INCH-POUND
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PERFORMANCE SPECIFICATION

ENGAGING DEVICE, AIRCRAFT ARRESTING SYSTEM - USAF PENDANT CABLE RETRACTION SYSTEMS (PCRS)

1. SCOPE

1.1 Scope. This specification establishes minimum military-unique operational and suitability requirements for the design, development and testing of United Stated Air Force (USAF) Pendant Cable Retraction Systems (PCRSs).

1.2 Classification. PCRSs are of the following types, as specified (see 6.2).

1.2.1 Types. The types of PCRS are as follows:

Type I – PCRS 150S (see 6.3.5)

Type II – PCRS 150M (see 6.3.6)

Type III – PCRS 200S (see 6.3.7)

Type IV – PCRS 200M (see 6.3.8)

Type V – PCRS 300S (see 6.3.9)

Type VI – PCRS 300M (see 6.3.10)

2. APPLICABLE DOCUMENTS

Comments, suggestions, or questions on this document should be addressed to: WR-ALC/GRVEC, Robins AFB GA 31098-1813. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at https://assist.daps.dla.mil .

AMSC N/A FSC 1710

2.1 General. The documents listed in this section are specified in sections 3, 4, or 5 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3, 4, or 5 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

FEDERAL STANDARDS

FED-STD-595/24052	Green, Semigloss
FED-STD-595/31136	Red, Lusterless
FED-STD-595/37038	Black, Lusterless

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-DTL-5541	Chemical Conversion Coatings on Aluminum and Aluminum Alloys
MIL-DTL-53030	Primer Coating, Epoxy, Water Based, Lead and Chromate Free
MIL-DTL-81706	Chemical Conversion Materials for Coating Aluminum and Aluminum Alloys
MIL-PRF-23377	Primer Coatings: Epoxy, High-Solids
MIL-PRF-26915	Primer Coating, for Steel Surfaces
MIL-PRF-85285	Coating: Polyurethane, Aircraft and Support Equipment

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-130	Identification Marking of U.S. Military Property
MIL-STD-461	Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment
MIL-STD-810	Environmental Engineering Considerations and Laboratory Tests
MIL-STD-882	System Safety
MIL-STD-889	Dissimilar Metals
MIL-STD-1366	Interface Standard for Transportability Criteria
MIL-STD-1472	Human Engineering

(Copies of these documents are available online at https://assist.daps.dla.mil/quicksearch/ or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.2.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

NAVAL AIR WARFARE CENTER (CAGE 80020)

NAVAIR DRAWING 515053	1 1/4 Dia. Non-rotating Wire Rope

(Copies of this document are available from the Naval Air Systems Command, Code 4.1.4, Lakehurst, NJ 08733-5100.)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

AMERICAN WELDING SOCIETY (AWS)

D1.1/D1.1M	Structural Welding Code–Steel
D1.2/D1.2M	Structural Welding Code–Aluminum

(Application for copies should be addressed to American Welding Society, 550 N.W. LeJeune Road, Miami FL 33126) may be obtained online at http://www.aws.org .

GULF & WESTERN (CAGE 24139)

DRAWING 52-W-2295-201	Arresting Gear Fairlead Unit Assembly

(Copies of these documents are available from WR-ALC/GRVEC, Robins AFB GA 31098-1813).

2.4 Order of precedence. Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein (except for related specification sheets), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 First article. When specified (see 6.2), one PCRS shall be subjected to inspections in accordance with 4.1.

3.2 PCRS description. In general, the PCRS is designed as a radio-controlled hydraulically or pneumatically operated two-position system intended for permanent installation at USAF airfield runway surfaces. It is an engaging device (pendant cable) support system compatible with tail

hooked equipped fighter aircraft, and is used in conjunction with Aircraft Arresting System (AAS) energy absorbing braking units (see 6.3.1). The PCRS's primary functions are:

a. raising and suspending the center of the pendant cable (see 6.3.3) 3-inches above and across a runway top surface

b. lowering and removing the pendant cable into a position below the runway top surface

Raising the pendant cable is necessary when required by fighter aircraft during in-flight, takeoff, or landing emergencies. Lowering the pendant cable allows non-troubled or non-tail hook equipped aircraft to traverse the runway unimpeded. The pendant cable positions are controllable from the runway edge, at split distances (see 6.3.4) up to 350-feet, and from the Air Traffic Control Tower (ATCT).

3.3 Design and construction. The PCRS shall be designed and constructed so that no parts will work loose in service. They shall be built to withstand the strains, jars, vibrations, and other conditions incident to shipping, storage, installation, and service. They shall be weatherproof and designed to prevent the intrusion of water and sand into critical operating components.

3.3.1 Materials, protective coatings, and finish.

3.3.1.1 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable materials should be used to the maximum extent possible provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

3.3.1.2 Protective coatings. Materials that deteriorate when exposed to sunlight, weather, or operational conditions normally encountered during the service life of the item shall not be used or shall have means of protection against such deterioration that does not prevent compliance with the performance requirements specified herein. Protective coatings that chip, crack, or scale with age or extremes of climatic conditions or when exposed to heat shall not be used. Fasteners, handles, and fittings used in the assembly of the item shall also be primed and painted.

3.3.1.2.1 Surface preparation and pretreatment. Surface preparation and pretreatment shall be in accordance with the respective primer and topcoat specifications. Structures shall be cleaned, degreased, and scuffed or blasted prior to priming; primer shall be applied before any oxidation or rusting occurs. Aluminum surfaces shall have MIL-DTL-81706, Type II, Class 1A, and MIL-DTL-5541, Type II, Class 1A, chemical conversion coating applied in accordance with the manufacturer's directions prior to priming.

