Power Cranes, and Shovels, Convertible Full-Revolving Type; Crawler, Truck, and Wheel Mounted; Including Clamshell, Dragline Lifting Crane, Hoe, Pile Driver, and Skimmer Scoop Operating Equipment (Export Classifications)

(Second Edition)

COMMERCIAL STANDARD CS90E–47

Effective Date for New Production from February 15, 1947

A RECORDED VOLUNTARY STANDARD OF THE TRADE

United States Department of Commerce • W. Averell Harriman, Secretary

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COMMERCIAL STANDARDS

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Organized in 1927, the Division of Trade Standards has assisted many industries in the development of Commercial Standards for a wide variety of commodities. A list of previously established commercial Standards appears herein.

Commercial Standard for Power Cranes and Shovels, Convertible Full-Revolving Type; Crawler, Truck, and Wheel Mounted; Including Clamshell, Dragline, Lifting Crane, Hoe, Pile Driver, and Skimmer-Scoop Operating Equipment (Export Classifications).

On June 6, 1940, a conference of representative manufacturers adopted a recommended Commercial Standard for Crawler Mounted, Revolving Power Shovels, Lifting Cranes, Dragline and Clamshell Excavators (Export Classifications). The standard was accepted by those concerned and issued as CS90E–41.

On September 4, 1946, a revision submitted by the Power Crane and Shovel Manufacturers' Export Standards Association and approved by the Standing Committee was circulated for acceptance. Those concerned have since accepted and approved the revised standard as shown herein.

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CONTENTS

Power Cranes and Shovels, Convertible Full-Revolving Type; Crawler, Truck, and Wheel Mounted; Including Clamshell, Dragline, Lifting Crane, Hoe, Pile Driver, and Skimmer Scoop Operating Equipment (Export Classifications)

(SECOND EDITION)

COMMERCIAL STANDARD CS90E–47

Purpose

1.01. The purpose of this commercial standard is to set up definitions and requirements for fair competition and a better understanding between buyers and sellers of power cranes and shovels, convertible full-revolving type; crawler, truck, and wheel mounted; including clamshell, dragline, lifting crane, shovel, hoe, pile driver, and skimmer scoop operating equipment, in export from the United States of America, and to provide a uniform basis for compliance through the use of labels or certificates.

Scope

2.01. This standard provides requirements, nomenclature, definitions, and information regarding application for such machines under headings of their basic component parts and their several convertible functional operating equipments, as indicated in the "Contents". It covers machines having shovel dipper capacities ranging from ⅜ to 2½ cu yd (0.286 to 1.91 cubic meters) and crane capacities ranging from 2½ to 60 ton (2268 to 54,432 kilograms). It describes the various types of front-end operating equipment, their uses, and adaptations. It sets up uniform methods of taking dimensions, determining working ranges, power, line speeds, line pulls, and lifting capacities that are to be furnished for comparison of models offered by manufacturers for export from the United States of America. It also covers a uniform method of labeling and certifying compliance with the standard.

2.02. *Requirements.*—The uniform methods and specifications of this standard that are considered as requirements to be met by those manufacturers who subscribe to this standard are printed in italic type to distinguish such requirements from other data of an informative or definitive nature.

Basic Components of Machines

3.01. *Basic operating components.*—The machines covered here are usually convertible for the several operating functions, as indicated by the title and further described and defined. Any machine when equipped for work consists of three main operating components, as follows:

a. *Revolving superstructure* includes power unit and machinery common to all functional operations with modifications of minor machinery or parts peculiar to given function or type of operation and mounting, as described in detail in paragraphs 4.01 to 4.16.

b. *Mounting* is to provide mobility while in operation and from job to job. Three types are covered herein: (1) Crawler mounting, paragraphs 5.01 to 5.11, (2) truck mounting (two engine, rubber mounted), paragraphs 5.12 to 5.19, (3) wheel mounting (single-engine, rubber-mounted) paragraph 5.20.

c. *Front-end operating equipment* manufacturers are usually in a position to provide convertible and interchangeable boom equipment with other accessories for the various types of operations or functions, such as clamshell, dragline, lifting crane, pile driver, shovel, hoe, and skimmer scoop, as described in paragraphs 6.01 to 6.63.

Revolving Superstructure

4.01. *Bed plate.*—The main frame that carries the operating mechanism. It may be of cast-steel or welded construction.

4.02. Boom hinge bracket.—Connecting brackets, integral or attached to the front of bed plate for attaching boom equipment. Figures or specifications shall show the height of these hinges from the ground and distance from center of rotation.

4.03. Power equipment.—Machines covered by this standard may be powered by internal-combustion engines or electric motors. Internal-combustion engines, either diesel or gasoline, shall be specified in terms of type, rated with full accessories, horsepower, number of cylinders, bore, stroke, cubic displacement, and full-load governed engine speed.

4.04. Rated engine horsepower is the net horsepower at sea level at the flywheel at full-load governed speed with engine fully equipped with all accessories, such as generator, fan, air compressor, etc.

4.05. Engine speed.

(a) *High idle speed is the top engine speed at which engine will run at no load, governor controlled.*

(b) *Full-load governed engine speed is the highest speed at which governor has fully opened throttle or fuel pump (this is usually seven (7) percent to ten (10) percent below high idle speed).*

(c) *Maximum torque engine speed is that speed at which engine develops its maximum torque.*

4.06. Altitude power loss.—Engines are selected by manufacturers to compensate for power losses up to 4,000-feet altitude above sea level. Manufacturers will make adjustments for greater altitudes, which must be specified by buyers. The general rule is that gasoline-engine horsepower decreases at the rate of three (3) percent per thousand feet. Diesel-engine power losses vary with the type of diesel and with the original fuel-pump setting. No fixed rule can be given.

4.07. *Power take-off* is the method of transmission of power from the engine to the revolving superstructure operating mechanism. It may be through a disconnecting mechanical or hydraulic clutch to a speed reduction of a train of gears or by chain drive, either silent or roller chain. There may be a countershaft to further distribute the power to the operating machinery.

4.08. Main hoist consists of drums controlled through clutches and provided with brakes with controls at the operator's position. Manufacturer will state type of clutches, whether outside contracting band, internal-expanding band, or others; whether the controls are manual, mechanical with booster clutches, hydraulic, air, or vacuum.

4.09. Boom hoist or derricking device.—For controlling the angle of the boom. Manufacturer will state type employed, whether worm and gear driven, spur-gear driven, planetary driven, or other type of drive; whether gravity-lowered boom type or power-controlled lowering, and whether it is completely independent of all other motions, together with description of drive and braking mechanism.

4.10. Laggings.—Removable and interchangeable drum spool shells for changing hoist drum diameter to provide variation in rope speeds and line pulls. This construction is optional with manufacturer.

4.11. Line pull.—Line pull is the single-line maximum pull in pounds (or kilograms) at the drum at full-load governed engine speed, with the specified hoist drum or lagging diameter.

4.12. Line speed is the speed in feet (or meters) per minute of a single line, based on the full-load governed engine speed for the specified hoist drum or lagging diameter on the basic revolving superstructure.

4.13. Swing mechanism controls the revolving function of the machine. Manufacturer will state type of drive, whether through clutch-controlled bevel gears, worm, or otherwise.

4.14. Roller path and ring gear are part of the swing mechanism attached to the mounting on which the revolving superstructure rotates. Manufacturer shall state whether roller path is of the hook-roller type or top-roller type, or whether combination of both or live-roller circle; whether cone or flat-faced roller is used, and whether the large swing gear has external or internal teeth, or describe such other design as may be employed.

4.15. *Travel mechanism on revolving superstructure.*—May be either through the mechanism on the revolving superstructure with declutching device or through an independent mechanism with its own controls to the vertical travel shaft that connects with the mounting.

4.16 Cab dimensions (see fig. 1).—The following over-all clearance dimensions of the revolving superstructure cab or other projections are as shown:

A. Width of cab.

B. Clearance height from grade (on various mountings).

C. Rear-end radius.

D. Radius of boom hinge pin.

E. Height of boom hinge pin above floor (for various mountings).

F. Gantry heights above ground when in operation and when folded (see paragraph 6.08).

G. Counterweight clearance from ground.

Mountings

Crawler Mounting

5.01 *Crawler-mounting definition.*—Two continuous parallel crawler belts consisting of a series of tread shoes or links encompassing rollers and drive tumblers supported by axles and a base frame which houses propelling mechanism driven and controlled from revolving superstructure. Final drive to crawler tread belts may be by chain or gears.

5.02. Crawler bearing length and area.—The length of each crawler bearing on the ground is computed as not more than the normal distance from the center to center of the crawler end sprocket or tumbler wheels, plus thirty-five (35) percent of the over-all crawler height at center of end sprocket or tumbler wheels. (This takes into account the bearing of about one additional pitch of the crawler tread shoes.) The crawler bearing area is computed by multiplying the total crawler bearing length (as above defined) of all crawler belts by the widths of tread shoes.

5.03. Ground pressure is the average pressure in pounds per square inch (kilograms per square centimeter), derived by dividing the total working weight of the machine with complete front-end equipment by the crawler bearing area.

5.04. Travel of propulsion—Machine shall be

capable of propelling itself either forward or backward. The travel speeds, both forward and reverse, shall be stated.

5.05. Traction lock or brake—A traction lock or brake shall be standard equipment.

5.06.—Steering.—Each machine shall be capable of being steered either way in either direction of travel with controls from the operator's position in the revolving superstructure cab.

surface, in working order (cooling system full, fuel tank half full), without load, with base rating length of boom at its minimum working radius, shall not be farther from the axis of rotation than seventy (70) percent of the radial distance from the axis of rotation to the tipping fulcrum in the least stable direction.

5.09. Least stable position.—In determining the least stable position, the load shall be lifted with the

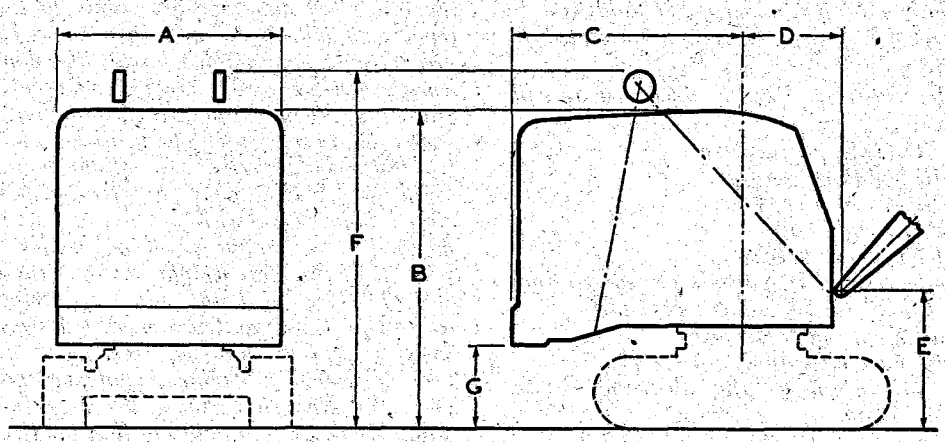

FIGURE 1.—*Cab dimensions, crawler mounting (paragraph 4.16).*

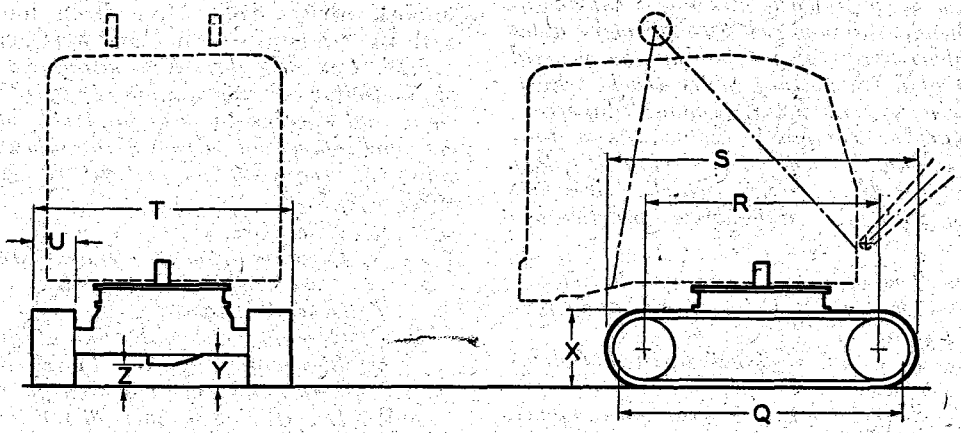

FIGURE 2.—*Crawler mounting (paragraph 5.11).*

5.07. Climb.—Each crawler machine shall have sufficient propelling power to climb a thirty (30) percent grade (30-ft rise in 100 ft horizontal or 9-meter rise in 30 meters horizontal) on smooth, firm, dry ground.

5.08. Backward stability for crawler-mounted machines.—To avoid excessive or unsafe counterweighting of machine on crawler mounting and to insure proper backward stability when used as lifting crane, dragline, clamshell, or pile driver, the center of gravity of any crawler mounted type of machine resting on firm, level, and uniformly even supporting

machine resting upon a firm, level supporting surface, and the machine shall then be rotated in an arc about the axis of rotation of the machine with the load tied to the boom foot to prevent outward swing on rotation. The least stable position is the position of the boom in rotation that provides the minimum of stability. (Generally with the boom at right angles to the crawlers.)

5.10. Tipping load at any given radius for crawler-mounted types of machines with tread belts resting on firm, level, and even supporting surface, shall be that load which overcomes the stability of the

machine in the least stable position, which is usually over the side, to the extent that the crawler's rollers on side opposite the boom are lifted away from contact with the treads. Should the position of minimum stability be over the front of the crawler, the tipping load is that which causes one-third of tread belt to be lifted from ground.

5.11. General data (see fig. 2).—The manufacturer shall supply the following information in regard to dimensions and specifications of the crawler furnished with the machine in addition to dimensions of revolving superstructure, as stated in paragraph 4.16:

Q. Crawler bearing length (see paragraph 5.02).
R. Center to center of tumblers.
S. Over-all length of crawler.
T. Over-all width of crawler.
U. Width of tread shoes.
V. Crawler bearing area.
W. Ground pressure in pounds per square inch (or kilograms per square centimeter).
X. Over-all height of tread belt.
Y. Crawler-base clearance.
Z. Other minimum ground clearance under crawler base.

Truck Mounting

5.12. Truck-mounting definition.—A heavy-framed, independently powered, two or more axles supported, rubber-tired carrier having the general characteristics of a heavy-duty motor truck, which, when the revolving superstructure is mounted thereon, provides a machine commonly known as a two-engine rubber-mounted unit. Drive may be either by chains or gear-driven axles, which drives are designated by standard automotive practice as follows:

(a) 4×2—Two axles, with rear-axle driven.
(b) 4×4—Two axles, both front and rear driven.
(c) 6×4—Three axles, with two rear (tandem) axles driven.
(d) 6×6—Three axles (two rear in tandem), all driven.

5.13. Transmission speeds shall be stated in the number forward and reverse to develop specified road speed in miles per hour (or kilometers per hour).

