

# LocoGear

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## **Technical Bulletin - 06**

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### **Fabricating Instructions for: Tender Frame End Casting - 853-B-5005 Safety Link Bar - 372-A-5082 Engine and Tender Clevis Pins - 372-A-5083**

The following instructions are a step by step description of the process for fabricating the Tender Frame End Casting (Lima Drawing Card Number 853-B-5005), the Safety Link Bar (Lima Drawing Card Number 372-A-5082) and the Engine and Tender Clevis Pins (Lima Drawing Card Number 372-A-5083). Only one of each part is used on the **Western Maryland Railway #6**. Note that all of these parts were also used on Lima's **Pacific Coast Shays**. You may also want to use as a reference the **WM #6's** Tender Frame drawing (Lima Card Number 858-A-5000). The Tender Frame drawing shows the Tender Frame End Casting in great detail.

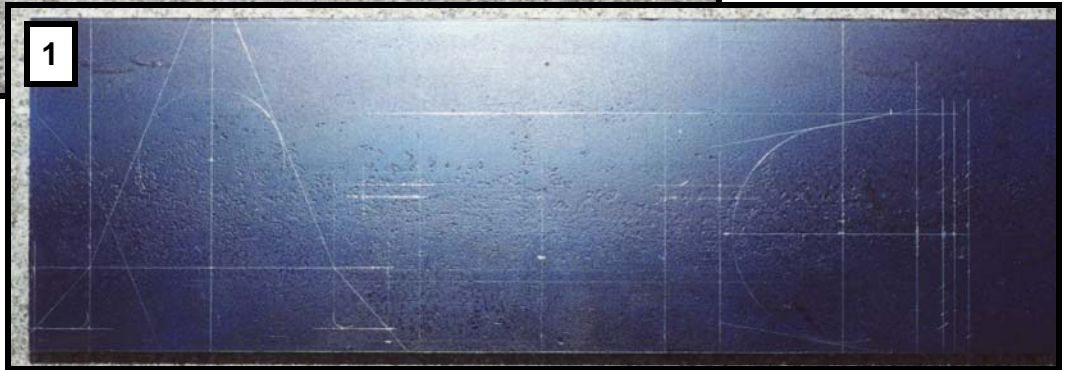
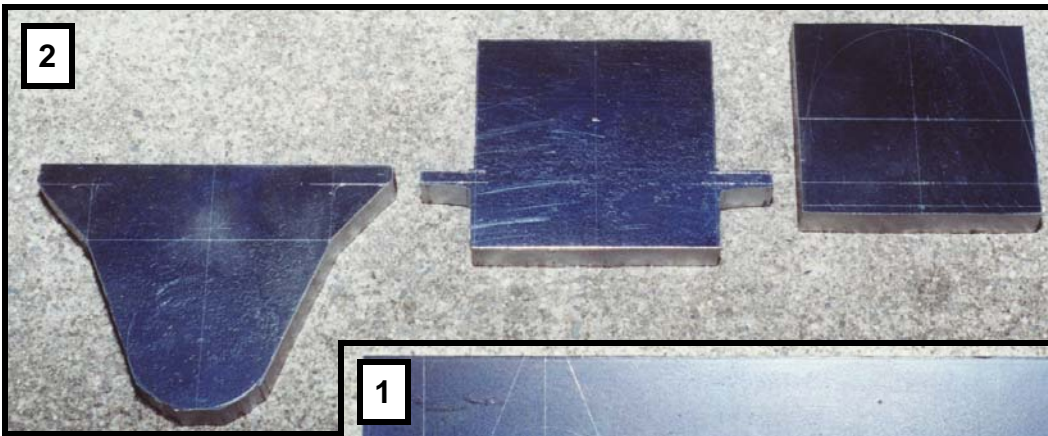
The Tender Frame End Casting is part of the Tender Frame and is the primary connection between the engine and tender. The tongue of the Tender Frame End Casting fits inside the upper pocket of the Engine Frame End Casting (Lima Drawing Card Number 483-A-5071) which are held together with the Engine Clevis Pin. The Safety Link Bar extends into the lower pocket of the Engine Frame End Casting and is connected with the same clevis pin. The Safety Link Bar also extends into the lower pocket of the Tender Frame End Casting and is connected with the Tender Clevis Pin. (See the prototype photos of these parts on the **Western Maryland Railway #6** on page three.)

Lima originally made the Tender Frame

End Casting as a single steel casting from Lima Pattern Number 85-110, but for the live steam model, this part can be fabricated from six steel pieces. The three large pieces, the Top, Center and Bottom Plates are cut from 1/2" cold rolled steel bar stock which are bolted and brazed together. The other three smaller pieces are made from 1/8" steel plate. We will begin by making the Top, Center and Bottom Plates, assemble them, and then finally rivet and weld these into place in the Tender Frame along with the smaller pieces.

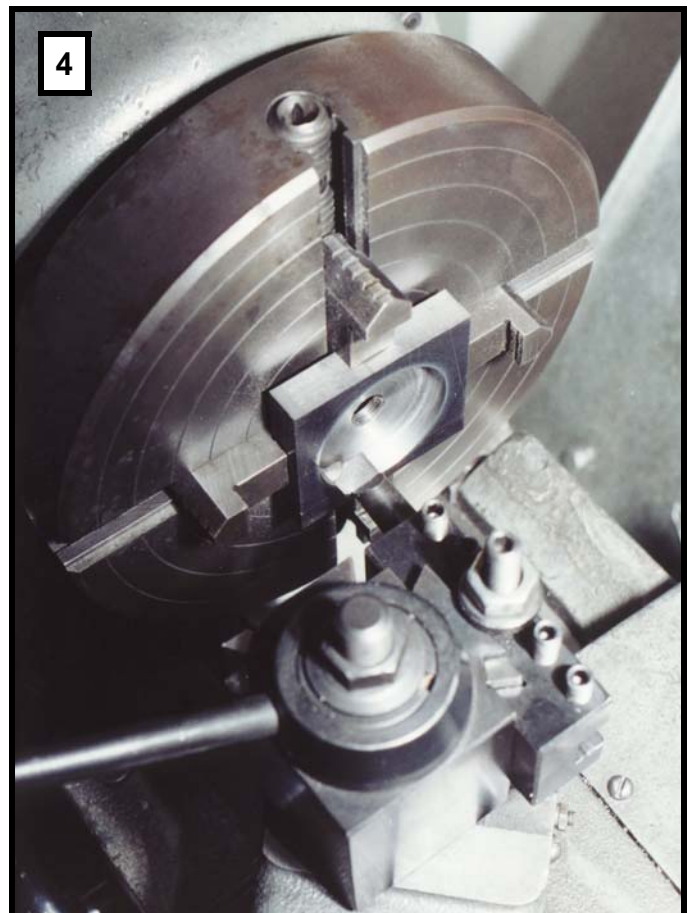
It should be noted that beginning with step 13, the Tender Frame should be nearly finished. The instructions to build the Tender Frame are **not** included in this **LocoGear Technical Bulletin**. The installation of the Tender Frame End Casting is the last component needed to complete the Tender Frame. A drawing of the Top, Center and Bottom Plates is on pages 6 and 7. A drawing of the smaller pieces is on page 10. A drawing of the Safety Link Bar is on page 12.