3.3.1.2.2 Primer. Raw metal edges, to include fastener and drain holes, shall be coated with primer before applying topcoat.

3.3.1.2.2.1 Ferrous surfaces. Ferrous structures and surfaces shall be primed with a water reducible zinc rich primer in accordance with MIL-PRF-26915, Type II, Class B; this shall be followed, within four hours, by a coat of MIL-DTL-53030 intermediate primer in a wet-to-wet

primer application. This two part primer system shall yield a dry-film thickness of 2.0-2.5 mils for the zinc primer and 0.9 to 1.1 mils for the intermediate primer. The two-primer system shall be allowed to dry and fully cure in accordance with the primer manufacturer's directions prior to top coating.

3.3.1.2.2.2 Aluminum and mixed aluminum and ferrous surfaces. Aluminum and mixed aluminum and ferrous structures and surfaces shall be primed with an epoxy primer, Type II, Class N of MIL-PRF-23377. This single part primer system shall yield a dry-film thickness of 0.6 to 0.8 mils.

3.3.1.2.3 Topcoat. Topcoat shall be polyurethane in accordance with Type II, Class H of MIL-PRF-85285. Neither Chemical Agent Resistant Coating (CARC) nor powder coating shall be used. Topcoat shall be applied to a dry film thickness of 1.6 to 2.4 mils in all instances, regardless of the primer system utilized. The coating shall be free from runs, sags, orange peel, or other defects.

3.3.1.3 Dissimilar metals. Dissimilar metals, as defined in MIL-STD-889, shall not be in contact with each other. Metal plating or metal spraying of dissimilar base metals to provide electromotively compatible abutting surfaces is acceptable. The use of dissimilar metals only when separated by suitable insulating material is permitted, except in systems where bridging of insulation materials by an electrically conductive fluid can occur. Sealants or gel type gasket materials shall be used between faying surfaces and butt joints.

3.3.1.4 Finish. The exterior finish color of the PCRS shall be Semigloss Green, Color Number 24052 of FED-STD-595.

3.3.1.5 Fluid traps and faying surfaces. There shall be no fluid traps on the PCRS. Faying surfaces of all structural joints, except welded joints, shall be sealed to preclude fluid intrusion.

3.3.1.5.1 Ventilation. Ventilation shall be sufficient to prevent moisture retention and buildup.

3.3.1.5.2 Drainage. Drain holes shall be provided to prevent collection or entrapment of water or other unwanted fluid in areas where exclusion is impractical. All designs shall include considerations for the prevention of water or fluid entrapment and ensure that drain holes are located to effect maximum drainage of accumulated fluids. The number and location of drain holes shall be sufficient to permit drainage of all fluids when the unit is in a zero degree incline in any plane. The minimum size of the drain holes shall be 0.25 inch.

3.3.2 Markings. All external devices which require an operational or maintenance interface shall be marked in accordance with MIL-STD-130. Markings shall be applied with decals and shall be 1-inch high block letters unless prohibited by the available space. In such cases, the markings shall be the largest size possible, but shall not be less than 1/2-inch high. Markings, Information/Caution shall be Lusterless Black, Color Number 37038 of FED-STD-595, and Markings, Warning/Danger shall be Lusterless Red, Color Number 31136 of FED-STD-595.

3.3.3 Identification plates. An identification plate in accordance with MIL-STD-130 shall be securely attached to the PCRS in a readily accessible location. The identification plate shall contain the following information: nomenclature, part number, serial number, date of manufacture, manufacturer's name, Commercial and Government Entity (CAGE) code, date of warranty expiration, and National Stock Number (NSN). The PCRS and any of its components for which the Government's unit cost is more than $5,000, is serially managed, or the procuring agency determines is mission essential, shall have Unique Identification (UID) (also known as Item Unique Identification (IUID)) information permanently affixed on or near the respective identification plate(s), marked in accordance with MIL-STD-130. UID information shall be included as both a bar code and human readable markings.

3.3.4 Safety.

3.3.4.1 System safety. The design of the PCRS shall not contain any system safety mishap risk categories greater than medium as defined in Table A-IV of MIL-STD-882.

3.3.4.2 Component protection. All space in which work is performed during operation, service, and maintenance shall be free of hazardous protrusions, sharp edges, or other features which may cause injury to personnel. All rotating and reciprocating parts and all parts subject to high operational temperatures or subject to being electrically energized, that are of such nature or so located as to be hazardous to personnel, shall be guarded or insulated to eliminate the hazard.

3.3.4.3 Foreign object damage (FOD). All loose metal parts, such as pins or connector covers, shall be securely attached to the PCRS with wire ropes or chains. "Dog tag" style beaded chains shall not be provided. Removable panels, if provided, shall be attached with captive fasteners. Tire valve stem caps shall be made of plastic.

3.3.4.4 Electrostatic discharge (ESD). The design of the PCRS shall preclude equipment damage due to ESD, protect personnel from electrical shock due to static charging, and prevent ignition of explosive atmospheres due to sparking.

3.3.5 Electromagnetic interference (EMI). The PCRS shall be in accordance with the following radiated emission and susceptibility requirements of MIL-STD-461: RE102 and RS103.

3.3.6 Human engineering. The PCRS shall be designed in accordance with MIL-STD-1472 for ease of operation, inspection, and maintenance, including the use of arctic mittens and Mission-Oriented Protective Posture (MOPP) Level 4 Chemical Warfare Gear.

