# REFERENCE MANUAL

# FOR

# CARGO GEAR

# CERTIFICATION

ICGB-101
ICGB-102
ICGB-103



**INTERNATIONAL CARGO GEAR BUREAU, INC.**

Transcribed by: Martin & Ottaway 2023

As used herein and hereunder the terms, “ICGB”, “International Cargo Gear Bureau”, “International Cargo Gear Bureau Inc.”, and “bureau” refer to one and the same non-profit membership corporation incorporated under the Membership Corporation Law of the State of New York under the formal name and style of “International Cargo Gear Bureau, Inc.”

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Compiled and Edited
by
Charles G. Visconti
*Executive Vice President*

**VOLUME ONE**

**INTERNATIONAL CARGO GEAR BUREAU, INC.**

Transcribed by: Martin & Ottaway 2023

**ICGB Technical Committee**

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## PREFACE

This Volume One of the ICGB “Reference Manual” contains three basic ICGB Publications, #101, #102, and #103 which were prepared with reference to the standards respecting cargo gear as set forth by ILO Convention No. 32 and as specified by individual National Authorities throughout the world. The standards provided herein are offered to describe for interested Owners and responsible National Authorities, the basic ICGB certification services which are available, and the related conditions and procedures required for the issuance of associated ICGB certifications.

The assistance and cooperation of the Merchant Vessel Inspection Division, U.S. Coast Guard; of the Longshore Branch, Bureau of Labor Standards, U.S. Department of Labor; and of ICGB Representatives throughout the world are especially acknowledged as having significantly contributed to the preparation of this volume which is published with the approval of the ICGB Technical Committee.

Charles G. Visconti

New York, New York
January 1968

## TABLE OF CONTENTS

# SUMMARY OF STANDARDS AND GUIDE FOR THE CERTIFICATION OF CARGO GEAR

ICGB-101

**INTERNATIONAL CARGO GEAR BUREAU, INC.**

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# Contents

## Section 1 GENERAL

### 1.1 Description of Organization

International Cargo Gear Bureau, Inc. is a non-profit membership corporation which provides cargo gear inspection, certification and consulting services throughout the world. International Cargo Gear Bureau, Inc. inspection and certification services may be arranged through the international headquarters office in New York or directly with any local bureau representative.

### 1.2 Standards Provided

ICGB endeavors to provide and promote services in accordance with ILO Convention 32 and other standards of certification generally accepted internationally. Further, in recognition of the variations in Regulations enforced by various countries, ICGB provides specialized certification services, upon request, to facilitate compliance. Therefore, the standards provided herein are offered to describe for interested Owners and responsible National Authorities, the basic ICGB certification services which are available, and the related conditions and procedures required for the issuance of associated ICGB certifications.

### 1.3 Methods and Procedures

ICGB endeavors to ensure that services and associated documents provided are acceptable to individual National Authorities, and consistent with specific requirements of prevailing Regulations. Accordingly, methods and procedures are under continual review.

### 1.4 Authorization

The international headquarters office of ICGB is located in New York, New York. Accordingly, the primary accreditations and authorizations of the ICGB Representatives throughout the world, as "competent persons" to provide cargo gear certification services, are derived from the U.S. Coast Guard and the U.S. Department of Labor. They are the responsible "competent authorities" of the United States of America whose requirements equal or exceed those of the ILO Convention 32, and require that shipboard cargo gear comply with the standards as set forth in such convention. Consequently, the acceptability of ICGB certificates associated with ICGB inspections in ports throughout the world may be confirmed through the respective Washington, DC headquarters offices of the U.S. Coast Guard (Merchant Vessel Inspection Division) and the U.S. Department of Labor (Bureau of Labor Standards, Longshore Branch); and/or through the U.S. Department of State (Office of Maritime Affairs), Washington, DC.

## Section 2 DOCUMENTATION

### 2.1 Issuing of Documents

Generally, all ICGB documents are issued from and coordinated by the international headquarters office of ICGB based upon inspection procedures accomplished by and required tests witnessed by authorized ICGB Representatives in accordance with associated reports submitted to the international headquarters office of ICGB. Therefore, complete details of ICGB

operations and certifications are maintained and controlled by the international headquarters office of ICGB. Further, consistency in certification procedures is thereby enhanced.

### 2.2 Registers and Certificates

Cargo Gear Registers are issued for equipment certified to provide a record of certification status at the location of the gear certified. Appropriate endorsements are made in such Registers by authorized ICGB Representatives to verify examinations accomplished and tests witnessed. Subsequently, associated certificates are issued to provide additional certification details and to confirm documentation. In this regard, effort is made to provide certificates without undue delay and under certain circumstances individual ICGB representatives are authorized to issue temporary certificates, which are valid for up to 90 days from the effective date of certification pending issuance of original documents by the international headquarters office of ICGB.

### 2.3 Entries in Registers

ICGB assumes no responsibility for entries made in Cargo Gear Registers, other than such entries which are made by authorized ICGB Representatives in connection with ICGB inspections. However, for the convenience of the Owner, and if consistent with applicable prevailing Regulations, favorable consideration may be given by ICGB to acknowledging in the ICGB records, certifications accomplished by other recognized organizations and/or Authorities.

### 2.4 Fees

Minimal fees and expenses are charged by ICGB to subscribing companies for services rendered consistent with the associated operating expenses incurred by ICGB in providing such services and as necessary to ensure the continuation of ICGB activities in a responsible manner.

## Section 3 DEFINITIONS

### 3.1 Cargo Gear

The term *cargo gear* includes masts, kingposts, booms (of derricks), winches, cranes, elevators, conveyors, standing and running gear forming that part of the equipment used in connection with the loading or unloading of a vessel with the exception of such items as hoses, hose connections, and supplementary components utilized to rig cargo gear into working positions.

### 3.2 Ton

Unless otherwise specifically indicated, the term *ton* means a long ton of 2240 pounds.

### 3.3 Resultant Load

The *resultant load* on a component of cargo gear is the single force which is equivalent to all the individual forces acting on the component under a given loading condition.

### 3.4 Maximum Resultant Load

The *maximum resultant load* on a component of cargo gear is the greatest anticipated load which can be imposed on the component in a given rigging arrangement, under anticipated loading conditions.

### 3.5 Safe Working Load

Safe working loads are defined as follows for various components of cargo gear:

**3.5.1** The *safe working load* (SWL) is the load for which the gear is designed and is approved to support, excluding the weight of the gear itself.

**3.5.2** The *safe working load* of rope is the maximum permissible line pull on the rope.

**3.5.3** For multiple sheave blocks and block fittings the *safe working load* is the maximum resultant load which is permissible to be imposed on the eye or pin of the block.

**3.5.4** For single sheave blocks, the *safe working load* is the maximum load which is permissible to be lifted by the block when the load is attached to a rope which passes around the sheave of the block, and when both ends of the rope lead parallel to each other from the block. *(Note: When the load is attached directly to the block as in the case of a single sheave lower hanging cargo purchase block, it is permissible that the load so lifted be up to two times this "defined SWL" of the block.)*

### 3.6 Proof Load

The *proof load* is the test load to which a component or an assembled unit is subjected as required by prevailing Regulations and/or to satisfactorily verify the suitable condition of the gear.

### 3.7 Through Examination

The term *thorough examination* is intended to include a visual examination, supplemented if considered necessary by the attending ICGB Representative by other usual and customary means such as a hammer test or a test with electronic or ultrasonic devices.

### 3.8 Dismantling or Disassembling of Gear

The terms *dismantling* and *disassembly* of gear are intended to include the taking apart of units of gear to the extent considered necessary by the attending ICGB Representative to determine the suitability of such gear for continued service and as may be specifically required to carry out the intent of a particular Regulation. After proofload tests, the disassembling need not necessarily include the sheaves and pins of the blocks included in the tests, unless there appears to be evidence of deformation or failure, or unless in the opinion of the attending ICGB Representative such disassembling is considered to be necessary to verify the satisfactory condition of the gear. However, in connection with unit tests accomplished in association with quadrennial certification procedures, it is intended that all gooseneck, swivel, etc., fittings be sufficiently taken apart when practicable to facilitate careful examination.

*(Note: Consistent with the provisions of prevailing regulations, means considered to be equivalent to careful examination of dismantled or disassembled gear, such as an electronic, ultra-sonic, or other equally efficient non-destructive examination may be accepted to verify the satisfactory condition of gear in lieu of. or in association with such careful examination.)*

### 3.9 Loose Gear

The term *loose gear* is intended to include any component of cargo gear *(i.e. block, shackle, link, chain, hook, ring, eye plate, swivel, etc.)* which upon removal from an assembled unit is a complete component of itself, or is able to be either utilized as an individual component or placed in service in another unit of cargo gear in a similar manner to that for which the complete component was utilized in the initial unit. However, it is not the intention of ICGB to impose specific *loose gear* certification requirements for components which may not be considered as being *loose gear* by individual National Authorities within the intent of their associated prevailing national regulations; nor is it the intention of ICGB to preclude the imposing of specific loose gear certification requirements for other components which may be considered by individual National Authorities to be subject to such requirements.

### 3.10 ICGB Representative

An *ICGB Representative* for the purpose of providing inspection and certification services in accordance with ICGB policies, standards, and procedures, is:

1) a person considered to be qualified by the international headquarters office of ICGB and appointed for a specific period directly by the international headquarters office of ICGB to provide such services, or
2) a person authorized upon request to provide such services in behalf of ICGB and considered by the international headquarters office of ICGB by virtue of being a representative of another recognized organization, to be qualified to provide such services, which services shall be rendered only in accordance with arrangements confirmed by the international headquarters office of ICGB. *(Note: Every ICGB Representative appointed by the international headquarters office of ICGB for a specified time should have a current ICGB Representatives Identification Card issued on or after June l, l966 to verify his authorization to provide ICGB services. The authorization of other persons to provide services in behalf of ICGB may be promptly verified through the international headquarters office of ICGB.)*

## Section 4 BASIC TESTS

### 4.1 General

The prooftesting of cargo gear usually involves at least two distinct testing procedures which are:

a) prooftesting of each article of loose gear, and
b) prooftesting of the assembled unit.

Prooftests required in connection with the issuance of associated ICGB documents generally are no less than as given in the following Tables A and B. Essentially, what is required is that each article of loose gear be proof tested prior to being employed for cargo handling operations, and that each assembled unit be proof tested as a unit at least once in every four years. *(Note: ICGB Quadrennial Certification procedures require unit testing in addition to and in association with thorough examination and dismantling or disassembly of cargo gear, and it is emphasized that neither of the prooftesting procedures described above is a substitute for the other.)*

### 4.2 Unit Testing Criteria

All unit tests should be accomplished under such operating or simulated conditions which represent the condition(s) imposing the greatest anticipated stresses on the booms, masts, winches, standing rigging, permanent fittings, etc., insofar as is practicable. For instance, unit testing of light lift shipboard cargo booms and accessory gear being certified for swinging boom operation should be accomplished with the proofload being supported with the designed rigging arrangement and with the boom at an angle which should not be greater than 15 degrees to the horizontal, or at the lowest practicable angle of elevation as determined from physical limitations, basic design considerations, current loose gear certification, previous documentation, etc.

### 4.3 Special Testing

Special testing of cargo gear may be witnessed by ICGB Representatives upon request, and the results of such tests certified as appropriate with due consideration of the intended use and/or the special design of such cargo gear. For example, when units of cargo gear are rated for various capacities at correspondingly varying operating radii, separate unit tests may be required in order to satisfactorily certify anticipated operating conditions. Further, as with certain hydraulic cranes with capacities limited by pressure, and with which it is not. possible to lift proofloads specified in Table B, the greatest possible load in excess of the safe working load should be utilized and recorded for associated certification purposes.

## TABLE A

**Schedule of Prooftest for Articles of Loose Gear**

(Whether accessory to machine or not)

| ARTICLES OF GEAR | PROOF LOAD |
|---|---|
| Chains, rings, hooks, links, shackles, swivels…… | Twice the safe working load. |
| Single sheave block……..... | *Four times the safe working load. |
| Multiple sheave block with safe working load up to and including 20 tons……...……. | Twice the safe working load. |
| Multiple sheave block with safe working load over 20 tons up to and including 40 tons……. | 20 tons in excess of the safe working load. |
| Multiple sheave block, with safe working load over 40 tons…….. | One and a half times the safe working load. |
| Roller chains (pitched chains) used with hand operated chain falls, and rings, hooks, shackles, or swivels permanently attached thereto……..... | One and a half times the safe working load. |
| Chain fall blocks used with roller chains (pitched chains, and rings, hooks, shackles or swivels permanently attached thereto…..... | One and a half times the safe working load. |

*For single sheave blocks, the safe working load is the maximum load which is permissible to be lifted by the block when the load is attached to a rope which passes around the sheave of the block, and when both ends of the rope lead parallel to each other from the block. *(Note: When the load is attached directly to the block, as in the case of a single sheave lower hanging cargo purchase block, it is permissible that the load so lifted be up to two times this "defined SWL" of the block.)*

## TABLE B

### Schedule of Prooftests for Assembled Units

(Winches with their accessory gear, including derricks and attachments; and cranes and other hoisting machines with their accessory gear)

| SAFE WORKING LOAD OF ASSEMBLED GEAR | PROOF LOAD |
|---|---|
| Not exceeding 20 tons…….... | 25 percent in excess of the safe working load. |
| Over 20 tons but not exceeding 50 tons….. | 5 tons in excess of the safe working load. |
| Over 50 tons…… | 10 percent in excess of the safe working load. |

### 4.4 Responsibility

While ICGB endeavors to advise subscribing Companies as to apparent lifting capabilities of gear and associated appropriate testing arrangements and provides testing standards for the convenience of and as a service to the Owners of such gear, lCGB assumes no responsibility for any damages caused by cargo gear tests arranged by or with the permission. of the Owners of such gear, nor does ICGB assume responsibility for testing equipment and/or weights provided by or with the permission of the Owners of such gear.

*(Note: Owners of cargo gear certified by ICGB should maintain a record of, and arrange to have ICGB provided with documentation for record purposes as to the certified accuracy of testing equipment and/or certified weights of test loads utilized in connection with related ICGB certifications.)*

## Section 5 BASIC CERTIFICATION SERVICES AVAILABLE

### 5.1 General

All cargo gear should be rigged and employed in an approved, certified, and safe manner. Certification services are made available by ICGB upon request in order to facilitate compliance by Owners of cargo gear equipment with prevailing Regulations and/or to facilitate implementation of safety codes voluntarily desired by Owners of such equipment.

While ICGB endeavors to ensure the suitability of gear for appropriate use in connection with associated certifications issued by ICGB and consistent with the requirements of prevailing Regulations, ICGB assumes no responsibility for maintenance or possible misuse of such gear. Further, when gear is certified by ICGB as being in satisfactory condition but recommendations are made by lCGB regarding the continued or special maintenance of such gear, it is the responsibility of the Owner of the gear to service, repair or replace the gear or components of the gear as necessary, consistent with such ICGB recommendations in order to ensure the continued satisfactory condition of the gear throughout the duration and within the intent of the associated ICGB certificate(s) issued.

### 5.2 Approval of Design

#### 5.2.1 Plan approval

The international headquarters office of ICGB will review and approve or comment upon design calculations and related data submitted to verify lifting capacities *(SWL)* of cargo gear, in order to facilitate, when applicable, submittal of ICGB approved technical material to National Authorities for anticipated confirmation of approval as may be required. However, ICGB reserves the right to require the submittal of such technical data in connection with any requests received for ICGB certifications which involve the certification as to lifting capacity *(SWL)*.

### 5.2.2 Special Gear

The international headquarters office of ICGB will give favorable consideration to reviewing and offering approval and/or comments in connection with technical data submitted to verify the suitability of design of special loose gear components or other special lifting devices. When such technical data is intended by the Owner to be offered in lieu of the usual proof tests to comply with the intent of prevailing certification standards it may be required by individual National Authority regulations that such ICGB approved technical data be submitted to the National Authorities for confirmation of approval and acceptance in lieu of the usual proof ·tests and it may be required by ICGB tor issuance of appropriate certificates that other tests be conducted to demonstrate the suitability of such special gear for the intended uses.

### 5.2.3 Design Considerations

Plan approval action by ICGB may be issued only by the international headquarters office of ICGB in New York and is accomplished with due consideration for accepted and recognized design methods and factors of safety, the basic minimum values of which generally are as given in the following Table C:

## TABLE C

## DESIGN SAFETY FACTOR

| Safe Working Loads for Component Parts | Safety Factors Based On* | | |
|---|---|---|---|
| | Ultimate Strength | Yield Point | Breaking Test Load |
| All metal structural parts except booms, stayed masts, pins and connections: | | | |
| 5 tons or less working load of the assembled gear……... | 5.00 | **2.75 | …… |
| 15 tons working load of the assembled gear…… | 4.00 | **2.20 | …… |
| 60 tons or more working load of the assembled gear……... | 3.75 | **2.05 | …… |
| Steel booms: | | | |
| 10 tons or less working load of the assembled gear……... | | 3.00 | …… |
| 13 tons or more working load of the assembled gear……... | | 3.00 | …… |
| Stayed masts: | | | |
| 10 tons or less working load of assembled gear…… | 5.00 | …… | |
| 13 tons or more working load of assembled gear……... | 4.00 | …… | |
| Pins and connections: | | | |
| 10 tons or less working load of assembled gear…… | | **3.00 | …… |
| 13 tons or more working load of assembled gear……... | | **2.50 | …… |
| Wire Rope: | | | |
| 10 tons or less working load……... | | | 5.00 |
| 13 tons or more working load…… | | | 4.00 |
| Fiber Rope: | | | |
| For running rigging……... | 7.00 | …… | |
| For fixed gear and vangs……... | 5.00 | …… | |
| Wooden structural parts……... | 8.00 | …… | |
| Chains…… | 4.50 | …… | |

* Intermediate values of safety factors may be used.

** The minimum yield point for design purposes shall not be considered greater than 72 percent of the minimum ultimate strength of the steel.

(Effective revision date; November 6, 1972)

#### 5.2.4 Verifying SWL by Special Testing

ICGB may acknowledge lifting capacity *(SWL)* rating of cargo gear based upon the satisfactory proof testing of cargo gear with a load of up to 100% in excess of the apparent SWL if such load is appropriately applied and if such a test is considered to demonstrate the suitability of the cargo gear to be appropriately employed to support the apparent SWL. Before voluntarily deciding to subject cargo gear to such overload testing the Owner should carefully consider the design, construction, record of performance, and current condition of the cargo gear to withstand such testing without damage. *(Note: This alternate method of soliciting ICGB acknowledgement as to apparent lifting capacity may only be arranged through the international headquarters office of ICGB in New York and does not supersede any special provisions of prevailing Regulations which may specifically require approved plans and calculations· in order to verify lifting capacity of cargo gear.)*

#### 5.2.5 Diagrams

ICGB provides as an additional service, upon request, rigging diagrams and similar material which may be placed in Cargo Gear Registers and/or suitably posted to describe certified rigging arrangements and satisfy the requirements of certain Regulations regarding the availability of such additional material at the location of the gear.

#### 5.2.6 Approval of Suitability of Design

Upon request ICGB will advise subscribing Companies as to the apparent design suitability of gear in connection with certifications issued. However, unless otherwise specifically provided for by associated ICGB documents, forms, diagrams, or correspondence, ICGB approval of the working capability of gear certified is restricted to the certification of the capability demonstrated and attested to by the specific tests to and inspections of such gear accomplished in accordance with corresponding standards and requirements for such tests and inspections as established by applicable prevailing Regulations, and consistent with the rated lifting capacity of such gear as previously documented by other recognized organizations and/or Authorities.

### 5.3 Quadrennial Certification

#### 5.3.1 General

The requirement for receipt of ICGB quadrennial certification is that the Owner of the cargo gear arrange to subject the gear to appropriate unit testing (re: Table B) in the presence of an ICGB Representative, arrange to have the gear dismantled and disassembled as considered necessary by the attending ICGB Representative to facilitate a thorough examination of the gear and individual components of the gear consistent with the requirements of prevailing Regulations, and arrange to accomplish any periodic heat treatment procedures which may be required.

### 5.3.2 Initial Unit Testing

When unit tests are being conducted for the first time, the gear is to be completely dismantled or disassembled for examination after testing. The sheaves and pins of the blocks included in such tests need not necessarily be removed unless there appears to be evidence of deformation or failure, or unless in the opinion of the attending ICGB Representative, such disassembling is considered to be necessary to verify the satisfactory condition of the gear.

### 5.3.3 Subsequent Unit Testing

For subsequent unit tests it may be required that the gear be disassembled and/or dismantled and thoroughly examined prior to the testing as decided by the attending ICGB Representative with further disassembling and/or dismantling and thorough examination as necessary being conducted after testing. This option of requiring disassembly and/or dismantling prior to testing is intended to facilitate proper evaluation of the condition of the gear prior to the gear being subjected to prooftest overloading. However, regardless of the extent of disassembling and/or dismantling and thorough examination prior to unit testing, it is intended that disassembling after such tests include, but not necessarily be limited to, the taking apart of associated gooseneck assemblies when practicable and as necessary to permit thorough examination of such assemblies.

### 5.3.4 Crediting Certification Date

If under certain circumstances it does not suit the Owner to schedule quadrennial testing and examination consecutively for a cargo gear unit, such procedures may be accomplished separately at the Owner's convenience with the date of quadrennial certification being credited upon completion of all required procedures as of the date of testing, providing that all such procedures be accomplished within a period not to exceed 90 days, and provided that no changes or alterations to the cargo gear being certified be made during the period of the continuous inspection with the exceptions of changes *in kind* or other changes to improve the gear which changes are appropriately recorded by a responsible Owner's Representative and reported to ICGB. *(Note: The completion of quadrennial recertification procedures should be within four years of the last previous quadrennial certification for gear continued in regular service.)*

### 5.3.5 General Prooftesting Procedure

All prooftests are to be accomplished in accordance with prevailing applicable Regulations and/or in a manner consistent with the design and certified intended use of the gear.

### 5.3.6 Methods of Prooftesting

Cargo gear being tested for the first time is to be tested with appropriate movable weights and the operation of such gear satisfactorily demonstrated by handling the proof load through a complete operating cycle or cycles and in accordance with applicable prevailing regulations. If movable weights for

prooftesting are not reasonably available, subsequent unit tests, and unit tests being accomplished in connection with the repair or replacement of gear *(i.e. repaired or replacement booms but not "upgradings")* may be accomplished by alternate means such as by the use of a spring or hydraulic scale which has been appropriately certified for accuracy. When such an alternate method of unit testing is employed the testing should be conducted in such a manner and under such varying conditions as may be decided upon by the attending ICGB Representative consistent with the requirements of prevailing Regulations. *(Note: It is· generally required that whenever such scales are used the indicator remain constant at the proofload position for a period of at least five minutes in order to satisfactorily test the gear in accordance with the intent of Quadrennial Certification or Special Certification procedures.)*

### 5.3.7 Winches

On all types of winches and cranes efficient means are to be provided to stop and hold the proof load in any position and the efficiency of such means is to be demonstrated.

5.3.7.1 When more than one device to stop and hold the proofload is available, at I such devices are to be in satisfactory operating condition, and it should be clearly indicated which device is to provide the primary and usual method of braking, and under what conditions, if any, any secondary device is necessary for efficient and effective braking.

5.3.7.2 Electric winches, electro-hydraulic winches fitted with electro-magnetic or hydraulic brakes at the winch, or cranes are to be equipped so that a failure of the electric power shall stop the motion and set the brakes without any action on the part of the operator.

5.3.7.3 Current for electric winches and crane operation during the tests is to be taken from the associated operating circuits. Shore current may be used if it passes through the associated operating circuits.

### 5.3.8 Progressive Quadrennial Procedure

Regarding shipboard inspections, where many lifting units are involved, it may be considered advantageous by some Owners to employ a *progressive quadrennial procedure,* similar in principle to normal progressive maintenance programs.

It is solely the prerogative of the Shipowner or Operator to decide whether the progressive quadrennial procedure is undertaken rather than scheduling a complete quadrennial for all units at the same time once every four years.

For the purpose of explanation, the example of a ship equipped with eight derricks may be considered. If Quadrennial certification were issued for all eight derricks in January 1966; quadrennial recertification for all eight derricks would be required by January 1970. Therefore, the choice would

be either to accomplish a complete annual inspection in January 1967, January 1968, January 1969 and a complete quadrennial inspection in January 1970; or to accomplish a complete annual inspection in January 1967 and quadrennial certification for two derricks at the same time, then a complete annual inspection in January 1968 with a quadrennial for two more derricks, and likewise in January 1969 and January 1970. Either procedure provides that at all the derricks receive annual certification every year, and receive quadrennial certification within a four-year period.

If, in the example discussed above, the ship's cargo gear had not been inspected at all prior to January 1966, the progressive quadrennial procedure should not be initiated by accomplishing quadrennial certification (in this instance, initial certification) for only two derricks. If this were done, six of the derricks would not have been quadrennially certified as required. In employing either procedure, all units at any given time must have been quadrennially certified within the previous four years.

