



An Association for Retired Professional Engineers

NEWSLETTER March 2016

President's Message

Welcome to the March Newsletter. We have now reached the end of our winter session of talks, all of which have been interesting, informative and well attended.

Although our total membership is slightly down, the majority of members able to get to our talks and events continue to support the Association, for which I thank you. However, we do need your help in recruiting new members for the long term future of the RCEA. Now that we have an excellent up to date website, it is worth asking anyone who may be interested in our activities to take a look.

Staying with the world wide web for a moment, our membership secretary regularly sends out updates and reminders to all those members for whom we have an email address. If you are missing out on these reminders please let Malcolm know your email address. We never publicise or pass them on so you can be sure you will not be swamped by unwanted mail as a result of letting us know.

Our Christmas lunch was a successful occasion and we are now looking forward to the spring lunch on Wednesday 20th April. We still have some spaces for this very reasonably priced event at Northbrook College. A reply slip is available in this newsletter if you would like to join us.

Details of the summer programme of visits and outings are in this newsletter together with the dates of our coffee mornings. Any updates will always appear on our website as soon as we are informed of programme changes.

Derek Webb

PROGRAMME OF EVENTS 2016

Wednesday	20th April	Spring Lunch at Northbrook College, 12.00 for 12.30pm
Thursday	21st April	Coffee - at Spotted Cow, Angmering
Thursday	28th April	Coffee - with Partners at Swallow's Return
Tuesday	10th May	Visit – Foulkes Halbard Collection at Filching Manor Motor Museum
Thursday	19th May	Coffee - at Spotted Cow, Angmering
Thursday	26th May	Coffee - with Partners at Swallow's Return

Wednesday	15 th June	Outing – Amberley Museum
Thursday	16 th June	Coffee - at Spotted Cow, Angmering
Thursday	30 th June	Coffee - with Partners at Swallow's Return
Thursday	7 th July	Outing – Borde Hill Garden
Thursday	21 st July	Coffee - at Spotted Cow, Angmering
Thursday	28 th July	Coffee - with Partners at Swallow's Return
Thursday	18 th August	Coffee - at Spotted Cow, Angmering
Thursday	25 th August	Coffee - with Partners at Swallow's Return
Thursday	15 th September	Coffee – at Spotted Cow, Angmering
Tuesday	20 th September	AGM and Talk – UK Trams
Thursday	29 th September	Coffee – with Partners at Swallow's Return
Tuesday	11 th October	Talk – The PowerFrame Tidal Generator
Thursday	20 th October	Coffee – at Spotted Cow, Angmering
Thursday	27 th October	Coffee – with Partners at Swallow's Return
Tuesday	8 th November	Cooch Memorial Lecture – Volk's Electric Railway – the Past and the Future
Thursday	17 th November	Coffee – at Spotted Cow, Angmering
Thursday	24 th November	Coffee – with Partners at Swallow's Return

All Talks and Meetings will commence at 2.30 pm and be held in the Chichester Room, Field Place, Worthing unless another venue or time is indicated.

Timings for visits and outings will be as printed in the detailed description of the activity.

Coffee mornings commence at 10.30 am.

Stop Press: An opportunity has arisen to join an IET retired members group outing on 14/6/2016 for a talk and viewing of the Thames Barrier and a guided tour of Tower Bridge. Further details are at the end of this newsletter.

Website of the RCEA

Our website, www.rceasussex.org.uk carries the very latest information on all of our events.

New Members and Speakers for Talks

The RCEA needs new members to ensure that we can continue as a thriving organisation. Please think of appropriate people you know and encourage them to come along to our talks and hopefully join the RCEA.

We also need more members to give talks to us on Tuesday afternoons from September to March. We are aware that many Members have the knowledge from their working careers to provide interesting talks. If you are willing to give a talk please let us know. Speakers from outside organisations are increasingly harder to find and often seek payment for their services.

RCEA Insurance

Members need to be aware that the insurance policy that the Association holds is solely for the protection for the assets and liabilities for the Association as an entity. The policy does not provide cover for personal injury or loss to individual members. Members attend the Association's events at their own risk; although under some circumstances there may be some cover from the insurance arrangements of the venue owner.

Brief Detail – Talks, Outings and other activities April – August 2016

Spring Lunch - Wednesday 20th April 2016, Northbrook College, Worthing, 12.00 for 12.30

There are still a few places available for our lunch. There will be a bar for pre-lunch drinks, the cost to be settled individually by members and guests. The cost of the three course meal is the same as last year at £14.00 per head including a tip, which in the past has proved to be very good value. Applications should be made by 17th April. The committee look forward to seeing you there.

Booking form is at the end of this newsletter.

Contact George Woollard 01903 523640, e-mail Georgewoollard1@hotmail.co.uk

Visit: Tuesday 10th May 2.00pm

The Foulkes Halbard Collection at Filching Manor Motor Museum, Jevington Road, Nr Polegate, BN26 5QA, East Sussex.

This private museum is only open by special arrangement, so this opportunity is not to be missed. The tour will last for about 2 hours and will include a visit to Filching Manor House, parts of which date back to the 15th Century; the Campbell Building which houses the K3 Bluebird boat with its Rolls-Royce R engine, the Beryl jet that powered the K7 Bluebirds and other Campbell memorabilia; the Motor Shed with a number of memorable cars including several Bugattis, Fangio's Alesso, and a 1904 chain driven Mercedes Racer. It will appeal to anyone with a trace of Castrol R in their veins, and to a number of their ladies with a touch of the Sheila van Damm!

Booking form is at the end of this newsletter.

Contact Perry Eastaugh 01903 788858, e-mail estaugh@live.co.uk

Visit: Wednesday 15th June 2016, 10.30am

Amberley Museum, Amberley, West Sussex, BN18 9LT

This is an ideal opportunity to bring your friends along for what we anticipate will be a very informative and interesting visit. On arrival please park in the adjacent station car park and meet up at the entrance to the museum at 10.30am so that we can all go in together.

Initially we will be given a talk about the museum in the Hay Loft for about 1 hour, after which we will be taken to the Electricity hall and given a demonstration of the various displays including the High Voltage Generator.

Afterwards you are free to wonder around the rest of the facility at our leisure: the onsite restaurant will be open for refreshments throughout the day.

Booking form is at the end of this newsletter.

Contact George Woollard 01903 523640, e-mail Georgewoollard1@hotmail.co.uk

Outing: Thursday 7th July at 2pm

Borde Hill Garden, Borde Hill Lane, Haywards Heath, West Sussex RH16 1XP

Set within an Area of Outstanding Natural Beauty with spectacular views over the Sussex Weald and Ouse Valley, Borde Hill's grounds extend to over 200 acres across the garden, woodland and parkland. The 17 acres of formal garden are designed in a series of outdoor 'rooms', each with its own distinctive character, colour and scent. From the exotic 'Garden of Allah' and the beautiful Azelea Ring, to the traditional Rose Garden and peaceful Italian Garden, Borde Hill is a treat for the senses. Their historic Garden is constantly evolving with new plantings and designs to add to variety, colour and interest throughout the year. Borde Hill has received numerous awards, including the Historic Houses Association 'Garden of the Year'. The visit will include a **1 hour guided tour** of the 17 acre formal garden for **up to 25 people**, starting at 2pm.

Booking form is at the end of this newsletter.

Contact Perry Eastaugh 01903 788858, e-mail estaugh@live.co.uk

Reports

Talk – Tuesday 8th December 2015 – ‘The Lighter Side of Defence Engineering’

Perry Eastaugh

Perry’s talk covered his career as a ‘hands-on’ engineer and included anecdotes of some of the people he met, as well as some of the technical challenges he encountered.

In 1966 he joined Rolls-Royce Derby as a University Apprentice on a Thick Sandwich course. At his selection interview, he recalled being asked to describe a bicycle to someone who had never seen one before – an interesting challenge which you might like to try. Presumably his answer satisfied the recruitment panel, and his first year in Derby covered a variety of roles, from setter’s mate in a drop forge to assistant to the Works Manager at the Mountsorrel Sheet Metal Works. One of his tasks at Mountsorrel was to assess the value of suggestions put forward through the Suggestions Scheme. If an employee’s suggestion was adopted, he received a percentage of the first year’s savings. Perry remembers trying to assess the value of one suggestion which achieved a significant reduction in the amount of water used for a process. He toured several departments before he found someone who didn’t think he was mad to be asking how much water cost! He also spent a number of weeks on the engine test beds in Derby.

At that time the RN was in the process of buying McDonnell Douglas Phantoms, but the aircraft were being re-engined with Rolls-Royce Speys. For this application Rolls-Royce had to develop a reheated version of the engine to give the short-term increase in thrust required for take-off from a carrier, or for combat manoeuvres. As the picture shows, the sight of an engine running with reheat is pretty impressive, with a sheet of flame 20–30 feet long emerging from the rear of the engine.

Unfortunately, R-R were having problems getting the reheat system to light reliably and Perry was helping to run tests to try and sort out the problem. To assist the engineers, a periscope had been installed in the detuner (silencer) downstream of the engine exhaust so that they could see how the lighting was working.



Because the reheat combustion process is relatively inefficient, it produced a large quantity of soot in the exhaust, which meant that the periscope needed cleaning quite frequently. Working with Perry on the test bed was a fellow apprentice, Taffy, who was rather full of himself. Some of the testbed crew decided he needed taking down a peg or two, so they asked him to climb into the detuner tube and clean the periscope lens. While he was in there, they initiated a ‘dry start’ – basically the way you start a gas turbine, except that you don’t inject the fuel. Taffy was a large lad but, when he heard the sound of the engine spooling up behind him, Perry reckoned that he could have won an Olympic medal for the speed with which he extracted himself from the detuner and shot out of the test cell, to be met with hoots of laughter in the control room.

