SURFACE VEHICLE STANDARD

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Superseding J917 SEP2014

Marine Push-Pull Control Cables

RATIONALE

Reviewed for consistency with current industry practices and minor revisions for clarity.

1. SCOPE

This SAE Standard covers dimensions, performance parameters, and nomenclature of a push-pull control cable used in outboard, inboard, and sterndrive marine throttle and shift applications.

1.1 Purpose

The flexible push-pull cable is a common motion transfer device for the remote operation of the throttle and/or shift levers on marine propulsion units. Satisfactory function of remote controls depends upon proper selection of control cable and providing adequate connection to the propulsion unit. This standard, therefore, establishes nomenclature, dimensions, performance classification, and installation recommendations for marine push-pull control cables.

1.2 General

The conventional marine push-pull cable is a mechanism in which an inner member is supported and guided by a conduit. Efficiency decreases with increased length and with each additional bend in the cable path. Lost motion increases with increased length and with each additional bend in the cable path. Both ends of both elements must be securely connected if the cable is to operate properly.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

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

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https://www.sae.org/standards/content/J917_202108/

3. DEFINITIONS

The following definitions apply to components of marine push-pull control cable installations.

3.1 CONDUIT ANCHOR POINTS

Permanently attached sections on the control cable conduit that provide connection points.

3.2 BACKLASH

The loss of output travel experienced by inner member moving from the outside to the inside radius of the conduit when the control cable is installed in a bend and the inner member experiences loads up to 67 N (15 pounds) push and pull forces.

3.3 CONTROL CABLE

The device which transmits motion from the remote control to the throttle or shift mechanism.

3.4 CONDUIT

The outer element of a control cable. Including inner member conduit and outer jacket of the control cable.

3.5 INNER MEMBER

The inner element (wire) of a control cable.

3.6 CYCLE

The movement of the inner member from a relative starting point through one complete extension stroke and one complete retraction stroke, returning to the relative starting point.

3.7 EFFICIENCY

The output force divided by the input force expressed in percentage.

3.8 SHIFT LEVER

The lever on the shift mechanism that is moved by the control cable.

3.9 LOST MOTION

Loss of output travel under loaded conditions due to the combination of backlash and elasticity.

3.10 RECOMMENDED OPERATING LOAD (ROL)

The force that the control cable can withstand without failure.

3.11 ROD

The rigid extension of the inner member.

3.12 TRAVEL

Total linear movement between inner member and conduit.

3.13 ULTIMATE LOAD

The highest force the control cable can sustain for one cycle before permanent deformation.

4. CLASSIFICATIONS

Criterion to consider in the selection of a control cable are recommended operation load, travel, mounting (style), efficiency, backlash, and operating temperature. These parameters depend on the application and installation of the control cable, and the selection is determined by the desired ergonomic force at each remote control station. Dimensions of the conduit anchor points are provided in Figures 2, 3, and 4.

4.1 Recommended Operating Load (ROL) and Cycle Test

To determine the ROL of the control cable, the manufacturer will grade their control cables based on tests under standard laboratory conditions [22 °C ± 6 °C (72 °F ± 10 °F)]. To grade a control cable, the test sample shall achieve 100000 cycles at ROL, in tension and compression while the input is stroked a minimum of 64 mm (2.5 inches), with no more than 10% decrease in efficiency and 10% increase in backlash. Test shall be run when the cable is installed with 270 degrees of bend at a bend radius of 203 mm (8 inches) (see Figure 1).

Grade	Recommended Operation Load	Figure
3	Up to 222 N (50 pounds)	2
4	Up to 445 N (100 pounds)	3
6	Up to 890 N (200 pounds)	4

4.2 Travel

2 50.8 mm (2 inches)

3 76.2 mm (3 inches)

4 101.6 mm (4 inches)

4.3 Style

B Bulkhead

BC Bulkhead-clamp

C Clamp

4.4 Efficiency

Efficiency of the control cable shall be a minimum of 65% when placed in a total of 270 degrees of bend at a bend radius of 203 mm (8 inches) and 50% of recommended operation load. The input force shall be measured while the cable is stroked a minimum of 64 mm (2.5 inches).

