MEMORANDUM ON THE CONSTRUCTION OF THE PENGUIN CLASS DINGHY

Before undertaking the construction of a Penguin dinghy the inexperienced builder should read a book on the subject of small boat building. This will save time and effort and will enable him to build a better boat. A number of good books on the subject may be purchased through the book departments of the better known yachting magazines or may be available in local libraries. Some facility in the use of the basic wood working tools is necessary.

The plans and specifications should be carefully studied before work is actually started on the boat. The inexperienced builder should be very careful about deviating from the plans for they reflect actual building and service experience. However, if there are any points or details which are not entirely clear, by all means write the Chairman of the National Measurement Committee for clarification. This is a part of his duties and he will gladly assist in any manner possible.

After the plans and the specifications have been studied it will be necessary to procure the materials. To avoid any misunderstanding over the various woods suggested in the specifications for the different items it will be wise to discuss them. First there is no limitation on the type wood used as long as it weighs at least 20 pounds per cubic foot. The woods suggested are those recognized as best suited for marine use. Each type wood has advantages and disadvantages. Spruce, for example, has the greatest strength for weight and is highly desirable for spars and, therefore, in the case of a Penguin, spruce may be used throughout. One of the drawbacks is that it will increase the cost. There has been considerable discussion about the importance attached to weight in the Penguin Class. In general, the lighter boats have proven faster. So, if the boat is to be built for racing make it as light as is consistent with good practice and, of course, it must comply with the specifications. To save weight, make the frames, keel, spars, thwart, mast partner, gunwale and chine of spruce or good cedar. Mahogany or oak should be used for the stem, breasthook and knees in any case. The fender may be made of spruce, but some do not feel that it will stand the wear that an oak or mahogany fender will. If the boat is to be raced the lighter boat has the definite advantage of being easier to haul in and out and to handle when loading on a car top or trailer. The completed hull ready to go with centerboard but not including rudder, sail, equipment, or spars, must weigh at least [redacted] pounds.

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Read the specifications.

The bill of materials below is only a guide listing the essential materials. This may have to be increased or decreased slightly depending on the builder. Lay out the work with some thought to conserving materials and to utilizing the left over materials. Try to keep scrap to a minimum and save all scrap until the boat is completed. It will be surprising how many times the scrap can be utilized. Much unnecessary labor can be saved by ordering material finished to the required size. For example, material for the frames should be purchased dressed to 5/8" and that for the side frames cut 2" in width as well. This will increase the cost but may be well worth it.

APPROXIMATE BILL OF MATERIAL

Item	Dimensions	Quantity
Keel	12' x 5-3/4" x 7/8" (or 5/8"; see specs.)	1 piece
Stem	1" x 3" x 2'	1 piece
Stem cap	2" x 4" x 2'	1 "
Side frames	2" x 5/8" x 20'	1 "
Bottom frames	4" x 5/8" x 20'	2 "
Transom - if solid	18" x 3/4" x 4'	1 "
- if plywood	18" x 1/4" x 4' plywood	(See planking)
framing for plywood	2" x 5/8" x 2'	1 piece
	4" x 5/8" x 8'	1 "
Breasthook and knees	10" x 3/4" x 3'	1 "
Chines	2" x 3/4" x 12'	2 "
*Chine battens	1" x 1/4" x 12'	2 "
Gussets	1/4" plywood	(Scrap from planking)
Gunwales	1" x 5/8" x 12'	2 pieces
Fenders	1" x 1/2" x 12'	2 "
Thwart	5-3/4" x 3/4" x 5'	1 "
Mast partner	5-3/4" x 3/4" x 3' - 3"	1 "
Centerboard trunk logs	4-1/2" x 3/4" x 4'-6"	2 "
Centerboard trunk sides	13" x 1/4" x 4'-6" plywood	2 "
Centerboard	12" x 3/4" x 4'	1 "
Head ledges	1-3/4" x 1" x 15"	2 "
Rudder (including cheek pieces)	12" x 3/4" x 4'	1 "
Skeg	4" x 13/16" x 2'	1 "
Mast	3-1/2" x 2-1/4" x 19'	1 "
Boom	2" x 2" x 10'	1 "
*Floorboards	3" x 3/8" x 90'	Random lengths
Tiller	1" x 3/4" x 3'	1 piece
Mast step	4" x 3/4" x 18"	1 "
Stringers (for thwart & partner)	1-1/2" x 5/8" x 6'	1 "
Planking	12' x 4' x 1/4" sheets plywood	2 pieces

This must be Marine Grade phenolic resin bonded hot pressed waterproof plywood.

