NTrak – UK

October / November 2019

Welcome to this latest issue of NTrak – UK. This is going to be a rather unusual issue in that it will be in two parts. Why, you ask?

Well, I have received a very large article from Hans Starmans and Hans Sodenkamp looking at the Union Pacific 'Big Boy' in considerable detail. This article had been very well laid out and I felt it would not fit easily into the two-column format we normally use for this newsletter. I therefore made the decision to send it out as a separate file. I hope you'll all agree it's a scholarly piece of work and worth the extra download.

Of course, a major event over the last months has been the sad loss of Barry Owen, a stalwart of NTrak – UK. More on this later.

Russ reports that the numbers for Bournemouth are a bit low at present. If you are intending to come, please complete a booking form and get it to Russ as quickly as possible. It would be a shame if this event disappeared from the calendar for lack of support.

Raymond Barry Owen "Barry"

Barry was born in Hull in February 1933 and grew up there. During his early years of growing up in wartime with very little, if any toys, young Barry took great pleasure from making his own toys. He would make anything from airplanes to trains and even made a bike from scratch. It was here that his love of modelling began.

Barry worked for EMI and then went to work for Imperial College in South Kensington as a researcher for the celebrated electrical engineer Professor Eric Laithwaite. This was a position he relished and he immersed himself wholeheartedly into the role, working on well-known projects such as the magnetic river and the scrap metal sorter. He even studied part-time and eventually became a Chartered Electrical Engineer. He stayed in this job until he elected to take early retirement at the age of 54.

Family holidays would always revolve around or include a detour via a railway or a model shop. The first holiday abroad was to America in 1991 when the boys drove from state to state in a huge station wagon. As a family, they had eleven of these transatlantic holidays in total, each time attending a different railway model convention. Barry's love of railways was such that he could be dropped off on the first day of the Railroad Modelers Convention and collected on the last and he would immerse himself into every aspect of the show, meeting other like-minded enthusiasts and making many friends, along the way, including Russ and Sue who they also met in Bournemouth.

Barry was a man who loved to talk. He had a passion for sport and intellectual conversation. He was kind, caring and generous to a fault. He took great satisfaction from the life that he lived and especially from the research he did to bring new and creative ideas to life. However, he was most proud of his two sons and the fine young men that they both grew up to become. His legacy will live on through them and his grandchildren. He will be remembered with love and affection by all those who had the privilege of walking part

of this life's journey with him. Never to be forgotten.

(*The above is extracted from Barry's funeral tribute and I am indebted to Barry's daughter-in-law Danni for the information)*

Russ Cook adds:-

Barry was involved with Ntrak from the 1970s with the likes of Ray Hamilton; also he produced a newsletter for Ntrak UK in the early days.

I first meet him and his wife Margaret at the Lakeside Hotel NMRA convention in 1989 and our friendship grew from then. At the 1993 NMRA Bournemouth convention Barry and Ray asked the BOD for more recognition for N scale modelers in the competitions and their reply was you should have your own convention. So, Ray called a Ntrak meeting that weekend and we agreed to go for it. Barry and Peter Smith got a hotel in Staines for our first convention in March 1995.

He has over the years been a big supporter of many meets and groups and came to all the conventions apart from this year's 25th because of ill health of which he was very disappointed.

His great love was the Santa Fe and over the years got to know a lot about the railroad. He also liked a good chat so when you rang him or he rang you, you had to have refreshments handy because it would be a long call. Barry was a true Gent and was always appreciative of what others did for Ntrak UK and I will miss both him and his late wife Margaret very much.

My own thoughts:-

Barry was one of the true 'father figures' of modular N Scale in the UK and from my own conversations with him two things shone through. One was his passion for the Santa Fe and the other was the way he brought a true engineer's approach to solving problems. I had many conversations with Barry, some quite lengthy, but you always ended up feeling encouraged to move forward with your own modelling. There was always an answer out there somewhere. I consider it a privilege to have known him and as I sit typing this, the Barry Owen Trophy for Structures is sitting on the windowsill beside me, a lasting reminder of Barry.

Switching a Switcher

(From Ali Smith)

If you were at this year's N-TRAK UK convention you may have noticed a funny little engine with a tender as big as itself lurking in a yard on the Poole club's layout. It can also be seen on one of Hans Sodenkamp's videos of the event. That model is my attempt at a Norfolk and Western S1a switcher.

In 1950 N&W was a 100% steam railroad, to the extent that it would not permit other railroads to exercise any traffic rights they might have with diesels. Although they were very modern if somewhat individualistic with their road engines, they didn't have any purpose-built switchers but relied on elderly road engines for this task. In that year the Chesapeake and Ohio decided to dieselise yard service and so put up for sale their C-16 0-8-0s of USRA design even though they were less than two years old. N&W, having no thoughts of dieselisation, were glad to snaffle 30 of these which they designated S1. Roanoke Shops improved these engines by adding over fire jets and a second air pump plus extending the tender upwards to increase both coal and water capacity.

Desiring more of the same, between 1951 and 1953 Roanoke built another 45, but rather than copy the C&O tender they built new superstructures on redundant long USRA underframes from Y3 2-8-8-2 tenders that had been fitted with N&W standard tenders.

S1a No. 244 was the last steam locomotive built for a Class 1 railroad.

Shortly after midnight on May 7th 1960 S1a No. 291's fire was dropped at Williamson,

WV. This was the end of steam on the Norfolk and Western.

It is one of these machines that I decided to build and fortunately Walthers had produced a USRA 0-8-0. It was either that or try to come up with a 4-8-0 of M, M1 or M2 class. Or the deeply strange one–off M2 Automatic.

