ROYAL AUSTRALIAN AIR FORCE

INVESTIGATION OF MUSTANG FLYING ACCIDENTS

by

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REPORT NO. 1

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CONFIDENTIAL

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SECTION I

Introduction

1. As a result of reported elevator trim tab defects from No. 77 Squadron Japan (refer Appendix "B" Sheets 6 and 7), it was decided to carry out a thorough investigation to determine if these defects, trim creep and failure of the trim control wire, had any bearing on the five aircraft failures (disintegrations) in the air previously set down in at least three cases as being structural failures caused by excessive accelerations induced by pilots' harsh handling of the aircraft.

2. Brief resumes of these accidents are attached to this Report at Appendix "B".

General

3. The basic Mustang was designed for an ultimate factor of 12 at an all up weight of 8,000 lb. representing a safety factor of 1.5 on the design or manoeuvre factor of 8.

4. Due to various operational requirements introducing additional equipment, the operational all up weight of the aircraft has been increased so that now the maximum approved all up weight for straight flying is 10,500 lb.

5. The graph at Appendix "C" shows the various factors ultimate and design for various weights from an all up weight of 7,700 lb. to an all up weight of 10,200 lb.

6. It will be seen that at 10,200 lb. the ultimate factor is reduced to approximately 9.5.

7. In the early life of Mustang aircraft (overseas) a number of tailplane failures occurred in flight.

8. It was concluded that the failures were caused by a high torque between the tailplane and fuselage. The basic cause was considered to be due to the ease with which side slip can be obtained at quite high speeds, thus giving rise to considerable asymmetry of tail load distribution between the two sides of the tailplane. (R.A.E. S.M.E. Departmental Note No. Accident 151).

SECTION II

Investigations - In Australia prior to visit to No. 77 Squadron.

1. During January, 1949, two defects in connection with Mustang elevator trim tab controls were reported from No. 77 Squadron Japan.

2. The first defect control creep had been occuurring over a considerable period and had not been officially reported prior to the visit to Iwakuni of D.F.S. to investigate the accident in which A68-802 disintegrated in the air during a pull out from a rocket exercise.

3. A request to the Unit for further information indicated that creep had been reported on numerous occasions and had been cured by re-tensioning the control wires.

4. Trim control creep had been previously reported by Care and Maintenance Unit Mildura in February, 1946, File 9/60/142. Other Units using Mustang were requested for reports. At this period no other Unit had experienced this defect, and no further action was taken at that time.

5. Apart from the abovementioned experience, no case of trim creep had been experienced by Units in Australia.

6. Up to the end of January, 1949, all attempts to induce creep failed.

7. However, during February, creep was induced in two cases, one at Aircraft Research and Development Unit and one at No. 77 Squadron by a member of the special investigation party. The causes and methods of rectification are dealt with in the Report of the investigations carried out in Japan.

8. The second defect (ref. File 9/60/142) was the failure of the elevator trim control operating cable at the turnbuckle joint in the tailplane. During take-off the pilot of A68-723 found the aircraft commencing to roll. Control was maintained and the pilot carried out a successful forced landing. Inspection revealed the port elevator trim tab raised one inch and starboard tab lowered one inch. The elevator trim control system had lost all tension. Further investigation showed that the turnbuckle end and the cable at the joint in the tailplane had parted.

9. It was found that at this joint the turnbuckle ends are sweat soldered to the cables, whereas in all other joints in the aircraft the turnbuckle ends are swaged to the cables, which is standard practice.

10. There is no apparent reason for this particular joint to be sweated, and investigation of drawings and discussions with Commonwealth Aircraft Corporation Engineering Staff and a Technical Representative of the North American Aviation Company in Japan failed to reveal the reason.

11. It is thought that in the production of Mustang aircraft it was considered that the control cable could not be assembled with both ends attached, therefore, the cable was manufactured less one end, assembled in the aircraft and the remaining end sweat soldered in place due to the impracticability of swaging in this position.

12. The design was changed to incorporate swaged fittings at each end of the cable in June, 1945, by North American Engineering Order T.68342 dated 26.6.45 applicable to parts 109-52534 and 52547.

13. The reasons for the change were "Terminals failing in Service".

14. This change was not retrospective and permitted existing made up cables to be used.

15. Therefore, all R.A.A.F. Mustangs received from America and all deliveries from C.A.C. were fitted with the sweated type ends.

16. On receipt of details of the failure and information given verbally by F/O Gooch, an engineer officer sent ot this Head-Quarters from No. 77 Squadron with samples of defective cables, an intensive investigation was initiated.

17. Aircraft flying was restricted to essential flying pending results of the investigation.

18. In view of the fact that the sweat soldered joints were failing under test loads of 50 lb. (whereas the complete cable with swaged ends is required to withstand a proof load of 288 lb. without any sign of failure) and the non-standard nature of the attachment, immediate action was taken to replace sweated cables with cables manufactured in accordance with the latest drawing - i.e. with all turnbuckle ends swaged in position.

19. Twenty sets of replacement cables were completed by the 20th January and forwarded to Japan safe-hand on the 21st January. The remaining requirements were given the highest manufacturing priority possible.

20. In the meantime, tests were carried out on elevator trim tab control systems at A.R.D.U. in an endeavour to determine what loads could be induced in the control system. It was found that by applying the greatest possible load to the control wheel, a load beyond that which a pilot could apply in flight, a tension of only 40 lbs. could be induced in the cable run at the position where the cable failed.

21. During these investigations it was found that if cables were only tensioned in the fuselage run, the tension was no spread through the complete system and later operation of the controls could reduce the tension throughout the system.

22. It is to be laid down that when tensioning any system after the first tensioning controls are to be operated to spread the tension and a re-check taken, additional tension being applied if necessary.

23. During the investigation into this defect, it was decided to simulate the failure by cutting an elevator trim control wire in an aircraft on the ground.

24. Aircraft A68-112 had been returned to Commonwealth Aircraft Corporation for repair, therefore, this aircraft was selected for the test.

25. It was noticed that with the trim indicator at neutral the tabs were one slightly up and one slightly down. The tension in the system was down to 5 lb.

26. The control was first wound from full tail heavy to neutral trim and the wire cut near the turnbuckle in the cable between the operating jack in the tailplane, in a position closely approximating the joint failure in A68-723.

27. On being cut, the cable unwound from the operating jack bobbins in a similar manner to a clock spring when suddenly released. In doing so, the port jack drum was revolved to raise the tab 11/16" whilst the starboard tab lowered 3/16". In moving the control wheel forward, the port tab moved up to 1½" whilst the starboard tab did not move. This is due to the fact that the cross wire being cut, there was no pull on the starboard jack drum, the wire from the control wheel to this drum under this movement would be under compression, therefore, it would only slacken. On moving the control wheel backwards to the tail heavy position, neither tab moved any further. It was then found that the wire had unwound from the control wheel bobbin.

28. It is considered that the above test duplicated what happened in the accident to A68-723, and if the failure occurred in a manoeuvre, could cause a considerable rolling moment, which it is considered could and would be automatically counteracted by the pilot by the use of aileron control.

29. However, with the replacement cables, it is considered that this type of failure is not likely to re-occur.

30. Investigating the system, it is considered that differential movement of the elevator trim tabs can only occur under this condition, i.e., the failure of the control wire joining the two operating jack cable drums.

31. After discussion with the Commanding Officer, Aircraft Research and Development Unit, the following tests were put in hand to determine -

(a) Loads in elevator trim tabs by measuring stick force to balance trim settings.

(b) Range of trim settings for various conditions of flight.

(c) Amount of side slip with changes of power and speed especially in pull outs from dives.

