GM MEDIUM DUTY TRUCK SELECTION SPECIFICATIONS

INDEX

GLOSSARY OF TRUCK TERMS

Product Knowledge: Product knowledge is an understanding of truck components. Basic components are:

Cab: Provides operator protection and center for vehicle control.

Other sheet metal: Provides good appearance and protection for power plant and cab from weather and front wheel splash.

Frame: Holds vehicle operating components in position and supports the load.

Engine: Provides power for vehicle operation.

Clutch: Connects engine to driveline when power is needed and allows engine to operate when power is not required.

Transmission: Provides variation of torque multiplication to meet varying requirements.

Propeller Shaft: Connects power plant to rear axle.

Rear Axle(s): Transmits engine power to vehicle motive power, multiplies engine torque, reduces engine RPM to usable quantity, and supports load at rear of vehicle.

Front Axle or Suspension: Supports front end load and provides vehicle direction (steering) control.

Springs: Provide cushioned support of load and compensate for road surface variations.

Wheel and Tires: Carry entire vehicle load, allow vehicle movement, and absorb road shock.

Vehicle Requirements: The third step in product knowledge is an understanding of vehicle requirements to meet operating circumstances. There are two primary needs in any trucking application, capacity and performance. Performance is the ability of a vehicle to move at the desired speed over the existing terrain with its load. This ability can be predetermined with fairly close accuracy, using the performance calculations listed in this section. Capacity is the ability of the vehicle to carry and/or pull the load. Each vehicle has two maximum capacities. These are load carrying capacity and load pulling capacity. Each capacity is determined by a number of vehicle components. Load carrying ability and combination carrying and towing ability, are affected by characteristics of engine, clutch, rear axle, front axle, springs, frame, and tires. Exceeding the abilities of any of these components will result in unsatisfactory service from the vehicle. Vehicles are designed to provide adequate components for all but the most severe applications within limits of GVW & GCW ratings as established by the load capacity chart.

TRUCK TERMS: The fourth and final area of product knowledge is an understanding of terminology used. Only with complete product knowledge can a truck salesman begin to select the proper unit for his customer. Some of the most common terms used in the Truck Data Book are listed here in alphabetical sequence along with a brief description of their meaning or use.

AF: Dimension between the center of the fifth wheel or the center of gravity of the body and rear axle. Maximum AF is longest dimension permissible to insure against load damage to frame. AF dimensions are based on frame strength and do not consider adaptability of average trailer or bodies to the available space behind the cab.

Air Brakes: Compressed air is used to provide the force required to expand the brake shoes by cam or wedge against the brake drums. Air pressure is supplied directly to the chambers at the wheel position.

Air Resistance: A measure of the ”drag” or retarding effect due to the air turbulence produced by a vehicle in motion. Because it varies theoretically as the square of the speed, it affects the ability of the vehicle to reach top speed as well as the gradeability at fast speeds.

Allowable Body-Payload: Weight rating designated by the truck manufacturer for model types which are later, equipped with some type of body (stripped chassis, chassis-cowl, or chassis-cab models for example). This is the combined allowance for total weight of body and payload together.

Allowable Payload: The maximum load weight, which may be carried without exceeding the truck manufacturer’s designated maximum rating, or some component rating or legal limit (such as axle capacity or legal axle load limits).

Alloy Steel: Steel to which any alloying element other than carbon is added to strengthen physical properties.

Auxiliary Springs: Usually rear only, are for increased load stability or capacity without affecting light ride. Mounted to act only after regular springs are partially deflected.

Auxiliary Transmission: Extra transmission mounted behind the main transmission to provide additional gear splits and greater versatility in handling heavy loads under adverse conditions.

AW: Axle width is the distance between the front wheels measured from the centerline of the front tires.

Axle, Full-Floating: The full-floating axle shafts have nothing to do but drive the wheels. The housing supports the entire rear weight through double opposed wheel bearings, which absorb all load and wheel stresses. Should axle shaft breakage occur, the truck can be towed since the wheel is supported by the wheel hub and bearings.

Axle, Rear, Double Reduction: A double reduction rear axle has a primary reduction through a hypoid or spiral bevel pinion and ring gear and a secondary reduction through a set of herringbone or helical gears. This rear axle is designed to maintain gear strength and give a more powerful driving force to the rear wheels without sacrificing road clearance and to provide higher numerical ratios than are possible with single reduction axles.

Axle, Rear, Single Reduction: This type rear axle has one driving pinion and one ring gear that turns the axle shaft. The driving torque at the rear wheels is increased or decreased according to the ratio of the teeth in the driving pinion to those in the ring gear.

Axle, Rear, Two-Speed: This rear axle provides for two full-sized final drives in a single unit. It contains a ”fast” ratio for maximum speed and a ”slow” ratio for maximum pulling power. This allows the truck driver to select the proper ratio for road, speed, and load conditions. Some two-speed designs use a single ring gear and pinion for its ”fast” ratio and a pinion, ring gear, plus a planetary unit for its ”slow” ratio. Another design is the double reduction two-speed type consisting of one hypoid ring gear and pinion and two sets of helical gears - one for the ”slow” speed, the other for the ”high” speed.

Axle, Semi-Floating: The inner shaft is carried on an extension of the differential, the outer or wheel bearings being carried directly on the axle shaft. With this type, the axle shafts and wheel bearings not only support the total rear weight but must also transmit driving torque to the wheels and resist stresses due to skidding, turning corners, and tractive forces.

Axle, Two-Speed: To meet the need for a wider range of gear selections in many applications, a rear axle with two ratios and a mechanism for selecting one or the other ratio is available for use with a standard type transmission. In most cases, except where a deep low reduction is necessary the two-speed axle works best with a close ratio transmission.

Axle, Three-Speed Tandem: Although there are a number of methods theoretically possible to provide three gear ratios in a tandem rear axle, there is one method which is proving successful. This system utilizes two regular type matched two-speed rear axles on a single suspension with an inter-axle differential. Ratios are obtained as follows: High Range - both two speed axles in high range. Intermediate Range - Rear-most axle in low range with forward unit in high range. Inter-axle differential compensates to provide a ratio halfway between high and low ranges. Low Range - both axle units in low range. By use of a forward axle low range sensing unit, differential lockout control operates only in low range to permit maximum traction under adverse conditions.

BA: Dimension from the front bumper to the centerline of front axle.

BBC: Dimension from the front bumper to the back of the cab.

GLOSSARY OF TRUCK TERMS

BC: Body clearance. Distance between the back of the cab and the installed body to prevent cab-to-rear body contact due to flexing of chassis frame.

Bearing Area, Circumferential: The total area of the bearing surface. For a cylindrical bearing it is equal to: (bearing diameter) x (bearing length) x (3.14)

Bearing Area, Projected: The area of the bearing when projected upon a flat surface parallel to the axis of the bearing. It is equal to: (bearing diameter) x (bearing length).

Body: The part of the vehicle designed to carry items related to the use of the vehicle rather than the operation of the unit. This does not normally include the cab except when the cab is an integral part of the body as in a school bus.

Bore: The diameter of an engine cylinder or bearing.

Brake, Engine: Brake device using engine compression pressure as a retarding medium.

Breakaway Valve: The equipment added to a tractor or trailer brake system, which, safeguards the air supply on leading units and automatically applies the brakes on any trailing units, which might accidentally become separated.

BW: Outer track - Measures the distance between the dual rear wheels from the outside of the outer wheels.

CA: The dimension from the back of the cab to the centerline of the rear axle. This dimension is important when determining the body application or fifth wheel mounting and weight distribution.

Cab: The part of the vehicle that encloses the driver and vehicle operating controls. The term cab may also include the front end, sheet metal housing, the engine, front fenders, etc.

Camber: The angle, which a front wheel spindle makes with a horizontal line.

(CWR) Cargo Weight Rating: The value specified by the manufacturer as the cargo-carrying capacity, in pounds, of a vehicle, exclusive of the weight of the occupants. The actual cargo weight is also called the payload.

Caster: The angle, which a kingpin makes, with a vertical line when viewed from the sides. Positive caster tends to keep the wheels traveling in a straight line.

CE: The dimension from the back of the cab to the rear of the standard frame. Used primarily to determine the size of the body, which may be used.

Center of Gravity: Point where the weight of the truck and /or body and payload appears to be concentrated, and if suspended at that point, would balance front and rear.

CGA: Center of gravity to axle. The distance measured from the center of gravity of the body and payload to the center of the rear axle (mid-point between the axles for a tandem).

Chassis: May be used to represent: 1 - Entire vehicle as produced by the factory when no body is included (Cab, frame, power plant, drive line, suspensions, axles, wheels, and tires); 2 - Same as number 1 except excluding cab and other sheet metal; or 3 - Frame only with brackets, bumper, and other miscellaneous parts directly attached to the frame.

Chassis Weight: The actual weight of the fully equipped vehicle without body and driver. This weight includes all fluids. (no driver or body).

Compression Ratio: The volume of the combustion chamber and cylinder when the piston is at the bottom of its stroke, divided by the volume of the combustion chamber when the piston is at the top of its stroke. Higher compression ratios tend to increase engine efficiency.

Conventional Cab: This is a cab design where the power plant is located ahead or mostly ahead of the cowl. Term may be applied to basic cab structure only or may include front fenders, hood, grille, etc.

Core: Tubular-fin structure acts as a heat exchanger in the radiator.

Cowl: The front part of an automotive cab or body directly below the base of the windshield between the dash panel, is used to indicate the complete vehicle (less body).

Crossmember: Structural shape tying in side rails of the frame.

Curb (Vehicle) Weight: The weight of the truck (without load, driver), including fuel, coolant, oil, body and all items of standard and optional equipment.

Deflection Rate: The deflection rate of a spring is the force required to compress or deflect the spring a distance of one inch. For torsion springs, this distance is measured at the end of the control arm attached to the springs.

Design Weight: This is the maximum to which a vehicle or component may be loaded without the danger of failure and/or premature wear taking place. It is a limit imposed by the manufacturer of that vehicle or component.

Differential: (A) Standard Type -The gear assembly on the drive axle that permits the wheels to turn at different speeds. (b) No-Slip or Limited-Slip Type- A gear assembly on the drive axle that will not permit one wheel to spin while the other is motionless - such as when a truck is stuck in snow or mud. Torque is transmitted to both wheels of the driving axle.

Disc Brakes: A brake assembly comprised of a disc, which, rotates as the wheel turns. A caliper device ”grabs” the disc to stop the wheel from rotating.

Displacement: The displacement of an engine is the volume displaced by a piston during one stroke multiplied by the number of pistons. Engine displacement is equal to: (bore) x (bore) x (stroke) x (no. of pistons) x (.785)

Drum Brakes: A brake assembly with brake shoes, which are pressed against a brake drum to stop the wheels from rotating.

Fifth Wheel: Load supporting plate mounted to the frame of the vehicle. Pivot mounted, it contains provision for accepting and holding the kingpin of a semi-trailer providing a flexible connection between the tractor and the trailer. Center of fifth wheel (where kingpin is held in position) should always be located ahead of the centerline of the tractor rear axle or axle group.

Forward Control: Vehicle with driver controls (pedals, steering wheel instruments) located as far forwards as possible. Supplied with or without body, the controls are stationary mounted as opposed to the special mountings of tilt cab models.

Frame Cut-off: Standard frame on most models extends behind the rear axle, far enough to support a body mounted on the vehicle. For special purposes’ bodies which maybe unusually short for the wheelbase of the vehicle on which it is mounted or in most tractor operations, this frame extension behind the rear axle may be shortened. The shortest allowable extension for each vehicle is referred to as ”maximum frame cut-off.”

Full Trailer: A trailing load carrying a vehicle, which, is entirely supported by its own suspension systems. The powered unit merely tows this type of trailer and does not directly support any of its weight. Sometimes referred to as a ”pup” when towed behind a truck with a mounted body or behind a tractor-semi-trailer combination. Tractor-semi-trailer-full-trailer combinations are often referred to as ”double” or ”double bottoms.”

(GAWR) Gross Axle Weight Rating: The value specified by the vehicle manufacturer as the load carrying capacity of an axle system measured at the tire-ground interfaces.

(GCW) Gross Combination Weight: Represents the actual weight of a vehicle at the ground with a trailer or trailers including vehicle, equipment, driver, passengers, fuel, and payload (everything that moves with the vehicle).

Gear Ratio: The number of revolutions a driving gear requires to turn a driven gear through one complete revolution. For a pair of gears, the ratio is found by dividing the number of teeth on the driven gear by the number of teeth on the driving gear.

GLOSSARY OF TRUCK TERMS

Geared Speed: The theoretical vehicle speed based on engine rpm, transmission gear ratio, rear axle ratio, and tire size.

Glad Hand: The air brake connector between a tractor and trailer.

Glider Kit: A complete cab, front axle system, and frame used to update and/or repair a damaged vehicle where the power train (engine, clutch, transmission, U-joints, driveline, rear differential) and rear axle system still have an economically sound, realistically useful life.

Gradeability: Ability of a truck to negotiate a given grade at a specific GCW or GVW.

(GVW) Gross Vehicle Weight: Actual weight of the entire vehicle including all equipment, fuel, body, payload, driver, etc. This is for the individual unit only such as a truck or tractor.

Helical Gears: Gears with slanted teeth, usually used in transmissions. The teeth are positioned diagonally across the face of the gear for quieter operation and more gear tooth contact.

Horsepower: A measure of the amount of work that can be done by an engine in a certain amount of time. One horsepower is equal to 33,000 ft.-lb. of work per minute. The horsepower of an engine depends upon the torque and speed of the engine.

Brake Horsepower: The actual horsepower delivered by the crankshaft and is measured by means of an electric dynamometer.

Gross: The brake horsepower of an engine with optimum ignition setting (manual instead of automatic advance) and without allowing for the power absorbed by the engine's accessory units such as the fan, water pump, generator, and exhaust system.

SAE, Net: The brake horsepower remaining at the flywheel of the engine to do useful work after the power required by the engine accessories (fan, water pump, generator, etc.) has been provided as measured in accordance with SAE standards.

Taxable: The N.A.C.C. (National Automobile Chamber of Commerce) adopted an arbitrary formula for estimating horsepower to enable comparison of engines on a uniform basis. It assumes that engines deliver their rated power at a piston speed of 1000 ft. per min. and that mechanical efficiency will average 75% Tax. HP = (Dia. of Bore) 2 x No. of Cylinders/2.5 = D^2N /2.5 Advancement in engine design since this formula was developed have obsolete the formula completely as a basis of estimating true engine output. The formula is still used in some states for licensing purposes, however.

Hotchkis Drive: Hotchkis drive is a term applied to that type of chassis design where the rear springs are mounted at the forward end in a stationary bracket (not shackled as at the rear end) and all driving and braking forces are cushioned by the springs and transferred directly to the frame side members. Open-type universal joints and propeller shafts are used in this design.

Hypoid Gears: Hypoid gears and pinions have a tooth form that permits the drive pinion to mesh with the driven gear below the center of the driven gear.

Inter-Axle Differential: Gear device that equally divides power between axles in a tandem assembly and compensates for unequal tire diameters.

Kingpin, Trailer: (Sometimes referred to as upper fifth wheel when considered with its mounting). It is a short heavy pin with a locking flange on its lower extremity. This pin is mounted near the front on the underside of a semi-trailer, and when positioned in the fifth wheel of the tractor, provides a flexible connection between tractor and semi-trailer.

Landing Gear: The two small wheels at the forward end of a semi-trailer used to support the trailer when it is detached from the tractor.

Maximum Rolling Grade: (Gradeability) Greatest grade a vehicle is able to climb while under motion, or the number of feet rise the vehicle can attain continuously for each 100 feet of horizontal movement. Maximum rolling grade is calculated with the vehicle in motion with rated load and with gearshift settings to obtain greatest gear reduction.

Maximum Starting Grade: (Gradeability) Greatest, grade a vehicle is able to start on from complete stop. Approximately 10% grade loss from the rolling gradeability. (Starting Gradeability (%) = Rolling Gradeability (%) -10%).

Maximum Speed: Ability of a vehicle to attain speeds under full load conditions. This speed is calculated using level road conditions and with best concrete road surface. When the vehicle power is great enough to exceed geared MPH, the geared MPH becomes the maximum speed. Speeds are calculated in the "best gear" to obtain the highest speed (using a lower gear if necessary).

Model Weight: Weight of the vehicle with all items of standard equipment, 150 lbs. per passenger in each designated seating position, and maximum capacity of fuel, oil, and coolant.

Nominal Truck Rating: An arbitrary classification of truck capacity in tons, such as 1/2 ton, 1-1/2 ton. Although this classification is still used, the correct rating of truck capacity is gross vehicle weight (GVW).

