

Phase 15: Tuning

This phase is basically a check list before the first flight.

Parts and other components

PARTS	DESCRIPTION	CODE	QTY.	PACK
	Main Rotor Protractor Adapter	CH 302	1	14
	Tail Rotor Protractor Adapter	CH 303	1	14

TOTAL PHASE 15 PARTS: 2

Check everything in the following order

Step 1- Adding lubricant to Main Rotor Gearbox

Add approx 2.25 liters of SWEPCO 201 SAE 90, Multi-Purpose Gear Lube, to the Main Rotor Gearbox.

CICARÉ recommends leveling the helicopter in both axis and verifying through the MRGB oil level indicator that the level is full filled.

After filling the oil, fit the oil plug and secure it with safety lock wire.

Step 2- Adding lubricant to the Tail Rotor Gearbox

Use the same lubricant as in the MRGB.

CICARÉ recommends leveling the helicopter in both axis and verifying through the TRGB oil level indicator that the level is half filled.

Then lock wire the top and bottom plugs.

NOTE

It is recommended to do this with a graduated syringe and the helicopter correctly levelled.

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Step 3- Engine oil

Refer to the original engine manual provided by ROTAX for the correct oil level in the oil tank and the oil specification

Step 4- Engine Lubrication system purge

Refer to the engine original manual provided by ROTAX. The engine must have oil circulated through the complete system before the first start otherwise severe damage may be caused in the engine.

Step 5- Cooling system purge

Refer to the engine original manual provided by ROTAX.

Step 6- Adding lubricant to Tail Rotor Output Shaft

In areas near the sea or in a moist environmental, apply WD40 or a similar product to the surface of the Tail Rotor output shaft to minimize the corrosive effects. In very dry or dusty conditions, use a dry Teflon spray or similar.

Step 7- Pre flight check

Do the pre flight check list as indicated in the Pilots Flight Manual provided by CICARÉ in this kit.

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Step 8- Rigging, tracking and balancing

Introduction

This Section contains the necessary procedures to calibrate the main rotor and tail rotor assemblies.

The critical part main and tail rotor blade assemblies are supplied master balanced from the factory ready to fit on the CH-7B with little or no further balancing required.

The main rotor assembly has been installed on an actual helicopter and ground run and then flown for about 30 minutes to check its track and balance and flight characteristics.

Provided the builder assembles the Main Rotor Assembly as it is notated on the actual parts; i.e. Blade 1 with MR Plate 1 with Pitch link tube 1, then no electronic balance may initially be required.

NOTE

This method also means that the builder should be first concentrating on getting the flight control rigging exactly right, without adjusting the pitch links, so that the initial blade angle should be zero degrees (approx) with the collective lever fully down

The alignment and balance procedures (track and balance) described herein, shall be applied together with the Chadwic-Helmuth (or similar balance equipment) instructions.

Procedure for adjusting “push-pull” tubes with rod ends fitted on their ends

The following is the normal procedure for the length adjustment of push-pull tubes not installed on the helicopter with rod ends on both ends.

Make a continuous fine paint marker line from a face on the rod end to be about an 5 mm long on the tube.

Loosen the lock nut that fastens the rod end to the tube end.

Turn the rod end in or out of the tube end as required to obtain the adequate length.

Verify that either an adequate number of rod end threads are screwed into the tube end or the rod end is seen in the witness holes in the tube.

The minimum screw length recommended is one equal to the inside diameter of the tube end.

If this minimum quantity of installed threads is not reached, then compensate by moving the rod end from the other end of the tube outwards..

It is necessary to align the rod ends from both ends of the push-pull tube to ensure the free movement from top to bottom.

WARNING

Rod ends must aligned correctly after the lock nuts have been tightened.

Failure to do this can cause binding, restrictions or damage in control movement or cause vibrations in the cyclic stick.

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Main rotor rigging

The main rotor rigging is determined by the average angle between both blades.

This angle is measured at 75 cm from the blade tip..

The main rotor blades angle of attack are measured with the protractor that is placed on the "CH 0301" special tool, supplied by CICARE S.A.

Place the protractor parallel to the blade chord.

