THE HISTORY OF THE AIR ENGINEER

by Flt Lt D.C. Stringman RAF

A HISTORY OF FLIGHT ENGINEER TRAINING IN THE ROYAL AIR FORCE

by

Flt Lt D. C. Stringman RAF

INTRODUCTION

Air engineers, or flight engineers as they were formerly and are still colloquially termed, form the smallest current aircrew branch within the RAF; its strength, at present, numbering only 340. It is also, with the obvious exception of the pilot branch, the oldest, having been continuously employed since early 1941. Written history concerning the engineer is sparse and as the years pass the documentary evidence required to support such a history decreases; only a short while ago the 1942 policy file, a unique document, was sent for destruction by the reviewers. Personal experience of the earlier period is becoming equally difficult to trace and can only reduce in the future.

It was necessary to limit the content of this short history to training and the major utilisations. During preparation a strong bias of content towards the war period emerged naturally; the pace of aircraft development and the expansion of their sphere of employment dictated rapidly changing responses from the aircrew and hence the organisations responsible for training. As a spare-time project it has been impossible to do more than outline the subject: 'war-stories' have, reluctantly, been omitted; most were interesting, some sad, some exciting and many humourous, such as the engineer in Japan who, on the turn of a card, inherited a house of ill-repute (fully furnished!) to find subsequently, when arrested by the military police, that his own property was out-of-bounds to him. Hopefully a professional author may one day produce a comprehensive study of the subject in which these anecdotes will have their place.

Undoubtedly there still remains a general ignorance of the engineer's professional role, perhaps the cause of his literary anonymity. The following article, which first appeared in the RAF magazine 'Air Clues' in May 1977, goes a long way towards clarifying this point and also outlines the present training scheme.

Systems Approach to Training principles are being used in the course for training Air Engineers. What is involved is discussed by

SQUADRON LEADER
D. CROWSON

The Air Engineer, whose counterpart is known as the Flight Engineer in civil aviation, is probably the least known and the most unpublicised aircrew member both inside and outside the RAF. However, the demand for engineers continues in aviation generally and this short article is aimed at making known the nature and extent of the training necessary and as an indication of the professionalism with which Air Engineers approach their duties.

First, the task of the Air Engineer. He is primarily concerned with the operation and monitoring of all aircraft systems, and is required to diagnose and where possible rectify or eliminate any faults that may arise. In addition to the basic airframe and engines of the large multi-engined aircraft, there are several major systems and sub-systems to be managed, including electrics, hydraulics, fuel, pressurisation and air conditioning, powered flying controls, ice and rain protection. Then there is a whole range of systems which come under the general heading of avionics, and others such as oxygen, fire protection, smoke detection, water and waste and galley supplies.

In short, the Air Engineer is responsible to his captain for engineering management at all times whilst the aircraft is under the control of the aircrew.

AB INITIO TRAINING

All RAF Air Engineers are recruited as NCO aircrew; some are ex-ground tradesmen, others are direct entrants.

Training takes place at No. 6 FTS at Finningley, starting with the 6 weeks Airmen Aircrew Initial Training Course which is designed to develop, test and assess personal qualities to ensure that the student has the potential to accept aircrew professional training and to assume SNCO rank. Subsequent professional training covers 43 weeks and is conducted in four phases of an objective syllabus.

Basic Academics

This first phase deals with the fundamentals of aircraft systems and includes a short course on mathematics and science. In the latter stages of the phase, Dominie aircraft systems are studied preparatory to phase two.

Flying Phase

Flying comes early in the course and syllabus content is conditioned by aircraft resources and economic considerations, as a result, apart from one hours Familiarisation flying in the Bulldog, all flying exercises are carried out conjointly with Navigator training. Following the introductory 1-hour Bulldog sortie, 9 exercises of 3 hours each in the Dominie are supplemented by ground instruction, but it is not possible to teach, practice and test all of the required skills at this stage. The main purpose of the flying exercises is to familiarise the student with the airborne environment, thus fulfilling a vital aspect of all aircrew training.

Advanced Aircraft Systems

An in-depth study of the Argosy aircraft is undertaken at phase 3. The systems and their interrelationships are examined, and also considered are the implications of malfunctions on aircraft operations. The student is now prepared for the final and most important part of the course.

Simulator Training

This training takes place in the Argosy Simulator currently located at RAF Benson. This simulator is the best one which is available for basic training which is sufficiently modern in concept, combining the necessary blend of relative simplicity and sophistication. With realistic systems presentation, it permits the student Air Engineer to translate the knowledge he has acquired so far into skills that can be demonstrated and measured. Each student completes 11 exercises of increasing complexity involving 38 hours of operating at the engineers station and 24 hours in the co-pilots seat.

Graduation

On successful completion of basic training, the student Air Engineer is awarded his flying badge; final confirmation of this award is conditional on his completion of conversion training on an operational aircraft.

TYPICAL FLIGHT FOR AN AIR ENGINEER

The easiest way to place the Air Engineers task into perspective is to describe briefly what he does on a typical flight of a VC10. The VC10 is chosen because it is an example of one of the Air Engineers more demanding roles and is familiar to many people.

Two hours before take-off the crew reports to the operations centre. The pilots and the navigator go to Flight Planning while the engineer, having ascertained the fuel requirements, goes to the First Line Servicing Office to check the aircraft technical log. This document provides up-to-date serviceability and replenishment states. It will take some 15 to 20 minutes for the Air Engineer to satisfy himself that all the documentation is in order prior to going out to the aircraft to check that is is ready for flight.

Pre-Flight Checks

The pre-flight check covers some 180 items, and to ensure that each item is checked quickly and thoroughly it is necessary to know the aircraft intimately and to work to a set pattern. A final fuel check is made to ensure that the fuel carried is in accordance with the flight requirements, including any amendments that may have been necessary at the flight planning stage. The Air Engineer will then calculate the fuel transfer between tanks that will have to be done after take-off to maintain the correct distribution of weight. By this time, the rest of the crew will be on board and when the engineer is ready, the captain will call for pre-start checks. When completed the engineer starts each engine in turn and initiates systems checks which will continue up to the time that the aircraft reaches the runway threshold.

Take-Off

During the take-off the engineer handles the throttles and checks the desired power settings via his instrumentation. If a serious malfunction occurs prior to Decision Speed he will advise the captain to stop the take-off. As the aircraft climbs away he will set the appropriate power for noise abatement procedures, for climb segments and intermediate holding heights. System monitoring continues throughout the climb, special attention being paid to engine responses at this time.

Climb

When settled into a smooth climb, the Air Engineer will calculate the engine RPM that will be required at the cruising flight level, also the high and low buffet speeds that will indicate the speed band within which the aircraft can operate safely. At the top of the climb, he sets cruising power and then makes his initial log entries. After calculating the fuel remaining, this figure is passed to the navigator for entry on the flight plan and the 'Howgozit' graph. At this busy stage of the flight the crew will be working as a well drilled team and there will be little need for them to speak to each other on the intercom. The Air Engineer will be listening to the pilots communicating with the ground stations and will be aware of Air Traffic flight clearances. He will also know the navigational aids that are in use and by reference to the appropriate instruments will monitor the progress of the flight.

Cruise

In the cruise it is the Air Engineers responsibility to maintain the desired cruising speed by keeping the engines synchronised at the correct RPM, which will vary with aircraft weight and outside air temperature. Even in slight turbulence this becomes a tedious and demanding chore as constant throttle adjustments are necessary. Buffet speeds are updated at regular intervals, and fuel is used and transferred between tanks in accordance with a prescribed drill in order to maintain the desired centre of gravity. Throughout the cruise the engineer keeps a very close check on fuel consumption to ensure that there are sufficient reserves to complete the flight safely. At regular intervals he will log all engine and aircraft systems performance figures, and from these he will be able to recognise any signs of impending malfunctions and take the necessary corrective action. Passenger comfort is an important consideration so the engineer will closely monitor and control the cabin height, temperature and humidity. Above all the Air Engineer will be prepared at all times to take his part in the major emergency drills for engine fire, the presence of fumes and depressurisation.

Descent

At the start of descent, out comes the check list again and progressively through the descent the engineer sets all systems to the landing configuration. Calculations of descent buffet and landing threshold speeds are made, along with fuel remaining and landing weight. Power settings throughout the descent and approach are the engineers responsibility on instructions from the captain.

After Flight

The rapidity of the aircraft turn-round for the next flight will largely depend on the efficiency with which the Air Engineer has pin-pointed the cause of aircraft defects. The technical documentation will have been completed as far as possible during flight and defects needing rectification prior to the next flight will have been notified to the servicing authority by radio. Operating costs are minimised by speedy turn-rounds, particularly at international airports. If the flight is to be continued with another crew, the engineer will brief his ongoing colleague.

CONCLUSION

In todays cost conscious service a serious attempt is made to train Air Engineers in the most economical manner; the dedication of the instructors coupled to the quality of the students make it a course of unparalleled success in all forms of aircrew training.

ACKNOWLEDGEMENTS

My thanks for their contributions are given to all who have assisted in this project: my wife and Sqn Ldr A L Wilson AFC (Retd) for their proof reading and constructive criticism, the majority of serving air engineers who have been unfailingly helpful and the following people in particular:

Engineers
Sqn Ldr Joe Acklam (Deceased)
M Eng Mick Ashbolt
M Eng Tony Bateson
Wg Cdr 'Bill' Berry (Retd)
M Eng 'Bill' Bridger (Retd)
FS H Brodie (Retd)
WO Albert Brookes (Retd)
WO Des Broughton (Retd)
WO William Brown (Retd)
M Eng Derek Butcher (Retd)
Sqn Ldr Mike Cawsey
Flt Lt Tom Clarkson (Retd)
Sqn Ldr Dennis Crowson
M Eng Dave Drinkwater
M Eng Ian Gibson (Retd)
Flt Lt Maurice Godfrey (Retd)
Flt Lt Brian Hemming
Flt Lt Ed Jacotine
Flt Lt Brian James
M Eng Derek Jeans
FS Kenyon (Retd)
M Eng Al Kitson
M Eng 'Chuck' Knight
Flt Lt Ted LeCount
Flt Lt 'Jock' McCullum
M Eng Alec McFall (Retd)
M Eng Joe Major (Retd)
WO Ted Michael (Retd)
Flt Lt Len Moren (Retd)
Flt Lt Norman Mullen (Retd)
M Eng Pete Neilson
Sqn Ldr Dave Nelson (Retd)
Sgt Jim Norval (Retd)
Wg Cdr Ken Owen
Flt Lt 'Pedro' Pederson (Retd)
Sqn Ldr Stan Piper
Sqn Ldr Ted Querzani
M Eng 'Curly' Richards
Flt Lt Ken Saxby (Retd)
Sqn Ldr Ken Simmons (Retd)
M Eng Bert Skeels
M Eng Leo Slee
Flt Lt Brian Spurway
M Eng Bert Suffolk (Retd)
WO Jeff Taylor (Retd)
Flt Lt A S Ware (Retd)
Flt Lt Roy Waters
Sgt Clyde Webb (Retd)
Sqn Ldr 'Bill' Wickson
M Eng Rick Williams

and
MAEOp Ron Radford
MAEOp Fred Reeves
Mr Howard – Air Historical Branch
Mr Turner – Air Historical Branch
Mr Maydew – Historian RAF St Athan
The Staff of the Public Record Office

Viewpoints, opinions and attitudes expressed in this history are those of the author and do not necessarily coincide with those held by the Air Ministry/Ministry of Defence.

CONTENTS

CHAPTER 1

During the evening of the 10 February 1941, over 10 tons of bombs were dropped on Rotterdam by No 7 Squadron in an attempt to destroy the oil storage tanks. Just 3 aircraft sufficed to carry this load, for they were the new Short Stirlings and this was the first 4 engined-bomber raid of the war by the RAF.

The attack itself has been well publicised, as befits a significant opening round in the great Bomber Command offensive, but the Operational Record Book of the squadron also indicates another unique event. The last name on each of the crew lists is that of an LAC whose flying duties are defined as 'Engineer/AG' (Air Gunner). Thus in the year following the decision that all aircrew were to be at least of sergeant rank, LACs Wilson, Nicholson and Richards had heralded the inauguration of the RAF flight engineer by being ushered in through the tradesman's entrance.

Over a year previously, on the 8 January 1940, a conference had been convened at the Air Ministry. This was in the middle of the 'phoney war', after Poland was overrun and then partitioned, yet 3 months before the invasion of Scandinavia and the blitzkrieg of the Low Countries and France. The uneasy lull brought a much-needed breathing space and on this particular day the Air Force was making plans for the future. Looking past the defensive victory of the Battle of Britain that would take place in the summer, after Europe had been transformed into an Axis conclave, to the offensive that must follow, the brief was to discuss the 'Numbers and Composition of Crews – Certain Bomber Aircraft'. These 'Certain Bomber Aircraft' were the still secret Short Stirling and Handley Page Halifax, the first of the new generation of heavy bombers for the RAF. The only precedent to the situation had occurred over 20 years before, when 6 Handley Page V/1500 biplanes were introduced in order to strike at the German homeland from bases in Britain. Too late to see action, they succumbed as one of the first victims of disarmament. This brief interlude held no relevance in 1940 and the concepts involved in operated a 4 engined landplane were steps into the unknown.

The chairman introduced the idea of a new aircrew member:

> "It is also desirable, with a view to obtaining the best possible performance from engines, to have someone watch the engine instruments, which in future multi-engined aircraft would be situated away from the pilot's dashboard. It is proposed that this duty should be undertaken by an additional member of the crew who would receive special training in the running of engines. The necessary training might be obtained at an engine factory, but it would be unnecessary to use fitters for the duty".

Air Commodore Lees asked:

> "Is it proposed that these flight engineers should have any other duties to perform, apart from watching engines?"

The chairman answered:

> "He would be expected to look after such things as petrol supply cocks, boost regulators and engine coolers. He might also be able to carry out certain temporary repairs to equipment damaged by enemy action, such as a broken oxygen lead. He would also be trained as an air gunner and would be available in an emergency to replace casualties among air gunners".

This is the original reference to the title of 'flight engineer' and establishes a firm link with the advent of the 4 engined bomber. Three other factors from this part of the conference also deserve comment. Firstly, the primary duty is already specified as

systems monitor and operator, defying the popular misconception that the early flight engineer was mainly an airborne repairman, or 'flying spanner'. This facet, as can be seen, was added to the job specification almost as an afterthought. Secondly, there is the mistaken estimation of the limited expertise required, an error that was corrected within 2 months of the Stirling's introduction to operations. Finally, the introduction was a well planned (as far as this stage of the proceedings is concerned!) permanent measure, reflecting foreseeable large aircraft technology and intended to put a specialist on a 3 man flight deck.

With the alacrity that was general during this phase of the war, 2 months elapsed before any further action was taken. On the 13 March 1940, Group Captain Nelson wrote from the Air Ministry to Headquarters, Training Command:

> "In the near future we will have to train personnel as flight engineers. These personnel are required for Stirling and Halifax Mk 1 and 2, 4 engined aircraft. I suggest that flight mechanics should have a short course at the engine manufacturers, then at the aircraft manufacturers in order to become familiar with all the instruments as they will be on the aeroplane. Their training in gunnery will have to be given later. I suggest that final training is given on the unit".

The reply was swift (2 weeks) and rather abrupt:

> "I have discussed the matter with C Eng (Bomber Command) and No 6 Group. General opinion is that any intelligent flight mechanic could do the job of flight engineer after a short period of training on one of the Operational Training Squadrons. No 6 Group consists entirely of this type of unit and when these aircraft come in, complete crews will have to be trained.
>
> It is suggested therefore that flight engineers be obtained by selecting volunteers from flight mechanics and putting them through the air gunner's course, duration 6 weeks. They would then be posted to a training squadron equipped with the particular type of aircraft on which they are to be employed. It does not seem that a course at the maker's works is necessary, as these courses are essentially for repair personnel. The flight engineer is only taking over part of what was, on smaller aircraft, the pilot's responsibility.
>
> Coastal Command have for some years used Fitters (2), in a similar capacity, with no special training".

It is perhaps appropriate here to explain the existing NCO rank and technical trade structure. The ranks ranges from aircraftsman, second class (AC2), in ascending order through aircraftsman, first class (AC1), leading aircraftsman (LAC), corporal, sergeant and flight sergeant, to warrant officer. The trade structure was a 3 tier system, which was only loosely tied in to the ranks. An entirely unskilled man, or one still under training, was normally an AC2 and would be designated as an aircraft hand (ACH). The 2 grades of skilled men were flight mechanics (FM) and fitters.

Flight mechanics were further sub-divided by trades, thus FME and FMA denoted engine and airframe mechanics, respectively. Normally advancement to fitter coincided with promotion to LAC. However the loose coupling of rank and trade meant that overlapping could occur either way. Numerous AC1 fitters and LAC flight mechanics existed.

At their pinnacle the fitters had the fitter 1 and fitter 2, both qualified in multiple trades. Wartime had resulted in increased specialisation, denoted normally by fitter 2(E) or fitter 2(A) dependant on qualification for either engines or airframes. Further sub divisions also emerged, such as fitter 2(AE), denoting an aero-engine worker.

The unenthusiastic reply from Training Command marks the beginning of a break in the correspondence, an understandable gap when considered against the developments of the war. On the 9 April, Denmark and Norway were invaded. Six weeks later the evacuation of Dunkirk, Operation 'Dynamo', commenced. The phoney war had ended with a contrast that is still awesome to contemplate. Britain now faced an invasion threat. On the 14 May the Ministry of Aircraft Production (MAP) was established under the control of the dynamic, effective and autocratic Lord Beaverbrook. The new Ministry was formed by combining the existing Air Ministry Research and Procurement Sections, then establishing them as a separate entity. Beaverbrook immediately concentrated all facilities towards the production of just 5 aircraft types, the Spitfire, Hurricane, Blenheim, Wellington and Whitley V. Resources that could be redirected to this programme were ruthlessly purloined and among the major sufferers were the heavy bombers. Beaverbrook's edict lasted for about 2 months, with the constraints gradually being eased towards the end of the period.

The effects of the Beaverbrook regime on the introduction of the Stirling and Halifax are arguable. AJP Taylor's biography of the man includes the view that more delays were caused by air raids on the factories together with development difficulties. Air Chief Marshal Joubert took a diametrically opposed stance. As is usual the truth probably lies somewhere in between. With regard to the crewing of these aircraft however, the directive was probably totally responsible for a 2 month break in planning the flight engineer's introduction. Air raids and teething troubles might, or might not affect production of any new aircraft and aircrew training commitments could hardly be modified on a day-to-day basis to allow for these vagaries. The heavy hand of the 'Beaver' was not a vagary. With the Battle of Britain about to open, there were possibly more important considerations than a new crew member for aircraft that had been shelved, initially for an indefinite period.

The MAP slowly relaxed their position, and the heavy bomber programme resumed. The interim period had seen one change that was, for the next 30 years, to have a profound effect on flight engineer training. On the 27 May 1940, Training Command had been divided to form Flying Training and Technical Training Commands.

Correspondence reopened on the 10 July 1940, when the Air Ministry neatly side-stepped making a decision and merely relayed to Bomber Command the perfunctory comments that had emanated from the, now defunct, Training Command. There was also an added implication that Engineering Officers who had completed courses with Bristol and Rolls-Royce, the engine manufacturers for the Stirling and Halifax, should be made responsible for training flight engineers.

Bomber Command's reply was sent only 6 days later and Group Captain Lejsk enquired:

> "What is the policy regarding flight engineers; how are they to be recruited and trained?
>
> Engineering officers are far too busy to undertake any training, and some form of training is obviously essential".

This terse note is probably the external vestige of some highly justified exasperation. The original conference at the Air Ministry had taken place 6 months before. Training Command's approaches to the C Eng and No 6 Group were probably on an unofficial basis, certainly the responses did not reflect Command policy. It is therefore assumed that Bomber Command, having heard nothing, believed that Training Command and its successors had the commitment well in hand. Now, a bare month before the first Stirlings entered service, the problem had been dumped upon them, with not a single

constructive action having been taken during the intervening period. Engineering officers were already responsible for the introduction of the new bombers, aircraft which were far more complex than any then in squadron use, and for ironing out the inevitably numerous teething troubles. The suggestion that they could also organise the training of a new aircrew category indicates either a total lack of thought or an astonishing naivety.

Bomber Command's exasperation with the initial letter must have been heightened when nobody condescended to answer their reply. Reminders were dispatched on the 4 September, 21 September and the 4 October. Finally, Group Captain Leisk reverted to the personal approach, his contact probably being in the Directorate of Training. Leisk referred to the original letters and the host of reminders, then stated:

> "We do not know why we have not had a reply but the matter is now of extreme interest with the advent of the Stirling etc.,* and we hope you will twist the tail of the individual who has failed to reply to us".

Three days later, on the 19 October, the belated reply left the Air Ministry:

> "I called for the file and found that the matter had been under discussion between Manning and Establishment, however establishments were fixed yesterday and I have asked D of O to let you have an official reply.
>
> With regard to training, this Directorate went ahead with planning, pending the settlement of the manning establishment question and if you will let me have a list of the names of men that you wish trained, I will see that they get vacancies on the manufacturers' courses with the least possible delay".

Unfortunately, this prompt response appears to have gone adrift during delivery. Bomber Command had certainly not received it over a week later and, with their patience exhausted, directed the next missive directly to the Under Secretary of State:

> "The Halifax and Stirling squadrons will require an extra crew member in the shape of the flight engineer. It is understood that the Air Ministry has the training of these airmen in hand although no answer has been received to this HQ letter dated 16 Jul 40 and subsequent hasteners dated 4 Sep 40, 21 Sep 40, 5 Oct 40 and 19 Oct 40. Such training must obviously be conducted before reaching an operational squadron, but it is not known if this is to be undertaken at OTUs or under previous Air Ministry arrangements".

The thread of this story now breaks abruptly. Possibly some correspondence was not filed, certainly some has been destroyed. Bomber Command had fought long and hard for a recognised form of training, although, to preserve perspective, it should be mentioned that this consisted of just a fortnight at the engine manufacturer's followed by a similar period with the airframe constructor. Despite, as yet, there being no firm directive on eligibility for the job, some training was established by the end of January 1941, evidenced by an enquiry from Bomber Command to the Under Secretary of State, regarding the number of men on courses.

On the 12 February 1941, a meeting was held at the Air Ministry 'To discuss the qualifications of tradesmen to be employed as flight engineers in heavy bombers and

* 'etc.' is a veiled reference to the Halifax, which remained on the secret list far longer than the Stirling.

flying boats'. This was an important step forwards, for not only would it solve Bomber Command's dilemma but it would also rationalise the branch throughout the Air Force. The conclusions from this meeting were not filed away as in the previous year, but broadcast to the Service generally. They form the basis of Air Ministry Order A190 (20 March 41)*, the flight engineer's founding charter.

Completely overturning the original recommendation, only highly skilled men were eligible; fitters 1, fitters 2, fitters 2(E) and fitters 2(AE). Influencing the decision were 3 main factors. Firstly, Coastal Command, who required flight engineers for their Sunderlands and Catalinas, had traditionally used fitters in a similar capacity. Secondly, although the AMO states that flight engineers are to be remustered as such, the text is ambiguous and further specifies that they are to be promoted to acting sergeant, if necessary, in their trades. Notwithstanding the loose inter-relationship between trades and ranks, a sergeant flight mechanic would be an unthinkable and unworkable anomaly. Finally, the Stirling had been in service for 7 months, the Halifax for 4; lessons would have been learned the hard way. A flight engineer needs either a wealth of knowledge to lean upon, or a lengthy and comprehensive training scheme. For the moment the Air Force adopted the former course.

Among those who saw the AMO on the squadron notice board were Sgt Nelson, a fitter 2(E) at Kinloss and Sgt Berry who had just arrived at the Stranraer-based 240 Squadron, which was re-equipping with Catalinas. Cpl Pederson's application was blocked by his Engineering Officer, who arbitrarily decided that he could not afford to loose a skilled tradesman. This practice became so widespread that when the AMO was revised in the following year, a clause was inserted specifically banning it. Cpl Pederson applied again in 1942 and was accepted.

In the same month that the AMO was issued, there were tangible signs that the bomber offensive was escalating. No 1 Group became operational and the first 4000 pound bomb was despatched, in a raid on Emden. In June 1941, the German war machine rolled eastwards toward Russia and the sustained pressure that Britain had solitarily resisted for a year was eased. The respite added extra impetus to Bomber Command's expansion. The aim was to put 4000 heavy bombers into service. It proved an over-optimistic target, but honestly reflected the mood of a nation which had endured the Blitz and now wished for reciprocal arrangements to be made for its authors.

* APPENDIX 1.

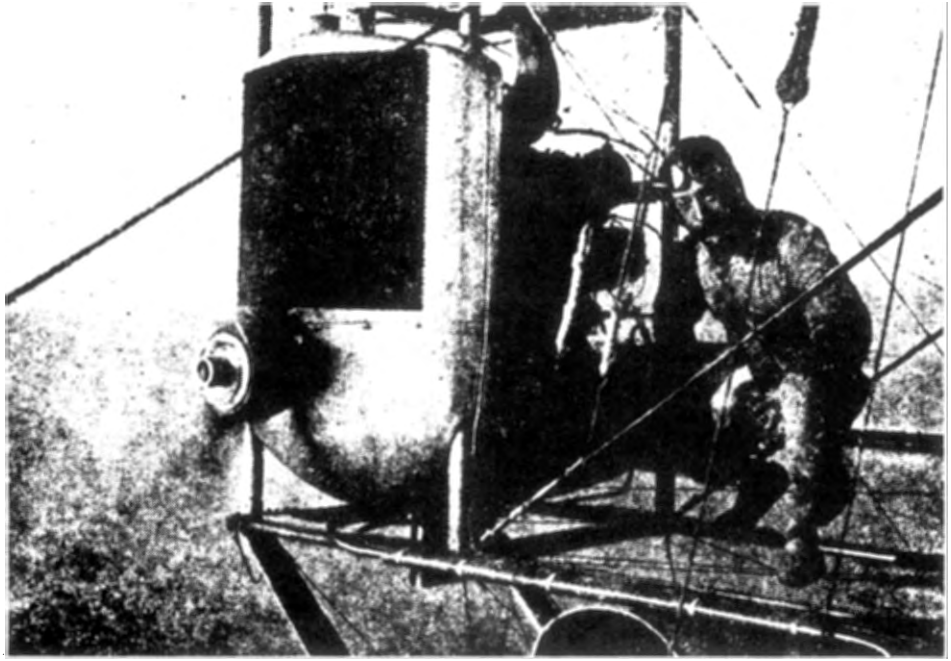
CHAPTER 2

The technological melting pot of the Great War accelerated the advance of aviation by at least 10 years but in the process it also developed 2 spectacular aeronautical anachronisms, the airship and the flying boat. Both of these machines exhibited 3 common factors; a long flight endurance, reasonable pay-load and, in the case of engine failure, the independance from having to land in the nearest field. Such a forced-landing could have 2 results that were entirely different, but equally conclusive. In friendly territory a phone call or messenger would summon aid from the military, a mechanic then arrived by road, repaired the fault and the flight was continued. On the wrong side of the lines, the conspicuousness of an aircraft in a field would draw prompt and unwelcome attention, denying the time for rectification even if a mechanic was available. It was in the airships and seaplanes that the engineer first left the ground, not as a flight engineer, but a fitter ready to practice his trade on the notoriously unreliable aero-engines of the period. The endurance of the aircraft increased the possibility of failure. The space and lifting capability existed to carry the man and the environment in which to diagnose and correct the fault was normally well outside the range of both hostile and friendly attention. Multi-engine installations did nothing to ease the basic problem, in fact the reverse. There was little redundant power on the aircraft and a single failure would cause an airship to drift in all but the lightest winds and a flying boat to alight on the water. The chances of incurring a failure also rose in direct proportion to the number of engines fitted. If these fitters held any in-flight duty, it was that of gunner. The art of air gunnery was then in its infancy and the major technicality, clearing the innumerable stoppages of a temperamental Lewis gun, was ideally suited to a practical mechanic.

The 1918 armistice reduced the newly formed RAF from its position of Cinderella of the Services, to the runt of the litter, fighting to stay alive through the famine of demobilisation. The Air Force was decimated, the military airship quickly succumbed and followed the other dinosaurs into extinction and the flying boats were particularly hard hit. The flying fitter/air gunner retained a precarious position on the few boats remaining and gradually Coastal Area, the progenitor of Coastal Command, started to rebuild the force, gaining in the process some excellent publicity from successful and well-conducted long range flights throughout the Empire.

With the observer becoming a navigation and bombing specialist, landplanes were also requiring air gunners and the obvious source was from amongst the squadron groundcrew who could split their servicing responsibilities with those of being part time aircrew. The contribution of the air gunner was recognised in 1923 by the issue of their first badge; the 'Flying Bullet'*. Gunnery training was carried out on the squadron and upon receipt of their flying badge the men gained 3d extra pay per day. Augmenting this was a further 6d crew pay, for each day when actually engaged in flying. In an attempt to administer the system fairly, many flight sergeants made their fliers pay the 6d into a fund that was then shared between all the mustered gunners. Anyone who tried to opt out would find himself poorer, as the flight sergeant also controlled the flying roster. Part time air gunners lasted until January 1939, by which time the consolidated rate of gunner/crew pay was 1s 3d a day extra. The wireless trades then took over the air gunnery commitment as full time aircrew and, with the exception of the flying boat fitters, the remainder were grounded. The order did not confine itself solely to gunners, henceforth all aircrew were full time. The change has often been interpreted to indicate that with war imminent, skilled tradesmen were at a premium. However with powered turrets and efficient sights, gunnery was an art which could not be mastered as a sideline to a primary job and it is this aspect which is stressed in the order.

* APPENDIX 2



An air-mechanic of the First World War working on the engine of an airship during flight

In December 1939, air gunners relinquished their brass insignia and exchanged them for the more familiar half wing cloth badge. The authorising AMO* emphasises the honour being bestowed upon the branch, so it is perhaps cynical to mention that the exchange took place at a time when non-ferrous metals were becoming scarce. The original cloth badge contained 13 prominent flight feathers on the wing. This unlucky number was, not unnaturally, linked by many to the heavy losses being incurred by the wearers. Superstition was powerful enough to cause action at high level, for on subsequent issues of this and all other half wing badges, the number was reduced to 12. By 1940, gunnery training at specialised schools had replaced squadron instruction and sergeant became the minimum aircrew rank †.

Flying boat fitters and mechanics soldiered on as before, a small and unique sideline. The minimal numbers of aircraft and men involved probably accounts for Coastal Command's apparent disinterest in flight engineers at this time. In 1938 the first Sunderland entered service, a military development of the Empire 'C' class flying boat on which the ship's clerk had been employed to operate the electrical system, fuel cocks and cowling gills. The Sunderland advanced on this and boasted a full flight engineer's position between the wing spars. Production, however, was slow; by June 1940 only 34 were in service and there would have been little difficulty in finding the requisite number of first class adaptable fitters to man the positions. The Catalina was an even simpler problem, just a single example being operated in 1940.

This was the situation pertaining when the heavy bomber entered service. The Stirling, Halifax and Avro Manchester all arrived in the later part of 1940, the Stirling in August leading the other 2 by 3 months. They were all operational by March of the following year, a considerable feat which entailed cutting many corners in development and modification. Only the Manchester was an unmitigated failure. The Stirling and Halifax were not brilliant aircraft, but comparison with the excellent Lancaster has eroded the parts played by these 2 sound and adaptable workhorses. From its inspired inception, the Lancaster became a legend that outgrew the actual aircraft. Undoubtedly it was the finest of the heavy bombers, a description justly earned by all-round adequacy, but the margin by which it received the accolade was not wide. The Stirling was more manoeuvrable, later marks of Halifax could outspace it by a good 25 MPH, but both initially had poor features including Achilles' heels sought for and discovered by the enemy defences.

Unlike the Halifax, which was originally designed as a twin-engined aircraft, or the Lancaster, which was a Manchester development, the Stirling was to be a 4 engined aircraft from the outset. The Air Ministry requirement of July 1936 was embodied in specification B 12/36. The limiting factor of this specification was a requirement for a wing span of less than 100 feet, so that the aircraft would fit existing RAF hangars! Short Brothers adapted the technology of the Sunderland and also took advantage of the power offered by the new Bristol Hercules 2 row radial engine; 1560 HP from the mark XI compared to 1280 available from the current Rolls-Royce Merlin X. The Stirling emerged as a large heavy aircraft that really required a span in the order of 120 feet. Tied by the specification, the 99ft 1in wing was necessarily of extremely low aspect ratio and this marred performance. The published ceiling was 17000 ft, but most crews considered themselves lucky if they could climb within 1000 ft of this. The wingform, however, endowed the aircraft with surprising manoeuvrability which, combined with the rugged structure, allowed the Stirling to be thrown around with fair abandon. The

* APPENDIX 3

† APPENDIX 4

low ceiling made the aircraft particularly vulnerable to flak, which became increasingly accurate as the war progressed. The other drawbacks were a very complicated construction and a segmented bomb-bay, dictating that no single bomb exceeding 2000 pounds could be carried. By the middle of 1943 losses reached a pitch which forced its re-allocation to less heavily defended targets and in the following year it was withdrawn from bomber operations completely. Relegated to the transport role, it gave excellent service until the end of the war as a freighter and glider-tug. The undercarriage did give problems, but strangely these were not with the characteristic double-articulating main units but with the twin retractable tailwheels. In all 2369 were built at Rochester, Swindon, Belfast and the Austin factory, Birmingham.

The Halifax originated under the same specification, P 13/36, as the infamous Manchester. This called for a twin engined aircraft utilising Rolls-Royce Vulture engines, which gave promise of 2000 HP per unit. Whilst still on the drawing board the Air Ministry, fearing a shortage of Vulture engines, persuaded Handley Page to modify the design to accept 4 Merlins. It is probable that the same 100 ft wing span constraint that crippled the Stirling was applied to the Halifax. However, being lighter and smaller it emerged as an aesthetically balanced design. One hundred were ordered straight from the drawing board.

In service the aircraft was subjected to continual modification in order to improve the mediocre performance. The evolution of the Mark 1 and 2 saw the nose turret and beam guns deleted, the dorsal turret fitted, removed and finally reinstated with the very neat Defiant-type 4 gun installation; and 400 HP added by the fitment of Merlin XX engines which incorporated a 2 speed supercharger and took advantage of the higher octane fuel now available. The original fins and rudders allowed excessive yawing which was not conductive to bombing accuracy and also caused an intriguing but dangerous trait when pilots indulged in a favoured method of fighter evasion. The ploy called for 2 throttles on one side to be snapped shut whilst applying hard rudder towards these engines. The aircraft violently slewed and rolled and also slowed down considerably. The attacking plane suddenly lost contact with its quarry and overshot it because of the speed reduction. The implication of this manoeuvre was that the Halifax could get into a stable sideslip with the rudders locked hard over by aerodynamic loads. The strain on the empennage was enormous and almost certainly caused aircraft losses. Flight testing established a safe minimum speed to carry out the tactic but the whole problem was only completely solved by the later fitment of redesigned and larger fins.

Construction was undertaken not only at Cricklewood, by the parent company, but also by English Electric at Preston, Fairey at Stockport and Rootes at Speke. The modifications to the early models added about 20 MPH to the top speed. Seven hundred assembled by the London Passenger Transport Board were particularly covetted by aircrew, not just because of the plush green leather upholstery that once graced London buses, but because the superior airframe rivetting was reckoned to add to the speed. Speed however could not compensate for the poor ceiling; authoritative figures are contradictory but 17500 ft with a reasonable bomb load is a consensus gleaned from ex-aircrew. In 1943 losses reached such a peak that, like the Stirling, the Halifax was only assigned to less hazardous targets.

The aircraft received a rejuvenation that stemmed paradoxically from the demise of the Stirling. The demand for Hercules engines eased and it was possible to install the units on all production Halifaxes from the Mark 3 onwards. A retractable tailwheel, ventral turret and 5 ft increase in wing span completed the major modifications. The radical redesign transformed the aircraft; it was now noticeably faster than the Lancaster and only lacked about 2000 ft to equal the ceiling. It was the proud boast of

the Halifax aircrew in No 4 Group, residing in Yorkshire, that they could land after a raid before the Lancasters crossed the Lincolnshire coastline. From February 1944 the 2 machines were the mainstays of Bomber Command. The loss rate of the Halifax always remained slightly higher than the Lancaster's, probably caused by the difference in ceilings. A night-fighter climbing into the bomber stream would intercept them first but if the Halifax was the nearer, it was not always the easier target, as was proved in June 1944, when No 4 Group destroyed 33 fighters, an all-time Bomber Command record.