OAL: Overall length of chassis measured from the front bumper to the end of the frame.

OH: Overall height of chassis measured from the ground to the topmost point of the cab.

On-Highway: Vehicle operation over well maintained major highways of excellent concrete or asphalt construction, level to rolling terrain with uniform grades. Subject to legal weight and dimensional limitations.

On-Off-Highway: Vehicle operation over secondary roads of good concrete or asphalt construction with partial operation on well, maintained crushed rock surface or similar material, variable grades. Subject to legal weight and dimensional limitations.

Off-Highway: Vehicle operation over private roads or asphalt or maintained crushed rock surface or similar material, variable grades. Not subject to legal weight and dimensional limitations.

Off-Road: Vehicle operation over private roads in areas with no maintained hard surface variable grades. Not subject to legal weight and dimensional limitations.

Overdrive Transmission: A transmission in which the high gear ratio is less than one to one. This permits the truck, under favorable conditions, to maintain a higher road speed with any given engine speed or a given road speed at a lower engine rpm. The primary use in trucks is for fuel economy on empty return trips.

OW: Overall width of chassis from the widest point of the cab.

Payload: Weight or commodity being hauled. This will include the packaging, pallets, banding, etc., but does not include the truck, truck body, etc.

Pintle Hook: Hook mounted on the truck or semi-trailer used to couple on a full-trailer.

Planetary Drive: Gear reduction system with sun gear transmitting reduction through planetary gears to main output shaft. See rear axle section.

Ply Rating (PR): A measure of the strength of tires based on the strength of a single ply of designated construction. An 8-ply rating does not necessarily mean that 8 plies are used in building the tire, but simply that the tire has the strength of 8 standard plies.

Power Curve: A graphic illustration of maximum output of power and torque at all operating speeds. These curves are established from data obtained by running a sample engine on an engine dynamometer. Curves are established using both bare operable engine and with standard accessories and by using SAE performance calculations. Net power figures are used in vehicle.

Power-Take-Off: A device usually mounted on the side of the transmission or transfer case, or off the front of the crankshaft, used to transmit engine power to auxiliary equipment such as pumps, winches, etc.

Power Train: A name applied to the group of components used to transmit engine power to the wheels. The power train includes clutch, transmission, universal joints, drive shafts, and rear-axle gears.

GLOSSARY OF TRUCK TERMS

Ratio: Proportion input revolutions to output revolutions of a unit (axle, transmission, steering gear, etc.) A two to one ratio (2:1) means that two complete revolutions must be made on the input shaft of the item to obtain one complete revolution of the output shaft. This is used primarily to multiply torque (turning force) which is opposite of speed. To interpret a ratio in terms of torque the expression becomes the proportion of the output to the input. Therefore, a 2 to 1 ratio means that two units of force are available at output shaft for each unit of force applied to input shaft.

Reduction: Used to indicate the slower output speed resulting from a ratio proportion (faster on reductions less than 1).

(RBM) Resisting Bending Moment: (Section modulus) x (Yield strength). This answer is used when comparing the strength of two frames made of different materials. See Frames Section.

Rim Pull: The force available at the road surface contacting the driving wheels of the truck. It is determined by engine torque, transmission ratio, axle ratio, tire size, and frictional losses in the drive train. Rim pull is also known as tractive effort.

Road Rolling Resistance: A measure of the retarding effect of the road surface to forward movement of the vehicle and varies with the type and condition of the road.

Rolling Radius (Loaded Radius): Tire-rolling radius is the distance from the center of the wheel to the road. Static radius applies when the vehicle is at rest, rolling radius for a vehicle in motion. The latter dimension is usually slightly greater than the static radius and is the figure used in determining the tire revolutions per mile.

Section Modulus: A measure of the strength of frame side rails determined by the cross-section area and shape of the siderails. See Frames Section.

Semi-Trailers: This is a trailering unit that is supported in the rear by its own suspension system and at the front by the towing vehicle. A separate suspension unit with towing provisions sometimes supports this type of unit, but while being used this way it becomes a full trailer. An exception is the utility type trailer, house trailer, etc., which is towed by a ball coupling. This is referred to simply as a trailer and is not designed as a semi or full trailer.

Set Back or Forward Front Axle: The front steering axle is normally as close to the front of the vehicle as the design and wheel and tire size permit on conventional and set forward axle (SFA) models. When the front axle is purposely located further toward the rear it is referred to as being set back or (SBA). The centerline of the front axle to the front bumper is normally 26 to 33-1/4 inches on Conventional and SFA models and 51-3/4 inches for set back front axle models. The purpose of moving the axle rearward is to increase loads applied to the front axle and increase maneuverability. Standard type front axle setting generally enables more economical cab construction and meets axle spread requirements of states using the "Bridge Formula."

Shipping Weight: The weight of the basic truck including all standard equipment plus grease and oil wherever required. It does not include the weight of fuel or coolant.

Slack Adjuster: Adjustable brake lever on air brake assemblies.

Spiral Bevel Gears: Gears with spiral-shaped teeth used primarily to change the direction of transmitted power, such as from the propeller shaft to axle shafts.

Spring Capacity At Pad: The amount of sprung weight, which will bend a leaf spring its maximum amount.

Spring Deflection Rate: The number of pounds necessary to deflect the spring one inch.

Springs, Auxiliary Type: Springs that do not come into operation until a predetermined load is placed on the chassis. They are designed to provide riding comfort whether the truck is empty or under partial load.

Springs, Progressive Type: Springs that automatically adjust to load or road conditions, assuring a smooth, comfortable ride.

Springs, Semi-Elliptical: Springs basically consisting of one main leaf with eyes at each end for connection to spring shackles and brackets and a number of shorter leaves of uniformly decreasing length shaped in the form of an arc.

Stroke: The distance traveled by a piston in a cylinder during 1/2 revolution of the crankshaft.

Synchromesh Transmission: A transmission with mechanisms for synchronizing the gear speeds so that the gears can be shifted without clashing, thus eliminating the need for double clutching.

Tachograph: Instrument to record vehicle trip record and operation as kph, rpm, "stop" and "go" periods.

Tandem Axle: Two axles operated from a single suspension. (Three axles placed together is sometimes referred to as tri-axle tandem). There are three tandem axles drive types. 1. Dual Drive Tandem: Both axles have drive mechanisms and are connected to engine power unit. 2. Pusher Tandem: Only the rearmost axle is driving type and forward unit is free rolling (load carrying only) commonly called "dead axle." 3. Trailing Axle Tandem (Tag Axle): Forward unit of tandem is driving type while rear unit is free rolling. This arrangement is sometimes installed locally on a single rear axle model, which has usually been built special to include a frame rail sufficiently long enough to support the extra axle. Both items 2 and 3 are sometimes used with "V-belt drive" which provides drive to both axles. This arrangement does not provide provision for inter-axle differential action.

Tilt Cab: Vehicle designed with the engine beneath the cab and having provisions for tilting the cab forward on a pivot near the front bumper to provide easy access to the engine.

Tire Load Capacity: The maximum recommended load, which may be carried by the tires. Altering the size of the tires on a vehicle will have a direct bearing on the load, which can be carried.

(TL) Trailer Length: Front of body to bumper.

Toe-In: The amount by which the front of the front wheels are closer together than the rear of the front wheels. Front wheels are toed-in to improve steering and increase tire life.

Torque, Converter: A torque converter is made up of a pump, a turbine, and a stator. It multiplies engine torque. When torque multiplication nears a one-to-one ratio, the converter acts as a fluid coupling between the engine and the transmission. At all other pump-turbine ratios, torque is automatically multiplied according to the load imposed on the vehicle, within the limits of the converter.

Torque, Engine: Engine torque is the amount of twisting effort exerted at the crankshaft by an engine. The unit of measure is a pound-foot, which represents a force of one pound acting at right angles at the end of an arm one foot long.

Torque, Gross: The maximum torque developed by an engine without allowing for the power absorbed by the engine's accessory units such as the fan, water pump, generator and exhaust system. Gross torque is used to determine gross horsepower.

Torque, Net: The torque available at the flywheel of the engine after the power required by the engine accessories (fan, water pump, generator, etc.) has been provided.

Tractive Effort: See Rim Pull.

Tractor (Highway): Vehicle designed for pulling loads greater than weight actually applied to the vehicle. Most standard series 5000 and up are designed for either tractor or truck service. Optional equipment is available to adapt each unit for the particular tractor or truck application for which it is to be used. GCW rating indicates total pulling capacity of a unit including its own weight when used as a tractor in a specified type of service. GVW rating also must not be exceeded.

Trailer, Full: A full trailer is a truck trailer constructed so that all its own weight and that of its load rests upon its own wheels (see full trailer).

Trailer, Semi: A trailer having axle (or axles) only at the rear, the front of the semi-trailer is supported by a tractor fifth wheel. A semi-trailer may be operated as a full-trailer by using a converter dolly to support the front of the trailer.

GLOSSARY OF TRUCK TERMS

Transmission: A transmission contains a number of gears which when a connection is made between a specific set provides a choice of ratio. Connection is made by sliding the teeth of one gear into mesh with another, or by engaging a tooth type clutch, which has one part, fastened to a gear already meshed to another, and the other part splined to a shaft. Synchromesh transmissions use gear speed synchronizers to ease engagement.

Tread: The distance between the centers of tires at the points where they contact the road surface. Duals are measured from the center of dual wheels.

Truck: Vehicle designed for carrying entire load, GVW rating indicates truck capacity. GCW will also apply if a trailer is to be pulled behind the truck. GVW and GCW ratings are maximum at the ground including vehicle, payload and all equipment. A load capacity chart for each model indicates basic equipment needed for each GVW and GCW.

Turbocharger: A rotary compressor that pressurizes engine intake air driven by the flow of exhaust gases. It raises the pressure in the combustion chamber to increase the power of the engine.

Turning Radius: Half the distance across the smallest circle in which a truck will turn. Can be measured from the centerline of the outside front tire or the outside of the front bumper.

Under Drive: Lowest ratio in the auxiliary transmission or multi-speed transmission.

Universal Joint: A particular coupling that permits a driving shaft to operate between two power train units that are not always in alignment with each other or subject to movement. For example, between a frame-mounted transmission and a spring-mounted rear axle, a universal joint will usually angle. When installed on a propeller shaft, it allows the shaft to rotate through an angle.

Vacuum Assist (Power) Brakes: Standard type hydraulic brakes with a pressure assist cylinder having a vacuum chamber which when atmospheric pressure is allowed to one side of the piston or diaphragm, drives a plunger in the hydraulic system increasing the effect of pedal pressure.

Weight Distribution: Portions of total weight of a vehicle, which will be supported by each axle. Proper predetermination of the distribution of vehicle, equipment, and payload weight is one of the most important requirements in selecting a truck or tractor for a particular operation.

Weight Sprung: The weight of those things supported by the springs, such as frame, engine, body, payload, etc.

Weight Unsprung: The weight of components such as tires, wheels, and axles that is not supported by the springs.

Wheelbase (WB): The distance between the centerlines of the front and rear axles. For trucks with tandem rear axles, the centerline is midway between the two rear axles.

Yield Strength: Yield strength is the maximum amount of stress in pounds per square inch to which material, for example, as in a frame, may be subjected through loading and return to its original shape upon removal of the stress, i.e., no deformation remains. See Frames Section.

ENGINE AND DRIVELINE SELECTION

The selection of a truck or tractor to perform a given job requires the selection of a proper engine and driveline. The first consideration should be the selection of the proper engine. To accomplish this, engine horsepower is needed to overcome certain forces that act upon the vehicle such as rolling resistance, grade resistance, and road surface resistance. These forces can be related to horsepower and have been conveniently tabulated into chart form which, when added together, give the total horsepower demand on the engine.

The following is a sample of the procedure to follow in determining power needs.

I. OPERATIONAL DATA. List all known operational data obtained from sources such as Online Order Guide, operator, or trailer manufacturer.

Average load - 29,000 lbs. normal complete load for actual run.
Maximum legal load - 32,000 lbs.
(Seldom achieved)
Road speed desired - 45 to 60 MPH.
Road surface - worn concrete
Altitude - 1,500 ft.
Grade required at top speed - .3%
Maximum grade encountered - 6%.
Average frontal area - C7C042 with 11 ft. high VAN BODY 84 sq. ft.
Tires used - 11R22.5G, load range F.
Probable driveline - 5 speed transmission with two-speed rear axle.

	Average Load @ 60 MPH	Maximum Load @ 45 MPH
II. POWER REQUIREMENT FOR GCW	29,000	32,000
Demand horsepower		
1. Rolling Resistance HP (Chart A)	62.3	46.4
2. Air Resistance HP (Chart B)	87.0	36.7
3. Grade Resistance HP (Chart C)	13.9	11.5
4. Total Demand HP	163.2	94.6

5. Demand HP Correction Factor (Chart E)
Five Speed Transmission & two-speed rear axle
Average Mechanical = .86
DIESEL= 3% per 1000 ft. altitude over 500 ft.
(1500 FT) .97 x 92 = .89
GAS=1.5 per 1000 ft. altitude over 500 ft.
(1500 FT) .985 x .92 = .91

6. Required Net Brake HP DIESEL	183.4	110.0
GAS	179.3	104.2

Since the engine power requirement for full load at 45 MPH is less than requirement for average load, we will now concentrate on obtaining the engine and driveline best suited to the maximum load. If the power requirement for maximum load were greater, we would probably lower our speed requirement unless forced into the speed by legal consideration.

III. RESERVE HORSEPOWER AND GRADEABILITY Select an engine with a maximum Net Brake HP equal to line 6 or greater.
It can be seen that it will take 179.3 Required Net Brake HP for a gas engine and 183.4 for a diesel to propel at 60 MPH our vehicle with 29,000 lbs. GCW over .3% grade road on worn concrete. Checking the Engine Section we find that a 295 net horsepower gas engine governed at 4000 RPM is available (with a 8.1L V-8 engine) or a 215 horsepower diesel engine governed at 2400. Now we select a truck that will qualify according to known operational data and with an engine that has adequate power. Consulting the Online Order Guide and comparing the two engines we find that a model C7C042 with either available Vortec 8.1L engine or Duramax diesel fills these operational requirements.

	GAS	DIESEL
Engine Net Brake	295	215
Minus Demand		
Net Brake HP (II, line 6)	179.3	183.4
Reserve Net Brake HP	115.7	31.6

Reserve Gradeability = $\frac{37{,}500 \times \text{Reserve HP}}{\text{MPH} \times \text{Gross Load}}$

GAS= $\frac{37{,}500 \times 115.7}{60 \times 29{,}000}$

DIESEL= $\frac{37{,}500 \times 31.6}{60 \times 29{,}000}$

Reserve Gradeability GAS = 2.49 DIESEL = .68

Note: .3% gradeability at full engine speed is recommended
Minimum reserve gradeability = .25 @ 45 mph

GAS = $\frac{37{,}500 \times 23.7}{45 \times 29{,}000}$ DIESEL = $\frac{37{,}500 \times 9.6}{45 \times 29{,}000}$

GAS = 0.738 DIESEL = .908

IV. SELECTING REAR AXLE RATIO Our first step is to select an ideal final drive ratio.

R = RPM x 60 / M x MPH

Where: R – Ratio
M - Tire revolutions per mile
MPH - Road speed
RPM - Engine RPM at HP required

The RPM in this formula will be based on 179.3 for gas and 183.4 for diesel Demand Net Brake HP. The power curves show us that approximately 2300 rpms are required for 179.3 net HP for the 8.1L Vortec gas engine and 1700 rpms for 183.4 net HP from the Duramax diesel engine.

Note: For any truck application or tractor service where GCW is substantially less than maximum permissible GCW, we should use governed or rated engine RPM in selecting the ratio.

R = $\frac{3200 \times 60}{499 \times 60}$ R = $\frac{2000 \times 60}{4.00 \times 60}$

GAS ENGINE R = 6.41 DIESEL ENGINE R = 5.00

Transmission Selection From Driveline

Our available transmissions with the gas engine are the Eaton FS5205A 5-speed or FS5406 6-speed and the FS6305A, FS6305B, FS6406A, ES066-7B, RT6609 and the 8908LL.

ENGINE AND DRIVELINE SELECTION

We must now select an available rear axle ratio nearest to the ideal. Where two ratios are close, one being over and one under (numerically), the greater numerical ratio will allow greater power output but may limit top speed if geared speed becomes lower than desired MPH, and the lesser numerical ratio will increase economy but may limit speed due to lack of power.

