31 December 2006

Atlantic Shore Line Railway
Locomotive 100
Curatorial Report No. 1
21 October – 31 December 2006
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Seashore Trolley Museum

Safely in the box On 21 October, crew of energetic Seashore members moved Cleveland center-entrance car 1227 out of the 'box', the area where it had been for nearly 18 years to permit the restoration of 100 to begin.[1] It actually moved into the box at the end of a long bug with **Eric Gilman** at the controls, the last powered move until restoration is complete. All controls, resistors, *etc.* have since been removed. Before that much of the brake equipment had been removed while the car was on the pit, clearing the way for eventual removal of its trucks.

What does it look like today? Well it's separated. The trucks and motors are in the bus box, the bronze bearings are under the front of the Rochester car, the car body now looks like a flatcar with the cab sitting down low at the south end of the block on horses and the main 'flatcar' raised on high horses. The decking is completely stripped off but lying (for position and identification) on the sills. The various pieces of hardware, air tanks, brake levers, etc., are all around the outside of the box or on shelves. It looks like chaos.

Randy Bogucki removing steel frame used in moving cab off deck while Chuck Griffith supervises

Documentation - Phil Morse, the Project Manager, who tirelessly went through the hoops several times, has spent considerable time working on disassembly of 100 supplementing it with thorough photo documentation with digital stills and video. He has recorded virtually every accessible area, inside and out, as the work progresses. He made a DVD of an interview he did of me as I described the various components and areas of the car, their condition, their function, materials (if necessary), and changes we noticed that appear to have occurred to 100 over the years.

The still photographs are on CDs and then down-loaded by component area into files on my computer. Eventually the relevant ones will be printed and made into a reference book for use when reassembly is begun. Many of the photos, especially of complicated areas, have been printed out and the various parts shown are

[1] The swap is covered in "The Big Swap" to appear in the November-December issue of the Trolley Museum *Dispatch.* If you don't have a preliminary copy of this article, it can be e-mailed to you. Just request it at dgcurry@gwi.net

identified and dimensions, where appropriate, are written in. Thanks to the advent of the digital camera and the necessary computer software, there is little question that this is the best documented project Seashore has ever undertaken. We have hoped that CAD drawings will be made of the critical areas but, at this point, pencil sketches will have to do.

The ultimate goal – We are making a thorough study of what we find in the car and comparing that with the historic photos we have in order to determine the final configuration of 100. Some time ago **Tom Hughes** made a matrix of significant features we had found in photos over 100's operating life. Since that time, we have discovered many more items that will add to those findings, giving a more accurate restoration.

It is not our goal to make it a 'brand new' locomotive as it left the Laconia Car Company plant 100 years ago. There were significant changes made within a year or two of that time, possibly even being done by Laconia for the ASL.

Rather, it is our intent to show this little locomotive, the last survivor of a once-common type[2], which greatly assisted in the formation of industry and commerce in York County, Maine. It operated for 42 years and was maintained by successive operators who had little to spend and only a small work force to do the work. It is an example of Yankee ingenuity and thrift. Making it back to day one would lose that essential part of its character.

Having said that, we do intend to have the lettering ATLANTIC SHORE LINE RAILWAY in large white letters along the sill, as it was for a number of years before it was finally painted out, leaving only the number 100 in the middle of the cab side.[3] There was even a time, during its 'maroon and cream' period, when it didn't even have a number. 100 is the one surviving representative of that line, the second longest trolley line in the state and so important to our area. Also stenciled beside that is the Laconia Car Company logo, something you don't often see on any trolley.

The only way we could keep the car of a period would be as it came to STM in 1949, only making repairs. If this were followed 100% it would eliminate the very significant lettering on the sills. Because this is only superficial and could be changed in the future if that is ever desired. The following is a summary of some of the features that will be found in the finished product:

- Wooden hoods of the type it had from about 1908 to the present except with canvas covering.
- Oak flooring and deck as during its life until SERy. Preserving most of what was within the cab.
- Solid southern yellow pine side sills as during its operating period.
- Single trolley pole which it had throughout almost its entire history.
- ATLANTIC SHORE LINE RAILWAY and Laconia Car Company logo on sills as on the locomotive from 1906 to at least 1915.
- Green paint on exterior
- Sand boxes as during latter part of its life
- Trucks and underbody painted black
- Stove and electric heaters as during its later years

Other details will be worked out pending further research.

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[2] There is one other in the state of Washington but it is in extremely poor condition and not apt to survive much longer.

[3] We feel safe in assuming that the lettering remained there at least until 1915, as shown in the photo of 102 at Town House pushing a Boston and Maine flat car.

1909 In Kittery after rescuing single-truck from the 'drink'

At Town House with Boston & Maine RR flat car
Likely used for harvesting wood along the current route of S.T.M.

At the York Utilities (YUCo) Carbarn, River & Brook Streets, Sanford probably in the 1930s[4]

100 a work in progress and a study in change

Initially we had thought that there were very few changes made to 100 during its lifetime but, as we studied it more carefully we found a great many. These were documented in our very detailed survey of the changes made to 100 during its period of service (and some by Seashore since it obtained the car in 1949)[5]. Some were found by comparing what shows in period photographs and others by disused holes, wires and other physical evidence found in disassembly in 2006. One of the major changes was the attractive metal covered hoods, which appear to have been removed within two years. The replacement was the present wood hoods with the lifting tops.

[4] This carbarn is still in use today as Bell/Simonds plumbing supply
[5] Survey of Changes and Body Structural and Electrical Details. If you have not received this it can be forwarded to you.