1. To begin making the Tender Frame End Casting, take a piece of 1/2" x 3" cold rolled steel bar stock and layout each of the three plates as dimensioned on the drawing on pages 6 and 7. The Top and Center Plates are then band saw cut to rough shape leaving as little material as possible to file,



grind and/or mill to the finished dimensions (see photos 1 & 2).

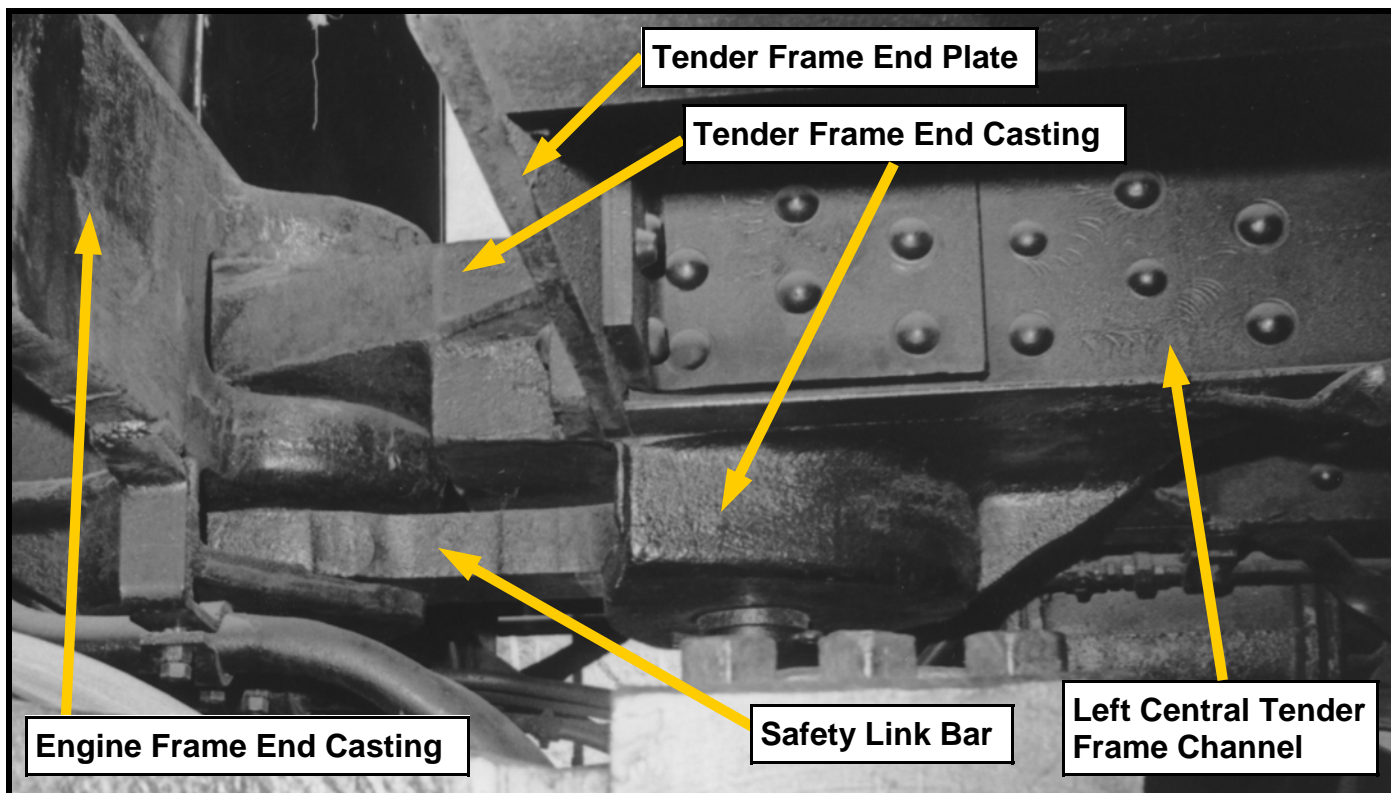
2. The Bottom Plate is rough band saw cut to about 2 1/2" x 2 1/4". The Bottom Plate is next centered in a four-jaw lathe chuck. A 1/2" hole is drilled through the center using a drill chuck in the lathe tail stock (see photo 3). Next a boring bar is setup in the lathe tool post and portion of the center hole is enlarged to 1.875" diameter and 0.312" deep (see photo 4). This will become the inside of the lower pocket of the Tender End Frame Casting used to connect with the Safety Link Bar.



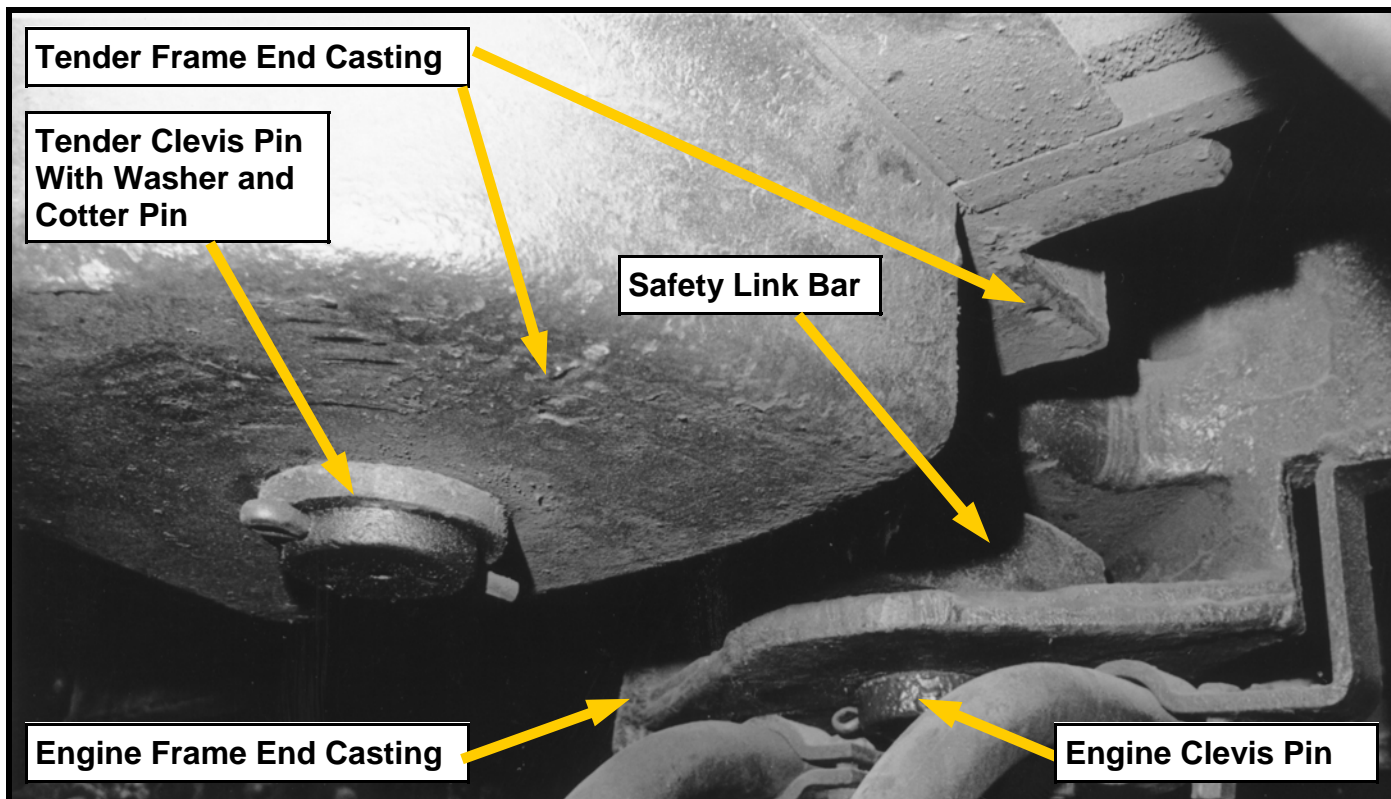
3. The Bottom Plate is then band saw cut across the front edge curve of the lower pocket leaving as little material as possible to then file or grind smooth to the finished dimension. This leaves

