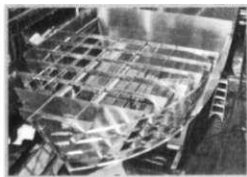


Third Edition

The Complete Guide to

METAL BOATS

BUILDING, MAINTENANCE, AND REPAIR



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BRUCE ROBERTS-GOODSON

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Preface to the Third Edition

It has given me much pleasure to have the opportunity to update the information for this third edition of my book, *The Complete Guide to Metal Boats*.

Metal boat building is under constant development and as designers we have the opportunity to take advantage of these improvements in materials and building techniques.

Even those of you who have read the previous editions of this book will find sufficient new information to make reading this third edition worthwhile.

I must again offer my sincere and grateful thanks to all of the builders of our designs who have contributed suggestions, building tips, and photos of their partially built and completed vessels. Seeing evidence of some of the many thousands of our boats out there makes our job so much more worthwhile.

Good boatbuilding!

Bruce Roberts-Goodson

www.bruceroberths.com

September 2005

Foreword

Who is this book written for? If you have an interest in metal boats, and perhaps a desire to own one, this book is for you. Building a metal boat from the ground up is a technically challenging project. I haven't attempted to cover every aspect of the subject—and I doubt any one book could. In particular, this book will not teach you how to weld. Those of you with experience of welding

and working with metal will have much to gain from my discussions of boat design and metal boat building techniques. In this regard, *Metal Boats* is intended to turn a welder into a boatbuilder.

On the other hand, you may come to metal boats with a solid background in boating and boat design but little experience of working with metal. If so, you may choose to subcontract out the weld-



This boat can be built from scratch as the Roberts 542 or from a precut kit as the Voyager 542. There are many examples of this design sailing in various parts of the world. (Full details available at www.bruce-roberts.com.)



The Euro 2300 version is a semidisplacement motor yacht (12-15 knots) and the Euro 2400 is a planing hull configuration (16-30 knots). The underwater shape of the hull together with the horsepower of the engines govern the performance and cruising speed that you can expect from this and other similar Euro Series Motor Yachts.

ing portions of the project. Many novice builders have attended evening classes in welding and become proficient enough to handle the easier welds and assist an expert brought in for the critical welds. You can learn a great deal by watching over an expert's shoulder.

Or you may plan to buy a used metal boat, or oversee the construction of a new one. In this case, my intention is to provide an overview of the whole process so you can make informed decisions.

One of the most frequently asked questions is, "Which metal should I use?" I have compared

the primary choices in some detail. Other major topics include choosing a suitable design, building from plans and precut kits, preventing corrosion, and selecting and installing an engine.

Finally, pride of ownership plays a big part in the pleasure of boating. I hope that by understanding the design and construction of your metal boat you will also deepen your enjoyment of it.

Good boatbuilding.

Bruce Roberts-Goodson
www.bruceroberths.com

Acknowledgments

My sincere thanks go to all those builders of metal boats in Europe, especially those in the Netherlands, who gave me such good advice when I needed it most, back in 1973. To Grahame Shannon, the developer of Auto Ship and other computer programs that have changed yacht design forever. To Max Pille, who provided me with additional information on things electrical. And to Del E Kahan, for his insights into the special requirements for electrical systems in metal boats.

To the many hundreds of builders of metal boats constructed from my plans who have sent photographs, asked intelligent questions, and offered valuable suggestions; these builders have made a great contribution to the development of our metal building techniques.

Special thanks are due to my wife, Gwenda, who has supported me in my work for over 30 years; as a very active first mate, she never hesitated to impose the woman's view when it came to designing items in which she was particularly interested. She certainly didn't restrict herself to the galley or other stereotyped areas of design.

My thanks to Andrew Slorach, my long-time partner and associate who is always ready to offer constructive advice; to George Love, my boat-building mentor, and to all those in the boating industry who, over the past 35 years, have helped me chart a course through the shoals that have claimed so many who have tried to turn a hobby into a business.



This Spray Trawler Yacht 52/58 has been built in steel and makes an excellent long-distance powerboat or motor sailer. (Steve Davis illustration)

Introduction

My first and later intense interest in metal boats came about almost by accident. By 1973, I was already established as a designer of custom fiberglass sailboats and powerboats, and fiberglass materials were inexpensive and readily available. Our building techniques were proven and widely accepted around the world; who needed any other building material? The oil embargo of the early 1970s changed all that.

Since our clients still wanted to build boats, we were forced to consider the options. Ferrocement was already thoroughly discredited as a boatbuilding material; wood-epoxy was established, but the materials were expensive and didn't have a wide enough appeal. By the process of elimination, we turned our attention to metal.

In 1973, there were relatively few designers and builders of metal pleasure boats apart from those in Europe, and especially in the Netherlands. Where to start? That was easy. The Dutch had been building metal, particularly steel, boats for a century, so I spent several weeks visiting many boatbuilding yards in the Netherlands. Fortunately I was able to study the building techniques and discuss construction methods with several established builders.