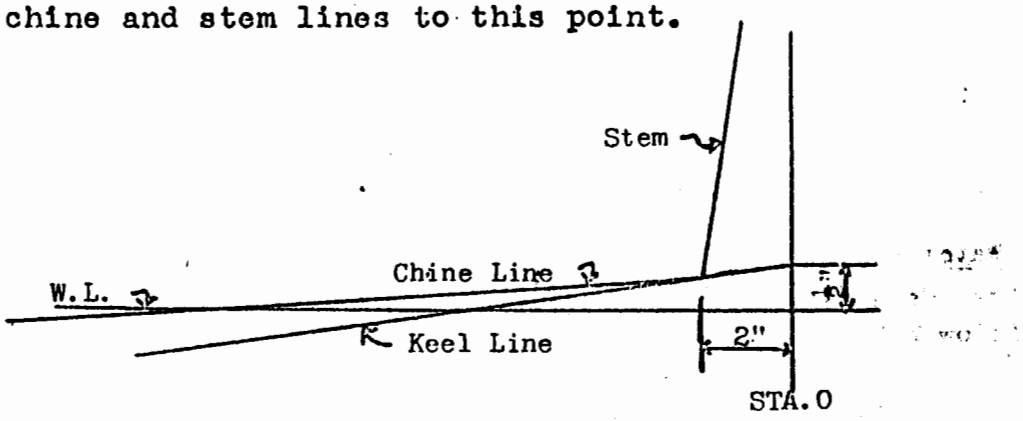
	The gussets, the transom, the bottom, and the sides may be cut from the two sheets of plywood if some care is taken in laying them out. Generally fir is used because it is cheapest but it may be bought with one or both sides mahogany.	
Screws	3/4" - #9 brass	6 gross
	Monel, silica bronze, or copper bronze boat nails can be used in fastening the planking to the structural members in place of screws.	
	2" and larger screws	few as needed
	1-1/2" - #9 brass	1/2 gross
Glue	Cascophen, or Weldwood (as these glues deteriorate if the top is not kept closed tightly it is suggested that they may be purchased in not over 1/4# cans as needed).	
Shrouds, headstay	3/32" dia. stainless steel	50'
Traveller	1/8" dia. stainless steel	6'
Track (optional)	7/8" sail track for shrouds(or 5/8")	4'
	5/8" sail track if used for outhaul on boom	12" to 18"
Track slides (optional)	7/8" (for lower end of shrouds)	2
	5/8"	No. depends on outhaul
Halliard	16' - 1/16" dia. stainless steel with 20'-3/16" dia. rope spliced to it	1
Mainsheet	1/4" dia. min.-length varies with arrangement	
*Turnbuckle (for head-stay)	1/4"	Depends on rig. 1
Mainsheet blocks	1-1/4" or 1-1/2" dia.	No. depends on rig
*Sheaves	2" for halliard	1
	1-1/2" for outhaul	1
Nipples and caps	for centerboard	See plan
Pins	As needed for sheaves and for centerboard	
Cleats	May be standard brass or bronze or very satisfactory ones may be cut out of oak or mahogany	Depends on rig
Mast tangs	1/8" brass, stainless steel, or bronze castings; if stainless steel 1/16" is O.K.	
Oars	6' spruce or ash	1 Pair
Oar locks & sockets		1 Pair
Kapok cushions or life jackets		2

NOTE: As stated above this bill of material is not exhaustive but merely a guide. Additional fittings may be necessary depending on how boat is rigged. Dimensions given are finished stock to be purchased and not finished sizes.
*See specs or "Construction Tips" for alternates.
Furnished with the plans are a set of templates. These templates were prepared because it was realized that a small boat such

as the Penguin is often built by someone with little or no experience in boat building. Every effort has been made to insure a reasonable accuracy in the templates. However, since paper swells and shrinks, depending on the humidity, the templates will eventually become distorted slightly. Using the templates of the frames and transom the boats will be within the tolerances if normal care is employed in building it. This is pointed out because the templates have been checked and at times were found slightly distorted. The more experienced builder will probably lay the lines down full size and fair them, rather than use the templates. If the builder has the necessary experience this is recommended. If this appears beyond the builder's scope, then it is recommended as a second alternative that the sections be drawn full size using the dimensions given in the table of offsets. The accuracy of the offsets given is very good. To employ the second method, proceed as described in a succeeding paragraph for drawing the sections when the lines are drawn and faired. The only difference is that the dimensions are taken from the table of offsets rather than the faired lines. These two procedures may not be considered feasible by some inexperienced builders. In this case, do not hesitate to use the templates for the sections. The templates for the stem, and the centerboard trunk logs may be used regardless of method employed for the frames. It is very important to remember that the templates are to the <u>inside</u> of the planking and are the true size for the frames, while the lines drawing and offsets are to the <u>outside</u> of the planking. In the first two methods it is necessary to subtract 1/4" to obtain the proper size of the frames, while this has already been done with the templates. The succeeding paragraphs are for those who decide to lay down the lines full size and fair them. Regardless of the method employed it is suggested that the builder read all paragraphs of the instructions.

