

**DEPARTMENT OF NATIONAL DEFENCE**

**ROYAL CANADIAN AIR FORCE**

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Date \_\_\_\_\_

**SPECIFICATION  
for**

REQUIREMENTS FOR THE SPARROW 2 MK 1 MISSILE

FOR THE ARROW 2 AIRCRAFT

WSC 1-4

ISSUE	DATE	REMARKS
1	14 Feb 58	

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  
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Prepared By: AFHQ/AMIS/CAE/  
DARME

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Issue 1

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Issue 1

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## 1. SCOPE

1.1 This specification states the requirements of the Department of National Defence, hereinafter called the Department for an Air-to-Air guided missile described as follows:

- (1) RCAF Model Designation - Sparrow 2 Mk 1
- (2) Number and kind of Engines - One solid propellant motor
- (3) The mission of this missile shall be to intercept and destroy enemy aircraft in all weather conditions.

1.2 Classification - Missiles constructed under this specification shall be production missiles.

## 2. APPLICABLE DOCUMENTS

2.1 The following documents of the issue in effect on the date of issue of this specification, shall form part of this specification except as specified herein.

2.1.2 Specifications - Material, process, design and installation specifications and equipment drawings, applicable to guided missiles, listed in the List of Military Specifications and Standards used by the Bureau of Aeronautics dated April 1956 and including the following specifications, except as specified herein.

### Royal Canadian Air Force

PROC 100-4 Identification and Marking RCAF property.

### Military

MIL-STD-210	Climatic Extremes for Military Equipment
MIL-G-3278	Grease, Aircraft and Instruments
MIL-T-5422	Testing Environmental, Aircraft Electronic Equipment
MIL-T-5021	Tests, Aircraft Welding Operator's Certification
MIL-B-5087	Bonding Electrical (for Aircraft)
MIL-W-5088	Wiring Aircraft, Installation of
MIL-C-6021	Castings, Classification and Inspection of
MIL-I-6051	Interference Limits and Methods of Measurement, Electrical and Electronic Installation in Airborne Weapons Systems and Associated Equipment.
MIL-W-6858	Welding, Low Carbon Steel, Austenitic Steels and Nickel Alloys, Spot and Seam
MIL-W-6860	Welding Aluminum and Magnesium Alloys Spot and Seam.
MIL-I-6870	Inspection Requirements, Non-destructive for Aircraft Materials and Parts
MIL-W-6873	Welding, Flash, Carbon and Alloy Steel
MIL-H-6875	Heat Treatment of Steels (Aircraft) Process for
MIL-F-7179	Finishes and Coatings, General Specification for Protection of Aircraft and Aircraft Parts.
MIL-S-7742	Screw Threads, Standard Aeronautical
MIL-E-8189	Electronic Equipment, Guided Missiles General Specification for
MIL-I-8500	Interchangeability and Replaceability, Physical of Component Parts for Aircraft Including Guided Missiles

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2. APPLICABLE DOCUMENTS (Cont'd)

2.1.2 Specifications (Cont'd)

Military

- MIL-I-8591 Airborne Stores and Associated Suspension Equipment, General Design Criteria for
- MIL-W-8604(Navy) Welding of Aluminum Alloys, Process of
- MIL-W-8611(Navy) Welding Fusion, of steels and corrosion and heat-resisting alloys; Process for (Aircraft Use)
- MIL-A-8629(Aer) Aeroplane Strength and Rigidity
- MIL-D-8684(Navy) Data, Design; Contract Requirements for Guided Missile Weapon System
- MIL-P-9024 Packaging, Guided Missile Weapon Systems, Specifications and General Design Requirements for
- MIL-C-18263 Colors Exterior, Naval Aircraft Requirements for
- MIL-F-18264 Finishes, Organic, Aircraft Application and Control of
- MIL-W-18326(Navy) Welding of Magnesium Alloys, Gas and Arc, Manual and Machine, Processes for

Bureau of Aeronautics

- ANC-5 Strength of Metal Aircraft Elements
- XAV-32 Radome for XAAM-N-3 Sparrow 2 Missile
- XAV-33 Radar Set AN/DPN-21 (XN-3)
- XAV-34 Autopilot, Guided Missile, XAAM-N-3
- XAV-35 Hydraulic Actuator Unit, Guided Missile XAAM-N-3
- XAV-36 Power Supply, Guided Missiles XAAM-N-3 (as amended to meet RCAF requirements).

2.1.3 Publications - Air Force Engineering Orders and logbooks shall be provided in the quantities specified in the contract.

2.1.4 Drawings - Drawings, applicable to guided missiles listed in the List of Aeronautical Standard Drawings used by the Bureau of Aeronautics dated March 1956, and including DWG MS33588, form part of this specification and shall be followed, where applicable, except as specified herein.

2.1.5 Other Publications -

Douglas Report SM-18765A - Sparrow 2 Performance Capabilities 25 Feb 55.

3. REQUIREMENTS

3.1 General - The missile configuration shall be of the wing control type with four fixed tail fins and four movable steering control wings. The missile shall be coordinated with Arrow Aircraft Weapons system to enable the required overall system performance to be accomplished.

3. REQUIREMENTS (Cont'd)3.1.1 Characteristics - The characteristics of the missile shall consist of the following:

missile configuration, weights, center of gravity locations, areas, dimensions and general data, control surface and corresponding control surface movements and moments of inertia.

3.1.1.1 Missile Configuration - Appendix 2 shall apply.3.1.1.2 Performance - The missile shall have performance to permit its employment against aircraft having characteristics as follows:

Target Speed Range	Up to Mach No 1.5
Target manoeuvrability	4g from sea level to 30,000 ft; linear variation from 4g at 30,000 ft to 2g at 50,000 ft.
Target altitude	Near sea level to over 60,000 feet

3.1.1.2.1 Guaranteed Performance - Excluding failures attributable to launching aircraft, launching aircraft equipment specified in Appendix 7, 95% of the missiles taken aloft and which have been properly maintained and prepared, in accordance with RCAF Engineering Orders, shall operate without a malfunction through launch and 80% of the missiles launched, within the allowable operational boundaries of the missile, shall operate in flight without malfunction and achieve direct or pass within 30 feet of the target center or within 10 feet of the nearest target surface.3.1.1.2.2 Performance Conditions - The missile shall be capable of the performance specified in 3.1.1.2.1 when used in a weapon system under the conditions stated below:3.1.1.2.2.1 Target reflective Area - The target reflective area for a small jet fighter and jet bomber shall be as specified in Appendix 8.3.1.1.2.2.2 Launching Velocities and Altitudes - The missile shall be capable of operation at altitudes from 300 feet to 60,000 ft with the following launch velocities:

60,000 ft altitude,	600 to 1940 fps
50,000 ft altitude,	600 to 1940 fps
40,000 ft altitude,	550 to 1940 fps
30,000 ft altitude,	500 to 1640 fps
20,000 ft altitude,	450 to 1460 fps
10,000 ft altitude,	400 to 1320 fps
5,000 ft altitude,	360 to 1240 fps
300 ft altitude,	340 to 1180 fps

3.1.1.2.2.3 Operational Altitudes - The missile, after launch, shall be capable of operation at altitudes from 50 ft to 65,000 ft.3.1.1.2.2.4 Allowable Launching Ranges - The allowable launching ranges versus aspect about the target from which the missile can be launched successfully without significant deterioration in accuracy are given in Appendices 3, 4 and 5 for three typical altitudes of 5,000, 30,000 and 50,000 ft.

3. REQUIREMENTS (Cont'd)

3.1.1.2.2.4 Allowable Launching Ranges (Cont'd)

Curves for both a small jet fighter and jet bomber target are shown. The radar reflective areas are as noted in para 3.1.1.2.2.1.

3.1.1.2.2.5 Allowable Launching Lead Angle Regions - A typical allowable launching lead curve for 5,000 ft altitude is shown in Appendix 6.

3.1.1.2.2.6 Properly Functioning Missile - A properly functioning missile is defined as one for which all the components of the system are operable, and one which has passed the checkout procedure in accordance with RCAF Engineering Orders using related standard and/or specified test equipment.

3.1.1.2.3 Gross Weight for Calculating Performance - The gross weight used for calculating performance shall be equal to the weight empty plus the useful load.

3.1.1.3 Weights

3.1.1.3.1 Gross Weight - The gross weight shall be the sum of the useful load and the weight empty. The gross weight is estimated to be as follows:

Gross Weight (at launch) (pounds)	432
-----------------------------------	-----

3.1.1.3.2 Useful Load - The useful load for the missile when carrying a warhead is estimated to be as follows:

Useful Load (pounds)	141
----------------------	-----

Propellant (including igniter propellant)	70.3	
---	------	--

Warhead	45.0	
---------	------	--

Fuze (including safety and arming device and structure)	25.8	
---	------	--

3.1.1.3.3 The useful load for the missile when carrying flight test equipment is estimated to be as follows:

Useful Load (pounds)	141
----------------------	-----

Propellant (including ignitor propellant)	70.3	
---	------	--

Flight test equipment	70.8	
-----------------------	------	--

3.1.1.3.4 Weight Empty - The guaranteed weight empty consists of sub-items estimated to be as follows:

Weight Empty (Guaranteed) (pounds)	291
------------------------------------	-----

Control and Stabilizing surfaces group	32.9	
--	------	--

Fixed	8.4	
-------	-----	--

Movable	24.5	
---------	------	--

Body Group	62.4	
------------	------	--

Radome	3.0	
--------	-----	--

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3. REQUIREMENTS (Cont'd)3.1.1.3.4 Weight Empty (Cont'd)

Guidance shell	5.5	
Autopilot shell	6.8	
Hub	28.3	
Power supply shell	8.9	
Aft fin support	5.6	
Attaching parts	4.3	
Propulsion Group (G. F. E)		48.0
Motor (burned out)	47.0	
Igniter assembly (burned out)	1.0	
Guidance and Control Group		74.0
Guidance equipment	58.0	
Autopilot equipment	14.5	
Wiring	1.5	
Hydraulic System		38.3
Power Supply Equipment		35.0