Health and safety was not quite the same in those days! Perry had another interesting experience with the Phantom Spey development – one of the reheat system control pipes was fracturing and no-one could understand why, as it wasn’t very highly stressed. Eventually, one of the engineers decided to strain gauge a pipe as soon as it had been manufactured and monitor the strain on it through assembly and operation. At one point during the assembly process, the strain gauge recorded a massive load. When the team went to see what was happening at that stage, they found that the engine was slung on a cradle and the technician needed to get from one side to the other, so he grabbed hold of the pipe and swung himself under the engine. Problem solved!

After the first year of his apprenticeship, Perry then went to Leicester University for 3 years to read Engineering. When he applied, he didn’t realise that the engineering building had won a major architectural award for its architects, Stirling and Gowan. Because of this, the building was visited by a stream of architecture students who were told about the design

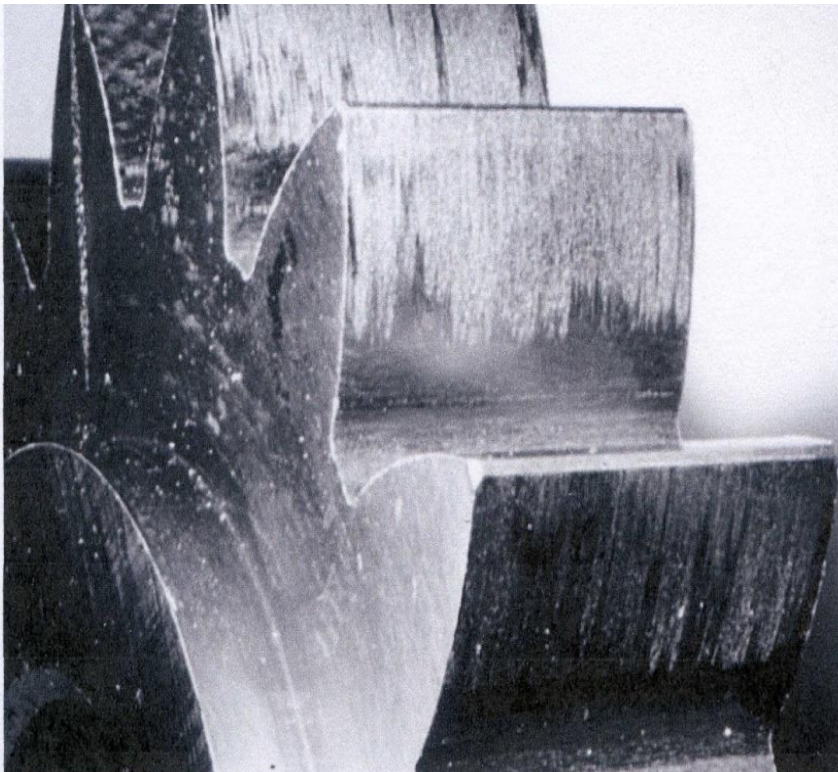
wonders of the building. Perry and his fellow students longed to hijack them and explain some of the multitude of design defects that made the building a nightmare to work in. He noted that, after 50 years, the building had been given Grade 2* listed status, but the complicated glass roof of the workshop area had reached the end of its life and was now in process of being replaced at an estimated cost of £20 million to allow it to last another 50 years. So much for architectural design! He remembered that, during a first year Thermodynamics lecture, the lecturer asked what temperature a turbine operated at. Perry suggested 1100 degrees. The lecturer then asked, “Centigrade or Fahrenheit?” Perry said Centigrade, while another of the students said Fahrenheit. It turned out they were both right. Of course Perry was talking about gas turbines, whereas the other student had come from Parsons and was talking about steam turbines!

One of the subjects Perry studied in his final year (and which was the basis for his final year project) was Tribology. The official definition is ‘The interaction of surfaces in relative motion’ but it is more commonly known as ‘Friction, Lubrication and Wear’ – a topic that would be important later in his career.

After graduating in 1970, he returned to Rolls-Royce for the final year of his apprenticeship. At that time, the key project was the development of the RB211 engine, initially for the Lockheed Tristar aircraft. This was the first triple shaft gas turbine – that is, the engine had three concentric shafts, rotating at different speeds, each carrying a set of compressor and turbine blades. The first (low pressure) stage of the compressor comprised a single set of large diameter blades which initially were intended to be made from carbon fibre. However, although carbon fibre is very strong, it is also brittle, and Rolls-Royce soon realised that the blades would be liable to catastrophic failure in the event of a bird strike. Eventually, the carbon fibre blades were replaced by titanium ones, but these were heavier and the Lockheed contract had severe penalties for failure to meet weight and fuel consumption targets. The net result of this and other development problems was that Rolls-Royce went into receivership in 1971, and all the apprentices were made redundant.

Looking for a new job was made more difficult because the postmen had decided to go on strike at that time. However, eventually Perry was invited for interview at the Admiralty Oil Laboratory in Cobham. This was a standard Civil Service interview, and the panel included a Principal Scientific Officer from the RAE at Farnborough, who he recalls asking him at great length to describe the problems of lubrication in outer space. The subject obviously interested him, though what relevance it had to the problems faced by the Royal Navy was less clear to Perry! Fortunately, Perry’s answers seemed to satisfy him and, after the inevitable delay for the security clearance process, he received a letter saying that he had been appointed a Scientific Officer of the Royal Naval Scientific Service at Her Majesty’s pleasure.

In those days, Terms and Conditions of employment were not exactly clear, and he could only assume that, if Her Majesty became displeased, he would be disappointed! Perry joined AOL in June 1971 – a very different environment from Derby. He had his own office, with French doors opening onto the rose garden; he could use the putting green at lunch time ... He was put in charge of the Mechanical Evaluation of Lubricants Laboratory – his main interests were in the performance of gear oils and hydraulic fluids for use by the RN.



The principles of gear lubrication are quite complicated but two factors are particularly relevant when trying to assess whether a lubricant will be able to protect the gears satisfactorily: the first is that the gear teeth are only in contact along a line so, with a reasonable load, the pressure on the contact area is high, even allowing for elastic deformation of the metal in the contact area to spread the load slightly. The second factor is that, especially as the teeth come into or out of the contact area, there is a significant amount of sliding between the teeth. The combination of high contact pressures (which can mean that the high spots on the gear surface penetrate the lubricant film) and high sliding speeds generates frictional heating which, if the loads are high enough, can cause the high spots to weld together and then get torn apart as the gears slide out of contact, leading to scuffing failure.

The picture of a scuffed gear shows the failure on one of the standard test machines used in Perry's lab. The load on the test gears is increased in stages until this failure occurs – the failure load is then an indicator of the ability of the oil under test to resist scuffing. Of course, for test results to be repeatable, the gears have to be made extremely accurately, which makes the test expensive to run. Because of this, initial tests are usually carried out on a cheaper (but less representative) test rig such as the 4 ball machine. In this test, three ½” diameter ball bearings are locked together in a cup, which also holds the test lubricant. The fourth ball is held in a collet and rotated at 1800 rpm. The test is run for a set time and repeated at increasing loads, until eventually the load is so high that the frictional heat causes the balls to weld together. One can plot the size of the wear scar against load, and this gives an indication of the lubricant's anti-wear and anti-scuffing capability.

Perry used to give welded ball pyramids to visitors as souvenirs. One in particular was memorable – the photograph shows Perry explaining the risk of welded balls to Admiral Dorian Dymock, who was obviously somewhat perturbed by the idea! Also worth mentioning is Rex Clutton, Perry's head of engineering at the time, who has his back to us in the photo. He was an amateur racing driver in his spare time, racing a vintage GP Amilcar. His everyday transport when Perry first knew him was a Ford Escort, with a 3 litre V6 shoehorned under the bonnet! He swapped that for a Reliant Scimitar GTE (also driven by Princess Anne). You may recall that they had fibreglass bodies.



Perry remembers him driving them down to Bath once and, as they headed down the M4, explaining that he didn't do more than 110mph as, at higher speeds, the doors lifted away from their seals at the top, and things got rather noisy. Despite that, Perry reckoned he was a very safe driver, no doubt because his racing experience had given him exceptional anticipation as well as good reflexes.

The work on gear lubrication became topical at the time of the 'Cod Wars' in the 1970s. Because the RN was at high alert, trying to protect British trawlers from the Icelandic patrol vessels, some of our ships were at sea almost continuously. After a few months, AOL heard that the RN dockyards were running short of white metal bearings used in ships' main gearboxes. It seemed that the bearings were failing because water was getting into the gearboxes and reacting with the chlorine based anti-scuffing additive in the gear oil, causing the white metal to oxidise. The question was, could the RN use a different oil without the chlorine-based additive? The problem was that RN gearing was more highly loaded than other gearbox designs, and there were no other commercially available lubricants that offered the same level of scuffing protection as the OEP-69 used by the RN.

After discussion with MoD, AOL decided to run trials on the nearest commercial equivalent, an oil used by the US Navy. It was put into 2 County Class Guided Missile Destroyers, and Perry spent many happy hours taking impressions of gear teeth (oddly, the best material they found for this was something called Xantopren, more normally used by dentists for taking impressions of human teeth). He did have one major dilemma, though. When he visited a ship for one of these inspections, he used to have lunch in the Officers' Mess. RN puddings were always a treat, and their bread and butter pudding in particular was really special. His dilemma was: should he forego the delights of the Naval puds and make life easy for himself when bending over the gearboxes in the afternoon, or enjoy the puds and suffer the consequences? As you may have guessed from his description, he enjoyed the puds.

