TÜRK LOYDU

Chapter 58 –Ocean Towage

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This latest edition incorporates all rule changes. The latest revisions are shown with a vertical line. The section title is framed if the section is revised completely. Changes after the publication of the rule are written in red colour.

Unless otherwise specified, these Rules apply to ships for which the date of contract for construction as defined in TL- PR 29.

"General Terms and Conditions" of the respective latest edition will be applicable (see Rules for Classification and Surveys).

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Ocean Towage

SECTION 1

SCOPE

A. Scope

1. These Rules provide a basis on which to assess in each particular case the safety of ocean towage operations in accordance with the documentation, already available or to be submitted, and the relevant surveys.

2. These Rules are intended to provide those concerned in towage operations (owners of vessels to be towed, tug masters and owners, shippers, insurers and competent authorities) with information relevant to conditions and feasibility.

3. These Rules apply to the towage of seagoing ships or other floating craft, with and without cargo, and also, where appropriate, to the conveyance under their own power of seagoing ships whose class is suspended or expired or whose class, in so far as it relates to the range of service, does not cover the proposed voyage.

4. On principle towage operations are formally covered by the by the necessary and available international and national certificates and by the class of the tug and its tow.

Türk Loydu intervenes, on application, only in those special cases where particular circumstances and factors signify an increased risk to vessel and/or cargo or where the risk cannot be evaluated on the basis of seafaring/nautical knowledge and experience alone.

The submission of an application for inspection, survey and certification in accordance with these Rules is left to the discretion of the tug owners/ship's command

5. These Rules do not apply to the conveyance of floating "offshore installations (marine structures)".

SECTION 2

CONDITIONS FOR OCEAN TOWAGE

A. Application, Assessment

1. Application for assessment of towing/conveying operations is to be made to the Head Office of Türk Loydu.

2. The extent of the assessment/survey will be agreed between the applicant and Türk Loydu in each case. Where necessary, the shipowner, the ship's command, the insurers and the authorities shall also be consulted.

The publication of these Rules shall not imply any obligation on Türk Loydu to carry out in every case an examination to the full extent provided for in these Rules.

3. Assessment of the towage/conveyance of vessels which, in respect of their type, design, equipment, cargo etc., are suitable for permanent seagoing service, is normally based on Section 3.

4. Special investigations and conditions become necessary in relation to the towing of vessels which are not suitable for permanent seagoing service, e.g. floating docks and inland ships, and of seagoing vessels with special cargoes especially sensitive to conditions at sea such as crane structures, exceptional heavy cargo etc. Section 4 "Controlled transport" is also to be applied, wherever relevant, to towing operations of this kind.

B. Details and Documents

1. General

The following details and documents are to be submitted to Türk Loydu in time for examination

1.1 Port of departure, expected start of voyage, route, port of destination, expected end of voyage.

1.2 Towed vessel:

Name, distinctive number or letters, port of registry, draught in tow, proof of adequate stability (not required where reference to available stability documents shows that stability is sufficient without special proof),

Certificates
(Certificate of Registry,
Tonnage Certificate,
Class Certificates,
Load Line Certificate,
Safety Construction Certificate,
Safety Equipment Certificate,
Safety Radiotelegraphy-Radiotelephony Certificate)

1.3 For a tow without **TL** class the following additional details are to be supplied:

Type of vessel (general arrangement plan), dimensions, class, anchor equipment, bilge arrangement.

1.4 Towing arrangement on the tow:

Towing brackets (strong points), chains, triangular plate, recovery devices, emergency towing gear.

1.5 Tug:

Name, distinctive number or letters and port of registry, if already known.

2. Controlled transport

The following are to be supplied in addition to the details and documents listed in para. 1:

2.1 Detailed information about proposed route, excepted speed, bunkering ports and possible ports of refuge. Meteorological advertise of the wind, sea conditions and swell to be expected during to proposed voyage supplied by the institute also advising respectively on the route during towage/conveyance.

2.2 Tow:

Proof of sufficient intact stability.
(In special cases, proof of unsinkability may be demanded).

Construction drawings and strength calculations for the tow and/or the cargo together with lashings.

2.3 Tug:

Name, distinctive number of letters, port of registry, bollard pull.

Also, for tugs without **TL** class:

Type of vessel (general arrangement plan), dimensions, class, stability calculations for departure and arrival, bollard pull/engine power, propeller/Kort nozzle, fuel consumption/fuel reserves, towing winch/holding load/quick release, towing lines/breaking strength.

C. Tug

1. The tug shall be suitable for the proposed towing operation in respect of its type, size, design, power, towing force and equipment.

