INCH-POUND
MIL-STD-3036 (USAF)
05 July 2013

DEPARTMENT OF DEFENSE
TEST METHOD STANDARD

USAF AIRCRAFT ARRESTING SYSTEMS

AMSC N/A FSC 1710

FOREWORD

1. This standard is approved for use by the Department of the Air Force and is available for use by all Departments and Agencies of the Department of Defense.

2. The standard shall be used to verify MIL-STD-3035.

3. This standard requires a full-scale test program, which will:

   a. determine the operational effectiveness and reliability of the Aircraft Arresting System (AAS),

   b. determine the arresting characteristics and the performance limitations (if any) of the AAS,

   c. determine the useful service life of AAS components,

   d. determine if the AAS components have the structural integrity and thermal capacity to accommodate repeated high energy arrestments,

   e. standardize AAS operational test requirements, and

   f. ensure that the AAS is suitable for installation on United States Air Force (USAF) airfields.

4. Comments, suggestions, or questions on this document should be addressed to AF-99 (agent for AF-84), AFSC/LOEP (WPAFB, OH), 5215 Thurlow St, Bldg 70-C, Suite 5, Wright-Patterson AFB, OH 45433-5750. or emailed to spec99@wpafb.af.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at https://assist.dla.mil .

CONTENTS

1. SCOPE

1.1 Scope. This standard establishes minimum military-unique test requirements necessary to evaluate the reliability and operational effectiveness of land-based Aircraft Arresting Systems (AASs) used within the United States Air Force (USAF).

1.2 Classification. The following types of testing are covered in this standard:

1.2.1 Types. The types of test methods are as follows:

Test Method I – Operational (runway) AAS Testing

Test Method II – Emergency (overrun/underrun) AAS Testing

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4, or 5 of this standard. This section does not include documents cited in other sections of this standard 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 standard, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks forma 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.

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-W-38461	Webbing, Nylon, Aircraft Arresting (Inactive for New Design)

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-3035	USAF Aircraft Arresting System, Design Criteria Standard

(Copies of these documents are available online at https://assist.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.

AIR FORCE INSTRUCTION (AFI)

AFI 32-1043	Managing, Operating, and Maintaining Aircraft Arresting Systems

(Copies are available through e-pubs; http://www.e-publishing.af.mil)

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.)

U.S. AIR FORCE (CAGE 98752)

USAF DRAWING 66D1751	Connector, 8 1/2-in Tape-BAK-12 Arresting Barrier, 1 1/4-in Runway Pendant Cable, Assy of
USAF DRAWING 7545764	Support, Donut Type-Wire Cable

(Copies of these documents are available from Robins AFB GA, (AFLCMC/WNZEC, 460 Richard Ray Blvd Ste 200, Robins AFB, GA 31098-1813) or emailed to 642CBSG.Workflow@robins.af.mil.)

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.

GULF & WESTERN (CAGE 24139)

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

(Copies of these documents are available from Robins AFB GA, (AFLCMC/WNZEC, 460 Richard Ray Blvd Ste 200, Robins AFB, GA 31098-1813) or emailed to 642CBSG.Workflow@robins.af.mil.)

2.4 Order of precedence. Unless otherwise noted herein or in the contact, 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. DEFINITIONS

3.1 AASs. Unless otherwise specified, AASs defined in this standard consist of the following:

a. Energy absorber units (see 3.4)

b. Fairlead unit assemblies [fairlead beams (see3.6)]

c. A hook cable (see 3.8)

d. Interconnect devices including:

i. Purchase tapes (see 3.10), and

ii. Purchase element connectors [tape connectors (see 3.11)]

3.2 Deadload vehicle. A deadload vehicle is a test vehicle that is outfitted with an instrumented tailhook; it is used to simulate fighter aircraft engagements of arresting system test articles without jeopardizing pilot safety or costly aircraft. Deadload vehicles can be configured to simulate engagements at various weights, and are programmable to engage the AAS at speeds up to 200 knots.

3.3 Emergency AASs. An Emergency AAS has a minimum kinetic energy absorbing capacity of 50 million foot-pounds while allowing aircraft runout up to 905-feet. In general, it is an emergency braking system available to aircraft in case of failure of a successful engagement by the Operational AAS (see 3.9) (or in cases where an Operational AAS is not available). Emergency AASs are generally positioned in the overrun and/or underrun area of the runway. The overrun is defined to be an area beyond the take-off runway designated by the airport authorities as able to support aircraft during an aborted take-off. This area is commonly referred to as "the underrun" when in front of the take-off runway (opposite end of the runway from the overrun).