the two front corners which will be milled to their final shape in step 5, but first we need to make a clamping fixture in step 4.

4. In order to hold the Bottom Plate while machining the two inside front corners of the lower

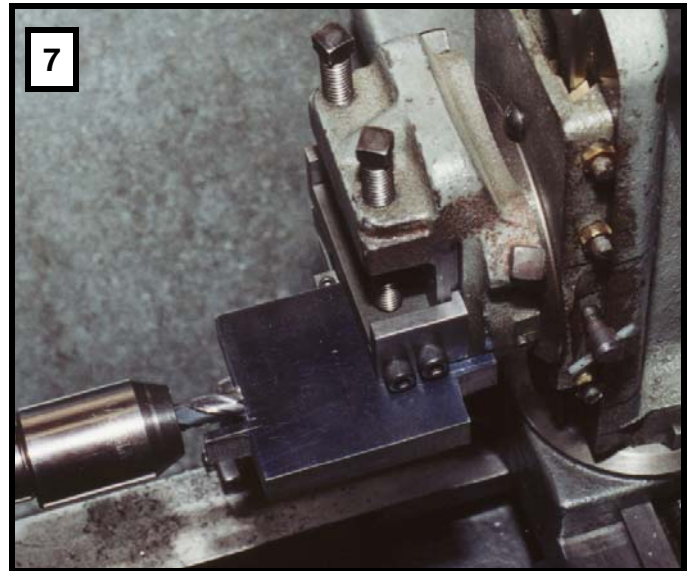
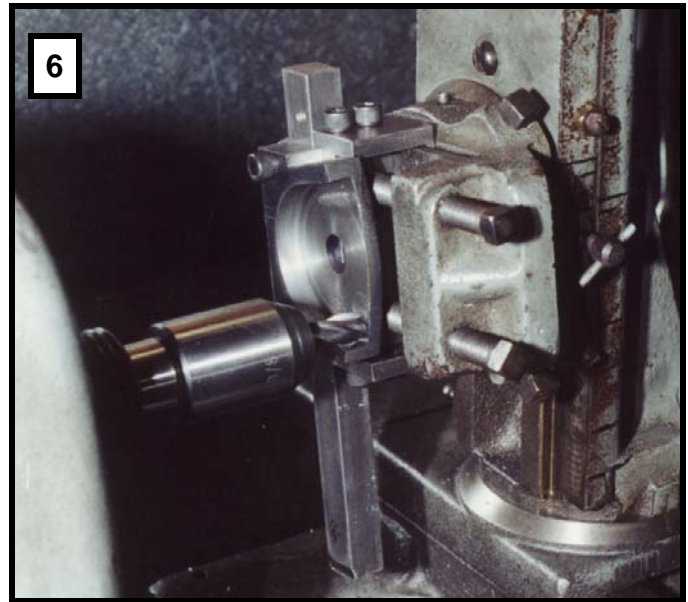
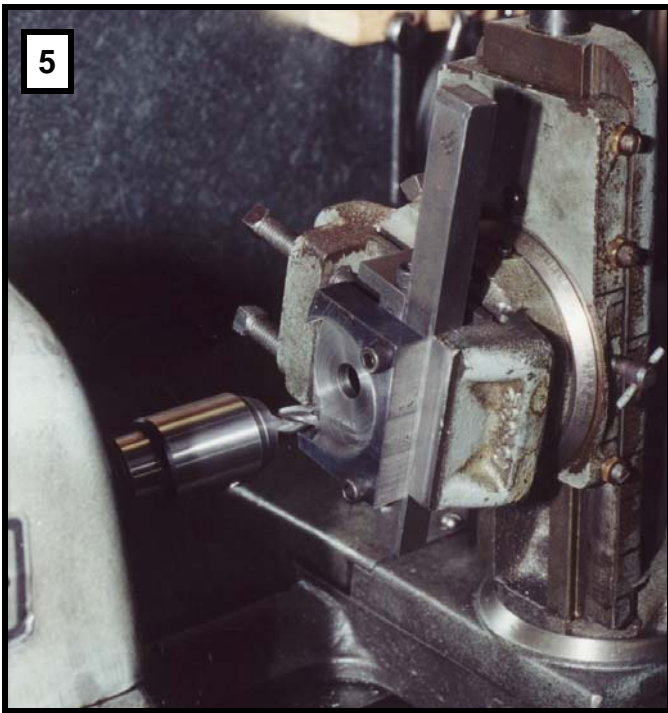


(Above) This prototype photo shows the Engine Frame End Casting, the Tender Frame End Casting and the Safety Link Bar on the **Western Maryland Railway #6**. This view is from the left side of the tender. Note the rivets through the left central tender frame channel connecting to the Tender Frame End Casting behind it. Also note the rivets which extend out the tender front plate through the side wing of the Tender Frame End Casting. (Below) This prototype view is from right side of the tender. Note that the Tender Clevis Pin uses a washer above the cotter pin. *Both Photos by Jim Salmons.*



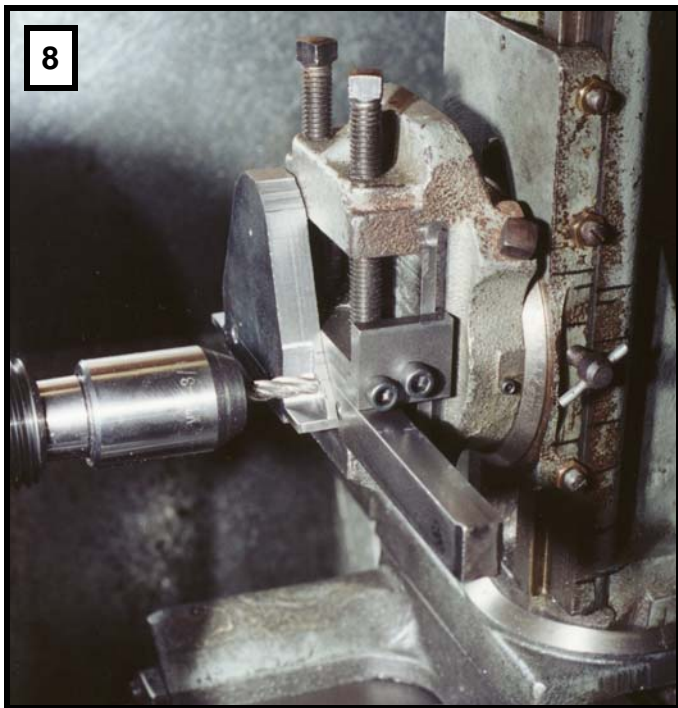


pocket, two 1/4" holes are drilled at the rear corners of the Bottom Plate in an area that will later be trimmed away. A piece of bar stock will be used as a fixture to clamp the Bottom Plate during the milling process in the step 5. This fixture is made from a piece of 1/2" x 5/8" cold rolled steel bar stock about 6" long which is drilled with two 7/32" holes matching the two holes at the back of the Bottom Plate and then taped 1/4"-28 tpi. Two 1-inch long 1/4"-28 socket head cap screws are used to hold the Bottom Plate to the clamping bar fixture. You may find it useful to drill the clamping fixture with additional holes to match the Center and Top Plates so that they can be clamped as well for milling.



