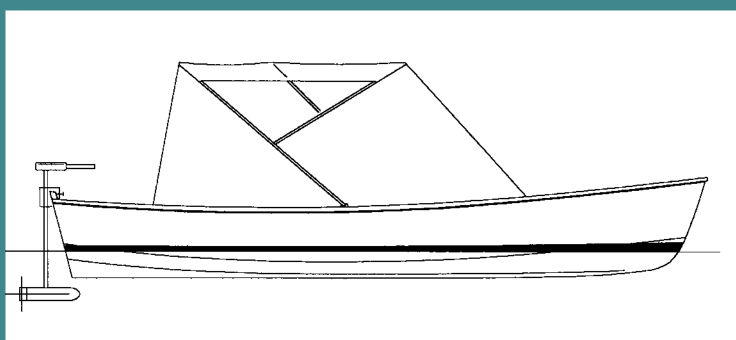
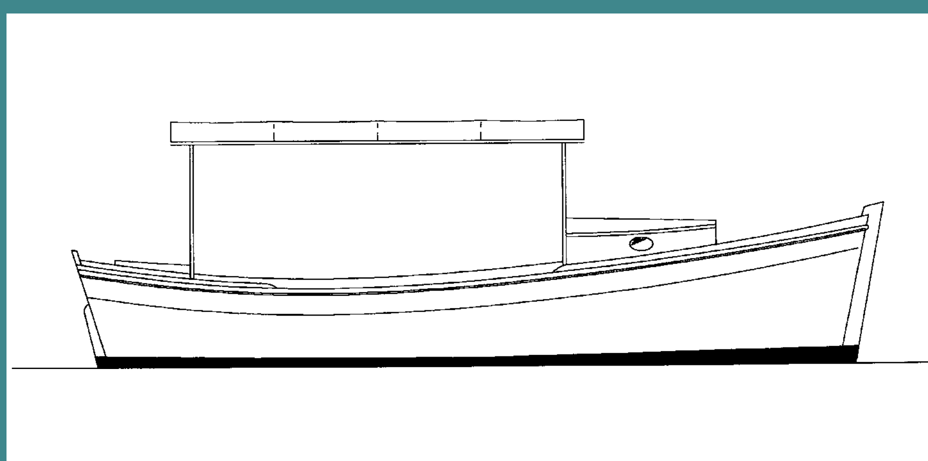
Electric Boat

Hull Design





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Hull Design Considerations for Electric Boats

Unfortunately, going 18 knots in an electric boat for any length of time is all but out of the question. The energy storage of batteries is not up to it for any length of time, even with the most advanced batteries. About 80% of hull speed is the most efficient use of power and weight capacity to carry the batteries needed for more than 8 hours of operation. Higher speeds are possible (i.e. hull speed) for a few hours. Boats that are designed for speeds higher than hull speed have a transom that is deeper in the water. This deeper transom clears the water at high speed. At low speed, the water doesn't clear and drags terribly. With cheap gas and high power, this isn't a problem. With electric, a flat transom dragging through the water is horribly in efficient. This is the paradigm that has to be accepted by boaters wanting efficient power. You can't have efficiency and high speed with current technology. Going half fast will have to be enjoyed for what it is. This is one among many shifts in cultural thinking that are going to have to be made in the years ahead.

Primary factors that influence boat hull efficiency include waterline length, displacement , surface area of hull and appendages and other hull shape factors.

