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NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY
(formerly National Bureau of Standards-NBS)

COMMERCIAL STANDARD CS142-65
AUTOMOTIVE LIFTS

Commercial Standard CSI42-65, Automotive Lifts, was withdrawn by the U.S. Department of Commerce on December 9, 1974.

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The following standard was used to replace CS142-65: ANSI Standard BI53.I, Safety Requirements for Construction, Care, and Use of Automotive Lifts.

For assistance and additional information on related standards and/or copies, contact:

American National Standards Institute (ANSI)
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The Automotive Lift Institute (ALI) was the sponsor of the commercial standard can provide further assistance and information.

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(ANSI/ALI ALIS-2001 Standard, Safety Requirements for Installation and Service of Lifts; ANSI/ALI ALOIM-2000 Standard, This American National Standard describes the safety requirements for Operation, Inspection and Maintenance of Automotive Lifts)

7/06

COMMERCIAL STANDARD CS142-65

SUPERSEDES CS142-62

Automotive Lifts

A recorded voluntary standard of the trade published by the U.S. Department of Commerce

WITHDRAWN

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U.S. DEPARTMENT OF COMMERCE

NATIONAL BUREAU OF STANDARDS

Office of Commodity Standards

EFFECTIVE DATE

Having been passed through the regular procedures of the Office of Commodity Standards (formerly the Commodity Standards Division, Office of Technical Services; transferred to the National Bureau of Standards July 1, 1963), and approved by the acceptors hereinafter listed, this Commercial Standard is issued by the U.S. Department of Commerce, effective September 1, 1965.

JOHN T. CONNOR, *Secretary.*

COMMERCIAL STANDARDS

Commercial Standards are developed by manufacturers, distributors, and users in cooperation with the Office of Commodity Standards of the National Bureau of Standards. Their purpose is to establish quality criteria, standard methods of test, rating, certification, and labeling of manufactured commodities, and to provide uniform bases for fair competition.

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Under a similar procedure the Office of Commodity Standards cooperates with industries in the establishment of Simplified Practice Recommendations. Their purpose is to eliminate avoidable waste through the establishment of standards of practice for sizes, dimensions, varieties, or other characteristics of specific products; to simplify packaging practices; and to establish simplified methods of performing specific tasks.

The initial printing of Commercial Standard CS142-65 was made possible through the cooperation of the Automotive Lift Institute, Inc., in securing copies for its members.

Automotive Lifts

(Fifth Edition)

[Effective September 1, 1965]

1. PURPOSE

1.1 The purpose of this Commercial Standard for automotive lifts is to establish minimum standard specifications for hydraulic, hydropneumatic, and mechanically operated automotive lifts. Its purpose is also to promote adequacy and safety in construction and operation; and to provide a basis for fair competition, for enhanced public confidence, and for identification of automotive lifts conforming with the standard.

2. SCOPE

2.1 This standard covers definitions and specifications for automotive lifts in rated capacities up to 75,000 pounds, inclusive.

2.1.1 This standard covers minimum specifications for outside installations as well as inside installations.

2.1.2 This standard covers minimum specifications for automotive lifts powered either by compressed air, oil pumps, or electric motors.

3. DEFINITIONS

3.1 Air-oil tank.—An air-oil tank is a pressure vessel separate from the actuating chamber of the cylinder assembly.

3.2 Bolster.—The bolster is the cross member connecting the load-supporting members (rails or runways) to the lifting means.

3.3 Chassis supports.—Chassis or axle supports are those movable or stationary adapters for accommodating a free-wheel or frame-engaging lift to the vehicle.

3.3.1 Auxiliary support.—An auxiliary support is a special-purpose support designed for accommodating a lift to a specific vehicle or vehicles.

3.4 Chocks, wheel.—Wheel chocks are stops to prevent the vehicle from rolling off a roll-on-type lift. They are of three kinds:

(a) Automatic, (b) manual, (c) permanent.

3.4.1 Chock, automatic.—An automatic chock is a wheel stop operated automatically by raising or lowering of the lift.

3.4.2 Chock, manual.—A manual chock is a wheel stop positioned by hand.

3.4.3 Chock, permanent.—A permanent chock is a vehicle wheel stop permanently affixed to the runway at the end of runway opposite to the approach end.

3.5 Cylinder (casing).—The cylinder is the casing in which the plunger operates.

3.6 Free-wheel rails (beams).—The free-wheel rails are the load-supporting members connected by bolster or cross member to the lifting means.

3.7 Guide bearings.—Guide bearings are the bearings which preserve the vertical alinement of the plunger.

3.8 Lift, automotive.—An automotive lift is a vehicle-lifting device, the purpose of which is to raise an entire vehicle to provide accessibility for convenient under-chassis service. There are two principal types:

(a) Hydraulic lift, (b) mechanical lift.

3.8.1 Lift, hydraulic.—A hydraulic lift is a vehicle-lifting device which employs one or more plungers actuated by a liquid under pressure encased in a cylinder or cylinders, plunger or plungers equipped with suitable load-carrying members; the pressure being generated by compressed air, by pump, or other suitable means. Hydraulic lifts may be made in either of two classes:

(a) Full hydraulic, (b) hydropneumatic (semihydraulic).

3.8.1.1 Lift, full hydraulic.—A full hydraulic lift is an automotive lift of the plunger type that employs a liquid under pressure as the direct lifting and load-sustaining agent. Such a lift is so designed and constructed that the full weight of the load and the lifting assembly rest on a continuous column of liquid which extends from the cylinder to the liquid-control valve.

3.8.1.2 Lift, hydropneumatic (semihydraulic).—A hydropneumatic lift is an automotive lift of the plunger type which employs compressed air as the primary lifting and load-sustaining agent; such compressed air acts continuously against a column of liquid to provide the lifting and load-sustaining effort.