SECTION III

REPORT ON INVESTIGATIONS INTO MUSTANG ACCIDENTS AND ELEVATOR TRIM TAB CREEP AT NO. 77 SQUADRON, JAPAN

7th February to 21st February, 1949

1. The investigation commenced with a general discussion with the Squadron flying personnel. The reason for this discussion was to indicate for what purpose the investigation was being carried out, the action taken to-date, and the information beinf looked for.

2. After this general discussion, opportunity was taken to put the questions listed at Appendix "D" to each pilot separately and without the pilots having an opportunity to discuss the answers as between themselves.

3. This action was taken to determine if any new or individual techniques had crept into the squadron flying which may have had an influence on the recentaccidents.

4. The average results of the replies are listed at Appendix "D". It will be seen that techniques vary considerably as between pilots and that developed and taught by Air Armament School. Also, that there was a lack of knowledge of flying limitations. Only 3 pilots out of 12 were aware of the correct maximum permissible diving speed at sea level.

5. As a result of the above, it is considdred that in No. 77 Squadron -

(a) there is no standardisation in flying techniques.

(b) there is a lack of knowledge of flying limitations.

6. During the general discussion, mentioned in paragraph 1 above, the flying personnel raised, amongst other points, two items of general interest, namely:-

(a) as these aircraft were old and had been stored for some time, they must be by now fatigued and worn out. Several queries as to the date of replacement of Mustangs by Vampires in the squadron gave an interesting lead as to the reason for the foregoing claim of obsolescence.

(b) that several aircraft in the squadron had required different elevator trim settings to the majority and, therefore, suggested that fuselages were twisted and/or tailplanes distorted.

7. It was pointed out that in regard to 6(a) above, that aircraft of the Mustang type deteriorated with use rather than with age, providing proper care was taken during the storage period. An inspection of the aircraft showed that they were in an excellent condition, very clean and without signs of corrosion as far as could be inspected without extensive dismantling. A survey of the flying hours (see Appendix "E") showed that only three of the 29 aircraft in current use, and of the 40 held altogether, had flown more than 500 hours. The maximum being 564.50 hours. It is considered that these hours are not sufficient to seriously affect the reliability of the aircraft.

8. In regard to 6(b) above. A rigging check of the aircraft mentioned as having varying flying characteristics.

Aircraft A68-754, 765 and 720 were checked.

Points measured were:-

Tailplane front spar at junction of tip to centre of mainplane lifting point plug. Port and starboard.

Fuselage rear at frame under tailplane to mainplane lifting point plug. Port and starboard.

Top of tailplane outer to top of fin. Port and starboard.

Underside of tailplane outer to rear fuselage. Port and starboard.

9. It was found that in the case of A68-754 and 765, the measurement between the outer tailplane and the mainplane varied by 1/4" between port and starboard. As this dimension is 17-1½ the variation of 1/4" (.12%) is considered to be well within manufacturing tolerances.

All other dimensions were equal.

In view of this check, it is considered that aircraft are not distorted, and the slight variation of dimensions to have no effect on the flying characteristic of the aircraft.

10. At this stage 20 aircraft had been fitted with new elevator trim tab control wires, and although a considerable mount of flying had taken place, no creep had been experienced. This is attributed to the fact that when the wires were installed, they were rigged (tensioned) in accordance with the method developed during the preliminary investigations carried out in Australia in an attempt to determine reasons for creep.

11. This technique is to tension the wires at the turnbuckles in the fuselage then operatethe control a number of times and then check the tension. If not correct, the tension is re-adjusted until constant throughout the system.

12. From the discussions with the flying personnel, no real lead could be obtained as to the cause of elevator control creep. The condition inducing creep appeared to be:-

(a) loose rigging of control wires.

(b) tight manoeuvres involving application of 3 to 5 G.

13. It was then arranged that Flight Lieutenant Glassop would participate in all squadron flying so as to observe technique and local conditions.

14. It was also arranged that any pilot experiencing creep was to note the conditions carefully, and if practical, return to base without altering the trim in order that an examination of the system could be carried out and flight check made.

15. In the meantime, action was taken to fly aircraft stated to have varying characteristics alongside normal aircraft. In no case did the flying qualities of the subject aircraft vary to any great extent from standard. In A68-720 flying in formation with another aircraft, straight and level at 240 knots, it was found necessary to use 7° Nose Heavy trim a gainst 3° in the leading aircraft. In

discussion with personnel in the squadron and at Aircraft Research and Development Unit, this was found to be not uncommon, as this variation was frequently noticed in other aircraft and could be brought about by variation in the basic rigging of the trim system or characteristics of the aircraft.

16. During the week, 7th to 11th February, there were no reported cases of creep although all normal flying was carried out, i.e. cross country, rocketeering and dive bombing.

17. During the following week, it was decided to progressively reduce the tension in the elevator control system of the aircraft flown by Flight Lieutenant Glassop until creep was experienced.

18. In re-rigging A68-726 to reduce the tension, the tension was reduced to a stated 10 lb. In flight, no creep was induced.

19. On a check of the tension prior to a further reduction of tension, the readins were so misleading that it was decided to check the tensiometer.

20. The tensiometer used was a product of the Pacific Scientific Instrument Co. recognised as one of the most reliable cable tension measuring instruments available.

It is to be noted that these instruments do not read direct in pounds tension, but give only an index figure which read against anvil and cable size listed in a table included with the instrument indicated tension.

The table included does not cover the wire size used in the trim circuits, therefore, an approximation was used, which after a calibration, was found to be incorrect.

21. To enable a reliable table of tensions to be compiled, a length of control wire was hung from the ceiling and loaded with various weights to cover the rigging range.

22. Aircraft A68-726 was re-rigged to 10 lb. tension and flown. During this flight, creep was experienced under the following circumstances.

Aircraft trimmed for straight and level flight, requiring 5° Nose Heavy Trim (considered normal). The aircraft was then subjected to high speed pull outs - steep turns and spiral dives without any alteration to elevator trim. At regulator intervals the aircraft was brought to straight and level flight, and in each case the nose tended to rise above the horizon. It was noted that the trim indicator was moving back to neutral. After 20 minutes of flying the trim had moved back approximately 6°, and appeared to remain at this position. The manoeuvres carried out were up to the grey out stage estimated to be 4½ G. During this flight, the aircraft was flown against trim.

23. Since returning from Japan, S/Ldr. Shields of D.F.S. also experienced creep using similar flying techniques. In this case, however, the movement was much quicker, being visible to the eye. The tension in this case was lowered to one pound, and this is considered to be the reason for the increased rate of movement.

24. During the mechanical investigation of the trim control system, it was found that the operating jack drums, when free of the control wires, could be made to revolve by working the trim tab up and down. In each case the movement was from extreme positions to neutral, rarely did the jack move past this neutral position. This reverse movement was stopped as soon as any pressure such as a control wire was put on the drum.

25. In view of the above, it is concluded that the cause of creep is -

(a) low rigging tensions.

(b) Tendency for trim tab jacks to reverse their movement with vibration. Possibly more so with worn jack threads. The elevator trim jacks from A68-765 are being brought to Melbourne to check for wear. This is because no suitable thread measuring instruments were available in Japan.

(c) high frequency vibration set up in the tabs when flying aircraft against trim.

26. Instructions were issued that the laid down tension of 20 lb. should be aimed at and the limits used to cover variations in rigging. In any case, the minimum of 15 lb. was not to be aimed at, and that 17 lb. would be the lower limit in future.

27. In the Court of Inquiry into the accident to A68-765, the court, on inspecting the aircraft, noticed that when the elevator trim tab indicator and the starboard elevator tab were in the neutral position, the port tab was 7/16" down. This variation was not explained. A careful survey of the system failed to reveal any defect in the system which would permit this variation. After an inspection of all aircraft on the Unit, it was found that in no case were the tabs in line when the indicator was set to neutral. The rigging tolerance 1° up or down is equivalent to 5/64". This tolerance plus the looseness in the connecting pins permits the tabs to be rigged out of line. In the majority of aircraft the tabs could be deflected so that one tab was up 3/16" and one tab down 3/16".

