

ASME B30.1-2015
(Revision of ASME B30.1-2009)

Jacks, Industrial Rollers, Air Casters, and Hydraulic Gantries

**Safety Standard for Cableways,
Cranes, Derricks, Hoists, Hooks, Jacks,
and Slings**

AN AMERICAN NATIONAL STANDARD



**The American Society of
Mechanical Engineers**

www.astaco.ir

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Two Park Avenue • New York, NY • 10016 USA

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The next edition of this Standard is scheduled for publication in 2020. This Standard will become effective 1 year after the Date of Issuance.

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FOREWORD

This American National Standard, Safety Standard for Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, and Slings, has been developed under the procedures accredited by the American National Standards Institute (ANSI). This Standard had its beginning in December 1916 when an eight-page "Code of Safety Standards for Cranes," prepared by an ASME Committee on the Protection of Industrial Workers, was presented at the annual meeting of the ASME.

Meetings and discussions regarding safety on cranes, derricks, and hoists were held from 1920 to 1925, involving the ASME Safety Code Correlating Committee, the Association of Iron and Steel Electrical Engineers, the American Museum of Safety, the American Engineering Standards Committee (AESC) [later changed to American Standards Association (ASA), then to the United States of America Standards Institute (USASI), and finally to ANSI], Department of Labor - State of New Jersey, Department of Labor and Industry - State of Pennsylvania, and the Locomotive Crane Manufacturers Association. On June 11, 1925, AESC approved the ASME Safety Code Correlating Committee's recommendation and authorized the project with the U.S. Department of the Navy, Bureau of Yards and Docks, and ASME as sponsors.

In March 1926, invitations were issued to 50 organizations to appoint representatives to a Sectional Committee. The call for organization of this Sectional Committee was sent out October 2, 1926, and the committee organized November 4, 1926, with 57 members representing 29 national organizations. Commencing June 1, 1927, and using the eight-page code published by ASME in 1916 as a basis, the Sectional Committee developed the "Safety Code for Cranes, Derricks, and Hoists." The early drafts of this safety code included requirements for "Jacks" but, due to inputs and comments on those drafts, the Sectional Committee decided in 1938 to make the requirements for "Jacks" a separate code. In January 1943, ASA B30.2-1943 was published addressing a multitude of equipment types and in August 1943, ASA B30.1-1943 was published just addressing "Jacks." Both documents were reaffirmed in 1952 and widely accepted as safety standards.

Due to changes in design, advancement in techniques, and general interest of labor and industry in safety, the Sectional Committee, under the joint sponsorship of ASME and the Bureau of Yards and Docks (now the Naval Facilities Engineering Command) was reorganized on January 31, 1962, with 39 members representing 27 national organizations. The new committee changed the format of ASA B30.2-1943 so that the multitude of equipment types it addressed could be published in separate volumes that could completely cover the construction, installation, inspection, testing, maintenance, and operation of each type of equipment that was included in the scope of ASA B30.2. This format change resulted in the initial publication of B30.3, B30.5, B30.6, B30.11 and B30.16 being designated as "Revisions" of B30.2 with the remainder of the B30 Volumes being published as totally new volumes. ASA changed its name to USASI in 1966 and to ANSI in 1969, which resulted in B30 volumes from 1943 to 1968 being designated as either "ASA B30," "USAS B30," or "ANSI B30," depending on their date of publication.

In 1982, the Committee was reorganized as an Accredited Organization Committee, operating under procedures developed by ASME and accredited by ANSI. This Standard presents a coordinated set of rules that may serve as a guide to government and other regulatory bodies and municipal authorities responsible for the guarding and inspection of the equipment falling within its scope. The suggestions leading to accident prevention are given both as mandatory and advisory provisions; compliance with both types may be required by employers of their employees.

In case of practical difficulties, new developments, or unnecessary hardship, the administrative or regulatory authority may grant variances from the literal requirements or permit the use of other devices or methods, but only when it is clearly evident that an equivalent degree of protection is thereby secured. To secure uniform application and interpretation of this Standard, administrative or regulatory authorities are urged to consult the B30 Committee, in accordance with the format described in Section IX of the Introduction, before rendering decisions on disputed points.

Safety codes and standards are intended to enhance public safety. Revisions result from committee consideration of factors such as technological advances, new data, and changing environmental and industry needs. Revisions do not imply that previous editions were inadequate.

B30.1 Jacks has been in existence since 1926, with new editions published in 1943, 1967, 1981, 1986, 1992, 1998, and 2004. The 2009 revision of this Volume revised the title to Jacks, Industrial Rollers, Air Casters, and Hydraulic Gantries. The Volume was reformatted to incorporate the requirements for jacks, air-lifting bags, industrial rollers, air casters, and telescopic hydraulic gantry systems into Chapters 1-1 through 1-6. The 2015 edition adds Chapter 1-7 on strand jack systems. It also addresses responsibilities of personnel, personnel competence, and translations.

This Volume of the Standard, which was approved by the B30 Committee and by ASME, was approved by ANSI and designated as an American National Standard on April 15, 2015.

ASME B30 COMMITTEE

Safety Standard for Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, and Slings

(The following is the roster of the Committee at the time of approval of this Standard.)

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SAFETY STANDARD FOR CABLEWAYS, CRANES, DERRICKS, HOISTS, HOOKS, JACKS, AND SLINGS

(15)

B30 STANDARD INTRODUCTION

SECTION I: SCOPE

The ASME B30 Standard contains provisions that apply to the construction, installation, operation, inspection, testing, maintenance, and use of cranes and other lifting and material-movement related equipment. For the convenience of the reader, the Standard has been divided into separate volumes. Each volume has been written under the direction of the ASME B30 Standard Committee and has successfully completed a consensus approval process under the general auspices of the American National Standards Institute (ANSI).

As of the date of issuance of this Volume, the B30 Standard comprises the following volumes:

B30.1	Jacks, Industrial Rollers, Air Casters, and Hydraulic Gantries	B30.23	Personnel Lifting Systems
B30.2	Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist)	B30.24	Container Cranes
B30.3	Tower Cranes	B30.25	Scrap and Material Handlers
B30.4	Portal and Pedestal Cranes	B30.26	Rigging Hardware
B30.5	Mobile and Locomotive Cranes	B30.27	Material Placement Systems
B30.6	Derricks	B30.28	Balance Lifting Units
B30.7	Winches	B30.29	Self-Erecting Tower Cranes
B30.8	Floating Cranes and Floating Derricks	B30.30	Ropes ¹
B30.9	Slings		
B30.10	Hooks		
B30.11	Monorails and Underhung Cranes		
B30.12	Handling Loads Suspended From Rotorcraft		
B30.13	Storage/Retrieval (S/R) Machines and Associated Equipment		
B30.14	Side Boom Tractors		
B30.15	Mobile Hydraulic Cranes (withdrawn 1982 — requirements found in latest revision of B30.5)		
B30.16	Overhead Hoists (Underhung)		
B30.17	Overhead and Gantry Cranes (Top Running Bridge, Single Girder, Underhung Hoist)		
B30.18	Stacker Cranes (Top or Under Running Bridge, Multiple Girder With Top or Under Running Trolley Hoist)		
B30.19	Cableways		
B30.20	Below-the-Hook Lifting Devices		
B30.21	Lever Hoists		
B30.22	Articulating Boom Cranes		

SECTION II: SCOPE EXCLUSIONS

Any exclusion of, or limitations applicable to the equipment, requirements, recommendations, or operations contained in this Standard are established in the affected volume's scope.

SECTION III: PURPOSE

The B30 Standard is intended to

(a) prevent or minimize injury to workers, and otherwise provide for the protection of life, limb, and property by prescribing safety requirements

(b) provide direction to manufacturers, owners, employers, users, and others concerned with, or responsible for, its application

(c) guide governments and other regulatory bodies in the development, promulgation, and enforcement of appropriate safety directives

SECTION IV: USE BY REGULATORY AGENCIES

These volumes may be adopted in whole or in part for governmental or regulatory use. If adopted for governmental use, the references to other national codes and standards in the specific volumes may be changed to refer to the corresponding regulations of the governmental authorities.

SECTION V: EFFECTIVE DATE

(a) *Effective Date.* The effective date of this Volume of the B30 Standard shall be 1 yr after its date of issuance.

¹ This volume is currently in the development process.

Construction, installation, inspection, testing, maintenance, and operation of equipment manufactured and facilities constructed after the effective date of this Volume shall conform to the mandatory requirements of this Volume.

(b) *Existing Installations.* Equipment manufactured and facilities constructed prior to the effective date of this Volume of the B30 Standard shall be subject to the inspection, testing, maintenance, and operation requirements of this Standard after the effective date.

It is not the intent of this Volume of the B30 Standard to require retrofitting of existing equipment. However, when an item is being modified, its performance requirements shall be reviewed relative to the requirements within the current volume. The need to meet the current requirements shall be evaluated by a qualified person selected by the owner (user). Recommended changes shall be made by the owner (user) within 1 yr.

SECTION VI: REQUIREMENTS AND RECOMMENDATIONS

Requirements of this Standard are characterized by use of the word *shall*. Recommendations of this Standard are characterized by the word *should*.

SECTION VII: USE OF MEASUREMENT UNITS

This Standard contains SI (metric) units as well as U.S. Customary units. The values stated in U.S. Customary units are to be regarded as the standard. The SI units are a direct (soft) conversion from the U.S. Customary units.

SECTION VIII: REQUESTS FOR REVISION

The B30 Standard Committee will consider requests for revision of any of the volumes within the B30 Standard. Such requests should be directed to

Secretary, B30 Standard Committee
ASME Codes and Standards
Two Park Avenue
New York, NY 10016-5990

Requests should be in the following format:

Volume: Cite the designation and title of the volume.
Edition: Cite the applicable edition of the volume.
Subject: Cite the applicable paragraph number(s) and the relevant heading(s).
Request: Indicate the suggested revision.
Rationale: State the rationale for the suggested revision.

Upon receipt by the Secretary, the request will be forwarded to the relevant B30 Subcommittee for consideration and action. Correspondence will be provided to the requester defining the actions undertaken by the B30 Standard Committee.

SECTION IX: REQUESTS FOR INTERPRETATION

The B30 Standard Committee will render an interpretation of the provisions of the B30 Standard. Such requests should be directed to

Secretary, B30 Standard Committee
ASME Codes and Standards
Two Park Avenue
New York, NY 10016-5990

Requests should be in the following format:

Volume: Cite the designation and title of the volume.
Edition: Cite the applicable edition of the volume.
Subject: Cite the applicable paragraph number(s) and the relevant heading(s).
Question: Phrase the question as a request for an interpretation of a specific provision suitable for general understanding and use, not as a request for approval of a proprietary design or situation. Plans or drawings that explain the question may be submitted to clarify the question. However, they should not contain any proprietary names or information.

Upon receipt by the Secretary, the request will be forwarded to the relevant B30 Subcommittee for a draft response, which will then be subject to approval by the B30 Standard Committee prior to its formal issuance.

Interpretations to the B30 Standard will be published in the subsequent edition of the respective volume, and will be available online at <http://cstools.asme.org/>.

SECTION X: ADDITIONAL GUIDANCE

The equipment covered by the B30 Standard is subject to hazards that cannot be abated by mechanical means, but only by the exercise of intelligence, care, and common sense. It is therefore essential to have personnel involved in the use and operation of equipment who are competent, careful, physically and mentally qualified, and trained in the proper operation of the equipment and the handling of loads. Serious hazards include, but are not limited to, improper or inadequate maintenance, overloading, dropping or slipping of the load, obstructing the free passage of the load, and using equipment for a purpose for which it was not intended or designed.

The B30 Standard Committee fully realizes the importance of proper design factors, minimum or maximum dimensions, and other limiting criteria of wire rope or chain and their fastenings, sheaves, sprockets, drums, and similar equipment covered by the standard, all of which are closely connected with safety. Sizes, strengths, and similar criteria are dependent on many different factors, often varying with the installation and uses. These factors depend on

- (a) the condition of the equipment or material
- (b) the loads

(c) the acceleration or speed of the ropes, chains, sheaves, sprockets, or drums

(d) the type of attachments

(e) the number, size, and arrangement of sheaves or other parts

(f) environmental conditions causing corrosion or wear

(g) many variables that must be considered in each individual case

The requirements and recommendations provided in the volumes must be interpreted accordingly, and judgment used in determining their application.

ASME B30.1-2015

SUMMARY OF CHANGES

Following approval by the ASME B30 Committee and ASME, and after public review, ASME B30.1-2015 was approved by the American National Standards Institute on April 15, 2015.

ASME B30.1-2015 includes editorial changes, revisions, and corrections introduced in ASME B30.1-2009, as well as the following changes identified by a margin note, (15).

<i>Page</i>	<i>Location</i>	<i>Change</i>
x–xii	B30 Standard Introduction	Updated
1, 2	Chapter 1-0	Title revised
	Section 1-0.1	(1) Revised (2) Paragraph 1-0.1.2 added
	Section 1-0.2	(1) Definitions of <i>appointed</i> and <i>designated person</i> deleted (2) Definitions of <i>birdcaging</i> , <i>LHE</i> , <i>strand jack</i> , <i>strand jack system</i> , and <i>tube guide</i> added (3) Definition of <i>load</i> revised
3–5	Section 1-0.3	Added
	Section 1-0.4	Added
	Section 1-0.5	Redesignated and revised
6	Figure 1-0.4.4-1	Added (moved from para. 1-6.9.5.2)
7	1-1.1.1	Subparagraph (c) deleted
10	1-1.7.2	Revised
	Section 1-1.8	Revised
11	1-1.9.2	Subparagraph (a) added and subsequent subparagraphs redesignated
	1-1.9.4	Subparagraph (a) revised
12	1-1.9.5.2	Figure designator in subpara. (b) revised
13	1-2.1.1	Subparagraph (c) deleted
15	1-2.7.2	Revised
	Section 1-2.8	Revised
16	1-2.9.2	Subparagraph (a) added and subsequent subparagraphs redesignated
	1-2.9.4	Subparagraph (a) revised
17	1-2.9.5.2	Figure designator in subpara. (b) revised

<i>Page</i>	<i>Location</i>	<i>Change</i>
19	1-3.1.1	Subparagraph (a) designator and subpara. (b) deleted
	1-3.1.2	(1) Revised (2) Subparagraph (b) added and subsequent subparagraphs redesignated
21	1-3.6.3	Revised
	1-3.7.2	Revised
	Section 1-3.8	Revised
22	1-3.9.2	Subparagraph (a) added and subsequent subparagraphs redesignated
	1-3.9.4	Subparagraph (a) revised
	1-3.9.5	(1) Title revised (2) Subparagraph 1-3.9.5.1(b) revised
23	1-3.9.5.2	Revised
24	1-4.1.1	Subparagraph (a) designator and subpara. (b) deleted
	1-4.4.1	Subparagraph (b) revised
26	1-4.7.2	Revised
	Section 1-4.8	Revised
27	1-4.9.2	Subparagraph (a) added and subsequent subparagraphs redesignated
	1-4.9.4	Subparagraph (a) revised
28	1-4.9.5.2	Figure designator in subpara. (b) revised
29	1-5.1.1	Subparagraph (a) designator and subpara. (b) deleted
	1-5.1.2	Revised
	1-5.1.3	(1) Revised (2) Subparagraph (e) added and subsequent subparagraph redesignated
	Section 1-5.4	Revised
31	1-5.7.2	Revised
	Section 1-5.8	Revised
32, 33	1-5.9.2	Subparagraph (a) added and subsequent subparagraphs redesignated
	1-5.9.4	Subparagraph (a) revised
	1-5.9.5	Revised
34	1-6.1.1	Subparagraph (c) deleted

<i>Page</i>	<i>Location</i>	<i>Change</i>
36–38	1-6.5.1	(1) Paragraph designator 1-6.5.1.1 and title added, and remaining paragraph designators revised (2) Titles added to revised designators
	1-6.7.2	Revised
	Section 1-6.8	Revised
	1-6.9.2	Subparagraph (a) added and subsequent subparagraphs redesignated
	1-6.9.5	Revised
40–45	Chapter 1-7	Added

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JACKS, INDUSTRIAL ROLLERS, AIR CASTERS, AND HYDRAULIC GANTRIES

Chapter 1-0

(15)

Scope, Translations, Definitions, Personnel Competence, Responsibilities, and References

(15) SECTION 1-0.1: SCOPE OF B30.1

Volume B30.1 includes provisions that apply to the construction, operation, inspection, testing, and maintenance of mechanical ratchet jacks, hand- or power-operated mechanical screw jacks, hand- or power-operated hydraulic jacks, air-lifting bags, industrial rollers, air casters, telescopic hydraulic gantry systems, and strand jacks.

