SAE The Engineering Society For Advancing Mobility Land Sea Air and Space®
INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

SURFACE VEHICLE STANDARD

SAE J1142 | REV. JUN91

Issued 1976-07
Revised 1991-06-10

Superseding J1142 JAN90

Submitted for recognition as an American National Standard

(R) TOWABILITY DESIGN CRITERIA AND EQUIPMENT USE—PASSENGER CARS, VANS, AND LIGHT DUTY TRUCKS

1. ***Scope***—The purpose of this SAE Recommended Practice is to provide guidelines for equipment usage and the design of vehicles to minimize damage in the towing of vehicles up to 4173 kg (9200 lb) GVWR in the event of disablement.

   NOTE—See 2.2 for glossary.

2. ***References***

2.1 Applicable Documents—The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply.

2.1.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J179—Labeling—Disc Wheel and Demountable Rims—Trucks
SAE J208—Safety for Agricultural Tractors
SAE J254—Instrumentation and Techniques for Exhaust Gas Emissions Measurement
SAE J274—Rated Suspension Spring Capacity
SAE J284—Safety Alert Symbol for Agricultural, Construction, and Industrial Equipment
SAE J670—Vehicle Dynamics Terminology
SAE J687—Nomenclature—Truck, Bus, Trailer
SAE J695—Turning Ability and Off Tracking—Motor Vehicles
SAE J706—Rating of Winches
SAE J743—Pipelayers and Side Booms, Tractor—Mounted—Specifications and List
SAE J853—Vehicle Identification Numbers
SAE J980—Bumper Evaluation Test Procedure—Passenger Cars
SAE J1041—Brake Test Procedure and Brake Performance Criteria for Agricultural Equipment
SAE J1085—Test for Dynamic Properties of Elastomeric Isolators
SAE J1143—Towed Vehicle/Tow Equipment Attachment Test Procedure—Passenger Cars, Vans, and Light Duty Trucks
SAE J1213—Glossary of Reliability Terminology Associated With Automotive Electronics
SAE J1229—Truck Identification Terminology
SAE J1451—A Dictionary of Terms for the Dynamics and Handling of Single Track Vehicles (Motorcycles, Mopeds, and Bicycles)
SAE J1473—Braking Performance—Rubber-Tired Earthmoving Machines

Printed in U.S.A.

2.1.2 FEDERAL PUBLICATIONS—Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

Federal Motor Carrier Regulations 393.70 and 393.71

Federal Highway Administration Title 49, Section 393.102(b), Securement Systems

Federal Highway Administration Title 49, Section 393.106, Front-end Structure

2.2 Glossary of Terms

ABOVE CAB CARRIER: A platform above the cab, which may be in a fixed or hydraulically adjustable position, for transporting vehicles.

AERO-SKIRTING: Aero-designed panels attached to lower side, or surrounding the lower side of the vehicle (see AIR DAM, FASCIA, VALENCE, AND CLADDING).

AIR DAM: Flexible air deflecting panel usually located below radiator support.

AIR RESISTANCE: A measure of the "drag" on a vehicle moving through air. Air resistance increases as a square of the speed, thus power requirements increase much faster than vehicle speed.

AMBIENT TEMPERATURE: The temperature of the environment surrounding the test specimen. (SAE J1085)

ANCHORING DEVICE: Used to attach cable ends, snatch blocks, safety chains, and tie-down assemblies to the towing vehicle.

APPROACH ANGLE: Angle between the plane of the platform and the ground.

AUXILIARY EQUIPMENT: Equipment that is not necessary to perform the basic function of the primary equipment.

AUXILIARY FUEL TANKS: Fuel tanks installed in addition to the standard equipment tank.

AUXILIARY TOWING LIGHTS: Stop, tail, and turn signal lights attached to the trailing end of the towed vehicle operated as part of the towing vehicle lighting system.

AXLE (DEAD): A dead axle is merely a means of support for the wheels at each end. This is contrasted to a "live" axle which is connected to the wheels and rotates with the wheels."

AXLE (DRIVE): Axle designed to support a portion of the vehicle weight and to transmit a driving force to the wheels. (SAE J687c)

AXLE (TANDEM): Any group of two or more axles, any of which may be powered, and/or steering, and which are attached one behind the other to the same vehicle and associated through a mechanism designed to provide a specific relationship between loading. (SAE J687c)

B.A. (BUMPER TO AXLE): The distance from the foremost point on the front bumper to the centerline of the front axle. See chassis manufacturer's dimensions.

BAFFLE: A plate or shield used for deflecting, checking, or regulating the flow of liquids, gases, or air.

BARREL: A cylindrical component of the hydraulic cylinder (piston chamber).

BATTERY: A DC voltage source which converts chemical, nuclear, thermal, or solar energy into electrical energy. (SAE J1213)

B.B.C. (BUMPER TO BACK OF CAB): The distance from the foremost point on the front bumper to the back of the cab. See chassis manufacturer's dimensions.

BENDING MOMENT: The force times the distance from a reference point to the point the force is applied causing bending.

B.H.P.: Brake Horsepower.

BODY: The structure mounted on a chassis cab or that portion of the vehicle that carries the load.

BODY HINGE: The attachment mechanism connecting the body to the hinge pin at the pivot axis about which the body rotates into the tilt position.

BODY SUBFRAME: Another term for body understructure or mounting subframe.

BODY UNDER STRUCTURE: Crossmembers and longitudinal members under body floor.

BODY WEIGHT: Unmounted weight of body with applicable options.

BOGIE AXLE: Two rear axles (three axles placed together is sometimes referred to as a tri-axle tandem). There are three tandem axle drive types.

a. Dual Drive Tandem: Both axles have drive mechanisms and are connected to engine power unit.
b. Pusher Tandem: Only the rearmost axle is driving type and forward unit is free rolling (load carrying only) commonly called "dead axle".
c. Trailing Axle Tandem (Tag Axle): Forward unit of tandem is driving type while rear unit is freely rolling.

BOLSTERS: The transverse members that are used to define the horizontal support for the diagonal braces of a vertical mast.

BOOM: The structural member that supports the load. (SAE J743)

BOOM ANGLE: The boom angle is measured between a horizontal line and a line through the boom pivot and the center of the sheave.

BRAKE, ENGINE: The engine's compression pressure is used for retarding the truck.

BRAKES—PARKING: A system used to hold a stopped machine in a stationary position. (SAE J1473)

BRAKES—SERVICE: The primary brake system used for retarding and stopping the truck. (SAE J1041)

BRIDLE: A V or Y type coupling device used to attach and center a cable in recovery, loading, and unloading operations.

BUMPER SYSTEMS: A system, the primary function of which is to provide protection against damage affecting the performance of front and rear external lamps and other components during low speed impacts, as in vehicle parking maneuvers. (SAE J980a)

C.A. (CAB TO AXLE): This is the distance from the back of the truck cab to the center of the rear axle. See chassis manufacturer's dimensions.

CAB: The driver/passenger carrying compartment.

