The Massive Yet Tiny Engine

Raphial Morgado on the MYT Engine Technology

By Tim Ventura & Raphial Morgado, May 11th, 2006

Imagine dumping the big V-8 in your SUV for a 25-pound, 2.4 liter engine that gives you 150 miles per gallon on biodiesel – with a boost in horsepower and torque to boot. Meet Raphial Morgado and the little engine that could... With up to 40 times the power to weight ratio of a conventional engine, flexible fuel compatibility, a displacement of 850 cubic inches and the torque of a 32-cylinder engine, the MYT is the beginning of a new paradigm for engines in the 21st century!

AAG: Let's start out with an overview of this remarkable new engine technology -- basically, you've created a radical new engine design with the "Massive Yet Tiny" (MYT) engine, which has some pretty serious claims in terms of size, performance, and efficiency. Can you tell us about the inspiration for this design?

The MYT Engine: A demonstration at the Los Angeles Auto-Show by Raphial Morgado.

Morgado: When I got back from Vietnam, the chaplain said "get busy or go crazy", so I got busy – I was a sheet-metal worker at the time and I got into drag-racing, and during that period blew up more than my share of conventional engines. Those engines were expensive, complex & difficult to maintain, and I started to wonder if there might not be better way to build a high-performance engine.

That's what gave me the inspiration for the MYT Engine design -- it came from the need to have an engine that can stand up to the tremendous abuse of drag racing. After literally blowing up more than my share of engines during racing, I swore to myself that I'd build something that met the required needs while providing higher-durability & reduced complexity in the process. Also, because this design was originally intended for the output demands of the drag-strip, I wanted a design that would give me the largest displacement, highest torque, and lightest weight available. The Massive Yet Tiny engine meets those needs, with 850 cubic inches of displacement, 32-pulses per cycle, and a 150 pound package measuring only 14" by 14" in diameter.

AAG: The MYT looks a bit like a Wankel rotary turbine, but appears to use 4 sets of paired-pistons that can move in relation to each other -- creating either 4 large "virtual cylinders" or 8 small ones per chamber. Can you give us an overview of how these pistons move in relation to each other to make the engine turn?

Raphial Morgado: The MYT engine inventor.

Morgado: The MYT and Wankel are both rotary engines, but that's where the similarity ends. Unlike the Wankel engine, which contains a solid rotor rotating inside the combustion chamber, the MYT's toroidal combustion chamber features 4 sets of piston pairs in each of the two "disks" (toroidal chambers) that are connected to the crankshaft. These not only rotate around the central shaft, but can also move in relation to each other, which leads to a brand new concept of "virtual displacement". Please refer to animation on our website, at www.angellabsllc.com.

The distance between the pistons is matched with their rotational position to maximize power during the combustion cycle, but the distance greatly decreases when they're not in use. Compare that to the displacement from each blade of the Wankel rotary, which takes up the same amount of space in the chamber whether or not it's in use at any given time. Thus, we're able to put a lot bigger cylinders in a much smaller space with the MYT, giving this engine up to 40 times the power to weight ratio of a conventional internal combustion engine. The magic is the timing, which produces a stop and go motion with the pistons themselves, but produces a smooth, continuous motion on the crankshaft itself.

The Wankel engine, at a weight of 200 pounds, only has 80 cubic inches of displacement, and it only fires 3 times per revolution. The Wankel traditionally suffers from low-end torque & leakage, and only generates good power at high-rpm. The MYT engine shares the rotating qualities of the Wankel engine, but it's a positive displacement pump similar to a conventional piston engine. Also, the MYT engine is not reciprocating – the air goes in and periodically stops, but does not reverse it's motion, which allows the engine to literally breathe more, and hence produce greater horsepower.

Piston Closeup: Eight pistons on two shafts give the MYT engine 850cu of displacement.

AAG: Let's talk about scalability: does the high power to weight ratio of the MYT engine scale very well for larger or smaller applications?