3.3.7 Fastening devices. All screws, bolts, nuts, pins, and other fastening devices shall be properly designed, manufactured, and installed with adequate means of preventing loss of torque or adjustment. Cotter pins, lock washers, or nylon patches shall not be used for this purpose, except for the attachment of trim items or as provided in commercial components. Tapped threads shall have a minimum thread engagement in accordance with Table I.

TABLE I. Minimum thread engagement.

Material	Minimum Thread Engagement
Steel	1.0 times the nominal fastener diameter
Cast iron, brass, or bronze	1.5 times the nominal fastener diameter
Aluminum, zinc, or plastic	2.0 times the nominal fastener diameter

3.3.8 Welders and welding. All welders shall be certified to weld in accordance with AWS D1.1 and AWS D1.2, or an internationally equivalent welding standard (to be approved by the Government), as applicable. The contractor shall make available to the Government certifications for all welders being utilized on the PCRS. Welding procedures and all welding on the PCRS shall be in accordance with AWS D1.1 and AWS D1.2, or an internationally equivalent welding standard (to be approved by the Government), as applicable. The surface parts to be welded shall be free from rust, scale, paint, grease, and other foreign matter. Welds shall be of sufficient size and shape to develop the full strength of the welded parts. Welds shall transmit stress without cracking or permanent distortion when the parts connected by the welds are subjected to test, proof, and service loadings.

3.3.9 Service life. The PCRS shall be designed for a minimum service life of 15 years, considering, at a minimum, all conditions specified herein.

3.4 Environmental conditions.

3.4.1 Operating temperature range. The PCRS shall be capable of operating in ambient temperatures ranging from -40F to 140F, with wind conditions continuously at 45 knots. This requirement shall be met without requiring secondary-type support (for example, use of deicing fluid, use of snow plow equipment, human intervention or support, and so forth). Within this temperature range, the PCRS shall not fail to operate in accordance with specifications herein. Additionally, under no circumstance shall the pendant cable freeze to any portion of the PCRS.

3.4.2 Precipitation.

3.4.2.1 Rain. The PCRS shall be capable of storage and operation during rainfall of 5-inches per hour for three consecutive hours and 10-inches per hour for 10 consecutive minutes, with winds of up to 35 knots; and with 6-inches of rain per hour impinging on the PCRS at angles from vertical to 45°.

3.4.3 Solar radiation. The PCRS shall not be adversely affected by full time exposure to solar radiation, such as those conditions encountered in desert environments.

3.4.4 Fungus. All materials used in the PCRS shall be fungus resistant or shall be suitably treated to resist fungus. Materials treated for fungus resistance shall retain their original electronic and physical properties, shall not present toxic hazards, and treatment shall last for the entire service life of the part. The PCRS shall be suitable for operation and storage in conditions encountered in a tropical environment.

3.4.5 Salt fog. The PCRS shall be capable of storage and operation in high temperature, high humidity, salt laden, sea coast environments without damage or deterioration of performance.

3.4.6 Sand and dust. The PCRS shall be capable of storage and operation during exposure to wind-blown sand or dust without damage or deterioration of performance.

3.5 Transportability.

3.5.1 Surface transportability. The PCRS shall be transportable via all modes of surface shipment (highway, rail, and water) in accordance with MIL-STD-1366, and shall be capable of withstanding the mechanical shock and vibration characteristics of highway, rail, and water transport, except that design for rail impact testing (see 5.2.5 of MIL-STD-1366) is not required.

3.6 Reliability. The PCRS, including subsystems such as the control system and pneumatic or hydraulic systems, shall meet the following reliability requirements:

In the raised position, the PCRS shall have a reliability of not less than 97 percent at a 0.90 confidence level using the binominal distribution. In this regard, the support system shall be capable of not less than 76 consecutive engagements without failure at speeds up to 180 knots, when proper maintenance procedures are performed. Missed tail hook engagements which result from items not related to the PCRS will not be considered a failure. Such items might be semi-flush mounted centerline light interference or irregularities in the concrete runway surface. Failure of major components or parts of a major component which render the component or system ineffective for the next engagement shall constitute a basis for rejection of the PCRS. However, damage of the PCRS support blocks after engagements do not constitute a failure of the system.

3.7 PCRS pendant cable pretension. The PCRS shall be designed to operate while supporting a 1.25-inch diameter pendant cable under 1,000 to 2,500 pounds (lbs) cable pretension.

3.8 PCRS wheel load requirements. Without resulting in component yielding, cracking, failing, or becoming disconnected, the PCRS shall be designed and constructed to withstand impact and cyclic loading of 305 pounds (lbs) per square inch (psi) distributed over the runway top surface portion of the PCRS.

3.9 PCRS support blocks (support blocks). The support blocks shall:

a. be mechanically connected to the PCRS in a manner which allows replacement within three minutes (or less), at all operational temperatures

b. provide for easy insertion of the pendant cable, requiring less than five seconds

c. accommodate a 1.25-inch diameter steel pendant cable

d. be physically and functionally interchangeable throughout the pendant cable support assembly (see 3.10), without requiring modification(s)

e. raise the center of the pendant cable 3 (+.1) inches above the runway surface, upon system activation

f. shall not cause or inflict damage to the aircraft tires or any other part of the aircraft, in the event of an aircraft tire rollover

g. be so designed as to retain the pendant cable the proper distance above the runway surface, to ensure a successful arrestment

h. be of such design that a successful engagement is insured even in the event of the aircraft tail hook striking any portion of a fully raised support block

i. be constructed of elastic polymer type material

j. be made of suitable all weather-resistant material so as to prevent damage due to aircraft main-gear trample or tail hook impact at all operational temperature conditions (ranging from -40F to 140F) specified herein. It is acceptable to have two types of material, one for warmer weather environments and one for colder weather environments; however, a single material is most preferred