When a ship is employing the progressive quadrennial procedure, effort is made to accomplish a complete annual inspection of all gear in conjunction with any quadrennial inspections performed on a portion of the total number of units aboard, even if the annual inspection is not due at the time, provided that the complete annual inspection can be accomplished without additional charges for services over those entailed for the quadrennial portion of the survey. This situation may occur when the quadrennial inspections get *out of phase*· with the annual inspections due to ship schedules and availability for cargo gear inspections. In this way, annual and quadrennial inspections are kept in phase.

## 5.4 Annual Certification

### 5.4.1 General

The requirement for receipt of ICGB annual certification is that the Owner of the cargo gear make such gear available for thorough examination by an ICGB Representative, arrange to have such gear dismantled and/or disassembled as may be required by the attending ICGB Representative in accordance with applicable prevailing regulations, and arrange to accomplish any periodic heat treatment procedures which may be required. Normally, it is not necessary to dismantle and/or disassemble the cargo gear to obtain ICGB annual certification, except as may be necessary for the heat treatment of components for which such periodic treatment may be required.

### 5.4.2 Relationship to Quadrennial Certification

An annual recertification for cargo gear is automatically issued upon satisfactory completion of a quadrennial certification for any unit comprised of such cargo gear. However, annual recertification does not extend any current quadrennial certification or substitute for any quadrennial recertification which may be required.

## 5.5 Loose Gear Certification

### 5.5.1 General

ICGB quadrennial, special test, or annual certificates do not routinely include specific certification of the associated individual articles of loose gear as required by separate prevailing Regulations regarding the testing and examination of loose gear prior to being taken into use.

Other than inspections of articles of loose gear which are accomplished in connection with initial, annual, or quadrennial certification of associated cargo gear units, specific ICGB certification of individual articles of loose gear may be obtained only if the Owner of such gear arranges to subject the gear to appropriate testing *(re: Table -A-)* in the presence of an ICGB Representative, arranges to have the individual articles taken apart including the removal of pins and sheaves of blocks to the extent that the construction of such blocks permits so as to facilitate careful examination, and arranges to have each article suitably and separately marked for identification.

5.5.1.1 In lieu of accepting articles for such specific certification on the basis of tests witnessed, and careful examinations accomplished by ICGB Representatives, ICGB may acknowledge, by the issuing of related ICGB loose gear certificates, previous test data and examinations as documented by appropriate certificates issued by other recognized persons provided that such test data is in accordance with the schedules included in Table A.

5.5.1.2 When such previous loose gear test data is not in accordance with Table A, but is in accordance with other, different established requirements or standards of another recognized Authority, ICGB will give due consideration to verifying on associated documents issued the particular acceptability of such test data in order to clarify for interested National Authorities the standards to which such tests refer. *(Note: When subscribing companies decide to retain such different loose gear test data, due consideration should be given by the companies to the acceptability of such certifications by the various interested National Authorities of the various countries where the cargo gear is likely to be employed.)*

### 5.5.2 Marking Systems

With regard to the marking of individual articles of loose gear, it is generally recommended for receipt of ICGB loose gear certificates that the articles be marked in accordance with the ICGB suggested method, which is described by other ICGB publications and provides for the separate and distinctive marking of each article of loose gear.
*(Note: Owners of cargo gear components should select means of marking which will provide reasonable and continued identification and liability but which will not cause the components to be unsatisfactory for continued use.)*

## 5.6 Special Certification

### 5.6.1 Special Types of Cargo Gear

ICGB certifications for special types of cargo gear and/or for specialized uses of cargo gear are available upon request, provided that sufficient technical data is submitted and/or tests accomplished as may be appropriate consistent with the design and/or intended use of such cargo gear.

### 5.6.2 Wire and Fiber Rope

ICGB wire and fiber rope certifications are available in association with the completion of required tests and examinations.

### 5.6.3 Heat Treatment

ICGB certifications of heat treatment for components of cargo gear which are required to be heat treated in accordance with prevailing Regulations and/or manufacturers recommendations are available upon the supervised completion of required procedures.

### 5.6.4 Burtoning (union purchase)

Certifications for burtoning are available upon request through the international headquarters office of ICGB in New York. However, if specific ICGB burtoning *(union purchase)* certification is not issued for cargo gear which is employed in such manner, burtoning operations should only be undertaken in accordance with approved proportional limits or other Regulations as described by National Authorities, and with due consideration of the relative stresses on the cargo gear developed by burtoning operations as compared to the certified swinging derrick ratings of such cargo gear.

### 5.6.5 Repairs, Alterations or Replacements

Special ICGB certificates are available to verify the suitability of cargo gear repairs, alterations, or replacements. *(Note: See Section 4 for basic testing requirements and Section 5.3.6 for unit prooftesting methods.)*

## 5.7 Other and Related Requirements

### 5.7.1 Marking *(SWL)*

To facilitate compliance with prevailing Regulations and in association with ICGB certifications accomplished, all units and components of cargo gear are to be marked for identification and SWL. For example, in addition to the loose gear markings mentioned in Section 5.5. herein, all booms should be marked to indicate the associated certified location *(i.e., boom at hatch #2 aft end stbd. to be marked "2AS")* and the SWL for an assembled unit of cargo gear is to be marked on the heel of the boom with the minimum angle to the horizontal for which the gear is certified for swinging boom operations. *(Additional swinging boom SWL markings may be required to distinguish single whip and multiple cargo purchase arrangements when applicable.)*

Further, when specific burtoning certification has been issued the associated capacity should be marked on the heels of the booms involved in connection with an appropriate identification *(such as including in the mark the letter "U" referring to "union purchase")* that the capacity indicated refers to the burtoning capacity; and it is recommended that the approved burtoning conditions be adequately described by suitable diagrams or other useful methods which would be conveniently available to persons operating such cargo gear.

*(Note: Owners of cargo gear should select means of marking which will provide reasonable and continued identification and legibility but which will not cause the gear to be unsuitable for continued use.)*

### 5.7.2 Special Recertification Requirements

Quadrennial certifications *(Section 5.3)* are normally required by prevailing regulations to be renewed once every four years. Annual certifications *(Section 5.4)* are normally required by prevailing regulations to be renewed once every year. Loose gear certification *(Section. 5.5)* for individual components may be verified by confirming markings or remarking from time to time as necessary although retesting of components is not normally required *(regardless of whether or not such components are transferred frame one cargo unit to locations of no greater loading in another unit)* unless significant repairs to or alterations of the· components are made and/or unless current loose gear documentation is not evident and readily verified by existing certificates. However, for the renewal of ICGB Quadrennial, Annual and/or Loose Gear Certifications, ICGB reserves the right to require special tests, repairs, replacements, disassembling and/or dismantling of gear as may be considered necessary or appropriate to verify the condition of cargo gear which may have been subjected to unusual use or stowed for a considerable length of time unused, which may be in an apparently damaged condition, or which may apparently be in marginally satisfactory condition.

### 5.7.3 Loose Gear Annual Inspection

Each component of loose gear in use in a cargo gear unit and spare gear which may be placed in service during intervals between regular certifications should be inspected and heat treated, if necessary, at least once each year in connection with Annual Certification requirements.

### 5.7.4 Loose Gear Marking

Loose gear marking and/or verification of loose gear markings is recommended and may be required by the attending ICGB Representative in connection with ICGB certifications in order to facilitate the verification of loose gear certification status and/or to confirm for future reference which components of cargo gear were utilized in an assembled unit at the time of ICGB certification.

### 5.7.5 Damaged or Excessively Worn Gear

Damaged or excessively worn gear should be repaired or replaced and recertified as appropriate prior to the continued use of such gear regardless of other current certification of such gear. When gear is damaged as an apparent result of proper prooftesting, such gear is to be repaired or replaced and subsequent proper prooftesting is to be satisfactorily completed without causing such damage before any associated certification may be issued.

### 5.7.6 Significant Alterations

When significant alterations to cargo gear are accomplished, suitable recertification should be completed prior to the use of such gear regardless of other current certification of such gear; and due consideration should be given by Owners of such gear to any related requirements for the prior approval of plans and/or calculations for such alterations.

### 5.7.7 Important Repairs or Renewals

Whenever important repairs or renewals for masts, booms, and permanent fittings of cargo gear are indicated, such repairs or renewals should be accomplished in an appropriate and approved manner and suitable recertification should be completed prior to the use of such gear regardless of other current certification of such gear – and due consideration should be given by Owners of such gear to any related requirements for the prior approval of plans and/or calculations for such repairs or renewals which are not in kind.

# LOOSE GEAR

# CERTIFICATION GUIDE

ICGB-102


**INTERNATIONAL CARGO GEAR BUREAU, INC.**

Transcribed by: Martin & Ottaway 2023

# Contents

# Loose Gear Certification Guide

## Section 1 DEFINITIONS

### 1.1 Loose Gear

The term loose gear is intended to include any component of cargo *gear (i.e., block, shackle, link, chain, hook, ring, eye plate, swivel, etc.,)* which upon removal from an assembled unit is a complete component of itself, or is able to be either utilized as an individual component or placed in service in another unit of cargo gear in a similar manner to that for which the complete component was utilized in the initial unit. However, it is not the intention of ICGB to attempt to impose specific loose gear certification requirements for components which may not be considered as being loose gear by individual National Authorities within the intent of their associated prevailing national regulations; nor is it the intention of ICGB to preclude the imposing of specific loose gear certification requirements for other components which may be considered by individual National Authorities to be subject to such requirements.

### 1.2 Resultant Load

The resultant load on a component of cargo gear is the single force which is equivalent to all the individual forces acting on the component under a given loading condition.

### 1.3 Maximum Resultant Load

**1.3.1** The *maximum resultant load* on a component of cargo gear is the maximum greatest anticipated load which can be imposed on the component in a given rigging arrangement, under anticipated loading conditions.

**1.3.2** The *maximum resultant load* on a block is the largest possible load which can be imposed on the eye or pin of the block in a given rigging arrangement.

1.3.2.1 With a single whip cargo fall and the boom topped high to an almost vertical position, the resultant load on the gin block *(boom head block)* is almost equal to twice the weight lifted. From a practical standpoint, the maximum resultant load for the gin block is taken as twice the weight of the load. Similarly, and again taking a single whip cargo fail, the maximum resultant load for the heel block is taken as twice the pull in the cargo runner, since both parts of the runner are almost parallel when the boom is at an almost horizontal elevation.

1.3.2.2 In instances where at least one of the wires passing around the sheave(s) of a block could never lead parallel to the other wires on the block, as in the case of some topping lift blocks and some lead blocks, the angle between the wire leads should be considered in determining the maximum resultant load.

### 1.4 Safe Working Load

**1.4.1** General Definition

The *safe working toad (SWL)* is the load for which the gear is designed and is approved to support, excluding the weight of the gear itself.

### 1.4.2 Rope

The safe working load of rope is the maximum permissible line pull on the rope.

### 1.4.3 Multiple Sheave Blocks & Block Fittings

For multiple sheave blocks and block fittings, the safe working load is the maximum resultant load which is permissible to be imposed on the eye or pin of the block.

### 1.4.4 Single Sheave Blocks

For single sheave blocks, the safe working load is the maximum load which is permissible to be lifted by the block when the load is attached to a rope which passes around the sheave of the block, and when both ends of the rope lead para I lei to each other from the block, as illustrated by the following *Sketches Showing Block Loads for Various Cargo Purchase Arrangements*.

1.4.4.1 The ICGB definition refers to one-half of the maximum resultant load for single sheave blocks as determined from the stress diagram for the unit or as determined from the construction of the block if the construction facilitates a greater rating than required for the intended use. *(Note: When the load is attached directly to the block, as in the case of a lower hanging cargo purchase block, it is permissible that the load so lifted be up to two times this "defined SWL" of the block.)*

1.4.4.2 It should be noted that other Standards may utilize other definitions for single sheave block safe working loads. For instance, referring block "C" of Panel Ill in the following Sketches, the SWL rating may on occasion be, (a) referred to as being the load attached directly to the block (9 LT) or, (b) referred to as being the load at the becket (3 LT). In such instances, the associated proof load is correspondingly specially defined so that the proof load for the selected block would be the same regardless of the method selected to define the safe working load, since the ICGB definition, definition (a), and definition (b), for safe working load have corresponding ratios of proof load to safe working load of 4, 2, and 6, respectively *(i.e. 4 x 4½ = 18, 2 x 9 = 18, and 6 x 3 = 18).*

### 1.4.5 Special Note

The safe working loads of individual articles of loose gear in a unit of cargo gear are not necessarily the same as the safe working load for the unit.

## 1.5 Proof Load

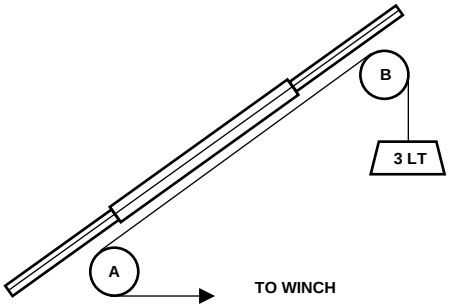
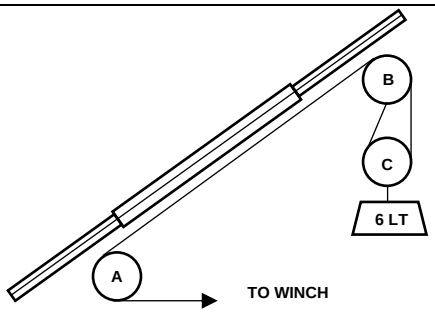
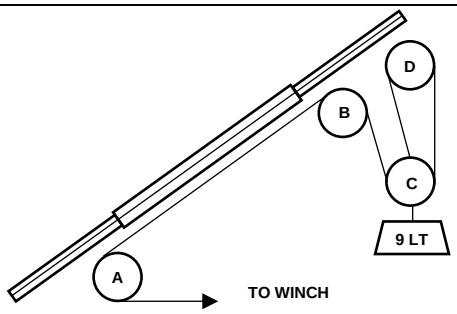
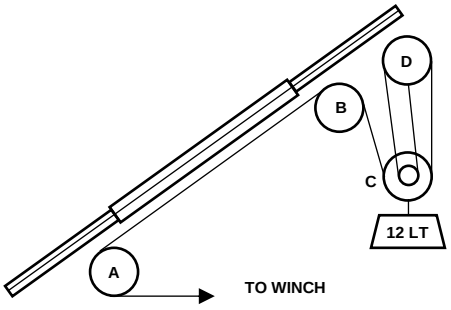
The *proof load* is the test load to which an article of loose gear is subjected as required by prevailing Regulations.

## 1.6 Ton

Unless otherwise specifically indicated, the term ton means a long ton of 2240 pounds.

## SKETCHES SHOWING BLOCK LOADS FOR VARIOUS CARGO PURCHASE ARRANGEMENTS

*(Note: Gear Weight Excluded for Purpose of Illustration)*

| | | |
|---|---|---|
| 1. Pull in each Wire = 3 LT (NO FRICTION) |  | Block (A)…<br>Max. Resultant Load (MRL) = 6 LT<br>Safe Working Load (SWL) = 3 LT<br>Proof Load (PL) = 12 LT<br><br>Block (B)…MRL = 6 LT<br>SWL = 3 LT<br>PL = 12 LT |
| 2. Pull in each Wire = 3 LT (NO FRICTION) |  | Block (A) = Block (C)…<br>MRL = 6 LT<br>SWL = 3 LT<br>PL = 12 LT<br><br>Block (B)…<br>MRL = 9 LT<br>SWL = 4.5 LT<br>PL = 18 LT |
| 3. Pull in each Wire = 3 LT (NO FRICTION) |  | Block (A) = Block (B) = Block (D)…<br>MRL = 6 LT<br>SWL = 3 LT<br>PL = 12 LT<br><br>Block (C)…<br>MRL = 9 LT<br>SWL = 4.5 LT<br>PL = 18 LT |
| 4. Pull in each Wire = 3 LT (NO FRICTION) |  | Block (A) = Block (B)…<br>MRL = 6 LT<br>SWL = 3 LT<br>PL = 12 LT<br><br>Block (C)…<br>MRL = 12 LT<br>SWL = MRL*<br>PL = 24 LT<br><br>Block (D)…<br>MRL = 9 LT<br>SWL = 4.5 LT<br>PL = 18 LT<br><br>*By definition for multiple sheave block |

<u>List of identical blocks</u> (identical in strength)

Blocks 1(A), 1(B), 2(A), 2(C), 3(A), 3(B), 3(D), 4(A), 4(B) are identical
Blocks 2(B), 3(C), 4(D) are identical
Block 4(C) is a multiple sheave block
Blocks are lettered in sequence following the wire rope lead from winch

### 1.7 ICGB Representative

An *ICGB Representative* for the purpose of providing inspection and certification services in accordance with ICGB policies, standards, and procedures, is:

a. A person considered to be qualified by the international headquarters office of ICGB and appointed for a specific period directly by the international headquarters office of ICGB to provide such services, or
b. A person authorized upon request to provide such services in behalf of ICGB and considered by the international headquarters office of ICGB by virtue of being a representative of another recognized organization, to be qualified to provide such services, which services shall be rendered only in accordance with arrangements confirmed by the international headquarters office of ICGB.

*(Note: Every ICGB Representative appointed by the international headquarters office of ICGB for a specified time should have current ICGB Representative's Identification Card issued on or after June 1, 1966 to verify his authorization to provide ICGB services. The authorization of other persons to provide services in behalf of ICGB may be promptly verified through the international headquarters office of ICGB in New York.)*

## Section 2 TESTS

### 2.1 General

The prooftesting of cargo gear usually involves at least two distinct testing procedures which are:

a. prooftesting of each article of loose gear, and
b. prooftesting of the assembled unit.

Prooftests required in connection with the issuance of associated ICGB loose gear documents generally are no less than as given in the following TABLE A. In essence, what is required is that each article of loose gear be prooftested prior to being employed for cargo handling operations, and that each assembled unit be prooftested as a unit at least once in every four years.

*(Note: ICGB Quadrennial Certification procedures require unit testing in addition to and in association with thorough examination and dismantling or disassembly of cargo gear, and it is emphasized that neither of the prooftesting procedures described above is a substitute for the other.)*

## TABLE A

**Schedule of Prooftest for Articles of Loose Gear**

(Whether accessory to machine or not)

| ARTICLES OF GEAR | PROOF LOAD |
|---|---|
| Chains, rings, hooks, links, shackles, swivels | Twice the safe working load. |
| Single sheave block | *Four times the safe working load. |
| Multiple sheave block with safe working load up to and including 20 tons | Twice the safe working load. |
| Multiple sheave block with safe working load over 20 tons up to and including 40 tons | 20 tons in excess of the safe working load. |
| Multiple sheave block, with safe working load over 40 tons | One and a half times the safe working load. |
| Roller chains (pitched chains) used with hand operated chain falls, and rings, hooks, shackles, or swivels permanently attached thereto | One and a half times the safe working load. |
| Chain fall blocks used with roller chains (pitched chains, and rings, hooks, shackles or swivels permanently attached thereto | One and a half times the safe working load. |

*For single sheave blocks, the safe working load is the maximum load which is permissible to be lifted by the block when the load is attached to a rope which passes around the sheave of the block, and when both ends of the rope lead parallel to each other from the block. *(Note: When the load is attached directly to the block, as in the case of a single sheave lower hanging cargo purchase block, it is permissible that the load so lifted be up to two times this "defined SWL" of the block.)*

### 2.2 Special Gear

ICGB will give favorable consideration to reviewing and offering approval and/or comments in-connection with technical data submitted to verify the suitability of design of special loose gear components or other special lifting devices. When such technical data is intended by the Owner to be offered in lieu of the usual proof tests to comp l y with the intent of prevailing certification standards, it may be required by individual National Authority regulations that such ICGB approved technical data be submitted to the National Authorities for confirmation of approval and acceptance in lieu of the usual proof tests, and it may be required by ICGB for issuance of appropriate certificates that other tests be conducted to demonstrate the suitability of such special gear for the intended uses.

### 2.3 Responsibility

While ICGB endeavors to advise subscribing Companies as to apparent lifting capabilities of gear and associated appropriate testing arrangements, and provides testing standards for the convenience of and as a service to the Owners of such gear, ICGB assumes no responsibility for any damages caused by cargo gear tests arranged by or with the permission of the Owners of such gear nor does ICGB assume responsibility for testing equipment and/or weights provided by or with the permission of the Owners of such gear.

*(Note: Owners of cargo gear certified by ICGB should maintain a record of, and arrange to have ICGB provided with documentation for record purposes as to the certified accuracy of testing equipment and/or certified weights of test loads utilized in connection with related ICGB certifications.)*

## Section 3 IDENTIFICATION

### 3.1 General

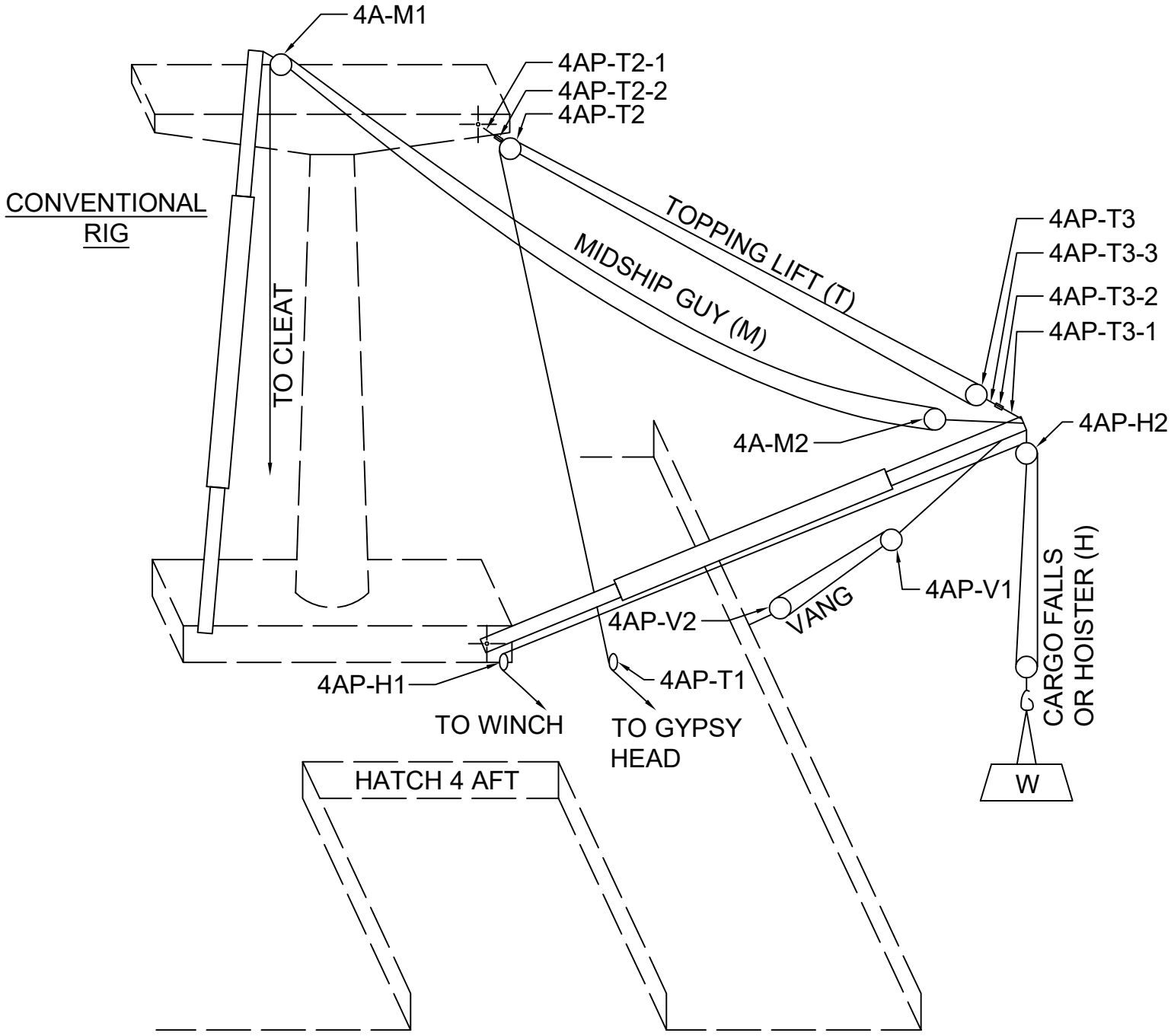
With regard to the marking of individual articles of loose gear it is generally recommended for receipt of ICGB loose gear certificates that, in addition to the marking of safe working load as required by prevailing Regulations, each article of loose gear be marked in accordance with the ICGB suggested method, which is illustrated by the following conventional rig sketch, and which is summarized as follows:

| | |
|---|---|
| First Character | Hatch number (1, 2, 3, 4, 5, etc.) |
| Second Character | Forward or aft (F or A) |
| Third Character | Port or starboard (P or S)* |
| Fourth Character | Hoister, topping lift, vang midship guy (H, T, V or M respectively) |
| Fifth Character | Sequence block in the arrangement (1, 2, 3, etc.) by following the run of the rope from the winch, cleat, or deck pad, and numbering the blocks in order of contact with the rope.** |

**With a heavy lift on the ship's centerline, the mark would be "C" and in the case of a midship guy (schooner guy) no C, P, or S is necessary.*

***If two separate vangs are fitted to a single boom, the outboard blocks would be numbered first.*

*(Note: Owners of cargo gear components should select means of marking which will provide reasonable and continued identification and legibility but which will not cause the components to be unsatisfactory for continued use.)*




ICGB METHOD OF IDENTIFYING LOOSE GEAR

FIRST CHARACTER..... HATCH NUMBER (1, 2, 3, 4, ETC.)
SECOND CHARACTER... FORWARD OR AFT (F OR A)
THIRD CHARACTER..... PORT OR STARBOARD (P OR S)...OR CTRLINE (C) FOR HEAVY LIFT RIGS
FOURTH CHARACTER... HOISTER (H), TOPPING LIFT (T), VANG (V), MIDSHIP GUY (M)

FIFTH CHARACTER..... SEQUENCE OF BLOCK IN THE ARRANGEMENT (1, 2, 3, ETC.)
BY FOLLOWING THE RUN OF THE ROPE FROM THE WINCH, CLEAT, OR DECK PAD AND NUMBERING THE BLOCKS IN ORDER OF CONTACT WITH THE ROPE.

