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STATEMENT OF WORK
REVISED ARROW PROGRAM

BROCHURE AD - 53

ISSUE 2

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AVRO AIRCRAFT LIMITED

MALTON - ONTARIO

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INTRODUCTION

This Statement of Work supersedes Avro brochures AD-51 Issue 2 and AD-53 basic issue. It presents the revised program of Avro Aircraft Limited for accomplishing the design, development, manufacture and test of Arrow 1 and Arrow 2 aircraft. Paragraph numbers of Parts 1 through 12 correspond to equivalent items of Brochure AD-51 Issue 2 (May 22, 1958) and of the preliminary review of AD-51 issued in September 1958.

Part 13 and Part 14 respectively contain the Phase 1 and Phase 2 program for engineering the MA-1 type electronic system, Falcon missiles, and the Genie (MB-1) rocket into the Arrow. This portion of the program was previously presented in preliminary form in Brochure AD-53 basic issue (October 10, 1958).

Work on Astra and Sparrow installations is shown as "work terminated", in accordance with DDP's stop-work telegram dated September 29, 1958.

Except where otherwise noted, all items of the product improvement and flight test program end on or before September 30, 1960, the delivery date of the last of the 20 Arrow development aircraft. Engineering support to production ends on July 31, 1961, the delivery date of the last of the 37-aircraft manufacturing program.

PART 1SPECIFICATIONS AND PRELIMINARY WORK

1.1 Preliminary engineering of the Arrow aircraft.

- 1.1.1 Design study and submission of a preliminary design. (Work completed.)
- 1.1.2 (a) Definition of, and fiscal investigations preparatory to, or as a result of, major revisions to the program.
(b) Additional studies at the request of the RCAF necessary to complement the design of the aircraft and associated GSE.

1.2 Preparation and revision of model specifications for:

- 1.2.1 The Arrow Weapon System. (Work terminated.)
- 1.2.2 The Arrow 1 aircraft.
- 1.2.3 Arrow 2 aircraft 25206.
- 1.2.4 Arrow 2 operational version.
- 1.2.5 Deleted.
- 1.2.6 Deleted.

1.3 Assistance to the RCAF in the preparation and revision of Requirement Specification WSC 1-2 - Requirements for the Airframe and GSM Installations for the Arrow Aircraft.

1.4 Evaluation of model specifications of sub-systems of Arrow Weapon System. (Work terminated.)

1.5 Deleted.

1.6 Deleted. Now included in 6.15.

PART 2ARROW 12.1 Arrow 1 Engineering

- 2.1.1 Arrow 1 basic airframe design comprising design and/or specification of structure and systems, contractor-furnished equipment and installation of CFE and GFE, including J75 engines and interim electronic system. (Work completed.)
- 2.1.2 Engineering work beyond basic design through December 1959, including ground testing of engineering changes; installation of these changes in development aircraft to permit their continuing participation in the Arrow 2 program.
- 2.1.3 Investigation of change requests and incorporation into the aircraft design, specification, and/or mock-ups of agreed changes resulting from the mock-up conference.
- 2.1.4 Transferred to paragraph 1.1.2.
- 2.1.5 Transferred to paragraph 9.7.

2.2 Arrow 1 Tooling

- 2.2.1 Process planning, design, development and manufacture or acquisition of such tooling, master models, jigs, dies, interchangeability media, fixtures and gauges as may be required for the airframe production and assembly of five Arrow 1 aircraft. (Work completed.)
- 2.2.2 Process planning, design and manufacture or acquisition of such production tooling as may be required for the manufacture and/or incorporation of modification kits for the Arrow 1 aircraft.
- 2.2.3 Maintenance, process planning, repair and replacement of tooling acquired under paragraph 2.2.1 and 2.2.2. Funds provide for tool maintenance through March 31, 1958.

2.3 Manufacture of Five Arrow 1 Aircraft

Note: This section includes costs accumulated on terminated work in connection with Astra and Sparrow installations.



- 2.3.1 The manufacture of airframes for, and the assembly of, five Arrow 1 aircraft, including the procurement of related contractor-furnished equipment and airframe sensing instrumentation for them, and the procurement of airborne data recording instrumentation for Arrow 1 aircraft allocated to airframe development.

Manufacturing costs include all those required to progress these aircraft through first flight. On completion of the first flight, these aircraft shall be accepted by the RCAF and transferred back to Avro Aircraft Limited to carry out the various phases of the flight test development program.

- 2.3.2 Manufacture and/or acquisition of spare parts and assemblies proposed by Avro as being required for the maintenance of Arrow 1 airframes, and approved by the RCAF, including packaging and storage as necessary.
- 2.3.3 Manufacture and/or acquisition of modification kits for Arrow 1 airframes and the incorporation of such modifications prior to RCAF acceptance, including packaging and storage as necessary. Work covered by paragraph 9.4 is excluded.

PART 3ARROW 23.1 Arrow 2 Engineering

3.1.1 Arrow 2 basic airframe design through December 1958 comprising design and/or specification of structure and systems, external fuel tank, Sparrow 2 Mk 1 weapon pack and launchers, contractor-furnished equipment, and installation of CFE and GFE as defined in the Model Specification for the Arrow 2 airframe and installed GSM, including Iroquois engine, Astra I electronic system and Sparrow missiles.

3.1.2 Continued engineering of Arrow 2 airframe beyond basic design, through date of delivery of the first squadron aircraft, to achieve operational standard.

Note: This paragraph includes costs accumulated on terminated work in connection with Astra and Sparrow installations.

3.1.3 Investigation of change requests and incorporation into the airframe design and/or mock-ups of agreed changes resulting from the mock-up conference.

3.1.4 Transferred to paragraph 1.1.2.

3.1.5 Transferred to paragraph 9.7.

3.1.6 Deletion of Astra and Sparrow from the Arrow program and associated drawing records.

3.1.7 Liaison with and technical assistance to Associate Contractors and major sub-contractors.

Note: Engineering of the MA-1/Genie/Falcon installation is covered in Parts 13 and 14.



3.2 Arrow 2 Tooling

Note: This section includes costs accumulated in connection with terminated work on Astra and Sparrow installations.

