



Update on Restoration of No. 460, the Lindbergh Engine. November 18, 2010

Parts Are Cast For No. 460

Staff and volunteers are focusing on small, behind-the-scenes tasks associated with the project. The services of Cattail Foundry of Gordonville, Pennsylvania were used to cast a variety of new metal parts that will replace missing or damaged originals, including a new cast iron step for the tender using a similar step from K4s No. 3750 as the pattern. The result was a perfect duplicate.

The smokestack, which had been broken into several pieces, has been welded back together and repairs to the air-powered bell ringer have been completed. In addition, the automatic train control box has been rebuilt and the restoration of the electronics contained within is underway, thanks in large part to the efforts of Museum volunteer Fred Merck. The next step will be to return No. 460 to the restoration shop from the pole barn for the application of a chemical rust inhibitor. Then, the task of rebuilding the tender begins.





The following article by Restoration Chief Allan Martin is from the October 2010 edition of *Milepost*. This journal of the Railroad Museum of Pennsylvania is available to members of the Friends of the Railroad Museum (FRM). Information on joining is available at rrmuseumpa.org/membership/join.shtml.

RESTORATION UPDATE: PRR NO. 460

by Allan C. Martin

DETAILED PLANNING FOR THE RESTORATION of Pennsylvania Railroad E6s locomotive No. 460 began early in the spring of 2010. Since considerable portions of the locomotive and tender contained heavy layers of rust, with some areas having already rusted completely through, we knew we were going to have to remove large amounts of steel with a burning torch before welding steel replacement patches into place. Neither the burning nor the welding process could be accomplished on a painted surface. To complicate matters, we also suspected that we might come into contact with large amounts of lead-based paint.

To verify what type of paint was on our locomotive, we hired an environmental safety and health consultant, Cocciardi & Associates, to take paint samples from all areas of the locomotive and tender for hazardous substance analysis, and to provide us with a written assessment of their findings. When the report was completed several weeks later, every single sample tested had proven “hot” with high levels of lead. This verified our suspicions and indicated that the paint needed to be removed before any burning or welding could be done. The lead in lead-based paint, when heated, is released from the paint in gaseous form. The smoke generated by the burning, cutting and welding of the painted steel of locomotive No. 460, therefore, would have been highly toxic, capable of causing lead poisoning in the blood of our technicians during the restoration process.

Much thought was given to the paint removal process. We already knew that standard sandblasting methods could not be used. The



sandblasting process uses compressed air, which forces sand through a small nozzle at a high rate of speed and with considerable force. When paint is struck by the force of the sand leaving the nozzle, the paint peels off the steel

substrate to which it is attached. In the process, the lead paint mixes with the sandblasting media, contaminating the sand.

It was expected that several tons of sand would be needed to remove

PHOTO ABOVE: Following the removal of the lead-based paint, No. 460 and her tender briefly rest outdoors as the environmental cleanup of the Museum's paint shed begins in earnest. The locomotive and tender moved back inside that afternoon, August 31, 2010. (Allan C. Martin Photo, Railroad Museum of Pennsylvania, PHMC)

PHOTO BELOW: A look inside the paint shed. Railroad Museum of Pennsylvania employees Shawn O'Brassill and Steve Meola assist employees of the I. K. Stoltzfus Service Corporation during a break in the action on August 18, 2010. (Allan C. Martin Photo, Railroad Museum of Pennsylvania, PHMC)



PHOTO ABOVE: *With all her paint removed, PRR No. 460 looks something like a full-scale, unfinished model kit. This is the first time that anyone has had this view of the Lindbergh Engine in nearly 60 years. (Ryan C. Kunkle Photo, Railroad Museum of Pennsylvania, PHMC)*

PHOTO BELOW: *Sunlight streams through an open stack and smoke box door, revealing deflector plates and screens inside. (Ryan C. Kunkle Photo, Railroad Museum of Pennsylvania, PHMC)*

the paint from locomotive No. 460 and her tender, all of which would have to be disposed of as lead paint waste. The current cost for the disposal of lead contaminated sand is approximately \$2.00 per pound. The total cost to dispose of all the sand needed for our project would have been prohibitive. We were also concerned that sandblasting might damage locomotive No. 460's fragile brass bearings. Sand grains propelled through a blast nozzle at high pressure could actually be pushed into the mating surfaces of the brass bearings, scoring and pitting the surfaces. A damaged and scored bearing will invariably heat up and eventually will fail. A later update will expand upon the reasons why we have to be very careful about keeping the bearings of locomotive No. 460 grit free.