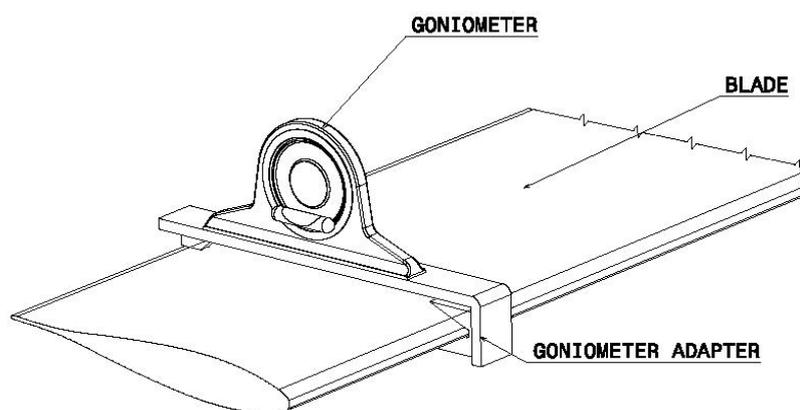


Fig. 1

NOTE

It is preferable to use an electronic inclinometer – similar to a Schwyz Pro360 - to achieve accurate results and better flight characteristics

Use the following processes to take the measurements:

Level the helicopter placing the mast perfectly vertical.

Place a uniform thickness layer such as masking tape parallel to the chord from the leading to trailing edges on each blade at 75 cm from the tip, to make sure that the protractor does not scratch or damage the top of the MR blade.

Identify each blade with different colors such as a blue and red Texta marking pen

NOTE

Do not mark any part of the rotor system with ball point pen or with any other sharp element. Use a wax pencil or a soft marker. Sharp elements may produce scratches on the blade surface that may cause blade cracks or defects due to fatigue

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Collective pitch rigging

Before rigging the collective blade angles, check the collective travel in the upper mast slides.



Fig. 2

Adjust the collective coupling fork – PN 11.019.1 so that the collective pitch lever travel ensures that Teflon bush in the collective full down position (bottom of the friction slider) has slightly less gap (about 5 mm) than collective full up.

At no time should the Teflon bush in the slide contact the top or bottom of the slide.

Place the cyclic stick in the neutral position. Use the level for lateral and the middle of the longitudinal friction plate as a guide to leveling.

Push the collective pitch lever fully downwards to the bottom of the collective friction slider plate. Fully apply the cyclic and collective pitch friction controls.

Measure the angle of each MR blade, verifying with the level that both are in a +0° angle as regards the horizontal position.

NOTE

Place the protractor on the chord at the 75 cm mark. The protractor base is to be perfectly parallel to the blade chord. The protractor must be placed in such way that the face containing the dial is on the same side in which it was set to zero in the hub. Verify with the blade position marked for that purpose.

For each blade measure the angles at the 12 o'clock and at 6 o'clock positions of the rotor quadrant and keep a record of the values:

<u>BLUE BLADE</u>	<u>RED BLADE</u>
Front.....	Front.....
Rear.....	Rear.....
 Average angle.....	 Average angle.....

Values shall be 0° ± 0.2° for each blades.

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Lift the collective pitch lever until it gets to the collective friction slider plate upper stop. Fully apply the collective pitch friction controls to hold it in place at the top.

Measure the MR Blade up angles using the same technique as full down collective and keep a record of them.

BLUE BLADE	RED BLADE
Front.....	Front.....
Rear.....	Rear.....
Average angle.....	Average angle.....

Values shall be +11° ±0.2° for each blades.

Cyclic pitch rigging

NOTE.

Do not adjust the cyclic pitch system unless the collective system has been rigged first.

Place the collective pitch lever in its full down position.

Check that the upper rocker arm (attached to the MR Blade pitch links) is level when the cyclic stick is level in each plane to be adjusted.

Place the cyclic pitch stick in the neutral position in the lateral sense and totally forward in longitudinal sense.

Recheck the upper rocker arm as it is necessary to verify the longitudinal axis of each blade is at 0° angle as regards the horizontal plane in order to measure the attack angles.

Forward cyclic pitch:

Turn the rotor as required to measure each blade angle at 3 o'clock in the quadrant:

BLUE BLADE
RED BLADE

The measured value of each blade shall be -9° ±0.5°

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Place the cyclic pitch stick in the neutral position in the lateral sense and totally backwards in longitudinal sense.

Backwards cyclic pitch:

Measure each blade angle at the 3 o'clock position in the rotor quadrant:

BLUE BLADE

RED BLADE

The measured value of each blade shall be $8^{\circ} \pm 0.5^{\circ}$

Place the cyclic pitch stick in neutral position in the longitudinal sense and totally leftwards in lateral sense.

Leftwards cyclic pitch:

Measure each blade angle at the 12 o'clock position in the quadrant:

BLUE BLADE

RED BLADE

The measured value of each blade shall be $-6^{\circ} \pm 0.5^{\circ}$

Place the cyclic pitch stick in its neutral sense in the longitudinal sense and totally rightwards in lateral sense.

Rightwards cyclic pitch:

Measure each blade angle placing it at the 12 o'clock position in the rotor quadrant:

BLUE BLADE

RED BLADE

The measured angle of each blade shall be $+5^{\circ} \pm 0.5^{\circ}$

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Tail rotor

The procedure to prepare the **CICARE** CH-7B for the tail rotor pitch rigging is as follows:

Level the helicopter, placing the mast perfectly vertical.

