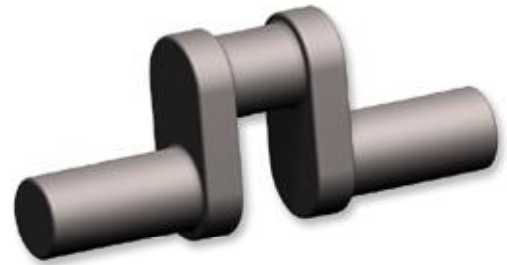


# The Crank Calls



April 2014

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## **MEMBERSHIP \$25.00 US**

Contact John Gilmore at  
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### **NEXT MEETING**

**April 19, 2014** at  
Chabot College, building 1500  
25555 Hesperian Blvd, Hayward 94545  
Doors open at **9:00 AM**  
Meeting starts at **10:00 AM**

### **Upcoming Events**

BAEM meetings:  
3<sup>rd</sup> Saturday of the month except December

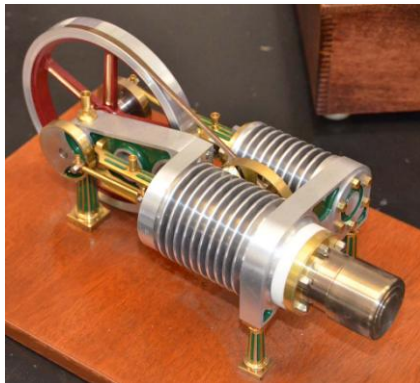
## **MEETING NOTES**

March 15, 2014  
Bob Kradjian

President Don Jones called the meeting to order at 10:00 am.

**VISITORS:** Roy Anderson's son, Carl, who is owner of Protoquick honored us with a visit. He is responsible for some of the nice metal samples Roy brings in for the group.

David Perez visited us from Santa Barbara and brought a lovely Sterling Cycle engine of Jerry Howell's design. He found us on line, and while visiting family in the area decided to attend our meeting. His Sterling was



built to a very high standard for anyone, let alone a second-time builder. His very first engine was a Stuart vertical single steam engine.

**MEETINGS:** The Hillsborough Concours will be held on July 20 this year at the Crystal Springs Golf Course. If there is interest on our side, and on the side of the Concours organizers, we may make an appearance. In the past, we have appeared there at least eight times.

### **SHOWS:**

The Palo Alto Concours has been cancelled for 2014 due to a lack of a suitable venue. This is the first time in many years that the show has been cancelled. We had our first major show there in 1997.

The Creekside Church in Martinez has a nice car and social event each year. They were very pleased with our club's appearance last year and some of our group is planning to exhibit engines again this year. They provide tables and lunch for exhibitors. It is scheduled for April 26 at 444 Figtree Lane, Martinez. See Creeksidechurch.com for the map.

The Blackhawk Museum folks have invited us to make an appearance at their “Father’s Day Car Show and Family Day”. The date is June 15. Several members have already indicated a willingness to show engines. We have a long history with the good Museum folks and have shown there a half dozen times.

The group that puts on the battleship combat show at Maker Faire each year has approached us to appear at the WEME show in August. If details can be arranged with the Good Guys staff, they can put up the pond and staff the popular exhibit.

The Golden Gate Model Yacht Club has also asked for a BAEM appearance for late September at Spreckel’s Lake.

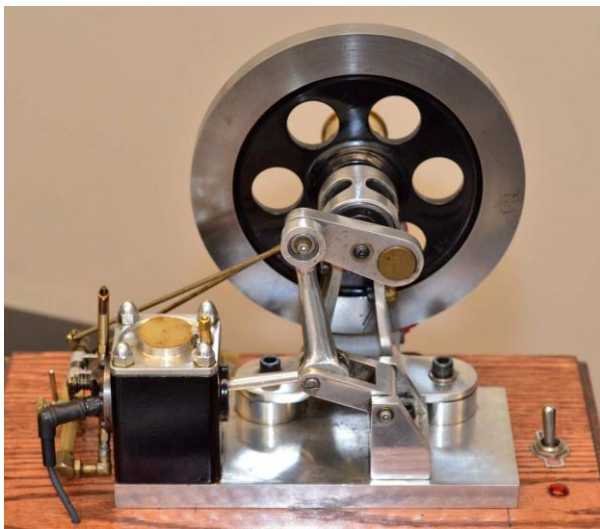
I gave an engine demonstration and an explanation of our club activities to a Bay Area Horseless Carriage Club meeting in Piedmont.

