# POWER CRANES AND SHOVELS

## COMMERCIAL STANDARD CS90–49

Effective Date for New Production from August 1, 1949

A RECORDED VOLUNTARY STANDARD OF THE TRADE

UNITED STATES DEPARTMENT OF COMMERCE • CHARLES SAWYER, Secretary

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### COMMERCIAL STANDARD FOR POWER CRANES AND SHOVELS

On November 30, 1948, at the instance of the Power Crane and Shovel Association, a Recommended Commercial Standard for Power Cranes and Shovels, adjusted in accordance with comment from interested organizations, was circulated to the trade for written acceptance. Those concerned have since accepted and approved the standard as shown herein.

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# COMMERCIAL STANDARD CS90–49
## for
# POWER CRANES AND SHOVELS

## Purpose

1.01. The purpose of this commercial standard is to provide uniform methods of supplying specification data, requirements, and definitions for fair competition and a better understanding between buyers and sellers of power cranes and shovels. This standard is further intended as a guide for a common basis of negotiations and for comparisons for procurement. It has the ultimate aim of simplification and standardization of common mechanical details and, at the same time, of the encouragement of initiative among manufacturers in the development of new engineering techniques and designs.

## Scope

2.01. *Sizes and types.*—This standard applies to power shovels and cranes of the convertible full-revolving type, crawler, truck, and wheel mounted, as herein defined, including front-end operating equipment for clamshell, dragline, lifting crane, pile driver, shovel, and hoe operation. It includes so-called "commercial" sizes nominally rated as to ...vel dipper capacity of ¼ to 2½ cu. yd., inclusive.

2.02. *Uniform specifications.*—The data supplied ...over uniform charts and tables for specifications, compliance requirements, definitions, and nomenclature. The charts and tables are included to provide uniform arrangement for supplying information in regard to dimensions and specifications of the major operating components of cranes and shovels. Wherever possible, the same arrangement appears in manufacturers' literature for convenience in comparison.

### Requirements

2.03. The requirements for compliance with this standard are given in two categories, and these paragraphs are printed in italic type:

a. Requirements which apply to design, construction, performance, and safety of the equipment.[1]

b. Requirements referring to information that the manufacturer will furnish on request if it is not included with his current printed specifications and sales literature.

2.04. *Compliance.*—Those manufacturers who have voluntarily subscribed to this standard will comply with the provisions contained herein in supplying information and data. Evidence of compliance is shown by means of labels and seals on literature, sales forms, and machines.

[1] This information is set in italic type to indicate requirements that are distinguished from other information of a purely definitive character.

There is no official regulatory power of control in the enforcement of the provisions, but through usage they become trade customs and practices and fulfill the purpose of this standard as described in paragraph 1.01 above. Instances will occur when it may be necessary to deviate from the standard, and a manufacturer's declaration of compliance does not preclude such departures; however, a manufacturer in subscribing to this standard indicates his intention to follow its provisions wherever practicable in the production of his product, and any deviation will be specified by exceptions therefrom.

## Basic Components of Machines

3.01. *Basic operating components.*—The machines covered in this commercial standard are usually convertible for the several operating functions, as indicated in the scope and further described and defined. Any machine when equipped for work consists of three main operating components, as follows: Revolving superstructure, mountings, and front-end operating equipment.

These three main operating components are further outlined in the following subparagraphs.

3.01a. *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 4.14, inclusive.

3.01b. *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 5.12, (2) truck-mounting (two-engine, rubber-mounted), paragraphs 5.13 to 5.21, (3) wheel-mounting (single-engine, rubber-mounted) paragraph 5.22.

3.01c. *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, and hoe, as described in paragraphs 6.01 to 6.43.

## Revolving Superstructure

4.01. *Revolving superstructure definition.*—The rotating frame, power unit, and machinery located thereon for performing all functional operations of the machine.

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 the hinge pins from the ground and distance from center of rotation.*

4.03. *Boom hoist.*—For controlling the angle of the boom; may be worm and gear driven, spur gear driven, or have other type of drive. Boom may be lowered by gravity alone or power controlled by engaging with prime mover. When it is completely independent of all other functions, it is usually designated as independent or live-boom hoist. *Braking mechanism is required regardless of type of drive.*[2]

*4.04. Engine specifications.—The following information shall be included:*

1. *Manufacturer's name, model number, and type of fuel.*
2. *Number of cylinders—bore and stroke—displacement in cubic inches.*
3. *Rated horsepower—net horsepower at sea level at the flywheel at full-load governed speed with engine fully equipped with all accessories, such as generator, fan, etc.*
4. *Full-load governed speed in revolutions per minute.*
5. *Type of starting equipment.*

*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. Engine power loss at high altitude.—Engines are selected by manufacturers to compensate for power losses up to a 4000-foot 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.*[3]

4.07. *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.

4.08. *Line pull.*—Line pull is the single line maximum pull in pounds at the drum at *full-load governed engine speed*, with the specified pitch diameter of hoist drum or laggings.

4.09. *Line-speed.*—Line speed is the line hoist speed in feet per minute of a single line based on the *full-load governed engine speed* for the specified pitch diameter of hoist drum or laggings.

4.10. *Power equipment.*—Machines covered by this standard may be powered by internal-combustion engines as covered by engine specifications or by electric motors. The rating of electric motors is usually approximately half that of the gasoline engine it replaces because it has a much higher overload capacity.

4.11. *Gantry or A-frame.*—Mounted on revolving superstructure and carries lead sheaves for boom-hoist cables. High gantry provides wider angle between crane boom and supporting cables to reduce stresses in both with long crane boom operations. *Manufacturer shall state whether gantry is permanent, is removable, or is folding—if the latter, whether manually or by power.*

4.12. *Swing mechanism.*—Controls the revolving function of the machine, usually through reversing clutches and bevel gears, but may be worm gear or otherwise.

4.13. *Travel mechanism on revolving superstructure.*—May be driven through clutches used for other functions, by means of declutching device, or through an independent mechanism with its own controls, to the vertical travel shaft.

*4.14. Revolving superstructure and cab dimensions and specifications (see fig. 1).*

*A. Width of cab.*
*B. Clearance height of cab from grade (on various mountings).*
*C. Clearance radius of rear end.*
*D. Location of boom hinge pin ahead of center rotation.*
*E. Height of boom hinge pin above grade (for various mountings).*
*F. Gantry heights above grade when in operation and when folded. (See paragraph 4.11.)*
*G. Counterweight clearance from grade.*
*H. Over-all width when running boards are used.*

## Mountings

### Crawler

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. 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 a lifting crane, dragline, clamshell, or pile driver, the center of gravity of any crawler-mounted type of machine resting on a firm, level and uniformly even supporting 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 to the rear of the axis of rotation than seventy (70) per*

[2] See footnote 1, page 1.
[3] See footnote 1, page 1.

*of the radial distance from the axis of rotation to the tipping fulcrum in the least stable direction.*[4]

5.03. *Bearing length and area.*—The length of each crawler bearing on the ground is computed as not more than the normal distance from center to center of the crawler end sprockets or tumbler wheels at midpoint of adjustment range, 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 width of tread shoes.

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

*5.05. Climb.—Each crawler machine shall have sufficient propelling power to climb a thirty (30) percent grade (30-ft rise in 100 ft horizontal) on smooth, firm, dry ground.*[5]

5.06. *Ground pressure.*—It is the average pressure in pounds per square inch derived by dividing the total working weight of the machine with complete front-end equipment by the crawler bearing area.