CAB PROTECTOR: Reference to Federal Highway Administration Title 49, Section 393.106.

CAB CONTROL LEVERS: Control handles to engage power takeoff and hydraulic valve, usually located in truck cab convenient to driver's hand.

CABLE: Steel wire rope used for pulling or support.

CAMBER: The inclination of the wheel plane to the vertical. It is considered positive when the wheel leans outward at the top and negative when it leans inward. (SAE J670c)

CAR CARRIER: Vehicles equipped to transport other vehicles mounted on a flat platform and/or with an additional assembly attached to the rear to facilitate towing a second vehicle. These units are also known as slidebacks, rollbacks, transporting equipment carriers, and flatbeds. (See CARRIER.)

C.G. (CENTER OF GRAVITY): If the vehicle is supported at this point, it will not rotate due to the force of gravity. (SAE J1451)

CARRIER: A platform body with a winch for loading.

CASTER: The angle in side elevation between the steering axis and the vertical. It is considered positive when the steering axis is inclined rearward (in the upward direction) and negative when the steering axis is inclined forward. (SAE J670)

CERTIFICATION LABEL: Required by Public Law 89-563, which states that a motor vehicle or item of motor vehicle equipment complies to all applicable Federal Motor Vehicle Safety Standards (FMVSS) in effect on the date of manufacture.

CHASSIS CAB: A vehicle consisting of a chassis on which is mounted a cab, capable of being driven by the addition of wheels or other items of running gear, but lacking a body or load carrying structure.

CLADDING: See AERO-SKIRTING.

CLASSIFICATION OF TRUCKS BY GROUND CONTACT: Trucks are classified by the number of wheels and the number of driving wheels. If a truck is designated as a 4 × 2, it has four wheels and two driving wheels. A 4 × 4 truck has four wheels and four driving wheels. A 6 × 4 truck has six wheels and four driving wheels. Wheels are considered a unit whether they have single or dual tires.

CLAWS: See WHEEL ARM.

C.O.E. (CAB OVER ENGINE): Cab design where driver is actually as far forward as possible. Engine directly under cab.

COMPLETED VEHICLE: A vehicle that requires no further manufacturing operations to perform its intended function, other than minor finishing operations such as painting.

CONTROL LEVER: A device for imparting motion into control linkage.

CROSSBAR: See LIFT BAR.

CROSS-MEMBERS: General term applied to transverse members in the understructure.

CURB WEIGHT: The weight of a vehicle in operational status, with all standard and commonly installed equipment and the gas tank filled to capacity. (SAE J254)

CYLINDER: A complete hydraulic cylinder assembly.

CYLINDER BASE: End of hydraulic cylinder opposite to header or rod end.

CYLINDER HEAD: End of a hydraulic cylinder through which the piston rod extends. Also called header.

DAMAGE RESISTANCE: Increases in resistance due to damage to the load. See RESISTANCE.

DEFLECTOR: See SNATCH BLOCK.

D-RING: See ANCHORING DEVICE.

DISPLACEMENT: Volume of oil required to extend piston rod through its working stroke. Product of multiplying the area times the length of stroke, usually measured in cubic inches.

DIVERTER VALVE: Auxiliary valve to provide hydraulic power from the hydraulic pump by switching the oil flow from its usual passageways into additional pieces of equipment such as snow plows or other lifting cylinders. Also called diversion or selector valve.

DOLLY: A four-wheeled carriage used in towing to support the trailing end of the towed vehicle.

DOLLY TOWING: Procedure used to support wheels, not supported by sling or wheel-lift towing equipment, that should not touch road surface as damage to driveline may result. (See 3.5.1.)

D.O.T. (DEPARTMENT OF TRANSPORTATION): A Federal Agency dealing with regulations concerning both the manufacture and operation of motor vehicles and motor vehicle equipment. (See BMCS and NHTSA.)

DRIVELINE: The driveshaft and associated joints.

DRIVETRAIN: Combination of a specific transmission (make, model, size, type), a specific differential assembly (make, model, size, type), and a specific driveline, if required.

DYNAMIC APPLICATION: Reference to rating specifications.

ELECTRICAL POWER: Derived from energy produced by electricity. See POWER.

EQUIPMENT CARRIER: See CAR CARRIER.

EXTENSION CYLINDER: Reference to SLIDE BACK EXTENSION CYLINDER.

FASCIA: Flexible material commonly used as a bumper cover (could extend below bumper).

FC (FRAME TO CAB): Distance from the top of the frame rail to the top of the cab.

FINAL STAGE MANUFACTURER: A person, firm, or corporation who performs such manufacturing operations on an incomplete vehicle that it becomes a completed (end-user) vehicle. (SAE J1229)

FMVSS (FEDERAL MOTOR VEHICLE SAFETY STANDARD): Regulations promulgated by NHTSA under Public Law 89-563, which are mandatory and must be complied with when motor vehicles or items of motor vehicle equipment are manufactured and certified thereto.

FRAME CUTOFF: Centerline of rear axle(s) to the rearmost point of the chassis frame as modified for body installation.

FRAME LIFT: See UNDER LIFT.

FREE SPOOL: The operation of unspooling wire rope from a drum by pulling on the end of the rope while the winch is stationary. The drum is disconnected (declutched) from its power train during this operation.

FORKS: A device attached to the lift bar for lifting a vehicle by the tires, axle, frame, or structural member.

FULL DRUM: A drum containing the maximum permissible number of layers of cable as defined in SAE J706, paragraph 3.5.

FW (FRAME WIDTH): Overall width of the chassis frame measured outside-to-outside.

GAWR (GROSS AXLE WEIGHT RATING): The value specified by the manufacturer as the load carrying capacity of a single axle system as measured at the tire-roadway interface. (SAE J1451)

GCWR (GROSS COMBINATION WEIGHT RATING): Represents the entire weight of a vehicle on the ground with a trailer or trailers including vehicle equipment, driver, fuel, and payload (everything that moves with the vehicle). Gross combination weights published represents maximum allowed.

GRAB HOOK: For use with safety chains and some tow sling hookups. (See 3.1.1.)

GRADE RESISTANCE: Increases in resistance due to grade (slope, angle). See RESISTANCE.

GVWR (GROSS VEHICLE WEIGHT RATING): The maximum total vehicle rated capacity, measured at the tire ground interface, as rated by the chassis manufacturer.

GVW (GROSS VEHICLE WEIGHT): Value specified by the manufacturer as the maximum loaded weight of a single vehicle including all equipment, fuel, body, payload, driver, etc. (SAE J1451)

HCG (HORIZONTAL CENTER OF GRAVITY): See C.G. (CENTER OF GRAVITY).

HEADBOARD: Reference to Federal Highway Administration Title 49, Section 393.106.

HYDRAULIC CONTROL VALVE: A mechanical device to divert or control the flow of fluid in a hydraulic system.

HYDRAULIC HOSE: Flexible oil lines used to transmit fluid.