In Chapters 6, 16, and 17, you'll find a wide selection of designs for metal sailboats and powerboats. They range in size from 26 to 73 feet (7.9 to 22.2 m), and all are intended for amateur construction. Our first plan designed for steel construction was the Mauritius 43 sailboat. Over the following twenty years, 800 of this design were built by individuals and another ISO were constructed by professional yards around the world. This first plan designed especially for steel

was quickly followed by several other sailboat and powerboat designs for steel construction, including the Roberts 34, the Offshore 44, and the Roberts 53. Early steel powerboat plans included the Coastworker 30, the Waverunner 34, the Waverunner 40/42, and the Waverunner 45. As of now, over 20,000 steel sailboats and powerboats have been successfully built to our designs.

Up until 1984, only a few boats of our design were constructed in round-bilge steel (these were built to modified versions of the fiberglass hull lines). At that time, most of the steel and aluminum boats built to our plans were constructed using the double-chine technique. In 1985, we switched to computer-aided design and this made it possible to draw radius-chine designs that were easy to build and had all the beauty of a round-bilge hull. At last we could offer metal hull shapes that rivaled their fiberglass sisters. These radius-chine hulls can be built by anyone with some welding experience, and are as simple to build as any hard-chine boat.

We were introduced to aluminum in 1974 when a client requested a design to be constructed in that material. Since that time, many aluminum boats have been built from our plans. My preferences will no doubt become obvious as this text develops, so I might as well state right off that I prefer the use of aluminum to be restricted to high-speed planing powerboats. In the latter case, the benefits of the material can be fully exploited. Fortunately for the sake of variety, not all builders agree with me. We often prepare plans for aluminum-hulled sailboats and semidisplacement powerboats, as well as for steel hulls and, more recently, for copper-nickel hulls.

chapter 1

WHY METAL?

HISTORY

Metal boats have a long and distinguished heritage stretching back 200 years. The first recorded instance of a small metal boat was a 12-foot (3.66 m) iron hull built on the banks of the River Fosse, in England, in 1777. Ten years later, the next known example, a 70-foot (21.33 m) iron canal boat, was built using 'A-inch (13 mm) riveted plates laid over a timber frame. In 1818, the first all-metal commercial boat was built in Scotland. The *Vulcan* was 63 feet (19.20 m) in length overall (LOA) and had a beam of 13 feet (3.96 m). This boat, with its flat-bar frames and riveted iron plates, was the forerunner of hundreds of boats and ships built using similar techniques.

As suitable timber for boatbuilding became increasingly hard to find, designers and shipbuilders turned to metal. In 1834, a violent storm drove hundreds of wooden boats and ships ashore in England, marking a milestone for metal boats. Most of the boats were totally destroyed, but one exception was the 125-foot (38.10 m) all-metal *Gary Owen*. After being driven ashore, this boat was able to withstand the severe pounding until the storm subsided. It did not go unnoticed that the *Gary Owen* suffered only a few scrapes and scratches, and that she returned to port under her own power. Another boost for metal ships occurred when the first all-metal liner, *Great Britain*, came to grief on the Irish coast and was later floated off to resume active service. The Great Britain went on to have a long and success-

ful career and the restored vessel is now on permanent display in Bristol Harbor in England. These incidents did much to popularize all-metal vessels, so that gradual acceptance turned into a flood of orders for builders of metal ships.

Shipowners soon found that metal ships were more resistant to the stresses of the sea in all weathers, and better able to keep schedules. Many wooden ships had been lost with all hands because some of the fastenings let go under extreme weather conditions. Shipowners found that although fire can occur in boats and ships constructed out of any material, metal vessels are better able to stay afloat, giving the crew more time to control the fire. As early as 1853, a survey of sailing ships operating in the Far East trade revealed that to build and operate metal ships cost as little as 80 percent of the cost of wooden ones. Comparing equal-sized vessels, it was proved that metal ships, because of their greater interior volume, smaller frames, etc., were able to carry as much as 25 percent more cargo than otherwise identical wooden vessels. The published results of this extensive survey gave a great boost to metal shipbuilding, and no doubt helped Great Britain become the largest builder of commercial shipping until World War II.

In 1858, the all-metal *Great Eastern* was built in the UK; at the time it was the world's largest ship—700 feet (213 m) long with a beam of 85 feet (25.9 m). In a world where trade was increasing at a great rate, this proved that there was virtually no limit to the size of ship that could be

built using metal. It's interesting to compare this early metal ship with the longest wooden ship ever built, the *Dunderberg*, which was a mere 377 feet (115 m) long.

METAL SHIPS

Steel

Up to the early 1860s, all metal ships were built of wrought iron, but thereafter a new material became available: steel. Steel was lighter than iron, but this new wonder material had one major drawback: it cost four times as much as the iron it would soon replace. Economy of scale soon prevailed, however, and steel became affordable. That, together with the fact that it was available in large sheets, soon established steel as the premium shipbuilding material. The giant liners of the past were built from steel, including the *France*, which was 1,035 feet (315 m) long and displaced over 70,000 tons. The liner *United States* holds the fastest passage time for a North Atlantic passenger ship, having made the trip between Europe and North America in only 3 days and 10 hours, averaging 35.59 knots for the crossing. High-speed ferries and other similar vessels are challenging this record. More recently, a large number of new giant liners entering the charter trade have spawned a great revival of steel shipbuilding.

Steel warships and oil tankers dwarf the famous passenger ships of the past. The aircraft carrier USS *Nimitz* displaces 95,000 tons, and the oil tanker *Seawise Giant*, which is 1,504 feet (458.5 m) long and 225 feet (68.6 m) wide, weighs in at 564,763 tons.