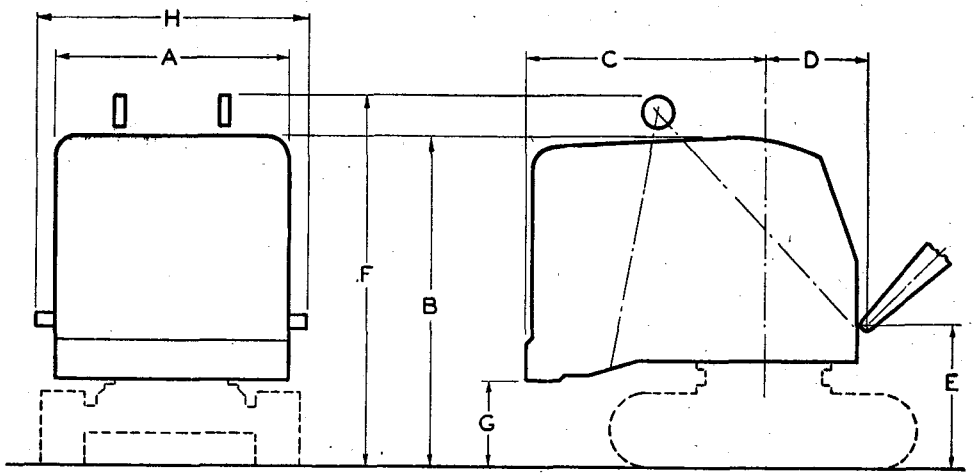


FIGURE 1. *Cab dimensions, crawler mounting (paragraph 4.14).*

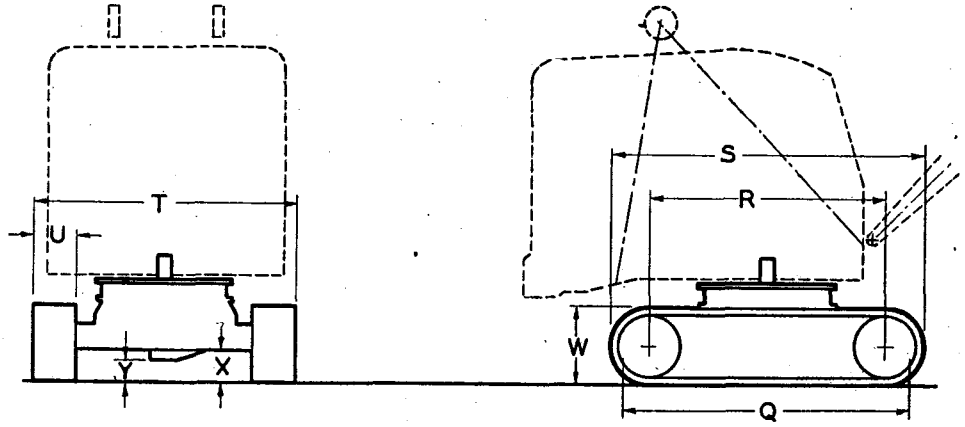


FIGURE 2. *Crawler mounting (paragraph 5.12).*

5.07. *Least stable position.*—In determining the least stable position, the load shall be lifted with the 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 which provides the minimum of stability. (Generally with the boom at right angles to the crawlers.)

[4] See footnote 1, page 1.

[5] See footnote 1, page 1.

*5.08. 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.*[6]

5.09. *Tipping load.*—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 bearing area of properly adjusted crawler tread belt to be lifted from ground.

*5.10. Traction lock or brake.—A traction lock or brake shall be standard equipment.*[7]

*5.11. Travel or propulsion.—Machine shall be capable of propelling itself either forward or backward. The travel speed shall be stated and if different speeds are obtained in forward and reverse, each shall be given and so indicated.*

*5.12. Crawler mounting dimensions and specifications (see fig. 2).*

*Q. Crawler bearing length.*
*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. Over-all height of tread belt.*
*X. Crawler base clearance.*
*Y. Other minimum ground clearance under crawler base.*

[6] See footnote 1, page 1.
[7] See footnote 1, page 1.

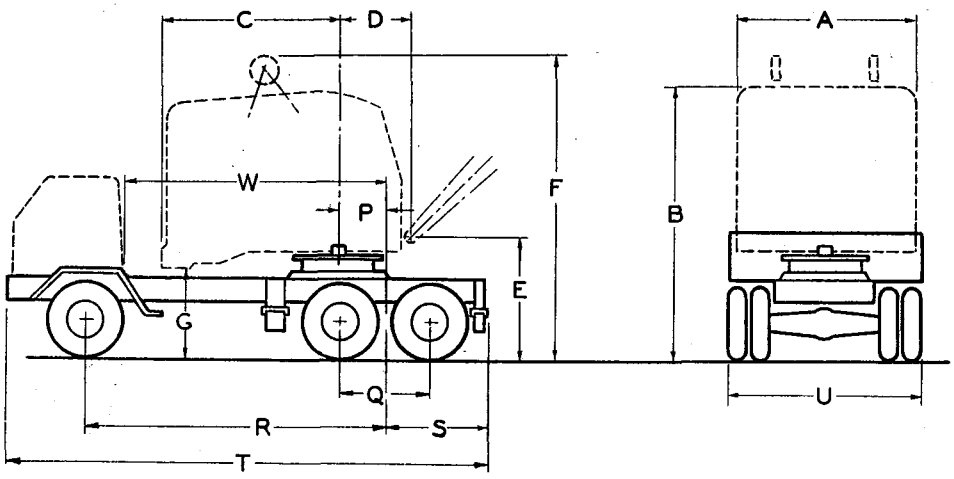


FIGURE 3. *Truck mounting, three axles (paragraph 5.21).*

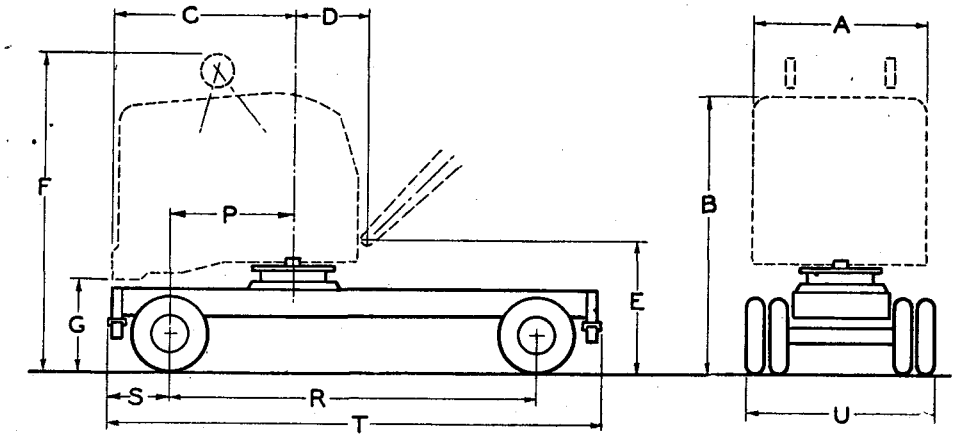


FIGURE 4. *Wheel mounting, two axles (paragraphs 5.21 and 5.22).*

### Truck

5.13. *Truck mounting definition* —A heavy-framed two-or-more-axle-supported, rubber-tired carrier having the general characteristics of a heavy-duty motor truck, upon which is mounted a revolving superstructure with appropriate front-end equipment. 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.

*5.14. Backward stability (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 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, 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 load on the front wheels with the axis of the boom on the axis of the truck (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.*[8]

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

*5.16. Outriggers.—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 load ratings shall be supplied with and without outriggers set.*

5.17. *Tipping load (without outriggers set).*—At any given radius for truck-mounted type 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 leave the ground.

5.18. *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-cross-section-diameter casing on 20-inch-diameter wheel or rim and 10-ply construction.

*5.19. Travel speeds.—The number of speeds forward and reverse shall be given—also the minimum and maximum speeds at full-load governed engine speed when traveling on a firm, level surface.*

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

*5.21. Truck mounting dimensions and specifications (see figs. 3 and 4).*

*P. Distance from center of bogie or axle to center of rotation.*
*Q. Distance between rear axles.*
*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 forward and reverse—also minimum and maximum speeds at full-load governed engine speed.*

### Wheel

5.22. *Wheel mounting definition.*—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. Definitions and requirements covering "Truck Mounting" also apply to wheel mounting. This is sometimes referred to as "Wagon Mounting."

## Front-End-Operating Types of Machines

### Common Crane Boom

6.01. *Common crane boom definition.*—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. *Boom angle.*—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. Boom angle is adjustable by means of the boom hoist, also called derricking device

[8] See footnote 1, page 1.

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

A. For the purpose of comparison of ratings in this classification, boom lengths are as follows for machines having nominal shovel dipper capacities as indicated in table 1:

TABLE 1.—*Crane boom lengths*

| Shovel dipper capacity | Base rating length of crane boom | Shovel dipper capacity | Base rating length of crane boom |
|---|---|---|---|
| *Cubic yards* | *Feet* | *Cubic yards* | *Feet* |
| ¼ | 20 | 1¼ | 45 |
| ⅜ | 25 | 1½ | 50 |
| ½ | 30 | 1¾ | 50 |
| ⅝ | 30 | 2 | 50 |
| ¾ | 35 | 2½ | 60 |
| 1 | 40 | | |

6.04. *Boom hoist cables.*

A. *Continuous boom hoist 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 boom hoist cable is reeved from the boom hoist or derricking drum in desired number of parts in line. From the floating frame to the boom head heavy cables 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 pendants and of the same length as intermediate section are inserted. These are equipped with sockets at each end to connect with pendants. Such boom hoist harness and cables eliminate necessity of changing a long derricking cable each time boom length is changed.

6.05. *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.

6.06. Boom jibs or boom tip extensions are attached to boom head to further lengthen the boom for purpose of handling light loads and usually are designed to take only one hoist line. Jibs are either goosenecked or straight.

6.07. *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, for instance, soft or uneven or inclined supporting surface, and suction or sticking of material in a bucket.

*6.08. Lifting capacity ratings—clamshell, dragline, lifting service and pile driver.—The lifting capacity in pounds 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.*[9]

*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.*

*6.09. Lifting capacity—tabulation.—Each declaration of lifting capacity in pounds shall always be accompanied by a figure showing the corresponding load radius in feet. A table showing the lifting capacities at various corresponding radii fulfills this requirement.*[10]

6.10 *Radius of load.*—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).

