10 August 1971

SUPERC RITICAL WING RESEARCH PROGRAM

TACT STATUS REPORT - NO. 1.

Contract AF 33615-71-C-1912

Project 484A
SUMMARY

1. The effective date of the TACT contract is 1 July, 1971.

2. The pre-contract wind tunnel test was completed on 27 June 1971. 180 hours of testing were completed.

3. Statement of work review and a revised cost quote were major items of effort during the reporting period.

4. Detail design is well underway. Tooling coordination and release plans are being finalized.

5. Plans for the second 1/15 scale entry, the 1/12 scale low speed entry and the 1/8 scale flutter model test are all well underway.

6. There were no changes in key personnel associated with the contract during this reporting period.
3.0 GENERAL

Program Coordination

For this first monthly R&D Contract Status Report all preceding activities relating to the pre-contract wind tunnel model effort will be included as well as the activities for the month of July.

Extensive effort was devoted during the reporting period to modify the Statement of Work task items to achieve the program objectives within the funding limits. Two meetings with the ADPO one on 1-2 July and another on 20-21 July, were instrumental in reaching joint agreement on task responsibilities between NASA, Convair and AFFDL.

Numerous in-house meetings were conducted, also, to assist the groups in keeping up with the changes in requirements such that their costs would be consistent.

A contract definitization plan was coordinated with ADPO. The final cost estimate is to be submitted by 23 August. Negotiations are scheduled for completion by 10 September with contract signing on 27 September and contract distribution by 10 October.

Coordination Meetings and Trips

(5 April 1971) Pre-Test Conference - D. G. Hammond visited Ames for the purpose of establishing data format, instrumentation requirements, and test requirements for the first 1/15 scale model entry. D. Petroff, L. Keel, W. Painter and J. Pyle attended this conference.

(10, 11 May) Pre-Test Briefing - A briefing was held at Ames at which time aerodynamic requirements, stability and control requirements and testing requirements were presented. The first 11 x 11 foot test entry run schedule was finalized.

(16-26 June) First 1/15-scale wind tunnel test - The test was conducted from 16 June to 26 June in the Ames 11 x 11 foot transonic wind tunnel.

(21, 22 June) Proposal Submittal Meeting - On 21 June the TACT proposal was submitted at Wright Field. Detail discussions were held on 21 and 22 June with representatives of the various technology groups and the ADPO.
(12 July) Cost Review Meeting - L. Kummeth and E. Daigle visited Fort Worth to discuss SOW task modifications and cost items.

(12 July) Wind Tunnel Test Meeting - J. R. Johnson, J. P. Lamers, C. E. Jackson, C. E. Laechelim visited AFFDL to discuss the wind tunnel test plans and obtain agreement on test configurations so as to be compatible with TACT schedule and hours. (1/15-Scale and 1/12-Scale Models)

(20, 21 July) Program Review Meeting - Cosenza, Kummeth, Cooper, Schofield, Painter, McTigue - The meeting was held in Fort Worth. The instrumentation task was firmed up and other items of coordination were resolved.

(20 July) PreTest Conference - D. G. Hammond visited Ames on 20 July for the purpose of reviewing requirements for the 12 foot low speed tests. Brief discussions were also held regarding the first 9 x 7 foot entry and the second 11 x 11 foot entry.

Manufacturing

Activity consisted of supporting cost exercises, assisting tooling develop a manufacturing plan, effort toward development of engineering release priority and sequence, and coordination of efforts of all functions of the manufacturing task.