3.10 PCRS support assemblies (support assemblies). The PCRS shall consist of support assemblies that:

a. are physically and functionally interchangeable

b. are equally spaced

c. are electrically interconnected (via end-trough and inter-trough sections cut beneath the runway surface (see 3.17)

d. are programmed to operate in phase (raise and lower simultaneously)

e. mount flush with the runway top surface, with the support block and installed pendant cable being the only protrusion above surface level when in the raised position

f. allow for the inclusion of heating elements

g. shall be thermally insulated to minimize heat loss, if installed at locations where temperatures range from -40ºF to 33ºF

h. shall have adequate drainage so that the PCRS does not fail due to debris entry

i. are accessible for replacement with minimal disconnecting of non-failed items

j. shall be provided whereby the operating condition can monitored by the ATCT, runway edge and at one or both of the energy absorbers

k. to ensure safety during routine maintenance, include an "ON-OFF" switch at the runway edge that cannot be overridden under any circumstance

The Type II, IV and VI shall be designed so that the support assemblies are modular. That is, they can me removed and replaced within the PCRS in less than 20 minutes.

3.11 Performance. The PCRS shall be compatible with existing USAF AAS energy absorbers and shall meet the following performance requirements:

3.11.1 Position cycling. The PCRS shall be capable of continuously and completely cycling from the raised to the lowered position and vice versa within eight seconds.

3.11.2 Engagement. When in its raised position, the PCRS shall permit engagement of tail hook equipped aircraft approaching from either direction. Wheel or tail hook impact on the fully raised support blocks shall not deny engagement of the aircraft, under any circumstance.

3.12 PCRS heaters. When specified (see 6.2), each PCRS shall contain heating elements to sustain system functionality and to prevent any degrade in system performance. Heater installations shall be appropriate for locations experiencing temperatures between -40ºF for 32ºF. The heater system shall:

a. be capable of operating at 220 Volt, alternating current, single phase, 60 Hertz, power supply

b. be capable of withstanding repeated impacts and vibrations caused by aircraft touching down on or rolling over the PCRS

c. be modular and removable so that maintenance and parts replacement can be easily performed

d. be so located that temperature-sensitive components are not subject to heat damage or deterioration by direct radiation

e. be provided whereby the operating condition of each heater can be checked at the ATCT, runway edge and at one or both of the energy absorbers

f. contain fuse design to prevent heater damage from current surges

g. be accessible for replacement with minimal removal of non-failed items

h. shall be protected from water damage and from short circuits caused by entry of water into the PCRS

i. provide an "ON-OFF" switch at the runway edge that cannot be overridden under any circumstance, to ensure safety during routine maintenance

3.13 Pneumatic or hydraulic systems (if applicable). Pneumatic or hydraulic systems which are subject to temperatures ranging from -40ºF to 33ºF shall be adequately protected and heated to prevent freezing. The system shall:

a. be designed to allow at least two cycles in the event of a power failure

b. not leak after installation

c. include all related piping and pneumatic or hydraulic hardware required for PCRS installation and operation

d. be accessible for replacement without disconnecting non-failed items

e. provide dry air into the pneumatic system (if applicable) at temperatures ranging from 40ºF to 33ºF

All controls, pneumatic or hydraulic power shall be located in the arresting pit or shack. If no pit or shack exists, these items shall be located in close proximity to the energy absorber in weatherproof housing.

3.14 PCRS electrical control system (control system). The PCRS control system shall operate on 115-Volt alternating current, single phase, 60 Hertz power supply, unless a contractor has proof of a previously approved system being accepted into USAF inventory. A master control system shall be located in the ATCT. A secondary control system shall allow the operator to command the control system from the runway edge or at the energy absorber. Only the ATCT shall be able to dictate which control system has total PCRS command. The PCRS control shall be exercised through radio controls (see 3.19). The control station shall contain pendant cable position indicator lights to show the position of the support blocks, and shall be located at the energy absorber and ATCT. Illumination of either position shall also indicate that the power is on for the cable support system. The control stations shall contain a two-position switch (or two switches) which controls the position of the cable supports (that is, raised or retracted). Pendant cable position indicator lights shall be actuated by a circuit closed to ground through switches in each pendant cable assembly. The pendant cable position indicator lights shall not be illuminated unless all pendant cable support assemblies are in the same position.

3.15 ATCT control station. The ATCT control station shall be in "box" form with lights, switches, and runway diagrams concisely arranged on the panel so that the control station will require no more than eight by eleven inches. The location of the cable position indicator lights

on the diagram shall correspond with the location of the cable support system installation on the runway. When more than one cable support system is installed at an airbase, separate cable position lights and controls shall be provided for each system and located on the ATCT controls station. A selection switch marked "TOWER/RUNWAY" shall be provided to permit the ATCT operator to transfer control of the system to the runway edge control station. The switch shall be connected to an indicator light appropriately located on the runway diagram. The indicator light shall be illuminated when the runway station has control of the system. The ATCT control station shall have the ability to override the runway station.

3.16 Runway edge control station. The runway edge control station shall be capable of raising and retracting the cable support system (by a two-position switch) when control is transferred to "RUNWAY" by the ATCT operator. The station shall be a wireless or portable unit capable of plug-in operation when connected to a control outlet. If portable, it shall be equipped with a cable of sufficient length to allow the operator to stand at the runway edge, when the unit is connected to the control outlet near the energy absorber. Connection or disconnection of this station shall not interfere with tower control of the PCRS. This unit shall be equipped with cable position lights appropriately marked to indicate "RAISED" and "RETRACTED." A lit indicator light shall be provided and shall illuminate when the system control is transferred to "RUNWAY."