Two thousand and fifty Merlin engined Halifaxes were produced, followed by over 4000 fitted with Hercules power-plants. It also saw service with Coastal and Transport Commands, with the latter, being adapted for paratrooping, freighting and glider towing. Its tremendous power to weight ratio made it the only aircraft capable of towing the giant Hamilcar glider. The only one of the original 3 heavy bombers that fulfilled its duty until the end of the war, it inspired a pride amongst aircrew the more fierce for being under-publicised. Only now is its contribution being recognised, as it is evaluated objectively instead of comparatively.

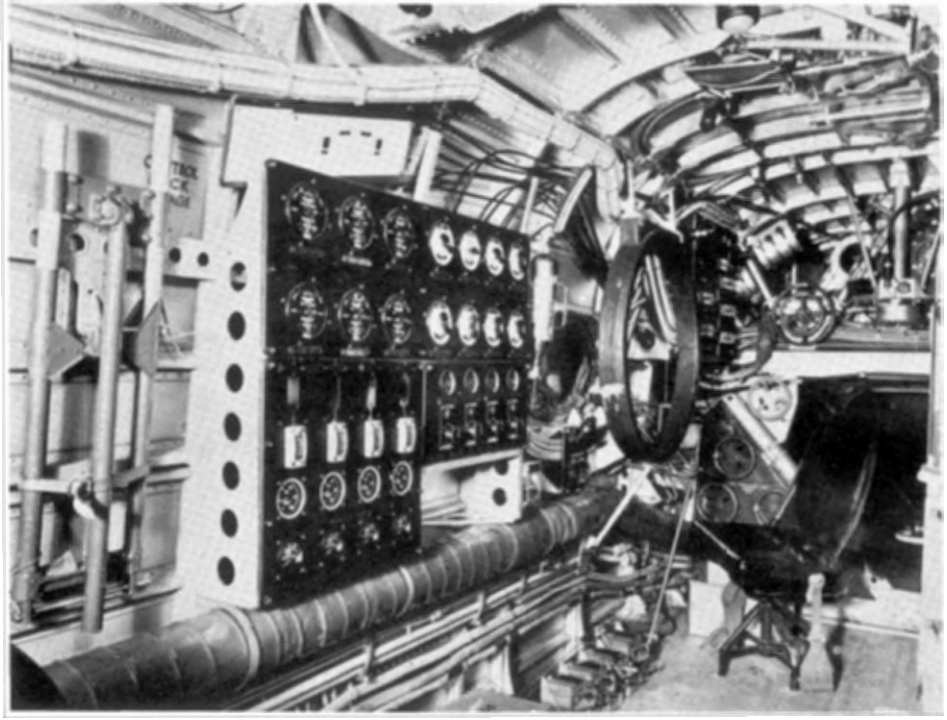
Flight engineers only became involved with the Avro Manchester when it had been withdrawn from active service and relegated to Conversion Unit duties where the similarity of systems made it an ideal preliminary trainer for the Lancaster aircrew. Initially the high powered airframe promised a heavy bomb load without the extra complications of 4 engines. In practice it was severly underpowered and exhibited a positively dangerous single engine performance. An engine failure shortly after take off, even on training aircraft at light weight, was a marginal situation; with a bomb load it was often terminal. Compounding the problem was the poor reliability of the engines. The Rolls-Royce Vulture was a simple concept, 2 V-12 Peregrine engines were built onto a common crankcase, forming an X-section 24 cylinder unit. The supercharger pressure was increased to take advantage of high octane fuel and the result was an instant 2000 HP engine. Unfortunately the Vulture possessed a few bad habits; cylinder blocks lifted from the crankcase, minor combat damage caused complete failures and in-flight fires occurred, apparently of their own volition. Rolls-Royce made great efforts to solve the problems but to little avail and the Manchester's brief bombing career spanned barely 16 months. Avro's only persuaded the RAF to stop flogging this dead horse by finally convincing them that the Lancaster was a thoroughbred successor.

The Stirling, Halifax and Manchester were introduced to service by Nos 7, 35 and 207 Squadrons, respectively; a selection made by reference to history, tradition, length of service and perhaps a little high-level patronage.

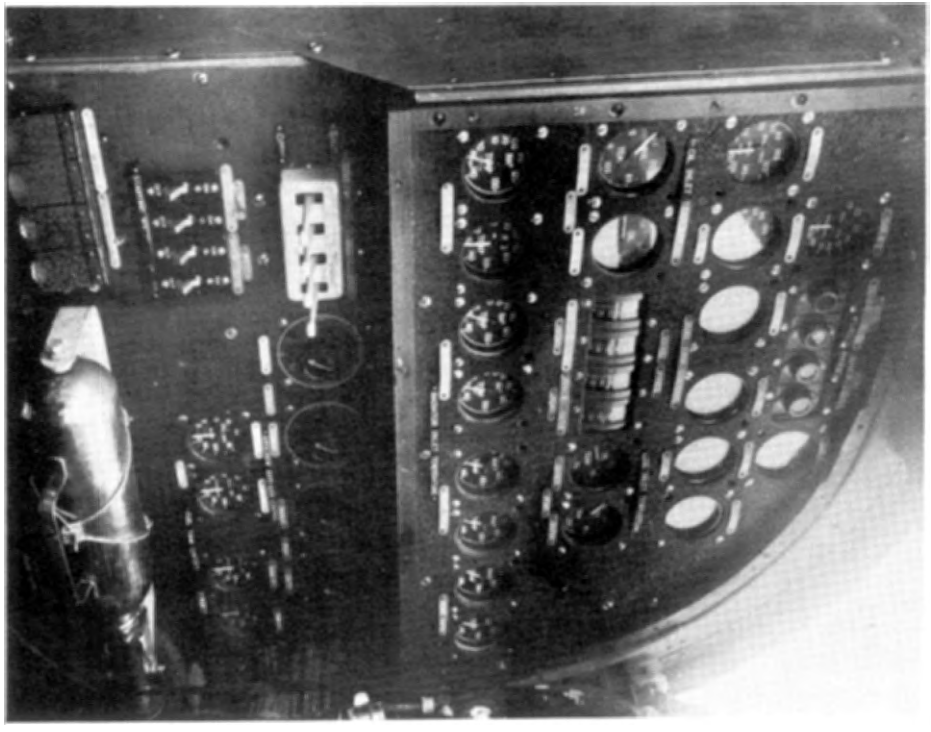
Formed in 1914, No 7 Squadron became a bomber unit in 1923, and in 1927 and 1928 won the Lawrence Minot trophy. A bomb aimer in each of these competitions was the CO, Wing Command Portal who had risen to C in C of Bomber Command at the time of the Stirling's introduction. The largest and potentially most prestigious aircraft therefore went to his old squadron, but trust was placed in a highly professional unit which had collected the Minot Trophy a further 6 times since his departure. The first Stirling was delivered in August 1940 and on the 26 January 1941, the squadron historian wrote:

> "Records informed us that as they were unable to supply flight engineers, we would proceed with the training of ACs, as tentatively arranged beforehand."

Relying on its previous experience, there is little doubt that the squadron established its flight engineers on the same basis as the pre-war fitter-mechanic/air gunners, a rather corrupt association of ideas. Throughout February, March and April, ACs, LACs and



Flight Engineer's panel – Short Stirling



Flight Engineer's panel – Handley-Page Halifax MkII

a solitary Cpl, J R Walker, were the unit's only flight engineers. There is good evidence that these mechanics and fitters became instant sergeants when actually on operations but relinquished the rank with equal rapidity after landing. The dubious honour of being the first flight engineer prisoner-of-war also belongs with the squadron; if LAC Macdonald survived the war his rank, status and backpay must have given problems. The first volunteers under the provisions of AMO A190/41 began to filter into the unit during April. These sergeants, having completed their makers and air gunnery courses, started replacing the original personnel on operations. Firstly the fitters disappeared, but only temporarily, most returning as sergeants a month later. The extra manpower had allowed them time, belatedly, to complete training. Apart from Cpl Walker, all the fitters were LACs who, according to the AMO, had to have exceptional qualifications. Having actually operated as a flight engineer for 3 months was presumably a powerful lever under this clause.

The flight mechanics who remained were placed in an invidious position. There was a loosely worded final section in the AMO that purported to protect their interests but the mysteries of promoting a flight mechanic to sergeant were not detailed. In the Air Ministry however was a man who was to become an outspoken ally of the branch, Wing Commander Costa, T Mech. He had foreseen the problem in March and written the following:

> "Referring to the AMO now in the course of preparation concerning the flight engineer, you will remember that there is a clause protecting the pioneer who has been flying with his squadron pending the issue of the AMO laying down the proper terms of reference for this duty.
>
> I think the clause promises individual consideration to these men and I anticipate that Commands will send forward lists of names once the AMO is published. I happen to know that a number of AC 2s have been employed and actually been on operational flights. Through force of necessity various artifices will have been used to get sergeant's stripes onto the arms of these men from the aspects of possible capture. I do not see how any airmen below the rank of LAC can be given the acting rank of sergeant in his trade. The flight engineer is supposed to be a sergeant in his trade.
>
> In deciding the course of action to be taken concerning these individual cases it may be helpful to suggest that acting flight engineers who are LACs or corporals should be made acting sergeants as flight engineers, but that airmen below the rank of LAC should be made sergeant aircrew* on the consolidated rate of pay applicable, until such time as they reclassify up to LAC in their trade.
>
> May this minute be put onto the proper file in due course."

The Wing Commander had highlighted the problem at an early stage and, although his specific advice was rejected, the essence of his letter was upheld. The majority of the flight mechanics became fitters, almost overnight it would appear from the squadron record book. As fitters, they continued their flying duties, but only for a short period, their names soon disappearing. Probably they too then went on the flight engineers' course, if only the air gunnery element, and then were posted to form the experienced nucleus of another squadron converting to Stirlings. The end of the era came on the 23 June 1941, when the last LAC, Owens, flew his final No 7 Squadron operation to Kiel.

* APPENDIX 4

Whereas the Stirling was inaugurated by No 3 Group, the Halifax came North to the Yorkshire based No 4 Group, initially to No 35 Squadron (Madras Presidency). The aircraft were accepted from Boscombe Down in November 1940 and the squadron returned to Leeming for a month before taking up permanent residence at Linton-on-Ouse. Although the squadron had been a bomber unit for a long period between the wars, it is a matter of conjecture as to why they received the aircraft, for their seniority in the group was below that of No 10 Squadron, then operating Whitleys. It is true that 35 Squadron had been disbanded in April and could therefore by conveniently reformed without re-allocating an existing aircraft but the disbandment had taken place in April, exactly as with No 7 Squadron who were relieved of their aircraft with the express purpose of introducing the Stirling. This parallel suggests a similar selection of No 35 Squadron for the Halifax.

Compared with No 7 Squadron, the lack of flight engineers for the Halifax was rectified in almost cavalier fashion. The Operational Record Book, in an entry for the 7 February 1941, details:

> "It being necessary for an engineer to be included in the aircrew to fly with Halifax aircraft, the following airmen of fitter trade* were specially selected and trained in this Squadron by Sgt S L C Watt (Late observer with A & AEE and awarded the AFM 24/12/40) passed out as flight engineers and promoted sergeant with effect 1 February 1941:
>
> | | | |
> |---|---|---|
> | 568825 | Corporal Aedy | Fitter 2(E) |
> | 569526 | Corporal Ogden | Fitter 2(E) |
> | 567891 | Corporal Wheeler | Fitter 2(E) |
> | 902598 | AC 1 Hill | Fitter 2(E) |
> | 22470 | AC 1 Willingham | Flight Mechanic (E)" |

The Halifax opened its operational career on the night of the 11/12 March, followed by a raid on Hamburg 48 hours later. This was the first 4 engined bomber raid on the German homeland and is perhaps better remembered than the tragic debut 2 nights previously. Five aircraft had bombed Le Havre and were safely back across the Channel when one of our own fighters contacted L 9489. Perhaps the thick veil of secrecy surrounding the Halifax caused the fighter pilot to assume he had found the enemy. The aircraft was shot down in flames at Normandy, Surrey, only the pilot and flight engineer escaping by parachuting to safety. The pilot was uninjured but Sgt Aedy was admitted to Guildford hospital with bullet wounds.

The quality of an Operational Record Book is entirely dependant upon the author. That of No 35 Squadron, with regard to flight engineers, is unfortunately confusing. Errors and omissions cloud the issue. However it can be deduced that there was an influx of flight engineers in April, following the first courses sponsored under AMO A190/41. There is also no reason why the original men should have received any less consideration than their peers on the Stirling.

Although the Manchester did not employ a flight engineer, the history of the inaugurators, No 207 Squadron, does provide one interesting extract. The aircraft was

* In this case 'fitter' is used as a generic term for engine tradesmen, mechanics or fitters. 'Rigger' was similarly used for the airframe trades.

grounded on numerous occasions for engine modifications, an occurrance which became so regular, another Manchester unit gained the nickname 'The 97th Foot'. Following one of these modifications, it was decided by 207 Squadron to carry out a protracted flight test.

> "Three crews will be taken off operations for one week to carry out intensive flying on modified aircraft, serial L 7419. The crews will fly 5 hours each during daylight, starting at 0600. Two corporals, prospective flight engineers, are to fly on alternate trips to advise the captains on the tests required and to record engine performance data. Each trip will include a climb to 17000 feet at +6 boost and 2850 RPM."

If the Rolls-Royce Vultures performed to their usual standard, it is doubtful if either the tests lasted for the whole week, or the corporals retained their enthusiasm for flying.

There was one other 4 engined bomber requiring a flight engineer and in connection with this, 12 sergeant engine fitters, all air-gunner qualified, gathered at RAF Uxbridge one morning in February 1941. In common with the rest, Sgt Owen who had come from No 231 Squadron, equipped with Lysanders, had no idea why he was there. He had previously volunteered, out of boredom, for a parachutist's course; an application that was rejected by his Squadron Commander but with the promise to get him on 'the next decent thing that comes along'. The 12 were told to buy civilian clothes, issued with passports describing the bearers as 'Government Officials' and then formally discharged from the RAF. The next stop was Stranraer, where they joined the troopship SS Orantes bound for Canada. On board ship were pilots and observers who had undergone this same demilitarisation. Their immediate destination was Montreal, where they became employees of the Canadian Pacific Railroad. The CPR at this time controlled the eastern end of the Atlantic Ferry, the organisation which pioneered the bold concept of flying, rather than shipping, Canadian and American built aircraft to Britain. Savings accrued in shipping space, dismantling and assembly operations but more importantly, time. A Hudson that would take 3 months to reach Britain from California by sea, could now be delivered in as many days.

At that time, America painstakingly preserved the letter, but certainly not the spirit, of neutrality. Aircraft were flown to the Canadian border by civilian pilots and landed on American soil. For the actual border crossing they were towed by horses, then flown on to Montreal to join the Ferry. Ken Owen and the other 'Government Officials' bided their time teaching ferry crews to operate Hudsons and Canadian built Handley Page Hampdens at Montreal's St Hubert airfield.

In April the Anglo-American Lease-Lend Act was passed and lip service to non-alignment was discarded. The real purpose of the Trans-Atlantic journey was now discovered as the men were sent by train to Seattle, the home of the Boeing Aircraft Corporation. The objective was to form an RAF training nucleus with Ken Owen and the other fitter/air gunners as the flight engineering element. When qualified, Ken left Seattle as engineer on one of the last Fortress 1 s delivered to the RAF. The machines flew directly from Newfoundland to Prestwick and upon landing the crews were swiftly inducted back into the Air Force.

The record of the Fortress 1 in Bomber Command was poor to an extreme. Designed to carry a bomb load to the then incredible altitude of 30,000 ft, it was completely under-developed for a modern war in the European theatre. The heart of the concept, the engine's turbo-chargers (exhaust driven superchargers which became more efficient as the altitude increased), were notoriously unreliable. No power-operated turrets were fitted and the tail was completely unprotected. In the chill of the

Sgt Ken Owen at Montreal prior to the signing of the Lease-Lend Act

One of the original Boeing Fortresses used by No 90 Squadron

upper atmosphere, everything froze, including windscreens, guns and crews. Only one Fortress bomber squadron ever formed, No. 90. The blame for this fiasco certainly does not lie with the manufacturers who categorically stated that these early machines were only fit for training. All the defects were remedied on later models, but by that time America required the aircraft for its own use.

Sgt Owen had been converted to flight engineer by Boeing, not the RAF, and initial attempts were made to return him to his previous trade. He was posted, however, to No 90 Squadron and continued flying. In common with many other qualified air gunners who converted to flight engineer, the actual date of remustering is unknown.

All of these early flight engineers were in an unenviable position, lacking any precedent or terms of reference, a condition bordering on professional illegitimacy. They bought time while the administrative and training machinery caught up with the situation. It is perhaps fitting that the least publicised aircrew branch was first represented by 3 LACs.

CHAPTER 3

When Sgt Berry volunteered for flight engineer duties under the provisions of AMO A190/41, there was little change in his circumstances. Already a qualified air gunner and substantive sergeant, his employment was as a flying fitter on Catalinas. Formal Catalina training during the period was carried out at the US Naval base at Pensacola, and this was only for pilots, so the remustering was reduced to a paperwork exercise on the 14 April 1941. Sgt Dave Nelson presents a more typical case of an early Bomber Command flight engineer. Following acceptance of his application, he was posted from Kinloss to No 7 Bombing and Gunnery School at Stormy Down in South Wales for the air gunners course.

Bombing and Gunnery Schools held a reputation for firm discipline and hard physical exercise and were considered as places to be avoided by as wide a margin as possible. The reason for the strict regime was to reinforce the basic service training of air gunners, the majority of whom had only recently joined the RAF. Flight engineer trainees were mainly corporals and sergeants and some took exception to this treatment. Friction reached such a stage that on one occasion a formal complaint about their attitude was made to the Air Ministry. The majority however realised that as volunteers they had effectively mortgaged their status for a limited period and being experienced service-men knew that fighting the system could result in infinitely more grief than simply accepting it.

At the end of the 3 week course they were allocated an aircraft type and squadron. Dave Nelson would, after the makers course, join No 76, the second Halifax unit to form. Throughout the war years type selection was entirely concerned with filling vacancies, as and when they appeared. No attempt was made to match the aptitude of the man to a particular aircraft. The whole procedure was so arbitrary that later, at St Athan, it began to assume comical overtones. The reason for receiving squadron postings before the specialist training commenced was presumably for administrative reasons, so that the men had nominal parent units whilst detached to the civilian firms.

The Halifax engineers, including Sgt Nelson, went to Rolls-Royce at Derby for a week, studying the Merlin X. This was followed by a fortnight at the Cricklewood factory of Handley Page, greatly appreciated because of the accessability of the London social scene. Dave then went north, to Linton-on-Ouse where the squadron was forming up.

Flight engineers on the Halifax initially held responsibilities at 3 positions on the aircraft. The main station was directly behind the first pilot's seat, the fuel gauges and engine instruments (excepting the RPM and boost indicators which were on the pilot's centre console) being set on the rear bulkhead of this position. The master engine fuel cocks were mounted on the low bulkhead which extended between the first pilot and the engineer. The second position was rearwards, through an armoured door (this was deleted on later models), at the wing spars. Here were mounted the fuel cocks, including those for the 14 individual tanks. They caused problems in service, being exactly the same size and shape, and extremely closely set. To add another dimension for error, they were placed in an unlighted position underneath the crew rest bunks. When a tank became empty and the engine being fed cut-out, the engineer would disconnect from intercom in the cockpit and move aft to the cocks. Deaf to the rest of the crew and blind in the darkness, he would close the cock of the empty tank (failure to do this resulted in the engine drawing air into the system in preference to fuel) and then open the cock of the next tank to be used. A mistake in the procedure could result, not only in the engine failing to restart, but also in the adjacent power-plant being reduced to the same condition. Moreover, until he returned to the cockpit and reconnected to intercom, he might not be aware of the mistake. Damage to the complicated system was another drawback. Sgt Bill Wickson came aft one night to find that a flak shell had exploded amongst the levers; a situation requiring a fair amount of knowledge of the system, and a great

amount of butchery in the dark, to regain some measure of control before the engines starved. In August 1942, the Air Ministry suggested moving the cocks forward to the engineer's panel, yet despite the other major modifications, this ergonomic nightmare was never altered.

The engineer's third area of responsibility was even further aft, manning the 2 beam guns during combat. These were deleted on later aircraft and it is believed the engineer took the dorsal turret until co-pilots were removed in 1942.

By contrast, the Stirling was well laid out, the panel neatly set on the starboard fuselage wall behind the co-pilot, with various mechanical controls placed along the front of the main spar within easy reach. The technology was redolent of a ship's engine-room, with oversize levers and large handwheels. However the size and comfortable spacing of the controls reduced both operating errors and the effects of battle damage. As with the Halifax, the engineer's gunnery responsibility was initially at the beam guns and later probably the dorsal turret.

Two amendments* to the original AMO were published during May 1941; the engineer was now entitled to wear a flying badge; that of the air gunner,† and it was categorically stated that no upper age limit was set for applicants, instead of being implied by omission. Generally the year slumped into a period of frustration and stagnation for the bomber force. The plan to put 4000 heavy bombers into service was scrapped, the actual number on the squadrons by spring 1942, was only 69. Within the branch accidents and incidents occurred which reflected badly on professionalism, and training; the electrically operated retractable tailwheel assembly on a Stirling failed to work automatically and was manually wound from the extended to retracted position, just before landing by an engineer who thought he was accomplishing the reverse. Another aircraft landed with the complete undercarriage retracted because the indications had been misread. The RAF became suspicious about the quality of instruction on the maker's courses and for a time shifted contracts around the various contractors and sub-contractors. For their part, the airframe manufacturers strongly rejected criticism of their training, although they did concede that problems existed on the practical side. An assembly shop, with aircraft in various stages of construction, was not as ideal a place to glean information as it ostensibly appeared. The production lines were on a war footing, crowded with workers and functioning around the clock; extraneous people could not wander around without affecting work. Completed aircraft could not be used; they were test flown and delivered to the squadrons as soon as they emerged from the factory. One Stirling released its first bombs over Germany less than 12 hours after the last nut and bolt was tightened.

That the standards of other aircrew branches were equally suspect, although no panacea to the engineer's problems, maintains them in perspective. Bomber Command was certainly not disillusioned about the employment of flight engineers, merely the unsatisfactory aspects of training and the attitudes thereby engendered. In December 1941, drawing on the experience of the last year, the Command approached the Under Secretary of State at the Air Ministry with the draft of a proposed RAF training course for flight engineers:

* APPENDICES 5 & 6

† Chapter 5 contains the explanation of this action

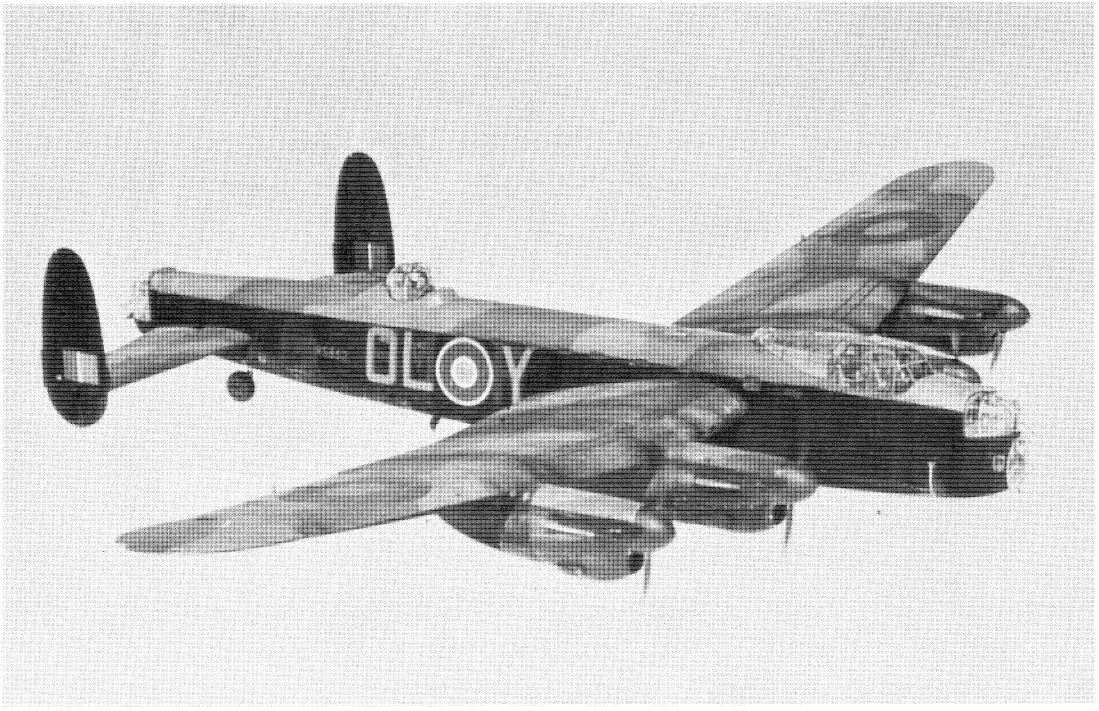
"It is increasingly evident that the flight engineer's position is as important as any other and it is essential that he cease to be considered, or consider himself, as an extravagance, or even unnecessary. He is not at the moment playing a large enough part in the operation of the aircraft, consequently extra burdens are placed on the captains and second pilots of our 4 engined bombers. It is suggested that training is re-organised along the lines shown in the appendix* to this letter".

The letter appears to have been ignored and as the attrocious winter deepened it was matched by the fortunes and morale of the bomber force generally. The aircraft loss rate forced the abandonment of daylight operations and the optimism surrounding the initial claims of night bombing accuracy was shattered by the Butt Report, which essentially stated that only one bomb in 3 was falling within 5 miles of the target. In order to emerge from this slough, Bomber Command required to undergo virtually a complete renaissance.

In material terms, hopes were pinned on the Avro Lancaster, which was proving to be in a class of its own when compared to the Stirling and existing models of Halifax. There was also the new radio bombing aid, 'Gee', which it was envisaged would have an effective life of 6 months before discovery and jamming by the enemy. From November 1941 until the spring, bombers were carefully conserved in order to make optimum use of the limited period.

Of far greater importance than these new tools however was the personality who would rebuild the morale of the Command. The constant redirection of effort between docks, ships, oil, transportation and industry, and the erosion of the force as experienced crews were posted to Coastal Command and the Middle East, gave those remaining the impression of indecision, impermanence and inferiority. To eradicate these negative attitudes required a leader who not only believed wholeheartedly in the bomber force but was also prepared to defend his views and his men against any detractor. It was a typically inspired choice by the Chief of the Air Staff, ACM Portal, when, on the 28 February 1942, ACM Arthur Harris was appointed as C in C of Bomber Command.

* APPENDIX 7



Avro Lancaster

CHAPTER 4

In Bomber Command, Arthur Harris inherited an organisation which had been blatantly robbed of skilled crews for the Middle East and Coastal Command, and pilloried for inefficiency. The effect on general morale was internally eroding a force which had enough trouble fighting the external opponents seeking its disbandment. The talents of Harris fitted the requirements of this situation with an exactness which was almost uncanny. The unequivocable support he gave to his Command and men was facilitated by his decisiveness and lucid, compelling oratory and writing. The crews respected and admired the powerful protection of their interests, and the earthy vocabulary and vindictive humour identified him closer with his men than would the stereotyped station visits that he rarely carried out. Certain historians attempt to make disparaging capital out of this point, succeeding only in insulting the intelligence of the crews, and Harris' assessment of them. The worth of leadership, not showmanship, was universally recognised. After a year of being incessantly sniped at by the other services and Commands, it was refreshing to have a man at the top who publicly stated:

"The army will never understand the value of tanks, until they eat hay – and shit."

The men regained their identity as members of what would become the most powerful force in history; the days of being the RAF's pool of trained reserves, who occasionally delivered a few bombs to Germany, were finished.

The revitalisation of the Command was steady, not spectacular, thus the revised terms of reference for the flight engineer, which appeared as AMO A262/42* on the 19 March 1942, were in fact a legacy of the previous administration. There was no great change in direction, nevertheless the detail amendments give some insight into the period.

Engineering officers could no longer hold back their top class fitters, men like Corporal Pederson who was considered too valuable to lose when he first volunteered in 1941. Highly skilled and professional, all of the early engineers provided the foundation stones upon which the later expansion of the branch was to have such a solid base. LAC engine mechanics were added to the sources of recruitment, suggesting that demand was expected to outstrip the numbers of suitable fitters. Flight engineers were no longer remustered to aircrew permanently, but expected at some stage to return to their basic trade. Finally, there is a reference to an Initial Training Wing (ITW). The establishment of large numbers of these ITWs was one facet of the build-up of effective large-scale aircrew training. Situated in requisitioned hotels at sea-side resorts such as Blackpool, Torquay and Newquay, they taught the information required by all aircrew branches, such as Morse, aircraft recognition and first-aid.

In the spring of 1942 Air Marshal Garrod, the Air Member for Training, proposed and carried a drastic revision to aircrew training and utilisation, which was still having repercussions over 10 years later. The basic provision of what came to be known as the 'New Deal' was that Bomber Command should henceforth dispense with the co-pilot. Halving the number of bomber pilots required, allowed longer training courses, which in turn increased the effectiveness of the captains. The idea probably originated from Air Vice Marshall McNeece-Foster, commanding No 6 Group, who had already noted formally the under-utilisation of co-pilots. To compensate for the loss, the flight engineer's sphere of responsibility was expanded to cover this area. It was not an immediately popular move; the pilots were unhappy about the loss of their right hand men, even the unorthodox Harris had qualms about this one, and specified the fitment of an auto-pilot to all heavy bombers along with the introduction of a revised training scheme for the flight engineer. In retrospect, the change was a sound move, not merely

* APPENDIX 8

an expediency; the concept of one pilot and a flight engineer in the cockpit outlasted the war and pilot shortages, and was the planned arrangement for the V-bombers on their introduction in 1954.*

The change-over took almost a year to implement fully on existing aircraft but was actioned straight away on the Avro Lancaster, which was just entering service in numbers. The conversion of the Manchester airframe to accept 4 Merlin engines, has been well documented but the fact that the Air Ministry refused to fund the project, telling Avro's to 'dig for it', has caused many literary recriminations. The more informed support their argument by using the Halifax as a precedent. Contrary to adding weight to the condemnation, this parallel proves the sense of the Ministry's stance. The Halifax had been modified at the drawing board stage yet, at this period it was underpowered, had a poor ceiling and displayed some decidely unpleasant handling characteristics. What mediocrity would result when Roy Chadwick performed the same modification to the existing Manchester and, more importantly, how many irreplaceable Merlin engines would be redirected to power it?

Fortunately the company had the faith to take up the project as a private venture. Defying the logical prognosis, the Lancster proved to be a winner from the start. A good ceiling, range and reasonable speed were accompanied by the ability to carry a prodigious bomb load. The cavernous bomb bay only needed slight modification to carry the 10 ton 'Grand Slam' bomb and the airframe was rugged enought to cope with the gross abuse this overload entailed. The resiliance of the airframe, which could absorb a remarkable amount of battle damage, emanated from the tremendously strong intersection of the wing spars with the heavy gauge bomb bay roof. Systems were basic, reliable and combat tested in the Manchester. † The fuel system, with only 3 tanks in each wing and a logical plumbing arrangement, was a distinct advance, in most ways, over the Halifax.

This aircraft, which is perhaps more closely associated with the flight engineer than any other would, but for Garrods 'New Deal', never have carried one. The cockpit lay-out, again largely inherited from the Manchester, had the majority of primary instruments and controls accessible to both the pilot and co-pilot. Secondary engine instruments and the fuel system gauges and controls were at a separate panel on the starboard fuselage wall behind the co-pilot's seat, positioned to be monitored by the observer. With the demise of the co-pilot, the engineer took over the right hand seat ‡ and also the systems panel. The first Lancaster engineers were trained under the existing scheme. Sergeant Tom Clarkson completed the 3 week air gunnery course at Walney Island, Barrow-in-Furness, in May 1942, spent a fortnight at Avro's, a similar period with Rolls-Royce and after a short holding period, joined No 49 Squadron.

Along with the recognition that the content of the makers' courses was insufficient for the increased commitment, there was the extra factor of the numbers reaching saturation level; indeed, by early 1942, some Merlin instruction for flight engineers had been taken over the by the RAF's No 4 School of Technical Training at St Athan in

* Refer to Chapter 9

† There was nothing wrong with the Manchester systems – just the engines!

‡ The 'right hand seat' of a Lancaster was dismountable and folded down from the starboard fuselage wall for use. When assembled it blocked entry to the forward section of the nose and as very few wartime Lancasters had dual controls fitted, most engineers preferred to leave it stowed. This practice also allowed easier and quicker access to the systems panel.

Short Stirling

Handley-Page Halifax

South Wales, a logical venue as the School trained all of the Service's engine tradesmen. In April 1942, the shape of the proposed RAF training course was finalised. Technical Training Command produced the draft of a 6 week syllabus, the content of which was enthusiastically received by both the Air Ministry and Bomber Command, although the latter was experiencing a dire shortage of engineers and wanted to cut the duration to 4 weeks. Because qualification in the engine trade was still the baseline of flight engineering, it was decided that 4 S of TT would host the entire course.

An Air Ministry internal memorandum details the planning for the initial courses at St Athan, and how, by cutting the length of the first 4 intakes, a compromise was reached to provide Bomber Command's urgent requirements.

> " ..... arrangements to date have been made for the following fitter 2(E) intakes for training at St Athan.
>
> | | | |
> |---|---|---|
> | 30 May 42 | 3 weeks | 100 men (including No 10 AGS output 30 May) |
> | 3 Jun 42 | 3 weeks | 100 men |
> | 13 Jun 42 | 4 weeks | 100 men |
> | 20 Jun 42 | 5 weeks | 100 men |
> | 27 Jun 42 | 6 weeks | 100 men |
>
> The last 3 to include No 10 AGS output, less Coastal Command urgent requirements. Courses thereafter will be of 6 weeks duration."

Initially the training at St Athan was entirely involved with the specific aircraft onto which the engineer would be posted. Engine operation and fuel system handling were the main priorities, secondary systems such as hydraulics and electrics being downgraded because of their basic simplicity and the limited timeframe. Throughout the war, actual flying never appeared in the training, not solely because of the lack of facilities, but also the attitude that Technical Training Command could not transgress into what was considered the province of conversion units.

Having been established to fulfill a Bomber Command requirement, the School was initially geared up to teach only the Stirling, Halifax and Lancaster, explaining Coastal Command's intention to withdraw its men after the gunnery course and carry out type training elsewhere, either at the maker's or on one of its Operational Training Units (OTUs). In fact, although the scale of the problem was much smaller, Coastal's expansion and consequent manpower problems paralleled the situation within Bomber Command. Apart from the build up in Sunderlands and Catalinas, the Fortress 1s had been inherited from No 90 Squadron and the Consolidated Liberator was arriving in numbers. Once the requirement was realised by St Athan, it demonstrated an immediate willingness to instruct engineers for any aircraft in either Command. So speedily was this policy implemented that 6 men from No 2 Entry were trained on Catalinas; one of them was Cpl Pederson.

The inaugural course at No 4 S of TT, which started on the 30 May 1942, consisted of only 60 men, compared with the projected figure of 100. It would appear the shortfall resulted from a hold up at the Gunnery School, for the numbers on the second course increased to 137. These delays at the Gunnery School became prevalent in the face of rapid expansion in all aircrew branches. From this time, until it was dropped in 1943, engineer's gunnery training did not necessarily precede the professional course, but was programmed at either end dependent on vacancies.

Sgt Pederson commenced training on Lancasters with No 2 Course but after a week was re-allocated to Catalinas because of his previous experience with the Pratt and

Whitney engines. Together with the other 5 who had been similarly transferred, he was detached to a maintenance unit at Gourock in Scotland; nobody at St Athan yet held the requisite knowledge to instruct on the aircraft. Information gained by being conducted around aircraft in various states of repair, and disrepair, was hastily scribbled down to be re-written in 'fair copy' during the evenings. On return to St Athan, these notes were collected by the Staff, not only to prepare a training syllabus for future intakes, but also to form an end of course examination, which the 6 were dutifully made to sit!

