The Rotating Cylinder Valve 4-stroke Engine
A Practical Alternative

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The Rotating Cylinder Valve 4-Stroke – A Practical Alternative

- ✓ 4-stroke emissions
- ✓ 2-stroke performance
- ✓ 2-stroke price
- ✓ Proven in the field
- ✓ Innovative, but NOT radical

Principle of Operation

- Cylinder rotates around piston at cam speed
- Single port in the rotating cylinder indexes with fixed radial inlet and exhaust ports to provide the valving function
- The rotating cylinder is effectively combined with the rotary valve in a single component, hence the name **RCV** –

Rotating **C**ylinder **V**alve

Technical Issues

- Major engine components are conventional.
- Conventional piston/cylinder
- Conventional crank
- Rotating cylinder around piston reduces friction and gives even thermal distribution.
- Oil cooling system.

One major design issue: the 4-Stroke Rotary Valve itself

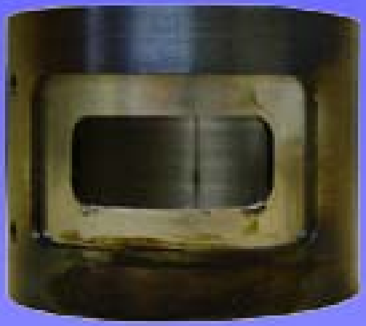
Four Stroke Rotary Valve Design

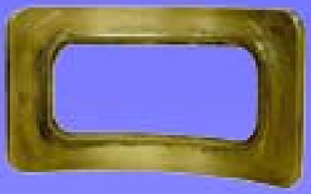
- Various attempts have been made to develop rotary valve 4-strokes
- ‘Cross’ valve design technically successful, but limited cost/performance benefits
- ‘Aspen’ valve design not technically successful
- ‘RCV’ valve design Is technically successful, and offers major cost/performance benefits
- Currently unique legislative incentive to develop low cost 4 stroke technology.

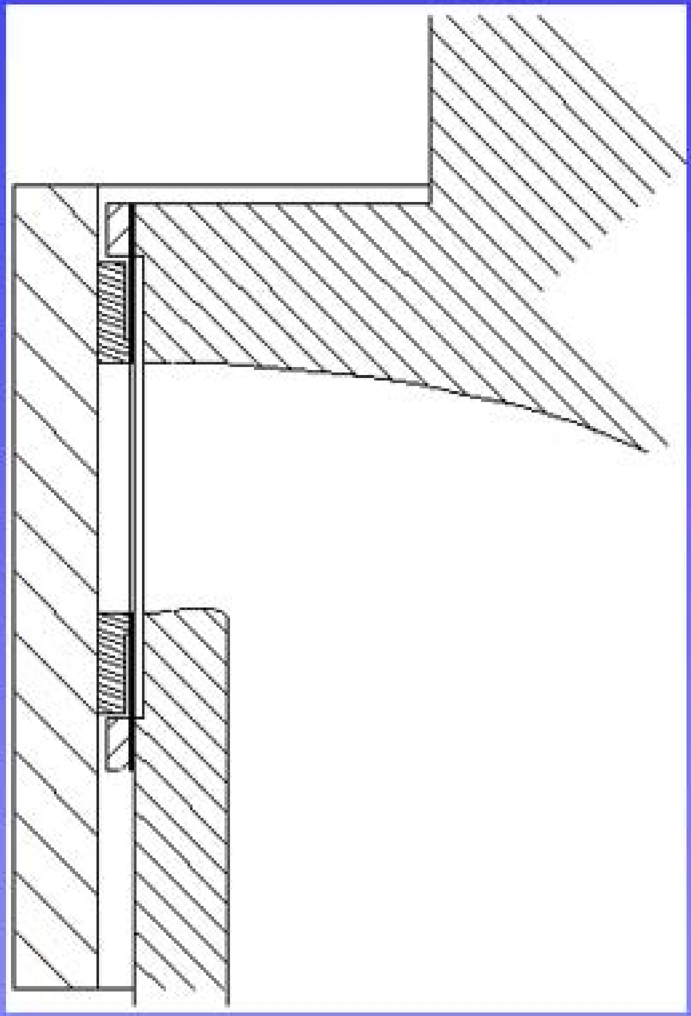
Rotary Valve Seal Design Principles

- A sprung sealing mechanism must be employed
  'The Sliding Seal'
- The spring behind the sliding seal must form a static seal with the rear of the sliding seal
  'The Seal Spring'
- The seal must be arranged so that the cylinder pressure augments the seal spring pressure
  'The Seal Pressurisation Area'
- The seal pressurisation area should be small
- A secondary sprung sealing device must be employed for the inlet and exhaust ports
- All seal components should be kept as light as possible

