

ICON



10000 after withdrawal, at Derby. *Paul Banks*

Welcome to Issue 15 of ICON — Tony Brown, Treasurer

Over the summer we have seen a lot of progress. The sheer volume of work happening, or lined up to happen, is quite overwhelming at times, but also it's very enjoyable to see so much development. As one of the team who isn't an engineer, I'm constantly in awe of the things I see happening!

So, over to the finances. We've recently invested in Xero, an excellent accounting software product that will help the back office team to provide more information on our sustainability and financial stability. This software will enable us to construct more detailed reports about our income and expenditure.

Soon, we will be entering the stage of the project when construction starts to take place at pace, following years of planning and foundation engineering. Of course, this is where we will be looking to ramp-up investment so we can take every available opportunity at the right and considered time.

In our financial reports, you will note that 2023 saw both income and expenditure decrease, but through 2024, we are already gaining more income and spending it wisely.

We have an excellent financial reserve in our bank accounts but will be fundraising again once our target figures are established. Some of the upcoming work will likely be expensive and we will tailor fundraising ideas in these areas once we know the amounts we need to realise for each step. We want to ensure that we raise funds in the right way and focus on each step with a joint engineering and financial view.

Other projects have seen significant milestones and challenges. Over the summer, new build steam loco 'Beachy Head', ran under its own steam and we send our huge congratulations to all involved. At the same time, the Class 22 new build diesel group have sadly closed down their project, partly due to a loss of cashflow. We feel the pain and frustration of those who had worked to make that project a reality.

In all projects such as ours and others, we know that we are dependent on skilled and dedicated volunteers and a consistent financial resource. Thank you to everyone who contributes toward our aim. There is a long way to go and much work and fundraising ahead.

We are glad that LMS 10000 is in a great position and the future is bright, and we will endeavour to ensure the future is black and silver - to be precise!

ENGINEERING

Progress with the traction motors

We have six traction motors at Winksworth, three from each bogie. Those from bogie 139 have been removed and dried out, so that electrical continuity tests can be made. This will then let us know how much refurbishment is required for each. Our initial estimate is that a traction motor overhaul would cost somewhere between £12k and £35k, depending on the level of work required.

Fortunately, over a year ago, we reached agreement with the Werkgroep 1501 to purchase from them three refurbished EM2 traction motors together with a couple of crates of spares, notably, including we hope, manganese liners.

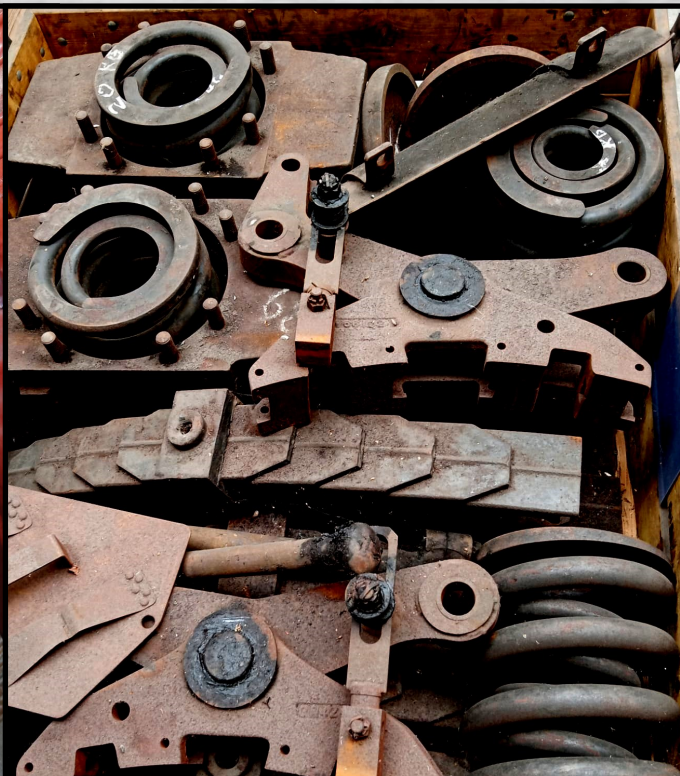
Since then we have tried without success to arrange transportation of them from the Netherlands to the UK. The problem lies in paperwork created by Brexit. Upon phoning NL Customs we were told, twice, that a private individual or charity did not need paperwork other than a list of the consignment, even if it was being transported in an articulated lorry. However, no sign of such advice is apparent online and no international transportation company has been able to confirm or clarify this, nor has any company been willing to step forward and do the job for us. Including some well known firms!

Our friends in the Netherlands have suggested a company there who can do the work for us.

We are making progress and our visit Blerick in the Netherlands, to assess the traction motors and parts there, is show on pages 4 and 5. Meanwhile, here are photos of work undertaken on the traction motors at Winksworth, *taken by Anthony Pilkington.*