5.14. *Bogie axle.*—Two automotive types of axles in tandem and connected so as to permit oscillation.

5.15. Outriggers are beams attached at right angles to chassis frame of truck or wheel carrier provided to develop maximum stability by reducing the loads on the tires and increasing the width of the operating base. Manufacturer shall specify whether front or rear outriggers (or both) are supplied, whether they are of the telescopic type and whether jack screws and supporting floats are a part of standard equipment. Crane lifting loads shall be supplied with and without outriggers set.

5.16. Backward stability for truck-mounted machines (without outriggers set).—In applying the following values, the boom is to be at its recommended minimum radius (usually 10 feet), the crane is to be unloaded, the cooling system full, and the fuel tank half full:

(a) All wheels.—Minimum total load on all wheels on the side on which the boom is located, with the axis of boom at right angle to the axis of the truck and with boom at minimum radius, using the minimum recommended length of boom, shall not be less than fifteen (15) percent of the total weight of the crane and truck in operating condition, without load.

(b) Front wheels.—The minimum total load on the front wheels with the axis of the boom on the axis of the truck with boom at minimum radius (boom either before or behind), using minimum recommended boom length, shall not be less than five (5) percent of the total weight of the crane and truck.

5.17. Tipping load (without outriggers set).—At any given radius for truck-mounted types of machines, the tipping load with tires resting on firm, level, and even supporting surface, shall be that load which overcomes the stability of the machine in the least stable direction to the extent that the tires opposite the load begin to leave the ground.

5.18. *Gradability* is the recommended maximum grade, in percent that the machine can climb on a smooth, dry surface, free from loose material, with the transmission in the lowest gear ratio.

5.19. General data.—The manufacturer shall supply the following information in regard to the dimensions and specifications of the truck furnished with the machine (see figs. 3 and 4), in addition to dimensions of revolving superstructure, as stated in paragraph 4.16.

R. Wheelbase.
S. Distance from rear end of carrier frame to center line of bogie axle.
T. Over-all length.
U. Over-all width with original equipment tires.
V. Minimum diameter of circle in which truck can be turned completely.
W. Distance from back of truck cab to center line of bogie axle.
X. Size and ply of tires.
Y. Size and type of emergency brake and service brake.
Z. Travel speeds—number of speeds forward and reverse, also minimum and maximum speeds at full-load governed engine speed.

Wheel Mounting

5.20. *Wheel-mounting definition* (see fig. 4).—A heavy-framed, rubber-tired carrier driven from revolving superstructure engine. When the revolving superstructure is mounted, this mounting provides a single-engine, rubber-tired machine,

with the travel driven and controlled from the revolving superstructure cab. Paragraphs 5.12 (a, b, c, and d) to 5.19, inclusive, covering "truck mounting" also apply to wheel mounting.

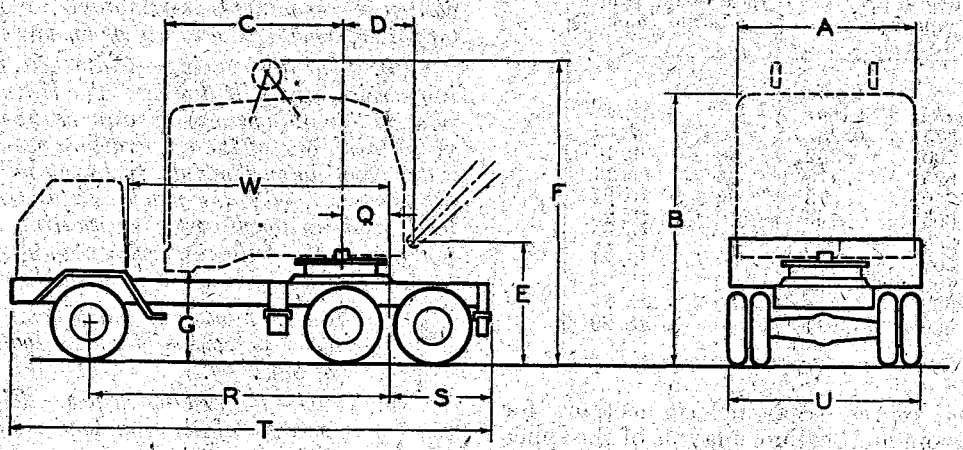

FIGURE 3.—*Truck mounting, 3 axles (paragraph 5.19).*

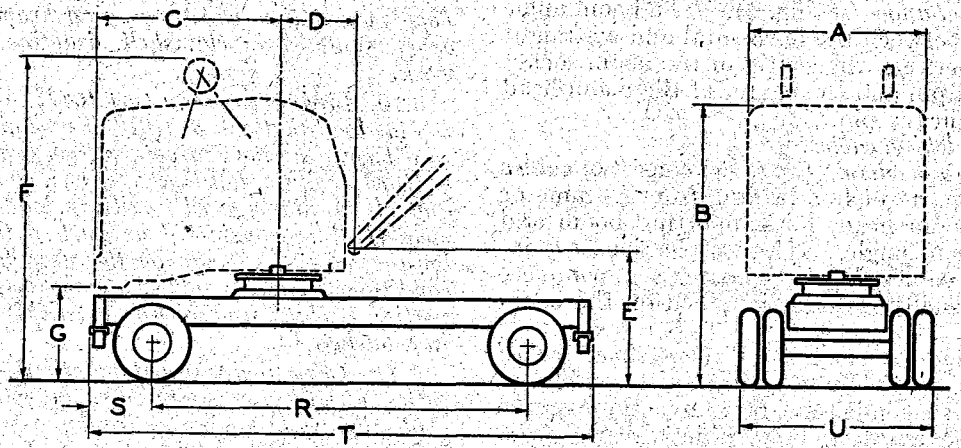

FIGURE 4.—*Wheel mounting, 2 axles (paragraph 5.19).*

Front-End-Operating Types of Machines

Common Crane Boom Equipment

6.01. *Common crane boom equipment* consists of crane boom structure with boom head and sheaves used with clamshell, dragline, lifting crane, and pile-driver operations. Boom structure usually consists of two sections—upper and lower—between which sections may be inserted for increasing over-all length of boom. Occasionally, special booms for various kinds of service are offered by manufacturers.

6.02. *Handled.*—The term "handled" shall comprise the lifting and swinging of rated loads through maximum arc of swing, with the machine resting upon a firm, level supporting surface.

6.03. Crane boom length.—The length of the crane boom is the straight-line distance in feet (or meters) from the center of the boom foot pin to the center of the boom head main hoist sheave pin. For the pur-

pose of comparison of ratings in this classification, boom lengths for machines having the nominal shovel dipper capacities are as indicated in table 1.

TABLE 1.—*Crane boom lengths*

Shovel dipper capacity		Base rating length of crane boom	
Cubic yards	*Cubic meters*	*Feet*	*Meters*
⅜ (0. 375)	0. 287	25	7. 62
½ (0. 500)	. 382	30	9. 14
⅝ (0. 625)	. 478	30	9. 14
¾ (0. 750)	. 573	35	10. 67
1 (1. 000)	. 765	40	12. 20
1¼ (1. 250)	. 956	45	13. 72
1½ (1. 500)	1. 147	50	15. 24
1¾ (1. 750)	1. 338	50	15. 24
2 (2. 000)	1. 529	50	15. 24
2½ (2. 500)	1. 911	60	18. 29

6.04. *Boom splices.*—Splicing connections for basic crane boom and sections may be of the splice plate type, pin type, or butt type.

6.05. *Jibs or boom tip extension* are attached to boom head for further lengthening the boom for purpose of handling light loads, and usually are designed to take only one hoist line. Jibs are either goosenecked or straight.

6.06. *Boom angle* (see fig. 5).—The boom angle is the angle between the horizontal and a straight line drawn between the center of the boom socket or boom foot pin and the center of the boom head main hoist sheave pin.

6.07. *Derricking cables.*

(a) *Continuous derricking cables* consist of cables of multiple parts of line leading from A-frame or gantry to boom head, for supporting boom and changing boom angle. If center sections are inserted when cables of this type are used, complete new cable usually must be installed on the boom hoist drum.

(b) *Floating boom harness* (*sometimes called bridle*) consists of frame with an assembly of sheaves and suspended not far above the A-frame or gantry. Main derricking cable is reeved from the boom hoist or derricking drum in desired number of parts in line. From this frame to the boom head, two heavy cables called standing part cables (sometimes called pendants), are used for supporting the boom. If intermediate sections are installed in the boom, short heavy cables of the same diameter as the standing part cables and same length as intermediate section and equipped with socket at each end are inserted. Such derricking harness and cables eliminate the necessity of changing a long derricking cable each time the boom length is changed.

6.08. A-Frame and gantry (see fig. 5).—A-frame is mounted on revolving superstructure and carries lead sheave for derricking cable system. Gantry is a high A-frame that provides wider angles between crane boom and derricking cables to reduce stresses on both derricking cables and boom in long crane boom operation. Manufacturer shall state whether gantry is permanent, is removable, or is folding—if the latter, whether manually or by power.

6.09. Lifting capacity.—Clamshell, dragline, lifting service, and pile driver.—The lifting capacity in pounds (or kilograms) of any crane-type machine performing one of these operations when in working order (cooling system full, fuel tank half full) at any given radius, with the machine standing on a firm, level, and uniformly even supporting surface, shall not exceed the following percentages of the tipping load at the same radius at least stable position.

a. Crawler-mounted machines.—Seventy-five (75) percent of tipping load without use of blocking.

b. Truck-mounted machines.—Eighty-five (85) percent of tipping load, with or without outriggers set.

c Wheel-mounted machines.—Eighty-five (85) percent of tipping load, with or without outriggers set.

Proper allowance should be made by the user for other conditions such as soft or uneven ground and excessive pendulum action when swinging heavy loads, such as encountered in clamshell, dragline, and magnet work.

6.10. Lifting capacity (net load).—In determining the load that can be lifted at any given radius or in determining the radius at which a given load can be lifted, buckets, fall blocks, slings, equalizer beams, and all similarly used auxiliary load-handling devices shall be considered as part of the load. Allowance shall be made by the user for all special conditions, such as soft or uneven or inclined supporting surface, and suction or sticking of material in a bucket.

6.11. Lifting capacity (tabulation).—Each declaration of lifting capacity in pounds (or kilograms) shall always be accompanied by a figure showing the corresponding load radius in feet (or meters). A table showing the lifting capacities at various corresponding radii fulfills this requirement.

6.12. *Radius of load* (*see fig. 5*).—The radius of load is the horizontal distance from the axis of rotation of the machine to a plumb line through the center of gravity of the suspended load with the machine standing on a level surface. (The outward swing of the load due to fast operations will reduce the safety factor and should be considered by the purchaser in determining the safe load).

6.13. *Rated load.*—Same as lifting capacity.

6.14. *Tipping load.*—See same item under crawler and truck mountings, paragraphs 5.10 and 5.17.

6.15. *Working radius.*—Same as radius of load (see paragraph 6.12).

Clamshell

(See common crane boom equipment)

6.17. *Clamshell operation* (see fig. 5) uses common crane-boom equipment, clamshell bucket, closing-line cable, holding-line cable, tagline mechanism and cable, and proper diameter laggings on hoist drums if such laggings are removable. The digging force is the closing action and weight of bucket, which consists of two half-scoops hinged at top, with mechanism for opening and closing.

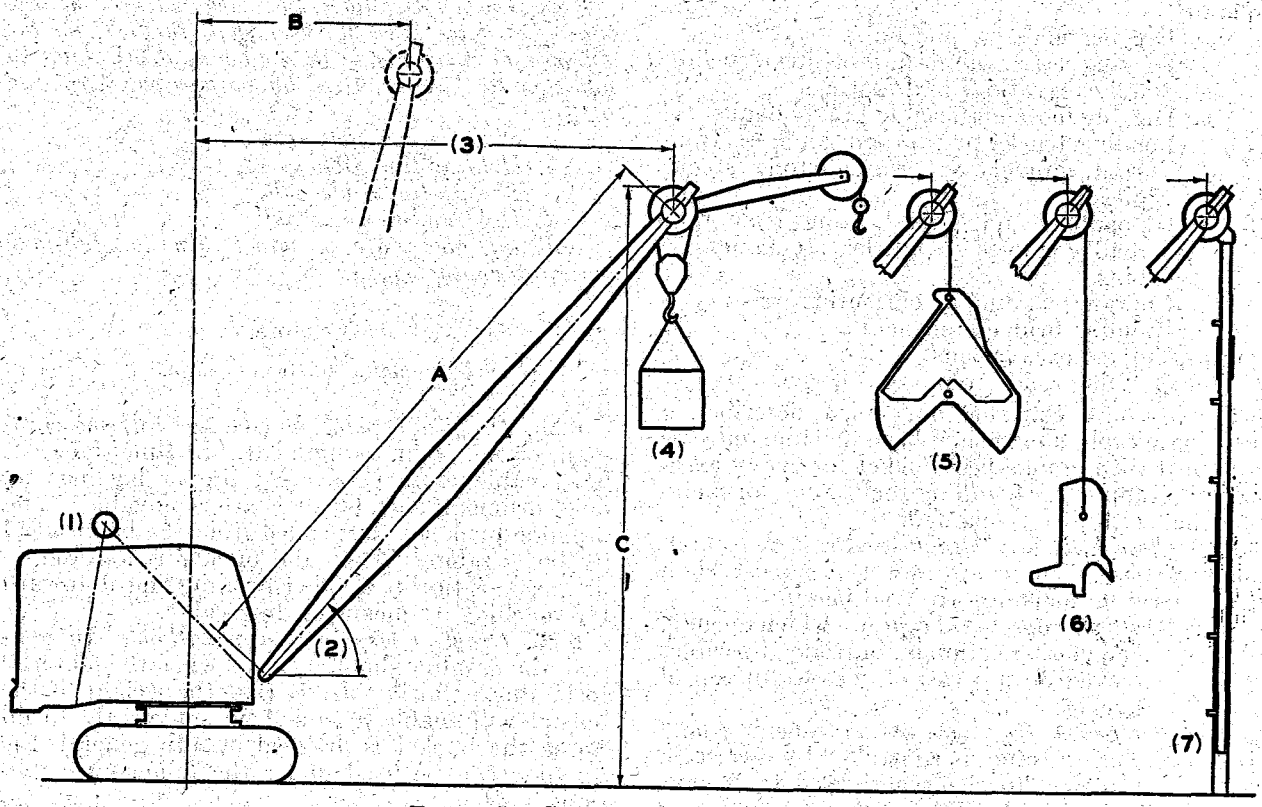

FIGURE 5.—*Common crane boom equipment.*

Also applicable to truck and wheel mounting.

(1) A-*frame and gantry (paragraph 6.08).*
(2) Boom angle (paragraph 6.06).
(3) Radius of load (paragraph 6.12).
(4) Lifting service operation (paragraph 6.34).
(5) Clamshell operation (paragraph 6.17).
(6) Dragline operation (paragraph 6.25).
(7) Pile driver (paragraph 6.37).