The engine is highly scalable – it's easy to adapt for both very large and very small applications. For instance, we performed a design-study for Exxon-Mobile to replace the 5-story tall diesel engines used on supertankers with the MYT, and replacement design we proposed to them measured only 5 feet in diameter and 7 feet long. This wasn't even as large as a single piston in the original engine!

Also, one of the real benefits to up-scaling the MYT design is that with a larger diameter chamber, we can increase the number of pulses per cycle – in this case, we increased them to over 200+ pulses per revolution without adding significant design complexity, but with a giant increase in output torque!

In terms of downscaling the design, we can still produce high-output small-scale engines for UAV's or even microgenerators for consumer electronics. These require a high power to weight ratio at a small size, and we can build them as small as ½ inch in diameter to power all sorts of consumer mobile-power applications.

The key to all of these applications is the power to weight ratio – the MYT engine opens to doors to previously inaccessible technologies like flying cars that simply couldn't provide enough power to be feasible in the past.

AAG: Since the pistons are both rotating & simultaneously moving relative to each other, I'm wondering if you can give us an overview of what this engine is like in terms of displacement? Also, given the design, how much smaller is the overall engine going to be to a standard automobile engine with similar displacement? The reason I ask is that there's a picture on the site that makes this difference in overall size quite profound...

Morgado: The displacement of the model on our website is 850 cubic inches. For an automobile, though, you could use a much smaller engine -- you'd be looking at an engine about 6 inches in diameter and around 8 inches long, with a weight of around 30 to 40 lbs. That would provide comparable power to a conventional automobile engine, but would weigh much less, providing an additional benefit in performance.

AAG: There's a picture on the www.angellabsllc.com website showing a 2,500 pound Cummins Turbo-Diesel with a displacement of 855 cubic inches next to a 150 pound MYT engine with a virtual-displacement of 850 cubic inches. Does this mean that the tiny 150-pound MYT can outperform the monster that it's sitting next to?

Morgado: Yes, the MYT Engine will easily beat the Cummins, both in torque and horse power! The Cummins engine is only a 6 cylinder engine (6 pulses) -- compared to the MYT Engine with 32 pulses (32 cylinder equivalent).

AAG: The same graphic suggests that the MYT performs like a 32-cylinder engine (if such a thing ever existed) -- does this mean that it's also an incredibly smooth-running engine, and does this give it higher torque?

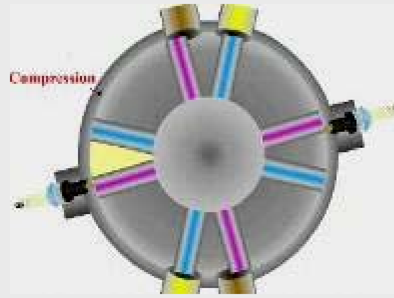
Morgado: A 32 cylinder engine with a radial "Corn Cob" configuration really existed. It was used by Howard Hughes in the "Spruce Goose". It was big & heavy, at around 2 tons in weight with dimensions close to 5 feet in diameter and 7 feet in length.

The MYT Engine is silk smooth in operation due to the well perfect balance, equal & opposite component arrangement. We all know a V12 engine will always put out more torque than an inline 4 cylinder. The MYT Engine with 32 pulses puts out tremendous amounts of torques with very little friction losses.