One visit, to a ship in Rosyth dockyard, was memorable for a different reason. The ship concerned was due to do a high power run across from Germany and Perry was to inspect it after the run to see what the effect on the gearing had been. He was told that the ship would be available for him to inspect first thing on a Monday morning, which meant flying up to Edinburgh on a Sunday. He was asked if he would take a young chemist who had recently started at the lab with him, so he was joined on this trip by an attractive blonde by the name of Joanna Pedley. On Monday morning they turned up at the ship and asked for the Marine Engineering Officer. He arrived and apologised profusely: the weather had been so bad that they had been unable to carry out the high power run. That meant there was no point in carrying out an inspection, but Perry thought he might salvage something, so asked the MEO if he'd mind showing Joanna the machinery spaces since they were there. He was quite happy to do that. As they donned their white overalls, he explained that the ship had held an open evening for families the night before and some of the sailors were suffering from the after-effects. As the three of them went down to the machinery spaces, the MEO leading and Perry bringing up the rear, he saw a

series of somewhat hung-over sailors take a casual glance at 3 guys in white overalls passing by, then the double takes as they spotted the long blonde hair and realised that the middle one wasn't a guy at all. It almost made the wasted trip worthwhile!

Perry's other key responsibility was the effect of lubricants on ball and roller bearings. One key point is that, because the contact area between ball or roller and running track is small, the contact stresses are high. Unlike gears, the motion is pure rolling, so scuffing isn't a problem, but the high cyclic stresses lead to fatigue failure. Using the right lubricant can help maximise the life of bearings; equally, some lubricant additives can reduce bearing life. This is complicated by the fact that fatigue is a random phenomenon so, no matter how good the bearings (or lab test pieces) are, their life varies widely. His lab had several tests to evaluate the effect of lubricants on fatigue life but, because of this random effect, they had to carry out a number of repeat tests on each to get some feel for the relative performance of different fluids.

Why does all this matter, you may ask? Well, the RN's nuclear submarine fleet used a special hydraulic fluid which was able to form a stable emulsion with sea water if it got into the hydraulic system. While the oil/ water emulsion was not a brilliant lubricant, it was a lot better than having the sea water being carried around as a slug of neat water which, if it went through a hydraulic pump or motor, could cause immediate catastrophic failure. In those days, there was only one supplier of this fluid and, around 1972, the Venezuelan crude oil they used as the base ran out, and they had to reformulate the fluid with a different base oil. Perry had been working at AOL for just over a year when, as he was running some tests on these fluids, he found that, while the new formulation had a similar effect on fatigue life to the old one, a 50/50 mix of the two fluids seemed to reduce bearing life dramatically. This had some interesting implications.

One option was to dock the nuclear submarine fleet, flush all the old fluid out of their hydraulic systems and re-fill with the new formulation – not likely to be a terribly popular move, especially as there was a possibility that, even though the tests were based on a statistical analysis of the results of 24 runs with each type of fluid, they might still be rogue results. His first step was to ask his long-suffering technicians to re-run the tests, working 24/7 to complete them as soon as possible. At the same time, they decided to put a fluorescent dye marker into the new formulation of the fluid so that it would be obvious which submarines were using each type of fluid.

Eventually the repeat tests were completed and, fortunately, he was able to show that the initial results had been a rogue set, so there was no need to dock the nuclear fleet. The lab used to host regular visits by Chief Petty Officers to explain what it did and, on one of these, Perry talked about these tests and said that, now it had been decided that the two formulations were compatible, there would be no need to keep putting the dye into the new formulation. At this point, the Submariner CPOs got rather agitated and said that the dye was the best thing for a long time – now, whenever there was a leak, it was so much easier to trace the source! So the dye stayed in the fluid – a happy conclusion to a worrying time.

As someone employed in an R&D lab, it was important for Perry to keep his knowledge up to date, and he used to attend IMechE Tribology conferences regularly. Tribology has been something of a niche subject, and has often confused non-specialists. At one conference in Glasgow, the organisers had arranged for a well-known Scots singer to entertain the delegates one evening. She appeared rather red-faced, and explained that she had put together a selection of songs from around the world, as she thought the delegates studied tribes! Nevertheless, Perry and the others enjoyed her singing. That conference was also memorable because it was sponsored by Seagrams, who at that time produced 100 Pipers whisky and Chivas Regal. The Tribologists were certainly well lubricated! Another Tribology conference, in Leeds, had a rather more erudite after-dinner entertainment. Prof Dowson there was one of the pioneers of designs for hip replacements, and delegates were treated to a film of an operation in glorious technicolour. Perry still remembers the commentator saying "... and now the surgeon taps the replacement ball joint into the femur .." as the film showed him hammering like mad to get it into place. The patient must have had a very sore hip!

Perry was also involved in Government to Government Information Exchange meetings with the Americans, Canadians and Australians which were very good value. In the early days, they were flown out to the North America courtesy of the RAF in VC10s. There were two main differences from civil airlines: the first was that they were dry – no doubt good for fighting jet lag, but it didn't help the time pass! The second was that the seats faced backwards (these were basically troop carriers, and rearward facing seats were safer in an emergency landing). This was not a problem in normal flight but the VC10 had a very good rate of climb and, after take-off it felt as though the passengers were in danger of being tipped out of their seats. He remembers one return flight from Washington particularly. He arrived at Dulles Airport (not exactly the centre of the universe) to discover that the take-off had been delayed by 4 hours. Apparently a message should have gone to his hotel, but he hadn't received it. Eventually, the flight was called and as they were being ferried out to the VC10 by bus, the RAF Loadmaster said over the PA system "Ladies and Gentlemen, apologies for the delay, but our navigation system has failed and we're flying overnight so we can navigate by the stars." The passengers all laughed dutifully, at which point he said "Don't laugh – it's absolutely true."

In the event, their astral navigation was pretty good, as the flight arrived on time, and the landing was as gentle as usual – RAF pilots' ability to land their aircraft with the minimum of noise and bounce makes most civil pilots look very amateur.

By 1983, AOL had become part of the National Gas Turbine Establishment as part of a Defence Rationalisation programme, as had the former Admiralty Engineering Laboratory at West Drayton. One day, Perry was called in by the Head of Naval Engineering Department and told that they wanted him to take on the job of Head of the Machinery Controls Section (MACO) at West Drayton. Perry did point out that, while he had a pretty good understanding of Tribology by then, his knowledge of control theory had been one of his weaker subjects at university! This didn't seem to worry the Head NED so, like a good civil servant, he agreed to do as he was told, with one proviso: he pointed out that plans were well advanced for the next Information Exchange meeting in Australia and he had a key role to play at the meeting. He didn't want to leave his colleagues in the lurch by abandoning them at the last minute. The fact that he had never been to Australia and was keen to see the continent was of course entirely irrelevant. The Head NED graciously agreed to this, so Perry prepared to change jobs. The key challenge facing the MACO team was to develop a real-time simulation of the proposed Single Role Minehunter. They would use it both to assess how the ship was likely to operate under manual control, and to examine the performance of automatic ship position control systems. The Naval Staff Requirement for the design stated that the ship had to be able to circle a suspected mine under automatic control with a course accuracy of X metres RMS. Perry can't remember what X was and, even if he could, he couldn't tell you!

Anyway, they produced an initial algorithm and tried it on the simulation. The result was not an astounding success – as the ship moved off its initial hover point to start circling, the effect of wind and tide was to take it almost over the suspected mine. The control system did recover fairly quickly and, after that, the ship followed the desired course reasonably well. The interesting thing was that, even though in real life the initial excursion would probably have caused the mine to detonate, analysis of the track between the two points showed that it met the accuracy specified in the NSR – writing specifications needs a lot of care! As well as using the MACO simulations, their customers in MoD decided that it would be a good idea for a small team to visit a ship using a commercial automatic position control system for 24 hours to see how it operated. Initially, the plan was that Perry's deputy, the technical lead in the section, would represent them.

However, he came up with some weak excuse (such as his wife was having a baby) so Perry agreed to go instead. So it was that, one January morning, a small group assembled on the dockside at Aberdeen to board the Stena Seaspread, which was a Rapid Intervention Vessel used to support the North Sea oil rigs. As the ship left Aberdeen, the captain welcomed the MoD team on board and explained that they were going out on a one month tour of duty! The team would be taken off by helicopter and flown back at the end of their visit.



As you will see from the photograph, the heli-deck was above the bridge – almost the highest point on the ship! If you can imagine the way the ship rolled in the Force 9-10 winds that were blowing at that time, it's not surprising that it was nearly a week before the weather moderated enough for a brave pilot to slam his helicopter onto the deck for just long enough for the team to scramble in, before taking off again: truly a white knuckle ride for all concerned.

Having said that, Perry was impressed with the ability of the ship to 'hover' under automatic control about 100m from an oil rig, holding position to an accuracy of about 3m in that foul weather. There is more to Perry's career, taking him through the Royal Aircraft Establishment and on to QinetiQ, but that's another story.