My main reference was Mallory Hope Ferrell's "Norfolk & Western…Steam's Last Stand", Hundman Publishing 2007, which contains drawings and photographs of C-16, S1 and S1a classes. Photos were found in a number of other books, with a particularly fine side view of an S1 on the endpapers of "The Last Steam Railroad in America" Harry N Abrams Inc,NY 1995, an album of O.Winston Link's N&W photographs.

Here's a picture of an unmolested Walthers model. This is a Southern one; I actually converted a Boston and Maine one but started work on it before it occurred to me to write this article and hence didn't photograph it.

Please ignore the shipping containers, modern industrial unit and concrete track. By means of some cosmic mix-up the engine has turned up in the year 2000 in the English midlands. I foresee loading gauge difficulties…

A quick search of the internet will soon provide a selection of photographs of the real thing for your enlightenment.

And so to work. I started with the tender because this is the most obvious difference and because it looked straightforward. I mentioned that the prototypes were built on redundant long USRA tenders. Having fitted N&W tenders (thanks to Steve D for supplying these) to Bachmann 2-6-6-2s I now had redundant long USRA tenders just like the N&W but in N-gauge. This is one of the reasons I chose the S1a over the S1. The other is that the tender superstructure was welded rather than rivetted so I didn't have to model those pesky pimples. Another advantage of the later tender, although I didn't realise this until after starting to build it, is that there is room for sound.

'And I would drive 600 miles…'

(with apologies to The Proclaimers)

Yes, we did! We drove the 600 miles from Portsmouth to Aberdeen to attend the NMRA's annual convention. The convention this year had a distinctly 'N' scale feel, with the two largest display layouts both being in our scale and much of the trade being 'N' focused (or scale independent). One was a particularly nice representation of Pennsylvania's 'Horseshoe Curve' complete with visitor centre and (non-operational) funicular.

Simon Ansell (N Scale Laser) gave a clinic to introduce some of the new kits he'll be producing this year. If you're looking for a large trackside warehouse (and I mean massive), visit his website at www.nscalelaser.com

New to You

Russ Kaufmann, The N Scale Architect has sent details of his latest kit.

ANNOUNCING THE LATEST ADDITION to expanding TRACKSIDE SERIES of kits… Roadside Eats !!! This is the thirteenth in this series which feature easy-to-build kits, unique signage and custom detail parts.

"Roadside Eats" features 'BBQ Smoker' and 'Food Trailer' castings from our own masters, two (2) photo-etched 'Picnic Tables & Umbrellas' kits, a full colour sign

sheet and 10" of photo-etched 'Picket Fence & Gates'.

This kit (#10050) retails for $45.95 and is available from local retailers or direct from THENARCH.COM.

Additional ‘Picnic Tables & Umbrellas’ kits (#96642) and Picket Fence (#61049 or #61056) are also available.

1 Front

2 Rear

3 Overhead

On the Road (and other places)

Road vehicles often seem to feature on these pages and this issue is no exception.

I’ve mentioned the Dutch firm Artitec before but here are examples of their growing range of vehicles based on The GMC 350 truck chassis; a crane truck and a fire engine (ideal for rural areas)

4 Crane truck

5 Fire Truck

These pictures are of ‘out of the box’ models with no additional work done. Note the subtle weathering and the ultra-fine etched brass details on both models. Also recently released by Artitec is this lovely horse drawn plough set (still wrapped in its plastic bag).

Very expensive but wonderful quality. A good source for Artitec is the German dealer DM-Toys (https://www.en.dm-toys.de/index.html). DM-Toys also make and distribute their own range of vehicle kits and assorted parts under the RailNScene and ModelBahnUnion brand names.

A fine example is this one-piece 3D printed spiral staircase. A two-story version is also available.

And now a mystery. At a Bournemouth convention a couple of years ago I purchased some kits of buses from Neal, including the 1954-56 GM PD4501 Scenicruiser pictured below built and painted.

I've still got a couple of these kits (another Scenicruiser and a 1951-53 GM PD4103 bus) but they had no indication of their maker. Can anyone help? Do they offer other vehicles in their range? The parts are all cast in light grey resin and the kit came complete with the Greyhound decals shown.

Small World

Chris White writes:

On the American side of things I was wandering around the Warwick show at the Anoraks Anonymous stand, and I picked up an Arnold Rock Island S2 switcher, which I recognised and yes, it was one I sold off many years ago, and it was still in my repaint of the red Rock Island livery, and it still worked very well, so another loco to test James' skill by fitting a sound decoder in.

Changes

You may have noticed a change in our banner this issue. After I published the last issue, I had a message from Bruce Alcock reminding me that, as this newsletter is published in the States via the NTrak website, we should use the new registered Ntrak logo to avoid potential copyright and trademark issues. Actually, I rather like the new logo. It's cleaner and clearer than the old one so I'm happy to comply with Bruce's request.

Next Issue

This issue has been delayed due to unforeseen circumstances (a major chest infection I picked up in Aberdeen). In order to get back to some sort of order I'm aiming to produce a December/January issue towards the end of November so please send me material in time for then.

Big Boy - King among giants?