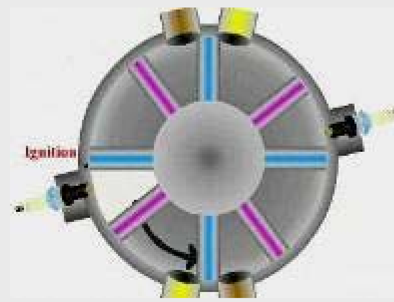
(torque) At 800 RPM, with 150psi of input pressure, the output torque is over 814 foot pounds of torque with and

MYT ENGINE CYCLE

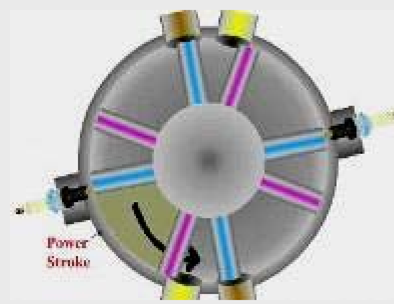
1: Air Fuel Intake



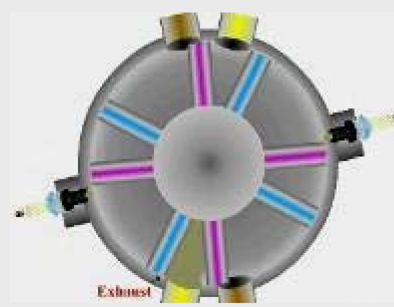
2: Compression



3: Ignition



4: Power-Stroke



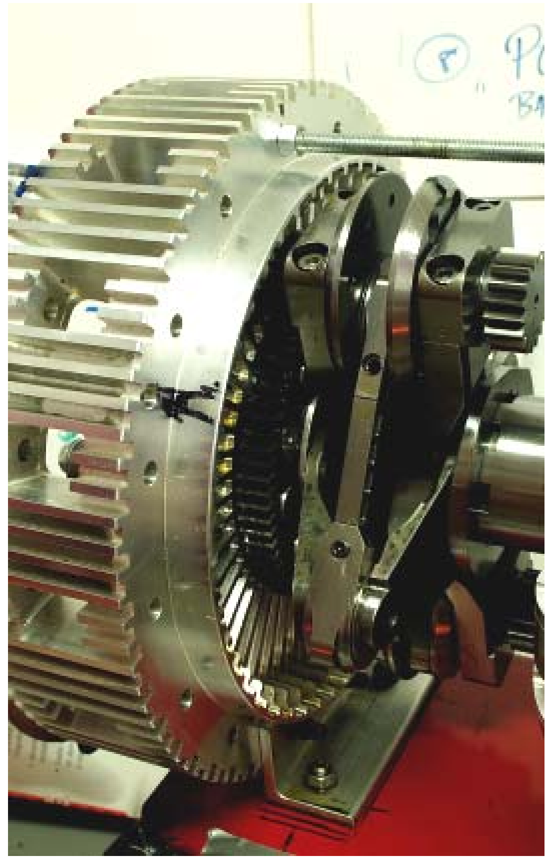
5: Exhaust

134 horsepower. That's on input air pressure alone – by burning fuel in a diesel cycle you can multiply that 5 times, which takes it up to 4,000 ft/lbs of torque!

AAG: Ok, disregarding the MYT's smaller size for a second, let's focus on efficiency: for a given consumption of fuel compared to a conventional automobile engine, how does the MYT compare in terms of power, rpm, and torque?

Morgado: Although the MYT Engine has 32 pulses, it does not have 32 individual cylinders and the friction from the associated components. Since the MYT is the equivalent of a 32-cylinder engine, you're essentially eliminating the kind of losses that you'd otherwise see in 4 V8 engines – this means that for the first time in a hundred years, the MYT engine makes all of that energy available at the crankshaft.

The MYT engine only has 15 moving components, which means that the RPM can be set higher because there aren't any reciprocating parts or cylinder heads with valves prone to "valve float" – the MYT doesn't have valves, lifters, or a camshaft. Again, with 32 pulses per cycle and approx 3,000 foot-pounds of torque, the fuel consumption is expected to be 3 to 6 times less because of lower friction and longer piston duration at Top Dead-Center (TDC), which lets us extract lot more energy from every gallon of fuel that we burn.



MYT Engine Gearing: Ratchets the pistons to provide 32 combustion pulses per cycle.