Not included in this Volume are jacks designed for automotive service, trip-lowered jacks, jacks designed for static support rather than load handling, and jacks, industrial rollers, air-lifting bags or air casters that are an integral part of other equipment.

1-0.1.1 Illustrations

Figures 1-0.4.4-1 through 1-7.1.1-1 show typical equipment and hand signals addressed in this Volume. They are not intended to be all-inclusive.

1-0.1.2 Translations

(a) Translation of non-English documentation into English

(1) The wording of written non-English safety information and manuals regarding use, inspection, and maintenance shall be translated into English by professional translation industry standards, which include, but are not limited to the following:

- (-a) translation of the complete paragraph message, instead of word by word
- (-b) grammatical accuracy
- (-c) respectfulness of the source document content without omitting or expanding the text
- (-d) accurate translation of the terminology
- (-e) reflection of the level of sophistication of the original document

(2) The finished translation shall be verified for compliance with paragraphs 1-0.1.2(a)(1)(-a) through 1-0.1.2(a)(1)(-e) by a qualified person having an understanding of the technical content of the subject matter.

(3) Pictograms used to identify controls shall be described in the manuals. The pictograms should comply with ISO 7000, ISO 7296, or other recognized source, if previously defined. The text of the description shall meet the criteria of paras. 1-0.1.2(a)(1) and 1-0.1.2(a)(2).

(b) Any non-English documentation provided in addition to English shall be translated and reviewed in accordance with the requirements listed above.

SECTION 1-0.2: DEFINITIONS

(15)

air bladder (air caster): a monofilm or fabric-reinforced material enclosure that directs air flow beneath the air caster's module structure.

air caster: a device that can provide lift and travel of a load using air flow as the support medium, often referred to as air skates or air bearings.

air caster, gap crossing: a fabricated module that contains a load support plate, a landing pad, and a perforated air bladder that provides the ability to travel across gaps and steps in the operating surface.

air caster, high lift: a fabricated module that contains a load support plate, a landing pad, and an air bladder that provides approximately twice the effective lift height of a low-lift air caster and inflates without requiring contact with the operating surface for inflation.

air caster, low lift: a fabricated module that contains a load support plate, a landing pad, and an air bladder that provides approximately half the effective lift height of a high-lift air caster and requires contact with the operating surface for inflation.

air caster system: consists of air supply, air hoses, pressure control console, and air casters.

air-lifting bag: a reinforced, flat, rubberized single-chamber inflatable bag designed to contain air at pressures above 100 psi.

air-lifting bag system: consists of air supply, air hoses, pressure control unit, and air-lifting bag.

authorized service center: an independent service facility designated by the manufacturer to repair and test equipment of their manufacture.

birdcaging: the permanent deformation of a section of strand in which the wires spread apart.

drift: horizontal displacement of the top of a telescopic lift boom that results from clearances between boom sections.

industrial roller: a structural frame containing interlinked rollers or wheels designed to support and transport a load, often referred to as skates or dollies.

jack: a portable hand or a power-operated mechanism with a base and a load point designed for controlled linear movement.

jack, double-acting hydraulic: a jack that is extended and retracted under hydraulic pressure.

jack, hydraulic: a jack using liquid to move the load.

jack, mechanical: a jack using any means other than fluid to move the load.

jack, self-contained: a hydraulic jack whose hydraulic reservoir and pump are contained within the jack's housing.

jack, single-acting hydraulic: a jack that is extended under hydraulic pressure and retracted by release of the hydraulic pressure.

landing pads: structural spacer(s) mounted below an air caster module structure, which provides support while the air bladder is deflated.

lateral: the horizontal direction perpendicular to the length of the gantry system track.

LHE (load handling equipment): all equipment covered by ASME B30.1.

load: the total superimposed weight or force to be overcome by the load handling equipment.

load point: the point of load application.

load point, auxiliary: any point of load application other than the load point.

load point, integral auxiliary: any nonremovable point of load application other than the load point.

longitudinal: the horizontal direction parallel to the length of the gantry system track.

module structure (air caster): the load support platform that interfaces between the load and the air bladder.

overload: any load greater than the rated load.

overtravel: movement beyond maximum travel (mechanical jack) or stroke (hydraulic jack) for which the jack was designed.

ply separation: a delamination of at least two layers of rubber and/or reinforcement material.

qualified person: a person who, by possession of a recognized degree in an applicable field or certificate of professional standing, or who, by extensive knowledge, training, and experience, has successfully demonstrated the ability to solve or resolve problems relating to the subject matter and work.

rated load: the maximum allowable working load established by the equipment manufacturer. The terms *rated capacity* and *working load limit* are commonly used to describe rated load.

screw extension: a device that increases the hydraulic jack's closed length.

service, normal: service that involves use of loads at or below the rated load.

service, severe: service that involves normal service coupled with abnormal rigging or operating conditions.

service, special: service that involves operation, other than normal or severe, which is approved by a qualified person.

shall: indicates that the rule is mandatory and must be followed.

should: indicates that the rule is a recommendation, the advisability of which depends on the facts in each situation.

side shift: lateral movement of a suspended load along the header beams of a telescopic hydraulic gantry system.

strand jack: hydraulic cylinder(s) configured to sequentially grip and release single or multiple strands to move a load.

strand jack system: one or more strand jacks, strands, anchors, a hydraulic power unit, control console, hoses, rigging, and accessories required to guide and manage the strands to move a load.

stroke: linear extending or retracting movement of the hydraulic jack (Chapter 1-2) or gantry leg (Chapter 1-6).

telescopic hydraulic gantry leg: a structural base that is supported on wheels or a frame and that has one or more vertical lift cylinders or boom.

telescopic hydraulic gantry system: two or more telescopic hydraulic gantry legs, a hydraulic power unit, control console, hoses, and one or more header beams that span between the legs.

travel: linear extending or retracting movement of the mechanical jack (Chapter 1-1); horizontal movement of the telescopic hydraulic gantry system along the track (Chapter 1-6).

tube guide: component of a strand jack that reduces the unsupported length of strand inside the jack to decrease the occurrence of birdcaging inside the jack.

(15) SECTION 1-0.3: PERSONNEL COMPETENCE

Persons performing the functions identified in this Volume shall meet the applicable qualifying criteria stated in this Volume and shall, through education, training, experience, skill, and physical fitness, as necessary, be competent and capable to perform the functions as determined by the employer or employer's representative.

(15) SECTION 1-0.4 RESPONSIBILITIES

While the organizational structure of various projects may differ, the following roles are described here for purposes of delineating responsibilities. All responsibilities listed below shall be assigned in the work site organization. A single individual may perform one or more of these roles.

LHE Operator: directly controls the LHE's functions.

LHE Owner: has custodial control of the LHE by virtue of lease or ownership.

LHE User: arranges the LHE's presence on a worksite and controls its use there.

LHE Director: directly oversees the work being performed by the LHE and the associated crew.

Site Supervisor: exercises supervisory control over the work site on which the LHE is being used and over the work that is being performed on that site.

1-0.4.1 Responsibilities of the LHE Owner and LHE User

In some situations, the LHE Owner and the LHE User may be the same entity and is therefore accountable for all of the following responsibilities. In other cases, the LHE User may lease or rent LHE from the LHE Owner without supervisory, operational, maintenance, support personnel, or services from the LHE Owner. In these situations, paras. 1-0.4.1.1 and 1-0.4.1.2 shall apply.

1-0.4.1.1 The LHE Owner's responsibilities shall include the following:

(a) providing LHE that meets the requirements of this Volume, as applicable, as well as specific job requirements defined by the LHE User.

(b) providing LHE and all necessary components, specified by the LHE manufacturer, that meet the LHE User's requested configuration and capacity.

(c) providing all applicable load/capacity chart(s) and diagrams.

(d) providing additional technical information pertaining to the LHE, necessary for LHE operation, when requested by the LHE User.

(e) providing field assembly, disassembly, operation and maintenance information, and warning decals and placards installed as prescribed by the LHE manufacturer.

(f) establishing an inspection, testing, and maintenance program in accordance with the applicable chapter and informing the LHE User of the requirements of this program.

(g) designating personnel for maintenance, repair, transport, assembly, and disassembly.

(h) designating personnel for inspections as required in the applicable chapter.

1-0.4.1.2 The LHE User's responsibilities shall include the following:

(a) complying with the requirements of this Volume, LHE manufacturer's requirements, and those regulations applicable at the work site.

(b) Using supervisors for LHE activities that meet the requirements for a qualified person as defined in Section 1-0.2.

(c) ensuring that the LHE is in proper operating condition prior to initial use at the worksite by

(1) verifying that the LHE Owner has provided periodic inspection documentation, if applicable

(2) verifying that a frequent inspection has been performed

(d) verifying that the LHE has the necessary capacity to perform the proposed LHE operations in the planned configuration

(e) ensuring the assigned LHE Operator(s) has been notified of adjustments or repairs that have not yet been completed, prior to commencing LHE operations

(f) designating personnel for inspections as required in the applicable chapter

(g) designating personnel for maintenance, repair, transport, assembly, and disassembly

(h) ensuring that all personnel involved in maintenance, repair, transport, assembly, disassembly, and inspection are aware of their responsibilities, assigned duties, and the associated hazards

(i) ensuring that the inspection, testing, and maintenance programs specified by the LHE Owner are followed

1-0.4.2 Responsibilities of Site Supervisor and LHE Director

In some situations, the Site Supervisor and the LHE Director may be the same person.

1-0.4.2.1 The Site Supervisor's responsibilities shall include the following:

(a) ensuring that the LHE meets the requirements of the appropriate chapter prior to initial site usage

(b) determining if additional regulations or requirements are applicable to LHE operations

(c) ensuring that a qualified person is designated as the LHE Director

(d) ensuring that LHE operations are coordinated with other jobsite activities that will be affected by or will affect LHE operations

(e) ensuring that the area for the LHE is adequately prepared. The preparation includes, but is not limited to, the following:

(1) access for the LHE and associated equipment
(2) sufficient room to assemble and disassemble the LHE

(3) an operating area that is suitable for the LHE with respect to levelness, surface conditions, support capability, proximity to power lines, excavations, slopes, underground utilities, subsurface construction, and obstructions to LHE operation

(4) traffic control as necessary to restrict unauthorized access to the LHE's working area

(f) ensuring that work involving the assembly and disassembly of LHE is supervised by a qualified person

(g) ensuring that operators meet the physical, knowledge, and skill requirements of the LHE's applicable chapter

(h) ensuring that conditions that may adversely affect LHE operations are addressed. Such conditions include, but are not limited to, the following:

(1) poor soil or support conditions
(2) wind velocity or gusting winds
(3) weather conditions
(4) extreme temperatures
(5) inadequate lighting
(6) operating surface conditions
(7) excessive noise
(8) proximity to energized sources (e.g., power lines, pressurized lines)

(i) ensuring that work performed by the rigging crew is supervised by a qualified person

(j) ensuring that LHE maintenance is performed by a designated person

1-0.4.2.2 The LHE Director's responsibilities shall include the following:

(a) being present at the jobsite during LHE operations.
(b) stopping LHE operations if alerted to an unsafe condition affecting those operations.

(c) ensuring that the preparation of the area needed to support LHE operations has been completed before LHE operations commence.

(d) ensuring necessary traffic controls are in place to restrict unauthorized access to the LHE's work area.

(e) ensuring that personnel involved in LHE operations understand their responsibilities, assigned duties, and the associated hazards.

(f) addressing safety concerns raised by the LHE Operator or other personnel and being responsible if he decides to overrule those concerns and directs LHE operations to continue. In all cases, the manufacturer's criteria for safe operation and the requirements of this Volume shall be followed.

(g) designating the signalperson(s) and conveying that information to the LHE Operator.

(h) evaluating LHE operation in proximity to energized sources.

(i) ensuring precautions are implemented when hazards associated with special load handling operations are present. Such LHE operations may include, but are not limited to, the following:

(1) multiple types of LHE used simultaneously
(2) shifting center(s) of gravity or lifting below the center of gravity

(3) shifting, inclined, or moving surfaces

(4) LHE operating on barges

(j) informing the LHE Operator of the weight and planned movement of the loads to be handled.

(k) obtaining the LHE Operator's verification that this weight does not exceed the LHE's rated load.

(l) ensuring that load rigging personnel have been designated for the LHE.

(m) ensuring that the load is properly rigged and stable.

1-0.4.3 Responsibilities of LHE Operators

The LHE Operator shall be responsible for the following listed items. The LHE Operator shall not be responsible for hazards or conditions that are not under his direct control and that adversely affect the LHE operations. Whenever the LHE Operator has doubt as to the safety of LHE operations, the LHE Operator shall stop the LHE's functions in a controlled manner. LHE operations shall resume only after safety concerns have been addressed and the continuation of the operation is directed by the LHE Director.

The LHE Operator's responsibilities shall include the following:

(a) reviewing the requirements for the LHE with the LHE Director before LHE operations.

(b) knowing what types of site conditions could adversely affect the operation of the LHE and consulting with the LHE Director concerning the possible presence of those conditions.

(c) understanding and applying the information contained in the LHE manufacturer's operating manual.

(d) understanding the LHE's functions and limitations as well as its particular operating characteristics.

(e) using the LHE's load/capacity chart(s) and diagrams and applying all notes and warnings related to the charts to confirm the correct LHE configuration to suit the load, site, and load handling conditions.

(f) refusing to operate the LHE when any portion of the load or LHE could be adversely affected by proximity to energized sources until evaluated and approved by a qualified person.

(g) performing inspections as specified in the applicable chapter.

(h) promptly reporting the need for any adjustments or repairs.

(i) following applicable lock out/tag out procedures.

(j) not operating the LHE when physically or mentally unfit.

(k) ensuring that all controls are in the off or neutral position and that all personnel are in the clear before energizing the LHE.

(l) not engaging in any practice that will divert his attention while actually operating the LHE controls.

(m) testing the LHE function controls that will be used and operating the LHE only if those function controls respond properly.

