

# Mad River Canoe Care and Repair

## Before You Use Your New Canoe

The wood gunwales of your Mad River Canoe were treated at the factory with three coats of Gunwale Guard preservative. Mad River Canoe recommends that upon receiving your canoe, you apply another coat yourself. Aluminum and synthetic gunwales are maintenance-free, although a coat of 303 Protectant will protect the finish.

We also recommend that before using your canoe you apply 303 Protectant to the outside of the hull to prevent fading from exposure to UV light. Finally, homeowners may wish to check with their insurance agent to make sure that their canoe is covered under their homeowner's policy.

## Care of Woodwork

Mad River Canoe strongly recommends regular use of Gunwale Guard preservative on Gunwales, Carry Handles, Decks, Seat Spacers, and Sliding Seat Runners.

Mad River Canoe does not recommend the use of varnish on the gunwales of your boat.

Gunwale Guard preservative is available in two shades: natural and walnut stain. Dark-stained gunwales will need Gunwale Guard Stain to maintain the color. Be sure to use Gunwale Guard preservative on the underside of the wood decks on decked boats. A long-handled brush is helpful in reaching deep into the bow or stern.

If your canoe has Royalex deck plates, you need to remove them to apply Gunwale Guard preservative to the gunwales beneath them. Refer to the container of Gunwale Guard for application directions.

## Care of Seats and Thwarts

The seats and thwarts of your canoe are protected with a durable marine spar varnish. If the varnish is marred, or becomes worn, lightly sand with fine sandpaper. Remove the dust and apply several thin coats of spar varnish to both the caning and woodwork to renew the finish.

## Hardware Maintenance

All of the hardware in your new Mad River Canoe is made of stainless steel and is not susceptible to rust or corrosion under normal circumstances. It is advisable, however, to periodically check all screws and nuts for tightness. Due to repeated use and/or vibration during transportation, the hardware can loosen over time and may require occasional adjustment.

## Frequency of Wood Refinishing

You will need to refinish your woodwork as often as your usage and the local environment require it. Plan on treating the gunwales and varnishing the seats, thwarts and yokes at least twice per year—once before storage, and once again in the spring. To test your gunwales, simply pour water on them. If it beads up, the gunwales are okay. If it

soaks directly in, it is time for another coat of Gunwale Guard preservative.

## Care of Hulls

Thanks to advances in canoe construction, today's hull materials need little maintenance beyond periodic cleaning and polishing. Before any polish or treatment is applied the hull must be clean of dirt or film. Mad River Canoe recommends GB-60, an excellent, biodegradable cleaner that will not harm the gel-coat of a laminate canoe nor the vinyl hull of an ABS Royalex boat. Be sure to thoroughly wash off any cleaning residue and let the hull dry before applying any 303.

Mad River Canoe strongly recommends the use of 303 Protectant to protect the color finish of Royalex or Laminate canoes. 303 Protectant will restore color to fading gel-coat and the vinyl skin of Royalex, but more importantly, will help prevent degradation from exposure to UV light. Application is as simple as spraying it on and wiping it off. Extensive fading of gel-coats that repeated rubbings with 303 will not remove should succumb to buffing with polishing compound.

Mad River Canoe does not recommend waxing your hull. Although it will do it no harm, it does not seem to provide any increase in speed through the water, and it will interfere with the UV protection of 303 Protectant. 303 Protectant generally needs once-a-month application during the canoeing season. Try spraying 303 on a small area of your canoe. If color is restored, it is time to re-apply 303.

## Minor Hull Repairs

### Gel-coat & Lightweight Constructions

Scratches will show white, regardless of hull color. As scratches are inevitable, think of them as badges of honor.

If you wish to repair any, they may be treated as follows:

1. Wash the hull with GB-60 and water, then wipe it dry.
2. For shallow scratches, wet sand with 400-grit sandpaper and then finish with polishing compound. For slightly deeper scratches, use 200-grit and then 400-grit sandpaper, and finish with polishing compound. You may wish to touch-up with gel-coat spray paint.
3. For chips or scratches that go through to the fabric, you will need a gel-coat or lightweight skin coat repair kit.

Gel-coat spray paint, gel-coat repair kits, and lightweight skin coat repair kits are available from your dealer in all Mad River colors. Complete instructions come with the kits.

## Royalex Canoes

Royalex scratches do not show as much as those in gel-coat, but the ABS substrate is susceptible to degradation from long-term exposure to sunlight. Any scratches that show the different color of the ABS substrate must be painted. Royalex paint works well. If you have more damage than a scratch, you will need a Royalex Repair Kit. Royalex paint

and Royalex Repair Kits are available in all Mad River Canoe colors from your dealer.

## **Winterization and Storage**

### **Winterizing the Gunwales**

Wood gunwales should be protected for storage by applying a coat of Gunwale Guard preservative. If the gunwales are dry or your climate is hot and humid, several coats may be necessary. In cold climates Gunwale Guard preservative is especially important to keep moisture out of the wood where it will freeze and expand. Be sure to protect under decks and other places where water may be trapped. Remove the deck plates on Royalex canoes to access the gunwales under them. On fiberglass or Kevlar canoes, this is a good time to tighten the screws along the gunwales.

Aluminum or vinyl gunwales, whether mounted on a Royalex, Royalex Lightweight, Fiberglass, or Kevlar hull are virtually maintenance free, and require no special attention prior to storage.

### **Seats and Thwarts**

No special care is needed for these components before winter storage, except to tighten any loose bolts and touch up any chipped varnish.

### **Storage Position**

The best canoe storage is upside-down in a cool, dry place. The canoe must be off the ground. A rack or sawhorses works well, but some protection can be obtained by using blocks. If you want to suspend the canoe from above, make sure the canoe's weight is resting evenly on the gunwales.

Do not store heavy objects on top of the canoe, and do not store a canoe on its side. Both will cause the hull to deform over time. If it will be exposed to wind, make sure your canoe is securely tied. Inside storage is preferred-it protects the hull from temperature extremes and exposure to rain or snow. Do not store our canoe a direct source of heat (e.g. a furnace): high temperatures are as detrimental as extreme cold.

If outside storage is necessary and a cover is desired, some precautions are needed. Make sure the cover will withstand snow loads or heavy rain. A plastic cover will protect the canoe from light precipitation and exposure, but do not allow the plastic to touch the hull. Leave the downwind end open for air circulation; moisture trapped between the cover and the canoe will discolor the hull. Some gray weathering of the gunwales will occur with outside storage.

### **Royalex Storage Information**

If a Royalex canoe with wood gunwales will be stored in near or below freezing temperatures, the Royalex material, which has a high shrink coefficient, must be given ample room to contract. To do this, loosen all the inside gunwale screws several turns. Then remove the four screws on the outside gunwales on each side of the bow and stern. Lift up the deck (the inside gunwales will still be attached), and from the ends of the canoe sandwich a thin piece of wood between the gunwale/deck assembly and the top of the hull at both the bow and stern. Failure to perform this procedure can result in a

cracked hull. In the spring, remove the pieces of wood, lower the gunwale/decks in place, replace the screws, and tighten all screws, including the inside gunwales.

## **Gunwale (Canoe Rails) Repair Guide**

### **Vinyl Gunwale Repair**

**When ordering replacement vinyl gunwale be sure to request the correct length - order rails longer than your canoe.**

Canoes are measured straight down the keel line. Gunwales take a bit more circuitous route getting from end to end. Vinyl rails come in three sizes, 15', 16' & 17'. All Mad River vinyl gunwales include a "L" shaped aluminum insert to add strength and structure to the rail.

Place orders for replacement gunwales through your authorized Mad River [dealer](#).

**Specify your model of canoe and hull material when ordering gunwales to ensure compatibility.**

Composite (fiberglass or Kevlar® hulls) differ in thickness from Royalex®. If you are unsure of model or material, bring your boat to the dealer, they can usually identify the model and material. If this is not practical, the serial number on your canoe will be helpful. Serial numbers are located on the right side of the stern of the hull just below the gunwale. It will either be engraved on a small brass plate or stamped directly into the hull. If difficult to read, make a rubbing by holding a piece of paper against hull and scraping a pencil point across paper. The number should be revealed on reverse side of paper.

**A complete re-rail installation will require 2 vinyl gunwales.**

Unlike ash gunwales which utilize an inside rail and an outside rail on each side, vinyl gunwales are a unibody construction in which the inside and outside gunwales are incorporated into one piece.

**In most cases, the decks on vinyl-railed canoes can be saved and reused with new rails.**

This assumes the new rails have the same profile and dimensions as the old rails. If you are replacing ash gunwales with vinyl, your canoe will require the addition of appropriate decks and hardware.

**Due to their length, vinyl gunwales cannot be shipped via UPS.**

One alternative is to ship by common carrier (via truck) but this is expensive (approximately .00 - 0.00). Gunwales shipped via common carrier will be sent freight collect (payment due on receipt). The best alternative is to arrange shipment of gunwales to accompany a shipment of boats to your local dealer. If this can be arranged, there is no freight charge for the gunwales.

## TOOLS REQUIRED

Rubber Mallet	Electric Drill
Pop Rivet Tool	17/64" Drill Bit
3/8" Wrench	3/8" Drill Bit
7/16" Wrench	13/64" Drill Bit
Hack Saw	6 3" C Clamps
20' Tape Measure	Putty Knife
Duct Tape	Pencil/Non-permanent Marker

## Procedure:

1. Run tape measure along hull below gunwale and mark center point on hull. Measure gunwales to confirm they are of sufficient length to cover length of hull. Check to make sure aluminum inserts are in place inside vinyl gunwale and ends are flush. If re-rail requires removal of existing gunwales follow steps 2-5:
2. Mark placement of seats, thwarts, and yokes on side of canoe hull with marker. This will provide a reference for replacement of these parts when new gunwales are installed.
3. Mark rivet or screw locations. When fastening new rails in place these marks will serve to space new rivet locations. It is preferable to use new holes rather than enlarge the existing holes with the new rails. Enlarged holes can result in rails becoming slightly loose over time.
4. For vinyl or aluminum gunwales: Using 13/64" bit, drill out existing rivets. Drill from outside hull positioning end of drill bit in center of rivet head. Drill until flange of rivet head separates from rivet stem. It may be necessary to poke rivet stem through hull to dislodge rivet. For wooden gunwales: Back out screws, starting at one end of hull and proceeding towards other end and continuing down other gunwale to return to end where started.
5. When all fasteners are free, pry up on decks and remove. This should also free gunwales along hull. On wooden gunwales, outwale will drop free when final fasteners are removed.
6. Place decks onto hull, making sure end of deck fits snugly against the bow and stern (see diagram 1). Tamp with rubber mallet to seat properly. With a pencil, mark outside of the hull at rear edge of the deck on both sides. Also mark point on deck where length of gunwale will be inserted. (see Point "A" of diagram 2). Remove decks after making marks.
7. Run tape measure along top edge of hull following outside surface of hull. Start measure at Point "A" at one end of canoe and measure to Point "A" at other end. Double check measurement as this will be length you will cut new gunwales.
8. Cut new gunwales to measurement made in step 7.

9. Mark center point on each new gunwale.

10. Position new gunwale on hull, matching center point marked on hull to point marked on gunwale. Narrow side of gunwale goes to the outside of the hull and wide side to inside to provide mounting point for hanging seats, thwarts, and yokes. Press the first 24" of the gunwale into place along top edge of the hull. Tapping down on the gunwale with a rubber mallet will help to ensure that the gunwale is fully seated onto hull. Secure the gunwale in place with "C" clamp. As you continue, you may find that wedging a putty knife between the gunwale and hull while tapping with the mallet will help. As you work your way along the hull you use duct tape to hold the gunwale in place. It is important that the gunwale be seated flush against top edge of hull throughout the length of the canoe.

11. Continue working down side of canoe, working towards end. Leave last 3 feet of each end of gunwale free to allow for insertion of decks.

12. Lift the ends of the gunwales from the hull and insert them into decks, to point "A" in diagram 2. Seat assembly onto hull, making sure it is fully seated against top edge of hull and correctly positioned as far as overhang at end of canoe as shown in Diagram #1. Pull assembly down tight on top of hull and tape in position with duct tape.

13. Step back and "eyeball" the gunwale. Look for any rises or humps that would indicate gunwale is not seated completely on hull. Tamp down and secure any section of rail necessary.

14. Along gunwale sections, refer to the marks locating the original rivet locations, Place evenly spaced marks between old rivet locations. These will be new rivet locations. At decks, mark locations as described in following step.

15. Mark point on the outside edge of the deck 1" from point where gunwale is inserted ("B" in diagram 2). Make a second mark 1" from end of deck ("C"). Make a third mark 3" forward of point "B" ("D"). and a fourth mark 2" from tip of deck ("E").

16. Wrap a piece of tape 3/4" from tip of 13/64" drill bit. This will prevent you from drilling all the way through inside wall of gunwale.

17. Drill at marks, positioning drill on outside of hull and drilling through bottom flange of gunwale. Insert rivet in each hole before proceeding to next mark. Place a #10 flat washer on inside of each of the rivets that will secure the decks.

18. Once all rivets have been installed on one side of canoe proceed to secure rivets with rivet gun. It may require several pulls on gun to snap rivet. For best results, release grip completely on gun and push nose of gun flush against hull between pulls. Keep gun straight and true while riveting, do not try to hurry things along by bending or twisting rivet gun. This can result in rivet stud being jammed in gun.

19. Take a minute and reseat rails on other side of canoe before repeating steps 16 and 17 on that side.

20. Using marks as reference, rehang seats, thwarts, yokes, etc. Drill 1/4" holes to accommodate Mad River Canoe mounting hardware.

If additional information is required or you need a question answered, contact your Authorized Mad River Canoe Dealer or call Mad River Customer Service @ 800/311-7245.

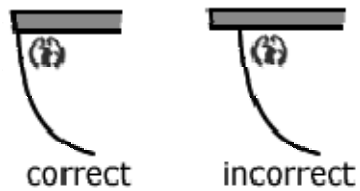


Diagram 1

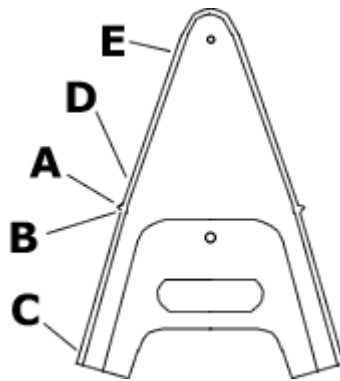


Diagram 2

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## Gunwale (Canoe Rails) Repair Guide

### IQ2 IQ2 Gunwale Replacement

When ordering replacement IQ2 gunwale be sure to request the correct length - order rails longer than your canoe.

Canoes are measured straight down the keel line. Gunwales take a bit more circuitous route

getting from end to end. IQ2 rails come in two sizes: under 15' and over 15" (fits up to 17 ½'). All Mad River IQ2 gunwales include a "L" shaped aluminum insert to add strength and structure to the rail.

IQ2 gunwales can be used as replacements for conventional IQ2 gunwales on rotomolded and Royalex Mad River Canoes. IQ2 gunwales will not fit Composite canoes.

Place orders for replacement gunwales through your authorized Mad River [dealer](#).

### **Specify your model of canoe and hull material when ordering gunwales to ensure compatibility.**

This will assist your dealer and Mad River Customer Service to make sure you receive the proper gunwale. If you are unsure of model or material, bring your boat to the dealer; they can usually identify the model and material. If this is not practical, the serial number on your canoe will be helpful. Serial numbers are located on the right side of the stern of the hull just below the gunwale. It will either be engraved on a small brass plate or stamped directly into the hull. If difficult to read, make a rubbing by holding a piece of paper against hull and scraping a pencil point across paper. The number should be revealed on reverse side of paper.

### **A complete re-rail installation will require 2 IQ2 gunwales.**

Unlike ash gunwales which utilize an inside rail and an outside rail on each side, IQ2 gunwales are a unibody construction in which the inside and outside gunwales are molded in one piece.

Gunwales are pre-bent to a curved form, which will fit most canoes. If your canoe hull doesn't fit to the gunwales easily you may find it necessary to further bend the gunwale to fit without distorting your hull. Make any needed bends slow and gradual working up and down affected length of gunwale. Avoid creasing gunwale by bending too quickly or sharply or with all effort at one point.

Gunwales are interchangeable, there is no right or left.

