

## Pump Jet (32mm 2212/2216/2217/2440 Motor)



N7 Cat

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### Summary

An offshoot of my project <https://www.thingiverse.com/thing:4606971> RC Pump Jet boat, I modeled a stand alone water...

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[2212](#) [waterjetpump](#) [waterjetdrive](#)

An offshoot of my project <https://www.thingiverse.com/thing:4606971> RC Pump Jet boat, I modeled a stand alone water jet originally intending boat to be modular in design. After consideration I decided to just integrate the pump jet with the boat body rather than try to seal the modular parts against water ingress.

Needz MOAR pump? 4/3 scaled pump and parts here <https://www.printables.com/model/413647-rc-boat-pump-jet-boat-large-yao-kong-chuan-pen-she> saved as inlet duct flanged

This model might still be useful for someone though. I've also kept the motor separate from the pump jet in case you want to model your own motor housing for different motors.

With the 3/19/2021 updates to stator and nozzle it reliably runs at all thrust levels once primed - smoothing and water proofing the inner running surfaces of the pump inlet via wax, epoxy or other means is recommended for reliable operation.

There is a split line at the motor mount, this is there in case you want to follow the same design philosophy as my boat project where the motor mount joins the two halves of your printed boat. Also note that for the part Inlet Duct you will need to specify supports touching build-plate as there is an unavoidable overhang for the mounting flange otherwise print settings will be the same as specified for the boat project mentioned above.

Depending on your weight limitations you might want to specify more walls than my boat project to make the parts sturdier - I was constrained by the displacement of my hull.

Note caution is warranted with the cooling impellers - the layer adhesion issues inherent to 3d prints makes it possible for the impellers to fracture under load. Wear eye protection and be mindful of risk when using. For added safety consider printing cooling impellers in TPU - higher layer adhesion should make failure less likely. Slicer setting recommendations can be found in my boat project

#### BOM:

- Motor Options:
  - 2212 <https://www.aliexpress.com/item/32672300112.html> or <https://www.aliexpress.com/item/1904754775.html>, the gateway motor, something between a 1400 KV and 2000 KV might be good.
  - 2216 <https://sunnyskyusa.com/collections/x-v3-motors/products/sunnysky-x2216> Sunnysky 2216 motor, going to test a 2600 KV motor soon - these angreh little kittehs push over 750 W of power from a ~70g package >o.o< really impressive performance - no gps telemetry yet for speeds but this is by far the fastest option - paired mine with a 60 amp ZTW shark esc
  - 2217 <https://www.aliexpress.com/item/2255800146800490.html> I used a 2300 KV motor combined with a water cooled esc and the direct vent boat body + cooling impeller for the pond pictures featured
  - 2440 water cooling motor ZTW <https://www.aliexpress.com/item/4000425168430.html>, note you will need to use water cooling version of the stator / cover and verify it is supplying enough cooling water to the motor and ESC. KVs (4500) on suggested motor might be high for the size of the impellers. I am not sure if all 2440s and water cooling sleeves are built to similar dimensions but you might want to substitute with a lower KV motor if you have one

- Prop: <https://www.aliexpress.com/item/32714017489.html>
  - If 2212 Motor L10 Shaft 3.18 mm (motor) Cardan
  - if 2216 Motor L10 Shaft 5.00 mm (motor) Cardan - still testing
  - if 2217 motor L10 Shaft 4.00 mm (motor) Cardan
  - If 2440 Motor L15 Shaft 2.3 mm (motor) Cardan
- ESC: Water proof ESC appropriately rated for your motor
- Servo: sized for 9g servo <https://www.aliexpress.com/item/1005002219839349.html>
- M3 X 6 X 5.3 Embedded Nuts (old link no longer works - possible substitution M3 X D5 X L6) <https://www.aliexpress.com/item/4000232858343.html> (also if using 2217 some 3mm high nuts are needed)
- M3 Machine Screws (Button head and Flat head) <https://www.aliexpress.com/item/32798146322.html> or stainless <https://www.aliexpress.com/item/32934186482.html>

Thrust vector nozzle, stator and motor cooling impeller should be printed in TPU for layer adhesion qualities.