*6.11. Crane boom lifting capacity data (see fig. 5).*

*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. Ballast designation.—Lifting capacity table shall indicate ballast on which it is based by combination number, type name, or otherwise if manufacturer supplies various counterweights for each model.*

## Clamshell

(See Common crane boom)

6.12 *Definition of clamshell.*—Uses common crane boom equipment, clamshell bucket, closing line cable, holding line cable, tagline mechanism and

[9] See footnote 1, page 1.
[10] See footnote 1, page 1.

cable and proper diameter lagging 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. In addition to clamshell buckets, as described in paragraph 6.13, a clamshell type of machine may be equipped with orange-peel bucket for heavy excavation, grapples for handling rock, wood, or metal scrap, or with lifting magnets.

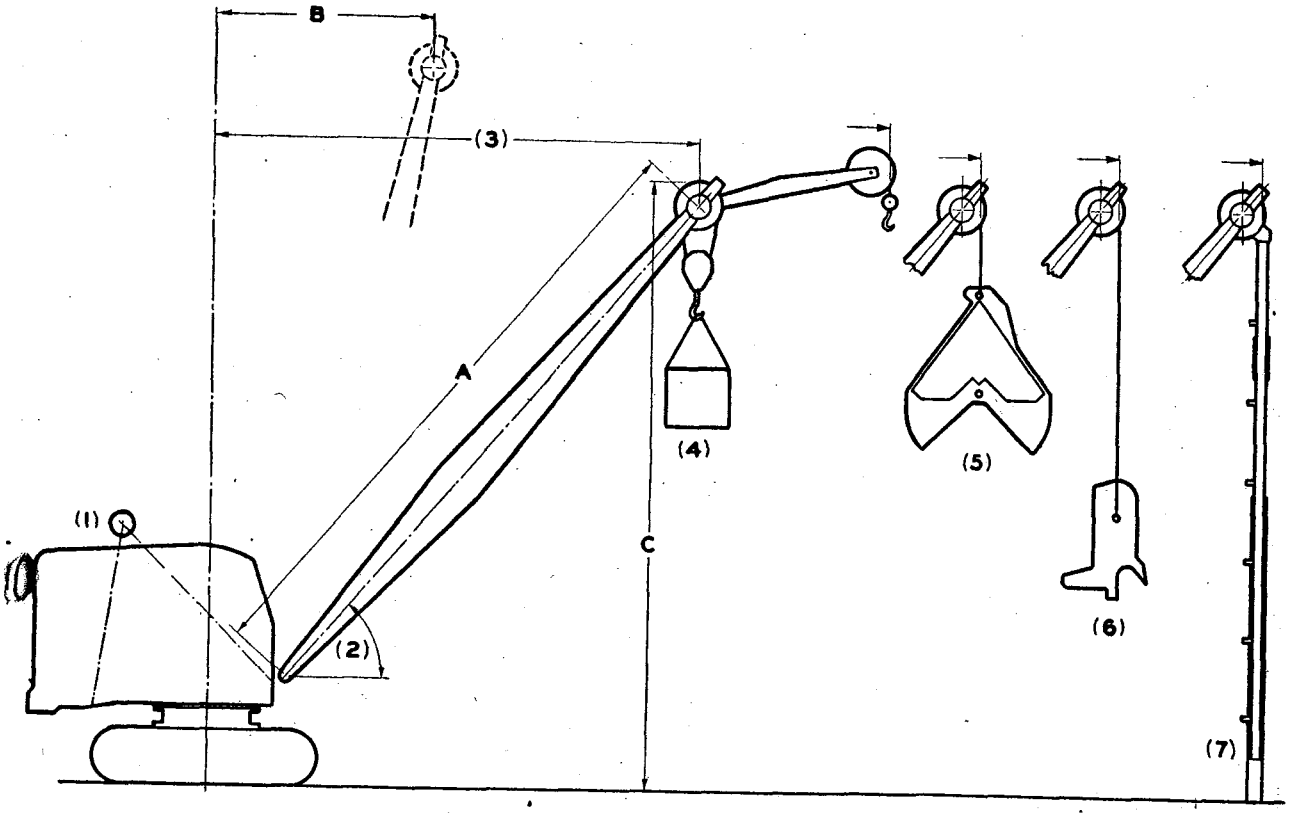


FIGURE 5. *Common crane boom equipment.*

Also applicable to truck and wheel mounting.

1. Gantry or A-frame (paragraph 4.11).
2. Boom angle (paragraph 6.02).
3. Radius of load (paragraph 6.10).
4. Definition of lifting service (paragraph 6.22).
5. Definition of clamshell (paragraph 6.12).
6. Definition of dragline operation (paragraph 6.17).
7. Definition of pile driver (paragraph 6.25).

6.13. *Clamshell-bucket designs.*—From 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.

6.14. *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* is a compromise bucket. Shells are of medium weight material. Counterweight or teeth may or may not be used.

C. *Rehandler type* is light bucket for use in loose materials and is seldom used with teeth or counterweight.

6.15 *Tagline* is a small cable in tension which prevents clamshell bucket from spinning or drifting. Mechanism controlling tagline may be of several types according to manufacturer's design, such as

(1) sliding weights in boom or on revolving superstructure; (2) slip friction; (3) electric; or (4) spring loaded device.

*6.16. Clamshell specifications.*

*A. Closing-line cable speed.*
*B. Holding-line cable speed.*
*C. Closing-line cable pull.*

## Dragline

(See Common crane boom)

6.17. *Definition of dragline operation.*—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.

6.18. *Dragline bucket weight types.*—Because a large portion of the digging action in dragline 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. Tltese 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 light-weight shell for use in light-weight or loose materials.

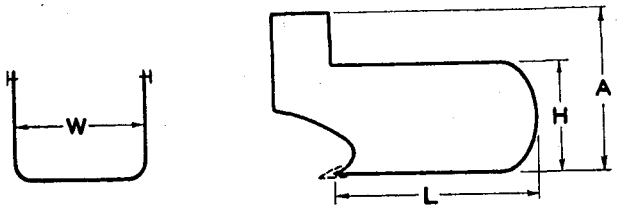


FIGURE 6. *Dragline bucket.*

Because weight of bucket and material to be handled also determine 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.

*6.19. 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 inside height of the bucket (H) by the inside width (W) by the length (L) (see fig. 6), (all dimensions in inches) and dividing by 46,656 and multiplying 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.*

*The formula*[11] *to be used to determine the capacity rating is*

$$\text{Capacity rating} = \frac{H \times L \times W}{46{,}656} \times K_1.$$

TABLE 2.—*Dragline bucket capacity rating factors*

| Bucket size | $K_1$ Factor |
|---|---|
| *Cubic yards* | |
| ¼ | 0.835 |
| ⅜ | .845 |
| ½ | .854 |
| ¾ | .864 |
| 1 | .874 |
| 1¼ | .888 |
| 1½ to 12 | .897 |

6.20. *Special dragline boom point 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 point sheaves, of a single-boom point sheave.

*6.21. Dragline specifications.*

*A. Dragline cable speed.*
*B. Hoist-line cable speed.*
*C. Dragline cable pull.*
*D. Hoist-line cable pull.*

## Lifting Crane

(See Common crane boom)

6.22. *Definition of lifting service.*—Uses common crane boom equipment, hook 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, the addition of the following equipment is often desirable—extended gantry, boom stop, floating boom harness, live or high-speed boom hoist. 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.

*6.23. Lifting service capacity designation.—The designated rating size of a lifting crane shall be expressed in short tons of 2,000 pounds according to manufacturer's rating charts, when using base rating boom length.*[12]

*6.24. Lifting crane specifications.*

*A. Single-line cable speeds (for first layer of cable on drum).*
*B. Single-line cable pulls (for first layer of cable on drum).*
*C. Maximum recommended load with 1-part line.*
*D. Maximum recommended load with 2-part line.*
*E. Maximum recommended load with 3-part line.*

[11] See footnote 1, page 1.
[12] See footnote 1, page 1.

*F. Maximum recommended load with other possible hitches.*
*G. Number of parts that can be used practicably.*
*H. Hook-block capacity.*
*J. Number of sheaves in hook block.*

## Pile Driver

(See Common crane boom)

6.25. *Definition of pile driver.*—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. Pile driver is a single purpose application for driving piling, either of the wood or concrete pole type or steel sheet piling.

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

6.27. *Pile hammers.*—The following types of pile hammers are used in pile driving work:

A. *Air hammer.*—Independently air-driven pile hammer.
B. *Drop hammer.*—Heavy cast or forged hammer with hook or eye for attaching to one hoist line which lifts and drops hammer for driving pile. It is usually grooved to fit in pile leads.
C. *Steam hammer.*—Independently steam-driven pile hammer.

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

6.29. *Winch head or auxiliary hoist drum.*—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.

*6.30. Pile driver specifications.*
*A. Drop-hammer weights available.*
*B. Lead lengths and weights available.*
*C. Third drum (if offered) cable pull.*
*D. Third drum (if offered) cable speed.*

## Shovel

6.31. *Definition of shovel.*—Equipment required to convert a basic machine with its mounting to shovel operation. Consists of shovel boom, dipper, dipper stick, dipper trip mechanism, padlock, crowding mechanism on superstructure and cables. 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.

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

6.33. *Crowd types.*—There are three 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 crowd*—may be driven by cable or chain, or combination of both, from reversing mechanism on revolving superstructure.
C. *Dual crowd*—an arrangement whereby the reaction from dead end of hoist hitch may be used to crowd out or retract the dipper and where independent crowding mechanism is also provided.