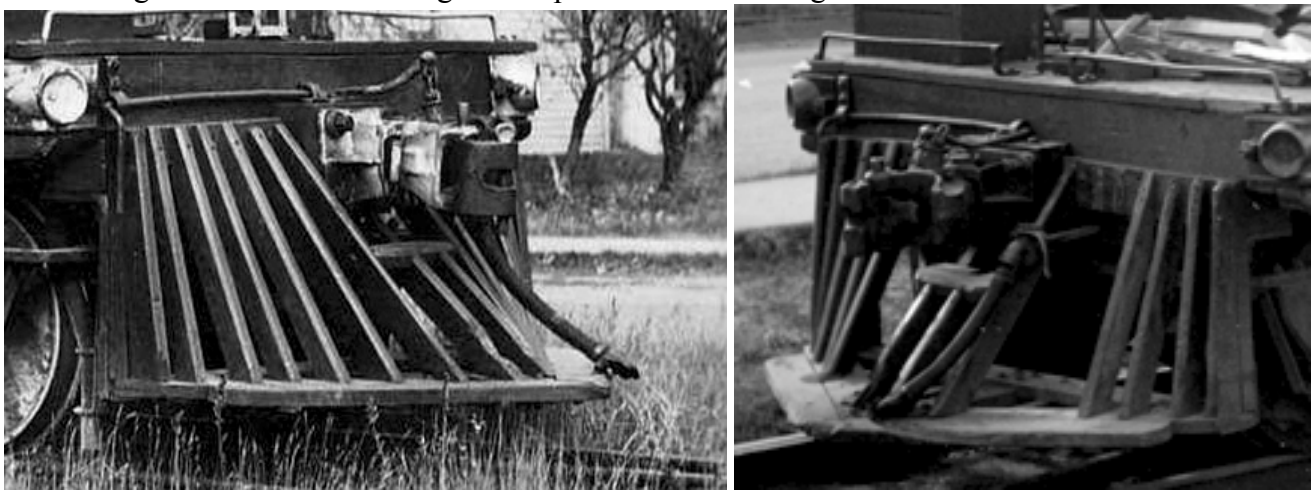
What have we found as we dig into 100? As this is written, we have done much of the 'exploratory surgery': removing the various components, decking, the cab, *etc*. so we have a pretty good idea of what is there. Our first goal was to determine its condition. Since it's virtually all-wood structurally except obviously for the trucks, control and brake equipment, it's highly vulnerable to deterioration from the weather, especially because of its two exposed decks. Knowing the size of the barns from which it operated and the many photos of its outdoors operation, it's obvious that it spent the majority of its life outdoors. Even after its arrival at Seashore in 1949, it still was outdoors until relatively recent times and even then it was at the end of a barn, barely sheltered from direct rain and hardly at all from wind-blown precipitation. Thus, you would expect deteriorated wood and we have found considerable, but not as much as we might expect.

At some time, very likely when our Terminal operation on Route 1 was built about 1957, where 100 served as the locomotive to pull the Warwick flatcar, adapted to carry a dump truck load of ballast, the exposed six feet of both decks was replaced by rough wood with a utilitarian purpose in mind.[6]

Our advantage – Unlike several of our recent projects: 639, 1227 and 4175, 100 is largely all there. So we have to do almost no 'reverse engineering', something that continues to be a major challenge with 639.[7] We know what is there and can either use it as a pattern or overhaul what we found.

The period of restoration – From what we can find, the most logical period to restore ASL 100 is the late 1920s-about 1940. There would be a few anachronisms and these will be clearly noted: the wheels were changed from the 'teardrop' spoked cast iron type to steel, the air compressor was moved under the hood and the Atlantic Shore Line lettering was painted over in favor of the simple "100". It would be virtually impossible and certainly not practical for us to totally get it to an exact 'minute'. Rather it will be a tasteful and thoughtful compilation of the major features on the car as we received it but with the acknowledgment of its lineage. The latter will be documented in text and photo displays and prominent lettering on the side sill.

Pilot's teeth – Over the years its oak pilots lost some of their 'teeth'. The no. 1 pilot is totally missing except for one of the mounting brackets. We have only four out of the total of 14[8] 'teeth', the two mounting brackets and enough of the bottom frame, center piece and top mount to draw plans for a new one. Apparently at the same time, the no. 1 end sill and pilot assembly were removed and no trace of the wood remains. It does appear that we have the original hardware including the coupler and its mounting.



Pilots on YUCo 100 1930s and 1949

[6] It has been rumoured that it was "Grouchy Mac" (the late Joseph McLaughlin) who installed the decking.

[7] All three cars have been back-dated: 639 and 4175 to their original condition and 1227 from latter-day Shaker Heights Rapid Transit to 1920s Cleveland Railway. So, much of what we found on the bodies was irrelevant to the present restoration. This very expensive and time-consuming option should be very seriously considered when the next major restoration project is being contemplated.

[8] The pilot in the 1907 photo, as close to a builder's photo we have, shows 16 'teeth'.

The no. 1 end pilot does show in the photo of 100 on a trailer in 1949 as it was being moved to the then Seashore Electric Railway. Some of the teeth are missing. We did find the right-hand top support (2 x 6 in. oak) which fastens (with two lag screws and one through-bolt) to the pilot support beam. All others have disappeared. A very important piece we found was the bottom crosspiece, which extends all across the back of the pilot. Both ends are half-lapped so you can tell the angle of the horizontal bottom diagonal pieces. Also, to it is bolted a piece which extends forward on the bottom to the point of the pilot, so between all, we have a pretty good idea of how it is shaped. There are traces of the screws which fastened the teeth so we can figure the spacing from that. In the middle is what gives the appearance of a fence stile. This consists of two 'teeth' with a horizontal flat between them with a stiffening tie-rod between. This fits under the coupler.

Sills - About 30(?) years ago some interested members replaced the left side sill, because it was badly deteriorated. They used a single 6 x 12 in. piece of spruce. That piece is still intact, however it is not the correct species nor the cross-sectional dimensions of the original.[9] We have examined all the sills and found many of them have been repaired by ASL or YUCo. These repairs consisted of removing the rotted/deteriorated section from the top of the sill, usually about 3 or 4 in. and laying in another piece of wood to fill the void. All sills on the no. 1 end require patching whereas the no. 2 end which will requires a much less repair.

The right side sill remains but in poorer condition than we had realized. First there was a longitudinal closure piece (about 2 x 6 in. red oak) running the length of the cab over the sill, which extended about 6 in. beyond the cab wall. This may well have been a replacement by STM. When it was removed, it revealed the inner top and as much as half or more of the inside of the side sill was badly deteriorated. In fact, at the doorway, much of the area had been filled with various bits of wood to bring the door sill up to the proper level.[10] The 'picture' side of the sill looked quite good and was still straight so we were fooled until the 'cap' piece was removed.

Initially, because of what we saw of the one remaining original side sill, we thought the side sills were 6 in. wide at the top with a rabbet along the bottom inner side bringing the thickness to slightly less than 5 in.[11] Complimenting this was the 6 x 12 in. cross section of the replaced left sill. However **Tom Hughes'** sharp eyes spotted a very well made splice on the no. 2 end, about 3 in. deep running from the end to near the hood about 6 ft. The spliced piece was 6 in. wide but, by the doorway, the sill was so badly deteriorated that it was impossible to tell its top dimension. However, as we poked around, we came to the conclusion that the sill was 5 in. wide for its entire length.

