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AD No. 16480
ASTIA FILE OCF,

TITLE
<i>(encl)</i>
<u>F-102A</u>
<u>WEIGHT HISTORY</u>



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CONSOLIDATED VULTEE AIRCRAFT CORPORATION
SAN DIEGO DIVISION . . SAN DIEGO, CALIFORNIA

ANALYSIS
PREPARED BY
CHECKED BY
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CONSOLIDATED VULTEE AIRCRAFT CORPORATION
SAN DIEGO DIVISION

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REPORT NO. ZW-8-002
MODEL F-102A
DATE 1 June 1953

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INTRODUCTION

This report consists of a summary of the major weight changes that have occurred since the original weight estimate was made. The original proposal gross weight was 22,940 lbs. as shown in Airplane Specification ZD-041 dated 29 December 1950. The first group of changes lists the derivation of the gross weight of 26,404 lbs. as shown in Airplane Specification ZD-8-001 dated 1 December 1952. A second group consists of weight changes occurring up to and including Weight and Balance Status Report #6 dated 1 June 1953.

The gross weights are summarized on page 2 and details of these totals are listed on pages 3 thru 11.

The take-off center of gravity was 29.3% M.A.C. for the original proposal of Specification ZD-041, 30.9% M.A.C. in Specification ZD-8-001, and is currently 29.8% M.A.C. as of 1 June 1953.

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F-102A WEIGHT HISTORY SUMMARY

	<u>LBS.</u>
Gross Weight of Original Proposal Airplane Specification ZD-041 dated 29 December 1950	22,940
Government Requested Changes and G.F.E. Overweight (For details see Part A, page 3)	+ 2,147
Convair Changes (For details see Part B, page 7)	+ 1,317
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Gross Weight of Revised Airplane Specification ZD-8-001 dated 1 December 1952	26,404
Government Requested Changes and G.F.E. Overweight (For details see Part C, page 9)	+ 746
Convair Changes (For details see Part D, page 10)	+ 639
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Gross Weight as of Weight and Balance Status Report No. 6 dated 1 June 1953	27,789

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DISCUSSION OF MAJOR CHANGES

Part A

Government Requested Changes & G.F.E. Overweight

1. Fuselage enlargement and redesign due to increase in missile length and span. Due to this increased size of missiles, the installation was completely revised. Formerly the missiles were installed in one bay directly beneath the engine and the rockets were carried in a separate bay forward of the missiles. Rather than increase the fuselage diameter with the resulting adverse effect on performance, the missiles were installed in two tandem bays with rockets also in each bay. Because of the missile arrangement the fuselage was increased in length 20 inches at Station 300. In addition, controls, tubing, wiring, etc. increased due to the added fuselage length. The total increase was estimated at 130 lbs. + 130
2. For increased maneuverability while taxiing, the Air Force requested that nose wheel steering mechanism be added. This was requested in WADO letter WCSWF/NMR/nlt dated 10-15-51. + 29
3. Change from J-67 engine of original Airplane Specification XD-041 to J-57 engine of current airplane Specification XD-8-001. Revised weight of J-57 engine vs. original weight of J-67 engine. The J-67 basic engine weight was based on the information in Advance Engine Spec. AC-177 for Wright Model TJ-3201 (YJ-67-W-1) dated 2 August 1951 showing 3,880 pounds. An estimated 550 lbs. was added for the afterburner. (3880 + 550 = 4430 lbs.) Latest information in Pratt & Whitney Preliminary Installation Design Data Handbook (dated 2-12-52 revised 5-16-52) lists the J-57-F-11 engine with afterburner and less air inlet screens as weighing 4825 lbs. for the partial titanium engine. (4825 - 4430 = 395 lbs. increase). The engine oil allowance in Useful Load was changed from 119 lbs. for the J-67 engine to the current 50 lbs. for the J-57, a saving of 69 lbs. The total effect of the partial titanium J-57 engine in lieu of the YJ-67-W-1 engine was +395 - 69 = 326 lbs. increase. + 326

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DISCUSSION OF MAJOR CHANGES (Cont'd)

Part A (Cont'd)

Government Requested Changes & G.F.E. Overweight (Cont'd)