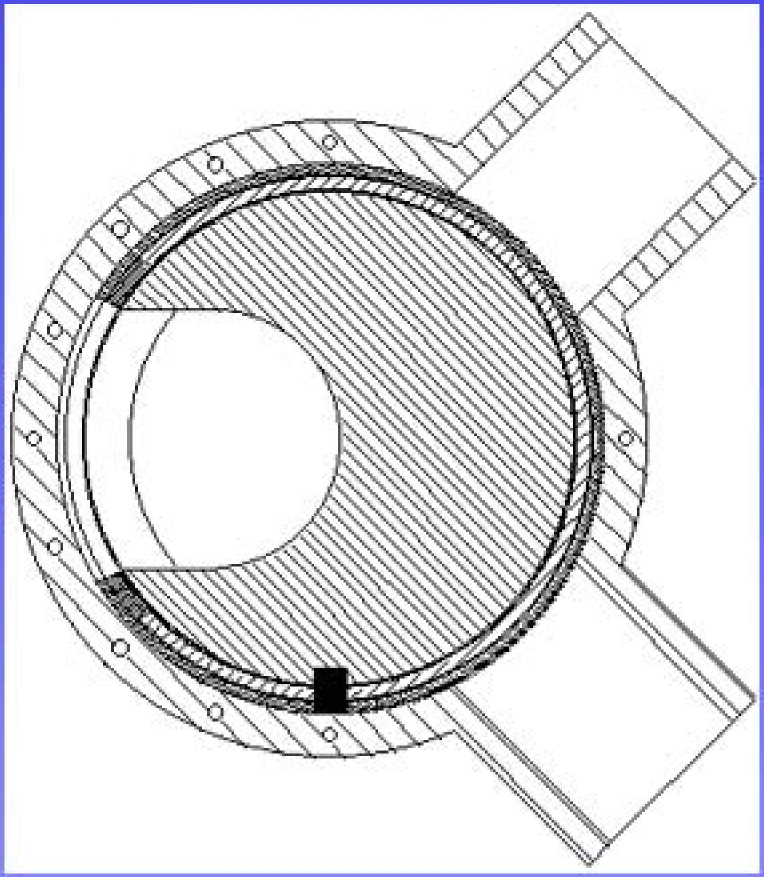
Basic Valve Seal Design







Sprung Expanding Ring Seal Design



Seal Frictional Losses Calculation

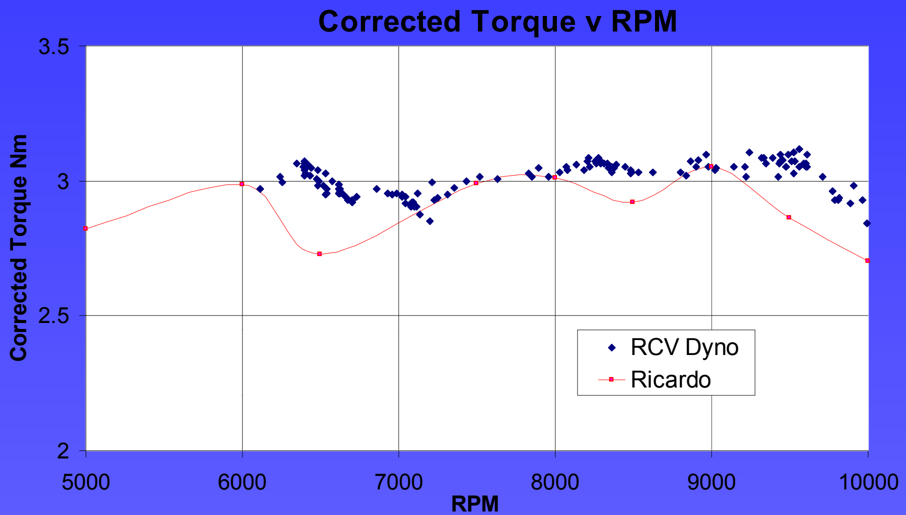
- Seal torque loss is seal force x coefficient of friction x valve radius.
- Seal force is made up of centrifugal force, seal spring force and seal pressurisation force
- Centrifugal force dependant on RPM and mass of seal components.
- Seal spring force dependant on design of seal spring
- Seal pressurisation force is dependant on the seal pressurisation area and combustion pressure
- Most important factor is seal pressurisation area

