4/1

Air 7-5

Inst 92-5

DEPARTMENT OF NATIONAL DEFENCE

ROYAL CANADIAN AIR FORCE

~~SECRET~~

UNCLASSIFIED

Classification cancelled/changed to .....
by authority of .....
(date) .....
Signature .....
Rank .....

SPECIFICATION
for

DEVELOPMENT OF AN INTEGRATED

ELECTRONIC SYSTEM FOR THE CF105 AIRCRAFT

AIR 7-5

ISSUE	DATE	REMARKS
1	7 April 55	

This Specification is not valid for contract purposes unless it is read in conjunction with the Specifications referred to herein, and the cover page bears the signature of the authorized representative of the Chief of the Air Staff.

No of Pages in this Specification
One Cover Page and FIFTY-THREE SHEETS

ISSUED ON AUTHORITY OF THE CHIEF OF THE AIR STAFF

APPROVED

for AOC

Prepared By: Air Force Headquarters File Reference: S1038CF105-180

UNCLASSIFIED

SECRET

This Document is the Property of H.M. Canadian Government

This specification is intended for the use of the recipient and such persons as have need to use it in the course of their duty, and may only be used in connection with work performed for or on behalf of H.M. Canadian Government. The unauthorized retention or destruction of this document, or the disclosure of its contents to any unauthorized person is forbidden.

Attention is hereby called to the fact that failure to comply with any of the above instructions is an infraction of the Official Secrets Act.

Any unauthorized person obtaining possession of this Specification by finding or otherwise, should forward it, together with his name, and address, in a registered envelope to the Chief of the Air Staff, Air Force Headquarters, Ottawa, Canada.

Applicable Specifications, Publications and Drawings

The following specifications, publications and drawings of the issue in effect on the date of invitation to tender, shall form a part of this specification, and the requirements therein are to be complied with, except as otherwise stated herein.

Where there is a variation between this specification and the specifications, publications and drawings listed below, this specification shall govern.

SPECIFICATIONS

Military Specifications

MIL-E-5400	Electronic Equipment, Airborne, General Specification for
MIL-T-5422 (ASG)	Testing; Environmental, Aircraft Electronic Equipment
MIL-I-6181	Interference Limits and Tests; Aircraft Electrical and Electronic Equipment
MIL-E-7894	Electric Power, Aircraft Characteristic of
MIL-W-5088	Wiring, Aircraft, Installation of
MIL-E-5272	Environmental Testing, Aeronautical and Associated Equipment (General Specification for)
MIL-R-5582	Radar, X-Band, Airborne - Standard Beacon Provisions
MIL-I-5997	Instruments and Instrument Panels, Aircraft Installation of
MIL-E-7080	Electrical Equipment; Aircraft Installation of, General Specification
MIL-E-7614	Electrical Equipment, Alternating Current, Aircraft Installation of, General Specification
MIL-I-8700	Installation and Test of Electronic Equipment in Aircraft, General Specification for
MIL-I-6051	Interference Limits and Methods of Measurement, Electrical and Electronic Installations in Airborne Weapon Systems and Associated Equipment

Air Force Specifications

AIR SPEC 7-4 Issue 3	Prototype, Supersonic, Interceptor Aircraft Type CF105.
IMST 92-1	Development of Automatic Flight Control Sub-system for CF105 Aircraft.

Other Specifications

ES464-00-1 (Hughes Aircraft Company)	Preliminary Specification for the Integrated Electronic and Control System (MX1179)

TABLE OF CONTENTS

TABLE OF CONTENTS (Cont.)

1. DEFINITION

1.1 This specification states the requirements of the Department of National Defence, Royal Canadian Air Force, hereinafter called the Department, for the design and construction of a prototype Integrated Electronic System for the CF105 aircraft.

2. GENERAL

2.1.1 While this specification is intended to cover design and construction of the prototype systems only, the design shall be such that the system will be suitable for large scale production.

2.1.2 Common component units produced for the USAF to Hughes Aircraft Company Specification ES464-001 are to be used wherever possible. On these units acceptance by the USAF will generally be accepted by the department. New units designed to meet the requirements of this specification must be acceptable to both the USAF and the department.

2.1.3 The finished equipment in production shall meet all requirements, inspections and test procedures covered by this specification. No departure from this specification shall be permitted except as detailed in paras 2.1.5 and 5.2. The prototype equipment shall not be required to pass all tests. The pre-production equipment shall pass all tests of para 5.2.

2.1.4 The material entering into the construction of this equipment shall be of the best quality. All workmanship and shop practice shall be in accordance with accepted standards of modern engineering practice and RCAF instructions.

2.1.5 Construction including material and workmanship shall be free from any characteristics or defects, which may render the equipment unsuitable for the intended purpose.

2.1.6 Minimum size and weight, simplicity of operation and an improvement in the performance and reliability of the specific functions beyond the requirements of this specification are objectives in the design of the equipment herein. The use of materials, parts and processes other than those required by this and concomitant specifications shall be investigated and when it appears that a substantial reduction in size and weight or improvement in simplicity of design, performance, or reliability can be realized by their use. Approval of new materials, parts, and processes shall be subject to the components, of which the feature is a part, passing all required tests and being accepted by the USAF and the department.

2.1.7 The use of easily disconnected, plug-in assemblies of one or more related circuits shall be investigated with a view towards reduction of size and weight, simplification of operation and maintenance or improvement in performance.

2. GENERAL (Cont'd)

2.2 Functions

2.2.1 The system shall, when integrated with the aircraft, perform the following functions:

2.2.1.1 Intercept Functions

During the intercept phase of a mission, the integrated electronic system will provide for operation under the control of a GCI net. The system shall provide the capability for operation in two modes, close control and broadcast control, either of which can be performed automatically or manually.

2.2.1.2 Attack Functions

The system shall provide for the preparation and firing of three different types of missiles; the Falcon GAR-1A, Falcon GAR-1C, and the Sparrow II. Once the system has been locked on a target, it shall automatically track the target and control the interceptor on a correct attack course for firing the interceptor's armament. The system shall automatically fire the armament at the correct time. Steering signals shall be presented to the pilot so that he may monitor the system's operation during the attack or, if he desires, may steer the attack manually. A breakaway warning shall be provided.

2.2.1.3. Return-to-Base Functions

The system shall be able to return the interceptor to its base automatically, either by navigating to a destination selected by the crew or by following close control instructions received from a ground station. It shall also provide for return to base manually, the navigation being performed by use of any or all of TACAN (or Doppler Radar) Radar Beacon, Radar Ground Map, and Dead Reckoning. The system shall provide for automatic approach by means of AGCA tie-in to the flight control equipment in the aircraft.

3. TECHNICAL REQUIREMENTS

3.1 General Description

3.1.1 The following sub-systems and instrumentation shall comprise the Integrated Electronic System.

3. TECHNICAL REQUIREMENTS (Cont'd)

3.1. General Description (Cont'd)

3.1.1 (Cont'd)

(a) Weapons Sub-system
(b) Telecommunication Sub-system
(c) Flight Control Sub-system
(d) Computer Sub-system
(e) Flight Sensing Instrumentation
(f) Power Supply Sub-system
(g) Cockpit controls and Presentations

3.1.2 Parts and Materials

3.1.2.1 In the selection of parts and materials, fulfilment of major design objectives shall be the prime consideration. In so doing the following factors shall govern:

(a) Parts and Materials as approved by Specification MIL-E-5400 shall be given first consideration.

(b) When the contractors can demonstrate to the department that the use of standard AN or JAN parts or materials will not fulfill the design objectives because of size, weight, performance or other reasons, materials and parts shall be used which most nearly meet or exceed the requirements of the respective standard specification.

(c) When a non-standard part is used, the meeting of general material requirements such as non-inflammability, fungus resistance, nontoxicity, etc., and, the meeting of environmental conditions as required by Specification MIL-E-5400 or MIL-T-5422 (ASG) shall be of prime consideration.

3.1.3 Service Conditions - The equipment shall be designed to operate satisfactorily throughout the aircraft range of operations, as specified in RCAF Air Specification 7-4, and under the environmental conditions and aircraft configurations encountered in operational use of the aircraft.

3.1.4 Total Weight - The total weight of the Items listed in Appendix "A" which constitute a tentative list of equipment excluding cables and mounting bases shall not exceed 2,000 pounds.

3.1.5 Operational Stability - The equipment shall operate without failure for 24 hours, continuously or intermittently, without necessity for readjustment of any controls which are non-accessible during flight.

3. TECHNICAL REQUIREMENTS (Cont'd)

3.1 General Description (Cont'd)

3.1.6 Operating Life

3.1.6.1 The equipment shall have a reliable operating life of at least 200 hours without removal for bench servicing. Parts requiring servicing or replacement at the end of this interval to renew this service life should be specified by the manufacturer.

3.1.6.2 The equipment shall have a minimum total operating life of 2000 hours with reasonable servicing and replacement of parts. Parts requiring replacement within this interval and the life of such parts shall be specified by the manufacturer.

3.1.7 Interconnecting Cabling

3.1.7.1 The following requirements are applicable to all articles of equipment, except those such as dynamotors, inverters, indicating instruments (meters), and the like in which it is extremely unlikely that additional circuits will be required:

(a) Extra unused receptacle contacts for external circuits of the total calculated as specified herein, shall be available for future use by the Department and shall be located in not more than two of the external receptacles of the particular article of equipment.

(b) The minimum quantity of extra unused contacts shall be as follows: Approval of the procuring agency shall be obtained if this requirement necessitates an additional connector.

Total No. of Connector Pins in Major Assembly	Extra Contacts
Up to 25	2
26 to 100	4
101 and over	6

(c) Each unused contact of the quantity required, as specified herein, shall be of size (s) comparable with the used contacts of each connector.

3.1.8 Over and Underload Protection

3.1.8.1 Overload protection for the equipment shall be provided in the equipment. All parts and circuits of the equipment which are likely to carry an overload due to any failure or poor adjust-

3. TECHNICAL REQUIREMENTS (Cont'd)

3.1 General Description (Cont'd)

3.1.8 Over and Underload Protection

3.1.8.1 (Cont'd)

ments shall have suitable protective devices or shall be proportioned to withstand such overload without permanent damage to the equipment. The use of fuses and other protective devices shall be held to a minimum.

3.1.8.2 The equipment shall not be damaged by voltages below that used in normal operation and shall automatically resume normal operation when the voltage returns within limits.

3.1.9 Interchangeability - The prototype shall be so designed that interchangeability of components and of systems in production equipment will be in accordance with Specification MIL-E-5400.

3.1.10 Radio Interference - The generation of radio interferences by the equipment and the vulnerability of the equipment to radio interference shall be controlled within the limits of Specification MIL-I-6181.

3.1.11 Explosion Proofing - The equipment shall be explosion proof to the fullest extent of the present art. In general, this requirement will be satisfied when components such as relays, switches, motors with commutators, etc., which in normal operation produce or are likely to produce sparking or arcing, and which are not contained within "pressurized containers", are made explosion proof.

3.1.12 Control and Adjustments - All panel mounted controls and internal adjustments shall be mechanically stable under any of the service conditions specified in Specification MIL-E-5400. Controls operable by means of a screwdriver shall be fitted with locking devices which must be released before an adjustment is made. All internal adjustments, wherever practicable, shall be readily accessible when the unit chassis are removed from their respective cases. It shall not be possible for the operator to compromise the setting of the internal adjustments by manipulation of any of the controls available to him in flight.

3.2 Weapons Sub-System

3.2.1 General

3.2.1.1 The weapons sub-system shall operate as a component of the integrated electronic system of the CF105. It shall supply, as required, information to other sub-systems so that the operational performance of the total system is maximized.