6.16. Lifting-capacity data (see fig. 5).—For each lifting crane, dragline or clamshell offered, the manufacturer shall furnish for purposes of comparison, the detail data indicated below in addition to those required by paragraph 4.16:

A. Length of boom.
B. Minimum practical operating radius.
C. Boom-head clearance height.
D. Lifting capacities at 5-ft. increments of radius for the length of boom offered.
E. Assumed ratio of lifting capacity to tipping load, in percent.
F. Hoist-line speed (single line).—At full-load governed engine speed.
G. Hoist-line pull (single line).—At full-load governed engine speed.

6.18. *Clamshell uses and applications.*—The clamshell can dig and dump below, at, or above the level of the machine. Because of this, it is a suitable machine for placing materials at a higher or lower level than would be possible with the shovel or dragline. In general, the clamshell can be used under the following conditions:

a. When the materials are relatively soft or loose.
b. When the digging is done below, at, or above the level of the machine.

c. Where the digging is "vertical", that is, mostly straight down.
d. Where it is necessary to dump materials at a considerable height above the level of the machine; as onto a stockpile or into a bin.

Jobs that can be done by the clamshell are as follows:

e. Digging shafts or pier holes.
f. Digging sewer, water- or pipe-line trenches.
g. Small excavations and footings.
h. Digging loose material in gravel banks.
i. Loading trucks or railroad gondolas from sand, gravel, or crushed-stone stockpiles.
j. Unloading sand, gravel, stone from railroad gondolas to trucks, stockpiles, or bins.
k. Charging loading or measuring bins.
l. Building bridge abutments.
m. Culvert excavations.
n. Building road ditches and berms.

In addition to clamshell buckets, as described in next paragraph, a clamshell-type machine may be equipped with orange-peel bucket for heavy excavation; grapples for handling rock, wood, or metal scrap; or with lifting magnets.

6.19 *Clamshell-bucket designs.*—From the standpoint of design there are two types most commonly used on machines covered herein:

a. *Multiple-rope reeved type,* on which opening and closing action is controlled by cables reeved on a series of sheaves in top of bucket.
b. *Lever-arm type,* on which opening and closing action is controlled by lever arm attached to shells activated by sheave and cable dead end.

6.20. *Clamshell-bucket weight types.*—Because clamshells are used in various kinds of materials ranging from solid and moderately hard to very loose materials and the weight of the bucket provides greatest portion of digging operation, clamshell buckets are available in three types, according to weight construction as follows:

a. *Heavy-digging type,* which has shells of heavy material equipped with counterweights and digging teeth.
b. *General-purpose type,* which has shells of medium-weight material. Counterweight or teeth may or may not be used.
c. *Rehandler type* is a light bucket for use in loose materials and is seldom used with teeth or counterweight.

6.21. *Closing line* is the cable reeved from main hoist drum to control closing of clamshell bucket.

6.22. *Holding line* is the cable reeved from second hoist drum for holding clamshell bucket suspended during dumping and lowering operations.

6.23. *Tagline* is a small cable in tension that prevents clamshell bucket from spinning or drifting. Mechanism controlling tagline may be of several types, according to manufacturers' design, such as (1) sliding weights in boom or on revolving superstructure, (2) slip friction, (3) electric, or (4) spring-loaded device.

6.24. Clamshell data.—For each machine of this type offered the manufacturer shall furnish, for the purpose of comparison, the following detail data, in addition to those required by paragraphs 4.16 and 6.16.

a. Closing-line cable speed.
b. Holding-line cable speed.
c. Closing-line cable pull.
d. Holding-line cable pull.

(All the above are on single line at full-load governed engine speed.)

Dragline

(See common crane boom equipment)

6.25. *Dragline operation* (see fig. 5) uses common crane boom equipment, dragline fairlead, hoist cable, drag cable, and proper laggings on hoist drums, if such laggings are removable. The dragline bucket is suspended from the boom head by hoist cable. When the bucket is lowered to digging position it is filled by dragging it toward the machine by means of drag cable.

6.26. *Dragline uses and applications.*—In general, the dragline should be used when the material to be dug is fairly soft, so that the weight of the bucket will enable it to sink in sufficiently to fill up as the bucket is dragged in. In general, the dragline can be used under the following conditions:

a. When digging is at or below the level of the dragline.
b. When material to be dug is soft to medium hard.
c. When it is desired to cast or dump materials as far away from the unit as the boom will reach. However, trucks may be loaded with dragline where material must be removed to a greater distance.

Jobs that can generally be done with the dragline are as follows:

d. Digging road ditches and berms.
e. Cleaning out ditches and streams.
f. Digging sewer, water- and pipe-line trenches.
g. Digging drainage and irrigation ditches.
h. Stripping overburden on gravel pits, quarries, and open-cut mines.
i. Some types of road grading and other light rough grading.
j. Excavations for small basements.

6.27 *Dragline-bucket weight types.*—Because a large portion of the digging action in dragli e

operation depends upon the weight of the dragline bucket, such buckets are made in three weight types recommended for use in accordance with hardness of material. These types are:

a. *Heavy-digger type,* which has a bowl or shell made of very heavy steel and usually has a cast digging lip and heavy teeth.
b. *General-purpose type* made of medium weight steel for use in medium hard materials.
c. *Light type* made with lightweight shell for use in lightweight or loose materials. The shell is sometimes perforated.

Because weight of bucket and material to be handled also determines the radius of operation and length of boom of the dragline excavator, the bucket selected should not be any heavier than required for excavating the material, with regard for reasonable wear and maintenance.

6.28. Dragline-bucket-capacity rating.—The rated capacity of the dragline bucket shall be not more than the number of cubic yards, or fraction thereof, obtained by multiplying the height of the bucket (H) by the inside width (W) by the length (L). (See fig. 6.) All dimensions in inches and divided by 46,656 and multiplied by the K_1 factor, as established by practice for various sizes of dragline buckets. A variation of two (2) percent is allowed. If the bucket is of special shape, proper allowance shall be made for the increased or decreased volume. If bucket sides are flared, use average dimensions.

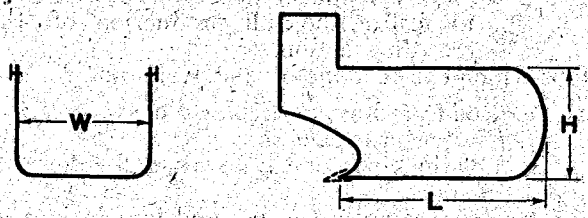

Figure 6.—*Dragline bucket.*

The formula to be used to determine the capacity rating is

$$\text{Capacity rating} = \frac{H \times L \times W}{46656} K_1.$$

TABLE 2.—*Dragline bucket capacity rating*

Bucket size		Factor, K_1
Cubic yards	*Cubic meters*	
¼	0. 191	0. 835
⅜	. 287	. 845
½	. 382	. 854
¾	. 573	. 864
1	. 765	. 874
1¼	. 956	. 888
1½ to 12	1.147 to 9.180	. 897

6.29. *Fairlead.*—A swiveling or hinged frame work carrying sheaves, mounted on front of revolving superstructure or at base of boom, for guiding the drag cable to or from drag drum (one of main hoist drums).

6.30. *Hoist cable* for dragline operation controls height of dragline bucket during loading and hoists it to dumping position.

6.31. *Drag cable* drags bucket toward machine for loading and controls dumping of loaded bucket, when released, after bucket has been hoisted to dumping position.

6.32. *Special dragline boom head sheave.*—If a crane-type machine will be used exclusively for dragline operation, the manufacturer may, at his option, for the purpose of reducing hoist-cable wear, recommend the substitution for standard boom head sheaves, a single boom head sheave.

6.33. Dragline data.—For each dragline offered, the manufacturer shall furnish, for purposes of comparison, the following detail data, in addition to those required by paragraphs 4.16 and 6.16:

a. Dragline-cable speed.
b. Hoist-line cable speed.
c. Dragline-cable pull.
d. Hoist-line cable pull.

(All of the above on single line at full-load governed engine speed.)

Lifting Crane

(See common crane boom equipment)

6.34. *Lifting-service operation* (see fig. 5) uses common crane boom equipment, hook and block for desired or required number of lines of cable, proper cables, and hoist-drum laggings for desired cable speeds and pull. For long-boom work, addition of following equipment is often desirable—extended gantry, boom derricking harness, live or high-speed boom hoist.

6.35. *Lifting-service uses and applications.*—The primary purpose of the crane is to lift a load, swing it, or travel it to a new position and lower and place it in a new location.

In general, the crane can be used under the following conditions:

a. Where the load can be handled (1) by hook block, or (2) by hook block in combination with cable slings, chains, clamps, or special hooks.
b. Where the load must be placed at same level as machine, far below it, or at a high elevated position.
c. Where load must be spotted accurately, as in steel erection.

In general, the following jobs can be done by lifting service:

d. Unloading and distributing steel.
e. Erecting and setting building steel and concrete.

f. Handling and erecting bridge trusses or girders.
g. Loading and unloading cast-iron, steel, or vitreous pipe.
h. Placing cast-iron, steel, or vitreous pipe into trenches.
i. Handling and setting machinery.
j. Handling heavy boxes and crates to or from railroad cars or ships.
k. Handling all types of heavy loads that are not loose or in bulk.

6.36. *Lifting-service-capacity designation.—The designated rating size of a lifting crane shall be expressed in short tons of 2,000 pounds (or 907.2 kilograms), according to manufacturer's rating charts.*

Pile Driver

(See common crane-boom equipment)

6.37. *Pile-driver operating equipment* (see fig. 5) consists of common crane-boom equipment, pile leads, pile hammer, pile cap, proper drum laggings, and cables. One hoist drum is used to hoist pile in leads and the other to lift and drop the pile hammer, or, if an air or steam hammer is used, to hold hammer in striking position.

6.38. *Pile-driver applications and uses.*—Pile driver is a single-purpose application for driving piling, either of the wood- or concrete-pole type or steel-sheet piling. Some jobs on which it may be used are:

a. Bridge footings and pier foundations.
b. On highway work to prevent slides from steep slopes.
c. On marine-construction work and for building cofferdams.
d. On building construction for subfoundation work.
e. On any construction work where extremely soft materials occur, such as quicksand, to provide footings or to prevent slides.

6.39. *Pile leads.*—Two parallel properly shaped members hung from crane-boom head sheave shaft to act as guide for pile hammer.

6.40. *Drop hammer.*—Heavy cast or forged hammer with hook or eye for attaching to one hoist line that lifts and drops hammer for driving pile. It is usually grooved to fit in pile leads.

6.41. *Air hammer.*—Independently air-driven pile hammer.

6.42. *Steam hammer.*—Independently steam-driven pile hammer.

6.43. *Pile cap.*—Protecting cap for fitting on top of piling to prevent battering or splintering.

6.44. *Auxiliary hoist drum or winch head* may be offered at manufacturer's option to provide a third line for pulling in (also called "snaking in") piles from storage position prior to being hoisted to driving position.

Shovels

6.45. *Shovel equipment description* is equipment required to convert a basic machine with its mountings to shovel operation and consists of shovel boom dipper, dipper stick, dipper trip mechanism, padlock, crowding mechanism on superstructure, and boom and cables.

6.46. *Shovel operation.*—Dipper is attached to the end of the dipper stick which slides relative to the shovel boom. In the digging motion the dipper is crowded (thrust outward into the bank) in order to fill it. As the bite is taken the dipper is hoisted simultaneously. After the dipper is loaded, the unit is swung to dumping position where the dipper is dumped by means of the dipper trip lever convenient to the operator.

6.47. *Shovel use.*—The shovel is a positive digging tool. It is used to dig the softest to the most difficult types of material. In general, the shovel should be used under the following conditions:

a. Where the material to be dug is firm or hard.
b. Where the excavation is large enough for the shovel to work, and for hauling equipment to have access to the shovel.
c. Where disposal or dumping of the material is on the same level or slightly above the shovel.
d. Where the nature of the excavation provides a bank for depth of cut sufficient to utilize the full production of the crowding action.

Jobs which can be done by a shovel are:

e. Road grading, particularly heavy cuts.
f. Gravel pit excavation.
g. Loading in stone quarries and open cut mines.
h. Excavating basements and foundations.
i. Excavating in borrow pits.
j. Railroad grading.
k. Grading airports and camp sites.

6.48. *Crowding and retracting* are the functions of thrusting the dipper and dipper stick (dipper handle) outward and inward.

6.49. *Shipper shaft.*—Shaft at center (or near center) of shovel boom, which acts as pivot point of dipper stick as its angle and thrust positions are changed and on which is mounted dipper stick crowding and retracting mechanism of the boom.

6.50. *Shovel crowd types.*—There are five types of crowd used on shovels. Manufacturer should specify which one of the following is used:

a. *Combination cable crowd,* which uses both hoist drums and brakes and requires no special reversing mechanism.
b. *Independent or positive cable crowd,* which uses both hoist drums but requires a reversing mechanism.

c. *Independent or positive chain crowd*, which uses only one hoist drum and requires an independently driven chain mechanism with reversing action.

d. *Combination independent cable and chain crowd.*—Superstructure shovel mechanism to boom hinge can be either by chain or cable and boom shovel mechanism can be either cable or chain. In either case reversing mechanism on superstructure is required.

e. *Electric separate motor driven*, used only on multiple electric-motor-driven machines (not covered herein) which has separate electric motors for main operating functions of hoist, swing, and crowd.

6.51. *Dipper stick drive.*—There are two methods of transmitting the power to the dipper stick at the point of the shipper shaft (drive point in boom) to transfer crowding and retract action:

a. *Rack and pinion drive* consisting of a geared pinion on shipper shaft meshing with a rack on the dipper stick.

b. *Sleeve type* in which the dipper stick slides freely in the sleeve at the shipper shaft point with the power applied through cables or chain to the ends of the dipper stick to move it through the sleeve in either direction.

6.52. *Padlock* sometimes called bail block, dipper sheave block, or snatch block is a sheave and its housing by which the hoist line is connected to the dipper either directly or through a bail.

