

# NEUFORM–3-Blade-Variable Pitch Propeller R2 Series

## Operating Manual

for Rotax 912, 912S, 914

Manual control by hand lever (H)  
or electric constant speed control (ECS)

Date: 28 April 2010



Your NEUFORM-Distributor:

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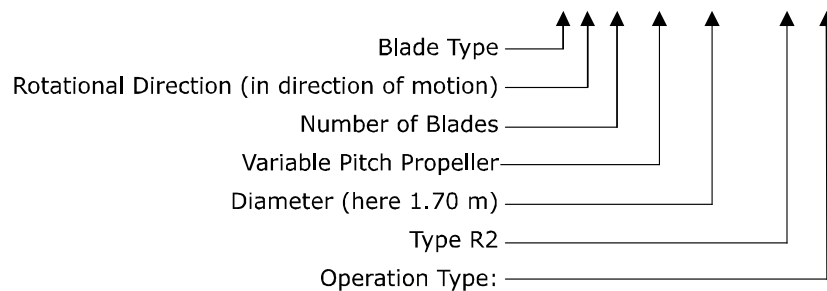
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#### List of amendments

<b>Date</b>	<b>Amendment</b>
15 February 2008	Re-edition after TM-08-01
28 April 2010	a) Increase of check time interval from 500 hours (3Years) to 750 hours (5 years) b) Addition of in-flight-operation for constant speed control operation <i>ECS-M</i>

## Type Description

### NEUFORM CR3-V-70-R2H



H - Manual Control with hydraulic hand force transmission

ECS - Electric Constant Speed Control

## General Remarks

The NEUFORM-Variable Pitch Propeller was designed for operation with the Rotax 912UL (59,6 kW), 912ULS (73,5 kW) and Rotax 914UL (84,5 kW) engines. Operation with similar engines is conceivable, but was not tried previous to the preparation of this manual.

There are two different propeller control methods available. Manual control is done by active change of the propeller blade angle by the pilot. When changing cruising speed, the pilot will have to adjust the propeller to the new cruising speed by hand-operated lever. With the constant speed control version, this is done automatically.

The propeller was carefully designed and calculated and before first delivery tested as well at our test plant (overload with double centrifugal force) as under flight conditions. As customary in ultra light aviation, the propeller has no certification according to FAR or JAR. *You use the propeller at your own risk.*

For operation, operation limits and due maintenance intervals must be observed.

## Operation Limits

Maximum nominal power input 84,5 kW (115 HP)

Maximum rpm 2600 1/min

## Recommended Accessories

Due to economical reasons it is advisable to set up the defined power settings recommended by the manufacturer of the engine. (See Rotax Aircraft Engines, Operation Manual for Rotax 912 resp. 914 Series). For this, a manifold pressure gauge is needed.

## In-Flight Operation

### a) Manual Control ("Control H"):

#### General Remarks

Control is done in several steps via the hand lever in the cockpit. The foremost pitch means "take off with maximum engine speed", the hindmost pitch "cruising". Right beneath the hand lever is the release (unlocking device). The lever snaps in at the respective pitch and thus assures a stable setting angle in the chosen position. Released (unlocked), the lever moves back through aerodynamic forces or return spring forward to the "take off" position. Against this reset force, any pitch can be chosen now by easy manipulation.

**Note: Generally, the propeller ought to be adjusted by checking the rev counter ONLY and not by the setting of the lever.**

#### Start-Up of the Engine and Pre-Flight Check

At start-up of the engine, the propeller lever must be set to the foremost pitch. As soon as the engine is warmed-up, a brief propeller-check must be performed. For that, the engine has to be run at a speed of 4000 1/min with the help of the throttle lever while the propeller lever is in take off position. Then pull the lever into cruising position. This must cause a significant slowing-down of the engine speed by several hundred revolutions per minute. The precise revolution speed is irrelevant. Then, the propeller level will be brought back into take off position. Here, the revolution speed will have to correspond exactly with the previous revolution speed. Should no significant lowering of the revolution speed be reached or should the revolution speed at the end of the check not correspond with the previous revolution speed, operational

deterioration of the propeller must be assumed. The aircraft must not take off and the propeller will have to undergo a technical check.

After successful functionality check, the propeller can be brought to the intended take off position. The propeller should only be set to the foremost pitch/position if full take-off performance is needed, for example at very short runways or for aeroplane towing. In most cases, more moderate setting is advisable.