3.2.1.2 The Radar Sub-System shall be designed to provide searching and tracking operations from interceptor altitudes within the flight envelope of the CF105. The system shall contain a tunable magnetron which shall permit manual or automatic control of tuning by the NAV/AI to change the frequency of the radiated energy. Provision shall be made for operation with air-to-air I.F.F. equipment. Provision shall be made for the weapons sub-system to supply appropriate signals:-

(a) to the computer sub-system for:

(1) use in steering the interceptor

(2) computation of positioning for weapons launch

(3) generation of pre-launch information for the missile auxiliaries;

(b) to the weapons for use as firing information, and in the early guidance phase.

3.2.2 Modes of Operation

Search information, which permits the NAV/AI to direct the pilot into attack position, and to secure radar lock-on, shall be presented on a 5-inch "B" type or PPI type cathode ray tube display in front of the NAV/AI. (Preference shall be given to a "B" type display.) During all search modes, an aircraft flight attitude indication shall be presented on a cathode ray tube display in front of thepilot.

3.2.2.1 Search

3.2.2.1.1 Automatic - A scan pattern, stabilized in pitch and roll with respect to the earth shall provide continual surveillance of a volume of space ahead of the interceptor. A major design goal shall be the possibility of utilizing such information as if available to the interceptor (either internally or via the data

3.2 Weapons Sub-System (Cont'd)

3.2.2 Modes of Operations (Cont'd)

3.2.2.1.1 Automatic (Cont'd)

link) for the purpose of selecting the position of the central axis and the angular coverage of the scan, the scan rate, the scan pattern and any other radar parameters, so that the coverage selected will result in maximum AI detection range. At any time, however, the choice of the volume searched shall be under the control of the NAV/AI if he so desires.

3.2.2.1.2 Manual - A hand control shall provide control of the direction of the antenna axis, so as to permit the operator to search discrete conical volumes ahead of the interceptor and to initiate radar lock-on.

3.2.2.2 Ground-Mapping - Long range ground mapping shall be provided with a single-bar scan. Ground mapping information shall be presented on a cathode ray tube display in front of the NAV/AI. Control of the direction of the antenna axis with the hand control; an expanded sweep (variable in range) shall be provided.

3.2.2.3 Beacon - Interrogation of surface or airborne X-band navigation beacons shall be in accordance with the requirements of MIL-R-5582. Beacon replies shall be presented on the cathode ray tube display in front of the NAV/AI. Control of the direction of the antenna axis with the Hand Control; an expanded sweep (variable in range) shall be provided to facilitate identification.

3.2.2.4 Attack - The sub-system shall, in co-operation with other sub-systems, automatically direct the interceptor along a lead collision or pursuit course to the selected target, and shall give a signal for automatic firing of the armament at such time as to give a maximum probability of kill. Notwithstanding the above automatic mode of operation, the sub-system shall provide information to enable the pilot, if he so desires, to direct the interceptor manually along a lead collision or pursuit course to the selected target, and shall give a signal for automatic or manual firing of the armament at such time as to give a maximum probability of kill.

3.2.2.5 AMTI - A low altitude search capability shall be provided. This shall be achieved by the inclusion of an AMTI search mode, the presentation to be made on the cathode ray tube display in front of the NAV/AI.

3.2 Weapons Sub-System (Cont'd)

3.2.2 Modes of Operation (Cont'd)

3.2.2.6 IFF - Interrogation of airborne X-band transponders shall be provided at the direction of the NAV/AI or pilot. Transponder replies shall be displayed on the NAV/AI's presentation, and on the pilot's presentation at the latter's discretion during the latter phases of an attack. A response from a friendly aircraft shall not automatically abort an attack. Results of pilot interrogation shall not appear on NAV/AI's presentation.

3.2.2.7 Optical - The sub-system shall include an optical sighting device to permit firing of weapons in the event of enemy counter-measures, ground clutter, or equipment malfunctions, so asto give a maximum probability of kill.

3.2.2.8 Steering Signal Recorder - The sub-system shall include a steering signal recorder to permit evaluation of the performance and operation of the system subsequent to flight.

3.2.3 Weapon Installation

3.2.3.1 Provision shall be made for a complement of either

(a) 8 Falcon GAR-1A missiles

(b) 8 Falcon GAR-1C missiles

(c) 4 Falcon GAR-1A and 4 Falcon GAR-1C missiles

(d) 4 Sparrow II missiles.

The missiles will be carried internally in a package which is removable from the armament bay.

(a) When inserted into the armament bay, the armament package will form a portion of the aircraft fuselage. The bay doors will be closed except for the short intervals during which the missile launchers are being extended or retracted:

(b) Launcher mechanism(s) with launcher rails and umbilical plug will extend the missiles in proper relationship to each other and the aircraft for proper separation and guidance. The umbilical plug must be designed for release by missile motion. Provision will be made to jettison the missiles without igniting their motors, by means of an electrical connection(s) between the

3.2 Weapons Sub-System (Cont'd)

3.2.3 Weapon Installation (Cont'd)

3.2.3.1 (Cont'd)

cock-pit and release mechanism. Missiles must be secured against release effected by landing loads;

(c) An intervalometer(s) when supplied the appropriate signal from the missle auxiliaries shall provide signals for the initiation of missile launcher extension and for theproper missile firing sequence.

(d) A program unit in conjunction with a hydraulic jack and servo valve will extend and retract the missile launchers and armament bay doors within the required time interval and at a predetermined rate.

3.2.3.2 Missile Auxiliaries: The missile auxiliaries will be housed in the electronics compartment. The working faces of all auxiliaries shall be available for trouble shooting through an access door. The missile auxiliaries shall accept signals generated in the computer sub-system and provide launching and firing signals in the proper time sequence in order that the missile may lock on the target signal return. The operations to be performed by themissile auxiliaries are as follows:

(a) Apply external power to critical circuits within the missile during the prelaunch period,

(b) Transfer to missile internal power,

(c) Servo the missile antenna into alignment with the tracking radar line of sight,

(d) Servo the radar transmitter and missile receiver to the same frequency.

(e) Servo the missile range gate into time coincidence with the radar range gate,

(f) Generate precise radar transmitter repetition rate,

(g) Relay the missile guidance and control parameters computed in accordance with aerodynamic conditions, and the missile propellant temperature,

(h) Blow the missile attenuator fuzes to set the computer parameters into the missiles,

3.2 Weapons Sub-System (Cont'd)

3.2.3 Weapon Installation (Cont'd)

3.2.3.2 (Cont'd)

(i) Provide for jettisoning.

★ For Falcon missiles as applicable.

3.2.4 Functions

3.2.4.1 Warm-up Period - The warm-up period shall be not more than 4.5 minutes after the application of primary power.

3.2.4.2 Output Power - The peak out put power measured at the output of the Receiver-Transmitter when terminated in a load whose voltage standing wave ratio is not greater than 1.05 shall be not less than 1.0 db below the minimum specified peak power output of the magnetron.

3.2.4.3 Transmitted Frequency -The system shall operate while the frequency of the transmitted signal is fixed between or varying from 8500 to 9400 megacycles per second. The operation frequencies for the various modes of system operation shall be as shown in Table 1 of this specification.

TABLE I

	SEARCH	TRACK	GROUND MAP	BEACON	AMTI
Frequencies (Megacycles)	8500 to 9030	8500 to 9030	8500 to 9030	Transmit 9375 Receive 9310	8500 to 9030
Pulse Length (Microseconds)	2.35 ★	0.5 ★	2.35 ★	2.35 ★	0.25
Pulse Rep. Rate, cps	415	1000	330	330	4000

★ Pulse length shall be measured between the 90 percent amplitude points for the long pulse, and between the 50 percent amplitude points for the short pulse.

3.2 Weapons Sub-System (Cont'd)

3.2.4 Functions (Cont'd)

3.2.4.4 Pulse Repetition Rate - The rate of the transmitted pulses shall be shown in Table I of this specification.

3.2.4.5 Pulse Length - The lenght of the transmitted pulse shall be as shown in Table I of the specification.

3.2.4.6 Receiver Sensitivity - The over-all receiver sensitivity shall be minus 97 dbm or greater.

3.2.4.7 Antenna Gain - The power gain of the antenna system shall be at least 35 decibels above that of an isotropic radiator.

3.2.4.8 Radiation Pattern - The antenna system shall produce a radiation pattern whose major lobe has a nominal width between the half-power points of 2.5 degrees. Minor lobes outside the swept volume of the main beam should be at least 20 decibels below the major lobe, measured on a one-way transmission basis.

3.2.4.9 Pressurization - The pressurized components of the system shall be supplied sufficient air to maintain a pressure sufficient to ensure system operation under all flight conditions.

3.2.4.10 Receiver Noise Figure - The receiver shall have a maximum overall noise figure not greater than 12 db.

3.2.5 Automatic Search Requirements The radar subsystem shall be capable of detecting a 5 square meter target, with an 80% probability at ranges up to 25 nautical miles. This requirement shall apply using a radome whose transmission loss on a one-way basis does not exceed 10%.

3.2.5.1 Radiation Coverage of Scan Pattern - The antenna shall automatically scan a pattern such that the radiation coverage shall be sufficient to illuminate the area in which the target is expected to lie, as observed and predicated by the GCI net. The time required to complete the scan cycle shall be a function of range to the target. The scan period and radiation coverage developed shall be submitted to the Department for approval.

3.2.5.2 Space Stabilization - Without elevation translation of the scan pattern, automatic search and manual search operation of the antenna shall incorporate space stabilization for at least plus and minus 70 degrees in pitch, and ± 90 degrees in roll.

3.2.5.3 Search Ranges - Nominal automatic search ranges shall be 5 nautical miles, 20 nautical miles or 60 nautical miles, as selected by the NAV/AI.

3.2 Weapons Sub-System (Cont'd)

3.2.5 Automatic Search Requirements (Cont'd)

3.2.5.4 Attack Presentation - There shall be no attack scape presentation during this mode.

3.2.5.5 NAV/AI's Presentation - The NAV/AI's Indicator presentation shall consist of the following:

(a) A range versus azimuth display. The instaneous position of the antenna, including the conical scanning device, shall be indicated.

(b) An elevation display. A marker corresponding to the antenna elevation position shall traverse the elevation scale at the right side of the display.

3.2.5.6 Suitable indications shall at all times be provided the NAV/AI to indicate the antenna position in elevation with respect to aircraft longitudinal axis, the range closure rate when tracking, and a range indication at short ranges.

3.2.6 Manual Search Requirements

3.2.6.1 Antenna Positioning - Operation of the hand control shall permit pointing of the antenna along any direction within a cone of 140 degrees included angle.

3.2.6.2 Space Stabilization - Space stabilization of the antenna shall be as described in paragraph 3.2.5.2 of this specification, for automatic search operation.

3.2.6.3 Search Ranges - Nominal manual search ranges shall be as described in pragraph 3.2.5.3 of this specification, for automatic search operation.

3.2.6.4 Attack Presentation - There shall be no attack scope presentation during this mode.

3.2.6.5 NAV/AI's Presentation - The NAV/AI's presentation shall be as described in paragraph 3.2.5.5 of this specification, for automatic search operation. The range tracking gate shall be indicated by a side deflection of the normal range trace at the proper range.

3.2.6.6 Range Gate - Fast and slow "range-in and range-out" gate sweeping shall be provided for at the discretion of the NAV/AI.

3.2.7 Track Requirements

3.2 Weapons Sub-System

3.2.7 Track Requirements

3.2.7.1 Angular Tracking Limits - The antenna shall track within a cone of 140 degrees included angle, centered about the longitudinal axis of the aircraft.