3.17 Cross-runway trough. A cross-runway trough, made of steel, shall:

a. provide a protective recess in the runway surface for retraction of the pendant cable

b. extend the full width of the runway, as well as into the shoulder area (see 6.2)

c. be chamfered and there will be no sharp edges that will damage the pendant cable

d. provide a space, underneath its groove, for routing of mechanical lines and heater elements into each support assembly

e. be located 90 degrees to the runway centerline

f. be 1.75-inches in width so that slightly kinked but still active and usable pendant cables can be fully retracted

Individual trough sections shall be available for removal and installation between each support assembly.

3.18 Operating instructions. Operating and precautionary instructions shall be permanently affixed on or near the control panel or other system components as necessary. The instructions shall be clear, concise, and adequate to enable operation without error or damage to the system or injury to the operating personnel. Precautionary instructions shall be so designed and located that the operator cannot fail to notice them before control, valves, or switches are operated. Schematic drawings of the electrical, hydraulic and pneumatic systems shall be furnished upon system delivery.

3.19 Radio controls. One of the following, if specified by the contract (see 6.2), shall be supplied to the Government: CAGE 06URO part number PAACS-14AC-1, PAACS-14AC-2, PAACS-HDC-1, or PAACS-HDC-2. Supply of alternate radio controls shall be reviewed and approved by the Government, if suitable.

3.20 Workmanship. The PCRS including all parts and accessories, shall be constructed and finished in a thoroughly workmanlike manner. Workmanship objectives shall include freedom from blemishes, defects, burrs and sharp corners and edges; accuracy of dimensions, surface finish, and radii of fillets; thoroughness of welding, painting, and riveting; marking of parts and assemblies; and proper alignment of parts and tightness of assembly fasteners.

3.20.1 Bolted connections. Bolt holes shall be accurately punched or drilled and shall be deburred. Threaded fasteners shall be tight and shall not work loose during testing or service usage.

3.20.2 Riveted connections. Rivet holes shall be accurately punched or drilled and shall be deburred. Rivets shall be driven with pressure tools and shall completely fill the holes. Rivet heads shall be full, neatly made, concentric with the rivet holes, and in full contact with the surface of the component.

3.20.3 Gear and lever assemblies. Gear and lever assemblies shall be properly aligned and meshed and shall be operable without interference, tight spots, loose spots, or other irregularities. Where required for accurate adjustment, gear assemblies shall be free of excessive backlash.

3.20.4 Cleaning. The PCRS shall be thoroughly cleaned. Loose, spattered, or excess solder; welding slag; stray bolts, nuts, and washers; rust; metal particles; pipe compound; and other foreign matter shall be removed during and after final assembly.

4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

a. First article inspection (see 4.2).

b. Operational inspection (see 4.3).

Certifications and analyses shall be provided in accordance with Table II.

TABLE II. Requirement verification matrix.

Section 3 Requirement	Verification Method	Section 4 Verification
3.1 First Article	Not Applicable (N/A)	
3.2 PCRS description.	N/A	
3.3 Design and construction.	Examination	4.5.1 Examination of product.
3.3.1 Materials, protective coatings, and finish.	N/A	
3.3.1.1 Recycled, recovered, or environmentally preferable materials.	Examination	4.5.1 Examination of product.
3.3.1.2 Protective coatings.	Examination	4.5.1 Examination of product.
3.3.1.2.1 Surface preparation and pretreatment.	Examination	4.5.1 Examination of product.
3.3.1.2.2 Primer.	Examination	4.5.1 Examination of product.
3.3.1.2.2.1 Ferrous surfaces.	Examination	4.5.1 Examination of product.
3.3.1.2.2.2 Aluminum and mixed aluminum and ferrous surfaces.	Examination	4.5.1 Examination of product.
3.3.1.2.3 Topcoat.	Examination	4.5.1 Examination of product.
3.3.1.3 Dissimilar metals.	Examination	4.5.1 Examination of product.
3.3.1.4 Finish.	Examination	4.5.1 Examination of product.
3.3.1.5 Fluid traps and faying surfaces.	Examination	4.5.1 Examination of product.
3.3.1.5.1 Ventilation.	Examination	4.5.1 Examination of product.
3.3.1.5.2 Drainage.	Examination	4.5.1 Examination of product.
3.3.2 Markings.	Examination	4.5.1 Examination of product.
3.3.3 Identification plate.	Examination	4.5.1 Examination of product.
3.3.4 Safety.	N/A	
3.3.4.1 System safety.	Analysis	4.5.2 System safety hazard analysis.
3.3.4.2 Component protection.	Examination	4.5.1 Examination of product.
3.3.4.3 Foreign object damage (FOD).	Examination	4.5.1 Examination of product.
3.3.4.4 Electrostatic discharge (ESD).	Analysis	4.5.3 Electrostatic discharge analysis.
3.3.5 Electromagnetic interference (EMI).	Test	4.5.5 Electromagnetic interference test.
3.3.6 Human engineering.	Examination	4.5.1 Examination of product.
3.3.7 Fastening devices.	Examination	4.5.1 Examination of product.
3.3.8 Welders and welding.	Examination	4.5.1 Examination of product.
3.3.9 Service life.	Analysis	4.5.4 Service life analysis.
3.4 Environmental conditions.	N/A	