2. The towing force is to be ascertained with due allowance for the tow, the route, the duration of the voyage and the weather and sea state proper to the time of the year. A general reference value may be taken as the power by which a tug is able to keep the tow in position with a head wind of v = 20 m/s = Bft 8-9 and a head current of v = 1 m/s **(*)**.

D. Survey

1. After examination of the documents by the Head Office of Türk Loydu and after the satisfactory survey carried out by a **TL** Surveyor, a Certificate of Conveyance will be issued.

2. Prior to the towage/conveyance of vessels whose class has expired, a survey equivalent to an Annual Class Survey is to be performed. This survey shall normally be carried out in dry dock if the last bottom survey has taken place more than 2,5 years previously.

3. Prior to the towage/conveyance of non-classified vessels, a survey equivalent to a survey for admission to class is to be carried out. The appropriate drawings and documents for the ship's hull and the machinery/electrical installation are to be submitted.

E. Ship's Command

1. The issue of the Certificate of Conveyance is subjected to the proviso that the towage operation will be performed by good seamanship and according to established seafaring practice. This includes compliance with the conditions stipulated in the Certificate.

2. If, in a special situation arising during the voyage, the master is no longer able to comply with the stipulated conditions, he will, after expert assessment of the situation, take such measures as are appropriate to the special circumstances.

(*) *This reference value is not to be interpreted to mean that a tug and tow drifting astern under the effect of higher winds and wave drifting forces in the open sea is exposed to danger. Controlled drifting in the open sea is generally to be regarded as acceptable. In tug service it is normal practice for a towing train to drift under appropriate current and weather conditions.*

3. In the vicinity of coasts or shallow waters, the course and the respective leg of the voyage are to be selected in such a way that the tug and tow can be either brough with adequate speed into safe waters (open sea or port of refuge) or kept clear of the coast or shallows under any foreseeable conditions of current or weather.

4. During the towing operation, the tow is to be repeatedly inspected, provided that weather conditions enable persons to be transferred. The first inspection is to take place when, after the start of the voyage, the tow, the cargo and the lashings have been subjected to the first loads due to motions in the seaway or listing caused by the wind.

5. The TL is to be notified of departure, arrival and any abnormal occurrences during the voyage. In special cases, the TL is to be kept regularly informed of position, towing speed, wind forces (Bft) and seaway (wave height and period).

6. The master of the tug remains solely responsible for the tug, the towing gear, the tow and the conduct of the towing operation as well as for the choice of route and any departures from the route which may prove necessary.

SECTION 3

INSTALLATIONS AND EQUIPMENT OF THE TOWED / CONVEYED VESSEL

A. Closing Appliances

1. Hatches, ventilators, air pipes, outside doors, windows and other openings through which water might intrude into the interior of the vessel are to be closed weathertight.

Sidescuttles in the shell plating are to be securely closed by fitting fixed covers.

Wherever practicable, the closing devices of sanitary discharges are to be secured in the closed position.

In addition, all sea and discharge valves of systems which are not required to operate during conveyance are to be closed.

2. The closing appliances of vessels not subject to the 1966 International Load Line Convention shall, as far possible, conform to the conditions of assignment for the load line.

3. The following systems shall comply with the TL's Rules for Construction:

- Air and overflow pipes,
- Combustion air supply to auxiliary engines,
- Design and arrangement of exhaust lines,
- Engine room ventilation,
- Sounding pipes of tanks, empty cells, cofferdams and the bilges of spaces which are not always accessible. Where these do not conform to the Rules for Construction, they are to be closed permanently.

B. Lights, Shapes, Sound Signal Appliances

1. The design and positioning of lights, shapes and sound signal appliances shall meet the requirements of the International Regulations for Preventing Collisions at Sea 1972 (COLREG).

A towed vessel shall carry:

- Side lights,
- A stern light,
- A diamond shape where it can best be seen, when the length of the tow exceeds 200 m.

2. The towed vessel, if manned, shall sound the signals prescribed in Rule 35 of COLREG in restricted visibility.

3. An adequate power supply is to be provided.

C. Anchoring Equipment

1. At least one anchoring equipment shall be available ready for use. Anchors and chains should comply with the TL's Rules for Construction.

2. Where wire ropes are fitted in lieu of anchor chain cables, the length of the wire ropes should be equal at least 1,5 times the length of the required chain cable length.

The wire rope's breaking strength should not be less than the breaking strength of the required chain cable of grade K1.

D. Strong Points for Towing Gear

1. At least two suitable strong points (towing brackets) as well as suitable fairleads through which the chains can be led shall be available on the tow.

Suitable bitts or the anchor installation of the tow can also be used as strong points.

2. The strong points shall be able to withstand at least 1,2 times the tensile breaking strength of the towing line/chain.

E. Securing the Rudder and Propeller

1. The rudder is to be locked in the midships position. This can be effected by means of the steering gear or other mechanical device.

