

INCH-POUND

MIL-PRF-7958D
16 September 2013
SUPERSEDING
MIL-PRF-7958C
1 December 1997

PERFORMANCE SPECIFICATION

PUSH-PULL CONTROLS, FLEXIBLE AND RIGID

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers flexible and rigid push-pull controls used for activating remotely located equipment such as flight controls, system components, and engine throttles.

1.2 Classification. Push-pull controls should be of the types and grades as specified. (see 1.2.1 and 1.2.2).

1.2.1 Types. The types of push-pull controls are as follows:

Type I – Push-pull controls with flexible tubular casing containing a moveable element.

Type II – Push-pull controls with rigid tubular casing containing a moveable element.

Type III – Push-pull controls with a combination of rigid and flexible tubular casing containing a moveable element.

1.2.2 Grades. The grades of push-pull controls are as follows:

Grade A – Push-pull controls made of specially selected components that are individually tested by the contractor to insure that the backlash and operating forces are reduced to the minimum values practical.

Grade B – Push-pull controls made to commercial standards for applications not requiring Grade A controls.

<p>Comments, suggestions, or questions on this document should be addressed to Oklahoma City Air Logistics Center/ENSDAA, 3001 Staff Drive, Tinker AFB, OK 73145 or emailed to af71@tinker.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.</p>

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2. APPLICABLE DOCUMENTS

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 these lists, document users are cautioned that they must meet the requirements specified in the 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. The following specifications 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.

DEPARTMENT OF DEFENSE SPECIFICATIONS

AN665 - Terminal-Threaded Clevis Type Tie Rod

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

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.

ASTM INTERNATIONAL

ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus

(ASTM documents may be obtained online at <http://www.astm.org> or from American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.)

AEROSPACE INDUSTRIES ASSOCIATION of AMERICA, INC. (AIA)

NASM27975 - Clevis, Rod End-Adjusting, Wide and Narrow Forks

(NA/NAS documents may be obtained online at www.aia-aerospace.org/ or from Aerospace Industries Association 1000 Wilson Boulevard, Suite 1700 Arlington, VA 22209-3928.)

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, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

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3. REQUIREMENTS

3.1 First article. When specified (see 6.2), a sample shall be subjected to first article inspection in accordance with 4.2.

3.2 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 Materials. All materials shall be suitably treated to resist corrosion due to electrolytic decomposition, salt fog, and any other atmospheric condition that may be encountered during operational use or storage. The use of toxic chemicals, hazardous substances, or ozone depleting chemicals shall be avoided, whenever feasible.

3.4 Interface.

3.4.1 Shape. The push-pull control shall be shaped or formed as specified on the installation drawing or template provided in the contract (see 6.2).

3.4.2 Movable element. The ends of the moveable element shall be threaded with an external thread .250-28 UNF-3A to accommodate an NASM27975-3, NASM27975-4, AN665-34R, or other internal rod ends.

3.4.3 Weight. The weight of the push-pull control parts shall not exceed the limits shown in Table I.

TABLE I. Weight limits

Item	Limit
Rigid Casing Control	0.30 lb/ft
Flexible Casing Control	0.58 lb/ft
Total for both End Fittings (rigid casing, 4-inch stroke)	0.47 lb
Total for both End Fittings (Flexible Casing, 4-inch stroke)	0.62 lb

3.5 Performance.

3.5.1 General. Push-pull controls shall be capable of transmitting tension and compression forces applied to either end of the moveable element. The moveable element may be either removable or permanently assembled. If removable, it shall be removed quickly and easily without the use of special tools for the purpose of inspection and re-lubrication. The push-pull control shall meet the performance values specified in Table II, given the setup in Figure 1.

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TABLE II. Performance values

Requirement (Note 1)	Room Temp (Note 2)		High Temp (Notes 3, 5)		Low Temp (Notes 4, 5)	
	Grade A	Grade B	Grade A	Grade B	Grade A	Grade B
Backlash (inches)	0.020	0.026	---	---	---	---
Max Operating Force (lbs)						
Under No Load	2.6	4.0	2.6	4.0	15.0	20.0
5 lbs Tension and compression	11.1	15.0	11.1	15.0	23.0	30.0
25 lbs Tension and compression	52.0	55.0	52.0	55.0	60.0	65.0
Max Breakaway Force (lbs)						
No Load	---	---	---	---	20.0	25.0
Notes: 1. Rigid control shall show no visible distortion. Flexible controls shall not show damage, such as breaking, chipping, or cracking. 2. 68° to 85°F (20° to 29°C) 3. 158° ± 2°F (70° ± 1°C) 4. -67° ± 2°F (-55° ± 1°C) 5. Soaking period prior to operation shall be 4 hours.						