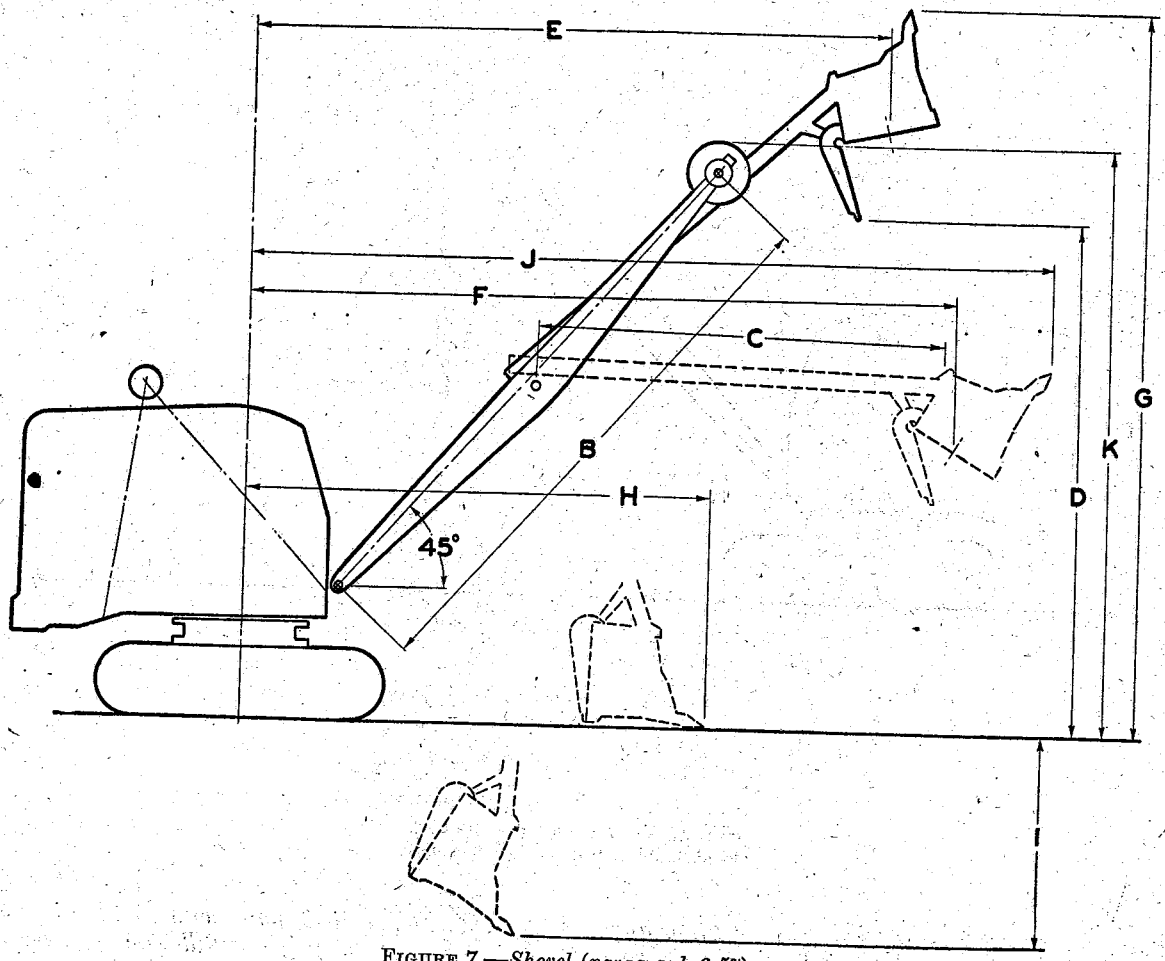

FIGURE 7.—*Shovel (paragraph 6.57).*
Also applicable to truck and wheel mounting.

6.53. *Bail* is a member that is sometimes used to attach the padlock or bail block or hoisting line to the dipper of the shovel.

6.54. Shovel dipper capacity rating.—The rated capacity of the shovel dipper shall not be more than the number of cubic yards (cubic meters) or fraction

thereof, obtained by multiplying the mean height of the dipper by the inside cross-sectional area of the dipper at one-half the minimum height. A variation of two (2) percent is allowed. The mean height is determined by taking one-half the sum of the maximum and minimum heights of the dipper body including its minimum lip projection without teeth. If the dipper is of special shape, proper allowance shall be made for the increased or decreased volume.

6.55. *Shovel sizes.*—The standard sizes of shovels (dipper capacity ratings) covered by this standard and generally available from American manufacturers are ⅜ to 2½ cu yd.

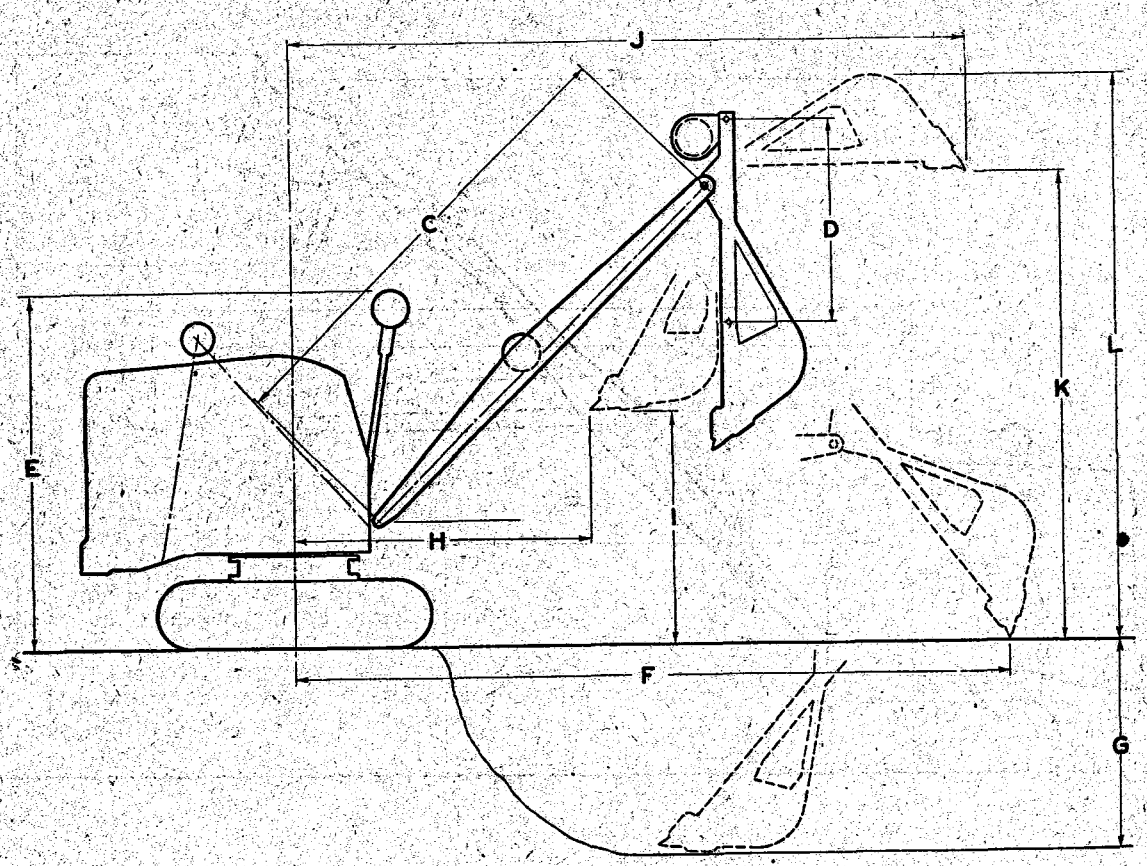

FIGURE 8.—*Hoe (paragraph 6.60).*
Also applicable to truck and wheel mounting.

6.56. *Shovel working range.*—*The working ranges and dimensions for shovels shall be given for a boom angle of 45°.*

6.57. *Shovel data (see fig. 7).*—*For each power shovel offered, the manufacturer shall furnish, for the purpose of comparison, the detail data indicated below for boom angle of 45°.*

A. Shovel dipper capacity in cubic yards.
B. Length of boom from boom hinge pin center to boom head sheave shaft center.
C. Length of dipper stick.
D. Maximum dumping height.
E. Dumping radius at maximum height.
F. Maximum dumping radius.
G. Maximum cutting height.
H. Maximum clean-up radius at floor level.
I. Maximum digging depth below floor level.
J. Maximum cutting radius.
K. Boom head clearance height.
L. Dipper bail speed (with number of parts of line stated)—at full-load governed engine speed.
M. Dipper bail pull (with number of parts of line stated)—at full-load governed engine speed.

Hoe

6.58. *Hoe operating equipment* consists of a boom, dipper, dipper stick, bail, proper drum laggings and cables and gantry or A-frame connected at or near boom hinge to provide proper cable leads. The hoe is a positive digging tool

best suited for excavating below ground level. Dipper arm is pivoted at end of boom and dipper is fastened to it. One hoist drum controls angle or position of boom which is live (boom hoist is not used). Other hoist cable controls angle of dipper arm and position of bucket, drags in bucket to load and releases it for dumping. *Hoe* is also called *trench hoe*, *back hoe*, *backdigger*, *drag shovel*, and *pull shovel*. Hoe dipper capacities are usually stated in terms of widths of cut. Nominal size is same as shovel dipper, but special trench widths affect the nominal capacity.

6.59. *Hoe uses and applications.*—The hoe should be used under the following conditions:

a. Where excavation is below the ground level.

6.60. Hoe data (see fig. 8).—For each hoe-type machine offered, the manufacturer shall furnish for the purpose of comparison, the detail data indicated below:

A. Hoe dipper nominal capacity in cubic yards.
B. Hoe dipper width.
C. Length of boom from boom hinge pin center to boom head sheave shaft center.
D. Length of dipper arm, center to center of end pins.
E. Height of hoe gantry, if used, in working position.
F. Maximum reach at ground level.
G. Maximum digging depth.
H. Radius at beginning of dump.
I. Clearance from ground at beginning of dump.

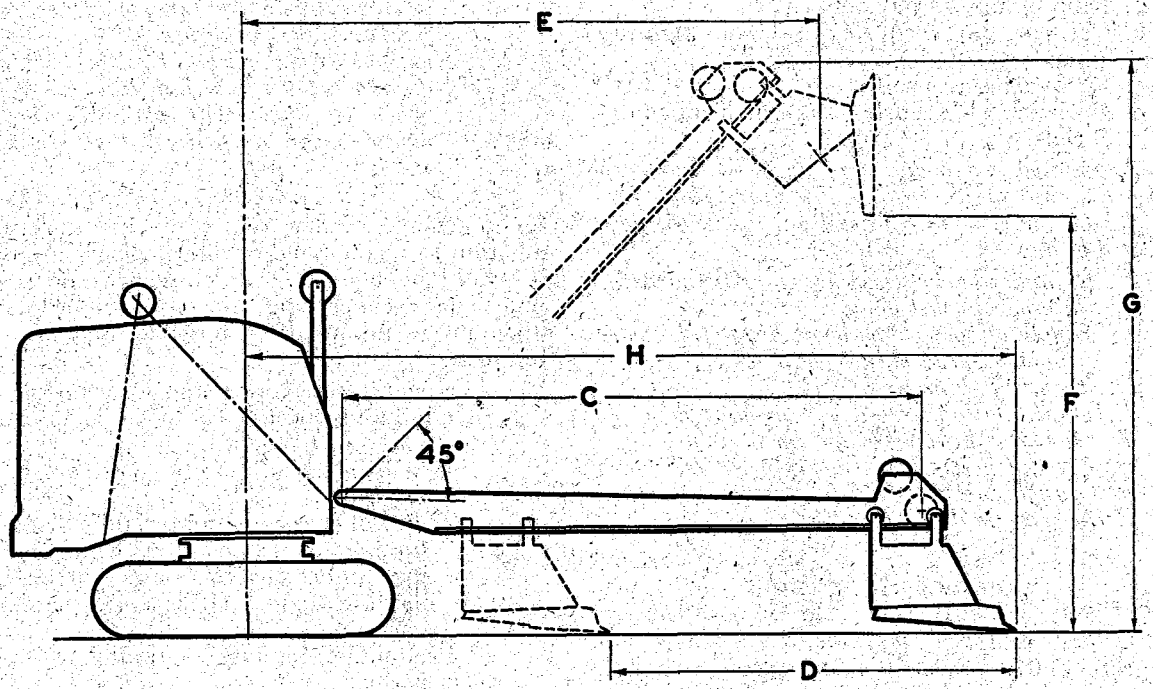

FIGURE 9.—*Skimmer scoop (paragraph 6.63).*

b. Where the material to be dug is firm or hard.
c. Where excavation cut must be closely trimmed.
d. Where disposal or dumping may be at short range.

Some of the jobs which can generally be done efficiently by the hoe are

e. Sewer and water line trenches.
f. Small basement and cellar excavation.
g. Oil and gas pipe line construction.
h. Railroad embankment grading and maintenance.
i. Digging large foundation footings.

J. Clearance radius at end of dump with dipper arm horizontal.
K. Clearance from ground at end of dump with dipper arm horizontal.
L. Over-all height at end of dump with dipper arm horizontal.

Skimmer Scoop

6.61. *Skimmer scoop equipment* (usually not standard equipment) consists of flat box type boom with flanges on each side in which a flat bottomed bucket hung and driven on trolley mechanism, is thrust forward or crowded for dig-

ging by one hoist cable. Bucket is retracted by gravity when boom is at angle or by a retracting clutch. Boom is "live," operated by second hoist cable to control its angle and dumping position of bucket. Bucket has hinged bottom controlled by trip cable actuated from operator's position. Boom hoist is not used. Skimmer bucket capacity is usually stated in terms of width of cut, but nominal capacity is same as shovel dipper capacity for any given machine.

6.62. *Skimmer scoop.*—Most manufacturers offer the skimmer scoop only on special order because of the limited demand for it and its few uses. It has a positive action and may be used on hard digging where a thin cut parallels the boom. It is best adapted to machines of ½- and ¾-cubic-yard capacity. It is effective under some conditions, such as

a. Ripping up old pavement.
b. Carrying an accurate grade on highway paving.
c. Excavating top soil.
d. Carrying an accurate slope in firm materials.

6.63. Simmer scoop data (see fig. 9).—For each skimmer scoop offered the manufacturer shall furnish, for the purpose of comparison, the detail data indicated below:

A. Skimmer bucket capacity in cubic yards.
B. Skimmer bucket width.
C. Length of boom from boom hinge pin center to boom head sheave shaft center.
D. Travel of skimmer bucket.
E. Dumping radius—at 45° boom angle.
F. Dumping height—at 45° boom angle.
G. Over-all height when dumping at 45° boom angle.
H. Maximum digging radius.

Complete Machines

7.01. *The complete machine.*—As stated in paragraph 3.01, "Basic operating components", the machines covered here are usually convertible for the several operating functions, as indicated by the title and as have been described in previous paragraphs. The three different types of mountings described possibly may be applied to any one specific size of revolving superstructure but are seldom capable of being economically interchanged after machine has been shipped from factory, so that from the standpoint of mountings, machines are not usually considered convertible. Therefore, the buyer must choose the type of mounting best suited for his conditions at time of his initial purchase.

Front-end equipments are interchangeable and machines are usually readily convertible for the various operating functions and kinds of work previously described. The change from one type of front-end equipment to another is a comparatively simple operation, depending on conditions and availability of all equipment. A buyer's initial purchase may cover one, two, several, or all of the front-end equipment. The manufacturer is usually in a position to supply at a later date, if and as required, those not originally purchased.

7.02. Complete-machine data.—For each type of complete machine offered, the manufacturer shall furnish for the purpose of comparison, the detail data indicated below in addition to that furnished for each type of mounting and each type of front-end equipment:

a. Net shipping weight with all equipment offered.
b. Operating weight with each type of front end.
c. Approximate gross weight packed for export shipment with all equipment (see export preparation, paragraph 8.01).
d. Nominal capacity when equipped as shovel.
e. Nominal capacity as clamshell and dragline when equipped with standard length of crane boom, as indicated in paragraph 6.03.