HYDRAULIC OIL: Fluid used in operation of hydraulic systems.

HYDRAULIC POWER: Derived from energy produced by fluid under pressure. See POWER.

HYDRAULIC RELIEF VALVE: A mechanical device used to limit the pressure in a hydraulic circuit.

INCOMPLETE VEHICLE: An assemblage consisting, as a minimum, of a frame and chassis structure, power train, steering system, suspension system, and braking system to the extent that those systems are to be part of the completed vehicle that requires further manufacturing operations.

INTERMEDIATE MANUFACTURER: A facility, other than the incomplete vehicle manufacturer or the final stage manufacturer, who performs manufacturing operations on an incomplete vehicle.

J-HOOK: Attachment device used for towing. (See 3.1.1.)

J.I.C. STANDARD (JOINT INDUSTRY COMMITTEE): An organization set up to standardize hydraulic fittings specifications and symbols.

L-ARM: See WHEEL ARM.

LCG (LATERAL CENTER OF GRAVITY): See C.G. (CENTER OF GRAVITY).

LIFT BAR: A transverse horizontally pivoting member attached to the boom of a wheel-lift or an under lift for attaching frame or wheel-lift devices.

LIFT CYLINDER: See TILT CYLINDER.

LIFT FORKS: See FORKS.

LIFT TOW RATING: Maximum steering towing load. (See 3.2.1.1 and 3.3.2.1.) Refer to towing equipment manufacturer's specifications.

LIGHT BAR: An array of lamps used in accordance with local ordinances.

LIGHT PYLON: Structure on which a light and/or light bar is mounted.

LOAD CELL: A device used to measure a load.

LONGITUDINALS: The lengthwise structural members of the body understructure. Also called long beams, long members, stringers.

MANUFACTURER (VEHICLE): Any facility engaged in the manufacturing or assembling of motor vehicle or motor vehicle equipment, including any facility importing same, for resale as defined by D.O.T. for vehicle certification.

MARKER LIGHTS: Small amber and red lights attached to bodies to indicate overall clearance at night.

MAST: Structure that houses the boom and winches. Also called a winch frame or wrecker frame.

MAXIMUM LOAD RATING—TIRES: The load rating at the maximum permissible inflation pressure for that tire.

MAXIMUM PERMISSIBLE INFLATION PRESSURE—TIRES: The maximum cold inflation pressure to which a tire may be inflated when fitted on the rim or wheel. (SAE J179)

MECHANICAL POWER: Work accomplished by a machine or other mechanical device. The source of power may be energy produced by electricity, hydraulics, or other means, such as an engine. See POWER.

MOTOR VEHICLE SAFETY STANDARDS: See FMVSS.

MOUNTING BRACKETS: Attaching fittings used to fasten equipment to the chassis. Also called mounting clip, angles, or bars.

MOUNTING HEIGHT: Distance from top of chassis cab frame at the back of the cab to a reference point on a body.

MOUNTING SUBFRAME: Subframe members securely affixed to a truck chassis frame. (See BODY SUBFRAME.)

MUD FLAPS: Splash deflecting shields at rear of wheels.

NHTSA (NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION): The federal agency responsible for promulgating and insuring compliance of regulations dealing with the manufacture and certification of motor vehicles or items of motor vehicle equipment. (See DOT.)

OVERHANG: The horizontal distance from the centerline of the rear axle to the point where the vertical component load is imposed.

OVERALL VEHICLE HEIGHT: Distance from the ground to the highest point on the vehicle with equipment in stowed position.

OVERALL VEHICLE WIDTH: The design dimension of the widest part of the vehicle, exclusive of signal lamps, outside rearview mirrors, flexible fender extensions, and mud flaps, determined with doors and windows closed and the wheels in the straight ahead position.

PICKUP CHAINS: See TOW CHAINS.

PLATFORM: Load carrying bed with or without removable sides. May be supplied with hydraulic cylinders to tilt and slide platform. (See CAR CARRIER.)

POWER: Capacity for doing work. Amount of work done in a certain period of time. Power equals force times distance, divided by time.

POWER DIVIDER: A small auxiliary gearbox or chain driven device to allow distribution of drive shaft power to several different mechanical devices mounted on the same truck.

PTO (POWER TAKEOFF): Mechanical device used to transmit engine power to auxiliary equipment. Power takeoffs can be mounted on either a main or auxiliary transmission. Front mounted and flywheel mounted power takeoffs are also used in various applications.

POWER TRAIN: The components that handle the engine power from the truck engine to the driving wheels. This includes transmissions, driveshafts, as well as differentials and driving axles.

PULLEY: A wheel grooved for a cable to transfer power.

PYLON: See LIGHT PYLON.

R.B.M. (RESISTING BENDING MOMENT): Resisting bending moment is a calculation used to compare frames of different section modules (shape) and of different material. It is the product of the section modulus times the minimum yield strength of the frame material and the formula is expressed as follows:

$$RBM = \text{Section Modulus} \times \text{Minimum Yield Strength} \qquad \text{(Eq.1)}$$

It is readily apparent from Equation 1 that yield strength and section modulus both affect frame strength. When materials of different strengths are used together, the lowest yield strength must be used to determine RBM. (See YIELD STRENGTH and SECTION MODULUS.)

REAR AXLE RATIO: The numerical ratio of the driveshaft speed to the speed of the rear tires.

REAR JACK: One or more feet designed, when used, to stabilize chassis.

RECOVERY: Act of moving a vehicle to a position from which it can be driven or towed.

RECOVERY ATTACHMENT POINTS: Areas provided and identified by the vehicle manufacturer, which can support the recovery connecting devices necessary in recovery operations.

RECOVERY CONNECTING DEVICE: Attachable device, used in winching recovery operations, compatible with the designated attachment points of a vehicle.

RECOVERY VEHICLE: Vehicle to retrieve and if necessary, lift tow other vehicles. (See TOW VEHICLE.)

REFLECTORS: Glass or plastic prism lenses that reflect light.

RESISTANCE: Restraining forces contributed to the load.

ROLLBACK: See CAR CARRIER.

ROLLING RESISTANCE: The restraining forces contributed to the load when rolling on wheels. See RESISTANCE.

RUB RAIL: Member running longitudinally providing rub service on side of body.

RVR (RECOVERY VEHICLE RATING): Manufacturer's rated capacity of recovery vehicle.

SAE: Society of Automotive Engineers.

SAFETY CHAIN(S)/CABLE(S): The chain from the front of a trailer, full trailer, and/or converter dolly to rear of the towing vehicle for purpose of retaining connection between towing and towed vehicles and of controlling direction of travel of towed vehicle(s) in the event of failure of drawbar or connection on rear of towing vehicle.

NOTE—A single chain or two chains, or a single cable or two cables, or a bridle arrangement of a single chain or cable, may be used if all requirements are met. (SAE J695)

SAFETY WRAP: Wrapping the tow chain(s) around the grab hooks of the tow bar inboard of chain.

SCOTCH BLOCKS: A device used to prevent chassis movement.