3.2.7.2 Angular Tracking Rate Limits - The system shall maintain lock-on at angular tracking velocities up to 30 degrees per second.

3.2.7.3 Lock-on Sensitivity - The minimum signal required to maintain lock-on shall be 92 decibels below one milliwatt. The system shall be capable of tracking any non-scintillating signal not less than minus 92 dbm which may be detected in automatic search within the tracking range limits.

3.2.7.4 Angular Tracking Accuracy - For a non-scintillating target, the accuracy of bearing data supplied to the Computer Sub-System, not including radome errors and errors introduced by improper bore-sighting, shall be as follows:

3.2.7.4.1 For a fixed target, the error shall not exceed plus or minus 2 milliradians;

3.2.7.4.2 For target motion which produces a constant angular velocity not greater than 15 degrees per second, the error shall not exceed 5 milliradians;

3.2.7.4.3 For target motion which produces a constant angular acceleration not greater than 10 degrees per second per second existing for not more than 2 seconds, the error shall not exceed 8 milliradians.

3.2.7.5 Space Stabilization Accuracy - As the interceptor moves so as to produce angular tracking velocities not greater than 30 degrees per second, or angular tracking accelerations not greater than 10 degrees per second per second existing for not more than 2 seconds, the error introduced in angular tracking data shall not exceed 6 milliradians.

3.2.7.6 Tracking Range Limits - The minimum tracking range shall be no greater than 150 yards. The maximum tracking range shall be not less than 50,000 yards.

3.2.7.7 Range Rate Limits - Lock-on to a signal shall be maintained as the range of the tracked signal varies between a closing rate of 2000 knots and an opening rate of 500 knots.

3.2.7.8 Range Voltage Accuracy - The accuracy of the range voltage shall be within plus or minus the quantity, 20 yards plus one percent of the indicated range up to 20,000 yards, or, 20 yards plus two percent

3.2 Weapons Sub-System (Cont'd)

3.2.7 Track Requirements (Cont'd)

3.2.7.8 (Cont'd)

of the indicated range beyond 20,000 yards.

3.2.7.9 ECM Tracking - Lock-on and angular tracking of active jamming sources and the subsequent generation of azimuth and vertical steering signals shall be provided.

3.2.7.10 Target Tracking - "Leading or trailing edge" tracking shall be available at the option of the NAV/AI.

3.2.7.11 Attack Presentation - The following displays shall appear on the attack indicator:

(a) An error indication, the position of whichshall indicate steering correction in elevation and azimuth.

(b) The interceptors attitude in the rolling plane.

(c) A time-to-go indication, which shall indicate the time remaining until the missile will hit the target.

(d) A closure rate indication, which shall indicate the rate of change of range as the attack progresses.

(e) A launch range limits indication, which shall indicate the range limits within which the missile may be fired.

3.2.7.11.1 A warning display shall appear at the center of the tube face when breakaway can be initiated without prejudicing the attack.

3.2.7.12 NAV/AI's Presentation - NAV/AI's presentation shall be as described in paragraph 3.2.5.5 of this specification, for manual search operation.

3.2.8 Beacon Requirements.

3.2.8.1 Antenna Scan Pattern - The antenna shall scan in azimuth in a single pattern. Azimuth coverage and elevation position shall be adjustable over the same limits as for Automatic Search. Normal elevation position shall be zero degrees.

3.2.8.2 Search Range - The nominal Beacon Search range shall be 200 nautical miles.

3.2.8.3 Manual Search - The antenna shall respond to the hand control as for the Manual Search mode.

3.2 Weapons Sub-System (Cont'd)

3.2.8 Beacon Requirements (Cont'd)

3.2.8.4 Attack Presentation - There shall be no attack scope presentation during this mode.

3.2.8.5 NAV/AI's Presentation - The NAV/AI's presentation shall be as described in paragraph 3.2.5.5 of this specification, for automatic search operation. For beacon identification, it shall be possible for the operator to expand any portion of the indication over a distance of 20 ± 4 miles. The beginning of the portion of the trace to be expanded shall be indicated by a marker on the trace.

3.2.9 Ground Mapping Requirements

3.2.9.1 Antenna Scan Pattern - The antenna shall operate as for beacon operation except that the normal elevation position shall be depressed to ensure adequate ground returns.

3.2.9.2 Search Range - The nominal Ground-Map Search range shall be up to 200 nautical miles.

3.2.9.3 Attack Presentation - There shall be no attack scope presentation during this mode.

3.2.9.4 NAV/AI's Presentation - The NAV/AI's presentation shall be as described in paragraph 3.2.5.5 of this specification for beacon operation.

3. TECHNICAL REQUIREMENTS (Cont'd)

3.3 Telecommunications Sub-system

3.3.1 General

The telecommunications sub-system shall provide integrated and associated radio facilities for:

(a) UHF voice communications.

(b) reception of target and control data from GCI facilities.

(c) derivation of interceptor position data from ground navigational aids.

(d) homing on UHF and radar transmitter.

(e) automatic approach and landing at bases equipped with AGCA.

(f) intercommunication and monitoring of radio facilities by aircrew.

(g) air-to-ground and air-to-air identification.

3.3.2 Control Methods

3.3.2.1 Interception control and return to base is to be maintained by (a) broadcast control or (b) close control or (c) a combination of both modes.

3.3.2.2 Broadcast control. In this mode, target information is to be passed to the interceptor.

(a) Via data links: Target position altitude, and ground velocity are passed by the G.C.I. station via data link to the interceptor's computer sub-system to be processed for automatic interception. Provision is also to be made for these factors to be displayed visually in the NAV/AI's position. In the event of computer failure, the last information displayed will be retained in order to aid the crew insolving the interception problem manually.

(b) By voice: This method of broadcast control is required when the data link is inoperative. Target position, altitude and ground velocity are passed by the GCI net by voice to the interceptor crew. The crew feeds the information to the computer for automatic interception or uses the intelligence to solve the interception problem manually, in the event of computer unserviceability.

3. TECHNICAL REQUIREMENTS (Cont'd)

3.3 Telecommunications Sub-system (Cont'd)

3.3.2 Control Methods

3.3.2.3 Close Control. In this mode, flight control instructions (heading, altitude and speed) are passed to the interceptor

(a) Via data links: Flight control instructions computed by the GCI net are passed via data link to the interceptors flight control sub-system through the computer sub-system. In the event of computer failure, these instructions shall be passed directly to the flight control sub-system. Provision is to be made for the required heading, altitude and speed to be displayed to the crew so that in the event of failure of the automatic flight control system, the crew may fly the aircraft manually to the acquisition point or to base.

(b) By voice: Flight control instructions computed by the GCI net are passed by voice to the interceptor crew. The crew feeds this information to the flight control sub-system either directly or through the computer for automatic flight to the point of acquisition or to base. In the event of computer failure, the crew flies the aircraft manually in accordance with the received instructions.

3.3.2.4 Return to Base. The system is to provide the interceptor with the capability of acting under close control (either via data link or voice) for return-to-base. Alternatively the crew is to insert the base location into the computor sub-system for independent automatic return-to-base. Return to base by means independent of the computor shall be provided. The approach and flare-out shall be accomplished under close control either via data link or voice.

3.3.3 Voice Communications

3.3.3.1 Voice communications for ground-air-ground and air-to-air is to be provided in the UHF region (225-400) megacycles by the ARC34. In the integrated system wiring cognizance must be taken of the growth potential in that a UHF equipment of similar form factors but of differing intercomponent wiring may be fitted e.g. AN/ARC52.

3. TECHNICAL REQUIREMENTS (Cont'd)

3.3 Telecommunications Sub-system (Cont'd)

3.3.3 Voice Communications (Cont'd)

3.3.3.1.1 Provision is to be made for automatic selection and transmission of the distress frequency upon pilot ejection.

3.3.3.1.2 The equipment is to be provided with emergency power in the event of failure of power supply sub-system and the aircraft electrical systems.

3.3.3.1.3 Every precaution is to be taken to prevent interaction between the UHF voice and the UHF data equipment, of the integrated system. Such precautions shall not affect the characteristic of received or transmitted information nor degrade the performance of the equipment.

3.3.3.2 Voice Intercommunication - Intercommunication between crew members shall be accomplished by use of the AN/AICIO.

3.3.3.2.1 Provision is to be made for:-

(a) "Hot Mic" operation.

(b) Pilot and NAV/AI to monitor radio facilities.

(c) Pilot and NAV/AI to transmit on UHF.

(d) Pilot and NAV/AI to hear sidetone on UHF transmission.

3.3.3.2.2 The equipment shall be provided with emergency power in event of failure in the power supply sub-system and the main aircraft electrical system.

3.3.4 Data Link Communications

3.3.4.1 GCI an AGCA ground derived data regarding interceptor and/or target shall be transmitted encoded via a UHF data link. The airborne terminal shall be the AN/ARR44 which is to provide close and broadcast (data link or voice) control together with AGCA on twenty preset channels in the UHF band of 225 to 400 megacycles.

3.3.4.2 Digital information from the ARR44 shall be fed to the computer sub-system. In the computer it is to be processed to provide display and automatic flight control functions.

UNCLASSIFIED

3. TECHNICAL REQUIREMENTS (Cont'd)

3.3 Telecommunications Sub-system (Cont'd)

3.3.4 Data Link Communications (Cont'd)

3.3.4.3 Under close control via data link it must be possible to transfer analog information from the data link convertor directly to the automatic flight control sub-system in the event of computer failure.

3.3.4.4 Under either broadcast or close control via data link, it must be possible to display data visually. In the event of computer failure, the crew will solve the interception problem. The pilot shall be able to fly manually in accordance with close control instructions or in accordance with manual computations provided by the the NAV/AI.

3.3.4.5 Reference para 3.3.3.1.3 Interference with UHF voice equipment.

3.3.5 Identification

3.3.5.1 Air-to-ground identification is to be accomplished by the AN/APX25 transponder.

3.3.5.2 The APX25 shall be provided with emergency power in the event of failure in the power supply sub-system and the main aircraft electrical system.

3.3.5.3 Provision shall be made in the APX25 integration for automatic selection of the emergency mode upon ejection.

3.3.5.4 Provision shall be made in APX25 integration for identification of position facility.

3.3.5.5 Although no requirement exists at present for an air-to-ground data link system, engineering should take cognizance of the fact that the APX25 may be required, at some future date, to transmit limited data.

3.3.5.6 Interference with ARN21. Refer. Para 3.3.6.1.4

3.3.5.7 Air-to-air identification shall be provided by a system which employs techniques similar to those used in the APX26 - APX27 interrogator - responsor equipment. APX26 - APX27 may or may not be used, but the design of the subsystem shall be such that it will not preclude integration of the APX26 - APX27 or a similar system at a later date.

3. TECHNICAL REQUIREMENTS (Cont'd)

3.3 Telecommunications Sub-system (Cont'd)

3.3.6 Navigation and Landing

3.3.6.1 The primary navigation equipment shall be the airborne portion of the TACAN system, AN/ARN21, or Doppler as an alternative.

3.3.6.1.1 The output of the ARN21 shall be fed to the computer subsystem.

3.3.6.1.2 Display of ARN21 information will depend upon the type of integrated display accepted. If the integrated display does not include the necessary information, a cross pointer type meter shall be required for landing approach using the ARN21.

3.3.6.1.3 Provision for the fitment of Doppler equipment as an alternative to TACAN (ARN21) shall be made by the aircraft manufacturer. This equipment must also be taken into account in the design of the Integrated Electronic System in that Doppler output must be fed into the computer sub-system for processing.