4.5 Backlash

Cable backlash shall be equal to or less than the values in Table 1 when the control cable is measured in 270 degrees of bend at a bend radius of 203 mm (8 inches) with a change of input load from compression to tension of 67 N (15 pounds). See Figure 1 for description of measurement fixture. This measurement shall be made with the output held in a fixture to prevent relative movement.

Table 1

Cable Length	Backlash
Less than 6.1 m (20 feet)	4.75 mm (0.187 inch)
6.1 to 11 m (20 to 36 feet)	5.5 mm (0.217 inch)
Greater than 11 m (36 feet)	6.35 mm (0.250 inch)

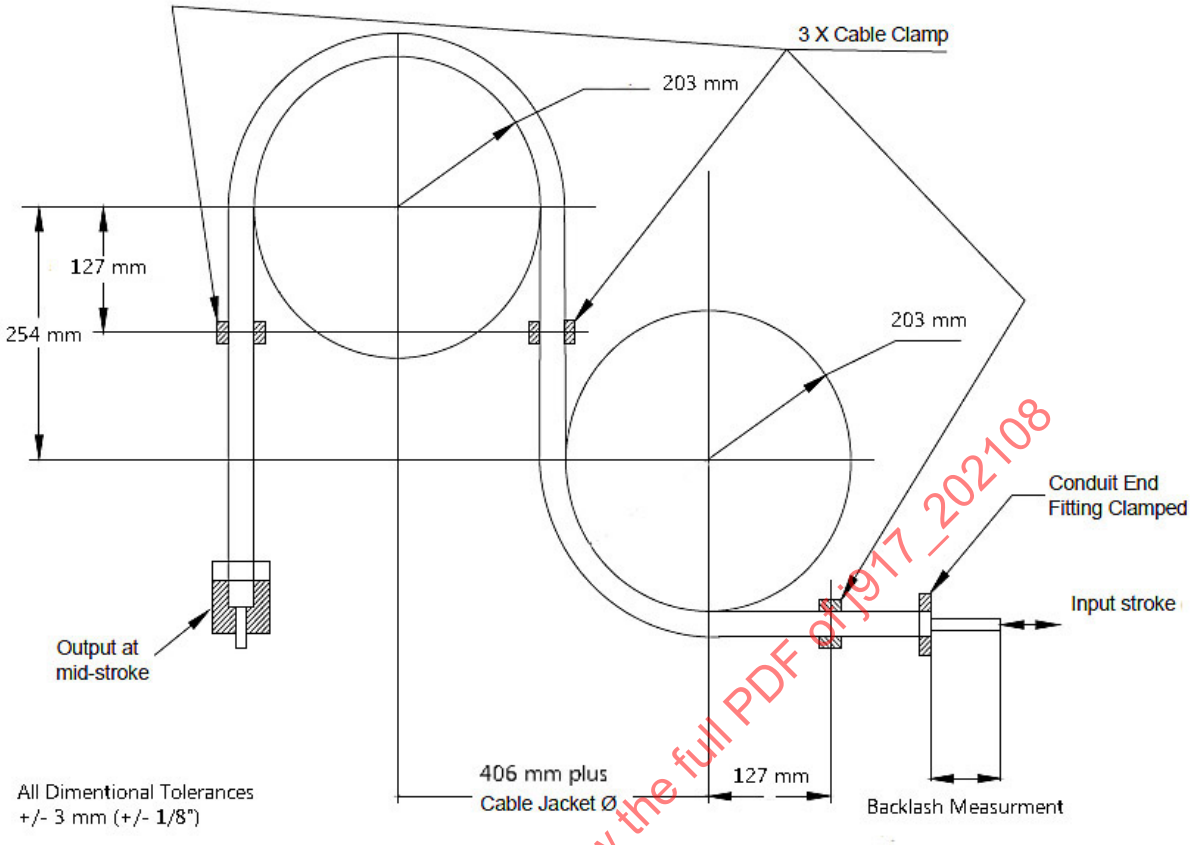


Figure 1 - Cable backlash measurement

4.6 Lost Motion

Shall be a maximum of 5.08 + (0.67 times the length of cable, in meters) mm [0.200 + (0.008 times the length of cable, in feet) inches] when the control cable is measured in 270 degrees of bend at a bend radius of 203 mm (8 inches) with a change of input load from 50% of the ROL in tension to 50% of the ROL in compression. This measurement shall be made with the output held in a fixture to prevent relative movement.

4.7 Temperature

4.7.1 High Temperature

The control cable shall be able to withstand 82 °C (180 °F) sustained for 24 hours with a maximum reduction in efficiency of 5% (but not lower than 65% efficiency) and/or a maximum increase in backlash of 5%.

4.7.2 Low Temperature

In addition, the control cable shall be able to withstand -18 °C (0 °F) sustained for 3 hours without loss of flexibility. Flexibility shall be determined after the cold soak, and at 18 °C (0 °F) the cable shall be bent 360 degrees around a mandrel set at the manufacturer's recommended minimum bend radii without signs of cracking, splitting, or shattering.

4.8 Ultimate Load Requirements