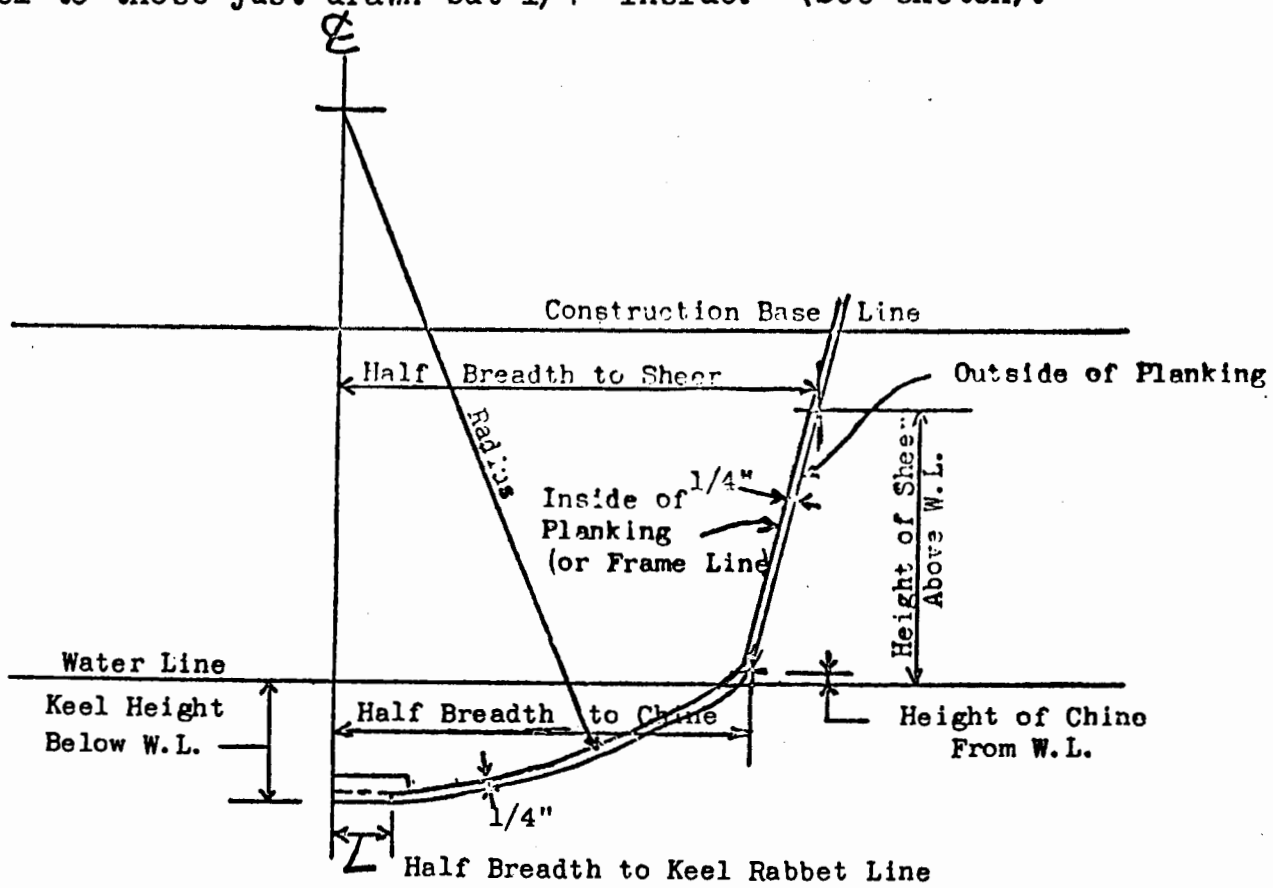
After materials have been procured the construction of the boat can start. When practicable the lines should be laid down (drawn) full size from the table of offsets and faired. Fairing should require a few changes in the offsets and certainly not over 1/4" for any of the dimensions. The bottom arcs may be obtained by swinging the arc or by cutting out the templates successively. In swinging the arcs from a point on the vertical center line, the radii may have to be varied slightly to make the arcs intersect the chine and the keel (at the centerline) properly. The variation in any radius will not be over 2" and this difference will have a negligible effect on the curvature of the bottom. Only one side of the boat need be laid down and if a smooth floor is not available for this purpose, one of the sheets of plywood, or a piece of very heavy paper will be satisfactory. The centerline is drawn first; it must be straight and can be best done by using a chalk line. Then the stations are laid off along the centerline accurately 1' 5-1/8" apart. At each station a line must be drawn at right angles to the centerline. Once the above lines have been drawn the keel rabbet, the sheer, and the chine points can be drawn in the plan view using the half-breadth dimensions given in the

table of offsets. (No keel rabbet is required if the planking completely covers the keel.) The dimensions are given in feet, inches, and the nearest eighth of inches. For example, 2'-6½" is written 2-6-4. A 1/2 after the last number means one half of an eighth, i.e., one sixteenth of an inch. A plus or minus sign means 1/32" added or subtracted. After the points for the plan view have been drawn the profile is drawn over the plan view using the same centerline as the waterline and the same station lines. The distances from the waterline to the sheer, chine, and the keel are obtained from the table of heights. Plus dimensions are measured in the direction from the waterline as stated at the top of the columns and minus ones in the opposite direction. Once all points have been laid off, the sheer line, the chine line, and the keel line are drawn in both views using a 3/4" square strip of wood as a batten. In drawing these lines the batten should be permitted to lie naturally and still go through a maximum number of points. The batten can be held in place while drawing the lines with weights or small brads. This is called "fairing" the lines. The lines will hit most of the points and those probably within an eighth of an inch. This will give a full size reproduction of plan and profile views of the lines drawing, except that the one is on top of the other. There has been some misunderstanding about the stem. The half inch given in the table of heights is at station "0" and not 2" aft. In the profile draw the keel line to station "0". Put a mark on keel line 2" aft of station "0" and draw the chine and stem lines to this point.



After the profile and plan views have been drawn and faired the sections can be drawn so that the frames may be laid out. Sometimes the sections are drawn over the plan and profile views. On the other hand putting them on a small piece of plywood or very heavy paper is more convenient when starting to lay out and cut the frames. Assuming that the sections are to be drawn on a separate piece of material, it is necessary to draw a horizontal line to represent the waterline and erect a perpendicular to it to represent the centerline. Half breadths are taken from the plan view and are measured from the centerline. Heights are taken from the profile view of the faired lines and are measured above or below the waterline. The intersection of a horizontal line, the distance of the chine above or below the waterline at one of the

stations, and a vertical line the distance of the chine from the centerline at the same station, gives the chine point for that station in the sectional views. Similarly, the sheer and keel points for the same station may be determined. Joining the sheer point and the chine point with a straight line and the chine point and the keel at centerline with an arc whose radius is given in the table of offsets, the shape of the boat at that station is determined. This process is repeated until all stations have been drawn. These sections which have been drawn are to the <u>outside</u> of the planking. Therefore, to determine the shape to make the frames, 1/4" must be subtracted. In other words, draw lines parallel to those just drawn but 1/4" inside. (See sketch).



The sections for one side of the boat will suffice as did drawing the plan view for only one side. However, drawing a complete section (both sides) can easily be done by repeating the above process on the other side. Some people prefer drawing both sides as it makes it a little easier to check the frames.

A list of essential tools is listed below. While power saws, drills and other tools make the job much simpler, they are not essential.

