

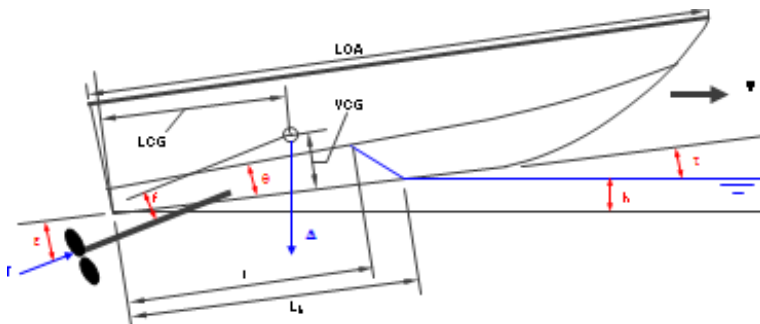
Surface Propeller Product

To extend the live of the 15 year old CB90 with water jet we suggest to replace present the drive train with a new drive train which includes a Levi Diamond Back surface propeller.



This drives were delivered 30 years ago. Please observe the quality of the material.

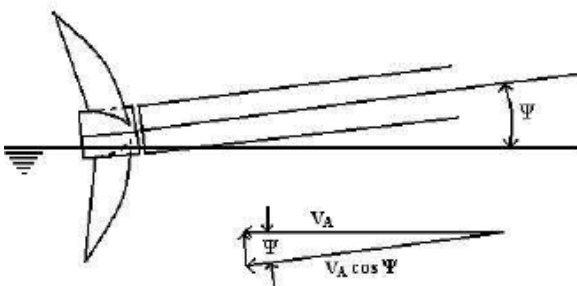
Bigger propellers are more efficient than smaller ones. To make boats faster designers want to increase the propeller size. But there is a limit to this.



To fit a bigger propeller underneath the boat you need to increase the propeller shaft angle.

The propeller tip clearance also needs to be observed. This increases the shaft angle even more.

The propeller shaft angle can't be increased unlimited. Since only the \cos (shaft angle) is used to propel the boat forward. The \sin (shaft angle) lifts the stern up and the bow down. (which increases the resistant of the boat and blocks the speed increase).

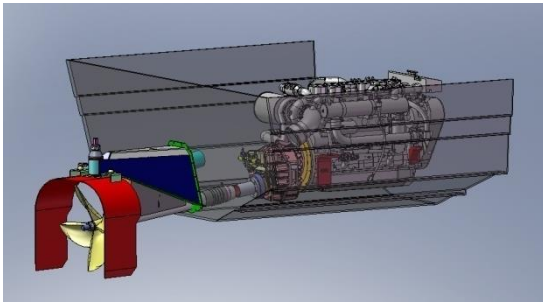


Engineers were looking for a solution to the problem. Before the end of WW1 a Canadian with the name of Hickman mounted the propeller on the transom.. The speed increased. The first Surface propeller was created. Hickman was relative successful and sold about 5000 units to the US navy. After the WW1 the idea was forgotten. Till in the 60's the famous race boat designer **Sonny Renato Levi** picked up the idea

and developed and patented his Levi Surface Drive Unit and Levi Surface Propeller. He won a lot of "off shore races" and developed a commercial propeller which not only could go fast forward but had also the capability to reverse. He named this propeller Levi Diamond Back propeller. Theses propeller series were tested again in the year 2012 by several Italian and Canadian Universities.

The results of these tests were published (see attachment) but since the form of the propeller belongs to Levi Drives, the shape of the propeller sections was never released.

Here the product info in short



- Surface propeller work behind the boat and not under the boat
- The draft is less, about 50% of the propeller diameter below the keel line.

- the propeller can be as big as desired, since there is no problem with propeller tip clearance or shaft angle. Our standard shaft angle is 8 degree

-The surface propeller area is about 150 % 200% of the normal propeller area (Remember a bigger propeller is more efficient than a smaller one)



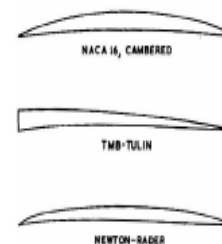
- at the pier the propeller is fully submerged.

- A normal engine would quit with overload and not able to turn such propeller,

- at work the position the surface propeller is about 50% out of the water



- To reach this working position special measures are necessary



-The surface propeller section looks more like a **wedge** not like an **air plane wing** shape

- Levi surface propeller geometry was never published



- The propeller section works only on the front
- The design of the surface propeller substitutes cavitations by ventilation and can produce higher speeds.
- **The propeller material is NIAI Bronze**
- **No more reduction of trust or destruction of propeller due to cavitations at higher speeds**



- The back side of the propeller is in cushion of air, this means the section can be made as thick as needed and don't increase frictional resistance.

-The efficiency of the propellers are in the range of 55-65 %

-The reverse capability has been enhanced by the Diamond Back propeller invention.

- **It is important to place the Surface propeller at the right position at the transom**



-Levi Drives has developed an optimal propeller holder (drive) for this.