3.3.6.1.4 Precautions shall be taken to minimize interference between ARN21 and air-to-ground IFF equipment. Such precautions however, must not alter in anyway, the operational characteristics of either equipment.

3.3.6.2 Secondary navigation equipment shall be the AN/ARN6 (or equivalent) LF/MF ADF and AN/ARA25 UHF ADF.

3.3.6.2.1 LF/MF ADF equipment installation will be designed by the aircraft manufacturer. The output shall not be fed to the computer sub-system.

3.3.6.2.1.1 LF/MF ADF display may be shared with ARA25 and ARN21 equipment.

3.3.6.2.2 ARA25 shall perform the dual function of a navigation aid and ECM UHF homer.

3.3.6.2.2.1 The ARA25 functions as an ancillary to the UHF transceiver.

3.3.6.2.2.2 ARA25 shall be part of the integrated electronic system. The output shall be fed only to a display instrument.

3.3.6.3 Automatic Ground Control Approach

3.3.6.3.1 The AGCA facility shall be an integral function of the data link equipment.

3.3.6.3.2 The AGCA data shall be displayed on a cross pointer monitor indicator.

3. TECHNICAL REQUIREMENTS (Cont'd)

3.3 Telecommunications Sub-system (Cont'd)

3.3.6 Navigation and Landing (Cont'd)

3.3.6.4 Landing

3.3.6.4.1 The AN/APN71 or equivalent flare-out altimeter shall provide vertical steering information to the computer sub-system for final phase of interceptor descent.

3.3.6.4.2 The APN71 information shall be displayed on the AOCA cross pointer monitor indicator.

3.3.7 Electronic Countermeasures

3.3.7.1 Passive electronic countermeasure against communications and radar jamming shall be provided.

3.3.7.1.1 The ARA25 shall be used for homing on enemy transmissions disrupting UHF communication.

3.3.7.1.1.1 ARA25 display may be shared with ARN6 and ARN21 indicator of para 3.3.6.2.1.1 Selection is to be made by Pilot.

3.3.7.1.2 A radar homer shall be used for homing on enemy radar transmissions including jammers, and navigation and blind bombing radars in the L and S bands.

3.3.7.1.2.1 The radar homer installation will be designed by aircraft manufacturer. The output shall be fed only to a display instrument for the NAV/AI.

3. TECHNICAL REQUIREMENTS (Cont'd)

3.4 Flight Control Syb-system

3.4.1 General

3.4.1.1 The flight control sub-system shall comprise the electronic circuitry necessary to deliver outputs to the damping system so as to automatically adjust the flight path vector and the orientation of the aircraft.

3.4.1.2 The automatic flight control system is specified in RCAF specification INST. 92-1.

3.4.1.3 It shall be integrated with the damping system, which is defined in Spec. Avrocan E-276. The damping system will provide both the command and damping servos, servo amplifiers, manual control stick force pick off, rate sensors and the circuitry required to perform the automatic stabilization of the aircraft and to co-ordinate turns.

3.2.1.4 The flight control sub-system shall in conjunction with other sub-systems enable the interceptor to perform the following functions:

(a) Automatic attack
(b) Automatic navigation and cruise control
(c) Automatic landing approach and flare out
(d) Pilot assist functions consisting of:

(i) Pitch angle hold
(ii) Heading hold
(iii) Heading selection
(iv) Altitude hold
(v) Altitude selection
(vi) Mach control

3.4.2 Sub-system Inputs

3.4.2.1 To provide the above facility, the flight control sub-system shall accept command signals from the other sub-systems. These are to be selected by the crew in accordance with the function to be performed and are specified below.

3.4.2.2 Automatic Attack:

It shall receive steering command and throttle control signals from the computer sub-system to enable the aircraft to fly a correct firing course during the attack and for automatic breakway.

3. TECHNICAL REQUIREMENTS (Cont'd)

3.4 Flight Control Sub-system (Cont'd)

3.4.2 Sub-system Inputs (Cont'd)

3.4.2.3 Automatic Navigation and Cruise Control

For close control it shall accept steering command signals from the data link receiver via the computer, or directly by means of a coupler, and throttle control signals from the computer. For broadcast control it shall accept steering command and throttle control signals from the computer.

3.4.2.4 Automatic Landing Approach and Flare-out

An AGCA ground installation shall provide the steering and descent for the approach through the data link receiver in the aircraft. Terrain clearance signals, and rate of descent for flare-out shall be provided by the absolute radio altimeter. Throttle control signals shall be provided by the computer.

3.4.2.5 Pilot assist

The pilot's cockpit controls shall enable him to select the required modes of operation and to provide the command signals necessary to perform the assist functions listed in 3.4.1.3 (d).

3.4.2.6 Other Inputs

Certain inputs are necessary during theperformance of all the functions listed in para 3.4.1.3 These shall be provided as follows:

(a) The flight sensing instrumentation shall provide the information outlined in para 3.6. as required for the various modes of operation.

(b) Computation of parameters for compensation as a function of flight conditions shall be done either in the computer sub-system or independently as determined by the requirements of this specification.

(c) The damping system shall provide roll, pitch and yaw rates as required.

3.4.3 Sub-system Outputs

The sub-system outputs shall enable the aircraft to perform the automatic flight and pilot assist functions outlined in 3.4.1.3. In particular, it shall provide:

(a) Command signals to the aircraft's command servos for flight path control

3. TECHNICAL REQUIREMENTS (Cont'd)

3.4 Flight Control Sub-system (Cont'd)

3.4.3 Sub-system Outputs (Cont'd)

(b) Command signals to the throttle control servo for speed control.
(c) Steering signals to the pilot's indicator display for manual steering and for monitoring during automatic control.

3.5 Computer Sub-system

3.5.1 General - In order to provide flexibility, conserve weight and space the computational facilities shall be centralized.

3.5.1.1 The computer shall be a general purpose digital computer capable of performing the computations required for:

(a) Navigation and cruise control.
(b) Target data
(c) Air data
(d) Fire control

3.5.1.2 Consideration should, at all times, be given to ensuring basic design flexibility to accommodate post production growth.

3.5.2 Technical Requirements

3.5.2.1 The computer sub-system shall accept inputs from the following sources:

(a) Weapons sub-system
(b) Telecommunication sub-system
(c) Flight control sub-system
(d) Flight sensing instrumentation
(e) Crew Control panels

3.5.2.2 It shall be capable of performing the general computations listed in para 3.5.1 and outlined in paragraphs below.

3.5.2.3 Navigation and Cruise Control

3.5.2.3.1 General

3.5.2.3.1.1 The navigation facilities shall be capable of functioning in all phases of operation of the aircraft, including the interception, the attack, and the recovery or return-to-base. It shall be capable at all times of indicating the actual geographical position of the aircraft. This information shall be provided

3. TECHNICAL REQUIREMENTS (Cont'd)

3.5 Computer Sub-system (Cont'd)

3.5.2.3.1.1 (Cont'd)

either by TACAN or Doppler radar, or, if neither of these aids are available, from the dead-reckoning capability of the computer.

3.5.2.3.1.2 The computer shall be capable of processing information supplied under both close control and broadcast control operations.

3.5.2.3.2 Close Control

3.5.2.3.2.1 Automatic - The computer shall accept appropriate flight control instructions from the data link. It shall process this information, and transmit aircraft steering signals to the automatic flight control sub-system. It shall also receive and store distance-to-go to an offset point, target altitude and required attack heading to fly from the offset point. With this information the aircraft can be controlled from the ground and automatically fly required heading, heights and speeds to intercept and attack the enemy. If GCI contact should be lost at any time, the computer shall process the information already stored to compute, and present steering information to reach the offset point, and automatically turn the aircraft onto the attack heading. This information will be used either for manual flying or for transmission to the automatic flight control sub-system.

3.5.2.3.2.2 Voice - If for any reason data link information should not be available to the aircraft, it shall be possible, when receiving steering information of required heading, altitude, speed and distance to fly, by voice from the G.C.I station, to insert this information manually into the computer, and to carry out the operation as described in paragraph 3.5.2.3.2.1 above.

3.5.2.3.3 Broadcast Control

3.5.2.3.3.1 Automatic - Under broadcast control mode of operation the computer shall receive by data link, the target position, altitude and ground velocity. By processing this information with the interceptors position supplied by the computer, it shall provide the steering information required for interception and attack and to complete the operation as outlined in paragraph 3.5.2.3.2.1.

3.5.2.3.3.2 Voice - Under broadcast control operations when no data link is available the crew shall be able to insert manually the information noted in paragraph 3.5.2.3.3.1 and carry out the attack either manually or automatically, as noted above.

3. TECHNICAL REQUIREMENTS (Cont'd)

3.5 Computer Sub-system (Cont'd)

3.5.2.3.4 Return-to-Base

3.5.2.3.4.1 Close Control - After the attack phase has been completed the interceptor shall be directed back to base under control of GCI net either by data-link or voice. An indication to enable the pilot to monitor and/or manually set in the appropriate information shall be provided.

3.5.2.3.4.2 Manually - In the event that GCI contact is lost, it shall be possible to obtain the same information from the dead-reckoning capabilities of the computer. It shall be possible for the crew to select a base to which to return. By inserting the position of the base, the computer by its dead reckoning capability shall provide the distance and heading to base.

3.5.2.3.5 Position Determination

3.5.2.3.5.1 Dead-Reckoning - Under broadcast control conditions when the aircraft receives no indication of its own geographical position from a GCI station, the computer shall at all times be capable of presenting position, from its own dead-reckoning capabilities. This will require inputs of wind velocity, true-heading and true airspeed.

3.5.2.3.5.2 Doppler - Although input of wind velocity shall be possible by manual means, the computer shall also be capable of accepting information from Doppler radar equipment, and processing it to provide the required information to monitor and correct dead reckoning facility of the compter.

3.5.2.3.5.3 Manual Correction - It shall be possible for the operator to manually correct the position indicated by the computer if he at any time has access to more correct information. By merely correcting the position, the latest wind velocity being used by the computer also shall be corrected automatically.

3.5.2.3.5.4 TACAN - If TACAN facilities are available to the aircraft it shall be possible to record the different TACAN stations on data storage devices. By selecting a TACAN station, the bearing and distance shall be indicated to the operator. The computer shall be capable of accepting the TACAN information and automatically correcting the position it is indicating. By doing so the wind information being used by the computer shall also be corrected automatically for use in the future dead-reckoning operations.

3. TECHNICAL REQUIREMENTS (Cont'd)

3.5 Computer Sub-system (Cont'd)

3.5.2.3.5.5 Computation of Best Speed and Altitude The computer shall accept input data (see para. 3.5.2.1 (b) (c) (d) (e)) and compute the control signals necessary to schedule speed and altitude during climb cruise and descent in order to obtain optimum performance. Optimum performance schedules shall be specified with respect to

(a) Minimum time to reach destination
(b) Maximum range from fuel remaining
(c) Maximum endurance from fuel remaining

Provision for selection of scheduling by the crew shall be provided.

3.5.2.4 Target Data

The computer shall perform the calculations required to convert GCI target position data into aircraft relative coordinates, for the purpose of placing a target marker on the radar operator's scope and to position the central axis of the antenna scan. Target data shall be supplied automatically via the data link or manually by the NAV/AI in the case of broadcast voice control.

3.5.2.5 Air Data

The computer shall accept inputs from the flight sensing instrumentation and compute the parameters required by the sub-systems in the performance of their functions as detailed in this specification.

3.5.2.6 Fire Control

3.5.2.6.1 Antenna - Aided Tracking

The computer shall provide the appropriate information to the antenna drive circuits to aid in target tracking during the attack phase.

3.5.2.6.2 Interceptor Steering

The steering signals required by the flight control sub-system during automatic attack shall be processed by the computer.

