

BUILDING THE CONESTOGA WAGON

1750 – 1850



Design, plans, instructions, and prototype model by Bob Crane

Technical Characteristics:

Scale: 1" = 12" (1:12)

Overall length: 19"

Height: 9"

The **Conestoga wagon** is a heavy, broad-wheeled covered freight carrier used extensively during the late 1700s and 1800s in the United States. It was large enough to transport loads up to 8 tons and was drawn by Conestoga horses. The first Conestoga wagons originated in Pennsylvania around 1750 and are thought to have been introduced by Mennonite German settlers.

The name came from the Conestoga valley near Lancaster, Pennsylvania. In colonial times the Conestoga wagon was popular for migration southward through the Great Appalachian Valley along the Great Wagon Road. After the American Revolution it was used to open up commerce to Pittsburgh and Ohio. In 1820 rates charged were roughly one dollar per 100 pounds per 100 miles, with speeds about 15 miles (25 km) per day. The Conestoga, often in long wagon trains, was the primary overland cargo vehicle over the Appalachians until the development of the railroad. The wagon was pulled by six to eight Conestoga horses or a dozen oxen.

The term "Conestoga wagon" refers specifically to this type of vehicle; it is not a generic term for "covered wagon" or "prairie schooner." The wagons used in the

westward expansion of the United States were, for the most part, ordinary farm wagons fitted with canvas covers.

The Conestoga wagon was cleverly built. Its floor curved boat like upward at the ends to prevent the contents from tipping and shifting.

The cracks in the body of the wagon were stuffed with tar to protect them from leaks while crossing rivers. Also for protection against bad weather, stretched across the wagon was a tough, white canvas cover.

The wagons were constructed entirely of wood of various species. The craftsmen who built the wagons knew which species of wood best suited the purpose at hand. Much hand forged iron work bolted or riveted to the undercarriage and wagon box reinforced the structure. The wheels were made of wood, reinforced with iron bands, and tired with iron. The tires were heated in a fire to red hot and dropped over the wheel assembly then quenched with water. The tire would shrink tightly around the wheel drawing all the parts tightly together.

Conestoga horses were a special breed of draft horses. These massive horses weighed 1800 pounds or more and stood sixteen or seventeen hands at the

withers. (One hand equals four inches.) Since Conestoga wagons often traveled over muddy roads, this special breed had no long hair beneath the fetlocks, the lowest joints on a horse's legs, and no long tails that could become matted. Sadly, these fine workhorses are now extinct. The left hand horse nearest the wagon was called the "wheel horse" or the "saddle horse." The teamster drove the team by working a single rein called the "jerk line." To turn the team to the right, the teamster would yell "Gee" and give several short jerks of the line. To go left, he would call "Haw" and pull steadily on the jerk line. Each horse wore a set of bells hanging from an arch that was attached to its collar. The horses in front had five bells; those in the middle wore four bells; and those next to the wagon had three bells. These bells announced that the team was coming and that people and cattle should get out of the way. The expression "I'll be there with bells on" comes from this custom.

The wagon teamster would often walk along side the wagon; he could also ride the wheel horse or pull out the lazy board to sit on; there were no seats on the wagon. The people who used the lazy board ran the risk of being called lazy. Since the lead horse was on the left and wagon driver would walk or ride on the left, this meant that if he needed to pass someone he would pass them on the left and drive on the right side of the road. This is thought to be how the custom of driving on the right hand side of the road began in the United States.

When going down a steep hill or if the wagon began moving too fast the driver could use a chain on the back wheel, called a wheel lock chain, so that it would no longer turn but would begin to slide, slowing down the wagon. He had to make sure the wagon didn't move so fast that it would run into and hurt the horses. Some of the equipment that was used with a Conestoga wagon was a feed box to feed the animals, a bucket to water the horses, and an ax to clear the road of any newly fallen trees. There was also a tool box that contained items that would allow the driver to make small repairs, a grease bucket to grease the wheels of the wagon, and a jack to remove the wheels if necessary.

It might take several days to move a load of goods the 60 miles down to Philadelphia, depending on road conditions. If it was muddy it would take longer while in winter when the roads were hard and frozen it would take less time. By the 1820s and 1830s better and cheaper ways of moving large amounts of goods began to appear, using canals and later railroads. Some Conestoga Wagons still exist; the Conestoga Area Historical Society has a small one while Landis Valley Farm Museum has several of the larger variety.

Our model is the most historically accurate model of the Conestoga wagon ever produced. The kit design, plans, and figures were done following drawings and sketches made by John Thompson and Ivan Collins. (see references) These two gentlemen created their drawings and sketches from measurements taken from real Conestoga wagons in museums.

Before you Begin

The model kit was designed to be as faithful to historical Conestoga wagon construction and detailing as reasonably possible. Research revealed a wealth of detail from reliable sources including the American museum in Britain and the Oregon Historical Society Research Library. Nearly all wooden parts are laser cut in basswood leaving very few parts to be made from strip wood. There was a great deal of hand forged ironwork on these coaches which in a model might be beyond the ability of all but experienced modelers to create. We have reproduced this ironwork in the form of photo-etched brass requiring only some shaping to add these essential details to the model. While it is possible to build the model omitting many of these details, we encourage you to include them resulting in a model that is as close to an historical wagon as possible. The results will be rewarding.

Working With the Plans and Parts

Before starting the model, carefully examine the kit and study the plans. First, locate all the parts as listed in the parts list. Handling the parts will produce a better understanding of the kit's requirements. Try to visualize how each piece will look on the completed model. Study the building sequence on the plans and in the manual. While it is not strictly necessary to follow an exact sequence and in fact some parts of the model may be constructed simultaneously with other parts, for example, the wagon body and the undercarriage, but keeping the sequence described will keep you out of trouble. A thorough knowledge of the plans and parts is essential.

1. The Plans

Five plan sheets are provided. Many drawings on the plans and figures in the manual are done in an isometric format illustrating the construction sequence and identifying the parts and their placement. Note that sheet 5 is for parts identification only and is not to scale.

2. Making Allowances Along the Way

Try to be exact when following the plans and instructions, but use common sense. Adjustments may be necessary to compensate for small differences in how your model is shaping up. Perhaps a bit of shaving here, a little shim there, a little filler there, etc., will alleviate any annoyances. Use logic and do not fret over exactness. An old saying in the building craft is that "if it looks right, it is right."

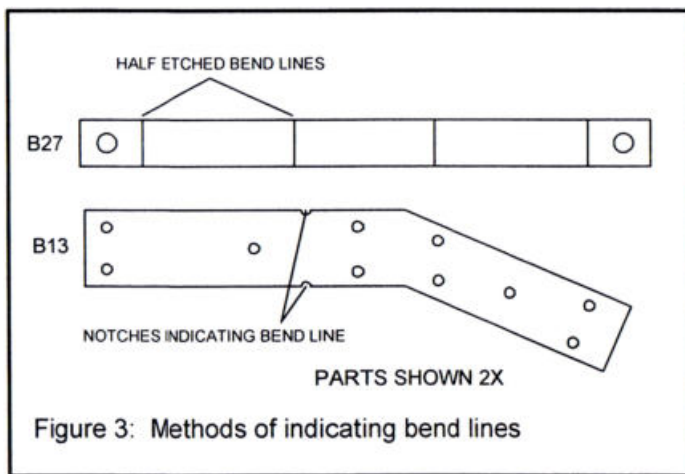
3. Kit Lumber

Strips, laser cut sheets of basswood and plywood, and dowels are supplied in the kit. The laser cut boards are labeled CW-1 through CW-11.

Sorting the wood in the kit by dimension will save time. After selecting and cutting what you need, return the remaining stock to the proper dimension pile. Don't worry about using a piece for one item intended for another. Model Trailways supplies enough extra wood to complete the model before running out.