**CAUTION: To not exceed the maximum revolution speed of the engine, we recommend not to set pre-flight a higher revolution speed than 5500 1/min.**

### Take Off

The propeller revolution speed changes very little during take off, so no adjustment of the propeller is necessary until after take off and the following climb flight a speed of 100 km/h is reached because the engine will not build up too high a revolution speed. Thus, the pilot's full focus can remain on the take-off. Still, the revolution counter ought to be watched carefully. For further increase in speed the propeller setting angle will have to be adjusted by pulling the propeller lever. The best climbing performance is reached at approx. 110-140 km/h, depending on the type of aeroplane.

### Cruising

For cruising, pull the propeller into cruising position (see Rotax Aircraft Engines, Operation Manual for Rotax 912 resp. 914 Series).

### Landing

Put the propeller in "take off" position for approach. Please include the item "propeller in take-off position" (lever turned forward as far as it will go) with the landing check.

### What happens in case of control system failure? (H)

In the case of a failure of the control system, the propeller turns back into "take off" position. Should that happen during fast cruising, this may result in very high engine speed. Reduce throttle to avoid excessive engine speed! Reduce air speed!

Note: The narrowest possible setting angle is mechanically limited within the hub. It is technically impossible to narrow this limited angle any further. This means that even in a worst case scenario the propeller will still perform at maximum climbing performance. Zero-, let alone reverse thrust, will not occur.

## b) Constant Speed Control Operation ("Control ECS-F")

### General Remarks

Operation is performed through the propeller control unit "**PropCon**" in the cockpit. The propeller control unit controls the electric spindle drive for infinite adjustment of the propeller blade angle.



Propeller control unit PropCon

The control unit knows two working conditions:

The **MAN**-condition overrides the electronics and the servo motor can be reached directly through the SET-keys. As the propeller is operated manually in this condition, chapter a) applies. Operation can be performed similar to the manual control version. However, the MAN-mode should only be used in case of malfunction or ambiguity. Standard operation is performed in **AUTO**-mode.

During **AUTO**-mode, constant speed control is operational. The setting angle of the propeller is automatically set to the engine revolution speed the pilot requires. This is done by comparing the required speed (below in the display) with the actual speed (above in the display).

*Therefore, the main function of the propeller control unit is to keep the engine speed required by the pilot as steady as possible.*

The required engine speed is put in via the SET-key in steps of 128 1/min. To keep the setting drive from being engaged non-stop, a tolerance margin was set, within which minor deviations are ignored.

### **IMPORTANT INFORMATION TO AVOID ENGINE OVER-REVING**

**It is recommended not to choose any set points exceeding 5500 1/min.**

Background: As the propeller control unit will start working at a specified deviation from the pre-set revolving speed, a setting of the highest possible speed of 5792 1/min would cause an over-rev situation (>5800 1/min) as soon as the deviation occurs. Additionally, the control unit will only work after a certain deviation of the set point occurs, which would cause too high an engine speed exceeding 5800 1/min.

**It is recommended to pull the throttle lever only with great caution during flight (ca. 3 sec for the transition from idle speed to full throttle).**

Background: If idle speed is chosen during flight, the control unit will detect a downward deviation from the engine speed and will react to such a situation by lowering the setting angle to the stop position, which is the minimum angle setting for the propeller meant for very slow speed only. At sudden accelerating, (e.g. touch-and-go), the setting drive will need about 3 seconds to reach a point that corresponds with the actual flight speed. The result is an over-revving during those 3 seconds.

This effect is, of course, the smaller the slower the aircraft flies. At a standard approach for landing, the danger of an over-rev is only minimal. For an aircraft on ground, the effect is non-existent.

If the pilot forms a habit of accelerating always very carefully, the effect can be avoided at all speeds.

#### Start-Up of the Engine and Pre-Flight Check

The propeller control unit is switched on only after start-up of the engine. As soon as the AUTO-mode is activated, the display will show the pre-set engine speed of 5024 1/min.

As soon as the engine is warmed-up, a brief propeller-check must be performed. For that, the engine has to be run at a speed of 4000 1/min with the help of the throttle lever.

With the SET-keys (+/-) the set point will be lowered by some steps; the actual value will have to follow and to be lowered accordingly. If the actual value doesn't follow as required, operational deterioration must be assumed. The aircraft must not take off and the propeller will have to undergo a technical check.