The selection procedure for the various aircraft was completed upon arrival at St Athan. The School was given the numbers required for each type, they in turn fitted names into the slots. In the early days it was standard practice to ask; "Who wants Halifaxes, who wants Lancasters, etc." in an attempt to give a choice, as far as was possible within the rigid numbers. Later, as the differing loss rates made certain aircraft rather less desirable, selection reverted to an entirely random system. The men were paraded outside a hangar and subjected to such banal questions as; "Who's got a 7 in his personal number?", "Who's got a hole in his sock?" The number of '7s' who replied might roughly tally with, say Lancaster quotas. If it was a good day for socks, the minimal numbers might be right for one of the more exotic aircraft, such as Sunderlands or Fortresses; a bad day, and the numbers might be right for Halifaxes. Another method involved forming up in a hollow square with the instructor at the centre. He would call the best postings first; "Three for Catalinas!" Those who wanted one of these slots, ran to the instructor. The first 3 to arrive gained them. This continued until the slowest men were left with the last aircraft, usually the Stirling which was being lost in large numbers. The first truly mechanised war still produced situations where physical fitness significantly affected the chances of survival.

An indication of the rapidly escalating requirement for engineers during the first half of 1942, is shown by 4 orders that were published in quick succession between April and July. The first, AMO A431/42,* required nominal rolls of all engine fitters, sub-divided to show suitability for flight engineer duties, to be passed to the Records section. The second, AMO A654/42,† extended this survey to include engine mechanics. AMO A681/42, published on the 9 July, opened recruitment to airframe tradesmen, both fitters and mechanics, whilst the last of this series, AMO A707/42,‡ allowed the conversion of flight mechanics to fitters directly after initial training, provided they were using the qualification as a stepping stone towards becoming a flight engineer.

This last AMO was responsible for introducing the first direct entrants into the branch, albeit by a tortuous route. The recruit would train as a flight mechanic, continue directly with a fitter's course and then move on to type training as a flight engineer. Although direct entry recruiting was not formally introduced until 1943, the induction of civilians before this date was no subterfuge, figuring favourably in Air Ministry memoranda and accepted to the extent that DEs completed the aircrew ITW course even before commencing flight mechanic training. Ken Saxby joined the Air Force in March 1942 and as soon as his background of being a skilled worker in an aircraft factory emerged, he was redirected into the flight engineer training machinery. Having completed 3 weeks at the Aircrew Reception Centre (ACRC) in Regents Park and 5 weeks at the Torquay ITW, he arrived at St Athan in August for a total of 24 weeks professional training. This equates to a 3 month flight mechanic course followed

* APPENDIX 9

† APPENDIX 10

‡ APPENDIX 11

by 6 weeks fitter conversion then an equal period of type training. The mass influx of DEs in 1943 brought about a drastic revision of the course design, yet this 24 week training period remained firmly established.

The purpose of AMO A746/42,* promulgated in July, was twofold. Firstly it was a directive, specifically authorising the establishment of the navigator branch and the demise of the observer. Secondly it was informative, outlining the effects of the 'New Deal' on the total aircrew structure, particularly those occasioned on multi-crew aircraft by the reduction to a single pilot. In an attempt to circumvent the lack of duplication, basic flying skills were added to the flight engineer's job specification and he became a quasi-co-pilot or 'Pilot's Assistant'. For those aircraft which did not carry an engineer, the venerable Wellington and a few other elderly twin engined machines, the air bomber was nominated for the duty. In practice, the basic idea was found to be unworkable on the Halifax, forcing the introduction of a bastardised system. The Halifax was unusual in having the important master fuel cocks, the sole means of isolating fuel from a burning engine, on the rear face of a half-bulkhead behind the pilot's seat. It was impossible to reach the cocks from the captain's position and not much easier for the co-pilot, therefore the engineer required to be at his panel during critical phases of flight. The remainder of the time, he needed the flexibility to leave the flight deck in order to operate the fuel system, as the numerous small tanks ran dry at regular intervals. As neither of these factors was compatible with the concept of a pilot's assistant, the air bomber was co-opted.

A month after the issue of this general order, details specific to the flight engineer appeared in AMO A978/42.† There are significant amendments to the structure of the branch, the relevance and interpretation of which require correlation with the preceding major AMOs, A190/41 and A262/42. The initial paragraph stating: "Flight engineers now form a separate aircrew category .....", appears to have been construed by most historians as formal establishment of a new flying branch. Certainly the majority attribute the origination of the flight engineer to the 'New Deal', under the misconception that it was a straight exchange for the co-pilot. The correct interpretation is the total divorce of the branch from a ground trade. Professionally, the association had already decayed significantly as the gulf between the 2 became evident and despite the engine-fitter recruitment baseline, the only true remaining links were pay and promotion. Commissioning in the branch, a source of controversy in the past, was introduced. Opposition had been strong and based on the fallacy of flight engineering being a minor, if interesting, diversification from the real job of a fitter: if the men wanted commissions, then it should be back on the ground, as engineering officers. Indeed, up to now flight engineers had been responsible to their squadron engineering officers. The concurrent dissolution of groundcrew links and the introduction of a commissioned flying element, completely and finally closed the issue. The field of recruitment was also enlarged, with all flight mechanics (E) and (A) becoming eligible, not merely LACs, and the eyesight standard applied by AMO A707/42 was slightly relaxed. Presumably the stringency had resulted in rejection of a large number of otherwise suitable candidates.

Flight engineer training quickly supplanted all other instruction at St Athan. Type training was augmented by the various preliminary courses, giving airframe fitters a knowledge of engines, converting flight mechanics to fitters and starting from basics with the DEs. By September the task had grown to the stage where other trainees were a rare minority. In this month the branch finally received its due recognition, with the award of the 'E' flying badge.

* APPENDIX 12

† APPENDIX 13

CHAPTER 5

"An aircrew badge should be struck for the flight engineer." These words conclude an Air Ministry letter dated as early as the 10 December 1940. The author was Wing Commander Costa (T. Mech), who later spearheaded the case for special treatment of the pioneers on Nos 7 and 35 Squadrons. Nearly 2 years passed before the idea became a reality, an inordinately protracted period especially when set against the 4 months for the air bomber, and less than 2 in the case of the navigator.

When the inertia which had held back the establishment of the branch was gradually being overcome in the opening months of 1941, inter-departmental minutes in the Ministry sometimes touched upon the badge question:

> "Since these men are being given a course of instruction and employed on full-time aircrew duties or offensive duties, the question will arise sooner or later, whether they shall be allowed to wear some form of badge."

and, following a preliminary meeting to discuss publication of an AMO:

> "This raises the minor (sic) point of whether flight engineers can put up the air gunners badge. No doubt enquiries will be made regarding this, and if it is in the intention they should be allowed to wear the badge, it would be as well to include a reference to this in the order."

The first solid recommendation for an individual badge resulted from the 12 February conference, 'To discuss the qualifications of tradesmen to be employed as flight engineers in heavy bombers and flying boats.' The decisions of this conference formed the framework around which AMO A190 was formulated. The conclusion regarding the badge is recorded thus:

> "The question of whether or not the flight engineer should be qualified to wear the air gunners badge was discussed. It was agreed that he was entitled to do so, but that it would be more appropriate if the letters 'FE' were substituted for 'AG'. The covering authority of DPS will be necessary."

At the end of February, the first draft of AMO A190/41 was produced for the appraisal of, and if needed amendment by, the various interested departments of the Ministry. Two aspects differ from the published version; postings were the responsibility of another authority and there was an additional paragraph, originally number 9:

> "9. Flight engineers will be entitled to wear a flying badge which will be similar to that worn by air gunners except that the letters 'FE' will be substituted for 'AG'."

S.10 disagreed with the postings authority, so this was amended and the final draft placed in the file, in order to go through the formality of a last round of the Ministry. It reached the desk of the DPS.

Not only had it been omitted to gain his authority for the badge, but this was also the first time he had seen the file since before the 12 February meeting. His rejection of the badge was possibly tinged with the antagonism of being bypassed:

> "1. The question of the badge for flight engineers, which was discussed at the meeting on 12.2.41, was not referred to this directorate until it came to light at M (minute) 50.
>
> 2. In para. 9 of the draft AMO at 50A, it is wrongly described in the first place as a flying badge, which is not a generic term but one used to describe the badge

worn by pilots.

3. In the second place it is undesirable to deface or disfigure the design of the present air gunners badge by changing the letters 'AG' to 'FE'. The air gunners badge is highly prized and is now well known and respected and we do not want to have imitations of it which might tend to detract from its value.

4. I can see no objections to flight engineers being awarded the air gunners badge. They qualify for air gunnery at a B & G school and presumably do as much in the way of gunnery training as the air gunner and WO/AG. T. Arm. could be asked to confirm this.

5. The solution to my mind is to extend the award of the air gunners badge to flight engineers who are fully qualified as such, including satisfactory passing out from a B & G school course, and I am prepared to agree to the use of the 'AG' badge in this manner.

6. If these views are accepted, it will be necessary to amend AMO A552/39."

S.10 provided the placatory reply:

"A draft order as at 50A was circulated to Directorate and all concerned, but as DPS copy was returned by P3 without comment, you may not have seen it. You are concerned with para. 9 and if, as we gather, you are likely to have objections to the arrangements, entailing further discussion, we suggest deletion of the para. for present, an amending order can be issued when a decision is reached. Will you please return file soonest, as issue of the order is overdue."

Wing Commander Costa loosed off one parting shot:

"Although the flight engineer may be qualified for the air gunner's badge, I consider this badge inappropriate as it applies to what amounts to a sideline, leaving his main duties undisclosed. The duties of the flight engineer are much more analogous to those of the air observer than the air gunner. As any aircrew badge is bound to include a wing or wings, whatever is designed for the flight engineer is almost bound to be open to the charge of defacing the air gunner's badge, but by the same reckoning the air gunner's badge is a defacement of the still more highly prized pilot's badge."

The decision, however was made and not about to be reversed. AMO A190 appeared without any mention of a badge, as suggested by S.10, and the amendment authorising the award of the air gunner's badge was promulgated on the 1 May 1941.

Although protection of the air gunner's badge was the claimed motivation for rejection of the flight engineer's, there is reasonable cause for doubt of such altruism. Engineers might do a gunnery course, and hence be entitled to the 'AG' badge, but this was only a peripheral aspect of their employment and not comparable to the utilisation, at least at this period, of the wireless operator/air gunner. The intrinsic devaluation of the badge by its inappropriate use was certainly greater than any which might have occurred from its modification. The credibility of the original argument was further weakened when, only 3 months later, alteration of the observer's badge was authorised to suit the new specialisation of radio observer. It would be hard to envisage a better parallel than substituting 'RO' for 'O' and 'FE' for 'AG', yet points concerning disfigurement, defacement, imitation and detraction from value of a badge that dated from the First World War, as opposed to 1939, were either discounted or, perhaps, not even raised.

The misuse of the 'AG' badge caused one immediate problem. Whereas air gunners received their badge and promotion at the completion of gunnery training, engineers had to wait until they finished the makers' courses. This irregularity met with objection from some quarters and a suggestion was made to reverse the syllabus. Makers' courses however were at a premium and, as someone with a wider grasp of the issue pointed out, it was pointless to waste this valuable training on men who might subsequently be found unsuitable for such a simple reason as airsickness. Wing Commander Costa, cognisant of the root of this problem, considered it an appropriate opportunity to raise it again with the DPS. On the 26 September 1941 he wrote:

> "On the subject of the award of the badge, the difficulties encountered would have been avoided had the flight engineer been given a badge of his own and not the inappropriate air gunner's badge. The flight engineer has claims to be considered the next most important of aircrew after the pilot, in fact on some types, he actually operates the engine controls. The performance and range of the aeroplane depend upon him. Furthermore, as a sergeant in his trade, he may be expected to be of longer service than other members of the crew. This being so, he is certainly more entitled to a distinctive badge than the observer radio, for instance, who has been awarded a badge of his own fairly recently, certainly since the flight engineer's badge was turned down. It is suggested that the objection to multiplicity of badges, as well as a number of minor difficulties, might be avoided by having one badge for all members of an aircrew, with the exception of the pilot."

The mention of the radio observer's badge perhaps touched on a raw nerve; certainly, as far as 1941 was concerned, the correspondence was now closed.

On the 3 February 1942, another Air Ministry conference was held, this time to discuss the revision of the flight engineer's terms of reference. Coastal Command's representative was Squadron Leader Young, Bomber Command's, Group Captains Warmsley (sic) and Williamson-Jones. Additionally, the meeting attracted 3 wing commanders, 5 more group captains and the Director of Technical Training in person, Air Commodore Gordon Dean. Apart from the amendments already discussed, there was a concensus of opinion that large scale recruitment of direct entrants was undesirable. The case for an individual badge then came on the agenda.

> "It was strongly recommended that a special badge be introduced for flight engineers, the new badge to be similar in design to the air gunner's, but with the letters 'FE' in substitution for 'AG'. DDPS 3 undertook to reopen this question and S.10 will initiate action."

There are only 3 remaining pieces of information, relevant to the badge, documenting the translation of the conclusions of the meeting into AMO A262/42. The first is the draft order, which has the bottom right hand corner destroyed, effectively removing any reference to the type of badge. Second is A262/42 as issued, also intriguing in that paragraph 9 carries the award of the air gunner's badge but scrutiny of paragraph 13 reveals a reference to 'the flight engineer's badge'. The obvious deduction is that the AMO initially contained the award of a new badge which was then removed at a late stage, so late in fact, that the second, minor, reference was missed. This explanation however does not seem compatible with the last piece of documentary evidence. On the 9 March, 10 days before publication of the AMO, S.10 wrote to DDM:

"We will initiate action as regards the badge question*, para. 16 of note, in the meantime the order provides for the award of the normal air gunner's badge."

It is fairly certain that the representatives from Coastal and Bomber Commands were fully in agreement with the recommendation for the 'FE' badge, reflecting the policy of their headquarters in so doing. The apparently arbitrary rejection of the badge, for the second time, resulted in a backlash. Coastal's reaction is uncertain but within Bomber Command the AMO was deliberately contravened, not just by individuals or even squadrons but at group level and perhaps even higher. Sergeant Clarkson, on joining No 49 Squadron in July 1942, was not just given sanction, but ordered to unpick the lettering in his air gunner's badge and sew in 'FE'. No 49 Squadron formed part of 5 Group, which occasionally tended to be a law unto itself. However this widespread practice is known to have extended north to the Halifax squadrons of 4 Group. It is not suggested that Bomber Command's new C in C was directly responsible, but the deep and public contempt in which Harris held the Ministry was hardly conducive to inhibiting this particular breach of regulations.

In July 1942, the demise of the observer was announced, destroying any further pretence of one branch having a monopoly over crewman's duties. The early air gunners were necessary and tolerated but not accepted on an equal footing. Even when all aircrew were placed on full-time flying duties in 1939, the air gunners' terms of reference were carefully phrased to imply that their status equated only to tht of pre-probationary observers. In May 1940, the pilot and observer of a Fairey Battle, Flying Officer Garland and Sergeant Gray, were awarded posthumous VCs following an attack on a canal bridge during which their aircraft was destroyed. The Battle however carried a crew of 3 and it is reasonable to assume that LAC Reynolds, the air gunner, had undergone the same ordeal. The lowest award for gallantry, a Mention In Dispatches, could also be given posthumously, yet Reynolds did not rate apparently for even this minor recognition. From late 1941, the situation began to change. The operation of large aircraft was proving that their effectiveness and survival was dependent on the professionalism of every single crew member. Any one might become a weak link causing the chain to break, commonsense therefore dictated that all were of the same importance.

The introduction of Garrod's 'New Deal' in 1942 may have contained a large element of expediency but in seeking to maintain total crew quality, this concept of professional specialisation quite naturally came to the fore. Each crew member held a defined sphere of responsibility, limited in size in order to achieve both realistic training times yet also a high standard of knowledge. There was little surplus capacity but a minimal amount of overlap between essential trades ensured that should any crew member be incapacitated, the aircraft could still be safely flown although its full operational capability might be degraded. The observer was established on precepts entirely alien to this idea and was finally forced to disband, the major specialisations of the trade being assumed by the new air bomber and navigator branches.

The observer may have gone, but the old habits of scrabbling for some form of seniority over the other crewmen did not pass with him and were transferred to the new trades. The relative seniority of people, units, branches, squadrons etc., is treated as a matter of some importance, not just by the RAF but all the Services. It is almost invariably assessed upon length of service and then denoted by the relative positions when placed on a composite list. The comprehensive list of aircrew badges, including the 3 new additions, which was promulgated in September 1942, completely overturned this con-

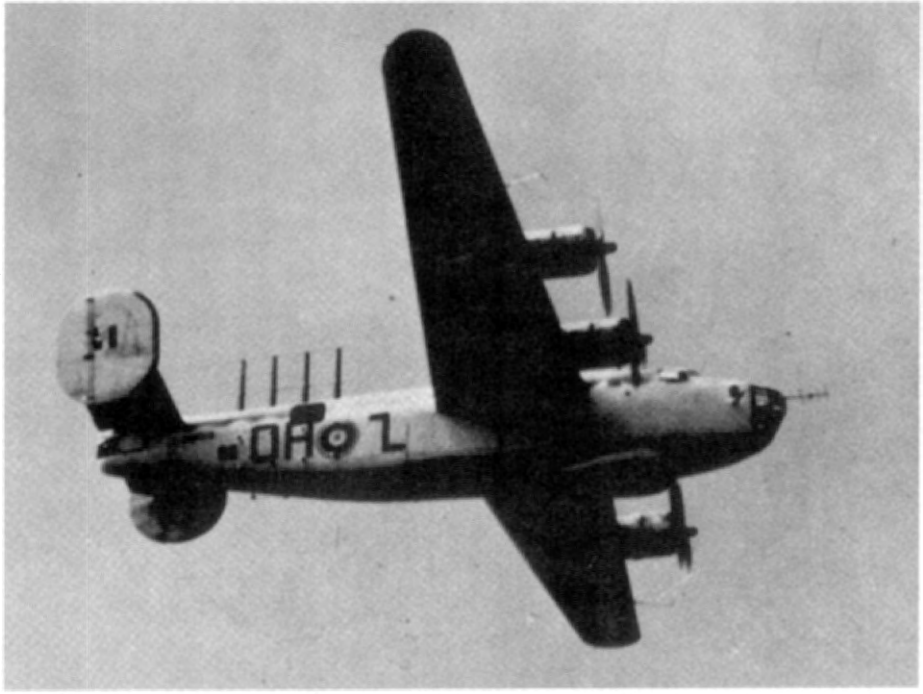
* This begs the question, what had S.10 been doing in the intervening month since the same action was agreed at the initial meeting?

vention. Although the flight engineer was quite correctly placed after the air gunner, the latter's undoubted right to be considered the senior crewman was prejudiced by the insertion of both the navigator and air bomber above him.

The flight engineer's badge was just an 'E' but this change from the original request would appear to be of little significance. The air bomber's was a simple 'B' and ease of manufacture and cost was the probable reason. The order also makes a veiled reference to the removal of unauthorised and obsolete emblems, the most numerous example in the first category probably being the 'FE' badge. The authorised version however, took a long time to supersede it completely. Shortages of the new badge forced the engineer to look elsewhere for stocks. Canadian badges, a rather droopy single wing with the letters 'FE', were obtained from the dominion aircrew who trained in large numbers at St Athan before their own School was opened late in the war. Another source was the many haberdashers and tailors who had extended their activities to the lucrative area of uniforms and associated accoutrements. The proprietors of the majority of these establishments did not feel constrained to conform to Service dress regulations, but merely supplied to the demands of their customers. Undoubtedly, under this practice, they had fabricated a good proportion of the initial 'FE' badges and also laid in stocks against future demand. Later, when flight engineers graduated but could not be provided with a badge, they would go directly to one of these shops. The authenticity of the old 'FE' badge that was offered would be guaranteed by the vendor who, not being privy to AMOs, probably believed it himself. The shortages continued well into 1943 but by this time the Station Tailoress at St Athan was producing a passable version of the correct badge by the subtle alteration of the 'B' in an air bomber's.

The last known 'FE' badges were being worn by instructors at the St Athan flight engineer's school as late as 1950. Of the crew badges existing or introduced in 1942, only 2 have remained in continuous use and can still be seen on the flight deck. The 'E' badge is one of these.

Consolidated Catalina



Consolidated Liberator

CHAPTER 6

The period from 1942 until D-Day in 1944 was the summit of the flight engineer training effort. At times 500 would leave St Athan in one week, the majority to replace Bomber Command casualties. These postings came from a school population which once totalled over 5,000. Superficially the training scheme appears reasonably settled and, in fact, the main framework remained intact, a tribute to the soundness of the original concept. The detail however was subject to constant changes. Streamlining and flexibility was the order of the day and corners were cut everywhere that surplus was found. The only proviso was that the product should still be of good quality (An increase in course length was actually approved in January 1943, because the failure rate was unacceptable). Typifying the prevailing attitude was the case of Sergeant Kenyon, a Lancaster engine fitter who bypassed all basic training and was posted directly to No 1660 HCU at Swinderby. Gunnery courses finally disappeared from the syllabus and direct entrants entirely displaced tradesmen by the end of the period.

The increase in training effort and effectiveness was dictated by an expansion, not only of sheer numbers, but heavy aircraft types and the roles in which they were utilised. Bomber Command's No 100 (Special Duties) Group was quietly introducing Fortress 2s, 3s and Liberators, transport squadrons were acquiring Stirlings and Halifaxes as they became obsolescent in the bomber role and a handful of Avro Yorks were being used for VIP flying. Coastal Command now operated a mixed bag of Liberators, Fortresses and Halifaxes alongside the Sunderlands and Catalinas.

The gunnery training was phased out in the summer of 1943. The exact date is believed to be July, but no directive exists to corroborate this. As early as January 1941, it had been questioned whether the compromise between gunnery and flight engineering was acceptable. The Air Ministry asked Bomber Command:

> "Doubt has been expressed as to whether the maintenance duties of the engineer/air gunner can be reconciled during air fighting with his duties as gunner for the beam guns and mid-upper guns, in view of the fact that immediate action may be necessary if engines or fuel system are damaged. Please forward your views urgently."

(The reply to this letter, if any, was not filed but it is thought that the engineer retained a specifically delegated gunnery position until 1942).

Throughout 1941 and early 1942, urgent Bomber Command replacements had been reaching the squadrons without any gunnery training – but still wearing the 'AG' badge! The official line on this anomoly was that "..... the training will be given later". There is however no known case of anybody actually complying with this vague and rather optimistic idea.

The demise of the co-pilot in 1942 put the writing on the wall. The engineer's gunnery commitment was now solely in emergencies. The course length decreased from 3 to 2 weeks early in 1943 before finally being dropped. Coastal Command insisted that it still required the qualification and from this time its engineers underwent the course before commencing OTU training. The reasons for the stance were sound and devolved upon the retention of the co-pilot and the differing theatres of action.

By October 1942 it was becoming obvious that the escalating requirement for flight engineers could only be met by introducing direct entrants en-masse. The premise that a flight engineer needs either a wealth of background experience or a comprehensive training scheme was not altered; St Athan now possessed that scheme and only needed to expand in breadth to cope with the numbers. The obligatory Air Ministry conference to discuss the matter was held on the 10th of the month and solidly supported the idea.

The quantity of DEs finding their way into the branch immediately soared, even though 8 months passed before the engineer's AMO was revised to formally endorse the change.

In January 1943, HQ Technical Training Command approached the Air Ministry with a request for increase in the St Athan course lengths. The argument was backed by some powerful statistics (airframe fitters were currently at a 25% failure rate) and against the general trend of the period, the extra time was agreed. Type training went from 6 to 7 weeks for all trainees. Ex-airframe tradesmen won hefty increases to their basic courses bringing it up to 8 weeks for fitters and 13 for flight mechanics. Direct entrants gained nothing, the extra week's type training being exchanged for a cut in the basic course from 18 down to 17 weeks.

AMO A538/43* was released in June 1943, breaking the last lingering fealties towards the ground trades and establishing the flight engineer as a truly independant professional man. The field of recruitment was enlarged to encompass not only direct entrants but also most trades within the RAF. It is in fact easier to state those still excluded, just wireless operators, medical personnel and the skilled workers from certain specialisations within Trade Group 1 which were not directly involved in the engineering support of aircraft. Wireless operators had their airborne branch as WO/AGs, and the other 2 categories were too valuable to retrain for an aircrew branch in which talents were of no benefit. Trainees no longer had to qualify as either airframe or engine fitters during the course, so the system was streamlined and technically competent ex-tradesmen just underwent the 7 week type training phase.

With the fitter qualification removed, the enhanced rate of pay of the flight engineer was no longer justified and it was reduced to parity with the air gunner. Those men already on the squadrons or under training kept their entitlement to the old rates, for a sergeant 12s 0d a day (A consolidated rate initially derived from 11s 0d a day basic pay, and war pay which had increased from 6d a day in October 1942, to 1s 0d). The new rate for a sergeant was 10s 0d a day total.

Only 9 days after issue of this order, the next changes were being discussed. The long term intention, as indicated by this letter from HQTTC, was to cut all internal recruitment and make direct entry the only route into the branch:

> "DEs at 60 per week are expected to rise to 120 in August and 150 in September. Strength will rise to 840 by the end of July, 1260 by the end of August, 2100 by the end of Novermber '43 and 2700 on the 5 April '44. Intakes of other airmen will vary with requirements, presently 1100, will fall away to 450 by the end of August and nil at the end of October.
>
> Tentative forecast:- 1 July '43
>
> | | |
> |---|---|
> | Preparatory course, ex ITW | 600 |
> | Preparatory course, tradesmen | 1155 |
> | Type training | 1185 |
> | Total | 2940 |
>
> 1 June '44
>
> | | |
> |---|---|
> | Total (All direct entrants) | 3750" |

* APPENDIX 15

Why, within the space of a single year, had recruitment of DEs changed from being "undesirable", to the point where it was now planned for them to take over the branch? One factor must have been that the DE was coping adequately with the job, far better than the original prognoses. Although, in connection with the drop in pay, an Air Ministry comment was made: "(From June 1943 there was a) much reduced quality of entrant.", this was probably a superficial assessment based only on the concept of DE versus tradesmen. Moreover it is a remark about entrants into training, not the product from it. Despite the planning, applications from serving airmen were invited, accepted and then carefully placed in abeyance, in fact the last limits on eligibility for internal recruitment were virtually discarded early in 1944. This pool of potential aircrew is probably the key to the whole situation.

By the summer of 1943, it was a case of 'when' not 'if' the invasion of Europe would occur. It was generally agreed that the casualties would escalate to a fearsome level during the campaign and all the Services started to accumulate surpluses of men and materials against this eventuality. Flight engineers started to find odd gaps in their training before reaching the squadrons, escape and evasion courses and even leave was inserted into the syllabus as the buffer grew. Although the DE course was almost 6 months in length, if the training could not only keep pace with requirements but also build up a slight surplus then it was sound commonsense to leave the skilled tradesmen alone for the moment. When the expected losses actually occurred, these men could be put through the St Athan type training course in just 7 weeks.

In the actual event, losses during the invasion period were remarkably low. If DE training could still match the requirements, what was the point in re-opening entry to serving airmen and in the process robbing the ground trades of their skilled workers?* In March 1944, Sergeant Acklam graduated from the engineer's school; an ex-engine fitter, he is the last tradesman known to have converted to flight engineer during the war.

The aircraft and roles to which the men were posted became quite varied. Although the vast majority would still go to Bomber Command's Halifaxes and Lancasters, the fringe activities were both exciting and portentious. A few engineers were occupying the right hand seat of No 100 Group's Liberators and Fortresses, but overshadowing this minor diversion was the introduction of heavy aircraft to the transport role.

Transport Command was formed on the 25 March 1943, by a marriage between Ferry Command, the successors to the Atlantic Ferry Organisation, and No 44 Group which controlled strategic transport within the UK. In the same month the new Command introduced the first Avro York, the aircraft which would become the RAF's standard, post-war, heavy transport. For this reason it is deserving of further description although during the war period only minimal numbers were produced. The reason for the slow production was that, apart from the centre fin and the box-section fuselage, the parts were directly 'borrowed' from the Lancaster and the bomber necessarily took the higher priority. Although Transport Command initially accepted Bomber Command's flight deck manning scheme, this was not feasible on the York. The standard Lancaster systems panel was repositioned aft, alongside the generator control system and the added length of the new fuselage placed the co-pilot's seat nearly 25 feet away. Short of employing Olympic sprinters, the obvious and accepted solution was to reinstate the co-pilot and leave the engineer to his inner sanctum under the wing spars. It was 1945 before a complete squadron, No 511, could be equipped with Yorks and until this time the Command employed only a handful of engineers.

* The list of tradesmen who volunteered was carefully filed. When the next flight engineer shortage occured, in 1948, some 20 names were extracted for aircrew training.

The Avro York, which became the RAF's first standard post-war transport aircraft

Transport operations, using converted bomber aircraft, were pioneered, strangely enough, by Fighter Command. The name of No 38 Group is now synonymous with heavy transport. The direct progenitor of the Group was No 38 (Airborne Forces) Wing, formed in 1943 as part of Fighter Command's Tactical Air Force. Battle weary, obsolescent Stirlings and Halifaxes provided the heavy element of the Wing. The change of role for the Stirling was even reflected at St Athan. In March 1943, Ken Saxby had just commenced type training on this aircraft when the course was abruptly halted and the members given an ultimatum (One of the very few occasions on which trainees were actually given a choice); if they wished to continue their instruction on the Stirling it would be on the understanding that they were now destined for the transport role. The alternative was to opt for reselection to another aircraft. No 38 Wing cut its teeth at the invasion of Sicily in July 1943. Halifaxes and Albermarles towed the Horsa gliders from England, across the Bay of Biscay and North Africa, in broad daylight, to take part in an invasion that so graphically illustrated the effectiveness of a combined surface and air assault, it would become the keynote of all major operations carried out in the future.

The Wing was upgraded to full Group status early in 1944 and began receiving its first specialist aircraft, the Stirling Mk 4. Devoid of nose and dorsal turrets, and modified for glider towing, it was equipping 2 squadrons at Fairford and another 2 at Keevil by D-Day. As part of the build-up to the invasion, No 38 Group and the Dakotas of Transport Command's No 46 Group were seconded as part of the Allied Expeditionary Air Force, their merger forming the first large-scale tactical transport force in history. The methods pioneered in Sicily were re-employed on a grand scale in Normandy, at Arnhem and during the Rhine crossing. Complementing the shop-window operations was the mundane, but no less essential, task of resupplying the needs of a swiftly advancing invasion force. One facet was importation of all the aviation fuel required by the fighters and light bombers of the Tactical Air Force. The ubiquitous Stirling was totally responsible, carrying this dangerous cargo in 5 gallon cans and delivering 600 gallons each trip. The effectiveness of air freighting and its diverse applications was proved, sowing the seeds for the post-war growth of Transport Command.

Derek Butcher was a Lancaster flight engineer whose metamorphosis from civilian to Bomber Command squadron member typifies thousands of men who passed through No 4 S of TT at St Athan during the war. A general policy existed, barring aircrew from operational flying until aged 19. Derek, just turned 18, was engaged and then placed on Deferred Service until February 1943, the delay ensuring that he reached the prescribed age by the completion of training. The policy was not always so rigidly adhered to. Ken Saxby had started the course the previous year when only 17½ and men of similar age were also being engaged in 1944. The main purpose of Deferred Service was to accumulate a large reserve of suitable manpower which was used to keep training working at maximum capacity. At the successful conclusion of 3 days at an Aircrew Selection Board the men were given their Service number, sworn into the RAFVR then returned home for an indefinite period, immune from being called-up by any other branch of the Armed Forces.

Derek reported in February 1943 to the St Johns Wood Aircrew Reception centre (ACRC), a block of flats adjacent to Regents Park Zoo. The previous year the recruits were actually eating in the zoo restaurant but by this time the basement garages of the flats had been converted to provide messing facilities, although use of the zoo premises continued for pay parades. At this time ACRC lasted for about 7 weeks and can be generally equated to normal recruit training but with an aircrew slant to the instruction. Upon finishing, the men were marched to the railway station for transportation to the various ITWs. Derek, the other prospective engineers, and the air gunners were sent to

Bridlington, a standard location for these 2 specialisations in 1943*. Accomodation was 4 to a room in the old terraced houses on the sea-front and the men were now allowed to wear a white flash in the bands of their forage caps to denote trainee aircrew status. During ITW continued instruction was given in foot drill, gas drills and PT together with new subjects such as morse, aircraft recognition, aircraft armament, first aid and basic navigation. The next move was to St Athan for the 24 week course, accomplished by train with the inevitable marches to and from the station.

The preparatory 17 week phase was designed to instil a basic knowledge of aircraft, their engines and systems, to a level which allowed the men to study and appreciate the individual applications on one particular type. This was no small task; the technical awareness of the general population was far lower than it is at present †. The mysteries of the internal combustion engine, even its simple form as applied to an automobile, were known only to a very few. Less had been in close proximity to a real aircraft and now, in 17 weeks, they had to absorb the entire range of aero-engineering including the complicated concepts inherent in the safe and efficient operation of supercharged power-plants. When Derek completed this phase, he was selected for Lancasters (Although uncertain in his memory, he believes the process was carried out on the basis of who was carrying a clean handkerchief). By now training facilities were so saturated that some, if not all, of Merlin engine instruction had reverted back to Rolls-Royce and Derek spent 2 of the 7 weeks type training up at Derby. Throughout the war, No 4 S of TT collected fuselages of all the aircraft which were taught. Usually from operational write-offs which had escaped total destruction, they were wrested, officially and other-wise, from salvage yards and set up in a hangar. Originally they were employed just for familiarisation with the layout, particularly controls and gauges, during type training. By 1944, however, services were being wired up and hydraulic pumps fitted in order to provide a large amount of systems operation simulation. This unique collection dis-appeared shortly after the war; its liberation from the scrap-yards was presumably only a temporary stay of execution.

Derek joined his crew at a Heavy Conversion Unit (HCU), the final training phase before reaching a squadron. The pilot, wireless operator/air gunner, one straight air gunner, the air bomber and navigator had already been together for some time. These 5 had crewed up at the start of the previous stage, Operational Conversion Unit (OCU) where, flying an old Whitley or Wellington, they learned the basics of bomber operation and how to work together in the air. HCU was normally equipped with the type of air-craft which would later be flown on the squadron and the first requirement of the skeleton crew was to acquire the flight engineer and an extra air gunner, needed to bring the numbers up to full complement.

Derek's HCU training was a departure from standard practice, in that the course was split; the first 2 months and 20 - 30 trips being on the Merlin engined Halifax with only the final 3 weeks and 12 flights on the Lancaster. The date gives a clue to the

* From 1944, it appears that the majority of engineers undertook ITW in the West Country, primarily at Newquay and Torquay.

† It was the technological advances of the Second World War which awakened the public's awareness and interest.

probable reason for this scheme* . The radial engined Halifax Mk 3 was now entering service and the older models, which were becoming extremely hazardous to fly on operations, started to be phased out. These Merlin powered aircraft had an established training organisation with a ready supply of machines but were entirely unsuitable for teaching crews bound for the Mark 3. A Merlin XX however, has the same operating characteristics, irrespective of whether it powers a Halifax or Lancaster airframe and the majority of training procedures were applicable to any heavy bomber. Use of the Halifax for the preliminary stage released the maximum number of Lancasters to the front line, for which they were better suited. Sound in theory, the practice was a bit more complicated and did have its drawbacks. The major problem concerned learning the ancillary systems of the Halifax from scratch and therefore only in a superficial manner. Two crews training alongside Derek's, died in crashes occurring just after take off, the wreckage of the second aircraft finishing up significantly close to the first. Investigation of both accidents suggested that inadequate or incorrect instruction had resulted in the flaps being retracted from the take off position in mistake for the undercarriage. The final training was carried out at a 'Lancaster Finishing School' an epithet which probably originated at this time, for it accurately describes the function. When the normal pattern of training resumed, the title was used and perpetuated by all Lancaster HCUs.

