1 Tethered Escort of tankers

Fig A.1 Example of a Voith Schneider escort tug assisting a large tanker. TSP (Tons SteeringPull)

1.1 Definition

Tethered Escort of tankers is performed by a special designed tug connected by a towline (tethered) to the tankers “strong point” aft. The purpose of the tug is to assist the tanker in case of an emergency (in the event that the tanker loses power and or has steering problems). The tug is available to improve the steering and arresting properties of the tanker by means of a tow line connected from the tug’s towing winch to the tanker’s center bollard aft.

The escort tug will have a towing winch on the foredeck and in some cases also on the aft deck. To improve the stability of the tug boat and improve the towing, steering and arresting ability a towing fairlead (staple) is located at a central position on the fore deck.

In harbor use, the tug can be used assisting in ship berthing and un-berthing maneuvers.

Escort tugs are equipped with a fin (skeg) which in most modern tugs is normally positioned under the bow. The fin generates most of the towing force at speeds greater than 5 knots. See picture A.1 above.

1.2 Background

The main purpose in using tethered escort towing is to control the ships course and speed in an emergency situation, and thereby reducing the risk of ship grounding or collision.

A substantial number of studies of ship casualty statistics have shown that grounding represents the predominant risk of ship accidents in approaches and narrow fairways as shown below

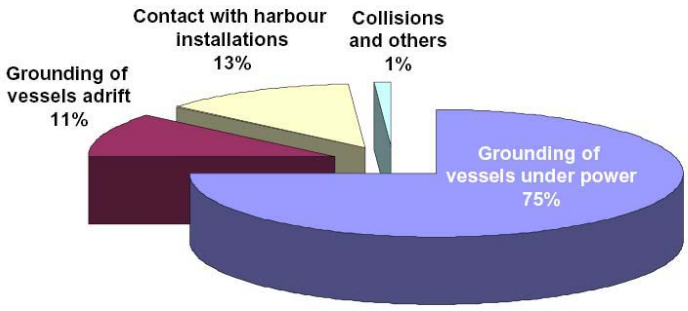

Figure A.2 Reasons for grounding.

Use of a certified escort tug has proven to be the single most effective tool for reduced risk of grounding. Some of the tugs are also designed for excellent performance in conventional ship berthing maneuvers.

1.3 Towing methods

For tethered escort there are two different methods used, governed primarily by the ships speed at the time of the maneuver.

1.4 Direct and indirect towing methods

The figures A.3 and A.4 show what are generally called the direct and indirect towing methods.

Direct towing is performed at low speeds from about zero to 4 - 5 knots. The tug boat uses the engine and propellers to generate the tow force, which is governed by the conventional bollard pull of the tug.

Indirect towing is performed at speeds of in the range of 5 to 12 knots. The tug boat uses the fin forward (“fin first”) to generate a tow force by angling the tug to the direction of tanker’s

heading. The attainable steering force is governed by the design of the “fin” and tug speed and angle of “attack”, but is generally 75% to 85% greater than the tug’s bollard pull.