4. Working with Brass

There are many photo-etched brass parts in the kit which represent the forged iron parts on the real wagon. Most of these parts require bending to shape. For your convenience the bend lines have been etched into the parts by two methods. Some parts have etched lines indicating the bend lines. The line is etched halfway through the brass making it easy to bend the part. Some parts have very small notches etched into the brass indicating the ends of the bend lines. Refer to Figure 3. Use a pair of needle nose pliers to make the bends. Study the plans and figures to understand which way the bend goes for each part. Some parts have left and right configurations which require bends in opposite fashion. An identifier sheet is included showing the part numbers of the photo-etched parts. Brass parts are given identifying numbers as B1, B2, B3,...etc.



Brass kit parts represent the many forged ironwork parts that were used to build the original wagons. The iron parts were typically painted black. To blacken photoetched brass there are products on the market formulated to chemically blacken the brass. One such product is BLACKEN-IT. It is available at hobby stores and can be ordered from Model Expo. The Model Expo part no. is AW2. It is important that the brass parts to be blackened are clean. It is best to wash the parts in a solvent such as Acetone or Lacquer Thinner and handle only with tweezers before immersing in the blackening solution. Follow the directions on the bottle.

Brass can also be blackened with markers such as the Sharpie brand. Markers leave a slight sheen on the parts which can be removed with an overspray of Testors Dullcote.

Glues

White or woodworker's glue in yellow or tan will suffice for most of the model. Five-minute epoxy provides extra strength for some cases. Super glues, such as Jet, Flash, or Zap, produce quick adhesion. For most applications, the medium viscosity, gap-filling variety is best. For some applications the gel type works best. The thin type is recommended for filling a narrow crack and wicking into laminate joints. The prototype model was built using tan woodworkers glue, gel type CA and an occasional use of epoxy and thin CA.

A word about gluing laser cut parts. Laser cutting burns through the wood and leaves a charred surface. This charred surface does not make good glue joints. It is recommended to lightly sand or scrape away the loose char before gluing. It is not necessary to remove all the char, just what comes off with light sanding or scraping. In most cases simply scraping with a no.11 blade is sufficient.

Clamps

Clamps are an essential part of the model building experience. In the full size building arena it is often said, "A builder cannot have too many clamps." This is true of model building also. There are so many situations in the course of building a model that require a particular type of clamp. The photo below shows a typical collection of clamps that are useful in model building.



Fortunately very few clamps were necessary in the course of building the prototype model.

Painting the Model

Beginning this manual with directions on applying finishes may seem strange. Not so! Much time and effort can be saved and more professional results obtained if the finishing process is carried on throughout construction. Proper timing in applying finishes and using masking tape to define painted edges should eliminate unsightly glue marks and splotchy, stained surfaces. Many parts in the kit can and should be pre-finished before assembly. This is much easier to do before assembly than after.

If you are not in a hurry to begin construction, think through what kind of finish you like, what parts are going to be exposed, etc. Research revealed that a most common paint scheme for Conestoga wagons was red and blue, red wheels and undercarriage and blue wagon box. Iron work was painted black. The prototype model was finished in this manner. The paint was thinned to the consistency of a wash to give a weathered, faded, look to the finish. This is the color scheme seen in most photographs of existing Conestoga wagons. Another possibility is to not paint at all but stain the wood as if weathered wood. This was the finish chosen by Ivan Collins, the famous model maker of horse drawn vehicles. The choice is yours. We will address the finishing of individual parts as we proceed through the construction sequence. Take advantage of these general suggestions:

Choosing paint: Glossy surfaces are not desirable on models. A flat finish or one with a slight sheen is best, because it doesn't reflect daylight or artificial lights. Consequently, details show up better. However, the undercoat or primer should be dead flat. A primer gives the surface a little tooth and helps top coats adhere better. A quick finish procedure for basswood parts is to spray them where possible with common aerosol primers, then steel wool with 0000 steel wool, this fills and smoothes the surface for painting. Any of the hobby paints are satisfactory such as Model Shipways, Testors, Humbrol, and Tamiya. Jo Sonja artists' paints (used by bird carvers) are also acceptable. They are a combination acrylic-gouache and dry dead flat. Hobby paints have a variety of reflectance levels from flat to gloss. When using a mixed group of reflectance levels, finish the completed model with a flat, clear coat. It also provides durability and seals any decals or dry transfer lettering.

Brush painting: Painting with fine, soft bristle brushes is probably best for the beginner. Many skilled model makers prefer the brushed-on technique, because its subtle imperfections impart a more lifelike appearance to the model. Brushes must be soft and of the highest quality. Artist grade sable or synthetics are the best. Use wider brushes for painting broad surfaces. If too narrow, the bristles will cause excessive streaking. When applying paint or stain with a brush, lay down one thin coat in a single stroke, then move to an adjacent area and coat it with a single stroke. Never go back over fresh paint. That will tear up the surface. Wait until it has dried to a hard finish before applying a second coat.

Spray painting: Although slightly expensive, a Paasche, Badger, Testors, Revell-Monogram, or similar airbrush will produce a first-rate job and is worth the investment. Airbrushes are either single action (trigger controls only airflow) or double action (trigger controls air and paint) and easy to use. Spray patterns can vary from thin to about 1/2" wide by either adjusting the needle or installing a different, sealed nozzle.

In some brands, paint travels through the airbrush body to the needle. These require disassembling to clean. Other designs bypass the body and bring paint directly to the nozzle. These clean by simply spraying solvent through them.

Paints are either water (acrylic) or solvent based. Solvent-based paints spray best. Acrylics are difficult to spray and must definitely be used with the manufacturer's special thinner. Thinning water-based paints with water creates surface tension problems, resulting in poor coverage and spray atomization. If a manufacturer's thinner is not available, alcohol can be used as a substitute. Experiment when using acrylics as some modelers have success and others don't. When using solvent-based paints, work outdoors or equip your shop with a spray booth. These fumes are toxic.

Many brands of aerosol paints produce good results. However, test them on scrap wood before spraying the model. Aerosols put out a lot more paint than an airbrush, so be careful to avoid runs. Spray on several light coats. A tip from the automotive industry is to heat the spray cans a bit which increases the internal pressure and produces a finer spray. Heat only in hot water from your household sink; do NOT use a flame of any kind or boiling water.

Most paint manufacturers have special thinners for their various paint lines. Follow each manufacturer's recommendations. Mixing brands is not a good idea, because they may not be compatible. Sometimes, however, no other option exists. If so, apply each brand separately and allow to thoroughly dry before adding the next. Always test to make sure the final flat or gloss finish is compatible with the paint it will cover.

Masking surfaces: Masking can be a tricky process. Some brands of masking tape are worthless for model work, because they allow paint to seep underneath their edges. For masking fine stripes or straight and curved lines, use a graphic arts tape such as Chart Pak. It comes in widths as fine as 1/64". Chart Pak tapes have superb adhesion and won't bleed when firmly applied (burnishing is recommended). Scotch Removable Magic Tape is also excellent. Scotch tape has the same, low stick adhesive as its famous Post-It pads. In fact, Post-It tape flags can be used for masking.

Building the Undercarriage

In the days of the Conestoga wagon era bolt heads and nuts were square. This was especially true in the coach; wagon, carriage, and farm implement industries. Square head bolts and nuts at our model scale are not available and are very expensive to manufacture in small quantities. We have solved the problem for the kit by using rod material and escutcheon pins to simulate bolts and providing laser cut square nuts.

