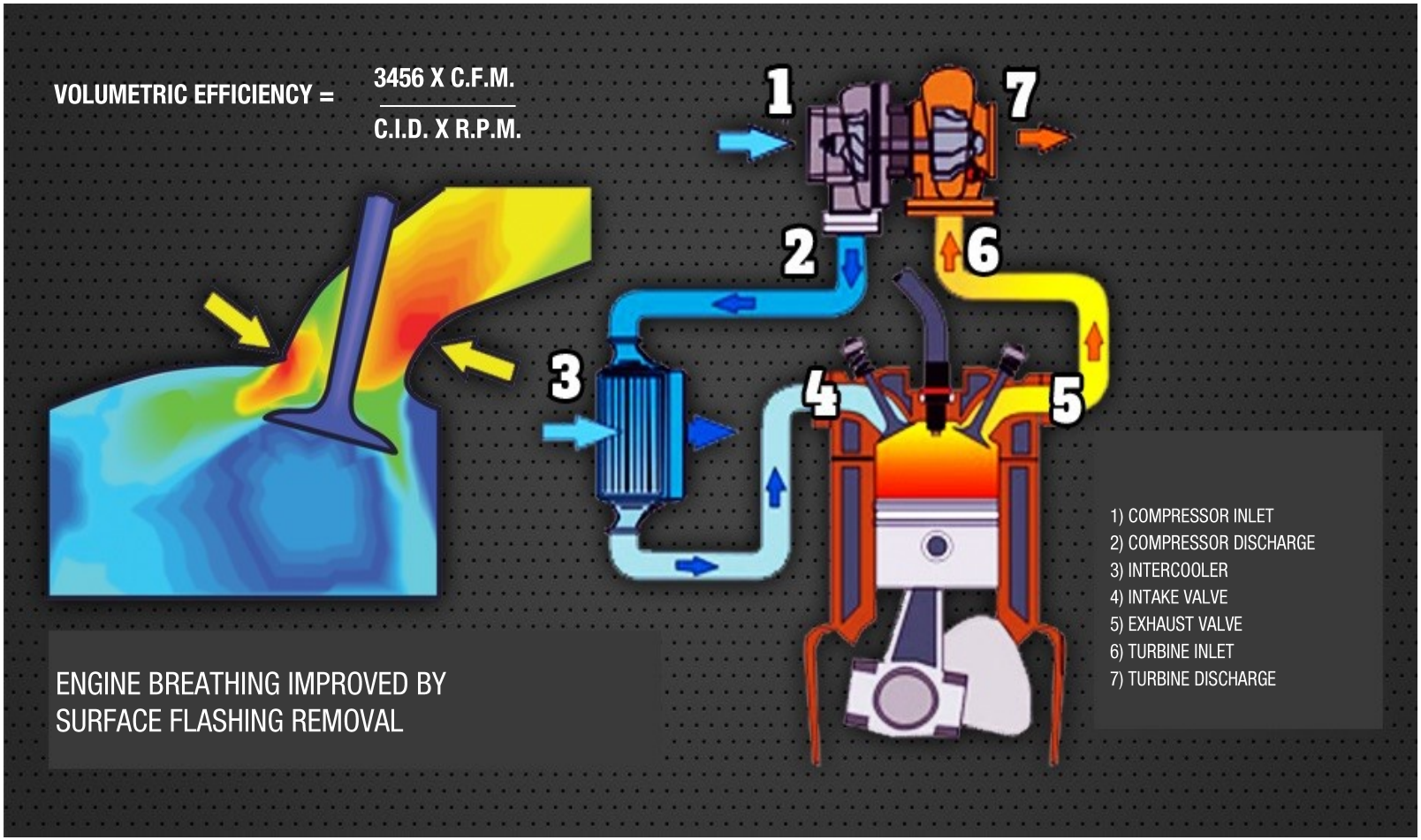
Vibratory Stress Relief Testing

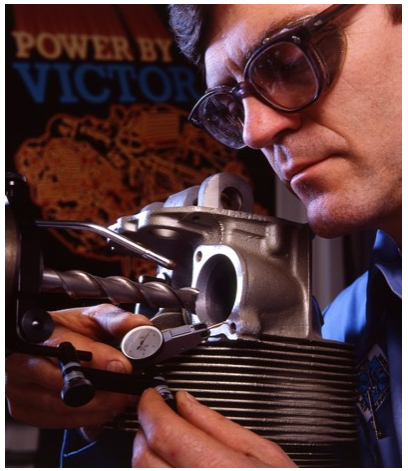
Vibratory stress relief testing is performed by vibrating engine parts at a sub-harmonic vibration frequency while real-time monitored with a full domain spectrum analyzer. This process measures changes in residual stress concentrations of engine parts caused by manufacturing processes. This FAA accepted testing process is also used to provide for more reliable magnetic test indications during non-destructive testing of engine parts because of any shifting of material composition due to stress changes. Using this process can improve parts longevity and durability by neutralizing residual stress and enhances engine part performance.



Cylinder Combustion Chamber Cubic Centimeter Testing

Cylinder combustion chamber and intake port volumes are cubic centimeter (CC) tested for uniformity by fluid test methods for improved engine power and superior engine smoothness on **XR BLACK EDITION® VII** engines. New cylinder castings have varying intake port and combustion chamber volumes and can cause changes in individual cylinder horsepower output. A cylinder's position installed on an engine can also change individual cylinder horsepower output due to changes in available induction airflow and cylinder cooling causing uneven cylinder effective compression ratio balance. By balancing the individual CC level of a cylinder to the available induction airflow and cylinder positioning on an engine, a superior improvement can be obtained in providing for the ultimate in engine smoothness and power balance of an engine.