For build instructions please go to post processing pictures at project <https://www.printables.com/model/291645-rc-boat-pump-jet-boat-yao-kong-chuan-pen-she-beng>

Josh at Flite Test did a good vid about waterproofing RC electronics with Peter Sripol (Flite Test | Waterproofing Electronics)

Enjoy >^.^< also let me know if there are any issues as my main focus for the near term will be the RC boat project and changes / improvements there may not make it here.

Updated 10/3/2020, removed the bar surrounding the servo to improve printability.

Updated 10/7/2020, improved printability by modifying the fillet around the shaft support

Update 10/9/2020, After a print failure of the protective grid on the intake as well as impact durability test failures I have replaced with a filament heat stake method as shown in my boat project post processing pics.

Insert 1.75 mm filaments into the slots and use a low temp soldering iron to melt the ends into the inlet - you could also use servo wire and glue in place...unless you like grinding baby fish into a pulp...u monster

Updated 10/11/2020, increased clearance for the prop shaft

Updated 10/15/2020, motor mount was a tight fit, increased clearances - note if print elephant foots you will still need to trim mount a bit

Updated 10/18/2020, Added a variable trim ride plate. A bent 1.5 mm servo wire serves as the retention and adjustment mechanism, backup retention provided by an embedded nut and M3 X 10 screw + spring. Joint held by filament joint. Note stator profile carried over from my boat project and outer gasket allowance missing :P caturday cat prefers to nap >^.^< it is a feature not a deficiency

Updated 10/20/2020, some weird artifacts were cropping up in cooling impeller during slicing, increased to high resolution stl and fixed wall width

Updated 10/21/2020 increased prop clearance on stator bowl

Updated 10/25/2020 improvements to thrust vector nozzle to allow M3 X 5 X 6 mm embedded nuts to ride on the inner race of the 623zz bearing

Update 11/6/2020, feedback on my boat project suggest that a thrust vector nozzle with a slight pitch up would be beneficial - added a thrust vector nozzle with a 5 degree pitch up. If you find that your own boat is going nose down this new nozzle will help :). Added a 10 deg pitch nozzle if your CG/CB requires it

Update 11/18/2020, first functional test of the waterjet - I found that even with TPU gasket air and water would spray out thus sealing the stator bowl to inlet duct body with silicone or glue is necessary. I found an issue with air locking - I don't fully understand the cause but experimentally determined a way to resolve this via a pending modification to the thrust vector nozzle. Update uploaded (Thrust Vector Nozzle Variable Pitch) but untested - I'll hopefully get a chance to print and test by tmw. Testing confirms the air lock issue is resolved with this new nozzle - there is some loss of efficiency. I don't really know why this fixes the air lock but I suspect the stator bowl fins were not redirecting enough of the rotational energy generated by the prop resulting in an area of low pressure which would draw air in from behind the outlet...without high speed cameras or CFD I can't really say. N7 Cat says "wut he trying 2 say iz I putz mah paw ober da nozzle and dat fixes it"

11/21/2020 did some more study on propulsor units and updated the pitch and number of stator vanes - 5 vane stator uploaded - will test later and delete original if testing displays improvement. Test showed marked improvement in both thrust and elimination of air lock using the 5 vane stator - original deleted. For anyone else designing or trouble shooting other pump jets on thingiverse the number of stator vanes needs to be a prime number and different than the number of prop blades otherwise a standing wave can develop. At some point in the future I might experiment with a properly designed axial flow prop and stator - salt sintering might be able to create a strong enough part for use as a prop.

11/25/2020 reverted thrust vector nozzle to neutral pitch

2/16/2021 added a printable gasket

3/17/2021 modified the thrust vector nozzle to try and fix an intermittent airlock issue

3/19/2021 tweaked the thrust vector nozzle and modified the stator bowl by extending parallel fin surfaces in attempt to reduce rotational energy of water

3/21/2021 experimental two stage impeller / stator uploaded - my first try at a printed impeller - going to test TPU and PETG but am skeptical about the robustness of either. Note there are two versions of the second stage impeller

3/23/2021 fixed some clearance and mounting issues with the experimental impellers

3/25/2021 fixed some clearance issues with the mid stator causing it to bind to the second stage shaft

3/25/2021 had a chance to test the two stage impeller system and found flow was disrupted past 40% throttle - I suspect the pitch angle is too aggressive - removed files until I can remodel all the components

3/26/2021 updated inlet duct in preparation for two stage impeller system, old model was missing a cutout for the impeller