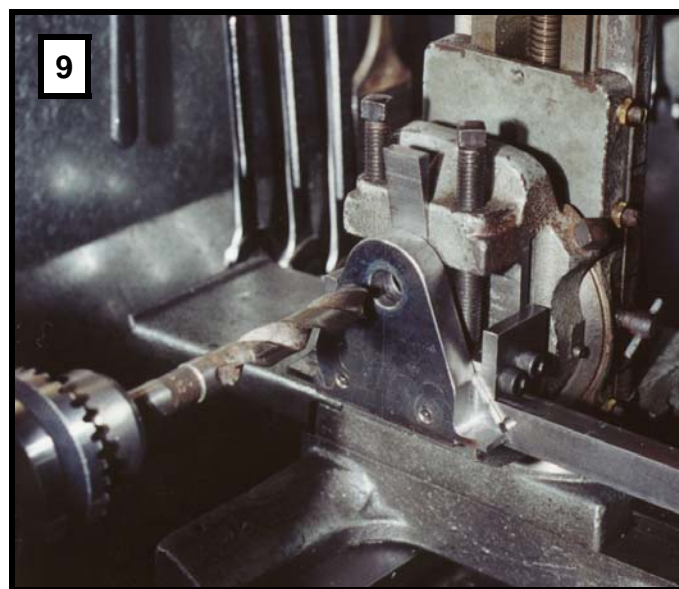
5. With the Bottom Plate bolted to the clamping fixture, clamp this assembly in the milling vise set at a 10-degree angle to mill out the inside front corners from the front edge to the tangent point of the inside back curve (see photos 5 & 6). Mill both inside front corners this way.
6. To finish the Bottom Plate, remove the clamping fixture and band saw around the outside rear edge leaving as little material as possible. Then file or grind to the finished dimension.
7. Mill all rough surfaces of the Center Plate to the finished dimensions (see photo 7). Note that the two side wings have a 1/8" radius to-

- ward the front which can be left by using a 1/4" diameter end mill, and are square toward the back. The front edge of the Center Plate is filed or ground to the finished radius of the curve as well as a radius along the bottom front edge.
8. Mill all rough surfaces of the Top Plate to the finished dimensions (see photo 8). The side wings are milled .375" deep from the top with a 1/4" end mill leaving the angled brace. Note that the two side wings also have a 1/8" radius toward the front which is left by the 1/4" diameter end mill, and are also square toward the back. The front edge of the Top Plate is filed or ground to the finished radius of the curve as well as a small radius along the top and bottom front edge.

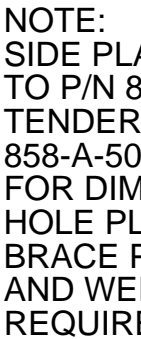


9. The Top and Center Plates each have three holes drilled in them. The 1/2" diameter hole in the Center Plate is aligned with the 1/2" diameter center hole in the Bottom Plate. This is for the 1/2" x 1-1/4" Tender Clevis Pin that is used to connect the Safety Link Bar. **NOTE** that on the model, we recommend the Tender Clevis Pin be oriented "upside down" with the flange below the Bottom Plate and the cotter pin hole above the Center Plate. There is **NOT** enough room for the Tender Clevis Pin to be inserted down into the hole from above once the Tender Frame End Casting is installed in what otherwise might be considered the "normal" orientation for a clevis pin. This is because the Forward Tender Frame Deck Plate covers the hole making this area nearly inaccessible. If the Tender Clevis Pin is positioned with the flange above the Center Plate, there is also **NOT** enough room to raise it high enough to insert the Safety Link Bar into the lower pocket and if the Tender Clevis Pin should need replacing, it will be very difficult to remove. The same problem was present on the prototype which Lima resolved by making cotter pin holes on both ends of the Tender Clevis Pin (see prototype photos on page 3). This method could also be used on the model, but with no advantage. If you follow our recommendation, **DO NOT** make the mistake of inserting the Tender Clevis

Pin from above before welding the Tender Frame End Casting into place, because you will never get the pin completely out! Since there is not very much room for full size hands to maneuver the cotter pin into the Tender Clevis Pin hole when it is inserted in the "upside down" orientation, it is recommended that a "snap" cotter pin be used instead of the standard "bent" cotter pin (see photo 12). Once the Tender Frame End Casting is installed, the "snap" cotter pin can be easily removed from the "upside down" oriented Tender Clevis Pin with a long needle nose pliers, thus allowing the Tender Clevis Pin to be completely removed for maintenance or replacement.