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

3.5 Excessive hook loading. An excessive hook load is defined as loading that exceeds the design limits of tail hook equipped fighter aircraft. Currently for USAF fighter aircraft, this design limit would be:

a. 75,000 pounds for aircraft weights up to 45,000 pounds, representative of the heaviest F-16, and

b. 80,000 pounds for aircraft weights up to 85,000 pounds, representative of the heaviest F-15.

3.6 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, and

e. serve to direct the tape path to the edge of the runway surface to prevent damage to the purchase tape by light fixtures, rocks, or other obstacles located along the runway shoulder.

3.7 Functional span. The cross-runway distance between the lead-off sheaves (front) of the fairlead beam (or the energy absorber units if fairlead beams are not installed) on either side of the runway is called the functional span.

3.8 Hook cable. Suspended 2-inches (minimum) above and across the runway surface by support donuts (see 3.13), wire rope hook 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.

3.9 Operational AASs. An Operational AAS has a minimum kinetic energy absorbing capacity of 100 million foot-pounds while allowing aircraft runout up to 1,200-feet.

3.10 Purchase tapes. Purchase tapes, in accordance with Type I of MIL-W-38461, have a minimum static tensile strength of 105,000 pounds; they are the mechanical means necessary to transmit engagement forces to the absorber.

3.11 Purchase element connectors (tape connectors). Tape connectors mechanically interconnect the end of a purchase tape to the terminal end of a hook cable. Tape connectors are constructed in accordance with CAGE 98752 drawing number 66D1751.

3.12 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 initial stages of the arrestment.

3.13 Support donut (disk). Support disks are manufactured in accordance with CAGE 98752 drawing number 7545764, and are used to vertically support hook cables.

3.14 Tape dive. A tape dive is an event wherein the purchase tape becomes jammed within the energy absorber during an arrestment. The results of a tape dive are usually catastrophic.

3.15 Walkback. Walkback of the aircraft or deadload vehicle can result from residual or stored energy within the stretched nylon purchase tapes at the end of the arrestment cycle. The stored energy converts to reverse velocity of the aircraft while its tail hook remains engaged to the arresting system's hook cable. While moderate walkback may be managed by aircraft braking and engine thrust, excessive walkback can damage aircraft.

4. GENERAL REQUIREMENTS

4.1 General. This standard shall be used to verify the requirements of MIL-STD-3035.

4.2 Test configuration.

4.2.1 Functional span. The functional span shall be 162-feet for all testing required herein.

4.2.2 Split distance. The split distance shall be 50-feet for all testing required herein.

4.2.3 Symmetric installation. The AAS shall be symmetrically installed for all testing required herein and the hook cable shall be positioned symmetrically between the fairlead beams (or equivalent equipment).

4.2.4 Hook cable pretension. While in the battery position (ready for engagement), a 1,500 pound to 2,500 pound tension shall be maintained against the AAS purchase system (for example, the hook cable, the tape connectors, and the purchase tapes) until test aircraft or deadload vehicle engagement. This shall be required for all testing required herein.

4.3 System configuration control. All testing described herein shall be conducted against a single system setting, against a single AAS. AAS replacement, adjustments or modifications (for example, modifying the braking or computer function or components) shall invalidate prior testing conducted, requiring a test program restart.

4.4 Data. For each test specified herein, at least the following data, unless not applicable, shall be recorded by the test activity and provided to the Government in a test report. Additional data shall be provided as appropriate for any specific test.

a. date and time of each test,

b. ambient temperature,

c. system configuration (for example, functional span, split distance, system settings, etc),

d. test event number,

e. hook cable pretension (pounds) prior to engagement,

f. test aircraft or deadload vehicle weight (pounds),

g. engagement speed (knots),

h. energy at arrestment (foot-pounds),

i. max hook load (pounds),

j. hook load (pounds) vs. runout (feet),

k. hook load (pounds) vs. time (centiseconds),

l. deceleration (Gs) vs. time (centiseconds),

m. tape tension (pounds) at portside energy absorber vs. runout (feet),

n. tape tension (pounds) at starboard side energy absorber vs. runout (feet),

o. end of arrestment G-loading (Gs),

p. walkback distance (feet),

q. maximum walkback velocity (knots),

r. walkback velocity (knots) vs. walkback distance (feet),

s. walkback velocity (knots) vs. time (centiseconds),

t. initial hook cable pickup location (if off-center),

u. final test aircraft or deadload vehicle position (with respect to test track or runway centerline and total runout distance) (feet), and

v. miscellaneous remarks (for example, residual speeds, hook cable or tape failure, aircraft thrust if applicable, and so forth).

4.5 Reliability. The AAS shall demonstrate, through test aircraft or deadload testing, a reliability of not less than 97 percent at a 0.90 confidence level using the binominal distribution.

4.5.1 Reliability and maintainability information. The following information shall be documented and included as an appendix to the test report:

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

b. A summary of the engineering analysis and tests conducted to determine causes for any failure or irregular functioning.