*6.34. Dipper capacity rating.—The rated capacity of the shovel dipper shall not be more than the number of cubic yards 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 of 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.*[13]

6.35. *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 obtain 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.

*6.36. Dipper trip mechanism.—Manufacturer shall state type of dipper trip mechanism used.*

6.37. *High lift.*—Term applied to shovel front-end equipment when longer than standard boom or dipper stick is installed to give greater dumping range and height.

6.38. *Shovel sizes.*—The standard sizes of shovels (dipper capacity ratings) covered by this standard and generally available from American manufacturers are ¼ to 2½ cubic yards (see table 1).

*6.39. Shovel dimensions and specifications (see fig. 7).*
*A. Shovel dipper capacity in cubic yards.*
*B. Length of boom from boom hinge pin center to boom point sheave shaft center.*
*C. Effective length of dipper stick.*

[13] See footnote 1, page 1.

*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.*

nected 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. 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

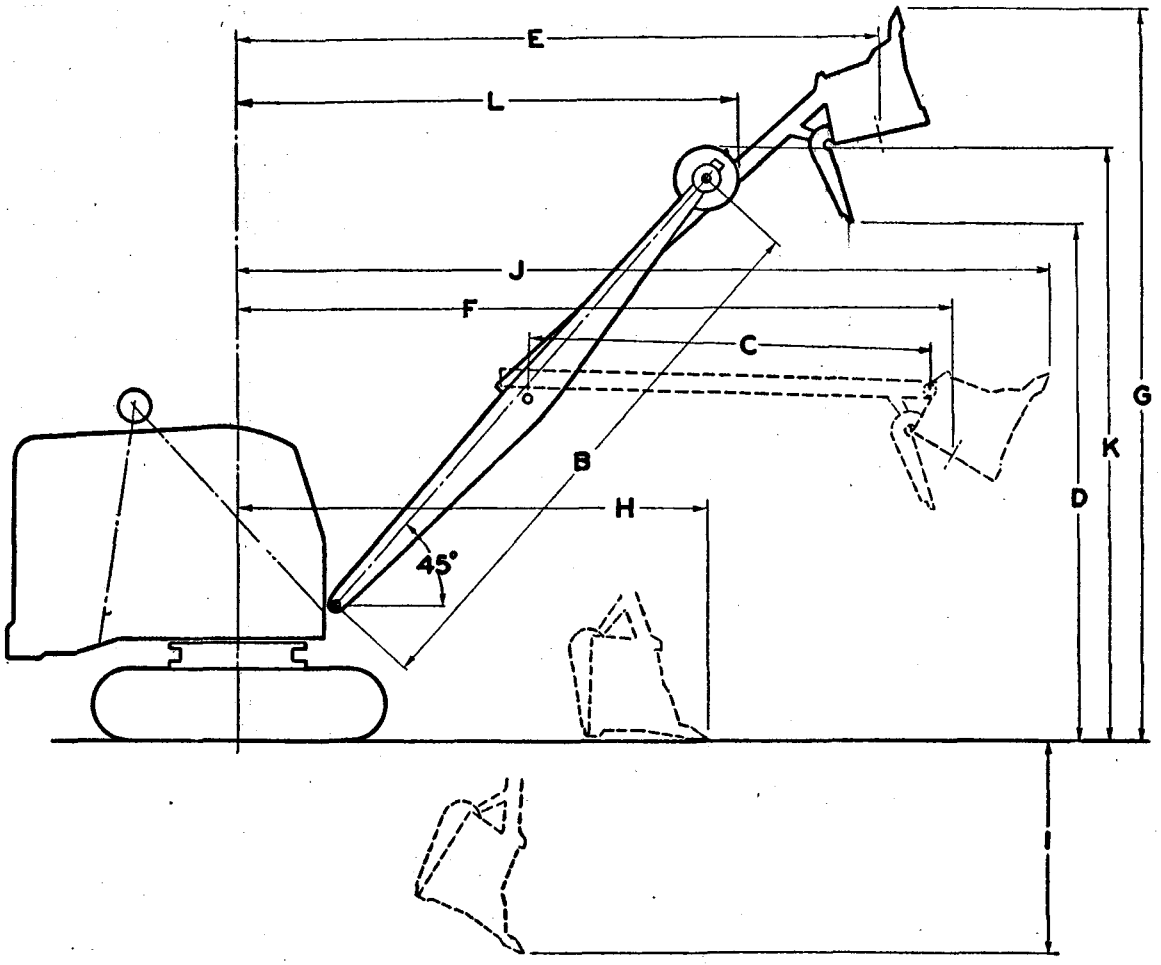


FIGURE 7. *Shovel (paragraph 6.39).*
Also applicable to truck and wheel mounting.

*L. Boom head clearance radius.*
*M. Dipper bail speed (with number of parts of line stated) at full-load governed engine speed.*
*N. Dipper bail pull (with number of parts of line stated) at full-load governed engine speed.*

## Hoe

*6.40. Definition of hoe operating equipment.*—Consists of a boom dipper, dipper arm, bail, proper drum laggings and cables and gantry or A-frame con-

*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 that of shovel dipper but special trench widths affect the nominal capacity.

6.41. *Digging depth, maximum.*—Distance below grade machine can excavate, measured with bottom of dipper horizontal and boom not lower than 55° below a horizontal line from center of boom foot pin to center of boom head pin.

6.42. *Dumping position.*

A. Beginning of dump—is taken with dipper pulled in toward boom as far as possible

and boom raised until bottom of dipper is horizontal.

B. End of dump—is taken with boom in same position as (A) but with dipper raised until bottom of dipper is vertical.

*6.43. Hoe dimensions and specifications (see fig. 8).*

*A. Hoe dipper nominal capacity in cubic yards.*

*B. Hoe dipper width over side cutters.*

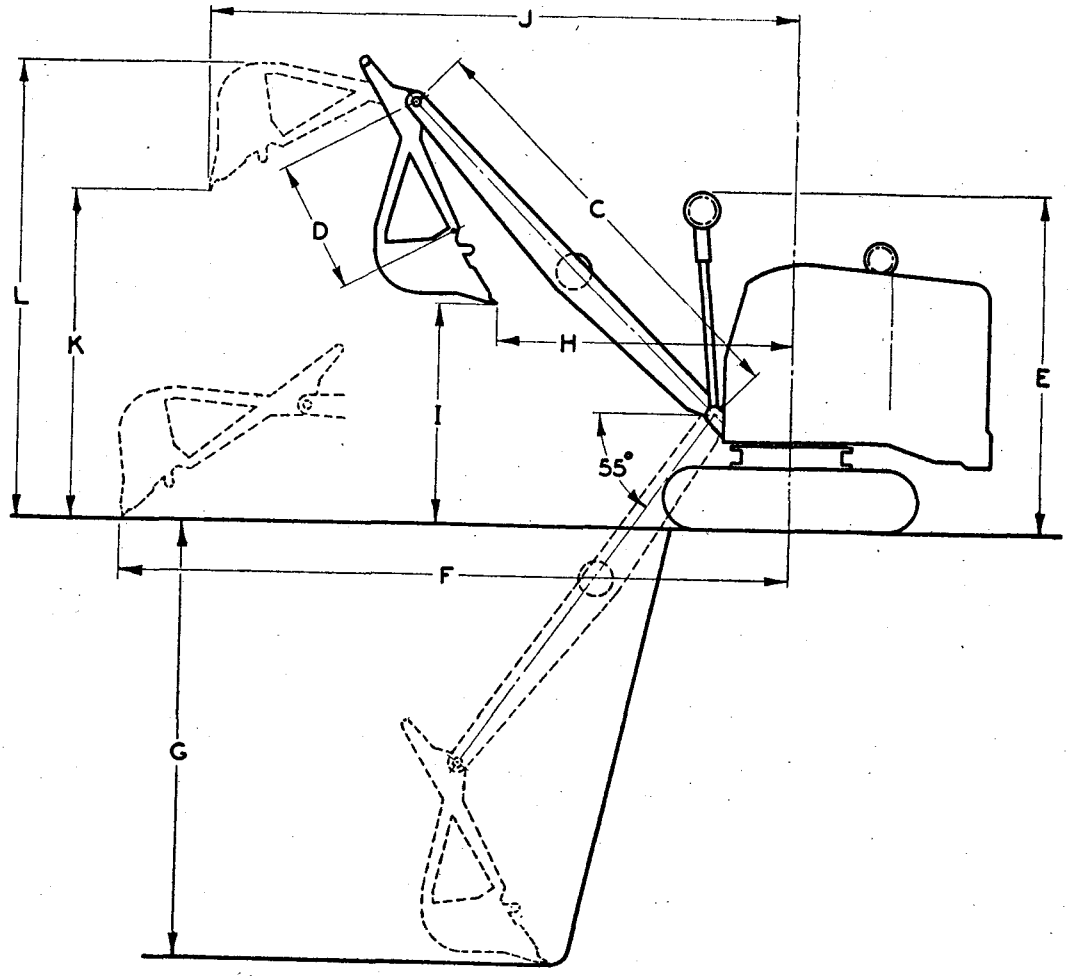


FIGURE 8. *Hoe (paragraph 6 43).*
Also applicable to truck and wheel mounting.