(n) operating the LHE's functions, under normal operating conditions, in a smooth and controlled manner.

(o) knowing and following the procedures specified by the LHE manufacturer or approved by a qualified person for assembly, disassembly, and setting up the LHE.

(p) knowing how to travel the LHE, if applicable.

(q) ensuring that the load and rigging weight(s) have been provided.

(r) calculating or determining the rated load for all configurations that will be used and verifying, using the load/capacity chart(s), that the LHE has sufficient capacity for the proposed LHE operation.

(s) considering all factors known that might affect the LHE capacity and informing the LHE Director of the need to make appropriate adjustments.

(t) knowing the standard and special signals as specified in the applicable chapter and responding to such signals from the signalperson. When a signalperson is not required, the LHE Operator is then responsible for

the movement of the LHE. However, the LHE Operator shall obey a stop signal at all times, no matter who gives it.

(u) understanding basic load rigging procedures. For responsibility of rigging the load and ensuring that the load is rigged properly; see paras. 1-0.4.2.2(l) and 1-0.4.2.2(m)

(v) if power fails during LHE operations

(1) set all LHE locking devices

(2) move all LHE power controls to the OFF or neutral position

(3) secure and stabilize the load, if practical

(w) before leaving the LHE unattended

(1) secure and stabilize the load

(2) set all LHE locking devices

(3) put LHE controls in the OFF or neutral position

(4) turn off the LHE power source

(5) follow the recommendations of the LHE manufacturer or a qualified person for securing the LHE

1-0.4.4 Standard Hand Signals

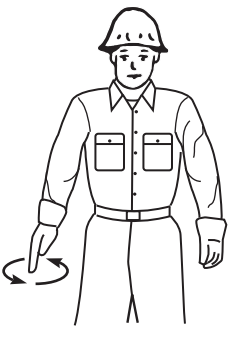
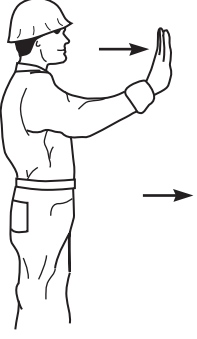
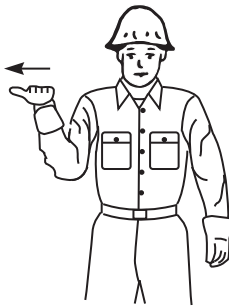
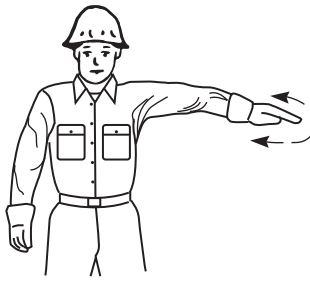
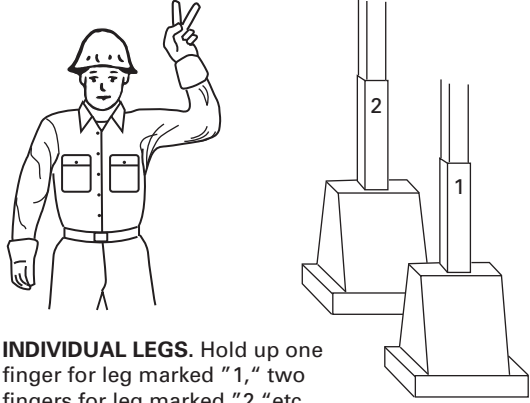
See Fig. 1-0.4.4-1.

SECTION 1-0.5: REFERENCE

Recommended Practices for Telescopic Hydraulic Gantry Systems

Publisher: Specialized Carriers & Rigging Association,
5870 Trinity Parkway, Suite 200, Centreville, VA 20120
(www.scranet.org)

(15) **Fig. 1-0.4.4-1 Standard Hand Signals When Using Jacks, Industrial Rollers, Air Casters, and Telescopic Hydraulic Gantry Systems**

 RAISE. With forearm vertical, forefinger pointing up, move hand in small horizontal circle.	 LOWER. With arm extended downward, forefinger pointing down, move hand in small horizontal circle.	 GANTRY TRAVEL. Arm extended forward, hand open and slightly raised, make pushing motion in direction of travel.
 SIDE SHIFT. Palm up, fingers closed, thumb pointing in direction of motion, jerk hand horizontally.	 STOP. Arm extended, palm down, move arm back and forth horizontally.	 EMERGENCY STOP. Both arms extended, palms down, move arms back and forth horizontally.
 DOG EVERYTHING. Clasp hands in front of body.	 INDIVIDUAL LEGS. Hold up one finger for leg marked "1," two fingers for leg marked "2," etc. Regular signals follow.	

Chapter 1-1

Mechanical Jacks

SECTION 1-1.0: SCOPE

This Chapter applies to mechanical jacks.

SECTION 1-1.1: TYPES AND DESIGN

(15) 1-1.1.1 Types

(a) Types are screw and ratchet style (see Figs. 1-1.1.1-1 through 1-1.1.1-4) and are primarily used in a vertical position.

(b) All jacks covered by this Chapter shall incorporate a positive stop or method to prevent over travel.

1-1.1.2 Design

(a) The load-bearing materials in the jack shall have sufficient strength and ductility to raise, lower, and support the rated load at the temperatures at which it will be used.

(b) The jack shall be designed to meet the proof load requirements in para. 1-1.4.2(a).

(c) The jack should be designed to ensure that the computed stress in the structural components of the jack does not exceed 50% of the yield strength of the material at the appropriate rated load for the components.

(d) Control parts and accessory equipment shall be designed to provide a means of operation and adjustment that will minimize exposure of the operator to injury.

(e) Carrying handles, if provided, shall be capable of statically supporting 200% of the weight of the jack.

(f) Changes in physical properties caused by welding handles, eyes, or other approved attachments to a mechanical jack shall be taken into account.

SECTION 1-1.2: DESIGN FACTOR

The design factor for mechanical jacks shall be determined by the manufacturer.

SECTION 1-1.3: RATED LOADS

Rated load shall be established by the mechanical jack manufacturer.

SECTION 1-1.4: PROOF TEST AND PROOF LOAD

1-1.4.1 Proof Test Requirements

(a) Each newly designed mechanical jack shall be proof tested by the manufacturer.

(b) All newly manufactured mechanical jacks shall be proof tested by the manufacturer with the jack extended to a point of at least 25% of travel.

(c) The manufacturer or a qualified person shall determine if a proof test is required for any altered, modified, or repaired mechanical jack.

(d) After proof testing, the mechanical jack shall be thoroughly inspected for the conditions stated in para. 1-1.8.4.

1-1.4.2 Proof Load Requirements

(a) When proof testing a newly designed mechanical jack

(1) the jack's load point shall be loaded to 110% of its lifting rated load and operated to its full length of travel through ten cycles (dynamic test).

(2) the jack's load point shall be loaded three times to 150% of its rated load. The rack bar or screw shall be at least 90% of full travel. After this test, the jack shall be functional for full extension under 100% of rated load (static test).

(3) each auxiliary load point shall be proof tested in accordance with the same cycles and percentages described in paras. 1-1.4.2(a)(1) and (2).

(b) The proof load for each newly manufactured mechanical jack shall be a minimum of 100% of the rated load.

(c) The proof load for each altered, modified, or repaired mechanical jack shall be a minimum of 100% of the rated load unless otherwise determined by the manufacturer or a qualified person.

SECTION 1-1.5: IDENTIFICATION

1-1.5.1 Marking

Each new mechanical jack shall have forged, cast, die stamped, etched, or fixed label markings by the manufacturer to show

(a) name or trademark of manufacturer

(b) rated load of the load point and auxiliary load point, if different

(c) model number or tracing code

(d) jack handle length and force required

1-1.5.2 Maintenance of Identification

Mechanical jack identification should be maintained by the user so as to be legible throughout the life of the jack.

Fig. 1-1.1.1-1 Ratchet Jack

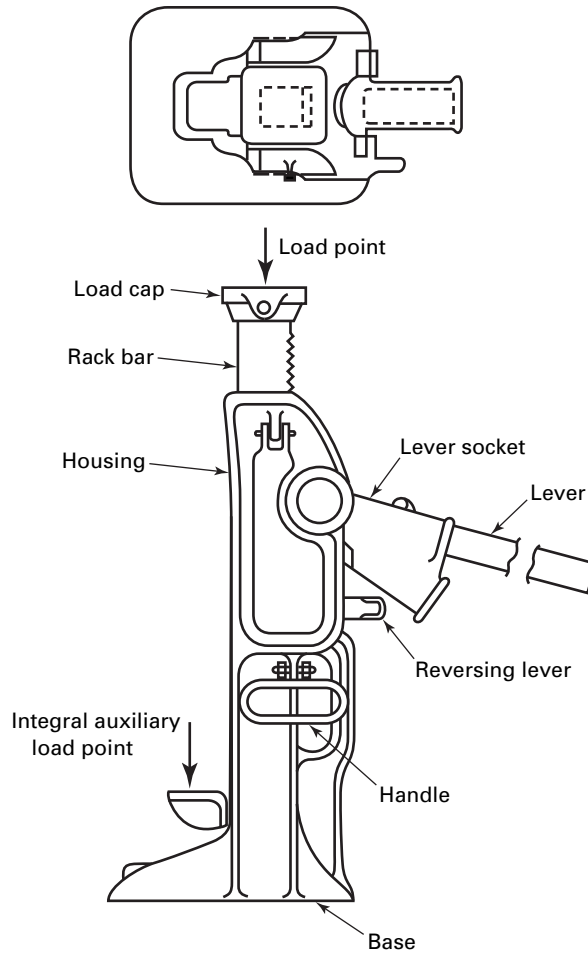


Fig. 1-1.1.1-2 Screw Jack

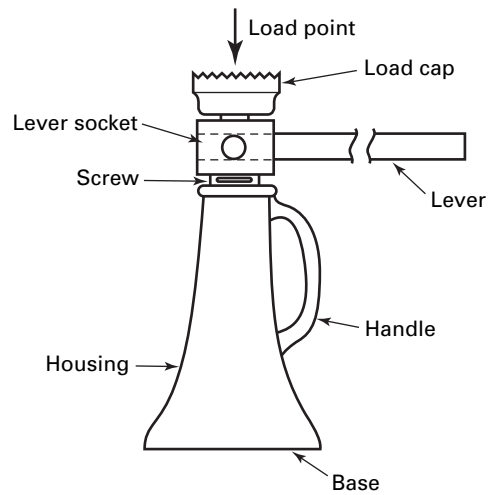


Fig. 1-1.1.1-3 Power-Driven Screw Jack

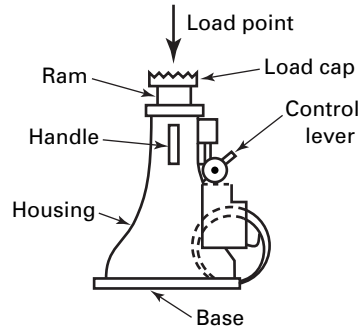
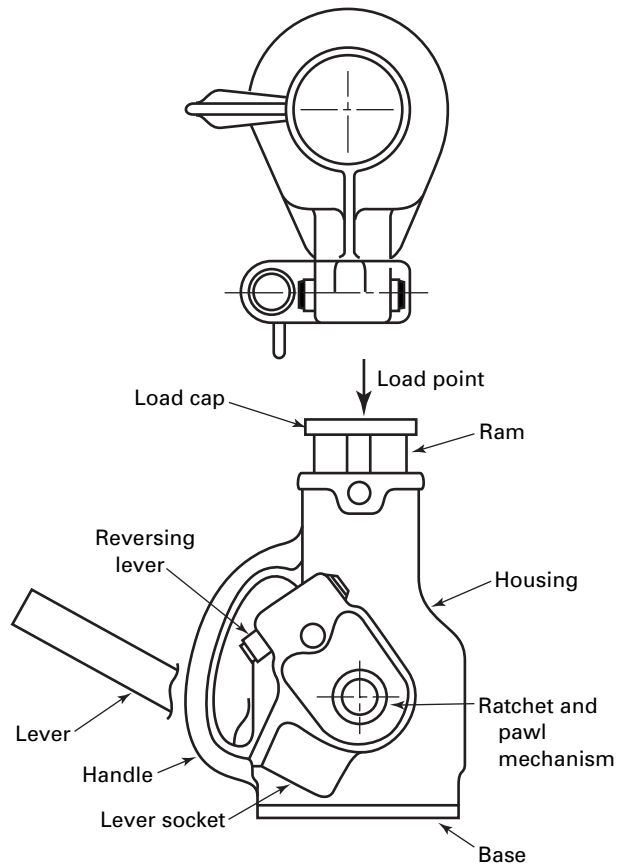


Fig. 1-1.1.1-4 Screw Jack With Ratchet



SECTION 1-1.6: EFFECTS OF ENVIRONMENT

1-1.6.1 Temperature

When mechanical jacks are to be used at temperatures above 140°F (60°C) or below -20°F (-29°C), the jack manufacturer or a qualified person should be consulted.

1-1.6.2 Chemically Active Environments

The strength and operation of mechanical jacks can be affected by chemically active environments such as caustic or acid substances or fumes. The jack manufacturer or a qualified person should be consulted before mechanical jacks are used in chemically active environments.

1-1.6.3 Other Environments

The internal workings of jacks can be affected by high moisture, gravel or sand, silt, grit, or other dust-laden air. Jacks subject to these environments should have their inner components frequently cleaned, inspected, and lubricated.

SECTION 1-1.7: INSTRUCTIONS AND TRAINING

1-1.7.1 Instructions

The manufacturer shall furnish information about jack selection, inspection, maintenance, cautions to personnel, effects of environment, and operating practices with each jack.

(15) 1-1.7.2 Training

Mechanical jack users shall be trained in the selection, inspection, maintenance, cautions to personnel, effects of environment, and operating practices as addressed by this Chapter and the manufacturer's instructions.

(15) SECTION 1-1.8: INSPECTION, REPAIR, AND REMOVAL

All inspections shall be performed by a designated person. Any deficiencies identified shall be examined and a determination made by a qualified person as to whether they constitute a hazard.

1-1.8.1 Initial Inspection

Prior to use, all new, altered, modified, or repaired mechanical jacks shall be inspected to verify compliance with the applicable provisions of this Chapter. Written records are not required.

1-1.8.2 Frequent Inspection

(a) A visual and functional inspection shall be performed each shift before the mechanical jack is used.

(b) Conditions such as those listed in para. 1-1.8.4 or any other condition that may be a hazard shall cause the mechanical jack to be removed from service. Mechanical

jacks shall not be returned to service until approved by a qualified person.

(c) Written records are not required for frequent inspections.

1-1.8.3 Periodic Inspection

(a) A complete inspection of the mechanical jack shall be performed. The jack shall be examined for conditions such as those listed in para. 1-1.8.4, and a determination made as to whether they constitute a hazard.

(b) *Periodic Inspection Frequency.* Periodic inspection intervals shall not exceed 12 months. The frequency of inspections should be based on

- (1) frequency of use
- (2) severity of service conditions
- (3) nature of jacking activity
- (4) experience gained on the service life of mechanical jacks used in similar circumstances
- (5) guidelines for the time intervals listed below
 - (-a) normal service — 1 month to 12 months
 - (-b) severe service — daily to monthly
 - (-c) special service — as recommended by a qualified person

(c) If external appearances suggest internal damage, the jack shall be disassembled for cleaning and examined for internal wear or damage. The disassembly, inspection, and reassembly shall be performed by an authorized service center or under the supervision of a qualified person.