28. It is considered that in the case of A68-765 the rigging was outside the tolerances, and when one tab was set to neutral, the opposite tab showed a deflection equal to the total variation.

29. A survey of the trim tab systems did not show any design feature which could be considered weak and liable to failure. However, a further investigation will be made as to the amount of wear experienced in service, and limits of wear will be laid down above which the jack will be required to be replaced.

30. In a general survey of the aircraft the following points were noted:-

(a) all aircraft are clean and from a maintenance point of view appear to be in good condition.

(b) elevator bob weights to increase stick loadings per "G" are fitted.

(c) all aircraft are fitted with fuselage fuel tanks.

(d) there appears to be no mass in the elevator trim control system to induce movement.

(e) Mustang Technical Order No. 49 - Carburettor Vent Line Re-Routing - had not been carried out due to lack of modification sets.

(f) on one aircraft (A68-726) the elevator trim tab operating rod attachment bracket screws were loose, permitting excess back lash of the tab. This was not noticeable on other aircraft. (see paragraph 33 below).

31. In regard to paragraph 30 (a) - Japanese labour is used for general cleaning work, and these people do a good job work. The s ame labour is used for certain dismantling operations, but a strict rule is enforced that they shall not be used on any assembly work.

32. In regard to paragraph 30 (e) - this modiciation was introduced to eliminate the possible build up, unwittingly, of fuel in the fuselage tank by ~~re-routing~~ the line to the wing tanks. It is stated that 8 to 10 gallons of fuel per hour can be passed from the carburettor. However, a check on an afternoon's flying indicated that the contents of the fuselage tank had not increased. It is considered that there is a possibility of a build up in the contents of the fuselage tank, therefore, action has been taken to expedite the supply of modification parts. (refer enclosures 53A and 55A, File 9/60/142).

33. Reference paragraph 30 (f) - a lessening of this bracket could permit flutter of the tab and is considered a possible source of sudden movement of the tab. A check-up indicated that whilst no other aircraft showed signs of similar looseness, a defect along similar lines was reported from Labuan in 1946. It was considered at the time that the bell mouthing of the hole was caused during manufacture. A request was made for reports to be made on the condition of replacement tabs. As no further case was reported, it was considered to be an isolated case.

Action will be taken to ensure that these screws are regularly checked for tightness, and a proposed modification will be investigated with a view to incorporation.

34. During discussions, it was brought out, although not generally known on the Unit, that Anti "G" suits were being used by several pilots in the Squadron. These suits are used during dive bombing exercises for the alleviation of fatigue. A "Watt" type accelerometer is fitted when these suits are used. This instrument is of the spring balance type and is not generally recognised as being entirely reliable. The maximum acceleration permitted in Mustang aircraft is 6 G. Due to the possibility of unsatisfactory operation of the accelerometer used, it is considered possible to exceed the above maximum acceleration when using Anti "G" suits. It is recommended that the use of Anti "G" suits be discontinued in Mustang aircraft or suspended pending the introduction of a more reliable accelerometer. This is in view of the fact that Mustang aircraft are being operated at loadings in excess of the original design weight and, therefore, in most flight cases the strength factors are down on the original requirements. - Refer D.T.S. Technical Bulletin No. 29 - with U.S.A.A.F. Technical Order No. 01-60J-28 attached.

35. The question of Mustang accidents was discussed with the engineering staff of the American 5th Army at Nagoya on the 17th February.

Those present were:-

Lt. Col. Ericson Capt. Went	American 5th Army
Mr. Adam	North American Service Representative
Mr. Codley	Wright Field (Engine Specialist)
S/Ldr. Butcher	Chief Technical Officer No. 77 Squadron
F/Lt. Glassop	Pilot Gunnery Instructor - Member of Investigation Party
Mr. Jones	of Directorate of Technical Services - Member of Investigation Party

The discussions were informal and covered the general matter of Mustang accidents.

At the outset, the American 5th Army representatives stated that they had not experienced any trim tab failures or creep.

All their accidents (3 in 18 months) were attributed to wing failures and assessed as being due to -

(a) excessive loads applied during flying by pilots.

(b) undercarriage up-lock failures.

(c) ammunition door failure.

36. Putting the first of the reasons down as being almost impossible to determine definitely, some very interesting information was submitted by Mr. Adam on the latter suspected causes.

37. These were -

(a) Cases had been reported where the towing eyes at the inboard ends of the wheel axles had been used as jacking points, causing upward distortion of the eyes. If this occurs, two things can happen.

(i) if slightly deflected, the flat end of the eye (port side) can chafe the carburettor vent return line, possibly cause a leakage of fuel or fuel vapour with consequent risk of fire.

(ii) if deflected more than in (i) above, the flat end of the eye can foul the edge of the clearance hole in the inner skin of the wheel bay, thus preventing safe and satisfactory locking of the undercarriage leg in the UP position.

(b) If the undercarriage is not corrected rigged, it was found that there was a possibility of the undercarriage leg "up" retaining pin riding on the point of the "up lock" hook.

38. It was considered by the American representatives that if either of the above states were present, the undercarriage leg in violent manoeuvres could fall into the fairing door, deflecting the door sufficiently for the airstream to force the door open, thus permitting the leg to further fall and impose loads on the wing, which in conjunction with these already imposed by the manoeuvre, would be sufficient to cause failure of the mainplane.

39. This theory is extremely interesting as it compares very closely with the statement of the Court of Inquiry inquiring into the accident to A68-97 at Werribee.

40. On return to No. 77 Squadron these points were checked. The results of the check did not reveal any defective towing eyes or signs of the locking pin riding on the point of the "up lock" hook.

41. In checking the action of Mustang landing gear during maintenance inspections, the correct "Up Latching" of the legs cannot be checked visually, due to the fact that the wheels and fairings obscure the mechanism. At present, the operation of the undercarriage warning lights and the "clang" at the end of the retraction operation are taken as being sufficient evidence of correct operation and locking.

42. As a result of the discussion, Mustang Undercarriage Rigging Instructions will be amended to provide for:-

(a) removal of the wheel.

(b) disconnection of the wheel fairing door retraction mechanism during locking checks so that the correct locking of the leg in the UP position can be observed.

43. Other points of interest brought out in the discussion were -

(a) If the bolts attaching the brake assembly to the axle torque flange are assembled with the nuts on the inboard side of the flange, these bolts can foul the fairing door timing valve mechanism. A check of 77 Squadron aircraft revealed that the bolts are correctly assembled. An instruction will be issued to ensure that this is always done.

44. A case had been experienced in the American service where the fin front attachment bolts, due to excessive length, bottomed on a fuselage angle before "clinching" the fin attachment. A check for this will be covered by a service instruction.

45. The U.S.A.A.F. had also found that the fabric aileron gap closing strip had deteriorated to such an extent that in places it had torn away and was restricting the movement of the ailerons. This will also be covered by a service check.

46. Checks to cover the above possible defects were instituted at No. 77 Squadron. Up to 21st February no defects had been found.

47. Another defect reported by the North American Technical representative was a distortion of a dorsal fin.

The fin area was increased in the early stages of the Mustang (approximately 1944) to improve the directional stability.

This dorsal fin is not exceptionally strong structurally.

In view of the fact that the representative could give no further details as to flight conditions under which the defect occurred, nothing definite could be achieved from this report.

A survey of No. 77 Squadron aircraft failed to reveal any similar defect.

48. American aircraft carrying out cross country flights from time to time drop into Iwakuni for various reasons.

One flight landed during a cross country flight and were kept on the ground due to weather conditions.