Rabbet plane
Cross-cut saw
Hammer
Counter sink
Nail set

Screw drivers
Brace and assorted bits
Plane
Clamps - dozen
Spirit level
Chalk line
Square
Ruler
Adjustable bevel

Before actually starting construction of the boat, glues should be investigated. Every joint should be glued. Resin glues such as "Weldwood", come in a powder form and are mixed with water. There is also the catalyst glue such as "Cascaphen" which comes in two cans, one of powder and one of liquid. The Catalyst glues are much more expensive but have the advantage of inherent strength so that a strong joint results even though the members are not drawn up absolutely tight. In the case of the resin glues, a good joint is required, but not more than the average builder can obtain. The resin glue requires pressure while it hardens. This is accomplished with clamps or screws. The screws may be removed and the holes plugged, but it is simpler and customary to leave the screws in. Excess glue squeezed out should be wiped off before it hardens, with both type glues. Catalyst glues will stain the wood. Epoxy glues should also be considered.

It will be necessary to construct an assembly jig or strongback on which the boat will be built. The strongback must be rigidly cross braced to withstand unequal stresses during the planking operation, must be adequately fastened down so that it cannot rise, and must be level and squared to a common base line. The two pictures give a clear understanding of the manner in which the strongback is made and the frames assembled and fastened to the strongback. See picture.

It is strongly recommended that the boat be built upside down because it is easier to support the frames rigidly, to fair them, and to plank the hull in this position. For this reason, it is necessary to draw a "construction" base line parallel to the waterline but above the sheer in the sectional view. (See sketch). An inspection of the templates furnished with the plans will show that they have a common construction baseline. By making the side frames extend to the baseline the frames will be in the proper relation vertically so as to provide the proper sheer and curvature to the keel when the frames are turned over. To actually lay out a frame, lay the side frame material (2" x 5/8") on the frame line so that it extends just beyond the bottom frame line and above the construction baseline by about 3". Mark the frame on both sides where it hits the constructional baseline and the bottom frame line, and where it hits the sheer line. Join the double marks with pencil lines and cut off the excess material below the bottom frame line. On all side frames except numbers 1 and 2 mark off 1-1/2" at sheer line from outboard side and join with line to bottom of

frame so frame can be cut with proper taper. Next, place the bottom frame material in place and mark where it hits the inside of the side frame line and the center line. By making paper patterns or cutting out the templates successively they may be placed on the bottom frame material and the bottom arcs drawn. After the side and bottom frames have been cut they should be placed on the section drawing to check to see if they are properly cut. If so, hold in place and fasten a gusset on one side with screws. Turn frame over, put glue on the area to be in contact and fit and fasten the other gusset in place. After this has been done the first gusset may be removed, glue applied, and the gusset replaced. This procedure is followed because it is hard to hold frames together properly and glue at the same time. However, if one gusset is fastened first without glue the trouble with slipping is avoided. Before the frames are assembled, the approximate bevels may be cut if the lines are drawn full size and angles measured from it. Otherwise, it can be done after frames have been set up. By springing a batten on the frames, the exact bevel may be obtained. When cutting out the material for the transom, or transom framing if the transom is plywood, care must be taken that enough material is left for the bevel. A study of the plans will show that the frames are located in respect to their respective station lines so that no extra material need be left for beveling. Also an inspection of the templates will show that the template furnished for the transom is for the forward side of the transom and if cut to that outline no extra material need be left for beveling. The notches for the keel, the chine logs, and the gunwale may be cut undersize, to allow for proper bevels, before the frames are set up. Do not cut the limber holes until the keel and the chine logs have been fitted and are ready for gluing. (See sketch Page 9)

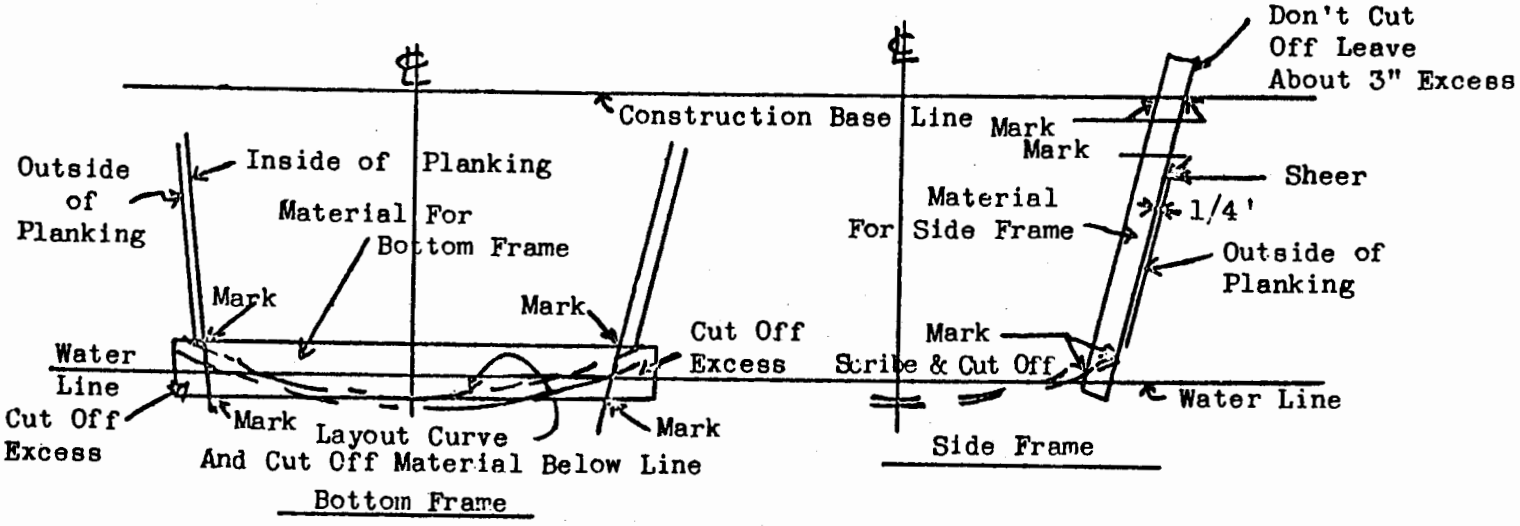
After the frames have been assembled, battens about 1" x 2" should be fastened across the top, just below (when frames are upright) the constructional baseline, to hold them so that they won't spread and so that the frames may be fastened to the assembly jig or strongback. The frames should be carefully checked for accuracy by placing over the section drawing after completion.