3.8.2 Lift, mechanical.—A mechanical lift is an automotive lift so designed that the motive power is transmitted to the lifting frame by mechanical means. It is divided into three principal classes:

(a) Cable and drum, (b) rack and pinion, (c) screw.

3.9 Lift, frameless suspension type.—A frameless suspension type lift is one so designed that the vehicle is raised from above and the lifting members are attached directly to the automobile.

3.10 Lift, frame-engaging type.—A frame-engaging type lift is one which engages the frame or body structure of the vehicle in raising and supporting it.

3.11 Lift, free-wheel type.—A free-wheel type lift is one which engages the axles or other wheel suspension members of the vehicle in raising and supporting it.

3.12 Lift, roll-on type (drive-on).—A roll-on type lift is one on which a vehicle is raised or supported on its tires or wheels.

3.13 Manufacturer.—A manufacturer is a prime fabricator of automotive lifts who affixes his trade mark or trade name to his product and maintains standards of uniformity in his production of designated models.

3.14 Packing.—The packing is the means of confining the liquid under pressure between the plunger and cylinder casing.

3.15 Plunger.—The plunger of a hydraulic lift is the moving member of the cylinder assembly which raises, lowers, and supports the load.

3.16 Plunger stop.—A plunger stop is a means provided for limiting the vertical travel of a plunger.

3.17 Power unit.—The power unit of a mechanical lift is the prime mover, which, by mechanical means, applies power for raising the vehicle.

3.18 Pressure heads (cylinder and plunger).—Pressure heads are fixed ends of plungers and cylinders subject to fluid pressure.

3.19 Pumping unit.—A pumping unit is a device that supplies liquid under pressure for actuating the plunger or plungers of a hydraulic lift.

3.20 Ramp.—A ramp is the inclined approach to a runway of a roll-on lift.

3.21 Rated capacity.—The rated capacity is the maximum live load for which the lift is designed and labeled with adequate provisions for safety as prescribed herein.

3.22 Runways.—Runways are the load-supporting members of a roll-on type lift connected by the bolster or cross member to the lifting means.

3.23 Speed control.—The speed control is an automatic device to control the speed of ascent or descent.

3.24 Toe clearance.—Toe clearance is the clear space provided along the lower edge of the outside of the runways for the protection of the operator's feet.

3.25 Transmission.—A transmission is the gear reduction train assembly of a mechanical lift.

3.26 Travel (Stroke).—The actual distance the plunger travels from its lowest to its highest point when attached to the superstructure.

4. GENERAL REQUIREMENTS

4.1 Electric equipment.—All electric wiring, when furnished, shall be in accordance with the National Electrical Code for ordinary locations.

4.2 Control mechanism.—The direct control device shall be of a type that will automatically return itself to the neutral or "off" position upon release by the operator for any cause.

4.3 Chocks.

4.3.1 Automatic chocks.—Automatic chocks shall be provided on the approach ends for roll-on runways to a minimum number of two per end of lift, and shall operate to lock in the first 12 inches of ascent and not unlock automatically before the last 12 inches of descent. The automatic chocks shall be of sufficient width to extend from a point 2½ inches from the inner flange of the runway to within 2½ inches of the outer flange of the runway measured on the flat.

4.3.2 Permanent chocks.—Where a roll-on lift is installed with one approach end only, the opposite end shall be equipped with permanent chocks. Width of permanent chocks shall be not less than is required for automatic chocks.

4.3.3 Manual chocks.—It is not intended to prohibit the use of manual chocks when used in addition to or in combination with automatic chocks.

4.4 Toe clearance.—The toe clearance for roll-on runways, except the ends, shall be not less than 4 inches in depth and 2 inches in height.

4.5 Ramps.—The approach ramp angle or slope shall not exceed 20°.

4.6 Chassis or axle supports.—The supports shall be constructed of structural steel or other suitable nonbrittle metal, except when subjected to compression only. Chassis or axle supports consisting of an over-balance type adapter or pad which can be erected or rotated about a hinge or pivot, shall be positioned, when fully erected, a minimum of 105 degrees from the retracted position. Adapters or pads, not of the over-balance type, shall be positioned not more than 75 degrees from the plane of the fully-retracted position, and shall be supported by a strut or other triangular means in any position except the fully-retracted position. (See fig. 1.) Chassis or axle supports