Our visit to the Netherlands

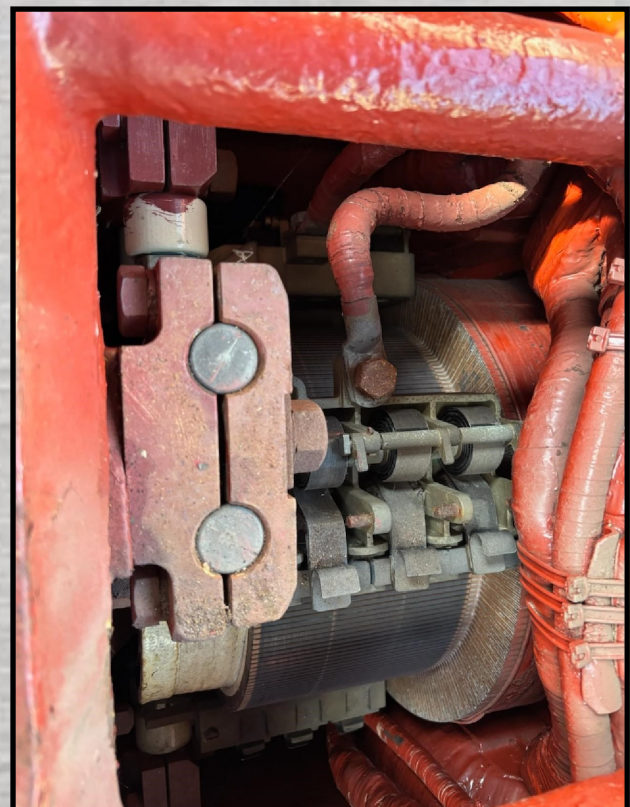
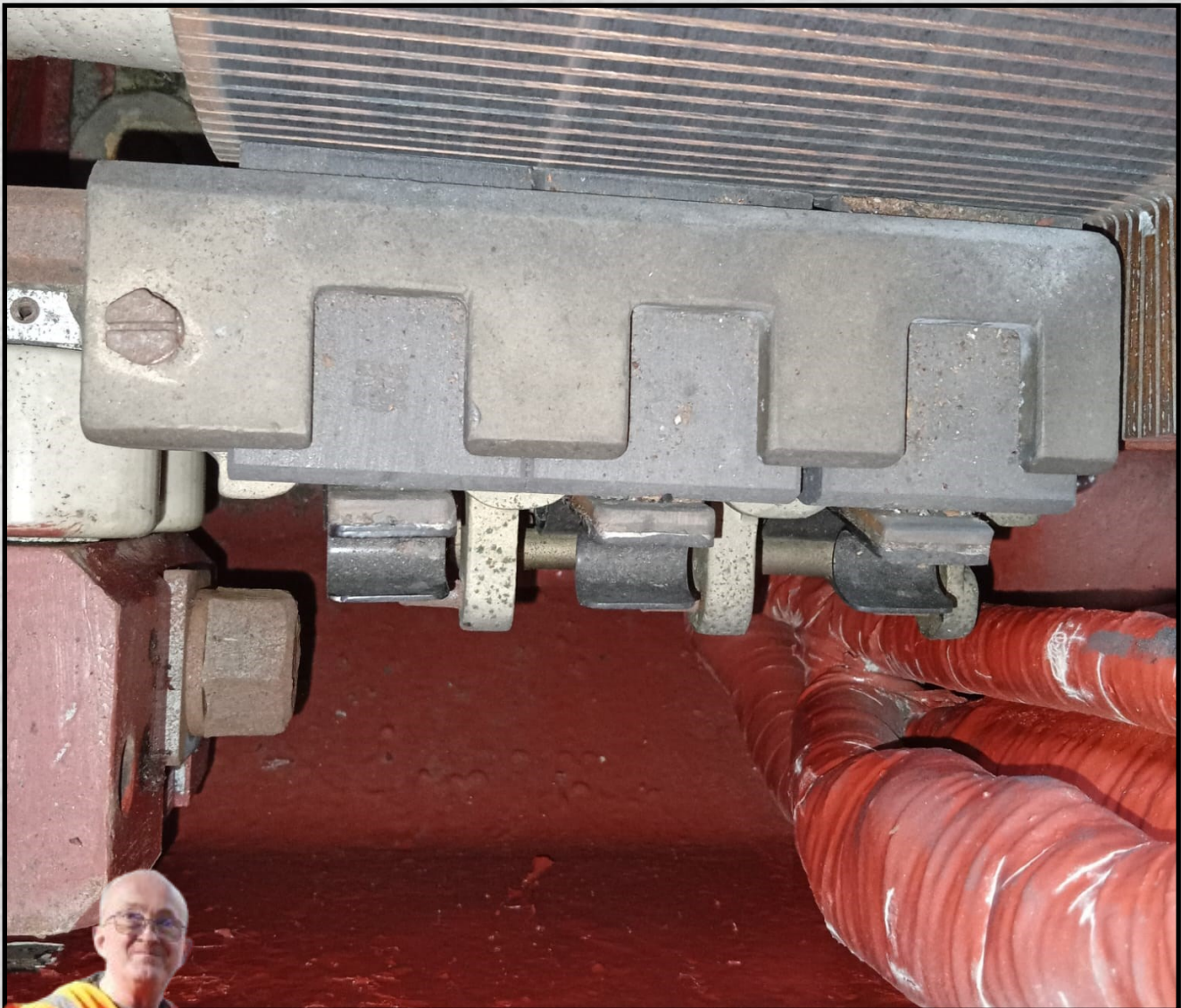
On the 10th of October, Paul and Graham visited the Werkgroep 1501 in the Netherlands. Our hosts, Martin and Vasco, were fantastic.

All three traction motors were ex works when handed to the Werkgroep in the 1980s. They test ran with very acceptable resistance figures, especially given the 40 years they've been unused.

The Werkgroep 1501 have our full support and we would therefore be willing to aid and assist with any future repair works to former class EM2, 1501 Diana, if there was a change of opportunity in running this historic locomotive again.

On the right you see some of the parts available for us to buy in addition to the traction motors.





The condition of the traction motors is very clean and, rumour says, left a loss for words!

These photos illustrate their condition compared to those at Wirksworth shown on pages 2,3 and 9. Photos by Paul Etherington, and Graham Clarke.

Paul's report 24 Aug

Mick and Phil got stuck straight into brake shoe removal of bogie 139 in anticipation of fitting our compression load cells and undertaking many brake tests to back up or prove changes to the design specification of the EM2. There has been much background work done with the entire subject with some fantastic thought process going into it. We will transfer these to paper in due course for evaluation, but I can say the brake cylinders will be in a better position within the bogie, improving aesthetics, improving loading and unloading, and protecting them from the elements.

Whilst the brake shoe removal and assessment was going on, Tony B and Anthony got on with cleaning up the stripped traction motor and prepping it for the drive end to be stripped off for assessment.

I brought the load cells and the purchased 2400 bar hydraulic pump and I'm very happy with our purchases that increase our productivity and competence dramatically.

A start was made on carefully removing the traction motor end plate and bearing. This went exactly to plan with a slight bit of heat applied to the labyrinth seal to ease the work required by the fabricated 1/2 Whitworth jacking bolts. Once the labyrinth seal had come off the parallel part of the shaft, the endplate was rigged up from the telehandler and was carefully and effortlessly removed from the armature resulting in that traction motor fully stripped. We were all amazed at the condition of the main bearing and grease.

The grease was old discontinued Shell Albida EP2 containing no contaminants whatsoever either from bearing wear or externally. The viscosity was starting to show its age with the caking effect, but would have still lubricated the bearing at full design speed with working temperature being achieved. Grease content was absolutely correct for its speed and application. Given to its storage temperature range, it was in a condition that you would expect of ten year old grease rather than nearly 40 years old. I have witnessed a 5 year old motor bearing grease in far worse condition than this.

The bearing contained no damp damage whatsoever. It is a special one being of two parts, inner race and outer race plus rolling elements. Definitely a bearing that will have to be special order. I was truly astounded at the interface between the inner race and rolling element which has clearly done very little since installation. The dulling that occurs from the rollers on the inner race is minimal.

