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**Ships and marine technology — Marine  
environment protection — Adapter for  
joining dissimilar boom connectors**

*Navires et technologie maritime — Protection de l'environnement  
marin — Adaptateur pour le raccordement de barrières antipollution  
munies de connecteurs dissemblables*



Reference number  
ISO 16446:2013(E)

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Published in Switzerland

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## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2. [www.iso.org/directives](http://www.iso.org/directives)

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received. [www.iso.org/patents](http://www.iso.org/patents)

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

The committee responsible for this document is ISO/TC 8, *Ships and marine technology*, SC 2, *Marine environment protection*.

This second edition cancels and replaces the first edition (ISO 16446:2002) which has been technically revised.

## Introduction

Historically, different types of boom end connectors have been produced. This International Standard addresses the need to connect booms having dissimilar connectors during oil spill incidents where various operators may join forces to combat an oil spill or where normally incompatible boom stock must be used together.

The American Society for Testing and Materials (ASTM) Committee F-20 (Hazardous Substances and Oil Spill Response) has been preparing standards on related subjects for years. This organization has prepared two standards relating to boom connectors, namely ASTM F962-99 and ASTM F1657-96.

The first of these standards, ASTM F962, specifies standard mating requirements, or geometry, for boom connectors or adaptors. ASTM F962 was never widely accepted in the international community because many users believe that this mating geometry has inherent design limitations. In particular, the required strict tolerance between mating faces of the two joining connectors can result in connection problems. Some reported concerns or deficiencies with boom connector designs that use the ASTM F962 mating specifications are as follows:

- Slight bending along the length of the connector can easily occur during operation or, in particular, during roll-up or storage on the boom reel, resulting in the inability to join them together again;
- The design is more susceptible to experiencing difficulties joining connector ends if the connector face has been dented or marred through impact;
- Dirt and debris can be trapped on a mating surface, preventing proper fitting and connection, or requiring careful cleaning of the connectors;
- During cold weather operations, ice can form at the mating faces, making connection difficult or impossible; and
- The connection is not always secure. The use of a self-locking pin has occasionally resulted in excessive play in the connection and eventual release.

With respect to permanently incorporating a universal requirement or standard connector in all boom systems (instead of using an adaptor only when required), discussions with spill response operators and oil boom producers clearly indicate that, in many cases, this will not provide an appropriate or realistic standard practice. Booms and connectors are often designed or selected by an operator based on the needs that are suitable for their particular operating conditions. Also, producers choose connectors based on the needs of the particular boom design. In effect, many users think it is unlikely that any single standard connector mating criteria (as, for example, ASTM F962) will provide the characteristics to satisfy the specific requirements of all users.

The second of these standards, ASTM F1657, was subsequently developed to provide another approach to oil boom connectors. Instead of providing a standard connector design, it provides a common method for joining existing booms with different connector designs in the field during a major spill incident. This standard does not attempt to have all manufacturers and spill responders use universal connectors at all times. Instead, it specifies modifications on existing connectors in the way of incorporating holes at specified locations to allow for this standard connection method during major response incidents. Alternatively, boom manufacturers may provide an adaptor that would accomplish the same end result.

After considering these existing ASTM standards and discussions with individuals involved in the development of these standards, i.e. spill responders and boom producers, this International Standard was developed to use the same mating specifications as in ASTM F1657. However, this International Standard encourages the use of separate adaptors in most cases, to avoid the possible adverse effects of modifications to existing connector designs when incorporating these mating specifications. These mating specifications may be incorporated into existing connectors, if preferred and possible, only when the manufacturer or user can ensure that the modifications will not alter the strength and performance of the connector.

## ISO 16446:2013(E)

This International Standard contains the essence of ASTM F1657, with changes and additional details incorporated in certain Clauses.

# Ships and marine technology — Marine environment protection — Adapter for joining dissimilar boom connectors

## 1 Scope

This International Standard specifies a universal method for the joining of oil spill containment booms with dissimilar connectors through the use of a standard adaptor with prescribed mating specifications. This International Standard does not intend to replace the design of existing connectors.

This International 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 International Standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

## 2 Terms and definitions

For the purposes of this International Standard, the following terms and definitions apply.

### 2.1

#### **boom**

floating barrier used to control the movement of substances that float

### 2.2

#### **bridle**

device attached to a boom to distribute the load exerted by towing or anchoring the boom

### 2.3

#### **draft**

minimum vertical depth of the boom below the waterline

### 2.4

#### **end connector**

device attached to the boom used for joining boom sections to one another or to other accessory devices

### 2.5

#### **freeboard**

minimum vertical height of the boom above the waterline

### 2.6

#### **tensile strength**

force required to stretch boom components to the point where a failure occurs

## 3 General functional conditions

The main precondition for the successful use of an adapter for dissimilar boom connectors is that the design of any boom connector meets the following criteria:

- The boom connector shall be strong enough to withstand impressing forces relating to the type, size and purpose of the boom it is mounted on.
- Oil leakage shall be avoided between boom sections.
- The boom connector shall be secure, as well as, easily connected and disconnected in and out of the water, in the presence of oil, dirt and ice, in rough water, or any combination thereof. Connectors that can be joined by simply drawing the ends together are preferred over those that require one to slide into the other.

