Designation: F841 – 84 (Reapproved 2011)

An American National Standard

Standard Specification for Thrusters, Tunnel, Permanently Installed in Marine Vessels[1]

This standard is issued under the fixed designation F841; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope

1.1 This specification supplies general characteristics and interface details of propeller type, fixed-tunnel thruster units permanently installed in marine vessels or structures.

1.2 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

NOTE 1—This specification supplies only general design, interface, and purchase information and does not include requirements for use, thruster controls, or associated equipment. The purchaser of the thruster equipment specified herein is cautioned that he must properly correlate the operating requirements with the thruster specified.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

A296 Specification for Corrosion-Resistant Iron-Chromium and Iron-Chromium Nickel and Nickel-B Alloy Castings; Replaced by A 743, A 744 (Withdrawn 1980)[3]

F25 Test Method for Sizing and Counting Airborne Particulate Contamination in Cleanrooms and Other Dust-Controlled Areas

2.2 *American Bureau of Shipping:*[4]

ABS Rules for Building and Classing Steel Vessels

2.3 *ISO Document:*[5]

ISO Recommendation ISO/DIS 484/1 (Draft)

3. Definitions of Terms Specific to This Standard

3.1 *thruster*—a device constructed such as to provide a force or thrust of controlled variable magnitude and direction to a marine vessel or structure, usually, but not limited to, a propeller mounted within a tunnel located below water level.

3.2 *fixed pitch*—(FP) a propeller in which the blades are part of, or are rigidly attached to, the hub such that the propeller pitch is constant for a given radius.

3.3 *controllable pitch*—(CP) a propeller in which the blades are attached to a mechanism within the hub by means of bolts or fasteners, so that controlled movement of the mechanism causes the blades to change pitch in unison.

3.4 *tunnel*—a part of thruster assembly of circular cross section which houses structure supporting a propeller and drive mechanism.

3.5 *peak power*—highest horsepower developed by the prime mover, or as limited by the thruster manufacturer.

3.6 *continuous duty*—operation of the thruster continuously at any power range, up to manufacturer's rating, for extended periods, but not to overlap into recommended maintenance intervals.

3.7 *intermittent duty*—operation of the thruster at peak power or RPM levels, or both, for periods not exceeding 1 h followed by periods of 1 h at the continuous rating or less, with total running time not exceeding 8 h in 24 h.

3.8 *landing bars*—permanent attachments, usually in the form of plates welded to the tunnel during manufacture, intended to provide joining facilities for deck plates or bulkheads, or both, at installation. Landing bars are neither

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] The last approved version of this historical standard is referenced on www.astm.org.

[4] Available from American Bureau of Shipping (ABS), ABS Plaza, 16855 Northchase Dr., Houston, TX 77060, http://www.eagle.org.

[5] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

intended to be part of the support structure for the thruster, nor provide support or transmit forces from the vessel structure to the thruster.

3.9 *prime mover*—the motor(s) or engine(s) providing the power to drive the thruster.

3.10 *grid bars*—bars installed at the tunnel entrances in the form of a mesh to prevent large objects from passing through the thruster tunnel. The area occupied by the grid bars shall not exceed 6 % of the tunnel cross-sectional area.

4. Classification

4.1 Thrusters manufactured in accordance with this specification shall be identified as follows:

4.1.1 *Type I*—Fixed pitch.

4.1.2 *Type II*—Controllable pitch.

4.2 Each type of thruster may be manufactured to the following grade:

4.2.1 *Grade 1*—Intermittent duty for docking and navigation.

4.2.2 *Grade 2*—Continuous duty for stationkeeping or dynamic positioning.