SIXTH CHARACTER..... SHACKLE OR LINK NUMBER IN SEQUENCE STARTING WITH THE NUMBER ONE AT EACH BLOCK AND FIRST MARKING THE SHACKLE OR LINK ATTACHED TO THE SUPPORTING FITTING ON THE MAST, BOOM, DECK, OR BULWARK.

### 3.2 Shackles, Chain Links, etc.

Shackles, chain links, etc., are identified by the same marking as the block to which they are attached, plus an additional number. This additional number in sequence starts with the first shackle, chain link, etc., attached to the supporting fitting on the mast, boom or deck as the case may be.

### 3.3 Special Articles

In addition to the general markings described above, the following markings for special articles are recommended:

#### 3.3.1 Topping Lift Bull Chain

Assuming it serves the after port boom at hatch #4, mark the upper and lower I inks 4AP-TB. Any shackles attached to the bull chain would be marked 4AP-TB-I, 4AP-TB-2, etc., starting with the lowest shackle on deck and ending with the uppermost shackle to the flounder plate (triangle plate).

#### 3.3.2 Topping Lift Flounder Plate (triangle plate)

Assuming it serves the after port boom at hatch #4, would be marked 4AP-TT. Shackles or links attached to the plate would be marked 4AP-TT-I, 4AP-TT-2, etc. *(no specified sequence, and optional marking of shackle between plate and bull chain which may be identified in either the TB series or the TT series.)*

#### 3.3.3 Cargo Hooks

If they are integral with a block they may be considered as being part of the block with no separate marking required. Independent hooks usually have a serial number corresponding to the manufacturer's test certificate. If a separate mark is needed, for instance, on a hook and associated shackles used with a boom at hatch #4 aft, port, the markings would be 4AP-HH, 4AP-HH-I, 4AP-HH-2, etc. *(Where the hook, shackles, link and rings serve both port and starboard booms in burtoning the. use of P or S is optional or may be omitted as with midship guy blocks.)*

#### 3.3.4 Spider or Vang Bridle Assembly

Assuming it serves the outboard vangs for both the after port boom at hatch #4 and for the forward port boom at hatch #5 it would be marked 4-5 PX.

#### 3.3.5 Turnbuckles Used with Standing Rigging

Starting with the turnbuckle of the starboard shroud or stay which is closest to the hatch served by the supported derrick *(or for gear located entirely on the port side, starting with the stay furthest from the hatch served and closest to the ship's centerline)* and numbering in sequence of position, identification series TX would be utilized. For example, if a heavy lift derrick serving hatch #4 aft end is supported by a centerline mast rigged with two shrouds either side and two backstays, each having a turnbuckle to the deck, the turnbuckle serving the forwardmost shroud on the starboard side would be identified as 4AC-TXI. The turnbuckle for the other starboard shroud would be identified as 4AC-TX2, and so forth 1 with the identifying mark for the turnbuckle serving the forwardmost shroud on the port side being 4AC-TX6. *(Note: If shackles are utilized they would be identified with the associated turnbuckles*

*in the same manner as shackles are identified with blocks to which they are attached.)*

### 3.3.6 Miscellaneous Items

Other items used in a specific location would be identified with the component to which they are most closely associated in the same manner as shackles are identified with blocks to which they are attached.

### 3.3.7 Spare Loose Gear, Beam Bridles, Tent Blocks, etc.

Such items may be marked as follows:

SWL _____ Tons (date)

ICGB *(Representative's initials)* – number*

** The number will be 1, 2, 3, 4, 5, etc., as per the individual ICGB Representative's record of loose gear certified in this manner.*

### 3.3.8 Relatively Small Articles

When extensive markings are not feasible, abbreviated separate and distinct markings would be employed for identification.

## 3.4 Other Methods of Identification

It is recognized that there are many other acceptable and recognized methods for identifying loose gear. The method offered herein is intended to provide the ICGB suggested and preferred method whereby each article is separately and individually identified in accordance with the requirements of prevailing Regulations, but is not intended to indicate any objection to other acceptable methods which may be preferred by other interested Agencies, Owners of cargo gear, etc.

## 3.5 Interchangeability and Replacement

With regard to the interchangeability and replacement of articles of loose gear in any derrick, *WHILE THE ICGB METHOD DOES NOT ENCOURAGE INTERCHANGING OF LOOSE GEAR COMPONENTS FROM ONE DERRICK TO ANOTHER, THE ICGB METHOD DOES NOT PROHIBIT SUCH INTERCHANGING WHEN PROPERLY ACCOMPLISHED.* Actually, using the location system for each article will facilitate proper and accurate recordkeeping for such interchanged or replacement articles, as illustrated by the following note:

*(Note: As an example, take a four hatch ship with a similar pair of 5 ton cargo derricks at each hatch, varying in "derrick ratio" (length of boom divided by effective mast height) from hatch to hatch, and assume that all loose gear is properly documented by test certificates, based upon associated maximum resultant loads, all loose gear is marked by the "Location system" utilizing the ICGB method, and a complete set of ICGB loose gear certificates (listing all loose gear by associated boom sets) is in the Cargo Gear Register Book.*

a. *If the cargo purchase heel block at hatch #1 aft end, starboard, is replaced by a new or spare block, with a proper certificate of test and identical markings on the certificate as appears on the block (say WXYZ), then the new individual certificate may be attached to the ICGB loose gear certificate for hatch #1 aft end, and a notation as to the replacement block may be made on the ICGB certificate (i.e., block 1AS-HZ replaced by block WXYZ on date). A notation on the new individual certificate should also be made to indicate the location where*

*the new or spare block has been placed into service. ·This process provides a direct method of recordkeeping, facilitates the comparison of SWL rating of the new and old block before actual replacement and enables one to locate readily the documentation for the replacement block (since the certificate would still be filed in accordance with the hatch location at which block WXYZ is being used.)*

*b. In connection with a subsequent ICGB certification of the cargo gear at hatch #1 aft end, starboard, the block marked WXYZ could be remarked as 1AS-H1 and a new ICGB loose gear certificate could be issued for the set of gear at hatch #1 aft end. The new ICGB certificate would differ from the old certificate in that a different date of test would presumably be listed for block 1AS-H1, and the new ICGB certificate would have a more current date of issue.*

*c. If, for some reason, it were to be decided to interchange the heel blocks for the booms located at hatches #1 aft end, starboard, and #4 forward end, port, then notation could be made in the associated ICGB loose gear certificates that such an interchange was made.*

*d. In any event, and regardless of any interchanges or replacements, one could always either locate a certificate for an article sighted in the rigging, or find in the rigging any article referred to on a certificate.*

*e. Certificates for spare gear should be kept separately from the certificates for the gear in use.*

*f. Since the derrick ratios from hatch to hatch would differ, it would be clear from the ICGB loose gear certificates that topping lift components may not be interchanged from hatch to hatch – but only from one derrick to the other derrick in a given pair.*

## Section 4 CERTIFICATION

### 4.1 General

ICGB quadrennial, special test, or annual certificates do not routinely include specific certification of the associated individual articles of loose gear as required by separate prevailing Regulations regarding the testing and examination of loose gear prior to being taken into use.

**4.1.1** Other than inspections of articles of loose gear which are accomplished in connection with annual and/or quadrennial certification of associated cargo gear units, specific ICGB certification of individual articles of loose gear may be obtained only if the Owner of such gear arranges to subject the gear to appropriate testing (re: Table A) in the presence of an ICGB Representative, arranges to have the individual articles taken apart including the removal of pins and sheaves of blocks to the extent that the construction of such blocks permits so as to facilitate careful examination, and arranges to have each article suitably and separately marked for identification.

**4.1.2** In lieu of accepting articles for such specific certification on the basis of tests witnessed, and careful examinations accomplished by ICGB Representatives, ICGB may acknowledge, by the issuing of related ICGB loose gear certificates, previous test data and examinations as documented by appropriate certificates issued by other recognized persons provided that such test data is in accordance with the schedules included in Table A.

4.1.2.1 When such previous loose gear test data is not in accordance with Table A, but is in accordance with other, different established

requirements or standards of another recognized Authority, ICGB will give due consideration to verifying on associated documents issued, the particular acceptability of such test data in order to clarify for interested National Authorities the standards to which such tests refer. *(Note: When subscribing companies decide to retain such different loose gear test data, due consideration should be given by the companies to the acceptability of such certifications by the various interested National Authorities of the various countries where the cargo gear is likely to be employed.)*

### 4.2 Confirmation of Loose Gear Marking

Loose gear certification for individual components may be verified by confirming markings or remarking from time to time as necessary although retesting of components is not normally *required (regardless of whether or not such components are transferred from one cargo unit to locations of no greater loading in another cargo unit)* unless significant repairs to or alterations of the components are made and/or unless current loose gear documentation is not evident and readily verified by existing certificates.

Loose gear marking and/or verification of loose gear markings is recommended and may be required by the attending ICGB Representative in connection with ICGB certifications in order to facilitate the verification of loose gear certification status and/or to confirm for future reference which components of cargo gear were utilized in an assembled unit at the time of ICGB certification.

### 4.3 Loose Gear Annual Inspection

Each component of loose gear in use in a cargo gear unit and spare gear which may be placed in service during intervals between regular certifications should be inspected and heat treated if necessary at least once each year in connection with Annual Certification requirements.

### 4.4 Special Certification

ICGB certifications of heat treatment for components of cargo gear which are required to be heat treated in accordance with prevailing Regulations and/or manufacturers' recommendations are available upon the supervised completion of required procedures.

### 4.5 Approval of Safe Working Load Ratings

Unless otherwise specifically provided for by associated ICGB documents, forms, diagrams, or correspondence, ICGB approval of safe working load ratings indicated for individual articles of loose gear on ICGB certificates is restricted to and assigned on the basis of manufacturers' recommendations or specifications and/or satisfactory associated proof test data.

### 4.6 Damaged or Excessively Worn Gear

Damaged or excessively worn gear should be repaired or replaced and recertified as appropriate prior to the continued use of such gear regardless of other current certification of such gear. When gear is damaged as an apparent result of proper prooftesting, such gear is to be repaired or replaced and subsequent proper

prooftesting is to be satisfactorily completed without causing such damage before any associated certification may be issued.

# FORCE DIAGRAM
# AND
# CALCULATION GUIDE

# LIGHT LIFT
# COPLANAR DERRICKS
# (SWINGING BOOM)

ICGB-103

**INTERNATIONAL CARGO GEAR BUREAU, INC.**

Transcribed by: Martin & Ottaway 2023

**Force Diagram and Calculation Guide**

# Contents

# Force Diagram and Calculation Guide

## Section 1 GENERAL

This publication has been prepared to explain the considerations for, and to provide a relatively simple method of determining sate working load *(SWL)* and prooftest load requirements for articles of loose gear and wire rope utilized in light lift coplaner derricks for swinging boom operations.

Reference to other ICGB publications concerning related certification standards and procedures is recommended.

## Section 2 PROOFTESTING REQUIREMENTS

### 2.1 Basic Requirements

In connection with certification requirements the prooftesting of cargo gear usually involves at least two distinct testing procedures which are:

a) prooftesting of each article of loose gear, and
b) prooftesting of the assembled unit

Neither of these testing procedures is a substitute for the other since the respective overload *(Testing)* schedules differ.

### 2.2 Loose Gear Testing Requirements

Articles of loose gear to be utilized in a cargo handling unit *(derrick)* should be selected after the rigging arrangement and SWL requirements have been determined. Certification standards usually require the individual prooftesting of each article prior to use for cargo handling purposes. *(Note: Individual testing is usually only required to be accomplished prior to initial use regardless of whether or not components are transferred from one cargo unit to locations of no greater loading in another cargo unit.)*

### 2.3 Unit Testing Requirements

Certification standards usually require the prooftesting of each unit after assembly with previously tested articles of loose gear.

*(Note: For all ICGB Quadrennial Certifications, initial and subsequent, unit testing is required to be accomplished.)*

### 2.4 Comparison of Loose Gear Testing and Unit Testing Loads

Figure 1 shows a force analysis for a conventional unit with a design hook load of 10 long tons.

Figure 2 shows a force analysis for the same derrick but with a unit test proof load on the hook of 12-1/2 long tons *(or 25% overload).*

The loads on the articles of loose gear and wire rope associated with each force analysis, and the loose gear prooftest and wire rope break test requirements are summarized in Tables A and B. Comparison of the loads listed for each item illustrates how the respective loads vary under normal design operation, with a unit test load, and with related loose gear and wire rope prooftest loads.

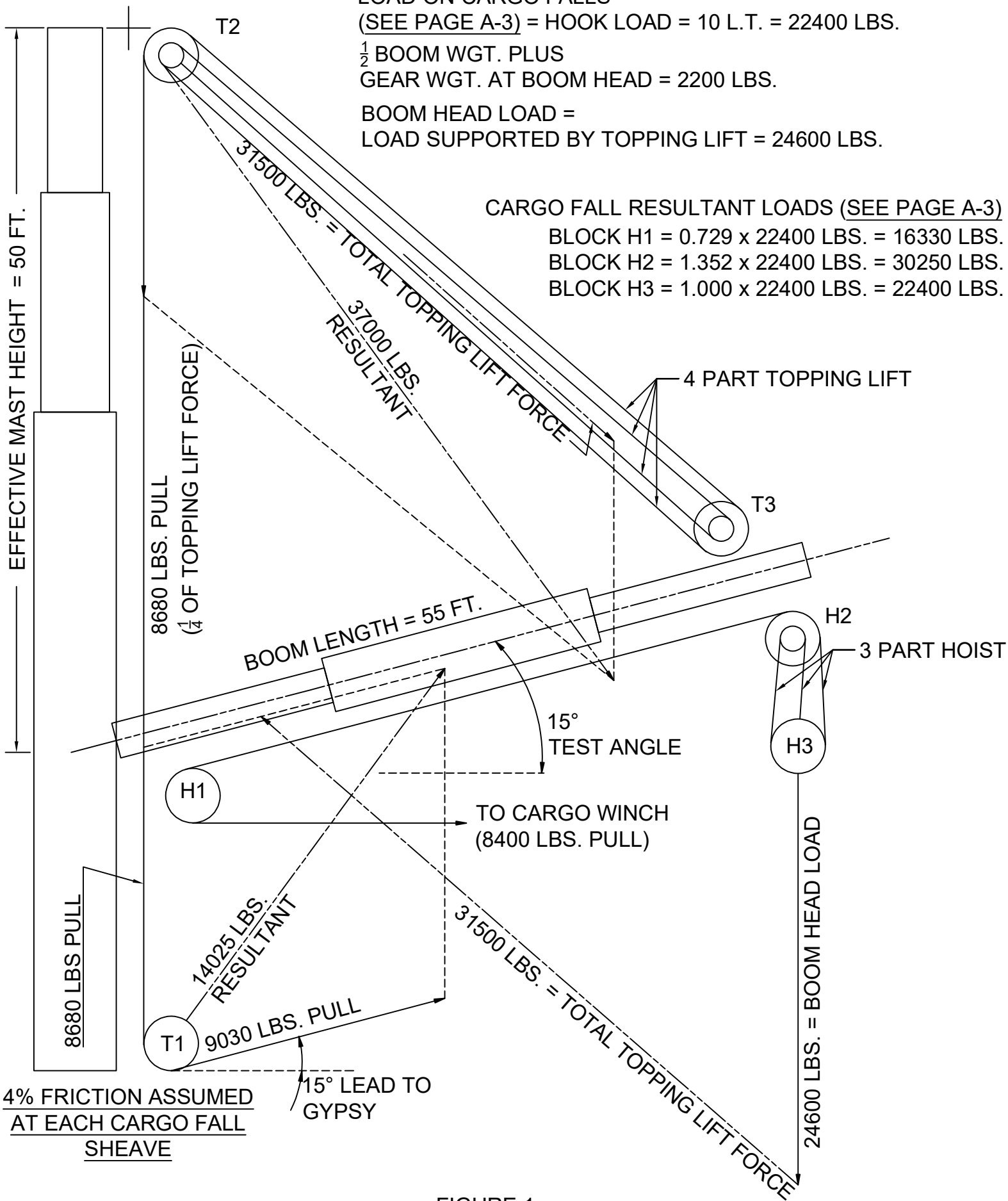



FIGURE 1.
DESIGN FORCE ANALYSIS FOR CONVENTIONAL 10 L.T. RIG

## SOLUTION TO DESIGN FORCE ANALYSIS FOR CONVENTIONAL 10 L.T. RIG AS GIVEN IN FIGURE 1.

### SOLUTION FOR CARGO FALLS (4% FRICTION ASSUMED AT EACH SHEAVE)

1. RQD. BREAK. STRENGTH OF WIRE ROPE = S.F. x PULL FACTOR x LOAD ON CARGO FALLS
   = 5.0 x (0.3603 x 1.04) x 22400 LBS. = 42000 LBS.

2. RQD. CARGO WINCH LINE PULL = PULL FACTOR x LOAD ON CARGO FALLS
   = 0.3603 x 1.04 x 22400 LBS. = 8400 LBS.

3. BLOCK H1 PROOF TEST LOAD = 2 x MAX. DESIGN RESULTANT LOAD
   = 2 x 16330 LBS. = 32660 LBS. = ABOUT 14-1/2 L.T.
   SAFE WORK LOAD = 1/2 x MAX. DESIGN RESULTANT LOAD
   = 1/2 x 16330 LBS. = 8165 LBS. = ABOUT 3-2/3 L.T.

4. BLOCK H2 PROOF TEST LOAD = 2 x 30250 LBS. = 60500 LBS. = ABOUT 27 L.T.
   SAFE WORK LOAD = 1 x 30250 LBS. = 30250 LBS. = 13-1/2 L.T.

5. BLOCK H3 PROOF TEST LOAD = 2 x 22400 LBS. = 44800 LBS. = 20 L.T.
   SAFE WORK LOAD = 1/2 x 22400 LBS. = 11200 LBS. = 5 L.T.

### SOLUTION FOR TOPPING LIFT (4% FRICTION ASSUMED AT EACH SHEAVE)

6. RQD. BREAK. STRENGTH OF WIRE ROPE = S.F. x PULL FACTOR x TOPPING LIFT FORCE
   = 5.0 x (0.2755 x 1.04) x 31500 LBS. = 45150 LBS.

7. BLOCK T1 PROOF TEST LOAD = 2 x MAX. DESIGN RESULTANT LOAD
   = 2 x 14025 LBS. = 28050 LBS. = ABOUT 12-1/2 L.T.
   SAFE WORK LOAD = 1/2 x MAX. DESIGN RESULTANT LOAD
   = 1/2 x 14025 LBS. = 7010 LBS. = ABOUT 3-1/8 L.T.

8. BLOCK T2 PROOF TEST LOAD = 2 x 37000 LBS. x 74000 LBS. = ABOUT 33 L.T.
   SAFE WORK LOAD = 1 x 37000 LBS. x 75000 LBS. = ABOUT 16-1/2 L.T.

9. BLOCK T3 PROOF TEST LOAD = 2 x 31500 LBS. x 63000 LBS. = ABOUT 28 L.T.
   = 1 x 31500 LBS. x 31500 LBS. = ABOUT 14 L.T.

NOTES:

1. THE PROOF TEST LOADS FOR SHACKLES AND CHAIN LINKS ARE THE SAME VALUES AS THOSE GIVEN FOR THE PROOF TEST LOADS OF THE BLOCKS TO WHICH THEY ARE ATTACHED.
2. SOLUTION TO THIS FORCE ANALYSIS BY USING THE ICGB TABLES IN APPENDIX A. IS GIVEN IN THE WORKED EXAMPLE ON PAGE A-8.
3. CARGO FALL FRICTION = 0.3603 x 1.04 = 0.375 (SEE PAGE A-3).
4. S.F. = SAFETY FACTOR

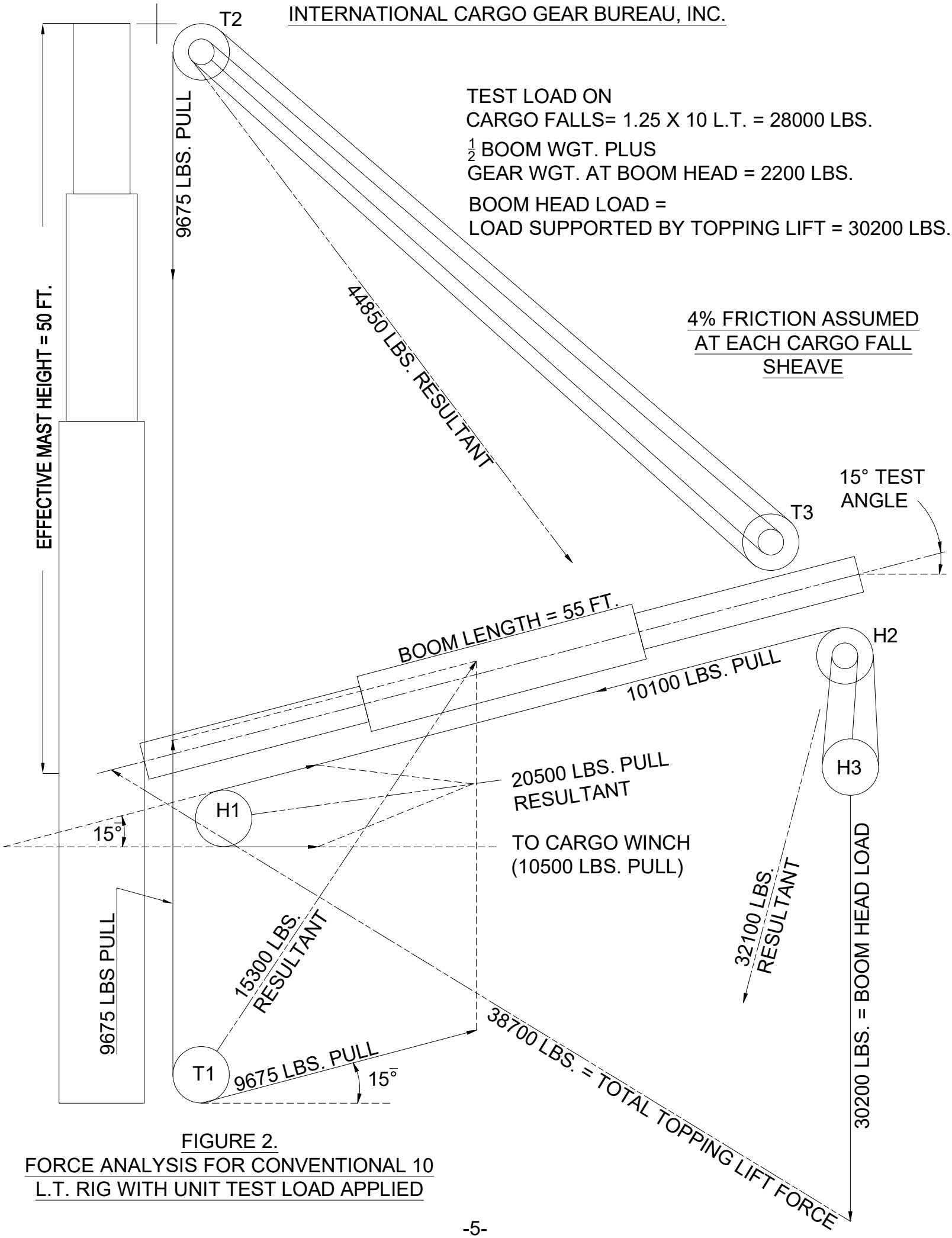



FIGURE 2.
FORCE ANALYSIS FOR CONVENTIONAL 10
L.T. RIG WITH UNIT TEST LOAD APPLIED

## COMPARISON OF LOADS ON LOOSE GEAR COMPONENTS WITH DESIGN HOOK LOAD ON RIG WITH UNIT TEST ON ASSEMBLED RIG AND REQUIRED LOOSE GEAR PROOF LOADS FOR CONVENTIONAL 10 L.T. RIG SHOWN IN FIGURE 1.