2. The propeller shaft shall, as a rule, be immobilized by appropriate means to prevent the shut down propulsion machinery from being transmitted.

F. Bilge Arrangements

1. All spaces, tanks and empty cells which affect the buoyancy of the vessel shall, as a rule, be provided with bilge arrangements.

2. At least one bilge pump is to be permanently installed on vessels with auxiliary machinery.

3. At least one transportable, power-operated bilge pump is to be carried on vessels without auxiliary machinery.

G. Fire Protection and Extinguishing Appliances

The type and extent of the fire protection and extinguishing appliances are to be agreed with **TL** with due regard to the vessel, the cargo and the crew.

H. Equipment for Crew on Manned Tows

Regarding accommodation, life-saving appliances and telephone communication between the tug and the tow are to comply with national regulations.

Where not specified, at least the following facilities should be available on the tow together with an adequate power supply:

1. Living quarters including day room, sleeping accommodation, galley and toilet facilities sufficient for all on board.

2. A liferaft capable of accommodating all persons on board and a ladder on each side of the tow,

4 lifebuoys, including two provided with self-igniting light and two fitted with a buoyant lifeline,
1 life-jacked for each person,
1 immersion suit for each person,
6 parachute signals,
6 hand flares,
1 daylight signaling lamp.

3. A VHF radiotelephone station providing permanent telephone communication between tow and tug on a ship-to-ship channel and on channel 16.

4. Access to tow

Means of access is to be provided on both sides of the towed vessel to allow it to be boarded from the tug, a utility boat or the water.

This means of access may take the form of steel ladders, rugs or rope ladders. Means must also be provided for fastening the latter to the ship's side.

I. Fuel reserves

Adequate fuel reserves are to be provided compatible with the of consumers which may be needed during the towing operation.

K. Stability-Freeboard-Trim

Adequate intact stability is stipulated. In case of doubt, proof is to be supplied of adequate stability (See also Section 2, B.1.2).

Where specially justified by circumstances, proof of unsinkability may be required.

When towing pontoon-shaped vessels, the towing speed must be such as to allow the maintenance of sufficient freeboard at the forward end of the pontoon in the direction of motion so as to avoid the danger of dipping and capsizing as a result of excessive towing speed. In order to reduce this danger, trimmed vessels should be towed so that the emergent end faces forwards. This arrangement can also have a beneficial effect on the course-holding behaviour of the vessel.

SECTION 4

CONTROLLED TRANSPORT

A. Definition / Certification

1. When transporting goods especially sensitive to conditions at sea (cf. Sec. 2, A.4) it is necessary that the planning and execution of the operation should meet the special requirements set out below. This applies especially to cases of unusual configuration and/or loading or where the dimensions of the towed vessel or transport vessel are not suitable (without restriction) for the route to be followed. In these circumstances a special investigation is needed into motion behaviour and into the dynamic loads generated by a seaway.

2. Fulfilment of the conditions applicable to “Controlled transport” is certified by **TL** by the issue of an appropriate Certificate, which may be backed up by an expert appraisal.

B. Conditions Applicable to Controlled Transport

1. Route planning

1.1 The routing of ocean towing operations normally comprises the following elements:

- Ports of departure and destination,
- Ports of refuge, bunkering ports,
- Shallows and restricted waters etc. (cf. Sec. 2, B.2.1).

1.2 The persistent or seasonably variable environmental conditions encountered along the route, or over parts thereof, are normally to be described statistically with the relevant probability of occurrence. This applies to the following in particular:

- Wind forces and directions,
- Characteristic wave heights h_i (with their probability of occurence P [h_i],
- Characteristic wave periods t_j (with their probability of occurence P [t_j],
- Current velocities and directions,
- Drift ice according to type and density etc.

(For this purpose, the characteristic wave heights and the characteristic wave periods may be equated with those observed visually).

1.3 Wherever possible, the combined probability of occurrence of characteristic wave height and characteristic period (P[h_i, t_j]) should also be ascertained. For much used routes, atlases are available which show these probabilities in terms of relative frequencies of occurrence. In special cases, hydrographic institutes, sea weather bureaux and similar institutions should be consulted.

1.4 The man sea steaming time(s) T_{sm} required for the journey, or the parts thereof, are to be calculated (cf. 3.4).

2. Motions and loads

2.1 The resistance of the towed vessel is to be shown in relation to various speeds and allowing for differing environmental conditions, including especially different seaways with the corresponding wind and current conditions. The calculation of the resistance must also allow for the drifting force of the waves exerted on the tow. A seaway is generally defined by a paired value (h_i, t_j) using an associated standard spectrum.

2.2 The thrust of the tug is to be shown in relation to towing speed and allowing for differing environmental conditions (cf. 2.1).