After successful pre-flight check, the required engine speed is set at the propeller control unit. **As explained above, please refrain from setting an engine speed higher as 5500 1/min.** For any normal case, an engine speed setting of 5024 1/min is absolutely sufficient. For the towing of banners and gliders or for taking off at extremely short runways, an engine speed of 5500 1/min will be ideal.

#### Take Off

Full throttle and up you go. With increasing speed the Propeller will be setting the appropriate angle without any help from the pilot.

#### Cruising

During cruising, one of the performance settings recommended by the engine manufacturers (see Rotax Aircraft Engines, Operating Manual for Rotax 912 resp. 914 Series) can be engaged. For that, the appropriate engine speed will be chosen via the SET-key and with the throttle lever the required manifold pressure can be set.

#### Landing

Put the propeller in "take off" position for approach. Please include the item "propeller in take-off position" (set point  $\geq$  5024 1/min) into the landing check.

#### Go-around/Touch-and-Go

Pull throttle lever carefully. (See information on page 7.)

#### What happens in case of control system failure? (ECS)

In the case of control system failure, the pilot must switch to MAN-mode and check whether the propeller can thus be handled. If that is the case, set the "take off" position of the propeller manually (press +-keys).

If the propeller control unit fails to work entirely, the propeller will stay in its last position. That may lead to drastically reduced climbing performance. Chose your flight path accordingly! However, if the propeller was properly installed, there is, even at an extreme cruising setting, still a minimum climbing performance left, in accordance with the Airworthiness Requirements, in Germany for example according to LTF UL 2003:

1,5 m/s). Please take into consideration at landing that there is less performance available than usual for go-around/touch-and-go should it become necessary!

Should the mechanical connection between electric drive and propeller fail, the propeller will move to the setting of the smallest possible climbing position. Should that happen during fast cruising, this may result in very high engine speed. Reduce acceleration to avoid excessive engine speed! Reduce flight speed!

Note: The narrowest possible setting angle is mechanically limited within the hub. It is technically impossible to narrow this limited angle any further. This means that even in a worst case scenario of mechanical failure the propeller will still perform at full climbing performance. Zero-, let alone reverse thrust, will not occur.

### c) Constant Speed Control Operation ("Control ECS-M")

#### General Remarks

Operation is performed through the propeller control unit "Flybox PR1-P" in the cockpit. The propeller control unit controls the electric spindle drive for infinite adjustment of the propeller blade angle.



Propeller control unit Flybox PR1-P

The control unit knows two working conditions:

During **MANUAL**-mode the servo motor can be reached directly through the RPM-INC/DEC-switch. As the propeller is operated manually in this condition, chapter a) applies. Operation can be performed similar to the manual control version. However, the MANUAL-mode should only be used in case of malfunction or ambiguity. Standard operation is performed in **Constant Speed**-mode.

During **Constant Speed**-mode, constant speed control is operational. The pitch of the propeller is automatically set to the engine speed the pilot requires. This is done by comparing the required speed (below in the display) with the actual speed (above in the display).

*Therefore, the main function of the propeller control unit is to keep the engine speed required by the pilot as steady as possible.*

The required engine speed is put in via the RPM-INC/DEC-switch or by the knob in the middle of the control unit.

### IMPORTANT INFORMATION TO AVOID ENGINE OVER-REVVING

**It is recommended not to choose any set points exceeding 5500 1/min.**

Background: Although the controller is working very quickly, depending on the active pitch of the propeller, it may take a few seconds until the propeller reaches the target pitch commanded by the controller.

**It is recommended to pull the throttle lever only with great caution during flight (ca. 3 sec for the transition from idle speed to full throttle).**

Background: If idle speed is chosen during flight, the control unit will detect a downward deviation from the engine speed and will react to such a situation by lowering the setting angle to the stop position, which is the minimum angle setting for the propeller meant for very slow speed only. At sudden accelerating, (e.g. touch-and-go), the setting drive will need about 3 seconds to reach a point that corresponds with the actual flight speed. The result is an over-revving during those 3 seconds.

This effect is, of course, the smaller the slower the aircraft flies. At a standard approach for landing, the danger of an over-rev is only minimal. For an aircraft on ground, the effect is non-existent.