[9] All eight sills are 5 x 12 in. x 30 ft. southern yellow pine.
[10] Some of these bits were plywood, making this a relatively recent repair.
[11] It is difficult to get a consistent thickness because the wood has tended to swell at cracks and around through-bolts.

Cab moved to end of deck, decking partially removed

Old wood for a vintage locomotive.
On 20 December we placed an order with "*BARNSTORMERS*" of Portland, ME, a company which salvages significant timber and 'remanufactures' it for other uses, principally flooring. Since the southern yellow pine that is available is new growth with wide annual rings. It is quite soft and does not have the strength or character of the old growth with which 100 was constructed. Additionally it will significantly crack and twist. So we have long been concerned especially about the long sills and secondarily with the end sills and patches for the long sills. Where could we get something that was durable, stable and historically correct? Tom Hughes had mentioned *Barnstormers* a couple of years ago; then Phil Morse made the actual contact on a tip from the Maine Historic Preservation Commission. Rob Coburn, their representative surveyed 100 with us, found the project very interesting and said they could furnish what we needed.

Barnstormers was in the process of salvaging timbers from the Bates textile mill in Lewiston, ME, some of which were 12 x 12 in. x about 38 ft. long. Two sills could easily come out of that piece. Of course, since they don't grow old growth timber any longer and because there's lots of labor salvaging, transporting, de-metalizing and milling it, it's expensive, in this case $3,100 for the pair.

At a slightly lesser cost per board-foot, they can furnish the stock for the end sills, pilot support beams and repair pieces on the other sills.

We are also going to replace the decks and cab floor with specially-milled red oak flooring salvaged from some sort of cabin in West Virginia. The will have it milled to the exact profile of the existing boards.

As we looked at the remains of the pilots, made from oak, we decided it was important to have these made of good oak so we are purchasing the stock from them.

All tolled the price for the wood is not to exceed $9,500. This includes milling and delivery, a great convenience.

The end sill/pilot support assembly on the no. 1 end is totally missing although it did arrive on the locomotive, albeit deteriorating. On the no. 2 end it was there, collapsing on to the truck frame with the through bolts

holding it together, largely rusted beyond re-use. There is just enough full cross-section wood to get the original dimensions.

Below the 7 ⅝ x 9 ⅝ end sill, is what we call the pilot support beam, which is fastened to the cross sill with 16 ¾ x 16 in. square-head machine bolts. It requires replacement as well as the 16 in. 6 ¾ x 5 ¾ blocks which shim the coupler out beyond the pilot. Below the pilot support beam is a short piece of s.y.p which holds the train air pipe. So, it's quite a massive assembly when completely assembled.

Removing no. 2 end sill assembly

On the end of each sill there is supposed to be a double tenon fitting into mortises on the cross sill. Many have rotted away or were removed in sill repairs. On the no. 1 end there are only two of the eight still have the double tenons from which others can be replicated with the replacement to be set into a notch cut into the end of the sill.

When we removed the remains of the sill on the no. 2 end we were pleasantly surprised to find all of the tenons remaining. The only one missing was on the left sill, replaced by STM. Some of the tenons are soft and will have to be stiffened by injecting them with epoxy resin.

Interestingly the pilot support beam was in near-perfect condition with splits only on one end. These may have been caused by the bolts holding the 'sandwich' together dragging on the truck frame when the truck swiveled. From its dimensions and the fact that it looks like it was creosoted leads one to believe it may have been a railroad tie. The beam under that which backs up the coupler blocks was also in similar condition.

It was impossible to remove the assembly without cutting some of the bolts with the Tiger Saw. Most, if not all, have deteriorated to the point that most of their original strength is gone, so they will all have to be replaced.

Deck-floor boards are made of two-inch red oak tongue-and-grooved pieces extending out over each side a few inches[12]. They were extant under each hood as well as in the cab. Laconia Car Co. appears to have had the practice of utilizing milled wood to the maximum. Instead of having the flooring all the same width, the boards vary from about 5 in. face to over 8 in. All were fastened to the sills by two 4-in. common nails at each sill[13].A common practice at the time was to have the tongue-and-groove is slightly below the midpoint of each board.[14]

[12] At first we thought they were white oak because they had 'grayed-out' from age.
[13] The heads on the nails varied in size but some were definitely larger than those on present-day common nails.
[14] In this case it is ⅛ in below the center line of the board.

This allows for some wear, more so than if they were in the middle. We also found this practice in the flooring of the vestibules for Chicago 225 and body flooring of Connecticut 1160.

These boards must have been applied without being fully dried because between each one was a 3/8 in. space which developed after the wood dried. Because of the wide spaces that must have formed later, we have the feeling that Laconia was in a hurry to deliver the car or didn't have a dried supply of that thickness wood in stock when 100 was built so it went on 'wet' ("stump dried"!). We also noted cracks as well running down the side sill(s?) of both 100 and 102. In fact, 100's shows up in the 1907 photo. What kind of guarantee came with the car??

We were surprised that they were red oak instead of white, which is a bit more durable. This didn't become obvious until Phil Morse accidentally split some which didn't cooperate when pried upon. We preserving most of the floor boards in the cab especially those in front of the controllers. There the floor is significantly worn by the feet of a couple of generations of motormen. (or are they 'engineers'?) Since we aren't trying to make 100 'show-room fresh', this wear is a significant 'artifact'. There are also prints and bolt holes for the two different controllers the car carried: early K-28F and 'present' K-35G.

We will have to examine every piece to see if we can re-use it. We have ordered enough new decking to replace any pieces we can't save as well as the missing area at the right-hand door. Since they are all different widths it will be tricky to fit them in so they look proper.

1 7/8 in. tongue-and-groove decking laid out for re-installation

Cab sub-frame and stay rods – Around the periphery of the cab runs a 3 x 3 in. ash sub frame. It fits between the inner and outer wainscoting. The cab is held to the deck by ten ¾ in. steel vertical stay rods running from under the sills up through to the cab's top frame, one at each window post: four across the ends and two on each side. These run from below the sills up through the top frame. Because of height restrictions in the box where restoration work is taking place, it was necessary to cut each rod before the cab could be lifted enough to clear the under frame. The frame was rotted on the sides and had to be largely destroyed to remove the cab. Its ends have mortise-and-tenon joints.

When we reassemble the cab we will have to remove portions of the wainscot and weld new ends to the stay rods.

What's under the hoods?