Cut out transom and install framing pieces, if a plywood transom is to be used. Be sure before making the cut that the proper allowance has been made for the bevel. The framing pieces are glued as well as screwed to the transom. Cut out the stem and the stem and transom knees using the templates or measurements from the full size lines. The angles of the knees must be cut very accurately.

As the frames are fastened to the strongback make certain that their centers are on the centerline of the strongback. After the frames are in place, light braces or battens tacked over the frames will hold them vertical until keel is put in place. Set up and attach the transom and the stem to the keel; and the keel, transom and stem are put in place as a unit Care must be taken

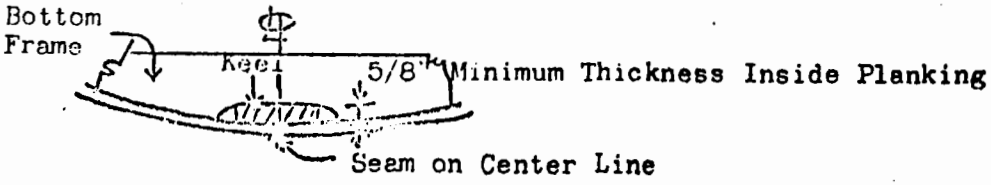
that the knee angles are correct for they can't be changed once glued. The only additional supports desirable, in addition to arrangements in the pictures, are struts supporting each frame at the centerline. Of course the centerboard trunk will prevent struts being on the centerline at frames 3, 4 and 5. At these frames the struts may be omitted and one placed at each end of the centerboard trunk. It is wiser to install frames 3, 4 and 5 without the bottom frames cut for the centerboard trunk. These frames can be cut later and it is easier to fit the keel with all frames intact.

Once the strongback has been built and the frames erected the keel must be cut. The length of the keel must be 11' - 1-5/8" from the forward side of the stem to the after side of the transom. This distance should be checked from the lines if drawn full size. Strike in a centerline on the material for the keel with a chalk line. Obtain the distances between the frames along the keel from full size lines or by bending a batten over the frames and lay them out along the centerline of the keel. On lines drawn perpendicular to this centerline at each frame, mark the keel rabbets the distance from the centerline given in table of offsets. The keel rabbet line must be drawn in on both sides of the centerline with a batten. If the keel is to be the minimum width of 5-3/4", draw lines on both sides of the centerline parallel to the rabbet lines but 7/8" farther from the centerline. These latter two lines are the keel outlines. The keel should be first cut out along the keel outlines and then a rabbet cut to the rabbet line and proper bevel. On some of the recent boats the bottom planking has been lapped completely over the keel using one or two pieces of plywood. In this case, as the keel is entirely inside the boat, no rabbet is required. (See sketch Page 10)



The keel must be the required 5-3/4" wide but may be reduced in thickness to 5/8". The one piece bottom should not be undertaken by the beginner and information regarding the difficulties involved should be obtained from the Chairman of the National Measurement Committee before undertaking a boat with a one piece bottom.

The centerboard trunk should now be started. The logs should be cut out in accordance with the templates furnished. The sides



of the centerboard trunk are of 1/4" plywood and should be cut out in accordance with the construction plans using the centerboard log template to obtain the proper curvature on the bottom edge. Each centerboard trunk side should be glued and well fastened with 3/4" screws to insure the proper pressure to its log. The two head ledges are then cut out. These should be left a little long and trimmed down after the centerboard trunk is assembled. Glue the ledges to one side of the centerboard trunk. Paint well the inside of the ledges and the centerboard trunk sides with Cuprinol or a good paint. Do not paint the head ledges or the unglued side on the areas that will be eventually glued together. The reason the inside of the centerboard trunk is painted now is that it is the only time when it is accessible. After the paint is dry, glue the second side to the head ledges. Take particular care in getting good contact and a good gluing job in building the centerboard trunk. This is the first place a leak will develop if a poor job is done.

Now fasten the stem to its knee and the keel with glue and large screws, approximately 1½" or 2" long. It is much easier to fasten through the keel and the stem into the stem knee rather than trying to go through the knee into the keel and inner stem. The stem cap will cover the screws in the stem and the holes in the keel can be plugged or filled with composition. The transom may be fastened to its knee and the keel at this time. Again, it is easier to put the screws in through the transom and the keel into the knee. Some builders prefer to set the transom up as the frames are done with the knee glued to it. Then the keel is fastened to the transom knee when the keel is put into place. The only advantage of the latter procedure is that the bevel of the transom knee and the notch in framing piece on transom for keel may be checked in place before they are glued finally to the keel.