In discussion with the Engineer Officer (pilot) with the flight, it was suggested by him that the elevator trim wires could jump the fairleads or fairlead pulleys.

An examination of the system showed this, due to the arrangement of the system, to be in our opinion impossible. Clearances around pulleys and fairleads are such that when rigging a new wire, these items have to be removed from mountings before the wire can be threaded.

49. A survey of Log Books and Maintenance Forms E.E.77 was made of the following aircraft.

A68-813
720
765
737

50. In the case of A68-813 - total hours 127.45 - it was noted that elevator trim creep had been experienced. During November, 1948, creep was reported. This was corrected by re-tensioning. During this period, it was reported that the aircraft required excessive Nose Heavy Trim during level flight and was exceptionally tail heavy during a landing with elevator trim set for landing. In discussing this case with the Squadron Engineer Officer, it was discovered that the aircraft landed with a full fuselage tank. Therefore, it is considered the aircraft did not possess any abnormal flying qualities. This was the aircraft flown by F/Lt. Glassop during the investigation. This pilot did not notice any abnormal flying qualities during his check flights.

51. In the case of A68-765 - This is the aircraft involved in the accident on 10.11.48. This aircraft has flown a total of 353.35 hours.

It was noticed that in November, 1945, the empennage assembly had been repaired and replaced. Unfortunately, no details were written up in the Log Book or E.E.77, nor did any of the personnel remember the incident. This repair took place after 52.25 hours flying.

Elevator trim creep was reported and corrected during June, 1946. During this month the starboard cowl broke away in flight. Attributed to incorrect attachment. Hours flown at this period were 84.15.

On the 11th November, 1948, this aircraft was involved in an accident which resulted in the buckling of the tailplane (port side bent upward). A Court of Inquiry was instituted which found that the aircraft was subjected to excessive stress applied during the recovery from the dive.

52. In the case of A68-720 - Total flying hours 499.20.

In November, 1948, Elevator Trim Creep was experienced. Corrected by tensioning cables.

In December, the aircraft was placed unserviceable due to stiffness of rudder trim control system. Tensions were checked and found to be within rigging limits. No further action was taken.

Note: As discussed in paragraphs 19 to 21, the tensions may have been excessive due to incorrect readings obtained from the tensiometer.

During December, 1948, whilst carrying out a daily inspection, it was found that the tailplane attachments were loose. This is considered an isolated case. However, if the tailplane attachments were loose, the flying characteristics of the aircraft would be very much affected.

53. In the case of A68-737 - Total flying hours 535.30.

Elevator Trim Creep was reported on 25.4.48. Corrected by re-tensioning.

54. During a check of aircraft loadings, it was discovered that a weight sheet summary was not made for each flight. Squadron personnel were confident that all loadings were within allowable limits.

The usual loads carried were:-

For Dive Bombing:	Full Wing Tanks (Internal) 20 galls. in Fuselage Tank. Bombs as required Pilot with Parachute, Mae West and "K" Type Dinghy.
For Rocketeering:	As above, except that 6 x 60 lb. rockets are used in place of the bombs.
For Cross Country Flights:	No armament stores, but full fuselage tank.

55. A weight sheet summary has been cast for A68-765. This aircraft was involved in an accident on 10.11.48 in which the port tailplane was deformed in flight. See Appendix "F" attached to this Report.

56. It will be seen that generally the C.G. tends towards the rearward C.G. position.

57. Attached to Directorate of Technical Services Technical Bulletin is U.S.A.A.F. Technical Order No. 01-60J-28 which covers Flight Characteristics and Flight Restrictions for Mustang aircraft (P.51 series).

58. It will be seen from this information that the aircraft is used at considerably greater loadings than what the original design provided for. This increase in loading has been brought about by additional navigational and radio equipment, armour and armament, and fuselage fuel tank. This means that although the aircraft was designed for a manoeuvre factor of 8 G, this factor at 10,000 lb. is reduced to approximately 6.7.

Note: The ultimate factor, i.e. load at which the structure will fail, is 1.5 times greater than those quoted above.

59. It is unfortunate that the greatest proportion of the extra equipment is so positioned that the C. of G. has moved rearward. With a C. of G. position for aft instability is likely to be experienced with a lightening of stick forces per "G". In fighter aircraft the recommended range of stick force per "G" is maximum 8 pounds, minimum 3 pounds. (Ref. N.A.C.A. Report Tech. Note 1670, A.A.F. Technical Order 01-60J-28 and R.A.E. Aero Discussion Note No. 22).

60. To increase the stick force loading gradient, a bob weight has been included in the elevator control circuit. (Note: All No. 77 Squadron aircraft are fitted with bob weights).

61. However, with the centre of gravity of the aircraft in the rearward range of the C. of G. limits and with a possible further movement to the rear by fuel being added to the fuselage tank by the carburettor vent line, the stick forces per "G" would become lighter as the C. of G. approached the manoeuvre point (i.e. the C. of G. location where the change in stick force per G is zero).

62. Under the above conditions one possible explanation for the failures is that due to the type of loading of the aircraft (rearward C. of G.) and the failure to trim the aircraft for the dive, the stick force required to impose excessive "G" in the pull out could easily be applied by a pilot who normally uses harsh control movements.

63. It is also considered that the overload forces may be only sufficient to slightly deform the structure (as in the case of A68-765) in the first instance and that another or several similar impositions may put the structure in such a condition that a medium applied acceleration would be sufficient to supply the final breaking load to the structure.

64. As stated in Section I, paragraph 6, in the introduction to this report, a number of tailplane failures were experienced in early Mustangs.

65. The cause of these failures (R.A.E. S.M.E. Dept. Note No. 151) was put down to high torque between tailplane and fuselage. This torque can be generated by assymetrical loading of the tailplane during yawing or side slipping.

66. Mustang aircraft are noted for large changes of directional trim with changes of speed and power and require in a dive as much force on the rudder pedals as the pilot can normally put on. It is therefore, normal to use rudder trim to keep rudder pedal loads down to a comfortable pressure and thus enable the pilot to keep better directional and yawing control.

67. As some pilots stated that they kept directional control by foot pressure on the rudder, it is possible that with a sudden relaxation, the aircraft may be allowed to assume a sudden yaw or side slip. This relaxation could be brought about by a partial or complete black-out.

68. It is considered then that a pilot in a dive, holding direction against rudder trim, accelerates the aircraft in a dive pull out up to the grey or black out stage, could so relax rudder pedal pressure that the aircraft would experience a sudden yaw or side slip such that the tailplane (due to blanking effect of the fin) experiences such assymetric loading as to deform if not fail the tailplane.

69. A survey of the wreckage of A68-97 indicates that the tailplane failed in upward loading. (The aircraft disintegrated in the air during a pull out from a dive, during a dive bombing demonstration). A68-765 at 77 Squadron, after a dive bombing exercise where the pilot blacked out in the dive recovery, landed with a deformed tailplane (port tailplane buckled due to upward bending).

70. In the case of A68-765, the pilot stated he commenced his pull out at 1200 ft. flying at 280-300 knots in a 50° dive. It is considered at this speed 1,000 ft. would be required to recover without using an acceleration of more than 4 G. In view of the fact that a 1,000 ft. recovery would bring the aircraft to approximately 200 ft. from the ground, it is suggested that the pilot tightened the manoeuvre to at least 5G, and in the ensuing black out, permitted the aircraft to yaw thus imposing sufficient load on the port tailplane to buckle the upper surface, indicating an excessive upward load on that component.

71. Whilst the failures covered by R.A.E. Report on tailplane failures (paragraph 65) were in the downward direction and the two cases in the R.A.A.F. of which there is definite knowledge, are upward, it is considered that the flight manoeuvre immediately prior to failure accounts for this difference. It is considered that manoeuvring loads decreasing speeds produce up loads on the tailplane. Whereas the British failures occurred in a dive after barrel rolls and circuits after a shallow spiral dive.