While this revolution in building large ships



This steel Spray 40, Mirounga, was built in Germany by Ulrich Kronberg.

moved almost all construction of commercial shipping out of the timber era and into steel, small boats continued to be built of wood, except in Europe—and there, mainly in the Netherlands.

This situation prevailed until the early 1960s when the advent of fiberglass changed the pleasure-boat scene forever.

Aluminum (or Aluminium)

This metal is refined from the natural material bauxite. Although it was discovered early in the nineteenth century, it was not until 1886 that the first practical refining methods were developed in France. As early as 1894, an aluminum alloy was



The Tom Thumb 26 is ideal for building in steel or aluminum. It would make a great first project for the novice metal boat builder.

used in Switzerland to build the power yacht *Alumina* for Prince Wilhelm zu Wied.

The designers of the liner *United States* made extensive use of this metal, saving over 27,000 tons compared to a similar-sized all-steel vessel. Today, aluminum is used to build sailboats and power yachts of all sizes. This material is especially useful where weight saving is the most important factor.

Copper-Nickel

In electro-chemical terms, copper is one of the most noble metals in common use. It has excellent resistance to corrosion in the atmosphere and in salt water. The British Royal Navy introduced copper cladding to wooden warships in the eighteenth century to prevent the hulls from being eaten by marine borers and fouled by other marine growth. The hulls of the *Cutty Sark* and other famous clipper ships were clad with copper. These vessels were required to make fast passages, and the copper ensured that their bottoms remained smooth. In 1893, the America's Cup defenders *Vigilant* and *Enterprise*, and other Cup de-

fenders of the period, had hulls of Tobin bronze, fastened with rivets of the same alloy.

The practice of cladding the hulls of wooden ships and pleasure boats with copper was common until the mid-1950s, when modern antifouling paints came into common usage. Copper cladding was the forerunner of modern copper-nickel alloys that combine superior resistance to corrosion with excellent antifouling properties. Copper-nickel is sometimes used to clad the underwater sections of commercial vessels but for several reasons—including difficulty in obtaining the material, difficulty of welding, and great expense—it is not suitable for constructing pleasure craft.

SMALL BOATS

It is only in recent times that steel and aluminum have been considered mainstream boatbuilding materials. Metal boat building has come a long way in a few years, and even as recently as 1965 very few small craft were built from these materials.

In the early 1970s, in Brisbane, Australia, I

knew every small craft in the area. Out of some 200 boats, only 3 were built of steel. By 1974, when I started to design in metal, there were still fewer than 10 steel boats in Brisbane. What a difference today, when metal boats are much more widely accepted, and are regarded by many as the best for serious offshore cruising. It's common for our office to receive from cruising people letters that read: "We are anchored off [a popular cruising area] and there are 20 boats here, and 12 are built from steel." A rare dash of modesty prevents me from quoting the large percentage of these boats that are to my design!

Steel

Steel is the most commonly used boatbuilding material. It has many advantages including great strength, low cost, and ease of fabrication. There are great numbers of experienced welders in all parts of the world. Add to this the ease of repair, and the availability of a wide selection of suitable plans designed especially for building in steel, and it's easy to see why this material has become so popular with the cruising fraternity. Successful steel cruising boats can be small, too—as little as 25 feet (7.62 m) in length. The Dutch even build steel dinghies of around 15 feet (4.57 m) and use them as tenders on their barges and other commercial craft.

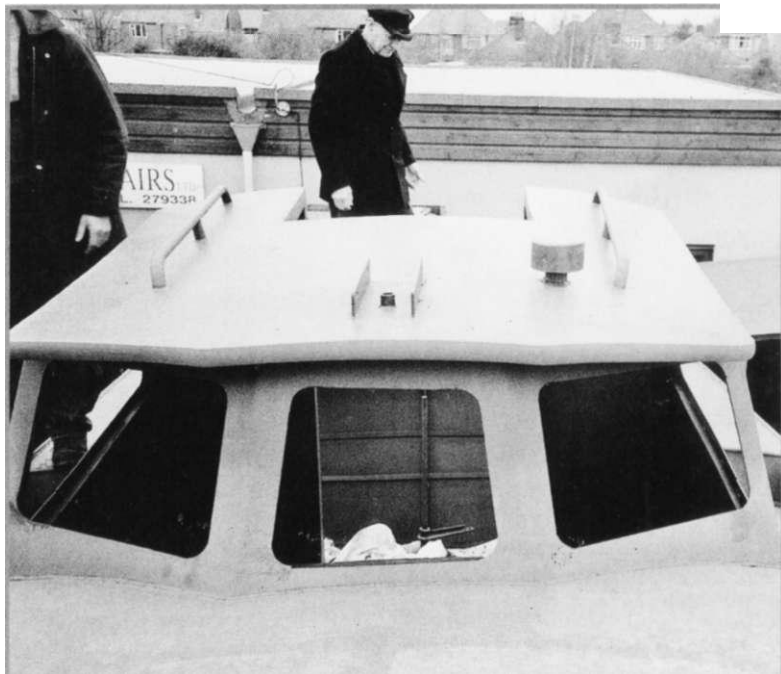
Steel is heavier than other boatbuilding materials, but that hasn't proved to be a disadvantage in cruising sailboats or powercraft. Steel needs some care and attention, but modern coatings have greatly reduced the chances of rust forming. As the owner of several steel boats, I must confess I have found it hard to find any seri-

ous disadvantages in building, owning, and maintaining a steel boat.