*C. Length of boom from hinge pin center to point shaft center.*

*D. Length of dipper arm from boom connecting pin to dipper connecting pins.*

*E. Height of hoe gantry in working position.*

*F. Maximum reach at grade level.*

*G. Maximum digging depth.*

*H. Radius of dipper teeth at beginning of dump.*

*I. Clearance of dipper from ground at beginning of dump.*

*J. Clearance radius at end of dump.*

*K. Clearance from ground at end of dump.*

*L. Over-all height at end of dump.*

## Complete Machines

(Miscellaneous data applying to all types of operation)

7.01. *The complete machine.*—As previously stated under "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 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 equipments. The manufacturer is usually in a position to supply those not originally purchased, at a later date.

There are many terms used in this commercial standard that are applicable to the complete machine or common to various front-end combinations. They are defined as follows:

A. *Bail pull.*—Total pull developed at point of attachment of hoisting line to dipper or bucket. In shovel operation this is about twice the line pull when hoist cable is reeved in two parts.

B. *Boom angle.*—The angle from horizontal at which the particular type of boom reposes. Boom angle is adjustable by means of boom hoist, also called derricking device.

C. *Clean-up radius.*—Maximum digging distance from revolving center at same grade on which machine mounting rests and operates.

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

E. *Dumping height.*—Maximum clearance height from operating grade of any bucket in dumping position at given boom angle. With shovel dippers and buckets with doors, this distance is measured from lowest point of arc of swing of the door.

F. *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.

G. *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 cannot be handled with a magnet.

H. *Stability.*—The ability of machine to resist tipping.

I. *Working weight.*—Weight of machine with engine radiator full, fuel tank half full, with complete front-end equipment.

*7.02. Complete machine specifications shall include:*

*A. Required data as outlined in this standard for the basic components going into the machine, namely: Revolving superstructure, mounting, and front-end equipment offered. For reference, the paragraphs covering each are:*

*Revolving superstructure . . 4.14*
*Mounting . . . . . 5.12, 5.21, or 5.22*
*Dragline front-end . . . . . 6.11 and 6.21*
*Clamshell front-end . . . . . 6.11 and 6.16*
*Lifting crane . . . . . 6.11 and 6.24*
*Pile driver . . . . . 6.11 and 6.30*
*Shovel front-end . . . . . 6.39*
*Hoe . . . . . 6.43*

*B. Net shipping weight of basic machine equipped as shovel, dragline, clamshell, lifting crane, pile driver or hoe.*

*7.03. Safety Requirements.*[14]

*7.03a. Revolving superstructure.*

*1. Principal platform walking surface should be of an antiskid type.*

*2. Grease fittings should be located in as easily accessible positions as possible.*

*3. All gear teeth, where exposed to contact, shall be either entirely enclosed, or equipped with a guard covering the gear face and having side flanges extending radially inward beyond the root of the teeth.*

*4. Load brakes shall be capable, when properly adjusted, of holding or lowering rated loads on recommended reeving. These brakes must be capable of being locked in the set position.*

*5. The boom hoist shall be capable of safe suspension of the boom with recommended reeving, without attention from the operator, and allow lowering only when under operator's control.*

*6. A locking means shall be provided for preventing rotation of the revolving superstructure when desired.*

*7. Hand holds and/or steps shall be provided on the revolving superstructure to facilitate entrance to and exit from the operator's station.*

*8. Engine fans shall be adequately guarded.*

*9. Engine clutch must be provided with a device requiring positive manual effort to engage so that it cannot be inadvertently engaged. Where a transmission having neutral position is used in combination with an engine clutch, the clutch may be of the spring loaded type.*

*10. The control levers, usually called hoist clutch control, swing clutch control and crowd clutch control, shall be free of all latches which may seriously delay emergency operation, with disastrous results.*

*11. All cab doors, whether of the sliding or swinging type, shall be adequately restrained from accidentally opening or closing while traveling or operating the machine.*

*12. A padlock or other means of securely locking the cab doors in the closed position when desired shall be provided.*

[14] See footnote 1, page 1. See also footnote 17, page 19.

*7.03b. Mountings.*

1. *Crawler.*
   a. *Wherever possible, grease fittings shall be located so as to be easily accessible from outside of the crawlers and lower base.*
   b. *Brakes or other locking means shall be provided to hold the machine stationary during the working cycle and while the machine is on level grade or any grade at which it will operate satisfactorily.*
2. *Truck mounting.*
   a. *Safety glass shall be provided in truck cab.*
   b. *Hand holds and steps shall be provided to facilitate entrance to the truck cab.*
   c. *Brakes shall be provided to safely bring the machine to a stop. In addition, locking means on the brakes to adequately hold the machine stationary shall be provided.*
   d. *A suitable number of hand holds and/or steps shall be provided to facilitate operator's ascent to or descent from operator's station in revolving superstructure.*
   e. *Where truck mountings will be used on the highway, stop lights, tail lights, clearance lights, and reflectors shall be furnished.*
3. *Wheel mountings.*
   a. *Brakes shall be provided to safely bring the machine to a stop. In addition, locking means on the brakes to adequately hold the machine stationary shall be provided.*
4. *Crane.*
   a. *A permanent capacity chart shall be provided and firmly fixed to the interior of the cab or other suitable location in the machine where clearly visible to the operator. This chart shall provide the following:*
      1. *Rated crane hook loads at various operating radii and with various boom lengths.*
      2. *Ratio of rated loads to tipping loads in percent.*
      3. *Indication that rated loads are gross loads and that buckets, hooks, chains or any other external auxiliary lifting means are to be included as a part of such rated loads.*
      4. *Statement that rated loads are on basis of machine standing on a firm, level, uniformly even supporting surface.*
      5. *Statement of deductions to be made from rated loads for component parts of crane attachment such as jibs, etc.*
      6. *Truck crane rated loads shall be given for operation with and without the use of outriggers.*
   b. *Wire rope sheaves shall be adequately guarded to prevent the wire rope from leaving the sheave groove during operation.*
   c. *A suitable permanent identification plate or plates shall be provided on each machine which shall contain manufacturer's name and address and serial number of the machine.*
   d. *All cranes to be operated in clamshell or magnet service shall be equipped with a suitable tagline mechanism.*

*7.03c. General.*

1. *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 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.*
2. *Truck cranes shall meet the following requirements on backward stability:*
   a. *With the shortest boom set at minimum operating radius, no load on the hook, and the axis of the boom at right angles to the axis of the truck, the minimum total load on all wheels on the side on which the boom is located shall not be less than 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.*
3. *Lifting capacity—clamshell, dragline, lifting service, and pile driver.—The lifting capacity in pounds 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.*

4. *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.*

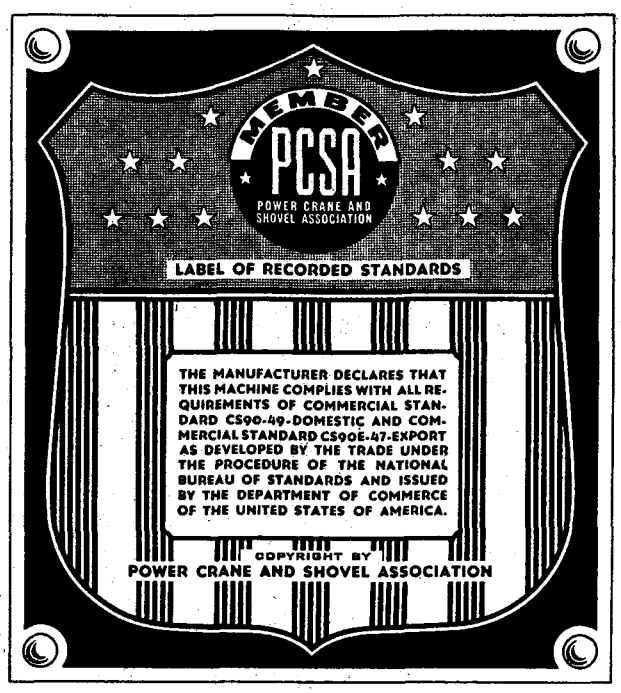


FIGURE 9. *Label adopted by the Power Crane and Shovel Association.*

## Labeling and Certification

*8.01. Identification.—The name of the manufacturer, model number, and serial number shall be shown in a conspicuous place in or on the machine.*[15]

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

> *The manufacturer declares that this machine complies with all requirements of Commercial Standard CS90-49 as developed by the trade, under the procedure of the National Bureau of Standards and issued by the United States Department of Commerce.*[16]

8.03. *Labeling.*—Figure 9 illustrates the label adopted by the members of the Power Crane and Shovel Association to certify compliance of any particular machine with the applicable parts of this standard.

[15] See footnote 1, page 1.
[16] See footnote 1, page 1.

## Nomenclature

9.01. The following is an index or glossary of nomenclature or 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 4.11.

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

*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 6.02.

*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.