SECTION IV

FINDINGS

References

Section II
Paras. 1 to 7

1. Elevator Trim Tab creep has been experienced and can occur under the following circumstances.

(a) Under tensioned trim control cables.

(b) Loose or worn trim tab operating jack threads.

(c) Tight flying manoeuvres involving accelerations of 4 G and over.

(d) Flight manoeuvres in which evolutions are performed against trim.

The above conditions can be aggravated by excessive clearance in the connections and out of line rigging of the tabs.

Creep can be eliminated by correct tensioning of the control wires, careful lining up of the tab surfaces and the reduction of back-lash in the system.

Elevator Trim Tab Creep is not considered to have a direct bearing on the flying accidents including disintegrations in the air.

Section II
Paras. 8 to 29

2. The failure of the elevator trim control cable at the turnbuckle joint in the tailplane between the two operating jacks is considered to have been caused by deterioration of the solder used in the attachment of the cable and turnbuckle ends. As all sweated ends are being urgently replaced with swaged on ends, it is considered that the possibility of this type of failure recurring has been eliminated.

Section III
Paras. 6 to 9
30 & 31

3. No. 77 Squadron aircraft are in good condition and from representative rigging checks are not deformed or distorted. The slight difference in distance between the mainplanes and tailplane in two aircraft is considered to have no effect on the flying characteristics of the aircraft.

4. The actual cause of disintegrations in the air has not been definitely established.

Appendix B
Sheets 1 & 2
Files 32/18/532
32/18/538

However, in the case of the first two accidents (disintegrations) A68-507 and A68-501 where the aircraft were climbed to approximately 35,000 ft., it is considered that in the ensuing dive the aircraft were allowed to exceed the critical speed for the type and in an attempted recovery imposed sufficient loading to cause structural failure.

References

References	
Appendix B Sheet 3 File 32/18/578	In the case of A68-785 in which the pilot carried out a long steep power dive with the fuselage tank nearly full, it is considered that the aircraft loading was such that stick forces were so reduced that in attempting a pull out the pilot, who is quoted as being harsh and heavy on the controls, imposed control loads on the structure sufficient to cause failure.
Appendix B Sheets 4 & 6 File 32/18/1049 9/60/230	As evidence was not so clear in the accidents in the accidents in which A68-97 and A68-802 were involved, and following a minor accident in which A68-765 suffered a buckled tailplane during flight, investigations were carried out at No. 77 Squadron.
Appendix B Sheet 5	These investigations opened up two possible causes of failure which are set down briefly below and which are recommended for further investigation.
Section III Paras 54 to 63	(a) with incorrect load distributions and accelerations in the order of 5 - 6 G, control stick forces may reduce to such an extent that harsh handling of the controls may impose sufficient loads to distort or even fail the structure. In extreme cases stick forces may possibly reverse.
Section I Paras. 7 & 8 Section III Paras 64 to 71	(b) Failure of tailplanes may occur due to high assymetrical loadings incurred during yawing or side slipping during pull outs from dives.
Section III Paras. 35 to 42	5. Precious evidence (Court of Inquiry into accident to A68-97, File 32/18/1049) and discussions with American 5th Army Engineering Personnel, suggests that inadvertent release of the undercarriage legs from their up locks may lead to distortion and extra loading in the mainplane structure sufficient to cause failure.

With correct rigging, the release of the undercarriage legs can only be brought about by excessive loading of the mainplanes so deflecting the structure that the leg locking pins are withdrawn laterally from the locking hooks.

A check 77 Squadron aircraft did not reveal any obvious signs of misalignment to indicate incorrect undercarriage rigging.

All R.A.A.F. Units using Mustang aircraft will be again instructed to check undercarriage rigging to ensure that the gear locks correctly in the UP position.

SECTION V

Recommendations

1. That all trim tab control circuits be rigged to 20 lb. tension.

2. That all trim tab control surfaces be adjusted that the trailing edges be in line with the master control surface trailing edge with the limits of + 0
   - 1/8"

3. That trim tab control rod attachment brackets be modified to ensure that the attachment screws cannot loosen and allow the bracket to rock.

4. That all tensionmeters in use in the Service and by Civil Contractors be regularly checked for correct readings. This checking to be carried out on cable sizes as used on aircraft types on which the tensionmeter is being currently used, and tensioned by dead weights representing the tensions used on particular aircraft.

5. That current undercarriage rigging instructions be amended to include additional checks to ensure correct up locking by visual inspection of the up locks.

6. That Mustang Technical Order No. 49 - Re-routing of the Carburettor Vent Line to the Port Centre Section Tank - be incorporated in all aircraft in use as early as possible.

7. That for all flying other than that requiring a safe endurance greater than that covered by the capacity of the wing tanks, the contents of the fuselage tank be not greater than 5 gallons.

8. That flying techniques be standardised, especially those for armament exercises. The techniques adopted for these latter exercises should be those developed by Air Armament School. Pilot gunnery instructors at the Units should be used to instruct aircrew in these matters.

9. In view of the apparent lack of knowledge of flying limitations (only three out of twelve knew the maximum permissible diving speed at sea level, in 77 Squadron), it is considered that some form of test should be introduced to check at regular intervals the pilot's knowledge of the aircraft he operates.

10. That the importance of regular checking of the aircraft loadings to ensure correct Centre of Gravity positions and loadings be again brought to all pilots' notice. Regular instructions in this matter are considered essential.

11. That the safety red line on airspeed indicators in Mustang aircraft now set at 450 knots as being the maximum permissible diving speed at sea level be deleted as it is misleading in view of the fact that Mustang flying limitations set the maximum diving speed at sea level at 391 knots.

12. That the use of Anti "G" suits in Mustang aircraft be discontinued or suspended pending the introduction of an improved type accelerometer.

13. That technical information such as Directorate of Technical Services Technical Bulletin No. 28 be re-issued from time to time to ensure that vital information in regard to the efficient and safe operation of the aircraft is not lost. None of the flying personnel of No. 77 Squadron had seen or remembered the above mentioned bulletin.

14. That an inspection of all Mustang aircraft for serviceability of the aileron gap sealing diaphragm be carried out.

15. That the length of the fin front attachment bolts be checked for correct clinching of the attachment fittings.

Recommendations for Further Investigations

16. That the deformed tailplane ex A68-765 now in transit from Japan be forwarded to C.S.I.R. Division of Aeronautics to determine the load applied to cause the deformation.

17. To determine at what position the buckling occurred in relation to the strengthening modification introduced after the earlier failures. This may indicate that there are stress concentrations at a change of section or that the stiffening has not been carried out far enough.

18. To gauge the elevator trim control jack threads to determine if the threads are unduly worn, thus permitting excessive back-lash which in turn may facilitate creep.

19. That a Test Schedule be raised on Aircraft Research and Development Unit to cover investigations into -

(a) control stick loads per "G" under various loadings and conditions of flight.

(b) to investigate various methods of dive recovery to determine the effect of yaw in relation to stick and rudder pedal forces.

(c) to install strain gauges to permit the measurement of loads (in the first instance tailplane loads) imposed during tests (a) and (b) so as to determine of loads applied are in the critical range.

(d) to determine the loads imposed on the undercarriage fairing doors and up locks during dives and dive pull outs to check if the distortion of these components induce unknown loadings in the wing structure.

Acknowledgements

It is desired to acknowledge the assistance given during these investigations by the undermentioned:-

A.O.C. and Staff of B.C.A.I.R.
C.O. and personnel of No. 77 Squadron
R.Tech. O. C.A.C.
Technical Staff C.A.C.
C.O. and personnel of A.R.D.U.