**Table A. Resultant Load on Eye of Block in Lbs.**

| BLOCK NO. | DESIGN LOAD | WITH UNIT TEST LOAD | LOOSE GEAR PROOF LOAD |
|---|---|---|---|
| H1 | 16330 | 20500 | 32660 |
| H2 | 20250 | 32100 | 60500 |
| H3 | 22400 | 28000 | 44800 |
| T1 | 14025 | 15300 | 28050 |
| T2 | 37000 | 44850 | 74000 |
| T3 | 31500 | 38700 | 63000 |

**Table B. Pull on wire in Lbs.**

| BLOCK NO. | DESIGN LOAD | WITH UNIT TEST LOAD | LOOSE GEAR PROOF LOAD |
|---|---|---|---|
| CARGO RUNNER | 8400 | 10500 | 42000 |
| TOPPING LIFT | 9030 | 9675 | 45150 |

## Section 3 FORCE DIAGRAMS AND CALCULATIONS

### 3.1 General

The conventional method of cargo gear force analysis involves the use of an accurately constructed force diagram supplemented by technical calculations. The ICGB method described herein, utilizing the Tables and Graphs in Appendix A, provides a relatively simple and rapid means by which approximate ratings for loose gear components and wire rope may be obtained.

### 3.2 Conventional Method of Force Analysis by Diagram

Figure 1 shows a conventional force analysis by use of a simplified force diagram in which the gear weight at the boom head and half the boom weight were included in the diagram as a single value of 2200 pounds.

It should be noted that when calculating the design loads on the cargo fat Is ·for a conventional light lift derrick, at least five main factors should be considered:

1) The arrangement of the cargo falls, including the number of blocks and the number of parts employed.
2) The hook load which may be taken as the actual load hoisted if the weights of the lowest hoister *(if one is used)* the cargo runner and hook are negligible.
3) The possible boom angles which may be expected while handling a hook load since changes in the boom angle will change the wire rope leads around some of the blocks. *(Note: See illustration on Page A-1 of the Appendix.)*
4) Friction at each sheave.
5) Lead angle to the cargo winch from the heel block.

The calculation of topping lift design loads should include consideration of at least six main factors:

1) The arrangement of the topping lift including the number of blocks and the number of parts employed.
2) The "boom head load" or load supported by the topping lift, which includes the hook load, the gear weight at the boom head, and half the boom weight. *(Note: See illustration on Page A-7 of the Appendix.)*
3) The boom unit test angle, which affects the topping lift force required *(the lower the boom angle, the greater the topping lift force required to support the boom head load.)*
4) The geometry of the rig, including the relative lengths of the boom and the effective mast height, which is illustrated in Figure 1 as the distance from the boom heel to the topping lift swivel on the mast *(the smaller the effective mast height for a given length boom, the greater the topping lift force required to support the boom head load.)*
5) Friction at each sheave to allow for the boom being topped under load *(i.e., adjusting the boom outreach)* if such capability is desired.
6) Lead angle to the winch from the topping lift winch lead block.

The variations in derricks aboard different ships are myriad. These variations include differences in boom capacities, rigging arrangements *(i.e., the number of parts in the*

*topping lift and cargo falls)* boom lengths, effective mast heights, and design boom elevation angles; all of which significantly affect the force analysis calculation.

An accurate force analysis is recommended as a preferred method of verifying. the required SWL ratings of loose gear components for a given derrick. However, in order to provide a positive means of quickly and adequately verifying the required SWL ratings of loose gear components the tables and graphs included in Appendix A have been developed and are presented in this publication.

### 3.3 Force Analysis by Use of ICGB Tables

The force analysis tables in Appendix A are not presented as a complete and accurate substitute for detailed force diagrams, but rather as a convenient means of obtaining approximate loose gear proof load and safe working load information.

The use of the tables is explained by the worked example given on Page A-8 of the Appendix.

Pages A-1 and A-3 illustrate the theoretical loads on 1, 2, and 3 part cargo fall arrangements considering 4% friction at each sheave and boom angles of 15° and 75° *(to obtain maximum loads on the heel blooks and boom head blocks, respectively.)* The tables on Pages A-2 and A-4 provide practical load values tor the cargo falls. The tabulated values for the blocks actually represent static load conditions without friction, but with all the wire rope leads around each block leading para I lei; and as such give an indication of the approximate SWL rating requirements of the cargo fall blocks.

The graphs on Page A-5 illustrate the variation in loads on topping lift components due to different values of "derrick ratio", which ratio is obtained by dividing the length of the boom by the height of the topping lift swivel above the boom heel *(effective mast height.)* For example, in a cargo rig having a 55 foot boom and an effective mast height of 50 feet, the derrick ratio would be 55 divided by 50, or all "derrick ratio."

The graphs on Page A-6 illustrate the variations in loads on topping lift lead blocks at the deck due to different values of "derrick ratio" and different lead angles from the block to the topping lift winch.

Page A-7 illustrates what is meant by the "boom head load" and gives a tabulation of various boom head loads depending upon the design hook loads and boom lengths of the rig. The tabulated loads are average values since it is recognized that boom weights of even equal length and capacity booms may still vary depending upon the construction of each boom and the associated derrick ratios. In actual practice, a more accurate value of "boom head load" could be obtained on board ship by use of the table on Page A-9 and the following procedure:

*As an example, consider the derrick shown on Page A-·7 assuming a 55' boom, a 1.1 derrick ratio and a design hook load of 10 long tons. The tabular value for "boom head load" is 24,600 pounds. However, if a scale were rigged to the topping lift lead wire with no hook load on the boom, and the scale read 640 pounds, the boom head load could be calculated. The 640 pound value could be multiplied by 4 (the number of parts in the topping lift) giving a value of total topping lift pull at the boom head of 2560 pounds. If the 2560-pound pull were then divided by the approximate load factor of 1.28 (see Page A-9 at a derrick ratio of 1.1) the resulting value of 2000 pounds would then*

*represent the sum of the gear weight at the boom head and half the weight of the boom.*

*By adding the calculated value of 2000 pounds to the design hook toad of 10 long tons, or 22,400 pounds the natural "boom head load" value of 24,400 pounds could be obtained.*

Pages A-9 through A-16 provide tables of load factors for 1, 2, 3, and 4 part topping lift arrangements. THESE LOAD FACTORS, WHEN MULTIPLIED BY THE APPROPRIATE "BOOM HEAD LOADS" GIVEN ON PAGE A-7 OR DERIVED FROM ACTUAL TESTING OR ACCURATE CALCULATION, WILL GIVE AN INDICATION OF THE PROOF LOADS, AND SAFE WORKING LOADS OF THE TOPPING LIFT COMPONENTS.

It should be noted that the tables on Pages A-9 through A-16 have been developed so that the proof load for all multiple sheave blocks is always given as twice the value of the safe working load of the block. Therefore, since loose gear testing schedules do not require such 100% overload testing for all multiple sheave blocks, special consideration should be given to any such ratings derived from the ICGB tables. The topping lift tables also assume that when a single sheave lead block is employed at the mast *(i.e. block t2)* in conjunction with another span block *(i.e. block t4)*, the lead block is at practically the same height on the mast as is the span block.

No allowance has been made in the topping lift tables for ship adverse list or trim since these factors are not normally considered in light lift cargo gear design.

### 3.4 Comparison of Conventional Force Diagram and ICGB Tables

A direct comparison of the two methods of force analysis may be obtained by comparing the load values given on the calculation page for Figure I with the values given on Page A-8 of the Appendix. Both calculations are based on identical derricks, assuming the same boom head load of 24,600 pounds. The only differences in the answers obtained by the two methods occur with the loads calculated for block H-1 *(item 3)*, block H-2 *(item 4)* and the required breaking strength for the topping lift wire rope *(item 6)*.

The tabular values for block H-1 are approximately 9% less than the theoretical values. Actually, the theoretical loads for this block may be just as easily obtained from the diagram on Page A-3 as the practical loads were obtained from Page A-4.

However, it should also be recognized that in many instances the lead from the heel block is not horizontal, but rather downward, and as such the tabular value would then most likely be conservative by being greater in value than the theoretical calculated loads for the heel block. Therefore, generally the tabular values for the cargo fail heel blocks presented on Pages A-2 and A-4 will indicate adequate SWL rating requirements for the heel blocks.

The tabular values for block H-Z and for the topping lift wire are respectively 1% and 1/2% less than the stress diagram values. These differences are considered to be within the overall accuracy of basic data usually utilized for cargo gear force calculations.

## 3.5 Force Analysis by Use of ICGB Graphs

With similar intent as discussed in section 3.3, the ICGB sample calculations and graphs on pages A-17 through A-24 are offered to provide a convenient and relatively rapid method of obtaining cargo gear forces with various derrick ratios, boom elevation angles, and topping lift arrangements.

The method is illustrated by the worked example on pages A-17 and A-18.

In addition to loads on topping lift components, approximate values of boom compression and topping lift loads at the mast may be obtained by use of the ICGB graphs.

# APPENDIX A

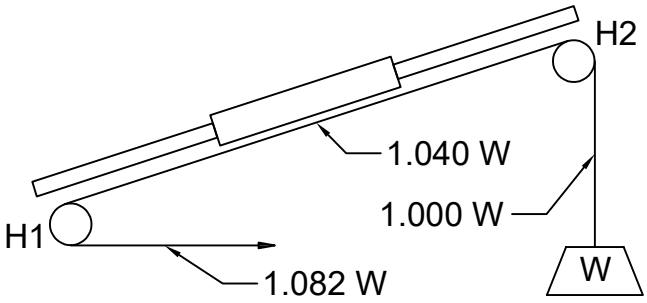
## FORCE ANALYSIS DATE, TABLES, AND GRAPHS

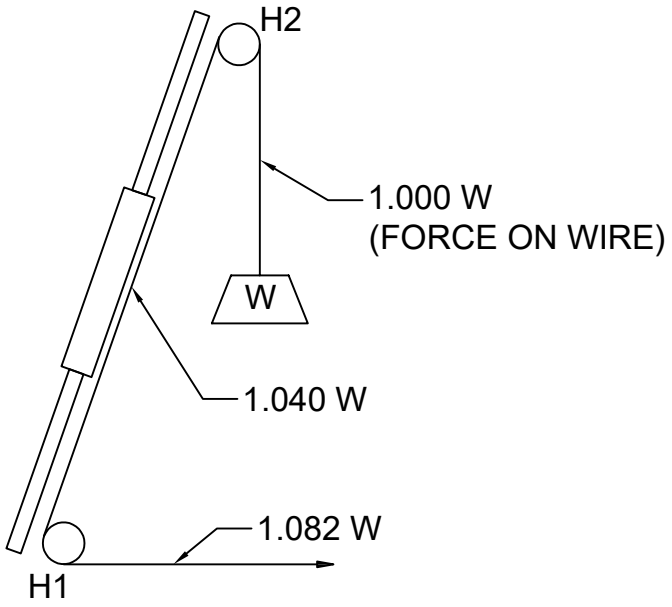
THEORETICAL LOAD FACTORS FOR
CARGO FALL LOOSE GEAR

(4% FRICTION ASSUMED AT EACH SHEAVE)

# 1 PART HOISTER

BOOM @ 15° ELEVATION
FOR MAX. LOAD ON HEEL BLOCK (H1)



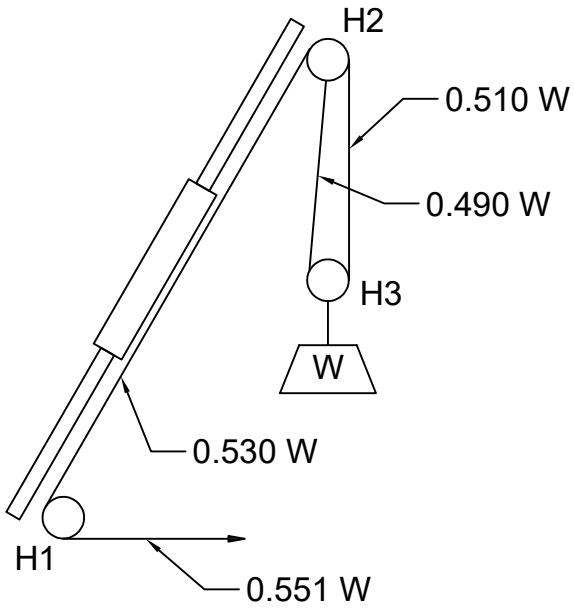




BOOM @ 75° ELEVATION
FOR MAX. LOAD ON GIN BLOCK (H2)

MAXIMUM RESULTANT LOAD ON BLOCK H1 = 2.100 W

MAXIMUM RESULTANT LOAD ON BLOCK H2 = 2.020 W

# 2 PART HOISTER




NOTE: IN LIGHT LIFT RIGS THE WEIGHT OF THE LOWER BLOCK AND CARGO HOOK IS USUALLY NEGLIGIBLE WHEN CONSIDERING THE FORCES ON THE CARGO FALL, BLOCKS, AND SHACKLES.

BOOM @ 15° ELEVATION
MAX. RESULTANT LOAD ON BLOCK H1 = 1.073 W

BOOM @ 75° ELEVATION
MAX. RESULTANT LOAD ON BLOCK H2 = 1.520 W
ON BLOCK H3 = 1.000 W

**TABLES FOR PRACTICAL VALUES**

**OF SAFE WORKING LOADS AND PROOF TEST LOADS**

**FOR CARGO FALL LOOSE GEAR**

# 1 PART HOISTER

| | PRACTICAL LOADS IN LONG TONS | | | | | | |
|---|---|---|---|---|---|---|---|
| | WIRE ROPE | | | BLOCK H1 | | BLOCK H2 | |
| HOOK LOAD (L.T.) | BREAK TEST LOAD | SAFE WORK LOAD | WINCH LINE PULL | PROOF TEST LOAD | SAFE WORK LOAD | PROOF TEST LOAD | SAFE WORK LOAD |
| 1 | 5.410 | 1.082 | 1.082 | 4 | 1 | 4 | 1 |
| 2 | 10.820 | 2.164 | 2.164 | 8 | 2 | 8 | 2 |
| 3 | 16.230 | 3.246 | 3.246 | 12 | 3 | 12 | 3 |
| 4 | 21.640 | 4.328 | 4.328 | 16 | 4 | 16 | 4 |
| 5 | 27.050 | 5.410 | 5.410 | 20 | 5 | 20 | 5 |
| 6 | 32.460 | 6.492 | 6.492 | 24 | 6 | 24 | 6 |

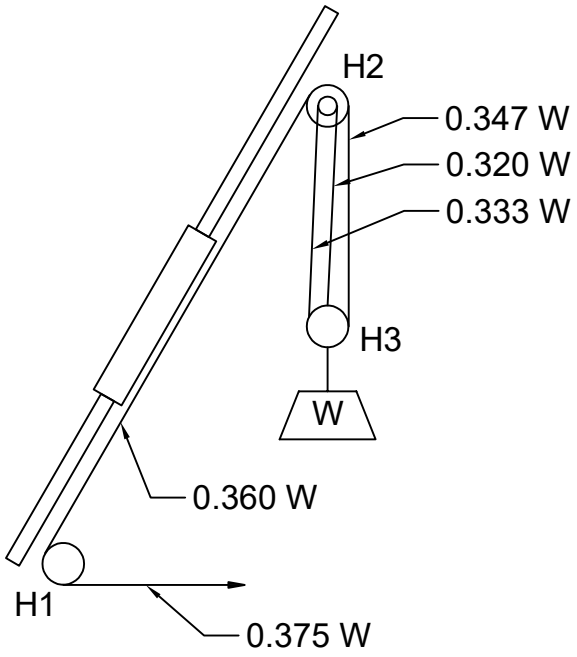
# 2 PART HOISTER

| | PRACTICAL LOADS IN LONG TONS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | WIRE ROPE | | | BLOCK H1 | | BLOCK H2 | | BLOCK H3 | |
| HOOK LOAD (L.T.) | BREAK TEST LOAD | SAFE WORK LOAD | WINCH LINE PULL | PROOF TEST LOAD | SAFE WORK LOAD | PROOF TEST LOAD | SAFE WORK LOAD | PROOF TEST LOAD | SAFE WORK LOAD |
| 4 | 11.020 | 2.204 | 2.204 | 8 | 2 | 12 | 3 | 8 | 2 |
| 5 | 13.776 | 2.755 | 2.755 | 10 | 2-1/2 | 15 | 3-3/4 | 10 | 2-1/2 |
| 6 | 16.530 | 3.306 | 3.306 | 12 | 3 | 18 | 4-1/2 | 12 | 3 |
| 7 | 19.285 | 3.857 | 3.357 | 14 | 3-1/2 | 21 | 5-1/4 | 14 | 3-1/2 |
| 8 | 22.040 | 4.408 | 4.408 | 16 | 4 | 24 | 6 | 16 | 4 |
| 9 | 24.795 | 4.959 | 4.959 | 18 | 4-1/2 | 27 | 6-3/4 | 18 | 4-1/2 |
| 10 | 27.550 | 5.510 | 5.510 | 20 | 5 | 30 | 7-1/2 | 20 | 5 |

THEORETICAL LOAD FACTORS FOR
CARGO FALL LOOSE GEAR

(4% FRICTION ASSUMED AT EACH SHEAVE)

## 3 PART HOISTER
(WITH DOUBLE SHEAVE BLOCK AT BOOM HEAD)

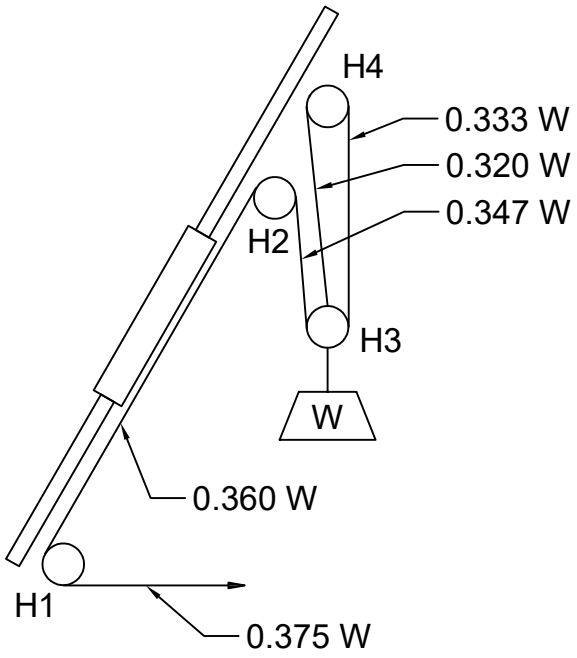



BOOM @ 15° ELEVATION
MAX. RESULTANT LOAD ON BLOCK (H1) = 0.729 W

BOOM @ 75° ELEVATION
MAX. RESULTANT LOAD ON BLOCK (H2) = 1.352 W
ON BLOCK H3 = 1.000 W

NOTE: IN LIGHT LIFT RIGS THE WEIGHT OF THE LOWER BLOCK AND CARGO HOOK IS USUALLY NEGLIGIBLE WHEN CONSIDERING THE FORCES ON THE CARGO FALL, BLOCKS, AND SHACKLES.

## 3 PART HOISTER
(WITH TWO SINGLE SHEAVE BLOCKS AT BOOM HEAD)




BOOM @ 15° ELEVATION
MAX. RESULTANT LOAD ON BLOCK (H1) = 0.729 W

BOOM @ 75° ELEVATION
MAX. RESULTANT LOAD ON BLOCK H2 = 0.701 W
ON BLOCK H3 = 1.000 W
ON BLOCK H4 (RAISING) = 0.653 W
ON BLOCK H4 (LOWERING ) = 0.680 W

**TABLES FOR PRACTICAL VALUES**

**OF SAFE WORKING LOADS AND PROOF TEST LOADS**

**FOR CARGO FALL LOOSE GEAR**

## 3 PART HOISTER

(WITH DOUBLE SHEAVE BLOCK AT BOOM HEAD)

| | PRACTICAL LOADS IN LONG TONS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | WIRE ROPE | | | BLOCK H1 | | BLOCK H2 | | BLOCK H3 | |
| HOOK LOAD (L.T.) | BREAK TEST LOAD | SAFE WORK LOAD | WINCH LINE PULL | PROOF TEST LOAD | SAFE WORK LOAD | PROOF TEST LOAD | SAFE WORK LOAD | PROOF TEST LOAD | SAFE WORK LOAD |
| 7 | 13.125 | 2.625 | 2.625 | 9-1/3 | 2-1/3 | 18-2/3 | 9-1/3 | 14 | 3-1/2 |
| 8 | 15.000 | 3.000 | 3.000 | 10-2/3 | 2-2/3 | 21-1/3 | 10-2/3 | 16 | 4 |
| 9 | 16.875 | 3.375 | 3.375 | 12 | 3 | 24 | 12 | 18 | 4-1/2 |
| 10 | 18.750 | 3.750 | 3.750 | 13-1/3 | 3-1/3 | 26-2/3 | 13-1/3 | 20 | 5 |

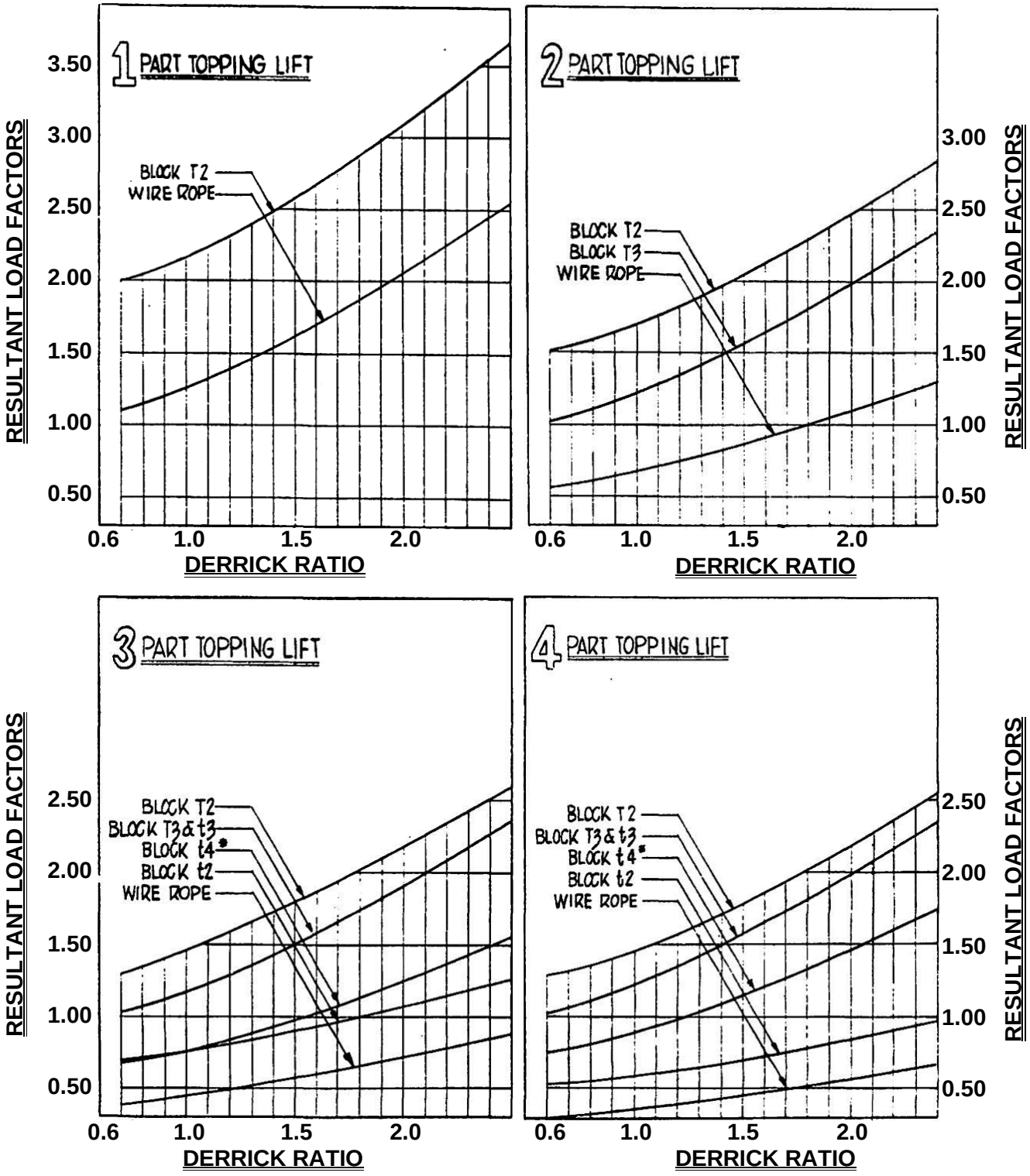
## 3 PART HOISTER

(WITH TWO SINGLE SHEAVE BLOCKS AT BOOM HEAD)

| | PRACTICAL LOADS IN LONG TONS | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | WIRE ROPE | | | BLOCK H1 | | BLOCK H2 | | BLOCK H3 | | BLOCK H4 | |
| HOOK LOAD (L.T.) | BREAK TEST LOAD | SWL | WINCH LINE PULL | PTL | SWL | PTL | SWL | PTL | SWL | PTL | SWL |
| 7 | 13.125 | 2.625 | 2.625 | 9-1/3 | 2-1/3 | 9-1/3 | 2-1/3 | 14 | 3-1/2 | 9-1/3 | 2-1/3 |
| 8 | 15.000 | 3.000 | 3.000 | 10-2/3 | 2-2/3 | 10-2/3 | 2-2/3 | 16 | 4 | 10-2/3 | 2-2/3 |
| 9 | 16.875 | 3.375 | 3.375 | 12 | 3 | 24 | 12 | 18 | 4-1/2 | 12 | 3 |
| 10 | 18.750 | 3.750 | 3.750 | 13-1/3 | 3-1/3 | 13-1/3 | 3-1/3 | 20 | 5 | 13-1/3 | 3-1/3 |

