

## **Short History of the Research & Instruments Group within Fairey Surveys and Clyde Surveys**

It all started in a Mustard Gas Decontamination Building on White Waltham Airfield!! There was a place to throw your clothes for burning. The ceiling was littered with water sprinklers and the floors sloped down from the centre to collect the water in gullies.

Towards the end of the second world war the Government in their wisdom thought that the need for continual development of antivibration mounts for airborne photographic reconnaissance aircraft was no longer necessary because of the introduction of the jet engine, as this would remove the source of vibration, namely the piston engine.

Indeed they were proven correct with the introduction of the Meteor & Vampire aircraft.

However aircraft development didn't stop there and by the early 1950s much larger aircraft were beginning to come into service, initially as defence weapons and subsequently modified for reconnaissance. These were the Canberra and V bombers.

It should have been recognised earlier that the vibration problem hadn't simply gone away because there had been numerable fatal accidents from 1945 onwards caused by structural failure, admittedly at high speeds. Instead vibration frequencies were getting lower and amplitudes getting higher.

So the Government then had to decide whether to reopen development at RAE Farnborough or go out to Contract for any future work of this kind.

A decision was made to go out to Fairey Surveys because they had vast experience of airborne photography for map making although little or no knowledge of designing antivibration mounts.

A small number of ex RAE people were recruited and a design and manufacturing facility was set up at White Waltham Airfield where the Survey & Mapping side was already based.

While development was proceeding it was necessary to continue testing other Manufacturers' production camera mounts and for this purpose a vibration test rig was developed to inject vertical and horizontal vibration. At that time an antivibration mount was basically sorbo rubber.

Vibration was injected via a 1 Kw amplifier and a Goodman loudspeaker which was completely useless below 30 Hz (cycles per second).

Since aircraft structural frequencies were now being experienced down to 5 Hz it became necessary to find another power source for the test rig.

Within the Fairey Aviation Group there was a Hydraulics Division designing Actuators for modern aircraft controls such as flaps etc. One of these was linked up to our test rig and driven by a sine wave generator which could operate down 0.5 Hz. with a 400 pound thrust. Thus emerged a means of vibration testing at lower frequencies than could be previously imagined.

The Hydraulic Vibrator was born, which took R&I into a whole new ball game which is summarised later.

Back to the new range of antivibration mounts.

Firstly the Aeroplane & Armament Experimental Establishment (A&AEE) at Boscombe Down established for each new reconnaissance aircraft the vibration frequencies and amplitudes present at the proposed camera position, using accelerometers.

R&I then designed the mounting system, based on a light alloy frame with 4 isolators supporting the camera. The isolators themselves consisted of a cupola supporting a spring whose natural frequency could be controlled precisely. The spring was immersed in a damping fluid which controlled the amount of movement. The position of the camera within the mount was critical because if its centre of gravity didn't fall precisely in line with the plane of resilience of the mount angular vibration would be induced and as every air photographer knows angular displacement is the death of decent photography.

The aircraft which had mountings designed by R&I were Victor, Valiant, Vulcan, PR9, Marathon, Islander, and a Helicopter for Antarctic Survey. The Victor and PR9 were the largest installations with horizon to horizon systems. All of the work was Classified at the time and subject to the Official Secrets Act. Many of us never saw any actual operational imagery during our work with MOD.

Now that time has moved on all of the work that was done is now declassified. There are several interesting examples.

### **RAF Wildenrath and the Marathon Aircraft**

If during the Cold War any military personnel (Army, Navy or RAF) needed to travel to West Berlin they were required to go to Wildenrath where they would be transported by a Marathon taxi aircraft down the Air Corridor. In the early 60s we were asked to design a mount for two special versions of the aircraft that would provide a horizon to horizon view. This was still in use in the late 80s and early 90s. Nowadays one of the 60 Squadron Marathon aircraft now appears at the Imperial War Museum (IWM) Duxford Airshows telling the story.

Going back to the secrecy which was paramount, sometimes it worked against the RAF's own departments.

All the imagery produced by the aircraft went to the British Military Base at Rheindahlen, which was Allied Headquarters Germany just down the road from Wildenrath. Here it was processed and interpreted using high speed processors which R&I manufactured and maintained at one time. If we wanted to go to the loo there, we were escorted!

We had a call from MOD in the 80s asking us to go to Rheindahlen because the system was "rubbish". We went out with MOD & Boscombe Down and laid out on the viewing table was an admittedly rubbish oblique photo of the house belonging to the Air Officer Commander-in-Chief (AOC-in-C) Germany, clearly out of focus and with vibration present.