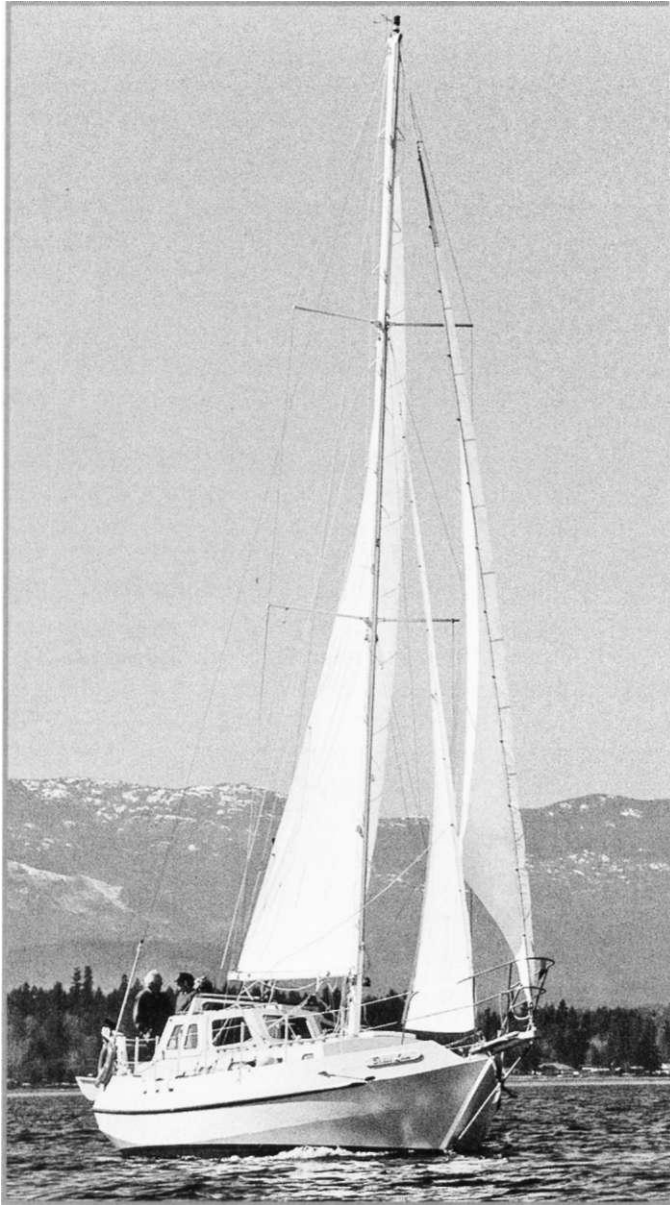
Aluminum

Now widely accepted as a boatbuilding material, aluminum has the advantage of being about one-third the weight of equal-size steel, although this is partly offset by the fact that you need a thicker material for boatbuilding. Aluminum is easy to work with. In fact, you can use hand tools on aluminum, even some woodworking ones. It's ideal for decks and superstructures where its light weight can be used to advantage. In some areas of the world, aluminum has become popular for building commercial craft and fishing boats; when the correct marine grades are used, the entire boat can be left unpainted.

The disadvantages include greater cost and relatively greater susceptibility to galvanic corrosion. Aluminum requires expert fabricators and experienced welders who are used to handling it.



This tidy pilothouse would look equally attractive on a sailboat or a powerboat.



Aluminum was the material chosen by Leuder Kerr for his Spray 33 Brass Loon. This strong hull has successfully withstood contact with many deadheads (near-submerged floating logs) in the Gulf Islands of British Columbia, Canada.

When it comes to repairs, experience won't be a problem if you have built your own aluminum boat. Aluminum should be used where its benefits can be exploited to the full. For instance if you

are considering building a fast, planing, metal powerboat, then aluminum will be worth your consideration. Another instance is where a vessel has a high superstructure; then aluminum may be used for the construction of those areas where its light weight will add to the positive stability of the vessel. Seek your designer's advice on this matter. It is a waste of money to use aluminum to build moderate to heavy displacement boats; steel is preferable as a construction material for these heavier hulls.

Copper-Nickel

In 1938, a 45-foot (13.7 m) motor cruiser, *Miss Revere*, was built in the United States using an alloy of 70 percent copper and 30 percent nickel, welded over framing of the same alloy, and fitted with aluminum bulkheads. Between 1938 and 1965, many U.S. Coast Guard motor whaleboats were sheathed at the waterline in copper-nickel. In 1968, the pleasure yacht *Asperida* was built, using 70-30 copper-nickel hull plating over framing of the same material; this boat is still in service today.

The first of several copper-nickel commercial fishing boats was built in 1971. The hull of the 67-foot (20.4 m) *Copper Mariner* was constructed from a 'A-inch (6 mm) alloy containing 90 percent copper and 10 percent nickel, installed over steel framing. More recently, several other trawlers and general-purpose fishing boats have been built using copper-nickel alloys.