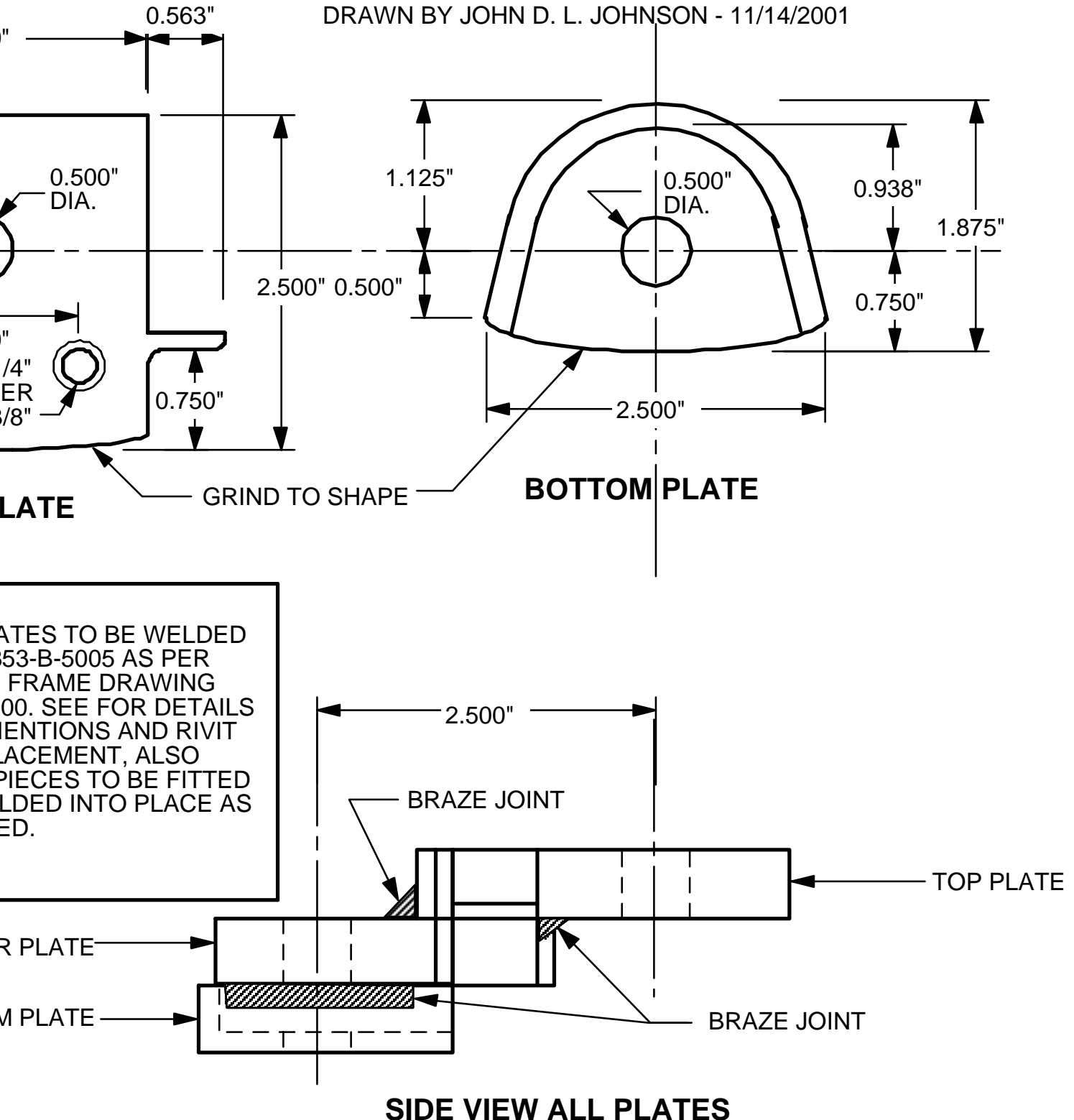
10. The 17/32" diameter hole in the Top Plate is aligned with the center hole in the Engine Frame Center, and is used for the 1/2" x 2-1/2" Engine Clevis Pin to connect the Tender Frame End Casting and the Safety Link Bar with the Engine Frame End Casting (see photo 9). This hole is made 1/32" larger to provide some play between the engine and tender. The tender may rock due to track conditions and some play will be necessary to avoid binding and possible breakage of any of these parts. A standard "bent" cotter pin was used on the prototype for the Engine Clevis Pin. Note that clevis pins of the two sizes required are commercially available, however, the drawing on page 8 shows their dimensions should you want to make your own.
11. The other two holes in each of the Top and



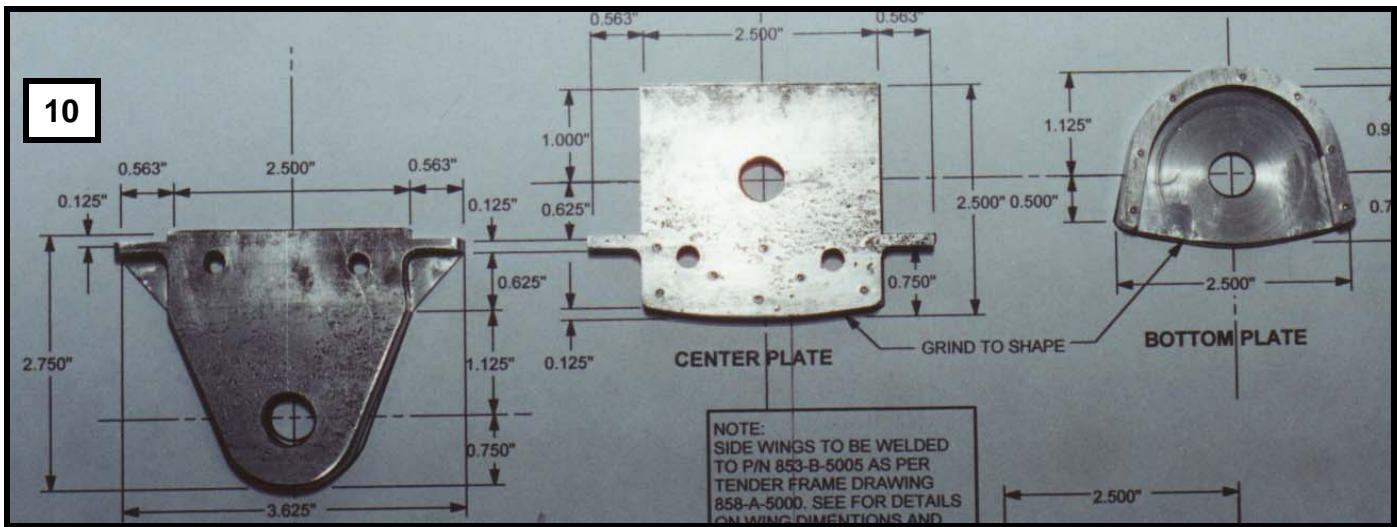
# WESTERN MARYLAND RAILWAY SHAY No. 6

## TENDER FRAME END CASTING TOP, CENTER & BOTTOM PLATES LIMA CARD NUMBER 853-B-5005

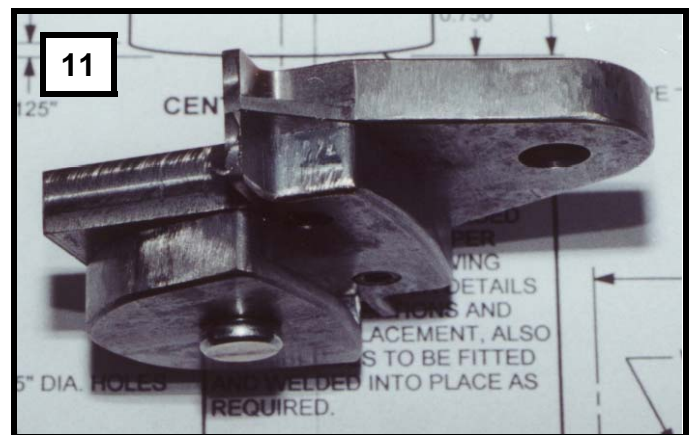
DRAWN BY JOHN D. L. JOHNSON - 11/14/2001