5. Ordering Information

5.1 Requests for quotation and purchase orders shall specify the following (in absence of specific requirements in ordering data, the unit will be provided only as specified herein):

5.1.1 Description of thruster.

5.1.2 ASTM designation and date of issue.

5.1.3 Type.

5.1.4 Grade.

5.1.5 Input Shaft Angle—Refer to Fig. 1.

5.1.6 Tunnel Extensions—Refer to Fig. 2.

5.1.7 Landing bars or other weldments to the thruster to be shown in a sketch or drawing provided by the purchaser.

5.1.8 Type of prime mover.

5.1.9 Input HP and RPM to thruster.

5.1.10 *Material Options for Hub and Blades:*

5.1.10.1 Ni-Al Bronze ABS Type 4.

5.1.10.2 Stainless steel Specification A296 – 72 GR CF-3 or CF-8C or other ABS approved material.

5.1.10.3 Manganese bronze ABS Type 2.

5.1.11 Blade hatch.

5.1.12 Instruction books (unless otherwise specified, six copies in English).

5.1.13 Tunnel insert (erosion liner).

5.1.14 Painting or coating, external (water contact surfaces).

5.1.15 Painting or coating, internal (inside hull).

5.1.16 *Blade Balancing*—Manufacturer standard practice or ISO Recommendation F484 Class II Draft International Standard ISO/DIS 484/2.

5.1.17 Special tools.

5.1.18 Spare parts.

5.2 As a minimum, the following vessel particulars shall be furnished when the thruster manufacturer is required to determine the thruster size; other particulars may be required by the thruster manufacturer.

5.2.1 Vessel type.

5.2.2 Applicable classification society.

5.2.3 Length at waterline.[6]

5.2.4 Width at waterline.[6]

5.2.5 Draft, loaded forward after or draft, ballast forward after.

5.2.6 Dimension of keel to thruster centerline.

5.2.7 Dimension of bow at waterline to thruster centerline.

5.2.8 Beam at the thruster centerline.

5.2.9 Vessel displacement.[6]

5.2.10 Vessel service and operating environment.

5.2.11 Whether grid bars are to be installed.

6. Materials and Manufacture

6.1 *General Requirements*—The tunnel shall be made of tested steel of ABS quality or equal, fabricated, cast or forged, or a combination thereof. All structural welding shall be in accordance with the applicable regulatory agency or the thruster manufacturer's recommendations or both. All welds exposed to (sea) water shall be overlayed with weld metal containing 2½ % nickel, minimum. The minimum tunnel material thickness shall meet applicable classification society requirements. A replaceable insert may be provided in the tunnel in way of the propeller tips to prevent erosion of the tunnel wall (Fig. 3). The minimum width of the insert shallbe 10 % of the propeller diameter. If an insert is not used, the tunnel thickness in way of the blades, and for a minimum length of 10 % of the tunnel diameter, shall be increased by at least 10 % of the required thickness. Reenforcement rings/stiffeners may be applied at each end of the tunnel by the manufacturer. The rings may or may not become part of the joint detail to the tunnel extension.

6.2 Propeller blades and hub may be one of the following materials or other material approved by the applicable classification society and shall be specified in the ordering data.

6.2.1 Ni-Al Bronze ABS Type 4.

6.2.2 Stainless Steel Specification A296 – 77 GR CF-3 or CF-8C.

6.2.3 Manganese Bronze ABS Type 2.

6.3 All fasteners exposed to (sea) water shall be of monel, stainless-steel, or bronze alloy, unless otherwise specified in the ordering data.