3.1.1.4 Center of Gravity Location - The center of gravity locations for this missile are estimated to be as follows (Horizontal center of gravity measured from St. 0, with hinge line of control fins constant at Sta. 76.0; vertical and lateral center of gravity measured from centerline of missile body):

	<u>Launching Condition</u>	<u>End of Motor Burning Condition</u>
Gross Weight - (Pounds)	432	361
Horizontal Center of Gravity (Sta.)	88.8	80.5
Vertical Center of Gravity	0.0	0.0
Lateral Center of Gravity	0.0	0.0

3.1.1.5 Areas - Areas are estimated to be as follows: (Not to be used for inspection purposes.)

Control Fins (Total exposed) (Sq. ft.)		5.06
Pitch and Roll Fins	2.53	
Yaw Fins	2.53	
Tail Fins (Total exposed) (Sq. Ft.)		3.08
Vertical	1.54	
Horizontal	1.54	

3.1.1.6 Dimensions and General Data - The principal dimensions and general data which agree with the data shown on the general arrangement drawings, are estimated to be as follows (Not to be used for inspection purposes.):

Wings (Control Fins)		40.128
Span, Maximum (inches)		
Chord		
At exposed root (inches)		19.406
At construction tip (inches)		3.406
Airfoil section, designation and thickness (percent chord)		

3. REQUIREMENTS (Cont'd)

3.1.1.6 Dimensions and General Data (Cont'd)

Diamond cross section	4.15
Incidence (degrees)	0
Sweepback (leading edge) (degrees)	45
Dihedral (degrees)	0
Effective aspect ratio	2.8
Tail (horizontal or vertical):	
Span, maximum (inches)	32.0
Chord	
At exposed root (inches)	18.5
At construction tip (inches)	0
Airfoil section, designation and thickness (Percent chord)	
Diamond cross section	2.9
Incidence (degrees)	0
Sweepback (degrees)	57.0
Aspect ratio	2.60
Fuselage Diameter, maximum, inches	8
Length, maximum (reference line level) (inches)	149.274

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3.1.1.7 Control Surface Movements - The control surface movements and rates of movement on each side of neutral position, for full movement as limited by stops, shall be as follows: (Not to be used for inspection purposes.)

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Wing:

Horizontal (pitch and roll)  
 Degrees up 22; rate 600 degrees/second  
 Degrees down 22; rate 600 degrees/second

Vertical (Yaw)

Degrees left 20; rate 300 degrees/second  
 Degrees right 20; rate 300 degrees/second

Differential - Pitch wings limited to 6° differential

Tail:

Horizontal and vertical: Fixed

3.1.1.8 Moment of Inertia - The moment and product of inertia about the missile c.g. in pitch and the missile centerline in roll for conditions of missile weight empty and gross weight are estimated to be as follows:

Pitching moment of inertia:	
Weight Empty	444,000 lb. - in. <sup>2</sup>
Gross Weight	598,000 lb. - in. <sup>2</sup>
Rolling Moment of inertia:	
Weight Empty	4,280 lb - in. <sup>2</sup>
Gross Weight	4,850 lb. - in. <sup>2</sup>

ws:

3.1.2 System Vehicle - See 3.1.

3. REQUIREMENTS (Cont'd)

- 3.1.3 Simplicity - Components shall be easily replaced and the system shall be capable of operation by Armament Systems Technicians and Munitions and Weapons Technicians using accepted guided missile procedures and standard and/or specified test equipment.
- 3.1.4 Reliability - Missiles, exclusive of the warhead and motor, which have passed the normal checkout procedure in accordance with RCAF Engineering Orders using related standard and/or specified test equipment shall operate in accordance with 3.1.1.2.1.
- 3.1.5 Vulnerability - Susceptibility to probable enemy countermeasures shall be minimized as specified in the US Navy. Specification XAV-33.
- 3.1.6 Protection From Interference - The missile shall be such that its electronic and electrical components shall minimize generation of, and susceptibility to, radiated and conducted noise.
- 3.1.6.1 Requirements for Allowable Interference - There shall be no significant interruption of normal output in any one of the aircraft installed electronic receivers, nor malfunctioning of any part of the electronic systems, aircraft or missile, due to radiated or conducted interference produced by this missile. This requirement applies to the entire frequency range of all installed electronic equipment and to those for which complete installation provisions have been made.
- 3.1.7 Production - The missile shall be adapted to mass production without degrading the missile performance specified herein. To the extent practicable the missile production shall employ established processing equipment and techniques. The mechanical finishes and tolerances shall be no more stringent than necessary to ensure reliable operation throughout the test, storage, and operating life of the missile. Assemblies, components and parts of the missile shall incorporate maximum producibility in the sense of simplicity of configuration, efficient and economical fabrication, efficient installation and minimum requirements for strategic materials, manpower and plant facilities.
- 3.1.8 Interchangeability - The assemblies shall be interchangeable and replaceable in accordance with the requirements of Specification MIL-I-8500. The working list required by Specification MIL-I-8500 shall include those components and parts of the guidance and control system for which functional and physical interchangeability is determined necessary by the contractor subject to RCAF approval. Functional interchangeability of equivalent items shall be based upon the statistical probability that 95% of the acceptable components will combine to make acceptable systems.
- 3.1.9 Interior Arrangements - The interior arrangement shall be such as to eliminate any interference between systems, assemblies, components, and parts during their assembly, servicing, and operation. The detail arrangement shall be in accordance with Appendix 2.
- 3.1.10 Sectionalization - The missile shall consist of main sections arranged as follows:
- (1) Guidance Section including Radome
  - (2) Electrical Power Section
  - (3) Wings and Wing Support Section
  - (4) Control Section

### 3. REQUIREMENTS (Cont'd)

#### 3.1.10 Sectionalization (Cont'd)

- (5) Fuse and Warhead Section
- (6) Motor Section
- (7) Aft Fin Support and Fins

These sections shall incorporate quick connect type attachments for joining sections rapidly and securely. These sections shall be arranged to prevent improper assembly of joints. The wing and fin panels shall be capable of being attached in not more than 5 seconds each and disconnected in not more than 1 minute each. This arrangement shall permit a complete check out of the missile prior to assembly, and shall provide for ease of handling.

- 3.1.11 Safety of Friendly Personnel and Equipment - Hazard to check out personnel shall be held to a minimum. It shall be possible to jettison the missile without arming the safety and arming device. The arrangement of controls and assembly sequences shall be such that RCAF Armament System Technicians and Munitions and Weapons Technicians shall be capable of testing, checkout and assembling the missile. The warhead shall be installed after the fuse has been assembled to the missile.
- 3.1.12 Jettisoning or Separating of Parts - The missile shall be capable of safe intentional jettisoning as an entity. The design shall be such as to prevent accidental jettisoning during flight on the launch aircraft, or breakup while in prelaunch or free flight.
- 3.1.13 Environment - The missile and all its components shall be capable of withstanding the environmental ranges specified herein for stowage, storage, transit, standby, and flight, without any modification, maintenance, and adjustments.
- 3.1.13.1 Missile Operating - The missile shall be capable of operation, consistent with published duty cycle, while being subjected to the following conditions, sub-item (1) through sub-item (6) or natural combination of conditions, sub-item (7):
  - (1) Temperature - Continuous operation over the range of -67 to +160 °F. For missiles stabilized at temperatures above, +35 °F it is required that the missiles be ready to launch within 2 minutes after application of all power supplied by the launching aircraft. For temperatures below +35 °F the time required to bring the missile to operating temperature by means of internal missile heaters shall be as specified in 3.1.36(d).
  - (2) Altitude - Barometric pressure ranging from 31.3 to 2.2 inches of mercury (approximately an altitude of 60,000 feet). The pressure may vary at a rate of up to one inch of mercury per second.
  - (3) Humidity - Relative humidity values ranging up to 100 percent with condensation up to a temperature of +122 °F. For temperatures higher than 122 °F, the moisture content of the surrounding air shall be no greater than that corresponding to 100% relative humidity at 122 °F.
  - (4) Vibration - See 3.1.19.3.

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### 3. REQUIREMENTS (Cont'd)

#### 3.1.13.1 Missile Operating (Cont'd)

- (5) Shock - The missile shall be capable of satisfactory operation during and after two applications of high impact shock along the longitudinal axis. The shock acceleration shall be such that the minimum average acceleration for a period of not less than 2.5 milliseconds shall be 70g. During the application of the shock the antenna shall be uncaged.
- (6) Combined Environment - Under combined conditions of sea level and plus 160 °F, and also under combined conditions of 60,000 feet altitude and temperature of -67 °F, vibration over the frequency range outlined in 3.1.19.3.
- (7) Precipitation - The missile shall be capable of withstanding precipitation which may be encountered during Sparrow 2 missions with the Arrow Weapons system.

#### 3.1.13.2 Missile Non-Operating - The missile shall be capable of operation after being subject to the following conditions while inoperative:

- (1) Temperature - -85 °F to +185 °F as specified in Specifications XAV-34 and XAV-34 and XAV-35. Temperature outside the operating range shall be sustained for a period of not longer than two hours.
- (2) Altitude - Barometric pressure ranging from 31.3 to 2.2 inches of mercury (approximately an altitude of 60,000 ft.). The rate of change in barometric pressure may vary as much as 0.5 inches of mercury per second.
- (3) Humidity - See 3.1.13.1 (3).
- (4) Shock - A series of 18 handling shocks of 30 g's for duration time of  $11 \pm 1$  milliseconds, three in each direction along each of the three mutually perpendicular missile axes.
- (5) Salt Spray - The assembled missile shall be capable of withstanding exposure to a salt spray solution for a period of 2 hours as specified in Specification MIL-T-5422.
- (6) Sand and Dust - The assembled missile shall be capable of withstanding exposure to an atmosphere of sand and dust as specified in MIL-STD-210 at a velocity of 3520 feet per minute for a period of four hours except as specified for the radome in specification XAV-32.
- (7) Sustained Acceleration - The missile sections shall satisfactorily withstand peak longitudinal and lateral accelerations which may be imparted during Sparrow 11 missions with the Arrow aircraft. Requirements for the gyro elements are as specified in Specifications XAV-33 and XAV-34 and XAV-35.