SECTION MODULUS: Frame section modulus is the engineering concept that relates shape to strength and stiffness. It takes into account frame depth, flange width, and material thickness. All

other things being equal, the frame with the largest section modulus will have the greatest strength and stiffness, i.e., the ability to more effectively resist deflection under load.

SERIAL NUMBER: An identification number stamped on a metal plate by the passenger car, van, or truck manufacturer (see VIN), or the towing equipment manufacturer, and placed on chassis, body, or components for identification purposes.

SHEAVE: See PULLEY.

SHORT CHAIN: Method of attaching a tow sling to a towed vehicle so that the tow chains support entire load.

SIDE RAILS: Horizontal extensions of the body sides, either sheet or tubular metal.

SLIDE BACK EXTENSION CYLINDER: A hydraulic cylinder, usually a long stroke, mounted horizontally at front of body used to slide body forward or rearward.

SNATCH BLOCK: A single or multiple pulley used to reduce line tension or change cable direction.

SPACER: Steel or wood section between chassis frame and body under frame to give proper tire clearance and/or required ground to floor height.

SPACER BLOCK PAD: Designated area to accept a spacer block.

SPACER BLOCKS: Used in conjunction with the 102 mm (4 in) × 102 mm (4 in) wood beam to provide additional clearance between the tow bar, chains, and the body of the vehicle. (See 3.1.4.)

SPADE: One or more ground penetrating feet designed primarily, when used, to stabilize rearward chassis movement. Refer to towing equipment manufacturer's procedures.

SPLASH GUARD: See MUD FLAPS.

SPOILER: Wind drag cosmetic device mounted on trunk of vehicle.

SPRING CAPACITY: A load rating assigned to each spring installation and vehicle application which will provide adequate spring durability and vehicle stability under all intended load conditions. The value of the load rating must equal or exceed that portion of the maximum allowable force of gravity (usually called 'weight' and equalling mass times acceleration of gravity) at the ground which relates directly to the spring. Therefore, the load rating is based on the total spring and unsprung forces of gravity (usually called 'spring weight' and 'unsprung weight') of the loaded vehicle. (SAE J274)

STABILIZERS: A hydraulic or manually operated leg device (i.e., outboard legs, outriggers, or jack legs) attached to trucks to give additional support down to the ground for improved stability.

STAKES: Metal or wood posts by means of which sides are attached to platforms or when used alone are means of retaining loads on flat deck platforms.

STAKE POCKETS: Apertures in the floor or sides of bodies for the reception of stakes.

STEERING SYSTEM AREA: Consists of control arms, struts, ball joints, idler arm, stabilizer bar, shock absorbers, tie rods, CV joints, and CV boots. Application depends on year, make, and model of vehicle.

STEERING WHEEL LOCKING DEVICE: Used to secure front wheels in lieu of standard steering column lock. (See 3.1.5.)

SWAGE: Cable coupling device.

SUCTION LINE: A tubular connection line to convey fluid between a reservoir or tank and the inlet of a hydraulic pump.

SUPPLY TANK: An oil reservoir used in the hydraulic system.

SUSPENSION AREA: Consists of springs, shock absorbers, axles, stabilizer bar, torsion bar, and sway bar. Application depends on year, make, and model of vehicle.

TAG AXLE: An auxiliary axle installed in conjunction with the rear axles of a truck chassis. A tag axle is installed behind the rearmost axle thus extending the length of the wheelbase. (See TANDEM AXLE.)

TANDEM AXLE: Two rear axles (three axles placed together is sometimes referred to as a tri-axle tandem). There are three tandem axle drive types.

a. Dual Drive Tandem: Both axles have drive mechanisms and are connected to engine power unit.
b. Pusher Tandem: Only the rearmost axle is driving type and forward unit is free rolling (load carrying only) commonly called "dead axle".
c. Trailing Axle Tandem (Tag Axle): Forward unit of tandem is driving type while rear unit is freely rolling.

T-HOOK: Attachment device used for towing. (See 3.1.1.)

TAIL PLATE: Rearmost part of the towing vehicle body.

TIE-DOWN ASSEMBLIES: Device(s) used to restrain cargo or vehicles (i.e., strap, bridle, chain, or cable). Reference Federal Highway Administration (FSA) Title 49, Section 393.102 (b).

THIMBLE: A shield to protect cable at hook assembly.

TILT CAB: See C.O.E.

TILT CYLINDER: Cylinders used to change the attitude of a structure or body.

TIRE CLEARANCE: Necessary space between tires and the nearest component to allow operation of truck without damage to the tires.

TOE: Measurement of how much the wheels are turned in/out from the straight ahead position (in — positive, out — negative). Insures wheels roll parallel.

TOW: Act of transporting a vehicle from one point to another by a second vehicle.

TOW APPARATUS: Equipment mounted on a chassis to facilitate the mission of tow or recovery vehicle.

TOW BAR: A device for positioning a towed vehicle behind a towing vehicle.

TOW CHAIN: Length of chain used to connect the sling with the towed vehicle.

TOW PAD: See SPACER BLOCK PAD.

TOW SLING: A device used for lifting and towing vehicles with a partial load supported on rubber belts. (See 3.2.)

TOW VEHICLE: Vehicle used to lift/tow other vehicles.

TOWING DOLLY WHEEL SECURING DEVICE: Used to secure towed vehicle wheels onto dollies.

TRANSPORTER: See CAR CARRIER.

TRUCK HITCH: A device for positioning and supporting one end of a towed vehicle.

TURNING CIRCLE: The shortest distance in feet required for a vehicle to negotiate a full circle or 360 degree turn.

TURNING RADIUS: One half the shortest distance in feet required for a given truck to negotiate a U-turn or make a 180 degree turn, the outer limit.

UNDER LIFT: A device used for towing vehicles by lifting one end of the towed vehicle from under the axle or structural member.

UNLOADED VEHICLE WEIGHT: Means the weight of a vehicle with maximum capacity of all fluids necessary for operation of the vehicle, but without cargo or occupants. Also referred to as curb weight.

V.C.G. (VERTICAL CENTER OF GRAVITY): See C.G. (CENTER OF GRAVITY).

V.I.N. (VEHICLE IDENTIFICATION NUMBER): The number assigned to a vehicle by the manufacturer primarily for registration and identification purposes. It may consist of numerals, letters, or a combination thereof. (SAE J853)

VALANCE PANEL: Material usually incorporated with fascia to afford cosmetic balance of vehicle.

WEIGHT DISTRIBUTION: The portion of total weight of the vehicle on each axle. (SAE J1451)

WHEEL ARM: A device that attaches to the lift bar for engaging the tires of a towed vehicle.

WHEELBASE: Horizontal dimension from centerline of front axle to the effective centerline of rear axle(s).

WHEEL BOX: See WHEEL WELL.

WHEEL FORK: See WHEEL ARM.

WHEEL HOUSINGS: Pockets in body floor to allow clearance over tires.