One interesting example of copper-nickel construction is the sailboat *Pretty Penny*. I inspected this boat in Faversham, England, after she had been removed from the water for the first time in 16 years. *Pretty Penny* was also scrubbed once a year, and there were only a few barnacles present when she was

hauled. I was most impressed with her condition.

All the advantages of steel accrue also to copper-nickel, which has the additional benefits of being resistant to corrosion and fouling by marine organisms. Copper-nickel requires neither painting nor anodes. It's a natural antifouling element. These benefits may make it the choice of those who can afford the costly material. Another advantage is that you will never be short of conversation with your peers if you choose copper-nickel.

The disadvantages of copper-nickel include the shortage of boatbuilders with experience in handling this metal, much greater cost, and the sense of being a pioneer when you decide to build a copper-nickel boat.

The Cost of Metal Boats

Steel is the cheapest metal suitable for boatbuilding. It's considerably cheaper than fiberglass or the materials used in wood/epoxy construction. Steel is definitely today's bargain boatbuilding material. Aluminum comes next in price, then fiberglass or wood/epoxy. Copper-nickel costs about ten times more than any other material and hence is the most expensive of all.

But you have to remember that the cost of the hull (meaning hull, deck, and superstructure) represents only about 33 percent of the total cost of the vessel. Thus, a good argument can be made for ignoring the cost of the hull. If your budget



Another attractive pilothouse. This one graces the steel Roberts 370 Tensile.

allows this, then choose the material that is most suitable for your needs. After you have examined the building techniques explained in later chapters, you will be in a better position to make an informed decision. Quite frankly, even if steel were the most expensive material, which it is not, because of its great strength advantage, you could still make a good case for choosing steel as the primary boatbuilding material.

chapter 2

BOAT AND BUILDING CHOICES

CHOOSING A SUITABLE BOAT

Before your decision-making process gets into top gear, you would be well advised to get your partner and family involved. Over the past 30-odd years, we've seen many boating projects come to grief because the senior family member failed to consult with, or listen to, the wishes of the others. You'll have to forgive us if we repeat this advice elsewhere; we feel it is worth the telling.

You'll find many fine designs for sail and power in Chapters 6, 16, and 17. But don't be tempted to buy or build a boat that is larger than you need. Reaching this decision is harder than you may imagine. If you have children who will accompany you throughout your boating adventures, make sure you think through the options. For instance, if you have teenagers, the chances are that within a few years they will be doing their own thing and not interested in accompanying their parents. It's a fact, though, that many families cruise with young children. Home schooling, and other concessions to your young crew, can turn cruising into a wonderful experience for the entire family.

What type of boat is right for you? Power, or sail, or perhaps a 50-50? That's a decision you may already have reached before you discuss the options with your spouse and other family members. Age has a bearing on this decision; if you're under 40, then you will most probably opt for sail; up to 50, it may be a toss-up; and over 50,

power may be your choice. There are many exceptions to the above but it's my experience that the happiest boaters fall into the age/sail/power categories outlined above. We are currently preparing a custom sailboat design for a client who has just turned 50; he admits that his next boat will be a trawler.

Many people enjoy the comfort, convenience, "level playing field," and perceived safety of powerboats. They don't particularly like preparing meals and generally keeping house at varying degrees of heel. If more sailors chose cruising powerboats, or at least comfortable sailboats like the Spray type, they and their families would be (and would remain) more enthusiastic about serious boating. Introduce your partner to boating in a sensible way. Do not choose the roughest day to show off your boating skills; if you do, then from then on you may boat alone.

That's our idea of the comfortable cruising lifestyle. In the many years we've spent designing and supervising the construction of hundreds of boats of all types, we have met many families before, during, and after their boating adventures. Our suggestion is that you give stability and comfort some serious consideration before you make a decision about which boat will suit you and your family. Most modern "off-the-shelf" sailboats sail to windward at considerable heel; in our case we prefer to design boats that sail with minimum heel. Surprisingly (to many), when tested under actual passagemaking conditions, these boats often outperform so-called performance cruisers.



Western Grace, built by Christensen Yachts in British Columbia, is a very successful charter vessel. See www.bruceroberths.com for details.

If you're new to boating, you may want to consider a boat that's suitable for weekend and holiday cruising as opposed to a fully equipped liveaboard cruiser. That would be jumping in at the deep end. Again, your age will have a bearing on your decision; the younger you are, the more time you will have to correct any mistakes of judgment you may make when choosing your boat. Most people who enjoy boating will own three or more boats in their lifetime. You'll need to consider if your first boat is truly "the" boat or just a stepping-stone in that direction.

A metal weekend cruiser can be as small as 25 feet (7.6 m) in length or as large as you can afford or handle with your family for crew. *My advice is never to own a boat that cannot be handled by a crew of two.* Most boats that are used regularly, as opposed to those that languish in the local marina, are crewed by a couple. How big is too big? We have many Roberts 53-foot sailboats successfully cruised by healthy and active (not necessarily young) couples. Neither crew member is required to have an outstanding physique. Modern equipment makes it possible for small persons to handle the sails and associated gear comfortably.

Before deciding on the size and type of vessel that will best suit your needs, you may wish to read more on the subject. See Appendix 1 for

a list of books that can help you to make an informed decision.