WATERLINE LENGTH

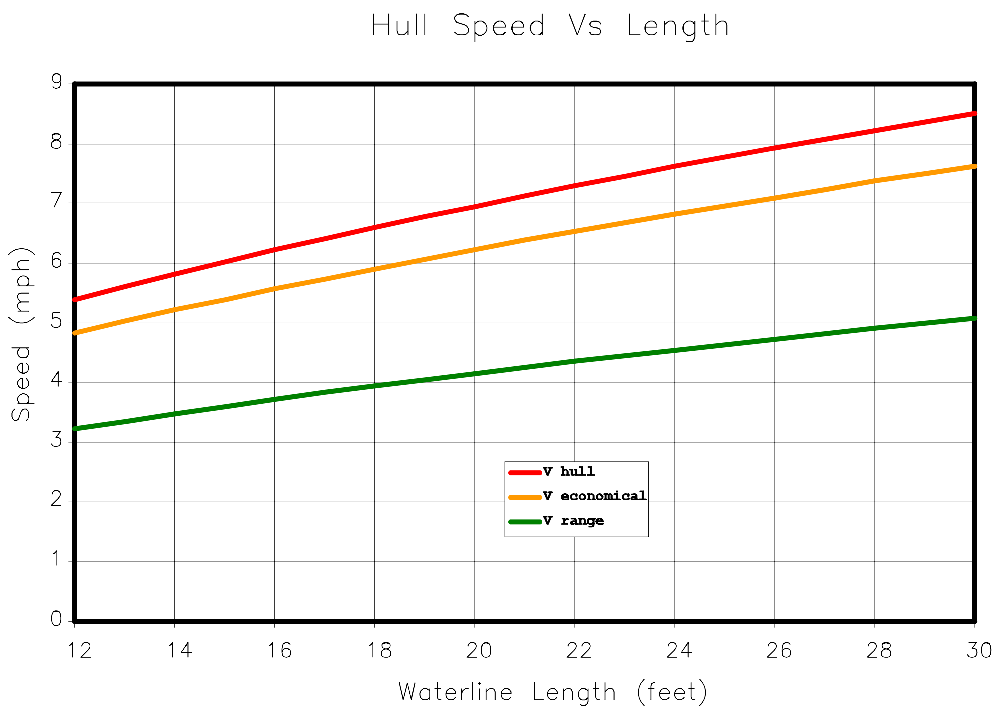
Longer is faster.

SPEED LENGTH RATIO $= V / \sqrt{LWL}$

= 1.34 theoretical maximum hull speed

= 1.2 most economical top powering speed

= .8 most economical for long range electric power



WEIGHT (DISPLACEMENT)

Lighter is faster for a give hull length.

DISPLACEMENT LENGTH RATIO = $DISP/(.01*LWL)^3$

> 200 heavy for electric boats

150 moderate, best range for electric boats

< 100 for small boats

Where displacement is in Long tons (2240 lbs) and LWL is in feet

WETTED SURFACE

Round hull sections have minimum wetted surface for given displacement.

Minimize appendage surface area. (e.g. skegs, keels, struts) They all contribute to parasitic drag.

TRANSOM IMMERSION

The bottom of the transom should be just touching the water under power. This provides maximum waterline length. Transoms should not be submerged because they will create eddies and create added drag. While the classic fantail launch is better than a deep transom, the stern lines closer to the water will provide a cleaner undisturbed flow of water leaving the boat.

HULL SECTION

Rounded sections produce minimum eddy resistance. Round over chines of hard chine hulls. Sharp corners create eddies and added drag. Hard chine hulls are more stable and have greater carrying capacity.

HULL SHAPE

Bow waterlines should be narrow (fine entry). The stem should be in the water to increase waterline length and minimize wave slap.

Stern sections should be long and straight when viewed from the side.

Graceful, clean lines are desirable. Short abrupt changes in the stern will produce eddy making drag and bad flow into the propeller.

APPENDAGES

Minimize hull appendage area in front of the propeller to provide good flow into the propeller. Struts are better than built up skegs and deadwood.

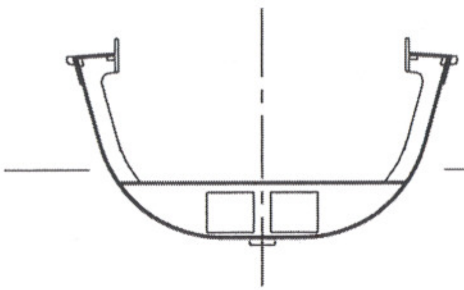
WINDAGE

Although not part of hull drag, wind resistance can exceed hull resistance in windier exposed areas. Wind force is proportional to velocity squared, so adds up fast to when going into a strong head wind. Minimize exposed area including freeboard, awnings etc.

SUMMARY

Electric boats should be long and light with clean hull shape. Minimize exposed area from hull freeboard and awnings if operating in exposed windy conditions.