A Wing Commander appeared on the other side of the bench and basically said to MOD "go away and buy us some decent American gear"!

Boscombe guessed correctly what the problem was. To prove it, he had the aircraft positioned on the tarmac so that the camera could see a church spire about a mile away. He then had the tarmac marked so that the aircraft position could be repeated. Different thickness shims were then inserted

between the lens and body and half a dozen shots were fired with each thickness. Of course a good focus was found. The upshot of this was that we found out that the engineers at Wildenrath had been swapping lenses on the cameras without refocussing!

On top of this they had leaks of fluid from the isolators which instead of cleaning and refilling they requested new ones from the UK. On finding them out of stock they ordered some which looked the same (they weren't), so the mounts were bottoming.

When it was all sorted we asked the aircrew if they would go out and take a couple more pictures of the house which we got processed.

Of course the results were superb and it was a great feeling inviting the Wing Commander to return and view the boss's house. He decided there and then to have a large print made to give to the AOC-in-C as a present!! We suggested that in future he should talk to his colleagues more frequently. No doubt it did him some good but probably didn't occur to him that visit must have cost the taxpayer more than £10000.

### **Hong Kong Police (Another case of secrecy reigning supreme)**

MOD asked us to provide a hand operated swivelling and tilting mount for a 36 inch camera in a Helicopter. This was years before the handover back to the Chinese although it was obviously in the offing. It was so tight that the door on each side of the fuselage had to be removed pre-flight.

We were told by MOD that it was going to be used to identify illegals attempting to cross the Border. When we went out there we got talking to the user who was more than a little surprised by what we had been told. They pointed out that by the time any imagery was processed the people would have long disappeared into the metropolis.

No, the object of the work was looking out to the horizon for "Pig Pens" because if the Chinese decided to move in early the first thing they would do would be to "move their food up"!! We suspected that this may also been a cover for something else!

### **U2 Aircraft**

We were asked to design a mount for a "Scanner" for the Canberra PR9. We were not allowed to see it and we were only given an outline drawing which showed the important features as far as we were concerned eg weight, centre of gravity etc. We had no idea where it had come from. To us it was simply a "black box".

We did it. It was apparently satisfactory. We were never told any more.

Because we never did see what was in the box we had no idea that when, during the 80s, MOD told us they had bought a new camera from the US for the PR9 and wanted us to test it in the Queenair, that this was the camera from the box. It turned out be a horizon to horizon 12 inch scanning camera on to 5 inch film.

I never did see the black box until 2015 when my next door neighbour said she had seen a film the night before which had aircraft with cameras in. The next night I went to see the film "Bridge of Spies" and there was "the box" being loaded into the U2 aircraft for Gary Powers to overfly the

USSR unsuccessfully (he got shot down). It turned out to contain a horizon to horizon scanning camera. Only 30 odd years after we first knew of it!

It was interesting how improvements had been made over the years. When we started, horizon to horizon recce was obtained with four 48 inch cameras and a survey camera recording on 9 inch film and now better imagery was being obtained with a 12 inch scanning camera on 5 inch film giving horizon to horizon cover.

Also while in Chicago R&I staff were shown the results of some vertical imagery on which they were asked to comment about the Quality. It was slightly embarrassing because we had seen better. We were then informed that they weren't photos but were digital images made up of pixels. We had no idea what they were talking about!! We thought a digit was a 0 or a 1!!

### **The Vulcan and The Falklands**

In normal circumstances you would reckon 3 – 5 years from the time somebody in the RAF had the idea to have a camera in an aircraft for the first time, to the point when it was with the customer. It starts off with an Air Staff Requirement followed by a feasibility study (which would include an input from the Aircraft Manufacturer) followed by a prototype development contract, a Contractor's Trial, a Trial Installation, an assessment by Boscombe Down (followed hopefully by Approval) and finally a Production Contract.

Just as the Falklands situation escalated we got called to a meeting at a London hotel on a Saturday morning by a Warrant Officer who told us not to inform our Masters (MOD Procurement Executive) but we would be paid. MOD PE didn't do either hotel meetings or Saturday mornings. Also the Warrant Officer was the top RAF guy on Recce so we realised something unusual was happening.

At that meeting we were asked if we thought there were any problems from the vibration point of view in fitting the Type 133 Mounting (which was a stabilised platform for the F49 Survey camera) in the tail of the Vulcan. Since we knew that the frequencies at the back of the Vulcan were similar to the Canberra PR9 which carried the 133 Mount we were able to say that it should be ok. We were very concerned however that they would lose a lot of power between the control box and the mounting over that distance. At that point we were thanked and dismissed.

