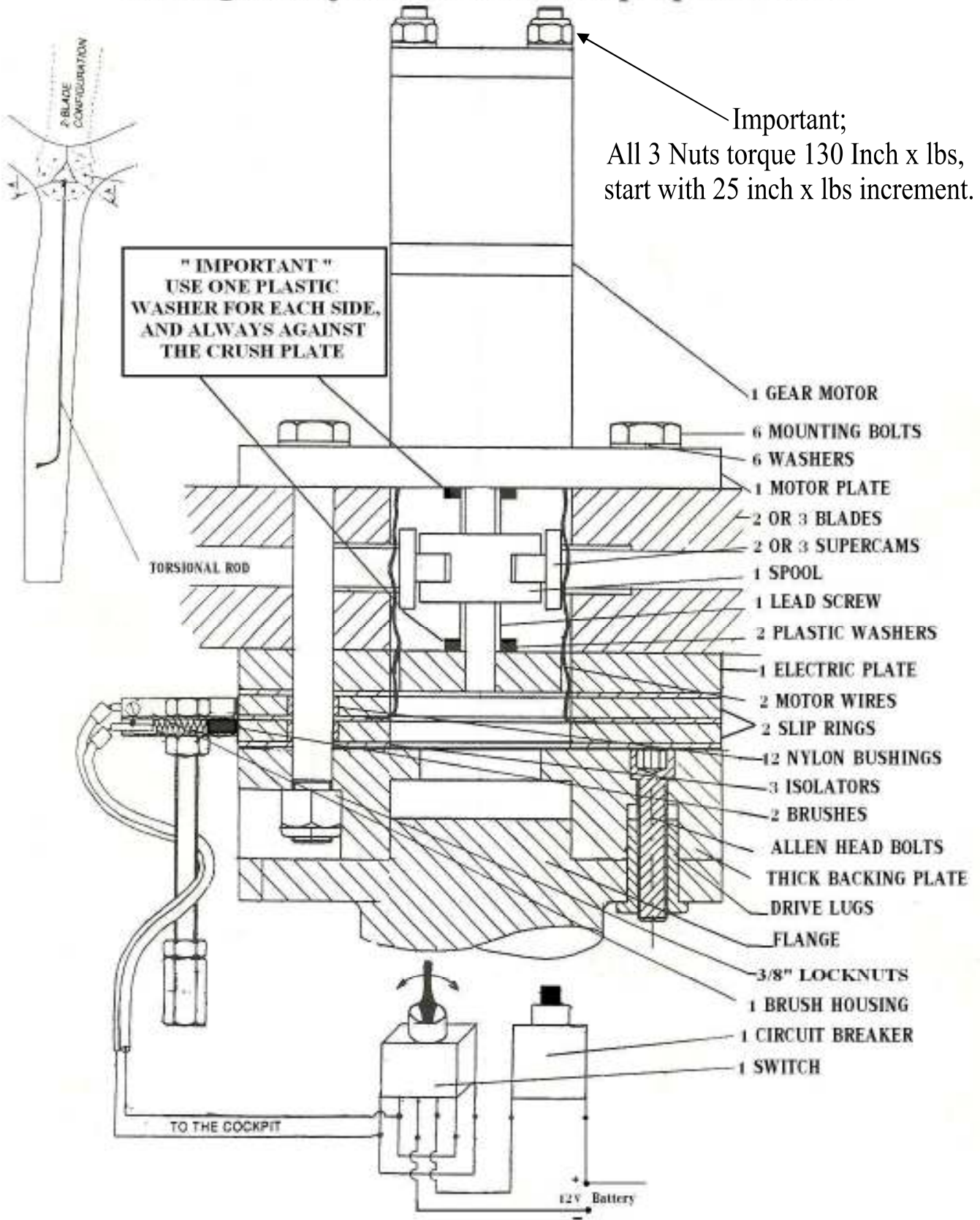


# In-Flight Adjustable Pitch Ivoprop Medium





# Ivoprop Corp.

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## Ivoprop Pitch-Change Design And How It Works Medium Propeller

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The IVOPROP operates on a COMPLETELY NEW AND UNIQUE adjustable pitch system that allows for substantially less hardware and rotating mass than any other pitch adjustable prop. The unique pitch adjustment design operates on the principle of twisting the blades through the chrom-moly alloy steel torsional rod cast inside the blade. The outer end of the torsional rod is firmly anchored inside the outer blade section. The round torsional rod is capable of rotating inside the blade, except for the outer end.