What makes the steeple-cab locomotive just that are the two hoods, one on each end with the cab (the "steeple") between. In 1908 the ASL converted 101 from the standard steeple cab appearance as part of the 'trio'

purchased from Laconia in 1906, to an express motor.[15] Apparently they felt the need of more enclosed space. There were two daily trips from Sanford to Portland which required that equipment. Being a thrifty New England enterprise, they took the cab from 101 and added it to the one on 102, doubling its length. We wondered which half of 102's cab was the new one, so Leo Sullivan commented that it must be the one with the newer looking numbers. We have speculated that, if they had had a 4th steeple cab, they might have doubled the cab on one and made another express motor. As it was they did purchase three more (104-106).

A study of the 1907 photograph of 100 shows the headlight mounted on a sort of wooden platform, triangular in shape to account for the slope of the hood. That and fixed hand rails on either side of the hoods, bolted to the corners of the cab imply the top of the hood could not be raised. The air compressor is mounted under the car so, unless there was a second one under a hood why, except for symmetry, would there have to be two hoods? Anyway, at some time, probably 20 years or so later, the present GE CP-30 air compressor was put under the no. 2 hood.[16] Under the second hood are the six large cast-iron traction motor resistor grids. These are wired in series with the motor circuit, gradually cut out of the circuit by the controllers as the locomotive accelerates. Originally these were bolted directly to the deck (The old holes are clearly visible) but later they were set up on two cross pieces of rough wood (2 x 4 and 2 x 6), apparently making it easier to reach the wiring taps which (unusually) come from underneath the deck. In this case these are definitely a generation later than the originals.

Under the other end is the big General Electric Co. CP-30[17] air compressor. The first compressor was mounted under the cab on a specially built steel framework. While we have no evidence for it there is a possibility that, in the more primitive air compressor days, there may have been a second one inside the hood.

We made some interesting discoveries as we removed the hoods. First, they are not the same. The no. 1 hood was very likely original, either built by Laconia originally; then modified in 1908 with the removal of the metal cover, or possibly made entirely new as a re-design by Laconia. It is framed with ash, joints are all mortise-and-tenon, held together with screws. The wainscoting is the same as on the cab.

The no. 2 hood is definitely 'home-grown' by York Utilities. It is soft-wood framed, all nailed together and the wainscoting is a different cross-section, very likely purchased at the local lumber company. It is slightly shorter than the no. 1 hood.

Both have a top that is hinged to lift up, covered at present with tar paper roofing but very likely were covered with canvas during its working days. These tops are very likely SERy construction, made of pine boards, nailed together with the too-long nails bent over. We will not make any changes to the sheathing as it is in good condition.

The end doors, which are often seen open in the photos of operations in Sanford, are in good condition. They were left open to disperse the large amount of heat created by the resistors. Interestingly the boxes themselves were did not have significant amounts of heat-shielding material to protect the wood.

The hoods are fastened to the decking with 'strap' bolts, which we can re-use.

The cab. On of our more senior members first comments about 100 when he saw it in its present disassembled state was, "this will be a replication; not a restoration!" He was assured that was not so. We will be retaining

[15] Unfortunately we have no photographs of 101 in its original configuration.
[16] We did examine the floor boards under the no.2 hood to see if there ever was another compressor mounted there and could not come to a definite conclusion as the few unused holes there don't form a logical pattern for a compressor mount.
[17] Cubic Feet Per Minute

virtually all of the cab and major portions of the rest of the wood, the notable exceptions being the side and end sills of the deck.

By building a framework made of pallet rack material we were able to lift the cab up a couple of inches to clear the deck, slide it back, toward the southern end of the box, past the end of the deck, then lower it down to about 2 ft. above the floor, a convenient height to work inside and out although we may lower it further to work on the roof.[18]

The wainscoting, both exterior (vertical) and interior (horizontal), will require only minimal patching. That which is across the ends is under the hoods so it was never painted. Interestingly, on one end, there are some runs of very old, possibly first-generation light olive green paint. Could this have been primer as it seems too light to be the dark color seen in the 1907 photograph? It may give a clue to the tone, *e.g.* olive, of the paint however. Another interesting thing we found was that end wainscoting was of various widths while that which showed (the sides) was all the same width. Like the decking, they must have made maximum use of the material they had. (The wood for the wainscot, unlike most passenger cars of the time, was made of fir rather than poplar.)

Wiring in the cab. We have traced the wiring in the cab which consists of lights, heat, compressor, portable headlight and the feed from the circuit breakers down to the controllers. It all was rubber-cotton-covered flexible copper as was all the rest of the wiring in the car.[19] There are also traces of other circuits, some cut-off wires, marks where staples have been pulled and traces of brass name tags.

This wiring will all be replaced in-kind with new type RHW, rubber insulated, cotton-covered flexible wire. This has been the standard on 4175 and 639. The original was gray but current production seems to be only in gray, which was used by some trolley builders. It is still made as telephone power system wire by the American Insulated Wire Co. (AIW) in Providence, Rhode Island.[20] This will also be used for all control and motor wiring except for the flexible leads (about 4 ft.) leading to the motors. The wiring that is in place had been patched a number of times although there is no evidence of any fires.

Paint – There are many layers of paint on the cab, especially on the exterior. This has served well to at least keep that part of the car preserved. The color that is apparent now is a sort of 'forest green', but this was done by SERy, using house paint, before we had done any research. The coat below that was Sherwin-Williams "R. & B[21]" Utility Paint which we purchased at $2.98 per gallon and applied in the 1950s.

We need to know the history of the paint on the car as well as what the first colors were. This will be done by Building Conservation Associates of Dedham, MA.[22] We will get an analysis of the exterior and interior wainscoting as well as the sash. We will then have to decide which scheme applies to the era we are representing. The maroon and cream was only on the car for a short time so we do not feel it represents the most significant period for 100.

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[18] We should have removed the trolley base when the car was outdoors. We found that the bolt which reduces the tension on the pole was frozen and are not quite how we're going to get the base off safely.

[19] There was some solid copper grounding wire remaining from the earliest days of the car.

[20] We required no. 12 for some of our applications and were unable to obtain it from our Boston Supplier, Arthur Hurley Co. So, thanks to a tip from Bay Area's Dave Johnston, we obtained it from A. & J Electric Cable Co. of Hayward, California. Strangely, it was much cheaper even including shipping than our New England connection!

[21] Ranch and Barn. This came in only a few colors and supposedly was made of left-over paint in the manufacturing process. Needless to say, it did not have much lasting quality. It was also applied to opens 838 and 1468 (which still has it).

[22] About 10 years ago Stephen Santarelli had a study done to determine the colors for Bay State Street Railway car 4175 by Society for Preservation of New England Antiquities (SPNEA). They no longer provide this service but the same people now work for or have formed Building Conservation Associates.