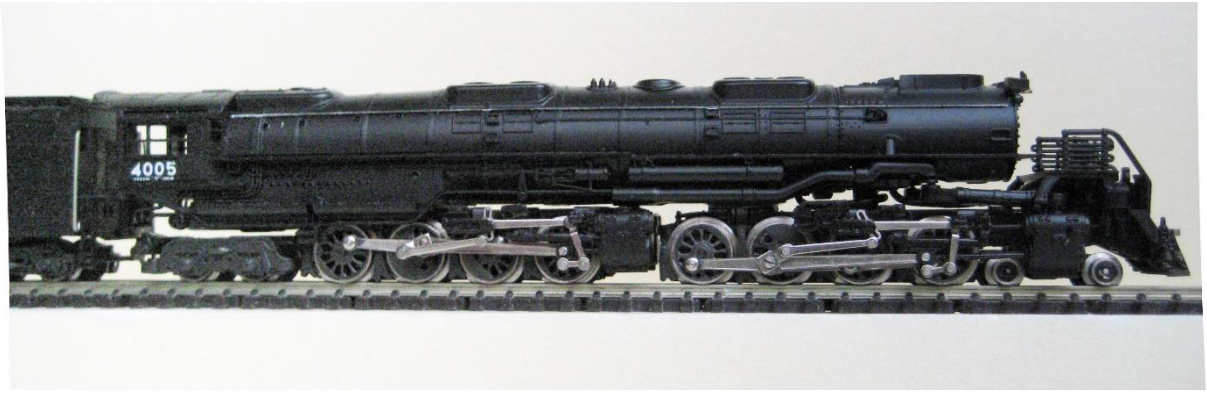
By Hans Starmans (photos and tables - Hans Sodenkamp)

On May 4th, 2019 and under its own steam, Big Boy 4014 made its maiden voyage to commemorate the 150th anniversary of the first transcontinental railroad. The Union Pacific and Central Pacific (precursor to the Southern Pacific) jointly completed this endeavor on May 10th 1869. At the centenary in 1969 the Union Pacific introduced its Centennial locomotives, 8-axle 100 foot diesel giants that to this day hold the record for size and power installed in a single unit at 6,600 HP available for traction. But it never reached the cult status of the 20 Big Boy 4-8-8-4's that Alco constructed in 1941, augmented by another 5 in 1944.

Back in 1980 Rivarossi were the first to offer a Big Boy in N scale. Now that Athearn have announced a rerun of their Big Boy as number 4014 equipped with Tsunami 2 sound and Kato are promising a Big Boy for 2021, this seemed a good time as any to attempt an investigation into the lure of UP's icon. Which statistics make it stand out as King among Giants? The use of the verb "attempt" is deliberate to avoid pretending absolute authority in this matter. I may have overlooked a contender, for example. What appeared to be a simple task of collecting statistics soon turned into a road riddled with potholes. Indeed, all my efforts notwithstanding, a few statistics from the Dutch version of this essay needed correction for this one. At some points contenders were left out as statistics tend to get boring quickly. My endeavor was further jeopardized by contradictory sources, facts adjusted in later stages and, in at least one case, outright fraud. To start with the latter: Another member of Big Boy's class of 1941 is the Allegheny 2-6-6-6 of the Chesapeake and Ohio. Weight of this locomotive is stated in the 1947 Locomotive Cyclopedia (Simmons - Boardman) as being 724.500 LBS, the value Lima calculated in the design stage. The official C&O diagrams state 771.300 LBS for the first 45, even though Lima in turn adjusts that to 766.OOO for the 21st to 45th loco whilst the last 15 turned the scales at 751.830 LBS. Then there is Gene Huddleston's book "Lima's Finest" in which a retired member of the Lima design team puts the weight of the first 10 loco's at 778.000 LBS. Against this stand the 772.300 LBS of the 1944 batch of Big Boys no. 4020 to 4024. Further complications in

the way of direct comparison are tolerances, accuracy and the way of presenting statistics. Baldwin, for example, often calculated locomotive length as being from the chaffing plate at the rear to the front buffer beam, even though locomotive parts extended beyond this point. Alco included the cowcatcher for the Big Boy, but not the bit up to the coupler pulling face, which would provide a value directly comparable to our length over buffers. Overall, the figures partly confirm the consensus about Big Boys, but also contain some unexpected surprises.

LOCOMOTIVE LENGTH WITHOUT TENDER.



Union Pacific 4-8-8-4 Big Boy

Length	Type of locomotive
85’ 3 3/8”	Union Pacific 4-8-8-4 Big Boy, both 1941 and 1944 batch
80’ 6 1/4”	Pennsylvania S1 6-4-4-6 Duplex
80’ 5 1/2”	Northern Pacific 2-8-8-4
79’ 6 1/2”	Duluth, Missabe & Iron Range 2-8-8-4
79’ 0 1/2”	Southern Pacific AC–9 2-8-8-4
78’ 10 1/4”	Southern Pacific AC–12 4-8-8-2 Cab Forward
77’ 8 1/2”	Baltimore & Ohio EM1 2-8-8-4
77’ 4 1/8”	Northern Pacific 4-6-6-4
76’ 8 3/8”	Chesapeake & Ohio H-8 2-6-6-6

The Big Boy measurement is with the front coupler stored in the pilot. The coupler pulling face would extend beyond the tip of the pilot with the coupler operational. Not surprisingly the entire list contains Mallets, except for Pennsylvania’s singleton S-1 Duplex. This loco was not articulated and possessed the longest cast frame ever produced in one piece. The driver sets were merely divided into two two groups to gain advantages in dynamics and steam passages. I calculated the exact length of the DMIR 2-8-8-4 by subtracting the tender length.

LENGTH INCLUDING TENDER.