Turn the tail rotor manually until one blade is parallel to the tail boom.

Place the blades at 90° exactly with respect to the rotor axis.

Use a soft marker or a wax pencil to mark each blade with a different color or mark.

The angle measurement shall be made at each 75% of each blade.

In order to do so it is convenient to mark this point on each blade with a band in the chord sense.

Tail rotor pitch rigging

The measurement shall be made with a propeller protractor or other similar instrument and with the use of the "CH 0302" special tool supplied by **CICARE** S.A., that enables the protractor to be placed perfectly parallel to the blade chord in the 75% station.

Push the left pedal until you hear and verify it hits its travel stop.

Measure the angle in both blades, placing them in horizontal position and on the boom.

With the left pedal on its stop, keep a record of the values:

BLUE BLADE
RED BLADE

The value obtained shall be $25^{\circ} \pm 0.2^{\circ}$

CAUTION

The maximum difference accepted in the blades alignment is 0.4° .
If this value is exceeded an adjustment shall be made.

Push the right pedal to its stop and keep a record of the angle values:

BLUE BLADE
RED BLADE

The value obtained shall be $10^{\circ} \pm 0.2^{\circ}$.

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Main rotor pitch correction

Collective pitch

If, when making the measurement of the blades angle maximum and minimum values by operating the collective pitch lever, the values specified previously are not obtained, you must proceed as follows:

If, when placing the collective pitch lever at its extreme bottom position, a $+0^\circ \pm 0.2$ MR Blade pitch angle is not obtained, then the coupling fork of the cyclic pitch central control lever with the collective pitch lever shall be extended or shortened.

If, when placing the collective pitch stick at its extreme upper position, a $+10 \pm 0.2^\circ$ pitch is not obtained, then the coupling fork of the cyclic pitch central control lever with the collective pitch lever shall be extended or shortened.

If the angle difference between both blades, with the cyclic control in its neutral position, exceeds 0.2° then it is necessary to reduce it by varying the length of the MR Blade pitch links.

Cyclic pitch

If, when making the measurement of the maximum and minimum blades angles by operating the cyclic pitch stick, the values specified previously are not obtained, you shall proceed as follows:

If, when placing the cyclic pitch stick at its maximum backwards position in longitudinal sense and in neutral position in lateral sense, a $+8^\circ \pm 0.5^\circ$ angle is not obtained in the blade pitch measurement, then the control rod located in the control swash plate rear arm shall be extended or shortened.

If, when taking the cyclic pitch stick to its maximum forwards position in longitudinal sense and in neutral position in lateral sense, a $-9^\circ \pm 0.5^\circ$ angle is not obtained in the blade pitch measurement, then the rear control rod located in the control swash plate rear arm shall be extended or shortened.

If, when taking the cyclic pitch stick to its maximum leftwards position while it is maintained in neutral position in longitudinal sense, a $-6^\circ \pm 0.5^\circ$ angle is not obtained in the blade pitch measurement, then the control rod located to the left of the control swash plate shall be extended or shortened, and the opposite shall be done with the rod located to its right.

If, when taking the cyclic pitch stick to its maximum rightwards position while it is maintained in neutral position in longitudinal sense, a $+5^\circ \pm 0.5^\circ$ angle is not obtained in the blade pitch measurement, then the control rod located to the left of the control swash plate shall be extended or shortened, and the opposite shall be done with the rod located to its right.

CAUTION

In all cases in which it is necessary to vary the length of an element with LH and RH rod end on each end, verify that the number of threads or covered screw length does not exceed the minimum to achieve a safe joint. In case of an element with rod ends which are individually used to vary its length, verify that so that both Rod ends are screwed approx the same amount.

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Tail rotor pitch correction

If, when taking the measurement of the maximum and minimum blade angle by operating the pedals, the values previously specified are not obtained, you shall proceed as follows:

In first place, you shall correct the rate between the blades minimum and maximum pitch. If it is not between 30° and 31°, then it shall be corrected by operating on the pedal stops.

If there is a difference between a tail rotor blade angle exceeding 0.2° it shall be corrected by extending or shortening the pitch rods, as it is required.

If once the blade pitch angle variation rate has been verified and is as specified, it is observed that it does not reach one of the values but exceeds the other, it is necessary to correct it varying the tail rotor control push-pull tube length located in the tail boom.

The length variation is obtained by inserting or removing the rod end from the tube front end.

Check that the tail rotor pitch slider bearing is not hitting the TRGB output shaft near the TRGB output shaft seal.

Rigging Record

On this list the tail rotor and main rotor blade average angles of attack for each control position are detailed, as required and as measured.