3.5.2 Casing.

3.5.2.1 Tubular casing. The tubular casing shall be of the types and grades specified in 1.2.

3.5.2.2 Seals. Seals shall keep the interior of the push-pull control and the moveable element free of dust and moisture while preventing lubrication loss.

3.5.2.3 Ends. Unless otherwise specified, the tubular casing shall have self-aligning end fittings capable of angular displacement of at least 10° from the normal position in any plane.

3.5.3 Moveable element.

3.5.3.1 Backlash. When the design of the push-pull control is such that lost motion can develop within the moveable member during normal service, a positive adjustment shall be provided in the moveable element capable of absorbing this lost motion.

3.5.3.2 Stroke. The length of the stroke of the moveable element shall be as specified in the contract (see 6.2).

3.5.4 Endurance. The push-pull control shall withstand 25,000 reversals of motion, while meeting performance criteria described in 3.5.1 at room temperature and experiencing a maximum change in backlash of 0.005 inches.

3.5.5 Lubrication. Lubricant shall not leak from the push-pull control at an operating temperature of 190° ± 4°F (88° ± 2°C) (see 6.3).

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4. VERIFICATION

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

- a. Qualification inspection (see 4.2).
- b. Conformance inspection (see 4.3).

4.2 First article inspection. First article inspection shall be performed on tests samples as defined in 4.2.1 and 4.2.2.

4.2.1 First article test samples. First article test samples shall consist of a push-pull control of the type and grade for which approval is desired. Two samples will be required if the control is permanently assembled.

4.2.2 First article tests. Push-pull controls shall be subjected to the following tests in the following order:

- a. Examination of product (see 4.6.1).
- b. Backlash (see 4.6.2).
- c. Operating force with no load (see 4.6.3).
- d. Operating force under tension and compression loads (see 4.6.4).
- e. Humidity (see 4.6.5).
- f. Lubrication (see 4.6.6).
- g. Break-away force (see 4.6.7).
- h. Endurance (see 4.6.8).
- i. Corrosion-resistance (see 4.6.9).

4.3 Conformance inspection. Conformance inspection of the push-pull controls shall include the following:

- a. Examination of Product (see 4.6.1).
- b. Operating Force with no Load (see 4.6.3).

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4.4 Inspection conditions. No backlash adjustment of the controls is permitted during the entire test program.

4.5 Requirements cross-reference matrix. Table III provides a cross-reference matrix of section 3 requirements tested or verified in the paragraphs below.

TABLE III. Requirements cross-reference matrix.

Requirement	Verification
3.1	4.2
3.3	4.6.9
3.4	4.6.1
3.5.1	4.6.1
3.5.2	4.6.1
3.5.3	4.6.1
3.5.4	4.6.8
3.5.5	4.6.6

4.6 Tests.

4.6.1 Examination of product. The push-pull control shall be examined to determine conformance with section 3 requirements and drawings provided in the contract.

4.6.2 Backlash. Backlash shall be determined by securing the output end of the control unit while subjecting the input to an operating force with 5 pound tension and a 5 pound compression load at room temperature, “(as defined in table II, note 2)”. The total travel of the input end shall be recorded as backlash and shall not exceed the limits specified in Table II.

4.6.3 Operating force with no load. The operating force required to push or pull the control shall be measured to verify performance specified in Table II.

4.6.4 Operating force under tension and compression loads. The operating force required to move the control shall be measured to verify performance specified in Table II. The operating force, with the control in tension, shall be measured by pulling the control. The operating force with the control in compression shall be measured by pushing the control.

4.6.5 Humidity. The push-pull cable and control shall be placed in a test chamber (see 4.6.5.1) with the temperature raised to $158^{\circ} \pm 3.6^{\circ}\text{F}$ ($70^{\circ} \pm 2^{\circ}\text{C}$), the relative humidity raised to $95 \pm 5\%$ and maintained for 6 hours. After 6 hours, the heat will be turned off. For the next 16 hours, the temperature shall decrease to 100.4°F (38°C) or less. At the end of the 16 hours, heat again will be applied for an additional 2 hours to stabilize the temperature at $158^{\circ} \pm 3.6^{\circ}\text{F}$ ($70^{\circ} \pm 2^{\circ}\text{C}$). This entire cycle shall be repeated 5 times for a total of 120 hours. The control shall be checked for deterioration, deformation, and damage. In addition, the push-pull control shall be examined for compliance with low temperature requirements in Table II.

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4.6.5.1 Humidity test chamber. The test chamber shall be capable of maintaining an internal temperature of $158^{\circ} \pm 3.6^{\circ}\text{F}$ ($70^{\circ} \pm 2^{\circ}\text{C}$) and an internal humidity of 95 ± 5 percent. The test chamber shall be capable of being sealed to retain the total moisture content in the test space. The heat loss from the chamber shall be sufficient to reduce the internal temperature from the above specified operating temperature to not more than 100.4°F (38°C) within a period of 16 hours from the time of removal of the source of heat. Distilled or demineralized water shall be used to obtain the required humidity.