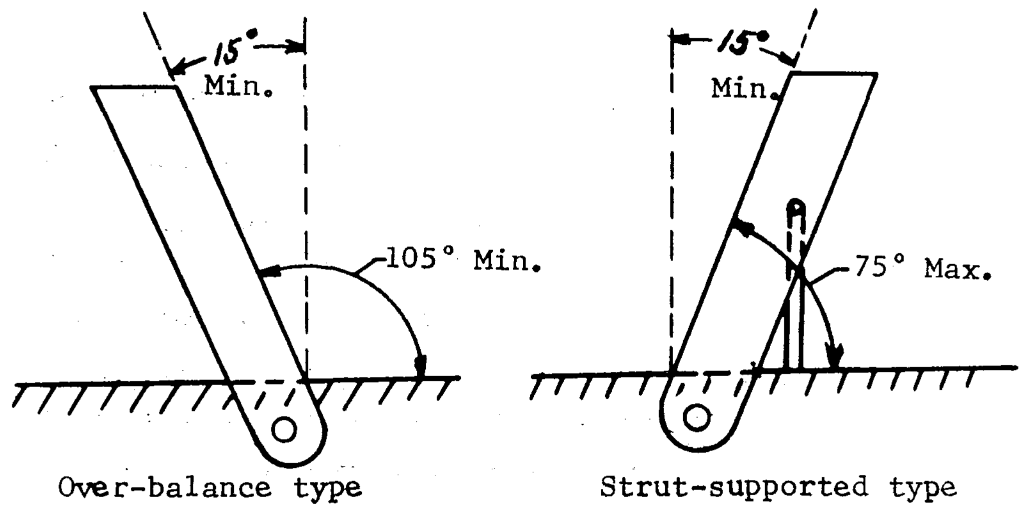

FIGURE 1. *Adaptor support measuring points.*

other than auxiliary supports shall be designed and rated for one-fourth the capacity of the lift. Auxiliary supports, where furnished, may be designed for lower capacities provided they are permanently marked to show their respective designed capacities and with the word "auxiliary". When supports of the overhanging or cantilever type are used, the additional bending or torsional stresses shall be included in the computations for design of bolster members and longitudinal members as given in 5.1.7.1, 5.1.7.2, 5.1.7.3, and 5.1.7.4. These computations shall be made on the basis of the rated capacity of the supports, with the points of support located 3 inches in from the ends of the longitudinal members.

4.7 Vehicle positioning means.—A suitable wheel-spotting indicator or other device physically contacting the vehicle, for positioning the vehicle longitudinally over the lift's superstructure, shall be furnished with each frame-engaging lift. Such device shall be suitable for installation in a position either protruding above or depressed below the floor level.

4.8 Non-rotating device.—Each frame-engaging lift shall be equipped with a device that prevents rotation of the plunger and superstructure during either ascent (raising) or descent (lowering) of the lift.

5. DETAIL REQUIREMENTS

5.1 Hydraulic Lifts

5.1.1 Plunger.—The plunger shall be of steel and if subjected to fluid pressure shall be designed for working pressure (in no case less than 200 psi) required at maximum rated capacity to satisfy the conditions described in 5.1.1.1, 5.1.1.2, and 5.1.1.3. Where the hydraulic system is air-oil operated, the working pressure shall not exceed 200 psi.

5.1.1.1 The maximum allowable stresses of the plungers shall be as follows:

Maximum principal stress, $S_{n(max)}=11{,}000$ psi.
Maximum tensile stress, $S_t=11{,}000$ psi.
Maximum compressive stress, $S_c=11{,}000$ psi.
Maximum shear stress, $S_{s(max)}=8{,}000$ psi.

5.1.1.2 The plunger shall be designed to satisfy the following formulas for short eccentrically loaded columns supported at one end:

$$S_{n(max)}=\tfrac{1}{2}(S_p+S_t)+\sqrt{\tfrac{1}{4}(S_p-S_t)^2+S_{pt}^2}$$

$$S_{s(max)}=\sqrt{\tfrac{1}{4}(S_p-S_t)^2+S_{pt}^2}$$

$$S_p=\frac{pd_i}{2t}$$

$$S_t=\frac{P_1}{A}\left(\frac{ed_o}{2r^2}-1\right)-\frac{P_2}{A}+\frac{p\pi d_i^2}{4A}$$

$$S_c=-\frac{P_1}{A}\left(1+\frac{ed_o}{2r^2}\right)-\frac{P_2}{A}+\frac{p\pi d_i^2}{4A}$$

$$S_{pt}=\frac{RQ}{bI}=\frac{\dfrac{RAX_c}{2}}{\dfrac{2t\,(d_o^4-d_i^4)}{64}}=\frac{8P_1e\,(d_o^3-d_i^3)}{3\pi Lt\,(d_o^4-d_i^4)},$$

because $R=P_1e/L$, where:

$S_{n(max)}$=maximum principal stress in pounds per square inch,

$S_{s(max)}$=maximum shear stress in pounds per square inch,

S_p=tangential stress due to fluid pressure in pounds per square inch,

S_t=tensile stress due to combined bending and direct stress in pounds per square inch (see S_c below),

S_c=compressive stress due to combined bending and direct stress in pounds per square inch—note: this stress should be substituted for S_t if thereby larger values of $S_{n(max)}$ and $S_{s(max)}$ are obtained,

S_{pt}=shear stress induced on neutral axis at plunger, in pounds per square inch, due to bending,

p=design pressure in pounds per square inch (200 psi minimum),

d_i=internal diameter of plunger in inches,

d_o=finished outside diameter of plunger in inches,

t=finished wall thickness of plunger in inches,

P_1=eccentric load applied at top in pounds,

P_1e=the maximum moment transmitted in the plunger. This quantity is defined in 5.1.7 for various types of lifts.

P_2=total design capacity load minus P_1=central load in pounds,

e=eccentricity of P_1 in inches, which is the distance from plunger to point of application of eccentric load,

r=radius of gyration of plunger cross section in inches,

A=cross-sectional area of finished plunger in square inches$=\pi(d_o^2-d_i^2)/4$,

R=external shear on plunger or side thrust in pounds at plunger base due to eccentric loading$=P_1e/L$,

L=minimum separation of plunger guide bearings in inches over-all,

Q=static moment of section above plane considered about diameter of plunger in inches, cubed,

$b=2t$,

I=moment of inertia of plunger cross section about diameter axis,

X_c=centroid distance from diameter axis of one-half cross section of plunger$=\dfrac{2(d_o^3-d_i^3)}{3\pi(d_o^2-d_i^2)}$.

5.1.1.3 The formulas in 5.1.1.2 are applicable to semihydraulic designs where fluid pressure exists within the plunger. For full hydraulic applications where fluid pressure is external to the plunger only, there is no head tension term ($p\pi d_i^2/4A$) admissible; accordingly, this term shall be deleted wherever it appears in the formulas for S_c and S_t in computing full hydraulic plunger stresses where the working stroke does not exceed six ($6d_o$) diameters. Where the working stroke is in excess of six diameters ($6d_o$) the semihydraulic formula above shall be used whether the fluid pressure is internal or external.