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

d. Clock time and man hours required for each maintenance and servicing action during the tests. A brief description of the experience and qualification of the personnel taking such action shall be included and shall be adequate to permit comparison to the personnel anticipate in similar field work.

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

f. 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.

Any of the above information that is already included in the test report body need not be repeated in the information require by this paragraph, but clear reference to the location of the data shall be included.

4.6 Test rejection criteria. Throughout all tests, the AAS shall be closely observed for any the following conditions, which shall be cause for rejection:

a. failure to conform to any requirement specified per MIL-STD-3035,

b. failure to conform to any requirement specified herein,

c. any spillage or leakage of any liquid from the energy absorber, including lubricant or hydraulic fluid, under any condition,

d. thermal or structural failure of any component of the AAS, including permanent deformation, or evidence of impending failure,

e. evidence of excessive wear (for example, component failure prior to allowing at least 76 consecutive arrestments prior to component replacements excluding consumable items such as the hook cable, purchase tape, or tape connector),

f. interference between components or between the AAS, the ground, and all obstacles,

g. misalignment of components,

h. conditions that present a safety hazard to personnel, aircraft, or pilot during operation, servicing, or maintenance,

i. evidence of corrosion,

j. evidence of deterioration,

k. failed hardware,

l. tape dive, and

m. excessive hook loading while engaging deadload vehicles or test aircraft a speeds less than 180 knots.

5. DETAILED REQUIREMENTS

5.1 Test Method I - Operational AAS Testing. Operational AASs shall be functionally tested against instrumented deadload vehicles or test aircraft in order to determine the arresting systems performance and characteristics, and to assure that the AASs function is effective, predictable and reliable enough to install on active USAF airfields. For testing described herein, data capture and reporting specific to 4.4 shall be accomplished. Such testing shall be conducted over a full range of aircraft weights and speeds, as specified in TABLE I and TABLE II, and shall include engagements made on-center and off-center up to 50 percent of the runway semi-span.

TABLE I. 1,200-foot runout test matrix; dry purchase tapes.

Approximate Deadload Weight for Test (lb)	Engaging Speeds (knots)								Off-center Engagement Location (ft)
19,000	80	100	120	140	160	170	180	190	0
25,000	80	100	120	120	120	140	140	140	0
29,000	80	100	120	140	150	160	180	190	0
35,000	80	100	120	120	120	140	140	140	0
39,000	80	100	120	140	160	170	180	190	0
47,000	80	100	120	140	150	160	170	180	0
58,000	80	100	120	130	140	150	160	170	0
69,000	80	100	120	130	140	150	160	170	0
75,000	80	100	100	120	120	140	140	140	0
85,000	80	90	100	110	120	130	140	150	0

TABLE II. 1,200-foot runout test matrix; dry purchase tapes.

Approximate Deadload Weight for Test (lb)	Engaging Speeds (knots)						Off-center Engagement Location (ft)
19,000	80	100	120	140	160	180	40
29,000	80	100	120	140	160	180	40
39,000	80	100	120	140	160	180	40
47,000	80	100	120	140	160	180	40
58,000	80	100	120	140	160	170	40
69,000	80	100	120	140	160	170	40
85,000	80	100	120	130	140	150	40

Further, wet purchase tape testing (for example, the purchase tapes shall be wetted through the thickness of the entire length with water prior to each engagement) shall be conducted to investigate tape dive tendencies, dynamic hook loads and system response. See TABLE III for an overview of the test requirements.

TABLE III. 1,200-foot runout test matrix; wet purchase tapes.

Approximate Deadload Weight for Test (lb)	Engaging Speeds (knots)								Off-center Engagement Location (ft)
69,000	80	100	120	130	140	150	160	170	0

TABLE I, TABLE II and TABLE III are based on a 100 million foot-pound kinetic energy capacity Operational AAS. If the kinetic energy capacity of the AAS being tested is rated to exceed 100 million foot-pounds, the Government reserves the right to require additional test trials, at higher kinetic energy levels, to verify the full-scale capacity of the AAS.

TABLE IV test matrix details the requirements for testing an Operational AAS while in a 905-foot runout configuration; de-rating the kinetic energy capacity to 65 million foot-pounds (minimum) due to runout distance limitations.

TABLE IV. 905-foot runout test matrix; dry purchase tapes.

Approximate Deadload Weight for Test (lb)	Engaging Speeds (knots)						Off-center Engagement Location (ft)
19,000	80	100	120	140	160	170	0
39,000	80	100	120	140	160	170	0
58,000	80	100	110	120	130	140	0

5.1.1 Test Method I order and summary. Order and summary of the required testing is presented in TABLE V.

TABLE V. Test Method I test order and summary.