TABLE II. Requirement verification matrix. - Continued

Section 3 Requirement	Verification Method	Section 4 Verification
3.4.1 Operating temperature range.	Test	4.5.6.1 High temperature storage and operational test. 4.5.6.2 Low temperature storage and operational test.
3.4.2 Precipitation.	N/A	
3.4.2.1 Rain.	Test	4.5.6.3.1 Rain test.
3.4.3 Solar radiation.	Examination	4.5.1 Examination of product.
3.4.4 Fungus.	Examination	4.5.1 Examination of product.
3.4.5 Salt fog.	Test	4.5.6.3.2 Salt fog test.
3.4.6 Sand and dust.	Test	4.5.6.3.3 Sand and dust test.
3.5 Transportability.	N/A	
3.5.1 Surface transportability.	Analysis	4.5.7 Surface transportability analysis.
3.6 Reliability.	Test	4.6.1 Functional inspection
	Test	4.6.2.c Operational testing
3.7 PCRS pendant cable pretension.	Test	4.6.2.c Operational testing
3.8 PCRS wheel load requirements.	Analysis	4.5.8 PCRS wheel load analysis.
	Test	4.6.2. Operational testing
3.9 PCRS support blocks (support blocks).	Demonstration	4.5.1 Examination of product.
	Test	4.6.2.c Operational testing
3.10 PCRS support assemblies (support assemblies).	Demonstration	4.5.1 Examination of product.
3.11 Performance.	N/A	
3.11.1 Position cycling.	Test	4.6.1 Functional inspection
3.11.2 Engagement.	Test	4.6.2.c Operational testing
3.12 PCRS heaters.	Test	4.5.6 Environmental testing. 4.5.6.1 High temperature storage and operational test. 4.5.6.2 Low temperature storage and operational test.
3.13 Pneumatic or hydraulic systems.	Test	4.5.6 Environmental testing. 4.5.6.1 High temperature storage and operational test. 4.5.6.2 Low temperature storage and operational test.
3.14 PCRS electrical control system (control system).	Demonstration	4.5.1 Examination of product.
3.15 ATCT control station.	Demonstration	4.5.1 Examination of product.
3.16 Runway edge control station.	Demonstration	4.5.1 Examination of product.
3.17 Cross-runway trough.	Examination	4.5.1 Examination of product.

TABLE II. Requirement verification matrix. – Continued

Section 3 Requirement	Verification Method	Section 4 Verification
3.18 Operating instructions.	Examination	4.5.1 Examination of product.
3.19 Radio Controls	Examination	4.5.1 Examination of product.
3.20 Workmanship.	Examination	4.5.1 Examination of product.
3.20.1 Bolted connections.	Examination	4.5.1 Examination of product.
3.20.2 Riveted connections.	Examination	4.5.1 Examination of product.
3.20.3 Gear and lever assemblies.	Examination	4.5.1 Examination of product.
3.20.4 Cleaning.	Examination	4.5.1 Examination of product.

4.2 First article inspection. The first article system shall be subjected to the analyses, demonstrations, examinations, and tests described in 4.5.1 through 4.5.8. The contractor shall provide or arrange for all test equipment and facilities.

4.3 Operational inspections. The PCRS shall be subjected to the examination described in 4.6, 4.6.1 and 4.6.2. All operational inspections shall be satisfactorily completed and Government approved prior to final PCRS acceptance.

4.4 Inspection requirements.

4.4.1 General inspection requirements. Apparatus used in conjunction with the inspections specified herein shall be laboratory precision type, calibrated at proper intervals to ensure laboratory accuracy.

4.4.2 Data. During all testing specified herein, at least the following data, unless not applicable, shall be recorded at intervals not to exceed 15 minutes. Additional data or shorter intervals shall be provided as appropriate for any specific test.

a. Date

b. Time started

c. Time finished

d. Ambient temperature

e. Ambient humidity

f. Engagement test event number

g. Test aircraft type

h. Test aircraft vehicle weight (lbs)

i. Test aircraft engagement speed (kts)

j. Energy at arrestment (ft-lbs)

k. Pendant cable pick-up location (on-center or off-center engagement) (ft)

l. All failures, servicing, adjustments, maintenance and irregular functioning shall be identified by accumulated operating time, cycles, or position in the test procedure, as appropriate. Test conditions at the time of the events identified shall be recorded

m. A summary of the engineering analysis and of any tests conducted to determine assignable cause for any failure or irregular function

n. A summary of the engineering analysis leading to any corrections made to design, construction, quality control, or other procedures, or leading to any corrections to be made to production items or proposed to be made. The summary shall also include an analysis of the predicted effectiveness of such corrections

o. Clock time and man-hours required for each maintenance and servicing action taken during the tests. A brief description of the experience and qualifications of the personnel taking such actions shall be included

p. Test activity or contractor comments on items features or requirements that, if modified, should improve the item

q. Test activity or contractor comments on use or maintenance conditions to be avoided or cultivated to increase the reliability or useful life of the item

Additionally, the following information shall be reported, at least once, for each test.

a. System configuration

b. Schematic of inspection and equipment set up

c. Location installed

d. Type installed

e. Equipment manufacturer identification

4.4.3 Test rejection criteria. Throughout all tests specified herein, the PCRS shall be closely observed for the following conditions, which shall be cause for rejection.

a. Failure to conform to design or performance requirements specified herein or in the contractor's technical proposal

b. Any spillage or leakage of any liquid, including fuel, coolant, lubricant, or hydraulic fluid, under any condition, except as allowed herein

c. Structural failure of any component, including permanent deformation, or evidence of impending failure

d. Evidence of excessive wear. If excessive wear is suspected, the original equipment manufacturer's (OEM's) specifications or tolerances shall be utilized for making a determination

e. Misalignment of components

f. Conditions that present a safety hazard to personnel during operation, servicing, or maintenance

g. Evidence of corrosion or deterioration

4.5 Test methods.

4.5.1 Examination of product. Each PCRS shall be examined to verify compliance with the requirements herein prior to accomplishing any other demonstrations or tests listed in 4.6. A contractor-generated, Government-approved checklist shall be used to identify each requirement not verified by an analysis, certification, demonstration, or test, and shall be used to document the examination results. Particular attention shall be given to materials, workmanship, dimensions, surface finishes, protective coatings and sealants and their application, welding, fastening, and markings. Proper operation of each PCRS function shall be verified. Certifications and analyses shall be provided in accordance with Table III. Each production PCRS shall be inspected to a Government-approved reduced version of the checklist.