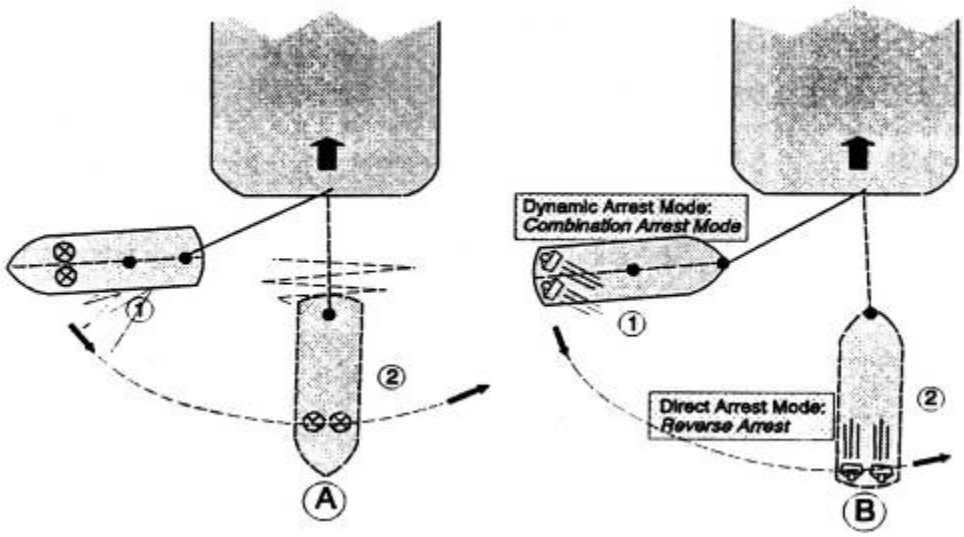

Fig A.3 ***Direct towing****: VSP tug (A) shown left and ASD tug (B) shown right*
Position 1: Steering and retarding. Position 2: Retarding

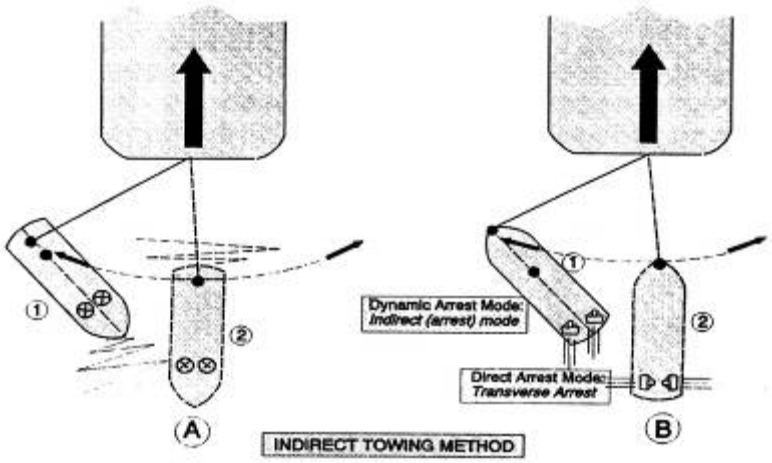

Fig A.4 ***Indirect towing****: VSP tug (A) shown left and ASD tug (B) shown right*
Position 1: Steering and retarding. Position 2: Retarding

1.5 Changing between direct and indirect towing

When an escort tug is tethered and is following a tanker the speed is typically kept at around 10 knots and normally not more than 12 knots. At this speed the tug would use indirect towing if the tanker needs assistance with steering. When the speed of the tanker drops to about 4 to 5 knots, it is more efficient for the escort tug to change into direct towing mode. Figure A.5 illustrates how the steering force in indirect mode is dependent of the speed (red curve). The blue curve illustrated how the force in direct mode increases as the speed reduces to zero. The optimal point for switching from indirect to direct mode is varies somewhat but is normally in the range of 4 to 5 knots.