Because it is so uneven and rough, it would be impossible to apply yet more paint and primer so it will all have to be removed.

The wainscoting and most of the area from the tops of the windows down is a sort of maroon but under that appears to be cream. SERy repainted about ¾ of the ceiling and above the windows white, something which was never there before. It appears to be gray. Hopefully the analysis will provide us with the information we require.

Except for some sample areas we will scrape off most of the paint and brush-paint primer and finish enamel, possibly using Fine Paints of Europe's *Dutchlac*.

Floor finish – There is absolutely no indication of any paint being applied to the floor of the car or under the hoods. We don't have any of the original decking so don't know what was done there. We will have to do something, very likely a penetrating sealer/preservative that will be nearly invisible but will keep moisture out of the wood. The same concern applies to the sills, the tops of which will be vulnerable.

Sash and Doors. Of the sash, without a very careful examination, it appears that eight of the ten will require little repair while one has warped so badly it will have to be remade. It appears that originally all 10 had one piece of glass but later they were divided horizontally into two panes. We will probably go back to the single piece of DSB glass.[23] One of the doors also had had a home-made divider in its sash. The hardware appears to be hardware store variety but probably was on the car for a long time so, if it works, it can be re-used.

The sash were raised with leather tabs held on with small bronze castings. Some are missing and will have to be re-cast. There are a few of the anti-rattler springs left so these also will have to be re-made.

We are uncertain of their final colors. They appear are different for various eras. Little contrast between sash and body colors is apparent in the 1907 print but from the mid-20s on they seem to be different in some eras. (They must have painted 100 quite often!) Again, paint analysis will be needed to help.

Stove – There are two shots of through the cab door, each of which definitely show a small pot-bellied coal stove. There is also a very simple open-topped smoke jack on the roof. We also found coal in cracks behind where the stove rested. When 100 came to SERy in 1949 the smoke jack was in place but nobody can remember if there was a stove. It should be possible to replace it. We can't find evidence of a coal bin so probably they just used a bucket. (hod?)

[23] Double-strength – 1/8 in.

Pot-bellied stove 1948 or 1949
Sanford

Other cab furnishings – The cab is quite simply furnished. In addition to the controllers and brake valves, there is a cabinet with a hinged-top desk, and a small fixed seat next to it. The cabinet is apparently original; the desk is home-made and the seat is cut down from the front bench of an open car with plain boards for the actual seat.

There are two electric heaters, two GE Type MR circuit breakers and a GE ML air compressor governor.

Control – The car was originally equipped with two GE K28F controllers but these were replaced, very likely because they could not take the load, with GE K-35Gs. Because there is no line breaker, all the load is broken within the controller, a difficult task for a K28 with its primitive blow-out system. Unfortunately during 100s 5 years at the Terminal operation, one of the controllers was stolen, the wires simply being sawed off at the floor. Fortunately this was done in such a way that there were no shorts and the car continued to operated for some time thereafter until the brakes failed. Dan and Paul Kochs brought in a controller from the recently scrapped Boston center-entrance sand car 6309. We may use it, however it is equipped with a ratchet switch for controlling a line switch. This doesn't change the way it would operate in 100. We have checked the inventory and find that there are 10 other K-35s in various conditions but none as good as this.

Although both controllers, upon a cursory inspection, appear to be in good condition, They will require renewal of many of their copper segments and fingers as well as cleaning and adjustments.

Grids – The resistor grids (6 banks of Westinghouse 8-in. 3-point type) are in excellent condition and will require virtually no work unless we choose to de-rust and paint their end frames.)

Motors – ASL 100 is equipped with four GE-80A 40-hp. traction motors, very likely the ones that came with it over 100 years ago. 100 ran in to the box on its last move, 21 October. The cab was then removed from the deck, the wires to the motors cut[24], the deck jacked up to a height of about 5 ft.; then the trucks were pulled out by the *Pettibone*. They went out back on the tail track, back through the bus box, along track 1, out into the yard, then were pushed on to the pit (track 3).

It was necessary to put the motors on the pit because the way the bolts on a GE 80 motor are set up, access is gained from the bottom.[25] Fortunately they are all the same size—1 ⅛ in. using a 1 ⅞ in. socket. Fortunately most of the ones for the axle caps came off readily although a 2-ft. pipe extension on the ratchet helped a lot. For those which didn't cooperate, the oxy-acetylene torch was called in to heat the offending nut red hot. (Fortunately these are not heat treated so this extra heating didn't affect their strength.[26]) The axle caps and the gear cases were quite heavy and required the use of the transmission jack keep them from dropping to the pit floor and lower them to a convenient height for carrying out of the pit.

In each axle cap was the lower half of the large bronze motor suspension (or 'axle') bearing. The other half remained held in place on the axle by the weight of the motor.

Dean Look came over back with the *Pettibone*, lifted each motor and carried it outside; then around and back into the bus box[27]. (Bus Curator **Tom Santarelli** has kindly allowed the use of the bus box as the temporary truck and motor shop for the winter.)

Because cars had been displaced from the Shop by the occupation of the pit track with the trucks, the trucks were pulled outside and pushed temporarily on to track 2. Unfortunately it was raining so the pristine axle bearing seats (2 per axle) got wet. The next morning, before any rusting could commence, Texaco Rustproof Compound "L" was brushed on.

In order to be able to pick up the motors or components thereof, it was necessary to have a hoist. The "Tebbetts" steel-framed hoist was out in the main hall but was too wide to fit with any clearance or flexibility into the box. So **Bill Pollman** and **Dean Look** cut off an unnecessary overhanging end of the top beam and reconfigured one of the angle braces from outside to inside. Then **Chuck Griffith**, with the *Pettibone* at maximum lift, picked the hoist up and set it down now spanning track 1 where it could be wheeled into the box. Then the trucks were rolled in.

Disassembly – The first job in preparing these motors to be sent to A.C. Electric, where they will be given preventative maintenance, was to make their job easier. Principally that involves loosening all the bolts and opening the motors up.

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[24] The set-screw type connectors on the motor leads (4 or 5 to each motor) had steel screws many of which had corroded to the point it was impossible to remove them with a screwdriver so, since the leads are going to be replaced, it was easier to cut the wires.

[25] When we overhauled 38's motors we had no pit. So we burned off (read: ruined special motor bolts to say nothing about the torch on which sparks kicked back!

[26] On later motors heat-treated bolts and nuts were used which meant they could be smaller diameter with ordinary sized nuts.