2.3 On the basis of the results obtained by applying 2.1 and 2.2, the mean towing speed V_s for the route, or parts thereof, is to be determined in relation to various environmental conditions. This is based on the condition: thrust equals resistance.

2.4 Under extreme environmental conditions, controlled drifting astern can be accepted provided that the steerability of the tug is not seriously impaired. In this context, extreme environmental conditions are defined by the following reference values:

- Wind speed over 20 m/s,

- Characteristic wave height greater than 7.5 m.

- Current velocity greater than 1 m/s.
  cf. Section 2, C.2.

In shallow waters (cf. 1.1), ocean towage is subject to limitations in respect of seaway (cf. 3.5).

2.5 When the environmental conditions are not extreme, the towing speed V_s shall be at least equal to 0.

2.6 With a heavy seaway the towing speed V_s should be limited to a maximum of 2 kn. A heavy seaway in this context is defined by the following reference value:

- Observed wave length equal to 0.7 – 1.1 times the length of the towed vessel (wave length in metres equal to 1.5 times the square of the wave period in seconds),

or

- Observed wave height greater than 0.07 times the observed wave length.

2.7 The seaway-related motions of the towed vessel provide the basis for calculating the corresponding magnitude of the forces acting in the cargo lashings. The recommended standard procedure for determining the motions and forces is the “spectral analysis”, which involves linear motions and load analysis in regular waves and its evaluation by reference to standard seaway spectra. By this method it is possible to calculate design values for safe lashings, the design value being defined as that value which is exceeded just once within a given safe period of time T_S (for T_S see 3.2).

2.8 Using the standard procedure referred to in 2.7 it is generally sufficient to allow for seaways running in the following two main directions:

- Towing condition: oncoming sea way

- Drifting condition: seaway from the side

2.9 Approximate load calculations based on motions at natural frequencies (cf. Section 4, C.) are generally suitable only for preliminary dimensioning and can be verified in accordance with the preceding 2.7 and 2.8.

3. Essential boundary conditions

3.1 The essential boundary condition for the application of the standard procedure described in 2.7 and 2.8 is the safe period of time T_S (for details see 3.2 – 3.4 below). In addition, maximum environmental parameters may, subject to certain requirements, be defined as essential boundary conditions (for details see 3.5).

3.2 If the mean sea steaming times T_{sm} for the journey, or parts thereof, are greater than the period for which the weather can be reliably forecast, an ocean towing operation may nonetheless be commenced provided that the design values of the lashings in accordance with 2.8 and 2.9, as applicable, are determined by applying a safe period of time T_S calculated as follows:

$$T_S = t_m \cdot 10^{\gamma} \; ; \quad \gamma = 1{,}1 \cdot \log\,(T_{sm}/t_m)$$

For the parameters t_m and T_{sm} see 3.3 and 3.4 below.

3.3 The mean wave period t_m is to be substituted by the weighted mean value of all the characteristic wave periods for the route, or parts thereof, as defined in 1.2.

$$t_m = \sum_{j=1}^{J} P\left[t_j\right] . t_j$$

The symbol J signifies the number of observation intervals of t_j used for the statistical analysis.

3.4 The mean steaming time is calculated from the length S of the route, or parts thereof, and the mean speed V_{sm} attained over that distance, i.e.:

$$T_{sm} = S/V_{sm}$$

The mean speed V_{sm} is determined by reference to the mean wave period t_m and the mean wave height

$$h_m = \sum_{i=1}^{I} P\left[hi\right] . h_i$$

in accordance with 2.1 – 2.3 for a mean seaway defined by the paired value (h_m, t_m). The symbol I signifies the number of observation intervals of h_i used for the statistical analysis.

3.5 If the mean sea steaming times T_{sm} for the route, or parts thereof, are shorter than the period of time for which the weather conditions can be reliably forecast, the motions and forces can be calculated by reference to a specified maximum value for the characteristic wave height and to other environmental parameters and can then be used as a basis for determining the dimensions of the lashings. In this case it is necessary to ensure that the entire ocean towing operation is independently monitored. Care must be taken to ensure in particular that the weather forecast is from a qualified source, so that the maximum value of the characteristic wave height is not exceeded during the planned duration of the voyage. When planning the route, due allowance is to be made for waiting times at ports.

C. Mechanical Strength, Securing of Cargo

1. Scope

1.1 The following Regulations concern the strength and constructional design of the structural members of the towed vessel as well as the ancillary equipment (dunnage blocks, lashing etc.) to be provided for securing or supporting the cargo.

1.2 The remarks apply in analogous manner to the components and equipment of ships with their own propulsion plant which are used to transport heavy deck cargoes.