WHEEL-LIFT: A device used for towing vehicles by lifting one end of the towed vehicle by the wheels.

WHEEL SECURING DEVICE: A strap or mechanical device, when attached to the wheel arm, which limits the potential for separation of the towed vehicle from wheel arm, (wheel-lift application), during operating conditions.

WHEEL STRAPS: Used to tie down wheels of the towed vehicle when using wheel-lift, car carrier, or dolly towing equipment to limit the potential for separation of the towed vehicle from the towing apparatus.

WHEEL WELL: See WHEEL HOUSINGS.

WINCH: A device for winding and unwinding cable. Reference SAE J706.

WINCH FRAME: See MAST.

WIRE ROPE: See CABLE.

WOOD BEAM, 102 mm (4 in) × 102 mm (4 in): A block or section of wood used in conjunction with a tow sling to support or protect the body of the vehicle when lifting. (See 3.1.3.)

WORKING LOAD LIMIT: Minimum breaking strength divided by the factor of safety.

WRAP: A single coil of wire rope wound on a drum.

WRECKER: See TOW VEHICLE, RECOVERY VEHICLE, or TOW APPARATUS.

WRECKER FRAME: See MAST.

YIELD STRENGTH: Yield strength describes the inherent strength of a material by indicating the maximum stress, which can be applied to that material before permanent deformation occurs. Yield strengths will vary with material composition and processing.

3. Towing Equipment

3.1 Chains and Hooks for Use With Towing Equipment

3.1.1 CHAINS WITH J-HOOKS, T-HOOKS, AND GRAB HOOKS—For use with tow sling (two required), see Figure 1 for example.

NOTE—The use of T-hooks is recommended in lieu of J-hooks.

3.1.2 SAFETY CHAIN(S)/CABLE(S)—Chain(s)/cable(s) with appropriate fasteners (e.g., grab hook and/or shackle). Required in accordance with Federal Motor Carrier Regulation 393.70 and 393.71.

3.1.2.1 *Safety Chain(s)/Cable(s)*—Required on all tow sling, wheel-lift, and car carrier hookups (see Figure 2 for sample illustration). Safety chains should be connected to towed vehicle (see auto manufacturers recommendations) and to a structurally strong area of the towing vehicles body or boom (see towing manufacturers' recommendations). Towing equipment manufacturers must provide as part of the towing equipment package.

3.1.3 102 MM (4 IN) X 102 MM (4 IN) WOOD BEAM—See Figure 3 for example. Either a 1219 mm (4 ft) or a 1524 mm (5 ft) length may be required.

3.1.4 SPACER BLOCKS—See Figure 3 for example.

NOTE—While the use of the 102 mm (4 in) × 102 mm (4 in) wood beams and/or spacer blocks is not encouraged, they are, nevertheless, included as a part of tow sling equipment. Because

of the limited availability of 102 mm (4 in) × 102 mm (4 in) wood beams and spacer blocks in the field and the difficulty of application in using them, vehicles should be designed to eliminate their need, whenever possible.

3.1.5 STEERING WHEEL LOCKING DEVICE—See Figure 4 for example. Required on all sling and wheel-lift towing with towed vehicle front or rear wheels raised. Required for vehicles that are classified as four-wheel steering. Refer to towing equipment manufacturer's recommendations.

3.1.6 WHEEL SECURING DEVICE—(See Section 6.) Required on/at each raised wheel of the towed vehicle when using wheel-lift equipment. Towing equipment manufacturers must provide as part of the wheel-lift package.

NOTE—Safety chains must be used in addition to wheel securing devices.

3.2 Tow Sling—See Figure 5 for example.

3.2.1 TOW SLING EQUIPMENT—Must be installed on the appropriate chassis, as recommended by the towing equipment manufacturer, so the rear axle GAWR of the tow vehicle is not exceeded when loaded. Historically, the towing industry has recommended that the towing vehicle front axle weight shall be no less than 50% of the original front axle curb weight (as tested) when towing is in progress.

To calculate the maximum steering towing load with a particular chassis and installed tow sling equipment, see 3.2.1.1.

3.2.1.1 *Steering Towing Load Formula for Tow Sling Equipment*—(See Figure 6.)

3.2.2 PASSENGER CARS—Tow sling, as shown in Figure 5, or equivalent, for static lifted loads up to 1361 kg (3000 lb) mounted on a minimum of 4536 kg (10 000 lb) GVWR chassis.

3.2.3 VANS AND LIGHT DUTY TRUCKS—Up to 4173 kg (9200 lb) GVWR.

3.2.3.1 Tow sling, as shown in Figure 5, or equivalent, for static lifted loads up to 1361 kg (3000 lb) mounted on a minimum of 4536 kg (10 000 lb) GVWR chassis.

3.2.3.2 *Chains and Hooks*—See 3.1 and 3.1.1.

3.2.3.3 *Safety Chain(s)/Cable(s)*—See 3.1.2 and 3.1.2.1.

3.2.3.4 *102 mm (4 in) × 102 mm (4 in) Wood Beam*—See 3.1.3.

3.2.3.5 *Spacer Blocks*—See 3.1.4.

3.2.3.6 *Steering Wheel Locking Device*—See 3.1.5.

3.3 Wheel-Lift Equipment—See Figure 7 for examples.

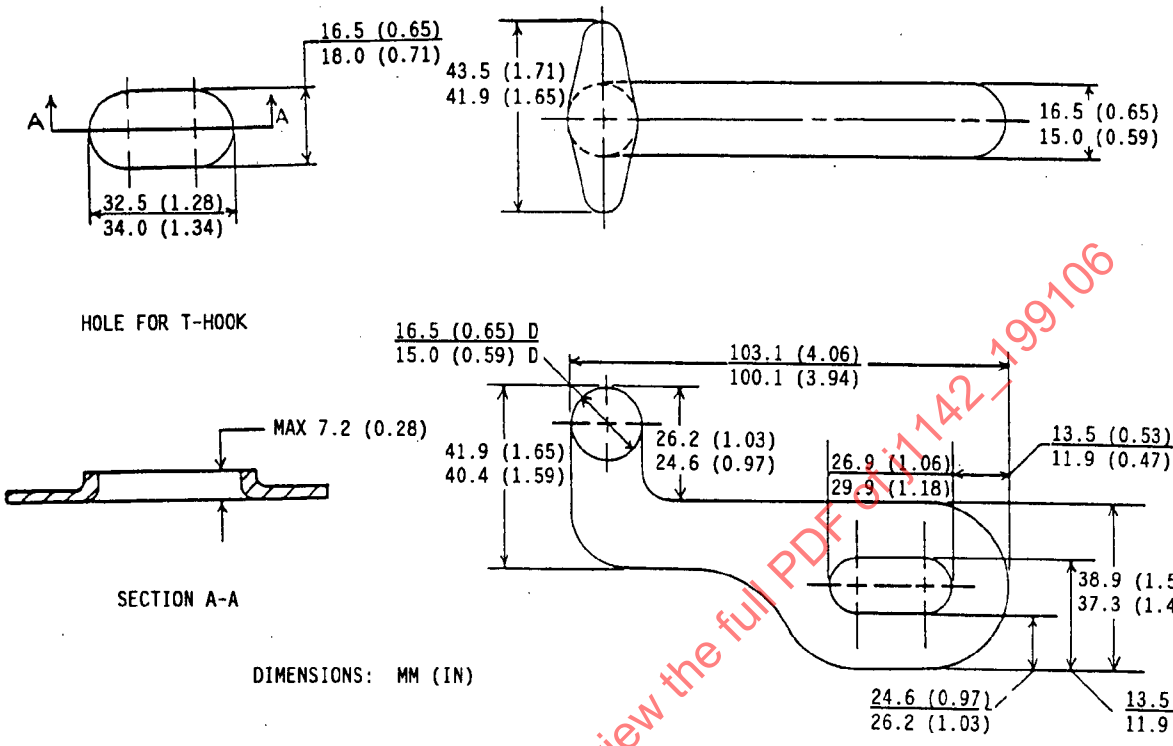
3.3.1 Wheel-lift equipment should be installed on a minimum of a 4536 kg (10 000 lb) GVWR chassis.