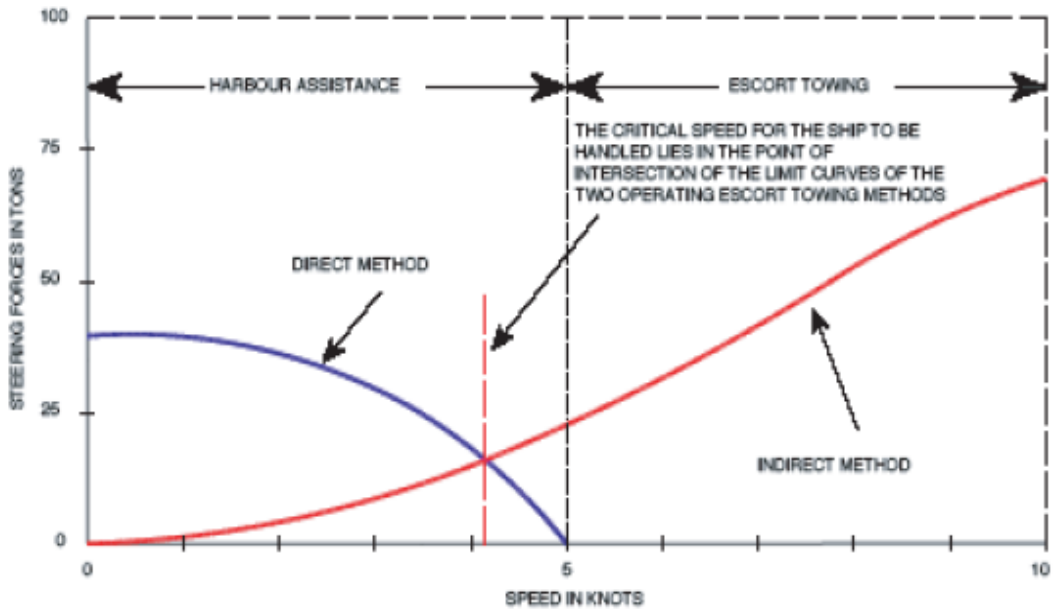

Fig A.5 Tow speed versus indirect and direct towing for a 40 t Bollard Pull tug

Example:
The steering forces versus tow speed for a Voith Tractor Tug of 40 tons bollard pull using direct and the indirect escort towing methods. In direct mode, achievable steering forces decrease when speed increases. At speeds greater than four to five knots higher steering forces (greater than 70% of conventional bollard pull) can be achieved in indirect mode.

1.6 Definition of towing forces

The forces from the tanker and the tug in indirect mode are illustrated in figure A.6. The speed of the tanker is 10 knots.

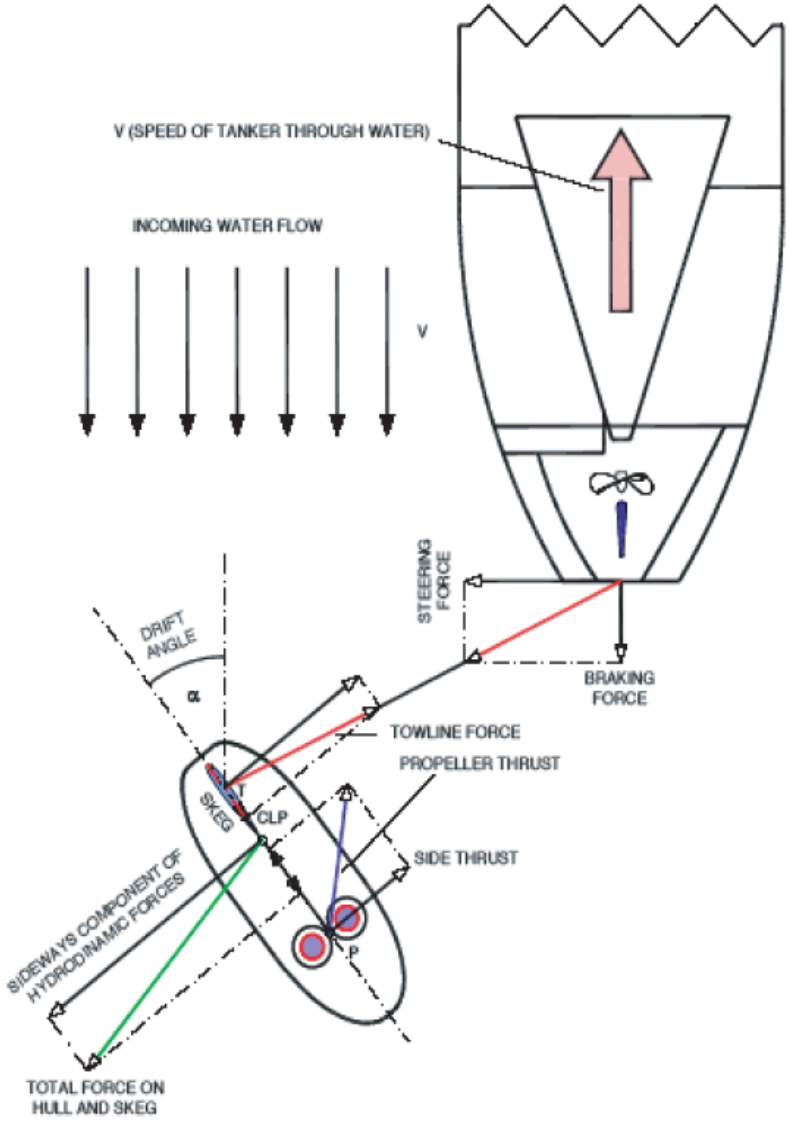

Fig A.6 Forces from the tanker and the tug in indirect towing mode.