IQ2 gunwales do not have entry slots pre-installed as proper location cannot be determined until

gunwales are installed. An IQ2 Spreader Tool (available from your Mad River dealer) will be necessary to install the entry slots.

You will need replacement rivets to install your new gunwales. These are available in 80 pack quantities from your Mad River dealer and are sufficient to re-rail all but the longest canoes.

### **In most cases, the decks on IQ2-railed canoes can be saved and reused with new rails.**

The IQ2 gunwale profile fits the vinyl gunwale currently (2005) used on Mad River Royalex boats. It will fit most current decks without trimming or adjustment but there are older decks or decks for some models that will either not fit or will require modification. If you are switching from wood or



aluminum to IQ2, you will need to order new decks. Some additional modification may still be required due to the number of models produced over the years and changes in product specifications. Vinyl decks can usually be successfully modified by cutting or trimming where necessary with a sharp knife or small saw.

### **Due to their length, IQ2 gunwales cannot be shipped via UPS.**

One alternative is to ship by common carrier (via truck) but this is expensive (approximately .00 - 0.00). Gunwales shipped via common carrier will be sent freight collect (payment due on receipt). The best alternative is to arrange shipment of gunwales to accompany a shipment of boats to your local dealer. If this can be arranged, there is no freight charge for the gunwales.

### **TOOLS REQUIRED**

Rubber Mallet	Electric Drill
Pop Rivet Tool	7/32" and 17/64" Drill Bit
3/8" Wrench	3/8" Drill Bit
7/16" Wrench	13/64" Drill Bit
Hack Saw	6 3" C Clamps
20' Tape Measure	Putty Knife
Duct Tape	Pencil/Non-permanent Marker

**NOTE:** Additional hardware may be required to complete replacement or rehabilitation of your canoe depending upon model, material, age. Mad River has been building canoes for over 30 years and many changes and improvements have been made during that time. For example, until 1998-99, Mad Rivers' used 1/4" hardware to mount seats, yokes, etc. Since that time MRC has used 3/16" hardware to save weight and allow improvements such as double bolting yokes for increased integrity. While the instructions may specify specific drill bits, please be aware that other sizes may in fact be necessary as needed.

### **Procedure:**

1. Run tape measure along curvature of hull below gunwale and mark center point on hull. Measure new gunwales to confirm they are of sufficient length to cover length of hull. Check to make sure aluminum inserts are in place inside IQ2 gunwale and ends are flush. If re-rail requires removal of existing gunwales follow steps 2-5:

2. Mark placement of seats, thwarts, and yokes on side of canoe hull with marker. This will provide a reference for replacement of these parts when new gunwales are installed. After marking, remove all carry handles, seats, thwarts, and yokes and set aside with all hardware.

3. Mark rivet or screw locations. When fastening new rails in place these marks will serve to space new rivet locations. It is preferable to use new holes rather than enlarge the existing holes with the new rails. Enlarged holes can result in rails becoming slightly loose over time.

4. For IQ2 or aluminum gunwales : Using 13/64" bit, drill out existing rivets. Drill from outside of hull, positioning end of drill bit in center of rivet head. Drill until flange of rivet head separates from rivet stem. It may be necessary to poke rivet stem through hull to dislodge rivet. For wooden

gunwales: Back out screws, starting at one end of hull and proceeding towards other end and continuing down other gunwale to return to end where started.

5. When all fasteners are removed, lift up on point of deck and then slide deck towards end of canoe to remove. This should also free gunwales along hull. On wooden gunwales, outwale will drop free when final fasteners are removed.

6. Place decks onto hull, making sure end of deck fits snugly against the bow and stern (see diagram 1). Tamp with rubber mallet to seat properly. With a pencil, mark outside of the hull at rear edge of the deck on both sides. Also mark point on deck where length of gunwale will be inserted. (see Point "A" of diagram 2). Remove decks after making marks.

7. Run tape measure along top edge of hull following outside surface of hull. Start measure at Point "A" at one end of canoe and measure to Point "A" at other end. Double check measurement as this will be length you will cut new gunwales.

8. Cut new gunwales to measurement made in step 7.

9. Mark center point on each new gunwale.

10. Position new gunwale on hull, matching center point marked on hull to point marked on gunwale. Narrow side of gunwale goes to the outside of the hull and wide side to inside to provide mounting point for hanging seats, thwarts, and yokes. Press the first 24" of the gunwale into place along top edge of the hull. Tapping down on the gunwale with a rubber mallet will help to ensure that the gunwale is fully seated onto hull. If your canoe has significant "sheer" (curvature of top of hull when viewed from the side), you'll need to make doubly sure that the gunwale is fully seated on top of hull as gunwale tends to run straight where hull curves. Secure the gunwale in place with "C" clamp placed over the gunwale and tightened onto the hull. As you continue, you may find that wedging a putty knife between the gunwale and hull while tapping with the mallet will help. As you work your way along the hull you use duct tape to hold the gunwale in place. It is important that the gunwale be seated flush against top edge of hull throughout the length of the canoe.

11. Continue working down side of canoe, working towards end. Leave last 3 feet of each end of gunwale free to allow for insertion of decks.

12. Lift the ends of the gunwales from the hull and insert them into decks, to point "A" in diagram 2. Seat assembly onto hull, making sure it is fully seated against top edge of hull and correctly positioned as far as overhang at end of canoe as shown in Diagram #1. Pull assembly down tight on top of hull and tape in position with duct tape.

13. Step back and "eye ball" the gunwale. Look for any ripples or humps that would indicate gunwale is not seated completely on hull. Tamp down and secure any section of rail necessary with additional "C" clamps.

14. Along gunwale sections, refer to the marks locating the original rivet locations. Place evenly spaced marks on the lower external flange of gunwales between old rivet locations. These will be new rivet locations. At decks, mark locations as described in following step.

15. Mark point on the outside edge of the deck 1" from point where gunwale is inserted ("B" in diagram 2). Make a second mark 1" from end of deck ("C"). Make a third mark 3" forward of point "B" ("D"). and a fourth mark 2" from tip of deck ("E").

16. Wrap a piece of tape 3/4" from tip of 13/64" drill bit. This will prevent you from drilling all the way through inside wall of gunwale. You only want to drill through outer side of gunwale, hull, through side of gunwale against hull, and internal aluminum stiffener, not all the way through inside gunwale. Mad River gunwales are designed to hide the rough ends of fasteners inside the gunwale to protect paddlers and for improved appearance.

17. Drill at marks, positioning drill on outside of hull and drilling through bottom flange of gunwale. Insert rivet in each hole before proceeding to next mark. Place a #10 flat washer on inside barrel of each of the rivets that will secure the decks.

18. Once all rivets have been installed on one side of canoe proceed to secure rivets with rivet gun. It may require several pulls on gun to snap rivet. For best results, release grip completely on gun and push nose of gun flush against hull between pulls. Keep gun straight and true while riveting, do not try to hurry things along by bending or twisting rivet gun. This can result in rivet stud being jammed in gun.

19. Take a minute and reseat rails on other side of canoe before repeating steps 16 and 17 on that side.

20. Using marks as reference, re-hang seats, thwarts, yokes, etc. Drill 7/32" holes to accommodate current Mad River Canoe mounting hardware.

21. After all gunwales and fittings are installed, locate IQ2 entry slots to provide access to the IQ gunwale channels on each gunwale, inside and out.

Factory installation includes:

Exterior gunwale channel: total: 4 (2 per gunwale, one at each end approximately 2" from end of deck)

Interior gunwale channel: total 8 to 12 depending on number of interior fittings (yokes, thwarts, seats, etc). Object is to provide access to all usable sections of interior gunwale.

Includes: 2 2" behind bow deck and 2 2" in front of stern deck, 1 on each gunwale 2" in front and behind center yoke. If your canoe has an additional thwart, install slot in each gunwale 2" behind thwart to allow access to area in front of stern seat.

22. To create feeder slots:

1) Heat gunwale section to be opened with hair dryer on high or heat gun on lowest setting. Keep heat moving and heat until gunwale is warm to touch, not hot. To protect hull, you may want to shield the hull from the heat source. Normally gunwale is properly heated well before any threat is posed to the hull material.

2) Align slot in edge of spreader tool with upper edge of channel in IQ rail and slide slot over edge of channel. Slowly and with steady pressure lever the tool head gradually upward until tool is in horizontal position to open slot. Do not bend gunwale quickly as this can crack the gunwale.

3) Align slot in edge of spreader tool with lower edge of channel and slide slot over edge. Slowly and with steady pressure lever the tool head downward slightly to further open the slot. It is not necessary to fully open the bottom edge of slot. It is sufficient to flare it slightly to make entry and exit of components easier.

If additional information is required or you need a question answered, contact your Authorized Mad River Canoe Dealer or call Mad River Customer Service @ 800/311-7245.

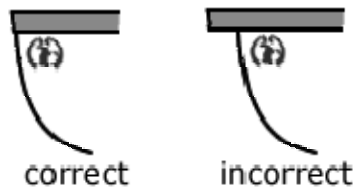


Diagram 1

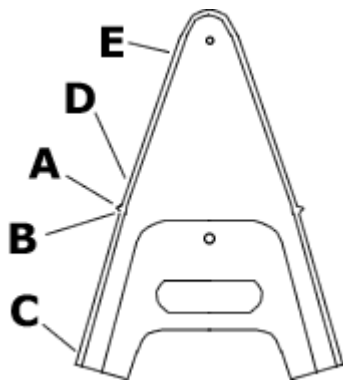


Diagram 2

## Gunwale (Canoe Rails) Repair Guide

### Wood Gunwale Repair

Canoes with fine woodwork are a tradition at Mad River Canoe. The rails, seats and thwarts on your Mad River Canoe are native Vermont straight-grained ash, chosen for its resiliency, strength and aesthetic appearance. Unlike aluminum or plastic materials, white ash will not kink upon impact and cause undue damage to the canoe hull.

There are more options involved in repair of wood gunwales than with vinyl or aluminum, making this section a bit longer than the corresponding instructions for other types of rails. Don't let the length of this document intimidate you - here's an overview of this section to help you plan your repair strategy:

**General Information** - Everyone should read this section.

**Pre-installation preparation** - Everyone should read this section.

**Gunwale replacement instructions** - How to replace both rails of your canoe.

**Replacing Gunwales with inset decks (including complete deck replacement)** - If your canoe has inset decks you will likely have to replace them when you replace your rails. The other option is:

**Short-splicing method to preserve original inset decks when rerailing** - You may cut the existing inwales of your canoe to avoid replacing your existing deck. The new inwale must be carefully spliced to the section of existing inwale.

**Installation of a 4' splicing section** - If you have damage to a small section of gunwale, you can splice in a replacement section on the inside, outside or both.

## General Information

### Ordering replacement ash gunwales

Rails can be ordered from an authorized Mad River [dealer](#). Replacement ash rails are available for all Mad River Canoes. Due to their length, ash rails cannot be sent UPS. One alternative is to ship by common carrier (via truck) but this is expensive (.00 - 0.00) and is sent freight collect (payment due upon delivery). The best alternative is to coordinate an order for replacement gunwales with a boat delivery to your dealer. If this can be arranged there is no freight charge for gunwales.

A full set of rails has four pieces: two inside (inwales) and two outside (outwales) strips. The rails are not pre-bent or pre-drilled, but are flexible enough to follow the shape of the canoe by just clamping them to the hull.

It is possible to replace a single outwale or inwale or the gunwales along one side if desired. Specify what rail you need (inwale or outwale). For best results, however, it is recommended that you replace a complete set of gunwales. A better job results if all the rails are of the same age and moisture content. Older rails, especially if they have not been reoiled, will be brittle and can break more readily than new ones soaked in a penetrating finish such as Gunwale Guard.

It is necessary to order rails longer than the length of your canoe to accommodate the curvature of the hull. To rerail a 14' or shorter canoe you will need 15' gunwales, 15' or 16' canoes will require 17' gunwales, etc.

### Specify your canoe model and hull material when ordering gunwales.

Wood gunwales for Royalex canoes are flat sided and are installed flush to hull on each side with top of hull material exposed in center. Gunwales for composite or laminate canoes "cap" the hull with a kerf or lip to cover and conceal the sharp edge of the cloth laminate. Fiberglass and Kevlar

canoes feature kerfed (lipped) outwales. If your boat is Kevlar/Airex, the inwales are kerfed. The gunwales on older Kevlar/Airex canoes are difficult to break loose as these rails were glued to the hull as well as screwed. Use caution in breaking the glue joint as damage to hull can result. If you can't. break the glue joint, it would be best to bring or ship the canoe to one of our Authorized Mad River Canoe Repair Centers.

When replacing gunwales, you may re-rail with the kerf inside or out, whichever is easier. It is possible to use rails for Royalex hulls on composite boats but the finish result is not quite as nice and care should be taken to sand the edge of the hull protruding between the rails. Gunwales for composite canoes will not work on Royalex hulls unless the kerf is removed.

Mad River ash gunwales can be used on canoes of other manufacturers. It may be necessary to make adjustments to accommodate existing deck designs.

Slotted inwales are available at additional cost.

Prior to 1985, Mad River Canoes were outfitted with square gunwales. At that time, Mad River switched to a rounded rail system for a more elegant, finished look and lighter weight. Replacement rails are available only in the rounded format. This system is very suitable for replacement of squared gunwales but will necessitate replacement of the decks as well.

### **Often, wood gunwale replacement will require replacement of decks as well.**

Decks can either be inset (fitted flush with the gunwales) or capped (decks sit on top of gunwales). Replacement of inset decks is more difficult than replacing capped decks simply because the capped deck covers (hides) the ends of the gunwales whereas fitted decks require careful trimming and fitting for best results. This can be the most challenging part of rerailing your canoe.

Most of our laminate (Fiberglass, Kevlar, or Hybrid) canoes feature inset hardwood decks. These decks require additional procedures for replacement and are detailed in the body of the instructions. Decks are screwed in place when the canoe is built; (early ones were both screwed & glued). It is not likely that they can be salvaged separately from the original rails. Replacement deck blanks are available. They are rough sized and will need final shaping to fit properly. Please specify canoe model when ordering deck blanks. An option discussed below is to splice the replacement rails in place just behind existing decks.

It is possible to adapt capped decks to canoes originally outfitted with fitted decks if preferred for ease of replacement. If existing decks are in satisfactory condition, the option exists to splice the replacement rails in place just behind the existing decks.

In 1991, Mad River Canoe switched from mahogany to butternut as the material of choice for our wood decks. Mahogany replacement decks are not available. Specify which model you have in order to obtain the correct sized parts.

NOTE: In all cases, the serial number from your canoe can be very helpful in determining the original gunwale system used on your boat and determine necessary replacement components.

## **Pre-installation preparation**

The rails are already dipped in a penetrating oil once at the factory. Additional sealing with penetrating oil such as Gunwale Guard™ before installation as well as after sanding the installed rails is recommended, especially on gunwale surface that will be installed against hull surface.

Replacement rails are finished natural. If you wish to replace stained rails, it is best to stain them to match existing rails before installing them on the boat.

In most cases, the rail screws are reusable as they are stainless steel and resistant to corrosion. It is recommended that to minimize the chances of stripping the screw heads, first back them out manually with a screwdriver and then remove with reversible drill with a #2 Phillips head bit. On the average, 80 screws are required to refasten a 16' canoe. It is recommended to have a package (12) of screws available should you inadvertently strip a few. Composite canoes use 1 1/4" screws and Royale hulls require 1 1/2".

## Gunwale replacement instructions

### Tools Required

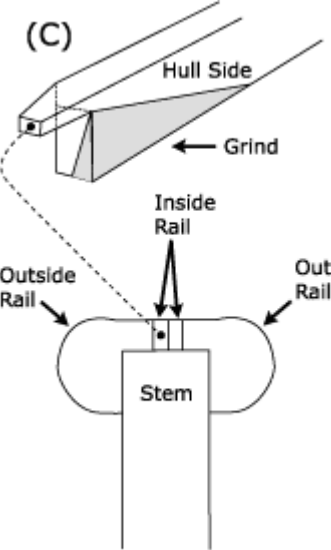
Variable speed reversible drill with bits:	6- 12 "C" or Welder's Clamps(2 or 3 spring clamps or bar clamps are helpful)
○ Tape	red:
	11/64"
○ Straight:	
	1/8", 1/4", 3/16
#8 Counter sink	20' Tape Measure
#P2 Phillips Screwdriver bit	#2 Phillips Screwdriver
3/8" & 7/16" Wrenches	Wax pencil or similar washable marker
Sandpaper: Medium & Fine Grit	Saw
Gunwale Guard	Gunwale Guard Stain (if appropriate)

### Procedure

1. Apply Gunwale Guard to all surfaces of new rails-follow instructions on the can. This is the time to make sure that the surface of the rail that will be against the hull will be thoroughly treated with Gunwale Guard. If stained rails are desired, stain rails prior to installation for best results.