7.03. *Buyer's specifications.*—In order that the manufacturer or his representative may be in position to recommend or offer proper equipment, it would be helpful if the buyer would give as much data concerning the work for which the machine is intended as possible, including the following:

a. General description and location of work.
b. Kind and character of material to be excavated or handled.
c. Will excavation be above or below level of ground.
d. How will excavated material be disposed—dumped on a bank (if so what are limiting dimensions, or factors) or loaded in hauling units. (If latter, describe size and type.)
e. Production required in units in specified period.
f. Skill or experience of operators available.
g. Delivery required at operating destination.
h. Altitude of operation.
i. Climatic conditions.

General Recommendations

8.01 *Export preparation.*—A number of factors influence the manner in which machines, as covered by this standard, may or should be prepared for export shipment overseas, namely:

a. Design and construction of basic superstructure and mounting.
b. Transportation and handling facilities to and at port of entry, ultimate destination or those of trans-shipment.

c. Excessive heavy lift or cubic content ocean freight charges which may be favorably offset by high costs of export packing or vice versa.

d. Type of skilled labor or facilities available at ultimate destination for erecting machines.

There are two general methods of export preparation as described below. Exact specifications should be negotiated upon between manufacturer and buyer at time order is placed.

8.02. Skidding.—General procedure of skidding for export consists of removal of front-end attachment from superstructure and removal of revolving superstructure from mounting. Superstructure is skidded. Mounting is shipped "loose" with those parts easily damaged covered by proper protection. Front-end attachment and other heavy parts are shipped loose or crated. Small parts are included in complete boxes. Consideration is given to keeping over-all cubic measurements of various pieces to minimum, because such shipments usually bulk considerable and are charged by measurement instead of weight. Slings for handling large pieces may be provided. Manufacturer shall furnish complete description and specifications of this "skidding" method of shipment, together with a pro-forma packing list showing weight and measurements of each piece.

8.03. Complete boxing consists of dismantling, or "knocking down", machine to meet conditions specified either by buyer or manufacturer or after negotiation between them, which determines the degree to which the machine is to be dismantled. Various segments of component parts are boxed or crated according to negotiated specifications. Manufacturer furnishes with his tender pro-forma packing list showing package weights and dimensions and detailed packing lists upon shipment.

8.04. *Spare parts.*—When the manufacturer has occasion to submit quotation, bid, or tender direct to a buyer who is the ultimate user, it is suggested that he recommend a spare-parts kit of sufficient quantity for maintaining and servicing the machine for a perod of 1 year.

Labeling and Certification

9.01. Identification plate.—The name of the manufacturer, model number, and serial number shall be shown in a conspicuous place in or on the machine.

9.02. Certification.—In order to assure the purchaser that he is receiving a machine which complies with the requirements of this standard, the manufacturer will attach in a conspicuous place in or on each machine a plate or label bearing the following wording:

> *The manufacturer certifies that this machine complies with all requirements of Commercial Standard CS90E–47, as issued by the National Bureau of Standards of the United States Department of Commerce.*

9.03. Labeling.—Figure 10 illustrates the label adopted by the members of the Power Crane and Shovel Manufacturers Export Standards Association to certify compliance of any particular machine with the applicable parts of this standard.

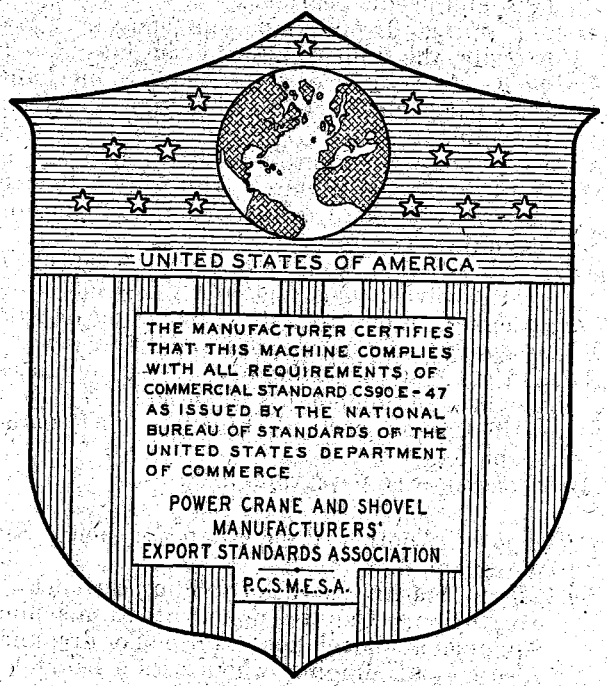

FIGURE 10.—*Label adopted by the Power Crane and Shovel Manufacturers Export Standards Association.*

Glossary of Technical Terms

10.01. The following is a glossary of technical terms and definitions peculiar to the power crane and shovel industry. No attempt has been made to list terms of a general mechanical engineering or design nature.

Accessory.—Any device, mechanical or otherwise, that assists or increases usefulness of the machine.

A-*Frame.*—See paragraph 6.08.

Air brake.—Brakes operated by compressed air developed from air compressor. Most important use is for service brakes on truck- and wheel-mounted machines.

Air cleaner.—Filtering device mounted on power unit to prevent dust or other foreign particles reaching combustion chamber.

Air hammer.—Compressed-air-driven pile hammer.

Alloy.—As applied to metals such as iron, steel, copper, etc. means another element or chemical which increases strength, abrasive resistance, or other desired qualities of the base metal.

Angle (boom).—The angle from horizontal at which the particular type of boom reposes. Boom angle is adjustable by means of the boom hoist also called derricking device. See paragraph 6.06.

Antifriction bearings.—Ball bearings, roller bearings, and needle bearings.

Arm (Dipper).—Dipper stick on shovel. Arm carrying the dipper or bucket on hoe.

Assembly.—Any minor or major group of mechanical parts designed to perform a given function.

Attachment.—An alternate way of designating a front end component. Any other device that may be added to a complete unit or assembly.

Axle.—The shaft or spindle on which a wheel or gear revolves. On truck and wheel mounted machines, refers to automotive type of axle assembly, including gearing and differential.

Axle (bogie).—Two automotive types of axles mounted in tandem in a frame so as to permit oscillation in vertical direction. See paragraph 5.14.

Axles (truck)—See paragraph 5.12.

Backdigger.—Another designation for hoe. See paragraph 6.58.

Backfiller.—Machine used for refilling a trench or excavation. Can be done with a machine equipped as shovel, hoe, clamshell or dragline. Also a small dragline which uses a backfiller board which is a device of one surface equipped with chains or bridles for connection to hoist and dragline cables.

Backward stability.—See paragraphs 5.08 and 5.16.

Bail (bucket or dipper).—Large clevis or U-shaped device hinged to front outsides of shovel dipper, hoe dipper or dragline bucket to which is attached connecting sheave or chains for hoisting or dragging function.

Bail pull.—Line pull developed when bail is used on dipper or bucket. In shovel operation, this is usually twice the single line pull because hoist cable is reeved in two parts.

Back hoe.—Another designation for *hoe.* (See paragraph 6.58.)

Ballast.—See Counterweight.

Ball bearing.—One type of antifriction bearings using hardened steel balls which may be enclosed in grease tight case or cage.

Band brake.—Circular type of brake either of external contracting type or internal expanding type, with a contacting surface consisting of a steel strap lined with heat and wear resistant friction material.

Band clutch.—Circular type of clutch either of external contracting or internal-expanding type, with a contacting surface consisting of a steel strap lined with heat- and wear-resistant friction material.

Band friction.—Lining used on brakes or clutch band. Usually made of heat-resistant or heat-absorbing material, sometimes containing asbestos.

Bank (lever).—Row of operating levers used for controlling various functions of machine.

Bar (dipper latch).—Bar attached to dipper door, fitting into latch or clevis on bottom of dipper, actuated by dipper trip mechanism, for opening and closing door for dumping material.

Barrel.—Casting or structural sleeve through which single dipper stick slides in certain types of shipper shaft construction.

Base (Crawler).—Same as crawler base.

Base (rotating).—Casting or structural member on which all revolving superstructure mechanism is mounted.

Base (turntable).—Same as rotating base.

Base (travel).—Sometimes used to describe complete mounting—crawler, truck, or wheel.

Bed plate.—See paragraph 4.01.

Belt (tread).—Assembled crawler treads and connecting pins around rollers and drive sprockets; that part of crawler in contact with the ground. Usually designated as two tread belts per crawler.

Block.—Sheaves or grooved pulleys in a frame provided with hook, eye, or strap.

Block (bail).—Block attached to shovel dipper or dragline bucket bail through which hoist line is reeved.

Block (hook).—Block with hook attached used in lifting service. It may have a single sheave for double or triple line or multiple sheave for four or more parts of line.

Bogie axle.—See paragraph 5.14.

Boom.—Structural member attached to revolving superstructure used for guiding and acting as support for front end operating mechanism.

Boom angle.—The angle from the horizontal which the particular type of boom reposes. Boom angle is adjustable by means of boom hoist also called derricking device. See paragraph 6.06.

Boom foot.—Base of boom where it is attached to revolving superstructure.

Boom hinges.—Projections or sockets on revolving bed plate in which fit boom hinges. See paragraph 4.02.

Boom mechanism.—All sheaves, pins, shafts, clevises, cables or other mechanism attached to the boom—everything on the boom in addition to bare boom structure.

Boom head.—Sheaves and pins at top or head of boom and any other mechanism at boom head including brackets for attaching boom tip extension.

Boom hoist.—See paragraph 4.09.

Boom lacing.—Structural truss members at angles

to and supporting four corner members of a structural boom.

Boom length.—Straight line distance from center of boom foot pin to center of boom head main hoist sheave. See paragraph 6.03.

Boom head fairlead.—A swiveling sheave or sheaves at boom head used to reduce hoist cable wear by compensating for operation not in line with the boom.

Boom sections.—Crane booms are usually in two sections—upper and lower. Such booms may be lengthened by insertion of one or more intermediate sections.

Boom splices.—See paragraph 6.04.

Booster.—An auxiliary clutch attached to main functional clutch to activate it for assisting in ease of operation.

Brake shoe.—That part of shoe type brake or clutch which makes contact with brake wheel, brake drum or clutch drum.

Brake band.—A circular steel strap lined with heat resistant friction material.

Bridle.—See paragraph 6.07b.

Buckets.—See Clamshell (paragraphs 6.17, 6.19, 6.20).

Dragline (paragraphs 6.27 and 6.28).
Shovel (paragraphs 6.46, 6.54).
Hoe (paragraph 6.58).
Skimmer scoop (paragraph 6.61).

Bucket (concrete).—Bucket for handling wet concrete, fitted with bail or bridle, usually handled on lifting crane and hoisted to dumping location.

Bull gear.—Same as swing gear (see paragraph 4.13).

Cab.—Housing on revolving superstructure, usually of sheet metal, on structural frame. Also, on truck crane carriers, the driver's enclosed position.

Car body.—Same as base (crawler).

Cable.—Steel wire cables or ropes used in various front end equipment operating functions.

Caterpillar mounting.—An alternate designation of a crawler mounting.

Center gudgeon.—Housing between revolving superstructure and travel base which carries strains at center of machine and in which center pin is located.

Center pin.—Large pin or vertical shaft which acts as rotation centering device for revolving superstructure and which may carry drive to travel base.

Center pintle.—Same as center pin.

Center post.—Same as center pin.

Chain (crawler).—See crawler chain.

Chain crowd.—See paragraphs 6.46, 6.48, 6.50.

Clean-up radius.—Maximum distance from revolving center at same plane or level on which machine mounting rests and operates.

Closing line.—See paragraph 6.21.

Climb.—See paragraph 5.07.

Combination crowd.—See paragraph 6.50.

Common crane boom.—See paragraph 6.01.

Component.—An assembly or group of mechanisms which when attached or installed on a machine enables the performance of distinct functions.

Continuous derricking cables.—See paragraph 6.07a.

Convertibility.—Ability of machine to be equipped for one type of work or another through interchangeability of front end equipment or mountings. (See paragraph 7.01.)

Counterweight.—Dead weights, usually of metal (cast iron or structural boxes filled with scrap) used for balancing operating loads and attached to rear of revolving superstructure—sometimes called ballast.

Crawler.—See paragraph 5.01.

Crawler base.—Cast or structural lower member to which are attached frame for carrying crawler mechanism including tread belt and on which are mounted roller path and ring gear.

Crawler bearing length.—See paragraph 5.02.

Crawler frame.—Substructures on which are mounted crawler base, and which carries tread belt, rollers, and final crawler drive.

Crawler shoes.—Same as treads.

Crawler chains.—Chains used as final drive from crawler frame to large sprocket to which is attached driving roller of tread belt.

Crowd.—See paragraphs 6.46, 6.48, and 6.50.

Cutting lip.—The edge of a bucket or dipper which penetrates material to be excavated. Teeth may or may not be attached.

Cutting width.—Actual width of opening cut by a bucket or dipper measured by overall width of outside teeth or cutters.

Deck.—Revolving superstructure turntable bed.

Derricking.—Operation of changing boom angle or of hoisting or lowering boom.

Derricking cables.—The lines or cables used in changing angle of boom or in derricking. See paragraph 6.07.

Digging radius.—Horizontal distance from center of rotation to dipper teeth at maximum reach of dipper or bucket at any given boom angle.

Dipper capacity.—See paragraph 6.54.

Dipper front.—The bottom surface or bottom side when teeth are in horizontal digging position.

Dipper back.—The top surface or top side of dipper when teeth are in horizontal digging position.

Dipper handle.—Another term for dipper stick.

Dipper latch.—Clevis attached to back side of dipper front or dipper bottom in which fits latch bar of dipper door used in dumping operation. Also applies to bottom dump hoe dippers and skimmer scoop buckets.

Dipper shell.—Dipper less teeth, door and door mechanism.

Dipper teeth.—Cutting points on dipper.
Dipper trip—Mechanism used in opening dipper door in dumping operation.
Dismantle.—Term used in knocking down machine for export packing. See paragraph 8.03.
Double reduction.—Automotive term applying to type of drive from drive shaft to differential in driving axles.
Dowel pin.—A fitted pin, which may be round, square or of any other cross sectional shape, usually employed for locating parts.
Drag cable.—Cable for pulling-in bucket in dragline or hoe operation.
Dragline.—See paragraphs 6.25 and 6.26.
Dragline bucket.—See paragraphs 6.27 and 6.28.
Dragline fairlead.—See paragraph 6.29.
Drag shovel.—Another term for hoe.
Drive tumbler.—Roller with teeth or lugs which contact matching recesses or lugs in tread shoes of crawler mechanism.
Drop hammer.—See paragraph 6.40.
Drum.—Any spool or large pulley on which are wrapped cables used in machine operation.
Dual crowd.—See paragraph 6.50d.
Dumping height.—Maximum clearance height from machine's operating level of any bucket in dumping position at any given boom angle. With shovel dippers and buckets with doors, this distance is lowest position with door open.
Dumping radius.—Maximum distance from center of rotation of machine to center line of bucket or dipper in dumping position with boom at any given angle.

Excavator.—A term for any machine which digs material.

Fairlead.—See paragraph 6.29.
Floating harness.—See paragraph 6.07b.
Fuel pump (hand).—Hand operated pump used for filling fuel tank by pumping from another receptacle.
Fuel pump (Diesel).—Pump on diesel engine which takes fuel from supply line and distributes to nozzles on injectors.
Fuel pump (gasoline).—Pump on gasoline engine which forces fuel in supply line to carburetor.
Fully enclosed cab.—Machine house or cab which encloses all machinery including operator's position.
Full-load speed.—See paragraph 4.05, full-load governed engine speed.