The ultimate load shall be at least twice the ROL for the grade of cable.

NOTE: Standard criterion to consider in the selection of a control cable are recommended operation load (ROL), travel length, and mounting (style). Grade codes are established for these criteria in 4.2. Additional considerations for efficiency, lost motion, and operating environment should be evaluated based on application requirements and manufacturer performance specifications.

5. ENVIRONMENTAL

5.1 Saltwater Exposure

The test samples shall sustain a salt fog test per ASTM B117 for 240 hours with a maximum decrease in efficiency of 10% and with a maximum of 5% red rust exhibited on the metallic surfaces.

5.2 UV Exposure

Plastics and elastomers that may be exposed to sunlight shall be designed to resist degradation by ultra-violet radiation.

6. INSTALLATION CONSIDERATIONS

6.1 For maximum efficiency, control cables should be installed with as few bends as possible. Bends are unavoidable, but when routing the control cables, chose a location that allows for a bend radius of at least 203 mm (8 inches), and never less than the cable manufacturer's recommendation.

6.2 The route of the cable to the throttle or shift mechanism should be direct as possible and unencumbered by accessory equipment.

6.3 The push-pull cable shall be selected to accommodate the throttle and shift lever length and arc of travel.

6.4 A rigid bracket for anchoring the shift and throttle cable should be provided at the correct anchor point for the control cable operation.

6.5 The control cable should not be installed in areas of heat in excess of 82.2 °C (180 °F), such as on or close to an engine exhaust manifold. An extension rod or other means should be used to avoid the heat area.

