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SHIP/PORT INTERFACE

Availability of tug assistance

1 The Facilitation Committee at its thirtieth session (27 to 31 January 2003), the Maritime Safety Committee at its seventy-seventh session (28 May to 6 June 2003) and the Marine Environment Protection Committee at its forty-ninth session (14 to 18 July 2003), recognizing the importance of the provision of adequate tug assistance in ports for ensuring maritime and port safety, the protection of the marine environment and the facilitation of maritime traffic, approved the issuance of this circular to assist port authorities and port operators in assessing the adequacy of the tug services in their ports.

2 The annex to this circular, which contains a detailed list of the contents of the Nautical Institutes publication 'Tug Use in Ports – A Practical Guide'*, provides guidance for conducting such an assessment. The key elements to be considered, when carrying out the assessment, are those highlighted in bold italics. Presently this publication is only available in the English language.

3 Member Governments are invited to bring this circular to the attention of administrations, port authorities, port operators, pilot organizations and tug services.

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* **The publication (ISBN 1 870077 39 3) can be obtained from;**

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ANNEX

LIST OF CONTENTS OF THE PUBLICATION
"TUG USE IN PORTS – A PRACTICAL GUIDE"

Remark:

The Chapters are shown in bold capital letters, while the section headings are shown in bold letters.
Key elements to be considered when conducting an assessment on the adequacy of tug services are highlighted in bold italics.

CHAPTER TWO – TYPES OF HARBOUR TUG

2.1 Classification of Harbour Tug types

a) Tugs with their propulsion aft and towing point near midships. These are conventional types of tug

b) Tugs with their towing point aft and propulsion forward of midships. These are tractor tugs.

2.2 Important general requirements and/or good tug performance

2.2.1 Tug performance and safety

- ***Response time***
- ***Effectiveness and safety of operations***
- ***Required manoeuvring space***

2.2.2 Wheelhouse construction and layout

- Visibility
- Manoeuvring stations
- ***Communication***

2.2.3 Tug superstructure and underwater design

2.2.4 Fendering

2.3 Conventional types of tug

2.3.1 General

2.3.2 Propulsion and rudders

- Propulsion and propeller control
- Propeller efficiency and manoeuvrability
- Movable flap-rudders
- Schilling rudders
- Flanking rudders
- Towmaster system
- Other systems
- Bow thruster

2.3.3 Manoeuvring conventional tugs

- Single screw tugs
- Twin screw tugs

2.3.4 Conventional tugs in shiphandling

2.4 Combi-Tugs

2.4.1 Designing and manoeuvring combi-tugs

2.4.2 Combi-tugs in shiphandling

2.5 Tractor-tugs with cycloidal propellers

2.5.1 Design

2.5.2 Propeller control

2.5.3 Manoeuvring

2.5.4 VS tugs in shiphandling

2.6 Tractor tugs with azimuth propellers

2.6.1 Design

2.6.2 Propeller control

2.6.3 Manoeuvring

2.6.4 Azimuth tractor tugs in shiphandling

2.7 Reverse-tractor tugs

2.7.1 Design

2.7.2 Propeller control, manoeuvring capabilities and shiphandling

2.8 Azimuth Stern Drive (ADS) tugs

2.8.1 Design

2.8.2 Propeller control, manoeuvring capabilities and shiphandling

2.9 Tug performance

CHAPTER THREE - ASSISTING METHODS

3.1 Introduction

In ports tugs may render one of the following services:

- ***Tug assistance during a transit to or from the berth including assistance during mooring and unmooring operations***
- ***Tug assistance mainly during mooring and unmooring operations only)***
- ***Giving steering assistance and controlling ship's speed***
- ***Compensating for wind and current during transit while a ship has speed***
- ***Controlling traverse speed towards a berth while compensating for wind and current during mooring/unmooring operations***