We're running the MYT engine in compression-ignition (diesel) mode, which has twice the thermal efficiency of a conventional gasoline engine. Also, the MYT has far fewer components to create friction compared to a conventional internal combustion engine. Add in the lack of valves to allow greater breathing, and you get higher power & much greater efficiency.

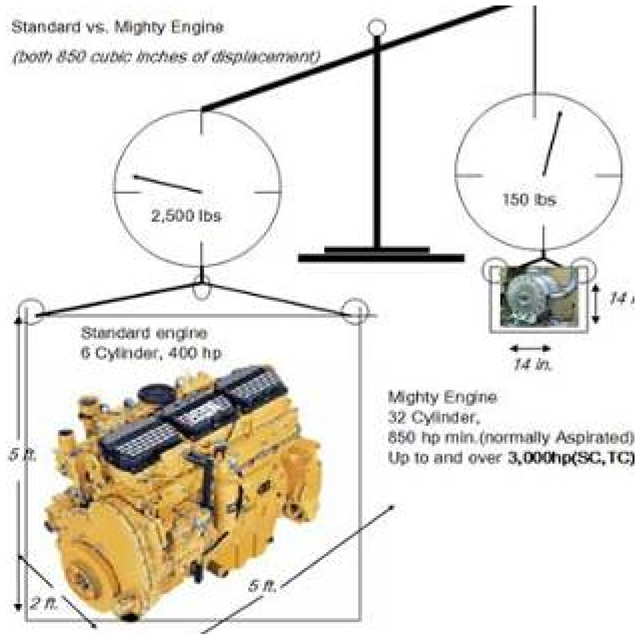
By replacing an 800 pound V-8 engine with a 25 pound MYT and running it on biodiesel, we can achieve 150 miles per gallon in an otherwise conventional vehicle – plus, you're going to have better take-off and stopping power by removing that 800 pound engine. That's what we can do. It is achievable.

AAG: As I understand the design, the MYT lacks 80% of the components required in a conventional engine, and yet produces higher-efficiency by allowing the pistons to stay in a Top-Dead-Center position for a longer duration, which produces a better overall combustion. Can you explain this a bit for us?

Morgado: At Top Dead-Center (TDC), a standard internal combustion engine has zero degrees of duration – in other words, the piston is always either approaching TDC or leaving it, but it doesn't ever remain there. In comparison, the MYT Engine has a carry-over of 12 degrees at TDC due to the 2 crankshafts' duration at the timing events. We expect a very clean combustion of the fuel-air mixture that lasts the duration of the power stroke, giving us better performance and a cleaner burn than in a conventional engine.

AAG: At least a few of the "missing components" in the MYT are the valves, right? The pistons create a one-way airflow action that eliminates the need for intake & exhaust valves, meaning that the engine only requires open ports, and hence breathes better. Can you elaborate a bit on this for us?

Morgado: Yes, there are no valves, and this means that the MYT engine breathes much better than a conventional engine does. Also, it gives us a lot of design flexibility -- the ports can actually be the same size as the bore or even larger since both sides of the piston are exposed to the intake and exhaust ports. As you might imagine, this opens the door to some very interesting possibilities for future designs.



Comparison: The 150 MYT design outperforms a conventional 2,500 lbs V-6 at 850 CI of displacement.

AAG: Because there are no valves, the MYT also doesn't require a cam-shaft to actuate them, which further eliminates the timing chain, lifters, and (in your design) even the cylinder heads! These components are usually involved with timing, though, and I'm wondering how you synchronize timing without having the normal cam-components to reference against? In fact, does the MYT even use sparkplugs?

Morgado: In the MYT Engine, the pistons have numerous functions -- they act as the cylinders, combustion chambers, valves, pistons, clock timing, and as continuous fans to suck in air and move it in the same direction with no reciprocation. You could easily integrate spark plugs if you want to run this on gasoline, however, the thermal efficiency of diesel is about double that of gasoline, so we prefer to run the MYT engine in diesel mode, which doesn't require plugs.