The posting Derek received was to No 166 Squadron at Kirmington, one of 175 crew members for the 25 aircraft. Thirty operations were normally required of a crew before they were withdrawn to other duties, and the statistics of life, and death, in Bomber Command make sober reading. Taking a sample of 100 men joining an HCU; 60 would die in training crashes or on operations; 12, in various states of health, would become prisoners of war and 3 suffer severe injuries. Twenty five, or one quarter, would survive a tour physically unharmed and on this side of the Channel. One of these 25, although shot down, would have evaded or escaped capture and managed to return home. Derek falls into this last category. Having baled out he was captured twice, escaped twice and was finally liberated when the advancing Allied army reached Brussels where he was hiding in a 'safe house'.

For those engineers who successfully completed a tour, the problem of future employment was now posed. Derek became the motor transport officer at Tempsford (His status as an ex POW barred him from operational flying). The majority went to instructional duties, some with their pilots to form a staff team at the HCUs, an occupation only slightly less dangerous than squadron flying. Others became ground instructors at OCUs, teaching engine handling and systems operation to pilots. A few taught at St Athan in the flight engineer's school. To find gainful employment for the rest, a School of Instruction Technique was established at St Athan in 1944. Education officers took entries of 25 to 30 men through a 4 week course, turning them into workshop instructors.

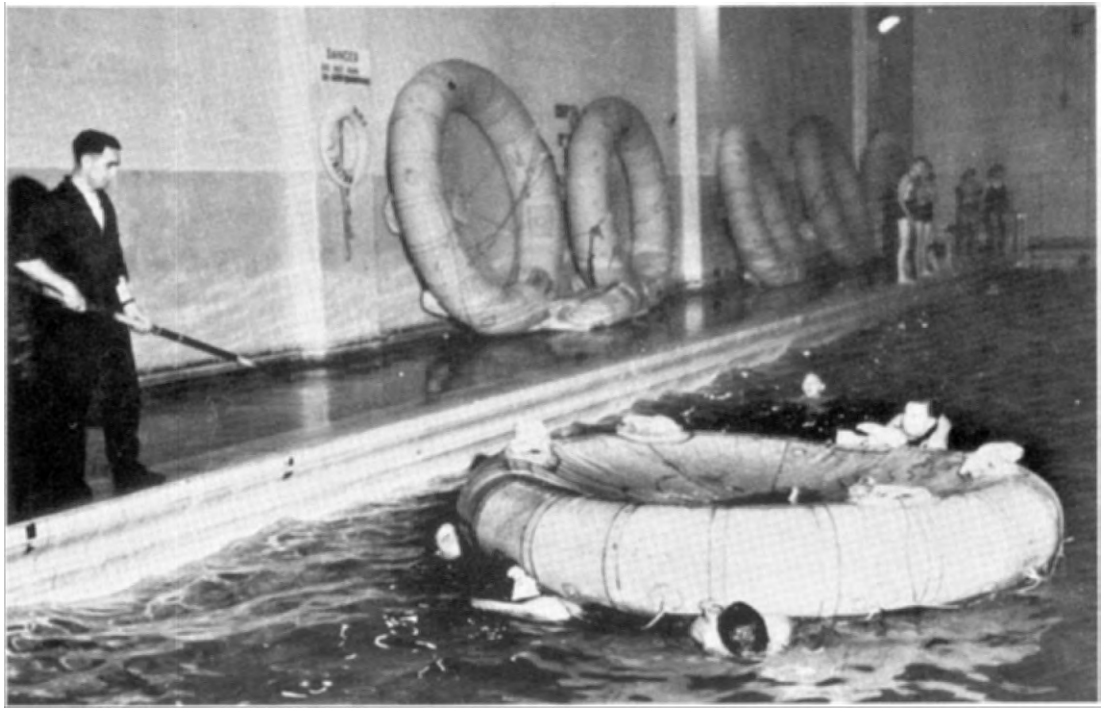
Perhaps the most surprising aspect is the number who quickly became bored and volunteered for a second tour. Men like Tom Clarkson, now commissioned, who joined No 617 Squadron just after the raid on the dams. This time his luck did not hold, his aircraft being shot down during a low level raid on Munich. Tom lost his freedom until the end of the war: he also gained the DFC.

* Although it was only employed for a short period, during this time it appears to have been universal practice. Sergeant 'Bill' Bridger, a contemporary of Derek, also undertook a split course; the Halifax HCU at Blyton and the Lancaster Finishing School at Hemswell.
Nothing has been discovered, but the corollary of using the Stirling to train Halifax Mk 3 crews would seem too obvious to have been missed at the time.

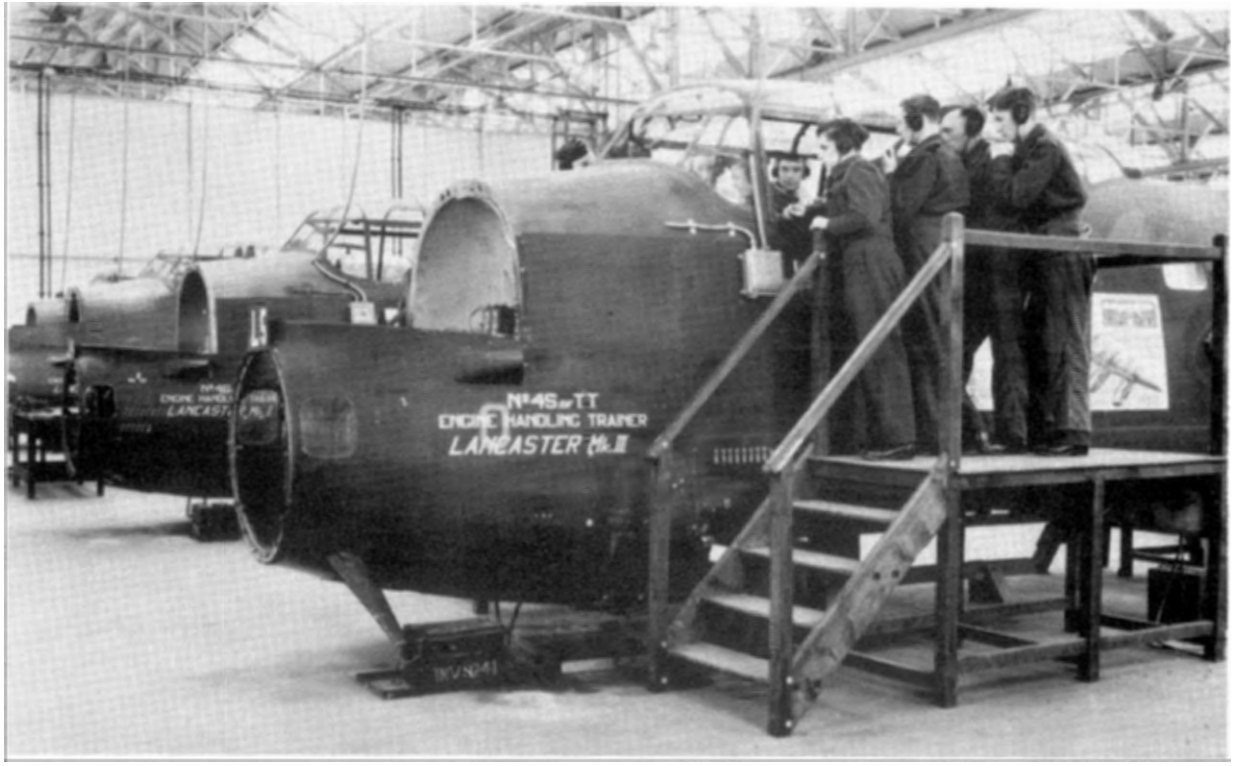
The following photographs form part of an official series, taken in August 1944, of flight engineer training at St Athan.

Corporal Williams giving tuition on the mechanical aspects of the Frazer-Nash gun turret

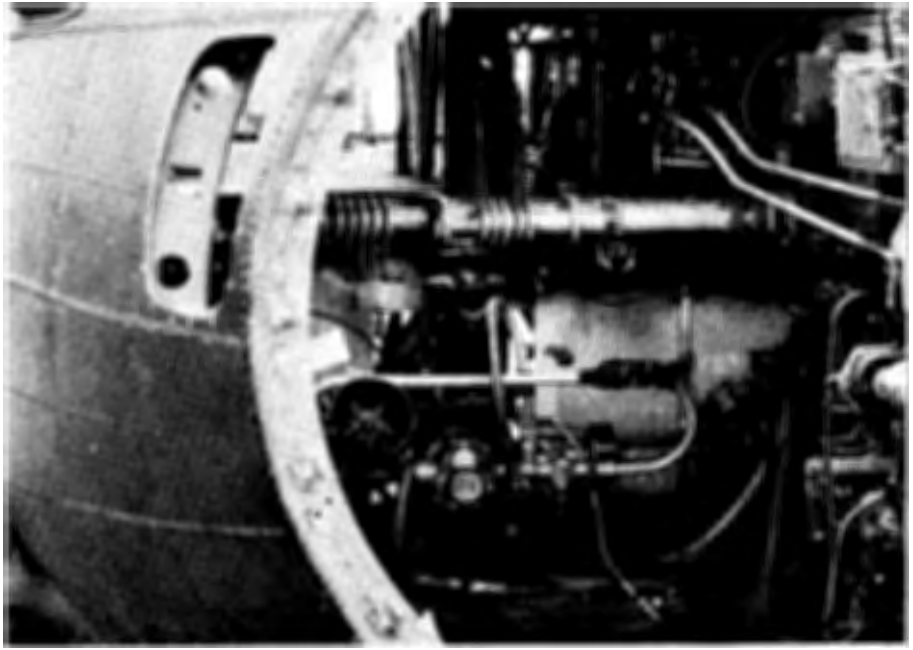
The Link Trainer, an early and very basic flight simulator, being used to teach engineers rudimentary flying skills



Dinghy drill – attempting to right an inverted dinghy



Engine handling trainer for the Lancaster MkIII



Forward view of the Lancaster engine-handling trainer. The 2 cranked rods protruding forward along the port side of the fuselage are connected to the throttle and RPM levers of one engine and used to present engine gauge readings in the cockpit. A hydraulic pump, air compressor and motor-generator allow the majority of aircraft systems and gauges to function representatively

CHAPTER 7

In December 1943, the Flight Engineer Leaders Courses were inaugurated at St Athan. Ten officers attended on each of the 32 intakes, until the training ceased in 1947. The object of the month-long course was to assess the potential of existing commissioned engineers and also impart an advanced appreciation of flight engineering. A comprehensive examination was set on the systems, operation and performance of an aircraft specified by the trainee. This was in order merely to qualify for entry! The last course graduated in December 1947, by which time 83 distinguished passes had been obtained. Two Flight Engineer Officers Courses were run, on an entirely separate basis, during 1946 but there is little information regarding these. It is believed that they were designed to expand the breadth of engineering knowledge, as opposed to the Leaders Courses, which increased the depth of specialist ability.

The overall contribution made to the branch by No 4 S of TT cannot be overstated. The quality of training endowed the engineer with professional aircrew acceptability and finally earned its just reward. In August 1944, HM King George VI authorised a unit crest* graphically symbolising the link between the 2. This zenith would never again be reached, in fact the run-down had already started.

In early 1944, St Athan became choked. Unlike most other aircrew which had training schemes in Commonwealth countries paralleling output at home, not only were all RAF flight engineers qualified at St Athan but also the Canadians, Rhodesians, Poles, Czechs, Belgians, Free French and Dutch. With the Glamorganshire Station threatening to burst at the seams, it was decided to include another Camp in the training scheme. Rather than duplicate the entire syllabus, the preparatory course was split into 2, with the first 10 weeks becoming the responsibility of No 5 S of TT at RAF Locking. St Athan then completed the last 7 weeks followed by the type training. The first course to pass through Locking arrived on the 17 February 1944 and it is possible to gain an accurate picture of the sheer numbers involved because the Station record was meticuously maintained until late in the year. Each week there was a new entry into Locking with an average strength of 171 men, equating to over 4,500 under training at any one time, if the failures are discounted.

There certainly were failures and despite the pressing need for flight engineers, it would appear that after a period of extra training had proved unsuccessful, they were unceremoniously rejected. The 10 weeks at Locking produced an 8% rate of total failures; relatively contemporary figures for St Athan (January-1944) only cover the type training. They were stated in a letter from HQ TTC as a lever to increase again the length of this phase:

"FLIGHT ENGINEER TYPE SYLLABUS

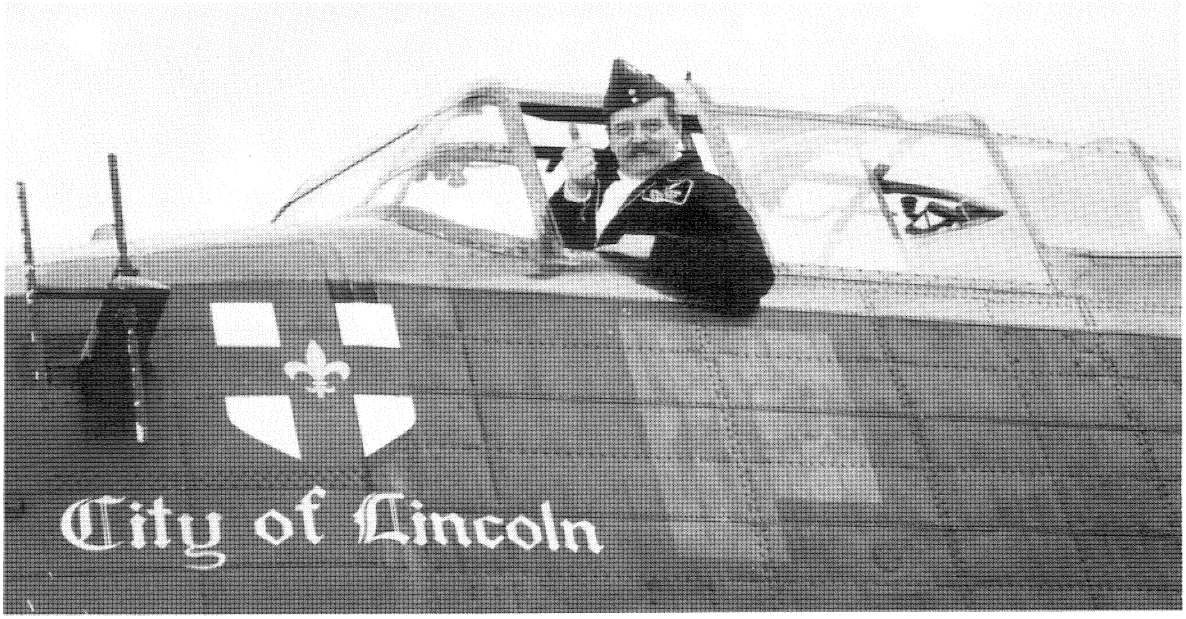
> ..... Wastage. Examination of results obtained during the last 6 weeks. 30% fail after 7 weeks whereas after 2 weeks extra training the total falls to 5%. 4 weeks further training only reduces this figure to 3.4%. Recommend increase to 9 weeks." †

Extrapolating these figures to cover the whole course, gives answers of extra training at the 35% level and complete failures at about 15%.

In April 1944 Canadians started their own flight engineer training programme. The

* APPENDIX 16

† Not approved



Master Engineer Derek Butcher concluded his operational career in 1982, on the same type of aircraft with which he commenced in 1943. In this case it is the Battle of Britain Memorial Flight's Lancaster PA 474, on which Derek had flow regularly as the Flight Engineer since 1973.

original intention had been to establish just the preparatory phase in Canada and continue with type training at St Athan. Help had been provided by No 4 S of TT, including the detachment of Sqn Ldr Adams from the School. A letter from him to Gp Capt Rapley at St Athan describes what occurred to change the plan:

> "Now that I have had time to appreciate the situation, I will try to tell you something of the set-up here. The original 10 weeks work is well done and the layout of the intermediate 7 weeks, allowing for the fact that no big stuff is available, was passable. I have been able to make a few suggestions and believe the product would have been able to make it on the type phase at St Athan, unless they forgot a lot during leave and the voyage over. A good exam board and exams at end of each completed 10 weeks and 7 weeks course are planned. Now however, a major snag has arisen. The general scene here is subservient to the political verb sap. It has now been ruled that no Canadian can go overseas without his stripes and brevet. I have told them that St Athan could not accept people for type training who had already got these, pointing out the difficulties. So they will do type training here also, due to start April 9th. They have as yet no aircraft, no place to put the school, no equipment and no instructors. I believe a signal has been sent tonight asking for St Athan instructors on loan. This is written to put you in the picture and in case you think I have gone mad here. I am busy trying to lay on type training at their request but all signals are theirs. My original attachment was for 3 months but I doubt if I will get back in that. My advice to keep type training at St Athan was ignored. ....."*

Before the war ended, the Canadians trained about 2,000 flight engineers, the majority of whom were absorbed by No 6 Group. This group was almost entirely funded by the Canadian government, and mainly operated Halifaxes, an aircraft type which was not produced overseas.† Doubt therefore exists about the quality of their type training, compared with St Athan, when the logistics of getting the requisite training aids across the Atlantic are considered.

In the latter half of 1944, aircraft production generally fell for the first time since the outbreak of war. The number of engineers trained immediately followed this trend, falling to about one third of the spring levels. Other aircrew branches, particularly the pilots, were not so quick to adjust supply towards demand, consequently at least 2 and

* The Sqn Ldr's letter continues, giving an insight into the training aids of the period:

> " ..... I have had a trip to American synthetic training places. They have some trainers on similar ideas to ours but factory built and generalised, e.g. not 'typed' like ours. Ingenious device for producing engine noise is by driving a 4 toothed wheel past a pick-up. Each motor has its own motor scheme and enables practice of synchronisation etc. Noise can be only in 'phones' or broadcast as required. Instruments can be controlled by instructor to put in high oil temp, low oil pressure, etc., to see pupil's reactions. Use of gramophone records for starting drills seems good too, could not get too close a look at work but it is basically like ours, cost about £1,500. Am trying to pick up ideas for improving St Athan, whether or not I return there. I do not know if this letter will help at all re- the type training. I would like to let Gp Capt Nelson (DDTT - author) know, if at all possible, and anyone else who you think should know. I am sorry to be so rushed but I have just come from New York and want to get this one off."

† The only heavy bomber mass produced in Canada was the 'Victory' - built Lancaster X with Packard Merlin engines.

possibly more hybrid aircrew trades were established. From the summer of 1944, a fair number of pilots who had completed basic training to 'wings' standard, were re-routed onto short courses at St Athan, graduating as pilot/flight engineers (PFEs). Most were posted to Lancasters, along with similarly side-tracked pilot/air gunners (PAGs). Captains, who only 2 years ago had bemoaned the loss of their co-pilots, were now heard to say: "I don't want one of them, give me a real engineer". These deviant aircrew rapidly disappeared at the end of the war, some re-adopted by their parent trade but most demobilised.

No 5 S of TT at Locking dropped out of the picture within a year, sometime during the winter of 1944/45. The last reference in the Station History was made during August 1944 but it is certain that training continued after this date. The historian probably decided that the flight engineer course was becoming too mundane to include, especially now that a scheme for training fitters 2(E) on a novelty called the 'jet engine', was in the offing. Sgt Stan Piper is the last engineer known to have passed through Locking and he departed for St Athan on the 8 November 1944.

The contraction of training at St Athan, started the previous year, was accelerated during the first months of 1945 and by the summer the number of engineers at the school was, quite literally, negligible. Stan Piper underwent a desultory and protracted course, graduated and received his badge on the 28 June and was immediately declared surplus to requirements. Training never ceased entirely but the Station that once held over 5,000 prospective aircrew now numbered its flight engineer students in ones and twos until 1947.

With the war reaching its conclusion, it is pertinent to examine the achievements within and attitudes toward the branch after the first 5 years of its existence. The whole aircrew structure had been radically altered over this period and, excepting the pilot, all of the current flying trades were introduced during this conflict as a direct result of operational requirements. Seventy five per cent of all aircrew were NCOs with each branch represented at squadron level by a commisioned 'leader', responsible for the practice within the unit of his particular specialisation. This then was the situation at the 'sharp end' of the Air Force, where mutual interdependance had long since shown the pointlessness in assessing the value of one trade against another. The only remaining flight deck hierarchy both began and finished, quite properly, at the aircraft captain. Official policy however, appears askew from such operational practicalities. A Preliminary Aircrew Training (PAT) scheme, which preceeded normal training, was established primarily for embryo pilots, but the ghost of the observer refused to be laid, and the navigator and air bomber were also included. The myth founded by this attitude has been perpetuated in written histories, describing the pilot, navigator and air bomber (PNB) as the 'brains' of the crew and the signaller (direct descendant of the wireless operator), engineer and air gunner (SEG) as the 'tradesmen', a connotation which, by inference, is not so much an acknowledgement of skilled workers, but more an assumption of a flight deck social division. One such history even attempts to use as ammunition an arguable generalisation on the ethnic origins of flight engineers. Any doubts that vested interest was maintaining a palpably false division can be dispelled by study of the air bomber branch. Apart from his duty as bomb-aimer he held 2 more, primary qualifications. One was front gunner; a position very little utilised, the other, map reading; a totally unfruitful occupation at night, over a blacked-out Continent, with the aircraft clawing its way as high as possible and the pilot making the most use of any cloud cover in the hope of avoiding both flak and fighters. Certainly as bomb-aimer he held the responsibility for a lost sortie if he missed the target but by the same token a rear gunner held the responsibility possibly for a lost aircraft and crew if he missed a night fighter. The air bomber was just another crew member. No mystical aura surrounded his job and absolutely nothing dictated an elevated status.

If credit for the emergence of a credible flight engineer branch can be placed with any one organisation, then that must be Technical Training Command, through the medium of No 4 S of TT at St Athan. Since mid-1942, nearly every allied flight engineer, apart from 2,000 Canadians and the Americans, passed through here. Over 20,000 men were trained and for the majority of the period it was the exclusive task of the School. The scale of operations may also be judged from the fact that the Commandant, who also fulfilled the role of Station Commander, was always of Air Commodore rank*.

The branch is also known to have received over 350 individual awards, mainly of the DFM and DFC but also at least one Conspicuous Gallantry Medal. Later, when returning POWs had been debriefed, among further honours retrospectively awarded was the flight engineer's only Victoria Cross †. Following an attack by a night fighter which caused an uncontrollable engine fire, Sergeant Norman Jackson climbed through the escape hatch of his Lancaster and jumped down onto the wing with a hand-held fire extinguisher tucked into his jacket. Attached only by the rigging lines of his deliberately spilled parachute and holding against the slipstream with one hand which was grasping the lip of the cabin air intake, he discharged the extinguisher through a hole in the cowling, effectively stopping the fire. The fighter then made a second attack, re-igniting the engine which covered him in flames and injuring his back and legs with shell splinters. His burned hands could no longer maintain their grip and he was swept off the wing into space until abruptly checked by his parachute rigging lines. He was now being dragged along at 200 miles per hour behind the crippled aircraft, watching the lines ignite and fray in the flames from the burning wing. The navigator and air bomber worked furiously to feed the parachute canopy out of the escape hatch and give the engineer some slim hope of survival before they too abandoned the aircraft. They finally succeeded, although in the process much of the canopy was burnt, or torn on metal projections. During the descent, Jackson extinguished the smouldering rigging lines by squeezing them in his hands. The canopy damage resulted in a heavy landing which broke one ankle and badly sprained the other. In this condition he was forced by the Gestapo to walk to the nearest village, helped along by the local policeman and to the accompaniment of jeers and stone throwing from the local populace.

If the work of St Athan can be likened to building the solid framework of the branch, then Norman Jackson and his kind added a cladding of heritage and tradition. So far the branch only had experience of war, a conflict which cost the lives of nearly 10,000 of its members. How would it now stand up in the transition to peace?

* APPENDIX 17

† APPENDIX 18

CHAPTER 8

Whereas the armistice of 1918 had resulted in the armed forces being ruthlessly pared away to the bone, peace in 1945 heralded a far more realistic exercise. It is true that manpower was cut by about ⅔ within 18 months but the atmosphere of stagnation which pervaded the inter-war period, was noticeably absent. There was a general acceptance that continued world peace would only be assured by maintaining viable armed forces and the RAF was at the spearhead of this concept. An extra factor was the indisputable adaptability of modern aircraft to support this continued posture outside times of actual conflict, a facet which was to be vividly demonstrated during the Air-Trooping Programme inaugurated in 1945.

The programme was designed to speed up the repatriation of demobilised men and POWs and, equally importantly, move replacements throughout Europe, the Middle East and the Far East. Transport Command assumed responsibility and were supplemented by large numbers of crews and aircraft on loan from Bomber Command. Over 18,000 men a month were airlifted on the eastern sector alone. Although the run down in Lancaster production was hastening the introduction of the York, most of the work was carried out by Dakotas and the various bomber conversions. At simplest, the conversion might involve removing the guns from a Lancaster and fitting 18 troops into the spartan fuselage with their kit-bags in the bomb bay. At the opposite end of the scale were aircraft such as the Stirling V. All the turrets had been removed and faired over and the nose was extended to form a freight compartment. This mark could accomodate up to 40 passengers and a crew of 5 in relative comfort.

Demobilisation in 1945 still resulted in savage cuts, especially in the flying branches. Most of the NCOs were posted to holding units such as Snaith in Yorkshire or St Eval in Cornwall, awaiting a decision about their future. Dependent upon age and length of service, the men were assigned varying demobilisation group numbers. When the number was published all of that particular group were discharged, the youngest men with the shortest service drawing group numbers which entailed a considerable waiting period. This latter category naturally included most of the large quantity of aircrew DEs inducted during the later part of the war. Many could be profitably detached or even remustered to a new trade before the expiry of their service. Ken Saxby, now commissioned as a flight lieutenant, was on the Staff of the St Eval holding unit and responsible for part of this manpower redistribution. A priority was placed on finding men suitable to specialise in radar as replacements for many of the wartime fitters who were Canadian and now being repatriated. Stan Piper spent 4 years in the trade before returning to flying duties and the knowledge he assimilated was put to good use nearly 30 years later when he formed part of the team responsible for the introduction of the Airborne Early Warning Shackleton. The other main diversion appears to have been motor transport driver.

Of all the aircrew trades, the flight engineer appears to have escaped emasculation in this carve-up by the greatest margin, probably the result of sound long term planning aided by the fact that the training system was centralised and therefore highly flexible. Training was virtually closed down from the beginning of 1945, whereas other branches continued to churn out prodigious numbers, mindless of future, or even immediate needs. The PFE scheme graphically illustrates this point. When the time came to form the structure of the peace-time Air Force, the administration could concentrate on sorting the wheat from the chaff of the more modest numbers involved. Of those who parted company with Service after the war some, certainly, were peremptorily ejected because their professional or personal standards were lacking but many more simply wished to pick up the threads of their pre-war life. Some excellent engineers departed, with the blessing and active support of the RAF, to find flying posts in the civil aviation industry. Their names are slowly disappearing from the very top of the airlines' seniority lists as they now reach retirement age. Within the RAF,key commissioned

posts were carefully filled with first class men, even repatriated POWs, such as Dave Nelson and Tom Clarkson, were fitted into jobs over the heads of men still in current flying practice. The branch was basically in an excellent position to face the new challenge. The pendulum swing of contraction was halted and even started to swing back slightly. Vacancies appeared and the men who were being misemployed were obvious candidates to fill these posts, most returned to flying within 3 years and it is believed all the rest received personal invitations during subsequent periods of acute shortages.

Flight engineer utilisation now ranged from the prestigious: an Avro Lancastrian unit working up at Full Sutton, York, to form an England-India-Australia airlink (subsequently abandoned), through the mundane: Transport, Bomber and Coastal squadrons, to the decidedly off-beat. Flying regulations were rather sparse and anybody with a flying badge was considered suitable to act as crew member on any aircraft. Ian Gibson who, like Stan Piper, had been declared surplus after finishing his course, was posted to Kinloss to run the technical library. He tended to spend a large proportion of the time occupying the right hand seat of a Vickers Warwick and once undertook an air-test as engineer on a Halifax notwithstanding that he had never flown in the aircraft before. Derek Butcher, now an MT driver at Tangmere, flew regularly in the rear seat of Royal Navy Fairey Fireflies and another engineer, remustered to LAC driver, spent most of a tour in the Far East as a Dakota co-pilot. The writing was on the wall, however, for this sort of unorthodox flying.

In January 1946, the Chief of the Air Staff, Marshal of the Royal Air Force Sir Arthur Tedder, highlighted the greatest problem of the period, the unacceptable rate of flying accidents. Transport Command was by no means the prime target for this criticism, indeed their fatality rate was less than ½ that of pre-war civil airlines, however, this was no cause for complacency. The Command was flying 3 times more passenger miles in a single year than had been achieved by British civil airlines in the 5 years prior to 1939. The statistics proved a lower fatality rate, but the implicit number of accidents appeared enormous and received unfavourable attention from a public which was rapidly becoming air transport minded, fed by a press unfettered by wartime security constraints.

In a major effort to cut this rate even further, a flight engineer, pilot and navigator from No 511 Squadron were seconded onto the Command Staff to devise a new continuation training and categorisation scheme. The resulting system required each crew member of a transport unit to regularly undertake theoretical and practical tests appropriate to his duties and a particular aircraft. The standard of results determined a categorisation of VIP, passenger carrying, freight only or failure, and was valid only for the individual aircraft type on which tested. The overall crew category was then governed by that of the lowest member. The excellence of the scheme may be judged from the fact that all other Commands rapidly adopted it and that it has survived, basically unaltered, to the present day.

During 1946 the retrenchment was completed, yet, just as it apeared that the flying branches were set to enjoy a period of stability, a completely new aircrew trade structure was announced. So radical were the provisions of this structure that over a year would pass before they were all implemented. The initial statement of policy appeared as AMO A492/46, issued on the 6 June. The most obvious facet, which is normally the only one now remembered and quoted, was the continuance of predominantly non-commissioned aircrew, albeit with entirely new and novel ranks. It is unfortunate that this single point should remain as the major memory when in fact it was a minor and uncharacteristic portion of a mainly reactionary concept. That the structure was an unmitigated disaster is self-evident, for it was scrapped after only 4 years, however, its

introduction degraded the flight engineer, signaller and air gunner corps to the extent that 17 years passed before the status enjoyed in 1945 was regained by the engineer. The air gunner did not survice the period and the signaller became a shadow behind the air electronics officer branch.

The commissioned element on the squadrons would now solely be a few pilots and navigators and the RAF College, Cranwell, re-opened in 1946 to receive its first post-war intake of officer cadets for these 2 branches. For the engineer, signaller and air gunner officers, only a meagre handful of specialised posts remained. Men like Ken Saxby and Tom Clarkson were told that they had no future in the RAF and were invited to leave at the earliest opportunity. The NCO element fared little better. Apart from the pilots and navigators, the remainder would be drawn from groundcrew for a 3 year temporary aircrew tour. The only exceptions to this were the ex-wartime NCOs who were afforded a protection of their permanent status. Each of the non-commissioned branches was divided into 2 grades, denoted by the suffix 'A' or 'B'. In the case of the engineer, having previously been a Group 1 tradesman entitled one to the more prestigious and higher paid 'A' classification. The branch titles were also modified, each becoming one word preceeded by the generic term of 'Aircrew'; as in 'Aircrew, engineer' and 'Aircrew, gunner'. On the 5 September 1946, the title of 'flight engineer' was declared obsolete. The new ranks also incorporated the branch name, and for the engineer ranged from 'Master Engineer', equivalent to warrant officer, down through 'Engineer 1' (usually shortened to E1) at flight sergeant level, 'E2' equal to sergeant and 'E3' and 'E4' placed on a par with corporal!

In early 1947, even before it was fully introduced, the structure was subjected to amendment, which for the engineer increased his term of aircrew service from 3 to 5 years. Concurrently, promotion through the new ranks was detailed. On receipt of his flying badge, the engineer became E4. Having completed his conversion and on being posted to a squadron, he was promoted to E3. Advancement to E2 was after 4½ years service from entry into training and was also linked with professional ability. Only the ex-wartime men would be able to go further, aided also by a decree that service during hostilities counted as double-time. The actual rank badges* were first issued on the 12 June 1947.

Notwithstanding the author's biased viewpoint, it is far too easy to see the 1946 aircrew trade structure as a vehicle for re-establishing the pre-war pilot and navigator† (observer) condominium and equally difficult to see it as an honest exercise in building from the experiences of a recent war to obtain the best possible standards throughout all aircrew branches. The engineers, gunners and signallers were deprived of their leadership, with a rapidity which was almost indecent, and then denied the opportunity to develop a structured corporate identity by being placed on temporary terms. It is true that in 1943, when the first 'pure' flight engineers had completed their tours, they became a short term embarrassment as regards further employment. The previous year however, the losses of tradesmen on a temporary flying appointment had caused real problems, not trivia about redeployment. In a peace-time environment, the concept is even harder to justify. Unhampered by such problems as flying and battle fatigue, which the finite tour length had allowed for, there was no reason why an engineer, gunner or signaller should not enjoy a full aircrew career. The new rank system thinly disguised a general devaluation of NCO aircrew. As P3, a pilot might be responsible for a bomber and its crew, yet he was rated the equal of a corporal who ran the bedding store.

* APPENDIX 19

† The air bomber disappeared in 1946.

The almost universal dislike of the structure, by aircrew who were subject to its contingencies, found a focus in the rank badges. During the Berlin Airlift, Marshal of the RAF, The Lord Tedder inspected a line-up of Hastings' crews in Germany. Upon enquiry of N1 Naylor his views on the new rank badges, the considered reply was "They make bloody fine jam labels, sir". In regard to the intrinsic design, the comment is superficially amusing. In the context that the badges were the visible label to the structure, it was a succinct reflection of contemporary opinion.

One positive effect was the expansion of engineer training at St Athan. Not, as yet, for ab-initios, still passing through in ones and twos, but in the form of refresher courses for the ex-wartime men now returning to flying. Having undergone selection and medical examination for the second time, they returned to No 4 S of TT for a short period in order to brush off the cobwebs. These courses had commenced by September 1947 and continued until all engineer training ceased in 1951. Instruction was only given on one aircraft, up to 1949 the Lancaster and for the final 2 years its successor in Bomber Command, the Avro Lincoln. As before, there was no flying programmed into the syllabus, although ad-hoc trips were sometimes arranged on aircraft from the Station's Maintenance Unit. The scheduled length of the refresher course is difficult to ascertain. Over the entire period it is usually quoted as 17 weeks however it is sure that Stan Piper and Tom Clarkson, who re-engaged as an NCO, only stayed for 12 weeks. Possibly, with 17 weeks as a standard figure, the actual period was adjustable dependent on an individual's ability and previous experience.

Both peace and the new aircrew structure appear to have left the operational Commands unimpressed. There were few changes for changes' sake. Among other aspects, the old war time crew complements were retained and new aircraft had their cockpit layouts designed to fit the requirements of the operator. Aircraft transferred between Commands, such as Lancasters to Coastal, were re-crewed in line with this policy. In August 1945, Bomber Command received the first Lincolns, a Lancaster development which became the first standard post-war bomber. Within the entirely new airframe were the tried and tested Lancaster systems, modified wherever short-comings had appeared. Whereas the Lancaster engineer had coped with occupying the co-pilot's position and monitoring a systems panel set behind it, the Lincoln was designed from the outset for single pilot and engineer operation. The panel, basically Lancaster, except for a revised fuel system, was re-located forward, beside the right hand seat. Transport Command had standardised on the York, with 2 pilots and an engineer, in the strategic role and the adaptable Halifax, with its old bomber crewing, as the mainstay for tactical work. Although the York had a recognised engineer's position, it omitted to provide the luxury of a seat and despite the longevity of some examples, can honestly only be considered as a stop-gap. In 1948, the replacement arrived, not only for the York but also the Halifax, for the Handley Page Hastings was specifically a tactical transport, with a large freight door and the capability of air-dropping men and supplies. However, with its highly respectable 350 MPH top speed and the increased range of the Mark 2 version, it was also an excellent strategic aircraft, only superseded when the turbo-prop Bristol Britannia entered service. The record of the Hastings was unfortunately marred by accidents at the beginning and close of its career, between were many years of sterling work. The Hastings carried 2 pilots and an engineer, a scheme which was henceforth the standard Transport Command arrangement. Immediately to the rear of the pilots were grouped the navigator, signaller and engineer, the latter with his own comprehensive aft-facing panel with many systems showing their family lineage from the Halifax. There was also a set of engine controls, duplicates of those on the pilots' throttle box, except for being shorter in length, the aim was to allow the pilot extra leverage should he decide to over-ride the engineer's inputs.