(d) A mechanical jack that has been idle for more than 12 months shall be inspected prior to use, and subject to the removal criteria in para. 1-1.8.4.

(e) Dated inspection records should be kept on all periodic inspections. A nondestructive external coded mark, tag, or other method of recording the inspection is acceptable in lieu of written records.

1-1.8.4 Removal Criteria

Mechanical jacks shall be removed from service if damage such as the following is present and shall only be returned to service when approved by a qualified person:

- (a) missing or illegible identification
- (b) pawl or rack teeth that are chipped, cracked, broken, or excessively worn
- (c) cracked or damaged housing
- (d) excessive pitting or corrosion
- (e) excessive nicks or gouges
- (f) improper engagement between rack bar and the pawls or wear plate
- (g) indications of structural damage due to heat, or evidence of unauthorized welding
- (h) excessive wear, bending, or other damage to threads
- (i) improperly functioning or damaged load cap or integral auxiliary load point

- (j) loose bolts or rivets
- (k) damaged or improperly assembled accessory equipment
- (l) other conditions including visible damage that cause doubt as to the continued use of the mechanical jack
- (m) other items as specified in manufacturer's instruction that may affect operation

1-1.8.5 Repairs and Modifications

- (a) Repairs, alterations, or modifications shall be as specified by the mechanical jack manufacturer or a qualified person.
- (b) All replacement parts including pins, bolts, caps, and keepers shall meet or exceed the original equipment manufacturer's specifications.

SECTION 1-1.9: OPERATING PRACTICES

1-1.9.1 Mechanical Jack Selection

- (a) Mechanical jacks shall be selected for the type of load and environment in accordance with the recommendations of the manufacturer or a qualified person.
- (b) The rated load of the mechanical jack shall not be exceeded.
- (c) Mechanical jacks shall not be used until inspected and accepted as usable under Section 1-1.8.

(15) 1-1.9.2 Maintenance

- (a) A preventive maintenance program shall be established and should be based on the recommendations outlined in the air caster manufacturer's manual.
- (b) All moving parts of the jack should be regularly cleaned.
- (c) Lubricate parts as required by the manufacturer's specifications. The type of lubricant should be as specified by the manufacturer or a qualified person. Lubrication systems should be checked to verify proper operation.
- (d) If additional maintenance is required, it should be completed in accordance with the instructions of the manufacturer or qualified person.

1-1.9.3 Storage

- (a) Mechanical jacks should be stored in an area where they will not be subjected to damage.
- (b) If extreme temperatures or chemically active or abrasive environments are involved, the guidance provided in Section 1-1.6 shall be followed.

(15) 1-1.9.4 Cautions to Personnel

- (a) Personnel shall not place any part of their body between the jack and the load during load handling operations.
- (b) Personnel shall not place any part of their body under a load supported by a jack.

(c) Personnel should not place any part of their body under blocking that is positioned to support the load, when the load is supported by a jack.

- (d) Personnel shall not straddle the handle of the jack.
- (e) Personnel should ensure there is sufficient swing area to avoid pinch points while using the jack handle.
- (f) Personnel should not be on a load supported by jacks.

(g) The jack operator should have firm footing and handle control while operating the jack.

(h) Unsynchronized operation of multiple ratchet jacks may produce increased or uncontrollable handle force.

(i) Personnel should avoid placing their head in the swing arc of the handle. Ratchet jack handles may produce sudden kickback while lifting or lowering the load. Ensure the handle load has been transferred to the jack before releasing the handle.

1-1.9.5 Jacking Practices

1-1.9.5.1 General

- (a) All mechanical jacks shall be used according to the manufacturer's recommendations.
- (b) A plan should be developed and communicated to affected personnel before the jacking operation begins. The plan should include load handling procedures and communication methods.
- (c) A piece of wood or other compressible material should be used between the jack load point and the load surface to promote the mating of the two surfaces and increase friction.
- (d) Off-center loading of the primary load point should be avoided.
- (e) When jacking, ensure that the load avoids contact with any obstructions.
- (f) When jacking, ensure that the primary or auxiliary load point is properly positioned under the load to avoid tip- or edge-loading.
- (g) When jacking one side or end of a load, ensure the opposing side or end is stabilized with sufficient blocking.
- (h) When jacking a load, it should be raised in stages. Jack one side or end, insert blocking, and lower the load down to the blocking. Jack from the opposite side or end, insert blocking, and then lower down to blocking. Reverse this process when lowering the load.
- (i) The jack handle, primary and auxiliary load points, and the jack base should be free of slippery material or fluids.

(j) When jacking, a load should be raised or lowered in a limited range. Avoid jacking the side or end of the load more than 4-in. lift over a 100-in. run (4% grade) unless approved by the manufacturer or a qualified person.

(k) When lifting one side of an object with a high center of gravity, personnel should be on the side of the load that is being lifted.

(l) After the raising or lowering operation is completed, remove the jack handle from the socket to avoid accidental dislocation of the jack and to reduce the tripping hazard.

(m) A load shall not be left unattended while supported by jacks. Blocking should be used to support unattended loads.

(n) The load weight and center of gravity shall be determined prior to selecting and placing jacks and blocking.

(o) Before jacking a load, consideration shall be given to fluids or other shifting materials that can change the location of the center of gravity.

(p) The base of the jack should be supported by a hard level surface (such as concrete, steel, or wood blocking) capable of supporting the load.

(q) The force of the jack's load point should be placed or distributed to prevent damage to the load.

(r) A jack handle of the size and length specified by the manufacturer shall be used. Never use an over length jack handle, extender, or "cheater pipe" over the handle.

(s) Ensure there is adequate range of motion for the jack handle to completely engage the operating linkage of the jack.

(15) 1-1.9.5.2 Communication

(a) Communication between personnel involved in the lift operation shall be maintained continuously during all jack movement. If at any time communication is disrupted, the jack operator(s) shall stop all movements until communication is restored.

(b) Signals to the jack operator should be in accordance with the standards prescribed in Fig. 1-0.4.4-1. If special signals are required, they shall be agreed upon by the load handling personnel prior to jacking operations. Signals shall be discernible or audible at all times. No action shall be taken unless signals are clearly understood.

(c) Jack operators shall obey any stop signal.

1-1.9.5.3 Synchronized Lifts

(a) When using jacks to lift the entire load in a synchronized lift, uneven raising and lowering can cause cross loading, instability, and overloading.

(b) Some loads may require multiple lifting points and complex lifting procedures. A qualified person shall analyze the operation and instruct all personnel involved in the proper selection and positioning of the jacks and the movements to be made.

(c) When using multiple ratchet jacks simultaneously, ensure they are identical type (manufacturer, make, model, and capacity), or lifting rate to ensure they are evenly loaded during jacking.

(d) Unsynchronized lowering can cause an overload to a jack and may result in kickback of the jack handle or instability of the load.

1-1.9.5.4 Blocking

(a) While jacking, blocking should follow the load up or down to serve as an arresting device if the load falls.

(b) Wedges or shims should be used as necessary to ensure the load is completely supported at its blocking points.

(c) Blocking should never be taller than twice the width of the blocking base.

(d) Blocking shall be of sufficient thickness, width, and length to prevent shifting, toppling, or excessive settlement of the load.

(e) Blocking shall be of sufficient strength to prevent crushing, bending failure or shear failure, and to adequately transmit the load's weight to the supporting surface.

1-1.9.5.5 Horizontal Jacking

(a) Applications may arise where jacks are used in a position other than vertical. These applications, referred to as horizontal jacking, require special attention.

(b) Horizontal jacking shall comply with the requirements of Section 1-1.9, Operating Practices, as applicable.

(c) A plan shall be developed and communicated to affected personnel before horizontal jacking operations begin. The plan shall consider but not be limited to the following:

- (1) load weight
- (2) effects of friction
- (3) angle from horizontal plane
- (4) load stability and control
- (5) obstructions
- (6) jack base support
- (7) jack support
- (8) load contact point
- (9) handle clearance
- (10) center of gravity of the load
- (11) personnel safety

(d) When jacking horizontally, the base of the jack should be perpendicular to the direction of load movement.

(e) If multiple jacks are used, maintain parallel lines of force to prevent side loading of the jacks.

Chapter 1-2

Hydraulic Jacks

SECTION 1-2.0: SCOPE

This Chapter applies to hydraulic jacks.

SECTION 1-2.1: TYPES AND DESIGN

(15) 1-2.1.1 Types

(a) Types include single-acting and double-acting hydraulic style (see Figs. 1-2.1.1-1 through 1-2.1.1-3) and are primarily used in a vertical position.

(b) All jacks covered by this Chapter shall incorporate a positive stop or method to prevent overtravel, but the stop shall not alter the operating characteristics of the jack.

1-2.1.2 Design

(a) The load-bearing materials in the jack shall have sufficient strength and ductility to raise, lower, and support the rated load at the temperatures at which it will be used.

(b) The jack shall be designed to meet the proof load requirements in para. 1-2.4.2(a).

(c) The jack should be designed to ensure that the computed stress in the structural components of the jack does not exceed 50% of the yield strength of the material at the appropriate rated load for the components.

(d) Control parts and accessory equipment shall be designed to provide a means of operation and adjustment that will minimize exposure of the operator to injury.

(e) Carrying handles, if provided, shall be capable of statically supporting 200% of the weight of the jack.

(f) Each double-acting hydraulic jack shall be fitted with a relief valve on the retract circuit, which allows hydraulic fluid to flow from the smaller effective area of the jack. A flow-restricting component shall not be present between the relief valve and the smaller area.

(g) Changes in physical properties caused by welding handles, eyes, or other approved attachments to a hydraulic jack shall be taken into account.

SECTION 1-2.2: DESIGN FACTOR

The design factor for hydraulic jacks shall be determined by the manufacturer.

SECTION 1-2.3: RATED LOADS

Rated load shall be established by the hydraulic jack manufacturer.

SECTION 1-2.4: PROOF TEST AND PROOF LOAD

1-2.4.1 Proof Test Requirements

(a) Each newly designed hydraulic jack shall be proof tested by the manufacturer.

(b) All newly manufactured hydraulic jacks shall be proof tested by the manufacturer with the jack extended to a point of at least 25% of travel for single-stage types, and sufficient travel to ensure testing of all stages for multiple-stage or threaded extension-type jacks.

(c) The manufacturer or a qualified person shall determine if a proof test is required for any altered, modified, or repaired hydraulic jack.

(d) After proof testing, the hydraulic jack shall be thoroughly inspected for the conditions stated in para. 1-2.8.4.

1-2.4.2 Proof Load Requirements

(a) When proof loading a newly designed hydraulic jack

(1) the jack's load point shall be loaded to 110% of its lifting rated load and operated to its full length of travel through ten cycles (dynamic test).

(2) the jack or cylinder's load point shall be loaded 3 times to 150% of its rated load. The ram(s) and screw extension shall be extended to at least 90% of full travel. After this test, the jack shall be functional for full extension under 100% of rated load (static test) and be free of leaks.

(3) each auxiliary load point shall be proof tested in accordance with the same cycles and percentages described in paras. 1-2.4.2(a)(1) and (2).

(b) The proof load for each newly manufactured hydraulic jack shall be a minimum of 100% of the rated load.

(c) The proof load for each altered, modified, or repaired hydraulic jack shall be a minimum of 100% of the rated load unless otherwise determined by the manufacturer or a qualified person.

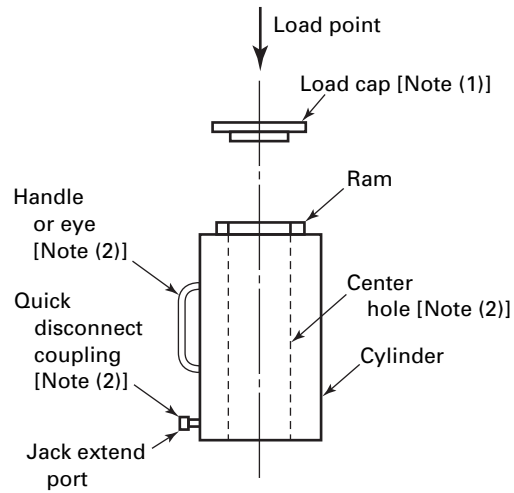
SECTION 1-2.5: IDENTIFICATION

1-2.5.1 Marking

Each new hydraulic jack shall have forged, cast, die-stamped, etched, or fixed-label markings by the manufacturer to show

(a) name or trademark of manufacturer

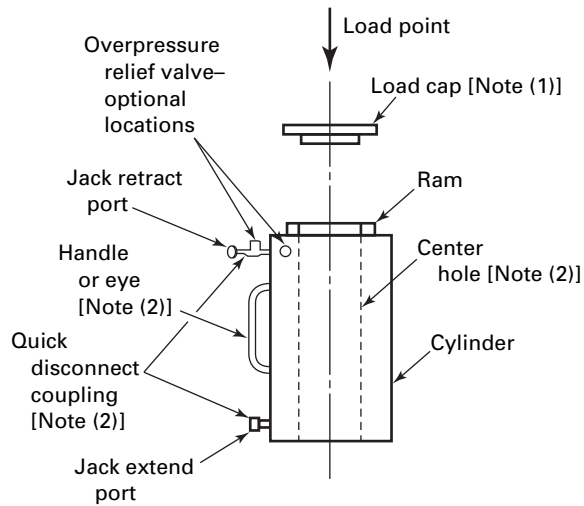
Fig. 1-2.1.1-1 Single-Acting Hydraulic Jack



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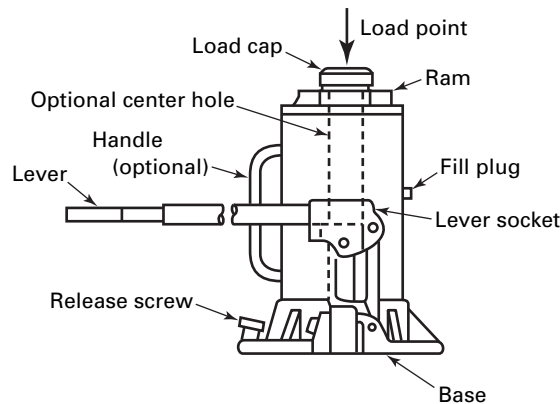
- (1) If required by jack manufacturer.
- (2) Optional.

Fig. 1-2.1.1-2 Double-Acting Hydraulic Jack



NOTES:

- (1) If required by jack manufacturer.
- (2) Optional.

Fig. 1-2.1.1-3 Self-Contained Hydraulic Jack

(b) rated load of the load point and auxiliary load point if different

(c) model number or tracing code

(d) the maximum hydraulic pressure for single- or double-acting jacks

1-2.5.2 Maintenance of Identification

Hydraulic jack identification should be maintained by the user so as to be legible throughout the life of the hydraulic jack.

SECTION 1-2.6: EFFECTS OF ENVIRONMENT

1-2.6.1 Temperature

When hydraulic jacks are to be used at temperatures above 140°F (60°C) or below -20°F (-29°C), the hydraulic jack manufacturer or a qualified person should be consulted.