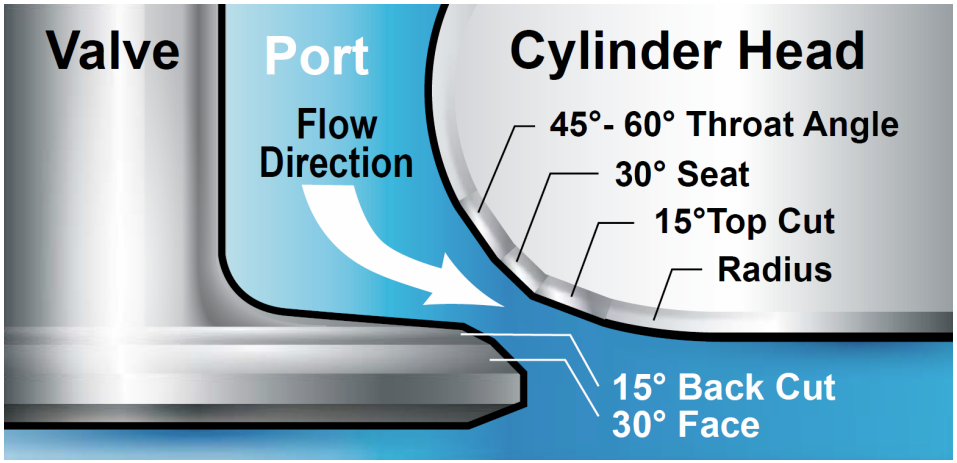




Cylinder Volumetric Efficiency Balancing and Airflow Testing

Volumetric efficiency testing measures the airflow into each cylinder and allows Victor Aviation to match cylinders for maximum power so that the pilot can have the benefit of using all available power uniformly and efficiently with all cylinders.

Horsepower of an engine is directly proportional to the volume of air drawn into the cylinders and retained until ignition occurs. With this FAA accepted process of polishing and removal of surface flashings of the intake and exhaust systems, a significant improvement in volumetric efficiency is available. It's quite common to find airflow volume variations in new cylinders as great as 15 percent between independent cylinders which causes inconsistent cylinder horsepower outputs. After cylinders are volumetrically balanced all cylinders produce uniform airflow to provide for improved uniformity of power distribution. Airflow balancing is performed at multiple valve lift openings to assure for the best in engine fuel efficiency. Such precision tests are virtually unique in the aircraft industry to "Power-By-Victor" **XR BLACK EDITION® VII** engines.