2. Mark location of all thwarts/yokes, seats, carry handles on hull of canoe with marker. Trace outside of seat hangers to provide accurate reinstallation. All these fittings are hung from existing rails, removal of those rails will result in loss of position of original fittings.

3. Remove all thwarts/yokes, seats, etc. from canoe. Canoe will become flexible once seats and thwarts or yokes are removed. This is not a problem. If you are concerned with maintaining shape especially if gunwale replacement may take extended period of time, make a brace from a 2 x 4



notched at same width as canoe's original beam. Label and mark ends of seats, yokes, etc. right or left to ensure proper reinstallation. Attach all hardware so as not to lose any parts.

4. Run tape measure around hull under existing rail. Mark center point on each side of hull. These marks will serve as centering points for new rails.

5. Mark rail screw locations on inside of hull just below the rail, except at ends of canoe where marks will have to be made on outside of hull. 5a. If re-rail will include short-splicing inwale to preserve existing inset decks please refer to specific directions below at this time.

6. Starting from one end loosen and remove screws along one side of canoe. Leave other rail intact. You will be doing one side at a time. If the decks are mounted on top of the rails, remove the mounting screws at this time.

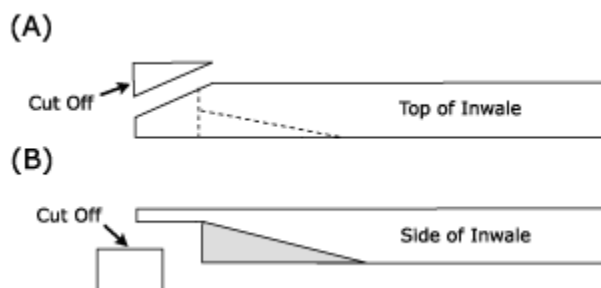
7. Remove old rails from canoe. If canoe has inset woods decks, use caution in removing old deck screws. They are 2 " long and should be removed slowly to prevent stripping of head. Clean exposed hull surfaces with GB-60 or a good household cleaner.

8. Using tape measure, locate center point of one pair of new rails. Mark point with marker on rails.

9. Position new rails on hull by aligning center marks on new rails with mark on hull. Clamp rails to hull at center point. Use of spring or bar clamps can be helpful at this point to temporarily secure rails to hull. Use C-clamps to finalize positioning. "S" hooks made from wire clothes hangers will help hold rails closer to hull at ends. Bend wire into an "S" shape, hook one curl over hull and set end of rail in other curl. Working towards one end, align rails even with top of hull (Royalex hull). For composite hulls, position rail with kerf as outwale and set so that bottom of kerf rests against top of hull. (Laminate hull). Clamp rail as needed, usually every 24-30". The use of cardboard squares inserted between the clamp and rail will lessen the compression of rail by the clamp. On laminate hulls, tamp rails on top with rubber mallet to make sure they are properly seated flush to top edge of hull. This is most important in the section of hull where rail begins to rise from center of canoe towards the ends.

10. The inwale will need to be trimmed to fit inside end of canoe. Holding the rail in place over stem of canoe, trace contour of stem of canoe onto rail so that rail will conform to hull shape. Make straight line at end of rail by sighting down to opposite end of canoe along keel line. Set saw just inside lines and trim off rail to form rounded end with straight side at center of canoe stem. If rerail job will include complete replacement of inset decks, care must be taken to ensure proper fitting of the ends of the inwales. The first inwale installed MUST be cut to fit flush against hull contour as well as along a center line INLINE to the "keel" line of the canoe. (See Diagrams A, B, & C). The second inwale must be cut to fit against this centerline and hull contour. It is best to cut conservatively and hand shape with file or sandpaper to achieve best results. Set rail in place in hull.





11. Once at end of canoe, return to center point and repeat procedure to opposite end of canoe. Step away from canoe and sight along rail to make sure it runs fair. Adjust position if necessary.

12. To determine new screw locations, run tape measure along inside of rail and mark rail at midpoint between old screw locations marked on hull. It is recommended to drill new holes evenly spaced between the old, as it is a hit or miss proposition to accurately drill through old holes. It is preferable to drill new holes rather than enlarge existing holes. On Royalex hulls, space screw holes at 6" intervals; 6 1/2" for composite hulls.

13. Starting at center point and working towards first one end and then the other, using drill with 11/64" TAPERED bit and countersink, predrill holes as marked along the rails. Set countersink to length of screw being used (1 1/2" for Royalex hulls or 1 1/4" for laminate hulls). Be careful not to drill all the way through rail. As you approach end of canoe it will become necessary to drill rails from outside of hull when hull is not wide enough to allow drill to align properly.

*(AT THIS POINT, IF YOUR CANOE HAS INSET DECKS, PLEASE REFER TO SPECIFIC INSTRUCTIONS BELOW)*

14. Start screws in holes and finish seating with fitted Phillips screwdriver or drill fitted with P2 bit. Be cautious not to strip screw heads. For best results run screws to just snug with drill and finish tightening by hand.

15. Repeat steps #6-14 on opposite rail. When fitting the ends of inwale inside stem, trace not only shape of stem of hull but also mark where other inwale will contact and cut accordingly. A close fit is desirable, more so if you are fitting inset decks; it is not as essential with capped decks as they will cover this junction. An additional step to consider is to drill a 1/4" hole through junction of inwales where they contact end of hull. This hole will allow easier and faster draining of any water trapped inside hull when canoe is inverted for transport or storage.

16. Drill 1/4" holes where marked for replacement of thwarts/yokes and seats. Using original hardware, reinstall fittings. Prior to inserting bolts, dip bolts into penetrating oil as this will aid in protecting internal wood surfaces newly exposed by drilling.

17. Using 3/16" bit and countersink drill holes to reinstall carry handles (if applicable).

18. Sand top and sides of gunwales with 120 grit sandpaper. Wipe clean and wet rails with Gunwale Guard. Remove excess and spillage from hull immediately.

19. For capped decks, center decks over ends of canoe and using 1/8" bit drill, drill through original holes in decks into new rails. Insert screw immediately after each hole is drilled to prevent deck from shifting.

# Replacing Gunwales with inset decks (including complete deck replacement)

## Additional Tools/Materials required:

Waterproof Wood Glue

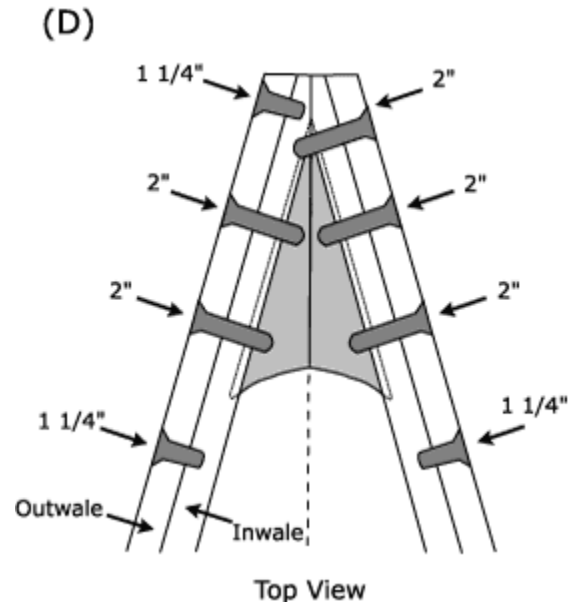
(12) 2 " Stainless #10 Screws

100, 120, 180, & 220 grit Sandpaper

File

1. FOLLOW THE STANDARD PROCEDURE ABOVE TO STEP 13 ONLY.
2. Treat underside of decks with Gunwale Guard and allow to dry before commencing installation.
3. As instructed above, drill and install screws to secure rails about 4' from center in either direction. Trim ends of inwales to fit inside end of canoe as described above. Leave ends of rails loose. Repeat procedure on opposite side.
4. Align the outside rails along the outside edge of the hull. Hold the decks in place over ends of the canoe and mark point on rail where deck ends. At the bow and stern drill with 11/64" tapered bit from the outside and countersink for four screws evenly spaced on each side of deck. Trim off the ends of the outwales, leaving about 1/4" overlap past end of the hull. Insert a standard gunwale screw (1 1/4 or 1 1/2") in holes nearest point of deck on one side (see Top View Diagram on Page 7) to secure gunwales while installing the deck.
5. Test fit deck by inserting deck dry. Mark any areas where fit is not correct and shave, file, or sand deck or inwale to allow proper fit.
6. If satisfied with fit, remove deck. Apply epoxy with a putty knife, coating the inside curve of the deck along both sides. Reinsert the deck and tamp into place with rubber mallet. "Lock" decks up in ends of canoes by securing a C-clamp to gunwale at junction of rear edge of deck. Epoxy should ooze from the glue joints. Remove the excess with the putty knife.
7. Leave standard gunwale screw in last hole and re-drill other holes so that drill penetrates into deck. Insert 2" screws and drive screws home. Remove standard screw set in last hole on one side (see illustration D) and re-drill and insert 2" screw and drive home. Leave short screw in place on opposite side. Repeat procedure to install other deck.
8. Make sure all of the screws are in tight. Proceed to install remainder of gunwale screws on rest of rails and remove the clamps. Resume re-rail procedure as described above as regards installation of seats, yokes, thwarts and carry handles (steps 16 - 18).
9. Trim ends of outwale on slight angle with edge of outwale against hull being further forward than outer edge. Sand or file edges of cut to relieve sharp edge.
10. Sand the decks and rail joints for a smooth finish. Start with 100 grit paper to remove the top 1/16" of the deck. Be very careful not to sand too deep so that the deck screws are exposed.

Change to 120 grit for a smoother finish. Finally sand with 180 and 220 grit wet/dry sandpaper using Gunwale Guard for a smooth finish.



## Short-splicing method to preserve original inset decks when rerailing

1. FOLLOW RERAIL INSTRUCTIONS THROUGH STEP 5. After seats, yokes, thwarts, carry handles are removed, lay new inwale on top of existing inwale and clamp in place. Make sure center mark on inwale is aligned with center mark on hull. Trim each end of inwale 3" short of end of deck. Release clamps and slide the new inwale into canoe under existing inwale. Align center marks and clamp in place.

2. Remove the screws located approximately 12" from end of decks. Draw a line bisecting a screw location at a 30-degree angle across the old rail. Angle should run so that end against hull will be closest to deck.

3. Making sure rails are firmly clamped to each other, pull both rails far enough away from hull to allow both to be cut with a saw. Cut both rails on line marked. Repeat procedure for opposite end.

4. Unclamp new rail and set aside. Remove old rail and clamp new one in place with outwale after coating ends with waterproof wood glue. If cut is correct, the new inwale will slide snugly in place of the old. Drill holes and set screws as described above. Drill and set screw through old hole bisecting the splice cut.

## Installation of a 4' splicing section

If you have only a small section of rail needing repair, consider using a 4' Splicing Section. Splicing sections significantly less expensive to purchase and to ship. They can be shipped UPS. Splicing sections work best at the ends of the canoe where the rails runs straight, not curving around the hull as in the center of the canoe. They can work on curved sections but care must be taken to fit splices carefully into existing gunwales and to secure them firmly. Avoid putting in multiple splice sections in any one rail.

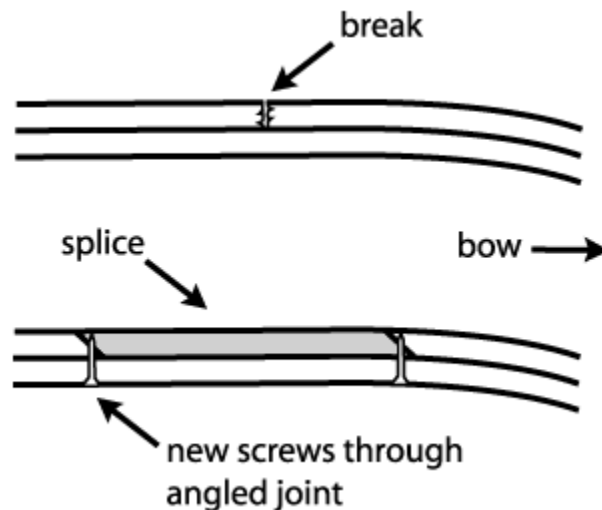
#### **Tools/Materials required:**

Saw	4 C-clamps (2 spring or bar clamps are helpful)
Phillips Screwdriver	Masking tape
Waterproof Glue	Gunwale Screws
Protractor with straight edge (in case existing fasteners are damaged)	Non-permanent Marker
Drill & 1/8" bit	#8 x 1 1/2" Self-tapping stainless steel flathead screws (2 required for each splicing section installed)
File	#8 Countersink (if repair requires redrilling of rail screws)

#### **Replacement of individual inwale or outwale section**

1. Splicing sections are 4' long. Isolate the damaged rail section and mark at points on either side where gunwale is sound. On straight sections of gunwale, the marked section can be quite short; on curved sections best results are obtained if the section to be removed is longer. Remember you are limited to a splice no longer than 42"/107cm.
2. Cut splicing section approximately 6" longer than section of gunwale to be replaced. Run a comparable length of masking tape along side of hull under existing gunwale.
3. Center and Clamp splicing section to underside of existing gunwale to be replaced. Position clamps to inside of marks on gunwale and at ends of splicing section.
4. At marks, use protractor to draw a straight line across top of gunwale at a 30° angle with leading edge towards bow (see diagram below). This will keep your paddle from catching along rail at junction of splicing section and original rail.
5. Remove any gunwale screw that bisects your angled line. Carefully cut both original gunwale and splice along line. If you are working with a kerfed gunwale, you'll need to careful cut the kerf as well. Cut at other mark as well.
6. Remove clamps holding splice in position and back out any gunwale screws between cuts. Damaged original gunwale should be easily dislodged.
7. Test fit splice into original gunwale. It may be necessary to lightly file ends of splice to get fit.

8. Once fit is fine-tuned, apply glue to angled ends of both original gunwale and splice and put splice in place. Clamp splice to hold position. Wipe up any glue oozing from joints. Remove masking tape from hull.
9. Using 1/8" bit, drill lead hole for #8 screw through each joint, positioned so that it bisects angled cut (as shown in diagram below). Insert screw and snug tight. If concealment of screw head is desired, make countersink shallow to prevent screw from protruding from opposite side of gunwale.
10. Once glue has set, back out any gunwale screws throughout repaired section. Using existing holes as guide, drill a little distance into splicing section to allow reseating of gunwale screws without splitting new gunwale section. Be careful not to drill all the way through the new gunwale.
11. Re-insert gunwale screws and tighten to secure new splice in place.
12. Sand splice and then finish with Gunwale Guard and/or stain as needed to make appearance consistent with existing gunwale.

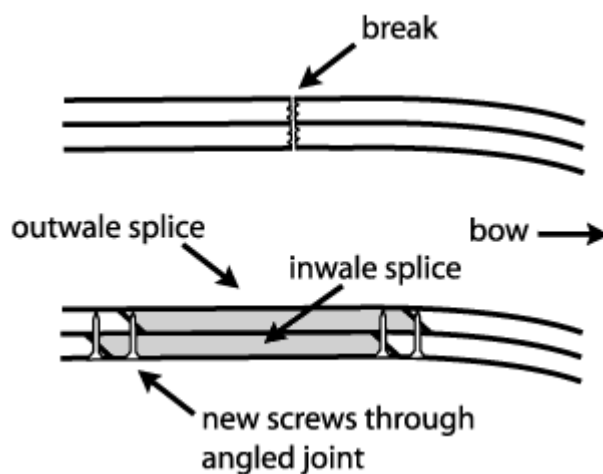


Outwale (or inwale) replacement

### Replacement of both inwale and outwale section

1. Splicing sections are 4' long. Isolate the damaged rail sections and mark at points on either side where gunwale is sound. Stagger position of marks on each rail (as shown in diagram below). On straight sections of gunwale, the marked section can be quite short; on curved sections best results are obtained if the section to be removed is longer. Remember you are limited to a splice no longer than 42"/107cm.
2. Cut splicing section approximately 6" longer than section of gunwale to be replaced. Run a comparable length of masking tape along both sides of hull under existing gunwales. Tape is to protect hull finish from saw.
3. Center and clamp splicing sections to underside of existing gunwales to be replaced. Position clamps to inside of marks on gunwale and at ends of splicing section.