Perry Eastaugh

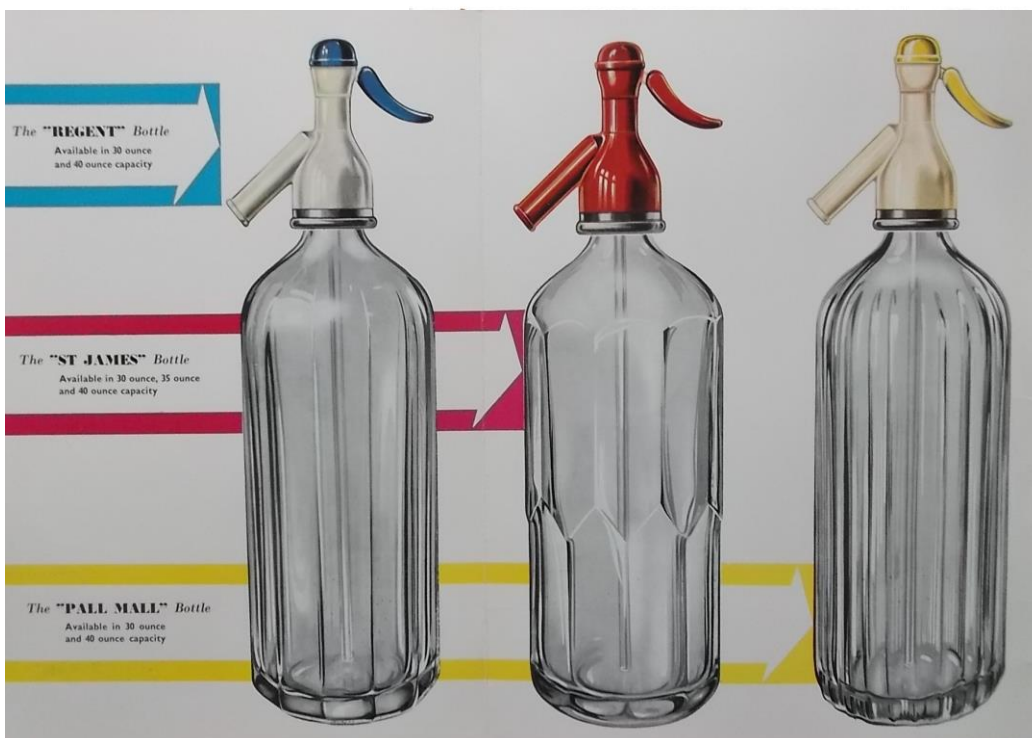
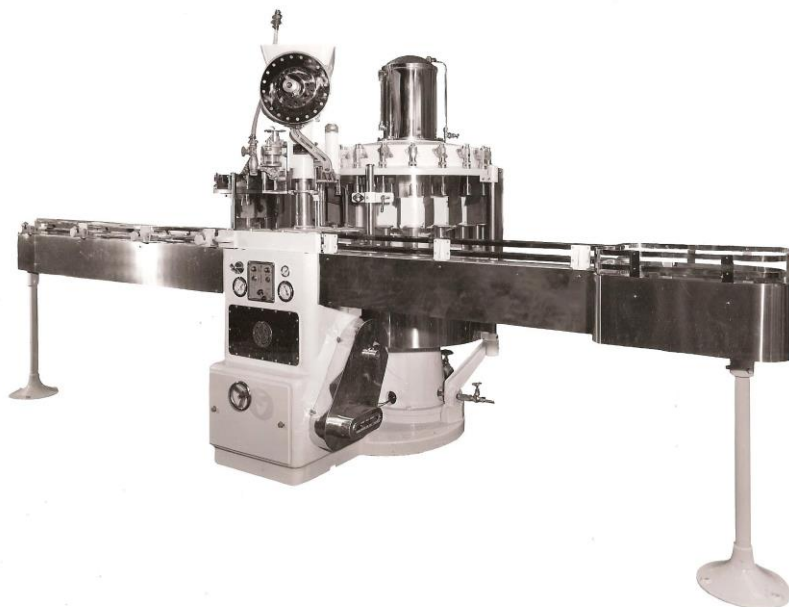
Talk – Tuesday 12th January 2016, ‘Syphons Made in Sussex’

David Jones

This talk was a combination of the background to this largely unknown Eastbourne soda water syphon manufacturer and David's five year engineering apprenticeship leading up to becoming a member of the I.Mech.E.

The British Syphon Company was founded in 1882 and based in Islington N1 up until 1957 when it moved to new premises in Hampden Park on the outskirts of Eastbourne

The firm immediately took on two apprentices in August 1957, so David and a fellow student from the Eastbourne Technical School, in its last year before closure, started a training period in the drawing office and on the shop floor. David outlined the comprehensive apprenticeship scheme undertaken which later included responsibility for all the tool and cutter grinding for which week-long courses at PERA in Melton Mowbray assisted. The range of syphon filling and bottling machines was covered including the responsibility of the drawing office to provide clear assembly and detail drawings for the shop floor, and which also included the compilation of instruction manuals and spares lists.



In due course, their main customer Schweppes identified a need for refrigerated counter units to dispense soft drinks such as Pepsi-Cola, so BSC embarked on a new range of cooling units which obviously involved a lot of new designs and development. This was a useful new range, as sales of syphons, some of which are shown opposite, were declining with the advent of the new Sparklets version from rival firm BOC.

There was an attempt to diversify into cough mixture filling machines and petrol station forecourt tank level meters, but both met with limited success.

The new cooling and dispense range, marketed under the Coldflow name, was based on the existing Cornelius products made in the USA, and required the company to expand into additional premises in the Eastbourne area. Much effort and experimentation had to be put into the increasing use of EN58F stainless steel in this new range so additional machine

tools had to be bought in including those for broaching, spot welding and vacuum forming. The business built up, especially the export market which was already strong with the Riley bottling machines, these having been supplied to all parts of the Empire in the 1900s. After David had left BSC to join Edwards High Vacuum, this expansion attracted the attention of a rival company based in Sheffield and there was a merger so creating a bigger concern, which itself was the subject of a takeover by IMI Cornelius. So eventually Coldflow, as it was now called closed the Eastbourne operation in 1990 after 33 years in the town and the building became an indoor Kart Racing centre. In due course this leisure activity folded and it is now home to Eastbourne Car Auctions, a far cry from engineering manufacture.

David Jones

Talk – Tuesday 9th February 2016, ‘Vehicle Emission Matters’

Ivan Farrow

Reducing vehicle emissions has exercised the brains of vehicle and test engineers since the late 60's. During this period the permitted levels have been reduced by 99% as technology has developed. Ivan provided a basic introduction to vehicle emissions and how they were, and are, tested in the laboratory and on the road. He examined the difficulties and variabilities encountered, as well as reviewing the difference between official laboratory tests and real-world emissions and fuel consumption, touching on the Volkswagen cheating admission in the process.

To ease the audience into the detailed technicalities he commenced with a walk-through of his career and how his aspirations were adjusted by factors mainly out of his control. He was always interested in how things worked and how to fix them, becoming obsessed with a 1934 Morgan three-wheeler at the age of fifteen and became the most enthusiastic member of the MTW club in the area. This provided an excellent pre-apprenticeship in automotive problem solving!

However he decided that the Motor Industry might be just a passing fancy and, looking for a long-term career, obtained a “thick sandwich” apprenticeship with AEI and Nottingham University.



Always looking for a good deal, he saw an opportunity to get a pilot's licence and hence become an airline pilot via the University Air Squadron. He was very frustrated when he was rejected because his legs were too long to safely eject from a Chipmunk.

AEI saw him experiencing “the trades”, quality control, large foundry operations, testing, installation on site and turbine development but became largely irrelevant when GEC and AEI merged. This reduced job opportunities so much that a career move seemed appropriate. His chief engineer advised him not to move, as steam turbine engineering was a far more reliable career than automotive! Fortunately he did not agree.

Ford Research Centre proved a much more attractive position than the British Leyland job offer and gave him 23 years of interesting employment. Unfortunately the engine development engineer position that he accepted at Ford was transferred, in a reorganisation, to Test Operations taking him out of the “front line” and into a supporting but important role from which he was never able to escape.

He changed jobs within the Engine and Emissions department roughly every two years until a management cull was introduced resulting in a stalling in his progress.

The expertise gained allowed him to present papers alongside VW engineers at International Symposia and he always felt that VW were the world experts at understanding the emissions game. He was also required to sit on international standards committees.

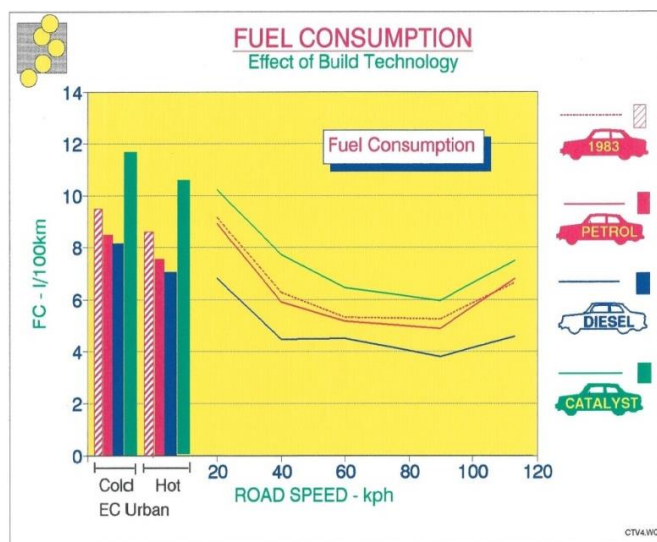
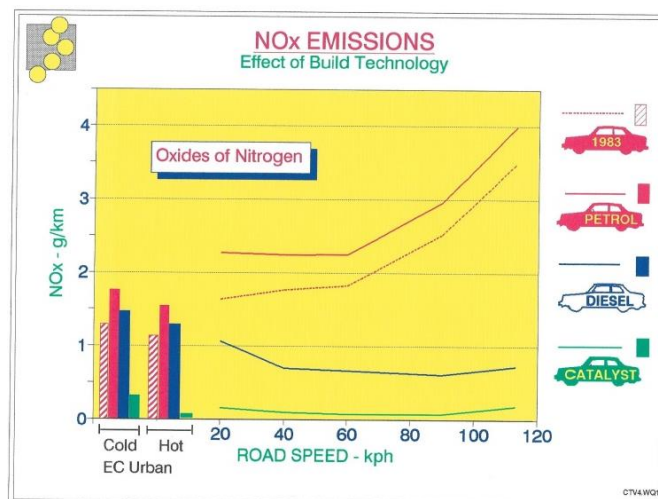
Trouble shooting test concerns provided some very interesting problems at external test sites, usually at short notice. “Get out to Australia ASAP (1st class, if necessary) and find out why we are blowing up expensive prototype engines while the manufacturers aren't” was one assignment. Within an hour of arriving in Perth he found that the manufacturers were cooling the engines with water whereas Dunton used the vehicle-specified anti-freeze. The difference in heat transfer rate caused the overheating. He was delighted to spend the rest of the week allocated to this problem enjoying the delights of Perth!