1-2.6.2 Chemically Active Environments

The strength and operation of hydraulic jacks can be affected by chemically active environments such as caustic or acid substances or fumes. The jack manufacturer or a qualified person should be consulted before hydraulic jacks are used in chemically active environments.

1-2.6.3 Other Environments

The internal workings of jacks can be affected by high moisture, gravel or sand, silt, grit, or other dust-laden air. Contaminated fluid can affect the operation of jacks. Jacks subject to these environments should have their components frequently cleaned and inspected.

SECTION 1-2.7: INSTRUCTIONS AND TRAINING

1-2.7.1 Instructions

The manufacturer shall furnish information about jack selection, inspection, maintenance, cautions to personnel, effects of environment, and operating practices with each jack.

1-2.7.2 Training

(15)

Hydraulic jack users shall be trained in the selection, inspection, maintenance, cautions to personnel, effects of environment, and operating practices as addressed by this Chapter and the manufacturer's instructions.

SECTION 1-2.8: INSPECTION, REPAIR, AND REMOVAL

(15)

All inspections shall be performed by a designated person. Any deficiencies identified shall be examined and a determination made by a qualified person as to whether they constitute a hazard.

1-2.8.1 Initial Inspection

Prior to use, all new, altered, modified, or repaired hydraulic jacks shall be inspected by a designated person to verify compliance with the applicable provisions of this Chapter. Written records are not required.

1-2.8.2 Frequent Inspection

(a) A visual and functional inspection shall be performed each shift before the hydraulic jack is used.

(b) Conditions such as those listed in para. 1-2.8.4, or any other condition that may be a hazard, shall cause the hydraulic jack to be removed from service. Hydraulic jacks shall not be returned to service until approved by a qualified person.

(c) Written records are not required for frequent inspections.

1-2.8.3 Periodic Inspection

(a) A complete inspection of the hydraulic jack shall be performed. The jack shall be examined for conditions such as those listed in para. 1-2.8.4, and a determination made as to whether they constitute a hazard.

(b) *Periodic Inspection Frequency.* Periodic inspection intervals shall not exceed 12 months. The frequency of inspections should be based on

(1) frequency of use

- (2) severity of service conditions
- (3) nature of jacking activity
- (4) experience gained on the service life of hydraulic jacks used in similar circumstances
- (5) guidelines for the time intervals listed below
 - (-a) normal service — 1 month to 12 months
 - (-b) severe service — daily to monthly
 - (-c) special service — as recommended by a qualified person
- (c) If external appearances suggest internal damage, the jack shall be disassembled for cleaning and examined for internal wear or damage. The disassembly, inspection, and reassembly shall be performed by an authorized service center or under the supervision of a qualified person.
- (d) A hydraulic jack that has been idle for more than 12 months shall be inspected prior to use, and subject to the removal criteria in para. 1-2.8.4.
- (e) Dated inspection records should be kept on all periodic inspections. A nondestructive external coded mark, tag, or other method of recording the inspection is acceptable in lieu of written records.

1-2.8.4 Removal Criteria

Hydraulic jacks shall be removed from service if damage such as the following is present and shall only be returned to service when approved by a qualified person:

- (a) excessively worn, scored, cracked, bent, or broken ram
- (b) cracked or broken jack housing or cylinder
- (c) internal or external hydraulic fluid leak
- (d) damaged seals or valves
- (e) excessive pitting or corrosion
- (f) excessive nicks or gouges
- (g) missing or illegible identification
- (h) indications of structural damage due to heat, or evidence of unauthorized welding
- (i) improperly functioning or damaged load cap or integral auxiliary load point
- (j) loose structural bolts or rivets
- (k) worn or damaged load-bearing threads
- (l) damaged or improperly assembled accessory equipment
- (m) missing relief valve for double-acting jack
- (n) damaged or severely worn hoses or couplings
- (o) contaminated hydraulic fluid
- (p) other conditions including visible damage that cause doubt as to the continued use of the hydraulic jack
- (q) other items as specified in manufacturer's instruction that may affect operation

1-2.8.5 Repairs and Modifications

(a) Repairs, alterations, or modifications shall be as specified by the hydraulic jack manufacturer or a qualified person.

(b) All replacement parts including the ram, hoses, couplings, seals, valves, and caps shall meet or exceed the original equipment manufacturer's specifications.

SECTION 1-2.9: OPERATING PRACTICES

1-2.9.1 Hydraulic Jack Selection

(a) Hydraulic jacks shall be selected for the type of load and environment in accordance with the recommendations of the manufacturer or a qualified person.

(b) The rated load of the hydraulic jack shall not be exceeded.

(c) Hydraulic jacks shall not be used until inspected and accepted as usable under Section 1-2.8.

(d) The components of remote control jacks should have compatible pressure ratings to avoid overloading the jack.

(e) Gages should be used to assist the jack operator in determining jack loading. Check-valves or load-holding valves should be used to prevent uncontrolled lowering.

1-2.9.2 Maintenance

(15)

(a) A preventive maintenance program shall be established and should be based on the recommendations outlined in the hydraulic jack manufacturer's manual.

(b) All moving parts of the jack requiring lubrication should be regularly lubricated. Hydraulic jack fluid systems should be checked to verify proper operation and the type of fluid should be as specified by the manufacturer or a qualified person.

(c) The ram should be cleaned and seals replaced as necessary.

(d) If additional maintenance is required, it should be completed in accordance with the instructions of the manufacturer or qualified person.

1-2.9.3 Storage

(a) Hydraulic jacks should be stored in a vertical position and in an area where they will not be subjected to damage.

(b) If extreme temperatures or chemically active or abrasive environments are involved, the guidance provided in Section 1-2.6 shall be followed.

1-2.9.4 Cautions to Personnel

(15)

(a) Personnel shall not place any part of their body between the jack and the load during load handling operations.

(b) Personnel shall not place any part of their body under a load supported by a jack.

(c) Personnel should not place any part of their body under blocking that is positioned to support the load, when the load is supported by a jack.

(d) Personnel should ensure there is sufficient swing area to avoid pinch points while using the jack handle.

(e) Personnel should not be on a load supported by jacks.

(f) The jack operator should have firm footing and handle control while operating the jack.

1-2.9.5 Jacking Practices

1-2.9.5.1 General

(a) All hydraulic jacks shall be used according to the manufacturer's recommendations.

(b) A plan should be developed and communicated to affected personnel before the jacking operation begins. The plan should include load-handling procedures and communication methods.

(c) A piece of wood or other compressible material should be used between the jack load point and the load surface to promote the mating of the two surfaces and increase friction.

(d) Off-center loading of the primary load point should be avoided.

(e) When jacking, ensure that the load avoids contact with any obstructions.

(f) When jacking, ensure that the primary or auxiliary load point is properly positioned under the load to avoid tip or edge loading.

(g) When jacking one side or end of a load, ensure the opposing side or end is stabilized with sufficient blocking.

(h) When jacking a load, it should be raised in stages. Jack one side or end, insert blocking, and lower the load down to the blocking. Jack from the opposite side or end, insert blocking, and then lower down to the blocking. Reverse this process when lowering the load.

(i) The jack handle, primary and auxiliary load points, and the jack base should be free of slippery material or fluids.

(j) When jacking, a load should be raised or lowered in a limited range. Avoid jacking the side or end of the load more than 4-in. lift over a 100-in. run (4% grade) unless approved by the manufacturer or a qualified person.

(k) When lifting one side of an object with a high center of gravity, personnel should be on the side of the load that is being lifted.

(l) After the raising or lowering operation is completed with a self-contained hydraulic jack, the operator should remove the jack handle from the socket to avoid accidental dislocation of the jack and to reduce the tripping hazard.

(m) A load shall not be left unattended while supported by a jack under hydraulic pressure. The load should be secured by blocking or by using integral jack locking rings.

(n) The load weight and center of gravity should be determined prior to selecting and placing jacks and blocking.

(o) Before jacking a load, consideration shall be given to fluids or other shifting materials that can change the location of the center of gravity.

(p) The base of the jack should be supported by a hard level surface (such as concrete, steel, or wood blocking) capable of supporting the load.

(q) The force of the jack's load point should be placed or distributed to prevent damage to the load.

(r) A jack handle of the size and length specified by the manufacturer shall be used. Never use an over length jack handle, extender, or "cheater pipe" over the handle.

1-2.9.5.2 Communication

(15)

(a) Communication between personnel involved in the lift operation shall be maintained continuously during all jack movement. If at any time communication is disrupted, the jack operator(s) shall stop all movements until communication is restored.

(b) Signals to the jack operator should be in accordance with the standards prescribed in Fig. 1-0.4.4-1. If special signals are required, they shall be agreed upon by the load-handling personnel prior to jacking operations. Signals shall be discernible or audible at all times. No action shall be taken unless signals are clearly understood.

(c) Jack operators shall obey any stop signal.

1-2.9.5.3 Synchronized Lifts

(a) When using jacks to lift the entire load in a synchronized lift, uneven raising and lowering can cause cross loading, instability, and overloading.

(b) Some loads may require multiple lifting points and complex lifting procedures. A qualified person shall analyze the operation and instruct all personnel involved in the proper selection and positioning of the jacks and the movements to be made.

1-2.9.5.4 Blocking

(a) While jacking, blocking should follow the load up or down to serve as an arresting device if the load falls.

(b) Wedges or shims should be used as necessary to ensure the load is completely supported at its blocking points.

(c) Blocking should never be taller than twice the width of the blocking base.

(d) Blocking shall be of sufficient thickness, width, and length to prevent shifting, toppling, or excessive settlement of the load.

(e) Blocking shall be of sufficient strength to prevent crushing, bending failure, or shear failure, and to adequately transmit the load's weight to the supporting surface.

1-2.9.5.5 Horizontal Jacking

(a) Applications may arise where jacks are used in a position other than vertical. These applications, referred to as horizontal jacking, require special attention.

(b) Horizontal jacking shall comply with the requirements of Section 1-2.9, Operating Practices, as applicable.

(c) A plan shall be developed and communicated to affected personnel before horizontal jacking operations begin. The plan shall consider but not be limited to the following:

- (1) load weight
- (2) effects of friction

(3) angle from horizontal plane

(4) load stability and control

(5) obstructions

(6) jack base support

(7) jack support

(8) load contact point

(9) handle clearance

(10) center of gravity of the load

(11) personnel safety

(d) When jacking horizontally, the base of the jack should be perpendicular to the direction of load movement.

(e) If multiple jacks are used, maintain parallel lines of force to prevent side loading of the jacks.

Chapter 1-3

Air-Lifting Bags

SECTION 1-3.0: SCOPE

This Chapter applies to air-lifting bags.

SECTION 1-3.1: TYPES AND DESIGN

(15) 1-3.1.1 Types

A reinforced, flat, rubberized, single-chamber inflatable bag (see Fig. 1-3.1.1-1) designed to contain air at pressures above 100 psi.

(15) 1-3.1.2 Design

(a) The load-bearing materials in the air-lifting bag shall have sufficient strength to raise, lower, and support the rated load at the temperatures at which it will be used.

(b) The load-bearing materials in the air-lifting bag should provide puncture and abrasion resistance.

(c) The air couplers and interconnect and supply hoses shall be selected for the air pressures and volumes required by the air-lifting bag system.

(d) A pressure gauge shall be provided at the pressure control unit for the air-lifting bag(s).

(e) The pressure control unit shall regulate air pressure to the air-lifting bag(s).

(f) A pressure relief valve shall be installed to prevent over-pressurization of the air-lifting bag(s) under normal operating conditions.

(g) Control parts and accessory equipment shall be designed to provide a means of operation and adjustment that will minimize exposure of the operator to injury.

SECTION 1-3.2: DESIGN FACTOR

The design factor for air-lifting bags shall be at least 4 times the maximum working pressure.

SECTION 1-3.3: RATED LOADS

Rated load shall be established by the air-lifting bag manufacturer.

SECTION 1-3.4: PROOF TEST

1-3.4.1 Proof Test Requirements

(a) All newly manufactured air-lifting bags shall be proof tested by the manufacturer.

(b) Proof testing an altered, modified, or repaired air-lifting bag shall be performed as determined by the manufacturer or a qualified person.

(c) After proof testing, an air-lifting bag shall be thoroughly inspected for the conditions stated in para. 1-3.8.4.

1-3.4.2 Proof Load Requirements

(a) When proof testing a newly manufactured air-lifting bag, the air-lifting bag shall be subjected to at least 200% of the maximum stated working pressure, in an unrestrained condition.

(b) The proof load for each altered, modified, or repaired air-lifting bag shall be a minimum of 100% of the maximum stated working pressure unless otherwise determined by the manufacturer or a qualified person.

SECTION 1-3.5: IDENTIFICATION

1-3.5.1 Marking

Each new air-lifting bag shall have molded, stamped, etched, or fixed label markings by the manufacturer to show

- (a) name or trademark of manufacturer
- (b) rated load
- (c) model number
- (d) serial number
- (e) the maximum allowable air pressure

1-3.5.2 Maintenance of Identification

Air-lifting bag identification should be maintained by the user so as to be legible throughout the life of the air-lifting bag.

SECTION 1-3.6: EFFECTS OF ENVIRONMENT

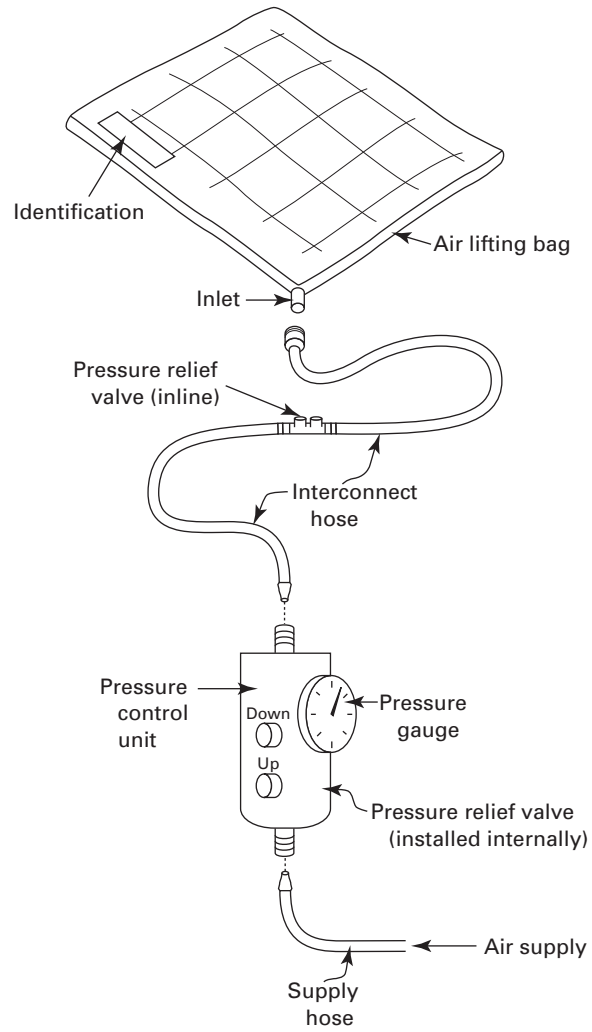
1-3.6.1 Temperature

When air-lifting bags are to be used at temperatures above 150°F (65°C) or below -40°F (-40°C), the air-lifting bag manufacturer or a qualified person should be consulted.

