MANLEY

VALVE TRAIN GUIDE

VALVE TRAIN
TROUBLE SHOOTING GUIDE

"You gotta be there at the end to win." Nothing could be more obvious; yet nothing could be more true. At Manley Performance we have made an unlimited commitment to ensure that our customers will be there at the end when they use our products.

The Manley commitment to product excellence is two phased. First, we continue to research, test and introduce improved materials, designs, heat treatment and finishes that result in superior products. Our HT titanium material, our impinged retainers, our Bead-Loc® keepers and our swedged end pushrods are all examples of new and improved commodities for the racing fraternity

Second, we have extensively tested to determine exactly what is happening to the valve train in a running engine. Our goal is to fully comprehend the problems each product faces in order to build the best piece possible. Our valve operating temperature data, our unbelievably vast valve fatigue testing (which we are convinced no other competitor has ever undertaken), and our comprehensive finite element analysis (FEA) of retainers are all illustrative of the depths to which we have probed to find real answers that result in real improvements.

There is another – absolutely crucial – ingredient in the success of a race engine, and that is the engine builder. The selection of related items such as camshafts and springs, and the preparation of the fuel system and the general state of the engine tune-up, all carry extremely heavy, often critical, responsibility for the success of the valve train components.

It is for the concerned engine builder that these remarks are targeted, so that hopefully with our test results and experience we can point out problem areas in the valve train and offer suggestions to keep everyone running at the end.

Valves don't just break. They are affected by temperatures and dynamic stress. Too much of either - or almost too much of both in combination - will result in valve failure. Valves MUST be kept within the temperature parameters of the material. Even the high temperature materials such as XH - 428 and XH - 430 stainless and HT titanium have finite limits. Items 6 and 7 expand on the subject of temperature. First, let's discuss dynamic stress.

In a smooth running Winston Cup engine with no valve float the valves are experiencing 20,000 psi of stress. If valve float occurs, the stress can reach 50,000 psi and this will reduce the life expectancy of the part by over 90%. And this happens if the valve temperature does not increase, which is an unrealistic expectation. Elevated temperatures will quickly reduce the life of the valve even more. From these facts - derived from our exhaustive rotating beam fatigue test - it is obvious that CONTROLLING THE VALVE TRAIN can not be emphasized too strongly.

1. VALVE LOCK SCRUBBING

This is the first place to look for valve float. If the locks are leaving scuff marks on the valve stem above and below the keeper groove, the valve is bouncing on the seat and the valve gear (lock, retainer, spring) is separating. Nothing but trouble is on the horizon.

SUGGESTIONS: Lighten the valve train. If using stainless valves, move to titanium. If using titanium, move to thinner stems to reduce weight. Change to a lighter retainer. Buy better valve springs, which can be found on pages 63 - 65 of this catalog. Go to a stiffer (3/8" diameter) pushrod. Finally, work with your camshaft grinder to develop a profile that won't toss the valve gear until eventual destruction.

2. MULTIPLE ROCKER PATTERN

The photo is fully illustrative of the multiple rocker contact areas on the valve tip. Since this type valve train is non-rotating by design, the only way the valve can rotate is if it experiences float. Again, disaster lurks around the corner when valve train instability is present.

SUGGESTION: See suggestions under #1.

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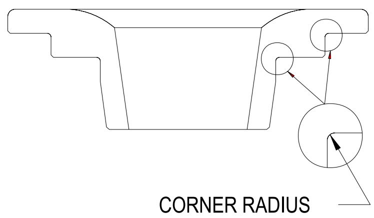
3. RETAINER FIT

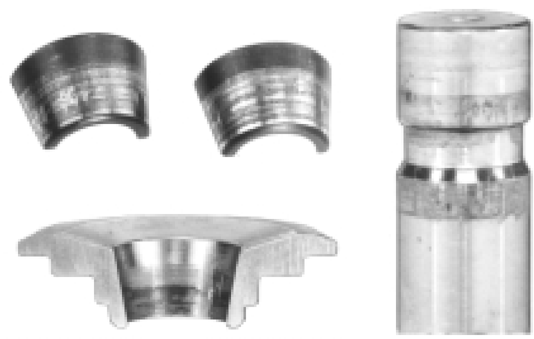
Retainer fit is an often over-looked issue. The steps on the retainer must match the I.D.'s of the spring package. Mismatch can cause the retainer to be overstressed and fail. Our FEA (finite element analysis) highlights the most highly stressed areas of the retainer, and our discovery of these potential trouble spots is evident in the design of our pieces.