3.5.2.6.3 Armament Ballistics

The computer shall perform the necessary ballistics computations for the missiles and attack modes outlined in this specification. (See paras. 3.2)

3. TECHNICAL REQUIREMENTS (Cont'd)

3.5 Computer Sub-system (Cont'd)

3.5.2.6 Fire Control (Cont'd)

3.5.2.6.4 Preparation of Missiles

The computer shall automatically provide the required signals to the missile auxiliaries in proper time sequences and firing signals, at times which maximize the probability of kill.

3.5.2.6.6 Snap-up Attack

The computer shall perform the computations necessary to provide an automatic "snap-up" attack facility.

3.5.2.6.7 Optical Attack Mode

An optical attack mode shall be provided as described in para. 3.2. Any computations necessary to provide this mode shall be made by the computer.

3.5.3 Design Characteristics

3.5.3.1 The computer shall be a general purpose machine using magnetic drum memory, delay line arithmetic registers, electron tube flip-flops, and crystal diode gating. The use of transistors and magnetic elements where applicable is not precluded. System variables shall be represented in serial binary digital form throughout. The computer shall perform arithmetic operations and manipulations on these numbers according to instructions represented by binary numbers recorded on the magnetic drum.

3.5.3.2 Design shall be in accordance with the most advanced electronic equipment packaging techniques to ensure minimum size, weight, and cooling, requirements. Reliability shall be a major design criterion.

3.5.3.3 Self testing capability. (Reference Para. 4.2)

3.6 Flight Sensing Instrumentation

3.6.1 General

3.6.1.1 The flight sensing instrumentation shall embody that instrumentation necessary to define or provide:

(a) Air data
(b) Aircraft attitude

3. TECHNICAL REQUIREMENTS (Cont(d)

3.6 Flight Sensing Instrumentation (Cont'd)

3.6.1.1 (Cont'd)

(c) Angle of attack
(d) Heading information
(e) Fuel State
(f) Acceleration data

3.6.1.2 Provision of items (a) (c) and (e) above shall be the responsibility of the aircraft manufacturer.

3.6.1.3 The computation necessary to process the data into a form usable by the other sub-systems shall be done, insofar as it meets the requirements of this specification in the computer sub-system.

3.6.1.4 Generation of special functions or parameters may, in some cases, be accomplished more suitably within the sensing element of transducer; in these cases, the computer should accept the information as generated by the transducers.

3.6.1.5 Care should be exercised throughout the design so that the requirements of all the sub-systems are integrated and that duplication is kept to a minimum.

3.6.2 Instrumentation

The instrumentation needed to provide the above information consists of the following:

3.6.2.1 A stable platform to measure the pitch, roll and heading angles of the aircraft. It shall be capable of measuring all aircraft attitude. Monitor control of stable platform heading indication shall be provided by the earth's magnetic field at the option of the crew.

3.6.2.2 Transducers to measure:

(a) Differential pressure
(b) Static pressure
(c) Air temperature
(d) Angle of attack

3.6.2.3 Accelerometers to measure acceleration along all axes.

3.6.2.4 A barometric altitude control.

3.6.2.5 Fuel totalizer to measure fuel remaining.

3. TECHNICAL REQUIREMENTS (Cont'd)

3.7 Power Supply Sub-System

3.7.1 The power supply sub-system shall provide operating electrical power as required by the other sub-systems described in this specification.

3.7.1.1 Voltage regulation shall be 2.5 percent for all outputs.

3.7.1.2 Frequecy regulation shall be 0.2 percent for alternating current outputs.

3.7.2 The power supply sub-system shall comprise one or more multi-output generators driven by an air turbine. The air turbine and speed controls shall be supplied by the aircraft contractor.

3.7.3 The power supply sub-system shall operate independently of the aircraft main power supply system.

3. TECHNICAL REQUIREMENTS(cont'd.)

3.8 Cockpit Controls and Presentation

3.8.1 General

3.8.1.1 The controls and presentations shall enable the crew to perform the functions outlined in this specification in the most efficient manner. They shall permit the crew to monitor all phases of the automatic mission. In the event that component failure renders automatic control impossible, the instrumentation shall provide information to enable the crew members to make maximum use of the remaining facilities to complete the mission when possible, and return to base.

3.8.2.1 Presentation and Control Philosophy

3.8.1.2.1 Close Control - When operating under close control via the the data link, monitoring facilities are required in the front cockpit as described in para 3.8.2.1.5. In the rear cockpit data listed in para 3.8.2.2.4 (a)(i-iv) shall automatically appear. When operating under close control voice the pilot will select the required interceptor heading, airspeed, and altitude through pilot assist function as per para 3.4.1.3(d).

3.8.1.2.2 Broadcast Control - When operating under broadcast control pilot monitoring shall be identical to that while operating under close control. If data link is functioning the target position, velocity, and altitude shall be fed to the computer and shall automatically appear on the NAV/AI's panel. If voice broadcast control is being used the same information shall be inserted manually by the NAV/AI. In both cases the computer shall ensure that the information displayed on the NAV/AI's panel is kept current.

3.8.1.2.3 Return to Base - When returning to base other than under close control of a GCI net the following procedure shall pertain. The NAV/AI will select destination as provided for in para 3.8.2.2.4(b). Heading and distance to the selected destination shall then be indicated to the pilot and to the NAV/AI. Once a destination is selected by the NAV/AI the above information shall always be available regardless of any other selection made by the crew that may require use of a common indicator for a short period of time.

SECRET

3. TECHNICAL REQUIREMENTS (cont'd.)

3.8 Cockpit Controls and Presentation (cont'd.)

3.8.2 Technical Requirements

3.8.2.1 The Pilot's Displays and Control

3.8.2.1.1 Radar Attack Presentation - The radar attack display shall be as described in paras 3.2.2.4, 3.2.5.4, and 3.2.7.11. A brilliance control shall be provided.

3.8.2.1.2 Optical Sighting Device - A suitable device with necessary controls as described in para 3.2.2.7 shall be provided.

3.8.2.1.3 Telecommunications Equipment Controls - Controls for the following items of telecommunications equipment shall be available to the pilot.

(a) UHF transceiver
(b) Intercomm
(c) Air-to-Air IFF
(d) LF/MF Radio Compass
(e) TACAN
(f) UHF/ADF
(g) Flare-out altimeter

3.8.2.1.4 Telecommunications Equipment Display - The pilot's telecommunications display shall include the following:

(a) LF/MF radio compass, TACAN azimuth, and UHF/ADF indications shall be displayed on one pointer of an azimuth indicator, with the facility desired being selected by the pilot.

(b) The TACAN range indication shall be presented on a veeder counter.

(c) For landing approach TACAN azimuth indications shall be displayed on a cross pointer instrument. AGCA and flare-out altimeter monitoring shall also be provided by the same cross pointer instrument.

(d) IFF display as outlined in para 3.2.2.6.

3. TECHNICAL REQUIREMENTS (cont'd.)

3.8 Cockpit Controls and Presentation (cont'd.)

3.8.2 Technical Requirements (cont'd.)

3.8.2.2 NAV/AI's Displays and Controls (cont'd.)

3.8.2.2.3 Telecommunications Equipment Display - The NAV/AI's telecommunications displays shall include the following:

(a) LF/MF radio compass, TACAN azimuth, and UHF/ADF indications shall be displayed on one pointer of an azimuth indicator, with the facility desired being selected by the NAV/AI.

(b) Radar Homer.

3.8.2.2.4 Navigation Controls and Display - Provision shall be made for the following:

(a) Manual insertion of the following data:

(i) Present position of target and interceptor
(ii) Velocity of target
(iii) Altitude of target
(iv) Wind Velocity
(v) Magnetic variation
(vi) Target information as outlined in para 3.3.2.2.(a).

(b) A capability shall be provided for selection of destinations by means of a simple control. Indications of the following shall then appear:

(i) Heading and distance to the selected destination
(ii) Pounds of fuel remaining on arrival over the selected base calculated on maximum range flying techniques.

3.8.2.3 Cockpit Missile Controls and Indicators - The following missile controls and indicators shall be provided:

(a) A two position arming switch labelled SAFE-ARM

(b) A multi-position armament selection switch.

3. TECHNICAL REQUIREMENTS (cont'd.)

3.8 Cockpit Controls and Presentation (cont'd.)

3.8.2 Technical Requirements (cont'd.)

3.8.2.1 The Pilot's Displays and Control (cont'd.)

3.8.2.1.5 Monitoring Displays - A facility shall be provided for the pilot to compare programmed and actual airspeed, heading, and altitude while operating under both close and broadcast control. An indication of distance to go to the offset point or destination shall be provided.

3.8.2.1.6 Flight Control Sub-System Controls - Controls shall be provided for:

(a) The selection of all pilot assist functions as outlined in para 3.4.1.3.(d).

(b) The quick release from automatic mode to manual control.

3.8.2.2 NAV/AI's Displays and Controls

3.8.2.2.1 NAV/AI's Radar Presentation - The NAV/AI's radar presentation shall be as described in paras 3.2.2.5, 3.2.2.6, 3.2.5.5, 3.2.5.6, 3.2.6.5, and 3.2.8.5. The controls necessary for operation in all modes shall be provided. A hand control to permit operation as described in para 3.2.2.1.2 shall be provided.

3.8.2.2.2 Telecommunications Equipment Controls - Controls for the following items of telecommunications equipment shall be available to the NAV/AI.

(a) Intercomm
(b) Air-to-Air IFF
(c) Air-to-Ground IFF
(d) Data Link
(e) LF/MF Radio Compass
(f) TACAN or Doppler
(g) UHF/ADF (indicator repeater only - channel is to be selected by the pilot)
(h) Radar Homer

3. TECHNICAL REQUIREMENTS (cont'd.)

3.8 Cockpit Controls and Presentation (cont'd.)

3.8.2 Technical Requirements (cont'd.)

3.8.2.3 Cockpit Missile Controls and Indicators (cont'd.)

(c) A light to indicate hang-fires.

(d) A SPENT-AVAILABLE indicator.

(e) An emergency switch labelled FIRE-OFF-JETTISON.

(f) A control grip trigger.

4. SYSTEM MAINTENANCE AND TESTING

4.1 General

The problems of maintenance and testing of the integrated electronic system shall be carefully considered during design. Self-testing features shall be provided wherever practicable. Test and alignment procedures shall be simple and straightforward. Special test equipment shall be simple and straightforward. Special test equipment shall be kept to a minimum. Alignment and calibration of the integrated electronic system shall be possible while installed in a CF105.

4.2 Self-Testing Features

4.2.1 The Integrated Electronic System shall contain within itself the necessary elements to provide the maximum practical degree of self-testing. The self-testing shall be obtained with minimum cost in added size, weight and complexity. The self-testing features shall permit the location of faults, the reduction of time required to determine the state of combat readiness, and the reduction of training time for technicians.

4.2.2 In cases where self-testing is not applicable, first consideration shall be given to standard items of JAN field test gear or combinations thereof. Items of special external test gear shall be avoided wherever possible.

4.2.3 Replaceable inter-component plug-in harnesses shall be provided, in order to simplify maintenance procedures. Test equipment access plugs will be used where access to internal circuits is required.

4.2.4 Interlock type of indication shall be incorporated where self-testing switches, test access plug jumper caps, or similar features are provided.

4.3 Equipment Accessbility

4.3.1 A major design criterium shall be that the Integrated Electronic System, when installed in the aircraft, shall provide a maximum degree of component accessiblility.

4.4 Test Procedures

4.4.1 Consideration shall be given during design of the Integrated Electronic System to facilitate routine inspections and servicing as outlined in RCAF maintenance policies. In addition, provision shall be made during taxiing, take-off and while airborne, for the crew to detect major malfunctions in the system.