I used to cut SKF BOFA fan bearings open to establish root cause analysis upon failure on all BOFAs throughout the UK and I can tell you that a week of service would cause that level of dulling! Utmost care must be taken with these bearings as I do believe now that we ought to have them deep cleaned and assessed for reuse by SKF. Bearing quality was at its pinnacle at this time with no influence from lower quality materials.

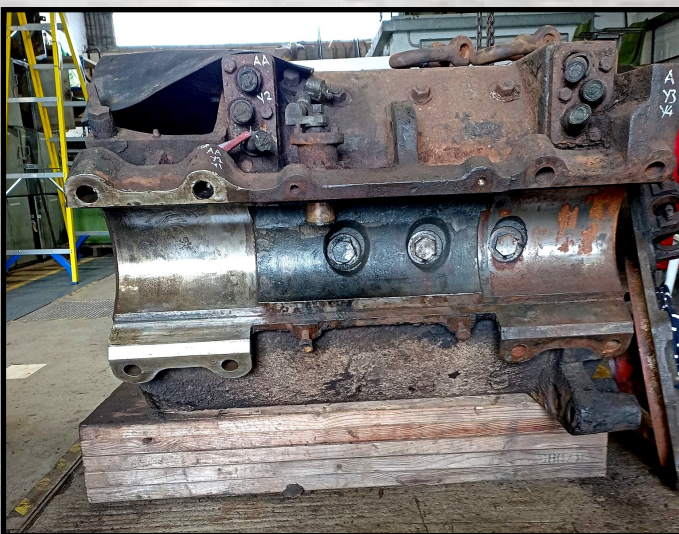
Both bearings on this traction motor are good for thousands of hours, if required to go again. A future task will be to investigate the removal of the cooling fan, to enable us to see if cost effective repair of this armature is possible or it is a source of spares.



The Traction Motor Pinion Nut is secured by a dished locking washer, the locking is secured by deforming the periphery of the washer into machined locations around the outside diameter of the nut. The picture shows that the nut has been removed. Gentle heat was applied to assist removal of the nut once the locking locations had been released. A special castellated socket was made by Phil Stanbridge to fit in all four slots of the nut, then an impact wrench made for easy removal.
Anthony Pilkington



The picture shows the drive end of the armature shaft after pinion removal. The nut was refurbished and has been refitted to protect the thread and to save it getting lost. The pinion was removed using a hydraulic pressure pump. Oil was pumped into internal oil-ways through a fitting on the end of the shaft to release it. Work can now continue on the Labyrinth seal.
Anthony Pilkington



Here is the traction motor with the Bearing Keeps and White Metal Shell Bearing halves removed. The bearing on the left has been cleaned and lightly greased with EP2 grade and Scotch Brite to aid further removal of ingrained oxidation, to make it ready for Bearing fitting trials. Once cleaned and inspected the keeps will be trial fitted to their most suitable locations, it's the important nip on the bearing shells once installed that we are hoping to ascertain and in accordance with the axle journal diameter positions.
Mick Clamp

Fast forward to the next weekend and the plan for the day was a simple one, evaluation of brake testing with our new compression dynameters. Further evaluation works on the armature and cleaning works on the stripped traction motor case plus refurbishing cubicle busbars.

The dynameters are thankfully perfect for the task giving us some reliable data plus educating us on the improvements required to our system prior to sending the dynameters off for calibration testing. Phil, Paul H and Mark ran three tests on three wheels giving us some repeatable results that is going to accurately prove what the EM2 brake system was actually capable of. As can be guessed it was a trial day with many brake applications which did bed the whole system into operating condition. We have purchased a separate air pressure regulator to enable very stable air pressure during testing. We have also purchased new seals for the air pipes to minimise any air leakage. These purchases will improve our accuracy of results and give the brake system more exercise.

Mick tackled the job of cleaning and assessing the removal of the cooling fan on the end of the armature with the help of Graham and a very busy drawing of the traction motor. We were able to identify how the whole armature was constructed. In short the cooling fan is not coming off unless we draw the shaft out of the armature, which is beyond what we aim to do at this moment in time.

We found that there is possibly a crack in the varnish and taping adjacent to the cooling fan that has possibly allowed moisture into the area where the windings reverse. Graham performed another insulation test on the armature to see if there has been any improvement over summer. To our surprise, there has been a small improvement, so we all agreed that before any more intrusive work is undertaken, another appointment with the oven beckons, to ensure it is completely dry.

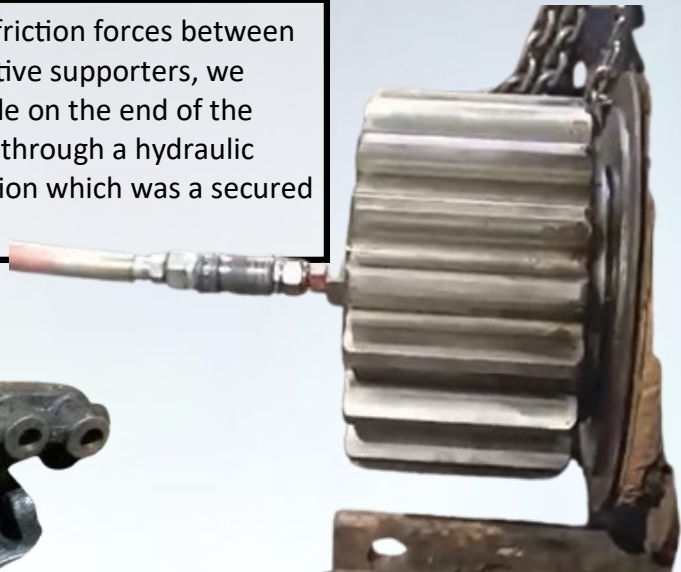
The Magnet of this machine which incidentally has reasonable resistance readings was further cleaned of rust and knackered varnish in preparation of laser ablation of the oxidised surface, Tony B and myself carefully made a good go at trialing different tools and methods on this highly important task to do carefully. The visible condition of the magnet internally is already vastly improved due to hours of hoovering and externally with years of grime previously removed. We have set up air extraction ducting and a fan. This work has identified a rehabilitation method that will see these traction motors prepped for varnish, without having to fully rewind them.

The plan at the minute is to carry on the careful removal of heavy oxidation, endoscopic inspection within the voids of the poles, high pressure steam cleaning outside, laser ablation then another two weeks in an 100 degree oven, re-establish and modify the power cables. If all goes to plan we will then send it away for a high quality re varnish, then rebuild.

We needed to develop a method of safely and successfully removing the drive pinion gear from the traction motor armature shaft.

All photos opposite by Paul Etherington.