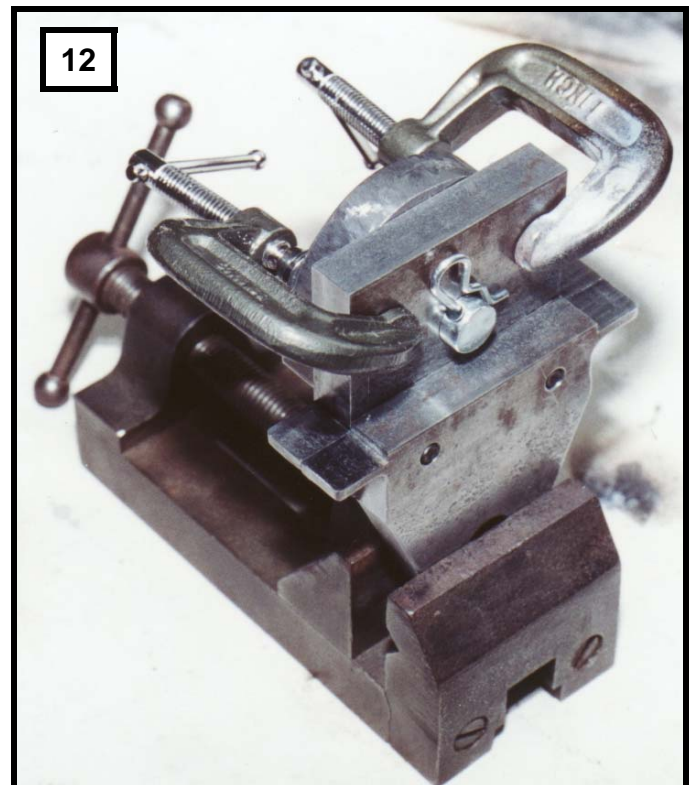




Center Plates are used to hold the plates together for brazing with two 1/4"-28 tpi socket head cap screws that are each 1-inch in overall length. The two 1/4" bolt holes in the Center Plate are counter bored from the bottom so the screws do not extend beyond the surface of the top of the Top Plate or the bottom of the Center Plate. The two bolt holes in the Top Plate are drilled 7/32" and tapped 1/4"-28 tpi. The alignment of the smaller holes is critical so that the center to center distance between the two larger holes used by the clevis pins is exactly 2.500". Once the Top and Center Plates are brazed together, the two screws are no longer needed, however, they can be left in place and just covered with filler before final painting.



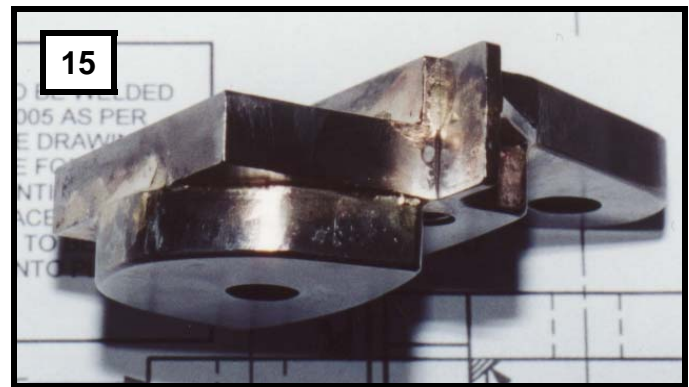
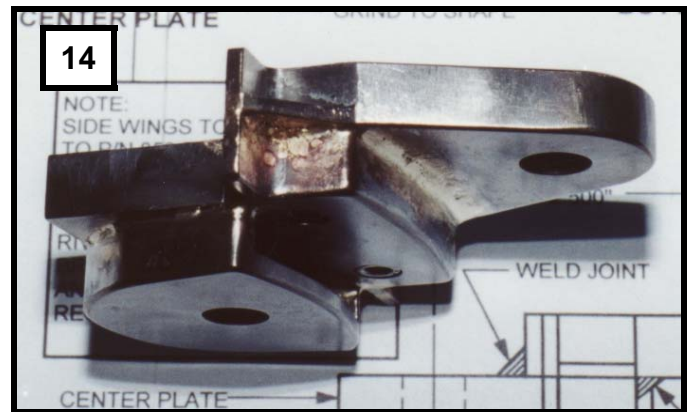
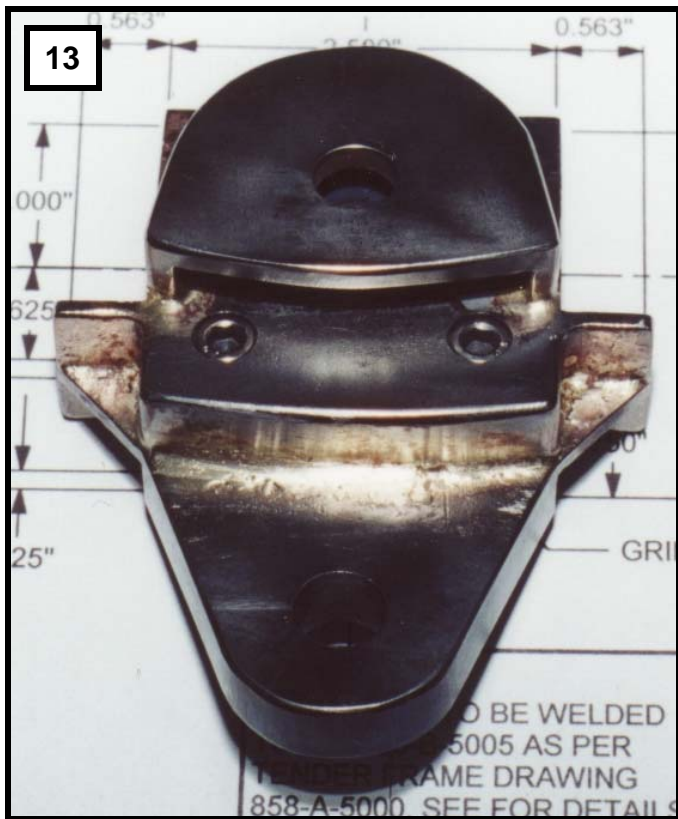
12. Once the machining of the Top, Center and Bottom Plates is completed, they should be cleaned for brazing. On the mating surfaces, prick punch several points so that once clamped together, there is a small space between the pieces to allow the braze to flow between them (see photo 10). Use the Tender Clevis Pin to hold the Bottom Plate in alignment with the Center plate while brazing (see photo 11 and 12). Clamp and braise the three plates together (see photos 13, 14 and 15).



13. The side wings of the Tender Frame End Casting are riveted to the Tender Frame with four rivets. These rivet holes should now be located and drilled for 1/8" rivets. At this point the Tender Frame should also be nearly completed and made ready for installation of the Tender Frame End Casting including the following steps 14 and 15.