*Axles (truck).*—See paragraph 5.13.

*Backdigger.*—Another definition for hoe. See paragraph 6.40.

*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.

*Back hoe.*—Another designation for hoe. (See paragraph 6.40).

*Backward stability.*—See paragraphs 5.02 and 5.14.

*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.

*Ballast.*—See Counterweight.

*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 type 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.

*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 Axle, bogie.

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

*Boom angle.*—The angle from horizontal at which the particular type of boom reposes. Boom angle is adjustable by means of boom hoist, also called derricking device. See paragraph 6.02.

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

*Boom hinges.*—Projections or sockets on revolving bed plate in which boom hinges fit. 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 4.03.

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

*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 6.04B.

*Buckets.*—See Clamshell (paragraphs 6.13 and 6.14); Dragline (paragraphs 6.18 and 6.19); Shovel (paragraphs 6.31 and 6.34); Hoe (paragraph 6.40).

*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 4.12).

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

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

*Car body.*—Same as base (crawler).

*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 6.31, 6.32, and 6.33.

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

*Climb.*—See paragraph 5.05.

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

*Combination crowd.*—See paragraph 6.33A.

*Common crane boom.*—See paragraph 6.01.

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

*Continuous boom hoist cables.*—See paragraph 6.04A.

*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 frames for carrying crawler mechanism including tread belt, and on which are mounted roller path and ring gear

*Crawler bearing length.*—See paragraph 5.03.

*Crawler frame.*—Substructure on which is 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 paragraph 6.33.

*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.*—Same as boom hoist cables. The lines or cables used in changing angle of boom or in derricking. See paragraph 6.04.

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

*Dipper capacity.*—See paragraph 6.34.

*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.

*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 paragraph 6.17.

*Dragline bucket.*—See paragraphs 6.18 and 6.19.

*Dragline 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).

*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 6.27B.

*Drum.*—Any spool or large pulley on which are wrapped cables used in machine operation.

*Dual crowd.*—See paragraph 6.33C.

*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 op

*Dumping radius.*—Maximum distance from cen of rotation of machine to center line of bucke or dipper in dumping position with boom at any given angle.

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

*Fairlead.*—See Dragline fairlead.

*Floating harness.*—See paragraph 6.04B.

*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 it to nozzles on injectors.

*Fuel pump (gasoline).*—Pump on gasoline engine which forces fuel in supply line to carburetor.

*Full-load speed.*—See paragraph 4.05, full-load governed engine speed.

*Fully enclosed cab.*—Machine house or cab which encloses all machinery including operator's position.

*Gantry.*—See paragraph 4.11.

*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 a rigid upper section 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 5.06.

*Louser.*—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 used in connection with boom hoist systems when floating boom harness is installed.

*Hammer (pile).*—See paragraph 6.27.

*Handle (dipper).*—Another term for dipper stick.

*Handled.*—See paragraph 6.05.

*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 is 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 6.40.

*Hoe mast.*—Same as hoe gantry.

*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.*—The cable reeved from second hoist drum for holding clamshell bucket suspended during dumping and lowering operations.

*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 8.01.

*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 6.33B.

*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 6.06.

*King pin.*—Another term for center pin.

*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.

*Latticed boom.*—Boom of open structural construction with angular lacing between four main corner members in form of truss.

*Lifting capacity.*—See paragraphs 6.07 and 6.11.

*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.

*Line speed* is the speed in feet 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.

*Live boom hoist.*—See paragraph 4.03.

*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 4.07.

*Mast.*—An adjustable frame hinged to the turntable at or near the boom hinge and extending above the cab for use in connection with supporting a boom. Head of mast is usually supported and raised or lowered by the boom suspension cables. When used with crane type booms it serves the purpose of a high A-frame. When used with pull shovels it serves as a jib frame to provide proper lead for the main hoist cable.

*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 5.16.

*Overhaul.*—Ability of a weight on end of hoist line to unwind cable from drum when brake is released.

*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.

*Pay load.*—The net load or volume handled exclusive of weight of bucket, dipper, hook or other handling mechanism.

*Pendants.*—See paragraph 6.04B.

*Pile.*—See paragraph 6.25.

*Pile driver.*—See paragraph 6.25.

*Pile driver leads.*—See paragraph 6.28.

*Pile cap.*—Protecting cap for fitting on top of piling to prevent battering or splintering (see paragraph 6.26).

*Pitch diameter.*—Diameter of drum, lagging or sheave plus the diameter of the cable.

*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 4.10.

*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.*—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.

*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 6.10.

*Rated load.*—Same as lifting capacity (see paragraph 6.09).

*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.

*Roller path.*—The surface upon which run the rollers which support revolving superstructure. May accommodate either cone rollers or cylindrical rollers or live roller circle. Where hook rollers are used path for hook rollers may be included as integral part.

*Ropes.*—Same as cables.

*Rope crowd.*—Same as cable crowd (see paragraph 6.33).

*Saddle block.*—Mechanism and bearings which carry shipper shaft drive and acts as guide for dipper stick.

*Safe load rating.*—See paragraph 6.09.

*Scoop (skimmer).*—(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 digging 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.

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.

*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.

*Skidding.*—Method of export shipping preparation.

*Skimmer scoop.*—See Scoop (skimmer).

*Slewing.*—Another term for swinging function.

*Stability.*—The ability of machine to resist tipping.

*Steam hammer.*—Steam-driven pile hammer (see paragraph 6.27C).

*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 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 4.12.

*Swing gear.*—External or internal gear attached to lower base with which swing pinion of revolving superstructure meshes to provide swinging motion. (See paragraph 4.12).

*Tagline.*—See paragraph 6.15.

*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 5.09 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 5.13.
*Tumbler.*—Large rollers of crawler tread belt.
*Turning circle.*—Minimum diameter of circle in which machine can be turned completely.
*Turntable.*—Another term for revolving superstructure of machine.
*Wagon.*—See Wheel mounting, paragraph 5.22.
*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 5.22.
*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.

## Effective Date

10.01. Having been passed through the regular procedure of the Commodity Standards Division and approved by the acceptors hereinafter listed, this commercial standard was issued by the United States Department of Commerce, effective from August 1, 1949.

Edwin W. Ely,
*Chief, Commodity Standards Division.*

## History of Project

11.01. On May 13, 1946, the Power Crane and Shovel Association requested the cooperation of the Division of Trade Standards (now Commodity Standards Division) in the development of a commercial standard for power cranes and shovels. On July 22, 1948, a draft prepared by the Association was circulated to all known manufacturers and to a representative group of distributors, users, and related interests for advance comment.

11.02. A recommended standard adjusted in accordance with the composite comment received was submitted on November 30, 1948, to producers, distributors, users, and to related interests for written acceptance.

11.03. Upon receipt of official acceptances estimated to represent a satisfactory majority of production by volume, and in the absence of active valid opposition, the standard was promulgated on June 29, 1949, as Commercial Standard CS90-49.[17]

## 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 Commodity Standards Division, National Bureau of Standards, which acts as secretary for the committee.

A. F. Busick, Jr. (chairman), Marion Power Shovel Co., Marion, Ohio.
C. S. Davis, The Utah Construction Co., No. 2 Giant Road, Richmond, Calif.
E. A. Fretz, Fretz Construction Co., 2000 Eastwood Street Houston 3, Tex.
M. B. Garber, The Thew Shovel Co., Lorain, Ohio.
B. H. Hardaway, III, Hardaway Contracting Co., 15 East 11th Street, Columbus, Ga.
R. L. Johnson, H. O. Penn Machinery Co., Inc., 140th St. & East River, New York 54, N. Y.
E. H. Lichtenberg, Koehring Co., Milwaukee 10, Wis.
H. D. Littlejohn, The Highway Equipment Co., 2150 Langdon Farm Road, Cincinnati 12, Ohio.
Alexander Maitland, Kansas City Bridge Co., 215 Pershing Road, Kansas City 8, Mo.
E. B. Nickles, Manitowoc Engineering Works, Manitowoc, Wis.
P. T. Redfern, Byers Machine Co., Ravenna, Ohio.
W. J. Rohan, Winston Bros. Co., 1470 Northwestern Bank Bldg., Minneapolis 2, Minn.
H. E. Shaw, Service Supply Corp., 20th & Erie Avenue, Philadelphia, Pa.
E. J. VanKeuren, The Osgood Co., Marion, Ohio.
G. K. Woodling, Harnischfeger Corp., Milwaukee 14, Wis.

[17] References for development of safety requirements: Operation of Power Shovels, Draglines and Similar Equipment, Data Sheet D-Gen. 25; Wire Rope, Industrial Data Sheet 26; Safe Use of Heavy Duty Equipment on Construction Jobs, Safety Reprint, Construction #10. Issued by National Safety Council, 20 N. Wacker Drive, Chicago 6, Ill.
Commercial Standard CS154E-49, Wire Rope (Export Classification); issued by the National Bureau of Standards, U.S. Department of Commerce, Washington 25, D.C.

## 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.....

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

Gentlemen:

We believe that the Commercial Standard CS90–49 constitutes a useful standard of practice, and we individually plan to utilize it as far as practicable in the

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

of power cranes and shovels.