5.1.2 Allowable stresses (*S*).

5.1.2.1 For load-carrying members subject to fluid pressure the allowable maximum stress shall not exceed one-fifth of the ultimate strength of the material for each type of stress considered, except for steel, which is covered in 5.1.1, above.

5.1.2.2 For load-carrying members not subject to fluid pressure the maximum principal stress ($S_{n(max)}$) shall be computed from the following formula:

$$S_{n(max)}=\tfrac{1}{2}(S_t+\sqrt{S_t^2+4S_s^2}),$$

where:

S_t=tensile stress due to bending or tension, in pounds per square inch,

S_s=shear stress due to induced or direct shear, in pounds per square inch.

The limiting allowable stresses shall be one-third of the ultimate strength of the material for each type of stress considered. For mild steel the following values shall prevail:

$$S_t=20{,}000 \text{ psi} \quad S_s=15{,}000 \text{ psi} \quad S_{n(max)}=20{,}000 \text{ psi}.$$

5.1.2.3 For bolts not subject to shock the allowable tensile stress shall be ¼ of the ultimate strength.

5.1.2.4 For bolts subject to shock use one-half of the value given in 5.1.2.3.

5.1.2.5 Threaded attachments for bolts shall be designed to have strength at least equal to the bolts used.

5.1.3 Minimum finished wall thickness (*t*) for plungers with an outside diameter of less than 12 inches shall be not less than 7/32 inch, and for plungers of 12- to 18-inches outside diameter, inclusive, it shall be not less than 2 percent of finished outside diameter of plunger. Nothing in this paragraph shall be interpreted to permit a thinner section than that determined by the actual stress analysis covered in other paragraphs of this standard.

5.1.4 Fastenings.

5.1.4.1 Guide bearing anchorages.

(1) It has become general practice throughout the industry to fasten the cylinder guide bearing to the cylinder shell either by means of welded anchors consisting of studs in shear, or by means of shear loaded shoulders of a removable type, such as piston rings, bayonet locks, etc. In such cases the shear area of section (A_s) required shall be computed as follows:

$$A_s=\frac{p\pi d_0^2}{4S_s},$$

where S_s is the allowable shearing stress, which shall not exceed one-fifth of the ultimate shear strength of the material.

(2) In cases where plunger impact is taken only by bolts in tension, maximum tensile stress on net bolt area calculated at root diameter of thread at the design thrust load shall not exceed that allowed in paragraph 5.1.2.4.

(3) Where removable guide bearing, stuffing box, or packing gland assemblies transfer impact loads to cylinder shell by shear fastenings, the maximum tensile stress at design pressure in attachment screws, bolts, or studs shall not exceed that allowed in 5.1.2.3 on the net effective area calculated at root diameter of thread.

5.1.4.2 Superstructure fastenings.—Wherever an arrangement or pattern of attachment bolts, screws, or studs securing superstructures to plunger are subjected to stress from eccentric loading, the maximum allowable tensile stress in the most highly loaded fastening in the pattern at rated capacity loading (as per 5.1.1) shall not exceed the limits specified in 5.1.2.3.

5.1.4.3 Welding requirements.

(1) Procedure.

(a) Preparation of base metal.—The edges or surfaces of the parts to be joined by welding shall be prepared by shearing, machining, grinding, or flame cutting, and shall be cleaned of all oil, greases, cutting slag, and excessive amounts of scale, rust, and foreign matter. Particular care shall be taken in preparing, alining and fitting of edges of other parts to be joined to conform to design requirements.

(b) Filler metal.—The filler metal used shall comply with pertinent specifications for filler metal established by the American Welding Society.[1] Where low alloy high strength base metals are used in making groove welds in metal greater than ½ inch thick, welding filler metal shall be of a classification suitable for the higher strength level of the base metal in accordance with AWS Specification A–5.1 for Mild Steel Arc Welding Electrodes or AWS Specification A–5.5 for Low Alloy Steel Welding Electrodes, as applicable.

(c) Weldings.—Each manufacturer or contractor shall be responsible for the quality of the welding done by his organization and shall use only competent men qualified to perform the work required. The current, voltage, and manner of depositing the weld metal shall result in the depositing of sound metal thoroughly fused with the base metal and thoroughly penetrating into the root of the joint. Where multiple pass welding is employed, particular care shall be taken to see that all slag is removed before laying the next successive bead.

(d) Defects.—Shrinkage cracks, cracks in base metal, craters overlapping, incomplete fusion, slag inclusions, and excessive porosity, shall be completely removed by chipping, grinding, or arc or oxygen gouging before depositing additional weld metal. Undercutting and under-size welds shall be corrected by cleaning and depositing additional weld metal. Repair welding shall blend with and have the same appearance as the adjoining welds.

(2) Design.

(a) All inserted flat heads shall be properly welded as described above, with final fillet throat of 1.25 times surrounding shell thickness.

[1] AWS-ASTM specifications for Mild Steel Arc Welding Electrodes, issued by the American Welding Society, 33 West 39th St., New York, N.Y., 10018, and American Society for Testing and Materials, 1916 Race St., Philadelphia, Pa., 19103. (AWS designation A–5.1; ASTM designation A–233.)

(b) For joints loaded by fluid pressure the allowable stress shall conform to Table 1.

TABLE 1.—*Allowable stresses in welds loaded by fluid pressure. (Except air-oil tanks, see 5.1.13)*

Description of weld	Allowable stress
	Psi
Single "V", square groove, butt joints for girth or head seams	6750
Fillet joints for girth or head seams	6750
Single "V", square groove, butt joints for longitudinal seams	6750

(c) Permissible unit stresses in welded joints constructed of mild steel base material and filler metal shall be in accordance with Table 2.