APPENDIX "A"

References:

R.A.E. S.M.E. Departmental Note No. Acc.151

Commonwealth Aircraft Corporation Report No. A.117 - Report on Accident to Mustang A68-97 at Werribee.

North American Aviation Inc. Report N.A.8469 - High speed and High Mach Number Dives on a P-51D-5-NA Aeroplane.

National Advisory Committee for Aeronautics Technical Note No. 1670 - Appreciation and Prediction of Flying Qualities.

R.A.E. Report Aero Technical Memo No. 3 Aero Discussion Note No. 22 - Current Longitudinal Stability and Control Problems.

APPENDIX "B"

Sheet 1

Accident to A68-507 at Mildura, Victoria, June, 1945 - File 32/18/532

Aircraft Disintegrated in the Air

Exercise:	Conversion Course. Climb to 35,000 ft., note performance and return to base.
Condition:	All fuel tanks full. (Extract from E.E.77). As fuselage tank was amongst wreckage, presumed that this tank was also full at take-off. Oxygen was satisfactory.
Statement by the Court:	Opinion that aircraft disintegrated at about 2,000 to 4,000 ft. Lack of evidence leaves cause of disintegration obscure.
Pilot's Ability:	Employed as a Staff Instructor. Average ability and no outstanding faults. Previously flown 2 hours on the type. Circuits and Aerobatics.
Disposition of Wreckage:	See attached sketch

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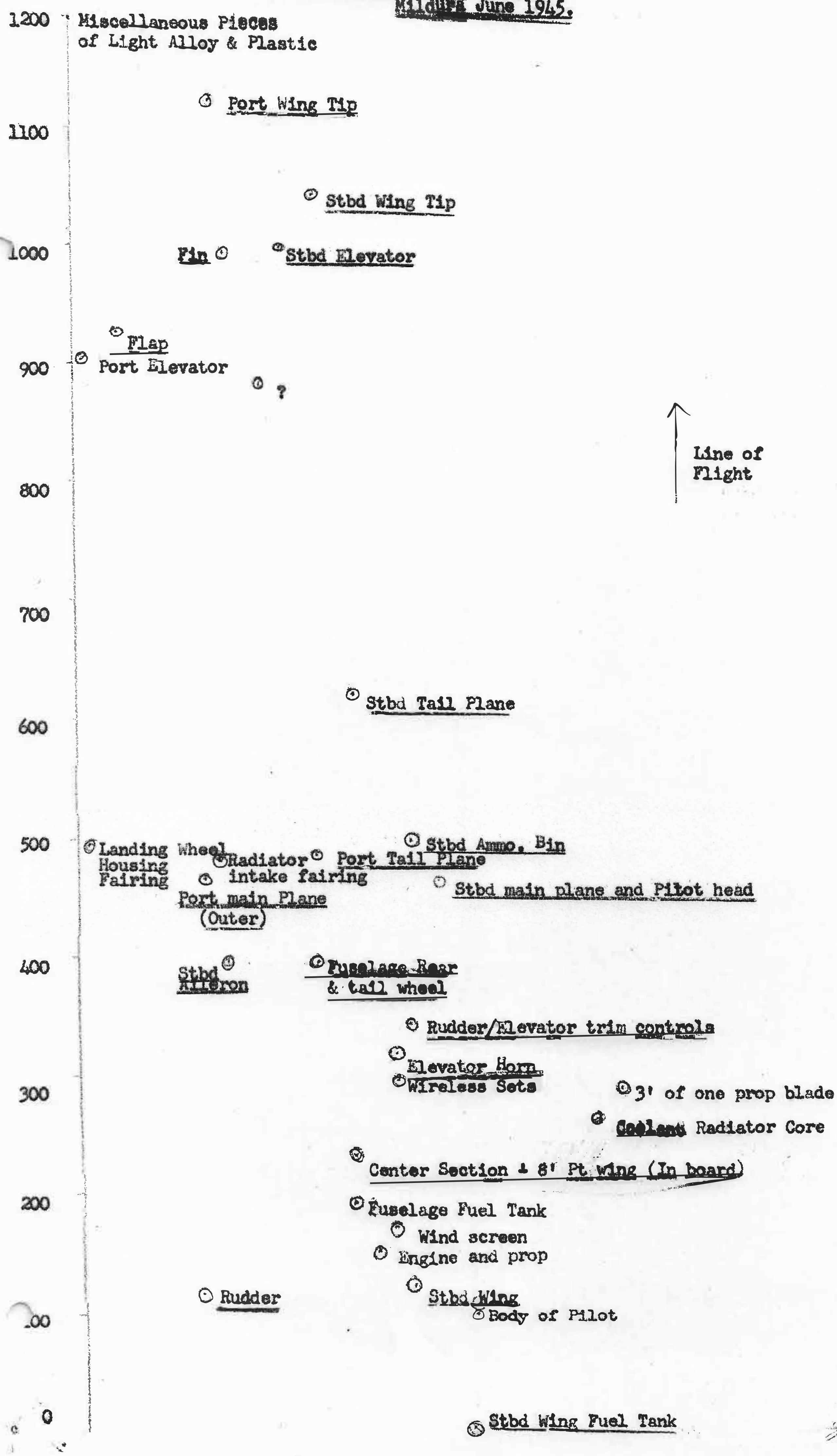
DISTRIBUTION OF WRECKAGE - A68-507
Mildura June 1945.



APPENDIX "B"

Sheet 2

Accident to A68-501 Townsville, Q'ld., August, 1945.

Aircraft disintegrated in the air. Ref.: File 32/18/538

Exercise:	Individual battle climb ti 36,000 ft.
Condition of Aircraft:	No evidence or information as to equipment carried of all up weight of the aircraft.
Briefing for Flight:	Before any battle climbs in Mustang aircraft, pilots were lectured on the demand type oxygen installation and on the effects of compressibility. Pilots were informed that the effects of compressibility could be experienced in mild form by approaching the critical speed at a particular height and application of positive "G". Critical speeds at various heights were quoted.
Sequence of Break Up:	One witness heard an explosion and on looking up saw an aircraft less one wing and tailplane. Another witness saw the aircraft less tailplane diving steeply, then one wing break away. In an attempt to recover the body of the pilot a diver made a search of the wreckage. He reported: Main body of fuselage badly broken and laying in an inverted position with one mainplane attached. Engine was 25 years east of the fuselage.
Statement by the Court:	After lecture on compressibility, several pilots endeavoured to experience these effects. This pilot may have attempted the same.
Pilot's Ability:	No record. He had flown 3 hours 40 minutes in Mustangs.

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APPENDIX "B"