3. REQUIREMENTS (Cont'd)

3.1.13.2 Missile Non-Operating (Cont'd)

(8) Vibration

(a) Sweep the vibration frequency range from 10 to 500 cps at 2 g's in 10 minutes.

(b) The test in (a) above shall be performed 10 times in each of the three mutually perpendicular axes.

(9) Precipitation - See 3.1.13.1 (8).

3.1.13.3 Stability-Operating - The operating stability shall be in accordance with Specifications XAV-32, XAV-33, XAV-34, and XAV-35.

3.1.13.4 Operating Life

3.1.13.4.1 Reliable Operating Life - The missile shall have a reliable operating life averaging at least 100 hours, except for lubrication, from the time of RCAF acceptance without removal for bench servicing. The operating life periods and test conditions shall be defined as those which would normally be encountered at a test location while conducting successive system tests in accordance with the applicable RCAF Engineering Orders and in repeated captive flight operations.

3.1.13.4.2 Total Operating Life - The missile shall have a minimum total operating life of 200 hours from the time of RCAF acceptance with reasonable servicing and replacement of parts. The operating life periods and test conditions shall be defined as being those which would normally be encountered at a test location conducting successive system tests in accordance with applicable RCAF Engineering Order and in repeated captive flight operations. Parts requiring replacement within this interval and the life of such parts shall be specified by the contractor and approved by RCAF.

3.1.13.4.3 Limitations on Operating Life - Limitations on operating life shall be as follows:

(1) Those limitations specified in Specifications XAV-33, XAV-34 and XAV-35.

(2) Components which cannot operate continuously without overheating shall not be required to operate beyond their rated duty cycle. Such components and their duty cycle shall be as specified by the contractor and approved by RCAF.

3.1.13.5 Climatic Requirements - The missile shall be capable of transfer from one climate to another without modification or adjustment. The missile shall operate satisfactorily at the conditions to be experienced at operating altitudes in the Arrow Weapons System operating envelope.

### 3. REQUIREMENTS (Cont'd)

3.1.13.6 Storage - The storage conditions specified herein shall not limit the application of service conditions as specified in 3.1.13.2 for short periods of time.

3.1.13.6.1 Packaged Storage - The missile and/or sections if packaged within 15 days after acceptance by the RCAF Inspector in containers conforming to 5.1 shall be capable of the guaranteed performance requirements of 3.1.1.2.1 after storage for a period of one year under conditions normally encountered in service subject to storage limitations of components as approved by RCAF. Performance guarantee shall be applicable after the missiles and/or sections have been tested and checked-out in accordance with the RCAF Engineering Orders using related standard and/or specialized test equipment. This testing and check-out shall require less than 70 minutes, exclusive of time required to remove the missile and/or sections from packaged storage. The average testing and checkout time shall be less than 32 minutes. The replacement of defective sections due to random failures shall be considered part of the test and check out time. The following shall define the conditions to be encountered:

3.1.13.6.1.1 Packaged Storage Conditions - The equipment shall withstand conditions as laid down in Specification MIL-P-9024.

3.1.13.6.2 Unpackaged Storage - The assembled missile, after unpackaging, shall be capable of storage for a period of 120 days under conditions to be encountered in service. The missile shall be capable of guaranteed performance (See 3.1.1.2.1) after being tested and checked out in accordance with RCAF Engineering Orders using related standard and/or specialized test equipment. The time required to test and check-out the missile following such storage shall be less than 40 minutes, exclusive of the time required to remove the missile from unpackaged storage. The average testing and check-out time shall be less than 22 minutes. Replacement of defective sections due to random failures shall be considered a part of the test and check-out time. The following shall define the conditions to be encountered:

3.1.13.6.2.1 Unpackaged Storage Conditions - The equipment shall withstand the following conditions during assembled storage:

- (1) Temperature - -40 °F to +125 °F.
- (2) Altitude - Barometric pressure ranging from 31.3 to 20.6 inches of mercury (up to approximately 10,000 feet).
- (3) Humidity - Relative humidity ranging up to 95% at temperatures ranging up to +95 °F.
- (4) Vibration - Vibratory acceleration in the frequency range of 10 to 25 cps of 1/2g.
- (5) Shock - A series of six handling shocks of 30 g's for a duration of 11 ± 1 milliseconds, one in each direction along each of the three mutually perpendicular missile axes.
- (6) Salt Spray - The completely assembled missile shall be capable of withstanding exposure to a salt spray for a period of 2 hours in accordance with the requirements of Specification MIL-T-5422, followed by 30 days storage after which the missile shall be free of corrosion which affects operation. Open sections of the missile shall not be subjected to salt spray unless the ends are protected by suitable covers.

3. REQUIREMENTS (Cont'd)3.1.13.6.2.1 Unpackaged Storage Conditions (Cont'd)

- (7) Sand and Dust - The completely assembled missile shall be exposed to an atmosphere of sand and dust for a period of 4 hours in accordance with the requirements of Specification MIL-STD-210 at a velocity of 3520 feet per minute. Open sections of the missile shall not be subjected to sand and dust unless the ends are protected by suitable covers except as specified for the radome in Specification XAV-33.

3.1.14 Materials - Materials shall conform to the requirements specifications and drawings to be selected from the lists specified in para 2. The selection of materials shall be made with special attention being given to the stringent requirements of temperature, temperature gradients, thermal conductivity, vibrations, loads and light-weight construction. When necessary to use other than specification materials the contractor shall submit evidence (test reports, etc.) to demonstrate that the replacement material has performance characteristics satisfactory for the intended application and acceptable to the RCAF. Where applicable RCAF Standards for sizes and gauges exist, they shall be used.

3.1.14.1 Critical and Strategic Materials - Materials shall also be selected on the basis of suitability and relative availability, taking into account the additional restrictions created during time of national emergency.

3.1.14.2 Non-Metallic and Sandwich Construction - Non-metallic materials, such as fiber glass laminates and sandwich construction may be used in structural applications approved by the RCAF subject to conformance with material and contractor-prepared process specifications approved by the RCAF

3.1.14.3 Moisture and Fungus Resistance - Unless otherwise specified, materials shall be used which will resist the corrosive action of salt air and damage from moisture and fungus. Protective coatings will not be acceptable as moisture, fungus, and corrosion preventatives on parts which will lose the coatings during the normal course of inspection, maintenance, and periodic tests.

3.1.14.4 Electrolytic Corrosion of Metal Parts - The use of dissimilar metals in immediate contact that tend to activate electrolytic corrosion in the presence of moisture or salt spray shall be avoided. This has particular reference to dissimilar metals as defined in Specification MIL-E-8189. Where the use of such metals in immediate contact cannot be avoided, particular care shall be given to the insulation of such parts.

3.1.14.5 Adhesive Bonding - Structural bonding adhesives may be used in structural applications approved by the RCAF subject to conformance with material and contractor-prepared process specifications approved by the USN for this missile.

3.1.14.6 Tubing - Tubing which is structural or a part of the surface control system, shall have a minimum wall thickness 0.035 inch unless otherwise authorized by the RCAF.

3. REQUIREMENTS (Cont'd)

- 3.1.14.7 Castings - Aluminum and magnesium alloys and steel are permitted for both structural and nonstructural castings subject to compliance with Specifications ANC-5 and MIL-C-6021.
- 3.1.14.8 Magnesium Alloys - Magnesium alloy castings and wrought forms shall conform with the specifications in 2.1.2. The use of wrought magnesium alloys for primary structure or in applications which are inaccessible or exposed to severely corrosive conditions may be approved by the RCAF provided the RCAF is informed of such applications. Aluminum alloy 56S rivets only shall be used for riveting magnesium alloy parts.
- 3.1.15 Processes - Standard aircraft processes, and special processes as approved by the RCAF, developed for manufacturing of guided missiles shall be used.
- 3.1.15.1 Metal Forming - Consideration shall be given to the use of casting, forging, stamping, extruding and other processes in which relative advantages of economy and efficient use of material may be obtained and which are capable of greatly accelerated production without severe manpower or facilities limitations.
- 3.1.15.2 Welding - Spot and seam welding of aluminum alloys and magnesium alloy shall be in accordance with Class B requirements of Specification MIL-W-6860. If practicable, fusion welding of all magnesium base alloys shall be by the inert-arc process. Joints depending on welding in tension shall be avoided where practicable. Electric welding, such as electric arc and electric resistance welding, may be used subject to the applicable specifications in 2.1.2. Spot and seam welding of low carbon corrosion resisting steels and nickel alloys shall be in accordance with Specification MIL-W-6858. The flash welding of carbon and low alloy steels shall be in accordance with Specification MIL-W-6873. The fusion welding of aluminum, magnesium and steel shall be in accordance with Specification MIL-W-8604, MIL-W-18326 and MIL-W-8611, respectively. Welding operators shall be certified in accordance with the requirements of Specification MIL-T-5021.
- 3.1.15.3 Brazing and Hard Soldering - For purposes of this specification, brazing and hard soldering alloys shall be defined as joining alloys melting above 1000 °F. For design purposes, brazed or soldered joints in tension shall not be depended on for any calculated strength. Allowable shear strengths shall be in accordance with Specification MIL-A-8629 or as approved by the RCAF. Critical structural parts shall not be brazed or hard soldered. Brazing or hard soldering shall be done by either dip, flame, or furnace methods. Where an oxyacetylene flame for brazing is used, it shall be neutral or slightly oxidizing. Subsequent fusion welding operations within 2 inches of a joint or other welding operations which might deleteriously affect the joint, are prohibited.
- 3.1.15.4 Soft Soldering - For purposes of this specification soft soldering alloys shall be defined as joining alloys melting below 1000 °F. Soft soldering shall not be depended on for any calculated strength. Restrictions on brazing specified in 3.1.15.3 also apply to soft soldered joints. Soft soldering used in electronic equipment shall be in accordance with applicable specifications.