4.6.6 Lubrication. After attaining $190^{\circ} \pm 4^{\circ}\text{F}$ ($88^{\circ} \pm 2^{\circ}\text{C}$), the push-pull control shall be operated through its full stroke at the rate of 20 cycles per minute for 30 minutes. The push-pull control shall exhibit no lubricant leakage.

4.6.7 Break-away force. The break-away force shall be measured at the end of the low temperature soaking period, and shall be the maximum force measured to pull the control on the first movement after the soaking period.

4.6.8 Endurance. The test shall be conducted at room temperature, “(as defined in table II, note 2)”. The reversals shall be applied at the rate of 20 cycles per minute with 4-inch stroke until the 25,000 reversals have been completed. The push-pull control shall be subjected to a 5-pound compression load during the push stroke and a 5-pound tension load during the pull stroke.

4.6.9 Corrosion. The control shall be operated through its full stroke at half-hour intervals for 50 hours in accordance with ASTM B117. Following this test, the control shall be tested at room temperature “(as defined in table II, note 2)” as described in 4.6.2 through 4.6.4. The operating force of the control shall not exceed 50% increase over the original operating force observed between 68° to 85°F (20° to 29°C). The control shall be disassembled and examined for evidence of wear or distortion. The casing shall be sectioned and the bends examined for decrease in thickness. Any evidence of wear, distortion, or decrease in thickness shall be cause for rejection.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the military service's system commands. 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.

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6. NOTES

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

6.1 Intended use. Push-pull controls covered by this specification are intended for use in aircraft for remote operation of equipment.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of this specification.
- b. Item identification.
- c. Type and grade of push-pull control required (see 1.2.1 and 1.2.2).
- d. When first article inspection is required (see 3.1).
- e. Drawing or template for the desired control installation showing length of control, radii and angle of bends, off-sets, length of stroke, and number of self-aligning ends (see 3.4.1).
- f. Data required (see section 4).
- h. Packaging requirements (see section 5.1).

6.3 Lubrication selection. For a guide to lubrication selection see MIL-HDBK-275.

6.4 Backlash. The term backlash is defined as the motion lost within the assembly as a result of the clearance between the moveable member and the casing, including the wear of the individual elements of the moveable member.

6.5 Subject term (key word) listing.

Engine throttle control

Flight control system

6.6 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

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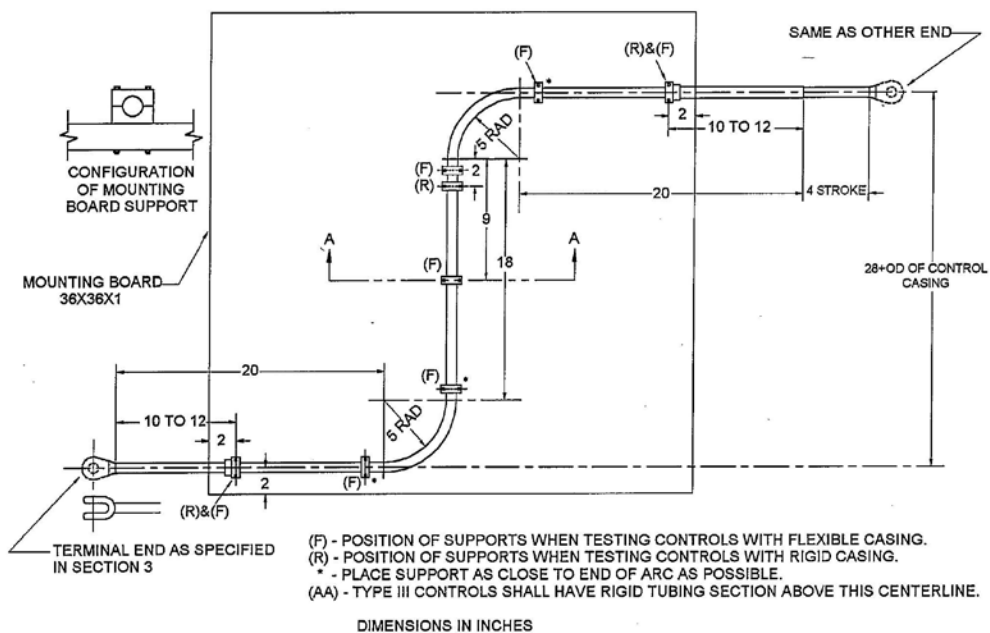


FIGURE 1. Push-pull control performance setup

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Custodians:

Army - AV

Navy - AS

Air Force - 71

Preparing Activity:

Air Force - 71

(Project 2995-2013-002)

Review Activities:

Air Force - 99

DLA - GS

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