## FACTORS FOR RESULTANT LOAD ON TOPPING LIFT COMPONENTS IN A CONVENTIONAL LIGHT LIFT RIG WITH BOOM AT 15 DEGREES

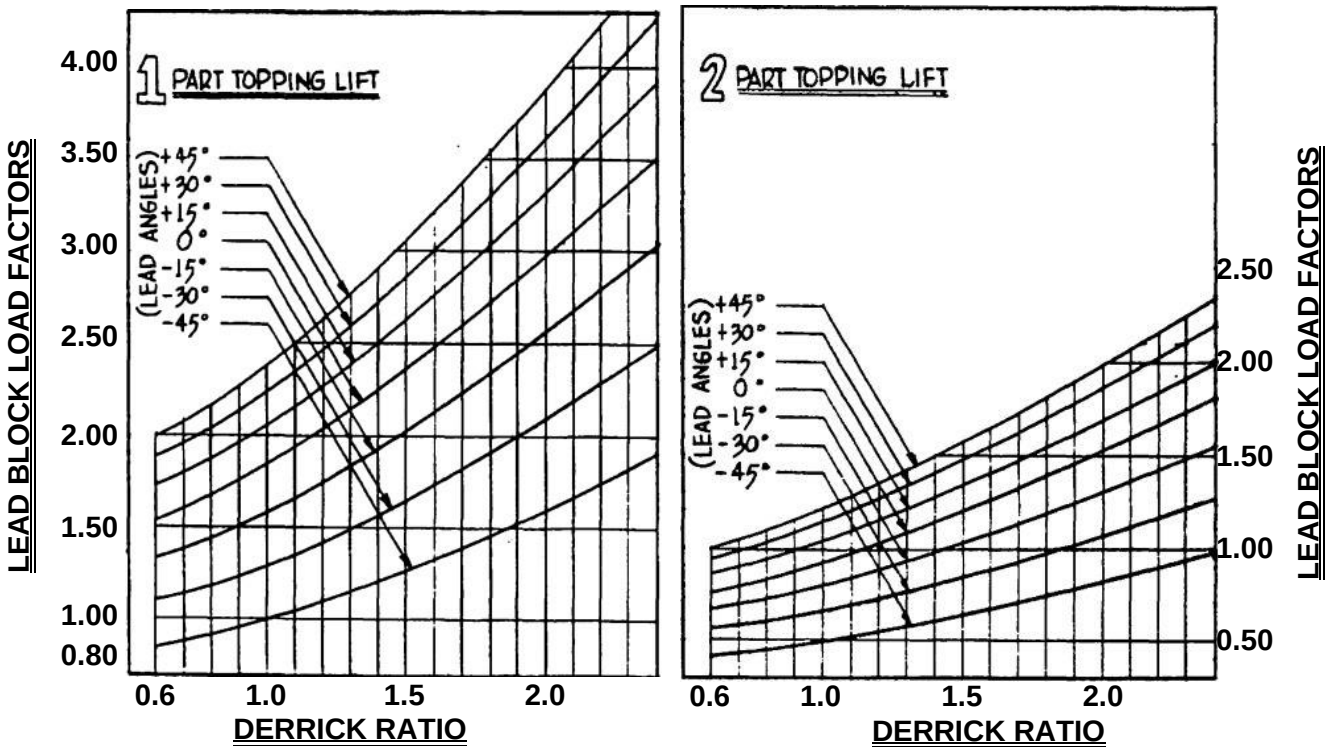
(4% FRICTION ASSUMED AT EACH SHEAVE)

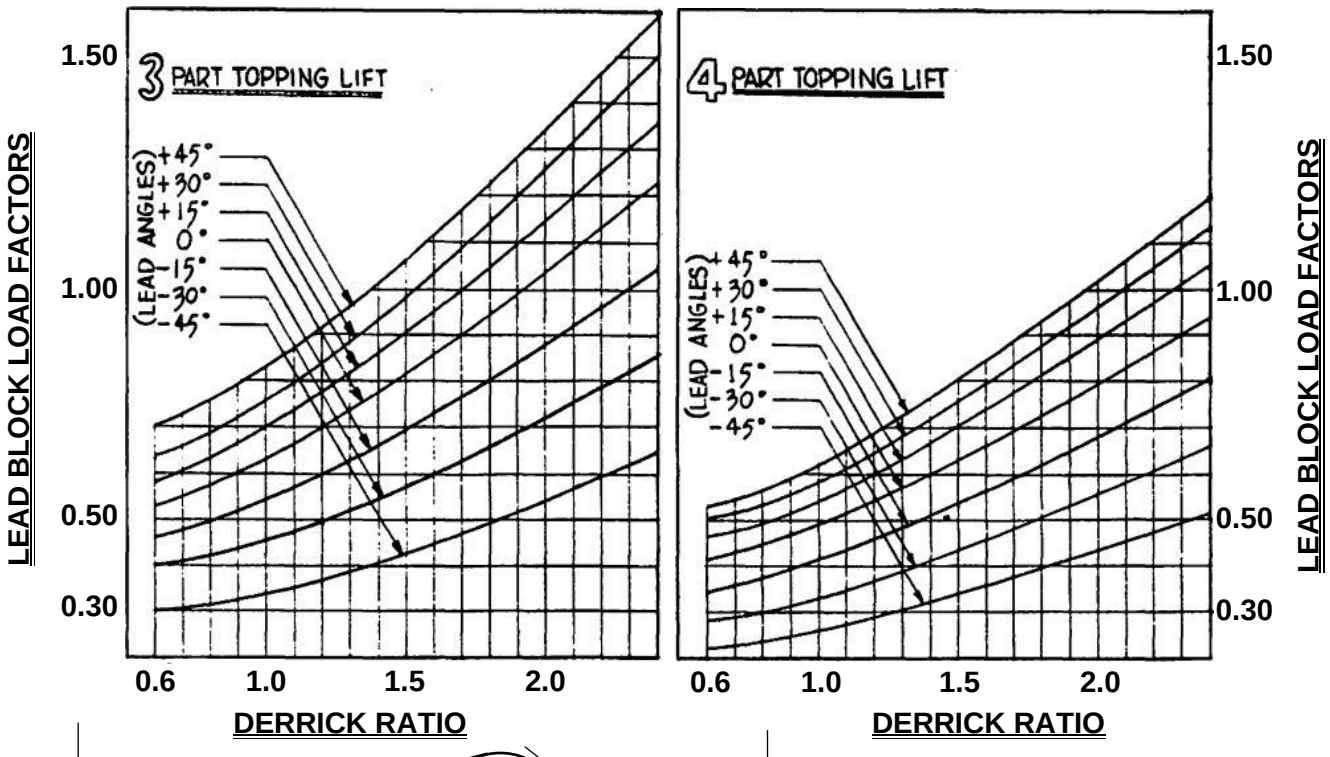


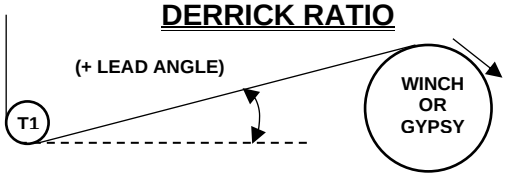

*FACTOR APPLIES WHEN RAISING BOOM. FOR MAX. VALUES WHEN LOWERING BOOM SEE PAGES A-23 & A-24

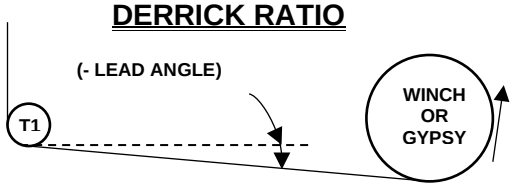
## FACTORS FOR RESULTANT LOAD ON TOPPING LIFT LEAD BLOCK AT DECK IN A CONVENTIONAL LIGHT LIFT RIG WITH BOOM AT 15 DEGREES

(4% FRICTION ASSUMED AT EACH SHEAVE)

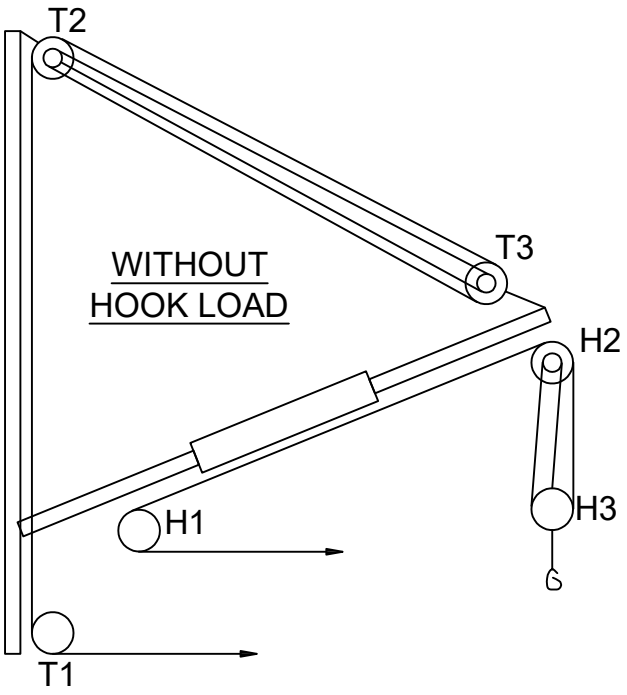


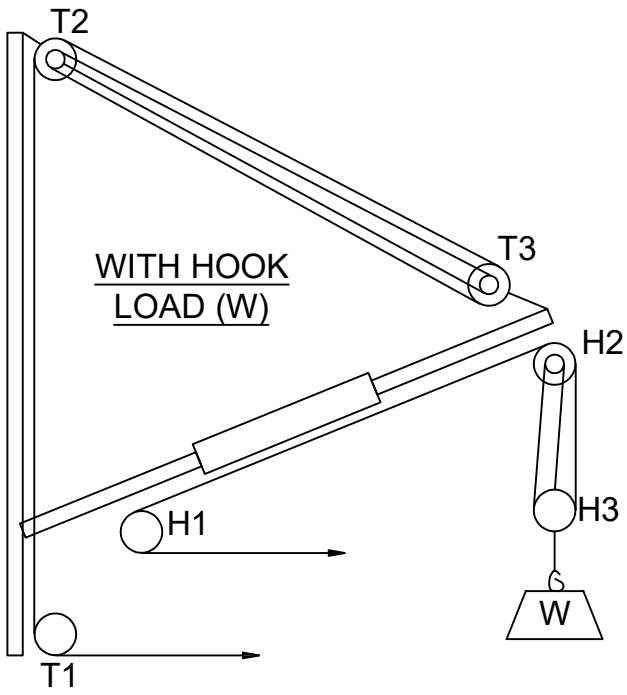



NOTE....THE "BOOM HEAD LOAD" IS THE LOAD SUPPORTED BY THE TOPPING LIFT




BOOM HEEL SUPPORTS $\frac{1}{2}$ WGHT. OF BOOM
TOPPING LIFT SUPPORTS $\frac{1}{2}$ WGHT. OF BOOM PLUS LOOSE GEAR AT BOOM HEAD (i.e. BLOCKS T3, H2, H3, SHACKLES, WIRE, HOOK)

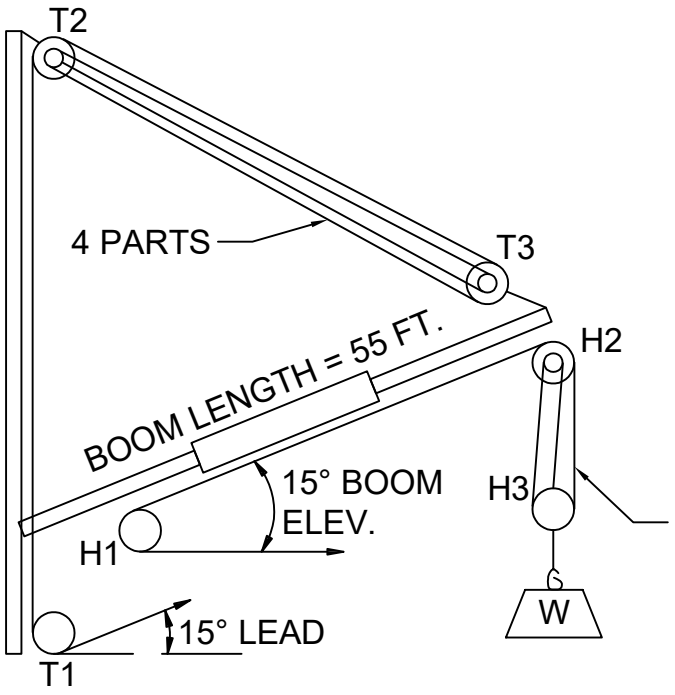



BOOM HEEL SUPPORTS $\frac{1}{2}$ WGHT. OF BOOM
TOPPING LIFT SUPPORTS $\frac{1}{2}$ WGHT. OF BOOM PLUS LOOSE GEAR AT BOOM HEAD PLUS HOOK LOAD

## TABLE OF AVERAGE BOOM HEAD LOADS FOR VARIOUS BOOM LENGTHS & CAPACITIES

| | LOOSE GEAR LOAD FACTORS IN A CONVENTIONAL LIGHT LIFT RIG | | | | | |
|---|---|---|---|---|---|---|
| | WIRE ROPE | | | BLOCK T2 | | TOPPING LIFT FORCE AT BOOM HEAD – OR SWL OF TOPPING LIFT BOOM HEAD FITTING |
| DERRICK RATIO | BREAKING TEST LOAD | SWL | WINCH LINE PULL | PROOF TEST LOAD | SWL | |
| 0.6 | 5.540 | 1.108 | 1.108 | 3.996 | 0.999 | 1.025 |
| 0.7 | 5.750 | 1.150 | 1.150 | 4.080 | 1.020 | 1.060 |
| 0.8 | 6.000 | 1.200 | 1.200 | 4.180 | 1.045 | 1.105 |
| 0.9 | 6.275 | 1.255 | 1.255 | 4.310 | 1.078 | 1.160 |
| 1.0 | 6.600 | 1.320 | 1.320 | 4.450 | 1.113 | 1.215 |
| 1.1 | 6.925 | 1.385 | 1.385 | 4.600 | 1.150 | 1.280 |
| 1.2 | 7.290 | 1.458 | 1.458 | 4.780 | 1.195 | 1.350 |
| 1.3 | 7.700 | 1.540 | 1.540 | 4.960 | 1.240 | 1.415 |
| 1.4 | 8.100 | 1.620 | 1.620 | 5.140 | 1.285 | 1.490 |
| 1.5 | 8.505 | 1.701 | 1.701 | 5.350 | 1.338 | 1.570 |
| 1.6 | 8.950 | 1.790 | 1.790 | 5.550 | 1.388 | 1.650 |
| 1.7 | 9.375 | 1.875 | 1.875 | 5.760 | 1.440 | 1.730 |
| 1.8 | 9.825 | 1.965 | 1.965 | 5.960 | 1.490 | 1.815 |
| 1.9 | 10.300 | 2.060 | 2.060 | 6.190 | 1.548 | 1.900 |
| 2.0 | 10.775 | 2.155 | 2.155 | 6.410 | 1.603 | 1.985 |
| 2.1 | 11.250 | 2.250 | 2.250 | 6.640 | 1.660 | 2.075 |
| 2.2 | 11.725 | 2.345 | 2.345 | 6.860 | 1.715 | 2.165 |
| 2.3 | 12.225 | 2.445 | 2.445 | 7.090 | 1.773 | 2.255 |
| 2.4 | 12.725 | 2.545 | 2.545 | 7.320 | 1.830 | 2.350 |

MULTIPLY VALUES IN THIS TABLE BY THE APPROPRIATE TOPPING LIFT LOAD FACTORS TO GET SAFE WORKING LOADS (SWL) AND PROOF TEST LOADS (PTL), IN POUNDS, REQD. FOR TOPPING LIFT




BOOM SAFE WORKING LOAD EQUALS
DESIGN HOOK LOAD WHICH EQUALS 10 L.T.

FOR 55 FT. BOOM WITH 10 L.T. CAPACITY
BOOM HEAD LOAD IS ABOUT 24600 LBS. (PAGE A-7)

DERRICK RATIO EQUALS
BOOM LENGTH / EFFECTIVE MAST HGHT. = $\frac{55}{50}$ =1.1

**SOLUTION FOR CARGO FALLS**

**SEE PAGE A-4**

1. REQUIRED BREAKING STRENGTH OF WIRE ROPE = 18.75 L.T. = 42000 LBS.
   (THUS, 3/4" DIA. 6x19 IPS WIRE ROPE WITH 47600 LBS. BREAK STRENGTH MAY BE USED)

2. REQUIRED CARGO WINCH LINE PULL = 3.75 L.T. = 8400 LBS.

3. BLOCK H1 PROOF TEST LOAD = 13-1/3 L.T.
   SAFE WORK LOAD = 3-1/3 L.T.

4. BLOCK H2 PROOF TEST LOAD = 26-2/3 L.T.
   SAFE WORK LOAD = 13-1/3 L.T.

5. BLOCK H3 PROOF TEST LOAD = 20 L.T.
   SAFE WORK LOAD = 5 L.T.

**SOLUTION FOR TOPPING LIFT**

1. RQD. BREAKING STRENGTH = LOAD FACTOR x BOOM HEAD LOAD
   WIRE ROPE (SEE PAGE A-15) = 1.825 x 24600 = 44900 LBS.

   (THUS, 3/4" DIA. 6x19 IPS WIRE ROPE WITH 47600 LBS. BREAK STRENGTH MAY BE USED)

2. WITH DERRICK RATIO OF 1.1 AND 15° LEAD UPWARD (SEE PAGE A-16)
   BLOCK T1 PROOF TEST LOAD = 1.140 x 24600 = 28050 LBS. OR ABOUT 12-1/2 L.T.
   SAFE WORK LOAD = 0.285 x 24600 = 7010 LBS. OR ABOUT 3-1/8 L.T.

3. WITH DERRICK RATIO OF 1.1 (SEE PAGE A-15)
   BLOCK T2 PROOF TEST LOAD = 3.010 x 24600 = 74000 LBS. OR ABOUT 33 L.T.
   SAFE WORK LOAD = 1.505 x 24600 = 37000 LBS. OR ABOUT 16-1/2 L.T.

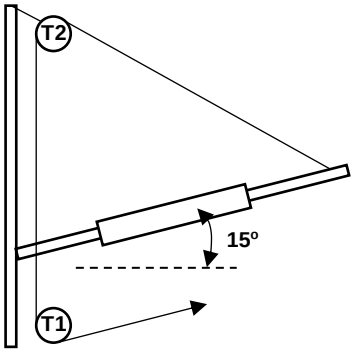
4. WITH DERRICK RATIO OF 1.1 (SEE PAGE A-15)
   BLOCK T3 PROOF TEST LOAD = 2.560 x 24600 = 63000 LBS. OR ABOUT 28 L.T.
   SAFE WORK LOAD = 1.280 x 24600 = 31500 LBS. OR ABOUT 14 L.T.

NOTES…. THE PROOF TEST LOADS FOR SHACKLES AND CHAIN LINKS ARE THE SAME VALUES AS THOSE GIVEN FOR THE PROOF TEST LOADS OF THE BLOCKS TO WHICH THEY ARE ATTACHED

## TABLE OF LOAD FACTORS FOR TOPPING LIFT COMPONENTS

## WITH 1 PART TOPPING LIFT RIG

(4% FRICTION ASSUMED AT EACH SHEAVE)




| | LOOSE GEAR LOAD FACTORS IN A CONVENTIONAL LIGHT LIFT RIG | | | | | |
|---|---|---|---|---|---|---|
| | WIRE ROPE | | | BLOCK T2 | | TOPPING LIFT FORCE AT BOOM HEAD – OR SWL OF TOPPING LIFT BOOM HEAD FITTING |
| DERRICK RATIO | BREAKING TEST LOAD | SWL | WINCH LINE PULL | PROOF TEST LOAD | SWL | |
| 0.6 | 5.540 | 1.108 | 1.108 | 3.996 | 0.999 | 1.025 |
| 0.7 | 5.750 | 1.150 | 1.150 | 4.080 | 1.020 | 1.060 |
| 0.8 | 6.000 | 1.200 | 1.200 | 4.180 | 1.045 | 1.105 |
| 0.9 | 6.275 | 1.255 | 1.255 | 4.310 | 1.078 | 1.160 |
| 1.0 | 6.600 | 1.320 | 1.320 | 4.450 | 1.113 | 1.215 |
| 1.1 | 6.925 | 1.385 | 1.385 | 4.600 | 1.150 | 1.280 |
| 1.2 | 7.290 | 1.458 | 1.458 | 4.780 | 1.195 | 1.350 |
| 1.3 | 7.700 | 1.540 | 1.540 | 4.960 | 1.240 | 1.415 |
| 1.4 | 8.100 | 1.620 | 1.620 | 5.140 | 1.285 | 1.490 |
| 1.5 | 8.505 | 1.701 | 1.701 | 5.350 | 1.338 | 1.570 |
| 1.6 | 8.950 | 1.790 | 1.790 | 5.550 | 1.388 | 1.650 |
| 1.7 | 9.375 | 1.875 | 1.875 | 5.760 | 1.440 | 1.730 |
| 1.8 | 9.825 | 1.965 | 1.965 | 5.960 | 1.490 | 1.815 |
| 1.9 | 10.300 | 2.060 | 2.060 | 6.190 | 1.548 | 1.900 |
| 2.0 | 10.775 | 2.155 | 2.155 | 6.410 | 1.603 | 1.985 |
| 2.1 | 11.250 | 2.250 | 2.250 | 6.640 | 1.660 | 2.075 |
| 2.2 | 11.725 | 2.345 | 2.345 | 6.860 | 1.715 | 2.165 |
| 2.3 | 12.225 | 2.445 | 2.445 | 7.090 | 1.773 | 2.255 |
| 2.4 | 12.725 | 2.545 | 2.545 | 7.320 | 1.830 | 2.350 |

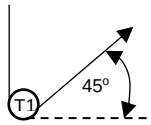
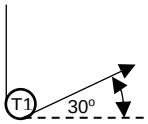
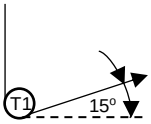
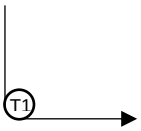
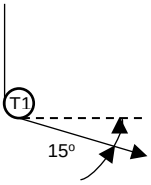
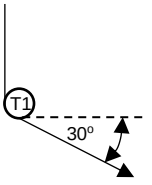
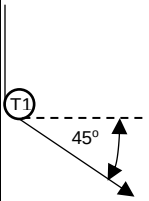
**NOTE**: LOAD FACTORS FOR “T.L. FORCE AT BOOM HEAD” MAY ALSO BE USED AS THE LOAD FACTORS FOR T.L. BULL CHAIN SWL RATINGS.