1.3 Components not specially mentioned below are to be dimensioned in accordance with the principles set out in the TL's Rules for the Classification and Construction of Seagoing Steel Ships.

2. Design strength

2.1 The structure of the towed vessel is to be investigated with regard to the global strength, e.g. longitudinal and transverse strength, with due consideration for the load distribution due to the deck cargo. Where very large and rigid items are transported, allowance is to be made for the reciprocal effects due to the relative rigidity/elasticity of the ship's hull and the cargo.

2.2 The local supporting or load-transmitting members under the deck are to be checked with regard to the stresses associated with the specified bearing points and mass distribution of the deck cargo and the assumed motions (accelerations) of the vessel. They are also to be checked for stability, e.g. with regard to local web failure or the tripping of beams. The permissible stresses and the execution of any reinforcements which may be necessary (supports, girders, slings etc.) are governed by the Rules for the Classification and Construction of Seagoing Steel Ships.

2.3 The anchorage points and guides for the towing line are to be checked for conformity with the arrangement adopted for the particular towing operation. The dimensional design and the verification of the stresses induced shall assume a force greater by 20% than the breaking strength of the towline.

Wherever their use is unavoidable, deviation guides shall be designed to minimize friction and prevent any bending over edges. Towropes shall not be used at guide points (cf. Section 3, D.).

3. Devices for securing cargo

3.1 Supporting structures, blocks

3.1.1 Devices and appliances on deck used for load distribution, support and/or transporting parts of the cargo are to be dimensioned in accordance with the static and dynamic loads referred to in 2. and 4. or in subsection B. respectively. Where such components are welded to the hull of the ship or pontoon, the TL's Rules for the Construction of Seagoing Ships are to be applied.

3.1.2 With regard to their loading, continuous beams or rails permanently fastened to the deck of the vessel are to be regarded as part of the ship's hull (e.g. they are to be included when determining the longitudinal strength, cf. 2.1).

3.1.3 As far as possible, pillars, rails, dunnage blocks etc. are to be located over strength members in the ship's hull which are suitable for withstanding the bearing loads (cf. 2.) and are to be adequately supported to resist the horizontal forces caused chiefly by inclinations of the ship and by the rolling and heaving motions of the towed vessel. Blocks (generally timber on steel) are to be secured to prevent horizontal displacement (slipping).

3.1.4 When determining the most unfavorable loading conditions, consideration shall in each case be given to possible displacements and elastic deformation of parts of the cargo.

3.2 Lashing components

3.2.1 The components of lashings and restraining devices such as rods, ropes, straps etc. which are mainly subjected to tensile stresses are to be dimensioned in accordance with the static and dynamic loads determined in accordance with 4. or subsection B. Where there is danger of the deck becoming awash, the forces due to the wash of the sea and to buoyancy shall be taken into account.

3.2.2 The materials used for lashing components must conform to the TL's Rules for Seagoing Ships and must be covered at least by a Works Acceptance Test Certificate to DIN 50049 – 3.1 B. In cases where such action is justified, **TL** reserves the right to demand Test Certificates to DIN 50049 – 3.1 C.

3.2.3 The use of chains as lashings is not recommended. Where ropes are used, deflections are to be avoided (danger of pinching and abrasion, see 2.3).

3.2.4 Special attention is to be paid to the design of the terminal fastenings. In cases where such action is justified, the strength and/or method of manufacture may have to be verified by testing.

3.2.5 2.2 and 3.1.3 apply in analogous manner to the fastening points on the deck of the vessel. Welded eyes, lashing rings and the like are to be designed and fitted in accordance with the relevant rules and regulations.

3.2.6 3.1.4 applies in analogous manner to lashing components. In general, attention shall also be paid to the elasticity of the lashing component itself and, where provided, to preloading (cf. 3.2.7). Unsymmetrical arrangements should be avoided.

3.2.7 Where the calculated deformations and/or movements occurring at the ends of lashing components (3.1.4/3.2.6) suggest the possible occurrence of comprehensive forces, elements such as rods or bars, which resist buckling, are to be used. Any slackening of lashing components designed only for tensile loads must be avoided. The preloading needed to achieve this must be applied in a controlled manner.