For the C7C042 with the 8.1L Vortec gas engine and 23090T, two-speed rear axle is available with several ratio's for the transmissions available, (See Engine Driveline Chart) 3.70/5.05, 3.90/5.32, 4.11/5.60, 4.33/5.90, 4.56/6.20, 4.88/6.64, 5.43/7.39, 6.17/8.40, 6.67/9.08

For the C7C042 with the Duramax Diesel, and the 23090T, two-speed rear axle is available with several ratios for the transmissions available. (See Engine Driveline Chart): 3.70/5.05, 3.90/5.32, 4.11/5.60, 4.33/5.90, 4.56/6.20, 4.88/6.64, 5.43/7.39, 6.17/8.40, and 6.67/9.08

Now a check is made of the selection ratios to see what horsepower is available at 60 miles per hour for the gas engine.

$$RPM = \frac{R \times M \times MPH}{60}$$

With 6.17 ratio $RPM = \frac{6.17 \times 499 \times 60}{60}$

RPM = 3078

Referring to the engine power curve we find that net HP at 3078 RPM is approximately 255 HP. This means that with the direct drive transmission our road speed would be about 60 MPH.

For the Diesel engine we compare:

With 4.63 ratio $RPM = \frac{4.63 \times 499 \times 60}{60}$

RPM = 2310

Referring to the diesel power curve we find that net HP at 2310 RPM is 206, with the required horsepower of 183.4 to attain 60 MPH we can see that the 4.63 will permit sufficient engine speed to attain the power required.

GMT CONVENTIONAL MEDIUM DUTY TRUCK
MINIMUM PERFORMANCE CRITERIA

Engine Driveline and Performance Guide Charts found at the beginning of each C Series Section were developed using this minimum performance criteria.

Startability Index at GVW: 15% gradeability for on highway applications, 20% gradeability for on/ off highway
Level Highway Top Speed - 50 MPH

Cruise Gradeability at GVW: 2.0% gradeability at 45 MPH for Truck (RQ2)-042 models, 2.0% gradeability at 35 MPH for Truck (RQ2)-064 models or Truck Tractor (RQ3) 042 / 064 models

Top Speed Gradeability at GVW/ GCW: 0.1% gradeability at 60 MPH or at engine governed speed in top gear whichever condition results in a lower speed.

Peak Torque Grade ability at GVW/ GCW: 1.0% gradeability at peak engine torque in top gear

Acceleration Requirement: None

Recommended combination performance criteria was calculated at rated axle GAWR;
assuming the following vehicle factors:
1) 80 square foot frontal area
2) .0018 drag factor
3) .75 tire pavement factor
4) drive line efficiency factor from Chart E
5) operating altitude is 1000 feet
6) Engine parasitic losses are 10 HP

ENGINE AND DRIVELINE SELECTION

V. SELECTING A TRANSMISSION

After selecting the best available rear axle ratio, transmission may generally be selected using the following:

For truck service

1. Use a single speed rear axle with 4 and 5-speed deep ratio transmission, providing sufficient maximum gradeability is provided. (Use maximum gradeability formula to determine.) Recommended startability is 14% turnpike, 16% general highway, 25% moderate on / off highway and 30% severe on / off highway. Maximum speed should be restricted to less than 70 MPH.
2. Use single speed rear axle (double reduction recommended for severe service) with main and auxiliary transmission combination, or a 10 to 13-speed transmission when steep grades are to be encountered or for off-road applications.
3. In cases where a deep ratio 5-speed transmission with a single speed axle is adequate except in starting, a 2-speed rear axle may be used to provide torque at rear wheels, using deep axle ratio only for starting and not split shifting up through the gears. Another use is on one way loaded operations where the deep axle ratio may be used when vehicle is loaded, and the fast axle ratio used when vehicle is operated light.

For tractor service

The choice of transmission and rear axle combination is dependent on several factors:

1. Generally, with low power to weight ratio, a maximum number of close gear steps are required to give the best performance possible with the available power. The 5-speed transmission and 2-speed rear axle combination provides close splits above 35 MPH, good for level or gently rolling terrain. The 13-speed transmission is well suited to severe operations where moderately close steps and high starting torque is required.
2. With more power or less weight, transmissions with fewer gear steps will do a good job. A 10-speed compound transmission is preferred by many operators, particularly in mountain areas, where quick dependable shifts are required. The wider rear steps (than 5-speed transmission with a 2-speed rear axle) reduce the number of shifts and consequent power interruptions per mile in rolling terrain.
3. Operator driver preference should certainly receive due consideration where you are proposing transmission and axle combinations. For example, it may be unwise to offer a 10-speed transmission to an operator whose drivers are accustomed to driving a 5-speed transmission with a 2-speed rear axle. Certainly, if such a change does take place, adequate driver training should be conducted to prevent increased operating costs.
4. Regarding choice of number of driving axles, it is not recommended to use single drive axles for tractors that pull in excess of 70,000 lbs. GCW because: (a) traction is poor on wet or icy pavement, and (b) tire wear on drive axle is rapid.
5. Usually the use of a 40,000 lb. capacity rear axle to carry 32,000 lbs. is not advocated, if both 34,000 and 38,000 lb. axles have the same differential carrier ring gear assembly. The customer pays more for more weight without benefit. However, for heavy service behind a high torque engine and a 13-speed transmission, a 40,000 lb. tandem would be recommended to withstand the possible high torque loads of this combination.
6. Single reduction tandem gearing is normally adequate for highway service.

AVERAGE FRONTAL AREA

Medium Duty Conventional 5000 / 6000 / 7000 Series = 50 Sq. Ft.

Average Frontal Area Vehicle with Body or Trailer (8 Ft. Wide)

Body Height Top to Ground (Ft.)	Frontal Area Sq. Ft.	Body Height Top to Ground (Ft.)	Frontal Area Sq. Ft.	Body Height Top to Ground (Ft.)	Frontal Area Sq. Ft.
6	44	9	68	12	92
6.5	48	9.5	72	12.5	96
7	52	10	76	13	100
7.5	56	10.5	80	13.5	104
8	60	11	84	14	108
8.5	64	11.5	88		

ENGINE AND DRIVELINE SELECTION

CHART A
ROLLING RESISTANCE DEMAND HORSEPOWER
FOR RADIAL TIRES ON WORN CONCRETE

Gross Weight (GW) (lbs.)	MPH												
	10	15	20	25	30	35	40	45	50	55	60	65	70
15,000	2.1	3.3	4.6	6.0	7.5	9.1	10.8	12.5	14.4	16.4	18.4	20.6	22.8
20,000	2.8	4.4	6.1	8.0	10.0	12.1	14.3	16.7	19.2	21.8	24.6	27.5	30.5
25,000	3.5	5.5	7.7	10.0	12.5	15.1	17.9	20.9	24.0	27.3	30.7	34.3	38.1
30,000	4.2	6.6	9.2	12.0	15.0	18.1	21.5	25.1	28.8	32.7	36.9	41.2	45.7
35,000	4.9	7.7	10.8	14.0	17.5	21.2	25.1	29.2	33.6	38.2	43.0	48.0	53.3
40,000	5.6	8.8	12.3	16.0	20.0	24.2	28.7	33.4	38.4	43.6	49.2	54.9	60.9
45,000	6.3	9.9	13.8	18.0	22.5	27.2	32.3	37.6	43.2	49.1	55.3	61.8	68.5
50,000	7.0	11.0	15.4	20.0	25.0	30.2	35.8	41.8	48.0	54.6	61.4	68.6	76.2
55,000	7.7	12.1	16.9	22.0	27.5	33.3	39.4	45.9	52.8	60.0	67.6	75.5	83.8
60,000	8.4	13.2	18.4	24.0	30.0	36.3	43.0	50.1	57.6	65.5	73.7	82.4	91.4
65,000	9.2	14.4	20.0	26.0	32.4	39.3	46.6	54.3	62.4	70.9	79.9	89.2	99.0
70,000	9.9	15.5	21.5	28.0	34.9	42.3	50.2	58.5	67.2	76.4	86.0	96.1	106.6
75,000	10.6	16.6	23.0	30.0	37.4	45.4	53.8	62.6	72.0	81.8	92.2	103.0	114.2
80,000	11.3	17.7	24.6	32.0	39.9	48.4	57.3	66.8	76.8	87.3	98.3	109.8	121.9
85,000	12.0	18.8	26.1	34.0	42.4	51.4	60.9	71.0	81.6	92.8	104.4	116.7	129.5

Tire Pavement Factor (1.20)

Formula: Rolling Resistance Demand Horsepower = $\dfrac{\text{MPH x Gross Weight x Tire Pavement Factor x } 6.75 + (.074 \text{ x MPH})}{375{,}000}$

CHART B
AIR RESISTANCE DEMAND HORSEPOWER

Frontal Area (Sq. Ft.)	MPH																	
	10	15	20	25	30	35	40	45	47	49	50	52	54	56	58	60	65	70
44	.2	.7	1.6	3.1	5.6	8.5	12.7	18.1	20.7	23.4	24.9	28.0	31.3	34.9	38.8	43.0	54.7	68.3
48	.2	.7 .8	1.7	3.4	5.9	9.4	14.0	19.9	22.6	25.7	27.3	30.7	34.3	38.3	42.5	47.1	59.9	74.8
50	.2	.8 .9	1.8	3.6	6.1	9.7	14.5	20.7	23.6	26.7	28.4	31.9	35.7	39.9	44.3	49.0	62.3	77.9
52	.2		1.9	3.7	6.4	10.2	15.2	21.6	24.6	27.9	29.6	33.3	37.3	41.6	46.2	51.2	65.1	81.3
56	.3		2.0	4.0	6.9	10.9	16.3	23.2	26.4	29.9	31.8	35.7	40.0	44.6	49.6	54.9	69.8	87.1
60	.3	.9	2.2	4.3	7.3	11.7	17.4	24.8	28.2	32.0	34.0	38.3	42.8	47.8	53.1	58.8	74.7	93.3
64	.3	1.0,	2.3	4.5	7.8	12.4	18.6	26.4	30.1	34.1	36.3	40.8	45.7	50.9	56.6	62.6	79.6	99.5
67	. 3	1.0,	2.4	4.8	8.2	13.0	19.5	27.7	31.6	35.8	38.0	42.7	47.9	53.4	59.3	65.7	83.5	104.3
68	.3	1.0,	2.4	4.8	8.2	13.2	19.7	28.1	32.0	36.2	38.5	43.3	48.5	54.1	60.1	66.5	84.6	105.6
72	.3	1.1	2.6	5.1	8.8	14.0	20.9	29.7	33.9	38.4	40.8	45.9	51.3	57.3	63.6	70.4	89.5	111.8
76	.4	1.2	2.8	5.4	9.3	14.8	22.1	31.4	35.8	40.6	43.1	48.5	54.3	60.6	67.3	74.5	94.7	118.3
80	.4	1.2	2.9	5.7	9.8	15.6	23.2	33.0	37.7	42.7	45.4	51.0	57.2	63.7	70.8	78.4	99.7	124.5
84	.4	1.3	3.1	6.0	10.3	16.3	24.4	34.7	39.6	44.8	47.6	53.6	60.0	67.0	74.3	82.3	104.6	130.7
88	.4	1.4	3.2	6.2	10.8	17.1	25.5	36.4	41.4	46.9	49.9	56.1	62.8	70.1	77.9	86.2	109.6	136.9
92	.4	1.4	3.3	6.5	11.3	17.9	26.7	38.0	43.3	49.1	52.1	58.6	65.7	73.2	81.4	90.1	114.5	143.0
96	.4	1.5	3.5	6.8	11.8	18.7	27.8	39.6	45.2	51.2	54.4	61.2	68.5	76.4	84.9	94.0	119.5	149.2
100	.5	1.5	3.6	7.1	12.2	19.4	29.0	41.3	47.0	53.3	56.6	63.7	71.3	79.6	88.4	97.9	124.4	155.4
104	.5	1.6	3.8	7.4	12.7	20.2	30.1	42.9	48.9	55.4	58.9	66.2	74.2	82.7	91.9	101.7	129.3	161.6

Formula: AR Demand HP = $\dfrac{\text{F x (MPH) 3 x K}}{375}$

Where: F = Frontal Area in Sq. Ft.
MPH = Miles per hour
K = Drag Coefficient (.0017)

ENGINE AND DRIVELINE SELECTION

CHART C
GRADE RESISTANCE DEMAND HORSEPOWER PER EACH 1% GRADE

Total Load (Lbs.)	MPH																	
	10	15	20	25	30	35	40	45	47	49	50	52	54	56	58	60	65	70
5,000	1.3	2.0	2.7	3.3	4.0	4.7	5.3	6.0	6.3	6.5	6.7	6.9	7.2	7.5	7.7	8.0	8.7	9.3
10,000	2.7	4.0	5.3	6.7	8.0	9.3	10.7	12.0	12.5	13.1	13.3	13.9	14.4	14.9	15.5	16.0	17.3	18.7
15,000	4.0	6.0	8.0	10.0	12.0	14.0	16.0	18.0	18.8	19.6	20.0	20.8	21.6	22.4	23.2	24.0	26.0	28.0
20,000	5.3	8.0	10.6	13.3	16.0	18.7	21.3	24.0	25.1	26.1	26.7	27.7	28.8	29.9	30.9	32.0	34.7	37.3
25,000	6.7	10.0	13.3	16.7	20.0	23.3	26.7	30.0	31.3	32.7	33.3	34.7	36.0	37.3	38.7	40.0	43.3	46.7
30,000	8.0	12.0	16.0	20.0	24.0	28.0	32.0	36.0	37.6	39.2	40.0	41.6	43.2	44.8	46.4	48.0	52.0	56.0
35,000	9.3	14.0	18.7	23.3	28.0	32.7	37.3	42.0	43.9	45.7	46.7	48.5	50.4	52.3	54.1	56.0	60.7	65.3
40,000	10.7	16.0	21.3	32.0	36.7	37.3	42.7	48.0	50.1	52.3	53.3	55.5	57.6	59.3	61.9	64.0	69.3	74.7
45,000	12.0	18.0	24.0	30.0	36.0	42.0	48.0	54.0	56.4	58.8	60.0	62.4	64.8	67.2	69.6	72.0	78.0	84.0
50,000	13.3	20.0	26.7	33.3	40.0	46.7	53.3	60.0	62.7	65.3	66.7	69.3	72.0	74.7	77.3	80.0	86.7	93.3
55,000	14.7	22.0	29.3	36.7	44.0	51.3	58.7	66.0	68.9	71.9	73.3	76.3	79.2	82.1	85.1	88.0	95.3	102.7
60,000	16.0	24.0	32.0	40.0	48.0	56.0	64.0	72.0	75.2	78.4	80.0	83.2	86.4	89.6	92.8	96.0	104.0	112.0
65,000	17.3	26.0	34.7	43.3	52.0	60.7	69.3	78.0	81.5	84.9	86.7	90.1	93.6	97.1	100.5	104.0	112.7	121.3
70,000	18.7	28.0	37.3	46.7	56.0	65.3	74.7	84.0	87.7	91.5	93.3	97.1	100.8	104.5	108.3	112.0	121.3	130.7
73,280	19.5	29.3	39.1	48.9	58.6	68.4	78.2	87.9	91.8	95.8	97.7	101.6	105.5	109.4	113.3	118.2	127.0	136.8
75,000	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	94.0	98.0	100.0	104.0	108.0	112.0	116.0	120.0	130.0	140.0
76,800	20.5	30.7	41.0	51.2	61.4	71.2	82.0	92.2	96.3	100.4	102.4	106.4	110.6	114.7	118.8	122.9	133.1	143.4
80,000	21.3	32.0	42.7	53.3	64.0	74.7	85.3	96.0	100.3	104.5	106.7	110.9	115.2	119.5	123.7	128.0	138.7	149.3
85,000	22.7	34.0	45.3	56.7	68.0	79.3	90.7	102.0	106.5	111.1	113.3	117.9	122.4	126.9	131.5	136.0	147.3	158.7

Formula: $\text{GR Demand HP} = \frac{\text{MPH} \times \text{\% Grade} \times \text{GW}}{37{,}500}$

Where: MPH = Miles per Hour
GW = Gross Weight

CHART D
ROAD SURFACE RESISTANCE

Road Surface	Lbs. Resistance per 1000 Lbs. of Load	Tire Pavement Factor Bias Ply	Tire Pavement Factor Radial
Best Concrete	10	1.00	0.70
Worn Concrete Asphalted Concrete (cold) Brick	12	1.20	0.90
Asphalted Concrete (summer heat)	15	1.50	1.20
Hard packed natural soil	17.5	1.75	1.45
Average packed gravel Asphalt in summer heat	20	2.00	1.70
Loose Gravel	75-100	8.75	8.45
Sand	100-150	12.50	12.20