## TABLE OF LOAD FACTORS

## FOR TOPPING LIFT LEAD BLOCK (T1 OR t1) AT DECK WHEN BOOM IS TOPPED AT 15 DEGREES AND WITH VARIOUS LEAD ANGLES TO WINCH OR TO GYPSY HEAD

## WITH 1 PART TOPPING LIFT RIG

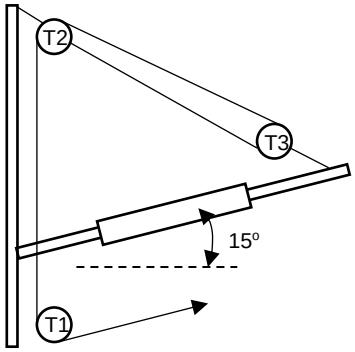
(4% FRICTION ASSUMED AT EACH SHEAVE)

| | FACTORS FOR LOADS ON TOPPING LIFT LEAD BLOCK IN A CONVENTIONAL LIGHT LIFT RIG | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| |  | |  | |  | |  | |  | |  | |  | |
| DERRICK RATIO | PTL | SWL | PTL | SWL | PTL | SWL | PTL | SWL | PTL | SWL | PTL | SWL | PTL | SWL |
| 0.6 | 4.010 | 1.003 | 3.760 | 0.940 | 3.440 | 0.860 | 3.060 | 0.765 | 2.660 | 0.665 | 2.200 | 0.550 | 1.650 | 0.415 |
| 0.7 | 4.140 | 1.035 | 3.900 | 0.975 | 3.560 | 0.890 | 3.200 | 0.800 | 2.760 | 0.690 | 2.260 | 0.565 | 1.750 | 0.438 |
| 0.8 | 4.320 | 1.080 | 4.060 | 1.015 | 3.740 | 0.935 | 3.340 | 0.835 | 2.860 | 0.715 | 2.360 | 0.590 | 1.840 | 0.460 |
| 0.9 | 4.540 | 1.135 | 4.260 | 1.065 | 3.920 | 0.980 | 3.500 | 0.875 | 3.020 | 0.755 | 2.460 | 0.615 | 1.900 | 0.470 |
| 1.0 | 4.760 | 1.190 | 4.460 | 1.115 | 4.100 | 1.025 | 3.680 | 0.920 | 3.160 | 0.790 | 2.560 | 0.640 | 2.000 | 0.500 |
| 1.1 | 5.000 | 1.250 | 4.700 | 1.175 | 4.300 | 1.075 | 3.860 | 0.965 | 3.320 | 0.830 | 2.700 | 0.675 | 2.100 | 0.525 |
| 1.2 | 5.280 | 1.320 | 4.920 | 1.230 | 4.500 | 1.125 | 4.060 | 1.015 | 3.500 | 0.875 | 2.860 | 0.715 | 2.200 | 5.550 |
| 1.3 | 5.520 | 1.380 | 5.160 | 1.290 | 4.760 | 1.190 | 4.300 | 1.075 | 3.660 | 0.915 | 2.980 | 0.745 | 2.300 | 0.575 |
| 1.4 | 5.800 | 1.450 | 5.440 | 1.360 | 5.000 | 1.250 | 4.500 | 1.125 | 3.840 | 0.960 | 3.140 | 0.785 | 2.420 | 0.605 |
| 1.5 | 6.160 | 1.540 | 5.740 | 1.435 | 5.240 | 1.310 | 4.720 | 1.180 | 4.040 | 1.010 | 3.300 | 0.825 | 2.540 | 0.635 |
| 1.6 | 6.440 | 1.610 | 6.000 | 1.500 | 5.540 | 1.385 | 4.960 | 1.240 | 4.260 | 1.065 | 3.460 | 0.865 | 2.640 | 0.660 |
| 1.7 | 6.740 | 1.685 | 6.300 | 1.575 | 5.800 | 1.450 | 5.200 | 1.300 | 4.460 | 1.115 | 3.640 | 0.910 | 2.760 | 0.690 |
| 1.8 | 7.110 | 1.778 | 6.600 | 1.650 | 6.100 | 1.525 | 5.460 | 1.365 | 4.660 | 1.165 | 3.800 | 0.950 | 2.900 | 0.725 |
| 1.9 | 7.420 | 1.855 | 6.900 | 1.725 | 6.350 | 1.588 | 5.700 | 1.425 | 4.900 | 1.225 | 4.000 | 1.000 | 3.040 | 0.760 |
| 2.0 | 7.760 | 1.940 | 7.240 | 1.810 | 6.640 | 1.660 | 5.950 | 1.488 | 5.140 | 1.285 | 4.200 | 1.050 | 3.200 | 0.800 |
| 2.1 | 8.140 | 2.035 | 7.540 | 1.885 | 6.920 | 1.730 | 6.220 | 1.555 | 5.360 | 1.340 | 4.400 | 1.100 | 3.320 | 0.830 |
| 2.2 | 8.440 | 2.110 | 7.840 | 1.960 | 7.220 | 1.805 | 6.480 | 1.620 | 5.580 | 1.395 | 4.580 | 1.145 | 3.480 | 0.870 |
| 2.3 | 8.800 | 2.200 | 8.180 | 2.045 | 7.500 | 1.875 | 6.740 | 1.685 | 5.820 | 1.455 | 4.760 | 1.190 | 3.620 | 0.905 |
| 2.4 | 9.200 | 2.300 | 8.600 | 2.150 | 7.860 | 1.965 | 7.000 | 1.750 | 6.100 | 1.525 | 5.000 | 1.250 | 3.800 | 0.950 |

## TABLE OF LOAD FACTORS FOR TOPPING LIFT COMPONENTS

## WITH 2 PART TOPPING LIFT RIG

(4% FRICTION ASSUMED AT EACH SHEAVE)



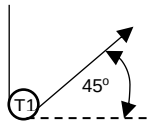
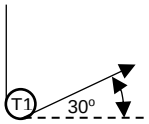
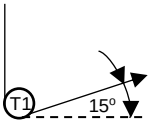
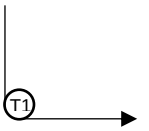
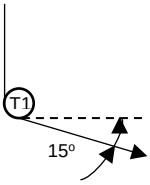
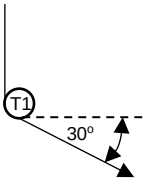
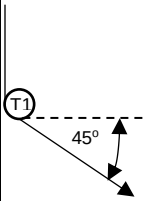

| | LOOSE GEAR LOAD FACTORS IN A CONVENTIONAL LIGHT LIFT RIG | | | | | | |
|---|---|---|---|---|---|---|---|
| | WIRE ROPE | | | BLOCK T2 | | BLOCK T3 | |
| DERRICK RATIO | BREAKING TEST LOAD | SWL | WINCH LINE PULL | PROOF TEST LOAD | SWL | PROOF TEST LOAD | SWL |
| 0.6 | 2.820 | 0.564 | 0.564 | 3.006 | 0.752 | 2.050 | 0.513 |
| 0.7 | 2.925 | 0.585 | 0.585 | 3.080 | 0.770 | 2.120 | 0.530 |
| 0.8 | 3.050 | 0.610 | 0.610 | 3.170 | 0.793 | 2.210 | 0.553 |
| 0.9 | 3.195 | 0.639 | 0.639 | 3.266 | 0.817 | 2.320 | 0.580 |
| 1.0 | 3.350 | 0.670 | 0.670 | 3.380 | 0.845 | 2.430 | 0.608 |
| 1.1 | 3.525 | 0.705 | 0.705 | 3.500 | 0.875 | 2.560 | 0.640 |
| 1.2 | 3.713 | 0.743 | 0.743 | 3.640 | 0.910 | 2.700 | 0.675 |
| 1.3 | 3.900 | 0.780 | 0.780 | 3.780 | 0.945 | 2.830 | 0.708 |
| 1.4 | 4.100 | 0.820 | 0.820 | 3.940 | 0.985 | 2.980 | 0.745 |
| 1.5 | 4.330 | 0.866 | 0.866 | 4.090 | 1.023 | 3.140 | 0.785 |
| 1.6 | 4.525 | 0.905 | 0.905 | 4.250 | 1.063 | 3.300 | 0.825 |
| 1.7 | 4.750 | 0.950 | 0.950 | 4.420 | 1.105 | 3.460 | 0.865 |
| 1.8 | 5.000 | 1.000 | 1.000 | 4.590 | 1.148 | 3.630 | 0.908 |
| 1.9 | 5.225 | 1.045 | 1.045 | 4.760 | 1.190 | 3.800 | 0.950 |
| 2.0 | 5.450 | 1.090 | 1.090 | 4.930 | 1.233 | 3.970 | 0.993 |
| 2.1 | 5.725 | 1.145 | 1.145 | 5.120 | 1.280 | 4.150 | 1.038 |
| 2.2 | 5.975 | 1.195 | 1.195 | 5.290 | 1.325 | 4.330 | 1.083 |
| 2.3 | 6.225 | 1.245 | 1.245 | 5.480 | 1.370 | 4.510 | 1.128 |
| 2.4 | 6.475 | 1.295 | 1.295 | 5.660 | 1.415 | 4.700 | 1.175 |

## TABLE OF LOAD FACTORS

## FOR TOPPING LIFT LEAD BLOCK (T1 OR t1) AT DECK WHEN BOOM IS TOPPED AT 15 DEGREES AND WITH VARIOUS LEAD ANGLES TO WINCH OR TO GYPSY HEAD

## WITH 2 PART TOPPING LIFT RIG

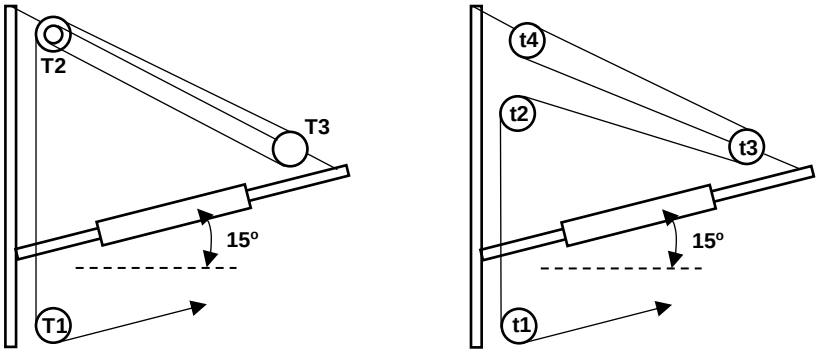
(4% FRICTION ASSUMED AT EACH SHEAVE)

| | FACTORS FOR LOADS ON TOPPING LIFT LEAD BLOCK IN A CONVENTIONAL LIGHT LIFT RIG | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| |  | |  | |  | |  | |  | |  | |  | |
| DERRICK RATIO | PTL | SWL | PTL | SWL | PTL | SWL | PTL | SWL | PTL | SWL | PTL | SWL | PTL | SWL |
| 0.6 | 2.040 | 0.510 | 1.880 | 0.470 | 1.700 | 0.425 | 1.500 | 0.375 | 1.320 | 0.330 | 1.100 | 0.275 | 0.800 | 0.200 |
| 0.7 | 2.100 | 0.530 | 1.980 | 0.495 | 1.800 | 0.450 | 1.560 | 0.390 | 1.400 | 0.350 | 1.150 | 0.288 | 0.850 | 0.213 |
| 0.8 | 2.200 | 0.550 | 2.060 | 0.515 | 1.880 | 0.470 | 1.660 | 0.415 | 1.440 | 0.360 | 1.200 | 0.300 | 0.900 | 0.225 |
| 0.9 | 2.312 | 0.578 | 2.160 | 0.540 | 2.000 | 0.500 | 1.740 | 0.435 | 1.520 | 0.380 | 1.240 | 0.310 | 0.940 | 0.235 |
| 1.0 | 2.420 | 0.605 | 2.280 | 0.570 | 2.080 | 0.520 | 1.820 | 0.455 | 1.600 | 0.400 | 1.320 | 0.330 | 0.980 | 0.245 |
| 1.1 | 2.540 | 0.635 | 2.400 | 0.600 | 2.180 | 0.545 | 1.960 | 0.490 | 1.660 | 0.415 | 1.400 | 0.350 | 1.040 | 0.260 |
| 1.2 | 2.686 | 0.672 | 2.500 | 0.625 | 2.260 | 0.565 | 2.000 | 0.500 | 1.760 | 0.440 | 1.440 | 0.360 | 1.060 | 0.265 |
| 1.3 | 2.840 | 0.710 | 2.660 | 0.665 | 2.400 | 0.600 | 2.160 | 0.540 | 1.850 | 0.463 | 1.520 | 0.380 | 1.140 | 0.285 |
| 1.4 | 3.000 | 0.750 | 2.800 | 0.700 | 2.540 | 0.635 | 2.280 | 0.570 | 1.980 | 0.495 | 1.600 | 0.400 | 1.200 | 0.300 |
| 1.5 | 3.136 | 0.784 | 2.960 | 0.740 | 2.680 | 0.670 | 2.400 | 0.600 | 2.040 | 0.510 | 1.680 | 0.420 | 1.260 | 0.315 |
| 1.6 | 3.300 | 0.825 | 3.100 | 0.775 | 2.800 | 0.700 | 2.500 | 0.625 | 2.140 | 0.535 | 1.750 | 0.438 | 1.340 | 0.335 |
| 1.7 | 3.450 | 0.863 | 3.240 | 0.810 | 2.940 | 0.735 | 2.640 | 0.660 | 2.260 | 0.565 | 1.840 | 0.460 | 1.400 | 0.350 |
| 1.8 | 3.620 | 0.905 | 3.400 | 0.850 | 3.100 | 0.775 | 2.800 | 0.700 | 2.380 | 0.595 | 1.960 | 0.490 | 1.500 | 0.375 |
| 1.9 | 3.800 | 0.950 | 3.550 | 0.858 | 3.220 | 0.805 | 2.900 | 0.725 | 2.500 | 0.625 | 2.040 | 0.510 | 1.550 | 0.388 |
| 2.0 | 3.960 | 0.990 | 3.720 | 0.930 | 3.400 | 0.850 | 3.050 | 0.763 | 2.600 | 0.650 | 2.120 | 0.530 | 1.620 | 0.405 |
| 2.1 | 4.140 | 1.035 | 3.880 | 0.970 | 3.520 | 0.880 | 3.180 | 0.795 | 2.720 | 0.680 | 2.220 | 0.555 | 1.700 | 0.425 |
| 2.2 | 4.320 | 1.080 | 4.040 | 1.010 | 3.680 | 0.920 | 3.320 | 0.830 | 2.840 | 0.710 | 2.320 | 0.580 | 1.800 | 0.450 |
| 2.3 | 4.480 | 1.120 | 4.220 | 1.055 | 3.820 | 0.955 | 3.460 | 0.865 | 2.980 | 0.745 | 2.400 | 0.600 | 1.860 | 0.465 |
| 2.4 | 4.680 | 1.170 | 4.400 | 1.100 | 4.000 | 1.000 | 3.600 | 0.900 | 3.060 | 0.765 | 2.500 | 0.625 | 1.900 | 0.475 |

## TABLE OF LOAD FACTORS FOR TOPPING LIFT COMPONENTS

## WITH 3 PART TOPPING LIFT RIG

(4% FRICTION ASSUMED AT EACH SHEAVE)



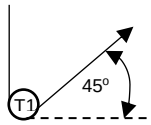
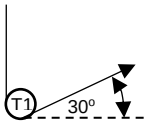
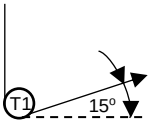
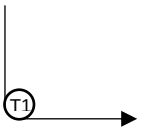
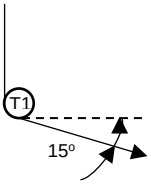
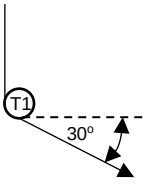
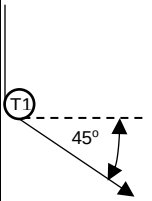

| | LOOSE GEAR LOAD FACTORS IN A CONVENTIONAL LIGHT LIFT RIG | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | WIRE ROPE | | | BLOCK T2 | | BLOCK T3 & t3 | | BLOCK t2 | | BLOCK t4* | |
| DERRICK RATIO | BREAKING TEST LOAD | SWL | WINCH LINE PULL | PTL | SWL | PTL | SWL | PTL | SWL | PTL | SWL |
| 0.6 | 1.920 | 0.384 | 0.384 | 2.690 | 1.345 | 2.050 | 0.513 | 1.384 | 0.346 | 1.338 | 0.335 |
| 0.7 | 2.000 | 0.400 | 0.400 | 2.760 | 1.380 | 2.120 | 0.530 | 1.420 | 0.355 | 1.390 | 0.348 |
| 0.8 | 2.100 | 0.420 | 0.420 | 2.840 | 1.420 | 2.210 | 0.553 | 1.450 | 0.363 | 1.450 | 0.363 |
| 0.9 | 2.175 | 0.435 | 0.435 | 2.940 | 1.470 | 2.320 | 0.580 | 1.493 | 0.373 | 1.516 | 0.379 |
| 1.0 | 2.300 | 0.460 | 0.460 | 3.050 | 1.525 | 2.430 | 0.608 | 1.550 | 0.388 | 1.600 | 0.400 |
| 1.1 | 2.425 | 0.485 | 0.485 | 3.180 | 1.590 | 2.560 | 0.640 | 1.600 | 0.400 | 1.680 | 0.420 |
| 1.2 | 2.525 | 0.505 | 0.505 | 3.300 | 1.650 | 2.700 | 0.675 | 1.655 | 0.414 | 1.762 | 0.441 |
| 1.3 | 2.675 | 0.535 | 0.535 | 3.450 | 1.725 | 2.830 | 0.708 | 1.720 | 0.430 | 1.860 | 0.465 |
| 1.4 | 2.800 | 0.560 | 0.560 | 3.580 | 1.790 | 2.980 | 0.745 | 1.780 | 0.445 | 1.960 | 0.490 |
| 1.5 | 2.945 | 0.589 | 0.589 | 3.734 | 1.867 | 3.140 | 0.785 | 1.852 | 0.463 | 2.058 | 0.515 |
| 1.6 | 3.075 | 0.615 | 0.615 | 3.900 | 1.950 | 3.300 | 0.825 | 1.920 | 0.480 | 2.160 | 0.540 |
| 1.7 | 3.225 | 0.645 | 0.645 | 4.050 | 2.025 | 3.460 | 0.865 | 1.990 | 0.498 | 2.280 | 0.570 |
| 1.8 | 3.405 | 0.681 | 0.681 | 4.210 | 2.105 | 3.630 | 0.908 | 2.067 | 0.517 | 2.378 | 0.595 |
| 1.9 | 3.550 | 0.710 | 0.710 | 4.380 | 2.190 | 3.800 | 0.950 | 2.130 | 0.533 | 2.490 | 0.623 |
| 2.0 | 3.725 | 0.745 | 0.745 | 4.540 | 2.270 | 3.970 | 0.993 | 2.210 | 0.553 | 2.610 | 0.653 |
| 2.1 | 3.895 | 0.779 | 0.779 | 4.720 | 2.60 | 4.150 | 1.038 | 2.294 | 0.574 | 2.716 | 0.679 |
| 2.2 | 4.050 | 0.810 | 0.810 | 4.900 | 2.450 | 4.330 | 1.083 | 2.360 | 0.590 | 2.840 | 0.710 |
| 2.3 | 4.225 | 0.845 | 0.845 | 5.080 | 2.540 | 4.510 | 1.128 | 2.450 | 0.613 | 2.960 | 0.740 |
| 2.4 | 4.400 | 0.880 | 0.880 | 5.250 | 2.625 | 4.700 | 1.175 | 2.532 | 0.633 | 3.075 | 0.769 |

## TABLE OF LOAD FACTORS

## FOR TOPPING LIFT LEAD BLOCK (T1 OR t1) AT DECK WHEN BOOM IS TOPPED AT 15 DEGREES AND WITH VARIOUS LEAD ANGLES TO WINCH OR TO GYPSY HEAD

## WITH 3 PART TOPPING LIFT RIG

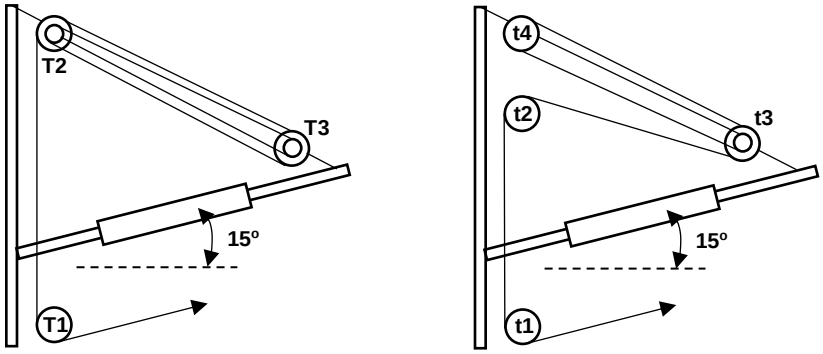
(4% FRICTION ASSUMED AT EACH SHEAVE)

| | FACTORS FOR LOADS ON TOPPING LIFT LEAD BLOCK IN A CONVENTIONAL LIGHT LIFT RIG | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| |  | |  | |  | |  | |  | |  | |  | |
| DERRICK RATIO | PTL | SWL | PTL | SWL | PTL | SWL | PTL | SWL | PTL | SWL | PTL | SWL | PTL | SWL |
| 0.6 | 1.390 | 0.348 | 1.260 | 0.315 | 1.160 | 0.290 | 1.000 | 0.250 | 0.920 | 0.230 | 0.800 | 0.200 | 0.600 | 0.150 |
| 0.7 | 1.450 | 0.363 | 1.320 | 0.330 | 1.210 | 0.303 | 1.090 | 0.273 | 0.960 | 0.240 | 0.820 | 0.205 | 0.610 | 0.153 |
| 0.8 | 1.510 | 0.378 | 1.370 | 0.343 | 1.260 | 0.315 | 1.140 | 0.285 | 0.990 | 0.248 | 0.840 | 0.210 | 0.630 | 0.158 |
| 0.9 | 1.574 | 0.394 | 1.440 | 0.360 | 1.330 | 0.333 | 1.200 | 0.300 | 1.040 | 0.260 | 0.870 | 0.218 | 0.650 | 0.163 |
| 1.0 | 1.650 | 0.413 | 1.510 | 0.378 | 1.400 | 0.350 | 1.260 | 0.315 | 1.080 | 0.270 | 0.900 | 0.225 | 0.680 | 0.170 |
| 1.1 | 1.730 | 0.433 | 1.590 | 0.398 | 1.470 | 0.368 | 1.320 | 0.330 | 1.140 | 0.285 | 0.940 | 0.235 | 0.700 | 0.175 |
| 1.2 | 1.828 | 0.457 | 1.660 | 0.415 | 1.560 | 0.390 | 1.400 | 0.350 | 1.200 | 0.300 | 0.980 | 0.245 | 0.720 | 0.180 |
| 1.3 | 1.920 | 0.480 | 1.760 | 0.440 | 1.630 | 0.408 | 1.480 | 0.370 | 1.250 | 0.313 | 1.040 | 0.260 | 0.770 | 0.193 |
| 1.4 | 2.020 | 0.505 | 1.860 | 0.465 | 1.720 | 0.430 | 1.550 | 0.388 | 1.320 | 0.330 | 1.090 | 0.273 | 0.810 | 0.203 |
| 1.5 | 2.130 | 0.533 | 1.960 | 0.490 | 1.800 | 0.450 | 1.630 | 0.408 | 1.380 | 0.345 | 1.140 | 0.285 | 0.850 | 0.213 |
| 1.6 | 2.220 | 0.555 | 2.060 | 0.515 | 1.900 | 0.475 | 1.710 | 0.428 | 1.460 | 0.365 | 1.200 | 0.300 | 0.890 | 0.223 |
| 1.7 | 2.330 | 0.583 | 2.170 | 0.543 | 2.000 | 0.500 | 1.800 | 0.450 | 1.530 | 0.383 | 1.250 | 0.313 | 0.930 | 0.233 |
| 1.8 | 2.464 | 0.616 | 2.300 | 0.575 | 2.100 | 0.525 | 1.860 | 0.465 | 1.600 | 0.400 | 1.320 | 0.330 | 1.000 | 0.250 |
| 1.9 | 2.564 | 0.641 | 2.400 | 0.600 | 2.190 | 0.548 | 1.980 | 0.495 | 1.680 | 0.420 | 1.370 | 0.343 | 1.030 | 0.258 |
| 2.0 | 2.680 | 0.670 | 2.510 | 0.628 | 2.290 | 0.573 | 2.060 | 0.515 | 1.760 | 0.440 | 1.440 | 0.360 | 1.080 | 0.270 |
| 2.1 | 2.820 | 0.705 | 2.620 | 0.655 | 2.390 | 0.598 | 2.160 | 0.540 | 1.840 | 0.460 | 1.500 | 0.375 | 1.130 | 0.283 |
| 2.2 | 2.920 | 0.730 | 2.750 | 0.688 | 2.500 | 0.625 | 2.260 | 0.565 | 1.920 | 0.480 | 1.570 | 0.393 | 1.180 | 0.295 |
| 2.3 | 3.040 | 0.760 | 2.870 | 0.718 | 2.600 | 0.650 | 2.360 | 0.590 | 2.000 | 0.500 | 1.640 | 0.410 | 1.240 | 0.310 |
| 2.4 | 3.186 | 0.797 | 3.000 | 0.750 | 2.720 | 0.680 | 2.460 | 0.615 | 2.100 | 0.525 | 1.720 | 0.430 | 1.300 | 0.325 |

## TABLE OF LOAD FACTORS FOR TOPPING LIFT COMPONENTS

## WITH 4 PART TOPPING LIFT RIG

(4% FRICTION ASSUMED AT EACH SHEAVE)