If the pilot forms a habit of accelerating always very carefully, the effect can be avoided at all speeds.

### Start-Up of the Engine and Pre-Flight Check

The propeller control unit is switched on only after start-up of the engine. As soon as the AUTO-mode is activated, the display will show a pre-set engine speed.

As soon as the engine is warmed-up, a brief propeller-check must be performed. For that, the engine has to be run at a speed of 4000 1/min with the help of the throttle lever.

With the RPM-INC/DEC-switch the set point will be lowered by some hundred rpm; the actual value will have to follow and to be lowered accordingly. In order to end the test the controller will be simply set back to Constant Speed Mode. The propeller than has to turn back to the original 4000 1/min. If the actual value doesn't follow as required, operational deterioration must be assumed. The aircraft must not take off and the propeller will have to undergo a technical check.

After successful pre-flight check, the required engine speed is set at the propeller control unit. **As explained above, please refrain from setting an engine speed higher as 5500 1/min.** For any normal case, an engine speed setting of 5024 1/min is absolutely sufficient. For the towing of banners and gliders or for taking off at extremely short runways, an engine speed of 5500 1/min will be ideal.

### Take Off

Full throttle and up you go. With increasing speed the Propeller will be setting the appropriate angle without any help from the pilot.

### Cruising

During cruising, one of the performance settings recommended by the engine manufacturers (see Rotax Aircraft Engines, Operating Manual for Rotax 912 resp. 914 Series) can be engaged. For that, the appropriate engine speed will be chosen via the SET-key and with the throttle lever the required manifold pressure can be set.

### Landing

Put the propeller in "take off" position for approach. Please include the item "propeller in take-off position" (set point  $\geq$  5024 1/min) into the landing check.

### Go-around/Touch-and-Go

Pull throttle lever carefully. (See information on page 7.)

What happens in case of control system failure? (ECS)

In the case of control system failure, the pilot must switch to MANUAL-mode and check whether the propeller can thus be handled. If that is the case, set the "take off" position of the propeller manually (RPM-INC/DEC-switch).

If the propeller control unit fails to work entirely, the propeller will stay in its last position. That may lead to drastically reduced climbing performance. Chose your flight path accordingly! However, if the propeller was properly installed, there is, even at an extreme cruising setting, still a minimum climbing performance left, in accordance with the Airworthiness Requirements, in Germany for example according to LTF UL 2003: 1,5 m/s). Please take into consideration at landing that there is less performance available than usual for go-around/touch-and-go should it become necessary!

Should the mechanical connection between electric drive and propeller fail, the propeller will move to the setting of the smallest possible climbing position. Should that happen during fast cruising, this may result in very high engine speed. Reduce acceleration to avoid excessive engine speed! Reduce flight speed!

Note: The narrowest possible setting angle is mechanically limited within the hub. It is technically impossible to narrow this limited angle any further. This means that even in a worst case scenario of mechanical failure the propeller will still perform at full climbing performance. Zero-, let alone reverse thrust, will not occur.

## Checks

### a) Daily Checks

Check the propeller prior to each operation for the following items:

- **Hub free of cracks**
- **Are all blades and all screws tight?**
- **No damage of the propeller blade composite fabric**
- **No cracks in the blade surface**
- **Sufficient lubrication (-> page 11)**
- **No blade tip play (-> page 13)**

### b) 25 Hours after Propeller Assembly

25 hours after each new assembly of the propeller hub, the tightening torque of the flange bolts must be checked as described in c).

### c) 100-Hours Check

- **Remove spinner cap**
- **Clean propeller thoroughly**
- **Perform daily checks (->a))**
- **Check the tightening torque of the flange bolts. Do not unscrew to do that. The correct tightening torque is 27 Nm. Use a calibrated torque wrench.**

**CAUTION: If the tightening torque is too high or too low, this may damage the screws!**

### d) 750-Hours-Check

**After either 750 hours of operation or 5 years, depending on what occurs first, the propeller must be submitted to a check at the NEUFORM works or at an authorized NEUFORM-Service-Partner. To keep a record of the operation time, a flight log must be kept. Any further operation of the propeller without this check after 750 hours/5 years is not permitted!**

## Damage

In case of cracks in blade or hub or in case of any damage of the propeller blade composite fabric, any operation of the propeller must be discontinued at once. The same applies to any case of doubt.