4. At marks, use protractor to draw a straight line across top of gunwale at a 30o angle with leading edge towards bow (see diagram below). This will keep your paddle from catching along rail at junction of splicing section and original rail.
5. Remove any gunwale screw that bisects your angled lines. Carefully cut both original gunwale and splice along line. If you are working with a kerfed gunwale, you'll need to carefully cut the kerf as well. As you get near the hull use a careful and light saw stroke to avoid scratching the hull surface. Cut at other marks as well.
6. Remove clamps holding splices in position and back out any gunwale screws between cuts. Damaged original gunwales should be easily dislodged. Remove one section at a time.
7. Test fit splice into original gunwale. It may be necessary to lightly file ends of splice to get fit.
8. Once fit is fine-tuned, apply glue to angled ends of both original gunwale and splice and put splice in place. Clamp splice to hold position. Wipe up any glue oozing from joints. Remove masking tape from hull. Once splice on one gunwale is clamped, proceed to repeat process with other splice.
9. Using 1/8" bit, drill lead hole for #8 screw through each joint, positioned so that it bisects angled cut (as shown in diagram below. Insert screw and snug tight. If concealment of screw head is desired, make countersink shallow to prevent screw from protruding from opposite side of gunwale.
10. Once glue has set, back out any gunwale screws throughout repaired section. Using existing holes as guide, drill a little distance into splicing section to allow reseating of gunwale screws without splitting new gunwale section. Be careful not to drill all the way through the new gunwale. If necessary, use countersink to "bury" screw heads as along original rail.
11. Re-insert gunwale screws and tighten to secure new splices in place.
12. Sand splices and then finish with Gunwale Guard and/or stain as needed to make appearance consistent with existing gunwale.



Splicing both gunwales

# Gunwale (Canoe Rails) Repair Guide

## Aluminum Gunwale Repair

As a lightweight option on our composite hulls, Mad River Canoe offers black powder-coated aluminum gunwales. A low-maintenance alternative to the traditional ash, aluminum gunwales save approximately 3-5 pounds per canoe.

**When ordering replacement vinyl gunwale be sure to request the correct length - order rails longer than your canoe.**

Canoes are measured straight down the keel line. Gunwales take a bit more circuitous route getting from end to end. Aluminum rails come in three sizes, 15', 16' & 17'.

Place orders for replacement gunwales through your authorized Mad River [dealer](#).

**Specify your model of canoe and hull material when ordering gunwales to ensure compatibility.**

Replacement aluminum gunwales are available for all current models of composite Mad River Canoes, with the exception of the Winooski and Missisquoi models. If you are uncertain of which model canoe you own, provide the serial number as an alternative. Serial numbers are located on the right side of the stern, just below the gunwale. It will either be engraved on a small brass plaque, or stamped directly into the hull. If it is difficult to read, try making a rubbing with a pencil and a small piece of paper. In the event that the model name is unknown and the serial number is completely unreadable, measure your canoe from stem to stem and width at center and we will approximate as best we can.

**Unlike wood gunwales, aluminum gunwales require only two rails per canoe.**

Aluminum gunwales are a "unibody" one- piece construction that incorporates inwale and outwale into one piece.

**It is recommended that you order replacement rails pre-bent to fit your particular canoe.**

Straight aluminum rails cannot be bent "onto" a canoe hull but must be pre-bent on a jig before installation. If you want to install aluminum gunwales on an older model Mad River canoe, you will need to come up with some kind of bending jig. A canoe hull is not strong enough to provide enough resistance to bend an aluminum rail in place as you go. Straight rails are available if necessary. Please specify.

**If you are replacing ash gunwales with aluminum, your canoe will require different seat hangers or trusses and will require appropriate decks.**

These components are available from your authorized Mad River Canoe [dealer](#).

## **Replacement rivets are required for both replacement and new installations.**

If you are removing existing gunwales the rivets will be destroyed in the process. The "average" installation requires 70+/- 5/32" diameter Buttonhead aluminum rivets with aluminum mandrels with grip range of 3/16" to 1/4". Rivets are available in packages of 80 from Mad River Canoe via your authorized [dealer](#).

## **Black plastic caps will be needed to cover seat, carry handle, yoke and thwart mounting hardware.**

These will range in quantity for 14 to 18, depending on outfitting for your particular boat. Each seat will require 4 caps, each carry handle 2, each thwart 2, each yoke 4. If you are replacing original aluminum rails it is likely that the existing caps can be reused. If you are replacing a different gunwale system, these caps can be ordered from your authorized Mad River Canoe [dealer](#).

## **Due to their length, aluminum gunwales cannot be shipped via UPS.**

One alternative is to ship by common carrier (via truck) but this is expensive (approximately .00 - 0.00). Gunwales shipped via common carrier will be sent freight collect (payment due on receipt). The best alternative is to arrange shipment of gunwales to accompany a shipment of boats to your local dealer. If this can be arranged, there is no freight charge for the gunwales.

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### **TOOLS & MATERIALS REQUIRED**

Variable Speed Reversible Drill	20' Tape Measure
5/32"; 13/64"; 25/64" Drill Bits	Wax or Grease Pencil, or non-permanent marker
Pop Rivet Gun	4 Quick-Grip, spring or Bar clamps
Buttonhead aluminum rivets with aluminum mandrels (5/32" diameter); grip range: 3/16" to 1/4"; Hole diameter .160 to .164	Prick or Center Punch
Rubber Mallet	Duct tape

## **Procedure:**

1. Mark location of all seats, thwarts, etc. on inside of hull with grease pencil or washable marker. Once original rails are removed, the proper locations for these fittings will be lost if not noted.
2. Run tape measure around hull just below existing rails. Mark center point on each side of hull just below rails. These will serve as centering marks for replacement gunwales.



3. Remove all seats, thwarts, yokes, etc. from canoe. Mark side to side reference on seats thwarts, yokes, etc. so that reinstallation will be consistent with original. Label and attach all hardware so that it can be reused in original position.
4. Remove old gunwales.
  - 4a. If you are replacing ash gunwales, simply remove all screws in the gunwales and the decks.
  - 4b. If you are replacing aluminum gunwales, tape existing gunwales in place by applying duct tape in strips from outside of hull, over gunwale, to inside of hull. Position tape so that it does not cover any rivets. Taping the gunwale will keep the gunwale in position as the rivets are removed and prevent the gunwale slipping or springing free and scratching hull or striking someone. Drill out the existing rivets with a 5/32" bit. Drill from the inside of hull, centering drill on head of rivet. You will need to continue all the way through the rail and hull. The rivet should then slip out easily. First drill through the rivets which attach the decks at either end of the canoe, and then drill out the rivets which attach the gunwales.
5. Once all the screws have been removed, or all the rivets have been drilled out, carefully separate the gunwales and decks from the hull and set them aside.
6. Clean exposed hull surfaces with GB-60 or a good household cleaner.
7. Set replacement gunwales on the ground next to your canoe hull. The replacement gunwales should be pre-bent, and cut at either end at an angle to fit new decks. If you are working with straight gunwales, now is the time to use your bending jig to pre-bend the gunwales to fit your canoe.
8. Using tape measure, locate and mark the center point of the replacement gunwales with grease pencil. This mark will line up with the center point you have marked on either side of the hull once the rail has been slid onto the hull.
9. Position one rail over side of hull, aligning center marks. Push rail down onto hull. Do not attempt to start at one end and push/slide rail down hull towards other end. This will scratch and possibly crack hull laminate. It is easier to start at one end and push rail down onto hull working towards opposite end. Looking down hull, make sure that edge of hull does not cross to outside of gunwale. If this happens and you are pushing rail down you can cut hull laminate. Having a second person assist you in this process is a big help. Thump rail down gently with palm of hand. Do not use mallet at this time to seat gunwale. Check periodically to be sure center points are aligned. If you need to move the rail backwards or forwards to line up the center marks, gently tap the end of the rail with a rubber mallet until the marks line up.
10. Once gunwale is in place over hull go back down length of gunwale tamping gently with mallet to fully seat gunwale over hull. Clamp rail to hull at approximately  $\frac{1}{4}$  and  $\frac{3}{4}$  of the length of the rail with 2 clamps to secure in position.
11. Repeat process with second rail on other side of hull. Make sure rail ends are even, tapping end of rail with mallet to align, if necessary after removing clamps. Reinstall clamps after ends are aligned.
12. Drill holes through cut end of each rail with 5/32" bit, within  $\frac{3}{4}$ " of the each end. Holes should be drilled from the outside of the rail. Place rivets through each hole after each is drilled. Once you have drilled all four go back and secure rivets with rivet gun. Slide rivet gun over rivet stud to point where head of gun is flush with head of rivet. This is most easily accomplished by making

sure handles of rivet gun are fully released. Squeeze handles together to snap rivet. It may be necessary to squeeze more than once to get rivet to pop. If one pull doesn't do it, release handles and slide gun forward until head of gun and head of rivet are again in contact and then squeeze handle. Keep rivet gun aligned level with rivet. Do not attempt to "help" the process by bending or "torqueing" the rivet gun. This can result in rivet stud being jammed in rivet gun.

13. Starting from stern end of each rail (end of canoe with serial number on right side), measure and mark locations of rivet holes on flat flange of inside of rails with grease pencil. The first rivet holes should be located 6 ½" from the end of each rail, and the second rivet holes should be located 7 5/8" from the first measured hole. Each successive rivet hole should be located 6 ½" from the previous one. Continue measuring and marking rivet hole locations until you reach the bow end of the rails. Do not be concerned if the distance between the two rivet holes nearest the bow is different from all previous distances.

14. Step back and "eyeball" each gunwale to make sure it is "fair" and follows sheer line of hull. Gently tap down any high spots or rises in gunwales.

15. Drill holes at all marked locations with a 5/32" drill bit. Holes should be drilled from the inside of rail, and should penetrate inside of rail and hull, but should not protrude through outside of rail. The rivets should be visible only on the inside of hull/gunwale. Measuring width of gunwale and wrap tape at corresponding length of drill bit will help prevent accidentally drilling through the outside of the gunwale.

16. Place rivets in all drilled holes and secure with rivet gun.

17. Mark locations of seats, thwarts, yokes on top of rails. The marks should be located on the inner half of the rail, such that a hole drilled straight down would penetrate the upper and lower half of the rail without contacting the hull itself. Position prick punch on mark and tamp with hammer to indent top of rail. The dent will help stabilize drill position and keep bit from slipping.

18. Using the 13/64" bit, drill straight down through the rail at all marked locations. This should include holes for the bolt hangers for the carry handles (two holes per each handle); seats (four holes per seat); thwarts (two holes per thwart), if applicable; and yoke (four holes total).

19. Changing to the 25/64" bit, enlarge all the holes you have just drilled, through the top of the rail only. This will allow the heads of the bolts which the seats, thwarts, and yokes hang from to pass through. The hole through the bottom of the rail should remain at the 13/64" size. To be sure to drill through top of rail only, wrap some tape around drill bit approximately 1/4" from tip and insert drill bit only until it contacts tape.

20. Hang seats, thwarts, yokes, etc. from rails, and tighten all hardware. NOTE: If you are replacing ash gunwales with aluminum, you will need kerfed trusses, and/or seat hangers, in order to accommodate the lip of the gunwale. Tighten hardware fully.

21. Insert black plastic caps into the holes used to hang seats, thwarts, etc. in the top of the gunwales.

22. Slide decks over cut ends of rails. Using 5/32" bit, drill holes for rivets through lower lip of deck and through hull. Each side of the deck should get two holes, one in each end. Place rivets through holes (four total), and pop with rivet gun.

## Care and maintenance of aluminum gunwales

Aluminum gunwales are basically care free. Over time and use, the black powder coating can be abraded, revealing the natural silver color of aluminum. This is a cosmetic issue only, the function and durability of the gunwale is not affected. If you want to restore the black finish, lightly sand area with fine grit sandpaper and paint with a flat black enamel. Multiple light coats will be longer lasting than one heavy coat. Please note this will not be a permanent "repair" and will likely need periodic repainting.

## Composite Boat Repair Q&A

### What is a composite boat?

Generally speaking, a composite boat is defined as one constructed of a matrix of resin and cloth, laid up in multiple layers to create a hull that is stiff and efficient to paddle. The resin adds little strength to the "lay-up" but serves primarily as the "glue" that holds it all together. The structure of the hull is derived from the fabrics encapsulated in the resin. There are a variety of fabrics available to manufacturers to choose in developing their lay-ups. The choice of fabric reflects the use for which the boat is intended and can range from chopped fibers to Kevlar® and graphite woven cloth and a multitude of variations in between. For the purposes of this discussion, suffice to say that we're dealing with the common basis of composite construction that boils down to layers of fabric bonded together by resin.

The exterior "skin" of most composite canoes and kayaks is made of gel-coat which in its simplest definition is a mix of resin and colored pigment. The gel-coat serves to make the boat attractive but also performs the important task of protecting the internal fibers from abrasion or moisture penetration. gel-coat can either be colored or clear.

Under the gel-coat, one finds the outer layer of fabric. The boat builder tailors the lay-up to provide the stiffness desired for efficient paddling while keeping the weight as low as possible. For this reason, you'll find parts of most canoes that may have twice the number of cloth layers as other parts. Additional layers increase stiffness and durability but add weight as well. Manufacturers, depending on desired usage will substitute foam or other stiffeners in place of multiple cloth layers to achieve desired stiffness while keeping weight down.

### How durable are composite boats?

Depends on the lay-up. We often get asked why you can find fiberglass boats ranging in price from 0 to 00. The price differential is due to the materials selected for construction. One can build a functional canoe using polyester resin and chopped fibers very quickly and inexpensively but such boats tend to be fragile and heavy. Most canoes and kayaks are built of engineered lay-ups using resins such as vinylster and epoxy and with stabilized woven cloth of differing weights. These materials have to be installed by hand but the result is a boat that is both lighter and more durable.

Generally, if you anticipate your boat being subject to constant banging and scraping such as found in whitewater paddling, you'll be wise to consider a boat constructed of polyethylene or Royalex®. There is a trade off as the most efficient hull shapes are found in composite boats and

their lighter weight lay-ups combine to produce boats that are faster and more responsive to the paddle stroke.

### **Is composite boat repair difficult?**

Depends on the extent and location of the damage. If the boat has been wrapped and has multiple tears or cracks, the process can be much more involved and complicated. With extensive damage you may have to remove or replace the gunwales of a canoe to relieve any distortion to the hull. Your intent in repairing your hull will be to restore stiffness and strength to the hull.

### **Is composite boat repair complicated?**

Again, it depends. Working with cloth and resin always has the potential to be challenging and unless you approach it in an organized manner, it can get messy in a heartbeat. It's best to get all the necessary components together and sorted out before starting. It may also be a situation where the repair is best performed over a series of days, rather than at one fell swoop. Generally, you will perform the structural repair on the inside of the hull to restore integrity while repair to the exterior of the hull will be more cosmetic in nature. If you are repairing a kayak hull sometimes it is unavoidable to perform the structural repair on the hull exterior if the interior surface is unreachable.

The actual process is pretty straightforward in that you wet out the prepared surface with resin, lay patching fabric in place, wet out that patch, and repeat the process until you have restored the hull to its original stiffness and structure. However, fiberglass resin is challenging to work with. It's sticky when wet and then you have a limited working time with which to apply it. As long as you're organized and have the materials and conditions at hand it is a realistic process to undertake.

### **How do I identify the damage that needs to be repaired?**

It can be tough with many boats, especially those with gel-coated exteriors and painted interiors. Just about any damage to a fiberglass hull will show up as white, whether it be a scratch or a fracture. Surface scratches, painful as they may be, are relatively easy to identify and quantify. Regardless of the color of your gel-coat, scratches coming as a result of beaching the boat or sliding over a midstream ledge or rock will show as white. If the gel-coat is still intact and you can't see any damage to the underlying fibers or cloth weave, most likely this isn't cause for concern. Eventually, you will want to restore the gel-coat in these areas to maintain the protection the gel-coat provides to the hull structure.

The key to determining structural damage is to keep an eye out for any new or excessive flexibility in your hull. If you've taken an impact but don't see any exterior signs of damage, take a minute and push against the hull in the area of the hit and compare how flexible the hull is in that area compared to a corresponding point on other side of the hull. If the impacted area is more flexible, then you may have an issue to deal with.