SUGGESTIONS: Use Manley titanium Super 7˚ ICD retainers with our exclusive impingement process that offers better abrasion resistance, improved impingement fatigue strength and an improved surface condition. Also, chamfer the I.D.'s of your spring to allow clearance between the spring and the corner radius of the retainer. If using springs with dampners, be certain to finish the ends of the dampners with a large radius and a smooth polish.

4. VALVE LOCK FIT

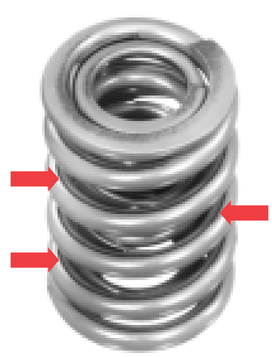
Do not underestimate the importance of proper fitting valve locks. The valve lock is designed to clamp on the stem of the valve - not in the root of the groove. The tongue of the lock is for locating purposes only. THERE ARE POORLY MACHINED LOCKS ON THE MARKET. Also, be certain the lock angle is compatible with the retainer angle. This is often not the case.



SUGGESTIONS: Use Manley Super 7˚ - either regular design or the safer Bead-Loc® style - along with Manley Super 7˚ retainers. These are made in our own double spindle CNC lathes to exacting tolerances to assure proper fit.

5. VALVE SPRING "LIFT-OFF"

Check the wear pattern in the photo. The coils are touching each other. Is this coil bind? No. The spring is actually lifting off the spring seat pad of the cylinder head causing the coils to touch each other. Springs have certain "fuss" points where in distinct rpm ranges they are in a harmonic state of discord and not under control. It is possible for a spring to control the valve train at 8500 rpm but be unable to do so at 8100 rpm.



SUGGESTIONS: Attempt to tune the "fuss point" out of the operating range of the engine with a different design valve spring. The best springs in the industry are found on pages 63 - 65. Also, stiffer pushrods and lighter valves and retainers will be beneficial.

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6. STEADY STATE RPM ENGINES

Assembling a steady state r.p.m. marine engine or a narrow range oval track engine is perhaps the greatest challenge a builder can face today. This statement in no way denigrates the efforts of the drag race community. Success in the straight line arena depends on producing peak horsepower at a very high rpm level, with a large premium on the flatness of the power curve. No easy assignment! The added wrinkle in constructing an oval or marine engine, not of immediate concern in a drag race powerplant, is the existence of dangerous “fuss points” that will inject instability into the valve train. An unstable valve train drastically decreases the life of the components, inevitably leading to failure.

It is the responsibility of the builder to determine where the “fuss points” reside in the engine and be absolutely certain that none appear in the operating range of the engine. Determining the location of an engine’s “fuss points” requires a Spintron machine to detect where the springs drift into a harmonic state of discord that allows the valve train to become disunited and the valves to bounce on the seats.

Building an engine to run in a narrow rpm range for extended periods of time without knowing positively if that range contains any “fuss points” is strongly discouraged. But if access to a Spintron is not possible, hopefully a few “bon mots” will benefit the engine builder.

1. The best marine engine builders change titanium valves after every race. Winston Cup valves only run one race. If the valves in your engine are experiencing bounce where the stresses are elevated to 40,000 psi from the normal 20,000 they may last 800,000 cycles or one five hundred mile race. But the fatigue life may be seriously compromised, and asking those valves to complete two or three more races may simply be beyond their fatigue life capabilities.

2. A valve spring cannot be judged solely on its ability to resist pressure loss. It is possible for a spring to control the valve train at 8400 rpm, end a race with minimal open load loss, yet be experiencing a “fuss point” at 8100 rpm that allows serious valve bounce.

3. Moving an engine’s rpm range up only 200 or 300 can have a major effect on the valve train. If a builder has researched (or stumbled upon) a combination that works in a certain range, boosting that range should not be undertaken without thoroughly revisiting the choice of valve springs and the weight of the reciprocating components.

CONCLUSIONS: In general, valve springs are NOT the place to effect economies. Purchase the best springs that have been proven to work with similar components both on Spintrons and in race engines. Lighten the valves and change them often, being sympathetic to the notion that they have a fatigue life that is seriously shortened by being bounced on the seats. Related components such as spring retainers and locks should be lightened, and pushrods should be stiff as well as light. Give us a call at Manley Performance; we are always happy to share our testing results to keep racers running at the end.