4. The hydraulic system was revised in accordance with requests in WADC letter WCSWF/NMR/nlt dated 10-16-51. This included removal of the emergency hydraulic system pump from the engine and provision of auxiliary electric power for the pump. (Note: Later a change was made to an auxiliary air turbine drive, see page 11) + 70
5. Revised weights due to MX-1179 Radar requirements. The original concept of the MX-1179 gear was that it would be a complete integral unit designed to fit into the F-102 airplane. Later information received from Hughes and listing later weights, showed that many individual units would be supplied which therefore required interconnecting cabling and individual mounting provisions. Also the electrical power requirements were learned which included the necessity of holding frequencies to much closer tolerances than anticipated. These changes resulted in an overall weight increase in Electrical and Electronics Group weights of 255 lbs. + 255
6. Increase in Windshield glass thickness to approximately one inch, for protection from debris, increased the weight 36 lbs. Reference WADC letter WCSWF/NMR/nlt dated 10-15-51 which requested a separate piece of 1 inch armor glass inside the canopy. + 36
7. The number of rockets carried in the basic loading was increased from 19 to 24 as requested in WADC letter WCSWF/NMR/nlt dated 10-15-51. This included 88 lbs. for the rockets and 17 lbs. for provisions. + 105
8. A hot air anti-icing system was added in lieu of provisions only as requested in WADC letter WCSWF/NMR/nlt dated 11-7-51. + 80
9. Original information indicated that the weight of Government furnished MX-1179 gear plus the missile was complete. However, a later breakdown from Hughes listed missile launchers as separate items. A weight allowance of 10 lbs. each was made for these items. + 60

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DISCUSSION OF MAJOR CHANGES (Cont'd)

Part A (Cont'd)

Government Requested Changes & G.F.M. Overweight (Cont'd)

10. Revised information from Hughes listed the MX-904 missile weight as 125 lbs. each vs. the 106.5 lbs. each originally quoted. + 111
11. Revision to fuselage and armament provisions to provide for maximum fire-power in the alternate all rocket armament condition, utilizing 12 rockets per missile in lieu of 4. Reference CVAC letter FMH:FBW:br 6-1843 dated 4-24-52. (This results in a maximum rocket load of 96 2.75" FFAR when no missiles are carried). + 275
12. Increase in airplane structure to provide strength for increased gross weight resulting from government requested changes. + 315
13. Increase in dive brake effectiveness as requested in WADO letter WCSWF/WMR/nlt dated 10-16-51. (Original proposal utilized extension of original rocket compartment door as a dive brake. New arrangement provides three hinged dive brakes located on the fuselage afterbody.) + 178
14. The airplane spec. revision of March 1952 included a brake parachute in accordance with verbal request of Air Force representatives. + 42
15. Revised information from Hughes showed electronic characteristics of the radome as dictated by the MX-1179 gear which resulted in a change in the radome material and an increase in its weight. + 46
16. Information from Pratt & Whitney indicated that above 40,000 feet altitude the fuel-oil cooler furnished with the J-57, would not cool the oil sufficiently due to the reduced fuel flow. Therefore, an engine auxiliary oil cooling system was added. + 36
17. At the Mock-Up Board Meeting of November 1952 a battery enclosing cover was added as RFA No. 56. + 15

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DISCUSSION OF MAJOR CHANGES (Cont'd)

Part A (Cont'd)

Government Requested Changes & G.F.E. Overweight (Cont'd)

- | | |
|---|--------------|
| 18. At the Mock-Up Board Meeting of November 1952 a radar recording device was added to the radar equipment as RFA No. 37 | + 10 |
| 19. Remainder and miscellaneous small changes total to plus 28 lbs. | + 28 |
| | <hr/> |
| TOTAL PART "A" | + 2,147 lbs. |

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DISCUSSION OF MAJOR CHANGES (Cont'd)

Part B.

Convair Changes

	<u>LBS.</u>
1. Increase in wing weight due to correction of arithmetical error in original wing skin calculations (416 lb.) revised distribution of and increase in loads, and increase in design temperatures due to aerodynamic heating (84 lb.)	+ 500
2. The original elevon weight was based on XF2Y-1 weights. Subsequent increase of XF2Y-1 elevons indicated an increase of 158 lbs.	+ 158
3. The engine air inlet ducts were re-estimated, based on revised pressures and temperatures. This indicated an increase of 99 lbs. due mainly to the flat sides of the ducts used to minimize airplane drag.	+ 99
4. The Air Turbine Motor, as originally proposed, did not have sufficient capacity. Type 70-1 is now being used. The presently proposed installation requires also that a fan be added to cool the turbine motor.	+ 78
5. Based on wind tunnel tests, a chordwise fence was added to the upper surface of each wing to eliminate chordwise center of pressure shift and resulting decrease in stick force per "g". (This is an insurance item and may be removed following flight tests).	+ 30
6. Information, from wind tunnel tests, indicated that the directional stability was less than originally estimated. As a result, the design side tail loads were increased. The fuselage frames and longerons, and the vertical tail structure were increased to provide the necessary strength.	+ 187
7. Design temperatures from aerodynamic and engine heating dictated the use of titanium for the aft fuselage frames in lieu of aluminum alloy. (Minimum gauge did not allow reduction in weight of titanium).	+ 46
8. Until chemical treatments for corrosion resistance can be incorporated on the interior structure, prime paint has been added at an estimated weight increase of 38 lbs.	+ 38

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DISCUSSION OF MAJOR CHANGES (Cont'd)

Part B (Cont'd)

Convair Changes (Cont'd)

	<u>LBS.</u>
9. The basic fuselage structure has been increased in weight due to the accumulated effect of the addition of several access doors. This includes doublers and skin gauge increases.	+ 82
10. The original proposed fuel system, was not approved by the Air Force. The revised system increased the weight 44 lbs.	+ 44
11. Yaw and pitch dampers were added to improve lateral and longitudinal dynamic characteristics.	+ 55
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TOTAL PART "B"	+ 1,317

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DISCUSSION OF MAJOR CHANGES (Cont'd)

Part C

Government Requested Changes & G.F.E. Overweight (Subsequent to Airplane Specification ED-8-001).