Attempts were made to break apart the friction forces between pinion and gear. With help from informative supporters, we identified that there is an oil injection hole on the end of the armature shaft and by applying pressure through a hydraulic line, seen here, we could remove the pinion which was secured by a key in the taper.

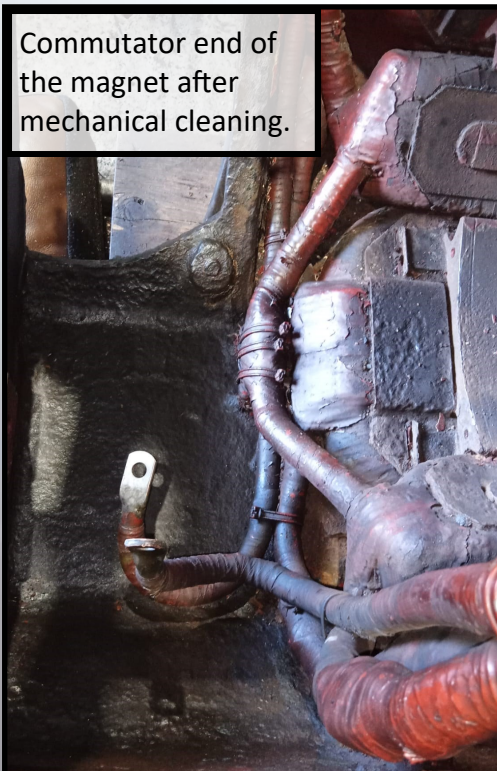


Left, a stripped traction motor magnet after turning over to commence internal cleaning.

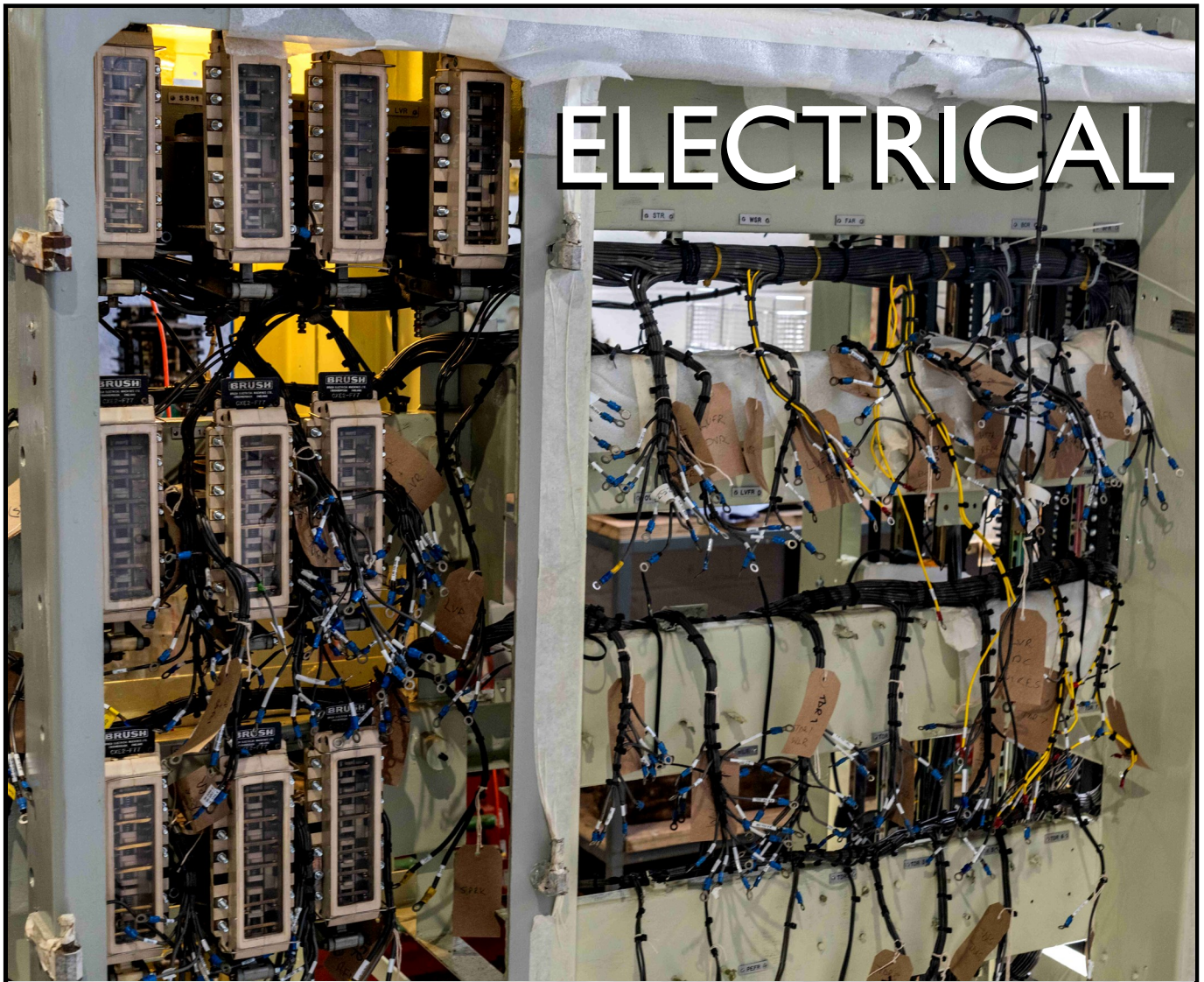
Right, the opposite side of the magnet after mechanical cleaning prior to steam cleaning and laser ablation.



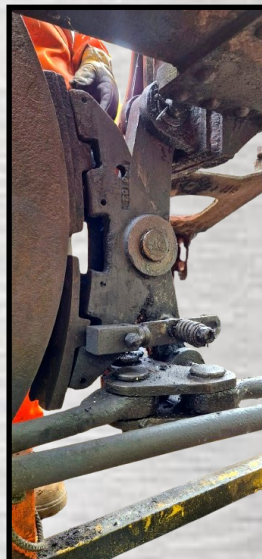
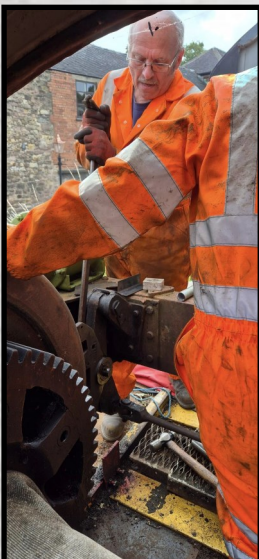
Commutator end of the magnet after mechanical cleaning.