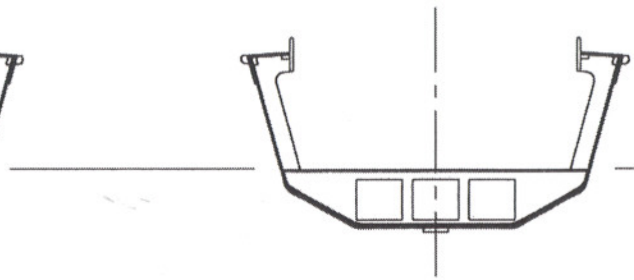
COMPARISON OF HULL SECTION SHAPE



ROUND

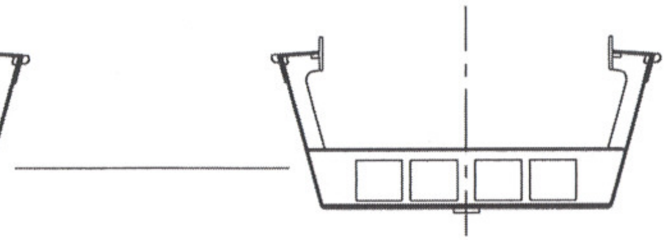
LEAST WETTED SURFACE FOR GIVEN DISPLACEMENT

MINIMUM HULL RESISTANCE



MULTI CHINE

GOOD COMPROMISE BETWEEN ROUND AND SINGLE CHINE HULL SHAPE



HARD CHINE

EASILY BUILT IN SHEET PLYWOOD CONSTRUCTION

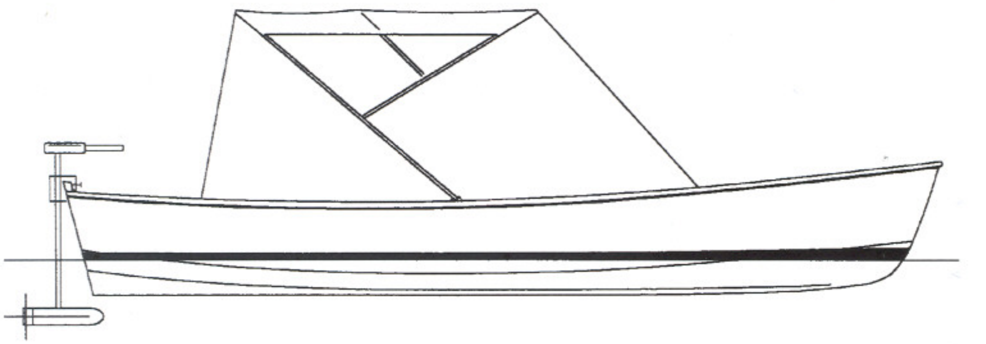
STABLE HULL FORM

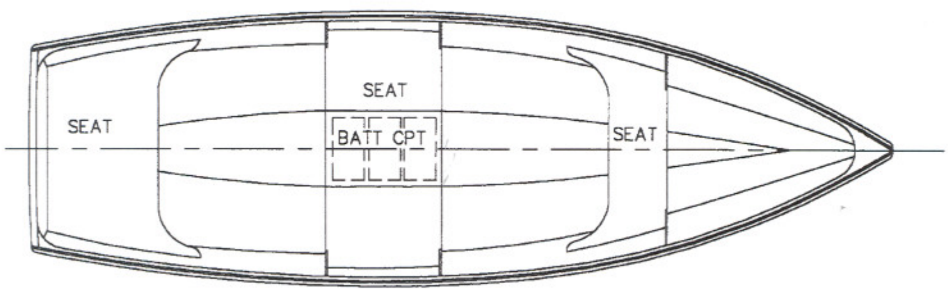
GREATEST BATTERY CAPACITY

SHALLOW DRAFT

E15

Length	15'-0"
Beam	4'-6"
Draft	0'-6"
Weight	185 lbs
Power	50-107 lbs thrust

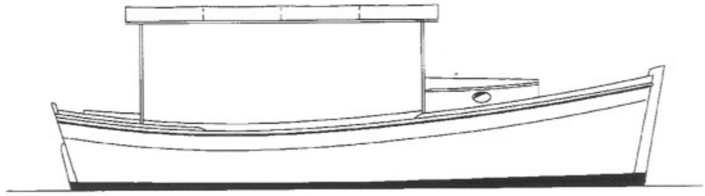


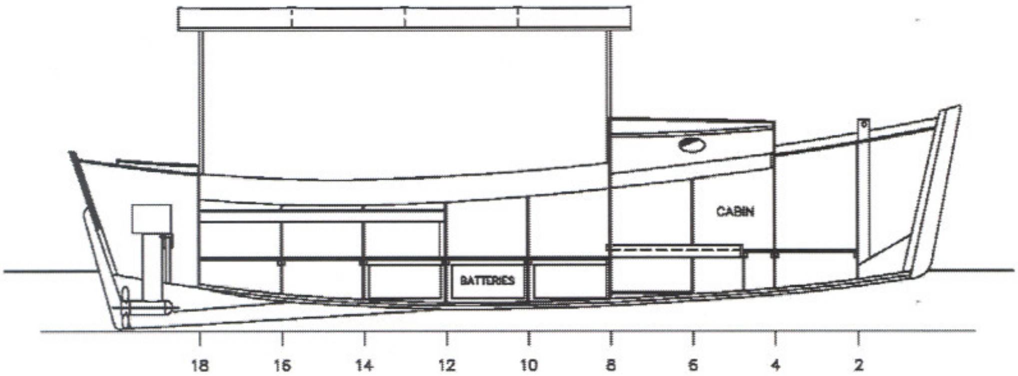


ELECTRIC 15 came about from a conversation with the president of the Electric Boat Association (Ken Mathews) at an annual electric boat gathering in St Michaels, MD. We discussed an entry level electric boat that is economical and fun to build by families and groups. A trolling motor is used for propulsion because they are readily available and easy to install. The **ELECTRIC 15** is built using the stitch and glue method therefore, no specialized tools or skills are required. She is stable and has a 500lb capacity. Three type 27 deep cycle batteries will provide enough electricity to cruise at 5 knots with full load