4.0 DESIGN

4.2.2 Basic Wing

Design

1. Preliminary detail drawings of the major components of the wing pivot fitting and actuator arm have been completed. Detail stress analysis and tooling analysis is in work. Drawings for open die forgings for the upper and lower plates, and actuator arm and brace, have been forwarded to Ladish Steel Company for comments on the feasibility of using forgings to reduce material and machining costs. D6-AC steel with a heat treat range of 200-220 KSI will be used for the pivot fitting components to obtain improved fracture toughness and stress corrosion resistance. Other D6-AC steel parts in the TACT wing will be in the 220-240 KSI strength range except where special hardness is required.
2. Detail design is continuing on the wing spars and skins. The upper and lower skin drawings have been revised to incorporate the latest skin thickness distribution. The thickness requirements are based on the following:

Net tension stress at ultimate load not to exceed 55,000 psi. Compression stress not to exceed:
(a) crippling stress at ultimate load with a cutoff equal to $F_{Cy}$. (b) Buckling stress at 100% of limit load.

3. Detail design of the wing tip is in work. The concept incorporates a laminated fiberglass shell with aluminum ribs bolted to the wing box. The design may be complicated by the addition of instrument compartments and access provisions when the wing pressure instrumentation requirements are finalized. Tip light provisions are not being incorporated.

4. The splice of the wing to the pivot fitting is being sized to the following criteria:

a) A 25% margin of safety on the net section at ultimate load.

b) A 15% M.S. on fastener strength. (Shear and bearing)

c) Yield stress will not be exceeded in net tension or bolt bearing at limit load based on elastic distribution of bolt loads.

d) The inboard and outboard rows of bolts to be critical in bearing rather than bolt shear.

The splice load, which is greater than the F-111 wing, and the above criteria will require the use of 3/4 inch diameter bolts in the splice. (Taper-Loks in the lower surface and straight shank bolts in the upper surface.)

5. A study is underway to determine the most practical method to prevent water entrapment within the wing box.
6. Spar design continues.

**Lines**

The basic lines task for the TACT wing is progressing as follows:

1. The lines definition of the inboard pivot area was completed 30 July.

2. The wing tip lines are being modified to remove a minor flat condition that exists in a 58° airstream cut.

4.2.3 **High Lift System**

1. Drawing No. 595RM1023 Hi Lift Control System, F-111 TACT-Proposed Schematic has been completed. Coordination copies have been furnished to all affected persons.

2. Drawing 595RM1024 "Hi Lift Drive System F-111 TACT-Design Analysis" is in work. Significant specifications and requirements for all components in the drive system will be maintained on this layout. Typical data are loads, kinematic relationships, power levels, gear data, switch settings, brake settings, screw leads, and limit displacements.

3. Krueger flap geometry is being developed in the stowed and extended positions.

4. Trailing edge flap geometry has been developed in the stowed and extended positions.

5. Preliminary meetings have been held with Flight Test Instrumentation Designers. It appears that instrumentation will have a dominant influence on the design of the movable surfaces. For this reason, a more complete definition of transducer installation, pressure lines, and harness routing requirements is being developed.

6. The distribution of area between the Krueger flap sections has been adjusted to gain uniform actuator loads.
7. AMR's have been released for the required quantities of 17 components which will be modified for use in the Hi Lift drive systems. It has been determined that most of these components are in Air Force inventory.

4.2.4 Spoiler Control System

The method of procuring the spoiler actuators is under reconsideration. In question is whether to procure new design actuators by performance specification or to modify existing actuators by drawing direction.

4.2.5 Fuselage Modification

The wing contours in the area of the overwing fairing have been established. These have all had 1.75g deflections and clearance lines added and a worst-condition composite of the various sweeps has been generated.

The wing composite has been added to the fuselage upper contours, along with the respective control lines, and fairing of the lower surface is currently in progress.

The fuselage-wing seal configuration has been determined. Procurement time will dictate early release of this item.

The basic lines task for the TACT fuselage modification is progressing as follows:

1. Cuts at 24 fuselage stations, showing fuselage and wing contours at 7 leading edge sweeps for each fuselage station, have been provided to the design group for use in design of the overwing fairing.

2. Lines development for the fixed leading edge is continuing.

3. Overwing fairing lines have been completed except for a transition from the overwing fairing area to the fixed leading edge area.