Both Ground and In-Flight Adjustable System utilize the same carbon / graphite fiber blades with stainless steel leading edges. The blades are capable of pitch change from 30° to 90°

### **The In Flight Adjustable Pitch Ivoprop**

- The ability to change the pitch in flight is as significant for the airplane pilot as for the driver of a car to shift gears in the transmission, this results in substantial savings in fuel, engine wear and noise.
- Pilot controls the pitch through the toggle switch mounted in the cockpit. Pressing the toggle switch one way sends electric current through the graphite brushes to the slip rings and finally to the electric motor.
- Depressing the toggle switch the other way reverses the polarity of the current and the rotation of electric motor. The pitch change operation is similar to the power windows in an automobile. As long as you hold the switch in one direction- the pitch changes in that direction and you observe the result on your RPM meter.
- Torque from the electric motor is multiplied in a 3 stage planetary gear drive, which turns the lead screw.
- Lead screw is supported by a thrust bearing and converts it's rotary motion into axial movement of the spool.
- The spool is linked to the supercams, which turn the torsional rods. Torsional rods transmit the movement from the center of the prop to the outside section of the blade. This causes the blade to twist therefore changing the pitch in the same manner as the ground adjustable pitch system.
- Total time required for full range of adjustment is about 10 seconds.
- Movement of the spool can be restricted each way by inserting washers on the lead screw. This limits maximum and minimum pitch and prevents engine over-revving.
- Older models Ivoprop ground adjustable props can be convert to In-Flight Adjustable System by means of retrofit kit.
- In-Flight adjustable hub comes assembled with instructions on how to use it.

# Ivoprop Medium Assembly

- Mount the Adaptor on the flange. Use Allen head bolts and blue loctite or lock nuts. **Torque 8mm bolts to 200 inch x LBS, 3/8" bolts to 30ft x LBS.**
- Insert the mounting bolt with the washer through the motor plate in one of the bolt holes closets to the two motor wires.
- Insert one blade on the mounting bolt. Flat airfoil side towards the electric motor for pusher. Curved airfoil side towards electric motor for tractor.
- Rotate the blades so that the supercam goes into the groove in the spool.
- Insert second bolt with washer through the motor plate and blade.
- Insert electric plate (The one without nylon bushings on the boltholes)
- Run the motor wires through the holes in the electric plate.
- Insert isolator.
- Insert slip ring on the bolts. Do not push out the nylon bushings.
- Bend one motor wire in right angle radially outward on the slip ring.
- Insert second isolator.
- Bend second motor wire the same way like the first one on the isolator.
- Insert second slip ring
- Insert third isolator
- Bolt prop loosely on the thick plate.
- Insert remaining blade (s) between plates and torque mounting bolts to **30 ft. x lbs.**
- Mount the brush housing "somehow" next to the flange so that brushes will contact slip rings. The mount must be rigid. There should also be a small clearance between brush housing and slip rings.
- Brushes should point directly towards the center of the prop.
- Install switch and circuit breaker in the cockpit in a place where you can easily reach but not accidentally activate.
- Attach 3/16" connectors to the brush housing.
- Attach battery connectors to the battery. Circuit breaker wire belongs to the positive pole.
- Write next to the switch direction of the pitch change. By interchanging brush connectors you can change the direction of pitch change.

Example:

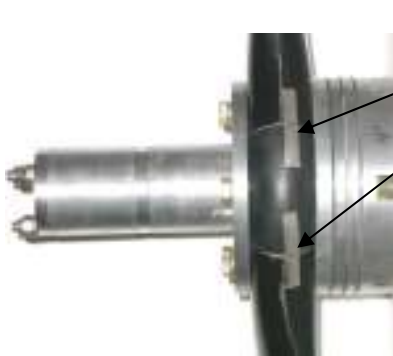
Pitch up	Pitch down
R.P.M. down	R.P.M. up
Cruise	Climb

- Caution: Brushes are brittle- Do not break them.
- If you wish to use the spinner. The spinner backing plate shall be inserted between the electric plate and the isolator.