The record list is prepared to keep a record of the angles measured in each inspection with the date thereof and the signature of the person responsible for said measurement.

MAIN ROTOR RIGGING RECORD

Collective.	Cyclic.	Blade Position.	Angle.	Measure.	Date.	Signature.
Down	Neutral	12 hrs	+0° ±0.2°			
Up	Neutral	12 hrs	+11° ±0.2°			
Down	Neutral lat. Front	3 hrs	-9° ±0.5°			
Down	Neutral lat. rear	3 hrs	+8° ±0.5°			
Down	Neutral long. left	12 hrs	-6° ±0.5°			
Down	Neutral long. right	12 hrs	+5°±0.5°			

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TAIL ROTOR RIGGING RECORD

Right pedal.	Left pedal.	Blade position.	Angle.	Measure.	Date.	Signature.
Down	-----	Parallel to tail boom.	+10°±0.2°			
-----	Down	Parallel to tail boom.	+25°±0.2°			

Tracking and balance; **Error! No se encuentra el origen de la referencia.**

Introduction

The main rotor tracking can be done with the flag method or using a "Track and Balance Chadwick-Helmuth" or similar equipment.

The flag method is enough if tracking equipment with a stroboscope is not available.

The "Chadwick-Helmuth" stroboscope equipment is necessary if the wind conditions are not calm and if flight tracking is needed.

The main rotor tracking adjustment is done by adjusting the length of the rod ends on the MR Blade pitch links.

After any adjustment, check that the rod ends are screwed the same length than the screw diameter in the corresponding record. If this is not verified, distribute the screw portion between both universal joints so that they are both screwed with the necessary quantity of threads to ensure safety.

Main rotor static tracking; **Error! No se encuentra el origen de la referencia.**

The normal procedure for the blades static tracking is the following:

Level the helicopter placing the mast in a perfectly vertical position.

Fix the cyclic friction controls in neutral and the collective full down

Mark with a crayon the chord at 75 cm from each blade tip.

Place a water level graduated in accordance with one of the blade chord; verify that the angle is ±0°.

If there is any difference it can be solved by modifying the pitch rods length.

Do the same with the other blade.

Once the rods are adjusted, tighten the corresponding screws.

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Main rotor tracking with flag method

Mark each blade tip with different colored wax pencils, one red and the other one blue.

Tie a small, soft paint brush to a broom handle or similar with masking tape.

Coat the tip of the paint brush with a light layer of colored grease.

Locate the helicopter facing into the wind.

Warm up the helicopter and bring the RRPM to 100% with the collective pitch fully down

Hold the cyclic in the neutral position.

The person holding the tracking flag must be placed at 90° as regards the wind direction and in the pilot's sight –usually this is either at the 3 or 9 o'clock position.

The pilot then carefully raises the collective lever to obtain a coning angle load on the MR Blades – usually this is at about 20 inches of MAP. Be careful that the helicopter does not become airborne.

Holding the flag firmly, the flag person should raise it very slowly, with a gentle and continuous movement, until it touches the rotor disc.

As soon as the flag can be felt to touch the rotor disc, immediately lower it.

The pilot then reduces RRPM and eventually stops the engine so that the MR Blades can be inspected for the grease mark.

Adjust any difference in the blade track by bring the high blade down using its MR Blade pitch link.

Recheck the track and repeat the process until the blades both touch the paint brush at the same instant.

Main Rotor blades static (Longitudinal) balance

The normal procedure for the static balance is the following:

Only do this procedure in a no wind area such as inside a hanger.

Mark all bolts, links and any part that is to be moved or unscrewed with a paint mark so that it can be returned to its original position to maintain the MR assembly chord wise balance.

Disconnect the lower rod ends of the pitch links rods and push them up so that they do not interfere

Remove the safety lock wire on the two safety nuts holding the two adjustment screws that fit in the MR Hub Side Plates needle roller bearing housings (used for Chord wise balance) and loosen the screws each out a half turn with a large flat blade screw driver.

Now place a water level on the main rotor plates and verify that both blades are level.

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In case a blade descends, it means that it is heavier than the other one.

In this case the weight of a blade must be changed.

This is achieved removing the screwed cap at the blade tip and varying the lead quantity inside the hole; then screwing the cap back on again.

Once the balance is achieved, adjust the main rotor chord wise balance screws back to their original positions – checking that there is an adequate friction so that the rotor tilts.

Blades dynamic balance

To achieve a correct dynamic balance on both rotors its recommended to use an electronic balance.

The accelerometer must be installed in a horizontal manner on the mast in the the main rotor, and in a vertical position at the tail rotor box.

The values obtained must be inferior to 0.2 IPS and it's recommended to check these values in hovering conditions.

If an optical RPM sensor is used, install it in the most convenient place for the user.