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3. REQUIREMENTS (Cont'd)

3.1.15.5 Heat Treatment - Alloy steels may be heat-treated to maximum range of 200,000 to 220,000 pounds per square inch provided a minimum temperature 850°F, or as specified in Spec. MIL-H-6875 whichever temperature is lower, is used. Heat treatment of higher strengths may be used if specifically approved by the RCAF

3.1.15.6 Work Hardening - Work hardening of parts resulting from stamping, drawings, or rolling operations, in lieu of hardening by heat treatment, shall be subject to approval by the RCAF.

3.1.15.7 Magnetic Particle Inspection - Parts and accessories shall be magnetic particle inspected in accordance with specification MIL-I-6870.

3.1.16 Design for Rapid Launching - See 3.1.36

3.1.17 Servicing and Testing - The missile shall provide means for positive periodic tests throughout the life of the missile to insure proper combat operation on short notice. Maintenance procedures during test and check-out using related specialized test equipment shall be based on the practice of correcting troubles by replacing easily removable and replaceable units and not requiring detailed diagnostic analyses. All equipment and components subject to removal for inspection and test shall be designed for removal and replacement with a view toward minimizing the time and cost required to accomplish these operations. The missile shall be capable of being checked out by "go-no-go" test equipment.

3.1.18 Access and Inspection - Each section of the missile shall be designed to provide access to all components contained therein, requiring removal, adjustment or check. Provision for accessibility to the interior of the assembled missile need not be provided.

3.1.19 Shock and Vibration

3.1.19.1 Transportation - The packaged missile and/or sections covered by this specification shall be capable of meeting the shock and vibration conditions specified in 3.1.13.6.1.1.

3.1.19.2 Shock - See 3.1.13.1 (5), 3.1.13.2 (4) and 3.1.13.6.2.1 (5).

3.1.19.3 Vibration - Missile sections shall operate satisfactorily during and after vibration as specified below. The vibration shall be applied to the missile when the missile is suspended in a manner simulating the flight conditions. Vibration levels shall be measured at the point of application of the force and at the forward end of the guidance section, and the higher of the two shall be used as the test value.

3.1.19.3.1 Free Flight - With the gyro antenna uncaged and up to operating speed, vary the vibration frequency from minimum to maximum and return in approximately one minute. The vibration shall be applied along the longitudinal, vertical, and horizontal axes separately for a period of 3 minutes according to each of the following frequency and amplitude schedules:

- (a) Frequency range 10 to 60 cps; peak acceleration of 3 g's vector.
- (b) Frequency range 60 to 500 cps; peak acceleration of 5 g's vector.

3. REQUIREMENTS (Cont'd)3.1.19.3.1 Free Flight (Cont'd)

- (c) Frequency range 500 to 1000 cps; peak acceleration of 7 g's vector.
- (d) Frequency range 1000 to 2000 cps; peak acceleration of 10 g s vector.

3.1.19.3.2 Captive Flight - With the gyro antenna caged and up to operating speed, the vibration of 3.1.13.2 (8) shall be applicable.

3.1.19.4 Acceleration, Sustained - Missile sections, less gyro elements, selected at random, shall operate satisfactorily during and after sustained accelerations of 40g along the longitudinal axis and 25g along any other two mutually perpendicular lateral axes. The duration of the accelerations shall be greater than 5 seconds and the test shall be operated 3 times with the equipment operating. Requirements for the gyro elements are as specified in Specifications XAV-33, XAV-34 and XAV-35.

3.1.20 Water Tightness - See 3.1.13.1, 3.1.13.2 and 3.1.13.6.2.1.

3.1.21 Water Recoverable Type Missiles - Provision for water recovery is not required.

3.1.22 Rust, Sand, Rain and Snow - See 3.1.13.1, 3.1.13.2 and 3.1.13.6.2.1

3.1.23 Lubrication - Lubrication fittings or other suitable means shall be provided for the control system and other movable parts only insofar as to maintain satisfactory lubrication of all such parts for tactical missiles during a single flight. These lubricants shall not interfere with the proper operation of the control and guidance section. Low temperature grease lubricant shall conform to Specification MIL-G-3278.

3.1.24 Physical Reference - Physical references shall be provided for measuring and levelling each missile, for weighing and for structural alignment. Structural members which are parallel to the reference planes shall preferably be used as the levelling references. A jig located structural member shall preferably be used as a jig joint for taking measurements.

3.1.25 Handling - The missile shall be clearly marked showing the proper location of support when the missile is normally placed on supports such as dollies or slings to prevent damage to fragile sections or components. All external provisions subject to damage in shipping and handling shall be protected by substantial, easily removable guards, or shall themselves be easily removable and replaceable. The capability for handling shall include provision for lifting, and similar operations conducted on the ground prior to and during preparation of the missile for launching.

3.1.25.1 Towing - Provisions for towing are not required.

3.1.25.2 Hoisting (Lifting) - Provision shall be made to permit lifting and handling the complete missile and missile sections.

3.1.25.3 Jacking - Provision for jacking is not required.

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3. REQUIREMENTS (Cont'd)

3.1.26 Finish - Finish shall be in accordance with Specification MIL-F-7179, except where special finishes are required to meet environmental requirements. These special finishes shall be as approved by the RCAF. In addition, insulation and finish of magnesium shall be as approved by the RCAF.

3.1.26.1 Surface Texture - The exposed surface shall present a degree of finish, consistent with performance and other requirements and shall be free from gross waviness, dents, buckles, scratches, projections and rough areas.

3.1.27 Identification and Marking - The contractor shall obtain from the RCAF an official designation for all components for which designation is required. Component nomenclature and nameplates shall be in accordance with Specification PROC 100-4. All missiles and missile components shall be marked in accordance with Specification PROC 100-4. All markings which would tend to disclose vital information to the enemy upon capture shall be of such a nature as to be readily removable prior to take-off of launch airplane. Interchangeable parts and assemblies shall be legibly marked with part numbers by the use of a rubber stamp using waterproof ink, pressure sensitive labels, embossing, or by a stencil. A manufacturer's nameplate or decalcomania shall be provided in each missile. The nameplate data shall include the missile model designation, contract number, missile serial number. The serial number series shall be as specified by the RCAF. All main operating levers, linkages, knobs, etc., which may be operated during ground check or warmup periods, shall be suitably marked to indicate the direction of movement for proper operation. Brief instructions and safety precautions shall be provided. Exterior color shall be in accordance with Specification MIL-C-18263.

3.1.27.1 Exterior Markings - Exterior markings shall be applied in accordance with Specification MIL-F-18264.

3.1.28 Anti-Corrosion Provisions - The missile elements exclusive of government furnished equipment shall be constructed in such a manner that corrosion sufficient to adversely affect the mission shall not result from holding of rain water, salt water or equivalent corrosives. Crevices, hollows, pockets, etc., which are not self-draining shall be avoided or shall be provided with suitable drains when the missile is in a normal captive flight, handling or storage attitude. The design of struts and welded tube struts and welded tube structures when practicable, shall provide for airtight closure by welding, anti-corrosion treatment, and subsequent positive sealing. At the discretion of the RCAF, permanent type protective coatings may be used internally in lieu of airtight closures. This requirement may be relaxed in the event sufficient protection is afforded by packaging during all phases of storage, handling and launching.

3.1.29 Government-Furnished Equipment - Government-furnished missile equipment or parts thereof shall not be modified by the contractor without specific permission by the RCAF in each case.

3.1.29.1 Equipment Furnished by Contractor - The contractor shall furnish all equipment not specified as being furnished by the Government.

3. REQUIREMENTS (Cont'd)

3.1.29.2 Equipment Installed by Contractor - The contractor shall install all equipment not specified herein as being installed by the Government.

3.1.30 Standard and Commercial Parts

3.1.30.1 Selection - The number of different types and sizes of standard hardware and fittings shall be kept to a practicable minimum.

3.1.30.2 Types and Sizes - Specific parts shall be selected from those which are in common use or readily available. The fullest practicable use, commensurate with design requirements, shall be made of standard parts and parts approved by the RCAF.

3.1.30.3 Electron Tubes - Electron tubes shall be as specified in Specifications XAV-33, XAV-34 and XAV-35.

3.1.30.4 Bushings - Tolerances on bushings or bearings pressed into aluminum and magnesium-alloy fitting parts shall be such that the residual stress in the fitting imposed by the seated bushing shall not exceed 50 percent of the yield stress of the material. When lubricants are used to prevent galling of the surface during the pressing operation, they shall be of a type which will not cause corrosion. Bushings need not be designed for oversize bolts. Holes that are not bushed need not be designed to permit oversize reaming.

3.1.30.5 Bearings - Hinges on movable surfaces and moving parts of the control system shall be provided with bearings, the friction of which, under aerodynamic loads, will not cause control moments higher than the capacity of the control actuating mechanisms. Bearings with thrust loads not greater than 5% of the radial load, may be fastened by staking or spinning. Special attention shall be given to the number and location of bearings or hinges on control surfaces in order that binding will not occur due to distortion of the surfaces.

3.1.30.6 Bolts

3.1.30.6.1 Taper Bolts - Taper bolts shall be used only upon specific approval of the RCAF. Taper pins shall be threaded and shall be secured with nuts and cotter pins or self-locking nuts subject to the restrictions specified in 3.1.30.10. Clevis bolts with shear nut properly secured by cotter pins shall be used in all locations where loss of the bolt would adversely affect operation of the missile. Self-locking nuts may be used with clevis bolts in such locations subject to the restrictions specified in 3.1.30.10.