Another assignment could have caused an international incident. During the Fiesta development a foreign manufacturer was obtaining unbelievably low fuel consumption figures at the country's national laboratory (using a Fiesta competitor car) that Dunton could not match when they tested it on their equipment. This time it was a much shorter flight to find that they had an aeration problem in their fuel measurement pipe work. He was not able to inform them or write any

report in case the country in question thought that the UK was accusing them of cheating. However it solved a major problem for the Fiesta Programme Manager.

Looking for a new challenge in a long-term secure job he was able to move directly to be Head of Vehicle Emissions at Warren Spring Laboratory. A Civil Service job working in many “Green” areas including the national air pollution survey couldn’t be more secure, he thought. Unfortunately, in the month between accepting the job and joining the Laboratory the Government’s large vehicle emission contract was cancelled!

There was much analysis to be done of a 200-car survey to show differences between fuel and vehicle technology as well as chassis and road testing in both cold and hot start conditions.



Rather than remaining on a “sinking ship” he was able to move to a job managing Ricardo Engine Test Operations. They had always been a target employer for him (as a world-class engine developer) and his experience at Ford matched their requirements. He loved the area and the job seemed secure so he made a rather rapid decision (for him) to move his family to a house that he is still enjoying.

Shortly after moving in, and landed with a big mortgage, the finger of fate dashed his aspirations when the MD who had employed him was removed overnight and the replacement reorganised the horizontal structure and replaced it with a vertical one without an Engine Test Operations!

The opportunities for suitable work, locally, were virtually none existent so he chose to “get on his bike” and very soon obtained a position with Land Rover in the Electronics development department.



This was virtually a very well paid apprenticeship in practical electronics that provided a totally new range of experiences. He was surprised to be selected for this position as a mechanical engineer but possibly his previous vacation work there and enthusiasm for the brand helped. He had owned two Land Rovers previously one of which was a very early model and other had been used for a Geological Expedition to the Western Desert of Egypt. (11000 miles in 11 weeks)

This is one of the OBD Misfire detection tests!

During this period he was staying in his caravan during the week and commuting to Solihull weekly.

Consequently when he heard that Daewoo were opening a research centre in Worthing he could not believe his luck. After been rejected by the Personnel Department twice he approached the MD and was instantly recruited.

He was prepared to do anything but soon found out that he was the only employee with engine knowledge – a very valuable bonus. Tasks included the design of an £18m engine and emission facility, diesel engine programme, new valve train development to avoid valve bounce, Cold climate testing in Sweden, trouble shooting, etc.

Trouble shooting was always interesting.

Out of the blue he was asked at short notice to fly to Korea (via the US where he had to evaluate some electronic testing kit) in order to investigate why a new car was suffering a lack of power in hot conditions during acceleration. As soon as he arrived he was hustled into a conference room full of chief engineers and vice presidents who demanded to know how he was going to fix the problem! Fortunately he had anticipated this question. He had discovered that the engine breathed air from within the bonnet, which got so hot that the ECU drastically reduced the ignition advance to protect the engine, consequently reducing the power. A minor revision to the intake duct to take engine air from the wheel arch solved the problem. It appeared that the Korean culture restricted subordinates from advising their bosses but a “so called expert” could work miracles. At least he got a full day in Hawaii en route!

Daewoo seemed to be the answer to his dreams until it emerged that their empire was built on straw and after a few years were absorbed by General Motors. The Worthing operation was closed down leaving only a very large hole in the ground designed to hold the equipment for the engine and emission tests facilities!

Once more he “got on his bike” to work away from home in Basildon and Millbrook Testing Ground. Companies he worked for included Ford New Holland Tractors on their engine development, Jaguar on exhaust systems, Iran Khodro developing Iranian built Hillman Hunters for better handling, integration of air conditioning, improved emissions etc.

He was then selected to engineer the transition of the Foggy Petronas FP1 to a fully homologated road bike. This was the most interesting, wide-ranging and most rewarding job of his whole career. The bike had been designed as a no-compromise racing bike and as a result had many challenges. The engine exhaust emerged from the rear engine at 800 degrees C to pass immediately under the carbon fibre seat that would soften at between 100 and 200 degrees C needing state-of-the-art insulation. The water pump was far too small as were the radiators, all requiring total redesign. The exhaust system and silencer needed to be optimised for the conflicting requirements of noise, power, torque and styling. Extensive testing and development in wind tunnels, at tracks in the UK and Italy was necessary.



These were interesting and exciting at times, including:-

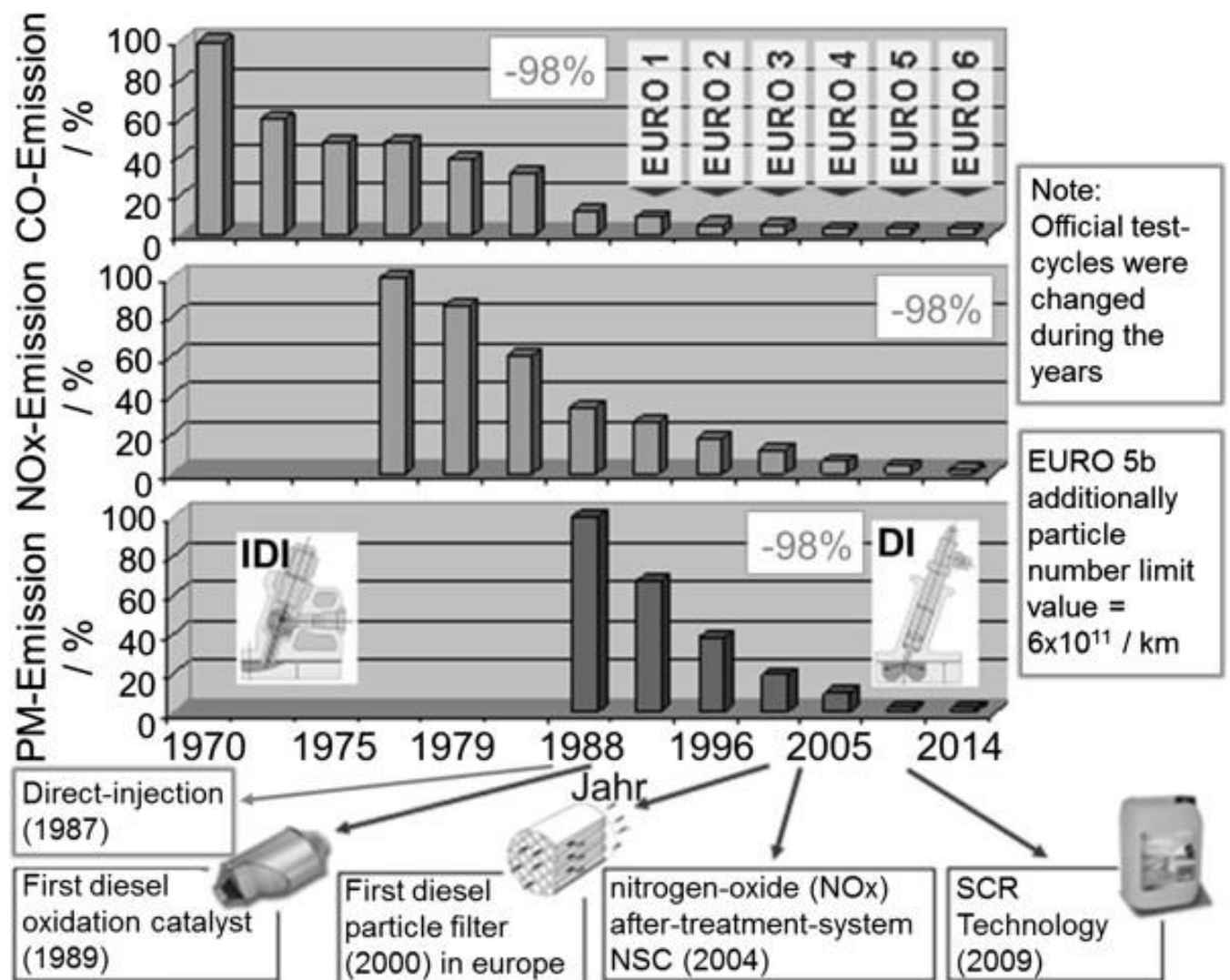
- Total engine failure at 140mph in the Ford wind tunnel
- Tyre failure at 150mph on the Nardo track
- Sudden hailstorm at 120mph at Nardo
- Clutch failures on the comparator Ducati under race start conditions
- When testing was complete 150 examples were manufactured ready to be sold to the public in order that the race bike could legally race in the World Super Bike class. However before they were sold Petronas abandoned their objective of becoming a major motorcycle manufacturer and stored them, probably in Malaysia, although when Ivan last saw them 75 were in Basildon, Essex.
- One day someone will discover the “barn find” of the century worth £3+ million in parts alone!!

Diesel Emissions

In order to throw some light on the press coverage of the Volkswagen Cheating Scandal Ivan had to expand on:

- how complex and variable emission testing is
- how emission drive cycles do not represent real world conditions
- how engineers can reduce emissions
- how engineers optimise test and vehicle conditions for best emissions within the regulations
- the pressures on engineering decisions
- the difference between chassis dyno testing and “real world” testing

Ivan set the scene by giving some history of emission levels and technology time-lines, referring to the diagram below:



He identified the major routes to low emissions:

- Improve combustion to give low engine-out emissions
- Add vehicle exhaust treatment to reduce tail pipe emissions with cost packaging and weight compromises
 - A. Catalysts
 - B. SCR – Selective Catalyst Reduction
 - C. EGR – Exhaust gas recirculation
 - D. Particulate traps
 - E. NOx traps
 - F.