- 3.2.1 Process planning, design, development and manufacture or acquisition of such tooling, master models, jigs, dies, interchangeability media, fixtures and gauges as may be required for the production of thirty-two Arrow 2 aircraft and the continued production of Arrow 2 aircraft at the rate of four aircraft per month thereafter, including MA-1 radar nose, Genie/Falcon weapon pack, long range fuel tank, and changes necessary for the incorporation of MA-1 electronic system in Arrow 2 aircraft.
- 3.2.2 Process planning, design and manufacture or acquisition of such tooling as may be required for the manufacture and/or incorporation of modification kits for the Arrow 2 aircraft.
- 3.2.3 Maintenance, process planning, repair and replacement of tooling acquired under paragraph 3.2.1 and 3.2.2, starting April 1, 1958.
- 3.2.4 Process planning, design, modification and incorporation, with DDP approval, of such tool improvements as are recommended by Avro Aircraft Limited as essential to reduce Arrow 2 airframe manufacturing costs to be compatible with the cost supplement to this Statement of Work.

3.3 Arrow 2 Manufacture

Note: This section includes costs accumulated in connection with terminated work on Astra and Sparrow installations.

- 3.3.1 The manufacture of airframes for, and the assembly of, Arrow 2 aircraft, including the procurement of related contractor-furnished equipment and airframe sensing instrumentation for them, and the procurement of airborne data recording equipment for Arrow 2 aircraft through 25220 allocated to contractor and RCAF test programs, except for MA-1 instrumentation procured in Part 13. Instrumentation will be simplified as much as possible.

Manufacturing costs include all those required to progress aircraft through RCAF acceptance. (Manufacture of production-type long-range fuel tanks is not included in this paragraph. These tanks are considered special order items. See paragraph 3.3.4.)

3.3.1.1 Three Arrow 2 Aircraft

Manufacture of three Arrow 2 aircraft (25206, 25207, 25208). These aircraft will be accepted



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3.3.1.1 Cont'd

upon completion of first flight. They will have the original Astra-type Arrow 2 radar nose. 25206 and 25208 will be equipped with standard instrument packs and instrumentation for airframe development. 25207 will be similar to 25206 and 25208 except that it will be fitted with instrumentation for Iroquois engine development.

3.3.1.2 Twenty-nine Arrow 2 Aircraft

Manufacture of twenty-nine aircraft (25209 through 25237). Aircraft 25209 through 25220 will be accepted upon completion of first flight, while aircraft 25221 through 25237 will be accepted after completion of a full production flight test program.

Aircraft 25209

This aircraft will be fitted with the original Astra-type Arrow 2 radar nose, a standard instrument pack and instrumentation for the Iroquois engine development program. No MA-1/Genie/Falcon provisions will be included.

Aircraft 25210 - 25220

These aircraft will be completed on the production line without a radar nose, weapon pack or other MA-1/Genie/Falcon provisions. Aircraft will then proceed through normal preflight functions prior to entering into an out-of-sequence program for the embodiment of MA-1 electronic system at which time the MA-1 radar nose will be available but with initial flights being made with temporary weapon or instrument packs. Aircraft 25215 and subsequent will be fitted with production Genie/Falcon weapon packs prior to delivery to RCAF.

Aircraft 25221 - 25237

These aircraft will have the MA-1 electronic systems and the Genie/Falcon pack incorporated during production.

- 3.3.2 Manufacture and/or acquisition of spare parts and assemblies proposed by Avro as being required for the maintenance of Arrow 2 airframes and approved by the RCAF, including storage and packing as necessary.



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- 3.3.3 Manufacture and/or acquisition of modification kits for Arrow 2 airframes and the incorporation of such modification into the aircraft prior to aircraft acceptance.
- 3.3.4 Manufacture of six production-type long-range fuel tanks which are required for ferrying purposes.
- 3.4 Support to production electronic system activities and flight testing.
 - 3.4.1 Provision of power and cooling facilities for testing MA-1 electronic systems in Arrow aircraft in production-floor positions. (Previously listed as item 12.15.)
 - 3.4.2 Provision of power and cooling facilities for use in conjunction with Government-furnished MA-1 support equipment.

PART 4TEST PROGRAMS4.1 Laboratory Programs

- 4.1.1 Design and construction of wind tunnel models and conduct of wind tunnel tests. (See also paragraph 13.2.6 for additional wind tunnel work for the Genie/Falcon program.)
- 4.1.2 Design and construction of free flight models and of required test rigs, and performance of tests. (Work completed.)
- 4.1.3 Design, specification and operation of systems analysis and flight simulation aids, including analog computer, for use in stability, control, autopilot and airframe systems problems. Operation of cockpit simulator and flying control test rig in conjunction with analog computer shall be included.
- 4.1.4 Deleted.
- 4.1.5 Deleted.
- 4.1.6 Conducting of a telecommunication antenna development and model test program.
- 4.1.7 Deleted.
- 4.1.8 Deleted.

4.2 Structural and System Test Programs

- 4.2.1 Manufacture of test components. Note: This includes costs accumulated on terminated work in connection with Astra and Sparrow installations. (See Appendix 1 for list of required components.)
- 4.2.2 Manufacture of fifteen pre-production launchers for Sparrow 2 missiles. (Work now terminated.)
- 4.2.3 Conduct of ground testing, including firing, of the Sparrow 2 weapon pack, excluding provision of missiles and simulated air vehicles. (Work now terminated.)
- 4.2.4 Structural and systems ground testing for the Arrow aircraft, including the design and specification of test specimens, design and construction of test rigs and facilities, conduct of tests, analysis of data and preparation of reports.
 - (a) Air conditioning systems.
 - (b) Fuel systems.



4.2.4 Cont'd

- (c) Flying controls.
- (d) Landing gear.
- (e) Static test aircraft.
- (f) Minor testing of escape system.

See 3.1.2 and 9.2.2 for continued structural and systems ground testing to achieve the Arrow 2 operational standard.

- 4.2.5 Sled testing and associated work on Arrow crew escape system. (Work terminated.)
- 4.2.6 Supply of items of contractor-furnished aircraft equipment required for test purposes.