14. Take a piece of 1/8" steel plate and layout each



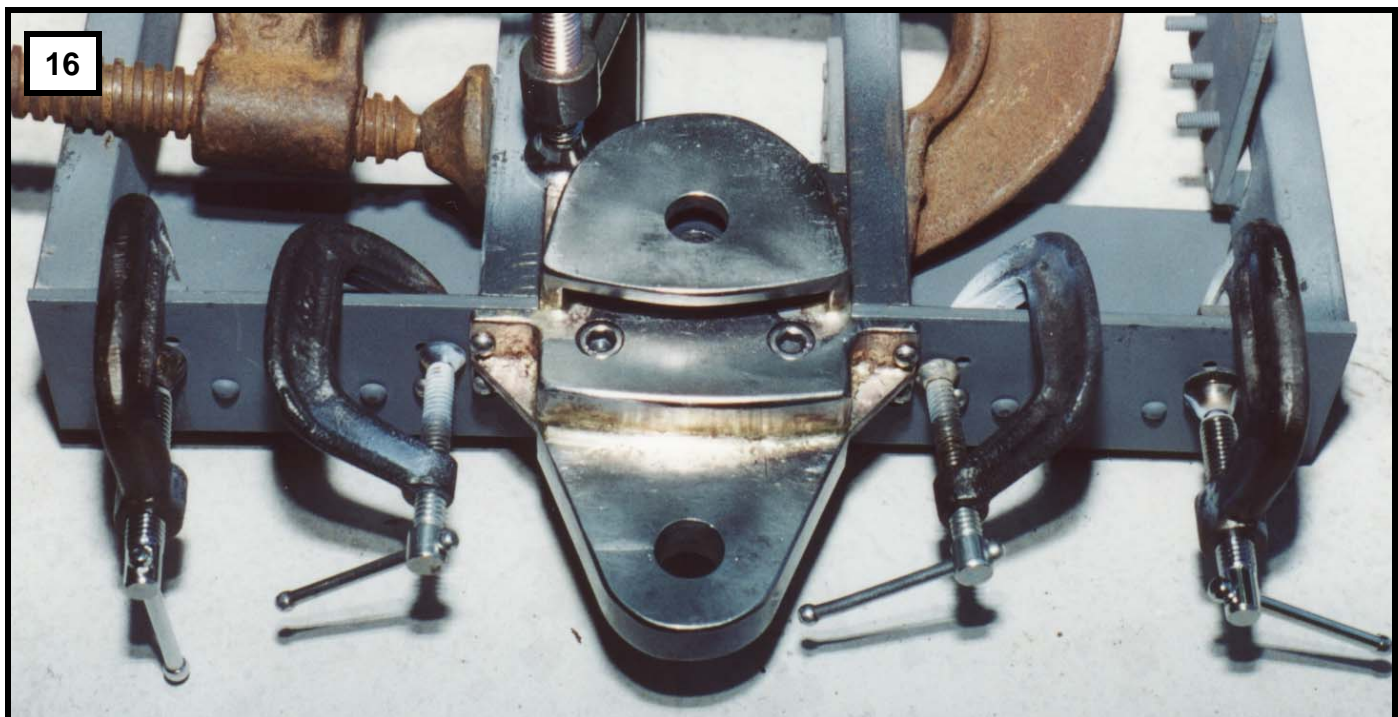


of the two Side Plates and Rear Plate as dimensioned in the drawing on page 6. They are then band saw cut to rough shape leaving as little material as possible to file, grind and/or mill to the finished dimensions.

15. The two Side Plates are drilled for 1/8" rivits and each riveted to the inside surfaces of the two central Tender Frame Channels **before** the

Tender Frame is built. The Side Plates then create a pocket in the Tender Frame for the other pieces to fit into for final welding.

16. To attach the assembled Top, Center and Bottom Plates in the pocket formed in the Tender Frame, first rivet the four rivets that hold the side wings to the Tender Frame Front Plate. Then with the Tender Frame upside



# Western Maryland Railway Shay #6

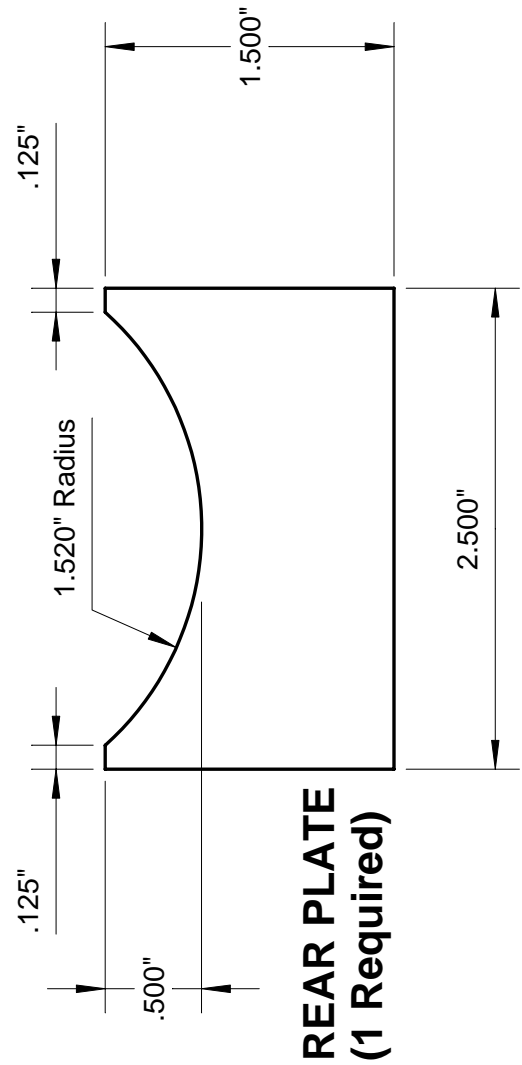
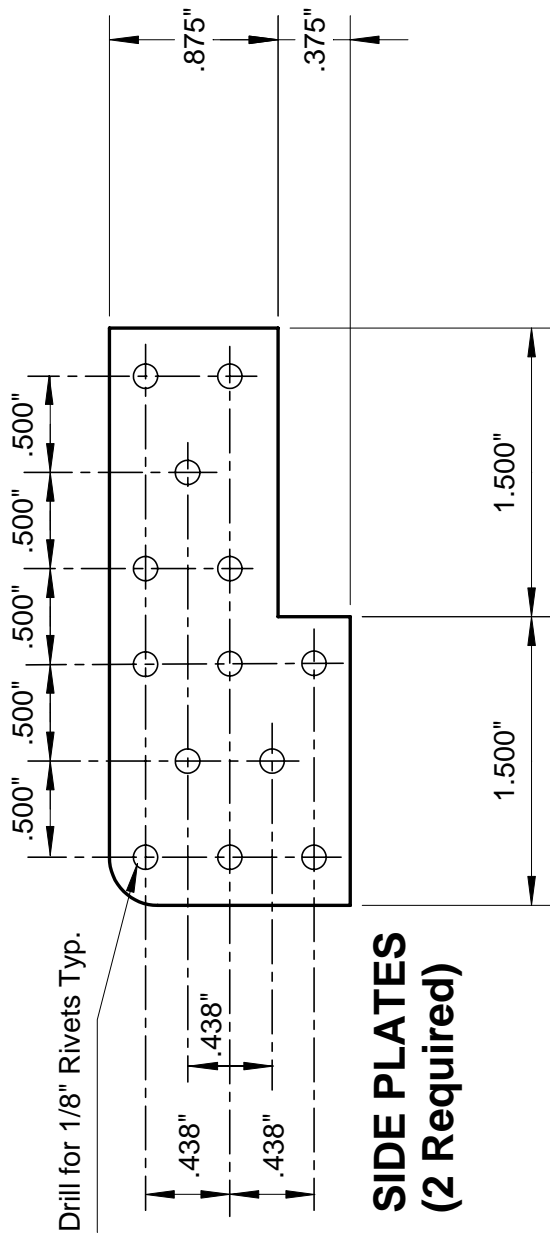
## Tender Frame End Casting Side & Rear Plates