- The boom connector shall be such that it matches the applicable boom end (see [Figure 1](#)) without male and female differentiation, and resists distortion, e.g. when winding on a reel.
- The boom connector shall be locked or secured by wing nuts or self-locking pins which are preferably secured to the boom or end connector, are easy to handle (e.g. when wearing gloves) and, do not require the use of tools. Where tools are needed, they shall be commonly available tools.
- The boom connector shall not have any negative influence on the boom's performance, i.e. freeboard and stability, and transfer tensile forces between boom sections, if the boom design requires this.

NOTE On some booms, the use of the adapter may cause a reduction in freeboard near the connector. This potential loss of freeboard is, however, outweighed by the benefit of being able to connect the dissimilar booms under emergency circumstances.

- Health and safety issues associated with the use of the boom shall be considered and mitigated.

## 4 Design criteria

### 4.1 Mating requirements

In order to comply with the practice for the joining of booms with incompatible connectors, an appropriate number of adapters must be provided by the manufacturer or user that, on one side, connect to the existing connector and, on the other side, consist of a flat plate that incorporates the mating requirements as described in [4.2](#). This requirement encourages the use of separate adapters to avoid the possible adverse effects of modifications made to existing connector designs when incorporating these mating specifications. However, in certain cases, the following mating requirements may be incorporated directly into an existing connector design, and thus preclude the use of a separate adapter. The latter option is possible only if the connector can accept the holes spaced as required without interfering with existing bolt holes or other connector features and if the manufacturer or user can ensure that the modifications will not alter the strength or performance of the adapter.

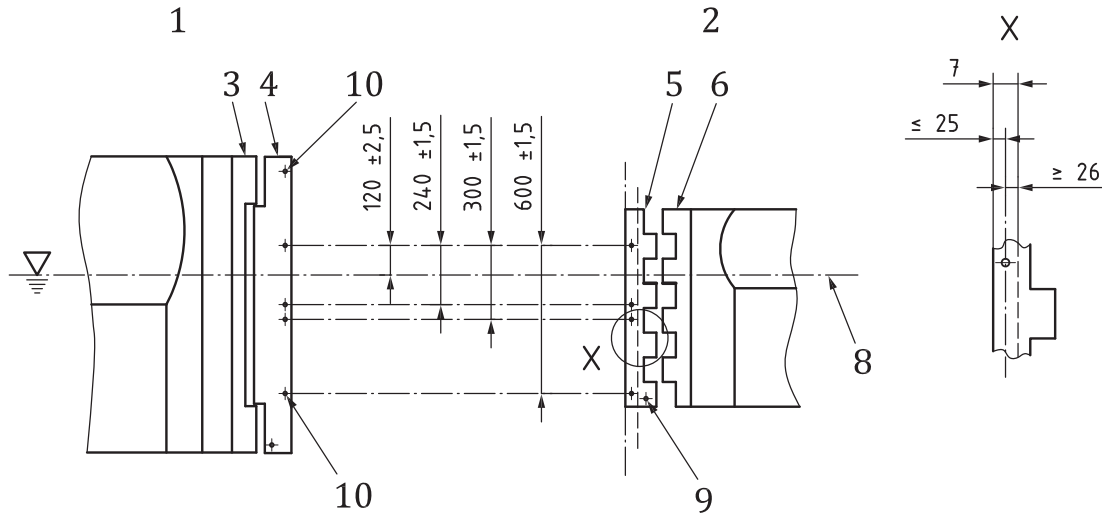
### 4.2 Bolt holes

The adapter shall have, on one side, a flat plate with a standard mating face with a minimum of three 16 mm holes, as shown in [Figure 1](#), to accommodate 12 mm (or 1/2 inch) diameter AISI 316 stainless steel<sup>1)</sup> bolts. These bolts should be provided with the adapter. An example of the shape of the boom connector, as well as, the detail of the bolt connection is shown in [Figure 1](#) and [Figure 2](#), respectively. Using the boom design waterline as a reference point, the centre of the first hole shall be 120 mm above the waterline, the centre of the second hole shall be 240 mm below the centre of the first hole, and the centre of the third hole shall be 300 mm below the centre of the first hole. For larger adapters, additional holes shall be placed at 300 mm increments from the first hole. To avoid tolerance accumulations, the distance to each hole is measured from the centre of the first hole. To ensure proper mating with other adapters based on this International Standard, the mating surface shall not exceed 25 mm from the hole centres to the outer edge and shall have a minimum of 26 mm space in from the hole centres. This mating area shall be flat and clear of any interference.