Gantry.—See paragraph 6.08.
Gantry crane (revolving).—A term applied to a machine mounted on a high structural base capable of traveling on rails.
Gooseneck boom.—A boom which has an upper section or tip extension projecting at angle from longitudinal axis of boom—usually a curved section.
Governed speed.—See paragraph 4.05, full-load governed engine speed.
Ground pressure.—See paragraph 5.03.
Grouser.—Projecting lugs attached to, or integral with, crawler treadshoes to provide additional traction.
Gudgeon.—See Center Gudgeon.
Guy rope.—Cables with both ends dead ended. Usually those used in connection with derricking systems when floating boom harness is installed.

Hammer (pile).—See paragraphs 6.37, 6.40, 6.41, and 6.42.
Handled.—See paragraph 6.02.
Handle (dipper).—Another term for dipper stick.
High altitude heads.—High-compression cylinder heads installed on internal combustion engines to partially compensate for low air pressure at high altitudes. See paragraph 4.06.
High lift.—Term applied to shovel front end equipment when longer than standard boom or dipper stick are installed to give greater dumping range and height.
High speed boom hoist.—Boom hoist with greater speeds than standard to provide for fast derricking of boom, particularly in lifting crane service.
Hoe.—See paragraph 6.58.
Hog rods.—Stationary boom supports used instead of derricking cables.
Hoist.—Function of lifting and lowering loads. Standard machines are usually provided with three hoist drums and mechanism, namely—main hoist, secondary hoist and boom hoist. Some manufacturers offer a fourth hoist drum for special purposes.
Holding line.—See paragraph 6.22.
Hook rollers.—A type of construction in which rollers for swinging function roll in double flanged path providing bearing against either top or bottom flanges, or with single flange with rollers on top and bottom.

Identification plate.—See paragraph 9.01.
Idler roller.—Rollers of tread belt mechanism which are not power driven.
Idler tumbler.—Large end roller of crawler tread belt mechanism at opposite end from drive tumbler and which is not power driven.
Independent crowd.—See paragraph 6.50.
Independent boom hoist.—Boom hoist which can be operated independently of any other machine function.

Jack shaft.—Term applied to any intermediate shaft.
Jib.—See paragraph 6.05.

King pin.—Another term for center pin.

Laggings.—See paragraph 4.10.
Latticed boom.—Boom of open structural construction with angular lacing between four main corner members in form of truss.
Lifting capacity.—See paragraphs 6.09 to 6.16 and 6.36.
Line pull.—See paragraph 4.11.
Line speeds.—See paragraph 4.12.
Live roller circle.—An assembly of multiple swing rollers free to roll between revolving superstructure and mounting.
Load line.—Another term for hoist line. In lifting crane service, it refers to the main hoist while secondary hoist is referred to as whip line.

Magnet.—Electric lifting magnet used for picking up loose ferro metal. Machine must be equipped with direct current electric power either by (1) independently driven generator, (2) generator driven from machine power unit, (3) power from outside source through plug-in arrangement. Manganese steel can not be handled with a magnet.
Magnet controller.—Electric controller for governing flow of current to magnet. Part of magnet equipment.
Main hoist.—See paragraph 4.08.
Mats.—Supports or floats used for supporting machine on extremely soft ground. Usually of timber construction.
Monkey line.—Another term for tagline.
Mounting.—See paragraph 3.01b.

Outriggers.—See paragraph 5.15.
Overhaul.—Ability of any weight on end of hoist line to unwind cable from drum when brake is released.

Padlock.—See paragraph 6.52.
Pay load.—The net load or volume handled exclusive of weight of bucket, dipper, hook or other handling mechanism.
Pile.—See paragraphs 6.37 to 6.44.
Pile driver.—See paragraph 6.37 to 6.44.
Pile driver leads.—See paragraph 6.39.
Pile cap.—Protecting cap for fitting on top of piling to prevent battering or splintering (see paragraph 6.43).
Points (dipper teeth).—Removable and replaceable points for dipper or bucket teeth.
Power boom lowering.—Boom hoist which has reversible mechanism permitting lowering boom under power rather than by gravity with brake control.
Power equipment.—See paragraph 4.03.
Power lowering.—Hoist mechanism with reversing drive permitting lowering load under power, for precision work, rather than by gravity with brake control.
Power take-off.—See paragraph 4.07.
Pull shovel.—Another term for hoe.

Rack.—Flat toothed surface on dipper stick which meshes with shipper shaft pinion, a flat gear.
Racking.—Operation of retracting extended dipper.
Radius (of load).—See paragraph 6.12.
Rated load.—Same as lifting capacity (see paragraphs 6.09 and 6.10).
Rear end radius.—Clearance distance from center of rotation to maximum rear extension of revolving superstructure.
Reeving.—The passing of cables or ropes over drums, sheaves and pulleys.
Revolving superstructure.—See paragraph 3.01a.
Ring gear.—Another term for swing gear (see paragraph 4.14).
Roller path.—See paragraph 4.14.
Ropes.—Same as cables.
Rope crowd.—Same as cable crowd (see paragraph 6.50).

Saddle block.—Mechanism and bearings which carry shipper shaft drive and acts as guide for dipper stick.
Safe load rating.—See paragraphs 5.08 to 5.10; 5.15 to 5.17; 6.10 to 6.16 and 6.36.
Scoop (skimmer).—See paragraphs 6.61 to 6.63.
Slewing.—Another term for swinging function.
Stability.—The ability of machine to resist tipping.
Shipper shaft.—See paragraph 6.49.
Skidding.—Method of export shipping preparation (see paragraph 8.02).
Steam hammer.—Steam driven pile hammer (see paragraph 6.42).
Stripper.—Machine used for excavating overburden in open cut mining. In this standard "Stripper" usually applies to a shovel or dragline capable of greater ranges than the manufacturer's standard ratings for the particular size of machine. A stripping shovel may be equipped with extra long boom and dipper stick and with a dipper slightly smaller than the nominal rated capacity. A stripping dragline usually has an extra long boom with a corresponding and compensating smaller bucket than the nominal rated capacity with base rating length of boom (see paragraph 6.03).
Superstructure (revolving).—See paragraph 3.01a.
Sway braces.—Stiffening cables or rods with or without turnbuckles, sometimes used on each side of boom.
Swing.—See paragraph 4.13.
Swing gear.—External or internal gear with which swing pinion of revolving superstructure meshes to provide swinging motion.

Tagline.—See paragraph 6.23.
Tail swing.—Same as rear end radius.
Third drum.—A third hoist drum, in addition to

two standard hoist drums, often used in pile driving for handling piles.

Tipping load.—See paragraphs 5.10 and 5.17.

Tire sizes.—Are specified by diameter of casing, diameter of wheel and number of plies, i. e., 9.00×20—10 ply is 9-inch-diameter casing on 20-inch-diameter wheel or rim and 10-ply construction.

Tooth base.—Main part of dipper tooth to which removable points are fastened.

Track.—Crawler tread belts.

Trailer.—Rubber tired vehicles on which machines are loaded for long moves, or used for hauling auxiliary equipment and pulled by machine, particularly truck mounted machines.

Travel.—Function of moving machine.

Travel base.—Same as crawler base.

Treads.—Hinged steel pads forming continuous crawler belt supporting the machine.

Trench hoe.—Another term for hoe.

Truck crane.—Crane mounted on engine-driven rubber-mounted carrier. See paragraph 5.12.

Turntable.—Another term for revolving superstructure of machine.

Tumbler.—Large rollers of crawler tread belt.

Turning circle.—Minimum diameter of circle in which machine can be turned completely.

Whip line.—Secondary hoist line (see load line).

Working weight.—Weight of machine with engine radiator full, fuel tank half full, with complete front end equipment installed including bucket or hook block.

Wheel base.—Center to center of front and rear axles. On three axle trucks, rear center is center of bogie axle.

Wheel machine.—See paragraph 5.20.

Effective Date

11.01. The standard is effective for new production from February 15, 1947.

Standing Committee

12.01. The following individuals comprise the membership of the standing committee, which is to review, prior to circulation for acceptance, revisions proposed to keep the standard abreast of progress. Each organization nominated its own representative. Comment concerning the standard and suggestions for revision may be addressed to any member of the committee or to the Division of Trade Standards, National Bureau of Standards, which acts as secretary for the committee.

EUGENE R. WEBER (chairman), Bucyrus-Erie Co., South Milwaukee, Wis.

G. K. WOODLING, Harnischfeger Corp., 4400 West National Ave., Milwaukee, Wis.

JULIAN R. STELLMAN, Koehring Co., 3026 West Concordia Ave., Milwaukee, Wis.

G. H. OLSON, Link-Belt Speeder Corp., 301 West Pershing Road, Chicago, Ill.

HARRY FIES, Engineering Department, The Marion Steam Shovel Co., Marion, Ohio.

STANDARDS COMMITTEE: Power Crane and Shovel Manufacturers' Export Standards Association.

History of Project

13.01. On December 14, 1939, a conference of representative manufacturers, held in Chicago, Ill., indicated its interest in the establishment of a commercial standard for exports of power shovels and cranes. The conference reviewed a tentative draft which had been prepared by the National Bureau of Standards, and requested that it be redrafted along the lines of classifications rather than definite specifications.

13.02. Accordingly. a revised draft was prepared and submitted to interested manufacturers for comment. The Bureau of Foreign and Domestic Commerce cooperated in obtaining comment on this draft from Latin-American countries and from Canada, which was placed before the American manufacturers and which indicated that such a standard would be very helpful in bringing about better understandings between buyers and sellers.

13.03. A subsequent conference of representative manufacturers held in Chicago on June 6, 1940, adjusted the revised draft in detail, and recommended its circulation to the industry for written acceptance. The recommended commercial standard was accordingly circulated for written acceptance on June 18, and upon receipt of written acceptances by a satisfactory majority, Commercial Standard CS90E–41 was promulgated in mimeographed form on November 9, 1940, to be effective for new orders from January 9, 1941.

First Revision

13.04. On June 21, 1946, at a meeting of the Power Crane and Shovel Manufacturers' Export Standards Association, a draft was adjusted for the revision of Crawler Mounted, Revolving Power Shovels, Lifting Cranes, Dragline and Clamshell Excavators (Export Classifications), Commercial Standard CS90E–41, and a recommendation was made that it be circulated to the trade for written acceptance. The recommended revision, following approval by the standing committee, was accordingly circulated for written acceptance on September 4, 1946. The revision of the standard provides for an expansion of CS90E–41 to include convertible full revolving type truck and wheel mounted power cranes and shovels together with additional front end operating equipment as hoe, pile driver, and skimmer scoop. Upon receipt of written acceptances by a satisfactory majority, Commercial Standard CS90E–47, as shown herein was promulgated on January 15, 1947, to be effective for new production from February 15, 1947.

ACCEPTANCE OF COMMERCIAL STANDARD

If acceptance has not previously been filed, this sheet properly filled in, signed, and returned will provide for the recording of your organization as an acceptor of this commercial standard.

Date _____

Division of Trade Standards,
National Bureau of Standards,
Washington 25, D. C.

Gentlemen:

We believe that the Commercial Standard CS90E–47 constitutes a useful standard of practice, and we individually plan to utilize it as far as practicable in the

production [1] distribution [1] testing [1]

of power cranes and shovels, convertible full-revolving type; crawler, truck and wheel mounted, including clamshell, dragline, lifting crane, hoe, pile driver, and skimmer scoop operating equipment (export classification).

We reserve the right to depart from it as we deem advisable.

We understand, of course, that only those articles which actually comply with the standard in all respects can be identified or labeled as conforming thereto.

(Cut along this line)

Signature of authorized officer _____
(In ink)

(Kindly typewrite or print the following lines)

Name and title of above officer _____

Organization _____
(Fill in exactly as it should be listed)

Street address _____

City, zone, and State _____

[1] Underscore which one. Please see that separate acceptances are filed for all subsidiary companies and affiliates which should be listed separately as acceptors. In the case of related interests, trade associations, trade papers, etc., desiring to record their general support, the words "General Support" should be added after the signature.

TO THE ACCEPTOR

The following statements answer the usual questions arising in connection with the acceptance and its significance;

1. *Enforcement.*—Commercial standards for exports are commodity specifications voluntarily established by mutual consent of those concerned. They present a common basis of understanding between the producer, distributor, and consumer and should not be confused with any plan of governmental regulation or control. The United States Department of Commerce has no regulatory power in the enforcement of their provisions, but their provisions through usage soon become established as trade customs, and are made effective through incorporation into sales contracts by means of labels, invoices, and the like.

2. *The acceptor's responsibility.*—The purpose of commercial standards is to establish for specific commodities, nationally recognized grades or consumer criteria and the benefits therefrom will be measurable in direct proportion to their general recognition and actual use. Instances will occur when it may be necessary to deviate from the standard and the signing of an acceptance does not preclude such departures; however, such signature indicates an intention to follow the commercial standard where practicable, in the production or exportation of the article in question.

3. *The Department's responsibility.*—The major function performed by the Department of Commerce in the voluntary establishment of commercial standards for exports on a Nation-wide basis is fourfold: first, to act as an unbiased coordinator to bring all interested parties together for the mutually satisfactory adjustment of trade standards; second, to supply such assistance and advice as past experience with similar programs may suggest; third, to canvass and record the extent of acceptance and adherence to the standard on the part of producers and exporters; and fourth, after acceptance, to publish and promulgate the standard for the information and guidance of buyers and sellers of the commodity.

4. *Announcement and promulgation.*—When the standard for exports has been endorsed by a satisfactory majority of production in the absence of active, valid opposition, the success of the project is announced. If, however, in the opinion of the standing committee or the Department of Commerce, the support of any standard is inadequate, the right is reserved to withhold promulgation and publication.

ACCEPTORS

14.01 The organizations listed have individually accepted this standard for use as far as practicable in the production, distribution or testing of power cranes and shovels, convertible full-revolving type; crawler, truck and wheel mounted: including clamshell, dragline, lifting crane, hoe, pile driver, and skimmer scoop operating equipment (export classifications). In accepting the standard they reserve the right to depart therefrom as they individually deem advisable. It is expected that articles which actually comply with the requirements of this standard in all respects will be regularly identified or labeled as conforming thereto, and that purchasers will require such specific evidence of conformity.

American Hoist & Derrick Co., St. Paul, Minn.
Bay City Shovels, Inc., Bay City, Mich.
Buckeye Traction Ditcher Co. The, Findlay, Ohio
Bucyrus-Erie Co., South Milwaukee, Wis.
Byers Machine Co., The, Ravenna, Ohio.
General Excavator Co., The, Marion, Ohio.
Hanson Clutch & Machinery Co. The, Tiffin, Ohio
Harnischfeger Corp., Milwaukee, Wis.
Hyster Co., Portland, Ore.
Insley Manufacturing Corp., Indianapolis, Ind.
Keystone Driller Co., Beaver Falls, Pa.
Koehring Co., Milwaukee, Wis.
Lima Locomotive Works, Inc., Lima, Ohio.
Link-Belt Speeder Corp., Cedar Rapids, Iowa.
Manitowoc Engineering Works (Division of Manitowoc Shipbuilding Co.), Manitowoc, Wis.
New York Testing Laboratories, Inc., New York, N. Y.
Oil City Boiler Works, Oil City, Pa.
Osgood Co., The, Marion, Ohio.
Pittsburgh Testing Laboratory, Pittsburgh, Pa.
Sterling Engine Co., Buffalo, N. Y.
Thew Shovel Co., The, Lorain, Ohio.