The visual condition of this 'least good' traction motor is apparent, especially compared to that in the Netherlands shown on pages 4 and 5. This one is in 'as used' condition and spent 30 years outdoors. Even so, we are encouraged by its condition, which suggests that the other motors on bogies 139 and 140 will be refurbishable.



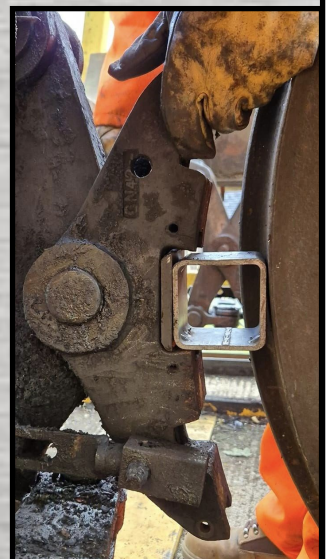
The cubicle is starting to look impressive, with refurbished and tested relays back in place. The quality of the cubicle work speaks for itself in pictures. We need to track down some replacement switches for the relays which is proving troublesome at the moment and as we would dearly like to replace like for like, the search goes on. *Photos: Graham Clarke.*



The first four photos along the bottom of these pages show brake tests on bogie 139.

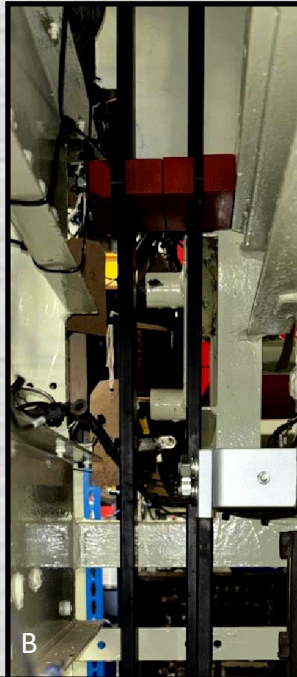
The far right photos show the newly purchased laser rust and paint removing machine under test.

All, Mark Langley





A



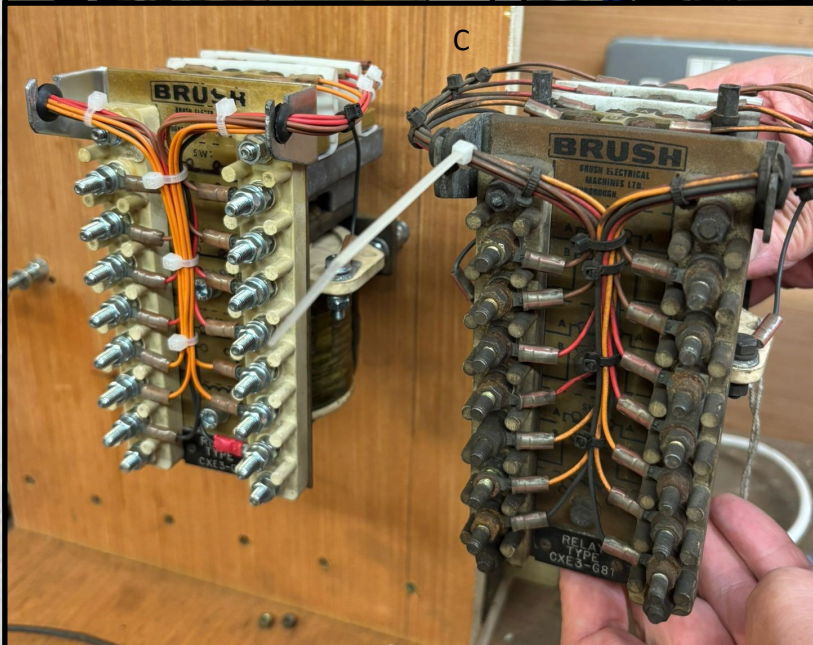
B



Graham reports: In early September, electrical works included adapting our CXE3 relay test to include a loaded test of the snap switches on the top of the relays.

With Phil's help I also managed to fit two motor contactors (marked A, left) and all the associated busbars and clamps (marked B, left). This was to prove everything fits okay and that we have everything we need, before all the kit is refurbished. There's nothing worse than finding out there's a problem later.

The photo left, (marked C), Stop Relay (STR) before and after example of the finished result on the left.



C



2024 AGM Minutes– Saturday 5th October 2024, starting at 1pm

Venue: Aston Court Hotel, Derby, DE1 2SL

1. The meeting was attended by 15 members in person and 8 online via Youtube. Tony Ellershaw (Chair introduced Andrew Hoseason (secretary, Paul Etherington (Lead engineer) and Tony Brown (Treasurer).

2. **Apologies** were received by 9 members.

3. **Minutes of the AGM held on 07 October 2023** were proposed by Michael Prince and seconded by Alan Taylor. No questions or matters arising.

4. Annual Report

Tony Ellershaw began with a vote of thanks for the volunteers who attend at our workshop to work on our various components, noting that we are making remarkable progress and that the building looks really tidy too. He then thanked Andrew Hoseason for his work on the computer. While the workshop isn't a perfect building, it does for what we need. We have added proper guttering which has solved a water leak problem. No ingress was found after recent storms. We have sealed the back office. Our information stand has attended two galas this year. Tony expressed his feeling that it was not very productive as most enthusiasts do not take the time to de-train and walk to the buildings in which we are placed.

5. Treasurer's Report - Tony Brown

Various financial reports had been shared in advance. We now use Xero accounting software which helps immensely to produce quick and accurate reports. We have received excellent donations this year. Most money has been moved to higher interest gaining accounts, but accounts which permit quick access. We are getting around £200 interest a month. Our income is steady but, of course, we need thousands of pounds more. It is good to have the help of Anthony Pilkington who has guided us.

Paul Harrison asked what was the status of the application for VAT registration. Andrew explained that the application has expired and we would need to begin again. He added that he felt uncomfortable processing the VAT application and it was not high on his IDRS To Do list so if another member is willing, it would get processed faster. Tony Brown volunteered to take over the VAT registration process. Tony Hewitt asked what the financial implications of being a trustee were. Andrew advised he knew of none. [Other than liability to replace a financial loss caused by lack of carrying out the basic duties of a trustee.] He added that the charity commission website has a good source of material to guide trustees about the responsibilities and expectations of their role. Tony Brown will share Charity Commission guidance with trustees, in connection with trustee risk.

Hanson Haigh noted that there was no asset register. Tony replied that this is acknowledged and is on the list to do, while at the same time noting that most asset's value to us are far more than their capital worth.