Sometimes structural failure is a cumulative thing that results from use over time and can't be attributed to one instance or one rock. Signs to look for are flexibility in the hull while paddling. Take a minute and drive your boat hard and watch the interior of the hull. Any up and down movement in the bottom of the boat is not a good sign. Unlike "rubber" boats (polyethylene & Royalex®) where such "oil-canning" is expected and desirable to a degree, such flex in a composite boat indicates a problem. Another area to look at is to inspect the exterior of boat along the chines (where the hull transitions from bottom to sides) and look for any pattern of parallel cracks in the gel-coat. If there is a series of cracks on one side or both, this can be an indication that the internal layup has been damaged and needs to be stiffened.

## **What kind of damage can be repaired and how would I know if I need to repair it?**

Literally, if you have the time and patience, you can restore a boat that's been broken into multiple pieces. It'll be heavier than it once was but it will be functional.

Generally speaking, damage to composite hulls falls into several categories. The first is cosmetic wear and tear. Scratching the hull is inevitable and the first scratches are the most painful. Regardless of the gel-coat color, composite hulls will scratch out white, making this type of damage look worse than it is. If the gelcoat is still intact and there is no sign of corresponding whiteness on the interior of the hull, its most likely that all you're facing is a gel-coat repair and this can easily be accomplished with the materials provided in Voyageur's gel-coat Repair Kit.

Most damage that requires structural repair is the result of impact or from excessive flexibility in the hull as the result of fatigue or unrecognized damage. It is true that continued severe abrasion can necessitate a structural repair if the gel-coat has been removed and you are seeing the white fibers of the cloth exposed or lifting up. However, what we're most concerned with here is fixing punctures and cracks or fractures. It's not necessary to have exposed fibers to indicate a fracture. A white line on the interior of the hull could indicate what is called a resin fracture where the fibers have not actually been torn but the bond between resin and fibers has been broken. It's important to be proactive. If you see a point where the hull has been damaged, it's best to repair it as quickly as possible to prevent damage to the lay-up from water getting inside the lay-up and causing further deterioration.

## **What's involved with the repair?**

First step will be to clean the hull thoroughly. This will make the extent of damage that more evident and allow you to assemble the necessary materials. Next, you will want to remove the damaged fibers and resin from around the area to be repaired. This is accomplished by a considerable amount of sanding and cutting of "loose" fibers from around the injury. It is key to remove any raised fibers as these have already been resin impregnated and will not absorb any new resin and you'll find them extremely stubborn in terms of trying to get them to lay flat under a new patch or reinforcement. This step actually resembles making the damage worse in that you are opening up the crack somewhat by removing material that is still present but no longer of any structural value.

The next step will be to cut reinforcing patches of cloth to lay in over the damage. Plan on laying in multiple layers of fabric to restore stiffness and integrity. Usually this can be done at one time. Once the patches have cured, then you've got a bit of sanding to be done to smooth down any sharp edges. As structural repair is done on the inside of the hull, its up to you how far you want to go in restoring the original appearance of your hull. On the exterior of the hull, with enough time and energy, you can make the damage invisible by using the appropriate colored gel-coat kit.

## **Once a hull is damaged, will it always be weaker at that point?**

No, that's one of the beautiful things about composite construction. You can repair your hull to the point where it is as strong as originally built or you can take it a step or two further and buttress the area by adding additional layers or specific types of fabric. The only drawback to building up an area is the additional weight involved.

## **Where can I get the materials needed for the repair?**

[Voyageur](#) offers prepackaged repair kits for Fiberglas or Kevlar® repairs. The kits contain enough material for most repairs of cracks or tears up to 12" long. You can also obtain additional resin and cloth from your local outdoor specialty store, marine stores, auto parts stores or from boat building supplies on the Internet.

## **How do I know what to choose from all the different types of cloth and resin available?**

As for resins, your choice will usually come down to polyester, vinylester, or epoxy. Most performance boats are built of either vinylester or epoxy. Both are significantly stronger than polyester (and more expensive). Polyester resin is adequate for the majority of repair work and bonds well to whatever resin may have been used originally. For extensive repairs in critical areas of the hull you may want to consider vinylester (has the advantage of being slightly more elastic and is less threatening to work with) or epoxy (stronger and lighter but more hazardous).

When it comes to fabrics, avoid fiberglass mat. Mat can be identified by fibers running in random directions with no semblance of a weave or pattern. Mat has the advantage of being able to easily conform to tight curves and corners but provides little or no strength, as the random fibers are not linked to each other. It is serviceable to use as a filler on the outside of a hull beneath the gel-coat or if you're trying to build up a repair right up in the nose of your boat but other than that you'll be better off going with a woven fabric.

Woven roving is characterized by a coarse weave consisting of large fibers. It has the advantage of providing substantial stiffness over a large area but tends to be heavy compared to more tightly woven fabrics as it collects substantial amounts of resin within its large weave. Its best application is to restore stiffness across the interior of the bottom of the hull. It does not conform to curves and corners very well.

"True" woven fabrics come in a variety of weights, usually measured in oz. per yard. For most repairs, a 6 oz. cloth will work fine. Its relatively fine weave provides a good resin-fabric ratio, it conforms to hull curvatures well and has good strength to weight characteristics, especially when used in multiple layers. Lighter weight cloth may be called for when you're working in an area with a tight curvature and need a more flexible cloth. Heavier weights such as 10oz. can be used where stiffness is desired or where you've got a fairly large area to restore. Many builders use a mix of different weights for best results.

In addition to weights, you'll also encounter different types of fabric. Your basic fiberglass fabric is called "e-glass" and is perfectly adequate for most applications. "S-glass" fabric does provide a higher level of abrasion resistance but is harder and stiffer to work with. If you're repairing the end or keel line of your boat and you feel like you have to reinforce the exterior of the hull, s-glass would be a good choice. Many manufacturers use it as the outside layer on their Kevlar® or graphite canoes for this reason.

Beyond fiberglass, one encounters the more exotic fabrics such as Kevlar® and graphite. Kevlar® has a well deserved reputation for providing lightweight durable canoes. It can be more difficult to work with as it is lighter than fiberglass cloth and may tend to "float" a little more in the resin, making it harder to get it to lay down in the center of a curvature such as the stem of your boat. Kevlar® also does not take to sanding very well as it tends to "fuzz" as you sand it. Graphite is rarely used in hull repair. It's a very stiff fabric that doesn't take well to being bent or forced to follow a hull's curves. It's also difficult to wet out with resin and hard to tell when it is sufficiently impregnated.

## **If I'm repairing a Kevlar® boat, do I have to use Kevlar® fabric?**

No. Since its the resin that bonds fiber to fiber, it's certainly feasible to use fiberglass cloth to repair localized damage on a Kevlar® hull. As mentioned above, many Kevlar® boats are built using fiberglass layers for good reasons such as added abrasion resistance. If your damage is relatively concentrated and doesn't require a lot of material, you'd be unlikely to notice the few ounces of added weight incurred by the use of fiberglass cloth. On the other hand, if you're repairing a wider expanse of the hull, you'd probably be better off using Kevlar® fabric to maintain a more consistent flex pattern throughout your hull.

### **What happens if I get into the repair and screw up? Can I start over?**

Certainly. You may be faced with more sanding or grinding than you may like but the damage can be undone and removed and replaced with proper repair.

### **What precautions should I use when performing these kinds of repairs?**

When sanding the fiberglass or other fabric, always wear a dust mask at the minimum, along with eye protection, and long sleeve shirt and long pants. Better yet would be a NIOSH approved respirator with an organic vapor cartridge. The primary dangers involved with composite boat repair are the dust from sanding and the vapors emitted by the resin used. Take necessary steps to minimize your exposure to these influences.

Fiberglass fibers are no fun to get onto your skin. They itch like mad so keep covered and when finished, wash the clothes worn while doing the work separately from other laundry or simply dispose of them outright.

The best location for doing this type of work is outdoors with the temperatures in the 65-75°F range and a light steady breeze blowing. If that is not possible and you must work indoors, make sure there is a positive ventilation flow by turning on a fan or two. Vacuum up all dust generated and dispose of used materials properly. Particularly make sure that any unused resin completely cures to a solid state before disposing in any closed or sealed container.

Follow instructions provided with repair materials carefully. All resins have a "working time" and repairs should be adjusted to fit within that time frame. Working time will vary with temperature, becoming shorter the warmer it is and longer when it is cooler. Do not undertake repairs when the temperature is 50°F or less unless you take steps to warm the resin mix and the curing resin/fiber patch with a hair dryer. Do not use a heat gun or open flame under any circumstances. If temperatures are warm, plan on mixing smaller and more frequent batches of resin to avoid a larger batch kicking over to a solid before you are finished with the work.

### **Where can I get additional information or assistance?**

If the job looks to be a little bigger than you want to tackle, check with your local outdoor specialty store. They may offer repair service or know of someone who can perform the repair. You can also check [here](#) for a national list of MRC dealers who repair canoes.

Another possibility is to look in the Yellow pages under boat repair. If you go this route, make sure that the people you have do the repair use the appropriate fabrics and resins. Many boat repair yards are more accustomed to working with mat type cloth and polyester resin.

# Royalex<sup>®</sup> Repair Q&A

## Is Royalex<sup>®</sup> care-intensive?

No, its probably the most carefree canoe material available, especially if the boat has vinyl or aluminum gunwales. Its always preferable to store the boat indoors if possible but if that's not an option, a Royalex<sup>®</sup> canoe is a good one to have.

## If I store my boat outdoors, do I need to worry about UV damage?

Not if the vinyl skin is intact. Over time there will occur some color fading but this can be prevented by periodic treatments of a UV protectant such as 303, available from Voyageur.

The application of a UV protectant will create a slippery surface for a limited period of time. One of the reasons we like 303 is that its water based and makes for a less slick surface. Nonetheless, when/if you treat the interior of you boat be cautious when you next use it to avoid slipping and losing your balance.

## Is temperature a threat to Royalex<sup>®</sup> canoes?

Yes and no. Very extreme heat can deform the canoe but the temperatures must be very high and very sustained. This is usually not a problem unless the canoe has been placed in a clear polyethylene sleeve or bag and left out in the sun. This can deform the canoe permanently but most people don't keep their canoes in a plastic bag. The problem occurs more often when new boats are delivered to a shop or customer and left outside in their packaging materials. Royalex<sup>®</sup> is much more resistant to heat deformation than canoes made of polyethylene.

Cold temperatures can pose a bigger threat. Royalex<sup>®</sup> canoes can be susceptible to cold cracks due to hull contraction and expansion. Wooden railed canoes are more prone to this than those with synthetic gunwales. Most canoe manufacturers have taken steps to minimize the possibility of cold cracks and include tips on how to store your boat for the winter season in their owner's manuals. More information on cold cracks and repair can be found below.

## Repairing Royalex<sup>®</sup> canoes?? Aren't they supposed to be indestructible?

ABS Royalex<sup>®</sup> is an incredibly durable material but it is not indestructible. Back when Royalex<sup>®</sup> started to show up in canoes, it was nothing short of a revolutionary advance in canoe materials. Its functional durability put it in a class by itself compared to other available technologies of the time such as aluminum or fiberglass or wood. Canoe manufacturers could be forgiven if they got a little too carried away with this almost magical material. Images of canoes sailing off factory roofs or falling from airplanes and surviving contributed to the growth of Royalex<sup>®</sup>'s reputation for being "indestructible."

## Is repairing Royalex<sup>®</sup> difficult?

Not particularly. Royalex<sup>®</sup> repair often consists of restoring damage caused by an accumulation of wear and tear and this type of repair is not difficult or complex. It does get more challenging if you're intent on repairing a boat that has been wrapped or severely distorted to the point where the hull has torn. The difficult part is not the actual repair of the hull material but in restoring the original hull shape. In situations like this, you are usually also facing replacement of the gunwales



or rails as the hull can be distorted far more severely without permanent damage than can these structural members.

Repair of dents and deep scratches involves filling with Royalex<sup>®</sup> repair resin. Repair resin is a puttylike 2-part resin that cures to a hard finish. Some sanding will be required as well. Repairing tears or cracks requires multiple layers of Kevlar<sup>®</sup> cloth laid in and covered by the repair resin. Fiberglass cloth can also be used but the inherent flexibility of Kevlar<sup>®</sup> better matches that of Royalex<sup>®</sup>. Structural repair is generally done on the interior of the hull.

### **The ends of my canoe are worn to the point where the outer layer is gone and I'm seeing some of the same problem at spots along the keel line. What should I do?**

The outer (and inner) layers of a Royalex<sup>®</sup> hull is vinyl. They're there to provide UV protection for the underlying ABS plastic layers that in turn surround the foam core. The ABS layers are quite susceptible to UV degradation. The vinyl layers block that potential damage. Over time and considerable use, it is not unusual for that vinyl layer to be worn away. As the vinyl wears, you'll start to see a new color appearing. The vast majority of Royalex<sup>®</sup> material has been made with the ABS layers of a differing color than the vinyl skin. This makes it easy to gauge the wear on the vinyl layer. While the canoe is still structurally intact, it is wise to restore that layer of UV protection to your hull. If the ABS has not been too deeply scratched or gouged a simple, albeit temporary, solution is to simply paint over the exposed layers. Most canoe manufacturer's provide color matched ABS Touchup paint. You can expect to have to paint again in the future as the paint is abraded away. A more permanent option to consider if the wear is concentrated at the ends of the boat and the underlying layers are in good shape is to install a skid plate kit. This will not only protect your hull's integrity but will add strength to the hull.

If the ABS layers have been scraped or gouged you may need to consider filling with Voyageur Royalex<sup>®</sup> Repair Resin and then painting over the new material. Repair resin is a thick paste that spreads easily and cures to an extremely hard finish. If properly installed, it is unlikely to require additional repair in the future.

### **I've got some dents and creases on the outside of my hull. Do I need to repair these?**

Probably not, especially if the outer skin is not cut or missing. Flip your boat over and look inside the hull. If you don't see a corresponding crease on the inner hull surface most likely the damage is cosmetic. Structurally, the hull is fine unless you see that corresponding crease. This indicates the damage extended first into the foam core, compressing it, and then through the inner ABS layers. If the boat is used primarily in milder waters, you can probably live with this damage if not too long or large in scope. If you're paddling demanding whitewater or going to remote locations it'd be prudent to repair it as this depression can become a "hinge" in event of an "incident."

Some shallow dents can be repaired by heating the area with heat gun. This can re-expand the foam core. If necessary, structural repair would consist of reinforcing the damaged area with a matrix of repair resin and glass cloth applied to the inside of the hull.

### **What is a cold crack?**

Paddlers living in colder regions or in areas subject to rapid temperature fluctuations have learned that Royalex<sup>®</sup> canoes can be subject to what are called cold cracks. Cold cracks occurred when temperatures reached the teens or lower and/or there was a rapid temperature swing of 20-30 degrees in a few hours. Royalex<sup>®</sup> is an elastic material and will shrink or expand

slightly due to temperature changes. At colder temps, the material has a tendency to contract. When that contraction occurs at a different rate than that experienced by the gunwales, the hull could crack at the screws or rivets used to attach the gunwales. These cracks would often extend up to 8-10" down into the hull of the canoe. Contrary to most damage incurred by paddling, cold cracks can be identified by their vertical orientation. In severe cases, one could encounter a series of 6 to 8 or more cracks originating at a succession of attachment points. Royalex<sup>®</sup> canoes with wooden gunwales were somewhat more susceptible to this problem than those with synthetic rails.

As canoe manufacturers became aware of this problem, they took steps to reduce its occurrence. Steps recommended for the user to take included backing out the screws in the ends of the boat as cold cracks tended to occur more frequently in these areas. Steps were also taken in the production of the boats to make this problem less likely and these precautions have appeared to have had an impact as incidents of cold cracks have diminished.

Still, its possible to experience the problem or to find a canoe for sale with the problem. Indeed, if you are fortunate to find such a boat, you will often find a bargain as the damage looks worse than it is. As cold cracks are found up near the gunwale, they're located in a less critical area than if they were found below the waterline. Repair consists of removing the gunwale, aligning the hull parts and reinforcing the interior hull with Royalex<sup>®</sup> repair resin and cloth. Cosmetic repair of the hull exterior is accomplished by slightly widening the crack and filling with repair resin.

