DAY 9 HRS

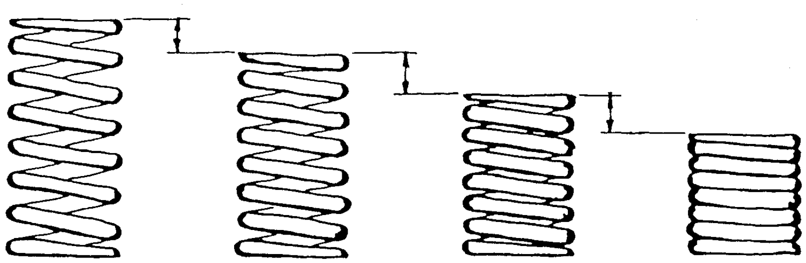
I. Clinic: Performance Engine Rebuild 5.0

A. Cylinder head set-up

II. Homework

I. Cylinder Head Set-Up

A. Definition of spring terms



1. Free-length
   a. Common OEM spec, not common to A/M
   b. Used to quickly spot fatigued springs
2. Installed height
   a. Spring already compressed before valve moves
   b. Results in two things
      (1) Pressure on valve face and seat
      (2) This pressure added to full open valve
3. Full open
   a. Maximum pressure point
   b. Largely dictates control of valve float
   c. Test pressure of spring at this position isn't full open pressure until seat pressure added in
4. Coilbound
   a. Metal to metal
   b. Valve train lock-up
   c. Must never happen during engine operation

Overhead

I.e. springs visually compared to each other

B. Ten valve/ spring checks
   1. Installed height
      a. Why
         (1) Seat pressure
            (a) More cylinder compression requires better sealing
            (b) More rpm = less time for sealing, cooling
         (2) Sometimes incorrectly used in place of full-open pressure to compare springs
      b. How
         (1) Assemble components w/o springs
         (2) Measure from retainer to spring seat
         (3) Adjust as necess to achieve manuf. spec
            (a) Machine spring seat (or increase valve protrusion) to increase
            (b) Shim spring seat to decrease
            (c) Check spring pack at this length in vise to find seat pressure, if desired
         (4) Method when spec unavailable
            (a) Assumes want max. seat press. spring can provide and still work properly
            (b) What is left after coilbound, 0.060" safety and max. lift accounted for

Recommend visually show students each valve interference situation, using soft springs, on a head, before getting into the math

Wheel bearing shims work well

Andrews Catalog p. 29

Installed height = Coilbound length
0.060" safety
+ Max. valve lift

Example:

0.940" coilbound length
0.060" safety
+ 0.600" max. valve lift
1.600" installed height

2. **Full-open pressure**
   a. **Why**
      (1) **All high perf. cams increase how quickly valve opens**
      (2) **Any increases in rpm add valve accel. also**
      (3) **Increased valve accel. results eventually in valve float**
      (4) **Valve spring full open pressure the major line of defense**
   b. **How**
      (1) **Method A**
         (a) **Determine spring pack min. working length**
         (b) **Compress pack to this length in spring tester**

Recommend pocket pressure tester, which will test full-open psi of all springs, dual or single rate

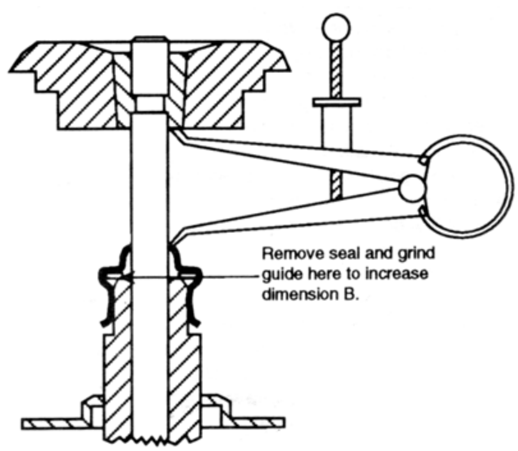
Minimum working length	=	Free length - Installed height + Max. valve lift
Example:		2.350” free-length - 1.600” installed height + 0.600” max. lift 1.350” min. working length