1.7 Required steering pull (TSP)

During the simulations discussions of needed tug size came up several times. According to IMO's guideline no 751, a ship of 300,000 dwt should be assisted by an escort tug with a steering pull of between 110 t to 140 t, see figure A.7.

Each ship has unique steering characteristics and rudder forces at different speeds and rudder angle.

IMO has issued rules for ships' maneuverability (IMO 751 – 10/10 zigzag maneuver criterion). To provide maneuverability corresponding to these rules, the escort tug requires a typical steering pull (TSP) as indicated below:

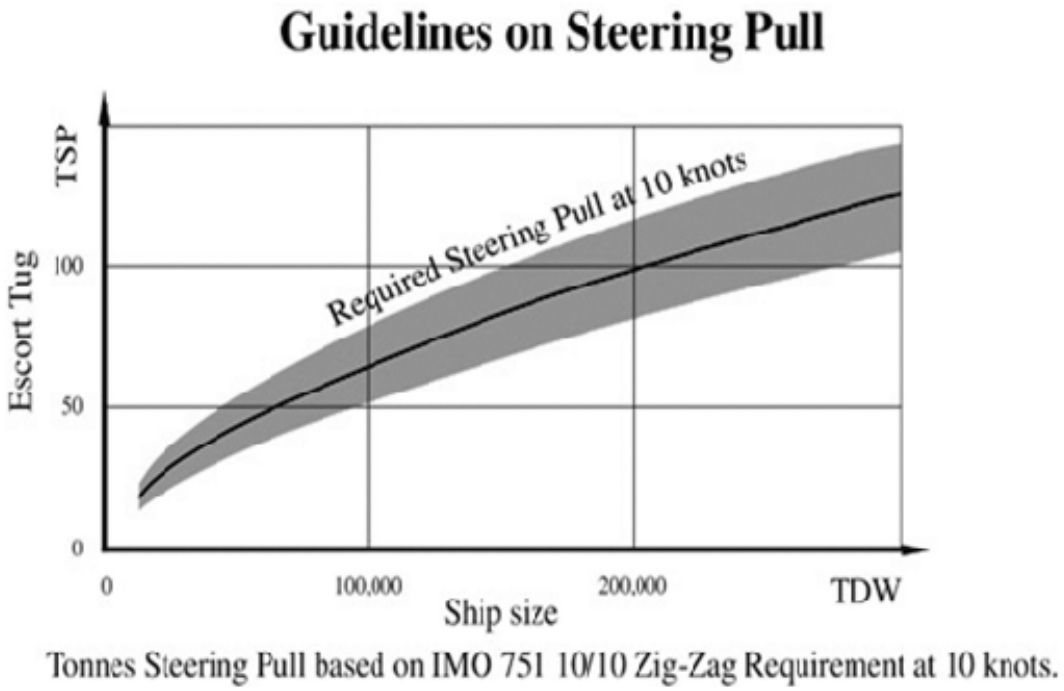

Fig A.7 IMO's guideline for required steering force (in tonnes) generated by a escort tug in indirect mode at 10 knots speed

Other sources indicate that the tug steering force guidelines outlined by IMO may be exceeded in certain cases. The final decision on tug bollard pull vs. fin design will be made by the naval architect responsible for the tug design, and will be governed by the size, speed, loaded condition and operating conditions applicable to the project site.

Two sizes of escort tugs were used during the simulations. One tug with a 90 t bollard pull and a corresponding steering pull at 10 knots of about 150 t, and one tug with a bollard pull of 125 t and a corresponding steering pull at 10 knots at approx. 230 t.