5. INSPECTION AND TEST PROCEDURES

5.1 Inspection

5.1.1 When inspection is conducted at the contractor's plant, all requirements specified herein shall be accomplished by the contractor under the supervision of the Department's authorised representative.

5.1.2 Acceptance or approval of material or parts during course of development shall in no case be construed as a guarantee of the acceptance of the finished product.

5.1.3 The contractor shall, during all working hours, afford unrestrained opportunity and facilities for the inspection of the work and materials by an authorized representative of the Department, in order to enable him to exercise reasonable control of quality.

5.1.4 Inspection by the Department's representative does not relieve the contractor of responsibility for conforming to: the standard laid down and accepted in general practice; the instructions and dimensions contained on the approved drawings of the parts or equipment and to the specification.

5.2 Tests

Applicable tests as agreed on by the contracting parties shall be made throughout the development program.

6. PREPARATION FOR DELIVERY

6.1 All major units and parts of the equipment shall be packaged, packed and marked for shipment in accordance with RCAF Specification Pack 3-1.

7. MISCELLANEOUS

7.1 Departure from Specification

7.1.1 If the contractor wishes to suggest alternatives, obtain concessions or other wise depart from the current issue of the specification, he is to forward his proposals immediately to the Department for Approval.

7.1.2 This specification was prepared to indicate a desired item and definite preference shall be given to this item. The burden of proof of equal excellence of substitutions shall rest with the bidder offering the substitute. If the material proposed varies in any part from the specification, special mention must be made of such points, apart from the general description or cuts submitted. When variations are not stated clearly and in detail it shall be understood that the

7. MISCELLANEOUS (Cont'd)

7.1. Departure From Specification (Cont'd)

7.1.2 (Cont'd)

bidder proposes to furnish material meeting all details of the original specification, and the bidder shall be held to strict compliance therewith.

7.1.4 Alterations of, or additions to, the requirements of this specification subsequent to the award of the contract shall be the subject of a separate agreement between the contractor and the Department of Defence Production.

7.2 Contractual Data

7.2.1 The Department through the Department of Defence Production may order extra work or make changes by altering, adding or deduction from the work; the contract sum being adjusted accordingly. No extra work shall be made unless in pursuance of written order from the Department of Defence Production, and no claim for an addition to the contract sum shall be valid unless so ordered. Drawings, or the equivalent, showing details of all extra work, must be approved by the Department and the right is reserved to reject any work not done in accordance with the approval of the Department's representative.

7.2.2 If the contractor claims that any instructions, by drawings, or otherwise involve extra cost to this contract, he shall give the Department of Defence Production written notice thereof within a reasonable lapse of time after receipt of such instructions, and in any event, before proceeding to execute the work. No claim shall be valid unless so made.

7.2.3 The contractor shall state in his tender any item which he cannot fulful as specified. He shall indicate any deviations, substitutions or changes which he requires as alternatives.

7.2.4 Any questions relating to this specification are to be referred to the Department's authorized representative.

7.2.5 Copies of this specification may be obtained by contacting the Department of Defence Production, Ottawa, Ontario, Canada.

NOTICE When Government drawings, specifications, or other data are used for any other purpose other than in connection with a definitely related Government procurement operation, the Canadian Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way

7. MISCELLANEOUS (Cont'd)

7.2 Contractual Date (Cont'd)

7.2.5 (Cont'd)

supplied the said drawings, specifications, or other data, is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

SECRET

APPENDIX "A"

TENTATIVE LIST OF COMPONENTS FOR THE INTEGRATED ELECTRONIC SYSTEM

1. Weapon's Subsystem

Radar Equipment

Unit	Quantity	Description	Nomenclature
Transmitter-Receiver Group			
065	1	Receiver-Transmitter -- Radar	
016	1	Waveguide Assembly -- Radar	
024	1	Gage, Pressure, Dial Indication	
045	1	Compressor, Air	
691	1	Regulator, Pressure	
097	1	Silica Desiccant	
295	2	Amplifier, Intermediate Frequency	
Synchronizer Group			
003	1	Synchronizer, Electrical -- Master Timer	
103	1	Synchronizer, Electrical -- Range Tracking	

Unit	Quantity	Description	Nomenclature
Synchronizer Group (Cont'd)			
020	1	Converter, Waveform -- AGC and Angle Track	
195	1	Amplifier-Sweep Generator -- Indicator Video and Azimuth Sweep	
095	1	Amplifier, Video - - Tracking Preamplifier	
389	1	Generator, Sweep -- Indicator	
082	1	Gate, Electronic --	
093	1	Oscillator, Radio Frequency	Precision rep rate for missiles
AMTI GROUP *			
495	1	Amplifier, Video -- AMTI	
150	1	Comparator, Signal -- AMTI	
203	1	Synchronizer, Electrical -- AMTI	
Signal Data Converter Group (Flight Display)			
223	1	Converter, Signal Data -- Attack Display	
523	1	Converter, Signal Data -- Time Sharing	
395	1	Amplifier-Modulator -- Attack Display	
Antenna Drive Group			
041	1	Amplifier-Power Supply -- Azimuth Gyro	

Unit	Quantity	Description	Nomenclature
Antenna Drive Group (Cont'd)			
041	1	Amplifier-Power Supply -- Azimuth Gyro	
141	1	Amplifier-Power Supply -- Elevation Gyro	
039	1	Controller--Antenna Program AZ	
539	1	Controller-Antenna Program EL	
106	1	Amplifier, Electronic Control -- Azimuth Drive	
206	1	Amplifier Electronic Control -- Elevation Drive	
Antenna			
017	1	Antenna, Radar	
Self-Test Group			
063	1	Switch Box, Radar Test	
096	1	Test Set No. 1, Radar	
196	1	Test Set No. 2, Radar	
Steering Indication Group			
246	1	Computer, Error, Radar Data -- Steering Signal	
346	1	Computer, Error, Radar Data -- Quick Indication	
Missile Auxiliaries (For Armament of Eight Falcon Missiles)			
030	2	Amplifier, Electronic Control, Missile Antenna	

SECRET

APPENDIX "A" (Cont'd)

Unit	Quantity	Description	Nomenclature
★ Missile Auxiliaries (For Armament of Eight Falcon Missiles)(Cont'd)			
031	3	Control -- Power Supply, Missile Heating	
032	8	Amplifier, Electronic Control, Missile Gate	
033	1	Relay Assembly, Armament Control	
034	8	Amplifier, Electronic Control, Missile AFC	
035	1	Amplifier, Electronic Control Transmitter	
036	3	Relay Assembly, Parameter Setting	
053	3	Coupler, Directional, Auxiliary	
187	8	Mixer Stage, Frequency	
054	8	Launcher, Rocket, Airborne GAR	

★ Appropriate Missile Auxiliaries for an alternate armament of four Sparrow II missiles.

2. Navigation and Communication Subsystem

Unit	Quantity	Description	Nomenclature
Navigation and Communication Equipment			
271	1	Receiver converter, Radio -- Data Link	ARR-44
165	1	Receiver-Transmitter, DME-Omni, Military	ARN 21
723	1	Antenna Group, ADF	ARA-25

Unit Unit	Quantity	Description	Nomenclature
Navigation and Communication Equipment (Cont'd)			
	1	Amplifier, Electronic Control, ADF	ARA-25
	1	Receiver-Transmitter, Command	ARC-34
	1	Radio Compass	ARN-6
	1	Centimetric Homer	ARD-10
	1	Doppler Radar	
	1	Radio Altimeter	APN-71
	2	Interphone	AIC-10
IFF Equipment - Reference 3.3.5.7			
003	1	Synchronizer, Electrical, Interrogator	
005	2	Control, Receiver	
066	1	Amplifier-Converter, Interrogator	
011	2	Tranmitter, Radio	
112	1	Duplexer -- Transmitter, Interrogator	
212	1	Duplexer -- Receiver, Interrogator	
014	1	Receiver, Radio, Interrogator	
116	1	Waveguide Assembly, Interrogator	
033	1	Synchronizer, Electrical Transpondor	
106	1	Amplifier-Converter, Transpondor	

SECRET

APPENDIX "A" (Cont'd)

Unit	Quantity	Description	Nomenclature
IFF Equipment - Reference 3.3.5.7 (Cont'd)			
113	1	Duplexer-Transmitter, Transpondor	
213	1	Duplexer-Receiver, Transpondor	
416	2	Coupler Directionce	
079	2	Antenuator, RF, Unidirectional	
	1	Receiver-Tranmitter	These four units comprise the APX25
	1	Coder, Transpondor Set	
	1	Power Supply	
	1	Keyer	

3. Computer Subsystem

Digital Computer

023	1	Converter, Signal Data, Phase Detection	
623	1	Converter, Signal Data, Resolver	
146	1	Computer, Arithmetic Electronic, Digital	
050	1	Comparator, Signal Analog-Digital	
051	1	Electronic Switch, Analog Signal Sampling	
053	1	Amplifier Assembly, Input-Output	
255	1	Control Data Signal, Input-Output	

APPENDIX "A" (Cont'd)

Unit	Quantity	Description	Nomenclature
Digital Computer (Cont'd)			
057	1	Memory, Magnetic Drum	
157	1	Memory, Electrical Register	
064	1	Relay Assembly, Phase Change	
291	1	Regulator, Voltage, Digital Computer	
		4. Flight Sensing Instrumentation	
655	1	Control, Altitude, Barometric	
166	1	Amplifier, Electronic Control - - Platform Data	
161	1	Accelerometer, Aircraft, Normal	
289	1	Generator, Stabilization Data, Platform	
		5. Flight Control Subsystem	
306	1	Amplifier, Electronic Control -- Elevator Positioning	
906	1	Amplifier, Electronic Control -- Aileron Positioning	
121	1	Amplifier- Computer -- Aircraft Roll Control	
221	1	Amplifier-Computer -- Aircraft Pitch Control	
139	1	Controler -- Remote, Flight Control	

SECRET

APPENDIX "A" (Cont'd)

Unit	Quantity	Description	Nomenclature
5. Flight Control Subsystem (Cont'd)			
239	1	Controller -- Remote Air Data Compensating	
		6. Power Supply Subsystem	
089	1	Generator, AC-DC	
189	1	Generator, DC	
091	1	Regulator, Voltage, Generator	
191	1	Regulator, Voltage, Low Frequency	
391	1	Regulator, Voltage, -15 V DC	
491	1	Regulator, Voltage Resolver Excitation	
591	1	Regulator, Voltage, +300 V DC	
791	1	Regulator, Voltage, -140 V DC	
891	1	Regulator, Voltage, +150 V DC	
920	1	Control Panel -- IFF	Combines controls for air-to-ground and air-to-air IFF.
020	1	Control Panel -- NAV/AI's Console	Contains most of the radar controls
071	1	Control Panel -- Attack Indicator	

Unit	Quantity	Description	Nomenclature
7. Cockpit Components (Cont'd)			
505	1	Control Panel--Voice Communication	
039	1	Autopilot Flight Controller	
079	2	Headphone Volume Control	
062	1	Pilot's Indicator	
080	1	Radar Operator's Indicator (Scope)	
019	1	Antenna Hand Control	
705	1	GCI Channel Selector	Tunes data-link receiver
055	1	GCI Subcarrier Selector	Selects data-link subchannel
	1	Optical Sight	
	1	Presentation and Control (Falcon Missiles)	
	2	Radio Compass Controls	
	1	Centimetric Homer Control	

SECRET

AVRo S4130-326
cc 9/50

UNCLASSIFIED

RECORD OF RCAF-HUGHES MEETING HELD 23 TO 25 MAY 1955 TO DISCUSS THE RCAF SPECIFICATION AIR 7-5 (INTEGRATED ELECTRONIC AND CONTROL SYSTEM FOR THE CF105)

The Roman numerals preceding items on the following pages refer to Categories agreed to by the conferees, as follows:

I Changes or additions to the Specification which are mutually agreed upon. It is intended that these will be incorporated into future issues of the Specification or possibly by amendment into the present issue.