3.2 Assisting methods

3.2.1 Assisting methods in use

There are only two markedly different assisting methods

- ***Tugs towing on a line***
- ***Tugs operating at a ship's side***
- Tugs alongside during approach to the berth and pushing or push while mooring
- Forward tug alongside and aft tug on a line during approach towards a berth and push-pull while mooring
- Tugs towing on a line during transit towards a berth and while mooring
- Tugs towing on a line during approach towards a berth and push-pull while mooring
- Combinations of above systems

3.2.2 Relationship between type of tug and assisting method

3.3 Tug assistance in ice

3.3.1 Introduction

3.3.2 Types of ship for manoeuvring in ice

3.3.3 Preparation before berthing or unberthing

3.3.4 Tugs and tug assistance

3.4.4 Berthing in ice

3.4.5 Unberthing in ice

3.4.6 Safety of tugs in ice

CHAPTER FOUR – TUG CAPABILITIES AND LIMITATIONS

4.1 Introduction

Apart from the essential issue of bollard pull, two very important aspects are considered:

- ***Correct tug positioning***
- ***The right type of tug***

4.2 Basic principles and definitions

4.2.1 Pivot point

4.2.2 Towing point, pushing point and lateral centre of pressure. Direct towing and indirect towing. Skegs

- The towing point
- The lateral centre of pressure
- Direct and indirect towing method
- Pushing point
- Skegs and their effect

4.2.3 Stability

- High GM and good dynamic stability
- Reducing the transverse resistance of the hull
- Reducing the height of the towing point
- Reducing the height of the pushing point
- A towline with good shock absorption characteristics
- Tug freeboard being such that the deck edge is not immersed at too small a heeling angle

4.3 Capabilities and limitations

4.3.1 Capabilities and limitations of tug types

- Tugs towing on a line
  - Forward tugs towing on a line
  - Stern tugs towing on a line
- Tugs operating at a ship's side
  - Pushing method

- Pulling mode
- Stopping assistance

- Summary
  - Conventional tugs
  - Tractor and reverse-tractor tugs
  - ADS-tugs

4.3.2 Effectiveness of tug types

- Performance diagrams
  - Performance of a conventional and an ADS-tug when pushing at a ship underway at speed
  - Performance of an ADS and VS tug while towing on a line
- Speed control – braking assistance

4.3.3 Effective tug position

4.3.4 Towing on a line compared with operating at a ship's side

4.4 Operational limits

4.5 Design consequences

4.6 Conclusion regarding tug types

4.7 Some other practical aspects

- ***Co-operation***
- ***Communications between pilots and tug captains***
- ***Tug use***
- ***Speed***
- ***Decreasing effectiveness of tugs when a ship gathers speed***
- ***Ship pulled or pushed around by a bar tug gathers speed***

CHAPTER FIVE – BOLLARD PULL REQUIRED

5.1 Introduction

- The phase whereby a ship has reasonable speed
- The intermediate phase

- The phase involving the final part of the arrival manoeuvre

5.2 Factors influencing total bollard pull required

The following main factors influence tug assistance:

- ***Port particulars, including:***

  Restrictions in the fairway, port entrance, passage to a berth, turning circle, manoeuvring space at a berth or harbour basin, available stopping distance, locks, bridges moored vessels, water depths, speed restrictions, and so on.

- ***Berth construction, including:***

  Type of berth: open, e.g. jetty, or solid

- ***The ship, including:***

  Type, size, draft and underkeel clearance, trim, windage, and factors such as engine power ahead/astern, propeller type, manoeuvring performance and availability of side thrusters and specific rudders

- ***Environmental conditions, including:***

Wind, current, waves, visibility, ice

- ***Method of tug assistance, including:***

Towing on a line, operating at a ship's side or a combination of methods

5.2.1 Wind forces

5.2.2 Current forces

5.2.3 Wave forces

5.2.4 The effect of ship's mass and berth construction

5.2.5 Tug wash effect

5.3 Bollard pull required

5.3.1 Bollard pull required based on environmental conditions and displacement

- ***Ships affected by current, wind and/or waves***
- ***Ships with large displacements***