COMMERCIAL STANDARDS

CS No.	Item
0–40.	Commercial standards and their value to business (third edition).
1–42.	Clinical thermometers (third edition).
2–30.	Mopsticks.
3–40.	Stoddard solvent (third edition).
4–29.	Staple porcelain (all-clay) plumbing fixtures.
5–46.	Pipe nipples; brass, copper, steel and wrought-iron (second edition).
6–31.	Wrought-iron pipe nipples (second edition). Superseded by CS5–46.
7–29.	Standard weight malleable iron or steel screwed unions.
8–41.	Gage blanks (third edition).
9–33.	Builders' template hardware (second edition).
10–29.	Brass pipe nipples. Superseded by CS5–46.
11–41.	Moisture regains of cotton yarns (second edition).
12–40.	Fuel oils (fifth edition).
13–44.	Dress patterns (fourth edition).
14–43.	Boys' button-on waists, shirts, junior and sport shirts (made from woven fabrics) (third edition).
15–46.	Men's pajama sizes (made from woven fabrics) (third edition.)
16–29.	Wall paper.
17–42.	Diamond core drill fittings (third edition).
18–29.	Hickory golf shafts.
19–32.	Foundry patterns of wood (second edition).
20–42.	Staple vitreous china plumbing fixtures (third edition).
21–39.	Interchangeable ground-glass joints, stopcocks, and stoppers (fourth edition).
22–40.	Builders' hardware (nontemplate) (second edition).
23–30.	Feldspar.
24–43.	Screw threads and tap-drill sizes.
25–30.	Special screw threads. Superseded by CS24–43.
26–30.	Aromatic red cedar closet lining.
27–36.	Mirrors (second edition).
28–46.	Cotton fabric tents, tarpaulins and covers (second edition).
29–31.	Staple seats for water-closet bowls.
30–31.	Colors for sanitary ware.
31–38.	Wood shingles (fourth edition).
32–31.	Cotton cloth for rubber and pyroxylin coating.
33–43.	Knit underwear (exclusive of rayon) (second edition).
34–31.	Bag, case, and strap leather.
35–47.	Hardwood plywood (third edition).
36–33.	Fourdrinier wire cloth (second edition).
37–31.	Steel bone plates and screws.
38–32.	Hospital rubber sheeting.
39–37.	Wool and part wool blankets (second edition). (Withdrawn as commercial standard, July 14, 1941).
40–32.	Surgeons' rubber gloves.
41–32.	Surgeons' latex gloves.
42–43.	Structural fiber insulating board (third edition).
43–32.	Grading of sulphonated oils.
44–32.	Apple wraps.
45–47.	Douglas fir plywood (seventh edition).
46–40.	Hosiery lengths and sizes (third edition).
47–34.	Marking of gold-filled and rolled-gold-plate articles other than watchcases.
48–40.	Domestic burners for Pennsylvania anthracite (underfeed type) (second edition).
49–34.	Chip board, laminated chip board, and miscellaneous boards for bookbinding purposes.
50–34.	Binders board for bookbinding and other purposes.
51–35.	Marking articles made of silver in combination with gold.
52–35.	Mohair pile fabrics (100-percent mohair plain velvet, 100-percent mohair plain frieze, and 50-percent mohair plain frieze).
53–35.	Colors and finishes for cast stone.
54–35.	Mattresses for hospitals.
55–35.	Mattresses for institutions.
56–41.	Oak flooring (second edition).
56E–41.	Oak flooring (exports).
57–40.	Book cloths, buckrams, and impregnated fabrics for bookbinding purposes except library bindings (second edition).
58–36.	Woven elastic fabrics for use in overalls (overall elastic webbing).
59–44.	Textiles—testing and reporting (fourth edition).

60–36. Hardwood dimension lumber.
60E–41. Hardwood dimension lumber (exports).
61–37. Wood-slat venetian blinds.
62–38. Colors for kitchen accessories.
63–38. Colors for bathroom accessories.
64–37. Walnut veneers.
65–43. Methods of analysis and of reporting fiber composition of textile products (second edition).
66–38. Marking of articles made wholly or in part of platinum.
67–38. Marking articles made of karat gold.
68–38. Liquid hypochlorite disinfectant, deodorant, and germicide.
69–38. Pine oil disinfectant.
70–41. Phenolic disinfectant (emulsifying type) (second edition) (published with CS71–41).
71–41. Phenolic disinfectant (soluble type) (second edition) (published with CS70–41).
72–38. Household insecticide (liquid spray type).
73–45. Old growth Douglas fir standard stock doors (third edition).
74–39. Solid hardwood wall paneling..
75–42. Automatic mechanical draft oil burners designed for domestic installations (second edition).
76–39. Hardwood interior trim and molding.
77–40. Sanitary cast-iron enameled ware.
78–40. Ground-and-polished lenses for sun glasses (second edition) (published with CS79–40).
79–40. Blown, drawn, and dropped lenses for sun glasses (second edition) (published with CS78–40).
80–41. Electric direction signal systems other than semaphore type for commercial and other vehicles subject to special motor vehicle laws (after market).
81–41. Adverse-weather lamps for vehicles (after market).
82–41. Inner-controlled spotlamps for vehicles (after market).
83–41. Clearance, marker, and identification lamps for vehicles (after market).
84–41. Electric tail lamps for vehicles (after market).
85–41. Electric license-plate lamps for vehicles (after market).
86–41. Electric stop lamps for vehicles (after market).
87–41. Red electric warning lanterns.
88–41. Liquid-burning flares.
89–40. Hardwood stair treads and risers.
90– . (Reserved for power shovels and cranes).
90E–47. Power cranes and shovels, convertible full-revolving type, Crawler, truck, and wheel-mounted; including clamshell, dragline, lifting crane, hoe, pile driver, and skimmer scoop operating equipment (export classification). (second edition).
91–41. Factory-fitted Douglas fir entrance doors.
92–41. Cedar, cypress and redwood tank stock lumber.
93–41. Portable electric drills (exclusive of high frequency).
94–41. Calking lead.
95–41. Lead pipe.
96–41. Lead traps and bends.
97–42. Electric supplementary driving and passing lamps for vehicles (after market).
98–42. Artists' oil paints.
99–42. Gas floor furnaces—gravity circulating type.
100–44. Porcelain-enameled steel utensils (second edition).
101–43. Flue-connected oil-burning space heaters equipped with vaporizing pot-type burners.
102– . (Reserved for diesel and fuel-oil engines).
102E–42. Diesel and fuel-oil engines (export classifications).
103–42. Cotton and rayon velour (jacquard and plain).
104–46. Warm-air furnaces equipped with vaporizing pot-type oil burners (second edition).
105–43. Mineral wool; loose, granulated, or felted form, in low-temperature installations.
106–44. Boys' pajama sizes (woven fabrics) (second edition).
107–45. Commercial electric-refrigeration condensing units (second edition).
108–43. Treading automobile and truck tires.
109–44. Solid-fuel-burning forced-air furnaces.
110–43. Tire repairs—vulcanized (passenger, truck, and bus tires).
111–43. Earthenware (vitreous-glazed) plumbing fixtures.
112–43. Homogeneous fiber wallboard.
113–44. Oil-burning floor furnaces equipped with vaporizing pot-type burners.
114–43. Hospital sheeting for mattress protection.
115–44. Porcelain-enameled tanks for domestic use.
116–44. Bituminized-fibre drain and sewer pipe.
117–44. Mineral wool; blankets, blocks, insulating cement, and pipe insulation for heated industrial equipment.
118–44. Marking of jewelry and novelties of silver.
(E)119–45.[1] Dial indicators (for linear measurements).
120–44. Standard stock ponderosa pine doors.
121–45. Women's slip sizes (woven fabrics).
122–45. Western hemlock plywood.
123–45. Grading of diamond powder.
(E)124–45.[1] Master disks.
125–45. Prefabricated homes.
126–45. Tank mounted air compressors.
127–45. Self-contained mechanically refrigerated drinking water coolers.
128–45. Men's sport shirt sizes—woven fabrics (other than those marked with regular neckband sizes).
129–46. Materials for safety wearing apparel.
130–46. Color materials for art education in schools.
131–46. Industrial mineral wool products, all types—testing and reporting.
132–46. Hardware cloth.
133–46. Woven wire netting.
134–46. Cast aluminum cooking utensils (metal composition).
135–46. Men's shirt sizes (exclusive of work shirts).
136–46. Blankets for hospitals (wool and wool and cotton).
137–46. Size measurements for men's and boys' shorts (woven fabrics).
138–47. Insect wire screening.
139–47. Work gloves.
140–47. Convectors: testing and rating.
141–47. Sine bars, blocks, plates and fixtures.

NOTICE.—Those interested in commercial standards with a view toward accepting them as a basis of everyday practice may secure copies of the above standards, while the supply lasts, by addressing the Division of Trade Standards, National Bureau of Standards, Washington 25, D. C.

[1] Where "(E)" precedes the CS number, it indicates an emergency commercial standard, drafted under war conditions with a view toward early revision.

ALPHABETICAL CONVERSION TABLE

The fundamental purpose of this chart is to furnish a source of reference for units, standards, and conversion factors

1 acre = 160 square rods.
1 acre = 4,840 square yards.
1 acre = 43,560 square feet.

1 barrel = 7,056 cubic inches.

1 board foot = 144 cubic inches.
1 board foot = 2,360 cubic centimeters.

1 B. t. u. (British thermal unit) = 778 foot pounds.
1 B. t. u. (British thermal unit) = 0.2930 international watt hour.
1 B. t. u. (British thermal unit) = 0.252 calorie (I. T.).

1 bushel = 2,150.42 cubic inches.
1 bushel = 1 1/4 cubic feet, approx.

1 calorie (I. T.) = 1/860 international watt hours.
1 calorie (I. T.) = 3.97×10^{-3} B. t. u.

1 carat, metric = 200 metric milligrams.
1 carat, metric = 3.0865 grains.

1 centare (square meter) = 10.764 square feet.
1 centare (square meter) = 1.196 square yards.

1 centimeter = 0.3937 inch.

1 chain (engineers) = 100 links of 1 foot each.
1 chain (engineers) = 30.48 meters.

1 chain (surveyors or Gunters) = 4 rods.
1 chain (surveyors or Gunters) = 100 links.
1 chain (surveyors or Gunters) = 66 feet.
1 chain (surveyors or Gunters) = 20.1 meters.

1 cheval (French horsepower) = 0.986 horsepower.

1 circular mil = Area of circle whose diameter is 1 mil, or 1/1000 inch.
1 circular mil = 0.000000785 square inch.

1 cord = 128 cubic feet.
1 cord = 3.625 cubic meters.

1 cubic foot = 1,728 cubic inches.
1 cubic foot = 60 pints.
1 cubic foot = 0.8 bushel.
1 cubic foot = 1,000 ounces of water, approx.
1 cubic foot = 0.028 cubic meter.
1 cubic foot = 28.32 liters.

1 cubic foot of water = 62.4 pounds.
1 cubic foot of water = 1,000 ounces, approx.

1 cubic inch = 16.39 cubic centimeters.

1 cubic meter = 35.314 cubic feet.
1 cubic meter = 1.308 cubic yards.

1 cubic yard = 27 cubic feet.
1 cubic yard = 0.765 cubic meter.

1 decimeter = 3.937 inches.

1 dram (fluid) = 60 minims.
1 dram (fluid) = 3.697 milliliters.
1 dram (fluid) = 4 cubic centimeters, approx.

1 em, 1 pica (printing industry) = 1/6 of an inch.

1 fathom (nautical) = 6 feet.
1 fathom (nautical) = 1.83 meters.

1 fluid ounce = 8 fluid drams.
1 fluid ounce = 29.573 milliliters.

1 foot = 12 inches.
1 foot = 0.305 meter.

1 foot pound = 0.1383 kilogrammeter.

1 furlong (British) = 220 yards.
1 furlong (British) = 201.2 meters.

1 gallon (U. S.) = 231 cubic inches.
1 gallon (U. S.) = 4 quarts.
1 gallon (U. S.) = 8 pints.
1 gallon (U. S.) = 3.875 liters.
1 gallon (U. S.) = 128 fluid ounces.

1 gallon of water = 8.33 pounds at 62° F. (16.67° C.) in air.

1 gallon per cubic foot = 133.7 liters per cubic meter.

Gallon (British Imperial and Canadian) = 277.4 cubic inches.
Gallon (British Imperial and Canadian) = 1.201 U. S. gallons.
Gallon (British Imperial and Canadian) = volume of 10 pounds water at 62° F. (16.67° C.).
Gallon (British Imperial and Canadian) = 4.546 liters.

1 gill = 1/4 pint.

1 grain = 1/7000 pound avoirdupois.
1 grain = 0.0648 gram.

1 gram = 15.43 grains.
1 gram = 0.0353 ounce.
1 gram = 0.0022 pound.

1 hand = 4 inches.

1 hectare (square hectometer) = 2.47 acres.

1 horsepower = 33,000 foot-pounds per minute.
1 horsepower = 42.41 B. t. u. per minute.
1 horsepower = 1.014 chevals.
1 horsepower = 746 watts.

1 hundredweight (British) = 112 pounds.
1 hundredweight (British) = 50.80 kilograms.

1 inch = 25.4 millimeters.

1 kilogram = 2.2046 pounds.
1 kilogram = 35.274 ounces.
1 kilogram = 15432.36 grains.
1 kilogram = 0.0011 short ton.
1 kilogram = 0.00098 long ton.

1 kilometer = 1000 meters.
1 kilometer = 0.621 mile.

1 kilowatt = 1.34 horsepower.
1 kilowatt = 56.9 B. t. u. per minute.

1 knot (nautical, speed) = 6080.20 feet per hour.
1 knot (nautical, speed) = 1.85 kilometers per hour.

1 light year = 5.9×10^{12} miles.
1 light year = 9.5×10^{12} kilometers.

1 link (surveyors measure) = 0.66 foot.
1 link (surveyors measure) = 0.201 meter.

1 liter = 1.000028 cubic decimeters.
1 liter = 0.264 gallon.
1 liter = 1.057 quarts.
1 liter = 61.03 cubic inches.
1 liter = 0.035 cubic feet.
1 liter = 33.8148 fluid ounces.
1 liter = 270.518 fluid drams.

1 meter = 39.37 inches.
1 meter = 3.28 feet.
1 meter = 1.09 yards.
1 meter = 1,553,164.13 wavelengths of red ray cadmium.

1 metric ton = 2204.6 pounds.
1 metric ton = 1.1023 short tons.