## Repair

Minor damage of the coloured surface may be repaired by persons with sufficient expertise. The necessary surface resin can be obtained through NEUFORM in small amounts.

All other repair of the blades should be made exclusively by NEUFORM. Any exchange of mechanical components can be performed at NEUFORM-Service-Points.

## Maintenance and Care

### a) Cleaning

Propeller and hub must be kept clean at all times to allow for a full sight check during the daily checks. For cleaning water with a bit of washing-up liquid and a soft sponge are recommended. From time to time the synthetic surfaces may be treated with car polish.

### b) Lubrication

There is no set interval for refreshing the lubrication. It is performed if necessary.

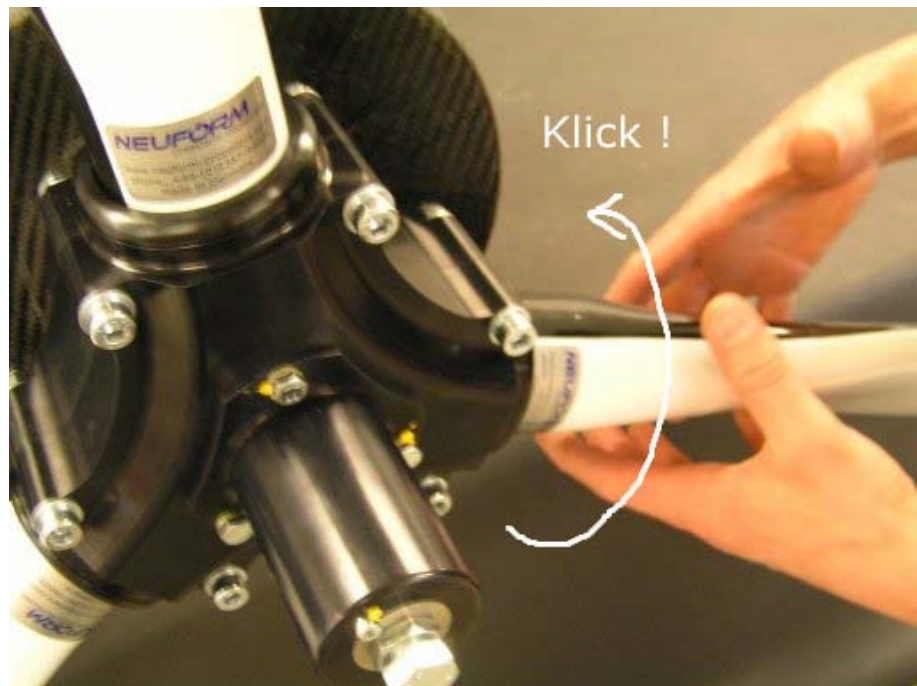
#### *Checking Lubrication*

Check the state of the lubrication with a simple test. With the electric (ECS) drive the top connecting pin at the setting lever must be removed first, for manual setting (H) no preparation is required.

Hold one of the blades tightly by hand and turn it on its own axis towards a high pitch angle. (This will require some degree of strength, see the following pictures.)



At release, the blade and the propeller should flip back to the minimum pitch angle (take off position) and the stop should make a clearly audible "clicking" noise.



Should there be no "click" or should the propeller move only slowly back into its former position, then the lubrication is not adequate!

Please refresh the lubrication as shown in the Assembling- and Maintenance Manual. Anybody without expertise in this field should have this done by a professional person or company.

### c) Blade Tip Play

Blade tip play itself is not dangerous but it lowers the service life of the bearings and thus ought to be put right immediately.

#### *Checking for Blade Tip Play*

Hold two of the blades tight with the hands and try to move them towards or away from each other. A discernible, evenly soft deformation caused by the elasticity of the blades is normal. Any uneven deformation is an indication of blade tip play.

In the case of blade tip play, the set initial tension (camber) of the bearing should be adjusted.

**CAUTION: Any manipulation of the bearing settings must under all conditions only be performed by authorised NEUFORM-Service-Staff.**

## Assembly

**CAUTION: Any assembly of the propeller may only be performed in compliance with "Assembly and Maintenance Manual V3-R2" not older than the issue dating 28 April 2010.** The manual is exclusively meant for people with the necessary expertise. Although assembly is not very difficult to perform, we strongly recommend that it is only done by professional experts, not by laypersons.