4.3 Test Provisions and Instrumentation

- 4.3.1 Sparrow weapon pack test provisions in aircraft 25203. (Work terminated.)
- 4.3.2 Instrumentation for Avro flight test program:
 - (a) Design and specification of airframe sensing and airborne data recording instrumentation.
 - (b) Design of instrumentation installation; manufacture of special parts for mounting; installation of recording instrumentation; check-out and calibration of instrumentation.
 - (c) Design, provision and installation of changes to airborne instrumentation.
 - (d) Maintenance of airborne instrumentation through aircraft 25214.
- 4.3.3 Design and/or specification, and fabrication of Arrow airframe system developmental installations in CF-100 test vehicles, including flying control, instrumentation, and telecommunication antenna work. (Completed.) Reconversion of aircraft if required will be done under CF-100 repair and overhaul arrangements.
- 4.3.4 Design and/or specification, and provision of ground telecommunication facilities required for the Arrow flight test program at Malton. (Work completed.)
- 4.3.5 Instrumentation for Orenda Engines Limited flight test program:



4.3.5 Cont'd

- (a) Design of the installation of airborne data recording instrumentation.
- (b) Installation, check-out and calibration of instrumentation.
- (c) Assistance with the maintenance of and changes to instrumentation.

4.3.6 Instrumentation for joint RCAF/Avro flight test program on aircraft 25215 through 25220:

- (a) Design and specification of airframe sensing and airborne data recording instrumentation.
- (b) Design of instrumentation installation including the manufacture of special parts for mounting, and installation, check-out and calibration of instrumentation.

4.3.7 Design, tooling, and manufacture of ten instrument packs, including terminated work on Sparrow combination weapon/instrument packs.

4.4 Engineering Flight Testing

4.4.1 Planning and conduct of the Avro flight test program.

4.4.1.1 Basic Arrow 2 aircraft:

- (a) Detail planning of test programs.
- (b) Specification of required instrumentation for specific flights.
- (c) Recording and reduction of flight test data.
- (d) Pre-flight testing.
- (e) Provision of flight crews.
- (f) Briefing and debriefing of flight crews.
- (g) Supply of flight test data to Orenda Engines Limited.
- (h) Analysis of test data and preparation of test reports.

4.4.1.2 Continued Arrow 2 flight testing to achieve Arrow 2 operational standard.

4.4.2 Deleted.



4.4.3 Maintenance and operation at Malton by Avro of aircraft 25201 through 25214 together with two Sabre 6 and one CF-100 Mk 5 chase aircraft. This shall include:

- (a) Supply of fuel and oil.
- (b) Procurement of maintenance assistance from sub-contractors other than Hughes Aircraft Company.
- (c) Support to RCAF Phase 2 program on one Arrow 1 aircraft.
- (d) Incorporation of Government-furnished kits for 6A modifications in chase aircraft.

(For procurement of HAC technical assistance see 13.1.)

4.4.4 Necessary alterations to three RCAF-supplied chase aircraft (namely one CF-100 Mk 5 and two Sabre 6's) to enable their use for this purpose. (Completed.) Reconversion of these aircraft, if required, will be covered by the repair and overhaul arrangements for the individual aircraft.

4.4.5 Planning, in conjunction with the other Associate Contractors, of an integrated weapon system flight test program. (Work terminated.)

4.4.6 Training of two Orenda pilots and on-the-job training of Orenda ground crews.

4.5 Aircraft/FCS/Weapon Compatibility Program

Base facilities are assumed to be provided and/or contracted for by the RCAF. No provision is made for chase aircraft other than the Arrow aircraft directly involved in this program. (See Page 35, item (a).)

4.5.1 Conduct of Genie and Falcon separation test program at a base to be designated by the RCAF on Arrow 1 aircraft equipped with interim Genie and Genie/Falcon weapon packs, including:

- (a) Maintenance and operation.
- (b) Provision of personnel to support the flight test program. (For HAC support see 13.1.)
- (c) Provision of technical assistance from major sub-contractors.
- (d) Provision of necessary GSE acquired per paragraph 10.3.



4.5.2 Conduct of an aircraft/FCS/weapon compatibility test program at a base to be designated by the RCAF on three Arrow 2 aircraft equipped with Genie/Falcon weapon packs including:

- (a) Maintenance and operation of three Arrow 2 aircraft.
- (b) Provision of personnel to support the flight test program.
- (c) Provision of technical assistance from major sub-contractors. (For HAC support see 13.1.)
- (d) Provision of necessary GSE acquired per paragraph 10.3.
- (e) Provision of modifications to enable each of these aircraft to be used as targets when necessary.
- (f) Provision of personnel to make necessary changes to these aircraft during the program.

Note: For provision of service representatives and modification kits to support this operation see 3.3.3 and 12.21.

4.5.3 Support of RCAF/Avro joint test programs at a base to be designated by the RCAF on six Arrow 2 aircraft fitted with Genie/Falcon weapon packs including:

- (a) Provision of personnel to assist the test program.
- (b) Provision of technical assistance from major sub-contractors. (For HAC support see 13.1.)
- (c) Provision of maintenance for airborne instrumentation.
- (d) Minimum essential planning and analysis.

Note 1: Aircraft allocation to this program will be four to six aircraft, depending on need for attrition replacements. See aircraft allocation chart.

Note 2: For provision of mobile repair and maintenance parties, service representatives and modification kits to support this operation see 3.3.3, 11.4 and 12.21.

PART 5MOCK-UP AND EVALUATION

- 5.1 Design and construction of the following developmental and demonstration mock-ups:
 - 5.1.1 Arrow 1 aircraft, including interim electronic system. (Work completed.)
 - 5.1.2 Arrow 2 aircraft, including the installation of Astra I system and Iroquois engine. (Work completed.)
 - 5.1.3 Weapon pack for Sparrow 2 Mk 1 missiles. (Work completed.)
 - 5.1.4 Ground support equipment. (Work completed.)
 - 5.1.5 Special cockpit mock-up for evaluation of take-off and landing conditions. (Work completed.)
 - 5.1.6 Continuing aircraft mock-up work as required during the development program. See also 13.2.1(d).
- 5.2 Construction of full scale Arrow 1 airframe metal mock-up. (Work completed.)
- 5.3 Provision of facilities and services for RCAF mock-up conferences relevant to the mock-ups in paragraph 5.1 above. (Work completed.)
- 5.4 Provision of facilities and services for RCAF Engineering Evaluation Conference for Arrow 2 GSE (Reference RCAF document DDA-24). (See also paragraph 6.3.) (Work completed.)