3.1.30.6.2 Shank Lengths - The shanks of all structural bolts shall be of such length that not more than one thread will be below the surface of the material being bolted, except where #8 and smaller bolts are used. In cases where the minimum grip of the proper length bolt is slightly greater than the thickness of material to be bolted, a washer shall be used to make up the difference. In cases where the shank length exceeds the thickness of material to be bolted, not more than two washers each .064 inch thick shall be used to make up the difference.

3. REQUIREMENTS (Cont'd)

3.1.30.6.3 Lockbolts and Hi-shear Rivets - Lockbolts and Hi-shear rivets may be used in applications approved by the RCAF.

3.1.30.6.4 Aircraft Bolts - Aircraft bolts shall be used for structural application. Cadmium plated bolts without aluminum alloy washers may be used if corrosion preventatives are also used. Approved internal wrenching bolts may be used in high strength (160,000 - 180,000 psi) applications.

3.1.30.7 Screws - Aluminum-alloy screws smaller than No. 6 shall not be used. Aluminum-alloy screws smaller than No. 10-32 shall be coarse thread series. Aluminum-alloy screws smaller than 1/4 inch diameter shall not be used as structural fasteners. Unless otherwise specified, self-tapping screws shall not be used in any application requiring their removal during normal servicing, test, and pre-flight assembly of the missile.

3.1.30.8 Seals and Connections - Seals and connections subject to deterioration shall be readily replaceable.

3.1.30.9 Rivets - Rivets shall conform to applicable ANA standards. Aluminum alloy round-head rivets, flat-head rivets, and brazier-head rivets shall be replaceable in service by universal-head rivets of the same diameter and material. Blind rivets shall be of an approved type; applications of blind rivets shall be subject to RCAF approval. Hollow rivets may be used as specifically approved by the RCAF. Flush rivetting shall be of the following types:

- (1) Conventional type involving driving of rivet without milling rivet head.
- (2) Conventional type involving driving of rivet and milling of manufactured rivet head.
- (3) NACA type involving driving of rivet and milling of driven rivet head.

The milling operation necessary for types (2) and (3) shall be performed with tools designed for this purpose and which will not cause any damage to the surface of the riveted sheet beyond occasional localized superficial scratching.

3.1.30.10 Nuts - All nuts for structural applications, except self-locking nuts and nuts for machine screws, shall be locked by cotter pins or safety wire except where the RCAF permits locking by peening the end of the bolt over the nut. Bolts and machine screws may be peened when used in place of rivets as a permanent or semi-permanent installation or where access is usually difficult and infrequent. Plain uncastelled nuts shall be used with peened bolts. Riveted pins or peened bolts shall be used in all universal joints. Shear or other types of nuts which have a fewer number of complete threads than the standard tension type shall not be used in primary structures in which the principal bolt loads are tensile, or where high tensile stresses are required in the bolts to maintain tightness or rigidity of the assembly. For such applications, standard tension nuts shall be used. Self-locking nuts, when used, shall be used subject to the restrictions of Dwg MS33588.

### 3. REQUIREMENTS (Cont'd)

3.1.30.11 Washers in Bushed Fittings - Where nuts and heads of bolts, or the heads of flat-headed pins, used in bushed fittings are not enough larger than the outside diameter of the bushing to prevent shifting of the bushings, washers of appropriate diameter and thickness shall be provided under the nuts or heads as required.

3.1.31 Threads - The tapping of screw threads in fittings, lugs, or other special parts for use with bolts or screws is not considered good practice, and shall not be used without approval of the RCAF. This requirement does not apply to special threaded fittings used in the ends of tubing for length adjustment, but does apply to sheet metal fittings, castings and forgings where bolts or special screws are in shear and bearing even though primarily designed for tension regardless of the method used for locking these bolts or screws. Threads shall conform to Specification MIL-S-7742. Internal screw threads in fittings, lugs, or other special parts for insertion of bolts or screws may be used subject to approval of the RCAF.

3.1.32 Holes - All holes shall be clean-cut and shall show no evidence of excessive deformation at the periphery. Holes for blind rivets shall be in accordance with the recommendations of the rivet manufacturer.

3.1.33 Ball and Socket Joints - Ball and socket joints shall not be used in any main structural member or structural assembly except as otherwise approved by the RCAF.

3.1.34 Fittings - Structural fittings shall be made from suitable aluminum alloy, steel, magnesium alloy, or other approved materials within the limitations specified herein or other applicable RCAF publications. Uniformity of materials for fittings shall be preserved insofar as practicable.

3.1.34.1 Use of 24ST or 17ST Fittings - In the event special circumstances necessitate the use of 24ST or 17ST fittings which are to be produced by machining to a considerable depth and which are to contain pressed-in heavy metal inserts not zinc or cadmium plated, the fittings shall be reheat-treated after removal of most of the excess stock. Reheat-treatment of fittings which are to be artificially aged is not required.

3.1.35 Design for Shipment - Missiles shall be capable of being shipped in a partly dis-assembled condition.

3.1.36 Readiness - The missile shall have the following performance with regard to readiness:

(a) Checkout Prior to Ready Storage - Using related standard and/or specialized test equipment, the time to connect the missile to the missile test equipment, to perform the checkout, and to disconnect the equipment from the missile, shall be less than 12 minutes. The missile shall maintain full effectiveness in the ready storage condition without further check, except for pressurization required by sections, for a period of 30 days.

(b) Pre-flight Servicing - A missile drawn from ready storage shall require less than five minutes for pre-flight servicing, exclusive of the time necessary to remove the missile from the ready storage area.

### 3. REQUIREMENTS (Cont'd)

#### 3.1.36 Readiness (Cont'd)

- (c) Installation on Aircraft - The missile, having undergone prior pre-flight servicing, shall require less than five minutes for attaching the missile to the aircraft, for boresight check, and for safety check. Full effectiveness shall be maintained for 72 hours.
- (d) In-Flight Readiness - Having undergone ready storage checkout (within 30 days) followed by a pre-flight servicing and installation on the aircraft, the missile shall be capable of being brought to warmed-up, ready-to-launch condition within 2 minutes after missile switch-on, provided that hydraulic oil is at operating temperature. The time required to bring the hydraulic oil to operating temperature shall be five minutes from +20 °F, 10 minutes from 0 °F, 25 minutes from -67 °F. The missile shall maintain this readiness for 24 hours.

#### 3.2 Aerodynamics and Ballistic - The design shall have such characteristics as to enable the missile to meet the performance specified herein.

3.2.1 Control - The aerodynamic controls shall have such characteristics as to enable the missile to meet the performance specified herein.

3.2.2 Stability - The missile shall have such aerodynamic stability characteristics as to enable the missile to meet the performance specified herein.

3.2.2.1 Adjustments for Stability - Provision need not be made to make ground adjustments.

3.2.3 Wing Aerodynamics - See 3.2.

#### 3.3 Structural Design

3.3.1 Structural Requirements - The structural design of the missile and components shall be such as to allow achievement of the performance requirements specified herein.

3.3.2 Strength and Rigidity - Compliance with the requirements for the prevention of flutter in accordance with MIL-A-8629 may be demonstrated by submittal of pertinent flight test data and/or analysis. Strength and rigidity shall be provided throughout the structure to withstand all design loads with positive margins of safety in all cases; at limit or applied loads there shall be no deflections or deformations detrimental to the performance characteristics of the missile. The design gross weight shall be the gross weight at launching. Strength shall be provided for the effects of aerodynamic heating and secondary stresses induced by structural deflection and the structure shall be capable of successfully withstanding the loading conditions specified herein.

3. REQUIREMENTS (Cont'd)3.3.3 Factors of Safety - The safety factors in the missile shall be as follows:

- |  |      |
|--|------|
| (1) All structures except as noted herein  | 1.00 |
| (2) Handling loads   | 1.00 |
| (3) Castings   | 1.00 |
| (4) Fittings   |      |
| (a) Analyzed but not proof tested  | 1.15 |
| (b) Proof tested (When yield strength is above 0.85<br>of ultimate use 0.85 ultimate as the yield strength). |      |
| (5) Bearing in accordance with ANC-5   |      |
| (6) Joints   |      |
| (a) Fusion welding in accordance with ANC-5 or specifically as approved by<br>the RCAF.                      |      |
| (b) Spotwelded in accordance with ANC-5.   |      |
| (c) Resistance seam as established by test welded  |      |
| (d) Riveted or bolted  | 1.00 |
| (7) Control System   | 1.00 |

3.3.4 Structural Design Criteria - The product of the limit load or stress and the applicable factor is the design yield load or design ultimate load. The following safety factors shall be applied to the limit loads:

- (1) Handling Conditions - For ground handling or loading conditions involving hazards to personnel, the yield factor shall be 1.15 and the ultimate factor shall be 1.50.
- (2) Launching Conditions - For launching conditions or while the missile is being carried by the aircraft, the yield factor shall be 1.15 and the ultimate factor shall be 1.50.
- (3) Flight Conditions - For all normal flight conditions the yield factor shall be 1.0 and the ultimate factor shall be 1.33. For all malfunction flight conditions the ultimate factor shall be 1.0.

3.3.5 Handling Loads - Strength shall be provided for a handling limit load factor of 2.67 reacted at the lifting lug, or other support points.3.3.6 Flight Loads - Limit strength shall be provided throughout the airframe structure for the maximum flight loads capable of being imposed by the normal operation control system except that load corresponding to the following conditions need not be exceeded:

## (1) NORMAL OPERATION

CONDITION I - A transient lateral acceleration of 27g in the combined 45° plane.

CONDITION II - A transient rate of roll of 400 degrees per second.

CONDITION III - Condition II superimposed on Condition I.

3. REQUIREMENTS (Cont'd)

3.3.6 Flight Loads (Cont'd)

CONDITION IV - A 20 foot per second gust superimposed on a trim manoeuvre of 20g in the 45° plane.

CONDITION V - MAXIMUM longitudinal acceleration at the end of motor burning.

(2) MALFUNCTION OPERATION - Defined as an operation resulting from any single failure in the control system.