Some time later we learnt that the RAF cut the necessary hole and had the system working in one week!!! and of course that Vulcan suitably modified and backed by 13 Victor tanker aircraft bombed the Stanley runway.

### **The Canberra PR9**

This was the standard Recce aircraft in RAF Service. Early on we had designed a mount for Survey purposes and later we were asked to provide a mount for a 48 inch oblique camera. Because the space was so tight and there were flight control rods passing through the bay, MOD arranged for a twenty foot length of fuselage including the bay area to be provided to be sure of getting it right. It turned out actually to be a PR3 fuselage which Short Bros & Harland had mocked up to PR9 standard (or so we were led to believe). We had to take an external wall out of the lab to get it in!

We got to the stage of a Contractor's Trial. That should have been just us and an NCO from the RAF to make sure we didn't break anything! However the MOD rep had called all the bigwigs in, which is normally final acceptance of the design. The Mount fouled the aircraft controls. That was

a major problem for us because although we were cleared there were a number of people who only remembered the problem. The following week we demonstrated to MOD at Maidenhead that it cleared the controls. It turned out that Shorts had made a mistake with the mock-up!! From then on it was remembered as “The cock-up with mock-up”. Some still thought it was our fault!

## **Wretar Cameras**

The name stood for Weapons Research Establishment Target Aircraft Recorder and was developed by them at Woomera to be installed in the wing pods of Target Aircraft to record the miss distance during a trial. The target aircraft was a drone (yes they were around quite some time ago) called Jindivic which was apparently an Aboriginal word meaning “The Hunted One”.

Two cameras were mounted in each wing pod and with a 186 degree field of view the missile approach could be detected from above or below.

We were responsible for servicing and calibrating them as well introducing any modifications the customer wanted. The Jindiviks were based at RAE Llanbedr and operated over Cardigan Bay with the test missiles being fired from Aberporth.

The Jindys were controlled for take-off and landing from a vehicle attached to a Land Rover so that it could easily move from one end to the other. It was fitted with 2 identical sets of controls so that the second controller could take over if the first one died! Once it was out to sea control was passed over to a radar controller at Aberporth. On return (if it was lucky!) the radar controller caused a flare to be lit under the fuselage to allow the ground controllers to see it and take over.

From time to time a Russian Trawler! could be seen sitting just outside territorial limits bristling with arials or maybe they were just fishing rods.

Drama was never far away. Jindivic took off on a trolley which was discarded as soon as it was airborne, and brought to a controlled stop. It was well known that occasionally on landing, the Jindivic was further down the runway than it should have been whereupon the controllers were down the steps and driving the Land Rover away.

After many years the runway surface had become very worn by the skids so it was decided to resurface. A very high friction surface material had become available so this was laid. On the first hot summer's day with the new runway, the radar controllers passed back control to the ground team on the downwind leg and they then turned on to the cross wind leg and prepared for landing. It still had altitude so could easily be seen. However the effect of altitude and heat shimmer suddenly became a problem and it disappeared completely!

Operations were suspended on hot days until R&I came back with the solution, a 2.5 metre high enclosed structure housing a 3 metre x 1 metre front silvered piece of glass 25 mm thick angled at 45 degrees. A similar piece of glass but much smaller could be flicked up in front of the controller's (WW2 German) binoculars so that they could be used either way.

When live testing missiles the Jindy winched out a flare behind it to act as a target. On that occasion two downward facing 1 inch focal length cameras were fitted to record the trial. Sometimes the missile preferred the Jindy exhaust to the flare so there are many many Jindiviks in Cardigan Bay!

A Jindivic can still be seen at the Farnborough Air Sciences Trust Museum.

## HYDRAULIC VIBRATORS

It wasn't very long after we built the first hydraulic vibrator for testing mounts that we realised there was potential for further development and for sales outside of our experience.

Initially we used actuators that we bought from Government Surplus suppliers. You may remember that we borrowed Pete Challis's Ford Anglia and mounted it on 4 actuators to demonstrate suspension systems. We demonstrated (not with Pete's car) at the Instrument Electronic & Automation Exhibition at Earl's Court early in the 60s which created a lot of interest.

From then on we built shakers up to about 20 tons thrust for a wide range of purposes.

Some as follows: -

Measuring the stiffness of a tower block (Ronan Point) after a disaster.

Used as a seismic device to measure the characteristics of suspension bridges.

Used again seismically to measure feedback from deep soil structures to aid the search for oil & gas reserves following airborne magnetic surveys.