PART 6DATA AND PUBLICATIONS

6.1 Supply to the RCAF of:

- (a) one microfilm copy of requested Avro sub-assembly and assembly drawings for the Arrow 1 and Arrow 2 aircraft, in accordance with a version of PROC 100-11 to be agreed between Avro and the RCAF,
- (b) one reproducible copy of GSE drawings prepared in accordance with PROC 100-2.

6.2 Supply of drawings to other contractors as necessary to ensure compatibility of equipment installation in the airframe.

6.3 Provision and publication of data and support for RCAF evaluation of Arrow 2 GSE. (Work completed.)

6.4 Provision of services and materials for maintenance appraisal and the collection and preparation of maintenance and logistics data on the airframe and associated GSE.

6.5 Included in 6.8.

6.6 Preparation and publication of a Program Planning Report. (Work terminated.)

6.7 Preparation and publication of periodic Arrow program reports, as follows:

- (a) Quarterly physical report.
- (b) Quarterly financial report.
- (c) Monthly letter report.
- (d) Quarterly technical report. (Work terminated.)

6.8 Provision of Engineering data and reports on request from the RCAF including:

- (a) Performance and weights reports.
- (b) Ground and flight test reports.
- (c) Wind tunnel, strength and system reports.



6.9 Arrow 1 Service Data, comprising:

6.9.1 Preparation and publication of Arrow 1 Service Data to November 30, 1958 describing and illustrating each aircraft system including component removal and installation, maintenance and trouble shooting procedures.

6.9.2 Preparation and publication of interim Arrow 1 Aircraft Operating Instructions to November 30, 1958 to support the aircraft in the absence of normal Engineering Orders.

6.9.3 Now included in 6.17.

6.9.4 Now included in 12.18.

6.10 Deleted. Now included in 6.7, 6.14, 6.15, 6.16, 6.17 and 10.7.

6.11 Preparation and publication of special Weapon System Co-ordination reports.

6.12 Preparation and maintenance of Arrow 2 systems brochures. (Work to continue on minimum essential brochures.)

6.13 Deleted.

6.14 Preparation and publication of the following Arrow 2 aircraft series Engineering Orders and revisions to such Engineering Orders generally in accordance with PROC 100-8 but with reduced-cost format to be agreed between AMC and Avro.

Aircraft Operating Instructions
Description and Maintenance Instructions
Structural Repair Manual
Illustrated Part List
Maintenance Schedules (Primary)
Maintenance Schedules (Periodical)

6.15 Preparation and publication of Arrow 2 equipment series Engineering Orders with reduced-cost format, and revision to such Engineering Orders as follows:

Selected items of proprietary equipment
Selected items of ground support equipment



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6.15 Cont'd

EO control forms shall be submitted in accordance with a version of PROC 100-15 to be agreed between AMC and Avro.

Note: These EOs will be prepared only for equipment for which existing publications are not available.

- 6.16 Preparation, publication and maintenance of aircraft service and modification bulletins.
- 6.17 Preparation and publication, using minimum cost presentation, of program proposals, special program reports, slides, transparencies, film scripts, and similar material for essential information purposes in support of the Arrow program.
- 6.18 Deleted.
- 6.19 Deleted.

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PART 7

STUDIES

- 7.1 Design study of an aircraft systems trainer for the airframe contractor-furnished systems, including construction of a model for design investigation. (Work completed.)
- 7.2 Design study for a ground equipment trainer. (Work completed.)
- 7.3 Measurement of in-flight thrust of the engines. (Preliminary investigation only.) (Work terminated.)
- 7.4 Studies relative to Astra I installation. (Work completed.)
- 7.5 Improvements to the crew escape system. (Work completed.)
- 7.6 Installation of arrester hook on the Arrow. (Work completed.)
- 7.7 Requirements for achieving compatibility between the Arrow and RCAF specified runway barrier. (Work completed.)
- 7.8 Physical installation of Genie rockets in the Arrow. (Work completed.)
- 7.9 Deleted. (See item 1.1.2.)
- 7.10 Weapon System mathematical model program. (Work terminated.)
- 7.11 Mathematical model extension re growth potential and tactics. (Work terminated.)
- 7.12 Deleted.
- 7.13 Studies of Arrow Weapon System air base requirements as follows:
 - 7.13.1 Study of operational air base requirements. (Work terminated.)

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- 7.13.2 Study of Cold Lake air base requirements. (Work terminated.)
- 7.13.3 Deleted.
- 7.14 Weapon System support studies:
 - 7.14.1 Deleted.
 - 7.14.2 Deleted.
 - 7.14.3 PRD study and co-ordination. (Work terminated.)
- 7.15 Analysis of Associate Contractor technical progress reports. (Work terminated.)
- 7.16 Study and analysis of technical problems with respect to GSM on request from the RCAF, and recommendations of solutions to these technical problems.
- 7.17 Deleted.
- 7.18 Deleted.
- 7.19 Deleted.
- 7.20 Study re flight and tactical trainer. (Work terminated.)
- 7.21 Deleted.
- 7.22 Deleted.
- 7.23 Study of semi-submerged carriage of Sparrow 2 missiles. (Work terminated.)

PART 8WEAPON SYSTEM DEMONSTRATION
AND SUPPORT TO ASSOCIATE CONTRACTORS

- 8.1 Support to RCA. (Work terminated.)
- 8.1.1 Modification of aircraft 25202. (Work terminated.)
 - 8.1.2 Modification of aircraft 25204 and 25205. (Work terminated.)
 - 8.1.3 Instrumentation of RCA Arrow aircraft. (Work terminated.)
 - 8.1.4 Manufacture of instrument packs for RCA Arrow aircraft. (Work terminated.)
 - 8.1.5 Deleted.
 - 8.1.6 Deleted.
 - 8.1.7 Support of RCA flight test program at Malton. (Work terminated.)
 - 8.1.8 Deleted.
 - 8.1.9 Deleted.
- 8.2 Support to Orenda Engines Limited.
- Now included in 4.3 and 4.4.
- 8.3 Support to Canadair Limited. (Work terminated.)
- 8.3.1 Deleted.
 - 8.3.2 Instrumentation of Canadair Arrow aircraft. (Work terminated.)
 - 8.3.3 Manufacture of weapon/instrument packs for Canadair Arrow aircraft. (Work terminated.)
 - 8.3.4 Deleted.
 - 8.3.5 Deleted.
 - 8.3.6 Deleted.