CONDITION I - A transient lateral acceleration of 40g in the combined 45° plane.  
CONDITION II - A maximum rate of roll achieved with differential wing deflection of 6°.  
CONDITION III - A transient resulting from maximum yaw deflection combined with differential wing deflection of 6°.

3.3.7 Captive Loads - Strength shall be provided in accordance with the applicable sections of Specification MIL-A-8591 for flight conditions while the missile is attached to the launching aircraft.

3.3.8 Allowable Loads and Stresses - MIL-A-8629 shall apply except that minimum guaranteed properties shall be used for the determination of allowable stresses. Elevated temperature due to aerodynamic heating or propulsion system operation, in excess of those covered by MIL-A-8629 and ANC-5, shall be based on the best elevated temperature test data available.

3.4 Wings - The wing group shall consist of cruciform configuration of four movable panels which may also act as control surfaces. The four panels shall be of modified delta planform.

3.4.1 Construction - The wing panels may be constructed from forgings, castings, extrusions, or plates of aluminum alloy, or other material approved by the RCAF.

3.5 Control and Stabilizing Surfaces

3.5.1 Control Surfaces - Since the wings are movable and act as control surfaces, no other control surfaces are required.

3.5.2 Stabilizing Surfaces - The stabilizing surfaces shall consist of cruciform configuration of four fixed panels of delta planform mounted on a removable collar.

3.6 Jet Vanes - Provision for jet vanes is not required.

3.7 Body Group - The body group shall consist of the fuselage only.

3.7.1 Fuselage - The fuselage shall consist of the fuselage proper. The fuselage shall be sectionalized as specified in 3.1.10. Suitable provision shall be made for the installation of necessary equipment.

3.7.2 Construction - The fuselage sections may be constructed of castings, extrusion or built-up structure, and material may be either aluminum alloy, magnesium alloy, steel or other materials approved by the RCAF.

3. REQUIREMENTS (Cont'd)

3.8 Launching and Recovery

3.8.1 Launching Provisions - The missile launching provisions shall be compatible with the provisions on the Arrow aircraft for the carriage and launching of the missile. Jettisoning provision shall be made for safe missile release from the launching aircraft without motor ignition or warhead arming.

3.8.1.1 Surface Launching (Ground or Water) - Provision for surface launching is not required.

3.8.1.2 Air Launching - The missile shall be coordinated with the launching aircraft and associated launching equipment including the ~~Arrow~~ Guided Missile Launcher for the Arrow aircraft to assure the release and clear separation of the missile, including umbilical connector, during launching operations. Launching shall be affected through the ignition of the missile power plant by electrical controls in the launching aircraft.

3.8.1.3 Boosters - Provision for boosters is not required.

3.8.2 Recovery Gear - Provision for recovery gear is not required.

3.9 Propulsion Unit Section - The propulsion unit section consists of the motor, igniter and igniter safety switch.

3.10 Propulsion

3.10.1 Power Plant - A solid propellant motor will be furnished by the Government. The motor will be in accordance with Appendix 1.

3.10.2 Propellants

3.10.3 Liquid Propellant System - Provision for a liquid propellant system is not required.

3.10.4 Starting and Ignition Systems

3.10.4.1 Starting - Provision for starting shall consist of the igniter and associated wiring to the umbilical plug.

3.10.4.2 Ignition - The igniter and igniter safety switch will be government-furnished and suitable for use with the power plant specified in 3.10.1. Igniters shall be accessible for installation and replacement, when the power plant is detached from the missile proper.

3.10.4.2.1 Electrical - Ignition or igniter circuits, shall be secured against excessive vibration and shall be adequately protected against short-circuits or grounds due to chafing. Ignition circuits shall be so installed that they shall be protected from excessive dampness due to spray, rain, or fog, and from excessive heat. Ignition circuits shall be isolated to prevent stray currents or current leakage, in order to obtain positive and uniform ignition and to eliminate the possibility of premature ignition.

3. REQUIREMENTS (Cont'd)

- 3.11 Secondary Power Systems - A secondary power system need not be provided.
- 3.12 Fire Detection - A fire detection system need not be provided.
- 3.13 Guidance System - The guidance system shall consist of radar target seeker and shall be provided in accordance with Specification XAV-33.
- 3.14 Control and Stabilization - A control and stabilization system shall be provided in accordance with Specification XAV-34 and XAV-35.
  - 3.14.1 Control System - The control system shall be in accordance with Specification XAV-34 and XAV-35.
  - 3.14.2 Stabilization System - The stabilization system shall be in accordance with Specifications XAV-34 and XAV-35.
- 3.15 Electronics - Electronics equipment shall comply with applicable requirements of Specifications XAV-33, XAV-34 and XAV-35.
  - 3.15.1 Installation - Electronic equipment shall be installed with particular attention to providing for ease of operation, servicing and preparation for flight.
  - 3.15.2 Anti-Precipitation Static - Anti-precipitation static provision is not required.
  - 3.15.3 Miscellaneous Instrumentation - Miscellaneous instrumentation need not be provided.
  - 3.15.4 Beacons, IFF and Deflecting Devices - Beacons, IFF and deflecting devices need not be provided.
  - 3.15.5 Radomes - A radome shall be provided in accordance with Specification XAV-32.
  - 3.15.6 Antennas - The AN/DPN-21 antenna shall be provided in accordance with Specification XAV-33.
- 3.16 Electrical
  - 3.16.1 Installation - Electrical equipment shall be provided in accordance with good electrical practices. The over-all electrical installation shall be such that the missile conforms with the intent of Specification MIL-I-6051, except that tests shall be conducted without the rocket motor running.
  - 3.16.2 Electrical Power System - The primary electrical power system shall be provided in accordance with Specification XAV-36. Prior to launch, electrical energy shall be furnished by the launching aircraft electrical system. Suitable means shall be provided for switching from external power to internal power at time of launch.
  - 3.16.3 Electrical Power Conversion - Electrical power conversion system shall be in accordance with Specification XAV-36.

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3. REQUIREMENTS (Cont'd)

- 3.16.4 Wiring - Electrical wiring shall be installed in such a manner as to provide high reliability. Unique or novel wiring system or devices may be utilized to take full advantage of their size, weight, and performance characteristics, subject to approval by the RCAF. The missile shall be compatible and operate satisfactorily with wiring installed in an airplane in accordance with Specification MIL-W-5088.
- 3.16.5 Bonding - Bonding shall be held to a practical minimum. Where used, bonding shall conform to Specification MIL-B-5087.
- 3.16.6 Lighting - Provision for an internal lighting system is not required.
- 3.16.7 Receptacles - Receptacles shall be provided for ground checking and warm-up of all electrical and electronic equipment using external electric power. An umbilical connector shall be provided to connect to the launcher. The connector shall permit positive release at launch. The umbilical connection shall be compatible with the launcher. Electrical power for the missile during prelaunch flight, and launching signals shall be provided through this umbilical connector.
- 3.16.8 Relays - Relays when required, shall be provided in accordance with Specifications XAV-33, XAV-34 and XAV-35.
- 3.16.9 Armament Electrical System - Electrical circuits shall be provided for the armament system of 3.18.
- 3.16.10 Umbilical Cord - An umbilical connector shall be provided in lieu of an umbilical cord.
- 3.17 Hydraulic and Pneumatic System
  - 3.17.1 Hydraulic System - An hydraulic system shall be provided in accordance with Specification XAV-34.
  - 3.17.2 Pneumatic System - A pneumatic system shall be provided in accordance with Specification XAV-35.
    - 3.17.2.1 External Source of Pneumatic Pressure - Provision shall be made to charge the hydraulic accumulator and the turbine power supply with the missile in the assembled condition.
- 3.18 Armament
  - 3.18.1 Warhead Provisions - Provision shall be made for the installation of the fuze and the warhead specified in Appendix 1. This provision shall be suitable for installing exercise head in lieu of warhead. This provision shall also be suitable for installing telemetering equipment in lieu of warhead. The fuze, safety and arming mechanism, and warhead will be furnished by the Government. The missile shall be designed in such a manner that the fuze and warhead can be readily removed and installed.
  - 3.18.2 Arming System - The arming system will be furnished by the government.
  - 3.18.3 Fuze Provisions - The fuze provisions are specified in 3.18.1.

### 3. REQUIREMENTS (Cont'd)

- 3.19 Heating and Cooling - Provision for heating the necessary components shall be made within the missile with adequate power supplied from external electrical sources.
- 3.20 Instrumentation - Provision for instrumentation shall be as mutually agreed upon by the RCAF and the Contractor to meet flight test requirements.
- 3.21 Self Destruction System - A self destruction system will not be provided. If self destruction system is required, it shall be the subject of separate negotiation.
- 3.22 Visual Identification (Tracking) - Provision shall be made for the installation of the spotting charges, pyrotechnic mixture and primers on evaluation missiles. Spotting charges shall be installed when exercise or telemetering equipment is carried.
- 3.23 Handbooks and Logbooks - Handbooks and Engineering Orders shall be provided in the quantities specified in the contract. Logbooks shall be provided in accordance with Addendum No. 13 to Specification MIL-D-8684.
- 3.24 Ballast - Ballast shall be provided if required when telemetering is carried. Ballast shall be securely attached to the missile structure.

### 4. QUALITY ASSURANCE PROVISIONS -

See Addendum No. 13 to MIL-D-8684 and Douglas Report SM-18765A.