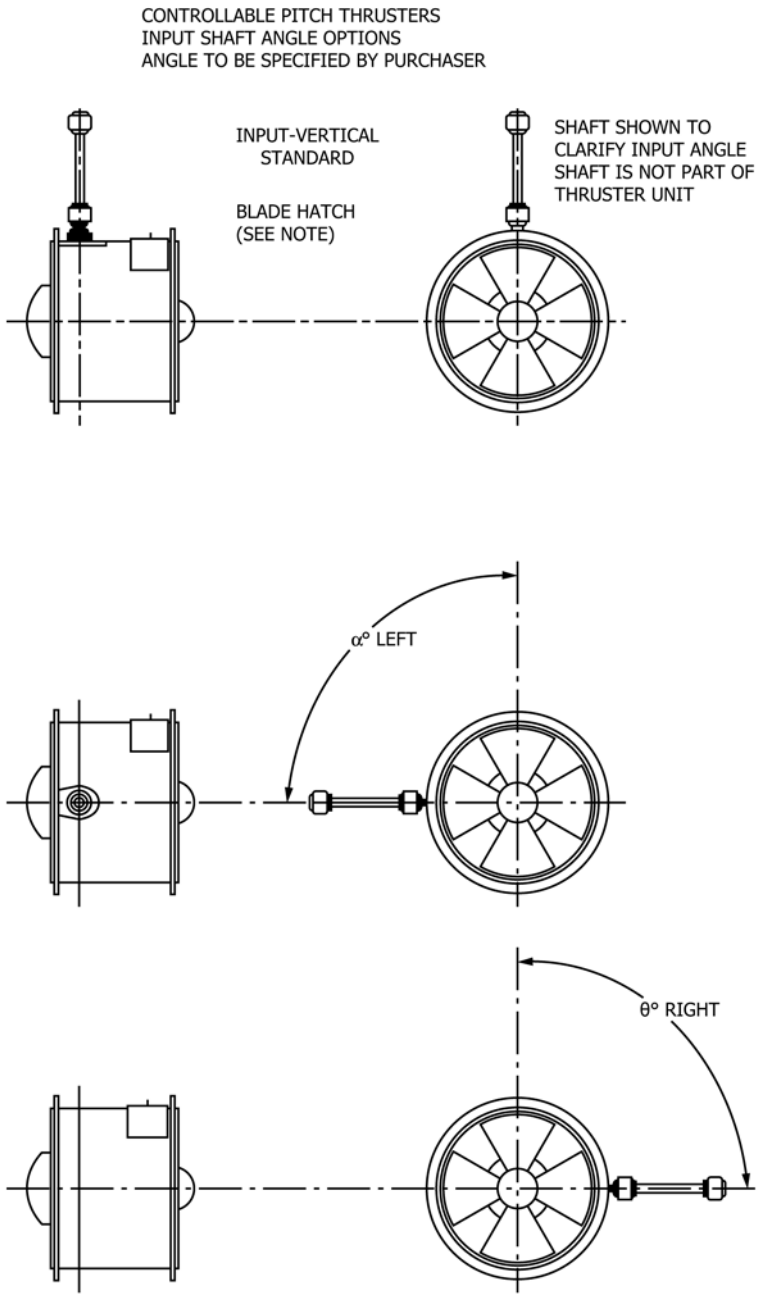
6.4 All materials shall be free of imperfections and defects that adversely affect serviceability.

6.5 All steel surfaces exposed to (sea) water shall be cleaned, painted, or coated in accordance with manufacturer's commercial practice or as otherwise specified in ordering data.

6.6 All steel surfaces that will be within the hull of the vessel shall be cleaned, painted, or coated in accordance with manufacturer's commercial practice or as otherwise specified in ordering data.

6.7 The thruster shall consist of a propeller mounted within a strongly fabricated circular tunnel. The propeller will be secured to a shaft that is rigidly supported in oil lubricated antifriction bearings.

[6] With reference to fully loaded design conditions.



NOTE 1—The thruster will be supplied without the blade hatch unless otherwise specified in the ordering data.

FIG. 1 Input Shaft Angle

6.7.1 A thrust bearing shall be contained within a housing that is securely attached to the tunnel section such as to transmit the thrust developed by the propeller.

6.7.2 A drive mechanism shall be provided to transmit power to the propeller. This also shall be within the housing and be oil lubricated.