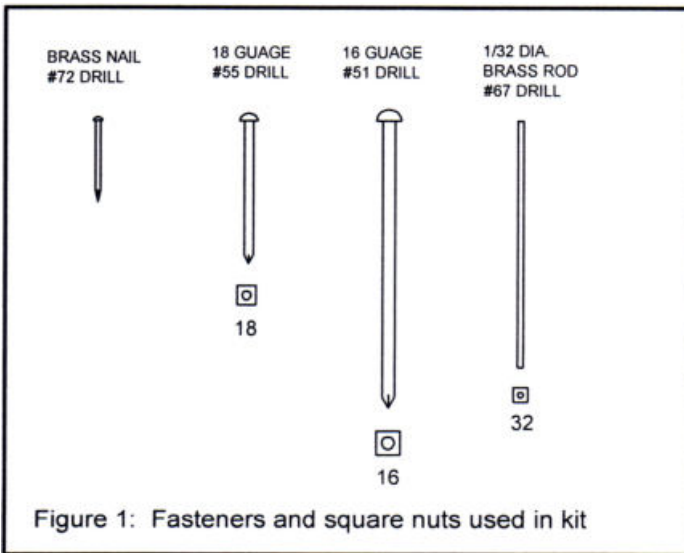


Figure 1: Fasteners and square nuts used in kit

The nuts are cut from a homogeneous tough material and can be readily glued in place. These are found on laser cut sheet CW-9. Once painted this combination of rod or pin and nut represent scale bolted connections very well. They are somewhat delicate. It is best to clear the center holes before removing the nuts from the sheet. To do this use an appropriate size drill bit holding the nut down to a suitable surface. In some cases the centers will fall out, in other cases they must be coaxed out. Cut the tabs holding the nuts in the sheet and cut the nuts apart with a sharp blade. Handle carefully when installing. Three nut sizes are provided, Two scaled to fit a simulated bolt made from 18 and 16 gage escutcheon pins, and one to fit a simulated bolt of 1/32" diameter. We will refer to these nuts on the plans and figures with the numbers 18, 16, and 32.

To make square headed simulated bolts out of escutcheon pins, refer to figure 2. The brass pins are soft and easily formed into square headed shapes. If you have a sturdy vise with smooth jaws you can squeeze the heads square. It is easy enough to just hold the pin head on a hard smooth surface and tap with a hammer. After forming the head square, file a bit of the roundness off, flattening the head.

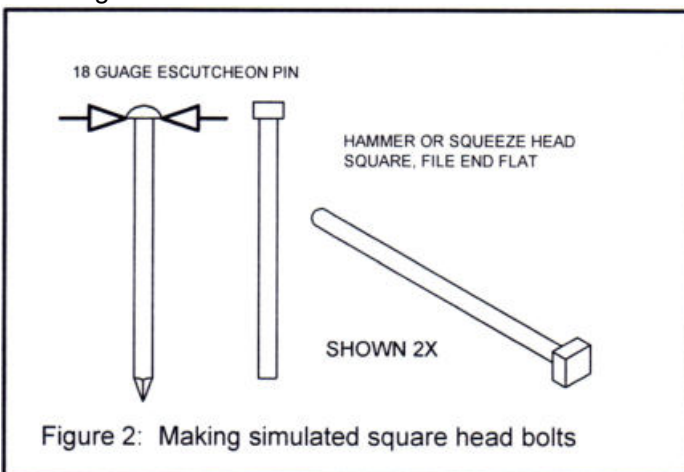


Figure 2: Making simulated square head bolts

The undercarriage of a Conestoga wagon is a curious structure that was probably developed over hundreds of years of wagon building. The front wheels and rear wheels are attached to structures called respectively front hounds and rear hounds. Each of these structures resembles a two wheeled cart.

They are connected together with a pole called the coupling pole. Each is pinned to the coupling pole with a heavy bolt. It is thought that this design evolved to be sturdy and flexible to take the punishment of travel over rough roads. Study the plans to familiarize yourself as to how the parts of the undercarriage go together.

Building the Fore Carriage

Front upper bolster: Refer to Detail 1-1. Locate two parts 30, two 2 parts 31, and two parts 32. Glue parts 30 and 31 together as shown in Detail 1-1. Sand the assembly to remove char. Carve the tenons on parts 32 as shown and glue in the slots left in parts 32 as shown. All heavy timbers on a Conestoga Wagon were heavily chamfered on their corners. This was probably done with a drawknife. Doing this will improve the appearance of your model and is easily done with a hobby knife and #11 blade. The chamfers should be crisp and not dulled by sanding. Form and blacken one brass part B5 and secure to the bolster with shortened 0993 nails. Ensure the part is centered by passing a #16 pin through the bolster. Note that the front upper bolster will later be glued to the wagon body.

Front lower bolster: Refer to Detail 1-2. Locate part 07, two parts 05, two parts 06 and part 04. Glue parts 05 and 06 to part 07 as shown. Use #16 pins to space the parts and ensure they are aligned. Glue part 04 to parts 05 and 06. Sand the assembly to remove char and chamfer the corners. The front upper bolster will be glued to the front hounds but first the notches must be prepared. The laser cut parts are designed so that the notches are spaced and sized to the extremities of the final notch and require only the removal of the corners. Note on Detail 1-2 and Figure 4 how the cut lines intersect the corners of the parts.

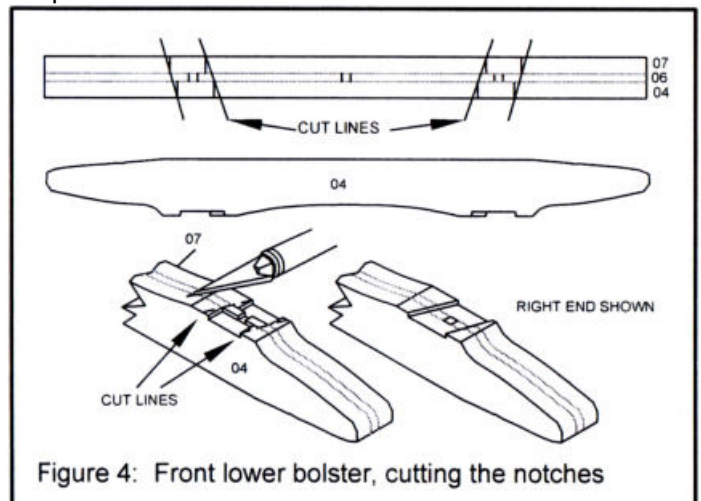


Figure 4: Front lower bolster, cutting the notches

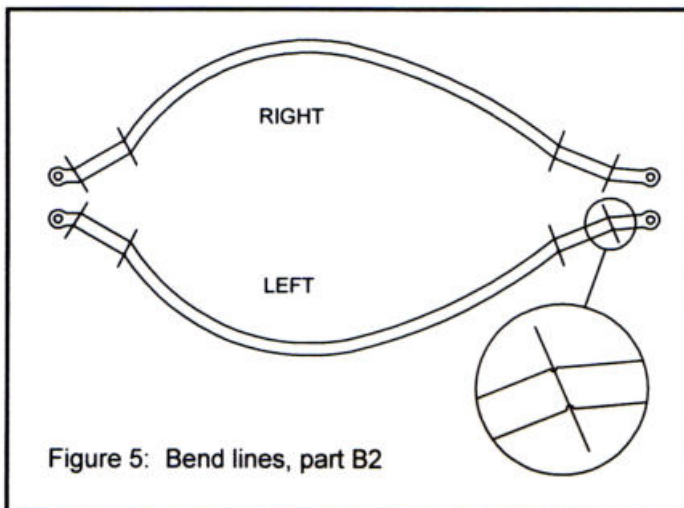
Complete the assembly by adding brass part B5 as shown.

Front axle tree: Refer to Detail 1-3. Locate parts 08, 09, and 10. Assemble as shown. Carve and clean out the notches as shown and as you did for the front lower bolster. Chamfer the corners of the assembly all around. The axles are 3/16" dowel. Cut 4 pieces 1 and 11/16" in length and chamfer the outboard end slightly. Glue two axles into the slot pushing them all the way in. Lay the assembly over the full size axle tree on plan sheet 1 and align the axles to the angle shown. Allow to dry thoroughly before handling. The other 2 axles are for the rear axle tree.