TABLE III. Certifications and analyses.

Paragraph	Required Certifications and Analyses
3.3.4.1 System safety.	Contractor system safety hazard analysis (see 4.5.2).
3.3.4.4 Electrostatic discharge.	Contractor analysis of the electrostatic discharge requirement (see 4.5.3).
3.3.9 Service life.	Contractor analysis of the service life requirement (see 4.5.4).
3.4.4 Solar radiation.	Contractor certification that the PCRC performance is not adversely affected by full time exposure to solar radiation, such as those conditions encountered in desert environments.

TABLE III. Certifications and analyses - Continued

Paragraph	Required Certifications and Analyses
3.4.5 Fungus.	Contractor certification that the materials used in construction of the PCRS are fungus resistant or suitably treated to resist fungus.
3.5.1 Surface transportability.	Contractor surface transportability analysis (see 4.5.7) and certification that the PCRS is transportable via all modes of surface shipment (highway, rail, and water) in accordance with MIL-STD-1366, and shall be capable of withstanding the mechanical shock and vibration characteristics of highway, rail, and water transport.
3.6 Reliability.	Contractor basic reliability model and prediction (see 4.5.8).

4.5.2 System safety hazard analysis. A system safety hazard analysis of the PCRS shall be conducted in accordance with 4.2 through 4.8 of MIL-STD-882 to demonstrate compliance with the mishap risk requirement of 3.3.4.1.

4.5.3 Electrostatic discharge analysis. An engineering analysis shall be performed to demonstrate compliance with the electrostatic discharge requirement of 3.3.4.4.

4.5.4 Service life analysis. An engineering analysis shall be performed to demonstrate compliance with the service life requirement of 3.3.9.

4.5.5 Electromagnetic interference test. A first article PCRS shall be tested in accordance with MIL-STD-461: RE 102 and RS 103 to demonstrate compliance with 3.3.5.

4.5.6 Environmental testing.

4.5.6.1 High temperature storage and operation test. A first article PCRS shall be tested in accordance with MIL-STD-810, Method 501.5, Procedures I and II, to demonstrate compliance with the high temperature storage and operating requirements of 3.4.1. Test duration shall be one 24-hour cycle for each procedure.

4.5.6.2 Low temperature storage and operation test. At first article PCRS shall be tested in accordance with MIL-STD-810, Method 502.5, Procedures I and II, to demonstrate compliance with the low temperature storage and operating requirements of 3.4.1. Test duration shall be one 24-hour cycle for each procedure.

4.5.6.3 Precipitation.

4.5.6.3.1 Rain test. A first article PCRS shall be tested in accordance with MIL-STD-810, Method 506.5, Procedure I, to demonstrate compliance with 3.4.2.1.

4.5.6.3.2 Salt fog test. A first article PCRS shall be tested in accordance with MIL-STD-810, Method 509.5, to demonstrate compliance with 3.4.5. Test duration shall be alternating 24-hour periods of salt fog exposure and drying conditions for 24-hour periods (two wet and two dry).

4.5.6.3.3 Sand and dust test. A first article PCRS shall be tested in accordance with MIL-STD-810, Method 510.5, Procedures I (12 hours) and II (90 minutes per side), to demonstrate compliance with 3.4.6.

4.5.7 Surface transportability analysis. An engineering analysis shall be performed to demonstrate compliance with 3.5.1. The engineering analysis shall utilize the data for road transportation in accordance with MIL-STD-810, Method 514.6, Table 514.6C-II.

4.5.8 PCRS wheel load analysis. An engineering analysis shall be performed to demonstrate compliance with the electrostatic discharge requirement of 3.8.

4.6 Operational inspection (to be conducted by the procuring activity).

4.6.1 Functional inspection. Following successful first article inspection completion, the PCRS shall be installed at a USAF airfield and a functional check to be capable of the following:

f. 76 consecutive cycles shall be conducted from the runway edge control station

g. 76 consecutive cycles shall be conducted from the energy absorber control station

h. 76 consecutive cycles shall be accomplished from the ATCT control station

Proper cycling shall be verified visually as well as by the indicator lights at each control box. No component damage or failure shall result from this activity

4.6.2 Operational testing. Following successful completion of requirements per 4.6.1, the PCRS shall be tested against manned USAF tail hook equipped fighter aircraft to determine compliance with 3.6. These tests shall be conducted over a full range of aircraft weight and speed and shall consist of the following:

a. 38 aircraft rollover tests with the PCRS cable in the raised position

b. 38 aircraft rollover tests with the PCRS in the retracted position

c. 76 USAF tail-hook equipped taxiway aircraft engagement trials with no misses; however, if one missed engagement is attributed to a malfunction of the PCRS, taxiway aircraft engagement trials will continue to 129 engagements. If two missed engagements are attributed to malfunction of the PCRS before 129 taxiway aircraft engagement trials are completed, testing will cease and the PCRS will be rejected for USAF use. See Table IV and Table V

The engagements will be conducted bi-directionally, duplicating both the approach end engagement (see Table IV) and departure end engagement (see Table V). During testing, the minimum acceptable aircraft engagement speed shall be 85 knots. The maximum recommended aircraft engagement speed should not exceed 150 knots during testing; however, should there be a need or Government requirement, testing up to 180 knots is acceptable.