NOTE—Due to weight transfer considerations, industry practice indicates a minimum of 4536 kg (10 000 lb) GVWR chassis be used for wheel-lift equipment.

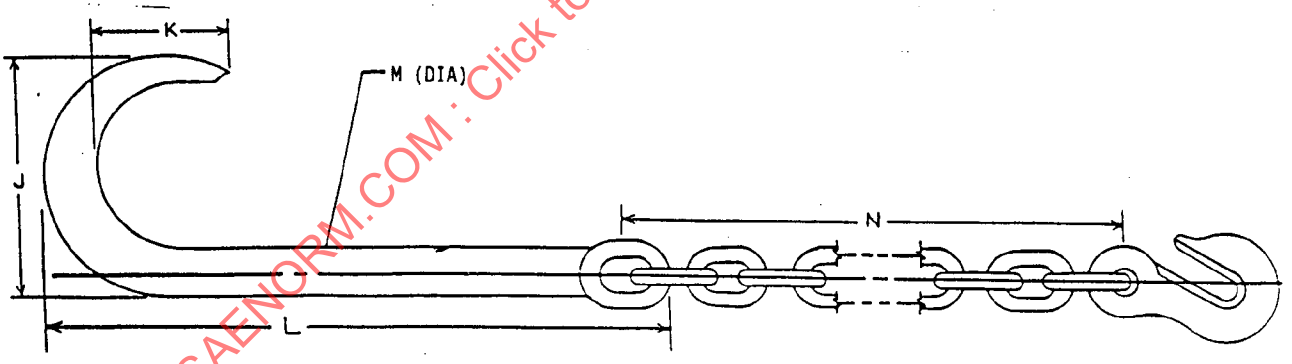
3.3.2 Wheel-lift equipment should be installed on the appropriate chassis, as recommended by the towing equipment manufacturer, so the rear axle GAWR of the tow vehicle is not exceeded when loaded. Historically, the towing industry has recommended that the towing vehicle front axle weight should be no less than 50% of the original front axle curb weight when towing is in progress.

To calculate the maximum steering towing load with a particular chassis and installed wheel-lift towing apparatus, see 3.3.2.1.

3.3.2.1 *Steering Towing Load Formula for Wheel-Lift Equipment*—(See Figure 8.)



T-HOOKS



DIMENSIONS - MM (IN)

J:	114-140	(4.5-5.5)
K:	76-102	(3-4)
L:	356-381	(14-15)
M:	22-23	(0.85-0.90)
N:	2290-2440	(90-96)
CHAIN:	8 (5/16) DIA	

FIGURE 1—CHAINS WITH T-HOOK, J-HOOK, AND GRAB HOOK

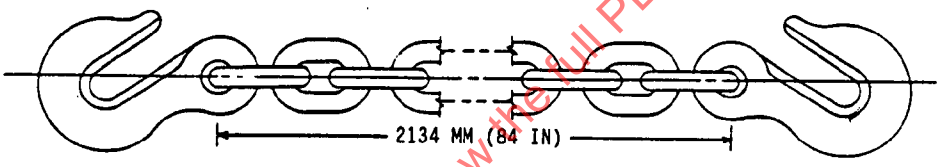
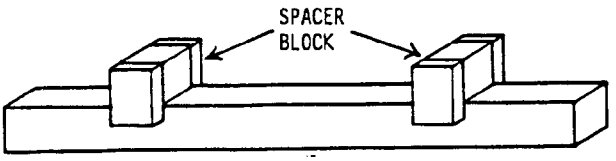
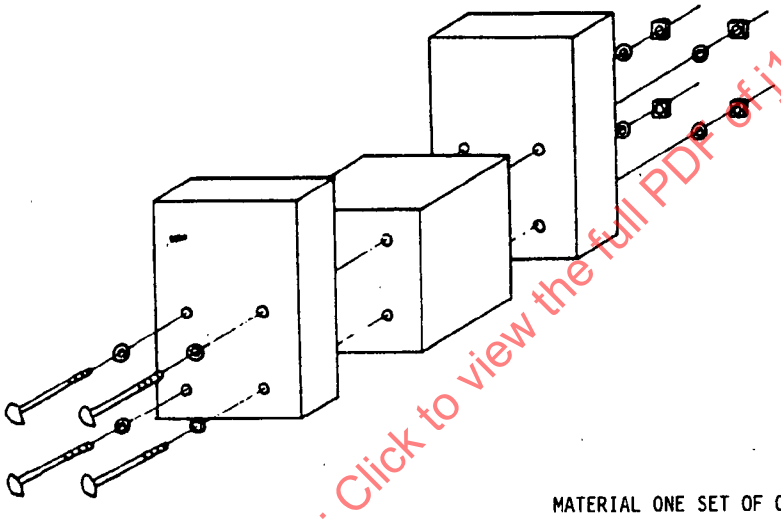


FIGURE 2—SAFETY CHAINS



ASSEMBLED VIEW



MATERIAL ONE SET OF CROSSBEAM AND SPACER BLOCKS

4-38 x 89 x 152 MM (2 x 4 x 6 IN)
2-89 x 89 x 89 MM (4 x 4 x 3 IN)
1-89 x 89 x 1524 MM (4 x 4 x 60 IN)
8-6.3 x 178 MM (1/4 x 7 IN)
CARRIAGE BOLT, WITH NUT
16 -6.3 MM (1/4 IN) WASHER

2 x 4 LUMBER ACTUALLY MEASURES
38 x 89 MM (1-1/2 x 3-1/2 IN)

4 x 4 LUMBER ACTUALLY MEASURES
89 x 89 MM (3-1/2 x 3-1/2 IN)