3.2.8 The permissible stresses/loads acting in lashing components are shown in the following Table:

Nature of lashing component	Method of calculating accelerations and restraining forces: Approximate in accordance with 4.		Computerized calculation of dynamic behaviour in accordance with subsection B.
Steel components and their welds		$\sigma_{müs} = \frac{1}{\nu \cdot k} R_{eH}$ $(\tau_{müs.})$	
	tension/compression/ flexion:	ν = 1,5	1,35
	shear:	ν = 2,6	2,30
	equivalent stress:	ν = 1,4	1,25
	buckling:	$P_{müs} = \frac{1}{\nu_B} \cdot P_{Kr}$ ν_B =2,8	2,50
Wire ropes		$P_{müs} = \frac{1}{\nu} \cdot P_{Kopma}$ ν_B = 2,7	ν =2,40

R_{eH} = upper yield points as shown on Material Certificate.

$$k = \frac{295}{R_{eH} + 60}$$

P_{kr} = critical buckling force

3.3 Loads acting on parts of cargo

3.3.1 The cargo components fastened to the deck, both regarding the total structure and the local strength at the anchorage points of the restraining devices, must be adequately dimensioned to withstand the forces occurring during the voyage. It is generally for the manufacturer to prove the strength of the transported items of cargo in relation to the means used to secure them.

3.3.2 Sensitive and projecting portions of the cargo such as the jibs of cranes shall, wherever possible, be dismounted or lowered and secured separately.

4. Approximate calculation of loads acting on supports and lashing components

4.1 As an approximation, the following procedure can be used to calculate the forces acting on the supports and lashings of deck cargo. Other values or factors more suitable in special cases are to be agreed with **TL**.

4.2 Forces acting athwartships

The force acting athwartships (parallel to the deck) is obtained by adding together the inertia forces of the cargo and the wind pressure (see Figure. 1):

$F_q = F_{qM} + F_{qW}$ (plus the wash of the sea, where applic., cf. 3.2.1)

The portion attributable to the cargo, acting at the center of mass of cargo item M, can be determined approximately by applying the expression:

$F_{qM} = M \cdot [k_\varphi \cdot b_\varphi \cdot \cos\beta + \sin\varphi_0 (g + k_\psi \cdot b_\psi \cdot \sin\delta + k_z \cdot b_z)]$

Where:

M = mass of cargo item concerned

β = see Figure. 1

δ = see Figure. 2

g = gravitational acceleration (9,81 m/s²)

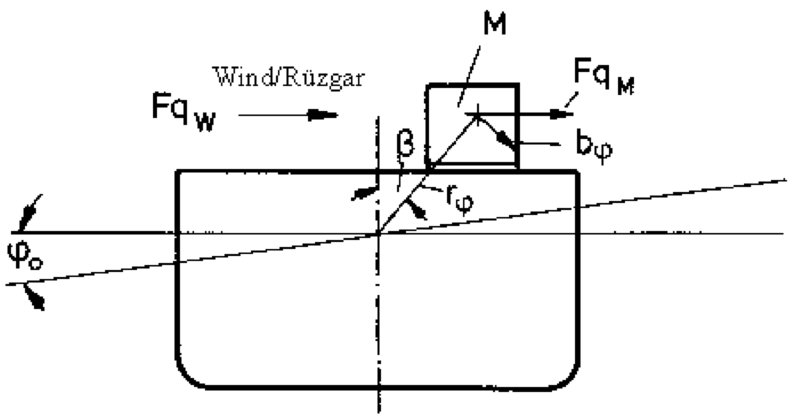

Figure 1

$$b_\varphi = r_\varphi \cdot \frac{\varphi_o \cdot \pi}{180} \cdot \left(\frac{2\pi}{T_\varphi}\right)^2$$ (rolling acceleration)

where;

r_φ = distance of centre of mass of cargo item from point of rotation, assumed to be at waterline (m),

φ_0 = maximum amplitude of roll (angle in degrees),

$T\varphi$ = period of roll (s).

For φ_0 and $T\varphi$ the most unfavourable combination of values liable to occur during transport is to be taken. If no more accurate values available, φ_0 and $T\varphi$ can be approximately determined as follows.

$$T_\varphi = c \cdot \frac{B}{\sqrt{M_B G}}$$

B = Breadth of the vessel [m]

M_BG = Metacentric height [m] for given loading condition

	φ_o	c
Ships	35 – L/13	0,8
Pontoons	15° or max. wave slope *)	1,1

L = Length of vessel [m]

*) The greater of the two values is to be used

k_φ , k_ψ , k_z: as a rough approximation, the k factors take account of the phase position. Two conditions are considered, for which the following values of k may be assumed:

	k_φ	k_ψ	k_z
Mainly rolling motion	1	0,6	0,8
Mainly pitching and heave motion	0,6	1	1

b_ψ , b_z: Pitching and heave acceleration (cf. 4.3 and 4.4)

Wind pressure, F_{qW}: If no reliable information is available concerning the likely wind velocities, F_{qW} shall be calculated on the assumption of a wind speed of 50 m/s.

4.3 Forces in the longitudinal direction

The force F_l acting in the longitudinal (fore-and-aft) direction of the vessel may also be important for the supports / lashings of the cargo.