Sheet 3

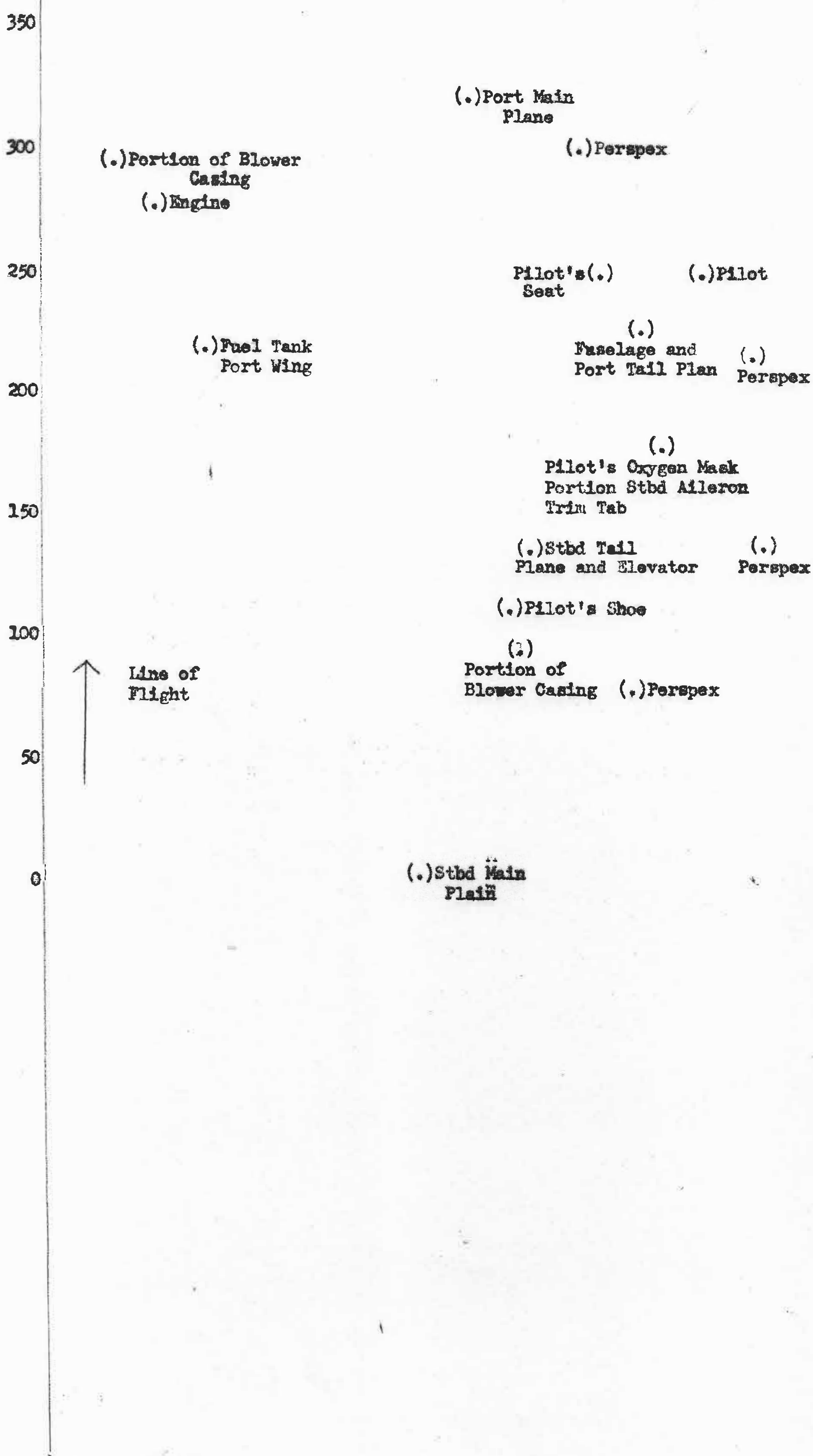
Accident to A68785 at BOFU Japan, March, 1947

Aircraft Disintegrated in the air. Ref.: Files 9/60/188
32/18/578

Exercise:	Independent aerobatics.
Condition:	Aircraft took off with full fuselage tank. Pilot was instructed not to undertake aerobatics until fuel in fuselage was reduced to a maximum of 25 galls.
Finding of Court:	Structural failure during recovery from a long steep dive with aircraft in unstable condition of loading giving reversed loading on elevator under certain conditions of flight. Pilot failed to comply with flight operating instructions.
Statement by Court:	Aircraft in power dive for at least 8 seconds. Angle of dive decreasing as the aircraft lost height between 5,000 and 2,000 ft. with a slightly nose up attitude at 1,500 ft., where it commenced to disintegrate.
Sequence of Break Up:	Starboard mainplane broke away striking the starboard tailplane. Starboard tailplane sheared off at fuselage and carried away by mainplane. Port mainplane, engine from fuselage. Fuselage with empennage (less starboard tailplane). See attached sketch.
Extracts from Pilot's Progress Sheet:	Heavy and harsh on controls. Careless. Very rough on controls. Still a little harsh with aerobatics, pulling out of initial dive too suddenly.
Approx. weight of Aircraft at Time of Accident:	10,000 lb.

APPENDIX B Sheet 3A
Japan March 1947

DISTRIBUTION OF WRECKAGE A68-485



APPENDIX "B"
Sheet 4

Accident to A68-97 at Werribee, Victoria, December, 1947

Aircraft disintegrated in the air. Ref.: Files 9/60/230
32/18/1049

C.A.C. Report No. A-117

Exercise: Dive Bombing Demonstration.

Condition: At take-off - full wing tanks, 25 gallons in fuselage tank, full ammunition for 6 guns and 2 x 250 pound bombs.

Weight at take-off 10,340 lb.
At time of accident approx. 9,500 lb.

Dive angle 50°. Dive from 8,000 ft., release of bombs 4,000 ft., pull out at 2,000 ft.
Speed approx. 360 knots.

Findings of the Court: Precise cause cannot be determined.

Evidence shows clearly that the port wing failed structurally towards the root end and was, as far as can be ascertained, the initial point of failure.

It is considered that the wing failure was the result of aerodynamic loads in excess of the design limit for the particular condition of loading. It is considered that contributary causes of excessive control forces were -

(i) carriage of fuselage tank fuel, of quantity which is officially not allowable for dive bombing.

(ii) the type (series) of aircraft was a variant of the type the pilot had been used to.

(iii) the pilot was inclined toward confident and abrupt handling of the aircraft.

Sequence of Break Up: Evidence seems to point to the fact that the port mainplane failed first.

Tailplane failure apparently caused by being hit by the mainplanes. See attached sketch.

Pilot's Ability: Rated as good fighter pilot. His success in handling a fighter was due to the fact that he ignored smooth manoeuvres. It has been stated that the pilot of this aircraft was noted for his spectacular dive recoveries. This is not borne out fully by official and more expert witnesses.

The Court found that the pilot was inclined towards confident and abrupt handling of the aircraft.

DISTRIBUTION OF WRECKAGE A68-97

APPENDIX "B" Sheet 4A
Werribee December 1947

2400

(.)Engine (Scattered)

2300

2200 (.)Target

(.)Body (.)Stbd Elevator(Trim On)

2100 (.)Mass Balance

2000

(.)Seat

1900

1800

1700

(.)Stbd Main Plane

1600

1500

1400 (.)Port Fuel Tank
Intact

1300 Line of Flight ↑

1200 (.)Unexploded Bomb
Arming Wire and Tail on Bomb

1100 (.) Fuselage

1000 (.)Air Scoop

900 (.)Port Side Fuselage

800 (.)Port Elevator

700

(.)Tail Plane(Port and Stbd)

600

(.) Port Main Plane (.)Top Side Port Main Plane (Inner)

500

400

(.)Port Main Plane
Fillet of Fairing

300

Port u/c(.) Fairing Door

(.)Tip Port Tail Plane
Fairing Stbd. T.P. to Fuselage

200

x x Light Pieces of
x x Tank Packing

100

0 Hood Perspex and Other Light Skin

Accident to A68-765 at Iwakuni, November, 1948

Aircraft landed with buckled tailplane. Ref.: Court of Inquiry 77 Sqdn. Nov. 1948

Exercise: Dive Bombing Exercise

Condition: At take-off. Full wing tanks, 20 gallons in fuselage tank. 8 x 11½ lb. practice bombs, 600 rounds ammunition. Take-off weight 9.843 lbs. C. of G. 140.9 ins. aft of datum.

Estimated weight at time of accident less 30 minutes fuel (including take-off and climb and one bomb) all up weight 9,470 and C. of G. 139.4. Dive angle 50°. From 4,780 ft. Pull Out 1,200 ft. Speed 280-300 knots.

Statement by Court: Elevator Trim Control tensions within limits. Elevator Trim. When indicator set to neutral - starboard tab neutral - port tab 7/16" droop.