5.0 ANALYSIS

5.1 Loads

5.1.1 Preliminary Design Loads

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The preliminary design loads task is approximately 95% complete. Preliminary design load tasks currently in work and nearing completion include (1) hardpoint design loads, (2) wing sweep actuator design loads and (3) stowed flap design pressure loadings.

The loads data reduction/handling programs and the associated data tape handling programs are being examined and modified to assure rapid machine data handling procedures.

5.1.2 Final Design Loads

The Ames Research Center (ARC) Test 11-558 pressure data tapes were received on 23 July. They are being rearranged into a tape format suitable for computer procedure AUO which integrates the pressure data to obtain section normal force, pitching moment, bending moment and torsional moment coefficients. Center of pressure is also computed.

5.2 Stress Analysis

A. Wing Pivot Fitting

1. A preliminary analysis was made of the wing sweep actuator arm braces.

2. Thickness requirements for the splice area were determined for the pivot fitting plates and the wing box skins.

3. Internal stress distributions and stability checks of the upper and lower plates are in work.

4. Detail analysis of the combined hub-shear fitting is in work.

B. Wing Structural Box

1. Basic thickness requirements for the upper and lower skins were established.

2. Basic web thickness requirements for the front and rear spars and two of the four auxiliary spars were established.
3. All critical wing conditions except the hi-lift conditions have been analyzed on a computer simulation based on 6 August 1970 stiffness data but with the latest pivot fitting design concept.

4. Updating of the computer simulation stiffness to reflect the latest skin and spar design data is approximately 75% complete.

C. High Lift System

During this period, the high lift stress effort was as follows:

1. Calculation of flap reactions and bending moments for stowed loads
2. Trial sizing of flap skins and rib spacing
3. Calculation of spoiler shear, bending moments, and hinge moments
4. Estimating required stiffness of trailing edge flap support ribs

5.3 Fatigue Analysis

A meeting has been arranged with NASA FRC on 4 August to obtain data on anticipated usage of the TACT aircraft during the flight test program. This data will be used in calculating the TACT fatigue loads spectrum.

5.4 Aerodynamics

5.4.1 The first ARC 11' tunnel test (ARC 11-558) was monitored on-site. The test data were received on 23 July. The data have not been corrected for flow angularity and amounts to a $+0.075^\circ$ increase in indicated angle of attack. Pressure data plotting (using computer-type plot format) is progressing. A considerable amount of magnetic tape data handling is required since the ARC tapes are not in the format which was requested. Although
the force data are to be recomputed after the next ARC 11' test, the data received are being comparison plotted and summarized in report form. The flow inclination correction is small and much information pertinent to test requirements for the next test can be obtained.

5.4.2 AIM 405, comparing available 1/24-scale and 1/15-scale LRC and ARC test data, has been published.

5.4.3 Camber slopes for W53, the airplane jig shape, were examined at several span stations. This was done to assure smooth variations with no unexpected trends.

5.5 Performance

5.5.1 Takeoff performance calculations for 30° flaps and P-9 engines has been initiated. Following completion of these data, aerodynamic estimations for 20° flaps will be made, followed by 20° flap takeoff calculations.

5.6 Stability and Control Analysis

1. Wind tunnel test plans for Ames 9 x 7, 11 x 11 and 12 ft test and the CVAL Low Speed Test were reviewed at AFFDL on 12 July 1971. The AMES 9 x 7 and 11 x 11 ft run schedules were also reviewed on 26 and 27 July 1971 at Fort Worth with Stanley Lash and Lt. Stuart Stoddard of AFFDL. Changes were recommended which would reduce wind tunnel program costs without eliminating required data.

2. A number of revisions to the TACT SOW were proposed, reviewed and incorporated in order to reduce costs.

3. Analysis of results of the AMES 558 transonic test began upon receipt of tunnel data on 28 July 1971.

5.7 Handling Qualities Analysis

Nothing to report.

5.8 Flight Control System

Requirements for structural mode and limit cycle analyses were discussed with AFFDL and NASA representatives at Fort Worth on 21 July 1971. It was agreed that the limit
cycle analysis of SOW paragraph 5.8.4 would be accomplished by AFTTC and NASA and that preliminary structural resonance studies based on DAEAC data would be deleted from the SOW.