The keel assembly should now be dropped into place. The stem and the transom should be temporarily screwed to the strongback and the keel temporarily screwed to the frames with 1½" screws. Check the notches in the frames for the proper depth and bevel and continue working until the keel fits correctly. Measure along the keel 3' 6" from the forward end. This point should be the <u>after</u> side of the forward centerboard trunk ledge when the centerboard trunk is installed; also check to see if it is 5½" from aft side of frame #3 as specified on the construction profile. If these dimensions do not agree use the point measured from the frame

rather than from the forward end of the keel. Measure forward from this point along the keel a distance equal to the fore and aft thickness of the forward centerboard trunk ledge and aft from this point along the keel 3'-10-3/4" plus the fore and aft thickness of the after centerboard trunk ledge. The two points just found are the extent of the slot cut in the keel for the centerboard. The procedure sounds involved but the length of the slot cut will vary slightly depending on the size of the head ledges which extend through the keel. As the size ledges given on the plans are the minimum it is possible that they might be made larger and the above procedure will insure that the centerboard is properly located regardless of size of the ledges.

Remove the keel assembly and cut the slot in the keel for the centerboard. This slot should be along the centerline of the keel, between the two points, and 1" wide. Before the slot is actually cut, check to make certain the distance of the slot agrees with the actual length of the centerboard trunk. After the slot has been cut, fit the keel to the centerboard trunk. The screws should be approximately 2" long, spaced about 3" apart, and go through the keel into the centerboard logs on both sides of the slot. Take plenty of time fitting the keel to the centerboard trunk, removing bumps along the bottom of the trunk that will prevent perfect contact. After a good fit has been obtained (no light should be seen through the seam when screwed together) separate, apply glue and refasten permanently. A good joint is very important between the keel and the centerboard trunk, so don't spare the time, the screws or the glue. See page 16.

The joint between the centerboard trunk and the keel on small boats has been traditionally made by using a layer of felt or canvas impregnated with marine glue between the two. Recent experience with resin and catalyst glues has proven their superiority as far as Penguins are concerned. A good job with a resin or catalyst glue will probably remain tight throughout the life of the boat. The centerboard trunk is subject to forces tending to separate it and the keel. The felt and canvas and marine glue have no structural strength to assist the screws in holding the pieces together while the resin and catalyst glues do. Also marine glue will eventually harden so that some leakage is inevitable on a dinghy, which is in and out of the water more than most boats. In case of a leak the corrective measure is the same in either case. Thin some marine glue, such as Jeffries Aviation Grade Marine Glue, with gasoline or alcohol. Using an oil can squirt the solution into the seam in question. The gasoline or alcohol will evaporate leaving the glue in place. Any excess glue can be wiped off with a rag dipped in gasoline or alcohol. In a few cases (only on a poorly constructed boat) the leaking seam may be large enough to permit calking with cotton or seam compound. In way of the ledges thin wooden wedges coated with glue may be inserted.

Cut the bottom frames #3, 4 and 5 to permit the keel assembly with the centerboard trunk now attached to be dropped into place.

This time surfaces to be in contact should be covered with glue and the assembly fastened in place permanently. The keel is screwed to the cut bottom frames and angle clips should be installed also, as shown in the construction plan. Either after the keel is permanently put in place or, better, just prior to this, cut the limber holes on either side of the keel at all frames except transom. This is easily done by make a 45° saw cut and rounding with a half-round file.

Next, the chines should be fitted. This will require clamping the chines in place, checking the bevels, removing the chines, filing the notches in the frames as necessary and repeating this procedure until a good fit is obtained. As there is a tendency for the chines to twist, it is easier to fit them before cutting the limber holes. After chines are satisfactorily fitted and fastened in place with a 1½" screw at each frame, remove them and cut the limbers at all frames except #1 and the transom, in a similar manner as was done for the keel. Limber holes are desirable at the chines as it is easier to bail a penguin by heeling it slightly. Then apply glue and permanently fasten the chine logs in place.

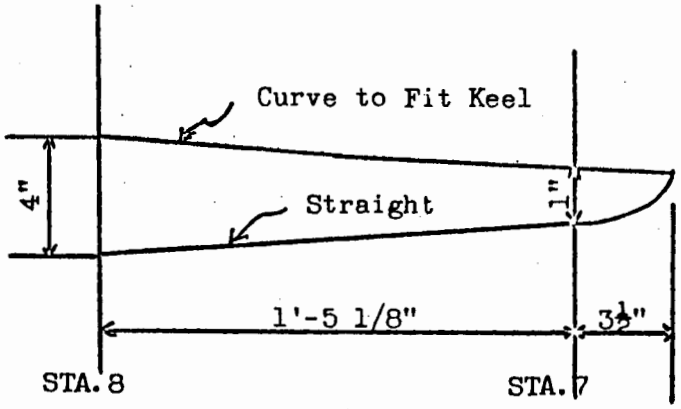
Fit the gunwales next. They are relatively simple to fit. The breasthook and quarter knees may be fitted now but it is a little bit awkward, so sometimes the ends of the gunwales are left free and the breasthook and quarter knees are fitted after boat has been planked and turned over.

With the keel, chine logs and gunwales in place and a light wooden batten used as a guide, the proper bevel may be planed on the frames, the chine logs, and edges of the keel. After this has been completed, fit the sides and bottom in place. The sides may be cut rough, clamped and screwed into place, and the exact outline traced on the sides. Only a few screws need be used with the clamps to fit the sides. Once fitted and removed they may be cut to within a 1/4" or 1/2" of the traced outline. If a chine batten is to be installed, deduct a strip from the bottom edge of the sides equal to the depth of the chine batten. Of course in this case, cut to the exact line and leave 1/4" or 1/2" margin only on other edges. When the sides are in place permanently they may be trimmed down. After the sides have been fitted and screw holes drilled and countersunk, they should be removed and the bottom fitted. By removing the sides, clamps may be used to fit the bottom. The bottoms should lay evenly and will have to be trimmed along the keel as well as at the chine. Knowledge of spiling will save time in fitting the bottom along the keel. The bottom will roll into place at the transom if started amidship and worked aft along the chine and the keel. The bottom may be permitted to extend beyond the chine and transom. Remove the bottom pieces after they have been fitted satisfactorily and screw holes drilled and countersunk. Screws for the side and bottom should be 3/4" and spaced 3" along the chines, keel and transom; 4" along the gunwale;