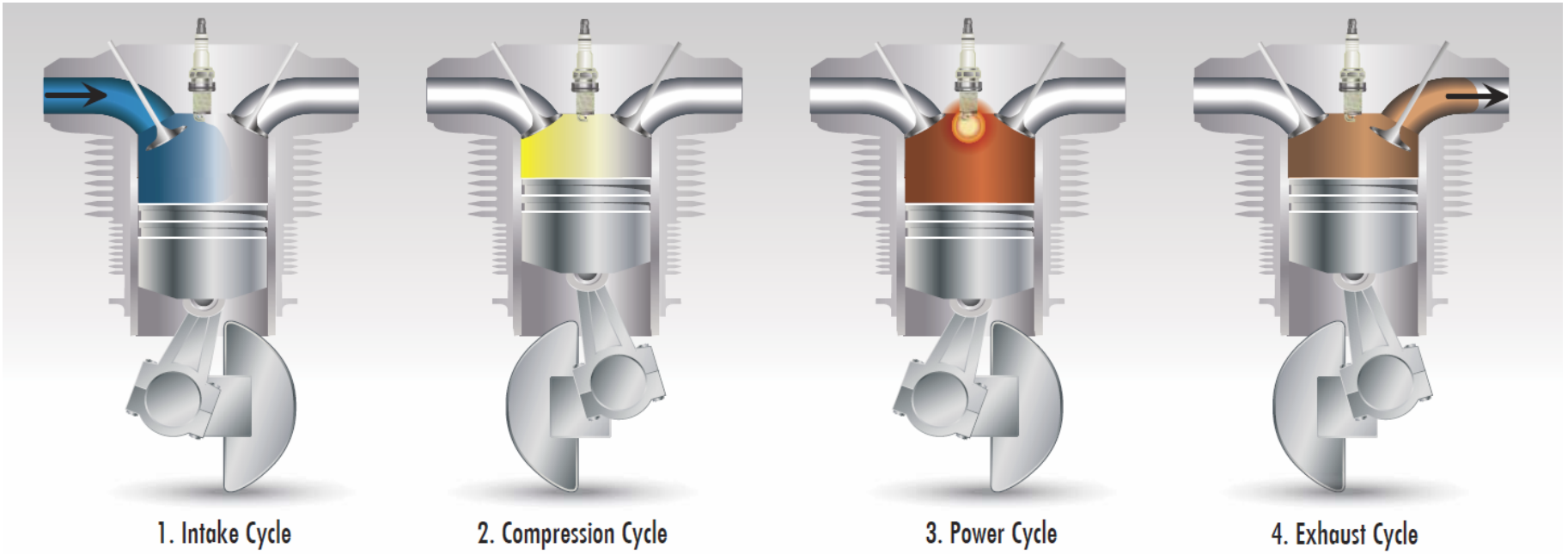


Multiple-Angle Valve and Seat Machining

Engine intake air flows in and out of the combustion chamber through the intake and exhaust system by the opening and closing of the valves. As the air passes through the cylinder intake and exhaust ports, the flow of air can be affected by the curvature or radius of the openings caused by the shape of the valve and seat angles. Using specialized equipment, Victor's technicians can shape these openings and improve the airflow and venturi characteristics by blending an improved curvature radius into the airflow path. Multiple-angle valve and seat machining is very effective in making the airflow more efficient. As a result, improved engine performance and fuel efficiency can be obtained with an enhanced throttle response.

Inertia Supercharging Airflow Optimization

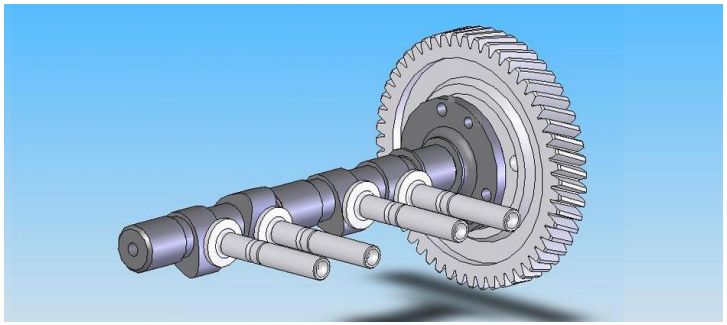
Inertia supercharging is a process to maximize the volume of air trapped in the cylinder for combustion by precisely timing and delivering the proper charge of air. This phenomenon takes advantage of the natural dynamic effects and inertia of the air during the intake cycle. When the intake valve closes, a fast-moving high pressure pulse will hit the valve and bounce back in the intake system. By measuring the intake flow rate and precision machine finishing of the intake tract the returning pulse can be timed to arrive just when the valve opens for the next event cycle, filling the cylinder with an additional charge of air. Since the air column has inertia created by its reversion back from its original collision with the closed valve, it's called "inertia supercharging." When this occurs, the manifold is said to be resonating or tuning. RPM, cubic-inch displacement, and airflow are related factors that are evaluated to help determine proper engine performance and horsepower which contribute to the inertia supercharging effect. By maximizing the kinetic energy of the airflow into the cylinders, the volumetric efficiency is improved and engine power.