We have been invited back to the Ironstone Concours in September. Ken Hurst and I made the trip last year and had a good time near Murphys, California. The showing does require an overnight stay though, unless you are willing to get out of bed and start driving in the early morning hours..

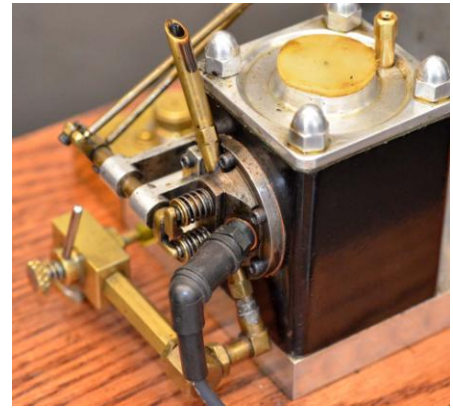
**TREASURER’S REPORT:** Club dues are payable. Please remit dues to treasurer John Gilmore at 1414 Linton Place, Martinez, 94553.

**CLUB BADGES:** If you need a badge, contact Mike Rehmus (mrehmus@byvdeo.com) who has offered to produce them.

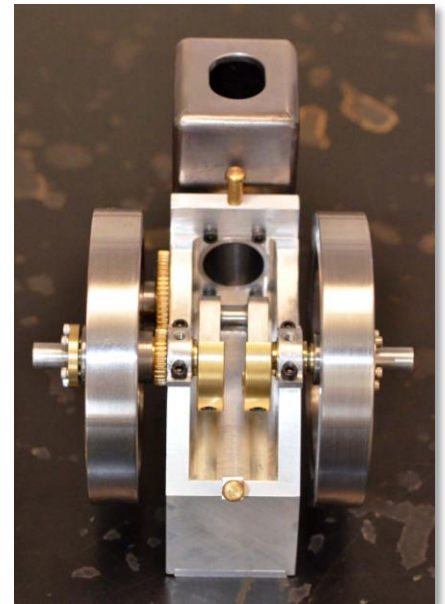
### **BITS AND PIECES:**



George Gravatt was given an Atkinson cycle engine by Dwight as a project about twenty years ago. It simply would not run. George made many modifications the ignition from a micro switch to a cam and breaker points. The carburetor also required extensive rebuilding. The engine now is a reliable runner and George demonstrated this with a single pull on the flywheel cord. After a short warm up, it idled down nicely.

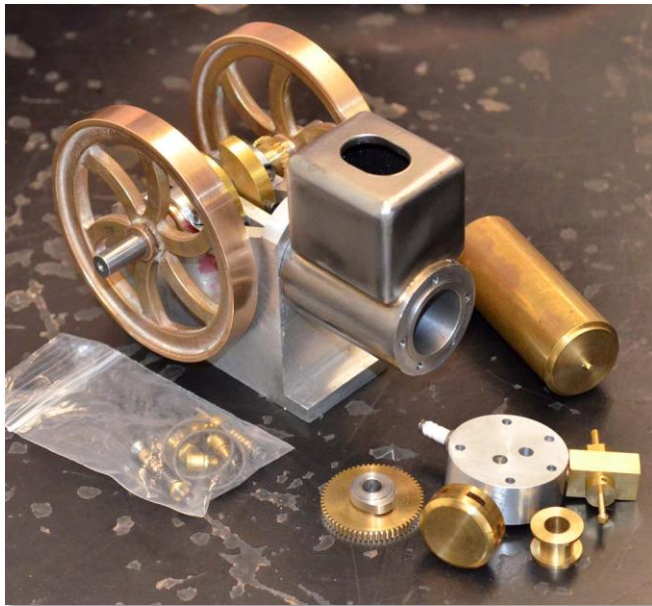


Paul Denham, responding to extreme pressure (and help) from Dwight is forging ahead on the Upshur style engine throttled (not hit and miss) engine. Dwight has supplied both the gears and the cam.