Income and Expenditure

Ivatt Diesel Re-creation Society

For the year ended 31 December 2024

Account	2024	2023	2022
Sales			
Ebay Sales	563.36	141.16	0.00
Other Revenue	0.00	264.94	0.00
Sale of locomotive parts	1,000.00	0.00	15,400.00
Sales	25.00	31.14	1,342.77
Total Sales	1,588.36	437.24	16,742.77
Other Income			
CoCo Club	1,060.00	1,280.00	1,170.00
Donations to LMS10000	32,518.53	38,065.42	74,124.21
HMRC Gift Aid	4,213.86	6,739.69	12,191.80
Interest Income	1,065.27	315.33	16.23
Restricted Donations to LMS10000	67,325.00	975.00	5,001.00
Refund	189.54	133.99	438.76
Total Other Income	106,372.20	47,509.43	92,942.00
Total Income	107,960.56	47,946.67	109,684.77

Expenditure

AGM Expenses	0.00	225.00	369.20
Centenary Works electricity	2,097.75	611.35	409.76
Centenary Works rent	8,262.00	11,016.00	11,016.00
Centenary Works Storage	572.19	0.00	7,884.00
Charitable Donations	105.00	0.00	0.00
CoCo Club PRIZE	687.50	570.00	599.25
Crane Hire	0.00	0.00	11,844.00
Ebay charges	11.47	17.93	12.60
Engineering expenses	663.09	804.10	4,258.86
Engineering services	0.00	0.00	624.00
General Expenses	0.00	0.00	11.48
Google Drive (Google One)	3.18	19.08	19.08
Health & Safety	59.40	810.00	506.29
Insurance	1,071.00	0.00	0.00
Magazine and printing	555.38	1,347.05	1,275.33
Parts for Electrical cubicle	461.11	0.00	0.00
Paypal charges and fees	2.39	18.34	0.00
Postage, Freight & Courier	462.82	814.23	335.02
Printing & Stationery	0.00	41.14	0.00
Publicity	551.19	1,374.99	3,459.25
Purchase of Drawings	0.00	0.00	43.20
Purchase of items to sell	0.00	0.00	421.14
Purchase of loco parts	200.00	2,000.00	33,502.28
Purchase of original photographs	390.27	1,919.74	492.63
Repayment of bank's error	0.00	0.00	1,000.00
Repayment of unpaid cheque	30.00	150.00	79.00
Software	172.15	80.78	79.99
Staff Training	340.00	0.00	0.00
Subscriptions	10.00	45.00	10.00
Telephone & Internet	54.00	72.00	82.63
Transportation	0.00	696.00	4,254.00
Travel - National	0.00	95.98	40.00
Website	426.63	208.47	253.34
Workshop equipment	12,067.89	0.00	0.00
Workshop signs	14.82	231.55	745.89
Workshop supplies	2,749.06	676.60	1,441.23
Xero software	245.70	0.00	0.00
Total Expenditure	32,265.99	23,845.33	85,069.45

Bank Summary

Ivatt Diesel Re-creation Society

For the period 1 January 2023 to 09 October 2024

Account	2023 Opening Balance	2023 Closing Balance	2024 Closing Balance
Co-Co Club	294.90	326.48	11.00
Electrical Cubicle	4,602.72	4,643.24	4,633.33
Treasurer's Account	28,819.44	51,793.70	511.68
Treasurer's Interest-Gaining	0.00	0.00	64,074.73
Paypal	1,994.52	0.00	19.32
Restricted exp	0.00	967.76	5,148.38
Rolling Chassis	23,755.73	23,974.85	81,426.42
Telehandler	3,013.48	3,040.00	3,068.54
Vampire appeal	0.00	0.00	1.00
Wheel Turning	4,100.79	4,136.89	4,175.74
Total	66,581.58	88,882.92	163,070.14

6. Election and re-election of trustees.

No new applications for the role of trustee have been received. Our Constitution permits 10 trustees and we have 8, so we are open to another 2 members. We are looking for people with experience with financial matters or fundraising.

The roles of Chair, Secretary and Treasurer were re-elected by members present, with Tony Ellershaw, Andrew Hoseason and Tony Brown continuing in the roles.

7. Confirmation of other roles.

The following roles are not required by the Charity Commission. The meeting was informed that Bernard Caddy would continue in the role of Co-Co Club organiser and Gift Aid administrator while Tony Thompson will continue as Health & Safety officer.

8. Engineering Summary

Paul Etherington spoke about the quality of workmanship being carried out and applauded all the volunteers for their contributions to the project. He highlighted the work of Tony Thompson to ensure that all volunteers are safe and cared for while on site. While the workshop isn't perfect, we are making the most of it for the purpose we envisaged, storage and refurbishing. This last week we fitted a load bearing steel section cover for the pit, enabling the telehandler to move anywhere within the workshop.

Our drying oven is seen left in Mark Langley's photo, taken during construction. The metal frame was later lagged to retain heat inside. Halogen lamps were the heat source used to dry out the traction motor. It works well and is cost effective in drying the motors, so we can take reliable electrical conductivity readings. We chose the one deemed to be in the least good condition and even this one seems to show signs of being reusable within limits. Once reassembled, we may consider running the traction motor on a test rig.

We have purchased a good range of equipment including those to enable brake tests. We have designed a method for calibrated brake force tests. The oil injection pump has been



These photos show the oven frame being lowered over the traction motor. Photos: Mark Langley.



very useful already. Work is ongoing on the electrical cubicle and the standard of work is second to none.

A lot of work is happening, taking a lot of time, revolving around the drawings and the road forward to design acceptance. Derek Payne has been working hard to complete A0 plans at a standard for manufacture, and they have already been assessed for suitability and further analysis is required, to get to authorisation to construct from the drawings.

One of the areas where we are doing work is on brake design, in conjunction with brake tests. We have been encouraged by the quality and strength of the EM2 brake system. Although we are only building for heritage line use, we want to design the braking system to stop the locomotive from the main line speeds of the original D16/I locos.

We have engaged with railway consultancy companies to further the acceptance of the design. This includes Vampire computer modelling enabling cost-effective analysis of rail vehicle performance and safety through simulation. We are producing the necessary documents as part of this process. This work will all come at a cost. Thankfully we have sufficient in the bank, but of course, fundraising must continue in earnest. Graham Clarke is working with Paul on the certification process.

We will be removing the wheel sets from bogie 139 and sending them for tyre turning. They have already been ultrasonically tested, with positive results.

We need to create a register of parts, their condition and what we know of their past.

Next week our engineers will go to the Netherlands to electrically test the three traction motors that have been offered to us. We also have to clarify the other items that we will buy at the same time. We can then repatriate them.