5.9 Flutter Analysis

The necessary drawings containing the wing structural geometry, upper and lower wing skin gages, spar web gages, etc., have been obtained for use in setting up the math model representing the wing structural stiffness. The drawings defining the spar cap areas and the leading and trailing edge flap skin gages are not available. However, work has begun on the setup of the wing structural geometry required for the math model.

5.10 Weight & Balance

Preliminary weight and center of gravity locations for all major assemblies within the movable wing have been determined.

Preliminary weight and c.g. locations have been determined for modifications to the overwing fairing and wing seal for the TACT installation.

These weights were based on calculations from layout drawings available to date and estimated weights where no layouts were available.

A weight and balance status report is in work summarizing the aircraft weight and balance status. This report will use F-lllA #13 as a baseline. Gross weight and balance data will be shown for the following conditions:

1. Clean wing
2. (12) M117's on outboard pivot pylons
3. (2) 600 gal (empty) fuel tanks on outboard pivoting pylons
6.0 FLIGHT TEST INSTRUMENTATION

6.4 Instrumentation Plan

Aerosystems Instrumentation Engineering (Dept. 062-4200) is performing research necessary to begin accomplishing preliminary installation design for (1) high response pressure transducers, (2) low response pressure taps and tubing, and (3) tubing and harness routing.

The preliminary instrumentation plan is in the process of being prepared and is approximately 5% complete.

7.0 TESTS

7.1 Wind Tunnel Tests

7.1.1 1/8 Scale Flutter Model

Airplane wing stiffness data and elastic axis location have been computed. This will be the data which the model wing will be designed to match. Airplane mass data is being compiled and is about 50 percent complete.

The first model wing structure has been analyzed on the computer and found to be in the approximate stiffness range to match the airplane. Additional structural changes will be made in the model design to more closely match the airplane stiffness and elastic axis location.

Design concepts for the dummy model wings have been explored and the type of design fairly well finalized.

The head of the 16 ft. transonic dynamics tunnel (Mr. Rainey) has been contacted in regard to the necessity for a stability analysis of the model mounted in the tunnel on the two-cable mount system. He has initially requested a comparison of the more important derivatives for the TACT airplane and the F-111A in order to make a judgment whether the stability analysis will need to be done. This comparison is underway.

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7.1.2.1 1/15-Scale Force Model

The pre-contract test in the NASA Ames 11-foot tunnel was completed on 26 June 1971. Data on tapes was received on 20 July 1971. This data is in error by a tunnel flow inclination angle.

The model was delivered to Ames on 26 July 1971 for the 9 x 7-foot tunnel test scheduled to commence 2 August 1971.

7.1.2.2 1/12-Scale Force Model

A pre-test conference was held at Ames on 20 July 1971 to present the proposed test program and test requirements to the 12-foot tunnel personnel. Model design work and construction has commenced for the scheduled test date of 20 September 1971. All work is on schedule.

8.0 FABRICATION & INSTALLATION

8.1 Tooling

A preliminary analysis has been made of tooling and manufacturing tasks of fabrication, methods, producibility, sequence, tool requirements, and manufacturing plan format.

Wing buck requirements were studied for a modified F-111 buck. Preliminary design layouts for the modifications are in progress.

A manufacturing plan is in progress.

An item and indenture breakdown has been completed.

Material

Nine (9) AMR's have been released for long lead time parts.

Of seventeen (17) material items released, five (5) were purchased line items and twelve (12) were GFP.
Assistance has been provided engineering in establishing metal cutting specifications to prevent waste.

Surveillance of Fort Worth Division continues for surplus material for use on the TACT program.

**Inspection**

Purchase orders are being monitored for specification requirements.

Special Projects quality control procedures have been aligned with TACT program concepts.

Coordination is continuing for all quality assurance efforts on the program (vendor, factory, shipping, etc.)