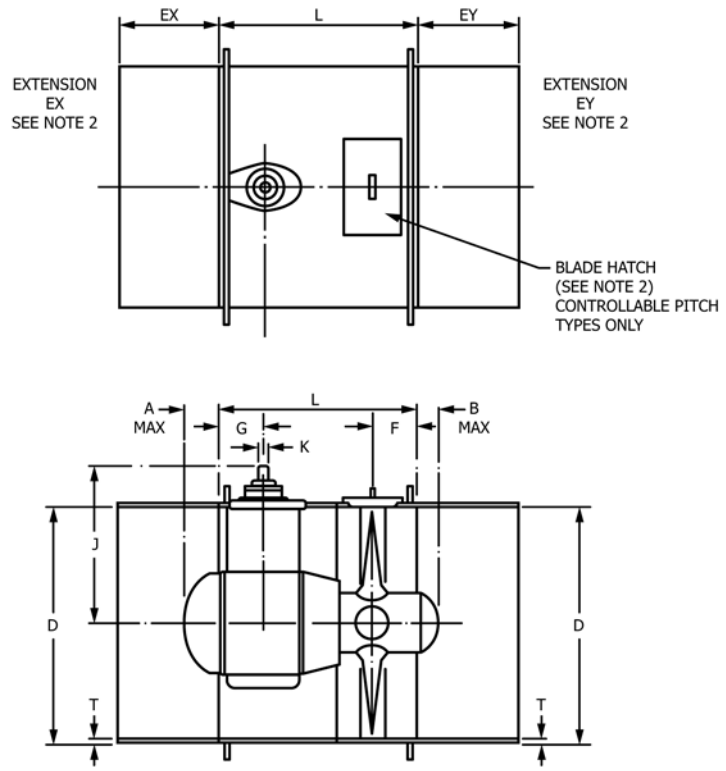
6.7.3 The right-angle drive shafting and propeller hub shall be removable, if necessary, for inspection or repair without removing the tunnel from the vessel.

6.7.4 The propeller shall be statistically balanced as specified in the ordering data.

6.7.5 For Type 2 controllable pitch thrusters, the tunnel may be equipped with a removable hatch over the propeller to permit withdrawal of blades. This requirement shall be specified in the ordering data.

6.8 The tunnel shall be attached to the ship's structure by means of tubular extensions that are part of or are welded to the ends of the tunnel. No other welding on the assembled unit is permitted without the manufacturer's approval in view of possible damage to the alignment of drive mechanism and bearings. Should other weldments, for example, landing bars, be required, they shall be specified by the purchaser before the tunnel manufacture.

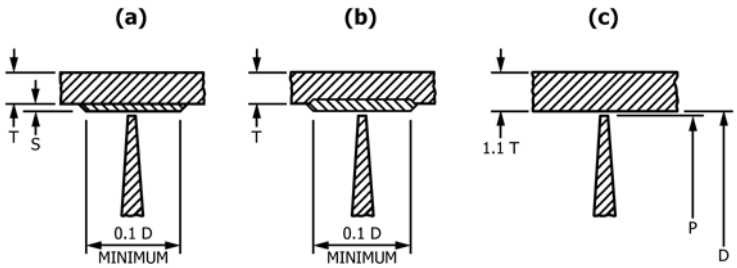
D	L	EX	EY	T	J	K	G	F	A MAX	B MAX



NOTE 1—*Ordering Information*—Dimensions in the table shall be supplied by the vendor, except dimensions *EX* and *EY* shall be specified by the purchaser.

NOTE 2—The thruster will be supplied without the blade hatch and without the tunnel extensions unless otherwise specified in the ordering information.

FIG. 2 Thruster Dimensions



Legend:
T = Minimum tunnel material thickness to meet applicable classification society requirements
D = Tunnel diameter (inside)
P = Propeller diameter
S = Tunnel insert (erosion liner) thickness
3/16 in. (5 mm) minimum for $D \leq 60$ in. (1.52 m)
1/4 in. (6 mm) minimum for $D > 60$ in. (1.52 m)

FIG. 3 Tunnel Insert (Erosion Liner) or Alternative Method

6.9 A lubrication system shall be provided for bearings and gears. Seals shall be provided to prevent leakage of oil out of the thruster and ingress of (sea) water into the thruster. A pressure shall be maintained within the thruster that is at least 1 psig (7 kPa) greater than the outside water pressure measured at the thruster centerline.

7. Other Requirements

7.1 *Propeller Design (General),* shall be based on standard series model tests carried out at a recognized marine laboratory or by substantiated test data from previous application.