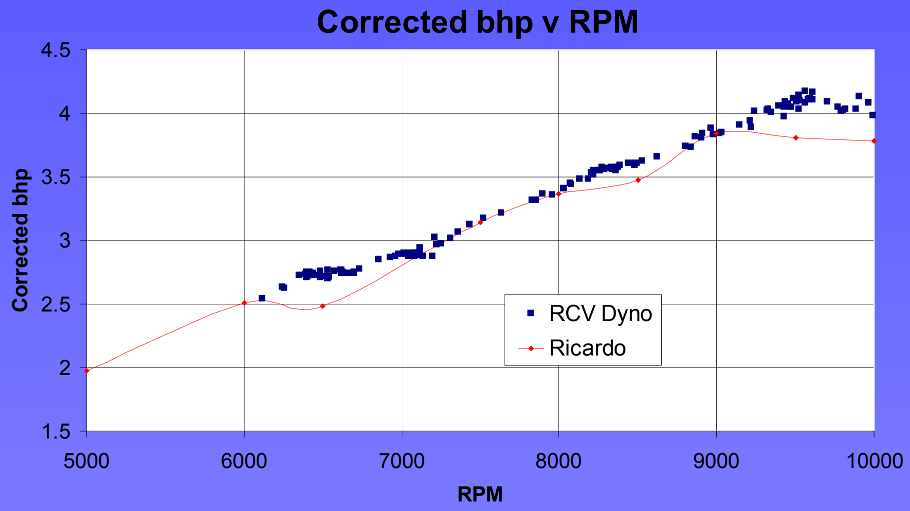
		Seal pressurisation area cm2		
		1.0	**2.0**	**5.0**
Spring Pressure N	**10**	2.1%	3.9%	9.9%
	20	2.6%	4.3%	10.3%
	50	3.8%	5.6%	11.6%

Valve Seal Durability & Lubrication

- A rotary valve is a sliding valve: same surface used for bearing and sealing.
- Sealing surface must be lubricated without excessive lubricant loss or emissions.
- Nearest equivalent to RCV valve is a direct injection 2-stroke piston:- a reciprocating sliding valve which achieves low emissions.
- In general piston/cylinder materials/technologies are applicable to RCV valve design (same surface speeds, temperatures and pressures).
- Sprung seal will cope with significant wear before loss in sealing function.
- Seal currently uses conventional materials.