BUYING NEW

If you're considering owning a powerboat in Europe, you will have a wide choice of metal boats. There are many builders of fine steel cruisers in Holland, Britain, and elsewhere in the European Union (EU). The off-the-shelf motor cruisers built by the Dutch used to be mainly intended for coastal and canal work. The quality of hull



Frank Ozannes built this steel Roberts 36 from scratch.

construction, interior joinery, and general finish is first-class. With the advent of the EU Norm rules for marine craft, the cruising capabilities of the boats built in Holland and elsewhere in Europe are superior to those built elsewhere. The strict and comprehensive rules of construction and general engineering ensure safe, seaworthy boats. All the boats designed and built by my own company in Holland are Class A, which means they are classified as suitable for unlimited offshore ocean cruising.

In the United States and Canada, there are a few builders of metal boats, many of whom build fine vessels. Fortunately, the shoddy builders soon disappear; but make sure you are not one of their customers before they quit the scene. You may wish to contact one of our offices for a current list of builders and kit manufacturers in your area. Visit our website at www.bruce.roberts.com for additional up-to-date information.

BUYING USED

Buying a used metal boat is another option, but the purchase of any secondhand boat can be fraught with traps for the unwary. The term "buyer beware" is never more apt than when buying a used boat. With any boat, age has its potential problems, so younger is usually—though not necessarily—better. Naturally, there are cases where a well-built and maintained older metal boat is superior to a jerry-built nearly new vessel. Nevertheless when buying a used boat try to consider only boats that are less than 5 years old. This advice applies to any boat, no matter what material was used to build the hull.

Older boats with teak decks are to be viewed with added suspicion. In fact, *any* boats with teak decks should be inspected with the utmost care. Assume you may have to replace or extensively repair the decks, and factor this into your offer. Remember that a boat that needs extensive repairs and renovation will cost you nearly as much as—or often more than—building a new one, and the result will still be an older boat with a doubtful resale value.

Now, having painted that picture of doom and gloom, let us say that there are some fine used metal boats out there, but you'll have to sort through a considerable number of undesirable examples before you find your dream boat. We have owned many boats, mostly new, but the last two were used steel boats. Both these boats were under 5 years old and had been only lightly used before we purchased them. With one of our previous boats, *K*I*S*S*, a 28-foot (8.53 m) steel Spray design, we were able to recover all of our investment after two years' use.

If you're able to deal directly with the owner, you may avoid some of the pitfalls associated with this type of purchase. You must make sure you are absolutely satisfied *before* you hand over your money. Always hire a qualified surveyor to check out your boat; also the report may be used to help with the price negotiations depending on what the surveyor finds. Again make sure you have all the facts before you part with any substantial amounts of cash.

In the United States, boats are often documented with the Coast Guard, which proves ownership. Another way to check ownership is to contact the yacht's insurers and the harbor master where the boat is kept. It's as well to remember that if you buy a boat from someone who doesn't have legal title to the vessel, and it's later reclaimed by its lawful owner, you may lose both the boat and your money. There's always a chance that the boat you're considering buying may be subject to a loan agreement, or it may form part of a legal dispute, or there may be some impediment in the title. Carefully check builders' certificates, bills of sale, and any other documentation that's offered to prove the current ownership.

Surveys are essential when you're buying a used boat. You'll have to bear the costs of hauling for a full survey, but before you commit to that, here's a tip. To cut your potential costs, conduct a very detailed inspection of the interior, galley equipment, pumps, heaters, batteries, mast(s), rigging, sails, dinghy, and electronic equipment before you commit yourself to a full survey. Do it yourself, and don't be rushed. Take your time,

and don't be afraid of being a nuisance. If you have trusted and knowledgeable friends, seek their help and advice at this early stage. Don't ignore advice because you've fallen in love with the boat. Assemble your facts, and on no account part with your cash before you are in possession of all the information about the boat's condition.

CUSTOM BUILDING

Many of you will be considering having your metal boat fully or partially built by professionals. But most owners of metal boats are better informed than owners of vessels built from other materials, and many are capable of building or supervising the construction of their new vessel.

If you opt for a custom-built metal boat, you'll need the services of a competent naval architect or boat designer who is familiar with your chosen material. Fortunately, there are several designers who have either specialized in, or had experience in, designing boats in steel or aluminum.

A custom-built boat need cost you no more than one from a production run. One way to save money is to act as your own contractor. You rent the building space and hire local workers to do the work. And here you reap another benefit of building in metal: any competent welder with experience in your particular metal can build a metal boat, given a kit or a detailed plan. All the materials and equipment, engines, electrical gear, and everything you need to build and equip your vessel can be purchased locally. If you go about this in the right way and buy most items at trade prices, you can save a great deal of money; perhaps this will enable you to afford a larger boat. A letterhead with your "Boatbuilding Company" name and address will go a long way toward convincing suppliers to give you



Build carefully if you wish to emulate this Spray 40 sailed to the Antarctic by her owner-builder, Alan Sendall.

trade discounts; make no mistake, they want your order, so make it easy for them to supply you at trade or discount prices.

STARTING FROM A KIT

It is now possible to purchase a kit of parts that have been pre-cut from plate. Your job then is to assemble them into a hull, deck, and superstructure. Some designers (including this one) have the ability to prepare a special computer disk with the parts "nested" to allow more economical cutting. It's necessary, of course, for the company producing the kit to have the automatic, computerized cutting devices. This service initially costs a little more, but if you can afford it, you will find this a practical and perhaps even economical way of getting your project off to a quick start. Recent cost comparisons have established that building from a pre-cut kit or cutting files does not involve additional costs when considering all the aspects of assembling your hull deck and superstructure (often referred to as the *shell*).