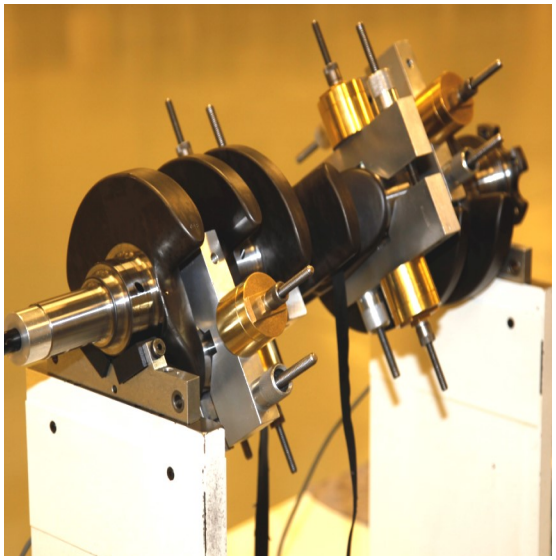
Iron Manganese Phosphate Internal Corrosion Coating

Internal engine parts are very sensitive to the effects of corrosion which can cause premature failure of the engine's camshaft, hydraulic lifters and gears. Iron manganese phosphate coating is a FAA accepted process of acid etching a lubricant into steel parts to reduce friction and provide for corrosion protection while improving fuel efficiency.

When new parts are installed in an engine there are initial contact surface break-in effects. Victor's phosphate coating will assure a smooth initial contact break-in effect and improve parts pitting fatigue life. Friction is reduced by the smoothing of the asperities of the mating gear surfaces and aids in keeping the gear tooth surface shape. This chemical conversion treatment forms a crystalline coated surface which provides for a significant improvement in contact fatigue strength and can greatly improve engine parts life.



Real Time Reciprocating and Rotational Engine Balancing



Engine thrust can be increased by reducing the amount of power wasted in offsetting counterbalancing forces induced by out-of-balance internal components. Improving parts balance allows the engine to deliver more power to the propeller and the engine becomes more efficient with less wear on internal moving parts. "Power-By-Victor" **XR BLACK EDITION® VII** engines are uniquely real-time motion balanced by Victor's ASE certified master machinists to within one gram. With this FAA accepted process, individual parts and cumulative reciprocating mass weights are balanced, to provide for the best longevity and smoothness of the engine.

To illustrate the importance of proper balance, a typical six-cylinder engine connecting rod travels four inches. If a connecting rod were only 35 grams out-of-balance at a takeoff rpm of 2700, the resulting centrifugal force imbalance would be approximately 255 pounds. Over a period of time, such an imbalance could crack engine and accessory mounts, crankcases, exhaust systems, cause premature bearing failure, cause accelerated fatigue to sensitive aircraft electronics, propeller and structural members of the aircraft. Additionally, an engine imbalance can introduce unwanted vibration harmonics in flight controls, navigational and flight instruments and is one of the leading causes for premature system fatigue.

Balancing not only improves thrust but also reduces pilot and passenger fatigue by lowering the amplitude of various vibration frequencies generated by the engine. The vibration that most pilots feel in an aircraft is generally low frequency vibration, often unrelated to propeller balance. Propeller dynamic balancing alone will not remedy an internal engine vibration and may only mask the symptoms of a larger problem. At Victor Aviation, engine vibration is reduced as a cumulative result of rotational, reciprocating and airflow balancing, improved valve train geometry, inertia supercharging, friction reduction and fuel distribution.