Remember, any calculation of full open pressure must have seat pressure added in, either by correcting for length, or by correcting for pressure

      (2) **Method B**
         (a) **Compress spring to valve lift spec w/ spring tester**
         (b) **Add seat pressure found previously**

3. Valve free travel
   a. Why
      (1) Monitors retainer-to-guide clearance
      (2) Prevents parts interference
   b. How
      (1) Assemble components w/o springs
      (2) Measure from retainer to guide/seal
      (3) Must be 0.060” more than lift

Measure from keepers if they protrude below retainer



Overhead

4. Coilbind clearance
   a. Why
      (1) Validates spring choice (reveals over-shimmed, incorrect springs)
      (2) Prevents part interference
   b. How
      (1) Method A
         (a) Subtract valve lift + 0.060” from installed height
         (b) Result must be more than coilbound length
      (2) Method B
         (a) Repeat full open test A
         (b) Compress 0.060” more

5. Valve to piston
   a. Why
      (1) Relationship of valve to piston changes in modified engine
      (2) Prevent interference of parts
   b. How
      (1) Method A
         (a) Solid lifters, soft springs
         (b) Oil valves and comb. chamber (but not piston)
         (c) Clay piston
         (d) Assemble top end — Clay method
         (e) Turn crank through couple revolutions
         (f) Remove cyl. head and bisect clay
      (2) Method B
         (a) Solid lifters, soft springs
         (b) Degree wheel on crankshaft/ true TDC
         (c) Indicator on valve retainer — Indicator method
         (d) Push valve down at TDC overlap and at points 30^{o} either side, in 10^{o} steps
6. Valve to valve
   a. Why
      (1) Changes to cam change valve-to-valve relationship
      (2) Prevent interference of parts
   b. How
      (1) Method A
         (a) Solid lifters, soft springs
         (b) At TDC overlap and 30^{o} either side, in 10^{o} steps
         (c) Wire or solder, flashlight, through spark plug hole — Sifton method
         (d) Push valve farther open to double-check

- (2) Method B
  - (a) Head on bench
  - (b) Valves assembled w/o springs
  - (c) Stop collar (drill stop) valves to TDC lift spec (if available)
  - (d) Must be 0.060" between valves
- (3) Method C
  - (a) Head on bench
  - (b) Valves assembled normally
  - (c) Add 0.060" to manufacturer's on-seat TDC lift spec

Andrews method

7. Retainer to rocker cover
   - a. Why
     - (1) Added valve protrusion results in retainer moving closer to cover
     - (2) Aftermarket heads often have valves repositioned also
     - (3) Prevent interference of parts
   - b. How
     - (1) Fit inner rocker cover to completed cyl. head
     - (2) Grind as necessary

This is an Evo problem

8. Rocker arm to cover
   - a. Why
     - (1) Changes to cam or to valve protrusion make rocker move closer to cover
     - (2) Prevent interference of parts
   - b. How
     - (1) Clay inside of outer cover
     - (2) Assemble everything w/ normal torque
     - (3) Turn crankshaft through couple revolution

Nos. 7-10 are all related to valve protrusion

S&S #2074

9. Retainer to rocker arm
   a. Why
      (1) Rocker tends to contact retainer's edge
         (a) Larger than usual retainers
         (b) Higher than normal valve protrusion
      (2) Best retainers are curved at edges
   b. How
      (1) Assemble everything w/ normal torque
      (2) Visually check for clearance under rocker
10. Rocker arm geometry
   a. Why
      (1) Imaginary center line of rocker shaft should intersect valve stem at 90^{o} angle when valve is open to ½ lift
      (2) Divides arc (and thus valve train forces) of rocker arm equally on opening and closing
      (3) Minimizes lateral thrust against valve
      (4) Directly related to valve stem protrusion
   c. How
      (1) Make special tool from old valve
      (2) Or, eyeball with straightedge