5.3.2 Number and total bollard pull of tugs a used in a number of ports

5.3.3 Summary

5.3.4 Influence of tariffs on availability and number of tugs used

CHAPTER SIX – INTERACTION AND TUG SAFETY

6.1 Introduction

6.2 Interaction and shallow water effects

6.2.1 Interaction effects influencing tug performance

- Tug-propeller – tug hull interaction
- Interaction of tug propellers
- Tug – ship interaction due to tug fendering
- Tug – towline interaction
- Tug propeller – ship hull interaction
- Tug hull – ship hull interaction
- Ship propeller/ship hull – tug interaction

6.2.2 Shallow water effects with respect to tug assistance

- Increase of bank suction and bow cushion effects
- Decrease of rudder effect
- Possible increment of transverse effect of the propellers
- Increase of turning circle radius
- Increase of stopping distance due to larger virtual mass

6.2.3 Interaction effects influencing tug safety

- Flow pattern around a ship
- Tug – ship interaction with respect to tug safety

6.2.4 Tug – ship interaction with respect to tug performance

6.3 Tug safety

6.3.1 Introduction

6.3.2 Coming alongside and departing from a ship's side

6.3.3 Passing a towline near the bow

6.3.4 Passing a towline at the stern

6.3.5 Overtaking a bow tug on a line – Girting – Tripping

6.3.6 Forward tug steering broadside

6.3.7 Stern tug steering broadside

6.3.8 Stern tug manoeuvring from a stand by position on starboard or port quarter towards a position astern of the ship

6.3.9 Stern tug manoeuvring from starboard to port quarter or vice-versa

6.3.10 Tug operating at ship's side

6.3.11 Fog

6.3.12 Some other practical aspects

- Bulbous bows
- Releasing towlines
- Underestimating wind and current forces
- Sudden changes in a ship's heading and speed
- Ship design consequences
- Information exchange pilot-shipmaster-tug captain
- Operating bow-to-bow

6.4 Summary and conclusions

CHAPTER SEVEN – TOWING EQUIPMENT

7.1 Introduction

7.2 Additional towing points and gob ropes

- Radial system
- Additional fixed towing points
- Gob rope system

7.3 Towing bitts, hooks and winches

7.3.1 Method of towing and varying towline lengths

7.3.2 Towing hooks

7.3.3 Towing winches

- Types of different towing winches
- Towing winch characteristics

7.4 Quick release systems

7.5 Towlines

7.5.1 Towline requirements

covering the following basic requirements:

- Strength
- Stretch
- Weight/Diameter
- Life

7.5.2 Steel wire ropes and synthetic fibre ropes

- Steel wire ropes
  - Lay
  - Right hand or left hand lay
  - Cross lay and equal lay
  - Lang's lay
  - Ordinary lay
- Synthetic fibre ropes
  - Left hand and right hand lay
  - Three strand ropes
  - Six strand ropes with core structure
  - Eight strand ropes
  - Twelve strand ropes
  - Double braid or braid-on-braid and circular braided
  - Description of different fibres or ropes
  - Polyester
  - Nylon
  - Polypropylene
  - Combinations of materials
  - Aramid and HMPE (Dyneema,Spectra)
  - Finishes and coatings
  - Handling and maintenance of fibre ropes, including towlines
  - Damage to towlines

7.5.3 Composition of towlines

7.5.4 Basic towline length

- Towline length in relation to ship's path width
- The effectiveness of a tug on a short steep towline
- Tug safety in relation to towline length

7.5.5 Strength of towline and safety factors

- Static forces in short and long towlines
- Dynamic forces in short and long towlines
- Safety factors regarding towline strength