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1) AISI 316 stainless steel is an example of a suitable product available commercially. This information is given for the convenience of users of this International Standard and does not constitute an endorsement by ISO of this product.



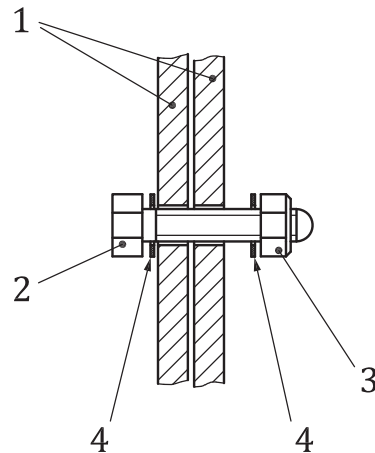


**Key**

- 1 Boom/connector with five holes
- 2 Boom/connector with four holes
- 3 Type-A connector
- 4 Standard adapter for type-A connector
- 5 Standard adapter for type-B connector
- 6 Type-B connector
- 7 Mating area
- 8 Design waterline
- 9 Hole(s) for tension member shackle or fastener
- 10 Holes

NOTE Dimensions in mm.

**Figure 1 — Example of boom connections using an ISO standard adapter**



**Key**

- 1 Adapter plate
- 2 12 mm x 60 mm (1/2 inch x 2-1/2 inch) bolt
- 3 Self-locking nut
- 4 Flat washer

NOTE 1 The drawing is a side view of examples of two different connectors and corresponding adapters.

NOTE 2 Assembly hardware is AISI 316 stainless steel<sup>2)</sup>, or equivalent.

NOTE 3 The first hole is above the waterline for accessibility and to minimize leakage.

NOTE 4 The first hole below the waterline is generally below the oil layer and in line with the tension member.

NOTE 5 The tension member shackle or fastener hole is located outside the mating area.

NOTE 6 On small booms, e.g. 250 mm, the adapter may be longer than the original connector in order to accommodate the necessary holes.

**Figure 2 — Bolt connection detail**

**4.3 Separate adapter not used**

In the case where a separate adapter is not used, these holes shall be incorporated into the existing connector without negatively affecting the performance or strength characteristics of the connector.

**4.4 Boom with separate tension members**

If the boom has separate tension members, e.g. chains, cables, etc., the adapter shall also have a hole for each tension member, located on the inner side of the mating area, to accommodate a shackle or other fastener to secure the tension member.

**4.5 Securing of material**

Assembly bolts, complete with washers and self-locking nuts, shall be attached to the adapter by means of a retaining chain or wire to avoid misplacing them when not in use.

2) AISI 316 stainless steel is an example of a suitable product available commercially. This information is given for the convenience of users of this International Standard and does not constitute an endorsement by ISO of this product.

## 4.6 Additional drilling considerations

Additional drilling of a connector should not significantly impact the general functional considerations, or the design tensile strength of the boom system in use.

## 4.7 Tensile strength

The end user has the responsibility to ensure that the use of the adapter is such that the tensile strength of one boom is transferred to another.

# 5 Operational considerations

## 5.1 General

This practice should allow for multiple boom connections at one point.

## 5.2 Tensile loads

Before using this connection method, the manufacturer and the end user shall consider the effective transmission of tensile loads between the joined sections. This will include tensile loads on the boom fabric and primary and secondary tension members, and the orientation of the tension members. Loads may be offset at a connection, depending on boom design and size variations between two connectors.

If the boom fabric is not designed to transfer or withstand tensile loads, the user shall ensure that the tension members of the different booms can be appropriately connected to each other or to the adapters so as to transfer the tensile loads.

## 5.3 Unwanted tensile loads

Although efforts should be made to maintain the integrity of the boom system, the use of this connection method may adversely affect the total tensile strength of the connected booms. In particular, the use of this practice with similar or different sizes of booms may cause the transmission of unwanted tensile loads and bending moments on certain boom parts, resulting in possible premature failure of the boom system.

## 5.4 Compatibility with spill material

This practice does not address the compatibility of oil spill control equipment with spill products. It is the user's responsibility to ensure that any equipment selected is compatible with the anticipated spill material and does not detract from the operational performance of the adjoining booms.

## Bibliography

- [1] ASTM F962-04, *Standard Specification for Oil Spill Response Boom Connection: Z-Connector*
- [2] ASTM F1093-99, *Standard Test Methods for Tensile Strength Characteristics of Oil Spill Response Boom*
- [3] ASTM F1523-94, *Standard Guide for Selection of Booms in Accordance with Water Body Classifications*
- [4] ASTM F1657-96, *Standard Practice for Joining of Boom with Incompatible Connectors*
- [5] ISO 16165, *Ships and marine technology — Marine environment protection — Terminology relating to oil spill response*

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