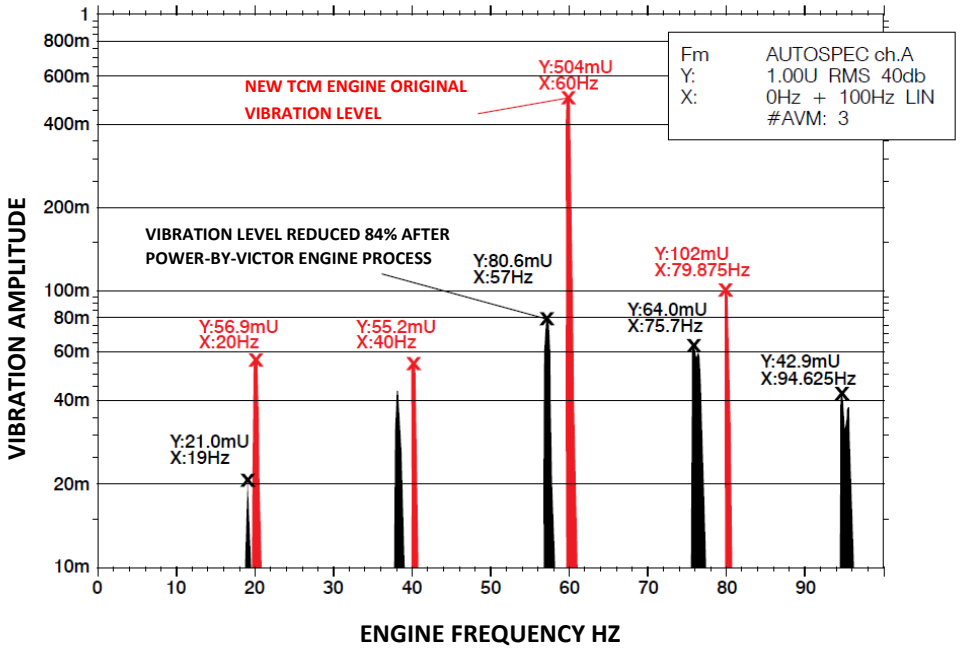
Engine Thrust Velocity Load Cell Testing

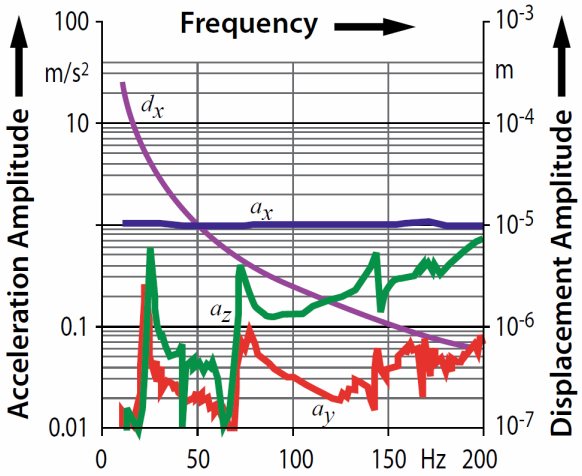
Engine testing at Victor Aviation is the most extensive procedure used in the industry and performed over a several day cycle process. Victor's state-of-the-art mobile engine testing apparatus, incorporates a thrust velocity load cell that measures the actual thrust force of the propeller. Engines are installed into a hydraulic activated engine mount, with engine accessories, induction system and exhaust system installed, to simulate real-time engine test parameters.

Using an electronic load cell wafer, the engine's real-time thrust velocity is recorded at all engine speeds. Internal engine parts are vibration monitored using tri-axial piezoelectric accelerometers and a full domain frequency analysis to determine real-time internal engine parts balance. During the test process special dyes are put into the oil system and examined under a black light canopy to detect for any discrepancies. Engines are tested at maximum power and must meet Victor's rigid **XR BLACK EDITION® VII** test standards.

VIBRATION ANALYSIS TEST COMPARISON

BEFORE AND AFTER **XR BLACK EDITION® VII** PROCESSES PERFORMED ON A FACTORY NEW ENGINE





Full Domain Frequency Vibration Testing

Internal engine components move at varying rates of motion and produce different frequencies. These components can be individually revealed by plotting vibration amplitude against frequency. The breaking down of vibration signals into individual frequency components is called frequency analysis, a technique which may be considered the cornerstone of diagnostic vibration measurements. Using a full domain frequency analyzer, the frequency and amplitude of a component's vibration level can be detected using a tri-axial piezoelectric accelerometer attached to the engine during engine testing.