When we started the search for the right method to remove the paint, we looked for a green, environmentally-friendly technology process. We needed to remove lead paint without damaging the surface of the steel, without damaging the bearing surfaces and without producing any more lead-contaminated blast media than was absolutely necessary. After considerable research, we looked at the possibility of using the carbon dioxide paint removal method.

The process works in a manner similar to that of sandblasting but, instead of sand, utilizes carbon dioxide ice crystals. Although this method initially looked promising, subsequent research indicated that the carbon dioxide process might have had difficulty removing paint that was over one quarter of an inch thick. Removing the paint from locomotive No. 460 using the carbon dioxide process would have cost approximately \$96,000.

Further research identified a different paint removal process employing aluminum oxide-impregnated sponge blast media. The Sponge-Jet® process is simple and sponge blasting quite literally describes the operation. The surface to be cleaned is bombarded with particles of a sponge medium. The particles are mixed with compressed air and propelled through a standard blasting hose and nozzle. The sponge particles have an open-cell structure and, as they collide with the substrate, they flatten into a compressed shape. As the sponges bounce back at low velocity, the surface of the sponges absorb dust, dirt and particles of paint. After use, the sponge particles are easily gathered and fed through a classifier to separate and to release the paint and dirt particles. They can then be reused.

The Sponge-Jet® blasting system incorporates various grades of water-based urethane foam as blast media. Abrasive media grades, consisting of grit-impregnated foam, are used to remove surface contaminants, paint and rust from a variety of surfaces. The abrasive media may contain aluminum oxide, steel, plastic or garnet, depending on the application. The equipment used in the process consists of three transportable modules which include the feed unit, the classifier unit and the wash unit.

The feed unit is pneumatically-powered for propelling the foam

cleaning media. The unit is portable and is produced in several sizes, depending on the capacity required. A hopper, mounted at the top of the unit, holds the foam media. The media is fed into a metering chamber that mixes the foam cleaning media with compressed air. By varying the feed unit air pressure and type of cleaning media used, sponge blasting can remove a range of coatings from soot on wallpaper to high performance protective coatings on steel.

The classifier unit is used to remove large debris and powdery residues from the foam media after each use. The used media is collected and placed into an electrically-powered sifter. The vibrating sifter classifies the used media with a stack of progressively finer screens. Large contaminants, such as paint flakes and rust particles, etc., are collected on the coarsest screens. The reusable foam media are collected on the corresponding screen size. The dust and finer particles fall through the sifter and are collected for disposal. After classifying, the reclaimed foam media can be reused immediately in the feed unit. The effect that this technology has on pollution prevention is that the blast media can be recycled 10 to 15 times. Typically, 85 to 90% of the sponge media is reusable after a blast cycle. Recycling the media 10 to 15 times is also a considerable cost saving measure not available when using sand or other forms of blast media. The biggest advantage to using sponge blast media is that the amount of lead-contaminated waste that must be disposed of is only 10 to 15% of that produced by other blast media methods currently available.

During degreasing applications, the foam media must be washed every three to five cycles. The washing of the foam media takes place in the wash unit, which is a portable centrifuge, closed-cycle device. The contaminated wash water is collected,



filtered and reused within the wash unit.