An approximate value of F_l is given by the expression:

$F_l = F_{lM} + F_{lW} = M\,[k_\psi \cdot b_\psi \cdot \cos\delta + \sin\psi_o\,(g + k_\varphi\, b_\varphi \sin\beta + k_z b_z] + F_{lW}$

(plus the wash of the sea, where applicable; the 2nd part in the square brackets can normally de disregarded).

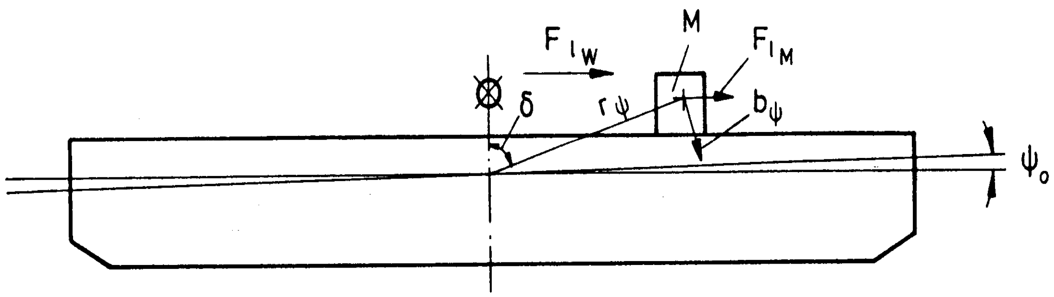

Figure 2

$$b\psi = r\psi\,\frac{\psi_o \cdot \pi}{180}\left(\frac{2\pi}{T\psi}\right)^2$$ (pitching acceleration)

where:

Ψ_p = maximum pitching angle [°]

T_ψ = pitching period [s] = $2\pi \cdot \sqrt{\dfrac{\theta_L}{D.M_L F}}$

(or applying a suitable approximation formula)

Θ'_L = Mass moment of inertia (in relation to transverse axis) including hydrodynamic mass [$kNms^2$]

D = Displacement [kN]

$M_L F$ = Metacentric radius (lengthwise) [m]

(Pontoon: $D \,.\, M_L F = \gamma \,.\, I_L = \gamma . \dfrac{L^3 B}{12}$)

For ψ_o and T_ψ the most unfavourable combination of values liable to occur during transport is to be taken. If no more accurate values are available, it may be assumed for ψ_o that:

ψ_o = 5° or maximum wave slope where relatively short vessels (pontoons) are towed in a seaway with widely spaced crests.

δ, r_ψ : see Figure. 2.

4.4 Forces perpendicular to the deck

Besides the weight of the cargo, consideration is also to be given to components of the pitching and heave motion of the vessel and to the tilting action of the transverse forces (F_q). The former can be summarized as follows (cf. Figure. 1-3):

$F_{vM} \cong M\,[k\varphi \cdot b\varphi \cdot \sin\beta + \cos\varphi_o\,(g + k_\psi \cdot b_\psi \cdot \sin\delta + k_z \cdot b_z)]$

b_φ , b_ψ , k factors etc.: as defined in 4.2 and 4.3.

$$b_Z = Z_O \cdot \left(\frac{2\pi}{T_Z}\right)^2$$ (heave acceleration)

where z_o = maximum assumed heave amplitude

ships: z_o = L/80 L = length of vessel [m]

Pontoons: $z_o = L/100$

unless more accurate values of z_o, or values producing a greater acceleration, are available.

$$T_Z \cong 2\pi \cdot \sqrt{\frac{2V}{A_{WL} \cdot g}} = 8{,}9 \cdot \sqrt{\frac{V}{A_{WL} \cdot g}}$$

V = Displacement [m^3]

A_{WL} = Waterline area [m^2]

The bearing forces A are to be determined for the two loading conditions "mainly rolling motion" and "mainly pitching and heave motion".

In the transverse direction, for example, the following expression applies:

$$\Sigma A_q = F_v M \cdot \frac{a_q}{e_q} + F_q M \cdot \frac{h_M}{e_q} + F_q W \cdot \frac{h_W}{e_q}$$

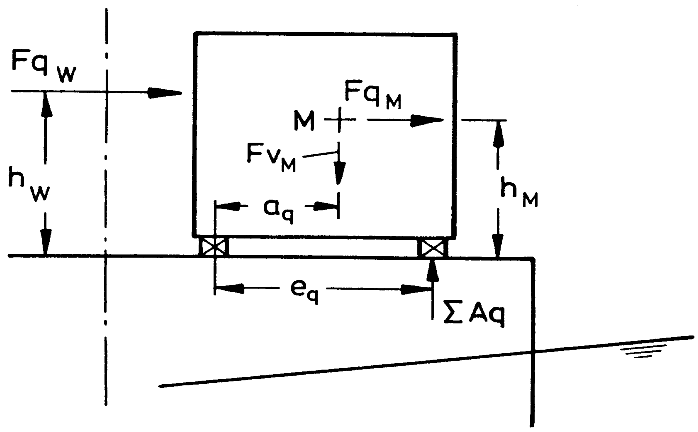

Figure. 3

The bearing forces generated by the forces in the longitudinal direction, A_L, are determined in similar manner. The most unfavourable bearing load in any given case is obtained by adding together the bearing forces derived from the transverse and longitudinal forces, F_q and F_l, plus F_v, relevant to the particular loading condition. Forces due to the wind and, where applicable, the wash of the sea are to be allowed for in one direction only.