### **I wrapped my canoe and it has several tears on one side. Is it junk?**

Might be, but just about any kind of damage can be repaired if you've got the desire. If the damage is extensive, it will require substantial material and this will make the canoe heavier but it can be restored to full structural integrity. Where there's a will there's a way.

Check for "companion" damage to other side of the boat. This will often appear as a series of through-hull creases caused by the expansion or contraction of the hull side. You'll want to repair this damage as well.

### **It may sound strange, but I've punched a hole in my boat. Can it be repaired?**

Unless it's big the hole can be fixed pretty easily by taping a piece of cardboard with a piece of wax paper or plastic wrap on the outside of the hull and then building up the gap with layers of fiberglass cloth and Royalex<sup>®</sup> resin.

### **How can I get a deformed canoe back into shape?**

You may need to build a "jig" to reshape the canoe to its original form. This can be done with duct tape, cardboard, and wood as well as any other materials that come to mind if they'll do the trick. Be creative. If the damage is confined to one side of the boat, you can force out (or in) the damaged side by bracing temporary cross-members off the sound side of the boat. Run a line of rope or cord down the center of the boat from end to end and sight down the line to assist in making the boat as symmetrical side to side as possible.

Getting the two sides of the crack to align can be trickier. Any bracing or jig should be applied to the hull exterior since you'll be doing the repair primarily on the inside of the hull. Taping lengths of cardboard or thin bendable wood strips will often help the hull take its original "fair" curves or close to it. It can be challenging to conform the crack should it extend through the chines (where hull side transitions to bottom). Again, be creative. You can force a hull "out" by running a down

brace from a thwart or yoke ending with a plywood or foam pad against the hull. If a thwart or yoke is not in proper position, make a temporary cross member and wedge it under the gunwale to anchor your down brace.

If you're faced with bringing in part of the hull to conform, it's a bit more challenging. It may sound counterproductive but you can drill two small holes close to the crack and run a line through them and up around a thwart or yoke and tension the line to conform the hull. In most cases the drilled holes will ultimately be covered by repair material so no further damage has really been done.

### **I installed some whitewater outfitting in my boat, and later noticed that the hull is kind of spongy under the knee pads. What's up?**

Probably what's happened is due to the adhesive or the amount of adhesive you used. Contact cement in particular emits styrene as it cures and if too much adhesive was used or the adhesive wasn't allowed to "flash off" before the outfitting was installed, the styrene will migrate into the hull where it can soften the ABS layers and break down the foam. The result is a soft wrinkled area in the hull. This should be repaired as it is a weak point and can be the starting point for more excessive damage.

Repair will involve removing the softened material and replacing it with successive layers of fiberglass cloth and repair resin.

This is an entirely avoidable type of damage. Proper selection and use of your adhesive will prevent its occurrence. Contact cement is commonly used as its simple to use, inexpensive, and it works. Use as little adhesive as possible, just enough to "skin" or cover the two surfaces to be bonded. Most adhesive damage comes from using excessive adhesive.

## **Gel-Coat Q&A**

### **What is a gel-coat and what is it for?**

Gel-coat is basically a relatively thick layer of resin with colorant added. In the manufacturing process it is the first layer of the hull, sprayed against the inner surface of mold. Its smooth shiny finish is an indicator of the mold finish. Any mold imperfections would be reflected in the gel-coat as well. Functionally, it serves as a protective finish to the structural portion of the hull's composite lay-up, particularly against abrasion. The gel-coat also provides a barrier to moisture penetration into the weave of the hull lay-up.

### **Is there anything special about the resin used for gel-coats?**

Yes, the resin is formulated specifically for this purpose. It tends to have a high elastic capacity and is engineered to provide superior strength without an inherent cloth structure as well as exceptional abrasion resistance.

### **What is a skin-coat?**

Skin-coat boats are boats made without a true gelcoat. There is a layer of resin applied to the mold surface and the hull is laid up directly on that layer of resin. This construction is performed

generally only when minimum weight is the goal such as for marathon and triathlon racers. These boats are usually much better taken care of than most recreational boats nor are they exposed to hazards as freely. Skin coated boats are lighter than gel-coated ones but are also more subject to porosity which can allow moisture to penetrate into the structural lay-up and cause deterioration.

### **Are clear-coated boats skin-coated?**

No. you can obtain clear-coat as a gel-coat. The same resin mix used in a gel-coat is used but no coloring has been added. This will lighten the boat a little as pigment does add weight. The disadvantage is discoloration of the lay-up fabric upon sustained exposure to UV light.

### **Why does my canoe seem to show every scratch?**

Every paddler knows scratches are inevitable and regardless of the color of the gel-coat, all scratches show up as white. This makes them very evident. Some paddlers will go so far as to select a white or sand colored hull to minimize this effect.

### **Are the scratches something to be concerned with?**

Not as long as they remain strictly a cosmetic issue. When scratches are deep enough to reveal the internal cloth's weave, it is time to take corrective steps.

### **Why does the gel-coat chip on the stems of my boat?**

Two reasons. The biggest is that this is the most likely place for the boat to sustain an impact. Additionally, the gel-coat is thickest as it wraps around the stem of the boat. This does weaken the bond between the gel-coat and the structural layers and when subjected to a sharp impact can be chipped away. Be thankful, for this is actually the gel-coat doing its job. Often the damage will be limited to the loss of a small piece of gel-coat with the underlying lay-up escaping any damage,

### **Is gel-coat difficult to repair?**

No. It takes some patience and some thoroughness to generate the best possible finish but that's pretty much up to you. Basically, you'll be filling a scratch, gouge chip, or hole with new additional gel-coat and then sanding and polishing to fair it in and bring up the shine. Deep scratches, holes, or chips may require multiple applications of gel-coat but this is not really a time consuming procedure.

### **Is the repair hazardous?**

Not if you wear the gloves provided and use safety glasses and a NIOSH certified respirator for Dust and Mists. Its best done outside and on a day with temperatures between 68-75°F for sufficient working time.

# Gunwale Q&A

**I'm considering purchasing a new canoe and see that you can get a canoe with wood, aluminum, or vinyl gunwales. Which is best?**

It depends on your priorities. Each system has its disadvantages and advantages. Wooden gunwales offer aesthetics, moderate weight, good balance between flex and stiffness (particularly for Royalex™ hulls), require the most upkeep and maintenance, and are more expensive. Aluminum are the stiffest and lightest but are lacking in aesthetics, and can crimp rather than flex. Vinyl gunwale systems (with or without aluminum inserts) are the heaviest, require the least upkeep, and are the easiest to replace if damaged.

**Why does Mad River use ash for gunwales instead of spruce or mahogany or other woods?**

Let's talk about the alternatives first. We don't use mahogany because it's a rain forest hardwood in decreasing supply. Before 1991 we used mahogany in deck plates but replaced it with butternut as the impact of the depletion and exploitation of tropical hardwoods became clear. Beyond the "political" implications, mahogany tends to be a short grained wood that is subject to cracking and splitting if stressed. It's also heavier than ash.

Spruce does have the advantage of lighter weight than ash but it's not as strong nor as flexible. Additionally, it is not as resistant to weathering as ash. Spruce is a soft wood and does not offer the strength and integrity of a hard wood. It's easily dented when bumped and will fracture if significantly distorted.

On the other hand, most hardwoods are too stiff to bend easily. Their grain structure is too dense to allow the wood to follow the hull contours of a canoe without being steamed or otherwise manipulated. For the most part, hardwoods also tend to be heavy as well. Maple or oak would make a right tough gunwale system except it'd probably add 10 or 15% to the canoe weight and wouldn't flex well if canoe was wrapped.

You could say that ash is a soft hardwood. Its characteristics kind of fall between soft and hard woods. It's a limber hardwood, capable of being bent to a canoe without requiring steaming or being prebent. While it's heavier than spruce or cedar or other softwoods, it is nowhere near as heavy as hardwoods such as maple or oak. Ash also has the advantage of being comparatively readily available as ash is a northeastern hardwood and quality ash is relatively convenient to our Vermont production facility.

Ash is a hardwood which translates to superior resistance to weathering compared to softwoods. It also tends to have a long straight grain structure which lends strength and more importantly, the ability to flex and bend without fracturing. In our archives, we have numerous testimonies from paddlers marveling at how the ash gunwales on their canoes remained intact even when their boat was caught in an end to end wrap or pin. This resilience is a trademark characteristic of ash and is a capability that often makes ash the gunwale system of choice for wilderness paddlers venturing hundreds of miles and multiple weeks from home or help. Ash is just about the only gunwale material, natural or synthetic, that can stand such severe distortion without fracturing or cracking.

**What are the disadvantages of ash?**

Foremost is probably the fact that it is not as rot or weather resistant as other hard woods. Left unprotected, ash will deteriorate and rot fairly quickly. It does require periodic treatment to preserve its integrity and elasticity.

Compared to a wood such as spruce or a synthetic rail system such as aluminum, ash is heavier. It's up to you to figure out which feature is more desirable-- weight savings or flexible strength.

### **Why are gunwales oiled instead of varnished?**

Canoe gunwales are subject to incessant flexing as the boat is handled and paddled. A certain amount of flex occurs every time you take a stroke. It's also inevitable that a gunwale will be bumped or scraped.

Varnish is great for use on static pieces of wood like furniture. It is a surface protectant that provides a barrier coat against the elements. Canoe-wise, you'll find varnish used to coat seat frames, yokes, and thwarts. These pieces are very static and rigid and not subject to flex. Flex causes problems for varnish as varnish is not very dynamic or giving. Repeated flex will create a series of minute stress cracks in a varnish coat. Bumps and scrapes will also crack or abrade the varnish top coat. Once that surface coat is cracked, water can creep underneath and affect the wood. This is evident by the gray discoloration that shows up on worn varnish coated products. Take a look at the edges of a used wooden canoe paddle and you'll see signs of water penetration via surface cracks or dings in the varnish.

Oil on the other hand is a penetrating finish that in effect is soaked up by the wood and then hardens to preserve the wood. As such, it is far better suited for use on canoe gunwales. As the oil has penetrated the wood, a bump or scrape doesn't remove the finish either.

The disadvantage to oil finishes is that they need to be periodically touched up and replenished.

### **Just how much maintenance do wood gunwales require?**

It's really not that demanding, especially if you start taking care of them right away. Generally, you need to re-oil them at least twice a year, preferably three or four times, especially if your canoe is stored outdoors.

What is the recommended method of treating and protecting ash gunwales?

Basically, the periodic replenishment of protective oil is all that is involved. The frequency of application depends on the frequency and type of usage your canoe experiences, the means in which it is stored, and even where you live. If your boat is used regularly and lives outdoors, you should anticipate treating the gunwales a minimum of three times a year, preferably four. If you live in a humid warm climate, you can expect to treat your gunwales more frequently than if you live in an arid area.

Regardless of where you are, the procedure remains much the same:

1. Clean your gunwales to remove any dried on debris or residue. Often a quick wipe down with a clean rag will do.
2. If your rails are badly soiled or you want to do a more thorough job, lightly sand the gunwales with 100 grit sandpaper. This will remove surface scum and will open the wood's surface pores to readily absorb the oil finish. Don't forget to treat the underside of the gunwales. If you're going to

sand the gunwales, it is recommended to run a length of masking tape on the hull below each side of gunwale to protect hull finish from abrasion by the sandpaper.

3. Using a brush or soft rag, wet the gunwales with Gunwale Guard™ or your choice of oil. Don't forget to coat the underside of the rails and to get under the decks. If your boat has a deck fixed to the top of the gunwales by screws, take the time to remove the deck and treat the rails underneath. Due to the canoe's shape, this area tends to collect and hold water more than anywhere else.

4. Let sit about 5 minutes and then wipe off excess.

That's really all there is to a basic maintenance program. If you want to restore your gunwales to showroom condition you can:

5. Using 220 grit sandpaper, wet sand the rail surface before removing the excess oil. Make sure the sandpaper stays wet as you sand. After waiting a few minutes, wipe off excess and buff with soft cloth.

All in all, a preventative rail treatment shouldn't take more than an hour at a time which really isn't too much of a commitment, is it?

**The ash gunwales on my canoe are all gray and rough, not the light blond they were when I brought my canoe home. What should I do to restore their original color?**

Gray shows the natural weathering of ash from exposure to moisture and to sunlight. To remove the gray you can sand the rails, clean them with a cleanser such as GB-60, or in worst case, use a diluted solution of household bleach in water. Sanding is the longest lasting remedy and will also remove the roughened surface.

**I know you can get "stained" rails as an option. Is there any functional advantage of this treatment?**

Not really, it's mostly a cosmetic choice. A dark stain, such as the walnut used by Mad River, will hide the graying of the rail to some degree but the same process is going on and the result is that you will still need to preserve your gunwales.

As the walnut is basically a stain, it is recommended that you finish your rails with a protective oil such as Natural Gunwale Guard as the last step in your rail treatment. This will not only provide maximum protection for your gunwales but will also protect the stain as well.

**Most of my gunwales are in okay condition but the ends of the rails are starting to get rough or split. What should I do?**

The very ends of the gunwales are the most prone to weathering. In the first place, the ends are the most open grain on the gunwales, providing the least resistance to water penetration. Additionally, when you turn your boat upside down water follows the natural curvature of the gunwales towards the ends, providing more exposure and more opportunity for the gunwale end to absorb water. Any time the canoe is inverted on the ground, the gunwale ends also come into contact with soil and dirt which can be caught in or around the end of the rails. Dirt holds moisture, thereby again increasing the likelihood of extended exposure to moisture.

First thing to do is to pay special attention to the rail ends when treating your rails. Go back and apply a second coat of protective oil to the ends. If the damage has been done but hasn't

progressed too far, sand the rail end to remove the damaged material until you reach sound wood. This may require loosening the endmost rail screws to allow the rail to separate from the hull to make sanding easier and more complete. Don't forget to treat the section of the rail against the hull while you have the opportunity.

If the damage is extensive enough to be beyond restoration, you may need to remove the damaged rail end and splice in a new one. Mad River does provide 4' splicing sections for "spot" repairs of damage. The cost is real reasonable and the procedure is not too involved.

### **I've got one cracked rail on the outside of my hull. Does this mean I have to replace the whole gunwale?**

Not by any means. Mad River offers 4' splicing sections for partial repair. Basically, you cut the existing rail at an angle on either side of the break, unscrew screws in that section, and remove. Cut the splicing section to fit, clamp in place, drill and screw and get back on the water.

### **Is there any difference to gunwales for Mad River Royalex® canoes compared to fiberglass or Kevlar®?**

Yes, there is. Gunwales for Royalex boats are flush sided and install in sandwich fashion with the top edge of the hull showing between the inside and outside gunwales. Gunwales for composite or laminate boats have a lip (or kerf) on the outside gunwale that caps the hull edge and butts against the inside rail.

### **Can you use gunwales cut for one material on the other?**

It is possible to use gunwales for Royalex canoes on composite boats as long as the sharp hull edge is sanded flush and smooth with the gunwale surface. You can't use composite rails on Royalex hulls as the Royalex hull is quite a bit thicker than a composite hull and the kerf will not reach the edge of the inside gunwale.

### **What's involved with replacing my wood gunwales?**

All in all, it's not too bad a process. In simple terms, you remove the existing gunwales (save the hardware), clamp new rails in place, trim to fit, and drill and screw them to attach them to the hull. There's no steaming or prebending necessary.

The most important part is making sure you've got the right gunwales and parts to start with. When ordering or buying gunwales, you need to buy gunwales that are longer than your canoe to compensate for the fact that the gunwales take a curved route from end to end rather than straight down the middle. Be aware that each gunwale actually consists of two rails, the inside (inwale) and outside (outwale). Thus, you will need 4 pieces to perform a complete gunwale replacement. Make sure you also know what material your boat hull is made of to be sure you get the appropriate gunwale and gunwale screws. If you have a fitted deck, you'll most likely need to obtain replacement decks as well. If your boat has a "capped" deck you're probably spared that problem. Last, while MRC's stainless steel hardware is tough stuff and corrosion resistant to boot and most can be reused, it's wise to obtain some spares just in case. Gunwale screws are available in packs of 12 from your Mad River dealer.

As for tools, you'll need about a dozen clamps. C-clamps work fine but you'll find a couple of spring or bar clamps helpful when first positioning the new gunwales. You'll also need a phillips screwdriver, (a reversible variable speed drill with phillips head bit makes a lot of sense too),



measure, marker, a drill with several drill bits, saw, a couple of wrenches, rubber mallet, and some glue if you're replacing your decks.