Test Order	Reference Table	Runout Distance (ft)	On-center trials	Off-center trials (40-ft)	Tape Condition
1	TABLE I	1,200	80	0	Dry
2	TABLE II	1,200	0	42	Dry
3	TABLE III	1,200	8	0	Wet
4	TABLE IV	905	18	0	Dry

One-hundred and forty-eight test trials, as specified in TABLE I through TABLE IV, shall be required as a means to:

a. determine the operational effectiveness and reliability of the AAS,

b. determine the arresting characteristics and the performance limitations (if any) of the AAS,

c. determine the useful service life of AAS components,

d. determine if the AAS components have the structural integrity and thermal capacity to accommodate repeated high energy arrestments, and

e. ensure that the AAS is suitable for installation on USAF airfields.

5.2 Test Method II – Emergency AAS Testing. Emergency AASs shall be functionally tested against instrumented deadload vehicles or test aircraft in order to determine the arresting systems performance and characteristics, and to assure that the AASs function is effective, predictable and reliable enough to install on active USAF airfields. For testing described herein, data capture and reporting specific to 4.4 shall be accomplished. Such testing shall be conducted over a full range of aircraft weights and speeds, as specified in TABLE VI and TABLE VII, and shall include engagements made on-center and off-center up to 50 percent of the runway semi-span.

TABLE VI. 905-foot runout test matrix; dry purchase tapes.

Approximate Deadload Weight for Test (lb)	Engaging Speeds (knots)								Off-center Engagement Location (ft)
19,000	80	100	120	140	160	170	180	190	0
25,000	80	100	120	120	120	140	140	140	0
29,000	80	100	120	140	160	170	180	190	0
35,000	80	100	120	120	120	140	140	140	0
39,000	80	100	100	120	130	140	150	160	0
47,000	70	80	90	100	100	120	130	140	0
58,000	70	80	90	100	100	120	120	130	0
69,000	70	80	90	100	100	120	120	120	0
75,000	70	80	90	100	100	100	110	110	0
85,000	70	80	90	90	100	100	100	110	0

TABLE VII. 905-foot runout test matrix; dry purchase tapes.

Approximate Deadload Weight for Test (lb)	Engaging Speeds (knots)				Off-center Engagement Location (ft)
19,000	100	120	140	160	40
29,000	100	120	140	160	40
39,000	80	100	120	140	40
47,000	80	100	120	140	40
58,000	80	100	120	130	40
69,000	70	80	100	120	40
85,000	80	90	100	110	40

TABLE VI and TABLE VII are based on a 50 million foot-pound kinetic energy capacity AAS. If the kinetic energy capacity of the AAS being tested does not equal 50 million foot-pounds (for example, the AAS is rated to have more than 50 million foot-pounds but less than 100 million foot-pounds), the Government reserves the right to require additional test trials, at higher kinetic energy levels, to verify the full-scale capacity of the AAS.

Further, wet purchase tape testing (for example, the purchase tapes shall be wetted through the thickness of the entire length with water prior to each engagement) shall be conducted to investigate potential tape slip characteristics, tape dive tendencies, and dynamic hook-loads and system response. See TABLE VIII for an overview of the requirements.

TABLE VIII. 905-foot runout test matrix; wet purchase tapes.

Approximate Deadload Weight for Test (lb)	Engaging Speeds (knots)				Off-center Engagement Location (ft)
69,000	70	80	100	120	0

5.2.1 Test Method II order and summary. Order and summary of the required testing is presented in TABLE IX.

TABLE IX. Test Method II test order and summary.

Test Order	Reference Table	Runout Distance (ft)	On-center trials	Off-center trials (40-ft)	Tape Condition
1	TABLE VI	905	80	0	Dry
2	TABLE VII	905	0	28	Dry
3	TABLE VIII	905	4	0	Wet

One-hundred and twelve test trials, as specified in TABLE VI and TABLE VII, shall be required a means to:

a. determine the operational effectiveness and reliability of the AAS,

b. determine the arresting characteristics and the performance limitations (if any) of the AAS,

c. determine the useful service life of AAS components,

d. determine if the AAS components have the structural integrity and thermal capacity to accommodate repeated high energy arrestments, and

e. ensure that the AAS is suitable for installation on USAF airfields.

6. NOTES

6.1 Intended use. The standard shall be used to verify MIL-STD-3035 and for all operational testing of AAS within USAF.

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number, and date of this standard.

6.3 Subject term (key word) listing.

AAS
Arrestment
Energy absorber
Engagement
Fairlead beam
Hook cable
Hook load
Kinetic energy
Nylon purchase tape
Tape connector
Tape dive
Walkback

Custodians:
Air Force – 84

Preparing Activity:
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