[27] First it was necessary to remove the Portland Mack bus from the box. For the winter it will be stored in behind the Shop close to where *Bullet* car 207 was stored. A crew of **Norman Down, Bob Reich, Lloyd Rosevear** and **Donald Curry** carefully tarped the bus with a "California Closets" tarp obtained some time ago by **Charlie Publicover.**

Inverted and opened GE-80A Traction Motor
Armature bearing caps and pinion still installed

GE 80 motors are the 'split-frame' type in which the bottom half of the motor can swing down while the motor is still installed in the car.[28] By removing the saddles which support each end of the armature, it too can be removed, allowing the rest of the motor to remain.

Unfortunately we discovered that many of 100's motor bolts had probably not been turned for the better part of a century so many required the 'gas wrench' which broke the rust 'bond', after which many could be turned by the use of the 1 ⅞ in. socket with extension. Some required the use of a 'slugging' wrench and others had to be cut off. In this case, if great care is used with the cutting torch, the nut only is destroyed and the threads on the bolt remain untouched.

The motor bolts are square-headed that fit into square areas around the various holes to keep them from turning when the nut is loosened from below. If this were not the case, it would be very awkward to hold the bolt without a second person. Because of 100's leaky deck, water and dirt and possibly salt accumulated on top of the bolts which the effect of corroding away major portions of the heads. Secondarily, water got between the bolt shaft and the motor casting causing rusting which swelled the diameter of the bolts making some of them nearly impossible to drive out even with a 10-lb. sledge hammer.

The hinges are a pair of special eye bolts with a steel pin as the pivot. Most of these required a lot of heat to loosen. One broke on what turned out to be an old fracture. It will require a new length of threaded rod to be welded to it so it will be long enough.

Additionally it was necessary to loosen the two nuts per field pole piece (8 per motor). Many of those on the bottom half were extremely difficult to remove because they had rusted considerably more than those on the top. **Doug Carrier** was invaluable wielding wrenches and the sledge hammer during this 'body-building' process!

We are also scraping off the thick layers of the grease-crater-dirt mix that has accumulated over the outside of the cases, removing the large squirrel nests from inside and cleaning up the armature bearing caps. **Doug** spent many hours sandblasting them. All bolts and nuts then had their threads chased so they could be readily threaded by hand, greatly easing motor re-assembly. To prevent further corrosion, all were then painted with gray *Awlgrip* epoxy primer followed by a coat of Jet Black *Awlgrip* enamel. We will put *Neverseeze* on the threads and the shank of the bolts so they will not get stuck again.

[28] This past summer this technique was used on Manchester car 38 to rectify a clearance problem in one of its motors.

We will turn off the corroded bolt heads and weld on square nuts, machining them down to the same dimensions as they were originally.

On motors 2 and 3 the armature bearing cap on their commutator end had a long-standing crack which will have to be nickel-welded. It is interesting that the crack formed on that end which has less strain than the gear end.

Gears and pinions – On one end of the motor armature shaft (the 'gear' or 'pinion' end, as it is called) is a small gear (17 teeth in this case) which is shrunk on to the tapered end of the shaft.[29] There is a keyway on the shaft and a matching one on the inside of the pinion. On the end of the shaft, which has a short threaded section, is the large (about 3 ¼ in.) pinion nut, held in place by a washer with 'ears' that could be bent over the sides of the nut to keep it from turning.[30] The pinion should have been installed by expanding its diameter slightly by heating it in boiling water, then putting it on the very clean armature shaft and hammering it home with a heavy lead hammer.

In order to remove the gear-end armature bearings it was necessary to remove the pinion, all the more so when we discovered how badly they were worn. (see below) Fortunately we have a couple of vintage pinion pullers just the right size for this sized pinion.[31] These basically are a collar shaped to just fit over the pinion teeth with two 1-in. rods extending out away from the motor (when installed for pulling), parallel with the shaft, a thick forged steel bar across both rods with a 1 ½ in. diameter screw which goes into the center-hole at the end of the shaft. By tightening up the screw against the end of the shaft and applying a heavy blow against the outer end of the screw, the pinion is supposed to come off. Here's what we found:

Motor 1 - pinion cannot be moved. The forged bar of the puller cracked. It will now be necessary to use another (overhauled now by Dean Look) puller and very judiciously apply some heat to expand the pinion slightly without removing its temper. This was tried on 30 December using a propane burner. Again, no luck especially after the second puller broke, this time with a stripped bolt. (Don Landry has offered to see if the machine shop where he works and which has a 100-ton puller, will pull it off. Dick Avy has offered to take it down and back.

Motor 2 - pinion fell off. Loose on the shaft, held only by the nut and kept from turning by the key which had beaten the shaft keyway up by the pinion's motion on the shaft. The tapered part of the shaft was covered with old oil indicating it had been loose for some time.

Motor 3 – pinion came of with considerable effort

Motor 4 – pinion came of with almost no effort.

The pinions and gears are in good to first-class condition and the pinions will be re-installed on the shafts after the motors return from their preventative maintenance. The shafts will be smoothed down and the fit checked by applying bluing die to see how well the pinion matches the shaft.

Some interesting data on the pinions – (No 1 is still on the shaft.)

No. 2 Made 1-17 (January, 1917) Other numbers 28387H 6464. Made by General Electric. Slightly worn—the edges of the teeth are slightly rounded over.

No. 3 Made Aug. 25 (August, 1925) Made by Tool Steel 'CINTI'[32]. No. 8385

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[29] The taper is a 'self-holding' taper at 1 ¼ in. per ft.

[30] In 100's place, almost every tab on every motor was broken off, meaning the locking device turned into just an unnecessary washer.

[31] These are definitely old-time technology. We understand they came either from the Connecticut Company's St. James St. barn in New Haven or the York Utilities' barn in Sanford.

[32] Tool Steel Gear Company of Cincinnati, Ohio, now known as Xtek. (Downloaded from their website): We purchased some pinions from them. Xtek built its reputation as a supplier to heavy industry as the "Tool Steel Gear and Pinion Company", founded in Cincinnati, Ohio, USA in 1909. Our company pioneered a unique method of hardening steel known as the Tool Steel Process (TSP).

No. 4 Made in USA by GE 2838 7M 223-2269.

100's speed – We checked the gear ratio of 100. The pinions have 15 teeth and the gears 71 for a ratio of .211.[33] According to Richey's *Electric Railway Handbook*, the GE 80 motor is rated at 40 hp at 510 R.PM.[34] With 33 in. wheels this gives a top speed of about 10 ½ mph, not a 'speed demon' but good for what it did, which was mainly shifting in the millyards. At its maximum safe armature speed of 1,840 R.P.M., 100 could go a respectable 37.9 M.P.H.