Probably the trickiest part of the procedure comes when you get to the ends of the canoe, particularly if your boat has fitted decks. Fitting new decks isn't terribly difficult, it just takes a bit more time and measuring. Complete instructions are available [here](#) on this website. If you're moderately handy with tools, the complete job can be done in a day.

**If my fitted decks are still good is there any way I can keep them intact when replacing the rest of the gunwale system?**

Yes, you can splice the rails behind the decks using the technique described in installing splicing sections.

**I've got damage to one side, the other's fine. Do I need to replace both or can I just do the side that's bad?**

You can replace one side if desired but be prepared for something of a mismatch cosmetically. Most likely you'll also end up short splicing the new rail to preserve the existing decks.

**My canoe has squared gunwales while I see the new boats have rounded rails. Can I get square rails still?**

Nope. In 1985 Mad River switched to rounded rails and square rails are not available. Rounded rails will work just fine in replacing square gunwales.

**Can I get replacement mahogany decks for my older boat?**

All decks are now made of butternut. Just as with replacing squared rails with rounded ones, butternut decks will work fine. Even if your canoe design is no longer in production deck blanks are available that can be used with minor reshaping required.

**What is involved with replacing aluminum gunwales?**

The procedure is pretty much the same as working with wooden gunwales. Instead of removing screws, you'll need to drill out the rail rivets and you'll need a rivet gun to install new rivets. It is essential to order gunwales specifically for your model of canoe so that they can be pre-bent for your hull at the factory. It is very difficult to bend rails properly in a home workshop. Not only does the rail assume a curved shape end to end but the ends of the canoe are higher than the center so the rail must also accommodate this curve. Canoe hulls are not strong enough to leverage the rail into the curve by sliding the gunwale onto the canoe and bending as you go.

Straight aluminum rails are available if you're working with an obsolete model or custom application but will require the development of a jig to provide for pre-bending on site.

What about vinyl rails?

Vinyl rails are pretty simple to install. Like aluminum rails, you'll need to drill out the rivets but the vinyl gunwales are flexible enough to tolerate being bent into place as you go. It's important that you make sure the rails are completely settled in contact with top of hull before you drill and rivet new rails in place.

**Can I put wood gunwales on synthetic railed canoe? Or vice versa?**

Certainly, but anticipate what's needed as far as fitting decks, seats, yokes, and thwarts. Generally, wooden and vinyl gunwales are compatible as far as hanging seats and crossmembers but aluminum rails require different attachment systems.

**Will Mad River gunwales work on other manufacturers' boats?**

Wooden gunwales will work fine. You do need to obtain proper length and pay attention to the hull material and order appropriate gunwales. Aluminum gunwales can be trickier due to variations in hull laminations between different manufacturers. It's probably best to stay with the original manufacturer for these gunwales. Vinyl gunwales are more universal and if used on Royalex™ or polyethylene hulls, the hulls can be shaved if need be.

**I also need to replace my seats and yokes and thwarts. What should I anticipate?**

Replacement seats and cross members are sold "uncut" to avoid confusion with all the different models of canoes and changes to models over the years. Measure your existing parts and order the size seat(s) or cross member(s) longer than needed. Use old parts as templates to cut the new ones and to locate holes to be drilled for hardware. Remember to coat the newly exposed wood surfaces where cut with varnish for protection before installation.

**Can I replace just the cane part of my seats?**

Yes, you can. Cane panels and splines are available from different sources. However, once paddlers realize how little a price difference there is between a complete new seat and the cane components and just how time consuming removing and installing new cane is, the majority choose to replace the entire seat.

**Can I order replacement gunwales direct from the factory?**

No. You need to order through your local [dealer](#). Gunwales are too long to ship UPS and require transport via common carrier (truck). One way this can be avoided is to order gunwales for shipment with canoes coming to your dealer.

**My canoe needs new gunwales but I don't have the time or I don't think I can handle the job. Can I get the work done professionally?**

Yes. A lot of dealers will perform this job. Either contact your local dealer to see if they perform this service. Another option is to bring or ship the canoe back to the Mad River factory.

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## Suggested Canoe Repair Centers

Here are some of the Mad River dealers who offer extensive repair services for canoe owners.

<b>New England</b>		
The Boat House	NY	518-393-5711
Umiak Outfitters	VT	802-253-2317
Moor and Mountain	MA	978-475-3665
Vermont Pack and Paddle	VT	802-496-7225
<b>Mid Atlantic</b>		
The Jersey Paddler	NJ	732-458-5777
Tussey Mountain	PA	814-355-5690
Wind & Water Boatworks	PA	724-586-2030
<b>Rocky Mountains</b>		
The Mountain Shop	CO	970-493-5720
White Water West	CO	970-241-0441
<b>Midwest</b>		
Rutabaga	WI	800-I-PADDLE
Northwest Canoe Company	MN	651-229-0192
Chicagoland Canoe Base	IL	773-777-1489
Spring Creek Outfitters	MN	218-735-8719
Whitewater Specialty	WI	715-882-5400
Canoe Sport	MI	734-996-1393
The Benchmark	MI	248-477-8116
<b>Southeast</b>		
Pier 17 Marine	FL	904-387-4669
Go with the Flow	GA	770-992-3200
Nantahala Outdoor Center	NC	828-488-2175
Canoe Shop	FL	850-576-5335
Pro Canoe	NC	336-294-3918
Pack Rat	AR	501-521-9135
Different Strokes	AR	501-758-4716
Mountain Sports	TX	830-238-4400
Chocolocco Canoe & Kayak	AL	256-835-9199
<b>Northwest</b>		
Idaho River Sports	ID	208-336-4844
Pacific Water Sports	WA	206-246-9385
Alder Creek Canoe and Kayak	OR	503-285-0464
Oregon Canoe Sport	OR	503-361-7824
REI - Seattle Flagship	WA	206-223-1944
Northern Lights Trading	MT	406-586-2225
<b>Southwest</b>		
California Canoe & Kayak	CA	510-893-7833

## **Limited Lifetime Warranty**

At Mad River Canoe we work hard to build the best canoes in the world. Each canoe is built by hand, coupling exhaustive research and design with the finest materials and superior craftsmanship. Our canoes are warranted against material or manufacturing defects for the lifetime of the canoe. If you ever have a problem with one of our canoes, contact the authorized Mad River Canoe dealer nearest you.

## **Limitations**

This warranty is limited as follows:

- a) The warranty is valid to any original consumer purchaser of a first quality Mad River Canoe from an authorized Mad River Canoe dealer, and is not transferable;
- b) Mad River Canoes sold as BLEMs or cosmetic seconds are not warranted against cosmetic defects, but otherwise will carry the full Mad River Canoe warranty;
- c) Canoes sold "AS IS" will not be covered under this warranty;
- d) This warranty does not apply to damage sustained by accident, neglect, improper use or handling, or normal wear and tear. Canoes that have been structurally altered will not be covered;
- e) In the unlikely event of a potential warranty problem, the consumer will be responsible for transporting the canoe to and from their nearest authorized Mad River Canoe dealer.

This warranty is in lieu of all other warranties, expressed or implied, with regard to the products of Mad River Canoe, Inc. In some states the above limitation may not apply.

We will not be responsible for any incidental or consequential damages resulting from any defects. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

This warranty gives you specific legal rights, and you may also have other rights that vary from state to state.

## **Warranty Exclusion**

Our warranty does not apply to damage sustained by accident, neglect or improper use or handling, or towing, nor to damage caused by the elements, or normal wear and tear. We do not warrant canoes labeled "AS IS." We do not warrant canoes which are used commercially or which are structurally altered.

## **How to Secure Warranty Service**

To make a claim, contact your local authorized Mad River Canoe dealer. All claims must be processed through a Mad River Canoe dealer. If upon inspection the dealer and Mad River Canoe determine that it is a valid warranty claim, we will either repair or replace your canoe at Mad River Canoe's option.

The owner will be responsible for transporting the canoe to and from their nearest authorized Mad River Canoe dealer, and any costs involved therein.

In its continuing product improvement policy, Mad River Canoe reserves the right to alter specifications without prior notification and without incurring any obligation to incorporate such changes in units already completed or sold.

## **Important information about Royalex canoes**

### **What are "cold cracks"?**

Royalex ® is a thermoformed composite material consisting of vinyl outer layers, interior ABS plastic layers and a foam core. It is an extremely durable material, capable of absorbing impacts and significant deflection without permanent damage.

However, it as, as are most plastic materials, sensitive to temperature. Simply put, Royalex will contract when exposed to cold temperatures. This material property is what results in what are termed "cold cracks." Cold cracks are fractures of the material usually running perpendicular to the keel line of the canoe and terminating at the gunwale line. A canoe can experience a single cold crack or show a series of roughly parallel cracks over a portion of the hull. The majority of cold cracks occur towards the ends of the canoe.

Cold cracks result when the hull contracts in opposition to the gunwales remaining stable. As the hull contracts in opposition to the unchanging gunwales, stress eventually builds up that results in a sheer tear in the hull material, usually aligned with a fastener used to secure gunwale to hull.

### **How common are cold cracks?**

Cold cracked hulls are actually quite rare (well less than .5% of Royalex hulls in existence) contrary to the amount of press and attention the problem receives amongst the paddling community. There are literally thousands of Royalex canoes that successfully winter over year after year in the northern United States and Canada without any problem. Some years the numbers are worse than others but a "bad" year, such as the winter of 2002-03 still only results in reports of 20-25 canoes suffering cold cracks. Most years we get reports of no more than 10.

### **At what temperature do cold cracks occur?**

We know why the problem occurs, the bigger issue is there is no absolute way to predict when a hull will crack. There's no such thing as a predictable threshold of 10o or 15o that will result in a cold crack. Nor can we specify that X temperature for X number of days will create a cold crack.

We've had times when we've received reports of hulls cracking as far south as North Carolina while at the same time not hearing of any problems in Ontario or Maine. We've also heard of one person finding his boat cold-cracked while his neighbor, who stored his boat in a very similar manner did not have the problem. This is one of the most frustrating aspects of this issue, there's seemingly no rhyme or reason to it.

Over the years, we have gathered enough history to determine that a rapid temperature drop over a short period of time can result in cold cracks. If any conditions could be said to be cold crack

conducive this would be it. However, there's no formula that specifies X degrees within an hour or a drop from X temperature to X temperature that will generate cold cracks.

## **Are certain types of gunwales more prone to cold cracking than others?**

Yes, wood gunwaled canoes are most prone to cold cracking. This is due to any moisture contained in the wood rail will expand as it freezes, resulting in a gunwale that is actually expanding while the hull is contracting.

Synthetic gunwales are less prone than wood but it is certainly not unheard of for a canoe with aluminum gunwales to cold crack, particularly if a rapid drop in temperatures occurs. Cold cracks are least frequent in canoes with vinyl gunwales as the shrinkage coefficient of the gunwale is consistent with that of Royalex. However, most vinyl gunwales have an aluminum insert to provide the necessary stiffness for paddling and in most cases, the gunwale is affixed to the hull via screws or rivets driven through the aluminum insert. Thus, it's certainly not impossible to find a vinyl railed canoe with a cold crack.

## **How can I prevent cold cracks?**

Honestly, it's almost impossible to entirely prevent them (short of storing your canoe in a heated area) primarily because the conditions at which they occur are so unpredictable. It is also possible that the older the canoe, the more prone to cold cracking it becomes as plastic becomes more brittle and less elastic over time.

Fortunately, there are ways you can minimize the likelihood of cold cracks. These range from storing your boat in a heated space to removing or loosening some of the fasteners in the gunwale. Here's what we recommend:

### **Canoes with Wooden Gunwales**

1. Keep gunwales well oiled. A properly oiled gunwale will absorb minimal moisture and is more flexible and pliable and better able to work with changes in hull. The majority of cold cracks we see are on boats where the gunwales have not been properly maintained.
2. Remove screws from gunwales from each stem for 2'. Back screws out with Phillips head screwdriver. You can leave screws in outwale if preferred, so long as gunwale and hull move independently.
3. Lift up on inwales and deck and insert a ¼" thick wedge between gunwales and hull so that gunwales are lifted above sheer line of canoe. This will allow end of canoe to contract if temperatures dictate.
4. Loosen screws on next 2' of gunwales so that there is some play between hull and gunwales.

Avoid moving or hitting canoe when temperatures are below 20o F. Like most plastics, Royalex becomes more brittle when cold.

### **Canoes with riveted Aluminum Gunwales**

With canoes with gunwales attached with rivets, there's not much to be done. If a strong cold front is predicted with significant and rapid temperature drop anticipated, you might be wise to throw a couple of mover's style blanket pads over canoe to slow down rate of temperature decrease.

## Canoes with square drive fasteners (such as IQ Gunwale system)

1. Remove decks by releasing bolt in each side of deck.
2. Slide cover sleeve on outwale to reveal fasteners for 2' from each end of canoe.
3. Remove screws from end of canoe for 2' towards center.
4. Lift up on interior gunwales and slide ¼" thick wedge between gunwale and sheer line of hull to elevate gunwales above top of hull.

## Are cold cracks covered under warranty?

No. Cold cracks are caused by subjecting the hull material to stress beyond its design limitations and are thus excluded from warranty coverage.

## The Hull Truth

The shape of a canoe hull defines its performance characteristics, and each hull is a subtle blending of individual design elements. The hull design begins as a concept, and each of those design elements is carefully evaluated and then artistically blended back into the whole, becoming a wood-strip prototype that can be paddled and tested. Although each design is different, our goal remains the same: to ensure that each of our designs, regardless of its final use, is the most versatile it can be.

## Elements of Hull Design

The overall performance of a canoe is most affected by the length and width of its hull. The length is the primary factor in determining potential speed. Given two canoes of different lengths but otherwise identical specifications, the longer canoe will be faster (and easier to paddle over distance), while the shorter canoe will be easier to turn. Width is a primary factor in determining stability: a wider canoe will be more stable. Here are the other major design factors:

## Cross-Section Shapes

These cross-section views are outlines of a hull as if the canoe were sliced in two at its widest point. It provides a sense of how the canoe will handle in terms of stability by giving the best look at what's going on below the waterline.

### [ Shallow V ]

The shallow-V is a Mad River Canoe trademark. It offers an outstanding combination of tracking, maneuverability, and seaworthiness—ideal in an all-around canoe. The concept is simple: Canoes that are underway on two opposing planes are more stable. It's like the wings of a soaring bird. The V-shape is not at its most stable when at rest, but in moving water or heavy waves, it settles into its slot. The old Viking ships were V-hulled. This is the most versatile canoe design, and one of the most emulated. We use the Shallow-V in such classic designs as the Explorer, Revelation, and Destiny.



## [ Broad Shallow Arch ]

The almost flat bottom of a broad shallow-arch offers exceptional stability, maneuverability, and reasonable forward speed. This is the most stable shape and we use it in beginner-friendly boats such as the Tahoe and Tahoe 16.



## [ Round V ]

In this design, the V-shaped ends blend into an arch in the center. This allows the hull to sideslip quickly and spin on a dime, while still providing the tracking required for "must make" ferries. This is the best shape for whitewater and you'll see it in the Guide and our Outrages.

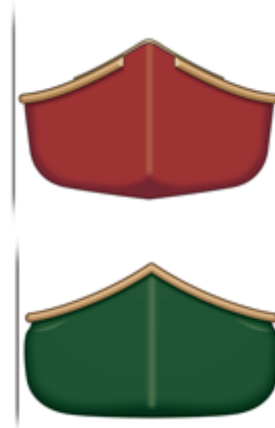


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## Above the Waterline

### [ Flare and Tumblehome ]

The "side" of a canoe can curve in toward the center as it rises from the waterline, or it can curve out. Flare curves out, and it can be very helpful at the bow and stern, where it makes for a drier ride. Tumblehome curves in, allowing a more vertical and efficient paddle stroke. Many Mad River canoes use flare in the bow and stern for a dry ride and tumblehome in the center for efficient paddling.



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## Rocker

When viewed from the side, "rocker" is the amount of curve in the hull, much like the rocker in a rocking chair. Rocker plays a key role in a canoe's maneuverability, determining in large part how it will turn.

### [ No Rocker ]

A canoe with no rocker, is built for covering long distances in a straight line. The full length of the hull is in the water, so it tracks well and has good speed. The Horizon is a good example of that.