Port tailplane buckled at approximately 18" from aircraft centre line due to deformation upwards.

From members' observations, it is obvious that an excessive "G" force was applied during the pull out.

Finding of Court: It is considered that the pilot's inexperience on this type of exercise, together with the possibility of a creeping elevator trim, was the cause of this accident.

Pilot's Ability: No evidence by the Court on this subject. Hearsay reports indicate that the pilot used harsh methods.

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Accident to A68-802 at Iwakuni, December, 1948

Aircraft disintegrated in the air
Report by D.F.S.

Ref.: File 9/60/230

Exercise: Rocket firing exercise using 50° dive attack from 7,000 ft. 6 x 60 lb. rockets were carried.

D.F.S. Report: Dive was made at approximately 45° after 3 rockets had been fire d. Dive recovery completed at 1,000 ft. without sign of violent recovery with attitude slightly nose up. The aircraft was seen to flick roll or flick from side to side. Just before striking the water, a large piece was seen to detach itself from the aircraft.

Opinion as to which part of the aircraft this was, was equally divided between the starboard mainplane and the tailplane.

(Note: During the investigation in Japan, Feb. 49, the pilot immediately following, stated that the tailplane failed first.)

Pilot's Ability: The pilot was considered of above average standard, who flew accurately and never imposed excessive stresses on his aircraft during manoeuvres or dive recoveries.

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Accident to A68-723 at Iwakuni, Japan, January, 1949.

Elevator Trim Control Wire failed at turnbuckle.   Ref.: File 9/60/142

Elevator Trim Control cable failed at joint of cable to turnbuckle end in tailplane at take-off.

Aircraft commenced to roll. Pilot maintained control and carried out successful forced landing.

Elevator trim tabs were found on inspection to be -

Port Tab up 1 inch; Starboard Tab down 1 inch.

Findings: For reasons unknown but thought to be ease of assembly, ~~the turnbuckle~~ ends when the elevator trim tab control wires join in the tailplane were sweat soldered to the cables. Due to either faulty workmanship or age deterioration, these joints fail under low tension loads.

All cables employing this type of joint have been replaced with swaged on ends.

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APPENDIX "D"

QUESTIONS PUT INDIVIDUALLY TO NO. 77 SQUADRON PILOTS

Question 1: During Dive Bombing and Rocket Projectile Attacks, when do you adjust trim?

	(a) Before Diving	(b) During Dive	(c) Hold aircraft in Manoeuvre
Answers:	4	4	4

Question 2: Do you ever use trim (elevator) to assist in recovery from the dive?

	(a) No	(b) Yes	(c) Occasionally
Answers:	10	Nil	2

Question 3: Have you ever experienced trim tab creep (elevator)

	(a) No	(b) Yes
Answers:	1	11

Question 4: What was the setting of the tab when creep occurred?

	(a) Straight and Level Flight (approx. 3° to 5° Nose Heavy)	(b) Dive Bombing
Answers:	8	2

Question 5: What kind of flying were you doing when you experienced creep?

	(a) Manoeuvres involving "G" Loading	(b) Steep Turns	(c) Aerobatics	(d) Dive Bombing
Answers:	3	4	2	2

Question 6: What is the maximum permissible diving speed at Sea Level?

	365 Kts.	390 Kts.	400 Kts.	450 Kts.	460 Kts.	475 Kts.	500 Kts.
Answers:	1	3	1	1	2	3	1

(The correct answer is 391)

Question 7: What height is used to recover from a 60° Dive commencing at 8,000 ft.?

	500'	1200'	1500'	1800'	2000'
Answers:	1	1	3	2	3

Question 8: What type of recovery do you use after dive bombing?

	(a) Straight Ahead and Up	(b) Climbing Turn	(c) Flat then climb
Answers:	2	8	1

Question 9: Do you adopt or use an evasive recovery?

(a) Only Once (b) No (c) Yes

Answers: 2 6 1

Question 10: Do you "black-out" often?

(a) Only Once (b) No (c) Yes

Answers: 2 6 -

Question 11: Do you use skidding tactic?

(a) No (b) Yes

Answers: 8 1

Question 12: Have you noticed any tendency for the aircraft to skid on "pull-outs"?

(a) No (b) Yes

Answers: 8 -

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APPENDIX "E"

LIST OF AIRCRAFT HELD BY NO. 77 SQUADRON

Showing Total Hours Flown up to 18/2/49

R = Aircraft held in reserve

G = Those aircraft known to have been used with "G" suits.

29 Aircraft on active list

11 Aircraft in reserve

Aircraft Number	Total Hours Flown
A68-723	564.50
737	535.30 (G)
774	521.05 (G)
720	499.20
704 (R)	491.50
715 (R)	475.40
796 (R)	467.50
726	463.45
706 (R)	463.35
722	455.40
791 (R)	451.05
708	442.25
755 (R)	440.55
753	433.10
775	428.25 (G)
782	421.25 (G)
763	418.40
757	414.55
739 (R)	397.45 (G)
729	389.55
705	388.40
760	379.45
725	373.30
754 (R)	372.00
709	369.50
780 (R)	369.10
804	366.50
736 (R)	365.56
765	353.35
772	334.05 (G)
809	253.10
801	237.45 (G)
756	193.00 (G)
811	176.20
799	158.50 (G)
813	127.45
803	125.55
812 (R)	124.50 (G)
806	100.55
808	96.40

MUSTANG (MARK 21) (A68-765)

Item	Weight (lb)	Arm (in.)	Moment (lb.in.)
TARE WEIGHT			
CREW			
Pilot, with parachute, dinghy Type K and Mae West	215	169.0	36,335
ARMAMENT			
Outboard -			
.50 in. Browning Guns (2) and accessories	139	155.0	21,545
Ammunition (200 rounds)	60	153.0	9,180
Centre -			
.50 in. Browning guns (2) and accessories	135	155.0	20,925
Ammunition (200 rounds)	60	153.0	9,180
Inboard -			
.50 in. Browning guns (2) and accessories	130	158.0	20,540
Ammunition (200 rounds)	60	153.0	9,180
Gunsight (Mark IID)	8.5	147.0	1,250
Gun Camera	3	109.0	327
RADIO			
V.H.F.	90	189.4	17,046
OXYGEN			
High Pressure Cylinders (2)	31	262.0	8,122
PYROTECHNICS			
Signal Pistol and Cartridges (6)	6	170.0	1,020
MISCELLANEOUS			
First Aid Kit	2	170.0	340
Fuselage Tank	112	212.0	23,744
BOMB LOADINGS			
Bomb Carriers (2)	35	138.0	4,830
11½ lb. Bombs (8)	92	137.0	12,604
FUEL (at 7.2 lb./gal.)			
Main Tanks (153 gals.)	1,102	163.0	179,636
Fuselage Tank (20 gals.)	144	212.0	30,528
OIL			
10 gals. at 9 lb./gal.	90	116.0	10,440
Totals:	9,843	140.9	1,487,442

C.G. = 140.9 Inches Aft of Datum

MUSTANG AIRCRAFT A58-765

Maximum Permissible Weight: = 10,500 lb.

C.G. Limits: Forward = 135.8 in.
Aft = 141.8 in.

Take-Off

Aircraft with full ammunition

A.U.W. 9,843 lbs.

C.G. 140.9 in.

After half hour flight

Fuel fot T.O. and climb to 5,000 ft.	=	17½ gals.
Time to 5,000 ft.	=	3½ mins.
Cruising (normal) at 370 m.p.h. fuel cons.	=	70 g.p.h.
Fuel cons. for 26½ min.	=	$\frac{70}{60} \times \frac{53}{2}$
	=	31 gals.
Total Fuel	=	49 gals.

A.U.W. 9,481 lbs.

C.G. 139.4 in.