Mick Clamp asked if we could do the chassis modifications on site. Paul replied that it is all about location. We would have to have a separate site, away from running lines. However the money saved would be far offset by the speed at which a company could do the work for us. The finished rolling chassis will be a tremendous bonus both for morale and publicity. Once we have a rolling chassis, we can begin to attach parts in a modular fashion similar to the original locos.

Hanson Haigh asked what cost we expected for the chassis modifications to achieve a rolling chassis. Paul explained that it could be £60-100k.

Michael Prince suggested we explore sponsorship for such jobs.



10000 during construction during 1947 showing the modular method of construction which we will also employ.

Progress will be visible once we can place components on the rolling chassis.

Photo: Midland Railway Trust / Brian Radford Collection.

Graham Clarke said that while the passage of time is a big risk factor for us, we have many opportunities to publicise the project and spur it along. He suggested a local "Made in Derby" campaign.

Michael Prince asked if we have an update about the 16SVT power unit stored in Lincoln. Paul explained that we were in no hurry and that the company is snowed under with work. Andrew proposed a vote of thanks for the company who have stored equipment for us, which no doubt is some inconvenience to them.

9. Publicity and Fundraising

Andrew Hoseason mentioned that he is Secretary, Membership Secretary, in charge of fundraising and publicity. It is a lot to do and assistance would make the work happen faster! First a membership report. We have 270 members and they donate over £2k a month which more than covers rent of our workshop and payment for utilities. Thanks are due to every member for giving what they can afford every month. We are on a very steady base there. We have £163,609.78 in the bank which sounds a lot but it will quickly disappear when we start paying professionals to do work for us.

Adverts have been placed for a couple of magazines. A major publicity campaign is planned once we have the chassis and bogies ready to go to a commercial site to be worked on and turned into the rolling chassis. This will in turn create more publicity and confidence in the project going forward.

Andrew mentioned that the Made in Derby proposal is a good one. He has tried to get a local group with local co-ordinator to bring about local publicity both to the public in supermarkets and to large companies with a view to sponsorship. Tony Brown made the point that he would love to do this task but he lives 170 miles away and doesn't have the local connections or knowledge required.

Tony Brown added that if we have individuals within our membership or the wider community, who can unlock such doors, could they please get in touch. Graham Clarke added that it is "us" who can do this work. We can wait for a 'messiah' but one is unlikely, it really is a task for eager members to grasp and run with.

One company donated £50k this year because they were happy and confident with the work

we are doing. On-site visits were made by the company owner. That is the kind of donation we would very much like to attract in the future.

We discussed the opportunities raised by Rail200 in 2025, including a 3 day open day at Derby and Andrew will work with Alan Taylor on this. Michael Prince highlighted Shildon's celebration of Rail200 and he will work with Andrew on this. Tony Hewitt mentioned a contact at Alstom Crewe who he could approach re Rail200. Paul will approach Wabtec to see if they have involvement with Rail200.

Alan Taylor suggested approaching Rail Forum Midlands and the Institute of Mechanical Engineers in Derby.

10. Any other business

- a. Co-Co Club - our quarterly draw lottery club. Half of the proceeds are prizes, half to the Society. The web link for this is lms10000.co.uk/coco-club-1 and the membership form can be found via our website's Download page.
- b. Gift Aid – we receive thousands of pounds of income from the HMRC as Gift Aid and encourage those who can to sign up. The form is on the Download page.

11. Open forum

- a) Alex Toyne suggested we explore 10000 in a train simulator program. He will explore this on our behalf.
- b) Tony Hewitt suggested we look to split Andrew's various tasks between two people. Tony Brown suggested it was an ideal Trustee role.
- c) Tony Brown talked about his discussions with a company who can help our members making a will. He plans to share information in future ICON magazines and the website.
- d) It was suggested that we could place adverts within Derby and Duffield stations. Alan and Andrew will follow this up.
- e) Mick Clamp asked if a further order for works plates could be made. Tony Ellershaw will follow this up.
- f) Date of next meeting. We discussed the date, as our meeting is on the same day as diesel galas each year, so the meeting it would be good to move our AGM into November. Trustees will confirm the date soon.



*A lot of strenuous work is carried out in unusual positions. Here we see Phil attending to bogie 139.
Photo: Mark Langley*

Drawings — Paul Etherington

Our very talented Mr Derek Payne joined the working group and brought with him a lot of hard work. Derek and I made a pact in 2011 that we would always work independently and not share calculus or measurements whilst undertaking any sort of drawing calculus or working out of engineering drawing for the simple reason that if we both arrived at the same measurements and conclusions, then it has a very high probability of being right.

Derek has completed a massive amount of hours re- drawing and fully re-evaluating the LMS10000 Chassis / Bogie interface drawings that took me a good solid 500 hrs to work out, on top of the original evaluation drawings done by the both of us in 2011-2012. These have passed through an independent structural design specialist beforehand and have been adapted to his specifications to ensure suitability for purpose as a "main line locomotive" with structural strength considered on 3 plains of axis whilst carrying 65 tonnes of body and equipment. It also adopts EN15227 crashworthiness regulations for railway vehicles as a guideline, to ensure this chassis supported locomotive will react in the worst case scenario of serious collision impact, to minimise loss of life as far as reasonably practicable with collision based on the Mk 1 /2 /3 type of passenger vehicle and also considering the crew of the locomotive.

Work has also been completed to establish the springing arrangement and locomotive braking characteristics. As you all know before it can go it must stop as well or better than an existing locomotive design. We currently have three designs on the board with previous proof of its suitability for braking a locomotive to the required standard with data to back up the statistics. These will be proven over the next couple of months with dynamic trials on bogie 139. Ideally we would like to employ the most aesthetically accurate solution, which in what was proposed to me today is as close as it gets, however priority is "Fit for purpose".

Basically the way we are dealing with all scenarios and making them fit within the envelope of LMS 10000 and also acknowledging modern railway vehicle design standards and protocols will ensure that we build the last mainline diesel locomotive built in Great Britain as good as the first and better. Doing it in the proper "Safety Method" with all the calculations approved and signed off by independent experts will probably lead to dynamic tests at suitable locations at high loads and high speeds, but this is the only sure fire way to ensure we can haul heritage trains on heritage railways to a high factor of safety, being designed and built to do what all other heritage locos did in their working career and acknowledge the improvements made in regards to safety on the modern railway.

Derek's drawings are now going to an independent expert to ensure accuracy of all dimensions stated. This will then be put through "Vampire" computer modeling and shared with a suitable railway signatory and the RSSB prior to the making of components and adaptation of chassis to ensure we do it right and do it once (for LMS10000)?