Assembling the fore carriage: Refer to detail 1 -4. Locate parts 01L, 01R, 02, and 03. Part 03 is notched into the hounds 01L and 01R about 1/16". The notches have been laser etched into the hounds making them easy and accurate to carve. Glue the hounds to part 02 and part 03 to the hounds. Insert #18 pins through part 03 and through the hounds. Lay the assembly over the full size plans to ensure proper alignment and let dry. Chamfer the corners of the hounds and part 03 as shown.

Make up and blacken two #16 square head pins and six #18 square head pins. Fit the front lower bolster to the hounds at the location defined by the laser engraved lines. Glue in place using #16 pins through the bolster and the laser cut holes in the hounds to ensure alignment. When dry, fit the front axle tree in its proper location directly below the bolster. Make sure the bolster and axle tree are parallel to each other and glue the axle tree in place. Pass a #51 drill through the bolster and drill all the way through the axle tree 3 places for the #16 pins. When drilling the center hole (for the kingpin) be careful to center the drill on the axle tree. If your holes are slightly off center it will not be seen in the finished model.

Bend and shape two parts B2, making a left and a right as shown in Detail 1-4. The bend lines are indicated by small notches etched into the parts as illustrated in Figure 5. Grip the parts with pliers carefully aligning the pliers along the bend lines between the notches and make the bend.



Bend two parts B3 to shape and assemble as shown.

TIP: Depending on how accurately the axle tree was aligned with the bolster and how accurately the pin holes were drilled you may find the span between the holes in part B3 a little long or a little short. This can be easily remedied by placing the part in a vise and elongating the holes with a round needle file. Finish off all pins with square nuts, snip them off and square the ends. Shape part B4, the axe holder, as shown on plan sheet 1. Attach in the location shown with 0993 nails. Locate the axe handle, part 66, and carve and sand to shape. Form the axe head, part B23 and glue to the handle with epoxy glue. The space left in part B23 may be filled with any hobby filler. Insert an eyebolt and split ring in the location shown. Make up black paper strips to the widths shown on plan sheet 1 and glue in place. The black paper sold for mounting photographs in albums is ideal for this as it is black through and through. Otherwise painted card stock will work as well. This finishes the front carriage assembly.



Photo 1: Front Carriage Assembly

Building the Rear Carriage

Rear bolster: Refer to Detail 1-5. Locate parts 12, 13, 14, 15, and 16. Assemble in the order shown using #16 pins to align the middle parts. Carve the notches for the hounds observing the cut lines depicted in Detail 1-5. Chamfer the corners of the bolster all around.

Rear axle tree: Refer to Detail 1-6. Locate parts 17, 18, and 19. Assemble as shown. Carve the notches for the hounds observing the cut lines depicted in Detail 1-6. Chamfer the corners of the axle tree all around. Glue in the axles and use the full size drawing of the axle tree to ensure the correct alignment of the axles.

Assembling the rear carriage: Refer to Detail 1-7. Make up and blacken two #18 and four #16 square head bolts. Locate parts 11L and 11R. Note that the location of the rear bolster is laser engraved into these parts. Glue 11L and 11R together at the fore ends and glue the rear

bolster across them at the engraved location. Insert #16 pins through the bolster and the hounds to ensure alignment.

Glue the rear axle assembly to the structure as shown, ensuring that the axle is directly below and parallel to the bolster. Pass a #55 drill through the bolster and drill down through the axle in four places as shown. Chamfer the corners of the hounds all around.

Locate brass parts B1, two parts B7, and two parts B30. Shape parts B7 and B30 as shown. Prepare two short pieces of 1/32 rod which will pass through part B1, through the hounds, and through part B30. Just make these extra long to be snipped off later after assembly. Assemble these parts as shown and finish with square nuts. Snip off the pins and rods to appropriate length and file their ends square. Install the two center #16 pins through the bolster and axle and apply square nuts.

Drill #72 through part B1 and the hounds and install 4 0993 pins as shown. These do not require nuts. Cut a strip of black paper to simulate an iron band and glue in place as shown. Carve the tenons in two parts 21, left and right and glue in place. This completes the sub-assembly of the rear carriage. Next we'll add the brake system assembly.

Brake system assembly: Study the full size top view and the exploded view of the brake system on plan sheet 2, and the full size views on plan sheet 1. Refer to Detail 2-2. Locate the beams parts 12 and 13, and two parts B6. Glue parts 12 and 13 to the hounds aligning them with pieces of 1/32 rod through the holes. Make up four pieces of card stock shims as shown and glue to the top side of parts 12 and 13. When dry drill up through the holes with a #67 drill. Glue two parts B6 to the underside of parts 12 and 13 and then insert four 1/32 rods leaving long on the topside. Finish the bottom side with square nuts. The other two parts B6 will be installed after installation of the brake system.

Cut a piece of 1/8" dowel to a length of 3 7/8". Locate all parts included in Detail 2-4. Locate 4 parts 60 and assemble on the dowel. Use Detail 2-3 to space and locate parts 60 on the dowel. Spot glue parts 60 and let dry, then run a bead of glue all around to secure them. The brass link B28 is 0.016" thick so use a couple of pieces of card stock or similar to space the parts 60. Note that the left end of the dowel will extend further than the right end. This is a good time to glue up the brake handle from 2 parts 62. When dry clean out the char in the 1/8" hole and check for fit to the dowel. Set the brake handle aside as it will be the last piece to install to avoid damage during further building operations.

Refer to the full size Detail 2-1 and lay brake beam, part 15 on the layout and mark the location of the holes which will accept parts B29. Drill #67 through part 15 two places. Check that part B29 will pass through the holes. Parts 16 may be glued to part 15. Note that parts 16 are not symmetric and have a distinct top and bottom. Refer to the full size side view on plan sheet 1. Open the eyes of parts B29 and insert parts B28. Insert parts B28 into

the crank arms, parts 60, and secure with pieces of 1/32 rods and square nuts. Be careful that when gluing the nuts on that part B28 remains free to rotate. Locate 2 parts 0992 and cut to length 7/16" as shown in Detail 2-1. Fit this assembly into position. You may have to bend B28 slightly, but it will easily straighten after fitting. Slide two parts 0992 on the dowel and fit into the slots in the bolster. Glue parts 0992 in the slots. Gel type epoxy is best for this. Assure that all is in proper alignment while the glue cures.

Work the parts B29 through the brake beam 15 and glue in place. Finish with 2 square nuts. Drop the brake beam in place. Add the 2 top parts B6 and finish off with square nuts. Refer to Detail 2-5 and photo 2.



Photo 2, Rear Carriage Assembly

Assembling the undercarriage: Refer to Detail 2-6 and photo 3. Locate the coupling pole, part 20. Clear the holes and chamfer the poll all around. Prepare 2 #16 pins as shown for the coupling pin and the kingpin. Insert the pole between the rear axle and the rear bolster and under the front of the hounds. Insert the coupling pin. If necessary pass a #51 drill through the holes.

Pass the pole over the beam, part 03, and between the front axle and the front lower bolster. Pass the king pin through the front upper bolster, then through the front lower bolster, through the pole, and through the front axle. It may be necessary to clear the holes with a #51 drill. Remember that the front upper bolster will later be glued to the wagon box and become a permanent part of it.

Double tree and single trees: Refer to detail 2-7 and photo 3. Now is a good time to complete the double tree and single tree details before the wagon box is installed later. Locate 2 parts 66, the single trees. The taper is laser cut on one side. Taper the other two surfaces to match. Carve away the corners leaving an octagon shape. Then carve and sand the trees round.

Locate part 14, the single tree. Remove char and chamfer the corners. Glue and pin part B9 with 0993 pins. Cut off the pins and sand the ends flush on the bottom

side. Glue and pin part B8 with 0993 pins. Cut off the pins and sand the ends flush on the top side. Form and shape 4 parts B10 as shown in Detail 2-7.