ENGINE AND DRIVELINE SELECTION

CHART E
DEMAND HORSEPOWER CORRECTION FACTOR

Driveline Type			Altitude (Ft.)											
Transmission	Drive Axles	Drive Line Efficiency	Sea Level	500	1500	2500	3500	4500	5500	6500	7500	8500	9500	10500
Four-Cycle GAS														
Manual	Sgl.	.92	.93	.92	.91	.89	.88	.87	.85	.84	.82	.81	.80	.78
Manual	Dual	.87	.88	.87	.86	.84	.83	.82	.81	.79	.78	.77	.75	.74
Manual/Aux	Sgl.	.87	.88	.87	.86	.84	.83	.82	.81	.79	.78	.77	.75	.74
Manual/Aux	Dual	.82	.83	.82	.81	.80	.78	.77	.76	.75	.73	.72	.71	.70
Automatic	Sgl.	.85	.86	.85	.84	.83	.81	.80	.79	.77	.76	.75	.74	.72
Automatic	Dual	.80	.81	.80	.79	.78	.76	.75	.74	.73	.72	.70	.69	.68

Formula: Driveline Efficiency x Altitude Correction = DHCF

CHART F
NET BRAKE HORSEPOWER REQUIRED

Demand Horsepower	Demand HP Correction Factor From Chart																	
	1.0	.95	.93	.90	.87	.85	.83	.80	.77	.75	.73	.70	.67	.65	.63	.60	.57	.55
10	10	10.5	10.8	11.1	11.5	11.8	12.1	12.5	13.0	13.3	13.7	14.3	14.9	15.4	15.9	16.7	17.5	18.2
20	20	21.1	21.5	22.2	23.0	23.5	24.1	25.0	26.0	26.7	27.4	28.6	29.9	30.8	31.8	33.3	35.1	36.4
30	30	31.6	32.3	33.3	34.5	35.3	36.1	37.5	39.0	40.0	41.1	42.9	44.8	46.2	48.7	50.0	52.6	54.6
40	40	42.1	43.0	44.4	46.0	47.1	48.2	50.0	52.0	53.3	54.8	57.1	59.7	61.5	63.5	66.7	70.2	72.8
50	50	52.6	53.8	55.6	57.5	58.8	60.2	62.5	64.9	66.7	68.5	71.4	74.6	76.9	79.4	83.3	87.7	90.9
60	60	63.2	64.5	66.7	69.0	70.6	72.3	75.0	77.9	80.0	82.2	85.7	89.6	92.3	95.2	100.0	105.3	109.1
70	70	73.7	75.3	77.8	80.5	82.4	84.3	87.5	90.9	93.3	95.9	100.0	104.5	107.7	111.1	116.7	122.8	127.3
80	80	84.2	86.0	88.9	92.0	94.1	96.4	100.0	103.9	106.7	109.6	114.3	119.4	123.1	127.0	133.3	140.4	145.5
90	90	94.8	96.8	100.0	103.5	105.9	108.4	112.5	116.9	120.0	123.3	128.6	134.3	138.5	142.9	150.0	157.9	163.6
100	100	105.3	107.5	111.1	114.9	117.6	120.5	125.0	129.9	133.3	137.0	142.9	149.3	153.9	158.7	166.7	175.4	181.8
110	110	115.8	118.3	122.2	126.4	129.4	132.5	137.5	142.9	146.7	150.7	157.1	164.2	169.2	174.6	183.3	193.0	200.0
120	120	126.3	129.0	133.3	137.9	141.2	144.6	150.0	155.8	160.0	164.4	171.4	179.1	184.6	190.5	200.0	210.5	218.2
130	130	136.8	139.8	144.4	149.4	152.9	156.6	162.5	168.8	173.3	178.1	185.7	194.0	200.0	206.4	216.7	228.1	236.4
140	140	147.4	150.5	155.6	160.9	164.7	168.7	175.0	181.8	186.7	191.8	200.0	209.0	215.4	222.2	233.3	245.6	254.6
150	150	157.9	161.3	166.7	172.4	176.5	180.7	187.5	194.8	200.0	205.5	215.3	223.9	230.8	238.1	250.0	263.2	272.7
160	160	168.4	172.0	177.8	183.9	188.2	192.8	200.0	207.8	213.3	219.2	228.6	238.8	246.2	254.0	266.7	280.7	
170	170	179.0	182.8	188.9	195.4	200.0	204.8	212.5	220.8	226.7	232.9	242.9	253.7	261.5	269.8	283.3		
180	180	189.5	193.6	200.0	206.9	211.8	216.9	225.0	233.8	240.0	246.6	257.1	268.7	276.9	285.7			
190	190	200.0	204.3	211.1	218.4	223.5	228.9	237.5	246.8	253.3	260.3	271.4	283.6					
200	200	210.5	215.1	222.2	229.9	235.3	241.0	250.0	259.7	266.7	274.0	285.7						
210	210	221.1	225.8	233.3	241.4	247.1	253.0	262.5	272.7	280.0								
220	220	231.6	236.6	244.4	252.9	258.8	275.0	285.7										
230	230	242.1	247.3	255.6	264.4	270.6	277.1											
240	240	252.6	258.1	266.7	275.9	282.4												
250	250	263.2	268.8	277.8														

Formula: Required Engine Net Brake Horsepower = Demand HP / Demand HP Correction Factor

ENGINE AND DRIVELINE SELECTION
PERFORMANCE FORMULAS

The following formulas will answer questions that an operator has when he is buying a truck or tractor with special engine, transmission, and rear axle combinations. For standard and optional combinations, these calculations are found on the performance pages for each truck model.

1. Total Maximum Gear Reduction: (Maximum transmission reduction) x (maximum auxiliary transmission reduction) x (maximum rear axle reduction). Total multiplication of torque provided by deepest ratios in transmission (auxiliary transmission or transfer case) and rear axle. Used by experienced truck people as a rule of thumb as a measure of starting and low speed performance. Maximum reduction is shown with gradeability figures.

2. Geared Speed In MPH. Maximum geared speed is computed with rear axle in high range. If axle is two-speed, maximum geared speed is computed with transmission with auxiliary in highest range. The geared speed is the road speed the vehicle will attain in each transmission (and axle) gear position, with tire size as specified in the heading for each performance set, when and if engine reaches governed speed or net rated RPM. This is strictly a mechanical speed and does not indicate whether or not power is available to attain this speed. **GEARED SPEED=** $\frac{\text{RPM x 60}}{\text{R x M}}$

RPM is at governed or recommended engine speed for above formula.

3. Maximum Gradeability. (Rolling.) Maximum gradeability is computed with the engine at maximum torque and gear train at maximum reduction. This figure is for performance comparison only, since center of gravity and surface traction are not considered. This figure is calculated at maximum driveline reduction and at engine speed producing the highest torque. Maximum practical grade in any specific application is subject to considerations of load distribution, and available traction as well as power.

Percent grade is the proportion of rise to distance traveled and can be interpreted directly as the number of feet of rise for each 100 ft. of level distance. The angle of ascent is not the same as the percent grade. For instance, a 10^0 angle of rise will be equal to approximately an 18% grade, a 20^0 angle to a 36% grade, a 30^0 angle to a 58% grade, and a 45^0 angle to a 100% grade. Maximum grade as published represents gradeability in motion. The formula used for rolling gradeability is:

MAXIMUM % GRADEABILITY (G)= $\frac{100TE}{GW} - \frac{RR}{10}$

4. Startability Index. To determine startability index the following formula should be used: **S=** $\frac{\text{TS x R x M}}{\text{10.7 GW}}$

5. Maximum Speed. This is the approximate maximum speed the vehicle combination will maintain when loaded to maximum rated GVW or GCW (as specified) on new smooth concrete, with specified tires, in still air at sea level and in the best gear position for the specific speed. To calculate maximum speed, it is necessary to assume a speed and then check if this speed can be obtained. If speedability does not match assumed speed, a new figure must be selected and checked. This is necessary since demand horsepower can only be calculated for the speed, which will determine the demand. The general approach is to check the top geared speed in each gear starting from the fastest until a speed range is bracketed, then to re-figure the speed to within a half MPH of the exact figure.

The method used is to match available net horsepower for speed selected with demand horsepower for the same speed. If the available horsepower is greater than the demand, then the truck will go faster (up to the limits of geared speed). If the demand HP is greater, the truck will not be able to reach that speed under the anticipated conditions. If equal, the speed ability is exact. The formula used is:

DHP (Demand Horsepower)=Engine Net Horsepower (NHP)
+RRHP (Rolling Resistance HP)
+ARHP (Air Resistance HP)
+ GRPH (Grade Resistance HP)
CF (Correction factor for drive line & Altitude)

TS-CHART

Engine	Starting Torque (Ts) Vortec 8.1L	Starting Torque (Ts) (Duramax/Isuzu)
LRW (325)	332 lb. ft.	
LRX (300)		345.0 lb. ft.
LYE (330)		345.0 lb. ft.
LYA (215)		361.4 lb. ft.
LYB (230)		361.4 lb. ft.
LYC / LYD (260)		361.4 lb. ft.
LQF (300)		361.4 lb. ft.

Computations are made from formulations derived from actual testing and are reasonably accurate for specified conditions of horsepower, torque, air and rolling resistance, and driveline frictional losses. Actual performance of a specific unit can be affected by variations in production tolerances in engine components, driveline components such as gear teeth surfaces or bearings, and in such environmental variations in barometric pressure, temperature, humidity, altitude, road surface, frontal area, tire pressure, wind direction, and wind velocity. Extreme caution should be exercised in specifying units based on exact compliance with this performance. These performance figures are published only as a guide and exact abilities of specific units cannot be guaranteed.

ENGINE AND DRIVELINE SELECTION PERFORMANCE FORMULAS

Definition Of Terms. The following are terms used in the above formulas
S- Startability Index
C- Constant .00104.
G- Grade in percent.
Percent grade is the number of units (feet) of rise for each 100 units (feet) of horizontal distance.
Example: 1 ft. rise in 100 ft. horizontal distance=1% grade. 12 ft. rise in 100 ft. horizontal distance=12% grade.
GW- Total weight of loaded vehicle. (Gross vehicle weight or Gross combination weight in pounds.)
M- Tire revolution per mile. (Found in the Tire Capacity Chart in Wheels-Tires Section.)
R- Ratio of reduction at axle shafts. Calculated by multiplying the rear axle ratio by the ratios of the gear positions used in the transmission and auxiliary transmission (if used).
RPM- Revolutions per minute of the engine for conditions required by the formulas.
RR- Rolling resistance of the road surface to the movement of the vehicle, in pounds.
RR for various road surface types are:

Road Surface	**RR***
Best concrete	**10 lbs.**
Worn concrete; asphalted concrete (cold); sheet asphalt (cold); brick	**12 lbs.**
Packed gravel, clay bound; asphalted concrete in summer heat	**15 lbs.**
Hard packed natural soil	**15 to 20 lbs.**
Average packed gravel; sheet asphalt in summer heat	**20 lbs.**
Packed natural soil, spongy	**25 to 40 lbs.**
Loose gravel	**75 to 100 lbs.**
Sand	**100 to 150 lbs.**

* RR used for data book calculations.

TE- Tractive effort in pounds.
TE= C x T x R x M
T- Net engine torque.
(a) Use T required for formula application.
(b) Use Maximum T for calculating maximum gradeability.
(c) Use engine power curves to obtain net torque at a given RPM.
TS = Engine Starting Torque

TRUCK ABILITY PREDICTION PROCEDURE -SAE J688

Introduction -The procedure has been developed to provide a practical method for the prediction of truck performance using accepted data. It is designed to help anyone concerned with the problem of truck selection.

By following directions, it is possible to determine the necessary information for intelligent truck selection without being concerned with the origin or derivation of the complex factors involved. With readily available specifications of a truck, information provided in the tables, and minimum calculation, it is possible to predict:

(a) The performance obtainable from a truck of given characteristics under given operating conditions.

(b) The characteristics required in a truck to meet different performance requirements under given operating conditions.

This report comprises a procedure form and 10 tables of data. A complete explanation of the truck ability prediction procedure is contained in SAE Technical Report HS-82, Truck Ability Prediction Procedure. Part I of HS-82 contains, in addition to the procedure form and tables, work sheets and an example. Part 2 demonstrates by practical examples how to obtain some of the answers other than gradeability, and presents a detailed procedure for computing instantaneous acceleration and the time or distance required to accelerate between specified limits of speed. Part 3 gives terminology, the fundamental relations, and the formulas, which form the basis for the procedure, a discussion of the reliability of factors and methods, and presents a method for evaluating the effect of wind on air resistance.

TABLE 1 -TIRE FACTOR

Tubeless Tire Size	Conventional Tire Size	Ply Rating	Tire Factor
6.00-16	6.00-16	6	12.40
6.50-16	6.50-16	6	11.85
7-17.5	7.00-15, 7.00-16	6	11.75
7-17.5	7.00-15, 7.00-16	8	11.75
7-22.5	6.50-20	6	10.15
7-22.5	6.50-20, 7.00-20	8	10.15
8-17.5	7.00-16, 7.50-15 , 7.50-16	6	11.45
8-17.5	7.00-16, 7.50-15, 7.50-16	8	11.45
8-19.5	7.00-17, 7.50-17	6	10.50
8-19.5	7.00-17, 7.50-17	8	10.50
8-22.5	7.50-20	8	9.50
8-22.5	7.50-20	10	9.50
9-22.5	8.25-20	10	9.20
9-22.5	8.25-20	12	9.20
10-22.5	9.00-20	10	8.80
10-22.5	9.00-20	12	8.80
11-22.5	10.00-20	12	8.55
11-22.5	10.00-20	14	8.55
11-24.5	10.00-22	12	8.15
12.00-21	12.00-20	14	8.05
12.00-25	12.00-24	14	7.35
12-22.5	11.00-20	12	8.30
12-22.5	11.00-20	14	8.30
12-24.5	11.00-22	12	7.90
12-24.5	11.00-22	14	7.90
13.00-21	13.00-20	16	7.75
13.00-25	13.00-24	16	7.10
14.00-21	14.00-20	16	7.35
14.00-24	14.00-24	16	6.75

$$\text{Tire Factor} = \frac{168}{\text{Loaded Radius}}$$

TRUCK ABILITY PREDICTION PROCEDURE – SAE J688

FORM FOR DETERMINING GRADEABILITY AT A GIVEN ROAD SPEED AND EQUIVALENT ACCELERATION RATE

DATA PERTAINING TO VEHICLE AND CONDITIONS OF OPERATION

Item

1. Vehicle identification [Make, model, and type of vehicle(s)]
2. Vehicle overall maximum dimensions (a) Height_________ft (b) Width_________ft
3. Total gross weight in thousand lb
4. Manufacturer's maximum gross vehicle weight rating for power unit in pounds
5. Gear ratios (a) Transmission___________(b) Auxiliary transmission___________(c) Axle
   (d) Total gear reduction
6. Tire size (driving wheels)
7. Net engine power at sea level (a)__________ HP at (b) ___________ rpm engine speed
8. Altitude ___________ ft
9. Road surface type and condition______________

PROCEDURE

Steps	Procedure	Value
1. Apparent road speed in mph (a)	(Item 7b) / (Item 5d) x (Tire factor, Table 1)	
2. Net engine hp corrected for altitude	(Altitude factor, Table 2) x (Item 7a)	
3. Rolling resistance HP	(Rolling factor, Table 3) x (Item 3)	
4. Air resistance HP	(Area factor, Table 4) x (Velocity factor, Table 5) x (Altitude factor, Table 6)	
5. Chassis friction HP	(Chassis factor, Table 7)	
6. Level road HP	Sum of values 3, 4, and 5	
7. Reserve HP (b)	(Value 2) minus (Value 6)	
8. Grade resistance HP per 1000 lb weight	(Value 7) / (Item 3)	
9. Gradeability on Class 1 roads (good) (c)	(Value 8) x (Grade factor, Table 8)	
10. Grade deduction for road type and condition	(Road factor, Table 9)	
11. Net grade ability at apparent road speed b	(Value 9) minus (Value 10)	
12. Approximate acceleration rate on level at apparent road speed in mph per sec (total gear reductions less than 10.0)	(0.2) x (Value 11)	

(a) Apparent road speed can be attained under given conditions only if sufficient net HP is available.

(b) If this value is negative, the net HP is insufficient to attain apparent road speed.

(c) Correct value using Table 8A if 20% or above.