PENNSYLVANIA Q2 4-4-6-4 DUPLEX

Length	Type of locomotive
140’ 2 1/2”	Pennsylvania S1 6-4-4-6 Duplex
132’ 9 7/8”	Union Pacific Big Boy 4-8-8-4
127’ 9 3/8”	Duluth, Missabe & Iron Range 2-8-8-4
126’ 9 7/8”	Southern Pacific AC-9 2-8-8-4, coupled to C&O H-7 tender
125’ 7 7/8”	Chesapeake & Ohio H-8 2-6-6-6
125’ 3 5/8”	Baltimore & Ohio EM1 2-8-8-4
125’ 1 5/8”	Northern Pacific 2-8-8-2
124’ 7 1/8”	Pennsylvania Q2 4-4-6-4 Duplex
123’ 8 3/4”	Southern Pacific 4-8-8-2 Cab Forward

The overall length including tender is, in some cases, surprisingly difficult to determine. Descriptions in the railroad press elaborately dealt with the locomotive but were often scant about the tender. The Southern Pacific AC-12 must have at least this length, but going over the real loco with a tape measure in the Sacramento, California, museum would, of course, yield the definitive figure. SP’s AC-9 ran with 3 different tenders from which only the length with C&O H-7 tender could be established with certainty. One has to stop somewhere, but a “bread and butter” Santa Fe 2900 class 4-8-4 with 8-axle tender still measured 120’ 8 1/4”, less than 13 feet short of a Big Boy.

LOCOMOTIVE WHEELBASE.

CHESAPEAKE & OHIO ALLEGHENY H-8 2-6-6-6

Length	Type of locomotive
72’ 5 1/2”	Union Pacific Big Boy 4-8-8-4
67’ 3”	Southern Pacific AC-12 4-8-8-2 Cab Forward
67’ 2”	Duluth, Missabe & Iron Range M3-4 2-8-8-4
66’ 8”	Northern Pacific 2-8-8-4
66’ 5”	Santa Fe 2-10-10-2
66’ 3”	Southern Pacific AC-9 2-8-8-4
65’ 2”	Baltimore & Ohio EM1 2-8-8-4
64’ 4”	Pennsylvania S1 6-4-4-6 Duplex
64’ 3”	Virginian 2-10-10-2
62’ 10”	Denver & Rio Grande Western L-131 2-8-8-2
62’ 6”	Chesapeake & Ohio Allegheny H-8 2-6-6-6

This length is between centre points of the first and last locomotive wheel sets and bears little significance other than spreading the load. The gaping separation between Big Boy and Allegheny does have a bearing in due course of this story. One might argue that the Virginian and Erie Triplexes had larger wheelbases at 91’ 3” and 90’ 0” respectively. However, the third driving unit under the tender performed the same function as the tender booster of a 1934 Pittsburgh & West Virginia 2-6-6-4, the tender of which was not counted as part of the locomotive wheelbase. Four Triplexes in all were produced and none of them was capable of sustained hard steaming. That was OK for short range pusher service on the Erie, but the Virginian was fed up quickly and received ten good steaming 2-10-10-2’s from Alco in 1918.

Wheelbase locomotive and tender.

Length	Type of locomotive
123’ 9 1/4”	Pennsylvania S1 6-4-4-6 Duplex
117’ 7”	Union Pacific Big Boy 4-8-8-4

113’ 4 3/8”	Duluth, Missabe & Iron Range 2-8-8-4
112’ 11”	Chesapeake & Ohio 2-6-6-6
112’ 6”	Baltimore & Ohio 2-8-8-4
112’ 2”	Southern Pacific AC-10 & 11 4-8-8-2 Cab Forward
111’ 11 1/4”	Southern Pacific AC-9 2-8-8-4 (with 222 R1 tender)
111’ 11”	Northern Pacific 2-8-8-4
110’ 0 1/2”	Northern Pacific 4-6-6-4
108’ 3 1/4”	Norfolk & Western Class A 2-6-6-4
108’ 2”	Santa Fe 4-8-4 with 8-axle tender

Separating a locomotive from its tender to turn it on a turntable is a menace and therefore rarely practiced. So this measurement governs the size of the turntable or the size a locomotive may be allowed to have in relation to existing turntables. The Pennsylvania 6-4-4-6 was always turned on Y’s (in the vicinity, one hopes…) simply because it exceeded all available turntables. Just one of many reasons why it remained a singleton.

Driving wheel diameter with 8 coupled axles.