for about 8 hours. Lighter loads will be faster and travel farther. She will be ideal for exploring the waterways or sunset cruises in style. Look for larger versions in the future. Plans include: panel layouts, construction, and details.

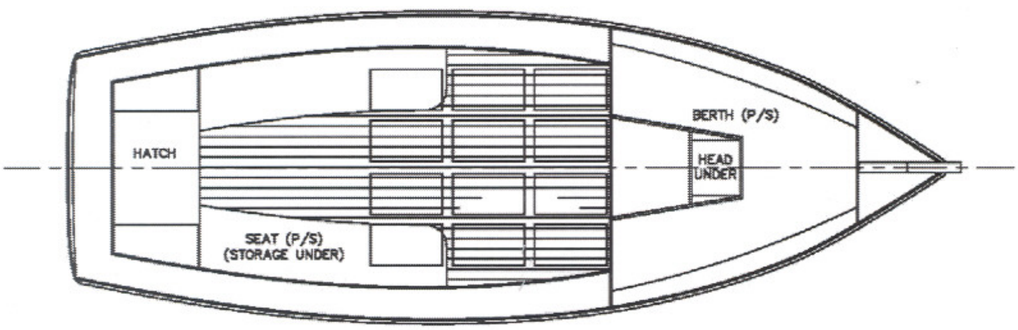
REDWING 21LE

Length	21'-0"
Beam	7'-6"
Draft	1'-4"
Weight	1800 lbs
Power	5 hp electric





INBOARD PROFILE



ARRANGEMENT PLAN

REDWING 21 LAUNCH is a new design for eco-tours and pleasure cruises. She is ideal as a six-pac ecological tour boat with inboard electric power. Whether used for work or pleasure, you will enjoy the sights and sounds as you travel quietly along the waterways. She has a shallow draft allowing entry into the areas where wildlife abounds. The electric power version has room for 12 - 8D batteries under the cockpit sole.

With this battery capacity, she will cruise for many hours at five to six knots. Higher speeds are possible depending on loading. Construction is stitch and glue or glue and screw using plywood and epoxy. Plans include: materials, lines, panel layouts, construction and arrangement. A new CNC plywood hull kit is available ready to stitch and glue together. This makes construction quick and easy, ready to finish out and be underway.