He also identified the very many interactive factors that affect engine-out emissions:

Combustion air and burn rate -

Pressure, Atmospheric, Altitude, Inlet restriction, Turbo/supercharger, Humidity, Water injection

Movement, Turbulence, Tumble, Temperature, Intercooler

Fuel Chemistry

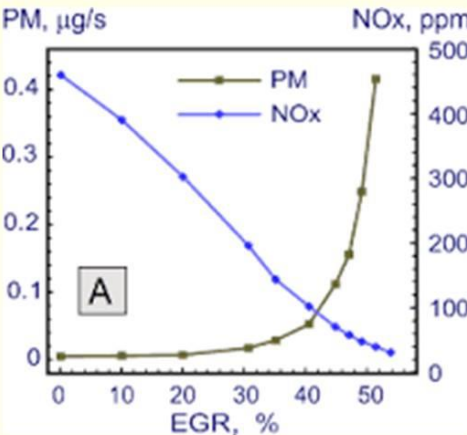
Ignition/injection -

Position of spark/injections, Timing of spark/injections, Intensity/fuel pressure, Burn rate, Detonation “pinking”

Injector Position -

In cylinder, In port, In manifold, Combined, Pressure, Spray patterns, Number of injections, Size of fuel particles

EGR reduces NOx but increases particulates
Nox/Particulate Trade off

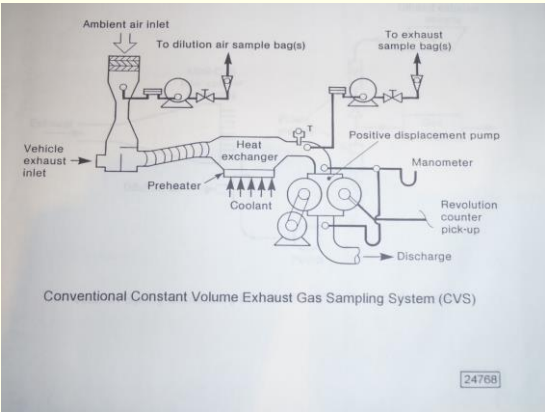


However one major conflict will always be the trade-off between NO_x and particulates. This allows a range of different routes to meet the targets by altering the EGR rate and therefore the exhaust system components.

Emission Testing

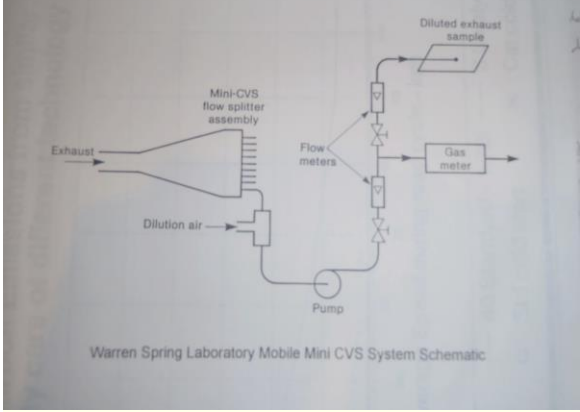
He covered all the major aspects of measuring emissions – in an emissions laboratory, including why a Constant Volume Sampling system is universally used to provide dilute exhaust samples: essential for accurate analysis.

Laboratory Emission Measurements Constant-Volume Sampling



He also showed how this very bulky apparatus was miniaturised to fit in a vehicle at Warren Spring Laboratory to enable 'real world' tests.

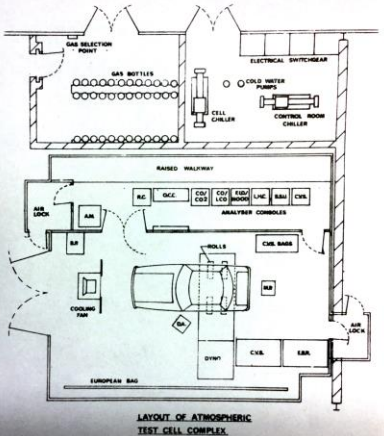
On-Road Emissions Testing



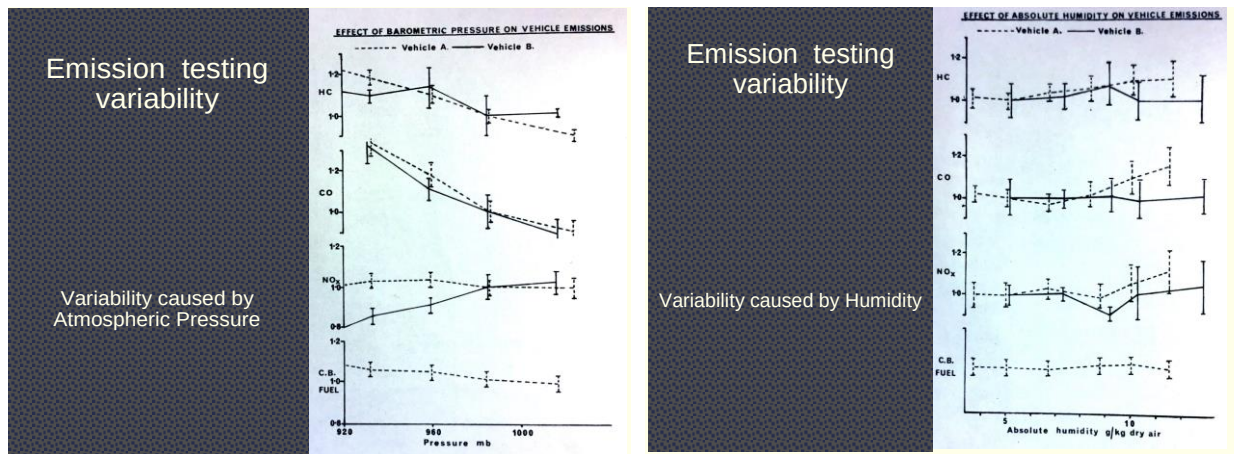
Laboratory Emission Measurements

Atmospheric Emission Test Chamber

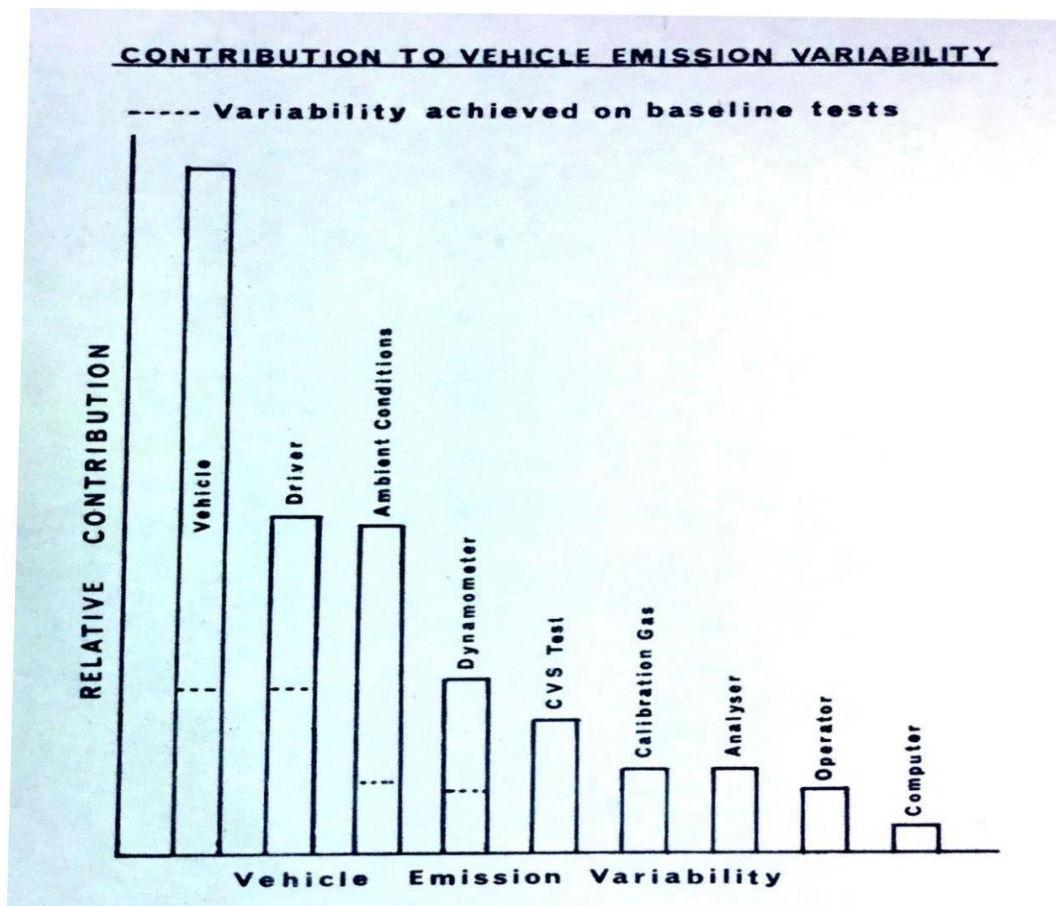
Atmospheric Emission Test Chamber



The Ford atmosphere emission test chamber was used to determine where the large variability in laboratory emissions results came from.



Variability of historic emission results.