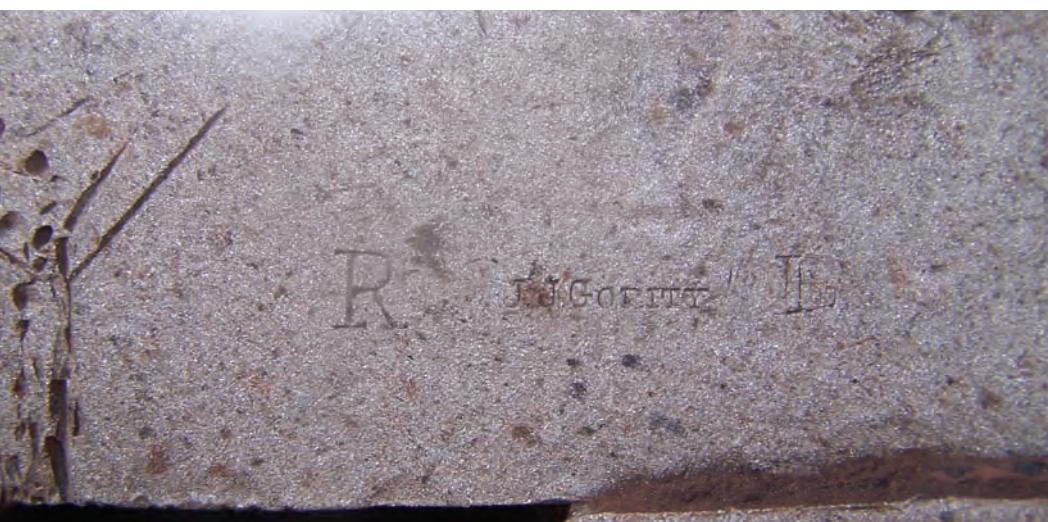
The I. K. Stoltzfus Service Corporation of Lancaster, Pennsylvania started removing paint from locomotive No. 460 on July 6, 2010 using the sponge blasting method. The project was estimated to take 140 blast hours to complete. The process went very well, so well in fact that we were able to consider moving locomotive No. 460 much sooner

than expected, so that the contractor could blast areas that were covered by drivers and drive rods.

Before we would consider moving the locomotive, however, our first concern was checking the condition of the brass bearing surfaces. Close examination showed no adverse affect to the brass bearings surfaces or any movable linkages at the drive rod pivot points. Restoration technician Steve Meola removed the snifter/

PHOTO ABOVE: An I. K. Stoltzfus employee removes grease, rust and lead-based paint from the ash pan and KW trailing truck of No. 460. (Allan C. Martin Photo, Railroad Museum of Pennsylvania, PHMC)

PHOTO BELOW: The interior of the water tank of tender No. 1565 now reveals details of the interior structure, after sponge blasting to remove rust and debris. (Allan C. Martin Photo, Railroad Museum of Pennsylvania, PHMC)



house valves and found that only minute quantities of blast media had gained entry into the valve chamber. Vacuuming took care of this problem. After Steve performed a thorough lubrication of all drive components, we moved the locomotive back a quarter turn on the drivers and the blast contractor finished the paint removal on the locomotive.

On Tuesday, August 17, 2010, the locomotive and tender were pulled out of the restoration pole barn so the contractor could clean and reclassify the sponge media that was trapped

PHOTO ABOVE: *The project got underway with the removal of the paint covering No. 460's sand and steam domes. The interior of the paint shed was draped in plastic sheeting to aid in post-project cleanup. (Allan C. Martin Photo, Railroad Museum of Pennsylvania, PHMC)*

PHOTO BELOW: *Among the many details revealed through the paint removal process are the timing marks left by J. J. GORITY on the right side crosshead guide of the locomotive. (Ryan C. Kunkle Photo, Railroad Museum of Pennsylvania, PHMC)*

under the locomotive and tender. With the locomotive and tender sitting outside, we had a chance to photograph the locomotive and tender without any paint covering the metal. We were astonished just how well the sponge blast media had actually removed the many layers of old lead paint, providing a perfect 4 mil profile (roughness) on all surfaces. This is an ideal surface to which new paint can bond.