The double tree was held to the fore carriage with a pin that also served as a hammer. Locate part 67, cut off the head of a #16 pin, and glue the pin to part 67. Carve part 67, hammer head, as shown. Locate 2 parts B21 and 4 parts B22. Form and shape and attach to the single trees as shown. Connect the single trees to the double tree with split rings as shown. Drill # 72 holes into the front axle at the approximate location shown and insert eyebolts to which the chains will attach. Position the double tree assembly on the fore carriage and secure with the hammer pin. Use a strip of paper or card stock extended between the double tree and the axle eyebolt with appropriate sag to determine the length of the chains.

Attach a split ring to one end of your chain, lay your strip of paper along side it and attach another split ring at your predetermined length. Cut off the chain and repeat for the second assembly. Attach the chains to the fore

carriage with split rings. This completes the undercarriage and we are ready for the wagon box.

Building the Wagon Box

Study the plans until you understand all aspects of how the wagon box goes together. Detail 2-9 shows how the understructure of the wagon box goes together but we will not build it that way. The reason is that there is considerable work to be done on the wagon box sides that is best done before assembling the sides to the understructure.

Begin by locating parts 41 and 42 and removing char. Lay the parts on Detail 2-8 and mark the locations of the front upper bolster, beams, crossbeam, and part B26. Make these marks on the bottom of part 41. Remember we are making a left and right part. Note that the hole in part 41 is at the rear of the wagon. Glue parts 42 to parts 41 as shown in Detail 2-10 then glue parts 43R and 43L to the 41, 42, assembly.

Photo 3: Undercarriage Complete with Coupler Pole, Double Tree, and Single Trees.

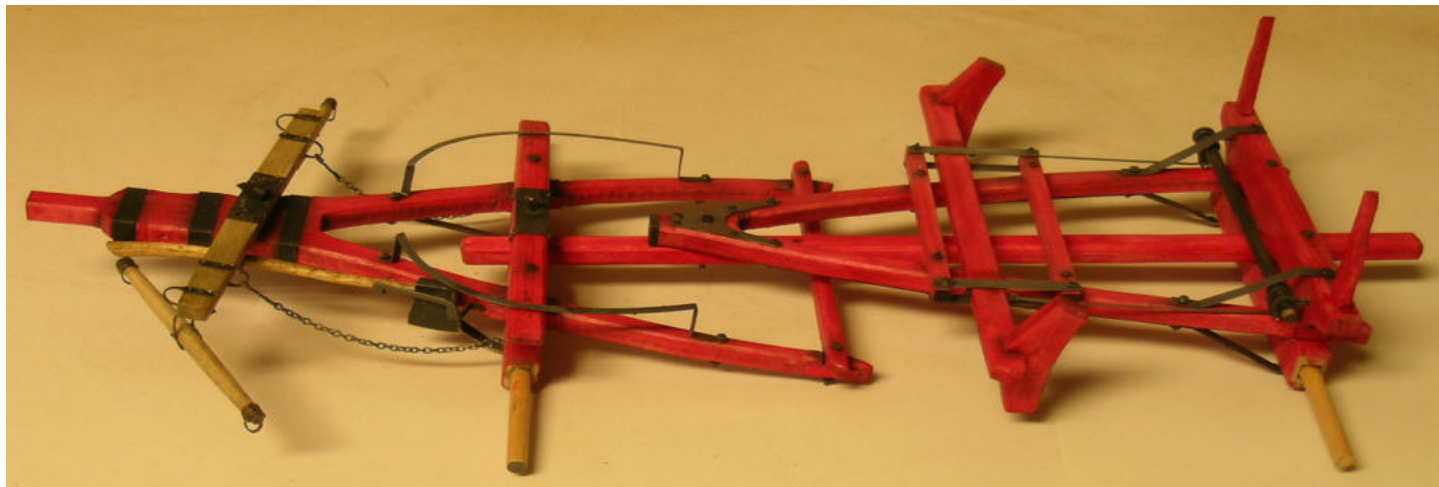
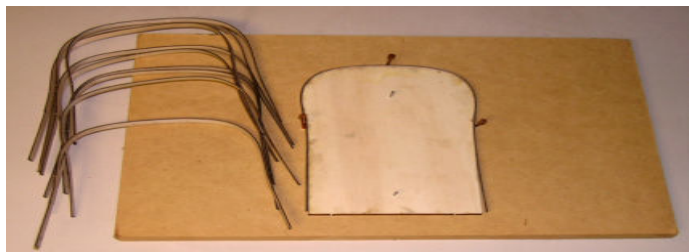


Photo 4: Forming the Roof Bows

Now is a good time to jump ahead and discuss the roof bows as it will take some time to prepare these. The bows are given letter designations of A through J. Refer to the parts identifier sheet 5 and laser cut board CW-7. Use a pencil to mark the letters on the bows for later identification. This is important as the bows are all unique and must be fitted in their proper location. It is not likely that you will be able to install the bows later without shaping them and even then they would not have the proper shape. Refer to photo 4.

Locate part K, the forming jig, on laser cut board CW-8. Tack nail the jig to a suitable surface. Soak a bow in water for a few minutes and then wrap around the jig assuring that the bow is centered and secure with 3 small nails as shown. Let this dry thoroughly preferably overnight. You can do one bow per day this way and not hold up your progress later. Now back to the wagon box.

Detailing the wagon box sides: Refer to Detail 2-11 and the full size side view on plan sheet 3. Locate parts 44 and 45. Remove char and glue in place on the wagon box side, part 43L. The location of part 44 is defined by gaps in the laser etched lines that locate the standards. Take care that the laser cut holes line up with the location of the standards. Both parts 44 and 45 have a rounded cross section as shown in Detail 2-11B, section drawing. This is easier to do after the parts have been glued to part 43L. Note that brass parts B12 and B15 attach to part 44.



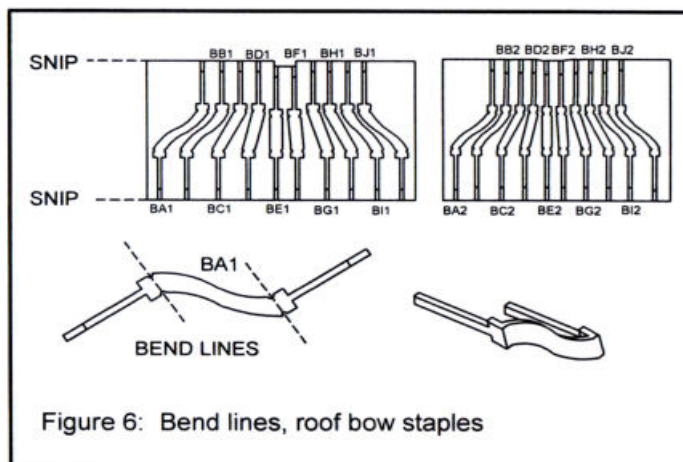
Do not round part 44 in way of these parts. Cut fit and glue in place the 1/16 x 3/16 basswood standards. There are 20 of these. Carve and sand the ends of part 45 to round sections as shown in Detail 2-11A, section detail. The tailgate and front gate will be fitted to these projections later. Refer to the side view on plan sheet 3 and mark the locations of the two draw bolts and drill #67 through the bottom rail and the top rail. Insert the 1/32 diameter brass rods through the holes. Note that the rods will have to bend slightly to fit over the mid rail, part 44. Finish with 1/32 square nuts.

Locate brass parts B26 and B14. Glue part B26 to the underside of the bottom rail using the location marks you make from Detail 2-8, remark if necessary. Part B26 should be centered on the bottom rail joint between parts 41 and 42. Drill #67 through the holes in B26 part way into the bottom rail and insert short pieces of 1/32 rod. Finish off with #32 square nuts as shown. Form part B14 to shape using the full size profile on Detail 2-11. Drill #72 into the bottom rail and install two 0993 pins. Be careful that the drill does not penetrate to the outside and mar your work.