Gear cases – Each set of gear and pinion is enclosed in a cast malleable iron gear case. This is made of an upper half which is bolted to the top half of the motor by three large bolts. Most of these were badly corroded in place and required a large amount of 'heating and beating' (and some cutting) to remove them. As of this date, one is still firmly held to in place and will require cutting off to remove it. The lower half is meant to be dropped, if necessary, in the pit and is held to the upper case by two of the above bolts. All cases are in excellent condition with no dents or leaks as are commonly found in others, especially the sheet metal type as weight considerations became more important.

Some indication of speed possibilities for the GE-80 motors can be found in the listing of different gear cases in the February 1928 parts catalog. 100's has the largest gear: 71 teeth, meaning it's the lowest speed. Since the gear centers are fixed as the number of gear teeth is increased, it is necessary to increase the number of pinion teeth, to as many as 27 teeth. These would be used on a high-speed interurban.

Axle collars- These all appear to be in good condition only needing cleaning and checking of clamping and adjusting bolts.

Restoring the hardware – In order to make reassembly of the motor possible, it was necessary to make sure that every nut goes on every bolt easily and smoothly. So the bolts and nuts were put into the degreaser to remove the layers of crater and crud. Then a die was run over each bolt and a tap run through each nut. In more than a few cases this required considerable effort.[35] After the threads were chased and the nuts turned readily on them, everything was sand blasted, primed with *Awlgrip* 545 gray epoxy primer followed by a coat of their Jet Black enamel. This should cut down on rusting within the motor shell. *Never-seeze* will also be applied to all bolts when the motors are finally assembled.

The bearing situation - Axle bearings - We were pleasantly surprised to find the axle (motor suspension) bearings were in excellent condition with minimal wear. These bearings are split in two halves because it is impossible to get a circular bearing around the axle after the wheel is pressed on. In these older motors the split is horizontal, meaning the wear is almost entirely in the top half. Wear is gauged by looking under the axle where the size of the space between the bearing and the axle. In this case these bearings are solid bronze (un-babbitted) and have openings in the top and the bottom through which the oil-saturated wool waste is forced down against the axle for lubrication. In many cases there are also grooves cut in the bearing surface which conduct the oil from the waste opening to the flange and near to the end, thus lubricating the entire surface. Some do and some do not.

We were interested to note that some of these bearings are stamped J.F. Hodgkins Co. Gardiner Maine. When we were overhauling Manchester 38 (mid-60s) we found the same inscription on some of the bearings and **Tom**

Today, along with the other products we have developed, we continue to focus on providing custom gears, made to your drawing specifications, or reverse engineered. We can also supply custom gears redesigned to meet your increasing demands

[33] This is the maximum gear ratio for this type of motor.

[34] GE-80 motors are rated at 500 volts. Non-commutating pole motors like the 80 were rated at this lower voltage while STM operates 17% higher than that-600 volts.

[35] This was due in some instances by different standards of clearance on the threads. The bolts had obviously come from YUCo;s odd stock.

Brigham, who was helping on the project, contacted Mr. Hodgkins, a gentleman who must have been in his 80s, came down and visited Shop 1, where the work was in progress. Subsequently we purchased axle bearings there until the company ceased operations.

Armature bearings are lined with a soft metal called Babbitt, a lead or tin-based alloy which lines the inside of the bronze bearing shell. Its purpose is to conform to any small irregularities in the armature shaft. We have the feeling that YUCo did an incomplete overhaul of 100's motors and trucks near the end of its service life, and possibly no longer had the capability of re-babbitting the shells. Or they probably didn't want to face the labor of pulling the pinion from the end of the armature shaft in order to remove the bearing on the pinion end.

What we found were extremely worn bearings with clearances of as much as 38 times the recommended. The clearance for the 2.75 in. shaft is 0.006-0.008 in. We have measured three of the bearings with the following results:

Motor 1 not measured
Motor 2 Gear end 0.230 in.
Motor 3 Gear end. 0.300+ Commutator end 0.160 in.
Motor 4 Gear end 0.130 in. Commutator end 0.090 in.

Our 'gauge' when we show this problem to interested visitors, is to shove a screwdriver into the clearance, all the way up to the handle!

Although we have re-babbitted bearings at Seashore in the past, it is a difficult process so we have been given the name of American Power Service, a company in Georgetown, MA which contracts out to various motor shops to perform this increasingly hard-to-find service. We will leave the bearings installed when the motors are taken to A.C. Electric. This will keep the armature from rubbing on the pole pieces. The will then measure the shafts and specify the finished bore needed in the re-babbitting. This will bring them back to the proper clearance both radially and axially. They will then bring the bearings back to Seashore for Norman Down to take to APS. Depending on the cost, we may do the finish boring here as that requires only a simple setup in the lathe.

Both the armature and axle bearings are kept from rotating along with their respective shafts by ⅝ in. steel dowel pins pressed into the bearing caps. Over time, they tend to work slightly within their housings, gradually becoming loose, consequently moving back and forth, elongating the holes in the bearing shell. According to the Wisconsin Utilities Association Standard Maintenance Practices the shells are supposed to be "oversize to insure a tight fit in the housings".

- Armature bearings 0.002"
- Axle bearings up to and including 5" Plus 0.015" to plus 0.017"

We have three options:

1. Do nothing knowing that 100 will be a limited operation car.
2. Shim the bearings in place with thin pieces of sheet metal.
3. Bore out the bearing caps and seat areas in the motor case, and weld in a piece of steel tubing to make up the difference; line-bore the new piece to the proper tolerance as above.[36]

Waste lubrication Both armature and axle bearings are lubricated with oil-saturated 100% wool waste. On these older style motors, the waste is held in 'boxes': one on top of the axle and one below. There is a small slot

[36] We have chosen this option for the motors in Connecticut car 1160 where the armature bearing housings have worn to the point (and each has worn to a unique diameter) making it impossible to fit a bearing properly. In this case Rail Tech of Guilford, CT (Bruce Thain) will be doing this.

(about ¾ x 4 in.) in top and a much wider one in the lower half. Apparently the designer of the motor intended the lower half should deliver the most lubrication. Unfortunately in practice this did not work. Unless the waste was conscientiously forced against the bearing surface frequently it would tend to fall away from the bearing surface. In 100 none of the eight bottom axle bearings received any lubrication from that source. Although it did come on the top, it was not really as much as on most cars. Further it was difficult to force the waste up against the axle because it is like a sink or toilet trap where the snake has to make a 'U' turn to get around the bend. Same thing here except the packing irons are not flexible.