4" to 6" along the frames; and about 2" along the stem. This spacing has been found best to insure proper pressure for the glue and enough fastenings to pull the plywood into place. Make certain that the holes are drilled in the centerboard trunk logs for the pin before planking is permanently in place. The sides should be glued first (one at a time of course). Start from the stem at the keel. Work along the stem and chine, down frame #1, then along the gunwale, the chine and each frame as work proceeds aft. If the breasthook and quarter knees are to be put in after the boat is planked and turned over, make sure the loose ends of the gunwales are clamped or screwed in correct position when glued to the sides. If no chine batten is used, it will be necessary to plane the sides where they overlap the chine logs before installing the bottoms. The bottoms should be started amidship. Work toward the bow first, in similar manner as done for sides, then work aft to the transom. If finished where the chine meets the transom the bottom will roll into place without any trouble. The only difficult place will probably be in fitting the sides at the bow. If the plywood appears unusually stiff, allow it to stand over night with the area in question covered with wet burlap bags or sawdust. This will cause the grain to pop up, but generally should not be necessary. Wiping off all excess glue before it hardens will save time and effort.

It is very hard at this point to resist the temptation to cut the boat loose from the strongback and launch it overboard. However, much time will be saved if the bottom and sides are trimmed down at the stem, transom and chines and the chine batten (if used) and stem cap installed first. The stem cap and chine battens should be glued. The chine batten need not extend beyond the sides but may be flush and may have a maximum curvature of 1/2" radius.

The plans are vague regarding the skeg dimensions so they are given here.



If it is fastened completely from the outside, this is best done before the boat is cut from the strongback. However, it is less work if the screws are put through the keel into the skeg where possible, eliminating counter boring and plugs. About four screws will be required for the skeg in addition to glue. The two forward

may be fairly short (about 1½") and put in from the inside of the boat. The transom knee makes it necessary to put the after screws in down through the skeg. These will have to be long husky screws and watch out about wringing them off. Drill adequate holes for them and use a little soap or tallow for lubrication if the screws still go in with difficulty. The batten around the after edge of the transom is neither required nor necessary but is sometimes installed to cover up the plywood edge.

Assuming that the boat has now been cut free of the strongback, there will be a jolt as there is plenty of work still to be done. With the boat upright, the sides must be planed down flush with the gunwales. The quarterknees and breasthook should be installed before this is done, if not installed before the boat is planked.

Next install the mast partners, thwart, fender, mast step, floorboards, etc. The four sketches furnished with the plan reflect service experience and are extremely valuable. It is recommended that the inwale be omitted unless made wide enough to permit proper fastening. The inwale is not required by the specifications.

The mast is made in two halves, which are glued together with a resin glue after the grooves for the sail bolt rope are cut. The material for the mast should be one piece. It should be cut down the centerline and the two pieces turned back to back (not end for end). In other words, the surfaces cut by the saw in splitting the single piece become the outsides. By doing this any natural tendency to bend in the two pieces will be opposed and difficulty with a natural kink in the mast avoided. While the two pieces are still square, the groove for the bolt rope shall be cut, then the two halves glued together. Use plenty of clamps and make sure the mast is straight when glued. Two pieces of wood and two nuts and bolts will make a suitable mast clamp. After the glue has set the mast is shaped down. Do not try to shape the mast, split it, cut grooves, and then glue it back together. It is very difficult to line up the grooves when using clamps on curved surfaces. That is why the mast is glued while it is still rectangular. Unless intending to use the Penguin as a tender, and making it desirable to stow the mast in the boat, it is recommended that the one piece mast (not counting the joint for grooves) be made. A jointed mast is more difficult to make because of the scarf and, unless properly done, it will be a source of trouble. If the scarf is carefully made and bands properly fitted a jointed mast will give satisfactory service. A jointed mast cannot be streamlined where the bands are located. The bands must be screwed to the lower section or the screws will block the groove. If the surfaces of the scarf are varnished, they will tend to stick in hot weather. A little paraffin wax on the scarfs and the sail groove will be helpful. If the mast is jointed, make certain that the grooves in the two sections line up properly.

The hole in the partner for the mast should be approximately 1/4" to 1/2" greater in diameter than the mast at that point to permit the mast to rotate freely so that it may line up with the sail. Also a metal chair runner or some other device is usually put on the foot of the mast to reduce the friction and make it rotate easier. Details of the rigging are given in one of the sketches. Leading the shrouds to the forward side of the mast will tend to make it self rotating. Don't locate the tangs any higher on mast than shown on sail plan. Actually, it is better if they are a little lower - say about one foot.* A sheave may be installed at the top of the mast or a groove cut. A wire rope halyard with a rope tail is not essential but eliminates the difficulty of the sail sagging as rope stretches.

The boom is simple to make and may be round, tee or rectangular as long as it will pass through a 2" x 2" square hole. Boom jaws have generally been satisfactory on Penguins as the masts are rotated. A gooseneck exerts a thrust on the mast tending to rotate it too far in a heavy breeze and in the wrong direction down wind.

The rudder, tiller and centerboard are completely detailed and should not be difficult to make. After the boat is complete it should be well painted and varnished. Plywood fillers are available which help to stop the grain of the plywood from popping up. Some of this is inevitable the first season but after sanding the boat prior to painting for the second season no further trouble should be encountered. Sails are difficult to make and purchase of a sail from a professional is recommended.

Now it is a good time to measure the boat. First, it is to determine how well she checks up. Measuring the boat will probably take an afternoon and is worth the trouble, considering the work put into building the boat. Also, if ever wanting to sell the boat, being able to show that it is an approved boat is of considerable value. Besides all this, the Penguin Class Dinghy Association is a non-profit organization composed of Penguin owners and people interested in Penguins. We are interested in <u>you</u> and <u>your</u> boat. The only way we know whether <u>you</u> ever built <u>your</u> boat is by receiving a measurement blank. If <u>you</u> ever desire to race your boat, and many do, a measurement certificate is required before a boat can enter sanctioned regattas.

You may or may not have done much sailing but as every boat has certain traits a few hints may be helpful:

(a) Your mast should be almost vertical or raked slightly forward.

* - 5' from top of mast.

(b) In light or moderate winds the centerboard should be about 3/4 the way down. When beating as the wind increases raise the centerboard so as to reduce the weather helm (pull on the tiller). This keeps the rudder drag to a minimum and keeps you out of stays - which is a characteristic tendency of catboats in a heavy breeze. In a heavy breeze your centerboard will be only about 1/2 the way down. Keep your pull in your helm to the minimum <u>always</u>.

(c) Watch where you sit. Keep the boat on its lines. Don't put everybody in the stern. The Penguin is a smart sailing boat but you have to do your part.

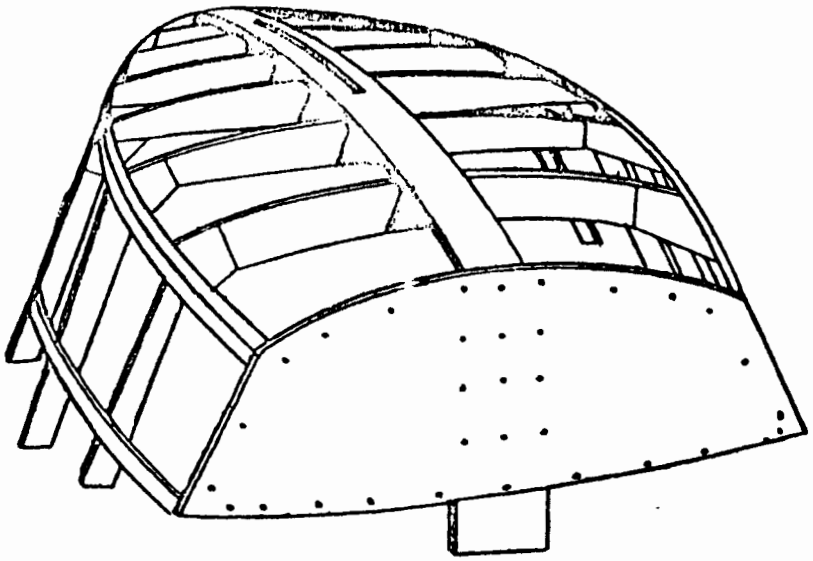
(d) Remember that the sail is loose-footed for a purpose. Slack the outhaul in light winds and when running down wind. In heavy wind pull sail out to the mark.

(e) In heavy weather in a chop keep the boat moving by not trying to point too close to the wind. A light boat such as a dinghy will have its headway killed if you point too high.

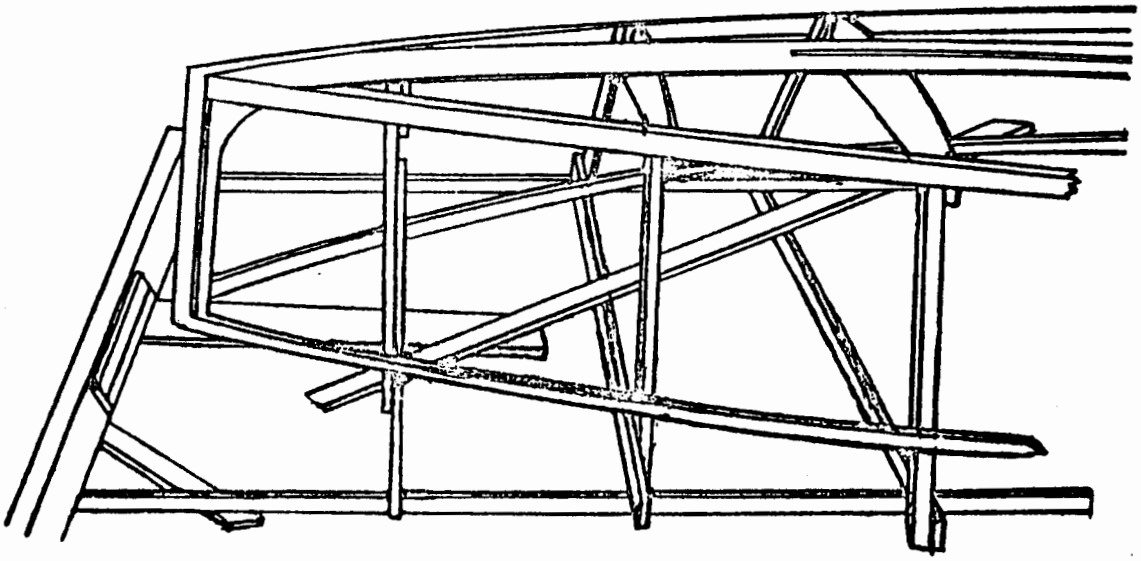
Ref. Page 11 - Connecting centerboard trunk to keel.

In way of the head ledges to insure a watertight fit, it is suggested that a small tapered soft pine wedge be inserted and cut off flush with the ledge and keel.

<u>NOTE</u>: If at all possible find a good competitive Penguin in your area, preferably one recently built. Call the owner, you will find him very cooperative. Check the construction and rigging features of his boat both before and during your own building project. A finished product is always an aid in clarifying the plans. Check your yearbook for Penguin owners in your area.



Boat in frame before planking



Strongback Jig for Framing