Adaptations required to the complete class 58 chassis have been drawn accurately and assessed independently by a locomotive structural design engineer. Slight material choices were made after assessment. The most notifiable engineering change is the adaptation of the class 58 traction centre and secondary suspension to allow the fitting and operation of the class EM2 bogies. This has been kept as simple as is possible, the space between the

original traction centre and the height of the EM2 secondary suspension spider is considerable. This has allowed for the incorporation of two large adapter plates vastly overengineered to actually bolt to the original traction centre. This allows a EM2-style pivot to be bolted to this plate as per the original LMSR 10000 and EM2 locomotive.

Due to the slight offset of the new pivot location, new brackets will be fabricated that replicate the original class 58 traction centre mount at the rear end of the adapter plates with these brackets fully welded in position on the centre beam of the chassis and bolted to the adapter plate. This allows the adapter plate to be unbolted as per class 58 when bogie separation is required for maintenance. (Ref. to attached drawings.) To take the weight of the locomotive eight bearer pads as per class EM2 are to be fitted to the underside of the chassis; four are located on re-enforced box section crossmember inboard of the locomotive. The outboard four require the addition of four heavily re-enforced extension pieces to be fully welded to the outboard crossmember sections.

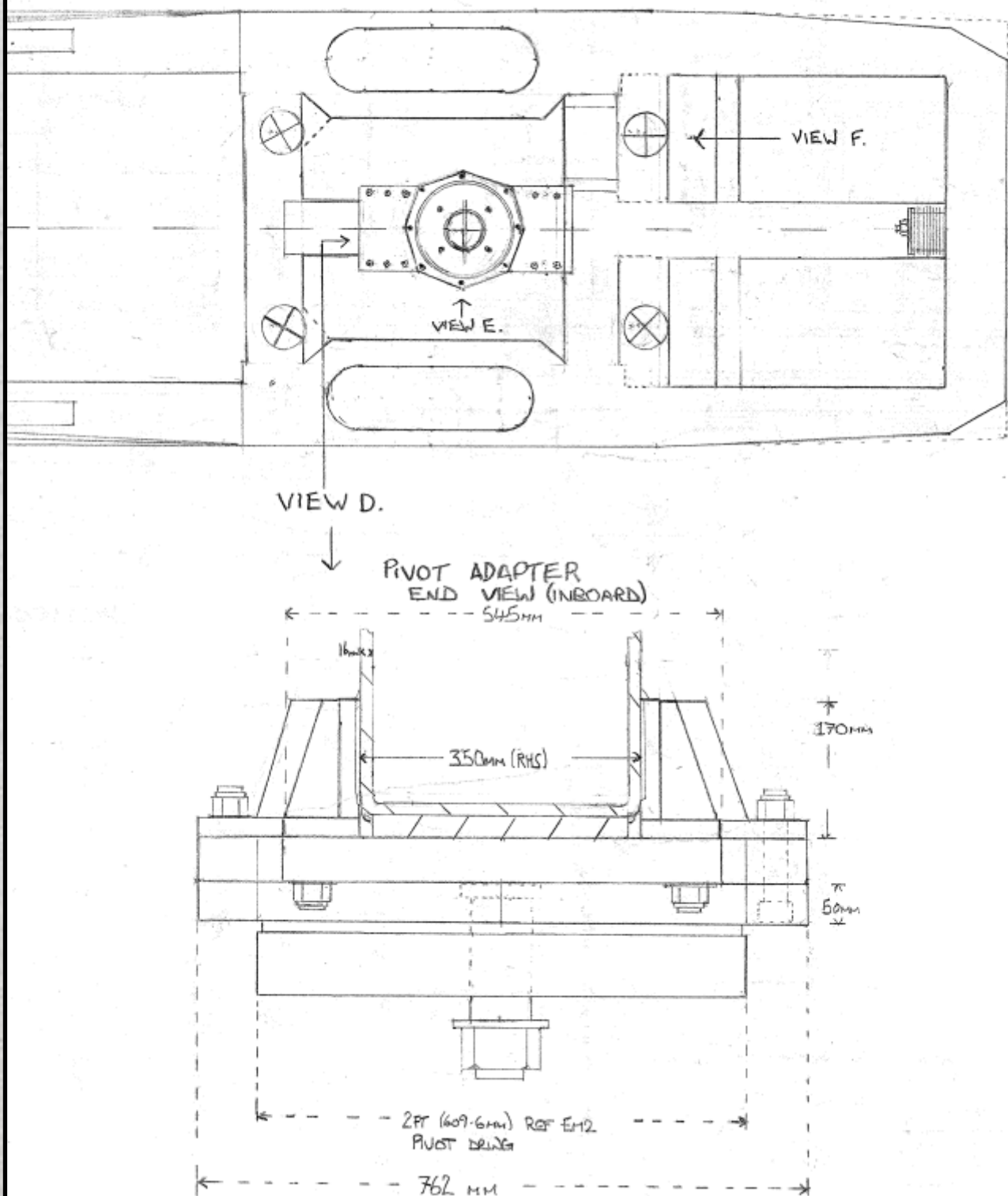
The secondary change required to enable the locomotive to follow the outside dimensions of the LMSR D16/I design is the removal of existing chassis outer edge steelwork, predominantly underneath the cabs. These areas at the fronts of the chassis have to taper in at a greater angle. (See attached drawings). This includes the trimming of the bottom outer edge of the centre “dropdown” of the chassis which has recently been reduced with the slight alteration of the tumblehome radius of the main body structure bottom. However, our calculations were concluded with a greater percentage of this area removed. To replicate LMSR D16/I design, the centre “dropdown” has been increased in depth with equivalent material fully welded to the chassis. This will inevitably alter the chassis frequency response stiffening even further the load bearing centre of the chassis. This adaptation work has been assessed on the drawing board with its reaction on a 4.5 chain curve, and loading / offloading from road transport. These drawings require independent assessment by a railway vehicle design engineer to verify all findings as factual and correct prior to Vampire modelling to assess its suitability and dynamic characteristics at speeds not exceeding 75mph.

The braking system will require further testing of the current set up to establish the ideal route forward to progressively stop the locomotive as best as possible without sliding of wheelsets or inferior performance due to lack of braking effort, whilst maintaining a reliable braking system that is fit for purpose and able to stop the locomotive effectively and progressively from high speeds repeatedly

Many Thanks to all involved.

Paul

UNDERSIDE VIEW OF CHASSIS



Part of a large drawing showing the underside of the chassis pivot area, detailing the alterations to be made. *Paul Etherington*