The Avro Lincoln, which superseded the Lancaster in Bomber Command

Handley-Page Hastings

Between 1947 and 1949, more changes were made to the aircrew structure as it affected NCO service, a disturbing indictment on the amount of detail planning which had originally gone into this aspect. Direct entrants were welcomed back, initially on an 8 year engagement but this was further modified in 1949, when they were given the opportunity to extend this term to a full 22 years. The suffix 'B' was also dropped from the description of the less highly qualified aircrew but this was in the nature of an administrative exercise. The division remained, the distinction now being between 'Aircrew (A)' and just 'Aircrew'.

In 1948, all aircrew training was placed on a new footing. Known as the 'All-through' programme, the major provision was for all instruction, up to the award of the aircrew badge, to be carried out at the same unit. Pilot training under the auspices of this programme commenced at Feltwell in 1948 and, as a stop-gap measure, 2 ad-hoc engineer courses were quickly arranged at St Athan. Drawn from the tradesmen who had volunteered in 1943, with approximately 10 men, ranging from corporal to flight sergeant, on each course, the training lasted about 6 months and was geared to the Lincoln. The Berlin Airlift resulted in a shortage of Hastings' crews and most of the 20 engineers were re-directed straight into Transport Command, contrary to the existing policy of only employing experienced aircrew for this duty. In December 1948 the first ab-initio engineer course genuinely sponsored under the new scheme arrived at St Athan. All-through training was nothing new to the engineer. Effectively it had been in operation since No 4 S of TT started aircrew instruction in 1942 and the excellent record achieved during the war may well have gone some way towards instigating its present, universal, adoption.

The new engineer's course duration was set at about 64 weeks, the longest it has ever been, either before or since. The first 3 months was a practical workshop phase for DEs and servicemen outside the Group 1 trades. It commenced at basic metalwork and culminated in the dismantling and re-assembly of an aero-engine. At the end of this phase they were joined by the Group 1 tradesmen, who would become 'Engineers (A)', and commenced a year of flight engineering study. Specific type-training was omitted, the course now being of a length whereby the different systems of all relevant aircraft could be taught generally and final instruction on specifics became the province of the Conversion Units. This approach also facilitated changes between aircraft types during an engineer's career, a factor which had been irrelevant during the war. Another departure from previous practice was the inclusion of flying in the syllabus, although the amount was minimal. Typical hours flown over a period of 2 days by Mike Cawsey on No 12 Course, were 15½, in 3 sorties, completing 4 exercises.

Although this training was now only one facet of No 4 S of TT, it did rate separate squadron status (No 6) within the School and occupied its own exclusive workshop-hangar on St Athan's East Camp. Initially the squadron was commanded by an engineer, Flt Lt "Jimmy" James. When Flt Lt James was posted from the School, he was replaced by Sqn Ldr Gotham, a navigator! Another engineer, Flt Lt Capucitti, appears to have remained in post, as second-in-command, throughout the life of the all-through courses. Following his refresher course, Tom Clarkson became the Chief Instructor and the staff were predominantly engineers. The courses were normally about 18 strong with about ⅓ being DEs, either on a regular engagement or as national servicemen. There was a 6 week gap between each new intake and the scheme ran like clockwork up to the end of 1949, when No 9 Course entered training.

In 1950, it appeared that the Cold War, which had been growing progressively warmer since the Berlin Blockade, was going to explode into another global conflict with the fuse as Korea. In the frantic expansion of the Services which occurred, plans were made to increase pilot training tenfold, from 300 to 3,000 a year and 500 ex-

The direct entrants of No 12 All-Through course at St Athan in 1950. Top left is Jim Mutsaars, now Wg Cdr and bottom centre is Mike Cawsey, now Sqn Ldr.

navigators were asked to re-enlist for extra service. In material terms a notable gain was the loan from the United States of 70 Boeing Superfortresses, renamed 'Washington' in British service, under a mutual arms aid agreement. To meet the demands for engineers, 2 new, short, courses were established at St Athan to run alongside the existing all-through training. One of these was for national servicemen, the other for regular airmen and they are believed to have been of 18 and 12 weeks duration respectively. Instead of receiving their flying badges at a formal graduation parade at St Athan, the men on the short courses had to wait until they had successfully completed flying training conversion and were posted to a squadron.

The Aircrew 1 to 4 rank system was officially abandoned on the 31 August 1950, under the provision of AMO A545/50. Aircrew 1 were re-graded as flight sergeants, the remainder became sergeants and only the master rank remained. Its retention was due to it not being an exclusively aircrew nomenclature, the ground tradesmen having master technician as their warrant rank. Generally the system had caused a great deal of confusion, especially when the aircrew status was being interpreted by members of the other 2 services, who automatically tended to equate engineer, signaller, etc., with the likes of seaman and bombardier. This AMO also marks the demise of the 1946 trade structure as originally envisaged but, apart from the aforementioned rank changes and the welcome re-introduction of flying pay, most of the provisions of that structure remained in force and had to be amended piecemeal over the following years.

Within a year, the branch had come to be known by its present title of 'Air Engineer' but it would appear that this name was assumed, not authorised. From 'Aircrew: engineer', it is an easy corruption to produce the new title and 'Aircrew: gunner' reverting naturally to their old name of air gunner would have set the precedent. Another clue to the unofficial nature of its origin is still evident in the 'master' ranks. Those which pre-date 1950 are still simply titled 'Master Engineer, Signaller, etc.' whereas branches introduced later include the word 'air' in the rank, as in 'Master Air Electronics Operator, Air Quartermaster and Air Loadmaster'.

Although Korea was fortunately de-escalated to the level of a localised conflict, with the only engineers involved being those on 3 Sunderland squadrons, there are few signs that the branch was overmanned in 1950 and 1951. Most graduates had a 3 month waiting period for OCUs, but this was just a bottleneck in the training progression, vacancies were still present on the squadrons. Apart from the Washington, the Avro Shackleton was arriving in Coastal Command and would be augmented in 1952 by Lockheed Neptunes, all these aircraft requiring engineers. It is therefore strange that between March and August of 1951, the hectic pace of the 3 tiered St Athan training was not just contracted, but braked to a complete standstill and the engineers' school closed.

Two possible reasons for the sudden closure present themselves. The first is that Technical Training Command decided to divest itself of its only aircrew training responsibility. The speed with which the closedown was accomplished would tend to point in this direction but it is difficult to believe that having nurtured the branch for 9 years, TTC would suddenly reject it. The second theory pre-supposes that Bomber Command's influence was still paramount at St Athan. BC was the original driving force in the establishment of engineer training and the St Athan product was a reflection of BCs requirements. The minority users, Coastal and later Transport Commands, had little influence on the training machinery, even though St Athan was willing to cater for their needs. In 1951, the Lincoln was the mainstay of Bomber Command but changes were afoot. May of the year saw the first English Electric Canberras in squadron service, exchanged for Lincolns and throwing up the air engineers, air signallers and air gunners as surplus to requirements. The Canberra was an obvious winner from the start

and additional orders had been placed when the aircraft was still only at the prototype stage. It became plain, during 1951, that the Lincoln's days were numbered and if Bomber Command indeed did still call the tune at St Athan, the obvious move would be to contract, or maybe even cease, training.

The inter-related fortunes of St Athan and the engineer branch were reflected by a memorial which was erected in No 2 Workshop on the camp. It lists, on 22 boards, the decorations awarded to over 370 engineers*, including Norman Jackson's Victoria Cross. As a heading to these boards, is a simple statement, the more effective because it stands in stark contrast to the enormous task undertaken:

"No 4 SCHOOL OF TECHNICAL TRAINING

IN THIS WORKSHOP BETWEEN THE YEARS 1941 (sic) - 1951 TWENTY TWO THOUSAND FIVE HUNDRED & NINETY NINE FLIGHT ENGINEERS INCLUDING THE ALLIED FORCES RECEIVED THEIR AB-INITIO TRAINING"

In 1982, the OC of No 4 S of TT, Wg Cdr P G E Murray, generously proposed that the memorial be transferred to the present Air Electronics and Air Engineer School, a project which received the enthusiastic support of the AOC Training Units, AVM F D G Clark. On the 30 November 1982 the memorial was re-erected in its present position at RAF Finningley.

* APPENDIX 20

The Flight Engineer Memorial moves from St Athan to Finningley in 1982. Sqn Ldr Rose of No 4 S of TT hands over Norman Jackson's VC citation to Sqn Ldr Mike Cawsey, OC Air Engineer Training Squadron.

CHAPTER 9

Formal ab-initio air engineer training ceased in August 1951 for a 9 year period and the branch, generally, was allowed to stagnate at the very time that the Air Force as a whole was moving rapidly into the nuclear age. The unfortunate baselines on which this stagnation was allowed to occur, those appertaining in 1951, were in fact little altered from the near-disasterous 1946 aircrew structure. The 2 tier system remained, with the air engineers (A) receiving preferential rates of pay and, together with the ex-tradesmen from outside Group 1, expected to return to the ground after a 5 year aircrew tour. Opportunities to extend existed, but only for 1, 2 or 3 years total. DEs, initially engaged for 8 years, but now with the chance to go on for a further 14 would, along with the war-time flight engineers, theoretically become the backbone of the branch, bringing continuity and stability. They would also be rated as second class and paid commensurately. The only positive amendment was the re-introduction of commissioning, on branch terms. Although this provided an avenue for tradesmen who wished to remain on permanent flying duties, more importantly it signified a start to the process of regaining representation at higher levels.

This less than ideal situation was further exacerbated by the differing utilisation in each of the Commands. Without agreement on their requirements of an engineer, there was little chance of them forming a united front in order to get his terms of reference amended and updated. Coastal and Transport, at this period, tended to isolate their engineers from the flight deck, not only by the positioning of his station but also in mental attitudes. This process was a 2 way affair, nobody questioning or monitoring the operation and control of the engineer's systems. Bomber Command also expected its engineers to carry out the routine duties but, on the 2 man flight deck, integration into the pure piloting aspects was total. The cross-monitoring function, which in modern practice is taken for granted, was both sustained and developed here. In fact the engineer was required to demonstrate a fair degree of flying skill and this was checked on the yearly categorisation – by another engineer!

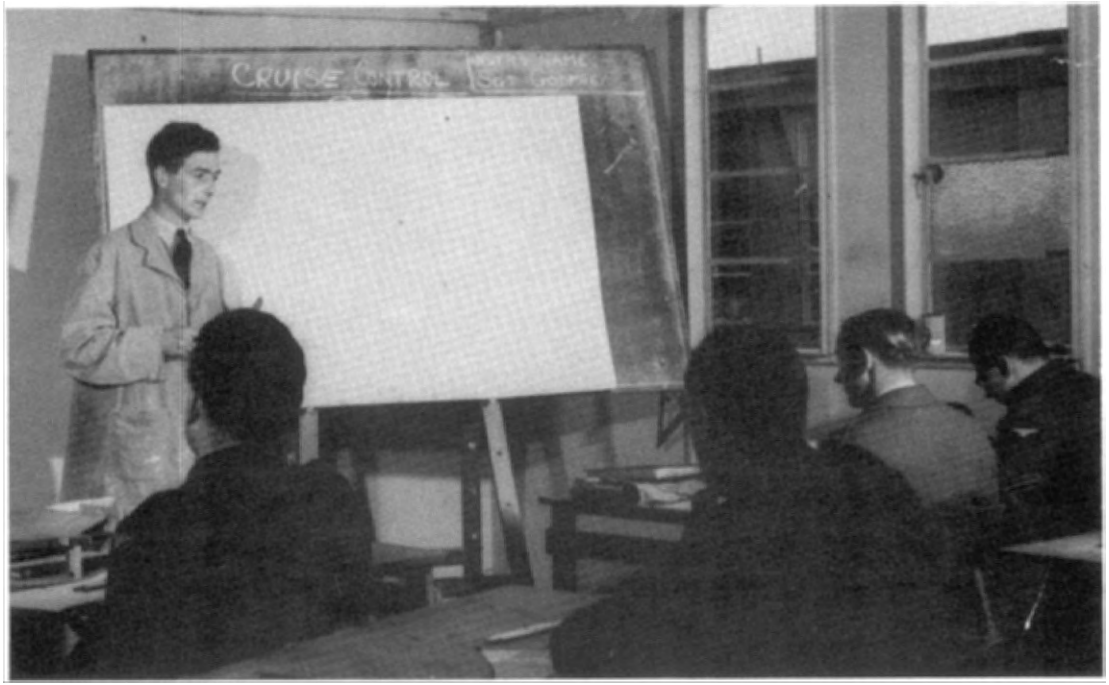
Ground aspects also exposed different emphases. Generally engineers (A) were required to maintain their trade proficiency, whilst the remainder were expected to work to a basic mechanic level. In order to satisfy these requirements, all Commands usually detached their engineers for a fortnight in every year to the hangar floor and, despite the limited period, the standards attained were quite high. Direct Entrants being well able to organise an entire engine change. It was Transport Command alone however, who required the regular employment, in depth, of this type of skill. TCs aircraft often landed at airfields with no RAF servicing facilities and the engineer was expected not only to carry out the normal refuelling and re-oiling but also to rectify any defects before the scheduled take-off time. Not as yet protected by a crew duty time, many engineers worked right through the period of a stop-over, then climbed back on board the aircraft to operate for another leg.

Before the advent of the air quartermaster in 1962, another facet which involved all engineers was the calculation of the aircraft weight and balance. Whereas bomber and maritime aircraft normally carried standard loads which were reasonably easy to compute, once again the Transport Engineer had his work cut out. Firstly he would probably have to organise and assist in the loading of his assorted cargo, ensuring it was correctly distributed and properly tied-down. Finally he had to check that the relationships between payload, fuel and all-up weight gave adequate safety margins around the multitude of relevant flight parameters.

The state of the branch through the 1950s was grossly unhealthy but external symptoms of the problems were slow to appear. AMOs were published at sporadic

Boeing Washington

Lockheed Neptune



An OCH Groundschool of the early 1950s. Maurice Godfrey instructs cruise control on the Boeing Washington.

Flt Lt Ken Owen at the Engineer's Panel of the Boeing Washington

intervals,* carrying the same non-commital message: "Recruitment is presently in abeyance ..... (but) open from time to time for those men from related trades." In fact the only known recruiting during the entire period was from engine and airframe fitters who worked on the major OCU of each user-Command. The personal tuition which could be given to this trickle of replacements, on an OCU course which was normally extended, tended to ensure a satisfactory quality of engineer. These men would be promoted to, or established as, sergeant air engineer (A) and placed on the normal 5 year temporary aircrew engagement. The majority of these stop-gap replacements were inducted in the early part of the period, many in 1952, more weight to the argument that overmanning was not intrinsically the cause of the cessation of formal ab-initio training. In 1952, Jim Norval, a corporal engine fitter at Kinloss, was remustered to fill a vacancy, not on the landplanes which were the province of Coastal's Kinloss OCU, but on the venerable Sunderland.

Despite the phasing out of the Lincolns, the first glimpse of any surplus did not appear until late in 1952. From this time about 20% of Boeing Washington co-pilots were drawn from the air engineers. Once trained, there was no integration between them and the operating engineer, each being solely responsible for his own department. The fact that this is the first time overmanning can be discerned makes it relevant, however it was a minor utilisation, absorbing at the most 30 men. Most of the Washingtons were returned to the United States during 1954, in an operation termed exercise 'Home Run', although a minimal number were retained until the end of the decade. For the first time since demobilisation there was now a large pool of unemployed engineers, but prospects for these men were bright. The first of the 3 V-Bombers was shortly to be introduced and some engineers already held provisional posting notices to the new aircraft.

There is no doubt that Bomber Command intended to pursue its general policy of one pilot and one engineer on the V-Bombers. Even today, over 25 years after its introduction, the Vulcan demonstrates this clearly in its cockpit layout; the co-pilot's position being surrounded by the system controls. In fact it is a logical family progression from the Lancaster and Lincoln. Why then, in the interrim between initial specification and introduction to Bomber Command, was this policy altered and a co-pilot substituted for the engineer?

The first of the Vs, the Vickers Valiant, entered squadron service in 1955, its introduction delayed at a late stage when an in-flight fire destroyed the prototype. Stan Piper was physically walking out of the gates at RAF Marham, leaving Washingtons and bound for the Valiant OCU at Gaydon, when the guardroom corporal called him back to inform him of the delay. On the 5 October 1955, Derek Butcher arrived back in this country after a Far East tour on Sunderlands. He was informed on the disembarcation interview that his next tour would be on Valiants and a formal posting notice would arrive through the mail while he was on leave. Tim Ware first flew in the right hand seat of a Valiant in October 1954. As an air engineer, seconded to the Ministry of Supply, he then operated the aircraft regularly during a tour at the Telecommunications Flying Unit at Defford. He was informed that his subsequent tour would be back in Bomber Command but remaining as a Valiant engineer. Late in 1955 the change of policy occurred. Stan Piper was re-posted to Shackletons and started his preliminary gunnery course at Leaconfield in October. Derek's posting notice duly arrived, simply stating 'RAF Manby' and it was only after his arrival on the unit that he discovered he was now flying on Lincolns. Tim Ware went to Transport Command as Engineer Leader on No 216 Squadron, responsible for introducing the Comet 2 into service.

* AMOs A301/52, A115/55 and A2/57.

Vickers Valiant

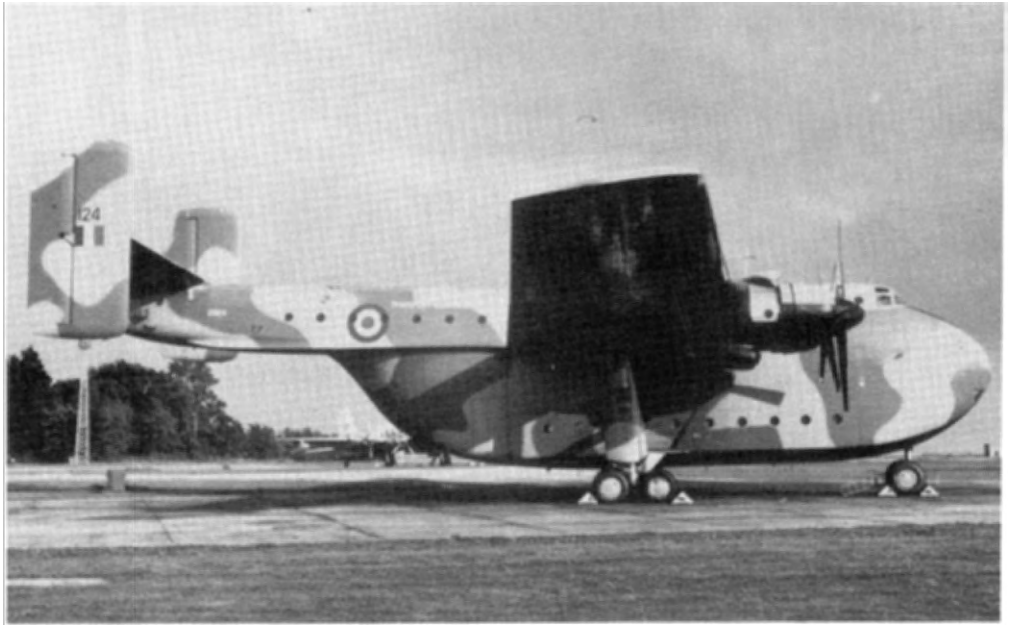
Dehavilland Comet Mk2

It would appear that at the root of the change was a decision by Bomber Command that its aircraft would henceforth operate with an all-commissioned crew. The return of the Washingtons made over 100 engineers available but only a handful of these were officers. Rather than commission engineers wholesale, a re-appraisal of the aircraft operating considerations would have indicated that the engineer's job was within the scope of a co-pilot. Compared with the Washington, a 10 year old machine but still reflecting the zenith of piston engined aircraft design, the pure jet V-bombers were far less complicated. The change from 4 twin turbo-charged radial engines to jets was itself a major simplification. Two engineers who taught Valiant, and later Victor, systems on the ground school of the Gaydon OCU, also became qualified to fly in the right hand seat of the aircraft. It may be coincidental, but both of them, Flying Officers Olliffe and Godfrey, were newly commissioned, yet they had previously been employed on the Washington OCU filling very similar posts quite satisfactorily as NCOs. During the next 3 years, Maurice Godfrey managed, as an aside from his primary duty, to fly 375 hours in these aircraft.

The new aircrew branch of air electronics officer was created at this time, primarily, but not exclusively, to fill a requirement on the Vs. Uninformed opinion has often jumped to the superficial conclusion that, because the engineer was dropped from the V-force and the air electronics officer introduced into it, the latter replaced the former. Apart from such points as the new branch occupying a rear seat in all the V-bombers, whereas the engineer was displaced from one at the front, the most obvious disclaimer is the date of introduction of the AE officer category. This was on the 8 March 1956 (AMO A54/56), the year after the engineer had been replaced. The AMO establishing the AEO Branch does, however provide one piece of information. Despite the introduction stating that: "They must possess sound technical ability ..... to a degree greater than has hitherto been required of air signallers, ...", the provisions detailed later on in the text entirely contradict this. Commissioned signaller leaders with an average assessment and NCO air signallers (A) with the normal base trade qualification, would be assimilated into the new branch with absolutely no further professional training (Although the NCOs obviously were required to undergo an officer training course). The only unique factor about the AE officer branch was simply that it rated a commission. This tends to add weight to the idea that an all commissioned crew was prescribed for the V-bombers.

Bomber Command never again employed engineers on front line aircraft although one tradition was maintained, to this day some engineers on ground tours are posted as instructors to bomber OCUs. Tradition however was little use in 1955 to an aircrew branch which had suddenly parted company with the Command which had created and shaped it. The engineer's continued existance, let alone progress, was totally dependant upon Coastal or Transport Command, up to now the slightly apathetic employers of someone else's child, taking over the parental responsibility.

Three years later, in 1958, Transport Command took on the task, not really through choice but force of circumstances. The introduction of a new generation of aircraft was the catalyst dictating this move. Whereas Coastal soldiered on with the Shackleton right through until 1969, Transport had accepted both the Comet and Beverley in 1956 and the Bristol Britannia was due, in large numbers, in 1959. The Comet boasted an engineer's flight deck position with side facing systems panel, an arrangement which was to become standard on most jet airliners. The Beverley was the antithesis of the graceful Comet, completely utilitarian and powered by 4, 18 cylinder Bristol Centaurus radial engines, a power-plant originally designed for fighter aircraft and which consequently gave high power but at the expense of reliability, desired for transport operation, and a legendary oil consumption. The Beverley entered service cleared for 2 pilot operation, although a small nucleus of engineers was posted to the squadron and used to augment the 2 pilots on longer routes. A year after its introduction, one aircraft, without an engineer,



Blackburn Beverley

Bristol Britannia

was lost in an accident at Drayton village, near Abingdon. The subsequent enquiry revealed that a non-return valve in the fuel system had been fitted the wrong way around. A major recommendation of the enquiry, later endorsed and adopted, was that an engineer became part of the basic crew complement.

Transport Command's airborne utilisation of the engineer as a plain systems operator, isolated in his own cubicle, died with the Hastings. Experience with the Beverley and more especially the Comet, established the necessity for a crew member capable of integrating into, and monitoring, aspects outside his own specialisation. The arrival of the Britannia would not only reinforce this new view but also demand a depth of electrical engineering knowledge far surpassing any previous aircraft.* Some idea of the electrical complexity of the Britannia can be gauged from the fact that there was not a single mechanical linkage between the cockpit and the engines. Throttles, propellers, fuel valves, anti-icing systems, etc. were all operated by electric actuators. In case of failure on the major controls, standby systems were installed – also electrically operated.

An aircrew redundancy scheme was initiated in 1958, designed primarily to reduce the numbers of signallers, air gunners and engineers who had been displaced from Bomber Command and were now surplus to flying requirements. The scheme was such a success, with large numbers being discharged, that within a year the signallers and engineers moved into a situation of critical shortage.

The remustering of fitters direct to engineer duties must have appeared an ideal situation to an Air Ministry which considered mainly the simplicity, costs and results of the system. This superficial success however, masked basic inadequacies which would readily become apparent if the throughput was increased by even modest numbers. Behind the facade, OCU staff worked hard to load the odds in favour of the few fitters who became engineers. The process started at the selection stage, where just the very best could be accepted. A good, adaptable engine or airframe fitter would have little difficulty assimilating the purely mechanical aspects of an aircraft and as most were carefully posted to older machines, their knowledge of instruments, electrics and airmanship could be left at a basic level. The numbers of men imposed little load on the instructional staff who could therefore devote a considerable amount of attention to each trainee. The system resembled a house of cards, good in appearance but ready to collapse under the weight of any sizeable increase in recruitment. The quality of men would fall, the OCUs would be unable to cope with the numbers of their fitters lost, first tourists would be required on far more complicated aircraft and an intolerable burden would be placed on the OCU training staff.

Transport Command assumed the patronage of the branch in 1958, when a Staff Engineer post was created. For the first time, an air engineer had access to a direct line of communication with the Air Ministry. The original incumbents of the new post, Flight Lieutenants Allan Mundy and Dave Nelson who succeeded him in 1960, used this opportunity to the full and, aided by Flt Lt Ken Owen from Transport's 242 OCU, inaugurated the revival of the air engineer branch by successfully campaigning for the re-introduction of formal ab-initio training.

* Except, perhaps, the Valiant.

CHAPTER 10

Early in 1959, Dave Nelson, seconded temporarily from Comets and No 216 Squadron, together with Ken Owen, travelled north to talk with their opposite numbers within Coastal Command at the Kinloss OCU. The object was to gain support so that any future recommendations made to the Ministry could be said to have the backing of both major employers. Two other factors also added weight to the case. Air signallers were about to re-open ab-initio training, and it had already been found necessary to give Britannia engineers pre-employment electrical courses. These courses were situated at No 12 School of Technical Training, RAF Melksham, and took the form of a modified electrical fitter's course.

Signaller and engineer training restarted in 1960, both trades having suffered from the over-effectiveness of the 1958 redundancy scheme, but any similarity ended there. Signaller training had been halted only 3 years previously, not 9, and their School had not closed, merely moved to Hullavington from Swanton Morely and contracted to train just AE officers; so an expansion of the facilities was virtually all that was required. Air engineers, starting again from scratch, had no chance, as yet, of getting their own purpose-designed course and the best which was offered was use of an existing system for training crew-chiefs. Crew-chiefs were mainly employed on the V-bombers filling, to a certain extent, the void left by the engineer's demise. Although they held no in-flight duties, their technical knowledge was broad-based and of a high standard. The complete course consisted of training to fitter standard in the engine, airframe, electrical and instrument trades and was of 8 months duration. It was not exactly ideal but to a branch which had suffered nothing but contractions in both training and employers for over a decade, any expansion, no matter how minor, represented the beginning of a new era.

Recruitment for engineers re-commenced in 1959 from senior technicians (a rank roughly equating to sergeant) of the engine and airframe trades. To state that response was poor, might be construed as understatement. To fill over 30 vacancies on the first course, there were just 6 suitable volunteers. In fact this should have been to the surprise of no-one for, by restricting entry to senior technicians without revising the conditions of service, it was almost a foregone conclusion. How many senior non-commissioned officers were expected to willingly undergo more than a year of intensive training for a totally new job, receive only marginally more pay for their efforts with the prospect of returning in 5 years to the problems of re-integration into their original trade. No 1 Course was postponed, several crew-chiefs assimilated directly into the branch to fill immediate vacancies, and the engineer's terms of service were quickly altered. The field of recruitment was expanded to include electrical and instrument fitters, and the limitation on rank reduced to encompass corporals and corporal technicians. The length of aircrew service was increased to 6 years but, for the moment, there was no change to the temporary aircrew concept. The prospects of quick promotion and enhanced pay proved sufficient enticement to many at corporal rank, and with its numbers filled, No 1 Course convened in the autumn of 1960.

Engines and airframes were taught consecutively during the first 4 months at No 8 School of Technical Training, RAF Weeton near Blackpool. A short period of leave in the middle of the course was followed by a further 4 months at No 12 S of TT, RAF Melksham, where electrics and instruments were covered. Although everyone on the course was qualified in one or another of these 4 trades, no dispensation was given against previous knowledge. Badges were only awarded when the subsequent OCU course was successfully completed. Later, when engineers were posted directly from basic training to helicopters as crewmen, not technical specialists, this proviso led to complications. In order to comply with the letter of the law, these men firstly undertook a fixed-wing OCU, normally on the Gloster-Whitworth Argosy, collected their badges and then moved straight across to helicopter training.

Avro Shackleton Mk2

No 10 Air Engineer Course, photograph taken at RAF Melksham in 1963

Bristol Belvedere

The basic format of the course was such that it could never become an ideal vehicle for air engineer training. Although a sound knowledge of systems was imparted, it was always within the general framework of a fitters course and tended to reflect the attitudes instilled into ground tradesmen, which at times could be poles apart from those required of an airborne operator. The Transport Command Staff Engineer fought an incessant battle with Technical Training Command over the syllabus and in later years took representatives of the OCU Staff to visit every course completing training. The problems were compounded by a slow but definite shift of the job emphasis. Flight and fuel planning and performance had been added to the engineer's responsibilities. The whole situation initiated controversy as to whether the overall Air Force policy really reflected what was required of the Branch.* No 1 Course had arrived at Weeton to be met with disorganisation and disinterest and the men were passed through there and Melksham exactly as per fitters. Gradually, however, over successive intakes, efforts were made to put a bias on the instruction. A theoretical airmanship phase was added before the electrical and instrument training; instructors were dedicated to the engineer's course, but few had a sound appreciation of flight engineering and none had first hand experience. However the syllabus might be altered, the interpretation given to it by these tutors would always be a shortcoming.

Up until the end of 1963, the intakes were programmed at 3 month intervals but the problem of a lack of volunteers recurred, forcing the cancellation of 2 courses due to start in the winter of 1961/1962. Meanwhile, in typically contrary fashion, vacancies were opening up. In September 1961, the Belvedere helicopter commenced its chequered career and in the following year the Argosy transport was introduced. To Transport Command's persistent pressure for a radical re-organisation of the branch, was now added the force of circumstances and on the 24 April 1963, the major part of the battle was won. The announcement came in AMO A147/63, the main provision of which was the re-introduction of permanent remustering to air engineer. As an adjunct to this, all former engineers who had completed aircrew tours and gone back to the ground, were invited to return under the new terms. In order to cope with the numbers required, and who would hopefully be attracted by the change, the interval between successive courses was halved to 6 weeks at the beginning of 1964, probably commencing at No 14 Course.

Although former and future engineers were covered by this AMO, those presently serving on 5 and 6 year engagements, trainees and even men awaiting courses at the time of issue, were already the subject of what amounted to a previous contract. This specified a fixed length aircrew tour, guaranteed the preservation of their position on the appropriate ground trade promotion roster, and was equally binding on both parties. The only legal method to circumvent it was to make individual offers of assimilation into the new system, in return for a signed waiver renouncing any allegiance to a ground trade. Some received such an offer immediately, others waited for varying periods but it is believed that no productive air engineer returned to a ground trade after 1966. During this 3 year change-over period, when men from both systems were working alongside each other, the anomolies between aircrew and groundcrew promotion were blatantly exposed. A senior technician, who adopted the aircrew rank of sergeant for his 6 year flying tour, could now be overtaken by a corporal with 11 years service who was on aircrew promotion rates and therefore moved up to flight sergeant. This threatened to become a source of internal friction and therefore probably hastened the offers of assimilation.

The gulf between the old terms and the new should also have shown itself at the

* APPENDIX 21

Weeton and Melksham Schools. Whereas previously, even while on the course, trainees reserved their groundcrew rights of rank, promotion and pay, those now engaged as prospective permanent aircrew should have been given the rank of acting sergeant, the status of aircrew cadet and had pay and promotion frozen for the duration of training. Although this was standard NCO aircrew training policy, by an oversight it was omitted from the AMO and also, quite naturally, overlooked at what were primarily groundcrew training establishments. It was not until late in 1963 that the mistake became apparent. A student became due for promotion to senior technician in his basic trade of airframe fitter. Whilst on one hand the RAF records section insisted that he was an aircrew cadet and therefore not eligible for promotion, the authorities at Weeton maintained that he was a corporal technician and liable to undertake any duties implicit in holding this rank. Nobody at Weeton was willing to take any action over this discrepancy and the case finally reached the desk of the Secretary of State for Air. The promotion was forthcoming but it was closely followed by a clarifying amendment to the AMO, forcing the training camps to recognise the status of trainee aircrew and firmly closing the loophole.

As National Service faded from the picture, the RAF went through a period of physical contraction and among the Stations scheduled for closure were Weeton and Melksham. By July 1964, demolition had commenced at Melksham and it was decided to resite air engineer training at its traditional home of No 4 S of TT, St Athan, for engine and airframe instruction, and at No 9 S of TT, RAF Newton, for electrics and instruments. The move was accomplished by stages, the first course affected being No 17, which passed through Weeton and the electrical phase at Melksham in the normal manner but then travelled to Newton in October 1964 for the final instrument phase. No 18 Course followed a similar pattern and by No 21 Course, which started in September 1964, the entire move was complete. Several civilian instructors also made the change-over, continuing their employment at the new venues. There was little noticeable effect upon the training. St Athan, despite the historical connections, appeared to take little interest and the major contribution from Newton was to interfere with the simple and concise Course numbering system insisting that each year's intakes restarted at No 1. Thus No 21 Course, upon arriving at Newton in January 1965, suddenly found that they had been transformed into No 1/65 Course. The stagnation occurred because the limits of course development had long been reached. Apathy had not engendered it, merely resulted from it. Fitter-based training continued until 1967 and the product, throughout the 7 years that it operated, demonstrated a consistantly high level of technical knowledge. Graduates were carefully posted* to the simpler aircraft of Transport and Coastal Commands. Equally consistant over the period was the air engineer's abnormally high failure rate at the OCUs.

The acceptance of the crew-chiefs' composite fitters course in 1960 was on the principle that it was the best option offered. It effectively gave half a loaf to a branch deprived of bread for nearly a decade. The compromise was accepted with more than just its immediate value in mind. It was the summit of what could be achieved using existing facilities and if it fell short in its purpose, then given time and the right circumstances it could become a powerful argument towards gaining a course uniquely designed for air engineers.

Following Allan Mundy's retirement in 1960, Dave Nelson became Transport Command's Staff Engineer. Ken Owen remained with 242 OCU, which in 1962 moved from RAF Dishforth in Yorkshire, down to Thorney Island on the South Coast. Ken opened the next round of negotiations in 1963, when he contacted the Staff Engineer,

* APPENDIX 22

on a formal basis, expressing his concern at the number of OCU failures. The problems which were arising, almost without exception, devolved from the lack of any previous flying training and ranged down, once again, to that simplest of medical aspects, airsickness. The end result in all cases was a year of wasted effort from various instructors, and the pupil himself. Dave Nelson passed the information upwards, using it to obtain agreement for Flying Training Command to sponsor the design of a new course.

Ken Owen, as Transport Command's acknowledged engineer training specialist, was detached to HQFTC at RAF Shinfield Park as co-ordinator of the work. From the outset, planning took account of the upheaval which would occur later when 3 new transport aircraft, the Hercules, VC 10 and Belfast, were introduced almost simultaneously in 1967. It would no longer remain feasible to direct all ab-initios towards the more basic machines, therefore, instead of pitching the level of training at the lowest common denominator, the technical content would have to reflect the highest common factor; the most complex aircraft and systems then in service, which normally equated to the Bristol Britannia. In 1964 the design was completed. The projected course was of 52 weeks duration and included an applied flying phase with 2 options for the training aircraft. The first involved modifying a DeHavilland (later Hawker Siddeley 125) Dominie by incorporating a side-facing engineer's panel. The alternative was an Argosy transport with facilities to duplicate the appropriate instrumentation at an alternative position in the freight bay. Both aircraft also offered the opportunity for conjoint training with other aircrew branches. It was an extremely ambitious plan but, strangely, the only item to draw immediate criticism was the most basic and logical provision that qualified air engineers held the bulk of instructional posts. The opposition argued that the OCUs and squadrons would be seriously embarrassed by the sudden loss of quality engineers in such numbers.