Shaking everything from railway wagons to parts for Concorde, missiles, military vehicle armour, people, automobile suspensions and tyre research.

A couple of amusing stories.

Very early on as thrusts became bigger we had a phone call from Walter Smith to say that his telephone in the office was moving across the desk with the vibration! This resulted in building a 10 ton reinforced concrete mass supported on four springs to absorb the energy. This only really became a problem with very high thrust machines being used vertically.

We had such an order from the French Navy and we advised them to install a similar mass, the design of which we were happy to provide free of charge. They told us the equipment was going to be mounted over old U-Boat pens on solid rock so this wasn't necessary. The payment conditions were 60% on satisfactory tests in the customer's presence at Maidenhead and 40% at Sud Aviation. The first part was successful and the gear was shipped out.

On test the equipment failed to meet the performance characteristics at a certain frequency band. It was tried a few times with the same result. We then approached the shaker to check whether the accelerometer measuring the performance was loose. It wasn't but the floor was going up and down at the same frequency and cracks were starting to appear in the floor radiating out from the shaker.

We were instructed to carry on but meanwhile some 5 or 6 of the customer's reps retired to the building exit door and watched from there! It wasn't very long afterwards that somebody noticed the sun shining through one of the walls where it shouldn't have done. End of story. We got paid.

Another incident occurred when Geoff Light was installing a system for Sud Aviation. Our French Agent had sent a young lad to assist him. He had no idea how to help but was happy to play with the control of an overhead crane which went 50 ft up to the roof. He seemed to get some satisfaction from holding the hook then raising and lowering it. Geoff went to get something from the vehicle and when he returned the guy was up in the roof having dropped the control when too high to let go. He was extremely lucky that Geoff wasn't too long!

## **Working with the Company Aircraft**

We had CAA Design Authority for mods to the Company Aircraft for Survey purposes. We weren't allowed to do any changes that affected the basic structural integrity.

We installed the first "Heli-telly" for trials for Marconi in Whiskey Charlie. It was a 1.5 metre diameter fibreglass ball mounted between the main undercarriage wheels immediately below the main fuel tanks! CAA insisted we fitted it with a bomb release so that it could be dropped in the event of a wheels up landing. When they came over to clear the installation they insisted on a guard being put over the switch in case the pilot sneezed and accidentally dropped it over Woodley!

Before the trials were complete and on the Thursday before Easter 1982 Marconi contacted WW to arrange to collect it that afternoon. They were told that everything was closed down but they would be happy to cooperate after the following Tuesday. Marconi made it clear that if necessary they would come over, cut the padlocks off the hangar and remove it from the aircraft! Provision was made for them to come.

Subsequently it was learnt that it went down with the Atlantic Conveyor in the Falklands. It was said by many that there were so many claims for items "lost" when it sank that it couldn't have set sail in the first place!

Another job which had a humorous side was for a magnetic survey in Egypt. As they were looking for more precise results the fibreglass tail extension on the Queenair was no good so we designed a cradle which fitted over the rear hole and a winch which could let the sensor out about 50 feet. The trouble was that it did look a bit like a bomb from underneath. Jock Kirkwood who was going to fly the job voiced his concern but we managed to convince him that you wouldn't notice it at 500 ft altitude.

All was going well until one day on take-off Jock sought WW Traffic Control for permission to go. This was given and just as he lifted clear Control came back and said "Where is it tonight Jock, Berlin or Hamburg"? The "bomb" was taken inside for transit!

## **WORKING WITH GROUND SURVEYS**

Probably the most memorable was Hungerford Bridge.

Hungerford Bridge was one of those jobs which grew and grew. It was initially quoted for on the basis of available drawings. What the customer or anybody else didn't know was that it didn't conform with the drawings in many respects due to visits by Herr Hitler during the Second World War.

The requirement was for a steel Company (Redpath Dorman Long) to manufacture about 30 replacement beams which spanned the tracks. Each beam was about 50 ft long and was attached to the bridge structure by about twenty or more rivets at each end. So Survey had to measure the distances to about 10 mm accuracy so that a new beam could be manufactured and slotted into place using the existing rivet holes!!

R&I's small but interesting involvement was to design clamping frames to allow the measuring instruments to be mounted below track level. There was no proper base to set tripods on.

A few interesting problems occurred for the surveyors. Firstly a fixed base from which measurements could be started was a long way from the bridge due to tidal movement. Secondly they were occasionally required to cross a track (700 volts)! And thirdly they were not allowed to cause a train to stop. For this Southern Rail kindly provided a man on the opposite platform who let the surveyors know when a train was coming by waving a red or green flag! (at the surveyors not the train).

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