The wagon box sides on the Conestoga wagons were constructed with rivets through the standards, sides, and iron straps on the interior of the box. For model work we need only to simulate the rivets on the outside of the box. Further, the roof bows, when installed, will cover any rivets other than those below the extent of the bows. Therefore we will only install two rows of rivets as shown in Detail 2-11. Mark the locations of these rivets with a pointed tool and drill through the standards and sides with a #72 drill. Install 0993 pins and cut off on the inside.

The roof bow stations are designated with the letters A through J from front to rear. The roof bow staples are photoetched brass and are identified with the letters A through J and the numbers 1 for the top rail and 2 for the mid rail. This should be evident in Detail 11. These identifiers are etched into the brass sheet. The layout on the brass sheet is reproduced here in Figure 6 for your convenience. Some staples may appear to be similar but they are all unique, no two are alike. To avoid getting them mixed up it is a good idea to blacken them before removing them from the brass sheet and to remove and install them one at a time.

Be sure to snip them off along the line indicated in Figure 6. Cutting them too short will not allow them to be clinched upon installation. The bend lines are indicated by small notches. Be careful to accurately align your pliers along these lines when bending to shape



The staples pass through the rails and are bent over on the inside to secure them. Their locating holes have been laser cut but will need to be drilled through the box sides. Use a #72 drill and drill all 40 holes.

Bend up a staple and install. It is a good idea to install both an upper and lower staple, e.g. BA1 and BA2 and then test the fit of bow A in the staples. If you incorrectly bend a staple it can easily be removed, straightened, and rebent. You can also shave the bows a bit if needed. Keep in mind that when you get to the other side (right side) these bends will be made in the opposite direction. Note that staple BA2 passes through part B12 and staple BJ2 passes through part B15. These parts may be installed now. Note that the holes in part B15 for the staples are not on the center line but are slightly offset. Observe the full size drawing of part B15 to get the proper orientation. Finally, install an eyebolt and split ring in the upper rail as shown. This will be the anchor point for the chain which supports the feed box at the rear of the wagon. This completes the left side of the wagon box. Repeat the procedures for the right side. Your side should look like Photo 5

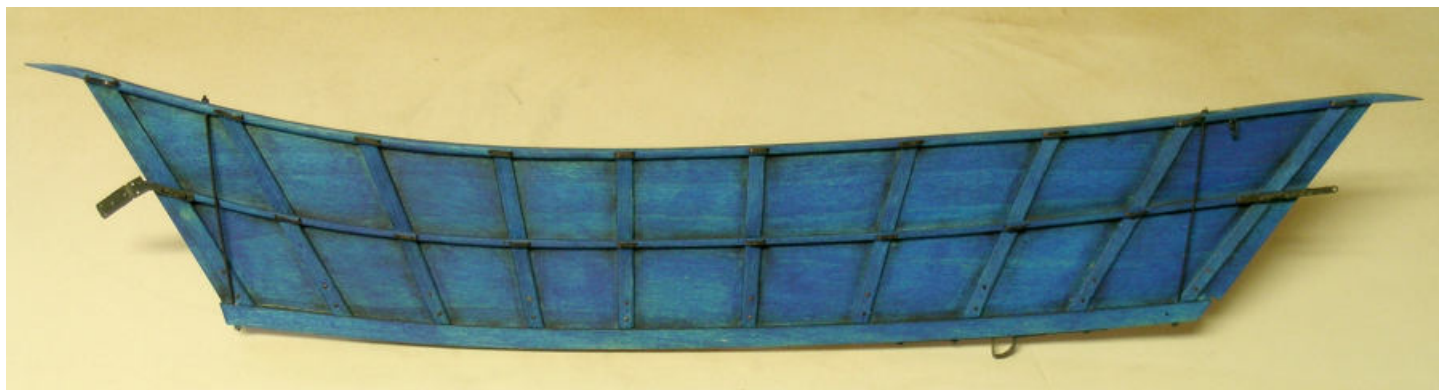


Photo 5: Wagon box left side

Assembling the sides and understructure: Turn the sides upside down and place them next to each other and verify that the locating marks for the cross pieces are still visible and that they line up with each other. Refer to Details 2-9 and 2-11. Place part 33 on the full size drawing in Detail 2-12 and mark the location of the tie rod holes, one each end, and drill for 1/32 rod. It is much easier to do this now rather than later. Glue the front upper bolster and the crossbeam, part 33, in their proper locations. Assure that the bolster and beam are square to the sides and that the sides are plumb. When dry enough to handle glue on the remaining parts 40.

TIP: A corner snipped off of a 3" x 5" card or similar serves well as a square when checking the squareness of an assembly.

Rear tail gate: Refer to Details 2-13, 2-13A, and 2-13B. Glue part 51 to part 50. Study the illustrations in Detail 2-13A concerning the unusual way the tail gate was supported by the extensions of the top rail. As noted the holes through the top of the gate were tapered and angled to fit over the rounded pointed ends of the top rail. We have accommodated this task for our model by laser cutting the exit holes in parts 50 and 51 and off setting them the proper distance. What remains is to carve and file out the holes achieving the effect of a tapered hole. This is easy to do using a #11 blade and a round needle file. Clean out the holes until you can properly fit the rear gate to the wagon box. Glue a piece of 1/8" square basswood crosspiece to the center of part 50 as shown. Cut fit and glue on the 1/16" x 3/16" standards. Use the full size drawing to determine the length and shape of the lower standards. Glue on parts B24 and B25.

Note that part B24 requires shaping to fit over the center crosspiece. Drill through the holes in the brass and insert 0993 pins and cut them off on the backside. Locate the rear crossbeam, part 52. Lay the part on the full size drawing below Detail 2-13B and mark the location of the two holes in the end and drill with a #67 drill. Dry fit the cross beam and the tailgate and make any adjustments necessary. The tailgate and crossbeam may now be glued to the wagon body. Be sure to center the crossbeam and that the lower standards are aligned with the holes that will receive the staples. Anneal a length of 1/32 brass rod and make up and install the staples. Form and install the 1/32 rod tie rods from the rear cross beam to the upper rail. Form and install 2 parts B11 with square nuts.

Refer to Detail 2-13B and Figure 7. Form a loop in part B16 as shown in Figure 7 and close through the hole in part B15. Finish by installing B17 with and 0993 pin and the 1/32 rod staple.

Front end gate: Locate parts 47, 48, and 49. Glue parts 48 and 49 to 47 as shown. Carve and file out the tapered holes in the front end gate and fit to the wagon box just as you did with the tail gate. Cut and fit the 1/16" x 3/16" standards as shown. Bevel the bottom of the end gate as shown in the full size side views.

Like the tail gate the front end gate was held together by rivets through the face and through iron straps on the inside. Use a pointed tool to spot the rivet locations and drill through the assembly with a #72 drill. Insert 0993 pins and cut off on the back side.

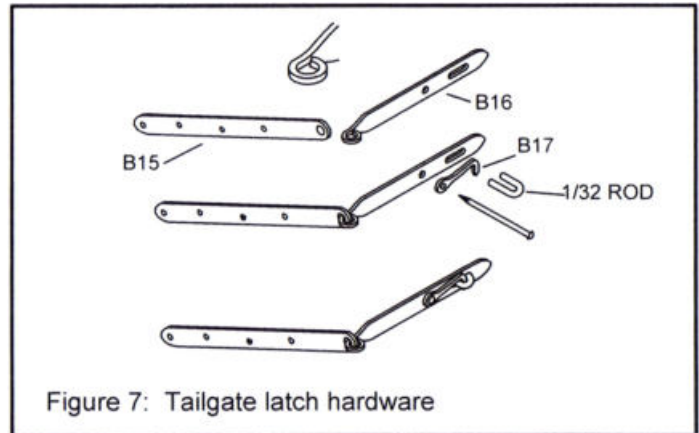


Figure 7: Tailgate latch hardware

Locate part 46, front cross beam, and fit the front end gate and part 46 to the wagon box. Glue these parts in place on the wagon body. Refer to Detail 3-2. Bend part B12 around the front end gate. If you have difficulty making a sharp bend part B12 can be easily removed to make the bend and then reinstalled. Bend part B13 to shape and install. Drill #72 through all holes in parts B12 and B13 and insert 0993 pins. Some of the pins will need to be cut short to prevent them from protruding in unwanted places. The floor boards, parts 63 and 64 may now be installed. Check the fit of the floorboards and make any adjustments necessary. Do not attempt to wet these boards to make them comply with the curvature of the understructure. They will likely cup which will make them difficult to install. Rather push the boards down and drill and install 0993 pins into the cross members.