3/30/2021 tested stage 1 impeller and thrust feels like it has doubled :D moar powah! You will need to print new model inlet duct before using. Will test the two stage setup soon. For now stage 1 works with existing stator and improves thrust

3/31/2021 tested two stage setup and it was overall a success, flow rate is higher with just the single stage but priming is much faster with the two stage setup. In fact device will prime even under full thrust, making for more reliable operation in choppy water. Two stage only functions with the new stator bowl axial, if you are only using the new stage one impeller it will still work with the old stator. Flow rates were getting so high that the nozzle started to impede flow, an open nozzle is now uploaded

6/25/2021 stronger servo mount on part inlet duct

6/30/2021 improved motor cooling impeller, larger fins, improved filleting, removed thin shroud, now secured by butting against cardan joint

7/11/2021 uploaded step files of the inlet duct and 2212 motor mount - note I combined the two parts into a single step file for alignment and

spacing when modeling - when designing you will probably want to re-separate as print orientation for the mount should be rotated 90 degrees

8/1/2021 it was getting tedious to maintain two different sets of designs so motor mount is now just the same model as the boat project - wires can be routed through lower duct

8/2/2021 uploaded variants without water cooling, for the no water cooling versions of the stator bowl and mid stator please use the stl files from the boat project

8/5/2021 improved motor cooling impeller profile

8/11/2021 stage two impeller was shearing from the embedded nut - altered stage two impeller so that embedded nut enters from other end and added some more material to the embedded nut hole to hopefully prevent this

8/12/2021 moved motor mount 10mm closer to inlet duct in order to improve strength of the stage 2 impeller

8/15/2021 unifying parts between boat project and pump jet. Updated water cooling stator bowl, uses embedded nut for more secure water nipple retention. Note water cooling is now intended to passively exit vs being pulled by pump jet (if this is insufficient let me know and I might revisit)

9/22/2021 did a rudimentary mass flow rate estimation on the impellers and determined that they were not matched - adjusted the pitch of the second stage

10/5/2021 moved the stator vanes closer to the stage 2 impeller as dimensions changed in 9/22/2021 update

10/12/2021 filleted the embedded nut cutout for the M3 water nipple retention nut for improved strength

11/4/2021 2440 motor mount added - note shaft length and cardan joint changes

11/17/2021 improved clearances on drive dog, and stator bowls

11/19/2021 added a flanged version of the stl and step files in case anyone is using as a retrofit pump for existing hulls

11/21/2021 minor improvements to mounting screw hole locations and reinforcement. Removed previous variant

3/10/2022 2217 motor mount added - note cardan joint changes

8/11/2022 added a larger ride plate

8/19/2022 Sunnysky 2216 motor mount added - note cardan joint changes

4/21/2023 improved ride plate by following streamlines of boat, scalloping base profile and creating sharp trailing edge - should reduce drag

5/24/2023 Stator bowl now has Venturi suction effect for either bilge pump or cooling - screw nipple directly into the intake next to the outlet. note: effectiveness of the bilge function is dependent on thrust, higher thrust levels = higher bilge pumping effectiveness

7/21/2023 fixed 2216 cooling impeller

Category: R/C Vehicles

## This remix is based on



**Pump Jet (32mm 2212/2216/2217/2440 Motor)**

by N7\_Cat

## Model files



**inlet\_duct\_flanged\_stl.stl**



**ride-plate.stl**



**stator\_bowl\_gasket.stl**



**stator-bowl-axial-water-cooling.stl**

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**stator\_bowl\_axial.stl**

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**thrust\_vector\_nozzle\_open.stl**

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**thrust\_vector\_nozzle.stl**

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**stage\_1\_impeller.stl**

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**mid\_stator.stl**

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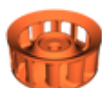
**stage\_2\_impeller.stl**

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**2212\_motor\_mount.stl**

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**2212\_motor\_cooling\_impeller.stl**

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**2217\_motor\_mount.stl**

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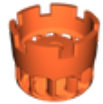
**2217\_motor\_cooling\_impeller.stl**

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**sunnysky\_2216\_motor\_mount.stl**

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**sunnysky-2216-motor-cooling-impeller.stl**

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**2440\_motor\_mount.stl**

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**inlet\_duct\_flanged.step**

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[Find source .stl files on Thingiverse.com](#)

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