-The standard propeller holder is constructed **complete from stainless steel 326 L which is considered the best material for marine use up to date.**

-Other materials are available at special requests (Al, normal steel)

- all welder have 6G stainless steel qualification

- they are supervised by an GL certified welding engineer

The main job of the of the Propeller Holder (Drive) is:



- To help in bringing the propeller from the resting position to the working position.

- Keeping the propeller at the right position.

- Assistant the surface propeller during reversing operation.

- steering the boat.

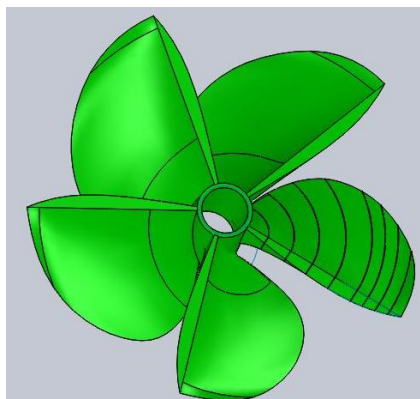
- protecting the user from the propeller.

- reducing the rooster tail from the propeller

- channelling the exhaust gasses

Levi Surface Propeller

We have basically 2 families of surface propeller. Most common are 4,5,6 bladed propeller of this **Cleaver** type. The second type is the **Scimitar** type.



How to produce a propeller

there are basically 4 steps to produce a surface propeller.

1. - design of the propellers
2. - producing the propeller molds
3. - casting the propeller
4. - machining and balancing of the propeller

To 1) The propeller design was done earlier by hand, now we use 3 D computer programs.

To 2) Propeller molds were done by hand from a wood block



- Wooden pattern are done for one blade only.
- Than the front and back is going to be for each blade.
- Several single sand blade molds will be joint for a propeller

-Several propeller molds add up to a propeller series. For one propeller diameter we vary the P/D ratio from 0.9 till 1.2



Series of 24 inch Diamond Back Propeller



Series of 17 inch Diamond Back Propeller

To 3) The machining can be done conventional or with CNC milling

To 4) The balancing can be done static and/or dynamic.



-Here a 24 inch Levi Diamond propeller in dynamic balancing machine

Future Developing

- Engineers like always to be faster and more exact.



- With the aim of powerful computers, we are able to mold complex parts like a propeller in 3D.

-We can use this information to machine wit 5 axis CNC mills the propeller out of a block of metal. This is possible , very exact but very expensive and has its own problems.

We use this technology to improve our sand cast molds.

We have started to produce propeller molds by the rapid prototype system. The rapid prototype system is very exact but was (2014) relative expensive. Big machines are hard to find.

We were build our own 3 D printer and were printing the bigger propeller in parts. After this the parts were jointed together'



Comparison between Levi Surface Propeller and Water-Jet driven Crafts

Two similar boats like the CB90

Test Boat name 1) “PP-2001” with Levi Surface Propeller

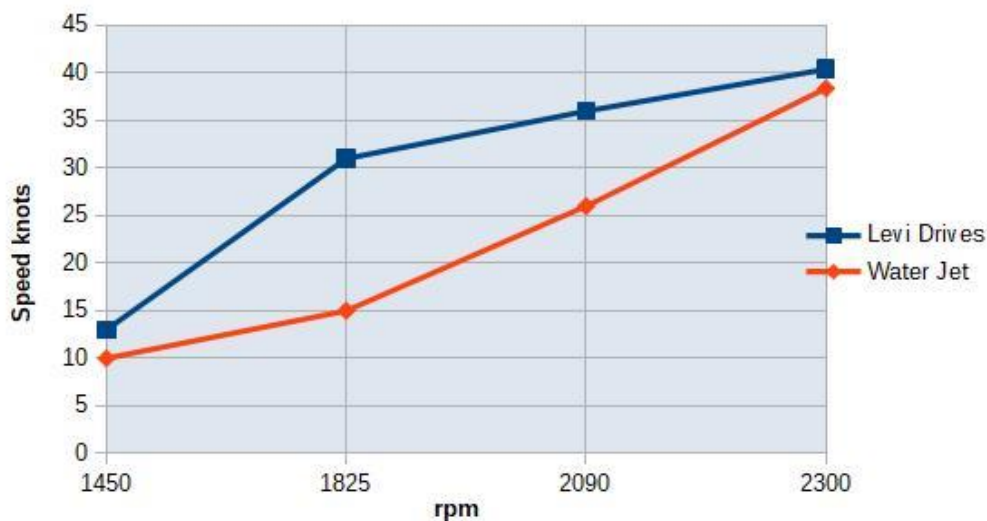
2) “PP-2005” with water jet

Name of Boat	PP 2005	PP 2001
LOA	15 m	15 m
LWL	13,5 m	13.5m
Hull type	Mono hull	Mono hull
Displacement	20 t	20t
Max output	2 x 605 kW	2 x 605 kW
Propulsion	2 x Waterjet	2 x Levi Drive



Levi Drives - Water Jet

test of 2 similar boats



rpm	<i>Levi Surface Propeller</i> PP-2001	<i>Water jet</i> PP- 2005	The advantage is specially visible at the normal cruising rage of 1825 rpm water jet 15 knots, Levi Surface propeller 31 knots
	(kn)	(kn)	
1450	13	10	
1825	31	15	
2090	36	26	
2300	40,4	38.4	