You alone can tell if the additional initial cost is justified; discuss these matters with the designer and with the company supplying the kit or cutting files. The best of these pre-cut kits are cut from shotblasted and primed steel that has been coated with a specially formulated weld primer. This coating doesn't give off fumes when you're welding. Another benefit of the weld primer is that there is little cleanup after welding; all you need to do is lightly grind the welds and then touch up the primer by hand in these areas.

HULL AND DECK OPTIONS

Many metal boat owners start with a hull, deck, and superstructure that have been built to their order and delivered to a suitable site for them to complete. Again, the owners buy all the equipment and finishing materials and then undertake as much of the labor as they wish. It's still a good idea to print your letterhead, as mentioned earlier, and buy at trade prices.

There are many books for those who want to build or partially build their own boats; you'll find some suggestions in Appendix 1. If you don't want to do some jobs yourself, you can hire local

electricians, mechanics, and other tradesmen to do them for you. You're in charge; you decide just how much or how little you want to do yourself. One thing is for sure: you'll save a great deal of money, and end up with a boat that you are totally familiar with and can then easily maintain. If you plan any extensive cruising, it's imperative that you be familiar with every aspect of your vessel. What better way to learn about your boat than to work on the construction? After studying all of the options, you can personally select all the equipment you need to complete your vessel.

BUILDING FROM SCRATCH

Many thousands of owners have built their metal boats from scratch. These determined individuals have selected a design, purchased plans and basic materials, and built their own hulls, decks, and superstructures. Depending on the size of your boat, and whether you are building part-time or full-time, this process will more than double the overall building time.

There are many of you who have some welding experience. If you feel you would like to build from the ground up, don't be put off by the size of the project, but keep in mind that you should never build more boat than you need. Choose a design that has been especially drawn for the less-experienced builder; there are many designers who can provide you with suitable plans. Some designers, including us, provide full-size patterns for the frames and other parts of the hull structure.

We're often asked how long it takes an amateur to build a boat. Here are a couple of extremes. One Roberts 53 steel sailboat, including the hull, deck, and superstructure, was built and equipped ready for sailing by one Australian man and an occasional helper in the unbelievable time of 10 months. We have to assume



This steel Spray 40 shows several attractive and sensible features, including substantial pipe guardrails (stainless would have been nice) and a nicely laid teak deck. Note the wide covering board around the edge, a sturdy pair of stainless steel bollards on the foredeck, a timber rubbing strip "stood off" the hull, a pair of stainless steel bow fairleads, and a well laid out fore-cabin top.

that this person purchased many items ready-made. Another builder of the same design took 10 years part-time, but he made everything himself, including the sails. This tenacious builder even made patterns for his cast winches, and then finished them himself. Photographs taken while he was sailing his 53-foot (16.2 m) boat off the Australian coast show a happy couple enjoying their boat and cruising far from home. In fact, this builder then completed a circumnavigation of the world before returning home to Germany. In our records there are hundreds of letters from builders who fall between these two extremes.

There have been many attempts by others and us to try and calculate building times for individual boats. In most cases this has proven a futile exercise. Factors such as starting from scratch versus buying a kit, cutting files, or a ready-built hull; the amount of help available from your partner and friends; how many hours a week you can devote to the project; and just how badly you want to get the job done all play a part in how long it will take you to complete the project.

FINANCE, OR PAY AS YOU BUILD?

Unless you are financially independent, you'll have to consider how you're going to pay for your new boat. If you buy a new or a used vessel, you may decide to finance *part* of the purchase. Many finance houses will give you a loan, perhaps as a second or refinanced mortgage on your home. Of course, you'll pay for this in interest, loan setup fees, and so forth. You may get a more favorable interest rate if you obtain a marine mortgage, as opposed to a simple bank or finance company loan. Many banks, savings and loan associations, and similar lenders will give you a loan for 10, 15, or 20 years to purchase a new boat. But before you sign any finance agreement, make sure you're aware of all the interest and other expenses involved.

Paying as you build is our preferred option, and means not only that will you save on the overall cost of the boat, but you'll also avoid in-

terest and other associated charges. We've seen thousands of fine boats built or completed by owners who, on launching day, have had the extra thrill of knowing that their pride and joy was debt free. Some builders even have it both ways—they build as much as they can afford (paying cash), and then they raise a loan, using the partly built boat as security.

BUILDING SITES

If you decide to build your own boat from a kit, cutting files, hull-and-deck package, or from scratch, you'll need a suitable building site. If you live in a warm area, a simple shelter will suffice. If your boat is to be built or completed in a cold climate, you'll need to consider a heated structure. In any case, you'll need some form of secure building in which to keep your tools and valuable supplies. Fortunately, when you're building a metal boat the lower perceived value of the materials will mean the need for security is relatively less than if you were building in fiberglass or plywood. This benefit lasts only until you start on the interior. Even if you're working outside, it's a good idea to keep your more valuable items out of sight, or maybe in more secure storage, until they can be properly installed in the boat.