## WARNING:

- ❖ SOME PROP ENGINE COMBINATIONS (DIRECT DRIVE, 2:1, 3:1, AND HIGHER REDUCTION RATIOS, 3-CYLINDER OR DIESEL ENGINES) CAN CREATE RESONANCE INTERACTION BETWEEN THE PROP AND THE POWER PLANT.
- ❖ IF THE PROP IS MOUNTED LOOSE AND, OR GETS IN RESONANCE WITH THE ENGINE, THE BLADES COULD MOVE INSIDE THE HUB BACK IN FORTH IN THE DIRECTION OF ROTATION.
- ❖ THE PURPOSE OF INSTALLING AND INSPECTING MOTION DETECTOR STAINLESS STEEL TAPE IS TO DETECT THE BLADE MOVEMENT BEFORE BREAKING BOLTS, BLADES, ETC...
- ❖ GET THE TORQUE WRENCH AND CHECK ITS CALIBRATION BY HANGING A KNOWN WEIGHT ON ITS ARM AND BY MULTIPLYING THE WEIGHT IN POUNDS BY ARM IN FEET. THIS READING SHOULD BE AS CLOSE AS POSSIBLE TO 30 FT X LBS. WE TRIED SEVERAL TORQUE WRENCHES AND MOST OF THEM WERE OFF AND BY A LOT.
- ❖ MARK THE PROP POSITION IN RELATION TO THE CRANK SHAFT ON DIRECT DRIVE ENGINES OR IN RELATION TO REDUCTION FLANGE ON 2:1, 3:1 OR 4:1 REDUCTIONS. THERE ARE 2 POSITIONS TO MOUNT 23-BLADE PROP AND 3 POSITIONS TO MOUNT THE 2 BLADE PROP. THIS MAKES A GREAT DIFFERENCE IN HOW THE PROP AND ENGINE VIBRATE TOGETHER AND EACH POSITION CREATES A TOTALLY NEW SITUATION.
- ❖ RUN THE PROP FOR 1 MINUTE ON THE GROUND, RE-TORQUE THE BOLTS.
- ❖ REPEAT THE ABOVE PROCEDURE UNTIL TORQUE STAYS THE SAME.
- ❖ CUT THE STRIPS OF STAINLESS STEEL TAPE ABOUT 2" LONG AND 3/8" WIDE (TAPE SUPPLIED WITH THE PROP)
- ❖ CLEAN THE AREA AROUND THE GAP BETWEEN THE BLADES OR GAP BETWEEN BLADES AND BLADE BLOCKS BY RUBBING IT WITH CLEAN NAPKIN SOAKED WITH M.E.K SOLVENT.
- ❖ APPLY STAINLESS STEEL TAPE ACROSS THE GAP NEXT AND PARALLEL TO MOLD PARTING LINE. USE A ROUND OBJECT TO PRESS THE TAPE ON THE SURFACE.
- ❖ FOLLOW THIS INSPECTION SCHEDULE TO CHECK IF THE TAPE IS BROKEN. AFTER A SHORT GROUND RUN UP THROUGH FULL R.P.M. RANGE AND THE FIRST 10 MINUTES, 15 MINUTES, 30 MINUTES, 1 HOUR, 2 HOURS, 4 HOURS AND THEN EVERY PREFLIGHT INSPECTION. ALSO FOLLOW THIS SCHEDULE FROM THE BEGINNING IF THE PROP HAS BEEN REINSTALLED. ANYTIME YOU INSPECT THE TAPE, CHECK THE TORQUE ON THE BOLTS DURING THE FIRST 4 HOURS. AFTER THAT, CHECK THE TORQUE EVERY 10 HOURS.
- ❖ IF THE TAPE BREAKS OR CRACKS REMOVE THE TAPE, CLEAN THE SURFACE WITH M.E.K. AND APPLY NEW TAPE AND START THE INSPECTION SCHEDULE FROM THE BEGINNING. IF THE TAPE BREAKS AGAIN REMOVE THE PROP FROM SERVICE AND CONTACT IVOPROP CORP.
- ❖ THE KNURLED PLATES SHALL BE INSTALLED SO THAT THE KNURLING FINISH ON EACH PLATE IS IN CONTACT WITH THE BLADES.
- ❖ THE KNURLED PATTERN IS 60 DEGREES SYMMETRICAL, SO IF YOU REINSTALL THE BLADES BETWEEN CRUSH PLATES LATER IN A DIFFERENT POSITION, THE IMPRINT ON THE BLADES SHOULD MATCH THE KNURLED PATTERN. HOWEVER (BECAUSE OF MANUFACTURING TOLERANCES) TO GET THE BEST MATCH YOU NEED TO NUMBER THE BLADES AND PLATES AND ALWAYS PUT THE BLADES BACK IN THE SAME PLACE.
- ❖ IF YOU GET A NEW BLADE OR IF YOU GET MIXED UP START THE TORQUE SCHEDULE OVER AGAIN.