FIGURE 3—4 X 4 WOOD BEAM AND SPACER BLOCKS

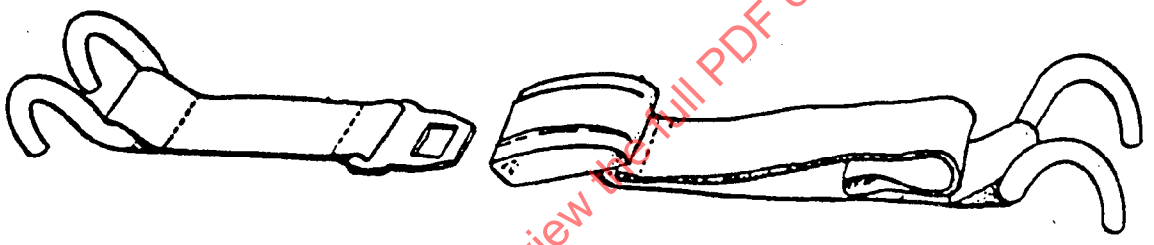
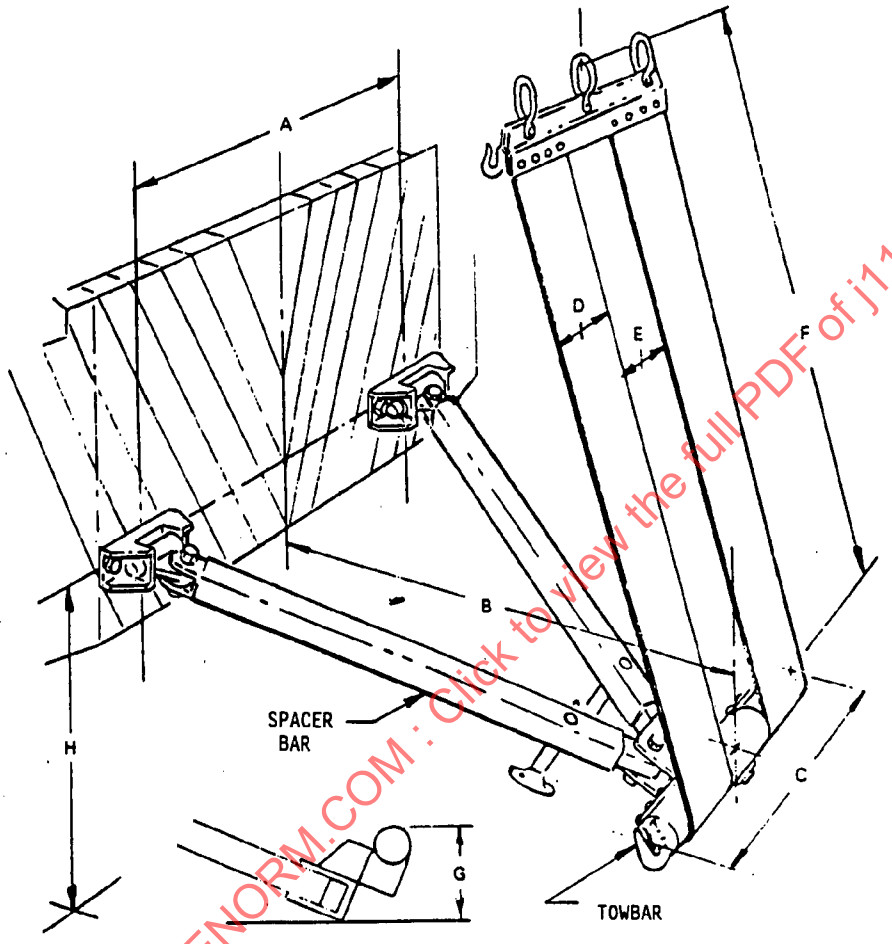


FIGURE 4—STEERING WHEEL LOCKING DEVICE



DIMENSIONS - MM (IN)

A:	914-965	(36-38)
B:	864-914	(34-36)
C:	864-914	(34-36)
D:	203-254	(8-10)
E:	330-508	(13-20)
F:	1118-1219	(44-48)
G:	102-142	(4-5.6)
H:	610-813	(24-32)

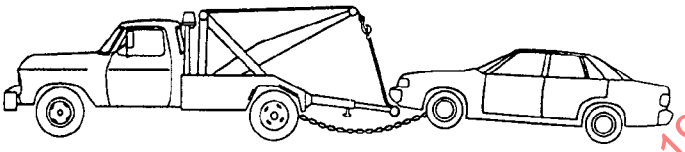
FIGURE 5—SAMPLE TOWING SLING

Chassis:

Year _____

Make _____

Model _____



SLING-TYPE

Equipment:

_____

_____

_____

Factory Ratings:	As Tested Weight:	Measurements:
FAWR: _____ kg (lb) [Front Axle Weight Rating]	Front Axle: A kg (lb)	Overhang: C mm (in)
RAWR: _____ kg (lb) [Rear Axle Weight Rating]	Rear Axle: _____ kg (lb)	Wheelbase: B mm (in)
GVWR: _____ kg (lb) [Gross Vehicle Weight Rating]	Total: _____ kg (lb)	Cab-to-Axle: _____ mm (in)

CALCULATIONS:

The steering towing load limit can be calculated using the following formula:

$$\frac{\text{Front Axle As Tested Weight kg (lb)} \times \text{Wheelbase mm (in)}}{2 \times \text{Overhang kg (in)}}$$

$$= \frac{D}{(A \times B \div 2\,C = D)} \text{ kg (lb) Load}$$

WARNING—This is the maximum load that can be lifted without dangerously unloading the tow truck's front axle. This load would be the weight of the towed vehicle at the bumper.