	<u>LBS.</u>
1. The first detailed weight breakdown of the MX-1179 electronic equipment received from Hughes totals 1740 lbs. This results in an increase of 599 lbs. This overweight was discussed in CVAC letter TMH: AOT:dah #6-1599, dated 4-8-53.	+ 599
2. Information from Pratt and Whitney representatives has indicated that the partial titanium J-57 engine will not be available for installation in early F-102 airplanes. Therefore, the weight of an all steel engine, as noted in "Pratt and Whitney Preliminary Installation Design Data Book", dated 2-12-52, revised 5-16-52, has been incorporated with a weight increase of 250 lbs. (This weight will be deleted eventually)	+ 250
3. Latest information from Hughes has indicated an additional weight increase of the MX-904 missiles from 125 lbs. to 130 lbs. each.	+ 30
4. In order to provide a better personnel escape system for operation at higher speeds, the ejection equipment has been changed to include a Type M-3 catapult in lieu of Type M-5 and the addition of a Type M-1 thruster. (Reference MCP #26).	+ 23
5. The interim electronic gear MG-3 has replaced the MX-1179 radar equipment at a weight saving of 150 lbs.	- 150
6. Remainder and miscellaneous small changes total to -6 lbs.	- 6
TOTAL PART "C"	+ 746 lb

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DISCUSSION OF MAJOR CHANGES (Cont'd)

Part D

<u>Convair Changes (Subsequent to Airplane Specification ZD-8-001)</u>	<u>LBS.</u>
1. For production and inspection reasons, additional access doors have been added in the wing.	+ 39
2. Revised weights of missile bay structure show an increase of 121 lbs. which is due mainly to air loads with doors open and to increase in design temperatures.	+ 121
3. As a result of structural tests, a portion of the fuselage skin has been increased in gauge to eliminate wrinkles.	+ 21
4. The wing structure has been increased due to redistribution of loads within the structure and revision of fuel tightening.	+ 120
5. Originally, a wing drag angle was assumed in the fuel tight area with a rubber strip in leading and trailing edges. Current design includes a drag angle the full length of the wing.	+ 28
6. The duct supplying air to the Air Turbine Motor did not deliver sufficient air, and therefore a second duct was added.	+ 27
7. Heat exchanger exit ducts are to be made of titanium rather than aluminum due to design temperatures.	+ 21
8. Original weights of several items of electrical power equipment were based on an early estimate by Jack and Heints. A later estimate from Jack and Heints, confirmed by an estimate from Westinghouse, has indicated a 30 lbs increase.	+ 30
9. As a result of structural tests, the fuselage fitting for attaching wing spar 5 has been increased in strength with a slight increase in spar 5 weight.	+ 14
10. Wing rib at buttock line 39 has been simplified in design.	- 7

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DISCUSSION OF MAJOR CHANGES (Cont'd)

Part D (Cont'd)

Convair Changes (Subsequent to Airplane Spec. ZD-8-001) (Cont'd)

	<u>LBS.</u>
11. The engine air inlet has been designed for fabrication from steel as a result of higher temperatures and pressures than originally estimated.	+ 65
12. Addition of lightening holes in engine air duct frames saves approximately 37 lbs.	- 37
13. Missile displacement frames are to be made of welded steel construction in lieu of aluminum forgings. This change is made to hold launching mechanism deflection to a minimum.	+ 25
14. A revised estimated weight on the ejection seat has been received from the vendor.	- 10
15. Vendor information has been received on weight of air conditioning equipment and results in a 13 lb. increase over original allowance.	+ 13
16. Because of wing bending, together with elevon deflection, the elevon has been split spanwise to prevent the trailing edge from failing in compression. This change increases the airplane weight 21 lbs. but is much lighter than would be required to make a single piece elevon strong enough to withstand the loads.	+ 21
17. The trailing edge extrusion on the elevon has been changed from magnesium to aluminum due to skin design temperatures.	+ 16
18. Increase in stiffness of main landing gear doors.	+ 43
19. Revised weight of missile launcher attaching parts.	+ 10
20. Change from electrical drive emergency hydraulic system to ram air turbine drive.	+ 25
21. Remainder and miscellaneous small changes total to 51 lbs.	+ 51

TOTAL PART "D"

639 lbs

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