Ken initially envisaged the course being loosely integrated with navigator training but carefully avoided limiting himself to this option. In fact the capacity for accomodating the training emerged from a rationalisation of the air signaller, air electronics officer and air electronics operator branches. The Air Electronics School, which in 1962 had again moved, from Hullavington to RAF Topcliffe in Yorkshire, had been fully occupied with the multifarious training and cross-training which took place within the jungle of categories evolving from the basic air signaller. In 1966 this was all swept away in favour of a single ab-initio course for air electronics operators, paralleled by a short and small conversion course for qualified air signallers. It was now possible to set up air engineer training at Topcliffe gaining as a fringe benefit the advantages from having 2 ab-initio NCO aircrew courses under a single existing administrative organisation.

Ken Owen was recalled to Flying Training Command to implement his plans and well within a year, on the 13 March 1967, the first air engineer entry started professional training. The objections to using qualified engineers as instructors had evaporated in the interim, in fact he was given an entirely free hand over the choice and to this end MOD made available the records of every air engineer in the Service. The flying phase was the only major departure from the original planning. Finance dictated use of the obsolescent, unpressurised, piston-engined Vickers Varsity aircraft which were the present equipment of the Air Electronics School. Although this was an initial disappointment, a viable syllabus was quickly constructed around the student's occupation of the right hand seat. It would be fair to state that the results obtained from the flying outstripped all expectations.

On the 30 January 1967, Squadron Leader Ken Owen became the first OC Air Engineer Squadron at the inauguration of the combined Air Electronics and Air Engineer School. The new pattern of air electronics training had already commenced, so the first engineers to arrive formed part of No 5 Course with subsequent entries at 8

week intervals. Six weeks of General Service Training, to fit the student for senior NCO rank, preceded the year-long main course which followed normal practive to culminate in applied flying training. Within this standard framework, it was the range, content and excellence of instruction which soon established a reputation for quality. Considerable changes to the original format have subsequently been made but the course standards have never suffered from compromise. Quality is a nebulous term, results are explicit; the OCU failure rate which triggered the affair has, since the inception of the course, fallen to a literally negligable level.

The Staff of the Air Engineer Squadron, Topcliffe, in May 1969. Rear row, L to R, Cpl Scatcliffe, Sgt McGraw, M Eng Wilkie, FS Latham and Sgt Waters.
Centre row, Fg Off Hooper, M Eng Walton, Fg Off Kelly, M Eng Perry and M Eng Harris.
Front row, Flt Lt Cookson, Flt Lt Brown MBE, Sqn Ldr Owen AFC DFM, Flt Lt King and Flt Lt Davis.

CHAPTER 11

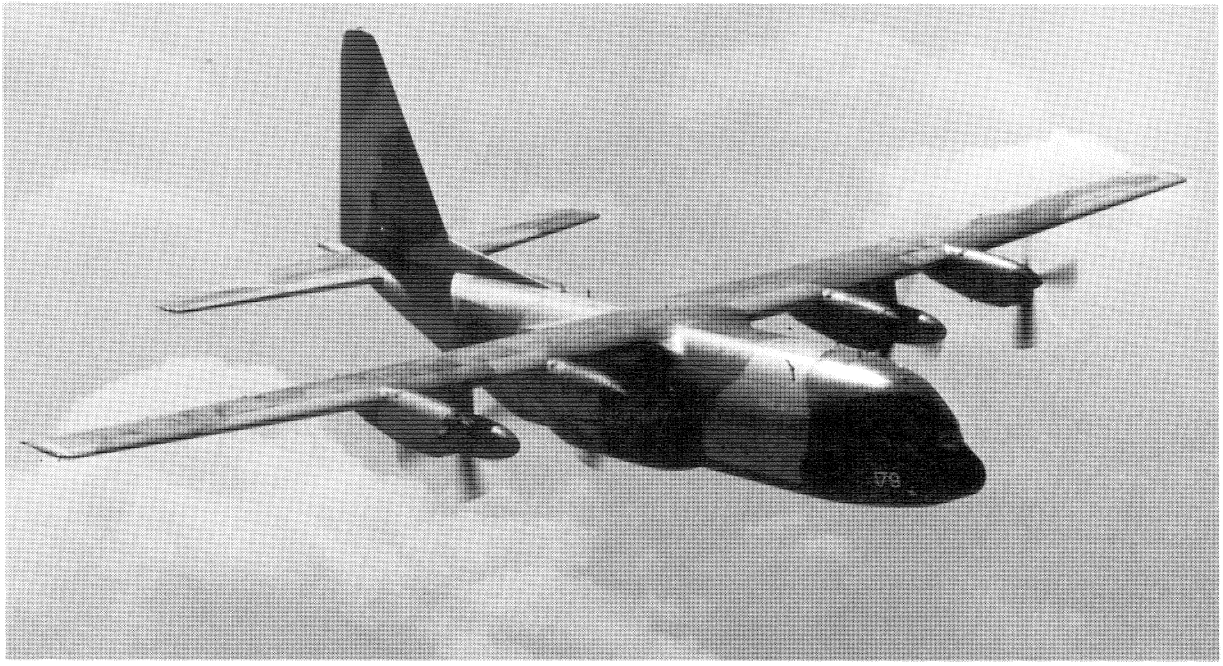
The establishment of the new course was the main factor towards modernisation of the branch but unsatisfactory peripheral aspects still lingered. Among these were the timing of the flying badge award, the demarcation between air engineer and air engineer (A), eligibility for training and onto which aircraft the trainees could be posted. A determined effort was now made to resolve the problems in order to place the branch in the forefront of current NCO aircrew.

The engineer's badge had, since the abandonment of the All-Through courses in 1951, not been awarded until successful completion of an OCU. The inclusion of flying training in the Topcliffe course automatically allowed the badge to be presented on graduation as with other established aircrew branches, although all of these awards were conditional until the end of the OCU. Until the late 1970s the graduation parade at Topcliffe was a major event in the life of the school, involving most of the training personnel. The reviewing officer was normally of Air rank although a notable exception occurred with No 16 Course when a retired warrant officer, Norman Jackson VC, took the stand.

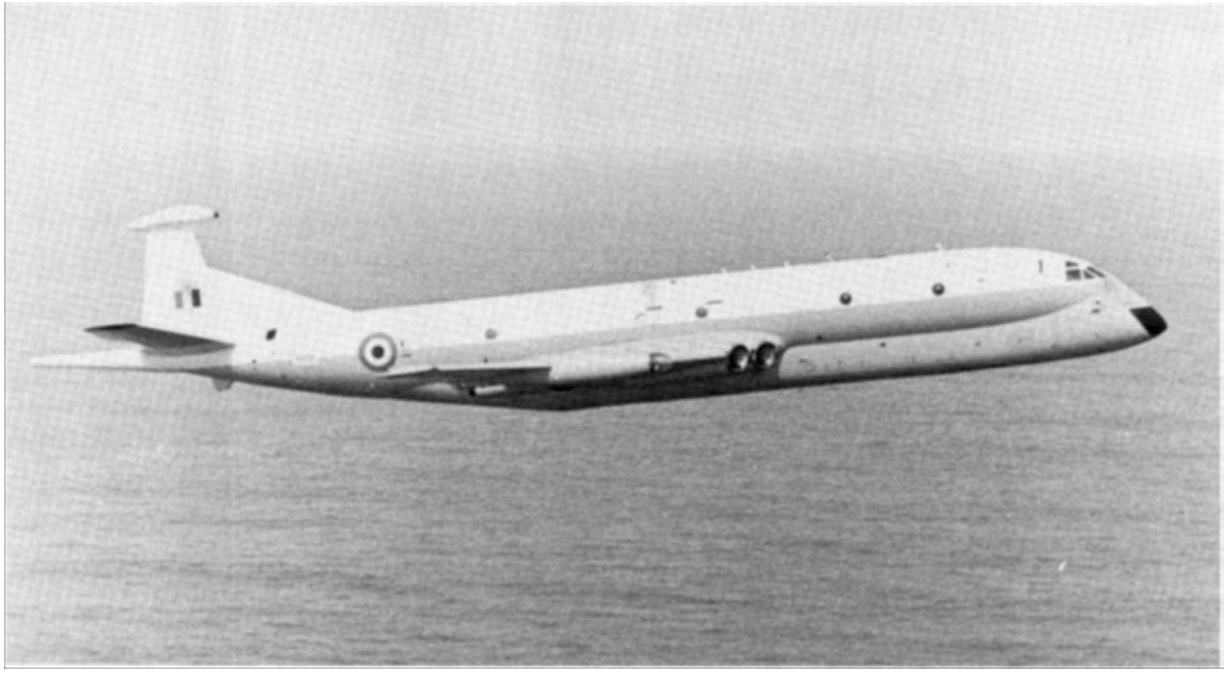
Eligibility was extended once more to direct entrants, the qualifications for application being 3 GCE O-levels, mathematics, English language and a science subject. As in 1943 and 1948, a specialised and comprehensive course had been established, giving the capacity for training from scratch. The required qualifications had changed somewhat since 1943, when a 20% mark on a basic mathematics paper was adequate. A unique feature of the present occasion was the minimal number of DEs who trained at Topcliffe during the first 5 years of scheme. Possibly, with 15 years having passed since the last DEs were trained, there was prejudice within the service, maybe even the branch itself, against what was virtually the unknown. The image of the air engineer as an elder crew member with hangar floor experience was firmly imprinted on many peoples minds. On the other side of the coin was the poor remuneration offered. In 1970, the pay of a sergeant air engineer was less than half that of his civilian counterpart. Despite the poor initial response from the intended quarter, the new conditions of entry attracted attention in a quite separate area. Within the service were willing applicants who, because of their rank or trade, had formerly come outside the limits of recruitment. With the right educational qualifications, their avenue of access was opened.

The picture of recruitment has changed radically over the intervening years to the present stage where there is virtually an equal ratio of DEs to serving airmen. Modification of attitudes and pay has been accompanied by cost consciousness. Even the training of ground tradesmen represents considerable expense nowadays and to convert these men to aircrew in preference to a DE, makes poor economic sense. In practice, the interrelation between the 2 groups during training brings definite benefits. A DE has the open-mindedness of one newly arrived in the service, the energy of youth and the capacity to absorb knowledge at a prodigious rate. Although air engineering has changed to the extent that a tradesmans specialist knowledge is of little relevance, he contributes experience, general service knowledge and maturity.

Amongst the training sponsored by the Air Electronics School before 1967, was a course to upgrade air signallers to air signaller (A) and a variation continued after that date, concurrently with the 2 ab-initio courses, converting master signallers to master signaller (A), which gave automatic qualification for the AE badge. Alone amongst the current aircrew branches, the air engineer had done nothing to resolve an internal division which was plainly irrelevant to modern utilisation. The decision to graduate every engineer from Topcliffe, regardless of background, as air engineer (A), added anomoly to the irrelevancy. Air engineers without the annotation, formerly and still colloquially known as air engineer (B), were direct entrants or men who had served outside the main



Lockheed Hercules Mk1



British Aerospace Nimrod Mk1

aircraft trade groups. Mainly ex-wartime flight engineers, or from the St Athan All-Through courses, they had given upwards of 15 years continuous aircrew service and in return received a lower rate of pay.

Although the solution was found in 1968, the problem had first been addressed in 1963, when engineers returned to permanent aircrew establishment. The protagonists were the Transport Command Staff Engineer and the Air Ministry, later MOD, civil servants holding the purse strings. The Staff Engineer argued that the division was not pertinant to modern operation, the civil servants refused to sanction what was effectively a pay rise for one section of the air engineers, unless some appropriate examination was passed which would provide corroboratory paperwork. The Staff Engineer was placed in an invidious position; any examination presented to these highly experienced men would be construed as questioning of their professional standards. If he and the civil servants agreed on the format of an examination which the affected engineers subsequently refused, en-masse, to even sit, then his whole credibility over this issue would be ruined and the matter closed, probably permanently. The negotiations were placed in abeyance and delicately re-opened, almost on an annual basis, in the hope of the civil servants relaxing their stance but to no avail. One suggestion made by MOD was to send the men on a fitters course for one of the 4 main aircraft trades, a precise answer in theory which must have appealed to the tidy, inflexible minds of civil servants. The impracticability of losing productive engineers for 2 months to gain an unnecessary qualification, always presupposing the men would actually agree to go, presumably was overlooked.

A compromise was reached in 1968; a single written examination, acceptable to MOD and, hopefully, the air engineers. Contrary to some opinion, the exam was not a mere formality. Although it was a basic test of flight engineering knowledge, it went to a considerable depth. The majority sat and passed the exam and were upgraded to air engineer (A). The minority stood on their dignity, refused, and quickly became an embarrassment to the rationalisation attempt. Various ploys were used to place them in close proximity to the paper and gradually their numbers were whittled away. It is rumoured that the last of these men on No 10 Squadron, possibly the last in the Air Force, was finally interviewed in a small office by a large squadron leader and invited to complete the examination before leaving. The 2 tier system thus ended somewhat scrappily and it is easy to deprecate the intractability shown on both sides of the fence. This however should not be allowed to cloud the worst aspect of the affair; how a poor provision from a bad trade structure was allowed to continue 18 years after the structure itself was abandoned.

Although, during the establishment of the course, changes from the original design had to be made, the concept of the graduates being fit for immediate conversion to any operational aircraft was not altered. The tradition however was difficult to break and for the first 18 months output was still directed exclusively towards the older, simpler machines. The mass influx of Hercules, Belfasts, VC 10s and, slightly later, Nimrods, replacing a large proportion of the obsolescent aircraft, forced the abandonment of this conservatism. No problems arose, fully vindicating the course design, and opposition disintegrated. Contractions in the transport fleet and the complete withdrawal of most of the earlier aircraft, presently limit the postings to either the Hercules or Nimrod, with a token number of exceptional students, approximately 2 a year, having their efforts rewarded by going to VC 10s.

In September 1973, as part of a cost cutting exercise, RAF Topcliffe closed and the Air Electronics and Air Engineer School moved to RAF Finningley in South Yorkshire. The move took place in 2 phases, covering a 6 week period, the ground training being re-sited during the first phase. About a month later, the aircraft and flying training

organisation followed. Training was established alongside but, at the time, completely independent from the existing navigator school. Planning however was under way to integrate the flying training of all non-pilot ab-initio aircrew.

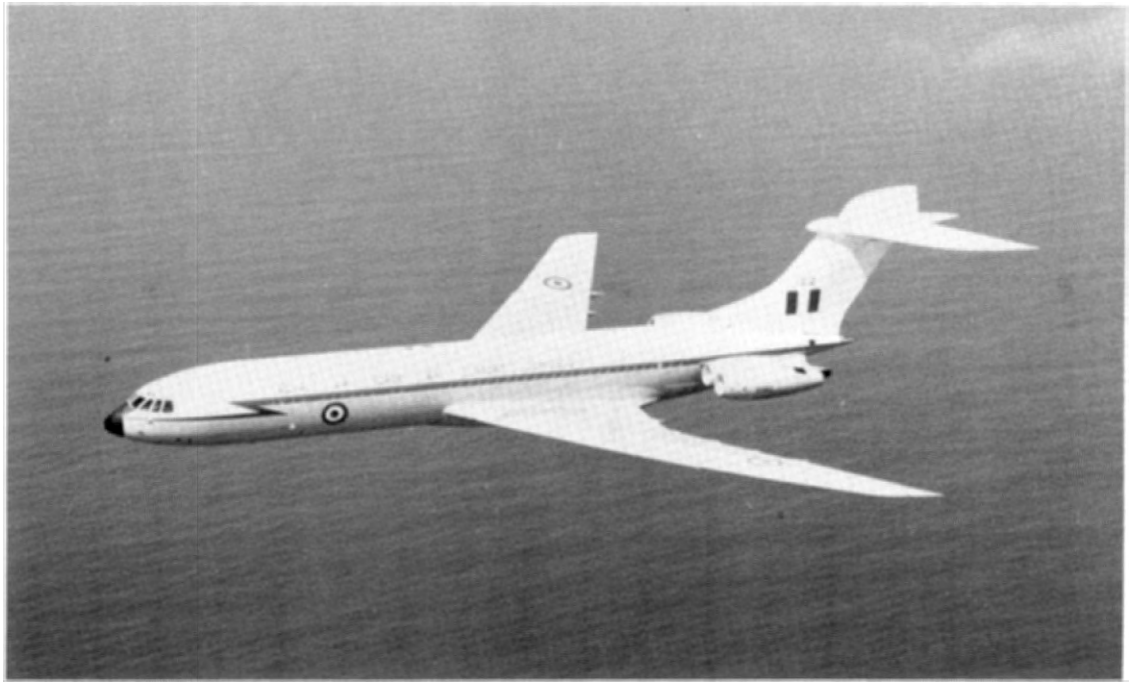
It had been decided to carry out all the flying training at Finningley on a common aircraft, the vehicle chosen being the Armstrong-Whitworth Argosy. The other aircrew categories had reservations about this choice, the air engineers none. It was an ideal blend combining the relative sophistication of a 4 engined aircraft with the individual system simplicity necessary in a basic trainer. Indeed, conjoint training on this aircraft had been proposed by Sqn Ldr Ken Owen, when he was working on the course design at FTC Headquarters, in the early '60s. Access, on a shared basis with No 115 Squadron, was available to the Argosy Simulator located at RAF Benson. With these resources, work started on the construction of a new syllabus. The first Argosy was delivered to Finningley and in March 1977, the last Varsity training flight took place. Although the aircraft had given excellent training value for the best part of a decade, another, even longer, link was broken and passed unnoticed. The Bristol Hercules engines, now silenced, and the flight engineer had both entered service in the Short Stirling, over 35 years previously.

The lone Argosy at Finningley existed in an aura which bordered upon secrecy, only flying at night or during quiet weekends and spending the remainder of the time locked in a hangar. It has been suggested that, as the aircraft was the first delivered, the handover from one Command to the other may have been slightly less than official. Unfortunately, not only was it the first delivered, but also the last; in the interests of economy, the Argosy project was scrapped in favour of the Hawker Siddeley Dominie.

The Dominie, with a pressurisation system and pure-jet engines, was technically a better training machine than the old Varsity and its employment, as an alternative to the Argosy, had been suggested to FTC in Ken Owen's original course design. The quality of Dominie flying now being offered, however, fell far short of the original idea. Ken had envisaged the aircraft being modified to incorporate a side-facing engineer's panel, whereas now the trainee would have to occupy the right hand seat. All flying was to be conjointed with navigator training and the flight profiles would be planned exclusively to meet the requirements of the navigators. The OC of Air Engineer Training, Sqn Ldr Dennis Crowson, reluctantly accepted this option. Dennis is a powerful protagonist in a conference, especially when the subject concerns his own branch, and only gave his agreement after being offered 70 hours of flying for each student. Within days this figure was arbitrarily cut back to an astonishing 20 hours.

With all these constraints it was plain that the flying could no longer form a final handling phase to the course without, in fact, becoming a retrograde step in training. The Argosy simulator, however, was still available and moreover, when No 115 Squadron retired their aircraft, the engineers could have its exclusive use. Not without some trepidation, it was decided to overturn the accepted conventions of aircrew training and when this was done, the outline shape of the new course, quite naturally, fell out. Training would start with academics and then basic systems instruction, geared towards the Dominie. The flying phase came next, its completion marking almost the mid-point of the course. This was to be followed by advanced training in more complex systems, preparing the student for a final handling phase on the Argosy simulator. Although the simulator was already life-expired, it was estimated that 5 or 10 more years, and another 5,000 hours, might be squeezed out of it. This was considered entirely adequate because the demand for air engineers had fallen rapidly and the throughput was now projected to be only 11 students per year. Training re-opened and the first 2 courses, Nos 71 and 73, were in residence when an unexpected manning shortage occurred in the branch.

Short Belfast Mk1

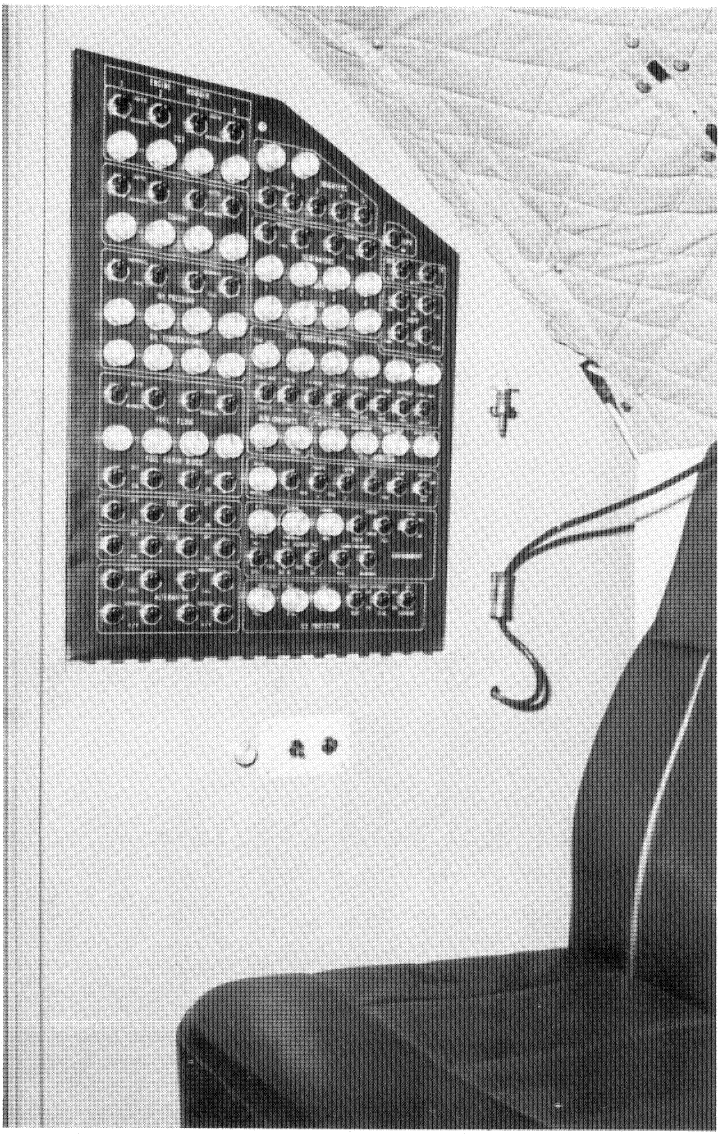


VC10 Mk1

The first Air Engineer Course at Topcliffe, No 5, which commended training in March 1967

The initial Argosy Systems Trainer, built in open plan on a wooden base

The final Argosy Systems Trainer, construction of which involved the removal of the entire cockpit of a written-off aircraft



The Instructor's Faults Panel on the final Argosy Systems Trainer

From initial selection, through basic and OCU training, until arrival on the squadron as productive aircrew, is approximately a 2 year span. Requirements, therefore, must be forecast somewhat in excess of this figure. The effects of some factors, such as the number of men due to be discharged and the planned introduction or phasing out of aircraft, can normally be calculated with reasonable accuracy but the number of variables forces the introduction of some intelligent guesswork. Although all aircrew trades are subject to the vagaries of this system, the engineers, being the smallest branch with less than 350 men, are least able to absorb a glut or cover a deficiency. In the early 1970s, during a period of overmanning, no engineers were trained on the odd numbered courses from No 25 to No 45 yet, despite this measure, the wait between graduation and a vacancy occurring on an OCU increased to 18 months at one stage. During such a time of overmanning, minimal numbers must still pass through in order to keep the School open; complete closure, on a temporary basis, is not a viable proposition. The basic aim is to erode a surplus, not add to it with redundant instructors.

The pendulum now swung to the opposite extreme. There was a shortage of flight engineers in civil aviation, resulting from a large and rapid expansion in this area. Many engineers in the Service exercised their 18 month option for discharge, in order to move across to civil flying. The flight sergeant, or middle experience, level was virtually wiped out overnight. The shortage became so acute that the remaining engineers, flying their maximum permitted hours, could not maintain the normal tasking of the transport fleet. Now, because the operational efficiency of the RAF had actually suffered, a 'stable door' working party was established to discover the reasons for the mass exodus. Pay and onerous non-flying duties were factors, but relatively minor; it appeared that the main dissatisfaction was the NCO status on the commissioned pilot and navigator flight deck. The working party made strong recommendations about this commissioning aspect which was, and still remains, a competition to fill establishment vacancies rather than judging the individual on his merits. The job opportunities in civil aviation, however, were soon exhausted; in fact the industry went into a long period of retrenchment. With temptation removed from the engineers in the Service, the working party's conclusions were quietly filed away and forgotten.

The new course at Finningley had been designed to intake 4 men at intervals of 16 weeks. It was now forced to cope with 10 or 12, every 8 weeks. This was a 500% increase for a training scheme with no dedicated flying and a life-expired simulator as its main resource. The problems were compounded in the following year, 1978, when a grounded Argosy aircraft, which was used as a training aid, was declared electrically unsafe and had to be withdrawn from use. In view of the low numbers originally envisaged, movement of the simulator at Benson up to the main School had not made economic sense. It was now working a 3 shift day without the administrative and engineering support which would have been available at Finningley. The increased tasking, whilst negating the financial argument, now made the move a physical impossibility. The estimated 14 months 'down time' represented an unacceptable gap in training and the suggestion that the delicate analogue computer might not survive the journey clinched the issue. For the moment, the simulator was living on borrowed time, figuratively as well as literally; the flexibility to carry out comprehensive servicing had been removed and the chances of a major breakdown were rapidly increasing.

The upsurge in numbers had not exposed any loopholes in the basic course design but the facilities were stretched to their limits. An increase in instructor establishment eased one aspect of the situation. The physical resources would have to be obtained by the method employed in the branch since its inception; self help.

Since the war years, at St Athan, when scrapped aircraft fuselages were modified in order to show systems operation in a realistic manner, engineers on instructional tours

have built a tradition of constructing advanced training aids.* Basic flight engineering requires the ability to visualise the operation of complex systems. It is just a short step, from visualising, to actually conceiving them and, with a large number of engineers being ex-tradesmen, the theory can be translated into practice.

In 1973, the instructors at Topcliffe had removed all the flight deck instrumentation from a scrapped Argosy and re-assembled it on an open-plan wooden base. The appealing possibilities of wiring up various circuits were immediately apparent and eventually reached the stage where the systems would interact and the complete perameters of the power-plant could be shown on one set of engine instruments. During the present crisis it was proving invaluable and the experience gained during its construction instigated a bold new project. Despite misgivings from outside the branch, approval was obtained to cut the entire cockpit out of the electrically unsafe Argosy, move it into the School building and wire it up as a fully functional flight-deck trainer. M Eng Tony Bateson designed all the circuits and, aided by 2 corporal electricians, fabricated and installed them. The work was scheduled to take a year; it was actually finished in 9 months and the results were outstanding. So faithfully did it represent the Argosy that it was now possible to move the first 3 exercises away from the Benson simulator which eased the load below the critical level.

Another problem existed on the Dominie flying phase; there were not enough aircraft on the ground, during normal training hours, for the students to familiarise themselves with the cockpit layout. Unlike the Argosy, there was no surplus or obsolete equipment available, so a case was made to obtain a cockpit shell fabricated in fibreglass. The completed shell was placed in a classroom at Finningley and again the instructors went to work. The requirement for this trainer was extremely urgent and there was no possibility of taking it out of use for a protracted period; this dictated a piecemeal programme of modification. To bring it into use as speedily as possible, M Eng Rick Williams fitted switches, controls and dummy instruments with manually moved pointers. These were later removed, one by one on an opportunity basis, and replaced with actual instruments or facsimiles built into instrument cases. When the training pressure eased slightly, FS Chris Baker, aided by local technicians, embarked on the task of wiring up the various circuits in a programme that was carefully phased, in order to minimise the periods out of use.

Although minor changes have been made in the course, primarily to update the syllabus in order to match the latest stage of the art, the framework has remained unaltered. Continuous pressure was needed in order to build, and maintain, a viable Dominie flying phase. Originating at 20 hours; a miserly 7 sorties per student, and fighting attitudes such as that expressed by a senior officer at Finningley, – "The engineers will handle the throttles on the Dominie over my dead body." – gradual inroads were made. A familiarisation sortie and the extension of one trip, to include a landaway from base, brought the total up to about 27 hours. It then became evident that another flight, at the mid-point of the phase, was required; this took the form of a specialised 2 hour sortie with a profile designed expressly for the air engineer student, consolidating his progress. It remains the only flight generated by the engineers and, even then, is offset against hours allocated for pilot continuation training. The actual results from the flying outstripped all expectations; those who passed approached the second half of the training with an enhanced appreciation of airmanship and operation, and the Staff found it an excellent early 'gate', where weak or unsuitable students could be identified.

In 1982 the standard length of the Dominie training sorties was cut by approximately

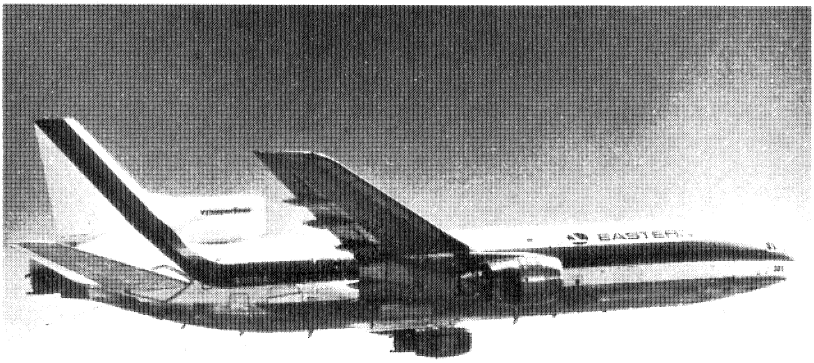
* APPENDIX 23

15 minutes. In order to compensate for the loss, the Engineer Squadron requested an extra flight. This was initially rejected, the reason being a fallacious assumption that the student was primarily concerned with the take-off and landing phases, not the cruise, therefore the cut had little effect on training value. As on so many previous occasions, the engineers were forced into print, not only to fight for adequate training but also to explain exactly what the job entailed. They won their case.

* * * * * * *

At the last count there were 281 NCOs and WOs in the branch and 59 officers spread across the General List, on Branch terms or as Specialist Aircrew. Despite the obvious disadvantages when compared with all-commissioned aircrew trades, engineers are slowly struggling to higher ranks. Wing Commander Jim Mutsaars is presently Station Commander of RAF Hullavington and Squadron Leader Keith Reynolds has just completed a Flight Commander's tour at RAF Lyneham during the latter half of which he was the Deputy CO of No 24 Squadron.

With regard to training aspects, the Argosy Simulator at Benson completed 21 years service on the 28 March 1983, accumulating nearly 65,000 running hours in the process. It is the oldest operational flight simulator in the RAF, yet its serviceability remains excellent and actually seems to improve as time passes. It will finally be retired in March 1984, when No 113 Course completes training. The replacement will be a purpose-built Air Engineer Procedure Trainer (AEPT), installed at Finningley. The contract for the AEPT was signed on the 5 January 1983 and it is due to be operational by July 1984. Virtually a Nimrod simulator, lacking motion but capable of reproducing the entire flight regime of the actual aircraft, the AEPT will be the hub of training for the next generation of RAF air engineers.



Lockheed Tristar

Nimrod AEW Mk3

VC10 K Mk2

A.190 – Provision of Flight Engineers for Certain Types of Heavy Bomber and Flying Boat Aircraft

(S.10(b). – 20.3.41.)

1. In the establishment of certain types of heavy bomber and flying boat squadrons provision is made for a post of flight engineer. The duties and responsibilities of flight engineers and the method of selection and training of airmen to qualify are as detailed in the following paragraphs.

2. Duties:-

(i) To operate certain controls at the engineer's station and watch appropriate gauges as indicated in the relevant Air Publications.

(ii) To advise the captain of the aircraft as to the functioning of the engines and the fuel, oil and cooling systems both before and during flight.

(iii) To ensure effective liason between the captain of the aircraft and the maintenance staff, by communicating to the latter such technical notes regarding the performance of the aircraft in flight as may be required.

(iv) To carry out practicable emergency repairs during flight.

(v) To act as standby gunner.

3. Eligibility – Flight engineers will be selected from airmen mustered as fitter 1, fitter 2, fitter 2 (engines) and fitter 2 (aero-engines) including airmen already mustered as air gunners who have the necessary trade qualifications. The rank of the post will be that of sergeant but selection will be open to suitably qualified corporals and LACs with exceptional qualifications.

4. Medical standards – Selected airmen will require to be category A3B and arrangement should be made for their medical examination at their stations. Forms 42 should be completed accordingly.

5. Training – Airmen will be required to undergo courses as follows:

(i) A 3 week course of air gunnery training at a Bombing and Gunnery School followed by –

(ii) Short courses of training at manufacturers works.

On satisfactory completion of these courses, operational training will be undertaken.

6. On satisfactory completion of prescribed courses of training mentioned in 5i and 5ii above, airmen will be remustered to flight engineer and where necessary promoted to temporary sergeants in their trades on the authority of the Air Officer i/c Records.

7. While undergoing a course at a Bombing and Gunnery School, airmen will receive flying instructional pay at the rate of 1s 0d a day, under the general conditions of Para 3458 of KRs and ACIs and on posting for duty as flight engineers they will be entitled to air gunner and crew pay under the provisions of Paras 3455 and 3457 of KRs and ACIs, they will also remain on their trade roster for promotion.

8. Flight engineers, while appearing as such in establishment will normally be designated by their trade mustering followed by "flight engineer" in brackets, e.g. Fitter 1 (Flight Engineer). This may be shortened to Fitter 1 (FE).

9. The Air Officer i/c Records will be responsible for the posting of flight engineers.

10. The names of volunteers who have the requisite qualifications and who can be recommended are to be forwarded by COs to the Air Officer i/c Records. In making recommendations COs should be satisfied that besides possessing the necessary qualifications airmen are of a type suitable to discharge the duties of air gunner. Following the initial recommendations, further lists will continue to be forwarded by COs to the Air Officer i/c Records on 1 July and 1 October 1941 and thereafter on 1 January, 1 April, 1 July and 1 October in each year.

11. The mustering of airmen now undergoing training as flight engineers but who do not possess the qualifications in Para 3 above will exceptionally be considered. Their names and particulars should be forwarded by COs to the Air Officer i/c Records who will transmit this information together with his recommendations to the Air Ministry (P3).

APPENDIX 2

204 – Introduction of Special Badges for wear by qualified Aerial Gunners and Physical Training Instructors

(370373/22)

AIR MINISTRY WEEKLY ORDER, issued 12 Apr 1923

1. Special arm badges in gilding metal have been approved for issue to aerial gunners and physical training instructors of ranks below warrant officer.

2. The designs of the badges are as follows:

Aerial gunner	Winged Bullet.
Physical training instructor	Three arms, each wielding a club, protruding from a centre piece bearing the letters "PTI".

3. The nomenclature and prices of these badges are as follows:

AIR PUBLICATION 809 – SECTION 22D

Reference No		
–	Badges, arm, gilding metal –	
238	Aerial gunner	each 2¼d
239	Physical training instructor	each 4½d

The scale of issues will be one to each entitled airman.

4. Initial issues are to be made free and demands to meet requirements are to be submitted forthwith to the Officer Commanding, No 1 Stores Depot, Kidbrooke.

5. The method of wearing these badges is shown below:

	Badge	How Worn	Position on garments
	—	—	—
(i)	Aerial gunner	Bullet to be in a perpendicular position	NCOs and LACs Immediately above the badges of rank, but worn on the right arm only. ACs I and II Nine inches below the shoulder seam of jacket.
(ii)	Physical training instructor	The letters "PTI" to be horizontal	As above

6. None of these badges are to be worn on the greatcoat. Where a non-commissioned officer or aircraftman has qualified for more than one of the foregoing badges, the badges are to be worn so that they will appear in the order mentioned above, i.e. from the top of the sleeve downwards.

APPENDIX 3

A547 – Distinguishing Badge for Wear by Officers and Airmen Qualified as Air Gunners – Introduction of New Pattern

(A 37464/30 – 21.12.39)

1. In recognition of the importance of the air gunner's role in war His Majesty the King has been graciously pleased to approve a new distinguishing badge for wear by officers and airmen who have qualified as air gunners in accordance with requirements notified in Air Ministry Orders from time to time.