1.8 Escort tug requirements

Below is a list of some of the general requirements for tethered escort tugs:

- Optimal maneuverability and high free running speed.
- High working reliability.
- Good sea keeping conditions, free running as well as in the escort operating mode .
- Sufficiently high freeboard.
- Good static and dynamic stability.
- A safe working deck for handling of towlines in rough sea conditions and at high speeds.
- Ability to apply high steering and/or breaking forces over the whole escort speed range and capability of assisting in different ways.
- A safe and effective location of the towing point with respect to heeling angle, attainable towline forces and potential tug engine failure.
- The tow winch should be a constant tension type with a synthetic fiber tow line of adequate capacity compatible with the design steering force of the tug.
- Deck equipment construction should be suitable for escort operations and be such that it can easily withstand the high towline forces. Towlines should have a high safety factor and preferably be made of light and strong synthetic fibers with positive buoyancy to enable safe, fast and easy handling. In case the ship requiring assistance has no power available at the mooring stations fore and aft, the ship should have reeled tow wire that can be manually deployed to the tug.
- Good fender, preferably all round the tug hull.
- Good all round visibility from the wheelhouse and including the towing winch.
- A high reliable radio communication system.
- Openings in superstructures, deckhouses and exposed machinery casings situated on the weather deck, which provide access to spaces below deck, should be fitted with watertight doors. These doors should be kept closed during escort operations.

1.9 Tug design for emergency ship steering and braking

A large ship navigating in confined waters is faced with the risk of collision or grounding which may have severe environmental consequences.

Adequate tug escort has proven to be a highly effective risk-reducing measure for ships entering and leaving port.

For decades many tug owners has focused on preserving the environment and property through the provision of superior tug design and continuous crew training.

The “Fin First” tethered escort tug system is an example of this commitment to marine safety.

1.10 Classification of adequate tug escort

The provision of **adequate tug escort** is dictated by the ability to perform emergency steering of the escorted ship by a tethered escort tug by exerting an external (tug) steering force to counteract the rudder force of the escorted ship, or arrest its motion in the event of a main engine failure.

Det Norske Veritas (DNV) has issued rules for escort tug classification, which include special requirements for:

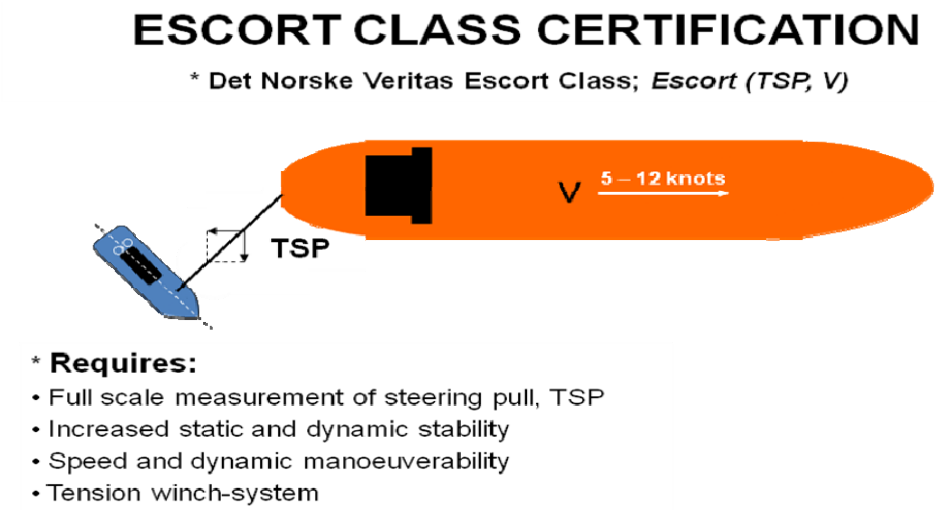

Fig A.8 Escort tug class certification by DNV

1.11 Training

Use of a full mission tug simulator for escort training of pilots, tug captains and shipmasters is efficient and economical. With a simulated escort tug and assisted ship, procedures and ship equipment failure scenarios for the most critical locations under different environmental conditions can be tested and practiced

1.12 Escort planning

A standard pre-escort checklist, adjusted to a specific situation, is an effective tool for successful operations. An example of items to consider is listed below:

- Dimension, draft and maneuvering particulars of the assisted vessel.
- Destination, transit route, passage times, planned escort speeds, emergency anchorages.
- Shipping traffic and hazards.
- Environmental conditions likely to be encountered.
- Size type and bollard pull of escorting tugs and method of escorting, and when there is no tethered escort, the required position of tugs relative to the vessel.
- The maximum towline forces the escort is capable of generating at the escort speeds.