8.3.7 Deleted.

8.3.8 Deleted.

8.4 Support to RCAF testing and evaluation.

Now included in 4.3.6, 4.4.5 and 4.5.3.

8.5 Support to the Weapon System demonstration.

8.5.1 Planning of integrated Weapon System demonstration. (Work terminated.)

8.5.2 Deleted.

8.5.3 Manufacture of weapon/instrument packs for weapon system demonstration aircraft. (Work terminated.)

8.5.4 Deleted.

8.5.5 Deleted.

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PART 9ENGINEERING SUPPORT TO PRODUCTION

- 9.1 Investigations into, and design and specification of, and testing of, changes, salvage schemes and/or material substitutions to aid production and/or servicing of the Arrow airframe and associated GSE.
- 9.2 Engineering work necessary to rectify problems resulting from the RCAF/Avro joint test program and from service flying, including the implementation of remedial action to improve the reliability of defective items.
- 9.3 Now included in 9.1 and 9.2.
- 9.4 Installation into Avro and Orenda flight test aircraft, after RCAF aircraft acceptance, of:
- (a) Mandatory modifications.
 - (b) Approved modifications necessary for the test program.
 - (c) Work necessary to attain completion to a standard to permit the commencement of the flight test program.
 - (d) Preliminary modifications to permit the development program to proceed.

Manufacture of parts when required prior to production availability is included.

- 9.5 Deleted. (See 11.1.)

- 9.6 Sustaining engineering on airframe equipment, including appraisal of vendors' proposals and monitoring of vendor qualification testing and type approval of CFE.



9.7 Defect Reporting

- 9.7.1 Collection and reporting of field and in-plant defects on the Arrow airframe and associated GSE; statistical and technical analysis of these reports; recommendation of remedial action to improve the reliability of defective items; monitoring of the implementation of these recommendations.
- 9.7.2 Analysis of statistical summaries of field and in-plant defects from Associate Contractors and major sub-contractors; recommendation of remedial action to improve reliability of defective items; monitoring of the implementation of these recommendations.



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PART 10GROUND SUPPORT EQUIPMENT AND TRAINERS

- 10.1 Design and/or specification of an aircraft systems trainer (AST) and of modifications thereto, for the instruction of RCAF personnel in maintenance aspects of the airframe systems and airframe ground support equipment.
- 10.2 Design and/or specification, after RCAF scheme approval, of contractor-furnished Ground Support Equipment for Arrow 1 and Arrow 2, as defined in Avro Report 70/GEQ/2-3, and of modifications to this GSE.
- 10.3 Provision of RCAF-approved Ground Support Equipment.
- 10.3.1 The manufacture and/or provision of Avro-furnished ground support equipment for support of aircraft 25201 through 25220 as defined in Avro Report 70/GEQ/2-3.
- 10.3.2 The manufacture and/or provision of additional GSE of the types covered by paragraph 10.3.1 for support of aircraft 25221 through 25237.
- 10.4 Investigation of change requests and incorporation into GSE design specifications and/or mock-ups of agreed changes resulting from the evaluation conference.
- 10.5 Manufacture and installation of minor modifications for Avro-furnished Ground Support Equipment specified in paragraph 10.3, such modifications to be approved by the RCAF and contractually authorized. All major modifications will require separate authorization.
- 10.6 Supply of spare parts and assemblies recommended by Avro as being required for the maintenance and/or repair and overhaul of Avro-furnished GSE specified in paragraph 10.3, and authorized by the RCAF, including packing and storage as necessary.
- 10.7 Procurement, manufacture, assembly and supply (including necessary publications and panel illustrations) of one Aircraft Systems Trainer.



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10.8 Supply to the RCAF of one reproducible copy of all drawings to PROC 100-2 of Aircraft Systems Trainer.

10.9 Transferred to 11.2.

10.10 Deleted.

10.11 Transferred to 10.7.

10.12 Deleted.

PART 11REPAIR AND OVERHAUL

- 11.1 Investigation and design of standard and specific repair schemes for Arrow airframe and for related spares, after acceptance by the RCAF, including accident investigation.
- 11.2 Repair and overhaul of thirty-seven Arrow airframes and related spares, and Avro-furnished GSE, after acceptance by the RCAF.
- 11.3 Acquisition and/or manufacture of repair and overhaul spares for Arrow airframes.
- 11.4 Provision of maintenance parties and mobile repair parties at one RCAF-designated proving base and one RCAF operational station.
- 11.5 Repair and overhaul of airborne flight test instrumentation used for Avro flight test vehicles.

PART 12TRAINING. TECHNICAL SUPPORT AND CO-ORDINATION

- 12.1 Now included in 12.14.
- 12.2 Deleted.
- 12.3 Deleted.
- 12.4 Training of Avro personnel on sub-systems supplied by Associate Contractors and major sub-contractors.
- 12.5 Co-ordination of Associate Contractors' statements of work. (Work terminated.)
- 12.6 Compilation and maintenance of a master phasing schedule for the Arrow program, including analysis and monitoring of program schedules of Associate Contractors and major sub-contractors.
- 12.7 Analysis of plans of Associate Contractors and major sub-contractors for Arrow program support, including such items as ancillary equipment, training, services, supporting personnel and facilities. Combination of above into unified support plan and monitoring of its progress.
- 12.8 Now included in 12.6.
- 12.9 Deleted.
- 12.10 Analysis of data control systems of Associate Contractors. (Work terminated.)
- 12.11 Provision of representatives at AAWS. (Covered by a separate contract.)
- 12.12 Deleted.



12.13 Deleted.

12.14 Continuous co-ordination and liaison with AAWS, Associate Contractors and major sub-contractors regarding schedule, progress, technical and responsibility aspects of the Arrow and its sub-systems.

12.15 Transferred to 3.4.1.

12.16 Transferred to 1.1.2.

12.17 Management of Arrow Weapon System training for RCAF personnel, including management of airframe, engine, electronic system and weapon training.

12.18 Preparation and presentation of airframe and engine training courses for RCAF.

12.19 Co-ordination of:

(a) Avro and Orenda personnel training, including provision of airframe courses for Orenda.

(b) Airframe and engine systems trainers.

12.20 Provision of assistance at Avro to support service representatives in the field.

12.21 Provision of field service representatives to support Arrow airframe activities at one RCAF-designated proving base and at one RCAF operational station.

12.22 Deleted. See 11.4.

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PART 13

MA-1/GENIE/FALCON PROGRAM - PHASE 1

Definition

Phase 1 is Avro's program for the engineering of a modified MA-1 electronic system, designated the MA-1C system, and a Genie (MB-1)/Falcon weapon pack into the Arrow 2 aircraft, with support by Hughes Aircraft Company (HAC). Phase 1 includes a trial installation of the XMA-1C/Genie system in one Arrow 1 aircraft.

13.1 Services and Materials Supplied by HAC

13.1.1 Engineering and modification of the MA-1 system for installation in the Arrow 1 including:

- (a) Provision of a definition of the XMA-1C system, including instrumentation, as modified for the Arrow 1, resulting in a master index and a system specification.
- (b) Engineering and fabrication of modifications to the MA-1 system and incorporation into two Government-supplied MA-1 systems including:
 - (i) Modification to operate with 400-cycle aircraft power supply where appropriate.
 - (ii) Construction of 1600-cycle motor generator sets.
 - (iii) Construction of static converter units.
 - (iv) Provision of attack presentation in front cockpit and converters as necessary.
 - (v) Revision of units for radar operating function in rear cockpit.
 - (vi) Study and incorporation of revisions to the values of the weapon parameters used in the computer, which are affected by the particular MA-1 installation.
- (c) Provision at Malton of spares for items peculiar to the XMA-1C system and modification of Government-supplied spares as appropriate.
- (d) Provision at Malton of a modified factory-type test position to support the XMA-1C system.



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13.1.1 Cont'd

- (e) (i) Provision at Malton of support equipment (with spares) peculiar to the XMA-1C system.
- (ii) Provision at Malton of modifications to Government-supplied MA-1 support equipment and spares for same, as appropriate.

13.1.2 Assistance with the engineering of the XMA-1C system into aircraft 25203, including:

- (a) Design and technical assistance at Malton.
- (b) Provision of one instrumentation system packaged in a Genie configuration for the XMA-1C system, including recording oscillograph(s), instrumentation spares and strike cameras.
- (c) Installation, check-out and flight test support at Malton through March 31, 1960.

13.1.3 Application engineering and the supply of data to Avro for the YMA-1C and MA-1C systems for Arrow 2, including:

- (a) Definitions of the systems, including master indices and system specifications.
- (b) Definition of the instrumentation for the systems.
- (c) Definition of the support equipment for the systems.
- (d) Outline and mounting drawings, wiring books, and other installation data.

13.1.4 Technical assistance to the Arrow 2 MA-1C engineering program comprising:

- (a) Support to Arrow 2 MA-1C installation design at Malton through March 31, 1960.
- (b) Installation and check-out assistance at Malton to support four systems referred to in paragraph 13.1.5.
- (c) Flight test support at Malton and at one RCAF-designated base through July 1961, including flight test data analysis and assistance in flight test planning.

13.1.5 Engineering and modification of four Government-furnished YMA-1C systems (less AFCS) and spares for installation in Arrow 2 aircraft, and of one set of Government-furnished MA-1 field-type special test equipment.

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- 13.1.6 Provision of three sets of instrumentation recording systems, including spares and strike cameras. These are additional to instrumentation covered by 13.1.2(b).
- 13.1.7 Studies, jointly with Avro, to determine the operational compatibility of the MA-1C system with Arrow 2 aircraft parameters and with the operational requirement of the RCAF defence mission.
- 13.1.8 (a) Provision of engineering services and materials for the modification, testing and support of a Government-furnished AFCS system (and spares) for Arrow 1.
(b) Provision of engineering services and materials for the modification, testing and support of four Government-furnished AFCS systems (and spares) for Arrow 2.

13.2 Services and Materials Supplied by Avro

- 13.2.1 Engineering and incorporation of the XMA-1C system into aircraft 25203, including:
 - (a) Detail design of changes to, and modification of, the airframe structure and systems to accommodate the XMA-1C system.
 - (b) Installation of one instrumentation system packaged in Genie configuration. See paragraph 13.1.2(b).
 - (c) Modified Arrow radome.
 - (d) Minimum mock-up work to assist installation engineering.
 - (e) Liaison with HAC including provisions to HAC of all necessary technical data and drawings.
- 13.2.2 Engineering of YMA-1C and MA-1C systems into the Arrow 2 including:
 - (a) Modifications to the radar nose structure.
 - (b) Wiring changes.
 - (c) Power supply changes.
 - (d) Air conditioning and miscellaneous aircraft system changes.



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13.2.2 Cont'd

(e) Miscellaneous aircraft structural revision to accommodate the system.

(f) Studies of control and utilization of Falcon and Genie weapons with the Arrow equipped with MA-1C.

13.2.3 Engineering and manufacture of seven interim weapon packs for testing, including:

(a) Pack design and manufacture.

(b) Provision of Genie launchers.

(c) Aircraft changes associated with the installation of the interim packs on Arrow aircraft.

13.2.4 Engineering of a weapon pack to accommodate Genie and Falcon weapons, and fuel, together with associated aircraft changes resulting from the introduction of this pack on Arrow 2 aircraft.

13.2.5 Ground testing of the weapon packs, including ground firing trials and the design and manufacture of required rigs.

13.2.6 Design, construction and/or modification of wind tunnel models and conduct of wind tunnel tests for the Genie/Falcon program.

Note: For flight testing, see items 4.5, 4.5.1, 4.5.2 and 4.5.3.

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PART 14MA-1/GENIE/FALCON PROGRAM - PHASE 2Definition

The basic Arrow program (Parts 1 through 12) and Phase 1 program (Part 13) provide complete engineering of the basic Arrow/MA-1/Genie/Falcon weapon system. The Phase 2 program details the application engineering required to introduce proposed electronic system modifications listed herein into the Arrow 2 aircraft. It is assumed that each item to be incorporated will have been fully developed under USAF contracts prior to introduction into the Arrow program.

- 14.1 Application engineering for introduction of the following proposed electronic system improvements:
- (a) A larger, hydraulically driven antenna (approximately 36" diameter).
 - (b) Master oscillator power amplifier (MOPA).
 - (c) Counter-countermeasures.
 - (i) Electronic system.
 - (ii) Chaff system.
 - (d) Provision for IR scanner tie-in (excluding scanning system).
 - (e) Time division data link.
 - (f) Complete conversion of the MA-1 system to 400-cycle power with the exception of the supply to the Falcon missiles.
 - (g) Appropriate modifications to system support equipment.

EXCLUSIONS

The following items are excluded from the preceding Statement of Work:

1. Extra work resulting from changes to Specification WSC 1-2 Issue 1 other than that associated with the introduction of MA-1/Genie/Falcon.
2. Deleted.
3. Missile development or evaluation, and/or the supply of tow targets, tugs, target drones, missiles and simulated air vehicles for ground and flight tests.
4. Design and development of antennas forming part of servo loops of Government-furnished sub-systems, and of multiplexing for antennas.
5. Repair and overhaul of any aircraft participating in the Arrow program other than Arrow aircraft, or of Government-furnished sub-systems or components thereof.
6. Measurement of in-flight thrust, including studies beyond preliminary investigation of methods of accomplishing it.
7. Deleted.
8. Work entailed by the failure of GSM to meet required schedules or standards.
9. Deleted.
10. Major re-engineering of any work within RCAF Specification WSC 1-2 Issue 1.
11. Provision of facilities for conducting training programs for RCAF personnel.
12. Any work involving aircraft other than Arrow aircraft, one CF-100 and two Sabre chase/target aircraft.
13. Manufacture of production-type long range fuel tanks other than those covered by paragraphs 3.3.4 and 4.2.1.
14. All changes to this program introduced after November 7, 1953.
15. Supply of any spares other than those covered by paragraphs 2.3.2, 3.3.2, 10.6 and 11.3.
16. Deleted.
17. Replacement of airborne instrumentation destroyed as a result of aircraft accidents.



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- (18) Costs for design and incorporation of items included in Part 14 of this Statement of Work.
- (19) Provision of accident investigation telemetry in aircraft subsequent to 25208.

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SUPPORT FROM CANADIAN GOVERNMENT AGENCIES

The following items of support are assumed to be provided by the Canadian Government:

- (a) Provision of the following at bases to be designated by the RCAF: data reduction facilities, fuel, oil, ground support equipment, laboratory and special test equipment, chase, ECM and target aircraft, drones, miss distance instrumentation, and facilities for repair and overhaul.
- (b) Provision of engines, electronic systems, and other GSM, including:
 - (i) Spare MA-1 systems for permanent allocation to test benches at Avro, additional to installation systems called out in GSM delivery schedule on Page 38.
 - (ii) Technical assistance, spares, repair and overhaul of GSM engines and components.
- (c) Provision of Government-furnished special test equipment. This shall include one set of MA-1 field type special test equipment, modified for Arrow use, additional to the sets of support and/or test equipment called out in Part 13.
- (d) Provision of modification kits for chase and target aircraft used during Arrow test programs at Malton and at bases designated by the RCAF.
- (e) Deleted.
- (f) Provision of office space, laboratory space and living quarters for personnel supplied by Avro in support of test programs at bases designated by the RCAF.
- (g) Supply of telecommunication equipment for ground telecommunication facilities to support the Arrow flight test program at Malton.
- (h) Deleted.
- (i) Provision of chase aircraft.
- (j) Provision of firing ranges and facilities.
- (k) Provision of flight crews, and instruments for photo panels for RCAF Phase 2 testing.
- (l) Provision of shuttle service between Malton and Culver City, California, to support the MA-1C program at Malton.



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- (m) Hughes Aircraft Company field service representatives and technicians to assist Avro with installation, testing, calibration, flight acceptance, repair and maintenance of production installations of MA-1C electronic systems installed in aircraft 25215 and subsequent.

SUPPORT FROM ORENDA ENGINES LIMITED

The following support is assumed to be provided by Orenda Engines Limited:

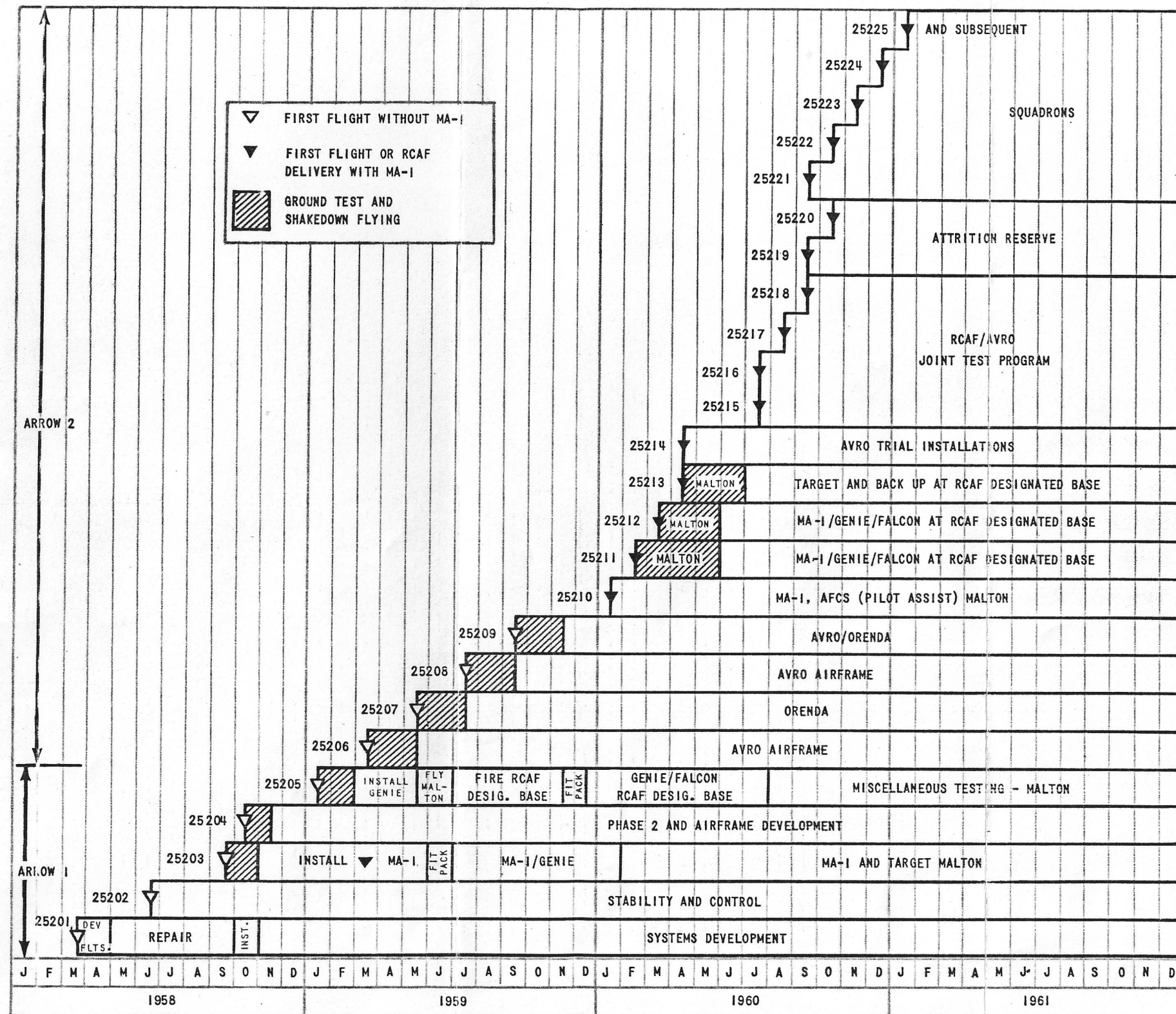
- (a) Suitably instrumented Government-furnished Iroquois engines for installation in aircraft 25207 and 25209.
- (b) Provision of, maintenance of (with Avro installation and removal assistance), and changes to airborne engine data telemetering adaptation equipment and special airborne instrumentation (other than airframe sensing instrumentation) in aircraft 25207 and 25209.
- (c) Provision of agreed Iroquois GSE for programs conducted at Malton.
- (d) Provision and operation at Malton, and operation at bases designated by the RCAF, of Iroquois maintenance facilities, for aircraft engaged in contractor flight test programs.
- (e) Provision of facilities and services to train Avro personnel on the Iroquois engine.
- (f) Technical assistance to Avro in obtaining RCAF acceptance of Arrow 2 aircraft.
- (g) Provision to Avro of available defect data and reliability data on components of the Iroquois engine.
- (h) Provision and operation of Iroquois engine run-up and check-out facilities at Malton.
- (i) Provision of flight crews for aircraft 25207 and 25209.
- (j) Supply of available data required for co-ordination of the Arrow program and for preparation of Arrow program reports.

Oct. 28/58

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3896-105-2

REVISION 1 - NOV. 10, 1958.



ARROW AIRCRAFT ALLOCATION

REVISION 1 - NOV. 7, 1958.

3897-105-2

ARROW AIRCRAFT DELIVERIES

PER MONTH

OUT-OF-SEQUENCE
DELIVERIES

CUM TOTAL

REQUIRED DELIVERY
TO AVRO OF MODIFIED
MA-1 SYSTEMS - 'B' COMPONENTS*
(SPARES OMITTED)
'A' COMPONENTS* REQUIRED
1 MONTH EARLIER

CUM TOTAL

A/C ALLOCATION

REQUIRED DELIVERY TO AVRO
OF IROQUOIS ENGINES
(SPARES OMITTED)

CUM TOTAL

A/C ALLOCATION

*'A' COMPONENTS = MOUNTS,
RACKS ETC

'B' COMPONENTS = BLACK BOXES

SQUADRON AIRCRAFT

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ARROW AIRCRAFT DELIVERY AND GSM SCHEDULE



SECRET

APPENDIX 1ARROW TEST COMPONENTS

<u>COMPONENT</u>	<u>QUANTITY (A/C SETS)</u>
Front Fuselage	1 Including canopy and canopy actuating mechanism.
Canopy	5 Including one (1) canopy mounted on the front fuselage.
Centre fuselage	1
Air intake	1
Duct bay	1
Engine bay	1
Rear fuselage	1
Inner wing complete	1
Outer wing	1
Dive brakes	1 brake, left hand component only
Aileron	2 Standard 1 Modified
Elevator	2 Standard 1 Modified
Fin	1
Rudder	2 Standard 1 Modified
Main and nose landing gear	1
Main landing gear pivot door	1 Door, right hand component only.
Main landing gear fairings	1 Fairing, right hand component only



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<u>COMPONENT</u>	<u>QUANTITY (A/C SETS)</u>
Fin trailing edge for rudder tests	1 Complete with control linkage and mountings
Outer wing trailing edge for aileron tests	1 Complete with control linkage and mountings
Air conditioning duct	1
Engine intake duct, forward portion	1
Engine intake duct, aft portion	1 Duct, left hand component only
Inner wing posted box tanks	5
Windshield for canopy testing	2
Power panel for electrical system	1
Ram and fan exhaust duct	1 (Part No. 7-2254-884)
Fan exhaust duct	1 (Part No. 7-2254-1171)
Transmission duct assembly	1 (Part No. 7-2254-663)
Dorsal fairing (Fibreglas)	1 (Part No. 7-1000-473)
Engine mount (Worm and gear)	6
Elevator drive links	3
Radar nose	1 Part only, unassembled details of Arrow 2 Astra nose
Engine intake transition duct (Arrow 2)	1
Dive brake (Arrow 2)	1 Brake, right hand complete (Part No. 7-1072-2)
Dive brake hydraulic jack	1 (Part No. 7-1956-7)
Hydraulic components required to complete right hand dive brake assembly to drawing 7-1956-42	1 set, right hand only



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COMPONENT

QUANTITY (A/C SETS)

Long range tanks	5
Former 469, Arrow 2	1 (Part No. 7-1054-15031)
Seat for linkage test	1

Miscellaneous items as required to supply production parts for interim Genie/Falcon packs, and for future tests.

Work on the following items, which were previously required, has been terminated:

Weapon pack, Sparrow	3
Single missile extension linkage	1
Radar nose	2

Production parts for combination Sparrow/instrument packs.