Baltimore & Ohio EM-1 2-8-8-4

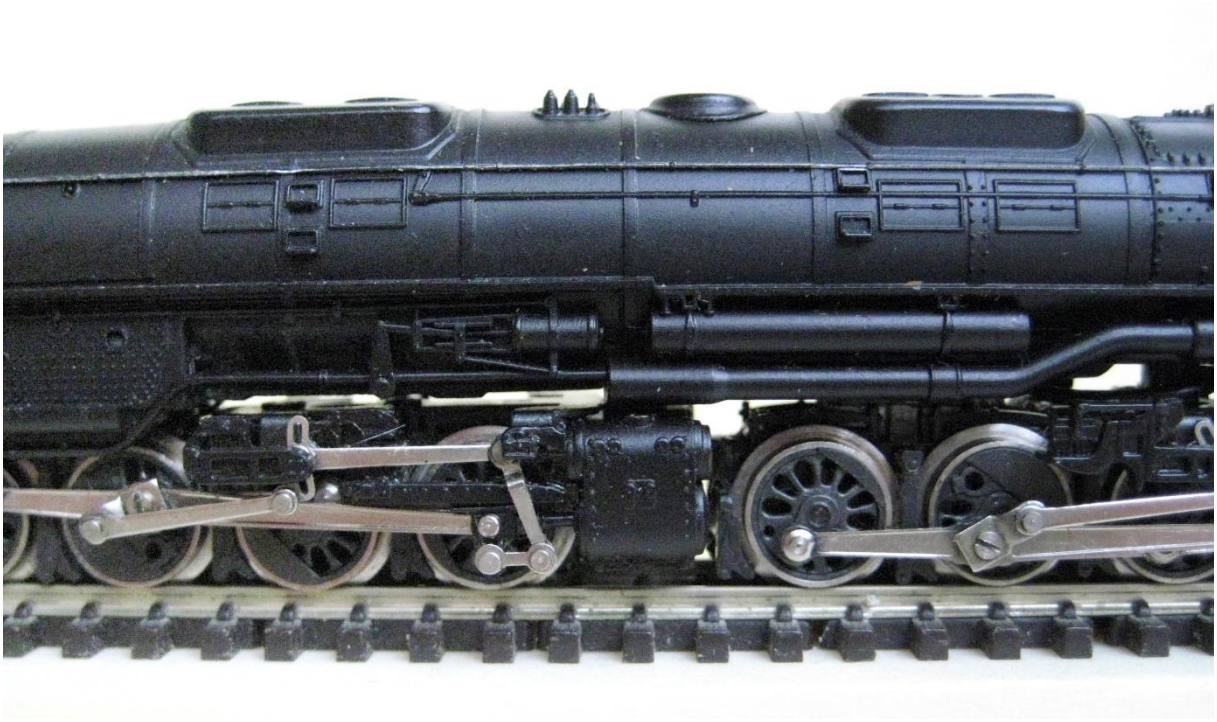
Length	Type of locomotive
68”	Union Pacific Big Boy 4-8-8-4
64”	Baltimore & Ohio EM-1 2-8-8-4
63 1/2”	Southern Pacific AC-9 2-8-8-4
	Southern Pacific AC 7 t/m 12 4-8-8-2 Cab Forward

63”	Northern Pacific 2-8-8-4
	Duluth, Missabe & Iron Range 2-8-8-4
	Denver & Rio Grande Western 2-8-8-2
	Western Pacific 2-8-8-2
	Great Northern R2 2-8-8-2
	Etc.

An undisputed world record size for 8 coupled axles which fully backs Big Boy’s reputation as a fast freighter. Some 4-8-4 classes from other roads featured the same size.

Locomotive weight excluding tender, in pounds

Detail



Detail of the Union Pacific 4-8-8-4 Big Boy

Weight (pounds)	Type of locomotive
778,000	Chesapeake & Ohio Allegheny H-8 2-6-6-6 no. 1600 - 1609
772,300	Union Pacific 4-8-8-4 Big Boy (1944)
771,300	Chesapeake & Ohio Allegheny H-8 2-6-6-6 no. 1610 - 1619
762,000	Union Pacific 4-8-8-4 Big Boy (1941)
723,400	Northern Pacific 2-8-8-4

699,700	Duluth, Missabe & Iron Range 2-8-8-4
689,700	Southern Pacific AC-9 2-8-8-4
684,000	Virginian 2-10-10-2
665,100	Western Pacific 2-8-8-2

More or less a tie at best for the Big Boy compared to the Allgheny's real weight disclosed at a later date. It is certain that the 1941 batch of Big Boys was eclipsed within 4 months when C&O # 1600 was delivered in December 1941. Alco on the other hand, could not possibly have been aware at the time they prepared their advertisement for the Big Boy whilst the official weight publicized for the Allegheny was false. Also keep in mind that a steam locomotive's weight in working order varies as a result of fluctuations in boiler water level. An Allegheny boiler contained about 2,200 LBS more water than the Big Boy. Hence the stated weights very much represent an "optimum" for the locomotives concerned rather than a fixed number at any time during operation.

ADHESION WEIGHT, IN POUNDS

PENNSYLVANIA HH-1 2-8-8-2

Weight (pounds)	Type of locomotive
774,500	Erie. 2-8-8-8-2 Triplex, tender full
726,000	Virginian 2-8-8-8-4 Triplex, tender full
617,000	Virginian 2-10-10-2
565,000	Duluth, Missabe & Iron Range 2-8-8-4
559,500	Denver & Rio Grande Western L-131 2-8-8-2
558,900	Northern Pacific 2-8-8-4
553,000	Pennsylvania HC-1 2-8-8-0 (as stated from 1930 onwards)

552,700	Western Pacific. 2-8-8-2
550,000	Atchison, Topeka & Santa Fe 2-10-10-2
545,200	Union Pacific 4-8-8-4 Big Boy (1944)
540,000	Union Pacific 4-8-8-4 Big Boy (1941)
507,900	Chesapeake & Ohio Allegheny H-8 2-6-6-6

This value represents the mass with which all driving wheels combined bear on the rails, excluding any non-driven wheels for guidances and support. It provides an indication as to what extend the rated tractive effort will be backed by grip on the rails. Triplexes are included in this line-up on grounds that the driving unit under the tender could not be disengaged, whereas the tender booster on the Pittsburgh and West Virginia 2-6-6-4, for example, could. Several 16 coupled Mallets from the Southern Pacific, Great Northern, Norfolk & Western, etc. have been omitted between the Big Boy and Allegheny to avoid an undue long list. Less than 16 tons separate the Big Boy from the Allegheny, possible only through accepting a very high axle loading for the Allegheny. Although of no detriment to C&O's right of way, the weight issue did become a case in court.