In all cases, the waste appears to have life-expired and will be removed and replaced by new wool waste.

We found that on Manchester 38 and some of the Connecticut Company cars, the lower opening was capped off and the lower half of the bearing had no windows. To save waste (now about $8.00/lb) we probably won't use them.

Further treatment - On 22 December we had a visit with Roger Paradie, Shop Superintendent of AC Electric Corp. of Auburn, ME[37]. His company did the excellent job of rebuilding 303's compressor. Barry Nelson had them do a walk-around visit a couple of years ago when the possibility of the TEA grant began to look better. At that time, of course, 100's motors had not been opened and were not really visible but it did give AC a better idea of what Seashore had and what we're all about. This time the motors were out on the Shop floor, and one was opened so the armature and field coils could easily be seen.

We asked him if we were preparing the motors properly for their shop, *i.e.* by loosening all the bolts and partially disassembling the motors. He assured us this was just what we should be doing as that could easily be the most expensive part of the preventative maintenance. When we send them to A.C. Electric, we will install the overhauled bolts without lock washers so they can easily disassemble the motors.

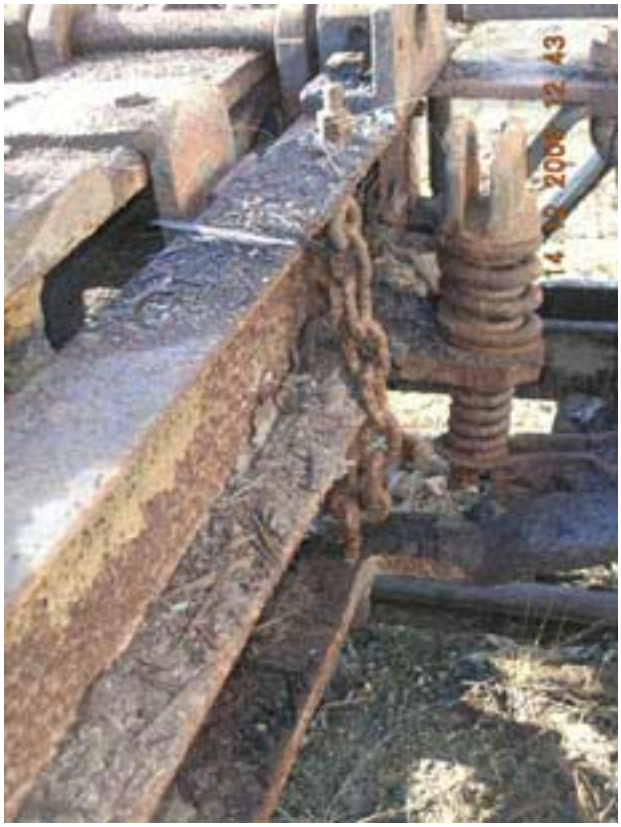
When we have finished our work of preparation, they will be partially reassembled for travel and picked up by their truck which is in this area every Thursday. In their Shop they will test them electrically, clean them and ultimately upgrade their insulation resistance. This may be by dipping and baking, vacuum-pressure impregnation or some other method to seal out moisture. Currently the motors have what appears to be original cotton insulation, which, in itself, has very low resistance value or moisture resistance.

The trucks – were made by American Locomotive Company. **Dan Cohen** has their period catalogue showing similar designs but not the same. We have the feeling that these were either very rare or possibly a one-shot order. Does anybody else have experience with this type of truck?

In some ways they are in very good condition. They have steel wheels with good flanges. The treads are getting quite thin and starting to wear a 'double-flange' but stay on our rails o.k. and are never going to wear significantly in our service. Initially we had considered replacing them but then we realized it would not be worth our while plus they have an old-style ribbed backing that was on the locomotive into the 1920s.[38] The gears are in like-new condition. Interestingly, the gear on the no. 1 axle is a split gear, *i.e.*, it can be taken apart in halves and removed from the axle without taking the wheel off. The other three are solid and were pressed on the axle before the wheels were pressed on.

[37] Their shop does the motor work for the locomotives of Montreal and Maine (ex-BAR), Atlantic & St. Lawrence and Providence and Worcester railroads as well as the coast Guard and paper mills.

[38] The latest photo we have that shows that style wheel appears to be taken in the mid-20s. Unfortunately we don't have many until the 40s when railfans began to descend on the YUCo.



Truck detail showing transom, motor mount bracket and brake beam with suspension chain and lots of corrosion and crud.

With the trucks out from under the body and the motors removed it is now possible to examine just what condition they are in. Fortunately they are complete, the only 'missing' components are the slack adjuster and brake levers that broke on one truck and they are in the pile of parts. The brake shoes are a larger sized shoe for which we have no spares but all have good wear; only one is worn somewhat crooked. The springs are likewise all there. We can't tell about the large coil springs on the equalizers which sit in sockets. They may be corroded in that area. Some of the four full-elliptic bolster leaf springs may be corroded but it is hard to tell without further disassembly.

There is considerable corrosion on everything especially on the transoms which are made of two heavy cross-section 10-in. channels. Many of the bolts are 'necked' down to nothing with corrosion. Wherever two pieces of steel are together, there is corrosion.

Basically the wheels will be removed and set to one side and the truck frames disassembled, cleaned, de-rusted and most of the hardware replaced. Further decisions will await the results of the disassembly.

Where will we store 100 when we are finished with it? One of the provisions in the TEA grant is that we have to provide long-term proper storage. This only makes sense because why should they want to give money to something that rapidly will return to "the dust from whence it was made".

With its open deck ends 100 is especially vulnerable as moisture will get down on to the top of the sills. While we will apply preventative treatments, they are not likely to be 'forever', so proper indoor storage is essential.

At the present time, in this writer's opinion, there is only one proper storage place in the entire museum: the box where 100's body is and where 1227 was until very recently. The humidity is relatively low and deterioration

therein is virtually non-existent. Having recently visited the new barns at Pennsylvania Trolley Museum and Western Railway Museum, which are insulated, climate-controlled and sprinklered, I have seen what can be done.

On a day when the temperature rises, the cold steel of the trucks, motors and underframe is literally streaming with water. Steel corrodes, wood rots and the cycle begins all over again, this time one step further from the original historic object to say nothing about the tremendous cost of time, materials and labor.