Wagon box, final details: Refer to Detail 4-1, the underside drawing of the wagon box. Part 65 is called the lazy board. It was a seat that could be pulled out for the driver to sit on. It seems a bit precarious being positioned directly in front of the rear wheel. Form part B31 to shape and pin to the lower rail and the underside of the cross beam as shown. There would have been some means of securing the inboard end of the board which is not known. For model work simply glue the inboard end to the bottom of the floor boards. Refer to Detail 3-3. Form parts B27 to shape and install with 1/32" rods and square nuts as shown. The beams, parts 41 were held to the bottom rails with U shaped clips, parts 21. Shape parts B32 and drill #67 alongside parts 40 up through the bottom rail. Take care that the drill emerges approximately in the middle of the rail. Install parts B32 and finish with square nuts.

Refer to Detail 3-4, toolbox construction. Locate parts 52, 53, 54, and 55. Glue together as shown. Bevel the front of part 53 to receive the lid, part 55. Finish by installing the brass parts B19 and B20.

Drill through the brass parts to receive 0993 pins and insert pins, cutting them off on the inside of the toolbox. A tie rod extended from the cross beam to the top rail and passed right through the tool box. For the model we need only to provide dummy rods top and bottom since the portion inside the toolbox will not be seen. Study Detail 3-4 and install these parts. Fit the toolbox over the tie rod and glue it to the wagon box side as shown on the full size side view on plan sheet 4. The toolbox is approximately parallel to the standards. On the other side of the wagon box the tie rod can be installed full length. Controlled refer to Detail 4-2. Locate the parts 56, 57, 58R, and 58L. Assemble the feed box as shown. Hang the tool box with chain as shown in the full size side view. Use split rings and a hook made from an eyebolt or simply open the eyebolts slightly and insert the chain.

Roof top canvas: The canvas top was made in three pieces, a top section and two side panels. Patterns for these pieces are shown full size on plan sheet 3. The roof bows form a saddle like shape and it is not possible to make a single piece of cloth conform to this shape. Think of how a hot air balloon is constructed, from shaped panels called “gores”. Our roof top canvas is not so complicated and requires only three pieces so shaped as to fit the saddle shape formed by the bows. Patterns for the panels are provided on plan sheet 5. If you don’t wish to cut up your plan sheet you can have a copy made. It is recommended that you cut out the patterns leaving excess around the edges and spray glue the patterns to poster board and then cut them out to the lines. This makes much stiffer patterns and will help considerably when tracing the pattern shapes onto your cloth material.

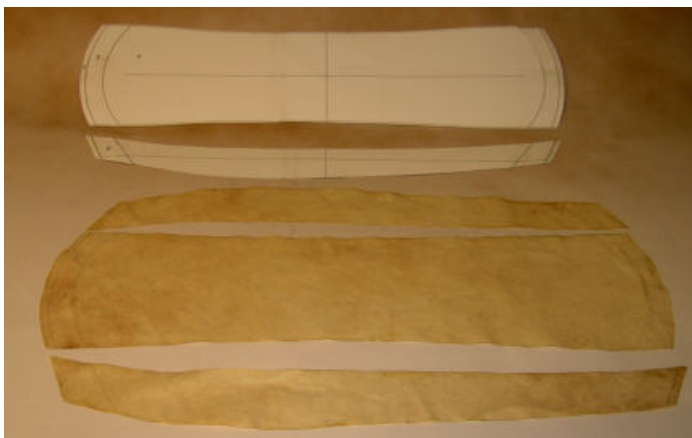


Photo 6: Roof patterns and canvas panels

The cloth (canvas) supplied is of an off white color and may be used as is. If you would like a little aging effect immerse the cloth in a dilute solution of Rit tan dye. This is how the prototype model was built. After drying iron the material to remove the creases. Lay the patterns on the material and mark around them with a soft pencil. It is important to prevent the edges of the material from fraying after they have been cut out. There are several products available in the fabric and sewing departments of

stores that are sold for this purpose. They are a clear glue like product that when spread along a cut line will prevent the material from fraying. Apply along the lines of your patterns and when dry cut out your panels.

It is advised that you not try to sew the panels together as even the smallest stitches will be grossly out of scale. Rather use fabric glue from the sewing department. Liquid stitch is one such brand. Observe which ends of your patterns are the front ends and begin gluing a side panel to the top panel. The side panel overlaps the top panel by about 0.070” as indicated by the lines on sheet 5. Run a bead of fabric glue a few inches at a time and secure the side to the top. The glue grabs very quickly, and then proceed to the next few inches. Install the draw lines by folding over the tabs as shown in Detail 3-5 and securing with fabric glue. As you proceed keep pulling on the draw line to ensure that you have not glued it to the material.

Place the roof top on the model, again observing which end is the front end and begin drawing the lines to draw the roof top ends over the end bows. Try to make the folds and tufts as small and as close together as possible. The ends of the draw lines were crossed and tied off at any convenient location, around a roof bow end, for example.

The canvas was held down by lacing which ran along the lower edge of the side panels and laced around the roof bows below the top row of bow staples. Refer to the lacing drawing Detail 4-3. Begin by making a hole in the canvas in the approximate location shown at bow A. Use a sharp point such as a compass point to make the hole. Pass the line through the hole and make a stopper knot on the inside. Bring the line forward and then under the top bow staple and behind the bow as shown. This pulls the canvas downward and well as forward. Proceed along the lacing path until you get to bows E and F.

Note the location of the holes changes and so does the path of the lacing. This is to provide both downward pull and pull to the rear.

The ends of the lacing are tied off at any convenient point such as the rear tie rod.

With the canvas roof installed the brake lever may now be permanently attached. Note the chain attached to the brake lever as in the side view on plan sheet 4. The working end of the chain was wrapped around the cross beam.

The Wheels: Making wagon wheels as the originals were made is an extremely laborious and exacting task requiring great skill. The wheel rim was made of individual segments called felloes. The joints of the felloes are indicated on the side view on plan sheet 4 and Figure 8.

Each felloe was mortised for two spoke ends. The hub was turned and mortises carved for the spoke tenons, then bored for the axle. The axles were clad with iron plates and the hubs bound with iron bands.

The wheel was assembled on a jig which gave the wheel a pronounced dish.

The dish creates a truss like effect that makes the wheel much stronger. Axles were canted downward so that as the wheel rotated, the spokes met the ground perpendicular to the ground. See the illustration in Figure 8. The iron tire was rolled to shape and the ends welded to form a ring. The iron tire was heated red hot in a fire to expand it and then forced onto the wheel.

The hot tire was immediately quenched with water. As the tire cooled it shrank and contracted which compressed the wheel assembly tightly together.

Fortunately, our wheel construction method is so designed as to simplify this complexity. The wheel hub is a casting, the spokes are laser cut, and the wheel is a continuous ring laser cut from 1/4" plywood. The wheels are assembled over a jig ensuring proper alignment of the parts and the proper dish. No mortising is required.