TABLE 2.—*Allowable stresses in welds not subject to fluid pressure.*

Kind of stress	Permissible unit stress *psi*
Tension, compression, or shear on section through throat of butt weld.	Same as corresponding stress for base metal.
Shear on section through throat of fillet weld, or on faying surface area of plug or slot weld.	13,600.

NOTES

(a) Fibre stresses due to bending shall not exceed the values above for tension and compression, respectively.

(b) Stress in a fillet weld shall be considered as shear on the throat, for any direction of the applied stress. The effective throat thickness of any equal-leg 45° fillet weld is 0.707 times the normal leg size of the weld.

(c) The effective throat thickness of a complete-penetration butt weld shall be the thickness of the thinner part joined.

(d) The effective throat thickness of an incomplete-penetration butt weld shall be considered as not more than 75% of the thickness of the thinner part joined.

(e) Where alloy electrodes producing weld metal of higher strength are used for making groove welds, the allowable stress shall be increased by the ratio representing the proportion of ultimate strength of the weld metal to 60,000 psi for mild steel electrodes.

(d) Where inset cylinder or plunger head joints are to be made, the head shall be inset at least $2t$ below the end, where t is the wall thickness of the shell.

5.1.5 Cylinder (casing).—The wall thickness of cylinder shall be figured in accordance with the following formula for thin, cylindrical pressure vessels, and designed for the working pressure (in no case less than 200 psi) required at the maximum rated capacity, with a maximum allowable fiber stress of 11,000 psi for steel:

$$T=\frac{Rp}{S},$$

where:

T=thickness of shell plate in inches,
R=inside radius of shell in inches,
p=design pressure (200 psi minimum),
S=maximum fiber stress in shell plate, in pounds per square inch.

The cylinder or casing shall have a minimum nominal wall thickness of $\frac{7}{32}$ inch.

5.1.6 Pressure heads.

5.1.6.1 The pressure heads of cylinders and immersed plungers shall be designed for the working pressure (in no case less than 200 psi) in accordance with the following formulas, except that steel heads shall in no case have a thickness of less than the required thickness of the adjoining shell.

(1) For flat unreinforced heads of steel and subject to fluid pressure loads only—

$$T=d_i\sqrt{\frac{Kp}{S}},$$

where $K=0.25$. Where the superstructure is attached to the pressure head (see 5.1.6.4), use $K=0.50$.

(2) For dished seamless heads concave to pressure, where l is not greater than d_i,

$$T=\frac{5pl}{6S},$$

where:

T=thickness of heads, in inches,
d_i=diameter of head between the supporting edges in inches,
p=design pressure (200 psi minimum),
S=maximum allowable fiber stress, 11,000 psi for steel,
l=radius to which head is dished, measured on concave side of head, in inches.

(3) For heads made of material other than steel, the above formulas, 5.1.6.1 (1) and 5.1.6.1 (2), shall apply when a value of S is substituted which does not exceed one-fifth of the ultimate tensile strength, in pounds per square inch, of the material.

5.1.6.2 Dished heads convex to pressure shall have a maximum allowable working pressure equal to 60 percent of that for heads of the same dimensions with the pressure on the concave side.

5.1.6.3 Reinforced flat heads, when used, shall have strength equivalent to dished heads, concave to pressure.

5.1.6.4 For flat, unreinforced pressure heads with added integral bolt holes, studs, or other fastenings, T shall be derived in accordance with 5.1.6.1.

5.1.6.5 Wherever plungers are not immersed and carry bottom sealing plunger head, the plunger may be considered a static load member subject to the stresses allowed in 5.1.2.2, and the plunger head shall be considered under 5.1.2.1 and all foregoing sections of 5.1.6.

5.1.7 Superstructure design.—The superstructure components shall be designed in accordance with the stress limits of paragraph 5.1.2.2 on the basis of the following:

5.1.7.1 Free-wheel and roll-on types (single plunger).—Free-wheel rails and roll-on runways shall be designed for a maximum loading of one-fourth of the rated capacity, with this load located at a point 3 inches in from the extreme end of each load-supporting member (rail), and with the cantilever considered as having free unsupported length from the bolster to the point of loading. The bolster shall be designed for a combined bending and torsion resulting from four equal loads, each ¼ of rated capacity situated on lifting members or extensions thereto, so that resultant of such loading falls on longitudinal centerline but off plunger center by an amount equal to ⅛ the length of superstructure, and this moment shall be taken as value of P_1e in the plunger design.

5.1.7.2 (a) **Free-wheel and roll-on type (multiple plunger, connecting rail type).**—The cantilever ends of free-wheel rails and roll-on runways for multiple-plunger connecting-rail type lifts, shall be designed for a loading of ¼ of the rated capacity with this load located 3 inches in from the extreme end of each rail. The rails or runways shall also be designed for bending between plungers, under a load on each rail of ¼ the rated capacity, concentrated at a point ¼ the distance between plungers. The bolster shall be designed for combined bending and torsion, if any, under either type of loading.

(b) **Free-wheel (multiple plunger, independent rail type).**—The cantilever ends of each superstructure shall be designed with a loading derived from the maximum centered, or rated load of the plunger. This rated load shall be moved outwardly, in the direction of cantilever, to provide a maximum eccentric moment P_1e limited by the resulting stresses in the plunger, bolted attachment, and superstructure as given in 5.1.1.1, 5.1.2.2, and 5.1.4.2. As the eccentricity e increases, the load P_1 shall be reduced so as to maintain the constant maximum eccentric moment.