1-3.6.2 Chemically Active Environments

The strength and operation of air-lifting bags can be affected by chemically active environments such as caustic or acid substances or fumes. The air-lifting bag manufacturer's instructions or a qualified person should be

Fig. 1-3.1.1-1 Air-Lifting Bags



consulted before air-lifting bags are used in chemically active environments.

(15) **1-3.6.3 Other Environments**

The internal workings of pressure control units, hoses, and valves can be affected by high moisture, gravel or sand, silt, grit, or other dust-laden air. Air-lifting equipment subject to these environments should have their inner components cleaned, inspected, and lubricated in accordance with subpara. 1-3.8.3(b)(5)(-b).

SECTION 1-3.7: INSTRUCTIONS AND TRAINING

1-3.7.1 Instructions

The manufacturer shall furnish information about air-lifting bag selection, inspection, maintenance, cautions to personnel, effects of environment, and operating practices with each air-lifting bag.

(15) **1-3.7.2 Training**

Air-lifting bag users shall be trained in the selection, inspection, maintenance, cautions to personnel, effects of environment, and operating practices as addressed by this Chapter and the manufacturer's instructions.

(15) **SECTION 1-3.8: INSPECTION, REPAIR, AND REMOVAL FROM SERVICE**

All inspections shall be performed by a designated person. Any deficiencies identified shall be examined and a determination made by a qualified person as to whether they constitute a hazard.

1-3.8.1 Initial Inspection

Prior to use, all new, altered, modified, or repaired air-lifting bags shall be inspected to verify compliance with the applicable provisions of this Chapter. Written records are not required.

1-3.8.2 Frequent Inspection

(a) A visual and functional inspection shall be performed each shift before the air-lifting bag system is used.

(b) Conditions such as those listed in para. 1-3.8.4, or any other condition that may be a hazard, shall cause the air-lifting bag or other system component to be removed from service. An air-lifting bag system component shall not be returned to service until approved by a qualified person.

(c) Written records are not required for frequent inspections.

1-3.8.3 Periodic Inspection

(a) A complete inspection of the air-lifting bag system shall be performed. The system shall be examined for conditions such as those listed in para. 1-3.8.4, and a

determination made as to whether they constitute a hazard.

(b) *Periodic Inspection Frequency.* Periodic inspection intervals shall not exceed 12 months. The frequency of inspections should be based on

- (1) frequency of use
- (2) severity of service conditions
- (3) nature of lifting activity
- (4) experience gained on the service life of air-lifting bags used in similar circumstances
- (5) guidelines for the time intervals are
 - (-a) normal service — 1 month to 12 months
 - (-b) severe service — daily to monthly
 - (-c) special service — as recommended by a qualified person

(c) If the external appearance suggests internal damage, the air-lifting bag system components shall be disassembled for further examination. The disassembly, inspection, and reassembly should be performed by an authorized service center or a qualified person.

(d) An air-lifting bag or system that has been idle for more than 12 months shall be inspected prior to use, and subject to the removal criteria in para. 1-3.8.4.

(e) Dated inspection records should be kept on all periodic inspections. A nondestructive external coded mark, tag, or other method of recording the inspection is acceptable in lieu of written records.

1-3.8.4 Removal Criteria

Air-lifting bag system components shall be removed from service if damage such as the following is visible and shall only be returned to service when approved by a qualified person:

- (a) missing or illegible identification
- (b) air-lifting bag punctures, cuts, abrasions, or surface cracks
- (c) air-lifting bag seam separation
- (d) air-lifting bag ply separation or delamination
- (e) heat or chemical damage
- (f) foreign material embedded in an air-lifting-bag surface
- (g) inhibited air flow from foreign objects
- (h) bent, cracked, or broken fittings, couplers, or valves
- (i) damaged air pressure control unit, gauges, regulators, or other components
- (j) hoses or couplers that are cut, severely abraded, gouged, cracked, or brittle
- (k) faulty engagement between a hose and fitting
- (l) missing, improper, or damaged air hose banding clamps
- (m) damaged or improperly assembled accessory equipment
- (n) missing or damaged O-ring, gasket, or seal on an air connection
- (o) evidence of unauthorized repairs

(p) evidence of ultraviolet ray degradation of synthetic components

(q) missing components or other items as specified in manufacturer's instruction that may affect operation

(r) other conditions including visible damage that cause doubt as to the continued use of the air-lifting bag system

1-3.8.5 Repairs and Modifications

(a) Repairs, alterations, or modifications shall be as specified by the air-lifting bag manufacturer or a qualified person.

(b) All replacement parts including air-lifting bag components, hoses, fittings, regulators, gauges, valves, and accessories shall meet or exceed the original equipment manufacturer's specifications.

SECTION 1-3.9: OPERATING PRACTICES

1-3.9.1 Air-Lifting Bag Selection

(a) Air-lifting bags shall be selected for the type of load and environment in accordance with the recommendations of the manufacturer or a qualified person.

(b) The rated load of the air-lifting bag shall not be exceeded.

(c) Air-lifting bags shall not be used until inspected and accepted as usable under Section 1-3.8.

(15) 1-3.9.2 Maintenance

(a) A preventive maintenance program shall be established and should be based on the recommendations outlined in the air-lifting bag manufacturer's manual.

(b) Keep the external surface of the air-lifting bag free of foreign material by cleaning with mild detergent and water.

(c) Accumulated moisture should be removed from the air-lifting bag system and its components.

(d) If additional maintenance is required, it should be completed in accordance with instructions of the manufacturer or qualified person.

1-3.9.3 Storage

(a) Air-lifting bags should be stored in an area where they will not be subjected to damage.

(b) When storing an air-lifting bag, protect the air inlet fitting from damage.

(c) If extreme temperatures or chemically active or abrasive environments are involved, the guidance provided in Section 1-3.6 shall be followed.

(15) 1-3.9.4 Cautions to Personnel

(a) Personnel shall not place any part of their body between the air-lifting bag and the load during load handling operations.

(b) Personnel shall not place any part of their body under a load supported by an air-lifting bag(s).

(c) Personnel should avoid straddling an air hose in case of unexpected disconnection. Hose restraints should be used at all hose connections.

(d) Route hoses to minimize trip hazards.

(e) Personnel should not be on a load supported by air-lifting bags.

(f) A designated operator shall remain at the pressure control unit while the air-lifting bag system is pressurized.

(g) Personnel should avoid pinch points between the load and surrounding obstructions while the load is in motion.

(h) Personnel shall not place any part of their body between the air-lifting bag and floor surface while pressurized.

(i) Personnel should never disconnect a pressurized air hose.

(j) Personnel shall not ride an air-lifting bag.

(k) When lifting a load on an incline, personnel should remain uphill of the load.

1-3.9.5 Load Handling Practices

(15)

1-3.9.5.1 General

(a) All air-lifting bags shall be used according to the manufacturer's recommendations.

(b) A plan should be developed and communicated to affected personnel before the lifting operation begins. The plan should include load handling procedures and communication methods.

(c) Off-center loading of the air-lifting bag should be avoided.

(d) When lifting, ensure that the load avoids contact with any obstructions.

(e) When lifting one side or end of a load, ensure the opposing side or end is stabilized with sufficient blocking.

(f) When lifting a load, it should be raised in stages. Lift one side or end, insert blocking, and lower the load down to the blocking. Lift from the opposite side or end, insert blocking, and then lower down to blocking. Reverse this process when lowering the load.

(g) The air-lifting bag should be free of slippery material or fluids.

(h) When lifting, a load should be raised or lowered in a limited range. Avoid lifting the side or end of the load more than 4-in. (10-cm) lift over a 100-in. (2.54-m) run (4% grade) unless approved by the manufacturer or a qualified person.

(i) During an air-lifting bag operation, the air supply hoses and the control unit should be arranged to minimize tripping hazards.

(j) A load shall not be left unattended while supported by an air-lifting bag under pressure. The load should be secured by blocking.

(k) The load weight and center of gravity should be determined prior to selecting and placing air-lifting bags and blocking.

(l) Before lifting a load, consideration shall be given to fluids or other shifting materials that can change the location of the center of gravity.

(m) The base of the air-lifting bag should be supported by a surface capable of supporting the load.

(n) The air-lifting bag should be placed so the force of the lifting bag is distributed to prevent damage to the load or bag.

(o) When lifting on an incline, a rectangular air-lifting bag should be used. The long axis of the bag should be in the uphill–downhill direction to inhibit the inflated bag from rolling under the load.

(p) When lifting one side of an object with a high center of gravity, personnel should be on the side of the load that is being lifted.

(q) Blocking should be used to minimize inflation height and maximize lift capacity.

(r) When lifting, never stack more than two air-lifting bags. If stacking two different size bags, place the smaller one on top and inflate the lower bag first.

(s) The air hose should not be used to position the air bag. In hard to reach places, use a tagline.

(t) When operating two or more lifting bags, a different color hose or other identifier for each lifting bag should be used.

(u) To avoid puncturing or cutting an air bag, substantial bearing material should be placed between the air bag and the load.

(v) The air-lifting bag should be inflated only enough to achieve the desired lift.

(w) To inhibit uncontrolled load movement, the pressure control unit should be actuated slowly when lifting or lowering.

(x) All air valves in the pressure control unit should be closed before opening the main air supply valve.

(y) During transport, the air-lifting bags should be carried in such a way to avoid damage to the air inlet nipple.

(15) 1-3.9.5.2 Communication

(a) Communication between personnel involved in the lift operation shall be maintained continuously during all lifting movement. If at any time communication is disrupted, the lift operators shall stop all movements until communication is restored and a proper signal is given and understood.

(b) Signals to the pressure control unit operator should be in accordance with the standards prescribed in Fig. 1-0.4.4-1. If special signals are required, they shall be agreed upon by the load handling personnel prior

to lifting operations. Signals shall be discernible or audible at all times. No action shall be taken unless signals are clearly understood.

(c) Load handling personnel shall obey any stop signal.

1-3.9.5.3 Synchronized Lifts

(a) When using air-lifting bags to lift the entire load in a synchronized lift, uneven raising and lowering can cause cross loading, instability, and overloading.

(b) Some loads may require multiple lifting points and complex lifting procedures. A qualified person shall analyze the operation and instruct all personnel involved in the proper selection and positioning of the lifting bags and the movements to be made.

1-3.9.5.4 Blocking

(a) While lifting, blocking should follow the load up or down to serve as an arresting device if the load falls.

(b) Wedges or shims should be used as necessary to ensure the load is completely supported at its blocking points.

(c) Blocking should never be taller than twice the width of the blocking base.

(d) Blocking shall be of sufficient thickness, width, and length to prevent shifting, toppling, or excessive settlement of the load.

(e) Blocking shall be of sufficient strength to prevent crushing, bending failure, or shear failure, and to adequately transmit the load's weight to the supporting surface.

1-3.9.5.5 Horizontal Jacking

(a) Applications may arise where air-lifting bags are used in a position other than vertical. These applications, referred to as horizontal jacking, require special attention.

(b) Horizontal jacking shall comply with the requirements of Section 1-3.9, Operating Practices, as applicable.

(c) A plan shall be developed and communicated to affected personnel before horizontal jacking operations begin. The plan shall consider but not be limited to the following:

- (1) load weight
- (2) effects of friction
- (3) angle from horizontal plane
- (4) load stability and control
- (5) obstructions
- (6) lifting bag base support
- (7) load contact point
- (8) hose and coupler clearance
- (9) center of gravity of the load
- (10) personnel safety

(d) When jacking horizontally, the base of the air-lifting bag should be perpendicular to the direction of load movement.

Chapter 1-4 Industrial Rollers

SECTION 1-4.0: SCOPE

This Chapter applies to industrial rollers.

SECTION 1-4.1: TYPES AND DESIGN

(15) 1-4.1.1 Types

Types include roller and wheel style (see Figs. 1-4.1.1-1 and 1-4.1.1-2).

1-4.1.2 Design

(a) The load-bearing materials in the industrial roller shall have sufficient strength and ductility to support and move the load at the temperatures at which it will be used.

(b) Control handles and accessory equipment shall be designed to provide a means of control and adjustment that will minimize exposure of the operator to injury.

(c) Carrying handles, if provided, shall be capable of statically supporting 200% of the weight of the industrial roller.

(d) All welding performed on the industrial roller shall be approved by the manufacturer or a qualified person.

SECTION 1-4.2: DESIGN FACTOR

Industrial rollers shall be designed to withstand 2.5 times the rated load without permanent deformation.

SECTION 1-4.3: RATED LOADS

Rated load shall be established by the industrial roller manufacturer.

SECTION 1-4.4: PROOF TEST AND PROOF LOAD

(15) 1-4.4.1 Proof Test Requirements

(a) Each newly designed industrial roller shall be proof tested by the manufacturer.

(b) Newly manufactured industrial rollers are not required to be proof tested unless specified by the purchaser.

(c) The manufacturer or a qualified person shall determine if a proof test is required for any altered, modified, or repaired industrial roller.

(d) After proof testing, the industrial roller shall be thoroughly inspected for the conditions stated in para. 1-4.8.4.

1-4.4.2 Proof Load Requirements

(a) When proof testing a newly designed industrial roller, the industrial roller shall be subjected to a load that is 200% of its rated load with no permanent deformation.

(b) The proof load for each new, altered, modified, or repaired industrial roller shall be a minimum of 150% of the rated load unless otherwise determined by the manufacturer or a qualified person.

SECTION 1-4.5: IDENTIFICATION

1-4.5.1 Marking

Each new industrial roller shall have forged, cast, die stamped, etched, or fixed label markings by the manufacturer to show

- (a) name or trademark of manufacturer
- (b) rated load
- (c) model number or tracing code

1-4.5.2 Maintenance of Identification

Industrial roller identification should be maintained by the user so as to be legible throughout the life of the industrial roller.

SECTION 1-4.6: EFFECTS OF ENVIRONMENT

1-4.6.1 Temperature

When industrial rollers are to be used at temperatures above 140°F (60°C) or below -20°F (-29°C), the industrial roller manufacturer or a qualified person should be consulted.

1-4.6.2 Chemically Active Environments

The strength and operation of industrial rollers can be affected by chemically active environments such as caustic or acid substances or fumes. The industrial roller manufacturer or a qualified person should be consulted before industrial rollers are used in chemically active environments.