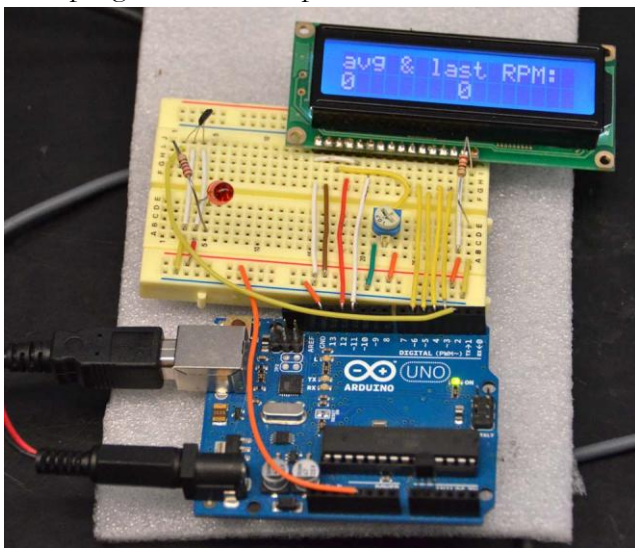
Paul now has nicely done flywheels with Dwight’s name engraved on the outer faces. He is using tapered bushings to secure the flywheels.





Mike Byrne also took up Dwight Giles kind offer of a cylinder and frame assembly as well as the “plans” for an Upshur farm engine. Another Mike, Mike Rehmus, also has the parts from Dwight to complete a similar engine. These builds will be described as a build project in a future edition of “Model Engine Builder”.

Mike Byrne also found the down side of visiting Dwight and his shop, as he came away with a long list of shop projects. Mike feels the obligation to show progress on the Upshur, and these neat tools



and gadgets have become distractions. Mike went tearing off on a tangent to build a digital tachometer for his vertical mill and then spent some more time writing a PowerPoint show to tell us how he did it.

He used a readily available Arduino micro-processor development board.

As he was learning about the processor he figured out that this device could be used for all kinds of neat projects such as: connect a thermistor for a digital thermometer; program a digital spark advance curve for an engine; build telemetry instrumentation; and a digital readout for a lathe or mill. These useful things are in addition to the long list of tooling that Mike saw in Dwight’s shop and would like to add to his repertoire. Mike concluded with “Dwight, it’s all your fault for inspiring the wonderful list of distractions from working on the Upshur.”

Now the tireless Dwight is planning a new and all original engine in the same general format. It will have a unique hopper design; 7/8<sup>th</sup> inch bore, and fabricated flywheels.

Dwight liked the built-up flywheels that John Palmer used on his J and E Junior hit and miss engine. Since imitation is the sincerest form of flattery, Dwight used the same theme with his TIG-welded wheels. He says

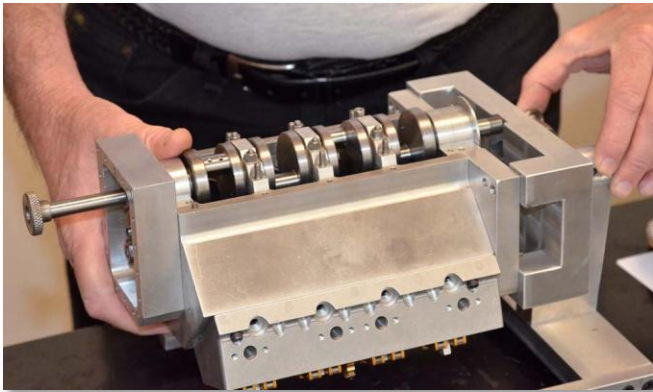


that silver soldering will work as well. No name has been chosen for the new engine.