TRUCK ABILITY PREDICTION PROCEDURE -SAE J688

TABLE 2 - ALTITUDE FACTOR (FOR NET HP CORRECTION)

Altitude, ft	Altitude Factor	Altitude, ft	Altitude Factor
0	1.00	8,000	0.68
1,000	0.96	9,000	0.64
2,000	0.92	10,000	0.60
3,000	0.88	11,000	0.56
4,000	0.84	12,000	0.52
5,000	0.80	13,000	0.48
6,000	0.76	14,000	0.44
7,000	0.72	15,000	0.40

TABLE 3 - ROLLING FACTOR

mph	Rolling Factor	mph	Rolling Factor	mph	Rolling Factor	mph	Rolling Factor	mph	Rolling Factor
1	0.020	17	0.414	33	0.930	49	1.569	65	2.331
2	0.041	18	0.443	34	0.967	50	1.613	66	2.383
3	0.063	19	0.472	35	1.003	51	1.658	67	2.435
4	0.085	20	0.501	36	1.041	52	1.703	68	2.488
5	0.107	21	0.531	37	1.078	53	1.748	69	2.541
6	0.130	22	0.562	38	1.117	54	1.794	70	2.595
7	0.154	23	0.593	39	1.155	55	1.841	71	2.649
8	0.177	24	0.625	40	1.195	56	1.888	72	2.703
9	0.202	25	0.657	41	1.234	57	1.935	73	2.758
10	0.227	26	0.689	42	1.275	58	1.983	74	2.814
11	0.252	27	0.722	43	1.315	59	2.031	75	2.870
12	0.278	28	0.756	44	1.356	60	2.080	76	2.927
13	0.304	29	0.790	45	1.398	61	2.129	77	2.983
14	0.331	30	0.824	46	1.440	62	2.179	78	3.041
15	0.358	31	0.859	47	1.483	63	2.229	79	3.099
16	0.386	32	0.894	48	1.526	64	2.280	80	3.157

$$\text{Rolling Factor} = \frac{(7.6 + 0.09\ \text{mph}) \times \text{mph}}{375}$$

TRUCK ABILITY PREDICTION PROCEDURE -SAE J688

TABLE 4 - AREA FACTOR

Maximum Vehicle Height, ft	Max Vehicle Width, ft						
	5	5-1/2	6	6-1/2	7	7-1/2	8
5	0.057	0.062	0.068	0.074	0.079	0.085	0.091
5-1/2	0.063	0.070	0.076	0.082	0.089	0.095	0.101
6	0.070	0.077	0.084	0.091	0.098	0.105	0.112
6-1/2	0.077	0.084	0.092	0.100	0.107	0.115	0.123
7	0.083	0.092	0.100	0.108	0.117	0.125	0.133
7-1/2	0.090	0.099	0.108	0.117	0.126	0.135	0.144
8	0.097	0.106	0.116	0.126	0.135	0.145	0.155
8-1/2	0.103	0.114	0.124	0.134	0.145	0.155	0.165
9	0.110	0.121	0.132	0.143	0.154	0.165	0.176
9-1/2	0.117	0.128	0.140	0.152	0.163	0.175	0.187
10	0.123	0.136	0.148	0.160	0.173	0.185	0.197
10-1/2	0.130	0.143	0.156	0.169	0.182	0.195	0.208
11	0.137	0.150	0.164	0.178	0.191	0.205	0.219
11-1/2	0.143	0.158	0.172	0.186	0.201	0.215	0.229
12-1/2	0.157	0.172	0.188	0.204	0.219	0.235	0.251
13	0.163	0.180	0.196	0.212	0.229	0.245	0.261
13-1/2	0.170	0.187	0.204	0.221	0.238	0.255	0.272

$$\text{Area Factor} = \frac{(\text{height} - 3/4) \times \text{width}}{375}$$

TABLE 6 - ALTITUDE FACTOR (FOR AIR RESISTANCE)

Altitude, ft	Altitude Factor
0	1.00
1,000	0.97
2,000	0.94
3,000	0.91
4,000	0.89
5,000	0.86
6,000	0.83
7,000	0.81
8,000	0.78
9,000	0.76
10,000	0.74
11,000	0.71
12,000	0.69
13,000	0.67
14,000	0.65
15,000	0.63

TRUCK ABILITY PREDICTION PROCEDURE -SAE J688

TABLE 5 - VELOCITY FACTOR

mph	Velocity Factor	mph	Velocity Factor	mph	Velocity Factor	mph	Velocity Factor
1	0.00	21	18.5	41	138	61	454
2	0.02	22	21.3	42	148	62	477
3	0.05	23	24.3	43	159	63	500
4	0.13	24	27.6	44	170	64	524
5	0.25	25	31.3	45	182	65	549
6	0.43	26	35.1	46	195	66	575
7	0.69	27	39.4	47	208	67	601
8	1.02	28	43.9	48	221	68	629
9	1.46	29	48.8	49	235	69	657
10	2.00	30	54.0	50	250	70	686
11	2.66	31	59.6	51	265	71	716
12	3.46	32	65.5	52	281	72	746
13	4.39	33	71.9	53	298	73	778
14	5.49	34	78.6	54	315	74	810
15	6.75	35	85.7	55	333	75	844
16	8.19	36	93.3	56	351	76	878
17	9.83	37	101	57	370	77	913
18	11.7	38	110	58	390	78	949
19	13.7	39	119	59	411	79	986
20	16.0	40	128	60	432	80	1024

Velocity Factor = 0.002(mph) 3

TABLE 7 - CHASSIS FRICTION HORSEPOWER*

Manufacturer's Max Gross Vehicle Weight Rating of Power Unit	Engine RPM													
	800	1000	1200	1400	1600	1800	2000	2200	2400	2600	2800	3000	3200	3400
10,000	2.6	3.0	3.4	3.8	4.2	4.6	5.0	5.4	5.8	6.2	6.6	7.0	7.4	7.8
11,000	2.7	3.2	3.6	4.1	4.5	4.9	5.4	5.8	6.3	6.7	7.1	7.6	8.0	8.5
12,000	2.9	3.4	3.9	4.4	4.8	5.3	5.8	6.3	6.8	7.2	7.7	8.2	8.7	9.2
13,000	3.0	3.6	4.1	4.6	5.1	5.6	6.2	6.7	7.2	7.7	8.2	8.8	9.3	9.8
14,000	3.2	3.8	4.4	4.9	5.5	6.0	6.6	7.2	7.7	8.3	8.8	9.4	10.0	10.5
15,000	3.4	4.0	4.6	5.2	5.8	6.4	7.0	7.6	8.2	8.8	9.4	10.0	10.6	11.2
16,000	3.6	4.2	4.8	5.5	6.1	6.8	7.4	8.0	8.7	9.3	10.0	10.6	11.2	11.9
17,000	3.7	4.4	5.0	5.7	6.4	7.1	7.8	8.4	9.1	9.8	10.6	11.2	11.8	12.5
18,000	3.9	4.6	5.3	6.0	6.8	7.5	8.2	8.9	9.6	10.4	11.1	11.8	12.5	13.2
19,000	4.0	4.8	5.5	6.3	7.1	7.8	8.6	9.3	10.1	10.9	11.6	12.4	13.1	13.9
20,000	4.2	5.0	5.8	6.6	7.4	8.2	9.0	9.8	10.6	11.4	12.2	13.0	13.8	14.6
22,000	4.5	5.4	6.3	7.1	8.0	8.9	9.8	10.7	11.5	12.4	13.2	14.2	15.1	15.9
24,000	4.8	5.8	6.8	7.7	8.7	9.6	10.6	11.6	12.5	13.5	14.4	15.4	16.4	17.3
26,000	5.1	6.2	7.2	8.2	9.3	10.3	11.4	12.4	13.4	14.5	15.5	16.6	17.6	18.6
28,000	5.5	6.6	7.7	8.8	9.9	11.1	12.2	13.3	14.4	15.5	16.7	17.8	18.9	20.0
30,000	5.8	7.0	8.2	9.4	10.5	11.8	13.0	14.2	15.4	16.5	17.8	19.0	20.2	21.3
32,000	6.1	7.4	8.7	10.0	11.2	12.5	13.8	15.1	16.4	17.6	18.9	20.2	21.5	22.7
36,000	6.8	8.2	9.6	11.1	12.5	13.9	15.4	16.8	18.3	19.7	21.2	22.6	24.0	25.5
40,000	7.4	9.0	10.6	12.2	13.8	15.4	17.0	18.6	20.2	21.8	23.4	25.0	26.6	28.2
45,000	8.2	10.0	11.8	13.6	15.4	17.2	19.0	20.8	22.6	24.4	26.2	28.0	29.8	31.6
50,000	9.0	11.0	13.0	15.0	17.0	19.0	21.0	23.0	25.0	27.0	29.0	31.0	33.0	35.0
60,000	10.6	13.0	15.4	17.8	20.2	22.6	25.0	27.4	29.8	32.2	34.6	37.0	39.4	41.8

*These values are tentative and apply only to rear wheel driven vehicles.

TRUCK ABILITY PREDICTION PROCEDURE -SAE J688

TABLE 8 - GRADE FACTOR

(use with correction Table 8A for grades over 20%)

mph	Grade Factor	mph	Grade Factor	mph	Grade Factor	mph	Grade Factor
1	37.50	21	1.78	41	0.91	61	0.61
2	18.75	22	1.70	42	0.89	62	0.60
3	12.50	23	1.63	43	0.87	63	0.60
4	9.38	24	1.56	44	0.85	64	0.59
5	7.50	25	1.50	45	0.83	65	0.58
6	6.25	26	1.44	46	0.82	66	0.57
7	5.36	27	1.39	47	0.80	67	0.56
8	4.68	28	1.34	48	0.78	68	0.55
9	4.17	29	1.29	49	0.77	69	0.54
10	3.75	30	1.25	50	0.75	70	0.54
11	3.41	31	1.21	51	0.74	71	0.53
12	3.12	32	1.17	52	0.72	72	0.52
13	2.88	33	1.14	53	0.71	73	0.51
14	2.68	34	1.10	54	0.69	74	0.51
15	2.50	35	1.07	55	0.68	75	0.50
16	2.34	36	1.04	56	0.67	76	0.49
17	2.20	37	1.01	57	0.66	77	0.49
18	2.08	38	0.99	58	0.65	78	0.48
19	1.97	39	0.96	59	0.64	79	0.47
20	1.87	40	0.94	60	0.62	80	0.47

Grade factor = $\frac{37.5}{mph}$

TABLE 8A - CORRECTION FOR VALUES OF GRADE ABILITY ABOVE 20%

Computed Grade Ability	Corrected Grade Ability	Computed Grade Ability	Corrected Grade Ability
20	20.4	37	39.8
21	21.5	38	41.1
22	22.6	39	42.4
23	23.6	40	43.6
24	24.7	41	45.0
25	25.8	42	46.3
26	26.9	43	47.6
27	28.0	44	49.0
28	29.2	45	50.4
29	30.3	46	51.8
30	31.5	47	53.2
31	32.6	48	54.7
32	33.8	49	56.2
33	35.0	50	57.7
34	36.2	51	59.3
35	37.4	52	60.9
36	38.8		

TRUCK ABILITY PREDICTION PROCEDURE -SAE J688

TABLE 9 - ROAD FACTOR

Road Class	Road Surface Type	Factor		
		Condition of Surface		
		Good	Fair	Poor
I	Cement concrete Brick Asphalt block Asphalt plank Granite block Sheet asphalt Asphalted concrete Bituminous macadam (high type) Wood block	0.0	0.1	0.2
II	Bituminous macadam (low type) Bituminous (tar) Oil mats (oiled macadam) Treated gravel	0.2	0.6	1.0
III	Sand clay Gravel Crushed stone Cobbles	0.5	1.0	1.5
IV	Earth Sand	1.0	1.5	2.5

SELECTING THE WHEELBASE - TRUCK

With engine and driveline selection fully analyzed, we have reached the point where the vehicle selected is determined to be the correct one to meet the operator's needs. We are certain that this vehicle will perform under its designed GVW because the proper driveline has been selected. To this point, we have concerned ourselves with the vehicle's ability to propel a specified load under conditions which have been specified by the operator. The question now is to find an ideal wheelbase that will permit the installation of a body to the chassis thus giving us the best possible weight distribution at front and rear axles. First let us familiarize ourselves with the symbols that will appear in the formulas that follow.

SYMBOLS AND MEANING

B - Body length in feet
BFW - Front axle to center of body
CA - Cab to rear axle
CB - Center of body
CO - Maximum frame cut-off
FABC - Front axle to back of cab (in.)
CGA - Center of body to rear axle center line
BC - Body clearance (3 inch minimum)
WB - Wheelbase

PERCENTAGE BODY AND PAYLOAD WEIGHT AT FRONT AXLE

Tables below are for uniform body and payload, with 3 inch body clearance. To determine percentage of load at rear axle, subtract percentage of load at front axle from 100.0%. Tables are calculated using the following formula:

$$100 \times \frac{\text{(Center of gravity to rear axle dimension)}}{\text{Wheelbase}} = \text{\% Body and Payload at Front Axle}$$

Note: Body Length is in inches for equation

$$100 \times \frac{CA - [(BC) + B/2]}{WB} = \text{\%Body Payload at Front Axle}$$

Body lengths, and percentage figures are found in the Body - Payload Weight Distribution Charts located on each model specification page in front portion of your Data Book. These charts represent all lengths that are possible to use. The shortest length in each case represents the smallest body that will reach the approximate end of the chassis frame at the maximum cut off. The longest length represents the largest body, which can be used without placing the center of gravity behind the rear axle.

Body lengths shown in the Body - Payload Weight Distribution Charts represent the entire outside length of the body (not necessarily nominal length) including sills or extensions of any kind. The center of gravity used is the exact center of the body length. For specific cases the exact center of gravity of body and payload should be determined. Body and payload center of gravity should always be ahead of the center line of the rear axle or bogie suspension. If the center of the load is behind the rear axle it will result in reduced steering control and may even lift the front wheels off the ground.

Weight distribution should be computed for all body applications. Some clearance must be maintained between the cab and body. Recommended minimum clearances (shown on tables) are used in calculating percentages shown in the charts on the preceding page.

Results of a weight distribution calculation should show:

1. Weight at front as close as possible, but not exceeding, front suspension capacity, and:
2. Weight at rear as close as possible, but not exceeding, rear axle capacity, and:
3. Front weight at ground of the loaded vehicle must exceed the front weight at ground of the unloaded vehicle.

If these conditions do not exist, recalculate the weight distribution using either different body or chassis size or using a different location of the body.

Extreme caution should be exercised in selecting the shortest or longest allowable body lengths. The shortest lengths will usually shift a major portion of the body and payload weight to the front axle of the vehicle. This will limit driver control of steering and reduce traction at the rear wheels. The longest bodies will usually restrict the weight distributed to the front axle. This will reduce the effect the steering mechanism and front wheels have on controlling the vehicle's direction of movement. In cases of special body and/or load distribution or where axle capacities are extremely over or under loaded, consult the factory for recommendations.

Calculation / GVW Rating

The 12% Federal Excise Tax of the retail selling price must be paid on all trucks with a GVW rating of 33,001 lbs. and above, along with all truck-tractors. All straight trucks with a GVW rating of 33,000 lbs. and below are exempt from this tax.

For purposes of determining Federal Excise Tax liability, the Gross Vehicle Weight Rating of a truck must be determined solely on the basis of the strength of the chassis frame, axle capacity, and placement.

The manufactured GVW rating that appears on the vehicle GVW plate will continue to be calculated based upon frame, axle, suspension, brakes, wheels, and tires. For further information, contact your tax advisor.

SELECTION THE WHEELBASE - TRUCK

(Example for RQ2 Truck Service Only)

I. CENTER OF GRAVITY (C.G.) DEFINITION AND DISCUSSION:
Center of gravity is a criteria used to evaluate the weight transfer of a vehicle. In simple terms, the center of gravity of an object is a straight line, which divides the object's weight in two, half above the line and half below the line. Obviously, the higher the load is stacked, the higher its C.G. will be.

For our discussion, we must define two terms. First, the vehicle design ability C.G.; the center of gravity, which the vehicle is designed to accommodate. Secondly, the actual C.G.; the center of gravity which the chassis body, and payload require.

The design ability C.G. of the vehicle is the maximum C.G. height, which can be utilized for the completed vehicle, including payload. For wheelbases greater than 156" the design ability C.G. height above the ground line shall not exceed 75" for tandem rear axle, and 70" for single rear axle vehicles. For wheelbases less than 156", for tandem and single rear axle vehicles, the design ability C.G. height above the ground line shall be limited to 70" or, the product of the maximum wheelbase to C.G. height ratio = (0.45) and the wheelbase, whichever is lower. For your convenience, the design ability C.G. for truck service is printed in the following locations

(1) On your invoice
(2) On the GVWR plate.

NOTE: If the actual required C.G. exceeds the 75" (tandem model) or 70" (single axle model), please contact the Sales Engineering Department for assistance.

If the vehicle ordered is changed after the order confirmation is received, the design ability C.G. may be affected. In this case, the C.G. imprinted on the GVWR plate is the design ability C.G.