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 office.....
(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 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 since they represent the will of the interested groups as a whole, 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, distribution, or consumption 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 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, distributors, and users; 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 has been endorsed by a satisfactory majority of production or consumption 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

The organizations listed below have individually accepted this standard for use as far as practicable in the production, distribution, testing, or purchase of power cranes and shovels. In accepting the standard, they reserved 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 as conforming thereto, and that purchasers will require such specific evidence of conformity.

### ASSOCIATIONS

(General Support)

American Society of Civil Engineers, New York, N. Y.
American Specification Institute, Chicago, Ill.
Associated General Contractors of America, Inc., The, Washington, D. C.
Building Officials Conference of America, Inc., Washington, D. C.

### FIRMS AND OTHER INTERESTS

Alabama, State Highway Department of, Montgomery, Ala.
American Manganese Steel Division of American Brake Shoe Co., Chicago Heights, Ill.
American Tractor Equipment Corp., Oakland, Calif.
Arcole Midwest Corp., Evanston, Ill.
Andersen Construction Co., Council Bluffs, Iowa.
Arkansas State Highway Department, Little Rock, Ark.
Atkinson, Guy F., Co., South San Francisco, Calif.
Baldwin Machinery Co., Charleston, W. Va.
Bay City Shovels, Inc., Bay City, Mich.
Bedford Construction Co., Chicago, Ill.
Benvenuti, N., & Sons, New London, Conn.
Bianchi, Carlo, & Co., Inc., Framington, Mass.
Blanchard, George L., New York, N. Y.
Bodner Construction Co., Indianapolis, Ind.
Boh Bros. Construction Co., New Orleans, La.
Browning Crane & Shovel Co., The, Cleveland, Ohio.
Buns Coal Co., Inc., Zanesville, Ohio.
Bucyrus-Erie Co., South Milwaukee, Wis.
Building Constructors, Inc., Memphis, Tenn.
Byers Machine Co., The, Ravenna, Ohio.
C & M Construction Co., Inc., Philadelphia, Pa.
Cahill-Mooney Construction Co., Butte, Mont.
California Department of Public Works, Division of Highways, Sacramento, Calif.
California, University of, Berkeley, Calif.
Casey & Emmert, Inc., Chicago, Ill.
Cheeseman Construction Co., Freeport, Ill.
Claussen-Lawrence Construction Co., Augusta, Ga.
Colorado State Highway Department, Denver, Colo.
Connecticut, State of, Highway Department, Division of Property Control, Hartford, Conn.
Construction Equipment Corp., Long Island City, N. Y.
Dawson, R. R., Bridge Co., Bloomfield, Ky.
Dayton, City of, Dayton, Ohio.
Degerstrom, N. A., Spokane, Wash.
Dickerson, Inc., Monroe, N.C.
Dunn & Jones, Washington, D. C.
Ewin, J. P., Inc., Mobile, Ala.
Expert Concrete Breakers, Inc., Long Island City, N. Y.
Fegles Construction Co., Ltd., Minneapolis, Minn.
Ferro Concrete Construction Co., The, Cincinnati, Ohio.
Fiske-Carter Construction Co. of South Carolina, Greenville, S. C.
Florida, State of, State Road Department, Tallahassee, Fla.
Fredrickson Bros., Emeryville, Calif.
Fretz Construction Co., Houston, Tex.
Fruin-Colnon Contracting Co., St. Louis, Mo.
General Electric Co., Schenectady, N. Y.
General Excavator Co., The, Marion, Ohio.
Glover, Geo. J., Co., Inc., New Orleans, La.
Goldberg, A. N., Inc., New Orleans, La.
Great Western Construction Co., Anaheim, Calif.
Grimshaw, W. R., Co., Tulsa, Okla.
Gumerson, Dow, Enid, Okla.
H. R. H. Construction Corp., New York, N. Y.
Hagerman Construction Corp., Ft. Wayne, Ind.
Handler, B. W., Construction Co., Chicago, Ill.
Hardaway Contracting Co., Columbus, Ga.
Harnischfeger Corp., Milwaukee, Wis.
Hauser Construction Co., Portland, Oreg.
Hawkins & Armstrong, Seattle, Wash.
Hayden Bros. Construction Co., East St. Louis, Ill.
Herron, James H., Co., The, Cleveland, Ohio.
Highway Equipment Co., The, Cincinnati, Ohio.
Hinkle Contracting Co., Paris, Ky.
Holmes-Talcott Co., Hartford, Conn.
Hunt, Robert W., Co., Chicago, Ill.
Hyster Co., Portland, Oreg.
Illinois Division of Highways, Springfield, Ill.
Indiana Engineering & Construction Co., Inc., Ft. Wayne, Ind.
Industrial Brownhoist Corp., Bay City, Mich.
Insley Manufacturing Corp., Indianapolis, Ind.
International Hoist & Machine Co., Newark, N. J.
Johnson, A. W., Co., Inc., Seattle, Wash.
Johnson, Arthur A., Corp., The, Long Island City, N. Y.
Jones, O. C., & Sons, Berkeley, Calif.
Jones, Spencer, New York, N. Y. (General support.)
Kansas City Bridge Co., Kansas City, Mo.
Kansas, State Highway Commission of, Topeka, Kans.
Keller Material Yard, Downers Grove, Ill.
Kennedy & Smith, Inc., Flushing, N. Y.
Kentucky, Commonwealth of, Department of Highways, Frankfort, Ky.
Key Contractors, Inc., Santa Fe Springs, Calif. (General support.)
Keystone Driller Co., Beaver Falls, Pa.
Kiewit, Peter, Sons' Co., Grand Island, and Omaha, Nebr.
Kliebenstein, E. H., Co., Ridgefield, N. J.
Koehring Co., Milwaukee, Wis.
Korshoj Construction Co., Inc., Blair, Nebr.
Lacy, L. H., Co., Dallas, Tex.
Laird Construction Co., Battle Creek, Mich.
Larson-Danielson Construction Co., Inc., La Porte, Ind.
Latta, J. E., Construction Co., Inc., St. Louis, Mo.
Lima Shovel & Crane Division, Lima-Hamilton Corp., Lima, Ohio.
Link-Belt Speeder Corp., Cedar Rapids, Iowa.
Lohse, Henry, Co., Inc., Newark, N. J.
Lonergan, E. L., Construction Co., Chicago, Ill.
Loney, Brack & Copeland, Case City, Mich.
Long Construction Co., Kansas City, Mo.
Loranger, Theodore, & Sons, New Bedford, Mass.
Los Angeles, City of, Purchasing Department, Los Angeles, Calif.
Los Angeles, City of, Department of Public Works, Bureau of Street Maintenance, Los Angeles, Calif.
M & K Corp., San Francisco, Calif.
MacDonald, Young & Nelson, Inc., San Francisco, Calif.
MacIsaac & Menke Co., Los Angeles, Calif.
MacMen, Inc., Los Angeles, Calif.
Mahon, R. C., Co., The, Detroit, Mich.
Maine, State of, State Highway Commission, Augusta, Maine.
Manitowoc Engineering Works, Manitowoc, Wis.
Marion Power Shovel Co., Marion, Ohio.
Martin, F. H., Construction Co., Detroit, Mich.
Massachusetts Institute of Technology, Cambridge, Mass.
McAndrew Construction Co., Inc., New York, N. Y. (General support.)
McKee, Robert E., Los Angeles, Calif.