The results were far better than we could have possibly hoped. Features of the locomotive and tender

previously concealed under a quarter of an inch of paint were now revealed. We found original timing marks that had been punched into the crosshead guides on both sides of the locomotive and the name "J. J. GORITY" was found stamped into the crosshead guide on the engineer's side of the locomotive. Mr. GORITY apparently stamped his name on the crosshead guide after setting the timing for the locomotive.

Continued examination of locomotive No. 460 also showed that it contained many parts originally manufactured for other E6s locomotives. The drive wheels on the fireman's side of the locomotive were number stamped 460, while those on the engineer's side were number stamped 1565. The number 1565 was also stamped on the valve stem crosshead on the engineer's side. Previously, we knew that locomotive No. 460 was coupled with the tender of locomotive No. 1565, but we did not realize there were other parts from No. 1565 installed on No. 460.

Similar discoveries followed. A valve stem crosshead guide from locomotive No. 759 was found on the fireman's side; the air reservoir on the fireman's side was number stamped 690 and the number 782 was found on the air reservoir on the engineer's side. Pennsylvania Railroad locomotives No. 690, No. 759, No. 782 and No. 1565 were all class E6s locomotives. We also found the number 51—standing for the year 1951—stamped on all of the drivers, indicating that all of the locomotive's tires were replaced in that year. Locomotive No. 1565 was officially scrapped by the Pennsylvania Railroad in 1952.

We have been presented with an interesting scenario. In 1951, we have locomotive No. 460 apparently in need of major drive parts and the PRR shop ready to scrap locomotive No. 1565. The decision to swap parts with No. 1565 was clearly made in 1951, since the new tires

were all installed at the same time.* In addition, we discovered that the original tender from No. 460 was transferred to maintenance-of-way service at Renovo, Pennsylvania on May 15, 1952. It is therefore possible that the tender of locomotive No. 1565 may have been first coupled to locomotive No. 460 at that time. E6s locomotives No. 690, No. 759 and No. 782 were all built in May 1914. Locomotive No. 690 was sold for scrap in December 1948 and locomotive No. 759 was sold for scrap in May 1949. It was standard operating procedure to remove parts that could be used on other locomotives prior to sending a locomotive to the scrapper, thus the reason behind the appearance of so many parts from sister engines on locomotive No. 460.

On Wednesday, August 18, 2010, restoration technicians Steve Meola and Shawn O’Brassill removed four large sections of the top of the tender with a plasma torch to allow I. K. Stoltzfus to sponge blast the interior of the tender water tank. Blasting of PRR No. 460 officially ended on Friday, August 27, 2010. 🟡

Allan C. Martin is a curator at the Railroad Museum of Pennsylvania.

Sponge-Jet® is headquartered in Portsmouth, New Hampshire. They are the world’s leading manufacturer of dry, low dust abrasive blasting media and equipment

*In addition to the stamped date number 51 found in several places on No. 460, we used two particular sources to determine dates of construction and servicing for No. 460 and the locomotives from which No. 460 borrowed parts: Pennsylvania Railroad equipment record cards, located at the Pennsylvania State Archives, and the locomotive rosters contained in the book *Keystone Steam & Electric* by William D. Edson.



PHOTO ABOVE: This is a view of No. 460’s running gear after paint removal. Subsequent investigation showed the engineer’s side drive wheels originated from sister E6s locomotive No. 1565. (Allan C. Martin Photo, Railroad Museum of Pennsylvania, PHMC)

PHOTO AT CENTER: Several badly corroded sections of decking were removed from the tender in order to facilitate removal of rust from the interior. Museum employee Steve Meola is seen here inspecting the inner structure. (Allan C. Martin Photo, Railroad Museum of Pennsylvania, PHMC)



PHOTO BELOW: A brass plate identifies No. 460’s tender. Class 70P66 tender was designed for passenger service and held 7,000 gallons of water. (Ryan C. Kunkle Photo, Railroad Museum of Pennsylvania, PHMC)