2. The badge consists of the letters "AG" of drab silk surrounded by a laurel wreath of brown silk with an outspread wing 2⅛ inches long, mounted on dark blue Melton cloth.

3. The badge will be worn on the service dress jacket and if no ribbons of order, decorations or medals are worn, is to be placed immediately above the top line of the left breast pocket, the letters being vertical and directly above the button. When ribbons are worn the badge is to be similarly placed directly above the centre of the row, or top row, of ribbons, with a space of ½ inch between the lowest part of the badge and the upper edge of the ribbons.

4. Badges, air gunners, for airmen are hereby introduced:

Stores Ref	Nomenclature	Detail	Class of Store
	Badges:		
22H/402	Air gunners	Embroidered	C

Demands according to the number of jackets held by airmen entitled to the badge on the basis of one per jacket, are to be submitted to the appropriate maintenance unit.

5. Badges, arm, air gunners (Stores Ref 22H/238), are hereby declared obsolescent and are to be withdrawn on issue of the new pattern. Stocks held at units and badges withdrawn from airmen are to be returned to the appropriate maintenance unit.

6. AP 1086, AP 830, Vol III, and AP 1358 will be amended accordingly in due course.

APPENDIX 4

A17 – Aircraft Crews (other than Pilots)

(869914/29 – 19.1.39)

I – GENERAL

1. With a view to providing efficient crews for the aircraft of high performance, long range and heavier armament now coming into service, it has been decided to modify the method of selection and the conditions of service of air observers and air gunners. It will be noted that the measures announced in this order have the effect of placing air observers on broadly the same footing, as regards pay, as airman pilots. The ultimate policy that will be worked to, as soon as practicable, is outlined in part II of this order and the interim measures during the transitional period in part III.

II – POLICY

Crew employment to be full-time

2. Employment as member of an aircraft crew will in future be regarded as full time employment and airmen for such duties will be provided additionally to the tradesmen establishment of all units concerned. As in the case of airman pilots it will be the duty of COs to ensure that observers and other members of an air crew are given every opportunity to maintain their efficiency in their basic trade.

Personnel for air gunnery duties

3. Except in the case of general reconaissance squadrons equipped with flying boats, the distinction between wireless operators (AG) and other air gunners will be abolished and all air gunners will be selected from airmen of the trade of wireless operator entered as boy entrants in accordance with para 4 below. The present policy under which air gunners in squadrons equipped with flying boats may be selected for training from other trades will remain unchanged.

4. Entry for training as wireless operator will be open to boys between the ages of 16 and 17¼ and towards the end of their initial course of training a selection will be made of those who are recommended for employment on air crew duties. Those selected for these duties will be given a course in air gunnery on the termination of their initial training or as shortly thereafter as possible. They will be employed on ground duties until attaining the age of 18 when, provided they have passed the air gunnery course, they will be remustered as wireless operator (aircrew). While so mustered they will be paid at group II rates and except as provided in para 6 will receive air gunner and crew pay in addition, under normal rules. Thereafter they will be employed continuously on crew duties unless they are found unfit for such duties, for medical or other reasons, when they will be remustered as wireless operator and will revert to ground duties.

5. Those who are not selected for aircrew duties or who fail to pass the air gunnery course, will normally be employed on ground duties only and their future career will be by way of conversion in due course to wireless and electrical mechanic if so selected.

Air observers

6. After a period of employment on crew duties, normally not less than 3 years, a proportion of wireless operators (aircrew) will, if recommended, be selected for training as air observer. On completion of the course (approximately 16 weeks in navigation and bombing) during which they will receive flying instructional pay of 1s 6d a day,

under the conditions laid down in para 3458 of KR & ACI but will cease to draw crew pay and air gunner pay, those successful will be granted the acting rank of sergeant and will be remustered as "acting observer". Those unsuccessful on the course or who are not selected for training will remain on wireless operator (aircrew) duties until the termination of their initial engagements.

7. After 6 months duty as acting observer those recommended will be confirmed in their rank of sergeant and remustered as "observer". They will also be authorised to wear the observer's badge (see para 22). The inclusive rates of pay of observers will be as follows:

	s	d
Acting sergeant (acting observer)	9	0
Sergeant (observer)	12	6
Sergeant (observer) after 4 years employment as such	13	6
Flight sergeant (observer)	15	0
Flight sergeant (observer) after 4 years employment as such	15	6
Warrant Officer (observer)	16	6

8. Subject to fitness and to the requirements of the service, an air observer will normally, if desirous and recommended, be allowed, after completing 8 years man service, to re-engage to complete the total 24 years service. His prospects of promotion above the rank of sergeant will be similar to those outlined for boy entrants generally in AMO A195/34.

9. It is contemplated that a proportion of observer posts shall be filled by commissioned observers and that a limited number of promotions to these shall be made from non-commissioned and warrant officer observers.

III – TRANSITIONAL PERIOD

10. Pending the full implementing of the policy outlined in part II, the personnel for aircraft crews will be provided as stated below:

Air Gunners

11. Existing air gunners other than wireless operators (AG) will continue to be employed in air gunner or air observer posts not requiring wireless operators until such time as they can be replaced by wireless operators (aircrew), or air observers.

12. Existing aircraftman wireless operators (AG) will be invited to volunteer for continuous employment on air duties and, if recommended, will be remustered to wireless operator (aircrew). Those not volunteering or not selected will continue to be employed as wireless operators (AG) until they can be replaced by wireless operators (aircrew) when they will revert to ordinary wireless operator duties.

13. Boy entrants under training as wireless operators will be dealt with as laid down in para 4 above except that pending the provision of training facilities those selected for air duties will continue to receive their training in gunnery duties at their units.

14. Wireless operator (aircrew) posts, which cannot during the transitional period be filled from the sources referred to in paras 12 and 13, will be filled by volunteers from wireless operators who are recommended for such employment. For the present, they will continue to be trained as air gunners in their units.

APPENDIX 5

AMO A300 1.5.41

AMO A190 is amended as follows:

Para 6 line 3, after "engineer" insert "awarded the air gunners badge".

APPENDIX 6

AMO A388 29.5.41

AMO A190 is further amended as follows:

Insert the following new paragraph:

4a. Age Limits – No specific age limits are laid down and provided airmen are eligible under paras 3 and 4 above they may be recommended for training.

APPENDIX 7

Bomber Command's suggested flight engineer course – December 1941

Initial training wing – disciplinary course – 2 weeks

including:

a. Brief description of flight engineer duties
b. Morse
c. Arithmetic
d. First aid
e. Drill and P.T.

Air gunnery course – 2 weeks

including:

a. Instruction of Browning gun and turrets
b. Free gun (air)
c. Free gun (ground)
d. Elementary gunnery theory

The object of both these courses is to eliminate those unfit physically and mentally. Subsequent courses will be less arduous, and will cover aircraft and airmanship.

Basic course at flight engineer school – 10 weeks

The school should be equipped with:

a. Instructional fuselage
b. Appropriate engines
c. Suitable demonstration facilities for auxilliary services
d. Appropriate turrets

Part 1 – 3 weeks

Subjects:

a. Engines – theoretical and practical
b. Airframes – theoretical and practical
c. Aerodynamics and elementary theory of flight
d. Study of graphs
e. Oxygen – theoretical

Part 2 – 6 weeks

Subjects:

a. Hydraulics
b. Electrics
c. Controls and trim tabs
d. Coolants
e. Petrol and jettison system
f. Bombing
g. Instruments
h. Turrets

i. De-icing
j. Airscrews and feathering
k. Braking systems
l. Cabin heating
m. Pesco pump
n. Refuelling and draining
o. Automatic pilot
p. Oxygen
q. Engine controls
r. Engine performance
s. Log keeping
t. Carburation and supercharging

Note: subject (r) is most important and considerable time should be devoted.

Part 3 – 1 week

Subjects:

a. Revision
b. Examinations
c. Practical examinations in instructional fuselage, showing ability to manipulate all controls in the dark

OTU conversion – 3 weeks

Subjects:

a. Two or more cross-country flights by day (log keeping and petrol consumption)
b. Two or more cross-country flights by night (log keeping and petrol consumption)
c. General air experience
d. Dinghy drill
e. Parachute packing
f. Parachute drill
g. Turrets (firing on range)
h. Aircraft recognition
i. Air fighting tactics
j. Air-sea rescue
k. Flight planning
l. Operations
m. Night photography and operation of camera
n. First aid
o. Astro

APPENDIX 8

A262 – Provision of Flight Engineers for Certain Types of Heavy Bomber and Flying Boat Aircraft

(S.10b). – 19.3.42.)

(COs of units at home are to ensure that the provisions of this order are brought to the notice of all eligible airmen and that every assistance is given to those who wish to apply for training. Eligible and suitable volunteers are to be recommended, whether or not they can be spared from their units).

1. The conditions of service and the arrangements for the selection and training of flight engineers have recently been reviewed and the following instructions on this subject supersede those promulgated in AMO A190/41 as amended by A300/41 and A388/41.

2. Duties and responsibilities:

(i) To operate certain controls at the engineer's station and watch appropriate gauges as indicated in the relevant Air Publications.

(ii) To advise the captain of the aircraft as to the functioning of the engines and the fuel, oil and cooling systems both before and during flight.

(iii) To ensure effective liason between the captain of the aircraft and the maintenance staff, by communicating to the latter such technical notes regarding the performance and maintenance of the aircraft in flight, as may be required.

(iv) To carry out practicable emergency repairs during flight.

(v) To act as standby gunner.

3. Sources of recruitment – Flight engineers will be selected from sergeants, corporals and LACs mustered as fitter 1, fitter 2, fitter 2 (engines), fitter 2 (aero-engines) and flight mechanic (engines). LACs who are recommended for training must be considered suitable for promotion to NCO rank.

4. Medical standard – The medical category for flight engineers is A3B.

5. Age limits – No specific age limits are laid down and provided volunteers are eligible under paras 3 and 4 above, they are to be recommended for training.

6. Selection procedure – COs are to submit their recommendations on Forms 1739, suitably amended, in respect of eligible airmen who volunteer for training as flight engineers. Station Commanders are to personally satisfy themselves, by interview, as to each airman's eligibility and suitability (including technical ability) and are to insert their remarks under section C of the form. They are to arrange for airmen to be medically examined by the Station Medical Officer, and for Form 42 and the section D of Form 1739 to be completed. They are also to arrange for airmen who they consider suitable for training to attend for interview at the nearest aviation candidates selection board, who are to forward Form 1739 in respect of suitable candidates, direct to the Air Officer i/c Records, Gloucester and inform the airman's Station Commander of their recommendations.

7. Training –

(i) Flight mechanics (engine) – These airmen will be posted for immediate conversion to fitter 2(E) and those who attain the classification of LAC will undergo the Junior NCO course. On the successful completion of this preliminary training they will be posted as required to undergo flight engineer training. Those who fail to qualify as LACs will be mustered to fitter 2(E) in the classification obtained. On the subsequent attainment by these airmen of the classification of LAC, COs of units are to inform the Air Officer i/c Records, Gloucester accordingly and state whether or not the airmen are still recommended for training as flight engineers. The Air Officer i/c Records will arrange for those who are recommended, to be posted for the prescribed training.

(ii) Fitters – Selected candidates will be required to undergo the following training –

(a) The Junior NCO course, for candidates below the rank of sergeant, unless they have already satisfactorily passed this course.

(b) A course of approximately 5 weeks at an Initial Training Wing.

(c) A 3 week course of air gunnery training.

(d) A short course of technical instruction, which may include a course at the manufacturer's works.

(e) Operational training.

8. Flying instructional pay – While undergoing the course of air gunnery training, airmen will receive flying instructional pay, at the rate of 1s 0d a day, under the general conditions of para 3458 of KRs and ACIs.

9. Remustering, etc. – On the satisfactory completion of the course of technical training, referred to in para 7 ii d above, airmen will be given the annotation flight engineer after their trade mustering, e.g. fitter 2(E) (Flight Engineer), awarded the air gunners badge and, where necessary, promoted to temporary sergeant in their trade. The annotation is to be promulgated in personal occurrence reports at the same time as the airman is promoted to sergeant and awarded the badge.

10. Air gunner and crew pay – On posting for employment as flight engineers, airmen will be eligible for air gunner and crew pay, under the provisions of paras 3455 and 3457 of KRs and ACIs.

11. Status and promotion – Flight engineers will remain on the promotion rosters of their basic trades, but while employed in the air they will be regarded as members of the aircrews for all purposes other than promotion. On promotion beyond the rank of sergeant they will, unless they can be absorbed in establishment vacancies in the higher rank, be withdrawn from employment in the air and will return to their normal trade duties as provided in para 13 below.

12. Posting – The posting of airmen while under training will be the responsibility of the Air Officer i/c Records, but on qualifying as flight engineers, they will be posted as aircrew by the Air Ministry (P3).

13. Withdrawal from flight engineer duties – On withdrawal from employment in the air, flight engineers will normally be employed in their basic trade in their existing rank. They will relinquish the annotation (Flight Engineer) but except as may be otherwise directed, they will retain the flight engineer's badge. Should they be withdrawn prematurely from employment in the air, for reasons within their own control however, they will return to their basic trade in the classification of LAC, or in the rank they would have held, had they not been selected for employment as flight engineers.

AMO A190/41, A300/41 and A388/41 cancelled.

APPENDIX 9

A431 – Fitters 1, Fitters 2, Fitters 2(E) and Fitters 2(AE) – Recommendations for Training as Flight Engineers

(30.4.42.)

1. With reference to AMO A262/42, large numbers of flight engineers are required and in order to ascertain the numbers likely to be available for this training, all units at home are to forward immediately to the Air Officer i/c Records (D5 section) Gloucester, nominal rolls of all sergeants, corporals and LACs mustered as fitter 1, fitter 2, fitter 2 (engines) or fitter 2 (aero-engines) held on their strength. These rolls are to be divided into 2 parts, part 1, airmen who volunteer and are eligible and suitable for training as flight engineers and part 2, airmen who do not volunteer, or who do volunteer but are not considered suitable.

2. Suitability for flight engineer training is to be assessed regardless of whether or not the airman can be spared from his unit at the time of rendering the return.

3. Arrangements for the completion of Forms 1739 in respect of invididual airmen, and in accordance with para 6 of AMO A262/42, should be pursued without delay.

APPENDIX 10

A645 – Flight Mechanics (E) – Recommendations for Training as Flight Engineers

(2.7.42.)

1. With reference to AMO A262/42, in order to ascertain the numbers likely to be available for training as flight engineers, all units at home are to forward immediately to the Air Officer i/c Records (D5 section) Gloucester, nominal rolls of all LACs mustered as flight mechanic (E) held on their strength. These rolls are to be divided into 2 parts. Part 1 is to consist of airmen who volunteer, are eligible and are considered suitable for training as flight engineers. Part 2 is to be subdivided into (a) Airmen who volunteer and are not considered suitable and (b) Airmen who do not volunteer.

2. Suitability for flight engineer training is to be assessed regardless of whether or not an airman can be spared from his unit at the time of rendering the return.

3. Arrangements for the completion of Forms 1739 in respect of individual airmen, and in accordance with para 6 of AMO A262/42, should be made without delay.

APPENDIX 11

A707 – Conversion of Flight Mechanics (E) and (A) to Fitters 2 (E) and (A).

(16.7.42.)

AMO A481/42 is amended as follows:

Para 3, add at end; 'This provision does not apply to flight mechanics (E) or (A) who volunteer for training as flight engineers under the terms of AMO A262/42. These airmen will be taken for training when required, irrespective of the length of unit service.

APPENDIX 12

A746 – Air Crew Categories – Duties and Medical Standards

(S.10(b). – 23.7.42.)

1. Following a recent review of the policy relating to the employment of aircrew personnel which led to the introduction of a new aircrew category of air bomber, as announced in AMO A505/42, it has been decided to change the title of air observer to navigator, those with special qualifications being indicated by annotations as shown in para 2 below.

2. The following is a brief summary of the various aircrew categories under the new policy, with medical standards and duties appropriate to each:-

(i) Pilot

Medical standard

A1B. Normal or safe colour vision. Night visual capacity minimum 13 is required for night fighter pilots.

(ii) Navigator

Medical standard	Duties
A3B. Visual acuity 6/18, correctable to 6/6. Normal or safe colour vision.	Navigation. Operation of gun in an emergency.

(iii) Navigator (B.)

Medical standard	Duties
A3B. Visual acuity without glasses 6/6 in one eye and at least 6/9 in the other. Colour vision normal or safe.	Navigation, bombing and gunnery.

(iv) Navigator (B.W.)

Medical standard	Duties
A3B. Visual acuity without glasses 6/6 in one eye and at least 6/9 in the other. Colour vision normal or safe.	Navigation, bombing, wireless operation and gunnery.

(v) Navigator (W.)

Medical standard	Duties
A3B. Visual acuity 6/18, correctable to 6/6. Normal or safe colour vision.	Navigation, wireless operation. Operation of gun in an emergency.

(vi) Navigator (radio)

Medical standard	Duties
A3B. Vision acuity at least 6/36 without glasses, correctable to 6/6. Need not be colour vision normal or safe.	Radio operation. Navigation.

(vii) Air bomber

Medical standard	Duties
A3B. Visual acuity without glasses 6/6 in one eye and at least 6/9 in the other. Colour vision normal or safe. Night visual capacity minimum 13.	Bombing. Map reading. Operation of gun in an emergency. To act as pilot's assistant, where there is no flight engineer, to the extent of being able to fly straight and level and on a course.

(viii) Wireless operator (air gunner)

Medical standard	Duties
A3B. Visual acuity at least 6/18 without glasses, correctable to 6/6. Colour vision normal or safe.	Wireless operation and gunnery. (Wireless operators (air gunner) in general reconnaissance units have to be qualified in radio in addition to their normal qualifications).

(ix) Air gunner

Medical standard	Duties
A3B. Visual acuity without glasses 6/6 in one eye and at least 6/9 in the other. Colour vision normal or safe. Night visual capacity minimum 13.	Gunnery.

(x) Air gunner (wireless operator mechanic), air gunner (flight mechanic (A)) and air gunner (flight mechanic (E))

Medical standard	Duties
A3B. Visual acuity without glasses 6/6 in one eye and at least 6/9 in the other. Colour vision normal or safe.	To carry out the duties of their trade in heavy aircraft of Coastal Command. Gunnery. (Air gunners (wireless operator mechanic) in general reconnaissance units have to be qualified in radio in addition to their wireless operator mechanic and air gunner qualifications).

(xi) Flight engineer

Medical standard	Duties
A3B. Visual acuity without glasses 6/6 in one eye and at least 6/9 in the other. Colour vision normal or safe.	In addition to the duties in connection with engine instruments as detailed in AMO A262/42, he will act as pilot's assistant to the extent of being able to fly straight and level and on a course. To operate gun in an emergency.

3. Airmen previously mustered as observer will be remustered to navigator (B.), navigator (B.W.), navigator (W.) or navigator (radio), according to their special qualifications and the duties they are required to undertake under the revised policy.

4. COs are accordingly to remuster the airmen concerned to their appropriate categories with effect from the date of this order, and for this purpose a table of equivalent categories is given below for their guidance. Remusterings are to be promulgated in unit personnel occurrence reports, this order being quoted as the authority.

	Former category of air observer	New category
(i)	Airmen who have successfully completed the normal courses of instruction in navigation, bombing and gunnery.	Navigator (B.)
(ii)	Airmen qualified as in (i) above and additionally qualified and employed as wireless operators.	Navigator (B.W.)

(iii)	Airmen who have successfully completed a navigation course only and are additionally qualified and employed as wireless operators.	Navigator (W.)
(iv)	Airmen qualified as observer (radio)	Navigator (radio)

5. Cases which present difficulty are to be referred to the Air Ministry (P3) with full particulars of the airmen's qualifications and medical standards.

6. A further order will be issued shortly regarding the badges to be worn by navigators of all categories.

APPENDIX 13

A978 – Flight Engineers – Revised Conditions of Service

(S.10(b). – 15.8.42.)

1. Flight engineers now form a separate aircrew category and as a consequence the conditions of service have been modified as regards pay, promotion and advancement to commissioned rank, while the field of selection has also been widened. The following instructions on the subject supersede those in AMO A262/42, as amended by A681/42.

2. Duties and responsibilities – The duties and responsibilities of flight engineers are as follows:

(i) To operate certain controls at the engineer's station and watch appropriate gauges as indicated in the relevant Air Publications.

(ii) To act as pilot's assistant on certain types of aircraft, to the extent of being able to fly straight and level and on a course.

(iii) To advise the captain of the aircraft as to the functioning of the engines and the fuel, oil and cooling systems both before and during flight.

(iv) To ensure effective liason between the captain of the aircraft and the maintenance staff, by communicating to the latter such technical notes regarding the performance and maintenance of the aircraft in flight, as may be required.

(v) To carry out practicable emergency repairs during flight.

(vi) To act as standby gunner.

3. Sources of supply – Flight engineers will be selected from airmen of the rank of sergeant and below mustered in the trades of fitter 1, fitter 2, fitter 2 (Engines), fitter 2 (Airframes), fitter 2 (Aero-engines), flight mechanic (Engines) and flight mechanic (Airframes). The selection of flight mechanics (Engines) or (Airframes) will be conditional on their successful completion of a conversion course to fitter 2 (Engines) or (Airframes), see para 7, sub para ii below.

4. Medical standards – A3B, with visual acuity of at least 6/18 correctable to 6/6. Normal or safe colour vision. AMO A746/42, para 2, sub para ix is accordingly amended as indicated in para 14 below and airmen rejected under the visual standard laid down in that order are eligible for reconsideration.

5. Age limits – No specific age limits are laid down and all volunteers eligible under paras 3 and 4 above are to be recommended for training.

6. Selection procedure – COs are to submit their recommendations on Forms 1739, suitably amended, in respect of eligible airmen who volunteer for training as flight engineers. Station commanders are personally to satisfy themselves, by interview, as to each airman's eligibility and suitability (including technical ability) and are to insert their remarks under section C of the form. They are to arrange for airmen to be medically examined by the Station Medical Officer and for Form 42 and section D of Form 1739 to be completed. They are also to arrange for airmen who they consider suitable for training to attend for interview at the nearest aviation candidates selection board, who are to forward Form 1739 in respect of suitable candidates, direct to the Air Officer i/c Records, Gloucester and inform the airmen's Station Commander of their

recommendations.

7. Training –

(i) Fitters – Selected candidates will be required to undergo the following training –

a. The Junior NCO course, in the case of candidates below the rank of sergeant, unless they have already satisfactorily passed this course.

b. A course of approximately 5 weeks at an Initial Training Wing.

c. A 3 week course of air gunnery training.

d. A course of technical instruction, which may include a course at the manufacturer's works and for fitters 2 (Airframe) will include additional instruction in engines.

e. Operational training.

(ii) Flight mechanics (E) and (A) – These airmen will be posted for immediate conversion training to fitter 2(E) or (A) as appropriate, on the completion of which they will undergo the Junior NCO course. They will then be posted for flight engineer training, as provided in sub para 1 above.

8. Flying instructional pay – While undergoing the course of air gunner training, airmen will receive flying instructional pay, at the rate of 1s 0d a day under the general conditions of para 3458 of KRs and ACIs.

9. Remustering etc. – On the satisfactory completion of the course of training as laid down in para 7, sub paras 1 a to d above, airmen will be promoted to the rank of temporary sergeant in the aircrew category of flight engineer and will be awarded the flight engineer's badge, particulars of which will be promulgated later.

10. Pay – Pay will be at the following inclusive rates:-

Sergeants	11s 0d a day	plus war pay at 6d a day.
Flight sergeants	12s 0d a day	

11. Status – Rank will be governed by aircrew conditions of service and as from the date of this order, no promotion will be made from the trade roster. The position of those airmen on the trade roster, however will be safeguarded under the terms of para 4 of AMO A326/41 which provides that on reversion to ground duties airmen will assume the rank and seniority in their trade that they would have held had they not been selected for aircrew. Airmen employed as flight sergeants, who have already been promoted in their trade to the rank of flight sergeant should be reverted to ground duties when sufficient flight engineers mustered under the foregoing conditions become available.

12. Commissioning – For each squadron or Operational Training Unit in which flight engineers are employed or trained, one post will be established for an officer of the rank of flight lieutenant or below. Commissions will be granted in the General Duties Branch and there will be time promotion to flying officer after one years service as pilot officer and to flight lieutenant after one years service as flying officer. Promotions to acting rank may also be made under the conditions of para 12 of AMO A913/40.

13. Posting, Airmen – The posting of airmen while under training will be the responsibility of the Air Officer i/c Records, but on qualifying as flight engineers, they will be posted as aircrew by the Air Ministry (DP3).

14. AMO A746/42 is amended as follows. Para 2, sub para ix, Medical standards, delete existing detail and substitute "A3B. with visual acuity of at least 6/18 correctable to 6/6. Normal or safe colour vision".

AMOs A746/42 amended. A262/42 and A681/42 cancelled.

APPENDIX 14

A1019 – Distinguishing Badges for Wear by Aircrew Personnel (Officers and Airmen) – Introduction of New Types of Badges

(A417220/42/E.13 – 17.9.42.)

1. Following the revision of the categories of aircrew personnel announced in AMO A746/42, approval has been given for the introduction of 3 new types of aircrew badges, which, together with the existing flying badge (pilot) and air gunner badge, will be the only badges to be worn by aircrew personnel in respect of current qualifications and duties.

2. The 3 new badges are of similar design to the existing air gunner badge, but they will bear within the laurel wreath the letters 'N', 'B' and 'E' and will be known as badges, 'navigator', 'air bomber' and 'flight engineer', respectively.

3. All personnel who are now, or in future, employed or available for duty as members of aircrews are to wear the badge appropriate to their category as detailed in para 2 of AMO A746/42, in accordance with the following table:

(i)	Pilot	Flying badge
(ii)	Navigator	Badge, navigator (N)
(iii)	Navigator (B)	Badge, navigator (N)
(iv)	Navigator (BW)	Badge, navigator (N)
(v)	Navigator (W)	Badge, navigator (N)
(vi)	Navigator (radio)	Badge, navigator (N)
(vii)	Air bomber	Badge, air bomber (B)
(viii)	Wireless operator (air gunner)	Badge, air gunner (AG)
(ix)	Air gunner	Badge, air gunner (AG)
(x)	Wireless operator mechanic (air gunner) Air gunner (flight mechanic (A)) Air gunner (flight mechanic (E))	No badge in respect of basic trade but badge, air gunner when qualified as such.
(xi)	Flight engineer	Badge, flight engineer (E)

4. The existing air observer badge (O) and observer (radio) badge (RO) may continue to be worn by personnel who have qualified for them in the past but who are no longer available by reason of age, medical standard or otherwise for posting for the duties of one of the new categories of aircrew.

5. The provision of AMO A89/42 will continue to apply.

6. The following badges for aircrew are hereby introduced:

Stores reference	Nomenclature	Detail	Class of store
	Badges:		
22H/618	Navigator	Embroidered	C
22H/619	Air bomber	Embroidered	C
22H/620	Flight engineer	Embroidered	C

7. Demands are to be submitted to the appropriate maintenance unit, and badges, air observer and observer (radio) (Stores reference 2H/371 and 22H/547) withdrawn from airmen when the new badges are issued, are to be returned to store.

8. AP 1086 and AP 830, Vol 3, will be amended.

APPENDIX 15

A538 – Flight Engineers Revised Syllabus of Training and Conditions of Service

(S.10(b). – 3.7.43.)

1. The field of selection for flight engineers has been further widened to include serving airmen of various trades, aircraft hands and direct entrants from civil life. Airmen are no longer required to qualify as fitters 2(E) or 2(A) during flight engineer training as this qualification is not necessary for the performance of their duties. The syllabus of training has been revised accordingly. With this departure from the fitter 2 standard, the rates of pay have been modified. The following instructions on the subject supersede those promulgated in AMO A978/42.

2. Duties – The duties and responsibilities of flight engineers are as follows:

(i) To operate certain controls at the engineer's station and watch appropriate gauges as indicated in the relevant Air Publications.

(ii) To act as pilot's assistant on certain types of aircraft to the extent of being able to fly straight and level and on a course.

(iii) To advise the captain of the aircraft as to the functioning of engines and the fuel, oil and cooling systems both before and during flight.

(iv) To ensure effective liason between the captain of the aircraft and the maintenance staff by communicating to the latter such technical notes regarding the performance and maintenance of the aircraft in flight, as may be required.

(v) To carry out practicable emergency repairs during flight.

(vi) To act as standby gunner.

3. Sources of supply – Flight engineers will be recruited from:

(i) Direct entrants from civil life.

(ii) Serving airmen in Groups ii to v except wireless operators, and those mustered in the trades of fitter 1, fitter 2, fitter 2 (Engine), fitter 2 (Airframe) and fitter 2 (Aero-engine), serving airmen of other Group 1 trades will not normally be accepted, but may be specially recommended to the Air Ministry.

4. Eligibility – To be eligible for consideration for training as flight engineers, candidates must fulfill the following conditions:

(i) Age limits – Direct entrants from civil life must have reached their 18th birthday, but not their 39th birthday, on the day of entry. There are no specific age limits for serving airmen.

(ii) Medical standard – A3B. with visual acuity of at least 6/18 correctable to 6/6. Normal or safe colour vision.

(iii) Educational standard – As set out in the appendix to this order.

5. Procedure for selection of serving airmen – This will be the same as for volunteers for other aircrew categories. Instructions in AMO A373/42, as amended by A504/42 and A946/42 will apply.

6. Training – Selected candidates will be required to undergo the following training:

(i) A course of approximately 6 weeks at an Initial Training Wing.

(ii) A course of technical training divided into 2 parts, one lasting approximately 17 weeks and the other 7 weeks.

(iii) Gunnery training.

Airmen mustered as fitters or flight mechanics or with comparable technical qualifications will be required to undertake only the final stage of technical training.

7. Mustering and pay during training –

Stage of training	Classification		Pay
Initial Training Wing	Aircraftman 2nd Class	Group v	3s 0d a day
Technical training Pt. 1	Aircraftman 2nd Class	Group v	3s 0d a day
Further training	Leading Aircraftman	Group v	5s 0d a day

Flying instructional pay of 1s 0d a day will be issued subject to the general conditions of para 3458 of KRs and ACIs during any period of further training spent at a gunnery school, during which gunnery training in the air is undertaken. If it is to their advantage, serving airmen may retain the rate of pay, except pay of acting rank, in issue to them immediately before entry into aircrew training.

8. Remustering etc. – On the satisfactory completion of the course of training as laid down in para 6 above, airmen will be remustered to flight engineer, promoted to the rank of temporary sergeant and awarded the flight engineer's badge.

9. Commissioning and promotion

(i) Grant of commissions – Airmen will be eligible for the grant of commissions in the General Duties Branch, on completion of training and subsequently on the same scale as wireless operator (Air gunner).

(ii) Promotion of airmen – Airmen will be eligible for promotion under the same conditions as other members of aircrew. These conditions are set out in AMO A426/43.

10. Pay – Airmens pay will be at the following rates:

Sergeants ..... 10s 0d a day
Flight sergeants .....12s 0d a day
Warrant officers .... 13s 6d a day

Airmen who were formally accepted for training as flight engineers before the date of this order will be entitled to the rates applicable at the date of their acceptance, as was set out in AMO A978/42 ie.

Sergeants ..... 12s 0d a day
Flight sergeants ..... 13s 0d a day

11. Posting – The posting of airmen while under training will be the responsibility of the Air Officer i/c Records, but on qualifying as flight engineers, they will be posted by the Air Ministry (D.G. of P.).

Paras 1 to 13 of AMO A978/42 cancelled

Appendix to AMO A538/43

Educational Standard for Flight Engineers

To be eligible for training as flight engineer, a candidate must have some knowledge of elementary mathematics, or must be capable of being brought up to the required standard by further instruction. Papers will be set on the following subjects:

1. The 4 arithmetical processes, vulgar and decimal fractions, the metric system, averages, ratios, square roots.

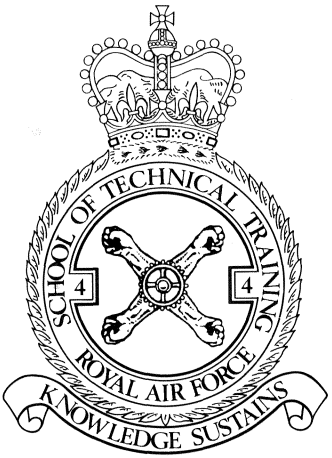
2. The elementary processes of algebra.

3. The measurement of angles, properties of the triangle and parallelogram, right angled triangles and similar figures.

4. Solution of problems by simple scale drawings, simple graphs.

Candidates will be required to obtain at least 8 marks out of 40. A sound knowledge of (1) above should normally suffice to pass this test.

APPENDIX 16



NUMBER 4 SCHOOL OF TECHNICAL TRAINING

(Formed: September 1938 at St Athan, Glamorganshire)

Description: Four cubit arms conjoined in saltire, the hands clenched, charged in the centre with a gear-wheel.

Motto: Knowledge sustains.

Authority: George VI, August 1944.

The design symbolises the function of the school which is to train flight engineers for four engined aircraft.

APPENDIX 17

COMMANDANTS OF NUMBER 4 SCHOOL OF TECHNICAL TRAINING – SEPTEMBER 1941 TO DECEMBER 1946

Ab-initio flight engineer training commenced at the School on the 30 May 1942. Between approximately, May 1943 and July 1945 it was the exclusive task of the School.

September 1941 – November 1942	Air Commodore J C Quinnell CBE DFC
November 1942 – May 1944	Air Commodore C B Cook CB CBE
May 1944 – December 1946	Air Commodore D W Clappen CB

APPENDIX 18

CITATION FROM THE LONDON GAZETTE

905192 SERGEANT (now Warrant Officer) Norman Cyril JACKSON, Royal Air Force Volunteer Reserve, No 106 Squadron, Bomber Command.

This airman was the flight engineer in a Lancaster detailed to attack Schweinfurt on the night of 27th April, 1944. Bombs were dropped successfully and the aircraft was climbed out of the target area. Suddenly it was attacked by a fighter at about 20,000 feet. The captain took evading action at once, but the enemy secured many hits. A fire started near a petrol tank on the upper surface of the starboard wing, between the fuselage and the inner engine.

Sergeant Jackson was thrown to the floor during the engagement. Wounds which he received from shell splinters in the right leg and shoulder were probably sustained at that time. Recovering himself, he remarked that he could deal with the fire on the wing and obtained his captain's permission to try to put out the flames.

Pushing a hand fire-extinguisher into the top of his life-saving jacket and clipping on his parachute pack, Sergeant Jackson jettisoned the escape hatch above the pilot's head. He then started to climb out of the cockpit and back along the top of the fuselage to the starboard wing. Before he could leave the fuselage his parachute pack opened and the whole canopy and rigging lines spilled into the cockpit.

Undeterred, Sergeant Jackson continued. The pilot, bomb aimer and navigator gathered the parachute together and held onto the rigging lines, paying them out as the airman crawled aft. Eventually he slipped, and falling from the fuselage of (sic) the starboard wing, grasped an air intake on the leading edge of the wing. He succeeded in clinging on but lost the extinguisher, which was blown away.

By this time, the fire had spread rapidly and Sergeant Jackson was involved. His face, hands and clothing was severely burnt. Unable to retain his hold, he was swept through the flames and over the trailing edge of the wing dragging his parachute behind. When last seen it was only partly inflated and was burning in a number of places.

Realising that the fire could not be controlled, the captain gave the order to abandon aircraft. Four of the remaining members of the crew landed safely. The captain and rear gunner have not been accounted for.

Sergeant Jackson was unable to control his descent and landed heavily. He sustained a broken ankle, his right eye was closed through burns and his hands were useless. These injuries, together with the wounds received earlier, reduced him to a pitiable state. At daybreak he crawled to the nearest village, where he was taken prisoner. He bore the intense pain and discomfort of the journey to Dulag Luft with magnificent fortitude. After 10 months in hospital he made a good recovery, though his hands require further treatment and are only of limited use.

The airman's attempt to extinguish the fire and save the aircraft and crew from falling into enemy hands was an act of outstanding gallantry. To venture outside, when travelling at 200 miles an hour, at a great height and an intense cold, was an almost incredible feat. Had he succeeded in subduing the flames, there was little or no prospect of his regaining the cockpit. The spilling of his parachute and the risk of grave danger to its canopy reduced his chances of survival to a minimum. By his ready willingness to face these dangers he set an example of self-sacrifice which will ever be remembered.