AXLE LOADING, PEAK OR AVERAGE IN POUNDS

Weight (pounds)	Type of locomotive
86,700	Chesapeake & Ohio Allegheny H-8 2-6-6-6, leading driver set.
79,780	Pennsylvania Q-2 4-4-6-4 Duplex, second driver set.
77,360	Western Maryland 2-10-0, average.
77,270	Pennsylvania J-1 2-10-4, leading driver set.
74,000	Northern Pacific 4-6-6-4, average.
73,500	Indiana Harbor Belt / New York Central 0-8-0, average.
73,000	Milwaukee A class 4-4-2, trailing pony!
72,150	Milwaukee A class 4-4-2, on drivers, average.
68,125	Union Pacific 4-8-8-4 Big Boy (1944), average.
67,500	Union Pacific 4-8-8-4 Big Boy (1941), average.
62,100	Baltimore & Ohio EM-1 2-8-8-4, third driver set.

This line-up is limited to cherries on the cake. Designers aimed to load all driving wheels evenly. In reality though, several thousands of pounds difference was not uncommon. Whole tribes of locomotives eclipsed the Big Boy on axle loading because the Union Pacific lagged behind on what could be permitted. This also explains UP's choice for a 4-12-2 in 1926 to obtain the desired adhesion weight whilst staying within the 60.000 LBS load limit. Western Maryland's heavy 2-10-0 of 1927 handsomely outweighed UP's 4-12-2 on 5 coupled axles! Big Boy's 68.000 LBS already represented

quite an advance for the UP. A similar story applies for B & O's EM-1 in relation to C&O's Allegheny which, with an average axle loading of 84,650 LBS, had more on 6 coupled axles than the B&O on all 8.

Indiana Harbor Belt 0-8-0

RATED TRACTIVE FORCE, IN POUNDS.

Tractive force (pounds)	Type of locomotive
176,600	Virginian 2-10-10-2, single expansion
166,300	Virginian 2-8-8-8-4 Triplex
160,000	Erie 2-8-8-8-2 Triplex
153,300	Northern Pacific 2-8-8-4, with booster
152,206	Norfolk & Western Y6b 2-8-8-2, single expansion
150,900	Western Pacific 2-8-8-2, with booster
147,640	Pennsylvania HC-1 2-8-8-0
147,200	Virginian 2-10-10-2 , working compound
146,000	Great Northern R2 2-8-8-2
140,000	Duluth, Missabe & Iron Range 2-8-8-4
	Northern Pacific 2-8-8-4 without booster, 70% boiler pressure
137,000	Western Pacific 2-8-8-2 without booster
135,375	Union Pacific 4-8-8-4 Big Boy

A commendable score for Big Boy, bearing in mind it has the largest driving wheels of them all. A direct comparison is further blurred by the 70% steam pressure in the rating for the Northern Pacific Z-5, as opposed to the 85% normally used. Not to be overlooked is the so-called adhesion factor (adhesion weight divided by calculated tractive effort) that determines the grip with which a loco may exert its power. Big Boy's is 4.0, which is normal. Below that, a locomotive tends to become slippery. The minimum value for an Allegheny was 4.5, which constitutes a huge redundancy against slipping. Compound Mallets had the option of feeding steam at (near) boiler pressure to the low pressure cylinders. However, it remains to be seen to what extent this extra punch at starting would be supported by sufficient adhesion of the leading engine. This very reason prompted the Norfolk & Western to stash several tons of lead in front units on their Y6 locomotives.

MAXIMUM BOILER DIAMETER, REGARDLESS OF PRESSURE.

Boiler diameter	Type of locomotive
118 1/2"	Virginian 2-10-10-2
112"	Buffalo, Rochester & Pittsburgh 2-8-8-2
110 1/4"	Northern Pacific Z-5 2-8-8-4
110"	Denver & Rio Grande Western L-131 2-8-8-2
	Pennsylvania HC-1 2-8-8-0
109 1/8"	Southern Pacific AC-9 2-8-8-4
109"	Chesapeake & Ohio Allegheny H-8 2-6-6-6
	Great Northern R-2 2-8-8-2
108 11/16"	Duluth, Missabe & Iron Range 2-8-8-4
	Western Pacific 2-8-8-2
108"	Chesapeake & Ohio T-1 2-10-4
	Pennsylvania J-1 & J-1a 2-10-4
106 9/16"	Union Pacific 4-8-8-4 Big Boy
106"	Southern Pacific AC-10, 11 & 12 4-8-8-2 Cab Forwards

The boiler diameter determines the number of tubes and flues that may be installed, but at the same time also has a bearing on weight and steam pressure. A larger boiler diameter or higher pressure - or both - involves the use of thicker plates. In the late 30's the Reichsbahn in Germany sought to increase boiler pressure by 25% without increasing plate thickness and weight by using a different steel alloy - with potentially catastrophic results. The new steel proved too brittle to deal with fluctuations of temperature and pressure. A boiler explosion was at least in one case attributed to this type of steel and its tendency to develop cracks. As such this comparison is somewhat academic and unfair because Big Boy carries by far the highest pressure.

BOILER DIAMETER, 300 PSI OR MORE.

