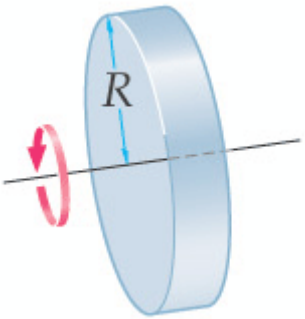
PROPELLERS & MOMENT of INERTIA

The inertia of an object is its capacity to resist a variation of speed. The slowness is directly connected to the mass of the object and thus confronts in kg.

For rotating objects, the mass is not a sufficient information. The mass of the object is associated with its distance by report the axis of rotation, in order to compare the capacity of resistance with a variation of angular speed.

It is the moment of inertia : **MOI (in kg.cm²)**.

The moment of inertia is a very important data for the propellers.



Indeed, the aeronautical engines are mostly piston motors. The brace undergoes a push of the connecting rod in every tour in 2-strokes engines, and both tours in 4-strockes engines. The brace is accelerated during an about-turn, and is slowed down during the rest of the cycle. It is the inertia of all the rotary set which is going to allow to assure the rise of pistons and regularization of the rotation.

The propeller makes the biggest steering wheel of inertia. If it is pulled by a reducer, the points of engine torque will be supported by the reducer. If it is directly bound on the brace (for direct drive engines), this one will support all the efforts. The efforts are besides passed on through all the system: the braces of redrive engines can also suffer if the moment of inertia of the propeller is too high. And the screws of the propeller are submitted to the same efforts.

Using of a propeller with a moment of inertia upper or lower to the values indicated by the engines manufacturers is going to decrease of the longevity, even to break the reducer or the screws of the propeller.

That's why the engines manufacturers indicate the value ranges of moment of inertia of the propellers which can be adapted to their engines.

Example for ROTAX engines, see the Rotax document : Propeller mass moment of inertia for ROTAX® Engine Type 916 i (Series), 915 i (Series), 912 i (Series), 912/914 (Series) and 2 Stroke Aircraft Engines (2021-05-28)
ROTAX SERVICE INSTRUCTION ref SI-912-034

3.3) Admissible mass moment of inertia

Depending on construction of the various propeller gearboxes offered by ROTAX®, the maximal admissible mass moment of inertia of a propeller is for

	Min.	Max.
Gearbox "A" and "B"	-	3000 kg cm^2 (7.119 lb.ft.^{2})
Gearbox "C"	-	6000 kg cm^2 (14.238 lb.ft.^{2})
Gearbox for 916 iSc B	1500 kg cm^2 (3.559 lb.ft.^{2})	9000 kg cm^2 (21.357 lb.ft.^{2})
Gearbox for 915 i A	1500 kg cm^2 (3.559lb.ft.^{2})	7500 kg cm^2 (18.238 lb.ft.^{2})
Gearbox for 912 i Sport	1500 kg cm^2 (3.559lb.ft.^{2})	6000 kg cm^2 (14.238 lb.ft.^{2})
Gearbox for 912	1500 kg cm^2 (3.559lb.ft.^{2})	6000 kg cm^2 (14.238 lb.ft.^{2})
Gearbox for 914	-	6000 kg cm^2 (14.238 lb.ft.^{2})

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Other example : on Jabiru 2200 engine, max MOI = 3000 kg.cm²

Be careful : in case of problems linked to the use of an unsuitable propeller, with a too high moment of inertia, engines manufacturers may refuse any guarantee.

Example at ROTAX :

Warranty
Using propellers of a mass moment of inertia above the max. admissible values indicated by ROTAX® means reduced lifetime or damage of the gearbox.
For such defects due to propellers of excessive mass moment of inertia ROTAX® refuses any claims for indemnity regarding product liability and warranty.

The E-Props moments of inertia are calculated when the propellers are designed. Then the data are verified and measured for each propeller.
The MOI values are indicated on each E-Props model (see the E-PROPS catalog).
They are all within the ranges imposed by the engine manufacturers.

=> It is important to know the moment of inertia of the propeller, and verify that this MOI respects the limitations of the engine manufacturer.

MEASURE OF PROPELLER MOMENT OF INERTIA

The procedure is described in the => ROTAX SERVICE INSTRUCTION ref SI-912-034

Thanks to their great lightness, the E-Props propellers largely respect the maximum moment of inertia limitations recommended by each engine manufacturer. They are also designed to respect the minimum limitations.