Fig. 1-4.1.1-1 Conventional Industrial Roller: Roller Type

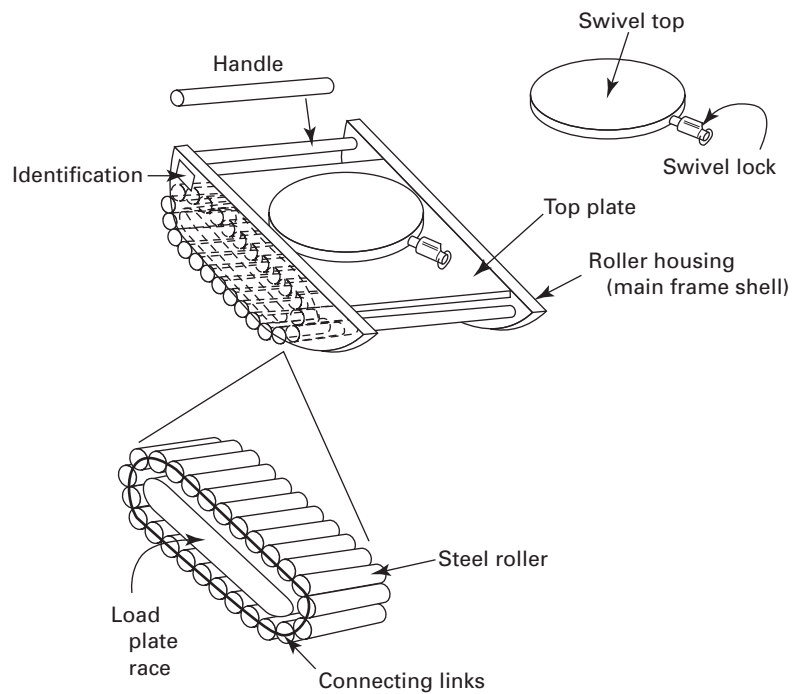
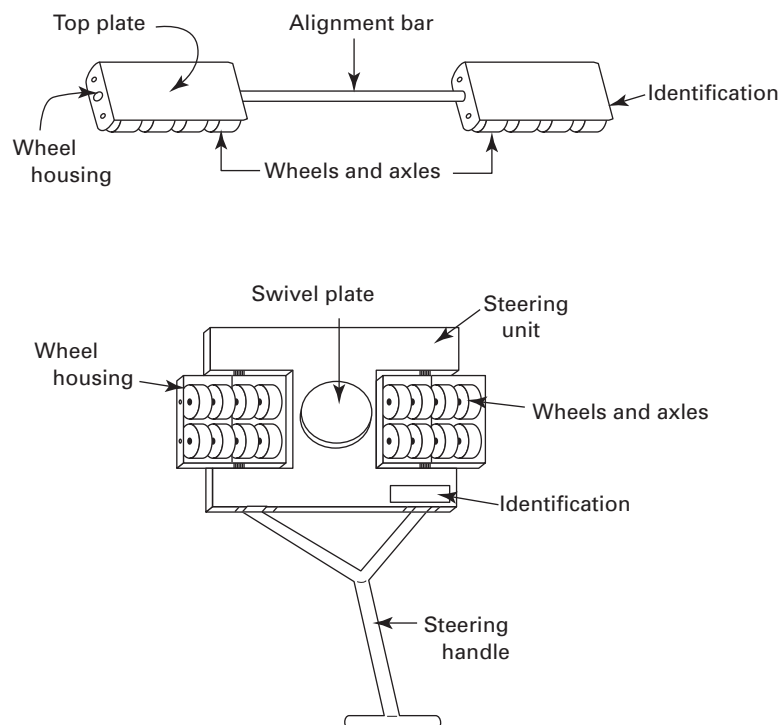


Fig. 1-4.1.1-2 Three-Point Rolling System: Wheel Type



1-4.6.3 Other Environments

Industrial rollers can be affected by high moisture, gravel or sand, silt, grit, or other dust-laden air. Industrial rollers subject to these environments should have their components frequently cleaned, inspected, and lubricated.

SECTION 1-4.7: INSTRUCTIONS AND TRAINING

1-4.7.1 Instructions

The manufacturer shall furnish information about industrial roller selection, inspection, maintenance, cautions to personnel, effects of environment, and operating practices with each set of industrial rollers.

(15) 1-4.7.2 Training

Industrial roller users shall be trained in the selection, inspection, maintenance, cautions to personnel, effects of environment, and operating practices as addressed by this Chapter and the manufacturer's instructions.

(15) SECTION 1-4.8: INSPECTION, REPAIR, AND REMOVAL

All inspections shall be performed by a designated person. Any deficiencies identified shall be examined and a determination made by a qualified person as to whether they constitute a hazard.

1-4.8.1 Initial Inspection

Prior to use, all new, altered, modified, or repaired industrial rollers shall be inspected to verify compliance with the applicable provisions of this Chapter. Written records are not required.

1-4.8.2 Frequent Inspection

(a) A visual and functional inspection shall be performed each shift before the industrial roller is used.

(b) Conditions such as those listed in para. 1-4.8.4 or any other condition that may be a hazard shall cause the industrial roller to be removed from service. Industrial rollers shall not be returned to service until approved by a qualified person.

(c) Written records are not required for frequent inspections.

1-4.8.3 Periodic Inspection

(a) A complete inspection of the industrial roller shall be performed. The industrial roller shall be examined for conditions such as those listed in para. 1-4.8.4 and a determination made as to whether they constitute a hazard.

(b) *Periodic Inspection Frequency.* Periodic inspection intervals shall not exceed 12 months. The frequency of inspections should be based on

(1) frequency of use

(2) severity of service conditions

(3) nature of rolling activity

(4) experience gained on the service life of industrial rollers used in similar circumstances

(5) guidelines for the time intervals listed below

(-a) normal service — 1 month to 12 months

(-b) severe service — daily to monthly

(-c) special service — as recommended by a qualified person

(c) If the inspection indicates possible component damage, the industrial roller shall be disassembled for cleaning and further examination. The disassembly, inspection, and reassembly shall be performed by an authorized service center or under the supervision of a qualified person.

(d) An industrial roller that has been idle for more than 12 months shall be inspected prior to use, and subject to the removal criteria in para. 1-4.8.4.

(e) Dated inspection records should be kept on all periodic inspections. A nondestructive external coded mark, tag, or other method of recording the inspection is acceptable in lieu of written records.

1-4.8.4 Removal Criteria

Industrial rollers shall be removed from service if damage such as the following is present and shall only be returned to service when approved by a qualified person:

(a) rollers or wheels that display cracks, severe gouges, nicks, flat spots, or material loss greater than 10%

(b) wheels or other components that have damaged bushings or bearings

(c) bent, cracked, worn, or broken roller connecting links or wheel axles

(d) bent, cracked, or broken frame, handles, or brackets

(e) cracked or broken welds on load-bearing components

(f) worn, bent, or broken load plate race, pins, or bolts

(g) excessive pitting or corrosion of load-bearing components

(h) indications of structural damage due to heat, or evidence of unauthorized welding

(i) missing or illegible identification

(j) seized or inoperable components that are designed to rotate under load

(k) loose bolts, missing components, or other items as specified in manufacturer's instructions that may affect operation

(l) other conditions including visible damage that cause doubt as to the continued use of the industrial roller

1-4.8.5 Repairs and Modifications

(a) Repairs, alterations, or modifications shall be as specified by the industrial roller manufacturer or a qualified person.

(b) All replacement parts including pins, bolts, links, rollers, axles, wheels, or keepers shall meet or exceed the original equipment manufacturer's specifications.

SECTION 1-4.9 OPERATING PRACTICES

1-4.9.1 Industrial Roller Selection

(a) Industrial rollers shall be selected for the type of load and environment in accordance with the recommendations of the manufacturer or a qualified person.

(b) The rated load of the industrial roller shall not be exceeded.

(c) Industrial rollers shall not be used until inspected and accepted as usable under Section 1-4.8.

(15) 1-4.9.2 Maintenance

(a) A preventive maintenance program shall be established and should be based on the recommendations outlined in the industrial roller manufacturer's manual.

(b) All moving parts of the industrial roller requiring lubrication should be regularly lubricated according to the manufacturer's specifications.

(c) Wheels and rollers shall be free of embedded materials that would cause them to roll unevenly.

(d) If additional maintenance is required, it should be completed in accordance with the instructions of the manufacturer or qualified person.

1-4.9.3 Storage

(a) Industrial rollers should be stored in an area where they will not be subjected to damage.

(b) If extreme temperatures or chemically active or abrasive environments are involved, the guidance provided in Section 1-4.6 shall be followed.

(15) 1-4.9.4 Cautions to Personnel

(a) Personnel shall not place any part of their body between the industrial roller and the load or blocking during load handling operations.

(b) Personnel shall not place any part of their body under a load supported by an industrial roller.

(c) Never straddle the steering handle of an industrial roller.

(d) Avoid pinch points while using the steering handle by ensuring there is a sufficient swing area.

(e) Personnel should not ride a load supported by an industrial roller.

(f) Personnel should have firm footing and handle control while steering the industrial roller.

(g) To avoid injury if the load shifts, use an overhand grip (palm down) when manipulating the steering handle.

(h) Personnel should avoid pinch points between the load and surrounding obstructions while the load is in motion.

(i) Personnel shall not place any part of their body between the industrial roller and rolling surface during movement of the load.

(j) Personnel shall not ride an industrial roller.

1-4.9.5 Rolling Practices

1-4.9.5.1 General

(a) All industrial rollers shall be used according to the manufacturer's recommendations.

(b) A plan should be developed and communicated to affected personnel before the moving operation begins. The plan should include load-handling procedures and communication methods.

(c) When using industrial rollers, a minimum set of three rollers should be used to maintain continuous loading of the rollers.

(d) When placing rollers under one side or end of a load, ensure the opposing side or end is stabilized.

(e) Wood or other friction material should be used between the industrial roller and the load surface to prevent metal-to-metal slippage.

(f) The industrial roller should be placed in a support location to prevent damage to the load.

(g) The roller's top plate or swivel head should be kept parallel to the rolling surface to prevent toe or heel loading.

(h) Align the rollers to prevent binding of the rollers, shifting of the load, or loss of control during movement.

(i) The load contact surface should cover the entire top area of the swivel top plate. If the load has insufficient contact area on the top plate, the manufacturer or a qualified person shall be consulted for instructions on how to prevent the load from falling off the roller.

(j) When moving up or down an incline, the industrial rollers shall be secured to prevent disengagement.

(k) Lock swivel top plates before aligning and placing under the load.

(l) The rolling surface should be kept clean of all debris that would interfere with smooth operation of the roller.

(m) The rolling surface shall be able to support the intended load.

(n) Handles should be used for steering the load. Pushing or pulling the load by the handle should be avoided unless approved by the manufacturer or a qualified person.

(o) When rolling a load on an inclined surface, a qualified person shall determine the type and capacity of a restraint system to avoid an uncontrolled movement.

(p) Remove or secure the steering handle when not in use to avoid accidental dislocation of the industrial roller and reduce the tripping hazard.

(q) The load should be parked while unattended. Block or restrain the load, or realign the rollers so they point toward the center of gravity to prevent movement.

(r) Load control shall be maintained at all times. Rate of travel should be governed by work environment, visibility, roller control, and ability to stop.

(15) **1-4.9.5.2 Communication**

(a) Communication between personnel involved in the industrial roller operation shall be maintained continuously during roller movement. If at any time

communication is disrupted, the load movement shall be stopped until communication is restored.

(b) Signals should be in accordance with the standards prescribed in Fig. 1-0.4.4-1. If special signals are required, they shall be agreed upon by the load-handling personnel prior to roller operations. Signals shall be discernible or audible at all times. No action shall be taken unless signals are clearly understood.

(c) Load handling personnel shall obey any stop signal.

Chapter 1-5

Air Casters

SECTION 1-5.0: SCOPE

This Chapter applies to air casters.

SECTION 1-5.1: TYPES, MATERIALS, AND DESIGN

(15) 1-5.1.1 Types

Types include low-lift, high-lift, and gap-crossing styles (see Figs. 1-5.1.1-1 and 1-5.1.1-2).

(15) 1-5.1.2 Materials

(a) The air bladder may be constructed from monofilm or fabric-reinforced materials.

(b) The module structure (mounting assembly) shall be made from metal or synthetic materials.

(15) 1-5.1.3 Design

(a) The load-bearing materials in the air bladder and the mounting assembly shall have sufficient strength and ductility to support and move the load at the temperatures at which they will be used.

(b) The air couplers, interconnect, and supply hoses shall be designed for compressed air use, and selected for the air pressures and volumes required by the air caster system.

(c) A shut-off valve and pressure gauge shall be provided at the main air inlet to the pressure control console.

(d) The pressure control console shall regulate air pressure to each air caster.

(e) Pressure regulation device(s) shall be provided to limit upstream pressure and relieve downstream pressure to protect the air casters.

(f) Each air caster shall have its own pressure gage.

SECTION 1-5.2: DESIGN FACTOR

The air caster system shall be designed to withstand 2 times the rated load without damage.

SECTION 1-5.3: RATED LOADS

Rated load shall be in accordance with the recommendation of the air caster manufacturer.

(15) SECTION 1-5.4: PROOF TEST

1-5.4.1 Proof Test Requirements

(a) Each newly designed air caster shall be proof tested by the manufacturer.

(b) Newly manufactured air casters are not required to be proof tested unless specified by the purchaser.

(c) The manufacturer or a qualified person shall determine if a proof test is required for any altered, modified, or repaired air caster.

(d) After proof testing, the air caster shall be thoroughly inspected for the conditions stated in para. 1-5.8.4.

1-5.4.2 Proof Load Requirements

(a) When proof testing a newly designed air caster, the air caster shall be subjected to a load that is 200% of its rated load with no permanent deformation to the mounting assembly or damage to the air bladder.

(b) The proof load for each new, altered, modified, or repaired air caster shall be a minimum of 100% of the rated load unless otherwise determined by the manufacturer or a qualified person.

SECTION 1-5.5: IDENTIFICATION

1-5.5.1 Marking

Each new air caster shall have forged, cast, die stamped, etched, or fixed label markings by the manufacturer to show

(a) name or trademark of manufacturer

(b) rated load

(c) model number or tracing code

(d) maximum operating pressure

1-5.5.2 Maintenance of Identification

Air caster identification should be maintained by the user so as to be legible throughout the life of the air caster.

SECTION 1-5.6: EFFECTS OF ENVIRONMENT

1-5.6.1 Temperature

When air casters are to be used at temperatures above 100°F (38°C) or below 32°F (0°C), the air caster manufacturer or a qualified person should be consulted.

1-5.6.2 Chemically Active Environments

The strength and operation of air casters can be affected by chemically active environments such as caustic or acid substances or fumes. The air caster manufacturer or a qualified person should be consulted before air casters are used in chemically active environments.