Boiler diameter	Type of locomotive
106 9/16”	Union Pacific 4-8-8-4 Big Boy
106”	Pennsylvania Q-2 4-4-6-4 Duplex
105 1/2”	Norfolk & Western Class A 2-6-6-4
104 1/4”	Norfolk & Western Y-6 2-8-8-2
104”	Santa Fe 2-10-4 (1938 version)
102”	Kansas City Southern class J 2-10-4
	Pennsylvania S-1 6-4-4-6 Duplex
	Pennsylvania S-2 6-8-6 Turbine
	Norfolk & Western class J 4-8-4
	Union Pacific Challenger 4-6-6-4 (1943, 1944)
	Santa Fe no. 3776 – 3785 4-8-4

Quite a deviation from the previous list! The second and third (largest) course in Big Boy’s boiler was rolled from 1 3/8” plate, exactly half an inch more than the frames of an LNER A3 or A4 Pacific. The 1 11/32” plate used on the 3rd course of the Allegheny boiler wasn’t peanuts either. But, taking the larger diameter in consideration, it remains to be seen if the steam pressure could have been raised from 260 psi to Big Boy’s 300 psi, as suggested by Gene Huddleston in his book “ Lima’s Finest”.

GRATE AREA IN SQUARE FEET

Grate area (square feet)	Type of locomotive
182	Northern Pacific. 2-8-8-4
152.3	Northern Pacific 4-6-6-4
150.3	Union Pacific 4-8-8-4 Big Boy
145	Western Pacific 2-8-8-2
139	Southern Pacific AC-4 tot to 12
136.5	Denver & Rio Grande Western L-131 2-8-8-2
135	Chesapeake & Ohio Allegheny 2-6-6-6
132.2	Union Pacific 4-6-6-4 (1943, 1944)

Note the absence of a loco such as the DMIR 2-8-8-4 due to an “undersize grate of only” 125 SQ feet! As a rule of thumb, a larger fire means more heat. But in this comparison too it is safe to keep in mind that a satisfactory steam production also depends on the shape of the grate and firebox plus the quality of the fuel. The Northern Pacific used Rosebud coal, a poor quality lignite. Initially their 2-8-8-4 Yellowstone hardly lived up to expectations, forcing the Northern Pacific to undertake quite a bit of rebuilding - including a grate reduction to 162 SQ feet to improve steaming - before they turned in good performances. Big Boy’s grate is a modest 8 feet wide and, consequently, became no less that 18’ 7” long in a shallow firebox positioned above 68” drivers. This made it somewhat cumbersome to fire whilst demanding skill and attention from the fireman. Although not ideal with this firebox, no.4014 has been converted to oil firing to avoid any hazard of sparks from the chimney, in exchange for some reduction in power output.

FIREBOX HEATING SURFACE (RADIATION SURFACE) IN SQUARE FEET

Surface (square feet)	Type of locomotive
872	Northern Pacific. 2-8-8-4
839	Northern Pacific 4-6-6-4
806	Denver & Rio Grande Western 4-6-6-4
762	Chesapeake & Ohio Allegheny H-8 2-6-6-6
756	Baltimore & Ohio EM-1 2-8-8-4
750	Duluth, Missabe & Iron Range 2-8-8-4
739	Western Pacific 2-8-8-2
725	Pennsylvania Q-2 4-4-6-4 Duplex
720	Union Pacific 4-8-8-4 Big Boy (1944)
715	Denver & Rio Grande Western L-131 2-8-8-2
704	Union Pacific 4-8-8-4 Big Boy (1941)

The crux in the firebox heating surface factor is that heat transfer in this area takes place in two ways: Through radiation comparable to sun rays and through convection, hot gasses actually touching the material. This factor also includes the so-called syphons, arch tubes and combustion chamber, an extension of the firebox ahead of the grate into the boiler barrel. The B&O EM-1 sores very high on this point due to no less than 5 syphons, whereas Big Boy had arch tubes, water pipes in the firebox that support the brick arch which deflects the flames rearward before they are drawn into the tube bank of the barrel.

HEATING SURFACE OF TUBES AND FLUES IN SQUARE FEET.

Surface (square feet)	Type of locomotive
8,090	Virginian. 2-10-10-2
7,388	Great Northern R2 2-8-8-2
6,801	Northern Pacific 2-8-8-4
6,478	Chesapeake & Ohio Allegheny H-8 2-6-6-6
6,418	Erie 2-8-8-8-2 Triplex no. 5016
6,329	Southern Pacific AC-9 2-8-8-4
6,141	Western Pacific 2-8-8-2
6,125	Pennsylvania HC-1 2-8-8-0

6,063	Norfolk & Western class A 2-6-6-4
6,032	Duluth, Missabe & Iron Range 2-8-8-4
6,000	Pennsylvania Q-2 4-4-6-4 Duplex
5,990	Chesapeake & Ohio T-1 2-10-4
5,262	Union Pacific 4-12-2 1926
5,185	Union Pacific 4-8-8-4 Big Boy (1941)
5,035	Union Pacific 4-8-8-4 Big Boy (1944)

This is the heating surface of the tube bank in the boiler barrel. It says little about any effectiveness in steam raising. This was certainly questionable with older types such as the Erie Triplex, which featured a large tube bank mated to a relatively small firebox. They were known for sorely lacking steam production. Hence focus shifted from tube bank to firebox in the 30's, as graphically demonstrated within the UP ranks!