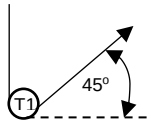
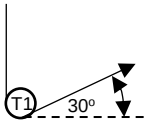
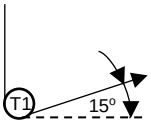
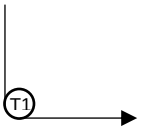
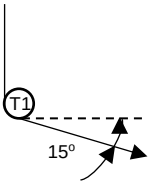
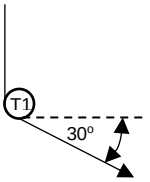
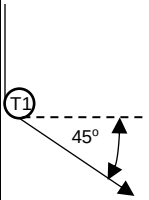

| | LOOSE GEAR LOAD FACTORS IN A CONVENTIONAL LIGHT LIFT RIG | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | WIRE ROPE | | | BLOCK T2 | | BLOCK T3 & t3 | | BLOCK t2 | | BLOCK t4* | |
| DERRICK RATIO | BREAKING TEST LOAD | SWL | WINCH LINE PULL | PTL | SWL | PTL | SWL | PTL | SWL | PTL | SWL |
| 0.6 | 1.450 | 0.290 | 0.290 | 2.560 | 1.280 | 2.050 | 1.025 | 1.060 | 0.265 | 1.500 | 0.375 |
| 0.7 | 1.525 | 0.305 | 0.305 | 2.610 | 1.305 | 2.120 | 1.060 | 1.080 | 0.270 | 1.560 | 0.390 |
| 0.8 | 1.575 | 0.315 | 0.315 | 2.690 | 1.345 | 2.210 | 1.105 | 1.110 | 0.278 | 1.620 | 0.405 |
| 0.9 | 1.650 | 0.330 | 0.330 | 2.780 | 1.390 | 2.320 | 1.160 | 1.140 | 0.285 | 1.700 | 0.425 |
| 1.0 | 1.750 | 0.350 | 0.350 | 2.880 | 1.440 | 2.430 | 1.215 | 1.180 | 0.295 | 1.790 | 0.448 |
| 1.1 | 1.825 | 0.365 | 0.365 | 3.010 | 1.505 | 2.560 | 1.280 | 1.220 | 0.305 | 1.890 | 0.473 |
| 1.2 | 1.925 | 0.385 | 0.385 | 3.140 | 1.570 | 2.700 | 1.350 | 1.260 | 0.315 | 1.980 | 0.495 |
| 1.3 | 2.025 | 0.405 | 0.405 | 3.270 | 1.635 | 2.830 | 1.415 | 1.310 | 0.328 | 2.080 | 0.520 |
| 1.4 | 2.125 | 0.425 | 0.425 | 3.410 | 1.705 | 2.980 | 1.490 | 1.360 | 0.340 | 2.200 | 0.550 |
| 1.5 | 2.225 | 0.445 | 0.445 | 3.560 | 1.780 | 3.140 | 1.570 | 1.410 | 0.353 | 2.320 | 0.580 |
| 1.6 | 2.350 | 0.470 | 0.470 | 3.720 | 1.860 | 3.300 | 1.650 | 1.460 | 0.365 | 2.430 | 0.608 |
| 1.7 | 2.450 | 0.490 | 0.490 | 3.880 | 1.940 | 3.460 | 1.730 | 1.520 | 0.380 | 2.550 | 0.638 |
| 1.8 | 2.575 | 0.515 | 0.515 | 4.040 | 2.020 | 3.630 | 1.815 | 1.570 | 0.393 | 2.680 | 0.670 |
| 1.9 | 2.700 | 0.540 | 0.540 | 4.200 | 2.100 | 3.800 | 1.900 | 1.620 | 0.405 | 2.800 | 0.700 |
| 2.0 | 2.825 | 0.565 | 0.565 | 4.380 | 2.190 | 3.970 | 1.985 | 1.690 | 0.423 | 2.920 | 0.730 |
| 2.1 | 2.950 | 0.590 | 0.590 | 4.540 | 2.270 | 4.150 | 2.075 | 1.750 | 0.48 | 3.050 | 0.763 |
| 2.2 | 3.075 | 0.615 | 0.615 | 4.720 | 2.360 | 4.330 | 2.165 | 1.810 | 0.453 | 3.180 | 0.795 |
| 2.3 | 3.225 | 0.645 | 0.645 | 4.890 | 2.445 | 4.510 | 2.255 | 1.880 | 0.470 | 3.320 | 0.830 |
| 2.4 | 3.350 | 0.670 | 0.670 | 5.080 | 2.540 | 4.700 | 2.350 | 1.940 | 0.485 | 3.460 | 0.865 |

## TABLE OF LOAD FACTORS

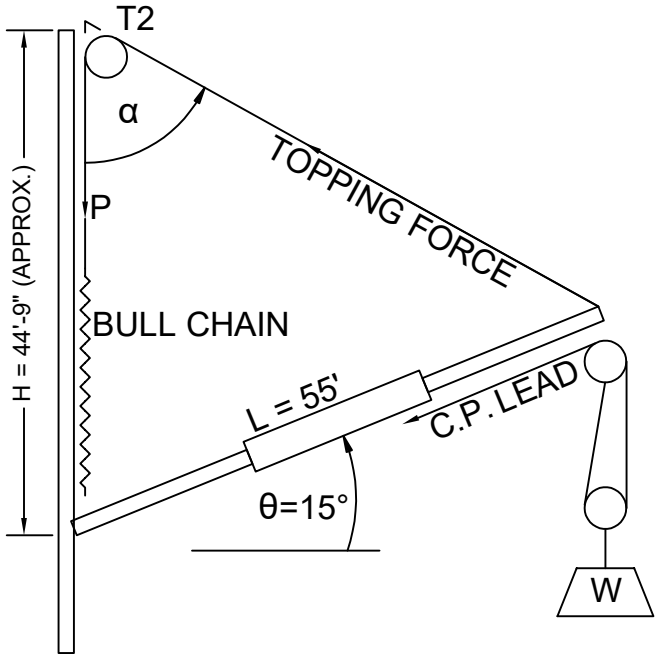
## FOR TOPPING LIFT LEAD BLOCK (T1 OR t1) AT DECK WHEN BOOM IS TOPPED AT 15 DEGREES AND WITH VARIOUS LEAD ANGLES TO WINCH OR TO GYPSY HEAD

## WITH 4 PART TOPPING LIFT RIG

(4% FRICTION ASSUMED AT EACH SHEAVE)

| | FACTORS FOR LOADS ON TOPPING LIFT LEAD BLOCK IN A CONVENTIONAL LIGHT LIFT RIG | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| |  | |  | |  | |  | |  | |  | |  | |
| DERRICK RATIO | PTL | SWL | PTL | SWL | PTL | SWL | PTL | SWL | PTL | SWL | PTL | SWL | PTL | SWL |
| 0.6 | 1.050 | 0.263 | 1.000 | 0.250 | 0.920 | 0.230 | 0.820 | 0.205 | 0.680 | 0.170 | 0.560 | 0.140 | 0.440 | 0.110 |
| 0.7 | 1.080 | 0.270 | 1.020 | 0.255 | 0.940 | 0.235 | 0.850 | 0.213 | 0.720 | 0.180 | 0.600 | 0.150 | 0.460 | 0.115 |
| 0.8 | 1.130 | 0.283 | 1.040 | 0.260 | 0.990 | 0.248 | 0.900 | 0.225 | 0.750 | 0.188 | 0.620 | 0.155 | 0.480 | 0.120 |
| 0.9 | 1.160 | 0.290 | 1.120 | 0.280 | 1.040 | 0.260 | 0.940 | 0.235 | 0.800 | 0.200 | 0.640 | 0.160 | 0.500 | 0.25 |
| 1.0 | 1.240 | 0.310 | 1.160 | 0.290 | 1.080 | 0.270 | 0.980 | 0.245 | 0.840 | 0.210 | 0.660 | 0.165 | 0.520 | 0.130 |
| 1.1 | 1.300 | 0.325 | 1.230 | 0.308 | 1.140 | 0.285 | 1.040 | 0.260 | 0.860 | 0.215 | 0.720 | 0.180 | 0.550 | 0.138 |
| 1.2 | 1.360 | 0.340 | 1.290 | 0.323 | 1.200 | 0.300 | 1.090 | 0.273 | 0.930 | 0.233 | 0.750 | 0.188 | 0.570 | 0.143 |
| 1.3 | 1.440 | 0.360 | 1.350 | 0.338 | 1.260 | 0.315 | 1.140 | 0.285 | 0.960 | 0.240 | 0.790 | 0.198 | 0.610 | 0.153 |
| 1.4 | 1.530 | 0.383 | 1.440 | 0.360 | 1.340 | 0.335 | 1.200 | 0.300 | 1.020 | 0.255 | 0.840 | 0.210 | 0.640 | 0.160 |
| 1.5 | 1.600 | 0.400 | 1.510 | 0.378 | 1.400 | 0.350 | 1.260 | 0.315 | 1.060 | 0.265 | 0.870 | 0.218 | 0.680 | 0.170 |
| 1.6 | 1.680 | 1.420 | 1.580 | 0.395 | 1.460 | 0.365 | 1.330 | 0.333 | 1.120 | 0.280 | 0.910 | 0.230 | 0.720 | 0.180 |
| 1.7 | 1.760 | 0.440 | 1.660 | 0.415 | 1.550 | 0.388 | 1.400 | 0.350 | 1.170 | 0.293 | 0.960 | 0.240 | 0.750 | 0.188 |
| 1.8 | 1.860 | 0.465 | 1.750 | 0.438 | 1.630 | 0.408 | 1.460 | 0.365 | 1.240 | 0.310 | 1.010 | 0.253 | 0.790 | 0.198 |
| 1.9 | 1.950 | 0.488 | 1.840 | 0.460 | 1.700 | 0.425 | 1.520 | 0.380 | 1.300 | 0.325 | 1.050 | 0.263 | 0.820 | 0.205 |
| 2.0 | 2.040 | 0.510 | 1.930 | 0.483 | 1.790 | 0.448 | 1.600 | 0.400 | 1.360 | 0.340 | 1.100 | 0.275 | 0.860 | 0.215 |
| 2.1 | 2.130 | 0.533 | 2.000 | 0.500 | 1.830 | 0.465 | 1.660 | 0.415 | 1.430 | 0.358 | 1.160 | 0.290 | 0.900 | 0.225 |
| 2.2 | 2.220 | 0.555 | 2.080 | 0.520 | 1.940 | 0.485 | 1.740 | 0.435 | 1.500 | 0.375 | 1.220 | 0.305 | 0.940 | 0.235 |
| 2.3 | 2.320 | 0.580 | 2.160 | 0.540 | 2.040 | 0.510 | 1.820 | 0.455 | 1.560 | 0.390 | 1.260 | 0.315 | 0.990 | 0.248 |
| 2.4 | 2.400 | 0.600 | 2.260 | 0.565 | 2.100 | 0.525 | 1.880 | 0.470 | 1.620 | 0.405 | 1.320 | 0.330 | 1.020 | 0.255 |

# FORCE ANALYSIS USING THE ICGB GRAPHS ~ WORKED EXAMPLE




NOTE: FOR TOPPING LIFT LOADS AT MAST REFER TO PAGE A-20

FOR TOPPING LIFT COMPONENTS, BOOM COMPRESSION & TOPPING LIFT LOADS AT MAST

GIVEN CONDITIONS:

SWINGING BOOM = 5 L.T. SWL
COPLANAR DERRICK
NO LIST OR TRIM
2-PART CARGO PURCHASE
1-PART TOPPING LIFT
55 FT. EFFECTIVE MAST LENGTH
44'-9" EFFECTIVE MAST HEIGHT
5 L.T. (11200 LBS.) HOOK LOAD, W
15° BOOM ANGLE, θ

FACTORS FROM ICGB GRAPHS & TABLES

1) BOOM HEAD LOAD = 13000 LBS. .....(RE: PAGE A-7)
2) DERRICK RATIO = 55/44.75 = 1.23
3) RE: PAGE A-18 BELOW (OR PAGE A-19) .....AT 1.23 DERR. RATIO & 15° BOOM ANGLE, θ:
   TOPPING FORCE FACTOR = 1.37
   & TOPPING ANGLE, α = 60°
4) RE: PAGE A-18 BELOW (OR PAGE A-21) .....AT 1.37 TOPP. FORCE FACTOR & 60° TOPP. ANGLE, α:
   BLOCK T2 SWL FACTOR = 1.21
   & WIRE ROPE LOAD FACTOR = 1.42
5) C.P. LEAD = 0.530 x 11200 LBS. = 5936 LBS. .....RE: PAGE A-1

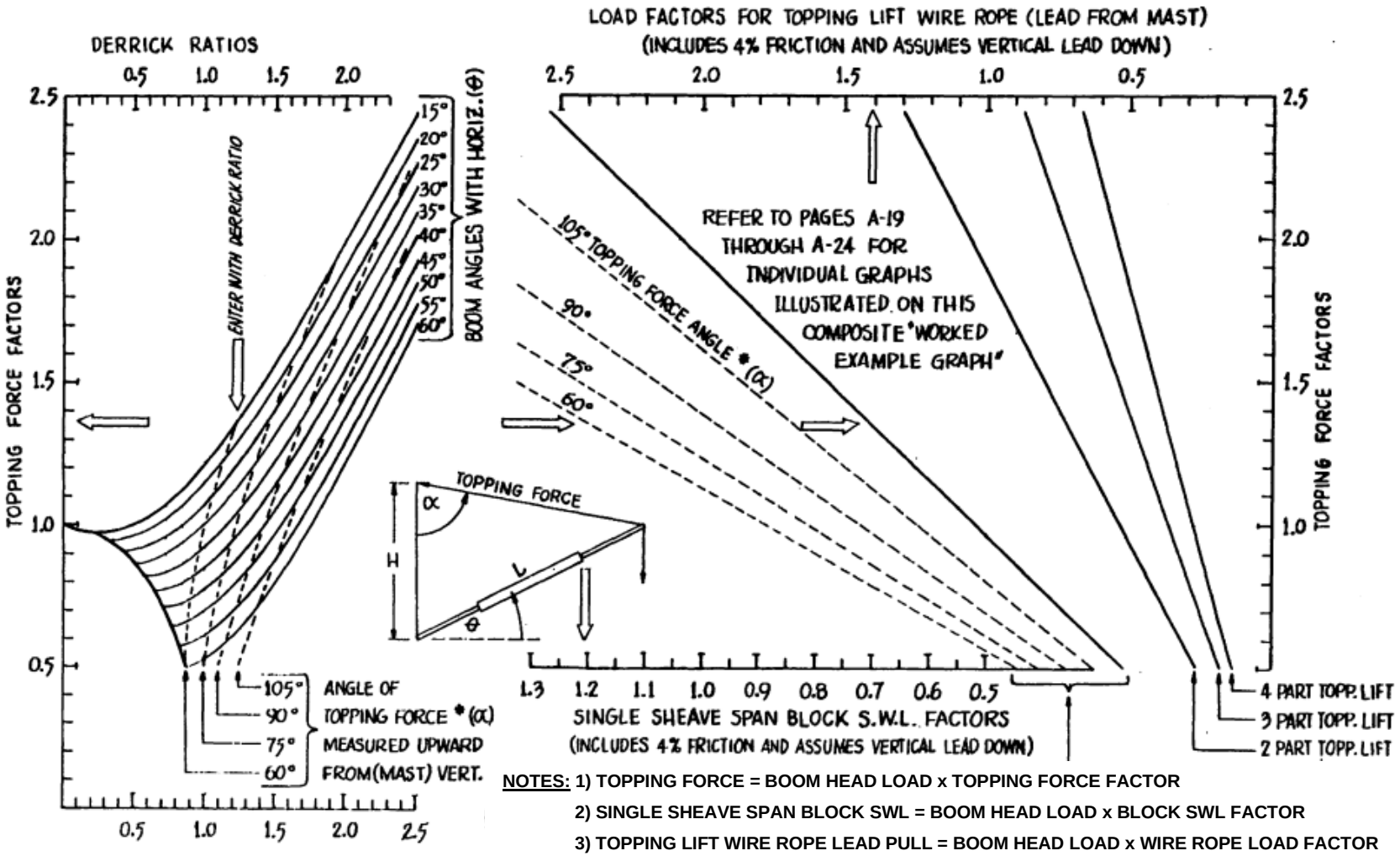
APPROX. LOADS

6) TOPPING FORCE = 13000 x 1.37 = 17800 LBS.
7) BLOCK T2 SWL = 13000 x 1.21 = 15700 LBS.
8) WIRE ROPE PULL, P - 13000 x 1.42 = 18400 LBS.
9) BULL CHAIN SWL = 13000 x 1.37 = 17800 LBS.
10) BOOM COMPRESSION AT MIDLENGTH = 5936 + (13000 x 1.23) = 21900 LBS.

RE: NOTES ON PAGE A-18 BELOW

## TOPPING LIFT LOAD FACTORS vs. DERRICK RATIOS at VARIOUS BOOM ANGLES ~ WORKED EXAMPLE GRAPH

## (FOR SWINGING BOOMS ~ LIGHT LIFT COPLANAR DERRICKS ~ NO LIST OR TRIM)



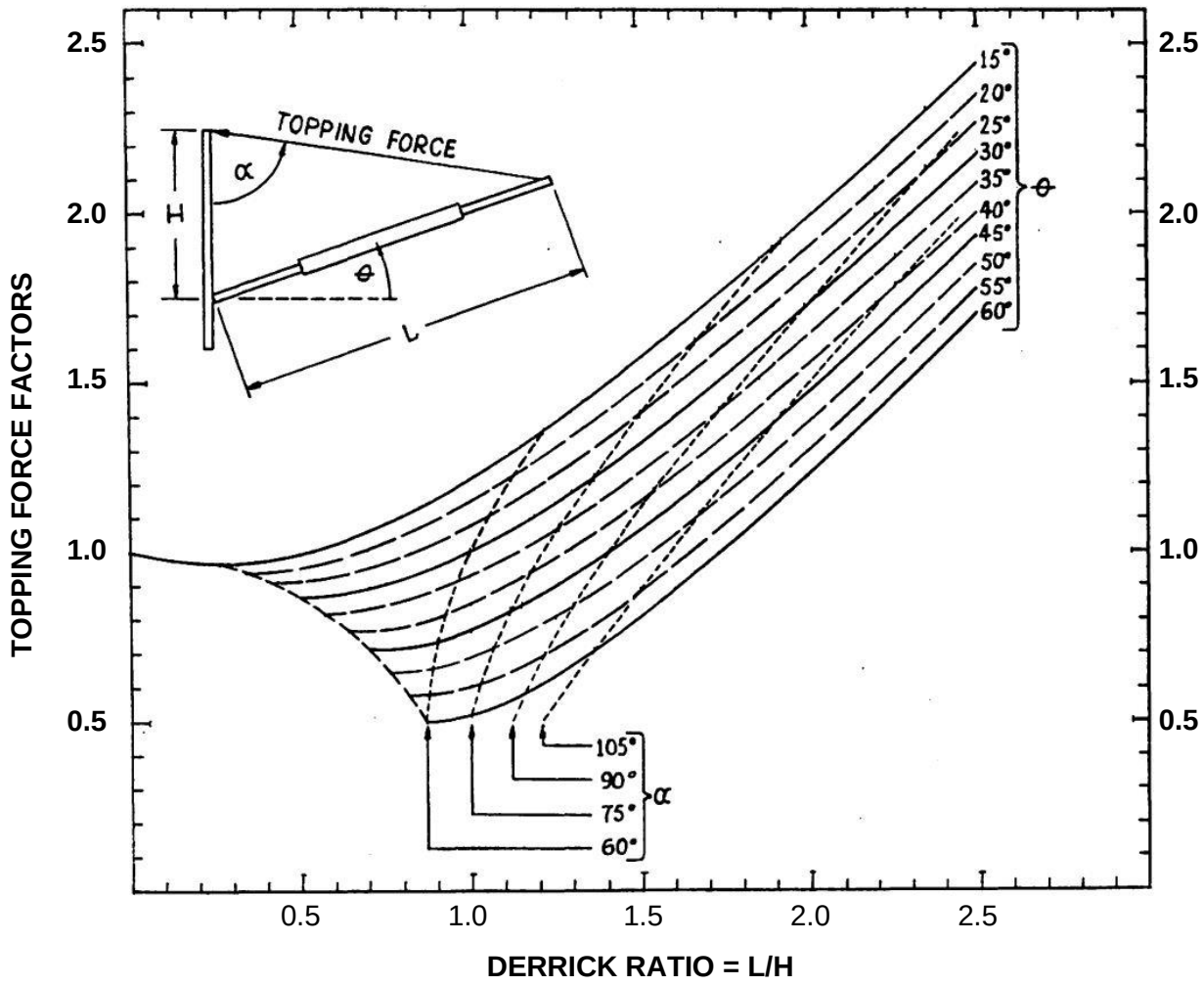

**NOTES:** 1) TOPPING FORCE = BOOM HEAD LOAD x TOPPING FORCE FACTOR

2) SINGLE SHEAVE SPAN BLOCK SWL = BOOM HEAD LOAD x BLOCK SWL FACTOR

3) TOPPING LIFT WIRE ROPE LEAD PULL = BOOM HEAD LOAD x WIRE ROPE LOAD FACTOR

4) WITH 1 PART TOPPING LIFT, BULL CHAIN SWL = BOOM HEAD LOAD x TOPPING FORCE FACTOR

5) BOOM COMPRESSION AT MID-LENGTH = CARGO PURCHASE LEAD FORCE + (BOOM HEAD LOAD x DERR. RATIO)



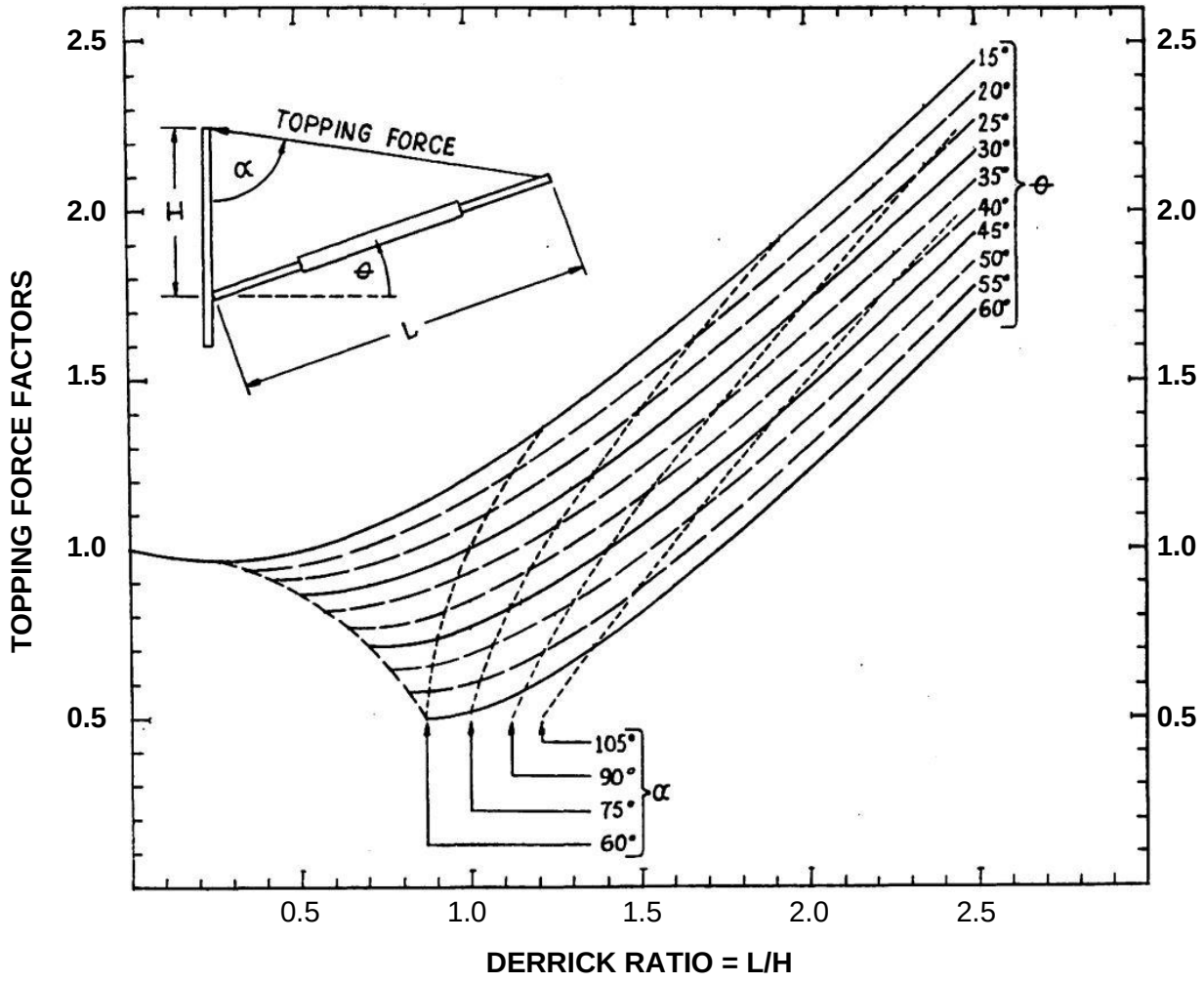

NOTES:

1) REFER TO PAGE A-7 FOR AVERAGE VALUES OF “BOOM HEAD LOAD”
2) TOPPING FORCE = TOPPING FORCE FACTOR x BOOM HEAD LOAD
3) BOOM COMPRESSION AT MID-LENGTH = CARGO PURCHASE LEAD FORCE + (DERR. RATIO x BOOM HEAD LOAD)
4) ENTER GRAPHS ON PAGES A-20 THROUGH A-24 WITH VALUES OF TOPPING FORCE FACTORS AND TOPPING LIFT ANGLES, $\alpha$ OBTAINED FROM THIS GRAPH BASED UPON SELECTED DERRICK RATIOS AND BOOM ANGLES, $\theta$

## TOPPING LIFT FORCE FACTORS & TOPPING LIFT ANGLES, α

## AT VARIOUS DERRICK RATIOS & BOOM ANGLES, θ

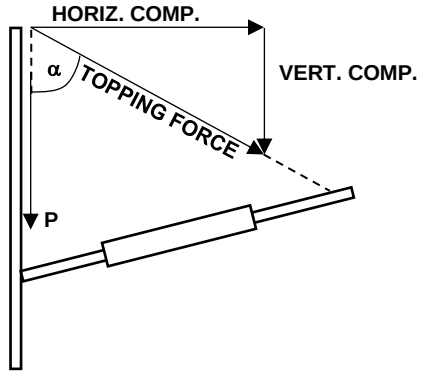
(FOR SWINGING BOOMS ~ LIGHT LIFT COPLANAR DERRICKS ~ NO SHIP LIST OR TRIM)

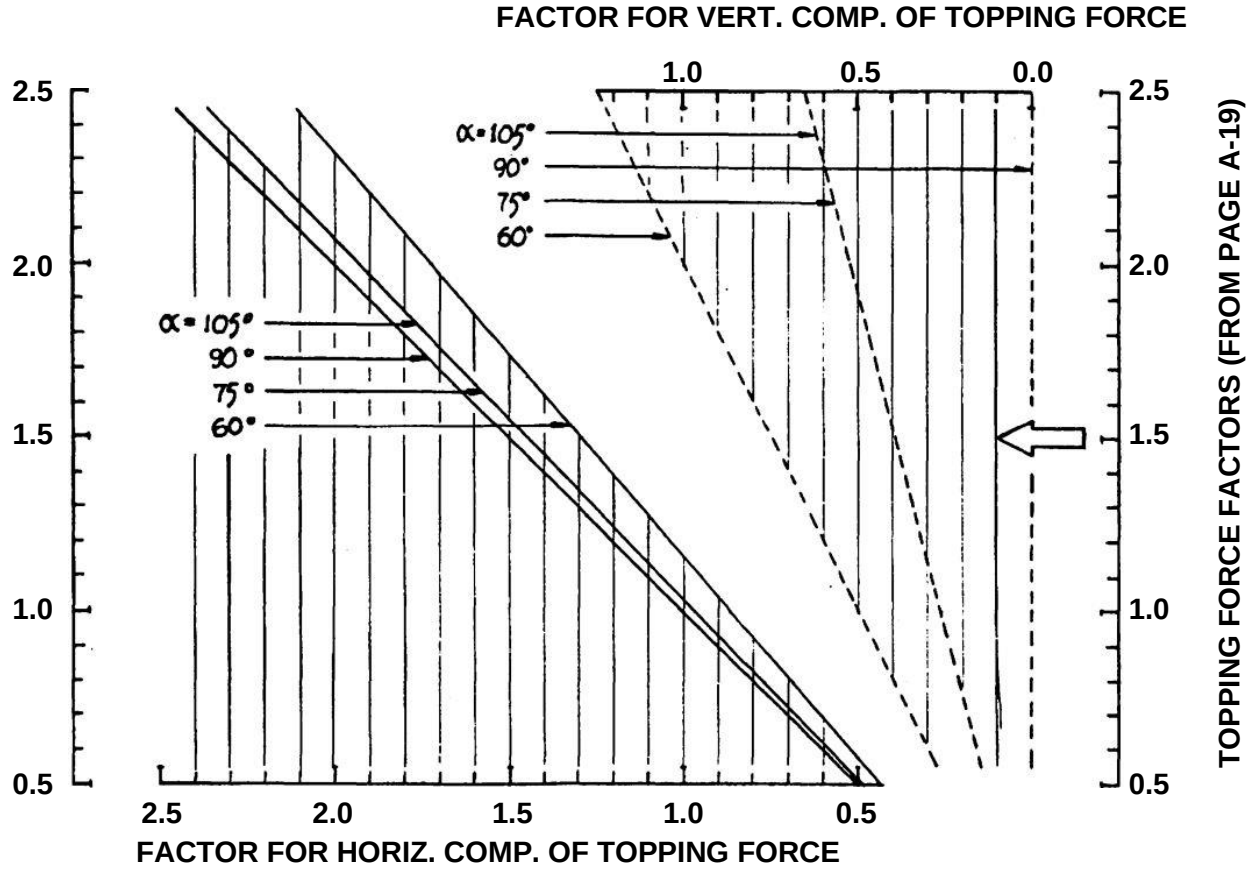



NOTES:

1) REFER TO PAGE A-7 FOR AVERAGE VALUES OF “BOOM HEAD LOAD”
2) TOPPING FORCE = TOPPING FORCE FACTOR x BOOM HEAD LOAD
3) BOOM COMPRESSION AT MID-LENGTH = CARGO PURCHASE LEAD FORCE + (DERR. RATIO x BOOM HEAD LOAD)
4) ENTER GRAPHS ON PAGES A-20 THROUGH A-24 WITH VALUES OF TOPPING FORCE FACTORS AND TOPPING LIFT ANGLES, α OBTAINED FROM THIS GRAPH BASED UPON SELECTED DERRICK RATIOS AND BOOM ANGLES, θ

## TOPPING LIFT LOADS AT MAST




WHERE $\alpha$ IS 90° OR LESS:

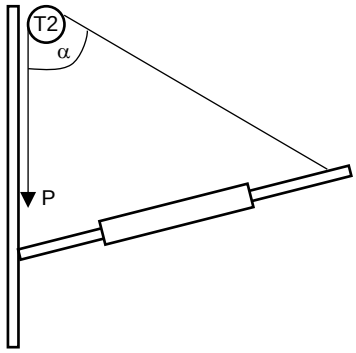
1) HORIZ. LOAD = BOOM HEAD LOAD x HORIZ. FACTOR
2) VERT. LOAD = (WIRE ROPE PULL, P) + (BOOM HEAD LOAD x VERTICAL FACTOR)

WHERE $\alpha$ IS 90° OR LESS:

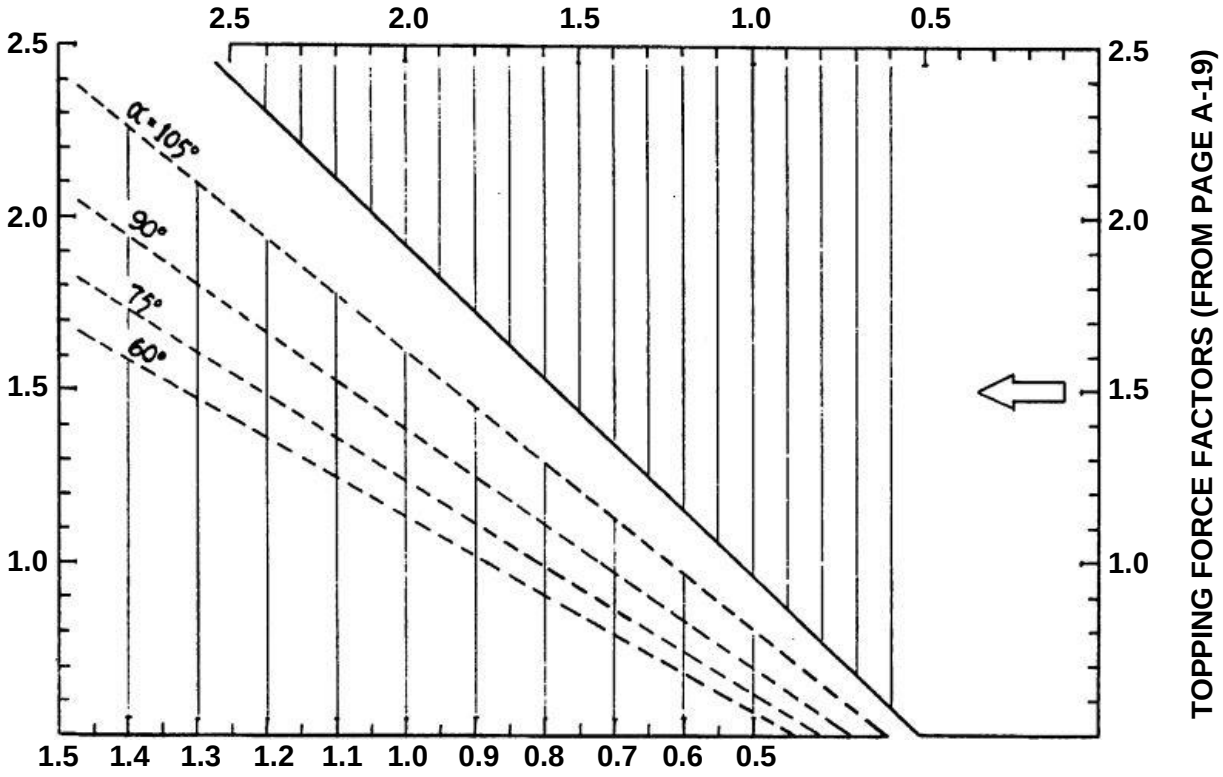
1) HORIZ. LOAD = BOOM HEAD LOAD x HORIZ. FACTOR
2) VERT. LOAD, DOWN = (WIRE ROPE PULL, P) – (BOOM HEAD LOAD x VERT. FACTOR)

## TOPPING LIFT LOAD FACTORS

## 1 PART TOPPING LIFT ARRANGEMENT




**LOAD FACTORS FOR WIRE ROPE PULL, P (RAISING BOOM & INCL. 4% FRICTION)**



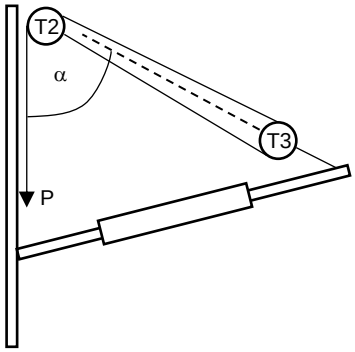

**SINGLE SHEAVE SPAN BLOCK SWL FACTORS FOR BLOCK T2**
**(INCLUDES 4% FRICTION & ASSUMES VERTICAL LEAD DOWN)**

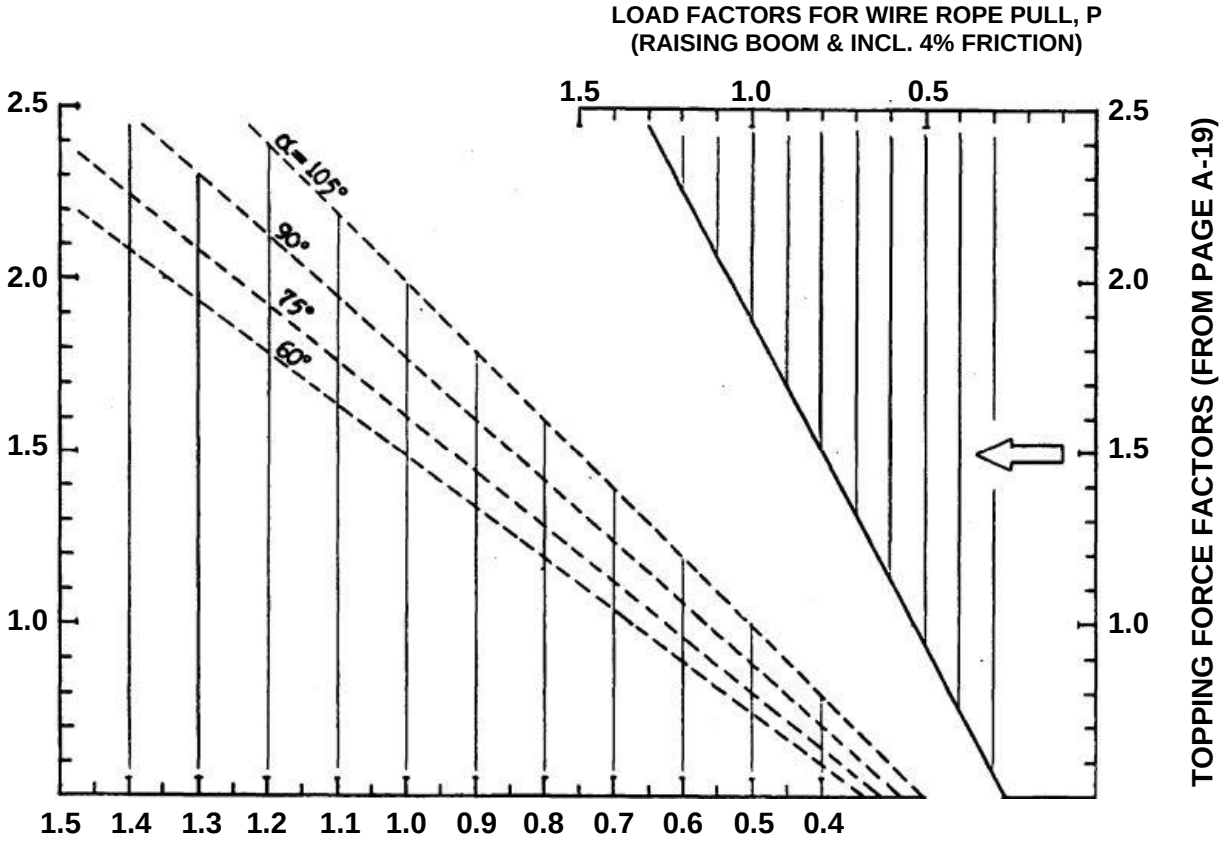
NOTES:

1) SWL BLOCK T2 = BOOM HEAD LOAD x BLOCK T2 SWL FACTOR
2) WIRE ROPE PULL, P = BOOM HEAD LOAD x WIRE ROPE LOAD FACTOR
3) TOPPING LIFT BULL CHAIN SWL = BOOM HEAD LOAD x TOPPING FORCE FACTOR

## TOPPING LIFT LOAD FACTORS

## 2 PART TOPPING LIFT ARRANGEMENT



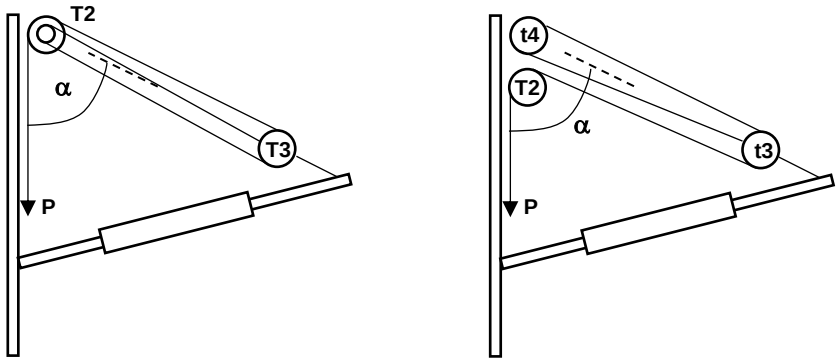




NOTES:

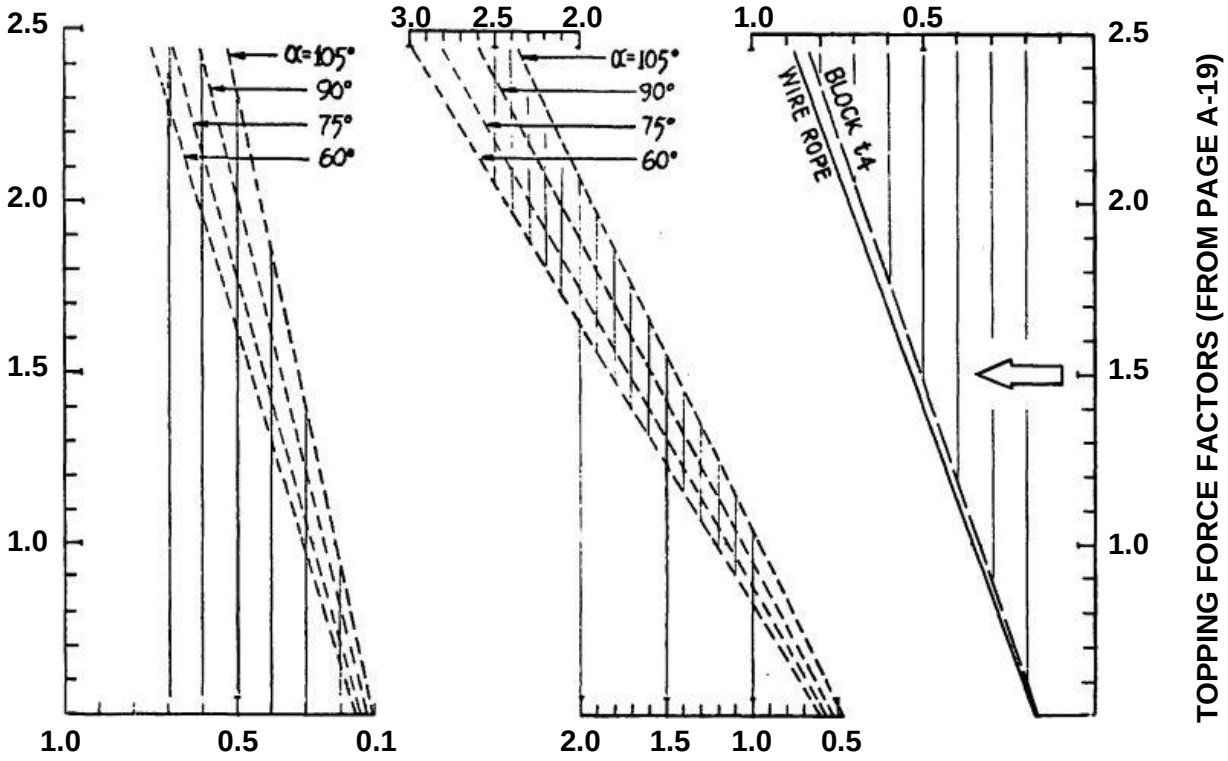
1) SWL BLOCK T2 = BOOM HEAD LOAD x BLOCK T2 SWL FACTOR
2) SWL BLOCK T3 = (BOOM HEAD LOAD x TOPPING FORCE FACTOR) / 2
3) WIRE ROPE PULL, P = BOOM HEAD LOAD x WIRE ROPE LOAD FACTOR

## TOPPING LIFT LOAD FACTORS

## 3 PART TOPPING LIFT ARRANGEMENT




**LOAD FACTORS FOR**
**WIRE ROPE PULL, P (RAISING BOOM & INCL. 4% FRICTION)**
**& BLOCK t4 SWL (LOWERING BOOM & INCL. 4% FRICTION)**



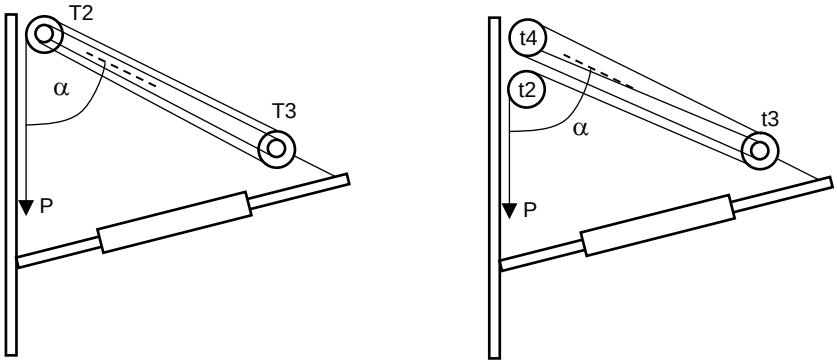

**BLOCK t2 SWL FACTORS** **BLOCK T2 SWL FACTORS**
**(RAISING BOOM, INCL. 4% FRICT. & ASSUMES VERT. LEAD DOWN)**

NOTES:

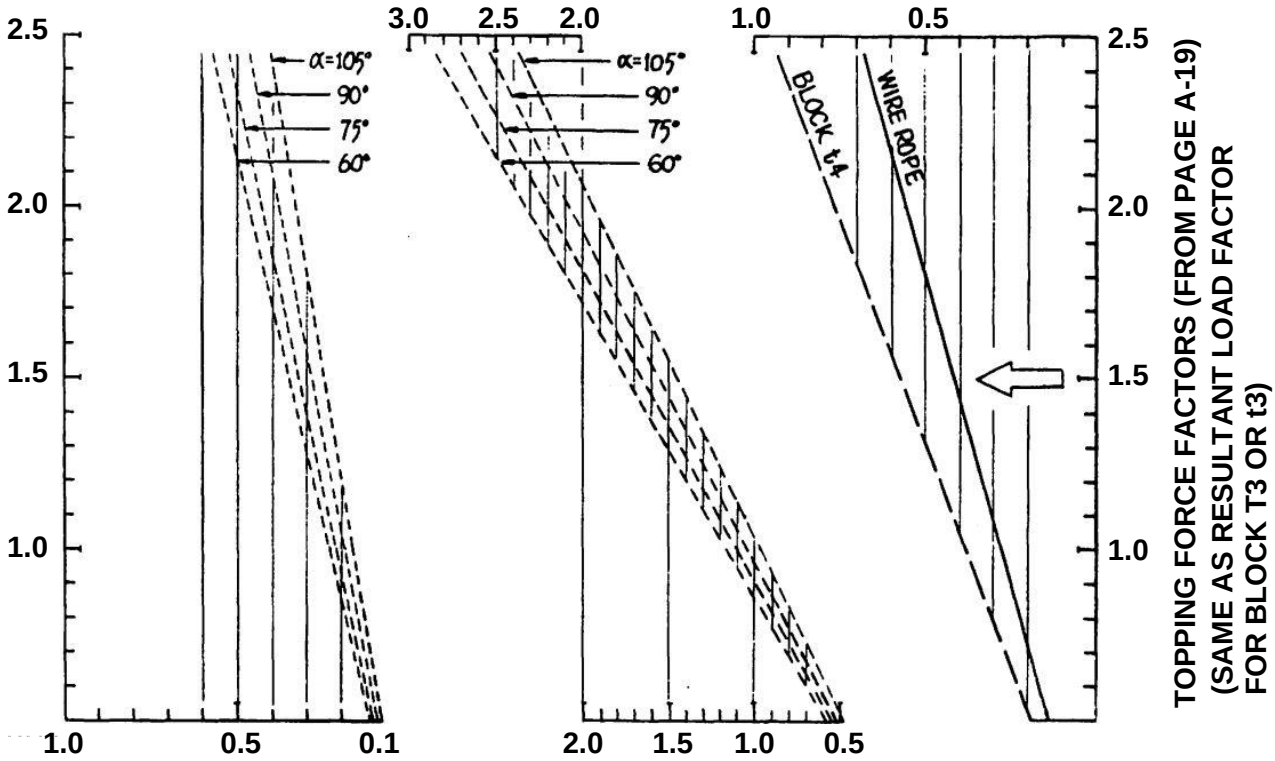
1) SWL BLOCK T2 = BOOM HEAD LOAD x BLOCK T2 SWL FACTOR
2) SWL BLOCK T3 OR t3 = (BOOM HEAD LOAD x TOPP. FORCE FACTOR) / 2
3) SWL BLOCK t2 = BOOM HEAD LOAD x BLOCK t2 SWL FACTOR
4) SWL BLOCK t4 = BOOM HEAD LOAD x BLOCK t4 SWL FACTOR
5) WIRE ROPE PULL, P = BOOM HEAD LOAD x WIRE ROPE LOAD FACTOR

## TOPPING LIFT LOAD FACTORS

## 4 PART TOPPING LIFT ARRANGEMENT




**LOAD FACTORS FOR**
**WIRE ROPE PULL, P (RAISING BOOM & INCL. 4% FRICTION)**
**& BLOCK t4 SWL (LOWERING BOOM & INCL. 4% FRICTION)**




**BLOCK t2 SWL FACTORS** **BLOCK T2 SWL FACTORS**
**(RAISING BOOM, INCL. 4% FRICT. & ASSUMES VERT. LEAD DOWN)**

NOTES:

1) SWL BLOCK T2 = BOOM HEAD LOAD x BLOCK T2 SWL FACTOR
2) SWL BLOCK T3 OR t3 = BOOM HEAD LOAD x TOPP. FORCE FACTOR
3) SWL BLOCK t2 = BOOM HEAD LOAD x BLOCK t2 SWL FACTOR
4) SWL BLOCK t4 = BOOM HEAD LOAD x BLOCK t4 SWL FACTOR
5) WIRE ROPE PULL, P = BOOM HEAD LOAD x WIRE ROPE LOAD FACTOR