1 microgram = 1/1000 milligram.

1 mil = 0.001 inch.
1 mil = 25.4 microns.
1 mil = 0.0254 millimeter.

1 mile = 1760 yards.
1 mile = 5280 feet.
1 mile = 320 rods.
1 mile = 1.61 kilometers.

1 milligram = 0.0154 grain.

1 milliliter (see liter above) = 1.000028 cubic centimeters.
1 milliliter (see liter above) = 0.0610 cubic inch.

1 minim (fluid) = 1/60 fluid dram.
1 minim (fluid) = 1/480 fluid ounce.

1 ounce (avoirdupois, ordinary) = 437.5 grains.
1 ounce (avoirdupois, ordinary) = 0.911 troy ounce.
1 ounce (avoirdupois, ordinary) = 0.0000279 long ton.
1 ounce (avoirdupois, ordinary) = 28.35 grams.

1 ounce, fluid = 1.805 cubic inches.
1 ounce, fluid = 29.573 milliliters.

1 ounce, troy = 480 grains.
1 ounce, troy = 31.103 grams.

1 perch (British) = 30.25 square yards.
1 perch (British) = 1/160 acre.

1 pied (French foot) = 12 Paris inches.
1 pied (French foot) = 0.325 meter.

1 pint = 0.4732 liter.

1 point (printers type) = 1/72 inch.

1 pole (British) = 5½ yards. = 5.03 meter. = 1 rod.

1 pouce (Paris inch) = 2.71 centimeter.

1 pound (avoirdupois, ordinary) = 16 ounces. = 7000 grains. = 454 grams. = 0.454 kilogram. = 14.58 troy ounces.

1 pound per cubic foot = 16.02 kilogram per cubic meter.

1 pound per square inch = 0.433 × head of water (in feet).

1 pound per square inch = 0.0703 kilogram per square centimeter.

1 pound per square foot = 4.88 kilogram per square meter.

1 quart = 2 pints. = 1/4 gallon. = 0.946 liter.

1 quarter (British quarter hundredweight) = 28 pounds. = 12.70 kilograms.

1 rod (surveyor's measure) = 16.5 feet. = 25 links. = 5.03 meters.

1 rood (British) = 40 perches. = 1/4 acre.

1 square centimeter = 0.155 square inch.

1 square foot = 0.093 square meter.

1 square inch = 6.452 square centimeters.

1 square kilometer = 0.386 square mile.

1 square meter (centare) = 10.764 square feet. = 1.196 square yards.

1 square mil = 0.000001 square inch. = 0.00000645 square centimeter.

1 square mile = 640 acres. = 3,097,600 square yards. = 2.59 square kilometers.

1 square millimeter = 0.00155 square inch.

1 square rod = 25.29 square meters.

1 square yard = 0.836 square meter.

1 stone (British) = 14 pounds. = 6.35 kilograms.

1 ton (short) = 2,000 pounds. = 907 kilograms.

1 ton (long) = 2,240 pounds. = 1,016 kilograms.

1 ton (metric) = 1,000 kilograms. = 2,204.62 pounds.

1 yard = 3 feet. = 36 inches. = 0.914 meter. = 1,420,212 wavelengths of red ray of cadmium.

DECIMAL AND METRIC EQUIVALENTS OF FRACTIONS OF AN INCH

Fractions of an inch	Decimals of an inch	Millimeters	Fractions of an inch	Decimals of an iach	Millimeters	Fractions of an inch	Decimals of an inch	Millimeters	Fractions of an inch	Decimals of an inch	Millimeters
1/64	0.0156	0.397	19/64	.2969	7.541	37/64	.5781	14.684	55/64	.8594	21.828
1/32	.0312	0.794	5/16	.3125	7.938	19/32	.5938	15.081	7/8	.8750	22.225
3/64	.0469	1.191	21/64	.3281	8.334	39/64	.6094	15.478	57/64	.8906	22.622
1/16	.0625	1.588	11/32	.3438	8.731	5/8	.6250	15.875	29/32	.9062	23.019
5/64	.0781	1.984	23/64	.3594	9.128	41/64	.6406	16.272	59/64	.9219	23.416
3/32	.0938	2.381	3/8	.3750	9.525	21/32	.6562	16.669	15/16	.9375	23.813
7/64	.1094	2.778	25/64	.3906	9.922	43/64	.6719	17.066	61/64	.9531	24.209
1/8	.1250	3.175	13/32	.4062	10.319	11/16	.6875	17.463	31/32	.9688	24.606
9/64	.1406	3.572	27/64	.4219	10.716	45/64	.7031	17.859	63/64	.9844	25.003
5/32	.1562	3.969	7/16	.4375	11.113	22/32	.7188	18.256		1.0000	25.400
11/64	.1719	4.366	29/64	.4531	11.509	47/64	.7344	18.653			
3/16	.1875	4.763	16/32	.4688	11.906	3/4	.7500	19.050			
13/64	.2031	5.159	31/64	.4844	12.303	49/64	.7656	19.447			
7/32	.2188	5.556	1/2	.5000	12.700	25/32	.7812	19.844			
15/64	.2344	5.953	33/64	0.5156	13.097	51/64	.7969	20.241			
1/4	.2500	6.350	17/32	.5312	13.494	13/16	.8125	20.638			
17/64	.2656	6.747	35/64	.5469	13.891	53/64	.8281	21.034			
9/32	.2812	7.144	9/16	.5625	14.288	27/32	.8438	21.431			

WEIGHTS OF MATERIALS

[Weight in pounds per cubic feet and cubic yard and kilograms per cubic meter]

Cubic yards		⅜	½	¾	1	1½	2	2½				
Cubic feet	1		13½		27		54					
Cubic meters									½	1	1½	2
	lb	lb	lb	lb	lb	lb	lb	lb	kg	kg	kg	kg
Ashes, piled, dry	35	420	473	709	945	1,418	1,890	2,363	281	562	843	1,124
Brickbats	55	660	743	1,114	1,485	2,228	2,970	3,713	442	884	1,326	1,768
Cement, portland	94	1,128	1,269	1,904	2,538	3,807	5,076	6,345	755	1,510	2,265	3,020
Charcoal	25	300	338	506	675	1,013	1,350	1,688	205	410	615	820
Cinders	55	660	743	1,114	1,485	2,228	2,970	3,713	442	884	1,326	1,768
Clinker, portland cement	85	1,020	1,148	1,721	2,295	3,443	4,590	5,738	683	1,365	2,048	2,730
Clay, dry, in lumps	63	756	851	1,276	1,701	2,552	3,402	4,253	506	1,011	1,517	2,022
Clay, compact, natural bed	109	1,308	1,472	2,207	2,943	4,415	5,886	7,358	875	1,750	2,625	3,500
Coal, anthracite	56	672	756	1,134	1,512	2,268	3,024	3,780	450	899	1,349	1,798
Coal, bituminous, run of mine, piled	55	660	743	1,114	1,485	2,228	2,970	3,713	442	884	1,326	1,768
Coal, bituminous, slack, piled	50	600	675	1,013	1,350	2,025	2,700	3,375	402	803	1,205	1,606
Coke, blast furnace size	27	324	365	547	729	1,094	1,458	1,823	217	433	650	866
Coke, foundry size	28	336	378	567	756	1,134	1,512	1,890	425	449	874	898
Concrete, ready to pour	148	1,776	1,998	2,997	3,996	5,994	7,992	9,990	1,188	2,376	3,564	4,752
Dolomite, crushed fine	95	1,140	1,283	1,924	2,565	3,848	5,130	6,413	763	1,525	2,288	3,050
Dloomite, broken lump	95	1,140	1,283	1,924	2,565	3,848	5,130	6,413	763	1,525	2,288	3,050
Earth, loamy, dry, loose	75	900	1,013	1,519	2,025	3,038	4,050	5,063	602	1,204	1,806	2,408
Earth, dry, packed	95	1,140	1,283	1,924	2,565	3,848	5,130	6,413	763	1,525	2,288	3,050
Earth, wet (mud)	110	1,320	1,485	2,228	2,970	4,455	5,940	7,425	884	1,768	2,652	3,536
Flue dust, blast furnace	115	1,380	1,553	2,329	3,105	4,658	6,210	7,763	925	1,850	2,775	3,700
Flue dust, blast furnace, wet	150	1,800	2,025	3,038	4,050	6,075	8,100	10,125	1,203	2,405	3,608	4,810
Gypsum, crushed to 3 in	95	1,140	1,283	1,924	2,565	3,848	5,130	6,413	763	1,525	2,288	3,050
Gypsum calcined gravel	60	720	810	1,215	1,620	2,430	3,240	4,050	482	964	1,446	1,928
Gravel, dry, loose	110	1,320	1,485	2,228	2,970	4,455	5,940	7,425	884	1,768	2,652	3,536
Gravel, wet packed	120	1,440	1,620	2,430	3,240	4,860	6,480	8,100	963	1,925	2,888	3,850
Iron ore, 60% iron	300	3,600	4,050	6,075	8,100	12,150	16,200	20,250	2,410	4,820	7,230	9,640
Iron ore, 50% iron	250	3,000	3,375	5,063	6,750	10,126	13,500	16,875	2,005	4,010	6,015	8,020
Iron ore, 40% iron	200	2,400	2,700	4,050	5,400	8,100	10,800	13,500	1,604	3,208	4,812	6,416
Iron punching, scrap	270	3,240	3,645	5,468	7,290	10,936	14,580	18,225	2,163	4,325	6,488	8,650
Iron turnings, scrap	175	2,100	2,363	3,544	4,725	7,088	9,450	11,813	1,405	2,810	4,215	5,620
Limestone, run of crusher	95	1,140	1,283	1,924	2,565	3,848	5,130	6,413	763	1,525	2,288	3,050
Limestone, fines out	100	1,200	1,350	2,025	2,700	4,050	5,400	6,750	802	1,604	2,406	3,208
Limestone, 1½- or 2-in. grade	85	1,020	1,148	1,721	2,295	3,443	4,590	5,738	683	1,365	2,048	2,730
Limestone above 2-in. grade	80	960	1,080	1,620	2,160	3,240	4,320	5,400	643	1,285	1,928	2,570
Phosphate, acid, (fertilizer)	85	1,020	1,148	1,721	2,295	3,443	4,590	5,738	683	1,365	2,048	2,730
Phosphate, rock	80	960	1,080	1,620	2,160	3,240	4,320	5,400	643	1,285	1,928	2,570
Pyrites	135	1,620	1,823	2,734	3,645	5,468	7,290	9,113	1,084	2,168	3,252	4,336
Salt	58	696	783	1,175	1,566	2,349	3,132	3,915	467	933	1,400	1,866
Sand, dry, loose	95	1,140	1,283	1,924	2,565	3,848	5,130	6,413	763	1,525	2,288	3,050
Sand, wet, packed	120	1,440	1,620	2,430	3,240	4,860	6,480	8,100	963	1,925	2,888	3,850
Scale, rolling mill, wet	132	1,584	1,782	2,673	3,564	5,346	7,128	8,910	1,060	2,120	3,180	4,240
Shale, broken	85	1,020	1,148	1,721	2,295	3,443	4,590	5,738	683	1,365	2,048	2,730
Slag, blast furnace, broken	138	1,656	1,863	2,795	3,726	5,589	7,452	9,315	1,108	2,215	3,323	4,430
Slag, open hearth, crusher	105	1,260	1,418	2,126	2,835	4,253	5,670	7,088	843	1,685	2,528	3,370
Slag, granulated, dry	38	456	513	770	1,026	1,539	2,052	2,565	306	612	918	1,224
Slag, granulated, wet	58	696	783	1,175	1,566	2,349	3,132	3,915	467	933	1,400	1,866
Snow	33	396	446	668	891	1,337	1,782	2,228	265	530	795	1,060
Sulfur, broken	60	720	810	1,215	1,620	2,430	3,240	4,050	482	964	1,446	1,928
Zinc ore, broken	150	1,800	2,025	3,038	4,050	6,075	8,100	10,125	1,203	2,405	3,608	4,810

CONVERSION TABLES

U. S. Weights and Measures

Measures of Length

12 inches (in.) = 1 foot.
3 feet (ft) = 1 yard.
5½ yards (yd) = 1 rod.
40 rods = 1 furlong.
8 furlongs = 1,760 yards.
1 mile = 5,280 feet.
3 miles = 1 league.

Measures of Area

144 sq inches = 1 sq foot.
9 sq feet = 1 sq yard.
30¼ sq yards = 1 sq rod.
160 sq rods
10 sq chains
43,560 sq feet = 1 acre.
640 acres = 1 sq mile or 1 section.

Measures of Volume

1,728 cu inches = 1 cu foot.
27 cu feet = 1 cu yard.
128 cu feet = 1 cord of wood.
144 cu inches = 1 board foot (volume of board 1 foot square by 1 inch thick).

Liquid Measure

4 gills = 1 pint.
2 pints = 1 quart.
4 quarts = 1 gallon.
7.48 gallons = 1 cu foot.
240 gallons of water = 1 ton.
340 gallons of gasoline = 1 ton.

Measures of Weights (avoirdupois)

16 ounces = 1 pound.
2,000 pounds = 1 short ton.
2,240 pounds = 1 long ton.

Circular Measure

60 seconds = 1 minute.
60 minutes = 1 degree.
90 degrees = 1 quadrant.
360 degrees = 1 circumference.

Metric Equivalents

Measures of Length

1 centimeter (cm) = 0.3937 inch.
1 meter (m) = 3.28 feet.
1 meter = 1.094 yards.
1 kilometer (km) = 0.621 mile.
1 inch = 2.54 cm.
1 foot = 0.305 meter.
1 yard = 0.914 meter.
1 mile = 1.61 km.

Measures of Area

1 sq cm = 0.1550 sq in.
1 sq meter = 10.764 sq. ft.
1 sq meter = 1.196 sq yd.
1 hectare = 2.47 acres.
1 sq km = 0.386 sq. miles.
1 sq inch = 6.452 sq cm.
1 sq foot = 0.0929 sq meter.
1 sq yard = 0.836 sq meter.
1 acre = 0.405 hectare.
1 sq mile = 2.59 sq km.

Measures of Volume

1 cu cm = 0.061 cu in.
1 cu meter = 35.31 cu feet.
1 cu meter = 1.308 cu yard.
1 cu inch = 16.4 cu cm.
1 cu foot = 0.028 cu meter.
1 cu yard = 0.765 cu meter.

Liquid Measure

1 liter = 0.0353 cu ft.
1 liter = 0.2642 gallon.
1 liter = 61.025 cu in.
1 liter = 2.202 lb water (62° F).
1 cu foot = 28.32 liters.
1 gallon = 3.785 liters.
1 cu inch = 0.0164 liter.

Measures of Weights

1 gram = 0.0353 ounce.
1 kilogram = 2.205 pounds.
1 ounce = 28.35 grams.
1 pound = 0.454 kilogram.
1 short ton = 0.907 metric ton.

Electrical Units

1 kilowatt = 1.34 hp.
1 horsepower = 746 watts.

Surveyors Measure

7.92 inches = 1 link.
100 links = 66 feet. = 4 rods. = 1 chain.
80 chains = 1 mile.

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