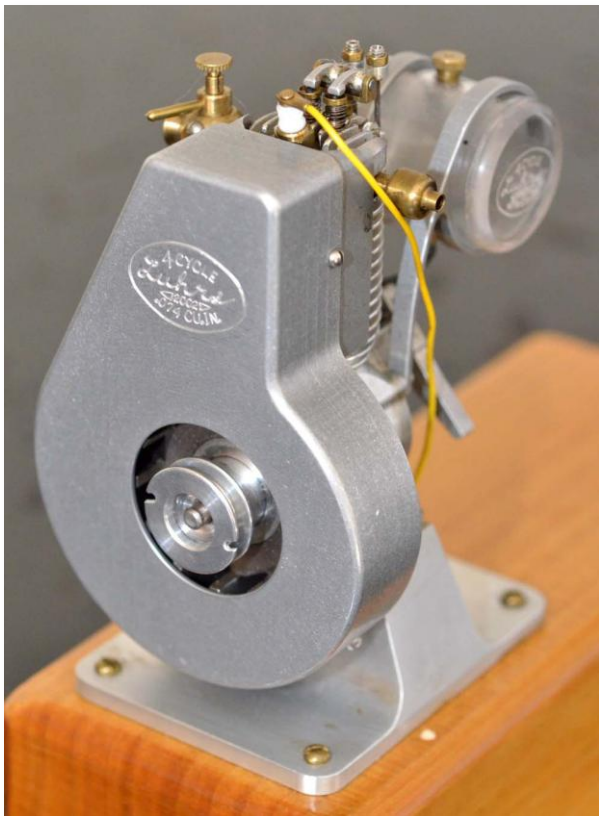
John Gilmore brought us up to date on his Black Widow V-8 build. He has been working with Carl Wilson on the design and grinding of the camshaft

for the V-8. His initial shaft had to be discarded because of an incorrect rocker-arm ratio calculation. This would have resulted in a greatly reduced lift. A new design is in the works.



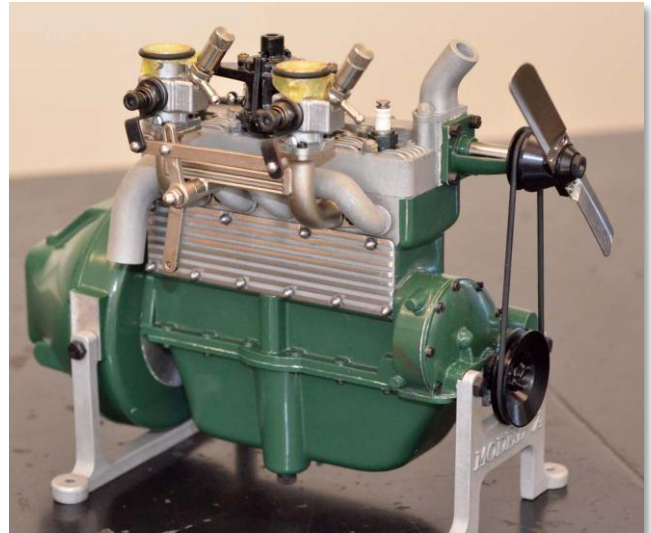
Jim Piazza is going to cut the master cam profile for the new shaft. Ken Hurst is building the blower for this engine.

John has purchased two cylinder heads from club member Jim Kipp in Southern California. They are made using CNC and are extremely well done.



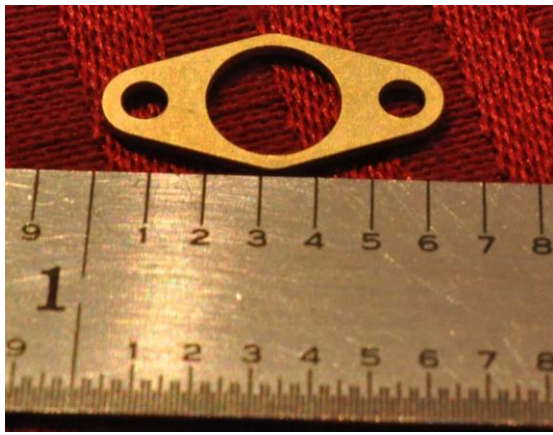
I showed the single cylinder “Briggs and Stratton” style engine that our late friend, George Luhrs, designed and built. George was the absolute master

of the ultra-tiny internal combustion engine. The displacement is .074 cubic inches. A tribute to the memory of this wonderful man will be in the next issue of *Model Engine Builder*.