McMullen & Pitz Construction Co., Manitowoc, Wis.
Meagher Construction Co., Upper Darby, Pa.
Merrill-Brose Co., The, San Francisco, Calif.
Meyer, Henry H., Co., Inc., The, Baltimore, Md.
Michigan College, Mining & Technology, Houghton, Mich.
Michigan Power Shovel Co., Benton Harbor, Mich.
Miller-Davis Co., Kalamazoo, Mich.
Millstone, I.E., Construction Co., St. Louis, Mo.
Minnesota Department of Highways, St. Paul, Minn.
Missouri State Highway Department, Jefferson City, Mo.
Minor Construction Co., Belleville, Ill.
Modern Builders Construction Co., Inc., Long Beach, Calif.
Montana Highway Department, Helena, Mont.
Moritz, C. J., Inc., Effingham, Ill.
Morrison-Knudsen Co., Inc., Boise, Idaho.
Municipal Reference Library, Los Angeles, Calif.
Nassau Construction Co., Inc., Woodside, L. I., N. Y.
National Engineering & Contracting Co., Cleveland, Ohio.
New Hampshire State Highway Garage, Concord, N. H.
New Jersey State Highway Department, Trenton, N. J.
New York Testing Laboratories, Inc., New York, N. Y.
Newport Construction Co., Portland, Oreg.
Nicholas, K. D., Ontario, Calif.
North Dakota State Highway Department, Bismarck, N. Dak.
North Shore Builders, Winnetka, Ill.
Northwestern Engineering Co., Rapid City, S. Dak.
Ohio, State of, Department of Highways, Columbus, Ohio.
Olesen, Jens, & Sons Construction Co., Waterloo, Iowa.
Olson Construction Co., Lincoln, Nebr.
Oregon State Highway Commission, Salem, Oreg.
Orton Crane & Shovel Co., Chicago, Ill.
Osgood Co., The, Marion, Ohio.
Parsons Co., The, Newton, Iowa.
Parsons, Ralph M., Co., The, Los Angeles, Calif.
Penker Construction Co., The, Cincinnati, Ohio.
Penn, H. O., Machinery Co., Inc., New York, N. Y.
Perrilliat-Rickey Construction Co., Inc., New Orleans, La.
Perry, B. F., Construction Co., Akron, Ohio.
Picard Testing Laboratories, Inc., The, Birmingham, Ala.
Pontiac, City of, Pontiac, Mich.
Powers-Thompson Construction Co., Joliet, Ill.
Providence, City of, Public Works Department, Providence, R. I.
"Quick-Way" Truck Shovel Co., Denver, Colo.
Reed, George H., & Co., Inc., Greenfield, Mass.
Reid-Naylor-Baldwin, Wichita Falls, Tex.
Reniger Construction Co., Lansing, Mich.
Rentlor Co., Inc., Grand Island, Nebr.
Rosoff, Samuel R., Ltd., New York, N. Y.
Ruby Construction Co., Inc., Madisonville, Ky.
Ruch Construction Co., The, Toledo, Ohio.
Rupert Construction Co., Wilmington, Del.
S & W Construction Co., Inc., Memphis, Tenn.
Sanders Engineering Co., Portland, Maine.
Sargent Machine Co., Inc., Ft. Dodge, Iowa.
Schuyler Holding Corp., Albany, N. Y.
Seattle Engineering Department, Seattle, Wash.
Select Service, Inc., Bayonne, N. J.
Service Supply Corp., Philadelphia, Pa.
Sessinghaus & Ostergaard, Inc., Erie, Pa.
Silent Hoist & Crane Co., Inc., Brooklyn, N. Y.
Silver State Construction Co., Fallon, Nev.
Smith, Paul, Construction Co., Tampa, Fla.
Snare, Frederick, Corp., New York, N. Y.
Soule Construction Co., Portland, Oregon.
South Bend, City of, Engineering Department, South Bend, Ind.
South Carolina State Highway Department, Columbia, S. C.
South Dakota Highway Commission, Pierre, S. Dak.
Springfield, City of, Department of Public Buildings, Springfield, Mass. (General support.)
Springfield, City of, Springfield, Mo.
Star Iron & Steel Co., Tacoma, Wash.
Stecker, G. R., Construction Co., Hazleton, Pa.
Sterling Engine Co., Buffalo, N. Y.
Sterling Excavation & Erection, Inc., Columbia, Mo.
Stock Construction Corp., New York, N. Y.
Stone & Webster Engineering Corp., Boston, Mass.
Strandberg, L. B., & Son Co., Chicago, Ill.
Sullivan, Long & Hagerty, Bessemer, Ala.
Superior Construction Co., Gary, Ind.
Swanson, Arnold, & Co., Hastings, Nebr.
Teer, Nello L., Co., Durham, N. C.
Tellepsen Construction Co., Houston, Tex.
Terpening & Sons, Ferndale, Wash.
Texas Highway Department, Austin, Tex.
Thew Shovel Co., The, Lorain, Ohio.
Thomason, C. Y., Co., Greenwood, S. C.
Tour, Sam, & Co., Inc., New York, N. Y.
Trends, Inc., Cleveland, Ohio.
Triangle Construction Co., Kankakee, Ill.
Unit Crane & Shovel Corp., Milwaukee, Wis.
United Excavating Co., Inc., Linden, N. J.
United States Construction Corp., Anaheim, Calif.
United States Testing Co., Inc., Hoboken, N. J.
Utah Construction Co., The, Richmond, Calif.
Vermont State Highway Department, Montpelier, Vt.
Virginia, Commonwealth of, Department of Highways, Richmond, Va.
Walbridge, Aldinger Co., Detroit, Mich.
Walsh, M. J., & Sons, Inc., Holyoke, Mass.
Walton, J. S., & Co., Mobile, Ala.
Washington Asphalt Co., Seattle, Wash.
Washington, State of, Department of Highways, Olympia, Wash.
Watson, M. W., Topeka, Kans.
Wayne County Road Commissioners, Board of, Detroit, Mich.
Wayne Crane Division, American Steel Dredge Co., Inc., Ft. Wayne, Ind.
Weber, Henry C., Construction Co., Bay City, Mich.
Weill Equipment Co., New York, N. Y.
Weinstein Construction Co., Inc., Akron, Ohio.
Weitz Co., Inc., The, Des Moines, Iowa.
Wellman Engineering Co., The, Cleveland, Ohio.
West Virginia, The State Road Commission of, Charleston, W. Va.
Western Asphalt Co., Seattle, Wash.
Wickes Engineering & Construction Co., Des Moines, Iowa.
Wildes Construction Co., Waterloo, Iowa.
Winston Bros. Co., Minneapolis, Minn.
Winston-Salem, City of, Winston-Salem, N. C.
Woodworth & Co., Inc., Tacoma, Wash.
Zachey, H. B., Co., San Antonio, Tex.
Ziegler, Wm. H., Co., Inc., Minneapolis, Minn.

UNITED STATES GOVERNMENT

Agriculture, U. S. Department of, Division of Purchase, Sales and Traffic, Washington, D. C.
Interior, Department of the, Bureau of Indian Affairs, Washington, D. C.
Justice Department, Bureau of Prisons, Washington, D. C.
Navy, Department of the, Bureau of Aeronautics, Washington, D. C.
Veterans Administration, Washington, D. C.

# 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).
12–48. Fuel oils (sixth 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.
17–47. Diamond core drill fittings (fourth edition).
18–29. Hickory golf shafts.
19–32. Foundry patterns of wood (second edition).
20–47 Staple vitreous china plumbing fixtures (fourth 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. (Withdrawn as a commercial standard March 15, 1948)
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.
45–48. Douglas fir plywood (eighth edition).
46–49. Hosiery lengths and sizes (fourth 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.
56–49. Oak flooring (third edition).
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).
60–48. Hardwood dimension lumber (second edition).
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).
73–48. Old growth Douglas fir, Sitka spruce, and Western hemlock standard stock doors (fourth 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.
77–48. Enameled cast-iron plumbing fixtures (second edition).
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.
90–49. Power cranes and shovels.
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.

| CS No. | Item |
|---|---|
| 100–47. | Porcelain-enameled steel utensils (third edition). |
| 101–43. | Flue-connected oil-burning space heaters equipped with vaporizing pot-type burners. |
| 102– . | (Reserved for Diesel and fuel-oil engines). |
| 103–48. | Rayon jacquard velour (with or without other decorative yarn) (second edition). |
| 104–49. | Warm-air furnaces equipped with vaporizing type oil burners (third edition). |
| 105–48. | Mineral wool insulation for low temperatures (second edition). |
| 106–44. | Boys' pajama sizes (woven fabrics) (second edition). |
| 107–45. | Commercial electric-refrigeration condensing units (second edition). (Withdrawn as commercial standard September 4, 1947). |
| 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. |
| 117–49. | Mineral wool insulation for heated industrial equipment (second edition). |
| 118–44. | Marking of jewelry and novelties of silver. |
| (E)119–45.[1] | Dial indicators (for linear measurements). |
| 120–48. | Standard stock ponderosa pine doors (third edition). |
| 121–45. | Women's slip sizes (woven fabrics). |
| 122–45. | Western hemlock plywood. |
| 123–49. | Grading of diamond powder (second edition). |
| (E)124–45.[1] | Master disks. |
| 125–47. | Prefabricated homes (second edition). |
| 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). |
| 129–47. | Materials for safety wearing apparel (second edition). |
| 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. | Testing and rating convectors. |
| 141–47. | Sine bars, blocks, plates, and fixtures. |
| 142–47. | Automotive lifts. |
| 143–47. | Standard strength and extra strength perforated clay pipe. |
| 144–47. | Formed metal porcelain enameled sanitary ware |
| 145–47. | Testing and rating hand-fired hot water supply boilers. |
| 146–47. | Gowns for hospital patients. |
| 147–47. | Colors for molded urea plastics. |
| 148–48. | Men's circular flat and rib knit rayon underwear. |
| 149–48. | Utility type house dress sizes. |
| 150–48. | Hot-rolled rail steel bars (produced from Tee-section rails). |
| 151–48. | Body measurements for the sizing of apparel for infants, babies, toddlers, and children (for the knit underwear industry). |
| 152–48. | Copper naphthenate wood-preservative. |
| 153–48. | Body measurements for the sizing of apparel for girls (for the knit underwear industry). |
| 154– . | (Reserved for wire rope). |
| 155–49. | Body measurements for the sizing of apparel for boys (for the knit underwear industry). |
| 156–49. | Colors for polystyrene plastics. |
| 157–49. | Ponderosa pine and sugar pine plywood. |
| 158–49. | Model forms for girls' apparel. |
| 159–49. | Sun glass lenses made of ground and polished plate glass, thereafter thermally curved. |
| 160–49. | Wood-fiber blanket insulation (for building construction). |

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

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

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