Current Performance

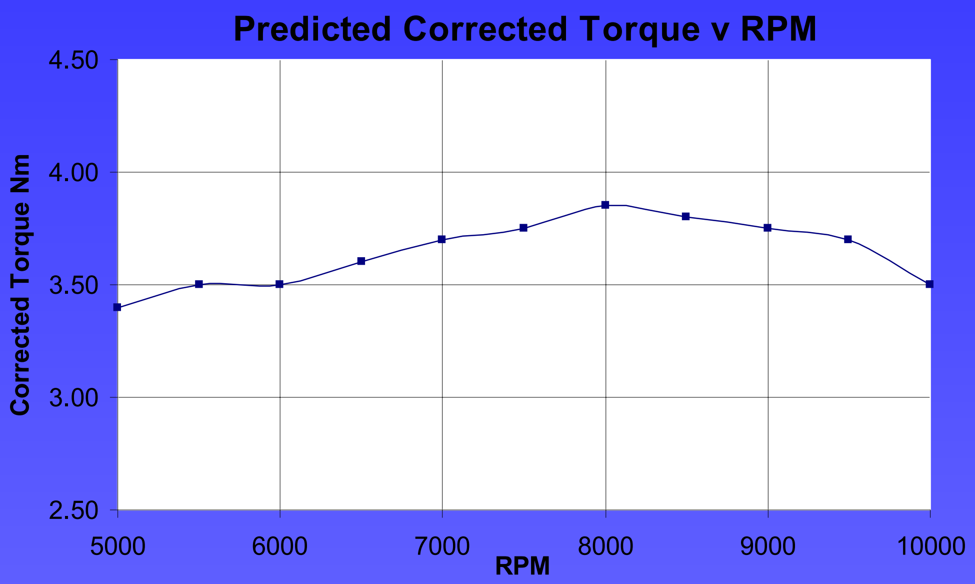


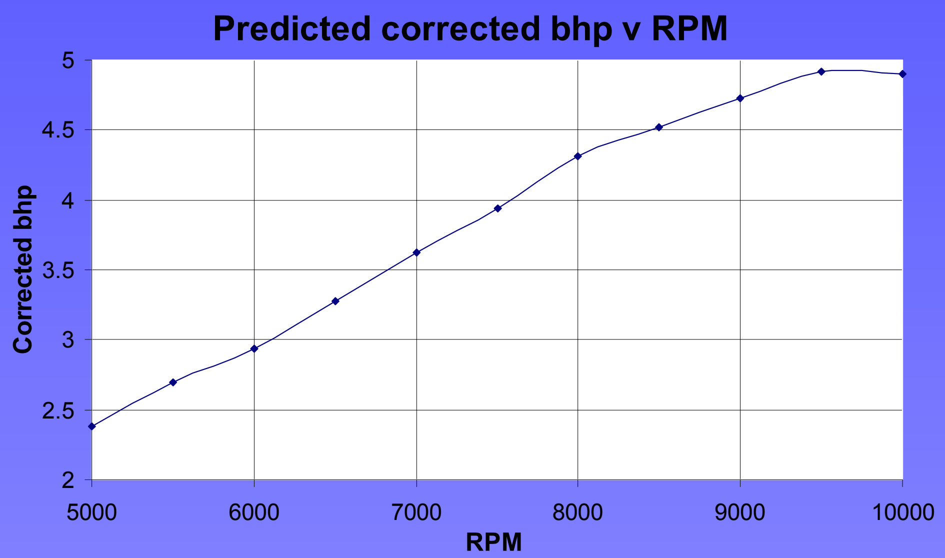


- Corrected max. power 4.1 bhp @ 9500 rpm (ISO 1585)
- 8.7:1 Compression
- BMEP - 8.0
- Peak torque @ 9500 rpm
- Engine is reliable, handles well and starts easily
- Performance achieved without complex setup.

RCV is already matching best production 49cc poppet valve designs

Predicted Performance





Potential power gains following specific improvements

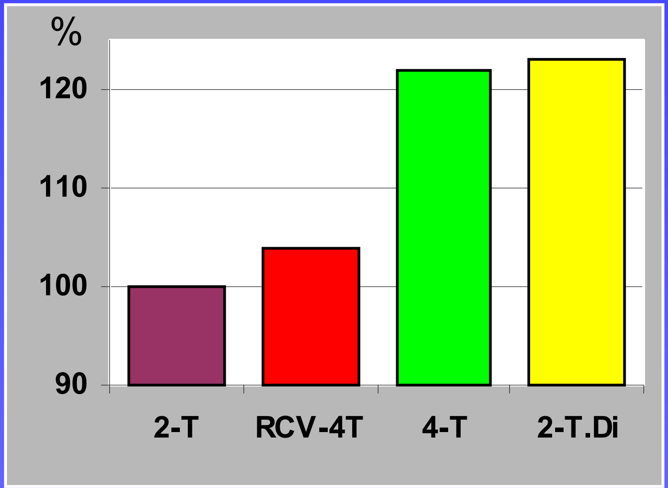
Raising CR to 11:1	8%
Breathing developments	5%
Valve timing and combustion chamber	5%
Inlet / exhaust tuning	5%

Predicted max power 4.9bhp @ 9500RPM

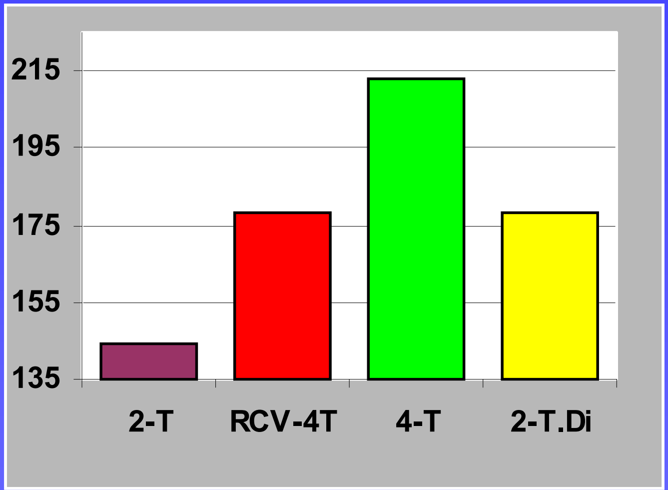
Reduced variator losses means same rear wheel power as 5.5bhp conventional engine

Production Benefits of RCV Design

Relative Cost %



Component Count



- ✓ Lower manufacturing costs. Up to 40% lower than poppet valve or 2TDI
- ✓ Use of conventional components means same plant can be used for manufacture
- ✓ Low component count

Technical Benefits of RCV Design

- ✓ Even thermal distribution
- ✓ Large port area
- ✓ Reduced frictional losses
- ✓ No complex valve train
- ✓ Compact combustion chamber
- ✓ High BMEP

Large port area and high BMEP means the RCV design is capable of achieving high power outputs

Application Benefits of RCV Design

- ✓ High fuel economy
- ✓ Good durability
- ✓ Reduced transmission losses
- ✓ Compact
- ✓ No complex external plumbing
- ✓ Optional low cost balance shaft

Reliability Benefits of RCV Design

- ✓ Uses conventional components
- ✓ Elimination of reliability weak spots
- ✓ Low maintenance
- ✓ Low component count

Conclusions

- ✓ The RCV offers significant benefits over conventional designs
- ✓ The RCV is particularly suitable for applications where emissions legislation is forcing out the carbureted 2-stroke
- ✓ The RCV is a field proven design
- ✓ Most RCV components are conventional.
- ✓ Only significant technical issue is the rotary valve. This has been successfully addressed
- ✓ The RCV engine is a practical alternative to more conventional designs for small engine applications