(c) **Free-wheel type (multiple plunger, rail-less type).**—The lifting cross-member of rail-less type lifts shall be designed for a loading of ½ the rated capacity of the respective plunger located at the extreme ends of the cross-member or extensions thereto.

(d) **Roll-on type (laterally positioned multiple plunger).**—Roll-on runways shall be designed for a loading of ¼ of the rated capacity located at a point 3 inches in from the extreme end of each load supporting member, and with the cantilever considered as having free unsupported length from the outside diameter of the plunger to the point of loading. The stabilizer mechanism or device shall be designed for a differential or loading between lifting members of ¼ the rated capacity. The plunger attachment means shall be designed in accordance with 5.1.7.1 with the eccentric moment divided equally between the plungers.

5.1.7.3 Frame-engaging lifts (single plunger).—The superstructure rails or lifting members of frame-engaging lifts shall be designed as a cantilever with a free unsupported length to the load-supporting point, under a loading of 4 equal loads, each one-fourth of the rated capacity, with the loads located at points 3 inches in from the extreme ends of each load-supporting member including pads and/or extensions thereto. The bolster, if any, shall be designed for combined bending and torsion resulting from 4 equal loads each one-fourth of rated capacity situated on lifting members and/or pads or extensions so that the resultant of such loading falls on the longitudinal centerline 7 inches off center, and this moment shall be taken as the value of P_1e in the plunger design.

5.1.7.4 Frame-engaging lifts (multiple plunger).—The superstructure rails or lifting members of multiple plunger frame-engaging lifts shall be designed as a cantilever in accordance with the loading specified in 5.1.7.3. The stabilizer mechanism or device shall be designed for a differential of loading between lifting members of ¼ the rated capacity. The eccentric moment P_1e in the plunger design and attachment of superstructure shall be determined by whichever of the following two conditions provides the greater moment: (1) The longitudinal moment to be divided between each plunger resulting from four equal loads each ¼ of rated capacity situated on lifting members and/or pads or extensions so that the resultant of such loading falls on the longitudinal centerline seven inches off center, or (2) the lateral moment in one plunger resulting from ½ the rated load, divided between two lifting arms or extensions which are moved outward laterally to a maximum rated width position, multiplied by the perpendicular distance of such load from the longitudinal plunger centerline.

5.1.7.5 For single plunger and mechanical lifts of 8,000 pounds capacity (for standard passenger automobiles) the length of free-wheel rails shall be not less than 14½ feet. Roll-on runways shall be not less than 15 feet in length. For frame-engaging lifts the minimum overall length of longitudinal members shall be 48 inches.

5.1.7.6 For roll-on lifts, except for lifts with laterally adjustable runways, the runways shall be so designed that the flat surfaces on which the vehicle is driven are not less than 15 inches wide across the flat section, exclusive of reinforcement flanges. The height of the inside wheel flange shall be not less than 1½ inches, except for a distance of 5 feet at each end. The runways shall be so designed that the tires of the vehicle will not contact sharp edges.

5.1.8 **Lowering speeds.**—The maximum lowering speed of a hydraulic lift shall be controlled by a valve, orifice, or passage restriction, mounted on or placed integral in the cylinder assembly to restrict the flow of oil exchange to storage when the plunger descends at the maximum rate of 20 fpm with rated load, so that if failure occurs in hydraulic piping, the lift will descend no faster than at the above safe rate.

5.1.9 **Bearings.**

5.1.9.1 **For plungers subjected to eccentricity of loading in excess of 12 inches,** the minimum overall length of plunger bearing, or the minimum overall distance across plunger bearing surfaces from top of upper bearing to bottom of lower bearing, where the bearing surface is not continuous, shall be not less than two times the outside diameter of the plunger for sizes less than 12 inches in diameter. For plungers 12 to 18 inches, inclusive, in diameter, the ratio shall be not less than one and one-half times the outside diameter of the plunger.

5.1.9.2 **For plungers subjected to eccentricity of loading of not more than 12 inches,** the minimum overall length of plunger bearing, or the minimum overall distance across plunger bearing surfaces from the top of upper bearing to bottom of lower bearing, where the bearing surface is not continuous, shall be not less than one and one-half times the outside diameter of the plunger for sizes up to 18 inches, inclusive, in diameter.

5.1.10 **Packings.**—The packings shall be easily removable for replacement and arranged to provide either automatic or manual adjustment to compensate for normal wear.

5.1.11 **Pumping unit.**—The pump shall be designed to withstand a static test pressure of not less than 150 percent of that required to raise the lift when loaded to rated capacity. A pressure regulator or a relief valve shall be provided, factory set at a pressure no more than the maximum design pressure of the hydraulic system. The pump motor when loaded at rated lift capacity shall not exceed the pump motor manufacturer's recommended loading for short period operation. The pump reservoir capacity shall be such that with the plunger or plungers in a fully elevated position there shall remain not less than 3 inches of usable oil in the storage tank.

5.1.12 **Air pocket elimination.**—If air pockets which interfere with safe operation due to entrapped air are not automatically eliminated, a positive means for conveniently venting same shall be provided.

5.1.13 **Air-oil tanks.**—All separate tanks for liquid storage under pressure, when not an integral part of the cylinder assembly, shall comply with the provisions of the 1952 edition of the ASME [2] Unfired Pressure Vessel Code for a working pressure of 200 psi. The storage capacity shall be such that, with the plunger or plungers in full elevated position, there shall remain not less than 3 inches of usable oil in the storage tank. Adequate means shall be provided for determining that the oil level in the reservoir, with plunger or plungers in the lowest position, is at or above the manufacturer's prescribed safe minimum operating level.

5.2 **Mechanical Lifts**

5.2.1 **Structural members.**—All structural members except rails and runways shall be so designed that when the lift is loaded to full capacity, the allowable maximum fiber stress shall not exceed one-third of the ultimate tensile strength of the material.