II. ACTUAL C.G. CALCULATION: CHASSIS, BODY, PAYLOAD:
Once the maximum allowable design C.G. is known, it is a relatively simple matter to determine if a particular body and payload will meet the C.G. criteria.

In order to determine the actual C.G. of the body, chassis, and payload, the C.G. of each of these components must be known. Fortunately, this is not a difficult task. The C.G. for each model is at the top of the unladen frame rail. This figure is conservative, so variances due to optional suspensions, rear axles, and tires need not be taken into account. The firm supplying the body will be able to provide the C.G. dimension of this body, measured from the top of the frame rail. The customer, in conjunction with the body builder, can discuss the loading characteristics of the payload and determine the C.G. of the payload itself.

Since all C.G. heights must be measured from the ground, it is necessary to add the frame height to any C.G. figure measured from the top of the rail.

Once the C.G. of the chassis, body, and payload are known, the combined C.G. is determined by the following formula.

Actual C.G. Height =
(Chassis Weight x Chassis C.G.) + (Body Weight x Body C.G.)
+ (Maximum Payload Weight x Maximum Payload C.G.)
GVWR

For calculation purposes, the vehicle should be loaded to rated GVWR (if possible). If the C.G. obtained by the above formula is lower than the maximum design ability C.G. at GVWR, the vehicle will meet the requirements. If the actual C.G. at GVWR is higher than the ability, the vehicle is unsatisfactory as specified and some change must be made before ordering the trucks. Changes, which affect the ability C.G. of the truck, may involve either brakes, axles, tires, or a combination of all three.

Let's now look at a number of examples, which will demonstrate the proper method of checking orders. For our first example, let's use a C7C042 with a van box to haul assorted groceries.

Recall that in order to figure the actual C.G. of the completed vehicle, we need to know the weight and C.G. of the chassis, the body, and the payload. The chassis was found to weigh 7400 lbs. after all options had been added, and the C.G. (unloaded frame height) was 37.35. " It was found that a 14.5' van box would give perfect weight distribution, and according to the body manufacturer, the van body weighs 2000 lbs. and has a C.G. of 28" above the frame or 65.35" from the ground. When fully loaded, the payload would weigh 18,100 lbs. and have a center of gravity of 44.3" from the top of the frame rail, or 81.65" from the ground. Remember that the manner in which the load is distributed in the body must be obtained from the owner, so as to properly determine the payload C.G. Taking the three major components into consideration, the chassis, body, and payload we are now ready to determine the actual C.G. **Actual C.G. =**
(Chassis Weight x Chassis C.G.) + (Body Weight x Body C.G.)
+ (Maximum Payload Weight x Maximum Payload C.G.)
GVWR

The numbers are as follows:

Chassis Weight = 7,400 lbs.	**Body Weight = 2,000 lbs.**
Payload Weight = 18,100 lbs.	**Chassis C.G. = 37.35"**
Body C.G. = 65.35"	**Payload C.G. = 81.65"**

The equation now looks like this:

(7,400 lbs. x 37.37") + (2,000 x 65.35") +(18,100 lbs. x 81.65")
27,500 lbs.

(276,390) + (130,700) + (1,477,865) = 1,884,955
27,500 lbs. 27,500

Actual required C.G. of all components = 68.54"

It was shown that this model had a design ability C.G. of 70. " The actual required C.G. was found to be 68.5, " a figure lower than the 70" allowed, therefore the body and payload combination is acceptable.

For our next example, let's look at a tandem axle conventional model, a C8C064, 236" W.B., 168" C.A. that is to be used as a dump application.

A C8C064, dump box, and hoist together have a C.G. of 50.9" and weigh 5,000 lbs. The maximum payload is 28,860 lbs. and has a C.G. (unloaded frame height) of 38.7 ". Our actual combined formula would then be:

(11,000 lbs. x 38.7") + (5,000 lbs. x 50.9") " (28,680 lbs. x 66.5")
44,860

Actual required C.G. of all components = 58"

It was shown that this model had a design ability C.G. of 75". The actual required C.G. was found to be 58", a figure lower than the 75" allowed, therefore the body and payload combination is acceptable.

SELECTING THE WHEELBASE - TRUCK

For this example, let us suppose that our prospect needs to haul approximately a 10,000 lb. payload in a 12-ft. van body, which weighs 3,000 lbs. Our customer prefers a conventional-style truck. A check of the Data Book shows that the average weight of a single-axle Medium Duty Conventional to be in the area of 7,000 lbs. This weight added to the body/payload weight requirement, plus an allowance for fuel, optional equipment, etc., indicates that we need a truck in the 18,000 to 19,000 lb. GVW range. Checking the GVW ratings of our Medium Duty Conventional, we find that the C6500 Series with GVWs ranging from 22,000-25,950 lbs. would appear to be our best choice. A C5500 series truck with GVW ranging from 18,000-19,500 lbs. might be acceptable but our weight requirements would be close to the GVW limit for this series. For the purpose of this example, let us concentrate on the C6500 Series. We find from the Body-Payload Weight Distribution Chart for Medium Conventionals in the Online Order Guide that both 170 and 176 inch wheelbases will accept a 12 ft. body. It would appear that our standard axle capacities of 8,000 lbs. front and 15,000 lbs. rear will be adequate. Weight allowances must be made for tires to carry the load plus fuel, driver weight, and optional equipment. Using the Weight Distribution Chart we can develop total weights for our two possible wheelbase selections.

Fuel weight distribution Front=.63 Rear= .37
1 gallon of fuel weights 6 lbs.
Passenger weight distribution Front=.76 Rear=.24
Passenger weight is estimated at 175 lbs.
C6C042 GVW Ranges from 22,000-25,950 lbs.
10,000 lb. payload wanted. Van body weight 3,000 lbs.

Model/Equipment	Weights					
	170-inch WB			176-inch WB		
	Front	Rear	Total	Front	Rear	Total
C6C042 (128" WB) Chassis	4,795	2,920	7,715	4,795	2,920	7,715
170-inch WB EH8	152.9	28.8	181.7	-	-	-
176-inch WB FNW	-	-	-	235.3	192.6	427.9
Stabilizer Bar F59	23.4	0.0	23.4	23.4	0.0	23.4
Frame Reinforcement F08	105.8	119.0	224.8	-	-	-
Frame FD5	-	-	-	0.0	0.0	0.0
19,000 lb. Rear Air suspension G40 & G68 shocks	-0.9	-25.1	-26.0	-0.9	-25.1	-26.0
Driver + 20 Gallons of Fuel	208.6	86.4	295	208.6	86.4	295
Total Chassis Weight	5284.8	3129.1	8413.9	5261.4	3173.9	8435.3

8,413.9 lb. Chassis Weight & Options for 170" WB
<u>13,000.0 lb.</u> Body & Payload Weight
21,413.9 lb. Gross Weight of 170" WB
8435.3 lb. Chassis Weight & Options for 176" WB
<u>13,000.0 lb.</u> Body & Payload Weight
21,435.3 lb. Gross Weight of 176" WB
Weight Distribution of Body & Payload for 12' Body is 16% Front & 84% Rear for 170" WB
Weight Distribution of Body & Payload for 12' Body is 19% front & 81% Rear for 176" WB
13,000 lb. Body & Payload Weight Distribution
170" WB 13,000 lb. x 0.16 lb. = 2,080 lb. Front
13,000 lb. - 2.080 lb. = 10,920 lb. Rear
176" WB 13,000 lb. x 0.19 lb. = 2,470 lb. Front
13,000 lb. - 2,470 lb. = 10,530 lb. Rear

	170-inch WB			176-inch WB		
	Front	Rear	Total	Front	Rear	Total
Chassis Weight	5284.8	3129.1	8413.9	5261.4	3173.9	8435.3
Body & Payload	2,080	10,920	13,000	2,470	10,530	13,000
Total Weight	7364.8	14,049.1	21,413.9	7713.4	13,703.9	21,435.3

Front: 170" WB 8,000 lb. – 7,364.8 lb. = 635.2 lb.
176" WB 8,000 lb. – 7,713.4 lb. = 286.6 lb.
Rear: 170" WB 15,000 lb. - 14,049.1 = 950.1 lb.
176" WB 15,000 lb. – 13,703.9 = 1,296.1 lb.
These calculations reveal that both the 170" & 176" wheelbase would be an unusable selection. The 170" wheelbase, on the other hand, provides a slightly tighter turning diameter.
We can compute an ideal wheelbase by using the following method.

Ideal Wheelbase

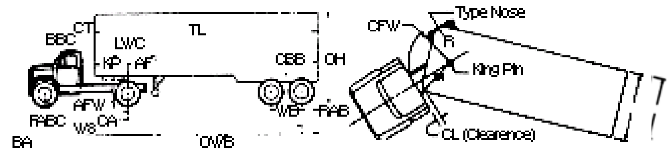
1.) Calculate CB (Center of Body) Dimension
CB = 1/2 x B x 12" B: is body length in feet CB = 6 x B
CB = 12 x 6 **CB = 72"**
2.) Calculate maximum CGA (Center of Body to rear axle)
CGA = CA - (BC + CB) For C6C042 & 176" WB
CA = 108.0" BC Standard is 3.0"
CGA = 108.0" - (3 + 72) **CGA = 33"**
3.) Calculate shortest BFW (Front Axle to Center of Body)
BFW = FABC + BC + CB FABC = 68.0" BC FA = 3.0"
BFW = 68" + 3.0" + 72.0" **BFW = 143.0"**
4.) Calculate ideal wheelbase (WB) for Body and Payload Weight Distribution WB = <u>BFW x Total Body Load</u>
Body Weight on Rear Axle
WB = (143.0" x 13,000) / 10,530
WB Ideal = 176.54" Use **WB Actual = 176"**
5.) Calculate CGA Ideal
(Ideal Center of Gravity of Body to Rear Axle)
CGA Ideal = WB Ideal - BFW
CFA Ideal = 176.54" – 143.0"
CGA Ideal = 33.54"
Since CGA Max = 26.0" & CGA Ideal = 26.06"
CGA Should have a value of 33.0"
6.) Recalculate BC (Body Clearance) Dimension
BC = CA - (CB + CGA) BC = 108 - (72" + 33.0")
BC = 3.0"
7.) Our BFW Dimension is
BFW = WB - CGA BFW = 176" - 33.0" **BFW = 143"**
8.) Body Weight on rear axle = (BFW x Total Body Load) / (WB Body Weight on Rear Axle) = (143 x 13,000) / 176
Body Weight on rear axle = 10,562.5 lb.
Body Weight on front axle = 13,000 lb. - 10,563 lb. = **2,437 lb.**

	Front	Rear	Total
Chassis Weight	5,261.4	3,173.9	8,435.3
Body & Payload	2,437	10,563	13,000
GVW Load Dist.	7,698.4	13,736.9	21,435.3

SELECTING THE WHEELBASE - TRACTOR

TRACTOR SEMI-TRAILER COUPLINGS

SYMBOLS AND MEANINGS



- AF - Center of rear axle or bogie to center of fifth wheel.
- AFW - Front axle to kingpin.
- BA - Bumper to center of front axle.
- BBC - Bumper to back of cab.
- CA - Back of cab to center of rear axle or bogie.
- CBB - Center of trailer axle or bogie to back of trailer.
- CL - Clearance in 45^0 turn, cab to trailer. (Recommended min. CL is 6 inches.)
- CT - Cab to trailer clearance, straight ahead.
- FABC - Front axle to back of cab.
- KP - Front of trailer to center of kingpin.
- LWC - Landing wheel clearance radius from center of kingpin to nearest interference point of landing gear or wheel.
- OL - Overall length tractor bumper to trailer bumper.
- OH - Overall height of trailer.
- OW - Overall width of trailer.
- OWB - Overall wheelbase of tractor and trailer.
- R - Corner radius or type of trailer nose.
- RAB - Center of rearmost axle to bumper.
- SB - Swing radius, kingpin to corner of trailer.
- TL - Trailer length, front of body to bumper.
- WB - Distance between axles.

SEMI-TRAILER SWING RADIUS DIMENSIONS (SR)

Inside Body Nose	Outside Corner Radius (R)	Front of Trailer to Kingpin (KP)				
		24	30	36	42	48
Flat	Square	54	56-1/2	60	64	68
Flat	5 in.	52	55	58	62	66
Flat	10 in.	50-1/2	53	56	60	64
Flat	18 in.	49	50-1/2	53	56-1/2	60-1/2
Oval	Oval	48	48	48-1/2	50-1/2	53

LANDING WHEEL CLEARANCE

Semi-trailer landing wheel clearance (LWC) is measured from the center of the kingpin to the closest interference point on the landing gear support of wheels. Sufficient landing wheel clearance must be allowed so that tractor rear wheels will clear the landing gear when tractor and trailer are turned sharply. Clearance required for the tractor is determined by the distance from the center of the fifth-wheel to the outer rear edge of the tires, assuming that the tractor frame is short enough to avoid interference. Actual minimum required landing gear distance is listed here for various fifth-wheel locations and tire sizes. At least two inches or more clearance should be provided for use of tire chains.

Four Wheel Tractor

Tire Size	Axle to Fifth-Wheel (AF) (inches)								
	4	8	12	16	20	24	28	32	36
9R22.5	51 1/2	53 1/2	55 1/2	58					
10R22.5	53	55	57	59 1/2					
11R22.5	54	56	58	60 1/2	63	66	68 1/2	71 1/2	
10.00/22	54 1/2	56 1/2	59	61	63 1/2	66 1/2	69	72	
12R22.5	54 1/2	56 1/2	58 1/2	61	63 1/2	66	69	72	
11.00/22	55	57	59	61 1/2	64	66 1/2	69 1/2	72 1/2	

Six Wheel Tractor

Tire Size	Axle Spacing (in.)	Tandem Axle Center to Fifth-Wheel (AF) (inches)					
		4	8	12	16	20	24
9R22.5	48	66	69	72	75		
10R22.5	48	67	70	73	76		
10R22.5	50	68	71	74	77	80-1/2	84
11R22.5	50	69	72	75	78	81-1/2	85
11R22.5	52	70	73	76	79	82	85-1/2
10.00/22	52	70-1/2	73-1/2	77	80	83	86-1/2
12R22.5	52	70	73	76-1/2	79-1/2	82-1/2	86
11.00/22	52	71	74	77	80	83-1/2	87

SELECTING THE WHEELBASE - TRACTOR

For this example, we have selected the model C7D042 with a 40 ft. van type tandem axle trailer. The problem before us is to derive the best possible wheelbase (WB) and the resulting rear axle to fifth wheel (AF) dimension. Our first step is to place all known factors on the appropriate worksheet. That is to say all information obtainable from your Data Book, the prospective operator, or from the trailer manufacturer (especially if a new trailer is being considered), and the applicable state laws. State laws referred to in these examples are used for illustration purposes only and are not intended to represent any particular state or locality.

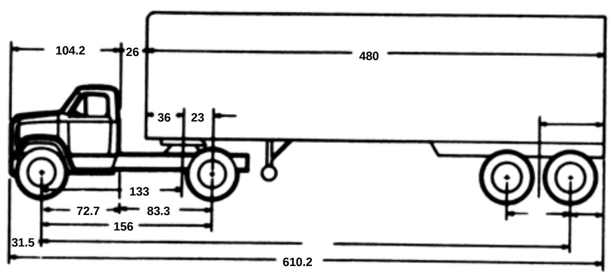
1. KNOWN FACTORS PERTAINING TO TRACTOR AND TRAILER.

BBC = 105.0”
BA = 37.0”
FABC = 68.0”
KP = 36” Average Setting
CL = 6” Minimum Clearance
TL = 40’ = 480”
Max. OAL = 60’ = 730”

Weight Data

Desired axle loads
Front axle - 9,000 lbs. Front axle capacity.
Rear axle - 18,000 lbs. Legal limits, state laws.
Trailer axle - 31,500 lbs. Legal limits, state laws.

These known factors can now be penciled into the appropriate spaces on the tractor-trailer diagram.



Desired Axle Loads

9,000 lbs. 18,000 lbs. 31,500 lbs.

With these basic factors established, we may now approach the several steps, which bring about the actual selection of a wheelbase. As these steps are completed, place dimensions on the diagram.

2. FORMULA FOR MINIMUM CT = (SR + min. CL) - KP

SR Value from Chart with 10” Round Trailer
SR = 56”
CT = (56” + 6”) - 36” CT = 26” minimum
Maximum CT = Max OAL - (BBC-TL)
Max CT = 720” - (105” + 480”) **Max CT = 135.0”**
OAL = CT + BBC + TL
OAL = 26” + 105” + 480”
OAL = 611.0” = 50.9’

3. CALCULATE MINIMUM USABLE WHEELBASE.

Min. WB = FABC + Min. CT + Min. AF + KP
Min. WB = 68.0” + 26.0” + 6.0” + 36”
Min. WB = 136.0” 3. Note: 6.0” is minimum AF Setting.