- The SWL (safe working load) of the fairlead, bollard and/or strong point on board the ship to be escorted.
- The escort's tug rendezvous position.
- Communication equipment and channels inclusive procedures.
- Requirements regarding towing equipment and towline handling.

Deck equipment construction on board the escorted vessel should be suitable for high towline loads and for the type of towline used. This is a very important aspect, because there have been several instances of failure of the ships strong points and fairleads. Ship mounted deck equipment which is not properly located or not strong enough to withstand the peak loads generated will result in the ship not being accepted in the vetting process.

1.13 Present day equipment on vessels

As noted, there have been a number of occurrences reported worldwide where Escort tugs have pulled the bollards or fairleads off the stern of a tanker while engaged in tethered escort maneuvers.

The problem is not limited to escorting since conventional harbor tugs are also becoming increasingly more powerful resulting in similar failures of standard ship fittings.

Mooring equipment on tankers generally complies with the Oil Companies International Maritime Forum (OCIMF) Mooring Equipment Guidelines (MEGL), Second Edition 1997. The term "mooring" most commonly refers to the system for securing a Ship to a Terminal where the strength of equipment and fittings is usually related to the strength of the ship mooring lines. The MEGL also covers other shipboard operations such as emergency towing and tug handling which require specialized equipment.

The provisions for tug handling consist of properly placed closed fairleads and associated bollards (bitts) for the guidance and attachment of the towing line. In addition means for hauling the tug line aboard must be provided.

When determining fairlead locations the following should be considered:

- Adequate separation of fairleads to allow for all possible tugs maneuvers.
- Fairlead locations should be in the same transverse plane as tug pushing points to enable tugs to push and or pull from the same location to check lateral ship motion.
- An alternative push or pull location is also required mid ships to allow lateral maneuvers without applying a turning moment.

ISO 3913 covers the construction of bollards and how they are attached to the tanker structure.

Where a bollard is used exclusively for securing harbour tug lines, the size should be related to the bollard pull of the tug, but need not exceed 500 mm. If this size bollard is fitted, ISO 3913 states that it should be capable of withstanding a Total Maximum Rope Loading (SWL) of 92 t when attached with single eye (e.g. the spliced eye at the end of the tug towline). This would appear to be more than adequate for port tug usage. The SWL of a 500 mm bollard is inadequate for forces generated during maneuvers by an escort tug.

1.14 Equipment for a strong point on tankers

OCIMF and SOLAS recommendations for ships recommend minimum capacities for ship mounted fittings to be used in tethered escort operations:

An extract from OCIMF chapter 4, page 9 and 10

Tankers over 20000 dwt but under 50000 dwt to provide:

A fairlead arrangement, with suitable reinforcement, having a minimum SWL of 100 metric ton; and

A strong point arrangement, with suitable reinforcement, having a minimum SWL of 100 metric ton when used with a single eye towing line or grommet.
Tankers of 50000 dwt and above to provide:

A fairlead arrangement, with suitable reinforcement, having a minimum SWL of 200 metric ton; and

A strong point arrangement, with suitable reinforcement, having a minimum SWL of 200 metric ton when used with a single eye towing line or grommet.

SOLAS requires all tankers over 20,000 DWT to be fitted with Emergency Towing Arrangements (ETA) at both the bow and stern. The regulations stipulate that these towing arrangements are the same as above mentioned.

In almost all cases a separate strong point should be available to attach the Escort or port tug line. If standard bollards are used for Active Escort towing, they should be of 800mm diameter. This would give an overall SWL of the towing unit of 200 ton.

It should also be remembered that the ETA has to be capable of being deployed within 15 minutes. Consequently component parts of this system should only be used for towing if such use does not extend the deployment of the ETA to a time in excess of 15 minutes.