Note: The citation differs from the account in the narrative in some of its details. The narrative has been written by reference to many sources and is believed to be accurate, discrepancies concerning trivia should not however, be allowed to detract from this amazing story of bravery.

APPENDIX 19

NCO AIRCREW BADGES OF RANK – 1946 AIRCREW TRADE STRUCTURE

Introduced under AMO A498/47, issued 12 June 1947.

Master aircrew

Aircrew 1

Aircrew 2

The badges were embroidered cloth, light blue on blue-grey, with the following exceptions:

1. The master's badge incorporated the warrant officer's insignia.

2. The stars for aircrew (B) were white in colour.

('Aircrew (B)' were retitled 'Aircrew' from May 1949).

The master's badge was worn on the lower sleeve, in similar fashion to a warrant officer's badge. The remainder were worn on the upper arm, in the position normally occupied by an NCO's chevrons.

When this structure was replaced in 1950, the master's nomenclature and rank survived. The badge was later modified with the cloth eagle replaced by one of brass and the background darkened to a deep navy blue.

Aircrew 3

Aircrew 4

Aircrew
cadet

APPENDIX 20

LIST OF AWARDS – ST ATHAN FLIGHT ENGINEER MEMORIAL

905192	SGT	JACKSON VC	
1672238	SGT	ALLISON	DFM
1785123	SGT	BARTON	DFM
1567283	SGT	BELL	DFM
1337086	SGT	BURTON	DFM
1622782	SGT	BEECH	DFM
1527297	SGT	BROOKES	DFM
1896581	SGT	BARUGH	DFM
805477	SGT	BLOOD	DFM
1808147	SGT	BATEMAN	DFM
2203719	SGT	BOSTOCK	DFM
1571262	SGT	BAILEY	DFM
1577300	SGT	BRIDGES	DFM
1802404	SGT	BURKE	DFM
1006065	SGT	BOYD	DFM
1628117	SGT	BURTON	DFM
1455027	SGT	BERGER	DFM
1801075	SGT	BOWYER	DFM
1389101	SGT	BECKETT	DFM

51696	F/O	BURROWS	DFC
171724	F/O	BURGESS	DFC
178825	P/O	BLAKE	DFC
169644	P/O	BETTELEY	DFC
174562	P/O	BURNS	DFC
516790	P/O	BOWEN	DFC
113543	P/O	BELL	DFC
183354	P/O	BULL	DFC
1716011	F/SGT	BOWEN	DFM
1006156	F/SGT	BROWNLOW	DFM
568520	F/SGT	BEANS	DFM
644725	F/SGT	BAILEY	DFM
991981	F/SGT	BROOKES	DFM
622610	F/SGT	BEESLEY	DFM
1523515	F/SGT	BRENNAN	DFM
536564	F/SGT	BELTON	DFM
170021	F/O	CASS	DFC
52165	F/O	CURTIS	DFC
1138804	SGT	ALLEN	DFM
521847	SGT	BURNSIDE	DFM
143809	F/LT	BAILEY	DFC
139290	P/O	BRIERLEY	DFC
654077	SGT	BAIN	CGM
636149	F/SGT	BARNLETT	DFM
1518162	SGT	BRIMELOW	DFM
570107	SGT	BENNETT	DFM
1562312	SGT	BLAIR	DFM
68061	SGT	BEBENSEE	DFM
1036043	SGT	CLIFT	DFM
1048381	SGT	CLIFTON	DFM
613136	SGT	CROMAR	DFM
14850	SGT	CORNWALL	DFM
1623515	SGT	CALVERT	DFM
1247451	SGT	CLARK	DFM
577064	SGT	CAWTHORPE	DFM
53140	F/O	CLARK	DFC
52689	F/O	CLARKSON	DFC
174046	P/O	COBDEN	DFC
159107	P/O	CRANE	DFC
54666	P/O	CARTER	DFC
1899509	P/O	COLE	DFC
1615842	P/O	CLARKE	DFC
1672387	F/SGT	CHRISTIE	DFM
652365	F/SGT	CADDEN	DFM
1803606	F/SGT	COCKADAY	DFM
1601795	F/SGT	COX	DFM
1531284	F/SGT	COX	DFM
1213124	F/SGT	CABLE	DFM
977944	F/SGT	CROSBY	DFM
1605068	SGT	CLARE	DFM
954100	SGT	CHEVALIER	DFM
1803718	SGT	CAPPS	DFM
1685085	SGT	COLE	DFM

1801491	SGT	CANFIELD	DFM
1803789	SGT	COWAN	DFM
171271	P/O	DEWEY	DFC
183639	P/O	DAVENISH	DFC
53731	P/O	DOWLAND	DFC
1624554	F/SGT	DIAPRE	DFM
1217245	F/SGT	DAVIS	DFM
576822	F/SGT	DOWDALL	DFM
1167089	F/SGT	DUNNING	DFM
577153	SGT	DAVIS	DFM
527589	SGT	DOLAMORE	DFM
1821127	SGT	DONALDSON	DFM
1142884	SGT	DOWLING	DFM
546108	SGT	DRINKWATER	DFM
1890887	SGT	DOWNS	DFM
2203987	SGT	DACK	DFM
619670	P/O	EDWARDS	DFC
904460	SGT	EALES	DFM
1622695	F/SGT	GILBERT	DFM
A68020	F/SGT	GRAYSON	DFM
577843	SGT	GREISON	DFM
1629827	SGT	GODWIN	DFM
1582631	SGT	GROSVENOR	DFM
1590030	SGT	GOULDEN	DFM
640455	SGT	GEORGE	DFM
1603857	SGT	GLENN	DFM
1567893	SGT	GRAY	DFM
52715	F/LT	HOWARD	DFC
155897	F/O	HANNAN	DFC
52619	F/O	HILL	DFC
172152	P/O	HIGGS	DFC
169053	P/O	HALLAM	DFC
177645	P/O	HOWE	DFC
177638	P/O	HUGHES	DFC
617515	W/O	HARBISON	DFC
1417802	W/O	HOWELLS	DFC
1058421	SGT	CABLE	DFM
753253	SGT	CALDERHEAD	DFM
573567	SGT	CARTWRIGHT	DFM
577497	F/SGT	CHAPMAN	DFM
1218716	F/SGT	CHILDS	DFM
1268573	F/SGT	CROSS	DFM
148835	P/O	CRAIG	DFC
148089	P/O	DAVIS	DFC
17608	P/O	DOLBY	DFC
54935	P/O	DUFFY	DFC
647705	F/SGT	DUFFY	DFM
622064	SGT	FAIRHEAD	DFM
1194020	SGT	GILES	DFM
649708	SGT	GRIFFITHS	DFM
1094266	SGT	GRAINGER	DFM
544467	W/O	GOODWIN	DFC

573990	F/SGT	EDWARDS	DFM
975515	SGT	EDWARDS	DFM
A10427	F/LT	FORSTER	DFC
176219	P/O	FARNWORTH	DFC
947962	F/SGT	FORBES	DFM
611697	F/SGT	FARADAY	DFM
1605591	F/SGT	FELSTEAD	DFM
574496	F/SGT	FLOWER	DFM
1864418	SGT	FRENCH	DFM
1475139	SGT	FIRTH	DFM
160061	F/LT	GOODWIN	DFC
170181	P/O	GURNEY	DFC
1895356	P/O	GIBBS	DFC
544878	W/O	GARDNER	DFC
611917	F/SGT	GAMBLE	DFM
1813336	F/SGT	GIBBONS	DFM
164571	F/SGT	GASTON	DFM
1005912	F/SGT	GRAY	DFM
935419	W/O	HOLLIDAY	DFM
1623883	W/O	HARRISON	DFM
1145051	F/SGT	HORSLEY	DFM
1584333	F/SGT	HEARNE	DFM
924379	F/SGT	HICKS	DFM
1151951	F/SGT	HOOTON	DFM
1580028	F/SGT	HOULDSWORTH	DFM
1386201	F/SGT	HUGHES	DFM
1566044	F/SGT	HENDERSON	DFM
1637106	SGT	HAWTHORNE	DFM
1120856	SGT	HACKETT	DFM
1279465	SGT	HOLT	DFM
1822179	SGT	HENDRY	DFM
1806337	SGT	HAWKINS	DFM
1426641	SGT	HEWITT	DFM
1819015	SGT	HARDING	DFM
51944	F/LT	INWARD	DFC
992149	SGT	INNES	DFM
R71968	SGT	IRELAND	DFM
C18596	P/O	JOHNSTON	DFC
979438	F/SGT	JERVIS	DFM
1650434	F/SGT	JONES	DFM
1396487	F/SGT	JOHNSON	DFM
1874852	SGT	JOYCE	DFM
1816698	SGT	JOHNSON	DFM
1315875	SGT	JONGS	DFM
1237141	F/SGT	KING	DFM
921981	SGT	KING	DFM
1321795	SGT	KILMINSTER	DFM
175974	P/O	LEES	DFC
1316274	SGT	LEWIS	DFM
1146797	SGT	LANCASTER	DFM
577197	SGT	LEYSHON	DFM
1821218	SGT	McALLISTER	DFM
1113149	SGT	MADDISON	DFM

146105	F/O	HAMILTON	DFC
1176333	SGT	HAMILTON	DFM
611242	SGT	HEYWARD	DFM
961043	F/SGT	HEMMING	DFM
1214979	F/SGT	HAMMOND	DFM
1236409	SGT	JENNER	DFM
146106	P/O	JOWERS	DFC
22170	W/O	KNOX	DFC
1203969	SGT	KNIGHT	DFM
1147982	SGT	LAWRENCE	DFM
645032	SGT	LORRIMORE	DFM
573957	SGT	LLOYD	DFM
545207	SGT	LAVERICK	DFM
1268110	F/SGT	LAWRENCE	DFM
147494	P/O	LISTON	DFC
156039	P/O	MATTHEWS	DFC
J17712	F/LT	McLEAN	DFC
19690	F/O	MADDER	DFC
1024283	P/O	MILLER	DFC
1604454	W/O	MATCHEM	DFC
1094376	F/SGT	MEER	DFM
962627	F/SGT	MORGAN	DFM
1582608	F/SGT	MANNING	DFM
1567575	F/SGT	McCABE	DFM
1697939	F/SGT	McIVER	DFM
615997	SGT	MOONEY	DFM
1268781	SGT	MARTIN	DFM
1582234	SGT	McINULTY	DFM
1245937	SGT	MOORE	DFM
148497	F/O	NANCEKIVEL	DFC
159101	P/O	NEWMAN	DFC
1591125	SGT	NEWTON	DFM
1801248	SGT	NEARY	DFM
1868905	SGT	NORMAN	DFM
1232068	SGT	LEE	DFM
1104645	SGT	LAMONT	DFM
1895615	SGT	LOOSEY	DFM
1592532	SGT	LYON	DFM
577212	SGT	LEWIS	DFM
572993	SGT	LEWIS	DFM
1316274	SGT	LEWIS	DFM
1661466	SGT	MORRISEY	DFM
1697939	SGT	McIVER	DFM
1820952	SGT	MATHEWS	DFM
176773	P/O	MIDDLETON	DFC
157630	P/O	MORGAN	DFC
170180	P/O	MORRISON	DFC
161289	P/O	MARTIN	DFC
1604454	W/O	MATCHAM	DFC
569429	F/SGT	McGREVY	DFM
1802857	F/SGT	MADGEWICK	DFM

183353	P/O	PERRETT	DFC
170186	P/O	REDDISH	DFC
53561	P/O	RADCLIFFE	DFC
528826	P/O	RUTTER	DFC
1002117	P/O	RICHARDSON	DFC
572468	W/O	ROBERTS	DFC
1114181	F/SGT	ROBINSON	DFM
1038418	F/SGT	RANDLE	DFM
1639906	F/SGT	REDFORD	DFM
1710456	SGT	ROBERTS	DFM
1400614	SGT	RICHARDS	DFM
1581823	SGT	RICE	DFM
1268896	SGT	REA	DFM
1804245	SGT	READ	DFM
1813959	SGT	RICHARDS	DFM
1892093	SGT	ROSE	DFM
573971	SGT	ROBERTS	DFM
183430	P/O	ROBOTHAM	DFC
52312	P/O	MARTIN	DFC
1004784	F/SGT	MARSHALL	DFM
536009	SGT	MARCH	DFM
570791	SGT	MITCHEM	DFM
574625	SGT	MULLANY	DFM
545886	SGT	McCREEDIE	DFM
515918	SGT	McKENNA	DFM
549157	SGT	McSHANE	DFM
143798	P/O	TAYLOR	DFC
1166079	F/SGT	THOMAS	DFM
747157	SGT	VINALL	DFM
21082	SGT	WALKLEY	DFM
539504	SGT	WILKIE	DFM
572802	F/SGT	WRIGHT	DFM
51704	F/LT	WHITAKER	DFC
149900	P/O	WEBSTER	DFC
53562	F/LT	O'REILLY	DFC
176931	P/O	OWEN	DFC
617319	F/SGT	OWEN	DFM
1584801	F/SGT	O'BYRNE	DFM
922297	F/SGT	PAGE	DFM
1576510	F/SGT	PACK	DFM
643812	F/SGT	PALMER	DFM
1456141	SGT	PILE	DFM
167039	SGT	POWELL	DFM
1522838	SGT	PAYNE	DFM
175300	P/O	PAYNE	DFC
53824	P/O	POSSEE	DFC
183353	P/O	PERRETT	DFC
1615040	P/O	POWEL	DFC
53553	F/O	PARSONS	DFC
145674	F/O	PHILLIP	DFC

148590	F/LT	SIMS	DFC
143793	F/O	SPENCER	DFC
C18909	P/O	SONDERGEARD	DFC
575361	W/O	SHAW	DFC
1586267	F/SGT	SNEDDON	DFM
990662	F/SGT	STEWART	DFM
577155	F/SGT	SLATER	DFM
1825315	SGT	SHERRY	DFM
1202972	SGT	SIMMONDS	DFM
1238049	SGT	SULLIVAN	DFM
1622583	SGT	STAMP	DFM
1541858	SGT	SMITH	DFM
1862542	SGT	STEVENS	DFM
1476776	SGT	STARK	DFM
1192589	SGT	SWEET	DFM
1532898	SGT	SHEASBY	DFM
1159268	SGT	SOAMES	DFM
987685	SGT	STEVENSON	DFM

992969	F/LT	WAITE	DFC
54239	F/LT	WRIGHT	DFC
161385	F/O	MOUNTFORD	DFC
54219	P/O	WALKER	DFC
1803862	F/SGT	WHITBREAD	DFM
1581755	F/SGT	WEAVER	DFM
1616266	F/SGT	WALKER	DFM
1523530	F/SGT	FLETCHER	DFM
1869162	SGT	WANBURN	DFM
1815736	SGT	WATT	DFM
1162227	SGT	WILLIMAN	DFM
R110337	SGT	WEBB	DFM
1277620	SGT	WHITEHOUSE	DFM
1632900	SGT	WREN	DFM
R53177	SGT	YULE	DFM
3000725	SGT	BALDERSTONE	DFM
939390	SGT	McABENDROTH	DFM
1087138	SGT	HEARD	DFM

184769	P/O	SCHOLES	DFC
1801888	P/O	STAPLEY	DFC
1478008	W/O	SABIN	DFC
1278152	W/O	SALTER	DFC
148590	F/LT	SIMS	DFC
1039037	F/SGT	SHAW	DFM
647641	F/SGT	STRETCH	DFM
1488306	F/SGT	SIMPSON	DFM
1089786	F/SGT	SMITH	DFM
1803962	F/SGT	SCUTT	DFM
142050	F/SGT	SOLDAN	DFM
701995	F/SGT	TURNER	DFM
994575	F/SGT	TOWNSLEY	DFM
939079	SGT	SILVERWOOD	DFM
4190A	SGT	SKEBO	DFM
1603870	SGT	SOPER	DFM
1299326	SGT	TURRELL	DFM
1393914	SGT	THOMPSON	DFM

51704	F/LT	WHITTAKER	DFC	
53934	P/O	TURNBULL	DFC	
1582711	P/O	TRUMAN	DFC	
174040	P/O	WAKEFIELD	DFC	
161279	P/O	WILTSHIRE	DFC	
159100	P/O	WEBB	DFC	
652142	F/SGT	VICKERSTAFF	DFM	
569640	F/SGT	WEBBER	DFM	
539478	SGT	TURNER	DFM	
1344591	SGT	TAYLOR	DFM	
R62332	SGT	TURNER	MID	
1853807	SGT	VEALE	DFM	
1418314	SGT	WADIA	DFM	
1593093	SGT	WILKINSON	DFM	
2204259	SGT	WAIND	DFM	
1671281	SGT	WEST	DFM	
1869162	SGT	WENBORN	DFM	
1652441	SGT	WILLIAMS	DFM	
52830	P/O	EVANS	DFC	
52745	F/O	POPE	DFC	
177518	F/O	KENNY	DFC	
187163	P/O	McMONAGLE	DFC	
186557	P/O	WATKINS	DFM	
176224	P/O	STOCKER	DFC	
179390	P/O	METCALF	DFC	
576385	W/O	LLOYD	DFM	
578366	W/O	ELDER	DFM	
542345	W/O	COULSON	DFC	
1423530	F/SGT	FLETCHER	DFM	
1125877	F/SGT	HUGHES	DFM	
1852559	F/SGT	LOADER	DFM	
1008953	F/SGT	SIBBURN	DFM	
2203614	F/SGT	EMMETT	DFM	
1521782	F/SGT	O'BRIEN	DFM	
954028	SGT	SIMISTER	MM	
1386783	SGT	WILLIAMSON	DFM	
1567658	SGT	FLOCKHART	BEM	
1591903	SGT	STOKES	DFM	
143796	F/LT	McCANN	DFC	
174699	F/LT	HUME	DFC	
158804	S/LDR	RICHARDS	DFC	
182662	F/O	ALLEN	DFC	
185944	F/O	MacDONALD	DFC	
51694	F/LT	KEENE	DFC	DFM
572262	F/SGT	HOWARD	DFM	
52800	F/LT	SPRACKLING	DFC	
571518	W/O	GEARY	DFC	
168966	F/LT	YOUNG	DFC	

NOTES:

1. This list includes errors which appear on the original boards.

2. The list is not comprehensive.

3. The award of DFMs to warrant officers and commissioned officers probably reflects promotion following the award.

4. Duplications may be errors, or might denote the award of a bar to the first decoration.

APPENDIX 21

EXTRACT FROM 'AIR CLUES' (THE RAF MAGAZINE) 1961

● LAST YEAR a special recruiting drive for Air Engineers was carried out and many men are now being trained to fill this vital role. However, here is one Master Engineer who feels that the present system of training does not fully equip the Air Engineer to meet the demands of modern aircraft.

● In this article he suggests that there should be a re-valuation of the duties of Air Engineers and that there is an urgent need to widen the scope of instruction – particularly in aircraft performance. An Air Ministry answer is given on the next page.

What is an Air Engineer?

– asks MASTER ENGINEER C. CURRAN (Lyneham)

As a result of the recent recruitment of Flight Engineers – the first for many years – a large number of men are now being trained in this capacity, to operate as crew members on aircraft already in service and on order.

This, surely, presents a good opportunity for re-thinking, overhauling and expanding the existing training scheme to meet modern requirements and produce more efficient Flight Engineers. I feel there is much to be done to improve the existing system of training.

The earliest type of engineer was merely a ground servicing technician whose function was to fly with the aircraft and carry out whatever servicing was required in flight. That this was necessary was usually due either to inefficient ground servicing or – bad design.

Things have changed radically from these times, yet those who devise training schemes for Flight Engineers seem unaware of this fact and act as though the old conditions still exist in modern aircraft, and a Flight Engineer's duties remain unaltered.

If this is not so, why is it that Flight Engineers are trained at ground staff schools with ground staff instructors? In my view, much of the trouble stems from the fact that to many people, the term "Flight Engineer" conjures up a grease-stained individual, fanatically devoted to engines, or, alternatively, the dour Scot type of engineer, complete with curly pipe in the boy's paper tradition.

It appears to me that the present training scheme has been based on duties carried out by Flight Engineers on earlier types of aircraft, these duties being devised by a combination of aircraft manufacturers and others not fully aware of the service requirements.

Changed situation

On earlier aircraft it may have been necessary to carry a specialised technician to ensure its safe arrival. Modern aircraft, however, are so designed that they require very little in-flight manipulation. To meet this changed situation, the Flight Engineer's main job should be pre-flight planning in flight performance and after-flight analysis, to ensure that maximum efficiency is obtained from the aircraft.

The present method used for training other crew members to carry out these duties may – after the whole structure of crew duties has been distorted – appear to be successful. This is not so. In order to disguise the fact that Flight Engineers' duties are not being performed efficiently, the most obvious of them are carried out by other crew members.

And they – usually the navigator and co-pilot – do not normally have sufficient time or knowledge of the subject to handle things properly.

The weakness of the existing system is perhaps best exemplified by the "Scheduled Performance" item – a straightforward engineering problem.

Scheduled Performance is devised to cover the whole of flight from take-off to touch down. Navigators, however, are usually taught to consider only take-off and nett flight path conditions. Owing to their limited knowledge of the subject, it is not unusual to find the same graph being used for two directions of a runway which has unlimited clearway at one end and none at the other. Other practices include using charts based on V1 as a fixed percentage of V2, considering the ample emergency stopping distance obtainable and completely disregarding the case of a continued take-off after engine failure at V1.

Incorrect training?

These are, to my mind, results of incorrect training which could lead to accidents. I feel this situation would be obviated if Flight Engineers were trained to interpret this type of performance information.

In my opinion many present-day Flight Engineers do not meet the requirements of modern aircraft and, though often unconsciously, resort to the undignified subterfuge of excessive log keeping and equipment checking to hide the fact that the aircraft is struggling along without assistance from them.

I would stress that I do not believe this is entirely the fault of Flight Engineers. It only highlights the lack of foresight in their selection and in their training. If we are to turn out more engineers I believe it is essential that we widen the scope of instruction given on performance. Only by doing this can we avoid raising another generation of crew chiefs with brevets.

The desire to use Flight Engineers on many aircraft is, to a large extent, due to their ability to keep aircraft operating efficiently over long distances. Much of the training they undergo at present is immensely useful in this respect. But it is a mistake to imagine that this aspect of their duty requires their full time and attention. If this were so it would be a sad reflection on the servicing departments of the RAF.

Although aircraft performance, fuel planning and other associated subjects are basic engineering problems, at no time during their training are Flight Engineers provided with any grounding in them. It is left to the individual to learn from the hard school of experience – plus a large degree of private study.

The modern Flight Engineer should be equipped with a slide rule – not a spanner. Only when the subject of aircraft performance is properly taught to Flight Engineers and they are enabled to put this knowledge into practice will the full benefit of their services be obtained.

Air Ministry comment

Master Engineer Curran is incorrect in suggesting that the modern flight engineer should dispense with his tool kit. With the variety of complex types of aircraft passing through staging posts at present, it is impossible for resident groundcrews to have a detailed knowledge of each type. The air engineer must be trained to advise and, if necessary, assist in servicing his particular type of aircraft away from base. A diversion

may put the aircraft down at an airfield where there may be no one with expert knowledge of that particular type. That is where the air engineer must be in a position to direct and assist in servicing the aircraft.

Expansion of duties

It is admitted that the duties of the modern air engineer have changed with the introduction of more advanced turbo-jet and turbo-prop aircraft. But this change has taken the form of an expansion of the air engineer's duties to embrace certain aspects of flight planning, flight performance and fuel planning. In this respect close liaison with the navigator on these subjects is ideal. Nevertheless the air engineer's primary responsibility is still the technical supervision, both in the air and on the ground, of all the aircraft systems to ensure safe and efficient aircraft operation under all conditions of flight. If the engineer carries out his job efficiently and conscientiously he should find himself fully employed in the air. To suggest that modern Transport aircraft require less technical "in flight" supervision than the older aircraft, is untrue.

Master Engineer Curran's criticisms of the present scheme of air engineer training suggests that he does not appreciate the type of "end product" required.

Engineers are recruited from Advanced Tradesmen who are specialised in one ground trade, i.e. the Airframe, Engine, Electrical or Instrument Trade groups. This specialised knowledge is expanded by an eight months' course at Technical Training Command Schools to cover all four trade groups. On completion of this course the trainee engineers are expertly conversant with all aspects of engineering. They then flow onto Operational Command conversion units for a period of five months to acquire both technical and operational instruction on type aircraft including "performance instruction". After further guidance by the Wing Training Staffs of the Operational Squadrons the individual should then prove to be a highly qualified air engineer able to carry out his duties in the most efficient way.

Wider scope

It is fully realised that there is a need for expert instruction on aircraft performance, especially as this subject is now part of the air engineer's categorisation scheme. Progressive steps are being taken in this sphere to widen the scope of instruction given and an increasing number of air engineers are benefiting from these measures.

Very little "spanner work" is carried out by air engineers today, but their status as technical experts on their particular aircraft has grown. This is largely due to their overall general engineering knowledge, as opposed to the limited specialised knowledge of servicing personnel. The assistance given to servicing staffs mainly in an advisory capacity has proved invaluable in the operation of route aircraft in Transport Command. One outstanding example of this is the technical liaison between Comet air engineers and serving personnel along the Transport Command routes, without which the Comet's operational record would be by no means as impressive as it is today.

APPENDIX 22

AIR ENGINEER TRAINING
PRE-COURSE BRIEFING 1964

Introduction

1. AMO A147/63 as amended by MOD (Air) Signal P9829/S10d dated 10th March 1964 gives details of the opportunity for ground tradesmen to serve as air engineers. Briefly the conditions of service as detailed in paragraph 39-45 and 56-57 of the AMO state that selected candidates who have not previously qualified as air engineers are to be remustered in their existing rank and trade (under training air engineers (A)) with effect from date of entry to training: they undergo a combined ground training course of thirty weeks, at Royal Air Force St Athan and Newton, and if successful, a five or six month course of flying training at an Operational Conversion unit, before entering productive employment as aircrew in either Transport or Coastal Command. Remustering to air engineer will be on award of flying badge at OCU. Airmen previously qualified as air engineers will proceed direct to OCU training.

Ground Training

2. Ground training will begin at Royal Air Force St Athan and is divided into two parts:

   a. Airframe training – 6 weeks.

   b. Engine training – 8 weeks.

There is then a leave break of one week between the end of training at Royal Air Force St Athan and the beginning of training at Royal Air Force Newton.

3. The Royal Air Force Newton training is divided into three parts:

   a. Technical education – 4 weeks.

   b. Instrument training – 6 weeks.

   c. Electrical training – 6 weeks.

Examination

4. Progress tests will be conducted at frequent stages throughout training at both schools. The final engine and airframe examination will be held at Royal Air Force St Athan at the end of this phase and the results will be recorded on Form 292. The final electrical and instrument examination will be held at Royal Air Force Newton and similarly recorded. Successful students will then be detailed for flying training at an OCU within the Command in which they will serve as air engineers.

5. All students will receive ground training in their own trade as refresher training.

Rank (AMO A147/63, paragraph 70 refers)

6. The rank which airmen will assume on remustering to air engineers is as follows:

Substantive rank in ground trade	Aircrew rank
Warrant Officer	Master Engineer
Flight Sergeant/Chief Technician	Flight Sergeant
Sergeant and below	Sergeant

Conditions of Service

7. As laid down in MOD (Air) Signal P9829/S10d dated 10th March 1964.

Married Quarters (AMO A135/61)

8. Under the terms of paragraph 48(b) of AMO A135/61, u/t air engineers may retain married quarters during training until posted to an operational Command as aircrew. On notification of the post-course duty station application for inclusion on the married quarters list of that station may be made from the day the posting is made known.

Pay (QR 2695A (4))

9. Trade pay ceases to become payable when an airman becomes eligible for flying instructional pay or flying pay.

Employment after completion of air engineer training

10. For their first tour after completing training engineers will be employed on either Shackleton, Hastings, Beverley or Argosy aircraft.

11. Shackleton squadrons are at Kinloss, Ballykelly and St Mawgan and overseas at Gibraltar, Malta, Aden and Singapore.

12. Hastings squadrons are at Colerne and at Cyprus and Singapore. Beverleys are at Abingdon and at Aden, Bahrein and Singapore.

13. Argosy squadrons are at Benson, and at Aden and Singapore.

General

14. A summary of AMOs and QRs is as follows:

AMO A147/63	– Conditions of aircrew service.
AMO A135/61	– Married quarters.
QR 573	– Re-engagement.
QR 526	– Return to ground trade.
QR 501	– Promotion.

Pre-Course Training

15. To ensure you possess the educational standard in mathematics to meet the requirements of the course you are advised to consult your Station Education Officer. Your present standard should be such as to be able to obtain a pass in the RAF Education Test Part II in that subject. If necessary, you must attend classes to attain the required standard before proceeding on the course. In addition, you are advised to read as widely as possible the RAF Flying Manual (AP 129) and Mechanics of Flight (seventh edition) by Kermode before entry into training.

APPENDIX 23

EXTRACT FROM 'AIR CLUES' (THE RAF MAGAZINE) MAY 1964

Simulator for Flight Engineers

This article, submitted by Flight Lieutenant F A PAINTER (Kinloss), describes how local initiative and inventiveness produced a flight simulator for Air Engineers. We have published it in the hope that others, hiding their talents in "do it yourself", may be stimulated to increase the efficiency of our operations in a similar way.

This simulator is now fully integrated into the programme of instruction at the Maritime Operational Training Unit, Kinloss: they don't know how they previously managed without it!

Training devices like this cost a considerable amount when purchased commercially. This equipment may not be as sophisticated as some, but it appears to be doing the job extremely well.

During the latter part of 1962, the instructors of the Air Engineers' Section of the M.O.T.U. Ground Training Squadron, Kinloss, felt that a need existed to improve, along certain lines, the training of student engineers. Recruitment was from Trade Groups I and IV, i.e. fitters in the engine, airframe, electrical and instrument trades. It has been noted that irrespective of previous trade, students had some difficulty in assimilating some aspects of the course. This was particularly apparent with the compilation of air logs. The efforts of most students to compile their first air log against the many distractions of actual flight was largely time wasted, for very few of the initial flying exercises were ideal ones for the production of a complete log.

Realistic training

Another problem which was causing concern at the time was how to assist the student in becoming completely familiar with his station in the aircraft before his first flight. The engineer's panel in the Shackleton, although not very complex by comparison with some aircraft, is still a bewildering array of dials, knobs and switches, to the uninitiated. Ideally, the student is required to sit at a "live" panel and operate everything, but to physically operate an emergency air lever for example in an aircraft, merely to get the "feel", could not come within the scope of normal familiarisation.

On the more practical side, it is one thing to be verbally taught the instrument, or other indications, of a pending engine or propeller failure, but quite another to witness the same indications in flight. Thanks to the reliability of the Rolls Royce Griffon and de Havilland counter-rotating propellers, failures for the majority of students were strictly for the classroom. A safe method had to be found whereby a fault could be demonstrated and also permit the student to make a diagnosis.

It was finally decided that a form of flight simulator would provide the required training assistance in the compilation of air logs and also aid the student to further his knowledge of the more complicated equipment, cruise control charts and graphs, which the present day engineer has to master.

Construction started after a considerable amount of sheer scrounging by all concerned. Scrap components and materials were obtained from our own station workshops – where the rumour of a prototype Fireball XL5 originated – other sections, and as far afield at No. 23 M.U. At one time there was so much accumulated scrap that we almost expected a call from those two personalities of T.V. fame!

Although all members of the section were actively engaged on the task, the course continued without interruption and many hands made light work of the early stages. Flight Sergeant C. ILEY was largely responsible for the design of twin simulators and console. As the scrap components first required repair or reconditioning, much of the preparatory work was done during off-duty hours to speed progress. The design problems involved a great deal of ingenuity and improvisation in order to modify instruments to function in the way which was required.

Simulating temperature indications proved to be the most simple of all the design problems. Connecting a variable resistance to the instrument permitted the indicator needle to be set to any desired position and varied by the console operator. Oil pressure, engine R.P.M. and boost gauges were all designed to operate in their normal sense from a 28v D.C. supply though a T.37 rectifier.

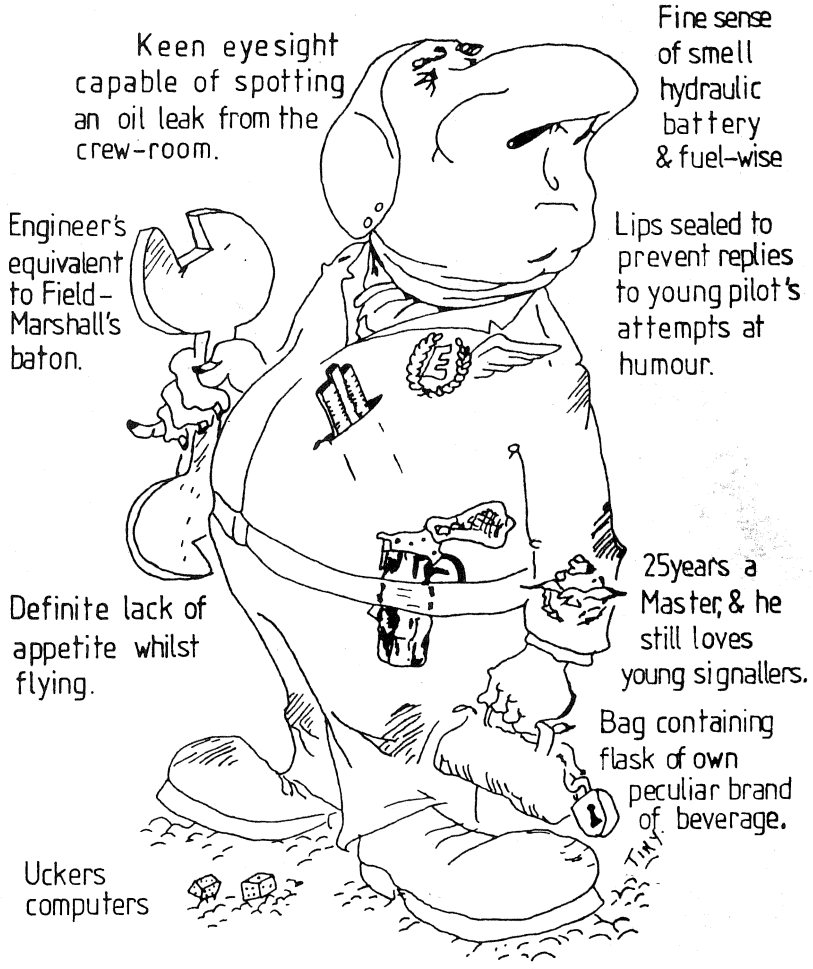
Operation of the gallons gone and air mileage counters was the biggest design problem. Initially, a system of relays and uniselectors gave only fair results. Sparking at the numerous contacts was troublesome and suppression was not the answer. Lack of equipment prevented multi-vibrator and other electronic circuits being used. Therefore, a basic "flasher" circuit was designed to feed a relay through a potentiometer and then into a capacitor, the time constant being the time taken to charge the capacitor through the potentiometer. In this way, the relay is alternately energised and de-energised at a rate of between one and forty seconds. This gives an apparent fuel consumption of between 30 G.P.H. per engine to 180 G.P.H. per engine and between 120 and 400 air nautical miles per hour.

So that a simulated flight of twelve hours or more is condensed into an exercise of three hours, the console operator can "race" the gallons gone meters and air mileage indicators. As the "flight" would be condensed, so the apparent passage of time has to be shown. After removing the balance wheel from an ordinary clock the escapement was operated by an electric solenoid, so enabling the clock to function up to five times normal speed. In this manner, all aspects of an air log for a "flight" of long duration, together with simulated engine and electrical faults, are covered during an exercise period.

A necessary design feature was to duplicate all the controls on the console and to include a modified three-way aircraft intercommunication system. This permits separate control over each student, as and when required, to suit individual progess.

It is believed that this equipment is the first of its type to be built and used in the Royal Air Force for the specific training of Air Engineers, who have now had full aircrew status for over 20 years.

THE SHACKLETON FLIGHT ENGINEER



ORIGINAL NOW HELD BY EIGHT SQUADRON-LOSSIEMOUTH