4. CALCULATE MAXIMUM WHEELBASE.

Max. WB = FABC + Max. CT + KP + Max. AF
Max. WB = 68.0” + 135.8” + 36” + 26” **Max. WB = 265.8”**
Note: Max. AF = 23”
Note: Maximum AF is based on recommended fifth wheel setting of 0-23.

5. CALCULATE IDEAL WB.

(a) Min. AFW = FABC + Min. CT + KP
Min. AFW = 68.0” + 26” + 36” **Min. AFW = 130.0”**
(b) Use WB = 140” Formula AF = Min. WB - Min. AFW
AF = 152”-134.7” AF = 17.3”
AF of 17.3” is larger than min. AF of 6” and smaller than AF of 23” so 17.3”
AF setting is a good setting.
(c) Calculate ideal WB

	Front	Rear	Total	Trailer Axle
Desired Axle Load	9,000	19,000	28,000	31,500
*Estimated Chassis Weight	4,043	2,865	6.908	
Desired KP Load	4,957	16,135	21,092	

*Note: Chassis Weight Does not include Fifth Wheel, Passenger, or Fuel.

Minimum AFW dimension = 134.7”

Ideal WB = $\frac{\text{AFW x Total KP Load}}{\text{KP weight on rear axle}}$

Ideal WB = $\frac{134.7 \times 20{,}192}{16{,}135}$

Ideal WB = 168.56”
Closest available WB is 152”
AF = 152”-134.7”
AF = 17.3”

SELECTING THE WHEELBASE - TRACTOR

6. VERIFY IDEAL WB

Checking the Data Book we find the wheelbase closest to our ideal is 156 inches. Putting this back into the formula, we compute the AFW dimension that will come closest to the ideal weight distribution. Formula: AFW = WB X KP Wt. on RA / Total KP Load

AFW = 152 x 16,135 / 20,192   AFW = 121,45 in.

Ideal AF = WB - AFW

152 - 121.45

Ideal AF = 30.55 in.

Since the recommended maximum AF setting is 23 inches, we select that dimension. To check our overall selection, we must prepare a complete Weight Distribution Diagram.

PREPARATION OF A FINAL WEIGHT DISTRIBUTION PROGRAM - TRACTOR

Assuming that all information is known to equip the selected tractor, we must now complete a Weight Distribution Diagram using the WB and AF setting determined to be the nearest to the ideal as computed in the previous section. To simplify this procedure let us follow the steps outlined.

Step 1. Fill in all dimensional information on Weight Distribution Diagram of model previously calculated.

Step 2. List base chassis weights, all tractor equipment including fifth wheel, driver, and fuel. These weights are obtained from specification Model Option weight calculator in the Medium Duty Online Order / Reference Guide.

Step 3. Calculate how much kingpin weight must be carried on tractor rear axle in order to load the drive axle to legal limit **Solution: KP Wt. on RA = (Legal limit on RA) minus (Total equipped tractor wt. on R.A.)**

Step 4. Calculate the total kingpin load. **Solution: Total KP load = (KP wt. on RA) x (WB) / AFW**

Step 5. Determine kingpin load on front axle. **Solution KP load on FA = (Total KP Load) minus (KP load on RA)**

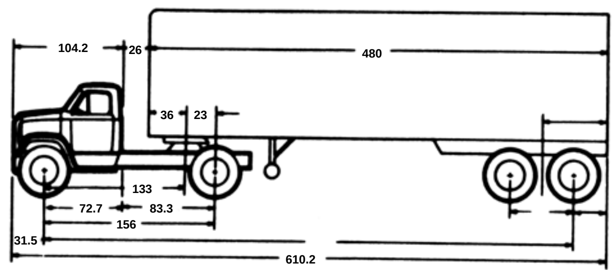
Step 6. Verify KP weight distribution. **Solution: KP wt. on FA = AF / WB x Total KP load**

Step 7. Add kingpin loads to tractor chassis weights to determine the individual axle loads and total GVW.

Step 8. Complete the Weight Diagram.

WEIGHT DISTRIBUTION DIAGRAM

Step 1. Note: The selected 152 in. WB has an 84 in. CA for the 105" BBC cab. With a few simple additions and subtractions, we now fill in our diagram as illustrated.



Step 2.

Item	Front	Rear	Total
C7C042 Chassis and Cab (152-inch WB)	5,243	2,892	8,135
RPO Nos. Tractor Equipment less fifth wheel, fuel and driver	207	117	324
Fifth Wheel - AF / WB x Wt. of fifth wheel = lbs. on FA			
23 / 152 x 400 lbs. = 59 lbs.	60.5	339.5	400
59 gal. fuel- Tank to RA / WB x Wt. of fuel = lbs. on FA			
98.65 / 152 x 350 lbs. = 227 lbs.	227	123	350
Driver- Seat to RA / WB x Av. wt. of driver = lbs. on FA			
102 / 152 x 200 lbs. = 134 lbs.	134	66	200
TOTAL EQUIPPED TRACTOR WEIGHT	5,871.5	3,537.5	9,409.0

Steps 3, 4, 5.

KP LOAD with Hitch setting of 152-23=129"

(3) KP Wt. on RA = 19,000 – 3,537.5 = 15,462.5

(4) Total KP load = 15,462.5 x 152 / 129 = 18,218.8

(5) KP load on FA = 18,218.8 - 15,462.5 = 2,756

Step 6.

Verify KP Wt. on FA = 23 / 152 x 18,218.8

Verify KP Wt. on FA = 2,757 lbs.

Steps 7, 8.

	Front	Rear	Total
TOTAL GVW	8,627.5	1,9000	27,627.5
TRAILER TANDEM WEIGHT	-		31,500
TOTAL GCW			59,127.5
LESS TOTAL TRACTOR WEIGHT			9,409.0
TOTAL TRAILER AND PAYLOAD			49,718.5

SHIFT PATTERN CHART

Shift pattern charts are easy to construct and are a definite sales aid. A typical chart to give a general idea of the power train combinations is worked out in this section. When specific charts and special combinations are desirable, the following explains how to make a shift chart.

I. For Data Book transmission and axle combinations, refer to the particular model series page in question. All combinations require calculating the geared speeds with this formula:

Miles per hour (MPH) = $\dfrac{\textbf{RPM x 60}}{\textbf{R x M x T}}$

RPM = Engine revolutions per minute

R = Axle ratio

M = True revolutions per mile (See Wheels-Tires)

T = Ratio of Top Transmission Gear

2. Using the Shift Pattern Chart on the back page of your Truck Selection Worksheet such as shown below, set up a vehicle geared speed (MPH) and engine speed (RPM) scales in the manner shown.
3. Calculate maximum geared speed in direct drive using maximum or governed RPM, whichever is applicable. For two speed axles, two calculations are required, one for high axle range and one for low axle range.
4. Divide the maximum geared speed calculated above by S. Mark each of these speeds with a dot on the maximum or governed RPM line.

S = $\dfrac{\textbf{T}}{\textbf{G}}$

G = Transmission Ratio in each Gear.

5. For auxiliary combination take vehicle speed calculated in each main transmission gear position (paragraph 4) and divide by each of the auxiliary transmission gear ratios. Mark each of these speeds with a dot on the maximum or governed RPM line.
6. Draw a light vertical line from each geared speed dot, which was marked on the maximum or governed RPM lines.
7. Lay a ruler with one end set on each dot on the maximum or governed RPM line and the other end set at Zero RPM. Using these points as guides, draw diagonal lines intersecting each of the vertical lines drawn in paragraph 6. Now that engine RPM drops have been established by the intersecting diagonal and horizontal lines, they can be retouched with dark lines. The balance of light horizontal line should be erased.
8. A shift pattern chart shows the driver at what speeds to shift and what combination to shift. It shows the operator what performance characteristics the drive train selected is capable of producing by the RPM drop at each shift point and the steps in MPH between each gear selection. When used with an engine performance curve, the salesman can show the horsepower and torque available at shift point RPM drops. When used in comparison with other shift pattern charts, this will show which combination will get the loaded vehicle back to top speed the quickest.

APPROXIMATE WEIGHTS AND MEASURES

STANDARD WEIGHTS AND MEASURES

Length

12 inches	= 1 foot
3 feet	= 1 yard
5-1/2 yards	= 16-1/2 feet
	= 1 rod
1760 yards	= 5280 feet
	= 1 mile

Area

144 square inches	= 1 square foot
9 square feet	= 1 square yard
30-1/2 square yards	= 1 square rod
160 square rods	= 43,560 square ft. = 1 acre
640 acres	= 17,878,400 sq. ft. = 1 sq. mile
1 circular inch	= area of circle 1 inch in diameter
	= 0.8754 square inch
1 square inch	= 1.2732 circular inches

Volume

1728 cubic inches	= 1 cubic foot
27 cubic feet	= 1 cubic yard
1 cord wood	= 128 cubic feet. One cord is 8 feet long, 4 feet wide and 4 feet high.
1 board foot	= 144 cubic inches
	= volume of board 1 foot square and 1 inch thick.
1 cylindrical inch	= volume of cylinder 1 inch in diameter and 1 inch long
	= 0.7854 cubic inch
1 cubic inch	= 1.2732 cylindrical inches

Liquid or Fluid Measure

4 gills (16 fluid ounces)	= 1 pint
2 pints	= 1 quart
4 quarts	= 1 gallon
31-11/32 gallons	= 1 barrel (there is no standard liquid "barrel")
1 U.S. gallon	= 231 cubic inches
	= 0.13373 cubic feet
7.4805 gallons	= 1 cubic foot

When water is at its maximum density, 1 cubic foot weighs 62.428 pounds and 1 gallon weighs 8.345 pounds. For approximations, 1 cubic foot of water equals 7-1/2 gallons.

Dry Measure

2 pints	= 1 quart
8 quarts	= 1 peck
4 pecks	= 1 bushel
1 U.S. bushel	= 2150.42 cubic inches
	= 1.22445 cubic feet
1 cubic yard	= 21.7 U.S. bushels (approximate)

Measures of angles or arcs

60 seconds (in.)	= 1 minute (ft.)
60 minutes (ft.)	= 1 degree
90 degrees	= 1 right angle or quadrant
360 degrees	= 1 circle

Avoirdupois Weight (U.S.)

437.5 grains (16 drams)	= 1 ounce
16 ounces	= 1 pound
100 pounds	= 1 hundred weight
2000 pounds	= 1 ton
2240 pounds	= 1 long ton

METRIC WEIGHTS AND MEASURES

Length

10 millimeters (mm.)	= 1 centimeter
10 centimeters (cm.)	= 1 decimeter
10 decimeters (dm.)	= 100 centimeters = 1 meter
1000 meter (m.)	= 1 kilometer (km.)

Area

100 square millimeters (sq. mm.)= 1 square centimeter
100 square centimeters (sq. cm.)= 1 square decimeter
100 square decimeters (sq. dm.) = 1 square meter

Volume

1000 cubic millimeters (cu. mm.) = 1 cubic centimeter
1000 cubic centimeters (cu. cm.) = 1 cubic decimeter
1000 cubic decimeters (cu. dm.) = 1 cubic meter

Capacity

10 millimeters (ml.)	= 1 centiliter
10 centiliters (cl.)	= 1 deciliter
10 deciliters (dl)	= 100 centiliters = 1 liter
1000 liters (l.)	= 1 kiloliter (kl.)

Weight

10 milligrams (mg.)	= 1 centigram
10 centigrams (cg.)	= 1 decigram
10 decigrams (dg.)	= 100 centigrams = 1 gram
1000 grams (g.)	= 1 kilogram
1000 kilograms (kg.)	= 1 ton (metric)

APPROXIMATE WEIGHTS AND MEASURES

EQUIVALENT WEIGHTS AND MEASURES

Length

1 inch	= 2.54 centimeters
1 foot	= 30.48 centimeters
1 yard	= 0.9144 meters
1 mile	= 1.609 kilometers
1 centimeter	= 0.3937 inch
1 meter	= 39.37 inches
	= 3.281 feet
1 kilometer	= 0.6214 mile
	= 1093.6 yards

DECIMAL EQUIVALENTS OF PARTS OF AN INCH

1/64 .	=015625	33/64	=.515625
1/32	=.03125	17/32	=.53125
3/64	=046875	35/64	=.546875
1/16	=.0625	9/16	=.5625
5/64	=.078125	37/64	=.578125
3/32	=.09375	19/32	=.59375
7/64	=.109375	39/64	=.609375
1/8	= .125	5/8	=.625
9/64	=.140625	41/64	=.640625
5/32	=.15625	21/32	=.65625
11/64	=.171875	43/64	=.671875
3/16	=.1875	11/16	=.6875
13/64	=.203125	45/64	=.703125
7/32	=.21875	23/32	=.71875
15/64	=.234375	47/64	=.734375
1/4	=.25	3/4	=.75
17/64	=.265625	49/64	=.765625
9/32	=.28125	25/32	=.781255
19/64	=.296875	51/64	=.796875
5/16	=.3125	13/16	=.8125
21/64	=.328125	53/64	=.828125
11/32	=.34375	27/32	=.84375
23/64	=.359375	55/64	=.859375
3/8	=.375	7/8	=.875
25/64	=.390625	57/64	=.890625
11/32	=.40625	29/32	=.90625
27/64	=.421875	59/64	=.921875
7/16	=.4375	15/16	=.9375
29/64	=.453125	61/64	=.953125
15/32	= .46875	31/32	=.96875
31/64	=.484375	63/64	=.984375
1/2	=.5	1	= 1.0

APPROXIMATE WEIGHTS OF MATERIALS

Most materials and commodities vary in weight and containers vary in shape and size. Therefore it is impossible to list any but average weights per cubic foot or per unit of measurement and the following weights should be used only for approximation purposes. When it is necessary to figure weights accurately for recommendation of truck or tractor-trailer equipment, exact weights and dimensions should be obtained from local sources. This is particularly true of fruits and vegetables, containers for which vary widely in type, size and shape according to commodity and locality.

A. BUILDING SUPPLIES

Other than lumber and stone.

		Pounds per	
		Cu. Ft.	**Cu. Yd.**
Asbestos		153	4130
Asphalt	brick	125	3375
	lumps	85	2300
	paving	100	2700
Cinders		50	1350
Clay	dry lumps	85	2300
	wet lumps	110	2970
	wet packed	135	3650
	fire	125	3375
Concrete	cinder or slag	120	3250
	gravel or stone	150	4050
	ave. wet mix	138	3730
Crushed stone, ave.		100	2700
Earth (loam) loose		76	2050
	shaken	87	2350
	packed	95	2565
	moist	100	2700
	wet	125	3375
Gravel	dry	95	2565
	wet	125	3375
Mortar	lime	110	2970
	rubble - dry	138	3730
	rubble - wet	154	4160
Mulch		19-30	500-800
Pitch		70	1900
Plaster of Paris (gypsum)		150	4050
Quicklime solid		95	2550
	ground- loose	55	1485
	shaken	75	2030
Rock crushed, ave.		100	2700
Sand	fine-dry	110	2970
	fine-wet	125	3375
	coarse-dry	95	2565
	coarse-wet	120	3240
Tar		65	1755
Terra Cotta		110	2970
Tile	solid	115	3100
	construction	40	1080

APPROXIMATE WEIGHTS AND MEASURES

Brick		Thousand
	Soft, 2-1/4 x 4 x 8-1/4	4320
	Common, 2-1/4 x 4 x 8-1/4	5400
	Hard, 2-1/4 x 4-1/4 x 8-1/2	6480
	Pressed, 2-3/8 x 4 x 8-3/8	7500
	Paving, 2-1/2 x 4 x 8-1/2	6750
	Paving block, 3-1/2 x 4 x 8-1/2	8750
	Fire, 2-1/2 x 4-1/2 x 9	7000

		Pounds	Per
Cement, Portland		94	sack
	(4 sacks per bbl.)		
Cement Block	8 x 8 x 16	42	each
	8 x 12 x 16	58	each
Cinder block	8 x 8 x 16	35	each
Cinder block	8 x 12 x 16	45	each
Glass	common window	162	cu. ft.
	plate, 1/4 thick	.3.3	sq. ft.
Lime	small barrel	210	barrel
	large barrel	320	barrel

B. FARM AND DAIRY PRODUCTS
(except Fruits and Vegetables)

		Pounds	Per
Alfalfa seed		60	bushel
Barley		48	bushel
Bran		20	bushel
Buckwheat		49	Bushel
Butter	15 dia. x 5-1/4	25	tub
	15 dia. x 15	70	tub
	10-1/4 x 8-3/4 x 10-1/2		
	(30 lb. bricks)	32	case
	9 lb. pail	10	each
Calf, live (avg.)		150	head
Cheese	15 dia. x 5-1/4	25	box
	15 dia. x 7-1/2	35	box
	15 dia. x 15	70	box
Chickens			
	Live-broilers		
	(20 avg.)	58	crate
	Live-fowl		
	(12 avg.)	78	crate
	Std. crate, empty		
	24 x 35 x 13	18	each
Clover seed		60	bushel
Corn	ear	35	bushel
	shelled	56	bushel
	sweet corn (green)	43	bushel
Corn meal		44	bushel
Cotton Gin bale			
	30 x 48 x 54	515	each
	Std. Bale		
	24 x 28 x 56	515	each
	Comp. Bale		
	20 x 24 x 56	515	each
Cotton seed		32	bushel
Cow	live-feeder (avg.)	600	head
	live-butcher (avg.)	800	head
	live-heavy steer(avg.)	1100	head
Eggs	30 doz.		
	12 x 12 x 26	55	crate
Flax Seed		56	bushel
Flour	19-1/8 head		
	30 stave	215	barrel
Hay, baled 17 x 22 x 40		60	bale
Hay, baled 14 x 16 x 43		85	bale
Hemp seed		44	bushel
Hog, live (avg.)		235	head
Horse, live (avg.)		1350	head
Ice cream	2-1/2 gal. 9 dia. x 11	18	can
	5 gal. 9 dia. x 21	35	can
Lamb, live (avg.)		80	head
Malt	barley	28	bushel
Malt	rye	32	bushel
Malt	brewer's grain	40	bushel
Millet		50	bushel
Oats		32	bushel
Popcorn	ear	35	bushel
	shelled	56	bushel
Rice, unhulled		43	bushel
Rye		56	bushel
Sheep, live (avg.)		138	each
Shorts		20	bushel
Soy beans		60	bushel
Straw, baled	17 x 22 x 40	45	bale
Tallow		60	cu. ft.
Timothy seed		45	bushel
Vetch seed		60	bushel
Wheat,	bulk	60	bushel
	bag	90	1-1/2 bushel
Wool, pressed		82	cu. ft.