5.2.2 **Load transfer device.**—Every mechanical four-post lift shall be equipped with adequate safety devices that, in case of failure of elevating mechanisms when the frame is at the top position, will automatically transfer the load to the corner posts.

5.2.3 **Limit stop.**—Every mechanical automotive lift shall be equipped with a device that automatically causes the motor to stop before the lifting frame reaches the safe limits of travel.

5.2.4 **Holding brake.**—Every mechanical automotive lift in which the friction of the gear train is insufficient to hold the load shall be equipped with a brake of adequate friction to hold a load of rated capacity. This brake shall be so designed that it automatically holds the load at any point as soon as lifting ceases for any cause.

5.2.5 **Lowering speed.**—Every mechanical automotive lift shall be equipped with a device that will control the descent of the lift so that it will not exceed a speed of 20 fpm with rated capacity load.

5.2.6 **Stopping brake.**—Every mechanical automotive lift having structural members that will interfere with an open door of a vehicle while it is being raised, shall be equipped with a quick-acting automatic device that will stop the ascent of the vehicle on contact with an obstruction.

5.2.7 **Cable and drum class.**

5.2.7.1 **Wire cables.**—If wire rope or cables are used, they shall be of such strength as to support the lifting frame loaded to full capacity, with a factor of safety not less than that recommended by the manufacturer of the wire cables used. In establishing this factor of safety, the fleet angle, the number of bends, reverse bends, and drum and sheave ratio to rope diameter shall be taken into consideration.

5.2.7.2 **Drums.**—On all lifts operated by means of wire rope or cables, the drums shall have a pitch diameter not less than that recommended by the manufacturer of the wire cables used. The drums shall be grooved to support the cables. The fleet angle of the cable and the helix angle of the drum grooves shall be of such proportions that the cable at no time will contact the cable in the adjacent groove nor contact the flares of the groove itself.

5.2.7.3 **Sheaves.**—On cable-operated lifts, the pitch diameter of the sheaves for lifting cables shall be not less than that recommended

[2] The American Society of Mechanical Engineers.

by the manufacturer of the wire cables used. The grooves in the sheaves shall be so designed as to properly support the cable. The depth of the groove shall be at least one and one-half times the cable diameter and the throat angle of the groove shall be of such dimensions that the cable will at no time contact the flares.

5.2.8 **Rack and pinion class.**

5.2.8.1 **All lifting members** shall have a safety factor of not less than 3 to 1.

5.2.8.2 **The rack engagement** shall be so designed that same will be released when obstruction on the floor prevents downward movement of lifting frame.

5.2.9 **Screw class.**

5.2.9.1 **Either the screw** or nut may rotate to lift load.

5.2.9.2 **Automatic lubrication** shall be provided to keep screw well lubricated.

5.2.10 **Transmissions.**—The gears for the transmission shall be so designed that the beam stress in no case exceeds one-half of the yield point of the material. Consideration shall be given to the dynamic load and the wear limit load.

5.2.11 **Rails and runways.**—Same as for hydraulic lifts. See 5.1.7.

5.3 **Frameless suspension Lifts**

5.3.1 **A frameless suspension lift** may be hydraulically or mechanically operated and the mechanisms shall comply with either hydraulic or mechanical prime movers as outlined in the appropriate specifications for automotive lifts of these types.

5.3.2 **Flexible lifting means,** if used, shall be stabilized against excessive lateral movement when in maximum up position.

5.3.3 **A safety device** shall be provided on each supporting member which will hold the load independent of the lifting means at maximum up position.

6. TESTS

6.1 Cylinders (casings) and plungers or hydraulic lift cylinder assemblies shall be pressure tested at a pressure of not less than 150 percent of maximum rated operating pressure, and in no case at less than 300 psi.

7. IDENTIFICATION

7.1 The name of the manufacturer, model number, serial number, and rated capacity shall be shown in a conspicuous place on each automotive lift.

7.2 In order that buyers may be assured that automotive lifts purchased actually comply with all requirements of this Commercial Standard, it is recommended that manufacturers include the following statement in conjunction with their name and address on labels, invoices, sales literature, etc.:

> This automotive lift complies with all requirements of Commerical Standard CS142-65 as developed under the procedure of the Commodity Standards Division, and issued by the U.S. Department of Commerce.
>
> ------------------------------
> (Name of manufacturer)

7.3 When space limitations require an abbreviated statement, the following is recommended:

Complies with CS142-65

HISTORY OF PROJECT

Earlier editions.—The first edition of this standard was approved for promulgation in 1947 and became effective in that year. Since that time the industry has maintained the standard abreast of changing conditions through revisions, the present one being the fourth. The three previous revisions, with a summary of changes accomplished by each, are designations CS142–51, CS142–58, and CS142–62, respectively.

Current revision.—In a letter dated April 29, 1964, the Automotive Lift Institute, Inc., requested the Office of Commodity Standards to submit to those concerned a revision of CS142–62, dated January 2, 1962. The revision consisted of a change in the section of the standard describing the chassis or axle supports (page 6, paragraph 4.6) to include a feature that would limit the maximum movement of the extender arms when in the over-balanced position so that unsafe conditions of loading are avoided.

The proposed revision was approved by the Standing Committee, and submitted to the acceptors of record for approval. No objections were received and the Office of Commodity Standards issued an announcement August 16, 1965, that the Commerical Standard, designated CS142–65, would become effective September, 1, 1965.

Project Manager: D. R. Stevenson, Office of Commodity Standards, National Bureau of Standards

Technical Advisor: Paul Achenbach, Building Research Division, National Bureau of Standards

STANDING COMMITTEE

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. Comment concerning the standard and suggestions for revision may be addressed to any member of the committee or to the Office of Commodity Standards, National Bureau of Standards, U.S. Department of Commerce, which acts as secretary for the committee.