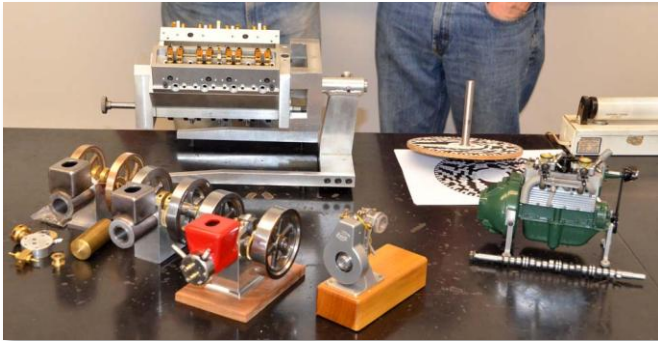


The “Hot-Rod” version of the one-fifth scale Model ‘A’ Ford engine built in the Ukraine was next. This is identical to the engine displayed by Dwight about a year ago, except that the Profi builders made it as the hot-rod version. This involved a finned cylinder head, double downdraft intake manifold with two Stromberg-style carburetors. It also had a finned valve chamber cover. These engines run quite well when fitted with a heavier flywheel. They have excellent compression and the lost-wax castings and the enamel finish are near perfection.





Jim Piazza made some very pretty and very small and delicate copper flanges for the water inlet pipe for a quarter-scale Offenhauser. He CNC'ed it against a sacrifice plate, loosened it with acetone, tumbled it with ceramic media and had a lovely results.



**TECH TOPIC:**  
**How to Reverse Engineer a Camshaft**  
**Carl Wilson**

John Gilmore showed his Black Widow V-8 sporting Jim Kipp heads and valve gear. That was the excuse I needed to talk about the design of the cam lobe profile. This was a BAEM “village” job: I ran the numbers; Roger Slocum checked the CAD drawing; Jim Piazza also checked the CAD work and then CNC milled the master. John ground the cam under the tutelage of Dwight Giles on the Switzer type cam grinder built by Dwight and Ken Hurst. Despite the many spoons in the soup, all turned out well.

John had a specific cam for the prototype: a Crane Fireball II for small block Chevy's. That cam was used by Jim Weber on his V-8 which, to John's ears, sounded authentic, and, of course, John wanted his to vibrate the ear drums in a similar manner. My

job was to figure out the profile used by Crane and design the master required to generate that sound.

There are several inter-related details that have to be calculated. The valve timing was easy: the Crane cam card had all the relevant numbers and these were retained into the Black Widow design.

VALVE SETTING: INTAKE .000		EXHAUST .000		→ HOT	
INTAKE @ CAM 3200		@ VALVE 480		ROCKER ARM RATIO 1.5	
LIFT: EXHAUST @ CAM 3200		@ VALVE 480		ALL LIFTS ARE BASED ON ZERO LASH AND THEORETICAL ROCKER RATIO	
CAM TIMING @ .001		OPENS INTAKE		CLOSES EXHAUST	
LIFT		EXHAUST		ADVERTISED DURATION	
		39 BTDC		83 ABDC	
		83 BBDC		39 ATDC	
				302	
				302	
SPRING REQUIREMENTS					
PART NUMBER 96802					
LOADS: CLOSED: 107 LBS @ 1.800 OR 1 13/16					
OPEN: 284 LBS @ 1.340					
RECOMMENDED RPM RANGE WITH MATCHING COMPONENTS					
MINIMUM RPM 3000					
MAXIMUM RPM 6000					
VALVE FLOAT 6500					
CAM TIMING @ .050		OPENS INTAKE		CLOSES EXHAUST	
LIFT		EXHAUST		MAX LIFT	
		7 BTDC		41 ABDC	
		51 BBDC		(3) BTDC	
				107 @ BTDC	
				228	
				117 @ BTDC	
				228	

The valve lift was set at 25% of the valve head diameter. This is a standard ratio and is close-enough. With the lift and the cam bearing diameter I could calculate the base circle radius which sets the overall size of the cam lobe.

That was a good start and as I worked on the profile I realized that seven numbers were required to define the profile:

1. Lift
2. Duration
3. Cam bearing diameter
4. Tappet clearance
5. Rocker ratio
6. Maximum lifter diameter
7. Acceleration ratio

Picking up the story at #4 (tappet clearance): any tappet clearance will reduce the lift by the amount of the clearance and will also reduce the duration by an amount proportional to twice the clearance. To maintain the timing desired by John I adjusted the lift of the cam to suit.

There is a bit more to the story: the valve lift will be equal to the cam lift only if the rocker ratio is 1:1. For a higher rocker ratio the valve lift will equal the cam lift multiplied by that ratio. Now hold this in your mind while I move on the maximum lifter diameter.

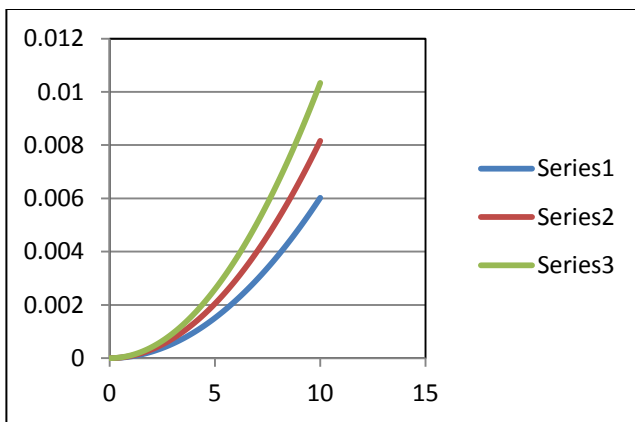
John's Black Widow's lifter bores are 0.250" diameter. The wasp in the jam jar was that any feasible cam profile required a minimum lifter of

about .0300". The edge of his lifters would ride on the surface of the cam lobe and cause excessive wear.

The easiest way out is to reduce cam lobe lift by designing for high ratio rocker arms: in this case 1:1.5. The cam lift will be substantially less than the valve list. That in turn reduces the minimum lifter diameter to about 0.200" which allowed for a margin on the edge of the lifter of 0.025".

At this point reality intruded and John discovered that the Kipp heads had 1:1 rockers and would not accommodate high ratio rockers. That was more than one wasp in the jar – it was a whole nest full! We discussed various "cures" and decided to do nothing. At this time the low lift cam will be used for initial testing of the engine. After all, it only needs to run well and sound wonderful. That is more a matter of timing than of lift. Besides the engine will have a blower and lift will therefore be less important.

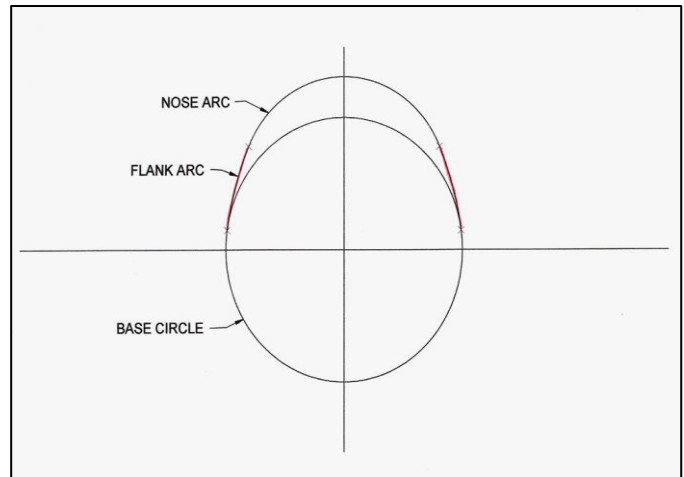
Now for the last number – acceleration ratio – some of you in the audience noted that I ran careful circles around that one. I'm going to do the same in this report. The reason is twofold: the time and space required for the gritty details, and that those details are mathematical. During my research I found two rules of thumb: use a number between 2 and 3; or between 3 and 4.



The horizontal axis is the angle of rotation of the Gilmore Special cam profile starting with the beginning of lift at zero degrees. The vertical axis is lift in inches. The blue curve is the lift for an acceleration ratio of 2; red is a ratio of 3, and green is 4. After 10 degrees of rotation there is a considerable difference in the lift. A ratio of 2 gives

a lift of 6 thousandths; a ratio of 3 gives a bit more than 8 thous; and 4 yields about 10.5 thou. A higher acceleration ratio yields a greater effective valve opening time and thus improved performance. That comes at the cost of higher forces, stiffer valve springs, and greater wear.

I am of the opinion that this number is not very important for our engines. The design method requires a number so for John's cam I used 4.



The broad nose of this cam profile is the result of long duration, high acceleration ratio, and low lift. So far we have wasps and jam jars: the icing on the cake was the approval of this cam profile given by the chief engineer of Crane Cams, who also ran my numbers through his software and confirmed my analysis of the kinematic parameters of the profile. It should work.

So John, it's over to you. I'm waiting impatiently to hear this one painfully vibrate my eardrums into hearing loss.