(e.g.: Loading condition: "Mainly rolling motion"; cross wind; 4 bearing points assumed:

$$A_{max} = F_{vM} \cdot \frac{a_q}{e_q} \cdot \frac{a_1}{e_1} + 1/2\ F_q M \cdot \frac{h_M}{e_q} + 1/2\ F_{qW}$$

$$\cdot \frac{h_w}{e_q} + 1/2\ F_{lM} \cdot \frac{h_m}{e_l}$$

F_{vM}, F_{qM}, F_{lM} determined by applying $k_\varphi = 1$, $k_\psi = 0{,}6$ and $k_z = 0{,}8$)

Because of the measures which may be necessary to prevent lift-off, the lowest possible values, A_{min}, are also to be investigated.

SECTION 5

TUGS

A. Suitability of Tug

1. The criteria mentioned in Section 2, C are to be applied.

2. The necessary towing force is determined in accordance with Section 4, B.2.

3. For assessing the suitability of a tug the bollard pull I is a basic, though not the sole, criterion.

4. All the prescribed certificates must be present and valid, e.g.:

- Certificate of Registry,
- Tonnage Certificate,
- Class Certificates (for hull and machinery),
- Load Line Certificate,
- Safety Construction Certificate,
- Safety Equipment Certificate,
- Safety Radiotelegraphy / Radiotelephony Certificate,
- Additional national certificates,

5. **TL** reserves the right to call for the following documents:

- Stability information,
- General arrangement plan,
- Drawing of towing winches,
- Sketch showing arrangement of towing gear with detailed information.

B. Towing Gear

1. Towing winch / towing hook

1.1 Construction and dimensioning must conform to the current edition of the TL's "Regulations for the Construction and Testing of Towing Gears".

1.2 On tugs whose keel was laid in1977 or later, the holding load of the towing gear (first rope layer on the drum) must equal 80 % of the specified minimum breaking strength of the towrope.

The brake of the towing winches on these tugs must be capable of quick release from the control stand on the bridge and from any other control stand.

On tugs whose keel was laid before 1977, the towing gear shall meet these requirements wherever possible. Account shall be taken of other suitable measures and of towrope guides.

1.3 The holding load of towhooks must equal at least the test load.

2. Towropes

2.1 The dimensioning of towropes is to be determined by the coefficient of utilisation K, which itself depends on the value of the bollard pull I.

Bollard pull I	K
Up to 200 kN	2,5
Over 1000 kN	2,0

Where the bollard pull I is between 200 and 1000 kN, the value of K can be determined by linear interpolation.

2.2 At least one spare towrope and accessoried must be carried on board.

ANNEX

RECOMMENDATIONS FOR THE PERFORMANCE OF BOLLARD PULL TESTS

1. To obtain comparable results when testing bollard pull, the details given in the "Protocol concerning the Determination of Bollard Pull" should be adhered to.

2. The measuring instrument must be calibrated and equipped to display and record the bollard pull. Wherever possible, it should also be capable of being coupled to record the engine output and speed. The calibration certificate is to be presented.

If the measuring instrument is not equipped to record the bollard pull, the test is to be conducted in the presence of two Surveyors.

3. The length of the towrope from hook or winch to the strong point shall be at least 100 m. During the test towrope shall be as near horizontal as possible.

4. There shall be sufficient open water, at least one ship's length in extent, on each side of the vessel together with a dept of water equal to twice the draught of the tug, subject to a minimum of 10 m.

5. Wherever possible, the bollard pull test is to be conducted in calm air and slack water or at a low wind velocity (of $v \leq 5$ m/s) and a low current velocity (of $\leq v$ 0,5 m/s).

6. In order to exclude dynamic effects, bollard pulls are to be recorded / read only when the tug is pulling dead ahead, i.e. without any sheering movements.

7. All auxiliary equipment such as pumps and generators which is driven by the main engine or the propeller shaft is to be operated during the test.

8. The bollard pull with the main engine running at its continuous power shall be maintained for at least 10 min.

9. The maximum bollard pull with the main engine running at an overload power of 10 % shall be maintained for at least one minute.