AAG: One of the real miracles in this design comes from the fact that you haven't engineered any new components for it -- all of the parts originate from conventional internal combustion engine designs and are thus less prone to suffer new or unexpected design-related failures, right?

Morgado: Correct. That's the real beauty of the design that will guarantee both ease of production and immediate market acceptance for the MYT engine. We're hoping that the fact that it can be constructed without major retooling means that it's suitable for a rapid commercial launch by engine manufacturing licensees.

AAG: Does the elimination of all these components give the MYT a higher top-end RPM, and what kind of power does it produce at the higher-end? Also, what RPM would you say the sweet-spot for the engine is?

Morgado: Correct. It can rotate at higher RPM. However, for best fuel economy, 1,800 to 2,000 rpm is best for the 850 cubic-inch displacement MYT Engine. We plan to use this particular engine size for 80,000 pound, 18 wheeler trucks. The RPM can be efficiently run much higher with our 2.4 liter MYT engine, which can optimally run at 10,000 to 15,000 RPM. That's also a smaller engine -- measuring only 4.5 inches in diameter x 7 inches long and weighing only 25 lbs.

AAG: Speaking of higher-RPM, you've said that this engine is suitable for use even as a jet-engine, and I'm wondering how it might work in an aircraft? Also, given the tremendous rotation speeds in a jet-engine, would you have to modify the piston rings or lubrication for the higher-velocities involved?

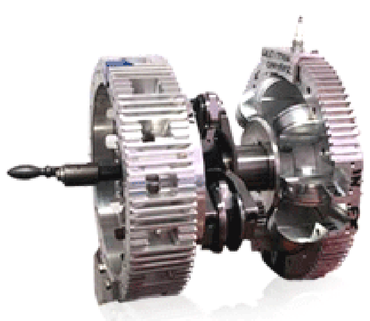
Morgado: The MYT engine will replace today's high-bypass turbofan engines for military & commercial airline applications. In a turbofan engine, 85% of the thrust is generated by a huge fans rotating at 3,000 RPM. The fan is typically driven by a jet-turbine rotating in excess of 20,000 RPM, with reduction gearing down to 3,000 RPM to rotate the fan. Thus, in a high-bypass turbofan engine, the turbine itself only contributes about 15% of thrust.

Cummins Turbo Diesel Engine	Mazda Rotary	The MYT™ Engine
Bore: 5.5", Stroke:6", 6 Cyl, 855 Cubic Inches Displacement, approx. 3,000lbs.	Engine 4cyl. Equivalent, 80 Cubic Inches Displacement approx. 200lbs.	Bore:3", Stroke:3.75", 32 Cyl. Equiv 850 Cubic Inches Displacement approx. 150lbs.

Comparison: The MYT weighs less & outperforms the Mazda Rotary & Cummins Turbo-Diesel engines.

By eliminating the primary jet engine and reduction-gearing on the turbofan engine and replacing it with a back-to-back version of the MYT Engine (64 pulses), a new turbo fan will be born that has a much higher power to weight ratio, runs more quietly, and has a greater mechanical and fuel efficiency than the thirsty jet engines in use today.

The back-to-back version that I mentioned contains rows of pistons in both the front and back of that produces 64 pulses per cycle, with a power to weight ratio of 40, which is double that of the most advanced jet engine on the planet! It's even better when you compare it to conventional jet turbines, which have only a 10 to 1 power-to-weight ratio. This is suitable for revolutionizing high-bypass-ratio turbofan applications in the aerospace industry.



The MYT: An exploded view of the 8-piston engine prototype.

AAG: In terms of experimental testing for this engine, there's at least one prototype shown online, and I'm wondering how many you've built and if you've been able to test the engine in an automobile yet? If so, how'd it work compared to the original internal combustion engine?