### BELOW 3/8" WIDE X 2" LONG STAINLESS STEEL TAPE APPLIED



SIDE VIEW 2-BLADE ELECTRIC PROP



SIDE VIEW 3-BLADE QUICK ADJUSTABLE PROP

# Medium Ivorpop

## Setting Your Own Pitch Limits

- The pitch change operation in flight can be greatly simplified by restricting movement of the spool therefore limiting the pitch change from your best climb pitch to your best cruise pitch.
- Land with the prop in your best climb pitch.
- If it is a 2-blade prop, remove the blade blocks (missing pieces of pie) and look inside to determine how many limit washers you need to put on the lead screw. If it is a 3-blade prop, look through the gap between blades using a flashlight.
- Land with the prop in best cruise pitch and repeat the above procedure.
- Bring prop to the neutral position (You can hear it – no load on the electric motor).
- Take prop apart.
- Insert the limit washers on the lead screw so that spool can not travel beyond your measurements.
- **Very important** not to forget to insert **plastic washers** on each side against the crush plate only. Inserting plastic washers between limit washers or between spool and limit washer will lead to the destruction of the gears in the planetary drive.
- Note: the thickness of plastic washer under load is about ½" of it's original thickness.

## How To Fly With It

- Run the prop W.O.T. on the ground and adjust pitch to your maximum hp. RPM (W.O.T. "means, wide open throttle")
- As you accelerate, start adding pitch to keep the engine from over revving.
- Climb W.O.T. and adjust the pitch to maximum climb rate. (Do not exceed maximum allowable R.P.M. for your power plant).
- Remember your R.P.M. at Your best climb pitch.
- After reaching cruising altitude, refer to your engine manual for recommended manifold pressure and R.P.M. adjust the throttle and pitch accordingly.
- Before landing, go for a moment into W.O.T. and start decreasing the pitch by short pulses until you reach your best climb R.P.M. which you remember from the take-off.

# Medium Ivorpop

## Important

- Assume that In-flight pitch adjustment can quit on you anytime in which case the pitch stays where it is. Therefore do not pitch prop up for cruise more than you need to slightly climb. So you can bring your plane back where you came from.
- Do not run the prop without the circuit breaker, which is supplied with it.
- If you hold the switch for a few seconds after reaching the pitch limit, the motor will stall. This will cause the circuit breaker to pop out and you have to wait several seconds to reset it.
- The system will not run reliably on regulated DC current from regulator, therefore you need a battery.
- Before disassembling the prop always bring the pitch to the neutral position.
- Never engage pitch adjustment on one blade only or on two blades spaced 120 degrees.
- Do not remove carbon deposit from the brushes on slip rings.
- Do not rely on a spring, which returns the switch lever to the neutral position.
- If you can't change the pitch In-Fight, try it in idle R.P.M. or try to move the switch lever back and forth.
- **Do not shorten 12' wires** or circuit breaker will pop out sooner.
- Keep the grease away from plastic and limit washers.
- Keep oil away from slip rings.
- Make sure that there is no electric continuity between slip rings and the engine frame otherwise you could destroy your regulator rectifier when changing the pitch while engine is running.
- After you are done with setting the limits and final installation seal the gaps between the blades with silicon.
- Tie down or put tape over the brush connectors so they will not come loose in flight.
- **Use only the hardware supplied with the prop. Never drill or modify the boltholes in the blade.**
- Make sure that there is at **least 5" of clearance** between the blade tips and trailing edge of the wing, radiator, rudder, or whatever, because the blades are designed to flex back and forth more than wooden blades.
- Do not slide your fingers along the trailing or leading edge of the blade, fibers may pierce your skin.
- Use only hardware supplied with the prop. Never drill or modify the bolt holes
- Do not cut the prop any less than 52" in diameter.
- To remove the adaptor from the flange take the prop off first. Remove allen head bolts from the adaptor. Mount the prop back on the adaptor. Wiggle the adaptor with the prop until it comes off.
- If you are going to use other than skull cap type spinner make sure that there is at least 1/4" clearance between blades and cut-outs in the spinner.
- If your aircraft holds U.S. experimental airworthiness certificate, you are supposed to contact the FAA FSDO before flying the aircraft. When notified, the FAA inspector can determine if the procedure was major change (As defined per FAR 21.93 and listed in appendix a part 43) and if any additional inspections or operating limitations are needed prior to the flight.
- Enjoy flying with Ivoprop.

## Continued Airworthiness Instructions

### **Pre-flight Inspection:**

Before starting the engine, cycle through the pitch range and listen for abnormal sound from gear motor. If it sounds louder or slower than usual or makes grinding sound find the cause and correct it.

### **Annual Inspection:**

Clean lead screw and spool thread with acetone and lubricate lead screw and groove in spool with white lithium grease.

Check Brushes, if they are too short replace them.

Check plastic bumper washers for deformation and limit washers for wear and replace if necessary.

Anytime you reinstall the prop refer to warning in instructions our service bulletins for proper torqueing, re-torqueing and monitoring.

### **500 Hour / 5 Year Inspection:**

Send gear motor unit to us for inspection and lubrication.

You can download AC 20-37E from [www.faa.gov/regulations\\_policies](http://www.faa.gov/regulations_policies) for more info on aircraft maintenance.