FIGURE 6—STEERING TOWING LOAD FORMULA FOR TOW SLING EQUIPMENT

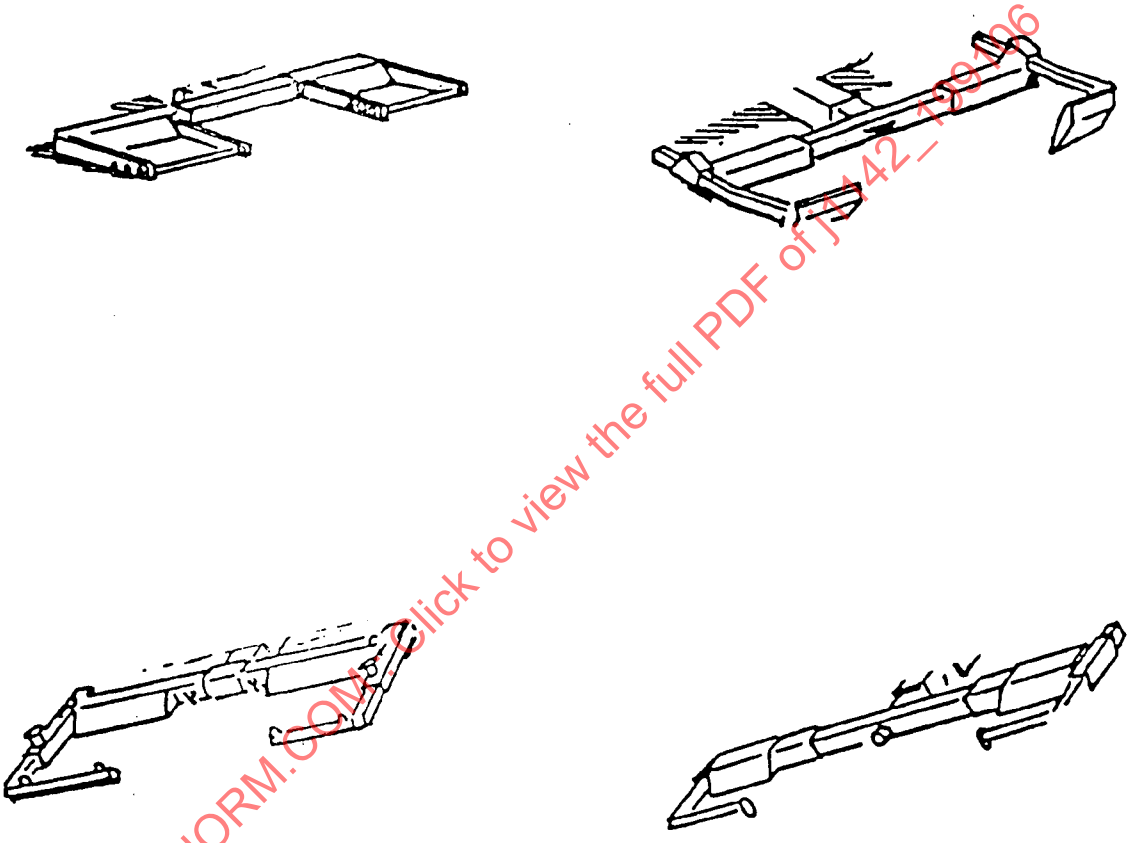
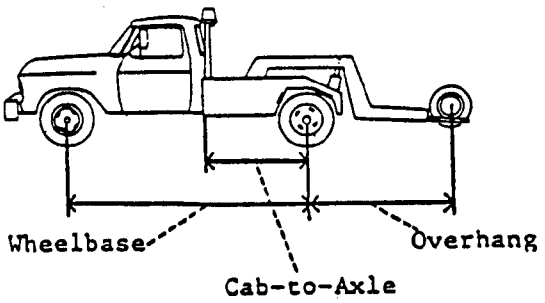


FIGURE 7—WHEEL-LIFT EQUIPMENT



Chassis:

Year _____

Make _____

Model _____

Equipment:

_____

_____

_____

Factory Ratings:	As Tested Weight:	Measurements:
FAWR: _____ kg (lb) [Front Axle Weight Rating]	Front Axle: A kg (lb)	Overhang: C mm (in)
RAWR: _____ kg (lb) [Rear Axle Weight Rating]	Rear Axle: _____ kg (lb)	Wheelbase: B mm (in)
GVWR: _____ kg (lb) [Gross Vehicle Weight Rating]	Total: _____ kg (lb)	Cab-to-Axle: _____ mm (in)

CALCULATIONS:

The steering towing load limit can be calculated using the following formula:

$$\frac{\text{Front Axle As Tested Weight kg (lb)} \times \text{Wheelbase mm (in)}}{2 \times \text{Overhang mm (in)}}$$

$$= \frac{D}{(A \times B \div 2\,C = D)} \text{ kg (lb) Safe Load}$$

WARNING—This is the maximum load that can be lifted without dangerously unloading the tow truck's front axle. This load would be the weight of the towed vehicle at the bumper.

FIGURE 8—STEERING TOWING LOAD FORMULA FOR WHEEL-LIFT EQUIPMENT

3.3.3 WHEEL SECURING DEVICE—Required on/at each raised wheel of the towed vehicle when using wheel-lift equipment. Towing equipment manufacturer must provide as part of the wheel-lift package.

NOTE—The availability and recommended use of wheel securing devices is the responsibility of the equipment manufacturer. It is the responsibility of the operator to read and understand the manufacturer's operating instructions and use the devices as recommended.

The development of performance tests to evaluate wheel securing devices is to be considered as a long-term program by the Towability Committee.

Safety chains must be used in addition to wheel securing devices.

3.3.4 STEERING WHEEL LOCKING DEVICE—See 3.1.5.

3.4 Car Carrier Equipment—NOTE—See Section 6.

3.4.1 CHASSIS MOUNTED CAR CARRIER EQUIPMENT

3.4.1.1 Car carrier equipment equipped to handle one vehicle on the carrier should be installed on the appropriate chassis, as recommended by the towing equipment manufacturer, so the GVWR of the chassis is not exceeded.

3.4.1.2 Car carrier equipment equipped to handle one vehicle on the carrier and one on the rear, (sling or wheel-lift device), should be installed on the appropriate chassis, as recommended by the towing equipment manufacturer, so the vehicles GVWR, GCWR, and/or the rear axle GAWR of the carrier chassis are not exceeded. Historically, the towing industry has recommended that the carrier chassis front axle weight should be no less than 50% of the original front axle curb weight nor exceed the rear axle GAWR when towing is in process.

3.4.1.3 Car carrier equipment equipped to handle two vehicles on the carrier, (one on the platform and one above the cab), should be installed on the appropriate chassis, as recommended by the towing equipment manufacturer, so the GVWR of the chassis is not exceeded.

3.4.1.4 Car carrier equipment equipped to handle two vehicles on the carrier, (one on the platform and one above the cab), and one vehicle on the rear, (sling or wheel-lift device), should be installed on the appropriate chassis, as recommended by the towing equipment manufacturer, so the vehicle's GVWR, GCWR, and/or rear axle GAWR of the carrier chassis is not exceeded. Historically, the towing industry has recommended that the carrier chassis front axle weight should be no less than 50% of the original front axle curb weight nor exceed the rear axle GAWR.

3.4.1.5 Car carrier equipment should be designed to have no more than a 13 degree approach angle. Ramps may be used to meet this specification.

3.4.1.6 Tie-down assemblies shall meet both vehicle and towing equipment manufacturer's recommendations.

3.4.1.7 Safety chain(s)/cable(s), see 3.1.2 and 3.1.2.1.

3.4.2 TRAILER DESIGNED CAR CARRIER EQUIPMENT

3.4.2.1 *Chassis and Load Requirements*—Refer to SAE Handbook Index, Trailer Heading.

3.4.2.2 See 3.4.1.5.

3.4.2.3 See 3.4.1.6.

3.4.2.4 See 3.4.1.7.

3.5 Towing Dolly

3.5.1 Towing dolly, as shown in Figure 9, or equivalent, for use in towing when wheels not supported by tow equipment must not touch road surface because of potential damage to the driveline of the towed vehicle.

3.5.1.1 Towing dolly minimum load rating and maximum speeds. The end of the towed vehicle supported by the dolly should not weigh more than the amount in columns 1 and 2 when matched with columns 3 through 9 of Table 1: