

The BMW R1100RS Motorcycle Engine



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The BMW engine, nestled in the cowl of a CH601 UL, sportin' a light-weight WoodComp www.woodcomp.cz ground adjustable propeller.

Do you think that the FAA or other regulatory agencies throughout the world are difficult to deal with? Try building and flying your own plane behind the Iron Curtain. This is how 39 year old Kuba began his aviation obsession. Now living in Konstancin, near Warsaw, Poland, Kuba has built 300+ hrs flying European "Microlights", mainly powered by automobile and motorcycle conversions. From East Germany's Trabant (an atrocious little boxy 2-door automobile, featuring a two-cylinder two-stroke 600cc engine) to West Germany's BMW pride.

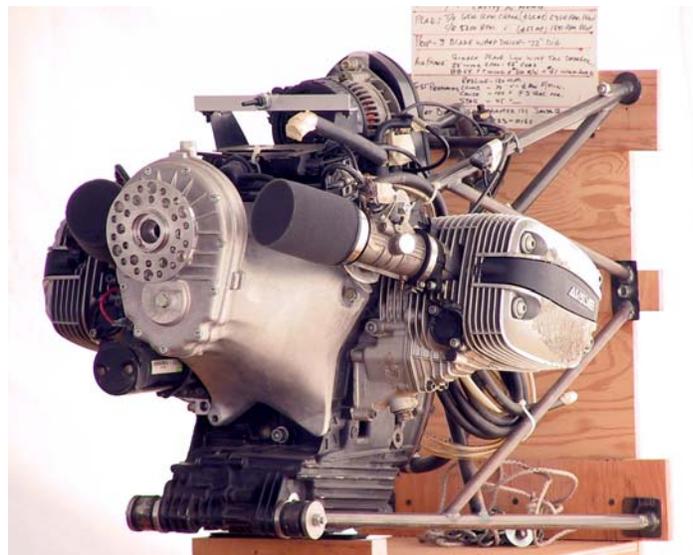
Are you searching for a new 100 HP engine for your experimental aircraft or future design? Then please read this article based on my personal experience with the BMW R1100RS motorcycle engine, as installed in the Zenair Zodiac CH601 UL. The particular plane I have experience with flew more than 1000 hours in 2003 with most of that flight time being logged as training flights at a local flight training school. Approximately 4,500 landings were logged, so in my estimation, this was a real test of the engine.

Kuba currently owns two planes: Czech's "Tulak" with his own 1800cc VW conversion installed and a motor-glider. But, (as Kuba puts it) "to stupid Polish regulations" all his flying has to be done in the nearby, aviation friendly Czech Republic.

While living behind the Iron Curtain, Kuba broke the law by building a motor-glider. His first flights were also illegal, being flown from an illegal airfield. This could make for an interesting movie. Now that the wall is down, Kuba is free to build his own machines, using almost every engine available (except, as he puts it, "to expensive Rotaxes"). With no available technical support from the manufacturer, all design work is seat-of-the-pants and truly experimental. Considering liquefied petroleum gas (LPG)? He's familiar with it. How about Diesel? That's old news. Kuba is now embarking on refining the BMW motorcycle engine, more specifically the 1150cc version.

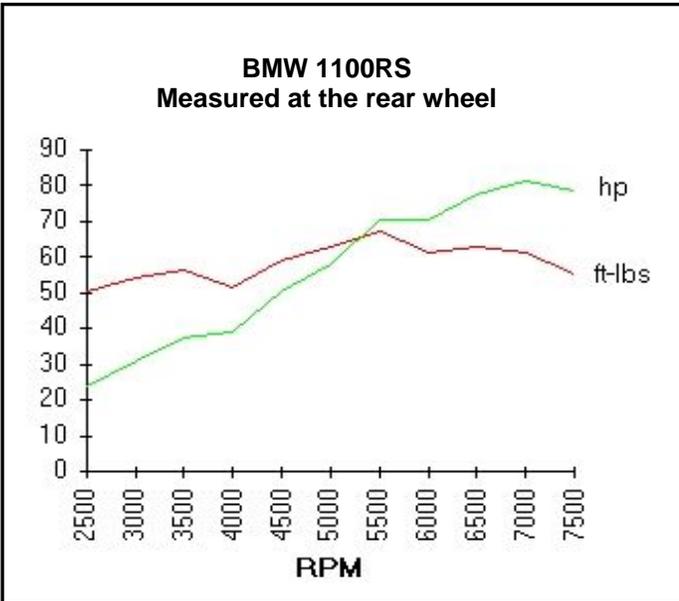
English is certainly not Kuba's native language but that's how he submitted this article. I've done my best to tweak it for him with out losing his voice. I hope you enjoy reading this article as much as I enjoy bringing it to you.

~ Pat



The above engine was displayed in the engine forum tent at Copperstate 2003. It's the product of Art Luther and he was kind enough to speak on the engine. Although this is not the same exact series of 1100cc BMW you are reading about, the redrive is the same.

Please note that this article describes the negative experiences (problems) encountered, none of which would cause us to quit using this engine. Be assured that any and all future projects of ours will utilize this great BMW engine. One issue more: All the opinions expressed are my own; I don't have any connection to "BMW", or the engine's conversion company "Take Off GmbH", www.takeoff-ul.de or any other company or business invested with BMW. I do not guarantee your results will be as good as ours and always remember, this is not an aircraft engine. Please also keep in mind as you read this, we are not engineers nor professional aviation mechanics. We are a bunch of enthusiasts and our testing is less than scientific. Please regard all these writings as those of an informed, experienced, amateurs.



BMW R1100RS

This is a two cylinder, 1100cc "boxer", 4-stroke, fuel injected engine with a single electronic ignition system. Power is rated at 100 hp @ 7500 rpm. The alternator is rated at 600 W (40-50 amps), and there are several reduction drives available: 2.46:1, 2.75:1, 3.05:1, 3.46:1. The weight is approximately 76 kg (168 pounds), dry, without the exhaust system

The engine we flew was converted by "Take Off GmbH" of Germany and used a reduction drive with a ratio of 3.05:1. In my opinion, 2.75:1 would probably work best, but we are going to check 2.45:1. The engine is equipped with a type of centrifugal clutch (It's an odd sight to see the prop spinning from the wind with the engine off.) This clutch allows the engine to run more smoothly and can also save the crankshaft in the event of a prop strike. We love this feature because our students must make hundreds of simulated forced landings -this is really good thing if you mustn't turn engine off for this.

COST

A new, aero-converted engine with reduction drive can cost about 7500-8500 EURO (around \$9-10,000 USD) Used engines can be secured and used as a starting

point. The cost of a low time engine (about 40,000km or about 25,000 miles) if purchased with out the computer and the injection system, can run as high as 1,500 EURO or \$1,800 USD. 5,500 EURO (\$6,500 USD) can get you a good used and very complete engine. The reduction drive can set you back another 2,000 EURO (\$2,500 USD). It all depends on the source, but you can find engines from a wrecked bike for the salvage price.

PERFORMANCE

The CH601 UL is typical all-metal Microlight. Due to its "school" function, the prop was set for best take-off and climb performance. With two persons on board, we saw a typical 5 meters per second vertical speed (1,000 FPM) and achieved 140km/h (70MPH) economy cruise. The fuel consumption at this setting is about 10-12 liters per hour (2.6-3.17 US gallons) of typical 95 octane automobile fuel. *Editor's note: With a "standard" BSFC, 2.6 GPH works out to be around 38 horsepower.*

The flight parameters for a "cruise" prop depends on the propeller manufacturer. When we set to approximately 20°-21° @75% power, we saw a 170 km/h (105 MPH) cruise, and 220 km/h (135 MPH) as max horizontal top speed.

Here are a few examples of typical engine speeds:

Engine Idle, prop not spinning - 1,200RPM

Centrifugal clutch engaged - 2,200 RPM

Cruise - 4,800-5200 RPM

Redline -7,200 RPM (depends on prop)

MY OWN OPINION

Excellent, brilliant engine, but at this time, the reduction drive leaves a bit to be desired. The reduction drive looks like it was designed for a pusher application. We are in the process of manufacturing our own redrive and it MAY be ready by the time you read this article.

With a new clutch and redrive there were no problems for the first 400 hours with the plane doing 99% take-off and landing exercises (patterns or circuits if you prefer). The engine manual supplied by "Take Off GmbH" states that the clutch is good for 400 hours and at exactly 400 hours, we encountered vibrations just before the clutch broke. The vibration was minimal at idle (1,200 RPM) and between 3,000-3,500 RPM. We replaced the clutch but after the next 250 hours, problems begin again. We fixed it a few times with these same results; due to vibrations we had a broken flywheel.

The flywheel is stamped steel, about 5 mm thick with a steel ring gear held in place with rivets. All damage was similar, just loose rivets. When we modified it to accept solid screws instead of rivets, the steel cracked. The boxers typically have a big and fast changes in a moment of inertia (torque) which simply destroyed our flywheel. The solution was a 3.90 kg flywheel. The original was only 1.90 kg, too light-weight and weak in my opinion. Once installed, the new flywheel made the engine run a bit smoother and seemed to solve our problem; the