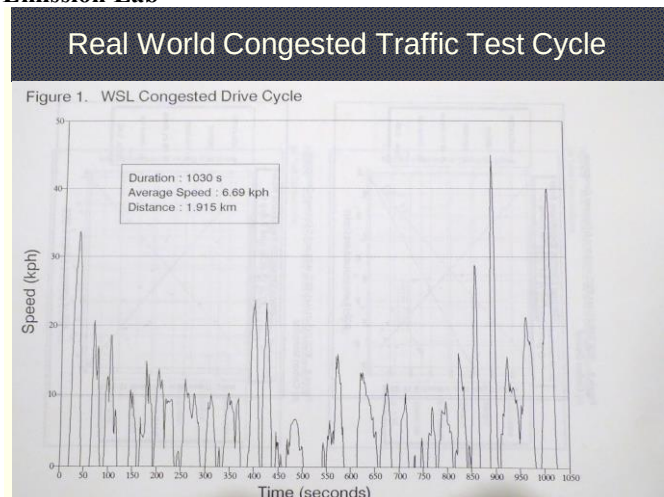
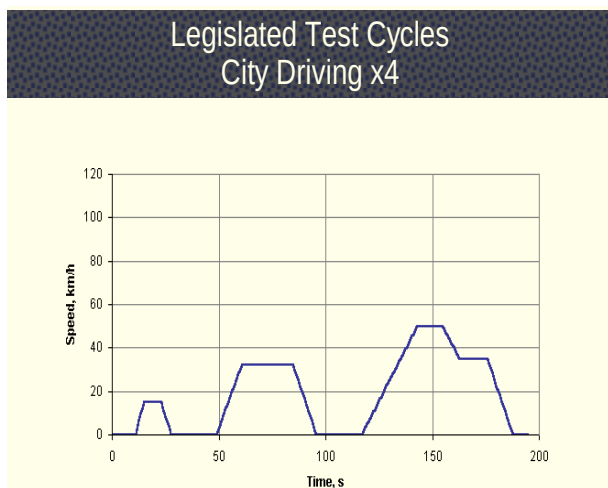
He covered how the chassis Dynamometer was set up to simulate road-loads and vehicle inertias

Objective – to simulate road loads

- Select equivalent inertia flywheels or electrical simulation
- Carry out run-down tests between two fixed speeds on track to determine overall drag
- Fit vehicle to chassis dynamometer and adjust to get similar run-down times
- Run preconditioning cycle and soak for legislated time



Small Emission Lab



In order to achieve, repeatable and comparable results the initial Test Cycles were very simple and unrealistic. Compare the above, legislated cycle with London Congested Traffic established while at Warren Spring Laboratory

How do engineers optimise test results legally - cheat?

- Reduce friction - Run-in Wheel bearings, Wheel alignment
 - Reduce Brake rubbing
- Charge battery
- Tape panel gaps in prototypes
- Use minimum soak period and highest soak temperature
- Increase tyre pressures
- Use lowest tolerance speedometer during run-down test
- Squeeze into lowest inertia band by using the weight tolerance
- Calibrate engine for optimum on the test cycle
- Blue-printed engine
- High temperature and altitude set-up testing
- Run tests at optimum pressure, humidity, and temperature
- The Legislation specifies test and vehicle conditions

How could VW have cheated?

Two programmes within the engine controller- one clean one dirty activated by
Parameter measured within the controller that characterises the emission cycle

- Air/Water/Oil start temperature
- Time since last run
- Specific speed/load characteristics of cycle
 - Throttle position sensor
- Wheel speed differential monitor switched off
- etc

What might have caused VW to Cheat?

Powertrain Programme constraints would have been agreed years before based on engineering estimates that may have been optimistic?

Production job-one timing was immovable without the enormous cost of delaying

Targets missed in any of the following?

- Fuel economy
- Emission regulations
- Performance
- Noise
- Cost

Emission equipment packaging not met for:-

- Catalyst size
- NOx / Particulate trap
- SCR – Insufficient urea capacity perhaps. Heavy trucks refill their urea tanks regularly but car manufacturers have chosen to fill only at the yearly service. Perhaps this is not achievable if the emission targets are to be met

However a company of their standing should only have made this error once and should have corrected it by retrofitting the affected vehicles.

Optimistic Fuel consumption Results

The VW cheating controversy has been reported by the press at the same time as the falsely optimistic fuel consumption results. As a result the public have understandably linked them and assumed the motor companies are cheating again. However it can be seen from the chart previously shown that on-road fuel consumption (22 years ago), at the low speed that the chassis dyno results were recorded at, did not differ widely from on-road cycles.

Emission Analytics are a commercial company with modern techniques and equipment who sell their on-road testing capability to car magazines etc. and have published some of their data. This shows that fuel economy results are now 20+ % optimistic but Ivan has not been able to scrutinize their methods so cannot comment on their accuracy.

However it does appear that downsizing of engines will produce better fuel economy under low power / low speed situations (like the Urban Drive Cycle) but not necessarily at the higher speeds that the public drive them at.

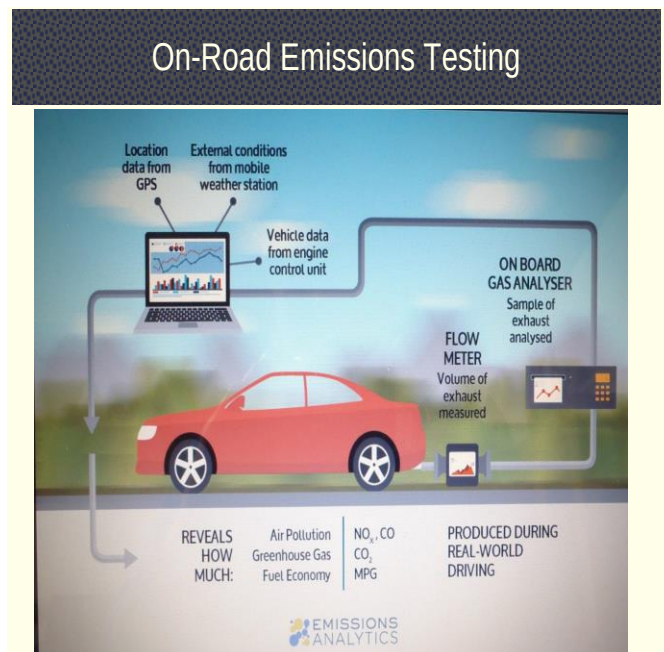
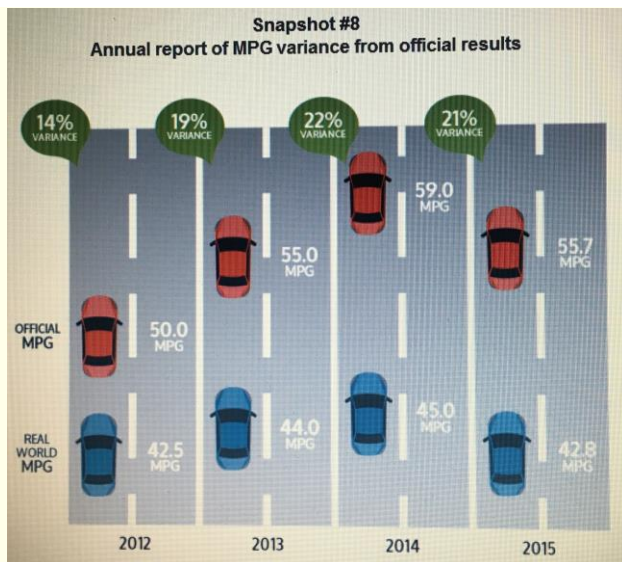
Considerable efforts have been and are being made, worldwide, into improving the accuracy and realism of the emission and fuel consumption drive cycles in the laboratory and there are pressures from many areas to carry out on-road tests too.

Bearing in mind the variation in results found when conditions are optimized in a laboratory using a simple test cycle Ivan cannot envisage anyway that these variations can be bettered on the road. However modern technology is a wonderful thing and he is looking forward to the future.

He identified the major routes to low emissions:

- Improve combustion to give low engine-out emissions
- Add vehicle exhaust treatment to reduce tail pipe emissions with cost packaging and weight compromises
 - Catalysts
 - SCR – Selective Catalyst Reduction
 - EGR – Exhaust gas recirculation
 - Particulate traps
 - NOx traps

Finally he concluded by showing the chart below and a diagram showing how on-road emissions are measured.



Ivan Farrow

Talk – Tuesday 8th March 2016, ‘An Engineer in Model Engineering’

Ray Parsons

Ray gave his talk at short notice to fill a gap created because an external speaker had had to postpone his talk. Ray explained that, shortly after he joined the RCEA in the 1990s, he had offered to give a talk on boiler water treatment, but that was deemed too specialised. Instead, he decided to base his talk on his hobby of model engineering. While his interest – building miniature locomotives – was quite specialised, by covering the activities of the Beech Hurst Park Miniature Railway he could address a range of engineering disciplines. Today’s talk is based on the material he used in the 1990s.

The Beech Hurst railway is operated by the Sussex Miniature Locomotive Society and can run 5” and 3 ½” gauge locomotives on a raised track in a public park. The engines are owned by individual members, while the rest of the rolling stock belongs to the club. The track is 2193ft long with a maximum gradient of 1:100; the station is at the bottom of the hill. It was first opened in 1954 and extended in 1972. Ray has been a member since 1959. Ray pointed out that the railway at the back of Field Place is similar to that at Beech Hurst Park – the Worthing club borrowed their drawings and jigs!



The first engine that Ray built was a 5” gauge, 11/16” to 1’ scale LBSCR Atlantic (Henry). The cylinders were made of gunmetal and the boiler from silver soldered copper, operating at 100psi. The engine ran for 11 years before a boiler tube holed. The driver has to sit behind the tender and reach over it to operate the controls. The skill is in moving the engine away from a standstill without spinning the wheels. On one occasion, Ray’s daughter asked if she could borrow his engine to use as part of a display at their local library. Ray loaded it onto a trolley and his daughter was towing it from their house down to the library with a friend when they met a lady with a dog who was standing watching them in a slightly supercilious way. As they passed, his daughter commented “Madam, everyone has a dog.”