### 5. PREPARATION FOR DELIVERY

- 5.1 Packing and Marking for Shipment - Packaging shall be as specified in Specification MIL-P-9024. Marking shall be as specified in the contract

### 6. NOTES

#### 6.1 Definitions

- 6.1.1 Provision for Etc. - The following terms requiring various degrees of "provision" for a specific item or installation, are defined as follows:

- (a) "Space Provision" means that suitable space only shall be reserved.
- (b) "Weight Provision" means that suitable weight allowance to simulate later incorporation of the item or complete installation shall be included in the design gross weights for the missile and in all applicable structural design conditions.
- (c) "Power Provision" means that the primary electrical, hydraulic or pneumatic power and distribution system shall be sufficient to permit later incorporation of the installation without primary power and distribution system modification
- (d) "Provision for" means that complete installation provisions, including all necessary supports, bracketry, wiring, tubing, connectors, interconnecting cables, fittings, etc. are installed for securing the item or equipment in place, ready for operation, without further alterations or additional fabrication of parts. Associated fastenings such as nuts and bolts for the item, are not to be included. The item or equipment, including its provisions, shall be included in the weight empty unless specifically stated in the detail specification to be variable load.

6. NOTES (Cont'd)

6.1.2 Provide and Install - The terms "provide" and "install" when used in this detail specification are defined as follows:

- (a) The term "provide" as related to a specific part of the missile or item of equipment means that the contractor furnishes and installs the part or equipment specified.
- (b) The term "install" as related to a specific part of a missile or item of equipment means that the part or item will be furnished by the Government and installed by the contractor.

6.1.3 Limit Load - The maximum load that will be experienced by the structure under the specified conditions of operation or use. At limit or applied loads there shall be no deflection of the structure components sufficient to prevent the missile from accomplishing its intended mission.

6.1.4 Design Load or Stress - The product of the limit load or stress and the applicable safety factor.

6.1.5 Allowable Load or Stress - The maximum load or stress to which a structural member may be safely subjected. The allowable load shall be based upon the yield strength of the material as defined by a 0.2 percent permanent set, or upon appropriate fatigue strengths when essential to reliable operation. In the case of structures where the design loads are carried through single members, the failure of which would result in the loss of the structure, the guaranteed minimum properties as determined by reliable strength tests, or by acceptable published data such as ANC-5 "Strength of Metal Aircraft Elements" shall be used. In the case of redundant structures, where failure of individual elements would result in the design load being carried by other load-carrying members, allowable loads may be established on the basis of "90% probability" strength, as given in ANC-5.

6.1.6 Proof Load - Load applied for test purpose to determine adequate strength, and shall be equal to the limit load.

6.1.7 Factors of Safety - A factor by which limit loads on structural members are to be increased to provide adequate structural safety as required.

6.1.8 Margins of Safety - The percentage by which the allowable load or stress of a structural member exceeds its design load or stress.

6.1.9 Fittings - Those parts used to connect one structural member to another, but not continuous joints in primary members.

6.2 Warhead Provisions - Provision shall be made for the warhead specified. The installation shall include chock, supports, and necessary accessories. The contractor will be held responsible for maintaining liaison with the development activity designated by RCAF and to supply the RCAF and the warhead contractor with the missile data necessary for the integration of the warhead and missile design.

6. NOTES (Cont'd)

- 6.3 Fuze Provision - It will be the contractor's responsibility to maintain liaison with the development activity designated by RCAF and to supply the RCAF and the fuze contractor with the missile data necessary for the integration of the fuze and missile design.
- 6.4 Contractor Responsibility Concerning Prototype Equipment - When equipment is to be manufactured from drawings, sketches, or other material furnished by RCAF, or patterned after prototype or other equipment furnished by RCAF as a model, the furnishings of any such item does not constitute a waiver to any requirements of this or related specifications. It shall be the responsibility of the contractor to determine whether or not the use of such material conflicts in any manner with the requirements of the applicable specifications, and to notify the RCAF in writing of any changes that are considered to be necessary in either materials or specifications. Where the requirements of this and related specifications refer to information to be furnished by RCAF, the contractor shall be responsible for requesting such information by official correspondence.
- 6.5 Deviation from Specification - If the contractor wishes to suggest alternatives, obtain concessions or otherwise depart from the current issue of this specification, he is to forward his proposals immediately to the Department for approval.
- 6.6 Inquiries - Any questions relating to this specification are to be referred to the Department's authorized representative.
- 6.7 Requests for Documents - Copies of this specification, applicable specifications, publications and drawings, required by contractors, other than those provided by the Department of Defence Production, Ottawa, Ontario, Canada, on acceptance of tender, may be obtained from the local TSU in the contractor area.

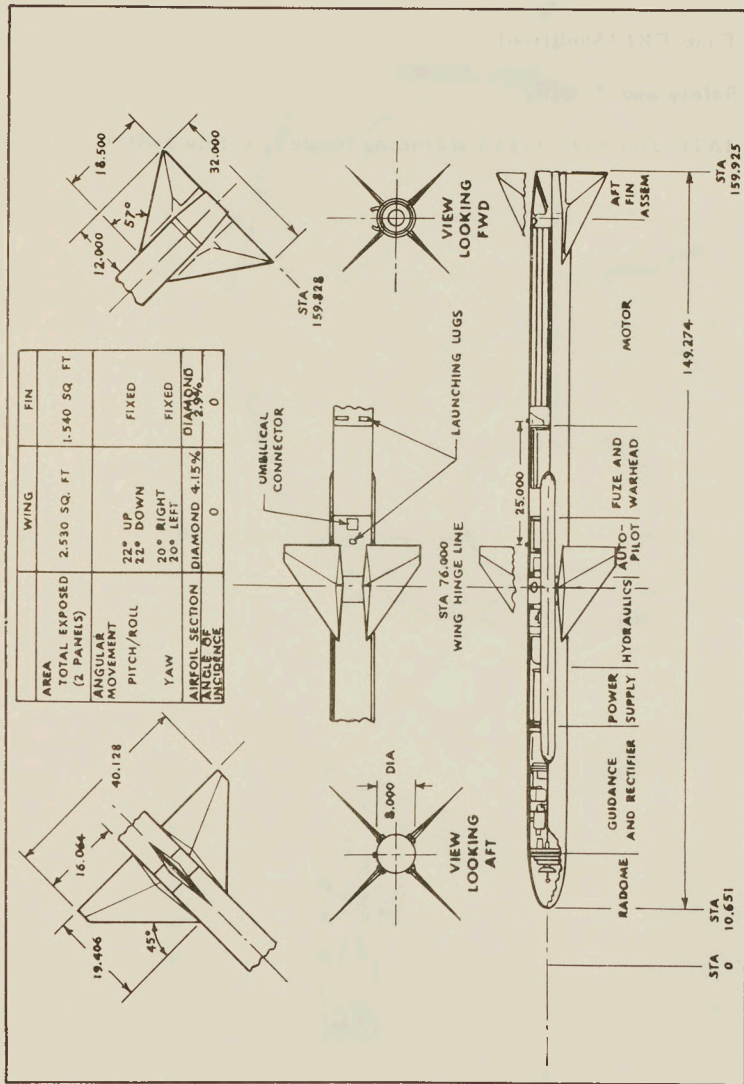
GOVERNMENT FURNISHED EQUIPMENT LIST

The following equipment shall be installed by the contractor:

- (a) Warhead EX5 Mod 1
- (b) Fuse EX2 (Modified)
- (c) Safety and Arming
- (d) JATO 2KS 8600 X121A including igniter, safety switch and launching lugs.