### [ Slight and Moderate Rocker ]

As the rocker increases, so does the ease of turning. The trick is to design a boat that



turns and tracks. The Explorer and Malecite, for example, have slight rocker, which (when combined with their Shallow-V hulls) provides the balance of tracking and turning. A longer hull with moderate rocker, like the Revelation, also has that balance.



### [ Pronounced Rocker ]

Pronounced rocker is the realm of whitewater boats, where turning rules. That's why the Outrage and Outrage X pivot with ease and spin on a dime.

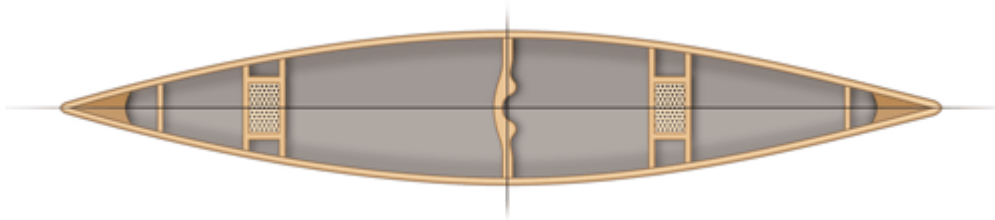


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## Hull Symmetry

### [ Symmetrical Hull ]

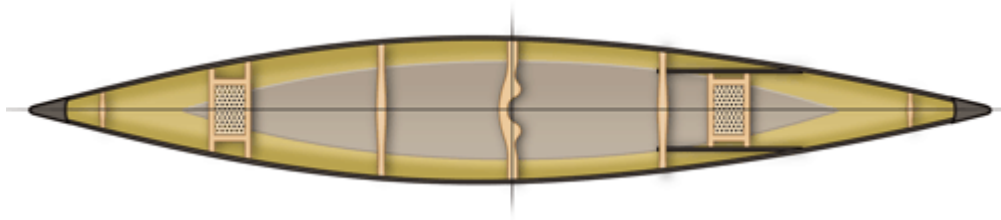
When viewed from above, a symmetrical hull has its widest point at the center of the hull and basically identical forward and aft sections. Symmetrical hulls are predictable, seaworthy, and versatile—it's a classic practice for solo paddlers to paddle tandem canoes backwards, sitting in the bow seat facing "backwards." It's another reason the Explorer is one of the most versatile canoes you can own.



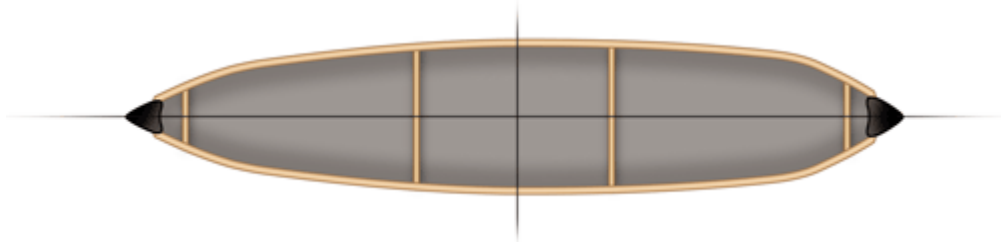
### [ Asymmetrical Hull ]

These designs feature different forward and aft sections: Swede-form has the widest section aft of centerline, creating a longer bow and producing enhanced forward speed

and tracking. It is often used on touring canoes, such as the Horizon.



Fish-form has the widest section forward of the centerline, producing a buoyant bow, ideal for paddling upstream and rising over large waves. It is common in whitewater canoes, such as the Outrage.



## The Hidden Features

We pride ourselves on building exceptional canoes but many of the features we incorporate in each canoe are hidden...

### Gunwales

Since these form the frame that supports the hull, they must be stiff, strong and weather resistant. We use three different gunwale systems, and most canoes are available in two gunwale trims:

#### [ Northern Vermont White Ash Gunwales ]

Each pair of inwales and outwales is grain-matched, numbered, dipped in Gunwale Guard (our specially-formulated, deep-penetrating, anti-fungal wood finish), and air-dried. Every gunwale is cut by hand to use the best grain—no knots, swirls, or short grain across the gunwales—increasing flexibility for top performance and long life. This is our strongest gunwale system, and is the easiest to repair in the field. Wood gunwales require more maintenance and special storage in cold climates when mounted to Royalex canoes.

#### [ Vinyl Gunwales ]

An extruded vinyl sheath with 6063-T5 aluminum inserts, these gunwales rival wood for

strength and require no special care or maintenance. They are very durable but are not as easy to repair in the field as wood.

## **[ Powder-coated Aluminum Gunwales ]**

Lightweight and low maintenance, these are intended for lighter weight, quiet water canoes.

## **Hardware**

All hardware used by Mad River Canoe—bolts, machine screws, and gunwale screws—is stainless steel, which offers superior strength and corrosion resistance. (On vinyl and aluminum gunwales, we use anodized aluminum rivets, colored to match the gunwales.)

## **[ Seats, Thwarts and Yokes ]**

Hardwood seat trusses complement the canoe's good looks while providing structural rigidity. Native New England butternut is used in the two-piece hardwood decks with a finger joint that is stronger than the wood itself—without using rain forest products. Standard hand-crafted ash-framed seats with cane inserts are cool, quick drying, comfortable and quite handsome; contoured cane seats are optional. (Optional web seats provide maintenance-free durability and unsurpassed strength.) Every canoe is hand-balanced prior to the installation of our standard ash yoke to enhance portaging comfort.

## **Construction**

All of our boats, regardless of construction technique, feature extra reinforcing in critical areas. In our Royalex® canoes, the bow, stern, center section, and keel line are reinforced for unmatched durability and stiffness. In our composite canoes, specially engineered resins maximize durability and stiffness, while extra layers of fabric and graphite reinforce critical wear and impact areas. Optional integral Kevlar® skid plates with graphite filled resin increase durability without compromising paddling efficiency or appearance.

## **Warranty**

Every Mad River Canoe undergoes an exhaustive multi-step quality assurance process during manufacturing; only after passing this test does the completed boat receive its Confident Rabbit logo, Mad River Canoe name, and signed Quality Assurance card. And, of course, there's our Lifetime Warranty. We proudly stand behind our products.

Although many of these components are hidden from your view, they all reflect our commitment to building the best canoes with the best materials. When combined with our innovative designs and state-of-the-art manufacturing techniques, it's easy to see why we say that excellence by design is no accident. It's our way of life.

## **Hull Materials**

No other manufacturer can match Mad River's ability to craft high-tech materials into timeless designs with outstanding performance. Each of our construction techniques has unique advantages, and the simplest way to approach the complex question of

selecting the right material is to determine where or how you will paddle. There are other factors to consider, such as weight and price, but being honest with yourself about where and how you paddle is the best place to start. Rest assured that whichever Mad River Canoe you buy, you're buying the best.

## **Roto-molded Polyethylene (R Series)**

Mad River introduced this new level of quality and affordability to canoeing in 2000. In our TripleTough™ construction, polyethylene powders are precisely loaded into computer controlled rotational-molding ovens. The powders are melted within the mold and oven rotations are timed and measured by sophisticated computer-driven programs to place just the right amount of materials and reinforcement where they are needed. The result is a three-layered skin-foam-skin hull that's tough, recyclable and impact-resistant.

Usage: Day cruising, sporting, quiet water touring, river touring.

Advantages: Affordable, stiff, strong, impact resistant.

Bottom Line: True canoe performance, most affordable Mad River Canoe material.

### **Construction**

A three layer rotomolded construction consisting of:

- Inner and outer layers of high density linear polyethylene for durability and impact resistance.
- Sealed closed-cell foam inner core layer for stiffness and flotation.
- Variations in mold surface temperature increase hull thickness in high impact areas.

### **Advantages**

- Perfect entry level recreation boat - inexpensive, safe and stable with lots of flotation.
- Very durable and long lasting.
- Very low maintenance.
- Less expensive than Royalex®.
- Quieter to paddle than aluminum.

## **Mad River versus the Competition**

- Advanced molding techniques put more material in the high impact areas and less in the low impact areas, resulting in a lighter and stiffer hull.
- Shallow V hull design enhances hull stiffness for improved paddling performance - it paddles like a Mad River, not a barge!
- Full length aluminum insert in gunwales for added torsional rigidity.
- Molded-in graphics won't peel or scratch off like decals.
- Webbed seats in solid ash frames are lighter and more attractive than rotomolded bucket seats.
- Environmentally friendlier manufacturing process than crosslinked polyethylene - no harmful formaldehyde gas emitted during molding.

## **Royalex® (RX)**

The gold standard for rugged all-around canoes. Royalex® sheets are custom-made in

a process that combines sheets of vinyl, ABS, and foam and then vulcanizes them together. The Royalex® sheet is then thermo-formed (with heat and vacuum) in a mold to create a hull with outstanding strength, internal flotation and a tough and slippery vinyl skin. It's lighter than roto-molded polyethylene, far quieter and "warmer" than aluminum, and virtually maintenance free. Each canoe's sheet construction is different; the exact placement of reinforcing ABS and foam reflects the requirements of that model. Certain models intended for quiet-water use a lighter weight sheet for easier portaging. Note: Our Royalex® is not the same as other canoe manufacturers'. You may notice that our canoes tend to be a little heavier than the competition, because we elect to place more reinforcing material into our Royalex® for a more durable canoe. That's one of the reasons we are able to offer our lifetime warranty to original purchasers.

Usage: All categories (may depend on construction--see model descriptions).

Advantages: Durable, quiet, comfortable, low maintenance, extremely tough, great value.

Bottom Line: For whitewater and demanding conditions, this is the material of choice. The lighter version is just as abrasion-resistant, quiet, and comfortable, but not as tough over time when used hard.

## **Construction**

## **Advantages**

A vulcanized sandwich construction consisting of:

- Pigmented vinyl inner and outer skin for UV protection and abrasion resistance
- ABS (Acrylonitrile butadiene styrene) substrate layers for impact resistance and stiffness
- ABS foam inner core for structural rigidity and flotation
- More durable and less maintenance than Kevlar® and fiberglass
- Lighter than polyethylene
- Quieter to paddle than aluminum
- Less expensive than Kevlar

## **Mad River versus the Competition**

- New state-of-the-art molding facility ensures consistent high quality — no weak spots from overheating or overstretching sheet during forming.
- Thicker substrate layers and more foam core increase durability and stiffness with little additional weight (see the difference by looking at hull thickness between wood gunwales).

## **K-Glass (KG)**

K-Glass is a hybrid laminate combining the tensile strength of Kevlar® and the rigidity of fiberglass: durable, extremely efficient and more affordable than all-Kevlar® construction. We modeled this on our proven Kevlar® Expedition lay-up and substituted select fiberglass internal layers to reduce cost without sacrificing performance. Features include Kevlar® and fiberglass keel line patches, a custom-formulated vinylester resin, full inner and outer layers of Kevlar® and Kevlar® reinforcing in critical wear areas. There is more Kevlar® in a Mad River Canoe KG construction than most of our competitors "all" Kevlar® canoes.

Usage: Quiet Water Touring, Day Cruising, Sporting, and Moving Water (mild).

Advantages: Finer entry and exit lines than Royalex®, much more durable and lighter than all-fiberglass construction; produces fast, rigid canoes with great response, stiffness and speed.

Bottom Line: Great construction and good value for canoes used mainly in quiet water.

## Construction

## Advantages

A handcrafted wet laminate consisting of:

- Outer surface of durable gel coat resin for abrasion resistance and UV protection.
  - Two full inner and outer layers of Kevlar cloth
  - Multiple layers of Kevlar reinforcing end patches in critical wear areas.
  - Kevlar and fiberglass keel line patches for added stiffness and durability.
- Lighter and more efficient to paddle than Royalex® or polyethylene.
  - Lighter and more durable than fiberglass
  - Less expensive than Kevlar with similar performance.
  - Intermediate price point between Royalex and Kevlar.

## Mad River versus the Competition

- More Kevlar® than any other hybrid construction.
- Full inner and outer layers of Kevlar provide greater tensile strength than fiberglass.
- Additional Kevlar reinforcing patches in all critical wear areas.
- Custom formulated vinylester resin provides better balance of stiffness and flexibility than polyester resin.
- Graphite tape and wound Kevlar fiber “rope” are laminated into the bow and stern of hull for greatest impact resistance on the market.
- Available with optional molded-in integral skid plate of carbon-impregnated Kevlar felt for enhanced durability and abrasion resistance.

## Kevlar® Expedition (KE)

### All Cloth

Our most durable composite. Using layers of Kevlar® we get a light, extraordinarily tough hull. We specify the weave and surface finish of our Kevlar® fabric and carefully match it to a proprietary vinylester resin for added resistance to impacts. Up to 11 layers of Kevlar® are used in our lay-ups. The gel coat outer surface adds protection and beauty.

## Airex™

In our large Kevlar® expedition canoes, we use an Airex™ foam core and ribs with the Kevlar®. This allows us to make an expedition-caliber canoe that is much lighter and stiffer than all-cloth construction. Airex™ has significantly better shear strength and impact resistance than other foam-core materials.

Usage: Day Cruising, Quiet Water Touring, River Touring, and Sporting

Advantages: Like K-Glass, Kevlar® Expedition produces much finer entry and exit lines than Royalex®, and it's far lighter than Royalex® and lighter and tougher than K-Glass, resulting in light, fast boats with great response and good stiffness.

Bottom Line: This is the perfect material—light and strong—for a canoe-touring hull.

### Construction

- Outer surface of durable gel coat resin for abrasion resistance and UV protection.
- Three full layers of Kevlar cloth.
- Multiple layers of Kevlar reinforcing end patches in critical wear areas.
- Multiple Kevlar keel line patches for added stiffness and durability.
- Multiple internal Kevlar belly layers for stiffness.
- Low elongation vinylester resin provides stiffness to balance Kevlar's flexibility.

### Advantages

- Much lighter and more efficient to paddle than Royalex® or polyethylene
- Lighter, more flexible, and more durable than fiberglass
- Best strength to weight ratio of all available materials
- The choice for expeditions!

### Mad River versus the Competition

- More Kevlar than any other all-Kevlar construction — up to 11 layers in high wear and impact areas!
- Additional Kevlar reinforcing patches in all critical wear areas.
- Custom formulated vinylester resin provides better balance of stiffness and flexibility than polyester resin.
- Graphite tape and wound Kevlar fiber “rope” are laminated into the bow and stern of hull for greatest impact resistance of any lightweight on the market.
- Available with optional molded-in integral skid plate of carbon-impregnated Kevlar felt for enhanced durability and abrasion resistance.

### Kevlar® Lite (KL)

This extremely lightweight construction features Airex™ foam reinforcement and a skin coat of pigmented resin, reducing hull weight by up to 20 percent when compared to Kevlar® Expedition. By using Airex™ and an S-glass outer layer, we are able to offer a superior construction, with better abrasion resistance and better impact tolerance than any other lightweight on the market.

Advantages: Our lightest hulls – extremely efficient and very stiff.

Bottom Line: The only choice if light weight matters above all else; best suited to deep water.

## Construction

A handcrafted vacuum-assisted laminate consisting of:

- Outer layer of S-glass fiberglass for better abrasion resistance.
- Two full layers and one belly layer of Kevlar® cloth.
- Multiple layers of Kevlar reinforcing patches in critical wear areas.
- Internal fiberglass layer for stiffness.
- Airex closed cell linear crosslinked foam core (and side ribs in longer models).
- High elongation vinylester resin.

## Advantages

- Stiffer and lighter than all — Kevlar® constructions
- Lighter and more durable than fiberglass
- Best strength to weight ratio of all available materials
- Easy to car-top and portage
- The ultimate in lightweight performance!

## Mad River versus the Competition

- S-glass outer layer is more abrasion resistant than Kevlar® outer layer in competitors lightweight fabrications.
- Airex foam core is more flexible than Divinacell or Clegicell linear cores used by other manufacturers — greater impact resistance.
- Additional Kevlar reinforcing patches in all critical wear areas.
- High elongation vinylester resin provides more flexibility to balance stiffness of foam core.
- Graphite tape and wound Kevlar fiber “rope” are laminated into the bow and stern of hull for greatest impact resistance of any lightweight on the market.
- Optional pigmented resin skin coat offers better UV resistance than clear coats.
- Available with optional molded-in integral skid plate of carbon-impregnated Kevlar felt for enhanced durability and abrasion resistance.