Part of the advantage of building in a place that's secure, comfortable, and weatherproof is purely psychological; it will be easier to make the effort to work on the boat. Also, if you're paying rent on a building, you're more likely to get on with the job. If you're building outdoors, exposed to the elements, then you'll often have to stop work because it's rainy, cold, or windy. The disadvantages of building outdoors can add months to your building program.

To determine how much space you'll need to house your boatbuilding project, plan for a space 50 percent longer and 100 percent wider than the finished boat. For instance, if you're building a boat 40 feet long by 13 feet wide (12.2 by 4.0 m), your working space should ideally be 60 feet long by, say, 26 feet wide (18.3 by 7.9 m). When it comes to handling plate and other construction members, you'll need plenty of space for



This Roberts 342, built in Europe, is a fine example of what you can achieve using the radius-chine technique to build in either steel or aluminum.

tools and materials, as well as room to move around.

For maximum efficiency, plan your building site so that you spend as little time as possible walking from one area to another. The positioning of benches and frequently used tools will play a part in making a comfortable and productive workplace.

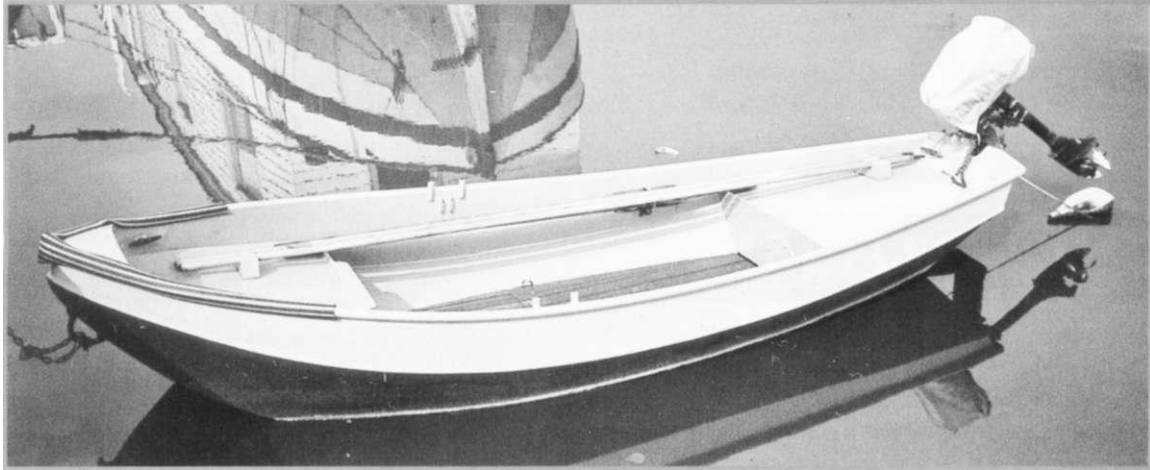
Your boatbuilding project should not be too far from home; this becomes even more important if you're only working part-time on the boat. Travel time can eat into valuable work time, and distance can be a deterrent to getting started evenings and weekends. Make sure also that your work site is accessible to the large trucks needed to deliver long lengths of plate and other necessary supplies. If you're working outdoors, be sure you have a flat, level site. Carrying tools and materials up even the smallest gradient can soon become a tiring exercise. And you'll be getting plenty of that already.

One obvious choice is to build your boat beside your house. Many fine boats of 65 feet (19.81 m) have been built to our designs beside the owners' homes. To make this a practical proposition, you need to live on a large lot or in an isolated area.

Local building ordinances may govern just what you can do in your own backyard. Check them before you start building a shelter or erecting boat frames beside your house. Generally speaking, the farther you live from the center of town, the better chance you have of being able to build or complete a boat on your own property. If you're not committed to a mortgage, you may consider renting a suitable house away from the town center and building your boat on the grounds of your rented property. Obviously, you need to check with the owner first and get permission in writing before you sign the lease.

If you start with a hull and deck, all you may need in the way of a building is a toolshed; the hull can be heated, and the outside work can be completed in fine weather. Another advantage of starting with a ready-built shell or kit is that you may be able to complete the boat in your own yard. Metalworking is noisy, especially when you're building the hull and deck. If you're building in a residential area, make sure the noise that can be heard outside the boat is kept to a minimum.

Here are a few suggestions for boatbuilding locations: your own yard; unused corners of marinas and boatyards; fenced-in, but unused, indus-



The Dutch love to build everything out of metal, as is evidenced by this attractive steel dinghy.

trial sites; beside or in an engineering business; inside old warehouses; inside or beside an old storage barn. These are just a few of the many possibilities and these locations can often be rented cheaply.

If you are building from a pre-cut kit, you may want to consider using an "own-your-own container" for transporting the kit from the supplier to your building site. If you are not constructing your boat in a secure building, the container makes a fine lock-up tool- and storage shed. These containers cost about \$1,500, so you

and your insurance company may consider this a worthwhile investment.

Make sure you think ahead to the day that the boat is completed and ready for launching. Can a low-load trailer and lifting crane get to your site and move your boat to the water? Have you surveyed the route? Check for low overhead wires and sharp corners in narrow streets. We've seen it all; there are hundreds of stories about boats being lifted over houses and hoisted from mountain sites by large helicopters. Some boats have been literally dragged through villages by willing helpers.



The ultimate metal boat building project! This Waverunner 706 can be built in aluminum, steel, or a combination of both materials.