Remove the wheels and assembly jig from board CW-11. Sand the wheels to remove loose char. Since they will be painted it is not necessary to remove all the char. The joints of the felloes have been simulated by laser engraving the wheel. For a bit of added realism the felloe joints can be carried around the wheel by making a shallow cut with a razor saw. Cut out the wheel patterns from the sheet provided and carefully cut out the center hole. Place a pattern in alignment with the hole in the assembly jig as shown in Figure 8. Lift the corners and place a dab of glue to secure the pattern. Turn over the jig and apply the other wheel pattern. Locate the rectangular riser blocks on board CW10 and glue in place on the jig as shown. The purpose of the riser blocks is to elevate the jig to clear the protrusion of the wheel hub.

It is a good idea to cover the pattern with waxed paper to avoid inadvertently gluing the wheel assembly to the jig. Position a wheel on the jig and align the circumference and the felloe joints with the pattern. Drill hole for pins and secure the wheel to the jig.

Check the wheel hubs for flash and clean up with a file. Check the fit of a 3/16 dowel in the bore of the hubs. You may need to clean up the bore with a round file. Wash the wheel hub parts in soap and water using a brush such as an old toothbrush to remove any traces of mold release and finger oil.

Assemble the wheel hubs with a few drops of CA glue. Note that the outboard end of the hub goes down into the jig. Insert a hub in the center hole and you are ready for the spokes.

Remove the spokes from board CW-10. Note that the spokes are not symmetrical. Study Figure 8 and the cross section of the wheel shown to familiarize you with how the spokes fit into the wheel and their proper orientation. Carve and sand the spokes as shown in Figure 8 to an oval shape at the outboard ends. This may seem like a tedious task but after a little practice it takes less than a minute to finish a spoke.

Extra spokes are included if you should ruin one. Cut a few pieces of 1/32 ply for spacers as shown in Figure 8. These spacers raise the spoke at the wheel joint to center the spoke on the wheel. Check a spoke for fit and adjust as necessary.

You may have to sand the butt end a bit in order to fit into the hub and butt to the wheel. When fitted apply a medium viscosity gap filling CA glue to the joints at hub and wheel. When all spokes have been fitted as in Photo 7, remove the wheel from the jig and liberally apply CA glue to the other side.

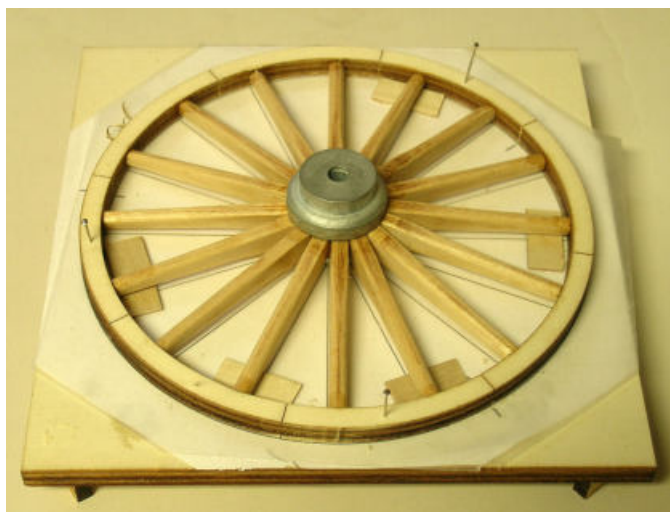


Photo 7, completed wheel assembly

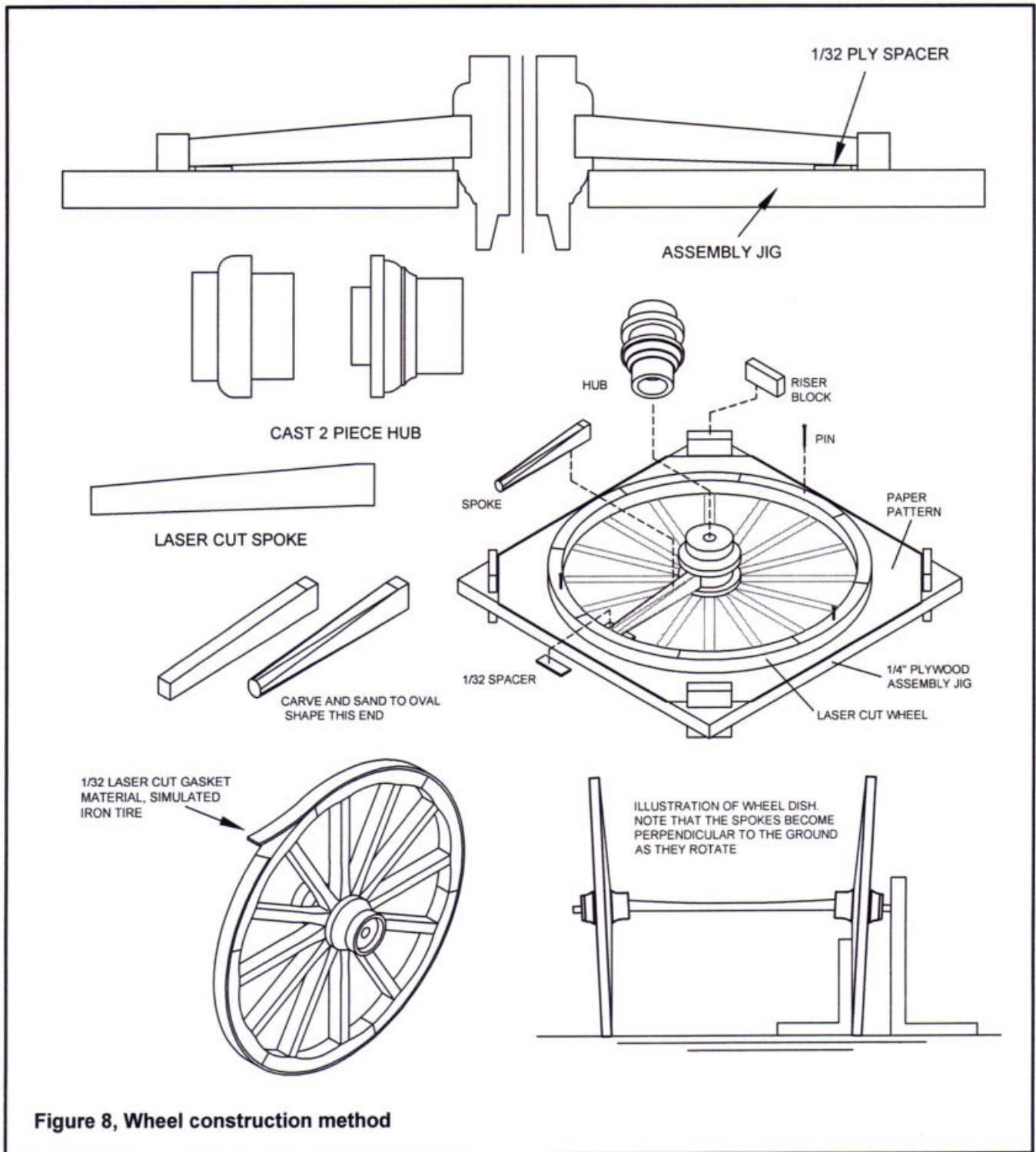
Paint the wheels red. While the wheels can be brush painted, an air brush or aerosol paint will make short work of this task.

Cut black paper strips using Detail 4-4 as a guide and glue to the wheel hubs as shown. Locate the simulated iron tire strips on CW-9 and glue around the tire as shown in Figure 8. Locate 4 parts 68, wheel nuts, and soak them with thin CA glue to strengthen them.

When dry check them for fit to a scrap piece of 3/16 dowel. The glue may swell the bore making for a tight fit. If needed work the bore with a round needle file for a good fit. Paint the nuts black. Install the wheels and secure with a part 68 nut. Apply a dab of CA glue to secure the nut to the axle being careful not to glue the wheel to the axle.

That's it! You are finished. Stand back and admire your work.

A note about handling your model: the wagon box is held to the undercarriage only by the kingpin as it is with the full size wagons. Warn your friends and family to handle the model only by the undercarriage or better yet only by the wheels.



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