7.2 The thruster manufacturer shall submit, as a minimum, the following plans for review by the purchaser.

7.2.1 Installation drawing.

7.2.2 Outline drawings of major assemblies showing overall dimensions, interface details, and weights.

7.3 It is recommended that an hour meter be installed in the system such that preventive maintenance and records of operation may be maintained.

7.4 *One Set of Special Tools,* as deemed necessary by the manufacturer, for removing the propeller hub and blades, shafting and right-angle drive parts shall be provided unless otherwise stated in the ordering data.

7.5 *One Set of Normal Onboard Spare Parts,* as recommended by the manufacturer for one year's service shall be provided unless otherwise stated in the ordering data.

7.6 Copies of instruction books of standard commercial format shall be provided, as required by the ordering data. Instruction books shall describe the installation, startup, operation, planned maintenance, troubleshooting, assembly, and disassembly of the manufacturer's equipment.

8. Dimensions and Ratings

8.1 Interface dimensions of thrusters shall be provided by the vendor and shall include at least the dimensions defined in Fig. 2 and Fig. 1.

8.2 At its normal continuous rating, the thruster shall be capable of producing a minimum thrust of 23 lb/hp (0.137 N/W). The input horsepower per square foot (propeller disk area) shall not exceed 50, for example, horsepower per area shall be $\leq$50 (401.5 kW/m^2). Propeller tip speed shall not exceed 6300 ft/min (1920 m/min).

8.3 The nominal thrust of 23 lb/hp (0.137 N/W) does not take into account losses for added tunnel length, bends, or grid bars and assumes a minimum submergence of one propeller diameter to the thruster centerline.

9. Workmanship

9.1 All workmanship shall be workmanlike and of acceptable commercial marine standard in all respects, and all materials, machinery, pieces, or parts specified shall be of recent manufacture and unused except for normal testing as required.

10. Inspection and Shop Testing

10.1 The manufacturer shall test the thruster unit to ensure proper assembly, alignment, and functioning of the internal mechanisms.

10.2 The manufacturer shall inform the purchaser at least ten days before testing such that the testing may be witnessed should the purchaser so desire.

10.3 During manufacture of the thruster, inspection records shall be made of at least the following:

10.3.1 Backlash, alignment, and pattern of gear (if used).

10.3.2 Blade tip clearances, each blade at eight equally spaced intervals.

10.3.3 For units with detachable blades, the blade weight and balance.

10.3.4 Mounting and clearance dimensions.

10.4 Final test and inspection shall include at least the following:

10.4.1 *FP Units:*

10.4.1.1 Spin test in air of sufficient duration to verify satisfactory operation,

10.4.1.2 Oil temperature before and during spin test, and

10.4.1.3 Visual inspection for leaks before and after spin test.

10.4.2 *CP Units:*

10.4.2.1 Spin test in air of sufficient duration to verify satisfactory operation,

10.4.2.2 Oil pressures and temperature before and during spin test,

10.4.2.3 Pitch changing pressures (or force if mechanical) (both directions),

10.4.2.4 Pitch changing-time full stroke, and

10.4.2.5 Visual inspection for leaks before and after spin test at relief-valve pressure operation for a period of 2 min.

10.5 Nonrotational tests shall include at least the following for CP thrusters.

10.5.1 Pitch changing time (full pitch to full pitch, both directions).

10.5.2 Minimum pitch changing pressure or force, both directions.

10.5.3 Visual leak inspection at relief-valve pressure operation for a period of 2 min.

10.5.4 Pressures during pitch cycling.

10.6 The recorded data shall be issued and become part of the instruction manual.

11. Product Marking

11.1 The thruster unit assembly shall include at least the following:

11.1.1 Manufacturer's name,

11.1.2 Model number,

11.1.3 Serial number,

11.1.4 ASTM specification number, and

11.1.5 Date of manufacture.

12. Keywords

12.1 fixed-tunnel thrusters; propeller-type thrusters