Ray planned to build a second, smaller engine (Ajax) which would be lighter and easier to handle, and would avoid having to lean over the tender. He started work – the supplier provides some castings (which then need machining) but everything else has to be made from sheet or bar material. The engines use radiant superheaters to improve efficiency, but they aren’t easy to manufacture. Ray used a combination of cutting threaded holes in the block ends – the tubes were gaunched into the block for mechanical fit and Sifbronzed to the block as well. The process of building an engine is very long job and Ray didn’t finish it, selling it to a colleague in due course.

Ray discussed the principles of scale modelling. In the UK, the most common scales are 11/16" to 1' and 1 1/8" to 1'. The latter scale gives a bigger engine which is better able to cope with the overload which results when hauling passengers. Ray's second engine, a *Black Prince* Stanier LMS Class 5 (Black 5) is a true 1 1/8" to 1' 5" gauge model. Martin Evans came up with the idea of using a hybrid scale: 11/16" for the length and height, with 1 1/8" for the width, so allowing for heavier bearings to be installed. The Americans use 1": 1', which makes calculations easier, but requires a 4 3/4" wide track which is incompatible with British models. Another alternative is to model narrow gauge engines, which allows a smaller engine to pull the rolling stock.



One unusual request that the club received was to provide a wedding train! Ray duly decked out Black 5 with wedding ribbons and carried the wedding party round the track – quite a challenge for some of the ladies in their formal dresses!

Occasionally, engines will malfunction while on the track, and the club has a facility that allows members to remove the wheels and change bearings etc as required – Ray had to do this once with Black 5 after a crank pin failed.

The track comprises 3 rails, so that either 3 1/2" or 5" gauge engines can be operated. They are set on wooden sleepers supported by concrete pillars. The rails are made of aluminium to minimise wear on the wheels, and have to be replaced every 6 years – the replacement is

managed as a rolling programme. There are two types of points which give access to the sidings: the first, a pneumatic point, requires the track to be lifted and moved across to change direction while the second is a rotary point, as used by the Ballybunion Railway (an Irish monorail dating back to 1888) – it is often mistaken for a turntable. There is an engine turntable, but it is a length of track supported by a central pillar which allows that section to be rotated.

When the track was being extended, the Council (who own the ground) asked that a section be run through a tunnel so that the land above could be used for greenhouses. This presented a considerable challenge, but the club members rose to it. One of them worked for JCB and arranged for a digger to be provided for a fortnight's 'demonstration'. The plan was to produce a 'cut and fill' tunnel 175' long and 7'x7' in cross section (the cross sectional dimensions were chosen so that, even if passengers tried to stand up, or hold their arms out, they wouldn't hit the walls). They became expert in producing wooden shuttering and installing reinforced concrete (with a little advice from a contractor building a local flyover). The ends of the tunnel were faced with brickwork to look good. The Council were so impressed with the result that they asked if the club could replace a nearby footbridge. The club agreed, and the request turned out to be well timed: when someone pushed the bridge to assess its solidity, it fell over! The club uses fully automatic 3 aspect signalling, with monitoring facilities in the club house and the station building: when a train is on a section of track, it shorts and the signal goes to red; a yellow indicates that there is a train on the next section, and a green that the track ahead is clear.



One of Ray's friends in the modelling world is Allan Stone. One day Allan contacted Ray and asked if he would help with an important visit from the East Midlands Area Board, who wanted to visit Allan's house to inspect a heat pump that he had installed. Allan thought it would be good to give them the bonus of a ride on the ground level railway that he had in his back garden. Allan would meet the visitors for initial discussions at his office in Boston, then one of his colleagues would drive them out to Allan's house through the centre of Boston while Allan nipped round the bypass (a much quicker route) to greet them on arrival. Ray willingly agreed to this; on the day, he had warmed up the engine and was setting off on a circuit of the track when he found that the garden gate had been closed across the track, and the visitors' cars were arriving. There

was no sign of Allan! Ray managed to stop the train in time and then went to greet the visitors. He managed to keep them happy – especially the EMAB Chief Engineer, who he allowed to drive the train! Allan eventually appeared: he hadn't realised that there were road works on the bypass that had caused chaos. He was able to give the required demonstration of his heat pump, and Ray thought that he had managed a difficult situation pretty well. It wasn't until the visitors had left that Allan's wife Wynn pointed out that she had taken great trouble to have all her best crockery set out in the hall to

greet the visitors with tea on arrival. Ray had hijacked the visitors and, eventually, brought them in through the back door, upsetting her carefully laid plans!

In conclusion, Ray warned his audience that the photographs were of Beech Hurst Park in the 1990s. If you go there today, you are much more likely to see battery-electric engines than the lovingly crafted steam miniatures that he and his colleagues made.

Perry Eastaugh

End of Newsletter

REPLY SLIP 1

To: George Woollard, 18 St Lawrence Ave, Worthing, West Sussex, BN14 7JF (01903 523640)
Email: Georgewoollard1@hotmail.co.uk

Please reserve me places for the Spring Lunch at Northbrook College, Worthing on **Wednesday 20th April 2016**. 12.00 for 12.30.

Full name:(Block capitals)

Address.....

.....

.....

Telephone Number.....Name of guest/s

Email address.....

I enclose a cheque made payable to RCEA for **£.....(£14.00) per person**
(Separate cheque for this event please)

If possible, I would like to be seated with.....

Applications by Sunday 17th April 2016

REPLY SLIP 2

To: Perry Eastaugh RCEA, 33 Ruston Park, Rustington, Littlehampton BN16 2AD, (01903 788858)
Email: eastaugh@live.co.uk

Please reserve me places to attend the visit to the **Foulkes Halbard Collection at 2pm on Tuesday 10th May**.

The cost of the visit is £7.50 per person.

Full name:(Block capitals)

Address.....

.....

.....

Telephone Number.....

Email address.....

I enclose a cheque (non refundable) made payable to RCEA for **£.....(£7.50) per person**

(Separate cheque for this event please)

Applications by Wednesday 27th April 2016.

REPLY SLIP 3

To: George Woollard, 18 St Lawrence Ave, Worthing, West Sussex, BN14 7JF (01903 523640)
Email: Georgewoollard1@hotmail.co.uk

Please reserve me places for the outing to Amberley Museum on **Wednesday 15th June 2016 at 10.30am**

Full name:(Block capitals)

Address.....

.....

.....

Telephone Number.....

Email address.....

I enclose a cheque made payable to RCEA for **£.....(£10.00) per person**
(Separate cheque for this event please)

Applications by Friday 10th June

Outing: Thames Barrier and Tower Bridge –Tuesday 14th June, 11:00

This is an opportunity to visit places of interest that are further afield. The outing is in association with the Solent area IET retired members section. The offer is intended for members of the RCEA and their guests. You do not have to be a member of the IET. We have been provisionally allocated 15 places. If these are taken up it could provide opportunities for further cooperation on such trips. It is a long day and requires walking and climbing stairs on Tower Bridge (Lifts are available). Overall plans are for 35 attendees, though may stretch to 45 and hence guests should be possible. Each person is responsible for themselves and cost for travel and refreshments. A well negotiated charge of £5 per person is applicable and payable at the time of booking.

The first event will start at 11:00 at the Thames Barrier which is about 10 minutes walking from Charlton rail station. Coffee/ tea + cake is served at £2.50 on arrival. A 1½ hour presentation and viewing will take place from the centre alongside the Barrier. <http://www.visitlondon.com/things-to-do/place/26941-thames-barrier-information-centre> We will clear the site by 13:00 and your return train ticket takes you to London Bridge station as the point to walk to the Tower Bridge entrance by 14:30 where guides are booked to take us round in 2 groups. On completion, 16:00 everyone is free to proceed independently. <http://www.cityoflondon.gov.uk/things-to-do/visit-the-city/attractions/Pages/tower-bridge.aspx>

As a basis for planning there is a prepared 'default' travel idea. Please do not stick to it until you are happy it suits your circumstances. Portsmouth & Southsea station 08:14 (Victoria service). This train also calls at Barnham(0849) and Horsham(0916). Travellers to change at East Croydon, thence to London Bridge, change again to Barneshurst Service and alight at Charlton station 10:56 and walk to the Thames Barrier visitor Centre. I appreciate this means arriving few minutes after 11:00 at the Thames Barrier and so an earlier service could be better This plan permits Senior Rail Card holders a better rate.

REPLY SLIP 4

To : David Thomas, 10 East Close , Bognor Regis, West Sussex. PO22 7RS (01243 586685)

Email: deltabravothomas@gmail.com

Please reserve me places to attend the **Outing on Tuesday 14th June to the Thames Barrier & Tower Bridge starting at 1100hrs at the Thames Barrier.**

Full name:.....(Block capitals)

Address.....
.....
.....

Telephone Number.....

Email address.....

I enclose a cheque (non refundable) made payable to RCEA for **£.....(£5.00) per person**

(Separate cheque for this event please).

Applications by 14th May 2016

REPLY SLIP 5

To: Perry Eastaugh RCEA, 33 Ruston Park, Rustington, Littlehampton BN16 2AD, (01903 788858)

Email: estaugh@live.co.uk

Please reserve me places to attend the visit to the **Borde Hill Garden at 2pm on Thursday 7th July.**

The cost of the visit is £11 per person. This includes entrance and the 1 hour conducted tour of the gardens.

Full name:.....(Block capitals)

Address.....
.....
.....

Telephone Number.....

Email address.....

I enclose a cheque (non refundable) made payable to RCEA for **£.....(£11.00) per person.**

Applications by 15th June 2016.