Morgado: There are 3 engines built and numerous parts. Most testing was done with the bullet proof prototype #1. It has been installed on a Ford Focus car running as a hybrid air car. A wonderful discovery but we can not disclose more. Please be patient.

AAG: What about smaller tools, where the bulk of traditional engines really gets in the way? Have you tested it in something like a chainsaw, weed-eater, or lawnmower yet?

Morgado: We're currently working on a new 2.4 liter engine to drive cars and the Angel's Flight Pack, but with more R&D dollars, we can downscale the design to even a 1/2-inch diameter engine as long as internals can handle the loads. The MYT engine architecture is scalable to any size.

AAG: From reading through the website, it appears that you've got both gasoline & diesel versions of the engine, right? Have you tested alternative fuels with it like ethanol, propane, or natural gas?

Morgado: We have not tried gasoline yet – we prefer to work with soybean based biodiesel, the only fuel that doesn't require oil change. However, the MYT will run on gasoline if you incorporate sparkplugs into the design.

AAG: Since you're already patent-protected for the engine design, have you considered selling kits or completed engines for people to experiment with? If so, what kind of price range would one of these engines be in?

Air Motoring: Compressed air testing at 150 psi generates over 800 ft/lbs of torque!

Morgado: Our business is to license the MYT engine technology so that new and/or existing engine manufacturers can license the technology and market, service customers all over the World. We are willing to license to any company with minimum license fee of $3M. Since it only takes 20 parts to manufacture, any company with reasonable funding can enter engine manufacturing business.

We're not in production yet, as we just came out of stealth-mode to begin educating the world about this technology, and one of our initial goals involves licensing the technology to auto manufacturer. We're also working on a small pilot production line to help introduce this engine to the market by constructing a series of 2.4 liter engines -- and we'll invite you over to watch the dyno tests when we get them ready to ship.

The claims for the MYT engine are so incredible that it's something that a lot of people have to see to believe, and we may have to actually begin selling production models before the commercial marketplace takes us more seriously, although licensing it to existing manufacturers is our preferred strategy. Once it launches, though, these will be easy to produce, because it uses components already found in conventional engines – there's not a lot of R&D left before we can put this directly into commercial service in a number of applications. At present, though, we're starting with the fundamentals, which mean that we're seeking recognition & publicity to build interest & educate the public.

AAG: Speaking of selling engines, have you been approached yet for any work in integrating this engine design into a marketable product yet, and what types of companies are you open to working with?

Morgado: We're currently in talks about licensing the engine with a number of companies small, medium, and large, and hope to sign license contracts in the near future. Unfortunately, we can't reveal their names at this time.

AAG: I've seen the animation online, but I'm wondering if you have any actual video of the MYT in action?

Morgado: We demonstrated the engine at the Los Angeles Auto Show, and shot a bit of Sony Handycam footage that shows the relationship of internal timing to piston movement fairly well, and of course, the presentation shows the air motoring tests which were performed by injecting compressed air into TDC to emulate fuel ignition.

Angel Labs: The Angel Labs team shown accepting an award in NASA's 2005 "Create the Future" contest

AAG: Are you currently looking for funding to further develop these engines, and how can potential funders or the general public get in touch with you to learn more?

Morgado: Yes, we are talking to a few investment bankers for financing. We have a lot of interest from supporters (to buy an engine and/or to invest into the company) and we will work with them through our website and the Forum.

We've already spent $4 million dollars on R&D for this engine over the last 5 years, and we're seeking our next round of funding to begin the next stage of testing. We're going to conduct more tests using soybean oil because it's self-lubricating, which makes it simpler to work with. The MYT can run on any kind of fuel, though – including biodiesel or gasoline. Thus, we believe that this engine is inherently environmentally friendly in addition to it's many other advantages.

Raphial Morgado is the inventor of the Massive Yet Tiny Engine, and the co-founder & managing member of Angel Labs, LLC in Lodi, California. You can visit Angel Labs online at the following URL: http://www.angellabsllc.com