C. FRUITS, VEGETABLES AND NUTS
(in bulk unless container specified)

	Size Container	Lbs. per Bushel or Container
Apples, fresh	bushel	48
Western, box	11-1/2 x 12 x 20	50
New England, box	11-1/4 x 14-1/4 x 17-1/2	56
Standard barrel	17 hd. 28-1/2 stone	160
Apricots, fresh	bushel	48
Western, box	5-1/2 x 12 x 20	23
Artichokes, box	10 x 11-1/12 x 22	44
Asparagus, pr. crate	11-1/2 high, 19-3/8	
loose	long, 9-3/4 wide	38
bunches	top, 11 bottom	31
Avocados box	5-3/4 x 11-1/4 x 17-1/2	16
Bananas Carton	4-1/4 x 14-1/4 x 30	38
Bananas single stem	bunch	55
Beans, dry castor	bushel	46
Beans, dry white	bushel	60
Beans, dry lima	bushel	56
Beans, fresh lima	bushel	39
Beans, fresh string	bushel	36
(hamper) string	5-peck	45
Beets (avg.)	bushel	55
Beets small crate	9-3/4 x 13-1/4 x 24	50
Western crate	14 x 19 x 24-1/2	95
Berries crate 24 pt.	9-3/4 x 9-3/4 x 20	25
Berries crate 24 qt.	11-3/4 x 11-3/4 x 24	48
Berries crate 32 qt.	15-1/2 x 11-3/4 x 24	63
Broccoli bu. crate	12-3/4 x 12-3/4 x 17	30
Brussel sprouts, crate	7-3/4 x 10-1/2 x 21-3/8	26
Cabbage hamper	1-1/2 bushel	58
Cabbage crate	12-3/4 x 18-1/2 x 19	60
Cabbage Western crate	14 x 19 x 24-1/2	85
Cabbage \bbl. crate	12-3/4 x 18-3/4 x 37-3/8	110
Cantaloupe, crate pony	11-3/4 x 11-3/4 x 23-1/2	58
standard	12-3/4 x 12-3/4 x 23-1/2	68
jumbo	13-3/4 x 13-3/4 x 23-1/2	78
pony flat	4-3/4 x 12-3/4 x 23-1/2	26
standard flat	5-1/4 x 14-1/4 x 23-1/2	28
jumbo flat	5-1/4 x 15-1/4 x 23-1/2	32

APPROXIMATE WEIGHTS AND MEASURES

C. FRUITS, VEGETABLES AND NUTS
(in bulk unless container specified)

	Size Container	Lbs. per Bushel or Container
Carrots topped	bushel	55
Carrots with tops	bushel	40
crate	11-3/4 x 14-1/8 x 24	60
Cauliflower	bushel	30
crate	9-3/8 x 19 x 24	50
Celery standard crate	11-5/8 x 22 x 22-5/8	70
Celery 1/2 crate	10-3/4 x 13 x 20-3/8	35
Celery Northern crate	16-1/2 x 21-1/4 x 22	85
Cherries unstemmed	bushel	56
Cherries stemmed	bushel	64
Cherries lug box	5-3/8 x 11-7/8 x 19-3/4	17
Chestnuts	bushel	50
Cranberries 1/4 bbl. box	9-1/2 x 11 x 14	28
1/2 bbl. box	12-1/4 x 14-3/4 x 22	60
Cucumbers	bushel	55
crate	9-3/4 x 13-3/4 x 24	75
case	5 x 13-1/4 x 19	26
Eggplant hamper	bushel	40
Eggplant crate	14 x 11-3/4 x 24	54
Endive basket	bushel	25
Endive hamper	1-1/2 bushel	36
Grapefruit Western box	11-1/2 x 11-1/2 x 24	68
Grapefruit Southern box	12-3/4 x 12-3/4 x 27	90
Grapes basket	bushel	48
Grapes lug box	5-3/8 x 16-3/8 x 17-1/2	30
Grapes Western keg	15-1/2 dia. x 14	45
Grapes basket	12 quarts	18
Greens	bushel	25
Hickory nuts	bushel	45
Horseradish roots	bushel	35
Kale	bushel	25
Lemons, Limes Western box	10 x 13 x 25	80
Lemons, Limes Southern box	12-3/4 x 12-3/4 x 27	90
Lentils	bushel	60
Lettuce hamper	bushel	25
Lettuce hamper	1-1/2 bushel	38
Lettuce basket	8-1/2 x 11-3/4 x 21-3/8	17
Lettuce crate	13-1/4 x 17-1/2 x 24-1/2	75
Lettuce 1/2 crate	9-1/2 x 13-1/2 x 24-1/2	40
Okra hamper	1/2 bushel	18
Okra hamper	bushel	34
Onions Dry basket	bushel	55
Dry bag	17 x 32	50
Dry crate	20-1/2 x 11-1/2 x 24	58
Green, with tops	bushel	32
Oranges Western box	11-1/2 x 11-1/2 x 24	80
Oranges Southern box	12-3/4 x 12-3/4 x 27	90
Oranges bushel box	10-3/4 x 10-3/4 x 23-1/2	65
Parsley bushel crate	12-3/4 x 12-3/4 x 17	30
Parsnips	bushel	50
Peaches basket	bushel	48
Peaches basket	1/2 bushel	25
Peaches crate	10-1/2 x 11-1/4 x 24	50
Peaches Western box	5-1/2 x 12-1/4 x 19-3/4	22
Peanuts, unshelled	bushel	22
Bag 100 Pears \- basket	bushel	50
Pears Western box	9-5/8 x 12-1/8, 19-3/4	51
Peas dry	bushel	60
Peas fresh hamper	bushel	35
Peas fresh hamper	40 quarts	45
Peas	large bag	100
Pecans	small bag	50
Peppers basket	bushel	25
Peppers crate	14-1/8 x 11-3/4 x 24	45
Pecans Pineapples crate	11 x 12-1/2 x 36	85
Plums basket	bushel	56
Plums Western box	5-5/8 x 16-3/8 x 17-1/2	25
Potatoes sweet	bushel	55
White or Irish	bushel	60
bag 1-2/3	bushel	102
	barrel	185
Prunes box	5-5/8 x 16-3/8 x 17-1/2	25
Quinces	bushel	50
Radishes basket	bushel	34
Radishes crate	9-3/8 x 13-3/4 x 24	40
Rhubarb box	5-1/4 x 11-1/2 x 22	24
Romaine crate	13-7/8 x 18-7/8 x 24-1/2	64
Romaine crate	12-1/4 x 13 x 15-1/4	27
Rutabagas	bushel	56
Spinach	bushel	27
Squash	bushel	46
Sweet corn basket	bushel	45
Sweet corn crate	13 x 13 x 24	60
Tomatoes basket	bushel	55
Tomatoes lug box	7-1/4 x 14 x 17-1/2	35
Tomatoes crate	10-1/2 x 11-1/4 x 24	48
Tomatoes basket	8-1/2 x 8-3/4 x 20	18
Turnips	bushel	54
Walnuts bulk	bushel	50
Walnuts	bag	100

D. LIQUIDS

	Cubic Foot	Pounds per Gallon
Acetone	50	6.6
Alcohol, commercial	51	6.8
Asphalt, hot oil	71	9.5
Carbolic acid	60	8.0
Castor oil	61	8.1
Chloroform	95	12.7
Coconut oil	58	7.8
Corn oil	58	7.8
Corn syrup	86	11.5
Cotton seed oil	58	7.8
Cream	64	8.5
Creosote	69	9.2
Crude oil	56	7.5
Ether	46	6.2
Fuel oil Diesel	52	7.0
Fuel oil Furnace	56	7.5
Gasoline	45	6.0
Glycerin 79	10.5	
Honey	90	12.0
Kerosene	50	6.6
Linseed oil	59	7.9
Lubricating oil	52	7.0
Maple syrup	82	11.0
Milk, bulk	64	8.6
Molasses	90	12.0
Muriatic acid, 40%	40	10.0
Naphtha, petroleum	42	5.6
Nitric acid, 91%	94	12.5
Olive oil	58	7.7
Peanut oil	57	7.6

APPROXIMATE WEIGHTS AND MEASURES

	Pounds per Cubic Foot	Pounds per Gallon
Petroleum	56	7.5
Sorghum syrup	86	11.5
Soybean oil	58	7.7
Sugar cane syrup	85	11.3
Sulfuric acid, 87%	112	15.0
Turpentine	54	7.3
Vinegar	64	8.5
Water, fresh	63	8.4

	Size Container	Lbs. per Container
Beer wood barrel	1/4 barrel	105
Beer steel barrel	1/4 barrel	95
Beer wood barrel	1/2 barrel	205
Beer steel barrel	1/2 barrel	190
Carton 24 12-oz.		
regular bottles	17-1/4 x 11-1/2 x 9-7/8	45
steinie bottles	18-3/8 x 12-1/8 x 7-3/8	40
tin cans	16-1/4 x 11 x 5-1/8	28
Wood case 24 12-oz.		
regular bottles	21 x 13-1/2 x 10	53
steinie bottles	22 x 13-3/4 x 7-1/2	46

Note Beer cases are of many types with variable size and weight. Cases shown are average for popular full depth type with partitions.

Milk 5 gal. can	10-1/4 dia. x 19	62
10 gal. can	13 dia. x 23	115
crate 20 1/2 pt. bottles		33
crate 20 pt. bottles		54
crate 12 qt. bottles		64

Note Milk bottle crates vary widely in dimensions and weights. Those shown are average weights.

Molasses 50 gal. bbl.	20 1/4 hd., 34 stave	675
Soft drinks		
Half depth bottle box		
24 6 to 8 oz. bottles	12-1/4 x 18-3/4 x 8-1/2	39
Full depth bottle box		
12 24 to 32 oz. bottles	13-3/8 x 18-1/2 x 12-1/4	60

E. LUMBER Air Dried

Kiln dried lumber averages 10% to 15% lighter, and green lumber 40% to 50% heavier than air dried.

	Pounds per Cubic Foot	Pounds per Thousand Board Feet
Ash black or red	40	3330
Ash white	46	3830
Bamboo	22	_
Basswood	30	2500
Beech	30	2500
Birch	48	4000
Butternut	30	2500
Cedar	30	2500
Cherry	44	3670
Chestnut	37	3080
Cottonwood	37	3080
Cypress	30	2500
Elm soft	38	3170
Elm rock	45	3750
Fir Douglas	32	2670
Fir Eastern	25	2080
Gum	40	3330
Hemlock	29	2420
Hickory	54	4500
Locust	42	3500
Mahogany	42	3500
Maple hard	44	3670
Maple soft	34	2830
Oak black	42	3500
Oak red	42	3500
Oak white	48	4080
Pine long leaf	44	3670
North Carolina	36	3000
Oregon	32	2670
Red	30	2500
White	26	2170
Yellow Northern	34	2830
Southern	45	3750
short leaf	38	3170
long leaf	44	3670
Poplar	27	2250
Redwood	30	2500
Spruce	28	2330
Sycamore	37	3080
Walnut	43	3580
Willow	31	2580

Lath Standard length 29 in. Put up in bundles of 50. Ave. bundle: dia. 9 in.; weight 25 lbs. Shingles Bundle contains the equivalent of 250 shingles; measures 24 x 20 x 10; ave. weight 50 lbs.

F. METALS, MINERALS, ORES, ROCK, STONE, COAL

	Pounds per Cu. Ft.	Pounds per Cu. Yd.
Alabaster, gypseous	160	4320
Aluminum, pure	165	4450
Andesite stone	180	4850
Antimony	420	11350
Asbestos	153	4130
Babbitt	440	11900
Barytes, mineral	280	7560
Basalt rock	185	5000
Bauxite	160	4320
Bluestone	120	3240
Borax	110	2970
Brass cast	525	14175
Brass rolled	534	14420
Brass drawn	542	14635
Bronze	550	14850
Chalk	137	3700
Charcoal oak	33	890
Charcoal pine	23	620
Coal, broken Anthracite	60	1600
Bituminous	45	1200
Pocahontas	50	1350
Cannel	50	1350
Coke	27	730
Copper cast	550	14850
Copper rolled	560	15120
Diabase	185	5000
Dolomite	181	4890
Emery	250	6750
Feldspar	160	4320

APPROXIMATE WEIGHTS AND MEASURES

	Pounds per Cu. Ft.	Pounds per Cu. Yd.
Flint	185	5000
Gneiss \- solid	160	4320
Gneiss \- crushed	95	2565
Granite \- solid	175	4725
Granite \- crushed	96	2590
Graphite	170	4590
Greenstone \- solid	187	5050
Greenstone \- crushed	107	2900
Gypsum	150	4050
Iron \- cast	450	12150
Iron \- wrought	485	13100
Hornblende	187	5050
Lead \- cast	710	19170
Limestone \- solid	166	4480
Limestone \- crushed	95	2565
Magnesite	187	5050
Manganese	475	12825
Marble \- solid	165	4455
Marble \- crushed	95	2565
Marl	140	3800
Mercury	850	_
Mica	185	5000
Nickel	537	14500

Ore Most ores are 15% to 20% heavier than the rock which forms the bulk of the ore.

Peat	50	1350
Phosphate rock	200	5400
Porcelain	150	4050
Porphyry	172	4645
Pumice	40	1080
Pyrites	315	8500
Quartz	165	4455
Rip rap stone	65	1750
Salt rock, solid	136	3670
very coarse	35	950
coarse	45	1215
fine	50	1350
barrel, avg.	280	per bbl.

	Pounds per Cu. Ft.	Pounds per Cu. Yd.
Saltpeter	69	1860
Sandstone solid	147	3970
Sandstone crushed	86	2325
Shale solid	172	4645
Shale crushed	92	2485
Silica	135	3650
Slag solid	175	4750
Slag crushed	75	2025
Slag screenings	100	2700
Slate	175	4725
Soapstone	169	4565
Steel Cast	490	13250
Steel rolled	495	13365
Stone crushed, avg.	100	2700
Sulphur	125	3375
Talc	170	4600
Tin	460	12400
Trap rock	187	5050
Zinc	440	11880

G. MISCELLANEOUS

	Pounds per Cu. Ft.	Pounds per Cu. Yd.
Ashes, cool (packed)	45	1215
Bone 115 3110 Cork	15	405
Furniture (household goods)	6	160
Garbage dry, paper wrapped	15-30	400-800
wet	50	1240
Groceries misc. assort.	30	810
Ice	57	1540
Paper solid, avg.	58	1565
Rubber goods	94	2540
Snow, moist packed	50	1350