D. M. Goldzwig, Joyce-Cridland Co., East 1st & Hott Sts., Dayton, Ohio. 45402 (Chairman)

David Laine, Automotive Lift Institute, 366 Madison Ave., New York, N.Y. 10017 (Alternate to Mr. Goldzwig)

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A. T. Browne, Globe Hoist Co., 1000 E. Mermaid Lane, Philadelphia, Pa. 19118

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J. J. Sussen, President, The Sussen Rubber & Supply Co., 3590 Carnegie Ave., Cleveland, Ohio. 44115

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M. R. Cothern, Superintendent of Equipment, The Texas Co., 135 East 42nd St., New York, N.Y. 10017

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Clarence F. Reinhardt, Project Manager, Marketing Facilities, Phillips Petroleum Co., Bartlesville, Okla. 74004

C. E. Gross, United States Air Compressor Co., 5300 Harvard Ave., Cleveland, Ohio. 44105

ACCEPTORS

The manufacturers, distributors, users and others listed below have individually indicated in writing their acceptance of this Commercial Standard prior to its publication. The acceptances indicate an intention to utilize the standard as far as practicable but reserve the right to depart from it as may be deemed desirable. The list is published to show the extent of recorded public support for the standard, and should not be construed as indicating that all products made by the acceptors actually comply with its requirements.

Products that meet all requirements of the standard may be identified as such by a certificate, grademark or label. Purchasers are encouraged to require such specific representation of compliance, which may be given by the manufacturer whether or not he is an acceptor.

ASSOCIATIONS
(General Support)

American Automobile Association, Washington, D.C.
Automotive Lift Institute, Inc., New York, N.Y.
American Specification Institute, Chicago, Ill.

FIRMS AND OTHER INTERESTS

Atlas-Royal Exchange-Sun Groups, New York, N.Y. (General Support)
Autoquip Corp., Chicago, Ill.

Camlet, J. Thomas, Architect & Engineer, Garfield, N.J.
Cochin, J. D., Manufacturing Co., South San Francisco, Calif.
Conrad & Cummings, Associated Architects, Binghamton, N.Y.
Curtis Manufacturing Co., St. Louis, Mo.

Detroit, City of, Department of Public Works, Detroit, Mich.
Dover Corp., Rotary Lift Division, Memphis, Tenn.

Eaton Metal Products Co., Denver, Colo.

General Motors Corp., Service Section, Detroit, Mich.
Gilbert & Barker Manufacturing Co., West Springfield, Mass.
Globe Hoist Co., Philadelphia, Pa.

Habhegger, E. O., Co., Philadelphia, Pa.

Joyce-Cridland Co., Dayton, Ohio

Lange Lift Co., Milwaukee, Wis.
Long Reach Machinery Works, Division Anderson, Clayton & Co., Inc., Houston, Tex.

McCullough, J. H., & Son, Philadelphia, Pa.
Mountjoy Co., San Antonio, Tex.

Parish, Archie G., St. Petersburg, Fla.
Phillips Petroleum Co., Bartlesville, Okla.
Post, Geo. B., & Sons, New York, N.Y.

Quick-Way Engineering Works, Inc,. Milledgeville, Ill.

Rowe Methods, Inc., Cleveland, Ohio
Russell, J., & Co., Inc., Holyoke, Mass.

Sears, Roebuck & Co., Chicago, Ill.
Severin Supply Co., Oklahoma City, Okla.
Stoetzel, Ralph, Inc., Architects-Engineers, Chicago, Ill.
South Carolina, State of, Highway Department, Columbia, S.C.
Southeastern Elevator Co., Inc., Atlanta Ga. (General Support)
Stanray Corp., Chicago, Ill. (General Support)
Sterling Fleischman Co., Inc., Morton, Pa.
Sun Oil Co., Philadelphia, Pa.
Sussen Rubber & Supply Co., Cleveland, 15, Ohio

Texaco, Inc., Construction & Equipment Division, New York, N.Y.

Ulrich Manufacturing Co., Roanoke, Ill.
Union Oil Company of California, Los Angeles, Calif.
United States Air Compressor Co., Cleveland, Ohio
United States Testing Co., Inc., Hoboken, N.J.

Wayne Pump Co., Division of Symington Wayne Corp., Salisbury, Md.
Weaver Manufacturing Division, Dura Corp., Springfield, Ill.
Western Electric Co., Chicago, Ill.
Western Electric Co., New York, N.Y.
Western Manufacturing Co., San Jose, Calif.
Witmer, Maurice E., Architect, Portsmouth, N.H.

U.S. GOVERNMENT

Atomic Energy Commission

Post Office Department

Treasury Department

Veterans Administration

ACCEPTANCE OF COMMERCIAL STANDARD
CS142-65 Automotive Lifts

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____________________

WITHDRAWN

Commodity Standards Division
Office of Technical Services
Business and Defense Services Administration
U. S. Department of Commerce
Washington 25, D. C.

Gentlemen:

We believe that this Commercial Standard 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 this commodity.

We reserve the right to depart from the standard 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.

Signature of authorized officer____________________
(In ink)

(Kindly typewrite or print the following lines)

Name and title of above officer____________________

Organization____________________
(Fill in exactly as it should be listed)

Street address____________________

City, zone, and State____________________

[1] Underscore the applicable words. 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 interest, trade associations, trade papers, etc., desiring to record their general support, the words "General support" should be added after the signature.

(Cut on this line)

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 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 nationwide 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 of the Department of Commerce, the support of any standard is inadequate, the right is reserved to withhold promulgation and publication.

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