### Lima Card Number 853-A-5005

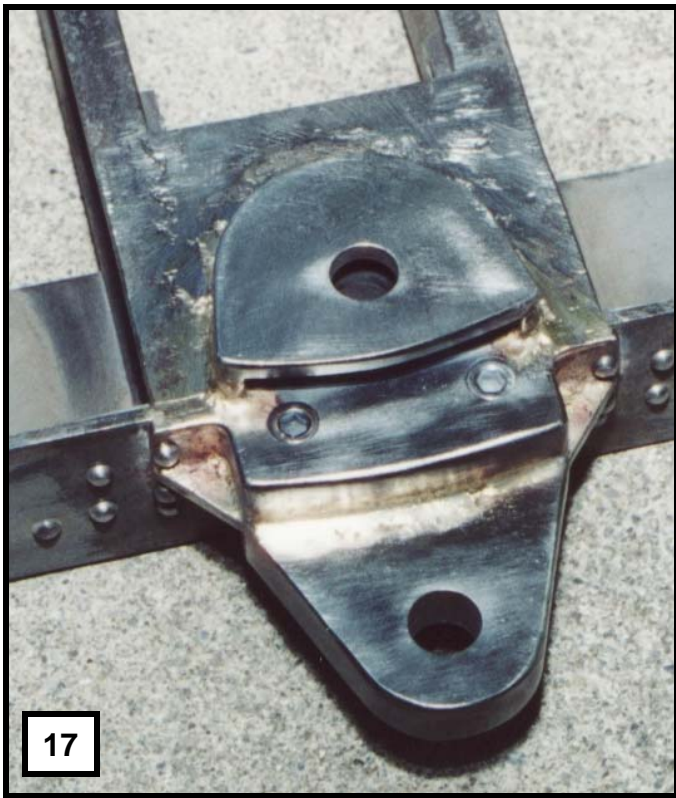
Drawn by John D.L. Johnson 11/13/2001

2 Required

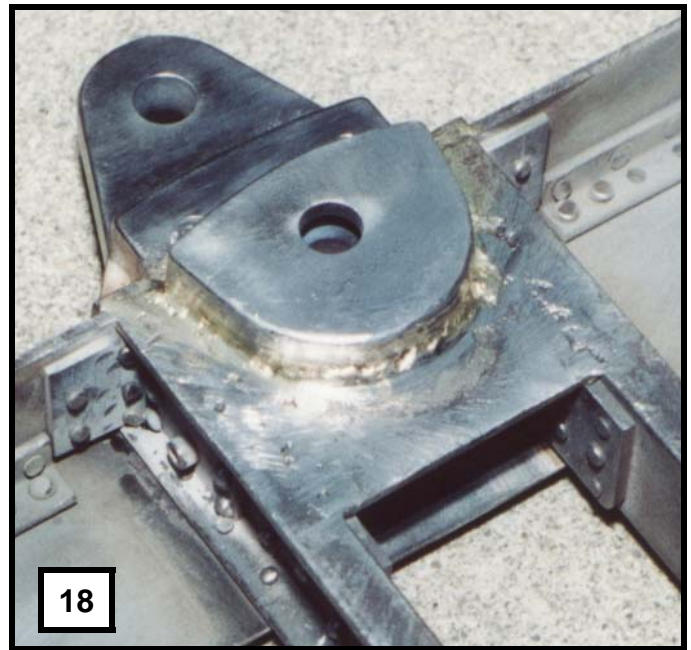
Made From 1/8" Plate Steel







down, clamp everything together except the Rear Plate and weld along the two seams where the Center Plate lays along the bottom inside edge of the two central Tender Frame Channels (see photo 16). Next insert the Rear Plate and continue welding along these seams as well as the bottom of the seam between the Rear Plate and the Center Plate. You may need to bevel



the edges of the Rear Plate along the weld seam to create a “V” groove for proper welding (see photo 17). Finally, turn the Tender Frame right side up and weld along the top of these seams to complete the welding.

17. Grind smooth all welds, clean and prime the Tender Frame for final painting (see photos 17, 18 and 19).

This completes the fabrication of the Tender Frame End Casting.





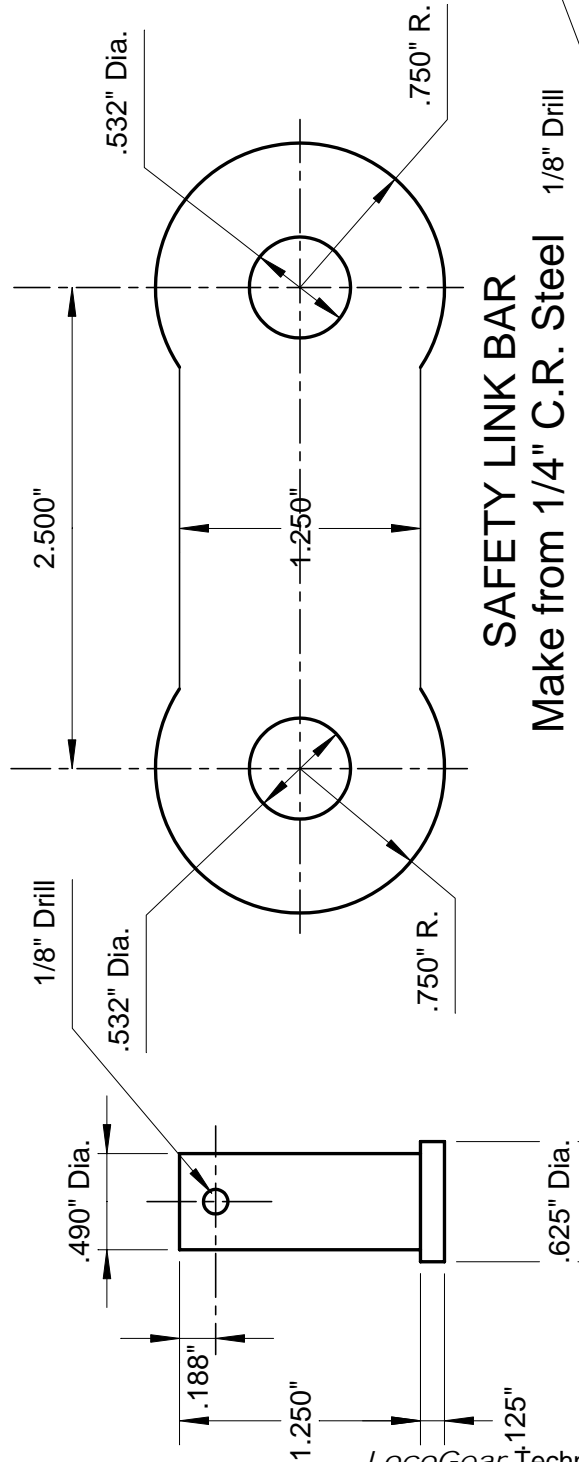
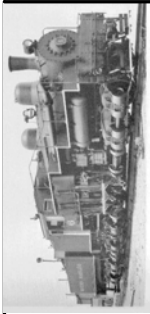


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# Western Maryland Railway Shay #6

## Safety Link Bar & Pins

Lima Card Number 372-A-5082/5083  
 Drawn by John D.L. Johnson 11/14/2001  
 1 Each Required  
 Made From Cold Rolled Steel



TENDER CLEVIS PIN

ENGINE CLEVIS PIN