II Items which the RCAF considers must remain in the Specification as requirements but which Hughes is unable to meet at this time and hence to which Hughes must request waivers.

III Items which Hughes will propose for incorporation into the Statement of Work of the proposed contract as items requiring varying degrees of study, development, or preliminary design prior to their acceptance as required design features of the System.

It is to be noted that both the RCAF representatives and those of the Hughes Aircraft Company stated at the outset of the conference that the meeting would constitute an exchange of views on a technical plane and should not be interpreted as having any implied contractual status.

Record prepared by

V. E. Crooke
V. E. Crooke

K W Cochran
K. W. Cochran

A. A. Hagedorn
A. A. Hagedorn

VEC:KWC:AAH:lm

SECRET

II	Page (i)	Hughes will request deletion of "MIL-T-5422 (ASG) Testing, Environmental, Aircraft Electronic Equipment".
II		Hughes will request addition of "MIL-E-4682 Choice and Application of Electron Tubes".
II		Add listing of "MIL-W-16878 Wire, Electrical (Insulated, High Temperature)".
II		"The Hughes Aircraft Company proposes not to prepare installation and test specification in accordance with MIL-I-8700 for developmental models of the system covered by this specification. However, it is intended to bear in mind that the requirement will apply to production articles and establish the requirement as an Item of Work in contracts for Service Test and Production Systems."
II	1.1, line 3,	Hughes will request as a deviation deletion of "prototype and substitution, "development models".
I	2.1.3, line 3,	Conferees agreed to delete the period and add, "and 5.3".
I	2.1.6, line 6,	Conferees agreed to delete "and".
I	2.2.1.3, line 3,	Conferees agreed to add after "the crew or" the following: "by GCI net in the broadcast control mode".
I	2.2.1.3, line 6,	Conferees agreed to insert in parenthesis after "Doppler Radar" the phrase "or Inertial System".
I	3.1.3	Conferees agreed to add "The equipment shall be designed to operate under environmental conditions as specified in MIL-E-5400 with the exceptions stated herein."
I	3.1.4	Conferees agreed to delete and substitute "The weight of the system excluding cables and mounting bases shall not exceed 2000 pounds."
I	3.1.5	Conferees agreed to delete and substitute "Equipment operation for 24 hours without failure and without necessity for readjustment of any controls which are not accessible during flight shall be a major design goal."
II	3.1.6.1	Hughes will request a deviation which, while stating the need for maximum operation time without servicing as a design goal, establishes that there is no requirement to demonstrate this by test.

II 3.1.6.2 Hughes will request a deviation to establish 2000 hours as a design objective for minimum total operation life.

I & II 3.1.7 to 3.1.12, inclusive

Hughes will prepare and submit proposed additions for inclusion in lieu of the existing paragraphs. Determination of whether each of these proposed additions should be considered Category I or II can be made by the RCAF.

I 3.1.13 Conferees agreed to add a new paragraph titled "States of Readiness" as follows:

States of Readiness - It shall be a design objective that this system be able to reach full operation and meet the performance requirements of this specification from any of the following states of readiness.

State 1. Full system operation shall be achieved in five minutes from an ambient of 25 degrees Centigrade and in 15 minutes from the lowest specified ambient. No power or cooling is required in this state.

State 2. After operation in "WARM" for at least 4 1/2 minutes, complete system operation ("OPERATE") may be achieved in two minutes from the start signal. State 2 requires a controlled ambient temperature of 0 to 30 degrees Centigrade and required application of power but not cooling.

State 3. After operation in "STANDBY" for at least five minutes, complete system operation "OPERATE" may be achieved in five seconds from the start signal. State 3 requires a controlled ambient temperature of 0 to 30 degrees Centigrade and requires complete system power and cooling provisions.

I 3.1.14 Add new paragraph

Airframe manufacturer shall supply necessary cooling air for the integrated electronic system.

I 3.2.1.2 Add words "Similar to APX-26 and APX-27" after "IFF Equipment".

III 3.2.2.1.1 - Hughes will propose, as an item of work in the contract, that a study be made of the desirability and practicability of providing automatic adjustment of the radar scan pattern in accordance with RCAF wishes.

II 3.2.2.1.1 Pending completion of the study noted above, Hughes will request waiver of the requirements of the second sentence of this paragraph.

I 3.2.2.2 Rewrite last sentence as follows: Control of the direction of the antenna axis with the Hand Control shall be provided.

III 3.2.2.2 Hughes will study expanded sweep requirement to determine if it can be accomplished at practical cost.

UNCLASSIFIED

I 3.2.2.3 Add to first sentence after MIL-R-5582: "except that the minimum setting of expanded sweep shall be 5 miles". Change wording in parenthesis from "variable in range" to "positionable in range".

I 3.2.2.4 Delete words in second line, "or pursuit", in lines 7 and 8, "or pursuit", in line 9, "or manual". Add the sentence: The aircraft shall be automatically directed to the optimum position relative to the target, independent of the type of weapon ~~ordnance~~ selected, so as to insure maximum probability of kill.

I 3.2.2.6 Delete and substitute the following:
IFF - Interrogation of airborne X-band transponders shall be provided at the direction of the NAV/AI. Transponder replies shall be displayed on the NAV/AI's presentation. A response from a friendly aircraft shall not automatically abort an attack.

III 3.2.3.1 Hughes will propose, as an item of work in the contract, the necessary study and preliminary design work to determine how the requirement for Sparrow II capability can best be incorporated in the System, including such matters as the degree to which units of the system should be exchanged when changing over from Falcon to Sparrow missiles and vice versa.

II 3.2.3.1 Pending completion of the study noted above, Hughes will request waiver of the requirement for Sparrow II capability in the development systems.

III 3.2.3.1 Hughes will propose, as an item of work in the contract, to assist AVRO in the determination of the optimum method of providing for jettisoning of Falcon missiles without igniting their motors.

II 3.2.3.1 Pending determination of the method to be used in meeting the missile jettison requirement (in which Hughes will assist AVRO as noted above), Hughes will request a waiver to allow jettisoning of missiles by launching.

I 3.2.3.2 Delete the entire paragraph including items (a) through (i) and substitute the following:

Missile Auxiliaries - The missile auxiliaries shall be housed in the electronics compartment and/or armament bay. The working faces of all auxiliaries shall be accessible for maintenance. The missile auxiliaries shall provide means for proper preparation and launching of the missiles; in addition, provisions shall be made for jettisoning as required.

I 3.2.4.1 Conferees agreed to delete and substitute:
"Warm-up periods shall be as set forth under states of readiness paragraph 3.1.13 herein."

3.2.4.3 Delete Table I and substitute the following as Table I:

	SEARCH	TRACK	(TRACK MISSILE MODE)	GROUND MAP	BEACON	AMTI
Frequencies (Megacycles)	8500 to 9030	8500 to 9030	9095 to 9170	8500 to 9030	Transmit 9375 Receive 9310	8500 to 9030
Pulse Length (Microseconds)	2.35*	0.47*	0.47*	2.35*	2.35*	0.25
Pulse Rep. Rate, cps	4.5	1000	2000	330	330	4000

I

* Pulse length shall be measured between the 90 percent amplitude points for the long pulse, and between the 50 percent amplitude points for the short pulse.

I 3.2.4.4 Add the word "nominal" preceding the word"rate".

I 3.2.4.5 Add the word "nominal" preceding the word "length".

I 3.2.4.6 Delete

II 3.2.4.7 Antenna Gain - Hughes will request a waiver of this requirement until antenna design work to be performed shows whether or not the requirement can be met with present airframe (radome diameter) limitations.

I 3.2.4.9 Add "and ground operation" at end of sentence.

II 3.2.4.8 Radiation Pattern - Hughes will request a waiver of these requirements.

I 3.2.4.10 Add at end of sentence: "with a design objective of 10 db".

I Add the following paragraphs:

3.2.4.11 The antenna will be the largest that is operable within a swept volume 40 1/8 inches in diameter, including allowance for clearance between antenna and radome.

3.2.4.12 Radome - The radome electrical tolerances will be defined in detail in a later issue of this specification.

I 3.2.5 Delete and substitute the following:
Automatic Search Requirements - Maximum search detection range consistent with the operational characteristics enumerated herein shall be a major design objective for this system. Further, it shall be a design objective that the Radar subsystem shall be capable of detecting a 5 square meter target, with an 80% probability at ranges up to 25 nautical miles.

I 3.2.5.1 Delete and substitute the following:
Subject to the space stabilization limits imposed by paragraph 3.2.5.2, the antenna shall automatically scan a pattern such that the radiation coverage limits shall be within a cone of 140 degrees included angle. The antenna shall automatically scan a pattern such that the radiation coverage shall be sufficient to illuminate the area in which the target is expected to lie, as observed and predicted by the GCI net. The scan period and radiation coverage developed shall be submitted to the Department for approval.

II 3.2.5.1 Hughes will request a waiver of paragraph 3.2.5.1 to substitute 130 degrees for the present 140 degrees.

I 3.2.5.2 Change to read "50 degrees in pitch, and 360 degrees in roll".

I 3.2.5.3 Delete and substitute:
"Nominal automatic search ranges shall be 3 nautical miles, 15 nautical miles, or 60 nautical miles as selected by the NAV/ AI."

I 3.2.5.4 Delete and substitute:
Attack Presentation - The pilot's attack scope display shall consist of the interceptors attitude.

I 3.2.5.5 Delete items (a) and (b) and substitute:

(a) A range versus azimuth display. The instantaneous azimuth position of the antenna, shall be displayed on the indicator.

(b) A marker corresponding to the elevation position of the scan axis shall be presented at the right side of the display.

(c) When operating with the data link a target marker shall be displayed.

I 3.2.5.6 Delete the paragraph. This requirement will appear as part of paragraph 3.2.7.12.

II 3.2.6.1 Hughes will request waiver of this requirement as stated. The following proposed wording will be suggested:

Antenna Positioning - Operation of the hand control shall permit pointing of the antenna along any direction within a cone of 130 degrees included angle subject to ±50° restriction in roll stabilized elevation angle.

I 3.2.6.4 Delete paragraph and substitute:

Attack Presentation - The pilot's attack scope shall display the interceptor's attitude.

I 3.2.6.5 After the phrase "——shall be indicated by" add the words "intensification and".

I 3.2.6.6 Delete paragraph and substitute:

Range Gate - Range gate sweeping shall be accomplished by positional control at the discretion of the NAV/AI.

II 3.2.7.1 Angular Tracking Limits - Hughes will request waiver of the 140° requirement and will suggest 130°.

I 3.2.7.5 Add at beginning of original paragraph: "The stabilization loops shall be dynamically compatible with AFCS loops. Subject to this requirement, it shall be a design objective to meet the following:

I 3.2.7.7 Delete paragraph and substitute: Range Rate Limits - Lock-on to a signal of -84 db or greater shall be maintained as the range of the tracked signal varies between a closing rate of at least 1800 knots and an opening rate of 500 knots.

I 3.2.7.8 Conferees agreed to delete and substitute: "The accuracy of the range voltage shall be within plus or minus the quantity 30 yards plus one percent of the indicated range from 200 yards to 15,000 yards, 30 yards plus 2 percent of the indicated range between 15,000 yards and 30,000 yards, 30 yards plus 3 percent between 30,000 yards and 40,000 yards, and 30 yards plus 5 percent between 40,000 yards and 50,000 yards."