TABLE IV. Approach end operational engagement tests to validate the PCRS.

Engagement Velocity Range (Knots)	76 Engagements Quantity	129 Engagements Quantity
85-110	10	17
111-130	10	17
131-180	2	4

TABLE V. Departure end operational engagement tests to validate the PCRS.

Engagement Velocity Range (Knots)	76 Engagements Quantity	129 Engagements Quantity
85-110	30	50
111-130	20	35
131-180	4	6

5. PACKAGING

5.1 For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.

6.1 Intended use. The PCRS is intended to support the deployment of tail hook equipped fighter aircraft to joint-use aircraft airfields, including civil airports.

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number, and date of this specification

b. If first article and operational inspection is required (see 3.1)

c. Type(s) required for delivery

d. If heaters are required (see 3.12)

e. Runway shoulder width (10-ft for military runways; 25-ft for civilian airfields) (see (3.17)

f. If applicable, type of radio required (see 3.19)

g. Packaging requirements (see 5.1)

6.3 Definitions.

6.3.1 Energy absorber units (energy absorbers). Two energy absorbers are required per one AAS; they are components designed to brake and decelerate the forward motion of tail hook equipped aircraft without causing damage to the airframe, airfield structures, or personnel.

6.3.2 Fairlead unit assemblies (fairlead beams). Fairlead beams are manufactured in accordance with CAGE 21439 print number 52-W-2295-201 or equal. They are designed to:

a. allow bidirectional aircraft engagements

b. reduce wing obstruction problems by allowing the energy absorber to be installed farther outboard of the runway

c. dampen purchase tape oscillations, following hook cable pick up and during the early stages of engagement, that would otherwise arrive at the energy absorber, which could cause a tape dive (see 3.14)

d. decrease tail hook loading during the dynamic, early adjusting phase of the engagement cycle

6.3.3 Pendant cable. Suspended above and across the runway surface by support blocks, braided steel pendant cables are the standard AAS engagement component in support of tail hook equipped fighter aircraft. They are manufactured in accordance with CAGE 80020 drawing numbers 515053-90 through 515053-303.

6.3.4 Split distance. Split distance is the distance between the runway fairlead beam and the lead-off sheave of the energy absorber unit on a given side. This distance is measured from the rear or entry point of the fairlead beam, to the edge of the energy absorber nearest to the fairlead beam. Split distances help to dampen the excessive dynamic hook loads that would otherwise be experienced during the early adjusting stages of the arrestment. Minimum split distance allowed for testing should be 57-ft.

6.3.5 PCRS 150S (Type I). The "PCRS" represents Pendant Cable Retraction System. The "150" represents the runway width (in feet) the system is designed for installation. The "S" represents a single runway end. The PCRS 150S is auxiliary equipment used in conjunction with an energy absorber. It provides a means to raise and lower a pendant cable above and below a runway surface.

6.3.6 PCRS 150M (Type II). The "PCRS" represents Pendant Cable Retraction System. The "150" represents the runway width (in feet) the system is designed for installation. The "M" represents a design in which the working mechanisms are modular. That is, they can be completely removed and replaced in under 20 minutes. The PCRS 150M is auxiliary equipment used in conjunction with an energy absorber. It provides a means to raise and lower a pendant cable above and below a runway surface.

6.3.7 PCRS 200S (Type III). The "PCRS" represents Pendant Cable Retraction System. The "200" represents the runway width (in feet) the system is designed for installation. The "S" represents a single runway end. The PCRS 200S is auxiliary equipment used in conjunction with an energy absorber. It provides a means to raise and lower a pendant cable above and below a runway surface.

6.3.8 PCRS 200M (Type IV). The "PCRS" represents Pendant Cable Retraction System. The "200" represents the runway width (in feet) the system is designed for installation. The "M" represents a design in which the working mechanisms are modular. That is, they can be completely removed and replaced in under 20 minutes. The PCRS 200M is auxiliary equipment used in conjunction with an energy absorber. It provides a means to raise and lower a pendant cable above and below a runway surface.

6.3.9 PCRS 300S (Type V). The "PCRS" represents Pendant Cable Retraction System. The "300" represents the runway width (in feet) the system is designed for installation. The "S" represents a single runway end. The PCRS 300S is auxiliary equipment used in conjunction with an energy absorber. It provides a means to raise and lower a pendant cable above and below a runway surface.

6.3.10 PCRS 300M (Type VI). The "PCRS" represents Pendant Cable Retraction System. The "300" represents the runway width (in feet) the system is designed for installation. The "M" represents a design in which the working mechanisms are modular. That is, they can be completely removed and replaced in under 20 minutes. The PCRS 300M is auxiliary equipment used in conjunction with an energy absorber. It provides a means to raise and lower a pendant cable above and below a runway surface.

6.4 Subject term (key word) listing.

AAS
Arrestment
Energy absorber
Engagement
Fairlead beam
Support assemblies
Support block

Custodians
Air Force - 84

Preparing activity:
Air Force - 84

Review activities:
Air Force - 99

Agent
Air Force - 99

(Project 1710-2011-002)

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at https://assist.daps.dla.mil.