SURPERHEATING SURFACE IN SQUARE FEET

Surface (square feet)	Type of locomotive
3,219	Northern Pacific 2-8-8-4
3,186	Chesapeake & Ohio Allegheny H-8 2-6-6-6
3,030	Chesapeake & Ohio T-1 2-10-4
2,930	Pennsylvania Q-2 4-4-6-4 Duplex
	Pennsylvania J-1 2-10-4
2,831	Southern Pacific AC-9 2-8-8-4
2,770	Duluth, Missabe & Iron Range 2-8-8-4
2,703	Norfolk & Western class A 2-6-6-4
2,675	Atchison, Topeka & Santa Fe 2-10-4 (1938)
2,525	Denver & Rio Grande Western 4-6-6-4
2,466	Union Pacific 4-8-8-4 Big Boy (1941)
2,152	Western Pacific 2-8-8-2
2,118	Baltimore & Ohio EM-1 2-8-8-4
2,043	Union Pacific 4-8-8-4 Big Boy (1944)

TENDER WATER CAPACITY IN US GALLONS

Tender Capacity (US Gallons)	Type of locomotive
26,500	Virginian 2-6-6-6
25,200	Southern Pacific AC-9 2-8-8-4
25,000	Union Pacific Big Boy, Challenger (1943, 1944)
	Chesapeake & Ohio Allegheny H-8 2-6-6-6
	Duluth, Missabe & Iron Range 2-8-8-4
	Northern Pacific Z-7 and 8 4-6-6-4
24,500	Atchison, Topeka & Santa Fe 2900 4-8-4

Some roads in the 50's such as the Norfolk & Western or the Baltimore & Ohio already ran with extra water tenders to increase the range of their locomotives. This practice gained widespread following in later years with steam excursions in the diesel era. There's enough footage of the UP Challenger with tenders trailing its own tender. My conservative estimate is that the Challenger on those occasions departed with no less than 63,000 US Gallons of water - enough to fill a hotel swimming pool.

COAL BUNKER CAPACITY IN POUNDS

Pennsylvania T-1 4-4-4-4 Duplex

Tender Capacity (Pounds)	Type of locomotive
92,000	New York Central Niagara S-1 4-8-4
85,200	Pennsylvania T-1 4-4-4-4 Duplex
84,000	New York Central Mohawk L-4 4-8-2
82,640	Pennsylvania Q-1 4-6-4-4 Duplex
60,000	Western Maryland 4-6-6-4 and 2-10-0
	Norfolk & Western 2-6-6-4 and 2-8-8-2
	Chesapeake & Ohio T-1 2-10-4

58,000	Union Pacific Big Boy, Challenger 1943, 1944

The bunker capacity of C&O 4-8-4 no. 614 was enlarged to 100,000 pounds for excursion service in the early 80's, thus following the trend on the New York Central and Pennsylvania. On these roads, taking coal was a lot more time consuming than taking water on the fly from troughs! The reduced water capacity on C&O 614's tender was taken care of by an additional water tender.

EPILOGUE

Most comparisons point toward Big Boy's undercarriage in relation to record sizes. Longest without tender, largest driver size and highest speed with 8 coupled axles. Big Boy was conceived for a maximum of 80 MPH and the undercarriage was more than up to the task with fantastic tracking abilities through curves. Herein lies Big Boy's real strength which does not appear in figures. That large undercarriage made Big Boy a Rolls Royce among Mallets. Each engine group has Alco lateral motion boxes with centering devises on the leading two coupled axles and there was also a centering devise on the boiler support over the leading engine unit. Under extreme conditions at least 8 flanges, 2/3 of all wheels on one side were engaged in taking the side thrust of Big Boy's mass in the curve. No other steam locomotive - Garratts included - could claim this. Big Boy's fixed wheel base was no longer than the 6' 1" of a Challenger. Dead slow the 4-8-8-4 actually could take a sharper curve than its tender….

Big Boy's boiler is big but, grate area and steam pressure aside, not exceptional. Most of the additional weight was in the undercarriage, not the boiler. It shares this trait with the Pennsylvania T-1 4-4-4-4 Duplex, the boiler of which was eclipsed by many a 4-8-4 even though the Duplex ranked among the heaviest of them in weight. Another fact that supports this trend is the 7,000 HP power output as claimed by Alco's Big Boy advertising, without indicating where or how it was measured. This happens to be significant. The highest numbers are scored with the so-called " indicated horsepower' rating, essentially depicting the boiler's steam raising capacity. The highest authenticated score in this field is 7,987 HP recorded for the Pennsylvania Q-2 4-4-6-4 Duplex. Cylinder horsepower already incorporates losses in the steam circuit and drawbar horsepower denotes the power left to move the payload after subtracting what is needed to move the locomotive. One of the Big Boys recorded a maximum of 6,360 drawbar HP at 42.5 MPH. It is then surprising how close a Norfolk & Western A class 2-6-6-4, exactly 200,000 lighter, comes with 6,300 drawbar HP at 45 MPH. The Allegheny sustained 7,375 HP and produced an all time record peak of 7,498 at 46 MPH. The Allegheny's boiler must have surpassed the 8,500 iHP to produce such a feat, bearing in mind that the 2-6-6-6 and its tender alone weigh as much as the entire test train pulled by A4 "Sir Nigel Gresley" for its main line ticket in 2006…. Note also how close the 2-8-8-2 of neighboring Western Pacific compares in boiler parameters. Of course, that loco lacked Big Boy's speedy undercarriage.

Big Boy was not an act of megalomania. It did not have C&O's humongous Allegheny axle loading. No oversize grate area like the NP 2-8-8-4, no oversize cylinders, boiler girth and loading gauge like the Virginian 2-10-10-2. It did not have an experimental character with too much of a good thing like the Pennsylvania 6-4-4-6 Duplex and 2-8-8-0 or the Santa Fe 2-10-10-2 and Triplexes. Nothing of the sort. Big Boy was essentially a Challenger with all its good points stretched to practical limits. The unusual long career for a modern American steamer of 17 years without much in the way of alterations is a

testimony to its success. Big Boy did not lead in all dimensions but its length was eye-catching. The rest is academic, for the name Big Boy is, by now, synonymous with the biggest and finest America has produced in reciprocating steam locomotives.

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