I 3.2.7.9 Delete paragraph and substitute: ECM Tracking - Lock-on and angular tracking of active noise, CW, and railing type jamming sources shall be provided, and as a design objective the subsequent generation of azimuth and vertical steering signals shall be provided.

I 3.2.7.10 Delete words "at the option of the NAV/AI".

3.2.7.11 Delete item (c) and substitute:

I (c) A time-to-fire indication, which shall indicate the time remaining until the missile is released.

II & III (e) Hughes will study the launch range limits indication as applicable to Sparrow II. Until such study has been made, Hughes will request waiver of this requirement.

I 3.2.7.12 Add second sentence: "In a ddition, the range closure rate when tracking and a range indication at short ranges shall be provided.

I 3.2.8.1 Add the word "bar" after the word "single".

I 3.2.8.4 Delete paragraph and substitute:
Attack Presentation - The pilot's attack scope shall display the interceptor's attitude.

I 3.2.8.5 Add "except for jizzle" after word "operation". Add as last sentence: "The minimum range setting on the expanded sweep shall be 5 miles."

I 3.2.9.3 Delete paragraph and substitute:
Attack Presentation - The pilot's attack scope shall display the interceptor's attitude.

I 3.2.9.4 Add at end of sentence "except for jizzle".

I 3.3.2.2

(a) Change second sentence as follows: "Provision is also to be made for target position and altitude to be displayed visually in the NAV/AI's position. In the event ...."

II 3.3.2.2

(a) Hughes will request waiver of requirement that last information displayed will be retained, in the event of computer failure.

I 3.3.2.3

(a) Delete second sentence.

I 3.3.2.4 Reword second sentence as follows: Alternatively the crew is to select one of a number of stored base locations for independent automatic return to base.
Delete "and flare-out" in the last sentence.

I 3.3.3.1 Add "or equivalent acceptable to the RCAF" following ARC 34.

I 3.3.3.1.3 Insert word "significantly" following word "affect".

I 3.3.3.2 Add at end of sentence "or equivalent acceptable to RCAF".

I 3.3.4.1 Change to read "AN/ARR44 or equivalent acceptable to RCAF".
Change to read"——Twenty or more preset channels in the UHF band".

I 3.3.4.3 Delete

I 3.3.4.4 Delete all except first sentence.

I 3.3.5.1 Air-to-ground identification is to be accomplished by the AN/APX 25 or equivalent acceptable to RCAF.

I 3.3.5.2 Add "or equivalent acceptable to RCAF" after APX 25.

I 3.3.5.3 Add "or equivalent acceptable to RCAF" after APX 25.

I 3.3.5.4 Add "or equivalent acceptable to RCAF" after APX 25.

I 3.3.5.5 Add "or equivalent acceptable to RCAF" after APX 25.

I 3.3.6.1 Add: "(or equivalent acceptable to RCAF)" following ARN 21.

I 3.3.6.1 Add as second sentence: "It shall be a design objective to incorporate an inertial system when such equipment is available in a suitable state of development."

III 3.3.6.1 Hughes item of work to include study of application of inertial system to integrated electronic system.

I 3.3.6.1.2 Substitute "director type instrument" for "cross pointer type meter".

I 3.3.6.1.4 Substitute "significantly" for "in any way".
Add "ARN-21 or equivalent acceptable to RCAF".

I 3.3.6.2 Add "or equivalent with RCAF approval" after AN/ARA 25.

I 3.3.6.2.2.1 Delete and substitute:
The ARA 25 or equivalent acceptable to RCAF shall operate in conjunction with either the UHF command set or UHF data link receiver at the option of the crew.

I 3.3.6.2.2 Add "or equivalent acceptable to RCAF" after ARA 25.

I 3.3.6.2.2.2 Add "or equivalent acceptable to RCAF" after ARA 25.

I 3.3.6.3.1 Delete and substitute:
The Airborne AGCA facility shall utilize the data link equipment as the airborne terminal of transmission.

I 3.3.6.3.2 Delete words, "cross pointer".

I 3.3.6.4.1 Delete "to the computer subsystem".

I 3.3.6.4.2 Delete words "the AGCA cross pointer".

I 3.3.7.1.2 Conferees agreed to insert after "radar homer" the phrase "not included as part of the system".

I 3.4.1.4 Change item (d) to read:
"Pilot assist function consisting of:
(i) heading hold
(ii) Mach hold or pitch angle hold.

I 3.4.2.2 Change to read: "It shall receive command signals from the computer subsystem to enable the aircraft to fly a correct firing course automatically during the attack and for automatic breakaway by applied stick force."

I 3.4.2.3 Delete and substitute "For close control it shall accept command signals from the data link receiver via the computer. For broadcast control it shall accept command signals from the computer."

I 3.4.2.4 Delete and substitute: "An AGCA ground installation shall provide the steering and descent for the approach through the data link receiver in the aircraft. Automatic flare-out shall be provided. Automatic throttle control, or equivalent acceptable to RCAF, shall be provided.

I 3.4.2.5 Change reference paragraph from 3.4.1.3 (d) to 3.4.1.4 (d).

I 3.4.2.6 Delete item (c) and substitute:
The signals used in the damping system shall be used in the AFCS where necessary."

I 3.4.3 Change reference paragraph from 3.4.1.3 to 3.4.1.4
Delete the words "In particular it shall provide"
(a) Delete
(b) Delete
(c) Delete

I 3.5.2.3.1.1 Add "except possible during attack" to last sentence.

I 3.5.2.3.2.2 Delete and substitute "It shall be possible to complete an interception manually when directed by voice under GCI control."

I 3.5.2.3.4.1 Delete "and/or manually set in"

I 3.5.2.3.4.2 Change title from "Manually" to "Autonavigation"
Delete and substitute: "In the event that GCI contact is lost, it shall be possible for the crew to select a base and be directed back to this selected base by means of the dead reckoning capabilities of the system. The system shall display the distance and bearing to base."

I 3.5.2.3.5.1 Substitute "from ground facilities" for "from a GCI station".

II 3.5.2.3.5.3 Hughes will request waiver on requirement of manual correction of position indicated by computer.

I 3.5.2.3.5.5 Delete item (c)

II & III 3.5.2.4 Hughes will request a waiver. Hughes will include as a study item on GCI control of the scan pattern. (See comment on paragraph 3.2.2.1.1)

III 3.5.2.5 Air Data - Delete the paragraph and substitute: An integrated air data computer may b provided to supply the necessary air data inputs to the various subsystems.

I 3.5.2.6.2 Delete paragraph and substitute: "The applicable steering signals required by the flight control subsystem during automatic attack shall be processed by the computer.

I 3.5.2.6.6 Delete word "automatic" preceding "snap-up"
Add "It shall be a design objective to make this capability automatic."

I 3.5.2.6.7 Delete last sentence and substitute "Necessary computations required for this mode shall be provided."

II 3.6.2.1 Hughes will request deviation against second sentence.

I 3.6.2.1 Conferees agreed to deletion of third sentence.

III 3.6.2.1 Hughes will furnish cost estimate of a 4-gimbal stable platform.

I 3.6.2.3 Delete word "all" and substitute word "required".

I 3.6.2.4 Conferees agreed to delete and substitute "A barometric attitude measuring device."

I 3.7.1.1 Change to read "plus or minus 2.5 percent"

I 3.7.1.2 Change to read "plus or minus 0.2 percent"

I Add the following paragraph:

3.7.4 Airframe manufacturer shall provide the emergency power source.

I 3.8.2.1 Should be numbered 3.8.1.2

I 3.8.1.2.1 Change reference in line 4 from "paragraph 3.8.2.2.4 (a) (i-iv)" to "paragraph 3.8.2.2.4 (b)"
Delete last sentence and substitute
"When operating under close control voice, the pilot may select the required function as per paragraph 3.4.1.4 (d)."

I 3.8.1.2.2 Rewrite as follows: "When operating under broadcast control, pilot monitoring shall be identical to that while operating under close control if data link is functioning. The target position, and altitude shall automatically appear on NAV/AI's panel. If voice broadcast control is being used the same information plus target velocity shall be inserted manually by the NAV/AI. In both cases, the computer shall insure that the information displayed on the NAV/AI's panel is kept current.

I 3.8.1.2.3 Change reference paragraph from 3.8.2.2.4 (b) to 3.8.2.2.4 (a)(vi).
Delete "Heading and distance" and substitute "Bearing" at beginning of third sentence.

I 3.8.2.1.3 Delete (a) (c) (e) and (g).

I 3.8.2.1.4 (a) Delete "one pointer of"

(b) Delete "on a veeder counter"

(c) Substitute "Director type" for the words "cross pointer" in the second line.
Delete words "cross pointer" in last line.

(d) Delete.

I 3.8.2.1.5 Delete paragraph and substitute: "A facility shall be provided to the pilot to compare command and actual airspeed and heading, while operating under both close and broadcast control. Horizontal and vertical steering signals and target altitude shall be displayed.

I 3.8.2.1.6

(a) Change reference paragraph from 3.4.1.3 (d) to 3.4.1.4 (d).

I 3.8.2.1.7 "Armament Subsystem Controls - A flight control grip firing trigger shall be provided." (This is a new paragraph.)

I 3.8.2.2.1 Delete paragraph reference 3.2.6.5 and substitute 3.2.7.12.

I 3.8.2.2.2

(g) Delete wording in parenthesis.

I 3.8.2.2.3 (a) Change to read, "LF/MF radio compass, TACAN position, and UHF/ADF indications shall be displayed on the same indicator, with the facility desired being selected by the NAV/AI.

I 3.8.2.2.4 (a)

(v) Change to read, "Magnetic variation as part of the compass system.

(vi) Delete and substitute, "Prestored base locations."

(b) Delete all of paragraph and substitute, Presentation of the following data:
(i) Present position of interceptor
(ii) Ground derived target position
(iii) Target altitude
(iv) Command course
(v) Fuel distance remaining on arrival over the selected base calculated on maximum range flying techniques.

II 3.8.2.2.4 (a)

(i) Hughes will request a waiver on requirement to manually insert interceptor position.

(b)

(v) Hughes is conducting a study to provide this feature but a waiver will be requested until this requirement can be met.

II & 3.8.2.3
III

(e) Hughes will request waiver on jettison method. Study required on paragraph 3.2.3.1 will include this required.

Conferees agreed to Section 5, as follows:

5 Inspection and Test Procedures

I 5.1 General

I 5.1.1 The equipment shall be designed so that production items will pass the qualification tests and production tests to be outlined in greater detail at a later date.

I 5.1.2 The development models shall be made with the above end in view but will not be required to pass all tests; the particular tests required will be decided jointly by the Department, the USAF, the airframe contractor, and the system contractor as development proceeds.

I 5.2 Inspection

I 5.2.1 When inspection is conducted at the contractor's plant, it shall be accomplished by the contractor under the supervision of the Department's authorized representative.

I 5.2.2 Acceptance or approval of material or parts during course of development shall in no case be construed as a guarantee of the acceptance of the finished product.

I 5.2.3 The contractor shall, during all working hours, afford unrestrained opportunity and facilities for the inspection of the work and materials by an authorized representative of the Department.

I 5.2.4 Inspection by the Department's representative does not relieve the contractor of responsibility for conforming to: the standard laid down and accepted in general practice; the instructions and dimensions contained on the approved drawings of the parts or equipment and to the specification.

I 5.3 Tests

Applicable tests as agreed on by the contracting parties shall be made throughout the development program.