7.5.6 Ship's mooring lines as towlines

7.6 Towline handling

7.6.1 Safe handling of towlines aboard ships

7.6.2 Some methods for passing, taking and/or securing towlines

- ***Cranes for towline handling***
- ***Quick release hooks on board ferries***
- ***Automatic hook up system***
- ***Emergency towing equipment***

CHAPTER EIGHT – TRAINING AND TUG SIMULATION

8.1 Reason for training

8.2 Different training objectives

8.2.1 Basic theoretical-practical training

The following main subjects are important:

For pilot training:

- ***Ship handling***
- ***Knowledge of the capabilities and limitations of tugs while rendering assistance***

For tug captain training:

- ***Handling of a free sailing tug***

- ***Knowledge of the capabilities and limitations of ships and of tugs while rendering assistance***
- ***What knowledge of tugs and tug use is required by a pilot?***
- ***What is useful for a tug captain to know about ships?***
- ***Additional training aspects***
- ***How can basic training be given?***

8.2.2 Training for specific situations and conditions

8.2.3 Training for a planned new port, harbour basin or berth

8.2.4 Training for specific ships coming to a port

8.2.5 Training for a new type of tug to be used in a port

8.2.6 How the specific training courses can be given

- ***Combined training***
- ***The use of ship manoeuvring simulators***

8.3 Calculating and simulating tug performance with desktop computers

8.3.1 Tug performance calculation programs

8.3.2 Fast time manoeuvring simulation programs

8.3.3 Real-time simulation on desktop simulators

8.4 Simulation by remote-controlled tug models

8.5 Tug simulation using bridge manoeuvring simulators

8.5.1 Requirements for correct tug simulations

8.5.2 Development in tug simulation towards interactive tugs

- Simple vector tug models
- Simple vector tug models combined with tug captain experience
- Advanced vector models
- Tug simulated on a monitor (bird's eye view) and operated by tug captains
- Interactive tug simulation

8.5.3 Important aspects for interactive tug simulation

- Visual presentation and orientation of control handles
- Tug performance in wave conditions

- Other practical aspects
  - Heeling angle
  - Engine noise
  - Control handles
  - Towline/fender characteristics

8.5.4 Method of tug simulation to be used

8.6 Simulator training

8.6.1 Enhanced training possibilities

8.6.2 Steps to be taken for a simulator training set up

- An accurate definition of training needs and training objectives
- A definition of training requirements
- An assessment of whether the simulator institute can meet the training requirements
- A validation phase
- A definition of training programmes

8.7 Areas of tug simulation that need further attention

- Tug model tests
- Effect of angle of heel and trim on forces on a tug's hull and appendages
- Influence of waves on tug performance
- Influence of flow around ship and of water depth and confinement
- Influence of a tug's propeller wash on ship's hull
- Towing and pushing forces
- Thruster – tug hull interaction and thruster – thruster interaction
- Out-of-the window view for interactive tugs
- Visualization of towline behaviour

8.8 Conclusions

CHAPTER NINE – ESCORT TUGS

9.1 The background to escorting

9.2 Studies on escort requirements

9.3 Escorting objectives and methods

9.4 Escorting by normal harbour tugs

9.4.1 Tug use

9.4.2 Escort training and planning

9.5 Escorting by purpose built tugs

9.5.1 Type of tugs, performance and operational requirements

- ***Types, terminology and factors affecting performance***
- ***Braking and steering forces***
- ***Required maximum speed free sailing***
- ***Stability***
- ***Design developments of escort tugs***
- ***Additional towing point for escort tractor tugs***
- ***Deck equipment, towlines and towline handling***
- ***Operating reliability and fail safe***
- ***Communication and information exchange***
- ***Active and passive escorting. Versatility of escort tugs***
- ***Escort planning***
- ***Escort tug standardisation***

9.5.2 Escort tug in use

9.5.3 Training and pilotage

9.5.4 Summary of escort tug requirements

9.6 Escort tug regulations

9.7 Concluding remarks

CHAPTER TEN – TUG DEVELOPMENTS

APPENDICES

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