This FAA accepted testing process enables Victor's technicians to not only test for complete engine balance but isolate exactly what internal engine components need correction. This level of engine vibration analysis by far exceeds industry standards and enables Victor's technicians to identify engine design and component problems allowing for a smoother running engine.

Preferred Installation Facilities

Victor Aviation can direct you to a “Power-By-Victor” Preferred Installation Facility near you. The benefit of having an aircraft engine installed by a “Power-By-Victor” Preferred Installation Facility is the extra confidence and peace of mind you receive by knowing the job is done right.

If you elect to fly your aircraft to a “Power-By-Victor” Preferred Installation Facility, they can provide engine removal and reinstallation, aircraft inspection, propeller and accessory replacement and avionics upgrade services.

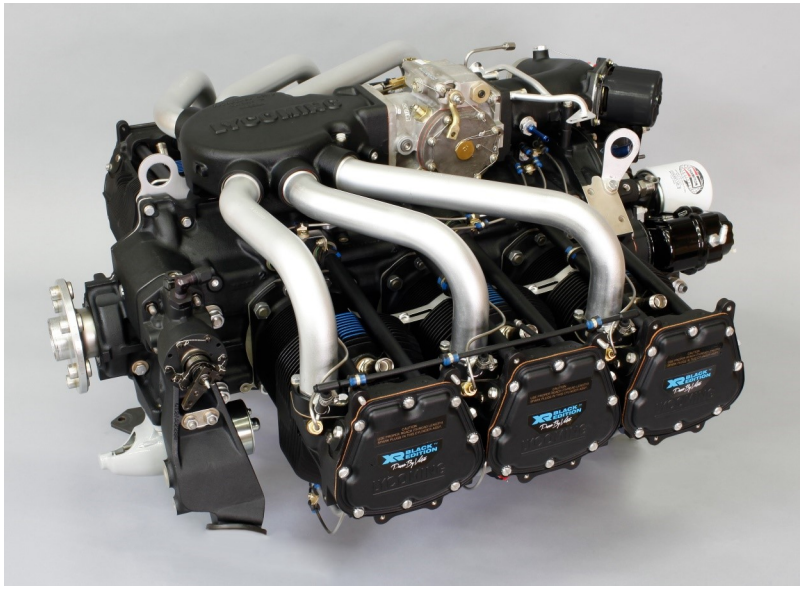
Expedited AOG Engine Overhaul Service

An expedited AOG (Aircraft on Ground) overhaul service for Domestic and International **XR BLACK EDITION® VII** customers is available. This program enables customers to get their aircraft returned to service as quickly as possible and meet any import or export calendar requirements.

The term “FAA accepted process” is used to describe a Victor Aviation Service, Inc. category or process. The definition is not intended to contradict any authorized manual, procedure, method, or any FAR or FAA authorized publication. Process specifications, technology, performance standards, warranty terms and conditions, subject to change without notice at any time.

Valued by the World's Leading Authority *Aircraft Bluebook* Price Digest as certified added value to your aircraft.

Aircraft Bluebook PRICE DIGEST®



About Victor Aviation Service, Inc.

FAA Approved Repair Station #BJ3R399L

Victor Aviation Service, Inc. is the world's most respected name in the Aircraft Engine Overhaul Industry with affiliate Preferred Installation Centers located worldwide.

The company has achieved international brand recognition using a business model focused on expanding and protecting its trademark rights and proprietary FAA approved processes while simultaneously promoting its approved patents in worldwide affiliations through its company alliances.

Victor Aviation Service, Inc. has ventured into providing other products and services branded with the Victor Aviation mark to Aerospace Industries including NASA, and other Fortune 500 commercial accounts. The team of professionals employed by Victor Aviation include only the highest qualified master machinists and skilled technicians with impeccable reputations for producing the consistent quality that shines under the Victor Aviation brand name products.

FAA Approved Repair Station #BJ3R399L

Victor Aviation™

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