Fig. 1-5.1.1-1 Air Casters

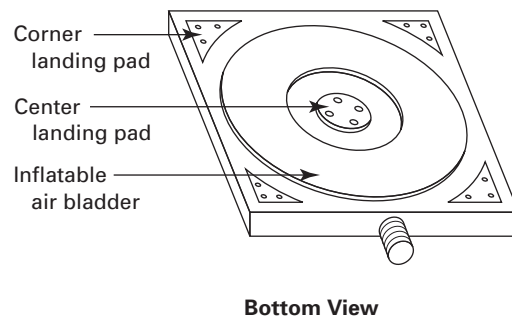
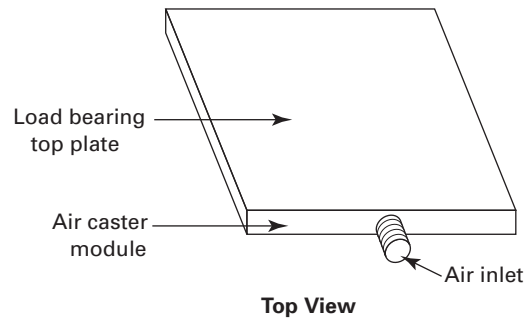
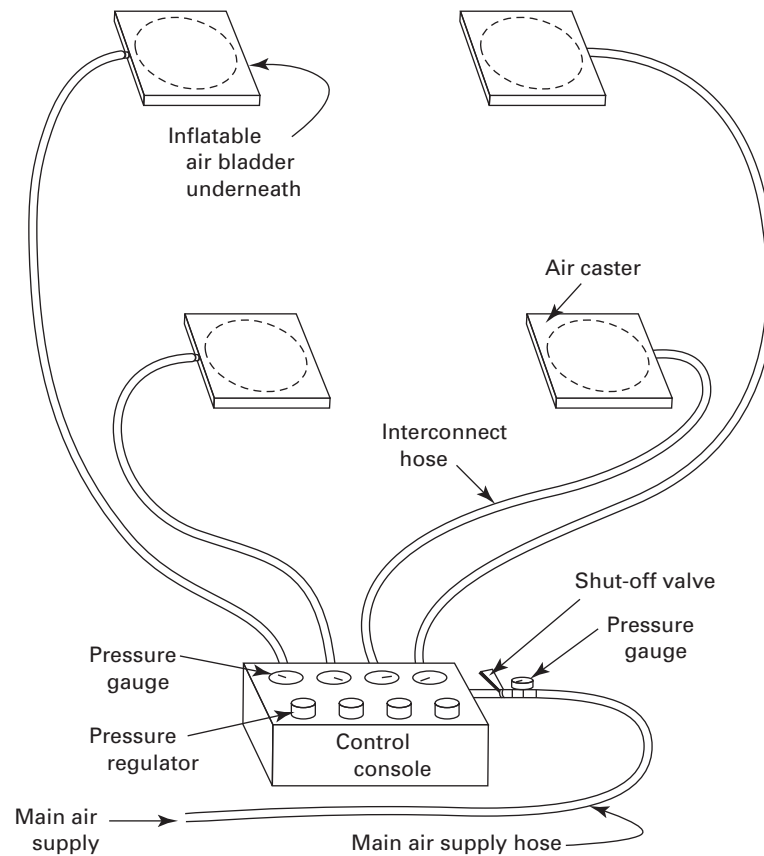


Fig. 1-5.1.1-2 Four-Unit Air Caster System



1-5.6.3 Other Environments

Air casters can be affected by the air supply containing moisture, particulates such as gravel or sand, silt, grit, or other contaminants. Air caster systems subject to these environments should have their components frequently inspected and maintained.

SECTION 1-5.7: INSTRUCTIONS AND TRAINING

1-5.7.1 Instructions

The manufacturer shall furnish information about air caster selection, inspection, maintenance, cautions to personnel, effects of environment, and operating practices with each air caster system.

(15) 1-5.7.2 Training

Air caster users shall be trained in the selection, inspection, maintenance, cautions to personnel, effects of environment, and operating practices as addressed by this Chapter and the manufacturer's instructions.

(15) SECTION 1-5.8: INSPECTION, REPAIR, AND REMOVAL

All inspections shall be performed by a designated person. Any deficiencies identified shall be examined and a determination made by a qualified person as to whether they constitute a hazard.

1-5.8.1 Initial Inspection

Prior to use, all new, altered, modified, or repaired air casters shall be inspected to verify compliance with the applicable provisions of this Chapter. Written records are not required.

1-5.8.2 Frequent Inspection

(a) A visual and functional inspection shall be performed each shift, before the air caster system is used.

(b) Conditions such as those listed in para. 1-5.8.4 or any other condition that may be a hazard shall cause the air caster or other system component to be removed from service. An air caster system component shall not be returned to service until approved by a qualified person.

(c) Written records are not required for frequent inspections.

1-5.8.3 Periodic Inspection

(a) A complete inspection of the air caster system shall be performed. The system shall be examined for conditions such as those listed in para. 1-5.8.4 and a determination made as to whether they constitute a hazard.

(b) *Periodic Inspection Frequency.* Periodic inspection intervals shall not exceed 12 months. The frequency of inspections should be based on

- (1) frequency of use
- (2) severity of service conditions
- (3) nature of transport activity
- (4) experience gained on the service life of air caster systems used in similar circumstances
- (5) guidelines for the time intervals are
 - (-a) normal service — 1 month to 12 months
 - (-b) severe service — daily to monthly
 - (-c) special service — as recommended by a qualified person

(c) If the external appearance suggests internal damage, the air caster system component shall be disassembled for further examination. The disassembly, inspection, and reassembly shall be performed by an authorized service center or under the supervision of a qualified person.

(d) An air caster or system that has been idle for more than 12 months shall be inspected prior to use, and subject to the removal criteria in para. 1-5.8.4.

(e) Dated inspection records should be kept on all periodic inspections. A nondestructive external coded mark, tag, or other method of recording the inspection is acceptable in lieu of written records.

1-5.8.4 Removal Criteria

Air caster system components shall be removed from service if damage such as the following is visible and shall only be returned to service when approved by a qualified person:

- (a) air bladder that is cut, punctured, or torn
- (b) debonding between the air bladder air caster backing plate
- (c) air bladder that is abraded, revealing fabric reinforcement
- (d) delamination between multiple bladder layers
- (e) loose, missing, substandard, or severely worn fasteners
- (f) missing or broken landing pads
- (g) heat, chemical, or corrosion damage
- (h) missing or illegible identification
- (i) cracked or broken load-bearing welds
- (j) deformed air caster backing plate
- (k) excessive material loss due to gouging or wear of the module structure
- (l) inhibited airflow from foreign objects
- (m) bent, cracked, or broken fittings, couplers, or valves
- (n) hoses or couplers that have been cut, severely abraded, gouged, cracked, or become brittle
- (o) partial engagement between a hose and fitting
- (p) missing, improper, or damaged air hose banding clamps
- (q) missing or damaged O-ring, gasket, or seal on an air hose fitting
- (r) evidence of unauthorized repairs

(s) evidence of ultraviolet ray degradation of synthetic components

(t) broken or damaged pressure gauges, regulators, or shut-off valves

(u) missing components or other items as specified in manufacturer's instruction that may affect operation

(v) other conditions including visible damage that cause doubt as to the continued use of the air caster system

1-5.8.5 Repairs and Modifications

(a) Repairs, alterations, or modifications shall be as specified by the air caster manufacturer or a qualified person.

(b) All replacement parts, including air caster components, hoses, fittings, regulators, gauges, and valves, shall meet or exceed the original equipment manufacturer's specifications.

SECTION 1-5.9: OPERATING PRACTICES

1-5.9.1 Air Caster Selection

(a) Air casters shall be selected for the type of load and environment in accordance with the recommendations of the manufacturer or a qualified person.

(b) The rated load of the air caster shall not be exceeded.

(c) Air casters shall not be used until inspected and accepted as usable under Section 1-5.8.

(15) 1-5.9.2 Maintenance

(a) A preventive maintenance program shall be established and should be based on the recommendations outlined in the air caster manufacturer's manual.

(b) Keep the external surface of the air bladder free of foreign material by cleaning with mild detergent and water.

(c) Accumulated moisture should be removed from the air caster system and its components.

(d) If additional maintenance is required, it should be completed in accordance with the instructions of the manufacturer or qualified person.

1-5.9.3 Storage

(a) Air casters should be stored in an area where they will not be subjected to damage.

(b) If extreme temperatures, chemically active or abrasive environments are involved, the guidance provided in Section 1-5.6 shall be followed.

(15) 1-5.9.4 Cautions to Personnel

(a) Personnel shall not place any part of their body between the air caster and the load during load handling operations.

(b) Personnel shall not place any part of their body under a load supported by an air caster(s).

(c) Personnel should avoid straddling an air hose in case of unexpected disconnection. Hose restraints should be used at all hose connections.

(d) Route hoses to minimize trip hazards.

(e) Personnel should not ride a load supported by air casters.

(f) Personnel should have firm footing while maneuvering a load being transported by an air caster system.

(g) A designated operator shall remain at the control console while the air caster system is pressurized.

(h) Personnel should avoid pinch points between the load and surrounding obstructions while the load is in motion.

(i) Personnel shall not place any part of their body between the air caster and floor surface while pressurized.

(j) Personnel should never disconnect a pressurized air hose.

(k) Personnel shall not ride an air caster.

1-5.9.5 Load Handling Practices

(15)

1-5.9.5.1 General

(a) All air casters shall be used according to the manufacturer's recommendations.

(b) A plan should be developed and communicated to affected personnel before the moving operation begins. The plan should include load handling procedures and communication methods.

(c) When using an air caster system, a minimum set of three air casters should be used to maintain stability of the load.

(d) When placing air casters under one side or end of a load, ensure the opposing side or end is stabilized.

(e) The air caster should be placed in a support location to prevent damage to the load.

(f) The air caster module should be kept parallel to the floor to ensure proper operation of the caster.

(g) Ensure proper air bladder inflation to avoid dragging the landing pads and the bladder against the floor surface.

(h) The load contact point for each air caster should be centered on the module.

(i) For loads with a minimal contact point (less than 10% of caster surface coverage), consult with the air caster manufacturer or a qualified person on how to prevent poor load handling performance or mounting assembly deformation.

(j) Variations in the inflated air caster lift can affect the desired load height and load handling operation.

(1) To overcome uneven floor surfaces, minimize the gap between the deflated air caster and the load contact point with blocking of sufficient strength to bear the imposed load.

(2) Remove any gap between the deflated air caster and the load with blocking to maximize the vertical lift height of the load.

(3) A gap between the deflated air caster and the load can minimize the vertical lifted height of the load.

(k) The floor surface should be kept clean of all debris that would interfere with smooth operation of the air caster.

(l) The floor surface shall be able to support the intended load.

(m) Personnel or equipment should be used to ensure controlled maneuvering and stopping of the load's horizontal movement during travel.

(n) When handling a load on an inclined surface, a qualified person shall determine the type and capacity of a restraint system to avoid an uncontrolled movement.

(o) When landing a load that is supported by air casters, ensure that all air hoses and couplers are clear of pinch points.

(p) The load should be parked with the air casters in a deflated condition when it is not attended by an operator.

(q) Load control shall be maintained at all times. Rate of travel should be governed by work environment, visibility, and ability to stop.

(r) The air caster operator should have an unobstructed view of the air caster system and load during operation of the system. If this is not possible, a signalperson(s) shall be used with an effective means of communication to provide direction to the air caster operator.

1-5.9.5.2 Communication

(a) Communication between personnel involved in the air caster operation shall be maintained continuously during movement. If at any time communication is disrupted, the load movement shall be stopped until communication is restored.

(b) Signals should be in accordance with the standards prescribed in Fig. 1-0.4.4-1. If special signals are required, they shall be agreed upon by the load handling personnel prior to air caster operations. Signals shall be discernible or audible at all times. No action shall be taken unless signals are clearly understood.

(c) Load handling personnel shall obey any stop signal.

Chapter 1-6

Telescopic Hydraulic Gantry Systems

SECTION 1-6.0: SCOPE

This Chapter applies to telescopic hydraulic gantry systems.

SECTION 1-6.1: TYPES AND DESIGN

(15) 1-6.1.1 Types

(a) Gantry leg types include bare cylinder and telescopic boom (see Fig. 1-6.1.1-1).

(b) A gantry system consists of two or more gantry legs and one or more header beams that span between legs (see Fig. 1-6.1.1-2).

1-6.1.2 Design

(a) The load-bearing structural, mechanical, and hydraulic components in the gantry leg shall have sufficient strength and ductility to raise, lower, and support the rated load at the temperatures at which it will be used.

(b) The gantry leg (see Fig. 1-6.1.1-1) shall be designed in accordance with the following criteria:

(1) The design vertical load shall be equal to the rated load.

(2) The design transverse lateral load shall be equal to 1.50% of the rated load.

(3) The design transverse longitudinal load shall be equal to 1.50% of the rated load.

(c) Header beams, lift links, track beams, track supports, and other accessories and equipment used as a part of the gantry system shall be designed or selected by the manufacturer or a qualified person for its intended use.

SECTION 1-6.2: DESIGN FACTORS

(a) The design factors for gantry legs shall be as follows:

(1) The service stresses in individual components of a gantry leg shall be computed on the basis of the rated load and the specified transverse loads and shall not exceed the applicable allowable stress. Allowable stresses for yielding shall be based on a minimum design factor of 1.67. The minimum design factor for local buckling shall be 1.67. Allowable stresses for fracture shall be based on a minimum design factor of 2.00.

(2) The stability of a gantry leg shall be such that the overturning moment shall not exceed 95% of the

stabilizing moment. The overturning moment acting on the gantry leg shall be equal to the horizontal load multiplied by the maximum height of the leg [see paras. 1-6.1.2(b)(2) and (3)]. The stabilizing moment of the gantry leg shall be equal to the rated load supported at the top of the leg and the leg self weight, each acting at its respective righting arm. The effects of an out-of-level support surface, lift boom drift, and lift boom or lift cylinder deflection as amplified by the axial load shall be considered. Stability shall be evaluated in both the lateral and longitudinal directions.

(b) The design factors for header beams, lift links, track beams, and other load-bearing components of the gantry system shall be determined by the manufacturer or a qualified person.

SECTION 1-6.3: RATED LOADS

The rated loads for the gantry legs shall be established by the manufacturer or a qualified person.

SECTION 1-6.4: PROOF TEST AND PROOF LOAD

1-6.4.1 Proof Test Requirements

(a) Each newly designed gantry leg shall be proof tested by the manufacturer.

(b) Each newly manufactured gantry leg should be proof tested by the manufacturer.

(c) The manufacturer or a qualified person shall determine if a proof test is required for any altered, modified, or repaired gantry leg.

(d) After proof testing, the gantry leg shall be thoroughly inspected for the conditions stated in para. 1-6.8.4.

(e) Proof test records shall be maintained by the manufacturer or the qualified person who has performed the test and be available to the user.

1-6.4.2 Proof Load Requirements

(a) When proof testing a newly designed gantry leg

(1) the leg shall be operated to the maximum allowable height corresponding to its maximum rated load and loaded to 110% of its maximum rated load. The suspended test load shall be lifted for a minimum of 12 in. (300 mm) during the test.

(2) if the leg has two or more stages, the leg shall be operated to its maximum possible extension and loaded to 110% of its rated load. The suspended test

Fig. 1-6.1.1-1 Gantry Leg Types

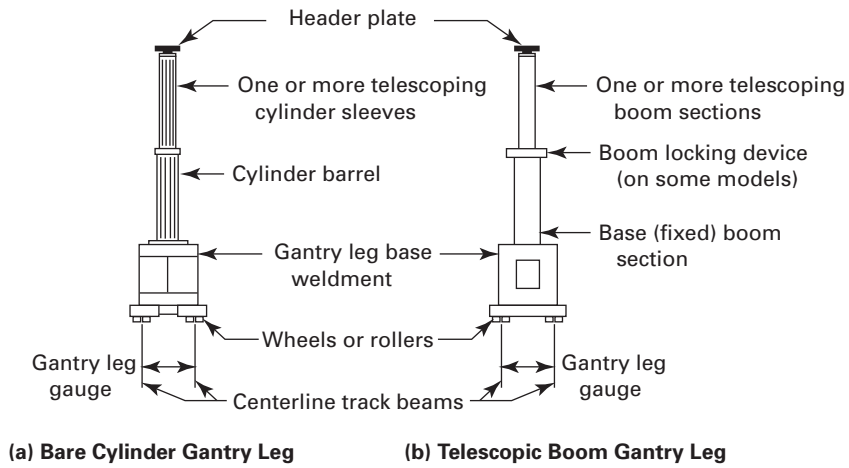


Fig. 1-6.1.1-2 Basic Gantry System