UNCLASSIFIED

Appendix 2 to  
WSC 1-4

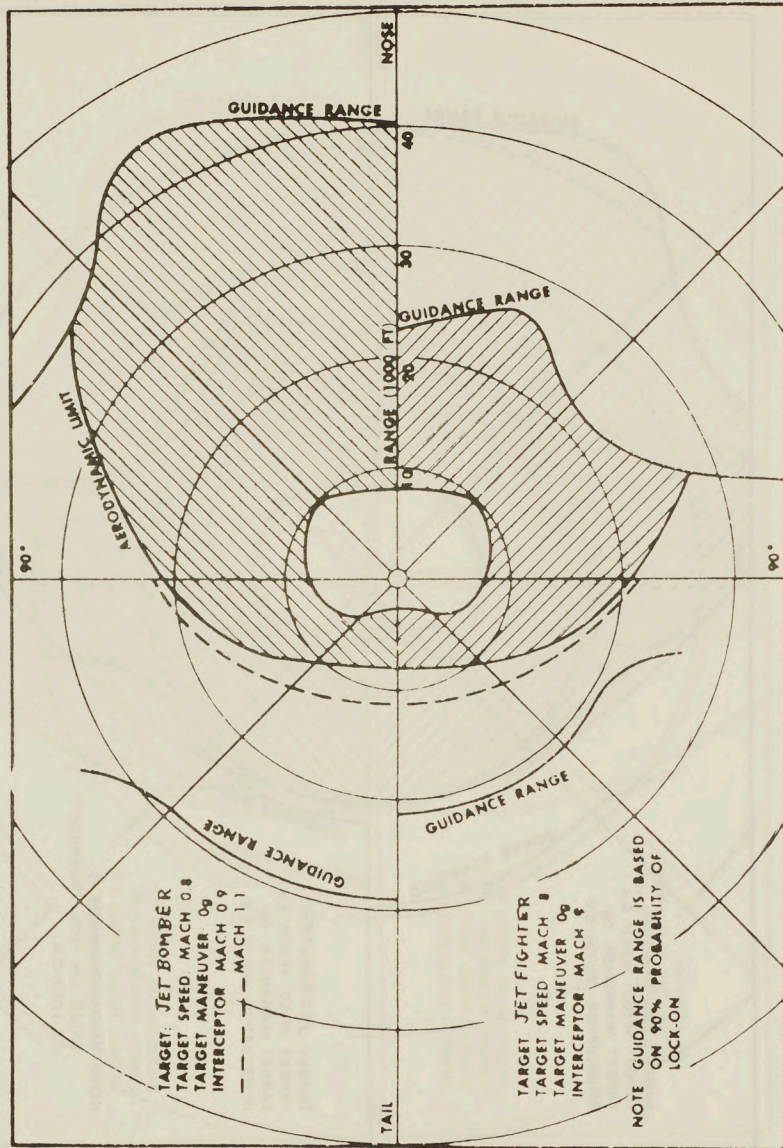


GENERAL ARRANGEMENT AND INBOARD PROFILE

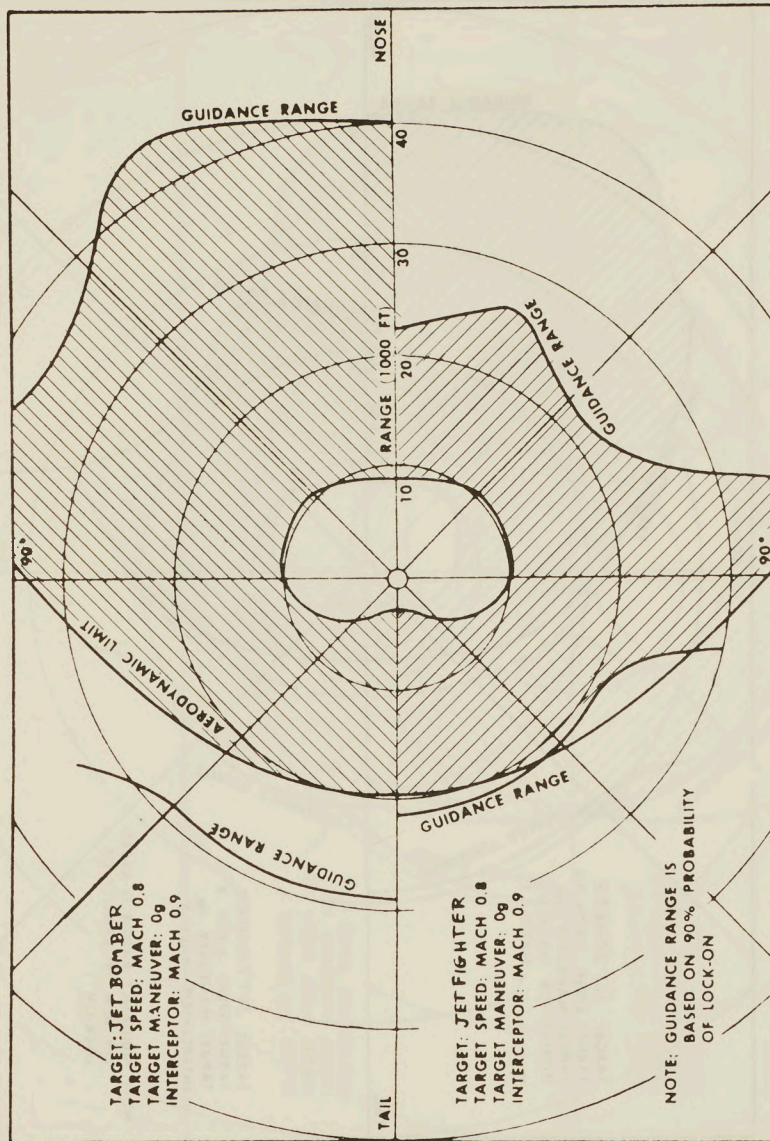
SPARROW 2 MK I

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Appendix 3 to  
WSC 1-4



ALLOWABLE LAUNCHING RANGES - ALTITUDE 30,000 FT. to 5,000 FT

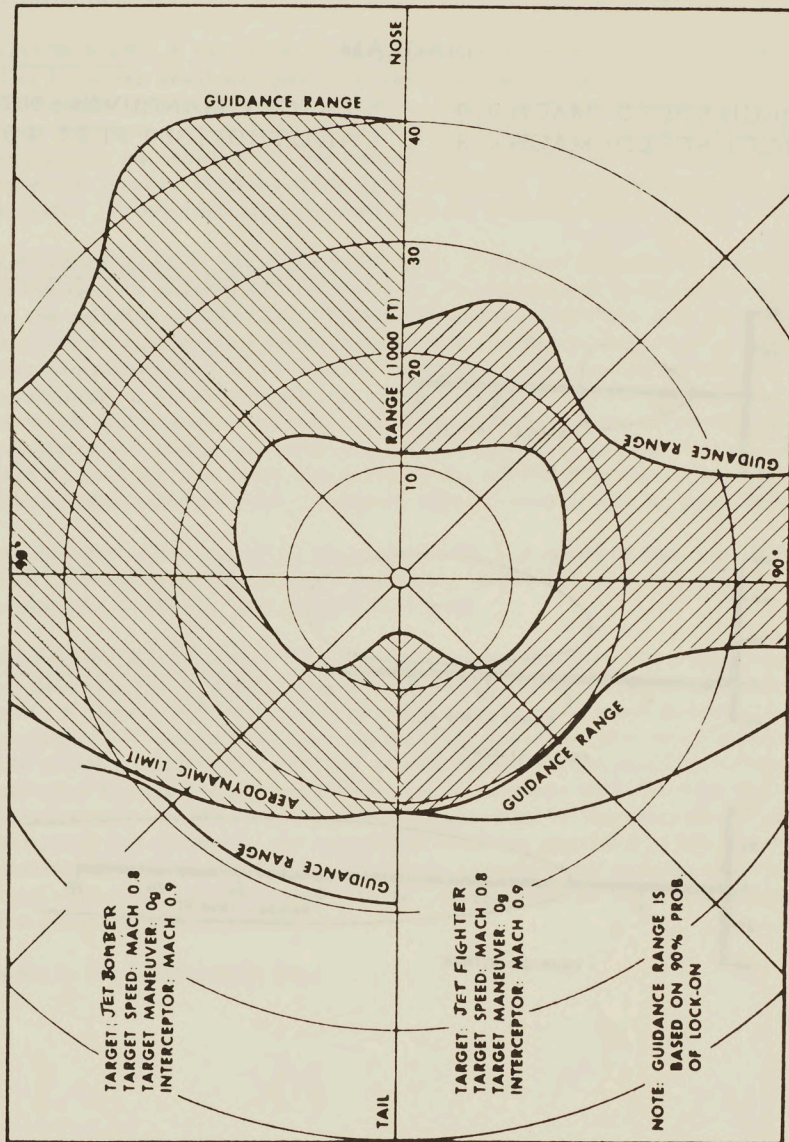


ALLOWABLE LAUNCHING RANGES - ALTITUDE 30,000 FT

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Appendix 5 to  
WSC 1-4



ALLOWABLE LAUNCHING RANGES - ALTITUDE 50,000 FT.

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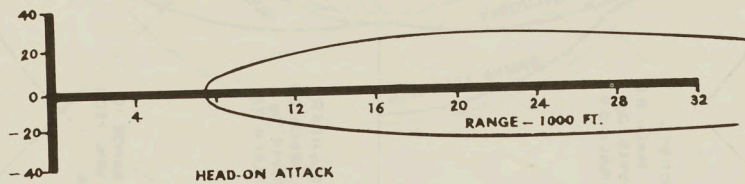
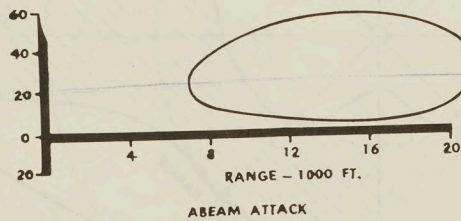
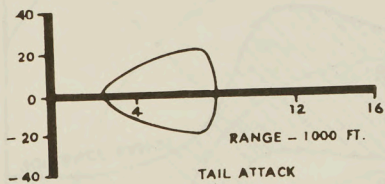
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Appendix 6 to  
WSC 1-4

TYPICAL  
ALLOWABLE LAUNCHING LEAD ANGLE  
DIAGRAM

LAUNCH SPEED: MACH 0.9  
TARGET SPEED: MACH 0.8

TARGET MANEUVER: NONE  
ALTITUDE: 300 FEET TO 5,000 FEET



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Appendix 7 to  
WSC 1-4

LAUNCHING AIRCRAFT EQUIPMENT USED IN CONJUNCTION WITH  
THE MODEL SPARROW 2 MKI GUIDED MISSILE

The missile will be carried by an aircraft provided with the following equipment and delivering the following power:

- (a) LAUNCHER: A rail-type launcher will be provided for each missile station. The launcher shall adequately support and brace the missile beneath the wing of the launching aircraft during launch, flight, and ground conditions. The launcher will house an umbilical connector, and other missile pre-launch control equipment as necessary. The umbilical connector will be suitable for providing external power, rocket engine ignition power, and providing information to the missile. Provisions shall be included for missile jettison.
- (b) LAUNCHING SET, GUIDED MISSILES: A Guided Missile Launching Set will provide such pre-launch functions as are necessary to ensure proper launching of the missile or missiles. These pre-launch functions may include turning on electronic equipment, power conversion, turbines activation, hydraulic arming, missile selection and activation. In addition, the launching set will include equipment to provide angle and range slaving of the missile system to the aircraft radar and a computer for determination of the allowable launch limits for the given range, altitude and closing speeds involved. Suitable switches will be included for jettisoning any or all missiles at the discretion of the pilot. Visual indication of proper missile radar tracking will be provided.
- (c) AI RADAR: The launching aircraft for the all-weather Sparrow II installation will include an airborne intercept radar which will provide search, acquisition, automatic tracking, and beacon functions.
- (d) ELECTRICAL POWER: The parameters for the aircraft power supply will be as described in Specification MIL-E-7894. Power conversion from 115/200 volt, 3 phase, 380-420 cps to 28 VDC may be used when there is an insufficient supply of DC power available for missile operation and when it is shown that the missile requirement for DC power cannot be satisfied by suitable AC powered equipment. Normal filtering, consistent with the size and weight requirements of the missile, shall be provided in the missile. It shall be assumed that filtering, or regulation shall be provided in the aircraft power distribution as necessary to effectively isolate each missile from high transient load variations or conducted interference normal to any other equipment using the common power source.

Note: This Appendix is for information only.

STANDARD JET AIRCRAFT TARGET

RADAR REFLECTIVE CHARACTERISTICS

This diagram presents the fourth root of the radar reflective area in square meters,  $\sigma^{1/4}$ , as a function of the aspect angle of the target.