6.6 Control cables should be routed to prevent contact with sharp edges.

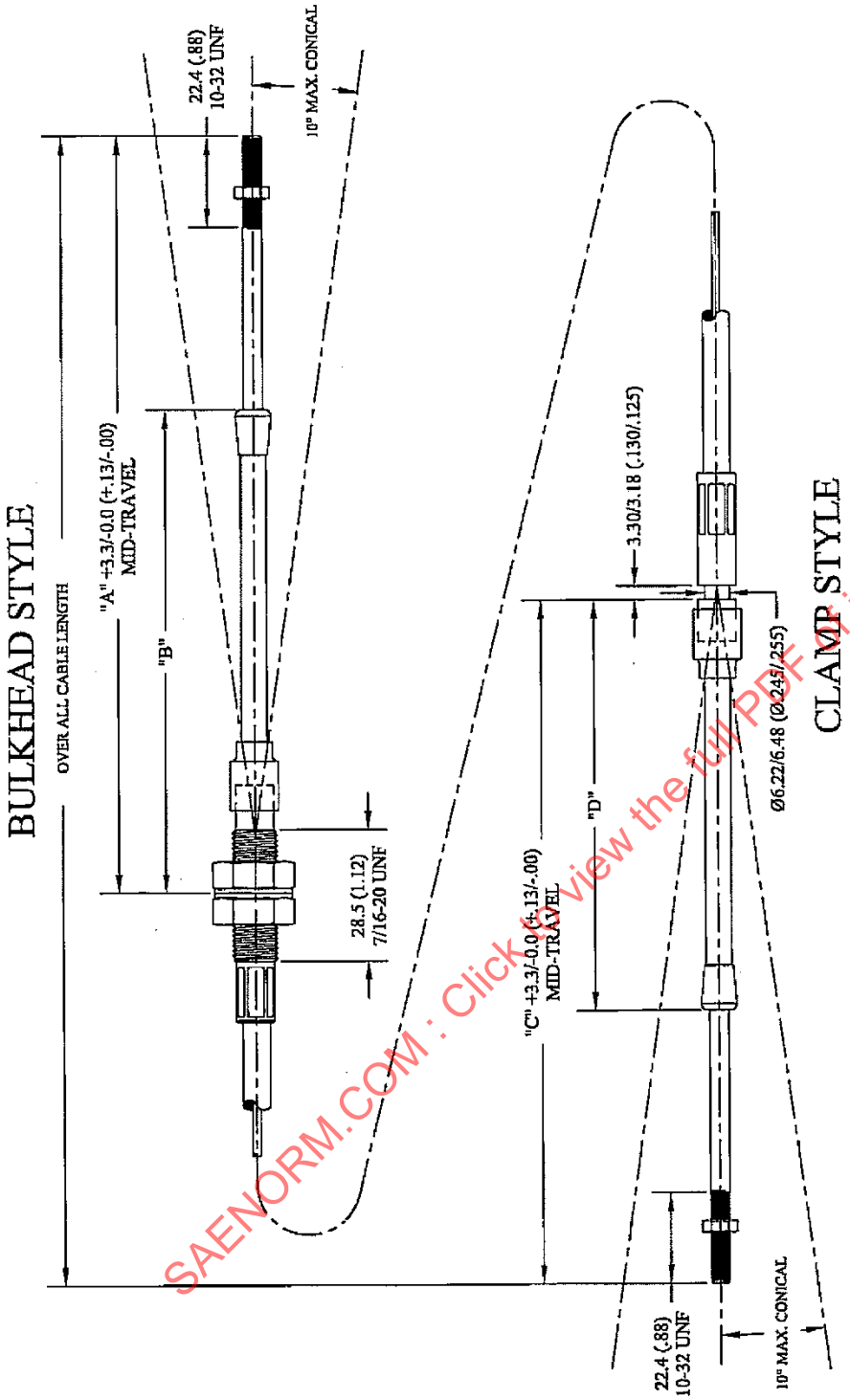
6.7 All threaded cable connections shall have a locking means.

6.8 During installation of the cable, consideration should be made to avoid locations where the cable may become pinched, crushed, or abraded by other moving parts.

7. NOTES

7.1 Revision Indicator

A change bar (l) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of this document. An (R) symbol to the left of the document title indicates a complete revision of the document, including technical revisions. Change bars and (R) are not used in original publications, nor in documents that contain editorial changes only.



GRADE / TRAVEL / STYLE	"A"	"B"	"C"	"D"
32B	149 (5.88)	101.6 (4.00)	-	-
32BC	149 (5.88)	101.6 (4.00)	132 (5.19)	84 (3.31)
32C	-	-	132 (5.19)	84 (3.31)
33B	187.5 (7.38)	127 (5.00)	-	-
33BC	187.5 (7.38)	127 (5.00)	170 (6.69)	109.5 (4.31)
33C	-	-	170 (6.69)	109.5 (4.31)
34B	225.5 (8.88)	152.4 (6.00)	-	-
34BC	225.5 (8.88)	152.4 (6.00)	208 (8.19)	135 (5.31)
34C	-	-	208 (8.19)	135 (5.31)

Figure 2 - Grade 3